Safety
in Construction Engineering

Engineering is a broad discipline that's often broken down into several sub-disciplines. One such sub-discipline is Construction Engineering which deals with designing, planning, construction and management of infrastructures such as roads, tunnels, bridges, airports, railroads, facilities, buildings, dams and utilities.

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The construction site is an important element in engineering. One key aspect to ensuring the success of a construction project is Safety & Health. However, quite often, this is viewed as a hindrance rather than a key element.

In this issue of *JURUTERA*, Ir. Haji Omar bin Mat Piah, Director General, Department Occupational Safety and Health (DOSH), talks about the importance of safety engineering in the construction field and gives an overview of safety and health as well as a glimpse into the future of safety regulation in Malaysia.

After he graduated in mechanical engineering from Universiti Malaya in 1985, Ir. Haji Omar joined DOSH. He then completed his postgraduate Masters in Industrial Safety in 2004 at Universiti Kebangsaan Malaysia.

At DOSH, he started his career in the Petroleum Safety Division which encompassed, among other things, pipeline system, LPG reticulation system and pressure vessels where he was exposed to the safety culture of the Oil & Gas industry. He was later transferred to the Major Hazard Division at DOSH headquarters in Putrajaya. This special division monitors and regulates the installation of any work environment which contains potentially hazardous elements and where any accident can turn into a major hazard with consequences that can spread beyond the workplace.

SAFETY AWARENESS

When asked for his opinion on safety awareness among Malaysians, Ir. Haji Omar says there has been a big improvement in terms of awareness of the importance of safety. Malaysians are now more aware of their rights and are complaining to DOSH. Safety incidents are also well publicised.

But there remains a gap in the awareness of safety practices. At the top end of the spectrum are the giant multinational companies in Oil & Gas and Electronic industries. Then there are the medium to small industries and the self-employed in rural areas where safety awareness is not at the level where it is supposed to be. It is

the vision of safety regulators for such gaps in awareness and practices to be kept at the minimum level.

There are many differences in safety practices between these companies. Big organisations usually have a master plan for preventive culture. The right to a safe and healthy working environment is respected at all levels of the organisations. It starts at the top management and moves down to the lowest rung in the organisation hierarchy.

In Malaysia, the average number of daily accidents on the road is 18. At the workplace, the reported daily average is 2 fatalities and 116 accidents. Unfortunately, most people typically believe that an accident will not befall them until it happens.

DOSH measures the rate of fatalities and accidents to gauge the effectiveness of existing Safety Acts and Guidelines. Since the Occupational Safety & Health Act (OSHA) was gazetted in 1994, the rate of fatalities and accidents has plateaued although there has been no improvements in the past 3 years.

Ir. Haji Omar believes this is because of people's attitude towards safety. Accidents happen because of an unsafe act or an unsafe condition. DOSH has addressed unsafe conditions with Acts and Guidelines which are already in place but if people persist in engaging in unsafe acts, then accidents will continue to happen.

Malaysia uses foreign labour extensively and safety culture will be influenced by the organisation that employs them.

Another example is the difference between working in Singapore and Malaysia. Why do foreign workers in Singapore generally exhibit better safety practices than their counterparts in Malaysia? Ir. Haji Omar is reminded of his experiences with a Japanese organisation which was involved in a water pipeline project in Pahang in 2010.

To illustrate just how the sense of civic duty and safety culture can be ingrained in the individual, he says that the project manager, when walking in a nearby village, could be seen picking up cigarette butts and disposing them in the dustbin.

While it may be effective to mould a safety culture through strict enforcement and fines, the best way to develop safety awareness is through education and organisation culture.

HAZARD IDENTIFICATION, RISK ASSESSMENT & RISK CONTROL (HIRARC)

The purpose of the Hazard Identification, Risk Assessment & Risk Control guideline is to provide a systematic and objective approach to assessing hazards and their associated risks which will provide an objective measure of an identified hazard as well as provide a method to control the risk.

It is one of the general duties prescribed under OSHA 1994 (Act 514) for employers to provide a safe workplace for their employees and other related persons. The 4 steps in the HIRARC process are:

1. Classify work activities
2. Identify hazard
3. Conduct risk assessment
4. Decide if risk is tolerable and apply control measures.

The purpose of hazard identification is to highlight critical operations or tasks that pose significant risks to the health and safety of employees as well as highlight hazards pertaining to certain equipment due to energy sources, working conditions or activities.

Hazards can be divided into three main groups.

1. The first is Health Hazards which is an occupational hazard that can cause serious and immediate effects or long term problems.
2. The second is Safety Hazards which is defined as any force strong enough to cause injury or damage to the property and workers. Injuries from such incidents are usually obvious, such as injury to or loss of limbs.
3. The third is Environmental Hazards which is defined as hazards released into the environment and which may cause harm or deleterious effects. An environmental release may not be always obvious, such as releasing chemical agents into the storm/ sewer system.

MAJOR HAZARD RISK EVALUATION

An example of a major hazard risk is a working environment where hazardous substances are used. These substances are classified as either toxic, flammable or explosive, such as chlorine. Each hazardous substance has a threshold quantity which is used to classify the substance as a major hazard installation.

For the safety of the workplace environment and the population around the hazardous installation, it is imperative that DOSH studies and classifies the impact of accidents which can happen at such premises and to validate the proper implementation of mitigation measures to control identified hazard risks.

To start, a major hazard control exercise which consists of risk assessments and which contains every possible accident scenario, is prepared. Take for example, chlorine. An evaluation of the risks of the chlorine tank is done using simulations of different scenarios of various leakage rates to simulate the effect of various flow rates of a chemical leak from the tank, in relation to different pressure levels within the tank.

With hazardous substances, a study will also be done, in coordination with the Meteorological Department, on the typical wind speed and direction over the period of one year at the major hazard installation location to evaluate exposure risk of the substance to the surrounding areas.

Based on the location and population level around the installation, a simulation test will be done to calculate the parts per million (ppm) of the substance which can be safely allowed into the environment. This simulation must take into account the type of hazardous substance as different substances have different threshold limits which will pose immediate danger to the health of people exposed to it.

Group photo

For example, if the substance is LPG, a risk assessment of such an installation has to consider 2 different phases (liquid and gas) and the different position of leakage from the LPG tank. Leakage towards the top of the tank will cause LPG gas to leak out immediately and leakage at the lower end will cause LPG liquid to flow out, pool under the tank and vaporise. In such a case, there is the possibility of explosion should an ignition element be accidentally exposed to the leakage location. A simulation on the effect of such risk scenarios must be done to determine its effect on people in the area and to ensure that measures to protect the workplace and surroundings are implemented. Today, such a simulation can be obtained quickly and easily but it was not so easy back when computers were first introduced!

An example of a major accident happened in 1997 in Bintulu, where an O&G plant suffered major damage and losses because a hazardous element was not identified during the risk assessment study. The plant was the first of its kind to utilise the gas to liquid process. During the hazard identification phase, an unexpected but critical element was not identified, so there were no mitigation measures put in place. Atmospheric particles from forest fires during the haze period caused an explosion at the plant. These tiny air particles from the haze had accumulated and entered the air separation unit after by-passing the air filters. When mixed with the gas process, these caused the explosion. Fortunately, the accident occurred during the festive season, so there were no fatalities. This was an example where a risk was not identified but which caused a catastrophic accident.

RISK CONTROL MANAGEMENT

In general, risk control consists of 5 control methods.

1. Elimination
2. Substitution
3. Engineering Control
4. Administrative Control
5. Personnel Protective Equipment

The first control method is elimination. The best example in Malaysia is the ban on firecrackers which totally eliminates the risk or physically removes the hazard. The elimination control method is the most difficult to implement especially in an existing process. Other socio-economic considerations will also have to be kept in mind such as employment opportunities for people.

In the second control method, substitution, the hazard element is replaced. This method is also difficult to implement in an existing process. If a project is still at the design stage, the substitution control method should be less expensive. For example, instead of chlorine, the management of Sunway Lagoon in Bandar Sunway, Selangor, opted for a less hazardous chemical in its water treatment and yet maintained its performance and functionality.

The third control method is engineering control. This means isolating people from the hazard by removing the hazard at the source before it comes into contact with humans. An example of engineering control is the introduction of enclosures to reduce noise pollution from a genset or generator set. A well-designed engineering control method can be most effective. While the cost may be higher initially than the fourth control method discussed below, it will be more economical and effective in the long run.

The fourth control method is administrative control. This procedural method changes the way people work and includes the implementation of procedures and methods of working. However, it may not be as effective as workers may not follow the safety procedures.

The fifth control method is Personal Protective Equipment (PPE) which includes the use of gloves, ear protection and protective clothing. This is the least effective way to protect people from workplace hazards. For safety professionals, this method should be used only as the last resort but to the public, PPE is the first line of risk control though this cannot be further from the truth. The best method is always to control the risk at source.

RISK CONTROL

DOSH practises strict enforcement and zero corruption. It makes evaluations based on risk controls implemented at the workplace, compared/benchmark to the code of practice, regulation and standard. If there are no gaps between the risk control standards tabled out and the actual practice, then the risk control is considered effective. If there are gaps, DOSH will evaluate the seriousness of the breach and either give a notice of prohibition or improvement. If the breach is too large, DOSH will issue a summons to the employer and make re-inspections of the workplace. If there is still no improvement, the employer will be charged in court.

Last year, apart from 324 cases brought to court, approximately 23,000 notices of prohibition and 34,000 notices of improvement were also issued.

CONCEPT OF OSHA

Ir. Haji Omar says: "All our regulations are written in blood as they are written after an incident has happened."

In 1994, the Occupational Safety & Health Act (OSHA) was gazetted. In tandem with existing safety legislations, it was designed to reduce industrial accident rates.

An important concept in OSHA is self-regulation. The philosophy here

is that responsibility for managing safety and health lies with those who create the risks and those who work with the risks. The employer creates the risk and the employee works with the risk.

It shall be the duty of every employer and every self-employed person to ensure, so far as is practicable, the safety, health and welfare at work of all his employees. "So far as is practicable" means:

- To provide and maintain plant and system of work
- To make arrangements for the safe use, operation, handling, storage and transportation of substances and plant
- To provide information, instruction, training and supervision
- To provide and maintain place of work and means of access to and egress from any place of work
- To provide and maintain a working environment that is safe and without health risk as well as adequate welfare facilities.

Practicable itself means practicable with regards to:

- The severity of the hazard or risk in question
- The state of knowledge about the hazard or risk and the way of removing or mitigating the hazard or risk
- The availability and suitability of ways to remove or mitigate the hazard or risk and
- The cost of removing or mitigating the hazard or risk.

The employer cannot say he/she doesn't know about the guidelines and code of practice as these are available on the DOSH website. Even though there is enforcement, DOSH encourages all employers to practise self-regulation.

In 2017, DOSH completed inspections on 34,000 lifts, 10,000 mobile cranes and 113,000 pressure vessels despite having only some 1,000 employees.

EXEMPTION OF CERTIFICATE

When asked about the recent Exemption of Certificate, which was gazetted under Factories & Machinery (namely the 2015 Order on hoisting machine and 2017 Order on unfired pressure vessel), Ir. Haji Omar says the decision was based on DOSH's risk-based enforcement. As the pressure vessel is a very low risk system, owners can do this on their own. OSHA is based on self-regulation and self-assessment.

As for hot works, he says safety programmes such as Hot Work Permit and Explosive Atmosphere, come under administrative control. It is based on the employer's self-regulation to control the risks. DOSH provides operation safety guidelines and codes of practice but it is up to the industry to follow the guidelines.

In addition, he says that safety committees are important because these provide employers with the opportunity to sit down with front line workers to discuss prominent safety concerns at the workplace. Safety committees set the lead for worker safety and allow them to play an important role in keeping not only themselves safe but also their co-workers.

DOSH has taken a pragmatic approach to enforce and educate NGOs or SMEs which do not have such committees by interviewing those who have lost limbs, inviting the victims to speak and share their experiences and showing videos of accidents.

Ir. Haji Omar says DOSH will be introducing new guidelines for Occupational Safety & Health Construction Industry Management (OSHCIM). These include stating that safety at the workplace is not only the duty of the main contractor but also that of the project owner and designer who must ensure safety during construction, maintenance and others. Risk assessment and risk control must be conducted during design stage (OSHCIM).

According to the current law, safety at the construction site falls under the main contractor, so project owners typically pass on the risk and do not bother about the safety elements. However, this will change with the new guidelines for construction industry management (which are expected to be introduced at the end of 2018), which states that it's the duty of the owner and designer to ensure safety during construction, maintenance and demolition.

INTERNAL AIR QUALITY (IAQ) MONITORING

When it comes to indoor air quality, Ir. Haji Omar says DOSH will usually go to the industry with the highest risk exposure. Every year DOSH runs a programme on Internal Air Quality (IAQ) awareness and it will only investigate if there are complaints about a certain workplace. Again, this falls back on self-regulation – the guidelines are available as is knowledge of the hazard and control. DOSH has suggested that another way to pave the path to self-regulation is to create a competent person responsible for IAQ, i.e. every building owner must be responsible for its temperature, humidity and air change.

This is also how DOSH audits offshore Oil & Gas facilities. All inspection is done by an offshore inspector appointed by the O&G company. The offshore inspector must go through modules and examinations set by DOSH before he/she can be accredited.

VISION

Last but not least, Ir. Haji Omar hopes that someday, products on the supermarket shelves will come with safety ratings as even the manufacturing of something as simple as a pen, is not without risks. If sales are affected by safety policies, it will encourage manufacturers to improve safety levels.

Currently, the processing of palm oil has to comply with RSPO (Roundtable on Sustainable Palm Oil) criteria before it is allowed to be exported. If this can be applied to all products, the need for DOSH will be minimised.

In conclusion, it is imperative that engineers and employers understand the concept philosophy of self-regulation, risk assessment, risk management as far as practicable and design for safety. ■