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Fracture Mechanics of Concrete Material Characterization and Testing Springer **In this volume on the mechanics of fracture of Portland cement concrete, the general theme is the connection between microstructural phenomena and macroscopic models. The issues addressed include techniques for observation over a wide range of scales, the influence of .microcracking on common measures of strength and de formability , and ultimately, the relationship between microstructural changes in concrete under load and its resistance to cracking. It is now commonly accepted that, in past attempts to force-fit the behavior of concrete into the rules of linear elastic fracture mechanics, proper attention has not been paid to scale effects. Clearly, the relationships among specimen size, crack length and opening, and characteristic material fabric dimensions have been, in comparison to their counterparts in metals, ceramics, and rocks, abused in concrete. Without a fundamental understanding of these relationships, additional testing in search of the elusive, single measure of fracture toughness has spawned additional confusion and frustration. No one is in a**

better position to document this observation than Professor Mindess. Fracture mechanics of concrete: Material characterization and testing Material Characterization and Testing Springer Science & Business Media **In this volume on the mechanics of fracture of Portland cement concrete, the general theme is the connection between microstructural phenomena and macroscopic models. The issues addressed include techniques for observation over a wide range of scales, the influence of .microcracking on common measures of strength and de formability , and ultimately, the relationship between microstructural changes in concrete under load and its resistance to cracking. It is now commonly accepted that, in past attempts to force-fit the behavior of concrete into the rules of linear elastic fracture mechanics, proper attention has not been paid to scale effects. Clearly, the relationships among specimen size, crack length and opening, and characteristic material fabric dimensions have been, in comparison to their counterparts in metals, ceramics, and rocks, abused in concrete. Without a fundamental understanding of these relationships, additional testing in search of the elusive, single measure of fracture toughness has spawned additional confusion and frustration. No one is in a better position to document this observation than Professor Mindess. Fracture Mechanics of Concrete Applications of Fracture Mechanics to Concrete, Rock and Other Quasi-Brittle Materials** John Wiley & Sons **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. Fracture Mechanics Test Methods For Concrete CRC Press **Compares currently used methods in determining concrete toughness and presents recommended test procedures with theories and models for describing cracking and fracturing phenomena. Effects of loading rate, temperature and humidity are also examined. Well referenced and illustrated, this book is filled with practical technical information for materials and structural engineers. Fracture Mechanics An Introduction** Springer Nature **This book discusses the basic principles and traditional applications of fracture mechanics, as well as the cutting-edge research in the field over the last three decades in current topics like composites, thin films, nanoindentation, and cementitious materials. Experimental methods play a major role in the study of fracture mechanics problems and are used for the determination of the major fracture mechanics quantities such as stress intensity factors, crack tip opening displacements, strain energy release rates, crack paths, crack velocities in static and dynamic problems. These methods include electrical resistance strain gauges, photoelasticity, interferometry techniques, geometric and interferometry moiré, and the optical method of caustics. Furthermore, numerical methods are often used for the determination of fracture mechanics parameters. They include finite and boundary element methods, Green’s function and weight functions, boundary collocation, alternating methods, and integral transforms continuous dislocations. This third edition of the book covers the basic principles and traditional applications, as well as the latest developments of fracture mechanics. Featuring two new chapters and 30 more example problems, it presents a comprehensive overview of fracture mechanics, and includes numerous examples and unsolved problems. This book is suitable for teaching fracture mechanics courses at the undergraduate and graduate levels. A “solutions manual” is available for course instructors upon request. Fracture Mechanics An Introduction** 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. Nonlinear Fracture Mechanics Springer **Fracture mechanics of concrete: Structural application and numerical calculation Structural Application and Numerical Calculation** Springer Science & Business Media **Concrete has traditionally been known as a material used widely in the construction of roads, bridges and buildings. Since cost effectiveness has always been one of the more important aspects of design, concrete, when reinforced and/or prestressed, is finding more use in other areas of application such as floating marine structures, storage tanks, nuclear vessel containments and a host of other structures. Because of the demand for concrete to operate under different loading and environmen tal conditions, increasing attention has been paid to study concrete specimens and structure behavior. A subject of major concern is how the localized segregation of the constituents in concrete would affect its global behavior. The degree of nonhomogeneity due to material property and damage. by yielding and/or cracking depends on the size scale and loading rate under consideration. Segregation or clustering of aggregates at the macroscopic level will affect specimen behavior to a larger degree than it would to a large structure such as a dam. Hence, a knowledge of concrete behavior over a wide range of scale is desired. The parameters governing micro-and macro-cracking and the techniques for evaluating and observing the damage in concrete need to be better understood. This volume is intended to be an**

attempt in this direction. The application of Linear Elastic Fracture Mechanics to concrete is discussed in several of the chapters. Fracture Mechanics Criteria and Applications Springer Science & Business Media **It is difficult to do justice to fracture mechanics in a textbook, for the subject encompasses so many disciplines. A general survey of the field would serve no purpose other than give a collection of references. The present book by Professor E. E. Gdoutos is refreshing because it does not fall into the esoteric tradition of outlining equations and results. Basic ideas and underlying principles are clearly explained as to how they are used in application. The presentations are concise and each topic can be understood by advanced undergraduates in material science and continuum mechanics. The book is highly recommended not only as a text in fracture mechanics but also as a reference to those interested in the general aspects of failure analysis. In addition to providing an in-depth review of the analytical methods for evaluating the fundamental quantities used in linear elastic fracture mechanics, various criteria are discussed re:O. ecting their limitations and applications. Par ticular emphases are given to predicting crack initiation, subcritical growth and the onset of rapid fracture from a single criterion. Those models in which it is assumed that the crack extends from tip to tip rely on the specific surface energy concept. The differences in the global and energy states before and after crack extension were associated with the energy required to create a unit area of crack surface. Applications were limited by the requirement of self-similar crack growth. Fracture and Size Effect in Concrete and Other Quasibrittle Materials** Routledge **Fracture and Size Effect in Concrete and Other Quasibrittle Materials is the first in-depth text on the application of fracture mechanics to the analysis of failure in concrete structures. The book synthesizes a vast number of recent research results in the literature to provide a comprehensive treatment of the topic that does not give merely the facts - it provides true understanding. The many recent results on quasibrittle fracture and size effect, which were scattered throughout many periodicals, are compiled here in a single volume. This book presents a well-rounded discussion of the theory of size effect and scaling of failure loads in structures. The size effect, which is the most important practical manifestation of fracture behavior, has become a hot topic. It has gained prominence in current research on concrete and quasibrittle materials. The treatment of every subject in Fracture and Size Effect in Concrete and Other Quasibrittle Materials proceeds from simple to complex, from specialized to general, and is as concise as possible using the simplest level of mathematics necessary to treat the subject clearly and accurately. Whether you are an engineering student or a practicing engineer, this book provides you with a clear presentation, including full derivations and examples, from which you can gain real understanding of fracture and size effect in concrete and other quasibrittle materials. Advanced Technology for Design and Fabrication of Composite Materials and Structures Applications to the Automotive, Marine, Aerospace and Construction Industry** Springer Science & Business Media **The last**

decade has seen a significant growth in the processing and fabrication of advanced composite materials. This volume contains the up-to-date contributions of those with working experience in the automotive, marine, aerospace and construction field. Starting with modern technologies concerned with assessing the change in material microstructure in terms of the processing parameters, methodologies are offered to account for tradeoffs between the fundamental variables such as temperature and pressure that control the product quality. The book contains new ideas and data, not available in the open literature. Fracture Mechanics of Concrete Structures Proceedings of the First International Conference on Fracture Mechanics of Concrete Structures (FraMCoS1), held at Beaver Run Resort, Breckenridge, Colorado, USA, 1-5 June 1992. CRC Press **This conference is the first in a series of conferences dedicated to Fracture Mechanics of Concrete Structures. Due to the recent explosion of interest in research on fracture in concrete, the conference has brought together the world's leading researchers in fracture of concrete and this book contains the proceedings. Current Trends in Concrete Fracture Research** Springer Science & Business Media **From time to time the International Journal of Fracture has presented matters thought to be of special interest to its readers. The last special topic review was presented by Drs W.G. Knauss and AJ. Rosakis as Guest Editors in four issues, January-April 1990, under the general title of Non Linear Fracture. It contained sections on damage mechanisms, interfaces and creep, time depen dence, and continuum plasticity insofar as they affect the mechanisms of the fracture process. Continuing this policy, which is consistent with our stated objectives, the two September issues deal with the behavior of concrete and cementious materials during fracture initiation and propagation. We hope that the ensuing state-of-the-art review will yield another instructive and timely product which readers will find useful. To assist us in presenting this subject, we have prevailed upon a well-known international expert in concrete behavior, Dr. Z.P. Bazant, Walter P. Murphy Professor of Civil Engineering, of Northwes tern University to act as Guest Editor. On behalf of the editors and publishers, I wish to thank Professor BaZant and his invited authors for undertaking this special effort. M.L. WILLIAMS Pittsburgh, Pennsylvania Editor-in-Chief September 1991 International Journal of Fracture 51: ix-xv, 1991. Z.P. Bafant (ed.), Current Trends in Concrete Fracture Research. Mechanics of Fracture Initiation and Propagation Surface and volume energy density applied as failure criterion** Springer Science & Business Media **The assessment of crack initiation and/or propagation has been the subject of many past discussions on fracture mechanics. Depending on how the chosen failure criterion is combined with the solution of a particular theory of continuum mechanics, the outcome could vary over a wide range. Mod elling of the material damage process could be elusive if the scale level of observation is left undefined. The specification of physical dimension alone is not sufficient because time and temperature also play an intimate role. It is only when the latter two variables are fixed that failure predictions can be**

simplified. The sudden fracture of material with a pre-existing crack is a case in point. Barring changes in the local temperature,* the energy released to create a unit surface area of an existing crack can be obtained by considering the change in elastic energy of the system before and after crack extension. Such a quantity has been referred to as the critical energy release rate, G e, or stress intensity factor, K Ie. Other parameters, such as the crack opening displacement (COD), path-independent J-integral, etc. , have been proposed; their relation to the fracture process is also based on the energy release concept. These one-parameter approaches, however, are unable simultaneously to account for the failure process of crack initiation, propagation and onset of rapid fracture. A review on the use of G, K I, COD, J, etc. , has been made by Sih [1,2]. Probabilistic fracture mechanics and reliability Springer Science & Business Media **With the advent of the 80's there has been an increasing need for analytic and numerical techniques, based on a thorough understanding of microstructural processes, that express in a manner suitable for practicing engineers the reliability of components and structures that are being subjected to degradation situations. Such situations fall within the framework offracture mechanics, fatigue, corrosion fatigue and pitting corrosion. Luckily, such techniques are now being developed and it was felt timely to combine in one volume reports by the leaders in this field who are currently making great strides towards solving these problems. Hence the idea of this monograph was born and I am pleased to be associated both with it and the contributors whose chapters are included in this volume. A very large part of the credit for this monograph must go to the authors who have taken time out from their busy schedules to prepare their submissions. They have all worked diligently over the last few months in order to get their manuscripts to me on time and I sincerely thank them for their help throughout the preparation of this volume. Fracture Mechanics for Concrete Materials Testing and Applications** Amer Concrete Inst **Analysis of Concrete Structures by Fracture Mechanics Proceedings of a RILEM Workshop dedicated to Professor Arne Hillerborg, Abisko, Sweden 1989** CRC Press **This book presents the latest research findings of the fast developing applications of fracture mechanics to concrete structures. Key papers from leading experts in the field describe existing and new modelling techniques in the analysis of materials and structures. The book explains the practical application of fracture mechanics to structural modelling, bending, shear, bond and anchorage. The proceedings of this RILEM Workshop will be an important reference for those engaged in design, development, research and teaching in the field of concrete structures. Strength of Structural Elements** Elsevier **This volume describes engineering applications of the mechanics of deformable bodies and the elasticity theory relevant to them. It is concerned mainly with one-dimensional problems, which arise because either one of the dimensions of a body is much greater than the remaining two or the functions of two or three variables may be reduced to one variable. Problems of this type are of twofold importance. Firstly, many engineering problems can**

be described with sufficient accuracy just in this way. Secondly, unidimensional problems with known analytical solutions may serve either for testing numerical methods or for the analysis of fundamental concepts and phenomena, whose physical nature in three-dimensional approach might be obscured by the analytical-numerical aspect. The authors have confined themselves for the most part to the analysis of elastic behaviour of structures; however some attention is also given to elastic problems. A deterministic approach has been applied throughout the book. It will serve as a springboard for further work with stochastic approaches which are being increasingly used in engineering practice today. Fracture and Complexity One Century since Griffith's Milestone Springer Nature **The book explores the two opposite natural trends of composite systems: (i) order and structure emerging from heterogeneity and randomness, and (ii) instability and chaos arising from simple nonlinear rules. Providing insights into the rapidly growing field of complexity sciences, the book focuses on the role of complexity in fracture mechanics. It firstly discusses the occurrence of self-similarity and fractal patterns in deformation, damage, fracture, and fragmentation of heterogeneous materials and the apparent scaling of the nominal mechanical properties of disordered materials, as well as of the time-to-failure after fatigue and creep loading. Then the book addresses criticality in the acoustic emissions from damaged structures and tectonic faults. Further, it examines the snap-back instability in the structural behavior of relatively large composite structures in the framework of catastrophe theory, and lastly describes the transition toward chaos in the dynamics of cracked elements. Toughening Mechanisms in Quasi-Brittle Materials** Springer Science & Business Media **A variety of ceramic materials has been recently shown to exhibit nonlinear stress strain behavior. These materials include transformation-toughened zirconia which undergoes a stress-induced crystallographic transformation in the vicinity of a propagating crack, microcracking ceramics, and ceramic-fiber reinforced ceramic matrices. Since many of these materials are under consideration for structural applications, understanding fracture in these quasi-brittle materials is essential. Portland cement concrete is a relatively brittle material. As a result mechanical behavior of concrete, conventionally reinforced concrete, prestressed concrete and fiber reinforced concrete is critically influenced by crack propagation. Crack propagation in concrete is characterized by a fracture process zone, microcracking, and aggregate bridging. Such phenomena give concrete toughening mechanisms, and as a result, the macroscopic response of concrete can be characterized as that of a quasi-brittle material. To design super high performance cement composites, it is essential to understand the complex fracture processes in concrete. A wide range of concern in design involves fracture in rock masses and rock structures. For example, prediction of the extension or initiation of fracture is important in: 1) the design of caverns (such as underground nuclear waste isolation) subjected to earthquake shaking or explosions, 2) the production of geothermal**

and petroleum energy, and 3) predicting and monitoring earthquakes. Depending upon the grain size and mineralogical composition, rock may also exhibit characteristics of quasi-brittle materials. Fracture of Concrete and Rock SEM-RILEM International Conference, June 17–19, 1987, Houston, Texas, USA Springer Science & Business Media **The International Conference on Fracture of Concrete and Rock was organized by the Society for Experimental Mechanics (SEM) subdivision on Fracture of Concrete and Rock and RILEM Committee 89-FMT Fracture MechanicS of Concrete; Test Methods. The venue was Houston, Texas on June 17-19, 1987 and cooperation was provided by ACI 446, Fracture Mechanics and RILEM 90-FHA Fracture Mechanics of Concrete; Applications. The conference co-chai rmen were Professor S. P. Shah, Northwestern Uni versity and Professor S. E. Swartz, Kansas State University with the able assistance of Professor K. P. Chong, University of Wyoming. The conference theme was Fracture Mechanics Applications to Cracking and Fracture of Concrete (plain or reinforced) and Rock Subjected to Uniaxial or Complex Stress States with Static- or Dynamic-Loading Rates. This theme was chosen in recognition of parallel efforts between the rock mechanics community and researchers working in the application of fracture mechanics methods to the problem of cracking and fracture of concrete. A Fracture Mechanics Approach to Failure Analysis of Concrete Materials Fracture Mechanics of Concrete Structures Applied Mechanics Reviews Fracture Mechanics of Concrete Structures From Theory to Applications : Report of the Technical Committee 90-FMA Fracture Mechanics to Concrete/Applications, RILEM (the International Union of Testing and Research Laboratories for Materials and Structures** Spon Press **Review of Progress in Quantitative Nondestructive Evaluation** Springer Science & Business Media **These Proceedings, consisting of Parts A and B, contain the edited versions of most of the papers presented at the annual Review of Progress in Quantitative Nondestructive Evaluation held at Bowdoin College, Brunswick, Maine on July 28 to August 2, 1996. The Review was organized by the Center for NDE at Iowa State University, in cooperation with the American Society of Nondestructive Testing, the Ames Laboratory of the USDOE, the Federal Aviation Administration, the National Institute of Standardsand Technology, and the National Science Foundation Industry!University Cooperative Research Centers pro gram. This year's Review of Progress in QNDE was attended by approximately 400 participants from the U.S. and many foreign countries who presented over 350 papers. As usual, the meetingwas divided into 36 sessions, with as many as four sessions running concurrently. The Review covered all phases of NDE research and development from fundamental investigations to engineering applications or inspection systems, and it included many important methods of inspection techniques from acoustics to x-rays. In the last eight to ten years, the Review has stabilized at about its current size, which most participants seem to agree is large enough to permit a full-scale overview of the latest developments, but still small enough to retain the collegial atmosphere which has marked the Review since its**

inception. Damage and Fracture Mechanics Failure Analysis of Engineering Materials and Structures Springer Science & Business Media **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. Fracture Processes of Concrete** CRC Press **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. Isodyne Stress Analysis** Springer Science & Business Media **''It is true that "Nothing is more practical than a theory" Provided - however - That the assumptions on which the theory is founded Are well understood. - But, indeed, engineering experience shows that "Nothing can be more disastrous than a theory When applied to a real problem Outside of the practicailimits of the assumptions made", Because of an homonymous identity With the problem under consideration. " (J. T. P.) The primary objective of this work is to present the theories of analytical and optical isodynes and the related measurement procedures in a manner com patible with the modem scientific methodology and with the requirements of modem technology pertaining to the usefulness of the stress analysis proce dures. The selected examples illustrate some major theses of this work and demonstrate the particular efficiency of the isodyne methods in solving the technologically important problems in fracture mechanics and mechanics of composite structures including new materials. To satisfy this objective it was necessary to depart from the common practice of presenting theories and techniques of experimental methods as a compatible system of equations and procedures without mentioning the tacitly accepted assumptions and their influence on the theoretical admissibility of analytical**

expressions and the reliability of the experimental or analytical results. It was necessary to design a more general frame of reference which could allow to assess the scientific correctness of isodyne methods and the reliability of experimental results. Fracture of Engineering Materials and Structures Springer Science & Business Media **Recent advances in the field of fracture of engineering materials and structures have increasingly indicated its multidisciplinary nature. This area of research now involves scientists and engineers who work in materials science, applied mathematics and mechanics, and also computer scientists. The present volume, which contains the Proceedings of the Joint FEFG/ICF International Conference on Fracture of Engineering Materials and Structures held in Singapore from the 6th to 8th of August 1991, is a testimony of this multidisciplinary nature. This International Conference was the Second Symposium of the Far East Fracture Group (FEFG) and thus provided a unique opportunity for researchers and engineers in the Far East region to exchange and acquire knowledge of new advances and applications in fracture. The Conference was also the Inter-Quadrennial International Conference on Fracture (ICF) for 1991 and thus appealed to researchers in the international arena who wished to take advantage of this meeting to present their findings. The Conference has brought together over 130 participants from more than 24 countries, and they represented government and industrial research laboratories as well as academic institutions. It has thus achieved its objective of bringing together scientists and engineers with different backgrounds and perspectives but with . a common interest in new developments in the fracture of engineering materials and structures. This volume contains 4 keynote papers, 4 invited papers and 130 contributed papers. Application of Fracture Mechanics to Cementitious Composites** Springer Science & Business Media **Portland cement concrete is a relatively brittle material. As a result, mechanical behavior of concrete, conventionally reinforced concrete, prestressed concrete, and fiber reinforced concrete is critically influenced by crack propagation. It is, thus, not surprising that attempts are being made to apply the concepts of fracture mechanics to quantify the resistance to cracking in cementious composites. The field of fracture mechanics originated in the 1920's with A. A. Griffith's work on fracture of brittle materials such as glass. Its most significant applications, however, have been for controlling brittle fracture and fatigue failure of metallic structures such as pressure vessels, airplanes, ships and pipe lines. Considerable development has occurred in the last twenty years in modifying Griffith's ideas or in proposing new concepts to account for the ductility typical of metals. As a result of these efforts, standard testing techniques have been available to obtain fracture parameters for metals, and design based on these parameters are included in relevant specifications. Many attempts have been made, in the last two decades or so, to apply the fracture mechanics concepts to cement, mortar, con crete and reinforced concrete. So far, these attempts have not led to a unique set of material parameters which can quantify the resistance of these**

cementitious composites to fracture. No standard testing methods and a generally accepted theoretical analysis are established for concrete as they are for metals. Fracture Mechanics Test Methods For Concrete CRC Press **Compares currently used methods in determining concrete toughness and presents recommended test procedures with theories and models for describing cracking and fracturing phenomena. Effects of loading rate, temperature and humidity are also examined. Well referenced and illustrated, this book is filled with practical technical information for materials and structural engineers. Applications of Fracture Mechanics to Reinforced Concrete** CRC Press **This volume emphazises the most recent advances in fracture mechanics as specifically applied to steel bar reinforced concrete. Fracture mechanics has been applied to plain and fibre reinforced concrete with increasing success over recent years. This workshop extended these concepts to steel bar reinforced and pre-stressed concrete design. Particularly for high strength concrete, which is a very brittle material, and in the case of large structural members, the application of fracture mechanics appears to be very useful for improving the present design rules. The pre-eminent participants at the Turin workshop contributed extensive expert opinions in four selected areas for which a rational approach, using fracture mechanics, could introduce variations into the concrete design codes: size effects; anchorage and bond; minimum reinforcement for elements in flexure; and shear resistance. The 23 chapters logically address these themes and demonstrate the unique ability of fracture mechanics to capture all the experimentally observed characteristics. The book is primarily directed to the researchers in universities and institutions and will be of value to consultants and engineering companies. Cement-Based Composites: Volume 64 Strain Rate Effects on Fracture** Materials Research Society **The MRS Symposium Proceeding series is an internationally recognised reference suitable for researchers and practitioners. Teaching and Education in Fracture and Fatigue** CRC Press **This proceedings contains the best contributions to the series of seminars held in Vienna (1992), Miskolc, Hungary (1993 and 1994) and Vienna (1995) and provides a valuable resource for those concerned with the teaching of fracture and fatigue. It presents a wide range of approaches relevant to course and curriculum development. It is aimed particularly at those concerned with graduate and post-graduate education. Fracture Mechanics of Cementitious Materials** CRC Press **The application of fracture mechanics to cementitious materials allows the investigation of many important factors relating to the durability of these materials. This new book provides a comprehensive and readable exposition of this subject and is written by two of the world's foremost experts. Fracture Mechanics of Concrete** Elsevier Science Limited **Advances in Fracture and Damage Mechanics XIV** Trans Tech Publications Ltd **Collection of selected, peer reviewed papers from the 14th International Conference on Fracture and Damage Mechanics (FDM 2015), September 21-23, 2015, Budva, Montenegro. The FDM2015 covers a wide range of topics: Structural Integrity, Failure analysis, Fracture Mechanics, Composites,**

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 Modelling Methods, Microstructural and Multiscale Aspects. Concrete Fracture A Multiscale Approach CRC Press **The study of fracture mechanics of concrete has developed in recent years to the point where it can be used for assessing the durability of concrete structures and for the development of new concrete materials. The last decade has seen a gradual shift of interest toward fracture studies at increasingly smaller sizes and scales. Concrete Fracture: A Nonlinear Fracture Mechanics: Time-dependent fracture** ASTM International