

PROGRAMME

Rock Mechanics and Rock Engineering: Structures on and in rock masses
European Rock Mechanics Symposium

EUROCK2014

VIGO (SPAIN) 27-29 MAY

www.eurock2014.com

Organizing Institutions:



Sociedad Española de Mecánica de Rocas
(Spanish National Group for Rock Mechanics)
<http://www.semr.es/>



University of Vigo- School of Mines
<http://webs.uvigo.es/etseminas/>



International Society for Rocks Mechanics
www.isrm.net

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EUROCK2014

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WELCOME TO
EUROCK 2014

Dear EUROCK friends,

On the behalf of the Organizing Committee we are pleased to welcome you to **EUROCK 2014**, the 2014 ISRM European Rock Mechanics Symposium '**ROCK ENGINEERING AND ROCK MECHANICS: STRUCTURES ON AND IN ROCK MASSES**', organized by the School of Mines of the University of Vigo and the Spanish Society for Rock Mechanics in the town of Vigo, Spain.

The Symposium is held on 27-29 May 2014 in the Centro Social Novacaixagalicia. Two short courses and a Workshop are held before the Symposium dates and some technical visits are programmed for the following day.

EUROCK 2014 is the latest symposium in the series of annual European rock mechanics symposia that started in 1992 with the symposium "Rock Characterization" held in Chester UK. It was preceded last year by EUROCK 2013, which was held in Wrocław, Poland, and will be followed next year by EUROCK 2015, which will be held in Salzburg, Austria. These Symposia periodically bring together researchers and practitioners for the exchange, assessment, discussion and dissemination of theory and practice in the field of rock mechanics and rock engineering. With a firm worldwide vocation, EUROCK has earned a solid reputation of being an international forum of technical discussion and scientific advance that has helped to shape the broad body of knowledge of rock engineering over the years.

6 keynotes and 249 papers from around 40 countries were accepted for publication, out of which around 160 are programmed for oral presentation and the rest will be shown as posters. Presentations and discussion will consolidate knowledge and bring out new ideas for rock engineering improvement and future research. Along with the conference a parallel exhibition provides an excellent opportunity to see the latest technologies of our field.

We would like to thank authors and delegates for taking their time to write and to share their knowledge through participation in EUROCK. Our recognition also to all those that have helped in the countless tasks that organizing a conference encompasses and, particularly, to the members of the Scientific and Review Committees. Thanks are also due to sponsoring companies and institutions, and exhibitors for believing in **EUROCK 2014** and helping with their support and presence to make this conference a success.

Vigo is Galicia's largest town. It is a location that is attracting an increasing number of tourists with its mix of history, outstanding gastronomy, beautiful beaches and a modern cosmopolitan outlook. It also offers wonderful opportunities for sightseeing and cultural tourism in the surrounding area. I am sure you will enjoy its appeal.

We wish the rock mechanics community gathered in Vigo a fruitful and joyful conference and look forward to several days of interesting discussions and pleasant events.

Leandro R. Alejano

Chairman of the organizing committee
Department of Natural Resources and
Environmental Engineering
University of Vigo
Vigo, Galicia, Spain

Aurea Perucho

President of the Spanish Group
of the ISRM
CEDEX
Madrid, Spain



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the key to our success



Who we are

Repsol is an integrated and global energy company with long experience in the sector, carrying out operations throughout the business chain including exploration, production, refining, transport, chemicals, petrol stations and new types of energy. The Repsol team is made up of more than 24.000 individuals of more than 80 nationalities; the company is present in 32 countries.

In exploration and production we have a great team of professionals made up of by more than 3.000 individuals - geoscientists, field engineers, petrophysicists, production engineers, economists and drilling engineers, who coordinate to successfully complete exploratory work as well as the management of our oil and gas fields.

Upstream in figures

- We have achieved **successes of worldwide relevance**, with more than 30 oil discoveries between 2008 and 2013. Some of them, like those in Brazil, Venezuela and Peru, were among the largest in the world in the year of their discovery.
- The average production in 2013 [346 kBOE/d] was +4% vs. 2012 [332 kBOE/d]. In total, we achieved more than 126 million BOE of annual production. Our 2012-2016 Strategic Plan emphasizes production growth, with an **average projected annual increase of 7%**.
- In 2013, with 275%, we achieved a record in replacement of proven reserves, better even than the excellent ratios achieved in 2012 [204%], 2011 [162%] and 2010 [131%]. **The incorporation of new resources** has significantly strengthened our future growth prospects.



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PLANNING **EUROCK**2014

Sunday 25th May		Monday 26th May		Tuesday 27th May	
SESSION	ROOM	SESSION	ROOM	SESSION	ROOM
8:30 - 9:00 Courses registration	REGISTRATION DESK 2nd Floor	8:30 - 9:00 Courses registration	REGISTRATION DESK 2nd Floor	8:30 - 9:30 Eurock 2014 - Registration	REGISTRATION DESK 2nd Floor
9:00 - 13:00 "Two day course: Numerical Modelling in Rock Engineering	ROOM 2 2nd Floor	9:00 - 13:00 "Two day course: Numerical Modelling in Rock Engineering"	ROOM 2 2nd Floor	9:30 - 10:20 Opening ceremony	AUDITORIUM 2nd Floor
		9:30 - 14:00 "One day course: Rock mechanics solutions for ornamental rock protection & archaeological site conservation	ROOM 4 2nd Floor	10:20 - 11:10 Plenary Session I	AUDITORIUM 2nd Floor
		10:00 - 13:45 "Workshop. Applicability and application of EUROCODE-7 to rock engineering design	CONFERENCE HALL 3rd Floor	11:10 - 11:40 Coffe break	EXHIBITION ÁREA Floor E - Main Floor
		11:40 - 13:40 Parallel sessions S1-S3		Session 1: Topic 1	AUDITORIUM
Lunch break	2nd Floor	Lunch break	EXHIBITION AREA Floor E - Main Floor	13:40 - 15:00 Lunch break	EXHIBITION AREA Floor E - Main Floor
14:30 - 18:00 "Two day course: Numerical Modelling in Rock Engineering	ROOM 2 2nd Floor	14:30 - 18:00 "Two day course: Numerical Modelling in Rock Engineering"	ROOM2 2nd Floor	15:00-16:45 Parallel sessions S4-S6	
		14:30 - 18:00 "Workshop. Applicability and application of EUROCODE-7 to rock engineering design	CONFERENCE HALL 3rd Floor	Session 4: Topic 1	AUDITORIUM
		15:30 - 18:30 "One day course: Rock mechanics solutions for ornamental rock protection & archaeological site conservation"	ROOM 4 2nd Floor	Session 5: Topic 5	CONFERENCE HALL
		16:45-17:10 Poster session - Topics 1, 5 & 6	POSTER EXHIBITION 2nd Floor	Session 6: Topic 6	ROOM A
		17:10-17:30 Coffe break	EXHIBITION AREA Floor E - Main Floor	17:30-18:30 Parallel sessions S7-S9	
				Session 7: Topic 1	AUDITORIUM
				Session 8: Topic 2	CONFERENCE HALL
				Session 9: Topic 4	ROOM A
				20:15 Welcome reception	

Wednesday 28th May		Thursday 29th May		Friday 30th May	
SESSION	ROOM	SESSION	ROOM		
9:00 - 9:50 Plenary Session II	AUDITORIUM 2nd Floor	9:00 - 9:50 Plenary Session IV	AUDITORIUM 2nd Floor	Technical visits	
9:50-10:40 Plenary Session III	AUDITORIUM 2nd Floor	9:50 - 10:40 Plenary Session V	AUDITORIUM 2nd Floor		
10:40-11:10 Coffe break	EXHIBITION AREA Floor E - Main Floor	10:40-11:10 Coffe break	EXHIBITION ÁREA Floor E - Main Floor		
11:10-13:10 Parallel sessions S10-S12		11:10-13:10 Parallel sessions S22-S24			
Session 10: Topic 1	AUDITORIUM	Session 22: Topic 7	AUDITORIUM		
Session 11: Topic 9	CONFERENCE HALL	Session 23: Topic 4	CONFERENCE HALL		
Session 12: Topic 3	ROOM A	Session 24: Topic 8	ROOM A		
13:10-13:40 Poster session Topics 2, 4 & 9	POSTER EXHIBITION 2nd Floor	13:10-13:45 Poster session Topics 3, 7 & 8	POSTER EXHIBITION 2nd Floor		
13:40-15:00 Lunch break	EXHIBITION AREA Main Floor	13:45-15:15 Lunch break	EXHIBITION AREA Floor E - Main Floor		
15:00-16:00 Parallel sessions S13-S15		15:30-16:20 Plenary Session VI	AUDITORIUM 2nd Floor		
Session 13: Topic 8	AUDITORIUM				
Session 14: Topic 9	CONFERENCE HALL				
Session 15: Topic 3	ROOM A				
16:00-17:00 Parallel sessions S16-S18		16:20 - 16:45 Gas Natural-Unión Fenosa	AUDITORIUM 2nd Floor		
Session 16: Topic 8	AUDITORIUM				
Session 17: Topic 9	CONFERENCE HALL				
Session 18: Topic 2	ROOM A				
17:00-17:30 Coffe break		16:45 - 17:45 Closing Ceremony	AUDITORIUM 2nd Floor		
17:30-18:30 Parallel sessions S19-S21					
Session 19: Topic 7	AUDITORIUM				
Session 20: Topic 4	CONFERENCE HALL				
Session 21: Topic 2	ROOM A				
21:00 Banquet					



Vivimos nunha cidade fermosa



We live in a beautiful city

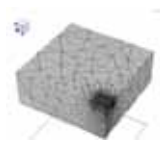
COURSES **AND** WORKSHOPS

NUMERICAL MODELLING IN ROCK ENGINEERING

2nd Floor - Room 2

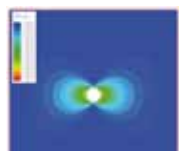
The course schedule will be from 9:00 am till 1:00 pm with mid-morning coffee break, then lunch and will continue at 2:30 pm till 6:00pm with an afternoon coffee break.

The objective of this course is to provide a background on the numerical modelling for rock engineering problems using two and three-dimensional finite element tools. The participants will be provided with Phase2 and RS3, state of the art 2- and 3-dimensional geotechnical software which are being used around the world.



Module I: Introduction to Finite Element Method for geotechnical problems

- Model development (construction of geometry, meshing, loads and boundary conditions, analysis options)
- Material models and constitutive relations
- Interpretation of results



Module II: Analysis of underground excavations using a two-dimensional approach (Phase2)

- Stress analysis
- Support types (bolts, liner, structural elements)
- Model development
- Interpretation of results



Module III: Support design for tunnels using three-dimensional FE tools (RS3)

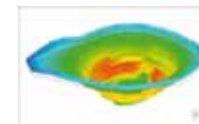
- Model development in 3D
- Sequence design
- 3D support elements (forepoles, liners, bolts, structural elements)
- Interpretation of results

Module IV: Continuum numerical modelling for jointed rock mass problems (Phase2)



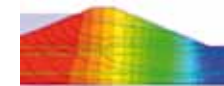
- Application of FEM to jointed rock mass
- Implicit vs. Explicit joint modelling
- Modelling of Discrete Fracture Networks (DFN)

Module V: Rock slope stability analysis using shear strength reduction method (Phase2 & RS3)



- Application of FEM to slope stability analysis
- Shear Strength Reduction approach
- Deep seated slope failure
- Blocky rock mass slopes

Module VI: Groundwater analysis (Phase2 & RS3)



- Saturated-Unsaturated transient groundwater analysis
- Permeability functions
- Boundary conditions
- Seepage analysis of staged excavations

Module VII: Probabilistic analysis for surface and underground excavations (Phase2)



- Principles of statistical analysis
- Probabilistic inputs and outputs
- Reliability
- Interpretation of statistical results

ROCK MECHANICS SOLUTIONS FOR ORNAMENTAL ROCK PROTECTION & ARCHAEOLOGICAL SITE CONSERVATION

2nd Floor - Room 4

Director & Chairman:
José Delgado Rodrigues,
Geologist, Principal Research Officer, LNEC-Portugal

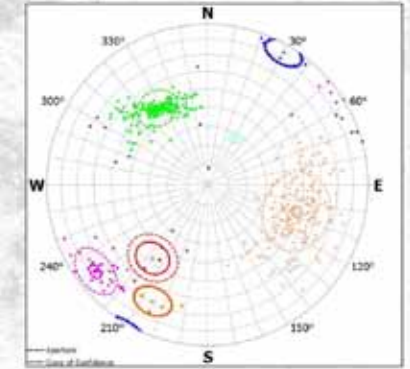
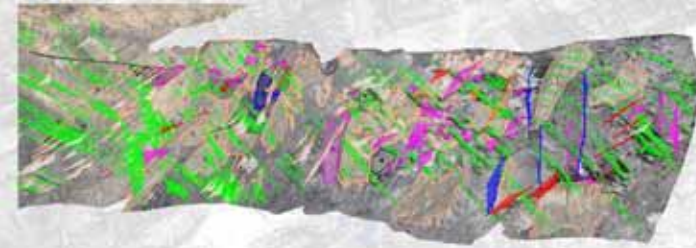
This course aims to provide a dialogue between rock mechanics and conservation of architectural and archaeological sites with the objective of identifying, in the field of geotechnical engineering, analysis and application technologies or novel theoretical premises able to characterize, diagnose and treat the conservation problems of the rocks used in architectural and archaeological heritage.

PROGRAM SCHEDULE

09.30	Presentation
10.00	Geological information for monuments preservation: from macro to micro scales <i>J. Delgado, LNEC-Portugal</i>
11.00	Physical and mechanical characterization: limitations on the study of rocks used in cultural heritage <i>T. Rivas, ETSI Minas, University of Vigo. Spain</i>
12.00	Coffee break
12.30	Evaluation of treatments for conservation and restoration of ornamental rocks. <i>M.J. Mosquera, Department of Chemistry-Physics, University of Cádiz, Spain.</i>

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13.30	Roundtable
14.00	Lunch
15.30	Modelling of masonry structures <i>J. Lemos, researcher of LNEC-Portugal</i>
16.30	Coffee break
17.00	Rock mechanics methodologies for the mechanical characterization of masonry structures <i>J. Muralha, researcher of LNEC-Portugal</i>
18.00	Presentation of issues by the participants and discussion roundtable

APPLICABILITY AND APPLICATION OF EUROCODE-7 TO ROCK ENGINEERING DESIGN

3rd Floor - Conference Hall

PROGRAM SCHEDULE

10:00 Introduction

Andrew Bond

Eurocode 7 and rock engineering: current problems and future opportunities

J. P. Harrison

10:25 EC7 review, rock mass characterisation

Some key issues regarding application of Eurocode 7 to rock engineering design

L. Lamas, A. Perucho & L.R. Alejano

Critical review of Eurocode 7 regarding rock mass characterization

L. R. Alejano, A. M. Ferrero & A. Sofianos

The approach to rock mechanics in Spanish normative documents

A. Perucho & J. Estaire

Critical review of EC7 concerning prescriptive measures for rock mechanics design

R. Olsson & A. Palmström

11:25 Discussion / refreshment break

12:05 Characteristic values, partial factors

EC7 and the application of analytical and empirical models to rock engineering

J. P. Harrison, H. Stille & R. Olsson

On the applicability of the Eurocode 7 partial factor method for rock mechanics

A. Bedi & T.L.L. Orr

Assessment of characteristic failure envelopes for intact rock using results from triaxial tests

J. Muralha & L. Lamas

Characteristic strength of anisotropic rock

N. Bozorgzadeh & J. P. Harrison

13:05 Discussion

13:45 Lunch

14:30 Design by empirical, prescriptive and calculation methods

Ultimate and Serviceability State Design Using the Same Partial Safety Factor of Contact Pressure for Strip Foundation Loaded by Column Loads

K.C. Avellan

Design of Rock Dowels Using Numerical Analysis and Eurocode 7

A. Koe & B. Ogunmakin

Reliability against translational slip of rock slopes designed according to Eurocode 7

P. P. Nomikos & A. I. Sofianos

Spread foundations and slope stability calculations on rocks according to Eurocode EC-7

J. Estaire & G. Olivenza

15:30 Discussion / refreshment break

16:10 Observational Methods

How to refine the Observational Method as described in EC7 in applied rock mechanics

H. Stille & D. Virely

Critical review of Eurocode 7 regarding monitoring rock masses by field instrumentation: devices and data analysis

M. R. Migliazza, A. M. Ferrero, A. Segalini & G. Umili

Application of the Observational Method in the Äspö Expansion Project

R. Christiansson, I. Olofsson, D. Martin, M. Holmberg, & Anders Carlsson

Towards an improved observational method

J. Spross, F. Johansson, H. Stille & S. Larsson

17:10 Discussion

17:50 Summary /Clousure

J.P. Harrison

PRODUCTS:

- Rockfall protection barriers (8.000kJ)
- Anti-erosion solutions
- Slope stabilization systems
- Slope reinforcement systems
- Avalanche control devices

SERVICES:

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- Technical assistance
- Assistance to consultant and designers
- Installation works support and control
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SCIENTIFIC PROGRAM

TUESDAY, 27TH MAY**08:30-09:30 REGISTRATION****09:30-10:20 OPENING CEREMONY**

Room: Auditorium – 2nd Floor

Chairman: *Leandro R. Alejano*

Opening address by *Leandro R. Alejano* Chair of the Organizing Committee

Opening address by *Xia-Ting Feng*, President of the International Society of Rock Mechanics (ISRM)

ISRM Presentation by *Dr. Luís Lamas*, Secretary General of ISRM

Opening address by *Abel Caballero*, Mayor of Vigo

Opening Address by *Salustiano Mato*, Chancellor of the University of Vigo

Opening Address by *Frédéric Pellet*, President for Europe of the ISRM

10:20-11:10 PLENARY SESSION I

Room: Auditorium – 2nd Floor

Chairman: *Eda Quadros*

Keynote *Shear strength of rock, rock joints and rock masses – problems and some solutions*

Nicholas R. Barton

11:10-11:40 COFFEE BREAK

Exhibition area – Floor E

11:40-13.40 PARALLEL SESSIONS 1-3**SESSION 1- TOPIC 1: ROCK PROPERTIES AND TESTING METHODS**

Room: Auditorium – 2nd Floor

Chairman: *Frederic Pellet*

Experimentally-based relation between dynamic and static elastic moduli of various sandstones and a quartzite

M. Alber

Artificial Neural Network (ANN) Based Model for Predicting of Overall Strength of Volcanic Bimrock

H. Sönmez, A. Coskun, M. Ercanoglu, D. Turer, K. E. Kasapoglu & C. Tunusluoglu

Quantifying the discrepancy in preloads estimated by Acoustic Emission and Deformation Rate Analysis

M. Karakus

Prediction of the mechanical compressive behavior of granite using intelligent tools

T. Miranda, F. F. Martins & G. Vasconcelos

A detailed look at pre-peak dilatancy in a granite – determining “plastic” strains from laboratory test data

G. Walton, M.S. Diederichs & J. Arzúa

Upscaling Elastic Moduli in Copenhagen Limestone

N. Katic & H. F. Christensen

Damage detection of rocks under conventional triaxial compression

R. D. Peng, Y. Ju, L. T. Mao, H. B. Liu & P. Wang

Effect of Loading Rate on Fracture Behaviour of Rock Materials

Q. B. Zhang & Y. Zou

Temperature-Confining Pressure Coupling Effects on the Permeability of Three Rock Types under Triaxial Compression

K. M. B. Alam, M. Niioka, Y. Fujii & D. Fukuda

Biot's Effective Stress Coefficient of Rocks for Peak and Residual Strengths by Modified Failure Envelope Method.

A. B. N. Dassanayake & Y. Fujii

SESSION 2- TOPIC 5: DESIGN METHODS AND ANALYSIS

Room: Conference hall – 3rd Floor

Chairman: *Tiago Miranda*

Continuum and discontinuum modelling of gravity dams on jointed rock foundations

Y. M. Alshkane, A. M. Marshall & L. R. Stace

Comparison of Predicted and Actual Conditions of the Rock Mass in the Tunnel Stražina

K. Ravnjak, G. Grget & M. S. Kova evi

On the Interpretation of Numerical Results in the Study of Rapid Landslide Run-out Phase

M. Pirulli, C. Scavia & M. Tararbra

CFD-DEM simulations for injection of cement-based grout - the effect of rock fracture roughness

Sakakibara Shinya, H. Shimizu & T. Koyama

Efficient Numerical Integration of Perzyna Viscoplasticity, with Application to Rock Slope Stability using Zero-Thickness Interface Elements

I. Aliguer & I. Carol

Kinematic analysis of block rotations in a jointed rock mass

M. Pötsch & W. Schubert

Vibration propagation in discrete element particle models of rock
R. Resende, E. Fortunato, C. Andrade & T. Miranda
 Different FEM Models for Simulation of the Osterberg Load Test in Rock Shafts
S. Melentijevic & C. Olalla
 System Reliability Analysis of a Circular Rock Tunnel Using a First Order Approximation
P. Zeng & R. Jimenez
 Application of a novel constitutive shotcrete model to tunneling
B. Schaedlich, H. F. Schweiger, T. Marcher & E. Saurer

SESSION 3- TOPIC 6: MONITORING AND BACK ANALYSIS

Room A - 4th floor
 Chairman: *Roger Olsson*

Photographic documentation of the face of a TBM-driven tunnel
M.R. Henzinger & R. Galler
 Rockfall monitoring system for improving road safety
Z. Agioutantis, E. Apostolou, S. Mertikas, A. Daskalakis, A. Tripolitsiotis, G. Kritikakis, C. Steiakakis & G. Kaplanidis
 Geotechnical safety management for tunnels
W. Schubert & B. A. Moritz
 Numerical simulation of sliding and toppling of a block system
Gian Paolo Giani, S. Orsatti & L.R. Alejano
 Determination of states of stress in hard rocks: Results of laboratory conducted finite deformation analysis
A. Förster & Ch. Lempp
 Monitored and calculated deformational behaviour of a large cavern during excavation
M. Espada & L. Lamas
 Towards rockfall prediction: linking pre-failure deformation with precursory rockfall events
M. J. Royan, J. M. Vilaplana & A. Abellán
 Determination material properties on Bedding Contact for slope stabilization at the low-wall part of coal mine
Sujatono Supandi. St. Mt.
 Analysis of the geotechnical data monitored during Saint- Martin-la-Porte access gallery excavation
H. Tran Manh, J. Sulem & D. Subrin
 Back analysis and Radar Interferometry Monitoring in a Large Open Pit Slope
C. González- Nicieza, O. Mora, M. I. Álvarez- Fernández & E. Amor- Herrera

13:40–15:00 LUNCH BREAK *Exhibition area – Floor E*

15:00–16:45 PARALLEL SESSIONS 4-6

SESSION 4- TOPIC 1: ROCK PROPERTIES AND TESTING METHODS

Room: Auditorium – 2nd Floor
 Chairman: *Luis González de Vallejo*

Reversible deformation phenomena of a high stressed rock samples
V. V. Makarov, L.S. Ksendzenko, A.M. Golosov & N. A. Opanasiuk
 Laboratory analysis of thermal fatigue in limestone
M. Gasc-Barbier, G. Girma & V. Gendre
 Identification of rheological behavior of salt rock at elevated temperature, case study: Gachsaran evaporative Formation, Iran
N. A. Ghavidel, A. Nazem, M. Heidarizadeh, M. Moosavi & H. Memarian
 Estimation of rock mass deformation modulus using a Bayesian approach
X. D. Feng & R. Jimenez
 Geotechnical characterization of low strength anisotropic rocks in the Strait of Gibraltar area
A. Perucho, M. Muñiz & J. A. Díez
 Identification of the dependency to water content of the mechanical properties of Channel tunnel chalk
S. Maiolino
 Experimental relationships among strength parameters in monoaxial loading conditions determined for porous effusive rocks
T. Rotonda, L. Verrucci & P. Tommasi
 Shapes of failure in collapsible materials
A. Perucho, A. Serrano & M. Conde

SESSION 5- TOPIC 5: DESIGN METHODS AND ANALYSIS

Room: Conference hall – 3rd Floor
 Chairman: *Diego Mas-Ivars*

Principles and methodologies for the design of hydroelectric large underground caverns
R. Plassart & F. Laigle
 D&B versus TBM: Review of the parameters for a right choice of the excavation method
F. J. Macias & A. Bruland
 Design and control of the EDZ for a deep repository in crystalline rock
H. Ittner, T. Lehtimäki & R. Christiansson
 Test study on a new rock burst tendency index—yield degree and its influencing factors
B. H. Guo, Chen & P.F. Gou
 Risk Associated with Swelling Rocks in Volcanic Formations in the Design of Hydro-Tunnels
J. M. Galera, M. Paredes, C.Menchero & V.Pozo

The Reduction of Surface Settlement by Employing Umbrella Arch Systems for Different Excavation Methods

J. Oke, N. Vlachopoulos & M. S. Diederichs

Abu Hamour, TBM Launch Shaft—a rock mass classification attempt for a deep shaft in Doha, Qatar

J. B. Stypulkowski, A. K. Pathak & F. G. Bernardeau

Finite element simulation of crack initiation and propagation in rocks

G. Sivakumar & V.B. Maji

SESSION 6- TOPIC 6: MONITORING AND BACK ANALYSIS

Room A - 4th floor

Chairman: *Antonio Abellán*

Modelling and redesign of retaining system of a Deep excavation in marl formation using back analysis results

Y. Kazan

Isolation roof caving control and monitoring technology of room and pillar method goafs

W. Li, B. Zhang & Z.W. Bi

A new approach for evaluation of in-situ inclinometer measurements based on two cases in Turkey

M. Mesuto lu & I. Ozkan

Deterministic In-situ block size estimation using 3D terrestrial laser data

H. Vanhaekendover, D. Ngan-Tillard, R. Lindenbergh, S. Slob & U. Wezenberg

A two-dimensional vibration model for mountain tunnel lining built with poling-board method

Y. Gao, Y. Jiang & B. Li

Real time displacement monitoring using GPS for assessing slope stability

N. Shimizu, S. Nakashima & Y. Furuyama

Analysis of the performance of an evolutionary computation algorithm in the identification of geomechanical parameters in underground works

T. Miranda, A. Gomes, J. Sena-Cruz, L. Costa & D. Dias

Extended rock mass characterization from 3D images

A. Gaich, M. Pötsch & W. Schubert

16.45-17.10 POSTER SESSION I

2nd floor (registration aisle)

TOPIC 1: ROCK PROPERTIES AND TESTING METHODS

A New Rheological Hardening Model for prediction of Creep Deformation of Rock Samples

M. Karami, A. Fahimifar & E. Pakniat

A lab-testing based geomechanical characterization of metamorphic rocks focusing on post-failure behavior

I. Pérez-Rey, J. Arzúa, J. Barbiero, L. R. Alejano & G. Walton

A new approach of limit equilibrium models for rock

M. J. A. Leal-Gomes, C. A. J. V. Dinis Da Gama

Development of testing methods of Thin Spray-on Liner shear-bond strength

Q. Q. Qiao, J. Nencik, I. Porter, E. Baafi, Z. Y. Zhang & Z. J. Shan

Proposal of a new rock creep model

V. Brotóns, S. Ivorra, R. Tomás, J. Martínez-Martínez & D. Benavente

Correlations between static and dynamic elastic modulus of a calcarenite heated at different temperatures

V. Brotóns, S. Ivorra & R. Tomás

Textural anisotropies characterization of granitic rocks using P waves velocity

L. Calleja, A. Rodríguez-rey, V.G. Ruiz De Argandoña, N. Sánchez Delgado & C. Camino

Considerations on the laboratory estimate of the basic friction angle of rock joints

J. González, N. González-Pastoriza, U. Castro, L. R. Alejano & J. Muralha

Failure behavior and acoustic emission pattern of slate and mica schist in uniaxial loading

N. Slatalla & M. Alber

The static and dynamic elasticity parameters of laminated silty-clay shales at the simulated depth up to 4 km

A. Dziejczak & J. Pininska

X-Ray fluorescence methods for the recognition of minerals and rocks. Application to granite

N. Barral-Ramón, R. Pérez-Álvarez & R. Laín Huerta

Applicability of acoustic emission technique for vertical stress determination in mine pillars

G. Paneiro & C. Dinis Da Gama

Fracturing and Indirect Tensile Strength of Brittle and Ductile Rocks

N. Erarslan & M. Ghamgosar

Petrophysical interpretation of mechanical behaviour of ornamental stones from Galicia (Spain)

N. Sánchez, A. Rodríguez-Rey, L. Calleja, V. G. Ruiz de Argandoña & C. Camino

TOPIC 5: DESIGN METHODS AND ANALYSIS

Advances, current limitations and future requirements for a numerical shear box for rock joints using PFC2D

E. Lassari, F. Johansson, D. Mas Ivars & A. Sánchez Juncal

A strain-dependent strength and dilation model of rock to study pre-peak behaviour in confined tests

J. González

Comparison between continuous and discontinuous approaches to tunnel models: FLAC- UDEC

M. Veiga, J. Barbiero, S. Alonso, L. R. Alejano & A. M. Ferrero

TOPIC 6: MONITORING AND BACK ANALYSIS

Monitoring of the landslide at Durres Morine road

A. Kosho, A. Malaj, L. Harizaj & S. Lamçe

Procedure for obtaining and analyzing the diametric deformation of a tunnel by means of tape extensometer convergence measures

A. Bernardo Sánchez & M. Arlandi Rodríguez

Monitoring of the geomechanical state of rock mass using complex of satellite geodesy

A. A. Panzhin & N.A. Panzhina

17:10–17:30 COFFEE BREAK *Exhibition area – Floor E*

17:30–18:30 PARALLEL SESSIONS 7-9

SESSION 7- TOPIC 1: ROCK PROPERTIES AND TESTING METHODS

Room: Auditorium – 2nd Floor

Chairman: *Rafael Jiménez*

Dynamic fracture behavior of cubic and core specimens under impact load

Gh. Khandouzi, A. Mirmohamadlou & H. Memarian

The influence of microwave radiation on hard rocks as in microwave assisted rock breakage applications

P. Nekoovaght & F. Hassani

Correlation of direct and indirect tensile tests for use in the Hoek-Brown constant mi

S. A. L. Read & L. R. Richards

Effect of infill thickness on shear behaviour of jointed rock under CNS condition

A. Kumar & K. S. Rao

Deformation Behavior and Shear Wave Velocity under Confined Triaxial Extension Stress

M. Takahashi, H. Park, Y. Fujii & M. Sato

SESSION 8- TOPIC 2: ROCK MASS CHARACTERIZATION

Room: Conference hall – 3rd Floor

Chairman: *Murat Karakus*

Characterizing the influence of micro-heterogeneity on the strength and fracture of rock using an FDEM- μ DFN approach

P. Hamdi, D. Stead & D. Elmo

Coupling photogrammetric data with a discrete element model for rock slope stability assessment

V. Bonilla- Sierra, F. V. Donzé, L. Scholtès & M. Elmouttie

Foundation properties of variably weathered rock beneath a heavy mineral processing plant

D. C. Starr & E. T. Brown

Estimation of crack tensor components for the different distributions of crack orientation

A. F. Idziak

Ageing of chalk rocks in underground quarries

N. Lafrance, M. Souley, C. Auvray, O. Favreau & V. Labiouse

SESSION 9- TOPIC 4: MINING AND QUARRYING ENGINEERING

Room A - 4th floor

Chairman: *José Miguel Galera*

The toppling of large blocks on the northeast slope of the Meirama mine

P. Ramírez-Oyanguren, C. M. Bassa, R. G. Philippon & M. Fernández-Pello

Mining induced static stress transfer and its relation to a high-precision located Mw = 1.9 seismic event in a South African gold mine

M. Ziegler, K.Reiter, O. Heidebach, A. Zang, G. Kwiatek, T. Dahm, G. Dresen & G. Hofmann

Kinematic analysis of the western pitwall of the Main Pit in the Letseng Diamond Mine, Lesotho

M. N. Lephatoe, E. D. C. Hingston, M. Ferentinou & N. Lefu

Prediction of Deformation Modes of Rock Slope Due to Excavation on Plateau Type Mine

Najib, D. Fukuda & J. Kodama

20:15

WELCOME RECEPTION

Castrelos Manor House

** There will be buses to the Welcome reception – see more information at General Information*

WEDNESDAY, 28TH MAY**09:00–09:50 PLENARY SESSION II***Room: Auditorium – 2nd Floor*Chairman: *Aurea Perucho*Keynote *Foundations on rock masses**Claudio Olalla***09:50–10:40 PLENARY SESSION III***Room: Auditorium – 2nd Floor*Chairman: *José Muralha*Keynote *Representation of rock discontinuities in safety analysis of large dams**José Lemos***10:40–11:10 COFFEE BREAK***Exhibition area – Floor E***11:10–13:10 PARALLEL SESSIONS 10-12****SESSION 10- TOPIC 1: ROCK PROPERTIES AND TESTING METHODS***Room: Auditorium – 2nd Floor*Chairman: *Alexander Sofianos*

Experimental evaluation of the fracture toughness of a limestone

G. SuheitHelmer, J. Sulem, J. Rohmer, S. Ghabezloo & Hild. F

Energy analyses of uniaxial impact compressive tests for coalmine sandstone after cyclic wetting and drying

P. Yuan & Q. Y. Ma

Abrasive measures on geotechnical materials of the Barcelona area

C. González, M. Arroyo & A. Gens

Measurement of the basic friction angle of rock by three different tilt test methods

J. Ruiz & C. Li

Evolution of Damage on Tensile Fracturing of Rock by Means of Elastic Ultrasonic Wave Velocity

M. Ghamgosar, N. Erarslan & D. J. Williams

The effect of Cyclic Loading Amplitude and Notch Crack Inclination Angle on the Fracture Toughness Test on Brisbane Tuff-Multiple Factorial Analyses

M. Ghamgosar & N. Erarslan

Understanding the boundary effects by means of numerical modelling when performing punching test on small samples

J. P. Tshibangu, F. Descamps & G. Di Paolo

The comparison of compression and impression relaxation tests with different diameters of indenter in salt rock

F. Tavanaei, M. H. Mehranpour & M. Moosavi

A Rock Mass Elastic Modulus Estimation Using Mae Moh Mine's Large Scale Experiment Data

*C. Leelasukseree, N. Mavong & A. Chaiwan***SESSION 11- TOPIC 9: PETROLEUM ENGINEERING, HYDROFRACKING AND CO2 STORAGE***Conference hall – 3rd Floor*Chairman: *José Albarellós*

Numerical Modeling of Composite Bilaminate Materials as an Analog for Strength Variation in Anisotropic Shale Formations

B.R. Crawford, N. DeDontney & B. Alramahi

Prediction of rock strength with matrix acidizing stimulation and induced wormhole by computational simulation methods

N. Jahani, G. Berge & B. Haugen

Effects of reservoir development on the well casing behavior

C. E. Ribeiro-Lautenschläger, G.L. Righetto, R.A.C. Albuquerque, N. inoue&S.A.B Fontoura

Fracture properties after hydraulic stimulation in low - permeability sediments (GeneSys - project)

E. Pechan, T. Tischner & J. Renner

Shale Geomechanics: Optimal Multi-Stage Hydraulic Fracturing Design for Shale and Tight Reservoirs

J. Leem & J. Reyna

A coupled HM-XFEM method for fracture dynamics and groundwater flow in geological porous media

M. Faivre, R. Giot, F. Golfier & P. Massin

Dependency of deformability, strength and failure characteristics of clay shales on capillary suction

F. Amann, K. Wild & L. Wymann

A preliminary evaluation of an enhanced FDEM code as a tool to simulate hydraulic fracturing in jointed rock masses

A. Lisjak, G. Grasselli, O. K. Mahabadi, P. Kaifosh & T. Vietor

QA/QC on Physical and Mechanical Rock Properties Relevant for Geomechanical Analysis

U. Prasad, J. A. Franquet & D. A. Curry

Wellbore stability prediction: An improved methodology for a limited set of data

A. Diaz & K. Williams

SESSION 12- TOPIC 3: ROCK MECHANICS FOR INFRASTRUCTURES*Room A - 4th floor*Chairman: *Fernando Pardo de Santayana*

Distinct element method simulation of stress fracturing around an underground opening

N. Bahrani, B. Valley & P. K. Kaiser

Gravitational instability of a micaschist formation and its effects on road infrastructure

D. Simic & J. López

In-situ stress amplification in tunnels from Spain, Iran and Chile estimated by TSI and SAF indices

L. González De Vallejo, T. Hijazo, J.M. Galera & Z. A. Entezari

Numerical analysis and monitoring of the Matinkylä Metro Station, Espoo, Finland

J. Pöllä & Konstantas

Quantitative assessment of an Excavation Damaged Zone from variations in seismic velocity and fracture distribution around a gallery in the Horonobe Underground Research Laboratory

K. Aoyagi, K. Tsusaka, K. Kondo & D. Inagaki

Main difficulties and lessons learnt during the TBM excavation in shales in the North portal of Pajares tunnels

M. B. Diaz Aguado, J. García De Muro & R. Rodríguez

Sliding stability analysis of a gravity dam founded on a rock mass with an impersistent joint set

M. Cabrera, S. Senent, C. Olalla & R. Jiménez

Analysis of the conditions of stability and stabilization of two slopes, in AP-68 with K.P. 59+743 to 60+038 and in AP-7 with K.P. 581+250 to 581+315, incorporating the terrestrial photo-restitution

*F.J. Castanedo-Navarro, S. Rodón & M. Sopena***13:10–13:40 POSTER SESSION II***2nd floor (registration aisle)***TOPIC 2: ROCK MASS CHARACTERIZATION**

Geophysical Characterization of an Instable Rock Mass

C. Colombero, C. Comina

Horizontal stresses at shallow depths in Seoul (Korea) gneissic region

E. S. Park, B. H. Choi, S H.. Bae & S. Jeon

On the use of the continuity factor for rock mass properties based on a review of the representative elementary volume

P. Zhou & F. Johansson

Geotechnical characterization and correlations obtained in Flysch unit

R. Moreno Bernal, Alkorta Lertxundi, G. Martínez Ruiz & S. Sánchez Rodríguez
Mechanical characterization of the rocks involved in the Albuñuelas landslide (South Spain)*J. Martínez- Martínez, J. Delgado, J. Garrido, S. Martino, D. Benavente, S. Ordóñez & M. A. García-del-Cura*

Characterization of the rock joints by fractal analysis

*R. Galindo, A. Serrano & C. Olalla***TOPIC 4: MINING AND QUARRIING ROCK MECHANICS**

Impact of destress blasting on stress field development ahead of hardcoallongwall face

P. Konicek, J. Ptacek, L. Stas, R. Kukutsch, P. Waclawik & A. Mazaira

Optimum Extraction of Pillars by FLAC-3D. Where Surface Features is the Major Constrain

K. Das & G. Shiva Kumar

Detection of faults and hidden granites in metallic mine using ground penetrating radar tomography

F. Yang, C. Du, X. Xu, Y. Liang & X. Xu

MGC-RocDesign|CALC: a geomechanical calculator tool for rock design

R. Pinheiro, L. Ramos, J. Teixeira, M. J. Afonso & H. I. Chaminé

An approximation to the prediction of the extent of the area crushed around a blasting drill

F. García-Bastante, E. Alonso & M. A. González

Preliminary Design of Underground Crushing Chamber

E. Trigueros, M. Martínez & I. Alhama

Slope Stability Control of a Coal Mine during the filling of the artificial lake

J. I. Piñeiro, J. Taboada & J. Martínez Torres

Back Analysis of a general rock failure in a marble quarry

*M. Martínez-Segura, E. Trigueros & J. Mulas***TOPIC 9: PETROLEUM ENGINEERING, HYDRO-FRACKING AND CO₂ STORAGE**Laboratory simulation of CO₂ injection in sandstones and sands for improved seismic monitoring of CO₂ reservoirs*I. Falcon-Suárez, L. North, A. Best, J. Sothcott, J. Canal-Villa & J. Delgado-Martín*Cements of improved sealing capacity in CO₂ geological storage*E. Estévez, L. Valle, D. del Barrio, G. Blázquez, T. Kovács & V. Blázquez*

Fracture Mechanical Evaluation of Hydraulic Fracturing Laboratory Experiments

F. Stoeckhert, S. Brenne, M. Molenda & M. Alber

Constraining the magnitudes of maximum and minimum horizontal stresses from borehole breakouts – A comparison between different rock failure criteria –

W. Lin

Drilling optimization based on A Geomechanical Analysis using Probabilistic Risk Assessment, A Case Study from Offshore Iran

S. Rafieepour & H. Jalalifar

Detection of underground instabilities in an old limestone quarry through acoustic monitoring

C. Occhiena, M. Pirulli, C. Scavia, A. Astolfi, G. E. Puglisi, L. Shtrepi, C. E. Nadim & P. Bigarré

13:40–15:00 LUNCH BREAK

Exhibition area – Floor E

15:00–16:00 PARALLEL SESSIONS 13-15

SESSION 13- TOPIC 8: CASE HISTORIES AND PRESERVATION OF NATURAL STONE

Room: Auditorium – 2nd Floor

Chairman: *Maria Rita Migliazza*

Hazard analysis for rock-fall onto touristic beaches from overhanging cliffs in ophiolitic rock-mass

M. Coli, I. Erbetta & E. Livi

A new approach for modeling heat transfer between a freeze pipe and the surrounding ground

M. Vitel, A. Rouabhi, M. Tijani & F. Guérin

Temperature induced-changes on the mechanical properties of a calcarenite

V. Brotóns, R. Tomás & S. Ivorra

Analysis of Potential Rockfalls and Protection Measures for the Mardin Castle, Turkey

N. Dadashzadeh, C. Aras, N. Yesiloglu-gultekin, A. Bilgin & H.S.B. Duzgun

SESSION 14- TOPIC 9: PETROLEUM ENGINEERING, HYDROFRACKING AND CO₂ STORAGE

Room: Conference hall – 3rd Floor

Chairman: *Brian Crawford*

Studies in fracture stimulation induced tectonics in rock require new test equipment

J. B. Surjaatmadja, D. Meadows, K. Coffman & D. Looper

Anisotropic mechanical properties of shales and the influences on hydraulic fractures

Tiegang Fan, Guangqing Zhang & Y. Lou

Hydraulic fracture propagation under steady state fluid flow

A. Pouya, Van-LinhNguyen & S. Ghabezloo

Hydraulic Fracturing of a Devonian Slate under confining pressure - with emphasis on cleavage inclination

S. Brenne, M. Molenda, F. Stöckert & M. Alber

Behavior of a Fractured Reservoir over Time based on geomechanical Modeling

H. W. Stockhausen, M. R. Lakshmikantha, V. Sifontes & M. E. Barboza

Hydro-mechanical coupling in zero-thickness interface elements, formulation and applications in geomechanics

D. Garolera, I. Aliquer, J. M. Segura, I. Carol, M. R. Lakshmikantha & J. Alvarelos

SESSION 15- TOPIC 3: ROCK MECHANICS FOR INFRASTRUCTURES

Room A - 4th floor

Chairman: *Claudio Olalla*

Update of 1989 Bieniawski's RMR guidelines for tunnel excavation and support

M. Romana

A review on the impacts and causes of landslides associated with recent earthquakes in Iran

F. Pellet, K. Amini Hosseini & M. Keshavarz Bakhshayesh

Application of the Hoek & Brown (1980) failure criterion to the definition of the foundation of an arch dam

C. M. Baena, C. Granell & C. Olalla

A unified thermo-plastic/viscoplastic constitutive model for geomaterials

S. Raude, F. Laigle, R. Fernandes & R. Giot

3D Geomechanical Modeling of Cavity Growth in Loosely Consolidated Sandstone

M. Nassir & D. A. Walters

16:00–17:00 PARALLEL SESSIONS 16-18

SESSION 16- TOPIC 8: CASE HISTORIES AND PRESERVATION OF NATURAL STONE

Room: Auditorium – 2nd Floor

Chairman: *Michael Alber*

Dynamic strain wave analyses of parallel cut blasting model test for vertical shaft

Q. Y. Ma, Pu Yuan, B. Han, J. S. Zhang & H. X. Liu

The use of active seismic methods to study seismic waves anisotropy in Triassic dolomites

I. Stan- Kłęczek & M. J. Mendecki

Slope stabilization at km 25.5 El Cobre highway – CODELCO Chile, El Teniente mine division

V.H. Recabarren & F.J. Peña Díaz

Analysis of a deep-seated slope movement in a marly-arenaceous formation

E. Celluzzi, A. Grazziani & A. Lembo-Fazio

SESSION 17- TOPIC 9: PETROLEUM ENGINEERING, HYDROFRACKING AND CO₂ STORAGE**Room: Conference hall – 3rd Floor**Chairman: *Jordi Delgado*

Application of Transient Methods to the Assessment of Permeability of Well Cements
I. Falcon-Suárez, B. Rodríguez - Cedrun, J. Delgado- Martín & J. Canal- Vila
Geomechanical Simulation of the Injection of CO₂ into Saline Aquifers with Respect to Risk Assessment

M. Adams, M. Feinendegen, M. Ziegler & T. Kempka

Coupled hydro-mechanical simulations demonstrate system integrity at the Ketzin pilot site for CO₂ storage, Germany

T. Kempka, S. Klapperer & B. Norden

Assessing the permeability anisotropy of claystone by pulse test methods

R. Giot, C. Auvray & A. Giraud

Effect of supercritical CO₂ on the Corvio Sandstone in a flow-thru triaxial experiment

*J. Canal, J. Delgado, I. Falcón, V. Barrientos, R. Juncosa & B. Rodríguez- Cedrún***SESSION 18- TOPIC 2: ROCK MASS CHARACTERIZATION****Room A - 4th floor**Chairman: *Harun Sönmez*

Relationship between RMRb and GSI based on in situ data

F. Ceballos, C. Olalla & R. Jiménez

Results of Laboratory Tests on Artificial Block-in-Matrix Rocks

T. Pilgerstörfer & W. Schubert

Preliminary assessment of the scaling relationships of in-situ stress orientation variations indicated by wellbore failure data

B. Valley & K. F. Evans

Mathematical development of stress-strain law for rock block contacts

R. Galindo, A. Serrano & C. Olalla

Geotechnical characterization of rocky materials from Arteara rock avalanche (Gran Canaria)

*M. Santana, J. Estaire & J. Yepes***17:00–17:30 COFFEE BREAK****Exhibition area – Floor E****17:30–18.30 PARALLEL SESSIONS 19-21****SESSION 19- TOPIC 7: EXCAVATION AND SUPPORT****Room: Auditorium – 2nd Floor**Chairman: *Mathew Perras*

Analytic stress solutions for a circular pressure tunnel at great depth including support delay and pure slip boundary condition

Z. Lu, N. Zhang, H. Y. Chen, Y. Qin & L. Q. Zhang

A semi-analytical procedure for circular opening in strain-softening rock masses

L. Cui, J. Zheng & R. Zhang

Rock grouting and durability experiments of colloidal silica at Kurashiki underground LPG storage base

S. Kobayashi, M. Soya, J. Nobuto, A. Nakaya, T. Okuno, S. Shimada, T. Kaneto, T. Maejima & N. Takeuchi

An Investigation of Different Drill Bits and Drilling Angles in Blast Hole Drilling

D. Akbay & R. Altında

The load transfer mechanics of fully grouted cable bolts: a theoretical analysis

*J. Chen, S. Saydam & P. Hagan***SESSION 20- TOPIC 4: MINING AND QUARRYING ENGINEERING****Room: Conference hall – 3rd Floor**Chairman: *Pedro Ramírez Oyanguren*

Evaluation of pillar width on crush pillar behavior using a limit equilibrium solution

M. Du Plessis & D. F. Malan

Application of Stress Control Technologies in Design of Multiple Seam Layouts at Energy West Mining Company

H. Maleki, K. Fleck, C. Semborski, J. Christensen & L. Tonc

Geotechnical Analyses of Mine Seismicity and Control Measures in the Western US Mines

H. Maleki

Using the distribution curves to optimize the block exploitation in natural stone quarries

Turanboy & E. Ülker

A study of a joint model incorporating excavation-induced opening effect

Y. Li, J. Oh, R. Mitra & B. Hebblewhite

SESSION 21- TOPIC 2: ROCK MASS CHARACTERIZATION*Room A - 4th floor*Chairman: *Harald Stockhäusen*

A Tool for Semi-Automatic Geostructural Survey Based on DTM – a Case Study from NW Italy

R. Facello, S. Bonetto & G. Umili

Effects of loading conditions on strength and deformability of fractured rocks – a numerical study

M. NoorianBidgoli & L. Jing

Improving teaching methods of rock mass classification parameters

P. Torrens Barbens, L. Uotinen, T. L. Toivanen & C. Edelbo

Experimental and numerical study of fracture aperture estimation and characteristics of non-linear fluid flow through artificial fracture intersections

R. Liu, Y. Jiang, B. Li, X. Wang & H. Huang

Geomechanical study with outcrop samples to improve drilling performance for an exploration well in Northwest Africa

*H. W. Stockhausen, J. M. Hernán-Gómez, H. Gallego, A. Alonso L., J. Barbiero & J. Delgado***21:00****BANQUET***Hotel Bahía de Vigo*THURSDAY, 29TH MAY**09:00–09:50 PLENARY SESSION IV***Room: Auditorium – 2nd Floor*Chairman: *Carlos Carranza-Torres*

Keynote The impact of brittle behaviour of rocks on tunnel excavation design
Derek Martin

09:50–10:40 PLENARY SESSION V*Room: Auditorium – 2nd Floor*Chairman: *Jean Paolo Giani*

Keynote Rock mass characterization by means of advanced survey methods
Anna María Ferrero

10:40–11:10 COFFEE BREAK*Exhibition area – Floor E***11:10–13:10 PARALLEL SESSIONS 22-24****SESSION 22- TOPIC 7: EXCAVATION AND SUPPORT***Room: Auditorium – 2nd Floor*Chairman: *Wolfgang Schubert*

Determination of an “empirical” ground reaction curve useful for designing coal mine roadways support

R. Rodríguez & M.B. Díaz-Aguado

Rock mass variability and TBM prediction

F. J. Macias, P. D Jakobsen & A. Bruland

The Development of a Distributed Optical Sensing Technique to Monitor Forepole temporary support elements employed within an Umbrella Arch System

N. Vlachopoulos, N. Forbes, B. Oke, J. & Hyett, A.J.

Face stability in tunnels excavated by the drill and blast method

S. Senent & R. Jiménez

Study on distribution law of surrounding rock pressure in unsymmetrical loading tunnel with coupling effect from topography and geology

Z. F. Wang, L. H. Xu, Y. Kang, X. C. Wang & X. P. Long

Effectiveness of applied support in tunnels in plastically deformed rockmass - an analysis based on tunnelling projects from Nepal Himalaya

P. K. Shrestha & K. K. Panthi

Analysis on the pre-injection grout consumption at Strindheim Road Tunnel Project, Trondheim, Norway

K. K. Panthi

Dimensioning of a flexible system for the stabilization of a landslide on the access road to Cotobello (Aller, Asturias)

J. Prieto, R. Luis, R. Fernández & M. Fernández

Protective actions against rockslides on roads of Serra de Tramuntana. The case of BlauGorg detachment on 2008, December 31st.

R. Fonseca, R. Luis, C. Raimat, J. Prieto, J. M. Rius & C. Massanet

A review of ground support systems performance subjected to dynamic loading

L. Li, P. Hagan & S. Saydam

SESSION 23- TOPIC 4: MINING AND QUARRYING ENGINEERING

Room: *Conference hall – 3rd Floor*

Chairman: *Antonio Samaniego*

Modelling methodology: structural geology and rock mass behaviour at Kiirunavaara Mine

J. Vatcher, S. D. McKinnon, J. Sjöberg & C. Dahnér

Advanced 3D geotechnical modeling of Las Cruces Open pit

J. M. Galera, S. Cooper, M.D. Rodríguez & V. Pozo

Parameter characterisation for rock mass preconditioning using hydraulic fracturing

A. Bedi, G. F. Gambino & J. P. Harrison

Simulating the effect of preconditioning in primary fragmentation

A. Sánchez Juncal, D. Mas Ivars, A. Brzovic & J. Vallejos

Mathematical approach for the analysis of in-situ measurements in unstable slopes:

A study based on the cases from coal mines in Turkey

I. Özkan

The interaction between the scale effect and the shape effect in the mine pillar design

A. L. M. Ayres Da Silva & L.A. Ayres Da Silva

Comparison of change of creep properties of chromite ore under varying stress and time factor to find their interdependence

S. Kabra

An application of epoxy and polyurethane on various marbles to enhance cuttability

M. Basyigit O. Bayram & H. Tunçdemir

SESSION 24- TOPIC 8: CASE HISTORIES AND PRESERVATION OF NATURAL STONE

Room A - 4th floor

Chairman: *Davor Simic*

Experiences implementing high energy dynamic barriers as a tool for creating a shadow zone against rockfalls in linear infrastructures

R. Luis, C. Raimat & A. Sanz

Influence of model selection, constitutive behavior assignment and parametric sensitivity on tunnel, cavern and pillar EDZ assessment for a long-term deep geological repository

M. S. Diederichs, T. Lam, M. Jensen, M. Perras & B. Damjanac

Comparison of disc cutter consumptions in two tunnelling machines due to wearing in two tunnels partially built in orthogneiss

P. R. Oyanguren & C. Laín

Analysis of a complex slope failure in a quartzite slope

C. León- Buendía, J. Santamaría, L. R. Alejano & R. Giráldez

Stability analysis of a room & pillar hematite mine and techniques to manage local instability problems

J. Arzúa, L. R. Alejano, I. Clérigo, B. Pons & F. Méndez F. Prada

Safety and economic advantages for rock blasting in urban áreas

C. Dinis Da Gama

Possible mechanical behavior of Elmadag and Artova Formations during tunnel excavation

S. Ö. Dinç & M. C. Tunusluo lu

Deepening of Juankoski Canal - Strengthening of Rock and Blasting Under Bridge

K. C Avellan & T. K. Nuutinen

13:10–13:45 POSTER SESSION III

2nd floor (registration aisle)

TOPIC 3: ROCK MECHANICS FOR INFRASTRUCTURES

Influence of intermediate principal stress on correction formula of bearing capacity in rock foundation

Z. M. Zhang & W. D. Lei

Underground Gas Storage in Portuguese Salt Caverns

P. Vidal & C. Dinis Da Gama

Slope stabilization methods. Alternatives for the containment of land slopes

N. Barral - Ramón, R. Pérez- Álvarez & R. Laín Huerta

Application of electrical tomography technique in the design of soil nailing reinforcement

I. Pérez - Santisteban, J. Dorronsoro & F. Puell

Rockfall protection structures in the Tramuntana range of Mallorca (Spain)

J.M. Rius Gibert & R. Aguiló González

TOPIC 7: EXCAVATION AND SUPPORT

Co-Relation Between Physico-Mechanical and Chemical Properties of Cement & Resin Capsules Used in Underground Mines

A. K. Rana, K. Das & G. S. Kumar

Developing Early Age Strength in Fibre Reinforced Shotcrete (FRS): Effects of Accelerator Type and Rate of dosage

M. Karakus, T. S. Baillie, O. R. Cannon, B. F. H. Forsyth & T. J. Snell

Research on the Pre-displacement of Surrounding Rock during Tunneling

W. Shi, L. Miao & B. Zang

A comparative study on the heat loss of rock cavern type and above-ground type thermal energy storage systems

J. W. Park, D. Ryu, D. Park, B. H. Choi, J. H. Synn & C. Sunwoo

Pit excavation for underground construction in an urban area near an old tunnel

Z. Arbanas, M. Vivoda & P. Kursar

In situ stresses in rock masses: methodology for its study in tunnel projects in Spain

G. Madirolas & A. Perucho

Abacus for the analysis of technical and economic consequences of over-excavation in tunnels

C. Iglesias, M. Veiga & H. Larrocha

Influence of groundwater and joints orientation in the Tunnel Prado support

D. Salorio, J. P. Villanueva, F. J. Castanedo, L. Jordá & C. Oteo

TOPIC 8: CASE HISTORIES AND PRESERVATION OF NATURAL STONE

Geotechnical characterization of the site and stability of a tailing dam in Ecuador

M. R. Ponce - Zambrano, D. P. Gordón, L. R. Alejano & I. Pérez - Rey

Unstable rock masses in the highway Durres- Prishtina

L. Sharra, L. Bozo & S. Allkja

A calcarenite exposed to true fire conditions: a methodological proposal

V. Brotóns, R. Tomás & S. Ivorra

Probability evaluation of localized failure: deep excavation case study

D. Lydzba, A. Rozanski & M. Sobótka

Evaluation of the effectiveness of a new nano-consolidant in granitic rocks

I. De Rosario, J. Feijoo, T. Rivas, M. J. Mosquera & F. Elhaddad

Protective treatments against pyrite and pyrrhotite oxidation in roofing slates

J. Iglesias, J. Feijoo, I. Cañas, J. Taboada & T. Rivas

Protecting roofing slates against oxidation: Analysis of the chemical interaction between protective treatments and pyrite

J. Iglesias, J. Feijoo, J. Taboada, T. Rivas & M. Modino

Rock strength comparative analysis on rocky coasts

A. Pires, H.I. Chaminé, A. Gomes, A. Pérez-Alberti & F. Rocha

Revise of caverns axes in Azad pumped storage project

M. R. Shahverdiloo, M. Behnia, A. Anvari & M. A. Motlagh

13:45–15:15 LUNCH BREAK

Exhibition area – Floor E

15: 30–16:20 PLENARY SESSION VI

Room: Auditorium – 2nd Floor Auditorium

Chairman: Luís Lamas

Keynote Case histories of rock engineering projects in China

Xia Ting Feng

16:20–16:45 PREMIUM SPONSOR PRESENTATION

Room: Auditorium – 2nd Floor

Gas Natural - Unión Fenosa

16:45–17:30 CLOSING CEREMONY

Room: Auditorium – 2nd Floor

Chairman: Áurea Perucho

- Presentation of the EUROCK 2014 Outstanding Paper Award for Young Scientists and Engineers to the award winner *Frédéric Pellet*, Vice-President of ISRM for EUROPE
- Presentation by the organizers of the ARMS 8 - The 2014 ISRM International Symposium - 8th Asian Rock Mechanics Symposium (Sapporo, Japan)
- Presentation by the organizers of EUROCK 2015 (Salzburg)
- Presentation by the organizers of the 13th Congress of the ISRM (Montréal, 10-13 May 2015)
- Closing Speech by *Marta Iglesias Bueno*, Member of the Provincial Government of Pontevedra
- Closing Speech by EUROCK 2014 Organizing Committee *Leandro R. Alejano & Áurea Perucho*
- Closing address by *Prof. Frédéric Pellet*, Vice-President of ISRM for EUROPE



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Underground storage



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Groundwaters



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TECHNICAL VISITS

TECHNICAL VISIT 1:

Underground slate mine & Las Médulas (Roman gold mining area)

- 08:00 Leaving Vigo
- 10:30 Visit of the underground mine: Pizarras Gallegas in Villamartín de Valdeorras
- 12:30 Visit of the transformation plant: Pizarras Gallegas in Villamartín de Valdeorras
- 13:30 Lunch at the restaurant Fernando III with mainland Galician specialities.
- 15:30 Visit of Las Médulas (old Roman Gold mining area)
- 18:00 Back to Vigo
- 21:00 Arrival in Vigo

TECHNICAL VISIT 2:

Venda Nova III underground reversible hydroelectric scheme, under construction, in Northern Portugal (160 km away from Vigo)

- 08:15 Leaving Vigo
- 10:30 Visit of the underground reversible hydroelectric scheme, under construction Venda Nova III
- 13:30 Lunch offered by EDP
- 16:00 Possible free time in the Portuguese town of Braga.
- 17:30 Back to Vigo
- 19:00 Arrival in Vigo

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- Rock Parameters easy to introduce for each Station
- based on Bieniawski (1993)
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- report generation in PDF format on site including discontinuity plots
- send or upload all data and reports by email and Dropbox
- generate KML or KMZ files for viewing in Google Earth
- send report or data while still on site*
- (* data connection required)

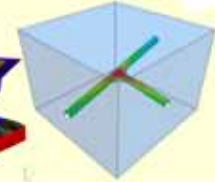
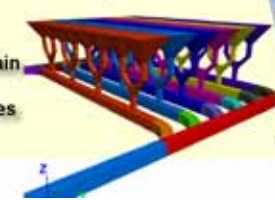


This is an app developed by Terrasolum, a Spain-based engineering company for soil and rock mechanics.



Contact:
Terrasolum SL
Av. Los Castros s/n
ES39005 Santander - Spain
Tel. 0034 942 272685
terrasolum@terrasolum.es
www.terrasolum.es

Block Caving



TECHNICAL VISIT 3:

Railway tunnel underground works near Verin (Ourense - 150 km)

- 08:30 Leaving Vigo
- 10:30 Visit of the underground tunnel.
- 14:00 Lunch
- 16:00 Free time in the Galician town of Ourense with thermal fountains.
- 17:00 Back to Vigo
- 18:00 Arrival in Vigo

* See more information about tickets and departure points at General Information

ISRM Regional Symposium

Future Development of Rock Mechanics

EUROCK 2015 & 64th GEOMECHANICS COLLOQUY
October 7. - 10. 2015, Salzburg, Austria

The Austrian Society for Geomechanics has the pleasure to invite you to the ISRM Regional Symposium EUROCK 2015 to be held in conjunction with the 64th Geomechanics Colloquy in Salzburg, the city where the International Society for Rock Mechanics (ISRM) was founded in 1962. The Geomechanics Colloquy in Salzburg since its initiation in 1951 has always been a perfect and distinguished meeting place for researchers and practitioners. The success of this concept not only shows in the continuous meetings over more than 60 years, but also in the attendance of regularly around 1000 participants.

Session Topics

- Long-term behaviour of engineering structures in rock
- Tunnelling under challenging conditions
- Mass movements
- Rock mechanical aspects of excavation
- Monitoring and safety management
- Determination of rock properties
- Rock mechanical aspects of nuclear waste repositories
- Micromechanics of rocks
- Modelling in rock and rock masses
- Mining rock mechanics
- Young researcher session

Workshops

- Rock mass characterization
- Design practices
- Contractual models

The conference is accompanied by a **technical exhibition**, **site visits** and a **accompanying persons program**.

Symposium Venue

The Symposium will be held at the Salzburg Congress. Salzburg itself is famous for its unique scenery and atmosphere. For more information on the city visit: www.salzburg.info/en/

Important Dates

Submission of abstracts	December 1 st 2014
Acceptance of abstracts	January 15 th 2015
Submission of full papers	March 15 th 2015
Early bird registration before	July 1 st 2015
Deadline for registration	September 1 st 2015

Correspondence

Until the launch of the EUROCK-homepage (www.eurock2015.com) in Summer 2014 all correspondence related to the Symposium shall be addressed to:

Austrian Society for Geomechanics

Innsbrucker Bundesstrasse 67
5020 Salzburg / Austria

T.: +43 662 87 55 19
E.: Salzburg@OEGG.at

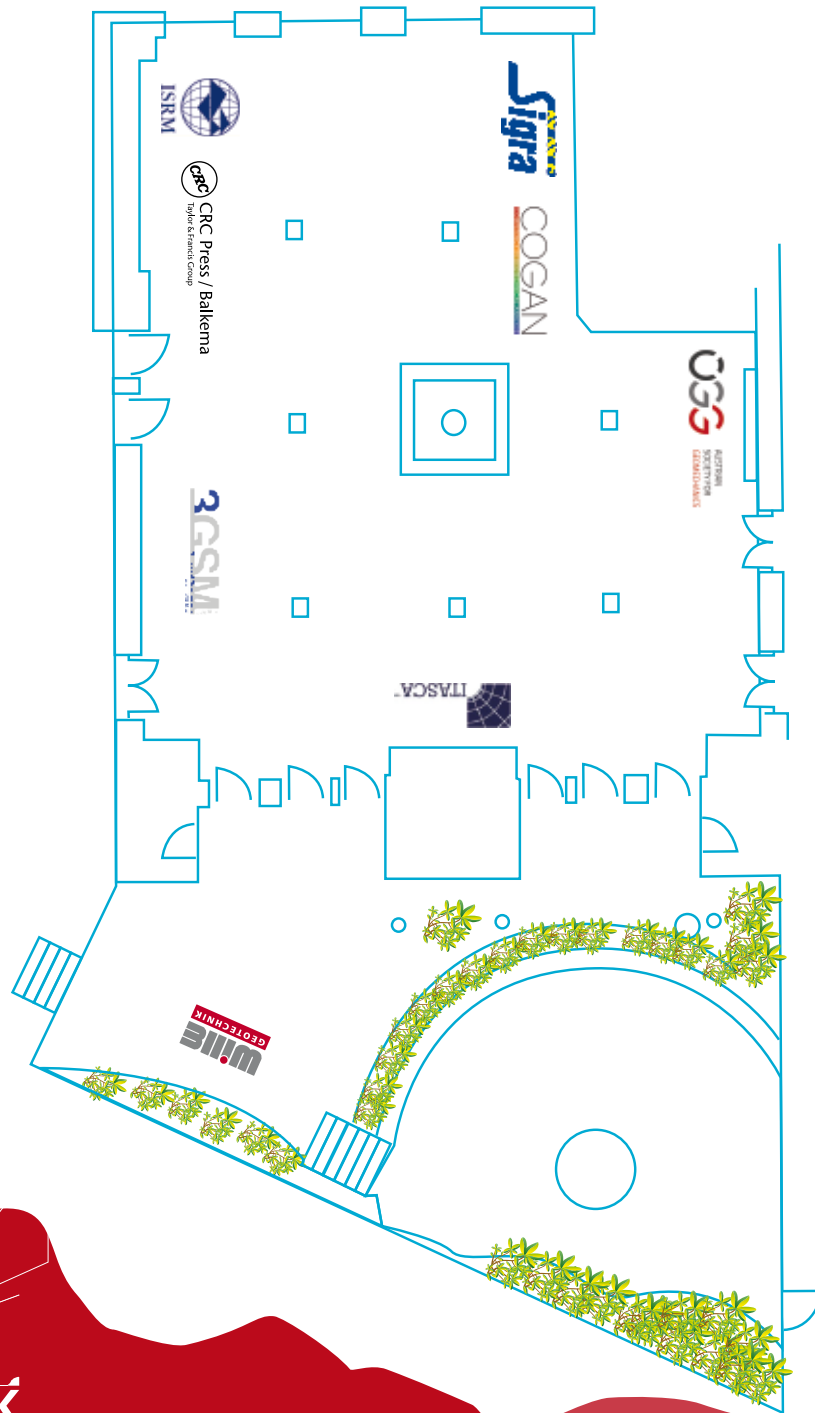
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EXHIBITION EUROCK2014

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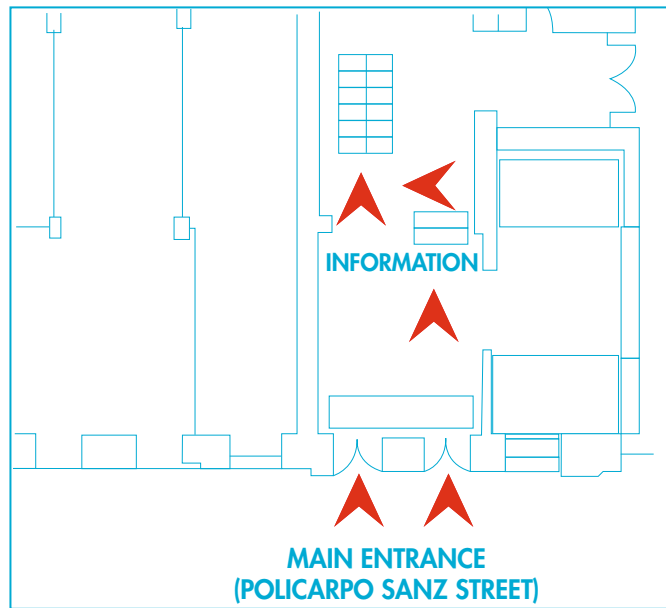


VENUE

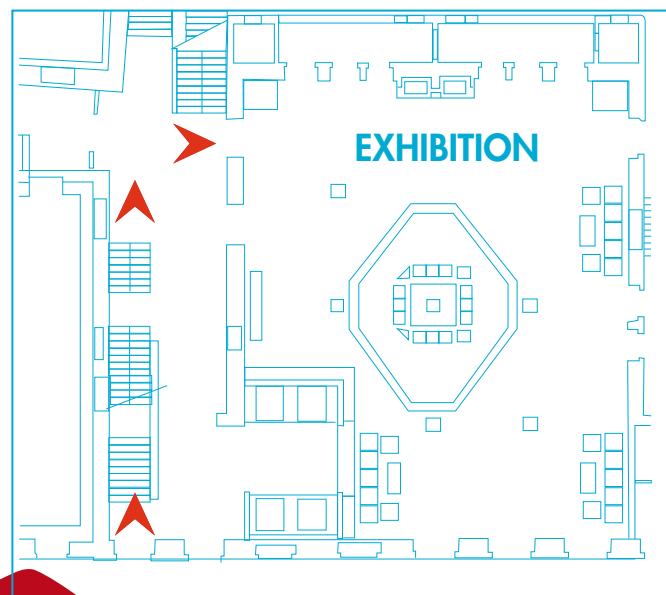
CENTRO SOCIAL NOVA CAIXA GALICIA

C/ Policarpo Sanz, 24-26
36202 Vigo - Pontevedra (Spain)

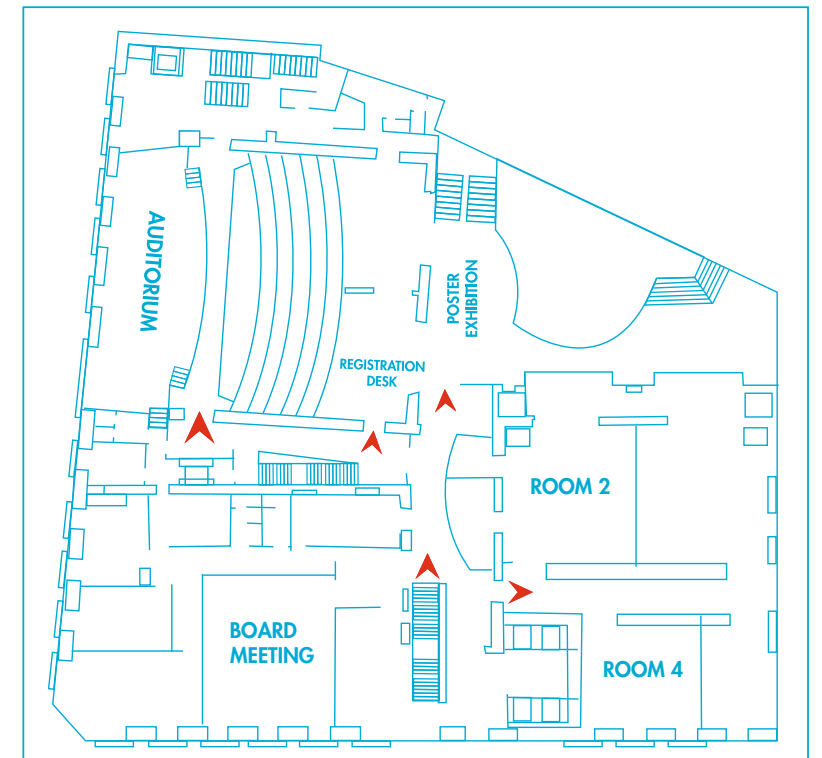
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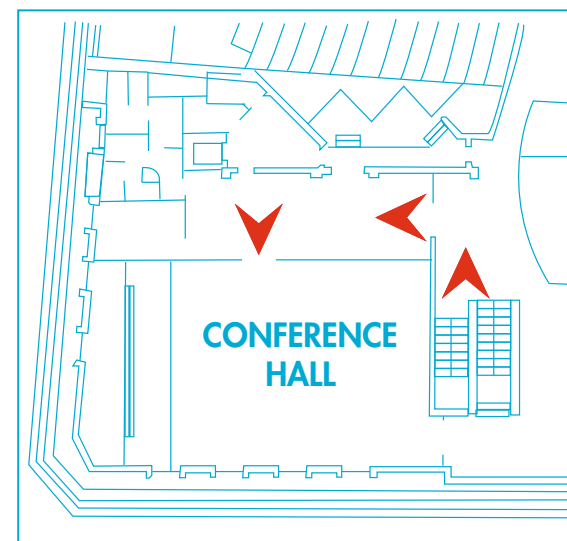
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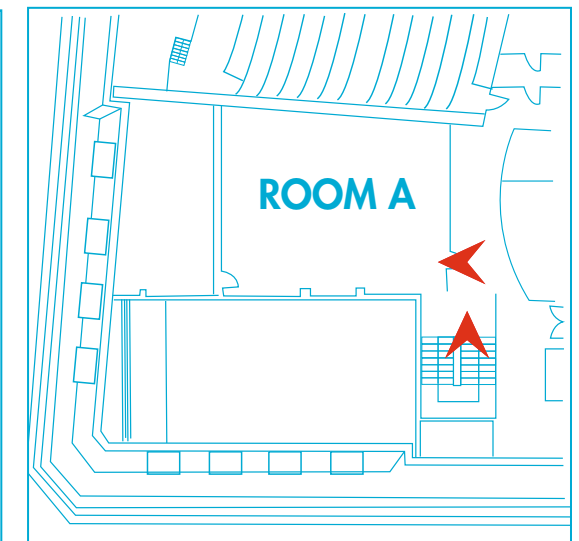
FLOOR 2



FLOOR 3



FLOOR 4





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GENERAL INFORMATION

LUNCHES & COFFEES

Symposium lunches and coffees will take place at the exhibition room (main floor). All attendees must have with them the credential to access the lunch area.

SOCIAL PROGRAMME

Please, remember that the corresponding tickets will be checked at the entrance of each social event. The credential with the tickets must be picked up at the registration desk at the venue. The attendees must confirm, in advance, the attendance to each social event.

WELCOME RECEPTION - Tuesday, 27th May

20.15 CASTRELOS MANOR HOUSE

The welcome reception will take place at Castrelos Manor House.

The buses to Castrelos Manor house will depart at 19:45 h. from the venue. There will be buses back to Vigo center at the end of the reception.

BANQUET - Wednesday, 28th May

21.00 HOTEL BAHÍA DE VIGO

Avda. Cánovas del Castillo, 24 36202 Vigo

*Special meal: In case that you need special meal ask for the corresponding ticket at the registration desk.

TOURS

The attendance to the following tours has to be requested in advance.

The ticket, that will include the information about the departure point, must be picked up at the registration desk. The attendees to the tours must deliver the corresponding ticket when boarding the bus.

BAIXO MIÑO - Tuesday, 27th May

VIGO - Wednesday, 28th May (walking tour)

SANTIAGO - Thursday, 29th May

TECHNICAL VISITS - Friday, 30th May

The attendance to the technical visits has to be requested before Wednesday, 28th of May.

The ticket, that will include the information about the departure point, must be picked up at the registration desk. The attendees to the technical visit must deliver the corresponding ticket when boarding the bus.

FREE WIFI: ncgwifi

TECHNICAL SECRETARIAT:

Orzán Congres S.L. Phone: +34 981 900 700 e-mail: eurock2014@orzancongres.com

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