Center of Rock Mechanics and Geo-hazards,Shaoxing University

Shaoxing International Forum on Rock Mechanics and Engineering Geology

B & R | The Rock Mechanical and Engineering Geological problems for the Silk Road Economic Belt and the 21st-Century Maritime Silk Road

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Shaoxing International Forum on

Rock Mechanics and Engineering Geology (SXFRG)

'Rock Mechanical and Engineering Geological problems for the Silk Road Economic Belt and the 21st-Century Maritime Silk Road (B&R)'

Shaoxing, China

28-30 October, 2017

ORGANIZER

Shaoxing University

CO-ORGANIZERS

- International Association for Engineering Geology and the Environment (IAEG)
- International Society for Rock Mechanics (ISRM)
- Natural Science Foundation of China (NSFC)
- Chinese Society for Rock Mechanics and Engineering
- Engineering Geology Commission of China
- Bulletin of Engineering Geology and the Environment (BOEG)
- Journal of Rock Mechanics and Geotechnical Engineering (JRMGE)
- Zhejiang Collaborative Innovation Center for Prevention and Control of Mountain Geologic Hazards

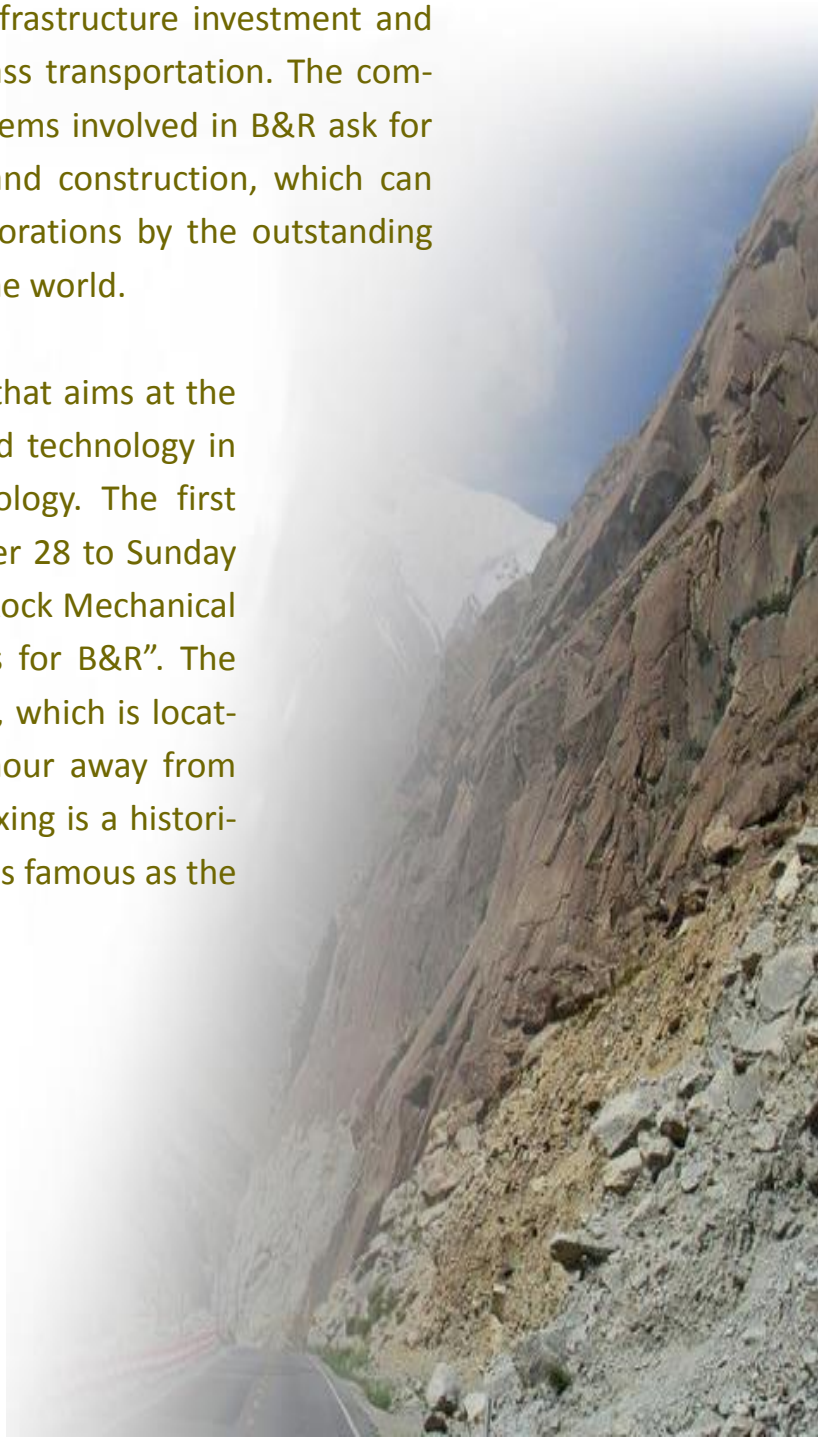
INVITATION

Entering to the new century, Chinese government initiated “The Silk Road Economic Belt and the 21st-Century Maritime Silk Road” (B&R) project to strengthen the connections among the huge populations and the numerous economic entities located in Eurasia and Africa, employing the massive infrastructure investment and construction as the foundation of mass transportation. The complex geological and geometrical problems involved in B&R ask for higher standards in survey, design, and construction, which can only be achieved by extensive collaborations by the outstanding scientists and engineers throughout the world.

The SXFRG is a series biennial forum that aims at the fundamental innovation of theory and technology in rock mechanics and engineering geology. The first Forum to be held on Saturday October 28 to Sunday October 29, 2017, will focus on “the Rock Mechanical and Engineering Geological problems for B&R”. The forum will be held in Shaoxing, China, which is located in the eastern China and is 1.5 hour away from Shanghai by high-speed railway. Shaoxing is a historical city with deep cultural connotations famous as the city of “Oriental Venice”.

Shaoxing welcome you!

Prof. Shigui Du, Chair of the SXFRG



Aims and Objectives

Rapid growth of economy and the accompanied infrastructure construction have significantly shaped the face of the world. Entering into the new century, Chinese government initiated “The Silk Road Economic Belt and the 21st Century Maritime Silk Road” (B&R) project to strengthen the connections among huge populations and numerous economic entities located in Eurasia and Africa through massive infrastructure investigation and construction as the foundation of mass transportation. While human beings are more frequently stricken by geological disasters induced by natural forces and engineering activities, the complex geological and geometrical problems involved in B&R ask for higher standards in survey, design, and construction that can only be achieved by extensive collaborations by the outstanding scientists and engineers throughout the world.

Researchers worldwide with their diligence and wisdom, their interests and passions, have already obtained some remarkable achievements in the related practices. In order to communicate and diffuse those achievements more rapidly and widely, work together to find out more efficient solutions to international challenges, it is really necessary to offer a stage to thoroughly discuss the outstanding issues involved in rock mechanics and engineering geology. Such communications and the common sense achieved would lead us to find a better way to face the even greater challenges in the rest of this century. This is the very purpose of this forum.

Conference Themes

- Rock mechanical and engineering geological problems along B&R
- Engineering geological issues in landslides and deep buried tunnels
- Monitoring and protection of geo-environment along B&R
- Rock mechanics and engineering geology in large-scale infrastructure projects
- New technology in investigation of geological hazards
- Rock burst in underground excavations
- Theoretical development in rock mechanics and engineering geology
- Laboratory testing on rocks
- Marine geological problems along B&R

General Information

About Shaoxing

Shaoxing is a prefecture-level city on the southern shore of Hangzhou Bay in eastern Zhejiang province, China. It was formerly known as Kuaiji and Shanyin and abbreviated in Chinese as 越 (Yuè) from the area's former inhabitants. Located on the south bank of the Qiantang River estuary, it borders Ningbo to the east, Taizhou to the southeast, Jinhua to the southwest, and Hangzhou to the west. As of 2010, its population was 4,912,339 inhabitants.

Notable residents of Shaoxing include Wang Xizhi, the parents of Zhou Enlai, Lu Xun, and Cai Yuanpei. It is also noted for Shaoxing wine, meigan cai, and stinky tofu, and was recently featured on A Bite of China. Its local variety of Chinese opera sung in the local dialect and known as Yue or Shaoxing opera is second in popularity only to Peking opera. In 2010, Shaoxing celebrated the 2,500th anniversary of the founding of the city.

Shaoxing University

Shaoxing University is the most prestigious institution of higher learning in Shaoxing, Zhejiang, China with a history of over 100 years. The University comprises 18 schools, offering 55 undergraduate programmes in 10 academic disciplines, three first-level disciplines for master's degree and one Master's degree granting unit. The University is now home to more than 23,000 full-time students. The Lanting School of Calligraphy is the first of its type ever established in China. It is also the calligraphy education base for both overseas students and Zhejiang Calligraphers Association. Among its 1,874 staff members, 1,238 are full-time faculty, with 147 professors and 303 associate professors. Among the faculty, there are 208 PhD degree holders and 505 Master's degree holders. Eight Guest Professors are academicians of the Chinese Academy of Science. Senior professional and technical personnel account for over 50% of the total. The University also has an independent college, Yuanpei College, and 3 affiliated hospitals. The University consists of 4 campuses, namely the Main Campus, Lanting Campus, Shangyu Campus and Jinghu Campus.

Shaoxing University was approved by the Ministry of Education of the People' Republic of China in 1996 as a multidisciplinary university growing in both popularity and strength. The history can be traced back to Shankuai Primary Normal School founded in 1909. In March 2010, the University was officially listed by Academic Degrees Committee of the State Council as a Master's degree authorization project construction unit. At present, the University has four Master's degree programmes of Chinese literature, business administration, chemistry and civil engineering.

The University has succeeded in getting 350 national and provincial projects in the past five years. It has a second prize of National Sciences and the Technology Invention, two first Prizes of Provincial Outstanding Achievements of Philosophy and Social Sciences, and the first prize of Provincial Science and Technology Progress Award. The University also has 54 scientific research institutes, such as Yue Cultural Institute, Shaoxing Institute of Economic Research, Lu Xun Research Institute, and Textile Engineering Institute. The Journal of Shaoxing University is among the science journals in China.

With the school motto "to cultivate moral integrity and to pursue the truth", the notion of "seeking the truth, committing to transformation, pursuing excellence and sharing development" and the concept of scientific development, "Shaoxing University aims at enhancing the quality of teaching and building the capacity of research. It will make further endeavors to develop itself into a top university of its kind with high prestige in China. It will strive to improve its educational services to make greater contribution to the regional, social and economic development."

Shaoxing Hotel

Shaoxing Hotel, which was founded in 1958, is a five-star tourist hotel. It is advantageously located in the center of Shaoxing, south to the Wolong Mountain and adjacent to the Town Square. Shaoxing Hotel, standing in simple and elegant surroundings, with winding path and corridor, buildings of white walls and black tiles, is provided with typical characteristics of Canal Town in South of Yangtze.

Tianhuangping Pumped Storage Power Plant

Tianhuangping pumped storage power plant is located in Anji County, Zhejiang Province. It is near the load center of East China Power Grid with a favorable position and easy accessibility, approximately 175 km away from Shanghai, 180 km from Nanjing, 57 km from Hangzhou, and 34 km from Pingyao 500 kV substation.

With a total installed capacity of 1,800 MW, the plant is a pure daily-regulated pumped storage poser plant. The designed annual energy output is 3.160 billion kWh and annual energy consumption for water pumping is 4.286 billion kWh.

The drainage area of Daxi creek, where the lower reservoir dam locates, is 24.2 km^2. The mean annual rainfall is 1,846 mm, and mean annual runoff is 24.50 million m^3. The stratum of the plant area mainly consists of Jurassic volcanic rock, and dikes intruded in later periods. The Quaternary stratum covers large area.

Main Structures

The plant consists of upper reservoir, lower reservoir, water conveyance system and powerhouse complex, which are in the middle area of Tianmu Mountains. The lower reservoir is in the valley of Daxi creek, a branch of Xishaoxi River in Taihu Lake basin, and the upper reservoir lies in a depression, where a branch of Daxi creek originated. The water conveyance system and powerhouse are underground. The natural head difference between the upper and the lower reservoirs is about 590 m, and the average head is about 570 m after the reservoirs formed. The horizontal distance between the two reservoirs is only about 1,000 m.

The average length of the water conveyance conduit is 1,428 m. the ratio of the water conduit length (L) to the potential head (H) is 2.5, which is much lower than the value of both domestic and abroad plants with similar heads. The plant has very favorable topographic values.

(1) Upper Reservoir

The upper reservoir, with one main dam and four subsidiary dams, was constructed by excavating and backfilling of a natural depression. The dams are earth-rock dams and the crest is at EL907-908.3 m. The main dam is 72 m high, and the crest length is 503 m. The total storage capacity of the reservoir is 8.85 million m^3, and the working depth is 42.2 m.

(2) Lower Reservoir

The lower reservoir has a concrete faced rock fill dam, with crest elevation of 350.2 m. height of 95 m and length of 230 m. there is a spillway on left bank, and a diversion tunnel on right bank. The total storage capacity of the reservoir is 8.87 million m^3, and the working depth is 49.5 m.

(3) Water Conveyance System

The water conveyance system is inside the mountains at the left bank of Daxi creek, and mainly consists of intake/outlets and gate shafts of the upper reservoir, inclined shafts, reinforced concrete manifolds, branch tunnels, tailrace tunnels and intake/outlets of the lower reservoir. There are two concrete inclined shafts, with the inclination of 58° and internal diameter of 7 m. Each shaft branches to three penstocks at elevation 225.0 m, with the internal diameter of 3.2 m. six tailrace tunnels are 4.4 m in diameter.

(4) Underground Powerhouse Complex

The underground powerhouse complex mainly consists of main and auxiliary machine hall, assembly bay, main transformer tunnel, bus-bar galleries, tailrace tunnels, and other tunnels and shafts for access, ventilation, drainage, etc. the main and auxiliary hall is 200.7 m in length, 21 m in width and 48 m in height.

(5) Switchyard

At the elevation of 350.2 m, the 500 kV switchyard is located above the tailrace tunnels on the left bank of the lower reservoir, with an area of $220^{o} \times 35$ m^2, equipped with GIS. The 35 kV substation is on the left of the switchyard, and the central control building on the right.

Friday 27 & Saturday 28 October

Friday 27 October

Registration
08:00 – 18:00

Reception
18:00 – 21:00

Location
Shaoxing Hotel

Saturday 28 October

Time	Program	Speaker	Topic
08:00-08:30	Opening Speech		
08:30-08:35	Award Ceremony		
08:35-08:50	Group Photos		
08:50-09:50	Keynote Report	Paul Marinos	Tunneling in Difficult Ground Uncertainties and Decisions. Attention to the Himalayan Range
09:50-10:00	**Coffee Break**		
10:00-11:00	Keynote Report	Zhigang Shan	Several Rock Mechanics Problems and Countermeasures in Deep-Buried Caverns of Hydropower Project
11:00-12:00	Keynote Report	Ricardo Oliveira	Engineering Geology in Large Scale Projects
12:00-13:30	**Lunch Time**	(Restaurant: Duizhu Hall)	
13:30-14:05	General Report	Yangsheng Zhao	An Experimental Study on Oil and Gas Extraction from Oil Shale by in-situ Steam Injection in Bogurada Mountain, Xinjiang Province
14:05-14:40	General Report	Victor Osipov	Engineering Geological Zoning of Urban Area as an Adaptive Nature-Use Technology
14:40-15:15	General Report	Huagang Shan	Geotechnical Problems in Large-Scale Infrastructure Constructions in Shaoxing Area
15:15-15:25	**Coffee Break**		
15:25-16:00	General Report	Bo-An Jang	Laboratory Investigation of Fracture Propagation by Hydraulic Fracturing Under Triaxial Stress
16:00-16:35	General Report	Jianbo Song	The Key Engineering Geological Problems of the Site Selection of Five-Hundred-Meter Aperture Spherical Telescope (China's Eye of Heaven) in Guizhou Province
16:35-17:10	General Report	Giorgio Lollino/ Paolo Allasia	Advanced Technologies in A Landslide Monitoring Systems. Application of The Robotized Inclinometer Systems in Landslide Areas
17:10-17:45	General Report	Jun Sun	Achieve the Innovation of Ultra-high-Speed Ground Transportation. Make the Dream of Building Cross-sea Bridges and Tunnels on Both Sides of the Taiwan Straits Come True

Sunday 29 & Monday 30 October

Sunday 29 October

Time	Program	Speaker	Topic
08:00-09:00	Keynote Report	Manchao He	Rock Mechanics and Engineering Geology Problems in B&R
09:00-09:35	General Report	Mark Eggers	Importance of the Engineering Geological Model in Rock Slope Engineering
09:35-10:10	General Report	Hehua Zhu	3D Nonlinear Strength Criterion for Rock and its Applications
10:10-10:20	**Coffee Break**		
10:20-10:55	General Report	Haris Saroglou	Rock Mass Classification in Anisotropic RockMasses. The New RockMass Classification System, A-RMR
10:55-11:30	General Report	Lanru Jing	Impact of Rock Fractures on Computational Rock Physics
11:30-12:05	General Report	Rafig Azzam	Monitoring and Early Warning System in Earth Management
12:05-13:30	**Lunch Time**	(Restaurant: Duizhu Hall)	
13:30-14:05	General Report	Carlos Delgado	Tunnel Under the Strait of Gibraltar
14:05-14:40	General Report	Guowei Ma	A Coupled THC Model for Wormhole Propagation in 3D Fractured Carbonated Rocks
14:40-15:15	General Report	Norikazu Shimizu	Monitoring Ground Displacements Using Satellite Technologies
15:15-15:50	General Report	Yonggang Jia	Marine Engineering Geology in the Maritime Silk Road: Geological Problems and *In-situ* Observation
15:50-16:00	**Coffee Break**		
16:00-16:35	General Report	Maria Heloisa Barros de Oliveira Frascá	Laboratory Testing in Engineering Geology/Stone Properties Determination and its Application
16:35-17:10	General Report	Xiating Feng	Monitoring, Warning and Dynamic Control of Rockburst at Tunnels
17:10-17:45	General Report	Scott Burns	Urban Landslides: Challenges for Forensic Engineering Geologists and Engineers
17:45-	Closing Speech		

Monday 30 October

Field Trip to Tianhuangping and Changlongshan

Set off at 7:30 AM at Shaoxing Hotel

Lunch location: Changgu Restaurant

Scientific Committee

(In Alphabet Order)

Chairs:

Manchao He, China
Scott Burns, USA

Members:

Rafig Azzam, Germany
Giovannia Barla, Italy
Fred Baynes, Australia
Zuyu Chen, China
Yujun Cui, China
Martin Culshaw, UK
Yogendra Deva, India
Shigui Du, China
Mark Eggers, Australia
Derek Elsworth, USA
Xiating Feng, China
Maria Heloisa Frasca, Brazil
Runqiu Huang, China
Jianliang Jiang, China
Yujing Jiang, China
Lanru Jing, China
Shucai Li, China
Xibing Li, China
Giorgio Lollino, Italy
Guowei Ma, China
Silvina Marfil, Argentina
Paul Marinos, Greece
Ricardo Oliveira, Portugal
Victor Osipov, Russia
Jianbing Peng, China
Qihu Qian, China
Eda Quadros, Brazil
Louis van Rooy, South Africa
Zhigang Shan, China
Norikazu Shimizu, Japan
Shengwu Song, China
Jun Sun, China
Chunan Tang, China
Resat Ulusay, Turkey
Sijing Wang, China
Faquan Wu, China
Caichu Xia, China
Qiang Yang, China
Hehua Zhu, China

Secretariat (In Alphabet Order)

Secretary-General:

L.R. Sousa, Portugal
Faquan Wu, China

Secretary:

Yunjin Hu, China
Bo Li, China
Zhuo Wang, China

Organization Committee

(In Alphabet Order)

Chairs:

Shigui Du, China

Members:

Zulie Fang, China
Yan Feng, China
Xiating Feng, China
Long He, China
Shengwen Qi, India
Wei Shen, China
Caichu Xia, China
Juhua Xiong, China
Wenli Xu, China
Fengwen Zhao, China

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Keynote Report

General Report

Paul G. Marinos
(Emeritus professor of Engineering Geology, Nat. Tech. Univ. Athens)

Paul G. Marinos is an Emeritus professor of Engineering Geology, Nat. Tech. Univ. Athens. Past President International Association of Engineering Geology and the Environment. Past President of the Geological Society of Greece. Independent Consulting Engineer.

Mining Engineering degree from the School of Mines of NTUA in 1966, graduate studies in Applied Geology and PhD from the University of Grenoble, France, 1969. Visiting Professor University of Grenoble (1987) and Paris School of Mines (2003).

Awards: Jahns Distinguished Lectrer of AEG/GSA, Hans Cloos medal of IAEG, Andre Dumont medal of the Geological Society of Belgium, Glossop medal of the GSL, presentation of named lectures around the world. Dr Honoris Causa of the University of Thrace. Knighted by the French Republic (Palmes Academiques).

Research on a variety of applications of geology to engineering particularly on rock mass characterization and behavior. Author of over 350 papers in journals or major conference proceedings. Editor in chief of the scientific journal “Geotechnical and Geological Engineering”

Consultant or expert on major civil engineering structures works all around the world, mainly dams and underground works, landslides and water resources projects.

Tunneling in Difficult Ground Uncertainties and Decisions. Attention to the Himalayan Range

Abstract: The growth of infrastructure needs has increased the demands for the excavation of tunnels in poor ground or varying geological conditions. The assessment of ground for design has to be based on a sound understanding of the regional geological rules and the establishment of a geological model, where data and conditions are translated into an engineering description. A series of geological models for a variety of rocks associated with different structural conditions in various tectonic environments, based on the geological history are presented. Site investigation is an important factor for the establishment of the geological model and it must be based on a sound geological understanding of regional geology, otherwise it is likely not to find much of value. Examples and cases from both mountain and urban tunnels under complex or difficult geological conditions are discussed.

Going from the geological model to the ground model, the design requires knowledge on the quality of the material in which the tunnel will be constructed.

Engineering design requires numbers and the lecture explores and discusses methods that can be used to assess the geological factors that have an impact on this quality. These mainly are the quality of the intact rock, the fabric of the mass, the quality of discontinuities. Since the attempt of Terzaghi, in 1946, to correlate the characteristics of a rock masses for the tunnel design, a

number of rock mass classifications have been developed and play an important role providing input data on strength and deformation properties of the ground for numerical models. A discussion on this issue is presented, with the field of application of this quantitative characterization of the rock masses and its limitations. Together with the rock mass properties, the in situ stresses field has to be estimated or measured and this is one of the most difficult tasks.

Although the role of engineering geology has been extended into the area of defining the design parameters, the idealization process, in the form of numerical analysis, should be driven by sound geologic reasoning in order idealization does not misinterpret reality. In this context, the understanding of the real behavior is indeed absolutely necessary before any calculation is attempted. Thus, the engineering geological "I.D" of the geo-material and the stress environment define this ground behavior such us: brittle failure, gravitational falling or sliding or "chimney" type failure, or raveling, or formation of a "plastic" zone by shear failure with deformation problems and squeezing, or swelling.

Mechanizing tunneling is discussed in relation with the geological conditions in complex mountain ranges and particularly the use of the appropriate type of TBM to face either rock bursting phenomena or squeezing ground.

Along the lecture geological uncertainties and decisions, in the design and construction are discussed. These relate to:
-spatial changes of the geological formations with particularities in their borders, some time with chaotic structure.
-variability of properties of the ground and its behavior
-in situ stresses, with some particular and extreme cases
-specific geological features, such as fault zones, thrusts
-hydrogeological conditions with special emphasis to karst
Examples from a number of tunnels from around the world illustrate the design and construction procedures. Attention is specified to tunnels in the Himalayan range.

Manchao He
(China University of Mining & Technology, Beijing, China)

Manchao He is currently an Academician in Chinese Academy of Sciences, Professor at China University of Mining and Technology, Beijing (CUMTB). He is also the Director of State Key Laboratory for Geo-mechanics and Deep Underground Engineering in Beijing, China. He is recognized as the leader of the Chinese Union for Mining Innovation (CUMI) and the President of Chinese Society for Rock Mechanics and Engineering (CSRME). And he served as the Vice President of International Society for Rock Mechanics (ISRM), Chairman of ISRM Education Fund Committee.

He received his Bachelor and Master Degree in engineering geology from Changchun College of Geology in 1981 and 1985 respectively, and obtained his Ph.D. in Engineering

Mechanics from CUMTB in 1989. He got an Honorary Doctorate from University of Mons in Belgium in 2012. He mainly engaged in the research of Rock Mechanics and Engineering, including landslide, active fault stability analysis, monitoring and control, rock burst mechanism, mining technologies, etc. He has published 5 books and over 160 papers in technical journals and in conference proceedings. He also serves on the Editorial Board of several Journals, and received four National Prizes and awards in his career.

Rock Mechanics and Engineering Geology Problems in B&R

Abstract: The route of One Belt and One Road need to across Europe and Asia, so the basic construction, element of B&R, will faces many complicated geological conditions. The geology disasters, such as landslide of slope, rock burst of deep tunnel or roadway, excavation subsidence and earthquake, are likely to appear. At present, the challenges, which need to find countermeasures, can be classified as three types: Monitoring of landslide and active fault, Prevention of mining subsidence, Prevention of rock burst.

Both landslide and earthquake can be shown in a model of double-blocks separated by a sliding plane. The key point for geo-disaster prediction is the Newton force variation along the sliding plane. However, measurement of the Newton force on the sliding plane is extremely difficult. Therefore, most of the current researches on earthquake and landslide rely on monitoring the displacement between the two blocks. The relative displacement between the two blocks is considered the necessary condition but not the sufficient condition for the occurrence of the earthquake and/or landslide. This may be the reason for the general recognition of the limitation on geo-disaster prediction. The Newton force is the necessary and sufficient conditions for initiating a geological disaster due to the block motion, using the so-called constant-resistance and large-deformation (CRLD) cable with negative Poisson's ratio (NPR) effect. Hence, the double-block mechanics (DBM) model of geological disaster based on the Newton force variation detection method provides theoretical and practical base for the monitoring pre-warning and control of similar geological disasters.

Underground mining produces mining pressure, which interaction with strong support can result in mining subsidence. The root is that conventional mining method (excavating two roadways with one pillar left for mining a working plane, called as 121 mining method) has not suitable. The countermeasure is find a new mining method (excavating only one roadway and leaving no pillar for mining one coal seam, called as 110 mining method), which has appropriate support and can utilizes mining pressure to release energy. This method can be implemented using cutting cantilever beam theory (CCBT) and the key technologies, including the directional presplitting roof cutting, CRLD bolt/cable supporting system with NPR effect material; remote real-time monitoring technology. The roof cutting not only optimizes the stress distribution but also cuts the path of stress transition, which reducing the mining pressure of roadway.

The rock burst will bring out greater threats to the underground openings and it mechanism and criteria have been investigated through laboratory experiments. The pre-

vention of rock burst must meet following requirements: absorbing energy and bear ing large deformation. The CRLD bolt/cable not only has the two requirements but also can keep constant. So, the rock burst can be prevented by designing the number and distribution of CRLD bolt/cable.

Hence, the countermeasures also have been found to meet the challenges of rock mechanics and engineering geology in B&R strategy.

RICARDO OLIVEIRA

President, Scientific Council of COBA Group Engineering and Environmental Consultants

Social Post

- President, Scientific Council of COBA Group, Engineering and Environmental Consultants
- President of COBA Group, Engineering and Environmental Consultants (1988/ 2011)
- Director of COBA Group, Engineering and Environmental Consultants (1972/ 1988)
- Emeritus Professor of Engineering Geology and of Rock Mechanics, New University of Lisbon (2008)
- International Consultant for Dams, Underground Works, Bridges and Motorways for several institutions, namely the World Bank, the Kuwait Fund and other multilateral Agencies
- President Executive Committee CRP (Portuguese Road Center)
- Specialist Degree (PhD level) in Engineering Geology (1965), LNEC, Portugal
- Senior Research Degree (Full Professor level) in Geotechnique (1983), LNEC, Portugal
- Doctor Honoris Causa, Complutense University of Madrid, Spain. (1998)
- Visiting Professor at several Universities, namely in Brazil; Canada, Soviet Union, Spain, and Switzerland
- Author of over 350 technical reports and scientific papers, general reports and chapters of national and international books
- Member of several Scientific and Professional Portuguese and International Associations
- Member of the Portuguese Academy of Engineering
- Member of the Brazilian National Academy of Engineering

Received several distinctions and honorable mentions from national and international scientific bodies namely the Hans Cloos Medal (IAEG, 1996), Manuel Rocha Research Prize (LNEC, 2002) and Andre Dumont Medal (Belgian National Group of IAEG, 1993)

- Delivered the IX Manuel Rocha Memorial Lecture (Lisbon, 1992)
- Was awarded the Insignia “Grande Oficial da Ordem de Merito” by the President of the Republic of Portugal (2006)
- Deputy Director of LNEC (1983/1991)
- Secretary General ISRM (1968/1974)
- President of IAEG (1990/1994)
- Vice President Europe of IAEG (1986/ 1990)

Engineering Geology in Large Scale Projects

Abstract: The safety of Large Scale Projects is a major requirement for their implementation. That safety depends on the structural behavior of the projects which is a function of the geological and geotechnical conditions of the related ground serving as foundations of the project (case for example of Dams and Bridges) or as a terrain to be excavated (case for example of Tunnels and High Slopes).

This implies, during the design stage; the assessment of the geological conditions and geotechnical behavior of the ground (rock mass or soil) in order to design these large projects properly, avoiding collapses and damages.

During the second half of the 20th century, large structures expanded all over the world because of the economic development experienced by many countries. In most cases, those structures had a significant interference with the ground and large collapses resulted from a lack of information concerning the geological, hydrogeological and geotechnical properties of the terrain.

That situation contributed to the establishment of two new sciences, Engineering Geology and Rock Mechanics, responsible for the geological modelling of the ground and for the assessment of its relevant geotechnical properties.

In general, that is only possible, after a comprehensive geological reconnaissance, through the establishment of a site investigations program, using techniques adapted to the nature of the ground and to the associated engineering problems. With that information, it will be possible to prepare the engineering geological model of the ground and, based on the respective characteristics, to have a proper and safe design of the respective foundations.

The presentation illustrates the principles referred above applied to the design of the foundations of Ribeiradio Dam, 76 m high concrete gravity, in a very difficult rock mass, and of Vasco da Gama Bridge, 13 Km long, crossing the Tagus River in Lisbon, through piles 75 m deep and up to 2.2 m in diameter. If time permits, the presentation will still include the interesting case of a very shallow double tunnel in a motorway, second ring road around Lisbon, which had to replace an open excavation section of the motorway, because Dinosaurs footprints were found during construction.

Zhigang Shan
(Huadong Engineering Corporation, PowerChina, Hangzhou, Zhejiang, China)

Social Post:
Professor of Engineering

- Postdoctoral Supervisor of Huadong Engineering Corporation
- Doctoral Supervisor of Hohai University
- Registered Engineer of Civil Engineering
- Winner of Special Government Allowance

- National Candidate of “New Century Talent Project”
- Young and Middle-aged experts With National Outstanding Contribution
- Master Designer of the National Electric Survey and Design Industry
- Master of Engineering Survey and Design of Zhejiang Province
- Young and Middle-aged Experts with Contribution to Zhejiang Province
- New Century 151 Talent Project Expert

Zhigang Shan has been engaged in engineering geological survey for 31 years. He holds a position in a number of institutes and organizations.

- Deputy Chief Engineer of Huadong Engineering Corporation
- Deputy Chief Engineer of Dam Safety Supervision Center of National Energy Bureau
- Member of the China national Committee of International Association of Engineering Geology and Environment (IAEG)
- Vice Chairman of Committee on Geology and Exploration of Chinese Society of Hydroelectric Engineering
- Vice President of Underground Engineering Branch of China Rock Mechanics and Engineering Society
- Member of the Committee on Engineering Geology of China Geological Society
- Vice President of Geomechanics and Engineering Society of Zhejiang Province

Zhigang Shan mainly engages in engineering geological survey, and research of hydropower and civil engineering. He has hosted and participated in geological survey of more than 40 hydropower projects, such as the national key project Jinping II hydropower station, Baihetan hydropower station. He has also took part in decisions making, technical managements of key geological and technical problems in more than 100 civil engineering projects. He has undertaken more than 20 scientific research projects.

- Four Natural Science Foundation of China (NSFC)
- One National Basic Research Program of China (973 Program)
- One editor-in-chief National Standard and five National Energy Industry Standard
- One coedit National Standard
- Nine National Energy Industry Standard

Awards and Patents:

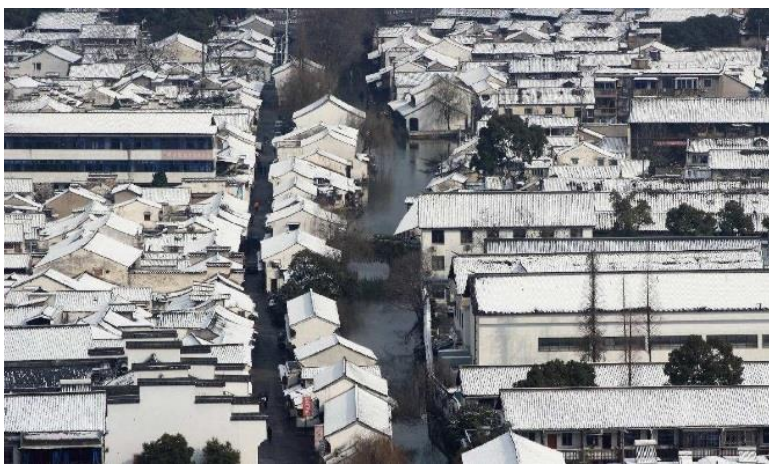
- The Second Prize of National Science and Technology Progress
- Several Provincial Prizes
- 48 Authorized Patents (23 for Invention), and More Than 90 Papers

Several Rock Mechanics Problems and Countermeasures in Deep-Buried Caverns of Hydropower Project

Abstract: Many deep-buried caverns are designed in China’s hydropower project, and rock mass of which are usually in high ground stress conditions. Strong excavation unloading and complicated geological conditions induce complexity of mechanical properties of rock mass, as well as diversity of rock mass failure types, which result in huge challenges for construction, normal support measures may not meet the requirements for stability. This paper puts forward several rock mechanics problems and countermeasures in powerhouses of Baihetan and deep-buried long tunnels in Jinping II.

Baihetan hydropower station is located in lower reaches of Jinsha River, which is the biggest hydropower station under construction in the world at present. Concrete hyperbolic arch dam is 289.0 m high maximum, with the installed capacity of 16,000 MW, including 8 Francis turbine generators of 1,000 MW respectively. There developed several disturbed belts and columnar joints in basalt rock mass of powerhouse site, and the maximum ground stress is up to 33 MPa. Therefore, both of the discontinuity and stress controlled instability problems occurred in the project, and the problem seems more serious when the columnar joints basalt under high ground stress, which is closely related to the cavern size, span and height. After rock deformation analysis, this paper puts forward the support requirements of systematicness (cooperative work of several support measures), timeliness and pertinence, blasting control, monitoring and detection (deformation, stress and relaxation depth), and corresponding countermeasures.

Jinping II hydropower station with the installed capacity of 4,800 MW. The four diversion tunnels, approximately 17 km each, are generally buried in the depth of 1000 ~ 1,500 m and even up to 2,525 m. The hydraulic tunnels of this project is largest in scale, most comprehensive difficulty, highest ground stress (up to 100 MPa), highest external water pressure (up to 10 MPa) all over the world. Due to the deep buried depth and high ground stress, 50% of the tunnel sections occurred high stress failure, and more than 1000 times rock burst, and 111 times in which are severe to extremely severe. The excavated ground water has some special characteristics, including high external water pressure, large discharge, highly exchange, abruptness, etc. And the maximum external water pressure attained is 10 MPa. In order to provide initial data for the rock mass stability analysis, several new measures are conducted or invented, including stress testing system of ultrahigh pressure hydraulic fracturing (fracturing pressure up to 94.97 MPa, maximum horizontal principal stress up to 113.87 MPa), deep buried brittle rock nondestructive sampling technology, rock mass classification system under deep-buried and high external water pressure. And several support measures are adopted in this project, including a method of dynamic back-analysis of rock mass stability for deep-buried project, in-time support (Spray Nano concrete + water expansion bolt, maintain the ground pressure and prevent the fracture progress), raised shell pre-stressed bolt (take full advantage of the arch effect of the palm), system shot bolting support system (strengthen the disturbed zone). In order to guarantee the long term safety for the hydraulic tunnels, the surrounding rock is considered to be the major bearing subject, and bolting and shot Crete support system, reinforced concrete lining and high pressure consolidation grouting measures are conducted to enhance the surrounding rock also, therefore, the rock mass and the support system become a unified complex and a complex bearing structure, by external water pressure release technology (Drainage drift + relief hole). The monitor results indicates that the operation situation of the project is well.



Achieve the Innovation of Ultra-high-Speed Ground Transportation. Make the Dream of Building Cross-sea Bridges and Tunnels on Both Sides of the Taiwan Straits Come True

Jun Sun

Abstract: The increase in transportation speed signifies the process and improvement of technology in transportation construction. Regarding the construction of high-speed railways, as the operational speed accelerates, the wind-driven resistance it receives in condensed atmospheric layer, various resistances caused by the friction between wheels and uneven rail surfaces, and the noises that they bring will increase exponentially. Therefore, the problems of operation economy and security involved become important factors that influence the further speed increases of ground transportation. This study presents a plan of building subsea vacuum tunnels and submerged long bridges employing vacuum pipes. The speed is expected to be more than 1,200 km/h, almost 4 times as fast as it is now, after the treatment of seal processing to the pipes and railway carriages, and the adoption of "Transporting System in Ultra-high-Speed Vacuum Maglev Train" utilizing magnetic levitation technology. The suggestions in this article are: first of all, build "submarine vacuum tour bus" for the purpose of developing the ecotourism of the port cities and the neighboring islands; then, carry out a series of necessary technological experiments during the test running, for the purpose of improvement and completion. It is probable to promote the ultra-high-speed transportation system in strait passages in China, and realize the dream of building a mighty country in bridge and tunnel constructions when considerable knowledge through the practical experiences is obtained.

Geotechnical Problems in Large-Scale Infrastructure Constructions in Shaoxing Area

Huagang Shan

Abstract: Shaoxing, a coastal city in Southeast China, being situated at the foot of hills and beside waters, is a typical Canal Town in South of the Yangtze. The terrain in Shaoxing is generally high in the North and Low in the South. The Northern parts are plains with densely covered river networks and numerous lakes, while the South parts are hilly areas with dense vegetation and beautiful scenery.

This article briefly introduces the geology of Shaoxing area, and lists some geotechnical problems in several large-scale infrastructure constructions and the corresponding solutions to them. such as the cases in large diameter pile foundation of large bridge, the control of soft soil foundation settlement in expressway, foundation pit excavation and supporting system in subway, prevention and control of geological hazard, and so on.

Engineering Geological Zoning of Urban Areas as an Adaptive Nature-Use Technology

Victor Osipov

Abstract: The strategy of human-nature interaction is considered, based on two kinds of anthropogenic activities: (a) nature consumption, i.e., extraction and use of natural resources necessary for civilization survival and (b) nature use or nature management in the course of economic activity, which is aimed at providing comfortable and safe living on the Earth. The rational application of the first principle depends on the technological level of civilization development, whereas the second principle is based on the requirement to adapt the economic activity to natural conditions. The principles of adaptive nature-use technologies and cases of their application are explained by the example of civil construction and waste management.

Engineering geological zoning of urban areas is the case of applying the adaptive nature-like technology in civil engineering. By the example of large-scale engineering geological zoning of Moscow area, it is shown that the engineering geological map permits to subdivide the area by its favorability for construction, to outline the optimal locations for residential, industrial and recreational zones, to develop the general scheme of engineering protection of the territory and to optimize the issues of safety, cost, and environmental comfort upon the constructional development of the city.

Seismic microzoning as another example of applying adaptive technologies of nature use to engineering geology. The case of seismic microzoning at the Imeretinskaya depression at the Black Sea coast in the vicinity of Sochi, Caucasus, performed at the Sergeev Institute of Environmental Geoscience RAS during planning the construction of the Olympic games facilities is considered.

And finally, the territory zoning for municipal landfill allocation is scrutinized as a case of applying the adaptive nature-like technology to waste management. The scheme of zoning of the Central region of Russia by the conditions of solid domestic waste disposal is given as an example.

The Key Engineering Geological Problems of the Site Selection of Five-hundred-meter Aperture Spherical Telescope (China's Eye of Heaven) in Guizhou Province

Jianbo Song

Abstract: On September 25, 2016, the five-hundred-meter Aperture Spherical Telescope (FAST), honored as "China's Eye of Heaven", was formally operated in DaWoDang depression of KeDu town, PingTang County, Guizhou province, which was the most recommended position of Prof. Song's scientific research team. How to find the most perfect “eye socket”-DaWoDang depression-as the site from numerous karst depression in Guizhou province was a vital scientific challenge in the construction of FAST project. Combining with the following issues: sites conditions, placement requirements and the key scientific problems needed to be solved during the site selection process, this report systematically expounds the theory & method of site selection of large spherical telescope（FAST/SKA）

in karst region, Guizhou province. The first part mainly expatiates the geological background, the characteristics of the new tectonic movement, the seismicity and the risk of earthquake, the characteristics of the tectonic stress field and the division of the tectonic region stability; The second part focuses on the regularities of distribution of karst and peak-cluster depression area in Guizhou province, the 3D simulation and optimization design system of the station location, the site evaluation and optimization theory of five-hundred-meter aperture spherical telescope (FAST), the site layout and the realization method of the square kilometer array (SKA); The third part preliminarily discusses the following key engineering geological problems of the core site-DaWoDang depression: the regional, geological and environmental conditions, the seismic and dynamic response characteristics, the stability evaluation theory of rock slope, karst collapse and the stability of its roof, etc.

Laboratory Investigation of Fracture Propagation by Hydraulic Fracturing Under Triaxial Stress

Bo-An Jang

Abstract: A laboratory-scale hydraulic fracturing test was conducted to investigate the characteristics of fracture development under variable conditions of differential stress and injection fluid viscosities. The breakdown pressure measured was identical to that calculated theoretically when the viscosity was 1 cSt; however, the breakdown pressures increased exponentially as the injection fluid viscosities increased. A slight difference in the rate of breakdown pressure increase during the experiment was observed in the 8 MPa case compared with the 3 MPa case.

Fracture development was controlled by the magnitude of differential stress. When the differential stress that is the difference between the maximum and the minimum principal stresses was small (3 MPa), the fracture propagation direction deviated from the maximum principal stress direction and multiple fractures were generated. In contrast, when differential stress was large (8 MPa), a single fracture propagated parallel to the maximum principal stress direction, as predicted by the elastic modelling of hydraulic fracturing. Fracture development in the 3 and 8 MPa cases was analyzed using AE signals, yielding results similar to those observed visually after the experiments. The fracture locations in the 3 MPa case were distributed more widely than those in the 8 MPa case. The results indicate that horizontal drilling for shale gas development should be oriented to ensure that the differential stress across the formation is small. In addition, low-viscosity injection fluid should be used to maximize the hydraulic fracturing of shale with a low breakdown pressure.

Advanced Technologies in a Landslide Monitoring Systems. Application of the Robotized Inclinometer System in Landslide Areas

Giorgio Lollino/ Paolo Allasia

Abstract: Monitoring systems are a very important element for the study of geo-hydrological problems and in the field of engineering geology. Hardware and software technology innovations over the last years have improved the features of the systems for the point of view of the algorithms, complexity, accuracy and costs. The application of advanced technologies joined at new investigation techniques allow continuous and remote controls on parameters involved in the evolution of the slope instability phenomena or in the geo-engineering problems.

In this field, the Geohazard Monitoring Group (GMG) of IRPI-CNR have developed and patented a new instrumentation to measure the deep-seated ground deformations using an inclinometer probe in a robotized system. Inclinometer measurements are widely used for monitoring of landslides, retaining walls, piles and in all geo-engineering contexts where is necessary to measure deep-seated ground behavior (landslide or other geo-engineering process). This instrumentation combines the advantages of the traditional measurements with a robotized approach that increase the results in term of revisit time, repeatability and accuracy. The AIS (Automated Inclinometer System) allow to explore automatically the complete length the borehole and can, sometimes, be used as an alternative to in place inclinometers or in combination with them.

This system was used in the last years in several landslide areas in Europe on boreholes until 120 meters depth with interesting results. With a daily (or more) measurements has been possible to investigate the relationships between deep displacements, rainfalls, snowmelt for landslide characterization but also to analyze the triggering factors.
A critical review on the monitoring approach, instrumentation and technologies used will be carried out through some case studies in Apennine and Alpine area (Italy and Swiss) and in the Pyrenees Mountains.

An Experimental Study on Oil and Gas Extraction from Oil Shale by in-situ Steam Injection in Bogurda Mountain, Xinjiang Province

Yangsheng Zhao

Abstract: oil Shale deposit is huge reserves, and undeveloped important unconventional oil and gas resources, scholars in many countries around the world are committed to in situ distillation of oil shale, as not yet the development of industrial scale. Authors devotes to the in situ thermal oil shale mining research for more than 20 years, this paper introduces under the action of different anaerobic dry distillation temperature, microscopic CT technology for oil shale pore, the changing rule of the micro cracks, expounds the change of microscopic pore and fracture in situ heating oil shale, relevant laws and the dry distillation and oil and gas migration. Put forward of coupling mathematical model for deformation, seepage, heat and mass transfer in situ thermal oil shale mining shale oil, and with a large number of numerical simulation

studies, revealed to process and law of heat transfer and pyrolysis from the macroscopic fracture to micro crack and pore, provides scientific guidance to thermal exploitation in situ of oil shale. Studied the xinjiang Bogurda Mountain shale deposit occurrence characteristics, and its development in situ technology solutions.

Importance of the Engineering Geological Model in Rock Slope Engineering

Mark Eggers

Abstract: This paper seeks to outline the interaction of engineering geology and rock mechanics in the slope design process. This interaction is best directed through the use of an engineering geological model which is a concept that is not well explained in standard texts on engineering rock mechanics and rock slope engineering. Often textbooks have an introductory chapter on geology which typically discusses the influence of geological factors on rocks and rock mass. However, the role of the engineering geological model in slope design is usually not addressed.

A key focus of model building in engineering geology is management of gaps and uncertainties in the site investigation and the resulting issues about accuracy and representativeness of the collected data. The modelling process is centered on the scientific method and employs the key ideas of heuristics and inductive reasoning. It is important the roles of the geologist and engineer are clearly communicated during each stage of project development including their contributions to the Conceptual, Observational, Geotechnical, Analytical and Construction model types.

In rock slope engineering the principal objective of the engineering geological model is identifying and understanding the geological controls on potential slope failure mechanisms. This understanding forms the basis for analysis and supports engineering decisions made in design. In particular the engineering geological model provides the analytical model geometry, informs the strength properties and groundwater conditions and explains the shape and nature of the failure path. This knowledge controls decisions on the most suitable methods to be adopted in engineering analysis.

Geological controls on the major components of the model for slope engineering are discussed including regional to project scale geological setting, rock mass, structure and water. The emphasis is on how these elements come together in the evaluation of the critical failure mechanism controlling slope design. This process is demonstrated for a number of mining and civil engineering projects in Australia, New Zealand and Southeast Asia.

3D Nonlinear Strength Criterion for Rock and its Applications

Hehua Zhu

Abstract: First, Hoek-Brown (HB) strength criterion is introduced and a generalized 3D HB strength criterion is presented, which is also called as Generalized Zhang-Zhu(GZZ) strength criterion by international researchers. The GZZ strength criterion is an ISRM suggested method (2012). Furthermore, the yield surface of the GZZ strength criterion is modified by using three different Lode dependences with characteristics of both smoothness and convexity to replace its Lode dependence. The modified criteria are applied to the verification on the yield surface of non-smoothness and non-convexity and strength prediction accuracy of strength; Second, the real parameters of GZZ criterion are obtained from field measuring by using binocular 3-D reconstruction technique based on single camera; Third, the constitutive model based on the GZZ criterion is implemented and validated using Tongji-Shuguang 3D numerical software platform (GeoFBA3D); Finally, a case study with the GZZ criterion is demonstrated.

Rock mass Classification in Anisotropic Rockmasses. The new Rockmass Classification System, A-RMR

Haris Saroglou

Abstract: The lecture will present an overview on the behavior of anisotropic and heterogeneous rocks and rockmasses. Anisotropic rocks possess inherent anisotropy, which has a significant effect on their strength and deformation properties.

The engineering framework of anisotropic rockmasses is based on identifying the anisotropy degree of rock, using the following indices: a) Uniaxial compressive strength index, b) Wave velocity index and c) Point load index.

The modified Hoek–Brown failure criterion for anisotropic rocks (Saroglou, 2007) and an update and applicability on its use in the last decade will be presented.

In the second part of the lecture, a new Rock Mass Classification system, called Anisotropic Rock Mass Rating (A-RMR), developed specifically for anisotropic rock masses will be presented.

A-RMR considers the following parameters: a) anisotropy strength index, Rc, b) uniaxial compressive strength of intact rock, c) degree of structure anisotropy, d) corrected Rock quality designation (RQD), e) condition of anisotropy surfaces and f) groundwater conditions. A correction of the total rating is also proposed based on the confining stress range of the project.

Its use will be demonstrated and explained through application in specific case studies from the design of tunnels and slopes in anisotropic rockmasses.

Finally, the application the rating system in the modified Hoek & Brown failure criterion will be presented and the limitations, advantages will be discussed.

Impact of Rough Fractures on Computational Rock Physics

Lanru Jing

Abstract: Many issues of energy and environment are interlocked in the geosphere of the Earth, and are critical to the developments, advances and safety of the human community on Earth. One most important issue is the fracture systems of different sizes, geometries, densities, physical-chemical behaviors and properties of the fractured rock masses, especially the coupled thermal, hydrological, mechanical and chemical processes that have been one of the driving issue of rock mechanics and rock engineering to meet the demands for the more save and efficient energy and safe environment. This presentation gives a brief but in-depth of the research results from a part of numerical modeling of computational rock physics issues involving mechanical, hydrological and coupled hydro-mechanical processes in fractured rock masses and single fractures, with focuses on outstanding issues of numerical modeling achievements and remaining challenges, and impacts of single rough fracture on computational rock physics, both numerical modeling and lab tests.

Monitoring and Early Warning System in Earth Management

Rafig Azzam

Abstract: The devastations and destructions caused by ***Geohazards***, such as tsunamis, earthquakes and landslides are increasing since the last years verifiable. Apart from socio-economic factors, like increasing population and concentrations of settlements on endangered areas, extreme weather conditions are the main reasons for this ascent. But these occurrences are not only concentrated on the high mountain ranges with steep slopes and strong relief. In February 2003, a landslide in the middle of Germany near the village of Wolfstein-Roßbach damaged some houses (one of them totally). Another example is the Manshiet Nasser failure in Cairo in September 2008, where a large rock tilt buried many houses. This few examples show the devastating effect of geohazards in settlement areas and the need for precise monitoring and early warning systems to protect human life and property.

Existing monitoring systems for early warning in areas prone to geohazards are often monolithic systems that are very cost-intensive, considering installation as well as operational expenses.

In this presentation, a new type of early warning and monitoring system in earth management using low-cost sensors from industry in a wireless Ad-hoc, Multi-Hop sensor network will be introduced. The self-organizing and self-administrating structure of such a system allows the setup of a very flexible sensor network, with independently working nodes due to their own energy supply. Micro sensors (MEMS) are used for tilt, acceleration, height and elongation measurements to observe surface deformation and joint's opening. Due to the fast data transfer, a special data infrastructure for processing and visualization process, monitoring and also warning in real time is possible. Sensor and data fusion are realized to minimize the false alarms and improve the criteria under which an early warning can be issued.

A Coupled THC Model for Wormhole Propagation in 3D Fractured Carbonate Rocks

Guowei Ma

Abstract: Aiming to promoting the oil production in carbonate reservoir, acidizing treatment is employed to dissolve damage and create dominant wormholes with high conductivity by injecting reactive fluid (hydrochloric acid) into the formation. In this study, a three dimensional thermal-hydro-chemical coupled Unified Pipe Network Method (UPM) is applied to simulate the acidizing process in the fractured carbonate rock. The concept of the traditional two-scale continuum model is completed by considering thermal effects and extended by incorporating multiphysical governing equations for fractures which are explicitly represented in the current method. Both matrix and fractures are discretized as equivalent pipes which are assembled to form the fractured porous media in the 3D UPM framework. The accuracy of the thermal-hydro coupled process is verified against commercial software (COMSOL Multiphysics). And the reliability of modeling the acidizing process in different temperature is demonstrated by comparing with previous experimental results. The influences of the existence of fracture network, varying reservoir or inlet acid temperature and formation heterogeneity on the acidizing efficiency are numerically analyzed. The current modeling gives insight understanding of the acidizing optimization process for practical field of fractured carbonate reservoir to achieve favorable acidizing treatment.

Monitoring Ground Displacements Using Satellite Technologies

Norikazu Shimizu

Abstract: Monitoring is important for assessing the stability of structures and for confirming the validity of the design during the construction and operation of structures. The ideal monitoring system for projects in Rock and Geotechnical Engineering would be able to monitor the behavior of small to extensive areas continuously and automatically with high accuracy. In addition, the costs should be low and the handling should be easy.

The concept of spatio-temporal continuous displacement monitoring is introduced in this presentation. The use of both satellite technologies and geotechnical instruments is effective for realizing such monitoring. Furthermore, practical applications of GPS and DInSAR for monitoring an unstable steep slope, a large landslide, large-area subsidence, and ground displacements due to an earthquake are illustrated.

Marine Engineering Geology in the Maritime Silk Road: Geological Problems and *In-situ* Observation

Yonggang Jia

Abstracts: With the flourishing exploitation and development of ocean energy engineering, port engineering, submarine communication engineering, and coastal reclamation engineering in the Maritime Silk Road, quite a number of engineering geological problems and geo-hazards have been encountered in the process of design, construction, operation, and maintainance. We analyzed and discussed typical issues in the Maritime Silk Road, including submarine slope failure, turbidity currents, tsunami and special hazards induced by gas hydrate dissociation, in terms of their definition, distribution, characteristics and case studies. In-situ observation/test devices we designed were introduced. They are offshore CPT devices for soil parameter evaluation in shoal water, free-fall CPT devices for evaluation in deep water; devices for monitoring seafloor horizontal deformation, and devices for monitoring engineering geological environment during hydrate production tests.

Monitoring, Warning and Dynamic Control of Rockburst at Tunnels

Xiating Feng

Abstract: This paper introduces key features and failure of rockbursts at tunnels, what is rockburst warning? Why can use the in situ monitored microseismicity to warn dynamically intensity and location of rockbursts? An intelligent micorseismicity system and sensors were developed. The in situ micorseismicity monitoring method is established. A dynamic method has been established to warn intensity and location of rockbursts. Techniques to optimize excavation, distressing, and support system have been developed to mitigate rockburst risk. The technology has been widely and successfully to mitigate rockbursts risk at headrace and drainage tunnels at Jinping II hydropower station, tunnels at China Jinping Underground Laboratory Phase II, tunnels at new Chuan-Zang Railway, and headrace tunnels at NEELUM-JHELUM hydroelectric project, Pakistan.

Laboratory Testing in Engineering Geology-Stone Properties Determination and its Application

Maria Heloisa Barros de Oliveira Frascá

Abstract: All engineering projects require several steps and one main task is to identify the most important characteristics of the rock types that will be excavated, crushed or mined for any different usage purpose, since large infrastructural works to single residential building. Laboratory investigation in engineering geology is complementary to site investigation – that usually determines the main macroscopic features of the rock (color, grain size, fabric etc.) and the rock mass (structure, discontinuities, alteration, jointing and others) – aiming to detail the most relevant features as well as to determine/quantify rock properties to design of structures (drill hole, a mining shaft, a tunnel, a reservoir dam, a repository, or a building) to be built in or of rock. So, most of laboratory tests follow the princi-

ples of rock mechanics aiming at to know the response of rock and rock masses to the requisitions of their future physical and/or chemical environment. A great diversity of laboratory tests is available, each one attempting to determine a rocky property that is significant to the planned use.

In order to simplify, they are herein separated in 2 groups: (a) the characterization test group, that intent to determine the fundamental characteristics, used for any rock application, such as density, porosity, compressive strength, tensile strength, dilatation coefficient and others, including petrographic analysis that provide key information as alteration degree, presence of unstable minerals, microcracking etc. besides the petrographic classification and the real origin of the rock; (b) the application test group, which involve tests designed to some specific rock usage, among then the abrasion/abrasivity tests (Cerchar, Los Angeles, Amsler, Taber and others), flexural and shear strength determination, particle size analysis, expansion index, California test etc. Tests may be carried in a great variety of samples, depending on the main purpose of each determination. It emphasizes the importance of sampling in order to obtain the most reliable results to the project.

Urban Landslides: Challenges for Forensic Engineering Geologists and Engineers

Scott Burns

Abstract: Each year landslides cause 25-50 deaths and result in $3.5 billion in damage within the United States. Many of these landslides occur in urban settings. Urban landslides occur in or near cities, generally involving humans, houses and/or businesses, and establishing the cause can be a challenge to any forensic engineering geologist and geotechnical engineer. Each landslide is a unique relationship of environmental circumstances, and the best mitigation approach is of paramount importance. Cities need to develop landslide inventory maps and corresponding susceptibility maps in order to help prevent further loss of human life and property. Controlling the water and recognizing ancient landslides, along with the use of LiDAR to reveal the geology history hidden by foliage can prevent future examples of damage and despair. Case histories such as Kelso, Washington, Burlingame Place, Bazazz Landslide, Newell Creek Apartments, Estacada Landslide, and Hidden Lakes Landslides have proven to accentuate the above points. The importance, lack of availability, and cost of landslides insurance for the average homeowner is also significant.

Tunnel Under the Strait of Gibraltar

Carlos Delgado

Abstract: The distance between the southernmost point of the Iberian peninsula is a mere 15 km. A project to unite the two continents was set up in the early 2000s. This is a geological-geotechnical evaluation report,in order to fill in information lacking for this project to unite Europe and Africa through the straits of Gibraltar, taking into account the special conditions of a closed – in sea between the two continents with remarkable depths and very strong currents to and from the Atlantic ocean.

The preliminary project considered the realization of two tunnels (West in phase 1 and East in phase 2) with an intermediate gallery for services.

The outline of the submarine tunnel is inscribed in the Camarinal submarine gorge with constitutes residual relief formed by tectonic scales of flysch which formed the Gibraltar junction before the opening of the straits 5 million years ago at the end of the Miocene period.

Laboratory tests are carried out on samples recovered in boreholes and in shafts excavated in Tarifa(Spain) and Malabate (Morocco) to determine the geomechanical parameters attributed to the different lithological types to model the convergence phenomenon in the area of clayey breccia.

These convergence parameters allow an analysis of the advancing speed of the TBM implied in the tunnel excavation and the pressure on the shields.

The tectonic activity in the area is analised with the last studies of Gutcher presented at the Lisbon Conference to commemorate the 250 anniversary of 1755 earthquake.

And finally an alternative solution, which had previously been rejected, is presented taking into account the very recent discoveries of new composite materials and new techniques for deep foundations on the sea bed.

Note:

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