TWO-DAY SHORT COURSE ON ROCK FRACTURE GEOMETRY CHARACTERIZATION AND NETWORK MODELING IN 3-D INCLUDING VALIDATIONS

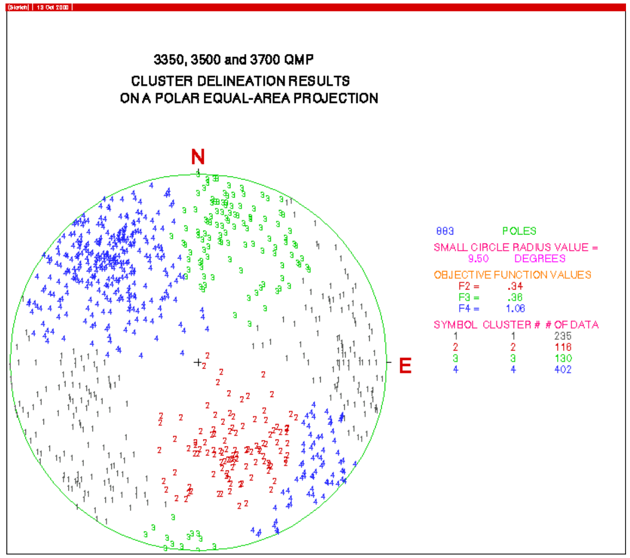
will be taught by

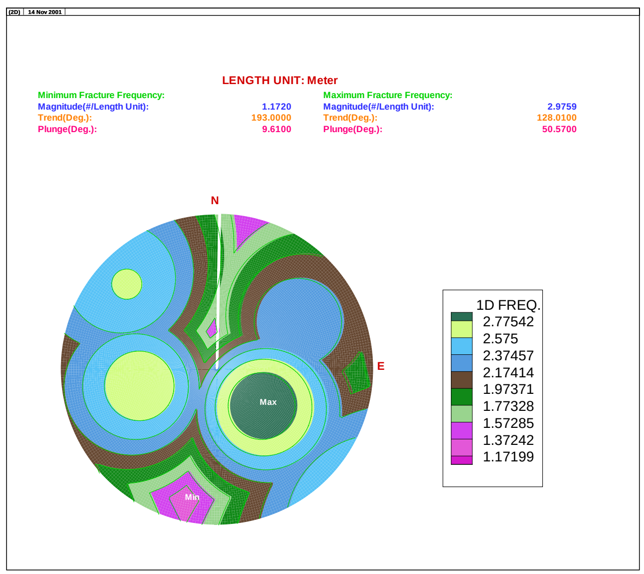
Professor P.H.S.W. Kulatilake
Director, Rock Mass Modeling and Computational Rock Mechanics Laboratories
The University of Arizona
Tucson, Arizona, USA
Ph: 520-621-6064
Fax: 520-577-6515
E-mail: kulatila@u.arizona.edu

December 13-14, 2014

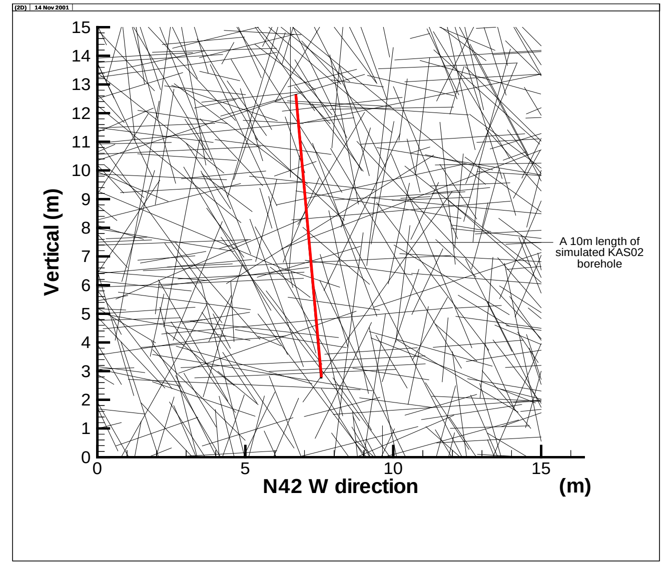
Course will be taught in
a hotel in Colombo, Sri Lanka

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

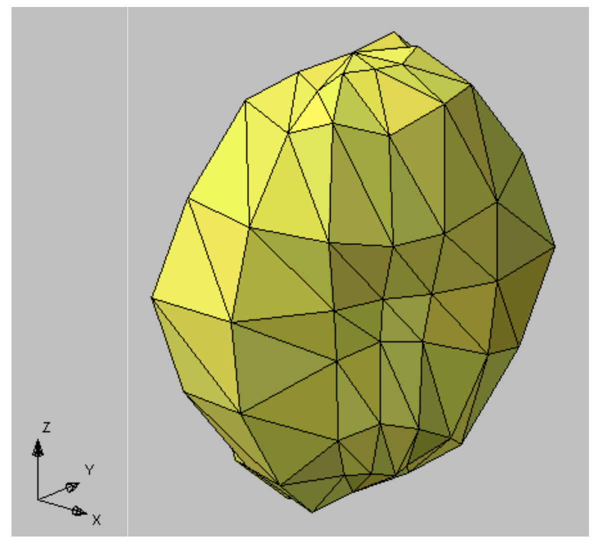




1-D fracture frequency distribution in 3-D on an equal-angle equatorial net



Fracture traces obtained from fracture generation on a vertical square window of size 15 m having strike same as the trend direction of borehole KAS02



Variation of directional hydraulic conductivity in 3-D space (scale: 1 cm = 2.1 x 10^{-7} m/s) – view along the direction having trend = 320º and downward plunge = 20º

INTRODUCTION AND COURSE OBJECTIVES

The first step in the procedure of discontinuity geometry modeling in a rock mass should be the identification of statistically homogeneous regions (structural regions). To model discontinuity geometry in 3-D for a statistically homogeneous region, it is necessary to know the number of fracture sets, and for each fracture set, the intensity, spacing, location, orientation, and size distributions. Discontinuity geometry parameters obtained by the field data are subject to errors due to sampling biases and represent only 1- or 2-D properties. Therefore, before inferring statistical distributions for these parameters, sampling biases should be corrected on field data. Principles of stereology need to be used in developing expressions for both corrections for sampling biases and inferring 3-D discontinuity geometry parameter values from either 1- or 2-D parameters.

Kulatilake et al. completed a software package named *FRACNTWK* (based on about 15 journal papers) to analyze discontinuity data obtained from boreholes, rock cores, scanlines and 2-D exposures such as rock outcrops, tunnel walls, tunnel roofs, etc. to perform fracture characterization and network modeling and to generate rock discontinuity systems in rock masses. This package provides procedures (a) to identify statistically homogeneous regions in a rock mass, (b) to identify discontinuity clusters in a statistically homogeneous region, (c) to apply corrections for sampling biases associated with orientation, spacing and trace length distributions of discontinuity clusters, (d) to obtain probability distributions for orientation, spacing, trace length and discontinuity size in 3D of discontinuity clusters, (e) to obtain a map of the discontinuity traces sampled through either scanline or area sampling surveys, (f) to estimate 1-D discontinuity frequency along mean normal vector directions of discontinuity clusters using discontinuity spacing data mapped from some other directions, (g) to estimate 1-D discontinuity frequency in any direction in the rock mass, (h) to estimate distributions for block size, number of blocks per unit volume and number of discontinuities per unit volume for the rock mass, (i) to estimate fracture tensor parameters for each discontinuity cluster as well as for the rock mass, (j) to generate discontinuities in 3-D for the rock mass and to obtain discontinuity trace predictions on vertical and horizontal exposures, and (k) to verify the used discontinuity system models.

This package has been used to perform fracture network modeling in 3-D incorporating corrections for sampling biases on fracture geometry parameters for several geo-engineering sites in the world. It has been used to build fracture networks to perform numerical discrete fracture fluid flow modeling in 2-D to study a ground water resources problem in Arizona, and in 3-D to study representative elementary volume behavior and estimate 3-D hydraulic conductivity tensor for a tunnel site in California. The package was also used to model the fracture system and then to conduct slope stability investigations for highway and mine sites. Most recently, it has been used to generate fractures in 3-D and then to estimate rock mass strength & deformability parameters for ASPO Hard Rock Laboratory, Sweden and a dam site in China. The computer package has 26 calculation and 24 graphical programs.

Usually this short course is taught during a three-day period. **However, due to time constraints it will be taught as a two-day short course.** The objective of the short course is to cover the salient features on the following topics associated with rock fracture characterization and network modeling: **(1) Fracture mapping through manual and remote techniques; (2) Modeling of statistical homogeneity; (3) Modeling of fracture orientation; (4) Modeling of rock fracture size; (5) Modeling of fracture spacing and frequency; (6) Modeling of fracture 3-D intensity parameters; (7) Rock fracture tensor; (8) Discontinuity generation & validation and fracture network modeling for mechanical and hydraulic behavior of rock masses.** In addition, the features of the *FRACNTWK* package will be discussed including applications to real world problems on fracture characterization and network modeling.

Medium of Instruction:
The medium of instruction will be English.

Who Should Attend:

Engineers, geologists and hydrologists who are involved in site characterization, analysis, design and construction activities associated with geo-engineering systems which are in or on jointed rock masses will benefit from the short-course.

Time Schedule:

8:00—10:00	Lectures
10:00—10:30	Tea/Coffee break
10:30—12:30	Lectures
12:30-- 13:30	Lunch
13:30-- 15:30	Lectures
15:30-- 16:00	Tea/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 Rock Fracture Geometry Network Modeling in 3-D, Colombo, Sri Lanka, December 2014

Name: ________________________________

Title: ________________________________

Organization: __________________________

Mailing Address: ___________________

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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$ 600 (SR 78000)
Government and University Faculty and Researchers in Sri Lanka: SR 37500
Students in Sri Lanka: SR 25000

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.