LECTURE SERIES AND WORKSHOPS ON GEOTECHNICAL ENGINEERING IN PRACTICE

Organised by: Centre for Infrastructure Engineering and Management and School of Engineering, Griffith University Gold Coast campus

Date: 13 – 17 February 2006

Venue: Building G23 (Multimedia Building) Room 2.07
Griffith University Gold Coast Campus

Content of Flyer:

See "Registration form" for daily registration.

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Introduction

In 2005, Prof. Harry Poulos started a Lecture Series at Griffith University on Piled Foundations. It gave an opportunity for a large number of practicing engineers to visit the university and to participate in the lectures. This was followed by the Queensland Main Roads, Ramanujam and others giving lectures on Pavement Design. Prof. David Williams then gave an excellent Seminar on Mining Geotechnics, which was an eye-opener for those of us in infra-structure Geotechnics. Prof. Kerry Rowe then gave a repeat of his Rankine Lecture on Environmental Geotechnics. Also, Geocopier was kind enough to conduct a course on ground improvement. These lectures and courses are well received by the participants.

This Workshop cum Lecture Series centred on Dr. Nick Barton's lectures on tunnelling and rock mechanics also cover a wide range of lectures on soil engineering as well by leading practitioners as drawn from Moh and Associates, Keller Ground Engineering, Sinclair Knight Merz (SKM), Golder Associates, Coffey and Partners, Earth Tech, Connell Wagner etc. In addition to Dr. Nick Barton, the following eminent lecturers are drawn from the private and academic sectors: Chris Nobes, Richard Hwang, Stephen Buttling, Harry Asche, Jay Ameratunga, Jeff Hsi, Jim Shiau, John Read, Kejing Chen, Oliver Batchelor, Patrick Wong, Sergei Terzaghi, and Ted Nye.

With increasing pressure in the universities to have a wider curriculum for civil engineering graduates, it is difficult to cover all aspects of geotechnics in an undergraduate course. Also, very few now days have the luxury to follow post graduate courses with increasing fees in education and high competition in obtaining scholarships for doctoral research. As such Courses conducted by authoritative lecturers like Profs. Harry Poulos, Kerry Rowe, Nic Barton, David Williams and eminent practitioners can help to continuously upgrade engineers with different seniority in practice as well as the academics and researchers.

These course and lectures will be beneficial to post-graduate students, engineers and those who are in the design and analysis side of Geotechnical Engineering and Practice both for infrastructures and mining works. It is hope that there will be very active participation from all the various sectors of our catchment of interested parties; Practitioners to Academics to Researchers to Graduate students.

Registration Form

Given Name:			
Last Name:			
Position:		Title:	
Organisation:			
Department:			
Address:			
State:		Postcode:	
Telephone:		Facsimile:	
Mobile:			
Email:			
Please inform us of any special dietary requirements. *The registration fee includes light refreshment, light lunch and handouts during the program.*			

Enclosed is my registration fee of: _____

□ **AUD$330** (*GST included*) – for 13 February.
□ **AUD$330** (*GST included*) – for 14 February.
□ **AUD$400** (*GST included*) – for 15 February.
□ **AUD$400** (*GST included*) – for 16 February.
□ **AUD$770** (*GST included*) – for 15 and 16 February.
□ **AUD$330** (*GST included*) – for 17 February.

Cheque Payments:

Cheques or money order to be made payable in Australian Dollars to "**Griffith University**". In Australia, the ABN, required to be used for GST purposes, is **78106094461**.

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Card Number: _____
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Amount to be charged: _____

Please fax or mail the completed form (by 10 February 2006) to
Prof. A. S. Balasubramaniam, School of Engineering,
Griffith University Gold Coast Campus, PMB 50 GCMC, QLD 4215, AUSTRALIA.
Fax: +61 7 55528065

PROGRAMME

13 February 2005 (Monday)

Ground Improvement and Soil Engineering Practice (I)

08:30	–	09:00 am	Registration
09:00	–	10:00 am	Geotechnical aspects of hydraulic structures at Port of Brisbane Speakers: Jay Ameratunga (Coffey Geosciences) & Peter Boyle, Port of Brisbane
10:00	–	11:00 am	Application of Soilfrac compensation grouting to mitigate tunnelling induced settlement Speaker: Oliver Batchelor (Keller Ground Engineering)
11:00	–	11:15 am	Coffee break
11:15	–	12:15 pm	Case histories on soft ground treatment Speaker: Patrick Wong (Coffey Geosciences)
12:15	–	01:00 pm	Lunch
01:00	–	02:00 pm	Geotechnical activities in Cairns Speaker: Kejing Chen (Golder Associates)
02:00	–	02:45 pm	New thoughts on pavement design Speaker: Jim Shiau (University of Southern Queensland)
02:45	–	03:00 pm	Coffee break
03:00	–	03:45 pm	Behaviours of residual and volcanic materials Speaker: Sergei Terzaghi (SKM)
03:45	–	04:30 pm	Deep chemical mixing in ground improvement Speaker: Sergei Terzaghi (SKM)
04:30	–	05:15 pm	Vacuum Consolidation in Ground Improvement of Soft Clay Speaker: Charles Spaulding (Austress Menard)

14 February 2005 (Tuesday)

Ground Improvement and Soil Engineering Practice (II)

08:30	–	09:00 am	Registration
09:00	–	10:00 am	Embankments constructed over soft ground - Yelgun to Chinderah Freeway, NSW Speaker: Jeff Hsi (SMEC)
10:00	–	11:00 am	Soil grouting and its applications Speaker: Oliver Batchelor (Keller Ground Engineering)
11:00	–	11:15 am	Coffee break
11:15	–	12:15 pm	Ground improvement works in Cairns Speaker: Kejing Chen (Golder Associates)
12:15	–	01:00 pm	Lunch
01:00	–	01:45 pm	Identifying the boundary between geotechnical and structural engineering in tunnel design and analysis Speaker: Ted Nye (SKM)
01:45	–	02:45 pm	Design and construction of Taipei Rapid Transit System Speaker: Richard Hwang (MAA)
02:45	–	03:00 pm	Coffee break
03:00	–	03:45 pm	Deep excavations in soft marine clays – Kallang and Paya Lebar Expressway, Singapore Speaker: Jeff Hsi (SMEC)
03:45	–	04:30 pm	Ground improvement with vibro-stone columns Speaker: Oliver Batchelor (Keller Ground Engineering)
04:30	–	05:15 pm	Development of Jet Grouting in Ground Improvement of Soft Soils – Recent Applications Speaker: Ing. A. Sanella (Auststress Menard)

15 February 2005 (Wednesday)

First day of Workshop by Dr. Nick Barton on "Practical rock engineering with Q in tunnel design and execution using TBM and drill-and-blast methods"

08:30	–	09:00 am	Registration
09:00	–	10:30 am	Introduction to topics in Rock Engineering Speaker: Nick Barton
10:30	–	10:45 am	Coffee break
10:45	–	12:15 pm	Introduction to the Q-System of Rock Mass Characterization Speaker: Nick Barton
12:15	–	01:30 pm	Lunch
01:30	–	03:00 pm	Linking Q to useful parameters for design Speaker: Nick Barton
03:00	–	03:15 pm	Coffee break
03:15	–	04:45 pm	Rock slope stability in mines Speaker: John Read

Content of Course for 15 February

1. INTRODUCTION TO SOME TOPICS IN ROCK ENGINEERING

   Some of the Uses of Rock Mass Characterization
   Seismic Characterization and Effects of Depth
   Modelling Rock Failure - Some Problems and Solutions

2. INTRODUCTION TO THE Q-SYSTEM OF ROCK MASS CHARACTERIZATION

   Background, motivation, characteristics
   The 6 Q-parameters explained with examples (and Jr links to JRC)
   Q-RMR comparison and useful link-plots, and Q-histogram logging

3. LINKING Q TO USEFUL PARAMETERS FOR DESIGN

   Core logging examples: Norway, Sweden
   Logging weathered core
   Rock mass strength estimation from Q (CC and FC)
   Seismic site description with Q
   Deformation modulus estimation from Q
   Tunnel convergence from Q for comparison to numerical models

16 February 2005 (Thursday)

Second day of Workshop by Dr. Nick Barton on "Practical Rock Engineering with Q in tunnel design and execution using TBM and drill-and-blast methods"

08:30	–	09:00 am	Registration
09:00	–	10:30 am	Tunnel support selection from Q classification, support properties, water control Speaker: Nick Barton
10:30	–	10:45 am	Coffee break
10:45	–	12:15 pm	Risk to TBM tunnelling from faults, TBM performance prognoses Speaker: Nick Barton
12:15	–	01:30 pm	Lunch
01:30	–	03:00 pm	Grouting for tunnels Speaker: Nick Barton
03:00	–	03:15 pm	Coffee break
03:15	–	04:45 pm	Some aspect of tunnelling practices in Queensland. Speaker: Harry Asche (Connell Wagner)

Content of Course for 16 February

4. TUNNEL SUPPORT SELECTION FROM Q CLASSIFICATION, SUPPORT PROPERTIES, WATER CONTROL

   1974 support scheme for mostly B+S(mr), NMT tunnel support philosophy
   1989-1993 update for mostly B+S(fr)
   S(fr) and Bolting details
   Water control including pre-injection
   Rock quality/parameter improvement by pre-injection
   RRS for bad ground
   Cost versus Q and tunnel size

5. RISK TO TBM TUNNELLING FROM FAULTS, TBM PERFORMANCE PROGNOSES

   The concept of 'multiple unexpected events'
   TBM tunnelling cases from England, Italy, Kashmir, Taiwan, Hong Kong
   The Q_{TBM} method explained

6. GROUTING FOR TUNNELS

   Some rock joint hydraulic concepts
   Interpreting Lugeon tests
   Joint aperture / cement size limitations
   Logic behind high pressure grouting
   Improved 'effective' rock mass

17 February 2005 (Friday)

Deep Excavation and Soft Ground Tunnelling

08:30	–	09:00 am	Registration
09:00	–	10:00 am	Deep excavations - design issues Speaker: Stephen Buttling
10:00	–	11:00 am	Deep excavations - construction issues Speaker: Stephen Buttling
11:00	–	11:15 am	Coffee break
11:15	–	12:15 pm	Deep excavations - details and failures Speaker: Stephen Buttling
12:15	–	01:00 pm	Lunch
01:00	–	02:00 pm	Evaluation of performance of diaphragm wall Speaker: Richard Hwang (MAA)
02:00	–	03:00 pm	Case histories of failures in geotechnical engineering practice Speaker: Richard Hwang (MAA)
03:00	–	03:15 pm	Coffee break
03:15	–	04:15 pm	"Soft Ground Tunnelling and Deep Excavations for the Bangkok MRT Blue line" Speaker: Doug Maconochie (Parsons Brinckerhoff)
04:15	–	05:00 pm	General Discussions / Closing

About the speakers

Dr. Nick Barton

Dr NICK BARTON (born in 1944 in England), lives in Høvik, Norway and some of the year in São Paulo, Brazil. He graduated in Civil Engineering in 1966 from the University of London's King's College, and obtained his Ph.D. on rock slope stability from Imperial College in 1971. He worked at NGI for two periods, from 1971 to 1980 and from1984 to 2000. He returned from four years in the USA as Division Director in NGI's Dam, Rock and Avalanche division, and was then Technical Advisor at NGI from 1989 to 2000. He is a well known international researcher and consultant in rock engineering, is the developer of the Q-system, and co-developer of the Barton-Bandis joint constitutive model. He has been visiting professor in the Universities of Utah, Luleå, and São Paulo. He is author or co-author of more than 200 papers on rock mechanics and rock engineering for tunnels, and has written a book on TBM tunnelling, and one on rock quality and seismic attributes. He has consulted in 28 countries during 35 years, mostly connected with hydropower, water-transfer, road and rail tunnelling through rock, also for rock caverns and nuclear waste projects in several countries. He has had his own consultancy Nick Barton & Associates since 2000.

Dr. Richard Hwang

Dr. Richard Hwang (born in 1943 in China) graduated in Civil Engineering in 1963 from the National Taiwan University, Taipei and obtained his Ph.D degree on soil dynamics and earthquake engineering from the University of California, Berkeley in 1974. He worked for Harding Lawson Associates and Woodward Clyde Consultants in California for years before he joined Kisojiban Consultants Pte., Ltd., (with headquarters in Tokyo) as General Manager of Singapore Branch in 1979. He was engaged by the Singapore MRT Corporation (now Land Transport Authority) in 1983 as geotechnical consultant on the Phases 1 and 2 constructions of the MRT systems. He has also been Geotechnical Engineering Specialist Consultant to the Department of Rapid Transit Systems of Taipei on the Stage 1 construction of the rapid transit systems. Dr. Hwang has authored and co-authored more than 100 technical articles on earthquake engineering, numerical analyses, deep excavations and tunnelling. He is now Senior Vice President of Moh and Associates, Inc., Taipei, Taiwan.

Oliver Batchelor - BEng MSc DIC

Keller Ground Engineering Pty Ltd

Graduating in Civil Engineering and Geology from London University in 1994 Oliver commenced his career carrying out Ground Investigation along the Channel Tunnel Rail Link. Subsequently he returned to university completing his Masters in Engineering Geology at Imperial College London in 1996 before commencing work with Keller Ground Engineering (UK) where he was involved in the day to day development of Grouting and Specialist Geotechnical Projects including London's DLR Compensation Grouting Project and numerous Jet Grouting and Compaction Grouting Projects. Since relocating to Australia in 2001 initially with Austress Freyssinet and most recently with Keller Ground Engineering (Australia), Oliver has been involved in the development of Jet Grouting and Compaction Grouting as recognised engineering techniques. He is responsible for Business Development for all of Keller's techniques from Stone Columns and Dynamic Compaction through to Jet Grouting, Soil Mixing and Slurry Walls.

Dr. Kejing Chen

Dr. Kejing Chen is a senior geotechnical engineer at Golder Associates Cairns Office. He obtained both his Bachelor and Master degrees from China in the early 1980s, and PhD in University of New South Wales. Kejing has over 20 years experience in geotechnical engineering including 8 years in China, two year in the UK and more than 14 years in Australia. Kejing's expertise includes, but is not limited to the following:

- Soil liquefaction
- Soft ground engineering
- Slope engineering
- Reinforced soil engineering
- Pavement engineering

In the last eight years Kejing has been project manager for Golder Associates involvement in many of the Cairns' land mark projects, including the following:

- Cairns International Airport
- Cairns Cityport Project
- HMAS Cairns Redevelopment
- Kuranda Road Stabilisation Works
- Blue Water Canal Development

Dr. Jay Ameratunga

Jay Ameratunga led the Geotechnical Team on the Seawall Project. He has a B.Sc (Eng) Hons from the University of Ceylon and a PhD in Geomechanics from Monash University. After a stint overseas he joined Coffey in 1989, initially attached to the Sydney office before coming to Brisbane in 1993. He has recently been associated with several major projects in SE Queensland. He was the Geotechnical Team Leader of the Port of Brisbane Motorway during the design phase, Geotechnical Design Manager for the Wivenhoe Alliance Project and led the Geotechnical team at the Seawall project.

Sergei Terzaghi

Sergei Terzaghi graduated from the University of Canterbury in 1986 with a Batchelor of Engineering (Hons) in civil engineering. He started his career with Murray-North Partners in Auckland, New Zealand. This firm was acquired initially by Woodward-Clyde consultants in 1993, which in turn was acquired by URS in 1998. Sergei joined Sinclair Knight Merz in Auckland in 2000, and has subsequently transferred to SKM, Sydney in 2005 where he is now the NSW geotechnical section manager. In the course of his career to date, he has been involved in many projects of note throughout the Asia-Pacific region, and across many areas of engineering endeavour. He provided the technical expertise for the successful introduction of deep soil mix technology into New Zealand. He has special interests in fundamental soil behaviour, especially the 'non-standard' soils or in non- standard situations such as high temperature areas (eg geothermal), and in numerical modelling of geotechnical systems.

Dr. Jim Shiau

Dr. Jim Shiau is a lecturer in Geotechnical Engineering, Faculty of Engineering and Surveying, University of Southern Queensland, Australia. Born in 1968, Jim grew up in Taiwan and lived there in most of his young life. Jim graduated from National Kaohsiung University of Applied Science in 1988. After two years' compulsory military service in Taiwan, he found an interest in pursuing a higher degree and become an academic staff in university. His life changing decision came about when he first arrived at Australia in 1990. Jim obtained his first degree, Master of Engineering Science, from University of New South Wales in June, 1992. After uncertainty of a career choice and a few years of "real world" experience being a structural engineer and thereafter a geotechnical engineer, he decided to undertake a PhD research project at Geotechnical Group, University of Newcastle in March 1998. He was awarded a PhD degree in December 2001 and attended graduation ceremony in 2002. Before taking up a lecturing position at the University of Southern Queensland in 2003, Jim had 6 years of research experience in limit and shakedown analyses whilst working in the Geotechnical Research Group at the University of Newcastle. During this period, he played a key role in the development and implementation of numerical techniques for performing lower bound shakedown analysis in road pavements. He also has extensive experience in applying the upper and lower bound limit analysis techniques to a number of geotechnical stability problems.
Jim's recent academic activities can be found at http://www.usq.edu.au/users/jimshiau/.

Dr. Stephen Buttling

Stephen Buttling graduated from Imperial College, University of London, in 1970 and immediately engaged in research at Bristol University leading to award of a PhD in January 1975. He has spent the last 32 years in geotechnical work, initially with Cementation Piling & Foundations for 5 years and then as a consulting engineer in the UK. In 1982 he moved to Hong Kong with Scott Wilson, working on the Island Line of the MTRC, and spent 1985 and 1986 in Singapore as Senior Geotechnical Engineer to the MRTC during the construction of Phases 1, 1A, 2A and 2B. After a further 3 years with Scott Wilson in Hong Kong he has been based in Bangkok, Thailand, where he renewed his acquaintance with Professor Bala.

After a year with Moh and Associates he was self-employed for 6 years, and then became Technical Manager in the Marine Division of Italian-Thai Development PCL, Thailand's biggest contractor. For the last 4 years he has been with Earth Tech, supervising the installation of 27,000 piles for the passenger Terminal Complex of the Second Bangkok International Airport, followed immediately by the supervision of the civil and structural works of the Underground Train Station at the airport to serve the Airport Express.

Dr. Jeff Hsi

Dr Jeff Hsi (born in 1957 in Taiwan), is a Chief Technical Principal in Geotechnics of the Snowy Mountains Engineering Corporation (SMEC) and is presently based in Sydney. He was awarded a PhD in Geotechnical Engineering by the University of Sydney in 1992, and previously received his BSc and MSc in Civil and Geotechnical Engineering from the National Cheng Kung University in Taiwan in 1981 and 1983 respectively. Prior to joining SMEC in 1995, he worked with Moh and Associates, a leading consulting firm in Taiwan, from 1985 to 1988 and with Coffey Partners International in Sydney between 1993 and 1995. He was also a Research Fellow at Sydney University and the National Cheng Kung University and is currently a Guest Lecturer at the Western Sydney University. He has had over 30 technical papers published in Australian and International journals and conferences. Most recently, he has been the Geotechnical Design Manager for Westlink M7 (AUD $1.6B) in Sydney and Kallang and Paya Lebar Expressway C421 (AUD $300M) in Singapore. Over his 20 years professional career, he has managed and led geotechnical designs and studies for many large-sized multi-disciplinary projects both within Australia and overseas.

Patrick Wong

Patrick Wong joined the Coffey Group in 1979, and has worked as a geotechnical consultant for his entire professional life. He has broad experience in a wide range of geotechnical projects including roads, bridges, dams, buildings, excavations, tunnels, marine structures, and landslip studies. He is a specialist in soft soils and ground improvement, and is widely consulted both in Australia and overseas. He has extensive management experience at the project and office level, and is currently a Senior Principal of Coffey Geosciences Pty Ltd.

Dr. John Read

Education
PhD, Geotechnical Engineering, Purdue University, USA, 1987
Grad Dip Mgmt, CIAE, Rockhampton, Australia, 1982
MSc (Hons), Geology, University of Canterbury, New Zealand, 1965
BSc, Geology, University of New Zealand, 1962

Professional Experience, Overview
Dr Read has 40 years experience as an engineering geologist in civil and mining engineering. He spent his early years working in Papua New Guinea with the Bureau of Mineral Resources (now Geoscience Australia) as a project engineering geologist on the investigation and construction of hydro-electric schemes, new roads and village water supplies. Back in Australia, in 1968, he worked with the geotechnical engineering consultants Coffey & Partners Pty. Limited on water supply dams, highway investigations and mining infrastructure projects throughout Australia, Papua New Guinea and Indonesia. From 1977 to 1980 he was Superintendent Engineering Geologist at the Melbourne and Metropolitan Board of Works and from 1980 to 1984 the Superintending Engineering Geologist at the Bougainville
Copper Mine in Papua New Guinea.

In 1984 Dr. Read moved to the USA, to Purdue University, where in 1987 he completed his PhD studies in Geotechnical Engineering. He then worked with the geotechnical engineering consultants Golder Associates Inc on USDOE programs for the underground disposal of nuclear waste in Washington State and Texas, and on slope stability and open pit metalliferous mine design tasks in North and South America.

In 1990 Dr. Read returned to Australia to commence his own geotechnical engineering practice, specialising in slope stability and open pit mine slope design work with projects in Australia, Fiji, Papua New Guinea, North and South America, South Africa, and Zambia. In 1994, he accepted a contract appointment with CSIRO as Deputy Chief, CSIRO Exploration & Mining and Executive Manager and CSIRO spokesperson to government and industry for the Queensland Centre for Advanced Technologies laboratories at Pullenvale, Brisbane. In 2004 Dr Read stepped back from both of these positions to establish a CSIRO mining industry funded research project (the LOP Project), which is directed at improving our ability to predict the reliability of rock slopes in large open pit mines.

Dr. Harry Asche
Connell Wagner Pty Ltd

Graduating in Civil Engineering from the University of Melbourne in 1979, Harry spent his early years working on bridge and geotechnical design in Melbourne and Sydney. In the 1980s Harry travelled to the UK to work on the Channel Tunnel. Today Harry is a Principal with Connell Wagner and possesses 26 years experience in the design and construction of tunnel, railways, bridge and road projects. Harry is in charge of the Infrastructure Section for the Brisbane office incorporating Transportation, Water and Environment, Urban Development and Advisory groups. Major projects Harry has been associated with include the Airport Link Tunnel ($1.5 billion) a 6km urban road tunnel in Brisbane and the North-South Bypass Tunnel ($1.5 billion) a 5.2km urban road tunnel also in Brisbane. He has also been heavily involved in the Eastlink Project in Melbourne ($2.3 billion) as tunnel design principal advisor for the detailed design of this 1.5km twin 3 lane tunnels and the Cross City Tunnel project in Sydney ($700 million) as tunnel design team leader. Previous Brisbane projects include the Brisbane Rail Tunnels, the South East Bus way tunnels and the S1 Sewer tunnel. Harry completed a PhD at the University of Queensland in 2003 with the topic being numerical prediction of tunnelling induced settlement in weak rock.

Details of Nick Barton's course on "Practical Rock Engineering with Q in tunnel design and execution using TBM and drill-and-blast methods" and abstracts of lectures.

15 February

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16 February

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   NMT tunnel support philosophy
   1989-1993 update for mostly B+S(fr)
   S(fr) and Bolting details
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   Improved 'effective' rock mass

(1) Evaluation of Performance of Diaphragm Walls

Richard Hwang
Moh and Associates

Abstract

Diaphragm walls are commonly used for retaining deep excavations in soft ground and much experience has been learned in recent years as numerous excavations were carried out for constructing deep basements and underground stations of rapid transit systems. Walls were previously designed on their structural capacity and toe stability. As many failures led to serious consequences, people are becoming more and more alerted. Therefore, walls are now designed to the allowable wall deflections so ground settlements behind the walls can be limited and adjacent structures will not be damaged. While numerical analyses are yet to be proved as a reliable tool, empirical approaches remain to be useful to guide designs. Based on field observations, it is possible to correlate wall deflections with wall stiffness and geological conditions and charts have been established for estimating wall deflections. The influence of various factors, including depth of excavation, wall thickness, ground treatment, etc. on wall deflections can be evaluated in a more rational way. These charts are also useful for explaining abnormal behaviour of walls.

(2) Case histories of failures in geotechnical engineering practice

Richard Hwang
Moh and Associates

Abstract

As more and more high-rise buildings are constructed in cities, excavations go deeper and deeper and potential of failure of cofferdams increases drastically. Furthermore, the construction of rapid transit systems usually calls for deep excavations and tunnelling in soft ground. Many failures have led to serious consequences, even fatalities. To be discussed are a few case histories of failures associated with the constructions of the Singapore MRT System and the Taipei Rapid Transit Systems with emphasis on remedial measures taken for the rectification of damaged structures and for the restoration of MRT structures. Also to be discussed are the methods adopted in protecting structures and properties adjacent to major underground works and some of the regulations governing new developments adjacent to rapid transit systems.

(3) Design and Construction of Taipei Rapid Transit System

Richard Hwang
Moh and Associates

Abstract

As the population in the city grew rapidly and traffic congestion became daily nightmare, the City Government of Taipei launched the project of the rapid transit system in the late 80's to solve the problem. The first stage of construction was successfully completed a few years ago and new lines are now being added to the network. With soft deposits extending to a great depth and water table being high, the ground conditions in the Taipei Basin are hostile to underground works. To ensure the project to proceed smoothly, the Department of Rapid Transit Systems engaged a team of specialists to assist the Department in the planning, design and construction of the system. Discussed are the geotechnical services provided by this team and the methods of construction adopted in cut-and-cover excavations and tunnelling. Also discussed are the problems encountered during construction and auxiliary measures, such as the use of compressed air, ground treatment, dewatering and ground freezing, adopted in dealing with various situations.

(4) New Thoughts on Pavement Design

Jim Shiau, PhD (Newcastle)
Faculty of Engineering and Surveying, University of Southern Queensland

Abstract

An excellent review of the current practice of pavement engineering has been given by Brown (1996) in the 33rd Rankine Lecture to the British Geotechnical Society. He emphasizes that practice is lagging behind knowledge of the behaviour of road materials obtained from laboratory experiments and that theoretical models need to be improved. Indeed, most pavement design methods currently used around the world are largely empirical. Both experimental data from full scale road tests and practical long term experience with the in-service pavement performance are still two important factors considered in the current pavement design approach.

A novel numerical and experimental approach is being developed at University of Southern Queensland to investigate the effect of repeated surface tractions on road pavements. Indeed it is not uncommon to see road pavement damage in areas near road intersections. One type of pavement failure found on major roads in urban areas appears to be caused by frequent decelerations and accelerations of heavy vehicles near signalized intersections. This mode of failure manifests itself as a shoving of the pavement surface and appears to result from repeated traction forces in the pavement materials. This type of failure has also been observed at some locations close to Stop and Give Way signs.

In this presentation, the design of a pavement testing facility that is being built at University of Southern Queensland, Australia is described. The developed facility will have the capacity to simulate the action of repeated loadings caused by frequent decelerations of vehicles. The equipment will also permit the evaluation of various base-subgrade systems under this form of loading. Together with the experimental development is the discussion of a novel numerical shakedown approach to the design of road pavements.

(5) Identifying the Boundary between Geotechnical and Structural Engineering in Tunnel Design and Analysis

Ted Nye
Tunnel Engineering Manager, Sinclair Knight Merz

Abstract

The construction of major urban tunnels requires an understanding of both geotechnical and structural analysis and design. The end use operational requirements applicable to a particular tunnel must also be understood and developed as part of the design process. There is a wide range of both analytical and design methodologies available for tunnels and one of the major issues is identifying which approach is the most appropriate, particularly when tunnel ground conditions could arguably be classified as either soft ground or rock. While rock mass reinforcing systems have their place, there becomes a turning point in the design process where only a structural solution is appropriate. Identifying this boundary and also the difference between analysis and design for any combination of ground conditions, tunnel configuration, span opening size and depth of ground cover is an important issue. There is likely to be a project cost penalty or an increased risk to the project when analysing and designing at these interfaces when either one or both have not be recognised or identified correctly.

(6) Soft Ground Treatment and Performance Yelgun to Chinderah Freeway, NSW, Australia

Jeff Hsi
Chief Technical Principal, Geotechnics, SMEC Australia Pty Ltd

Abstract

Yelgun to Chinderah Freeway was a major road project in NSW, Australia. The project involved design, construction and maintenance for 10 years of the 28.5 km freeway. One third of the route traversed flood plain and marshy ground consisting of very soft alluvial soils. The presence of soft soils imposed significant constraints on the project involving embankment instability during construction, prolonged consolidation process and excessive post-construction settlement.

Developing safe, robust and cost-effective soft ground solutions was the most technical challenging feature of the project. The solutions included the use of timber piles in conjunction with bridging rock mattresses at the bridge approach areas to provide smooth transitions, preloading and surcharging with wick drains to speed up the consolidation process and reduce creep settlement, and high strength geotextile to improve embankment stability during construction. State-of-the-art design approaches using modern computer techniques were adopted. These methods allowed modelling of the fully coupled behaviour between the soil and the ground water and interaction between various foundation treatments components.

Measures taken to reduce geotechnical uncertainties and risks included extensive site investigations, construction of trial embankments, and implementation of instrumentation and monitoring. The field measurements were used to calibrate the geotechnical models for the prediction of the long term embankment performance. This presentation will include the subjects of geotechnical investigations and field monitoring, methods of soft ground treatment, design approach and methodology and field performance.

(7) Kallang and Paya Lebar Expressway - Contract 421, Singapore

Jeff Hsi
Chief Technical Principal, Geotechnics, SMEC Australia Pty Ltd

Abstract

A 1.5 km long cut and cover tunnel between Nicoll Highway and East Coast Parkway (ECP), forming part of the 12 km long Kallang and Paya Lebar Expressway (KPE) in Singapore, was awarded as a design and construct contract (C421). The project involves the construction of a vehicular tunnel, a KPE/ECP interchange, an at-grade road, a bridge over Geylang River on top of the tunnel and a ventilation building. The Contractor is Sembcorp, the Principal Consultant is STAE and SMEC is the Specialist Consultant for the design of the temporary and permanent tunnel structures. The most critical component of KPE C421 was to construct the 1.5 km tunnel entirely in soft marine clays using the cut and cover method. The support system adopted for the temporary excavation consisted of sheet piles and internal struts. The excavation was up to 20 m deep with an excavated width of 40–60 m. Both bottom-up and top-down construction methods were used on this project.

Design and construction of this cut and cover tunnel presented particular challenges to the designer and the contractor, as the tunnel was to be built in very soft marine clays with an undrained shear strength as low as 8 kPa and a thickness up to 40 m. Special features of the project included: bored piles of 1–1.2 m diameter up to 70 m long supporting the tunnel; sheet pile walls incorporating pre-excavation to reduce ground pressure and preloading of struts to control wall deflection; cofferdams for construction of the Geylang River crossing; and jet grout slabs to support the sheet pile walls pulled up in marine clays.

Stability of the sheet pile walls and ground movement associated with the excavation were the main concerns of the project. Sophisticated numerical modelling was carried out to assist in the design of the walling system taking into account the soil-structure interaction and the coupled behaviour between the soil and the ground water. Extensive geotechnical instrumentation was implemented to closely monitor the performance of the work. This presentation will include subjects of the geology and geotechnical characteristics of the site, special features of the project, critical geotechnical and structural issues, design methodology and considerations, predicted and actual performance of the excavation.

(8) Residual and Volcanic soils

Sergei Terzaghi
Sinclair Knight Merz (SKM)

Abstract

These are two groups of soils that appear to behave very differently compared to the 'classic' European and North American soils, yet are common in this part of the world. This lecture will look at these differences, explores some of the issues with interpreting lab test results, and examines some of the reasons for the differences and pitfalls with using these materials. Some suggestions as to what might be done in practice in using this material will be looked at.

(9) Deep Soil Mixing

Sergei Terzaghi
Sinclair Knight Merz (SKM)

Abstract

Deep soil mixing is a relatively new technology in Australasia that holds a lot of promise for the future, in combination with recent developments in these areas internationally. This lecture will cover some of the technologies and uses, experiences, and design methods that can be used with the technology. The current limitations in design approaches (and technologies) and reasons for these limitations will be discussed.

(10) Geotechnical Activities in Cairns

Kejing Chen
Senior Geotechnical Engineer, Golder Associates

Abstract

Cairns is Australia's fastest growing regional city and is recognised as the international gateway to the Tropical North Queensland. Merging here of two of the world's greatest natural wonders, the World Heritage Listed Wet Tropical Rainforest and the Great Barrier Reef provides Cairns with the unique status and special attractions as a tropical paradise for holiday makers from worldwide and Australia as well. The demands for the public infrastructures, tourist accommodations and residences for the locals are enormous. Statistical data from Cairns Post in 2005 indicates that Cairns region attracted $4 billion worth developments with another $3 billion worth developments at the stage of planning and approvals. The developments range from the high-rise apartment buildings along the Cairns CBD to land subdivisions at hill slopes, from residential estates to industrial complexes, from Taxiways/apron bays expansions at the Cairns International Airport to City-port foreshore upgrades.

Geologically Cairns situates on quaternary sediments between the Coral Sea and the Lamb/MacAllister ranges which form part of the Great Dividing Range. Most of Cairns city including its CBD areas, airport, seaports and the major transportation corridors spreads along the coastal plain made of marine deposits with depths typically varying from 5 to 15 m and locally up to 30 m. Soft and thick marine clays pose special challenges to the geotechnical engineers.

Significant proportions of the existing and future developments in Cairns region including four national highways, a state railway line and some of the residential suburbs extend to the hill slopes west of the coastal areas. The geology of hill slopes is dominated by the Middle Palaeozoic Hodgkinson formation comprising metamorphic with some Granite intrusions. The steep terrain plus wet tropical climate makes the developments on the hill slopes very prone to the landslides and rock falls. The new State Planning Policy (SPP/03) requires that landslide risk assessment be carried out prior to any development within the hill slopes.

The presentation will cover the following geotechnical aspects associated with the developments in Cairns region:

- Marine clay distributions in Cairns region and its engineering properties
- Geotechnical design parameters of soft marine clays
- Ground improvement for soft marine clay
- Landslide hazards and risk assessments and remediation
- Slope stability and stabilisation

(11) Ground improvement works in Cairns

Kejing Chen
Senior Geotechnical Engineer, Golder Associates Cairns

Abstract

Cairns City is spreading along the east coastal area between the Coral Sea and the Great Dividing Range with its CBD and major infrastructures (including Cairns International Airport, Seaports, Northern and Southern Waste Water Treatment Plants built on soft marine clays). Significant portion of the infrastructures (i.e. road, highways, railways and water supplies) and the residential developments extend to the hill slopes behind the coastal areas. These pose significant challenges to a geotechnical engineer. Golder Associates as a geotechnical consultant in Cairns region plays key roles in providing innovative solutions to all respective of geotechnical engineering. This presentation will show some examples of the solutions, viz

- Compaction
  - Shallow improvement, eg impact roller (<0.5m), Broms and Landpac (<3-5m)
  - Deep improvement, eg dynamic consolidation and stone columns (not used in Cairns)

- Ground improvement by excavation and replacement- Case Histories:
  - Bluewater Canal and Harbour development Cairns, Cardno (2003-2004)

- Pre-loading and Surcharging- Case Histories:
  - The lakes development Edge Hill, GHD (1997-2003)
  - Cairns One Project Cairns, H Vision (2003 to present)
  - Business Park Cairns International Airport, Cardno and SKM (2005 to present)

- Geosynthetic reinforced fill- Case Histories:
  - Cairns Cityport Project – Northern Reclamation, Cairns Port Authority (2002)
  - Waste Recovery Facility Portsmith Landfill, Cairns Water (2004)
  - Road Subsidence, Kuranda Range, Department of Mainroads (2004)
  - Sinkholes Wrotham Park Station Resort, P&O Australia (2005)

- Soil Nails - Case Histories:
  - Embankments Lake Morris Road, Cairns Water (2003)
  - Embankment Stabilisation Kuranda Range Railway Line, Queensland Rail (2002)

- Embankment stabilisations Kuranda Range Road, Department of Mainroads (2004)
- Batter Failure Ferntree Close, Cairns Water (2005)
- Stabilisation of cut batter failures in various hill side residences in Cairns region

- Under Pinning- Case Histories:
  - Cracking House 83 English St, Manunda (1998)
  - Footing stabilisation Granite Close, Brinsmead (1999)
  - Sinking House Holloway Beach (2000)

- Special Ground improvements - Case Histories:
  - Ground with remnant piles following demolishment of super structures, Apron Bays 8 and 9, Cairns International Airport, SKM (2002)
  - Landslide Remediation Ski Lake Smithfield, Lambert and Rebein (2004)

(12) FPE Seawall Project – Port of Brisbane

Jay Ameratunga
Coffey Geoscience

Abstract

The largest infrastructure project handled by the Port of Brisbane Corporation in recent years was the construction of a 4.6km Seawall, which extends 1.8km into Moreton Bay and encloses an area of some 230Ha, which is available for future port expansion. The Port of Brisbane Corporation formed an Alliance to deliver the $90M Seawall Project, and selected as partners Leighton Contractors, WBM Oceanics, Coffey Geosciences and Parsons Brinckerhoff. An Alliance was adopted due to the significant geotechnical, environmental and construction risks associated with the project's delivery, because of the variable and weak subsurface profiles, close proximity of Moreton Bay Marine Park, and varying water depths and sea conditions expected during construction. Soft clays exist along the full length of the alignment with the thickness varying from 6m near the existing reclamation increasing to 30m towards the east. The consistency of the soft clay at the seabed surface is very soft to soft, with undrained shear strengths generally as low as 5 kPa. The design was based on the use of high strength geotextiles, sand pancakes and rock bunds. A 'multipurpose' barge was used for laying both geotextiles and for placing the sand through a spreader system. As part of the risk management process, physical modelling studies and construction trials were carried out to provide a better understanding of critical issues related to the Seawall's design and construction and to verify assumptions.

(13) Rock Slope Lecture - Rock mechanics and slope stability for rock slopes in open cut mines

John Read
CSIRO

Outline of Lectures

The lecture will focus on:

- Geological Framework, outlining the nature of the geological events that lead to the formation of the ore body.
- Characterising the Rock Mass, outlining the type of data that is required for processing and entry into the design analyses.

Details of specific data collection methods, including geological mapping, drilling, logging, groundwater monitoring, and laboratory testing will be highlighted with respect to the preparation of:

- Geological Model; regional geology linked to a mine scale description and presentation of the nature (rock type, degree of weathering & alteration) and distribution of each lithological unit.
- Structural Model; orientation, distribution, and nature of (a), through-going faults at regional, pit and inter-ramp scales scale and (b), lesser faults and joints at bench and inter-ramp scale. Hydro-geological Model; overview of the slope engineering and ground water hydrology, focussing on an explanation of the concepts of fracture flow, recharging of fractures by rainfall and/or surface water, phreatic and piezometric surfaces, hydraulic gradients, pore pressure distribution in fractured rock, total and effective stress, and the distinction between slope depressurisation and dewatering.
- Geotechnical Model; focussed on the engineering properties of each or feature in the geological and structural models, including for example, UCS (σci), Is50, RQD, GSI, *m*i, *mb*, and Ei.
    - Data Analysis, focussing on how the rock mass characterisation data is processed and made ready for use in the design analyses, with special attention to (a), peak and residual shear strength and the realisation of cohesion and scale effects when estimating the shear strength of the faults and joints that intersect the rock mass and (b), the reality and applicability of different methods of estimating the strength of the rock mass, including the generalized Hoek-Brown criterion and RQD-based procedure developed by other practitioners.
    - Analytical Methods, focussing on methods currently in use to predict, back-analyse and formalize the design and estimate the reliability of the final pit walls, especially the current processes of optimising the design of batter, inter-ramp and overall slopes.
    - Acceptance Criteria, focussing on current deterministic and probabilistic approaches.
    - Slope Performance & Management, focussing on limits blasting, slope monitoring systems, slope support, and emergency response.