JURUTERA

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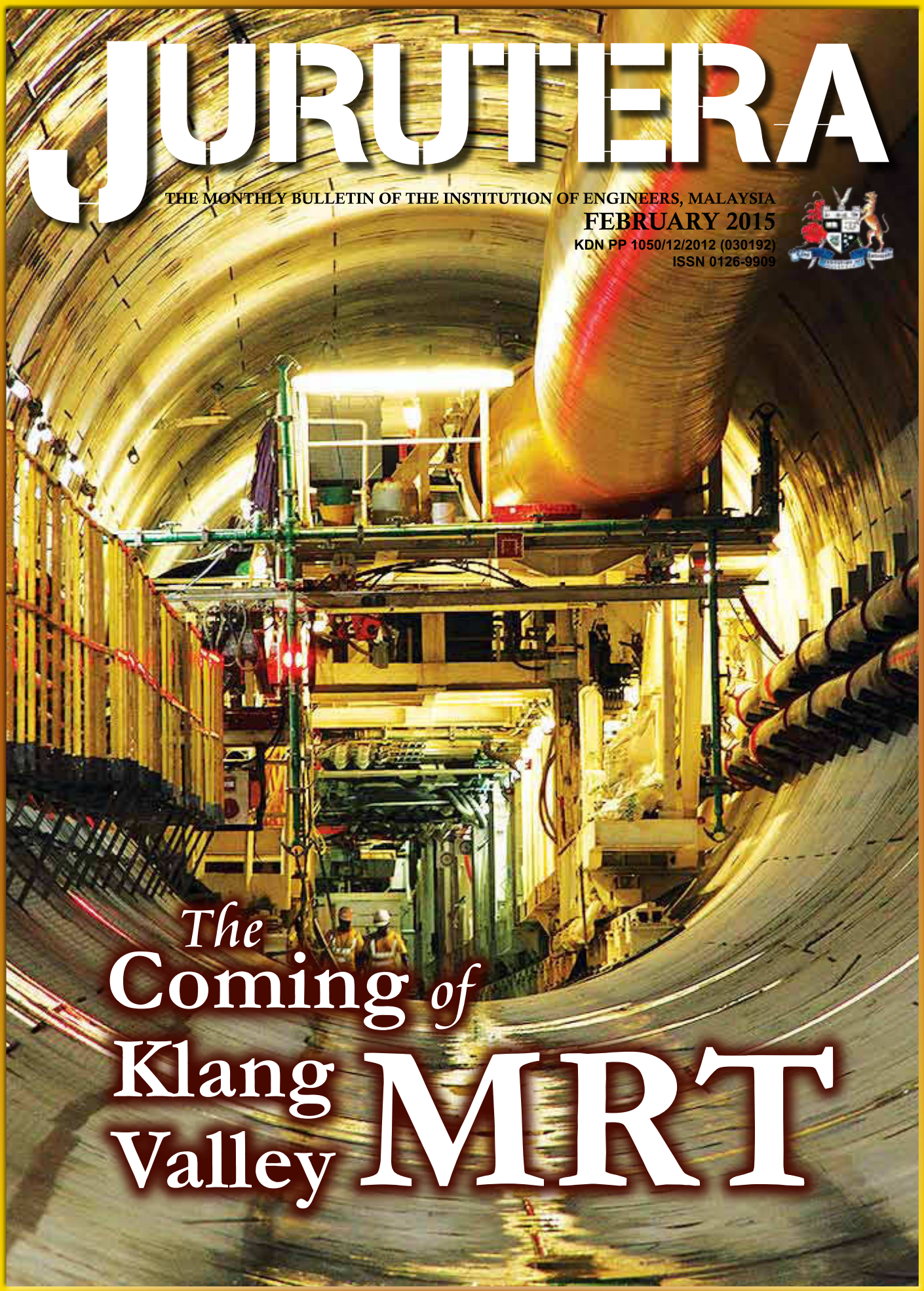

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JURUTERA

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BULETIN BULANAN IEM

JURUTERA

THE MONTHLY BULLETIN OF THE INSTITUTION OF ENGINEERS, MALAYSIA

Circulation and Readership Profile

Our esteemed readership consists of certified engineers, decision making corporate leaders, CEOs, government officials, project directors, entrepreneurs, project consultants, engineering consulting firms and companies involved with engineering products and services.

JURUTERA is circulated to more than **30,000 registered members** of The Institution of Engineers, Malaysia (IEM), with an **estimated readership of 120,000** professionals.

Advertising Benefits

Our business partners can be assured that their products and services will be given the circulation and exposure it deserves, thus maintaining a sustained advertising presence to our core readers of decision-making engineers and technical experts. Our website offers an even wider market reach, with added international presence, aided by our international affiliation with official engineering bodies all over the world. Our online and offline advertising features such as banner advertising, article sponsorship and direct e-mail announcements have proven to be successful marketing strategies that will set the businesses of our partners apart from their competition.

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Inside Back Cover (IBC)	6,750	6,250	5,950	5,650	5,350
Page 1	6,650	6,150	5,850	5,550	5,250
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KVMRT- The Game Changer

by Ir. Andrew Yeow
Chairman of the Tunnelling and Underground Space Technical Division

When fully operational in Dec 2017, the Klang Valley Mass Rapid Transit (KVMRT) SBK Line from Sg Buloh to Kajang will be able to carry 400,000 commuters a day! Without doubt the KVMRT will be transformational as it changes the way people commute as well as create lots of regeneration opportunities to the neighbourhood and communities along the line.

With 31 stations, the 51km KVMRT SBK Line (Line 1) will connect KL city centre to Sg. Buloh, Kota Damansara, Cheras, Bandar Tun Hussein Onn and Kajang. This way, a commuter in Kajang can hop into the train, ride in comfort and, in less than an hour, go shopping in 1Utama or The Curve in Petaling Jaya! Another commuter can travel from Sg. Buloh to KL City centre in just 30 minutes, regardless of the traffic situation on the roads!

For the KVMRT project, there will be 9.5km of twin tunnels and 7 underground stations in the KL city centre. The need to overcome problems in tunnelling through the KL karstic limestone formation also resulted in the world's first Variable Density TBM, jointly developed by a German TBM manufacturer and Malaysian engineers.

This issue of JURUTERA is dedicated to the KVMRT with a focus on the construction of the tunnelling and underground works. It features several articles and activity reports related to tunnelling and underground space development/construction.

In addition, IEM will hold the International Conference & Exhibition on Tunnelling and Underground Space on 3rd - 5th March 2015, with eminent global speakers, particularly from the International Tunnelling Association (ITA). The ITA President will give the opening Keynote Lecture and the Executive Board Members will hold their meeting prior to the conference. IEM and ITA will also organise a 2-day workshop on tunnelling from 28th February, 2015 to 1st March, 2015. ■

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Tunnelling & Underground Space Development in Malaysia

Photo 1: TBM breakthrough at KVMRT Maluri Station in April 2014 (Picture courtesy of Ir. CK Lee)

Ir. Dr Ooi Teik Aun *is the Founder Chairman of the IEM Tunnelling and Underground Space Technical Division and an Organizing Chairman of the International Conference & Exhibition 2015 (ICETUS2015. He is also the current Chairman of Dispute Resolution Practice (DRP) Subcommittee. He is an Advisor for Consulting Engineering Special Interest Group (CESIG). Ir. Dr Ooi is an Honorary Fellow of IEM, Fellow of the Malaysian Institute of Arbitrators and Past President and is ICE Country Representative for Malaysia. He is currently the Chairman of Dispute Resolution Practice (DRP) Sub-committee and an Advisor for Consulting Engineering Special Interest Group (CESIG). Ir. Dr Ooi is an Honorary Fellow of IEM, Fellow of the Malaysian Institute of Arbitrators, Past President, the ICE Country Representative for Malaysia and the President of Southeast Asia Geotechnical Society (2010-2016).*

By Ir. Dr Ooi Teik Aun

The development of tunnels and underground space in Malaysia has been slow due, perhaps, to the geology of Kuala Lumpur and the lack of know-how and confidence among the construction industry in tackling the problems presented by the Kuala Lumpur Limestone Formation.

But with the rapid development of tunnelling and ground improvement technologies in the last 30 years, this is set to change, especially with the active participation of the International Tunnelling Association (ITA) and the implementation of Line 1 of the Klang Valley Mass Rapid Transit (KVMRT) in 2012.

In July 1994, the Institution of Engineers, Malaysia (IEM) organised an International Conference cum Exhibition on Trenchless Construction – Towards Trenchless Cities. In February 2000, IEM also organised a seminar on Design, Construction, Operation And Other Aspects Of Tunnels. Prior to the seminar, the ITA held its executive committee meeting in Petaling Jaya, Selangor.

With the encouragement of ITA, the Tunnelling and Underground Space Technical Division (TUSTD) of IEM was formed at the seminar and inaugurated in 2001 with the objective to undertake activities related to the promotion and advancement of the science and engineering of tunnels and underground space technologies. IEM TUSTD becomes a country member of ITA representing Malaysia. The first and second International Conference and Exhibition on Tunnelling and Trenchless Technology were held in Malaysia in 2006 and 2011 respectively.

In 2003, construction of The Stormwater Management And Road Tunnel (SMART) in Kuala Lumpur, started. The storm drainage and road structure was aimed at solving the problems of repeated flooding and traffic congestion in the business district of the city. The 9.7km tunnel is the longest stormwater tunnel in South East Asia and the second longest in Asia.

At the 2006 Conference, a special session was dedicated to papers from the SMART project which won the British Construction Industry International Award in 2008. In 2011, the SMART project received the UN Habitat Scroll of Honour Award for its innovative and unique management of storm water and peak hour traffic.

This year, IEM will again organise the third conference and exhibition on Tunnelling and Underground Space on 3rd - 5th March at Dorsett Grand Subang Hotel, Subang Jaya, Selangor. This event coincides with the development of the massive Klang Valley Mass Rapid Transit (KVMRT) Line 1. Currently at construction stage, it is expected to be in an advanced stage of completion this year.

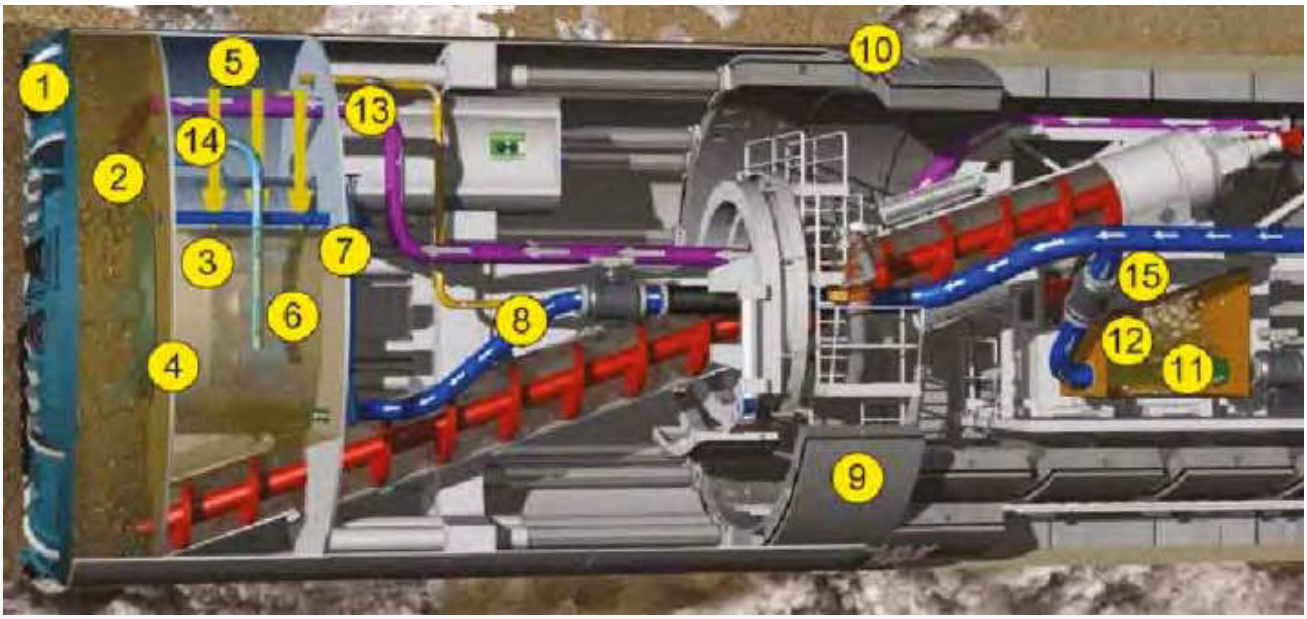


Figure 1: VDTBM components (after Klados et al., 2015)

1. *Cutting wheel*
2. *Excavation chamber*
3. *Face support medium*
4. *Submerged wall*
5. *Air bubble*
6. *Working chamber*
7. *Bulkhead*
8. *Feedline (LDSM)*
9. *Segment*
10. *Tailskin*
11. *Slurry line*
12. *Slurryfier box*
13. *Suspension line (HDSM)*
14. *Communication pipes*
15. *Rotary crusher*

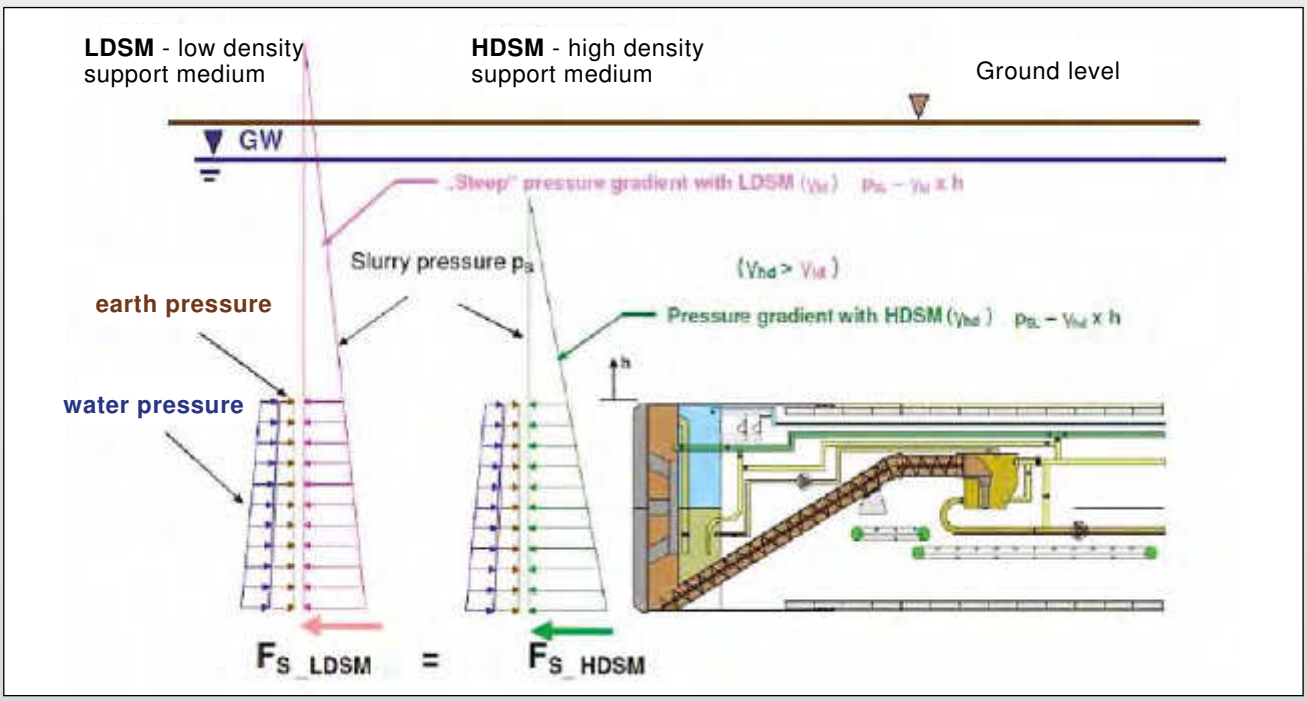
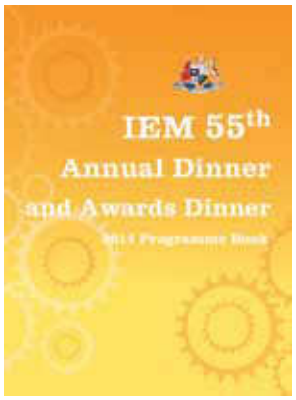


Figure 2: Effect of variation of support medium density (after Klados et al., 2015)

IEM 56th Annual Dinner and Awards Night 2015 Programme Book



We are pleased to inform that IEM will be holding the 56th Annual Dinner and Awards Night 2015 on **18 April 2015**. Dimension Publishing has been appointed to put together the Annual Dinner Programme Book which will be circulated to all **1,200 guests** on that night at **Sime Darby Convention Centre**.

It is an annual event organised by IEM to present awards to winners of projects and at the same time to announce the new committee for year 2015/16. Special guests of honour will be invited to officiate the event.

We are now calling for interested advertisers to book their preferred advertising position in this programme book. Below please find the advertising rates for your immediate action and reply. We hope to hear from you soon before the closing date on **16 March 2015**.

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	:	**23 March 2015 (Mon)** *(Artwork Submission)*

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Inside Back Cover (IBC)	3,200	( )	
Page 1	3,000	( )	
Facing Chairman's Message	2,800	( )	
Facing President's Message	2,800	( )	
Facing Past Presidents List	2,800	( )	
Run-On-Page (ROP)	1,900	( )	
Double Page Spread (DPS)	4,500	( )	

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KVMRT Line 2 is currently in the detailed design stage for the elevated sections and construction work is expected to start in 2016, while the underground section is in tender stage. The conference will have 1 Opening Keynote Lecture, 3 Keynote Lectures, 5 Special Lectures, 1 Special Technical Session for KVMRT papers and other Technical Sessions consisting of 20 Technical Papers. The conference is endorsed by the International Tunnelling and Underground Space Association (ITA) and supported by Construction Industry Development Malaysia (CIDB), Mass Rapid Transit Corporation Sdn. Bhd. (MRT Corp) and The Institution of Civil Engineers (ICE), UK. It is sponsored by Gamuda Berhad, China Railway Engineering Corporation, Herrenknecht Asia Headquarters Pte. Ltd. and Sepakat Setia Perunding Sdn. Bhd.

Tunnelling activity is increasing all over the world and the last three decades have seen great advances being made in the construction of tunnels for various purposes. Malaysia is no exception, starting from the days of railway tunnels back in the 1900s. Tunnelling activity has been steadily increasing and tunnels are associated with water supply and power generation from the 1960s. From 1970s, roads and highway tunnels were built.

By and large, these tunnels were constructed using drill and blast method. The use of TBMs in Malaysia started with the Sungei Kelinchi water transfer tunnel project in 1995 in Negeri Sembilan. The TBMs were also used in the 1990s in the Kuala Lumpur LRT tunnel construction and in sewerage projects in Kuala Lumpur.

With the experience gained in the innovative use of EPB Shield TBM technique in the SMART project to overcome the treacherous Kuala Lumpur Limestone Formation, the project team made further advances in TMB technology in the KVMRT project by using the Variable Density TBM (VDTBM).

It is understood that this innovation is the first in the world. The mixed tunnel face is characterised by the simultaneous presence of soft soil and intact or fractured rock within the excavated cross-section. Excavations are carried out in karstic ground where fractured rock or mixed face conditions are often encountered in KVMRT. ■

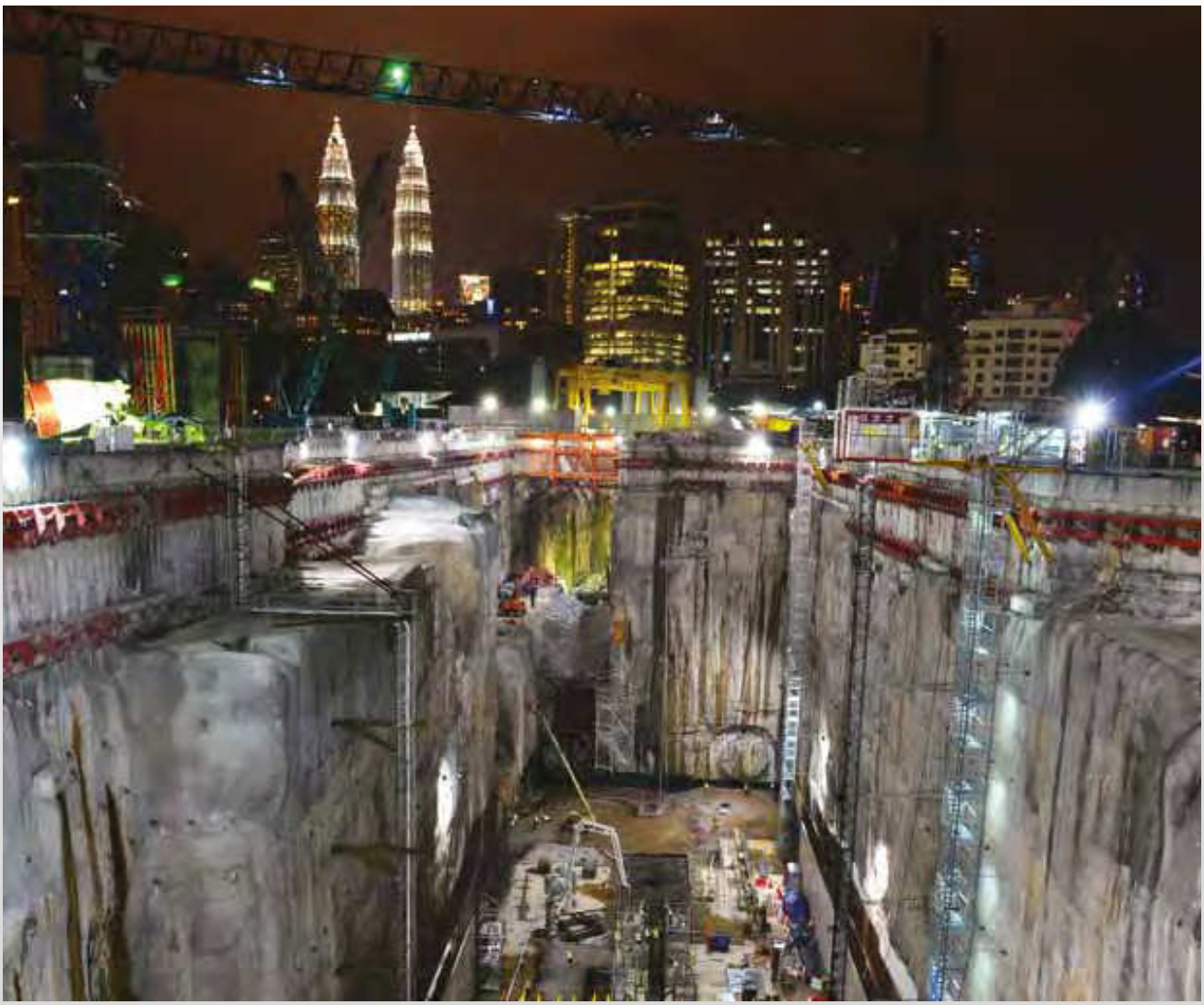

Photo 2: TBM breakthrough at KVMRT Maluri Station in April 2014 (Picture courtesy of Ir. CK Lee)

Challenging Engineers In National Economic Transformation Programme

BIODATA

Y.Bhg. Dato' Ir. Lim Chow Hock

IEM PRESIDENT SESSION 2014/2015

Y.Bhg. Dato' Ir. Lim Chow Hock (林照福) was the Director of the Division of River Basin and Coastal Zone Management with the Department of Irrigation and Drainage Malaysia (JPS). He holds a B.Eng (Hons) (Civil) from the University of Malaya and a post graduate Diploma in Water Resources Engineering from the University of Birmingham.

Prior to being elected as the President of the Institution, he served IEM in various capacities including as Deputy President, Vice President, Chairman of the Standing Committee on Finance, Chairman of the Standing Committee on Corporate Affairs, Deputy Chairman of the Standing Committee on Welfare and Service Matters and member of several other Standing Committees, Subcommittees and Technical Divisions. He also serves as the Chairman of the APEC/ International PE Registers. He was the Chairman of the IEM Southern Branch from 1991 to 1993.

Y.Bhg. Dato' Ir. Lim has more than 35 years of experience in irrigation, agricultural drainage, flood mitigation, urban stormwater management, river engineering, coastal zone management, hydrology and water resources management. He has served in many States in various capacities throughout his career at JPS district, project, State and headquarters offices. In his current role at JPS, he oversees all programmes and initiatives associated with Integrated River Basin Management (IRBM) and Integrated Coastal Zone Management (ICZM); including major projects such as the River of Life Project, the Melaka River Beautification Project, the Pahang River Mouth Breakwaters and the Tok Jembal Beach Nourishment Project in Terengganu. He is also responsible for all water management capacity building in Malaysia especially in relation to Integrated Water Resources Management (IWRM).

He is the Chairman of the Malaysian Capacity Building Network (MyCBNet) and Member of several other professional associations including the Board of Engineers Malaysia, the Malaysian Institute of Management, the Malaysian National Committee on Irrigation and Drainage, the Malaysian Hydrological Society and the International Association for Hydro-Environment Engineering and Research. He is also an Exco member of the Malaysian Water Partnership. He is a Certified Auditor with the Malaysia Register of Chartered Auditors (MRCA) and also a Certified Professional in Erosion and Sediment Control (CPESC).

Y.Bhg. Dato' Ir. Lim received the "Pingat Sultan Ismail" award from Johor in 2001. In 2008, he received the "Dato' Paduka Setia Mahkota Kelantan" (D.P.S.K.) which carries the title "Dato" from His Majesty Al-Sultan of Kelantan.

I am honoured to be elected as the President of the Institution of Engineers, Malaysia (IEM) for the 2014–2015 session and I thank the IEM Council for their vote of confidence. I will do my utmost for the Institution and the engineering fraternity at large.

I would not be at the helm of the Institution today, had it not been for the invaluable guidance of Past Presidents and Council Members. I am also indebted to fellow engineers and members who have shared their views and experiences with me.

I am fully cognisant of the responsibilities that lie before me. It is a challenging task that is both exciting and daunting, one that will require the collaboration of each and every member of this Institution. I therefore ask for your fullest support and cooperation to assist me in not only maintaining the excellent tradition of this Institution but also making IEM even more relevant and recognised than it is today.

As President, I will embrace and continue with the good works of our Past Presidents. I will also take stock of our strength and weakness as well as to refocus and set the direction for the Institution. Allow me to share my thoughts on what I see as opportunities and challenges that lie ahead for us.

In 2010, the Prime Minister launched the Economic Transformation Programme (ETP) to spearhead Malaysia

towards becoming a developed nation, in line with Vision 2020. Realising the significant role that engineers must play in our national development agenda has prompted me to speak on "Challenging Engineers In National Economic Transformation Programme".

THE NATION IN TRANSFORMATION

In a highly globalised environment, Malaysia must adapt and seek solutions to the challenges posed by the changing social, economic and technological landscape.

The Government has given high priority to the social and economic development of the nation. Implicit in the strategies and action plans of the ETP is the strong commitment to leverage on engineering as the foundation for the necessary economic transformation. So to this end, engineers must take on an increasingly prominent role.

The ETP takes on new perspectives that are holistic, inclusive and sustainable, with social and environmental impact to be given due prominence. The approach to policy making and its implementation will see greater integration and co-ordination among the different authorities and agencies as well as greater partnership between government, private sector, civil society and non government organisations such as IEM.

WHAT THE ETP MEANS FOR THE NATION

The ETP represents the catalyst for economic growth and investments needed for us to achieve developed-nation and high-income status by 2020, with Gross National Income (GNI) per capita of RM48,000 or US$15,000 compared to RM23,700 or US$6,700 in 2009. This will be achieved by attracting RM1.4 trillion in investments which will, in turn, create 3.3 million new jobs by 2020.

While the Government will play a facilitator role in funding the ETP, the private sector has been placed in the driver's seat and is expected to fund the bulk of the investments needed to implement the projects drawn up in the ETP. It is envisaged that, in terms of the overall funding, 60% will come from the private sector, 32% from the Government Linked Companies (GLC) and the remaining 8% from the public sector.

The ETP will be achieved through the implementation of 12 National Key Economic Areas (NKEAs), representing economic sectors which account for significant contributions to Gross National Income (GNI) and which can create multiplier effects across the national economy. Each NKEA will have various Entry Point Projects (EPPs), which are new growth programmes with high economic impact for moving the sector up the value chain.

The ETP is also centred on raising Malaysia's competitiveness through the implementation of six Strategic Reform Initiatives (SRIs). These comprise policies which will strengthen the country's commercial environment to ensure that Malaysian companies are globally competitive and sustainable.

WHAT THE ETP MEANS FOR ENGINEERS

The ETP is heavily dependent on advanced engineering knowledge and specialised skills to deliver most if not all of the Entry Point Projects identified under the respective NKEAs.

Engineering based activities dominate in 11 of 12 NKEAs, directly or indirectly, and provide substantial business and employment opportunities. The oil, gas and energy sector, for example, will see 50,000 new jobs with about 40% for professionals such as engineers of various disciplines.

Extensive infrastructure build-up, particularly in the areas of broadband and logistics, is necessary to support the communications, content and infrastructure sector. The penetration rate for broadband is targeted to reach 75 percent of households by the end of 2015 from the current 40 percent. Infrastructure such as roads, ports and airports are being upgraded and major projects in the pipeline include the new West Coast Highway, the extension of the north–south electrified double-track railway line to Johor Bahru and the Kuantan Port expansion.

The urban populationwill grow from 64 percent to 70 percent, mostly in the Greater Kuala Lumpur-Klang Valley (KL-KV) where there will be a continuous demand for infrastructure projects to cope with the increase. Among the most ambitious projects are the River Of Life, which will see the cleaning, beautification and re-development of the Klang and Gombak Rivers, the Mass Rapid Transit system and the proposed high-speed rail system from Kuala Lumpur to Singapore. Extensive growth is also taking place in Penang and the Iskandar Region.

Education is one of the most critical drivers for transformation. The strategy is to rebrand Malaysia from a stopover location for education to a major education centre of choice globally. As the private education sector is expected to grow six-fold, an additional 500,000 jobs will be created, especially in professional and technical fields.

The structure of our economy will have to be transformed. Liberalisation measures are being put in place to expand the potential market of the country beyond national boundaries, intensify competitiveness, as well as attract foreign investments. The economy will become less dependent on resource-intensive industries and will instead, be driven more by innovation and a shift to higher value-added activities.

The services industries in particular, will become more crucial and is estimated to increase to 65 percent of the Gross Domestic Product by the year 2020.

CHALLENGING ENGINEERS

The ETP depends on a new paradigm shift that demands new ways of thinking, new skills and capabilities and new methods of doing things. There will be a need for innovation, for entrepreneurship, for business acumen, good management ability, a global perspective and multi-disciplinary skills to meet the challenges set by the ETP and will demand no less than a major transformation of the engineer.

Engineers are trained to solve problems and to build things which form a strong foundation for innovation but that is not enough. They will need to think "out-of-the-box", to view things in a different perspective and to challenge the norm.

Innovation brings about new ideas but creating value from these new ideas will require skills to translate them into

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successful businesses. Engineers already have the analytical and problem solving abilities but they will need to augment those abilities with soft skills and business knowledge such as finance, marketing, and sales.

With society becoming more complex and engineering jobs becoming more diverse, it will be necessary for engineers from different disciplines to work together. They can expect to work more with experts from other fields such as scientists, economists, planners, politicians, business and community leaders and others. Technical knowledge alone will no longer suffice; engineers will need to know about social sciences, the arts and commerce to get a more holistic view of how things can be done.

IEM IN TRANSFORMATION – AVISION OF WHAT IT CAN BE

Human Capital Development

IEM has a role to ensure that the education, training and qualifying standard for professional engineers is on par with the best in the world. It must also ensure a sufficient pool of competent technical personnel to meet demand. Already, IEM has initiated the Structured Training Program to provide an alternative path for engineers to meet the requirements of practical experience when they do not have the opportunities at their work place.

To complement the Government's effort to increase local talent, both in quantity and quality, IEM already has several Continue Professional Development (CPD) programmes, aimed at upgrading the knowledge and skills of the engineers in the ever-changing technological landscape. In view of this, I shall ensure that all CPD programmes are continuously reviewed, revised and upgraded to the standards to suit the current needs of the nation, in particular the ETP. The Institution shall identify new training areas and focus on priority sectors that can support the ETP, based on regional needs.

As innovation is a key success factor in the ETP, IEM shall work closely with the Ministry of Science, Technology and Innovation (MOSTI), institutions of higher learning and other engineering research organisations to conduct necessary complementary courses related to innovation, standards and accreditation.

We must produce engineers who are relevant to the needs of the industries and the public sector. In this respect, IEM shall complement the Government's effort to educate students in schools on what engineers actually do and to assist universities develop an engineering education curriculum that is more practical, relevant and interesting.

Re-establish a Special Link with PEMANDU

The Performance Management & Delivery Unit (PEMANDU) under the Prime Minister's Department, was established in 2009 to plan, oversee the implementation, and assess the progress and impact of the ETP. Since the bulk of the Entry Point Projects (ETPs) of most NKEAs are engineering based, it is pertinent that IEM re-establishes a strong link with PEMANDU.

For its view to be heard and considered, IEM must engage proactively with the Government at all levels by offering expert advice on matters related to engineering.

IEM must be seen as the most relevant body to be invited by the Government to give professional engineering input at every stage, especially during policy formulation of all our national socio-economic development programmes. I shall actively liaise with all relevant Government authorities, including local authorities, for IEM to be represented in the appropriate decision-making bodies or committees. In a similar vein, IEM must position itself to respond to such invitations in the most effective and timely manner.

IEM must also work closely with various related statutory bodies such as the Board of Engineers Malaysia (BEM), the Construction and Industry Development Board (CIDB), the Energy Commission, the Malaysian Communication and Multimedia Commission, etc. to provide the necessary synergy towards nation development.

Engagement with the Media

To be an effective voice of the profession, IEM must be able to reach out to the public through the media, particularly the print and electronic media. For that to happen, IEM must have a good database of relevant engineering information and position papers on all major engineering issues which define the views and stands of the Institution. It must also have in place, members with the expertise and credibility to provide the necessary input in preparing Press statements on behalf of the Institution.

I will continue to engage actively with the media to project the image of IEM as the professional organisation collaborating with the Government to tackle the nation's engineering issues. IEM must fulfil one of its most important primary roles: To shape the practice of engineering, to protect the interests of engineers and the public at large, and to contribute to the success of nation development.

Liberalisation, Competition and the Borderless World

With the impending liberalisation of trade within ASEAN, APEC and across the world, the engineering community must be ready to work in a borderless environment where competition intensifies and opportunities abound. Engineers must adopt a global outlook as potential clients, partners and competitors will come from all corners of the world. I shall follow up closely on current efforts taken by the Institution in collaborating with the Ministry of International Trade and Industry (MITI) to promote the export of engineering services in the global market.

CONCLUSION

IEM must fully support the ETP and engineers must seize the opportunities available and rise to the challenges. There must be active engagement with PEMANDU and all relevant Government authorities, statutory bodies, related business communities, the media and the public.

I implore members to participate actively in all engineering related issues in society so that our expert views and contributions will be appreciated and acknowledged.

Last but not least, I envisage an enlarged IEM with the continuation of Vision 100K in order to have more clout, a louder voice and stronger leverage to enable us to champion the advancement of the engineering profession. ■

Challenges in the Underground Space Development in the Urban Environment

By Ir. Dr Ooi Teik Aun

Ir. Dr Ooi Teik Aun is the Founder Chairman of the IEM Tunnelling and Underground Space Technical Division and an Organizing Chairman of the International Conference & Exhibition 2015 (ICETUS2015. He is also the current Chairman of Dispute Resolution Practice (DRP) Subcommittee. He is an Advisor for Consulting Engineering Special Interest Group (CESIG). Ir. Dr Ooi is an Honorary Fellow of IEM, Fellow of the Malaysian Institute of Arbitrators and Past President and is ICE Country Representative for Malaysia. He is President of Southeast Asia Geotechnical Society (2010-2016).

Part of the Kuala Lumpur City Centre (KLCC), the Petronas Twin Towers building is located in the contact zone of the Kuala Lumpur limestone and Kenny Hill formation.

Kuala Lumpur limestone formation is characterised by subsurface karstic features consisting of pinnacles, solution channels, cavities, overhangs and floaters. The Kenny Hill formation comprises a series of interbedded shale, phyllite, sandstone and quartzite. Ooi, T.A. (1986) discussed the design and construction problems of foundation for highrise structures in the Kuala Lumpur area at that time.

Bored piles and barrette piles were used as the foundation for Pan Pacific Hotel, Putra World Trade Centre and the Mall. It is common practice to install a diaphragm wall or contiguous bored pile wall at the boundaries of the sites. These walls are constructed prior to excavation work being carried out.

In the KLCC Petronas Twin Towers, 20m excavation was made for the basement car park in Kenny Hill Formation. Ooi *et al.,* (2013) reported a recent mixed development of approximately 9ha (22acres) in the southern region of Kuala Lumpur city where the site is located in variable quality of limestone formation. The development (known as Velocity) is divided into 3 phases with Phase 1A having limestone bedrock from 3m to 45m below ground level.

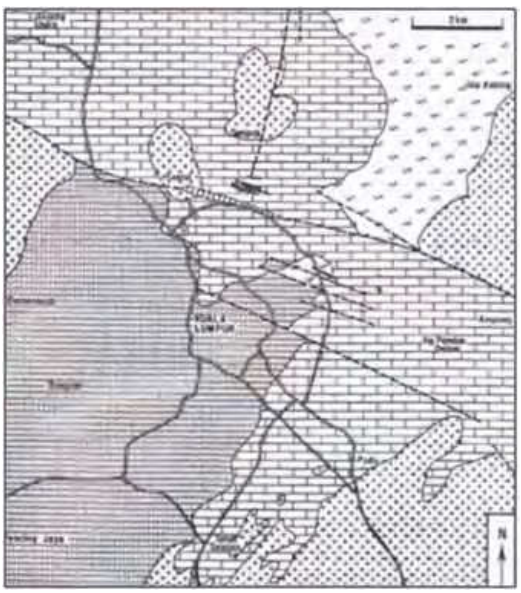

Photo 1: Surface geology of the Kuala Lumpur area (after Yeap, 1985; Ooi,1986)

The site is bounded by the Cochrane and 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 20 MPa to 80 MPa. 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 level with a slope height of 13m. No ground water was encountered during the construction of the basement even though at the time of site investigation, monitoring indicated ground water at 1-2m below ground level. The building consists of one 18-storey service apartment and one block of 13-storey shop office. Raft foundation was used for 3 level of basement built on excavated sound limestone outcrop while bored piles were used for those areas with limestone outcrop in a deeper part of the site.

In the KVMRT underground stations, Goh *et al.,* (2015) discussed an overview of the construction of the Maluri MRT Underground Station by MMC-Gamuda since May 2012, outlining strategies for the successful management and mitigation of the challenges of safely incorporating an underground station into the substrata of a densely populated urban centre predisposed towards gridlocked traffic conditions and located in direct proximity to established residential properties and active

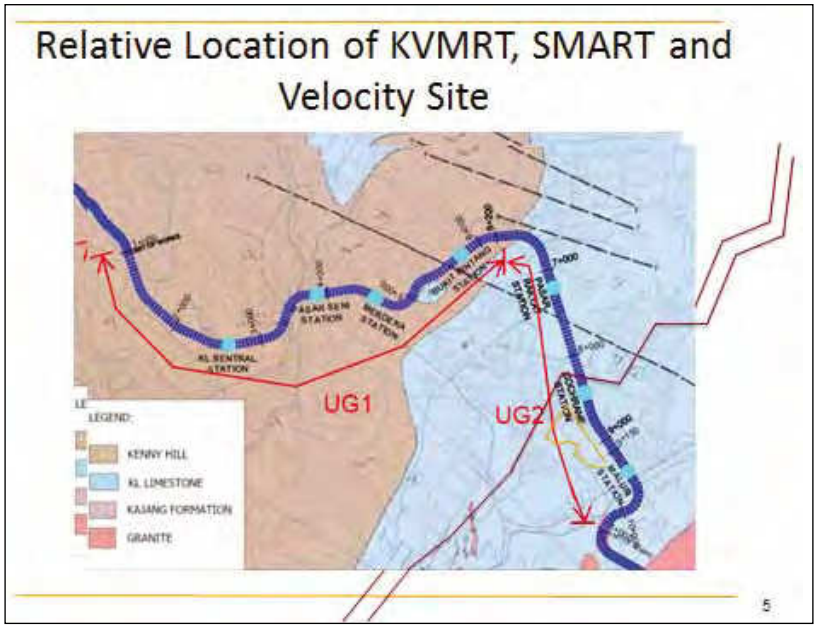

Photo 2: Relative locations of KVMRT, SMART and Velocity (after Ooi et al., 2013)

retail business premises. The project design, from the ground up, focused on pragmatic, usable connectivity on three fronts, namely for pedestrians, private vehicle access and connectivity to public transport networks.

In addition to project design, the scope of engineering works included a systematically sequenced roll-out, beginning with relocation of underground civil utilities serving the existing built environment, traffic mitigation through staged traffic diversion retaining full unimpeded use of six fast-flowing traffic lanes, construction of underground station including activities such as ground treatment, secant pile wall installation, strutting, decking, rock blasting and miscellaneous works, concurrent with installation of steel decking as an expedient to allow heavy traffic flow to continue directly over the station excavation and construction works area and ending with final reconstruction of the road surface and completion of pedestrian access infrastructure.

The total time allowed for the construction of Maluri MRT Underground Station was 60 months. Amberg & Cornaro (2012) discussed the use of underground space for the sustainable transformation of urban infrastructures. It concluded that using the underground space strategically could contribute to the sustainability of cities in a major way.

It suggested some examples of various uses that had helped to create more liveable cities by placing transport, utilities and other "land consumers and polluters" underground, thereby freeing up valuable surface space and leaving space for more amenable uses to urban life above ground. Underground space should be considered a crucial layer in urban spatial planning and land use in the bid to accommodate an additional 3 billion global population in urban environments in the next few decades.

In accommodating the increased associated traffic and congestion in urban areas, in reducing the pollution from transport, industrial or production facilities, in securing our drinking water supply and recycling waste water, in protecting us and our cities and infrastructures from natural disasters, we are reaching the conclusion that the use of underground space will be an important component for improving overall urban qualities and towards a sustainable transformation of urban infrastructures. Kuala Lumpur has the advantage of learning from others at this stage. ■

Photo 3: Excavations in Limestone at Velocity Site

Photo 4: Overview of Maluri Station and Crossover (after Goh et al., 2015)

Photo 5: Blast area preparation at Maluri site (after Goh et al., 2015)

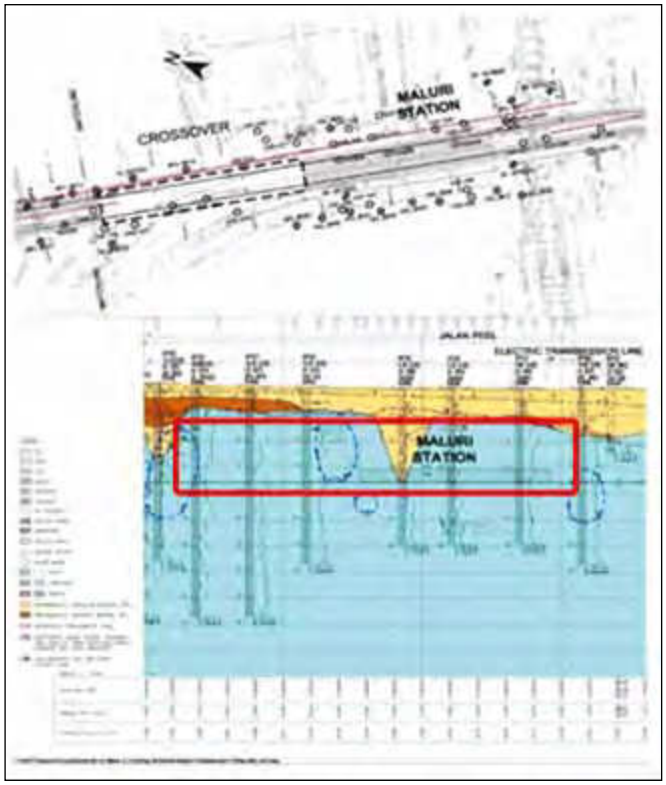

Photo 6: Maluri Station elevation and borelog records (after Goh et al., 2015)

Photo 7: Temporary struts and ground anchors installed in phased sequence of excavation (after Goh et al., 2015)

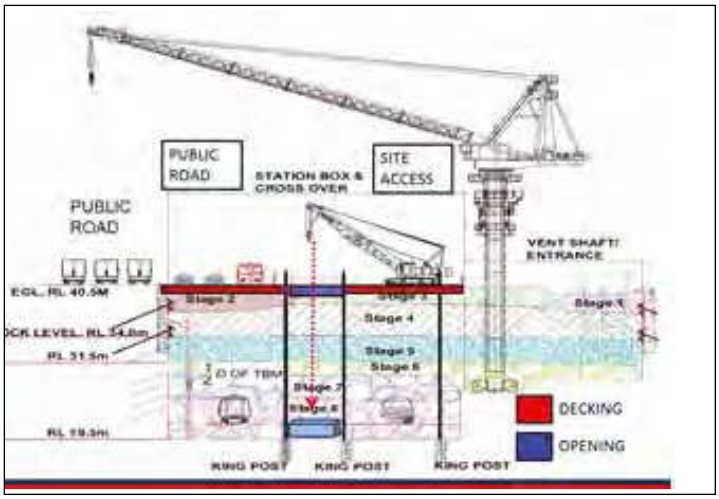

Photo 8: Typical cross section of the station box excavation work sequence (after Goh et al., 2015)

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IEM DIARY OF EVENTS

Title: 2-Day International Seminar and Workshop on Presentation and Reviewing of the Draft Malaysian N.A. for EC8

9th Feb 2015 - 10th Feb 2015

Organised by : Civil and Structural Engineering Technical Division
Time : 9.00 a.m. - 5.30 p.m.
CPD/PDP : 13

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Summary on Installation, Testing & Commissioning and Acceptance of Medical Device Guideline

By Ir. Dr Syed Mustafa Kamal Bin Syed Aman

***Ir. Dr Syed Mustafa Kamal Bin Syed Aman** is the Deputy Director (Biomedical) of Engineering Services Department, Ministry of Health Malaysia, Putrajaya. He obtained a B.Sc.(Hons) in Electrical (Electronics) Engineering (University of Aberdeen, U.K) and M.SC. in Biomedical Instrumentation Engineering (University of Dundee, U.K) and Ph.D. in Biomedical Physics (University of Exeter, U.K). He has worked as an Electronics/ Biomedical Engineer for more than 28 years and certified as PE in the field of Biomedical. He is a member of IFHE, BEM, IEM, EAC, BEAM, MEAM and as industry advisor to UTM, MMU, UNIKL, UTHM, KKTM, PSA. He is very active in developing standards and guidelines for SIRIM, DSM and MDA. His areas of interests are in Management of Active Medical Devices, Ionizing and non-ionizing Medical Radiation, Functional Magnetic Resonance Imaging (fMRI) and touch perceptions (http://www.centres.exeter.ac.uk/pmrrc/individual/syed.html).*

This guideline has been prepared under Medical Device Bureau Technical Committee, Ministry of Health Malaysia, with the intention to provide guidance to ensure the medical device is appropriately installed, tested and commissioned by the equipment specialists or competent personnel and accepted in accordance with manufacturer's specification, purchase agreement and statutory requirement.

The guideline applies to all products that fall within the definition of a medical device, as defined in Medical Device Act 737-2012 and applies to all medical devices which require installation, testing and commissioning (T&C) and acceptance in healthcare facility, aesthetic settings and premises for wellness programmes as well as related services.

PROCESS FLOW OF T&C AND ACCEPTANCE OF MEDICAL DEVICE

For a newly purchased medical device, the medical device establishment (i.e. vendor or supplier) shall be responsible for carrying out the installation and T&C of the medical device while the medical device owner (i.e. hospital, clinic, etc.) shall be responsible for the acceptance processes of the medical device.

Medical devices which are leased or on loan, trial evaluation and clinical investigation, transferred and undergone major upgrading, shall also be installed, tested and commissioned before use.

(Refer to flowchart Figure 1).

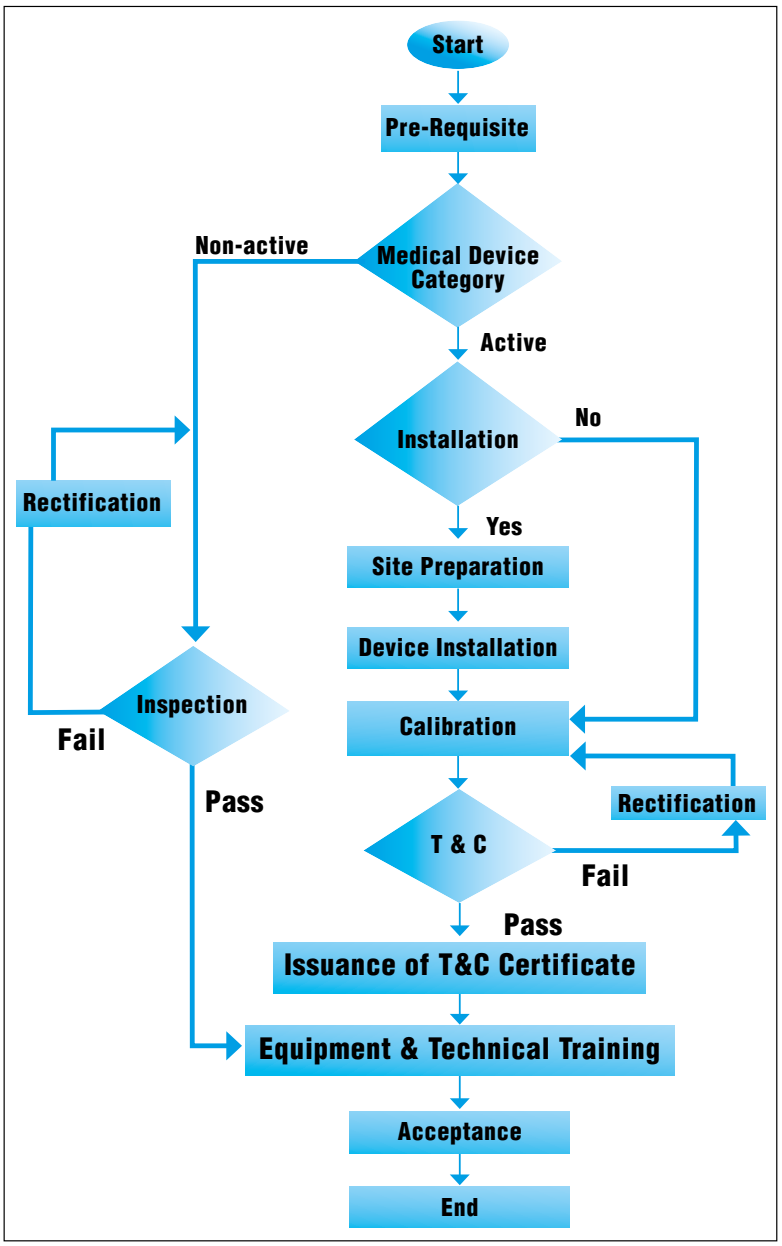

Figure 1: Flowchart of testing & commissioning and acceptance of medical device

PRE-REQUISITE

In any purchase of a new active medical device, documentation shall be made available to medical device owner by the medical device establishment prior to T&C. Example of documents are: Device registration certificate, Establishment Licence from Medical Device Authority (MDA), purchase agreement, relevant licences, test certificates, manuals (user/operation/service/maintenance) and build drawing of site and facility where relevant.

The medical device establishment shall provide written notification of any specific installation and T&C requirements to the medical device buyer.

Apart from new purchases, medical devices on lease, loan, trial evaluation, clinical investigation, transfers, donations and those that have undergone major upgrading, documentation shall also include maintenance history, a clear statement that the equipment is being resold or donated and proof of decontamination.

For a designated medical device, all drawings, safety requirements and installation plan shall be submitted for approval to the relevant regulatory authority. For management of radioactive source, the medical device owner shall refer to the medical device establishment and regulatory authority.

For non-active medical devices, only inspection, training and acceptance procedure are required.

MEDICAL DEVICE CATEGORY

Medical devices are categorised into active medical device and non-active medical devices. Active medical device refers to any medical device, operation of which depends on a source of electrical energy or any source of power other than that directly generated by the human body or gravity and which acts by converting this energy.

Medical devices intended to transmit energy, substance or other elements between an active medical device and the patient, without any significant change, is not considered active medical device.

INSTALLATION

a. For active medical device that requires installation

Installation usually applies when any of the following occurs:

1. Substantial assembly work will be required on-site;
2. There are dedicated plumbing, electrical and gas pipeline connections for the equipment
3. The device needs to be permanently fixed in place.

The medical device owner, with medical device establishment input or advice, shall ensure site preparation is in accordance to manufacturer and regulatory requirement. The medical device owner shall ensure that all technical drawings (medical device layout, mechanical and electrical, civil and structural) are submitted to the relevant authorities or departments for approval prior to installation.

Professional, competent technical personnel shall endorse the medical device installation layout. The medical device establishment shall install the medical device in accordance to the manufacturer's technical specification for installation work. All as-built drawings shall be made available and submitted to competent technical personnel of the medical device owner.

b. For active medical device which does not require installation

The medical device owner, with medical device establishment input or advice, shall perform a pre-check prior to T&C. The pre-check includes availability and sufficient utility such as medical gas, electrical supply (essential/non-essential), water supply, appropriate placement area i.e.; ventilation, humidity, room temperature.

SITE PREPARATION

a. Renovation

The medical device owner shall furnish the details of the renovation scope of work and a room data sheet recommended by medical device establishment. A room data sheet provides information on the minimum requirements for the room where the medical device is to be installed. The medical device owner shall prepare shop drawings that include:

1. Architectural drawings;
2. Structure drawing endorsed by the professional engineer if required
3. Layout and positioning details of the medical device and related systems as recommended by the establishment and local statutory and regulatory requirement and
4. Utilities details to support the installation of medical device and corresponding associated drawing.

Prior to installation, all shop drawings related to the installation of the medical device shall be verified by professional, competent technical personnel and agreed to by the medical device owner.

The medical device owner shall carry out the renovation and site preparation works according to the approved scope of work and shop drawings. Competent technical personnel shall supervise the renovation and site preparation works.

b. New building/ new building extension

If a new building or new extension building is to be constructed to accommodate the new medical device, the medical device owner shall appoint a team of consultants consisting of architects, civil and structural engineers, mechanical and electrical engineers, quantity surveyor and medical device planner. The consultants should be registered with their respective professional boards or other relevant bodies.

c. Mobile Healthcare Facilities

Mobile healthcare is a service that is provided on fixed routes and at a number of points, which are visited on a regular basis. Some visiting points may involve the use of a room in a building but the resources (equipment, stocks) are provided from the mobile when the service is available and are not maintained at the visiting point. The medical device

owner shall submit a technical report on the suitability of the proposed vehicle to the Road Transport Department.

The medical device owner shall prepare relevant document that includes drawings giving details of retrofitting works, layout and positioning details of the medical device and related systems, safety features and utilities details such as cold water supply, treated water supply, electrical supply, steam supply, medical gases and drain. The relevant authority shall approve all drawings.

The mobile medical device owner shall carry out the vehicle renovation and site preparation works according to the approved scope of work and drawings. Appointed consultants and competent technical personnel shall supervise the renovation/site preparation works.

DEVICE INSTALLATION

Site preparation works for the installation of the medical device shall be ready prior to installation. Competent technical personnel appointed by the medical device owner shall verify all relevant documents prior to device installation and ensure the facility is ready prior to installation. They will also ensure that the installation complies with the manufacturer's instructions and that all safety requirements are as required by the manufacturer and relevant authority. The medical device establishment shall ensure only equipment specialist(s) will carry out the installation.

CALIBRATION

The medical device establishment shall produce the manufacturer's calibration certificate or report for any medical device that does not require on-site calibration. The medical device establishment shall perform the calibration as per manufacturer's specification for any medical device that requires on-site calibration. A recognised and certified calibration laboratory shall do this for any medical device that requires certified calibration. The medical device establishment shall submit the calibration test report and calibration certificate of the medical device to the medical device owner. The medical device establishment shall rectify all faults that can cause calibration to fail and re-perform the calibration until it passes.

TESTING AND COMMISSIONING

The medical device owner shall verify that the medical device delivered is in good condition and complete, based on the purchase document. Physical evaluation or visual checks of the medical equipment include observations of chassis, mount/fasteners, castor/brakes, power cord, connectors, control/ switches, indicators/displays, accessories and labeling. T&C is best performed at the very location where the medical equipment will be placed for use.

The medical device establishment shall operate the medical device to ensure it is functional and ready to be tested. The competent technical personnel of the medical device owner shall ensure that all required documents are made available during T&C by the medical device establishment, such as a copy of delivery note (which specify separately between main system, subsystems, accessories and consumables), certificates, calibration report, manuals and backup copy of software, declaration of previous recalls/device alerts/end of life date, quality assurance, service engineer training certificate (manufacturer training), response time during warranty period and tentative date for equipment and technical training.

The medical device establishment is required to perform specific tasks during T&C on the medical device. These include confirmation of items delivered based on purchase document, validation of the specification/parameters using appropriate test equipment and all other relevant safety tests to the equipment which shall also be conducted and recorded accordingly.

The equipment specialist from the medical device establishment shall carry out performance and safety tests as required by the manufacturer, and witnessed by competent technical personnel.

A label indicating that the medical device has passed the electrical safety test, shall be affixed at a visible area on the device. All results shall be documented and the medical device establishment shall keep all documents according to retention period as specified by MDA. A copy is to be submitted to the medical device owner.

T&C shall be repeated upon rectification of all deficiencies by medical device establishment.

INSPECTION OF NON-ACTIVE MEDICAL DEVICE

The medical device owner accepting the device has the discretion to determine when and where the device should be inspected and sampled for conformance to specifications, depending upon the risk that failure of that device may pose. The non-active medical device shall be inspected by the medical device establishment, medical device owner (material/procurement warehouse) and medical device owner (user).

The medical device owner shall perform general acceptance inspection on random sampling basis for the non-active medical device against the purchase order. Inspection tasks shall include but not be limited to:

1. Checking and verifying that the product is exactly as ordered and corresponds with the delivery note
2. Verification of quantity, size, consumable items and accessories delivered as stated in the purchase agreement
3. Visual inspection of the device or equipment for physical damage, incompleteness, misassembling, void, wear and/ or abuse
4. Check relevant labelling on the device
5. Take note of batch number or lots in the event of a product recall
6. Contamination
7. Disseminate instructions and safety information when necessary.

Rejected medical devices shall be documented, rectified or replaced by the medical device establishment. The medical device establishment shall provide proof of compliance to the specification in purchase document and the medical device owner shall keep records of inspection.

ISSUANCE OF T&C CERTIFICATE

The medical device establishment shall issue a T&C certificate once the T&C process is successfully completed. The medical device establishment, medical device owner and competent technical personnel shall sign the T&C certificate.

TRAINING

EQUIPMENT TRAINING

The medical device establishment shall provide on-site, hands-on equipment training. The equipment training module shall include but not be limited to:

a) Safety precautions in operating the medical device
b) Proper operation/application
c) User maintenance
d) Cleanliness and decontamination
e) Operational verification procedures
f) Recognition and correction of common operational problems
g) Recognition of defective equipment and potential hazards
h) The risk associated with the device.

The medical device establishment shall issue a certificate of attendance to the user upon completion of the training.

TECHNICAL TRAINING

The medical device establishment shall conduct on-site technical training to the competent technical personnel of the medical device owner during and after the T&C. A certificate of attendance shall be issued upon completion of the training.

For the recognition of technical competency on that particular medical device, the medical device establishment shall offer detailed technical training according to maintenance competency level, with a reasonable fee. The medical device establishment shall issue a certificate of competency to the competent technical personnel upon completion of the training. The detailed technical training module shall include equipment training module and other module but not be limited to:

a) PPM according to manufacturers' specification
b) Maintenance competency as defined by MDA.

The medical device establishment shall issue a certificate of competency to the competent technical personnel upon completion of the training.

ACCEPTANCE

NON-ACTIVE MEDICAL DEVICE

Non-active medical device is accepted upon completion of successful inspection and training. The medical device establishment and medical device owner shall sign the records of acceptance.

ACTIVE MEDICAL DEVICE

Competent technical personnel shall perform the tasks that include, but not be limited to:

a) Ensuring the medical device is exactly as ordered and corresponds with the delivery note
b) Verifying the quantity, consumable item and accessories delivered as stated in the purchase agreement
c) Ensuring the equipment has successfully undergone performance and safety tests
d) Checking of relevant labelling on the device
e) Ensuring the medical device is delivered with a full set of documentation including user and operating manuals, spare parts list, schematic diagram, PPM manual and checklist as recommended by manufacturer,

Figure 2: Magnetic Resonance Imaging (MRI) installation

validated T&C report and certificate, calibration certificate, training certificate and any other relevant document

f) Ensuring the medical device technical support information from the medical device establishment is submitted (address, person in-charge, telephone number, fax number, medical device registration number and any relevant information)

g) Ensuring the user and technical training on the medical device has been carried out.

Upon passing the acceptance testing, the medical device shall be labelled to indicate asset identification, warranty information, performance test pass label, electrical safety pass label (where applicable) and next PPM due date.

The medical device establishment shall issue an acceptance certificate once the acceptance process is successfully completed. The medical device establishment, medical device owner and competent technical personnel shall sign the certificate. The warranty period and PPM frequency (within the warranty period) shall be specified in the acceptance certificate.

CONCLUSION

This guideline aims to lay down the minimum installation, testing and commissioning and acceptance requirements to be carried out on all medical devices in Malaysia. ■

IEM DIARY OF EVENTS

Title: Talk on "Impact of Leadership and Teambuilding in Project Management"

7th March 2015

Organised by : Project Management Technical Division
Time : 5.30 p.m. – 7.30 p.m.
CPD/PDP : 2

Kindly note that the scheduled events below are subject to change. Please visit the IEM website at www.myiem.org.my for more information on the upcoming events.

Pengumuman yang ke-78

SENARAI PENDERMA KEPADA WISMA DANA BANGUNAN IEM

Institusi mengucapkan terima kasih kepada semua yang telah memberikan sumbangan kepada tabung Bangunan Wisma IEM. Ahli-ahli IEM dan pembaca yang ingin memberikan sumbangan boleh berbuat demikian dengan memuat turun borang di laman web IEM http://www.iem.org.my atau menghubungi secretariat di +603-7968 4001/5518 untuk maklum,at lanjut. Senarai penyumbang untuk bulan Januari 2015 adalah seperti jadual di bawah:

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1	03902	AB. MAJID BIN AZIZ	14	43737	MOHD ROSLAN BIN DAUT
2	10152	ABDUL JAMAL BIN MOHD JOHAR	15	17993	MOHD. AZMAN BIN AB. AZIZ
3	20675	AMINUDIN BIN MOHD. ISA	16	19701	MOHD. NADZRI BIN MOHAMAD
4	06273	CHANG LEONG HAO	17	69499	SIM WEI TAT
5	03650	CHUA LEE BOON	18	41027	SITI RAFIDAH BINTI MOSLIM
6	16515	DR. MASITAH BINTI HASAN	19	70213	SIVALINGGAM A/L SELLIAH
7	02851	HJ. MOHAMED RIZA BIN MOHAMED ISMAIL	20	20928	SYARUZMI KHALID
8	02827	HOR YOOK KONG	21	15194	TAN CHUAN HO
9	13239	LAU KOK KEE	22	08955	TAN GEEM ENG
10	20689	LUKMAN BIN MD. AKIM	23	42233	TAN MENG YUE
11	06158	MD. NUJID BIN ISMAIL	24	36838	TE CHOON CHIAM
12	25574	MOHAMMAD FADHLI BIN MAT SHAH	25	07537	TIONG HONG HEE
13	19969	MOHANA MURALI A/L KUPPUSAMY	26	50777	WAN IKRAM WAJDEE BIN WAN AHMAD KAMAL
			27	24697	WAN ZUHAIRI BIN WAN YAAKUB

ANNOUNCEMENT

List of IEM Panel Arbitrators / Adjudicators

The Subcommittee on Dispute Resolution Practice (DRP), with the approval of the Standing Committee on Professional Practice (PPC), IEM in January 2015, wish to invite members who are practising as an Arbitrator and/or Adjudicator to register your interest to be listed in the IEM Panel of Arbitrators and/or Adjudicators. Kindly call the Secretariat at 03-7968 4006 for more information and the reply form.

Thank you.

Chairman

Subcommittee on Dispute Resolution Practice (DRP), PPC, IEM

Safety First, We Care

By Ir. Dr Cheong Thiam Fook

Ir. Dr Cheong Thiam Fook is the Chairman of Sub Committee on Membership Drive and Promotion and a member of the Mechanical Engineering Technical Division.

Isn't it scary to hear about the many accidents at construction sites? This is mainly due to the large number of construction projects going on at the same time, be they high-rise projects or infrastructure projects and whether in urban or rural areas. Accidents that are reported in the media are usually serious and often with fatalities. What about those we aren't aware of as they go unreported? Add to that instances of near accidents? However, we believe that authorities like CIDB and JKKP have all the statistics.

We have all read reports from the clients and developers, main contractors, engineering societies, with oft-said and similar statements such as "we are investigating the accidents" and "we will tighten the Safety Management Plan" etc.

Some parties may even start to hold others responsible and terminate subcontractors etc. But will such actions, always taken after the accidents have happened, help to solve the reoccurrence of the accidents?.

The answer is "No" because we can see that accidents continue to happen. After so many wake-up calls, it is time that we take serious action to improve safety at construction sites. Safety is a collective responsibility of all parties, especially when it comes to infrastructure projects like the MRT and LRT.

Here are some suggestions to Safety First:

1. TRAINING

Employ only trained and qualified construction professionals for high risks works such as crane lifting. CIDB conducts such training of various categories of construction professionals and skilled workers and crane lifting is no exception.

2. PLANNING AND EXECUTION

Issue clear directives to cordon off lifting sites to prevent the public from entering or passing by. I once visited a construction site in Japan and I noticed that, during the lifting operation, they really cleared the site to ensure there was no trespassing.

3. CHECKING AND REPORTING

Allow a proper reporting system for the public to report malpractices by contractors, with evidence such as photographs sent to CIDB or DOSH for routine investigation by the respective departments. The clients and developers should be kept informed of the incidences.

4. ENFORCEMENT

Clients and contractors who fail to observe the safety procedures in execution of the works, should be heavily punished. It is important that all parties ensure Safety First at all construction sites and proper punishment such as stop work orders, must be meted out to parties which have committed offences.

5. WARNING AND AWARENESS

There is often a lack of adequate signboards at construction sites to warn the public of possible falling objects and heavy machineries. At the very least, such signboards will serve to warn the public to stay away.

Safety policies are a top-down commitment. Implementing safety procedures is a bottom-up execution and we must start to do this seriously to achieve our committed safety statement. Safety First, We Care. ■

IEM DIARY OF EVENTS

Title: Talk on Fasteners to Concrete and Steel: New Developments, Failures and Solutions

5th March 2015

Organised by : Civil and Structural Engineering Technical Division
Time : 5.30 a.m. - 7.30 p.m.
CPD/PDP : 2

Kindly note that the scheduled events below are subject to change. Please visit the IEM website at www.myiem.org.my for more information on the upcoming events.

COLLAPSE OF BUNGALOW AT BUKIT JALIL – OBSERVE STRICT SAFETY PROCEDURE

The Institution of Engineers, Malaysia (IEM) noted a news report concerning the collapse of a bungalow under construction in Jalan Alam Sutera, Bukit Jalil on 1st Dec 2014. The incident resulted in the death of one worker. Another was injured. It also affected public confidence in the safety of the construction works.

We would like to express our heartfelt sympathies to the family of the victim.

In view of the incident, IEM considers it is important to highlight the need to observe safety procedures in construction work. IEM would like to emphasise the need for more stringent or stricter safety requirements through the inclusion and strict adherence to such provisions in design standards and industry code of practise.

IEM would like to highlight that the method of construction and all temporary works such as falseworks and scaffoldings should be properly designed, endorsed and supervised by a Professional Engineer to reduce risks of accidents.

IEM is willing to provide the technical expertise and offer independent advice to the authorities by conducting investigations into the cause of the accident and by reviewing the follow-up measures required to prevent similar accidents from occurring.

Dato' Ir. Lim Chow Hock
President
4th December 2014

MALAYSIA 2014 MONSOON FLOODS – ENGINEERS READY TO HELP

The Institution of Engineers Malaysia (IEM) is extremely concerned over the recent nationwide floods which have resulted in devastating damage of over RM1 billion to properties and public infrastructures. The floods too have claimed a few lives and affected the livelihood of about 200,000 people.

According to the official report, the rainfall recorded in the East Coast States of Kelantan, Terengganu and Pahang, far exceeded that with a return period of more than 100 years. It was further observed that the amount of rain that fell continuously over 10 days, from 14th to 25th Dec 2014, at the upper catchment of Gua Musang, was equivalent to 50% of the average annual rainfall.

This continuous rainfall caused the saturation of the catchment areas, resulting in an extremely large runoff of over three times more than the capacity of the river system. This caused the rivers to overflow and flood the surrounding low lying areas, especially towns and villages along the river banks.

For towns near the coast, the extent and duration of the floods were compounded by the high tides that occurred in the month of December.

Now that the floods have subsided, the government has launched programmes to build temporary and permanent houses for those whose homes were destroyed in the floods. IEM welcomes the Federal Government's assurance that more funds will be approved for flood mitigation measures under the 11th Malaysia Plan.

In carrying out flood mitigation measures, there is a need to consider both the structural and non-structural measures that must be implemented under the short/long term development programmes. In addition, it is important that all components or scope of works proposed under each structural measure be implemented according to the planned schedules and obviously, sufficient funding must be made available for the relevant implementing agencies either at the Federal or State levels.

In most cases, we have to consider a combination of physical works such as the building of multi-purpose dams, deepening and widening of rivers, dredging of river mouths, building of flood walls, dykes and river bunds, improvement to local drainage system including the use of flood gates and pumps, constructing new diversion channels and the construction of breakwater to prevent siltation at the river mouth.

In this respect, IEM is ready to assist both Federal and State governments to draw up the necessary flood mitigation master plans based on the need of each major river basin in the country.

Non-structural measures involve the control of land development. The relevant authorities must be serious in tackling the root cause of the major siltation of the rivers and waterways. It is also important to educate the population with respect to the dumping of rubbish in local drainage systems and to uplift the maintenance culture of local governments for a better drainage system.

The government should look into the most appropriate mechanism to formulate and implement the best management practices based on the concept of Integrated River Basin Management (IRBM), which is a proven integrated approach that will solve both the problem of water resources as well as the issue of annual flooding.

Again, IEM is willing to help the Government with the necessary technical advice in the preparation of such a River Basin Management Plan, including the Public Outreach Programme.

During the recent floods, IEM launched the IEM-YES Disaster Relief Operation 1.0, to provide basic assistance

to flood victims and will continue to provide whatever assistance that is needed.

IEM is also organising a course on Flood Emergency Response Planning on 26th January, 2015. The event is open to the public and all proceeds will be donated to the flood victims to help them rebuild their livelihoods.

Dato' Ir. Lim Chow Hock
President
15th January 2015

The Press Statement was published in the following media:

(17th Jan 2015)

1) New Straits Times – ENGINEERS OFFER HELP WITH FLOOD MITIGATION PLAN (NEWSPRINT)
2) The Star – IEM Offer expertise on flood control master plan (NEWSPRINT + Online News)
   http://www.thestar.com.my/News/Nation/2015/01/17/IEM-offers-expertise-on-flood-control-master-plan/
3) Free Malaysia Today – Engineers offer to help in flood mitigation master plan (Online news)
   http://www.freemalaysiatoday.com/category/nation/2015/01/17/engineers-offer-to-help-in-flood-mitigation-master-plan/

(16th Jan 2015)

4) BERNAMA – IEM Ready to Assist Government to Draw Up Flood Mitigation Master Plan (Online news)
   http://www.freemalaysiatoday.com/category/nation/2015/01/17/engineers-offer-to-help-in-flood-mitigation-master-plan/
5) The Rakyat Post – IEM ready to lend govt a helping hand with flood mitigation (Online news)
   http://www.therakyatpost.com/news/2015/01/16/iem-ready-lend-govt-helping-hand-flood-mitigation/

(15th Jan 2015)

6) Malaysian Digest – ENGINEERS READY TO LEND EXPERTISE IN DRAWING UP FLOOD MITIGATION PLANS (Online News)
   http://www.malaysiandigest.com/news/537751-engineers-ready-to-lend-expertise-in-drawing-up-flood-mitigation-plans.html

ERRATA

Error on Feature Rationalised Settlement Criteria for Pile Load Test – published in JURUTERA January 2015 page 27 – 34.We wish to inform that on page 27 under the heading of SETTLEMENT/FAILURE CRITERIA FOR PILE LOAD TESTS - Table 1 is missing in the article.

Method	Criteria
Davisson criterion (1972) (suggested by CGS (1995), BD (1997), NAVFAC (1982), Norway)	$\Delta_M < PL/AE + 0.15in + Q_{tip}$, where PL/AE is the elastic shortening; Δ_M is the pile head settlement, 0.15in – based on observation and experience; Q_{tip} is the displacement required at pile toe to cause soil 'quake' (displacement at which yielding of soil at the pile base occurs).
10% diameter (adopted by BSI (1986); EC7 (BSI, 1997); ISSMFE (1985); Norway	Failure load is the load causing pile head settlement equal to 10% of pile base diameter. For long pile, the 10% may be required to adjust for elastic shortening (BSI, 1986).
AS-2159 (SAA, 1995)	Δ_M< 50mm at 1.5 design action effect (DAE). Δ_R< 30mm after unloaded from 1.5 design action effect. Δ_{WL}< 15mm at serviceability load (= 0.75S). $\Delta_{R,WL}$< 7mm after unloaded from serviceability load
JGJ (1995) (Technical Code for Building Pile Foundations, People's Republic of China)	Ultimate load is the load at which settlement continues to increase without any increase of load. For large diameter pile, the failure load is defined as the load corresponding to Δ_M< 3-6% d and for slender pile (L/d > 80) corresponding to Δ_M< 60-80mm. Based on Δ-log t plot, the failure load is the load just before an obvious bend occurs.
FDT (1999)	Δ< PL/AE + d/30 in Factor of safety = 2. Smaller piles use Davisson criterion.
Buildings Department, HKSAR (BD)	$\Delta_M < PL/AE + D/120 + 4$ (mm) $\Delta_R < D/120 + 4$ (mm) where PL/AE is the elastic shortening, D is the pile diameter, Δ_M is the pile head settlement, Δ_R is the residual settlement.
Housing Authority, HKSAR (HA)	Δ< PL/AE + D/30 (in mm) Δ_R^f< D/50 or 10mm whichever is smaller Δ_R^b< D/100 or 5mm whichever is smaller where Δ_R^f is the residual settlement for pile embedded in soil, Δ_Rb is the residual settlement for pile bearing on rock.
Federation of Piling Specialists (FPS), UK (2006)	For insensitive buildings: Settlement at DVL, Δ_M < 10mm + PL/AE for piles less than 1000mm diameter. For test piles greater than 1000mm diameter a value in excess of 10mm may be appropriate. Maximum settlement at loads greater than DVL should not be specified for insensitive buildings. DVL is the working load plus allowances for soil induced forces such as downdrag or heave, and any particular conditions of the test such as variation of pile head casting level.

Half-Day Seminar: Inclinometer Measurements and Errors & Ground Anchors-From Design to Construction

TUNNELLING AND UNDERGROUND SPACE TECHNICAL DIVISION

By Ir. Syed Rajah Hussain

Ir. Syed Rajah Hussain *graduated from Bolton University, United Kingdom. He joined a British Civil Engineering and Tunnelling Contractor JF Donelon and worked on various tunnelling project throughout UK. He then joined the Kelana Jaya LRT Line with a Project Management Company and was involved in the underground works. He later joined various Consultants and Developers and involved in local and overseas developments notably in Indonesia, Kazakhstan and Pakistan.*

Participants during Q&A Session

On 9th August 2014, Dr V. Ganeshan of AECOM Singapore Pte Ltd gave a half-day seminar to 63 participants on two important subject related to Tunnelling And Underground Works.

The seminar was held in Wisma IEM, Petaling Jaya.

The lecture was delivered in two sessions. The first session was on Inclinometer Measurements And Errors and the second session was on Ground Anchors – From Design To Construction. Dr Ganesh, who has over 35 years of experience in all aspect of geotechnical works, gave a detailed and comprehensive lecture on both topics.

INCLINOMETER MEASUREMENT AND ERRORS

Dr Ganesh said geotechnical instrumentation are used in almost all deep excavation works but the inclinometer is one of the most crucial instrument that ensures safety at site.

The inclinometer, as the name implies, measures the inclination of a particular structure that it is intended to measure. It measures the lateral displacement of the structure, for example a retaining wall trough out the wall full depth and beyond, when installed below the wall toe.

He explained how inclinometer measurements are installed, the data read and the associated errors. It is crucial to study and explain in-depth the associated errors as, on numerous occasions, the anticipated wall lateral movement is not as expected, according to the results of the inclinometer readings.

Errors in installation and measurements as well as method of correcting measurements with systematic errors were presented. Dr Ganesh covered in-depth the types of errors inherent to the inclinometer as follows:

Systematic Error	Random Errors
Zero Offset / Bias Error	Depth Positioning Error
Bias- Shift Error	Casing Irregularities
Sensitivity Error	
Orientation / Spiral Error	
Rotational Error	
Gravity Error	

GROUND ANCHORS – FROM DESIGN TO CONSTRUCTION

In the second session, Dr Ganesh presented the standard terms for the design of ground anchors and stressed on the importance of gaining compression in the grouting and introducing the Single Bore Multiple Anchor® system.

He continued his lecture on special features and considerations that need to be taken while designing and installing ground anchors.

The lecture concluded with the 3 criteria for testing of anchors that includes Proving Test, Onsite Suitability Test and On Site Acceptance Test.

The lecture ended at 1.30 p.m. with an question and answer session. There was active discussion from the floor and participants gave Dr V. Ganeshan a round of applause for his well-presented seminar.

On behalf of TUSD, its chairman Ir. Andrew Yeow Pow Kwei presented a memento to Dr Ganeshan. ■

IEM DIARY OF EVENTS

Title: Evening Talk on "Sustainable Water Supply Technologies for Rural Communities"

10th February 2015

Organised by : Water Resources Technical Division
Time : 5.30 p.m. – 7.30 p.m.
CPD/PDP : 2

Title: Talk on "Introducing the Holistic Management Methodology for Railway Systems Projects"

11th February 2015

Organised by : Engineering Education Technical Division
Time : 5.30 p.m. – 7.30 p.m.
CPD/PDP : 2

Title: Talk on "INTEGRITY - Our Responsibilities and Lessons Learnt" - Postponed from 17 January 2015 (Saturday)

12th February 2015

Organised by : Project Management Technical Division
Time : 5.30 p.m. – 7.30 p.m.
CPD/PDP : 2

Title: Talk on Essential Soft Skills to be A High Performance Engineer

14th February 2015

Organised by : Oil, Gas and Mining Engineering Technical Division
Time : 9.00 a.m. – 11.00 a.m.
CPD/PDP : 2

Kindly note that the scheduled events below are subject to change. Please visit the IEM website at www.myiem.org.my for more information on the upcoming events.

Tunnel Boring and Other Underground Works of the KVMRT SBK Line

TUNNELLING AND UNDERGROUND SPACE TECHNICAL DIVISION

By Ir. Khoo Chee Min

Ir. Khoo Chee Min *is currently a Committee Member of IEM Tunnelling and Underground Space Technical Division (TUSTD) and works as Senior Manager in Mass Rapid Transit Corporation Sdn Bhd.*

Participants during the session

The Tunnelling and Underground Space Technical Division (TUSTD) organised an evening talk on Tunnel Boring & Other Underground Works Of The KVMRT SBK Line on 17th November 2014, at the C&S Room, Wisma IEM.

The speaker was Mr. Gusztav Klados, Project Manager of MMC-Gamuda KVMRT (T) Sdn Bhd for the KVMRT Sungai Buloh – Kajang Line (SBK Line) Underground and Tunnelling Works. A total of 64 participants had attended the talk.

Mr. Gusztav started the talk with a brief overview of SBK Line, the first line currently implemented under the Klang Valley Mass Rapid Transit project in Malaysia. When completed, the SBK Line will measure a total length of 51km and have 7 underground stations and 24 elevated stations.

The talk focused on the underground section, including the 9.5km tunnelling within the KL city centre.

The speaker, Mr. Gusztav Klados

The tunnels are being constructed by two types of tunnel boring machines (TBM). These are Earth Pressure Balance (EPB) TBM for the

Momento presented to Mr. Gusztav by Ir. Andrew Yeow

Kenny Hill Formation and Variable Density (VD) TBM for the extreme karstic limestone formation. The VD TBM is a slurry machine designed for several modes of tunnelling, both in slurry and EPB, with a facility to vary the density of the slurry. The VD TBM works on a two-pronged approach towards minimising tunnelling risk, primarily caused by ground settlement:

- Higher viscosity slurry prevents loss of slurry into the cavities and this in turn prevents sinkholes
- Higher viscosity slurry prevents slurry from flooding the ground surface, hence helping to maintain the pressure between the cutterhead and the excavated surface, therefore minimising incidence of sinkholes.

This technological innovation is the first of its kind in the world and the contractor is proud to announce that the tunnelling in KL karst limestone has been completed successfully by VD TBM with just 2 minor sinkholes reported.

This is a major improvement compared to SMART project (i.e. 41 major ground collapses). This translates to 4.6/km sinkholes for SMART vs 0.3/km sinkholes for KVMRT. Other new techniques in tunnelling for this project include the full adoption of steel fibre reinforced concrete (SFRC) tunnel segment lining with universal rings (7 + 1 key), except hybrid lining to be used for certain areas (e.g. Pudu).

Mr. Gusztav then highlighted the key design features and engineering challenges faced at each underground station, of which some had been identified during tender and design stages while new challenges were encountered during construction. All 7 underground stations were being constructed using cut-and-over method with maximum excavation depths of up to 40m below ground level for the Tun Razak Exchange (TRX) Station.

For those in the Kenny Hill formation, construction followed the top-down process while those in KL limestone were designed for bottom-up sequence. Mr. Gusztav also shared his opinion that top-down construction was preferred and could be more economical than conventional braced excavation with extensive temporary strutting.

Apart from the above, the talk also provided participants with the latest updates on the KVMRT project with regards the progress of the various components of the underground section.

At the end of the talk, there were discussions and questions raised by the participants. Then the Chairman of TUSTD presented a memento to Mr. Gusztav, followed by a round of applause from the participants. ■

CAFEO 32 in Yangon, Myanmar

A VICE PRESIDENT AND A PAST PRESIDENT OF IEM

By Ir. P.E. Chong

Ir. P.E. Chong, *IEM Vice President, concurrently the Secretary General of AFEO.*

Dato' Lim Chow Hock, AFEO Vice Chairman presenting the Certificate of Honourary Distinguished Patron to HE U Thien Sein while Ir. U Win Khaing, AFEO Chairman (on the right) and Ir. P.E. Chong (centre) witnessing the presentation

The ASEAN Federation of Engineering Organisations (AFEO) is made up of the 10 national engineering organisations in ASEAN countries. Its main activity, Conference of AFEO (CAFEO), is held annually in one of the 10 countries, on a rotation basis according to alphabetical order.

This year's CAFEO 32 (the number indicates how many times CAFEO has been held so far), was organised by Myanmar Engineering Society (MES) and held in Yangon, Myanmar, from 10th to 12th November, 2014. Myanmar held the chair of AFEO for 2014 until the conclusion of CAFEO 32.

The event proceeded as planned in Hotel Sedona. The Governing Board meeting was held back-to-back with this annual event for a get-together at the end of the year. More than 600 participants from various parts of Asia and South East Asia attended.

EVENT PRECEDED CAFEO 32: TRIPS BY CHAIRMAN OF AFEO

The Chairman of AFEO and President of Myanmar Engineering Society (MES), Ir. U Win Khaing made one trip to the AFEO Secretariat for meetings and discussions, among others, on the arrangement for technical and other meetings.

The Secretariat also met Ir. U Win Khaing earlier in the hotel lobby for discussions on his personal trip to Kuala Lumpur.

WELCOMING RECEPTION

The Welcoming Reception, held a day before the Opening Ceremony, allowed all participants to meet, network and get know each other. It was very well attended with plenty of food and drinks to go along with it.

OPENING CEREMONY

The Conference was preceded by a golf competition among the heads of delegations

From left: Ir. P.E. Chong, Dato' Ir. Lim Chow Hock, Ir. U Win Khaing, AFEO Chairman, Ir. Gunasagaran Kristnan, AFEO Hon Treasurer.

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AFEO Board Meeting in session

Some VIP Observers Delegates from Laos (LUSEA) & Indonesia(PII)

AFEO Board Meeting in session

and some delegates in the early morning. This was followed by the presentation of some technical papers. There were other activities in the afternoon as well on the day before the Conference proper.

On the second day, the grand Opening Ceremony started at 9.00 a.m., officiated by H.E U Kyaw Lwin, Union Minister of Construction, Myanmar, and H.E U Myint Swe, Chief Minister of Yangon Region, Myanmar.

The ceremony started early to accommodate a special visit to Naypyitaw, the administrative capital of Myanmar. After the ceremony, all the Heads of Member Organisations and other AFEO Office Bearers left immediately for the airport to board a plane for Naypyitaw to attend and witness the conferment ceremony of Distinguished Honorary Patron award to His Excellency, U Thein Sein, President of the Republic of the Union of Myanmar. The ceremony took place at the President's Palace.

CONFERMENT OF THE AFEO DISTINGUISHED HONORARY PATRON

The delegation was given VVIP treatment by the Myanmar government which provided a return chartered flight from Yangon. Unfortunately the original outbound plane intended for the flight developed a technical glitch, so we were transferred to a commercial flight which was diverted to Naypyitaw to ensure that the delegation would arrive at the Palace in time for lunch as the President was available for the conferment and lunch with the delegation. The President was extremely busy as he had to meet and entertain the overseas heads of States, including US President Barrack Obama who was there for the ASEAN Summit.

We understood that the other passengers on this commercial flight were not aware that the plane was being diverted and they were not allowed to disembark when the plane landed in Naypyitaw.

We were taken immediately to the VIP lounge for transfer to vehicles that would take us to the Palace, accompanied by police outriders. The roads leading to the Palace were lined with policemen to ensure that the journey to the Palace was not interrupted by traffic at the many road junctions.

All the way, we were accompanied by the Minister of Construction, HE U Kyaw Lwin, his Deputy, HE Dr Win Myint, and other high ranking officers.

After the conferment ceremony, the delegation was entertained to lunch by HE U Thein Sein, President of the Republic of the Union of Myanmar.

From left: Ir. Gunasageran, Ir. P.E. Chong, Dr Dang Vu Minh, President VUSTA, Y.B. Hj. Zulkipli Hj. Abdul Hamid, President of PUJA, HE Lim Sothaw, Sec Gen BEC, Ir. Bobby Gafur Umar, President PII, Ir. U Win Khaing, MES President/AFEO Chairman, HE U Kyaw Lwin, Union Minister of Constrction, Myanmar, HE U Myint Swe, Chief Mininster, Yangon Region, Dato' Ir. Lim Chow Hock, IEM President/AFEO Vice Chairman, Ir. Somphone Phanousith, Sec Gen LUSEA, Federico A. Monsada, President, PTC; Er. Chong Kee Sen, President IES: Prof. Dr Sucatvee Suwansawat, President EIT; Ir. U Kyaw San Win, CAFEO Organising Chairman, Dato Ir. Dr Andy Seo Kian Haw, AFEO Head Commissioner.

TECHNICAL AND MEETINGS

Back in Yangon, the Workshop on Transportation and Logistics as well as conference technical sessions continued. There were

Picture shows Myanmar recipients of Certificates of ASEAN Engineer Membership Award at the Welcoming Reception with Ir. U Win Khaing (6th from left), Dato' Ir. Lim Chow Hock (7th from left), Ir. P.E. Chong (5th from left), Dato Ir. Dr Andy Seo Kian Haw (8th from left)

many different engineering displays at the exhibition booths located at the entrance to the Conference Ballroom. Besides the conference sessions, the working group meetings, Young Engineers of AFEO (YEAFEO) and Woman Engineers of AFEO (WE-AFEO) meetings also went on as scheduled.

WE-AFEO was formed only in 2013 to discuss women engineer issues within the ASEAN countries. The Energy and Environment Work Group was chaired by Malaysia, Education and Capacity Building by Singapore, and the Transportation and Logistic and the Disaster Support was chaired by Thailand.

Country Reports were presented by the respective Heads of member organisations that afternoon upon their return from Naypyitaw. The day ended with the ASEAN Engineers Register Commission meeting in the evening.

AFEO BOARD MEETINGS

The AFEO Board meeting also discussed the possibility of member organisations coming together with a Declaration to be announced as the Yangon Declaration II. This was a follow-up to the Yangon Declaration signed 10 years ago in Yangon.

The Yangon Declaration II signing ceremony was held at 4.30 p.m. in the presence of the members of the Press and TV from Myanmar. This Declaration can be viewed at the AFEO website: afeo.org.

CLOSING CEREMONY/BANQUET

In the evening, there were lively activities including the presentation of awards for best engineering projects, feats and individuals of the various ASEAN countries. Outstanding engineers and eminent personalities were also conferred Honorary titles. These were followed by lively performances of singing and dancing, by delegates and young engineers from the various countries.

The handover ceremony was also held during the grand Gala Dinner. By rotation, after Myanmar, it now falls on IEM (Malaysia) to hold the AFEO Chair and to host CAFEO 33 in 2015. The AFEO flag was handed over to IEM President Dato' Lim Chow Hock, marking the end of CAFEO 32.

IEM Penang Branch has been tasked to organise this event for CAFEO 33 which will be held in Penang, Malaysia. The Organising Chairman of CAFEO 33 is Immediate Past Branch Chairman Ir. Paul Por Chi Wei. Assisting him will be the current Penang Branch Chairman Ir. Dr Mui Kai Yin and his committee while IEM Standing Committee of Activities will be tasked to help in the co-ordination.

IEM Members & Other Malaysians singing the One Malaysia song at the Closing Ceremony

Invitations were extended to all participants from ASEAN and ASIA to CAFEO 33 which was expected to be held from 22nd to 26th November, 2015.

The night ended with lots of singing and dancing, marking the end of a very successful conference.

TECHNICAL VISITS

The host had kindly organised technical visits to various places of interests on Day 3, 13th November. These included Nyaung Done Bridge, Mini Hydro Power Improvement Project, Bago Division and Thaukyegat 120 MW Hydro Power Station.

Some sites took 3-8 hours of travelling time by coach and a total of 7 buses left for the various destinations.

Those who did not take part in these visits returned home while some stayed on for social tours and shopping in Yangon. Most delegates returned home on 14th November.

MYANMAR ENGINEERING SOCIETY, HOST OF CAFEO 32 AND ALL:

On behalf of AFEO, we wish to thank the government of the Republic of the Union of Myanmar for its support, through its relevant Ministries and Departments and agencies, in rendering all the assistance required for the success of CAFEO 32 in Yangon. This was also made possible by the good leadership, great effort and excellent work by the Myanmar Engineering Society led by Ir. U Win Khaing, its hardworking organising committee and other volunteer members.

We also wish to thank AFEO Heads of Delegations and delegates coming from far and near for their enthusiastic participation and the generous sponsors without whom CAFEO 32 would not have achieved such great success. Thank you very much. A Very Happy New Year 2015 to all. ■

INTRODUCTION TO

FLNG PROJECT DEVELOPMENT & FSRU TECHNOLOGY

Kuala Lumpur	Miri	Singapore
12-13 January (closed)	9-10 February	26-27 January (closed)
16-17 March	20-21 April	30-31 March
18-19 May	22-23 June	1-2 June

This course will provide participants with a broad understanding of the LNG industry, the LNG value chain, and an approach to FLNG (Floating Liquefied Natural Gas) field development planning. This includes a review of the fundamentals of naval architecture, hull design, and LNG containment systems for FLNG facilities. The course will also cover the marine engineering discipline, gas receiving, pre-treatment and liquefaction processes, offloading of LNG and regasification processes, operational challenges and technical risks, and financial and contracting strategies for FLNG and FSRU (Floating Storage & Regasification Unit) projects. Aspects of the Shell Prelude FLNG and PETRONAS PFLNG will be shared. The objective is to provide participants with a strategic overview covering both technical and commercial knowledge, which will enable participants to make informed decisions and help them in planning their respective FLNG and FSRU projects.

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Half-Day Seminar on Overview of Design & Construction of Deep Excavation & Tunnelling Projects in Singapore

TUNNELLING AND UNDERGROUND SPACE TECHNICAL DIVISION

By Ir. Dr Ooi Teik Aun

Ir. Dr Ooi Teik Aun *is the Founder Chairman of the IEM Tunnelling and Underground Space Technical Division and an Organizing Chairman of the International Conference & Exhibition 2015 (ICETUS2015. He is also the current Chairman of Dispute Resolution Practice (DRP) Subcommittee. He is an Advisor for Consulting Engineering Special Interest Group (CESIG). Ir. Dr Ooi is an Honorary Fellow of IEM, Fellow of the Malaysian Institute of Arbitrators and Past President and is ICE Country Representative for Malaysia. He is President of Southeast Asia Geotechnical Society (2010-2016).*

Visit to KVMRT Site on 25th July 2014

On 26th July 2014, the Tunnelling And Underground Space Technical Division (TUSTD) of IEM organised a half-day seminar on "Overview of Design & Construction of Deep Excavation and Tunneling Projects in Singapore" at Wisma IEM.

It attracted about 80 participants, including students from the ICE Student Chapter of University of Nottingham Malaysia Campus.

This seminar was made possible as the two speakers - Er. Dr Victor Ong Chee Wee and Er. David Ng Chew Chiat - made a

Er. David Ng delivering his lecture on deep excavation at the seminar

Er. Dr Victor Ong delivering his lecture on boring tunnelling at the seminar

Some of the participants in the auditorium

special trip to visit KVMRT in Kuala Lumpur a day earlier so that they could share their expertise and experience on the subject matter with members of IEM.

The speakers are consultants based in Singapore and are involved in the MRT projects in both Malaysia and Singapore.

They elaborated on the design and construction of deep excavation and bored tunnelling projects in Singapore. They stressed that the design and construction of bored tunnelling and temporary works for deep excavation rely on moderately conservative ground parameters, robust design solutions and close engineer's supervision to limit movements of both the temporary works system and surrounding ground or structures to within acceptable limits, which is particularly true when working in an urban environment.

Instrumentation results also need to be precise and accurate to enable the construction works to proceed in a controlled manner and the instrumentation layout needs to be designed with careful consideration of the excavation and each instrument located with a specific purpose.

The talk ended with an active Q&A session as well as interactive discussion on the various issues of design and construction of deep excavation and bored tunnelling. Certificates of appreciation as well as IEM heritage books were presented to Er. Dr Victor Ong and Er. David Ng at the end of the session. ■

THE FIRE ADVISORY BOARD (FAB) ANNOUNCEMENT

BOMBA CIRCULARS

Members at times find difficulties in getting the latest Bomba circulars which will have a major impact on the design of the fire fighting systems. In this respect, FAB has undertaken to provide all future circulars from Bomba and these circulars will be uploaded to the IEM website. Members are now able to check the latest Bomba circular under the heading of Publication. FAB is unable to compile all the previous circulars and will only upload the circulars which is available.

Thank you.

One-Day Course on Introduction to LiDAR Survey Technology

WOMEN ENGINEERS TECHNICAL DIVISION

By Ir. Raftah Mahfar

Ir. Raftah Mahfar *is currently a Director of SCG Consultants Sdn. Bhd., a Structural, Civil, Infrastructure, Geotechnical and Railway engineering Consultants.*

Ir. Raftah is active as Corporate Member of Institution of Engineers, Malaysia (IEM) and a Professional Interviewer for IEM's Professional Interview. She is the committee member of IEM Women Engineers from year 2008 and the Chairperson of IEM Women Engineers Sub-Committee for session 2012/2013. Presently, she was Chairman of IEM-WE Section for Session 2013/2014.

A one-day course on Introduction To LiDAR Survey Technology was organised by the IEM Woman Engineer section (IEM-WE) on 6th August, 2014, at Wisma IEM, Petaling Jaya. A total of 14 participants attended the course.

The course was conducted by Engr. Trudy R. Ganendra, who had successfully completed over 60 LiDAR projects in different applications at national and international levels. She is the Managing Director of Ground Data Solution R&D Sdn. Bhd. (GDS), a Malaysian high-tech mapping and surveying service provider, specialising in airborne LiDAR survey.

First, she introduced LiDAR survey technology. LiDAR is formally known as Light Detection And Ranging, a laser mapping technique in which laser pulses are emitted towards the surface and the time for their return is measured. There are five types of LiDAR data: Airborne LiDAR, Bathymetric LiDAR, Terrestrial Mobile & Fixed LiDAR, Handheld LiDAR and Waveform LiDAR.

LiDAR data consist of three main components – Global Positioning System (GPS), Inertial Measurement Unit (IMU), and Laser Scanner. Processing the data from these 3 sensors together generates 3D "point cloud" of the mapped area. Each of the component details is listed in the Table 1 below:

Table 1: Main components of LiDAR data

GPS	Used to precisely locate the position of the scanner during the measurement
IMU	Measure the angular changes thereby allowing the analyst to determine the orientation of the scanner
Laser Scanner	Using accurate timing, the distance to the featured can be measured

During laser scanning, laser pulses are directed towards the ground, usually by a movable reflecting surface (mirror) which orients the individual pulses into a scanning swath.

There are two primary styles of scanning, namely Rectilinear (even spacing) and Galvanometric (sinusoidal) as well as another less prevalent style, Orbital (circular).

The details of both primary styles are listed below:

Table 2: Details of two primary scanners

Linear Scanners	Galvanometer Scanners
Use multiple mirror faces	Use single mirror
Rectilinear point spacing with easy mechanics	Adjustable swath width
Improved surface triangulation geometry	High pulse utilisation
Eg. Riegl scanner	Eg. Optech scanner
Easier analysis due to even spacing	Less easy analysis

The LiDAR survey procedure started with system calibration and ended with final deliverables (Figure 1 below):

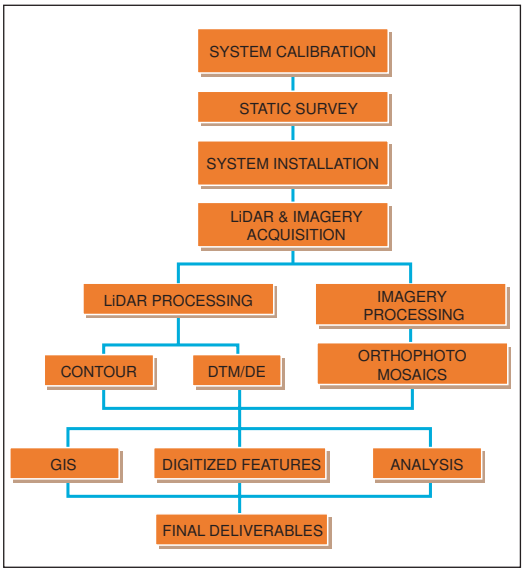

Figure 1: LiDAR survey procedure

Ms. Trudy further explain that LiDAR survey is cost effective for medium to large mapping area/corridor, fast data collection, has negligible impact on the environment, cloud free imagery, robust against weather conditions, accurate measurement in dense forest and steep terrain, independent of sun angle and acquisition based on accurate GPS network. For Airborne LiDAR survey, data acquisition using manned aircraft, will produce good, quality LiDAR data and imagery compared to using Unmanned Aerial Vehicle (UAV).

Table 3: Comparison between manned aircraft and UAV

Manned Aircraft	UAV
More cost effective for large areas (>10km)	Cost effective for small area (>1 km)
Able to fly in much more challenging terrain and weather condition	Not applicable for urban area with high rise building or challenging terrain and weather conditions
Long flight time	Short flight time compared to the manned aircraft
Able to fly in most airspaces	Highly dependent on civil aviation authority approval
	Ability to fly very low altitudes

LiDAR survey is suitable for engineering purposes as it offers detailed and accurate topography survey even in challenging terrain. Some applications of LiDAR data arelisted in the Table 4 below:

Table 4: LiDAR survey application

Infrastructure/ Engineering:	• Road/Railway/ Pipeline • Transmission line • Dam survey
Environment / Disaster	• Flood Mapping • Slope Mapping • Telecommunication & Urban Planning
Natural Resources	• Forest / Agriculture • Water catchment • Mine Site

In the 2nd session of the workshop, Ms. Trudy gave an introduction to the LiDAR processing software normally used by the LiDAR provider. These are Microstation with TerraScan and TerraModeler tools and MARS Viewer - a LiDAR freeware. The software is used to read, view and edit LiDAR points, to classify LiDAR points, surfacing, contouring and can easily handle tens of millions of points with optimum performance.

Microstation is a CAD software product for 2D and 3D dimensional design and drafting works. Microstation offers a robust sub system for consistent integration of geometry and LiDAR data.

TerraScan and TerraModelerare dedicated software solutions for processing laser-scanning points and creating

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Photo 1: Group photo

Photo 2: Ms. Trudy talking about LiDAR survey technology data

fully-featured terrain models. The MARS viewer is user-friendly freeware software which has a viewing application, support basic LiDAR data navigation and 3D visualisation for casual users. With MARS viewer software, we can read LiDAR point cloud, orthophoto image, view point cloud in different modes, 3D and profiling.

Ms. Trudy also shared her experience in utilising LiDAR data by using Power Line System – Computer Aided Design and Drafting (PLS-CADD) software for new transmission route alignment design and Modelling of Surface with String (MOSS)/MX software for civil engineering works.

During the hands-on session, GDS staff assisted participants in exploring LiDAR point cloud data using Microstation andfreeware software. They were guided in these procedures:

- Reading the point cloud and orthophoto image
- Viewing LiDAR data in different modes, 3D visualisation and view point cloud profile
- Measuring point density for all points including ground points, checking vertical accuracy, check point spacing and pixel resolution calculation.

The course ended with a note of appreciation from the organiser to Miss Trudy, followed by taking of photographs of all participants and organiser. ■

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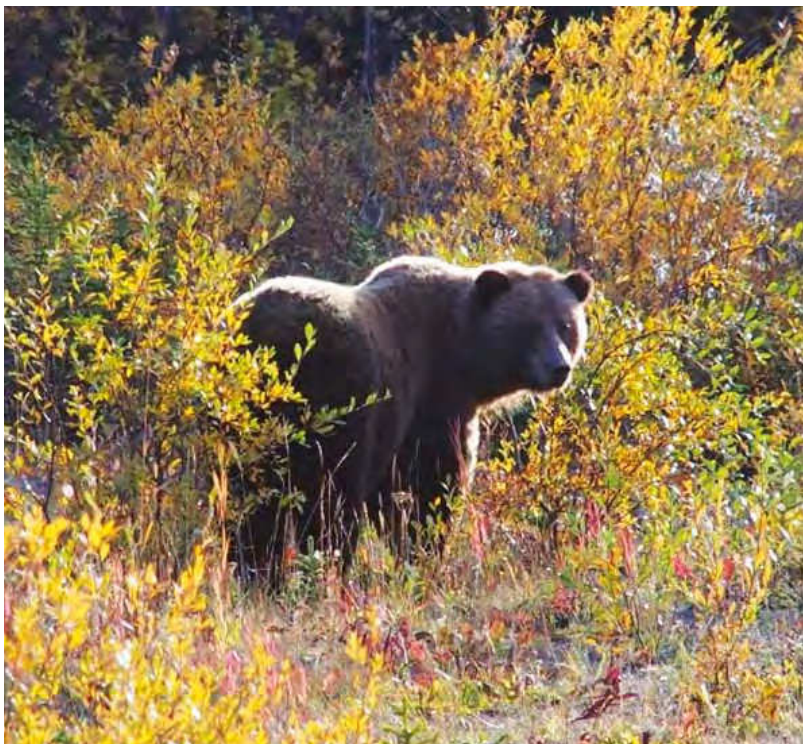
Close Encounter of the Grizzly Kind



Ir. Chin Mee Poon
www.facebook.com/chinmeepoon

Ir. Chin Mee Poon *is a retired civil engineer who derives a great deal of joy and satisfaction from travelling to different parts of the globe, capturing fascinating insights of the places and people he encounters and sharing his experiences with others through his photographs and writing.*

On the 10th day of our trip in Alaska, our ferry M/V Malaspina docked at the ferry terminal in Skagway, a small town nestled at the northern end of the Inside Passage in southeast Alaska.

We started our voyage up the Inside Passage from Bellingham in Washington State of USA andmade overnight stops in Ketchikan, Wrangell, Petersburg and Juneau.

Like our earlier stops, Skagway was also a lovely place to spend a day or two in, but to get to the rest of Alaska from here, we would have to travel overland as the ferry service linking southeast Alaska with south-central Alaska was not available in September. In fact, even public buses stopped running at this time due to lack of demand, so we would have to drive.

Fortunately there was a car-rental company in Skagway and the drive from Skagway to Fairbanks in central Alaska via Whitehorse in the Yukon Territory of Canada turned out to be a very pleasant one for several reasons – the roads were generally in very good condition, traffic was very light, many sections of the road passed through spectacular scenery and we did not encounter any inclement weather.

My wife and I took turns to drive. When my wife was at the wheel, I was able to capture the beautiful scenery with my camera without having to stop the car. The drive from Skagway to Whitehorse was particularly enjoyable as the full splendor of autumn colourscould be seen along most of the way. We frequently stopped our car to take in the view.

As if that was not enough to quench our appetite for nature's beauty, we had the extremely good fortune to run into a mother grizzly bear and her two cubs. That rare encounter was really the icing on the cake for us.

The encounter took place when we were on our way to Whitehorse. We were attracted by the sight of a few cars which had pulled over to the side of the otherwise quite deserted road. Experience told us that the motorists must have been attracted by something interesting at the side of the road.

Sure enough, as we joined the motorists, we saw a mother grizzly bear and her two cubs busy eating berries. We thanked our lucky stars for having come to the right place at the right time as just a few minutes later, the bears had eaten their fill of berries and promptly disappeared into the forest. Motorists who arrived at the scene a few minutes after us, were disappointed.

In Alaska, there are three species of bears: Brown, black and polar. Grizzly bears are a subspecies of the brown bear. They are found inland and subsist largely on grass, whereas brown bears are found along the coast and are larger in size than grizzlies because of the abundance of salmon in their territory. ■

TEMUDUGA PROFESSIONAL

Tarikh: 12 January 2015

To All Members,

SENARAI CALON-CALON YANG LAYAK MENDUDUKI TEMUDUGA PROFESIONAL TAHUN 2015

Berikut adalah senarai calon yang layak untuk menduduki Temuduga Profesional bagi tahun 2015.

Mengikut Undang-Undang Kecil IEM, Seksyen 3.9, nama-nama seperti tersenarai berikut diterbitkan sebagai calon-calon yang layak untuk menjadi Ahli Institusi, dengan syarat bahawa mereka lulus Temuduga Profesional tahun 2015.

Sekiranya terdapat Ahli Korporat yang mempunyai bantahan terhadap mana-mana calon yang didapati tidak sesuai untuk menduduki Temuduga Profesional, surat bantahan boleh dikemukakan kepada Setiausaha Kehormat, IEM. Surat bantahan hendaklah dikemukakan sebulan dari tarikh penerbitan dikeluarkan.

Ir. Gunasagaran Kristnan
Setiausaha Kehormat, IEM,

PERMOHONAN BARU

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54003	TAN WEI HOW	BE HONS (USM) (ELECTRICAL, 2004)
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(The donation list to the Wisma IEM Building Fund is published on page 21)

Note: *This is a continuation of the list which was first published on page 47 of the January 2015 issue.*

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68280	KWONG JUN YE	1ST YEAR(UTHM) (ELECTRONIC)
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68505	LEE WEI HANG	1ST YEAR(MONAS) (ELECTRONIC)
68447	LEE WENG PHANG	1ST YEAR(UTAR) (ELECTRONIC)
67043	LIM CHUN MING	1ST YEAR(USM) (ELECTRONIC)
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68282	MOHAMAD AMIRUDDEN B. MOHD TAHIR	1ST YEAR(UTHM) (ELECTRONIC)
67048	MOHAMAD AMIRUL B. ZAKARIA	1ST YEAR(USM) (ELECTRONIC)
68283	MOHAMAD ARIFF FAIZAL B. ZAINAL ABIDIN	1ST YEAR(UTHM) (ELECTRONIC)
68284	MOHAMAD FADZIL B. ABDUL LATIB	1ST YEAR(UTHM) (ELECTRONIC)
68831	MOHAMAD FARIDUDDIN B. IBRAHIM	1ST YEAR(UTHM) (ELECTRONIC)
67049	MOHAMAD HAFIS HAFIZE B. YUSRI	1ST YEAR(USM) (ELECTRONIC)
68285	MOHAMAD NAZRI B. MOHAMAD SALEH	1ST YEAR(UTHM) (ELECTRONIC)
68286	MOHAMAD NOR IZAKI B. SUDARMAN	1ST YEAR(UTHM) (ELECTRONIC)
68287	MOHAMAD NURAZMI B. AB RAMAN	1ST YEAR(UTHM) (ELECTRONIC)
68288	MOHAMAD SYARIF B. MOHD ZIN	1ST YEAR(UTHM) (ELECTRONIC)
68832	MOHAMED SHAHREL NEZAM B. HUSSIN	1ST YEAR(UTHM) (ELECTRONIC)
68289	MOHAMMAD ADZLAN DANISH B. ADAM	1ST YEAR(UTHM) (ELECTRONIC)
68290	MOHAMMAD HAIRUM B. HASNAN	1ST YEAR(UTHM) (ELECTRONIC)
68833	MOHAMMAD HAKIM B. MAHADI	1ST YEAR(UTHM) (ELECTRONIC)
68291	MOHAMMAD NASHRUL B. MAT DESA	1ST YEAR(UTHM) (ELECTRONIC)
68292	MOHAMMAD NAZRI B. ROSLI	1ST YEAR(UTHM) (ELECTRONIC)
68293	MOHAMMAD ZAKI B. ABDUL RAHMAN	1ST YEAR(UTHM) (ELECTRONIC)
68294	MOHAMMAD ZULKIFLI B. ADZIZ	1ST YEAR(UTHM) (ELECTRONIC)
68295	MOHAMMED IKHWAN B. AHMAD HANAFIAH	1ST YEAR(UTHM) (ELECTRONIC)
68296	MOHD ABUNIDAL B. SABDAL MUNLISI	1ST YEAR(UTHM) (ELECTRONIC)
68297	MOHD AMAN B. MD SUHUD	1ST YEAR(UTHM) (ELECTRONIC)
68298	MOHD AZRIN B. MD. DISA	1ST YEAR(UTHM) (ELECTRONIC)
68299	MOHD FAKHRURAZI B. MUDA	1ST YEAR(UTHM) (ELECTRONIC)
68300	MOHD FAQIH HILMI B. MOHD JALANI	1ST YEAR(UTHM) (ELECTRONIC)
68834	MOHD FIRDAUS B. MAZLAN	1ST YEAR(UTHM) (ELECTRONIC)
68301	MOHD HILMI B. OMAR@MANSOR	1ST YEAR(UTHM) (ELECTRONIC)
68302	MOHD KHAIRUL HIZAM B. MOHD ISA	1ST YEAR(UTHM) (ELECTRONIC)
68303	MOHD ZAKI B. ROHAIZAD	1ST YEAR(UTHM) (ELECTRONIC)
68304	MUHAMAD HAMIZAN B. MOHTAMIN	1ST YEAR(UTHM) (ELECTRONIC)
68305	MUHAMAD HAZIM FITRI B. MAZLAN	1ST YEAR(UTHM) (ELECTRONIC)
68306	MUHAMAD IRFAN B. SANIF	1ST YEAR(UTHM) (ELECTRONIC)
68307	MUHAMAD NURSYAMZAREE B. ABDUL RAZAK	1ST YEAR(UTHM) (ELECTRONIC)
68308	MUHAMAD SHAHRUL ZARIF B. MOHD SALIM	1ST YEAR(UTHM) (ELECTRONIC)
68309	MUHAMAD ZAIN B. MUHAMAD ZAIM	1ST YEAR(UTHM) (ELECTRONIC)
68310	MUHAMAD ZAKRI B. KAMARULAKHIR	1ST YEAR(UTHM) (ELECTRONIC)
68311	MUHAMAD ZULHUSNI B. OTHMAN	1ST YEAR(UTHM) (ELECTRONIC)
68312	MUHAMMAD AFHAM B. MOHAMAD	1ST YEAR(UTHM) (ELECTRONIC)
68313	MUHAMMAD AFIQ B. ABD RASHID	1ST YEAR(UTHM) (ELECTRONIC)
68314	MUHAMMAD AMZAR B. KHALID	1ST YEAR(UTHM) (ELECTRONIC)
68315	MUHAMMAD ASHRAF HAFIFIE B. SHAARI	1ST YEAR(UTHM) (ELECTRONIC)
68316	MUHAMMAD ASRAF WAJEDEE B. MD NOOR	1ST YEAR(UTHM) (ELECTRONIC)
68317	MUHAMMAD ASYRAF B. ISHAK	1ST YEAR(UTHM) (ELECTRONIC)
68318	MUHAMMAD AZHAR B. JAAFAR	1ST YEAR(UTHM) (ELECTRONIC)
68319	MUHAMMAD AZMI B. MAZLAN	1ST YEAR(UTHM) (ELECTRONIC)
68320	MUHAMMAD HAFIZ B. YUSOF	1ST YEAR(UTHM) (ELECTRONIC)
68321	MUHAMMAD HAFIZUDDIN B. RAMLAN	1ST YEAR(UTHM) (ELECTRONIC)
68835	MUHAMMAD HANIFF B. S.M JOHAN	1ST YEAR(UTHM) (ELECTRONIC)
68322	MUHAMMAD HARIZ B. MOHD SHARIF	1ST YEAR(UTHM) (ELECTRONIC)
68323	MUHAMMAD IDZWAN B. LAILI	1ST YEAR(UTHM) (ELECTRONIC)
68324	MUHAMMAD KHAIRIN B. MOHD TAIB	1ST YEAR(UTHM) (ELECTRONIC)
68325	MUHAMMAD NAZREN B. MD MUHSIN	1ST YEAR(UTHM) (ELECTRONIC)
68326	MUHAMMAD SAFWAN B. CHE NAN	1ST YEAR(UTHM) (ELECTRONIC)
68327	MUHAMMAD SHAZWAN B. AMZAH	1ST YEAR(UTHM) (ELECTRONIC)
68328	MUHAMMAD SUKRI B. ZULKIFLI	1ST YEAR(UTHM) (ELECTRONIC)
68329	MUHAMMAD SYAMIM B. SHAMSUDDIN	1ST YEAR(UTHM) (ELECTRONIC)
68330	MUHD NASYRIL B. AHZEMI	1ST YEAR(UTHM) (ELECTRONIC)
68331	NAIMAH BT. JALALUD-DIN SAIUFI	1ST YEAR(UTHM) (ELECTRONIC)
67050	NAZRIN B. MOHD RAFIDI	1ST YEAR(USM) (ELECTRONIC)
67051	NG KEN HOE	1ST YEAR(USM) (ELECTRONIC)
68508	NG LI LOK	1ST YEAR(MONAS) (ELECTRONIC)
68509	NGEW CHUAN TEE	1ST YEAR(MONAS) (ELECTRONIC)
68048	NOOR FAIZAH BT. MD.YUSOF	4TH YEAR(UTHM) (ELECTRONIC))
68332	NOOR MAZLIZA BT. BADRUL SHAM	1ST YEAR(UTHM) (ELECTRONIC)
68333	NOOR SHAFIQAH BT. MOHAMMAD KHAWARI	1ST YEAR(UTHM) (ELECTRONIC)
68334	NOORFAIEZAH BT. IDRIS	1ST YEAR(UTHM) (ELECTRONIC)
68335	NOORLYANA BT. DAMIRI	1ST YEAR(UTHM) (ELECTRONIC)
68336	NOR AILNI HALIDAH BT. MA'ROP	1ST YEAR(UTHM) (ELECTRONIC)
68337	NORADILAH BT. MOHAMED	1ST YEAR(UTHM) (ELECTRONIC)
68049	NORAKMA BT. MOHD YAMAN	4TH YEAR(UTHM) (ELECTRONIC))
68338	NORHAFIZAH BT. ZAKARIA	1ST YEAR(UTHM) (ELECTRONIC)
68339	NORIDAYU BT. BAZID	1ST YEAR(UTHM) (ELECTRONIC)
68050	NUR AMIDATUL IMA BT. IBRAHIM	4TH YEAR(UTHM) (ELECTRONIC))
68340	NUR ATIEQAH NATASHA BT. ROSLAN	1ST YEAR(UTHM) (ELECTRONIC)
68836	NUR ATINA BT. MOHAMAD RAZALI	1ST YEAR(UTHM) (ELECTRONIC)
68341	NUR ATIQAH BT. MD YAZID	1ST YEAR(UTHM) (ELECTRONIC)
68342	NUR AZZAH NADIAH BT. MOHD HANAFIAH	1ST YEAR(UTHM) (ELECTRONIC)
68343	NUR FARHANA BT. MOHD JUBER	1ST YEAR(UTHM) (ELECTRONIC)
68344	NUR FARINA BT. ABD HALIM	1ST YEAR(UTHM) (ELECTRONIC)
68345	NUR FATIHAH BT. MOHD DAUD	1ST YEAR(UTHM) (ELECTRONIC)
68346	NUR FATIN NABIHAH BT. MOHD ZAIDI	1ST YEAR(UTHM) (ELECTRONIC)
68347	NUR FIFI ASSILA BT. RUSLAN	1ST YEAR(UTHM) (ELECTRONIC)
68348	NUR IZZATI BT. RAMLI	1ST YEAR(UTHM) (ELECTRONIC)
68349	NUR LIYANA BT. RAZALI	1ST YEAR(UTHM) (ELECTRONIC)
67052	NUR MUSYAHADAH BT. AZIZUDDIN	1ST YEAR(USM) (ELECTRONIC)
68350	NUR ZEHAN AN'NISA BT. MD SHAH	1ST YEAR(UTHM) (ELECTRONIC)
68051	NUR ZURIKA BT. MUHAMAD	4TH YEAR(UTHM) (ELECTRONIC))
68351	NURAIN FADHILAH BT. BEDU PATTA	1ST YEAR(UTHM) (ELECTRONIC)
68352	NURAZLINA BT. MOHD MAHYUDIN	1ST YEAR(UTHM) (ELECTRONIC)
68353	NURHANISAH BT. ZULKIFLI	1ST YEAR(UTHM) (ELECTRONIC)
68354	NURLIYANA BT. ZULFIFLEE	1ST YEAR(UTHM) (ELECTRONIC)
68355	NURNAZTULHIDAYAH BT. OTHMAN	1ST YEAR(UTHM) (ELECTRONIC)
68356	NURSAFIRAH BT. ABDUL RAZAK	1ST YEAR(UTHM) (ELECTRONIC)
68357	NURUL AIDATUL AISYQIN BT. MOHD FAHMY	1ST YEAR(UTHM) (ELECTRONIC)
68358	NURUL AMALLIANA BT. JAIS	1ST YEAR(UTHM) (ELECTRONIC)
68359	NURUL ANISA BT. AWALUDDIN	1ST YEAR(UTHM) (ELECTRONIC)
68360	NURUL MUNIRAH BT. ARIFIN	1ST YEAR(UTHM) (ELECTRONIC)
68361	NURUL NASUHA BT. MOHD AZAHARI	1ST YEAR(UTHM) (ELECTRONIC)
68052	NURUL NATASHA BT. HASHIM	4TH YEAR(UTHM) (ELECTRONIC))
68362	NURUL SYAFIQAH BT. ABD RAHIM	1ST YEAR(UTHM) (ELECTRONIC)
68363	NURUL SYAZWANI BT. MOHD ROSLI	1ST YEAR(UTHM) (ELECTRONIC)
68364	NURULWAHMI BT. ABU	1ST YEAR(UTHM) (ELECTRONIC)
67053	OH HAI SENG	1ST YEAR(USM) (ELECTRONIC)
68449	ONG YEW FAI	1ST YEAR(UTAR) (ELECTRONIC)

KEAHLIAN

67054	OOI CHOK DONG	1ST YEAR(USM) (ELECTRONIC)
68365	PANG JIA SHIM	1ST YEAR(UTHM) (ELECTRONIC)
68510	PANG WENG YEONG	1ST YEAR(MONAS) (ELECTRONIC)
68366	PAVITRAN A/L MUNIANDY	1ST YEAR(UTHM) (ELECTRONIC)
68367	RAIMI FARHAN B. RAMLEE	1ST YEAR(UTHM) (ELECTRONIC)
68837	RATHY -SHRY A/P VELOO	1ST YEAR(UTHM) (ELECTRONIC)
68368	SATHIASEELAN A/L MUTHAIAH	1ST YEAR(UTHM) (ELECTRONIC)
68369	SENG WEIL YEN	1ST YEAR(UTHM) (ELECTRONIC)
68370	SHAFIE B. AWANG RAHIM	1ST YEAR(UTHM) (ELECTRONIC)
68371	SHAH RIDZWAN B. SAHROM	1ST YEAR(UTHM) (ELECTRONIC)
68511	SHAK JIAN MENG, KELVIN	1ST YEAR(MONAS) (ELECTRONIC)
68372	SHAKIRAH BT. YATIM	1ST YEAR(UTHM) (ELECTRONIC)
67055	SIM CHOON YEE	1ST YEAR(USM) (ELECTRONIC)
68373	SITI HAJARUL HANIM FATIMAH BT. ROSLI	1ST YEAR(UTHM) (ELECTRONIC)
67056	SOONG XING ERN	1ST YEAR(USM) (ELECTRONIC)
68374	SULAIMAN B. MAZLAN	1ST YEAR(UTHM) (ELECTRONIC)
68375	SUZIEAWA BT. JUSTINE	1ST YEAR(UTHM) (ELECTRONIC)
68053	SYUZILLA BT. ABDUL RAHMAN	4TH YEAR(UTHM) (ELECTRONIC))
67057	TAN KER LEE	1ST YEAR(USM) (ELECTRONIC)
68512	TAN KWONG YEW	1ST YEAR(MONAS) (ELECTRONIC)
67058	TAN WEI JUN	1ST YEAR(USM) (ELECTRONIC)
68376	TAN YING YIN	1ST YEAR(UTHM) (ELECTRONIC)
67059	TANG BAO YAN	1ST YEAR(USM) (ELECTRONIC)
68377	TENGKU AHMAD KHAIREE B. TG MOHD ARIFFIN	1ST YEAR(UTHM) (ELECTRONIC)
68513	THE YI SHENG, BENNY	1ST YEAR(MONAS) (ELECTRONIC)
67060	TIONG RENG XIAN	1ST YEAR(USM) (ELECTRONIC)
68378	TUAN MIRA ELIZA BT. TUAN ZIN	1ST YEAR(UTHM) (ELECTRONIC)
68379	UMI KALSUM BT. MOHAMAD	1ST YEAR(UTHM) (ELECTRONIC)
68380	WAN MUHAMMAD ADZRI AZAHARI B. WAN ADZMI	1ST YEAR(UTHM) (ELECTRONIC)
68381	WAN MUHAMMAD AZLAN B. W MAHMUD	1ST YEAR(UTHM) (ELECTRONIC)
67061	WAN NURNBILAH BT. ZAHARIM	1ST YEAR(USM) (ELECTRONIC)
68382	WAN NURUL NABIHAH BT. WAN SHUHAIMI	1ST YEAR(UTHM) (ELECTRONIC)
67062	WONG KWO YIANG	1ST YEAR(USM) (ELECTRONIC)
68450	WONG WEI YAO	1ST YEAR(UTAR) (ELECTRONIC)
68451	WOON XUET YEN	1ST YEAR(UTAR) (ELECTRONIC)
68452	YEO WEI LONG	1ST YEAR(UTAR) (ELECTRONIC)
68383	YUSWAN B. YAHYA	1ST YEAR(UTHM) (ELECTRONIC)
68384	ZULFA HUSNA BT. HUSSIN	1ST YEAR(UTHM) (ELECTRONIC)
68385	ZURAIRAH BT. AWANG	1ST YEAR(UTHM) (ELECTRONIC)
68535	ABD MAJID B. SYLVIA	1ST YEAR(UMS)(CHEMICAL)
67172	ABDUL FAIZ SAIFUL B. ABD RAZAK	2ND YEAR(UITM)(CHEMICAL)
67173	ABDUL MUAZ B. IDERIS	2ND YEAR(UITM)(CHEMICAL)
67174	ADDY HELMY B. OMAR	2ND YEAR(UITM)(CHEMICAL)
68536	ADELISA SENTIKA ANAK JUKA	1ST YEAR(UMS)(CHEMICAL)
67175	ADHWADIN B. MOHAMMAD	2ND YEAR(UITM)(CHEMICAL)
67176	ADIENA AMIEZLYN BT. MOHD SHUKRY	2ND YEAR(UITM)(CHEMICAL)
70884	AFIQAH BINTI YEOP	4TH YEAR(UMP)(CHEMICAL)
71035	AHMAD FAIZ B ABDULLAH	1ST YEAR(UTP)(CHEMICAL)
71022	AHMAD FARHAN BIN AHMAD AZHAR	1ST YEAR(UTP)(CHEMICAL)
71069	AHMAD FARIDUDDIN BIN AB.HAMID	3RD YEAR(UTP)(CHEMICAL)
67177	AHMAD FARIS B. ALI BADERUDIN	2ND YEAR(UITM)(CHEMICAL)
67178	AHMAD HAFIZIE B. ZAINI	2ND YEAR(UITM)(CHEMICAL)
67179	AHMAD HAIQAL B. ABDULLAH	2ND YEAR(UITM)(CHEMICAL)
67180	AHMAD NAQIB B. RAHMAT	2ND YEAR(UITM)(CHEMICAL)
67181	AHMAD PUTRA B. MOHD MASIR	2ND YEAR(UITM)(CHEMICAL)
67182	AHMAD TAUFIK B. ARIFFIN	2ND YEAR(UITM)(CHEMICAL)
67183	AHMAD ZAKI B. MOHD SUHUD	2ND YEAR(UITM)(CHEMICAL)
67184	AIMAN B. ZAWAWI	2ND YEAR(UITM)(CHEMICAL)
67185	AIN MUNIRAH BT. AHMAD	2ND YEAR(UITM)(CHEMICAL)
67186	AIN NADHIRAH BT. AHMAD SAZLI	2ND YEAR(UITM)(CHEMICAL)
70882	AIN ZUHAILI BINTI MOHD SALEHEN	2ND YEAR(UMP)(CHEMICAL)
68537	AISHATUL FARHAH BT. MOHD KHIRULTHZAM	1ST YEAR(UMS)(CHEMICAL)
67187	ALEXION DATU ANAK BRANDAH	2ND YEAR(UITM)(CHEMICAL)
67188	ALI IMRAN ZULKIFLI	2ND YEAR(UITM)(CHEMICAL)
67189	AMEERUDDIN B. ASA-ARI	2ND YEAR(UITM)(CHEMICAL)
67190	AMIRUL HAKIM B. MAT AZAHAR	2ND YEAR(UITM)(CHEMICAL)
67191	ANIDA SUHISZUWAN BT. AJRI	2ND YEAR(UITM)(CHEMICAL)
67192	ASIYAH SYAFIQHA BT. MOHAMAD HAMDAN	2ND YEAR(UITM)(CHEMICAL)
71074	AZHAR BIN ZAWAWI	2ND YEAR(UTP)(CHEMICAL)
67193	AZIMA BT. ZAMRI	2ND YEAR(UITM)(CHEMICAL)
67194	AZREEN BT. CHE HILLMIN	2ND YEAR(UITM)(CHEMICAL)
67195	AZREEN ELYANI BT. ROSLAN	2ND YEAR(UITM)(CHEMICAL)
67196	AZUANI BT. MUSA	2ND YEAR(UITM)(CHEMICAL)
67197	AZWAN B. MAKMUR	2ND YEAR(UITM)(CHEMICAL)
67198	BASIL GIRI DAVIS	2ND YEAR(UITM)(CHEMICAL)
67199	BERNADINE BUNGAN SALO	2ND YEAR(UITM)(CHEMICAL)
67200	BRYAN ALBERT SIGAU	2ND YEAR(UITM)(CHEMICAL)
71028	BRYAN TEE HWANG CHUNG	1ST YEAR(UTP)(CHEMICAL)
68458	CHAI CHOON THYE	1ST YEAR(MONASH) (CHEMICAL)
68459	CHAW KHAI JIE	1ST YEAR(MONASH) (CHEMICAL)
68062	CHEAH KHAI CHUN	1ST YEAR(UTAR)(CHEMICAL)
68538	CHEARWIN KENLEY KENNY	1ST YEAR(UMS)(CHEMICAL)
71066	CHEW LI EAN	2ND YEAR(UTP)(CHEMICAL)
68460	CHIA YOONG JIAN, DARREN	1ST YEAR(MONASH) (CHEMICAL)
68539	CHIENG CHING HANG	1ST YEAR(UMS)(CHEMICAL)
68386	CHIN IUN HAO	3RD YEAR(UMP)(CHEMICAL)
68540	CHONG KAI CHERN	1ST YEAR(UMS)(CHEMICAL)
68541	CHOO KENN	1ST YEAR(UMS)(CHEMICAL)
68542	COREZZA ADELE CHIN	1ST YEAR(UMS)(CHEMICAL)
68543	DANIAL B. ALFRED	1ST YEAR(UMS)(CHEMICAL)
67201	DG NUR ZILAH HASSILAH AG KACHEE	2ND YEAR(UITM)(CHEMICAL)
68063	DHIVIYAN A/L JANARDHARAN	1ST YEAR(UTAR)(CHEMICAL)
68461	DURKHA SANTHINEE A/P NAGESPERAN	1ST YEAR(MONASH) (CHEMICAL)
71036	EIN KYIN NYUIVT	1ST YEAR(UTP)(CHEMICAL)
68544	ELPHIDEA PAULUS	1ST YEAR(UMS)(CHEMICAL)
68545	ELYANA NAUMI AMBU	1ST YEAR(UMS)(CHEMICAL)
67202	ENITH ANAK AUSTIN	2ND YEAR(UITM)(CHEMICAL)
67203	EVELYN SEBI ANAK KEMARAU	2ND YEAR(UITM)(CHEMICAL)
67204	EZANI HAFIZA BT. ROSHDI	2ND YEAR(UITM)(CHEMICAL)
67205	FAIZRUL AMRI B. IBRAHIM	2ND YEAR(UITM)(CHEMICAL)
67206	FAMEZA BT. REHAN	2ND YEAR(UITM)(CHEMICAL)
67207	FARAH BT. JAMALUDDIN	2ND YEAR(UITM)(CHEMICAL)
67208	FARAHANNA BT. MD AKHIR	2ND YEAR(UITM)(CHEMICAL)
68546	FARRAH FRITDA ROSSA BT. ADNAN	1ST YEAR(UMS)(CHEMICAL)
71068	FATEN FARAHIN BINTI SHIHAFUDDIN	2ND YEAR(UTP)(CHEMICAL)
68547	FATIN FAZIRA BT. CHE DAUD	1ST YEAR(UMS)(CHEMICAL)
67209	FATIN HAFIZAH BT. MOHAMAD YUSOP	2ND YEAR(UITM)(CHEMICAL)
68548	FATIN NABILA BT. ISHAK HISHAM	1ST YEAR(UMS)(CHEMICAL)
67210	FATIN NABILAH BT. SUHAIMI	2ND YEAR(UITM)(CHEMICAL)
67211	FATIN NADRAH BT. RAMLI	2ND YEAR(UITM)(CHEMICAL)
68549	FAYSLEY JOCA JOLDIN	1ST YEAR(UMS)(CHEMICAL)
68550	FAZLIN SUZLIYANA BT. ABDUL SALIM	1ST YEAR(UMS)(CHEMICAL)
68462	GAN YI FENG	1ST YEAR(MONASH) (CHEMICAL)
68551	GOH CHUN JIE	1ST YEAR(UMS)(CHEMICAL)
68387	GOH ZHAN RONG	3RD YEAR(UMP)(CHEMICAL)
66969	GOPINATHAN A/L SUBRAMANIAM	1ST YEAR(USM)(CHEMICAL)
67212	HAFIZZUDDIN B. OTHMAN	2ND YEAR(UITM)(CHEMICAL)
67213	HASNIZAH BT. HABIBUN	2ND YEAR(UITM)(CHEMICAL)
67214	HAZIMAH BT. MADZAKI	2ND YEAR(UITM)(CHEMICAL)
67215	HEIKAL HAYAT B. MOHD AZMI	2ND YEAR(UITM)(CHEMICAL)
68552	HENG SIEW YEE	1ST YEAR(UMS)(CHEMICAL)
67216	HUMAIRA BT. ROSLELI	2ND YEAR(UITM)(CHEMICAL)
67217	IKMAL HAFIS B. SHAMSUDIN	2ND YEAR(UITM)(CHEMICAL)
68553	ILANCHELVI A/P KUMAR	1ST YEAR(UMS)(CHEMICAL)
67218	ISMADI IRWAN B. ISMAIL	2ND YEAR(UITM)(CHEMICAL)
71020	ISWARYA	1ST YEAR(UTP)(CHEMICAL)
67219	IZATHUL SHAFINA BT. SIDEK	2ND YEAR(UITM)(CHEMICAL)
68554	JESSIECA SIMARA	1ST YEAR(UMS)(CHEMICAL)
68555	JOHNSON KIU	1ST YEAR(UMS)(CHEMICAL)
68556	JOVANNEY JAIBET	1ST YEAR(UMS)(CHEMICAL)
67220	KAMAL ZAKI B. GAHAZALI	2ND YEAR(UITM)(CHEMICAL)
67221	KARTINA BT. EMBONG	2ND YEAR(UITM)(CHEMICAL)
68388	KAU WEI CHI	3RD YEAR(UMP)(CHEMICAL)
71026	KEESON KON	1ST YEAR(UTP)(CHEMICAL)
71025	KESHVEENI KUANASEALAN	2ND YEAR(UTP)(CHEMICAL)
67222	KHAIROTONNAZRAH BT. SUHUT	2ND YEAR(UITM)(CHEMICAL)
67223	KHAIRUL ANUAR B. AHMAD ZAMIL	2ND YEAR(UITM)(CHEMICAL)
67224	KHAIRULADHA B. BORHANUDIN	2ND YEAR(UITM)(CHEMICAL)
67225	KHAIRUN NISA BT. AZMAN	2ND YEAR(UITM)(CHEMICAL)
67226	KHAIRUNNISA KAMAR SHAH	2ND YEAR(UITM)(CHEMICAL)
66970	KISHOR KUMAR A/L A. MURUGAN	1ST YEAR(USM)(CHEMICAL)
71030	KOI ZI KANG	1ST YEAR(UTP)(CHEMICAL)
68557	KUOK MEI ERH, ANGEL	1ST YEAR(UMS)(CHEMICAL)
68463	LAI GHIN YEE	1ST YEAR(MONASH) (CHEMICAL)
68389	LAI YEN YI	3RD YEAR(UMP)(CHEMICAL)
71027	LAW ZI JUN	1ST YEAR(UTP)(CHEMICAL)
68558	LEA VITALIS	1ST YEAR(UMS)(CHEMICAL)
68464	LEE CHIA CHEAN	1ST YEAR(MONASH) (CHEMICAL)
68465	LEE CHIA PING, DANIEL	1ST YEAR(MONASH) (CHEMICAL)
68466	LEE MAY VERN, JACQUELINE	1ST YEAR(MONASH) (CHEMICAL)
68467	LEE PIH GUO	1ST YEAR(MONASH) (CHEMICAL)
68468	LEE SIANG HIN	1ST YEAR(MONASH) (CHEMICAL)
68469	LEE TIEN LOONG, CORNELIUS BASIL	1ST YEAR(MONASH) (CHEMICAL)
68470	LEE WEN HUI	1ST YEAR(MONASH) (CHEMICAL)

68559	LEONARD OWEN MORRIS	1ST YEAR(UMS)(CHEMICAL)
68560	LI SIAW BAU	1ST YEAR(UMS)(CHEMICAL)
68471	LIM CHER RIZ	1ST YEAR(MONASH)(CHEMICAL)
68472	LIM CHZE HEU	1ST YEAR(MONASH)(CHEMICAL)
68473	LIM JEE AN	1ST YEAR(MONASH)(CHEMICAL)
68561	LOO WAI MUN	1ST YEAR(UMS)(CHEMICAL)
66971	LOW KOK WEI	1ST YEAR(USM)(CHEMICAL)
67227	LYDIA BT. MOHAMAD	2ND YEAR(UITM)(CHEMICAL)
68474	MADIHAH BT. MOHD ASRI	1ST YEAR(MONASH)(CHEMICAL)
71038	MARYAM BINTI NASARUDDIN	1ST YEAR(UTP)(CHEMICAL)
71014	MASRIHAN BIN ABU HASAN	1ST YEAR(UTP)(CHEMICAL)
68562	MASZIAH BT. MANSUR	1ST YEAR(UMS)(CHEMICAL)
67228	MAYAMIN BT. MOHD RAZALI	2ND YEAR(UITM)(CHEMICAL)
71071	MEGAT NAIMPUTRA BIN MGT RODZED	3RD YEAR(UTP)(CHEMICAL)
67229	MELBERT R.R GODOMON	2ND YEAR(UITM)(CHEMICAL)
68563	MERA EDORA BT. AIDI	1ST YEAR(UMS)(CHEMICAL)
67230	MIRZA AZRI B. MISPARI	2ND YEAR(UITM)(CHEMICAL)
71015	MOHAMAD ALIF BIN ROSLAN	1ST YEAR(UTP)(CHEMICAL)
67231	MOHAMAD ARMANDA ALNIDZAM B. ABD MALEK	2ND YEAR(UITM)(CHEMICAL)
67232	MOHAMAD ASLAM B. NORDIN	2ND YEAR(UITM)(CHEMICAL)
67233	MOHAMAD BAIN B. KHAIRUDIN	2ND YEAR(UITM)(CHEMICAL)
67234	MOHAMAD EFFENDI B. ISMAIL	2ND YEAR(UITM)(CHEMICAL)
67235	MOHAMAD FAIZ B. ISHAK	2ND YEAR(UITM)(CHEMICAL)
67236	MOHAMAD FAIZ B. ZEPARI	2ND YEAR(UITM)(CHEMICAL)
67237	MOHAMAD FAIZZULHAKIM B. MOHAMAD NAWI	2ND YEAR(UITM)(CHEMICAL)
67238	MOHAMAD SAFWAN B. ZAZARLI SHAH	2ND YEAR(UITM)(CHEMICAL)
67239	MOHAMAD SHAFIQ B. SALEHUDDIN	2ND YEAR(UITM)(CHEMICAL)
67240	MOHAMAD SHAHREPA B. BADARUDDIN HASSAN	2ND YEAR(UITM)(CHEMICAL)
67241	MOHAMAD SHARIQ IZZUDIN B. SUHAIMI	2ND YEAR(UITM)(CHEMICAL)
68067	MOHAMAD YUSRI B. YUSOFF	3RD YEAR(UITM)(CHEMICAL)
67242	MOHAMAD ZHAFRY B. SAMSUDDIN	2ND YEAR(UITM)(CHEMICAL)
67243	MOHAMMAD AKMALHAKIM B. ZAKARIA	2ND YEAR(UITM)(CHEMICAL)
67244	MOHAMMAD FAHMI B. SOFI	2ND YEAR(UITM)(CHEMICAL)
67245	MOHAMMAD NABIL B. ABDULLAH	2ND YEAR(UITM)(CHEMICAL)
67246	MOHAMMAD SAIFUL B. ANNUAR	2ND YEAR(UITM)(CHEMICAL)
67247	MOHAMMAD SYAFIQ B. KAMALUDDIN	2ND YEAR(UITM)(CHEMICAL)
67248	MOHAMMAD ZULKARNAIN B. MAT JAHI	2ND YEAR(UITM)(CHEMICAL)
71019	MOHANA A/P SUPPAYAH	1ST YEAR(UTP)(CHEMICAL)
67249	MOHD ADIB B. MOHD NOR	2ND YEAR(UITM)(CHEMICAL)
67250	MOHD AIDE SYAFIQ B. SHAHIDI	2ND YEAR(UITM)(CHEMICAL)
67251	MOHD AKMAL B. ATKALANI	2ND YEAR(UITM)(CHEMICAL)
67252	MOHD AMIRO IQBAL B. ABDULLAHA	2ND YEAR(UITM)(CHEMICAL)
67253	MOHD ARIZUDDIN B. ABU BAKAR	2ND YEAR(UITM)(CHEMICAL)
67254	MOHD DANIAL B. MOHD ADENAN	2ND YEAR(UITM)(CHEMICAL)
67255	MOHD FAIZAL B. MAHRIT @ HANAFI	2ND YEAR(UITM)(CHEMICAL)
67256	MOHD FAIZAL B. MOHD SALLEH	2ND YEAR(UITM)(CHEMICAL)
67257	MOHD FIRDAUS B. ZAINUDDIN	2ND YEAR(UITM)(CHEMICAL)
71032	MOHD FIRDAUS BIN LABABA	1ST YEAR(UTP)(CHEMICAL)
67258	MOHD HAKIMIE B. MOHAMAD HUSIN	2ND YEAR(UITM)(CHEMICAL)
67259	MOHD HAZIAFIZ B. ABD HALIM	2ND YEAR(UITM)(CHEMICAL)
71013	MOHD HILMI BIN ROSELAN	1ST YEAR(UTP)(CHEMICAL)
67260	MOHD HUMAIDI B. JAMONEK @ JAMHURI	2ND YEAR(UITM)(CHEMICAL)
67261	MOHD IBRAHIM B. MOHAMMAD DIN	2ND YEAR(UITM)(CHEMICAL)
67262	MOHD ILHAM SHAH B. HAMDAN	2ND YEAR(UITM)(CHEMICAL)
67263	MOHD IZWAN B. ABDUL KADIR	2ND YEAR(UITM)(CHEMICAL)
68564	MOHD KHAIRUL SAFUAN B. SUEBE	1ST YEAR(UMS)(CHEMICAL)
67264	MOHD ROZAINI B. RAZMAN	2ND YEAR(UITM)(CHEMICAL)
67265	MOHD SABRI B. ZULKIFLI	2ND YEAR(UITM)(CHEMICAL)
67266	MOHD SYAFIQ B. ABDUL RAHMAN	2ND YEAR(UITM)(CHEMICAL)
67267	MOHD SYAHIDAN B. MAT SAMAN	2ND YEAR(UITM)(CHEMICAL)
67268	MOHD ZULFAHMIE IZZUWAN B. MD ZAIN	2ND YEAR(UITM)(CHEMICAL)
67269	MONICA ANAK JOHN	2ND YEAR(UITM)(CHEMICAL)
67270	MUHAMAD ASLAM B. ZAINUDIN	2ND YEAR(UITM)(CHEMICAL)
67271	MUHAMAD ASRUL AZIZAM B. ABDUL WAHAB	2ND YEAR(UITM)(CHEMICAL)
67272	MUHAMAD AZUHAIRI B. MOHAMED ZAINUDIN	2ND YEAR(UITM)(CHEMICAL)
67273	MUHAMAD HAFIS B. TOMIJAN	2ND YEAR(UITM)(CHEMICAL)
68565	MUHAMAD IZZAT ISLAM B. MOHD NOOR	1ST YEAR(UMS)(CHEMICAL)
71033	MUHAMAD NASRI BIN ABDUL HALIM	1ST YEAR(UTP)(CHEMICAL)
71017	MUHAMAD NUR SALAM BIN MOHD YUNUS	1ST YEAR(UTP)(CHEMICAL)
67274	MUHAMMAD ABEED B. MOHD YUSOFF	2ND YEAR(UITM)(CHEMICAL)
67275	MUHAMMAD ATIF ADHWA B. MALAHI	2ND YEAR(UITM)(CHEMICAL)
67276	MUHAMMAD AZAM NAJMI B. ABDUL MUTALIB	2ND YEAR(UITM)(CHEMICAL)
71018	MUHAMMAD AZIZI B TOPEK	1ST YEAR(UTP)(CHEMICAL)
67277	MUHAMMAD B. AJMI	2ND YEAR(UITM)(CHEMICAL)
67278	MUHAMMAD FAIZ B. MAHAMAD TAJUDDIN	2ND YEAR(UITM)(CHEMICAL)
67279	MUHAMMAD FAIZ B. MOHD NOOR	2ND YEAR(UITM)(CHEMICAL)
67280	MUHAMMAD FARHAN B. MUHAMAD ARBI	2ND YEAR(UITM)(CHEMICAL)
67281	MUHAMMAD FARIS B. JALALUDDIN	2ND YEAR(UITM)(CHEMICAL)
68566	MUHAMMAD FARUQI B. JUSOH	1ST YEAR(UMS)(CHEMICAL)
67282	MUHAMMAD FIRDAUS B. MUHAMAD NOR	2ND YEAR(UITM)(CHEMICAL)
70886	MUHAMMAD HAIQAL SHUKRI BIN ABU BAKAR	2ND YEAR(UMP)(CHEMICAL)
71034	MUHAMMAD HAIRE BIN YUSRI	1ST YEAR(UTP)(CHEMICAL)
71011	MUHAMMAD HAREIZ NOR B. NOR RIZAN	1ST YEAR(UTP)(CHEMICAL)
67283	MUHAMMAD HELMI B. JAMAL @ JAMIL	2ND YEAR(UITM)(CHEMICAL)
67284	MUHAMMAD IHSAN SOBRI B. YUSOF	2ND YEAR(UITM)(CHEMICAL)
67285	MUHAMMAD ILHAM B. JUANDA	2ND YEAR(UITM)(CHEMICAL)
67286	MUHAMMAD IQHMAL B. BORHAN	2ND YEAR(UITM)(CHEMICAL)
67287	MUHAMMAD KAMIL B. KHAIRUDIN	2ND YEAR(UITM)(CHEMICAL)
67288	MUHAMMAD NAJMI B. IBRAHIM	2ND YEAR(UITM)(CHEMICAL)
70314	MUHAMMAD RINAL BIN MUHAMMAD SHAH RAJENDRAN	3RD YEAR(USM)(CHENICAL)
71016	MUHAMMAD SHAHIR IMAN BIN ABU HAMID	1ST YEAR(UTP)(CHEMICAL)
67289	MUHAMMAD SHUQRI HAMBALI B.MOHD DALI	2ND YEAR(UITM)(CHEMICAL)
67290	MUHAMMAD SYAFIQ B. MD NASRUDDIN	2ND YEAR(UITM)(CHEMICAL)
67291	MUHAMMAD SYAFIQ B. MOHD ZAINUDDIN	2ND YEAR(UITM)(CHEMICAL)
67292	MUHAMMAD SYAZWAN B. AZHARAN	2ND YEAR(UITM)(CHEMICAL)
67293	MUHAMMAD ZULHAFIZI B. KAMARUDDIN	2ND YEAR(UITM)(CHEMICAL)
67294	NABILAH BT. ZAINUDIN	2ND YEAR(UITM)(CHEMICAL)
67295	NADIRA BT. IKHSAN	2ND YEAR(UITM)(CHEMICAL)
67296	NAJWA NAQIBAH BT. AHMAD DZULKARNAIN	2ND YEAR(UITM)(CHEMICAL)
67297	NAZIRAH BT. MAMAT	2ND YEAR(UITM)(CHEMICAL)
67298	NAZMI NAIM B. ABD GHANI	2ND YEAR(UITM)(CHEMICAL)
71012	NAZRIL DANIEL BIN ABDULLAH	1ST YEAR(UTP)(CHEMICAL)
68475	NG TJUN KITT, NICHOLAS	1ST YEAR(MONASH)(CHEMICAL)
67299	NIK AHMAD SHAAKIR B. NIK MOHD YUSOFF	2ND YEAR(UITM)(CHEMICAL)
67300	NIK NAZIHAH BT. NIK AZIZ	2ND YEAR(UITM)(CHEMICAL)
67301	NISWAH HASHINA BT. ZULKIFLI	2ND YEAR(UITM)(CHEMICAL)
71009	NOOR HAFIZAINIE BINTI MOHD ZOHAN	1ST YEAR(UTP)(CHEMICAL)
68567	NOOR SHAHAZNY BT. A.HALIM	1ST YEAR(UMS)(CHEMICAL)
67302	NOOR SYAFIQAH AMERAH BT. AHMAD TARMIZI	2ND YEAR(UITM)(CHEMICAL)
67303	NOORSHAMIMI BT. SHAHBUDIN	2ND YEAR(UITM)(CHEMICAL)
71070	NOORSYAKIRAH BINTI CHE JALIR	3RD YEAR(UTP)(CHEMICAL)
67304	NOORUL ATIKAH BT. IBRAHIM	2ND YEAR(UITM)(CHEMICAL)
67305	NOR AMALINA HAZWANI BT. ABD RANI	2ND YEAR(UITM)(CHEMICAL)
67306	NOR EKANADIRAH ABDUL RAHMAN	2ND YEAR(UITM)(CHEMICAL)
67307	NOR HALINA BT. MOHD ZAINI	2ND YEAR(UITM)(CHEMICAL)
67308	NOR MARLIA BT. MASTAN	2ND YEAR(UITM)(CHEMICAL)
70878	NOR MUNIRAH BINTI SHAHAR	2ND YEAR(UMP)(CHEMICAL)
67309	NOR SYAZWANI MOHD YUSOFF	2ND YEAR(UITM)(CHEMICAL)
67310	NORAAKINAH BT. HASSAN	2ND YEAR(UITM)(CHEMICAL)
67311	NORAINI BT. ZAINUDIN	2ND YEAR(UITM)(CHEMICAL)
67312	NORASIKIN BT. MUHAMAD IDRIS	2ND YEAR(UITM)(CHEMICAL)
68476	NORLAILI BT. HASHIM	1ST YEAR(MONASH)(CHEMICAL)
67313	NORMAHIRA BT. ABDUL MANAF	2ND YEAR(UITM)(CHEMICAL)
67314	NORSAZUANI BT. AB. WAHAB	2ND YEAR(UITM)(CHEMICAL)
67315	NORSYUHADA BT. ROSLE	2ND YEAR(UITM)(CHEMICAL)
67316	NUR AFIQAH BT. SISWAYA	2ND YEAR(UITM)(CHEMICAL)
67317	NUR AISYAH BT. AHMAD	2ND YEAR(UITM)(CHEMICAL)
68568	NUR AMANINA ASMUIN	1ST YEAR(UMS)(CHEMICAL)
68569	NUR AMERAH AFIKAH BT. ABD RAZAK	1ST YEAR(UMS)(CHEMICAL)
71067	NUR AMIRAH HANIM BINTI RAHIM	2ND YEAR(UTP)(CHEMICAL)
71010	NUR AQILAH HUSNA BINTI MOHD AMDAN	1ST YEAR(UTP)(CHEMICAL)
67318	NUR ASHIKIN BT. MUSLIM	2ND YEAR(UITM)(CHEMICAL)
67319	NUR ASHYKIN BT. MOHD YUSSOF	2ND YEAR(UITM)(CHEMICAL)
67320	NUR ATHIRAH BT. ADAM	2ND YEAR(UITM)(CHEMICAL)
71121	NUR AZEANNI BINTI ABD GHANI	3RD YEAR(UTP)(CHEMICAL)
67321	NUR EZZAH BT. HANIF	2ND YEAR(UITM)(CHEMICAL)
67322	NUR FAEZAH BT. ANUAR	2ND YEAR(UITM)(CHEMICAL)

Note: *Remaining list would be published in the March 2015 issue. For the list of approved "ADMISSION TO THE GRADE OF STUDENT", please refer to IEM web portal at http://www.myiem.org.my.*

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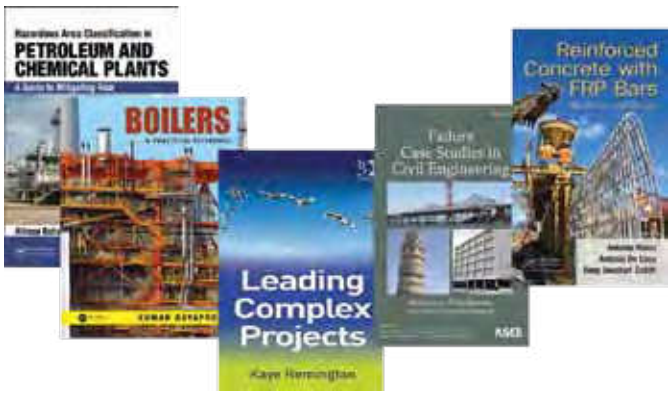

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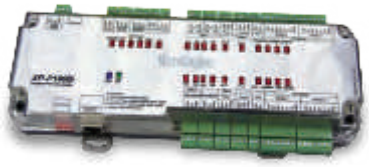

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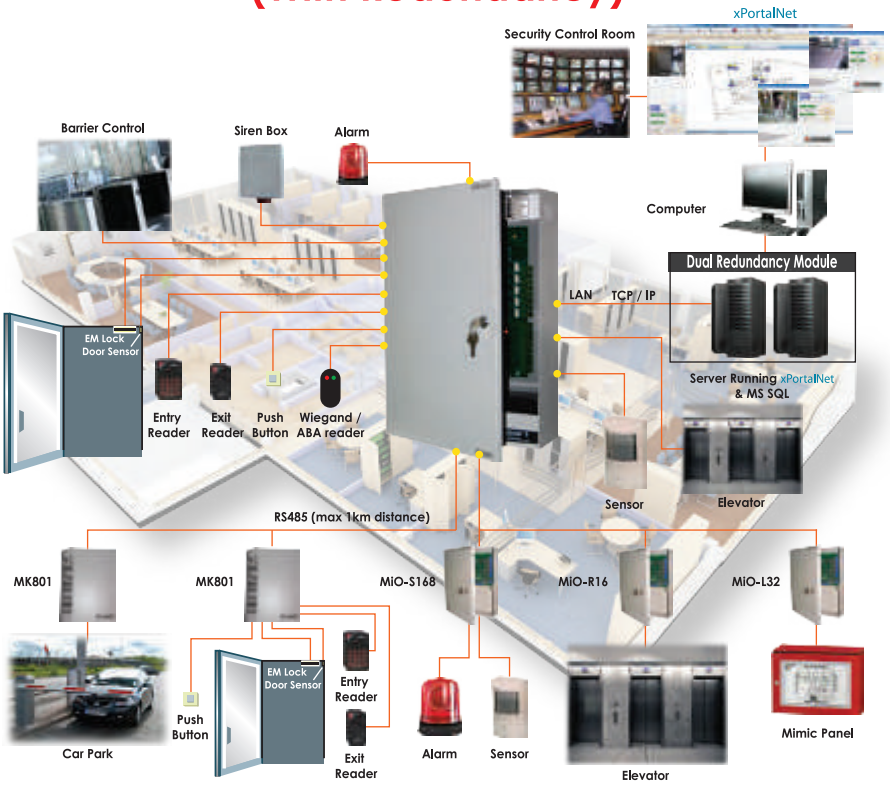

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