

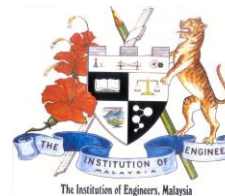
Secretariat

IEM TRAINING CENTRE SDN. BHD. (127273-K)

No. 33-1A, Jalan 52/18, P.O. Box 224 (Jalan Sultan),
46720 Petaling Jaya, Selangor

Tel. no. 03-79586851 Fax no. 03-79582851

Email: faiza@iem.org.my or nora@iem.org.my



2-DAY SEMINAR ON TUNNELLING & UNDERGROUND SPACE

Speakers

Ir. Dr. Ooi Lean Hock	Ir. Tan Joon Gei
Ir. Thavanendran Mahalingam	Prof. Jenny Yan
Er. David Ng Chew Chiat	Ir. Khoo Chee Min
Ir. Dr. Ooi Teik Aun	Er. Ir. Dr. Ong Chee Wee, Victor
Mr. Klados, Gustav	Mr. Don Hall
Ir. Neo Boon Kheng	Mr. Tan Boon Kong

1 & 2 September 2016

9.00 am – 5.00 pm

Auditorium Tan Sri Prof. Chin Fung Kee, 3rd Floor, Wisma IEM, Petaling Jaya

BEM Approved CPD/PDP Hours: 13 CPD
Ref. No. : IEM16/HQ/349/S

Closing Date: 31 August 2016

NO online registration will be allowed after the closing date

REGISTRATION FEE (GST INCLUDED)

GRADE	NORMAL	ONLINE
IEM Student Member	RM424.00	RM318.00
IEM Graduate Member	RM848.00	RM742.00
IEM Corporate Member	RM1,060.00	RM954.00
Non IEM Member	RM2,120.00	RM1,908.00

Organized by:

Tunneling & Underground Space Technical Division, IEM

Managed by

IEM Training Centre Sdn. Bhd.

Payment Methods

- ✓ For **ONLINE REGISTRATIONS** (www.myiem.org.my), only ONLINE PAYMENT is applicable [via Maybank2u –Personal Saving & Personal Current; Credit Card - Visa/Master].
- ✓ For **NORMAL REGISTRATIONS** (faiza@iem.org.my/nora@iem.org.my), Payment via CASH / CHEQUE / BANK-IN TRANSMISSION / BANK DRAFT / MONEY ORDER / POSTAL ORDER / LO / WALK -IN will be considered as NORMAL REGISTRATION
- ✓ FULL PAYMENT must be settled before commencement of the course, otherwise participants will not be allowed to enter the hall.
- ✓ For CASH: RM enclosed.
- ✓ For CHEQUE: Cheque no. _____ for the amount of RM _____ (non-refundable) and made payable to "IEM TRAINING CENTRE SDN BHD" AND "CROSSED A/C PAYEE ONLY".
- ✓ Bank Transfer (Please forward soft copy of payment advice)

✓ Account Name : IEM TRAINING CENTRE SDN BHD
✓ Account Number: 514169143176
✓ Bank Name : Malayan Banking Berhad
✓ Bank Address : Jalan Sultan, 46200 Petaling Jaya, Selangor Darul Ehsan, Malaysia
✓ Swift Code : MBBEMYKL

Terms & Conditions

- ✓ If a place is reserved and the intended participants fail to attend the course, the fee is to be settled in full.
- ✓ Fee paid is not refundable. Registration fee includes lecture notes & refreshment.
- ✓ The Organizing Committee reserves the right to cancel, alter, or change the program due to unforeseen circumstances. Every effort will be made to inform the registered participants of any changes.
- ✓ In view of the limited places available, intending participants are advised to send their registrations as early as possible so as to avoid disappointment.

Name of Organization: _____

Address: _____

Telephone No.: _____ (O) _____ (Fax)

PROGRAMME

1st September 2016 (Thursday) : Day 1	
08:30 – 09:00	REGISTRATION
09:00 – 09:05 a.m	Welcoming Speech by Chairman of Organising Committee, Ir. Dr. Ooi Teik Aun
09:05 – 9:10	Welcome Speech by Chairman of TUSTD
09:10 – 10:10	Speaker 1 – Prof Jenny Yan
10:10 – 11:10	Speaker 2 – Dr. Ooi Lean Hock
11:10 – 11:40	TEA BREAK
11:40 – 12:40	Speaker 3 Ir. Khoo Chee Min
12:40 – 14:00	LUNCH
13:00 – 14:00	Speaker 4 Mr. Tan Boon Kong
14:00 – 15:00	Speaker 5 Ir. Thavanendran Mahalingam & Er. Abhishek Murthy
15:00 – 16:00	Speaker 6 Ir Tan Joon Gei
16:00 – 16:30	TEA BREAK
16:30 – 17:30	Speaker 7 Gusztáv (Gus) KLADOS
2nd September 2016 (Friday) : Day 2	
8:30 – 09:00	REGISTRATION
09:00 – 10:00	Speaker 8 Ir. Dr. Ooi Teik Aun
10:00 – 10:30	TEA BREAK
10:30 – 11:30	Speaker 9 Er. Ir. Dr. Ong Chee Wee, Victor
11:30 – 12:30	Speaker 10 Er. David Ng Chew Chiat
12:30 – 14.30	LUNCH
14:30 – 15.30	Speaker 11 Mr. Don Hall
15.30 – 16.30	TEA BREAK
16:30 – 17:30	Speaker 12 Ir. Neo Boon Kheng
17:30 – 18.00	Forum and Discussions

ABOUT THE SPEAKERS

Ir. Thavanendran Mahalingam

Thavanendran is currently Director of AEM Consultants or formerly Amberg Engineering Malaysia. He passed out from University Malaya in 1997 and was previously attached to Prasarana as Technical Manager of the LRT Line Extension Projects. He has been the Professional Engineer for the KVMRT Muzium Negara Station and Independent Reviewer of KVMRT SBK Line. He is also Secretary of the Engineering Education Technical Division of IEM.

Er. Abhishek Murthy

Er Abhishek Murthy is the Managing Director of CKMBT International Pte Ltd (CKM), a civil & structural engineering consultancy firm in Singapore and India. He is a registered professional engineer in Singapore, president of the Prestressed & Precast Society of Singapore, Vice-President of ASCE-Singapore Section and a Senior Member of Institution of Engineers, Singapore.

He has been involved in many complex projects involving the appraisal & strengthening of foundation structures including award-winning projects like the “14-storey Office extension of Amara Hotel & Shop Centre” and “Creation of Basement beneath the century-old Abdul Gafoor Mosque, a National Monument”. is also actively involved in MRT projects in Singapore and his current project is the Maxwell and Outram Stations and Tunnels which are being constructed in a highly built up environment.

Prof. Jenny Yan

Prof. Jinxiu YAN, has worked as consulting engineer for many major tunnel projects for 30 years. In the past 3 years, she has made 10 international Keynotes or lectures in Asia, Europe, America and Middle East. As research team leaders or experts appointed by the governments or the project owners, she have been involved in the construction of many major railway, highway tunnels and metro projects as well as long subsea tunnels in China, such as the longest 32km long Guanjiao Railway Tunnel under construction, 18km long Qinling Railway Tunnel (completed in 1999), 13 km long Yesahnguan Tunnel in Karstic geology (completed in 2010), 18km Qining Zhongnanshan Highway Tunnel(completed in 2009), the longest subsea highway tunnels in China---7.8km long Qingdao Jiaozhou Bay Subsea Highway Tunnel (completed in 2011) as well as 8.6km long Xiamen Xiang'an Subsea Highway Tunnel (completed in 2010). She has won the Winner for 2012 China Economic Female Entrepreneur Figures, Expert for enjoyment of China State Council Special Allowance for Outstanding Contribution to Engineering in 2011, Winner for the 5th Talent Prize of China Zhantianyou Development Foundation for Railway Science and Technology(2008) as well as Winner for Tip-top talent by the Ministry of Railways, P.R.China (2000)

Mr. Gusztáv (Gus) KLADOS

Gus Klados is the Director, Tunnels for the Underground Works Package Contractor MMC Gamuda KVMRT (T) Sdn. Bhd. for the Sungai Buloh – Serdang – Putrajaya (SSP) Line and has been the Project Manager for the Sungai Buloh – Kajang (SBK) Line in Kuala Lumpur.

Gus has forty plus years’ experience in tunnelling and related construction worldwide on major infrastructure projects out of which twenty two years in South- and South-East Asia. He started in Budapest on the M2 and M3 metro lines, worked in Belgrade, than in Yugoslavia on the Vračar rail tunnel, in India on the Calcutta- and Delhi metros, in England on the Channel Tunnel, in South Africa on the Lesotho Highlands Water Project, in Greece on the Athens Metro Lines 2 & 3, in Singapore on the Deep Tunnel Sewer System, in Malaysia on the SMART project, in Hungary - again in his native country after 28 years of absence - as project director of the Client on the Budapest Metro M4 Line. He returned to Kuala Lumpur in March 2011 to assist MMC and Gamuda to win and construct the underground works contract for the SBK Line and to win the tender and build the tunnels for the SSP Line, the first and second MRTs or heavy metro lines in the Klang Valley in Malaysia.

Mr. Tan Boon Kong

Mr. Tan was formerly Associate Professor of Engineering Geology at Universiti Kebangsaan Malaysia, Bangi, where he had served for 33 years. He retired from the university in October 2006.

In addition to teaching and research in the university, Mr. Tan was also engaged occasionally on an ad-hoc or project basis in consulting practices in Engineering Geology with the private sectors, mostly with the Geotechnical and Civil Engineering consulting companies or contractors. He now continues his practice as an independent, freelance Consultant Engineering Geologist. He has published widely on Engineering Geology and Rock Mechanics in local and international conferences and Technical Journals (see List of Publications).

Mr. Tan has also been actively involved in professional bodies such as the Geological Society of Malaysia (GSM), the Institute of Geology Malaysia (IGM) and the Institution of Engineers Malaysia (IEM) as a member of the Council (GSM, IGM) or Technical Divisions (IEM). He is the Chairman of the Working Group on Engineering Geology, Hydrogeology and Environmental Geology under GSM.

Ir. Dr. Ooi Teik Aun

Ir. Dr. Teik Aun Ooi graduated in Civil Engineering in 1966 from Auckland University, New Zealand and obtained his Master degree from the same University in 1968. He obtained his Doctor of Philosophy from Sheffield University in 1980. He is an Honorary Fellow of The Institution of Engineers, Malaysia (Hon. FIEM), Fellow of The Malaysian Institute of Arbitrators (FMIArb) and Fellow of The Institution of Civil Engineers, United Kingdom (CEng FICE), Fellow of the Society of Adjudicators, Malaysia (FSAM), Fellow of the Asean Academy of Engineering & Technology (FAAET). He is an Engineer (Malaysia), Accredited Checker (Geotechnical Engineering) and Chartered Engineer (C.Eng.), United Kingdom ASEAN Engineer, APEC Engineer, International Professional Engineer, ASEAN Chartered Professional Engineer, Professional. He is a Specialist Engineering Consultant, an Arbitrator, an Adjudicator, an Accredited Checker and Expert Witness.

Ir. Dr. Ooi is an active and a long serving member of IEM since 1970s. He was IEM Council Member in 1981 - 1984, Vice President in 1988 - 1990 and is a Director of IEM Training Centre Sdn Bhd since 1991. He has

been ICE Country Representative for Malaysia (2000 – 2015). He was President of the Southeast Asian Geotechnical Society (SEAGS) in 1993 – 1996 and re-elected for two more terms in 2010 – 2013 and 2013 – 2016), President of MIArb in 2008, Chairman of IEM Geotechnical Engineering Technical Division in 1991 - 1992. Chairman of IEM Tunnelling and Underground Space Technical Division in 2002 - 2003 and 2006 – 2009. He was the Organizing Chairman for the Annual Professor Chin Memorial Lecture 1995 – 2008, Organizing Chairman for the 12th SEAGC in 1996, 16th SEAGC in 2007, 19th SEAGC in 2016, Organizing Chairman for the International Tunnelling Conferences in 2006 and 2011 and 2015, ICE International Conference in 2011. He was Chairman of Pro-Tem Committee to set up the Association of Geotechnical Societies in Southeast Asia (AGSSEA) and was Chairman of AGSSEA from 2007 – 2010. He was also Chairman of Pro-Tem Committee to set up the IEM Engineering Consultancy Practice Special Interest Group (CESIG) and became its founding Chairman in 2009. He was Organizing Chairman for the 1st and 2nd International Green Workshop on Sustainable Infrastructures and Buildings held in 2010 and 2012 respectively. He was a member of the Technical Committee set up by the Government to investigate the collapse of the Highland Towers in 1993.

Er. Ir. Dr. Ong Chee Wee, Victor

Ir. Er. Dr. ONG Chee Wee, Victor is Managing Director of ONE SMART Engineering (Malaysia & Singapore) Sdn. Bhd. He is PE (Civil) registered with Board of Engineers Malaysia and ASEAN Chartered Professional Engineer. He is also a Specialist PE (Geotech) as well as PE(Civil) registered with Professional Engineers Board (PEB), Singapore. He obtained his PhD in Geotechnical Engineering from the National University of Singapore (NUS). Dr. Ong is currently serving on two International Technical Committees for International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) - Technical Committees TC 207 on Soil-Structure Interaction and Retaining Walls and TC 212 on Deep Foundations. Dr. Ong is also serving as Technical Committee of Asian Technical Committee (ATC-6) "Urban GeoEngineering". He was recently elected as SPRING Singapore Technical Committee for The Standards Council (Civil & Geotechnical Works). Dr. Ong is a recipient of Best Contribution Award in Asian Young Geotechnical Engineers Conference and The Hulme's Prize Award by Tunnelling & Underground Construction Society of Singapore (TUCSS). He was also named Young Consulting Engineer of the Year in 2014 by the Association of Consulting Engineers Singapore (ACES). Dr. Ong is also actively involved in Singapore and Kuala Lumpur's tunnelling and deep excavation projects.

Er. David Ng Chew Chiat

David Ng is Executive Director of **ONE SMART ENGINEERING** with offices in Singapore and Malaysia. He is a Specialist Geotechnical PE registered with Singapore PEB. He graduated in 1999 with a Master Degree in Geotechnical Engineering from NUS where he received the Innovation Award and NSTB Gold Award for his outstanding academic results and research work. In 2000, he was awarded the First Prize of the prestigious Hulme's Competition by the Tunnelling & Underground Construction Society of Singapore for his technical paper in tunnelling. In 2013, he has received the Young Consulting Engineer Award 2013 by the Association of Consulting Engineers of Singapore (ACES). He has published 39 technical papers in the field of geotechnical engineering. He has been involved in the design, supervision and project management of major infrastructure projects with deep excavation, mined tunnels and bored tunnels in Deep Tunnel Sewerage System, Kallang Paya Lebar Expressway, North East Line, Circle Line & Downtown Line during his 16 years of working experience.

Ir. Khoo Chee Min

Khoo Chee Min graduated in Civil Engineering from University Technology Malaysia in 2002 and joined G&P Geotechnics as a geotechnical engineer working on diverse infrastructure and building projects in wide range of ground conditions. In October 2010, he joined AECOM in Singapore, an international consultant renowned for major infrastructure and transportation projects worldwide. In recent years, he has actively involved in tunnelling projects such as Klang Valley MRT SBK Line and SSP Line in Malaysia, MRT Thomson Line and East-West Transmission Cable Tunnel in Singapore. He is currently working as Senior Manager in MRT Corporation managing the geotechnical and tunnelling designs for the underground works of SSP Line.

He is a Professional Engineer registered with the Board of Engineers Malaysia, a Chartered Professional Engineer registered with Engineers Australia, an International Professional Engineer registered under APEC/ EMF Registers as well as an ASEAN Chartered Professional Engineer. He is at present serving as Deputy Chairman of Tunnelling & Underground Space Technical Division of the Institution of Engineers

Malaysia.

Ir. Neo Boon Kheng

Ir Neo Boon Kheng holds a degree in Civil Engineering and Master of Engineering specialize in Geotechnical Engineering from USA. He has 15 years' experience in trenchless technology projects, ie pipe jacking, micro-tunnelling, horizontal directional drilling, RD utility detection & ground penetration radar detection and over 10 years' experience in design of sewerage network, pumping main & sewerage treatment plant and supervision of sewerage work in the capacity as resident engineer.

He is registered with the Board of Engineers, Malaysia (BEM); a member of The Institutions of Engineers, Malaysia (MIEM); a member of American Society of Civil Engineer (MASCE); an ASEAN Engineer; a member of Road Engineering Association of Malaysia (REAM) and a member of Permanent Way Institution (PWI) He has served as Chairman, Tunnelling & Underground Space Tech Division; Committee Member; Tunnelling & Underground Space Tech Div (2009 – present), Oil, Gas & Mining Technical Div (2006-2007) IEM Library Subcommittee (2014-present).

Mr. Don Hall

Don has had more than 30 years of experience in Underground and Tunnelling Projects worldwide including, SMART Tunnel, Malaysia, Lesotho Water Transfer Tunnel, Athens Metro, Channel Tunnel Project, Cairo Wastewater Scheme, and most recently Line 1 of the Klang Valley MRT, Malaysia. Three years ago Don established a joint venture company with China Railway Engineering & Equipment Group (CREG) to promote and sell their TBMs on the International market. CREG now have sales in Singapore, India, and Lebanon and are active in Turkey and the Middle East.

Ir Dr Lean Hock Ooi

Ir Dr Lean Hock OOI graduated with PhD from University of Sydney, Australia. In the past he has worked as a geotechnical consultant and a specialist contractor. He is currently the lead geotechnical engineer in the Design and Technical Department of MMC GAMUDA KVMRT (T) Sdn Bhd for the second line of Klang Valley Mass Rapid Transit from Sg Buloh- Serdang- Putrajaya (SSP) line. He has extensive experience in ground treatment works, more recently in deep excavation and tunneling works. He also has a keen interest in geotechnical instrumentation and testing. He has been involved in many interesting infrastructural projects such as railways, runways, highways, tunnels and hydropower both locally and abroad.

Ir Joon Gei Tan

Ir. Tan Joon Gei graduated with M.Eng Degree from Imperial College, London in 1997 and practicing as an Engineer in Malaysia since then, specifically in the field of Geotechnical Engineering. He has 4 years' experience working established Malaysian consultants like Minconsult and Zaidun-Leeng and another 13 years of design and built experience with Gamuda Berhad with their Design and Technical team, working on many of the company's projects like SMART, Ipoh-Padang Besar Double Tracking, Kaohsiung MRT project, Bahrain's Sitra Bridges and recently the Klang Valley MRT (KVMRT). He is one of the pioneer geotechnical member of MMC-Gamuda JV team who began studying and proposing the KVMRT project back in 2009 including preparing the project base design, design criteria and project brief under the PDP (Project Development Partner) role for the Government of Malaysia. He was stationed on the KVMRT, SBK (UG) site as a Geotechnical Design Manager attached to the MMC-Gamuda's underground project team, completing the 9.3km underground portion of the work with 7 underground stations. Currently he is with the MGKT (UG) team which is the successful tenderer for the KVMRT, SSP underground package which comprises 10 underground stations and 13.5km of tunneling works worth RM15.47 billion since 31st March 2016.

SYNOPSIS

RISK MANAGEMENT ON SOME LARGE TUNNELLING PROJECTS by Mr. Gus Klados

The author presents the basics of the modern trend of risk management on tunnelling projects, required by the **Code of Practice for Risk Management in Tunnels** (Code) prepared by The International Tunnelling Insurance Group. Though the application of the Code is voluntary, it is practically impossible to obtain **Contractor's All Risk Insurance** or **Third Party Liability Insurance** without practicing the Code. Without these insurances employers do not sign contracts with contractors.

The author discusses typical risks and risk mitigation in tunnelling through some examples of **The Channel Tunnel Project, The Lesotho Highlands Water Project, The Deep Tunnel Sewer System, The Athens Metro Lines 2 & 3, The SMART Project, The Budapest Metro Line 4 and the KVMRT SBK Line Projects** he participated in. Although the Code was not in force during the execution of most of these projects common engineering sense and good practice demanded that the principles of assessing, managing and mitigating risks/hazards were applied without using the terminology of the relatively new Code.

The Code was used during the construction of the KVMRT SBK Line to the satisfaction of the project insurers and is going to be used on the SSP Line, too.

CHALLENGES OF TUNNELLING AND UNDERGROUND SPACE DEVELOPMENT IN CHINA by Prof. Jinxiu Yan (Jenny Yan)

Since 1980s, tunneling and underground works has been developing rapidly in China. Especially, in the past 15 years, the length of the tunnels built is 3 times the total length of all tunnels built before the year of 2000. Up to the end of 2015, around 40,000km tunnels have been built in China, including railway tunnels, highway tunnels, metro tunnels as well as water tunnels. Moreover, around 10,000 km tunnels are currently under construction and a large number of tunnels under design to be built in the near future. China has been the largest tunneling country in the world and around 70% of world tunneling activities are going on in China. Those tunnels, with different lengths, different size and different use, have been built by a variety of methods. Because of variable geology in China, the vast tunnel projects have been built across almost all types of complex geology and surrounding situations.

This paper will present the tunneling development, the state of art of tunneling (for railway tunnels, highway tunnels, metro tunnels and water tunnels), and the challenges of the future tunneling, such as "long" (super long tunnel), "deep" (extra deep overburden), "big" (big cross section), "high" (high ground stress) and "complex" (complex geology) etc.

BUILDING RESPONSES DUE TO DEEP EXCAVATION FOR MUZIUM NEGARA MRT STATION, KUALA LUMPUR by Ir. Khoo Chee Min

Muzium Negara underground MRT station was constructed within 16m of the National Museum, a historically significant structure in Kuala Lumpur. The museum main building is founded on shallow footing in Kenny Hill formation. The 27m deep station excavation was constructed using diaphragm walls and top-down method. Built in 1960s, the building may have previously undergone some degree of settlement due to a series of upgrading works over the years before the station box excavation. It was therefore considered it would be more sensitive to ground movements making the challenge of controlling the impact of construction settlement even greater. This paper presents the actual performance of the settlement sensitive heritage building responses to a deep excavation carried out in close proximity.

GEOLOGY VIS-À-VIS TUNNELLING IN THE KUALA LUMPUR AREA by Ir. Tan Boon Kong

Geology has a direct impact on tunnelling works. Risk assessment of potential geohazards due to various ground conditions (i.e. geology) is an important component in the planning and execution of tunnelling projects. This paper discusses the geology of the Kuala Lumpur (KL) area and its impact on recent tunnelling works carried out in the area.

The rock formations encountered in recent tunnelling projects in the area include Granite, the Kenny Hill formation, and the KL Limestone. Since these rock formations have their own unique features and characteristics, they impact tunnelling works differently. For example, granite exhibits distinct weathering profiles with possible boulders in the grade IV zone; hence potential soil-rock mixed face with boulders for the Tunnel Boring Machine (TBM). The Kenny Hill formation comprises interbedded Quartzite and Phyllite, with the former having very high strength (Unconfined Compressive Strength, UCS of up to ~ 300 MPa) which impedes the progress of TBM. Quartzite is also highly abrasive to TBM cutters since its mineralogical composition is basically 100% quartz or silica (SiO₂). The KL Limestone is well known for its

karstic features (irregular or pinnaced bedrock profile, cavities and solution channels, slump zone with Standard Penetration Test, SPT N = 0, etc.) which pose serious geohazards to tunnelling works.

In addition, superficial deposits such as Alluvium and Mine Tailings also pose potential problems since they are weak materials/soils. Mining slime deposits are particularly treacherous with SPT N = 0. The occurrence of mine tailings in the Limestone pinnacle zone can potentially trigger a sinkhole when intersected by a TBM.

Finally, geological structures such as major faults, quartz and granitic dykes which are prevalent in the KL area can also impact on tunnelling works. Tunnelling through major faults or fault zones would encounter highly crushed/brecciated rock weathered to soils (i.e. weak zones). Quartz dykes consisting of crystalline quartz would be highly abrasive to TBM cutters and impede TBM progress. Granitic dykes encountered tend to be weathered to weaker materials/soils. In any case, faults and dykes would serve as conduits for groundwater ingress into the tunnels. In Singapore latest MRT Line construction phase, Havelock Station is located beneath Zion Road and there are five entrances connected to the station, known as Entrance A, B, C, D & E. An innovative method of using Rectangular Tunnelling Machine (RTBM) has been employed for the first time in Singapore for the underpass construction linking Entrance E & D to the main station with trenchless method. Compare with the original cut and cover method, advantages of trenchless method are such as reducing disruption and construction impact on Zion Road and preventing adverse impact to the underlying utilities and services. It will also greatly improve the productivity of construction for this underpass and reduce the duration required for the completion of this underpass structure. There could be difficulties in ground settlement control, deviation from the horizontal axis, roll of shield body, higher requirements on strength of shield body for large width of cross section. This talk will discuss the challenges during tunnelling work and design on the rectangular tunnelling machine and ground improvement.

CHALLENGES OF UNDERGROUND SPACE DEVELOPMENT IN CONGESTED URBAN REGION OF KUALA LUMPUR by Ir. Dr. Ooi Teik Aun

This paper discusses two case histories of urban underground space development one in a mixed development of approximately 9 ha (22 ac) in the southern region of Kuala Lumpur city, the site consists of variable quality of limestone formation. The development is divided into 3 phases with Phase 1A having limestone bedrock varying from 3m to 45m below the existing ground level. The site is bounded by the Cochrane and the Maluri Klang Valley Mass Rapid Transit (KVMRT) stations. The quality of limestone bedrock at the shallow part of the site has average RQD (rock quality designation) of 0 percent and 70 percent while that of the deep part has average RQD of 0 percent to 80 percent. The Unconfined Compressive Strength (UCS) of the limestone below the basement 3 level varies from 20MPa to 80MPa. Contiguous Bored Pile (CBP) walls were used at the north and south sides of the site. The length of the CBP wall varies from 13.5m to 24m below ground level. Open cut method was adopted on the east and west side to the basement 3 levels with a slope height of 13m. Raft foundation was used for basement with limestone outcrop while bored piles were used for those deeper parts of the site. The other site is the Damansara Town Centre which was constructed in 1983 to 1986. The nine blocks of eight to ten storey buildings were founded on bored pile and H-pile foundations located in the Kuala Lumpur Kenny Hill Formation. The construction of two MRT stations within its vicinity and the rapid development in the surrounding areas has prompted the developer to decide to redevelop the more than nine acre site into a high density high rise mixed development consisting of five levels of basement car park, four levels of podium for commercial, nine blocks of 18 storey office towers and three blocks of more than 40 storey residential towers with a total built up area of 300,000 m². The original development has four levels of basement car park resulting in the formation level of the foundation pilecap to be at RL47m. The existing retaining wall system is counterfort RC wall. The bored piles and H piles were approximately 18 metre long below the pilecap level. The redevelopment will have additional 5 levels of basement resulting in the need to install new contiguous bored pile (CBP) wall / diaphragm wall (Dwall) from ground level with diaphragm walls at the vicinity of the MRT stations. Instrumentation of CBP/Dwall is required to ensure lateral wall movements are within the allowable limits.

THE IMPORTANCE OF PROTECTING OUR BUILDINGS AND INFRASTRUCTURES & INNOVATIVE RESTORATION TECHNIQUES by Ir. Thavanendran Mahalingam & Er. Abishek Muurthy

Buildings are generally susceptible to gradual dilapidation over time. This problem is further exacerbated by the robust development in highly dense central business districts with the construction of various underground infrastructures within close proximity to old buildings. More than often such buildings are usually compromised and in need to be demolished if its structural integrity is not intact. Hence it is utmost important that diligent long term measures are put in place to ensure these buildings are constantly maintained and its structural integrity and serviceability is not compromised at any cost. There is a growing need for Engineers to resort to innovative solutions to solving the degradation of buildings other than demolition. The cost effective way to restoring and enhancing a building is by structural strengthening and innovative retrofitting. This paper discusses the actual experience encountered in selected buildings failures and deterioration and the solutions to restore and enhance the functionality of the buildings. The challenges faced in the restoration works as well as lessons learned from past failures are also discussed.

DESIGN AND SUPERVISION OF BORED TUNNELLING WORKS IN SOFT GROUND by Ir. Er. Dr. Ong Chee Wee, Victor

It is increasingly economically viable to build underground tunnels as precious urban lands can then be utilized for the development of buildings. However, during tunnelling, the soil around the tunnel often moves towards the tunnel opening, especially in soft ground condition. The resulting ground movements induce additional settlement, axial force, deflection and bending moment on adjacent foundations. As a result, the foundations may not be able to resist the loads induced by tunneling nearby. As more and more underground tunnels are being constructed in densely populated area, an appreciation and understanding of tunneling issues in soft ground is critical for the safety and progress of society. This talk aims to give an overview on design and supervision of bored tunnelling works in soft ground.

THE APPLICATION OF GEO SPRAY SYSTEM FOR TUNNEL REPAIR & PIPELINE REHABILITATION by Ir. Neo Boon Kheng

This paper discusses the application of GeoSpray, a spray applied system for a range of rehabilitation applications ranging from utility pipelines to large tunnels. This paper will also include case studies from recent projects.

The high strength, ultra-low porosity GeoSpray geopolymer fiber-reinforced material is made from natural mineral polymers and recycled industrial waste. This material is designed specifically for corrosion prevention and structural enhancement of utility tunnels, sewers, chambers, manholes, potable water mains and a host of other critical structures. GeoSpray is engineered and blended suitable for pouring, placing, trowelling, spraying or centrifugal spin casting application techniques.

GeoSpray geopolymer system provides cost effective, environmental friendly rehabilitation and structural improvement solution to degrading infrastructure.

ADVANCES IN TUNNELLING IN URBAN AREAS by Mr. Don Hall

In today's environment of increasing traffic congestion in cities clients are looking to reduce the impact on the surface during construction works.

Following the successful completion of a CREG project in Zhengzhou, China, which involved jacking four (4) tunnels with two rectangular EPB Box-jacking machines and the start of the Thomson Line T221 contract in Singapore CREG are now looking at innovative ways to use box-jacking to save space in inner cities.

This presentation will show the status of the T221 project and introduce the new concept of applying this technology to constructing underground car parks and storage areas.

LESSONS LEARNED FROM DESIGN OF DEEP EXCAVATION IN KENNY HILL FORMATION OF SPT 'N' >50 by Ir. Joon Gei Tan & Ir. Dr. Lean Hock Ooi

This paper presents the lesson learned from deep excavation in Kenny Hill Formation of SPT 'N' >50. The technology to constructing underground car parks and storage areas deep excavations are for the Klang Valley MRT underground stations; which have retained depth of up to 33.5m. The stations diaphragm wall's predicted and measured displacements and strut forces are compared and discussed. The methods to obtain and tests SPT'N' >50 undisturbed samples are elaborated. The results of the laboratory tests, the

parametric studies using Finite Element back analyses to match the measured deflected diaphragm wall displacements and the lessons learned and possible optimisation are discussed.

LESSONS LEARNED DEEP EXCAVATION WORKS IN KUALA LUMPUR KARSTS – SOME CONSIDERATIONS by Ir. Dr. Lean Hock Ooi and Ir. Dato' T. T. HA

In Kuala Lumpur Malaysia, many prestigious structures are founded in Kuala Lumpur Limestone. The Kuala Lumpur limestone is generally classified as extreme tropical karst. The karst features reported include but are not limited to the highly variable bedrock profile, and intricate three dimensional network of solution channels littered with cavities, vertical cliffs and overhangs. The challenges of civil engineering works in limestone have been acknowledged by many designers and contractors and it was given a special session in the 8th South East Asian Geotechnical Conference (SEAGC 1985) in Kuala Lumpur. In spite of the complexities related to karsts, Malaysians have successfully completed the large diameter SMART tunnel and many deep excavations and foundations in such challenging ground conditions. This paper presents the challenges and risks related to deep excavation works in karsts and some of the possible measures to minimize these risks.

TRENCHLESS METHOD FOR UNDERPASS CONSTRUCTION by Er. David Ng Chew Chiat

In Singapore latest MRT Line construction phase, Havelock Station is located beneath Zion Road and there are five entrances connected to the station, known as Entrance A, B, C, D & E. An innovative method of using Rectangular Tunnelling Machine (RTBM) has been employed for the first time in Singapore for the underpass construction linking Entrance E & D to the main station with trenchless method. Compare with the original cut and cover method, advantages of trenchless method are such as reducing disruption and construction impact on Zion Road and preventing adverse impact to the underlying utilities and services. It will also greatly improve the productivity of construction for this underpass and reduce the duration required for the completion of this underpass structure. There could be difficulties in ground settlement control, deviation from the horizontal axis, roll of shield body, higher requirements on strength of shield body for large width of cross section. This talk will discuss the challenges during tunnelling work and design on the rectangular tunnelling machine and ground.