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2 Important Facts on Fall Control Measures

INTRODUCTION

The Workplace Safety & Health Report 2016 published by the Workplace Safety and Health Institute reported a total of 66 fatal accidents in 2016, of which 13 (20%) of these were due to Fall from Heights (FFH). FFH contributed to the largest proportion of workplace fatal injury every year, as shown in Figure 1.

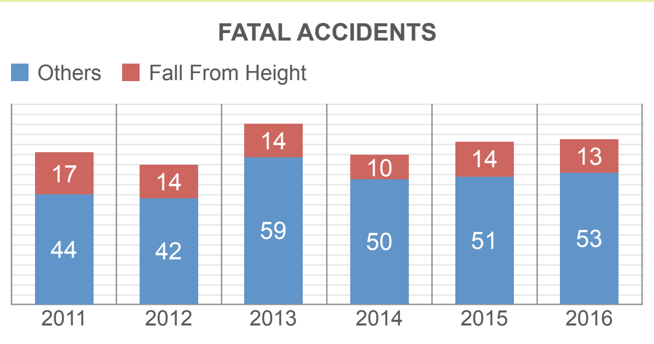

Figure 1: Number of fatal accidents due to FFH as compared to all other types of work[1]

In the latest issue of LTA's Annual Safety Performance report, a total of 46 MOM reportable accidents occurred on LTA project sites in 2016. Although there were no fatalities resulting from FFH at LTA work sites, 4 of the 47 injured persons sustained FFH injuries. As shown in Figure 2, FFH is also one of the top 5 accidents that occurred at LTA work sites.

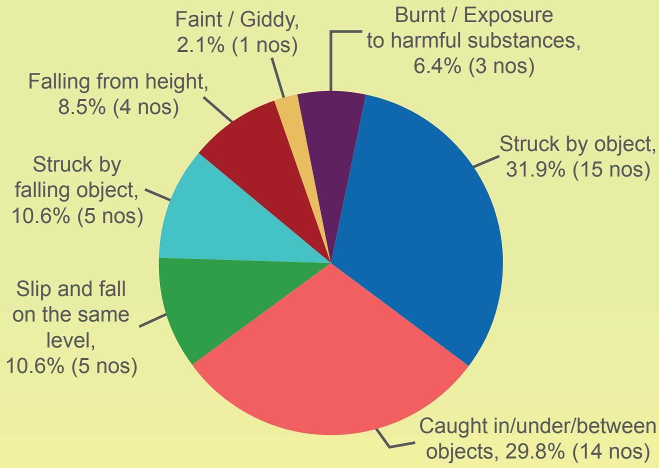

Figure 2: MOM reportable accidents in LTA sites[2]

To raise awareness on FFH, this article will highlight the important facts pertaining to fall control measures.

Prior to any Work at Heights (WAH), a risk assessment must be conducted. This identifies the work risks and the people exposed to it. Knowing these will allow for a risk management plan to be developed. The Risk Management process should always follow the order of Elimination, Substitution, Engineering Controls, Administrative Controls, and then only as a last resort, Personal Protective Equipment.

FALL CONTROL MEASURES

An effective Fall Prevention Plan (FPP) shall eliminate or reduce FFH risk. An effective FPP generally consist of the following measures:

1) Providing Safe Means of Access and Egress

Contractors must always provide their workers with a safe means of getting to and from the location of work. Greater emphasis has to be given to less accessible areas especially where an area accessed poses a risk of falling. This is especially crucial when working on inclined structures such as roofs where the risks of falling is exacerbated by the sloping roof. Access should further be supplemented by the provision of adequate lighting and removal of obstructions that would otherwise hinder the movement of workers, their equipment, and work materials.

2) Edge Protection

Edge Protection is essential in reducing the risk of a person falling from open sides or through openings on a surface.

Edge protection shall be provided up to the edge of a scaffold, walkway, ramp and landing, or wherever a person is at risk of falling from open sides. Effectively, edge protection must be designed to withstand the impact of a falling person against it. In accordance with Singapore Standards SS 567, the guard-rail must be able to withstand 100kg applied at any direction at any point.

A temporary edge protection system will consist of a principal guardrail, an intermediate guardrail and a toe board. Each of these components should adhere to the design shown in Figure 3.

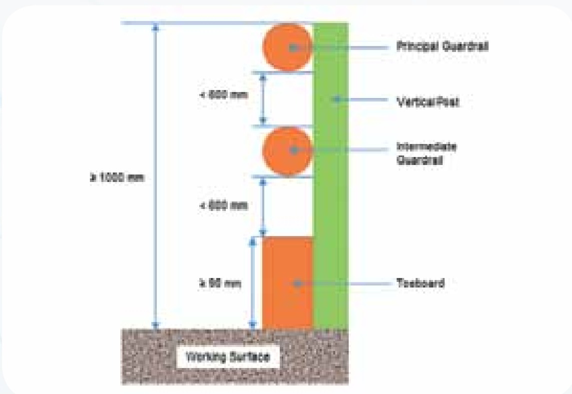

Figure 3: Edge protection requirements[3]

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1 National WSH Statistics Report 2016
2 LTA Annual Safety Performance Report 2016
3 Code of Practice for Working Safely at Heights

Figure 4: Example of poor edge protection where there is risk of person falling from open sides

Figure 5: Example of good edge protection where guardrails and toe boards are securely installed

3) Slab Opening Control Measures

Due to the dynamic nature of workplaces, any work area over voids and openings must be identified prior to the start of work and appropriate measures shall be taken to eliminate risks of falling through them.

LTA has introduced control measure guidelines for voids / openings depending on their size. For openings with widths less than 300mm, a distinctively painted plywood cover must be secured to cover the opening. For openings with widths between 300mm and 1000mm, an A13 mesh with design load of 1.5kN must be cast into the slab opening, a plywood cover should also be used to prevent debris from falling through. The mesh should only be removed when requested. For openings wider than 1000mm, standard barricades with toe boards and netting should be provided to protect people or prevent objects from falling through. When an opening is protected by a cover, a suitable signage should also be placed nearby or onto the cover itself to warn people of the hazard. For an area where vehicle movements are expected, a PE-designed steel deck should be erected to prevent vehicles or machinery from falling through.

4) Travel Restraint System

This is a system which restricts the travelling range of a person wearing the safety harness or belt attached to a lanyard secured to a static line or anchorage point[3]. A Travel Restraint can be adopted when the edge protection or the slab opening cover has yet to be installed.

When used correctly, it will restrict the travelling range of a person, such that the person will not get into a position where he / she could fall off the edge of a surface.

5) Individual Fall Arrest System

A Fall Arrest System should only be used when it is not reasonably practicable to provide other measures to prevent a fall[3].

The Fall Arrest System comprises of the use of lifelines and safety harness. There are three main categories of lifelines, namely vertical, horizontal and self-retracting lifeline. Contractors should deploy the lifeline which best suits the work to be done.

Lifelines can deteriorate over time and must be properly maintained to ensure its effectiveness. They can be affected by ultraviolet light, sparks or flame, chemicals, marking or dying, friction and abrasion, and the way it is stored. Each of these factors must be considered when selecting and using lifelines, as its durability and effectiveness are impacted.

Lifelines should be checked on a daily basis by a competent person before usage. If there is any shear or cut, discolouration, missing inspection label or connecting hardware damaged, the lifeline is deemed unsafe and must not be used further.

Users of personal fall arrest systems must undergo WAH training conducted by Accredited Training Providers before commencing WAH. This course trains workers on the correct procedures of securing their personal fall arrest system, the hazards and the safe work practices associated with WAH. Also, workers should always practice the 100% tie off habit and adhere to safety precautions at all times.

CONCLUSION

Fall control measures are an integral part of workplace safety. When actively practiced, it can save lives and ensure workers' safety. The FPP and its control measures should be reviewed periodically to ensure its relevance and effectiveness. Let us work together in bringing down the number of FFH accidents and work towards our vision of Zero Accident.

Kenneth Chan
Assistant Safety and Health Manager
Safety Division

4 Thematic Exercise on Electrical and Hot Works

INTRODUCTION

As part of Safety Division's continuous efforts to improve the safety standards on our worksites, thematic exercises focusing on critical work activities are conducted regularly during the different phases of work. The recently concluded thematic exercise focused on both electrical and hot works.

A total of 28 worksites along the Thomson East-Coast Line (TEL) Project were audited during this thematic exercise.

SUMMARY OF FINDINGS

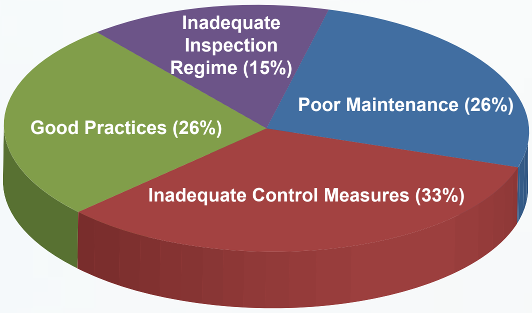


Figure 1: Pie chart summarising the findings in the thematic exercise

In general, both the statutory and contractual requirements on the safe operation of electrical and hot works on site were largely adhered to. However, there were still some areas for improvement and these could be broadly categorised as:

- Inadequate Control Measures (33%)
- Poor Maintainance (26%)
- Inadequate Inspection Regime (15%)

On a positive note, there were many good practices observed on site that were beyond statutory and contractual requirements, and these accounted for slightly more than a quarter (26%) of the findings on site.

GOOD PRACTICES

Apart from complying with the Workplace Safety and Health (Construction) Regulations as well as LTA contractual requirements, many of our Contractors have gone the extra mile to implement good practices and safety initiatives to ensure that their workforce is kept safe with regards to work activities involving electrical and hot works.

The following are some of the noteworthy practices / initiatives observed in this exercise:

- A systematic way to identify and monitor all the electrical distribution boxes (DBs) on site with their actual locations clearly defined on regularly updated site plans (Figure 2). This assists both the Contractor's safety team and Licensed Electrical Worker (LEW) in ensuring that these DBs are checked and maintained regularly. The site plans also identifies potential areas that may require the shifting of the DBs for efficiency.
- The use of protective sleeves to prevent damage to the gas hoses as well as the use of coil springs to minimise the bending radius of the gas hose connection to the gas cylinder gauge outlet (tight bending radius causes over stretching of the gas hose which may result in cracks or in more severe cases, the disconnection of the gas hose) (Figure 3).
- Installation of the weatherproof protection box cover for Socket-Outlet Assembly (SOA) located in open areas exposed to the environment, to eliminate water ingress to electrical sockets during inclement weather (Figure 4).
- The use of recycled construction waste such as PVC pipes and rubber paddings to guide and protect electrical cables and gas hoses laid into the launch shaft or station box to minimise contact with sharp edges along the way.

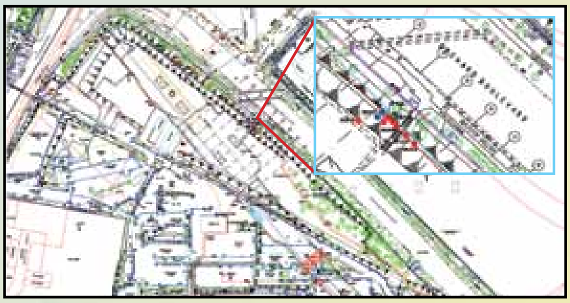


Figure 2: Systematic electrical DB tracking of actual site location

Figure 3: Engineering control to protect gas hoses

Figure 4: SOA with weatherproof box cover

AREAS FOR IMPROVEMENT

The following section highlights the common findings of substandard practices and conditions found during the thematic exercise. These findings are common on many worksites, but can easily be eliminated if proactive measures are strictly followed.

Inadequate Control Measures

Inadequate control measures on the safe use of electrical equipment and appliances as well as hot work related equipment contributed to one third of the findings. Some of the more common findings include:

- Improper / inadequate earthing of equipment (Figure 5)
- Substandard SOA extensions (Figure 6)
- Improper personal protective equipment used
- Gases not purged from hoses when not in use.

Figure 5: Welding machines not adequately earthed

Figure 6: Substandard SOA extensions

Poor Maintenance

Poor maintenance of equipment accounted for a quarter of all findings. The common ones include:

- Exposed and damaged welding cables / terminals (Figure 7)
- Damaged gas hoses (Figure 8)
- Damaged pressure gauge on gas cylinders
- Defective fire fighting equipment (empty / expired fire extinguishers).

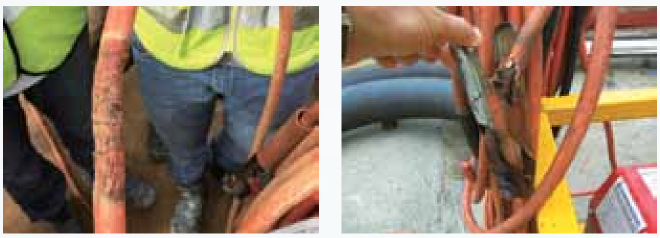


Figure 7: Damaged / exposed welding cables

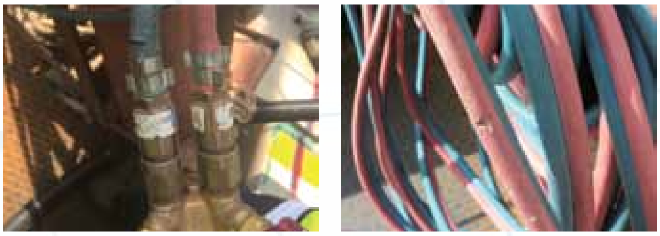


Figure 8: Damaged / cracked gas hoses

Inadequate Inspection Regime

While not widespread, inadequate inspection regime at some sites had resulted in workers using faulty electrical equipment, exposing them to electrical hazards. To prevent accidents from happening, it is important that electrical equipment are regularly inspected by a LEW to ensure that they remain in good working condition. Factors contributing to inadequate inspection include:

- Poor control of sub-contractors
- Poor working attitude of LEW
- Poor or missing maintenance records for each equipment.

Figure 9: Electrical equipment / tool without LEW's monthly inspection sticker

CONCLUSION

Electrical and hot works hazards if not properly managed can potentially cause harm to workers. It is therefore important that supervisors and workmen understand the importance of electrical and hot work safety and take the necessary precautions when handling with electrical tools or performing hot works.

Moving forward, Safety Division will continue to carry out thematic exercises focusing on the various high risk work activities and enhance competency of the workforce. Good practices and areas for improvement will be shared to raise the level of awareness and to benchmark WSH practices across all LTA worksites.

Eric Tan S T
Deputy Safety and Health Manager
Safety Division

6 Noise Mitigation Measures For LTA Construction Sites

INTRODUCTION

In 2016, the launch of the East Coast Package of Thomson-East Coast Line (TEL) resulted in LTA reaching an unprecedented number of 115 Major and Mega construction projects throughout Singapore. With the upcoming Circle Line 6 and North South Corridor (NSC) project, there will be even more construction sites across the country. This means that more stakeholders would be susceptible to construction noise generated from LTA projects. With the existing projects, the total number of feedbacks received via NEA increased by 10%, from 679 in 2015 to 755 in 2016. To minimise the disturbance caused to the public, implementation of effective noise mitigation measures is necessary. In addition, proper public relation efforts are also required to seek understanding from the public.

INNOVATIVE NOISE MANAGMENT

Jagged Edge Noise Barrier Design

To reduce the impacts on noise sensitive receivers around the construction sites, LTA embarked on a research collaboration with National University of Singapore (NUS) in 2015, to develop innovative solutions to mitigate construction noise.

Noise barriers are typically put up around construction sites to mitigate noise generated by construction works. Since Downtown Line to Thomson-East Coast Line, the height of perimeter noise barriers on our sites have increased from 6m to 12m. However, due to space and safety considerations, there is a height limit for the noise barriers on our construction sites. Hence the focus of this research project was to overcome site constraints and enhance the performance of the existing noise barriers through design modification.

To achieve this, the first step was to conduct noise mapping to analyse noise arising from the construction activity, as well as understanding the frequencies and the sound level emitted from noisy machineries (Figure 1).

	Bore Piling	Vibratory Piling	Excavating	Hacking	Concreting
Sound Pressure Level	91 $dB_{(A)}$	104 $dB_{(A)}$	84.5 $dB_{(A)}$	94.7 $dB_{(A)}$	92.5 $dB_{(A)}$
Peak Frequency	800 Hz	250 Hz	250 Hz	800 Hz	630 Hz

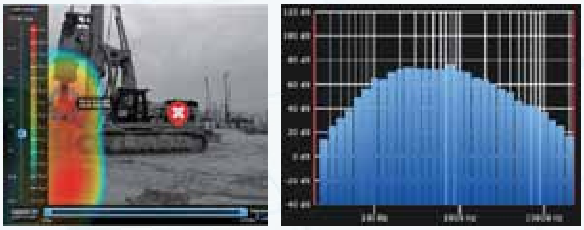


Figure 1: Analytical results for noise mapping

With the establishment of these parameters, the research team then developed a new noise barrier design inspired by the engine nacelle of the Boeing 787 plane. The principle behind the jagged-edge design was that it results in destructive interference of the sound waves, which reduces more noise as compared to a straight-edge design.

To determine the effectiveness of this design, noise measurements were taken for both noise barrier designs, under similar site conditions (Figure 2) at TEL Contract T221 Havelock Station. The results proved that the jagged edge noise barrier design consistently achieved a better performance with noise reduction of up to 5dbA (Figure 3), which is equivalent to 30% reduction in human perception.

Figure 2: Normal cantilever barrier (left), and new jagged edge design (right), at TEL T221 during pilot testing

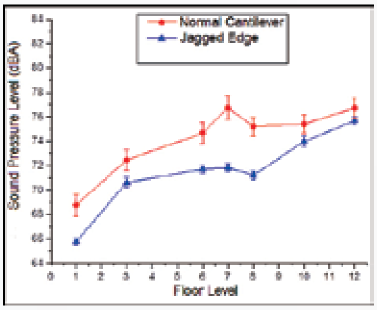


Figure 3: Comparison of noise measurement results between normal cantilever and jagged edge noise barriers

With the effectiveness in noise reduction proven, contractors from other TEL projects have implemented the new design across their sites. The design will also be made mandatory for future LTA projects.

This new jagged, flat tipped noise barrier design has also clinched a merit award at the 2017 Minister for National Development's Research & Development Award, given out by National Development Minister Mr. Lawrence Wong.

GOOD INITIATIVES FOR NOISE MANAGEMENT

Apart from the research project with NUS, several of LTA's contractors have also came up with good initiatives and practices for noise management. The following initiatives are some of the good examples that other contractors can follow.

Re-Scheduling of Noisy Works

Noisy operations and works are re-scheduled to be carried out in shorter duration each day over a longer period of time instead of running it at continuous hours over one or two days. One example is the restriction of crane movement after 10pm.

Noise Mitigation Measures For LTA Construction Sites

Quieter and Newer Machineries

Quieter machines and methods are adopted to reduce noise generated at source. For example, employing quieter alternatives such as silent piler instead of traditional vibro hammer to install sheet piles, and use of aqua cutter instead of hacking machine.

Figure 4: Use of a silent piler (left) and aqua cutter (right)

Noise Enclosure

- **At launch shaft**

  Noise enclosure at launch shafts is provided to reduce the noise emitted from noisy tunnelling works. As illustrated in Figure 5 (right), the retractable noise enclosure provided at TEL Contract T216 allows for the flexibility in movement of machineries, including multiple TBM launches.

Figure 5: Full noise enclosure at DTL C935 (left), and retractable noise enclosure at TEL T216 (right) installed at launch shafts for noisy tunnelling works

- **At source**

  Noise enclosures are also provided at stationary noise sources such as ventilation fans to minimise the noise emission. One example is the introduction of noise enclosure over ventilation fan units at TEL Contract T221 to minimise noise emission. Alternatively, silencers are also installed onto ventilation fans at DTL Contract 929A to ensure good noise control.

Figure 6: Noise enclosure over the ventilation fan unit at TEL T221 (left), and ventilation fan silencer installed at DTL C929A (right)

Portable Noise Barriers

Portable noise barriers are used to reduce noise emission at source with greater mobility. These barriers can be installed to form partial enclosures and partitions, which are useful for unavoidable night works. Some examples of portable noise barriers include the mobile barrier and the inflatable barrier (Figure 7).

Figure 7: Mobile noise barrier at DTL C923 (left) and air inflated temporary noise barrier at TEL T211 (right)

Inventive Approach for Noise Barrier Installation

Space constraint has been recognised as a major obstacle on site when erecting noise barrier. In view of that, contractors has initiated to propose inventive ideas to rectify this obstacle. At TEL Contract T211 (Figure 8, left), the work site is right below a HDB block where there is no space for the erection of a 10m noise barrier. Hence, the contractor used noise panels to construct a roof canopy along the corridor of the second storey to reduce noise impact on nearby residents. Likewise, in order to overcome space constraint at Stevens Road, TEL Contract T216 has constructed a narrow strip footing for installation of the perimeter noise barrier (Figure 8).

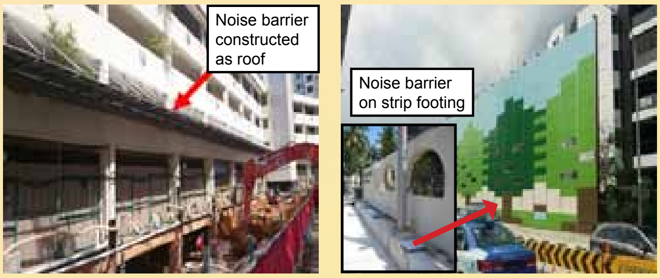


Figure 8: Noise panels was used to construct roof canopy at TEL T211 along the corridor (left), and noise barrier was constructed on a narrow strip footing at TEL T216 to overcome space constraint (right)

CONCLUSION

Noise pollution control remains a challenge for LTA with the increasing number of projects ongoing across the island. Hence, effective noise mitigation measures need to be implemented before the commencement of noisy works to curtail the impact of construction noise. LTA, together with its partners will continue to develop and deploy innovative methods to reduce noise emission from our sites.

Tan Yong Liang Benny
Assistant Environmental Manager
Safety Division

8 Electromagnetic Compatibility (EMC) for Rapid Transit System (RTS) Projects

INTRODUCTION

Electromagnetic Compatibility (EMC) is the ability of an electronic equipment / system to function without any degradation or electromagnetic interference from surrounding equipment / systems. There are three elements in EMC, namely the source (culprit), coupling path, and receptor (victim). When the source emits unwanted electromagnetic energy to the surrounding environment, it may cause the adjacent equipment / system to malfunction. This is termed as Electromagnetic Interference (EMI). The coupling path is the mechanism by which the emitted electromagnetic interference reaches its victim. There are four common coupling mechanisms: conductive, capacitive, inductive, and radiative. Figure 1 gives an illustration of the four EMI coupling mechanisms.

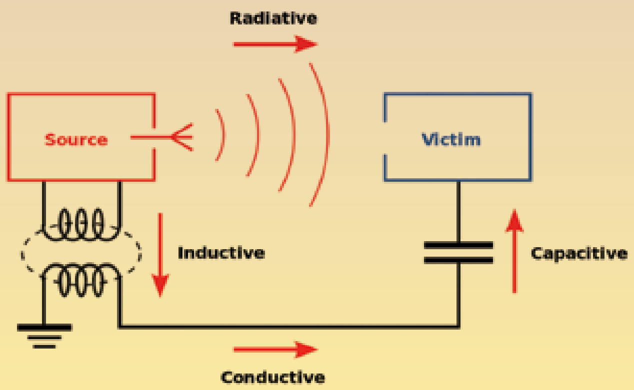


Figure 1: EMI Coupling Mechanisms

EMC IN RAILWAY

Interaction between Systems and Design Considerations

In railway EMC, the main contributing problems are the increasing number of electronic modules and the miniaturisation of electronics components, which result in higher cases of interference. It is crucial to manage electromagnetic interactions between systems to avoid fatal system failures. There are many systems present in the railway environment, such as trains, signalling system, traction power system, supervisory and control system, communication system, platform screen doors, maintenance management system, access management system, automatic fare gates, tunnel ventilation systems, lifts, escalators, lighting, etc. Figure 2 illustrates an overview of the railway EMC environment.

Indeed, railway EMC environment is complex and many design considerations have to be taken into account. These include but not limited to:

i. Placing of sensitive equipment rooms away from high power rooms
ii. Following international railway EMC standards
iii. Segregating frequency bands used by different systems
iv. Separating cables of different classes at a safe distance
v. Earthing and bonding arrangements

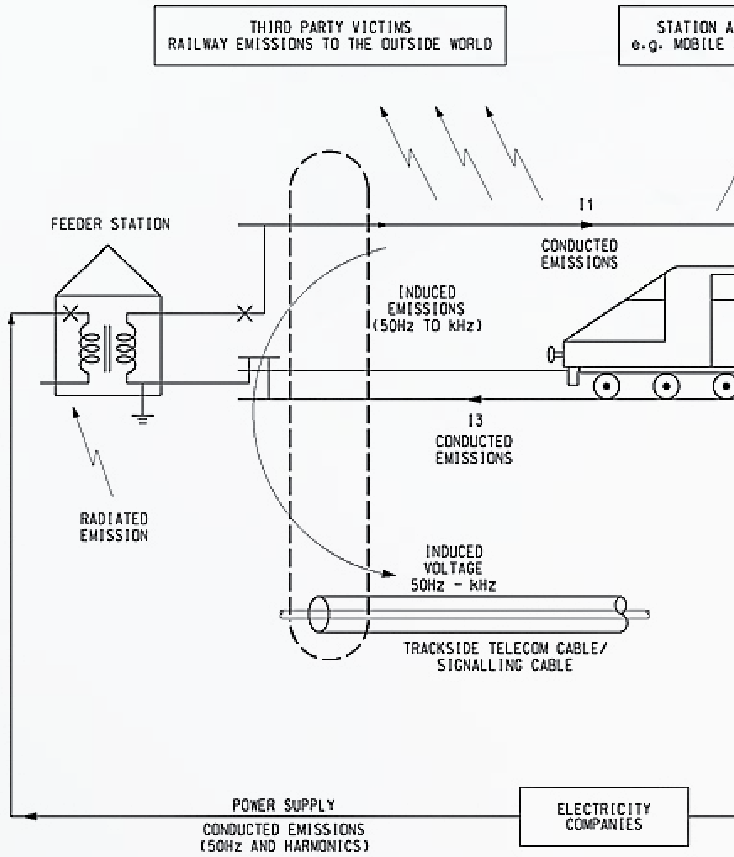


Figure 2: Railway EMC Environment

EMC TESTS

EMC tests in railway are mainly divided into two categories, namely laboratory test and on-site test.

Laboratory Test

Laboratory tests are conducted in controlled electromagnetic environment (e.g. EMC chambers). This provides a more accurate and consistent measurement with less external noise from the environment. Laboratory tests include radiated emission test, conducted emission test, electrostatic discharge test, power frequency / magnetic field immunity test, etc.

On-Site Test

On-site test are normally conducted when exact measurement of the electromagnetic ambience of the installation site is required. As shown in Figure 3, various types of antennae are used to measure emissions of different frequency ranges. The measurement result is then shown on a display screen for analysis.

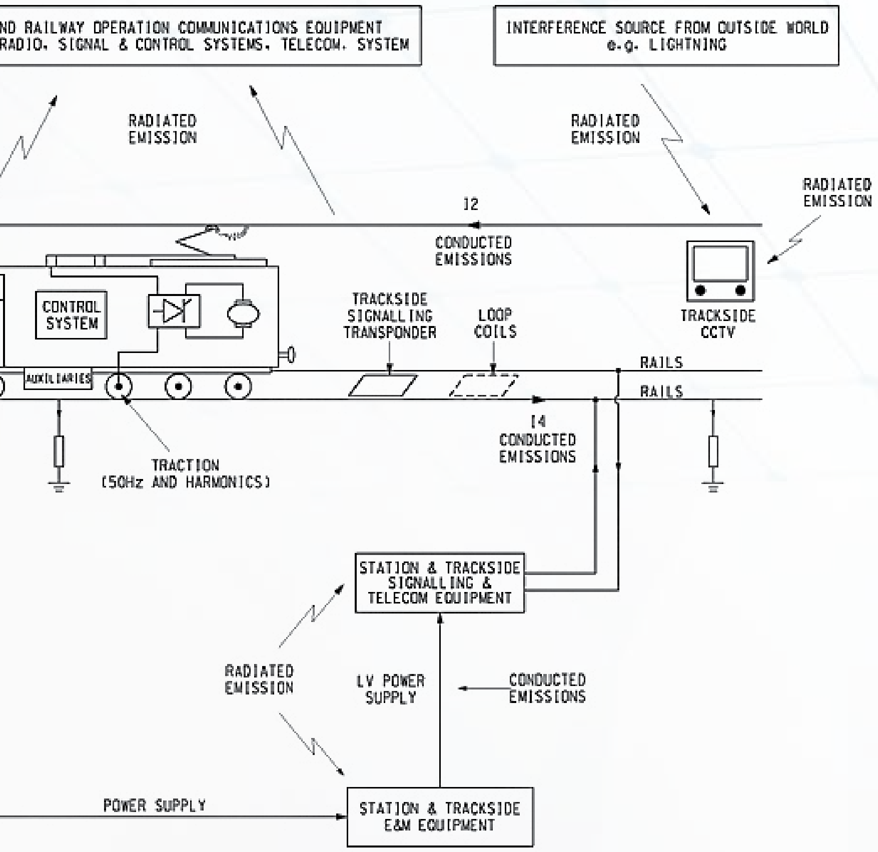


Figure 3: On-Site Train Emission Measurement

CASE STUDIES

Cable Routing Case Study

During the design stage of a recent railway project, it was brought to the attention of LTA EMC team that the space allocated for different classes of cables is limited in a certain location inside the depot. According to international standard, cables of sensitive class, such as signalling cables, should be placed at certain distances away from the noisy cables such as power cables in long parallel runs. This is to ensure interference is minimised. Together with the contractors' in-charge, an analysis was carried out to determine a suitable cable route to ensure that the separation distance for the cables is acceptable to all parties.

Formula One Interference Case Study

LTA's EMC team supported the investigation of the suspected interference case which happened at Singapore's inaugural Formula One night race in year 2008. Mark Webber, racer of Red Bull Racing team, experienced gearbox malfunction when he was on course for a possible podium. The racing team suspected that an interference from the nearby Mass Rapid Transit (MRT) system was responsible for the gearbox malfunction. However, the nearest MRT track is 200 metres away with a depth of 10 metres. After thorough investigation and on-site measurement, the LTA EMC team determined that interference from MRT was not the cause for the gearbox malfunction.

CONCLUSION

EMC management is vital to ensure safe and reliable railway operations. Engineering considerations are required to address railways' specific issues and challenges.

Zhang Yujie
Senior Engineer
Systems Assurance and Integration

10 Overview of Road Safety Review

INTRODUCTION

What is a Road Safety Review?

A Road Safety Review is the formal and systematic assessment of the safety performance of a new road, traffic improvement project or an existing road by an independent and qualified team. The review identifies potential road safety deficiencies and makes recommendations to remove or mitigate the deficiencies. It considers the safety of all road users. Apart from motorists, the vulnerable road users such as the visually and mobility impaired, cyclists, pedestrians, motorcyclists, children and elderly are also included. The road safety review has the greatest potential for improving safety and is most cost-effective when it is applied to a road or traffic design before the project is implemented.

In Singapore, as part of LTA's safety management system, road safety review is integrated into the project development process for new road projects and traffic diversion schemes. Road safety review is carried out during project development phase commencing from the planning and design stages until the project completion stage. It is also conducted for traffic diversion schemes during the construction stage. The different phases of road safety reviews conducted at various stages of a project life cycle are shown below:

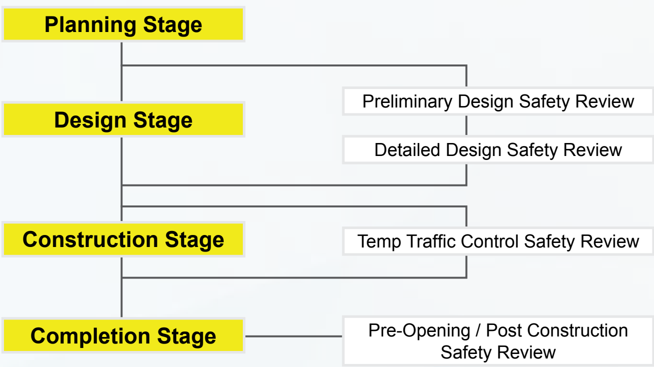


Figure 1: Different types of road safety reviews

Why there is a need to conduct a Road Safety Review?

A road scheme is designed and built in accordance with current standards and guidelines. However, the following instances could exist, compromising the safety of road users:

- Unable to incorporate the design requirements into the scheme due to site constraints, and / or
- Combination of road elements individually designed to standard may be inadequate and cause a problem. For example, a road with a combined horizontal and vertical alignment complying with minimum criteria may lead to inadequate sight visibility for motorists.

Therefore, a road safety review is conducted by an independent third party check to identify safety deficiencies in the road schemes from a safety viewpoint.

What is not regarded as a Road Safety Review?

Design checks on the road scheme are part of the design review process to ensure adherence to design standards and guidelines. Hence, it is important to note that a road safety review is NOT:

- A check of compliance with standards;
- A substitute for design checks; or
- An opportunity to redesign a scheme.

HOW IS A ROAD SAFETY REVIEW CONDUCTED?

How is a Road Safety Review conducted?

Before the commencement of a safety review, a qualified safety review team needs to be formed to conduct the safety review.

a) Requirements of a Road Safety Review Team

A road safety review team generally consists of one Team Leader and at least one Team Member who are independent of the planning or design team. It is desirable that the members are from diverse backgrounds to view from different approaches of the scheme. Such arrangement will ensure that the design is viewed with 'fresh eyes' and not influenced by the familiarity with the project.

Each road safety reviewer shall possess the following qualifications and skills:

- Be a qualified engineer;
- Experience in road design, road construction and traffic / transportation engineering and road safety engineering;
- Knowledge of accident investigation and prevention techniques;
- Formal training in conducting road safety reviews;
- Undertaken a number of formal road safety reviews; and
- Good understanding of all road users' behaviour.

The team leader is required to be more experienced and should have conducted more safety reviews than its members.

b) Commencement Meeting

A commencement meeting between the designer and safety review team is held prior to the document review and site inspection for the following purposes:

- Be briefed on the project background, design parameters and any design / site constraints by the designer;
- Check to confirm that all necessary design details are available for review; and
- Determine if additional details are required from the designer, e.g. junction analysis, swept path analysis, traffic flow data, accident statistics, etc.

c) Document Review and Site Inspection

The safety review team then studies the given information, conducts day and night site visits and assesses the road safety aspect of the design.

The road safety review team may use the appropriate safety review checklist as a guide when reviewing the drawings. The checklist ensures that the review is carried out in a structured manner and assists to check whether all relevant groups of road elements and users have been taken into account. Some of these include:

- Horizontal and vertical alignment;
- Layout of at-grade road junctions and interchanges;
- Details of cross-sections;

- Traffic signs;
- Pavement markings and delineation;
- Traffic signals and control;
- Provision for service, maintenance and emergency facilities;
- Landscaping and street lighting;
- Provision for commuter / roadside facilities;
- Safety of vulnerable road users;
- Road safety barriers; and
- Site access for temporary road works.

Besides observing the road infrastructure and its surroundings, the safety review team also looks out for interaction between the various road users and their environment. From these, the team identifies potential safety issues and makes recommendations to reduce the risks associated with the hazards to as low as reasonably practicable.

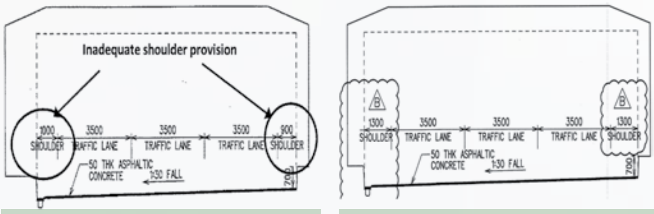
d) Road Safety Review Report

Following the review and site inspection, the safety review team will produce a written formal safety review report which documents the identified safety hazards and the recommended mitigation measures with photographs and sketches for clear illustrations. The report is subsequently forwarded to the designer for consideration to address the road safety deficiencies.

EXAMPLES OF HAZARDS IDENTIFIED IN ROAD SAFETY REVIEW

The following are examples of potential hazards that were identified during the various stages of safety reviews and their corresponding mitigation measures:

Preliminary Design Safety Review

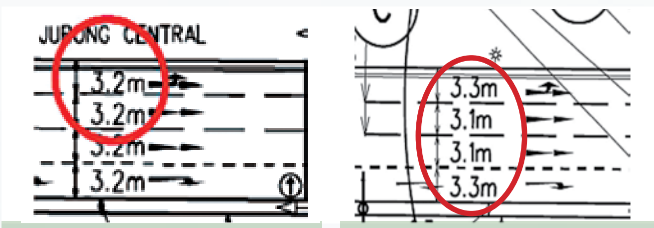


Safety Issue Identified:
Inadequate road shoulder width within underpass.

Recommendation:
Provision of road shoulder with widened width

Figure 2a: Safety issue identified during preliminary design stage

Detailed Design Safety Review

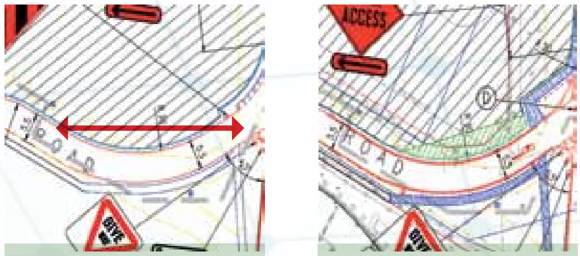


Safety Issue Identified:
Inadequate lane width to accommodate heavy goods vehicles (i.e. trucks, buses).

Mitigation Measure:
Redistribution of lane widths to increase width of lane adjacent to the kerb and centre median.

Figure 2b: Safety issue identified during detailed design stage

Temporary Traffic Control Safety Review



Safety Issue Identified:
Inadequate sight distance around road bend due to placement of site hoarding.

Recommendation:
Provision of half-height hoarding and 'No Obstruction by Machinery' zone.

Figure 2c: Safety issue identified during construction stage

Pre-Opening Safety Review (for New Road)

Safety Issue Identified:
The top of the parapet wall is not flushed with the railings.

Recommendation:
The height of the parapet wall and railings are flushed.

Figure 2d: Safety issue identified before public opening of a new road after completion

Post Construction Safety Review

Safety Issue Identified:
Sign is blocked by trees on the sidetable.

Recommendation:
Trees are pruned to ensure that the sign is clearly visible.

Figure 2e: Safety issue identified at project completion stage

CONCLUSION

A road safety review is considered to be a valuable instrument among other strategies in a road safety program to enhance road safety. It brings about benefits as listed below:

- Hazards are identified and rectified at an early stage;
- Cost-saving opportunity as undertaking expensive rectification works can be eliminated;
- Hazards are removed / mitigated prior to road operation;
- Minimises likelihood and severity of accidents occurring in the future; and
- Enhance road safety awareness among policy-makers and designers, and promoting safety culture within the industry.

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EDITORIAL PAGE

LTA CONTRACTORS' SAFETY FORUM 2017

LTA hosted the Contractors' Safety Forum on 12th May 2017 at the HSO Auditorium.

At the Safety Forum, LTA Chief Executive Mr Ngien Hoon Ping highlighted that the accident statistics in 2015 and 2016 showed three repeated areas of concern - Supervision lapses, Unsafe practices and Gaps in Safe Work Procedures. These boil down to Safety Ownership and Competency across all levels. He emphasised that Contractors should demonstrate leadership, create a culture of continuous learning, instil corporate ownership and accountability for safety.

A good safety culture requires a concerted effort from all levels within the organisation. He also highlighted that safety leadership should extend outwards to external parties such as suppliers and subcontractors as well.

A total of five topics were shared at the Safety Workshop:

- LTA's Construction Safety Performance in 2016
  by LTA Safety Division DSHM, Mr Kenneth Cheong
- LTA's Environmental Performance in 2016
  by LTA Safety Division DEVM, Ms Teng Wei Ling
- Safety Excellence in STEC's Projects
  by Shanghai Tunnel Engineering Co. (Singapore) Pte Ltd, MD, Mr Khor Eng Leong
- KTC's Journey towards Safety Excellence
  by KTC Civil Engineering & Construction Pte Ltd, Deputy CEO, Mr Chan Hiang Kiat
- Maintaining a Safety Culture by WorleyParsons, HSE Manager – SEA, Mr Gregory Chew

LTA Chief Executive **Mr Ngien Hoon Ping**

LTA Safety Division DSHM, **Mr Kenneth Cheong**

LTA Safety Division DEVM, **Ms Teng Wei Ling**

Shanghai Tunnel Engineering Co. (Singapore) Pte Ltd, MD, **Mr Khor Eng Leong**

KTC Civil Engineering & Construction Pte Ltd, Deputy CEO, **Mr Chan Hiang Kiat**

WorleyParsons, HSE Manager – SEA, **Mr Gregory Chew**

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