JURUTERA

THE MONTHLY BULLETIN OF THE INSTITUTION OF ENGINEERS, MALAYSIA
MARCH 2015
KDN PP 1050/12/2012 (030192)
ISSN 0126-9909

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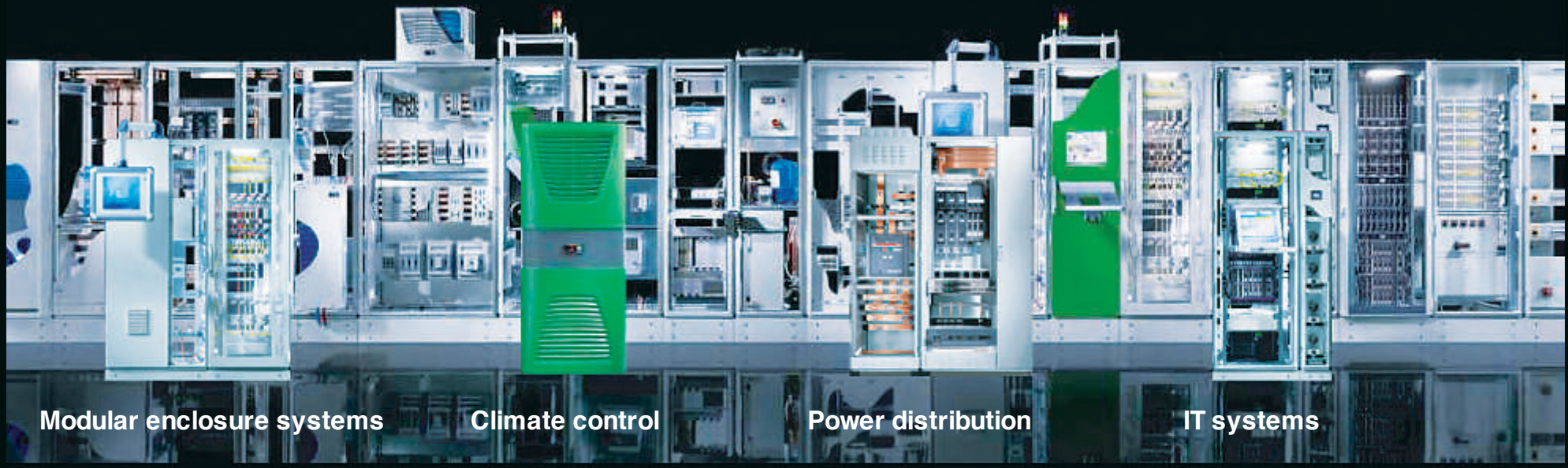

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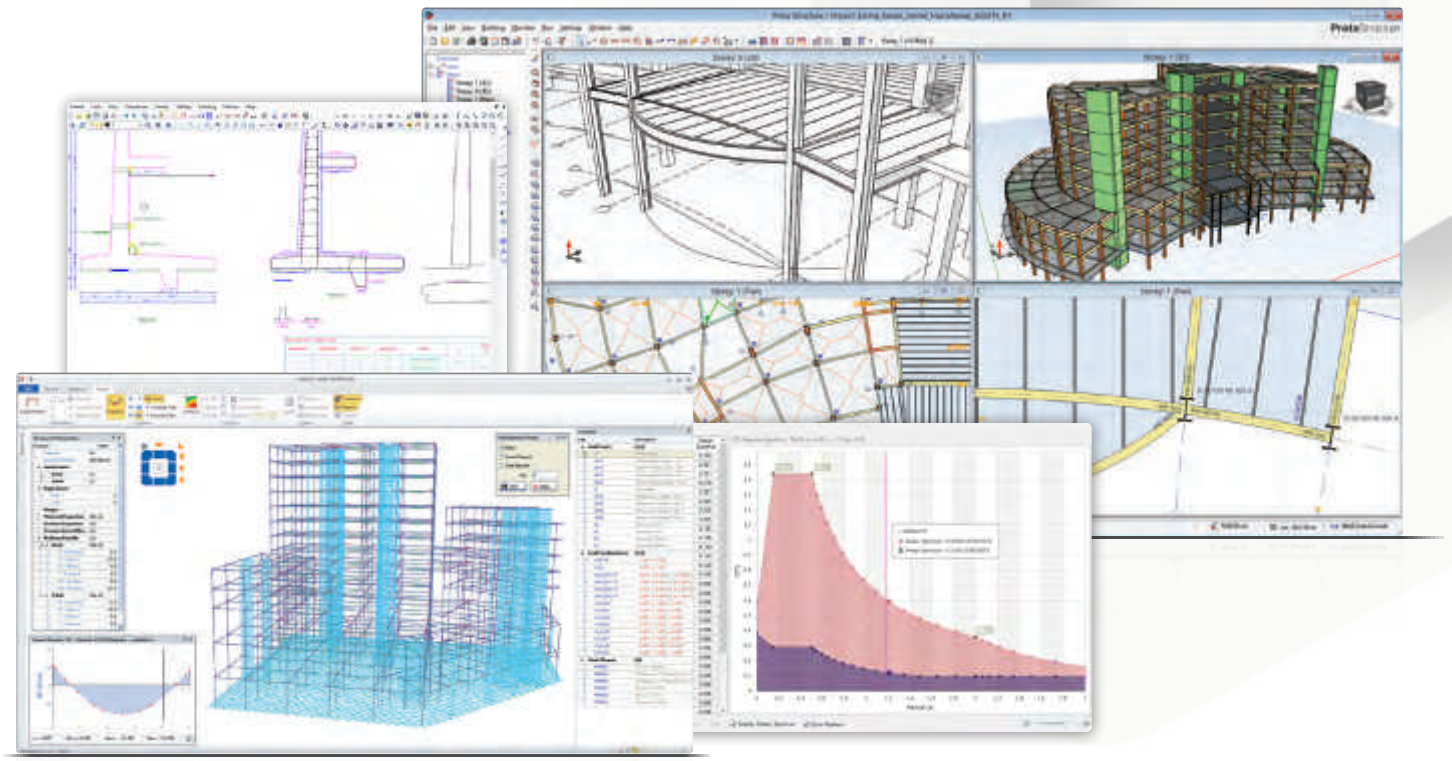

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CONTENTS

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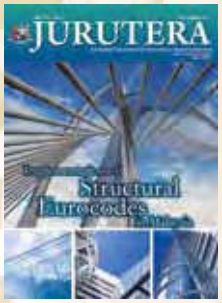

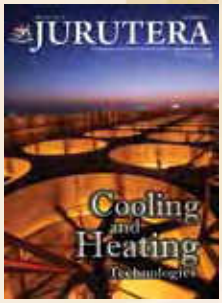

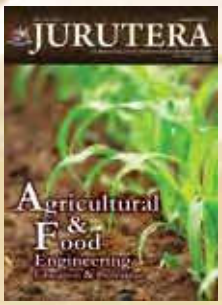

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Progress in finalising National Annex to Eurocode 8 Design for Earthquake Resistant Structures

By Ir. Prof. Dr Jeffrey Chiang
Chairman of IEM-SWO Technical Committee on Earthquake

Dr Jeffrey Chiang, currently IEM Honorary Treasurer, has previously served as IEM Honorary Secretary, Chairman of IEM Civil & Structural Engineering Technical Division, Chairman of IEM-SWO Technical Committee on Wind Loads, as well as Secretary of IEM-SWO Technical Committee on Eurocode 2 Concrete Structures Design. Presently, Dr Chiang is also the Dean of the Faculty of Engineering & the Built Environment in SEGI University, Kota Damansara Campus, Petaling Jaya.

The road has been very long, with many hurdles, twists and turns, but the finishing line is in sight. By the second half of the year, we hope to have the final version of the Malaysian National Annex to MS EN 1998 Part 1: Design of structures for earthquake resistance, well in place.

As chairman of the Technical Committee on Earthquake, it is my pleasure to present, in this issue of IEM Jurutera, the results of the hard work put in by our Working Group 1 members. A preview of the findings was published in the September 2014 issue of IEM Jurutera, where three response spectrums were unveiled, for Peninsular Malaysia as well as for Sabah and Sarawak.

The proceedings of the recently-concluded International Seminar on NA to Eurocode 8 are also presented in this issue.

This could not have come to fruition without the active participation of seismic experts from Australia, Hong Kong, Singapore and other countries in the region. Just like the committee members of the TC and WG, these experts offered their time and services gratis; all are voluntary in nature, in the spirit of international collaboration and the exchange of academic knowledge and ideas without boundaries and divides.

For March, the cover story is on the dialogue between the IEM delegation, including international seismic experts, with senior officials and engineers in Jabatan Kerja Raya (JKR) at its headquarters in Kuala Lumpur. A special interview was also conducted with a senior JKR officer on the implementation of Eurocodes in Malaysia, in particular the Eurocode 8, on earthquake resistance design.

We hope our readers will gain valuable insights into the intricacies of EC8 and the work done by local and international experts to come up with a state-of-the-art code of practice for earthquake design in local structural engineering practices. ■

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No Turning Back in Accepting New Design Structures For Earthquake Resistance

Dato' Ir. Dr Abdul Aziz b. Haji Arshad *is the immediate past Senior Director of Civil and Structural Engineering Branch, Public Works Department (JKR) Malaysia, has previously served as the Director of JKR for the State of Selangor and the Director of Roads. He has also served as an Adjunct Professor for the School of Environmental Engineering, Universiti Malaysia Perlis (UniMAP), Industry Panel for the Faculty of Civil Engineering, Universiti Teknologi Mara (UiTM), Board of Trustees for the Construction Research Institute of Malaysia (CREAM) and the Chairman of the Investigation Committee for the Roof Collapse Incident at the Sultan Mizan Zainal Abidin Stadium in Kuala Terengganu. Presently, he is a Council Member of the Road Engineering Association Malaysia as well as Board Member of the Malaysian Structural Steel Association.*

Ir. Prof. Dr Jeffrey Chiang *is currently IEM Honorary Treasurer, has previously served as IEM Honorary Secretary, Chairman of IEM Civil & Structural Engineering Technical Division, Chairman of IEM-SWO Technical Committee on Wind Loads, as well as Secretary of IEM-SWO Technical Committee on Eurocode 2 Concrete Structures Design. Presently, Dr Chiang is also the Dean of the Faculty of Engineering & the Built Environment in SEGI University, Kota Damansara Campus, Petaling Jaya.*

by Putri Zanina

The development of the National Annex (N.A.) to Eurocode 8 (EC 8) pertaining to the Design of Structures for Earthquake Resistance looks set to achieve its implementation objective with the latest move by the IEM-Technical Committee (TC) on Earthquake to invite the Public Works Department Malaysia (Jabatan Kerja Raya Malaysia or JKR) to jointly develop, promote and enforce the N.A.

The invitation to JKR was extended during a dialogue session between the IEM delegation and the senior management and technical officials of the Civil and Structural Engineering Branch of JKR on 6th February 2015 at JKR Malaysia Headquarters in Kuala Lumpur.

Led by the Chairman of IEM-TC on Earthquake, Ir. Prof. Dr Jeffrey Chiang Choong Luin, the IEM representation was strengthened by the presence of the international expert group for Malaysian N.A. for EC 8, comprising Prof. Nelson Lam, Associate Professor and Reader in Civil Engineering at The University of Melbourne; Prof. Murat Saatcioglu, Professor in Civil Engineering, Faculty of Engineering, University of Ottawa, Canada; Ir. Adjunct Prof. M.C. Hee, the principal of M. C. Hee & Associates; and Hing-Ho Tsang, Senior Lecturer, Faculty of Engineering and Industrial Sciences, Swinburne University of Technology, Australia.

Present on behalf of JKR were the Director of Expert Services and Management Division, Civil and Structural Engineering Branch of JKR, Ir. Dr Kamaluddin b. Abdul Rashid, and senior officials of JKR's Civil and Structural Engineering Branch. Also present was the former Senior Director of the Civil and Structural Engineering Branch of JKR, Dato' Ir. Dr Abdul Aziz b. Haji Arshad, who retired from service recently.

DEVELOPMENT FOCUS AREAS

In extending the invitation to JKR, which is the technical adviser to the Government of Malaysia on matters concerning the construction and maintenance of public infrastructure in the country, Ir. Prof. Dr Chiang emphasised on four parts of the N.A., which are particularly relevant to the work of JKR, namely:

- BS EN 1991-1-2:2003 Actions on Structures. Traffic Loads for Bridges.
- BS EN 1992-1-2:2004 Design of Concrete Structures. General Rules, Structural Fire Design.
- BS EN 1992-2:2005 Design of Concrete Structures. Concrete Bridges. Design and Detailing Rules.
- BS EN 1992-3:2006: Design of Concrete Structures. Liquid Retaining and Containing Structures.

He said these four areas, which are BS EN standards on concrete structures, would be the focus of development in the immediate future. "These British Standards have yet to be drafted as MS Eurocodes. They have to be further studied with a view for adoption and for developing the N.A. to EC 8 with local parameters incorporated into the code," he said, adding that JKR would be invited to join the TC to develop the four areas.

JKR's assistance is also needed in the move to adopt the EC. "There is no turning back, as the IEM-TC for Earthquakes has already voted to approve the adoption of the main EC8

> *"Why do we have the perception that destructive earthquakes won't happen in Malaysia? Although the land size is small, you need to have statistical data based on research. Don't wait too long to capture statistics. You must interpret earthquakes because you have smaller land mass."*
>
> ***Prof. Nelson Lam, earthquake engineering expert***

document as MS EN 1998-1:2015. The next step to take is the adoption of the N.A. to EC 8 as N.A. to MS EN 1998-1:2015," he said.

OBSOLETE BRITISH STANDARDS IN CONSTRUCTION

Besides requesting JKR to endorse the work done to date in view of the progress made towards the adoption of the N.A. to EC 8 for Malaysia, IEM also invited JKR to assist in educating the profession in adopting and enforcing the use of structural Eurocodes as MS EN standards in place of British Standards (BS), which have been withdrawn in the UK since 2012.

Ir. Prof. Dr Chiang explained that as a former British colony, Malaysia had been using BS in the construction industry in the past. However, the UK is now no longer using, updating or improving the BS as it is currently using Eurocodes.

Eurocodes are a set of harmonised technical rules developed by the European Committee for Standardisation for the structural design of construction works in the European Union (EU). In March 2010, Eurocodes became mandatory for the specification of European public works and have since become the de facto standard for the private sector in the EU.

"In view of the development, Malaysia must now adopt the EC as well. If we continue to use BS, we would be stuck in terms of advancement. Currently, the law states that the BS is the accepted standard for use in Malaysia. If there are any changes in the standard used, then it will conflict with the by-laws," said Ir. Prof. Dr Chiang.

He reiterated that IEM had studied the issue thoroughly and concluded that using EC was the way to go. "It is logical and reasonable to follow the steps taken by the UK, which had fully adopted the EC. We will have to adopt the EC in line with the withdrawal of the BS in Malaysia."

Besides the UK which has adopted EC 8 and produced its own N.A. to EC8, Singapore has also adopted EC 8 since 2013 and will be fully using it from April this year. As for Malaysia, Ir. Prof. Dr Chiang said, it was still at the deliberation stage and discussed by the TC. It now requires the input by all stakeholders of industries to produce the N.A. with local parameters before the full adoption of EC 8 by Malaysia. The N.A. document will be subject to voting later on. Full adoption can only happen with the acceptance of both EC 8 and the N.A. document. "What is crucial now is setting the deadline for the full adoption of the EC," he said.

He added that in line with the proposed adoption of the N.A. to EC 8, a guidebook is being prepared. Ir. Prof. Dr Chiang said it will be ready by the end of the year. Once the N.A. is adopted, all new projects must be designed according to the new code therefore the guidebook will be a necessity.

MALAYSIAN STANDARDS ALIGNED WITH EC

Ir. Prof. Dr Chiang also presented the scope of BS EN 1998-1: 2004 EC 8. It refers to the design of structures for earthquake resistance – General rules, seismic and rules for buildings. This applies to the design of buildings and civil engineering works in seismic regions and deals with the following:

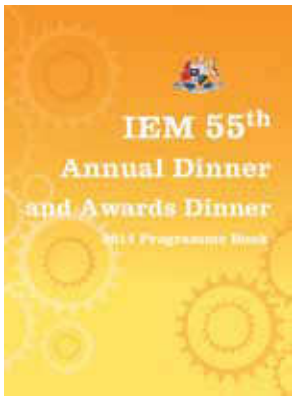
- Basic performance requirements and compliance criteria applicable to buildings and civil engineering works in seismic regions.
- Rules of the representation of seismic actions and for their combination with other actions.
- Fundamental requirements and other relevant aspects of design and safety related to base isolation of structure specifically to base isolation of buildings.
- General design rules relevant specifically to buildings. Specific rules for various structural materials and elements relevant specifically to buildings.

He disclosed that in 2010, the Department of Standards Malaysia (Standards Malaysia) released a two-in-one package comprising the Malaysian Standards (MS) called MS EN 1990:2010 Eurocode: Basis of Structural Design as well as the MS EN 1990-2010 (National Annex) – Malaysia National Annex to Eurocode – Basis of Structural Design.

Also released was another package comprising the MS EN 1991-1-1: 2010 EC1: Actions on Structures – Part 1-1: General actions – densities self-weight, imposed loads for buildings, and the MS EN 1991-1-1: 2010 Malaysia National Annex to EC1: Actions on Structures – Part 1-1: General Action - densities, self-weight, imposed loads for buildings. The MS EN 1997-1-2012 (National Annex) Malaysia National Annex to EC 7: Geotechnical design – Part 1: General rules was also developed and released.

Ir. Prof. Dr Chiang, who is also the Dean of the Faculty of Engineering & Built Environment, SEGI University, has been actively involved in drafting the MS on design of concrete structures. He served as the TC's Secretary and was also the Past Chairman of IEM-TC for Wind Loading.

IEM 56th Annual Dinner and Awards Night 2015 Programme Book



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

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

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RECENT PROGRESS OF IEM-TC ON EARTHQUAKE

Ir. Prof. Dr Chiang also took the opportunity during the dialogue to give a briefing on the progress made in recent years. He said the drafting of the N.A. for EC 8 as part and parcel of MS EN to be developed by Standards Malaysia started in 2007, about two years after the 2004 Aceh tsunami. The relevant IEM position paper on the need to have guidelines for earthquake engineering was released in 2007. In 2008, IEM as a standards writing organisation (SWO) was invited by Standards Malaysia through SIRIM Berhad to form a TC to draft the Malaysian Standard (MS), which would serve as the N.A. for earthquake design.

In 2009, following Ir. Prof. Dr Chiang's appointment as Chairman of the TC, all the relevant international standards around the world were studied. This move was part of the preparation to draft the N.A. (MS EN 1998 Part 1), which would tie in with the adoption of EC 8. The TC also organised a series of events, including symposiums and workshops from 2011 to 2013 which saw the participation of both local and international experts.

Last year, a two-day workshop was held to give further explanation on the progress. The highlight was the recommended earthquake loading model in the proposed National Annex to EC 8 for Sabah and Sarawak, as well as an update on the progress for Peninsular Malaysia. Discussions included the approaches for modelling site effects in local earthquakes and the method to compute the natural period with the use of shear wave velocity and how to use average shear wave velocities through layers of different soil with different soil properties.

As far back as 2010, the development progress of MS based on EC design was highlighted in the IEM magazine – *Jurutera*. The article focused on the need to adopt and implement EC in Malaysia, as well as develop the N.A. for the EC.

Ir. Prof. Dr Chiang also shared that a preview of the N.A. to EC 8: Seismic Loadings for Peninsular Malaysia, Sabah and Sarawak was carried out in 2013. *Jurutera* magazine published a technical paper entitled "Recommended Earthquake Loading Model for Peninsular Malaysia" in April that year, and later published another paper on "Earthquake Loading Model in the Proposed National Annex to Eurocode for Peninsular Malaysia". In both papers, which were prepared by Prof. Lam, the Preliminary Hybrid Seismic Responses Spectrum Model for Peninsular Malaysia was presented internationally for the first time.

In July 2014, the updated preliminary design spectrum for Peninsular Malaysia and a newly established preliminary design spectrum for Sabah and Sarawak were introduced. The report gave a brief introduction into the above-mentioned response spectre, for a return period of 2,500 years of seismic wave transmission at bedrock level.

Prof. Lam is an internationally recognised expert in structural dynamics, earthquake engineering and protective technology. In the past 25 years, he has been researching and consulting widely in this field and has published some 200 technical articles which include some 80 journal articles.

MALAYSIA'S POTENTIAL SEISMIC HAZARDS

Invited by IEM TC to be a member of the study group, which is formed to study the key features for EC8 for Malaysia as far back as 2009, Prof. Lam said the Malaysian context is quite complex in terms of seismic hazard. "Malaysia has three distinct regions – Peninsular Malaysia, Sarawak and Sabah. Peninsular Malaysia is in the middle but away from the tectonic plate boundary, though quite near. It is the interpolate area – along tectonic area of Sumatra, and the Philippines, which is within the tectonic plate of regions including Australia. This is why I have been researching the same type of environment in the last 25 years – giving advice to some of these regions," he said.

He elaborated that Peninsular Malaysia falls under the plate that was hit by a massive earthquake, resulting in the 2004 tsunami. The seismic effects of the long distance earthquake

Photo 1: Some of the key participants of the dialogue between IEM delegation and JKR.

could be felt in Malaysia and Singapore. Peninsular Malaysia is subject to earthquakes that occur in long distances, including Sumatra, as well as susceptible to local hazards.

Sarawak, he continued, seems to be far way from these types of disturbances but the state has local earthquakes due to intraplate seismicity. Sarawak is subject to this sort of hazard.

Sabah is affected by high seismic activity dominated by active faults in surrounding seas of Sabah and The Philippines and therefore it has high risk. The seismicity here is random in nature, similar to the Australian environment.

"Land size in Malaysia is small, and you have not captured much data but earthquakes can still be potentially hazardous here. Data for Peninsular Malaysia has to be developed from scratch. Singapore is near to Kuala Lumpur so it has similar environment. We can apply the knowledge we have gathered on Singapore after the Aceh tsunami to Peninsular Malaysia.

Prof. Lam said local earthquakes in Malaysia are certainly something which researchers have ignored. "Hardly can we find local literature about this. All we obtained was a record of tremors in Bukit Tinggi near the capital city of Kuala Lumpur. But in 2013, another earthquake had happened up north in Perak. Bukit Tinggi activity is a local earthquake but it doesn't mean that it will only happen here. You cannot preclude it from happening elsewhere," he said.

"Why do we have the perception that destructive earthquakes won't happen in Malaysia?" Prof. Lam asked. "Although the land size is small, you need to have statistical data based on research. Don't wait too long to capture statistics. You must interpret earthquakes because you have smaller land mass," he urged. He revealed that Singapore has started implementing earthquake loading standard since last year. "But they have not yet incorporated their local provision in their standard. They are rolling out their standard in stages. Singapore also needs to consider the hazards of local earthquake," he added.

Sumatran earthquakes and long distance earthquakes can affect the taller buildings. Malaysians who were in tall buildings have been reported to have experienced earthquake tremors. Prof. Lam warned that should local earthquakes occur, they could be very hazardous to even low-rise buildings.

"In the summary of technical details which the TC for earthquakes is preparing in accordance with EC8, we will include the design for low collapse conditions. For hospitals, emergency services and other lifeline built facilities, Malaysia need to consider other design criteria which are more complete in terms of earthquake resistance. For most other buildings, consider only low collapse potential," said Prof. Lam as he presented the recommended categories of building design for Peninsular Malaysia and Sarawak (see Table 1).

Prof. Lam said the recommendations at this stage are subject to more debate and check and balance. For Sabah, he said, different importance factors would have to be determined based on earthquake hazards potential occurring in the state. "It is also important to come out with comparisons with other countries like Singapore, Vietnam and China. Don't look at what we have got only but the observation must be consistent with what's around us," he said.

He added that JKR has a role to play. "This role is to help determine which buildings can be classified as what. The standards design for buildings and all the framework of classifying buildings must involve the government. The NGOs and the private sector can't do it as the country's infrastructure comes under the government."

He added that the outcome of research done by academicians must be considered. Another factor to consider is costing. "In preparing the N.A. to EC 8, look also at the cost aspect. If complying with the N.A. to EC 8 is very costly, no one will want to adopt it. The reaction of the industry has to be taken into account as well."

SCENARIO IN CANADA

During the dialogue, Prof. Murat Saatcioglu also shared the Canadian experience. He said Canada suffers from earthquakes too. The interplate activities in the country are local therefore extra detailing design of buildings has to be done. He said poorly designed buildings and bridges in densely populated areas can result in devastating losses – both human and economic.

His research showed that the number of seismically deficient buildings and bridges in Canada was estimated to be alarmingly high, with worse scenarios in many other countries in the world.

Prof. Saatcioglu is the President of the Canadian Association for Earthquake Engineering. His recommendations include retrofitting and strengthening as the economically viable approach to reduce seismic risk. His research efforts include the development of new and innovative seismic retrofit technologies for reinforced concrete structures, such as buildings and bridges.

Both Prof. Lam and Prof. Murat were among the international experts invited to speak at the 3rd Symposium and Workshop on Earthquake in February in Kuala Lumpur. The event was part of the efforts geared towards drafting of the National Annex MS EN Standard Eurocode 1998 on earthquake which is scheduled to be ready by the middle of this year. ■

Table 1: Categories of Design Peak Ground Acceleration (PGA) on Rock Sites for Peninsular Malaysia and Sarawak

IMPORTANCE FACTOR	DESCRIPTION	CONSIDERED PGA (G'S)
0.8	Minor constructions	0.06 (0.8 x 0.07)
1.0	Ordinary buildings (individual dwellings or shops in low rise buildings)	0.07 (reference PGA)
1.2	Buildings of large occupancies (condominiums, shopping centres, schools & public buildings)	0.08 (1.2 x 0.07)
1.5	Lifeline built facilities (hospitals, emergency services, power plants & communications)	0.10 (Design PGA consistent with return period (RP) of 2,500 years)

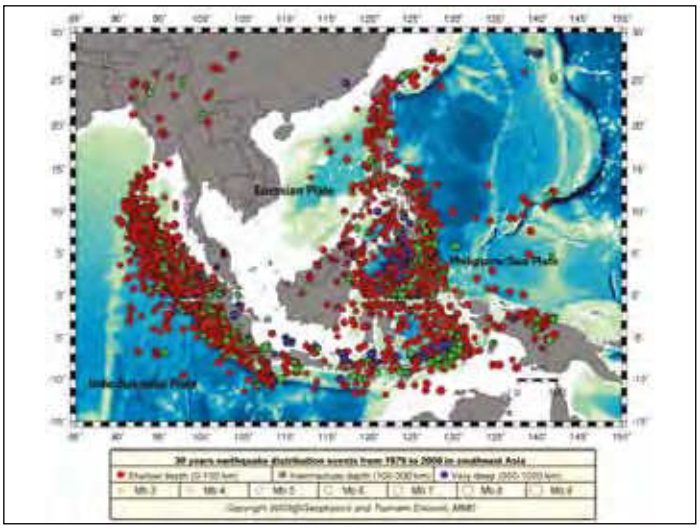

Figure 1: Regional seismicity of ASEAN countries

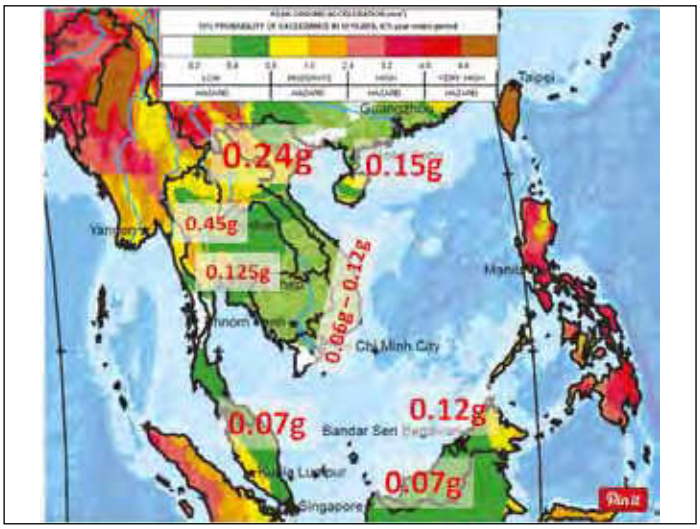

Figure 2: Seismic hazard map of ASEAN region

LEVEL OF READINESS FOR EARTHQUAKE RESISTANCE DESIGN A MAJOR CONCERN

In responding to the update and comments made on the development of the National Annex (N.A.) to Eurocode 8 (EC 8) during the dialogue between the IEM delegation and JKR, the former Senior Director of the Civil and Structural Engineering Branch of the Public Works Department, Dato' Ir. Dr Abdul Aziz b. Haji Arshad, said JKR was involved in drafting the N.A. to EC 8.

"JKR has one seismic expert to oversee matters pertaining to EC8 and we are quite positive we will implement what's required by the law," he said. However, he said there were some major concerns.

"First is our readiness. We must have our designers all well versed to adopt the EC in our design. We are also concerned whether the consultants we engage for our infrastructural projects have the knowledge and skills to design according to the new requirements," he said.

Another concern was the expected increase in cost to incorporate earthquake resistance elements in building and structural designs. "We have to do comparative studies and the cost increase is expected to be not quite nominal. The studies have to be done from scratch as the country lacks the knowledge on seismicity requirements. When you model your structure or design, it must be inclusive of all requirements. There are lots of parameters, not just soil structures to consider in the design but also geo-technical parameters and others. We also need to have new softwares to do various design analyses," he said.

He added: "Malaysia is within low and moderate seismic region. Our clients – the various ministries, departments and government agencies – are aware of this. Therefore, what is most difficult for us is to convince them that it is still important to include earthquake requirements in building design. For example, the last big flood in the country occurred 100 years ago. But because of the change in our environment such that we have lots more jungles in the past compared to today with more land being cleared, the return period of floods has become shorter. It's the same thing with earthquakes. We cannot say they will not happen here. We have no other choice but to have new building design with earthquake resistance factors."

He said the way forward is to reach a level of preparedness where everyone will accept and do all that is necessary to incorporate earthquake design. "Our clients have to be reminded of the earthquake that triggered the 2004 tsunami which also hit Malaysia. However, the country did not experience any structural defects due to earthquakes. But that is also the problem – because we have not experienced such situations, it is harder for us to convince the decision-makers that it is necessary to incorporate earthquake designs for structures to prepare for earthquake occurrences. Their concern is mainly the increase in cost. We have to justify this increase."

"We have to do comparative analysis to justify the cost increase. As the government technical adviser, we have to do this. We will not deviate from this task of meeting certain standards. But we do have constraints in terms of knowledge and the lack of local research."

In terms of local research, he conceded that there might have been independent research carried out by universities and other bodies. "But there is no co-ordination between them and therefore there is no sharing of data. There must be a body to co-ordinate the whole research projects so that the relevant ones can be disseminated to parties which need the research findings," he said.

"Despite the challenges, our emphasis now is to get the National Annex to EC 8 adopted. In Malaysia, the Eurocode is managed by IEM whereas in the UK, it's the government that drives it. This is the problem. NGOs like IEM cannot plan for the country. So the government must drive it. But here in JKR, whether we are ready or not, we have to take the initiative, do our own thinking and give the proper technical advice to the government. We must be prepared for the probability of major earthquakes happening in the country," he concluded. ■

WISMA IEM Part 2

by Dato' Ir. Pang Leong Hoon

***Dato' Ir. Pang Leong Hoon** was formerly the Director-General, Department of Irrigation and Drainage, Malaysia. He was also the Past President of IEM for Sessions 1984/1985 and 1985/1986.*

This is a compilation of articles under the Sub-Committee on Documentation and Recording of IEM Historical Events under the chairmanship of Datuk Ir. Prof. Dr Ow Chee Sheng. Committee members comprise Ir. Chiam Teong Tee, Dato' Ir. Pang Leong Hoon, Ir. Gunasagaran Kristnan and Ir. C.M.M.Aboobucker

THE PROCESSES

By the end of March 2007, the Ad Hoc Committee for the acquisition of IEM Land/Building had viewed the building and gathered sufficient information from the broker of the property at Lot 109 Jalan Selangor, Petaling Jaya, to put up a working paper. In preparing the paper, the Ad Hoc Committee took into consideration the earlier papers (dated 3 December, 1993, and 20 September, 2004) on the subject matter as prepared by previous Ad Hoc Committees on Developing Institution Land and on IEM Building-Land. In addition, the current Ad Hoc Committee also took into consideration a report by the broker, Messrs K. Ramanathan & Company, that the purchase would be RM13.50 million, although the initial asking price was RM16 million.

For such a heavy undertaking/investment, the Excomm and Standing Committee on Finance was closely involved in the deliberation and development of the purchase although the Ad Hoc Committee had been doing all the spade work.

The Ad Hoc Committee completed a proposal paper titled "Institution Building" which was submitted initially to the Standing Committee on Finance. The paper was deliberated at the 307th Meeting of the Standing Committee held on 18 April, 2007. It was accepted and the Standing Committee recommended it to the Excomm for the IEM Council to give a mandate for the Excomm to proceed with the negotiation for the purchase of the property.

In the meantime, the Ad Hoc Committee on Acquisition of IEM Land/Building continued to gather more information on the property and the terms and conditions of the purchase.

THE CONSIDERATION / DECISION

The Excomm considered the proposal paper and the recommendation of the Standing Committee on Finance. With the endorsement of the Excomm, a Council paper was prepared and presented to the Council at its 357 meeting held on 21 April 2007. The Council was briefed on the proposal to purchase the property at Lot 109 Jalan Selangor, Petaling Jaya and took note that:

a) The building was a worthwhile purchase, based on the proposed price of RM13.5 million
b) The initial quoted price was RM16 million
c) There were originally 16 interested bidders. These were shortlisted to two i.e. IEM and the current tenant ICHS.
d) The need to pay the 2% earnest deposit as registration of the IEM's interest in the bidding.

The Council deliberated on the paper and decided in favour to purchase the property. The motion for the purchase of the building at RM13.5 million (maximum) was approved for the Excomm to take follow-up action. Following the decision of the Council, active discussion and negotiations with the Broker/Vendor were carried out on the Sale and Purchase Agreement.

An Extraordinary Council Meeting was held on 20th June 2007 to consider a Council Paper (the latest report by the Ad Hoc Committee and the Fund Raising Committee) on the purchase and the financial plan and its implications. The Council took note of the decision taken on 21st April 2007 authorising the Excomm to proceed with the negotiation. The Hon. Secretary briefed the Council on the development and progress of negotiations leading to this Extraordinary Council Meeting. The Council Paper was discussed and deliberated in depth.

Having noted the above, the Council requested that due diligence be made on the purchase, and accepted the recommendation of the Excomm to purchase the property. It authorised the Excomm to proceed with the detail negotiation, with the purchase price to be capped at RM13.50 million.

Following the Council's decision, the Ad Hoc Committee on Acquisition of IEM Land/Building and the Standing Committee on Finance proceeded to work towards the purchase of the property. To assist them, the Excomm appointed two consultants:

a) Solicitors: Messrs Chye, Chow, Chung & Co.
To advise on legal matters e.g: Sale and

Purchase agreement, etc. (Ref: 391st Excomm Meeting on 27 April 2007)

b) Tax Consultant: Messrs PKF Tax Consultant
It had come to a stage when the Excomm was directly involved in the negotiation and decision making.

THE SALE & PURCHASE AGREEMENT

As required, the payment of RM260,000 (or 2% of the purchase price) was paid to Messrs. Tenggara Plaza Sdn. Bhd. (in liquidation), the owner of the building, in mid-May, 2007, at the time of bidding. In the meantime, the Hon. Treasurer was requested by the Excomm to look into the consolidation of funds to raise the balance of the initial 10% of the purchase price which worked out to RM1,090,000.00. He was also requested to expedite the formation of the Special Committee on Fundraising.

For the preparation of the draft Sale & Purchase Agreement, IEM was requested to decide whether the property would be purchased under the name of IEM or via a Special Purchase Vehicle (SPV). After the explanation given by our Tax Consultant, Ms Elaine Tan, the Excomm decided to use the name of IEM.

The draft Sale & Purchase Agreement was obtained by the IEM lawyer on 12 June 2007 and it was immediately circulated among members of the Excomm. The lawyer informed IEM that the Sale & Purchase Agreement was ready and expected to be signed on 22 June 2007.

In view of this development, an Extraordinary Meeting of the Council was held on 20 June 2007 to deliberate and decide on the following major issues:

a) The Tenant ICHS had defaulted in rental
b) The need to secure a bank loan. The Hon. Treasurer and his Committee had put up possible means to service the loan.
c) Financial situation with and without the Tenant ICHS.

After long deliberation, the Council decided to proceed with the purchase and gave a strong mandate to the Excomm to deal with the details of the purchase and to finalise the Sale and Purchase Agreement. As planned the Sale and Purchase Agreement was signed on 5 July 2007.

The Sale & Purchase Agreement was signed by:
Purchaser: The Institution of Engineers, Malaysia

- The President, Dato' Paduka Ir. Hj. Keizrul Abdullah
- The Deputy President, Dato' Ir. Prof. Chuah Hean Teik
- The Hon. Secretary, Ir. Oon Chee Kheng
  Witness: Mr. Low Bin Hwa, Advocate & Solicitor.
  Vendor: Alto Armani Sdn Bhd
- Director/Secretary
  Witness: Director

..... to be continued Part 3

INTRODUCTION TO

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Design and Construction Considerations for Prestressed Concrete Structures

by Siao Wen Bin

***Siao Wen Bin** is currently a lecturer with INTI International University. He has worked for a prestressed concrete specialist doing design and site management. He is a registered professional engineer.*

by Cheah Beng Khoon

***Cheah Beng Khoon** is also currently lecturing in INTI International University. He is a corporate member of IEM with many years of industrial and academic experience.*

by Susan Chong

***Susan Chong** is also a lecturer with INTI International University. She has vast experience in structural design and academia.*

With the increasing use of prestressed concrete in buildings, this article is timely. Most consultant engineers are not familiar with prestressed concrete design and are happy to leave it to the specialists. But more knowledge about prestressed concrete can go a long way towards ensuring that the owner's interests are properly safeguarded if problems do crop up. The following considerations should be looked into when opting for a prestressed solution.

RESTRAINING WALLS

Adverse effects of restraining walls should be taken into account when prestressing is applied. Members under compression due to prestressing will contract and, if prevented by stiff walls, tend to crack especially when such walls are located towards the two ends where stressing takes place Figure1 (1). Favourably placed walls located towards middle of building as in Figure 2 (1) will not interfere with the free contraction of prestressed members. Otherwise most of the prestress will end up in the walls rather than the members they are supposed to precompress. Figure 3 (1) shows crack pattern in prestressed slab in a building with shear walls unfavourably positioned.

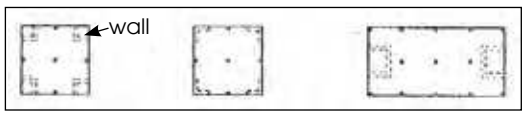

Figure 1: Unfavourable arrangement of restraining walls

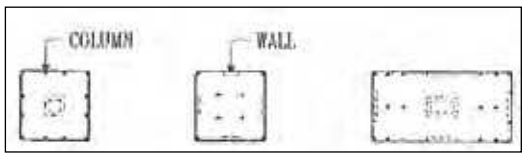

Figure 2: Favourable arrangement of restraining walls

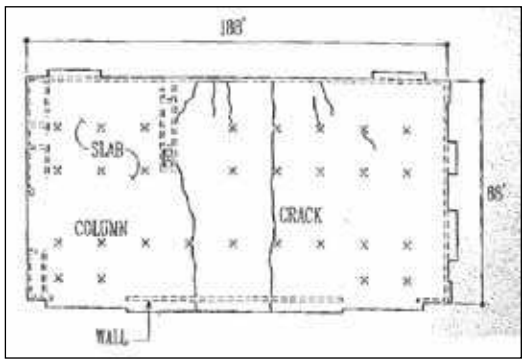

Figure 3: Crack pattern for prestressed slab with unfavourably placed walls

BASEMENT WALLS

Where basement walls are present, slabs and beams should not be prestressed (2) without taking into account the stiffness of the walls. As such, walls are relatively stiff compared to the flexural members. They tend to attract most of the the prestressing force and distress will show up later in the flexural members which end up with only a fraction of the intended design prestress.

POUR STRIPS

However if unfavourable location of shear and basement walls is inevitable, then the judicious placement of pour strips Figures 4 & 5 may overcome the abovementioned diversion of prestress to the stiffer walls. Pour strips are gaps left between two regions of prestressed slabs which are concreted after contraction due to prestressing and preliminary drying shrinkage has taken place.

If pour strips are not provided, then more prestressing will be required where restraining shear walls are countering the effective prestressing of the slab Figure 6 (1). For such cases, a certain amount of previous experience will prove invaluable when deciding how much more to provide.

OPENINGS IN PRESTRESSED SLAB

Openings in prestressed slabs are areas of discontinuity which are prone to cracking. Figure 7 (1) shows that terminating all tendons at the edges of the opening will promote cracking whereas overlapping of tendons will help to inhibit cracking.

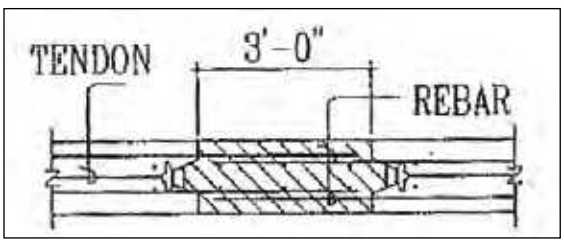

Figure 4: Pour strip

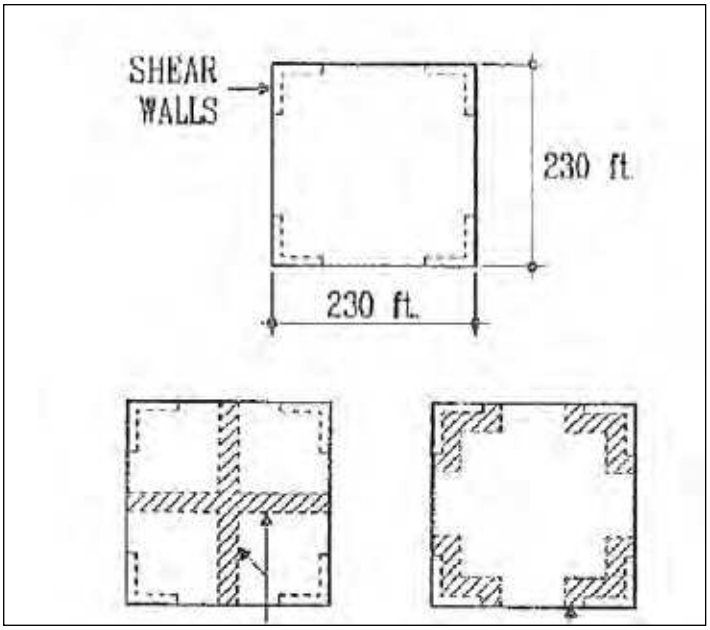

Figure 5: Placement of pour strips

OPENINGS IN PRESTRESSED BEAMS

Although openings in prestressed beams are not recommended, there are times when this cannot be avoided. Currently, openings in reinforced concrete beams are well researched (3), (4) , (5) and published investigations into openings in prestressed beams are comparatively scarce (6), (7). Abdalla *et al.*, (5), (6) have proposed a method for checking the strength of prestressed beams with openings which are modified from that proposed for reinforced concrete beams (4) (5) by taking the effect of prestressing into account. A simpler method however is desirable as this method can be rather time consuming. Currently the authors are working on a quicker approach to this problem.

PRESTRESSED BEAMS ON CORBELS

There is a need to consider horizontal forces and possible movement of bearing pad as continuous contraction is expected due to prestressing and shrinkage effects. Design of reinforced concrete corbels is a straightforward thing (8) but for prestressed beams, shortening of the beam and horizontal forces due to contraction need to be estimated and taken into account in the design. Improper positioning of the bearing pad may be exacerbated by contraction and will result in spalling of concrete cover at the face of corbel in many instances.

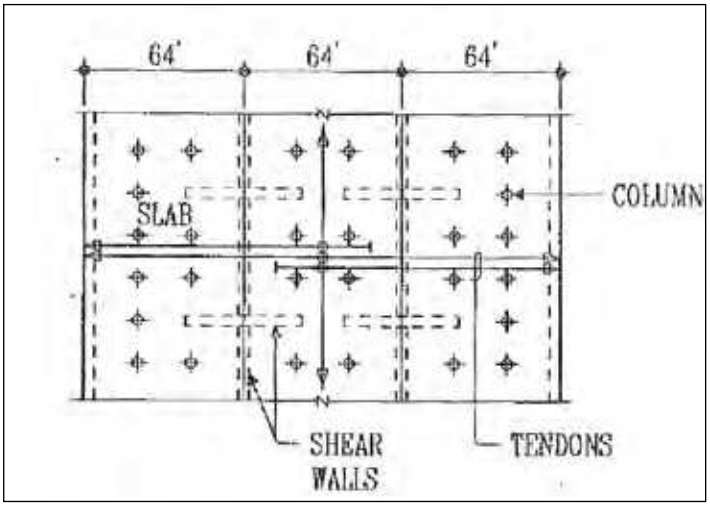

Figure 6

GROUND SLABS

Prestressing of ground slab and beams needs to be carefully evaluated as the restraining effect of the ground, pile caps or even piles need to be evaluated. Indiscriminate application of prestressing may lead to much of the prestressing ending up in members other than those intended Figure 7.

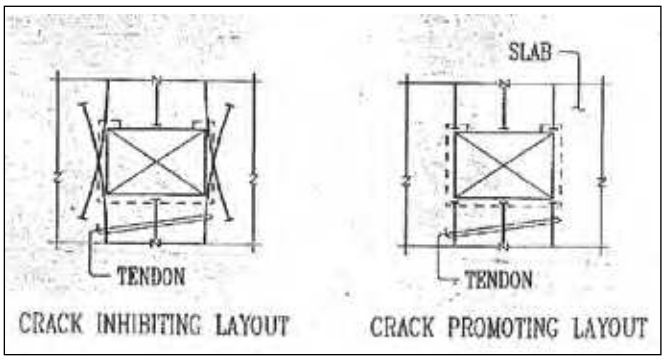

Figure 7

STAGE STRESSING

This is normally required for transfer beams. Depending on the number of storeys supported, the transfer beam needs to be stressed in stages and definitely more than once. Of course it costs less to do it fewer times. But in doing so, take great care and ensure accuracy in estimating the actual building loads. It is a misconception that overestimating the building loads will result in a "safer" design. This may be true for reinforced concrete buildings but it's not necessarily true for prestressed buildings as a greater load may require a higher prestressing force which, if carried out, can cause cracking if not countered in actuality by the expected heavier load.

CURVED PRESTRESSED BEAMS

Beams curved on plan are susceptible to torsion from prestressing as the tendon in the beam will apply an eccentric radial force about beam's centroid, giving rise to torsional moments which, if ignored, have been known to cause beam failure in certain instances.

MEASUREMENT OF TENDON ELONGATION DURING STRESSING

The importance of this activity in the construction of prestressed beams

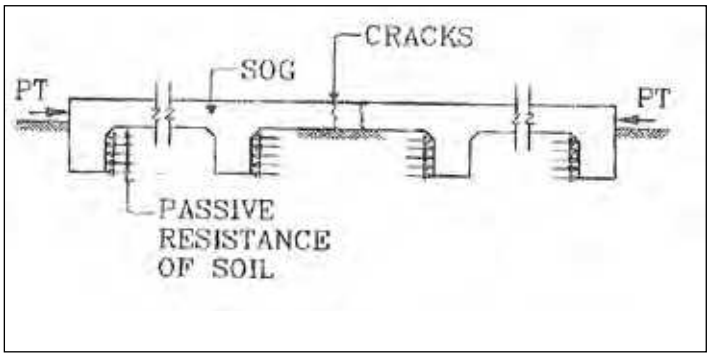

Figure 8: Cracks arising from resistance of ground to prestressing of ground slab

cannot be overstressed. Accurate measurement of tendon elongation and comparison with predictions are crucial in determining if stressing has been carried out properly and that everything is going according to plan. Any discrepancy can be attributed to a variety of reasons: Faulty jacks, breakage of tendons, leakage of grout into ducting, overstressing and understressing. Such occurrences need to be fully and thoroughly investigated till a satisfactory explanation is obtained. Otherwise it may spell disaster.

CONCLUSION

The above factors affecting design of prestressed beams are not comprehensive or exhaustive. What we hope for is that it will lead to more articles. The exchange and sharing of information/knowledge in this area is always considered the exclusive purview of specialists. ■

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Introduction to Groundwater Flow Modelling

by Samantha Loke Yin Ying

***Samantha Loke Yin Ying** is a Master of Environmental Engineering (University of Melbourne) and a Bachelor of Engineering (Civil) with Honours (Kolej Universiti Teknologi Tun Hussein Onn, which is now the University Tun Hussein Onn Malaysia). She has over seven years' experience in design management and infrastructure design in the fields of hydrology and hydraulics.*

Groundwater plays a significant role in many water resource systems (Bear & Verruijt, 1987) and it is especially important where surface water is scarce. Groundwater models are simplified representations of groundwater systems and are developed for various purposes such as for prediction of groundwater conditions, natural resources management and estimation of aquifer properties (American Society of Civil Engineers, 1996).

Groundwater models can be classified into various user-defined categories, as illustrated in Figure 1. As shown in Figure 2, three types of models are generally used to study groundwater flow, namely sand tank models, analogue models and mathematical models (Wang & Anderson, 1982). With the advent of computational technology, electric analogue models (Figure 3) have faded-out and are replaced by mathematical models, particularly numerical models (Anderson, 1995). Sank tank models (Figure 4) are now used as a teaching aid to demonstrate basic groundwater concepts instead of solving field problems.

The objective of this review is to compare physically based mathematical models, i.e. analytical and numerical methods in general terms. Two of the most widely used numerical solutions, i.e. finite difference and finite element methods are briefly introduced.

In addition, contribution of remote sensing and geophysical survey to groundwater flow modelling will be briefly presented. Finally, likely future developments in groundwater flow modelling will also be suggested.

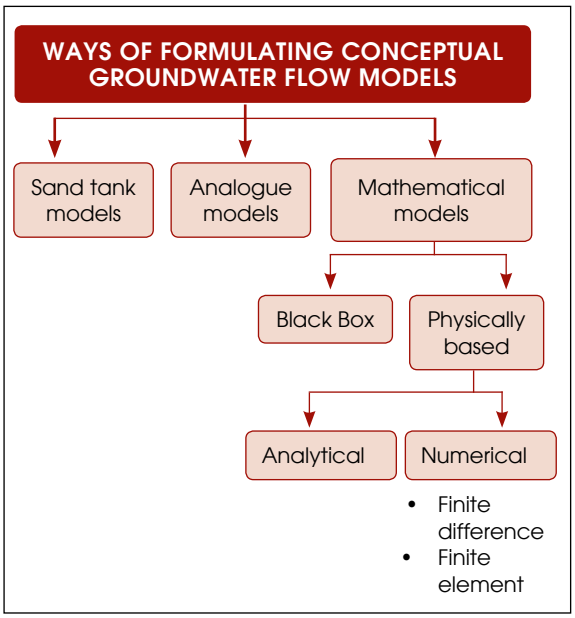

Figure 2: Types of groundwater models according to solution techniques and ways of formulating conceptual models

2.0 GROUNDWATER FLOW MODELLING

In terms of functionality, groundwater models can be divided into two broad categories, i.e. flow and transport models (Mandle, 2002; van der Heijde, El-Kadi, & Williams, 1988). The concern of flow models is

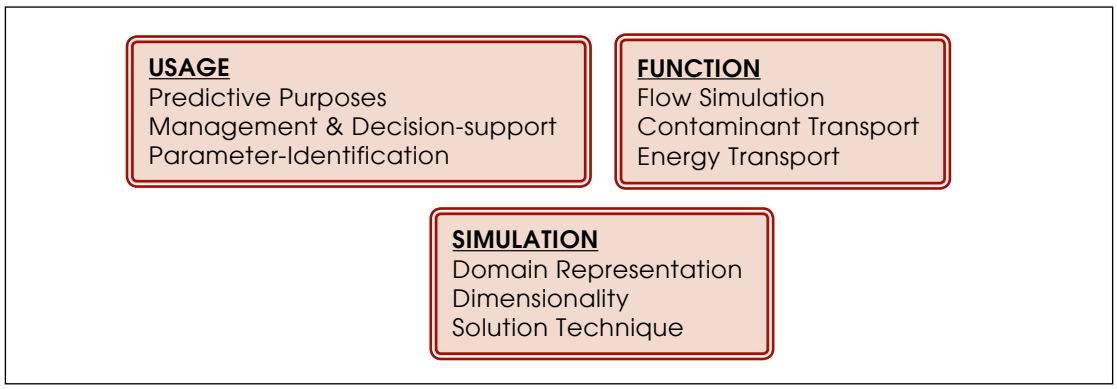

Figure 1: Groups of classification criteria for groundwater models
Groundwater models may be categorised by the criteria of (1) intended use of the model, (2) functional capabilities of the model, (3) simulation framework i.e. formulation and solution of the governing equations
Source: American Society of Civil Engineers (1996, p. 24)

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Figure 3: Historical electric analogue groundwater flow models
Source: University of Illinois (2011)

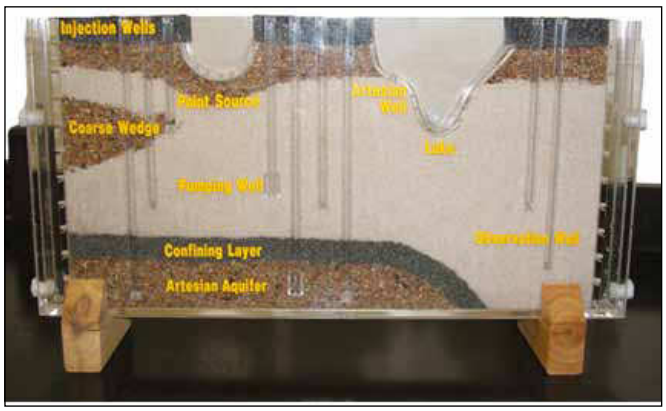


Figure 4: A sand tank model
Source: University of Nebraska-Lincoln (2009)

more on quantity or more specifically, the rate and direction of movement of groundwater (Mandle, 2002). The typical outputs from flow models are groundwater flow rates and hydraulic heads. The data required to develop typical groundwater flow models are as summarised in Table 1:

Table 1: Data required to develop typical groundwater flow models
Adapted from Mandle (2002) and Coffey Geosciences (2006)

DATA	EXAMPLE OF PARAMETER
Subsurface extent and thickness of aquifers and confining units	Ground surface levels
Hydrologic boundaries (also referred to as boundary conditions)	
Hydraulic properties of the aquifers and confining units	Aquifer transmissivity and specific yield
Groundwater levels (hydraulic head) for initial, steady-state and transient state conditions	
Distribution and magnitude of groundwater recharge	Rainfall
Discharge zones - leakage to or from surface-water bodies, etc. (sources or sinks, also referred to as stresses whether it is constant or transient)	

Mathematical models representing groundwater system are made up of a set of partial differential equations (PDE) (American Society of Civil Engineers, 1996). These equations could be solved using analytical and numerical methods using the initial and boundary conditions established.

ANALYTICAL METHODS

Analytical solutions are generally easy to apply and give the modellers a good appreciation of the model. The methods assume the model domain to be continuous in time and space (indicated by blue line in Figure 5) and provide an exact solution to the groundwater flow of low complexity. Analytical methods involve simplifying the flow equations to account only for uniform flow, homogeneous aquifer properties (such as uniform aquifer geometry and hydraulic properties) and steady-state conditions (Mandle, 2002), which are rarely the case in field conditions. Such simplifications do not take into account the spatial and temporal variability of groundwater flow or direction and hence, are unable to address complex interactions (Armstrong & Narayan, 1998). With the drawback of such simplification, analytical solution is recommended to be used for (Mandle, 2002):

- Groundwater system with simple flow processes (justified by field data)
- Checking on the performance of numerical solutions
- Initial assessment of site conditions and setting up of data collection where accuracy is of less concern

Analytical solution is seen as a top-down approach as it starts simple and only adds complexity as required, using big picture hydrogeological principles (considering large time span and hence permit steady-state conditions) and aims to capture generalities.

NUMERICAL METHODS

Numerical methods provide approximate solutions to the groundwater flow equations of more complex conditions. The approximation requires spatial and temporal discretization which is a process of subdividing the modelled area and time into small cells by model grid and time steps respectively, as shown in Figure 5. Unlike analytical methods which are using global values for aquifer properties, numerical methods could

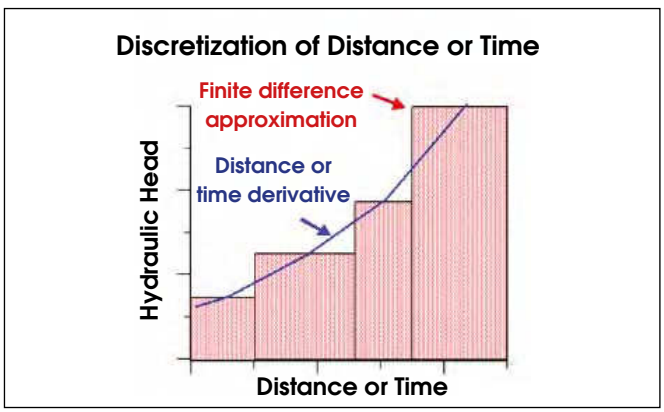


Figure 5: Discretization of distance or time versus continuum in distance or time (blue curve) "The blue curve represents the continuous variation of a parameter across the model space or time domain. The bars represent a discrete step-wise approximation of the curve". Source: Mandle (2002, p. 10)

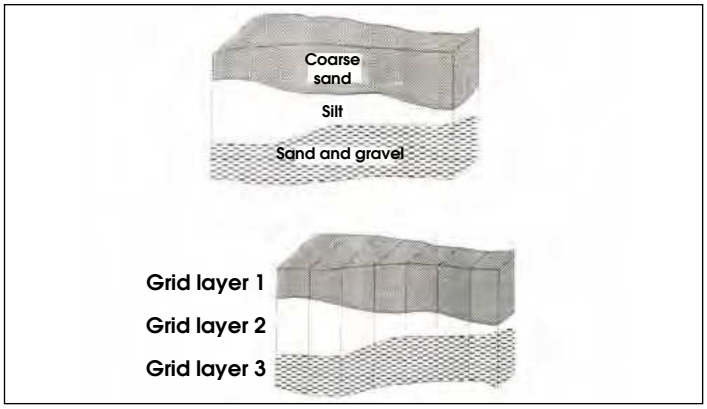


Figure 6: An example of representing a multi-layered aquifer system in a numerical model via discretization. Source: Mandle (2002, p.11)

account for the field conditions that change with time and space such as variation in flow rate or direction, hydraulic and aquifer properties (Figure 6).

Numerical methods are best used for (Mandle, 2002):

- Groundwater system with complex flow processes
- Hydraulic and aquifer properties exhibit significant spatial and temporal variability

In contrast to the analytical method, the numerical method is seen as a pro-bottom-up approach as it conceptualises the temporal and spatial variability and combines into an overall model.

The two most widely used approaches to implement numerical solutions, i.e. finite difference and finite element methods are briefly introduced below.

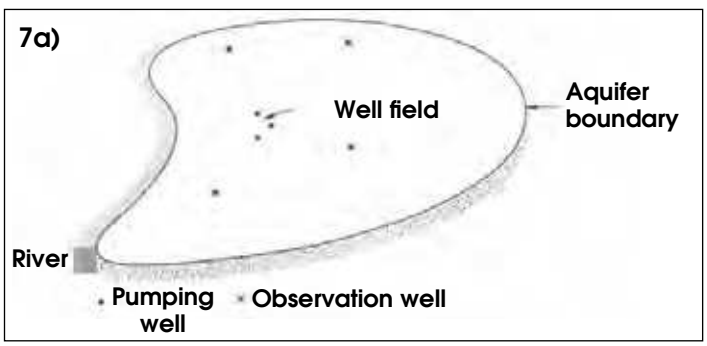
FINITE DIFFERENCE (FD)

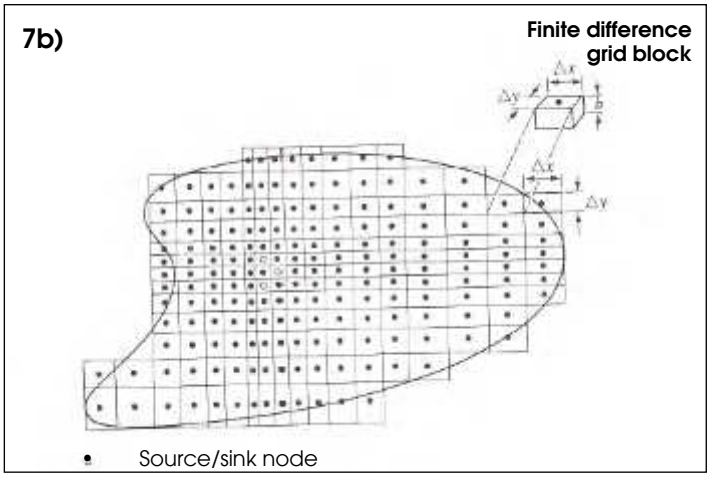
Two key features of FD approach are:

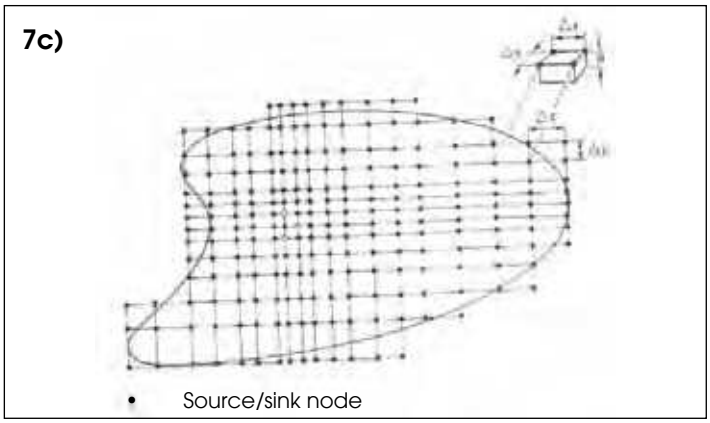
- Discretizing the model domain by rectangular shaped and regular-spaced mesh or grid points as shown in Figure 5 (Mandle, 2002)
- Solving the governing flow equations by approximating the derivatives of the PDE (van der Heijde, El-Kadi, & Williams, 1988)

FINITE ELEMENT (FE)

For FE approach, "the PDE is approximated using the method of weighted residuals to obtain a set of algebraic equations which are solved using direct or iterative matrix methods" (Mandle, 2002). Even though FE requires more coding efforts than FD, it provides more flexibility and accuracy in representing irregular aquifer geometries as the cell shape of the discretization could be triangular or almost any polygonal shape (Younger, 2007), as illustrated in Figure 7.







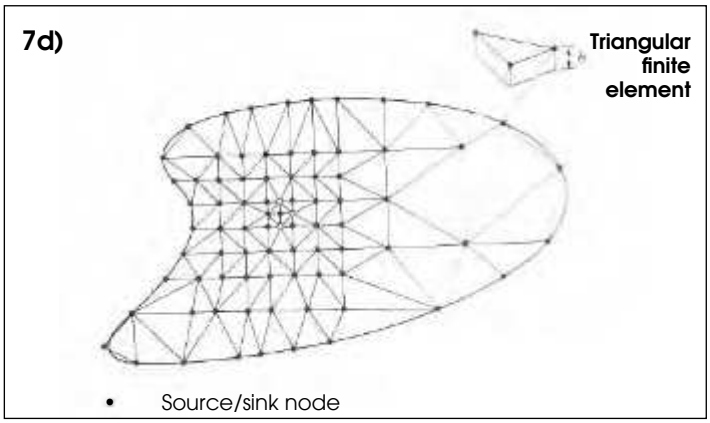


Figure 7: Finite difference and finite element representations of an aquifer region (a) Map view of aquifer (b) Finite difference grid with block-centred nodes where b is the aquifer thickness (c) Finite difference grid with mesh-cantered nodes (d) Finite element mesh.
Source: Wang & Anderson (1982, p. 4-5)

3.0 CONTRIBUTION OF REMOTE SENSING AND GEOPHYSICAL SURVEY IN GROUNDWATER FLOW MODELLING

Even though groundwater flow modelling has come a long way and is now highly evolved and mature, data availability and dealing with spatial variability and data limitations are still big issue. The main benefit brought by remote sensing (RS) and geophysical survey (GS) to groundwater modelling is the ability to provide spatial and temporal distributed input and calibration data (Brunner, Franssen, Kgotlhang, Bauer-Gottwein, & Kinzelbach, 2007). Some may say

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that RS data often require another modelling step to convert them to useable groundwater modelling data which would involve the correlation with ground observation data and hence be subjected to noise. Even so, RS data is still considered to be more superior than conventional data which are mere mathematical interpolation from point measurements (Brunner *et al.*, 2007).

The airborne RS information which have been identified to be of potential use in groundwater modelling are inclusive but not limited to the following (Brunner *et al.*, 2007):

- Identification of faults and dikes
- Changes in lithology and the depth of magnetic features
- Lineaments on the surface
- Surface elevations (upper boundary of phreatic aquifer)
- Vegetation type, vegetation density or other land surface characteristics (which would affect the infiltration rate)
- River and lake levels

Conventional subsurface measurements which involve drilling, probing and digging can only provide details of specific points. Gravitational, magnetics and electromagnetic GS, which are non-destructive subsurface investigation methods are expected to provide better representation/indication of the following aquifer properties which are required to run typical groundwater flow models:

- Subsurface extent and thickness of aquifers and confining units
- Hydrologic boundaries/boundary conditions
- Hydraulic properties of the aquifers and confining units - temporal changes in the total water storage (surface water, soil water and groundwater), specific yield

4.0 FUTURE DEVELOPMENTS

It is anticipated that future developments of groundwater flow modelling are more to polishing the approaches of parameter optimisation, uncertainty assessment as well as better representation of spatial distribution of input and calibration data.

More contribution is expected from geophysics surveys and remote sensing to supplement distributed spatial data instead of the conventional point measurements (Brunner *et al.*, 2007).

Population growth and climate change have worsened the water scarcity crisis on a global scale. Keeping this in view, it is likely that groundwater flow modelling will emphasise more on multi-disciplinary to address bigger picture i.e. integrated catchment management (ICM), than just conventional surface-groundwater relationship (Middlemis, 2004).

The general lack of communication and consistency among modellers warrant for the need for establishing specific guidelines in the field of groundwater modelling as in the case of Groundwater Modelling Guidelines for Australia (Middlemis, Merrick, Ross, & Rozlapa, 2001). Good and consistent modelling protocols are envisaged to further improve model reliability.

5.0 CONCLUSION

Both analytical and numerical methods have their merits and limitations. Adding complexity to a simulation does not guarantee accuracy. When simplifying assumptions can be justified to be appropriate to the field condition, an analytical solution can out-perform a poorly devised numerical model (Armstrong & Narayan, 1998).

Advancement in computer technologies and modelling software has reduced the calculation and analysis effort of groundwater flow modelling. However, as the modellers only see the final modelling results, potential errors made in the conceptual model and misunderstandings of applications and limitation of numerical methods are difficult to detect. Therefore, it is still essential to have a comprehensive and sound understanding of the underlying concepts and assumptions of groundwater systems in order to develop a reliable groundwater flow model. ■

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IEM DIARY OF EVENTS

Title: Half Day Seminar on Computational Fluid Dynamics in Building Services Applications

25th March 2015
Organised by : Mechanical Engineering Technical Division
Time : 9.00 a.m. – 1.00 p.m.
CPD/PDP : 3.5

Title: Talk on Submarine Landslide Flows Simulation Through Centrifuge Modelling

25th March 2015
Organised by : Geotechnical Engineering Technical Division
Time : 5.30 p.m. – 7.30 p.m.
CPD/PDP : 2

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

Review and Check Activities Required to Avoid Representation Errors in Documents and Drawings

by Ir. Gan Chun Chet

***Ir. Gan Chun Chet** is holds a Master of Science (MSc) in Operations Management (University of Manchester Institute of Science and Technology, UMIST) and Bachelor of Science (BSc), with honours, in Mechanical Engineering (University of Manchester). He has 16 years experience in manufacturing, oil and gas engineering design sectors. Currently venturing into engineering management consultancy services.*

In managing the quality of technical documents and drawings as well as to ensure that clients will accept them, a series of review and check activities are required. In producing engineering documents or drawings, accuracy and details are required to ensure the documents contain sufficient technical information and drawings have sufficient technical graphics so that those reading these documents or drawings will understand what is required by the client, project or discipline.

This article highlights some key points to note when preparing the documents or drawings, based on my past experiences in purchasing technical equipment and preparing technical drawings. These points are highlighted to avoid a wrong representation in the documents or in the drawings. If the technical information or graphic is represented wrongly, suppliers will deliver the wrong products or services. Similarly, the system will be configured wrongly as well.

SERIES OF REVIEW AND CHECK ACTIVITIES (CHECK POINTS)

Ideally, documents or drawings should be in the proper order to avoid the recipient giving a wrong quotation or delivering wrong products or services to the client. Review and check activities are required to ensure that the products or services are correct at the point of purchase. It is advisable to have a series of review and check activities. Below is an example of review and check activities Figure 1.

There are a few stages to completing technical documents or drawings. In the process of producing these documents or drawings, the stages in practice, from start to finish, are described below.

1. IDC (Interdisciplinary Check): This is when preliminary documents or drawings are prepared. At this stage, resources are planned to meet the schedule and individuals are allocated responsibilities to prepare the preliminary documents or drawings based on the conceptual idea. The documents or drawings are then sent to other disciplines for review and comments on interface requirements.
2. IFR (Issued For Review): The documents or drawings, with comments from other disciplines included, are send to the client for review.
3. AFC (Approved For Construction): Comments or additional requirements from the client are included in the drawings or documents and delivered to the suppliers.
4. Finish (or As-built): Where site changes or other inputs or design corrections are included.

The series of review and check activities are point checks throughout the preparation of technical documents or drawings to ensure that these are complete as well as customer satisfaction at a later stage (near the end) of the project.

Figure 2 shows the check points at various stages of the project in order to prepare documents or drawings that are acceptable to the client. Where performance rating is a key indicator in the project, the review and check activities will work to avoid errors.

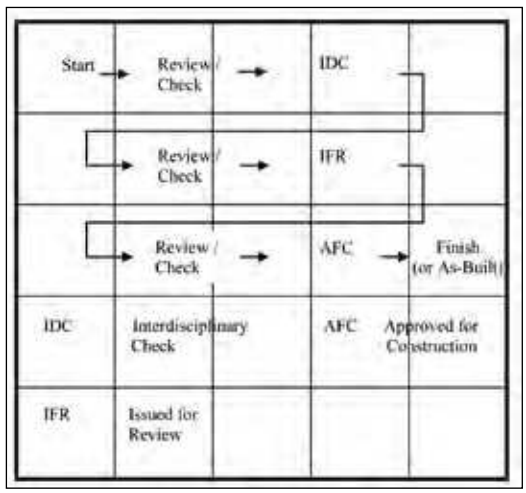

Figure 1: Series of review and check activities

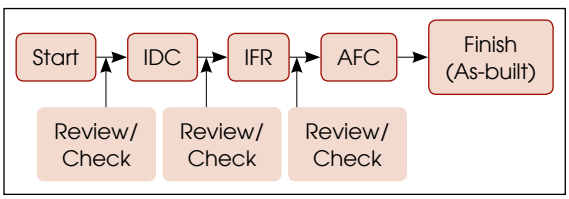

Figure 2: Check points at various stages in preparing the documents or drawings

ADVICE FOR AVOIDING ERRORS (IN PREPARING DOCUMENTS AND DRAWINGS)

When preparing the technical documents, ensure that the general requirements are stated in the documents as required and can be met by a few suppliers. Technical consistency in the documents needs to be standardised at beginning when preparing the main document. This will ensure repeated technical requirements will appear the same in other documents. These are requirements that will not change unless otherwise instructed. At a later stage, non-standard requirements can be added. This will allow you to manage the technical information in the documents throughout the different stages. New requirements can be added on each time the documents are revised while the existing requirements remain unchanged from the start.

When preparing the technical drawings, make sure the general graphical representations are shown correctly as required and that they are understood by the suppliers. Technical details that suppliers need to know must be specified in the drawings.

For example, in generating the fire and gas cause and effect matrix for an addressable system, the "effect" must be identified properly. Otherwise, the supplier will not be able to programme the system to activate a particular device. For another example, when preparing the fire and gas layout drawings for buildings on an offshore platform, ensure the governing standards are stated on the drawings. The type of detectors to be used must be properly shown and their locations must be indicated specifically.

At different review stages, the comments have to be incorporated, based on the marked input. It is then considered complete at design stage.

FAILURE IN PREPARING THE DOCUMENTS AND DRAWINGS

When documents or drawings are rejected, this means failure in delivering the intended purpose and the consequences may be substantial. In my opinion, the technical documents and drawings need to be checked by experienced engineers in the field. A series of review and check activities are required to ensure that documents and drawings requirements are checked at various stages to prevent rejection at late stages.

CONCLUSION

At various stages of a project, the documents and drawings generated need to be reviewed and checked to ensure that the requirements are properly captured. This way, suppliers will be able to deliver the products or services as intended and systems will function properly. ■

IEM DIARY OF EVENTS

Title: The 2nd FAB Roadshow on Latest Development in Fire Protection Practices, Open Forum and Technical Dialogue

23rd March to 24th March 2015

Organised by : Standing Committee on Professional Practice
Time : 8.30 a.m. – 6.30 p.m.
CPD/PDP : 14

Title: One-Day Course on Enterprise Risk Management and Business Continuity Management

24th March 2015

Organised by : Building Services Technical Division
Time : 9.00 a.m. – 5.00 p.m.
CPD/PDP : 7

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ANNOUNCEMENT

INTRODUCTION

Department of Standards Malaysia (STANDARDS MALAYSIA) was established on 28th August 1996 under the purview of the Ministry of Science, Technology and Innovation (MOSTI) and is responsible for developing and promoting Malaysian Standards (MS). STANDARDS MALAYSIA, as the National Standardisation Body is a member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

Public comment is an important stage in the MS development process. The period of public comment is for two months (60 days), to allow for the submission of comments on the draft or existing MS by interested parties. This is consistent with Article 4, 4.1 and Annex 3 of WTO/TBT Agreement. All views and comments will be deliberated by the relevant committee and further drafting will be made, if necessary.

DURATION

1st February 2015 - 1st April 2015

PUBLIC COMMENT

SIRIM Berhad as the Standards Development Agency (SDA) appointed by STANDARDS MALAYSIA, invites feedback for the following:

- Draft MS
- MS to be withdrawn

Draft MS for public comment can be downloaded from the website at no charge. However, the draft MS which are adopted in total from International Standards are available at a charge as indicated. The details on the draft MS and existing MS that are proposed to be amended and/or withdrawn can be obtained from: http://www.smsonline.gov.my/ (please click "Public Comment" under the "Services" that displayed on the left, top). You may also obtain the hardcopies of the draft MS from:

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Two-Day International Seminar & Workshop on Presentation and Reviewing of the Draft Malaysian National Annex to Eurocode 8

CIVIL & STRUCTURAL ENGINEERING TECHNICAL DIVISION

reported by Ir. Prof. Dr Jeffrey Chiang

Ir. Prof. Dr Jeffrey Chiang *is currently Honorary Treasurer of IEM. He has previously served as Honorary Secretary of IEM and is still serving as a member of IEM Technical Division of Civil & Structural Engineering, and as Chairman of IEM Technical Committee on Earthquake. He is also the Dean of Faculty of Engineering & Built Environment at SEGi University, Kota Damansara Campus.*

Speaker presenting his paper

IEM Civil & Structural Engineering Technical Division and IEM Technical Committee on Earthquake organised a two-day International Seminar & Workshop on Presentation and Reviewing of the Draft Malaysian National Annex to Eurocode 8, on 9-10 February 2015, at Armada Hotel, Petaling Jaya, Selangor.

A total of 83 participants attended the seminar cum workshop, including 10 invited international and local speakers who presented their respective papers relating to earthquake engineering standards requirements for low to moderate seismic zones such as Peninsular Malaysia, Sabah and Sarawak. This was a follow-up forum to two earlier symposium/workshops on earthquake engineering organised by IEM in 2011 and 2013.

The list of invited international and local speakers and their paper presentation titles are as follow:

1. Prof. Dr Koh Chan Ghee (National University of Singapore) – "*Consideration of Sumatra Earthquakes for Seismic Design in Singapore*".
2. Prof. Dr Friedemann Wenzel (Karlsruhe Institute of Technology, Germany) – *"Seismic Hazard and Residual Risk"*.
3. Prof. Dr Ray Su (University of Hong Kong) – *"Simplified Seismic Assessment of RC Buildings in Malaysia under Rare Earthquake Actions"*.
4. Dr Kushan Wijesundara (University of Peradeniya, Sri Lanka) – *"Direct Displacement Based Design of Steel Concentrically Braced Frame"*.
5. Prof. Dr Murat Saatcioglu (University of Ottawa, Canada) – *"Canadian Design Practice for Reinforced Concrete Buildings in Regions of Low to Moderate Seismicity"*.
6. Prof. Dr Han Seon Lee (Korea University, Seoul) – *"Seismic Design Implications for Low-to-Moderate Seismicity Regions from Earthquake Simulation Tests on RC Building Structures in Korea"*.
7. Prof. Dr Nelson Lam (University of Melbourne, Australia) – *"Key Features of the Proposed Malaysian NA to MS EN 1998"*.

8. Dr Tsang HingHo (Swinburne University, Australia) – *"Soil Response Spectrum Model in the Draft Malaysian NA for EC 8".*
9. Engr. Daniel Looi Ting Wee (University of Hong Kong) – *"Operational Details of Malaysia Response Spectrum".*
10. Ir. Adjunct Prof. MC Hee (The Institution of Engineers Malaysia) – *"The Cost Implications and Engineer's Perspectives of NA to MS EN 1998".*

Ir. Mun Kwai Peng (Chairman of WG3 Geotechnical Aspect of Earthquake – part of TC Earthquake) chaired the first day of the seminar, while Ir. Prof. Dr Jeffrey Chiang (Chairman of TC Earthquake) chaired the seminar/workshop session on the second day.

The seminar/workshop had the support of Jabatan Kerja Raya (JKR) which sponsored 6 of its engineers to attend the event. Ir. Mohd Noor Azudin bin Mansor, a senior Principal Assistant Director of JKR, was also invited to chair the first paper presentation on the first day.

SEMINAR PROCEEDINGS

The first speaker, Prof. Dr Koh Chan Ghee started with his presentation by focusing on Singapore's experience in publishing its own NA to Eurocode 8. Some recent studies seemed to suggest that higher than expected peak ground acceleration was recommended for design of buildings against earthquakes. This was likely attributed to adoption of unsuitable attenuation equations. Probabilistic seismic hazard analysis (PSHA) was conducted by assessing the existing ground motion prediction equations (GMPE). New GMPE was developed based on recorded ground motions experienced from long-distance earthquakes from Sumatra strike-slip fault and the Sunda trench subduction zone. These were compared and verified against works by other researchers.

Interestingly, Prof. Koh concluded that the PGAs of Singapore and Kuala Lumpur (for a 500-year return period) were 0.009g and 0.0155g respectively. Compare this to some local researchers' results of more than 0.08g to 0.10g - which were considered unrealistically high by IEM technical reviewers. When based on 2,500-year return period, Prof. Koh calculated the PGAs to be 0.013g and 0.023g for Singapore and Kuala Lumpur respectively. Singapore's NA to Eurocode 8 actually adopted a PGA of 0.0175g, a more conservative value than Prof.Koh's findings.

Second speaker Prof. Dr Friedemann Wenzel's presentation can best be summarised as follows:

- The determination of hazard results, for the purpose of categorisation (such as producing zoning or mapping) can be significantly different for subsequent assessments, without obvious reasons-most notably in earthquake events which are very unpredictable in magnitude and frequency, not to mention even in timing and location.
- Validation of hazard results is still in its infancy.
- Achieving equal safety standards using return periods as a guide, is not exact but is still considered as probably good, as the best alternative.
- There is a need to produce loss exceedance curves as a measure of societal risk, and ultimately this should control the design levels – the best example is in determining the importance factor for design of buildings for earthquake resistance.
- An alternative to loss exceedance curves, may be to use proxies based on hazards faced, such as likelihood of tsunami occurrence with earthquake events.

The next speaker, Prof. Ray Su, spoke on an interesting topic which proposed the use of a versatile Timonshenko beam model to assess the seismic performance of low-rise RC frames and high-rise RC wall buildings. This model is integrated with a modal response spectrum analysis, and the focus is on rare earthquake design load with a return period of 2,475 years in Peninsular Malaysia. He estimated that based on that seismic design load, high-rise wall buildings of 14-40 storeys and low-rise infilled RC frames of 2-10 storeys can sustain these rare earthquake loads with their inherent lateral strength and deformation capacity. However, low-rise framed buildings without shear walls, but less than 16m height

may still satisfy the 475-year return period requirement (in accordance to Eurocode 8), with perhaps some damage to non-structural elements.

The next speaker, Dr Kushan Wijesundara, was the only speaker who talked about the seismic effect on steel structures, in particular, steel concentrically braced frame. His methodology of design is direct displacement-based design, which emphasises ductility, non-linearity in structural behaviour and equivalent viscous damping – which is derived from procedures originated by renowned seismic expert Nigel Priestley in 2006. At the end, Dr Kushan concluded that, from results obtained from the non-linear dynamic analysis, it was proven that the presumed linear displacement profile proposed by Priestley for low-rise moment resisting frames (MRFs) was reasonably valid for low-rise steel concentrically braced frames. For medium-rise MRFs, the use of inelastic first mode displacement profile with higher drift concentration at the lower floors also gave a good estimation with actual measured values.

The analysed behaviour/performance of such structures was in agreement with direct displacement design approach. This was a point that needed to be stressed: The general approach in developing the Malaysian NA to Eurocode 8 is based on displacement method, which is the preferred choice in seismic analytical approach nowadays.

Prof. Dr Murat Saatcioglu from Ottawa University was no stranger to this forum, as he was a panel speaker in the first symposium held in 2011. His presentation touched on the Canadian practice in using NBCC 2010 and CSA 2004 as performance criteria in design of buildings – firstly for the safety of occupants, followed by damage-limitation control and finally, structures still functional in post-disaster scenarios.

He said Canada was also moving towards accepted international practices in adopting a return period of 2,475 years in earthquake predictions instead of the previous norm of 475 years. He emphasised that the authorities had the role and responsibility to ascertain the importance factor to be attached to certain critical buildings requiring special attention in earthquake events, such as heritage buildings and buildings used in post-disaster recovery, e.g. hospitals, fire and police stations, telecommunication facilities. NBCC had provisions for ductility and over-strength factors in adjusting related force from seismic events, exerted on different building configurations. He also presented the importance of considering torsional effects for structural having certain irregularities in its outlook and profile.

Prof. Dr Han Seon Lee gave an insight into South Korea's experience in tackling the issues of design for earthquake for RC buildings, in low to moderate seismic regions there. He presented the experimental simulation tests done on scaled-down RC buildings, using shaking table tests and pushover tests by his co-researchers. The South Korean practice follows closely the American ACI318-05 standards for design of concrete structures. This is a good guide for Malaysian code drafters in producing the National Annex to Eurocode 8.

KEY WORKSHOP PRESENTATIONS FOR NA TO EUROCODE 8

As a key panel speaker and the main contributor to the development of NA to Eurocode 8, Prof. Dr Nelson Lam is

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a familiar face at many IEM-organised seminars over the years, in particular on dynamic analysis of structures under earthquake loadings. For this particular seminar, in view of the near-to-completion of the NA to Eurocode 8, he presented the updates of the development of MS EN 1998 on justifications and verifications of analysed data and models prescribed for Peninsular Malaysia, Sabah and Sarawak.

Key presentation by Prof. Dr Lam was on the following areas:

1. Introduction to Malaysian Seismic Hazard
2. Hybrid model for Peninsular Malaysia
3. Modelling of local earthquakes
4. Performance objectives and return period considerations
5. Design peak ground acceleration
6. Ductility or behaviour q-factor
7. Summary

Prof. Dr Lam referred to two previous Earthquake Symposia where the following resolutions were presented and endorsed by majority of participants present then:

1. In 2011, the hybrid response spectrum (in which both near-and far-field earthquake effects were incorporated into one spectrum) was presented and adopted as the basis for developing the NA to Eurocode 8; besides the inclusion of site natural period as an additional parameter for site classification.
2. In 2013, it was decided that the 2,500 years return period and the displacement-based approach would be used as the basis in developing the NA to Eurocode 8, as well as adopting one unified response spectrum for the whole of Peninsular Malaysia while a two-tier site factor approach would be used.

There was some confusion, judging from some of the questions posed by the audience. A prominent local university seismic researcher queried why probabilistic analysis was not used in place of the deterministic approach. Prof. Lam answered that in his presentation slides, it was shown that the modelling of the response spectra was done by including the probabilistic seismic hazard assessment (PSHA) approach. That showed the level of understanding in Malaysia, even among the local seismic experts.

Below is a summary of his presentation:

1. Separate response spectrum models have been recommended for Peninsular Malaysia, Sabah and Sarawak.
2. A hybrid model has been adopted for Peninsular Malaysia to model contributions from both local and distant seismic hazards.
3. The low (short) period part of the response spectrum is controlled by local earthquakes whereas the high (long) period part by distant earthquakes.
4. In regions of low to moderate seismicity areas, a global modelling approach is recommended as opposed to PSHA, which is based upon analysing the disposition of a few local events.
5. Consequently, a uniform level of hazard is specified within the peninsula, Sarawak and Sabah, without involving contouring or zonation.
6. A design PGA value of 0.10g was estimated by the Global Model for the peninsula and Sarawak for a return period of 2,500 years.
7. A design PGA value of 0.18g was estimated by the Global Model for Sabah for a return period of 2500 years.
8. Performance criterion of No Collapse (NC) was used as the basis of design as per Eurocode 8 modelling principles.
9. No collapse performance criterion is not to be confused with Near Collapse performance criterion, which is at Ultimate Limit State (ULS).
10. The term: Full Design Seismic Action or Design Seismic Action (or Design PGA) is based on a return period of 2,500 years and is used for the design of Importance Class IV buildings such as hospitals.
11. The term: Reference Seismic Action (or Reference PGA) is Design Seismic

Action divided by 1.5 and is used for the design of Ordinary (Importance Class II) buildings.

Another speaker, Dr Tsang Hing-Ho, was also a regular panel speaker at previous earthquake seminars organised by IEM. He is one of the international advisors to the Technical Committee on Earthquake. He presented on four key areas:

1. Fundamentals of local site effects
2. Review of codified soil spectrum models
3. Latest development of soil spectrum models
4. Adapting Eurocode 8 model for Malaysia

His findings on effects of earthquake from source to site are: Theoretically, for flexible soil sites, de-amplification occurs at short period range (normally for near earthquake events), while large amplification happens at medium to long period range (distant earthquakes). In short, softer (or more flexible) soils usually de-amplify more.

He contended that Eurocode 8 allowed flexibility as code drafters may define suitable response spectra in their own National Annex, by specifying respective corner periods, T_B, T_C and T_D which are relevant to local conditions. This is clearly spelt outin Eurocode 8-1: Cl. 3.2.2.2 (2)P.

The recommended response spectra for Malaysia is based on Type 2 spectrum model given in Eurocode 8, where the surface-wave magnitude M_s is not greater than 5.5, which is relevant to a low-to-moderate seismic zone like Malaysia. Singapore is also following this step, although they prefer to stick to the Eurocode 8 recommendation of 500-year return period, while Malaysia is moving forward to a 2,500-year return period, consistent with international practice where both near and far-field earthquakes are to be considered.

Dr Tsang went on to make some recommendations for Malaysia in adapting to Eurocode 8 provisions:

Table 1 – Values of the parameters describing the recommended Type 2 elastic response spectra (based on Eurocode 8)

Site natural period	Group type		Soil factor	Corner periods in response spectrum (s)		
			S	T_B	T_C	T_D
$T_s < 0.15s$	A	Rock	1.0	0.1	0.3	1.25
$0,15 \leq T_s < 0.5s$	B	Stiff soil	1.5			
	C					
$T_s > 0.5s$	D	Flexible Soil	3.6	0.1	$1.2T_s$	$1.5T_s$
			Implied S-factor at short period ≤ 1.8			

Note: Site natural period is given by: $T_s = 4H_s / V_s$, where H_s = height of soil profile, V_s = shear wave velocity of soil

The operational details on how the National Annex on the proposed Malaysian Response Spectrum came about, was presented by Engr. Daniel Looi, a PhD candidate at Hong Kong University under the supervision of Prof. Dr Ray Su. Engr. Looi went through the steps in constructing the response spectrums, in terms of acceleration, displacement and velocity, deciding on the consideration of PGA with respect to importance factors attached to building types and functionality.

He used the equivalent static load method of analysis, to describe the process in producing the necessary results for the local parameters to come out with the response spectra.

1. Assume information and data on building type, properties and importance factor attached, using also sample borehole log information to ascertain soil type.
2. Calculate for the site natural period, T_s
3. Choose the corresponding response spectrum based on calculated site natural period.
4. Estimate the building natural period from the selected response spectrum.
5. Calculate the base shear, F_B of the building.
6. Distribution of base shear to every floor of the building from base to the top, using recommended formulation.
7. Use standard analytical methods (manual or computerised) to determine structural deflection, e.g. 3D-frame analysis.
8. Calculate effective displacement, using recommended formulation.
9. Calculate effective mass (of the building structure), again using recommended formulation.
10. Calculate the effective stiffness of the building using the calculated base shear and effective displacement.
11. Calculate the effective natural period of the building using the effective mass and effective stiffness, in the standard formula for natural period.
12. Calculate the improved displacement and compared this with the first estimation found earlier; use this improved displacement to re-work the base shear, F_B
13. Re-distribute the base shear to all floors-and re-analyse the structure.
14. So the iteration process goes on – until a refined value of displacement is obtained, with little difference in the improved value and the last estimation.

One of the most intriguing topics was presented by Ir. Adjunct Prof. MC Hee on preliminary cost implications once the NA to Eurocode 8 takes effect and is applied in the industry, with the use of hybrid model of response spectrum for Peninsular Malaysia, Sabah and Sarawak.

First, he described the types of structures he had considered when studying the impact of earthquake design, namely one-storey, five-storey high moment-resisting structure frames, and 10-storey, 30-storey dual (MRF and shear walls). He referred to the findings of the international panel of experts in terms of referenced peak ground accelerations recommended, i.e. 0.07g for both Peninsular Malaysia and Sarawak, and 0.12g for Sabah – all based on a 2,500 years return period in the hybrid model response spectrum for NA to Eurocode 8.

He also made assumptions of some basic costings, i.e.

1. Formwork used = RM40 per sq. metre
2. Concrete grade C30/37 used = RM300 per cu. metre
3. Steel reinforcement used = RM3.50 per kg mass

Using these with some advanced level structural analysis on computer software, he produced calculations showing reduced stiffnesses and behaviour factor changes, due to

detailing changes required for seismic design considerations. The two tables below are samples of his recommendations.

Table 2 – Cost summary for Peninsular Malaysia upon implementation of Eurocode 8 Design of Structures for Earthquake Resistance

Building type	No. of stories	% increase in structural cost (on reduced stiffness)	% increase in structural cost (on behaviour factor)
2-D 1-storey MRF	1	0	0
2-D 5-storey MRF	5	0	0
2-D 10-storey Dual	10	+0.7	+0.8
2-D 30-storey Dual	30	0	0

Table 3 – Preliminary % increase in structural cost with one standard deviation for office buildings (based on behaviour factor, q = 1.5

Building type	% change in structural cost		
	Peninsular Malaysia	Sarawak	Sabah
2-D 1-storey MRF	+0.7	+0.3	+7.7
2-D 5-storey MRF	+0.9	+0.3	+2.5
2-D 10-storey Dual	+1.1	+0.8	+6.4
2-D 30-storey Dual	+0.3	+0.4	+1.4

OUTCOME OF THE OPEN FORUM DISCUSSION

In the Open Forum Discussion session in the late afternoon, Prof. Dr Nelson Lam gave an overview of the presentations made by all the invited international speakers, including himself. After this, questions or comments were invited from the floor.

One question posed by a noted local university earthquake researcher was on the lack of local research incorporated into the National Annex to Eurocode 8. Prof. Dr Lam pointed out that the work done by local researchers were considered in the first two symposiums (2011 and 2013) and were found wanting, simply due to lack of data verifications and publications in prominent international journals of earthquake engineering.

This was on top of the in appropriateness of the local research findings which covered only long-distance earthquakes from Sumatra subduction faults, in which the attenuation formulas were based on high seismicity zones from USA. Hence, the predictions were relatively high at near to 0.10g PGA for Peninsular Malaysia, especially for a 500-year return period, whereas prominent regional researchers like Balendra (NUS) and Megawati (NTU) have published in respectable journals presenting predictions of ground motions in Singapore and Peninsular Malaysia to be at PGA of 0.03g or even much lower, which dovetailed to the measured readings in MMD stations at West Coastal zones in the peninsula.

In the proposed NA to Eurocode 8, the recommended PGA values of 0.07g for Peninsular Malaysia, is for a 2,500-year return period, covering both near and distant earthquakes. If a 500-year return period was used, the predicted PGA values would be much lower, perhaps at 0.03g or less.

Another member of the audience, an experienced consultant, said he fully supported the work by the IEM Technical Committee on Earthquake, aided by the international panel of experts. He pointed out that consultants in the industry were not well-versed in seismic design as it was never a requirement in the British Standards and was not required in the Uniform Building By-Laws. He suggested that the committee come out with simple procedures which consultants can follow easily. He added that he was not too fussy over how the figures of PGA came about, so long as there were technical merits and justifications for use in the local context, were spelt out clearly and logically in the NA to Eurocode 8.

The event was officially closed by the Chairman of the session at 5.00p.m.

All the invited speakers and chairpersons were duly thanked and applauded by the participants. They were then presented with tokens of appreciation by the organisers. ■

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Wealth Creation: Facilitating the Mobility of Engineering Services via the Malaysian Service Providers Confederation (MSPC)

STANDING COMMITTEE ON CORPORATE AFFAIRS

reported by Ir. Choo Kok Beng, FASc

Ir. Choo Kok Beng, *IEM's Immediate Past President and the current President of the Malaysian Service Providers Confederation (MSPC)*

Dato' Ir. Lim and Ir. Choo with the MPSC team

On 5 January, 2015, Ir. Choo Kok Beng, the Immediate Past President of IEM and current President of the Malaysian Service Providers Confederation (MSPC), and the MSPC secretariat team met Dato' Ir. Lim Chow Hock, President of IEM and its excomm members.

The MSPC was set up in 2009 to facilitate the export of Malaysian Services and to be the voice of its members to The Ministry of International Trade and Industry on matters that will enhance business success. It is a member of the Malaysian Services Development Council (MSDC), chaired by the Minister of MITI and entrusted to help achieve the country's second quantum leap to be a developed nation by 2020 with a sustainable revenue source thereafter. IEM is one of its founding members.

As its second president, Ir. Choo has the opportunity to not only promote the export of the engineering services and the expertise of IEM members as he had been doing in the past but also that of other service industries.

MSPC's immediate target is the Asean countries and to date, positive inroads have been made in Myanmar via members of the Myanmar Engineering Society (MES).

Ir. Choo said the role of MSPC will complement the initiatives of the Asean Engineering Register for greater mobility of the Asean engineering fraternity, both to support the formation of the Asean Economic Community (AEC) by the end of the year and the creation of WEALTH, especially for IEM members and associates.

The immediate benefit to IEM members is the Apec Business Travel Card (ABTC), which can be applied for through MSPC. The card will facilitate travel to Apec countries with visa exemptions and the use of the express lane at Immigration. He urged IEM member companies to join MSPC to give it more strength to be successful.

Dato' Ir. Lim Chow Hock was pleased to note that engineers were now playing a major role in the country's economic development. He pledged IEM's support and presented Ir. Choo with a cheque for its membership payment, officially making IEM the first organisation to pay membership fees to MSPC for 2015. ■

IEM POSITION PAPER

WATER QUALITY & ENVIRONMENT

Executive Summary

In view of the country's rapid development towards becoming a fully developed nation by 2020, various environmental issues, in particular those relating to water pollution have arisen and caught the attention of the general public. In our dynamism and excitement to achieve this status, the quality of the environment must also be preserved for the benefit of future generations. Water pollution, which degrades the water quality of rivers not only destroys aquatic habitation but also compromises economic diversity, such as fishery activities, eco-tourism and potable water resource.

Although a general improvement trend is depicted in the current Water Quality Index (WQI) benchmarking scheme, the perception of the public sentiment and perception still remain critical. This perception is not entirely without basis, as the WQI benchmarking system has its own shortcomings and should not be taken as the ultimate indicator of a water quality condition.

One of the key problems related to river basin management is the disintegrated institutional approach that has been in place since independence, such as the segmentation of state and federal level agencies related to river management. The disintegration results in inadequate control of pollution sources and disparity of management policies. To tackle these problems at a macro-level, defragmentation of the current condition must first be achieved, coherent to the Integrated River Basin Management (IRBM) aspiration. Legal provisions that put emphasis on the total amount of pollution load entering the water column or Total Maximum Daily Load (TMDL), relative to its Waste Assimilative Capacity (WAC) must be devised for sustainable outcome. This TMDL approach must encompass all pollution sources and should not be bounded by jurisdictional boundaries. The centralization of sewage and industrial pollution sources to centralized treatment facilities will help facilitate the TMDL objective.

Besides structural control measures, management practices can also help improve water quality such particularly in the case of NPS pollution. Riparian zone preservation and other Best Management Practices (BMPs) help minimize the impact of NPS pollution at the same time creating a good riverside habitat. A good road map to achieve sustainable water quality preservation is the national river study conducted by many federal and state levels agencies. These studies may need to be further rationalized and integrated to achieve a common goal, putting emphasis of all aspects of water quality and river preservation.

The full Position Paper is available in IEM website http://www.myiem.org.my

Prepared by The Position Paper Committee:

1. Datuk Paduka Ir. Prof (Dr) Hj.Keizrul bin Abdullah – Chairman
2. Ir. Dr Zaki Zainudin – Secretary
3. Pn. Daria Mathew – WWF
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9. Dato' Ir. Lim Chow Hock / En. Azmi B. Md. Jafri – JPS/DID
10. Ir. Oh Chin Wah - Member

Technical Visit to Pahang River Mouth Improvement Project in Pekan, Pahang

WATER RESOURCES TECHNICAL DIVISION

reported by Ir. Sreedaran Raman

Ir. Sreedaran Raman *is a Certified Professional in Sediment and Erosion Control (CPSEC), committee member of IEM's Water Resources Technical Division (WRTD), Chairman of IEM's Engineering Week 2015 and a member of The Association of Registered Engineering Services for Disaster Relief, (RedR) Malaysia. Currently, after completing his sabbatical leave pursuing his Master Degree, he is now posted as Senior Assistant Director at the Coastal Zone and River Basin Management Division of DID Malaysia.*

On 12th April 2014, the Water Resources Technical Division (WRTD) organised a technical site visit to the Pahang River Mouth Improvement (PRMI) Project site in Pekan, Pahang. The visit, comprising a team of 17 engineers, was led by Ir. Sreedaran Raman.

Briefing from DID Project Engineer Ir. Muhamad bin Kadir

The PRMI project is one the biggest coastal engineering project currently undertaken in the country. It is funded by the Federal Government and carried out by the Department of Irrigation and Drainage Malaysia (DID).

The aim of the project is mainly to solve the problem of siltation at the river mouth which affects the navigation of fishing vessels, to provide adequate navigation channels, berthing and mooring areas and to provide shelter for vessels at Lembaga Kemajuan Ikan Malaysia (LKIM) pier.

Currently the construction of Phase 1 and Phase 2 has been completed and work for Phase 3 is on-going. The project is expected to be completed by September, 2015.

The design-and-built project was awarded to Malaysian Corporation Resources Berhad (MRCB) with a total cost of RM437.2 million for the three phases. The three phases are only part of the overall solution and the remainder of the project will be carried out according to fund allocation from the Federal Government.

First, we were briefed by DID Project Engineer Ir. Muhamad Kadir, who presented the background and overview of the project. Then Dr Lim Foo Huat of Angkasa Jurutera Perunding Sdn. Bhd. gave an overall project design briefing.

After this, we were driven to the project site and given a construction briefing on the project and solutions to the problems they had encountered during the construction, especially before and during the construction of the breakwater and river dredging works.

The construction of Phase 1 at a total cost of RM258.1 million started on 1 August 2005 and was completed on 30 June 2011. The main scope of work in Phase 1 was numerical and physical modelling prior to the construction of 555m of breakwater, 400m of dyke, 1,850m of rock revetment and 1,370m of Pulau Syed Hassan bypass channel.

Phase 2 construction started on 24 October 2011 and was completed on 28 February 2013 with a total cost of RM49,045,086.30. It comprised the construction of 200m breakwater (continuation of Phase 1) and dredging works at the river mouth and navigation channel.

The current on-going Phase 3 works, awarded on 19 September 2013, is expected to be completed in September 2015. The cost of this phase is RM130 million which continues with the extension of the breakwater structures on the both side of river banks.

Later, the project team from DID, Angkasa and MRCB took us on a guided tour of the site and answered all our queries. It was a great and unique experience for the participants.

Before we left, we presented our hosts with mementos to show our appreciation for their hospitality. ■

Participants studying the overall Project's Model

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APU and UKM Join List of Universities Signing MoU with IEM

ADMISSION AND PRACTICAL TRAINING

reported by Ir. Wong Chee Fui

***Ir. Wong Chee Fui** is the Executive Director of IEM.*

MoU Signing Ceremony between IEM President Dato' Ir. Lim Chow Hock and APU Chief Executive Officer of APIIT Education Group, Datuk Dr Parmjit Singh.

The Institution of Engineers Malaysia (IEM) signed Memorandums of Understanding (MoU) with Asia Pacific University of Technology and Innovation (APU) on 6th Jan 2015 and Universiti Kebangsaan Malaysia (UKM) on 22 Jan 2015.

The MoU between IEM and APU was signed between IEM President Dato' Ir. Lim Chow Hock and the Chief Executive Officer of APIIT Education Group, Datuk Dr Parmjit Singh.

The signing ceremony between IEM and UKM was during the 30 Anniversary Celebration for UKM's Faculty of Engineering And Built Environment. The signatories were IEM President Dato' Ir. Lim and UKM Vice-Chancellor Prof Datuk Dr Noor Azlan Ghazali.

Present at the ceremony was Emeritus Dato' Dr Mohamad Zawawi Ismail, Chairman of the Board of Directors for UKM and former Dean of UKM's Faculty of Engineering And Built Environment (FKAB), who officiated at the 30th Anniversary Celebration. Dato' Dr Mohamad Zawawi talked in length about his early involvement in UKM which was instrumental to the formation of FKAB.

Also present were Ir. Prof Dr Wan Mahmood bin Wan Abdul Majid (IEM Vice President and Chairman of Standing Committee of Admission and Practical Training), Ir. Gunasagaran Kristnan (IEM Honorary Secretary), Ir. Dr Cheong Thiam Fook (Chairman of IEM Membership Drive), Ir. Wong Chee Fui (Executive Director of IEM) and the Deans and Vice-Chancellor of both universities.

The purpose of the MoU is to strengthen, promote and develop international and research co-operation between IEM and the universities (APU and UKM) for mutual benefits.

The MoU will enhance co-operation that will bring about benefits to both the engineering students as well as the academic staff of APU and UKM. The MoU will also provide incentives to the IEM-Student Chapter in both universities to conduct engineering activities for the students.

MoU between IEM and UKM was signed between IEM President Dato' Ir. Lim Chow Hock and UKM Vice Chancellor Prof. Datuk Dr Noor Azlan Ghazali.

IEM is currently in discussion with several other universities to establish similar MoUs and so provide opportunities for engineering lecturers and students to attend courses and workshops organised by IEM to enhance their technical knowledge in latest engineering aspects.

During both MoU signing ceremonies, Dato' Ir. Lim Chow Hock strongly encouraged students of both universities to become Student Members of IEM and subsequently become the Graduate Members upon graduation. He also encouraged engineering lecturers to become members of IEM and registered Professional Engineers. ■

IEM DIARY OF EVENTS

Title: Technical Visit to Jutasama Sdn. Bhd.

27th March 2015

Organised by : Chemical Engineering Technical Division
Time : 9.30 a.m. – 1.00 p.m.
CPD/PDP : 2.5

Title: Talk on "Renewable Energy System Integration"

28th March 2015

Organised by : Graduates & Student - The Young Engineers Section
Time : 9.00 a.m. – 11.00 a.m.
CPD/PDP : 2

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

Little Free Library

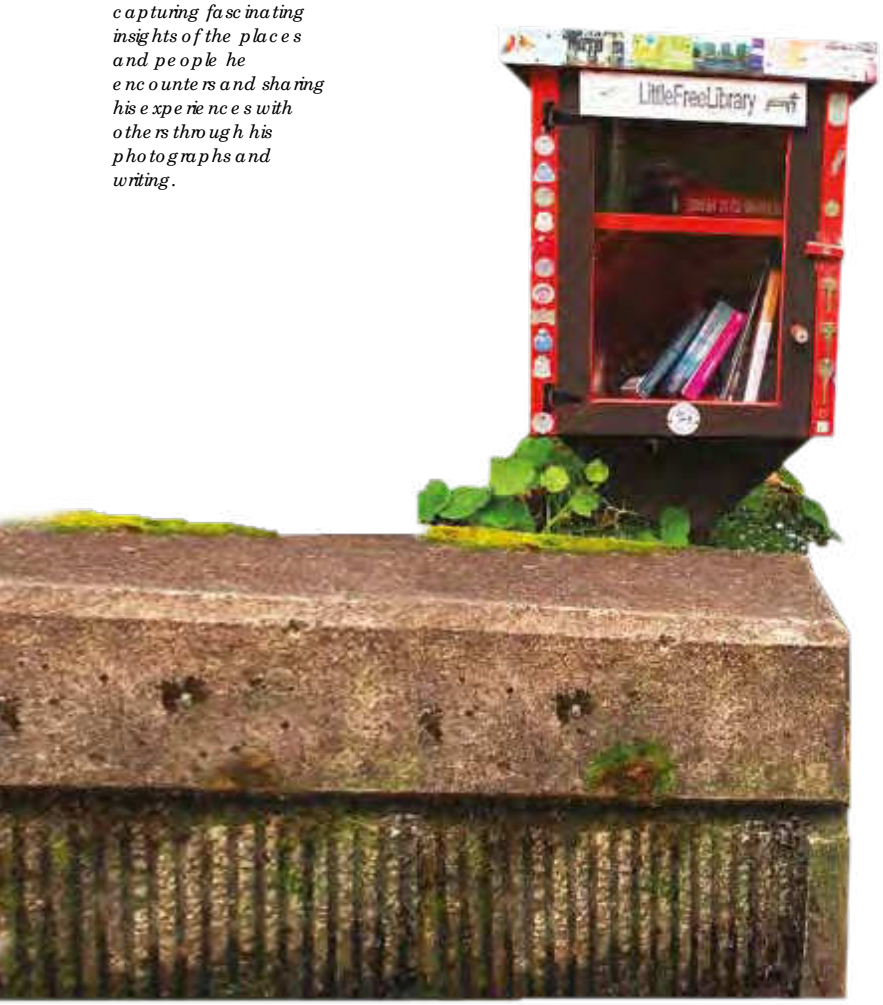
Ir. Chin Mee Poon
www.facebook.com/chinmeepoon

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

When my wife and I were backpacking in Alaska, we came across something very cute and inspiring in Juneau.

Juneau, the capital of Alaska, is a small town near the northern tip of the Inside Passage in southeast Alaska. It has a population of about 32,000. It is a scenic place with a beautiful setting and every summer, its streets are swarmed by hordes of camera-wielding tourists when luxury cruise ships call at its port almost incessantly. Yet, like many other towns and villages in Alaska, Juneau is not linked to the outside world by road. It is only accessible by boat or aeroplane.

To get to Juneau, we took the Alaska Marine Highway ferry, M/V Taka, from Petersburg, a village of about 3,000 people located less than 200km to the southeast.



When we were on a walking tour of the city of Juneau (in Alaska, every urban centre, regardless of its size, is known as a city), we saw a pretty wooden box affixed to a wooden pole next to a flight of concrete steps leading to a building. The box had a glass door and through this, we could clearly see some books inside which appeared to be pretty new. Across the top the door were the words "Little Free Library".

We had never seen anything like this in all our years of travel. A little research revealed that the first such little library was started in Hudson in Wisconsin, USA, in 2009. A man named Todd Bol, who was good at carpentry, made a wooden model of a one-room school building, fixed it to a single wooden pole in his front-yard and filled it with books. He did this as attribute to his mother, who loved books and who had just retired from her teaching career. Anybody could borrow books from his little library; they just had to remember to return a book after taking one from it. His neighbours and friends liked the idea so much that he made a few similar structures and gave them away.

Through word of mouth, the idea spread quickly. Barely a year later, Madison had its first little free library and, by 2011, there were some 400 such little libraries throughout USA. The initiator then decided to form a non-profit organisation to coordinate the increasingly widespread distribution of such little libraries. By the beginning of 2014, the organisation had already registered 15,000 little free libraries in many parts of the world.

From the organisation's distribution map, one can see that most of the Little Free Libraries are located in USA. There are many in Europe too. Even Africa has a few. In Asia, only China, The Philippines, Vietnam and Brunei have one each. There is none in Malaysia.

Later in our Alaska trip, we saw another little free library in Whitehorse in Yukon Territory, Canada. Recently we saw a third one in Christchurch, New Zealand.

When will Malaysia have its first little free library? ■

TEMUDUGA PROFESSIONAL

Tarikh: 13 February 2015

To All Members,

SENARAI CALON-CALON YANG LAYAK MENDUDUKI TEMUDUGA PROFESIONAL TAHUN 2015

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

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

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

Ir. Gunasagaran Kristnan
Setiausaha Kehormat, IEM,

PERMOHONAN BARU

Nama	Kelayakan
KEJURUTERAAN AWAM	
AZHAR BIN ABDULLAH	BE HONS (UiTM) (CIVIL, 1996)
MUHAMMAD AZHAR BIN AZIZAN	BE HONS (UTM) (CIVIL, 2007)
SHAIFUL MUNIR BIN LEMAN	BE HONS (UTM) (CIVIL, 2006) ME(UTM) (PROJECT MANAGEMENT, 2014)
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KEJURUTERAAN ELEKTRIK	
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KEJURUTERAAN ELEKTRONIK	
MOHD BADRULHISHAM BIN ISMAIL	BSc (HARTFORD) (ELECTRICAL, 1997) MSc (UiTM) (TELECOMMUNICATION & INFORMATION, 2014)
KEJURUTERAAN ALAM SEKITAR	
KOO CHAI HOON	BE HONS (UKM) (CIVIL, 2005) ME (UTM) (CIVIL-ENVIRONMENTAL, 2006) PhD (UKM) (CIVIL & STRUCTURAL, 2014)
KEJURUTERAAN MEKANIKAL	
BURHANUDDIN BIN ABDUL RAHMAN	BE HONS (USM) (2001)
ISMI BIN MOHAMED	BE HONS (UTM) (MECHANICAL, 2009)
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44133	CHING YERN CHEE	BE HONS (UTM) (CHEMICAL, 1999) ME (UTM) (POLYMER, 2002) PhD (UM) (2011)
	CHING YERN CHEE	BE HONS (UTM) (CHEMICAL, 1999) ME (UTM) (POLYMER, 2002) PhD (UM) (2011)
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28237	AZRUL AFFANDHI BIN MUSTHAFFA AL BAKRI	BE HONS (UTM) (CIVIL, 2007) MSc (UPNM) (CIVIL, 2014)
27953	CHAI YOKE LEE	BE HONS (USM) (CIVIL, 2006)
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43783	LEE SIANG HOE	BE HONS (USM) (ELECTRICAL, 2009)
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25087	NAVINDRAN ANDIAPPEN	BE HONS (USM) (ELECTRICAL & ELECTRONIC, 2001) CONVERSION (UNITEN) (2011)
54531	NIK MOHD FADZLAN BIN MAT YASIN	BE HONS (UKM) (ELECTRICAL & ELECTRONIC, 2006)
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54221	SUGUNESAN A/L GUNALAN	BE HONS (UNITEN) (ELECTRICAL POWER, 2009)
58682	TAN HAK VUI, MALEK	BE HONS (UMS) (ELECTRICAL & ELECTRONICS, 2008)
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37281	MOHAMAD SHAIFUDIN BIN HASSAN	BE HONS (UTM) (ELECTRICAL, 2001)
48466	MOHD NIZAM BIN OTHMAN	BE HONS (USM) (ELECTRICAL & ELECTRONIC, 1999)
60660	MUHAMAD SABRI BIN RAZALI	BE HONS (MULTIMEDIA) (ELECTRONIC, 2007)
52390	MUSA BIN OTHMAN	BE HONS (UTM) (ELECTRICAL, 1998)
51713	RAZALI BIN MOHD ARSAD	BE HONS (UKM) (ELECTRICAL, ELECTRONICS & SYSTEM, 2000)
49418	TAN BAN SOON	BE HONS (UTM) (ELECTRICAL - ELECTRONICS, 2005)
KEJURUTERAAN GEOTEKNIKAL		
21187	EOW THEIN EWE	BE HONS (UTM) (CIVIL, 2002)
KEJURUTERAAN MEKANIKAL		
33837	ABD RAZAK BIN AHMAD	BE HONS (UTM) (MECHANICAL, 2000)
30976	ALEXANDER GOTTE	BE HONS (UNIMAS) (MECHANICAL & MANUFACTURING SYSTEM, 2008)
35768	CHONG KIAN WEI	BE HONS (UTM) (MECHANICAL-MANUFACTURING, 2010)
52576	LAI HAN LYN	BE HONS (USM) (MECHANICAL, 2009)
25175	MOHAMED THARIQ BIN HAMEED SULTAN	BE HONS (UTHM) (MECHANICAL, 2004) MSc (UPM) (AEROSPACE, 2007) PhD (SHEFFIELD) (2011)
26461	MOHD NAZREE BIN MHD NOOR	BE HONS (USM) (MECHANICAL, 2001)
52375	MOHD SHAIFUL ADLI CHUNG	BE HONS (UTM) (MECHANICAL, 2000)
46858	NADIAHNOR MD YUSOP	BE HONS (USM) (MECHANICAL, 2001) MSc (LEEDS) (COMPUTATIONAL FLUID DYNAMICS, 2002) PhD (LEEDS) ((2008)
36937	TEO HIU HONG	BE HONS (UTHM) (MECHANICAL, 2003) ME (UPM) (MANUFACTURING SYSTEMS, 2006)
KEJURUTERAAN SUMBER MINERAL		
23630	MOHD HAZIZAN BIN MOHD HASHIM	BE HONS (USM) (MINERAL RESOURCES, 2002) MSc (USM) (MINERAL RESOURCES, 2006) PhD (NEW SOUTH WALES) (2012)
KEJURUTERAAN STRUKTUR		
45995	YEE CHIN SZEN	BE HONS (UKM) (CIVIL & STRUCTURAL, 2008)

PERMOHONAN BARU MENJADI AHLI KORPORAT

Nama	Kelayakan
KEJURUTERAAN AWAM	
WAHID ANUAR BIN AHMAD	BSc (ASTON) (CIVIL, 1980)

CONTRIBUTIONS TO WISMA IEM BUILDING FUND

RM 2,554,349.20 from IEM Members and Committees RM 741,502.00 from Private Organisations

(ANOTHER RM 4,256,858.33 IS NEEDED)

TOTAL RM 3,295,851.20

The Institution would like to thank all contributors for donating generously towards the IEM Building Fund HELP US TO PROVIDE BETTER SERVICES TO YOU AND TO THE FUTURE GENERATION

(The donation list to the Wisma IEM Building Fund is published on page 36)

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

68570	NUR FASEHAH BT. FAUZI	1ST YEAR(UMS)(CHEMICAL)
67323	NUR FATHILAH BT. MOHD YUSOF	2ND YEAR(UITM)(CHEMICAL)
67324	NUR HAFIZAH BT. AB RAHMAN	2ND YEAR(UITM)(CHEMICAL)
67325	NUR HAHIDATUL AZNI BT. SAMSURI	2ND YEAR(UITM)(CHEMICAL)
70885	NUR HASHIMAH BINTI HASSIM	4TH YEAR(UMP)(CHEMICAL)
67326	NUR HAZIRA BT. MOHD ATNI	2ND YEAR(UITM)(CHEMICAL)
67327	NUR HIDAYATI BT. ABDULLAH	2ND YEAR(UITM)(CHEMICAL)
67328	NUR LIYANA BT. JAMALUDIN	2ND YEAR(UITM)(CHEMICAL)
68571	NUR MUJAHADATY BT. BASIRON	1ST YEAR(UMS)(CHEMICAL)
68572	NUR MUNA SYARFA BT. ZULKEFLI	1ST YEAR(UMS)(CHEMICAL)
67329	NUR NABILAH BT. TAMIZI	2ND YEAR(UITM)(CHEMICAL)
67330	NUR RAIHAN BT. BAHRIN	2ND YEAR(UITM)(CHEMICAL)
71072	NUR SHAMIMI BINTI ABDUL RAHIM	3RD YEAR(UTP)(CHEMICAL)
68477	NURAISYAH BT. MAZLAN	1ST YEAR(MONASH) (CHEMICAL)
67331	NURAZZAHRA ATIQAH BT. AZHAR	2ND YEAR(UITM)(CHEMICAL)
68573	NURFATIN LYANA BT. JIMMY	1ST YEAR(UMS)(CHEMICAL)
67332	NURFAZLIN BT. CHE MANSHOR	2ND YEAR(UITM)(CHEMICAL)
67333	NURILLYANI BT. MAT RADZI	2ND YEAR(UITM)(CHEMICAL)
67334	NURJIHAN BT. SADON	2ND YEAR(UITM)(CHEMICAL)
67335	NURSUHAILAH BT. ROSLAND	2ND YEAR(UITM)(CHEMICAL)
67336	NURUL AIMI FAEQA BT. AHMAD FARIS	2ND YEAR(UITM)(CHEMICAL)
68574	NURUL AMIRAH FATEHAH ABD RAHMAN	1ST YEAR(UMS)(CHEMICAL)
67337	NURUL ASHIKIN BT. MOHD JAMADIL @ APAK	2ND YEAR(UITM)(CHEMICAL)
67338	NURUL ASYIQIN BT. MOHD RAZALI	2ND YEAR(UITM)(CHEMICAL)
70879	NURUL ATIKA BINTI MOHD YATIM	2ND YEAR(UMP)(CHEMICAL)
67339	NURUL FARHANA BT. AHMAD	2ND YEAR(UITM)(CHEMICAL)
67340	NURUL FARHANA BT. HAMZAH	2ND YEAR(UITM)(CHEMICAL)
67341	NURUL FITRI BT. MOHD YUSOF	2ND YEAR(UITM)(CHEMICAL)
67342	NURUL HAZWANI BT. MOHAMAD	2ND YEAR(UITM)(CHEMICAL)
67343	NURUL HAZWANI BT. ROHALIM	2ND YEAR(UITM)(CHEMICAL)
67344	NURUL HIDAYAH BT. ABDUL AZIZ	2ND YEAR(UITM)(CHEMICAL)
67345	NURUL HUMAIRA BT. HISHAMUDIN	2ND YEAR(UITM)(CHEMICAL)
67346	NURUL IFFAH BT. ISHAK	2ND YEAR(UITM)(CHEMICAL)
68575	NURUL NADIA BT. AMMERILL	1ST YEAR(UMS)(CHEMICAL)
70888	NURUL SYAZWANA BINTI NOORAZMI	2ND YEAR(UMP)(CHEMICAL)
67347	NURUL SYUHADA BT. HAMID	2ND YEAR(UITM)(CHEMICAL)
68478	ONG QI REN	1ST YEAR(MONASH) (CHEMICAL)
68576	PRISSILA SEBAI ANAK CINAN	1ST YEAR(UMS)(CHEMICAL)
68577	RASRINA BT. RAZIN WONG ABDULLAH	1ST YEAR(UMS)(CHEMICAL)
67348	RASYIDAH BT. AB RAZAK	2ND YEAR(UITM)(CHEMICAL)
67349	RAZZANA BT. ROSLI	2ND YEAR(UITM)(CHEMICAL)
68578	RICCO IRZWIN SYAZRYN B. MOHD IRFAN	1ST YEAR(UMS)(CHEMICAL)
67350	ROBBSON WITT AK CHRISTOPHER	2ND YEAR(UITM)(CHEMICAL)
67351	ROZALIN DANIS	2ND YEAR(UITM)(CHEMICAL)
67352	SAIPURAH BT. AHMAD	2ND YEAR(UITM)(CHEMICAL)
67353	SALIHAH BT. MUHAMMAD HASHIM KOH	2ND YEAR(UITM)(CHEMICAL)
67354	SAMIHAH BT. ABU BAKAR	2ND YEAR(UITM)(CHEMICAL)
68579	SANTHIA A/P TELLICHANDRAN	1ST YEAR(UMS)(CHEMICAL)
66972	SATHIYA SEELAN A/L NAHANDIRAN	1ST YEAR(USM)(CHEMICAL)
68580	SAUFI AZRA'EI B. RAYMIE	1ST YEAR(UMS)(CHEMICAL)
71023	SHAAVESH KUMARAN A/L PARAMESWARAN	2ND YEAR(UTP)(CHEMICAL)
67355	SHAZRAEI AIZAD B. SAHUDDIN	2ND YEAR(UITM)(CHEMICAL)
67356	SHIELLA ROSE VITALIS	2ND YEAR(UITM)(CHEMICAL)
67357	SITI AZURAH BT. SULIMAN	2ND YEAR(UITM)(CHEMICAL)
67358	SITI FAIZAH BT. CHE GHANI	2ND YEAR(UITM)(CHEMICAL)
67359	SITI FARHANA BT. MOHD RAMLY	2ND YEAR(UITM)(CHEMICAL)
67360	SITI NABHIAH BT. JAMALUDIN	2ND YEAR(UITM)(CHEMICAL)
67361	SITI NAJAH BT. IBRAHIM	2ND YEAR(UITM)(CHEMICAL)
67362	SITI NAQIAH BT. SIJAA	2ND YEAR(UITM)(CHEMICAL)
67363	SITI NUR AISYAH BT. MOS	2ND YEAR(UITM)(CHEMICAL)
70880	SITI NUR BAIZURA BT YUSUF	2ND YEAR(UMP)(CHEMICAL)
67364	SITI NUR DINI BT. MOHD ZAIN	2ND YEAR(UITM)(CHEMICAL)
68581	SITI NUR HAMIZAH BT. MOHD SHAHRIL	1ST YEAR(UMS)(CHEMICAL)
67365	SITI SAKINAH BT. MOHD ISA	2ND YEAR(UITM)(CHEMICAL)
67366	SITI SAMIHAH BT. MAHMOOD	2ND YEAR(UITM)(CHEMICAL)
70877	SITI SHARIAH BT GHAZALI	2ND YEAR(UMP)(CHEMICAL)
67367	SITI ZAUWIYAH BT. ABDUL MALIK	2ND YEAR(UITM)(CHEMICAL)
67368	SITI ZULAIHA BT. ZAKARIA	2ND YEAR(UITM)(CHEMICAL)
70881	SITI ZULAIKHA BINTI ZAINAL	3RD YEAR(UMP)(CHEMICAL)
67369	SITY SOFIA BT. MOHAMMAD SHAWAL	2ND YEAR(UITM)(CHEMICAL)
71029	SO TSUK MAY	1ST YEAR(UTP)(CHEMICAL)
67370	SOVIANA ANAK SIBANG	2ND YEAR(UITM)(CHEMICAL)
71037	SUGENTTHER A/L CHANTHRAVARNAM	1ST YEAR(UTP)(CHEMICAL)
70883	SURIANI BINTI HUSAINI	2ND YEAR(UMP)(CHEMICAL)
68582	SURIANI BT. RASMIH	1ST YEAR(UMS)(CHEMICAL)
67371	SUZAMI JUNAIDAH BT. ARIFFIN	2ND YEAR(UITM)(CHEMICAL)
67372	SYAMIMI BT. SAAD	2ND YEAR(UITM)(CHEMICAL)
70887	SYAMSIAH BTE MOHAMED ALAM SICKANDAR	2ND YEAR(UMP)(CHEMICAL)
67373	SYAZA AQILAH BT. KAMARUDIN	2ND YEAR(UITM)(CHEMICAL)
67374	SYAZWANI ASILAH MOHD ZAINI	2ND YEAR(UITM)(CHEMICAL)
67375	SYED MUHAMMAD ASRI AL-EDRUCE B. WAN IBRAHIM	2ND YEAR(UITM)(CHEMICAL)
68479	TAN GHEE YONG, ADAM	1ST YEAR(MONASH) (CHEMICAL)
71021	TAY SYN YEE	1ST YEAR(UTP)(CHEMICAL)
68480	TEE YEE KWANG, NICHOLAS	1ST YEAR(MONASH) (CHEMICAL)
68583	THAMAYANTI A/P VITHILINGAM	1ST YEAR(UMS)(CHEMICAL)
68481	THEN WEE WEI	1ST YEAR(MONASH) (CHEMICAL)
68584	THIAN SIOK CHEN, EVON	1ST YEAR(UMS)(CHEMICAL)
68585	TIE HIENG YIK	1ST YEAR(UMS)(CHEMICAL)
71031	TONG CHAN RAY	1ST YEAR(UTP)(CHEMICAL)
68586	TOU JOON HAU	1ST YEAR(UMS)(CHEMICAL)
67376	UMMI SALAMAH BT. KAMARUDIN @ ABDUL SHUKOR	2ND YEAR(UITM)(CHEMICAL)
71008	UMMU ATHIYAH BT MUHD IDRIS LUTFI	1ST YEAR(UTP)(CHEMICAL)
71024	VAAGHISEN A/L DEVAN	2ND YEAR(UTP)(CHEMICAL)
71073	VIVENDRAN A/L KRISHNAN MOORTHY	2ND YEAR(UTP)(CHEMICAL)
67377	WAN AHMAD DANIAL B. WAN AB RAHMAN	2ND YEAR(UITM)(CHEMICAL)
67378	WAN ASHRAFF B. MOHAMAD NOOR	2ND YEAR(UITM)(CHEMICAL)
67379	WAN AZFAZANITUL IZNOR BT. ANJUMA	2ND YEAR(UITM)(CHEMICAL)
67380	WAN LUKMAN HAKIM B. HASSAN	2ND YEAR(UITM)(CHEMICAL)
67381	WAN NADATUL NADWA BT. WAN ALI	2ND YEAR(UITM)(CHEMICAL)
67382	WAN NURMAWADDAH WAN ABDUL RAHMAN JAUHARI	2ND YEAR(UITM)(CHEMICAL)
68587	WOONG CHA ZEONG	1ST YEAR(UMS)(CHEMICAL)
68588	YEE KAR TECK, ISAAC	1ST YEAR(UMS)(CHEMICAL)
67383	YUSRI B. YUSOF	2ND YEAR(UITM)(CHEMICAL)
68589	ZULAFA ZUYYIN BT. INCHE AZMI	1ST YEAR(UMS)(CHEMICAL)
71055	ABANG AIDEL FAREZZUAN B ABANG JUGAH	3RD YEAR(UTP) (MECHANICAL)
67384	ABDUL ALIFF B. MAZLAN	2ND YEAR(UITM) (MECHANICAL)
70781	ABDUL DADIR ZAILANI BIN HASAN	4TH YEAR(UMP) (MECHANICAL)
67385	ABDUL DZIZ B. BAHARI	2ND YEAR(UITM) (MECHANICAL)
67386	ABDUL HADI B. ABDUL MANAF	2ND YEAR(UITM) (MECHANICAL)
70808	ABDUL HADI BIN ABU BAKAR	4TH YEAR(UMP) (MECHANICAL)
67387	ABDUL HAFEEZ B. ABDUL RAZAK	2ND YEAR(UITM) (MECHANICAL)
67388	ABDUL HALIM B. HASHIM	2ND YEAR(UITM) (MECHANICAL)
70994	ABDUL HANIF BIN LAHMUDDIN	1ST YEAR(UTP) (MECHANICAL)
67389	ABDUL HAZIM B. ABDUL HALIM	2ND YEAR(UITM) (MECHANICAL)
67390	ABDUL MUIZ B. SARINGON	2ND YEAR(UITM) (MECHANICAL)
67391	ABDUL MUZAMMIL B. MOHD AZAIAUDDIN	2ND YEAR(UITM) (MECHANICAL)
70850	ABDUL RAHIM BIN SAKARI	4TH YEAR(UMP) (MECHANICAL)
67392	ABDUL RAHMAN B. MOHAMED AFFANDI	2ND YEAR(UITM) (MECHANICAL)
68175	ABDUL RAHSID B. DAUD	1ST YEAR(UTHM) (MECHANICAL)
67393	ABDULLAH ARIFF B. TUPIN	2ND YEAR(UITM) (MECHANICAL)
68482	ABRAHAM MATTHEWS JOSHUA	1ST YEAR(MONASH) (MECHANICAL)
67394	ADAM HAFIY B. AHMAD	2ND YEAR(UITM) (MECHANICAL)
67395	ADIB ZULFADHLI B. MOHD ALIAS	2ND YEAR(UITM) (MECHANICAL)
67396	ADIBAH BT. MOHAMMED DIAH	2ND YEAR(UITM) (MECHANICAL)
71007	ADRIAN YEO TAU JIUN	1ST YEAR(UTP) (MECHANICAL)
67397	AFAF AMERA BT. ABD GHAWI	2ND YEAR(UITM) (MECHANICAL)
67398	AFIZI IZWAN B. ABDUL RAHMAN	2ND YEAR(UITM) (MECHANICAL)
70759	AFNAN SYAFIQ BIN SHUHAIRI	2ND YEAR(UMP) (MECHANICAL)
70721	AFWAN BIN ZANUDDIN	4TH YEAR(UMP) (MECHANICAL)
70906	AHMAD AIZAD BIN JAMIL	4TH YEAR(UMP) (MECHANICAL)
68176	AHMAD AIZUDDIN B. SAAD	1ST YEAR(UTHM) (MECHANICAL)
67399	AHMAD AIZUDDIN B. ZAILANI	2ND YEAR(UITM) (MECHANICAL)
67400	AHMAD AJWAD B. AWANG	2ND YEAR(UITM) (MECHANICAL)
67401	AHMAD AKHRAM B. ABDUL RAHNAN	2ND YEAR(UITM) (MECHANICAL)
67402	AHMAD ALMIZAN B. CHE OMAR	2ND YEAR(UITM) (MECHANICAL)
67883	AHMAD AMIRUL B. NORDIN	1ST YEAR(UITM) (MECHANICAL)
67403	AHMAD AMIRUL FITRI B. AHMAD JOHARI	2ND YEAR(UITM) (MECHANICAL)
67404	AHMAD AMZAR B. ZULKIFLY	2ND YEAR(UITM) (MECHANICAL)
67405	AHMAD AZAHARI B. ZAINUDDIN	2ND YEAR(UITM) (MECHANICAL)
67406	AHMAD AZARI B. ROSLAN	2ND YEAR(UITM) (MECHANICAL)
67407	AHMAD AZIM B. AWISKARNI	2ND YEAR(UITM) (MECHANICAL)
67884	AHMAD B. S HAARI	1ST YEAR(UITM) (MECHANICAL)
70894	AHMAD BIN ABDUL	2ND YEAR(UMP) (MECHANICAL)

67408	AHMAD FADIL B. IDERIS	2ND YEAR(UITM) (MECHANICAL)
67885	AHMAD FAHMI B. ZAHARI	1ST YEAR(UITM) (MECHANICAL)
70704	AHMAD FAHMI B.YA'AKOB	4TH YEAR(UMP) (MECHANICAL)
67886	AHMAD FAISAL ARIFFIN B. RUSNI	1ST YEAR(UITM) (MECHANICAL)
67409	AHMAD HANAFI B. CHE MOHAMAD	2ND YEAR(UITM) (MECHANICAL)
67410	AHMAD HANIFF ILMUDDIN B. MOHAMAD NAWI	2ND YEAR(UITM) (MECHANICAL)
67411	AHMAD HASIF B. MAHAT	2ND YEAR(UITM) (MECHANICAL)
67412	AHMAD HASSAN B. MUHAMMAD MUHAYYIDIN	2ND YEAR(UITM) (MECHANICAL)
67413	AHMAD HELMI B. AHMAD KUSHAIRI	2ND YEAR(UITM) (MECHANICAL)
67414	AHMAD HELMI B. SALIM	2ND YEAR(UITM) (MECHANICAL)
67415	AHMAD HILMI B. MOHD ARIFF	2ND YEAR(UITM) (MECHANICAL)
70783	AHMAD HUZAIFAH B. ABDUL GHANI	2ND YEAR(UMP) (MECHANICAL)
67887	AHMAD IMRAN SOLIHAN B. YUSOF	1ST YEAR(UITM) (MECHANICAL)
70698	AHMAD MUHARIMI BIN ALI	2ND YEAR(UMP) (MECHANICAL)
67888	AHMAD NAJMI B. AHMAD NAZRI	1ST YEAR(UITM) (MECHANICAL)
67416	AHMAD NAQUIYUDDIN B. RASID	2ND YEAR(UITM) (MECHANICAL)
67417	AHMAD NAZRIN B. ABD WAHAB	2ND YEAR(UITM) (MECHANICAL)
67418	AHMAD QAYYUM B. AHMAD SAZLI	2ND YEAR(UITM) (MECHANICAL)
68177	AHMAD SAFWAN B. ABDUL RAZAK	1ST YEAR(UTHM) (MECHANICAL)
67889	AHMAD SYAFIQ B. SALAHUDDIN	1ST YEAR(UITM) (MECHANICAL)
70712	AHMAD SYAFIQ B.JOHAN	4TH YEAR(UMP) (MECHANICAL)
67419	AHMAD SYAHIR B. ABU BAKAR	2ND YEAR(UITM) (MECHANICAL)
67420	AHMAD SYAHIR B. ILIAS	2ND YEAR(UITM) (MECHANICAL)
67421	AHMAD SYARAFI B. KAMSO	2ND YEAR(UITM) (MECHANICAL)
67422	AHMAD SYAZNI B. MOKTAR	2ND YEAR(UITM) (MECHANICAL)
70903	AHMAD SYAZWAN KAMIL BIN RAZALI	4TH YEAR(UMP) (MECHANICAL)
68178	AHMAD TAJUL ARRIFFIN B. MAAROF	1ST YEAR(UTHM) (MECHANICAL)
70798	AHMAD TAMIMI BIN AHMAD TERMIZI	2ND YEAR(UMP) (MECHANICAL)
70864	AHMAD TARMIZY BIN ABDUL RAFA	4TH YEAR(UMP) (MECHANICAL)
68179	AHMAD ZAHID B. AMRAN	1ST YEAR(UTHM) (MECHANICAL)
67890	AHMAD ZAKWAN B. ABD LATIFF	1ST YEAR(UITM) (MECHANICAL)
67423	AHMAD ZAKWAN B. SHAMSUDDIN	2ND YEAR(UITM) (MECHANICAL)
70754	AHMAD ZARIF B.AHMAD FAUZI	3RD YEAR(UMP) (MECHANICAL)
67891	AHMAD ZUFAYRI B. AHMAD SAARI	1ST YEAR(UITM) (MECHANICAL)
70844	AIDIL BIN HASSAN	4TH YEAR(UMP) (MECHANICAL)
68654	AIDILRIZAM B. AZMI	2ND YEAR(UITM) (MECHANICAL)
67424	AIMI AMIRAH BT. SHAHRANI	2ND YEAR(UITM) (MECHANICAL)
67425	AIMI B. EZANI	2ND YEAR(UITM) (MECHANICAL)
70865	AIMI SYAZWAN BIN AZMI	3RD YEAR(UMP) (MECHANICAL)
67426	AIZAT AKMAL B. ABD. RAHMAN	2ND YEAR(UITM) (MECHANICAL)
67892	AIZAT FADZLI B. AYOB	1ST YEAR(UITM) (MECHANICAL)
67427	AIZZAT SHAFEEQ B. SAMSURI	2ND YEAR(UITM) (MECHANICAL)
67428	AKBAR B. HAJI MASROH	2ND YEAR(UITM) (MECHANICAL)
70681	AKMAL ARIFFIN B RUKIJAN	4TH YEAR(UMP) (MECHANICAL)
68655	ALI IMRON B. IMAM SHOBAR	2ND YEAR(UITM) (MECHANICAL)
67429	ALIF ASRAF B. ZULKIFLI	2ND YEAR(UITM) (MECHANICAL)
68656	ALIFAH ALYANA BT. AZHARI	2ND YEAR(UITM) (MECHANICAL)
67430	AMAL HAZIQ B. MOHMAD	2ND YEAR(UITM) (MECHANICAL)
71089	AMANINA FARHANA BINTI AHMAD	3RD YEAR(UMP) (MECHANICAL)
67431	AMAR B. IBRAHIM	2ND YEAR(UITM) (MECHANICAL)
68483	AMAR IKHWAN B. AB'LLAH	1ST YEAR(MONASH) (MECHANICAL)
67432	AMEERUL ASHRAF B. AWALLUDIN	2ND YEAR(UITM) (MECHANICAL)
67433	AMIN HAMIZAN B. DZULKARNAIN	2ND YEAR(UITM) (MECHANICAL)
68180	AMIR DZAHIN B. KERYA	1ST YEAR(UTHM) (MECHANICAL)
67434	AMIR FAIZAL B. ALI	2ND YEAR(UITM) (MECHANICAL)
70805	AMIR FITRI BIN ZAIDI	3RD YEAR(UMP) (MECHANICAL)
67893	AMIR RAFIQ B. MOHD RADZI	1ST YEAR(UITM) (MECHANICAL)
67435	AMIRAH ATIQAH BT. BADRUL HISHAM	2ND YEAR(UITM) (MECHANICAL)
70794	AMIRAH FATIN BINTI AMRAN	2ND YEAR(UMP) (MECHANICAL)
67436	AMIRUDEEN AKHYAR B. HAZIMAN	2ND YEAR(UITM) (MECHANICAL)
68657	AMIRUL ASHRAF B. HASSAN	2ND YEAR(UITM) (MECHANICAL)
68181	AMIRUL ASYRAF B. ZULKEFLI	1ST YEAR(UTHM) (MECHANICAL)
67437	AMIRUL FAZREEN B. MOHD ZAIN	2ND YEAR(UITM) (MECHANICAL)
67438	AMIRUL SYAFIQ B. ABD. RASHID	2ND YEAR(UITM) (MECHANICAL)
70868	AMIRULHAMZAH BIN ZAINUDDIN	4TH YEAR(UMP) (MECHANICAL)
67894	AMIRUN NISYAM B. AMIRUDDIN	1ST YEAR(UITM) (MECHANICAL)
70756	AMMAR BIN A. HAMID	4TH YEAR(UMP) (MECHANICAL)
70874	ANBALAGAN A/L JAYABALAN	4TH YEAR(UMP) (MECHANICAL)
67439	ANDERSON CYRIL ANAK ATIEN	2ND YEAR(UITM) (MECHANICAL)
67440	ANEURIN NANGGAR ANAK NYANDANG	2ND YEAR(UITM) (MECHANICAL)
70917	ANG CHAN MUN	3RD YEAR(UMP) (MECHANICAL)
71052	ANGELA ANTHONY	4TH YEAR(UTP) (MECHANICAL)
71092	ANIS UMIRA BINTI ABDUL KHALIM	3RD YEAR(UMP) (MECHANICAL)
68182	ANWAR B. JAMIL	1ST YEAR(UTHM) (MECHANICAL)
70873	ARAVIND A/L KOTTASAMY	4TH YEAR(UMP) (MECHANICAL)
70764	ARDI BIN MUHAMMAD RASYID	2ND YEAR(UMP) (MECHANICAL)
67441	ARIFEEWAN AZMAN B. JAMALUDIN	2ND YEAR(UITM) (MECHANICAL)
70824	ARMI AIN FARISHA BINTI AZMI	3RD YEAR(UMP) (MECHANICAL)
67895	ASHRAF B. MUSTAZA	1ST YEAR(UITM) (MECHANICAL)
67442	ASMIDA BT. SAFIE	2ND YEAR(UITM) (MECHANICAL)
67443	ASNAWI B. MUHAMMAD NAZRI	2ND YEAR(UITM) (MECHANICAL)
67444	ASSHIP BAKHIAL B. MOHAMAD	2ND YEAR(UITM) (MECHANICAL)
67445	ASYRAFOL AMIN B. HANIB	2ND YEAR(UITM) (MECHANICAL)
68183	ATHIRAH BT. AZAHARI	1ST YEAR(UTHM) (MECHANICAL)
67446	AWAD B. ABDULLAH	2ND YEAR(UITM) (MECHANICAL)
71084	AWANG KU AFIF IRFAN BIN AG JAAFAR	3RD YEAR(UMP) (MECHANICAL)
67447	AZIMOKHZANI B. AZIZUL GHAFAR	2ND YEAR(UITM) (MECHANICAL)
70901	AZIRAH BT HAZEMI	4TH YEAR(UMP) (MECHANICAL)
67448	AZLINA BT. YAHYA	2ND YEAR(UITM) (MECHANICAL)
67449	AZMIN B. JALALUDIN	2ND YEAR(UITM) (MECHANICAL)
67450	AZNOL B. ABD. HADI	2ND YEAR(UITM) (MECHANICAL)
67451	AZREEN SULAINA BT. ABDUL SALAM	2ND YEAR(UITM) (MECHANICAL)
67452	AZRIL AZRAEI B. AZIM NG	2ND YEAR(UITM) (MECHANICAL)
70753	AZYAN SYAZWANI BTE MOHAMMAD ARIFF	4TH YEAR(UMP) (MECHANICAL)
68184	CHAI TECK WEI, RONNIE	1ST YEAR(UTHM) (MECHANICAL)
70697	CHAN SOON UIN	3RD YEAR(UMP) (MECHANICAL)
70927	CHANG TING SHENG	2ND YEAR(UMP) (MECHANICAL)
68590	CHAU KIAN HAO	1ST YEAR(UMS) (MECHANICAL)
67896	CHE MOHD HAFIZULLAH B. CHE HAZEMI	1ST YEAR(UITM) (MECHANICAL)
70892	CHE ZAFIRAH BINTI ROSLY	3RD YEAR(UMP) (MECHANICAL)
70825	CHIN SAN WEI	2ND YEAR(UMP) (MECHANICAL)
68065	CHIN ZHAN YIE	1ST YEAR(TAYLORS) (MECHANICAL)
68484	CHONG SHAN LI	1ST YEAR(MONASH) (MECHANICAL)
68485	CHOONG KOK HOE	1ST YEAR(MONASH) (MECHANICAL)
70914	CHOW KEAN CHOONG	3RD YEAR(UMP) (MECHANICAL)
68486	CHUI PEK WAN, DIANE	1ST YEAR(MONASH) (MECHANICAL)
68185	CHUNG SHE MAN	1ST YEAR(UTHM) (MECHANICAL)
68487	CHUNG XIN MAY, NICOLE	1ST YEAR(MONASH) (MECHANICAL)
67453	DANIAL AIMAN B. RAHIM	2ND YEAR(UITM) (MECHANICAL)
67454	DANIAL ARIFF B. HOOD	2ND YEAR(UITM) (MECHANICAL)
67455	DEDISAPUTRA B. HERMAN	2ND YEAR(UITM) (MECHANICAL)
70792	DZULFARITH BIN ZULKIFLI	2ND YEAR(UMP) (MECHANICAL)
68488	EDWIN A/L JESU DASS	1ST YEAR(MONASH) (MECHANICAL)
67897	EFNIE FAREEZ B. ABD AZIZ	1ST YEAR(UITM) (MECHANICAL)
70482	ELWIN HENG CHIA JIE	2ND YEAR(NILAI) (MECHANICAL)
67456	ENGKU MUHAMMAD SYARIFUDDIN B. ENGKU RAHAN	2ND YEAR(UITM) (MECHANICAL)
70677	ERFAN BIN UMAR	2ND YEAR(UMP) (MECHANICAL)
67898	EYLIA NADIAH DRAHMAN	1ST YEAR(UITM) (MECHANICAL)
67457	FADHILAH BT. MOHD HANAPIAH	2ND YEAR(UITM) (MECHANICAL)
67458	FADHLAN SYAHIDI B. SHAARI	2ND YEAR(UITM) (MECHANICAL)
67459	FADZWAN B. KAMAL	2ND YEAR(UITM) (MECHANICAL)
68186	FAIRUZ RIDZMAN A. RASHID	1ST YEAR(UTHM) (MECHANICAL)
67460	FAISAL B. PADZIL	2ND YEAR(UITM) (MECHANICAL)
67461	FAKHRI HAFIZ B. OTHMAN	2ND YEAR(UITM) (MECHANICAL)
67899	FARAH ALIAH BT. ABD RAHMAN	1ST YEAR(UITM) (MECHANICAL)
67462	FARAH ATHEERAH BT. MOHD RAUF	2ND YEAR(UITM) (MECHANICAL)
70829	FARAH AYUNI BINTI FAUZI	4TH YEAR(UMP) (MECHANICAL)
67463	FARAH EZZATI RANI BT. HASSAN RANI	2ND YEAR(UITM) (MECHANICAL)
68187	FARAH SYAZWANI BT. MUSTAFA	1ST YEAR(UTHM) (MECHANICAL)
67464	FARAH ZAHIRAH BT. KAMARUL ZAINI	2ND YEAR(UITM) (MECHANICAL)
67465	FAREEZ B. MOHAMAD NASIR	2ND YEAR(UITM) (MECHANICAL)
68188	FARHAN NAJMI B. FERDINAND BAKRI	1ST YEAR(UTHM) (MECHANICAL)
67466	FARHAN SHAFIQ B. ABDUL RAIS	2ND YEAR(UITM) (MECHANICAL)
70780	FARID IZZUDDIN B. ABDUL MALEK	2ND YEAR(UMP) (MECHANICAL)
70800	FARID IZZUDDIN B. ABDUL WAHID	3RD YEAR(UMP) (MECHANICAL)
70862	FARIS IRHAM BIN ABDUL RAMIT	4TH YEAR(UMP) (MECHANICAL)
70699	FARIZ HAZIQ BIN JALALUDIN	2ND YEAR(UMP) (MECHANICAL)
67467	FARRAH HANIM BT. AZMAN	2ND YEAR(UITM) (MECHANICAL)
70897	FATIMATUR RIFQAH BINTI YAHAYA	4TH YEAR(UMP) (MECHANICAL)
68189	FATIN FARHANA BT. ANUAR	1ST YEAR(UTHM) (MECHANICAL)
67468	FAUZUL AZIM B. ABDUL JALIL	2ND YEAR(UITM) (MECHANICAL)
70817	FAUZY BIN MUSA	2ND YEAR(UMP) (MECHANICAL)

67469	FIKRI ARIF B. BAHRIM	2ND YEAR(UITM) (MECHANICAL)
67470	FIRDAUS B. MUSTAFA	2ND YEAR(UITM) (MECHANICAL)
70910	FONG LI QI	3RD YEAR(UMP) (MECHANICAL)
68190	FOO CHIN TOONG	1ST YEAR(UTHM) (MECHANICAL)
70715	FOO CHUN YANG	2ND YEAR(UMP) (MECHANICAL)
68528	GOBHIRAJ PANCHANATHAN A/L MOHANA SUNDRAM	1ST YEAR(UMS) (MECHANICAL)
70786	GOVINDA NAIR A/L SANKARA NARAVANANAIR	4TH YEAR(UMP) (MECHANICAL)
71051	GRACE ANAK UNI @ RICKIESON UNNI	4TH YEAR(UTP) (MECHANICAL)
67471	HAFIZAH BT. HADRAN	2ND YEAR(UITM) (MECHANICAL)
70701	HAMIZAN BIN ABD. HAMID	4TH YEAR(UMP) (MECHANICAL)
70773	HAMZAH BIN MOHD BORHAN	1ST YEAR(UMP) (MECHANICAL)
67472	HANISAH BT. HASNI	2ND YEAR(UITM) (MECHANICAL)
67473	HANISAH BT. JUMADIR	2ND YEAR(UITM) (MECHANICAL)
70720	HASINAH BINTI MOHD SHARIFF	4TH YEAR(UMP) (MECHANICAL)
67474	HASNOL BASRI B. HASAN NUALDIN	2ND YEAR(UITM) (MECHANICAL)
67475	HASWIRA AIMAN B. HASSAN MERICAN	2ND YEAR(UITM) (MECHANICAL)
67476	HAZWAN B. AMAN SHAH	2ND YEAR(UITM) (MECHANICAL)
70812	HISYAM BIN ABDUL AZIZ	3RD YEAR(UMP) (MECHANICAL)
70827	HO SIEW FENG	2ND YEAR(UMP) (MECHANICAL)
70750	HOH JIAN DE	3RD YEAR(UMP) (MECHANICAL)
67477	HURIL AIN BT. MOHD HANAFI	2ND YEAR(UITM) (MECHANICAL)
67478	IBRAHIM B. WAHID	2ND YEAR(UITM) (MECHANICAL)
67479	IKHWAN NAIM B. HAZREE	2ND YEAR(UITM) (MECHANICAL)
68191	INTAN NORFAZILAH BT. MELAK	1ST YEAR(UTHM) (MECHANICAL)
67480	IQBAL HARITH B. ABDUL WAHAB	2ND YEAR(UITM) (MECHANICAL)
67481	ISA B. SAHARI	2ND YEAR(UITM) (MECHANICAL)
67482	ISKANDAR DZULKERNAIN B. MD RAFFEE	2ND YEAR(UITM) (MECHANICAL)
68192	ISMA HAZIQ B. ISHAK	1ST YEAR(UTHM) (MECHANICAL)
68658	ISMAIL FITRI B. JAZIZ	2ND YEAR(UITM) (MECHANICAL)
71076	IYLIA SYAZIANA BINTI ISMAYUDDIN	4TH YEAR(UMP) (MECHANICAL)
68193	IZZAT AFIFI B. MOHD ZAIN	1ST YEAR(UTHM) (MECHANICAL)
68194	JAHIS SYAHAR BT. JAMAL	1ST YEAR(UTHM) (MECHANICAL)
70480	JONATHAN WU JO-HAN	2ND YEAR(NILAI) (MECHANICAL)
68195	JUNDULLAH HIKMATIYAR B. ABIDIN	1ST YEAR(UTHM) (MECHANICAL)
67483	KAMAR HAKIM B. KAMARUZAHA	2ND YEAR(UITM) (MECHANICAL)
67484	KAMARULSANI B. MD TAIB	2ND YEAR(UITM) (MECHANICAL)
67485	KHAIRIL AMRI B. SAHLAN	2ND YEAR(UITM) (MECHANICAL)
67900	KHAIRIL IKMAL B. HAMID @ YUSOFF	1ST YEAR(UITM) (MECHANICAL)
67486	KHAIRUL AZMEER B. MOHAMED IBRAHIM	2ND YEAR(UITM) (MECHANICAL)
67487	KHAIRUL EZWAN B. ZAHARI	2ND YEAR(UITM) (MECHANICAL)
67488	KHAIRUL HAZMAN B. KAMARUDIN	2ND YEAR(UITM) (MECHANICAL)
70866	KHAIRUL IHSAN B. YAAKOB	4TH YEAR(UMP) (MECHANICAL)
67489	KHAIRUL IKHWAN B. KHAIRUL SALLEH	2ND YEAR(UITM) (MECHANICAL)
67490	KHAIRUL NIFAIL B. MOHMMAD MOSLIH	2ND YEAR(UITM) (MECHANICAL)
67901	KHAIRUL NIZAR B. MUHAMMAD NOOR	1ST YEAR(UITM) (MECHANICAL)
67491	KHAIRULAMIRIN B. MOHD RIDZUAN WUI	2ND YEAR(UITM) (MECHANICAL)
71091	KHAIRUNISA BINTI TAHER	3RD YEAR(UMP) (MECHANICAL)
70820	KHOR TING WEI	3RD YEAR(UMP) (MECHANICAL)
67063	KOGULAN A/L LETCHUMANAN	1ST YEAR(USM) (MECHANICAL)
68489	KOK ZEN YEE	1ST YEAR(MONASH) (MECHANICAL)
70832	KOO KUAN HSIUNG	3RD YEAR(UMP) (MECHANICAL)
70722	KOR KIN YANG	4TH YEAR(UMP) (MECHANICAL)
67492	LAILATUL NUR BT. MOHD YUNUS	2ND YEAR(UITM) (MECHANICAL)
68490	LAO JIAWEI WILLIAM	1ST YEAR(MONASH) (MECHANICAL)
68196	LAU SHIAU FEN	1ST YEAR(UTHM) (MECHANICAL)
68197	LAU YAN HOW, DANIEL	1ST YEAR(UTHM) (MECHANICAL)
70705	LEE CHON WEE	3RD YEAR(UMP) (MECHANICAL)
68491	LEE KAE VUN, NICHOLAS	1ST YEAR(MONASH) (MECHANICAL)
68198	LEE SHEE YAO	1ST YEAR(UTHM) (MECHANICAL)
70814	LEE SIEW KEONG	3RD YEAR(UMP) (MECHANICAL)
70757	LEE SING SOON	3RD YEAR(UMP) (MECHANICAL)
68529	LEE WEI PIN	1ST YEAR(UMS) (MECHANICAL)
70717	LEONG CHEE WAI	2ND YEAR(UMP) (MECHANICAL)
70902	LIEW KHEE YAN	3RD YEAR(UMP) (MECHANICAL)
67064	LIEW SHAN KUN	1ST YEAR(USM) (MECHANICAL)
68199	LIGESH A/L MANNI VATTIYAN	1ST YEAR(UTHM) (MECHANICAL)
68492	LIM TZE MENG, ANDREW PETER	1ST YEAR(MONASH) (MECHANICAL)
70916	LIM WEI YONG	3RD YEAR(UMP) (MECHANICAL)
68493	LIM ZHU MING, SHAPHAN	1ST YEAR(MONASH) (MECHANICAL)
70835	LINNISH A/L MITRAN	3RD YEAR(UMP) (MECHANICAL)
68494	LIONG CHEE KHONG	1ST YEAR(MONASH) (MECHANICAL)
70752	LIYANA BINTI BADDAR KHAN	4TH YEAR(UMP) (MECHANICAL)
71004	LOGESS A/L VIJAYA KUMARAN	1ST YEAR(UTP) (MECHANICAL)
70909	LUQMAN BIN MD HUSIN	3RD YEAR(UMP) (MECHANICAL)
67902	LUQMAN UL-HAKIM B. OTHMAN	1ST YEAR(UITM) (MECHANICAL)
70904	M.HAFIZIE BIN HAMZAH	4TH YEAR(UMP) (MECHANICAL)
70889	MAK YIP KHUAN	3RD YEAR(UMP) (MECHANICAL)
70801	MANUGARI A/P PERUMAL	2ND YEAR(UMP) (MECHANICAL)
67065	MARK SELVAN A/L A.R. LOUIS	1ST YEAR(USM) (MECHANICAL)
70793	MATHAEUS ANAK JOHANI	2ND YEAR(UMP) (MECHANICAL)
68200	MAXIMUS KDHNIZIQ B. MAHLI	1ST YEAR(UTHM) (MECHANICAL)
67903	MD. ZULHILMI B. SALLEH	1ST YEAR(UITM) (MECHANICAL)
68495	MEK ZHE JIE, JASON	1ST YEAR(MONASH) (MECHANICAL)
70761	MICHAEL ANAK JANGI	4TH YEAR(UMP) (MECHANICAL)
67493	MICHEAL FRANKLIN ANAK SAM	2ND YEAR(UITM) (MECHANICAL)
70925	MIFTHAL FARID BIN MOHAMAD AZMI	1ST YEAR(UMP) (MECHANICAL)
67494	MIRWANSAH B. MOHAMAD	2ND YEAR(UITM) (MECHANICAL)
67495	MOHAMAD ADAM B. ISMAIL	2ND YEAR(UITM) (MECHANICAL)
67496	MOHAMAD AFIQ AFIFI B. MOHD ZAFIE	2ND YEAR(UITM) (MECHANICAL)
67497	MOHAMAD AFIQ B. ABD SAMAT	2ND YEAR(UITM) (MECHANICAL)
67498	MOHAMAD AFIQ B. SAID	2ND YEAR(UITM) (MECHANICAL)
67499	MOHAMAD AIMAN B. KHASSIN	2ND YEAR(UITM) (MECHANICAL)
68201	MOHAMAD AIMAN HARIZ B. MOHD HALIM	1ST YEAR(UTHM) (MECHANICAL)
70726	MOHAMAD AKRAM BIN ROZALI	3RD YEAR(UMP) (MECHANICAL)
70785	MOHAMAD ALIFF ASHRAF BIN CHE ROJA	2ND YEAR(UMP) (MECHANICAL)
67500	MOHAMAD AMIRUL SHAFIQ B. MUDA	2ND YEAR(UITM) (MECHANICAL)
67501	MOHAMAD ANIQ SYAMIL B. MOHD SOHAIMI	2ND YEAR(UITM) (MECHANICAL)
67502	MOHAMAD ARIFF ASYRAF B. RASHID	2ND YEAR(UITM) (MECHANICAL)
70695	MOHAMAD ARIFIN BIN IRWANSYAH	4TH YEAR(UMP) (MECHANICAL)
67503	MOHAMAD ARSYAN B. AZEMI	2ND YEAR(UITM) (MECHANICAL)
67504	MOHAMAD ASRI B. MOHD PORWADI	2ND YEAR(UITM) (MECHANICAL)
67505	MOHAMAD AZAM SHAH B. AZIZ SHAH	2ND YEAR(UITM) (MECHANICAL)
67506	MOHAMAD AZREN B. ABU HANIFAH	2ND YEAR(UITM) (MECHANICAL)
67507	MOHAMAD AZRI B. ABU BAKAR	2ND YEAR(UITM) (MECHANICAL)
67508	MOHAMAD AZRIL B. SUPIAN SURI	2ND YEAR(UITM) (MECHANICAL)
67509	MOHAMAD AZRIN B. BURHANUDDIN	2ND YEAR(UITM) (MECHANICAL)
70913	MOHAMAD FAIEZ HAKIMI BIN MOHD SALEH	4TH YEAR(UMP) (MECHANICAL)
67510	MOHAMAD FAIRUS B. ISMAIL	2ND YEAR(UITM) (MECHANICAL)
67511	MOHAMAD FAISAL B. SURAJI	2ND YEAR(UITM) (MECHANICAL)
67512	MOHAMAD FAIZ B. MHD NOOR	2ND YEAR(UITM) (MECHANICAL)
67513	MOHAMAD FARID B. AHAMAD FASIAL	2ND YEAR(UITM) (MECHANICAL)
67514	MOHAMAD FARIS B. KADIR	2ND YEAR(UITM) (MECHANICAL)
68202	MOHAMAD FARIS HAKIMI B. RAMLI	1ST YEAR(UTHM) (MECHANICAL)
67515	MOHAMAD FATHI B. AB AZIZ	2ND YEAR(UITM) (MECHANICAL)
67516	MOHAMAD HAKIMI B. KHAIRUDDIN	2ND YEAR(UITM) (MECHANICAL)
67517	MOHAMAD HANIFF B. MOHD YASIN	2ND YEAR(UITM) (MECHANICAL)
67518	MOHAMAD HASROL AZLAN B. CHE HASSAN	2ND YEAR(UITM) (MECHANICAL)
70898	MOHAMAD HAZIM BIN MOHAMAD HAFIDZ	1ST YEAR(UMP) (MECHANICAL)
67519	MOHAMAD HAZIMUDDIN NAZRI B. HAMDAN	2ND YEAR(UITM) (MECHANICAL)
68203	MOHAMAD HAZIQ ZAIM B. SAKIR	1ST YEAR(UTHM) (MECHANICAL)
70743	MOHAMAD HAZREEN B.HALIM	4TH YEAR(UMP) (MECHANICAL)
67520	MOHAMAD HISYAMUDIN B. ROSLAN	2ND YEAR(UITM) (MECHANICAL)
68204	MOHAMAD IKMAL B. ABDULLAH	1ST YEAR(UTHM) (MECHANICAL)
67521	MOHAMAD IZZHAM B. MOHD AZIZ	2ND YEAR(UITM) (MECHANICAL)
67522	MOHAMAD KHAIROL NIZAM B. MOHAMAD NOR	2ND YEAR(UITM) (MECHANICAL)
68205	MOHAMAD KHAIRUL ANUAR B. AB KARIM	1ST YEAR(UTHM) (MECHANICAL)
67523	MOHAMAD KHAIRUL IKRAM B. AMAN	2ND YEAR(UITM) (MECHANICAL)
67524	MOHAMAD MUZAMIL B. HAMDAN	2ND YEAR(UITM) (MECHANICAL)
67525	MOHAMAD NAZRIN B. MD NASIR	2ND YEAR(UITM) (MECHANICAL)
67526	MOHAMAD NUR SHAFIQ B. ZULKIFLI	2ND YEAR(UITM) (MECHANICAL)
70790	MOHAMAD OMAR HAKIMI B. MOHD SAMAN	2ND YEAR(UMP) (MECHANICAL)
70890	MOHAMAD RIZDWAN BIN RASHID CHAND	4TH YEAR(UMP) (MECHANICAL)
71003	MOHAMAD ROSMAN BIN MOHAMAD RAZIF	1ST YEAR(UTP) (MECHANICAL)
70821	MOHAMAD SAFWAN FAIZ BIN ABDULLAH	3RD YEAR(UMP) (MECHANICAL)
67527	MOHAMAD SAIFUL B. SAADON	2ND YEAR(UITM) (MECHANICAL)

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

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