One-Day Short Course on Measurement and Quantification of Joint Roughness, Normal Deformation, Peak Shear Strength, Aperture and Fluid Flow through Single Joints

will be taught by

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Course will be taught in
a hotel in Colombo, Sri Lanka

Information pertaining to this will be provided in early November 2014 by the Short Course Co-ordinator Ms. Woshari Mahawattage (woshari@gmail.com)

OBJECTIVES

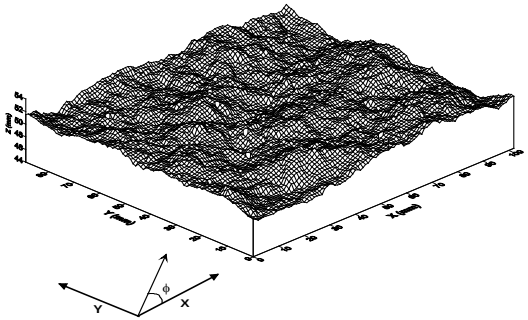
The objective of the short course is to provide the state-of-the-art on Measurement and Quantification of Rock Joint Roughness, Normal Deformation, Peak Shear Strength, Aperture and Fluid Flow through Single Joints. The course lecture notes that is equivalent to about 175 pages will be distributed at the start of the course. The lecture notes are drawn from 9 journal papers that the instructor published with his graduate students. Several power point presentations will be used to teach the short course. Application of the theory will be illustrated using real world discontinuity data from a several completed research projects.

COURSE CONTENT

Strength and deformability of rock joints depend very much on the surface roughness of joints. Hydro-mechanical properties of a rock fracture depend very much on the aperture distribution of the fracture. Therefore, accurate quantification of roughness and aperture is important in modeling strength, deformability and fluid flow behaviors of rock joints. Rock mass strength, deformability and fluid flow behaviors in turn depend very much on the hydro-mechanical properties of joints.

The methods that are used to measure joint roughness, normal deformation, peak shear strength, aperture and fluid flow through single joints in the laboratory as well as joint roughness in the field will be discussed in the course.

To quantify rock joint surface roughness, several methods have been proposed in the literature: (a) Joint Roughness Coefficient, (b) statistical parameters based on Euclidean geometry and (c) fractal parameters. Statistical and fractal parameters have been suggested to quantify joint aperture. Strong features as well as limitations of each of the aforementioned methods will be discussed in the course. Two types of fractals are discussed in the literature: (a) self similar and (b) self affine. Rock joint roughness and aperture belong to self-affine category. The divider method, which belongs to self similar category, has been modified and used in modeling joint roughness on natural rock joint surfaces. The box method, which belongs to self similar category, has been modified and used to model joint aperture in three dimensions. The variogram, roughness length, spectral and line scaling methods, which belong to self affine category, have been used to model joint roughness. The variogram method also has been used in modeling joint aperture. Applicability of each type of aforementioned fractal methods in modeling joint roughness and aperture will be discussed in the course. Capturing of anisotropy of both roughness and aperture will be discussed in the course.

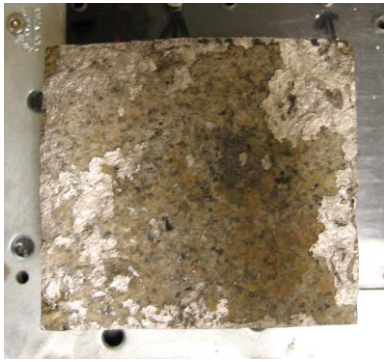


Pictorial view of a rough rock joint

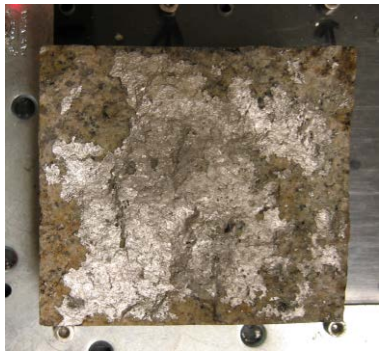
Laser profilometer with a data acquisition system

State-of-the-art on normal deformation and peak shear strength modeling will be discussed in the course. Incorporation of joint roughness in estimating peak shear strength will be addressed.

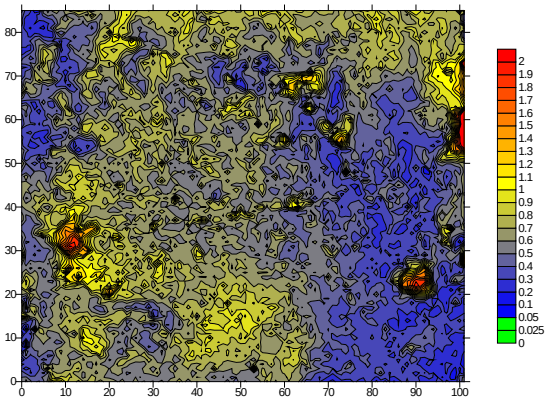
Experimental and numerical approaches to estimate fluid flow through single joints will be covered. Possible relations developed between fluid flow through single joints and aperture parameters will be presented. Influence of normal stress on the developed relations will be discussed.



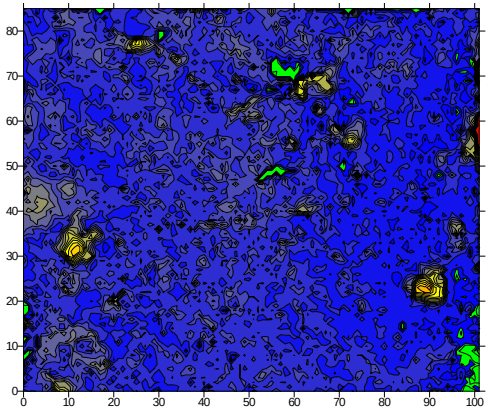
(a)
Top part of sample at 8 MPa normal stress



(b)
Bottom part of sample at 8 MPa normal stress
Wood's Metal coating distribution



0 MPa



8 MPa
Aperture Distribution

Who Should Attend:
Civil, Mining, petroleum and Geo-engineers, hydrologists, and geologists who work on projects in rock engineering, petroleum engineering and engineering geology associated with jointed rock masses will benefit from the short-course.

Time Schedule:

8:00—10:00	Lectures
10:00—10:30	Coffee break
10:30—12:30	Lectures
12:30-- 13:30	Lunch
13:30-- 15:30	Lectures
15:30-- 16:00	Coffee break
16:00-- 18:00	Lectures

Narrative Biography of Prof. Kulatilake:
Dr. Pinnaduwa H.S.W. Kulatilake is a Professor of Geotechnical Engineering and Director of Rock Mass Modeling and Computational Rock Mechanics Laboratories at the University of Arizona. He is a registered Professional Civil Engineer in California. He received his B.Sc. (in 1976) in Civil Engineering from the University of Sri Lanka, Peradeniya, MS (in 1978) in Soil Engineering from the Asian Institute of Technology, Bangkok, Thailand and Ph.D. (in 1981) in Civil Engineering (with geotechnics emphasis) from the Ohio State University, USA. He has over 34 years of experience in rock mechanics & rock engineering associated with mining, civil and petroleum engineering, geotechnical engineering, and applications of probabilistic and numerical methods to geo-engineering. He has written over 200 papers and is a member of several technical committees. He has delivered 25 keynote lectures and over 40 other invited lectures throughout the world on topics related to rock fracture network modeling, probabilistic geotechnics, mechanical and hydraulic properties of joints, rock slope stability and mechanical and hydraulic behavior of rock masses. He has been a research paper reviewer for 20 technical Journals and an editorial board member for Int. Jour. of Rock Mechanics & Mining Sciences, Int. Jour. of Geotechnical and Geological Engineering, Int. Jour. of Advances in Geological and Geophysical Engineering, Coal Science and Technology and Journal of Mining & Science-Turkey. He has taught short courses on stochastic fracture network modeling, rock slope stability analysis, Block theory, and rock joint roughness and aperture in Sweden, Mexico, Austria, USA, Canada, Hong Kong, Poland, Finland, Australia, South Korea, Sri Lanka, Egypt, Iran, Chile, China, Italy and Peru. He has served over 20 years either as the primary or the sole examiner for the geological engineering professional exam conducted by the Arizona State Board of Technical Registration. He was a Visiting Professor at the Royal Institute of Technology and Lulea University of Technology in Sweden as part of his sabbatical leave. Also, he was a Visiting Research Fellow at the Norwegian Geotechnical Institute, for another

part of his sabbatical leave. Due to the contributions he made on teaching, research, consulting and service activities, he was elected to the Fellow Rank of the American Society of Civil Engineers at the relatively young age of 45. In 2002, he received Distinguished Alumnus Award from the College of Engineering, Ohio State University and Outstanding Asian American Faculty Award from the University of Arizona in recognition of his achievements and contributions made to the advancement of his profession. In December 2005, Eurasian National University, Kazakhstan conferred him "Honorary Professorship". In August 2007, he organized and ran a successful International Conference on Soil & Rock Engineering in Sri Lanka. In January 2009, he organized and ran a high quality International Conference on Rock Joints and Jointed Rock Masses in Tucson, Arizona. He was the guest editor for two special issues published in the Jour. of Geotechnical and Geological Engineering. He received "Kwang-Hua Visiting Professorship" for 2009-2010 from the College of Engineering, Tongji University, China. He is a Recipient of "Guest Professorship" from Wuhan University, China for 2010-2013. Recently he received an award in the amount of 515,000 RMB (US$ 81,320) from the Chinese Academy of Sciences to spend a sabbatical in China as a Senior Visiting Professor. Currently he has research funding in the amount of US$ 1.5 million to conduct research in the rock mechanics and rock engineering field.

Registration Conditions:

The course fee must be paid in full by the registration deadline of November 3, 2014. The course fee includes course notes, lunch and refreshments for morning and afternoon tea/coffee breaks. The number of applicants for each course is limited and acceptance will be on a first come, first served basis. If the course is cancelled, then the full short course fee will be refunded. **No refund will be given after November 10, 2014. Non-arrivals at the course will be liable to pay the full course fee and no refund will be given. However, substitutions will be allowed.**

Registration Form
Short Course on Measurement and Quantification of Joint Roughness, Normal Deformation, Peak Shear Strength, Aperture, and Fluid Flow through Single Joints, Colombo, Sri Lanka, December 2014

Name: _____

Title: _____

Organization: _____

Mailing Address: _____

_____

Telephone Number: _____

Fax Number: _____

E-mail address: _____

Registration Fee: See below

I have read and agree to the conditions of entry as stipulated in this brochure.

Signature :_____ Date: _____

Registration Fee:

Foreign delegates and private company delegates in Sri Lanka: US$ 300 (SR 39000)
Government and University Faculty and Researchers in Sri Lanka: SR 19000
Students in Sri Lanka: SR 12500

Course Co-ordinator for course registration, accommodation reservation and other practical matters:

Ms. Woshari Mahawattage
Tel:+94 77 3412703
E-mail: woshari@gmail.com

Methods of Payment:

Sri Lankan delegates:

Option 1: Cash payments to
Ms. Woshari Mahawattage
Tel: 0773412703
E-mail: woshari@gmail.com

Option 2: Bank Pay Order (Cashier's check): The information on how to write the check will be provided by Ms. Woshari Mahawattage later upon receiving the completed Registration form.

Foreign delegates:

Option 1: Make a Cashier's check or money order payable in US funds, through a US bank to:
P.H.S.W. KULATILAKE and mail it to:

Prof. P.H.S.W. Kulatilake
Dept. of Materials Science & Engineering
Mines Bldg. # 12, Rm 131
1235 E. James E. Rogers Way
University of Arizona
Tucson, AZ 85721, USA

Option 2: Wire transfer: Name of the bank, routing number & the account number will be provided later upon receiving the completed Registration form.