

**Springer Series in
GEOMECHANICS & GEOENGINEERING**

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Constitutive Modeling of Geomaterials

Advances and New Applications



Springer

Constitutive Modelling Of Geomaterials

Fusao Oka, Sayuri Kimoto



Constitutive Modelling Of Geomaterials:

Constitutive Modeling of Geomaterials Qiang Yang, Jian-Min Zhang, Hong Zheng, Yangping Yao, 2012-08-22 The Second International Symposium on Constitutive Modeling of Geomaterials Advances and New Applications IS Model 2012 is to be held in Beijing China during October 15 16 2012 The symposium is organized by Tsinghua University the International Association for Computer Methods and Advances in Geomechanics IACMAG the Committee of Numerical and Physical Modeling of Rock Mass Chinese Society for Rock Mechanics and Engineering and the Committee of Constitutive Relations and Strength Theory China Institution of Soil Mechanics and Geotechnical Engineering China Civil Engineering Society This Symposium follows the first successful International Workshop on Constitutive Modeling held in Hong Kong which was organized by Prof JH Yin in 2007 Constitutive modeling of geomaterials has been an active research area for a long period of time Different approaches have been used in the development of various constitutive models A number of models have been implemented in the numerical analyses of geotechnical structures The objective of the symposium is to provide a forum for researchers and engineers working or interested in the area of constitutive modeling to meet together and share new ideas achievements and experiences through presentations and discussions Emphasis is placed on recent advances of constitutive modeling and its applications in both theoretic and experimental aspects Six famous scholars have been invited for the plenary speeches of the symposiums Some prominent scholars have been invited to organize four specialized workshops on hot topics including Time dependent stress strain behavior of geomaterials Constitutive modeling within critical state soil mechanics Multiscale and multiphysics in geomaterials and Damage to failure in rock structures A total of 49 papers are included in the above topics In addition 51 papers are grouped under three topics covering Behaviour of geomaterials Constitutive model and Applications The editors expect that the book can be helpful as a reference to all those in the field of constitutive modeling of geomaterials Constitutive Modelling of Geomaterials Bernard Cambou, Claudio Di Prisco, 2000-01-01 The Alliance of Laboratories in Europe for Research and Technology A L E R T Geomaterials has been created in 1989 as a pioneering at that time effort to develop an european school of thinking in the field of the Mechanics of Geomaterials The generic name Geomaterials is viewed as gathering together materials whose mechanical behaviour depends on the pressure level which can be dilatant under shearing and which are multiphase materials because of their porous structure The label Geomaterials brings together mainly concrete soils and rocks This book presents the course proposed at the European Graduate School Geomaterials 2000 Constitutive Modelling of Geomaterials It gives a comprehensive and updated view of constitutive modelling of materials encountered in civil engineering The established theories as the most recent developments in this field are treated in a didactic manner elasto visco plasticity incremental non linearity damage mechanics enriched constitutive equations discrete modelling As well as to diploma level students it is addressed to students reading for a first degree in civil engineering to practising engineers and to research workers in this

field

Constitutive Modeling of Geomaterials Teruo Nakai, 2012-07-23 Written by a veteran geotechnical engineer with a long record of research discoveries *Constitutive Modeling of Geomaterials Principles and Applications* presents a simple and unified approach to modeling various features of geomaterials in general stress systems The book discusses the fundamentals of the constitutive modeling of soils and illustrates the application of these models to boundary value problems Helping readers easily understand the fundamentals and modeling of soil behaviors the author first explains the ideas and formulations for modeling soil features in one dimensional conditions He then extends the one dimensional models to three dimensional models using the t_{ij} concept The text covers the subloading t_{ij} model and other methods that describe density bonding time effect and more Moving on to the practical application of the constitutive models the author presents the numerical simulations of typical geotechnical problems numerical modeling and the corresponding model tests physical modeling Using a framework that leads to a unified set of material parameters this book shows how to formulate a constitutive model capable of simulating the main features of soil behavior It not only covers recent methods and models but also uses real test data to prove their reliability

The SMP Concept-Based 3D Constitutive Models for Geomaterials Hajime Matsuoka, 2014-04-21 The Cam Clay model is a fundamental constitutive model in soil mechanics but is only suitable for normally consolidated clay under triaxial compression stress states This book introduces the SMP criterion its integration with the well known Cam clay model and its application to the general elastoplastic constitutive models for geomaterials like clay sand and unsaturated soil

Frank L. Di Maggio Symposium on Constitutive Modeling of Geomaterials June 3-5 2002 Hoe I. Ling, 2003-01-23 Scientists involved with geomaterial modeling honor the retirement of distinguished colleague Frank L DiMaggio civil engineering and engineering mechanics Columbia U by offering contributions representing recent advances in the modeling of sand clay and concrete DiMaggio contributed to the d Application of an Evolutionary Data Mining Technique for Constitutive Modelling of Geomaterials Alireza Ahangar, 2012

Computational Modeling of Multiphase Geomaterials Fusao Oka, Sayuri Kimoto, 2012-07-05 Drawing on the authors well regarded work in the field this book provides readers with the knowledge and tools to tackle problems in geomechanics It shows how numerical methods and constitutive modeling can help predict the behavior of geomaterials such as soil and rock The authors describe the constitutive modeling of soils for rate dependent behavior strain localization multiphase theory and applications in the context of large deformations They also emphasize viscoplasticity and water soil coupling

Constitutive Modelling in Geomechanics Alexander Puzrin, 2012-01-21 The purpose of this book is to bridge the gap between the traditional Geomechanics and Numerical Geotechnical Modelling with applications in science and practice Geomechanics is rarely taught within the rigorous context of Continuum Mechanics and Thermodynamics while when it comes to Numerical Modelling commercially available finite elements or finite differences software utilize constitutive relationships within the rigorous framework As a result young scientists and engineers have to learn the challenging subject of constitutive modelling

from a program manual and often end up with using unrealistic models which violate the Laws of Thermodynamics The book is introductory by no means does it claim any completeness and state of the art in such a dynamically developing field as numerical and constitutive modelling of soils The author gives basic understanding of conventional continuum mechanics approaches to constitutive modelling which can serve as a foundation for exploring more advanced theories A considerable effort has been invested here into the clarity and brevity of the presentation A special feature of this book is in exploring thermomechanical consistency of all presented constitutive models in a simple and systematic manner

Handbook of Materials Behavior Models, Three-Volume Set Jean LeMaitre, 2001-11-17 This first of a kind reference handbook deals with nonlinear models and properties of material In the study the behavior of materials phenomena no unique laws exist Therefore researchers often turn to models to determine the properties of materials This will be the first book to bring together such a comprehensive collection of these models The Handbook deals with all solid materials and is organized first by phenomena Most of the materials models presented in an applications oriented fashion less descriptive and more practitioner geared making it useful in the daily working activities of professionals The Handbook is divided into three volumes Volume I Deformation of Materials introduces general methodologies in the art of modeling in choosing materials and in the so called size effect Chapters 2 5 deal respectively with elasticity and viscoelasticity yield limit plasticity and viscoplasticity Volume II Failures in Materials provides models on such concerns as continuous damage cracking and fracture and friction wear Volume III Multiphysics Behavior deals with multiphysics coupled behaviors Chapter s 10 and 11 are devoted to special classes of materials composites biomaterials and geomaterials The different sections within each chapter describe one model each with its domain of validity its background its formulation the identification of material parameters for as many materials as possible and advice on how to implement or use the model The study of the behavior of materials especially solids is related to hundreds of areas in engineering design and control Predicting how a material will perform under various conditions is essential to determining the optimal performance of machines and vehicles and the structural integrity of buildings as well as safety issues Such practical examples would be how various new materials such as those used in new airplane hulls react to heat or cold or sudden temperature changes or how new building materials hold up under extreme earthquake conditions The Handbook of Materials Behavior Models Gathers together 117 models of behavior of materials written by the most eminent specialists in their field Presents each model s domain of validity a short background its formulation a methodology to identify the materials parameters advise on how to use it in practical applications as well as extensive references Covers all solid materials metals alloys ceramics polymers composites concrete wood rubber geomaterials such as rocks soils sand clay biomaterials etc Concerns all engineering phenomena elasticity viscoelasticity yield limit plasticity viscoplasticity damage fracture friction and wear

Deformation Characteristics of Geomaterials H. DiBenedetto, T. Doanh, H. Geoffroy, C. Sauzéat, 2005-03-03 Solutions for soil engineering and soil structure interaction

problems need realistic and pertinent experimental and modelling tools In this work extensive developments proposed by the invited speakers of the Lyon International Symposium held in September 2003 are presented including experimental investigations into deformation properties laboratory in situ and field observation interpretations behaviour characterisation and modelling and case histories The contributions include recent investigations into anisotropy and non linearity the effects of stress strain time history ageing and time effects yielding failure and flow cyclic and dynamic behaviour In addition advanced geotechnical testing is applied to real engineering problems and to ways of synthesising information from a range of sources while engaging in practical site characterisation studies

Numerical Models in Geomechanics G.N. Pande,S. Pietruszczak,H.F. Schweiger,2020-12-17 In this volume a number of developments on a variety of topics have been reported These topics include partially saturated soil instabilities in soil behaviour environmental geomechanics parallel computing and applications to tunnels embankments slopes foundations and anchors

Practice of Constitutive Modelling for Saturated Soils Zhen-Yu Yin,Pierre-Yves Hicher,Yin-Fu Jin,2020-09-11 This book describes the development of a constitutive modeling platform for soil testing which is one of the key components in geomechanics and geotechnics It discusses the fundamentals of the constitutive modeling of soils and illustrates the use of these models to simulate various laboratory tests To help readers understand the fundamentals and modeling of soil behaviors it first introduces the general stress strain relationship of soils and the principles and modeling approaches of various laboratory tests before examining the ideas and formulations of constitutive models of soils Moving on to the application of constitutive models it presents a modeling platform with a practical simple interface which includes various kinds of tests and constitutive models ranging from clay to sand that is used for simulating most kinds of laboratory tests The book is intended for undergraduate and graduate level teaching in soil mechanics and geotechnical engineering and other related engineering specialties Thanks to the inclusion of real world applications it is also of use to industry practitioners opening the door to advanced courses on modeling within the industrial engineering and operations research fields

Recent Advances in Earthquake Geotechnical Engineering and Microzonation Atilla Ansal,2006-09-27 Outstanding advances have been achieved on Earthquake Geotechnical Engineering and Microzonation in the last decade mostly due to the increase in the recorded instrumental in situ data and large number of case studies conducted in analyzing the observed effects during the recent major earthquakes During the 15th International Conference on Soil Mechanics and Geotechnical Engineering held in Istanbul in August 2001 the Technical Committee of Earthquake Geotechnical Engineering TC4 of the International Society of Soil Mechanics and Geotechnical Engineering organised a regional seminar on Geotechnical Earthquake Engineering and Microzonation where an effort has been made to present the recent advances in the field by eminent scientists and researchers The book idea was first suggested by the participants of this seminar The purpose of this book as well as of the seminar was to present the broad spectrum of earthquake geotechnical engineering and seismic microzonation including strong ground motion site

characterisation site effects liquefaction seismic microzonation solid waste landfills and foundation engineering The subject matter requires multidisciplinary input from different fields of engineering seismology soil dynamics geotechnical and structural engineering The chapters in this book are prepared by some of the distinguished lecturers who took part in the seminar supplemented with contributions of few distinguished experts in the field of earthquake geotechnical engineering The editor would like to express his gratitude to all authors for their interest and efforts in preparing their manuscripts Without their enthusiasm and support it would not have been possible to complete this book Plastic Mechanics of Geomaterial Yuanxue Liu,Yingren Zheng,2019-01-07 This book presents the basic theories of Plastic Mechanics of Geomaterial including the static and dynamic mechanical properties nonlinear and classical plastic theory yield surface theory hardening model flow rule and loading unloading criterion the calculation theory of principal stress axe rotation and limit analysis of geomaterial and the latest advances in FEM limit analysis It also set forth the typical static and dynamic constitutive model of geomaterial in detail Broadening our understanding of the basic mechanical properties and constitutive model for geomaterial the book helps readers to establish and select the most appropriate constitutive model according to the specific engineering problems and geomaterial characteristics This book is a valuable resource for designers and researchers in fields related to geotechnical engineering and it can also be used as a textbook for graduate courses

Advances in Bifurcation and Degradation in Geomaterials Stéphane Bonelli,Cristian Dascalu,François Nicot,2011-08-03 This book presents contributions to the 9th International Workshop on Bifurcation and Degradation in Geomaterials held in Porquerolles France May 23 26 2011 This series of conferences started in the early 1980s is dedicated to the research on degradation and instability phenomena in geomaterials The volume gathers a series of manuscripts by brilliant international scholars reflecting recent trends in theoretical and experimental research in geomechanics It incorporates contributions on topics like instability analysis localized and diffuse failure description multi scale modeling and applications to geo environmental issues This book will be valuable for anyone interested in the research on degradation and instabilities in geomechanics and geotechnical engineering appealing to graduate students researchers and engineers alike

Modern Trends in Geomechanics Wei Wu,Hai-Sui Yu,2006-11-22 This book is loaded with rich and stimulating articles by a roster of brilliant scholars reflecting some recent trends in the frontier research of geomechanics This collection of 32 contributions stems from an international workshop on Modern Trends of Geomechanics held in Vienna The contributions span a wide range of topics and an enormous range of physical scales from micromechanics at grain scale to engineering problems at large scale from laboratory and field testing over constitutive modelling to numerical analysis The key features of this book are thermodynamics multiphase continua and transport phenomena constitutive modelling localized bifurcation micropolar theory unsaturated soil viscous and cyclic behaviour numerical and analytical methods discrete element method micromechanics grain crushing and damage laboratory and field testing foundation and mining engineering This book will be

rewarding for anyone interested in the frontier research in geomechanics and geotechnical engineering appealing to graduate students researchers and engineers alike

Pre-failure Deformation Characteristics of Geomaterials M. Jamiolkowski, Renato Lancellotta, D. Lo Presti, 1999

Deformation Characteristics of Geomaterials V.A. Rinaldi, M.E. Zeballos, J.J. Clariá, 2015-12-11

In November 2015 Buenos Aires Argentina became the location of several important events for geo professionals with the simultaneous holding of the 6th International Symposium on Deformation Characteristics of Geomaterials the 15th Pan American Conference on Soil Mechanics and Geotechnical Engineering XV PCSMGE the 8th South American Congress on Rock Mechanics SCRM as well as the 22nd Argentinean Congress of Geotechnical Engineering CAMSIGXXII This synergy provided a unique opportunity to exchange ideas and discuss current and future practices in the areas of soil mechanics and rock mechanics and their applications in civil energy environmental and mining engineering This book presents the proceedings of the 6th International Symposium on Deformation Characteristics of Geomaterials As well as 118 articles selected for publication after peer review it includes 7 lectures delivered by invited keynote speakers and the Third Bishop Lecture delivered by Professor Herve Di Benedetto of the University of Lyon France who presented a reference work on the advanced testing and modeling of bituminous bounded and unbounded granular materials The conference brought together practitioners researchers and educators from around the world engaged in the understanding of the deformation properties of geo materials before failure and the small strain parameters as fundamental characteristics of geo materials The main topics covered by the symposium include experimental investigations from very small strains to beyond failure including multi physical approach HTC M coupling behavior characterization and modeling of various geo materials and interfaces and practical prediction and interpretation of ground responses field observation and case histories

Bifurcation and Degradation of Geomaterials with Engineering Applications Euripides Papamichos, Panos Papanastasiou, Elena Pasternak, Arcady Dyskin, 2017-04-21

This book contains the scientific contributions to the 11th International Workshop on Bifurcation and Degradation in Geomaterials IWBDG held in Limassol Cyprus May 21 25 2017 The IWBDG series have grown in size and scope since their inception 30 years ago in Germany covering more and wider areas of geomaterials and geomechanics research including modern trends The papers cover a wide range of topics including advances in instabilities localized and diffuse failure micromechanical multiscale phenomena multiphysics modeling and other related topics This volume gathers a series of manuscript by brilliant international scholars who work on modern recent advances in experimental theoretical and numerical methods The theoretical and applied mechanics are linked successfully with engineering applications in traditional and in emerging fields such as geomechanics for the energy and the environment The quality of the contributed papers has benefited from the peer review process by expert referees This book can be used as a useful reference for research students academics and practicing engineers who are interested in the instability and degradation problems in geomaterials geomechanics geotechnical engineering and other related applications

Computational Modelling of Concrete Structures Gunther Meschke, René de Borst, Herbert Mang, Nenad

Bicanic, 2006-03-16 This conference proceedings brings together the work of researchers and practising engineers concerned with computational modelling of complex concrete reinforced concrete and prestressed concrete structures in engineering practice The subjects considered include computational mechanics of concrete and other cementitious materials including masonry Advanced discretisation methods and microstructural aspects within multi field and multi scale settings are discussed as well as modelling formulations and constitutive modelling frameworks and novel experimental programmes The conference also considered the need for reliable high quality analysis and design of concrete structures in regard to safety critical structures with a view to adopting these in codes of practice or recommendations The book is of special interest to researchers in computational mechanics and industry experts in complex nonlinear simulations of concrete structures

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