IEM
The Institution of Engineers, Malaysia

# Jurutera

THE MONTHLY BULLETIN OF THE INSTITUTION OF ENGINEERS, MALAYSIA

JUNE 2022


## Dengue Menace in a Built Environment:

## From Cradle to Grave

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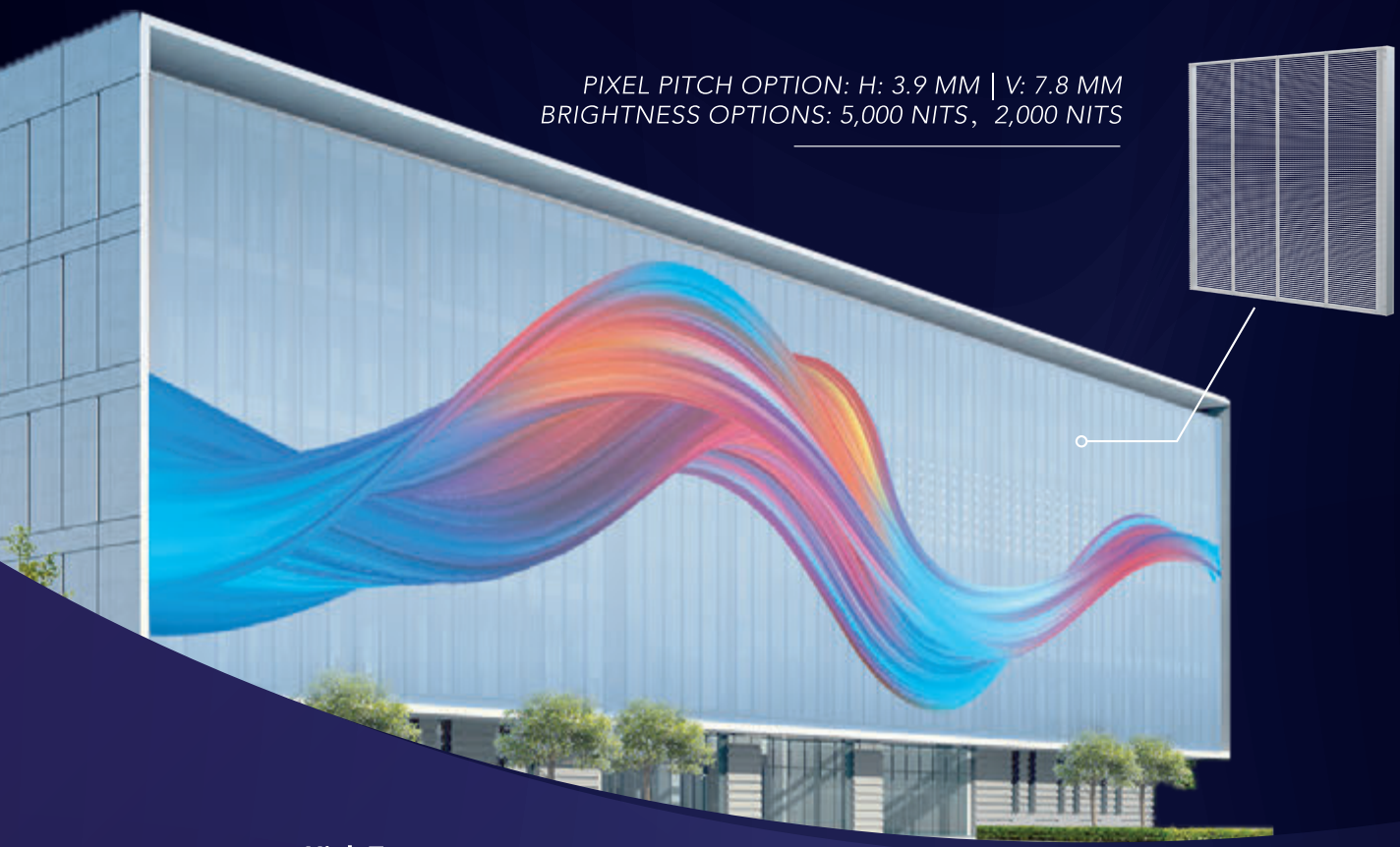

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HEAD OF MARKETING & BUSINESS DEVELOPMENT
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PRODUCTION EDITOR
TAN BEE HONG • *bee@dimensionpublishing.com*

CONTRIBUTING WRITERS
PUTRI ZANINA • *putri@dimensionpublishing.com*
HANNA SHEIKH MOKHTAR • *hanna@dimensionpublishing.com*

SENIOR GRAPHIC DESIGNER
SOFIA HANIS • *sofia@dimensionpublishing.com*

ADVERTISING CONSULTANTS
THAM CHOON KIT • *ckit@dimensionpublishing.com*

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Tel: +(603) 7493 1049 Fax: +(603) 7493 1047
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Jalan 52/4, P.O. Box 223 (Jalan Sultan),
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*by Ir. Cha Hoong Kum*
*Chairman, Building Services Technical Division (BSTD)*

# COVER NOTE

## Eliminating The Dengue Menace

Dengue is caused by a virus carried by the aedes mosquito and is the main contributor to the huge number of dengue cases is our built environment.

Every year, Malaysia records a high number of dengue cases. According to the Director General of Health, Tan Sri Dr Noor Hisham Abdullah, there were 90,365 cases in 2020 and 26,365 cases in 2021.

Past IEM President Dato' Ir. Lim Chow Hock has taken the initiative to form a task force to develop the IEM Guideline on the Prevention & Control of Dengue. Last year, Ir. Gary Lim, a committee member of the Building Services Technical Division (BSTD), conducted a series of talks titled Eliminate Aedes Mosquito Breeding Grounds In Your House.

The aim was to create awareness among engineers and the public with the hope of reducing the high rate of mosquito breeding in our built environment and, at the same time, to promote the IEM Dengue Guideline.

Proper implementation and understanding of the Guideline will result in reducing the breeding grounds for mosquitoes and this, in turn, will reduce the number of dengue cases.

Last, but not least, the Dengue Guideline will also be promoted to neighbouring South-East Asian countries at the upcoming Conference of the Asian Federation of Engineering Organisation (CAFEO). ■

# EDITOR'S NOTE

## An Old Foe, A New Principal Bulletin Editor

*by Ir. Dr Siow Chun Lim*
*Principal Bulletin Editor*

It is already mid-2022. Have you achieved 50% of your resolutions for the year?

The transition from the recent pandemic to an endemic stage seems to be going on smoothly. Most activities are almost back to normal, though we continue to wear masks in public places of course as the threat of COVID-19 is still around. Let us remain vigilant. We must also not forget our old foe, dengue.

Dengue has long been a menace, especially in a built environment. Minimising, if not eliminating such a threat is necessary due to the harm it can bring upon us. As an engineer involved in the building industry, what should I do? As a member of the public, what can I do? Fret not as in this June 2022 issue of *Jurutera*, the Building Services Technical Division has offered various solutions.

To the Standing Committee on Information & Publication, thank you for entrusting me with the role of Principal Bulletin Editor. To my esteemed predecessor, Ir. Prof. Dr Zuhaina Binti Zakaria, I assure you that your good work with *Jurutera* will be continued. Together, we will strive to create greater value for our readers. ■


# Guideline to Help Control

# Dengue Menace


**The threat of dengue originating from a built environment is real, from as early as during earth works and construction to abandoned buildings. To eliminate this menace, IEM recently developed the IEM Guideline on the Prevention & Control of Dengue which contains appropriate measures and controls for the building industry.**

Dengue is caused by a virus carried by aedes mosquitoes. According to the Director-General of Health, Tan Sri Dr Noor Hisham Abdullah, the number of dengue cases recorded every year remains high, with 90,365 cases in 2020 and 26,365 cases in 2021. Most of the cases resulted from our built environment.

IEM Past President Dato' Ir. Lim Chow Hock had taken the initiative to form a task force to develop the IEM Guideline on the Prevention & Control of Dengue. Building Services Technical Division (BSTD) Committee Member Ir. Gary Lim successfully conducted a series of talks last year, titled Eliminate Aedes Mosquito Breeding Grounds In Your House, which helped to create awareness among engineers and the public of the need to reduce the incidences of mosquito breeding in our environment while promoting the IEM's Dengue Guideline.

Through proper implementation and understanding of the Dengue Guideline, there will be a reduction in breeding grounds for the aedes mosquito, hence reducing cases of dengue in urban areas.

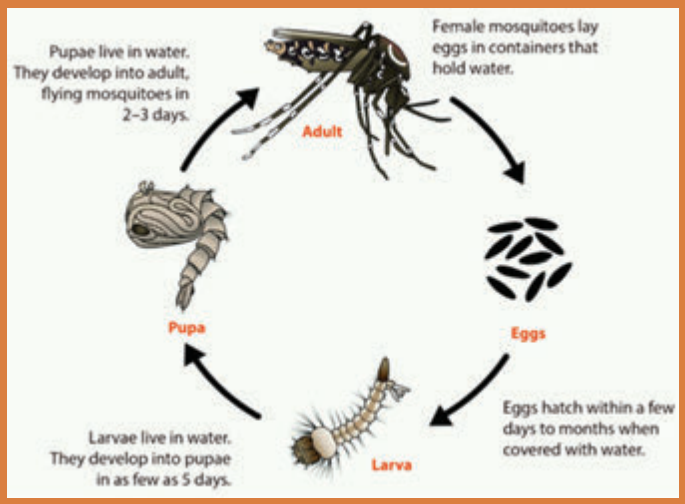
Last but not least, the Dengue Guideline will be promoted to neighbouring South-East Asian countries at the upcoming Conference of the Asian Federation of Engineering Organisation (CAFEO), country members of ASEAN Federation of Engineering Organisations (AFEO) and the Federation of Engineering Institutions of Asia and Pacific (FEIAP).

# IEM Guideline on the Prevention & Control of Dengue

**On 16 April 2022, IEM Guideline on the Prevention & Control of Dengue was approved. The task force, under the Chairmanship of Dato Ir. Lim Chow Hock, with the assistance of the Deputy, Ir. John Cheah, and the Secretary, Associate Professor Ir. Dr Hayati Abdullah took 18 months to complete the Guideline. All branches and 8 technical divisions of IEM were invited to be part of the task force. Ir. Gary Lim Eng Hwa represented BSTD.**

**To appreciate the preventive and controls measures suggested in the IEM Guideline, there is a need to understand the life stages of the aedes mosquito (see illustration and table).**

*Life stages of Aedes aegypti and Aedes albopictus (CDC, 2020)*




| Life-cycle Stages | Days | Under Normal Condition |
|---|---|---|
| Eggs to larvae | 0 | Assumed already inside the water because eggs are hardy and can last up to six months. |
| Larvae to pupa | 5 | Water remains stagnant or almost zero water velocity on the sides or insufficient incoming water to interrupt the development of the larvae to pupa. |
| Pupa to adult | 2-3 | Water remains stagnant or almost zero water velocity on the sides or insufficient incoming water to interrupt the development of the pupa to adult aedes mosquito. |

*Y.Bhg. Dato' Ir. Lim Chow Hock is an Honorary Fellow of IEM, a Fellow of the Academy of Sciences Malaysia (ASM), Professional Engineer registered with the Board of Engineers Malaysia (BEM), IEM President (2014-2016) and sits on the IEM Council as Past President. He retired from public service in 2014, after serving the Department of Irrigation & Drainage Malaysia (DID) for 36 years.*

*Ir. Gary Lim Eng Hwa is a Professional Engineer registered with BEM, a Fellow member of IEM and a committee member of BSTD since 1998. He worked in the manufacturing industries for over 20 years before joining the insurance industry as a Risk Engineer. He has since retired. He is also a trainer who conducts design courses in Plumbing & Sanitary Systems and Active Firefighting Systems at IEM.*

**Representatives of BSTD, led by its Chairman, Ir. Cha Hoon Kam, spoke to Dato' Ir. Lim Chow Hock and Ir. Gary Lim Eng Hwa, to find out more about the IEM Guideline on the Prevention & Control of Dengue.**

**Q What motivated Dato' to take on the role of task force Chairman to prepare the IEM Guideline on The Prevention & Control of Dengue?**

**Dato' Ir. Lim:** Dengue is a widespread mosquito-borne tropical disease and dengue cases in Malaysia are among the highest in the Western Pacific region. It is crucial in the fight against dengue to prevent the breeding of the aedes mosquito. As the mosquito breeds in stagnant water, engineers need to ensure that buildings and infrastructures do not create breeding grounds for the mosquito.

In this respect, engineers have an important role to play to ensure that, as far as possible, there is no stagnant water during the whole life-cycle of the buildings and engineering infrastructures. Available guidelines on the prevention and control of dengue will help to create greater awareness of our role and responsibility as engineers in combating the dengue menace. This is certainly another

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**The aedes mosquito completes its life-cycle stages after seven days in stagnant water. Understanding what constitutes stagnant water is important in efforts to take preventive and control measures to break the life-cycle stages of the aedes mosquito.**

**The cradle-to-grave of a built environment starts from earth works, construction, erection of machinery, stalled construction and testing and commissioning of equipment to operation, maintenance of the building and finally, abandonment of the building. During this period of existence, taking appropriate measures and controls is crucial in order to eliminate the dengue menace.**

***References:***

1. ***IEM Guideline on the Prevention & Control of Dengue.***
2. ***Mosquitoes and their Controls 2nd Edition.***
3. ***Effect of salinity on the behaviour of Aedes aegypti populations from the coast and plateau of south-eastern Brazil by Marylene de Brito Arduino1, Luis Filipe Mucci1, Ligia Leandro Nunes Serpa1 & Marianni de Moura Rodrigues2.***

contribution of IEM to the nation. I must congratulate BSTD for taking the lead by not only conducting 4 talks on dengue control in 2021, but also in preparing this article for the IEM Bulletin as in a way, it helps to create awareness among all our members.

The Guideline is prepared as a technical reference and planning tool for mosquito control from the engineering perspective. It takes a holistic approach in providing considerations for dengue prevention and control in all aspects of engineering works, from planning, design and construction to management, operation and the maintenance of buildings and infrastructure.

**Q According to WHO, 70% of dengue cases occur in Asia. Is this due to the species of mosquito, the weather or other factors?**

**Ir. Gary Lim:** Mosquitoes have good survival instinct and are adaptable to the environment. The book, Mosquitoes and Their Controls 2nd Edition, states: "There is hardly any aquatic habitat anywhere in the world that does not lend itself as a breeding site for mosquitoes. They colonise the temporary and permanent, highly polluted as well as clean, large and small water bodies; even the smallest accumulations such as water-filled buckets, flower vases, tyres, hoof prints and leaf axes are potential sources."

The alarming figure of 70% may be due to three major factors, namely:

- The high number of rainy days and precipitation per year. For example, Kuala Lumpur has 221 rainy days or 60.5% of the year with 2,245mm of rainfall.
- The lack of public awareness that mosquitoes breed in stagnant water.
- The people's bad habit of littering and throwing plastic bottles, metal cans and other items indiscriminately as these will turn into potential mosquito breeding grounds.

It is almost a certainty that after each rainfall, there will be stagnant water collected, particularly in heaps of discarded impervious containers and these are often unnoticed by the public. Thus, good habits should be taught in school and included in the syllabus, encompassing moral lessons on developing good hygiene habits and understanding that the life-cycle of a mosquito starts in stagnant water.

The IEM Guideline on Prevention & Control of Dengue provides a comprehensive coverage of all aquatic habitats while our focus is only on a built environment, from cradle to grave.

**Q What are the most common breeding grounds for the aedes mosquitoes and how can we prevent them breeding and ultimately stop the spread of dengue?**

**Ir. Gary Lim:** There is a need to understand the life stages of mosquitoes (please refer to the illustration) and to find ways to break any one of the stages. This involves identifying all possible stagnant water in a built environment and taking the necessary steps to eliminate the spread of dengue. Stagnant water is water with little or no movement. It includes bodies of water which have stopped flowing, such as rivers and water contained in systems within buildings. If residual stagnant water persists, the water pH or salinity must be adjusted to make it unconducive for mosquitoes to breed. In this respect, having a deeper understanding of the term stagnant water is important. "Stagnant water means motionless water, not flowing in a stream or current; it is also known as Standing Water. Water shall be deemed to be 'stagnant' if the structure, excavation, ruts or depressions are capable of holding standing water for more than four consecutive days" *(Source: https://www.lawinsider.com)*.

Immediately after the rain, pooled water in the surrounding area should not be considered stagnant water because there is a time element of four days and its existence within this timeframe is only temporary. The following key factors will determine if it is stagnant water on the fourth day after the rain when this water then becomes an ideal breeding ground for mosquitoes:

- The gradient of water conveyance such as gutters, perimeter drains, scupper drains and reinforced concrete (RC) roofs, suggests that if the situation allows

design up to 10 degrees, that can effectively eliminate stagnant water.
- Evaporation rate will depend on the amount of water and the exposure to sunlight (such as in the case of the roof gutter where the gradient is 2.5 degrees towards the downpipe), resulting in the evaporation of residual water due to the effect of direct sunlight.
- Absorption or infiltration rate will depend on the type of surface (impervious or pervious) holding the water, such as manholes and construction site pits.
- Replacement rate will depend on the frequency of incoming water such as the water seal inside water closets or consecutive heavy rainfall creating water velocity of 0.6m/s.

In a built environment, if the above factors can be controlled, resulting in no stagnant water after the fourth day, then the aedes mosquito life-cycle stages are disrupted and this effectively stopping their breeding.

For the built environment from cradle to grave, there will be situations where stagnant water is not eliminated after four days or the water is intentionally kept as stagnant water, such as in water storage tanks, then control measures can be implemented according to the types of water, namely:
- Non-potable treated water such as that used for cooling towers and firefighting systems.
- Potable treated water such as that in plumbing systems.

For non-potable water, the following ways can be implemented to make it unconducive for mosquitoes to breed:
- The pH of stagnant water should be at least 10 and above. Use of soap is a simple method that's friendly to the environment and as the water evaporates over four days, the pH will increase accordingly. [2]
- The salinity of the stagnant water should be 17%. As the water evaporates over the four days, the salinity will increase accordingly. [3]
- Fully exposed:
  - Rear fish, e.g. in unused swimming pools.
  - Use larvicide e.g. in cooling tower water basins.
  - Use a tight cover over the container to prevent mosquitoes from entering.
- Fully enclosed:
  Use netting to prevent mosquitoes from entering e.g. in firefighting water storage tanks.

For potable water, the following ways, when implemented, make it unconducive for mosquitoes to breed:
- Fully enclosed with netting to prevent mosquitoes from entering e.g. in plumbing water storage tanks.

**During construction, it is inevitable to find ponding everywhere, even after moderate rainfall. How can we prevent these ponds from becoming mosquito breeding grounds?**

**Ir. Gary Lim:** It is a fallacy that ponds of water after a moderate rain must be removed immediately. Doing so will incur unnecessary resources. I say this on the assumption that a scheduled practice of clearing all stagnant water after the fourth day, has been implemented at the construction site. After rain, all ponds at construction sites are temporary water and these must be identified and inspected after four days. If the ponds are still filled with stagnant water, then the water must be pumped out with minimum residual water which may then evaporate in the next five days. If there is consecutive rainfall over a week, the fourth day after the first rainfall will be the reference, after which all the water will be deemed as stagnant water. At the end of the fourth day, if there is residual water in the ponds, lift pits, manholes etc., then the use of soap is recommended to adjust the pH of the residual water to a reading of 10 and above. Soap is a common item that is used daily and it is also environmentally friendly. If potash alum or baking soda is used, there is a health risk such as irritation to the skin and eyes, so more precautions are required when using these chemicals.

**Does improper design contribute to the spread of dengue? How can young engineers become more aware of this when designing new buildings?**

**Ir. Gary Lim:** When designing a new building, engineers must identify the possible areas within and around the building where water can become stagnant from the 2 main sources: Rainwater and incoming/discharge of wastewater. Rainwater Harvesting System (RWHS), which is mandatory in most built environments, is an enclosed system with the gutter gradient up to 5 degrees with multiple downpipes. RWHS can eliminate mosquito breeding grounds. The systems for the incoming water and discharge of the wastewater to the external sanitary system are enclosed and when the building is occupied, it is very unlikely that these will become mosquito breeding grounds.

The surrounding drains can be either a dry drain or a wet drain. Whichever the type, the gradient of the drains should be up to 10 degrees. This will ensure that water entering the drain will either flow or dry up, hence eliminating stagnant water collecting. Dry drains will gradually accumulate sediment, which will make the surface pervious; this will indirectly help to displace any stagnant water.

**Construction sites always schedule their roads and drains as finishing works, thus creating a mess of small water puddles here and there at the sites which may allow mosquito breeding. What procedures can be enforced to improve the situation?**

**Ir. Gary Lim:** The mess as described happens after the rain when water puddles occur inside and outside the building.

This is inevitable because our country experiences rainfall of up to 3,000mm per annum with heavy rainfall during the monsoon seasons.

When this happens, there is a need to check whether the temporary water (described earlier) has turned stagnant on the fourth day. Some puddles may have stagnant water while elsewhere, the water may have evaporated or slowly infiltrated into the ground.

Stagnant water must be pumped out and, if there is residual water, provide a grace period of another four days to allow the water to evaporate or infiltrate into the ground. During the removing of the water, there is excessive disturbance to the water, so it can be considered as "fresh" water in the pit or sump.

Covered drains are another likely area where temporary water becomes stagnant due to blockage or if debris hinders the flow of water. Low evaporation rate occurs under such condition. In this respect, these drains must be inspected on the fourth day after the rain to ascertain if water has stagnated.

Another approach is to ensure that all temporary drainage and emergency spillways are constructed with a gradient that allows for free flow of water which will avoid ponding.

**Q In all construction projects, the main contractor will engage regular fogging to prevent dengue but fogging uses a lot of chemicals and this has an adverse impact on the environment in many ways. The method also chases mosquitoes away temporarily and does not solve the problem of breeding. What other methods can be enforced by the local authorities to eradicate the aedes mosquito more effectively than fogging?**

**Ir. Gary Lim:** "Male mosquitoes live only for 6-7 days on average, feeding primarily on plant nectar and do not take blood meals. Females with an adequate food supply can live up to 5 months or longer, with the average female life span being about 6 weeks." *(Source: https://www.vdci.net)*

In the hierarchy of controls, fogging should be the last resort to be implemented. It must be based on a "need-to" basis rather than on a scheduled basis because, as rightly pointed out, the chemicals will impact the environment. While it will be unwise to fog only after a confirmed dengue case, there should be feedback from the workforce at the site if they have been bitten by female mosquitoes or if they see a swarm of male mosquitoes at the site. This can help confirm the presence of mosquitoes. Fogging can eliminate adult mosquitoes.

**Q During construction, a building will progressively be shielded from rain and internal work of the various building services will commence. In such a situation, what are the likely areas where stagnant water can occur?**

**Ir. Gary Lim:** When equipment and materials stored at the site are exposed to rain, there can be stagnant water present as rainwater will flow into any impervious surface. The following are some prudent steps to take:

- Store all pipes at an incline or in a sloping position to prevent water accumulation.
- Discarded pails, skip tanks and empty chemical/paint cans must not be left in the open where rainwater can accumulate.
- Refuse bins must be properly covered.

A scheduled inspection of the area must be carried out on the fourth day after the rain to check for stagnant water.

As for building services like plumbing, sanitary, firefighting and air-conditioning systems (whichever is applicable), these are all generally enclosed systems except for certain areas like cooling tower basins. However, when reinforced concrete (RC) potable water storage is erected, there is a need to prevent mosquitoes from breeding inside once potable water has filled up the tank as in the case of hydrostatic testing. All openings into the tank must have netting installed to prevent mosquitoes from laying eggs inside. Do not add chemicals to the water as this will contaminate the potable water storage tank.

**Q During construction, it is difficult to maintain good housekeeping due to debris such as falling leaves and construction waste. What is the best way to ensure the prevention of mosquitoes breeding?**

**Ir. Gary Lim:** When housekeeping is carried out, the focus should be on areas where there is a likelihood of stagnant water present. At the site, all refuse bins must be equipped with proper covers. Disposable food containers, plastic bags and bottles must be emptied daily or at least twice a week (maximum four days) to break the life stages of mosquitoes.

In the staff quarters which are erected within a building, such as in the car park zone or the compound of the construction site, there is a need to review the incoming water supply, storage, shower/toilet facilities and discharge of the soil and wastewater. There should be no leaks which can potentially cause ponding or stagnant water.

**Q Once a project is completed, what does the building maintenance team need to do in order to mitigate mosquito breeding?**

**Ir. Gary Lim:** After a building is completed, there is a time gap before the occupants move in; it may even take years for a building to be fully occupied. The unoccupied units or

sections can turn into ideal mosquito breeding grounds, especially the water seal in floor traps which are exposed to rainwater. In this respect, it is recommended that the floor traps which are located outside the living room such as in the balcony, common corridors and parking bays, should be built without water seals. Instead, provide a direct discharge to the sanitary system or rainwater downpipes.

Where there is sump pump installed at the basement floors, the residual water inside the sump can become stagnant. Maintenance staff must carry out mitigation measures for the sumps as well as adjust the pH level of the residual water to level 10. As the water evaporates, the pH level will increase accordingly. Often, a sump with a submersible pump operates when there is rainwater entering the basement.

**Q Abandoned buildings or stalled construction are the main culprits for the rise in dengue cases. With the IEM Guideline, can local councils or relevant parties grant access to these areas to prevent the outbreak of dengue? Fogging and larviciding are just temporary measures. Is there any permanent solution apart from demolishing the abandoned building? If the land owners/building owners ignore the notification, is there any legal measure to take if it is found that the abandoned building or stalled construction is a breeding ground for mosquitoes?**

**Ir. Gary Lim:** When buildings are abandoned or construction work stalled, efforts must be made at the outset to identify the areas with ponding and stagnant water in case of rain. Once these areas are identified, preventive and control measures can be applied accordingly. Where there is ponding, which is inevitable, fish can be reared in the pond and the water level must be maintained at all times. All water seals in sanitary fittings must be removed. Downpipes along the gutters must have wire mesh mounted over them to ensure there is no blockage of the downpipe and that rainwater still flows by the force of gravity. Any residual water should evaporate when exposed to direct sunlight.

The local authority must instruct the owner of the abandoned building to check for stagnant water on the fourth day after rain, and there must be a record kept of all the identified areas of stagnant water, with control measures put in place.

**Q Dato' Lim, after developing the Dengue Guideline, what measures are being taken to ensure it is promoted effectively to society and that it is being implemented and adopted significantly?**

**Dato' Ir. Lim:** The IEM Guideline is intended to assist engineers, consultants, developers, construction site operators, site inspectors, local authorities, academicians, government agencies, and other interested parties related to engineering in ensuring buildings and infrastructure will not be turned into breeding grounds for mosquitoes.

The following measures have been planned:

1. A copy of the Guideline will be distributed to all relevant agencies, local authorities, professional associations, non-governmental organisations, civil society organisations and institutions of higher education.
2. IEM will organise a series of public webinars.
3. IEM will arrange a press conference to explain the Guideline.
4. IEM Branches will conduct public outreach and awareness programmes at community levels. ■


*Left to Right: Ir. Leong Hon Wah, Ir. Yap Chee Hong, Ir. Gary Lim Eng Hwa, Ir. Cha Hoong Kum, Ir. Tan Chew*

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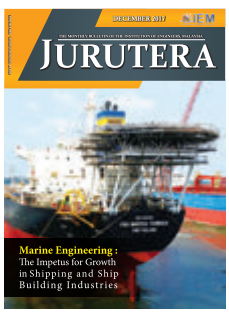





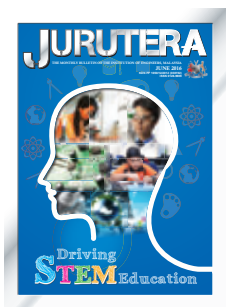


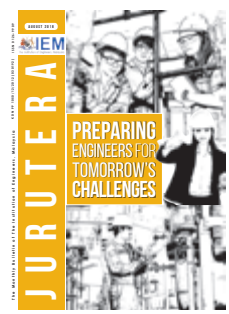


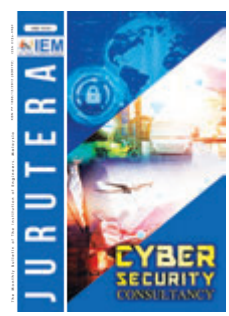


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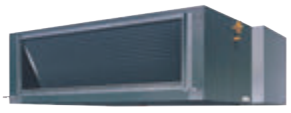

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# Indoor Environmental Quality Building Ventilation

**Written and Prepared by:**

**Ir. Yong Gee Suan**

*Head of Product Development at Daikin R&D Malaysia and Committee Member of IEM Building Services Technical Division (BSTD).*


*Figure 1: Covid-19 situation in the world (Source: World Health Organisation)*

As of 6 May 2022, the World Health Organisation (WHO) had received reports of 513,955,910 confirmed cases of Covid-19, with 6,249,700 fatalities. Figure 1 shows the Covid-19 situation in the world.

The disease is caused by the SARS-CoV-2 virus, which is transmitted among humans in various ways but primarily through the airborne dispersion of aerosols from an infected person. This is due to the aerosols being able to remain airborne for a period of time and to travel beyond a conversational distance of 1-2m. The concentration of the virus can become progressively higher in poorly ventilated indoor environments.

## Fresh & Pure Air Solution

**Fresh Air:** Fresh air refers to the drawing of clean air indoors from outdoors to dilute and displace indoor air pollutants while pure air refers to the cleaning of the air via filtration units. In an enclosed room or workplace, air cannot easily exit or exchange with outside air. Thus, air pollutants will remain or increase in the room. By introducing "treated" fresh air into the room, it is expected that dilution and displacement of such air pollutants will take place.

The idea is to introduce a large amount of fresh air into the enclosed room. However, several considerations need to be taken care of. Is the outside air clean enough to be drawn in? Do we need any filtration for this fresh air? Will the indoor temperature then become uncomfortable as outside air can reach temperatures of 33-35°C? If it is an existing building, can the current ventilation system (duct size and fan motor external static pressure, ESP) support the increase in air flow rate?

A good way to treat fresh air is to include a filtration unit capable of filtering particulate matter (PM) 2.5. PM2.5 has a diameter of 2.5 micrometres or less (100 times smaller than human hair) and is able to travel into our respiratory system, penetrate lungs and enter our blood stream, which may then cause serious health issues.

On the other hand, fresh air should be pre-cooled to a comfortable temperature before it is introduced into a room to avoid high heat load being created as this may cause more problems than offer solutions.

**Pure Air:** Purifying the recirculated indoor air is equally important, especially where introducing large amounts of treated fresh air is not practical. An easier approach is to

use an air purifier unit with a good filter and mechanism to decompose harmful bacteria. It must be noted that while an air purifier unit can improve certain indoor air quality (IAQ) parameter, it cannot reduce $CO_2$ concentration in the room.

In some applications, we can combine air purification and the drawing in of fresh air. Various air purifier models are available but it is recommended to use one with an electrostatic HEPA filter which requires less maintenance and is long lasting (some manufacturers have claimed lifespans of up to 10 years when evaluated with JEMA standard).

Electrostatic HEPA filters use electrostatic charge to increase its ability to capture certain particles while non-electrostatic HEPA filters use fine mesh material to capture particles. Non-electrostatic HEPA filters provide consistent filtration efficiency if the filters are replaced regularly as per manufacturer recommendation (e.g. within 6-12 months). In contrast, electrostatic HEPA filters have the advantage of never needing to replace filters within its lifespan (e.g. 10 years). Figure 2 shows the differences between electrostatic and non-electrostatic filter.

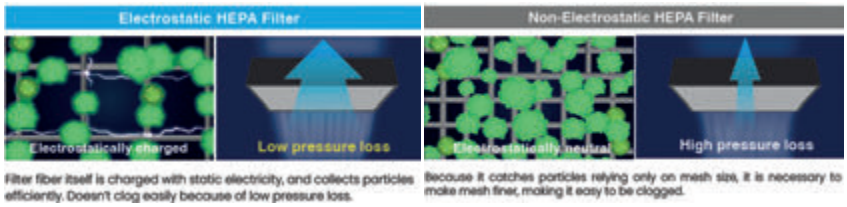



*Figure 2: Differences between electrostatic and non-electrostatic filter (Source: Daikin.com)*

An air purifier unit with plasma discharge mechanism to decompose harmful bacteria trapped in filters is also very much recommended. A plasma discharge emits high-speed electrons to collide and fuse with nitrogen and oxygen molecules in the air to form 4 decomposing elements, namely OH radical, Oxygen radical, Excited Oxygen and Excited Nitrogen. These can break down and decompose harmful substances caught in the filter. Figure 3 shows the mechanism of decomposition.

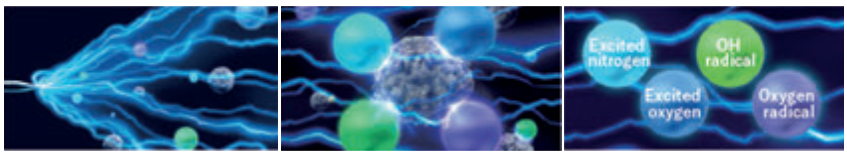



*Figure 3: Mechanism of decomposition (Source: Daikin.com)*

**Indoor Air Quality (IAQ) & Ventilation for Non-Residential Premises:** SARS-CoV-2 virus particles spread more easily indoors than outdoors because the concentration of viral particles indoors is high due to poor air ventilation. As a result, it is critical to improve indoor air ventilation to reduce virus concentration.

It is essential to improve indoor ventilation for non-residential settings because these include workplaces where employees spend most of their working day, along with their clients. Schools, universities, religious and commercial spaces are also examples of non-residential premises.

According to Guidance Notes from the Department of Occupational Safety & Health (DOSH), Ministry of Human Resources, on ventilation and IAQ for non-residential settings during the Covid-19 pandemic, there are a few engineering controls that can be implemented, such as increasing the outside air ventilation to a higher level, increasing air filtration and removing

the aerosol particles. It has also been suggested to upgrade the HVAC filters rating to MERV 13, or above and placing portable air purifiers in areas which are hard to ventilate with outside air.

**Classrooms:** According to an article by Mariano Zafra and Javier Salas, there is a high risk of the Covid virus spreading in enclosed indoor spaces but this can be reduced by several countermeasures. Below is an overview of how Covid infection can happen in a classroom, based on three scenarios: Length of exposure, use of face masks and ventilation.

Zafra and Salas wrote that the pattern of infection via aerosols in a classroom was different as it depended on whether the infected person was a student or a teacher. As teachers spoke more often and louder, the dispersion of contagious aerosols into the air space was increased as compared to an infected student. Figure 4 shows an initial setting where the classroom is enclosed without ventilation with 1 infected teacher and 24 non-infected students. Figure 5 shows that after two hours (without safety measures such as face masks), the risk of infection spreading is high and as many as 12 students may be infected. On the other hand, if everyone wears a face mask, the number of infected students will drop to five (Figure 6).

In a real outbreak, all students can be infected regardless of their proximity to the teacher as the aerosols in the air are spread randomly in the room. Lastly, Figure 7 shows a room well ventilated either by natural or mechanical means and the class is halted after every hour to allow total displacement of the inside air with outside air. The risk drops significantly under such a situation. (Mariano Zafra and Javier Salas, 2020).

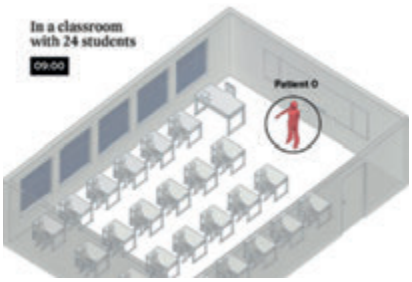



*Figure 4: An enclosed classroom without ventilation with 1 infected teacher and 24 non-infected students (Source: Elpais.com)*

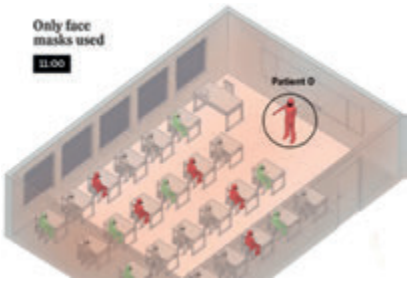



*Figure 6: If everyone wears a face mask, the number of infected students will drop to 5*

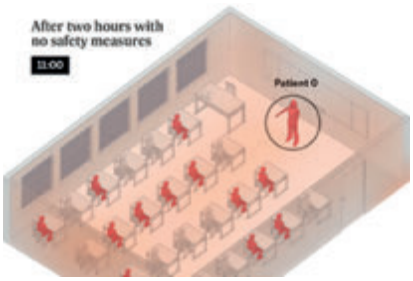



*Figure 5: After two hours of lecture without applying safety measures such as face masks, the risk is high and 12 students may become infected*

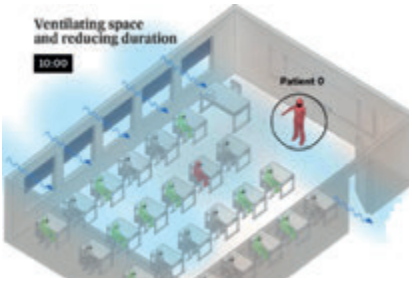
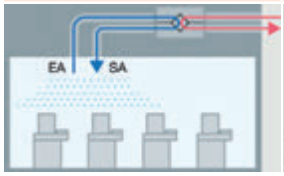
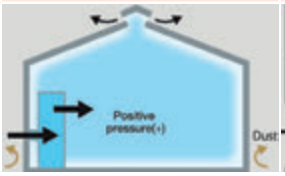
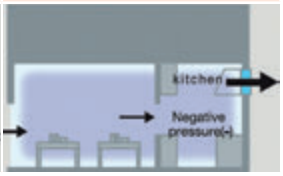



*Figure 7: The risk is significantly reduced if the room is well ventilated (Source: Elpais.com)*

## Ventilation

The supply of fresh air can be classified into Class 1, 2 and 3 ventilation, as illustrated in the Table 1 below.

*Table 1: Types of ventilation*

| Class 1 Ventilation | Class 2 Ventilation | Class 3 Ventilation |
|---|---|---|
| Both supply air and exhaust air are controlled by mechanical ventilation in order to achieve stable ventilation when required. | System that uses mechanical ventilation for supply air and natural ventilation for exhaust air. | System that uses natural ventilation for supply air and mechanical ventilation for exhaust air. |
| Suitable for most areas which apply balanced room pressure such as offices, schools and residential.<br><br>Example Energy Recovery Ventilator/ Heat Reclaim Ventilator. | Used for specified purpose: Positive pressured room such as hospital/factory clean rooms. | Used in areas with high odour generation such as kitchens, toilets or isolation rooms. |
|  |  |  |

There are 3 major issues with natural or normal mechanical ventilation systems (Class 2 and Class 3).

1. Ventilation is not consistent, i.e. it is subjected to wind weather.
2. Hot and polluted air flows into a room via the window or other openings.
3. Hot air increases the air conditioning load tremendously.

Class 1 Ventilation is ideal where the fresh air enters a room in a "controlled manner". The ventilation or air volume rate is consistent as per user setting, while polluted air is filtered by optional PM2.5 filters, and energy loss of air conditioner is reduced with a heat recovery element.

**Energy Recovery Ventilator/Heat Reclaim Ventilator:** An Energy Recovery Ventilator/Heat Reclaim Ventilator (ERV/HRV) recovers energy lost through ventilation and regulates changes in room temperature caused by ventilation, thus keeping a comfortable and clean indoor space.

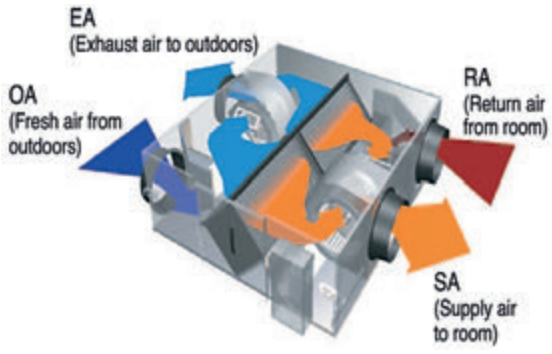



*Figure 8: ERV/HRV utilises two blowers to ventilate both fresh air supply and exhaust air independently (Source: Daikin.com)*

**How it works:** ERV/HRV utilises two blowers (one for supply air and one for exhaust air) which work independently (Figure 8). When both blowers are operating, fresh air from outdoor ambient at 32°CDB 70% RH is pre-cooled

to 27.4°CDB 63% RH by return air from room at 26°CDB 50% RH. The heat exchange element comes with high efficiency paper media which is superior in moisture-absorption properties and is capable of recovering both sensible and latent heat (Figure 9).

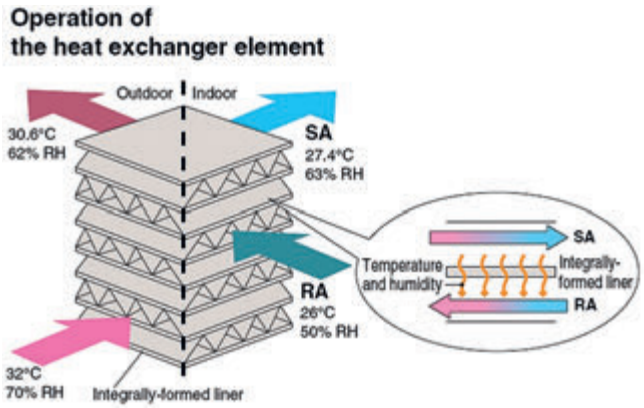



*Figure 9: Operation of the Paper Heat Exchanger Element (Source: Daikin.com)*

**Performance on $CO_2$ and PM2.5:** Figure 10 shows the experiment setup to compare the performance of $CO_2$ and PM2.5 under three conditions – ERV/HRV, natural and mechanical ventilations.

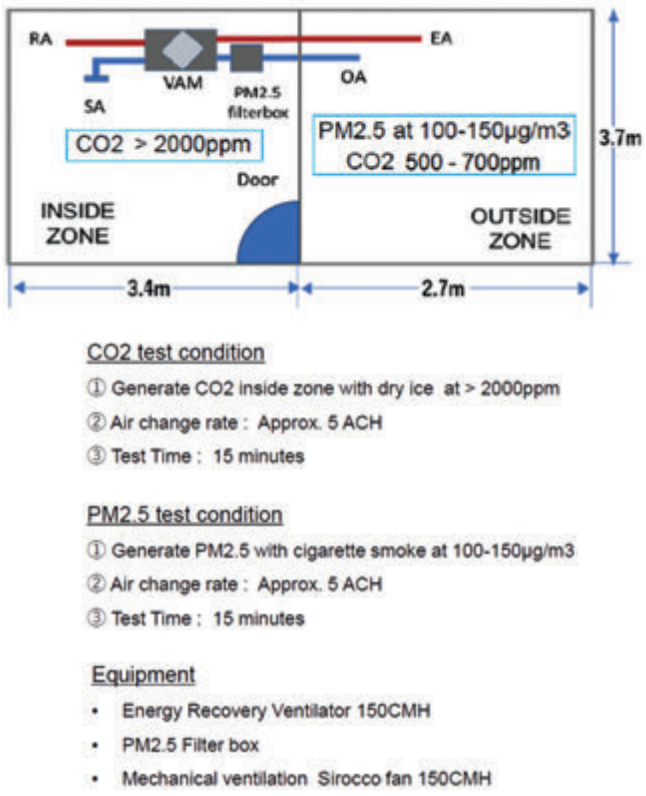



*Figure 10: Experiment Setup for CO2 and PM2.5 Performance Testing (Source: Daikin.com)*

As a result, all conditions (ERV/HRV, natural ventilation and mechanical ventilation) are able to reduce $CO_2$ effectively under these testing conditions. Refer to Figure 11 for details.

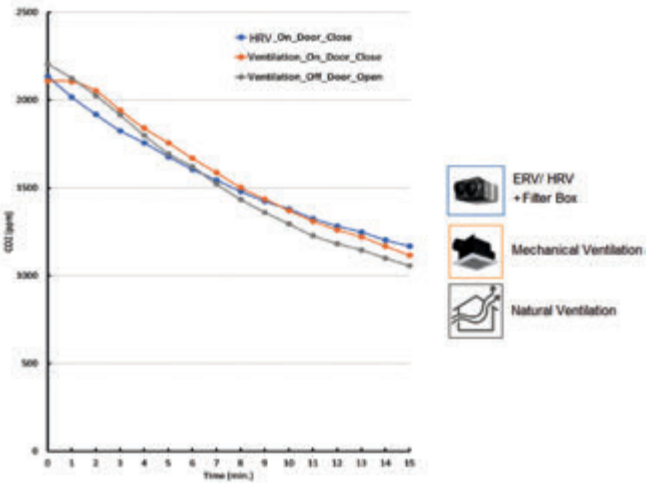



*Figure 11: Test result for the $CO_2$ concentration under 3 conditions (Source: Daikin.com)*

As for the testing results for PM2.5, the ERV/HRV with PM2.5 filter box shows the best performance (<10 µg/m³) while natural ventilation and mechanical ventilation have significantly higher PM2.5 value. Refer to Figure 12 for details.

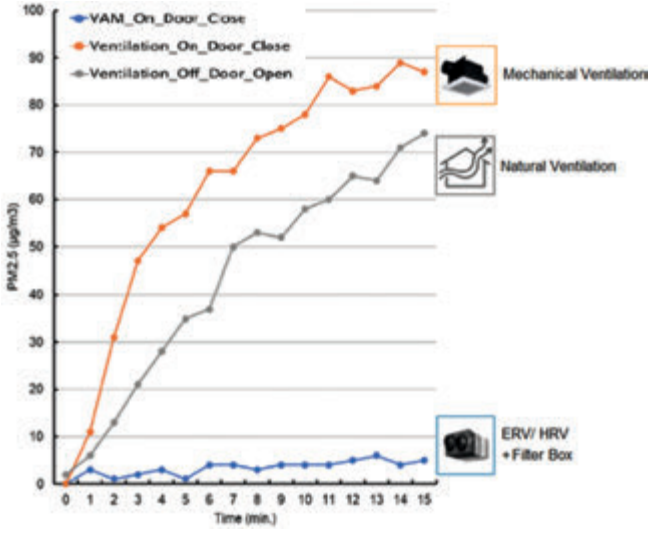



*Figure 12: Test result for PM2.5 under 3 conditions (Source: Daikin.com)*

From these experiments, using ERV/HRV is shown to effectively keep indoor air clean by reducing PM2.5 and $CO_2$ concentration, suggesting lower risks of virus transmission via aerosol particles.

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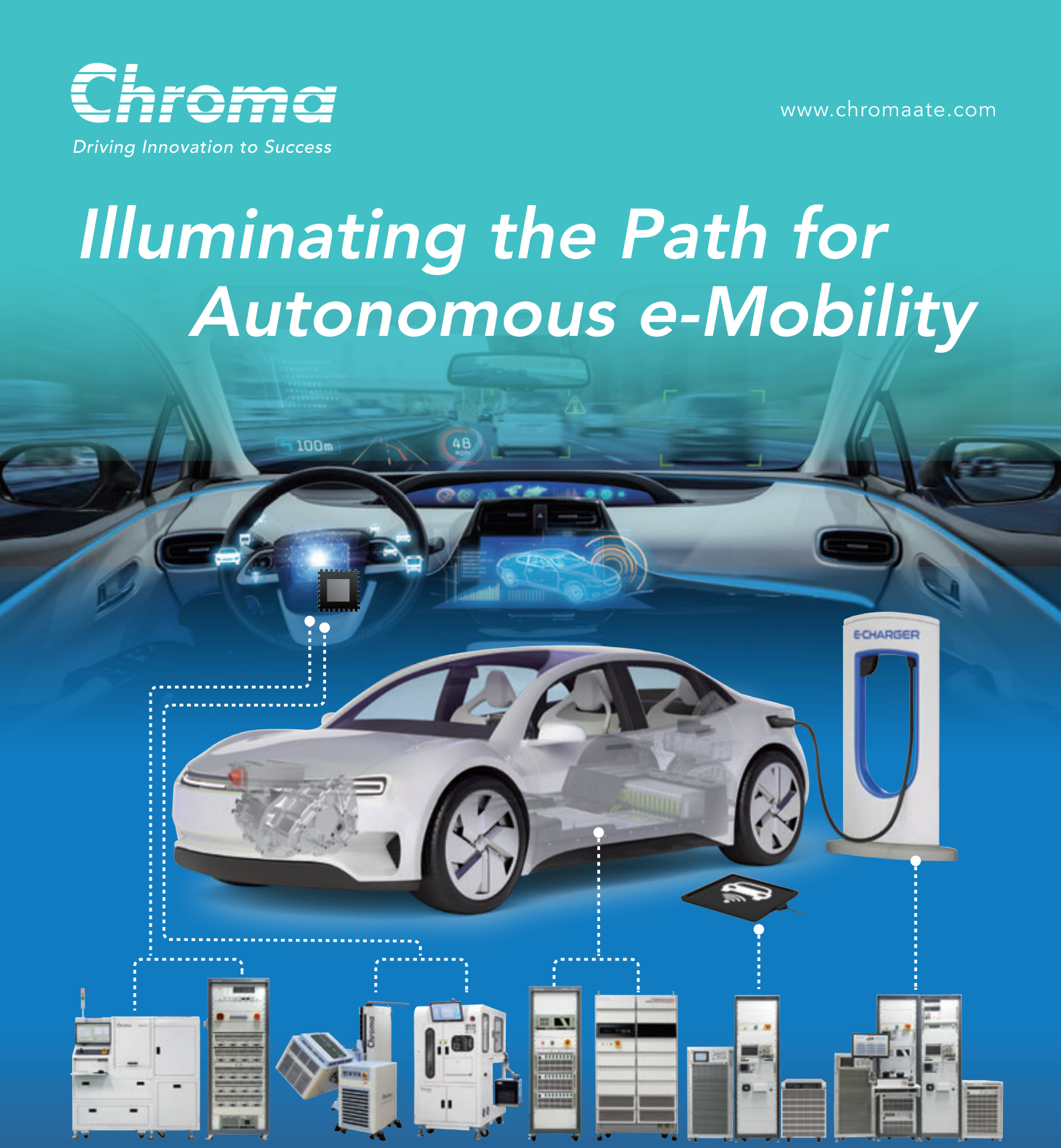


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**Streamer Duct Chamber:** Streamer Duct Chamber (SDC) is a complete air purification system that recirculates and cleans air in a controlled environment. It combines pre-filter, streamer, dust collection filter (MERV14 grade) and deodorising filter to remove airborne particles, gaseous contaminants, viruses, bacteria, fungus and mould to provide total clean air solution. As one of the solutions for preventing the spread of viruses, SDC can be used with ducted unit or heat recovery unit.

**How it works:** SDC consists of pre-filter, streamer, dust collection filter (MERV14 grade), deodorising filter and differential pressure sensor. Mould, bacteria and viruses captured by the dust collection filter (MERV14 grade) are decomposed by the streamer to clean the air. The SDC is controlled by the differential pressure sensor to enable connection with any ducted type indoor unit within the specified airflow range. For use with air conditioning units, it must be installed before the air conditioner unit. With ventilators, it can be installed before or after the unit. Figure 13 shows streamer duct chamber major component.

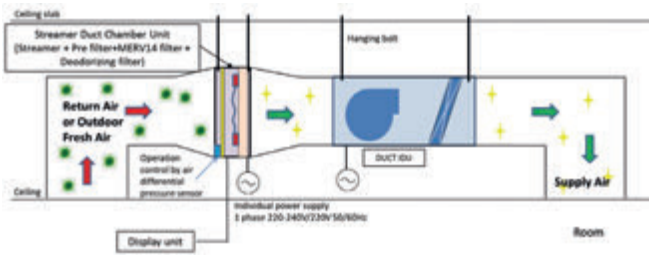


*Figure 13: Streamer Duct Chamber major component (Source: Daikin.com)*

**Airborne Bacteria Removal Performance:** An airborne bacteria removal performance test was conducted at the Tropical Infectious Disease Research Centre (TIDREC), Universiti Malaya (Test Number:TS4-0390). Airborne removal of bactericidal activity by the SDC and ERV unit installed in the testing chamber was based on JEM1467 (Appendix D) testing method. This was conducted in a room with volume of 24.0m³. It was shown that the SDC was able to remove more than 99.9% of airborne bacteria after 30 minutes of operation. Refer to Figure 14 for details.

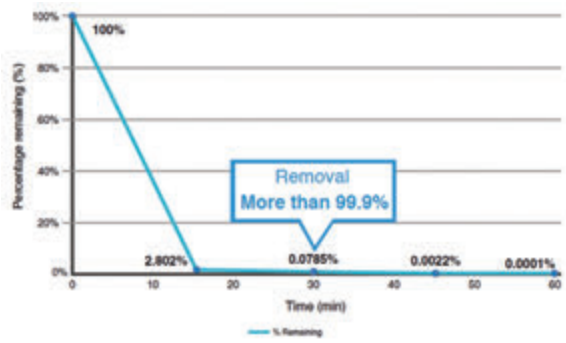


*Figure 14: Test result on Airborne Bacteria Removal Performance (Source: Daikin.com)*

**Bacteria Decomposition Performance:** A bacteria decomposition performance test was also conducted at TIDREC (Test Number:TS4-0390). The testing of the SDC unit coupled with ERV was based on JEM 1467 (Appendix F) standard, conducted in a room with volume of 31.2m³. The results show that the SDC was able to inactivate bacteria by 99.99% on the dust collection filter (MERV14) after an exposure of 4 hours. See Figure 15 for details.

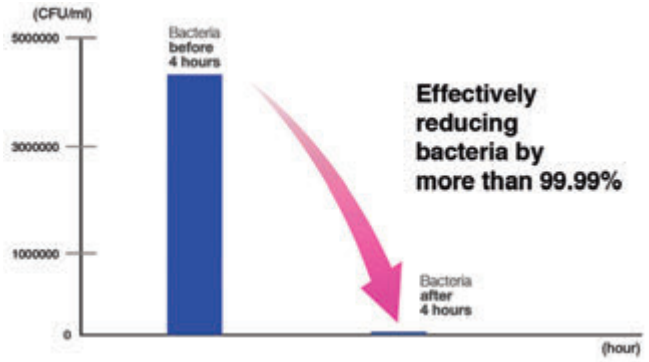


*Figure 15: Test result on Bacteria Decomposition Performance (Source: Daikin.com)*

## Conclusion

SARS-CoV-2 viral particles spread more easily indoors than outdoors when there is little or no air flow to blow away the particles and to lower the virus concentration in the air. As a result, it is critical to ensure that ventilation methods are capable of assisting in the reduction of virus concentration in the premise.

Class 1 Ventilation is ideal where fresh air enters the room is in a "controlled manner". The ventilation or air volume flow rate is consistent as per user setting, where polluted air is filtered by the PM2.5 filter, and energy loss of air conditioner is reduced with a heat recovery heat exchanger. SDC is also an option to complete the air purification system to recirculate and clean the air in a controlled environment. ■

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# Challenges of Medical Gas Systems during COVID-19 Pandemic: A Silent Battle

**Written and Prepared by:**

**Ir. Al-Khairi Mohd Daud**

*BSTD Committee member Ir. Al Khairi Mohd Daud is Chief Consultant of Faqeh Management, specialising in healthcare facilities management, medical gas system and energy management system.*

In 2020, the world was struck by the Coronavirus (COVID-19) pandemic. In Malaysia, the latest statistics showed that more than 4.2 million people had been infected and the death toll was over 35,000 (Figure 1). COVID-19 is an infectious disease caused by the SARS-CoV-2 virus. Most people who are infected will experience mild to moderate respiratory difficulties but they usually recover without the need for any special treatment. However, some do become seriously ill and require medical attention.

The virus infects the respiratory system. Patients may require oxygen support to breath or need to be ventilated using a life support machine. When there was an influx of patients requiring breathing support, many hospitals were overwhelmed by the need to ensure that there were proper facilities (isolation rooms, available wards and most importantly, an adequate supply of oxygen and medical air) for the warded patients.

Hospitals were forced to create makeshift ICUs and COVID-19 wards. A shortage of ventilators and oxygen was common. Faced with a surge of patients, hospitals were unable to meet the demand for medical gas which was stretched to beyond their capabilities, especially during the Third Wave (dominated by the Delta variant). The sudden flood of infected patients also did not allow for much planning or reaction time.


*Figure1: Statistics from Google trending on Malaysia's Covid-19 cases, showing the waves of cases*

Just like in hospitals, the medical gas suppliers too were not prepared for the sudden increase in demand.

## Challenges for Medical Gas Systems

Medical gas systems are critical to the efficacy of surgical teams, life support, comfort and the well-being of the patients. The Medical Device Authority (MDA) has classified medical gas system as medical device regulated under Medical Device Act 2012. MDA has enacted MS2675:1 2017 Medical Gas System Code of Practice for the design, installation, validation, and verification as the standard for installation and operation of medical gas in the country. The standard governs medical gas design and construction to comply with the safety measures, redundancies, system monitoring and materials. It also spells out the requirements of competent personnel and the training required to operate and maintain the system.

Though the design standard requires for redundancies in oxygen supply, the COVID-19 pandemic pushed many installations to their limits and often overwhelmed the capability. In design, the terminal units are designed with diversified flow of 10 l/min whereas in critical areas, the design flow is 100 l/min. When a hospital was dedicated as a COVID hospital, only patients requiring breathing supports were admitted. Overnight critical units were developed to support the needs. However, the medical gas piping systems were not able to cater to such a surge in capacity demand, thus overwhelming the system.

Before COVID-19, a pandemic was a rarity. No hospitals were designed and equipped with the capacity adequate to supply medical gas to all beds and this included the designated centre of disease hospital. With medical gas in short supply and health systems overwhelmed as new cases were being admitted continuously, healthcare workers had to resort to whatever means necessary to save lives.

Medical gas was found to be seriously lacking as all COVID-19 patients required breathing support or ventilation. When oxygen became scarce, caregivers often resorted to using any solution available to them, even if this was not the most appropriate. Ventilators were used in normal wards while ventilator sharing on a single gas outlet or placing multiple patients on a single ventilator and other risks were common. Extreme actions like these often placed equally extreme demands on medical gas systems. It was reported that some hospitals had to replace the gas cylinders every hour and that the line pressure dropped to nearly one bar instead of the 4.2 bar standard pressure requirements. The standard reserved capacity of 48 hours could not be met. Typical condition of oxygen gas manifold in hospital is shown in Figure 2.

*Figure 2: Oxygen cylinders and manifold*

*Figure 3: New VIE tank installation during the pandemic*


*Figure 4: Newly installed Field Hybrid Intensive Care Unit (ICU)*

*Figure 5: Bed head panela with medical gas terminal units in the field hybrid ICU*

While doctors were doing their best to save the patients, hospital engineers were fighting against time to improve the capacity of medical gas supply to support the patients' lives. As the number of patients increased during the Third Wave, plans were made for hospitals in every state to be dedicated to COVID-19 patients. Emergency oxygen manifold systems were prepared. Later, new VIE tanks (Figure 3) were installed in these hospitals to support the existing installations. Field hybrid ICU units (Figure 4) were built at the dedicated hospitals to support the overloaded ICUs. The medical gas at the bed head panels (Figure 5) in the hybrid ICU are being supplied from a separate gas manifold to cater for the continuous needs of the ventilated patients.

## Lessons Learnt

In April 2022, the Health Ministry declared that the country was in transition to the endemic phase. But we are not out of the woods yet. A new strain variant or another virus may hit the country anytime. We have to be prepared for when this happens.

So, what have we learnt so far in the management of medical gas system during a pandemic?

1. **Disaster Management Preparedness:** The Malaysian Society for Quality in Healthcare Standards (MSQH) specifies requirements that a hospital needs to be prepared for internal and external disaster scenarios. A biological outbreak potential is clearly stated. However, the COVID-19 pandemic had affected hospitals in many ways as, apart from the overwhelming admission rate of patients, caregivers were also infected by the virus, resulting in many healthcare services closing down as the staff had to be quarantined too. The unprecedented turn of events caught the hospitals off-guard. As patients needed support to breathe, ventilators were sought to solve the shortage. Medical gas systems too exceeded the capacity to supply to the needs of hospitals throughout the country; it was a major challenge. Hospital engineers and Authorised Engineers for Medical Gas Piping System (AE-MGPS) had to respond quickly and urgently.

At the peak of the pandemic, COVID-19 patients were being treated in spaces not designed for the purpose. An image of an overcrowded emergency department with patients not getting oxygen to support their breathing once went viral on social media.

It is important for hospitals to establish a pandemic response plan where patients will be sent to the right treatment areas supplied with adequate medical gas outlets facilities as well as the need for proper isolation and ventilation

requirements. A comprehensive plan for disaster management to deal with the next outbreak must be instituted so that hospitals are able to cope with the need of the utilities supply, including medical gas requirements.

Pandemic response planning needs to be an integrative and collaborative process. Input from a variety of experts is needed to craft and execute these plans. Pulmonologists, infection control specialists, nurses as well as front-liners, caregivers, hospital administrators, building facility managers, medical equipment manufacturers and building design professionals should all be included in the planning process. AE-MGPS must be part of the response team to ensure that the medical gas systems are integrated into response plans.

2. **Design Standards:** Prior to the introduction of MS2675-1, 2017, the design and installation of medical gas were done mainly by medical gas vendors/ contractors. The main reference standards were the British Health Technical Memorandum – HTM2022 and HTM 02-01. There are a few hospitals being built using other standards such as the American or the Japanese standards. The different design standards pose a difficulty for AE-MGPS to find ways to create additional capacity into existing systems.

None of these standards prepare the medical gas system design for pandemic/respiratory conditions. In addition, during an emergency, various types of ventilators are used. These ventilators have a wide range of gas consumption, depending on the type that introduces a high level of variability in system sizing. For example, standard invasive types use around 12 litres per minute while non-invasive high flow types (CPAP) use up to 75 litres per minutes.

It is important that the experience gained from the pandemic be put into the revision of the MS2675-1 standard in preparing for the next outbreak, which should include equipment manufacturer operating requirements that eliminate design uncertainties.

3. **Installation:** For new installations, the AE-MGPS and hospital owners must conduct risk assessment of the need for adequately sized MG pipes in case of a pandemic to avoid costlier renovation work later. There must be a strategy where wards can be dedicated to highly infectious patients and isolation rooms can be converted into ICUs so that the medical gas infrastructure can be appropriately sized to meet demands. Pandemic-ready facilities had never been considered in hospital development so far.

When an outbreak occurs, wards can be easily converted into infectious disease wards with medical gas piping sized appropriately to accommodate the surge in gas consumption requirements. It is easier to size pipes for medical air plants. The piping can be sized to accommodate normal demands but outfitted with the ability to quickly add additional compressors during peak demand.

On the other hand, oxygen supply may be more difficult to be supported as the oxygen manifolds or VIE tanks cannot be expanded quickly. Over time, liquid oxygen in these tanks evaporate if not used and when over pressured, the oxygen gas will be discharged through safety valves. Therefore, it is more cost effective to design for expansion or addition of source equipment, such as creating a connection point for an emergency oxygen supply, such as a high-pressure cylinder manifold, to allow for additional connection.

4. **Operation & Maintenance:** The MS2675:2 2017 Medical Gas System Code of Practice for Operation & Maintenance clearly states that all drawings, maintenance and retrofit work of an MG system must be kept throughout the life-cycle of the MGPS. However, in many instances, As Built Drawings are not available and the routing of the piping cannot be ascertained; this is common in the older buildings.

Without updated drawings and design capacity, the Authorised Person (AP-MGPS) and the Competent Person (CP-MGPS) will not be able to ascertain the actual system capacity. In many cases the ability to isolate the system is not possible when there are no isolation valves located at the entrance of the unit services. The plant rooms too can be small, are not located appropriately for easy access or allow space for additional equipment.

Thus it is important that an AE-MGPS be engaged to verify and audit the system installation in health care facilities so that any need for changes to meet a surge in medical gas requirements, can be speedily met.

## Conclusion

Hospital engineers at the Ministry of Health have been grossly occupied to meet the healthcare facility requirements during the pandemic. They are the unsung heroes, quietly supporting doctors and nurses to save seriously ill patients by providing and retrofitting existing medical gas facilities and life support equipment within the available resources. It is a race against time.

As we enter the endemic phase and the number of COVID-19 cases becomes manageable, it's time for the National Disaster Management Committee to initiate an investigation team to capture the lessons learnt during the pandemic and to prepare a strategic plan on how to handle similar situations in the future. Medical gas systems, being the life savers in respiratory issues, is vital in the whole disaster management plan. Failing to plan is planning to fail. ■

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# CALISTO T1

*All-in-One Condition Monitoring System to Prevent Transformer Failures*


## ASSESS BUSHINGS, PARTIAL DISCHARGE AND I/O FROM ONE UNIT

The Calisto™ T1 encapsulates the functionality of bushings, partial discharge and Input/Output modules in a single configurable package in a cost-effective manner. It provides a clear user interface through a built-in server and manages user access, alert setting, alert management and data visualization - bringing together data from Doble and third-party devices. Standard communication protocols include Modbus and DNP3 with optional IEC 61850, that allow data to be moved between Calisto T1 and other applications such as SCADA.

## FEATURES

The Calisto T1 can be scaled from a single component to a comprehensive transformer monitor covering partial discharge (PD), bushings, operational data that connects to Dissolved Gas Analysis (DGA) and third-party monitors.

- Doble PD-Guard™ monitors partial discharge (PD)
- Doble IDD™ bushing monitor detects deterioration in bushings
- Doble iO™ records and displays data from multiple sensors and sources

## BENEFITS

- Simplify field configuration of condition monitoring installations
- Comprehensive alert management
- Simplified upgrade path
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- Calisto T1 allows for field upgrade of hardware so that you can start small and grow. For example, start with IDD bushing monitoring and add main tank PD later

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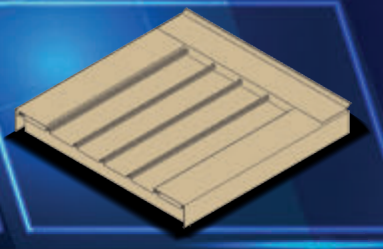
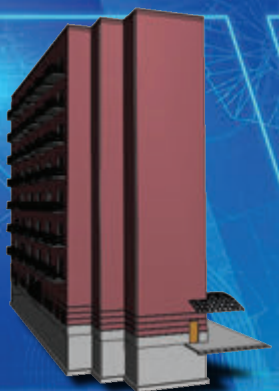
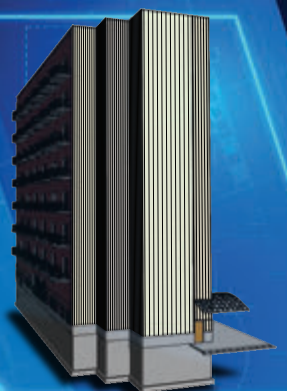




**Revit model without Lysaght BIM object**



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# Introduction of Ultrasonic Thermal Energy Metering

**Written and Prepared by:**

**Ir. Marcus Ng Yen Cheong**

IEM's Building Services Technical Division (BSTD) collaborated with Vector R. Asia Sdn. Bhd. to organise a webinar titled Introduction of Ultrasonic Thermal Energy Metering on 30 September 2021.

It was presented by Mr. Soren Lang, who has more than 30 years of experience in product management with thermal energy meters, standardisation and type approvals. Mr Lang is also the Technical Product Manager in the Heat/Cooling Division of Kamstrup A/S, Denmark.

During the webinar, he described the basic principle of thermal energy metering on heat and cooling systems with water as the heat conveying liquid. He explained why thermal energy metering is the way to fair billing, which flow sensor principles to choose, the European standards and approvals and what accuracies to expect. The report also gave examples on the inaccuracy over time.

Thermal energy meters are often available as heat meters, cooling meters or bi-functional heat/cooling meters, mainly for use with water as the heat conveying liquid. Thermal energy meters measure the energy given up or absorbed in a precise way. Therefore, the measured energy can be used for billing of the consumed energy.

When the heat or cooling water is distributed to several consumers, the inlet temperature can vary by several degrees Celsius, unless the water circulation is very fast but this would be too costly. The consumer farthest from the cooling production may expect an inlet temperature of 2°C higher than that for the consumer closer to the cooling production. Such a difference may cause more than the double volume consumption. When the cooling energy is measured with a cooling meter, only the consumed energy is to be paid on the bill, which is fair to all consumers. Figure 1 shows the temperature differences compared to flowrates.

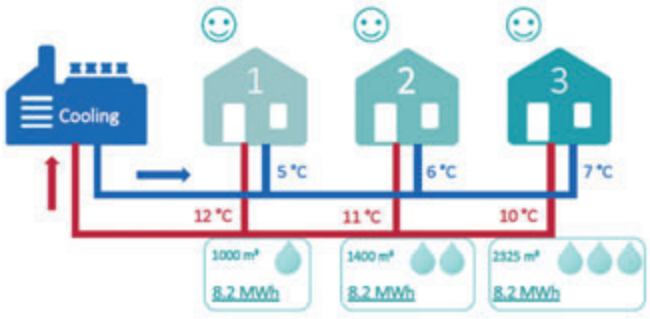



*Figure 1: Temperature differences compared to flowrates*

Most cooling meters are based on either mechanical, electromagnetic or on ultrasonic flow sensors. Each principle has individual characteristics and the price and selection may depend on many criteria. If the goal is reliable metering for many years, then the selection criteria listed below are to be considered. Figure 2 shows type of sensors and the benefits of each of the sensor.

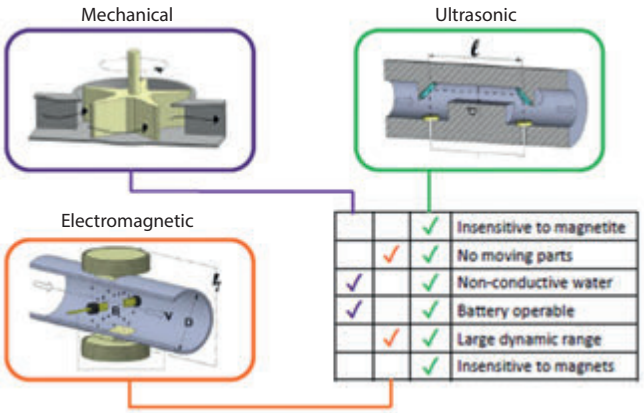



*Figure 2: Type of sensors and benefits*

## Thermal Energy Meter Consisting of 3 Sub-Assemblies

Unlike other approved meter types, the thermal energy meter may consist of up to 3 sub-assemblies, each with individual approval.

## Calculator

The calculating unit (Figure 3) gets volume pulses from the flow sensor and temperature signal for the platinum sensors. Based on a standardised energy formula, the calculator primary calculates the accumulated energy but can also show several other values on the display. All important information is shown on the front of the calculator.


*Figure 3: The Calculating Unit*

## Flow Sensor

The flow sensor (Figure 4) converts the volume flow into electrical pulses with a specific pulse value. The necessary information is printed on the flow sensors type label.

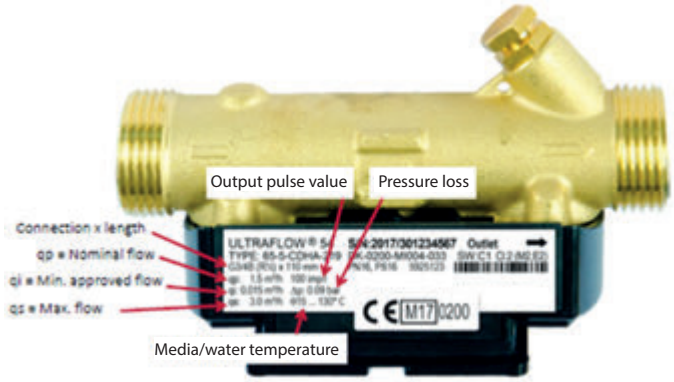



*Figure 4: Flow Sensor*

## Temperature Sensor Pair

The temperature sensor pair (Figure 5) is typically based on platinum, Pt500 and the two sensors in a pair must not be separated as they are matched together. The necessary information is printed on the sensors type label.


*Figure 5: Temperature Sensor Pair*

## Initial Verification

During the factory initial verification, the sub-assemblies are calibrated individually on precision equipment, which references are traceable to international standards.

The calculator is calibrated by means of precision resistors that simulates both the inlet and the outlet temperatures. Volume simulation is made by a pulse generator. According to the European standard, heat and cooling meters shall be calibrated at several temperature test points to check both accuracy and linearity.

The temperature sensors are calibrated at 3 different temperatures, typically at 10°C, 75°C and 140°C. This, according to IEC 751, is adequate to calculate the accuracy at any temperature within the specified range. A matching process, based on the calibration results, ensures optimum accuracy, even at the smallest temperature differences.

The calibration bench for the flow sensors is by far the most expensive equipment and, to ensure the best accuracy, only flow test benches with a weighing tank is acceptable. All flow sensors shall be calibrated at the nominal flow rate, at 0.1 x nominal flow rate and at their minimum flow rate. According to the European rules, all calibration results (for all sub-assemblies) shall be available from the manufacturers laboratory upon request for at least 10 years after the date of production.

## Accuracy of Meters, Flow Sensors and Temperature Sensors

The maximum permissible error of the calculator and the temperature sensor pair are always the same in EN 1434, meaning there are no accuracy classes for these.

The maximum permissible error of the flow sensor has different classes and Class 2 is the most frequently used. Within EN 1434, the accuracy includes all errors, such as repeatability error, temperature curve errors etc. So, the accuracy class in EN 1434 cannot be directly compared to an industrial accuracy specification for example. Figure 6 shows the flow sensor ranges and limits of errors.

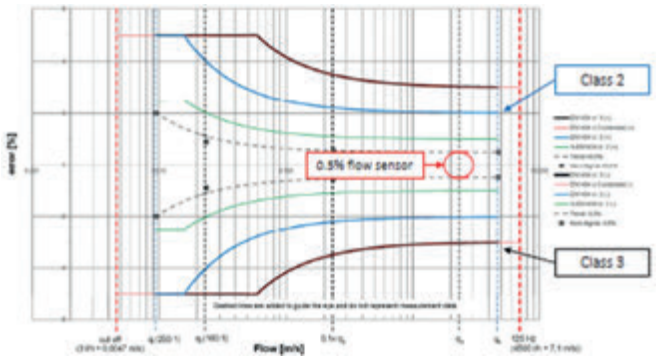



*Figure 6: Flow Sensor Ranges and Limits of Errors ($q_p$ 1,5m³/h)*

The total error on a cooling meter can be calculated as the sum of errors for all sub-assemblies or as the RMS sum if a typical error should be found, as shown in the Table 1 below:

*Table 1: Comparison on Accuracy Specifications (Calculated at 5.6K Temperature Difference)*

| Sub assemblies | M&V Example | Typical accuracy with a EN 1434 Class 2 flow sensor | Typical accuracy with a 0.5% flow sensor |
|---|---|---|---|
| **Temp. sensors** | 1.79% | 0.4+4/5.6 = 1.11% | 0.4+4/5.6 = 1.11% |
| **Flow sensor** | 1+1 = 2% | 1+1% = 2% | 0.5+1% = 1.5% |
| **Calculator** | 1% | 0.15+2/5.6 = 0.51% | 0.15+2/5.6 = 0.51% |
| **Total Error $_{RMS}$** | **2.86%** | **2.34%** | **1.93%** |

## Impact of Inaccuracy Across Many Years of Operation

Every year the accredited meter laboratories re-calibrates a huge number of meters. The general experience from the last 20+ years shows that "static" meters are more robust over time than mechanical meters. Most static meters sold are the ultrasonic type and some have proven to last for up to 30 years of operations. Figure 7 and Figure 8 below are the re-calibration results from 9-year-old ultrasonic meters.

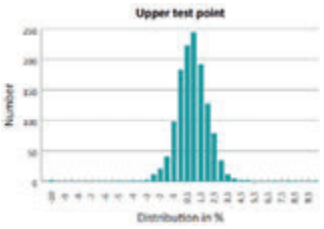



*Figure 7: Upper Test Point of recalibration result*

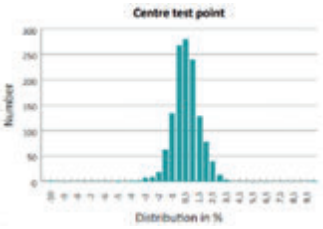
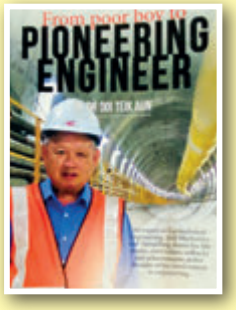



*Figure 8: Centre Test Point of recalibration result*

The webinar received overwhelming support from consultant firms and IEM members. After the webinar, there was a short quiz for participants, with merchandise from Vector R Asia Sdn. Bhd. as prizes. ■

**Book Review:**

**From A Poor Boy to A Pioneering Engineer**




In this inspirational story of a poor boy who made a name for himself as a pioneer in geotechnical engineering, soil mechanics and tunnelling in Malaysia, Ir. Dr Ooi Teik Aun recounts his life story, one marked by poverty in the early years that prepared him for a life of humbleness and integrity. It also has lots of motivational tips, especially for young, aspiring engineers. Discover Dr Ooi's journey to success. From start to finish, this book is definitely a worthwhile read.

**Author:**
Ir. Dr Ooi Teik Aun

**Available at:**
IEM Secretariat (03-7968 4001 or email *sec@iem.org.my*)

**Price:**
RM60 per copy (IEM Members)
RM80 (Non-members)

# Green Design on Healthcare/ Hospital Related Air-Conditioning Design & Analysis

**Written and Prepared by:**

**Ir. Pua Ching Tian**

**Mr. Pua Qie Shang**

**Ir. Wong Chu Loong**

On 16 December 2021, IEM's Building Services Technical Division (BSTD) organised a half-day webinar titled Green Design on Healthcare/ Hospital Related Air-Conditioning Design & Analysis, conducted by Ir. Pua Ching Tian of KVA Konsult. There were 24 participants. The basis of the course was as follows:

## Design & Analysis of ACMV (Air-Side)

With extreme weather events happening around the globe, there is a renewed sense of urgency to limit global warming to well below 2° Celsius compared to pre-industrial levels, as outlined in the Paris Agreement[1].

One of the key initiatives is developing greener, more sustainable buildings to reduce carbon emissions. To understand the problem at scale, buildings are accountable for almost one-third of total global energy consumption and nearly 15%[2] of direct $CO_2$ emissions.

In Malaysia, buildings account for 14.3%[3] of total electrical energy consumption. Hospitals and medical centres are some of the most energy intensive buildings in the country as these must meet strict regulatory requirements and are constantly in operation. Since air-conditioning and mechanical ventilation (ACMV) systems consume more than half of the energy usage, designing an energy efficient ACMV becomes increasingly critical.

ACMV design in hospitals must comply with guides and standards such as ASHRAE 170, Malaysia's Private Healthcare Act, JKR Mechanical Need Statement, MOH or CKAP's Guideline and MS 1525. One criterion is that operating theatres, pathology laboratory and isolation rooms are required to get 100% fresh air. In addition, operating theatres must maintain temperature set point of 18°C and 50% humidity. Furthermore, operating theatres must have a minimum of 30 air change in compliance with the JKR Mechanical Need Statement, whereas a pathology laboratory, sterile and TPN/CDR departments require a minimum 12 air change or higher. To meet such stringent criteria, ACMV systems in hospital are, inadvertently, very energy intensive.

Let's focus on the air-handling units (AHU), which is the heart of the ACMV systems. To comply with JKR's mechanical need statement, AHU in specialist clinics, A&E and non-critical departments must have the following configuration: Supply and return AHU with an average of 15-25% fresh air, minimum 6 air change of supply air, cooling coil and heating coil as well as primary and secondary filter in AHU. On the other hand, operating theatres should have 100% fresh air supply, AHU with pre-cooled heat recovery wheel, cooling and heating coils, primary, secondary and tertiary HEPA filters.

After understanding the AHU requirements, multiple AHU designs are simulated using a cutting-edge software called IES VE[4] to compare the energy consumption. In the case example of specialist clinics, A&E and non-critical departments, 2 different types of AHU designs are compared, which are typical supply and ducted return AHU (Figure 1) and another AHU with by-pass ducted return (Figure 2). Simulation results demonstrate that adding a simple bypass achieved better humidity with the same room space temperature, thus conserving energy.

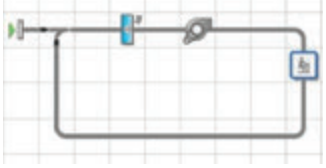


*Figure 1: Typical ducted return AHU*

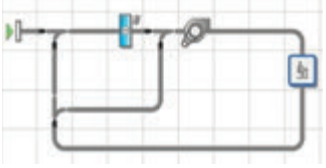


*Figure 2: By-pass ducted return AHU*

For operating theatres, 4 different AHU configurations are simulated:

a) Figure 3: 100% fresh air supply and 100% exhaust AHU with heat recovery
b) Figure 4: 100% fresh air supply and 100% exhaust AHU with heat pipe located between cooling coil
c) Figure 5: 100% fresh air supply and 100% exhaust AHU with heat pipe, pre-cooling at exhaust duct.
d) Figure 6: Combination of AHU Figure 3 and Figure 5.

The designs are illustrated in the diagrams.

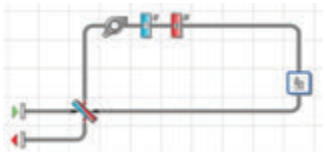
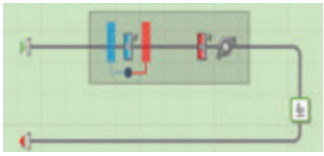


Figure 3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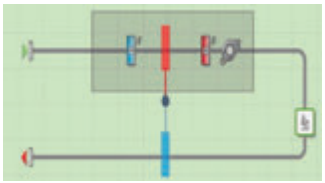
Figure 5

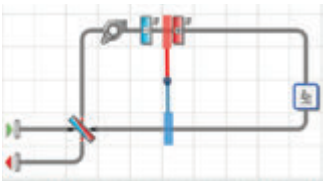
Figure 6

Based on the simulation, the optimum AHU configuration is Figure 6, for 100% fresh air with high air change conditions, as it consumes the least amount of energy while meeting the strict requirements of an operating theatre.

In conclusion, for non-critical departments, adding a bypass in the AHU improves the performance of the ACMV system. For operating theatres, a simple upgrading, such as hybrid of heat pipe and heat recovery with proper set points, improves the efficiency of the ACMV system by reducing the capacity of cooling and heating coils. Therefore, the design and optimisation of AHU configuration are critical not only to meet the performance standards but also to minimise energy consumption for greener health institutions.

The webinar was highly informative and relevant for current times. Overall, the objective was to offer participants a deep understanding of the design of air-conditioning systems in hospitals, in compliance with green requirements and compliant with regulatory requirements as well as understanding various air-side and water-side plant system selections for high efficiency design objectives. ■

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[1] https://www.mdpi.com/2071-1050/13/16/9244/htm#:~:text=In%20Malaysia%2C%20buildings%20consume%2014.3,and%20to%20reduce%20energy%20use

[2] https://www.iea.org/topics/buildings

[3] https://www.mdpi.com/2071-1050/13/16/9244/htm#:~:text=In%20Malaysia%2C%20buildings%20consume%2014.3,and%20to%20reduce%20energy%20use

[4] https://www.iesve.com

# Machine Learning and Google Analytics

**Written and Prepared by:**

**Ms. Ong Ye Shian**

Young Engineers Section (YES)

Young Engineers Section (IEM-YES) organised 3 virtual workshops back-to-back in January. These were Python Machine Learning Crash Course (2 days), Advanced Python Machine Learning Workshop (2 days) and Google Analytics Crash Course (½ day). There were 43 participants.

The main objective of the workshops was to share the latest technology in the market with both students and professionals as part of their engineering lifelong learning experience to upgrade knowledge. The workshops also provided an opportunity for participants to discuss the latest challenges and to learn coding tips as well as best practices from expert trainers.

As we move towards Industrial 4.0, Python, a highly popular and versatile programming language used worldwide, has undeniably become an essential framework for data science, automation, machine learning and artificial intelligence. Machine learning is the ability of computer to learn and automate the decision-making process without being explicitly programmed.

Through both Python workshops, participants learned about the fundamental concepts and applications of Python in the field of machine learning. The Python content shared to participants included NumPy, Pandas and Matplotlib, decision trees and labelled data used to supervise learning.

Google Analytics, on the other hand, is a web analytics service offered by Google which allows users to track and report website activity, gauge user engagement and analyse web traffic for better content as well as performance optimisation. The Google Analytics workshop provided participants with the skills to design and publish their own website. Participants also learned to apply Google Analytics to their personal websites and to interpret the report generated from the analysis.

The trainers for Python and Google Analytics workshops were Dr Chaw Jun Kit and Dr Yu Yong Poh respectively. Both are SAS Certified Predictive Modellers and are experts in the area of computer vision, deep learning, artificial intelligence, data science and analytics.

The three workshops were carried out in an interactive manner. Beside presenting talks, trainers conducted live demo sessions. Hands-on sessions were also allocated for participants who could ask questions throughout the workshops. Some participants also shared their experiences in the industry, specifically in the field of machine learning and artificial intelligence.

The workshops were a huge success and positive feedbacks were received from the participants. They were truly fruitful events organised by IEM-YES, with the full support of both trainers and participants (Figure 1). ■

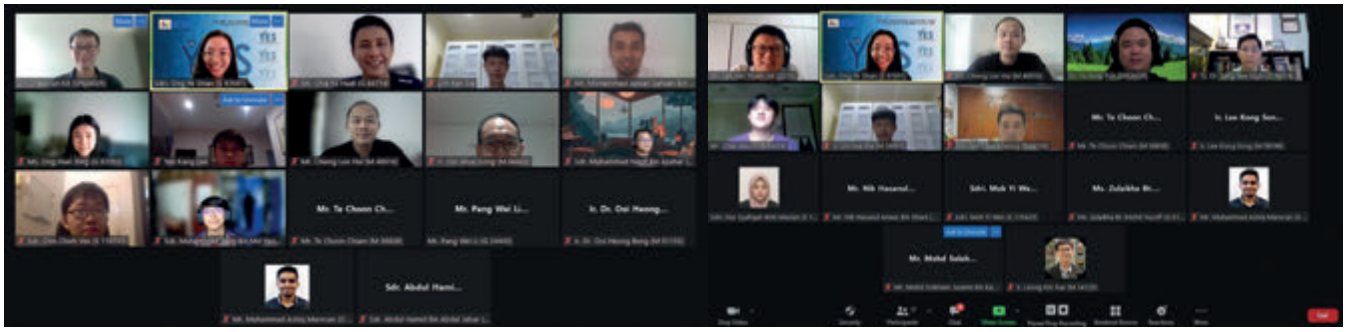

*Figure 1: IEM-YES virtual workshops*

# When Artificial Intelligence Meets 5G

**Written and Prepared by:**

**Ir. Prof. Dr Leong Wai Yie**

**Ir. Yam Teong Sian**

**Ir. Chong Chee Yen**

The Institution of Engineers Malaysia (IEM) Negeri Sembilan Branch and Yayasan Amal INTI recently held a webinar conference on When Artificial Intelligence Meets 5G (Figure 1). The co-organisers were INTI International University & College, INTI Alumni Association (INTIAN), The Institution of Engineering & Technology (IET), Malaysian Board of Technologists (MBOT), Technological Association Malaysia (TAM) and Malaysian Invention & Design Society (MINDS). The aim was to share contemporary technology knowledge, keep pace with the times and to promote interest in science, technology, engineering and mathematics. There were more than 300 participants.

Datuk Tan Yew Sing, Chairman of INTI Foundation, said China has become a global artificial intelligence (AI) power, rapidly developing the technology in the past 10 years. For China, AI was a historic strategic opportunity, which was crucial to alleviating the pressure of population ageing in the future, coping with the challenges of sustainable development and promoting the transformation and upgrading of the economic structure.

Ir. Prof. Dr Leong Wai Yie spoke on how the 5G system can deeply explore AI in the higher protocol layer. AI refers to the simulation of human intelligence in machines which are programmed to think like humans and to mimic human behaviour. The term can also be applied to any machine that exhibits characteristics associated with human thinking, such as learning and problem solving.

5G is the fifth generation wireless network technology, offering significant advantages over previous technologies, with virtually unlimited capacity and low latency. In addition to higher quality and faster streaming, 5G is also expected to provide a revolutionary immersive experience. It provides high data transfer rates, reduces latency, supports a large number of users, devices and services as well as improves and enhances network efficiency.

Ir. Prof. Dr Leong talked about the effects and projects of the combination of AI and 5G. AI helps everyone integrate into a business, increases agility, reduces costs, increases productivity, reduces frustration, minimises failure and enhances customer satisfaction. It brings more value with less investment, thereby promoting the sustainable development of businesses. Nonetheless, development of AI initiatives should be considered in terms of specific business forces rather than technologies.

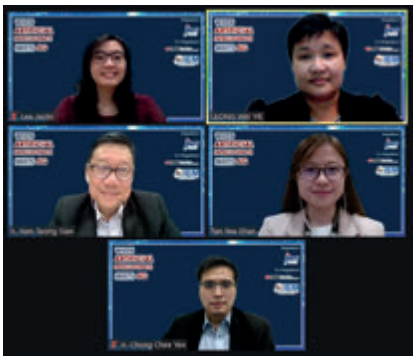

*Figure 1: Webinar conference on When Artificial Intelligence Meets 5G*

In agriculture, drones used to spray pesticides, real-time monitoring of crop status and material procurement employ AI. In transportation, in addition to applications such as maps and navigation, driverless vehicles have also seen new progress made. Machines can now screen and analyse medical images to assist doctors make a diagnosis. In media, production tools such as manuscript writing robots and smart video scissors are constantly emerging. In education, personalised learning tools emerge in an endless stream. In speech recognition and translation, translation software can support the translation of dozens of popular languages around the world. In finance, the application of biometric technology makes payment through face recognition a reality. In logistics, intelligent products such as order splitting, intelligent distribution robots, unmanned warehouses and drones have been put into use.

The webinar was moderated by Ir. Yam Teong Sian, Immediate Past President of Technological Association Malaysia (TAM), who also talked about his own experiences and insights in construction engineering.

IEM NS Branch Chairman Ir. Chong Chee Yen said IEM welcomes collaborations to promote and advance engineering science and the profession as well as to facilitate the exchange of engineering-related information and ideas.

Ir. Prof. Dr Leong won the 2021 World Federation of Engineering Organisations (WFEO) Outstanding World Female Engineer Award, the 2021 Malaysia United Nations Women's Empowerment Principles (WEPs) 2021 Leadership Commitment category and the 2016 INTI Outstanding Alumni Academic Excellence Award. ■

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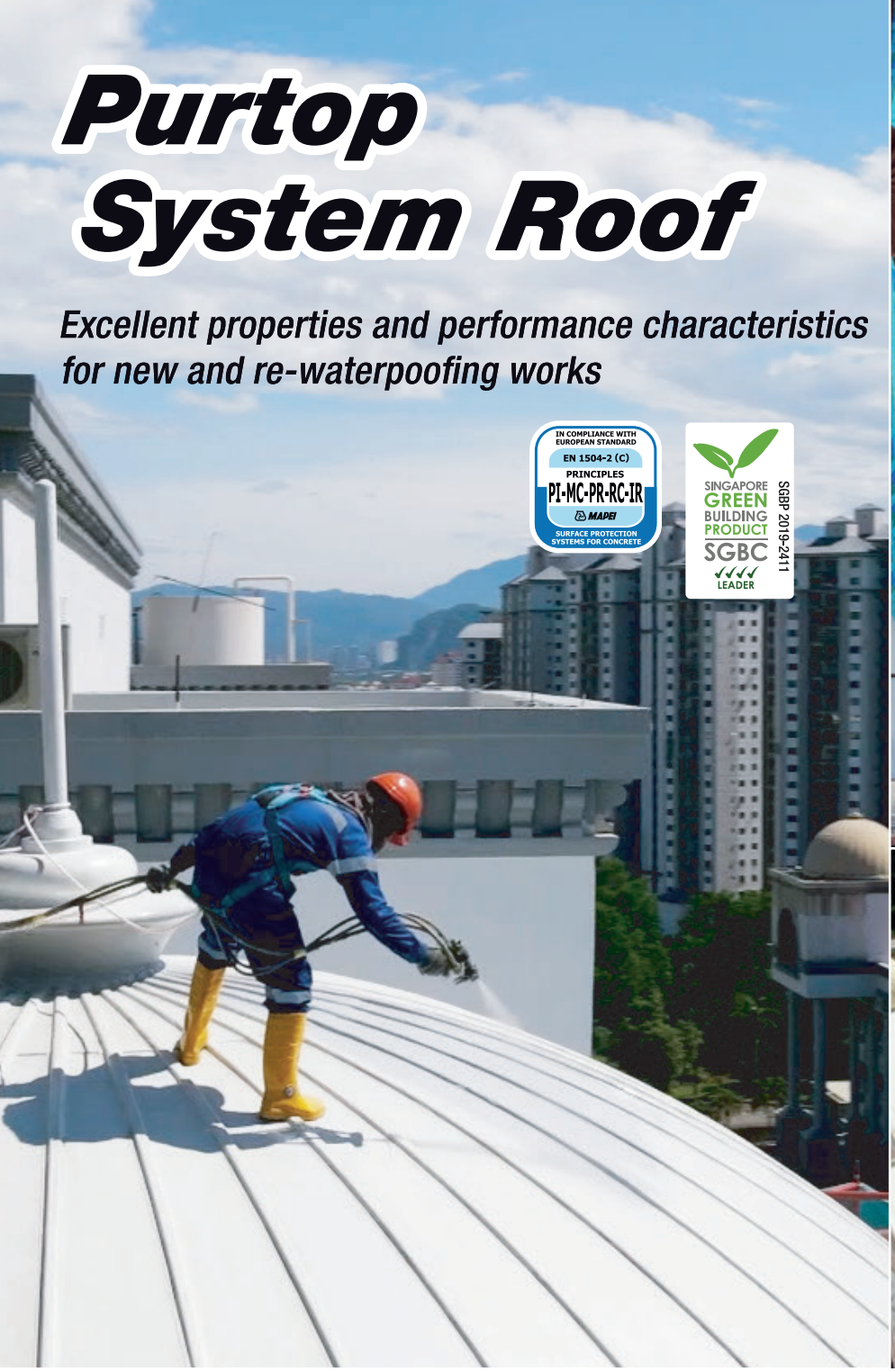

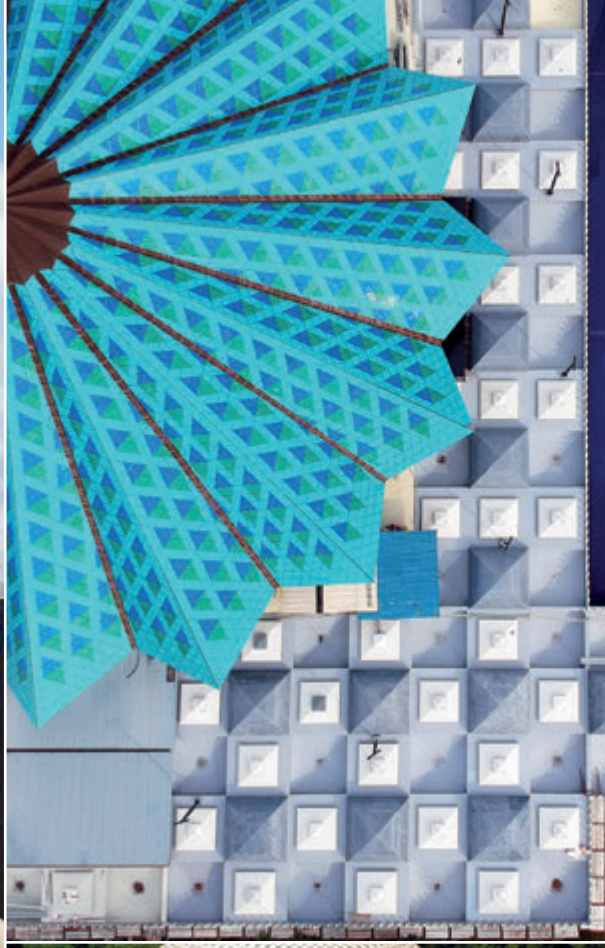

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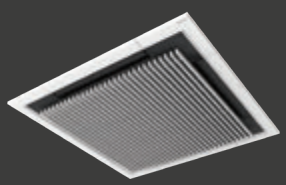

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# Panmunjom, The Last Standing Demilitarised Zone in the World

Written and Prepared by:

*Ir. Dr Oh Seong Por*

*The Past Chairman of IEMNS and Director of Samsung SDI Energy (M). Sdn. Bhd.*

While pursuing an engineering course at Hanyang University, Seoul, Republic of South Korea, I had the opportunity to visit Panmunjom in the Korean Demilitarised Zone (Figure 1).

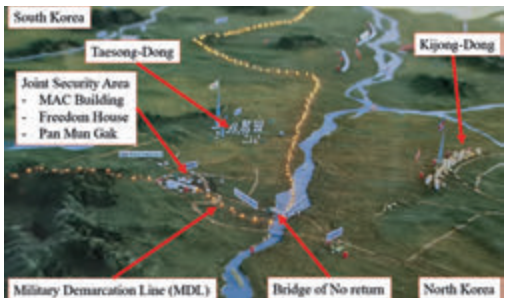


*Figure 1: The Panmunjom Demilitarised Zone*

Panmunjom is the site where armistice was reached in 1953 to end the Korean Civil War which lasted for 3 years. Only non-Korean residents are permitted to visit Panmunjom. All visitors are required to register with a tour agency in Seoul at least 3 days prior to the trip. The agency will provide a bus and a tour guide. On the way to Panmunjom, the guide will give a brief history of the Korean War.

## The Korean War

At the end of World War II, the Korean peninsula was divided at the 38th parallel with the North under communist rule, while South Korea adopted a democratic government. Under the pretext of wanting to re-unify the Korean peninsula under communist rule, the North Korea People's Army (KPA) launched a surprise attack on South Korea at 4am on 25 June 1950.

The well-trained KPA was supported by T-34 tanks as well as long range artillery. In contrast, South Korea's Republic of Korea Army or ROKA was poorly trained and poorly equipped. They failed to repel the invaders and retreated to the port city of Pusan at the south-eastern tip.

The United Nation strongly objected to the invasion and decided to commit troops to support South Korea. US World War II veteran commander General Douglas MacArthur was called back to active duty to lead the UN forces. Operation Chromite was initiated which saw a surprise but well-coordinated amphibious landing at Incheon Port, 177km behind enemy lines, on 15 September 1950. This operation cut off the enemy's supply route, forcing KPA to retreat and liberating parts of the land back to South Korea.

UN forces continued to push northwards and captured more North Korean territory. China, which shared a border with North Korea, felt threatened, so Chairman Mao Zedong sent thousands of Chinese People's Volunteer Army (PVA) personnel to assist North Korea. The UN forces were pushed back to behind the 38th parallel. The fighting continued, until the armistice was signed in 1953.

## Panmunjon and the DMZ

Panmunjon is located about 51km north of Seoul. On the way there, I could see many concrete blocks positioned in a zig-zag formation beside the highway as well as huge overhead concrete slabs built across the highway. According to the tour guide, the zig-zag structures were meant to stop any advancement of tanks southwards. In the event of war breaking out, the supports to the overhead concrete slabs would be destroyed to block the road which was a direct access route to Seoul.

Before reaching Panmunjom, we stopped at the Memorial Monument which was erected to honour over 7,000 Filipino soldiers who were part of the UN forces involved in the war.

We continued on to Panmunjom until we arrived at the 1st Guard Post where a US army sergeant boarded the bus. He introduced himself as the sergeant on duty and said he would accompany us around the Joint Security Area or JSA. He led us to Camp Bonifas, the United Nations Command's Advance Camp at the entrance to JSA. There, all visitors were ushered into a room for a briefing on the JSA and security protocols.

## Joint Security Area, JSA

The JSA is set up as an area for negotiation between the UN Command (UNC) and the KPA. It covers an area of 800m radius and houses the Military Armistice Commission Building (MAC) where meetings are conducted. The yellow Military Demarcation Line (MDL) that separates North Korea and South Korea, runs across the meeting table.

The JSA is closely watched both day and night by special guards from both sides who are allowed to carry arms to protect their respective areas. There is no physical barrier to separate them except MDL that keeps the guards confined to their positions. Both sides constantly observe each other's actions suspiciously and are ever ready to retaliate if necessary.

The MAC building is sandwiched between the Freedom House erected by South Korea and Pan Mun Gak Building built by the KPA (Figure 2).

*Figure 2: The author standing in front of Freedom House Pagoda*

There is a small village called Taesong-Dong or Freedom Village on the outskirts of the JSA and adjacent to the MDL. Despite the risks, the villagers have opted to remain on their ancestral land, working in the fields under the protection of UNC forces. KPA has also established a settlement called Kijong-Dong which lies opposite Freedom Village. The UNC claims that Kijong-Dong is inhabited by only a few caretakers as it is built for propaganda purposes only. ■

Next issue: Bridge of No Return

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Berikut adalah senarai calon yang layak untuk menduduki Temuduga Profesional bagi tahun 2022.

Mengikut Undang-Undang Kecil IEM, Seksyen 3.8, nama-nama seperti tersenarai berikut diterbitkan sebagai calon-calon yang layak untuk menjadi Ahli Institusi, dengan syarat bahawa mereka lulus Temuduga Profesional tahun 2022.

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. Prof. Dr Zuhaina binti Zakaria**
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| 87393 | MOHD KASIM BIN KASWI | BE HONS (UiTM) (ELECTRICAL, 2000) |
| 41875 | W NURUL ALIAA BINTI W MAZLAN | BE HONS (UTeM) (ELECTRONICS (TELECOMMUNICATION ELECTRONICS), 2010) |
| **KEJURUTERAAN KIMIA** | | |
| 25000 | MOHD RIZAL BIN ADNAN | BE HONS (MALAYA) (CHEMICAL, 2005) |
| 25327 | WAN YOKE KIN | BE HONS (UTM) (CHEMICAL, 2007)<br>PhD (NOTTINGHAM) (2016) |

## IEM ENGINEERING HALL OF FAME AWARD 2023

The Sub-Committee of Engineering Hall of Fame under the auspices of the Standing Committee on Professional Practice is proud to invite nominations for the IEM Engineering Hall of Fame Award 2023.

It is timely and expedient to induct and to record the accomplishments of engineers in the country who have or had demonstrated particularly outstanding professional achievements and provided excellent services to the Institution, the engineering industry and the Nation.

The IEM Engineering Hall of Fame is established with the aim to confer recognition and to celebrate the accomplishments of members of the IEM:

- Who have demonstrated outstanding professional achievements.
- Who have made significant contributions to the engineering profession, the Institution of Engineers, Malaysia (IEM) and the Nation.
- Who have rendered valuable service to the Community.

The Engineering Hall of Fame will serve as the focal point or showcase of outstanding Malaysian engineers, past and present, who had or have made great contributions to the engineering profession and to the quality of life in Malaysia. Engineers honoured in the Engineering Hall of Fame will also serve as a beacon and as role models for young engineers as well as create greater interest in engineering in general and awareness of the contributions made by outstanding engineers in the country.

Nominations for the Award are open to Malaysian citizens who are or have been Corporate Members of the IEM.

The closing date for receipt of nominations for IEM Engineering Hall of Fame Award is **31 October 2022**.

Please submit nominations to:

**Honorary Secretary**
**The Institution of Engineers, Malaysia**
**Bangunan Ingenieur, Lots 60&62**
**Jalan 52/4, 46720 Petaling Jaya, Selangor.**

The nomination form can be downloaded from the IEM website at
***www.myiem.org.my***
For further details, kindly contact IEM Secretariat at
**03-7968 4001/2**

## IEM AWARD FOR CONTRIBUTIONS TO THE ENGINEERING PROFESSION IN MALAYSIA 2023

To encourage an interest in engineering and to recognise important services or contributions to engineering in Malaysia, the IEM Award for Contribution to the Engineering Profession in Malaysia is to be presented to the person(s), who has:

- Contributed to the advancement of engineering in Malaysia, and/or
- Designed and constructed an original engineering device or system of merit and applicability to industry.

This Award is open to all Malaysian citizens and permanent residents.

**NOMINATIONS**

- Nominations will be invited annually. The closing date for receipt of nominations for each year is 30 September.
- Nominations shall be made through a member of the Institution. Each member is restricted to one nomination per year.
- Each nomination shall be accompanied by a brief write up of the services rendered or contributions made or system designed and/or constructed together with relevant photographs and other documents.

**AWARD**

- The Award is to be made by the Council upon recommendation by the Awards Committee.
- The Award shall comprise a metal plaque, a scroll and a sum of RM1,000.

The closing date for nominations is **31 October 2022**.

Please submit nominations to:

**Honorary Secretary**
**The Institution of Engineers, Malaysia**
**Bangunan Ingenieur, Lots 60&62**
**Jalan 52/4, 46720 Petaling Jaya, Selangor.**

The nomination form can be downloaded from the IEM website at
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For further details, kindly contact IEM Secretariat at
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## IEM OUTSTANDING ENGINEERING ACHIEVEMENT AWARD 2023

The IEM Outstanding Engineering Achievement Award is created to confer recognition to an organisation or body for outstanding engineering achievements within Malaysia. The award will be given to an organisation or body responsible for an outstanding engineering project in the country.

The basis for the award shall be an engineering achievement that demonstrates outstanding engineering skills which has made a significant contribution to the profession and to the quality of life in Malaysia. In making the selection, the following criteria will be given special consideration:

1) Contribution to the well-being of people and communities,
2) Resourcefulness in planning,
3) Creativity in the solution of design problems,
4) Pioneering use of materials and methods,
5) Innovations in planning, design and construction,
6) Unusual aspects and aesthetic values.

Engineering achievements which include, interalia, the following can be submitted for consideration:

- Bridges, Tunnels, Waterways Structures, Roads
- Telecommunications of national/international character, Power Transmission and Transportation
- Dams and Power Stations
- Ports and Harbours
- Building and Structures
- Airports
- Water Supply, Waste Disposal Projects
- Military projects such as bases, launching units, harbour facilities
- Drainage, Irrigation and Flood Control Projects
- Local design and manufacture of high technology products
- Energy, Heat, Mass Transfer

- Outstanding work in engineering research and development
- Chemical processing of indigenous raw resources such as rubber, palm oil and various other local plants
- Innovative use of local engineering materials
- Outstanding contribution in engineering education
- Original discovery of useful engineering theory

Nominations are invited from all members of the Institution. Each nomination submitted should contain a brief summary/write-up of the project in approximately 1,000 to 2,000 words together with full relevant reports on the project and three copies of supporting documentation including photographs. A project or component part thereof which has received an earlier award, from IEM does not qualify for nomination.

- The award in the form of a metal plaque, naming the achievement shall be given to the organisation or body responsible for the project for permanent display.
- The award shall be presented with due ceremony at an appropriate function of the IEM.

The closing date for nominations is **31 October 2022**.

Please submit nominations to:

**Honorary Secretary**
**The Institution of Engineers, Malaysia**
**Bangunan Ingenieur, Lots 60&62**
**Jalan 52/4, 46720 Petaling Jaya, Selangor.**

The nomination form can be downloaded from the IEM website at
***www.myiem.org.my***
For further details, kindly contact IEM Secretariat at
**03-7968 4001/2**

## IEM YOUNG ENGINEER AWARD 2023

The objective of the Award is to encourage interest in engineering and to recognise potential among young engineers in Malaysia. The Award will be presented to the person who has shown outstanding ability and leadership qualities, **either**

i) in the design and/or construction of an engineering device or system of merit; **or**

ii) in the research and development or teaching of engineering.

In any one year, the Award may be made in either one or both of the categories mentioned above. If the Award is to be made in only one of the two category may be made in the year. The Award is open to candidate who are:

i) Registered member with the Board of Engineers, Malaysia and under 35 years of age

ii) Malaysian citizens or permanent residents of Malaysia

ii) Graduate or Corporate Members of IEM.

The Proposer may or may not be a member of IEM. However, each nomination shall be supported by a brief recommendation from two Referees who are Corporate members of IEM. If the Proposer himself is a Corporate member of IEM (or higher), then he may also act as one of the two required Referees.

The Award will comprise a cash prize of RM500.00, a scroll and plaque, to be presented with due ceremony to each recipient of the Award.

The closing date for nominations is **31 October 2022**.

Please submit nominations to:

**Honorary Secretary**
**The Institution of Engineers, Malaysia**
**Bangunan Ingenieur, Lots 60&62**
**Jalan 52/4, 46720 Petaling Jaya, Selangor.**

The nomination form can be downloaded from the IEM website at
***www.myiem.org.my***
For further details, kindly contact IEM Secretariat at
**03-7968 4001/2**

## IEM WOMAN ENGINEER AWARD 2023

The primary objective of the Award is to recognise the contributions by women engineers. This Award may also incidentally encourage interest in engineering among women and encourage them to strive towards greater excellence. The Award will be presented to the woman engineer who has shown outstanding ability and leadership qualities, or has been a pioneer in any more of the following areas:

- In the design and/or construction of an engineering device or system, structural system, planned development, environmental improvements or,
- In the research and development of engineering device, systems, processes and/or materials, publication of paper or,
- In the teaching of engineering or,
- In the management of engineering projects,
- Entrepreneurship in the commercial sector.

In making the selection, the following criteria will be given special consideration:

- Contribution to the well-being of people and communities
- Resourcefulness in planning and in the solution of design problems
- Pioneering in use of materials and methods
- Innovations in planning, design and construction
- Unusual aspects and aesthetic values

The Award is opened to candidates who are:

- Registered members of the Board of Engineers, Malaysia,
- Malaysian citizens or permanent residents of Malaysia,
- Graduate or Corporate Members of The Institution of Engineers, Malaysia.

The Proposer may or not be a member of IEM or BEM, or an engineer. However, each nomination shall be supported by a brief recommendation from two Referees who are Graduate or Corporate member of IEM. If the Proposer is herself either a Corporate or Graduate member of IEM (or higher), then she may also act as one of the two required Referees.

The Award shall comprise a cash prize of RM800.00, a scroll and plaque, to be presented with due ceremony to each recipient of the Award.

The closing date for nominations is **31 October 2022**.

Please submit nominations to:

**Honorary Secretary**
**The Institution of Engineers, Malaysia**
**Bangunan Ingenieur, Lots 60&62**
**Jalan 52/4, 46720 Petaling Jaya, Selangor.**

The nomination form can be downloaded from the IEM website at
***www.myiem.org.my***
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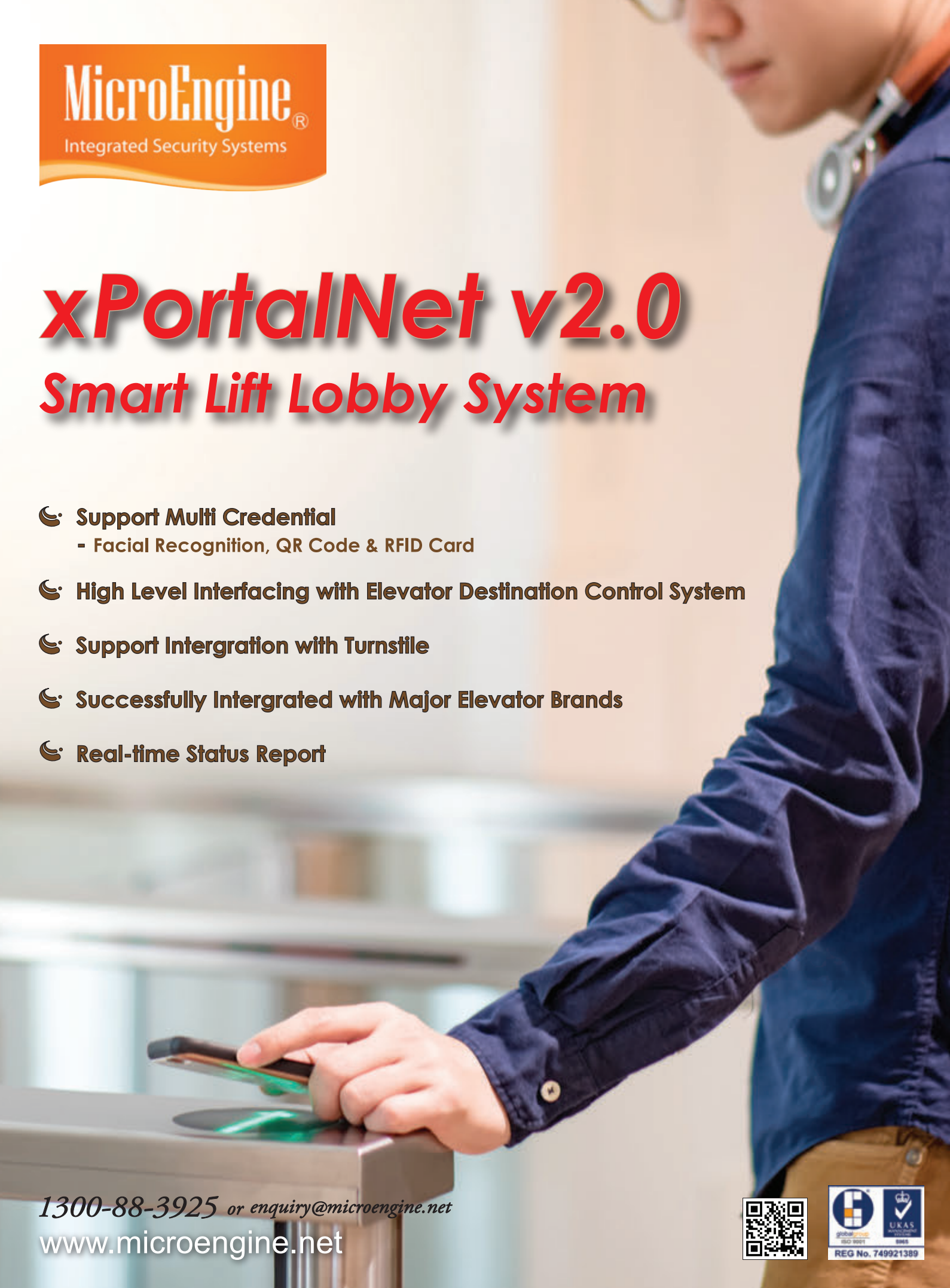

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