# Modeling Fracture And Failure With Abaqus Shenxinpu

Modeling Fracture and Failure with ABAQUS 6.12Modeling Fracture and Failure with ABAQUS 6.11Hydraulic Fracture ModelingGulf Professional Publishing

FRACTURE MECHANICS OF CONCRETE AND ROCK This book offers engineers a unique opportunity to learn, frominternationally recognized leaders in their field, about the latesttheoretical advances in fracture mechanics in concrete, reinforcedconcrete structures, and rock. At the same time, it functions as asuperb, graduate-level introduction to fracture mechanics conceptsand analytical techniques. Reviews, in depth, the basic theory behind fracture mechanics * Covers the application of fracture mechanics to compressionfailure, creep, fatigue, torsion, and other advanced topics * Extremely well researched, applies experimental evidence ofdamage to a wide range of design cases * Supplies all relevant formulas for stress intensity * Covers state-of-the-art linear elastic fracture mechanics (LEFM)techniques for analyzing deformations and cracking * Describes nonlinear fracture mechanics (NLFM) and the latestRILEM modeling techniques for testing nonlinear quasi-brittlematerials * And much more Over the past few years, researchers employing techniques borrowedfrom fracture mechanics have made many groundbreaking discoveriesconcerning the causes and effects of cracking, damage, andfractures of plain and reinforced concrete structures and rock.This, in turn, has resulted in the further development andrefinement of fracture mechanics concepts and tools. Yet, despitethe field's growth and the growing conviction that fracturemechanics is indispensable to an understanding of material andstructural failure, there continues to be a surprising shortage oftextbooks and professional references on the subject. Written by two of the foremost names in the field, FractureMechanics of Concrete fills that gap. The most comprehensive bookever written on the subject, it consolidates the latest theoreticalresearch from around the world in a single reference that can beused by students and professionals alike. Fracture Mechanics of Concrete is divided into two sections. In thefirst, the authors lay the necessary groundwork with an in-depthreview of fundamental principles. In the second section, theauthors vividly demonstrate how fracture mechanics has beensuccessfully applied to failures occurring in a wide array ofdesign cases. Key topics covered in these sections include: * State-of-the-art linear elastic fracture mechanics (LEFM)techniques for analyzing deformations and cracking * Nonlinear fracture mechanics (NLFM) and the latest RILEM modelingtechniques for testing nonlinear quasi-brittle materials * The use of R-Curves to describe cracking and fracture inquasi-brittle materials * The application of fracture mechanics to compression failure,creep, fatigue, torsion, and other advanced topics The most timely, comprehensive, and authoritative book on thesubject currently available, Fracture Mechanics of Concrete is botha complete instructional tool for academics and students instructural and geotechnical engineering courses, and anindispensable working resource for practicing engineers.

All materials contain numerous defects, such as microcracks, microvoids, inhomogeneities, dislocations, etc., which precede possible fracture. Thus mathematical modeling becomes necessary. This volume contains some introductory material, aspects of fracture mechanics, the theory of crystal defects, computational micromechanics, and the heterogenization methodology.

Hydraulic Fracture Modeling delivers all the pertinent technology and solutions in one product to become the go-to source for petroleum and reservoir engineers. Providing tools and approaches, this multi-contributed reference presents current and upcoming developments for modeling rock fracturing including their limitations and problem-solving applications. Fractures are common in oil and gas reservoir formations, and with the ongoing increase in development of unconventional reservoirs, more petroleum engineers today need to know the latest technology surrounding hydraulic fracturing technology such as fracture rock modeling. There is tremendous research in the area but not all located in one place. Covering two types of modeling technologies, various effective fracturing approaches and model applications for fracturing, the book equips today's petroleum engineer with an all-inclusive product to characterize and optimize today's more complex reservoirs. Offers understanding of the details surrounding fracturing and fracture modeling technology, including theories and quantitative methods Provides academic and practical perspective from multiple contributors at the forefront of hydraulic fracturing and rock mechanics Provides today's petroleum engineer with model validation tools backed by real-world case studies

The First African InterQuadrennial ICF Conference "AIQ-ICF2008" on Damage and Fracture Mechanics – Failure Analysis of Engineering Materials and Structures", Algiers, Algeria, June 1–5, 2008 is the first in the series of InterQuadrennial Conferences on Fracture to be held in the continent of Africa. During the conference, African researchers have shown that they merit a strong reputation in international circles and continue to make substantial contributions to the field of fracture mechanics. As in most countries, the research effort in Africa is und- taken at the industrial, academic, private sector and governmental levels, and covers the whole spectrum of fracture and fatigue. The AIQ-ICF2008 has brought together researchers and engineers to review and discuss advances in the development of methods and approaches on Damage and Fracture Mechanics. By bringing together the leading international experts in the field, AIQ-ICF promotes technology transfer and provides a forum for industry and researchers of the host nation to present their accomplishments and to develop new ideas at the highest level. International Conferences have an important role to play in the technology transfer process, especially in terms of the relationships to be established between the participants and the informal exchange of ideas that this ICF offers.

Damage Modeling of Composite Structures: Strength, Fracture, and Finite Element Analysis provides readers with a fundamental overview of the mechanics of composite materials, along with an outline of an array of modeling and numerical techniques used to analyze damage, failure mechanisms and safety tolerance. Strength prediction and finite element analysis of laminated composite structures are both covered, as are modeling techniques for delaminated composites under compression and shear. Viscoelastic cohesive/friction coupled model and finite element analysis for

delamination analysis of composites under shear and for laminates under low-velocity impact are all covered at length. A concluding chapter discusses multiscale damage models and finite element analysis of composite structures. Integrates intralaminar damage and interlaminar delamination under different load patterns, covering intralaminar damage constitutive models, failure criteria, damage evolution laws, and virtual crack closure techniques Discusses numerical techniques for progressive failure analysis and modeling, as well as numerical convergence and mesh sensitivity, thus allowing for more accurate modeling Features models and methods that can be seamlessly extended to analyze failure mechanisms and safety tolerance of composites under more complex loads, and in more extreme environments Demonstrates applications of damage models and numerical methods

Shock-induced dynamic fracture of solids is of practical importance in many areas of materials science, chemical physics, engineering, and geophysics. This book, by an international roster of authors, comprises a systematic account of the current state of research in the field, integrating the large amount of work done in the former Soviet Union with the work done in the West. Topics covered include: Wave propagation, experimental techniques and measurements, spallation of materials of different classes (metals, ceramics, glasses, polymers), constitutive models of fracture processes, and computer simulations.

Presenting original results from both theoretical and numerical viewpoints, this text offers a detailed discussion of the variational approach to brittle fracture. This approach views crack growth as the result of a competition between bulk and surface energy, treating crack evolution from its initiation all the way to the failure of a sample. The authors model crack initiation, crack path, and crack extension for arbitrary geometries and loads.

Introduction to Fracture Mechanics presents an introduction to the origins, formulation and application of fracture mechanics for the design, safe operation and life prediction in structural materials and components. The book introduces and informs the reader on how fracture mechanics works and how it is so different from other forms of analysis that are used to characterize mechanical properties. Chapters cover foundational topics and the use of linear-elastic fracture mechanics, involving both K-based characterizing parameter and G-based energy approaches, and how to characterize the fracture toughness of materials under plane-strain and non plane-strain conditions using the notion of crack-resistance or R-curves. Other sections cover far more complex nonlinear-elastic fracture mechanics based on the use of the J-integral and the crack-tip opening displacement. These topics largely involve continuum mechanics descriptions of crack initiation, slow crack growth, eventual instability by overload fracture, and subcritical cracking. Presents how, for a given material, a fracture toughness value can be measured on a small laboratory sample and then used directly to predict the failure (by fracture, fatigue, creep, etc.) of a much larger structure in service Covers the rudiments of fracture mechanics from the perspective of the philosophy underlying the few principles and the many assumptions that form the basis of the discipline Provides readers with a "working knowledge" of fracture mechanics, describing its potency for damage-tolerant design, for preventing failures through appropriate life-prediction strategies, and for quantitative failure analysis (fracture diagnostics)

The micro-mechanics based approach to the study of ductile fracture has successfully overcome many of the limitations (such as large scale material yielding, cyclic loading, and size/scale dependence of J) of traditional fracture mechanics approaches (i.e. K, J and CTOD's). A number of the currently available micro-mechanics models (i.e. SMCS, Hancock and McKenzie, 1975; VGM, Kanvinde and Deierlein, 2006) predict fracture accurately under high triaxiality and axisymmetric conditions; however, the mentioned conditions do not encompass the full range of stress states (including low-triaxiality or non-axisymmetric conditions) which are relevant to the structural, mechanical and aerospace industries. As such, the primary objective of the work presented in this dissertation is to inform the development of a more general damage model which is applicable to a broader range of stress states and seismic (i.e. cyclic) loading which can result in ultra-low cycle fatigue (ULCF) failures. New model development is realized through a collaborative multi-scale approach which combines the results of an extensive test series (Smith, 2014) and a series of computational void simulations. To probe the full range of practical stress/loading conditions, a more general finite element (FE) framework for simulating the response of micro-voids is developed. The new void cell framework and the results of the 146 void simulations comprise the primary body of work presented in this dissertation. The void simulations can be divided into two groups: (1) those which effectively simulate an array of voids while modeling a representative void cell, and (2) those which explicitly model an array of voids. Void growth rates measured from the single void model (SVM) are used to inform the selection of a new functional form for the damage model presented in this dissertation while the multi-void model (MVM) provides qualitative and quantitative insights regarding localized deformation between neighboring voids. Findings from the MVM simulations are (1) in agreement with observations obtained from sectioned images (Smith, 2014) of fracture coupons that expose undergrown voids in the near vicinity of the failure surface and (2) are used to develop a strain-based indicator for localization initiation that shows strong agreement with failure strains observed from coupon scale tests (Myers, 2009). Moreover, the trends observed from both model types indicate that there is minimal void growth and that localization does not occur at low triaxialities. Both finding suggest that an alternate fracture mechanism than the traditionally excepted 'growth to coalescence' mechanism is active under these conditions. Despite the power of micro-mechanics based models, the ability to arrive at accurate fracture predictions is contingent on the calibration of the parameters which define the material constitutive response. The capability for complementary FE simulations to reproduce the force-displacement response obtained from physical tests (which is typically relied upon for model calibration) provides a false sense of security and neglects issues (i.e. non-uniqueness of the model parameter set) associated with model over-fitting. To investigate the susceptibility of typical calibration approaches to result in non-unique fits, a simple example is employed. Results of the example demonstrate that (1) multiple (and therefore non-unique) parameter sets may adequately reproduce the force-displacement response of typical calibration specimen and

(2) that local plastic strains (often used to evaluate local fracture criteria) can result in error more than 65% despite agreement with the calibration metric. Thus, selection of parameter sets based solely on qualitative agreement between test data and complementary simulations can lead to erroneous results when evaluating material resistance to fracture. This book presents recent advances related to the following two topics: how mechanical fields close to material or geometrical singularities such as cracks can be determined; how failure criteria can be established according to the singularity degrees related to these discontinuities. Concerning the determination of mechanical fields close to a crack tip, the first part of the book presents most of the traditional methods in order to classify them into two major categories. The first is based on the stress field, such as the Airy function, and the second resolves the problem from functions related to displacement fields. Following this, a new method based on the Hamiltonian system is presented in great detail. Local and energetic approaches to fracture are used in order to determine the fracture parameters such as stress intensity factor and energy release rate. The second part of the book describes methodologies to establish the critical fracture loads and the crack growth criteria. Singular fields for homogeneous and non-homogeneous problems near crack tips, v-notches, interfaces, etc. associated with the crack initiation and propagation laws in elastic and elastic-plastic media, allow us to determine the basis of failure criteria. Each phenomenon studied is dealt with according to its conceptual and theoretical modeling, to its use in the criteria of fracture resistance; and finally to its implementation in terms of feasibility and numerical application. Contents 1. Introduction. Part 1: Stress Field Analysis Close to the Crack Tip 2. Review of Continuum Mechanics and the Behavior Laws. 3. Overview of Fracture Mechanics. 4. Fracture Mechanics. 5. Introduction to the Finite Element Analysis of Cracked Structures. Part 2: Crack Growth Criteria 6. Crack Propagation. 7. Crack Growth Prediction in Elements of Steel Structures Submitted to Fatigue. 8. Potential Use of Crack Propagation Laws in Fatigue Life Design.

Understanding of failure of quasibrittle materials is of paramount importance in many engineering fields. This subject has become a broad and important field of considerable mathematical complexity, with many competing models and unsolved problems. Attention in this volume focuses on concrete, rock, masonry, toughened ceramics, ice and other quasibrittle materials characterized by the development of large zones of cracking or other microstructural damage, and its localization into major fractures.

This book contains a selection of fully peer-reviewed papers which were presented at the 2nd ESIS TC4 Conference, held in Les Diablerets, Switzerland 13 - 15 September 1999. The meeting was designed to reflect the activities of the Committee over the last 15 years, and to plan future activities. The papers have been divided into four chapters under the headings of Composites, Elastic-Plastic Fracture, Adhesion, and Impact and General Fracture. These are convenient groupings, but there are many interactions between the areas, with the common theme of Fracture Mechanics underlying it all.

The combined finite discrete element method is a relatively new computational tool aimed at problems involving static and / or dynamic behaviour of systems involving a large number of solid deformable bodies. Such problems include fragmentation using explosives (e.g rock blasting), impacts, demolition (collapsing buildings), blast loads, digging and loading processes, and powder technology. The combined finite-discrete element method - a natural extension of both discrete and finite element methods - allows researchers to model problems involving the deformability of either one solid body, a large number of bodies, or a solid body which fragments (e.g. in rock blasting applications a more or less intact rock mass is transformed into a pile of solid rock fragments of different sizes, which interact with each other). The topic is gaining in importance, and is at the forefront of some of the current efforts in computational modeling of the failure of solids. * Accompanying source codes plus input and output files available on the Internet * Important applications such as mining engineering, rock blasting and petroleum engineering * Includes practical examples of applications areas Essential reading for postgraduates, researchers and software engineers working in mechanical engineering.

Frac-pack design is still done on conventional hydraulic fracturing models that employ linear elastic fracture mechanics. However it has become evident that the traditional models of fracture growth are not applicable to soft rocks/unconsolidated formations due to elastoplastic material behavior and strong coupling between flow and stress model. Conventional hydraulic fracture models do not explain the very high net fracturing pressures reported in field and experiments and predict smaller fracture widths than expected. The key observations from past experimental work are that the fracture propagation in poorly consolidated sands is a strong function of fluid rheology and leak off and is accompanied by large inelastic deformation and shear failure leading to higher net fracturing pressures. In this thesis a numerical model is formulated to better understand the mechanisms governing fracture propagation in poorly consolidated sands under different conditions. The key issues to be accounted for are the low shear strength of soft rocks/unconsolidated sands making them susceptible to shear failure and the high permeabilities and subsequently high leakoff in these formations causing substantial pore pressure changes in the near wellbore region. The pore pressure changes cause poroelastic stress changes resulting in a strong fluid/solid coupling. Also, the formation of internal and external filtercakes due to plugging by particles present in the injected fluids can have a major impact on the failure mechanism and observed fracturing pressures. In the presented model the fracture propagation mechanism is different from the linear elastic fracture mechanics approach. Elastoplastic material behavior and poroelastic stress effects are accounted for. Shear failure takes place at the tip due to fluid invasion and pore pressure increase. Subsequently the tip may fail in tension and the fracture propagates. The model also accounts for reduction in porosity and permeability due to plugging by particles in the injected fluids. The key influence of pore pressure gradients, fluid leakoff and the elastic and strength properties of rock on the failure mechanisms in sands have been demonstrated and found to be consistent with experimental observations.

This book presents fractography and failure analysis at a level that is accessible for non-expert readers, without losing

scientific rigor. It offers a comprehensive description of fracture surfaces in engineering materials, with an emphasis on metals, and of the methodology for the observation of fracture surfaces. It also discusses in detail the main fracture mechanisms and their corresponding fracture surfaces, including brittle, ductile, fatigue, and environmental fractures. The last chapter is dedicated to the use of fractography in determining of the causes component failure. In modern engineering, the analysis of fractured components is a common practice in many fields, such as integrity management systems, materials science research, and failure investigations. As such this book is useful for engineers, scientists, engineering students, loss adjuster surveyors and any professional dealing with fractured components.

Modelling Damage, Fatigue and Failure of Composite Materials provides the latest research on the field of composite materials, an area that has attracted a wealth of research, with significant interest in the areas of damage, fatigue, and failure. The book is a comprehensive source of physics-based models for the analysis of progressive and critical failure phenomena in composite materials, and focuses on materials modeling, while also reviewing treatments to give the reader thorough direction for analyzing failure in composite structures. Part one of the book reviews the damage development in composite materials such as generic damage and damage accumulation in textile composites and under multiaxial loading, while part two focuses on the modeling of failure mechanisms in composite materials with attention given to fibre/matrix cracking and debonding, compression failure, and delamination fracture. Final sections examine the modeling of damage and materials response in composite materials, including micro-level and multi-scale approaches, the failure analysis of composite materials and joints, and the applications of predictive failure models. Examines current research in modeling damage, fatigue, and failure of composite materials Provides a comprehensive source of physics-based models for the analysis of progressive and critical failure phenomena in composite materials Assesses the failure and life prediction in composite materials Discusses the applications of predictive failure models such as computational approaches to failure analysis

This book offers a collection of 17 scientific papers about the computational modeling of fracture. Some of the manuscripts propose new computational methods and/or how to improve existing cutting edge methods for fracture. These contributions can be classified into two categories: 1. Methods which treat the crack as strong discontinuity such as peridynamics, scaled boundary elements or specific versions of the smoothed finite element methods applied to fracture and 2. Continuous approaches to fracture based on, for instance, phase field models or continuum damage mechanics. On the other hand, the book also offers a wide range of applications where state-of-the-art techniques are employed to solve challenging engineering problems such as fractures in rock, glass, concrete. Also, larger systems such as fracture in subway stations due to fire, arch dams, or concrete decks are studied.

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

Mechanics of Fatigue addresses the range of topics concerning damage, fatigue, and fracture of engineering materials and structures. The core of this resource builds upon the synthesis of micro- and macro-mechanics of fracture. In micromechanics, both the modeling of mechanical phenomena on the level of material structure and the continuous approach are based on the use of certain internal field parameters characterizing the dispersed micro-damage. This is referred to as continuum damage mechanics. The author develops his own theory for macromechanics, called analytical fracture mechanics. This term means the system cracked body - loading or loading device - is considered as a mechanical system and the tools of analytical (rational) mechanics are applied thoroughly to describe crack propagation until the final failure. Chapter discuss: preliminary information on fatigue and engineering methods for design of machines and structures against failures caused by fatigue fatigue crack nucleation, including microstructural and continuous models theory of fatigue crack propagation fatigue crack growth in linear elastic materials subject to dispersed damage fatigue cracks in elasto-plastic material, including crack growth retardation due to overloading as well as quasistationary approximation fatigue and related phenomena in hereditary solids application of the theory fatigue crack growth considering environmental factors unidirectional fiber composites with ductile matrix and brittle, initially continuous fibers laminate composites Mechanics of Fatigue serves students dealing with mechanical aspects of fatigue, conducting research in fracture mechanics, structural safety, mechanics of composites, as well as modern branches of mechanics of solids and structures.

An extensive and comprehensive survey of one- and three-dimensional damage models for elastic and inelastic solids. The book not only provides a rich current source of knowledge, but also describes examples of practical applications, numerical procedures, and computer codes. The style throughout is systematic, clear, and concise, and supported by illustrative diagrams. The state of the art is given by some 200 references.

It is commonly accepted that the majority of engineering failures happen due to fatigue or fracture phenomena. Adhesive bonding is a prevailing joining technique, widely used for critical connections in composite structures. However, the lack of knowledge regarding fatigue and fracture behaviour, and the shortage of tools for credible fatigue design, hinders the potential benefits of adhesively bonded joints. The demand for reliable and safe structures necessitates deep knowledge in this area in order to avoid catastrophic structural failures. This book reviews recent research in the field of fatigue and fracture of adhesively-bonded composite joints. The first part of the book discusses the experimental investigation of the reliability of adhesively-bonded composite joints, current research on understanding damage mechanisms, fatigue and fracture, durability and ageing as well as implications for design. The second part of the book covers the modelling of bond performance and failure mechanisms in different loading conditions. A detailed reference work for researchers in aerospace and engineering Expert coverage of different adhesively bonded composite joint structures An overview of joint failure

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.

Porous Rock Failure Mechanics: Hydraulic Fracturing, Drilling and Structural Engineering focuses on the fracture mechanics of porous rocks and modern simulation techniques for progressive quasi-static and dynamic fractures. The topics covered in this volume include a wide range of academic and industrial applications, including petroleum, mining, and civil engineering. Chapters focus on advanced topics in the field of rock's fracture mechanics and address theoretical concepts, experimental characterization, numerical simulation techniques, and their applications as appropriate. Each chapter reflects the current state-of-the-art in terms of the modern use of fracture simulation in industrial and academic sectors. Some of the major contributions in this volume include, but are not limited to: anisotropic elasto-plastic deformation mechanisms in fluid saturated porous rocks, dynamics of fluids transport in fractured rocks and simulation techniques, fracture mechanics and simulation techniques in porous rocks, fluid-structure interaction in hydraulic driven fractures, advanced numerical techniques for simulation of progressive fracture, including multiscale modeling, and micromechanical approaches for porous rocks, and quasi-static versus dynamic fractures in porous rocks. This book will serve as an important resource for petroleum, geomechanics, drilling and structural engineers, R&D managers in industry and academia. Includes a strong editorial team and quality experts as chapter authors Presents topics identified for individual chapters are current, relevant, and interesting Focuses on advanced topics, such as fluid coupled fractures, rock's continuum damage mechanics, and multiscale modeling Provides a 'one-stop' advanced-level reference for a graduate course focusing on rock's mechanics

Advances in Applied Mechanics draws together recent, significant advances in various topics in applied mechanics. Published since 1948, the book aims to provide authoritative review articles on topics in the mechanical sciences. While the book is ideal for scientists and engineers working in various branches of mechanics, it is also beneficial to professionals who use the results of investigations in mechanics in various applications, such as aerospace, chemical, civil, environmental, mechanical, and nuclear engineering. Includes contributions from world-leading experts that are acquired by invitation only Beneficial to scientists, engineers, and professionals who use the results of investigations in mechanics in various applications, such as aerospace, chemical, civil, environmental, mechanical, and nuclear engineering Covers not only traditional topics, but also important emerging fields

A Practical Approach to Fracture Mechanics provides a concise overview on the fundamental concepts of fracture mechanics, discussing linear elastic fracture mechanics, fracture toughness, ductile fracture, slow crack propagation, structural integrity, and more. The book outlines analytical and experimental methods for determining the fracture resistance of mechanical and structural components, also demonstrating the use of fracture mechanics in failure analysis, reinforcement of cracked structures, and remaining life estimation. The characteristics of crack propagation induced by fatigue, stress-corrosion, creep, and absorbed hydrogen are also discussed. The book concludes with a chapter on the structural integrity analysis of cracked components alongside a real integrity assessment. This book will be especially useful for students in mechanical, civil, industrial, metallurgical, aeronautical and chemical engineering, and for professional engineers looking for a refresher on core principles. Concisely outlines the underlying fundamentals of fracture mechanics, making physical concepts clear and simple and providing easily-understood applied examples Includes solved problems of the most common calculations, along with step-by-step procedures to perform widely-used methods in fracture mechanics Demonstrates how to determine stress intensity factors and fracture toughness, estimate crack growth rate, calculate failure load, and other methods and techniques

Understanding damage and failure of composite materials is critical for reliable and cost-effective engineering design. Bringing together materials mechanics and modeling, this book provides a complete guide to damage, fatigue and failure of composite materials. Early chapters focus on the underlying principles governing composite damage, reviewing basic equations and mechanics theory, before describing mechanisms of damage such as cracking, breakage and buckling. In subsequent chapters, the physical mechanisms underlying the formation and progression of damage under mechanical loads are described with ample experimental data, and micro- and macro-level damage models are combined. Finally, fatigue of composite materials is discussed using fatigue-life diagrams. While there is a special emphasis on polymer matrix composites, metal and ceramic matrix composites are also described. Outlining methods for more reliable design of composite structures, this is a valuable resource for engineers and materials scientists in industry and academia.

Thematerialsusedinmanufacturingtheaerospace,aircraft,automobile,andnuclear parts have inherent aws that may grow under uctuating load environments during the operational phase of the structural hardware. The design philosophy, material selection, analysis approach, testing, quality control, inspection, and manufacturing are key elements that can contribute to failure prevention and assure a trouble-free structure. To have a robust structure, it must be designed to withstand the envir- mental load throughout its service life, even when the structure has pre-existing aws or when a part of the structure has already failed. If the design philosophy of the structure is based on the fail-safe requirements, or multiple load path design, partial failure of a structural component due to crack propagation is localized and safely contained or arrested. For that reason, proper inspection technique must be scheduled for reusable parts to detect the amount and rate of crack growth, and the possible need for repairing or replacement of the part. An example of a fail-sa- designed structure with crack-arrest feature, common to all aircraft structural parts, is the skin-stiffened design con

guration. However, in other cases, the design p- losophy has safe-life or single load path feature, where analysts must demonstrate that parts have adequate life during their service operation and the possibility of catastrophic failure is remote. For example, all pressurized vessels that have single load path feature are classi ed as high-risk parts. During their service operation, these tanks may develop cracks, which will grow gradually in a stable manner.

Despite tremendous advances made in fracture mechanics of concrete in recent years, very little information has been available on the nature of fracture processes and on reliable test methods for determining parameters for the different models. Moreover, most texts on this topic discuss numerical modeling but fail to consider experimentation. This book fills these gaps and synthesizes progress in the field in a simple, straightforward manner geared to practical applications.

Volume is indexed by Thomson Reuters CPCI-S (WoS). This volume covers a wide range of topics: Fracture Mechanics, Failure Analysis, Composites, Multiscale Modeling, Micromechanics, Structural Health Monitoring, Damage Tolerance, Corrosion, Creep, Non-Linear Problems, Dynamic Fracture, Residual Stress, Environmental Effects, Crack Propagation, Metallic and Concrete Materials, Probabilistic Aspects, Computer Modeling Methods (Finite Element, Boundary Element and Meshless), Microstructural and Multiscale Aspects.

The volume is a collection of edited papers presented at the 18th International Conference on Fracture and Damage Mechanics (FDM 2019), which was held in Rodos Palace Hotel, Rhodes, Greece. The papers cover a wide range of topics related to fracture and damage mechanics. Studies on failure analysis, fracture mechanics, composites, micromechanics, multiscale modeling as well as probabilistic aspects, computer modeling methods, and non-linear problems are presented for a wide range of structural materials, both monolithic and composite. Studies include fatigue, corrosion, creep, dynamic fracture and durability together with damage tolerance aspects. Selected papers on multiscale and multifunctional composites have been presented together with works on structural health monitoring, remaining life assessment methodologies and predictive modeling.

This is an introduction to molecular and atomistic modeling techniques applied to fracture and deformation of solids, focusing on a variety of brittle, ductile, geometrically confined and biological materials. The overview includes computational methods and techniques operating at the atomic scale, and describes how these techniques can be used to model cracks and other deformation mechanisms. The book aims to make new molecular modeling techniques available to a wider community.

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