Engineering Plasticity Johnson Mellor

Classical plasticity is a well established domain of mechanics and engineering, providing the basis for many engineering structural design, manufacturing processes and natural phenomena. New important characteristics are emerging in the interdisciplinary approach of micro-, meso- and macro-mechanics, and through analysis, experiments and computation. The interaction of mechanics and materials scientists is introducing tremendous changes in the two disciplines, so that the possibility of materials being processed on the microscale to achieve the desired macroscopic properties is rapidly approaching. A comprehensive overview on the latest developments in both macroplasticity and microplasticity theories, their interactions and applications in various engineering disciplines such as solid mechanics, structural analysis and geo-mechanics, materials science and technology, and metal forming and machining, is given in this volume. Case studies written by international experts focus on aspects such as the applications of plasticity in interdisciplinary and non-conventional areas. The 150 papers provide a current and useful reference source on the latest advances for both research workers and engineers in the various fields of plasticity.

Understanding the elastoplastic deformation of metals and geomaterials, including the constitutive description of the materials and analysis of structure undergoing plastic deformation, is an essential part of the background required by mechanical, civil, and geotechnical engineers as well as materials scientists. However, most books address the subject at a introductory level and within the infinitesimal strain context. Elastoplasticity Theory takes a different approach in an advanced treatment presented entirely within the framework of finite deformation. This comprehensive, self-contained text includes an introduction to nonlinear continuum mechanics and nonlinear elasticity. In addition to in-depth analysis of the mathematical and physical theories of plasticity, it furnishes an up-to-date look at contemporary topics, such as plastic stability and localization, monocrystalline plasticity, micro-to-macro transition, and polycrysalline plasticity models. Elastoplasticity Theory reflects recent trends and advances made in the theory of plasticity over the last four decades. It will not only help stimulate further research in the field, but will enable its readers to confidently select the appropriate constitutive models for the materials or structural members relevant to their own applications.

This book begins with the fundamentals of the mathematical theory of plasticity. The discussion then turns to the theory of plastic stress and its applications to structural analysis. It concludes with a wide range of topics in dynamic plasticity including wave propagation, armor penetration, and structural impact in the plastic range. In view of the rapidly growing interest in computational methods, an appendix presents the fundamentals of a finite-element analysis of metal-forming problems.

In this book the classical rigid-plastic model of deformed workpiece and the characteristic (slipline) method of analysis is assumed. The rigid-plastic solid assumption is deemed reasonable for the problems of technological plasticity with large scale plastic flow, where small elastic stains are negligible. Along with classical results of the theory of plasticity the book includes many original analytical and numerical solutions of the problems of technological plasticity obtained by the authors in Russia and unknown for most western readers. The results of the analyses are given by analytical formulae and many graphs and tables, so the book will be useful for the practical and research engineers. It may also be used as a textbook by graduate students and engineers.

The aim of Plasticity Theory is to provide a comprehensive introduction to the contemporary state of knowledge in basic plasticity theory and to its applications. It treats several areas not commonly found between the covers of a single book: the physics of plasticity, constitutive theory, dynamic plasticity, large-deformation plasticity, and numerical methods, in addition to a representative survey of problems treated by classical methods, such as elastic-plastic problems, plane plastic flow, and limit analysis; the problem discussed come from areas of interest to mechanical, structural, and geotechnical engineers, metallurgists and others. The necessary mathematics and basic mechanics and thermodynamics are covered in an introductory chapter, making the book a self-contained text suitable for advanced undergraduates and graduate students, as well as a reference for practitioners of solid mechanics.

Material properties -- Sheet deformation processes -- Deformation of sheet in plane stress -- Simplified stamping analysis -- Load instability and tearing -- Bending of sheet -- Simplified analysis of circular shells -- Cylindrical deep drawing -- Stretching circular shells -- Combined bending and tension of sheet -- Hydroforming.

An important collection of review papers by internationally recognized experts on the broad area of the mechanics of solids.

Presenting the use of photonics techniques for measurement in mechanics, this book provides a state-of-the-art review of this active and rapidly growing field. It serves as an invaluable resource for readers to explore the current status and includes a wealth of information on the essential principles and methods. It provides a substantial background in a concise and simple way to enable physicists and engineers to assess, analyze and implement experimental systems needed to solve their specific measurement problems.

Never before have the wide range of disciplines comprising manufacturing engineering been covered in such detail in one volume. Leading experts from all over the world have contributed sections. The coverage represents the most up to date survey of the broad interests of the manufacturing engineer. Extensive reference lists are provided, making this an indispensable work for every engineer in industry. Never before have the wide range of disciplines comprising manufacturing engineering been covered in such detail in one volume. Leading experts from all over the world have contributed sections. Materials and processes are described, as well as management issues, ergonomics, maintenance and computers in industry. CAD (Computer Aided Design), CAE (Computer Aided Engineering), CIM (Computer Integrated Manufacturing) and Quality are explored at length. The coverage represents the most up-to-date survey of the broad interests of the manufacturing engineer. Extensive reference lists are provided, making this an indispensable work for every engineer in industry.

This book focuses on the plastic property of materials, and the way in which structures made of such material behave under load. It is intended for civil, mechanical, electro-mechanical, marine, and aeronautical engineers for under-graduate or post-graduate courses or research, and professionals in industry. Professor Calladine, from long experience in teaching, research and industry, here delivers a readable and authoritative account of theory and applications. He presents the classical "perfect plasticity material" as a model of irreversible mechanical behaviour, using this perfect plasticity property to analyse a range of continuum structural problems and metal-forming processes relevant to engineering practice.

Mechanical engineering, an engineering discipline forged and shaped by the needs of the industrial revolution, is once again asked to do its substantial share in the call for industrial renewal. The general call is urgent as we face profound issues of productivity and competitiveness that require engineering solutions, among others . The Mechanical Engineering Series features graduate texts and research monographs intended to address the need for information in contemporary areas of mechanical engineering. The series is conceived as a comprehensive one that covers a broad range of c- centrations important to mechanical engineering graduate education and research . We are fortunate to have a distinguished roster of consulting editors on the ad-

sory board, each an expert in one of the areas of concentration . The names of the consulting editors are listed on the facing page of this volume . The areas of conc- tration are applied mechanics, biomechanics, computational mechanics, dynamic systems and control, energetics , mechanics of materials, processing, production systems, thermal science, and tribology . Plasticity is concerned with understanding the behavior of metals and alloys when loaded beyond the elastic limit, whether as a result of being shaped or as they are employed for load bearing structures. Basic Engineering Plasticity delivers a comprehensive and accessible introduction to the theories of plasticity. It draws upon numerical techniques and theoretical developments to support detailed examples of the application of plasticity theory. This blend of topics and supporting textbook features ensure that this introduction to the science of plasticity will be valuable for a wide range of mechanical and manufacturing engineering students and professionals. Brings together the elements of the mechanics of plasticity most pertinent to engineers, at both the micro- and macro-levels Covers the theory and application of topics such as Limit Analysis, Slip Line Field theory, Crystal Plasticity, Sheet and Bulk Metal Forming, as well as the use of Finite Element Analysis Clear and well-organized with extensive worked engineering application examples, and end of chapter exercises

The principal aim of this text is to encourage the development and application of numerical modelling techniques as an aid to achieving greater efficiency and optimization of metal-forming processes. The contents of this book have therefore been carefully planned to provide both an introduction to the fundamental theory of material deformation simulation, and also a comprehensive survey of the "state-of-the-art" of deformation modelling techniques and their application to specific and industrially relevant processes. To this end, leading international figures in the field of material deformation research have been invited to contribute chapters on subjects on which they are acknowledged experts. The information in this book has been arranged in four parts: Part I deals with plasticity theory, Part II with various numerical modelling techniques, Part III with specific process applications and material phenomena and Part IV with integrated computer systems. The objective of Part I is to establish the underlying theory of material deformation on which the following chapters can build. It begins with a chapter which reviews the basic theories of classical plasticity and describes their analytical representations. The second chapter moves on to look at the theory of deforming materials and shows how these expressions may be used in numerical techniques. The last two chapters of Part I provide a review of isotropic plasticity and anisotropic plasticity.

J. Ross Publishing Classics are world-renowned texts and monographs written by preeminent scholars. These books are suitable for students, researchers, professionals and libraries.

It is a mechanics book written for materials scientists. It provides very simple basic principle written for audience with non mechanics background, so that readers who plan to adopt and integrate the mechanics in their research areas can do it the smart way. The book also has plenty examples on the simple applications of mechanics in various materials science areas: in metallurgy, in coating, in design and in materials science in general. This book is filling the gap between the concept of mechanics used in the 'mechanics world' and the concept of mechanics 'outside mechanics world'. It is perfect for researchers outside mechanics, especially in materials science, who want to incorporate the concept of mechanics in their works. It is originally a script used by a research group in materials science with no mechanics background.

An all-in-one guide to the theory and applications of plasticity in metal forming, featuring examples from the automobile and aerospace industries Provides a solid grounding in plasticity fundamentals and material properties Features models, theorems and analysis of processes and relationships related to plasticity, supported by extensive experimental data Offers a detailed discussion of recent advances and applications in metal forming

Ideal for those involved in designing sheet metal forming processes, where the understanding of advances in plasticity theory is essential.

This book covers recent research and trends in Manufacturing Engineering. The chapters emphasize different aspects of the transformation from materials to products. It provides the reader with fundamental materials treatments and the integration of processes. Concepts such as green and lean manufacturing are also covered in this book.

This book concentrates upon the mathematical theory of plasticity and fracture as opposed to the physical theory of these fields, presented in the thermomechanical framework.

The aim of this book is to summarize the current most effective methods for modeling, simulating, and optimizing metal forming processes, and to present the main features of new, innovative methods currently being developed which will no doubt be the industrial tools of tomorrow. It discusses damage (or defect) prediction in virtual metal forming, using advanced multiphysical and multiscale fully coupled constitutive equations. Theoretical formulation, numerical aspects as well as application to various sheet and bulk metal forming are presented in detail. Virtual metal forming is nowadays inescapable when looking to optimize numerically various metal forming processes in order to design advanced mechanical components. To do this, highly predictive constitutive equations accounting for the full coupling between various physical phenomena at various scales under large deformation including the ductile damage occurrence are required. In addition, fully 3D adaptive numerical methods related to time and space discretization are required in order to solve accurately the associated initial and boundary value problems. This book focuses on these two main and complementary aspects with application to a wide range of metal forming and machining processes. Contents 1. Elements of Continuum Mechanics and Thermodynamics. 2. Thermomechanically-Consistent Modeling of the Metals Behavior with Ductile Damage. 3. Numerical Methods for Solving Metal Forming Problems. 4. Application to Virtual Metal Forming.

Adiabatic shear bands are found in a variety of metals and other materials; they cause rapid weakening due to energy concentration into narrow regions of the material. This is the very first book on this important topic and the only true introduction to the subject. An enhanced and updated student-friendly edition of the authors' 1992 book Adiabatic Shear Localization: Occurrence, Theories and Applications, this seminal text now includes essential Further Reading sections in some chapters. It explains adiabatic shear bands in a descriptive rather than a mathematical way, with a 'quick reference' section for readers wanting a more rapid introduction. Entirely comprehensive, the reader can dip into the chapters as suits his or her course material or research. If you are a postgraduate materials scientist, engineer, physicist, metallurgist, or indeed any researcher in materials that undergo rapid deformation and failure, this text is not to be missed.

From the point of view of mechanics, this monograph systematically demonstrates the theory of plastic bending and its engineering applications; most of the contents of the book are based on the authors' research in the past decade. The monograph not only expounds the contributions of the authors to the fundamental theory of plastic bending, but also presents various applications of the theory in sheet metal forming, particularly in the analysis and prediction of springback and wrinkling of strips and plates subjected to bending or stamping. In addition to theoretical modelling, attention has also been paid to the development of related numerical methods; comparisons with experimental results are also presented.

Explores the Principles of Plasticity Most undergraduate programs lack an undergraduate plasticity theory course, and many graduate programs in design and manufacturing lack a course on plasticity—leaving a number of engineering students without adequate information on the subject. Emphasizing stresses generated in the material and its effect, Plasticity: Fundamentals and Applications effectively addresses this need. This book fills a void by introducing the basic fundamentals of solid mechanics of deformable bodies. It provides a thorough understanding of plasticity theory, introduces the

concepts of plasticity, and discusses relevant applications. Studies the Effects of Forces and Motions on Solids The authors make a point of highlighting the importance of plastic deformation, and also discuss the concepts of elasticity (for a clear understanding of plasticity, the elasticity theory must also be understood). In addition, they present information on updated Lagrangian and Eulerian formulations for the modeling of metal forming and machining. Topics covered include: Stress Strain Constitutive relations Fracture Anisotropy Contact problems Plasticity: Fundamentals and Applications enables students to understand the basic fundamentals of plasticity theory, effectively use commercial finite-element (FE) software, and eventually develop their own code. It also provides suitable reference material for mechanical/civil/aerospace engineers, material processing engineers, applied mechanics researchers, mathematicians, and other industry professionals.

Plasticity of Metallic Materials presents a rigorous framework for description of plasticity phenomena, classic and recent models for isotropic and anisotropic materials, new original analytical solutions to various elastic/plastic boundary value problems and new interpretations of mechanical data based on these recent models. The book covers models for metals with both cubic and hexagonal crystal structures, presents the mechanical tests required to determine the model parameters, various identification procedures, verification, and validation tests, and numerous applications to metal forming. Outlines latest research on plastic anisotropy and its role in metal forming Presents characterization and validation tests for metals with various crystal structures Compares the predictive capabilities of various models for a variety of loadings

The materials mechanics of the controlled separation of a body into two or more parts – cutting – using a blade or tool or other mechanical implement is a ubiquitous process in most engineering disciplines. This is the only book available devoted to the cutting of materials generally, the mechanics of which (toughness, fracture, deformation, plasticity, tearing, grating, chewing, etc.) have wide ranging implications for engineers, medics, manufacturers, and process engineers, making this text of particular interest to a wide range of engineers and specialists. * The only book to explain and unify the process and techniques of cutting in metals AND non-metals. The emphasis on biomaterials, plastics and non-metals will be of considerable interest to many, while the transfer of knowledge from non-metals fields offers important benefits to metal cutters * Comprehensive, written with this well-known author's lightness of touch, the book will attract the attention of many readers in this underserved subject * The clarity of the text is further enhanced by detailed examples and case studies, from the grating of cheese on an industrial scale to the design of scalpels

An ideal textbook for a first tribology course and a reference for designers and researchers, Engineering Tribology gives the reader interdisciplinary understanding of tribology including materials constraints. Real design problems and solutions, such as those for journal and rolling element bearings, cams and followers, and heavily loaded gear teeth, elucidate concepts and motivate understanding. The hallmark of this work is the integration of qualitative and quantitative material from a wide variety of disciplines including physics, materials science, surface and lubricant chemistry, with traditional engineering approaches. Reviewers have praised the coverage of: both elastic and plastic stresses at surfaces in contact; the mechanisms of friction, wear and surface distress, and wear; thick pressurized fluid films in both hydrostatic and hydrodynamic bearings; elasto-hydrodynamic lubrication; boundary lubrication mechanisms; dry and marginally lubricated bearing design; the design of rolling contacts and bearings.

Engineering Plasticity focuses on certain features of the theory of plasticity that are particularly appropriate to engineering design. Topics covered range from specification of an ideal plastic material to the behavior of structures made of idealized elastic-plastic material, theorems of plastic theory, and rotating discs. Torsion, indentation problems, and slip-line fields are also discussed. This book consists of 12 chapters and begins by providing an engineering background for the theory of plasticity, with emphasis on the use of metals in structural engineering and the nature of physical theories. The reader is then introduced to the general problem of how to set up a model of the plastic behavior of metal for use in analysis and design of structures and forming processes, paying particular attention to the plastic deformation that occurs when a specimen of metal is stressed. Subsequent chapters explore the behavior of a simple structure made of elastic-plastic material; theorems of plastic theory; rotating discs; and indentation problems. Torsion, slip-line fields, and circular plates under transverse loading are also considered, along with wire-drawing and extrusion and the effects of changes in geometry on structure. This monograph is intended for students of engineering.

This important study focuses on the way in which structures and materials can be best designed to absorb kinetic energy in a controllable and predictable manner. Understanding of energy absorption of structures and materials is important in calculating the damage to structures caused by accidental collision, assessing the residual strength of structures after initial damage and in designing packaging to protect its contents in the event of impact. Whilst a great deal of recent research has taken place into the energy absorption behaviour of structures and materials and significant progress has been made, this knowledge is diffuse and widely scattered. This book offers a synthesis of the most recent developments and forms a detailed and comprehensive view of the area. It is an essential reference for all engineers concerned with materials engineering in relation to the theory of plasticity, structural mechanics and impact dynamics. Important new study of energy absorption of engineering structures and materials Shows how they can be designed to withstand sudden loading in a safe, controllable and predictable way Illuminating case studies back up the theoretical analysis

Metal Forming: Formability, Simulation, and Tool Design focuses on metal formability, finite element modeling, and tool design, providing readers with an integrated overview of the theory, experimentation and practice of metal forming. The book includes formability and finite element topics, including insights on plastic instability, necking, nucleation and coalescence of voids. Chapters discuss the finite element method, including its accuracy, reliability and validity and finite element flow formulation, helping readers understand finite element formulations, iterative solution methods, friction and contact between objects, and other factors. The book's final sections discuss tool design for cold, warm and hot forming processes. Examples of tools, design guidelines, and information related to tool materials, lubricants, finishes, and tool failure are included as well. Provides fundamental, integrated knowledge on metal formability, finite element topics and tool design Outlines user perspectives on accuracy, reliability and validity of finite element modeling Discusses examples of tools, their design guidelines, tool lubricants, and tool failure Considers the role played by stress triaxiality and shear and introduces uncoupled ductile damage criteria Includes applications, worked examples and detailed techniques

The building materials covered by the Concise Encyclopedia of Building and Construction Materials are classified in three groups: structural materials, semistructural materials, and auxiliary materials.

The surface coating field is a rapidly developing area of science and technology that offers new methods and techniques to control friction and wear. New coating types are continually being developed and the potential applications in different industrial fields are ever growing, ranging from machine components and consumer products to medical instruments and prostheses. This book provides an extensive review of the latest technology in the field, addressing techniques such as physical and chemical vapour deposition, the tribological properties of coatings, and coating characterization and performance evaluation techniques. Eleven different cases are examined in close detail to demonstrate

the improvement of tribological properties and a guide to selecting coatings is also provided. This second edition is still the only monograph in the field to give a holistic view of the subject and presents all aspects, including test and performance data as well as insights into mechanisms and interactions, thus providing the level of understanding vital for the practical application of coatings. * An extensive review of the latest developments in the field of surface coatings * Presents both theory and practical applications * Includes a guide for selecting coatings

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