

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 W Cosgrove, John A Hudson



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Rock Engineering in Finland, 1986 Rock Engineering and Rock Mechanics: Structures in and on Rock Masses R. Alejano, Áurea Peruchó, 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 *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 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 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 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

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

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

Geotechnical Engineering for Transportation Infrastructure F. B. J. Barends,1999

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 spa *Finnish rock engineering* M. Smith,1991 *Geological Survey of Finland, Special Paper* ,1987

Minerals Yearbook ,1992 **Modelling Rock Fracturing Processes** Baotang Shen,Ove Stephansson,Mikael Rinne,2020-05-06 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 *Finnish Trade Review* ,1927 Mine Planning and Equipment Selection 1997 R. Farana,V. Kebo,L. Smutny,V. Strakos,2020-12-18 Presenting current and emerging technologies in the field of mine planning and equipment this volume also covers control and automation for surface and underground mining A wide range of papers from professionals in Europe South America Africa and Australia are featured Finland, Sources of Information: 1978-1986 Kyllikki Ruokonen,1988 **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 1820 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 **The Mining Engineer** Institution of Mining Engineers (Great Britain),1898 Ground Support in Mining and Underground Construction Ernesto Villaescusa,Yves Potvin,2004-09-15 The purpose of ground support is to safely maintain excavations for their expected lifespan The effectiveness of ground support can be seen both in terms of personnel and equipment safety and in terms of allowing the most economic extraction Scientists practitioners and technology developers have contributed to this volume which covers rock mass characterisation open pit mining and tunnelling The methods described include modelling and dynamic testing while international case studies provide ample illustration of both failures and triumphs in ground support

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