Damage and Failure of Composite Materials

Mechanics of Laminated Composite Plates and Shells: N. Reddy 2003-11-24 The use of composite materials in engineering structures continues to increase dramatically, and there have been equally significant advances in modeling for general and composite materials and structures in particular. To reflect these developments, renewed academic, industrial, and research interest has been generated.

Fatigue Life Prediction of Composites and Composite Structures-A P Vassilioupolos 2010-07-27 The use of composites in growing in structural applications in industries such as aerospace, marine, wind turbine and civil engineering. There are uncertainties about the long-term performance of these composites and how they will perform under cyclic fatigue loading. Fatigue life prediction of composites and composite structures provides a comprehensive overview of fatigue damage and fatigue life prediction methodologies for composites and how they can be used in practice. After an introductory chapter, Part one reviews developments in the field of modelling composite structures. Section two considers fatigue testing methodology and variable amplitude loading as well as multi-axial and cyclic loading. Part three then describes applications such as fatigue life prediction of bonded joints and wind turbine blades. The book provides simplified models for predicting the life of composite structures and composite components and structures. Examines past, present and future trends associated with fatigue life prediction of composite structures and composite materials under constant and variable amplitude loading. Specific chapters investigate fatigue life prediction of wind turbine rotor blades and bonded joints in composite structures.

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Uncertainty Quantification in Laminated Composite-Stupuy Day 2018-09-19 Over the last few decades, uncertainty quantification in composite materials and structures has gained a lot of attention from the research community as a result of industrial requirements. This book presents computationally efficient uncertainty quantification schemes following model-based approaches for stochasticity in material and geometric parameters of laminated composite structures. Several metamodels have been studied and comparative results have been presented for different static and dynamic responses. Results for sensitivity analyses are provided for a comprehensive coverage of the relative importance of different material and geometric parameters in the global structural responses.

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Analysis and Performance of Fiber Composites: A practical reference book for designers of heavily loaded composite parts. Fully updated to mirror the exponential growth and development of composites, this English-language Third Edition: Contains all new coverage of nanocomposites and bicomposites Reflects the latest manufacturing processes and applications in the aerospace, automotive, naval, wind turbine, and sporting goods industries Provides a design method to define composite multilayered plates under loading, along with all numerical information needed for implementation Presents original study of composite beams of any section shapes and thick-laminated composite plates, leading to technical formulations that are not found in the literature Features numerous examples of the pre-sizing of composite parts, processed from industrial cases and rewritten to highlight key information Includes test cases for the validation of computer software using finite elements Consisting of three main parts, plus a fourth on applications, Composite Materials: Design and Application, Third Edition features a technical level that rises in difficulty as the text progresses, yet each part still can be explored independently. While the heart of the book, devoted to the methodical pre-design of structural parts, retains its original character, the contents have been significantly rewritten, restructured, and expanded to better illustrate the types of challenges encountered in modern engineering practice.

Interface Fracture and Composite Deformation of Model Laminates—Matthew R. Fox 1999

Structural Integrity and Durability of Advanced Composites—Peter Beaumont 2015-05-19 Structural Integrity and Durability of Advanced Composites: Innovative Modelling Methods and Intelligent Design presents scientific and technological research from leading composite materials scientists and engineers that showcase the fundamental issues and practical problems that affect the development and exploitation of large composite structures. As predicting precisely where cracks may develop in materials under stress is an age old mystery in the design and building of large-scale engineering structures, the burden of testing to provide “fracture safe designs” is imperative. Readers will learn to transfer key ideas from research and development to both the design engineer and end-user of composite materials. This comprehensive text provides the information needed to understand deformation and fracture phenomena resulting from impact, fatigue, creep, and stress corrosion cracking and how these phenomena affect life, safety, and productivity. Surfaces and the durability of structures. Presents scientific and technological research from leading composite materials scientists and engineers that showcase fundamental issues and practical problems Provides the information needed to understand deformation and fracture phenomena resulting from impact, fatigue, creep, and stress corrosion cracking Enables readers to transfer key ideas from research and development to both the design engineer and end-user of composite materials.

Mechanical Response of Composites—Pedro P. Camanho 2008-06-20 The methodology for designing high-performance composite structures is still evolving. The complexity of the response of composite materials and the difficulties in predicting the composite material properties from the basic properties of the components turn the need for a well-planned and exhaustive test program. The recommended practice to mitigate the technological risks associated with advanced composite materials is to substantiate the performance and durability of the design in a sequence of steps known as the Building Block Approach. The Building Block Approach ensures that cost and performance objectives are met by testing greater numbers of smaller, less expensive specimens. In this way, technology risks are assessed early in the program. In addition, the knowledge acquired at a given level of structural complexity is built up before progressing to a level of increased complexity. Achieving substantiation of structural performance by testing alone can be prohibitively expensive because of the number of specimens and components required to characterize the contents have been significantly rewritten, restructured, and expanded to better illustrate the types of challenges encountered in modern engineering practice.


Damage Tolerance and Durability of Material Systems—Kenneth L. Reifsnider 2002-04-24 A daring, original approach to understanding and predicting the mechanical behavior of materials. "Damage is an abstraction... Strength is an observable, an independent variable that can be measured, with clear and familiar engineering definitions." From the Preface to Damage Tolerance and Durability of Material Systems ISBN-13: 978-0471677284 Long-term behavior is one of the most challenging and important aspects of material engineering. There is a great need for a useful conceptual or operational framework for measuring long-term behavior. As much a revolution in what is a new discipline as an engineering approach, Damage Tolerance and Durability of Material Systems postulates a new mechanistic philosophy and methodology for predicting the remaining strength and life of engineering material. This philosophy assigns the local physical changes in materials and stress states caused by time-varying applied environments with global properties and performance. The book's aim is to enable the mechanistic behavior of engineering materials and structures: their stiffness, strength, and life. It teaches the reader the fundamental insights into the lives of these materials and structures: their stiffness, strength, and life. It is intended to be a comprehensive and self-contained introduction to the subject of composite materials. It can be used as a textbook for courses in composite materials, or as a reference for researchers and engineers in the field. The book is divided into three parts: Part I provides the fundamental concepts and basic mathematical tools for the analysis of stress concentration and fracture mechanics, Part II covers the mechanics of composite materials, and Part III deals with the design and analysis of composite structures.

Micromechanics in Practice—Michal Šejnoha 2013 The book will concentrate on the application of micromechanics to the analysis of practical engineering problems. Both classical composites represented by carbon/carbon textile laminates and applications in Civil Engineering including asphalts and masonry structures will be considered. A common denominator of these considerably distinct material systems will be randomness of their internal structure. Also, owing to their complexity, all material systems will be studied on multiple scales. Since real engineering, rather than academic, problems are of the main interest, these scales will be treated independently from each other on the grounds of fully uncoupled multi-scale analysis. Attention will be limited to elastic and viscoelastic behavior and to the linear heat transfer analysis. To achieve this, the book will address two different approaches to the homogenization of systems with random microstructures. In particular, classical averaging schemes based on the Eshelby solution of a solitary inclusion in an infinite medium represented by the Hashin-Shtrikman variational principles or by considerably simpler and more popular Mori-Tanaka method will be compared to detailed finite element simulations of a certain representative volume element (RVE) representing accommodated geometrical details of respective microstructures. These are derived by matching material statistics such as the one- and two-point probability functions of real and artificial microstructures. The latter one is termed the statistically equivalent periodic unit cell owing to the assumed periodic arrangement of reinforcements (carbon fibres, carbon fibre tows, stones or masonry bricks) in a certain matrix (carbon matrix, asphalt mastic, mortar). Other types of materials will be introduced in the form of exercises with emphasis on the application of the Mori-Tanaka method in the framework of the previously mentioned uncoupled multi-scale analysis.