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IEM
The Institution of Engineers, Malaysia
(Penang Branch)

INGENIEUR PENANG

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COMPLIMENTARY ISSUE

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Chairman's Corner

Greetings to IEM Penang Engineers,

It is again time for me again to pen down a few words for this coming Ingeniur Penang and it would be my last message as the IEM Penang Branch Chairman. I pray that everyone is well and safe.

It has been 2 years since I have taken office as IEM Penang Branch Chairman and to serve for the betterment of IEM and the community of Penang. It was indeed an honor to be given this opportunity to serve as IEM Penang Branch Chairman from 2021 to 2023.

I would continue to do my best to promote sound professional engineering practice as well as contributing towards nation building primarily.

I would like to thank the newsletter editorial team who had been for working very hard and persistently pushing and finally come out with this edition of newsletter. I would also like to thank all the contributors of this newsletter. Without all your contribution there is no Ingeniur, Penang. The Ingeniur, Penang is one of my tools that I would continue to use in keeping our Penang engineers abreast of what is happening.

As the IEM Penang Branch Chairman, I am very happy and really thank all the various IEM Penang Branch Sub-Committee for their hard work to organize various activities, like technical webinar, workshop, conference, technical visit, and CSR activities for all your members. I hope that all members will come out and support the event.

Last year November 26, 2022, IEM Penang Branch held our 55th Annual Dinner successfully, it was grace by our honorable chief minister YAB Tuan Chow Kon Yeow. I would like to thank all the sponsors, committee members, our engineers that came out and supported the event.

Finally, my sincere gratitude to all my fellow engineers, friends, and sponsors for their warm and generous support to IEM Penang Branch.

Before I end my message, I would like to leave with the following quote, ***"The strength of the team is each individual member. The strength of each member is the team."—Phil Jackson***

Each of us are unique with our own strength, together IEM strength we can make changes for the betterment of humanity.

Ir Bernard Lim
Penang Branch Chairman

Editorial Note

Greeting from IEM Penang Branch.

A few months have gone by at the blink of an eye. Without realizing, we have been through Christmas, New Year, Lunar New Year, Thaipusam, etc. In conjunction with the new year, I would like to share a quote which I learnt recently:

"Learn from yesterday, live for today, hope for tomorrow."—Albert Einstein

Let us embrace new year with new aspirations. My new year aspiration for IEM is to promote IEM as a professional society of choice to all engineering fraternities. Let us make IEM a learning society whereby every engineer can join in to learn, to network and to have fun.

In this upcoming edition, I would like to share some interesting events that were held in the last 6 months. First came to the list is our annual dinner. The successful annual event was held at the SPICE Convention center and more than 100 tables of invitees joined us after a few years of not seeing each other.

The next amazing event that we had is the Geotechnical Engineering Seminar. The seminar featured prominent speakers from Penang, Kuala Lumpur and Singapore who shared their knowledge and insights on various topics and challenges in geotechnical engineering.

Of course, there are many more great events that were actively participated by IEM Penang Branch. Some notable events are 40th Conference of ASEAN Federation of Engineering Organization (CAFEO40) and National Summit (NATSUM 2022). The events were both held in Cambodia and Kota Kinabalu respectively.

Ir. Khaw Yao Shun

Challenges in Implementing Unleaded Sn-based Solders for Automotive Electrical Parts.



Assoc. Prof. Ir. Dr. Mohd Arif Anuar Mohd Salleh | **Dr. Rita binti Mohd Said** | **Dr. Flora Somidin**

Faculty of Chemical Engineering and Technology, Universiti Malaysia Perlis

Introduction to Electric Vehicles

Higher energy demand from economic activities, transportation, residential areas and environmental degradation are the results of migration from rural to urban regions [1]. Generally, most of the energies consumed are from non-renewable energy, mainly the fossil fuels and coal. These non-renewable energies are frequently used in generating electricity and other economic activities which in turn pollute the environment [2]. Therefore, one of the solutions to improve the urban air quality and maintain good environment is by reducing the carbon dioxide (CO2) emissions such as from transportation.

Nowadays, transportation becomes an important aspect in developing better essential infrastructure. A transportation contributes to a significant value of total CO2 emissions in Malaysia [3]. To lower the CO2 emissions from transportation, electric vehicle (EV) is introduced. EV is a vehicle that either partially or fully powered by electric power. There are two main types of EV which are battery electric vehicle (BEV) and plug-in hybrid electric vehicle (PHEV). In EV, rotating vehicle electrical components such as starter and alternators contain a number of parts that need to be soldered into place either during the manufacturing process or rebuilding.

Challenges of current Lead-free solder for solder connection

Due to the toxic element of lead (Pb), Pb-free solder is introduced and used to reduce the risks during manufacturing process and eliminate Pb from possible land-fill disposal. In addition, most EVs used Insulated Gate Bipolar Transistor (IGBT) as electronic switch. An IGBT module acts as a core of an inverter for controlling motors in EVs. IGBT failure is mainly caused by solder layer fatigue or bond wires fall-off. The bond wire is mainly used to connect the chip (IGBT chip or diode chip) and the terminal (gate or emitter). The major factor for the bond wire to fall off is due to the inconsistent coefficient of thermal expansion (CTE) of each layer of the semiconductor device [4]. Figure 1 shows the different value of CTE of each layer of the IGBT module.

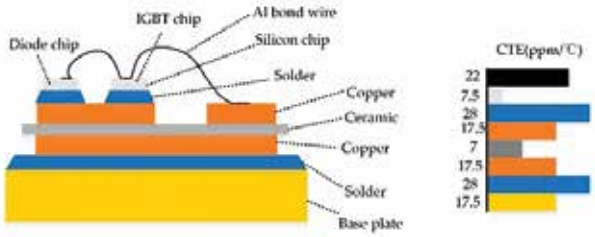

Figure 1: Insulated Gate Bipolar Transistor (IGBT) module structure and material coefficient of thermal expansion (CTEs) [4].

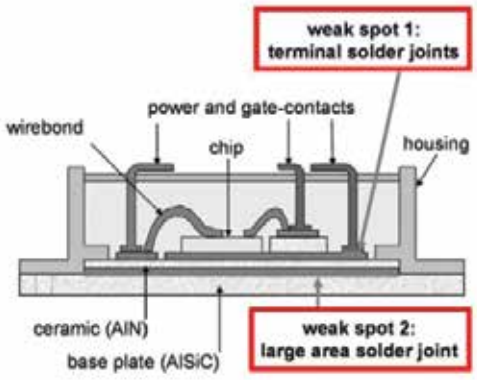

Figure 2: Solder joint area in electrical component (IGBT).

The soldered components (figure 2) work in a harsh environment such as in a state of continuous high temperature owing to the heat generated by power semiconductors. As a result, it is necessary to use Pb-free solder with heat resistance up to considerably higher working temperatures than those conventional solders used to join electronic components on PCBs in EVs. Higher the soldering temperature, greater the thermal deformation of electronic components, resulting in the formation of defects [5]. Hence, Sn-based Pb-free solders with high performance for electrical components near the EV engine temperature are received huge demand. Various Pb-free solders have been proposed and developed after the restriction of hazardous substance (RoHs) in electronic industry.

Sn-based Pb-free solder such as Sn-Cu, Sn-Ag-Cu and Sn-Bi have been used extensively as soldering materials in electronic packaging. Previous research shown that the Sn-Cu systems with trace additions of Ni (Sn-0.7wt%Cu-0.05wt%Ni) and a commercial alloy based on the discovery, (SN100C®) which has an addition of <0.01 wt% Ge solder joints have good performance to be used in control panels, cables, and connectors of EV [6]. Research on low melting solder which can withstand the high temperature during service are required especially for EV application. Solder alloys are not just a conduit for current but also need to handle the heat. Other Pb-free solder potential candidates are Sn-Bi and Sn-In materials.

Conclusion

Awareness on the sustainability and climate change promotes a global response including our country, Malaysia to tackle the issue through policy market solution. Under the 12th Malaysian Plan, Malaysia has set to be a carbon neutral nation by 2050 by upgrading its National Determined Contributions (NDCs) target to reduce intensity of CO2 emissions by 45% by 2030 unconditionally and a net-zero emissions target by 2050 [7]. The CO2 emissions account from the transportation can be reduced by introducing EV. Hence, soldered components work in EV requires high reliability and good performance during application. In other words, it is necessary to use a Pb-free solder with good properties and also able to withstand in harsh environment.

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Courtesy Visit to City Secretary, Ir. Rajendran

Reported by:

Ir. Teh Siew Yin

On 24th June 2022, the IEM Penang Branch, represented by its 4 committee members paid a courtesy visit to the City Secretary, Ir. Rajendran s/o P. Anthony at the City Council of Penang Island (MBPP) in Level 17, Komtar. It was also a privilege and an honor to be accorded a warm welcome by the Acting Director of Planning & Development TPr. Zuraini Bt. Mat Rasit, Director of Building Tn.Haji Rizuwan B. Salleh and Acting Director of Engineering Ir. Cheah Chin Kooi.

The objective of the visit was to have an insight into the current situation and established a greater rapport and cooperation between IEM (Pg) and the City Council. From the visit, we learned about the challenges faced by the city council and the demand for making smart decision on the spot when faced with exceptional situation or emergency. While they are expected to be in compliance with the rules and regulations at all times, there were at least a few instances when staying 100% in compliance with the regulations was next to impossible. Sometimes, the prevailing situation may require amendments to the current regulations and guidelines to cater for local demand and expectations.

The City Council owns a wide range of properties in the state of Penang. Some of their old buildings require assessment to ensure that they are still safe to be occupied. IEM Penang is indeed very pleased that preference has been given to our local consultants for most of the state projects except for some projects which involve complex planning.

Ir. Rajendran praised IEM Penang Branch for its ever swift and efficient response to their emergency calls during times of urgency. He also commended Ir. Chua Beng Seong for his dedication and service for the past few years in providing initial site investigation reports that enabled the City Council to come up with recommendations for further actions. He also thanked Ir. Chua for his leadership in IEM (Pg) collaboration with the universities (USM & UiTM) and the authorities on earthquake studies.

Figure 1: Presentation of plaque by IEM Penang Branch Chairman Ir. Bernard Lim to City Secretary Ir. Rajendran A/L P.Anthony

Figure 2: From Left to Right: Ir. Teh Siew Yin, Ir. Andy Lian Shin Wai, Ir. Khaw Yao Shun, Ir. Bernard Lim, Ir. Rajendran A/L P.Anthony, Ir. Cheah Chin Kooi, Tn.Haji Rizuwan B. Salleh & TPr. Zuraini Bt. Mat Rasit.

Under Street, Drainage and Building Act 1974: Section 85A, buildings exceeding 5 storeys must be visually inspected at least once every 10 years upon issuance of certificate of completion and compliance. This assessment of the condition and performance of the building is necessary to ensure that the building will be safe for occupation for another 10 years. If, there is a defect, deformation or deterioration in the building or its structural elements will likely endanger or reduce the structural stability or integrity of any part of the building then a full structural investigation will be required. Currently there are about 551 buildings in the state that would require such an assessment. Regrettably, only 20% of these owners of the buildings have done their due diligence and submitted their assessment report to the local authority.

In order for the City Council to respond to our feedback in the most effective manner IEM (Pg) is advised to raise any local authority system shortcomings or problems on a monthly basis instead of postponing till the next SPEAD meeting.

IEM (Pg) is encouraged to meet with the farmers especially through their association to provide them guidance in safe agriculture practice on hill land and hopefully to provide other further assistance. We should also encourage the Surveyors to collaborate with us in this matter. The Council is also worried about the accommodation provided by online brokers that lack regulations in many aspects, particularly homestays on the hillside.

The City Council also mentioned that there are still other aspects in engineering that IEM (Pg) could collaborate with them, not just only in the aspects of civil and structural engineering but also in mechanical and electrical engineering as well.

Figure 3: IEM Penang Branch & City Council Round Table Meetng.

IEM YES Technical Visit to Intel PG16 HEC Customer Experience Center

Venue : Intel PG16 HEC Customer Experience Center
Date : 16th December 2022
Time : 09:00 a.m. to 11:00 a.m.
Host : Intel Malaysia General Manager of NESG (HEC) Dr. Ngoo Seong Boon
Moderator : Elwin Heng & Ooi Beng Le

The visit to Intel PG16 HEC Customer Experience Center on 16th December 2022 was participated by 83 participants coming from IEM participants, Intel employees and UiTM Students. This IEM event comprised demonstration sessions of the Introduction of Intel Malaysia, Intel HEC Customer Experience Center targeting to showcase Intel product applications, Introduction of IEM focusing on Intel employees and visitation of Intel facilities.

Time	Schedule	Venue	Speaker
0900 - 0915	Arrival at Intel PG16 & Register	Lobby	Beng Lee & Elwin
0915 - 0945	Brieting & Malaysia Intel Introduction	PG16 Multi-Purpose Hall	Dr. Ngoo
0945 - 1015	IEM Introduction	PG16 Multi-Purpose Hall	Ir. Benard
1015 - 1045	Demo	HEC Customer Experience Center & IFS Lab	Intel Engineer
1045 - 1100	Check Out (Tour of Intel)	Lobby	Lobby

Figure 1: Division and Operation of Intel in Malaysia

The participants were received by Intel's General Manager of Malaysia NESG (HEC) division, Dr. Ngoo Seong Boon. Detail background of Intel Introduction, product application, and technology sharing was shared by Dr. Ngoo, providing an extraordinary insight into the overview of Intel. As a focus on semiconductors in Malaysia, there was also an in-depth overview of Intel's footprint in Malaysia, its contribution and its social impact on the country. A series of sharing, discussion and Q&A was carried out in the 30 minutes session.

The subsequent session continued with the sharing of the IEM Introduction focusing on the institution's background, and membership registration was given by IEM Young Engineers Section Chairman Mr. Sim (covered for Ir. Bernard absence). The session received overwhelming responses and questioning from Intel employees about the professional registration. Several IEM Professional Engineer Members and Committee members such as Ir. Lee Choo Yong and Dr. Lee Meng Chuan had also helped answering questions of Intel employees about professional registration.

Figure 2: Discussion of Professional Registration with Dr. Lee

Before moving to the next session, a token of appreciation of IEM was presented to Dr. Ngoo (Right) as an appreciation for receiving and hosting IEM participants and granting this visit to Intel.

Figure 3: Token of appreciation of IEM was presented by IEM to Intel, Dr. Ngoo (Right)

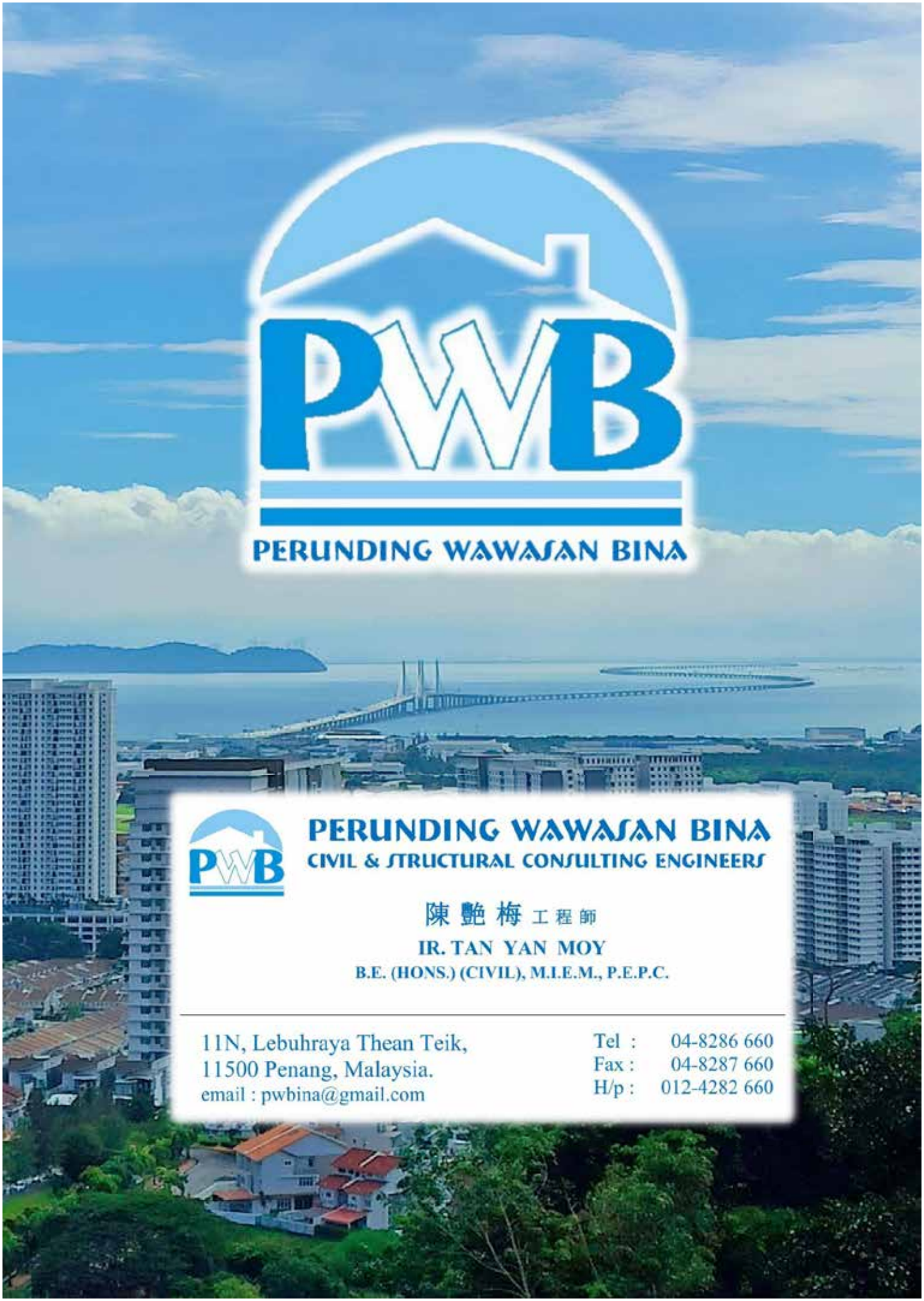
Figure 4: Group Photo Session

Next the highlight of the visit, was the visit to the HEC Customer Experience Center. Which showcased the Intel production solution and how Intel's product is being integrated into devices as a solution for the OEM and Customer. In the demonstration center, the participants were shared by Intel engineers on how Intel products into the devices and machine, to be used in applications like ATM machines, Auto grading devices used for education, and ordering machines in restaurants. These Intel application and solution covers education, customer service, banking, IoT, automation and other wide range of application.

Figure 5: Demonstration to IEM participant by Intel Engineers

Figure 6: Demonstration to IEM participant by Intel Engineers

The last agenda was the touring of PG16 facilities, Intel's commitment to ensure green and environmental sustainability could be seen through the incorporation into building design Intel's commitment to building a Great Place to Work (GPTW) for its employee, with a series of employee benefits, comfortable environment, leisure area and various services. All of these initiatives had helped Intel attract talent at the same time while raising the bar for other MNCs in Malaysia to follow suit in providing good benefits to attract talent in local employment markets to stay competitive. The trip was slightly extended to beyond 12pm, the visitation comes to the end upon completing the last tour, with the participant surrendering visitor card and leaving Intel premises.



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Technical Visit to Micron Memory Malaysia Sdn. Bhd.

Date : 3 December 2022 (Saturday)
Time : 9:00am to 12:30pm
Venue : PMT 779, Lingkaran Cassia Selatan, Taman Perindustrian Batu Kawan, 14110 Bandar Cassia Penang, Malaysia.
Total Participants Attended: 25 pax

Reported by:

Ir. Dr. Mui Kai Yin is the Chairman of IEM Electronic Engineering Technical Division (eETD).

Ir. Dr. Huzein Bin Fahmi is the Deputy Chairman of IEM Electronic Engineering Technical Division (eETD).

The IEM Electronic Engineering Technical Division (eETD) had hosted a technical visit to **Micron Memory Malaysia Sdn. Bhd.** in Batu Kawan Penang on 3rd was headed by IEM eETD Chairman, IEM Penang Branch Invited Past Chairman, Ir. Dr. Mui Kai Yin. A total of 25 delegates from IEM joined the visit. IEM members were warmly welcomed by Micron Memory Malaysia Sdn. Bhd. management team, including Senior Manager of Engineering and Maintenance (Facilities) Ir. Sim Soo Choon (Figure 1). Ir. Dr. Mui sincerely thanked Micron Memory Malaysia Sdn. Bhd. and their senior management team for allowing IEM members visiting the facility (Figure 2).

Roots in Boise, Idaho, Micron has grown into an influential global presence committed to being the best memory company in the world. Micron memory and storage solutions define what the world can do with data. With more than 40,000 team members, in 17 different countries, work with countless customers to innovate every day and pursue the products that will shape how we live and work tomorrow.

Since 2018's greenfield investment of US$350 million in Penang, Micron has steadily grown its presence in Malaysia to establish the Center of Excellence for Solid State Drive (SSD) Assembly and Test. With close to 4,000 team members currently, they plan to generate another 2,000 jobs over the next three to four years to fuel new device experiences and infrastructure innovation across the data center and the intelligent edge.

Micron manufactures the industry's broadest portfolio of memory and storage technologies: DRAM, NAND and NOR memory. With close industry partnerships and memory solutions expertise, their unique insight gives them the ability to address most challenging needs. Micron solutions are sparking new possibilities in everything from computing, networking, and server applications, to mobile, consumer, automotive and industrial designs.

Micron believes in fostering a supportive work environment where team members thrive, engage in meaningful work and bring their best selves every day. Because of that, Micron continues to invest in its people and their capabilities through our Technical Leadership Program, Technical Innovator Program, Leadership in Action Program, Micron Women's Leadership Network, and other programs – all designed to foster innovative thinking and leadership in our workforce.

This technical visit started off with an interactive presentation by Ir. Sim Soo Choon, who is the Senior Manager of Engineering and Maintenance (Facilities) and involved in many new facilities development projects. Ir. Sim shared the history and future direction of the company. He also presented the latest development plan and technology in memory products manufacturing processes and skills, as well as the future road map in their industry (Figure 3 to 4). The session continued with a series of questions and answers (Q&A). Several interesting questions were raised by the branch engineers, such as the sustainability of the facilities, green building directive, business challenges and competitiveness, as well as the cost effectiveness of manufacturing processes.

After the informative introduction and discussion, IEM members were given opportunity to visit to various manufacturing facilities, utilities systems inside the plant and outside the plant (Figure 5 to 9), including:

1. Admin Building.
2. FAB Building level 3, Change room.
3. FAB level 3, Burn in Oven class 100k clean room to view Test process and Glycol system and Electrical bus duct set up.
4. Central Utilities Building level 1 and 2, Wastewater treatment plant and DI water plant.
5. Central Utilities Building level 2, 11KV and 33KV switch room.
6. Central Utilities Building level 3, Glycol chillers, compressor, vacuum and process chilled water (PCW) plant.
7. Central Utilities Building level 4, HVAC Chiller system.
8. Central Utilities Building level 5, Cooling tower and Scrubber yard.
9. 132KV Substation and Transformer room.
10. Micron Memory Malaysia Urban Farming.

The in-house urban farming is one of the interesting projects cum initiative Micron Penang Team embarked on a few years ago. Where many types of vegetables and fruits were grown. The company harvested them and prepared delicious meals for employees.

The technical visit session ended with a group photograph at the plant entrance area (Figure 10) and certificate of presentation to the host (Figure 11).

Figure 1: Welcome speech by Ir. Sim Soo Choon, Senior Manager of Engineering and Maintenance (Facilities) Micron Memory Malaysia Sdn. Bhd

Figure 2: Welcome speech by Ir. Dr. Mui Kai Yin, Chairman of the Institution of Engineers Malaysia, Electronic Engineering Technical Division.

Figure 3: Explanation of technical visit program flow by Ir. Sim Soo Choon (Micron).

Figure 4: Explanation of Micron Memory Malaysia Sdn. Bhd. Key Performance Indicator (KPI) by Ir. Sim Soo Choon (Micron).

Figure 5: Participants Visiting the Manufacturing Process Area.

Figure 6: Group Photo of Participants at 11KV Switch Room.

Figure 7: Group Photo of Participants at 132KV Sub Station.

Figure 8: Participants Visiting the Wastewater Treatment System.

Figure 9: Group Photo of Participants at Central Utilities Plant besides 2400RT Chillers.

Figure 10: Group Photograph of Participants at the Frontage of 100% RE Powered Micron Memory Malaysia Sdn Bhd.

Figure 11: Certificate of Appreciation Presentation to Micron Memory Malaysia Sdn. Bhd.

Time	Activity
0900 - 0930	Arrival of IEM Delegates
0930 - 1030	Technical Talk by Mivron Memory Malaysia
1030 - 1200	Factory Visit Host by Micron Memory Malaysia
1200 - 1230	Question and Answer Session
1230 - 1240	Closure and Group Photo

IEM Penang Silver Jubilee Old Folks' Home Visit

Date : 28 January 2023 (Saturday)
Time : 1:30PM - 3:30PM
Location : Silver Jubilee Home For The Aged, Jalan Sungai Dua Gelugor, 11700 Bayan Lepas, Pulau Pinang.

On 28 Jan 2023, The Institution of Engineers, Malaysia (Penang Branch) organised a donation drive in conjunction with the Chinese New Year (CNY visit) to Silver Jubilee Home in Gelugor, Penang. The invited guest of honour was YB. Kumaresan A/L Aramugam, the state assemblyman for Batu Uban. Apart from touring the homes while giving mandarin oranges to the aged, YB. Kumaresan also had a fruitful discussion with the IEM team on various Corporate Social Responsibility (CSR) collaborations in the near future.

The team led by the Branch Chairman, Ir. Bernard Lim Kee Weng, IEM Penang Branch Chairman, has initiated donation funding for the visit among the branch's executive committee members, Young Engineers Section (YES) and Women Engineers (WE). Before the official visit, the representatives from the Young Engineers Section (YES) has also helped with cleaning and gardening works for Silver Jubilee Home since the morning of the eventful day.

Figure 1: The team arranged items to donate for a group photograph.

Figure 2: YB. Kumaresan (Left pic) and Ir. Bernard Lim (right, in white IEM shirt) giving mandarin oranges and pack food to the old people.

Figure 3: The team took a group photo with outside Cheah Leong Keah Hall, Silver Jubilee Home.

40th Conference of ASEAN Federation of Engineering Organisation (CAFEO40)

Day 1 (4th December 2022)

Malaysia delegates safely landed at Phnom Penh International Airport at 2:15pm local time; weather was sunny at Phnom Penh. After passing through the immigration and custom check point, IEM Penang YES delegates heading to Angkor International Hotel for check-in. Right after keeping luggage at hotel, immediately they proceeded to the YEAFEO Friendly Marathon's starting point, which about 8km from hotel.

YEAFEO Friendly Marathon was flagged off on 5:00pm, and all participants managed to complete the run in half hour. Prize-giving ceremony was conducted at Tonle Sap Street's Square, after the balloon was released to air and it symbolized the opening of YEAFEO, with all delegates dancing together to the Khmer traditional dance with the guidance of organizing committee.

Figure 1-4: YEAFEO Friendly Marathon.

Figure 5: Free and easy session.

Day 2 (5th December 2022)

Figure 6: Malaysia Delegates at Malaysia Pavilion.

Delegates departed early at 8am to Sokha Phnom Penh Hotel, for registration and conference kit collection. After registration, delegates after assisting in the setting up of IEM booth in Malaysia Pavilion, they also visited the exhibition held around the ballroom, and attended a few AFEO related meetings.

After lunch, all YEAFEO delegates gathered at Kravan Meeting Room, for the YEAFEO Country Report. All ASEAN Country + Japan, Hong Kong, took turns to present their country's Young Engineers division reports.

Thereafter, all delegates were having networking sessions at Sokha Hotel's foyer, before departing back to the hotel for rest. The evening was free and easy.

Day 3 (6th December 2022)

Delegates departed from Angkor International Hotel to Sokha Phnom Penh in the early morning around at 6:30am for the official opening ceremony. Which was presided over by H.E. Dr. Ith Samheng, Minister of Labour and Vocational and Chairman of the Council of the Board of Engineers, Cambodia. Penang delegates also attended Malaysia Pavilion with display of booths from Malaysian companies and sponsors, and assisted to take turns in duty for attending the booth and AFEO pins selling. Penang delegates took photos with the other Malaysian branches and HQ for opening ceremony of the Malaysian Pavilion booth.

At around 12:30pm in the afternoon, YEAFEO Governing Board Meeting kicked off, with each of the ASEAN country delegates presenting about their activities and challenges faced. Japan and Hong Kong delegates were also among those presented. There were also green initiatives to plant trees brought up by the Philipines delegates.

The meeting was delayed and ended at around 2pm with souvenirs exchanges between countries and plenty of photographs. Then, the delegates proceeded for buffet lunch in Sokha Hotel. After lunch, all delegates departed to visit Win-win memorial in Kandal, before dinner. The Win-Win Memorial is a monument that marks the end of civil wars in Cambodia. It was inaugurated on 31 December 2018 by Prime Minister Hun Sen to mark the end of the civil war 20 years ago.

Figure 7: Group photo in front of Win-win Memorial.

Figure 8: The team had dinner at Phka Chan Restaurant, hosted by Cambodia BEC before returning to hotel.

Day 4 (7th December 2022)

At 7:45am, Penang delegates departed from Angkor International Hotel to Sokha Hotel Phnom Penh. Together with the rest of the delegates, Penang delegates arrived and visited at Vattanac Capital Building (Technical Visit) at 9am. The teams were actively involved in Q&A after a technical presentation was conducted on the engineering of the building.

Figure 9-11: Group photo infront of Vattanac Capital Building.

A Group Photo Session marked the end of the visit before proceeding to the next tower visit - the Morgan building at 10:30am. After the visit, we had buffet lunch provided by the Morgan building owner. Then, Penang delegates visited the Russian Market to puchase souvenirs. The team also visited royal palace in Phnom Penh. The Royal Palace of Cambodia is a complex of buildings which serves as the royal residence of the King of Cambodia.

Figure 12: Group photo infront of Morgan Building Phnom Penh.

5:30pm at night, the team attended the farewell Dinner Host by BEC. There have been representative from Penang and Malaysia receiving awards as Honorary member of AFEO. The team congratulated IEM Penang Branch Chairman, Ir. Bernard for being conferred AFEO Hon. Member that evening, during the CAFEO40 Farewell Dinner in Cambodia.

Figure 13-14: Malaysia delegates attending farewell Dinner.

Day 5 (8th December 2022)

CAFEO finished on 7th December and the organizer continued for 3 days to Siam Reap for visitation to Angkor Wat and tour till 10 December.

Penang delegates did not join the subsequent tour due to time conflict and the team opt to extend only 1 day for visitation in Phnom Penh for cultural understanding and assessment of the country.
The delegates visited Cheong Ek (Killing Field), Toul Sleng (Genocidal Museum) to understand the history of Cambodia country during the Khmer Rogue in the country dark history of 1975-1979.
Visited Russian Market, a local Cambodian market to purchase souvenir for team members and subsequently visited Nagaworld and Diamond Island area, afluent area of within Phnom Penh.

Day 6 (9th December 2022)

On Day 6th, which is the last day, Penang delegates visited Cambodia National Museum which is within walking distance from the accommodation hotel. It was the last visit which the team decided to take the opportunity to leverage from this CAFEO trip to visit Cambodia's national museum to understand the culture and the history of this country.

Subsequently, upon finishing the visit. Penang delegates returned to Penang from Cambodia on 2:25PM flight from Phnom Penh to KLIA2 and layover to transit again to Penang International Airport at 10:25 PM as there is no direct flight. The second flight was delayed and reschedule to 11:05 PM. All Penang delegates arrived in Penang around 12:15 AM midnight.

WEA Engineers & Associates Sdn. Bhd.

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Perunding P.L.A. was incorporated on 08 August 2001 as a firm of professional Mechanical and Electrical Engineers. We offer Mechanical, Electrical and Process (MEP) engineering consultancy services in various types of project including residential, commercial, educational, healthcare, industrial and manufacturing buildings.

Services

Our main disciplines are Mechanical, Electrical and Process (MEP) Engineering related works. We are well equipped and competent to carry out comprehensive engineering design, supervision, project management and contract administration for the following development:

- Industrial Buildings
- Landed Housing Scheme
- Hotels
- Warehouses
- Residential- Low and High Rise Building
- High Rise Office Buildings
- Institutional Buildings
- Place of Worship
- Educational Buildings
- Petrochemical Plants
- Commercial Buildings

The scope of services that we can offer include preliminary investigations, feasibility and cost benefit studies, engineering design, calling of tender and tender appraisal, contract supervision, contract administration and project management of the followings services:

- Process Utilities
- Hot Water Services
- Clean Rooms
- Fire Protection Systems
- Air Conditioning and Mechanical Ventilation System
- Extra Low Voltage Systems (ELV)
- Cogeneration Power Plant
- Hoists, Lift and Escalators
- External Electrical Distribution System
- Lightning Protection System
- Refrigeration and Cold Rooms
- Standby Generator Set
- Industrial Gases System
- Swimming Pool Filtration Equipment
- Building Automation System
- Waste Water Treatment Plant
- Purified Water System
- Water Treatment and Filtration Systems

The Institution of Engineers, Malaysia (Penang Branch) Earthquake-Resilient Tower (ERT) Design Competition 2022.

12 November 2022 – The Institution of Engineers, Malaysia (Penang Branch) organised its first Earthquake-Resilient Tower (ERT) Design Competition on 12 November 2022. This earthquake awareness event was co-organised between the branch's Young Engineers Section (YES), Earthquake Engineering Sub-Committee, and Science, Technology, Engineering and Mathematics (STEM) Sub-committee. The event took place at 1st Avenue Mall, Penang, the venue sponsor for this competition. Two other gold sponsors include Perunding Wawasan Bina (PWB) and Choongcons (Pg) Sdn. Bhd.

Figure 1: The competition attracted a large crowd of over 300 audiences in total, including 75 secondary schools' participants forming 20 teams contesting in the design competition, teachers and parents, the professionals, and the public.

In the welcoming speech by IEM Penang Branch Vice Chairman, Ir. Chan Wah Cheong mentioned that the efforts to encourage STEM and promote engineering knowledge and creativity has always been one of the branch's key objectives. Knowledge can be more effectively instilled to younger generations though a series of interesting activities such as this. Similar to the ERT Design Competition, IEM Penang Branch has also organised Build and Break Design Competition, Boulders' Fence Design Competition in s the previous years. Ir. Chan, on behalf of IEM Penang Branch, remarked that there would be more interesting upcoming branch activities, including the IEM Penang Branch 55th Anniversary Exhibition and Dinner, which would take place on 26th November 2022, at SPICE Convention Centre, Penang.

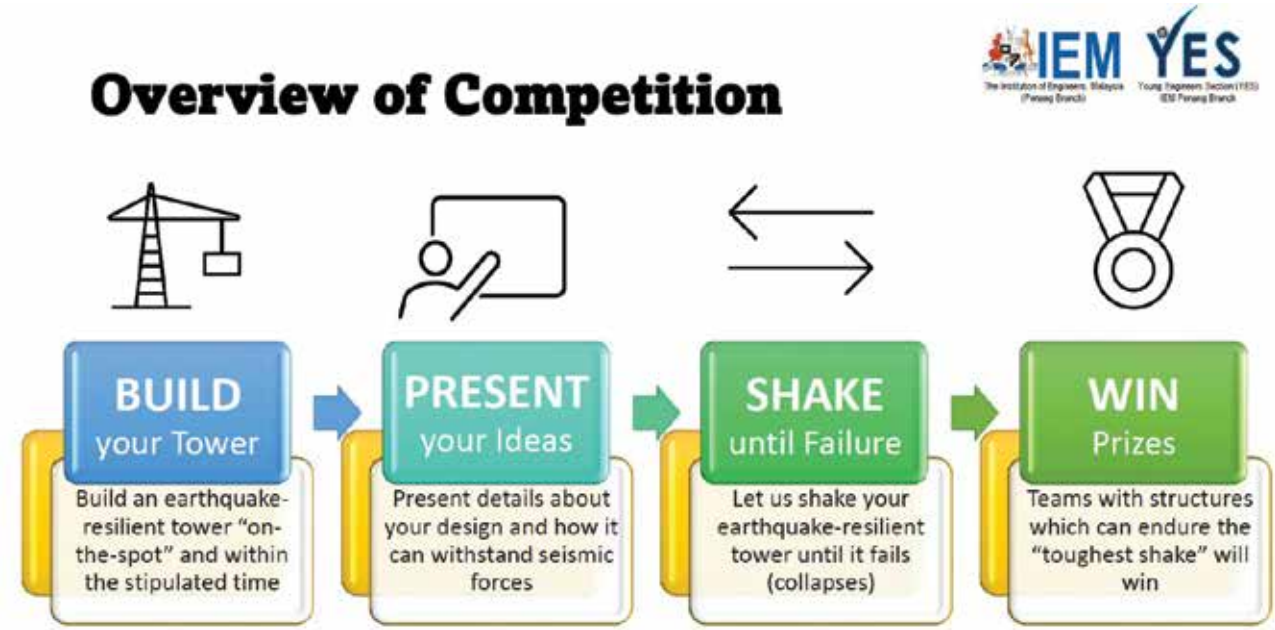
Chair of IEM Penang Branch Earthquake Engineering Sub-Committee, Ir. Chua Beng Seong congratulated the success of the working committee in his opening speech. He expressed satisfaction seeing the overwhelming responses from the young blood, hence more works have been in progress to cater for these growing interests and also in the field of earthquake engineering.

He said that more hands-on experiences through activities of this kind could be give a higher impact for learning, whereby in this case, we would give feeling of how earthquake impacts a building rather than just through reading books.

Besides, Ir. Chua also mentioned that East Malaysia experienced higher seismic impacts than the Peninsular Malaysia which is located in the stable Sunda shelf, with low to moderate seismic activity. With such, the British Code and European code we apply in building designs mainly focused on wind loading rather than seismic load. However, there have been recent counts of tremors which triggered the state to work with IEM Penang for more studies into the subject of earthquake design provisions in the Penang Island. Consequently, in 2019, the Earthquake Engineering Sub-committee chaired by Ir. Chua has been established. Collaborative studies in Earthquake Engineering between the Sub-committee, Universiti Sains Malaysia (USM) and Universiti Teknologi Mara (UiTM) is currently in its 4th year, focusing on building designs based on peak ground acceleration (PGA) of 5%g for Penang. The outcome of the collaborative study will soon be published.

A very knowledgeable panel of judging for the ERT Design Competition comprised of Ir. Chua Beng Seong, Dato' Seri Lim Kok Khong and Dr. Ngoo Seong Boon. Other key players present in the competition included the Chair of IEM Penang STEM Sub-committee, Ir. Dr. Khor Jeen Ghee, IEM Penang Branch Young Engineers Section Chairman, Ts. Sim Kai Sheng, Vice Chairman, Ir. Ts. Lim Wei Hong and Past Chairman Ir. Ts. Wong Kok Nian, ERT Design Competition Chairman, George Lim Jing Wei, and committee members Phuah Yong Zhen, Goh Shing Yi, Lee Sang Yu, Lim Wei Hang, Ong Han Bin, Tan Shih Ming, as well as the Assistant General Manager of 1st Avenue Mall, Tracy Tan Ling Hong, and representative Mr. Tay Chih Hern.

The Competition overview comprises of 4 steps – Build, Present, Shake and Win, as summarised in the chart and photographs below.



ERT Design Competition 2022 Overview

Figure 2: Team Members constructing their Earthquake-Resilient Towers.

Figure 3: All Teams' Models were displayed for Public Viewing prior to the presentation by the respective group on stage.

Figure 4: Team Members mounting their models onto the shake platform to be tested

Group Photos: Front row from the Right, George Lim Jing Wei, Ts. Sim Kai Sheng, Ir. Ts. Wong Kok Nian, Mr. Tay Chih Hern, Ir. Dr. Khor Jeen Ghee, Ir. Chan Wah Cheong, Ir. Dr. Chang Chun Kiat, Dr. Ngoo Seong Boon, Ir. Chua Beng Seong, and Dato' Seri Ir. Lim Kok Khong.

The winning teams of the Competition were as follows:

Champion:
ERT ZAID, SMKA AL-MASHOOR (L)

1st Runner-up:
PROJECT F.M.A.D, KOLEJ VOKASIONAL BATU LANCHANG

2nd Runner-up:
CHC2, SMJK CHUNG HWA CONFUCIAN

Most Creative:
THE CLIFFHANGERS, SMJK CHUNG LING BUTTERWORTH

Best Presentation:
THE CLIFFHANGERS, SMJK CHUNG LING BUTTERWORTH

Resource Management:
TARP WINGS, SMT TUNKU ABDUL RAHMAN PUTRA

The Top 3 teams with their models with the working committee on stage

ANNUAL DINNER 2022

Reported by:
Organizing Chairman: Ir. Chan Wah Cheong

On November 26th, 2022, the IEM Penang celebrated its 55th anniversary with a grand and glamorous event at the Setia Spice Convention Centre. The event included a full day of fun and informative activities, such as legacy lectures by three distinguished engineers, exhibitions showcasing the latest developments and innovations in engineering products, and a gala dinner featuring lively entertainment by a full-piece band and an illusionist show.

The night was attended by esteemed guests, including local government officials, industry leaders, and academics, with the Chief Minister as the special guest. The event had almost 99 tables and close to 970 members and notable guests in attendance. Attendees also participated in exciting lucky draws during the dinner.

The event's theme, "Engineers are the CAPSTONE - Things Breakdown without us," highlighted the critical role of engineers in shaping and sustaining the world. The night started with speeches from the IEM (Penang) Chairman Ir Bernard Lim and the organizing Chairman, followed by an opening address from the Chief Minister YAB Tuan Chow Kon Yeow and a keynote address from the Deputy of the IEM President Ir. Prof. Dr. Jeffrey Chiang.

With a star-studded key sponsors like Midea Scott and English Electronics Sdn Bhd (Cullinan Diamond Sponsor), Total Engineering Provider (Omphacite Jadiete Sponsor), Signify Malaysia Sdn Bhd, MicroEngine Technology Sdn Bhd and Acson Malaysia Sales and Service Sdn Bhd (Bahia Emerald Sponsors), 17 Sunrise Ruby Sponsors and another 25 Logan Sapphire Sponsors that supported the event had reflected the importance of the institution in our society.

The IEM Penang 55th anniversary celebration recognized the achievements and contributions of various individuals and organizations, including special distinguished engineer awards and souvenirs presented to the Chief Minister, sponsors, and Penang state award recipients. Two distinguished engineers, Dato' Ir. Dr. Goh Teik Cheong and Ir Dato' Ir. Rajendran P Anthony, received special distinguished engineer awards in 2020 and 2021, respectively.

Overall, the IEM Penang 55th anniversary celebration provided valuable networking opportunities, raised awareness of new developments in the exhibitions, and promoted the achievements of engineers in the region. It was a triumphant occasion, highlighted by an exciting and diverse line-up of programs that kept attendees engaged and entertained throughout the celebration.

The success of the IEM Penang 55th annual dinner is a testament to the hard work and dedication of the organizing committee. Their efforts and meticulous planning ensured that the event was a resounding success, providing an unforgettable experience for all attendees. We extend our heartfelt gratitude to the organizing committee for their exceptional work and tireless efforts in making this event possible.

We hope for continued supports from all stakeholders in our future events.

The organizing committee and volunteers that were helping out for the event.

Grand Opening By CM accompanied by IEM Chairman & Organizing Chairman.

Happy and Fun Moments.

Welcoming Speeches and Opening Addresses.

Highlight of the nights.

Main Sponsors and Exhibitors.

Distinguished Engineer Award Legacy Lecture

Reported by:
Ir. Dr. Chang Chan Kiat

The Institution of Engineers, Malaysia (Penang Branch) initiated the Distinguished Engineer Award in 2008. The ultimate objective of this award is to compliment and value the great contributions made by the individual engineer in various field of works throughout their engineering career. The recipient of this award will deliver a Legacy Lecture, highlighting key learnings and experiences that young and future engineers can emulate. However, due to the COVID-19 pandemic, many events, including the 2019 and 2020 Distinguished Engineers' Legacy Lectures, were postponed for almost two years. As a result, the 2019, 2020, and 2021 Distinguished Engineers' Legacy Lectures were combined and held on 26 November, 2022 at Setia SPICE Convention Centre. The award presentation is held during 55th IEM (Penang Branch) Annual Dinner. The recipients of this award are as follow:

2019 Distinguished Engineer -
Dato' Ir. Addnan Bin Mohd Razali

2020 Distinguished Engineer -
Dato' Ir. Dr. Goh Teik Cheong

2021 Distinguished Engineer -
Dato' Ir. Rajendran P Anthony

The event commenced with a welcoming speech, by IEM (Penang Branch) Chairman, Ir Bernard Lim Kee Weng, followed by a talk presented by Dato' Ir. Addnan Mohd Razali on the topic of "Flood Mitigation & Disaster Management in Penang Island." During his lecture, he discussed the measures and plans implemented by Penang Island City Council (MBPP) and Department of Irrigation and Drainage Malaysia (JPS) to mitigate flash floods on the island since 2008. These flash floods are known to increase in frequency and magnitude during the South-West to North-East monsoon transition period from September to November each year. The main causes of flash floods are river overflow, undersized drains, blockage by rubbish, tidal effect, and poor construction site management. Besides that, floods caused by heavier than usual monsoon rains are also linked to climate change. The presentation highlighted the importance of these efforts in combating the impact of climate change in Malaysia, as more severe storms and floods are expected in the future.

During the event, Dato' Ir. Dr. Goh Teik Cheong delivered a talk on "Practising Engineers' Involvement in Institutions of Higher Learning's Engineering Education," where he shared his experiences and thoughts on the subject. The talk emphasized the importance of collaboration between academicians and practising engineers in producing quality engineers. Practising engineers have a crucial role to play in society as well as in the engineering education of Institutions of Higher Learning (IHL). They are encouraged to attain a minimal standard that is comparable to global practices and to be actively involved in providing industrial training to students, accommodating IHL's industrial visits, participating in students' integrated design projects, delivering talks/lectures as guest lecturers, serving on the panels of industry advisories, panel evaluators for accreditation, consultancy collaboration, and more. The aim is to create a symbiotic relationship between IHLs and practising engineers that ultimately benefits the engineering profession and society as a whole.

Finally, Dato' Ir. Rajendran P Anthony, City Secretary of the Penang Island City Council (MBPP) gave a talk on the important topic of "Meeting the Challenges of Climate Change and the Green Initiatives by City Council of Penang Island". The Penang Green Agenda aims to engage all stakeholders and Penangites to identify and combat the environmental challenges facing the state, proposing feasible solutions. The City Council of Penang Island has been proactively planning and implementing projects and programs for several decades to meet the challenges of climate change. The Penang Green Policies & Programs were launched in 2009 and included initiatives such as No Free Plastic Bag Day Every Monday, Every Day is No Free Plastic Bag, among others. However, the need to intensify efforts has become more critical in recent years, leading to the launch of Penang Green Agenda 2030 and Penang Waste Management Roadmap 2030. One of the initiatives is the City Council of Penang Island's commitment to providing a connected pedestrian sidewalk network to encourage the public to walk around Penang Island, providing a safe and convenient walking infrastructure that complies with universal design criteria, reducing traffic congestion, and reducing carbon footprint. Additionally, the Penang Tree Inventory System (PeTIS) has been developed to manage and monitor the effective and efficient plants in Penang. To meet the aspirations of the Penang State Government, there is a greater need to instill awareness among the people about the importance of sustainable practices.

Technical visit to Pejabat Pengurusan Lembagan Sg Muda (PLSM) & Sg Muda Barrage

Reported by:
Ir. Dr. Chang Chun Kiat

On 3rd July 2022, the Institution of Engineers, Malaysia (IEM) Penang Branch successfully organized a technical visit to Pejabat Pengurusan Lembagan Sg Muda (PLSM) & Sg Muda Barrage at Kota Kuala Muda, Kedah. The overall objective of this technical visit is to get a better understanding of Sg Muda Barrage and its operation. Sungai Muda, which is located within the boundary of Kedah and Pulau Pinang with a catchment area of 4,210 km2 and 180 km length begin from Muda Dam and flows across district of Baling, Sik and Kuala Muda. Water supply for agricultural, industrial and domestic sector for both Penang and Kedah is the key role of the river.

A total of 20 delegates participated in the technical visit. Upon arrival at PLSM, delegates received a warm welcome from the director of PLSM, YM Tengku Zamri Bin Raja Zainal Abidin and the team. PLSM was established in 2014 and focuses on Muda River Basin management, not limited to Sg Muda Barrage operation and other infrastructures along Sungai Muda, such as irrigation pump house, sluice gates and tidal control gates. Besides that, PSLM is also in charge of water resources management for Beris Dam, which located in Sik.

The event started with a technical briefing by En. Ahmad Mustakim Bin Che Aziz. Sg. Muda barrage is the main control structure controlling the inflow and outflow of water from Sungai Muda, 180km long in the south of Kedah. The Sg. Muda barrage is part of the Sungai Muda Flood Mitigation Plan (RTB Sg Muda) components.

It was built in 2002 and completed in 2006 with an original contract value of RM150 million. Sg. Muda barrage has 14 bays, 12 meters wide and 5.25 meters high, single-leaf vertical lift gate, and 1 small boat passage (navigational gate) with 7 meters wide and 110 meters length. The navigation gate is a double leaf miter gates, with 2 penstocks for water filling and emptying system. The primary function of Sg. Muda barrage are as follow:

1. **Flood control**
2. **Reservoirs for domestic water supply and irrigation**
3. **Control of salt water during high tide**

Today, Sg. Muda barrage plays a significant role in benefiting more than 45,000 residents of Southern Kedah, especially in the districts of Kuala Muda, Baling, Kuala Ketil and Sik, including the residents of Seberang Perai Utara in Pulau Pinang.

The delegates visited the Sg Muda barrage control room after the technical briefing. Encik Adi Azfar bin Adnan, the mechanical engineer in PLSB is used to brief all delegates about the Supervisory Control & Data Acquisition (SCADA) system and water level monitoring along Sungai Muda. He also demonstrates how the Sg Muda barrage works, where the delegates came face to face with the barrage operating system. Generally, public could access the information (such as barrage gate status, water level, etc.) via the official web of Sungai Muda Flood Mitigation System.

Figure 1: Technical briefing by En. Ahmad Mustakim

The last stop was visiting the Sg Muda Barrage, where En. Ahmad Mustakim explained how the water surges into the sea when the gates are opened. Generally, the gate can either be operated in manual operation via hand wheel, full automation based on three preset modes, or remote operation from the control centre as well as through SCADA panel.

At the end of the visit, it was concluded with a token exchange ceremony. Ir Dr. Chang, vice chairman of IEM Penang Branch presented a plaque as a token of appreciation to the director of PLSM for a comprehensive and enjoyable visit. The director of PLSM also presented a souvenir to IEM Penang Branch.

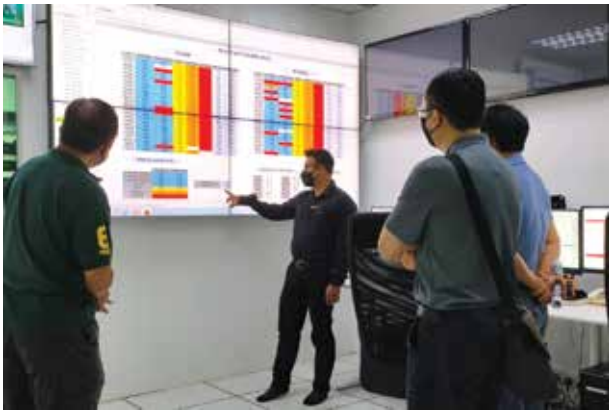


Figure 2: The Delegation being given brief by En. Adi Azfar on water level monitoring along Sungai Muda

Figure 3: The Actuator can be operated in manual operation

Figure 4: The Delegation at the Sg. Muda Barrage

Figure 5: The Delegation at PLSM

Figure 6: (left) Ir Dr. Chang, vice chairman of IEM Penang Branch presented a plaque as a token of appreciation to the director of PLSM

(right) Director of PLSM, YM Tengku Zamri Bin Raja Zainal Abidin presented a plaque to IEM Penang Branch

PROGRESS DEVELOPMENT ON: EARTHQUAKE DESIGN CONSIDERATIONS OF BUILDING STRUCTURES IN PENANG ISLAND. A COLLABORATIVE STUDY BETWEEN IEM (Pg) / USM / UiTM

PART V

Ir. Chua Beng Seong
Chair, Earthquake Engineering Sub-Committee

BACKGROUND INFORMATION

This is a continuation of a series of technical sharing on the progress development of the collaboration work between IEM (Pg) / USM/ UiTM on the above subject of study. Part IV article was published in the Issue No. 2/2022 of the INGENIUR PENANG.

As a recap, Part IV paper discussed and compared on the analysis results of Base Shear & Story Shear Distribution between the Seismic model (Gk+Qk+EQ) and Wind Load Model (Gk+Qk+WL_{100}).

In this article, the subjects of Fundamental Period (T_1) & Natural Frequency (f_1) will be discussed. A comparison on the analysis results of Fundamental Period & Natural Frequency, between the Seismic model (Gk+Qk+EQ) and Wind Load Model (Gk+Qk+WL_{100}) will also be elaborated.

2.0 FUNDAMENTAL PERIOD & NATURAL FREQUENCY

Every structure has a natural vibration frequency. When a structure is excited by external forces, it starts to vibrate. The lowest natural frequency (f) of vibration of a structure corresponds to the longest time period (T) of vibration. Mathematically, frequency (in Hertz) and time period (in seconds) are inversely proportional:

T=1/f (1.0)

Structure will have multiple natural modes of vibration where subsequent frequencies will be higher and time periods will be shorter than the fundamental period. The first mode is called Fundamental Period of Frequency (f_1) or Natural Frequency and the time period corresponding to this mode is called the Fundamental Time Period (T_1) or Natural Period.

3.0 DEGREE OF FREEDOM & MODE SHAPES

A degree of freedom is the **number of possible movements of a structural system**. The degrees of freedom can be used to describe displacements and rotations at a nodal point. Thus, each degree of freedom allows for a displacement or a rotation in a certain direction.

A planar structure (2D) has three possibilities of movement (degrees of freedom). Two displacements i.e., in the horizontal X-direction and in the vertical Z-direction as well as one rotation about the global Y-axis.

A spatial structure (3D), on the other hand, has six possibilities of movement (degrees of freedom). Three displacements and three rotations, each in the X-, Y- and Z-direction.

In a linear elastic static analysis such as **Lateral Force Method**, only one fundamental mode is being considered to compute the fundamental period (T_1) in X or Y direction, hence the base shears and horizontal shear forces in each storey in the direction X and Y are the same in either direction.

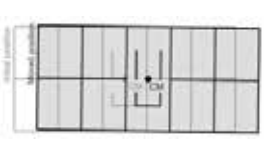
However, in a linear elastic dynamic analysis such as in a **Modal Spectrum Analysis**, three fundamental periods of vibration of the building structure are considered in each floor. They are:

Mode 1: Translational in Direction X/Y/Torsional Z axis;
Mode 2: Translational in Direction Y/X/Torsional Z axis;
Mode 3: Torsional about vertical Z axis/Direction X/Y

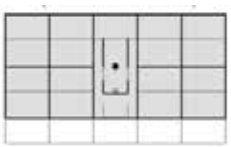
Mode 1 to 3 depends on the Modal Direction Factors. Therefore, the fundamental mode 1 can be either in direction X or Y or Torsional about Z axis. It represents the highest period of vibration, T_1.

Therefore, in a 10-storey structure as an example, there will be 30 modes (3x10) of vibration to be considered. However, in the modal response analysis, not all the modes need be taken into account. Only the first few modes would be sufficient to satisfy the requirements in EC8/EN 1998-1/4.3.3.3.1(3) which states that the sum of the effective modal masses must amounts to at least 90% of the total mass.

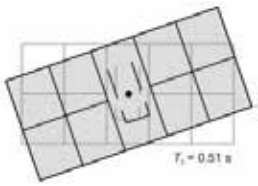
Figure 1.0 shows a typical three fundamental modes of vibration for a typical floor plan.



Typical Mode 1
Translation in Direction X



Typical Mode 2
Translation in Direction Y



Typical Mode 3 Torsional

Fig 1.0 Typical Three Fundamental Modes of Vibration

Figure 2.0 illustrates that the Modal Direction Factors (from ETABS) of mode shapes for a 10-Storey 7x3 Bays structure where:
Mode 1 = translational in X direction, T_1=1.88s;
Mode 2 = Torsional about Z axis, T_2= 1.48s;
Mode 3 = Translational in Y direction, T_3= 1.24s.

TABLE: Modal Direction Factors

Case	Mode	Period	UX	UY	UZ	RZ
		sec				
Modal-Seismic	1	1.88	0.99	0.00	-	0.01
Modal-Seismic	2	1.48	0.01	0.27	-	0.73
Modal-Seismic	3	1.24	0.00	0.74	-	0.27

Fig 2.0. Modal Direction Factors For 10-Storey 7x3 Bays

Figure 3.0 illustrates the Modal Participating Mass Ratios (from ETABS) where the first 24 modes will be sufficient to satisfy the requirements in EC8/EN 1998-1/4.3.3.3.1(3) instead of the complete 30 modes.

TABLE: Modal Participating Mass Ratios

Case	Mode	Period	SumUX	SumUY	SumRZ
		sec			
Modal-Seismic	1	1.883	0.677	0.000	0.005
Modal-Seismic	2	1.479	0.682	0.179	0.514
Modal-Seismic	3	1.244	0.682	0.666	0.697
Modal-Seismic	4	0.468	0.825	0.666	0.699
Modal-Seismic	5	0.390	0.828	0.685	0.818
Modal-Seismic	6	0.294	0.828	0.845	0.834
Modal-Seismic	7	0.204	0.879	0.845	0.836
Modal-Seismic	8	0.181	0.881	0.849	0.880
Modal-Seismic	9	0.160	0.881	0.849	0.880
Modal-Seismic	10	0.157	0.882	0.849	0.880
Modal-Seismic	11	0.133	0.882	0.895	0.884
Modal-Seismic	12	0.130	0.882	0.895	0.884
Modal-Seismic	13	0.128	0.882	0.895	0.884
Modal-Seismic	14	0.123	0.882	0.895	0.884
Modal-Seismic	15	0.122	0.891	0.895	0.884
Modal-Seismic	16	0.120	0.899	0.895	0.885
Modal-Seismic	17	0.113	0.899	0.895	0.885
Modal-Seismic	18	0.111	0.899	0.896	0.901
Modal-Seismic	19	0.106	0.904	0.896	0.905
Modal-Seismic	20	0.103	0.908	0.896	0.906
Modal-Seismic	21	0.102	0.908	0.896	0.906
Modal-Seismic	22	0.092	0.908	0.896	0.906
Modal-Seismic	23	0.091	0.908	0.896	0.906
Modal-Seismic	24	0.083	0.909	0.915	0.907
Modal-Seismic	25	0.081	0.909	0.915	0.907
Modal-Seismic	26	0.081	0.909	0.915	0.907
Modal-Seismic	27	0.080	0.912	0.915	0.916
Modal-Seismic	28	0.075	0.920	0.915	0.919
Modal-Seismic	29	0.071	0.921	0.915	0.919
Modal-Seismic	30	0.071	0.921	0.915	0.919

Fig 3.0. Modal Participating Mass Ratios For 10-Storey 7x3 Bays

4.0 THE FUNDAMENTAL PERIOD, T_1

4.1 LINEAR ELASTIC STATIC ANALYSIS

In Linear Elastic Static Analysis such as **Lateral Force Method of Analysis**, EC8/EN 1998-1/4.3.3.2.2(3) states that for building heights of up to 40m, the value of T_1 may be approximated by the following expression:

$$T_1 = C_t \cdot H^{0.75} \quad (2.0)$$

Where C_t = 0.075 for moment resistant space concrete frames.

The value of T_1 can be computed and compared (after variables of f_1 & S_i have been obtained from earlier analysis) by using an alternative expression based on method of structural dynamics i.e., Rayleigh Method:

$$T_1 = 2\pi \sqrt{\frac{\sum_{i=1}^{n}(m_i \cdot s_i^2)}{\sum_{i=1}^{n}(f_i \cdot s_i)}} \quad (3.0)$$

where,
$\mathbf{m_i}$ = storey masses;
$\mathbf{f_i}$ = horizontal forces acting on storey **I**;
$\mathbf{S_i}$ = displacements of masses caused by horizontal forces $\mathbf{f_i}$
$\mathbf{S_i}$ can be computed from the expression:
$\mathbf{S_{Dc}(T) = S_c(T) \cdot [T/2\pi]^2}$ of EC8/EN 1998-1/4.3.2.2.2(5) P.

4.2 LINEAR ELASTIC DYNAMIC ANALYSIS

In Linear Elastic Dynamic Analysis such as **Response Spectrum Analysis (RSA)**, the computation of Time Periods is much more complex.

It considers mode shapes and modal mass participation of the structure for different building frequencies. It involves Eigenvector Analysis or Ritz-vector Analysis. We shall discuss this topic in the future article.

5.0 IMPORTANCE OF TIME PERIODS & MODE SHAPES

5.1 BASE SHEAR AND DISTRIBUTION OF HORIZONTAL FORCES ALONG THE ELEVATION

It is to be emphasized that Time Periods are the main functions in the computational of Horizontal Shear Force, $\mathbf{S_i}$ and Base Shear, $\mathbf{F_b}$ due to seismic loads.

On the other hand, Fundamental Period $\mathbf{T_1}$ is required when computing the building acceleration due to static wind loads. The building acceleration on the other hand is required in determining the threshold of occupant comfort criteria under a 2-5-year return period of wind velocity.

EC8/EN 1998-1/4.3.3.2.2(1)P states that the seismic **Base Shear Force**, F_b for each horizontal direction can be determined by expression:

$$\mathbf{F_b = S_d\ (T1) \cdot m \cdot \lambda} \quad (4.0)$$

where
$\mathbf{S_d}(T_1)$ = ordinate of the design spectrum at Period $\mathbf{T_1}$ which can be computed from EC8/EN 1998-1/3.2.2.5(4)P;
m = total mass of the building;
$\boldsymbol{\lambda}$ = the correction factor; $\boldsymbol{\lambda}$= 0.85 if $T_1 \leq 2T_c$ and the building has more than 2 storeys, or $\boldsymbol{\lambda}$ = 1.0 otherwise.

When the fundamental mode shape is approximated by horizontal displacements (such as **Lateral Force Method**) increasing linearly along the height, EC8/EN 1998-1/4.3.3.2.3(3) states that the horizontal force $\mathbf{F_i}$ can be expressed as:

$$F_i = F_b \cdot \frac{z_i = m_i}{\sum z_j = m_j} \quad (5.0)$$

where
$\mathbf{z_i}$, $\mathbf{z_j}$ = heights of the masses $\mathbf{m_i}$, $\mathbf{m_j}$ above the level of application of the seismic action.

In **Modal Response Spectrum analysis (RSA)**, EC8/EN 1998-1)/4.3.3.3(3) states that the effective modal mass $\mathbf{m}_k$, corresponding to a mode **k**, is determined so that the base shear force $\mathbf{F}_{bk}$, acting in the direction of application of the seismic action, may be expressed as:

$$\mathbf{F_{bk} = S_d\,(T_k) \cdot m_k \cdot \lambda} \qquad (6.0)$$

(Note: The sum of the effective modal masses (for all modes and a given direction) is equal to the mass of the structure.)

When the fundamental mode shape is approximated by **structural dynamic**, EC8/EN 1998-1/4.3.3.2.2(P) further states that the horizontal force F_i can be expressed as:

$$F_i = F_b \cdot \frac{s_i \cdot m_i}{\sum s_j \cdot m_j} \qquad (7.0)$$

where
$\mathbf{S_i}$, $\mathbf{S_j}$ = displacements of $\mathbf{m_i}$, $\mathbf{m_i}$ in the fundamental mode shape.

6.0 COMPARISON OF FUNDAMENTAL PERIOD (T_1) & NATURAL FREQUENCY (f_1) BETWEEN WIND LOAD MODEL AND SEISMIC MODEL

Case study of Fundamental Period, T_1 and Natural Frequency, f_1 for Models of 7 x 3 Bays ranging from 10, 15, 20, 25, 30, 35 & 40 storeys are presented for comparison.

Two different sets of Modal Analysis had been carried out. They were: Wind Load Models: Figure 6.0 (Gk + Qk + WL) and Seismic Load Models: Figure 7.0 (Gk + Qk + EQ). Both sets of models had identical physical dimensions both in plans, elevations, frames and shells.

The only differences are:

a. EC8/BS EN1998-1:2004/4.3.1(7): The elastic flexural and shear stiffness properties of the concrete elements for cracked elements in Seismic Models were taken to be equal to one-half of the corresponding stiffness of the uncracked elements in Wind Load Models;

b. EC2/EN1992-1-1-2004/3.1.3(4): The Poisson's Ratios of the uncracked and cracked concretes were taken as 0.2 and 0.0 respectively;

c. EC8/BS EN1998-1:2004/4.2.4(2)P & Table 4.2: The Combination Coefficients or Mass Multiplier for **Live Load** Pattern **(Ψ Ei = $\phi \cdot \Psi$ 2i)** for Typical floors and Roofs of Seismic Models were taken as 0.24 and 0.3 respectively.

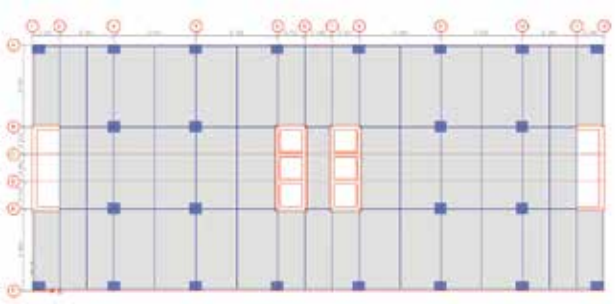


Fig 4.0. 7x3 Bays Floor Plan

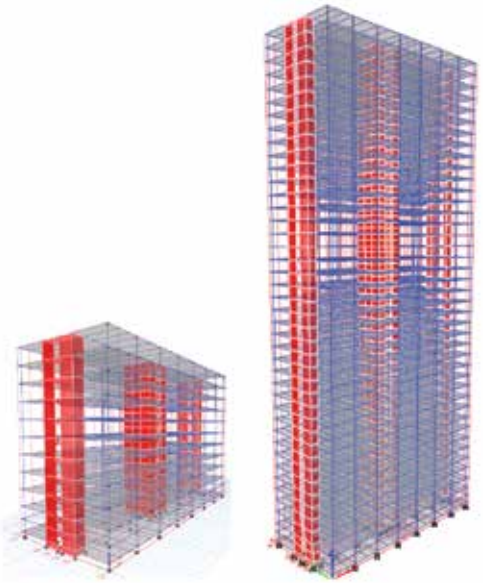


Fig 5.0. 10-Storey & 40-Storey 3D-Elevations

No of Bays	Lx x Ly = 7 x 3		Storey						
Slenderness Ratio	λ = 2.33		10	15	20	25	30	35	40
Height	H	m	43.20	63.20	83.20	103.20	123.20	143.20	163.20
Gk+Qk+WL Model									
Fundamental Period	T1	sec	1.42	2.24	3.25	4.22	5.36	6.554	7.788
Fundamental Frequency	f1	Hz	0.70	0.45	0.31	0.24	0.19	0.153	0.128

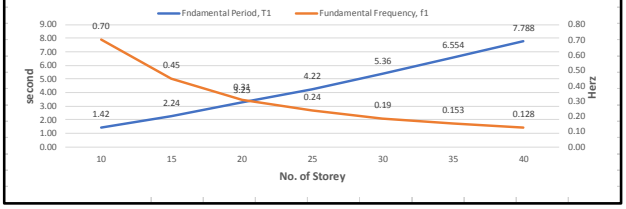


Fig 6.0. T1 & f1 for Wind Load Models (Gk + Qk + WL)

No of Bays	Lx x Ly = 7 x 3		Storey						
Slenderness Ratio	λ = 2.33		10	15	20	25	30	35	40
Height	H	m	43.20	63.20	83.20	103.20	123.20	143.20	163.20
Gk+Qk+EQ Model									
Fundamental Period	T1	sec	1.88	2.97	4.31	5.68	7.21	8.76	10.73
Fundamental Frequency	f1	Hz	0.53	0.34	0.23	0.18	0.14	0.11	0.09

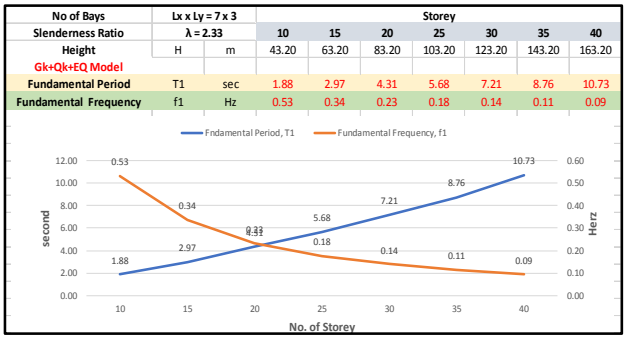


Fig 7.0. T1 & f1 for Seismic Load Models (Gk + Qk + EQ)

7.0 CONCLUDING REMARK

For both Wind Load Models & Seismic Models, the results were consistent with the general expression for free vibrations of an elastic body where Natural Period, **$Tn = 2\pi\sqrt{(m/k)}$:**

1. As the height of a building increases, its mass (m) increases but overall stiffness (k) decreases. The Fundamental Period (T_1) of a building increases when the stiffness of a building decreases;

2. Conversely, the corresponding Natural Frequency (f_1) decreases when the stiffness decreases;

3. With the increasing mass of building, Fundamental Period (T_1) increases while the Natural Frequency (f_1) decreases;

4. As the height of building increases, Fundamental Period (T_1) increases while the Natural Frequency (f_1) decreases;

5. It is to be noted that due the combined differences as stated in Section 6.0 (a, b, c) above, the Fundamental Period (T_1) for Seismic Load Models is higher by an average of 33% while the corresponding Natural Frequency (f_1) is lower by an average of 25% as compared to Wind Load Models.

8.0 PHASE 4 (2022/23 SESSION) TRAINING / TUTORIAL

To ensure consistency in the modelling, analysis and design specification, training and tutorial by IEM (Pg) to the USM and UiTM final year project students (undertaking the collaborative study) on ETABS computer modelling were being held regularly at the IEM Secretariat.

Fig 8.0. Phase 4 (2022/23 Session) Training & Tutorial in Progress

Geotechnical Engineering Seminar 2022

Date: 1st September 2022
Reported by: IEM Penang Women Engineers Sub-Committee

By: Ir. Heng Lee Sun

In the year 2022, the Penang Branch Women Engineers (WE) under the astute leadership of Ir. Catherine Sim achieved remarkable success in organising events that were of benefit to the members of IEM. Notably, in September, WE received a collaboration task with the IEM Penang Branch Geotechnical Sub-Group and local municipal councils to host the highly successful Geotechnical Seminar. This joint effort was a significant milestone that marked the culmination of the journey in 2022. The event would not have been possible without the unwavering support of our sponsors, who generously contributed as exhibitors and helped to defray costs. We extend our heartfelt appreciation to all our sponsors for their invaluable assistances in making the seminar a resounding success.

On September 1, the IEM Penang Branch organised a full day Geotechnical Engineering Seminar 2022 at Gurney Hotel, Penang. The seminar was led by the immediate past chairman, Ir. Yau Ann Nian, and supported by Women Engineers, Young Engineers, and organising committees of the Penang Branch. The objective of the seminar was to provide a platform for collaboration between municipal councils and IEM Penang Branch members, and to enhance their understanding of the authority submission requirements from the Majlis Bandaraya Pulau Pinang (MBPP) and Majlis Bandaraya Seberang Perai (MBSP). The seminar featured prominent speakers from Penang, Kuala Lumpur, and Singapore who shared their knowledge and insights on various topics and challenges in geotechnical engineering. The event received an overwhelming response, with 180 participants attended physically, which was the highest participant rate recorded for the year.

The Geotechnical Engineering Seminar 2022 served as a pivotal event that shed light on a multitude of challenges encountered by professionals and municipal councils in the field. The seminar was strategically designed to augment the technical proficiency of geotechnical engineers, while simultaneously providing a prime opportunity for the attendees to forge valuable connections with like-minded professionals who share a common interest in continuing professional development. Moreover, the seminar served as an invaluable platform that facilitated a deeper understanding of geotechnical engineering from both the design and construction industry and the statutory perspective. By bringing together experts from Penang, Kuala Lumpur, and Singapore, the seminar provided a unique opportunity for the attendees to learn from their knowledge and insights on a broad range of topics and challenges in the field.

Figure 1: Back row started from the left, number 6th to the right: WE Chairlady Ir. Catherine Sim with the speakers and working crew (women engineers and young engineers) at the front row.

Through this event, the attendees gained a comprehensive understanding of the various facets of geotechnical engineering, which will help them to overcome the challenges they face in their respective careers.Ir. Heng in her capacity as the emcee for the event, expressed her pleasure at the successful officiation of the Geotechnical Engineering Seminar 2022 by the Penang State Executive Councillor of Infrastructure and Transport, Yang Berhormat Zairil Khir Johari. The seminar was a resounding success, attracting a diverse range of locally and regionally renowned speakers with diverse areas of expertise and knowledge related to the subject matter. Among the seven industry experts who graced the seminar with their presence, two were invited from the Penang Municipal: Ir. Cheah Chin Kooi and En. Mohd Syukri, who currently serve as the acting directors for the Engineering Department. They provided valuable insights on the engineering plan submission highlights of the Majlis Bandaraya Pulau Pinang (MBPP) and Majlis Bandaraya Seberang Perai (MBSP). The remaining five speakers hailed from different states in Malaysia, and one came all the way from Singapore, adding to the richness and diversity of the seminar.

Kicking off the seminar was the esteemed Ir. Yau Ann Nian, a Fellow member of IEM, who boasts four decades of civil engineering experience in the construction industry. As the Director of WEA Engineers & Associates from Penang, he shared an enthralling presentation on the Penang Hill-site Development and Agricultural Land, covering aspects such as planning, design, stabilization, and maintenance. Following this, Ir. Dr. Lee Sieng Kai, the managing director of Glostrext Group of Companies from Kuala Lumpur, took to the stage and captivated the audience with his enlightening discussion on Wireless Network Automation (WiNA) System, Data Management & Visualization Platform for Geotechnical & Structural Health Monitoring. This topic revealed the latest technology advancements in the industry, offering a fascinating glimpse into the future of geotechnical engineering.

Dr. Leong Kam Weng, the Director of Keller Foundations (S.E. Asia) Pte Ltd from Singapore, then gave an informative presentation on Ground Improvement for Reclamation & Developments on Reclaimed Land. This presentation proved to be highly beneficial for engineers in the construction industry. Next, Ir. Dr. Goh Teik Lim, a renowned geotechnical specialist and founder of ATSUNEW GIKEN, took the stage and delivered an awe-inspiring presentation on Earth Retaining or Stabilising Structures (ERSS) Works using Advanced Steel Sheet Pile Materials and the Silent Piling Method. The innovative techniques and materials highlighted in this presentation benefitted greatly the audience. Wrapping up the seminar, Ir. Dr. Wong Fook Keong, the Managing Director of WEA Engineers & Associates from Selangor, shared a fascinating Case Study of Negative Skin Friction on piles in a Project and Evaluation of Pile Acceptance based on MLT Results. This presentation provided a unique perspective on the challenges and solutions encountered in geotechnical engineering projects.

It was a very fruitful and exciting event involving the sharing of valuable experiences and materials that we could not have obtained any other way. This event was meaningful due to the excellent feedback and support that we received from the attendees and the committees.

Program Komuniti Sihat, Inovasi dan Hijau 1.0 @ Kampung Che Aminah
Date: 2nd October 2022
Reported by: IEM Penang Women Engineers Publication

Majlis Bandaraya Seberang Perai (MBSP) together with IEM Penang Women Engineers and Universiti Teknologi Malaysia (UTM) had a meaningful Corporate Social Responsibiltiy (CSR) farming activity with the communities at Kampung Che Aminah in Nibong Tebal, SPS, on 2nd October 2022. The programme themed Komuniti Inovatif, Sihat dan Hijau was attended by 45 participants consisting of MBSP programme initiators Ms Heng Yeh Shiuan and Mr Chew Eng Seng, Ir. Ts. Dr. Mohd Fadhil Md Din and Dr. Huszalina Hussein from UTM Johor Bahru, engineers from IEM Penang Woman Engineers Section and Young Engineers Section, and communities of Kampung Che Aminah. The objective of the programme was to equip the community with a new farming technique- “Hügelkultur technique”.

How to Implement BIM in JKR’s Projects
Date: 2nd November 2022
Reported by: IEM Penang Women Engineers Publication

This one full day seminar was co-organised by Women Engineers Section and Jabatan Kerja Raya (JKR) with the aim to improve the awareness and preparation for the industry players on the implementation of BIM for JKR projects. A total of 65 engineers participated in the seminar which was held in JKR DTL Dewan Myristica on 2nd November 2022. There were 5 experienced invited speakers of the day, i.e. Ir. Ahmad Ridzuan bin Abu Bakar, Ir. Ts. Mohd Faiz bin Shapiai, Mr Muhammad Iyas bin Mahzan, Mr Razak Wong Chen Keng and Mr Bryan Ewe Teik Tsia. Some of the highlighted topics in the seminar were the integration of BIM in both structural and infrastructural works, preparation of construction drawings and how to monitor and validate the site progress using the BIM implementations.

THE INSTITUTION OF ENGINEERS, MALAYSIA (PENANG BRANCH) YOUNG ENGINEERS SECTION (YES) ANNUAL GENERAL MEETING (AGM) SESSION 2022 / 2023

Date : 04 February 2023 (Saturday)
Time : 10.30 a.m.
Venue : IEM Penang Office (E-Gate Pg)

On 4th February 2023, IEM Penang Branch organised YES Open Day 2023 in conjunction with its Annual General Meeting (AGM) for session 2022/2023.

In the morning session, all attendees broke the ice by introducing themselves to the audience. To encourage new members registering as IEM members, guidance was provided on-the-spot for new members who are interested to register as graduate members. This was then followed by a brief sharing and Q&A for Professional Interview (PI) and route to professional engineer.

Then, the Chairman of IEM - YES (PG) Session 2021/2022, Sim Kai Sheng delivered his opening speech, before the Chairman of IEM Penang Branch, Ir. Bernard Lim Kee Weng officiated the AGM virtually. Ir. Bernard congratulated YES for the successful year and has announced that the executive committee will continue to support and entrust YES for many more successes to come.

The Annual Report was then presented by Sim. The list of activities and related photo for session 2021/2022 was also presented. It has been informed that IEM-YES PG has been awarded as IEM Outstanding YES Branches 2021/2022. Subsequently, Phuah Yong Zhen, honorary treasurer for IEM YES 2021/2022 presented the Treasurer Report for the year. Both reports were confirmed without any objection.

After that, Certificates of Appreciation were presented to all Committee and Volunteers for 2021/2022 by Ir. Chan Wah Cheong (incoming Chairman of IEM Penang Branch) and Ir. Dr. Chang Chun Kiat, who represented the executive committee physically at the event.

Next, the Election of Young Engineers Section Committee for Session 2022/2023 began shortly after Sim announced the dissolution of Young Engineers Section Committee Session 2021/2022.

The new committee line-up for YES 2022/2023 are as follows:

Chairperson
1. George Lim Jing Wei

Vice Chairperson
1. Phuah Yong Zhen
2. Goh Shing Yi

Secretary
1. Tan Shih Ming

Treasurer
1. Lee Sang Yu

Ordinary Committee
1. Ong Chen Chiet
2. Lim Kent Khai
3. Richard Tang Li Zhe
4. Ong Han Bin
5. Lim Ze Qi
6. Lye Jin Hong
7. Jack Loh Yong Chiat

The AGM adjourned at 12:15p.m. after a closing remark delivered by the new Chairman of IEM – YES (PG) Session 2022/2023. The team then proceed for a lunch at Queensbay Mall, Penang.

NATSUM Kota Kinabalu

On 27th October 2022, 6 delegates from Institution of Engineers (IEM) Penang Branch, namely Ir. Lim Wei Hong, Phuah Yong Zhen, Sim Kai Sheng, Goh Shing Yi, Ong Han Bin, George Lim Jing Wei has attended IEM YES National Summit (NATSUM) 2022 in Kota Kinabalu (KK), Sabah. The team of 6 arrived at Kota Kinabalu International Airport in the early morning, where they were warmly greeted by the hosts represented by IEM Sabah. The team checked in at Toujou Hotel, KK and had a great time exploring the foods and culture around the KK town. At night, the team was greeted by delegates from all other branches and were having a great night breaking the ice through various teambuilding activities.

The next day, the team departed to University Malaysia Sabah (UMS) for the Annual Interbranch meeting, before heading to various sites for technical visits. Those included the Jesselton Twin Tower, and Nutribah Organic Farm. The team had a fulfilling buffet dinner at Nutribah before proceeding for more social activities with the other branches in the second evening.

The subsequent day was a tiring day. The team members were divided into several teams and had an entire day of challenging teambuilding games at Zip Borneo. Around 3 p.m., the team departed back to hotel for preparation, and then proceeded to Sabah International Convention Centre (SICC) for a remarkable closing dinner. At the closing dinner, IEM Penang Branch delegates received the award for the IEM YES Outstanding Branch Award in recognition of the branch's contributions for organising impactful events throughout the year.

Figure 1: Ice Breaking Session at Toujou Hotel, KK

Figure 2: The team joined various technical visits around Kota Kinabalu, which include the Jesselton Twin Tower and Nutribah Organic Farm.

Figure 3: IEM YES Penang Branch receiving the Outstanding Branch Award 2021/2022 at Sabah International Convention Centre (SICC) during the closing ceremony of NATSUM Sabah.

IEM Penang STEM Innovation Showcase (SIS) Competition 2022

As part of the IEM's vision, the STEM Innovations Showcase (SIS) was a competition hosted by IEM Penang Branch to encourage students' engagement in extra-curricular activities that tap into their creativity, ingenuity and application of Science, Technology, Engineering and Mathematics (STEM). The SIS competition is organised in conjunction with the STEM Showcase in Han Chiang High School, Penang, on 2nd and 3rd September 2022.

The SIS competition was a collaboration between IEM Penang STEM Sub-committee group and Young Engineers Section (YES).

Figure 1: All Teams set up to showcase and present their projects in their respective booths.

Figure 2: Visitors and VIP toured the booths to hear from the participants about their projects showcase.

All secondary school students were invited to participate in the contest. Months before the competition date, all registered teams submitted a project abstract to be shortlisted to the final, where they were given the "ticket" to showcase their project to the panel judges. The projects were designed based on 2 themes, namely, Engineering Innovation in Environment & Sustainability, and Engineering Innovation in Automation & Artificial Intelligence.

All teams showcased their innovations in their respective booth to all visitors. At allocated times, the teams presented for 2 rounds to the panel judges, which were experts from different industrial backgrounds.

A cash prized totalling RM4,400 was awarded to different categories of prizes as shown below. The champion of the competition was Team Communet from Chung Ling Private High School, which was also the winner for the best commercial potential.

PRIZE	PRIZE AMOUNT (RM)	TEAM NAME	SCHOOL NAME
FIRST PRIZE	1000	COMMUNET	CHUNG LING PRIVATE HIGH SCHOOL
SECOND PRIZE	800	IOT-DRAINTECTOR	CHUNG LING PRIVATE HIGH SCHOOL
THIRD PRIZE	600	MOSSKIN	HAN CHIANG HIGH SCHOOL
COMMERCIAL POTENTIAL	300	COMMUNET	CHUNG LING PRIVATE HIGH SCHOOL
AUTOMATION & AI	300	THE ROJAK CO.	HAN CHIANG HIGH SCHOOL
ENVIRONTMENTAL & SUSTAINABILITY	300	GENE-THINK	SMJK JIT SIN
AESTHETIC VALUE	300	ELITE	PENANG FREE SCHOOL
CONSOLATION 1	200	TEAM BOB	SMJK CHUNG LING PULAU PINANG
CONSOLATION 2	200	BBCAR	SMK JAWI
CONSOLATION 3	200	SYSCORE WARRIORS	SYSCORE ACADEMY
CONSOLATION 4	200	HABIT CHAIR	CHUNG LING PRIVATE HIGH SCHOOL

Figure 3: Newspaper articles showing winners of SIS competition on stage to receive awards.

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