Evening talk titled "Assessment of defect properties and its application in rock engineering" by Dr. Mogana Sundaram

By: Ir. Yee Thien Seng

The talk took place on 21 December 2009 at the Tan Sri Professor Chin Fung Kee auditorium. It commenced at 5.30 p.m. and was attended by 50 participants.

Dr. Mogana is a practising engineering geologist. He started out by defining the key terms for his talk.

Intact Rock is the term used to describe a compact, coherent, indurated naturally occurring material comprising one or more minerals whilst Rock Mass is a complex system of intact rocks and defects or discontinuities. Rock Mechanics refers to a framework of mechanics to describe the behaviour of rock masses whilst the design and construction in rock masses is a practice termed as Rock Engineering.

Rock engineering applications include slope constructions, excavatability evaluations and tunnel support constructions employing rock mass classifications and rock mass strength determinations.

Owing to inherent inhomogenuity, Dr. Mogana pointed out that rock mass properties are difficult to establish or control with their mass mechanical behaviours being dictated by the system of pre-existing discontinuities/defects which are in turn scale/size dependent. For this reason, the properties of the 5 percent unrecovered material in rock engineering work are frequently more crucial than the 95 percent recovered material from field investigations. Insitu stresses also influence rock mass behaviour in response to construction or service conditions.

Physical property tests on rock samples include moisture content, porosity, density, swelling, hardness, permeability and seismic velocity and durability tests such as abrasion resistance and slake durability index. Mechanical property tests commonly conducted on samples of intact rock are tensile strength, shear strength, fracture toughness, Young's modulus, Poisson's ratio, unconfined compressive strength (UCS) and Point Load Index (PLI).

Data on discontinuities or pre-existing defects in the rock mass are collected from boreholes, surface exposures or underground features such as adits, tunnels and caverns. The data include intact rock type, orientation of joint sets, discontinuity/defect type, aperture size, roughness, infill material type at discontinuities, wall strength, weathering state, spacing, block size, persistence and seepage condition.

Various methods and tools used in industry for observing, measuring and logging discontinuity data were shown. Procedures for processing and reduction of the data; principally employing stereographic projection techniques, to usable forms representative of the discontinuity properties in the rock mass were also presented. Methods for measurement of shear strength properties at discontinuity surfaces were illustrated.

Dr. Mogana then proceeded to demonstrate how the strength information from element tests need to be adjusted or modified to account for the defects present in the rock mass to arrive at the mechanical properties for the rock mass before being applied to engineering applications. The Modified Hoek-Brown failure criterion with further adaptation to include the Geological Strength Index (GSI) was employed for the process. This is an empirical procedure developed through experience by the industry.

A selected collection of both defect controlled and mass controlled stability problems in rock slope constructions were presented to illustrate use of rock mechanics in such applications.

Whilst most rock engineering problems are controlled by rock mass properties, Dr. Mogana pointed out that stability in rock slopes can be controlled by defect properties (defect controlled) or mass properties (mass controlled) or even both; dependant on the geometry of the slope in relation to the governing features in the rock mass.

A number of rock mass classification systems exist to assist in decision making on rock mass controlled processes like stability of slopes, ground excavatability and tunnel stability. The common ones are Rock Quality Designation (RQD), Rock Mass Rating (RMR) and Tunnel Quality Index (Q). These classification systems are continually updated with experience accumulated and are readily available in engineering geological publications. Dr. Mogana presented correlationships between RMR and Q used for various parts of the world.

An informative questions and answers period ending at 7.00 p.m. followed the talk with a round of applause from the audience for Dr. Mogana’s well delivered presentation.