Seepage And Groundwater Flow Numerical Analysis By Analogue And Digital Methods Series In Geotechnical Engineering

In this study, The Beach Dewatering System, a relatively recent technology to combat beach erosion, which is proposed as a practical alternative to more traditional shoreline stabilization methods, is investigated and an informative overview on the genesis, development and recent use of this technique is provided. On the basis of the link existing between the elevation of beach groundwater and erosional or accretionary trends at the beach face, a numerical model that simulates groundwater flow in a coastal aquifer under beach drainage is presented. In this model, the seaward boundary of the domain is considered to be tidally fluctuating in a large scale to represent the occurrence of seepage face significantly. The unsteady groundwater flow equation is solved numerically using the method of finite differences. The results clearly showed that the water table being lowered caused the reduction of the seepage face which is the main aim of Beach Dewatering projects. The positional design parameters, i.e. horizontal and vertical location of the drain, are also investigated by utilizing an efficiency index. It is observed that the system efficiency decreased as the drain is shifted landward. The results also indicated that, the efficiency slightly increased with the vertical drain elevation.

Based on the graduate course in Earthquake Hydrology at Berkeley University, this text introduces the basic materials, provides a comprehensive overview of the field to interested readers and beginning researchers, and acts as a convenient reference point.

*Up-to-date coverage of fundamental seepage principles, closed-form solutions, and applications Seepage in Soils combines a broad range of applications with rigorous quantitative skills to give insight into the fundamental principles and mathematical solutions of seepage. A wealth of closed-form analytical solutions are provided to solve a variety of problems, minimizing the use of computer software and numerical models. Completely up to date with coverage of new developments in separators, filters, and geosynthetics, this textbook includes exercises in seepage quantification, seepage forces, and dewatering. Complete coverage is useful in all subdivisions of civil engineering. Material is divided into three modules: * Principles and mathematical solutions * Filters and drainage layers * Applications Only a nominal background in mathematics and soil mechanics is required for Seepage in Soils to serve as an invaluable resource for civil engineering students across many subdisciplines. In addition, it serves as a useful reference for geotechnical, environmental, and structural engineers, hydrologists, geologists, agronomists, and soil scientists.*

NUMERICAL MODELING OF GROUNDWATER FLOW BEHAVIOR IN RESPONSE TO BEACH DEWATERING.

Finite Elements in Water Resources

Numerical Modelling of Groundwater Basins

Hydraulic Research in the United States and Canada

High-solid and Multi-phase Bioprocess Engineering

The Foundation Engineering Handbook, Second Edition

The Department of Energy (DOE) is preparing an Environmental Impact Statement (EIS) as part of the process for continuing operation of three reactors at the Savannah River Site (SRS). As required by the National Environmental Policy Act (NEPA), the EIS must address the potential environmental consequences to human health and the environment of this major federal action." Some of the possible consequences are related to subsurface transport of radionuclides released to seepage basins during normal reactor operation. To assist in the evaluation of the potential subsurface environmental impacts of these releases, Camp Dresser McKee Inc. (CDM) was contracted in June of 1989 to develop a three-dimensional groundwater flow and contaminant transport model which will simulate the movement of radionuclides at each of the reactor areas after they enter the groundwater system through the seepage basins. This report describes the development, calibration, and simulation results of the groundwater flow and contaminant transport model developed for this task. 10 refs., 63 figs., 11 tabs.

Praise for the Second Edition: "This is the book that the dewatering sector really needs – it is reliably based on sound theory and profound understanding of the physical processes, yet is presented in a very accessible and user-friendly manner. It draws on many, many decades of experience, and yet is utterly up to date. . . . It is a one-stop shop for the dewatering practitioner – who can nonetheless rest assured that the theoretical basis of the methods presented is flawless." — Professor Paul L. Younger, FGS, FICE, C.Geol., C.Eng., FREng, University of Glasgow, Scotland, UK "The best reference on this topic available . . . and will prove useful to a wide variety of readers ranging from junior construction engineers or dewatering contractors to theoretical hydrogeologists and environmental managers. It is rare that a book is able to bridge the gap between theoretical design guidance and practical application." — S.N. Sterling, University of Waterloo, Canada The extensively updated Groundwater Lowering in Construction: A Practical Guide to Dewatering, 3rd Edition offers practical advice on all phases of groundwater control systems, from planning and design, through installation and maintenance, and ultimately decommissioning. The expertise provided in this book can help you improve working conditions, increase project viability, save time and reduce excavation costs. Designers and managers of construction and engineering projects are given the tools necessary to effectively control groundwater. The content is divided into three sections – Principles, Design and Construction. The Principles section explains the fundamentals of groundwater flow as it relates to civil engineering excavations. The Design section explores in extensive detail site investigation, permeability assessment methods and groundwater control strategies. Chapters in the Construction section describe dewatering and exclusion techniques, and examine the complete life cycle of a groundwater control scheme, including monitoring, maintenance and decommissioning. This section incorporates eleven case histories from the authors' casebook. The 3rd edition has been greatly revised and updated, and contains more than 200 new illustrations. The new content covers: Permeability of soils and rocks Groundwater problems for excavations in rock Groundwater control for tunnelling projects, such as shafts and cross passages Methods for assessing permeability Decommissioning of dewatering systems Optimisation of groundwater control schemes. The new, expanded content offers valuable direction that can give you a true competitive advantage in the planning and execution of temporary and permanent dewatering works for excavation and tunnelling. Written for practising engineers, geologists and construction managers, as well as postgraduate engineering students, this revamped manual on design and practice presents numerous case studies and extensive references to enhance understanding. Martin Preene is a groundwater consultant, based in the UK. He has more than 30 years' experience working on dewatering and groundwater control projects worldwide. The late Pat Cashman was the leading British exponent of groundwater control for his generation, championing a practical and straightforward approach for more than forty years.

Considering how structures interact with soil, and building proper foundations, is vital to ensuring public safety and to the longevity of buildings. Understanding the strength and compressibility of subsurface soil is essential to the foundation engineer. The Foundation Engineering Handbook, Second Edition provides the fundamentals of foundation engineering needed by professional engineers and engineering students. It presents both classical and state-of-the-art design and analysis techniques for earthen structures and examines the principles and design methods of foundation engineering needed for design of building foundations, embankments, and earth retaining structures. It covers basic soil mechanics, and soil and groundwater modeling concepts, along with the latest research results. What's New in the Second Edition: Adds alternative analytical techniques to nearly every chapter Supplements existing material with new content Includes additional applications in the state of the art such as unsaturated soil mechanics, analysis of transient flow through soils, deep foundation construction monitoring based on thermal integrity profiling, and updated ground remediation techniques Covers reliability-based design and LRFD (load resistance factor design) concepts not addressed in most foundation engineering texts Provides more than 500 illustrations and over 1,300 equations The text serves as an ideal resource for practicing foundation and geotechnical engineers, as well as a supplemental textbook for both undergraduate and graduate levels.

Numerical and Analytical Methods for the Analysis of Flow of Water Through Soils and Earth Structures

A Practicum Submitted in Partial Fulfillment ... for the Degree of Master of Science in Natural Resource Policy ...

School of Underground Mining 2011

A Practical Guide to Dewatering

Isotopic Tracer Techniques and Numerical Modeling

Hydraulic Research in the United States and Canada, 1976

Seepage and Groundwater FlowNumerical Analysis by Analog and Digital MethodsJohn Wiley & Sons IncorporatedSeepage and Groundwater FlowNumerical Analysis by Analog and Digital MethodsMeasuring Groundwater Flow with Seepage Meters at Whitmore Lake, Michigan (with Numerical Modeling Appendix)A Practicum Submitted in Partial Fulfillment ... for the Degree of Master of Science in Natural Resource Policy ...Numerical Modeling of Variably-saturated Groundwater Flow Problems with Seepage-face BoundariesFinite Element Techniques in Groundwater Flow StudiesWith Applications in Hydraulic and Geotechnical EngineeringElsevier

This new edition adds several new chapters and is thoroughly updated to include data on new topics such as hydraulic fracturing, CO2 sequestration, sustainable groundwater management, and more. Providing a complete treatment of the theory and practice of groundwater engineering, this new handbook also presents a current and detailed review of how to model the flow of water and the transport of contaminants both in the unsaturated and saturated zones, covers the protection of groundwater, and the remediation of contaminated groundwater.

This chapter presents a compendium of the primary methods that are used to perform water flow analyses with a focus on computational approximation methods. Some of the current algorithms for carrying out this type of analysis are summarized. In addition, general guidelines are provided for using the methodologies for specific types of analysis, such as transient-state flow caused by water drawdown and flow in unsaturated media. Emphasis is placed on the need for stochastic analysis of water flow. Lastly, conclusions and general recommendations are given for performing numerical groundwater seepage analyses in soils.

Selected Irrigation Return Flow Quality Abstracts

Finite Difference and Finite Element Methods

Principles and Applications

Spreadsheet Solution Method for Groundwater Flow Problems

User Guide to the Subsidence and Aquifer-system Compaction Package (SUB-WT) for Water-table Aquifers

With Applications in Hydraulic and Geotechnical Engineering

It has been recognized that submarine groundwater discharge (SGD) may be one of the principal pathways for delivering nutrients to surface water bodies, resulting in eutrophication of many nearshore coastal areas throughout the world. A one-year study of the coastal aquifer system (A1, A2, A3-Aquifers) of Gulf Shores, Alabama was conducted to assess SGD fluxes, characterize contaminant and nutrient transport through the aquifer system, and determine the availability of future aquifer resources. A three-dimensional density-dependent groundwater flow and transport model (SEAWAT), based on the coupling of MOFLOW and MT3DMS, was used to simulate the transport of nitrate and sulfate through the groundwater system to the coast. The model was refined and calibrated using independently determined field-based radon (222Rn, t1/2=3.82 d) isotopic tracer time-series surveys across a portion of the model area to enhance estimates of nearshore SGD. Two SGD approaches, integrated with 222Rn-determined seepage rates, were developed to determine (1) localized; and (2) entire-shoreline SGD. Thirty-two groundwater wells within the study area were sampled to constrain the groundwater 222Rn end-member in the model and characterize the extent of nutrient contamination. The ArcGIS database was used to spatially plot and interpret nutrient and 222Rn data, and generate iso-concentration maps detailing groundwater contamination and aquifer piezometric surfaces across the study area. Radon concentrations measured in groundwater from the shallow A1 and deeper A2 Aquifers were statistically identical, an indication that there is direct connection between the two systems. Elevated nitrate and sulfate concentration (up to 30 mg/L and 724 mg/L, respectively) were observed through active monitoring with zones of principal discharge identified in the lower A2 Aquifer. A groundwater seepage rate of 18.3 cm/day, calculated through the radon mass-balance model at a model area lake, was used to calibrate the numerical model surficial aquifer zone. Final shoreline seepage fluxes of 6.41 and 8.62 cm/day were determined from the results of both the multi-cell and shoreface numerical model simulation SGD approaches, respectively. The results of the two numerical SGD methods demonstrate good agreement with the 222Rn-derived methods, and provided an effective approximation technique that can be inexpensively duplicated in other similar shoreline areas.

This book provides a comprehensive description of theories and applications of high-solid and multi-phase bioprocess engineering, which is considered as an important way to address the challenges of "high energy consumption, high pollution and high emissions" in bio-industry. It starts from specifying the solid-phase matrix properties that contribute to a series of "solid effects" on bioprocess, including mass transfer restrictions in porous media, water binding effects, rheological changes. Then it proposes the new principles of periodic intensification which combines the normal force and physiologic characteristics of microorganism for the bioprocess optimization and scale-up. Further breakthroughs in key periodic intensification techniques such as periodic peristalsis and gas pressure pulsation are described in detail which provide an industrialization platform and lay the foundation for high-solid and multi-phase bioprocess engineering. This book offers an excellent reference and guide for scientists and engineers engaged in the research on both the theoretical and practical aspects of high-solid and multi-phase bioprocess.

The spreadsheet block method is a practical tool for the solution of steady state confined groundwater flow problems. The methodology is simple and yet incorporates many of the aspects of the general flow condition, including: anisotropy, heterogeneity, pumping, and complex boundary geometry. In addition, since the spreadsheet equations are programmed manually, the method provides the user with a good physical intuition for a problem. Governing equations are developed for anisotropic and heterogeneous flow conditions. Mathematical treatment of boundary conditions is presented, as well as the means to incorporate pumping wells into the analysis. The sensitivity of solutions to choice of block spacing and number of calculation iterations is illustrated using two example problems. Lastly, advantages and limitations of the technique are discussed in comparison to other numerical solution methods.

Analytical Methods, Numerical Modeling, and Monitoring Strategies for Evaluating the Effects of Ground-water Withdrawals on Unconfined Aquifers in the New Jersey Coastal Plain

Measuring Groundwater Flow with Seepage Meters at Whitmore Lake, Michigan (with Numerical Modeling Appendix)

The Handbook of Groundwater Engineering

Earthquakes and Water

Theory and Practice

Geohydrology and Numerical Model Analysis of Ground-water Flow in the Pullman-Moscow Area, Washington and Idaho

New trends of mineral deposits mining in the world consist of intensifying and concentration of mining operations. This is achieved with the help of new technical equipment that is more reliable, having greater service life and more available power. Consideration is given to quantity reduction of stopes and development workings together with their geometrical dimensions growth; also length increase of longwalls and extraction panels is examined. Innovative technologies helping to increase technical-economic indices, extraction volume, working efficiency and safety rules are presented in the book. Specific attention is given to unmanned mineral extraction technologies development using electro-hydraulic management systems of machinery. Plough systems are examined for coal extraction from thin and very thin seams (ranging from 0.8 to 1.2 m of thickness with gaining of stable daily output equal to 2.5-3 thousand tons). Analytical models describing geomechanical interaction between "massif-support" system elements are presented, finite-element method use for research and simulation of stress-strain state around stopes and development workings at coal, ore and other mines are also given. The borehole underground coal gasification technology is introduced with receiving technical gas for electricity generation, and syngas for usage in the chemical industry. Also research of gas hydrates and development of technologies for their extraction from the Black sea bottom is further scrutinized in this book.

Groundwater is a vital source of water throughout the world. As the number of groundwater investigations increase, it is important to understand how to develop comprehensive quantified conceptual models and appreciate the basis of analytical solutions or numerical methods of modelling groundwater flow. Groundwater Hydrology: Conceptual and Computational Models describes advances in both conceptual and numerical modelling. It gives insights into the interpretation of field information, the development of conceptual models, the use of computational models based on analytical and numerical techniques, the assessment of the adequacy of models, and the use of computational models for predictive purposes. It focuses on the study of groundwater flow problems and a thorough analysis of real practical field case studies. It is divided into three parts: * Part I deals with the basic principles, including a summary of mathematical descriptions of groundwater flow, recharge estimation using soil moisture balance techniques, and extensive studies of groundwater-surface water interactions. * Part II focuses on the concepts and methods of analysis for radial flow to boreholes including topics such as large diameter wells, multi-layered aquifer systems, aquitard storage and the prediction of long-term yield. * Part III examines regional groundwater flow including situations when vertical flows are important or transmissivities change with saturated depth. Suitable for practising engineers, hydrogeologists, researchers in groundwater and irrigation, mathematical modellers, groundwater scientists, and water resource specialists. Appropriate for upper level undergraduates and MSc students in Departments of Civil Engineering, Environmental Engineering, Earth Science and Physical Geography. It would also be useful for hydrologists, civil engineers, physical geographers, agricultural engineers, consultancy firms involved in water resource projects, and overseas development workers.

BASIC Hydraulics aims to help students both to become proficient in the BASIC programming language by actually using the language in an important field of engineering and to use computing as a means of mastering the subject of hydraulics. The book begins with a summary of the technique of computing in BASIC together with comments and listing of the main commands and statements. Subsequent chapters introduce the fundamental concepts and appropriate governing equations. Topics covered include principles of fluid mechanics; flow in pipes, pipe networks and open channels; hydraulic machinery; and seepage and groundwater flow. Each chapter provides a series of worked examples consisting primarily of an introduction in which the general topic or specific problem to be considered is presented. A program capable of solving the problem is then given, together with examples of the output, sometimes for several different sets of conditions. Finally, in a section headed Program Notes the way the program is constructed and operates is explained, and the engineering lessons to be learned from the program output are indicated. Each chapter also concludes with a set of problems for the student to attempt. This book is mainly intended for the first- and second-year undergraduate student of civil engineering who will be concerned with the application of fundamental fluid mechanics theory to civil engineering problems.

Groundwater Hydraulics

A Selective Annotated Bibliography

Basic Hydraulics

NBS Special Publication

Analytical Solutions and Computer Programs for Hydraulic Interaction of Stream-aquifer Systems

Finite Element Techniques in Groundwater Flow Studies

DIVLogical, analytical approach to solution of groundwater and seepage problems. Coverage of Russian work, advanced engineering mathematics, numerous worked-out examples, over 200 problems. /div

The finite element method (FEM) is one of those modern numerical methods whose rise and development was incited by the rapid development of computers. This method has found applications in all the technical disciplines as well as in the natural sciences. One of the most effective applications of the finite element method is its use for the solution of groundwater flow problems encountered in the design and maintenance of hydraulic structures and tailing dams, in soil mechanics, hydrology, hydrogeology and engineering geology. The stimuli to write this book came from the results obtained in the solution of practical problems connected both with the construction and maintenance of fill-type dams and tailing dams and the utilization of groundwater in Czechoslovakia, and on the other hand from the experience gained in teaching hydraulic structures theory at the Faculty of Civil Engineering of the Technical University of Prague. All the experience so far obtained shows markedly the advantages of the finite element method and the great possibilities of its further development as well as its considerable demands on the algorithmization, programming and use of computer possibilities. The reader will find an explanation of the fundamentals of the finite element method directed mainly toward isoparametric elements having an exceptional adaptability and numerical reliability. The finite element method application to groundwater flow concerns mainly two-dimensional problems, which occur most frequently in practice. Considerable attention is given to non-linear and non-stationary problems, which are most important in application. A computer program (based on the eight-noded isoparametric elements) is included and fully documented. The book will be useful to civil engineers, hydrogeologists and engineering geologists who need the finite element method as a solution tool for the complex problems encountered in engineering practice. The dramatic advances in the efficiency of digital computers during the past decade have provided hydrologists with a powerful tool for numerical modeling of groundwater systems. Introduction to Groundwater Modeling presents a broad, comprehensive overview of the fundamental concepts and applications of computerized groundwater modeling. The book covers both finite difference and finite element methods and includes practical sample programs that demonstrate theoretical points described in the text. Each chapter is followed by problems, notes, and references to additional information. This volume will be indispensable to students in introductory groundwater modeling courses as well as to groundwater professionals wishing to gain a complete introduction to this vital subject. Key Features * Systematic exposition of the basic ideas and results of Hilbert space theory and functional analysis * Great variety of applications that are not available in comparable books * Different approach to the Lebesgue integral, which makes the theory easier, more intuitive, and more accessible to undergraduate students

MODFLOW Ground-water Model

Numerical Modeling of Variably-saturated Groundwater Flow Problems with Seepage-face Boundaries

Scientific Investigations Report

Proceedings of the 5th International Conference, Burlington, Vermont, U.S.A., June 1984

Selected Water Resources Abstracts

Groundwater Hydrology

The groundwater science and engineering has been closely connected with various fields (1) Groundwater Hydrology, (2) Groundwater Hydraulics or Geohydraulics, (3) Fluid Dynamics in Porous Media, (4) Groundwater Quality Engineering, (5) Soil Physics, and (6) Hydrogeology or Geohydrology. The purpose of the book is to present an update textbook of groundwater hydraulics, which includes all of basic items in above-mentioned fields, to students (of graduate school), researchers and practitioners. The students and beginners who intend to specialize in groundwater hydraulics through one semester will master contents of the book.

The oceans cover 70% of the Earth's surface, and are critical components of Earth's climate system. This new edition of Encyclopedia of Ocean Sciences summarizes the breadth of knowledge about them, providing revised, up to date entries as well coverage of new topics in the field. New and expanded sections include microbial ecology, high latitude systems and the cryosphere, climate and climate change, hydrothermal and cold seep systems. The structure of the work provides a modern presentation of the field, reflecting the input and different perspective of chemical, physical and biological oceanography, the specialized area of expertise of each of the three Editors-in-Chief. In this framework maximum attention has been devoted to making this an organic and unified reference. Represents a one-stop. organic information resource on the breadth of ocean science research Reflects the input and different perspective of chemical, physical and biological oceanography, the specialized area of expertise of each of the three Editors-in-Chief New and expanded sections include microbial ecology, high latitude systems and climate change Provides scientifically reliable information at a foundational level, making this work a resource for students as well as active researches

A new computer program was developed to simulate vertical compaction in models of regional ground-water flow. The program simulates ground-water storage changes and compaction in discontinuous interbeds or in extensive confining units, accounting for stress-dependent changes in storage properties. The new program is a package for MODFLOW, the U.S. Geological Survey modular finite-difference ground-water flow model. Several features of the program make it useful for application in shallow, unconfined flow systems. Geostatic stress can be treated as a function of water-table elevation, and compaction is a function of computed changes in effective stress at the bottom of a model layer. Thickness of compressible sediments in an unconfined model layer can vary in proportion to saturated thickness.

A User-oriented Manual

Subsurface Water Pollution

Encyclopedia of Ocean Sciences

Numerical Analysis by Analog and Digital Methods

Conceptual and Computational Models

Numerical Models of Groundwater Flow and Solute Transport in Three-dimensional Heterogeneous Aquifers

We investigated the performance of a groundwater flow and solute transport model when different combinations of hydraulic head, seepage flux, and chloride concentration data were used in calibration of the model. Using additional calibration data, beyond traditionally-used head data, improved performance of the model during a test period separate from the calibration period. This confirms the merit of collecting seepage flux and concentration data, and using them together with head data in parameter estimation for a numerical groundwater model. Our work also contributed to improvement of the Army Groundwater Modeling System (GMS), by identifying numerous software problems and working with GMS developers to correct them.

The model. Scope of the book. Data required to develop a groundwater model. Physical framework. Topography. Geology. Hydrological stress. Groundwater balance. Description of the model. Program details. Sample run. Calibration and production runs.

This book is the edited proceedings of the Fifth International Conference on Finite Elements in Water Resources, held at the University of Vermont, USA in June 1984. This Conference cont inues the successful series started at Princeton University in 1976, followed by the Conference in Imperial College, London, UK in 1978, the third Conference at the University of Mississippi, USA in 1980 and the fourth at the University of Hannover, Germany in 1982. The objective of this Conference is to provide engineers and scientists interested in water resources with the state-of-t- art on finite element modelling. The Proceedings review the basic theory and applications of the technique in groundwater and seepage, transport phenomena, viscous flow, river, lake and ocean modelling. The fundamentals of the numerical techniques employed in finite elements are also discussed. Many applications illus trate the versatility and generality of the Finite Element Method for the simulation of a wide range of problems in water resources. More recent schemes, in particular, boundary elements, are also presented, together with a series of advanced numerical techniques. The Conference has become an internationally accepted forum for the presentation of new developments of finite elements in water resources techniques. Because of this, a large number of abstracts were submitted to the Organizing Committee and it is our only reg ret that it was impossible to accept all these contributions. The overwhelming response to our Call for Papers has ensured the high quality of these proceedings.

Using Flux Information at Surface Water Boundaries to Improve a Groundwater Flow and Transport Model

Technical and Geoinformational Systems in Mining

Groundwater and Seepage

Tunnels and Metropolises

Seepage and Groundwater Flow

Seepage in Soils