One-Day Short Course on
Measurement and Quantification of Joint
Roughness and Aperture

March 16, 2010
Course will be taught at
Four Points by Sheraton
Tucson University Plaza
1900 East Speedway
Tucson, Arizona 85719
Tel: 520-327-7341
Fax: 520-327-0276
Email: 97506FrontDesk@fourpoints.com
http://www.starwoodhotels.com/fourpoints/

by
Professor P.H.S.W. Kulatilake
Dept. of Materials Science & Engineering
The University of Arizona
Tucson, Arizona, USA
Ph: 520-621-6064
Fax: 520-621-8059
E-mail: kulatila@u.arizona.edu

OBJECTIVES
The objective of the short course is to provide the state-of-the-art on Measurement and Quantification of Rock Joint Roughness and Aperture. The course lecture notes that is equivalent to about 135 pages will be produced on a CD and will be distributed at the start of the course. The lecture notes are drawn from 8 journal papers that the instructor published with his graduate students. Several power point presentations will be used to teach the short course. A few computer programs will be applied to joint data to illustrate the applications.

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 in the laboratory as well as in the field and the methods that are used to measure joint aperture in the laboratory will be discussed in the course.
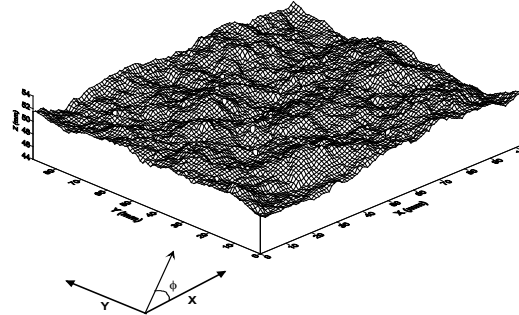
Pictorial view of a rough rock joint

Laser profilometer with a data acquisition system

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. The divider method, which belongs to self similar category, has been used in modeling joint roughness. The box method, which belongs to self similar category, has been used to model joint aperture. 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.

Roughness modeling in both one and two dimensions including the anisotropy will be covered in the course. Aperture modeling will be covered in three dimensions.
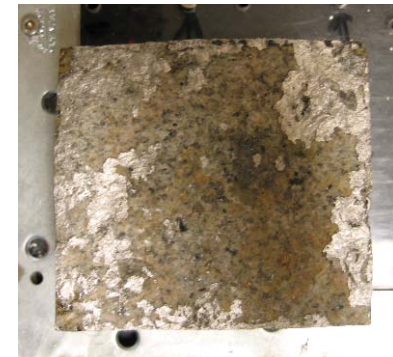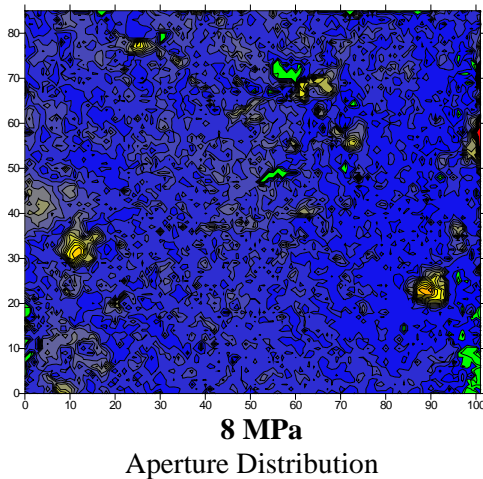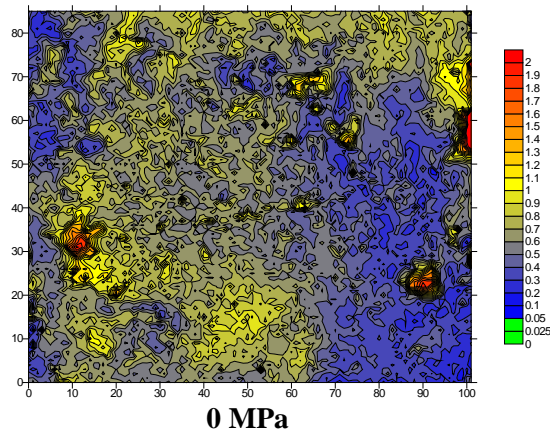

(a)
Top part of sample at 8 MPa normal stress
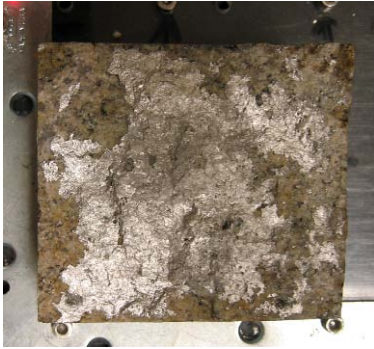
(b)
Bottom part of sample at 8 MPa normal stress
Wood's Metal coating distribution

0 MPa

8 MPa
Aperture Distribution

Who Should Attend:

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

Time Schedule:

8:30—10:15	Lectures
10:15—10:30	Coffee break
10:30—12:15	Lectures
12:15-- 13:15	Lunch
13:15-- 15:00	Lectures
15:00-- 15:15	Coffee break
15:15-- 17:00	Lectures/computer demonstrations

Narrative Biography of Prof. Kulatilake:

Pinnaduwa H.S.W. Kulatilake, Ph.D., P.E., F.ASCE, is a Professor of Geological/Geotechnical Engineering at the University of Arizona. He has over 30 years of experience in rock mechanics, geotechnical engineering, and applications of probabilistic and numerical methods to geotechnical engineering. He has written over 150 papers and is a member of several technical committees. He has delivered 16 keynote lectures and 40 other invited lectures throughout the world on topics related to fracture network modeling, probabilistic geotechnics, mechanical properties of joints, rock slope stability and mechanical and hydraulic behaviour of rock masses. He is a research paper reviewer for 16 technical Journals and an editorial board member for Int. Jour. of Rock Mechanics & Mining Sciences and Int. Jour. of Geotechnical and Geological Engineering. He has taught short courses on stochastic fracture network modeling, rock slope stability analysis and Block theory in Sweden,

Mexico, Austria, USA, Canada, Hong Kong, Poland, Finland, Australia, South Korea, Sri Lanka, Egypt, Iran and Chile. He 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 that 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 very successful International Conference on Soil & Rock Engineering in Sri Lanka. In January 2009, he organized and ran a successful, high quality International Conference on Rock Joints and Jointed Rock Masses in Tucson, Arizona.

Registration Conditions:

The course fee of US$ 375 must be paid in full by the registration deadline of February 15, 2010. 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 February 20, 2010. 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 and Aperture, Tucson 2010

Name: _____

Title: _____

Organization: _____

Mailing Address: _____

_____

Telephone Number: _____

Fax Number: _____

E-mail address: _____

Registration Fee: **US $ 375**

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

Signature :_____ Date: _____

Method of Payment:

Option 1: Approval to charge to a credit card. Send name on card, card number, expiry date (MM/YY) and card verification number (3 digit code on back of card or 4 digit code on front of card located above the credit card number) to fax number: US Code-520-529-7116. Please follow up with an e-mail to: kulatila@u.arizona.edu stating that you sent a fax (please do not send credit card information through e-mail).

Option 2: Make 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 3: Wire transfer: Name of the bank, Routing number & the account number will be provided later upon receiving the completed Registration form.