Land Transport Authority

SAFETY NEWS

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Inculcate Safety Awareness -
"Enhancing Safety Awareness of Workers"

FEATURED ARTICLES

Enhancing Safety Awareness of Workers

INTRODUCTION

Most accidents and incidents occur either when people fail to recognise a potentially hazardous situation or when they fail to take preventive measures. Lessons from near misses and past accidents also indicate that many of these were due to a lack of risk awareness among the workforce. To create safe workplaces, it is essential that these weaknesses be addressed and action taken to deal with them. Hence, it is no coincidence that one of LTA's key strategies to achieve zero accident is to "Inculcate Safety Awareness" among the workers.

This article aims to introduce the various measures that are currently in place to inculcate safety awareness as well as showcase some of the best practices adopted by contractors within LTA worksites.

TRAINING

a) Behavioural Based Safety (BBS)

BBS is a process that uses behaviour analysis methods to achieve continuous improvement. It is widely used in many international organisations to reduce workplace accidents.

LTA embarked on BBS in 2010 and after a successful pilot programme it is now implemented on all LTA rail and road projects. The BBS implementation programme covers the conduct of safety culture survey, baseline observations and intervention strategies. One of the key outcomes of BBS is the influence of the workers' attitude towards safety by increasing their risk awareness.

b) Contractor's Safety Training Centre

Safety training creates a safety culture in which employees help to promote proper safety procedures while on the job. Effective safety training is more than just forcing workers to watch a video; it needs interaction, engagement, and most of all, effective delivery of the intended message.

Some of our contractors have developed safety training centres with different mock-up areas in order to enhance the training given to workers. The establishment of interactive, hands-on, and innovative safety training will allow workers to have a clearer understanding of the work activities, potential hazards and the safe working procedures; this will ultimately lead to a safer workplace.

Classroom training

Working at height training

Figure 1a: Training Centre with different mock-up areas

Confined space training

Figure 1b: Training Centre with different mock-up areas

COMMUNICATION

a) Construction Safety Handbook

To better help our contractors understand safety requirements and identify unsafe site conditions, an in-house publication was produced by LTA, the Construction Safety Handbook. This Handbook provides pictorial information with description on common safety compliance and non-compliance to legislated requirements, code of practices and LTA safety specifications. The information in the handbook is a useful safety reference material to provide guidance on important safety practices. The Handbook is printed and circulated to LTA project staff as well as contractors. Contractors in turn use the Handbook to brief their workers, thereby creating greater awareness of the safety standards required on LTA worksites.

b) Pictorial Safe Work Procedure (SWP)

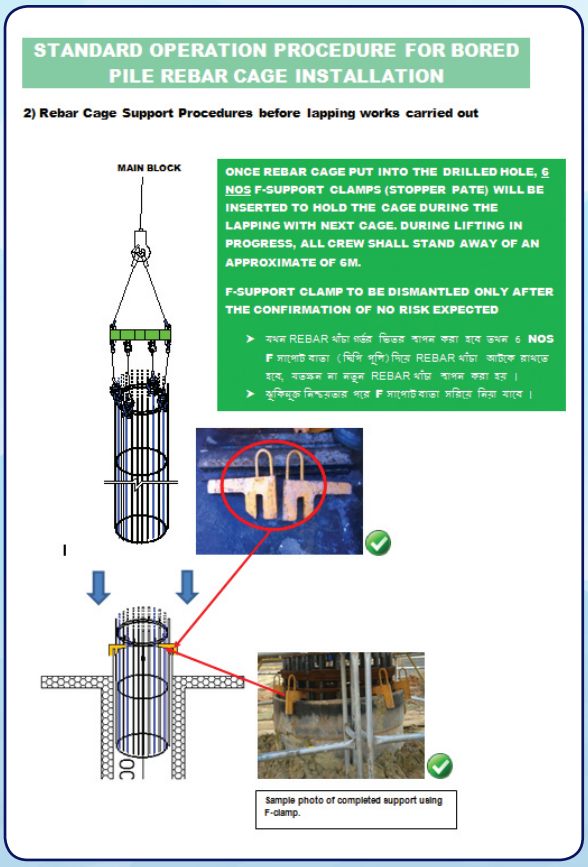

Figure 2: Pictorial SWP

Understanding the Safe Work Procedures creates an awareness as to how a work operation can be carried out

safely. To ensure their workers understand the SWP, some of our contractors have developed pictorial SWPs.

These pictorial SWPs differ from the conventional SWPs as they are illustrated with photos and sketches so that it is easier for workers to understand. In addition, it is also translated to the native languages of the various foreign workforce. As the saying goes, "A picture paints a thousand words", a pictorial SWP will go a long way in enabling workers to have a greater understanding of the work procedures, a better appreciation of the potential hazards they face and the means to mitigate these hazards.

c) Safety Meetings

Safety meetings serve as a good medium in which to communicate safety information and are excellent platforms to develop the workers' safety awareness.

Contractors across LTA worksites have implemented many different safety meetings to enhance awareness among workers. Apart from toolbox meetings, where workers are briefed on hazards relating to their scope of work, contractors also carried out meetings such as safety committee meetings, risk meetings, and coordination meetings. These meetings will be attended by a workers' representative. The topics discussed during the meeting will then be cascaded by the workers' representative to other workers on site.

A good example of developing workers' safety awareness is the "Take 5" programme implemented at some of LTA's worksites. This programme aims to focus on the particular work activity; in turn creating a better understanding of the work procedures, identifying potential hazards as well as the necessary precautions needed to mitigate these hazards. It is carried out daily before the commencement of any work activity.

In addition, LTA's project management team also take the lead in conducting regular special toolbox meetings to raise safety awareness through sharing of accident case studies.

Figure 3:
Special toolbox meeting talk by LTA's SPM

PROMOTION

a) Safety Time-out

Safety Time-out was introduced by LTA to allow contractors to take stock and refocus on safety issues and review their current work activities and its associated hazards. It also allows them to identify additional safety measures required to maintain high WSH standards on the worksites. During these time-outs, safety retraining is conducted with the workers, reminding them of the proper and safe methods of work, common and specific hazards to look out for and the necessary means to keep themselves and their fellow workers safe. Feedbacks from workers have been positive as they were appreciative of the efforts in cultivating their safety awareness.

b) Safety Promotional Programmes

Contractors have developed various programmes to engage and educate workers. Some of the programmes include, hand safety campaign, the program aims to identify activities on site that can cause hand injuries and focuses on eliminating them. Workers are made aware of the potential hazards around them through safety posters and safety warning signs at the pinch-point location. Another example is the weekly housekeeping programme developed by one of our rail contractors to instil a sense of responsibility and creating awareness among workers on the importance of good housekeeping at site.

c) Recognition and Incentive Programme

Implementing a recognition and incentive programme can help to enhance safety awareness among the workers as they would be motivated to work safely and contribute to the worksite's overall condition.

Figure 4: Worker reporting a RUI for improvement

At one of our Rail project site, a system called Report Unwanted Incident (RUI) was introduced to encourage workers to report near-misses, unsafe conditions and give suggestions for improvement. Good RUIs are selected every month by the WSH committee and the winners are awarded with $50 worth of shopping vouchers. In addition, a generous prize of a return home ticket was also given to one of their workers who display exemplary effort in safety compliances. This in turn creates greater motivation among the workers to put in more effort in ensuring a safe worksite.

Figure 5: Return home ticket given to safety champion

CONCLUSION

Safety awareness amongst workers is important as it will help them learn how to work safely within their daily environments. Ensuring the safety at workplace does not require huge investment of time or money or other resources. All you need is to establish the basic framework and pathways to achieve the desired targets. Every working individual must be made aware of their responsibilities towards safety. When individuals practice safety at workplace on a daily basis, it becomes a second nature. A safe and healthy workplace leads to confident and productive workers.

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Legal Requirements on Working At Heights

INTRODUCTION

The national workplace statistics show that fall from heights is the leading cause of industrial fatalities in Singapore. Injuries involving those who work at heights are generally much more severe than other workplace accidents. These types of injuries can often be life-threatening – some are even fatal. It is therefore essential for those who are required to work at heights be aware of these dangers and the mitigating measures to be taken.

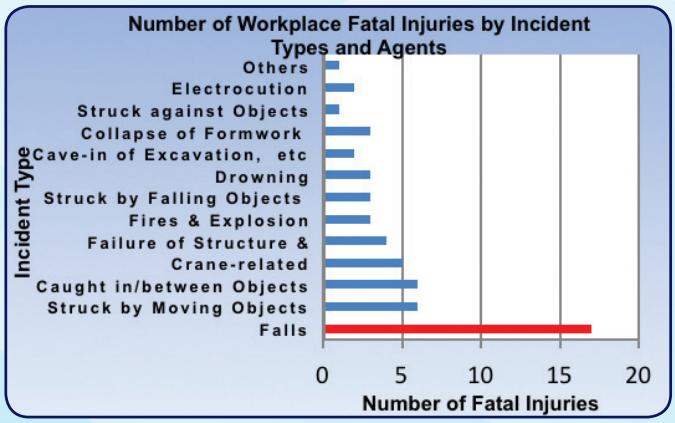

Figure 1: Statistics on fatalities (Source: WSH Institute Workplace Safety and Health Report 2012)

In this issue, we will highlight some of the key requirements relating to work at heights as stipulated in the Workplace Safety & Health (Work at Heights) Regulations which came into effect on 1 May 2013. The purpose of introducing this regulation is to enhance the safety of persons while working at heights.

KEY REQUIREMENTS OF WORKPLACE SAFETY & HEALTH (WORK AT HEIGHTS) REGULATIONS 2013

a) Fall prevention plan

It is the duty of the occupier of every workplace to establish and implement a fall prevention plan when work is being carried out at height.

The Fall Prevention Plan (FPP) shall be a site-specific plan prepared by a competent person for the purpose of reducing or eliminating the risk of falls. The FPP ensures that all reasonable fall prevention measures and methods have been implemented, prior to the commencement of work.

Some of the key elements of the FPP include:

1. Fall prevention policy;
2. Responsibilities;
3. Risk assessment;
4. Control measures;
5. Procedures;
6. Personal fall prevention equipment;
7. Equipment inspection & maintenance;
8. Training;
9. Incident investigations; and
10. Emergency preparedness

b) Training for persons at work

It is the duty of the responsible person of any person who carries out or is to carry out any work at height to ensure that the person shall work at height in a workplace only after he has first received adequate safety and health training; so as to familiarise himself with the hazards associated with work at height and the precautions to be observed.

Note: Responsible person herein refers to his employer or the principal under whose direction he carries out or is to carry out any such work.

c) Open sides and openings

It is the duty of the occupier of a workplace to ensure that every open side or opening into or through which a person is liable to fall more than 2 metres shall be covered or guarded by effective guard-rails or barriers to prevent fall.

Figure 2: Floor opening cover is flushed and secured against moving.

d) Cover, guard-rail and barrier to prevent fall

Where a cover is provided in a workplace to prevent any person from falling, it is the duty of the occupier of the workplace to ensure that the cover:

- is of good construction, sound material and adequate strength to withstand the impact during the course of work in the workplace; and
- is securely fixed in place to prevent accidental displacement.

Where any guard-rail or barrier is provided in a workplace to prevent any person from falling, it is the duty of the occupier of the workplace to ensure that:

- every guard-rail or barrier is of good construction, sound material and adequate strength to withstand the impact during the course of work in the workplace;
- the top guard-rail or the barrier is at least one metre above the work platform or working place from which any person at work is liable to fall; and
- the vertical distance between any 2 adjacent guard-rails provided or between any work platform or working place and the guard-rail immediately above it, does not exceed 600 millimetres.

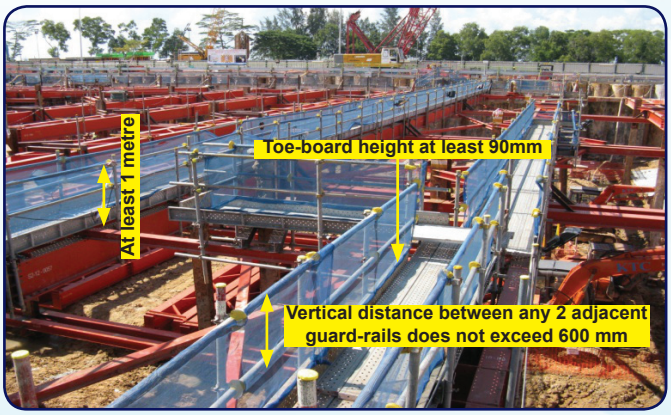

Figure 3: Guard-rails & barriers

e) Fall arrest system

Where a fall arrest system such as a full-body harness is used, it is the duty of the responsible person of any person who carries out or is to carry out at that workplace any work at height to ensure that:

- the system incorporates a suitable means of absorbing energy and limiting the forces applied to the user's body;
- there is enough fall clearance available to prevent the user from hitting an object, the ground or other surfaces, in the event of a fall.

Figure 4: Use of fall arrest system

f) Inspection of travel restraint system & record keeping

A competent person has to be appointed by the responsible person to inspect both the anchorage and the anchorage line of the travel system before commencement of work to make sure that they are safe to use; otherwise they will be removed from service if found to be faulty. The appointed personnel shall also record the inspection results and relevant details into a register and provide these records to the responsible person before the end of the work shift.

g) Ladders

It is the duty of the responsible person of the person who is carrying out the work to ensure that any ladder used is suitable and safe for the intended purpose. Portable aluminium ladders of industrial type shall only be used for access and low level work of short duration. Industrial type refers to those that are suitable for use in heavy duty industrial applications and able to withstand a lateral force of 175 kg applied on the step. The responsible person shall establish a ladder inspection procedure and performs checks prior to the commencement of work. While conducting an inspection on the ladder, among others one must:

- Ensure that the feet are not broken or malfunctioning and that the slip-resistant pads are secure.
- Inspect the ladder for cracks, bends, and splits on side rails, rungs or steps.
- Check all rung / step-to-side rail connections, as well as hardware, fittings, and accessories. Make sure both rung locks are in working order.
- Ensure that all bolts and rivets should be secure. Never use a ladder if any bolts or rivets are missing or if the joints between the steps (or rungs) and the side rails are not tight.
- Make sure the ladder (particularly the steps and rungs) is free of foreign materials such as oil and grease.
- Ensure that the spreaders are straightened and firmly locked before use.

h) Permit-To-Work system

A Permit-To-Work system (PTW) is required for any hazardous work being carried out at height, particularly for workers who are exposed to a height of more than 3 metres. The PTW will first be evaluated by the work-at-height safety assessor, where he will assess whether all reasonably practicable measures have been taken to ensure the safety and health of the person carrying out the work. The authorised manager may then issue the PTW upon endorsement by the assessor. The PTW has to be clearly posted at the work area and not removed until the date of expiry / revocation, or upon the completion of the work.

i) Industrial rope access equipment

Industrial rope access systems are typically used for areas that are harder to reach and require a high level of competency from the users, thus the workers must be trained and supervised adequately to ensure safe usage of the equipment. Where such system is used in the workplace, the responsible person of a person who is carrying out the work has to ensure that there is at least 2 independent anchorage lines (one working line and one safety line) where a suitable harness can be connected to. The working line must also possess a self-locking system to prevent the worker from falling should he accidentally loses control of his movements.

Figure 5: Use of industrial rope access equipment[1]

CONCLUSION

The introduction of the new Regulations provides a structured approach and practical guidance to those engaged in work at heights. Compliance with the new requirements on site can reduce the risk of workers falling from height.

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[1]Source: http://www.irata.org/flash_gallery/gallery_general.php

Safety Consideration in the Tunnel Ventilation System for Downtown Line Project

INTRODUCTION

The tunnel ventilation system is a critical fire and life safety component in an underground rapid transit system. In the event a fire occurs in the tunnel, the tunnel ventilation system controls the smoke flow so that a safe evacuation path is maintained for the passengers and it also facilitates rescue and fire fighting operations.

In addition, the tunnel ventilation system is also designed to address the normal and congestion scenarios that are part of the operations of the underground rapid transit system. This article will mainly focus on the fire and life safety aspect of the tunnel ventilation system for Downtown Line (DTL) project.

BACKGROUND

The DTL will comprise 34 new stations with 10 interchanges with the existing rail network. It will be the longest automated underground MRT line in Singapore.

The tunnel ventilation system for DTL is designed in accordance with the requirements specified in the Standard for Fire Safety in Rapid Transit System (SFSRTS).

COMPONENTS OF THE TUNNEL VENTILATION SYSTEM

Tunnel ventilation fans (at least 1.6m in diameter) are installed in the tunnel ventilation fan rooms at each end of the station, (see Figure 1). Each tunnel ventilation fan is fully reversible, which means that the fan can be operated to draw air from the external environment into the tunnels and it can also operate in the reverse direction to extract and discharge air or smoke from the tunnel to the external environment. The tunnel ventilation fan rooms are connected to the tunnels by dampers. By opening and closing the dampers, airflow can be directed into or out of one tunnel or both bounds of the tunnels simultaneously.

Figure 1: Tunnel ventilation fan room

In addition to the tunnel ventilation fans, tunnel booster fans are installed in tunnel sections with crossovers and cripple sidings to supplement the tunnel ventilation fans, (see Figure 2).

Figure 2: Tunnel booster fans installed in tunnels

Each station is equipped with a pair of underplatform exhaust / smoke extraction fans which serves triple functions:

1) To remove heat dissipated by the train propulsion system and air-conditioning condensers when a train stops at a station;
2) To extract smoke from the tunnel during a tunnel fire emergency; and
3) To extract smoke from the station in the event of a fire in the station public area.

All the tunnel ventilation system equipment is rated to operate in an environment of 250°C for at least two hours.

Fan redundancies are provided such that the system design can be maintained in the event that one of the fans in the tunnel ventilation system is not operational.

FIRE DETECTION AND PASSENGER EVACUATION

DTL trains are constructed of low flammability, low smoke emission and low toxicity materials. A 45-minute fire barrier is provided between the train's underframe and saloon and trains are also provided with fire detection systems to detect fires in the vehicle. An alarm is sent to the Operation Control Centre when smoke is detected by the train's fire protection systems.

Where possible, the incident train will be brought to next station's platform where the passengers can evacuate easier and faster. At the incident station, all the tunnel ventilation fans will be operated to extract smoke from the incident trackway. Air will be induced through the station entrances and platform screen doors, creating tenable conditions for passengers to evacuate through the station's public area and entrances.

If the incident train on fire stalls in the tunnel, the Operator at the Operation Control Centre will decide the direction of evacuation and operate the tunnel ventilation system in a push-pull configuration such that a smoke free path is created for the evacuation of passengers, as illustrated in Figure 3. The Operator at the Operation Control Centre will also communicate the direction of evacuation to the

passengers in the incident train through the Communication System and direct the passengers to evacuate the train using the end detrainment doors into the tunnels and move towards the next station. Illuminated Tunnel Evacuation Signage System in the tunnels will also be lighted up to guide the passengers along the evacuation path.

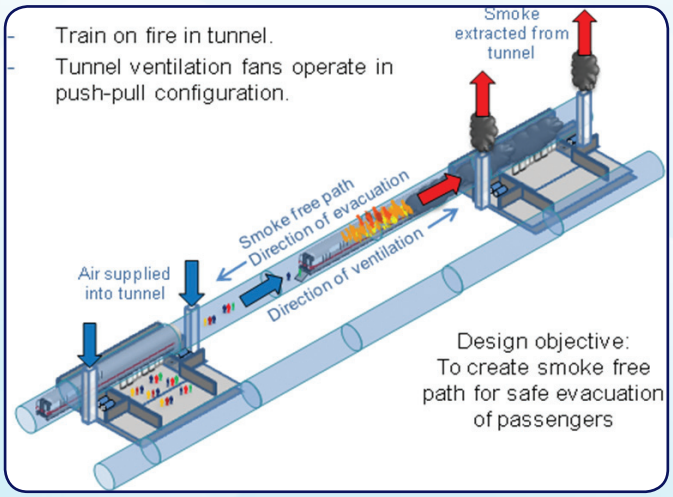

Figure 3: Tunnel ventilation strategy for emergency operation (train on fire in tunnel)

If there is another train behind the train on fire in the same tunnel, the default mode of ventilation is to blow the smoke in the direction of train travel, so that the train behind the incident train will not be exposed to smoke. Passengers will evacuate to the upstream station (i.e. to the station from which they have just departed).

DESIGNING THE TUNNEL VENTILATION SYSTEM

Extensive simulations are carried out for each tunnel section using the Subway Environmental Simulation and Fire Dynamics Simulator software to analyse the airflow, temperature and smoke flow in the tunnels and verify that the tunnel ventilation system can provide a tenable environment for safe evacuation of passengers during a fire emergency.

TESTING AND COMMISSIONING

To ensure that the fans and dampers supplied meet the performance requirements and are able to integrate with the other interfacing systems as per the design intent, factory acceptance tests, tunnel air flow and smoke tests, and integrated testing and commissioning are conducted for the tunnel ventilation system, (see Figure 4 for Factory Acceptance Test and Figure 5 for smoke test during testing & commissioning).

Figure 4: Factory Acceptance Test - High temperature test setup

Figure 5: Smoke tests conducted to verify effectiveness of tunnel ventilation system during testing & commissioning

OPERATION AND CONTROL

The tunnel ventilation system is monitored and can be controlled from the Local Control Panel and Ventilation Control Panel in the station's Local Sequential Control Room and Passenger Service Centre respectively, as well as from the Operation Control Centre. The Operation Control Centre has the highest priority of control, followed by the Ventilation Control Panel and the Local Sequential Controller.

Depending on the train and fire location during emergency operation, different fan and damper configurations are operated. To reduce the Operator's workload and time required to operate the tunnel ventilation system, operational requirements are pre-programmed in the control system.

When a fire is detected on a train in the tunnel, the Integrated Supervisory and Control System (based on information from the signalling and train fire detection system) will automatically recommend the most appropriate emergency operation mode for the tunnel section to the Operator at the Operation Control Centre. The Operator may choose to operate this particular mode of operation or other modes depending on the situation at hand.

CONCLUSION

The tunnel ventilation system plays an integral role in ensuring passengers' safety in an underground MRT system. The provisions for the tunnel ventilation system for Downtown Line are able to provide a tenable environment for passengers to evacuate during a fire emergency.

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Dengue Contingency Plan

INTRODUCTION

Since the start of the year, one of the most pressing issues for Singapore is Dengue. NEA convened the Inter-Agency Dengue Task Force (IADTF) to coordinate actions across governmental agencies and relevant associations to control the spread of this potentially deadly disease, and LTA made no hesitation in supporting the IADTF. In April 2013, the LTA Dengue Contingency Plan was formalised and implemented at all of our construction sites.

This article will cover the plausible reasons for this epidemic and the additional dengue prevention initiatives LTA has put in place during this critical season.

THE EPIDEMIC

In the beginning of the year, an elevated number of dengue cases were observed despite the colder months where breeding of mosquitoes are expected to be low. By week 15, the accumulated numbers escalated to about four times more than in 2012. In June, dengue cases were hitting a record high of 853 cases[1] per week and 4 deaths were recorded. This aggravation of the epidemic could be due to several factors, and they include the virus type, herd immunity and the climate.

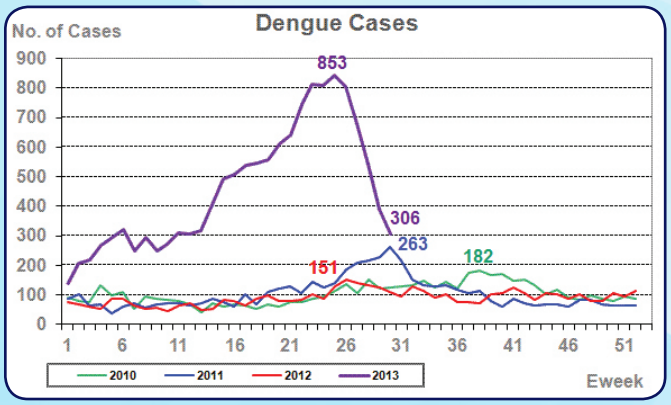

Figure 1: Number of Dengue cases in 2013 in Purple, as of week 30.[2]

There are four serotypes of dengue virus (DEN-1, DEN-2, DEN-3 and DEN-4). For these cases, it was observed that the virus serotype in circulation had shifted from the conventional DEN-2 to DEN-1 and DEN-3. This would mean that those who previously developed immunity to the conventional DEN-2 virus would still be susceptible to the DEN-1 and DEN-3 viruses.

Infection with one dengue serotype would confer lifelong immunity to that particular serotype[3]. It would also mean that our general community has developed higher immunity towards the conventional DEN-2 virus strand, but low immunity towards DEN-1 and DEN-3.

Warmer climate hastens the maturation of larvae and shortens the incubation period of the virus in mosquitoes. With the weather becoming warmer from January to June, the number of mosquitoes, acting as carriers for the virus increases.

Hence due to the shift in serotype predominance, the low herd immunity, and coupled with the warming climate, we are therefore experiencing the current epidemic.

a) Aedes Mosquito

The two species of aedes mosquito, Aedes aegypti and Aedes albopictus, are the main vectors that transmit dengue virus. The viruses are passed on to humans through the bites of an infected female aedes mosquito, which acquires the virus while feeding on the blood of an infected person. Below are the common characteristics of aedes mosquitoes:

- Features: Black and white stripes

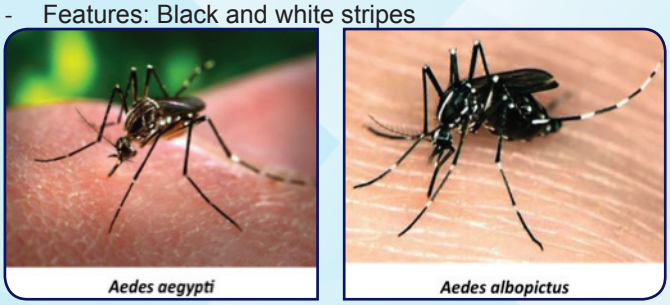

Figure 2: Picture example of an Aedes aegypti and Aedes albopictus

- Feeding Time: Day Time (most active at dawn and dusk)
- Attracted to mammals' sweat and carbon dioxide

Various species of aedes mosquitoes are differentiated by their particular ecology, behaviour and geographical distribution. Aedes albopictus is primarily a forest species while Aedes aegypti is an urban mosquito that breeds in clean water and near urban population[4].

Flight range studies suggested that most female Aedes aegypti may spend their lifetime in or around the house and they usually fly an average of about 568 metres[5]. This means that people, rather than mosquitoes, move the virus more rapidly within and between communities and places.

b) Dengue Fever

Dengue fever and dengue haemorrhagic fever (a more severe form) are the most common mosquito-borne viral diseases in the world.

At present, there is no specific treatment for dengue fever and the recovery is solely dependent on the patient's immunity, with only general measures to aid the recovery process. Hence, it is vital for all to be extra vigilant, especially if your project sites or home are situated within an active cluster. Studies have also suggested that if an individual who has previously been infected and recovered from a particular

[1] Source: http://www.moh.gov.sg/content/moh_web/home/statistics/infectiousDiseasesStatistics/weekly_infectiousdiseasesbulletin.html

[2] Source: http://www.dengue.gov.sg/subject.asp?id=73

[3] Source: http://emedicine.medscape.com/article/215840-overview

[4] Source: http://www.who.int/denguecontrol/mosquito/en/index.html

[5] Source: Liew, D. C. (2013). Mosquitoes Of Public Health Significance In Singapore. Singapore: Environmental Health Institute, National Environment Agency.

serotype, but is now infected with any of the other three, he may have an increased risk of developing a more severe form of dengue[6].

c) Chikungunya

Other than dengue fever, there is also an outbreak of another mosquito-borne disease, chikungunya, this year. As of June 2013, 378 cases of chikungunya have been reported in Singapore, which is already a seventeen times increase, as compared to 22 chikungunya cases in the whole of 2012.

While dengue can be fatal, chikungunya rarely is, though the joint pain upon the onset can be more severe, and sometimes do last for several months. Similar to dengue, there is no cure for this disease. Both shared similar symptoms that include abrupt onset of fever, muscle pain, headache, nausea, fatigue and rash. The treatment of chikungynuya is focused on relieving the symptoms.

Chikungunya is also transmitted through the bites of infected female mosquitoes, and the primary vector that spread this virus is the forest dwelling Aedes albopictus. Thus, LTA project sites that are near forested areas need to take up additional vector control measures.

d) Common Breeding Grounds

Clearing of stagnant water and removal of water receptacles will prevent on-site breeding. Below are some areas where breeding is commonly found:

- Construction materials and equipment (e.g. beams, under decking, metal toe-board, canvas sheet, water-stop)
- Unused materials (e.g. unused water tanks, plastic containers, drums, pipes and hose, strutting)
- Discarded receptacles (e.g. waste storage area, skip tank, litters or waste material, etc)
- Ground depression (e.g. hole in ground, concrete floor, water ponding on site, etc)
- Others (e.g. vegetation, brick hole, water dispenser tray, statue at site office, etc)

Hence, all contractors need to conduct daily in-house vector inspection in order to remove all potential breeding areas.

CONTINGENCY PLAN

LTA formalised a set of contingency plan in line with NEA's nation-wide Dengue Community Alert System. The alert system is classified into Green, Yellow or Red zone where Yellow dengue alert highlights that there are less than 10 dengue cases in a cluster, red alert signifies there are 10 or more cases in a cluster. For community that does not have dengue cases over 21 days of surveillance, it will be classified under green zone.

Under the 3 level colour-coded alert systems, contractors are required to follow the measures of respective alert level in their zone (refer to Figure 3).

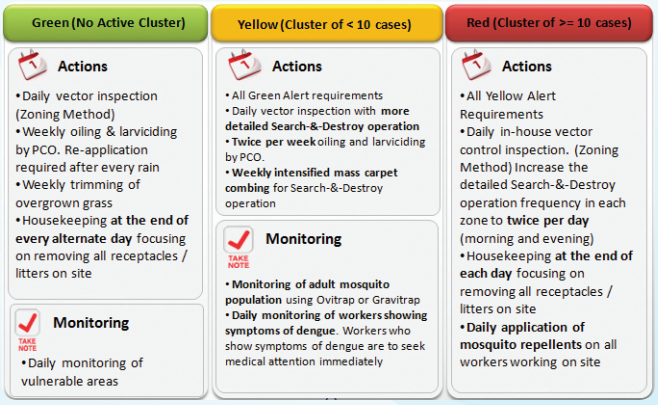

Figure 3: Measures to be undertaken by projects under the revised contingency plan

In event when a site worker / staff is diagnosed with dengue, the below steps shall be taken:

- Inform Safety Div through our Environmental Engineers (or send to LTA-ENV@lta.gov.sg) as soon as possible
- Provide us with details of the patient as follows: name, company, date of diagnosis, residential address, location of workplace(s), and current well being of the worker
- Isolate patient from site
- Ensure that patient applies mosquito repellent daily to prevent mosquito from biting him, thereafter spreading the virus
- Conduct carpet combing of site as soon as possible (fogging, search-&-destroy inspection and housekeeping)
- Follow yellow alert measures for 21 days (this will be reflected in the weekly updates to the project team)
- Advise other workers to apply insect repellent

CONCLUSION

As Singapore is in the tropics, dengue remains a prevalent issue. This year, dengue records have hit a new height. LTA has fully engaged all construction sites to take action against the spread of dengue by increasing awareness and carrying out housekeeping, targeted at reducing potential mosquito breeding spots. Our senior management also came down personally to pledge against dengue in support of ASEAN dengue day on 17 June 2013. While LTA and the contractors continue to look at ways to improve site vector control, it is also everyone's responsibility to ensure there is no breeding of mosquitoes on site.

While the spotlight shines on dengue prevention this year, we should continue to ensure all environmental standards are maintained.

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Assistant Environmental Manager
Safety Division

[6] Source : http://newscenter.berkeley.edu/2011/12/21/dengue/

Safety Barriers for Temporary Road Works

INTRODUCTION

A road safety barrier is a roadside device that is intended to reduce the potential risk of a collision with the roadside hazards if a vehicle veers off the carriageway. At a work zone, the function of safety barriers includes shielding the construction works, workers within the site and providing a physical separation between opposing traffic flow.

FUNDAMENTAL REQUIREMENT

Due to the dynamic nature of a vehicle impact, safety barriers are required to be crash-tested in order to demonstrate that the barriers are able to safely contain and redirect an errant vehicle. The evaluation standards for roadside safety devices include the National Cooperative Highway Research Program (NCHRP) Report 350, Manual for Assessing Safety Hardware (MASH) and EN 1317.

TYPE OF SAFETY BARRIERS

Different type of safety barriers are available to cater for various site conditions or type of road works to be carried out. If there is inadequate space behind the safety barrier for it to deflect when impacted, then a rigid or fully restrained barrier has to be used.

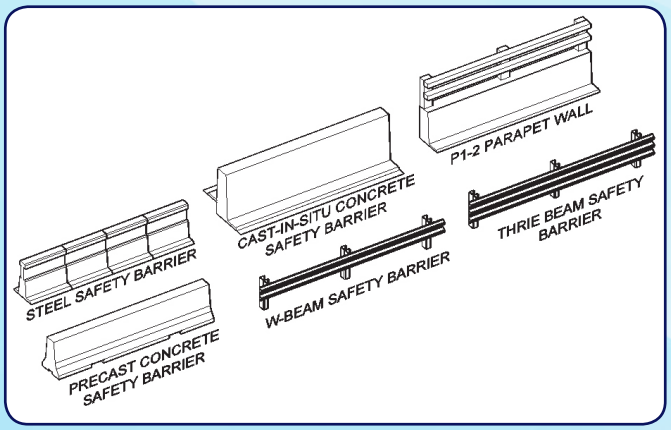

Figure 1: Types of safety barriers that can be used for temporary road works

DESIGN CONSIDERATIONS

To ensure that the safety barriers are able to perform as intended, it is important that the barriers are used and installed according to the design specifications or manufacturer's recommendation for proprietary systems. Some of the main design considerations include:

a) Length of safety barrier

A safety barrier should be sufficiently long not only to adequately shield the hazard, but also a minimum length has to be provided based on the actual system that has been crash-tested. If a safety barrier is to be used along a road bend, the barrier should be extended along the straight section before and after the road bend.

b) Anchorage for temporary safety barriers

Where moveable temporary safety barriers have to be restrained, the provision of the ground anchorage must be in accordance with the design specification or manufacturer's recommendation for the specific safety barrier to be installed. This is to ensure that the barrier will not fail when impacted or result in undesirable consequences such as over-turning or vaulting.

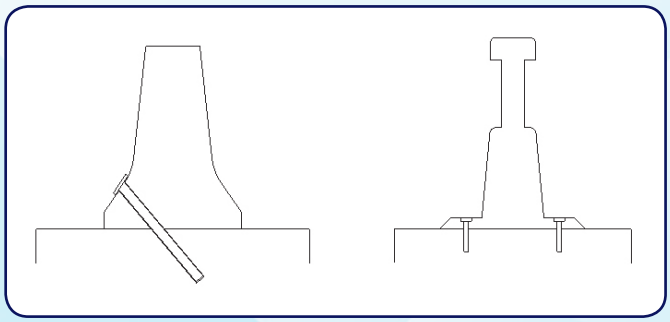

Figure 2: Examples of ground anchorage for temporary precast concrete safety barrier (left) and steel safety barriers (right).

c) Safety barrier end treatment

While a safety barrier is intended to mitigate vehicular conflict with roadside hazards, the exposed ends of a safety barrier could potentially be hazardous if impacted. At locations where there is a considerable risk of vehicles impacting the leading terminal, appropriate treatment such as a crash cushion has to be provided.

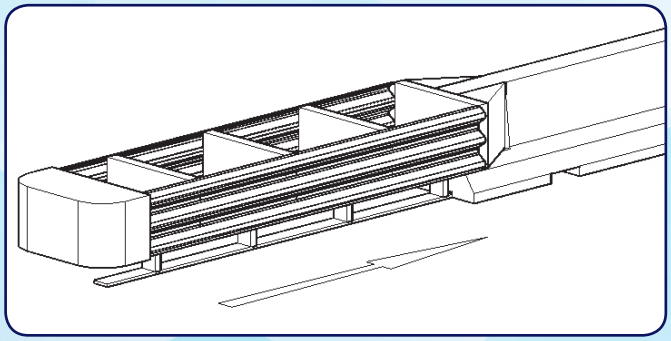

Figure 3: Use of crash cushion as end treatment for concrete barrier

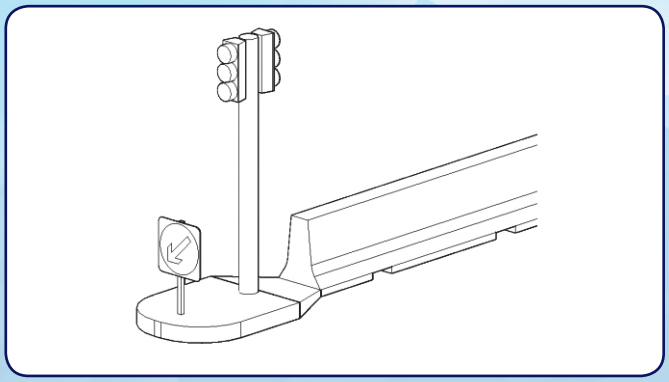

Figure 4: At a road junction, if the risk of vehicles veering off the carriageway is low, the concrete barrier can be placed behind the kerbed median and traffic signal.

d) Connecting different type of safety barriers

Safety barriers should generally be of the same type for a particular installation so that the barriers can perform adequately. However, when there is a need to join different type of safety barriers together, appropriate transition section has to be used.

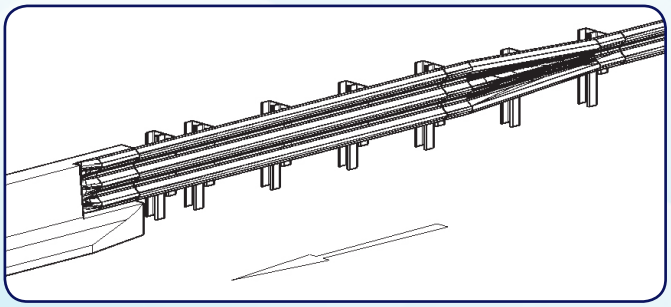

Figure 5: Connecting concrete safety barrier to w-beam guardrail using 6.0m thrie beam transition section at 0.5m and 1m post spacing

e) Provision of safety barrier along road bends

The typical 3.8m long precast Type F concrete barrier is generally suitable at locations where the carriageway is fairly straight. However, at locations such as along road bends and corner sections, the rigid individual precast sections will not be able to be properly interconnected. For such applications, other types of safety barriers such as w-beam, thrie-beam or modular steel safety barriers would be more appropriate. It is necessary to ensure that the correct type of safety barrier is selected at the design stage based on the alignment of the carriageway to ensure that the barrier can be properly installed on site.

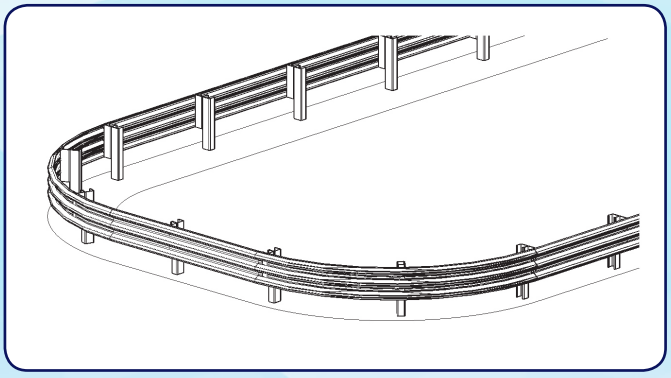

Figure 6: Use of thrie-beam guardrail at corner section

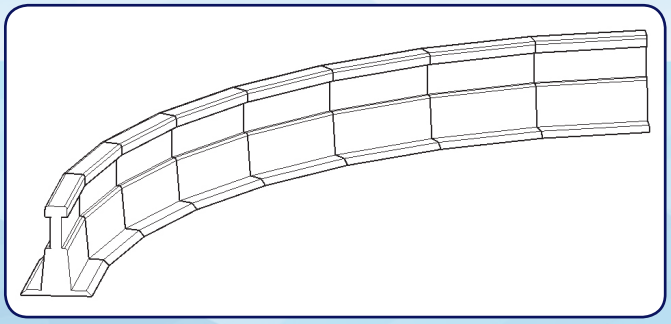

Figure 7: Apart from the standard 3.8m Type F barrier, other type of temporary safety barriers are available in shorter span and angled sections which are suitable to cater to corners and road bends such as modular steel barriers

f) Provision of adequate visibility

At locations such as the approach to road junctions or along the inner radius of road bends, the placement of the safety barriers have to take into consideration the need to maintain adequate Stopping Sight Distance (SSD). This is to ensure that motorists will have adequate time to avoid a collision with another vehicle or a fallen object along the carriageway.

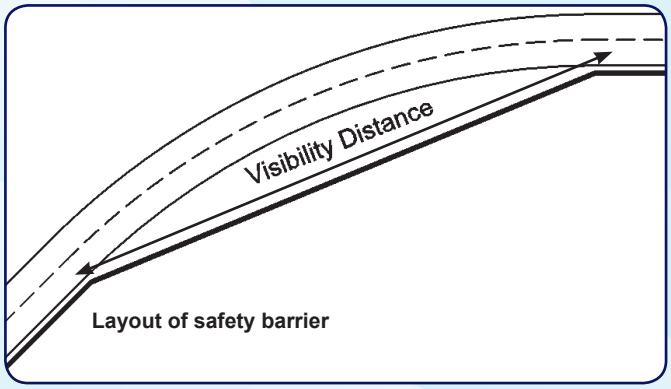

Figure 8: Provision of an offset of the safety barriers from the carriageway to maintain adequate visibility across the road bend

g) Delineation

As safety barriers are located near the carriageway, adequate delineation is required to guide motorists to keep an appropriate distance from travelling too close to the barriers. Type of delineation include the provision of edge lines, painting of concrete safety barrier, mounting of lighted or non-lighted devices on the safety barrier and attaching delineating strips along the traffic face of the safety barrier.

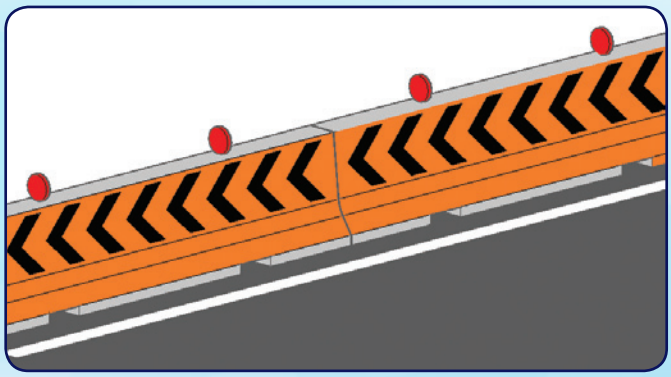

Figure 9: Example of precast concrete safety barrier to delineate deviations along the carriageway

CONCLUSION

The provision of safety barriers for temporary traffic scheme is intended to mitigate any potential risk in the event that a vehicle veers off the carriageway. It is important that the selection, design and installation of the safety barrier is adequate to ensure that the barrier will be able to properly contain and redirect the impacting vehicle with minimal risk to the vehicle's occupants and other road users.

Mohamad Rozmand Bin Jamaludin
Deputy Roads System Safety Manager
Safety Division

Editorial Page

LTA X-Dengue Campaign

On 17 June 2013, in support of the 3rd ASEAN Dengue Day, the LTA X-Dengue Campaign was held at Downtown Line 3 (DTL3) Contract 923 Samsung C&T Corporation site office where LTA's senior management pledged our commitment to keep our major civil construction sites dengue free. This pledge reaffirms LTA's commitments in tackling dengue. NEA Director-General Mr Derek Ho was also present to witness this pledge signing ceremony.

The pledge was led by our Deputy Chief Executive (Infrastructure & Development) Mr. Chua Chong Kheng together with LTA's senior management consisting of Senior Group Director Rail, Group Director Roads Projects, and Group Director Safety and Contracts. Acknowledging that Dengue can pose serious health problems, in his speech, he reiterated LTA's strong commitment to keeping all its construction sites free from potential breeding area.

On the pledge signing day itself, mass "carpet-combing" exercises were carried out on all LTA sites across Singapore. Together with LTA project teams, contractors pulled in all their resources for the morning to ensure all areas on-site were combed for stagnant water to eliminate all potential breeding areas.


TUESDAY, JUNE 18, 2013 THE STRAITS TIMES

LTA pledges to keep worksites dengue-free


加强"黑区"工地防蚊力度

LTA's X-Dengue Efforts featured in local media

DCE Mr. Chua Chong Kheng

Guest speaker
Mr. Jeffrey Ng
(NEA)

Guest speaker
Mr. Mike Murugan
(Samsung)

Signing of X-Dengue Pledge by LTA Senior Management, witnessed by NEA Director-General Mr. Derek Ho

Carpet combing exercise at DTL3 Contract 923

Football size mozzie models made by ECO in efforts to attract curiosity and raise awareness among workers at Contract 1687

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