Fundamentals Of Discrete Element Methods For Rock Engineering Theory And Applications Volume 85 Developments In Geotechnical Engineering

The science of complex materials continues to engage researchers from a vast range of disciplines, including physics, mathematics, computational science, and virtually all domains of engineering. This volume presents a unique multidisciplinary panorama of the current research in complex materials. The contributions explore an array of problems reflecting recent developments in four main areas: characterization and modeling of disordered packings, micromechanics and continuum theory; discrete element method; statistical mechanics. The common theme is the quest to unravel the connection between the microscopic and macroscopic properties of complex materials. Sample Chapter(s). Chapter 1: Foam as granular matter (2,433 KB). Contents: Foam as Granular Matter (D Weaire et al.); Delaunay Simplex Analysis of the Structure of Equal Sized Spheres (A V Anikeenko et al.); On Entropic Characterization of Granular Materials (R Blumenfeld); Mathematical Modeling of Granular Flow-Slides (I Vardoulakis & S Alevizos); The Mechanics of Brittle Granular Materials (I Einav); Stranger than Friction: Force Chain Buckling and Its Implications for Constitutive Modelling (A Tordesillas); Investigations of Size Effects in Granular Bodies During Plane Strain Compression (J Tejchman & J Grski); Granular Flows: Fundamentals and Applications (P W Cleary); Fine Tuning DEM Simulations to Perform Virtual Experiments with Three-Dimensional Granular Packings (G W Delaney et al.); Fluctuations in Granular Materials (R P Behringer); Statistical Mechanics of Dense Granular Media (M Pica Ciamarra et al.); Compaction of Granular Systems (P Richard et al.). Readership: Physicists, material scientists, soil engineers and applied mathematicians.

This book is devoted to the Discrete Element Method (DEM) technique, a discontinuum modelling approach that takes into account the fact that granular materials are composed of discrete particles which interact with each other at the microscale level. This numerical simulation technique can be used both for dispersed systems in which the particle-particle interactions are collisional and compact systems of particles with multiple enduring contacts. The book provides an extensive and detailed explanation of the theoretical background of DEM. Contact mechanics theories for elastic, elastic-plastic, adhesive elastic and adhesive elastic-plastic particle-particle interactions are presented. Other contact force models are also discussed, including corrections to some of these models as described in the literature, and important areas of further research are identified. A key issue in DEM simulations is whether or not a code can reliably simulate the simplest of systems, namely the single particle oblique impact with a wall. This is discussed using the output obtained from the contact force models described earlier, which are compared for elastic and inelastic collisions. In addition, further insight is provided for the impact of adhesive particles. The author then moves on to provide the results of selected DEM applications to agglomerate impacts, fluidised beds and quasi-static deformation, demonstrating that the DEM technique can be used (i) to mimic experiments, (ii) explore parameter sweeps, including limiting values, or (iii) identify new, previously unknown, phenomena at the microscale. In the DEM applications the emphasis is on discovering new information that enhances our rational understanding of particle systems, which may be more significant than developing a new continuum model that encompasses all microstructural aspects, which would most likely prove too complicated for practical implementation. The book will be of interest to academic and industrial researchers working in particle technology/process engineering and geomechanics, both experimentalists and theoreticians.

This book systematically introduces readers to computational granular mechanics and its relative engineering applications. Part I describes

the fundamentals, such as the generation of irregular particle shapes, contact models, macro-micro theory, DEM-FEM coupling, and solid-fluid coupling of granular materials. It also discusses the theory behind various numerical methods developed in recent years. Further, it provides the GPU-based parallel algorithm to guide the programming of DEM and examines commercial and open-source codes and software for the analysis of granular materials. Part II focuses on engineering applications, including the latest advances in sea-ice engineering, railway ballast dynamics, and lunar landers. It also presents a rational method of parameter calibration and thorough analyses of DEM simulations, which illustrate the capabilities of DEM. The computational mechanics method for granular materials can be applied widely in various engineering fields, such as rock and soil mechanics, ocean engineering and chemical process engineering.

Designed for a one-semester course in Finite Element Method, this compact and well-organized text presents FEM as a tool to find approximate solutions to differential equations. This provides the student a better perspective on the technique and its wide range of applications. This approach reflects the current trend as the present-day applications range from structures to biomechanics to electromagnetics, unlike in conventional texts that view FEM primarily as an extension of matrix methods of structural analysis. After an introduction and a review of mathematical preliminaries, the book gives a detailed discussion on FEM as a technique for solving differential equations and variational formulation of FEM. This is followed by a lucid presentation of one-dimensional and two-dimensional finite elements and finite element formulation for dynamics. The book concludes with some case studies that focus on industrial problems and Appendices that include mini-project topics based on near-real-life problems. Postgraduate/Senior undergraduate students of civil, mechanical and aeronautical engineering will find this text extremely useful; it will also appeal to the practising engineers and the teaching community.

The Sixth Edition of this influential best-selling book delivers the most up-to-date and comprehensive text and reference yet on the basis of the finite element method (FEM) for all engineers and mathematicians. Since the appearance of the first edition 38 years ago, The Finite Element Method provides arguably the most authoritative introductory text to the method, covering the latest developments and approaches in this dynamic subject, and is amply supplemented by exercises, worked solutions and computer algorithms. • The classic FEM text, written by the subject's leading authors • Enhancements include more worked examples and exercises • With a new chapter on automatic mesh generation and added materials on shape function development and the use of higher order elements in solving elasticity and field problems Active research has shaped The Finite Element Method into the pre-eminent tool for the modelling of physical systems. It maintains the comprehensive style of earlier editions, while presenting the systematic development for the solution of problems modelled by linear differential equations. Together with the second and third self-contained volumes (0750663219 and 0750663227), The Finite Element Method Set (0750664312) provides a formidable resource covering the theory and the application of FEM, including the basis of the method, its application to advanced solid and structural mechanics and to computational fluid dynamics. The classic introduction to the finite element method, by two of the subject's leading authors Any professional or student of engineering involved in understanding the computational modelling of physical systems will inevitably use the techniques in this key text

Since the 1990s five books onApplications of Computational Mechanics in Geotechnical Engineering have been published. Innovative Numerical Modelling in Geomechanics is the 6th and final book in this series, and contains papers written by leading experts on computational mechanics. The book treats highly relevant topics in the field of geotechnic

Numerical Methods and Implementation in Geotechnical Engineering explains several numerical methods that are used in geotechnical engineering. The second part of this reference set includes more information on the distinct element method, geotechnical optimization

analysis and reliability analysis. Information about relevant additional numerical methods is also provided in each chapter with problems where applicable. The authors have also presented different computer programs associated with the materials in this book set which will be useful to students learning how to apply the models explained in the text into practical situations when designing structures in locations with specific soil and rock settings. This reference book set is a suitable textbook primer for civil engineering students as it provides a basic introduction to different numerical methods (classical and modern) in comprehensive readable volumes.

The study of rock dynamics is important because many rock mechanics and rock engineering problems involve dynamic loading ranging from earthquakes to vibrations and explosions. The subject deals with the distribution and propagation of loads, dynamic responses, and processes of rocks and rate-dependent properties, coupled with the physical environment. Rock dynamics has a wide range of applications in civil, mining, geological and environmental engineering. However, due to the additional "4th" dimension of time, rock dynamics remains, in the discipline of rock mechanics, a relatively more challenging topic to understand and to apply, where documented research and knowledge are limited. Advances in Rock Dynamics and Applications provides a summary of the current knowledge of rock dynamics with 18 chapters contributed by individual authors from both academia and engineering fields. The topics of this book are wide-ranging and representative, covering fundamental theories of fracture dynamics and wave propagation, rock dynamic properties and testing methods, numerical modelling of rock dynamic failure, engineering applications in earthquakes, explosion loading and tunnel response, as well as dynamic rock support.

This book presents some fundamental concepts behind the basic theories and tools of discrete element methods (DEM), its historical development, and its wide scope of applications in geology, geophysics and rock engineering. Unlike almost all books available on the general subject of DEM, this book includes coverage of both explicit and implicit DEM approaches, namely the Distinct Element Methods and Discontinuous Deformation Analysis (DDA) for both rigid and deformable blocks and particle systems, and also the Discrete Fracture Network (DFN) approach for fluid flow and solute transport simulations. The latter is actually also a discrete approach of importance for rock mechanics and rock engineering. In addition, brief introductions to some alternative approaches are also provided, such as percolation theory and Cosserat micromechanics equivalence to particle systems, which often appear hand-in-hand with the DEM in the literature. Fundamentals of the particle mechanics approach using DEM for granular media is also presented. · Presents the fundamental concepts of the discrete models for fractured rocks, including constitutive models of rock fractures and rock masses for stress, deformation and fluid flow · Provides a comprehensive presentation on discrete element methods, including distinct elements, discontinuous deformation analysis, discrete fracture networks, particle mechanics and Cosserat representation of granular media · Features constitutive models of rock fractures and fracture system characterization methods detaiing their significant impacts on the performance and uncertainty of the DEM models "Granular Gases" are diluted many-particle systems in which the mean free path of the particles is much larger than the typical particle size, and where particle collisions occur dissipatively. The dissipation of kinetic energy can lead to effects such as the formation of clusters, anomalous diffusion and characteristic shock waves to name but a few. The book is organized as follows: Part I comprises the rigorous theoretical results for the dilute limit. The detailed properties of binary collisions are described in Part

II. Part III contains experimental investigations of granular gases. Large-scale behaviour as found in astrophysical systems is discussed in Part IV. Part V, finally, deals with possible generalizations for dense granular systems.

Heat transfer is the area of engineering science which describes the energy transport between material bodies due to a difference in temperature. The three different modes of heat transport are conduction, convection and radiation. In most problems, these three modes exist simultaneously. However, the significance of these modes depends on the problems studied and often, insignificant modes are neglected. Very often books published on Computational Fluid Dynamics using the Finite Element Method give very little or no significance to thermal or heat transfer problems. From the research point of view, it is important to explain the handling of various types of heat transfer problems with different types of complex boundary conditions. Problems with slow fluid motion and heat transfer can be difficult problems to handle. Therefore, the complexity of combined fluid flow and heat transfer problems should not be underestimated and should be dealt with carefully. This book: Is ideal for teaching senior undergraduates the fundamentals of how to use the Finite Element Method to solve heat transfer and fluid dynamics problems Explains how to solve various heat transfer problems with different types of boundary conditions Uses recent computational methods and codes to handle complex fluid motion and heat transfer problems Includes a large number of examples and exercises on heat transfer problems In an era of parallel computing, computational efficiency and easy to handle codes play a major part. Bearing all these points in mind, the topics covered on combined flow and heat transfer in this book will be an asset for practising engineers and postgraduate students. Other topics of interest for the heat transfer community, such as heat exchangers and radiation heat transfer, are also included.

The Cell Method (CM) is a computational tool that maintains critical multidimensional attributes of physical phenomena in analysis. This information is neglected in the differential formulations of the classical approaches of finite element, boundary element, finite volume, and finite difference analysis, often leading to numerical instabilities and spurious results. This book highlights the central theoretical concepts of the CM that preserve a more accurate and precise representation of the geometric and topological features of variables for practical problem solving. Important applications occur in fields such as electromagnetics, electrodynamics, solid mechanics and fluids. CM addresses non-locality in continuum mechanics, an especially important circumstance in modeling heterogeneous materials. Professional engineers and scientists, as well as graduate students, are offered: • A general overview of physics and its mathematical descriptions; • Guidance on how to build direct, discrete formulations; • Coverage of the governing equations of the CM, including nonlocality; • Explanations of the use of Tonti diagrams; and • References for further reading.

Geotechnical engineers are at work worldwide, contributing to sustainable living and to the creation of safe, economic and pleasant spaces to live, work and relax. With increased pressure on space and resources, particularly in cities, their expertise becomes ever more important. This book presents the proceedings of the 5th iYGEC, International Young Geotechnical Engineers' Conference, held at Marne-la-Vallée, France, from 31 August to 1 September 2013. It is also the second volume in the series Advances in Soil Mechanics and Geotechnical Engineering. The papers included here cover topics such as laboratory and field

testing, geology and groundwater, earthworks, soil behavior, constitutive modeling, ground improvement, earthquake, retaining structures, foundations, slope stability, tunnels and observational methods. The iYGEC conference series brings together students and young people at the start of their career in the geotechnical professions to share their experience, and this book will be of interest to all those whose work involves soil mechanics and geotechnical engineering. The cover shows Dieppe harbour breakwater project, Louis-Alexandre de Cessart, 1776-1777. © École Nationale des Ponts et Chaussées.

The Discrete Element Method (DEM) has emerged as a solution to predicting load capacities of masonry structures. As one of many numerical methods and computational solutions being applied to evaluate masonry structures, further research on DEM tools and methodologies is essential for further advancement. Computational Modeling of Masonry Structures Using the Discrete Element Method explores the latest digital solutions for the analysis and modeling of brick, stone, concrete, granite, limestone, and glass block structures. Focusing on critical research on mathematical and computational methods for masonry analysis, this publication is a pivotal reference source for scholars, engineers, consultants, and graduate-level engineering students.

The investigation of multiscale problems in multibody system contacts is an interesting and timely topic which has been the subject of intensive research. This IUTAM Symposium facilitated discussions between researchers active in the field. This proceedings volume summarizes contributions of many authors active in the field and gives insight in very different areas of this fascinating research. It reviews the state-of-the-art and identifies future hot topics.

This publication includes 82 technical papers presented at Rocscience International Conference (RIC) 2021, held online on April 20 and 21, 2021. Rocscience created this event to bring geotechnical academics, researchers and practitioners together to exchange ideas as part of celebrating 25 years of the company’s existence. The papers in these proceedings were from keynotes, panel discussions and papers, selected after careful review of over 100 technical submissions delivered at RIC 2021. The technical papers were grouped into sessions based on their subject areas. The conference aimed to stimulate discussions that could help the industry work towards overcoming geotechnical engineering limitations today. It also sought to foster creative thinking that will advance the current states of the art and practice. The keynote addresses, panel discussions and technical presentations tried to examine geotechnical problems and situations from fresh perspectives. RIC 2021 hopes that the proceedings will continue to enrich our thinking and contribute to achieving a critical mass of change in our practices and approaches. We look forward to significant improvements in our industry.

Rock Mechanics and Rock Engineering: From the Past to the Future contains the contributions presented at EUROCK2016, the 2016 International Symposium of the International Society for Rock Mechanics (ISRM 2016, Ürgüp, Cappadocia Region, Turkey, 29-31 August 2016). The contributions cover almost all aspects of rock mechanics and rock engineering from theories to engineering practices, emphasizing the future direction of rock engineering technologies. The 204 accepted papers and eight keynote papers, are grouped into several main sections: - Fundamental rock mechanics - Rock properties and experimental rock mechanics - Analytical and numerical methods in rock engineering - Stability of slopes in civil and mining engineering - Design

methodologies and analysis - Rock dynamics, rock mechanics and rock engineering at historical sites and monuments - Underground excavations in civil and mining engineering - Coupled processes in rock mass for underground storage and waste disposal - Rock mass characterization - Petroleum geomechanics - Carbon dioxide sequestration - Instrumentation-monitoring in rock engineering and back analysis - Risk management, and - the 2016 Rocha Medal Lecture and the 2016 Franklin Lecture Rock Mechanics and Rock Engineering: From the Past to the Future will be of interest to researchers and professionals involved in the various branches of rock mechanics and rock engineering. EUROCK 2016, organized by the Turkish National Society for Rock Mechanics, is a continuation of the successful series of ISRM symposia in Europe, which began in 1992 in Chester, UK.

This contributed volume presents a multi-perspective collection of the latest research findings on oil and gas exploration and imparts insight that can greatly assist in understanding field behavior, design of test programs, and design of field operations. With this book, engineers also gain a powerful guide to the most commonly used numerical simulation methods that aid in reservoir modelling. In addition, the contributors explore development of technologies that allow for cost effective oil and gas exploration while minimizing the impact on our water resources, surface and groundwater aquifers, geological stability of impacted areas, air quality, and infrastructure assets such as roads, pipelines, water, and wastewater networks. Easy to understand, the book identifies equipment and procedural problems inherent to oil and gas operations and provides systematic approaches for solving them.

The evaluation of in-situ rock stress is not only important in the exploration and engineering involving rock masses for mining, hydropower, tunneling, oil and gas production, and stone quarrying, but also in the geodynamics and earthquake prediction. The methods of determining these stresses for shallow crust in the engineering practice, including

Complex behavior models (plasticity, cracks, visco elascticity) face some theoretical difficulties for the determination of the behavior law at the continuous scale. When homogenization fails to give the right behavior law, a solution is to simulate the material at a meso scale in order to simulate directly a set of discrete properties that are responsible of the macroscopic behavior. The discrete element model has been developed for granular material. The proposed set shows how this method is capable to solve the problem of complex behavior that are linked to discrete meso scale effects. This first book solves the local problem, the second one presents a coupling approach to link the structural effects to the local ones, the third book presents the software workbench that includes all the theoretical developments.

XAFS for Everyone provides a practical, thorough guide to x-ray absorption fine-structure (XAFS) spectroscopy for both novices and seasoned practitioners from a range of disciplines. The text is enhanced with more than 200 figures as well as cartoon characters who offer informative commentary on the different approaches used in XAFS spectroscopy. The book covers sample preparation, data reduction, tips and tricks for data collection, fingerprinting, linear combination analysis, principal component analysis, and modeling using theoretical standards. It describes both near-edge (XANES) and extended (EXAFS) applications in detail. Examples throughout the text are drawn from diverse areas, including materials science, environmental science, structural

biology, catalysis, nanoscience, chemistry, art, and archaeology. In addition, five case studies from the literature demonstrate the use of XAFS principles and analysis in practice. The text includes derivations and sample calculations to foster a deeper comprehension of the results. Whether you are encountering this technique for the first time or looking to hone your craft, this innovative and engaging book gives you insight on implementing XAFS spectroscopy and interpreting XAFS experiments and results. It helps you understand real-world trade-offs and the reasons behind common rules of thumb.

An introductory textbook covering the fundamentals of linear finite element analysis (FEA) This book constitutes the first volume in a two-volume set that introduces readers to the theoretical foundations and the implementation of the finite element method (FEM). The first volume focuses on the use of the method for linear problems. A general procedure is presented for the finite element analysis (FEA) of a physical problem, where the goal is to specify the values of a field function. First, the strong form of the problem (governing differential equations and boundary conditions) is formulated. Subsequently, a weak form of the governing equations is established. Finally, a finite element approximation is introduced, transforming the weak form into a system of equations where the only unknowns are nodal values of the field function. The procedure is applied to one-dimensional elasticity and heat conduction, multi-dimensional steady-state scalar field problems (heat conduction, chemical diffusion, flow in porous media), multi-dimensional elasticity and structural mechanics (beams/shells), as well as time-dependent (dynamic) scalar field problems, elastodynamics and structural dynamics. Important concepts for finite element computations, such as isoparametric elements for multi-dimensional analysis and Gaussian quadrature for numerical evaluation of integrals, are presented and explained. Practical aspects of FEA and advanced topics, such as reduced integration procedures, mixed finite elements and verification and validation of the FEM are also discussed. Provides detailed derivations of finite element equations for a variety of problems. Incorporates quantitative examples on one-dimensional and multi-dimensional FEA. Provides an overview of multi-dimensional linear elasticity (definition of stress and strain tensors, coordinate transformation rules, stress-strain relation and material symmetry) before presenting the pertinent FEA procedures. Discusses practical and advanced aspects of FEA, such as treatment of constraints, locking, reduced integration, hourglass control, and multi-field (mixed) formulations. Includes chapters on transient (step-by-step) solution schemes for time-dependent scalar field problems and elastodynamics/structural dynamics. Contains a chapter dedicated to verification and validation for the FEM and another chapter dedicated to solution of linear systems of equations and to introductory notions of parallel computing. Includes appendices with a review of matrix algebra and overview of matrix analysis of discrete systems. Accompanied by a website hosting an open-source finite element program for linear elasticity and heat conduction, together with a user tutorial. Fundamentals of Finite Element Analysis: Linear Finite Element Analysis is an ideal text for undergraduate and graduate students in civil, aerospace and mechanical engineering, finite element software vendors, as well as practicing engineers and anybody with an interest in linear finite element analysis.

The book contains 11 chapters written by relevant scientists in the field of particle-based methods and their applications in engineering and applied sciences. The chapters cover most particle-based techniques used in practice including the discrete

element method, the smooth particle hydrodynamic method and the particle finite element method. The book will be of interest to researchers and engineers interested in the fundamentals of particle-based methods and their applications.

Particulate discrete element analysis is becoming increasingly popular for research in geomechanics as well as geology, chemical engineering, powder technology, petroleum engineering and in studying the physics of granular materials. With increased computing power, practising engineers are also becoming more interested in using this technology for analysis in industrial applications. This is the first single work on Discrete Element Modelling (DEM) providing the information to get started with this powerful numerical modelling approach. Written by an independent author with experience both in developing DEM codes and using commercial codes, this book provides the basic details of the numerical method and the approaches used to interpret the results of DEM simulations. Providing a basic overview of the numerical method, Particulate Discrete Element Modelling discusses issues related to time integration and numerical stability, particle types, contact modelling and boundary conditions. It summarizes approaches to interpret DEM data so that users can maximize their insight into the material response using DEM. The aim of this book is to provide both users and prospective users of DEM with a concise reference book that includes tips to optimize their usage. Particulate Discrete Element Modelling is suitable both for first time DEM analysts as well as more experienced users. It will be of use to professionals, researchers and higher level students, as it presents a theoretical overview of DEM as well as practical guidance on running DEM simulations and interpreting DEM simulation data.

Particle Technology and Engineering presents the basic knowledge and fundamental concepts that are needed by engineers dealing with particles and powders. The book provides a comprehensive reference and introduction to the topic, ranging from single particle characterization to bulk powder properties, from particle-particle interaction to particle-fluid interaction, from fundamental mechanics to advanced computational mechanics for particle and powder systems. The content focuses on fundamental concepts, mechanistic analysis and computational approaches. The first six chapters present basic information on properties of single particles and powder systems and their characterisation (covering the fundamental characteristics of bulk solids (powders) and building an understanding of density, surface area, porosity, and flow), as well as particle-fluid interactions, gas-solid and liquid-solid systems, with applications in fluidization and pneumatic conveying. The last four chapters have an emphasis on the mechanics of particle and powder systems, including the mechanical behaviour of powder systems during storage and flow, contact mechanics of particles, discrete element methods for modelling particle systems, and finite element methods for analysing powder systems. This thorough guide is beneficial to undergraduates in chemical and other types of engineering, to chemical and process engineers in industry, and early stage researchers. It also provides a reference to experienced researchers on mathematical and mechanistic analysis of particulate systems, and on advanced computational methods. Provides a simple introduction to core topics in particle technology: characterisation of particles and powders: interaction between particles, gases and liquids; and some useful examples of gas-solid and liquid-solid systems Introduces the principles and applications of two useful computational approaches: discrete element modelling and finite element modelling Enables

engineers to build their knowledge and skills and to enhance their mechanistic understanding of particulate systems
This book presents the latest advances in Discrete Element Methods (DEM) and technology. It is the proceeding of 7th International Conference on DEM which was held at Dalian University of Technology on August 1 - 4, 2016. The subject of this book are the DEM and related computational techniques such as DDA, FEM/DEM, molecular dynamics, SPH, Meshless methods, etc., which are the main computational methods for modeling discontinua. In comparison to continua which have been already studied for a long time, the research of discontinua is relatively new, but increases dramatically in recent years and has already become an important field. This book will benefit researchers and scientists from the academic fields of physics, engineering and applied mathematics, as well as from industry and national laboratories who are interested in the DEM.
A fundamental and practical introduction to the finite element method, its variants, and their applications in engineering.
Gives readers a more thorough understanding of DEM and equips researchers for independent work and an ability to judge methods related to simulation of polygonal particles Introduces DEM from the fundamental concepts (theoretical mechanics and solidstate physics), with 2D and 3D simulation methods for polygonal particles Provides the fundamentals of coding discrete element method (DEM) requiring little advance knowledge of granular matter or numerical simulation Highlights the numerical tricks and pitfalls that are usually only realized after years of experience, with relevant simple experiments as applications Presents a logical approach starting withthe mechanical and physical bases,followed by a description of the techniques and finally their applications Written by a key author presenting ideas on how to model the dynamics of angular particles using polygons and polyhedral Accompanying website includes MATLAB-Programs providing the simulation code for two-dimensional polygons Recommended for researchers and graduate students who deal with particle models in areas such as fluid dynamics, multi-body engineering, finite-element methods, the geosciences, and multi-scale physics.
This collection of papers on research into and management of underground structures in salt formations represents the state-of-the-art on applications of salt mechanics in mines and storage caverns for gas/hydrocarbon, radioactive waste and toxic waste disposal. The contributions cover laboratory experiments, constitutive numerical modeling and fie
In the years since the fourth edition of this seminal work was published, active research has developed the Finite Element Method into the pre-eminent tool for the modelling of physical systems. Written by the pre-eminent professors in their fields, this new edition of the Finite Element Method maintains the comprehensive style of the earlier editions and authoritatively incorporates the latest developments of this dynamic field. Expanded to three volumes the book now covers the basis of the method and its application to advanced solid mechanics and also advanced fluid dynamics. Volume Two: Solid and Structural Mechanics is intended for readers studying structural mechanics at a higher level. Although it is an ideal companion volume to Volume One: The Basis, this advanced text also functions as a "stand-alone" volume, accessible to those who have been introduced to the Finite Element Method through a different route. Volume 1 of the Finite Element Method provides a complete introduction to the method and is essential reading for undergraduates, postgraduates and professional engineers. Volume 3 covers the whole range of fluid

dynamics and is ideal reading for postgraduate students and professional engineers working in this discipline. Coverage of the concepts necessary to model behaviour, such as viscoelasticity, plasticity and creep, as well as shells and plates.Up-to-date coverage of new linked interpolation methods for shell and plate formations.New material on non-linear geometry, stability and buckling of structures and large deformations.

Fundamentals of Discrete Element Methods for Rock Engineering: Theory and ApplicationsElsevier

Principles is the first volume of the five-volume set Rock Mechanics and Engineering and contains twenty-four chapters from key experts in the following fields: - Discontinuities; - Anisotropy; - Rock Stress; - Geophysics; - Strength Criteria; - Modeling Rock Deformation and Failure. The five-volume set “Comprehensive Rock Engineering”, which was published in 1993, has had an important influence on the development of rock mechanics and rock engineering. Significant and extensive advances and achievements in these fields over the last 20 years now justify the publishing of a comparable, new compilation. Rock Mechanics and Engineering represents a highly prestigious, multi-volume work edited by Professor Xia-Ting Feng, with the editorial advice of Professor John A. Hudson. This new compilation offers an extremely wideranging and comprehensive overview of the state-of-the-art in rock mechanics and rock engineering and is composed of peer-reviewed, dedicated contributions by all the key experts worldwide. Key features of this set are that it provides a systematic, global summary of new developments in rock mechanics and rock engineering practices as well as looking ahead to future developments in the fields. Contributors are worldrenowned experts in the fields of rock mechanics and rock engineering, though younger, talented researchers have also been included. The individual volumes cover an extremely wide array of topics grouped under five overarching themes: Principles (Vol. 1), Laboratory and Field Testing (Vol. 2), Analysis, Modelling and Design (Vol. 3), Excavation, Support and Monitoring (Vol. 4) and Surface and Underground Projects (Vol. 5). This multi-volume work sets a new standard for rock mechanics and engineering compendia and will be the go-to resource for all engineering professionals and academics involved in rock mechanics and engineering for years to come.

Analysis, Modeling & Design is the third volume of the five-volume set Rock Mechanics and Engineering and contains twenty-eight chapters from key experts in the following fields: - Numerical Modeling Methods; - Back Analysis; - Risk Analysis; - Design and Stability Analysis: Overviews; - Design and Stability Analysis: Coupling Process Analysis; - Design and Stability Analysis: Blast Analysis and Design; - Rock Slope Stability Analysis and Design; - Analysis and Design of Tunnels, Caverns and Stopes. The five-volume set “Comprehensive Rock Engineering”, which was published in 1993, has had an important influence on the development of rock mechanics and rock engineering. Significant and extensive advances and achievements in these fields over the last 20 years now justify the publishing of a comparable, new compilation. Rock Mechanics and Engineering represents a highly prestigious, multi-volume work edited by Professor Xia-Ting Feng, with the editorial advice of Professor John A. Hudson. This new compilation offers an extremely wideranging and comprehensive overview of the state-of-the-art in rock mechanics and rock engineering and is composed of peer-reviewed, dedicated contributions by all the key experts worldwide. Key features of this

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Frattura ed Integrità Strutturale (Fracture and Structural Integrity) is the official Journal of the Italian Group of Fracture (ISSN 1971-8993). It is an open-access Journal published on-line every three months (July, October, January, April). Frattura ed Integrità Strutturale encompasses the broad topic of structural integrity, which is based on the mechanics of fatigue and fracture, and is concerned with the reliability and effectiveness of structural components. The aim of the Journal is to promote works and researches on fracture phenomena, as well as the development of new materials and new standards for structural integrity assessment. The Journal is interdisciplinary and accepts contributions from engineers, metallurgists, materials scientists, physicists, chemists, and mathematicians.

This book reflects the latest research results in computer modelling of landslide-induced debris flows. The book establishes an understanding of the initiation and propagation mechanisms of landslides by means of numerical simulations, so that mitigation strategies to reduce the long-term losses from landslide hazards can be devised. In this context, the book employs the Discrete Element Method (DEM) and Computational Fluid Dynamics (CFD) to investigate the mechanical and hydraulic behaviour of granular materials involved in landslides – an approach that yields meaningful insights into the flow mechanisms, concerning e.g. the mobilization of sediments, the generation and dissipation of excess pore water pressures, and the evolution of effective stresses. As such, the book provides valuable information, useful methods and robust numerical tools that can be successfully applied in the field of debris flow research.

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

practical examples of applications areas Essential reading for postgraduates, researchers and software engineers working in mechanical engineering.

This book is the second edition of the well-known textbook Modelling Rock Fracturing Processes. The new and extended edition provides the theoretical background of rock fracture mechanics used for modelling of 2-D and 3-D geomechanics problems and processes. Fundamentals of rock fracture mechanics integrated with experimental studies of rock fracturing processes are highlighted. The computer programs FRACOD 2D and 3D are used to analyse fracture initiation and propagation for the three fracture modes: Mode I, II and III. Coupled fracture modelling with other continuous and distinct element codes including FLAC, PFC, RFPA, TOUGH are also described. A series of applications of fracture modelling with importance for modern society is presented and discussed by distinguished rock fracture modelling experts.