

Eurocodes in Hard Rock Engineering in Finland

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1. Introduction

The Eurocodes are a set of European design principles, rules, and guidance intended for the design of load carrying structures. The codes have been compiled by the CEN Technical Committee 250 (CEN/TC250). The intent of the Eurocodes is to unify the design methodology. Parallel use with existing national building codes is allowed during the transition period (2007–2010) to ensure a smooth transition and enough time to make the necessary changes.

In Finland (and Sweden and Norway), there is no formal procedure on how to design rock spaces. The design is based on a designer's expertise, experience, views, and specific procedures. The problem here is that identical initial data could generate very different results depending on the way the initial data is interpreted and which design methods are used. The Eurocodes do not explicitly state how to design rock spaces, but they define the minimum requirements on how to design structures.

The Eurocodes are divided into 10 areas. Of these ten, only a part will affect how to design rock spaces. Eurocode 0 defines the main principles concerning the whole design process. Eurocode 1 defines the loads. Eurocode 2 defines the design of concrete structures (e.g. design of reinforced concrete structures, shotcrete, and grouted rebars). Eurocode 3 defines the design of steel structures (e.g. design of non-grouted bolts, steel columns, and pillars). Eurocode 7 defines the design of geotechnical structures. Eurocode 8 would define the design against earthquakes, but it is not required in Finland, unless otherwise stated.

2. Eurocodes change the design of rock spaces

Many projects already require the use of the Eurocodes. Design working life is a concept which defines an assumed period for which a structure or a part of it is to be used for its intended purpose with anticipated maintenance but without major repair being necessary. For many rock engineering projects a normal specification is 100 years while previously the design assumption has been 50 years. For practical purposes, design working life can be interpreted to mean that 95 percent of the structure must last longer than the specified time with the specified maintenance.

In the highest geotechnical class GC3 (corresponding to the highest Finnish difficulty class AA) it is no longer possible to use empirically based design only. Eurocode 7 states that prescriptive measures may be used if calculation models are not available or not necessary. Empirical methods (such as the Q-method or the RMR-method) may still be used to give a rough estimate to assess the validity of design. However, the Eurocode does allow the use of the Observational Method when prediction is difficult or impossible, but monitoring and redesign are possible. Because prediction is often difficult and monitoring is often recommended, this should be viewed more as a part of a standard design process (Ström 2009) than a stand-alone method.

The Finnish regulation for the design requirements of civil defence shelters within rock states that rock engineering calculations should be made if the span is wide or the rock conditions are difficult. This implies that empirical design methods should not be used in geotechnical class GC3. The

Rock Engineering In Finland

John A. Hudson, Xia-Ting Feng



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Rock Engineering in Finland ,1986 **Rock Mechanics and Rock Engineering** ,1985 **Rock Mechanics and Rock Engineering: From the Past to the Future** Reşat Ulusay,2016-11-18 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 rg p 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 **Rock Engineering Risk** John A. Hudson,Xia-Ting Feng,2015-05-05 This book provides a new necessary and valuable approach to the consideration of risk in underground engineering projects constructed within rock masses There are Chapters on uncertainty and risk rock engineering systems rock fractures and rock stress the design of a repository for radioactive waste plus two major case examples relating to th **Structural Geology And Rock Engineering** John W Cosgrove,John A Hudson,2016-08-08 The exploration and extraction of the earth s resources are key issues in global industrial development In the 21st century emphasis has increasingly being placed on geo engineering safety engineering accountability and sustainability With focus on rock engineering projects Structural Geology and Rock Engineering uses case studies and an integrated engineering approach to provide an understanding of projects constructed on or in rock masses Based on Professors Cosgrove and Hudson s university teaching at Imperial College London as well as relevant short course presentations it explains the processes required for engineering modelling design and construction The first half of the book provides step by step presentations of the principles of structural geology and rock mechanics with special emphasis on the integration between the two subjects The second half of the book turns principles into practice A wealth of practical engineering examples are presented including evaluations of bridge foundations quarries dams opencast coal mining underground rock engineering historical monuments and stone buildings This up to date well illustrated guide is ideal for

teachers researchers and engineers interested in the study and practice of rock based projects in engineering

Rock Mechanics and Engineering Volume 2 Xia-Ting Feng, 2017-07-12 Laboratory and Field Testing is the second volume of the five volume set Rock Mechanics and Engineering and contains nineteen chapters from key experts in the following fields Triaxial or True triaxial Tests under Condition of Loading and Unloading Joint Tests Dynamic and Creep Tests Physical Modeling Tests Field Testing and URLs 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

Rock Engineering in Difficult Ground Conditions - Soft Rocks and Karst Ivan Vrkljan, 2009-10-14 Containing 129 papers in geological and hydrogeological properties of karst regions rock properties testing methods and site characterization design methods and analyses monitoring and back analysis excavation and support environmental aspects of geotechnical engineering in karst regions and case histories this volume is of interest to professionals engineers and academics involved in rock mechanics and rock engineering

Rock Engineering and Rock Mechanics: Structures in and on Rock Masses R. Alejano, Aurea Perucho, Claudio Olalla, Rafael Jiménez, 2014-05-12 Rock Engineering and Rock Mechanics Structures in and on Rock Masses covers the most important topics and state of the art in the area of rock mechanics with an emphasis on structures in and on rock masses The 255 contributions including 6 keynote lectures from the 2014 ISRM European Rock Mechanics Symposium EUROCK 2014 Vigo Spain 27-29 May

Geological Survey of Finland, Special Paper, 1987

Underground Space Raymond L. Sterling, John Carmody, Yingxin Zhou, Monique Labbé, Xiaozhao Li, Jianqiang Cui, 2025-10-07 Unlocking the Hidden Potential of Cities from the Ground Down With cities worldwide facing pressures from rapid urbanization climate change and land scarcity underground space has become a vital resource for sustainable and resilient urban development Underground Space Use

Planning and Design provides a comprehensive framework for planners engineers architects and policymakers to understand and apply underground solutions and updates a landmark reference work on the topic Combining many decades of research practice and global examples this book offers authoritative guidance on how underground space can contribute to the creation of livable future ready cities Written by a team of experts from around the globe Underground Space offers An understanding of the many reasons why underground space is used and when to choose to build underground Broad coverage of underground uses from transport and urban utilities to underground architectural applications Recent advances made in three dimensional urban underground planning Updated design approaches and human centered considerations for the exterior and interior design layout lighting and safety of underground spaces In depth exploration of sustainability resilience and adaptability issues Insights from several decades of hands on experience with modern underground designs Underground Space Use Planning and Design is an essential up to date reference on the subject for architects planners and engineers in public agencies private sectors and research institutions It is also valuable for use in courses on architectural design urban planning underground infrastructure and infrastructure provision

Underground. The Way to the Future Georg Anagnostou, Heinz Ehrbar, 2013-05-20 Underground the way to the future was the motto of the World Tunnel Congress 2013 in Geneva Switzerland The use of underground space has gained importance during the last years due to the tremendous global urbanization the high demand on transportation capacities and energy production All this result in a wider range of use of underground space besides the traditional road railway metro and utility tunnels more and more other functionalities of modern life are placed under ground in order to free the surface for other uses The 300 papers of the present book cover important aspects of modern underground infrastructures Development and use of underground space project planning and implementation construction management risk control cost estimation and scheduling contracting practices design and analysis methods and considerations construction technology developments tunnel operation safety maintenance rehabilitation and repair case histories learning from failures long deep tunnels underground construction for hydropower Underground the way to the future will be invaluable to specialists contractors and design engineers in underground planning construction and tunnelling worldwide and to academics interested in underground and geotechnical engineering

Prediction And Performance In Rock Mechanics and Rock Engineering Giovanni Barla, 2022-05-04 A collection of conference proceedings on rock mechanics and rock engineering covering such topics as foundations of dams bridges and large structures mining structures formulation of geotechnical models rock mass characterization and recent advances in modelling

Underground Excavations in Rock Evert Hoek, 1980-06-30 Underground Excavations in Rock deals with the geotechnical aspects of the design of underground openings for mining and civil engineering processes

Minerals Yearbook , 1992 **Encyclopedia of Mineral and Energy Policy** Günter Tiess, Tapan Majumder, Peter Cameron, 2023-07-14 This Encyclopedia provides a cutting edge up to date reference source on mineral and energy policies

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Geomechanics and Geodynamics of Rock Masses Vladimir Litvinenko, 2018-05-15 Geomechanics and Geodynamics of Rock Masses contains contributions presented at EUROCK 2018 the 2018 International Symposium of the International Society for Rock Mechanics ISRM 2018 Saint Petersburg Russia 22-26 May 2018 Dedicated to recent advances and achievements in the fields of geomechanics and geotechnology the main topics of the book include Physical and mechanical properties of fractured rock laboratory testing and rock properties field measurements and site investigations Geophysics in rock mechanics Rock mass strength and failure Nonlinear problems in rock mechanics Effect of joint water on the behavior of rock foundation Numerical modeling and back analysis Mineral resources development methods and rock mechanics problems Rock mechanics and underground construction in mining hydropower industry and civil engineering Rock mechanics in petroleum engineering Geodynamics and monitoring of rock mass behavior Risks and hazards Geomechanics of technogenic deposits Geomechanics and Geodynamics of Rock Masses will be of interest to researchers and professionals involved in the various branches of rock mechanics and rock engineering EUROCK 2018 organized by the Saint Petersburg Mining University is a continuation of the successful series of ISRM symposia in Europe which began in 1992 in Chester UK

The Second Half Century of Rock Mechanics, Three Volume Set Luis Ribeiro e Sousa, Claudio Olalla, N. Grossmann, 2007-08-05 Forty one years ago the International Society for Rock Mechanics ISRM held its 1st International Congress in Lisbon Portugal In July 2007 the 11th ISRM Congress returned to Lisbon where the Portuguese Geotechnical Society SPG the Portuguese National Group of the ISRM hosted the meeting The Second Half Century of Rock Mechanics comprises

Ground Characterization and Structural Analyses for Tunnel Design Benjamín Celada, Z.T. Bieniawski, 2019-08-06 This practical and design oriented book focuses on ground characterization and structural calculation as part of the active structural design methodology With a focus on rock tunnelling it offers a comprehensive rather than a topic based perspective deriving sound tunnel design criteria and methods from basic principles Ground characterization includes excavations site investigation and in situ stress determination culminating in geotechnical classifications The book

then deals with various construction methods and their appropriate calculations which range from constitutive models for the stress strain behaviour of an excavation and tunnel support elements to a full stress strain analysis methodology The heavily practical approach of the book draws on the authors twenty years of tunnelling experience in Spain and South America It will help any young or established professional who wants to develop a career in the underground field across both civil engineering and geology As it incorporates the very fundamentals of tunneling design it can be used as a support for tunneling courses or as a textbook for master s and PhD courses Benjam n Celada was Chief Tunnel Engineer at Hunosa and Potasas de Navarra S A before founding Geocontrol S A He has also worked for twenty years as Professor of Underground Works at the Polytechnic Mining University in Madrid Spain Z T Bieniawski directed the Rock Mechanics Department of the Council for Scientific and Industrial Research in Pretoria then taught at the Pennsylvania State University for twenty years

In-situ Rock Stress Michael Tucker, Juergen Liebermann, 2015-10-12 With the new classification of chronic myeloproliferative disorders and the rise of interest in molecularly targeted therapies this timely text brings together international experts on the topic to discuss the current technologies and their implications for the treatment of patients This title comprehensively covers chronic myeloid leukemia and Ph negative chronic myeloproliferative disorders and is an essential resource for all practitioners in Hematologic Oncology [Rock Characterisation, Modelling and Engineering Design Methods](#) Xia-Ting Feng, John A. Hudson, Fei Tan, 2013-05-17 Rock Characterisation Modelling and Engineering Design Methods contains the contributions presented at the 3rd ISRM SINOROCK Symposium Shanghai China 18-20 June 2013 The papers contribute to the further development of the overall rock engineering design process through the sequential linkage of the three themes of rock characterisation model

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Table of Contents Rock Engineering In Finland

1. Understanding the eBook Rock Engineering In Finland
 - The Rise of Digital Reading Rock Engineering In Finland
 - Advantages of eBooks Over Traditional Books
2. Identifying Rock Engineering In Finland
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Rock Engineering In Finland
 - User-Friendly Interface
4. Exploring eBook Recommendations from Rock Engineering In Finland
 - Personalized Recommendations
 - Rock Engineering In Finland User Reviews and Ratings
 - Rock Engineering In Finland and Bestseller Lists

5. Accessing Rock Engineering In Finland Free and Paid eBooks
 - Rock Engineering In Finland Public Domain eBooks
 - Rock Engineering In Finland eBook Subscription Services
 - Rock Engineering In Finland Budget-Friendly Options
6. Navigating Rock Engineering In Finland eBook Formats
 - ePub, PDF, MOBI, and More
 - Rock Engineering In Finland Compatibility with Devices
 - Rock Engineering In Finland Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Rock Engineering In Finland
 - Highlighting and Note-Taking Rock Engineering In Finland
 - Interactive Elements Rock Engineering In Finland
8. Staying Engaged with Rock Engineering In Finland
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Rock Engineering In Finland
9. Balancing eBooks and Physical Books Rock Engineering In Finland
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Rock Engineering In Finland
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Rock Engineering In Finland
 - Setting Reading Goals Rock Engineering In Finland
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Rock Engineering In Finland
 - Fact-Checking eBook Content of Rock Engineering In Finland
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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