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Bangunan Ingenieur, Lots 60 & 62, Jalan 52/4, P.O. Box 223, (Jalan Sultan), 46720 Petaling Jaya, Selangor Darul Ehsan.
Tel: 603-7968 4001/4002 Fax: 603-7957 7678
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Chairman ROBERT MEBRUER

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General Manager SHIRLEY THAM
shirley@dimensionpublishing.com

Head of Marketing & Business Development JOSEPH HOW
joseph@dimensionpublishing.com

Editor TAN BEE HONG
bee@dimensionpublishing.com

Contributing Writers PUTRI ZANINA & ZOE PHOON
putri@dimensionpublishing.com
zoe@dimensionpublishing.com

Senior Graphic Designer SUMATHI MANOKARAN
sumathi@dimensionpublishing.com

Graphic Designer NABEELA AHMAD
beela@dimensionpublishing.com

Advertising Consultants THAM CHOON KIT
ckit@dimensionpublishing.com

Accounts cum Admin Executive YEN YIN
yenyin@dimensionpublishing.com

For advertisement placements and subscriptions, please contact:

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Chief Editor
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cover note

Living with Explosives

by Ir. Mohd Azwira bin Mohd Azmi
Chairman,
Oil, Gas and Mining Technical Division

In this issue of *JURUTERA*, IEM's Oil, Gas & Mining Technical Division (OGMTD) focuses on a part of the industry that is important and highly specialised but full of risks, the engineering of the explosion.

The word "explosives" is taboo for most and should not be uttered especially at the airport or in any public place but this month, we will discuss extensively the topic of explosives. Controlled handling and transporting of explosives as well as usage methods are paramount to ensure the safety of the public and environment.

Explosives support the Oil & Gas industry, especially in seismic survey activities during the exploration phase and in well perforation during the development phase. In the mining industry, explosives are heavily used in underground mining and in the quarry to break rocks.

JURUTERA interviewed Encik Shahar Effendi bin Abdullah Azizi, the Director-General of the Department of Mineral and Geoscience Malaysia (Jabatan Mineral & Geosains) who shared his experience and knowledge in managing this complex, sensitive and dangerous material.

As for oil price, we continue to hope that the market will reach an equilibrium between price and production cost so that exploration and development projects can continue to be economically feasible for implementation. May 2018 be a better year for all of us. ■

IEM DIARY OF EVENTS

Title: 2-Day Course on "What Got You Here Won't Get You There: A Critical Thinking Journey"

14-15 Nov 2017

Organised by: Oil, Gas and Mining Engineering Technical Division
Time : 9.00 a.m. - 5.00 p.m.
CPD/PDP : 10.5

Title: Talk on "Embracing Uncertainty, Risk Management"

15 Nov 2017

Organised by: Engineering Education Technical Division
Time : 5.31 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.

ENHANCING THE COMPETENCY OF EXPLOSIVES USERS

Industrial blasting activities require a high level of expertise. With the utmost concern for safety, regulatory policies, technical advisory assistance and safety standards guidelines must be in place. The Director-General of the Department of Mineral and Geoscience Malaysia, Encik Shahar Effendi bin Abdullah Azizi, talks about the vital work of the department which is one of the bodies that regulate such activities in the country.

A practical exam candidate inserting a detonator into explosives

Industrial blasting involving the use of explosives is a highly specialised field. This is a job that requires competent and certified shotfiring specialists as well as engineers as the safety of the public, workers and the environment is a major consideration.

One wrong move and the result can be catastrophic. Flyrocks have caused deaths and injuries. Damage to the surroundings, including public properties, is also a real danger. Obviously this is an area that requires stringent control, expert advice and compliance to specific standards and safety guidelines.

So which body safeguards and regulates industrial blasting activities in Malaysia? This mammoth responsibility is shared between several bodies such as the Department of Mineral & Geoscience or Jabatan Mineral dan Geosains (JMG) and the Ministry of Natural Resources & Environment.

The Director-General of JMG, Encik Shahar Effendi bin Abdullah Azizi, says which authority is responsible will depend on where the activities are carried out and, to a certain extent, hinge on the approving authority for specific areas.

Encik Shahar Effendi bin Abdullah Azizi is Director-General of the Department of Mineral & Geoscience or Jabatan Mineral & Geosains (JMG). Prior to his present position, he served as Deputy Director-General and Director of JMG's Mineral Research Centre in Perak. He has contributed a lot to improving the local mining and quarrying industry, especially in drafting guidelines and regulations, as well as formulating policies, including the National Mineral Policy 2.

"For example, for mining activities, which fall under the Mineral Development Act (Blasting Regulations) 2013, and quarrying that is governed by the State Quarry Rules, the regulatory body is JMG. For construction in local authority areas, the regulatory body is the respective area's local authority. In other areas that need blasting, such as for construction, tunnelling or road building, the Royal Malaysian Police (Polis DiRaja Malaysia or PDRM) is the regulatory body. But on the whole, for any blasting activity to take place, permission as well as the issuance of licence to sell, purchase and use explosives, fall under PDRM. JMG only provides expert advice when asked by the relevant authorities," he says.

Explaining the role of JMG, Shahar says the department's scope is in the fields of mineral and geoscience. Apart from ensuring that the country's mineral resources are developed safely and sustainably as well as giving optimum returns, JMG also makes sure mines and quarries are developed according to the mining and quarrying laws currently in force.

Shahar explains that all matters with regards to the manufacture or supply of explosives, fall under the purview of PDRM. However, the Explosives Act 1957 (Act 207) requires any person or company that wants to manufacture, supply, sell or purchase explosives, to obtain licences for those respective activities. To become a supplier for explosives, one must get a licence approved by the Minister of Home Affairs.

Overall, PDRM is entrusted with regulating the supply of explosives, while JMG regulates blasting activities in mines and quarries. Together, JMG and PDRM are the certification bodies for blasting competency.

Shahar says: "With regards to blasting, JMG's roles are to ensure that activities carried out are safe and sound, without causing any adverse impacts so as to protect the people and the environment. We have officers with mining or mineral resources engineering background as well as the knowledge and experience in the use of explosives and blasting activities in quarries and mines."

NEW SHOTFIRER LICENCE

On 20 September, 2017, the Deputy Minister of Natural Resources & Environment (NRE), Datuk Ir. Dr Haji Hamim bin Samuri, officially launched the new Shotfirer Licence, which is the result of the combination of the Shotfirer Certificate (Sijil Pembedil) issued by JMG and Blasting Expert Certificate (Sijil Juruletup) by PDRM.

The Shotfirer Certificate was previously required for blasting works in mines and quarries governed by States Quarry Rules and the Blasting Expert Certificate was for carrying out work on construction blasting sites. The new Shotfirer Licence, which became valid on 1 January, 2017, will henceforth facilitate all blasting works in quarries, mines, construction sites and other areas.

"With the co-operation of PDRM, blasting competency is being enhanced. Both JMG and PDRM have successfully activated a Steering Committee to co-ordinate, tackle issues and raise the competency and standard with respect to blasting and explosives users in Malaysia," says Shahar.

As of 30 June, 2017, JMG had received 592 conversion applications out of 1,400 holders of the old Shotfirer Certificates. Combined with the conversion applications received by the PDRM, the total stands at 650 at the middle of the year.

Shahar says all holders of valid Shotfirer Certificates and Blasting Expert Certificates are allowed to convert to the new Shotfirer Licence. However, the conversion is subject to their attending a JMG-sanctioned Shotfirer refresher course following the approved syllabus and conducted by registered lecturers and training providers, including the Malaysia Quarry Association and the Malaysian Chamber of Mines. Attendance is compulsory before they are

Shotfirer practical exam

allowed to sit for a theory examination. In addition, the Shotfirer Licence will be issued to qualified and eligible Malaysians only and renewals will be based on the holders having completed certain hours of Continuing Professional Development (CPD) courses, which are in the planning stage.

New applicants must first be vetted by PDRM for security reasons and the control of persons allowed to handle explosive materials. Once they pass the vetting process, they take the theory test. When they pass, they are allowed to sit for the practical examination.

"JMG encourages engineers involved in blasting works to take the Shotfiring Licence to enable them to supervise the blasting work themselves," says Shahar, adding that IEM can play a role in helping to improve and promote the safe use of explosives in blasting activities.

"For a start, IEM can assist JMG to raise the competency level, such as setting the requirements of CPDs in terms of courses approved and hours required. In view of IEM having professional members who are experts in blasting and explosives, we also invite IEM to be one of the training providers. Apart from being competent blasting engineers and consultants for the designing and monitoring of blasts, it can also provide services on blast monitoring work, prediction and analysis of blast performance and other expert advice. Its members can also become lecturers for CPD courses, giving technical talks and conducting training programmes and technical visits. IEM can help JMG draw up or improve current modules and syllabi on more advanced explosives and blasting courses for professionals. "

In turn, he says JMG officers can give technical talks, get involved in forums and assist in providing courses planned by IEM. This will help improve the quality of engineers involved in this field, provide better services to the local industry and support the export of their expertise overseas.

CERTIFICATION PANEL

On a more important note is the establishment of a Certification Panel to drive the enforcement of the Mineral Development (Blasting) Regulations 2013. Shahar points out that there is a requirement under these regulations for the formation of a panel with respect to blasting and explosives.

The Panel, to be chaired by the Deputy Director-General of JMG, will consist of three representatives from JMG and four from the industry. Its functions will be to establish and review the syllabus for the shotfirers examination and to carry it out, to establish, assess and review the competency standards of shotfirers, to establish training requirements for shotfirers and, where deemed fit, to suspend certificates issued by JMG.

Shahar says the Panel will also oversee the regulatory requirements for having a blasting management plan before any work can be carried out. The plan must cover, among others, the blasting method, measures to monitor the impacts of the blasting and ways to deal with the occurrence of negative impacts. Consultants registered with the Board of Engineers Malaysia (BEM) who also possess the IEM practising certificate, are the ones required to produce the blasting management plan, in accordance with the requirements spelt out under Mineral Development (Blasting) Regulations 2013.

FUTURE OUTLOOK

Touching on the current scenario and the potential for the commercial explosives industry here, Shahar says Malaysia has about 10 hard rock mines and 330 quarries (as at 2016) that use explosives.

"Malaysia is also building mega projects such as the MRT and LRT extensions, East Coast Rail Link (ECRL), Pan-Borneo Highway, Pengerang Rapid Project, the Tun Razak Exchange (TRX) development project, Bandar Malaysia and many other big commercial complexes. All these projects require building materials and most of them, like highways and railroads, need explosives to blast certain areas. The need will extend until completion of the projects. The consumption of explosives is also expected to increase with new projects in years to come," he says.

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As the nation develops further, with more constructions that will require more rock aggregates for building materials, this will lead to increased blasting activities at quarries and the use of more explosives.

Old buildings also need to be demolished so that they can be replaced with new ones. Demolition of high-rises or tall buildings requires explosives as will special projects such as pipe-line trenching, underground construction, etc.

"Statistically, about 10 years ago, we had only two explosives suppliers, but now with the increase in economic activities, we have four multinational companies supplying and exporting explosives, so based on these scenarios, the future of the explosives industry looks bright," says Shahar.

"Apart from mining and quarrying, I also foresee that explosives will be used a lot in construction (such as foundation levelling and underground parking/basement level), in roads (especially highways), in railway lines and in other specialised uses such as urban blasting, underwater deepening, seismic, trenching, etc. These will require the expertise of blasting engineers. Normally, JMG is asked by the approval authorities to vet the blasting proposals forwarded by the blasting consultants, for suitability and practicality."

MAIN CHALLENGES

Shahar highlights the challenges that his department faces in regulating industrial blasting activities.

"With regards to blasting activities, two issues normally crop up: Security and safety. The security aspect is dealt by the PDRM, while technical agencies like JMG deal with the safety aspect. JMG's focus on the safety issue is two-sided. One is the operational aspect, which requires the development of skilled workers and professionals in safety, safe-work/best practices and compliance to regulations/laws," he says.

"The second encompasses regulations and laws vis-a-vis regulators. The industry needs better co-ordination among the various regulators. It seems heavily regulated because it is based on where the activities take place. It is site-specific, such as in mines, quarries, local areas or outside the local

Safety briefing given by the examiner prior to a practical shot-firer exam

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Thumbs up from the recipients of the newly launched Lesen Pembedil, recognised by the authorities on blasting

areas. Ideally, it will be best to have one regulatory body to oversee all the sites."

To add to this, he explains that sometimes, security and safety requirements are mixed up, with no clear dividing line.

"Take for example, the requirement of the Shotfirer or Blasting Expert Certificate from PDRM and JMG. Previously both certificates were needed in quarries whereby the Blasting Expert Certificate was for purchasing and transporting explosives, while the Shotfirer Certificate was for blasting activities," he says.

"This caused enormous problems to the industry because not only were these certificates hard to obtain but companies also needed to have both certificates to carry out blasting. Besides, assessment standards were different although technically, they were meant for the same purpose. However, under the guidance of the National Blue Ocean Strategy (NBOS) promoted by the Government to ease measures in doing business, as well as the willingness of the respective regulators, the issue was resolved and a joint Shotfirer Licence was issued that was recognised by both agencies."

Shahar reiterates that JMG is now working in tandem with PDRM to oversee the competency and certification for blasting and explosive-related uses.

"With this mammoth task, JMG has to plan and develop the competency and certification in the industry. Traditionally, JMG is the regulator for blasting and use of explosives in mines and quarries governed under the Mineral Development Act 1994, Blasting Regulation 2015 and The State Quarry Rules. However, outside of mines and quarries, the regulator or approving authority to be exact, would depend on site specifics, such as the respective local authorities for towns and cities. So the challenge is to certify works using explosives in places outside mines and quarries. But since JMG and PDRM have been tasked with enhancing the competency and certification of explosives use under NBOS, the task will, hopefully, be much easier."

Currently, JMG requires mines and quarries to have competent personnel or to use the services of competent persons for the following:

a) Operational mining or quarrying scheme.
b) Blast Management Plan.
c) Mine or quarry manager.
d) Blast design and shotfiring.
e) Safety, health and environment officer.
f) Effluent samplings and analysis.
g) Monitoring and analysis of vibration, airblast and dust.
h) Technical supervisors and
i) Training/basic courses for new workers and refresher courses for existing workers.

"So, to set a standard on competency certification for the above, a lot of work is needed to build up modules and syllabi. It is hoped these can also be used for works done outside mines and quarries," says Shahar, adding that immediate needs are competency and certification for underground construction blasting like tunnelling, basement parking and building of underground train stations.

Apart from requiring the mining and quarrying industry to have the above-mentioned competency, Shahar says JMG is also involved in other matters concerning explosives usage such as providing expert advice to other authorities on applications for construction projects using explosives. ■

Use of Explosives in Well Perforation

Ir. Razak Yakob

I placed my hands on the tubing (carbon steel pipe) which protruded vertically from the rig floor. It was connected 2.5 km to below the surface. This was the moment I had been waiting for. Everyone went quiet. I gave the signal to release the mechanical bar to rupture the disc that would trigger a string of explosions underground. One minute… 2 minutes… 3 minutes passed. Then I felt the tubing shudder. This was an indication that the well had been perforated successfully. I beamed with excitement as this was my very first calculation of an underbalanced perforation using the Tubing Conveyed Perforation method. As a young engineer, I did not get the chance to really design, calculate, prepare and execute the procedure in the field until I had proved I was worthy of leading the whole operation. It was not an easy task; on my shoulders were the lives of the 128 people on board the drilling rig at that time. If I had made an error in calculation or if I hadn't followed the guidelines accurately or if I hadn't thought through the steps carefully, then I would be putting every single one of us in danger. As engineers, it is our responsibility to ensure the safety of everyone in all our projects.

This article is written to share the knowledge on the use of explosives in the oil & gas well perforation. Well perforation is an important segment of the process of well drilling and completion. After the drilling, running in casing and cementing are completed, the operation is shifted to completion phase.

Upon cleaning the wellbore, a gun is lowered to punch and create holes in the casing for fluids from the formation to flow in. Well perforation is complex, with many details that need to be described meticulously for a complete understanding. The writer will attempt to describe the process in a simplified manner for general understanding.

The purpose of well perforation is to provide a channel between formation (that contains hydrocarbon) and wellbore, which is separated by the cemented casing.

Figure 1 shows how this done. The first step is lowering a gun into the hole to the intended depth where there is good hydrocarbon potential. In the second step, the gun is fired, creating holes on the casing and cement to allow the communication from outside of the casing to inside. The third step shows that the holes created allows hydrocarbon to flow into the casing or wellbore area.

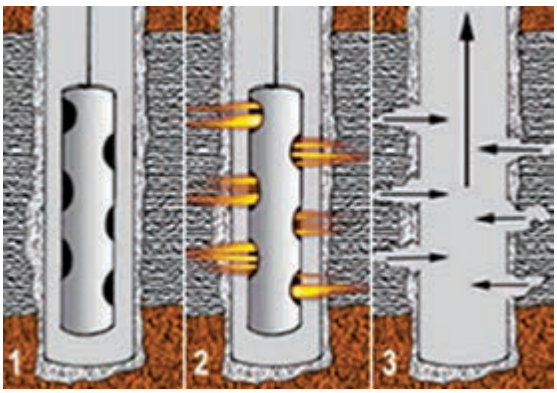

Figure 1: Gun lowered into the hole to perforate and create a channel for the flow (Source: http://mpgpetroleum.com/images/perfor.jpg)

LOWERING THE GUN

As mentioned at the start, we were performing a Tubing Conveyed Perforation. In this method, the gun is lowered to the intended depth. There are two methods to do this. The first method uses a strong wire, normally electric wireline, simply called E-Line. This line conducts electricity for information transfer to carry instruction from surface or to retrieve information from the bottom to the surface. Another is to use a wire called slickline, which is possible in newer technologies. It utilises fibre optic lines which can transmit data along the length of the slickline. This information allows very precise operations of various down-hole tools, including perforation guns.

The second method is to use either normal tubing or coiled tubing. This method is especially required when dealing with high angle wells. Imagine a piece of heavy equipment is lowered down the hole. Due to gravity and the weight of the equipment, this is naturally easy. However, high angle wells dampen this gravity effect due to contact with the hole wall and buoyancy force from wellbore fluids. So, to add the weight as well as move the equipment down the hole, solid body tubing is used instead of just wire.

PERFORATING TECHNIQUES

Another thing mentioned at the start of the article is that the perforation was done underbalanced. There are two variations in the perforating technique – overbalanced and underbalanced.

An overbalanced perforation means the casing is filled with fluids which will create higher hydrostatic pressure inside

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the casing compared to the formation pressure. Therefore, when holes are made during the perforation, the pressure from the inside casing will stop hydrocarbon or any other fluid from the formation to enter the wellbore. Hydrostatic pressure in the wellbore is larger than the formation pore pressure. This is to ensure the well is always under control. The complexity here is to have a good pressure difference balance between the outside and the inside of the wellbore, not too high and not too low. If the pressure difference is too high, then there is always the potential of fluids inside the wellbore to lose out into the formation. This is not desirable as fluid losses not only need to be replenished but this may also lead to formation damage.

If the pressure difference is too low, fluids from the formation may enter the wellbore, which may also result in a well control situation. Thus, correct analysis of pressure difference is very important.

On the other hand, underbalanced perforation can only be done using the tubing. This is because the tubing has to be lowered into the hole and this creates a lower pressure compared to the formation. Therefore, upon perforation, there will be a rush of pressure from the formation entering the wellbore.

Again, a balanced pressure difference is important because too great a difference will create a great push of pressure from the formation which can be dangerous if uncontrollable. If the difference is too low, it may not result in an effective underbalanced perforation which will promote better production. Underbalanced perforation is usually recommended when the formation does not have good flow potential. Underbalanced perforation will help by reducing formation damage due to invasion of fluids from the wellbore

THE GUN

The perforating gun has 4 components (see Figure 2): Conveyance for the shaped charge, individual shaped charge, detonating cord and detonator. When the gun is detonated, it will go off instantaneously with the pressure of 10-15 million psi. This pressure penetrates the casing as well as the formation, creating a radial path for hydrocarbon to flow in.

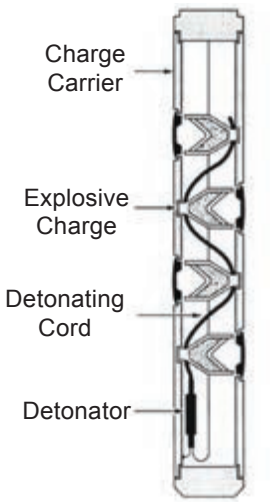

Figure 2: Perforating Gun – Hollow Steel Carrier Wireline Conveyed (Source: http://www.devonenergy.com

Figure 2 also shows the sample of perforating gun system, a hollow steel carrier wireline conveyed type. The detonator is actually below the charges by design. Some perforating systems such as Thru Tubing Wireline Conveyed Perforation as well as Tubing Conveyed Perforation commonly have the detonator above the charges.

Shaped charge plays an important role in creating the explosion to penetrate the formation. Figure 3 shows the sample of shaped charge with the cross-section figure showing the components of a shaped charge.

Thermite is a pyrotechnic composition of metal powder, fuel and metal oxide. When ignited by heat, thermite undergoes an exothermic reduction-oxidation reaction which can create brief bursts of high temperature in a small area.

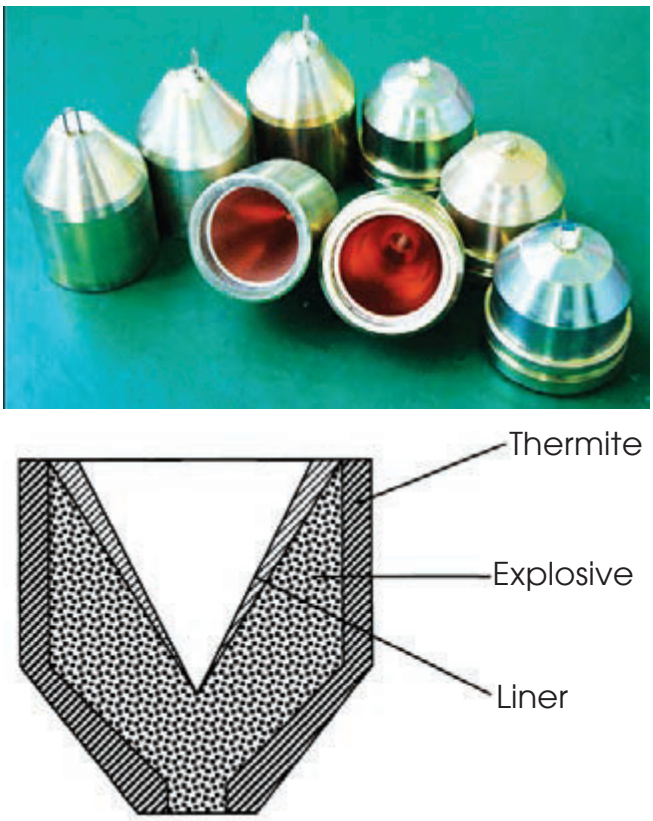

Figure 3: Shaped Charge (Sources: https://media.licdn.com/mpr/mpr/shrinknp_800_800/ AAEAAQAAAAAAAAhEAAAAJDM3NWYxMDEzLWE0MmYtNGJiMS1iMzBhLWJkZmU0MTBhNDE0ZA.jpg, http://patentimages.storage.googleapis.com/US20110146519A1/US20110146519A1-20110623-D00000.png)

EXPLOSIVE TYPES

There are 3 types of explosives commonly used in well perforation: RDX, HMX and HNS. The use of these explosives is highly controlled by the operations as well as the authorities. RDX is a white solid organic compound classified chemically as nitramide, and similar to HMX. RDX is a more energetic explosive than TNT (Trinitrotoluene - yellow solid that is sometimes used as a reagent in chemical synthesis, but is best known as an explosive material that is easier to handle). RDX was popular during WWII and was secretly

known as "Research Development Explosive". In well perforation usage, RDX has a 1-hr rating of 166°C and 100-hr rating of 115°C thermal stability.

HMX is a powerful and relatively insensitive nitroamine high explosive, chemically related to RDX. It's also known as High Melting Explosive, Her Majesty's Explosive, High-velocity Military Explosive or High-Molecular-weight RDX. Because it is more complicated to manufacture than most explosives, it's confined to specialised applications. In well perforation usage, HMX has a 1-hr rating of 204°C and 100-hr rating of 149°C thermal stability.

HNS (Hexanitrostilbene) is a yellow-orange solid organic compound used as a heat-resistant high explosive. Produced by oxidising TNT with a solution of sodium hypochlorite, HNS has a higher insensitivity to heat than TNT but like TNT, it is insensitive to impact. In well perforation usage, HNS has a 1-hr rating of 260°C and 100-hr rating of 238°C thermal stability.

There are complex simulations that can be run to determine the effectiveness of perforation or how deep the explosion can penetrate the formation. However, such simulations can only achieve limited accuracy as there are many unquantifiable factors that can impact the effectiveness such as formation hardness (grain size, porosity), explosives strength, explosive charge arrangement, casing strength, cement strength and cement hardness.

CONCLUSION

Well perforation is a significant process of completing a well for production. With the involvement of explosives, the work becomes more dangerous. Safety precautions in handling the explosives as well as perforation design planning and implementation must be observed to ensure the successful delivery of a well.

After the shudders and rumbles of the tubing had subsided, we knew it was only an indication that a successful perforation had taken place. The next question was, "Were all the guns fired? What if some of the guns did not fire?". It would be highly risky to bring a partially fired gun up to the surface as an unstable gun could potentially explode anytime if not properly secured. As the guns were reaching the rig floor, I could feel my heart pounding as if I had just completed a 100 km sprint. ■

Author's Biodata

Ir. Razak Yakob, *is a Drilling Engineering Consultant who has been in the Oil & Gas industry for over 20 years. He is an IEM Council Member and also Secretary/Treasurer of the OGMTD.*

IEM DIARY OF EVENTS

Title: IEM Form of Contract for Civil Engineering Works & IEM Form of Contract for Mechanical and Electrical Engineering Works

16 Nov 2017

Organised by: Sub Committee on Engineering Contracts of Standing Committee on Professional Practice
Time : 9.00 a.m. - 5.30 p.m.
CPD/PDP : 7

Title: ICTSIG Junior Digital Class (November 2017) - S.T.E.M fun learning Introduction: Prototyping of Arduino application using Microduino #1

17 Nov 2017

Organised by: Information and Communications Technology Special Interest Group
Time : 8.00 a.m. - 12.00 p.m.
CPD/PDP : 0

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.

Coal Mining in Sarawak: An Overview

Salehudddin bin Mohamad

Ir. Hj. Look Keman bin Sahari

For Malaysia, in particular Sarawak, the diversity of available energy resources is a huge advantage. In addition to renewable energy resources such as hydropower, biomass and solar-generated power, Sarawak also has a large potential reserve of non-renewable fossil fuel such as oil, gas and coal.

Coal is actively mined in several areas in the state, including Silantek, Mukah and Merit-Pila in central Sarawak. These are among the largest coal deposits in the state and in the country. Coal plays a vital role in the generation of electricity in Malaysia, especially in Sarawak. Coal-fired power plants currently produce approximately 10% of the state's electricity and the figure is steadily growing.

There are many reasons for the increasing use of fossil fuel, including strategic, economic and availability factors. Use of coal as an energy source, together with its useful heating properties in the manufacture of cement and bricks as well as in power generation, is now commonplace in Sarawak. Furthermore, with the relatively high price of oil in the global market, electricity corporations find that coal is a more economical option.

HISTORY OF COAL MINING IN SARAWAK

The Silantek coalfield had been in operations as early as 1920s. Previous investigations of the coalfield were carried out by the following companies:

- Evans J.W. (1925-1926).
- Osborne and Chappel (1928-1931).
- N.S. Haile (1954) and the Nippon Coal Mining Sdn. Bhd. (1961-1962).
- Joint investigation between Nippon Coal Mining and Ataka Company (1969-1970).
- Sarawak Coal Prospecting Corporation (1981-1982) was granted a GPL in 1981 to prospect the Silantek and Sg. Merah region.

After the Sarawak Coal Prospecting Corporation, Luckyhill Mining Sdn. Bhd. applied for and was granted a prospecting licence for the Silantek coalfield. Prospecting work started in April 1983 and ended in November 1983.

Currently, the coalfield produces a good quality coking coal with a relatively high net calorific value. Due to its excessively thick overburden ranging up to 55 metres, a longwall mining method is being carried out in the underground mine in the Silantek area.

An exploration company has been prospecting for coal in the Merit-Pila coalfield in Sarawak from 1974 to 1978. Detail surveying, mapping and diamond drilling were carried out to further delineate the coal reserves by establishing the number and thickness of coal seams present, the geological structure of the area and the quality of the coal. The area was proven at the time to have coal reserves of 4.4-5.2 million tonnes of sub-bituminous coal which could likely be recovered using the opencast mining method.

As for the Mukah-Balingian coalfield, the area was first explored in 1974 by Sarawak Shell Berhad and Amax International, followed by a few more local companies. Currently, 6 mineral tenement holders (Mining Lease holders) occupy several areas in Mukah and Balingian where the quality of lignite is slightly low and of an inhydrous nature. A straightforward approach of opencast mining is being carried out here with lots of excavation work and machineries used in the mining pit and along the benches.

MAIN TYPES OF MINING METHODS

1. **Opencast mining**
   - Use of excavators, haulage lorry.
   - Proposed to use explosive.
   - To form several pit benches for ground stability.
   - Simple documentation of Operational Mining Scheme.

2. **Underground mining**
   - Using longwall method.
   - Sometime explosives are used when approaching granitic host rock.
   - Complex preparation of Operational Mining Scheme.
   - Ventilation system and roof supports.

The main objective in any commercial mining operation is the exploitation of the mineral deposit at the lowest possible cost with a view of maximising profits. The selection of physical design parameters and the scheduling of the ore and waste extraction programme are complex engineering decisions of enormous economic significance.

The planning of an open pit mine is, therefore, basically an exercise in economics, constrained by certain mining engineering and geologic aspects. In an open pit coal mine, the pit bottom would be the bottom mined coal seam elevation, since it is usually feasible to extract multiple seams when using surface mining method to extract coal.

Sometimes coal seams run too deep underground for opencast mining and so require underground mining. The complexity of mining engineering factors such as ventilation

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system, selection of material for roof supports, underground surveying etc., proves that it can be quite challenging to implement. A thorough analysis of an expert consultant's technical review, is needed.

PRODUCTION STATISTICS

From 2000 to 2016, 27 million tons of coal were produced in Sarawak and the figure is expected to go up with the increase in the number of prospecting licences for coal in recent years and due to high energy demand with the introduction of the Sarawak Corridor of Renewable Energy (SCORE) project.

ROLES & COMMITMENT

Mining in Malaysia is under the supervision of the Department of Mineral & Geosciences (DMG) Malaysia, as stipulated in the Mineral Development Act 1994 (Chapter 525) and its Regulations. The main role of DMG is to ensure that the tenement holders execute mining operations in a workman-like manner, efficiently and applying engineering best practices as well as maintain productive and sustainable operations. The mining companies are also required to plan and implement the rehabilitation programme during/and post-mining phases.

An open pit coalmine in progress in Mukah

Compliance inspection of an underground coalmine in Silantek

In Kapit, a barge is filled with coal via a conveyor belt

Apart from that, the self-regulated Act actually gives the mineral tenement holders a certain degree of freedom in terms of setting up both mining and technical conditions, based on their own operational considerations, with supervision and approval from the Department. Operational and mining engineering aspects pertaining to safety, health and environmental compliance will always be the Department's main commitment for advancement and a sustainable mining industry, in tandem with the National Mineral Policy 2.

CONCLUSION

With the depletion of non-renewable oil and gas resources, the availability of coal in Sarawak is of great strategic value to Malaysia. However with deeper deposits, there is a need to apply high technology mining methods to ensure a safe mining operation.

Therefore, mining companies need to hire and train very highly qualified people, particularly in underground mining. Methane emission is also a problem when it comes to underground coal mining and DMG and the operators will need to address this at source. Safety is a necessity to attract more locals to the industry.

Sarawak has a good future in coal mining. Coal will allow Malaysia to diversify her energy resources and reduce her dependence on oil and gas. ■

Authors' Biodata

Salehudddin bin Mohamad, *is the Head of Mine and Quarry Unit at Department of Mineral & Geoscience Malaysia, Sarawak. He has 14 years working experience within the Department.*

Ir. Hj. Look Keman bin Sahari, *is a Consultant Engineer specialising in explosives and blasting in Mining, Quarry and Construction. He retired from the Mines Department, Malaysia (now DMG) in 1996.*

IEM DIARY OF EVENTS

Title: 27th Annual Professor Chin Fung Kee Memorial Lecture : Underground MRT in Kuala Lumpur - The Inevitable Urban Transit Solution

18 Nov 2017

Organised by: The Institution of Engineers, Malaysia and Engineering Graduates Alumni Association Universiti Malaya (2017)
Time : 9.00 a.m. - 1.00 p.m.
CPD/PDP : 2

Title: ICTSIG Digital Class (November 2017) - Introduction to Web Page Design WITH HTML, JAVASCRIPT and CSS (PART 3) - Postponed from 11 November 2017

18 Nov 2017

Organised by: Information and Communications Technology Special Interest Group
Time : 11.05 a.m. - 1.00 p.m.
CPD/PDP : 2

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Digitalisation: A Paradigm Shift in Oil & Gas Industry

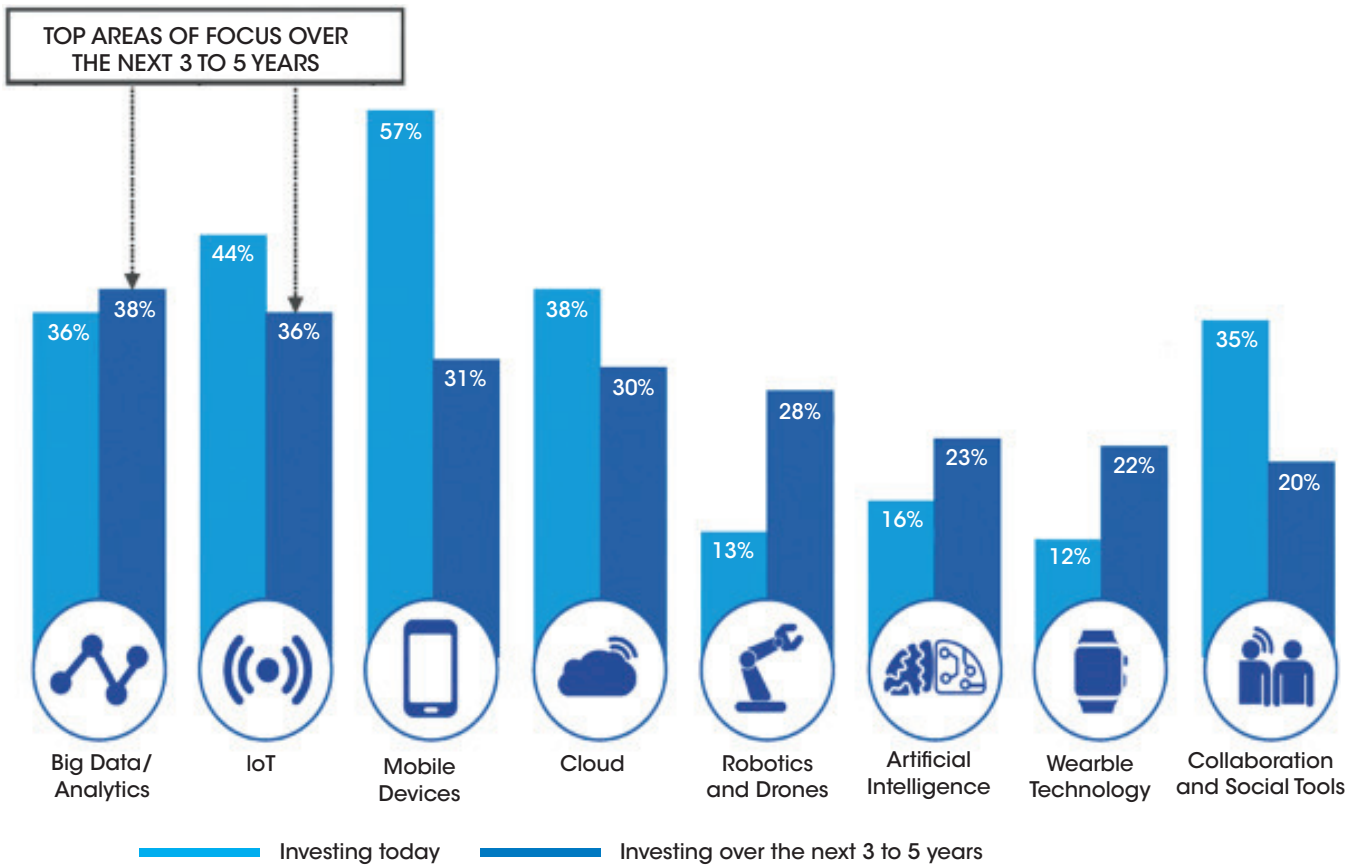
Ir. Davendren Vereya

The Oil & Gas industry was one of the pioneers which adopted digital technologies as early as in the 1980s. The industry had long depended on high volume of data to understand reservoir resource, production potential, improving safety and health and boosting operational efficiencies at oil fields.

However, the true potential of the data generated is yet to be realised by generating actionable insight. Based on a recent study, digital transformation can unlock approximately US$1 trillion in value for the Oil & Gas industry. Environmental benefits include reducing CO2-equivalent (CO2e) emissions by approximately 1,300 million tonnes, saving about 800 million gallons of water, and avoiding oil spills equivalent to about 230,000 barrels of oil. Ever since oil prices began declining, digitalisation had been rising as a strategic business priority for Oil & Gas companies. This "new oil field" paradigm will differentiate between the players that succeed and those that disappear over the next decade.

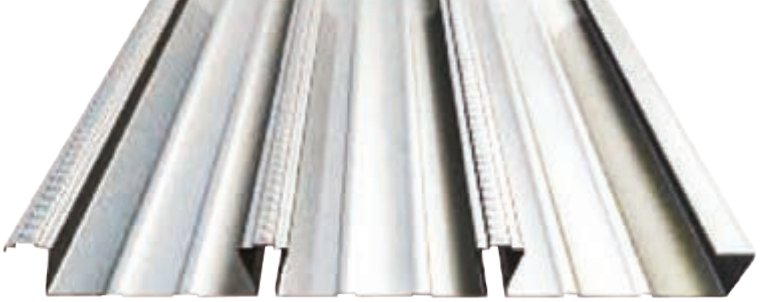
DIGITALISATION

Digitalisation is the use of digital technologies to change a business model and to provide new revenue and value-producing opportunities. Digital technologies include Big Data Analytics, IIoT, Mobile Devices, Cloud, Robotics and Drones, Artificial Intelligence, Wearable Technology and Social Tools. According to a recent survey by Accenture, Big Data Analytics and IIoT are emerging as top digital topics for Oil & Gas companies, based on the percentage of current investment and the expected investment over the next 5 years.



* The percentages in the bars are the proportion of Oil and Gas companies surveyed.
Source: Accenture, The 2016 Upstream Oil and Gas Digital Trends Survey

Figure 1: Investment in Digital Technologies



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INTERNET OF THINGS (IoT)

Internet of Things is a system of connected computing devices, machines, objects or people with unique identifiers and the ability to transfer data over a network without human-to-human or human-to-computer interaction. IoT is a revolutionary advancement between operation technology (OT) and information technology (IT). IoT also enables machine-to-machine interactions.

Plants and refineries are mostly automated and under constant surveillance and control loops. Advanced measurement devices such as electronic flow metering technology, data-intensive pipeline inspection gauges (PIGs), SCADA, and digital sensors are embedded in vessels, tanks, compressors, turbines and pipelines to capture real time data. Recent offshore drilling platforms have about 80,000 sensors. All real time data captured via these sensors are usually sent to the control rooms for diagnosis and monitoring activity by experts.

Machinery used in O&G, especially drilling equipment, has to operate in harsh conditions and, over prolonged periods, is susceptible to wear and damage. With the advancement of IoT, machinery is now fitted with smart sensors to collect data about its performance, enabling maintenance and parts replacement to be done efficiently.

IoT has enabled unstructured, machine-generated data to be analysed for insights that drive improvements in design and operation, leading to smarter, faster decision-making with minimised downtime.

BIG DATA ANALYTICS

Big Data Analytics is the theory and practice of applying advanced computer analysis to the ever-growing amount of digital information collected from smart elements. A single drilling rig can generate one terabyte (1024 gigabytes) of data per day. The total amount of data collected from an oilfield during its lifetime can reach up to 15 petabyte (15 thousand terabytes).

Big Data Analytics will help companies navigate this enormous amount of data. An analyst builds a simulation interconnecting these data and the elements of business. The simulation is used to explore how tweaks in certain operations may have an impact on the productivity or efficiency of another.

The huge amount of data collected from all segments of the business activity results in a higher degree of accuracy in simulations, as close as possible to the way things will play out in the real world. This helps decision-makers make better decisions which can affect the company's fortune. Recent findings show that only 13% of O&G companies are using the insight from the Big Data Analytics to drive their approach towards the market and their competitors. Based on a recent study, analytics can help exploration companies extract 3-5% more oil.

Shell uses Big Data Analytics for preventative maintenance and to reduce breakdowns and downtime. In 2015, it saw a US$1 million return on an US$87,000 investment in sensors and analytics to monitor oilfields in some of Nigeria's toughest terrain.

DIGITALISATION ENABLERS

Cisco estimates that companies will see 11% earnings growth across the value chain, with most of the cost savings upstream. One integrated oil company managed to save about 10% on unit costs by digitising a remote offshore operations centre. Another reduced operating costs per barrel by about 10% and improved recoverability of reserves by applying selective applications in intelligent oilfields through collective computing and sharing real-time information at all company levels. The cost saving potential is evident. Disruptions in supply, demand and commodity prices will maintain the pressure on oil price and push O&G companies to focus on reforming their portfolio and establishing a bigger footprint in the digital transition to bring down the cost of production.

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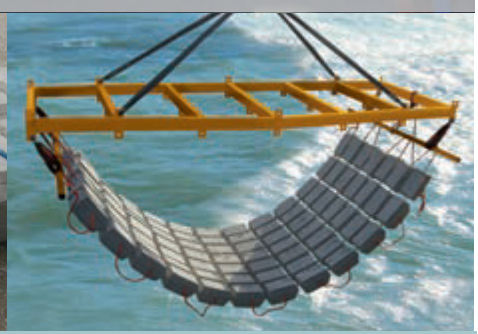

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There is also a growing number of push and pull from the industry itself for swift digitalisation effort. The first drive is from the search for new hydrocarbon deposits, which carries a high cost of over US$100 million. With the huge amount of effort, material and manpower needed in new field explorations, there is no room for error or looking in the wrong place.

The emerging digital assets, such as drilling algorithm and intelligent pipelines innovation, are also driving the digitalisation effort positively. With advancement of the technology, communication between field workers and smart devices is becoming more collaborative and two-way. On-site work autonomously performed and remotely managed, for example, use drones for inspections, material transfers and maintenance.

The industry is also venturing into innovations and research efforts on application of robotics to handle complex and repetitive task such as connecting pipes and replacing broken machinery. At the moment, robotics is being used in autonomous drilling where workers are completely removed from the drill floor. Other advancements include robotic moving platforms for shale wells and remote-controlled trucks to transport oil or gas. According to a study, 47% of jobs in the industry will be automated with robotics over the next 20 years.

The rapid advancement of technology is expected to save the field service industry US$1 billion annually. This is possible with the use of smart glasses to diagnose and fix problems faster. For example, maintenance workers can expect to get instant access to information regarding a specific pump and its maintenance history or a wearable smart device such as Google Glass, which identifies the equipment automatically.

INDUSTRY DRIVERS

Royal Dutch Shell is one of the world's largest O&G companies and the fourth largest by revenue. It has been developing the idea of a "data driven oilfield" in attempts to bring down the cost of drilling for oil which is the industry's highest expense.

Shell has partnered with Hewlett-Packard to develop special fibre optic sensor probes which are put into the earth at the survey spot; these will register the pattern of the waves distorted as they pass through oil or gas. Data is then transferred to its private servers maintained by AmazonWeb Services. Shell expects to get a far more accurate image of what lies beneath. This will then be compared alongside others around the world to enable geologist to make more accurate recommendations on where to drill.

Schlumberger is the world leading provider of technology for reservoir characterization, drilling, production, and processing to the oil and gas industry. Schlumberger is now monitoring subsea conditions using "wave gliders" or unmanned marine surface vehicles. These use solar and wave energy and can travel across the oceans to collect data for up to one year without fuel or crew.

In 2016, GE announced a series of partnership agreements with small and large oil companies to implement digital devices, databases and sensors which includes Meridium (a leader in the industrial asset performance management), Bit Stew Systems (experts in data integration and analysis for Industrial Internet systems) and ServiceMax (a provider which enables technologies for field service technician and engineers). GE is also investing in the deployment of more than 550,000 digital twins and exploring various scenarios for interaction between users and digital twins, with the aid of voice recognition and Microsoft HoloLens visualisation.

DIGITALISATION IN THE NEAR FUTURE

Digitalisation will drive the industry to rely less on personal experience and preference and to rely more on science which can be understood and shared by all. Some jobs such as equipment inspector may possibly be replaced but jobs requiring digital literacy skills, analytic skills and skills of developing new software and intelligent hardware, will emerge as the new requirement in the industry.

In future, wells may also be equipped with smart technologies that enable them to initiate and participate in conversations to increase performance using social tools such as Chatter. A well may, for example, initiate a discussion thread when there is a possible problem such as high temperature reading or abnormal vibration. The idea is for the well to initiate the dialogue, similar to how a patient calls for a doctor. Smart analytics can then pull specific people with the right expertise into the discussion forum to solve the problem collaboratively.

The vision is to have an unmanned control centre powered by the platform with artificial intelligence coordinates operation in real time, bringing together supply and demand. This operating model can significantly increase the life-cycle of O&G assets while driving efficient operations and HSE performance.

EXPECTATIONS FROM ENGINEERS

Digitalisation of the O&G industry is only possible with the active involvement of engineers. However, the expectations from engineers may differ in the digitalisation era.

- 11,900 new data analysts are needed in the energy industry to make sense of big data. 90% of these new jobs require excellent digital skills, which are different from engineering skills of the past. The expectation is to have digital literacy and scientific skills with the ability to interpret and turn information into key decisions. Future engineers need to be comfortable working with new digital tools, analytics and to understand behavioural economics.
- Engineers need to develop just-in-time skills and to use technology to support new skills. In future, they will not only be relying on years of experience but they will also need to acquire just in-in-time skills and to apply these directly at work.

- With digitalisation, the industry will rely on an open innovation model to solve problems in innovative manner. Digital innovation will be a highly sorted out skills needed in an engineer.
- In order to be successful, engineers will have to remain agile to adapt to the changes and be flexible enough to respond quickly to dynamic technology changes.
- Certainly, there will be an increasing need for engineers to work on providing only the right data to the right people at the right time, in an easily digestive format.
- To be successful, engineers must remain agile to adapt to current changes and be able to respond quickly to dynamic technology changes.

CONCLUSION

In order to gain a competitive advantage, O&G companies will need to develop a strategic plan for the use of digital technology, over the next three to five years. With the current market situation of volatility and uncertainty, these companies will need to focus on transformational efforts required to create a winning strategy. They must remain agile to adapt to current changes and be flexible enough to respond to the dynamic technology changes and grasp the full potential of digitalisation. The expectations from engineers to enable this new paradigm shift are enormous; they will be expected to remain agile and lead the change process.

"It is not the strongest or the most intelligent who will survive but those who can best manage change," – Charles Darwin. ■

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Author's Biodata

Ir. Davendren Vereya, *graduated with a Mechanical Engineering Degree and MBA in Construction Management. He has involved in many engineering projects in the oil & gas industry as mechanical engineer, piping engineer & application coordinator. He is also a committee member in Oil, Gas, Mining Technical Division, IEM.*

CONGRATULATIONS

The IEM Council records its heartiest congratulations to IEM President **Ir. Dr Tan Yean Chin** for being awarded the **SME Icon Award 2017** from the **Malaysian Service Providers Confederation (MSPC)** on **2 October 2017**.

The IEM Council records its heartiest congratulations to IEM Past President **Y.Bhg. Dato' Ir. Dr Gue See Sew** for the following achievements:

1. **Conferred the SME Icon Award 2017 from the Malaysian Service Providers Confederation (MSPC) on 2 October 2017.**
2. **Conferred the CEO of the Year Award 2017 from the Construction Industry Development Board (CIDB) on 18 September 2017.**
3. **Appointed as Chair of the International Professional Engineers Agreement (IPEA).**

ANNOUNCEMENT

Kindly be informed that effective **1 January 2018**, there will be an increase in the Professional Interview (PI) fee as well as the PI Processing Fee as follows:

- Processing Fee: RM100.00
- PI Fee for Graduate Member: RM200.00
- PI Fee for Non-Graduate Member: RM300.00

Seismic Experts Explain Key Technical Issues in the Draft of National Annex to Eurocode 8

CIVIL AND STRUCTURAL ENGINEERING TECHNICAL DIVISION

reported by

Daniel Looi

Ir. Prof. Dr Jeffrey Chiang

A 2-Day workshop on seismic analysis methods for regions of low-to-moderate seismicity, with emphasis on Eurocode 8 and the proposed National Annex for Malaysia, was held at the Armada Hotel in Petaling Jaya on 11-12 April, 2017. The aim was to explain the distinctive features of the post-public comment draft National Annex prepared by IEM and the justifications for their adoption, citing results of studies that had been undertaken along with recommendations by world literature.

It saw a record attendance of 165 participants, comprising 90% consulting engineers and the remaining 10% others, including academicians. IEM had invited international and local experts to give presentations during the workshop. They included (in alphabetical order) as below:

- Professor Azlan Adnan (Universiti Teknologi Malaysia): He leads local experts in undertaking probabilistic seismic hazard analysis in different parts of Malaysia.
- Professor Robert Geller (retired, University of Tokyo, Japan): World expert in earthquake sciences.
- Ir. Adjunct Specialist M.C. Hee (MC Hee & Associates, Malaysia): An expert in earthquake engineering and mentor of the team which drafted the NA. He has his own structural design consulting firm and is a leading figure in code developments.
- Professor Nelson Lam (University of Melbourne, Australia): Experienced in the drafting of earthquake codes, with some 30 years' engagement in earthquake engineering and structural dynamics research. He was a member of the code committee developing the Australian Standard for seismic actions and led the drafting of the Malaysia NA.
- Ir. Lim Ek Peng (Hashim & Neh Consultants, Malaysia): A leader in the structural design of buildings and a key contributor in the drafting of the Malaysia NA.
- Professor Kyriazis Pitilakis (Aristotle University of Thessaloniki, Greece): A world leader in geotechnical earthquake engineering who is co-leading the continuing development of Eurocode 8.
- Dr Hing-Ho Tsang (Swinburne University, Australia): A key contributor to the drafting of the NA, he also wrote a book on earthquake hazard assessment (Tsang and Lam, 2010).

Figure 1: Presenters and session chairs (from left), Prof. Azlan Adnan, Dr Hing-Ho Tsang, Prof. Nelson Lam, Prof. Kyriazis Pitilakis, Prof. Robert Geller, Ir. Adjunct Specialist MC Hee, Ir. Prof. Jeffrey Chiang, Ir. K.P. Mun and Ir. E.P. Lim

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In his opening address, Professor Lam outlined the topics that the workshop would focus on:

1. Justification for the minimum design PGA value of 0.07g for the peninsula, Sarawak and Western Sabah, and 0.12g for Central and Eastern Sabah.
2. Justification for the use of a response spectrum model which is different to Eurocode 8 Type 1 and 2 response spectra.
3. Justification for the site factor model which features the use of the site natural period as a parameter for site classification and determination of the site amplification factor.
4. A review of seismic zonation maps that were originally proposed by IEM in the draft NA (2015), maps proposed by Professor Felix Tongkul during public comment period (2016), maps by a team led by UTM (2016) and maps submitted by IEM as a proposal to reach a consensus (2017).

Professor Lam presented a table which listed important references in support of the minimum design PGA value of 0.07g to allow for uncertainties in a stable (intraplate) environment.

*Table 1: Presented by Prof. Lam citing support from world literature in specifying a minimum design PGA value of 0.07g (*Note: Probabilistic Seismic Hazard Assessment (PSHA), Peak Ground Acceleration (PGA)*

Ref.	Literature References	Comments/ Recommendations
1.	Mulargia, Stark & Geller (2017)	"The **insufficiency of the available seismicity data** means that it is **highly questionable that PSHA can provide reliable and accurate hazard** analyses".
2.	Lam, Tsang, Lumantarna Wilson (2016)	**Minimum design PGA value of 0.07g** is recommended for stable regions.
3.	Wilson (2015)	**Minimum design PGA value of 0.08g** is recommended for the **stable region of Australia**.
4.	Tongkul (2016)	**Design PGA value of 0.05g - 0.1g** is recommended for **Peninsular Malaysia and Sarawak**.
5.	Pinto (2000)	Minimum design PGA value of **0.07g - 0.1g**.

The concept of taking the design PGA value as 2/3 of the value predicted for a return period of 2,475 years, was also explained, citing recommendations in the textbook authored by Professor Michael Fardis (Fardis, 2009), chairman of the CEN sub-committee CEN/TC250/SC8 for Eurocode 8: "Design of Structures for Earthquake Resistance" (1999-2005). Prof. Fardis led the development of its six parts into European Standards; he is the Director of Structures Laboratory, Civil Engineering Department, University of Patras, Greece. Given that local buildings will remain non-ductile instead of going for capacity design principles, then global collapse in a very rare event will not be prevented even though the Design Seismic Actions will take care of Life Safety (no local collapse).

In this case, we have to do something to the strength of the building. To take care of Collapse Prevention we must design for a 2% probability of exceedance in a design life of 50 years (i.e. designing for 2,475-year Return Period).

In explaining the rationale behind the adoption of the response spectrum model that had been written into the Draft NA, Professor Lam made references to long-distance earthquake hazards generated by high seismic sources in the Sumatran Island, and subduction sources offshore of Sumatra as well as from the Philippines in combination with local incidences of small and medium magnitude intraplate earthquakes. This unique combination of seismic hazard not commonly seen in Europe, explained the need to specify a response spectrum model which was different from the standard Eurocode Type 1 and 2 response spectrum models (*Lam et al., 2009*).

For the same reason, Singapore had redefined the shape of the response spectrum, neither using EC8 Type 1 nor Type 2 in its provisions Clause 3.2.2.2(2)p Note 1, to allow for long distance seismic hazards affecting the city state. Figure 2 shows the normalised spectrum shape compared to the proposed response spectrum model in the Malaysia NA and the generic EC8 for Europe and the Singapore NA.

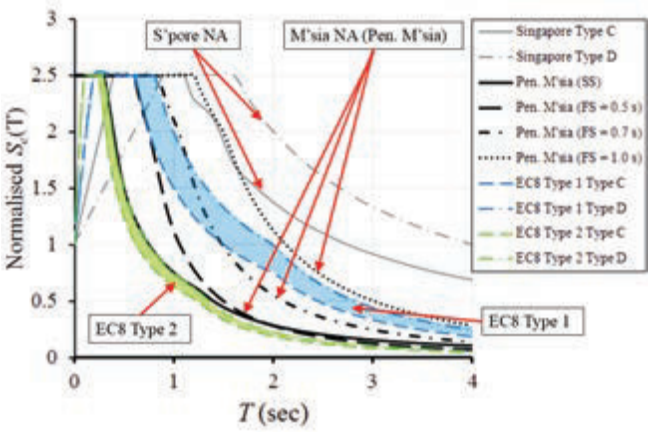

*Figure 2: Normalised spectrum shape comparison of the proposed response spectrum model in the Malaysia NA (Peninsular Malaysia) with the generic EC8 for Europe and the Singapore NA. *Note: Stiff Soil (SS) and Flexible Soil (FS) with site natural period*

In a later session, Dr Tsang presented the site factor model (*Tsang et al., 2017*) which had been written into the draft National Annex. The model incorporated the site natural period (which took into account the depth of soil sediment to bedrock) as a modelling parameter in view of its importance in controlling the potential occurrence of resonance with non-ductile construction.

Professor Pitilakis, who is also Vice President of the European Association of Earthquake Engineering (EAEE), had led the drafting of Eurocode 8 in relation to geotechnical matters. Both speakers explained that the inability of the current site factor model in EC8 to properly address deep site geology was a matter of concern. It is planned to have the next edition of Eurocode 8 to be revised to the form (*Riga et al., 2016; Pitilakis et al., 2013; Pitilakis et al., 2012*) which is consistent with the model proposed by IEM.

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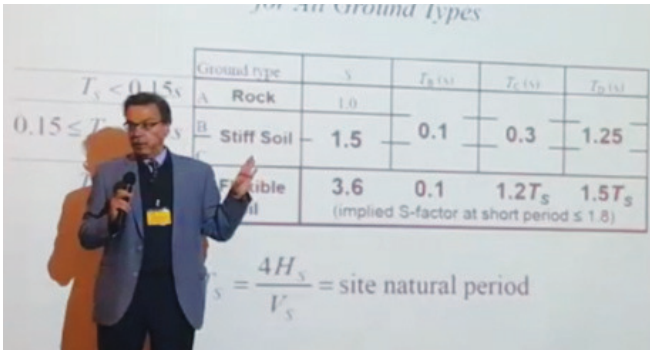
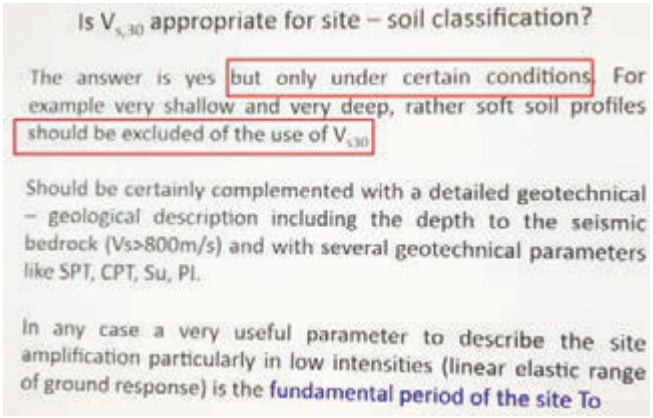


(a)



(b)

Figure 3: (a) Prof. Pitilakis spoke in favour of the proposed site factors model NA. (b) Slide presented by Prof. Pitilakis cautioning use of current provisions in EC8 as basis of soil classification

On the second day of the workshop Prof. Lam presented the seismic zonation map that had been written into the draft NA prepared by IEM, along with a map prepared independently by Prof. Tongkul (Tongkul, 2016). Prof. Azlan then presented the seismic hazard map generated by conventional probabilistic seismic hazard analysis (PSHA) prepared by a team led by Universiti Teknologi Malaysia (see Figure 4).

In his presentation, Professor Geller pointed at the great uncertainties of PSHA in view of the poor track record of the methodology in terms of predicting earthquake hazards for the future (*Stein et al. 2012, 2013; Mulargia et al., 2017*). The credibility of the predictions is further compromised in the case of Malaysia, which has only 38 years (from 1979) of complete instrumental record (Che Abas, 2001; MOSTI, 2009) on a small land area showing 2 earthquakes exceeding magnitude 5 (12 February, 1994, & 1 May, 2004) occurring in the Peninsula and Sarawak combined. He advocated the use of common sense as opposed to believing in information generated by the computer as there is definitely insufficient information to precisely predict the location of future earthquake occurrences. An approach based on averaging global rate of occurrence of earthquakes in tectonically stable regions *(Lam et al., 2016)* is supported. Figure 5 shows the slide presented by Prof. Geller citing the highly uncertain nature of PSHA.

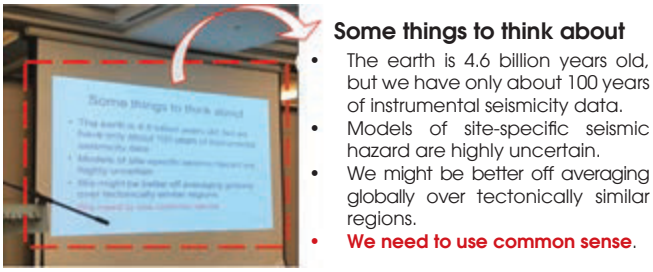


Figure 5: Slide presented by Professor Geller, citing the highly uncertain nature of PSHA

In a bid to reach a consensus while addressing the concern of modelling uncertainties, Prof. Lam presented a seismic zonation map (Figure 6) which featured a minimum design PGA value of 0.07g for the peninsula, Sarawak and west Sabah (including Kota Kinabalu), and 0.12g for central & eastern Sabah to avoid leaving out areas with a design PGA value which was too low, as featured in results of PSHA presented by the local UTM-led teams.

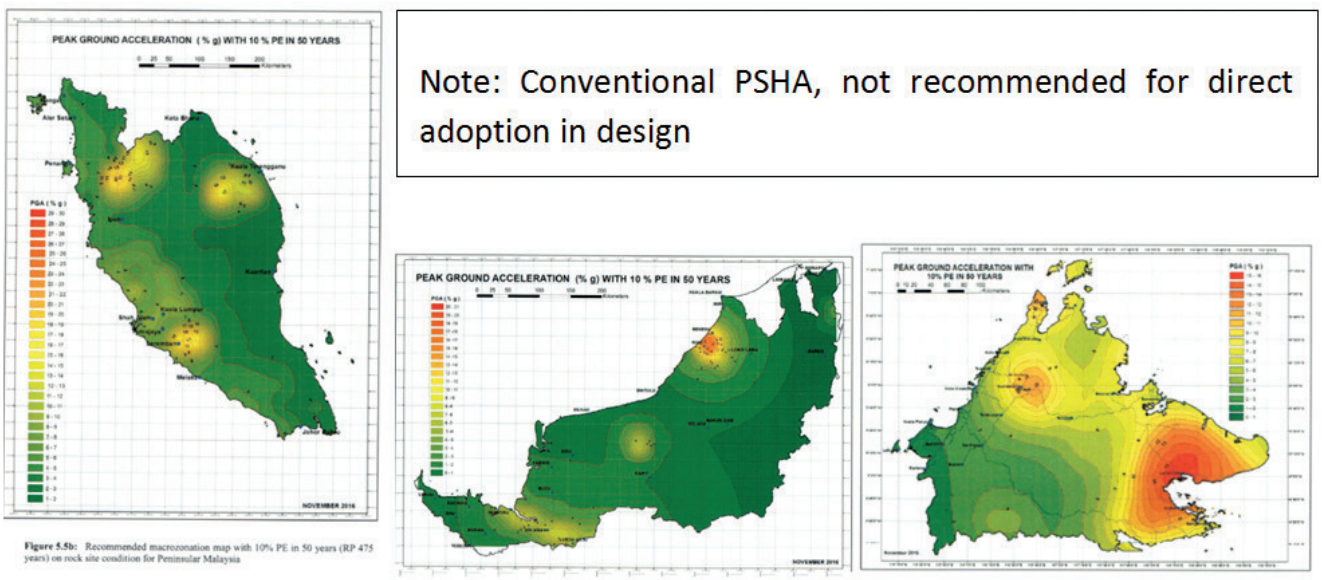


Figure 4: Seismic hazard contours generated by conventional PSHA for the peninsula, Sarawak and Sabah prepared by local team led by Prof. Azlan

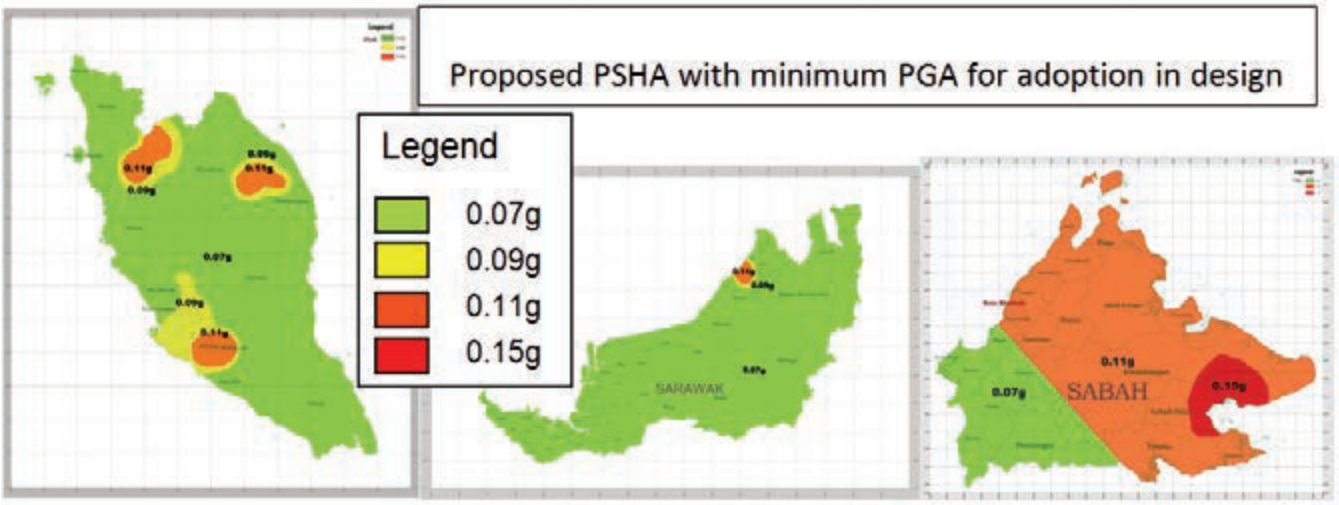


Figure 6: Proposed seismic hazard contours featuring a minimum design PGA value to reach consensus

CLOSING REMARKS

What was demonstrated at the 2-day workshop was that the draft National Annex had incorporated contemporary principles of seismic hazard assessment, taking into account the development of knowledge and practice since Eurocode 8 was first developed two decades ago. Particular attention was devoted to the importance of maintaining the following key features in the draft National Annex by IEM:

1. A minimum design PGA value of 0.07g (0.12g for central & east Sabah) irrespective of results from PSHA because of considerable modelling uncertainties.
2. Response spectrum models which deviate from EC8 Type 1 and 2 because of the need to address both local and long distance seismic hazard and.
3. A site classification and site amplification model which incorporates the site natural period as a design parameter (as opposed to only considering the upper 30 m of soil sediments). ■

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One-Day Course on the Design of Oil & Gas Fixed Offshore Platform

OIL, GAS AND MINING TECHNICAL DIVISION

reported by

Ir. Shazlan Rahman

In Malaysia, most oil and gas reservoirs are located offshore, from 50m to over 1,000m under sea level. Clearly, it will require cunning structural engineering to extract the hydrocarbon from these reservoirs.

For reservoirs in shallow water (less than 300m), the preferred method is using fixed offshore platforms (Figure 1).

Figure 1: Fixed offshore platform (photo obtained from https://commonswikimedia.org)

Designing an offshore structure requires a lot of technical knowledge and skills. Unfortunately, since the drop in global oil price three years ago, the number of young structural engineers being recruited is almost zero. As a result, there will be a generation gap in structural engineers when the oil price picks up again.

Realising this, IEM's Oil, Gas & Mining Technical Division (OGMTD) organised a one-day course on "The Design of Oil & Gas Fixed Offshore Platform", aimed at providing exposure and basic knowledge on how to design an offshore platform.

The course was held on 12 August, 2017, at Wisma IEM. Dr Venkatesh Rajagopalan, the Regional Manager of Oglaend Industries, who has more than two decades' experience in the offshore industry, was invited to present the course (Figure 2). The course was chaired by Ir. Shazlan Rahman, a committee member of the IEM OGMTD.

Figure 2: Dr Venkatesh making the presentation

Dr Venkatesh started with an overview of the Oil & Gas industry, including how the industry started 150 years ago and how the technology had evolved throughout the years. He then went through the various types of oil and gas structures, explaining the roles of these structures in the upstream, midstream and downstream sections of the industry.

He then discussed the components of fixed offshore platforms (Figure 3, Page 34). In general, an offshore platform comprises three parts:

1. Topsides: Where the equipment, utilities, office and accommodation are located.
2. Jacket: Its main function is to support the topsides and to protect it against waves.
3. Foundation: Usually made of steel piles.

For each of the structural components, Dr Venkatesh discussed the analyses which must be performed during the in-service and pre-service conditions.

In-service condition is where the structures have been completely installed and are in operation. The main analyses that are carried out for this condition are static analysis, fatigue analysis, and dynamic analysis.

On the other hand, pre-service condition is the condition of the structure during installation. Some of the analyses carried out are load-out analysis, transportation analysis and lifting analysis.

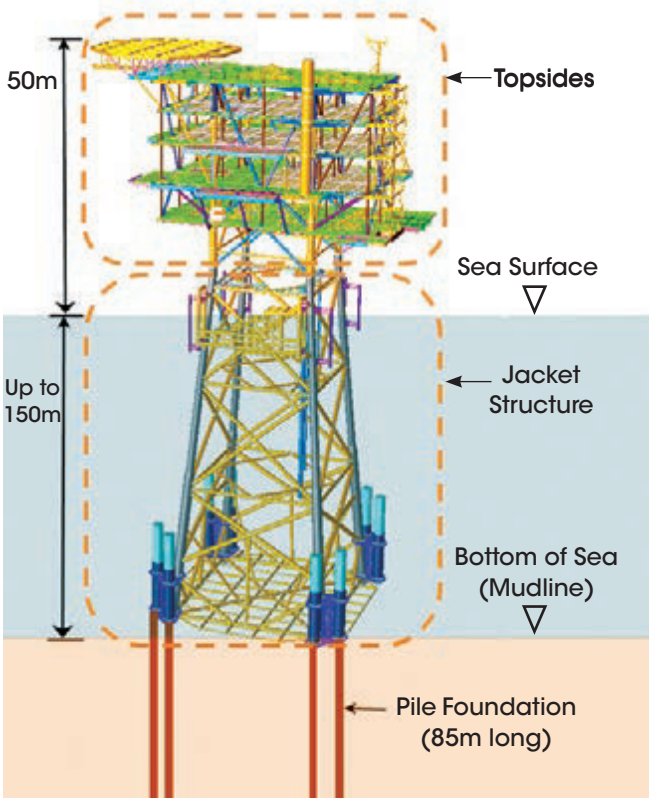


Figure 3: Components of a fixed offshore platform

For each in-service and pre-service condition, Dr Venkatesh discussed the loading that needed to be accounted for, such as gravity load, environmental load and accidental load. He also explained the design codes that should be considered, such as the American Petroleum Institute (API) standards and American Institute of Steel Construction (AISC).

Figure 4: Ir. Shazlan presenting Dr Venkatesh with a token of appreciation

The course ended with Ir. Shazlan presenting a souvenir and a certificate to Dr Venkatesh as a token of appreciation (Figure 4). IEM OGMTD hopes the course will inspire young structural engineers to join the Oil & Gas industry. ■

Prediction and Performance of Construction in Soft Ground

GEOTECHNICAL ENGINEERING TECHNICAL DIVISION

reported by

Ir. Yee Thien Seng

Professor Andrew Whittle of the Massachusetts Institute of Technology (MIT) conducted a one-day seminar on Prediction & Performance of Construction in Soft Ground at the C&S and TUS Lecture Room in Wisma IEM, Petaling Jaya, on 15 January, 2016.

Jointly organised by IEM's Geotechnical Engineering Technical Division and the Malaysian Geotechnical Society, it was attended by 76 participants.

Prof. Whittle started by demonstrating the ability of the MIT-E3 constitutive soil model in simulating the responses of natural Boston Blue Clay (BBC) samples under a variety of laboratory test paths that better matched measured behaviours than was possible using the pioneering Modified Cam-Clay (MCC) constitutive soil model. MCC does not allow for anisotropy and it also computes excessive dilation, leading to overly high undrained shear strengths in simple shear and triaxial extension. He then satisfactorily repeated the same with the updated MIT-S1, a unified material model for clay and sand. He also touched on the Mohr-Coulomb (MC) model which he regarded as "ancient".

With the MIT-E3 and MIT-S1 models incorporated into finite element (FE) packages and executed in 2-dimensional (2-D) and 3-dimensional (3-D) modes, Prof. Whittle showed results from analyses for a number of actual underground constructions. These involved supported excavations for deep basements, cut-and-cover tunnels and bored tunnels in soft ground, comprising varied support systems as well as with complex construction sequences such as the Stacked Drift Cavern excavation for a tunnel constructed in Puerto Rico. Attributes such as ground deformations and loads in structural support elements generally matched well with those values measured by field instrumentations. The back-evaluation for the 2004 Nicoll Highway tunnel collapse in Singapore was, however, less satisfactory. Professor Whittle found that the demands of conducting 3-D analyses exceeded the capabilities of FE software packages using conventional Direct or Iterative Solvers and could, instead, only be accomplished with the use of Parallel FE computation with Scalable Algorithms on a Scalable Computing infrastructure.

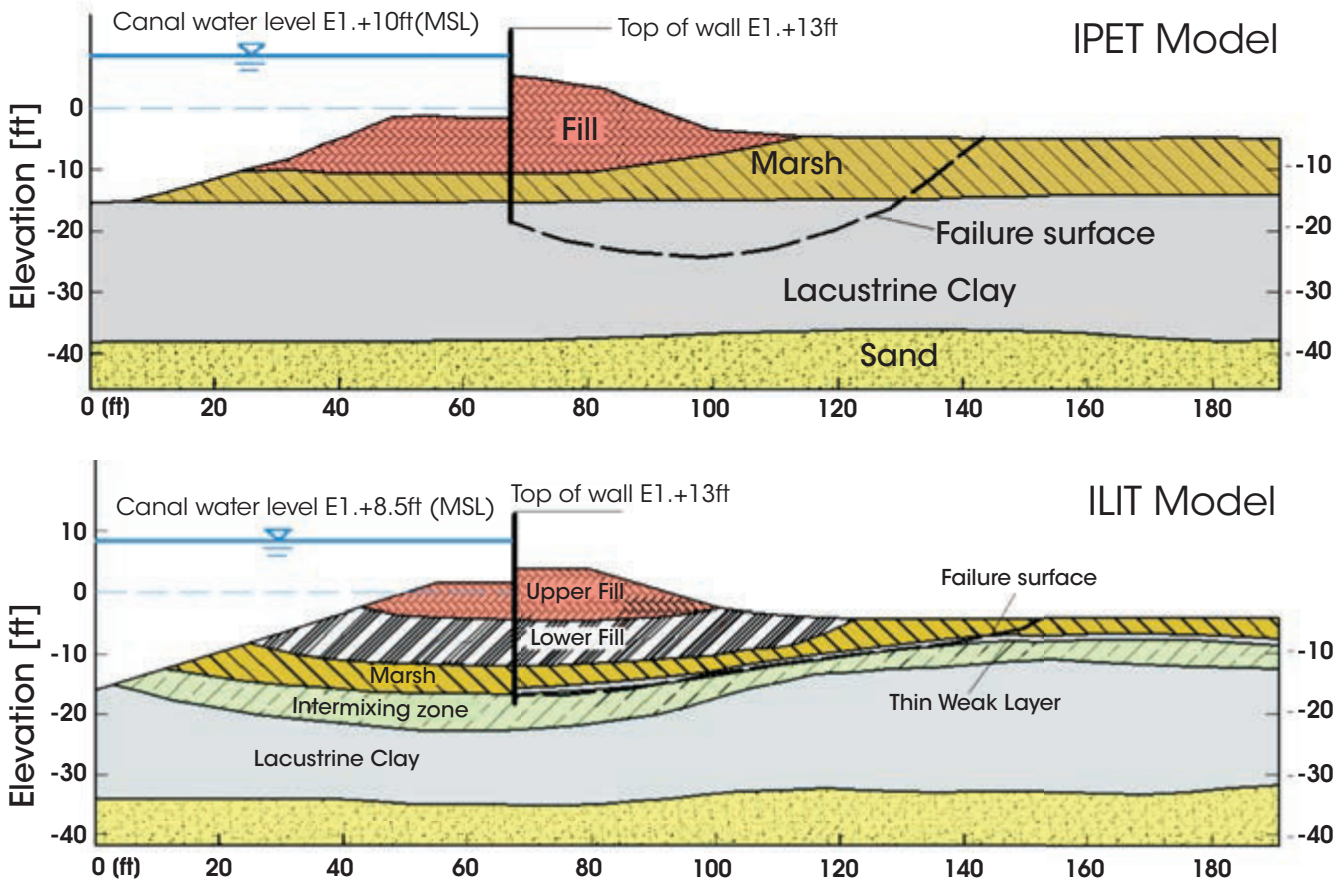
Then Prof. Whittle dealt with the issue of evaluating undrained stability of embankments on soft ground. He demonstrated the superiority of the Numerical Limit Analysis (NLA) over the legacy Limit Equilibrium Method (LEM) as well as the FE method which had difficulties coping with shearing/deformations concentrated along discrete planes in the ground. The NLA is a hybridised limit analysis relying on effective stresses from the FE method to determine shear strength reductions required to "induce" the collapse of earth structures and is suited to rigid-perfectly plastic problems.

He emphasised the importance of first establishing the correct stratigraphy in the ground for satisfactory analyses to be carried out, by showing the New Orleans Hurricane Katrina levee failure case where 2 authoritative organisations produced starkly different stratigraphies from the same set of site investigations data (see diagram).

On the subject of settlement computations for embankments constructed over soft soils, Prof Whittle demonstrated the importance of employing soil models that reproduce the lateral spreading behaviour in the underlying soft soils during consolidation to ensure reasonable computed settlements. The matches between actual field measurements over time and computed ones were satisfactory without the need to include creep in the computations even when the field data on settlements and pore water pressures suggest the existence of creep during consolidation. He pointed out that there were serious limitations with most viscoplastic soil models in dealing with soil creep behaviour and disclosed the availability of a new generalised Elasto-Viscoplastic (EVP) model – the MIT-SR model with the ability to represent all rate dependent clay behaviours.

Finally with availability of capable computational tools to the industry, Prof Whittle expounded the benefits of conducting real-time review of performance data collected and the updating and calibration of analysis models in the course of construction of Temporary Earth Retaining Structures (TERS) to reduce the risks of a catastrophic failure.

17th Street Canal: Stratigraphy – Two Versions



Two different ground stratigraphies from same set of site investigations data

Wireless networks allow a dense array of sensors to be deployed to monitor the whole structure simultaneously. This allows captured measurements of structural loads, deformations and pore water pressures to be accessed online to permit real-time reviews of the state of the engineering system. Imaging devices and sensors mounted on remotely controlled multi-rotor copter drones would facilitate inspection and mapping to areas of the construction that are of interest to the engineer, with little attendant risks to personnel.

The seminar was concluded at 4.30 p.m. ■

IEM DIARY OF EVENTS

Title: IEM Form of Contract for Civil Engineering Works & IEM Form of Contract for Mechanical and Electrical Engineering Works

25 Nov 2017

Organised by: Sub Committee on Engineering Contracts of Standing Committee on Professional Practice
Time : 9.00 a.m. - 5.30 p.m.
CPD/PDP : 7

Title: Talk on "Healthcare Engineering – Optimizing The Healthcare Delivery Through Interdisciplinary Technology Integration"

29 Nov 2017

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

Title: IEM Form of Contract for Civil Engineering Works & IEM Form of Contract for Mechanical and Electrical Engineering Works

5 Dec 2017

Organised by: Sub Committee on Engineering Contracts of Standing Committee on Professional Practice
Time : 9.00 a.m. - 5.30 p.m.
CPD/PDP : 7

Title: ICTSIG Digital Class (December 2017) - Introduction to PYTHON Programming (Part 1)

9 Dec 2017

Organised by: Special Interest Group - Information and Communications Technology (ICT)
Time : 11.01 a.m. - 1.00 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.

9th Annual General Meeting of Electronic Engineering Technical Division

ELECTRONIC ENGINEERING TECHNICAL DIVISION

reported by

Ir. Dr Wong Yew Hoong

The 9th AGM of eEtd, attended by 30 members, was held at Penang Skills Development Centre (PSDC) in Penang on the 1 July, 2017. Its Chairman, Ir. Bhuvendhraa Rudrusamy, gave a welcome speech and thanked all the members who were present, especially those who had come from Miri and Kuala Lumpur.

He also expressed gratitude to committee members for their support and dedication by organising various activities which benefitted IEM members and cultivated engineering innovation in undergraduate students.

Ir. Bhuvendhraa and Ir. Assoc. Prof. Dr Khor Jeen Ghee were re-elected eETD Chairman and Deputy Chairman respectively. The new line-up of committee members (2017/2018) is as follows:

Chairman	Ir. Bhuvendhraa Rudrusamy
Deputy Chairman	Ir. Assoc. Prof. Dr Khor Jeen Ghee
Honorary secretary cum treasurer	Ir. Dr Lee Choo Yong
Committee members	Ir. Dr Wong Yew Hoong Dr Yeap Gik Hong Dr Leow Cheah Wei Dr Huzein Fahmi Hawari Ir. Dr Mui Kai Yin Mr. Sivarama Rajah Mr. Tiong Teck Chai Mr. Lau Heng Kar
Advisor	Ir. Bernard Lim Kee Weng

It was announced that eETD recorded an increase in membership from 585 in the previous year to 683. Membership breakdown, as of 30 June, 2017, is as follows:

Membership Grade	Number of Members in eETD
Fellow	6
Senior member	3
Member	176
Companion	13

Membership grade	Number of Members in eETD
Graduate	389
Incorporated	4
Associate	4
Student	88

The eETD held 11 committee meetings from August 2016 to June 2017 and organised 6 technical talks by scholars or engineers worldwide, held mostly at Universiti Sains Malaysia (USM) for the convenience of engineers working in the Bayan Lepas industrial zone. Technical talk details are shown in the table below:

Date	Title	Speaker	Organisation
12 Oct, 2016	Ethics and Professional Engineering Practice	Ir. Bernard Lim	Tactilis Sdn. Bhd.
19 Oct, 2016	Globalisation & Challenges Faced by Future Graduates/ Engineers	Ir. Prof. Dato' Dr Chuah Hean Teik	UTAR
15 Dec, 2016	VLSI Thermal Management with On-Chip Digital Temperature Sensors	Prof. Dr Ng Wai Tung	University of Toronto, Canada
24 Feb, 2017	Overview of IC Packaging Concepts (Materials and Methods)	Dr Sim Lim Chong	Robert Bosch
20 Apr, 2017	Introduction to Theory of Inventive Problem Solving (TRIZ) and E-Waste	Dr Yeap Gik Hong & Ir. Bhuvendhraa Rudrusamy	KDU Penang & Altramax Technologies Sdn Bhd
17 May, 2017	Acoustic Engineering	Mr. Kee Chin Min	Knowles Electronics Malaysia Sdn. Bhd.

In continuance of the 2015/2016 session, The University of Nottingham, Semenyih Campus, proposed to promote and recognise extra-curriculum and activities for students. The merits will be captured as Student-CPD to encourage students to participate in personal development and lifelong learning in areas critical to their future professional career in real world career pursuits. IEM eETD will sponsor a 1-year student membership for the most active student by the end of students' year calendar. This initiative was led by Ir. Assoc. Prof. Dr Khor Jeen Ghee.

IEM eETD also organised 3 technical visits for 2016/2017: SilTerra Kulim on 24 August, 2016, Knowles Electronics Penang on 16 February, 2017, and Honda Batu Kawan on 24 May, 2017. These visits were moderated by Dr Huzein Fahmi Hawari, Dr Leow Cheah Wei, Ir. Dr Lee Choo Yong and Dr Muhammad Nasiruddin bin Mayhuddin, respectively.

Participants benefitted in terms of attaining knowledge shared by the industry on the latest technology related to electronics and had a chance to visit the manufacturing floor.

IEM eETD also co-organised IEEE-IEM eETD Mini Colloquium with IEEE Penang Joint Chapter (IEEE Penang) on 24 September, 2016, in EGC foyer, Penang Skills Development Center (PSDC), Bayan Lepas, Penang. IEEE Penang is the IEEE chapter based in Penang, affiliated to technical societies of Electron Devices (ED), Microwave Theory and Techniques (MTT) and Solid-States Circuits (SSC). The mini colloquium comprised talks delivered by IEEE lecturers Dr Hideto Hidaka, Dr Makoto Ikeda and invited speaker Dr Alastair Trigg. The 30 participants comprised IEEE and IEM members as well as engineers from electronics companies in Penang. The first two sessions were chaired by IEEE Penang chairman Dr Wong Peng Wen and the third session by eETD chairman Ir. Bhuvendhraa Rudrusamy.

The eETD also continued to sponsor the Best Paper Award, worth RM1,500, in Innovate Malaysia Design Conference (IMDC). This multi-discipline engineering design conference and competition was supported by technological companies. Most of the eETD committee members were involved in reviewing the selected technical paper for this award which was open to all undergraduate

Membership Drive at AIMST University

Membership Drive at UniMAP

Malaysian students in engineering and computer science to promote the culture of innovation.

The grand finale was held in Equatorial Hotel Penang on 8-9 August, 2016. A total of 264 teams from various universities took part in the IMDC. These included USM, UniMAP, INTI, UTAR, UTP, IIUM, UiTM, UPM, UM, MMU, UKM, UniKL, USIM, Monash University Malaysia, Nottingham University Malaysia, UPNM, UMP, UTHM, UTM, Southampton University Malaysia, UNIMAS, Swinburne University Malaysia and Curtin University Malaysia.

The event also involved 9 industry tracks, namely Altera (now part of Intel), Intel, Keysight, National Instruments, Siltera/CEDEC, MathWorks, Microsoft, Motorola Solutions, and ViTrox. Eventually, 45 finalist teams submitted technical papers for IEM Best Paper Award and DreamCatcher Best Demo Video Award, which were sponsored by IEM and Dreamcatcher Consulting Sdn. Bhd., respectively.

To inspire the university students and young engineers to pursue engineering as career choice, IEM eETD organised 2 InspireMe Talks: "Engineering Career Development as Techno-Entrepreneur, Academic and Individual Contributor" on 8 December, 2016, and "How to Thrive as an Engineer" on 15 December, 2016.

For the first talk, the speakers were Mr. Ng Sang Beng (CEO, Aemulus Corporation Sdn. Bhd.), Prof. Dr Raymond Ooi (Professor, University of Malaya) and Mr. Ooi Eng Hun (Principal Engineer, Intel Corporation). For the second talk, the speaker was Dr Hari Narayanan (Motorola Solutions Sdn. Bhd.)

IEM eETD continued to work with the various institutions of higher learning on its student membership drive and extended membership drive to professionals of various companies during the technical talks and technical visits.

eETD will continue to organise technical talks and technical visits, hold membership drives, update the website and Facebook and hold seminars and workshops for university students, university-level competition (ENGINOVATE), national-level competition (IMDC), eETD networking programming, and many more.

eETD would also like to thank IEM Penang Branch committee and secretariat for the support. ■

CONGRATULATIONS

Our heartiest congratulations to:

*Ir. Dr Leong Wai Yie** on being conferred the following awards:

1. The ASEAN Meritorious Science Award 2017 from The ASEAN Committee on Science and Technology (COST).
2. The Top Research Scientist Malaysia 2017 from Academy of Sciences Malaysia (ASM).

***Ir. Gopal Narian Kutty** on being appointed as Senior Director, Cawangan Kejuruteraan Mekanikal (CKM) Ibu Pejabat JKR on 16 October 2017.

Congratulations to following members on their respective conferments by **Tuan Yang Terutama Yang di-Pertua Negeri Sabah, Tun Datuk Seri Panglima (Dr.) Haji Juhar Bin Datuk Haji Mahiruddin (S.M.N, S.P.D.K, P.G.D.K, P.J.N, A.S.D.K, J.P.)** on his Excellency's 64th Birthday on 7th October 2017.

***Datuk Ir. Hj. Yahiya Bin Awang Kahar** (Director of Jabatan Pengairan dan Saliran, Sabah cum Branch Chairman of IEM Sabah) and **Datuk Ir. Willis Ansoi** (Director of Jabatan Air Negeri Sabah) on being conferred the state award of Panglima Gemilang Darjah Kinabalu (P.G.D.K.) which carries the title "DATUK"

***Ir. Lau Kin Swa** and **Mr. Dexter Lim Ming Guan** on being awarded Ahli Setia Darjah Kinabalu (A.S.D.K.)

Ir. Paul Yap Kok Wai (Immediate Past Chairman of Acem Sabah cum Executive Committee Member of Sea & IEM Sabah) on being awarded Ahli Darjah Kinabalu (A.D.K.)

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Sungai Lembing: El Dorado of the East

Ir. Dr Oh Seong Por

Ir. Dr Oh Seong Por *serves as a committee member at Standing Committee on Information and Publications at HQ and committee member of IEM Negeri Sembilan branch. He is a Deputy Managing Director at Samsung SDI Energy (Malaysia).*

In Spanish, El Dorado means "The Golden One", a title used originally to describe a chief of the Muisca natives who lived in the Andes Mountain in Columbia, South America. Over time, the name changed from a man's description to that of a lost city of gold and today, it's used to describe any place where wealth can be rapidly acquired.

In Malaysia, we too have our own El Dorado, an underground mine in Sungai Lembing, Pahang. The mining town, located approximately 40km from Kuantan, was rich in gold, tin and copper and small scale tin mining started as early as 15th century.

In 1888, a British company, Pahang Corporation, was awarded mining concession land of 2000 sq. miles to carry out underground mining. This marked the beginning of underground tin mining in the country. Mining activities intensified when Pahang Consolidated Company Limited (PCCL) took over from Pahang Corporation in 1906.

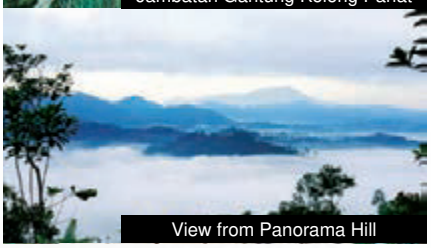
Sungai Lembing grew rapidly and became a prosperous town with a population of over 10,000 during its glory years. However, in 1985, the world price for tin collapsed, forcing PCCL to cease operations and transforming Sungai Lembing into a sleepy hollow.

Nevertheless, it has retained its unique charms. Wooden houses built for miners and rows of pre-war double storey shops still stand though uninhabited. The main road is lined with century-old trees and nearby Panorama Hill is a popular with hikers who come for fresh air, the sunrise and a spectacular view of the sea.

The biggest attraction though, is its subterranean network of underground mines which, at over 322km long and 700m deep, is the longest and deepest in the world. Even after mining went on for 100 years (1888-1985), Sungai Lembing still has an abundance reserve of tin. It really deserves the title, El Dorado of the East.

The world's longest and deepest underground mine

Jambatan Gantung Kolong Pahat



View from Panorama Hill

Entrance to the underground tunnel

Old mining equipment

On 3 June, my family and I visited mine. We took a train to the stop point and then walked into the underground tunnel. Electric lights provided visibility and the air was chilly. The walls were fortified with concrete to replace the original wooden 20X20cm pillars. The ground was wet and water flowed in through a side drain. We were in the 1st storey mine shaft, about 100 feet deep. The tunnels were dug in vertical storeys of approximately 30m apart. Only the 1st storey was accessible as the rest were flooded after the mine closed. Water pumps kept the 1st storey accessible to visitors and we were only allowed to explore 600m of the tunnel. We exited via another opening.

Enroute to the mine, we stopped at Jambatan Gantung Kolong Pahat, a hanging bridge across Sungai Kenau which connected to the miners living quarters. It was built around 1888, using cables from the mine shaft lifter and woods from the nearby forest. It was reconditioned in 2014. ■

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Kepada Semua Ahli,

SENARAI CALON-CALON YANG LAYAK MENDUDUKI TEMUDUGA PROFESIONAL TAHUN 2017

Berikut adalah senarai calon yang layak untuk menduduki Temuduga Profesional bagi tahun 2017.

Mengikut Undang-Undang Kecil IEM, Seksyen 3.8, nama-nama seperti tersenarai berikut diterbitkan sebagai calon-calon yang layak untuk menjadi Ahli Institusi, dengan syarat bahawa mereka lulus Temuduga Profesional tahun 2017.

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. Yap Soon Hoe
Setiausaha Kehormat, IEM,

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NURZALISA BINTI ABD RAHIM	BE HONS (UTM) (CIVIL, 2001)
ROZELAWTI BINTI ISHAK	BE HONS (UTM) (CIVIL, 2008)
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SULAIMAN BIN ISMAIL	BE HONS (UTM) (CIVIL, 1995)
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KEJURUTERAAN INSTRUMENTATION DAN KAWALAN	
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PERPINDAHAN AHLI

No. Ahli	Nama	Kelayakan
KEJURUTERAAN AWAM		
45340	WOO PEGGY	BE HONS (LEEDS) (CIVIL & STRUCTURAL, 2003)
43716	SHIRLEY HENG SHIN AI	BE HONS (UKM) (CIVIL & ENVIRONMENTAL, 2006)
39062	DEREK CHUA MING XUAN	BE HONS (CURTIN) (CIVIL & CONSTRUCTION, 2008)
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25287	MOHD IRWAN BIN JUKI	BE HONS (UTM) (CIVIL, 1998) ME (UTM) (STRUCTURE, 2001)
43741	NURUL AINAA BINTI SELAMAT	BE HONS (CIVIL, 2008)
26867	RIDUAN BIN YUNUS	BE HONS (UTM) (CIVIL, 2001)
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14770	ALLAN GUY GOONTING	BE HONS (MONASH) (CIVIL, 1991)
23496	LAI YET RU	BE HONS (UTM) (CIVIL, 2002)
40531	NURSYUHADAH BINTI MOHD ISA	BE HONS (UTM) (CIVIL, 2011)
28797	MOHD HADZMIR BIN YUSOFF	BE HONS (UTM) (CIVIL, 1991)
59909	DARRELL CHOONG THIAM CHYE	BE HONS (UPM) (CIVIL, 2012)
62058	TAN LAI WAI	BE HONS (UTM) (CIVIL, 2001) ME (UTM) (CIVIL-HYDRAUL & HYDROLOGY, 2003)
KEJURUTERAAN ELEKTRIKAL		
81277	SHARUL ANNUAR BIN SHARANI	BE HONS (UTM) (ELECTRICAL, 2014)
92323	MOHD KHAIRUL IZWAN BIN OTHMAN	BE HONS (UTM) (ELECTRICAL, 2008)
88842	HASAN SYUKRI BIN ABDUL HAMID	BE HONS (UniMAP) (ELECTRICAL SYSTEMS, 2012)
61125	MOHD AZRI AFIFI BIN MOHAMAD SANUSI	BE HONS (UTM) (ELETCRICAL, 2009)
43784	FENDY HASMARDY BINTI MOHAMAD	BE HONS (UNIMAS) (EKECTRICAL & ELECTRONIC, 2008)
90362	RUBAKANTHAN A/L SARAVVANAN	BE HONS (MULTIMEDIA) (ELECTRICAL, 2009)
34059	MOHD FADHIL BIN MUSA	BE HONS (UiTM) (ELECTRICAL, 2006)
23926	ZULFAZLI BIN MOHD ZIN	BE HONS (UTM) (ELECTRICAL, 2011)
60653	SHARMINIE BINTI ZAINUL ABIDIN	BE HONS (UM) (ELECTRICAL, 2005)
72633	HISHAMUDDIN BIN BUYONG	BE HONS (UiTM) (ELECTRICAL, 2013)
44353	AZRI BIN AB AZIZ	BE HONS (UTeM) (INDUSTRY POWER, 2011)
50142	FAIRUZ NIZAM BIN AZMI	BE HONS (UNITEN) (ELECTRICAL & ELECTRONIC, 2008)
47608	LEE MING YUEN	BE HONS (UNITEN) (ELECTRICAL POWER, 2010)
26223	FAIZAL ZAMANI BIN DOLLAH	BE HONS (UTM) (ELECTRICAL, 2007)
50183	MOHD AZELY BIN ABD KADIR	BE HONS (UTM) (ELECTRICAL, 2009)
88839	MOHD MAHZUZ BIN MAMAT	BE HONS (UKM) (ELECTRICAL & ELECTRONIC, 2012)
49712	NURSYUHADA BINTI RADZALI	BE HONS (UTHM) (ELECTRICAL, 2012)
59914	MOHD HAFIZ FIKRI BIN MAT DESA @ ISMAIL	BE HONS (UKM) (ELECTRICAL & ELECTRONIC, 2007)
22648	ISKANDAR HASZUAN BIN ISMAIL	BE HONS (UTM) (ELECTRICAL, 1998)
76040	MOHD SAZLI BIN SAAD	BE HONS (UiTM) (ELECTRICAL, 2002) ME (UTM) (ELECTRICAL-MECHATRONIC & AUTOMATIC CONTROL, 2007)
KEJURUTERAAN ELEKTRONIK		
26750	AMARUL BIN TALIP	BE HONS (UTHM) (ELECTRICAL, 2005)
28065	NICHOLAS PHILIP	BE HONS (UTM) (ELECTRICAL-TELECOMMUNICATION, 2006)
64565	MOHD SHUHAIBUL FADLY BIN MANSOR	BE HONS (SURREY) (ELECTRONIC, 2004) MSc (UM) (BIOELECTROMAGNETISM, 2011)
38364	MOHD AZLAN BIN ABU	BE HONS (ELECTRICAL-ELECTRONIC, 2008) ME (ELECTRICAL, ELECTRONIC & TELECOMMUNICATIONS, 2010)

TEMUDUGA PROFESIONAL

KEJURUTERAAN MEKANIKAL

79586	LIM JIN LUN	BE HONS (MULTIMEDIA) (MECHANICAL, 2010)
75284	SHASHI KUMAR A/L LINGAM	BE (PORTSMOUTH) (MECHANICAL, 1998)
18698	KARTHIGEYAN A/L NALLASAMY	BE HONS (UPM) (MECHANICAL/SYSTEM, 1999)
40642	MOHD ZAKIYUDDIN BIN MOHD ZAHARI	BE HONS (UTM) (MECHANICAL, 2011)
30859	SUBRAMANIAM A/L NITAMAKWUAVAN	BE HONS (UTM) (MECHANICAL, 2010)
61958	MOHAMAD TARMIZI BIN ABU SEMNA	BE HONS (UiTM) (MECHANICAL, 2001) MSc (USM) (BUILDING TECHNOLOGY, 2007)
30266	MOHD FIRDAUS BIN AB HAMID @ FAUZI	BE HONS (UTeM) (MECHANICAL-DESIGN & INNOVATION, 2011)
70460	WONG CHUN HOE	BE HONS (UniMAP) (MECHANICAL, 2013)
71109	MOHD KAMAL HAZIQ BIN KAMARUZAMAN	ME (MANCHESTER) (MECHANICAL, 2013)
94027	AHMAD ZAHIRUDDIN BIN SARUJI	BE HONS (UTM) (MECHANICAL-AUTOMOTIVE, 2008)
27659	LEE PEI YUEN	BE HONS (UKM) (MECHANICAL, 2006)

KEJURUTERAAN KIMIA

59131	LEONG KAH LOON	BE HONS (UMS) (CHEMICAL, 2008)
18298	ABD RAHMAN BIN KADIR	BE HONS (MALAYA) (CHEMICAL, 1992)
66387	ANG TIONG TUCK	BE HONS (SINGAPORE) (CHEMICAL, 2002)
22761	CHOK VUI SOON	BE HONS (UTP) (CHEMICAL, 2003)
79013	TEE PEI FANG	BE HONS (UPM) (CHEMICAL, 2007)

KEJURUTERAAN PERKHIDMATAN BANGUNAN

61140	MOHD FAIZAL NURHAKIM BIN MOHD ESAH	BE HONS (UTHM) (MECHANICAL, 2011)
93827	MUHAMMAD SIDDIQ BIN SALLEHUDDIN	ME (SHEFFIELD) (MECHANICAL, 2013)

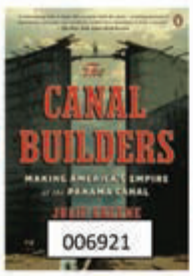
KEJURUTERAAN SENIBINA KAPAL

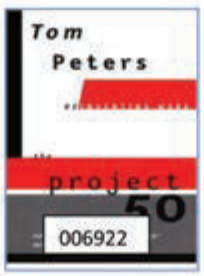
70364	MOHD FAKHRUDDIN BIN ZAINAL ASHIRIN	BE HONS (TASMANIA) (MARINE & OFFSHORE SYSTEMS, 2011)

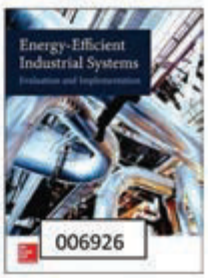
PERMOHONAN BARU/PEMINDAHAN MENJADI AHLI KORPORAT

No. Ahli	Nama	Kelayakan
KEJURUTERAAN AWAM		
56488	NOOR SHAFAWATI BT. MOHD BADARI	BE HONS (UTM) (ELECTRICAL, 2007)
KEJURUTERAAN KIMIA		
44028	GOH WAI BOON	BE HONS (UTP) (CHEMICAL, 2012)

LIBRARY BOOK ANNOUNCEMENT







CONTINUATION LIST FROM OCTOBER JURUTERA 2017 ISSUE

PEMINDAHAN KEPADA AHLI SISWAZAH

No. Ahli	Nama	Kelayakan
KEJURUTERAAN AWAM		
33188	NUR HIZARUDDIN BIN CHE AJID	B.E.HONS.(UITM)(CIVIL, 2010) M.E.(UTM)(CIVIL-TRANSPORTATION & HIGHWAY, 2012)
47944	ONN SZE YING	B.E.HONS.(UTAR)(CIVIL, 2011)
47844	OOI LER XUEN	B.E.HONS.(USM)(CIVIL, 2012)
72739	QAMARUL ARIFFIN BIN SAHID	B.E.HONS.(UNITEN)(CIVIL, 2015)
21173	REDZUAN BIN MD YUNUS	B.E.HONS.(UITM)(CIVIL, 2003)
88458	SANDESH SINGH BHATT	B.E.HONS.(SEGI)(CIVIL, 2016)
65875	SITI NORADILA BINTI ABD RAHMAN	B.E.HONS.(UITM)(CIVIL, 2014)
72330	TAN WEN JIA	B.E.HONS.(UTAR SG LONG)(CIVIL, 2017)
KEJURUTERAAN ELEKTRIKAL		
66614	CHEW QUIN SHEN	B.E.HONS.(UNITEN)(ELECTRICAL POWER, 2013)
48523	KOK CHIN CHAI	B.E.(WARNBOROUGH UNI.)(ELECTRICAL, 2001) M.E.(UTAR)(ELECTRICAL, 2016)
40851	LAHARAJA BIN LAHADI	B.E.HONS.(UMP)(ELECTRICAL-POWER SYSTEM, 2010)
66619	LEE CHIEN WU	B.E.HONS.(UNITEN)(ELECTRICAL POWER, 2013)
58158	LOGENDRAN A/L S. MARAGATHAMANI	B.E.HONS.(UNITEN)(ELECTRICAL POWER, 2016)
45137	MOHAMAD HISHAM BIN MOHAMAD NASIR	B.E.HONS.(UTP)(ELECTRICAL & ELECTRONICS, 2011)
34664	MOHD. GHAFFAR BIN GHAZI	B.E.HONS.(UTEM)(ELECTRICAL-POWER ELECTRONIS & DRIVE, 2009)
73917	MUHAMMAD AZIQ BIN HANUAR	B.E.HONS.(MMU)(ELECTRICAL, 2015)
72676	MUHAMMAD JAMILUL NA'IM BIN MOKHTAR	B.E.HONS.(UKM)(ELECTRICAL & ELECTRONIC, 2015)
42112	STELLA ANAK JAGAH @ SUBENG	B.E.HONS.(UTP)(ELECTRICAL & ELECTRONICS, 2010)
37426	TUNG SOON SENG	B.E.HONS.(UTAR)(ELECTRICAL & ELECTRONIC, 2009)
49187	VASUDEVAN A/L PRABHAKARAN	B.E.HONS.(UNITEN)(ELECTRICAL POWER, 2014)
KEJURUTERAAN ELEKTRONIK		
52024	FARHANAH BINTI AZMI	B.E.HONS.(UNIMAS)(ELECTRONIC-TELECOMMUNICATIONS, 2015)
66508	TEO YOW CHUAN	B.E.HONS.(MMU)(ELECTRONICS-TELECOMMUNICATIONS, 2016)
KEJURUTERAAN KIMIA		
66060	KHAW WEI CHUEN	B.E.HONS.(TAYLOR'S)(CHEMICAL, 2017)
45884	NURUL DARSANI BINTI AMAT DARBIS	B.E.HONS.(USM)(CHEMICAL, 2013)
72316	PARAMESPARAN PAVITHIRAH	B.E.HONS.(UTAR SG LONG)(CHEMICAL, 2017)
87019	TAN CHIN HOW	B.E.HONS.(UTAR SG LONG)(CHEMICAL, 2017)
73197	TAN YONG CHAI	B.E.HONS.(UMP)(CHEMICAL, 2015)
81056	VILAASHINI A/P NAGENDERAN	B.E.HONS.(UTAR)(PETROCHEMICAL, 2016)
KEJURUTERAAN MEKANIKAL		
50289	ABDUL HAZIQ BIN ABDUL MAJID	B.E.HONS.(UITM)(MECHANICAL, 2014)
39691	AHMAD AZRI BIN MOHD	B.E.HONS.(UTM)(MECHANICAL, 2014)
30414	ARMAN BIN ABDUL RASHID	B.E.HONS.(UITM)(MECHANICAL, 2010)
61286	AZWAN B. ABDULLAH	B.E.HONS.(UITM)(MECHANICAL, 2016)
50848	CHANG FOO KOON	B.E.HONS.(USM)(MECHANICAL, 2015)
65029	CHOONG PUI YUNG	B.E.HONS.(TAYLOR'S UNI.)(MECHANICAL, 2015)
46690	FARIS FIRDAUS BIN ABDUL MUTALIB	B.E.HONS.(UITM)(MECHANICAL, 2014)
55120	GOH WEI LOON	B.E.HONS.(UTHM)(MECHANICAL, 2016)
42893	HARTINI BINTI ABDUL RASHID	B.E.HONS.(UITM)(MECHANICAL, 2014)
55928	LAU LEE SIAN	B.E.HONS.(UTHM)(MECHANICAL, 2015)
53945	LEE KEAN YOONG	M.E.HONS.(UNI OF NOTTINGHAM)(MECHANICAL, 2015)
21908	LEE SEE PENG	B.E.HONS.(UTM-SPACE)(MECHANICAL, 2017)
80340	LEE YIN SIANG	B.E.HONS.(UTAR SG LONG)(MECHANICAL, 2017)
80314	LOW YONG CHEN	B.E.HONS.(UTAR SG LONG)(MECHANICAL, 2017)
35455	MOHD FAROUQ BIN BAHARIN	B.E.HONS.(UITM)(MECHANICAL, 2013)
45975	MUHAMMAD AMMAR YASSER BIN MOHD ZAID	B.E.HONS.(UITM)(MECHANICAL, 2013)
30468	MUHAMMAD FAISAL BIN ISKANDAR	B.E.HONS.(UITM)(MECHANICAL, 2011)
67632	MUHAMMAD HANIF B. BAHARUDDIN	B.E.HONS.(UITM)(MECHANICAL, 2017)
61266	NG MAN SHING	B.E.HONS.(UTAR SG LONG)(MECHANICAL, 2017)
86997	NG YEONG JIANG	B.E.HONS.(UTAR SG LONG)(MECHANICAL, 2017)
39713	NORAISHAH BINTI MOHAMAD NOOR	B.E.HONS.(UTHM)(MECHANICAL, 2007)
53459	NUR' SYAFIQAH BINTI ISMUINI	B.E.HONS.(UTEM)(MECHANICAL-DESIGN & INNOVATION, 2015)
80286	ONG SOON LENG	B.E.HONS.(UTAR SG LONG)(MECHANICAL, 2017)
86992	OOI GUO JIE	B.E.HONS.(UTAR SG LONG)(MECHANICAL, 2017)
58240	UGEASWARAN A/L PERUMAL	B.E.HONS.(UTHM)(MECHANICAL, 2015)
KEJURUTERAAN PEMBUATAN		
60234	MOHD RADHI BIN NORZAKI	B.E.HONS.(UTEM)(MANUFACTURING-ROBOTICS & AUTOMATION, 2013)
34951	MOHD SYAZNI BIN MOHD NIZAM	B.E.HONS.(UITM)(MECHANICAL-MANUFACTURING, 2012)
KEJURUTERAAN SUMBER MINERAL		
57963	RIZAL HAFIZ B. RAZALI	B.E.HONS.(USM)(MINERAL RESOURCES, 2016)

PERMOHONAN MENJADI AHLI SISWAZAH

No. Ahli	Nama	Kelayakan
KEJURUTERAAN AEROANGKASA		
	NUR SHAHIBRAHIM BIN MAHAMUDIN	B.E.HONS.(IIUM)(AEROSPACE, 2014)
KEJURUTERAAN AERONAUTIKAL		
93691	MUHAMMAD FAIRUZ BIN MUHAMMAD NASIR	B.E.HONS.(UPM)(AEROSPACE, 2009)
KEJURUTERAAN AWAM		
93870	ABDUL AZIM BIN MUSTAPA	B.E.HONS.(UITM)(CIVIL, 2013)
93787	ABDUL QADIR BIN JAILANI	B.E.HONS.(UTP)(CIVIL, 2010)
93673	ANNUAR BIN ABDULLAH	B.E.(UMP)(CIVIL, 2010)
	AZZAIYAD BIN AHMAD KEHAN	B.E.HONS.(UKM)(CIVIL & STRUCTURE, 2001)
93917	BONG MAI WENG	B.E.HONS.(UTM)(CIVIL, 2015)
93966	CHEE CHIEN CHERN	B.E.HONS.(UTM)(CIVIL, 2012)
93542	CHIA YING SIM	M.E.HONS.(UNI. OF LEEDS)(CIVIL & STRUCTURAL, 2011)
93579	CHONG HAW JIUN, CLEMENT	M.E.HONS.(UNI. OF NOTTINGHAM)(CIVIL, 2016)
93852	CLIFF JUDE ZEHNDER	B.E.HONS.(SWINBURNE UNI. OF TECH.)(CIVIL, 2015)
93970	DR TAN CZHIA YHEAW	B.E.HONS.(UTM)(CIVIL, 2005) PHD.(NUS)(2012)
93962	HASMIDAH BINTI SAID	B.E.HONS.(UNITEN)(CIVIL, 2016)
93951	HIU CHI YIP	B.E.HONS.(UTAR SG LONG)(CIVIL, 2017)
93930	HO FOOK MING	B.E.HONS.(SWINBURNE UNI. OF TECH.)(CIVIL, 2014)
93714	IR. MOHAMMAD AZMAN BIN RAZALI	B.SC.(UNI. OF ABERDEEN)(CIVIL, 1988) M.SC.(LOUGHBOROUGH UNI.)(AIRPORT PLANNING & MANAGEMENT, 1997)
93835	JOHN GARY ANAK JENTRY	B.E.HONS.(UNIMAS)(CIVIL, 2009)
93689	KHAIR BIN BADRI	B.E.HONS.(UMP)(CIVIL, 2014)
93911	KONG SOON THAI	M.E.HONS.(UNI. OF NOTTINGHAM)(CIVIL, 2017)
93548	KUEH LING LEE	B.E.HONS.(SWINBURNE UNI. OF TECH.)(CIVIL, 2015)
93968	LAM TIAN FOOK	B.E.HONS.(UTM)(CIVIL, 2012)
93921	LAU JIAN NING	B.E.HONS.(USM)(CIVIL, 2016)
93929	LAW CHENG YANG	B.E.HONS.(SWINBURNE UNI. OF TECH.)(CIVIL, 2014)
93831	LEE LONG GUANG	B.E.HONS.(UNITEN)(CIVIL, 2017)
93585	LEE PUI YIT	B.E.HONS.(UCSI)(CIVIL, 2015)
93704	LEE SIEW CHENG	B.E.HONS.(USM)(CIVIL, 2012)
93543	LIEW KHANG YUEH	B.E.HONS.(UTAR)(CIVIL, 2016)
93837	LIM CHONG WEI, FABIAN	B.SC.(OKLAHOMA STATE UNI.)(CIVIL, 1997)
93573	LOO PIN HONG	B.E.HONS.(UNSW)(CIVIL, 2011)
93836	MOHAMAD SALIHIN SF BIN SALIM	B.E.(TOTTORI UNI.)(CIVIL, 2010) M.E.(TOTTORI UNI.)(MANAGEMENT OF SOCIAL SYSTEMS & CIVIL ENGRG., 2012)
93807	MOHAMED ALIF BIN MOHAMED ROZNAN	B.E.HONS.(UITM)(CIVIL, 2010)
93514	MOHD. GASSRY NAZMY BIN SAHARUDIN	B.E.HONS.(UMP)(CIVIL, 2016)
93700	MOHD. NASRULLAH BIN OMAR	B.E.HONS.(UNIMAS)(CIVIL, 2014)
	MOHD. NURHAKIM BIN ABDUL RAHIM	B.E.HONS.(UTM)(CIVIL, 2015)
93856	MOHD. RASHIDI BIN BAKLI	B.E.HONS.(UITM)(CIVIL, 2012)
	MOHD. SHAHRIL BIN WAN MOHAMED YUSOF	B.E.HONS.(UTHM)(CIVIL, 2003)
93583	MOHD. SHAHRUL IZWAN BIN RAZMI	B.E.HONS.(UNIMAP)(BUILDING, 2012)
93898	MOHD. SUKRY BIN ISMAIL	B.E.HONS.(UTM)(CIVIL, 2016)
	MOHD. YUSRI BIN YUNUS	B.E.HONS.(UTM)(CIVIL, 2000)
93563	MOHD. ZAMRI BIN TASIMAN	B.E.HONS.(UTM)(CIVIL, 2003)
93674	MUHAMAD AFIQ BIN HASANUDDIN	B.E.HONS.(USM)(CIVIL, 2014)
93868	MUHAMMAD AMIN BIN AZHARI	B.E.HONS.(UTP)(CIVIL, 2012)
93907	MUHAMMAD NASHRIQ FARHAN BIN SUPANDI	B.E.HONS.(UTM)(CIVIL, 2007)
93710	MUHAMMED RIFHAN BIN RAMLI	B.E.HONS.(UTM)(CIVIL, 2015)
93706	NAZURAH ZAHIDAH BINTI UMAR BAKI	B.E.HONS.(UNIMAS)(CIVIL, 2011) M.E.(UTM)(CIVIL-TRANSPORTATION & HIGHWAY, 2013)
93801	NOR ARFIAN BIN YUSOF	B.E.(CARLETON UNI.)(CIVIL, 1998)
93844	NORHAFIZAH BINTI BAZAL AHMAD	B.E.HONS.(USM)(CIVIL, 2014)
93841	NORHAFIZAH BINTI SAFRIMAN	B.E.HONS.(UTHM)(CIVIL, 2014))
93825	NUR ALIA BINTI SULAIMAN	M.E.HONS.(UNI. OF NEWCASTLE UPON TYNE)(CIVIL,2016)
93959	NUR ZUKRINA BINTI ZUHAIRI	B.E.HONS.(UNITEN)(CIVIL, 2016)
93969	NUR'ATIAH BINTI ZAINI	B.E.HONS.(UTM)(CIVIL, 2013) M.E.(UNITEN)(CIVIL, 2016)
93564	NUREZZATY BINTI FADIL	B.E.HONS.(UTM)(CIVIL, 2012)
93889	PANG SWEE NGEE	B.E.(UMP)(CIVIL, 2010)
93782	RAHMAT ZULHAIRI BIN MOHAMED	B.E.HONS.(UTM)(CIVIL, 2010)
93565	RAJA SYAZANA BINTI RAJA SHUIB	B.SC.(SEOUL NATIONAL UNI.)(CIVIL & ENVIRONMENTAL, 2013)
	RUZYTA BINTI ZAKARIA	B.E.HONS.(UKM)(CIVIL & STRUCTURAL, 1999)
93685	SAIFUL ADLI BIN MAT SANI	B.E.HONS.(IUKL)(CIVIL, 2008)
93557	SALWA BINTI SERE	B.E.HONS.(UTHM)(CIVIL, 2012)
93842	SANGEETHA A/P RAMASAMY	B.E.(UMP)(CIVIL , 2011)
93553	SHANMUGAPRIYA DEWEDREE	B.E.HONS.(SEGI UNI.)(CIVIL, 2015)
93679	SHARIL IMRI BIN SHUIB	B.E.HONS.(UITM)(CIVIL, 2007)
93572	SIA CHIONG HUO	B.E.(UMP)(CIVIL, 2010)
93923	SII CHUNG CHYI, AMANDA	B.E.HONS.(CURTIN UNI. OF TECH.)(CIVIL & CONSTRUCTION, 2016)
93541	SITI ZULAIKHA BINTI ZULKEFLI	B.E.HONS.(UITM)(CIVIL, 2017)

KEAHLIAN

93540	SRI EKA WAHYUNI BINTI NAZARUDDIN	B.E.HONS.(UITM)(CIVIL, 2017)
	SUHAILA BINTI MOHD REDZUAN	B.E.HONS.(UNITEN)(CIVIL, 2012)
93811	SUHAIZA BINTI MOHD SALLEH	B.E.HONS.(UITM)(CIVIL, 2008)
93858	SYAHMIZZI IFWAT BIN AZHARNIM	B.E.HONS.(UITM)(CIVIL, 2013) M.E.SC.(UITM) (GEOTECHNICAL, 2015)
93675	SYERRY SHAFIKHA BINTI MAT NOR HAIRI	B.E.HONS.(UITM)(CIVIL, 2013)
93809	TAN KOON WEE	B.E.HONS.(UTM)(CIVIL, 2005)
93820	TAN MING EE	B.E.HONS.(UTP)(CIVIL, 2016)
93808	TAN YUN PING, JERREN	B.E.HONS.(UNIMAS)(CIVIL, 2013) M.E.(UNIMAS)(2016)
93853	TING MUI HENG, JUDE	B.E.HONS.(MALAYA)(CIVIL, 2010)
93888	TONG KWAN SHEN	B.E.HONS.(UTAR)(CIVIL, 2016)
93965	UMMU BALQIS BINTI JOHARI	B.E.HONS.(UTM)(CIVIL, 2005)
93904	WAN KHAIRUL AZMAN BIN WAN ZAWAWI	B.E.HONS.(UITM)(CIVIL, 2016)
93897	WONG CHEA HAO	B.E.HONS.(NTU)(CIVIL, 2011)
93891	WONG CHOONG LUM, RICKY	B.E.HONS.(UMP)(CIVIL, 2014)
93544	WONG KEAW YUN	B.E.HONS.(UNITEN)(CIVIL, 2009)
93708	WONG WENG HONG	B.E.HONS.(UNITEN)(CIVIL, 2014)
93927	YAP KAH MING	B.E.HONS.(UNIMAS)(CIVIL, 2011)
31261	ZAKRIL SYAFRANI BIN SAMSUDI	B.E.HONS.(MALAYA)(CIVIL, 2009)
	ZARIFAH BINTI ZULKIFLI	B.E.HONS.(UNISEL)(CIVIL, 2010)
93558	ZARINA BINTI YUSOF	B.E.HONS.(UTM)(CIVIL, 2011) M.E.(UTM)(CIIVL-GEOTECHNICS, 2013)
93701	ZURHIJJAS BIN RABIEE	B.E.HONS.(UNIMAS)(CIVIL, 2011)

KEJURUTERAAN BAHAN

93943	LEE SUE MAYNE	B.E.HONS.(UTAR SG LONG) (MATERIALS, 2017)
93815	YEE SWEE LI, MAXINE	B.E.HONS.(MALAYA) (MATERIALS, 2000) M.TECH.(MALAYA)(MATERIAL SCIENCE, 2004)

KEJURUTERAAN BIO-PERUBATAN

93688	ASMA KHAIRU BINTI MAJID	B.E.HONS.(UNIMAP) (BIOMEDICAL ELECTRONIC, 2014)
93786	HANAFI BIN MUSA	B.E.HONS.(UTM) (BIO-MEDICAL, 2014) M.SC.(UNI. OF MANCHESTER) (BIOMATERIALS, 2015)

KEJURUTERAAN EKLEKTRIKAL

93894	ABDUL AZEEM BIN MOHAMED MOHIDEEN	B.E.HONS.(UTP)(ELECTRICAL & ELECTRONIC, 2013)
	ABDUL SYAHID BIN ISMAIL	B.E.HONS.(UTM)(ELECTRICAL-INSTRUMENTATION & CONTROL, 2008)
93843	AHMAD FIRDAUS BIN KAMARAZAMAN	B.E.(UNSW)(ELECTRICAL, 2013)
93550	AMAR HAKIM BIN NOOR RAHIM	B.E.HONS.(UTEM) (ELECTRICAL-INDUSTRIAL POWER, 2012)
93554	AMAR NAZIRUL BIN AMAN SARIFUDIN	B.E.HONS.(UTM)(ELECTRICAL, 2012)
93912	AMIRZAKI BIN ZAHARI	B.E.HONS.(UITM) (ELECTRICAL, 2009)
93702	ANG KEAT HONG	B.E.HONS.(UTAR) (ELECTRICAL & ELECTRONIC, 2017)
93823	AZLEY BIN JAMALUDDIN @ ABDUL AZIZ	B.E.HONS.(UNITEN) (ELECTRICAL POWER, 2007)
93864	CHIN JIAN JI	M.E.HONS.(NOTTINGHAM) (ELECTRICAL & ELECTRONIC, 2017)
93964	CHIN KIAN SENG, ALSTON	B.E.HONS.(MONASH UNI.) (ELECTRICAL & COMPUTER SYSTEMS, 2011)
93551	CHONG HENN HOW	B.E.HONS.(UNITEN) (ELECTRICAL POWER, 2013)
93788	CHUNG TIIN KANG, MATTHEW	B.E.HONS.(UMS)(ELECTRICAL & ELECTRONIC, 2011)
93913	DR AVINASH ASHWIN RAJ	B.E.HONS.(UNITEN) (ELECTRICAL & ELECTRONICS, 2007) M.E.(UNITEN) (ELECTRICAL, 2012) PHD.(UNITEN)(ENGINEERING, 2016)
93539	DR KHAIRUNNISA BINTI HASIKIN	B.E.HONS.(MALAYA) (ELECTRICAL, 2007) M.E.SC.(MALAYA) (ELECTRICAL, 2011) PHD.(USM)(2014)
93577	DR MOHAMAD HAFIZ BIN MAMAT	B.E.(NAGOYA UNI.) (ELECTRICAL, ELECTRONIC & INFORMATION ENRG, 2005) M.E.(UITM) (ELECTRICAL, 2010) PHD.(UITM)(ELECTRICAL, 2013)
93824	DR TAN CHEE PIN	B.E.HONS.(UNI. OF LEICESTER)(ELECTRICAL & ELECTRONIC, 1998) PHD.(UNI. OF LEICESTER) (2002)
93903	FOO CHUAN CHUEN	M.E.HONS.(UNI. OF NOTTINGHAM)(ELECTRICAL, 2013)
93575	HAFIZI BIN HALIM	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONIC-POWER, 2011)
93637	IR. MUHAMED TARMIZY BIN YAACOB	B.SC.(UNI. OF SUSSEX) (ELECTRICAL, 1983)
	IZZAT BIN SAAT	B.E.HONS.(UITM) (ELECTRICAL, 2011)
93670	JAGDESH RAO A/L KRISHNAN	B.E.HONS.(UTM)(ELECTRICAL, 2016)
93696	JAMILAH BINTI MD ISA	B.E.HONS.(UITM) (ELECTRICAL, 2014)
93899	KHAIRUL AZHAR BIN MD. JAMIL	B.E.HONS.(UNIMAP) (ELECTRICAL SYSTEMS, 2010)
93552	KUAN LUK CHEONG	B.E.HONS.(RMIT) (ELECTRICAL, 2013)
93784	LIM CHIA YEE	B.E.HONS.(UMS)(ELECTRICAL & ELECTRONIC, 2016)
93859	LIM YIN KIN	B.E.HONS.(LIVERPOOL JOHN MOORES)(ELECTRONICS & CONTROL SYSTEMS, 2012) M.SC.(UNI. OF NEWCASTLE UPON TYNE)(ELECTRICAL POWER, 2016)
93680	MAHMUD HAFIZ BIN MOHAMAD TAHIR	B.E.HONS.(USM)(ELECTRICAL POWER, 2001)
93780	MAHYARUDIN BIN MOHD	B.E.HONS.(UTM)(ELECTRICAL-INSTRUMENTATION & CONTROL, 2008)
93869	MELISSA SHAMANI GANASON	M.E.HONS.(ICL)(ELECTRICAL & ELECTRONIC WITH MANAGEMENT, 2008)
93961	MISHAN ARAVIND S/O DINESH ARAVIND	B.E.HONS.(UTAR) (ELECTRICAL & ELECTRONIC, 2013)
93569	MOHAMAD FIKRI HISHAM BIN OSMAN	M.E.HONS.(UNI. OF SOUTHAMPTON) (ELECTRICAL, 2016)
	MOHAMAD REDZA BIN MOHAMAD RADZUAN	B.E.HONS.(KUTKM) (ELECTRICAL-INDUSTRIAL POWER, 2006)
93798	MOHD. ADZHAR BIN AZIZAN	B.E.HONS.(UTM-SPACE) (ELECTRICAL, 2016)
93795	MOHD. AZRIN BIN MOHD IZAB	B.E.HONS.(UTM-SPACE) (ELECTRICAL, 2012)
93960	MOHD. FAISAL AMIR BIN MUSTAPHA	B.E.HONS.(UITM) (ELECTRICAL, 2009)
93854	MOHD FAZLI BIN ZAKARIA	B.E.HONS.(MALAYA) (ELECTRICAL, 2006)
93785	MOHD. KHAIRIL BIN MOHAD HZER	B.E.HONS.(UITM) (ELECTRICAL, 2013)
93833	MOHD. MAZLIH BIN AWANG	B.E.HONS.(UTEM) (ELECTRICAL-CONTROL, INSTRUMENTATION & AUTOMATION, 2007)
93709	MOHD. NASHRIQ BIN MOHAMAD DAT	B.E.HONS.(UITM) (ELECTRICAL, 2010)
93586	MOHD. SUFIAN BIN MD HASSAN	B.E.HONS.(UTHM) (ELECTRICAL, 2012)
93849	MOHD. YASMER BIN DAUD	B.E.HONS.(UITM) (ELECTRICAL, 2009)
93840	MOHD. ZULHILMI BIN ABD RAHNI	B.E.HONS.(UITM) (ELECTRICAL, 2011)
93588	MOHD. ZURAIDI BIN ABDUL THANIM	B.E.HONS.(UNIMAP) (ELECTRICAL SYSTEMS, 2009)
	MUHAMAD AZAM BIN HAMZAH	B.E.HONS.(UTM-SPACE) (ELECTRICAL, 2016)
93926	MUHAMAD HAZIM BIN ABDULLAH	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONIC-POWER, 2013)
93556	MUHAMMAD AIDIL ADHA BIN AZIZ	B.E.HONS.(UITM) (ELECTRICAL, 2014)
	MUHAMMAD AZRI BIN MOHD ZAWAWI	B.E.HONS.(UITM) (ELECTRICAL, 2014)
93905	MUHAMMAD FAHMI BIN ISA	B.E.HONS.(UNIMAP) (ELECTRICAL SYSTEM, 2016)
	MUHAMMAD FARID BIN SHAMSHUDDIN	B.E.HONS.(UTM)(ELECTRICAL, 2016)
	MUHAMMAD FIRDAUS BIN RAMLI	B.E.HONS.(UITM) (ELECTRICAL, 2014)
93562	MUHAMMAD HAIKAL BIN ZAKARIYA	B.E.HONS.(UTP)(ELECTRICAL & ELECTRONICS, 2014)
93865	MUHAMMAD MAZHAR BIN MOFTY	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONIC-POWER,2012)
93914	MUHAMMAD ZA'IM HAKIMI BIN JAFAR	B.E.HONS.(UNITEN) (ELECTRICAL POWER, 2016)
	NABILAH HIDAYAH BINTI MAT DIYAN	B.E.HONS.(UTHM) (ELECTRICAL, 2015)
93698	NAWAI ANAK LANGAR	B.E.HONS.(UTEM) (ELECTRICAL-POWER ELECTRONIC & DRIVE, 2007)
93789	NG CHIEN MING	B.E.HONS.(UNI. OF NURTHUMBRIA AT NEWCASTLE)(ELECTRICAL & ELECTRONIC, 2013) M.E.(MALAYA)(POWER SYSTEMS, 2016)
93806	NG KAR LAI	B.E.HONS.(UNI. OF NURTHUMBRIA AT NEWCASTLE)(ELECTRICAL & ELECTRONIC, 2013) M.E.(MALAYA)(POWER SYSTEMS, 2016)
93568	NOR AZIELA BINTI ALIAS	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONIC-POWER, 2012)
	NUR FATIHAH BINTI IBRAHIM	B.E.HONS.(UTEM) (ELECTRICAL-INDUSTRIAL POWER, 2016)
	NURIMAN BIN CHE YAHAYA	B.E.HONS.(UNISEL) (ELECTRICAL, 2011)
93925	OOI YEW CHONG	B.E.HONS.(UMS)(ELECTRICAL & ELECTRONICS, 2014)
93549	RAIMI BIN AB. LAJIS	B.E.HONS.(UITM) (ELECTRICAL, 2013)
93918	RAJA ISKANDAR BIN RAJA IDRIS	B.E.HONS.(UTHM) (ELECTRICAL, 2012)
93862	RUEBAN ANTONY	B.E.HONS.(UNITEN) (ELECTRICAL & ELECTRONIC, 2011)
93817	SAIFUL ISHAM BIN ISMAIL	B.E.HONS.(UNITEN) (ELECTRICAL POWER, 2011)
	SITI NADIAH BINTI MOHD AINI	B.E.HONS.(UITM) (ELECTRICAL, 2010)
	SYAHRIL IZUAN BIN ILIYASAK	B.E.HONS.(UITM) (ELECTRICAL, 2007)
93935	TENG JIA HO GAVIN	B.E.HONS.(UTAR SG LONG) (ELECTRICAL & ELECTRONIC, 2017)
93915	THEN KIM KIAN	B.E.HONS.(MALAYA) (ELECTRICAL, 2012)
93829	TING SIAW HUI, JACQUELINE	B.E.HONS.(UNIMAP) (INDUSTRIAL ELECTRONIC, 2014)
93690	WAN ABD KHALID BIN ABD RAZAK	B.E.HONS.(UITM) (ELECTRICAL, 2012)
93810	WAN ABDUL AZIR BIN WAN MUSA	B.E.HONS.(UTHM) (ELECTRICAL, 2005)
93832	YEOH CHEE KEONG	M.E.HONS.(UNI. OF NOTTINGHAM)(ELECTRICAL & ELECTRONIC, 2017)
93712	ZAHIRUDDIN BIN MOHAMED ISA	B.E.HONS.(UNISEL) (ELECTRICAL, 2012)
93781	ZULAZHAN BIN ABU BAKAR	B.E.HONS.(UTM)(ELECTRICAL, 2004)

KEJURUTERAAN ELEKTRONIK

93922	ALI IMRAN BIN IBRAHIM	B.E.HONS.(UNIMAP) (BIOMEDICAL ELECTRONIC, 2011) M.E.(MALAYA)(INDUSTRIAL ELECTRONICS & CONTROL, 2016)
93779	ASYRAN BIN AHMAD	B.E.HONS.(UKM) (ELECTRICAL, ELECTRONIC & SYSTEMS, 1999)
	AWIS BIN ALI	B.E.HONS.(UNIMAP) (INDUSTRIAL ELECTRONIC, 2012)
93850	AZFAR ASYRAFIE BIN AHMAD	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONIC-COMMUNICATIONS, 2015)
93813	AZMAN BIN ABD AZIZ @ MOHD YUSOF	B.E.HONS.(UNI. OF HERTFORDSHIRE) (ELECTRICAL & ELECTRONIC, 1999) M.SC.(IIUM) (MECHATRONICS, 2009)
93805	AZRIF BIN MANUT	B.E.HONS.(UKM) (ELECTRICAL, ELECTRONIC & SYSTEMS, 2001) M.SC.(UKM)(ELECTRICAL, ELECTRONIC & SYSTEMS, 2007)
93580	DR GOH KAM MENG	B.E.HONS.(UTM)(ELECTRICAL-ELECTRONICS, 2010) PHD.(UTM)(ELECTRICAL, 2015)
93900	DR SARAH YASMIN BINTI MOHAMAD	B.E.HONS.(UITM) (ELECTRICAL, 2009) M.E.(UKM)(COMMUNICATION & COMPUTER, 2011) PHD.(THE QUEEN'S UNI. OF BELFAST)(2015)

93567	DR TANG TONG BOON	B.E.HONS.(UNI. OF EDINBURGH)(ELECTRONICS & ELECTRICAL-COMMUNICATIONS, 1999) PHD.(UNI. OF EDINBURGH) (ENGINEERING, 2006)
93711	FAIRUZ ATTRAS BIN MUHAMAD	B.E.HONS.(UITM) (ELECTRICAL, 2009)
	FARAH BINTI AHMAD KAMAL	B.E.HONS.(IIUM) (COMMUNICATION, 2014)
93860	FLETCHER SARIP	B.E.HONS.(MONASH) (ELECTRICAL & COMPUTER SYSTEMS, 2016)
93902	FONG LEN NIE	B.E.HONS.(KUITTHO) (ELECTRICAL-MEDICAL ELECTRONICS, 2003)
93944	LEE QING XIANG	B.E.HONS.(UTAR SG LONG)(ELECTRONIC COMMUNICATION, 2017)
93576	MOHD. AKBAR BIN ABU BAKAR	B.E.HONS.(UTM)(ELECTRICAL-ELECTRONICS, 2009)
	MOHD FIRDAUS BIN IBRAHIM	B.E.HONS.(KUITTHO) (ELECTRONIC, 2002)
	MOHD FIRDA'UZ BIN SUHAIMI	B.E.HONS.(UTM)(ELECTRICAL-ELECTRONICS, 2006)
93547	MOHD. HELMY HAKIMIE BIN MOHD ROZLAN	M.E.HONS.(BRUNEL UNI.) (ELECTRONIC & ELECTRICAL, 2012)
93804	MOHD. TOHER BIN MOHAMED KENAPIAH	DIPL-ING.FH.(FRANKFURT UNIVERSITY OF APPLIED SCIENCES)(ELECTRICAL ENERGY & AUTOMATION TECHNOLOGY, 2010)
	MUHAMAD FARIQ BIN AHMAD	B.E.HONS.(UTEM) (ELECTRONIC-INDUSTRIAL ELECTRONICS, 2013)
	MUHAMAD SHAIDE BIN ABDUL KARIM	B.E.HONS.(UITM) (ELECTRONICS-INSTRUMENTATION, 2013)
	MUHAMAD UZAIR BIN SHAMSUL	B.E.HONS.(UITM) (ELECTRONIC, 2013)
	MUHAMMAD HANIF BIN YAHYA	B.E.HONS.(UTEM) (ELECTRONIC-TELECOMMUNICATION ELECTRONICS, 2013)
93561	MUHAMMAD HANIS BIN OMAR	B.E.HONS.(UTEM) (ELECTRONIC-WIRELESS COMMUNICATIONS, 2013)
	MUHAMMAD NUR HAKIM BIN NORDIN	B.E.HONS.(UTHM) (ELECTRONIC, 2014)
	MUHAMMAD SAFWAN BIN ABDUL RAZAK	B.E.HONS.(UNITEN) (ELCTRICAL & ELECTRONICS, 2012)
93819	MUHD. FAIZ BIN ROSLI	B.E.HONS.(UTM)(ELECTRICAL-ELECTRONIC, 2009)
93972	NOOR ADZIELLA BINTI MOHAMAD	B.E.HONS.(UITM) (ELECTRONICS-INSTRUMENTATION, 2013)
93895	NOOR ARJUNADI BIN MOHD NOOR	B.E.HONS.(UTM)(ELECTRICAL, 2000)
93971	NOR ASHRAF BIN MOHD SALIM	B.E.HONS.(STAFFORDSHIRE UNI.)(ELECTRICAL, 2006) M.E.(STAFFORDSHIRE UNI.) (ELECTRICAL, 2008)
	NOR ILFA BINTI MD NOR	B.E.HONS.(UPM) (COMPUTER SYSTEM & COMMUNICATIONS, 2002)
93821	RABINDRA A/L GANDHI THANGARAJOO	B.SC.(ROBERT GORDON UNI.)(ELECTRONIC & ELECTRICAL, 1998) M.E.(UTM)(ELECTRICAL-ELECTRONICS & TELECOMMUNICATIONS, 2009)
	RAJA AHMAD KAMIL BIN RAJA YACOB	B.E.HONS.(UTEM) (ELECTRONIC-TELECOMMUNICATION ELECTRONICS, 2009) M.SC. (UTM)(PETROLEUM, 2013)
	ROMAZAM BIN HIZAT	B.E.HONS.(UTM)(ELECTRICAL-ELCTRONICS, 2003)
93818	ROSLI BIN KHALID	B.E.HONS.(UTM)(ELECTRICAL, 2004)
93919	SHAHMINI SUBRAMANIAM	B.E.HONS.(MMU) (ELECTRONIC-TELECOMMUNICATIONS, 2013)
93871	SITI AZURA BINTI RAMLAN	B.E.HONS.(UITM)(COMPUTER, 2007)
93692	SITI NORSYAZWANI BINTI YAAKOB	B.E.HONS.(UNITEN) (ELECTRICAL & ELECTRONICS, 2012)
93793	SOO ZHEYAN, JOSHUA	B.E.HONS.(MMU) (ELECTRONIC-NANAOTECHNOLOGY, 2016)
93955	TAN THENG GUAN	B.E.HONS.(MMU) (ELECTRONICS, 2005)
93695	WAN MUHAMMAD RAFIQI BIN WAN ZAIN	B.E.HONS.(UNITEN) (ELECTRICAL & ELECTRONICS, 2013)

KEJURUTERAAN GEOTEKNIKAL

92418	CHIN THAU WUI	B.E.HONS.(UNI. OF PORTSMOUTH, CIVIL, 2009) M.SC.(UNI. OF BIRMINGHAM) (GEOTECHNICAL, 2010)
93581	LING GUONG WEI	B.E.HONS.(UNI. OF EAST LONDON)(CIVIL, 2012) M.E.(UTM)(CIVIL-GEOTECHNICS, 2014)

KEJURUTERAAN KIMIA

93838	ABDUL RAHMAN BIN HARIRI	B.E.HONS.(MONASH) (ENGINEERING, 1986)
93783	ANG WEI HAO	M.E.HONS.(UNI. OF NOTTINGHAM)(CHEMICAL, 2016)
93906	BRENDAN VINSENT	B.E.HONS.(MONASH UNI.) (CHEMICAL, 2016)
93954	CHEAH CHEE CHONG	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93916	CHIAH YOKE YI	B.E.HONS.(UTP)(CHEMICAL, 2014)
93956	DR CHUNG YING TAO	B.E.HONS.(UKM) (CHEMICAL, 2012) PHD.(UKM)(CHEMICAL & PROCESS, 2016)
93828	DR KOR YANN KAE	B.E.HONS.(UNI. OF SDYNEY)(CHEMICAL, 2006) PHD.(UNI. OF SDYNEY) (ENGINEERING, 2010)
93797	DR LEE CHERN LEING	B.E.HONS.(UNI. OF ADELAIDE)(CHEMICAL, 2006) PHD.(UNI. OF CAMBRIGDE) (2011)
93952	GAN FUNG PING	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93950	KEK LI YIN, KRYSTIN	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93948	KONG WEN GIE	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93812	LIM GEK JOO, SHERON	B.E.HONS.(CURTIN UNI. OF TECH.)(CHEMICAL, 2016)
93846	MOHD. AIMAN BIN MOHD. NOOR	B.E.HONS.(UTP)(CHEMICAL, 2011)
93546	MOHD. SAUFI BIN MD ZAINI	M.E.HONS.(UNI. OF SHEFFIELD)(CHEMICAL, 2011) M.SC.(UITM)(CHEMICAL, 2016)
93941	NG SU XIN	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93957	NICOLAS SELVAKUMAR PAUL	B.E.HONS.(UTAR)(CHEMICAL, 2014)
93890	NUR IZZAQIAH BINTI JAMADIN	B.E.HONS.(UITM)(CHEMICAL & PROCESS, 2017)
93816	ONG EU JIN	M.E.HONS.(UCL)(CHEMICAL, 2016)
93940	PONG XIU MAN, JOANNE	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93587	SHAH RIZAN BIN SULAIMAN	B.E.HONS.(USM)(CHEMICAL, 2002)
93939	SUMITHIRA A/P NANTHA KUMAR	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93938	TAN MAY YEE	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93937	TAN SHU HAU	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93934	TING HUI LING	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)
93932	YEE HSIN YI	B.E.HONS.(UTAR SG LONG) (CHEMICAL, 2017)

KEJURUTERAAN KOMPUTER

	MUHAMMAD SYAFIQ BIN MOHD SHARIF	B.E.HONS.(UNIMAP) (COMPUTER, 2015)

KEJURUTERAAN KOMPUTER & KOMUNIKASI

93928	DR MOHD. SHAHNAN BIN ZAINAL ABIDIN	B.E.HONS.(UPM) (COMPUTER SYSTEM & COMMUNICATIONS, 2002) M.SC.(UPM) (COMMUNICATIONS & NETWORK, 2005) PHD.(UPM)(PHOTONICS & FIBER OPTIC SYSTEMS ENGINEERING, 2014)

KEJURUTERAAN KOMUNIKASI

93893	DR NORUN FARIHAH ABDUL MALEK	B.E.HONS.(IIUM) (COMMUNICATION, 2006) PHD.(LOUGHBOROUGH UNI., 2013)

KEJURUTERAAN MEKANIKAL

93578	A.SHARMA S/O ARUNASALAM	B.E.HONS.(UNITEN) (MECHANICAL, 2009)
93545	ABDUL HAKIM ADZIM BIN MOHD. ZAIN	M.E.HONS.(QUEEN'S UNI. OF BELFAST)(MECHANICAL, 2014)
	ABDUL MANAN BIN O T ABD RAHMAN	B.E.HONS.(MIDDLESEX UNI.) (MECHANICAL, 1997)
93681	ABDUR RAHIM BIN ABDUL RAHMAN	M.E.HONS.(UNI. OF MANCHESTER)(MECHANICAL, 2013)
93677	ADRI BIN NASIR	B.E.HONS.(UNITEN) (MECHANICAL, 2017)
93683	AHMAD NASAFI BIN AZMAN	B.E.(UNI. OF SYDNEY) (MECHANICAL, 2016)
93713	AISAMUDDIN BIN MUSTAFFA	B.E.HONS.(KUITTHO) (MECHANICAL, 2006)
93672	ANUAR BIN HASHIM	B.E.HONS.(UITM) (MECHANICAL, 2010)
	AZIZUL IZZAT BIN HASHIM	B.E.HONS.(UTM) (MECHANICAL-MANUFACTURING, 2005)
93791	AZLIN BIN SAMSUDIN	B.E.HONS.(UTM) (MECHANICAL, 2001)
93794	AZMI BIN KISSON	B.E.HONS.(USM) (MECHANICAL, 1994)
93867	CALVIN CHANDRAPAL	B.E.HONS.(MONASH) (MECHANICAL, 2016)
93920	CHAN SAI MUN	B.E.HONS.(USM) (MECHANICAL, 2012)
93560	CHEAH SOON YI	B.E.HONS.(INTI INT.) (MECHANICAL, 2017)
93861	CHONG YIN HO	M.E.HONS.(NOTTINGHAM) (MECHANICAL, 2011)
93953	CHUO CHUNG HENG	B.E.HONS.(UTAR SG LONG) (MECHANICAL, 2017)
93582	DINESH KUMAR A/L SUBRRAMANIAM	B.E.HONS.(UPNM) (MECHANICAL, 2013)
93671	FAIZ ASYRAF BIN ROSLAN	B.E.(UMP)(MECHANICAL, 2009)
93699	FIKRI IZZAT AKMAL BIN HAMZAH	B.E.HONS.(UTM) (MECHANICAL, 2015)
93790	HENG CHIANG LEONG	B.E.HONS.(CURTIN UNI. OF TECH.)(MECHANICAL, 2011)
	HIDAYATULLAH BIN MASJUD	B.E.HONS.(UTHM) (MECHANICAL, 2013)
93814	HILMI HARIZ BIN MAHABOT	B.E.HONS.(IIUM) (MECHANICAL-AUTOMOTIVE, 2016)
	JUWAIDI BIN JAMADIN	B.E.HONS.(UTHM) (MECHANICAL, 2014)
93949	KEU JIANN RONG	B.E.HONS.(UTAR SG LONG) (MECHANICAL, 2017)
93584	KHAIRUL AZRIL BIN KALID	B.E.(TOKAI)(PRECISION ENRG, 2007) M.E.(TOKAI)(MECHANICAL, 2009)
93559	LEE CHONG JIN	M.E.(UNI. OF CAMBRIDGE) (ENGINEERING TRIPOS, 2012)
93946	LEE PEI LUN	B.E.HONS.(UTAR SG LONG) (MECHANICAL, 2017)
93945	LEE PIN YANG	B.E.HONS.(UTAR SG LONG) (MECHANICAL, 2017)
93942	LEW KANG JUN	B.E.HONS.(UTAR SG LONG) (MECHANICAL, 2017)
93574	LIM PENG LUN	B.E.HONS.(UKM) (MECHANICAL, 2012)
93676	MOHAMAD AYUB BIN ILIAS	B.E.HONS.(UITM) (MECHANICAL, 2016)
93570	MOHAMMAD DIAH BIN OTHMAN	B.E.HONS.(UTM) (MECHANICAL-AUTOMOTIVE, 2007)
93555	MOHAMMAD FAIZAL BIN ABDUL KADIR	B.E.HONS.(UTP) (MECHANICAL, 2013)
93826	MOHAMMAD KHALID BIN WAHID	B.E.HONS.(UTM) (MECHANICAL, 2006) M.E.(UPM)(MANUFACTURING SYSTEM, 2012)
93799	MOHD. AZLAN IBERAHIM	B.E.HONS.(UTM-SPACE) (MECHANICAL, 2016)
93715	MOHD. FAISAL BIN JAMIL	B.E.HONS.(UTM) (MECHANICAL, 2008)
93839	MOHD. FAIZAL BIN NORSARI	B.E.HONS.(UTHM) (MECHANICAL, 2012)
93697	MOHD. HAIRULNIZAM BIN MOHAMED	B.E.(UMP)(MECHANICAL, 2009)
93694	MOHD. HELMY BIN SAKIR	B.E.(TOKYO UNI. OF SCIENCE) (MECHANICAL, 2006)
93803	MOHD. RAFIQ BIN MOHD. HANI	B.E.HONS.(UNISEL) (MECHANICAL, 2011)
	MOHD. SAFRIZAL BIN MOHAMED AZHARI	B.E.HONS.(MALAYA) (MECHANICAL, 2006)
93707	MOHD. SUPIAN BIN ABU BAKAR	B.E.HONS.(UTM) (MECHANICAL, 2006) M.SC.(UPNM)(MECHANICAL, 2015)
93908	MUHAMAD FARID MUHAMAD KHOSIM	M.E.HONS.(THE UNI. OF SHEFFIELD)(MECHANICAL, 2016)
	MUHAMMAD FADHLI BIN ABDUL RAHMAN	B.E.HONS.(IIUM) (MECHANICAL-AUTOMOTIVE, 2014)

93796	MUHAMMAD FADIL ARSAD BIN MOHD USOPE	B.E.HONS.(UNITEN) (MECHANICAL, 2015)
93866	MUHAMMAD HAIKAL BIN ROSLAN	B.E.HONS.(UPNM) (MECHANICAL, 2014)
93678	MUHAMMAD HARESTH BIN BAHARUDIN	B.E.HONS.(UNITEN) (MECHANICAL, 2017)
	MUHAMMAD IQBAL BIN SHA'RANI	B.E.HONS.(RMIT) (MECHANICAL, 2013)
93863	MUHAMMAD ISKANDAR BIN ISMAIL	B.E.HONS.(UTP) (MECHANICAL, 2013)
	MUHAMMAD SHAFIQ ILHAM BIN BAHAROM	B.E.HONS.(UPNM) (MECHANICAL, 2014)
93857	MUHAMMAD SHAHZALIE B IBRAHIM	B.E.(UNI. OF NEWCASTLE) (MECHANICAL, 2014)
93827	MUHAMMAD SIDDIQ BIN SALLEHUDDIN	M.E.HONS.(UNI. OF SHEFFIELD)(MECHANICAL, 2013)
93822	MUHAMMAD ZAFIRUL HAKIM BIN NORDIN	B.E.HONS.(UTP) (MECHANICAL, 2015)
	MUHMAD ROSDI BIN AB RAHIM	B.E.HONS.(USM) (MECHANICAL, 2001)
93687	NIK MOHAMAD AMRI HAFIZ BIN ZULKIFLI	B.E.HONS.(IIUM) (MECHANICAL-AUTOMOTIVE, 2015)
93566	NIZAM BIN NADZIMUDDIN	B.E.HONS.(UNI. OF ADELAIDE) (MECHANICAL, 2003)
93792	NOR FARAHTUL AIN BINTI HARUN	B.E.HONS.(MMU) (MECHANICAL, 2016)
	NUR ASMAH BINTI SEPO	B.E.(CARLETON UNI.) (MECHANICAL, 2015)
93958	ONG CHEW YI	M.E.HONS.(UNI. OF NOTTINGHAM)(MECHANICAL, 2016)
93909	PUA HAU KUAN	B.E.HONS.(UNI. OF BRADFORD) (MECHANICAL, 2010) M.SC.(UNI. OF BRADFORD) (MECHANICAL, 2011)
93924	PUVANESAN A/L VELAYUTHAM	B.E.HONS.(UNITEN) (MECHANICAL, 2016)
	ROQHIB BIN ROSHIDAN	B.E.(UNI. OF WESTERN AUSTRALIA)(MECHANICAL, 2014)
93896	RUBHENDRAN KRISHNAN	B.SC.(KOREA UNI.) (MECHANICAL, 2011)
	SHAHRIL AZAM BIN ABD RAHMAN	B.E.HONS.(UITM) (MECHANICAL, 2013)
93830	SHAIK MOHAMMED HAIKHAL BIN ABDUL RAHIM	B.E.HONS.(UNITEN) (MECHANICAL, 2015)
93705	SIA KWANG YAW, DENNIS	B.E.HONS.(MMU) (MECHANICAL, 2010)
	SYED MOHD FAISAL BIN SYED KAMARUDDIN	B.E.(UNI. OF SOUTH AUSTRALIA)(MECHANICAL, 1997)
93933	WOO YIK HWAN	B.E.HONS.(UTAR SG LONG) (MECHANICAL, 2017)
93684	YASMIN FARIDHA IZZATY BINTI SHOLIKHIN	B.E.HONS.(UNI. OF WAIKATO) (MECHANICAL, 2017)
93931	YEW KHAI CHUN	B.E.HONS.(UTAR SG LONG) (MECHANICAL, 2017)

KEJURUTERAAN MEKATRONIK

	ANNA AMALINA BINTI ZAINOL ABIDIN	B.E.HONS.(UNIMAP) (MECHATRONIC, 2014)
	AZRUL NASRUN BIN AWANG @ ZAKARIA	B.E.HONS.(IIUM) (MECHATRONICS, 2015)
93571	CHIA KOK SIANG	B.E.HONS.(UTAR) (MECHATRONICS, 2011)
93682	KAN MUN PUNG	B.E.HONS.(UNSW) (MECHATRONIC, 2006)
93947	LAU CHEE MAN, BRYAN	B.E.HONS.(UTAR SG LONG) (MECHATRONICS, 2017)
93703	MOHAMAD SYAZWAN BIN MAZUKI	B.E.HONS.(IIUM) (MECHATRONICS, 2013)
	MOHD NOR FAKURAZY BIN ABU BAKAR	B.E.HONS.(UTEM) (MECHATRONIC, 2010)
	MUHAMMAD ASHRAF BIN MOHD IBRAHIM	B.E.HONS.(IIUM) (MECHATRONICS, 2015)
93802	NOOR HAFIZATUN BINTI ZAINI@ ZULKIFLY	B.E.HONS.(UNISEL) (MECHATRONICS, 2009)
93693	SAZWAN SYAFIQ BIN MAZLAN	B.E.HONS.(UNIMAP) (MECHATRONIC, 2012) M.SC.(USM)(ELECTRONIC SYSTEMS DESIGN ENRG., 2014)
93845	SYED MOHD SYAFIQ BIN SYED MAHMUD	B.E.HONS.(UTEM) (MECHATRONICS, 2011)
93936	TANG TEE YANG	B.E.HONS.(UTAR SG LONG) (MECHATRONICS, 2017)
93855	TAY KHENG LIANG, BONAVENTURE	B.E.HONS.(UNIMAP) (MECHATRONICS, 2009)

KEJURUTERAAN PEMBUATAN

	AMER RIFDI BIN HJ ARIPIN	B.E.HONS.(UKM) (MANUFACTURING, 2015)
93967	AZIZUL QAYYUM BIN BASRI	B.E.HONS.(UTEM) (MANUFACTURING-MANUFACTURING PROCESSES,2009) M.E.(MANUFACTURING SYSTEMS, 2013)
93851	JAYEE A/L SREETHARAN	B.E.HONS.(MALAYA) (MANUFACTURING, 2010)
93901	KHOR HAN WEI	B.E.HONS.(UTEM) (MANUFACTURING-MANUFACTURING DESIGN, 2010)
93686	MOHAMED AZUAN BIN MOHAMED ABU BAKAR	B.E.HONS.(IIUM) (MANUFACTURING, 2015)
	MUHAMMAD KHAIRUL AFFIQ BIN JASRI	B.E.HONS.(UITM) (MECHANICAL-MANUFACTURING, 2016)

KEJURUTERAAN PERTANIAN

93847	WONG MUN SHUAN	B.E.HONS.(UPM) (AGRICULTURAL & BIOSYSTEMS, 2010)

KEJURUTERAAN PETROLEUM

93834	ABDUL RAZAK BIN MOHAMED AFFANDI	B.E.HONS.(UTP)(PETROLEUM, 2009)
93963	SAIDAH NAFISAH BINTI KHALID	B.E.HONS.(UTP)(PETROLEUM, 2014)
93910	SHAHIRA BINTI MOHAMAD JUMAILI	B.E.HONS.(UTP)(PETROLEUM, 2016)

KEJURUTERAAN POLIMER

93848	DR CHAN MING YENG	B.E.HONS.(UNIMAP) (POLYMER, 2012) PHD.(UNIMAP)(MATERIALS, 2015)

KEJURUTERAAN SISTEM MEKANIKAL

93800	MUHAMMAD TAQIYUDDIN BIN CHE AB MALIK	B.E.HONS.(TAKUSHOKU UNI.) (MECHANICAL SYSTEM, 2012) M.E.(TAKUSHOKU UNI.) (MECHANICAL SYSTEM, 2015)

KEJURUTERAAN TELEKOMUNIKASI

93892	DR NORAZLINA BINTI SAIDIN	B.E.HONS.(MALAYA) (TELECOMMUNICATION, 2005) M.E.(MALAYA)(OPTICAL TECHNOLOGY, 2010) PHD.(MALAYA)(FIBER OPTICS, 2015)

PERMOHONAN MENJADI AHLI 'INCORPORATED'

No. Ahli	Nama	Kelayakan
KEJURUTERAAN ELEKTRIKAL		
	ABDUL RAHMAN BIN AB RAZAK	BE.TECH.HONS.(UNIKL) (ELECTRICAL, 2014)
	MOHD. ABDUL SYUKUR BIN MUSA	BE.TECH.HONS.(UNIKL) (ELECTRICAL, 2014)
93884	NG KIENG LENG	B.E.HONS.(UNI. OF LINCOLNSHIRE & HUMBERSIDE, 2001)
KEJURUTERAAN ELEKTRONIK		
	MUHAMAD ARIF BIN AMRAN	BE.TECH.HONS.(UNIKL) (MEDICAL ELECTRONICS, 2015)
KEJURUTERAAN MEKANIKAL		
	ABU HASANI SAZALI BIN AZAM	BE.TECH.HONS.(UNIKL) (MECHANICAL-AUTOMOTIVE, 2014)
93533	LIM SOON YEEN, JOEL	B.E.TECH.(UNI. OF SOUTHERN QUEENSLAND) (MECHANICAL, 2010)
93669	MUHAMMAD SYAFIQ ASYRAAF BIN KAMARUZAMAN	B.E.HONS.(UNI. OF NOTTINGHAM)(MECHANICAL, 2015)
KEJURUTERAAN MEKATRONIK		
	AHMAD HAZIM BIN MOHD RUSLI	BE.TECH.HONS.(UNIKL) (MECHATRONICS, 2015)
	MOHAMMAD FAIZOL BIN AMRAN	BE.TECH.HONS.(UNIKL) (MECHATRONICS, 2011)
	MOHD. AMIRUL BIN AZMI	BE.TECH.HONS.(UNIKL) (MECHATRONICS-AUTOMOTIVE, 2015)
	MOHD. JAZREEN BIN CHE RAHIM	BE.TECH.HONS.(UNIKL) (MECHATRONICS-AUTOMOTIVE, 2015)
	MOHD. SHAHRUL REDZUAN BIN SHAHSUDIN	BE.TECH.HONS.(UNIKL) (MECHATRONICS, 2014)

KEJURUTERAAN TEKNOLOGI MAKLUMAT

	NOR QUSIAH BINTI ABDUL RAZAK	B. IT.(UMT)(INFORMATION TECHNOLOGY-SOFTWARE ENRG., 2008)

KEJURUTERAAN TENAGA

93768	MUHAMMAD SUFYAN BIN HAFIZ	BE.TECH.HONS.(UNIKL) (BIOSYSTEM, 2013) M.E.TECH.(UNIKL-HOCHSCHULE ROSENHEIM) (GREEN & ENERGY EFFICIENT BUILDINGS, 2015)

PERMOHONAN MENJADI AHLI 'AFFILIATE'

No. Ahli	Nama	Kelayakan
KEJURUTERAAN BANGUNAN		
93883	RAMASH A/L K. MADHAVAN	B.SC.HONS.(USM)(HOUSING, BUILDING & PLANNING-BUILDING ENGINEERING, 1995)

PERMOHONAN MENJADI AHLI 'ASSOCIATE'

No. Ahli	Nama	Kelayakan
KEJURUTERAAN AWAM		
93532	ASRAF BIN MOHD ZIN	DIPL.(PSA)(CIVIL, 2005)
KEJURUTERAAN ELEKTRIKAL		
93668	LEE YOKE HWA	DIPL.(FIT)(ELECTRICAL, 2002)
93767	ROLAND LAGATA	DIPL.(POLIMAS)(ELECTRICAL-CONTROL & ELECTRONIC POWER, 2003)
KEJURUTERAAN MARIN		
93766	DARMENDRAN RATHINA PANDI	DIPL.(UNGKU OMAR POLYTECHNIC)(MARINE, 2001)

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