Delamination Of Composites Pdf

Delamination Buckling of Composite Materials

LIOn Delamination of Laminated Composites (a) Fiber-Reinforced Composites Considerable technological advances in the production of high-strength fibers (graphite, boron, etc.) have led to a wide use of light high-strength composite materials (graphite epoxy, boron-epoxy, etc.). It is expedient, to make thin walled composite rods, plates, and shells from such materials. Plates can be made by bonding a set of unidirectional thin fiber layers, Fig.l.l. Such plates are orthotropic, as a rule. A random short-fiber composite is shown in Fig. 1.2. Fiber-reinforced composites are widely used in thin-walled aircraft structures because of their specific high strength. For example, the graphite-epoxy composite is characterized by a unidirectional tensile strength of 1.4 GPa while the density is 1.6 Mg/rrt? . For comparison, we may take a steel (steel 4340) whose corresponding properties are identified by values like 1.2 GPa and 7.8 Mg/rrt? . 1. INTRODUCTION Figure 1.1 2 1.1. On Delamination of Laminated Composites Figure 1.2 3 1. INTRODUCTION It is characteristic for laminated plastic material to possess a fairly low bonding. Therefore, low-velocity impacts and defects in manufacturing lead to local delamination. (b) Linear Problems of Delamination Buckling Delamination can significantly reduce the compressive strength and stiffness of the laminate. Local delamination can be considered as a crack in the bond. Under buckling there appears a high interlaminate stress at the crack edge that leads to a spreading of the crack. Delamination growth can lead to structural instability.

Interface Fracture and Delaminations in Composite Materials

Part I of this SpringerBrief presents the problem of a crack between two dissimilar isotropic materials and describes the mathematical background. A fracture criterion is discussed and Methods for calculating fracture parameters such as stress intensity factors using the finite element method and three post-processors are considered. Actual test data and both deterministic and statistical failure curves are presented.In Part II of the book, similar descriptions are given for delaminations in composite laminates. The mathematical treatment of this type of damage including the first term of the asymptotic expansion of the stress and displacement fields is considered. Numerical post-processors for determining stress intensity factors for these cases are reviewed. Two examples of specific laminates are presented: one with a failure curve and the other with a failure surface. Finally, beam specimens used for testing such failures are discussed.

Delamination in Wood, Wood Products and Wood-Based Composites

In the last quarter century, delamination has come to mean more than just a failure in adhesion between layers of bonded composite plies that might affect their load-bearing capacity. Ever-increasing computer power has meant that we can now detect and analyze delamination between, for example, cell walls in solid wood. This fast-moving and critically important field of study is covered in a book that provides everyone from manufacturers to research scientists the state of the art in wood delamination studies. Divided into three sections, the book first details the general aspects of the subject, from basic information including terminology, to the theoretical basis for the evaluation of delamination. A settled terminology in this subject area is a first key goal of the book, as the terms which describe delamination in wood and wood-based composites are numerous and often confusing. The second section examines different and highly specialized methods for delamination detection such as confocal laser scanning microscopy, light microscopy, scanning electron microscopy and ultrasonics. Ways in which NDE (non-destructive evaluation) can be employed to detect and locate defects are also covered. The book’s final section focuses on the practical aspects of this defect in a wide range of wood products covering the spectrum from trees, logs, laminated panels and glued laminated timbers to parquet floors. Intended as a primary reference, this book covers everything from the

microscopic, anatomical level of delamination within solid wood sections to an examination of the interface of wood and its surface coatings. It provides readers with the perspective of industry as well as laboratory and is thus a highly practical sourcebook for wood engineers working in manufacturing as well as a comprehensively referenced text for materials scientists wrestling with the theory underlying the subject.

Delamination Behaviour of Composites

Given such advantages as low weight compared to strength and toughness, laminated composites are now used in a wide range of applications. Their increasing use has underlined the need to understand their principal mode of failure, delamination. This important book reviews key research in understanding and preventing delamination.The first part of the book reviews general issues such as the role of fracture mechanics in understanding delamination, design issues and ways of testing delamination resistance. Part two describes techniques for detecting and characterising delamination such as piezoelectric sensors, the use of lamb waves and acoustic emission techniques. The next two sections of the book discuss ways of studying and modelling delamination behaviour. The final part of the book reviews research on delamination behaviour in particular conditions such as shell and sandwich structures, z-pin bridging and resin bonding.With its distinguished editor and international team of contributors, Delamination behaviour of composites is a standard reference for all those researching laminated composites and using them in such diverse applications as microelectronics, aerospace, marine, automotive and civil engineering. - Reviews the role of fracture mechanics in understanding delamination, design issues and ways of testing delamination resistance - Discuss ways of studying and modelling delamination behaviour - A standard reference for all those researching laminated composites

Damage and Fracture of Composite Materials and Structures

This monograph presents recent research findings on fracture properties and behavior of the composites, and their damage and cracking process under both quasi-static and impact loading conditions. Theoretical treatment, experimental investigation and numerical simulation aspects of the mechanics of composites, including sandwich structures are included.

New Achievements in Continuum Mechanics and Thermodynamics

This book presents a liber amicorum dedicated to Wolfgang H. Müller, and highlights recent advances in Prof. Müller’s major fields of research: continuum mechanics, generalized mechanics, thermodynamics, mechanochemistry, and geomechanics. Over 50 of Prof. Müller’s friends and colleagues contributed to this book, which commemorates his 60th birthday and was published in recognition of his outstanding contributions.

Defects and Damage in Composite Materials and Structures

The advantages of composite materials include a high specific strength and stiffness, formability, and a comparative resistance to fatigue cracking and corrosion. However, not forsaking these advantages, composite materials are prone to a wide range of defects and damage that can significantly reduce the residual strength and stiffness of a structu

Analysis and Performance of Fiber Composites

Having fully established themselves as workable engineering materials, composite materials are now increasingly commonplace around the world. Serves as both a text and reference guide to the behavior of composite materials in different engineering applications. Revised for this Second Edition, the text includes a general discussion of composites as material, practical aspects of design and performance, and further

analysis that will be helpful to those engaged in research on composites. Each chapter closes with references for further reading and a set of problems that will be useful in developing a better understanding of the subject.

Dynamic fracture

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.

Mechanics Of Composite Materials

This book balances introduction to the basic concepts of the mechanical behavior of composite materials and laminated composite structures. It covers topics from micromechanics and macromechanics to lamination theory and plate bending, buckling, and vibration, clarifying the physical significance of composite materials. In addition to the materials covered in the first edition, this book includes more theory-experiment comparisons and updated information on the design of composite materials.

Stress Analysis of Fiber-reinforced Composite Materials

Updated and improved, Stress Analysis of Fiber-Reinforced Composite Materials, Hyer's work remains the definitive introduction to the use of mechanics to understand stresses in composites caused by deformations, loading, and temperature changes. In contrast to a materials science approach, Hyer emphasizes the micromechanics of stress and deformation for composite material analysis. The book provides invaluable analytic tools for students and engineers seeking to understand composite properties and failure limits. A key feature is a series of analytic problems continuing throughout the text, starting from relatively simple problems, which are built up step-by-step with accompanying calculations. The problem series uses the same material properties, so the impact of the elastic and thermal expansion properties for a single-layer of FR material on the stress, strains, elastic properties, thermal expansion and failure stress of cross-ply and angle-ply symmetric and unsymmetric laminates can be evaluated. The book shows how thermally induced stresses and strains due to curing, add to or subtract from those due to applied loads.Another important element, and one unique to this book, is an emphasis on the difference between specifying the applied loads, i.e., force and moment results, often the case in practice, versus specifying strains and curvatures and determining the subsequent stresses and force and moment results. This represents a fundamental distinction in solid mechanics.

Impact Behaviour of Fibre-reinforced Composite Materials and Structures

Much of the early, pioneering work on the properties of composites under impact is still conceptually relevant, yet the results of many such analyses are outdated. The accuracy of these results depend specifically on the materials used (fibre, resin), interface, and method of fabrication. Development of new materials, cost effective design, and analysis and prediction of structural behaviour have all established a need for timely, wide ranging research on impact behaviour. Impact Behaviour of Fibre-Reinforced Composite Materials and Structures brings together - for the first time - state-of-the-art research from the most recent works of leading,

international experts. An important new study, this book extensively investigates impact response, damage tolerance, and failure of fibre-reinforced composite materials and structure, from a number of expert viewpoints. This book explores the nature of modern polymer composites based on glass, carbon, aramid, ceramic and polymer fibres in a polymer matrix, and details various ways of analysing the impact process. Impact Behaviour of Fibre-Reinforced Composite Materials and Structures will prove itself a valuable tool for research and development engineers, structural engineers, materials scientists, designers, and students and researchers of related disciplines.

Uncertainty Quantification in Laminated Composites

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 meta-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.

Damage and Failure of Composite Materials

Bringing together materials mechanics and modelling, this book provides a complete guide to damage mechanics of composite materials for engineers.

The Virtual Crack Closure Technique: History, Approach and Applications

An overview of the virtual crack closure technique is presented. The approach used is discussed, the history summarized, and insight into its applications provided. Equations for two-dimensional quadrilateral elements with linear and quadratic shape functions are given. Formula for applying the technique in conjuction with three-dimensional solid elements as well as plate/shell elements are also provided. Necessary modifications for the use of the method with geometrically nonlinear finite element analysis and corrections required for elements at the crack tip with different lengths and widths are discussed. The problems associated with cracks or delaminations propagating between different materials are mentioned briefly, as well as a strategy to minimize these problems. Due to an increased interest in using a fracture mechanics based approach to assess the damage tolerance of composite structures in the design phase and during certification, the engineering problems selected as examples and given as references focus on the application of the technique to components made of composite materials.

Engineering Mechanics of Composite Materials

Principles of Composite Material Mechanics covers a unique blend of classical and contemporary mechanics of composites technologies. It presents analytical approaches ranging from the elementary mechanics of materials to more advanced elasticity and finite element numerical methods, discusses novel materials such as nanocomposites and hybrid multis

Principles of Composite Material Mechanics

This book deals with all aspects of advanced composite materials; what they are, where they are used, how they are made, their properties, how they are designed and analyzed, and how they perform in-service. It covers both continuous and discontinuous fiber composites fabricated from polymer, metal, and ceramic matrices, with an emphasis on continuous fiber polymer matrix composites.

Structural Composite Materials

Machining of Polymer Matrix Composites will serve as an indispensable reference/source book for process design, tool and production engineers in composite manufacturing. This book provides the reader with a comprehensive scientific treatment of the theory of machining as it applies to fiber reinforced polymer composites, covers the latest technical advances in the area of machining and tooling and discusses the applications of fiber reinforced polymer composites as they are used in the aircraft and automotive manufacturing industries.

Machining of Polymer Composites

A comprehensive treatment of the mechanics of multilayers and its implications for reliability, with easy-to-use software to compute key results.

The Mechanics and Reliability of Films, Multilayers and Coatings

Finite element modelling of composite materials and structures provides an introduction to a technique which is increasingly being used as an analytical tool for composite materials.The text is presented in four parts: - Part one sets the scene and reviews the fundamentals of composite materials together with the basic nature of FRP and its constituents. Two-dimensional stress-strain is covered, as is laminated plated theory and its limitations. - Part two reviews the basic principles of FE analysis, starting with underlying theoretical issues and going on to show how elements are derived, a model is generated and results are processed. - Part three builds on the basics of FE analysis and considers the particular issues that arise in applying finite elements to composites, especially to the layered nature of the material. - Part four deals with the application of FE to FRP composites, presenting analytical models alongside FE representations. Specific issues addressed include interlaminar stresses, fracture delamination, joints and fatigue.This book is invaluable for students of materials science and engineering, and for engineers and others wishing to expand their knowledge of structural analysis. - Covers important work on finite element analysis of composite material performance - Based on material developed for an MSc course at Imperial College, London, UK - Covers particular problems such as holes, free edges with FE results compared with experimental data and classical analysis

Finite Element Modelling of Composite Materials and Structures

Engineered composites materials display superior properties to pristine materials. Glass fibres have been used for years in the production of light weight composites. This book is a much needed update as to the processing methods and technologies present in the manufacturing of GFRP. Coverage of machining, cutting, tools, and thermal loads are discussed. Ideal for researchers in academia and industry.

Glass Fibre-Reinforced Polymer Composites

This multiauthor volume provides a useful summary of current knowledge on the application of fracture mechanics to composite materials. It has been written to fill the gap between the literature on fundamental principles of fracture mechanics and the special publications on the fracture properties of conventional materials, such as metals, polymers and ceramics.The data are represented in the form of about 420 figures (including diagrams, schematics and photographs) and 80 tables. The author index covers more than 500 references, and the subject index more than 1000 key words.

Application of Fracture Mechanics to Composite Materials

The growing use of polymer composites is leading to increasing demand for fractographic expertise. Fractography is the study of fracture surface morphologies and it gives an insight into damage and failure mechanisms, underpinning the development of physically-based failure criteria. In composites research it

provides a crucial link between predictive models and experimental observations. Finally, it is vital for post-mortem analysis of failed or crashed polymer composite components, the findings of which can be used to optimise future designs.Failure analysis and fractography of polymer composites covers the following topics: methodology and tools for failure analysis; fibre-dominated failures; delamination-dominated failures; fatigue failures; the influence of fibre architecture on failure; types of defect and damage; case studies of failures due to overload and design deficiencies; case studies of failures due to material and manufacturing defects; and case studies of failures due to in-service factors.With its distinguished author, Failure analysis and fractography of polymer composites is a standard reference text for researchers working on damage and failure mechanisms in composites, engineers characterising manufacturing and in-service defects in composite structures, and investigators undertaking post-mortem failure analysis of components. The book is aimed at both academic and industrial users, specifically final year and postgraduate engineering and materials students researching composites and industry designers and engineers in aerospace, civil, marine, power and transport applications. - Examines the study of fracture surface morphologies in uderstanding composite structural behaviour - Discusses composites research and post-modern analysis of failed or crashed polymer composite components - Provides an overview of damage mechanisms, types of defect and failure criteria

Failure Analysis and Fractography of Polymer Composites

This is a book for people who love mechanics of composite materials and ? MATLAB . We will use the popular computer package MATLAB as a matrix calculator for doing the numerical calculations needed in mechanics of c- posite materials. In particular, the steps of the mechanical calculations will be emphasized in this book. The reader will not ?nd ready-made MATLAB programs for use as black boxes. Instead step-by-step solutions of composite material mechanics problems are examined in detail using MATLAB. All the problems in the book assume linear elastic behavior in structural mechanics. The emphasis is not on mass computations or programming, but rather on learning the composite material mechanics computations and understanding of the underlying concepts. The basic aspects of the mechanics of ?ber-reinforced composite materials are covered in this book. This includes lamina analysis in both the local and global coordinate systems, laminate analysis, and failure theories of a lamina.

Mechanics of Composite Materials with MATLAB

Machining is one of the most important manufacturing processes. Parts manufactured by other processes often require further operations before the product is ready for application. “Machining: Fundamentals and Recent Advances” is divided into two parts. Part I explains the fundamentals of machining, with special emphasis on three important aspects: mechanics of machining, tools, and work-piece integrity. Part II is dedicated to recent advances in machining, including: machining of hard materials, machining of metal matrix composites, drilling polymeric matrix composites, ecological machining (minimal quantity of lubrication), high-speed machining (sculptured surfaces), grinding technology and new grinding wheels, micro- and nano-machining, non-traditional machining processes, and intelligent machining (computational methods and optimization). Advanced students, researchers and professionals interested or involved in modern manufacturing engineering will find the book a useful reference.

Toughened Plastics

Practical Multiscaling covers fundamental modelling techniques aimed at bridging diverse temporal and spatial scales ranging from the atomic level to a full-scale product level. It focuses on practical multiscale methods that account for fine-scale (material) details but do not require their precise resolution. The text material evolved from over 20 years of teaching experience at Rensselaer and Columbia University, as well as from practical experience gained in the application of multiscale software. This book comprehensively covers theory and implementation, providing a detailed exposition of the state-of-the-art multiscale theories and their insertion into conventional (single-scale) finite element code architecture. The robustness and

design aspects of multiscale methods are also emphasised, which is accomplished via four building blocks: upscaling of information, systematic reduction of information, characterization of information utilizing experimental data, and material optimization. To ensure the reader gains hands-on experience, a companion website hosting a lite version of the multiscale design software (MDS-Lite) is available. Key features: Combines fundamental theory and practical methods of multiscale modelling Covers the state-of-the-art multiscale theories and examines their practical usability in design Covers applications of multiscale methods Accompanied by a continuously updated website hosting the multiscale design software Illustrated with colour images Practical Multiscaling is an ideal textbook for graduate students studying multiscale science and engineering. It is also a must-have reference for government laboratories, researchers and practitioners in civil, aerospace, pharmaceutical, electronics, and automotive industries, and commercial software vendors.

Advanced Materials by Design

More and more companies manufacture reinforced composite products. To meet the market need, researchers and industries are developing manufacturing methods without a reference that thoroughly covers the manufacturing guidelines. Composites Manufacturing: Materials, Product, and Process Engineering fills this void. The author presents a fundamental

Machining

This book presents a unified approach to fracture behavior of natural and synthetic fiber-reinforced polymer composites on the basis of fiber orientation, the addition of fillers, characterization, properties and applications. In addition, the book contains an extensive survey of recent improvements in the research and development of fracture analysis of FRP composites that are used to make higher fracture toughness composites in various applications.The FRP composites are an emerging area in polymer science with many structural applications. The rise in materials failure by fracture has forced scientists and researchers to develop new higher strength materials for obtaining higher fracture toughness. Therefore, further knowledge and insight into the different modes of fracture behavior of FRP composites are critical to expanding the range of their application.

Practical Multiscaling

The stress field near the tip of a central longitudinal crack in a plate strip is investigated. Several plane elastostatic problems involving opening and in-plane shearing of the crack, as well as one plate bending problem, are analyzed. Stress intensity factors are obtained as a function of the ratio of strip width to crack length. In addition, for several problems some plots of the stresses on the longitudinal edges are presented to illustrate some additional effects of the proximity of the crack to the boundary. Finite strip width is shown to exert a strong influence on stress intensity factors in certain ranges of the ratio of strip width to crack length. Results for the fixed-edge plane problems and the plate bending problem are only slightly influenced by changes in Poisson's ratio. The results should be useful in the design of fracture test specimens and in the analysis of fracture test data.

Composites Manufacturing

This book provides the first comprehensive review of its kind on the long-term behaviour of composite materials and structures subjected to time variable mechanical, thermal, and chemical influences, a subject of critical importance to the design, development, and certification of high performance engineering structures. Specific topics examined include damage, damage characterization, and damage mechanics; fatigue testing and evaluation; fatigue behaviour of short and long fibre reinforced polymer and metal matrix materials; viscoelastic and moisture effects; delamination; statistical considerations; the modeling of cumulative damage development; and life prediction. The volume provides an extensive presentation of data, discussions, and comparisons on the behaviour of the major types of material systems in current use, as well

as extensive analysis and modeling (including the first presentation of work not found elsewhere). The book will be of special interest to engineers concerned with reliability, maintainability, safety, certification, and damage tolerance; to materials developers concerned with making materials for long-term service, especially under severe loads and environments, and to lecturers, students, and researchers involved in material system design, performance, solid mechanics, fatigue, durability, and composite materials. The scope of the work extends from entry level material to the frontiers of the subject.

Fracture Failure Analysis of Fiber Reinforced Polymer Matrix Composites

The Fourth Conference on Fibrous Composites in Structural Design was a successor to the First-to-Third Conferences on Fibrous Composites in Flight Vehicle Design sponsored by the Air Force (First and Second Conferences, September 1973 and May 1974) and by NASA (Third Conference, November 1975) which were aimed at focusing national attention on flight vehicle applications of a new class of fiber reinforced materials, the advanced com posites, which afforded weight savings and other advantages which had not been previously available. The Fourth Conference, held at San Diego, California, 14-17 November 1978, was the fi rst of these conferences to be jointly sponsored by the Army, Navy and Ai r Force together with NASA, as well as being the first to give attention to non-aerospace applications of fiber reinforced composites. While the design technology for aerospace applications has reached a state of relative maturity, other areas of application such as mi litary bridging, flywheel energy storage systems, ship and surface vessel components and ground vehicle components are in an early stage of development, and it was an important objective to pinpoint where careful attention to structural design was needed in such applications to achfeve maximum structural performance payoff together with a high level of reliability and attractive economics.

Fundamentals of Fracture Mechanics

Marine Composites: Design and Performance presents up-to-date information and recent research findings on the application and use of advanced fibre-reinforced composites in the marine environment. Following the success of their previously published title: Marine Applications of Advanced Fibre-reinforced Composites which was published in 2015; this exemplary new book provides comprehensive information on materials selection, characterization, and performance. There are also dedicated sections on sandwich structures, manufacture, advanced concepts, naval architecture and design considerations, and various applications. The book will be an essential reference resource for designers, materials engineers, manufactures, marine scientists, mechanical engineers, civil engineers, coastal engineers, boat manufacturers, offshore platform and marine renewable design engineers. - Presents a unique, high-level reference on composite materials and their application and use in marine structures - Provides comprehensive coverage on all aspects of marine composites, including the latest advances in damage modelling and assessment of performance - Contains contributions from leading experts in the field, from both industry and academia - Covers a broad range of naval, offshore and marine structures

Stresses at the Tip of a Longitudinal Crack in a Plate Strip

Contributed by leading authorities in the field from around the world, this text provides a comprehensive insight into buckling and postbuckling. Basic theory, methods of buckling analysis and their application, the effect of external variables such as temperature and humidity on the buckling response and buckling tests are all covered.

Fatigue of Composite Materials

Advanced Composite Materials for Aerospace Engineering: Processing, Properties and Applications predominately focuses on the use of advanced composite materials in aerospace engineering. It discusses both the basic and advanced requirements of these materials for various applications in the aerospace sector, and includes discussions on all the main types of commercial composites that are reviewed and compared to

those of metals. Various aspects, including the type of fibre, matrix, structure, properties, modeling, and testing are considered, as well as mechanical and structural behavior, along with recent developments. There are several new types of composite materials that have huge potential for various applications in the aerospace sector, including nanocomposites, multiscale and auxetic composites, and self-sensing and self-healing composites, each of which is discussed in detail. The book's main strength is its coverage of all aspects of the topics, including materials, design, processing, properties, modeling and applications for both existing commercial composites and those currently under research or development. Valuable case studies provide relevant examples of various product designs to enhance learning. - Contains contributions from leading experts in the field - Provides a comprehensive resource on the use of advanced composite materials in the aerospace industry - Discusses both existing commercial composite materials and those currently under research or development

Fibrous Composites in Structural Design

Developed from the author's graduate-level course on advanced mechanics of composite materials, Finite Element Analysis of Composite Materials with Abaqus shows how powerful finite element tools address practical problems in the structural analysis of composites. Unlike other texts, this one takes the theory to a hands-on level by actually solving

Marine Composites

This authoritative reference provides comprehensive coverage of the topics of damage and healing mechanics. Computational modeling of constitutive equations is provided as well as solved examples in engineering applications. A wide range of materials that engineers may encounter are covered, including metals, composites, ceramics, polymers, biomaterials, and nanomaterials. The internationally recognized team of contributors employ a consistent and systematic approach, offering readers a user-friendly reference that is ideal for frequent consultation. Handbook of Damage Mechanics: Nano to Macro Scale for Materials and Structures is ideal for graduate students and faculty, researchers, and professionals in the fields of Mechanical Engineering, Civil Engineering, Aerospace Engineering, Materials Science, and Engineering Mechanics.

Buckling and Postbuckling of Composite Plates

Advanced Composite Materials for Aerospace Engineering