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WPH-GMS-4405-1.1

MANAGE WORKPLACE SAFETY AND HEALTH IN CONSTRUCTION SITES

LEARNER'S GUIDE

Version Control Record

Version	Effective Date	Changes	Author
1.0	JUNE 2022	First Issue SSG	EFG Training Services

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Introduction

Course Objective:

The aim of the course is to provide Learners with the knowledge and skills to manage worksites safety and health management system, ensuring the safety and health measures are put in place in construction activities, so that work can be carried out safely.

It covers the following competencies:

PS1. Understand the legal obligations of duty holders, including the project manager of a worksite, under the new WSH framework UK1. Workplace Safety and Health Act and related Subsidiary Legislation
PS2. Form the WSH Committee and implement its functions UK2. WSH (WSH Committees) Regulations
PS3. Plan and implement safety programme, system and safe work procedure for construction activities in accordance with WSH (Construction) Regulations UK3. WSH (Construction) Regulations UK4. General Worksite Safety UK5. Mechanical Material Handling and Scaffold UK6. Excavation, Tunneling Work and Compressed Air Environment
PS4. Plan and implement an occupational health programme and risk assessment in accordance with general principles and requirements of related WSH Regulations and Guidelines UK7. Occupational Health
PS5. Plan and implement risk management for all construction activities in accordance with general principles and requirements of related WSH Regulations and Guidelines UK8. An Overview of Risk Management
PS6. Establish the procedures for incident reporting, accident prevention and investigation in accordance with general principles and requirements of related WSH Regulations and Guidelines UK9. Accident Prevention and Investigation
PS7. Establish and implement Safety and Health Management System in worksite in accordance with general principles and requirements of related WSH Regulations and Guidelines UK10. Safety and Health Management System
PS8. Plan and participate in safety and health audit and review in worksite in accordance with general principles and requirements of related WSH Regulations and Guidelines UK11. Safety and Health Audits

This unit leads to the award of a Statement of Attainment (SOA) in WSQ Generic Manufacturing Skills under the competency category of Quality Systems.

Training format:

Day / Evening Class: Full Time / Part Time

Course Duration:

Theory 30 Hours: Assessment 4 Hours

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Assessment:

Assessment	Assessment Methods	Duration	Candidate to Assessor ratio
Part 1 Written Questioning	Candidates will be assessed on 60 MCQ & 2 short essay questions	2 Hour	1: 20
Part 2 Practical performance	Candidates will be assessed using Case Study scenarios	2 Hours	1:20
Total Duration		4 hours	

Written Assessment (WA) and Practical Performance (PP)

Training Methodologies

1. Learners are required to take part in group discussion and presentation
2. Training methodologies consists of :

- Lecture with Q&A and sharing of workplace practices
- Case studies
- Group discussion
- Videos and other e-resources and instructional media

Attendance Requirement: Min 75%

Certification:

Upon successful completion of the course of training and pass the assessments, learners will be awarded the certificate of "Manage Workplace Safety And Health In Construction Sites"

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Performance Statement and Underpinning Knowledge

WPH-GMS-4405-1.1 **Manage Workplace Safety And Health In Construction Sites** *Competent individual must be able to successfully perform the following:*	
PS1 Understand the legal obligations of duty holders, including the project manager of a worksite, under the new WSH framework	**UK1** Workplace Safety and Health Act and related Subsidiary Legislation
PS2 Form the WSH Committee and implement its functions	**UK2** WSH (WSH Committees) Regulations
PS3 Plan and implement safety programme, system and safe work procedure for construction activities in accordance with WSH (Construction) Regulations	**UK3** WSH (Construction) Regulations **UK4** General Worksite Safety **UK5** Mechanical Material Handling and Scaffold **UK6** Excavation, Tunnelling Work and Compressed Air Environment
PS4 Plan and implement an occupational health programme and risk assessment in accordance with general principles and requirements of related WSH Regulations and Guidelines	**UK7** Occupational Health
PS5 Plan and implement risk management for all construction activities in accordance with general principles and requirements of related WSH Regulations and Guidelines	**UK8** An Overview of Risk Management
PS6 Establish the procedures for incident reporting, accident prevention and investigation in accordance with general principles and requirements of related WSH Regulations and Guidelines	**UK9** Accident Prevention and Investigation
PS7 Establish and implement Safety and Health Management System in worksite in accordance with general principles and requirements of related WSH Regulations and Guidelines	**UK10** Safety and Health Management System
PS8 Plan and participate in safety and health audit and review in worksite in accordance with general principles and requirements of related WSH Regulations and Guidelines	**UK11** Safety and Health Audits

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Lesson 1 Workplace Safety and Health Act and Related Subsidiary Legislation

PS1

Understand the legal obligations of duty holders, including the project manager of a worksite, under the new WSH framework

UK1. Workplace Safety and Health Act and Related Subsidiary Legislation

- The need for reform
- Principles of new WSH framework
- Workplace Safety and Health Act (WSHA)
- Scope and coverage of WSHA
- Legal obligations of various stakeholders
- Enforcement strategy to ensure compliance
- General penalties for contravention
- Business Under Surveillance (BUS) programme
- Demerit Point Scheme (DPS)
- Subsidiary legislations
- National Workplace Safety and Health Strategy WSH 2018
- Implementing WSH 2018 for construction industry
- Duties and roles of project manager in a worksite

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UK 1 UK Workplace Safety and Health Act and Related Subsidiary Legislation

1.1 The Need for reform

The WSH 2015 and WSH 2018 National Strategies have brought about significant WSH improvements over the years. While our WSH performance has deteriorated in the 1st half of 2016, we need to persevere on our journey towards WSH excellence.

This is pertinent as Singapore transforms into a manpower-lean economy amidst an ageing workforce. Helping all our workers stay safe, healthy and productive is a national priority. Building on our past efforts, WSH 2018 Plus sets out the plan to bring our performance back on track and advance our WSH performance towards the 2018 target and beyond.

Target

WSH2028 Strategy: Singapore's plan for the next decade.

By 2028, we aspire to reduce workplace fatality rate to less than one per 100,000 employed persons on a sustained basis.

WSH 2018 plus: Visions

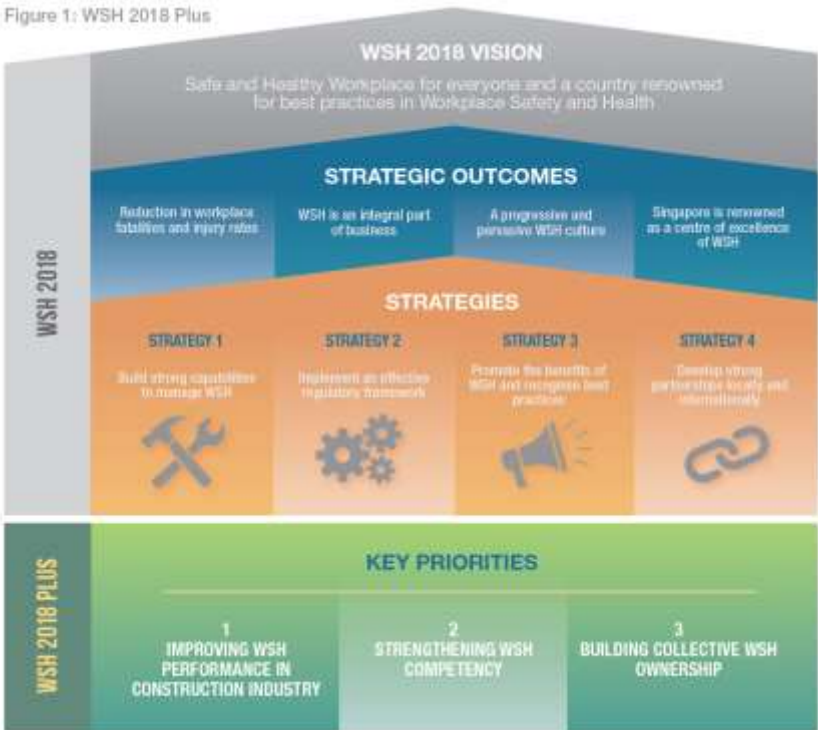
Advancing Workplace Safety & Health in Singapore for 2018 and Beyond

While the vision, strategic outcomes and strategies under the WSH 2018 remain relevant, more efforts are needed. WSH 2018 Plus sets out the plan to bring us back on track to achieve the 2018 target while laying the foundation to address emerging WSH challenges and sustain continuous improvement beyond 2018.

The WSH 2018 Plus plan has three key priorities:

1. Improving WSH Performance in Construction Industry
2. Strengthening WSH Competency
3. Building Collective WSH Ownership

Figure 1: WSH 2018 Plus



Reference: WSH 2018 plus publish by WSHC

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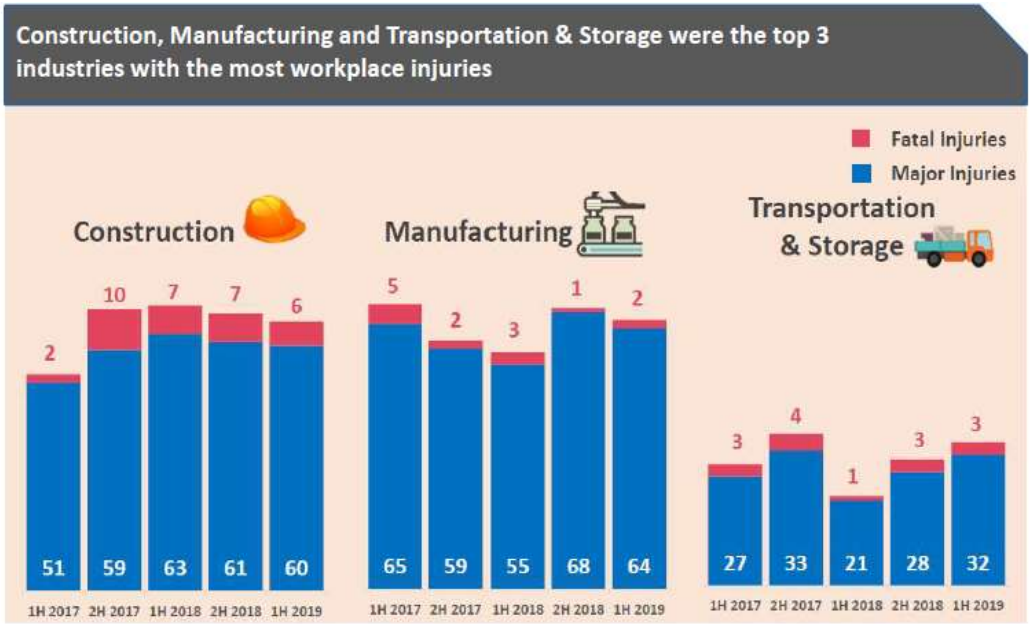
1.2 Principles of new WSH framework

Insights

The situation in the construction sector is of concern. Construction remained the main contributor to workplace fatalities with 14 deaths (43% of total fatalities) in 2018. This would set us back to the high point in 2013. Workplace safety records in the other sectors have stayed relatively stable, but we need to ensure that they can be sustained and improved over the long term.



Improving WSH Performance in Construction Industry

Enact Progressive WSH Legislation

Legislative levers are effective in bringing about the desired changes towards WSH in the industry. MOM will continue to adopt an outcome-based approach grounded on principles of risk management in reviewing/enacting WSH legislation.

The WSH (Design for Safety) Regulations effected on 1 Aug 2016 is a good example. It places greater responsibilities on developers and designers to address foreseeable risks at the design and planning phases. MOM believe this regulation will drive upstream WSH prevention, but the benefits will be seen a few years down the road.

MOM will take the same approach in reviewing the WSH (Construction) Regulations to improve formwork safety and on-site traffic safety.

Reference: WSH 2018 plus publish by WSHC

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1.2 Principles of new WSH framework

Three Guiding Principles of WSH Framework

- Principle 1 - Reduce risks at Source

  Require all stakeholders to eliminate or minimise the risks they create
- Principle 2 – Greater industry ownership of WSH outcomes

  Proactive planning to achieve a safe and healthy workplace
- Principle 3 – Prevent accidents through higher penalties for poor safety and health management

Poor safety and health management is costlier.

Mindset Change

3 Key Principles	Desired Mindset Change	
	From	To
Reduced risk at source by requiring all stakeholders to eliminate or minimise the risks they create	Managing risks	Identifying and eliminating risks before they are created
Greater industry ownership of WSH outcomes	Compliance with "letter of the law"	Proactive planning to achieve a safe & healthy workplace
Prevent accidents through higher penalties for poor safety and health management	Accidents are costly	Poor safety & health management is costlier

1.3 Workplace Safety and Health Act (WSHA)

An Act relating to the safety, health and welfare of persons at work in workplaces

The WSHA is the key legal instrument to affect the principles of the new OSH framework – Administered by the Commissioner for Workplace Safety and Health. It replaces the Factories Act, with effect from 1 March 2006.

Features of WSHA

- It places the responsibility for workplace safety on all stakeholders along lines of control at the workplace.
- It focuses on WSH systems and outcomes, rather than merely on compliance.
- It facilitates effective enforcement through the issuance of remedial orders.
- It imposes higher penalties for non-compliance and risky behaviour.

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Better defined liability regime to reduce risks at source

- WSH Act imposed liability primarily on the registered factory occupier.
- The WSHA assigns legal responsibility to those who create and have control over safety and health risks.
- Imposed a general duty to take reasonably practicable measures to protect people affected ; employees, workers as well as members of public

1.4 Scope and coverage of WSHA

The Workplace Safety and Health (WSH) Act was extended to cover all workplaces on Sep 2011. Under the Act, employers must manage risks at work while employees must adhere to safe work practices

- Better defined liability regime along lines of control.
- Stronger personal accountability.
- Move from prescription to performance based.
- Higher penalties for poor safety management and performance.
- Enhanced enforcement powers to deal with systemic weaknesses.

Coverage of WSH Act

What it covers?

- The WSH Act covers All Workplaces, unless exempted.
- Detail of exemption see six schedules of WSHA - Who is exempted?

What is a workplace?

- A workplace is any place where a person carries out work or is to work. Some of these workplaces are further classified as a factory.

Meaning of factory

- the handling, sorting, packing, storing, altering, repairing, construction, processing or manufacturing of any goods or product
- the handling, sorting, packing, storing, processing, manufacturing or use of any hazardous substances
- the repair, construction or manufacturing of any vessel or vehicle
- any building operation or work of engineering construction
- the operation or maintenance of any facility or system related to the provision of any public utility
- and those specified in the Fourth Schedule of WSHA

Fourth Schedule Section 5(2)

Workplaces Specified as Factories specified in 4th schedule as workplace in WSHA and some example of factories ad follows:

1. Any premises using an assembly-line manufacturing process in connection with the manufacturing, for the purposes of trade or gain, of any goods or products using mechanical power, not being a restaurant or kitchen.

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2. Any premises used for the manufacturing, for the purposes of trade or gain, of fabricated metal products, machinery or equipment.
3. Any premises used for the manufacturing, for the purposes of trade or gain, of wood products using mechanical power.
4. Any premises used for the production of gas for commercial sale.
5. Any premises used for the manufacture of pharmaceutical products or its intermediates.

1.5 Legal obligations of various stakeholders

Roles and responsibilities of employee

Under the Act, all employees have a duty to keep their workplace and colleagues safe. As an employee, you should:

- follow safety and health procedures at your workplace.
- not endanger yourself and your colleagues.
- not tamper with safety devices or perform wilful or reckless acts.
- report unsafe work conditions, behaviours and workplace incidents (regardless of whether an injury has taken place); and
- provide suggestions to improve safety and health at work.

Roles and responsibilities of employers

Under the Act, employers are required to ensure the safety and health of every one of their employees. Employers should:

- remove or control risks at their workplace.
- maintain a safe work environment.
- make sure that safety is maintained in the handling of all equipment used at the workplace.
- develop plans for dealing with emergencies; and
- provide employees with clear plans and resources to keep their workplace safe.

Legal obligations of various Stakeholders under the Liability Regime (Part IV of the WSHA)

Duty of occupier of workplace (S. 11)

As far as reasonably practicable, ensure that the workplace, all entrances to and exits from the workplace, and all machinery, equipment, plants, articles and substances within are safe and without risks to health of every person within those premises, whether the person is at work or is an employee of the occupier.

Occupier may also be responsible for the common areas used by your employees and contractors. Common areas include the following:

- Electric generators and motors.
- Hoists and lifts, lifting gears, lifting appliances and lifting machines.
- Entrances and exits.
- Machinery and plants

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Duties Employers (including self-employed) for work processes. (S.12 and 13)

To take reasonably practicable measures to ensure the safety and health of his employees or persons not being his employees at the workplace.

The measures to be taken shall include:

- providing and maintaining a safe and healthy work environment;
- ensuring adequate safety measures are taken in respect of any machinery, equipment, plant, article or process used by persons at work;
- ensuring persons at work are not exposed to hazards;
- developing and implementing emergency procedures;
- ensure persons at work are trained and supervised.

Duties of Principal under S 14

A principal is any person or organisation who engages another person or organisation to supply labour or perform work under a contract for service. As a principal, you must ensure that the contractor you engage: Is able to perform the work they are engaged for.

Principal is required to ascertain that the contractor engaged by the principal and any employee of the contractor:

- have sufficient experience and training to carry out the work for which the contractor is engaged by the principal to do
- have obtained any necessary licence, permit, certificate or any other document in order to carry out the work for which the contractor is engaged by the principal to do.
- has conducted a risk assessment in relation to the safety and health risks posed to any person who may be affected by the work for which the contractor is engaged by the principal to do

Addition duties of Principal in addition to contractors (S14A)

In any proceedings for an offence under this section, it shall not be a defence for the principal to prove that he has taken, so far as is reasonably practicable, such measures as are necessary to ensure compliance with this section solely by providing directly or Indirectly, by a term in a contract with his contractor, that the contractor has complied with or will comply with the requirements (Safety & Necessary Expertise)

Addition duties of Principal in addition to contractors (S14A)

New S 14A of the WSHA will impose on principals a duty to take, so far as is reasonably practicable, such measures as are necessary to ensure that any contractor engaged by them:

1. Has the necessary expertise to carry out the work. In this regard, the principal needs to ascertain that the contractor and its employees have sufficient experience and training to carry out the work for which they are engaged to do, and have in place the necessary licence, permit, and/or certificate in order to carry out the work.

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2. Has taken adequate safety and health measures in respect of any machinery, equipment, plant, article or process used, or to be used, by the contractor or its employee. In this regard, the principal needs to ascertain that the contractor has conducted a risk assessment in relation to the safety and health risks posed to any person who may be affected by the work for which the contractor is engaged to do, and has informed any person who may be affected by the work of the nature of the risk involved in the work and any measure or safe work procedure which is implemented at the workplace.

A failure by a principal to discharge these new duties is an offence. The offence is punishable, in the case of a natural person, with a fine not exceeding S$200,000 or imprisonment for a term not exceeding two years, or both. In the case of a body corporate, the offence is punishable with a fine not exceeding S$500,000.

Duties of person at work (S15)

Employees (persons at work) to co-operate with employers and not endanger the safety and health of others. (S. 15)

- use personal protective equipment (PPE) while at work;
- co-operate with his employer or principal to comply with the provisions of the Act.
- shall not interfere with or misuse any appliance, PPE or equipment.

Duties of Manufacturers & supplier (S16)

Manufacturers & supplier of dangerous machinery, equipment and hazardous substances (S. 16)

Provide the following information about the safe use of the machinery, equipment or hazardous substance:

- the precautions to be taken for the proper use and maintenance of the machinery, equipment or hazardous substance;
- the health hazards associated with the machinery, equipment or hazardous substance; and
- ensure that the machinery or equipment is erected, installed or modified in such manner that it is safe, and without risk to health when properly used.

Duties Persons, who erect, install, modify or maintain such machinery. (S. 17)

Ensure that the machinery and equipment that you have erected, installed or modified is safe and without safety or health risks when properly used.

In Summary, under the WSH Act, the stakeholders and their responsibilities are as follows:

Employer

As an employer, you must protect the safety and health of your employees or workers working under your direction, as well as persons who may be affected by their work.

You must:

- Conduct risk assessments to identify hazards and implement effective risk control measures.
- Make sure the work environment is safe.
- Make sure adequate safety measures are taken for any machinery, equipment, plant, article or process used at the workplace.
- Develop and implement systems for dealing with emergencies.
- Ensure workers are provided with sufficient instruction, training and supervision so that they can work safely.

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Principal

A principal is any person or organisation who engages another person or organisation to supply labour or perform work under a contract for service.

As a principal, you must ensure that the contractor you engage:

- Is able to perform the work they are engaged for.
- Has made sure that any machinery, equipment, plant, article or process that is used at work is safe.
- However, if you instruct the contractor or the workers on how the work is to be carried out, your duties will include the duties of an employer.

Self-employed

You are required to take measures to ensure the safety and health of anyone in the workplace who may be affected by your work.

1.6 Enforcement strategy to ensure compliance

Enforcement strategy will be targeted, intelligence led, employing different regulatory tools appropriate for the breach:

- Notice of non-compliance
- Letters of Warning
- Composition fines
- Remedial orders
- Stop-work orders
- Demerit Point System
- Prosecution
- BUS

Enforcement Framework

Focus will be to improve OSH performance as well as to penalize for non-compliance.
New enforcement tool - Power to issue "Remedial Orders" (S. 21)

- Remedial Orders can be issued even when there is no immediate danger to life and limb
- Remedial Orders will be the primary enforcement tool in improving OSH systems, including requiring employers to improve their risk assessments.

Workplace Inspections

Inspectors are empowered to enter, inspect and examine any workplace at any time to ensure workplace safety.

- An inspector may inspect, examine and make copies of any workplace documents.
- An inspector may take samples of any material or substance found in, or being discharged from, any workplace for the purpose of analysis or test.
- An inspector may take photographs and video recordings to record the conditions and the processes carried out in the workplace.
- He may take into custody any article in the workplace for the purpose of an investigation or inquiry under the Act.

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Investigations

The Commissioner may order an investigation into any workplace accident or incident. In the course of investigations, the inspector may inspect the accident scene and workplace, and interview and record statements of persons. The persons interviewed are bound to state the truth and assist in the investigations.

Suspension of Certificates

When necessary, the Commissioner may suspend any certificate. Examples of certificates issued under the Act include Certificates of Factory Registration and certificates of test / thorough visual examination of lifting equipment.

1.7 Higher Penalties for Poor Safety Management and Performance

"The WSH Act contains a stepped penalty regime based on the harm done. The inadequacy of this regime is that it does not allow for meaningful penalties in cases where there are severe lapses, but fortuitously no accidents have occurred."

Penalties under the WSH Act-

- Minor (Technical Offence) Max. fine - $1,000 / $2,000
- ***Results in 2 or > death Max. fine - $200,000 and/or 2 year jail***
- ***For Repeat Offender Max. fine of twice the amount that is specified in the Act***

General Penalties (for offences where no penalty is expressly provided by WSHA)

Offender Category	Maximum fine		Maximum Imprisonment	Conditions
	1st conviction*	2nd & subsequent conviction**		
Individual persons	$200,000	$400,000	2 years	Either or both
Corporate body	$500,000	$1 million		
Persons at work who misused or failed to use protective equipment provided	$1,000	$2,000		

* 1st conviction for an offence that causes the death of another person
** 2nd & subsequent conviction of same offence that causes the death of another person

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Not complying with a Remedial Order or Stop Work Order

Offence	Maximum fine	Maximum imprisonment	Conditions
Not complying with Remedial Order	$50,000 and additional fine of $5,000 for each day of continued offence	12 months	Either or both
Not complying with Stop Work Order	$500,000 and additional fine of $20,000 for each day of continued offence	12 months	Either or both

Composition fines

For offences, instead of prosecution in Court, the Commissioner may consider compounding the offence.

Offences may be compounded to a sum not more than half the maximum fine prescribed for the offence or $5,000, whichever is lower.

1.8 Business Under Surveillance (BUS) programme

The Business Under Surveillance programme helps companies with poor workplace safety and health records to develop or improve on their safety and health management system.

What is Business under Surveillance?

The Business Under Surveillance (BUS) programme helps poor-performing companies improve their workplace safety and health (WSH) performance by requiring them to develop and implement a robust safety and health management system.

A company could enter the BUS programme if it has:

- Had fatal accidents.
- Demonstrated poor WSH management (such as poor site conditions that result in Stop Work Orders).
- Accumulated demerit points.

This programme is has two phases:–

- Assessment phase
- Surveillance phase.

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In the Assessment phase, companies who have had fatal accidents, demonstrated poor WSH management (such as poor site conditions that result in Stop Work Orders) or have had accumulate a number of demerit points would typically be considered for entry into the BUS programme.

- A thorough review of the implementation of the risk assessment and the strength of the management system would be conducted.
- If the company fails the assessment, they will be subjected to close surveillance.

In the Surveillance phase, OSHD requires the company's management to develop and commit to a comprehensive and sustainable Action Plan.

- The company is held accountable to their proposed Action Plan and reports the implementation progress on a regular basis to OSHD.
- Inspections carried out frequently by the OSHD to verify the implementation.
- The company will exit from the programme upon demonstrating significant improvement in its WSH performance and management.

Source:https://www.mom.gov.sg/workplace-safety-and-health/monitoring-and-surveillance/business-under-surveillance-programme

Business under Surveillance Overview

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1.9 Demerit Point Scheme (DPS)

Under the Workplace Safety and Health Act and relevant subsidiary legislation

- All main and sub-contractors in the construction sector will be issued with demerit points for breaches under the Workplace Safety and Health Act and relevant subsidiary legislation.
- Under the single-stage Demerit Points System (DPS) for the Construction Industry, the number of demerit points awarded depends on the severity of the infringement. An accumulation of a minimum of 25 demerit points would immediately trigger debarment for the contractor. Applications from the company for all types of work passes for foreign employees will be rejected by MOM. The accumulation of more demerit points will result in longer periods of debarment.
- Contractors that have been issued with demerit points will be informed by MOM in writing. Each demerit point is valid for 18 months.
- If a contractor continues to commit workplace safety and health offences, applications from the company for new and renewal of all types of work passes for all foreign employees will be rejected by MOM.
- Contractors who have been issued with demerit point(s) will be informed by MOM in writing

Source: MOM http://www.mom.gov.sg/workplace-safety-and-health/monitoring-and-surveillance/demerit-points-system

The number of demerit points issued to contractors will be based on the severity of the offences committed:

Type of Incident	Number of demerit points
Composition fines	1 point per fine, from the fourth fine onwards.
Stop Work Order (Partial)	5
Stop Work Order (Full)	10
Prosecution action taken for accident that led to serious injuries to any person	18
Prosecution action taken for dangerous occurrence (potential for multiple fatalities)	18
Prosecution action taken for accident that led to death of one person	25
Prosecution action taken for accident that led to death of more than one person	50

Demerit points for a contractor are calculated by adding the points accumulated from all the worksites under the same contractor.

Source: MOM http://www.mom.gov.sg/workplace-safety-and-health/monitoring-and-surveillance/demerit-points-system

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What penalties will be imposed

Contractors, including all main and sub-contractors who accumulates a pre-determined number of demerit points within an 18-month period, will be debarred from employing foreign workers. The following table indicates the scope and duration of debarment for the accumulated demerit points.

Phase	Demerit Points accumulated within 18-month period	Allowed to hire new workers	Allowed to renew existing workers	Duration of debarment
1	25 to 49	No	Yes	3 months
2	50 to 74	No	Yes	6 months
3	75 to 99	No	Yes	1 year
4	100 to 124	No	Yes	2 years
5	125 and above	No	No	2 years

For clarifications, please email **mom_oshd@mom.gov.sg**.

Source: MOM http://www.mom.gov.sg/workplace-safety-and-health/monitoring-and-surveillance/demerit-points-system

1.10 Subsidiary legislations

WSH (Risk Management) Regulations

Intention of the Regulation

- To change mindsets to make those in charge take responsibility for managing their own safety outcomes, not rely on Government to prescribe standards
- This regulation will require all employers / principals covered by the Act to assess risk to safety and health of any persons who may be affected by the undertaking
- Risk Assessment is one way in which general duties under Part IV of the main Act will be discharged – senior managers must lead the way.
- The risk assessment (RA) should be a genuine attempt to identify hazards and risk of injuries/accidents, not a bureaucratic form filling exercise – hence no prescribed template.

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WSH (Construction) Regulations 2007

- Form work definitions and duties of PE in form work design (SS580:2012)
- Cantilever platform - design standard and certification by PE
- Project co-ordination meeting - Rg 26 A
- Chute - PE to ensure construction in accordance with design
- Design of runway - PE to ensure construction in accordance with design
- Piling, shoring etc - PE to ensure construction in accordance with design
- PTW - included the types of work that need to be controlled by this system including evaluation & monitoring of permit.

WSH (WAH) Regulations 2013

- New definition - Work At Height / Hazardous Work At Height
- wef 1st May 2014
  - Fall Prevention Plan (FPP) Reg. 5 (5)
  - Competent personnel for WAH Reg. 6, 7 & 20 (2) (a) & (b)
  - PTW – for Hazardous WAH Reg. 19
- Fall prevention equipment have to be approved for use. Reg. 12
  - Anchorage points
  - Travel restrainer and
  - Fall prevention systems

Key provision the WAH Regulation

WSH (Scaffolds) Regulations 2011

- Approved Scaffold contractor
- Scaffold Erectors & Scaffold Supervisor
- PPE for scaffold erectors
- Supervision of construction, erection, installation, re-positioning, alteration, maintenance, repair or dismantling of scaffolds
- Designated access point for scaffolds
- Design by PE
- Metal Scaffolds
- Timber Scaffolds
- Suspended Scaffolds
- Other Scaffolds

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WSH (WSH Committee) Regulation 2008

- management representative
- workers representative
- meet at least once a month
- chairman - project manager
- secretary - safety officer
- Minutes
- Matters to discuss
- conduct safety inspections
- investigate accidents

WSH (Operation of Cranes) Regulations

- To establish and implement a Lifting Plan
- Registration of Crane Operators
- Duties of Crane Operators
- Appointment and Duties of Rigger
- Appointment and Duties of Signalman
- Appointment and Duties of Lifting Supervisor
- Only approved crane contractor to install, repair, alter or dismantle mobile crane or tower crane

WSH (Explosive Powered Tools) Regulations

- <u>Explosive Powered Tools</u>
  - Direct Acting Tool
  - Indirect Acting Tool

- <u>Tools Marking and Identification</u>
  - 10 seconds
  - model
  - serial number
  - protective shield

- <u>Tools Testing</u>
  - Testing body acceptable to the Commissioner
  - 3 years

Operation & Use of Tools

- Tampering
- incompatible charges, projectiles
- operator must be trained
- dangerous environment
- shield - 50mm (for direct acting tool)
- projectile fly free
- unsuitable materials:- tiles, glass, marble, granite, high tensile steel, reinforced concrete, near to a hole
  - steel reinforcement -15mm / 10mm
  - concrete - 75mm / 50mm

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Other Subsidiary Legislations

Subsidiary legislation	Applicable workplaces
• WSH (Workplace Safety and Health Officers) Regulations	• Factories
• WSH (General Provisions) Regulations	• All workplaces
• WSH (Construction) Regulations 2007	• All worksites
• WSH (First Aid) Regulations	• All workplaces
• WSH (Incident Reporting) Regulations	• All workplaces
• WSH (Risk Management) Regulations	• All workplaces
• WSH (Exemption) Order	• Premises owned by the Singapore Armed Forces and domestic premises
• WSH (Composition of Offences) Regulations	• All workplaces
• WSH (Transitional Provision) Regulations	•
• WSH (Offences and Penalties) (Subsidiary Legislation under Section 66(14)) Regulations	•
• WSH (Shipbuilding and Ship-repairing) Regulations 2008	• Shipyards and ships in harbour
• WSH (Registration of Factories) Regulations 2008	• Factories
• WSH (Workplace Safety and Health Committees) Regulations 2008	• Factories
• WSH (Abrasive Blasting) Regulations 2008	• All workplaces
• WSH (Explosive Powered Tools) Regulations 2009	• All workplaces
• WSH (Confined Spaces) Regulations 2009	• All workplaces
WSH (Safety and Health Management System and Auditing) Regulations 2009	• Factories
• WSH (Noise) Regulation 2011	• All workplaces
• WSH (Medical Examinations) Regulations 2011	• All workplaces
• WSH (Operation of Cranes) Regulations 2011	• All workplaces
• WSH (Scaffold) Regulations 2011	• All workplaces
• WSH (Work at Heights) Regulations 2013	• All workplaces
• WSH (Asbestos) Regulations 2014	• All workplaces
• WSH (Design for Safety) Regulation 2015	• Construction

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1.11 National Workplace Safety and Health Strategy WSH 2028

WSH 2028
Singapore Aims to Be One of The Safest Workplaces In The World By 2028

National Workplace Safety and Health (WSH) strategies developed in 2005 (WSH 2015) and 2008 (WSH 2018) have been instrumental in reducing Singapore's workplace fatal injury rates from 4.9 per 100,000 workers in 2004 to 1.2 in 2017 and 2018. This is the lowest rate ever recorded for Singapore.

New target for year 2028

We aim to reduce Singapore's workplace fatal injury rate by 30% on a sustained basis: from a 3-year average of 1.4 per 100,000 workers in 2018 to **below 1.0 per 100,000 workers within the next 10 years.**

Building on the foundation of WSH 2015 and WSH 2018, the WSH 2028 Tripartite Strategies Committee have presented three strategies and seven recommendations for the next 10 years in realising the vision, "A Healthy Workforce in Safe Workplaces; A Country Renowned for Best Practices in Workplace Safety and Health".

1. Strengthen WSH Ownership

The level of ownership for WSH by all stakeholders has to move beyond "basic" to be global-leading for sustained improvements in WSH. The recommendations are:

- Make WSH more salient in business decisions
- Align company directors and top management to WSH ownership
- Strengthen WSH ownership of workers

2. Enhance Focus on Workplace Health

A healthy workforce is the outcome of a safe workplace. At the same time, a healthy workforce is also a contributor to safety. This encompasses both the prevention of occupational diseases and the promotion of workforce health. The recommendations are:

- Expand occupational disease prevention efforts
- Build companies' capabilities to promote workforce health

3. Promote Technology-Enabled WSH

By the year 2028, Singapore will have made much progress towards its vision to be a Smart Nation. There is thus immense potential for the practice of WSH itself to be transformed through technology. The recommendations are:

- Develop a WSH Technology ecosystem to deepen industry capability
- Strengthen WSH training through technology

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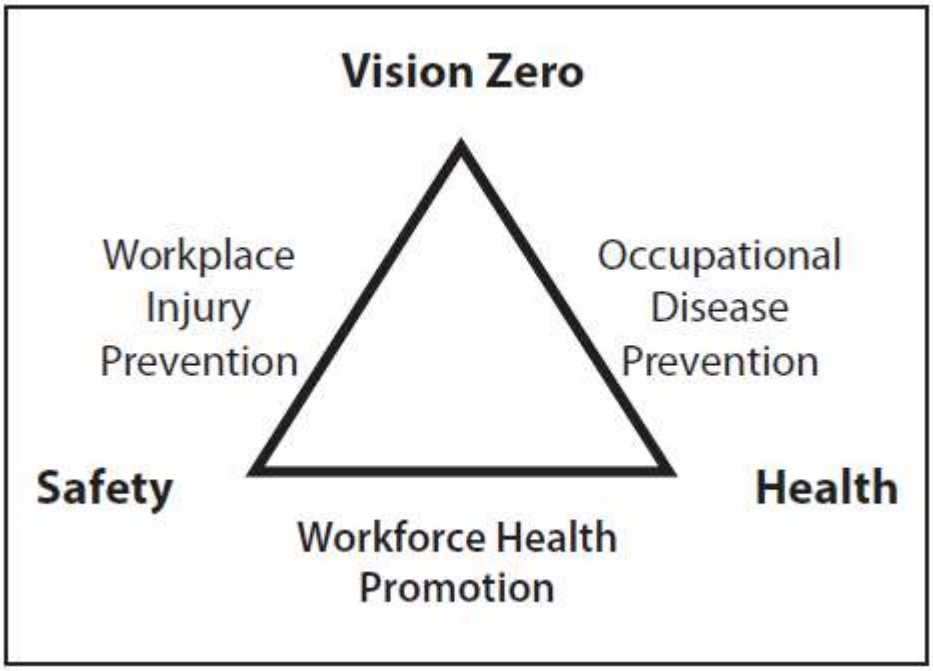
WSH 2028 Vision and Strategic Outcomes



VISION

A Healthy Workforce in Safe Workplaces.

A Country Renowned for Best Practices in Workplace Safety and Health

Success indicators	Current[3] (2016-18 average)	Desired (Three-year average by 2028)
Workplace fatal injury rate per 100,000 workers	1.4	<1.0
Workplace major injury rate per 100,000 workers	17.2	<12.0

Success indicator	Current (2018)	Desired (by 2028)
Proportion of workplaces under MOM's surveillance that implement upstream controls to remove noise and chemical-related health risks	46%	>75%

Source: WSH 2028 Booklet

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Strengthen WSH Ownership

Make WSH More Salient in Business Decisions

- Publish every company's WSH performance in terms of workplace fatality and major injury rates, normalised by workforce size and industry to facilitate meaningful comparison
- Share work injury compensation claims data with insurance industry, so that premiums can be differentiated according to the WSH performance of a firm
- All public-sector developers to adopt harmonised criteria to disqualify unsafe construction firms
- Share list of disqualified construction firms with private developers
- Provide incentives for supply chain leaders, such as main contractors and shipyards, to invest to improve WSH capability of their suppliers
- Allow leading enterprises to certify their in-house WSH training as fulfilling government mandated training requirements and to offer them to supply chain partners

Align Company Directors and Top Management to WSH Ownership

- Introduce an Approved Code of Practice on WSH duties of company directors
- Introduce an Approved Code of Practice on WSH duties of principals to their contractors

Strengthen WSH Ownership of Workers

- Labour Movement's Collective Agreements and MOUs with companies to institutionalise: WSH Committee comprising workers and management
- System to report and learn from near-misses
- System to empower workers to stop work in unsafe conditions
- Joint worker-management teams to conduct internal WSH inspections and implement control measures
- Build in-house WSH expertise in every union
- Mobilise Migrant Workers' Centre to educate foreign workers on progressive WSH practices.

Enhance Focus on Workplace Health

Expand Occupational Disease Prevention Efforts

- Encourage adoption of upstream measures to prevent ODs
- Expand the WSH Act's list of reportable ODs
- Raise capabilities of medical community to detect and report ODs
- Increase health hazard surveillance to more workplaces

Build Companies' Capabilities to Promote Workforce Health

- Develop guidelines on job adaptations that employers can take to support workers in managing their chronic diseases
- Increase companies' access to Total WSH Services
- Upskill WSH professionals in workforce health
- Raise awareness of measures that promote workers' mental health

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Singapore's Vision of Smart Workplaces

The Committee envisions that Smart Workplaces of the future would be "connected" on many fronts; using technology to improve planning, design, operations and maintenance processes to enhance both productivity and WSH outcomes. For example, a Smart Worksite in the construction industry (see illustration) would enable real-time surveillance, monitoring and management of WSH risks in the following ways:

- Wearable devices that use IoT to detect if a worker's health status is "at-risk", such as due to heat stress, fatigue, abnormal heart rate and proximity to hazardous equipment
- Wireless surveillance equipment such as drones attached with cameras and other IoT sensors to detect unsafe work conditions or practices, or perform safety inspections for works at-height
- Biometric technology that integrate workers' WSH information (e.g. training qualifications) with digitised work processes (e.g. e-permit to work system) and entry / exit control systems to verify workers' competency in high-risk work
- DFMA using Prefabricated Prefinished Volumetric Construction (PPVC) to make construction safer by reducing workers needed onsite and activities at-height
- Cloud platforms that allow developers, architects, consultants, main contractors and subcontractors to have real-time collaboration in terms of monitoring work progress, managing WSH risks and sharing of data

1.12 WSH 2028 for Construction industry

1. Building strong capabilities to better manage WSH
   - Individual level
   - Corporate level
   - Industry level

2. Developing a Performance based regime
   - Include Designers and Developers in the regulatory framework
   - Improved Management of Workplace Health
   - Self-Regulation
   - Setting industry standards

3. Promoting the benefits of WSH and Integrating WSH in to business
   - Driving improvements through large organizations
   - Assessment of Safety and Health Management systems
   - Business case
4. Creating and building partnerships
   - Co-ordination of work
   - Industry-led taskforces

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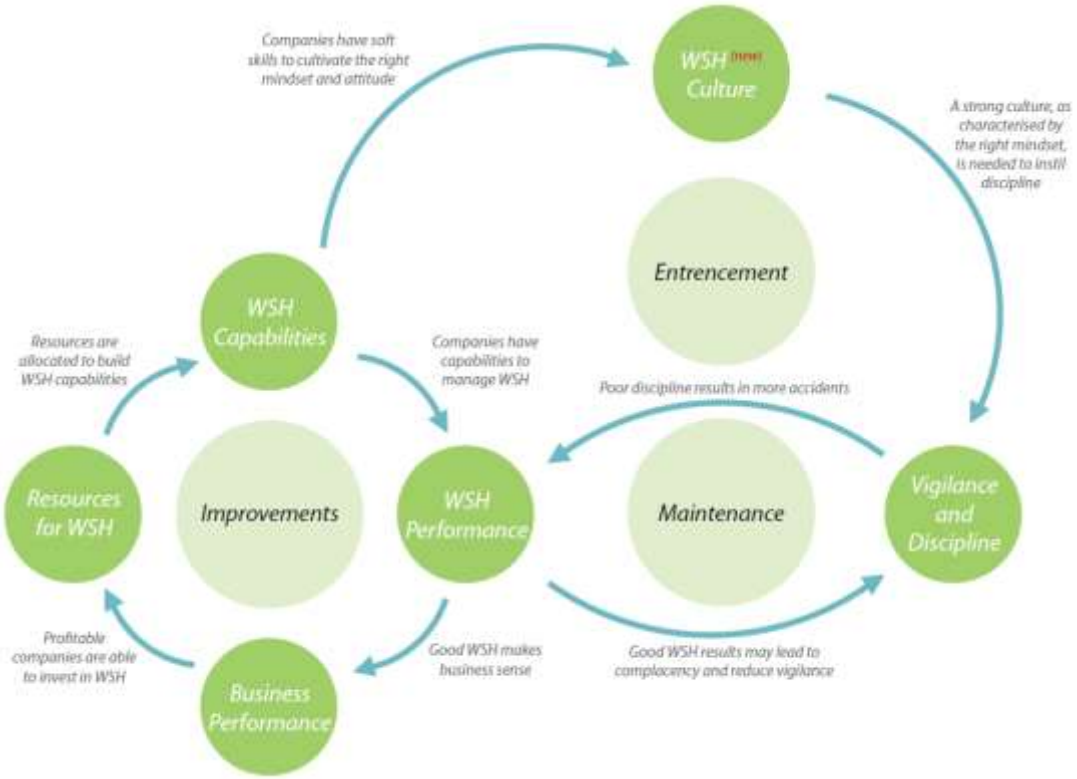
5. Implementation and Review



1.13 Duties and Roles of Project Manager in a worksite

A project manager is the company's main representative on a worksite, with authority over the progression of the project and site supervision. Because project managers represent management on the project, they are responsible for health and safety at the worksites. He shall be the Chairman of the WSH committee and be the overall in charge for Workplace Safety and Health in a worksite.

Roles and responsibilities Project manager as an employer

- remove or control risks at their workplace;
- maintain a safe work environment;
- make sure that safety is maintained in the handling of all equipment used at the workplace;
- develop plans for dealing with emergencies;
- provide employees with clear plans and resources to keep their workplace safe;
- providing and maintaining a safe and healthy work environment;
- ensuring adequate safety measures are taken in respect of any machinery, equipment, plant, article or process used by persons at work;
- ensuring persons at work are not exposed to hazards;
- developing and implementing emergency procedures; and
- ensure persons at work are trained and supervised.

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As an Occupier

As far as reasonably practicable, ensure that the workplace, all entrances to and exits from the workplace, and all machinery, equipment, plants, articles and substances within are safe and without risks to health of every person within those premises, whether the person is at work or is an employee of the occupier.

Occupier may also be responsible for the common areas used by your employees and contractors. Common areas include the following:

- Electric generators and motors.
- Hoists and lifts, lifting gears, lifting appliances and lifting machines.
- Entrances and exits.
- Machinery and plants

Learning Activity 1

Objective: Identify Legal requirement and legislation relevant to construction industry

Discuss and write down the key points

- Stakeholder and their duties and responsibilities
    - Occupier
    - Employer
    - Project Manager
    - Person at Work
- Three guiding principle of WSHA
- Penalties for violation
- Business under surveillance (BUS) and how this would affect a construction firm
- Demerit point system
- List key legislation relevant to construction industry

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Lesson 2 - WSH Committee

PS2
Form the WSH Committee and Implement Its Function

Learning Objective

At the end of the Topic, learner is able to explain:

- Formation of WSH Committee
- Role of Project Manager in the WSH Committee
- Meetings of WSH Committee
- Functions of WSH Committee
- Regular inspection
- Inspection after accident occurrence
- Safety promotion
- Guidelines for safe conduct of work
- Penalties for non-compliance

UK 2 Workplace Safety and Health (WSH Committees) Regulations 2008

Legal Requirement

Application

- These regulations shall apply to every factory/workplace in which 50 or more persons are employed.
- The occupier or his authorized manager shall be the Chairman of the Workplace Safety and Health committee.

The occupier or his authorized manager shall as far as practicably implement every recommendation of a Workplace Safety and Health committee.

- A Workplace Safety and Health committee shall consist of representatives of both the employees and the management.
- The representatives of the management shall include the occupier or his authorized manager.

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2.1 Formation of WSH Committee

Composition of WSH Committee

It shall be the duty of the occupier of a factory to ensure that,

- the workplace safety and health committee of the factory consists of members who are representatives of persons at work in the factory and of the management of the factory; and
- at all times, the number of members who are representatives of the persons at work in the factory is not less than those who are representatives of the management of the factory

"Authorized Manager" means –A person authorized by an occupier to deal with any matter relating to the safety and health of the persons employed therein.

"Chairman" means -The chairman of a Workplace Safety and Health committee

"Members" means -The members of a Workplace Safety and Health committee.

"Workplace Safety and Health committee" means -A Workplace Safety and Health committee established at a factory/workplace.

"Secretary" means –The secretary of a Workplace Safety and Health committee.

Basic knowledge of members of workplace safety and health committee

It shall be the duty of the occupier of a factory to take, so far as is reasonably practicable, such measures to ensure that the members of the workplace safety and health committee have a basic understanding and knowledge of the functions and duties of a workplace safety and health committee under the Act.

It shall be the duty of the chairman, Project Manager, of the workplace safety and health committee of the factory to ensure that the workplace safety and health committee —

(a) discusses the observations of the members during the inspection at its next meeting; and

(b) records in a report —

  (i) its opinion in respect of the lack of any measure, or any deficient measure, taken to ensure the safety and health of persons at work in the factory; and

  (ii) its recommendations on the actions to be taken in the factory to ensure the safety and health of persons at work in the factory.

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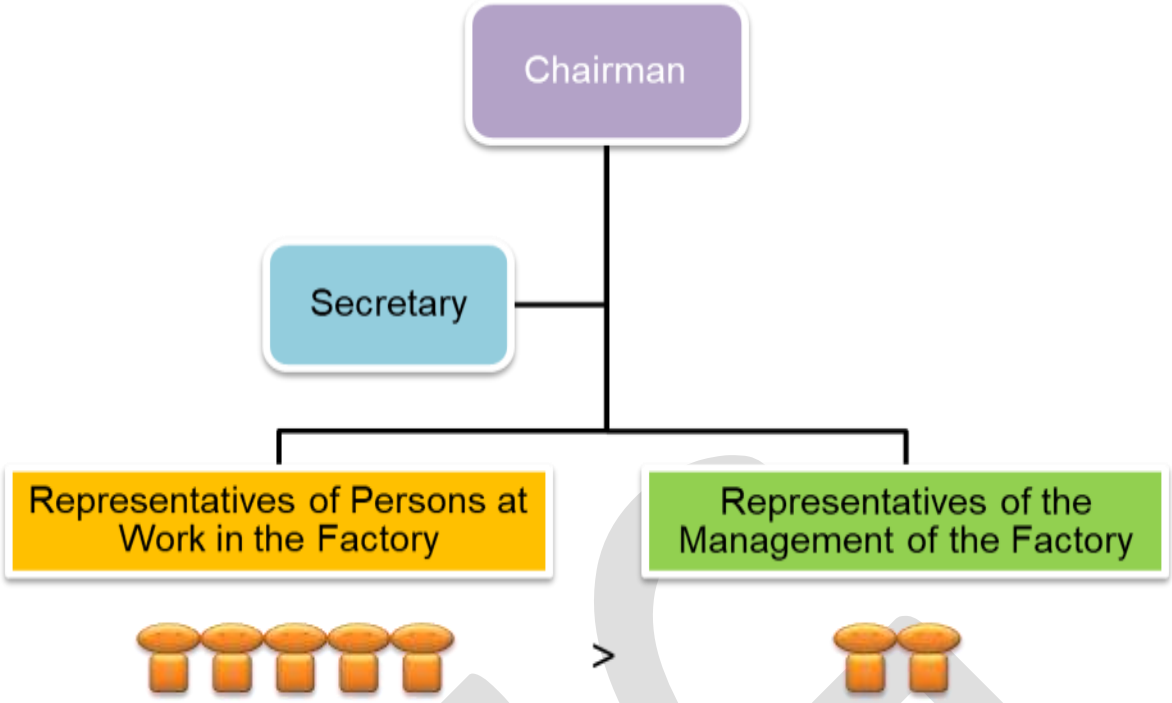

2.2 Role of Project Manager in WSH Committee

- Project Manager shall be the Chairman of Workplace Safety and Health committee.
- Project Manager to lead and attend all the Workplace Safety and Health committee meetings.
- Safety officer shall be the secretary of Workplace Safety and Health committee.
- Alternatively, the chairman may appoint a member of the committee to act as secretary.
- The number of representatives of the employees shall not be less than those of the management

2.3 Meeting of WSH Committee

- Workplace Safety and Health committee shall meet at least once in a month.
- Every member shall be given reasonable notice and agenda of meeting before attending
- All the meetings will be preceded or followed by an inspection of the workplace
- The copy of safety meeting minutes will be communicated to all Workplace Safety and Health committee members for information and acceptance.
- A copy of every meeting minutes shall be kept for inspection by an inspector.
- Secretary to furnish the minutes of WSH Committee Meeting to all members and keep a copy of such minutes in the factory
- To invite non-member who has involved with an accident to discuss about the accident
- Only matters relating to safety and health to be discussed

2.4 Function of WSH Committee

Functions of WSH Committee

- Inspection of Workplace
- Accident Investigation
- Safety Promotion
- Issue WSH Guidelines

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Successful WSH Committees Meetings

- Develop action plans (Annual work plan, focus on significant hazards, statistics, etc.)
- Meet at least once a month, and keep meeting short – less than an hour.
- Prepare an agenda in advance.
- Take attendance and inform members whom cannot attend.
- Update what has occurred since the last meeting
- Assign action items and require follow-up.
- Committee may break down into smaller group to tackle issues as they arise
- Maintain meeting minutes.

2.5 Monthly Regular General Inspection

A Workplace Safety and Health committee shall inspect the factory –

a) at least once a month; and

b) immediately after any accident or dangerous occurrence.

- The observations made during the inspection shall be discussed at the Workplace Safety and Health committee meeting and recorded.
- Solutions will be arrived to fix safety issues during the meeting
- Only safety related issues will be discussed during safety meeting

The safety officer or the chairman shall furnish a copy of the inspection report to the occupier or his authorized manager.

- Regular inspection
- Inspection of accident occurrence
- Safety promotion
- Guidelines for safe conduct of work\

A Workplace Safety and Health committee shall inspect the factory:

- At least once a month; and
- Immediately after any accident or dangerous occurrence.
- The observations made during the inspection shall be discussed at the Workplace Safety and Health committee meeting and recorded. Solutions will be arrived to fix safety issues during the meeting
- Only safety related issues will be discussed during safety meeting.

Discuss & record in a report in the next meeting:

- Observations,
- unsafe conditions & unsafe acts,
- recommendations on the remedial action to be taken.

2.6 Inspection after Accident or Dangerous Occurrence

- Members immediately carries out an inspection of the factory.
- WSHO to investigates and furnish a report to Chairman. Chairman to indicate his opinion in the report including recommendations.
- Chairman to hold a meeting to discuss observations, causes, preventive measures with members.

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Discuss the observations

- Record in a report:
- Failure of any safety measures & cause of the accident
- Recommendations on action to be taken.

2.7 Safety Promotion

Organize any contest, competition or other activities to promote the safe conduct in the workplace

- WSH contest (safety slogan, SIT etc)
- WSH competition (safety awards) Other activity
- For the purpose of promoting the safe conduct of work in the factory
-

2.8 Guideline for Safe Conduct of Work

Issue a set of guidelines to promote safety & health work in the workplace.

• Amend or revoke the guidelines.

• Publish the guidelines to ensure awareness.

Guidelines for safe conduct of work

(1) The workplace safety and health committee of a factory shall, with the approval of the occupier of the factory, issue a set of guidelines to promote the safety and health of persons at work in the factory.

(2) The guidelines may, with the approval of the occupier of the factory, be amended or revoked by the workplace safety and health committee.

(3) It shall be the duty of the occupier of the factory to publish a copy of the guidelines, and all amendments made to the guidelines, in such manner as will secure adequate publicity at the factory for the guidelines.

Powers of WSH Committee

The workplace safety and health committee of a factory shall, for the purposes of discharging its functions and duties under the Acts. Have the power to do all or any of the following:

(a) to enter, inspect and examine the factory at any reasonable time;

(b) to inspect and examine any machinery, equipment, plant, installation or article in the factory;

(c) to require the production of factory records, certificates, notices and documents kept or required to be kept under the Acts. including any other relevant document, and to inspect and examine any of them;

(d) to make such examination and inquiry of the factory and of any person at work in that factory as may be necessary to execute its duties;

(e) to assess the levels of noise, illumination, heat or harmful or hazardous substances in the factory and the exposure levels of persons at work therein;

(f) to investigate any accident, dangerous occurrence or occupational disease that occurred within the factory.

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2.9 Penalties for non-compliance

Any person who contravenes regulations, shall be guilty of an offence and shall be liable on conviction —

(a) for a first offence, to a fine not exceeding $10,000; and

Any person who contravenes regulations, shall be guilty of an offence and shall be liable on conviction —

(b) for a second or subsequent offence, to a fine not exceeding $20,000 or to imprisonment for a term not exceeding 6 months or to both.

Learning Activity 2

Objective: Describe the function of a WSH committee and roles and responsibilities of the Chairman

Discuss and write down:

- List the function and key point of WSH committee
- Importance of performing inspection before meeting
- How to convene an effective WSH committee meeting
- List the duties and responsibilities of project manager as a WSH committee chairman.

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Lesson 3 - WSH (Construction) Regulations

PS3.

Plan and implement safety programme, system and safe work procedure for construction activities in accordance with WSH (Construction) Regulations

UK3 WSH (Construction) Regulations

Learning Objective

At the end of the Topic, learner is able to explain:

- Permit-to-work system
- Ladders
- Cantilevered and material platforms
- Electrical Safety
- Disposal of materials
- Formwork structures
- Demolition
- Explosives
- Piling
- Compressed air environment
- Penalties for non-compliance

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3.1 Permit-To-Work System

Part III Permit-To-Work System

- A permit-to-work system may be described as formal documents to ensure all hazardous works are coordinated and carried out safely.
- The permit-to-work system lists out all the safety precautions that need to be taken prior and during the hazardous works.
- With an effective permit-to-work system in place, incompatible works can be avoided at the same place and time.

Where is a Permit-To-Work applicable?

Application

This Part shall apply only to the following types of work that form part of any building operation or works of engineering construction (referred to in these Regulations as high-risk construction work):

(a) demolition work;

(b) excavation and trenching work in a tunnel or hole in the ground exceeding 1.5 metres depth;

(c) lifting operations involving tower, mobile or crawler crane;

(d) piling work and;

(e) tunnelling work.

WSH (WAH) Regulation

(f) Work at height that a person could fall more than 3 meter

WSH .

(Confined Spaces) Regulation

(g) work involving entry into a confined space

Flow Chart for PTW

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1. Posting PTW permit by supervisor

The supervisor in-charge shall display the PTW permits at the vicinity of work area before starting work activities

2. Review of PTW permits

PTW permits shall be reviewed on a daily basis and ensure that all checklists, all prevention system are in place

3. Monitoring of PTW system

Ensure that no incompatible works are being carried out at the same vicinity

4. Return of PTW permit

Upon completion of work, the site supervisor shall return the permit to authorized manager, who will then close the permit if there is no safety issues.

Summary of duties and responsibilities of various stakeholder of PTW

Worker (Doer)
- **Follow safe work procedure**
- **Identify hazard and report to supervisor**

Supervisor
- Perform Risk Assessment
- Implement control measure
- Brief and train worker
- Ensure compliance to SWP
- Continuous monitoring

Assessor
- Evaluate the PTW and make recommendation
- Continuous monitoring

Manager
- Ensure no incompatible work in the same vicinity
- Approval of the PTW
- Continuous monitoring
- Revoke the PTW if non-compliance is found

Responsibility & Authority
- The Issuing Authority is usually the company designated personnel
- The Performing Authority is the party that will be performing the work, who will raise the permit- to-work and submit the permit to the Issuing Authority.

Responsibilities of Issuing Authority

Safety precautions to be taken to ensure the work is carried out safely, such as:
- Risk Assessment
- Safe Work Procedures
- Appropriate PPE
- No incompatible works in the vicinity;
- Adequate ventilation for confined space work;
- Adequate lighting;
- Area to be barricaded and safety signs displayed;
- Tools inspected and tagged, etc.
- Comply with the safety requirements stated in the permit-to-work.
- Monitor the work and ensure the work is being carried out safely.
- Stop work immediately if there is change in conditions.
- Carry out work only at the stipulated area as per the permit-to-work.
- Display a copy of the permit-to-work at the work site.

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Upon completion of the work, sign off and return the permit to the issuing authority.

General Requirement

- No permit - no work.
- All permit requirements must be completed
- Permit must be appropriately authorized
- Issuing authority must acknowledge acceptance of the permit
- Automatically invalid when conditions change.

Workers to immediately notify supervisors about the condition change.

- Cannot be reinstated, once it was revoked (Must apply new permit)
- Valid until expiry. (But normally valid for a period of one day)
- No alteration of the work permit

General Preparation Work

- Stop work when emergency siren/alarm sounded
- Gas test must be conducted for Hot work and confined space
- Recertification Gas test for extension of the above permit
- Permit to work must be accompanied with Risk Assessment
- On job completion, permit must be appropriately sign off

3.2 General Provisions

Stability of Structures

It shall be the duty of the occupier of a worksite with a supporting structure to take, so far as is reasonably practicable, such measures as are necessary to ensure that the supporting structure, including its foundation, shall be of sound design, good construction and in accordance with the design, and of adequate strength for its intended purpose.

Protection against Falling Objects

Occupier to ensure that adequate overhead protection is provided in the worksite.

Slipping Hazards

Employer and Principal to ensure that any passageway, scaffold, platform or other elevated working surface is kept free from slipping hazards.

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Storage and placement of materials and equipment

It shall be the duty of the employer and principal who carries out the work of storing, stacking or placing materials or equipment in a worksite to ensure that the material or equipment is not stored, stacked or placed so close to any opening or edge of a floor, scaffold, platform or structure as to endanger persons below the opening or edge**.**

Work on Roofs

Where in a worksite, any person carries out any work on any roof from which he is liable to fall off or through a distance of more than 2 metres, it shall be the duty of the occupier of the worksite to provide -

- sufficient and secured anchorage for the attachment of safety harness in the course of the person's work; and
- protection of the person against any sliding or fall from the roof.

Hazards arising from protruding objects

It shall be the duty of the occupier of a worksite to ensure that at the worksite -

- all passageways, stairs, platforms and other means of access or places of work in the worksite are kept free from debris or protruding objects or any other obstruction that could cause tripping; and
- any sharp projection which is present in any passageway, stair, platform and other means of access or place of work in the worksite and which may injure any person is removed or otherwise made safe.

Entry into Building Under Construction
Duty of the occupier
where a building under construction in the worksite is more than 2 storeys high, to provide designated entry and access at the ground floor with adequate overhead protective cover for persons entering or leaving the building; and to take all reasonably practicable measures to prevent any person from entering or leaving the worksite by or through other means of entry and access

Safe Means of Access
Safe means of access and egress between different working levels in building or structures

Where in a worksite, work is carried out by persons required to work between different levels of a building or structure, it shall be the duty of the occupier of the worksite to take, so far as is reasonably practicable, such measures as are necessary to ensure safe means of access to and egress from the different levels of the building or structure at all times.

Lighting

It shall be the duty of the occupier of a worksite to -

(a) provide and maintain in the worksite -

(i) sufficient and suitable lighting, whether natural or artificial, in every part of the worksite in which persons are at work or passing; and

(ii) emergency lighting for use in the event of a power failure affecting the general lighting; and

(b) ensure that the level of illumination provided by the emergency lighting shall be sufficient in intensity and distribution to allow for the safe evacuation or rescue of persons in the worksite

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Personal Protective Equipment

Employer or Principal to provide appropriate PPE to their workers.

Head protection	- struck by falling objects
Head covering	- entangled with moving parts of machinery
Hand protection	- cuts or burns to hands
Foot protection	- hot, corrosive substances or falling objects
Hearing protector	- hazard of excessive noise
Respirator	- hazard of toxic substances
Goggles	- eye injuries

Duties of PE undertaking design of temporary works

Strengthen the regime for temporary work to be on par with permanent work;
PE to ensure that:

- His design can be executed safely;
- Provide design documentation;
- It is constructed in accordance with his design; and
- Issue a certificate that it is safe for its intended use

3.3 Ladders

Construction

- It shall be the duty of the employer and principal to ensure that the ladder is of good construction, sound material and adequate strength for the purpose for which it is used.

Resting surface and prevention against slipping

- Every ladder in a worksite shall be positioned and securely fixed when used by any person carrying out any work so as to prevent slipping, swaying or sagging.
- If such fixing is impracticable, the ladder shall be held in place by a person.

Landing place

- every ladder or run of ladders used by any person carrying out any work which rises a vertical distance of over 9metres shall, if practicable, be provided with an intermediate landing place so that the vertical distance between any 2 successive landing places shall not exceed 9 meters
- Where a vertical ladder used by any person carrying out any work in a worksite rises a vertical distance of more than 3 metres, there shall be provided a safety cage or other practicable measures to prevent fall of persons.

Platform Ladder

It is safer.

- Provides a much larger work surface than a step ladder.
- Can be used when the task involves external periods working at height or with restricted movement and vision.

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3.4 Cantilevered and material platforms

Part VII Cantilevered and Material Platforms
Applicable to any material platform which

(i) is used for the purposes of loading and unloading of any material or equipment; and
(ii) is subjected to a load weighing 1,000 kilograms or more.

Cantilevered platform or material platform used in the worksite is

(i) designed such that it is capable of bearing a load of at least twice its safe working load; and
(ii) constructed, installed or repositioned in accordance with the design and drawings of a professional engineer who designed the platform;

It shall be the responsibility of Employer / Principal of user of platform to ensure that:

- The cantilevered platform or material platform used in a worksite shall not be loaded beyond its safe working load except by an inspector or a professional engineer when testing the platform.
- Materials or equipment shall not remain on a cantilevered platform or material platform used in a worksite for a period longer than is necessary for loading or unloading.

Guard-rails and toe-boards

It shall be the duty of the occupier of a worksite,

- To provide guard-rails and toe-boards around the platform.
- If any gate is provided in place of guard-rails at the outer edge of a cantilevered platform or material platform used in a worksite, it shall be constructed to open inwards to the platform.

Use of wire rope

- No wire rope shall be used as a load carrying member unless it is terminated fitted with thimble eyes
- Wire rope clips shall not be used for termination.

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Inspection by designated person

It shall be the duty of the occupier of a worksite to —

- ensure that every cantilevered platform or material platform in the worksite is inspected by a designated person at least once every 7 days;

Summary

Any cantilevered materials platform subjected to load of 1000kg or more:

- PE design and certificate for safe for use
- Safe working load sign
- Materials or equipment does not remain on a cantilevered platform or material platform
- Every open side of a cantilevered platform or material platform more than 2 metres height to be provided with guard-rails and toe-boards
- Use of wire rope terminated with eyes fitted with thimbles
- Inspected by a designated person at least once every 7 days
- Rectify immediately any unsafe condition
- Result of the inspection is entered by the designated person into a register

3.5 Electrical Safety

WSH (Construction) Regulations

Part V Electrical safety

- Electrical power circuits
- Installation of electric wiring and power lines
- Bare wires and exposed live conductors
- Residual current circuit breakers and overcurrent protective devices
- Prohibition on use of fuse
- Welding sets
- Industrial plug and socket-outlet
- Distribution board and socket-outlet assembly
- Electrical installations and equipment used underground or in confined space

Some Key points of Electrical Legal Requirement

- Welding sets are fitted with an effective voltage limiting device or shock preventor;
- Industrial plug and socket-outlet ;
- Electrical installations and equipment used underground or in confined space shall be low voltage.

Installation of Electric Wiring and Power Lines

- Employer or Principal to ensure all wiring in the worksite shall be supported on proper insulators and not be looped over nails or brackets.
- Electrical wiring or cables to be of weatherproof type and provided with adequate protection against wear and tear.

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Welding Sets

Employer or Principal to ensure that all alternating current welding sets are fitted with an effective voltage limiting device or shock preventor.

Industrial Plug and Socket-Outlet

Occupier to ensure that the plug and socket-outlets used at site are of the heavy-duty industrial type.

- Electricity is only dangerous if it is not properly used and if electrical equipment are not properly installed, maintained and operated.
- Death by electrocution is a common cause of fatalities at the workplace

SS650- Part 1 (Formal CP88-Part 1)
DB box with RCCB and other safety devices

Residual Current Circuit Breakers

Occupier to ensure that effective RCCBs are installed for all temporary electrical installations for earth leakage protection; and over-current protective devices for short-circuit and over-current protection.

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Industrial Plugs & Socket-Outlets

Industrial plugs and socket-outlets must be used with SOA.

- All industrial plugs, socket-outlets and cable couplers must be identified by the colour code as given below

Operating Voltage V	Color	Examples
55	White	
110	Yellow	
230	Blue	
400	Red	

Portable Electrical Equipment

Flexible cables used for portable electrical equipment such as hand-held tools must not exceed 3 metres or such other length as supplied by the manufacturer.

Light Fixtures

- Light fixtures used outdoor or at locations where there is likelihood that such fixtures are subject to splashing water, shall be of the weatherproof type.
- Temporary lights and equipment installed in areas where explosive gas atmospheres may be present, shall be of the flameproof type.

Electrical installations and equipment used underground or in confined space

All electrical appliances use in confined space and underground should be lower voltage.

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3.6 Disposal of materials

WSH (Construction) Regulations

Part VIII Disposal of Materials

- It is the responsibility of Occupier to ensure that the debris are not allowed to accumulate.
- It is the responsibility of Employer or Principal to remove the debris by means of chutes, buckets, hoists or any other method which will not endanger any person in the worksite.

Floor openings for debris removal

- The floor openings used for debris removal shall be closed from floor to ceiling except the chute opening.
- If left open, there should be a barricade to prevent access for a horizontal distance of 6metres from chute.

Construction of chutes

- Occupier to provide proper chutes for rubbish removal
- It shall be kept closed all the times when not in use.

Debris collection area

- Debris collection area shall be enclosed to a height of 2metres.
- Warning sign boards shall be provided

Design of chute by Professional Engineer

- Any chutes exceeding 12metres in height shall be designed by a Professional Engineer.
- PE to inspect the chute and certify the construction upon installation.

Accumulation of debris

- It shall be the duty of the occupier of a worksite to ensure that debris shall not be allowed to accumulate so as to constitute a hazard in the worksite.

Method of removal of debris, etc.

It shall be the duty of -

(a) the employer of any person who carries out work in a worksite; or

(b) the principal under whose direction any person carries out work in a worksite, to ensure that any debris, brick or other materials in the worksite shall be removed by means of chutes, buckets, hoists or any other method which will not endanger any person in the worksite.

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3.7 Formwork structures

WSH (Construction) Regulations 2007

Reg. 57 to 68

- General duty on occupier
- General requirement
- Supports and shores
- Appointment of formwork supervisor
- Duties of formwork supervisor

General requirements

- Occupier to ensure that sound materials are used for formwork
- The minimum safety factor for Formwork structures shall be 2

Appointment of formwork supervisor

- Employer or Principal to appoint a formwork supervisor to supervise the construction, erection, alteration or dismantling of any formwork structure in a worksite.
- No formwork structure shall be constructed, erected, altered or dismantled in a worksite except under the immediate supervision of a formwork supervisor.

Duties of formwork supervisor

- To ensure that all the components of the formwork structure are properly erected, seated, connected, braced and tied so as to maintain its position and shape

Register

- Formwork Supervisor to enter the results of every inspection into a register;
- keep the register of such inspections of the formwork structure at the worksite; and
- Produce the register for inspection upon request by an inspector.

Register

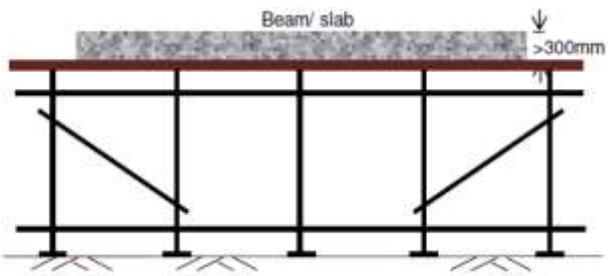
It shall be the duty of the formwork supervisor to —

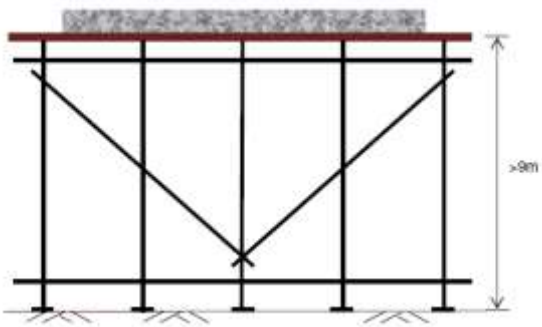
(a) enter the results of every inspection referred to in regulation 61(b) into a register;
(b) keep the register of such inspections of the formwork structure at the worksite; and
(c) produce the register for inspection upon request by an inspector.

Design and construction of formwork structure

PE's design is required if:

- the height exceeds 9metres in height
- consists of any formwork which is supported by shores constructed in 2 or more tiers; or
- consists of any formwork where the thickness of the slab or beam to be cast in the formwork exceeds 300millimetres





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Duties of professional engineer on formwork structure

- To inspect the formwork structure to ensure that it is as per design
- To issue a certificate of inspection

Responsibilities of Supplier of proprietary formwork
(SS 580:2012)

- Formwork supplier to provide "information"
- A checklist shall be jointly prepared by the contractor and formwork supplier to ensure that all requirements are met.

Design and construction of formwork structure

63(1) It shall be the duty of the occupier of a worksite where there is situated a formwork structure that —
(a) exceeds 9 metres in height;
(b) consists of any formwork which is supported by shores constructed in 2 or more tiers; or
(c) consists of any formwork where the thickness of the slab or beam to be cast in the formwork exceeds 300 millimetres, to comply with paragraphs (2) to (5).

63(2) Any formwork structure referred to in paragraph (1) that is in a worksite shall be designed by a professional engineer and no other.

63(3) No alteration shall be made or allowed to be made to a formwork structure referred to in paragraph (1) unless its design and drawings have been reviewed and endorsed by a professional engineer.

63(4) The design and drawings of a formwork structure referred to in paragraph (1) made by a professional engineer shall be kept at the worksite and shall be produced for inspection upon request by an inspector.

63(5) No formwork structure referred to in paragraph (1) shall be used in a worksite unless the certificate referred to in regulation 64(2)(ii) has been issued in respect of it.

Duties of professional engineer on formwork structure

64(1) (a) to take, so far as is reasonably practicable, such measures **to ensure that his design can be executed safely by any person** who constructs or uses the formwork structure according to his design; and

64(2) (b) to take, so far as is reasonably practicable, such measures … to ensure that the formwork structure:
(i) is constructed in accordance with the design of the professional engineer who designed it; and
(ii) is safe for its intended use when completely … issue a certificate stating that the formwork structure is safe for its intended use.

Concrete work

- Concreting to be carried out only after Formwork Supervisor has inspected the formwork structure
- During the concreting, the Formwork Supervisor shall be present
- Formwork supervisor shall regularly inspect the formwork structure in a worksite during the placement of concrete to monitor the stability and soundness of the formwork structure.
- A formwork Watcher is to be assigned during the concreting to check for leakage, foundation settlement, sway, buckling or other adverse effects during concreting. (SS580:2012)

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Dismantling

- Occupier to ensure that the dismantling of a formwork structure in a worksite shall not commence until the concrete is set.
- The strength of the concrete may be accesses by test on cubes cured as far as possible under the same conditions as the concrete in the element and tested in accredited laboratory. (SS580:2012)

Steel reinforcement

- It shall be the duty of the occupier of a worksite to ensure that steel reinforcement for any column, wall, floor or any other structure in the worksite is adequately supported to prevent collapse

Re-shoring

- Re-shoring shall be provided when necessary to safely support slabs and beams after a formwork structure in a worksite is dismantled, or where such slabs or beams are subjected to any superimposed load due to any construction work above.
- The re-shoring shall be inspected by the FW supervisor and the results of the inspection shall be entered by the formwork supervisor into a register.

3.8 Demolition

WSH (Construction) Regulations 2007
Part X DEMOLITION

- General duty on occupier
- Preparation of demolition work
- Protection of adjacent structures
- Removal of load bearing structures
- Demolition of walls, partitions, etc.
- Access to floor
- Barricades, catch platforms and warning signs
- Mechanical method of demolition

Duty of the occupier to ensure all glass and claddings on the exterior of the building to be demolished shall be removed; and all gas, electric, water, steam and other supply lines shall be shut off and capped before demolition.

Access to floor

There shall be provided at all times safe access to and egress from every building in the worksite in the course of demolition by means of entrances, hallways, stairways or ladder runs which shall be so protected as to safeguard the persons using them from falling material.

Demolition of walls, partitions, etc.

Demolition of walls and partitions in a worksite shall proceed in a systematic manner and all work above each tier of floor beams shall be completed before the safety of its supports is impaired.
Masonry shall neither be loosened nor permitted to fall in a worksite in such masses as to endanger the structural stability of any floor or structural support.
No wall, chimney or other structure or part of a structure which is being demolished in a worksite shall be left in such a condition that it may -

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(a) fall or collapse inadvertently; or
(b) be weakened due to wind pressure, vibration or other causes.
Where any demolition work in a worksite is carried out with the use of hand-tools -
(a) safe footing in the form of sound flooring or scaffolds shall be provided for persons working on an exterior wall; and
(b) walls or partitions shall not be left standing more than one storey above the uppermost floor on which persons are working.

Mechanical method of demolition
Where a swinging weight is used in demolition operations in a worksite, the building or structure or remaining portion thereof shall be not more than 24 metres in height; and a zone of demolition having a radius of at least one and a half times the height of the structure or portion thereof being so demolished shall be maintained around the points of impact.
Where other mechanical contrivances are being used for the demolition work in a worksite, there shall be maintained in the area into which affected persons may fall an adequate zone of demolition to ensure the safety of the person.

Protection of adjacent structures
the stability of the walls, ceilings, slabs, beams and all other structures adjacent to the structure which are to be demolished shall be determined.
No demolition shall be performed unless sheet piling, shoring, bracing or such other means as may be necessary to ensure the stability of the adjacent structure and to prevent the structure or other property from collapsing is provided.
Removal of load bearing structures shall be carried out with due regard to the integrity of the remaining structure; and in accordance with the method statement prepared by a professional engineer.

Protection and Shoring:

- no person is allowed to work where there is danger of building collapse
- shoring is to prevent structure or adjacent building from collapse

Catch Platforms:

- to catch any falling objects
- to protect workers / public
- not > 2-storey below work level
- at least 2m wide
- should be inclined

Precautions:

- do not drop or accumulate debris
- load bearing structure demolished last
- maintain good stairway
- prevent workers from falling
- scaffolding is securely tied back

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Mechanical method of demolition

- whole structure falling - fencing > 1.5 time of building height
- to protect mechanical equipment driver
- ladder should not lean against structure to be demolished
- safety zone of 1.5 times the building height for swing weight method\

Where a swinging weight is used in demolition

Operations

- the building or structure or remaining portion thereof shall be not more than 24metres in height
- safety zone of 1.5 times the building height for swing weight method
- Where a clamshell bucket is being used for the demolition work in a worksite, a zone of demolition shall be maintained within 8metres of the line of travel of the bucket.

Inspection:

- daily - before and end of work
- weakened floor and structure
- opening - falling hazard
- structural collapse
- shoring of weak structure
- loose falling object

Asbestos - Bearing Materials:

- health hazard
- blue asbestos for fire protection or thermal insulation - to prevent breathing in of the dust
- isolation from other work
- positive pressure breathing apparatus
- PPE e.g., protective clothing
- training - PPE and removal
- wet method rather than dry method
- arrangement with MOM and NEA for the safe removal and disposal of asbestos-contaminated debris

Causes of Accidents:

- incorrect method of demolition
- unsafe place of work
- unintentional collapse of building
- collapse of an adjoining structure

In summary

The Demolition Protocol is a set of procedures to help demolition contractors better plan their demolition procedures so as to maximise recovery of waste materials for beneficial reuse/recycling.
This protocol has also been incorporated into the new standard SS 557: Code of Practice for Demolition.

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Before Demolition: Pre-Demolition Audit & Method Statement

- Obtain a set of the building plans of the structures to be demolished
- Assess the construction method, structural framing system, and critical building elements that need special treatment during sequential demolition.
- Assess the types of material used in the construction of the building through desk study of the building blueprint and site visits

Planning & Preparation:

- apply permit to demolish
- written method statement
- provisions for access and exit passages
- removal of debris
- protection of workers from falling
- remove glass material
- to stabilise unstable parts of the building
- identify and disconnect services
- keep the public away
- inspection by a designated person

Process & Procedure:

- systematic way
- prevent isolated walls
- debris should not be accumulated
- debris should not be allowed to drop from a height
- avoid working directly from parts of the building
- safe access must be provided
- make sure vibration does not cause loosening of structure
- avoid work simultaneously at different levels
- water sprays may be used for excessive dust

Method Statement & SWP

- Sequence of demolition
- Detailed work schedule
- Selection of suitable machinery & equipment
- Temporary shoring method
- Other precautionary measures to safeguard the stability of any adjoining & adjacent buildings
- Details of safety procedures to remove or cut off existing utility installations
- Details of temporary services required for the execution of work
- Details of methods for dealing with flammable material & gases
- Details of methods to be used for the disposal of substances hazardous to health & any necessary protective equipment
- Arrangements for the control of site transport used for the removal of demolition debris
- Special precautions for entering confined space in demolition site
- Arrangements for the protection of personnel & public & the exclusion of unauthorised person eg. Hoardings, covered walkway, warning signs & etc
- Measures to protect the environment eg. Controlling excessive noise & dust emission
- Contingency plan for flooding, fire, explosion & accidents
- Close surveillance of safe working practices
- Training requirements – management, supervisory staffs & workers

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3.9 Explosive

Handling of explosives

It shall be the responsibility of employer or principal to ensure the following:

- Explosives shall not be handled or used in a worksite except in accordance with the manufacturer's instructions
- Smoking, open lights and flame or spark producing devices shall be prohibited in or around the explosive magazine or storage enclosure in a worksite.
- Appropriate warning signs of the prohibitions shall be posted and maintained at every place where the explosives are kept or stored
- Packages of explosives in a worksite shall not be opened at any point less than 15.5metres distance from any explosive magazine.
- Metallic instruments shall not be used for opening packages of explosives in a worksite.

3.10 Piling

Part XIV PILING

- Stability of adjacent structures
- Inspection
- Pile driver not in use
- Pile testing
- Footing

General Precautions:

- Percussion Piling, Bored Piling & Sheet Piling
- Trained operator > 18 years old
- Locate and make safe underground services
- Firm level base for crane - crane mat
- PPE - helmet, ear & eye protection
- Statutory test for crane and lifting appliances, gears
- Damage to lifting gear from sharp edges
- Written method statement
- Specified training to supervisor and operator

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Stability of adjacent structures

Duty of the occupier to ensure the structure is adequately supported by underpinning, sheet piling, bracing or other means of shoring in accordance with the design of a professional engineer with issuing of certificate stating that the underpinning, sheet piling, bracing or other means of shoring is safe for its intended use.

A designated person before the start of any piling work for the day and that every defect is corrected before the piling equipment is used.

Pile driver not in use

To ensure that when the pile driver is not in use, the hammer is choked or blocked in the leads or lowered to the ground.

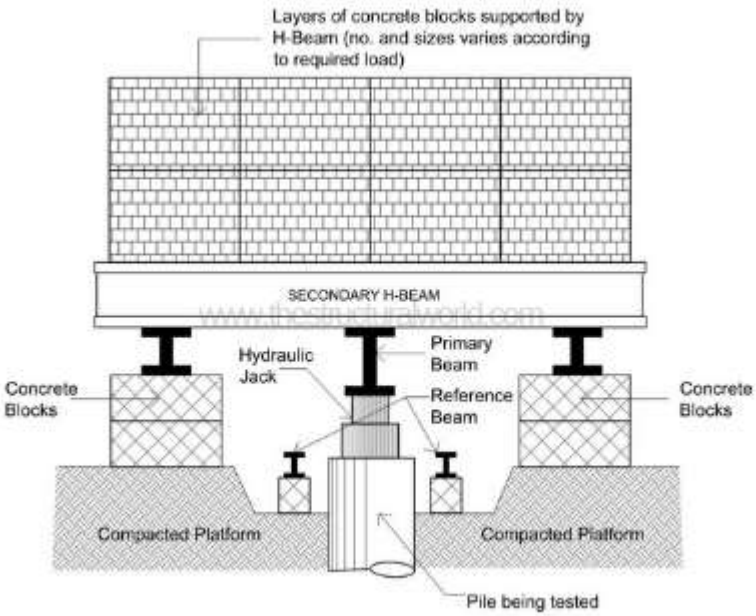
Pile testing

The testing of piles in a worksite shall be conducted under the direct supervision of a designated person.

Warn persons not to approach the pile test area in a worksite.

No unauthorised person shall be allowed to approach a pile test area in a worksite while the process of increasing or decreasing test loading is being carried out.

Designated person to take, so far as is reasonably practicable, such measures as are necessary to ascertain that the pile testing system in a worksite is in a stable condition and is safe for approach. After placing or advancing a piling frame in a worksite, an inspection and correction of the footing shall be carried out to ensure stability.



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Footing

- The ground of site shall be inspected by a designated person and made firm and level before placing or advancing a piling frame.
- After placing or advancing a piling frame, an inspection and correction of the footing shall be carried out to ensure stability.

Percussion Piling:
H-section or precast column insert into ground by a pile driven rig

Common causes of accident:

- pile hits workers while pulling and lifting
- pile hammer crushes the worker
- toppling of pile driving rig
- pile drops onto worker
- worker's fingers crushed in between cable and pulley
- workers hit by loosened screw & nut

Safety Measures

To prevent the above accidents, directly or indirectly, safety rules should be observed during percussion piling operations.

a) All workers must be cleared from the neighborhood of the hoisting area.

b) The angle of lift must be kept to the minimum (i.e. not to pull a pile from a distance).

c) The designated person must always be directing the operator and ensure that no one is in the path of the movement.

d) A hand rope should be fastened to the pile that is being hoisted, to control its movement.

e) Every piling frame and its attachments must be examined by an approved person at least once in every year.

f) Regular inspection by designated persons must be carried out.

g) Lifting wire rope should not be used where visible broken wires are found.

h) Shackles and hooks should be used when lifting piling and these must be of sufficient strength and of the correct sizes.

i) The excavator's driver should be trained to operate the excavator.

j) Proper design should be done for the piling machine e.g. the pulley's groove should be deep enough to prevent the cable from slipping out easily.

k) Before placing or advancing a pile driver, a designated person shall inspect the ground and where necessary, for firm and level footing, timber or steel mats should be used.

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Bored Piling:

In bored piling, a vertical shaft is dug in the ground and then the shaft is filled with concrete. Much of this work has been done without accident. Nevertheless, it is clear that there are risks involved. The results of which could be serious unless reasonable precautions are observed.

In the bored piling works, the worker is subjected to the following hazards:-

a) The worker could be hit by loose boulders and stones dislodged from the wall of the borehole.
b) The displacement of soil from the wall of the borehole could bury the worker.
c) Explosive gas and air mixtures are sources of danger to all men working around boreholes.
d) Workers might fall into uncovered boreholes.

Some of the safety measures that should be carried out during bored piling operations are:

Lining of Holes

The borehole must be lined to maintain its stability and also the ground nearby. The lining should be supported to prevent it from slipping from the set position. Water seeping into the hole should be sealed off by driving the lining tube sufficiently into the impervious layer e.g. clay, where it is not possible, other precautions, such as pumping must be taken if water is liable to enter a borehole.

Protection of Boreholes
The upstand may be formed by the lining of the hole or a similar tube projecting above ground level to the required height. The protection may be removed when workers or materials are lowered in but they must be replaced soon after.

Common causes of accident:

- collapse of piling machine
- hit by loose boulders and stones
- buried by displacement of soil
- explosive gas
- fall into uncovered boreholes
- struck by falling objects (eg tools)

Safety measures for Bored Piling:

- lining of boreholes
- protection of boreholes to prevent collapse of boreholes
- Firm and level footing
- Compacted ground and steel plate footing

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Sheet Piling:

The sheet piling process involves:

a) The transportation and positioning of sheet piles;
b) The driving of sheet piles, waling and strutting of the sheet piles after each layer of excavation is carried out until the required depth is reached in accordance with the design drawings;
c) The extraction of sheet piles after backfilling of sand and granular materials when work is completed.

Transportation and Positioning of Sheet Piles

Sheet piles are lifted and brought to the correct position to be driven. In the process the sheet piles swing about the working area where the workers are present. The workers are exposed to the risk of being hit by the moving sheet piles.

Safety Measures

The worker must be provided with a safety harness when he is to position the sheet piles correctly and to release the sheet piles from the rope.

The horn fitted on the crane to warn the workmen of the danger must be maintained in working condition.

Driving Of Sheet Piles

a) The process of driving the sheet piles would cause noise-induced deafness to the workers. It is observed that the noise produced makes conversation inaudible. Precautionary measures such as silencer should be used. Earplugs and other ear-protection are necessary.

Waling and Strutting

Workers are exposed to the electric arch flash in welding joints for the walers and welding struts to the walers. Welders are sometimes found not wearing the protective equipment such as shields, goggles, gloves and protective clothing. If the installation of walers and struts is delayed or if the welding joints of the sheet piles are poor, the earth pressure can cause the sheet piles to bend or give way.

Therefore workers working at the bottom of the trench are exposed to the risk of collapsing walers and struts. Inspection should be carried out regularly to ensure that the installation of walers and struts are properly done.

Extraction Of Sheet Piles

Using the extraction hammer could result in the emission of excessive noise as loud as the driving of the sheet piles. This can also cause noise-induced deafness to the workers after prolonged period of exposure.

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Common causes of accident:

- collapse of piling machine
- fall from height
- electrical shock and electrocution
- finger or hand crush between sheet pile
- knock by sheet pile
- Noise hazards

Safety measures for sheet Piling:

- transportation and positioning of sheet piles
- Safe work procedure
- Establish and implement safe work procedures for the clamping, lifting and release of sheet piles. Workers must be familiar with the use of lifting clamps*
- Keep loads low to the ground and stay out of the "drop-zone". In this case, the sheet pile may fall on its edge before falling to one side. driving of sheet piles
- Platform for installing wailing and strutting
- Welders are sometimes found not wearing the protective equipment such as shields, goggles, gloves and protective clothing
- SWP for extraction of sheet piles

3.11 Compressed Air Environment

Part XII Compressed Air Environment

Compressed air environment

a. Safe system of work

No person shall enter, work in or leave the compressed air environment except in accordance with a safe system of work.

b Warning notices

Unauthorised entry warning notice shall be displayed at entrance to compressed air environment and informing them of:

- the danger of not undergoing proper compression and decompression;
- fire and explosion hazards;
- evacuation procedure in case of an emergency.

c Supply of air

There shall be adequate supply of compressed air and there shall be a reserve supply of compressed air available for every man-lock and medical lock. Air intake of air supply shall be located away form fumes, exhaust gases or other air contaminants.

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d Power source

Every low pressure air compressor shall be provided with at least 2 independent and separate source of power supply which shall be capable of supplying power automatically when one source fails.

e Temperature and humidity

The temperature in any working chamber, man-lock or medical lock shall not exceed 29°C and the relative humidity not exceed 85%.

f Means of communication

Effective and reliable means of communication shall be maintained at all times and shall connect the following locations,

g Condition for person working in compressed air environment

Every person who is employed in a compress air environment shall spend not less than 12 consecutive hours at atmospheric pressure in any 24-hour period.

A person who has not carried out any work in a compressed air environment for more than 14 consecutive days shall not carry out such work exceeding one bar for more than 4 hours in one day.

h Condition for multiple entries in compressed air environment

No person who has undergone 3 decompressions from a pressure exceeding one bar in any 24-hour period preceding the time he is to enter a compressed air environment shall carry out any work in compressed air except for the purpose of carrying out rescue work.

i Man-locks

A suitably constructed and equipped man-lock shall be provided for each tunnel.

j Medical locks

A suitably constructed and equipped medical lock shall be provided and maintained where persons are working a pressure exceeding one bar. Where more than 100 persons are employed in a compressed air environment exceeding one bar, a medical lock shall be provided.

k Resting facilities and first aid room

Adequate and suitable facilities shall be provided for persons requiring to remain at the worksites for one hour or more after decompression from pressures exceeding one bar. A first-aid room shall be provided and readily available.

l Maintenance of records

A register showing the name, identity card number, passport number, work permit number, date of birth, nationality, home address and occupation of each employee in a compressed air environment shall be prepared and kept. A copy of every lock attendant's register shall be kept for a period of 3 years after its making.

m Training of personnel

The employer of person shall ensure that the person does not carry out such work unless he has received adequate safety and health training to familiarize himself with the hazards associated with such work and the precautions to be observed.

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3.12 Penalties for non-compliance

Any person who contravenes any provision of these Regulations which imposes a duty on him shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $20,000 or to imprisonment for a term not exceeding 2 years or to both.

Learning Activity 3 – Case Scenario

Objective: List the violation and safety measures to be implemented to conform to Construction Regulation

Group Discussion & Presentation

You are newly appointed as PM to take charge of a new worksite

- Based on the photos identify the violation and safety measure you will implement at you work site to conform to WSH (Construction) Regulation

Resource: Sites hazards photos to be distributed for discussion

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Lesson 4 - General Worksite Safety

PS3.

Plan and implement safety programme, system and safe work procedure for construction activities in accordance with WSH (Construction) Regulations

UK4 General Worksites Safety

At the end of the Topic, learner is able to explain:

- Worksite registration under WSH (Registration of Factories) Regulations
- Restricted activities near MRT under Rapid Transit Systems (Railway Protection, Restricted Activities) Regulations
- Legal requirement of Workplace Safety and Health Officer under WSH (WSHO) Regulations
- Personal protective equipment
- Vehicular safety
- Access to and egress from worksite
- Hazards of working at height
- Falling from height
- Fall Protection Plan
- Falling objects
- Mechanical hazards
- Electrical hazards
- Lock-out procedures
- Explosive power tools
- Fire prevention
- Confined spaces

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UK4 General Worksites Safety

4.1 Worksite registration under WSH (Registration of Factories) Regulations 2010

MOM Circular

MOM/OSHD/2019-02 19 SEP 2019

Construction worksites **are no longer required to register with MOM** As part of the Government's efforts to streamline business processes, with effect from 1 April 2019, construction worksites no longer need to register with the Ministry of Manpower (MOM).

Previously, construction worksites need to register the worksite with MOM as well as apply to the Building Control Authority (BCA) for a permit to carry out structural works. Now, worksites only need to apply for the permit from BCA. MOM will obtain the relevant worksite information from BCA.

However, all construction worksites must still comply with the Workplace Safety and Health Act (WSHA) and its subsidiary legislation such as Workplace Safety and Health (Construction) Regulations and Workplace Safety and Health (Safety and Health Management System and Auditing) Regulations.

More information is available at: www.mom.gov.sg/workplace-safety-and-health/factory-notification-and-registration/requirements-for-factories

1. What premises are considered construction worksites?

Construction worksites include:

- Premises that carry out building operations (e.g. construction, demolition, structural alteration, repair or maintenance, electrical installation, lift replacement of a building as well as site preparation, laying of foundation for an intended building)
- Premises that carry out works of engineering construction (refer to Third Schedule of WSHA).

2. Can my worksite start site preparation without factory registration?

You may start site preparation (e.g. erect hoarding, mobilisation for the construction worksite) and building operations (e.g. mechanical works, electrical and instrumentation (E&I) works, process modification works) in the worksite without a factory registration. You are reminded to conduct risk assessment before starting any work. However, you are not required to submit the risk assessment to MOM.

3. How do I get a workplace number for my construction worksite to carry out WSH transactions if my worksite does not need to be registered?

If you have already applied for a permit for structural works at the worksite with the Building and Construction Authority (BCA), you will receive a workplace number assigned to your worksite via email.

If your worksite does not need a BCA permit, you can log in to WSH e-Service using your company's CorpPass to create a non-notifiable workplace number.

You can also log in to WSH e-Service using your company's CorpPass to search for active workplace records under your company.

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4. Is my worksite still required to conduct and submit the initial SHMS audit since there is no need to register for a Factory Registration?

Construction worksites must implement a Safety and Health Management System (SHMS) and conduct SHMS audit or internal review as required by Workplace Safety and Health (Safety and Health Management System and Auditing) Regulations. Please refer to the new timelines for submission.

Worksite	Conduct SHMS audit or internal review
Worksite with contract sum $30 million and above	• Conduct SHMS audit by SAC-accredited WSH Auditing Organisation at least once every 6 months. • If your worksite has applied with BCA for a permit for structural works, you must conduct SHMS audit within 6 months of their approval date. • If your worksite doesn't need BCA permit, you must conduct the audit within 6 months of starting operations.
Worksite with contract sum less than $30 million	• Conduct internal SHMS review at least once every 6 months. • If your worksite has applied with BCA for a permit for structural works, you must conduct internal review within 6 months of their approval date. • If your worksite don't need BCA permit, you must conduct internal review within 6 months of starting operations.

5. Can a worksite have multiple occupiers? For example, are specialist contractors directly appointed by the developer allowed to have their own workplace number that is different from the main contractor?

In general, there should only be a single occupier holding charge, management and control of a specific worksite. Unless there are clear contractual demarcation, the main contractor appointed by the developer will remain as the occupier of the worksite.

Specialist contractors and other sub-contractors must continue to coordinate with the main contractors to ensure that any work carried out does not compromise the safety and health of the workers.

6. Is my existing factory registration valid?

For existing construction worksites already registered with MOM, the factory registration remains valid until the contractor terminates the registration upon project completion.

More information is available at: www.mom.gov.sg/workplace-safety-and-health/factory-notification-and-registration/requirements-for-factories

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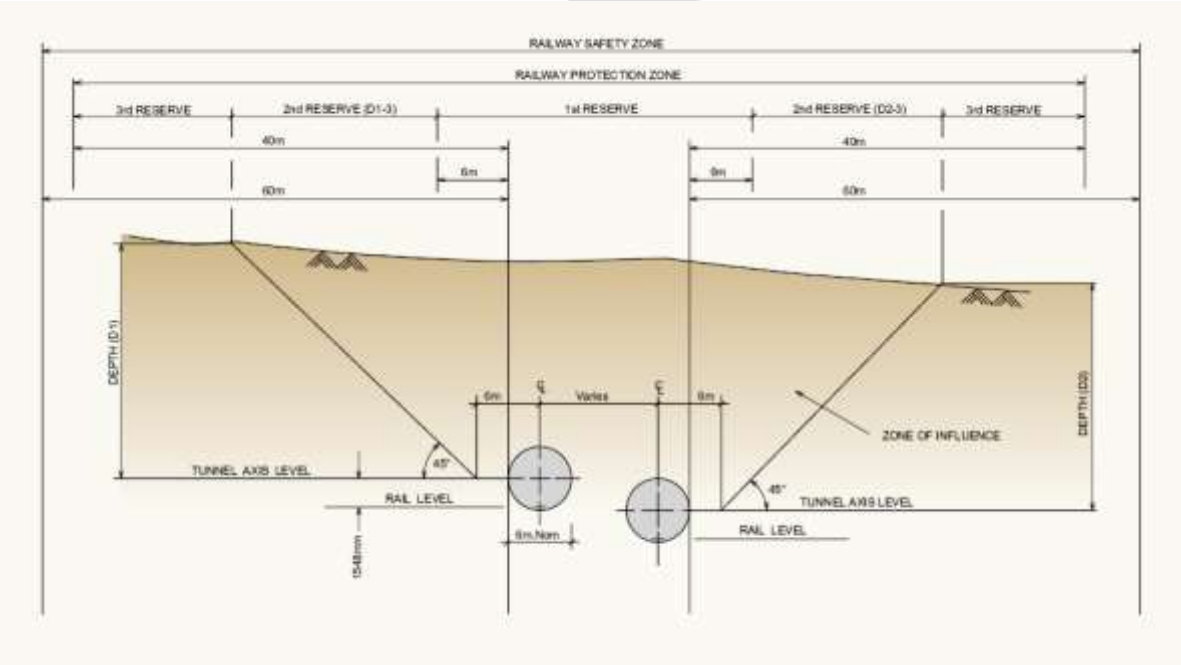
4.2 Restricted activities near MRT under Rapid Transit Systems (Railway Protection, Restricted Activities) Regulation

Requirement

There are three boundaries established by the authorities. Namely:

- Railway Safety zone,
- Railway protection zone
- First reserve line.

Prior approval from LTA and SMRT are required if the works are with in this zone.



DEFINITIONS OF RESERVE LINES AND
ZONE OF INFLUENCE FOR BORED TUNNEL

This Code of Practice for Railway Protection (herein referred to as the Code) is issued under Regulation 8 of the Rapid Transit Systems (Development and Building Works in Railway Corridor and Railway Protection Zone) Regulations.

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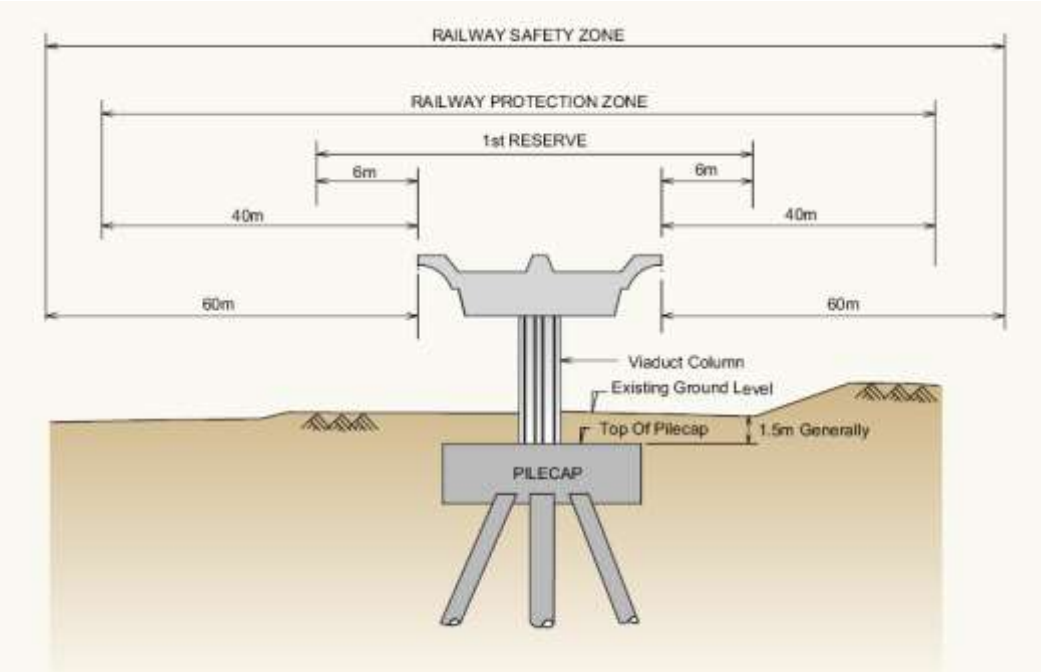
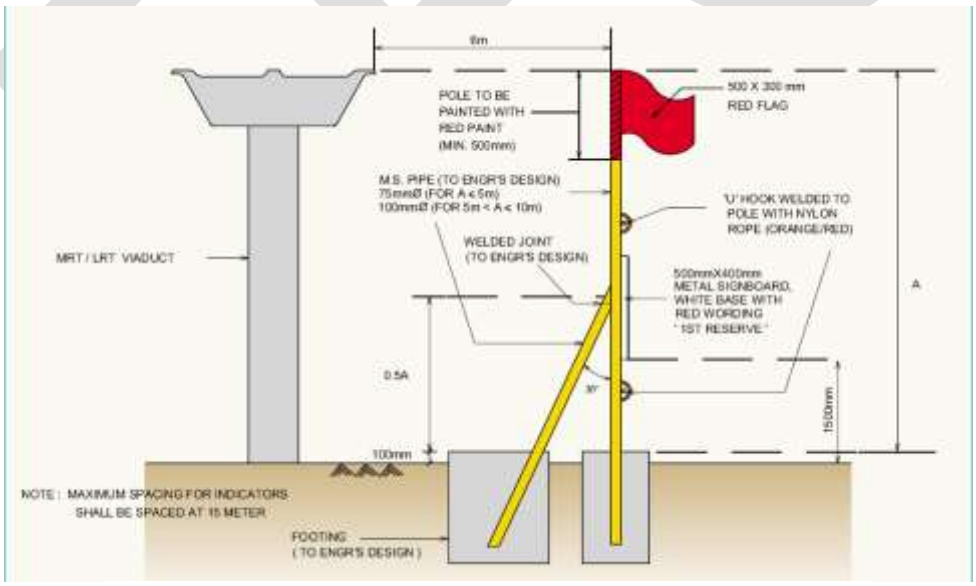


DEFINITIONS OF RESERVE LINES AND
ZONE OF INFLUENCE FOR ABOVE GROUND STRUCTURE



DEMARCATION DETAILS FOR FIRST RESERVE LINE

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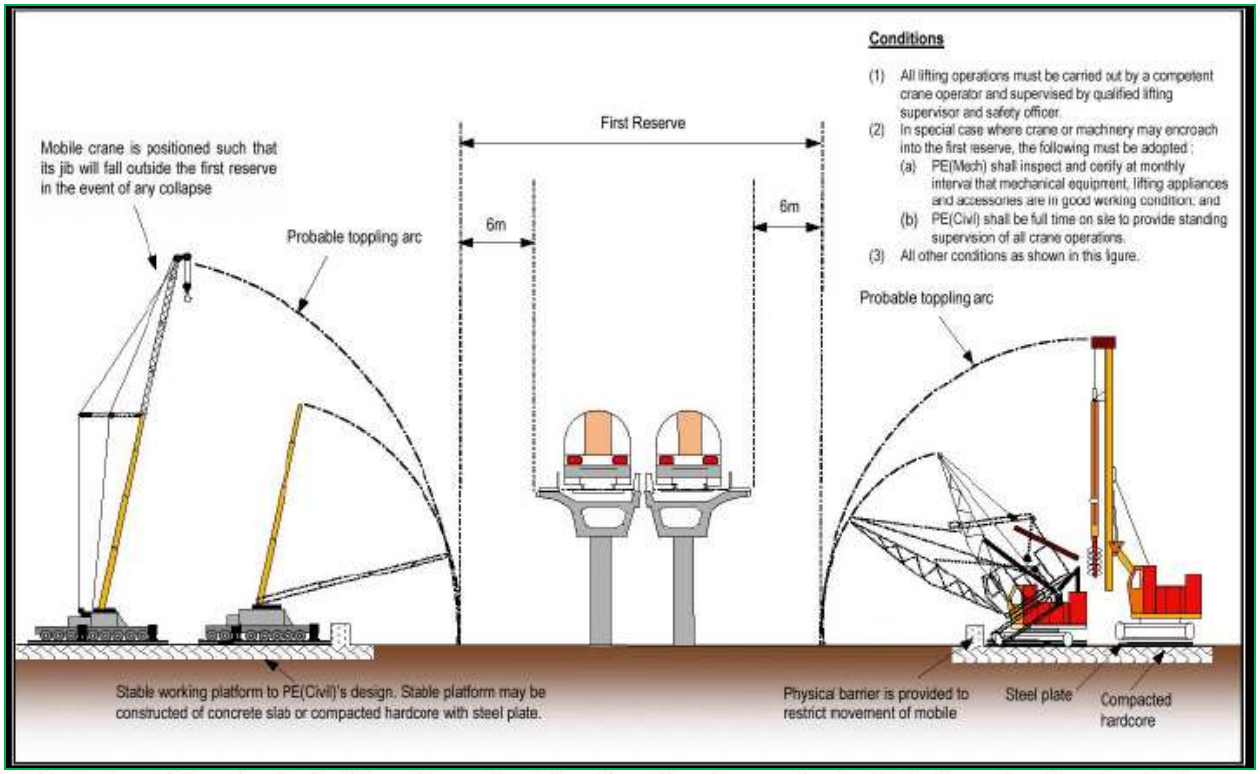

This Code of Practice for Railway Protection (herein referred to as the Code) is issued under Regulation 8 of the Rapid Transit Systems (Development and Building Works in Railway Corridor and Railway Protection Zone) Regulations.

If the works are in the safety zone,

Length of boom is restricted so as to prevent it falling in to the reserve line, if at all there is a collapse of crane.
If the works are in the protection zone,

1. Physical barrier to prevent crane movement
2. PE (Civil) to co-ordinate the works full time on site
3. PE (Mechanical) to inspect the crane and other lifting machinery on monthly basis.

LTA Regulations concerning Lifting Equipment

- Before commerce work all cranes will be thoroughly checked for compliance with legislative requirements and LTA's GS requirements.
- When performing lifting works near to MRT track lines, this zone is called "Railway Safety Zone."
- Compared to similar exercises carried out previously, many of our contractors are now more concerted efforts to comply with our contractual requirements.

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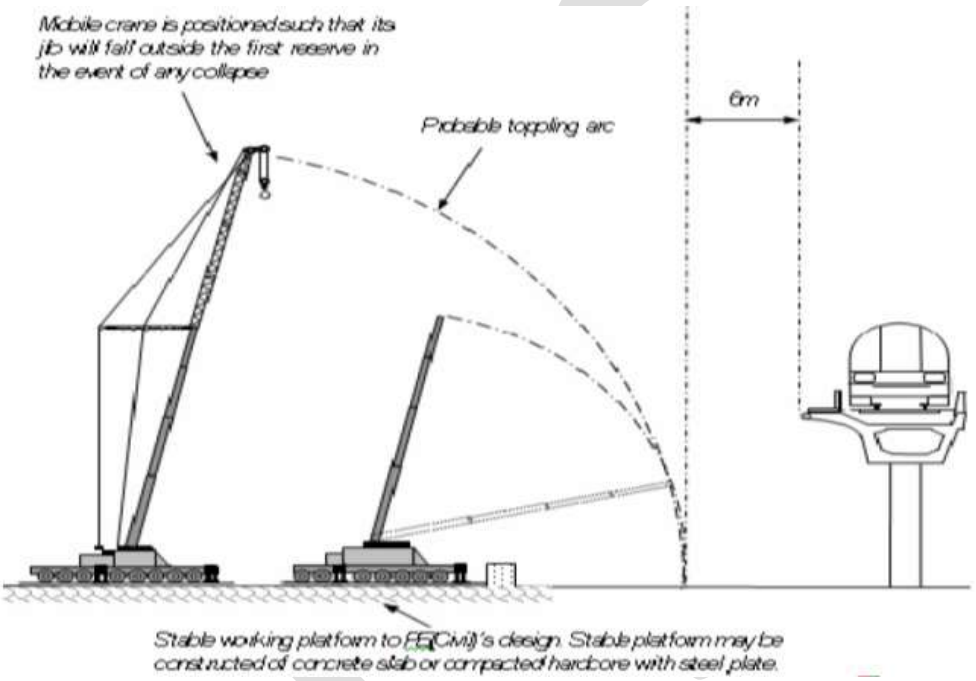
Use of Mobile Crane, Drilling or Piling Equipment, Lorry Crane, Cherry Picker in vicinity of Elevated and at Grade Railway

The risks posed by the movement and operation of carne, drilling or piling equipment on the elevated and at grade railway could include:-

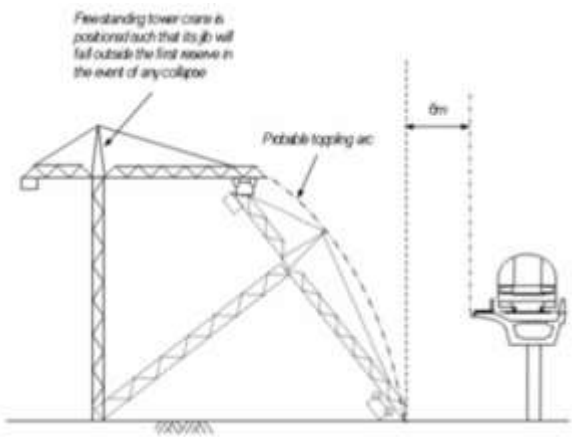
- These equipment may topple and hit the railway structures and trains.
- Boom of equipment could slew and hit the railway structures and trains.
- Load lifted by crane may swing into the direction of passing trains.
- Materials being lifted could drop and strike the railway structures and trains.

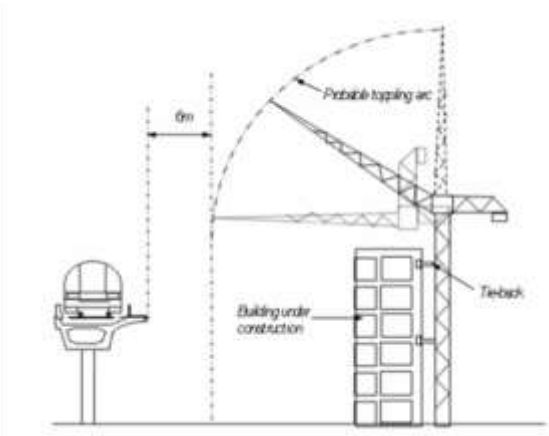
Use of Mobile Crane, Drilling or Piling Equipment, Lorry Crane, Cherry Picker in vicinity of Elevated and at Grade Railway



Special condition for Crane or Piling Equipment operations in 1st Reserve line

Use of Tower Cranes –Safety Measures





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Layout and Design of any Building under the Viaduct

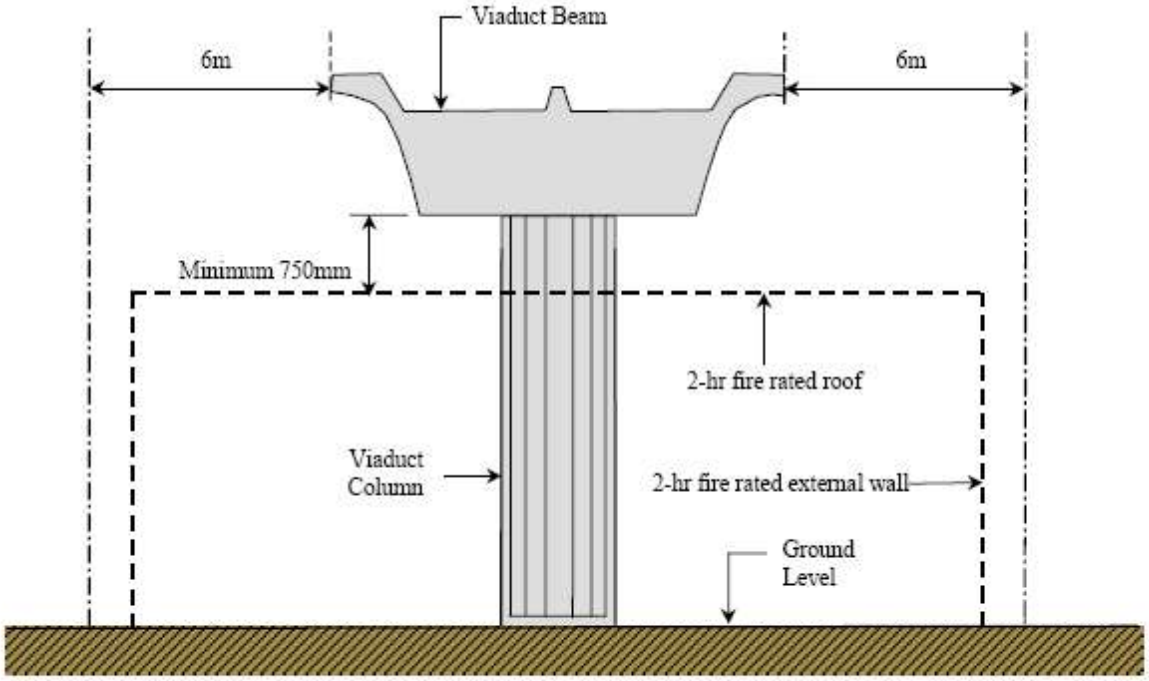

Diagram 12.4.2.1(d)
Clearance of building roof below viaduct

All the cranes used on site were found to be in compliance to LTA's requirements to be not more than 15 years old from date of manufacture.

The auxiliary load-line was tested by Authorized Examiners (AE) and the results were reflected in the Lifting Machine (LM) certificate

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What are restricted activities?

Restricted activities are listed in the schedule of the Rapid Transit System (Railway Protection, Restricted Activities) Regulation. They are briefly summarized as:

a. Use of crane, drilling or piling equipment, excavator or any other mechanical equipment or vehicle

b. Installation of boreholes, wells, sheet-piles, pile foundations, ground anchors and horizontal tie backs

c. Storage of materials

d. Excavation of trenches, pits, earthworks, backfilling

e. Dredging of sea beds or river beds, anchoring of vessel with displacement weight more than 20 tons

f. Erection of temporary structures such as maintenance towers, ladders, hoardings, and others such as those for trade fair, fun fair. exhibitions, entertainment, night markers, religions functions or ceremonies

g. Planting of trees with full grown height above parapet wall or wing wall of railway

h. Use of explosive material for blasting, demolition or removal of rocks

i. Construction of underground passageway for use of street, railway, conduit for utilities, and access for people, vehicles, or equipment to underground working site

Railway Protection Plan (RPP)

Railway Protection Plan shows railway (MRT/LRT) safeguarding information graphically on approved cadastral data provided by Survey Services Department of Singapore Land Authority. Railway Protection Plan (RPPs) can be obtained for current valid cadastral lots only.

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4.3 Legal requirement of Workplace Safety and Health Officer under WSH (WSHO) Regulations

Requirements for approval as workplace safety and health officer

(*a*) successfully completed a training course to equip him to become a workplace safety and health officer; and

(b) at least 2 years' practical experience relevant to the work to be performed by a workplace safety and health officer; or

(c) although not having the qualifications and practical experience in paragraph (*a*), he nevertheless has had such other qualifications and practical experience as to render him, in the Commissioner's opinion, competent to act as a workplace safety and health officer.

Workplace safety and health officer to attend courses

- To attend training courses which are relevant to the work of a workplace safety and health officer.

Workplaces requiring workplace safety and health officers

- Every workplace within the prescribed class or description of workplaces specified in the Second Schedule shall appoint a workplace safety and health officer.
- A workplace safety and health officer referred above shall be appointed by the occupier of a workplace.

Any occupier of a workplace who contravenes shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $10,000 and, in the case of a continuing offence, to a further fine not exceeding $1,000 for every day or part thereof during which the offence continues after conviction.

Duties of WSHO

- to assist the occupier of the workplace to identify and assess any foreseeable risk arising from the workplace or work processes therein;
- to recommend to the occupier of the workplace reasonably practicable measures to eliminate any foreseeable risk to any person who is at work in that workplace or may be affected by the occupier's undertaking in the workplace;
- where it is not reasonably practicable to eliminate the risk, to recommend to the occupier of the workplace —
  - such reasonably practicable measures to minimize the risk; and
  - such safe work procedures to control the risk; and
- to assist the occupier of the workplace or other person in charge of the workplace to implement the measure or safe work procedure.

Any workplace safety and health officer who, contravenes in his duties shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $5,000 and, in the case of a second or subsequent offence, to a fine not exceeding $10,000 or to imprisonment for a term not exceeding 6 months or to both.

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Powers of workplace safety and health officer

(a) to enter, inspect and examine at any reasonable time the workplace;

(b) to inspect and examine any machinery, equipment, plant, installation or article in the workplace;

(c) to require the production of workplace records, certificates, notices and documents kept or required to be kept under the Act, including any other relevant document, and to inspect and examine any of them;

(d) to make such examination and inquiry of the workplace and of any person at work at that workplace as may be necessary to execute his duties;

(e) to assess the levels of noise, illumination, heat or harmful or hazardous substances in the workplace and the exposure levels of persons at work therein;

(f) to investigate any accident, dangerous occurrence or occupational disease that occurred within the workplace.

4.4 Personal Protective Equipment (PPE)

It shall be the duty of —

the employer or principal of any person who carries out any work in a worksite to provide and maintain, as far as is reasonably practicable, the appropriate personal protective equipment to the person.

- eye protection;
- fall protection;
- Hand & foot protection;
- head protection;
- hearing protection; and
- respiratory protection.

4.5 Vehicular Safety

Vehicular Hazards

It shall be the duty of the occupier of a worksite to ensure that no person shall drive a vehicle of any class or description in the worksite, except a person who has obtained the authorisation to do so.

- Operator has received sufficient training to operate or drive the vehicle.
- Nothing in this regulation shall derogate from the effect of the Road Traffic Act (Cap. 276).

Any person who contravenes paragraph (3) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $1,000 and, in the case of a second or subsequent conviction, to a fine not exceeding $2,000.

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Where in a worksite, any work is performed over, on or in close proximity to a street, public road or any other place where public vehicular traffic may cause danger to any person who carries out the work, it shall be the duty of the employer or principle s' duty to ensure that -

(i) the worksite is barricaded;

(ii) suitable warning signs and warning lights are set up to direct traffic away from the worksite; and the traffic is specially controlled by designated persons.

It shall be the duty of the owner of any vehicle used in a worksite to ensure that the vehicle is of good construction and roadworthy.

No person shall drive a vehicle of any class or description in a worksite unless he has obtained the authorisation of the occupier of the worksite to do so.

It shall be the responsibility of employer or principal to ensure the following:

The worksite is barricaded;
Suitable warning signs and warning lights are set up to direct traffic away from the worksite; and
Where necessary, the traffic is specially controlled by designated persons.

No person shall drive a vehicle of any class in a worksite unless he has obtained the authorisation of the occupier of the worksite to do so.
It shall be the responsibility of employer or principal to ensure the following:

a) All operators should be at least 18 years old
b) All operators should be Trained and Qualified, otherwise only Authorised and Designated operator
c) Demarcate traffic zone and separate pedestrian access
d) Ensure adequate and sufficient lighting
e) Provision of blind spot mirror at junction / corner
f) Appoint traffic controller at critical point.
g) Limit the speed at work area
h) Ensure road works workers are equipped with luminous vest
i) Designated parking area
j) Preventive maintenance & inspection program
k) System and procedures to report mal-function

4.6 Access and egress for workplaces

Regulation 30 Entry into building under construction

It shall be the duty of the occupier of a worksite —

(a) where a building under construction in the worksite is more than 2 storeys high, to provide designated entry and access at the ground floor with adequate overhead protective cover for persons entering or leaving the building; and

(b) to take all reasonably practicable measures to prevent any person from entering or leaving the worksite by or through other means of entry and access

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Provision of Overhead Protection

In a worksite where work is carried out by persons to work between different levels of a building or structure,

It shall be the duty of the occupier of worksite to ensure, so far as is reasonably practical, safe means of access to and egress from different levels or structure at all times.

General guideline on Provision of Overhead Protection

Buildings under construction

- > 15m - Peripheral Overhead Protection
- 2m wide
- Erect at not more than 5m from ground
- The outer edge of the shelter shall be 150 mm higher than the inner edge
- or not more than 20 degrees to the horizontal sloping into the building

Key Points

a) Provide access to building
b) Erect overhead protection (shelters)
c) Provide head protection
d) Avoid overhead work areas
e) Cordon off the danger areas
f) Display warning signs

4.7 Hazards of Working at Height

The main hazard at the construction worksite is:
Fall from Height- The top workplace killer in Singapore for the past number of years.

Common sources of hazard

- Floor opening
- Scaffolding
- Work platform
- Open sides of formworks
- Ladder
- Steel structure
- Roof/ Fragile roof

Preventive Measures

- All openings on floor shall be securely covered or fenced.
- Every staircase with open sides shall be provided with handrails.
- Any person who is liable to fall from one level to another level an dcause injury; orinto any substance or area which is likely to cause drowning or asphyxiation shall be provided with a secure foothold and handhold for ensuring his safety.
- Implement fall protection plan
- All floor openings shall be securely covered.
- Provide and maintain a handrail or other effective means to guard open sides of staircases.
- Building opening to be securely fenced or provided with effective barricade.
- Provide safety harness, belts with secured anchorage point and lifelines to prevent fall.
- Any fencing shall be properly maintained

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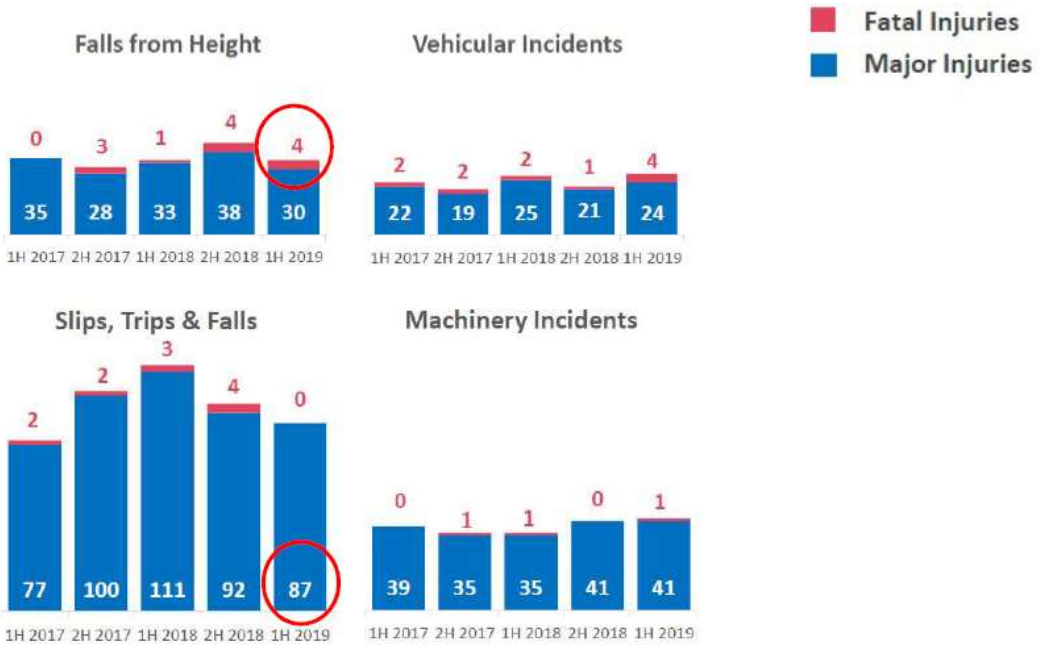
4.8 Falling from height

Reasons to emphasize on WAH Safety



Legal Requirement

WSH (Construction) Regulations

Falling hazards

22.-(1) It shall be the duty of the occupier of a worksite to take, so far as is reasonably practicable, such measures as are necessary to comply with paragraphs (2), (3) and (5) at the worksite where a person is liable to fall a distance of more than 2 metres.

(2) Subject to paragraph (4), in a worksite, 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, barriers or other equally effective means to prevent fall.

(3) In a worksite, every guard-rail, barrier or other similar means of fall prevention referred to in paragraph (2) shall —
(a) be of good construction, sound material and adequate strength to withstand the impact during the course of work in the worksite;
(b) be placed on the inside of the uprights and secured so as to prevent accidental displacement; and
(c) be placed so as to prevent the fall of any person.

(4) Every guard-rail, barrier or other similar means of fall prevention referred to in paragraph (2) may be removed where free access is required for work actually in progress in the worksite.

(5) In a worksite, every guard-rail, barrier or other similar means of fall prevention referred to in paragraph (2) which are removed under paragraph (4) shall be reinstated or replaced immediately when access of persons or movement of materials is not taking place at the open side or opening.

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WSH (Work @ Height) Regulations 2013

Work At Height Definition:

"Hazardous work at height" means work —
(a) in or on an elevated workplace from which a person could fall;
(b) in the vicinity of an opening through which a person could fall;
(c) in the vicinity of an edge over which a person could fall;
(d) on a surface through which a person could fall; or
(e) in any other place (whether above or below ground) from which a person could fall, a distance of more than 3 metres;

The key provisions of WSH (Work @ Height) Regulations 2013

- Fall Prevention Plan
- Permit to Work System
- Training
- Measures for fall prevention
- Inspection
- Work on Roof and Fragile surface
- Industrial Rope Access

Permit To Work (PTW) System, Part III

Reg. 22 - **Application** – by WAH supervisor with control measures
Reg. 23 - **Evaluation** – by WAH assessor - endorsement to WAH Manager
Reg. 24 - **Issue** – by WAH Manager
Reg. 25 - **Posting** – at work area until expiry / revocation
Reg. 26 - **Monitoring** – WAH supervisor / WAH Manager
Reg. 27 - **Incompatible work reporting** – unsafe – by anyone witness
Reg. 28 – **Review and Revocation** of PTW – due to unsafe work

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Training

- Duty of responsible person to ensure no person shall work at height unless he has received adequate training on WAH
- No person shall work at height except under immediate supervision of a competent person who has sufficient training and experience.

Inspection

- Competent person to inspect the anchorage and anchorage line at the start of every work shift
- Ensure that the anchorage and anchorage lines have the capacity to support any foreseeable loading

Industrial rope access system

Where any industrial rope access system is used in a workplace, it shall be the duty of the responsible person of a person who carries out or is to carry out work at height at a workplace to ensure that —

(a) it comprises at least 2 independent anchorage lines, of which one is the working line and the other is the safety line;

(b) the person who uses the industrial rope access system is provided with a suitable harness connected to the working line and the safety line;

(c) the working line is equipped with safe means of ascent and descent and has a self-locking system to prevent the user from falling should he lose control of his movements; and

(d) no part of the system comes into contact with anything that could affect the safe use of the system.

WSH(WAH) Reg 29

Fragile Roof - Skylight

- Avoid work near fragile roof
- All fragile roof barricaded, covered or protected with platform
- Warning notice

Examples of Fragile Roof:

- Asbestos roof
- Polycarbonate roof
- Old ceramic roof

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Workplace Safety and Health (Work at Heights) (Amendment) Regulations 2014

Citation and commencement

These Regulations may be cited as the Workplace Safety and Health (Work at Heights) (Amendment) Regulations 2014 and shall come into operation on 1st May 2014.
The key changes are incorporated in the WSH (WAH) (Amendment) Regulations 2014 which came into force on 1 May 2014. These key changes are:

- The PTW requirements will apply only to workplaces defined as Factories under the WSH Act, instead of all workplaces.
- The requirement for the role of the Work at Heights (WAH) Safety Assessor and Authorized Manager to be carried out by different persons has also been removed.
- With the exception of the PTW and FPP requirements, all other general provisions under the Regulations continue to apply to all workplaces on 1 May 2014.

Workplace Safety and Health (Work at Heights) (Amendment) Regulations 2014

Amendment of regulation 20

Regulation 20 of the principal Regulations is amended —
(a) appoint a competent person for the hazardous work at height at the factory to carry out the duties of an authorised manager in accordance with this Part; and
(b) Appoint a competent person for the hazardous work at height at the factory to carry out the duties of a work-at-height safety assessor in accordance with this Part.
Workplace Safety and Health (Work at Heights) (Amendment) Regulations 2014

Amendment of regulation 20

(2) Before and during the carrying out of any hazardous work at height at a factory, it shall be the duty of the occupier of the factory to ensure that a permit-to-work system in accordance with this Part is implemented for that hazardous work at height."

4.9 Fall Prevention Plan (FPP)

- Where work at height is carried out in a factory in which 50 or more persons are ordinarily at work
- FPP shall be established and implemented in accordance with generally accepted principles of safe and sound practice
- Occupier of the factory shall ensure that the FPP is made available upon a request from an Inspector

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

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Key Elements of FPP

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
10. Emergency preparedness

Steps for preparing Fall Protection Plan (FPP)

1. Objective:

The objective of this plan is to prevent the falls of person / material which is the number killer in a construction site.

2. Policy for Fall Prevention

Write the FPP policy

The company shall define, endorse and document its policy for fall protection, appropriate to the needs, nature and scale of the organization's work at heights risks.

3. Roles and Responsibilities

The roles and responsibilities of all personnel involved in working at height shall be defined clearly. (Eg) Engineer, Supervisor, Workers etc.

4 Safe work procedure (SWP) & Risk Assessment (RA)

Safe work procedure (SWP) and Risk assessment should be prepared for the work at height to be carried out.

a) SWP should cover all the works at height involved in the workplace.
b) The methods of carrying out each and every task should be defined clearly. (e-g): Using scissor lift, scaffolding, step platform, ladder etc.
c) The hazards involved in each of the activities shall be covered in the RA
d) All the planned control measures for handling the hazards shall be clearly specified in the SWP and RA.
e) The SWP should cover all the machinery and equipment necessary for the WAH
f) Necessary personal protective equipments required for carrying out the tasks should be included in the SWP.
g) The training requirement of workers and supervisors on working at height shall be included.
h) Emergency rescue procedures during an emergency are to be detailed

5 Communication

The means of communication to all personnel involved in the WAH activity shall be specified and necessary arrangements for documentation shall be recorded.

6 Review

The FPP review requirements shall be specified in the plan.

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Duties and responsibilities of Manager in FPP

Shall ensure, with regard to WAH:

a. Hazard Identification, Risk evaluation and SWP Reg. 24 (1) (a)

b. No incompatible works in surrounding environment Reg. 24 (1) (b)

c. Availability of competent work group with necessary PPE

d. Implementation of control measures Reg. 24 (1) (c)

e. Site coordination / safety meetings for communication Reg. 24 (1) (c)

f. Establishment, implementation and maintenance of FPP

e. Emergency Response Plan and rescue team

f. Revoke PTW when deemed necessary Reg. 28 (2)

The appointed authorised manager must be suitably trained and competent to manage the safety processes with regards to work at heights (e.g., attended relevant Work at Heights courses for authorised managers accredited by the Ministry of Manpower).

The manager could be a project manager, operations/ engineering/ maintenance

WAH Manager has to review the

a. Necessity of WAH activities

b. Availability of alternate work possibilities

He / she has to ensure the

a. Availability of competent work group to work at height

b. Establishment, implementation and maintenance of FPP

c. Implementation of control measures

d. Necessary PPE and WAH equipment

e. Emergency Response Plan and rescue team

Reg 24 PTW

(1) May issue a permit – hazardous work at height, if he is satisfied that-

a) Proper evaluation of the risk and hazards involved;

b) No incompatible work at the same time in the same vicinity;

c) Implementation of control measures

d) Communication of hazards associated with.

(2) Shall retain a copy of the permit-to-work.

(3) Shall exercise all due diligence when performing his function in relation to the issuance of a permit-to-work.

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Reg 26 Monitoring of Work

Shall continually review the progress of all hazardous work at height.

Reg 26 Daily Review and Revocation of PTW

Review and assess the need to continue the hazardous WAH on a daily basis,

(1) Revoke the PTW issued in respect of the hazardous WAH if

a) Work is completed

b) Poses or is likely to pose a risk to safety and health of persons

Fall Prevention Systems

Edge Protection

- Guard-rails are fixed to prevent people from falling from open sides
- To be provided at the edge of scaffold, ramp or walkway
- The guard-rail shall withstand the impact of a person falling against it
- Top rail @ 1 meter high
- Mid-rail and toe board to be provided as well
- Special gate (inter-locking) is required for passenger hoist

Figure 14.2: Unprotected stairways pose a falling hazard.

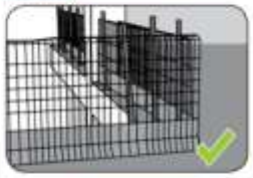

Figure 14.1: Perimeter guard-railing.

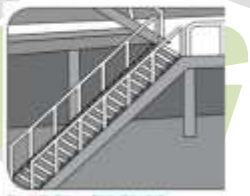

Figure 14.3: Stairways fitted with handrails.

http://www.hse.gov.uk/work-at-height/wait/wait-tool.htm

Travel Restraint System

Definition of travel restraint system
"Travel restraint system" means a system consisting of a full-body harness or restraint belt, attached to one or more lanyards, each of which is attached to an anchorage line or anchorage point, designed to restrict the travelling range of a person wearing the full-body harness or restraint belt so that the person cannot get into a position where the person could fall off an edge of a surface or through a surface.

Definition Source : COP working safely at height

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Design Consideration

- The travel restraint system should prevent a person falling from the edge of building or edge of a roof.
- The system should not be used on fragile roofs; and
- Persons setting up and/ or using the system should be able to demonstrate that they have a clear and thorough understanding of the system and how the work area can be accessed without the possibility of a fall occurring.
- A roof anchor may be used as a travel restraint on steel sheeting or tiled roofs during construction of the roof. It is lightweight, portable and can be installed and removed with minimal time and effort.

Travel Restraint System – Implementation

Travel Restraint System
10. Where a travel restraint system is used in a workplace, it shall be the duty of the responsible person of a person who carries out or is to carry out any work at height to ensure that
(a) The travel restraint system
(i) is of good construction, sound material and adequate strength;
(ii) is free from patent defects, and
(iii) is suitable and safe for the purpose for which it is intended and
(a) Every person using the travel restraint system is trained in the safe and correct use of the system.

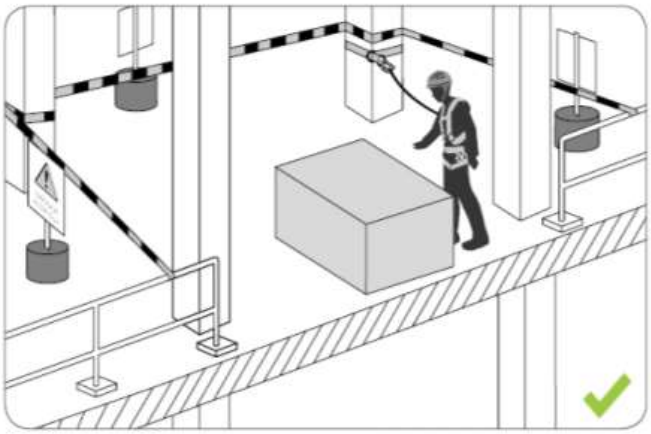

Illustration Extract from ACP

Definition Source : COP working safely at height

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Travel Restraint System – Implementation

Some applications

a. Roof inspection (not on fragile roofs)

b. Installation and removal of perimeter guard-rail systems

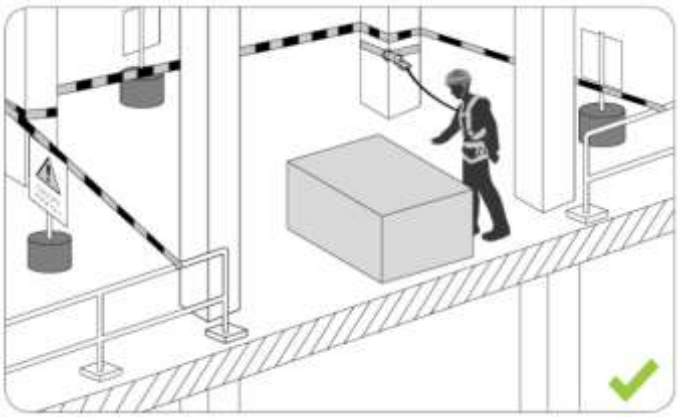
c. Minor repair work - replacement of isolated parts of the roof

d. Painting and cleaning

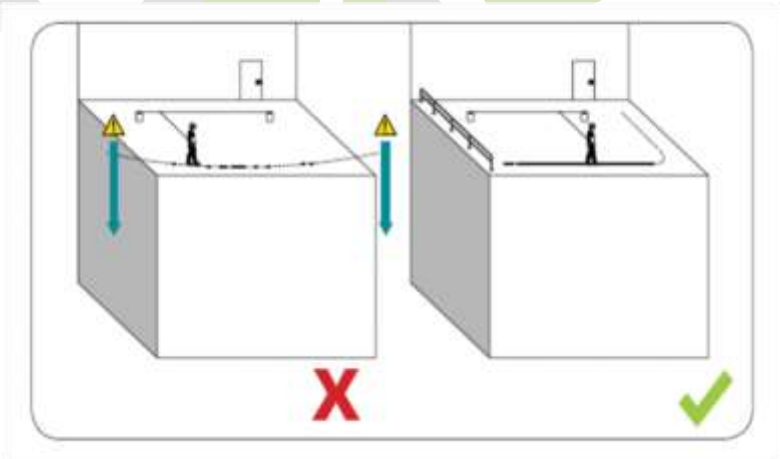
e. Installations of skylights and ventilation fixtures

f. Pointing up tiles or fitting ridge capping metal roofs

Example of proper demarcation and travel restraint for worker during temporary removal of edge protection



Example of do and don't in travel restraint for worker during temporary removal of edge protection



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Work Positioning System

A work positioning system is defined by OSHA as "a body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall (or a pole), and work with both hands free while leaning."

A positioning-device system with self-retracting lifeline

Fall Arrest Systems

Definition of fall arrest system
"Fall arrest system" means equipment and/ or material that is designed for the purpose of preventing, or reducing the severity of injury to a person in the event of a fall such as safety harness systems.

Restraint belts are used in a travel restraint system and are not to be used in a fall arrest system.

Definition Source: COP working safely at height

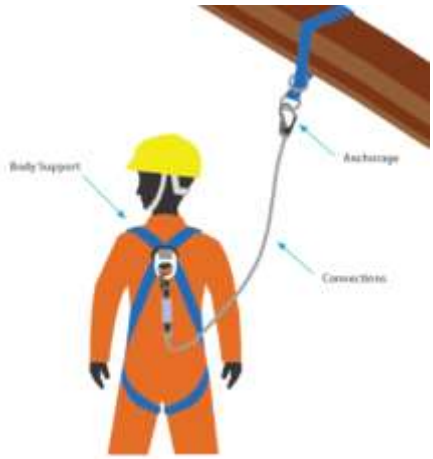
WSH (WAH) Regulation Requirement

11. —(1) Where a fall arrest system is used in a workplace, it shall be 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 —

(*a*) the **fall arrest system** —
- (i) is of **good construction, sound material and adequate strength**;
- (ii) is **free from patent defects**; and
- (iii) is **suitable and safe** for the purpose for which it is intended;

(*b*) every person using the fall arrest system is **trained** in the safe and correct use of the system; and

(*c*) no part of the fall arrest system comes into contact with anything that could affect the safe use of the system.



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Differences between Travel Restraint and Fall Arrest

Fall Arrest System

It is designed to safely stop a worker from falling an uncontrolled distance and to reduce the impact of the fail.
Individual fall arrest systems are an assembly of interconnected components consisting of a harness connected to an anchorage point or anchorage system either directly or by means of lanyard.
Safety harnesses should be used if the intention is to provide fall arrest instead of travel restraint.
Differences between Travel Restraint and Fall Arrest

Fall Arrest System - Guidelines

System should be rigged such that if a fall occurs, the distance fallen will be the shortest. This is to minimize the impact and swing of the arrest.
The fall arrest equipment should be visually checked prior to use.
Once a fall arrest system has been used to arrest a fall, it must be removed from service and not to be used again.

Fall Arrest System - Guidelines

Anchoring of lanyards to guard rails of scaffolding should be avoided where possible unless the guard rail is designed to be able to withstand the force generated by a falling person (about 22.2 KN per person attached).
If it is absolutely necessary to anchor to the guard-rails, the part to be anchored to must be properly tightened. The vertical pieces are better suited for anchorage than the horizontal pieces.

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4.10 Falling Objects

Struck by falling objects is the second top killer in the construction industry here in Singapore.
In past years there were many fatalities due to strike by falling objects.

Common causes of falling objects:
- Careless handling of tools;
- Loose or unsecured objects;
- Throwing objects down;
- Poor housekeeping on elevated work platforms.

Preventive Measures

- Maintain good housekeeping.
- Scaffold and other work platforms installed with toe-boards.
- Place tools in tool boxes when working at height.
- Maintain good housekeeping.
- Scaffold and other work platforms.
- Installed with toe-boards.
- Place tools in tool boxes when working at height.
- Materials lifted by crane to be properly secured and all lifting activities to be under the supervision of a qualified lifting supervisor.
- Barricade area below during the erection and dismantling of scaffold.
- Never stand or work under suspended load.
- Never throw objects down from height.
- Wear safety helmet with chin strap all the time at the work area.
- Secure all loose objects on scaffold.
- Handle tools properly with firm grip.

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Sample Risk Assessment for Falling from height

RISK ASSESSMENT FORM

Company:	ABC Company	Conducted by: Names, designations) (Date)	Tan Ah Lee, Supervisor, Ong Huat Ling, Worker Tan Ai Ling, Worker, 1 Aug 2007
Process / Location:	Painting / 1st Floor of House, exterior		
Approved by: (Name, designation)	Salim Bin Samat, Manager 5 Aug 2007	Last Review Date: 5 Aug 2007	Next Review Date: 5 Aug 2010

No	Work Activity	Hazard	Possible Accidents / Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Controls	Action Officer, Designation (Date)
1	Accessing and exiting work area using a ladder	Fall from height	Injury or death	• Ladder is checked every 6 months for defects by a competent person. • Ladder is visually checked before usage. • Training provided to worker to ensure that 3 point contact to be maintained by worker while climbing the ladder. • Tools are not to be carried by hand, a belt pouch had been provided for this purpose.	High	Occasional	Medium	Ladder is secured at the top using rope or footed at the bottom before usage. An alternative is that another worker can be assigned to hold the ladder firmly in place during climbing.	Tan Ah Lee Supervisor (Jan 2008)
2	Other work activities	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...

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Sample Risk Assessment for Falling Object Hazards

No	Work Activity	Hazards	Possible Accidents/ Ill Health and Persons-at-Risk	Existing Risk Control (if any)	Likelihood	Severity	Risk Level	Additional Risk Controls	Action Officer, Designation (Date)
1	Transfer of metal pipes using overhead travelling crane	Struck by falling load	Injury or death to persons struck	Use of tag lines to control load sway/ swing Barricades and signs to keep non-essential personnel from entering the affected area Crane alarm is switched on during movement	Unlikely	Catastrophic	Medium	Nil	Supervisor (immediate)
		Struck by falling lifting gear	Injury or death to persons struck	Barricades and signs to keep non-essential personnel from entering the affected area Crane alarm is switched on during movement	Unlikely	Catastrophic	Medium	Nil	Supervisor (immediate)
2.	Installation of new racks	Struck by falling objects (materials, tools, fittings such as brackets, screws.)	Injury or death to persons struck	Wearing of helmet within work area Warning signs placed (wearing of helmet, no entry to unauthorised persons)	Possible	Catastrophic	High	Work area cordoned off with barricades Tools and materials kept in boxes and bags when not in use	Supervisor (immediate)

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4.11 Mechanical Hazards

Major Hazards

- Struck by moving part.
- Body part trapped between parts of machinery.
- Cutting hazard.

Struck by Moving Parts of Machines

Prevention:

- Create a safety zone.
- Prohibit any unauthorized workers from coming nearer.
- Machine operated by authorized operators.
- Provide regularly maintenance by competent persons.

Crushed hands and arms, severed fingers, blindness -- the list of possible machinery-related injuries is as long as it is horrifying. There seem to be as many hazards created by moving machine parts as there are types of machines.

Safeguards are essential for protecting workers from needless and preventable injuries.

Dangerous moving parts in three basic areas require safeguarding:
The point of operation: that point where work is performed on the material (Such as cutting, shaping, boring, or forming of stock.)

Power transmission apparatus: all components of the mechanical system which transmit energy to the part of the machine performing the work.
(These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.)

Other moving parts: all parts of the machine which moves while the machine is working. These can include reciprocating, rotating, and transverse moving parts, as well as feed mechanisms and auxiliary parts of the machine.

Hazardous Mechanical Motions and Actions
A wide variety of mechanical motions and actions may present hazards to the worker.
These can include the movement of rotating members, reciprocating arms, moving belts, meshing gears, cutting teeth, and any parts that impact or shear.

Trapped between Moving parts of Machinery

Prevention:

- Provide with proper guarding on moving parts of machinery
- Guarding provide must be of good construction, sufficient strength & good material
- Guarding must be properly maintained

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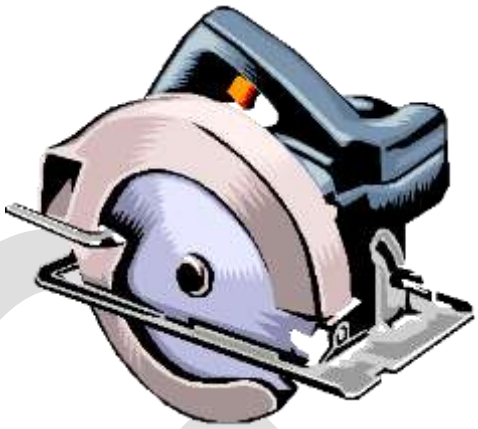
Cutting Hazard

Prevention:
- Ensure only trained workers are allowed to use the machine
- Ensure workers exercise due care when using these machines

Principles of safe guarding
- Identification of hazards
- Elimination/Reduction of hazards
- Use of safe guards
- Use of safe working procedures



Classification of guards
- Fixed guards
- Adjustable guards
- Interlocking guards
- Sensor devices
- Two hand control

Hand Tool Safety
- Use the right tool for the job. Be sure it is the right size.
- Use good quality tools, and use them for the job they were intended to perform. For example, it is often tempting to use a screwdriver for a chisel or a pair of pliers for a wrench—avoids such practices. The right tool will do the job faster and safer.
- Keep a firm grip on tools to prevent them from slipping away.
- Do not overload or force a tool beyond its capabilities.
- Never force a tool.
- Check any tool that has become jammed or otherwise overstressed for damage before reuse.
- Anticipate the reactive force from tools.
- Anticipate what might happen to a component that is to be loosened or unbolted from its working position.
- Do not bypass interlocks on equipment. Bypassing defeats the safety device and creates a possibly serious hazard.
- Inspect tools before use & never use a tool that is in poor or faulty condition.
- Keep all hand tools in good working condition.
- Store hand tools in a safe place. Each tool should have a designated place in the tool box or electrician's pouch.

4.12 Electrical Hazards

Electrical Hazards
- Electricity is **NOT** dangerous only if it is properly used and if electrical equipment is properly installed, maintained and operated.
- Electrical hazards are 1 of the 4 main hazards in construction causing serious injury or death.

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If not properly operated, it may cause

- Electric shock and Electrocution
- Fire and Explosion
- Electric Burns
- Arc Eye

Identification of electrical hazards

- Exposed wire
- Wrong connection
- Damage plug

Prevention of Electrocution:

- Use Residual Current Circuit Breaker (RCCB)
- Proper Earthling
- Use All-Insulated and Double Insulated Appliances
- Use Low Voltage Supply
- Use Appropriate Personal Protective Equipment

Fire and explosion

When any confined space contains flammable or explosive mixtures of liquids or gases, a small amount of heat can cause mixture to ignite.

Heat from electricity may be generated in the following ways:

- Excessive current in an electrical circuit causing overloading and subsequent breakdown of insulation;
- Lack of ventilation causing heat buildup in an electrical conductor;
- Sparking or arcing at switches, push buttons, electrical contacts or at broken wires;

Arc eye

This is caused by the hot and intense rays from an electric arc which reaches the unprotected eye. It is very painful and causes temporary lost of sight. Permanent damage can occur from arc eye. Protection by shielding eyes

Electric Burns

High Voltage current can cause internal burns if allowed to pass through the body

Signs of Electrical Hazards

- Wires which are squashed or damaged.
- Plug receptacles that appear to be loose or damaged.
- Cords/cables with holes in the insulation.
- Sparks or arcing between tool and work surfaces.
- Ground pins broken or missing from 3 pin plugs.
- Tools that are inserted into sockets without the use of a plug.
- Damaged extension cords.
- Fallen wires or wires lying unattended
- Electric tools that are cracked or used in damp/wet locations
- Explosive environments

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The most frequent causes of electrical injury/death are:

- Contact with power lines
- Lack of ground-fault protection
- Path to ground missing or discontinuous
- Equipment not used in manner prescribed
- Improper use of extension and flexible cords

Power Lines

Overhead and buried power lines at your site are especially hazardous because they carry extremely high voltage. Fatal electrocution is the main risk, but burns and falls from elevation are also hazards. Using tools and equipment that can contact power lines increases the risk.

Control of Electrical Hazards

Fuses

- Fuses are the most common safety devices used to protect people and equipment against overloading of electrical circuits.
- Fuses functions to disconnect a circuit when an element inside the fuse body, usually a metal ribbon or link, melts from the heat produced when too much current passes through it.

Circuit Breakers

- Circuit breakers functions to disconnect a circuit when excessive current flows causes a heat build-up in a bi-metal strip that will move and release a spring loaded switch that will open the circuit.

Fuses & Circuit Breakers

- Fuses and circuit breakers must be installed on the "Live" conductor of any circuit. Does not function as intended if installed on the "neutral" conductor
- 2 fuses may look alike and be rated for the same voltage but may have different current carrying capacities. Fuses should be inserted and removed with proper tools

Thermal trip devices

- Possible to fit a thermal tripping device to a circuit of an appliance. Device would operate on the differential expansion of a bi-metal strip. If pre-determined temperature is exceeded, the expansion of the bi-metal strip would open the circuit and cut off power of the appliance.
- Ensure proper/correct electrical connections. International standards have set for color-coding of electrical conductors.
- Live Brown (or red)
- Neutral Blue (some older circuits - black)
- Earth Yellow/green
- Wrong connections can cause equipment to be energized without being switched on

Grounding/Earthling

The term "ground" or "earth" refers to a readily conductive body, usually the earth. By grounding a tool or equipment, a low resistance path to earth is intentionally created. This path has sufficient current carrying capacity to prevent a buildup of current that may result in an electric shock.

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Two kinds of grounding:

- System grounding: The electrical mains are grounded when one conductor is intentionally connected to ground.
- Equipment grounding: Equipment grounding provides a path for leakage or fault current to return to system ground.

NOTE: Grounding uses the characteristic of electricity to travel along the path of least resistance. Grounding creates a low-resistance path from a tool to the earth to disperse unwanted current

Earth Leakage Circuit Breaker (ELCB)

- Earth Leakage Circuit Breaker or ELCB is also known as Residual Current Circuit Breaker or RCCB.
- When a metal casing or housing becomes "live", some current will "spill over" into the metal casing or housing.

Any person touching or coming into contact with the casing or housing will be electrocuted. "Spill over" current is called the Leakage/Fault current. Need to drain the leakage current from the equipment. Simply done by grounding the equipment.

Just draining away the current is not sufficient. Source of leakage current must be terminated otherwise leakage current will still circulate in the equipment no matter how much you drain it by grounding. Terminate the source by using an Earth Leakage Circuit Breaker (ELCB) using either Voltage operated ELCB or Current operated ELCB.

Current operated ELCB

- Works the principle that in a circuit which has no fault, the current in the "live" and "neutral" conductors is the same.
- What goes into the equipment via the "live" conductor must come out via the "neutral" conductor.
- The "live" and "neutral" conductors are wound on a ring so that they produce opposing magnetic fields.
- Normally there is no magnetic field in the ring as the fields set up by the "live" and "neutral" currents in the ring cancel each other out.
- When there is a leak, the current in the "neutral" will be smaller than that of the "live" conductor.
- Differing magnetic field generates a current which will flow to a trip coil and open the mains switch thereby cutting the power to the equipment

Double Insulation

- Double layer of flexible but tough molded insulation protection over the current carrying conductors.
- Higher quality than normal standard.
- Double insulated appliances do not have any grounding or earthling conductor.
- Plug is hard and durable material. Only "Live" & "Neutral" pins

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Guards or Barriers

To protect workers from electrical injuries, guards and barriers can also be installed.
Guarding of "live" parts may be accomplished by:

a) locating energized equipment/ systems in a room accessible only to authorized personnel;
b) placing equipment on an elevated platform, out of reach to personnel.

4.13 Procedural Control (Lock-Out & Tag-Out)

WHAT IS LOTO?

Lock-out Tag-out (LOTO) is the physical restraint of all hazardous energy sources that supply power to a piece of equipment, machinery or system.
It shall be the responsibility of each employer whose employees are engaged in erecting, installing, constructing, repairing, adjusting, cleaning, inspecting, operating, or maintaining the machine, to develop and implement a lockout procedure.

Lock out Tag out System

- Lockout and tag out is a system where electrical equipment is maintained in the dead and safe condition while maintenance and repair or refitting is carried out.
- Switch off all powers.
- "Lock out" the switches so no one can accidentally switch it on.
- Key for locking device kept by maintenance person.
- He should tag switch and warn others that equipment has been switched off for maintenance.

5 Simple Steps of LOTO

1. Announce the shutdown
2. Shut down the machine
3. Disconnect all energy sources
4. Apply lock-out
5. Verify the isolation and lock-out

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4.14 Explosive power tools

Workplace Safety and Health (Explosive Powered Tools) Regulations 2009

Salient point

6. No tool shall be used unless —
   (a) it is of good construction, sound material and adequate strength, is free from patent defects and is in accordance with a standard or specification acceptable to the Commissioner;

   (b) a projectile cannot be discharged from it if it is dropped onto a surface from a height of 3 metres or more;

   (c) it cannot be discharged accidentally while being handled; and

   (d) where it is a direct acting tool, it can only be discharged —
      (i) if a force of 110 newton or more is applied by its operator to the springs of the breech and firing mechanisms; and
      (ii) if the axis of its barrel or barrel extension does not deviate by more than 7 degrees from a right angle formed by the barrel and the surface into which a projectile is to be fired from it.

Operation & Use of Tools

- Operative must be trained and competent
- No tampering
- Regular inspection and testing once every three years
- Danger of incompatible charges, projectiles
- No operation dangerous environment
- Shield - 50mm (for direct acting tool)
- Projectile may fly free
- Unsuitable materials: - tiles, glass, marble, granite, high tensile steel, reinforced concrete, near to a hole
- Steel reinforcement -15mm / 10mm
- Concrete - 75mm / 50mm

4.15 Fire prevention

Chemistry of Fire

What is Fire?

- Fire is a complex set of chemical reactions in which fuel combines with oxygen and an ignition source to produce heat.
- In order for a fire to occur, three elements must be present.

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The Fire Triangle

- Three elements, i.e. Fuel, oxygen and an ignition source such as heat, are needed to be present in the correct concentration for a fire or an explosion to occur.
- These three elements can be represented in a triangle called FIRE TRIANGLE.

Extinguishing Fire

- Interrupting the Chemical Chain Reaction
- Elimination of Heat - Remove by cooling
- Elimination of Fuel - Remove fuel
- Elimination of Oxygen - Excluding the air or limit oxygen
- Inhibit the flame chain reaction

Fire Protection and Firefighting systems

- Maintain fire protection and firefighting systems.
- Establish inspection programme for firefighting equipment and systems.
- Ensure access to fire extinguishers, hoses, alarms, fire exits and other emergency equipment are free form obstructions.
-

Causes of Fire

- Welding and Cutting
- Electrical Equipment Fires
  - overheating of electrical equipment
  - arcs (sparks)
- Smoking
- Flammable and Combustible Liquids
- Construction Sheds and Workers' Quarters

Emergency Response Planning

- A written emergency response plan should be established.
- Emergency response equipment should be kept on site and made readily available and accessible.

WSH (General provision) Reg

Effective steps to be taken to ensure that all the persons at work are familiar with means of escape and the route to be follow in the case of fire.

Fire control measures in worksite

WSH (General provision) Reg

There shall be effective warning devises that:

a) Are capable of being operated without exposing any person to undue risk
b) Are maintain and tested once every month
c) Give warning in case of fire; and
d) Are clearly audible throughout the factory

Water Supplies

One of the first considerations is to have sufficient water supply for fire-fighting. Plans should also be made to have at least a partial supply available early. Be sure to check with the local fire department so that your water connection fittings will match theirs.

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Firefighting equipment

Means of extinguishing fire shall be provided and maintained and be readily available. It must be adequate, suitable and tested by a competent body yearly. Regular inspection by supervisor at regular interval.

Emergency Lightings

Construction sites should also include emergency lightings at strategic locations inside the building to ensure that there is sufficient lighting available to safely guide the workers to the outside of a building, in the case of any emergency like fire or blackout.

Fire Alarms

Fire alarms are very important in the success or failure of extinguishing a fire. Consequently, management should make certain that alarms are strategically located for notifying the fire department quickly. The following procedures should be helpful in accomplishing the placement of such alarms:

- Signs should be posted instructing personnel how and where to send in an alarm - whether by telephone or fire alarm box.
- Management should make sure that firemen will always have easy access to all parts of a project.

Rubbish Disposal

Trash and debris present a likely place for fire to start. The chance of a fire increases as the amount of easily ignited fuel exposed to an ignition source is increased. Therefore:

Training & Drill

- Employees should be trained on fire-fighting, safety related operations and procedures, such as evacuation, location and use of emergency equipment, activation of alarms, etc.

4.16 Confined Spaces

Workplace Safety and Health (Confined Spaces) Regulations 2009
(Detail of Regulations will be discuss in Lesson 6.2)

These Regulations may be cited as the Workplace Safety and Health (Confined Spaces) Regulations 2009 and shall come into operation on 1st November 2009.

These Regulations shall apply in relation to confined spaces in workplaces.

Definition of Confined Space

A confined space may be defined as a space having one or more of the following characteristics:

a) an enclosed space with poor natural ventilation;

b) has limited or restricted openings for entry or exit;

c) not designed for continuous human occupancy;

d) a space that could cause engulfment;

e) contains or likely to contain any of the following:

   i) an atmosphere with harmful contaminants;
   ii) an oxygen deficient atmosphere

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Some of the common types of confined spaces in process industry:

a) Storage tanks

b) Pressure Vessels

c) Boilers

d) Sewers

e) Furnaces

f) Silos

g) Pipes

h) Towers

Confined Space Hazards

Hazards in confined spaces can be classified into the following types:

a) Physical hazards
b) Mechanical hazards
c) Electrical hazards

Atmospheric Hazards

Common types of atmospheric hazards:

a) Oxygen level
b) Flammable gases
c) Toxic gases

a) **Oxygen Levels**

> 23.5%	-	Oxygen Enrichment
19.5% - 23.5%	-	Safe levels
< 19.5%	-	Oxygen Deficiency

b) Flammable Gases

- Methane
- Petroleum vapours
- Paints and solvent vapours
- Leakage of fuel gases such as LPG and Acetylene

c) Toxic Gases

Common types of toxic gases in confined spaces:

- Hydrogen Sulfide
- Carbon Monoxide
- Welding fumes
- Benzene, petroleum vapours etc.

Physical Hazards

a) **Noise**--High noise levels can cause hearing loss.

Sources of noise in confined spaces are noisy operations such as powered hand-tools, knocking etc.

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b) Temperature Extremes

Temperatures in confined space can rise due to hot weather or hot works carried out in the confined space.

c) **Engulfment**

Workers can be trapped or buried by dry bulk material or liquid such as:

- grains, sand, flour, cement, etc.
- flooding while working in storm drain.
- Water flow

Mechanical Hazards

Mechanical hazards are caused by unexpected movement of mechanical equipment such as:

- Blenders
- Stirrers
- Shafts
- Chain or belt drives

Ensure all mechanical equipment are locked out and tagged before entering the confined space.

Electrical Hazards

Electric Shock is also a possible hazard in Confined Spaces.
Electrical Hazard Sources include:

- Broken lighting
- Frayed electrical wires
- Hazards from portable electrical equipment

WSH (Construction) Regulations 2007 Reg 88

Duty of the employer of any person who carries out any work in a tunnel or the principal to ensure that the person does not carry out the work unless the person has received adequate safety and health training to familiarize himself with the hazards associated with such work and precautions to be observed

Warning notices
Reg77. —(1) Notices shall be put up at appropriate and conspicuous positions to warn about the excavation(tunnel) in a worksite

Illumination level
Reg 83. —
(a) All areas in the tunnel shall be adequately illuminated: and

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Learning Activity 4

Objective: Identify common workplace hazards and recommend preventive measures

Discussion and presentation

Break into group of 5 and select a leader to lead the discussion

Based on the printed photos, each group to select 5 photos and discuss the hazards and what the prevention measures to prevent accident reoccurrences.

Each group to pen down their finding and present to the class for class discussion.

Resources: Photo pack 1

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Lesson 5 - Mechanical Material Handling and Scaffold

PS3.
Plan and implement safety programme, system and safe work procedure for construction activities in accordance with WSH (Construction) Regulations

UK5. Mechanical Material Handling and Scaffold

- Legal requirement under WSH (Construction) Regulations 2007, WSH (Operations of Cranes) Regulations, SS 536: 2008, CP 62: 1995 and CP 63: 1996
- Lifting plan
- Lifting equipment – mobile crane & tower crane, lorry crane
- Hoists and lifts
- Lifting personnel – Lifting Supervisor, Crane Operator, Rigger & Signalman

Scaffold

- Legal requirement under Factories (Scaffold) Regulations
- Obligations of scaffolds personnel
- Metal and timber scaffolds
- Suspended scaffolds
- Tower scaffolds

Other equipment

MEWP

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Mechanical Material Handling

1.1 Legal requirement under WSH (Construction) Regulations, WSH (Operations of Cranes) Regulations 2011, SS 536: 2008, SS559 : 2010 and CP 63: 1996

Legal requirement under Factories (Operation of Cranes) Regulations 2011

Approved Code of Practice

- SS 536: 2008 Safe Use of Mobile Cranes
- SS 559: 2010 Safe Use of Tower Crane
- CP - Safe Lifting Operations in the Workplaces (WSHC)
- CP 63: 1996 Lifting of Persons in Work Platforms Suspended from cranes

WSH (Construction) Regulations

General Requirement

Strength and stability

It shall be the duty of the owner of a crane, an employee's lift or a material handling machinery being used in a worksite to ensure that the crane, employee's lift or material handling machinery is —
(*a*) of good construction, sound material and adequate strength;
(*b*) free from patent defects; and
(*c*) properly maintained.

It shall be the duty of the operator of a crane or material handling machinery being used in a worksite to ensure that the crane or machinery, as the case may be, is positioned and operated as to be stable.

Capacity chart

It shall be the duty of the owner of any crane used in a worksite to ensure that the Capacity chart be posted and maintained in the crane which is clearly visible to the operator.

Set out the safe loads for various lengths of jib at various angles and radial distances; and

- be prepared and certified by an authorised examiner, unless it is furnished by the manufacturer or builder of the crane.
- Where outriggers are provided, the safe loads with and without the use of outriggers shall be specified

Examination and inspection

It shall be the duty of the occupier of a worksite to ensure that before any crane, employee's lift or material handling machinery is put into service for the first time in the worksite —

(a) it has been thoroughly examined and inspected by a competent person; and

(b) in the case of a crane or an employee's lift, such examination and test is conducted by an authorised examiner.

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Handling of suspended loads
It shall be the duty of the operator of any crane or material handling machinery to ensure that loads that have a tendency to swing or turn freely during hoisting are controlled by tag-lines.

Prohibition on riding on loads
It shall be the duty of the employer or the principal to ensure that no person rides on the loads, buckets, skips, cars, slings or hooks of the machinery.

Workplace Safety and Health (Operation of Cranes) Regulations

Definition
"Responsible Person", in relation to a workplace where a crane is, or is to be, operated by a person means —
(a) the employer of the person; or
(b) the principal under whose direction the person operates the crane;

Lifting plan
Reg(4).—
(1) Where any lifting operation involving the use of any crane is carried out in a workplace by a crane operator, it shall be the duty of the responsible person to establish and implement a lifting plan.

(2) It shall be the duty of the responsible person to ensure that the lifting plan is made available for inspection upon request by an inspector.

Only registered crane operator to operate a mobile crane and tower crane
Reg(5).—
(1) No person shall operate a mobile crane (not being a lorry loader) or tower crane in a workplace unless he is a registered crane operator.

(2) It shall be the duty of the responsible person to ensure that no person, other than a registered crane operator, is employed, permitted or made to operate a mobile crane (not being a lorry loader) or tower crane in a workplace.

(3) A person, whether or not he is also a registered crane operator, may drive a mobile crane in a workplace if he is the holder of a driving licence issued under the Road Traffic Act (Cap. 276) authorising him to drive a mobile crane of a class or description permitted by the licence, but he shall not operate the mobile crane unless he is also a registered crane operator.

(4) No person shall operate a lorry loader unless
(a) he has successfully completed a training course, acceptable to the Commissioner;
(b) if required by the Commissioner, he attends re-training on the operation of a lorry loader and successfully completes such re-training; and
(c) if required by the Commissioner, he produces a current medical certificate from a registered medical practitioner certifying that he is medically fit to operate a lorry loader.

(5) It shall be the duty of the responsible person to ensure that no person is allowed to operate a lorry loader unless the person medically fit.

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Registration of Crane Operators
Requirements for registration as crane operator
Reg(7).— (1) A person may register as a crane operator if he satisfies the Commissioner that —

(a) he has successfully completed a training course acceptable to the Commissioner on the operation of a mobile crane or tower crane;

(b) he has sufficient experience in operating a mobile crane or tower crane and has passed a proficiency test acceptable to the Commissioner; or

(c) he possesses any other equivalent qualification acceptable to the Commissioner.

(2) The Commissioner may require an applicant to produce a current medical certificate from a registered medical practitioner which certifies that the applicant is medically fit to operate a mobile crane or tower crane.

(3) The Commissioner shall not register an applicant who has been certified by a registered medical practitioner to be unfit to operate a mobile crane or tower crane.

Register of crane operators
Production of certificate of registration upon request 10.—

1) It shall be the duty of a registered crane operator to produce his certificate of registration for inspection upon request by an inspector.

(2) Any person who contravenes shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $1,000 and, in the case of a second or subsequent conviction, to a fine not exceeding $2,000.

Duties and Responsibilities of Approved Crane Contractor
Approved Contractor shall:-

- Obtain a **manufacturer's manual** which contains instructions on the safe procedures for the installation, repair, alteration and dismantling of the tower crane
- Ensure that the crane is installed, repaired, altered or dismantled in accordance with the instructions contained in such manual.
- Where the manual is not available, it shall be the duty of the approved crane contractor to ensure that the installation, repair, alteration or dismantling of any mobile crane to tower crane shall be under the immediate supervision of an **authorized examiner.**

Appointed person (SS559)
The appointed person need not be hired solely for the purpose of managing the cranes. He could, for example, be an existing employee who has adequate training and experience to enable him to carry out his duties competently
The appointed person's duties should include the establishment and implementation of a safe working procedure and method for the safe installation/jacking/dismantling of tower crane.

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5.2 Lifting Plan

General

The Lifting Plan is a set of plans which is created for use in any crane lifting operation. All lifting operations shall be accompanied by a lifting plan supported by a risk assessment, a safe work procedure and/or method statement, and PTW.

Frequent or routine lifting operations may only require a basic lifting plan supported by an on-site risk assessment and briefing to related personnel. High risk or complex lifts however, requires additional engineering design efforts to ensure that the lifting is conducted safely.

Elements of a Lifting Plan

The lifting plan shall include but not be limited to the following considerations:

- The personnel required
- The personnel's roles, responsibilities and competencies
- Compliance to statutory requirements and manufacturer's operation manual for the lifting equipment
- Permit-to-Work system which is mandatory for all lifting operations.
- Nature and weight and dimension of load – including the NET and GROSS weights.
- Type and location of lifting / rigging points.
- Selection of appropriate lifting equipment, lifting gear and appliances.
- Application of the correct lifting methods
- Application of the correct lifting methods
- Position of lifting equipment, personnel and of the load, before and after the lift operation.
- The work site operation including proximity of other lifting equipment and work activities.
- Requirements to erect / dismantle the lifting equipment.
- Assessment of the need for tagline to control movement of the suspended load.
- Means of communication during lifting operations.
- Environmental factors detrimental to the lifting operations such as ground conditions, adverse weather, wind, and poor illumination.
- Ensuring a system for reporting any defects is in place.
- Provision of a safe place of work for all personnel during lifting operations

Reference: COP Safe Lifting Operations in the Workplaces Ver 2014

Routine versus Non-routine Lifts

Routine lift

- ❑ It is repetitive in nature and involves loads that are known size, shape and weight.
- ❑ For example, daily lifting activity like hoist of rebar, formwork, concrete bucket, scaffolding frame, etc..,

Non-routine lift

- ❑ Lifting operation that is complex, carried out for the first time or lifting close to the lifting capacity of the crane. For example, a tandem "tilt-up" operation (i.e., lifting using two or more cranes),
- ❑ erection and dismantling of tower crane,
- ❑ Learn from past experiences, most crane accidents happened during a routine lift rather than a non-routine lift.
- ❑ Hence, any lifting operation whether routine or non-routine requires the lifting plan.

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We need to prepare the lifting plan based on the following key factors

1. Details of the load
2. Details of the lifting equipment/ lifting gears used
3. Means of communications
4. Personnel involved in the lifting operation
5. Physical and environmental considerations
6. Sequence/ special precautions
7. Sketch of the zone of operation

Appendix 1: Sample Lifting Plan/ Permit-To-Work

1. General			
Project			
Location of lifting operation			
Contractor carrying out the lifting operation		Date/ time of lifting operation	
		Validity period of lifting operation	

2. Details of the Load/s			
Description of load/s			
Overall dimensions			
Weight of load	Kg / tonne	☐ Known weight	☐ Estimated weight
Centre of gravity	☐ Obvious	☐ Estimated	☐ Determined by drawing

3. Details of the Lifting Equipment/ Lifting Gears			
Type of lifting equipment			
Maximum SWL as certified on the LM cert		Date of last certification	
Max boom / Jib length	m	Fly jib / offset	
Intended load radius	Distance between the load and the crane	SWL at this radius	
Type of lifting gears	Slings / webbing / chains / shackles / spreader beam / receptacle		
Combined weight of the lifting gears	Kg / tonne	Certification of lifting gears	☐ Yes ☐ No

4. Means of Communications		
Can the operator see the loading and unloading point for the load from his position?		
☐ Yes	☐ No	
What are the means of communication between the lifting crew?		
☐ Standard hand signals	☐ Radio	☐ Others _____

Sample Lifting Plan from Code of Practice

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5. Personnel Involved in Lifting Operation

Position	Name	Qualification/ Experience
Site Supervisor		
Lifting Supervisor		
Crane Operator/ Lifting Equipment Operator		
Rigger		
Signalman		
Others (please state)		

6. Physical and Environmental Consideration (please include any details in the space provided)

Ground conditions	Is the ground made safe (e.g., placing steel plate)? _____	☐ Yes ☐ No
	Are the outriggers evenly extended? _____	☐ Yes ☐ No
Obstacles	Are there any overhead obstacles such as power lines? _____	☐ Yes ☐ No
	Are there nearby buildings or structure, equipment or stacked materials that may obstruct lifting operation from being carried out safely? _____	☐ Yes ☐ No
Lighting	Is the lighting condition adequate? _____	☐ Yes ☐ No
Demarcation	Has the zone of operation been barricaded (with warning signs and barriers) to prevent unauthorised access? _____	☐ Yes ☐ No
Environment	Do not proceed with the lifting operation under the following circumstances: ☐ Thunderstorm and lightning strikes in the area. The ground condition must be checked after a thunderstorm. ☐ Strong winds that may sway the suspended load. ☐ Other circumstances (please specify).	

7. Sequence / Special Precautions	8. Sketch of the Zone of Operation:
	(It is recommended that you include the initial location of the load, the final location and path of the load. It is also important to indicate any obstructions or equipment that may obstruct the lifting operation).

Sample Lifting Plan from Code of Practice

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Applied by: Name:	Signature:	Date: Time:
Prepared by: Name:	Signature:	Date: Time:
Assessed by: Name:	Signature:	Date: Time:
Approved by: Name:	Signature:	Date: Time:

Note:

1. This is only a sample Lifting Plan/ PTW, the content is by no means comprehensive. Users would have to include key critical document and information such as load capacity chart, range diagram, rigging method, sling angle, etc to ensure safe lifting operations.
2. Further guidance can be obtained from the following collaterals:
   - Guidebook for Lifting Supervisors
   - Worker's Safety Handbook for Crane Operator
   - Worker's Safety Handbook for Rigger and Signalman

5.3 Lifting Equipment – Mobile Crane & Tower Crane, Lorry Crane

- Truck Mounted Lattice Boom Cranes
- Crawler Mounted Lattice Boom Cranes
- Truck/Crawler Mounted Telescopic Boom Cranes
- Mobile Tower Cranes
- Lorry loaders

Types of Tower

- Fixed Tower
- Slewing Tower
- Mono Tower
- Climbing Tower
- Telescopic Tower
- Mobile Tower

Types of Jib

- Saddle Jib (Hammerhead)
- Luffing jib
- Articulated Jib
- Flat top

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This checklist provides an overview of the basic requirements to be checked which would help to ensure that a mobile/ crawler crane is safe for use. Mobile/ crawler crane users should consult manufacturers, suppliers and owners to check on minimum requirements and address any concerns before using the equipment. These items in this checklist are non-exhaustive and users are recommended to make the necessary modification and customisation to suit your work processes and conditions at the workplace.

S/N	Items	Yes/ No	Remarks
A. Mobile/ Crawler Crane Approved for Use			
1.	The mobile/ crawler crane age is within limits set by MOM.	☐ Yes ☐ No	
2.	The mobile/ crawler crane has a valid Lifting Machine (LM) certificate (issued less than 12 months ago).	☐ Yes ☐ No	
B. General Requirements			
3.	The mobile/ crawler crane is provided with markings of the Safe Working Load, and LM number.	☐ Yes ☐ No	
4.	Proper and safe access and egress (with proper foot and hand holds/ supports) are provided to the crane operator.	☐ Yes ☐ No	
5.	A load capacity chart is displayed in the operator cabin.	☐ Yes ☐ No	
6.	Operator crane cabin is provided with a locking mechanism so as to prevent unauthorised entry.	☐ Yes ☐ No	
7.	An approved fire extinguisher is provided in the operator cabin.	☐ Yes ☐ No	
8.	An Operation and Maintenance log book is available in the operator cabin.	☐ Yes ☐ No	
9.	A Manufacturer Operating Manual and Maintenance Manual are made available.	☐ Yes ☐ No	
10.	Crane hook is provided with a safety catch to prevent displacement of the sling or load from the hook.	☐ Yes ☐ No	
11.	Main and auxiliary wire ropes are well lubricated and that there are no visible defects such as broken wires, kinks, excess wear, crushing etc.	☐ Yes ☐ No	
C. Safety and Operational Devices			
12.	A load radius indicator with warning alarm is installed.	☐ Yes ☐ No	
13.	An effective hoist and derricking braking mechanism are maintained.	☐ Yes ☐ No	
14.	A swing lock or swing brake capable of preventing unintended rotation is functional.	☐ Yes ☐ No	
15.	Limit switch to prevent over-hoisting of the hook (i.e., anti-two block device) is functional.	☐ Yes ☐ No	
16.	Limit switch to prevent over-derricking of boom (for crawler crane) is functional.	☐ Yes ☐ No	
17.	Load Moment Limiter to prevent over-turning moment is functional.	☐ Yes ☐ No	

Sample Checklist for Mobile Cranes

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D. Maintenance			
18.	The mobile/ crawler crane has a regular maintenance programme that is in accordance with manufacturer's specifications.	☐ Yes ☐ No	
19.	Maintenance work on the mobile/ crawler crane is carried out by Competent Persons.	☐ Yes ☐ No	

Inspected by: Crane Operator	Supervised by: Lifting Supervisor
Signature / Date	Signature / Date

Mechanical Material Handling
In a worksite, material is moved either by: Manual or Mechanical (Using material handling equipment) means:

Manual handling
Hazards of manual handling:

- Strains and Sprains to the hands, legs, feet and back
- Fractures and bruises

Under WSH Act, all the tools and equipment used for lifting purpose are classified as a lifting equipment (LE).

- Lifting equipment are further classified as
  - Lifting Machines
  - Lifting Gears
  - Lifting Appliances

a) Lifting appliances - Include any pulley block, gin wheel, chain block or set of chain blocks

b) Lifting machines - Includes any crane, winch, piling frame and any suspended scaffold capable of being raised or lowered by climbers or winches; and

c) Lifting gear - Includes any chain, rope, chain sling, rope sling, ring, hook, shackle, swivel, eye bolt and any cage or work platform used for carrying persons while it is suspended from the load line of a crane.

Lifting Gears
Legal Requirements

- Good construction, adequate strength, sound and suitable material, adequate strength, free from defect and properly maintained.
- Be tested and examined by approved person before use.
- Inspected once every 12 months by approved person
- Must not be overloaded during use.

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Lifting machines

Legal Requirement

- Good construction, adequate strength, sound and suitable material, adequate strength, free from defect and properly maintained
- Thoroughly examined by an approved person once it is constructed.
- Examined by approved person every 12 months once in use.
- Every crane and winch shall be provided with a readily accessible and efficient brake or other device.
- Clearly marked with safe working load
- Trained and competent operator.
- Age at least 18 for operator and signalman.

Crane's Load chart

Every crane shall be provided with a capacity chart which is posted and maintained in a place clearly visible to the operator.
Capacity chart must be in a language comprehensible to the crane operator and lifting supervisor

5.4 Hoist and Lifts - WSH Act

Legal Requirement

- Good mechanical construction, sound material, adequate strength and properly maintained
- Inspected once every six month by Authorized Examiner
- Automatic devices to prevent the cage from over-running
- Hoist way and lift way efficiently protected by enclosure fitted with interlocking gates
- Safe working load (SWL) must be conspicuously showed
- Fitted with efficient devices to support the cage with maximum load in the event of the breakage of the rope or gears

Use of lift and hoist

- Transport workers
- Transport Material to the designated floor

5.5 Lifting personnel – Lifting Supervisor, Crane Operator, Rigger & Signalman

Guidelines of Lifting Operation – Lifting Team

Lifting Team

- The Lifting Team refers to the group of personnel that is appointed to be directly involved in the lifting operation.

- The key factors to consider in selecting a Lifting Team include:

1. Competency - Only suitably trained and competent personnel should be deployed as part of the Lifting Team.

2. Composition –It is good practice to try to maintain the same group of individuals in a Lifting Team so that the trust and rapport among team members can be built up over time.

3. Communication –The Lifting Team must use a common language that all members can understand. Any miscommunications can result in accidents.

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Lifting Supervisor Appointed in writing by the contractor.
All lifting operation must be supervised by the appointed lifting supervisor and shall:-.

- Co-ordinate all lifting activities in accordance with the lifting plan.
- Brief all lifting team members on the lifting plan, safe lifting procedure and risk assessment.

1. Ensure that only registered crane operators, appointed riggers and appointed signalmen participate in any lifting operation involving the use of mobile and tower cranes.
2. Ensure that the ground conditions are safe for any lifting operation to be performed
3. Be present during all lifting operations.
4. Take suitable measures to rectify any unsafe conditions to ensure the lifting operation can be conducted safely.

Most important personnel of the Lifting Team-controls the lifting equipment.

- Key competencies of the operator of mobile, crawler or tower cranes; ability to read and interpret the load capacity chart, and to differentiate weight of load and capacity of crane

The appointed lifting equipment operator shall:

- Carry out the lifting operation in accordance with the Lifting Plan.
- Inspect the lifting equipment prior to use to check for abnormalities.
- Check that load radius indicator and other safety devices are functioning properly.
- Ensure the ground is stable and the surrounding is free from any structures or materials
- Carry out lifting operation only when a lifting supervisor is present on site.
- Disengage from any manoeuvre that is dangerous
- Monitor environmental effects such as thunderstorm and strong wind
- Report any defects immediately to the lifting supervisor, and
- Record such defects in maintenance log book.
- Stop the lift whenever unsafe conditions occur and
- To check crane wire rope to ensure it is still within safe use.

Signalmen
The appointed signalmen shall:-

- Ensure the load is correctly rigged up prior to giving signals to commence the lift.
- Give correct and clear signals to the lifting equipment operator to manoeuvre the load safely from the point of lift to the destination.
- Ensure communications are maintained throughout the lift in accordance with the lifting plan.
- Ensure the lift is controlled throughout
- Ensure that the immediate areas within the lift are clear of any hazards during manoeuvre.
- Maintain his / her position so as to ensure line of sight during the controlled phase of the lift and to ensure this position is free of danger.
- Refrain from handling load/rigging simultaneously when giving signal to the crane operator

Riggers

- The appointed riggers shall ensure:-
- All slings, webbings, shackles and other lifting gears used to rig the load are within the safe working load (SWL) of the lift, in good condition and duly certified.
- The load is rigged up in a such a manner that it is ;stable, balance (centre of gravity beneath the hook) and secure (i.e. no loose items)

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Scaffolds

5.6 Legal requirement under WSH (Scaffolds) Regulations

General Provisions (Reg 4)

- No scaffold (Other than a tower scaffold and a trestle scaffold) shall be erected, installed re-positioned, altered or dismantled except by an approved scaffold contractor.
- The above shall not apply to a scaffold which, when completed and excluding the handrails and their supports at the uppermost lift of the scaffold, is less than 4 metres in height.
- An approved scaffold contractor shall employ or engage only scaffold supervisors, scaffold erectors and suspended scaffold riggers who have undergone a course of training approved by the Commissioner.

Materials and Administration (Reg 8, 20 & 30)

- All scaffold erection, addition, alteration or dismantling shall be supervised closely by a qualified and experienced scaffold supervisor.
- Every metal scaffold exceeding 30 metres in height in any factory other than in a shipyard shall be constructed in accordance with the design and drawing of a professional engineer.
- A copy of the design calculations and drawings certified by the professional engineer (PE) shall be kept available at the worksite for inspection by an inspector.

Materials and Administration (Reg 3, 29)

- All metal scaffolds must be of the type tested by tester body recognised body.
- Only approved scaffold contractors will be allowed to erect, install, re-position, alter or dismantle scaffolds (other than a tower scaffold and a trestle scaffold) which, when completed and excluding the handrails and their supports at the uppermost lift of the scaffold, are more than 4 metres in height.
- The approved scaffold contractor shall employ or engage scaffold supervisors, scaffold erectors who have undergone a course of training for such work approved by the MOM.

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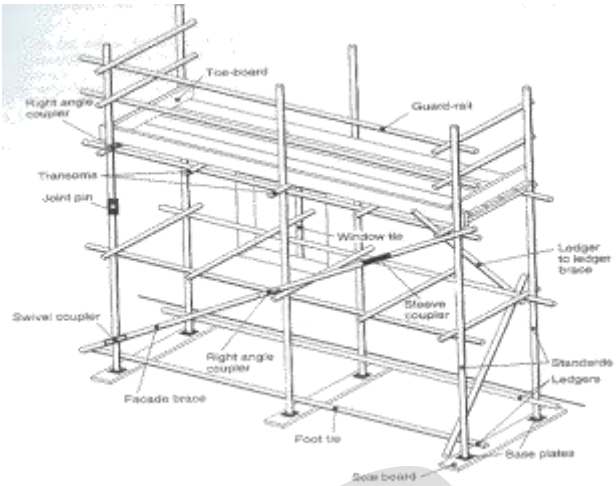

Work platforms requirement (Reg 18 & 21)

- In the case of metal scaffolds, no more than 4 persons shall work on a work platform in any one bay.
- Where a metal scaffold is used to support more than 4 persons in any one bay (limit 8 persons), the scaffold shall be constructed in accordance with the design and drawings of a professional engineer.
- The maximum loading on any work platform in any one bay of a scaffold shall not exceed 220 kgf per square metre for persons and materials.
- Signboards stating the maximum permissible weight of tools and materials and the maximum number of persons permissible per bay shall be prominently displayed at suitable locations at the work platforms.
- Work platform should be closely boarded planked or constructed of metal decking and be at least 500 millimetres wide if it is used to provide footing for not more than three persons and to support tools and materials not exceeding 25 kgf per bay of a scaffold.
- The vertical distance between any two work platforms shall not exceed 4 metres, unless approval is given in writing by the Commissioner for WSH.
- A work platform and its support shall be constructed in accordance with the design and drawings of a professional engineer where the work platform is used to provide footing for more than 2 persons per bay or to support tools or materials exceeding 25 kgf per bay.
- Work platforms shall be provided at intervals of not less than every alternate lift of any scaffold, except a tower scaffold or a trestle scaffold, used in any premises where building operations are being carried on and, unless approval is given in writing by the Chief Inspector, the vertical distance between any 2 work platforms shall not exceed 4 metres.
- Every work platform provided under this regulation if used to provide footing for not more than 3 persons and support tools and materials not exceeding 25 kgf per bay of a scaffold, at least 500 millimetres wide.
- The distance between a building or any structure and the work platform shall be as narrow as practicable and shall in no case exceed 300 millimetres.
- All material, including concrete waste or other debris, which may endanger the safety of any person shall be removed from the scaffold.
- Every work platform shall cover the lift of a scaffold throughout its entire length.

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- A work platform and any support thereof shall be constructed in accordance with the design and drawings of a professional engineer where the work platform is used,

  – To provide footing for more than 2 persons in each bay; or
  – To support tools or materials exceeding 25 kgf in each bay.

Reg 19 & 20

- The maximum loading for persons and materials on any work platform in any bay of a scaffold shall be –

  – In the case of a timber scaffold, 75 kgf per square metre; or
  – In any other case, 220 kgf per square metre.

- For timber scaffold, not more than 2 persons shall work on a work platform in any bay.
- For metal scaffold, not more than 4 persons shall work on a work platform in any bay.
- Signboards stating the maximum permissible weight of tools and materials and the number of persons permissible on each bay shall be prominently displayed at suitable locations on the work platforms.
- The distance between a work platform and any building or other structure shall be as narrow as practicable and shall not exceed 300 millimetres.
- All boards, planks or decking used in construction of work platforms shall –

  – Be capable of supporting a load of 670 kgf per square metre with due regard to the spacing of the supports;
  – Be flushed along their lengths and secured.

- Any metal decking which forms part of a work platform shall be provided with non-skid surfaces.

Boards, planks & Decking (Reg 21)

- Boards, planks or decking used in the construction of work platforms must be of uniform thickness and capable of supporting a load of 670kg/m2 with due regard to the spacing of the supports.
- Metal decking used for the construction of work platforms should be provided with non-skid surfaces. Board and plank should not project beyond its end support by less than 50mm or more than 4 times the thickness of the board or plank unless effectively secured or tied down to prevent tipping or uplift. Boards, planks or decking should be flushed and secured.
- No opening in any work platform should be permitted unless it is for access purposes. Ladders shall be provided so as enable persons to gain access from one platform to another.
- Any board or plank which forms part of a work platform shall project beyond its end support to a distance of not less than 50 millimetres and not more than 4 times the thickness of the board or plank unless it is effectively secured to prevent tipping or uplift.
- Where a metal scaffold is used to support more than 4 persons in any bay, the scaffold shall be constructed in accordance with the design and drawings of a professional engineer.

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Guardrails and Toe Boards (Reg 22)

- The guard-rails and toe-boards shall:
  - be of good construction, sound material and of adequate strength to withstand the impact during the course of work;
  - be placed on the inside of the uprights and so secured to prevent accidental displacement; and
  - be so placed as to prevent fall of any person or material.
- The guard-rails shall be at least 1.0 metres above the work platform or workplace. The height of toe-boards shall not be less than 90 millimetres. The space between any two guard-rails or between any toe-board and the guard-rail immediately above it shall not exceed 600 millimetres.

Guardrails and Toe Boards (Reg 22)

- Every side of a work platform or workplace from which a person is liable to fall more than 2 metres shall be provided with guard-rails and toe-boards.

Reg 24

- Scaffold to be free of substances which endanger safety.
- Where work is to be done at the end of a wall or work area, the work platform at such wall or work area shall, where practicable, extend at least 600 millimetres beyond the end of wall or work area.
- No person shall be permitted on a scaffold that is damaged or weakened except for a scaffold erector who is carrying out repairs thereto.
- There shall be no opening in any work platform except to allow access to that work platform.

Stairs and Ladders (Reg 13)

- Stairs and ladders shall be provided to enable persons to gain access from one level of any scaffold to another and shall, as far as practicable, be installed within the scaffold.

Designated access (Reg 13)

- Any defects discovered shall be notified to the occupier of the factory in which the scaffold is installed and the occupier shall take immediate steps to rectify the defect.
- Every scaffold shall have at least one designated access point from which a person may gain access onto the scaffold.
- All designated access shall be

  – Clearly marked with a sign or label
  – Made safe for use by any person

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Ties (Reg 31)

- Ties could be considered the most important part of a scaffold, for without them, the scaffold could not stand by itself and collapse will occur. The following requirements in the Factories (Scaffolds) Regulations shall be followed closely.
- Every alternate and every uppermost lift of an independent tied metal scaffold shall be effectively tied to the building or structure by means of ties.
- Ties shall be located no further than one bay from the ends of the scaffold and thereafter, at intermediate spacing of not more than 3 bays or 7.5 metres apart, whichever is the lesser.
- Ties other than tie tubes and couplers shall not be used without the written approval from the Commissioner.

Loading requirement (Reg 19, 24)

- A scaffold shall not be overloaded and, as far as practicable, the load thereon shall be evenly distributed.
- When any material is transferred to or from a scaffold, it shall be moved or deposited without imposing any violent shock.

Overlay or screening nets (Reg 23)

- Overlay or screening nets shall be used to envelop any timber or metal scaffold which is erected on the outside of a building.

Bracing (Reg 16)

- Every scaffold shall be effectively braced by means of longitudinal and transverse bracing systems which shall extend from the base to the top of the scaffold.
- The joints in bracing members shall be lapped or spliced.
- Longitudinal bracing members shall be continuous and fixed at approximately 45° to the horizontal.
- Every lift shall be crossed by at least one longitudinal bracing member in every 10 metres of length of the scaffold.
- Frame scaffold shall be provided with horizontal bracings or lacings at intervals of not more than every 5 lifts.
- Every frame scaffold shall be provided with horizontal bracings or lacings at intervals of not more than every 5 lifts.

Foundation (Reg 10)

- Where a scaffold is to be founded on soil, the soil shall be well-consolidated.
- A scaffold exceeding 15 metres in height or being erected on poorly drained soil, base plates shall bear upon sole plates of strength not less than 670 kgf per square metre and of a length suitable to distribute the load.
- There shall be no cavity under the sole plate immediately below any standard.
- Scaffold shall not be overloaded, as far as practicable, the load thereon shall be evenly distributed.

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Spot mistakes in below photos

5.7 Obligations of scaffolds personnel

Duties and Responsibilities (Reg 5 & 6)

- Scaffold supervisors, scaffold erectors and suspended scaffold riggers shall be a person who has undergone a course of training approved by the Commissioner.
- Every scaffold erector and every suspended scaffold rigger shall be provided with a safety harness attached to a shock absorbing device and use the safety harness provided.
- No suspended scaffold or scaffold exceeding 4 metres shall be erected, installed, re-positioned, altered or dismantled except under the immediate supervision of a scaffold supervisor.
- Every scaffold erected at a building under construction shall, as far as practicable, be erected such that it precedes the construction of the uppermost permanent floor of the building by not less than 1 metre above that floor.
- If the scaffold extends beyond the uppermost permanent floor by 2 metres or more, it shall be adequately supported to prevent collapse.

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Inspection (Reg 26)

- No scaffold shall be used unless it has been inspected by a scaffold supervisor
  - Within the 7 days immediately preceding the use of the scaffold
  - Since exposure to weather conditions likely to have affected its strength or stability or to have displaced any part
- The scaffold supervisor shall enter the results of any inspection into a register containing such details as may be required by the commissioner.
- The register shall be kept available at the factory for inspection by an inspector.
- The scaffold supervisor shall immediately after the inspection, display a notice or label indicating whether the scaffold is safe for use or otherwise.

Reg 27

- Prominent warning notices in languages or signs understood by all persons indicating that the scaffold or part thereof is not to be used is affixed near any point at which the scaffold, or part, as the case may be, is liable to be approached for the purpose of use.

Label and Notice (Reg 27)

- The notice or label shall
  - Be in language or signs easily understood by the persons employed in the factory
  - Be in a form approved by the Chief Inspector
  - Be displayed at every designated access point.
- No person shall use any scaffold unless a notice or label is displayed at the designated point indicating that the scaffold is safe for use.
- The above paragraph shall not apply to
  - A scaffold erector who is carrying out any repair on a scaffold
  - A scaffold supervisor who is carrying out any inspection of a scaffold

Professional Engineer Design (Reg 30)

- No scaffold or support which is designed by a professional engineer shall be used unless

– It has been examined after installation by the professional engineer and a certificate stating that the scaffold is safe for use has been obtained from the professional engineer

– A copy of the design and drawings certified by the professional engineer are kept available in the factory for inspection by an inspector

– The scaffold or support, as the case may be, has been inspected by a professional engineer at least once every 3 months to ensure that it is safe for use.

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- The above paragraph shall apply to
  – Any metal scaffold exceeding 30 metres in height
  – Any cantilever or jib support

- The following scaffold designed by a professional engineer and installed in a factory shall not be used unless a copy of the design and drawings certified by the professional engineer is kept available at the factory for inspection by an inspector
-
  – Work platform or its support referred in regulation 10(5);
  – Metal scaffold referred to in regulation 12(3) or 33(1);
  – Scaffold ties referred to in regulation 43(3) (a);
  – Outrigger or other overhead support referred to in regulation 46(3);
  – Hanging scaffold referred to in regulation 59(3);
  – Trestle scaffold referred to in regulation 60(2).

5.8 Timber scaffold

Construction and materials

Timbers used must be
- Of suitable quality
- In Good condition
- Bark of timbers should be stripped off and painting should be avoided in order to check for any defect in timber.
- Bitangor rollers or other species having similar properties and approved by the chief inspector, shall be used for construction of timber rollers.

Height limitation and design
- The diameter of poles used for standards should be at least 50mm, and spacing between the standards should not exceed 1.5m.

- Ledgers, placed vertically should not exceed 1.8m and are tied properly.

- Timber scaffold with two or more rows of standards not more than 15m in height.

- Bintangor should comply the following

  - Well-Erected continuously around the building without any break
  - tied and braced at the corners
  - Rigidly anchored to the building at regular close intervals.
- Rattan strips are used for lashing and should be at least 1.8m long and able to go round the members at least 6 times.

- Braces are securely placed and lashed to standards.

- Each and every two lifts and three bays should be tied to the building by means of ties.

- Wires are not used as ties.

- Lifetime for the bintangor or other timber roller scaffold is 9 months after erection and after this period it is dismantled and new one is erected.

- Scaffold should be inspected once in every week or when exposed to inclement weather.

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5.9 Suspended Scaffold (SS SS 598 : 2014 SS for suspended Scaffold)

No suspended scaffold shall be used unless-

a) It has been designed and constructed in accordance with an acceptable standard or code;

b) It has been tested by an approved person after installation.

c) The climbers or winches are properly maintained and inspected and serviced at least once every 12 months by a competent person; and

Note: Under WSH (GP) Reg. Suspended scaffold is a lifting platform and require AE examination once every six month.

d) Inspection and servicing records are kept.

e) No one shall be allowed to access the platform from other levels except from ground level.

Age limit of operator

Operator of a suspended scaffold shall not be below the age of 18 years.

Duties of persons in suspended scaffold

Every person on a suspended scaffold shall wear a safety harness which shall be attached to a secured anchorage at all times.

Duties of persons in suspended scaffold (contd.)

No person shall enter or leave the cradle of a suspended scaffold unless it is at rest on the ground or at any level which affords a safe means of access or egress.

Safe working load

SWL sign should display at the suspended scaffold.

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5.10 Tower scaffold

- The height of a tower scaffold other than on board a ship shall not exceed 8 times the lesser of the base dimensions.
- No more than 2 work platforms shall be used on a tower scaffold at any time.

Tower scaffold

- Tower scaffold which are moved on casters shall be provided with casters having a locking device to hold the scaffold in position.
- No person shall remain on a tower scaffold when it is being moved

Hanging scaffold

A hanging scaffold shall be –

- Erected before being hung into position on a building or other structure;
- Provided with safe means of access to and egress from its platform by means of stairs or ladders.
- A hanging scaffold from which a person may fall more than 2 meters shall be constructed and installed in accordance with the design a d drawing of a PE.
- Persons working on a hanging scaffold shall be provided with a safety harness and sufficient and secured anchorage by life line

Free Standing Tower Scaffold

Hanging Scaffold

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5.11 Other Equipment

Mobile Elevated Work Platform (MEWP)

- Boom lifts
- Scissor lifts
- One man lift

Mobile Elevated Work Platform (MEWP)
The key factors to be taken into consideration:-

- 3 types: Scissors, Telescopic & Articulating
- Access Path (demarcation and SWL signboard)
- **This equipment is for gaining access and not to be used as material handling**
- This equipment should not be used in high wind condition or during lightning
- Only trained operator allowed to operate
- Competent operator to conduct visual checks and functional checks
- He or she shall do RA before operation and conduct pre-use check and enter the findings

The key factors to be taken into consideration:-

- No alteration or modification or any MEWP and any of its safety devices
- Operator shall be able to recognize any terrain, slopes, or trenches
- Operator must anchor his safety harness
- Use of ladders, planks or any other devices is prohibited
- Always refer to manufacturer's manual for any additional safety requirements.

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Legal requirements

- Equipment shall be inspected by an AE once in every 6 months and provided with a valid certificate.
- Operator shall be trained on safe operation, maintenance and hazards associated in handling the machine.
- Machine shall be maintained as per the user manual.
- Machine shall not be shifted when the boom / scissor is in its extended position.
- Provide a banks man to guide the movement of machine
- Do not turn the boom when it is in the extended position.

Learning Activity 5

Objective: Identify cause of crane & Scaffold accident and recommend preventive measures

Based the case studies discuss the cause of accident and preventive and corrective measures to be taken

Break into group of 5 and select a leader to lead the discussion

Each group to pen down their finding and present to the class for class discussion.

Case 1 Worker hit by precast component and fall to death

A construction worker was standing on the 19th storey of an unfinished Sengkang HDB block when a 7,660kg prefabricated structure carried by a tower crane crashed into him.

Chinese national Liu XX 40 was initially pinned against the wire mesh barricades at the side of the unfinished building at Ferndale Street. Then the barricades gave way and Mr Liu, who was from Shandong, fell to his death.

Case scenario

His colleague, who was operating the crane, claimed to have barely moved the controller joystick when the accident happened on Jan 23 last year.

But the crane had swung at its maximum speed, said Ministry of Manpower (MOM) investigation officer XXX yesterday in an inquiry into Mr Liu's death at the State Courts.

Initially, human error was suspected to be the cause of the accident as a check on the crane soon after the incident did not uncover any disconnected wires or damage, said Mr XXX.

But further investigation by MOM revealed that a possible design flaw of the tower crane was the most probable cause, which is possibly inherent in the 13 other such cranes used here.

Worker dies in Sengkang worksite accident after falling 19 storeys

This prompted State Coroner XXX to call for an advisory to be sent out to those using the same types of crane.

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At about 2pm on the day of the accident, the crane was being used to lift a pre-cast bathroom unit, after four others were successfully installed earlier that day.

The crane operator, who had about 20 years' experience, had manoeuvred the unit from the first storey to the 19th storey, where Mr Liu was standing.

Mr Liu, who was then working as a signal man, instructed his colleague to shift the bathroom unit to the right but the crane suddenly moved at high speed and the structure it was carrying crashed into him.

After rounds of simulation and testing, MOM officers found that a loose wiring connection - possibly caused by vibrations - could have caused the crane to swing at maximum speed once the operating joystick was moved, Mr XXX said.

The crane would then have continued moving at the highest speed even after the joystick was released and the only way to stop it was to press the emergency stop button.

SLOWEST GEAR

That day, the crane operator had engaged the first - and slowest - of four gears and had immediately released the joystick, said Mr Wong.

The XXX Crane was manufactured in Shandong before being shipped to Singapore, where it was assembled by an engineering company here, he said.

The XXX Crane is also used in China, Malaysia, Thailand and South Africa.

He also said MOM spoke to two other crane operators who had similar encounters with the Crane before the fatal accident in January last year.

But they did not report the incidents because their cranes returned to normal after they hit the emergency stop button.

Their cranes were not carrying any loads then, Mr YYY said.

Mr XXX said he would deliver his findings at a later date, but asked that an advisory be quickly issued on the potential problems with the cranes.

"We don't know when (an incident)... is going to happen. Could be tomorrow or next week," Mr YYY said.

Mr XXX said MOM will be following up with companies using the cranes and the Chinese manufacturer. Police have ruled out foul play in the death of Mr Liu.

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Case 2

FALL FROM A SCAFFOLD

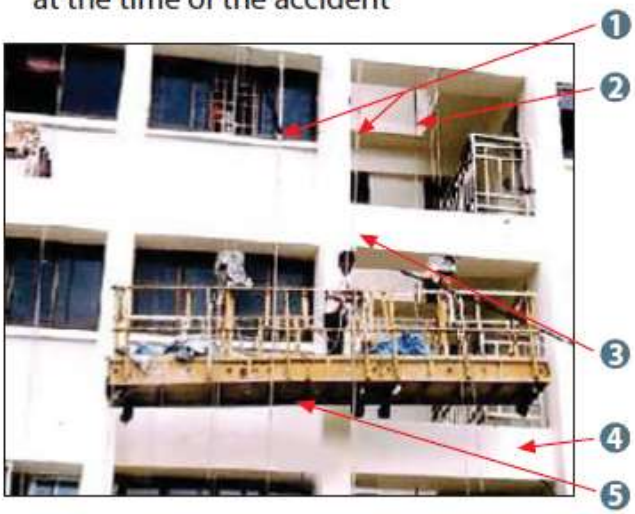
Description of Accident

A worker was intending to paint the walls adjacent to a ledge. He tried to climb out of a suspended scaffold onto the building ledge but lost his footing and fell from the nineth storey of the building.

Causes and Contributing Factors

- The worker was not wearing any safety harness or safety belt.
- The suspended scaffold had last been examined in August 2002, contrary to the legal requirement which states that such equipment must be thoroughly examined and certified for use by an approved person once every 12 months.

1. The deceased landed here
2. The suspended scaffold was re-positioned here
3. The position of the suspended scaffold at the time of the accident



1. The lifeline installed outside the suspended scaffold
2. A lifeline installed in between the ledges and kitchen area
3. A worker attached the fall arrestor device to a lifeline
4. One of the cross beams
5. The suspended scaffold installed at the façade

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Lesson 6 - Excavation, Tunneling Work and Compressed Air Environment

PS3.
Plan and implement safety programme, system and safe work procedure for construction activities in accordance with WSH (Construction) Regulations

UK6 Excavation, Tunnelling Work and Compressed Air Environment

Excavation and tunneling works

- Legal requirement under WSH (Construction) Regulations 2007
- WSH (Confined space) Regulations 2009
- Duties of occupier & Professional Engineers
- Safety measures for excavation work

Compressed Air Environment

- Legal requirement under WSH (Construction) Regulations 2007
- Safety measures for work in a compressed air environment

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Introduction

Excavation and tunneling works
An **excavation** is defined as any man made cut, cavity, trench or depression in the earth's surface formed by earth removal.

A **trench** is defined as a narrow underground excavation in which the depth is more than it is width and not wider than 15 feet (4.5 meters).

Tunnelling may be defined as any work which is carried out below ground / water level through a barrier. Tunnelling ~ provide passage around an obstacle, transportation, security and mining.

6.1 Legal requirement under WSH (Construction) Regulations

Reg. 77 General requirements on excavation work
Reg. 78 Duties of professional engineers on excavation
Reg. 79 Access and egress from excavation
Reg. 80 General duty on occupier
Reg. 81 Stability of tunnelling work
Reg. 82 Ventilation
Reg. 83 Illumination level
Reg. 84 Access to and egress from tunnels or shafts
Reg. 85 Plant and ancillary equipment
Reg. 86 Means of communication
Reg. 87 Tampering with fittings
Reg. 88 Training
Reg. 89 Rescue Team
Reg. 90 Fire-fighting facilities and procedure

6.2 Legal requirement under WSH (Confined spaced) Regulations

GENERAL PROVISIONS

Record of confined spaces in factory
4. Where a fixed and stationary confined space is sited in a factory, it shall be the duty of the occupier of the factory to —
(a) make a record of the description and location of the confined space; and
(b) inform persons who are liable to be exposed to the hazards of the confined space, of the existence and hazards of the confined space.

Access to and egress from confined space
5. It shall be the duty of the occupier of a workplace to take, so far as is reasonably practicable, measures to ensure that the means of entry into and egress from any confined space in the workplace are safe and without risks to the health of every person entering or leaving the same.

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Opening of entrance cover of confined space

6. It shall be the duty of the responsible person of a person entering or working in a confined space which contains any substance under pressure greater than atmospheric pressure to ensure that —

(a) the entrance cover of the confined space is not removed unless the confined space is depressurised and rendered safe for opening; and

(b) when such entrance cover is removed, the opening to the confined space is barricaded or guarded by railings or other effective means, to prevent any person or object from falling into the confined space.

Lighting in confined space

7. It shall be the duty of the responsible person of a person entering or working in a confined space to ensure that there is sufficient and suitable lighting for such entry into or work in the confined space.

Ventilation in confined space

8.—(1) It shall be the duty of the responsible person of a person entering or working in a confined space to ensure that the ventilation in the confined space complies with this regulation.

(2) Adequate and effective ventilation shall be maintained in the confined space for the purposes of entry into and work in the confined space.

(3) The air supply for the ventilation shall be —

(a) from a source free from contaminants; and

(b) directed to the area where a person is or will be present in the confined space.

(4) Where exhaust ventilation is used, the exhaust air from the ventilation system shall be exhausted to a location outside the confined space where it does not present a hazard to any person.

PART III

CONTROL OF ENTRY INTO CONFINED SPACE

Implementation of confined space entry permit

9. Before any person enters or works in a confined space, it shall be the duty of his responsible person to —

(a) appoint a person whom the responsible person reasonably believes is competent to carry out the duties of an authorised manager, as an authorised manager for the confined space;

(b) appoint a person whom the responsible person reasonably believes is competent to carry out the duties of a confined space safety assessor, as a confined space safety assessor for the confined space; and

(c) ensure that a confined space entry permit has been issued in respect of the entry into or work in the confined space which specifies —

(i) the description and location of the confined space;

(ii) the purpose of entry into the confined space;

(iii) the results of the gas testing of the atmosphere of the confined space; and

(iv) its period of validity.

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No entry into or work in confined space without evaluation and confined space entry permit

10.—(1) Subject to paragraph (2), no person shall enter or work in a confined space unless

(a) the occupier of the workplace in which the confined space is sited has made an evaluation that it is necessary for such person to enter or work in the confined space; and

(b) a confined space entry permit has been issued in respect of such entry into or work in the confined space.

(2) Paragraph (1)(b) shall not apply if the person entering or working in the confined space —

(a) is wearing a suitable breathing apparatus;

(b) has been authorised to enter or work in the confined space by the authorised manager for the confined space; and

(c) where reasonably practicable, is wearing a safety harness with a rope securely attached and there is a confined space attendant keeping watch outside the confined space who is provided with the means to pull such person out of the confined space in an emergency.

Application for confined space entry permit

11. An application for a confined space entry permit shall —

(a) be made by the supervisor of the person who is to enter or work in the confined space;

(b) be made in such form and manner as may be required by the authorised manager for the confined space;

(c) state the measures which will be taken to ensure the safety and health of persons who enter or carry out the work in the confined space; and

(d) be addressed to the authorised manager and submitted to the confined space safety assessor for the confined space.

Evaluation of confined space entry permit

12.—(1) On receipt of the application for a confined space entry permit, the confined space safety assessor shall test the atmosphere of the confined space prior to entry by any person into the confined space.

(2) The confined space safety assessor shall, in relation to the testing of the atmosphere referred to in paragraph (1) —

(a) use a suitable and properly calibrated instrument;

(b) conduct the test in the following sequence:

  (i) test for level of oxygen content;

  (ii) test for level of flammable gas or vapour; and

  (iii) test for concentration of toxic gas or vapour, where applicable;

(c) conduct the test in a manner that will not endanger himself or others; and

(d) record the results of the test in the confined space entry permit.

(3) If the confined space safety assessor is satisfied that entry into or work in a confined space can be carried out with due regard to the safety and health of persons who enter or work in the confined space, he shall endorse the application for the confined space entry permit and forward the endorsed application to the authorised manager for the confined space.

(4) It shall be the duty of the confined space safety assessor to exercise all due diligence when performing his functions in relation to the testing, evaluation and endorsement of an application for a confined space entry permit under paragraphs (1), (2) and (3).

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Issue of confined space entry permit

13.—(1) The authorised manager for a confined space may issue a confined space entry permit in respect of entry into or work in the confined space if the authorised manager is satisfied that —

(a) The level of oxygen in the confined space is within the range of 19.5% to 23.5% by volume;

(b) the level of flammable gas or vapour in the confined space is less than 10% of its lower explosive limit;

(c) the levels of toxic substances in the atmosphere of the confined space do not exceed the permissible exposure levels as specified in the First Schedule to the Workplace Safety and Health (General Provisions) Regulations (Rg 1);

(d) the confined space is adequately ventilated;

(e) effective steps have been taken to prevent any ingress of dangerous gases, vapors or any other dangerous substances into the confined space; and

(f) all reasonably practicable measures have been taken to ensure the safety and health of persons who will be entering or working in the confined space.

(2) If the authorised manager issues a confined space entry permit, it shall be his duty to retain a copy of the permit.

(3) It shall be the duty of the authorised manager to exercise all due diligence when performing his function in relation to the issuance of a confined space entry permit under paragraph (1).

(4) If the entry or work in the confined space for which the confined space entry permit is issued is not completed within the validity period of the permit, a fresh application shall be made in accordance with regulation 11.

Posting of confined space entry permit

14. Where a confined space entry permit is issued to a supervisor of a person who is to enter or work in a confined space, it shall be the duty of the supervisor to —

(a) clearly post a copy of the permit at the entrance to the confined space, including where reasonably practicable, a sketch of the area within the confined space where the entry is to be made or work is to be conducted; and

(b) ensure that the copy of the permit is not removed until —

(i) the date of expiry of the permit;

(ii) the revocation of the permit; or

(iii) the person entering or working in the confined space has left the confined space after achieving the purpose of the entry or completing the work, as the case may be, whichever is the earliest.

Monitoring to ensure safety and health of worker during entry into or work in confined space

15.—(1) It shall be the duty of the responsible person of a person entering or working in confined space and the authorised manager for the confined space to ensure that all measures necessary to ensure his safety and health are taken and in place at all times during his entry into, stay or work in the confined space.

(2) it shall be the duty of the responsible person of a person entering or working in a confined space to inform the authorised manager for the confined space when the person entering or working in the confined space has left the confined space after achieving the purpose of the entry or completing the work, as the case may be.

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Periodic testing of atmosphere

16.—(1) It shall be the duty of the responsible person of a person entering or working in confined space to ensure that —

(a) the atmosphere in the confined space is tested by a confined space safety assessor at such intervals as is necessary to evaluate the safety and health of the person entering or working in the confined space;

(b) if there are 2 or more persons present in the confined space, at least one of them continuously monitors the atmosphere in the confined space with a suitable gas detector; and

(c) if a hazardous atmosphere in a confined space is detected by the tests or continuous monitoring referred to in sub-paragraphs (a) and (b) —

(i) all persons in the confined space shall vacate the confined space immediately;

(ii) an evaluation is made to determine how the hazardous atmosphere developed; and

(iii) no person re-enters the confined space until a new confined space entry permit is issued by the authorised manager for the confined space.

(2) It shall be the duty of the confined space safety assessor referred to in paragraph (1)(a) to record the results of the tests referred to in that paragraph.

(3) It shall be the duty of the responsible person to ensure that each of the records referred toxin paragraph (2) are kept for not less than 2 years from the date it is made.

Duty to report incompatible work

17.—(1) It shall be the duty of any person who is aware of any work being carried out in workplace in which a confined space is sited which is incompatible with any other work being carried out in the confined space, to immediately report the incompatible work to his supervisor, the workplace safety and health officer, the workplace safety and health coordinator or the authorised manager for the confined space.

(2) In paragraph (1), “incompatible work” means work which is carried out at or in the vicinity of any work carried out in the confined space and which is likely to pose a risk to the safety and health of persons present in the confined space.

Review and revocation of confined space entry permit

18.—(1) It shall be the duty of the authorised manager for a confined space who has issued confined space entry permit to review and assess the need for entry into or work in the confined space on a daily basis and revoke the permit if he thinks fit to do so.

(2) If, after issuing a confined space entry permit, the authorised manager is of the view that the carrying out of the work in the confined space poses or is likely to pose a risk to the safety and health of persons entering or working in the confined space, he may order all persons to leave the confined space immediately and all work in the confined space to cease immediately, and revoke the confined space entry permit.

(3) Without prejudice to paragraph (2), the authorised manager —

(a) may revoke a confined space entry permit in respect of a confined space if he is satisfied that —

(i) the entry or work in the confined space has been completed; or

(ii) the entry or work in the confined space cannot be continued for a significant period of time; and

(b) shall, in the circumstances described in regulation 16(1)(c), revoke the relevant confined space entry permit.

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Warning sign

19. It shall be the duty of the occupier of any workplace in which a confined space is sited to clearly post a notice at the entrance to the confined space to warn persons of the hazards of the confined space unless —

(a) a copy of the confined space entry permit in respect of the confined space is posted therein accordance with regulation 14(a); or

(b) there is no entrance which persons may use to enter the confined space.

Display of name or identification badge

20. It shall be the duty of a person entering a confined space to display his name and identification badge at the entrance to the confined space; and it shall be the duty of his responsible person to ensure that he does the same.

Training of workers and supervisors

21.—(1) It shall be the duty of the responsible person of a person entering into or working in confined space to ensure, before such entry or work, that the person has first received adequate safety and health training for the purpose of familiarising himself with the hazards associated with such entry into or work in the confined space and the precautions to be observed.

(2) Where any person conducts oversight or supervisory work in a confined space, it shall bathe duty of his responsible person to ensure that the person has first received adequate safety and health training to ensure that the work which the person oversees or supervises can be carried out safely.

Appointment and duties of confined space attendant

22.—(1) It shall be the duty of the responsible person of a person entering into or working in confined space to appoint a confined space attendant before such entry or work.

(2) It shall be the duty of the confined space attendant to remain outside the confined space in order to —

(a) monitor persons entering into and working in the confined space;

(b) maintain regular contact with the persons in the confined space and when necessary assist them to evacuate should the need arise; and

(c) alert the persons appointed to carry out rescue work in the event of an emergency.

Rescue operation

23.—(1) It shall be the duty of the responsible person of a person entering into or working in confined space to —

(a) establish a written rescue plan for the purpose of rescuing persons in the confined space in the event of an emergency;

(b) appoint persons to carry out rescue work and ensure that such persons have first received adequate training in rescue operation including first-aid and the proper use of personal protective equipment and other equipment necessary for carrying out a rescue operation in the confined space; and

(c) ensure that there is a sufficient supply of suitable breathing apparatus, safety harness and ropes, suitable rescue equipment and suitable reviving apparatus which are —
   (i) kept readily available;
   (ii) properly maintained; and
   (iii) thoroughly examined by a competent person at least once a month or at such other intervals as the Commissioner may require.

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(2) It shall be the duty of the competent person referred to in sub-paragraph (c) of paragraph (1) to —
(a) exercise all due diligence when making the examination referred to in that sub-paragraph; and
(b) record every examination made under that sub-paragraph and produce such record for inspection upon request by an inspector.

(3) It shall be the duty of the responsible person referred to in paragraph (1) to ensure that each of the records referred to in paragraph (2)(b) is kept for not less than 2 years from the date each is made.

Offences
24.—(1) Except as otherwise provided in this regulation, any person who contravenes any provision of these Regulations shall be guilty of an offence and shall be liable on conviction —
(a) in the case where the person is an individual, to a fine not exceeding $20,000 or to imprisonment for a term not exceeding 2 years or to both;
(b) in any other case, to a fine not exceeding $20,000.

(2) Any person who contravenes regulation 9 or 10(1) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $20,000.

(3) Any person who contravenes regulation 20 or 22(2) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $1,000 and, in the case of a second or subsequent conviction, to a fine not exceeding $5,000.

(4) Any person who contravenes regulation 23(2) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $2,000 and, in the case of a second or subsequent conviction, to a fine not exceeding $5,000.

Key Points of Confined Space Entry

The Authorised manager for a confined space may issue a confined space permit in respect to entry into or work in a confined space if the authorised manager is satisfied that:

- Oxygen level is between 19.5% to 23.55
- Level of flammable gas or vapour is less than 10% of its lower explosive limit
- Level of toxic substances in the atmosphere of the confined space do not exceed the permissible exposure level*
- Confined space is adequately ventilated
- Effective steps are taken to prevent ingress of dangerous gases into the confined space
- All reasonably practicable measures have been taken to endure the safety and health of person who will be entering or working tin the confined space.

Appointment and duties of confined space attendant
It is the duty of the responsible person to appoint a confined space attendant before such entry or work.

It is the duty of the confined space attendant to remain outside the confined space in order to —
(a) monitor persons
(b) maintain regular contact
(c) alert the persons appointed to carry out rescue work in the event of an emergency.

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Rescue Operation

It is duty of the responsible person

(a) establish a written rescue plan

(b) appoint persons to carry out rescue work

(c) sufficient supply of suitable breathing apparatus, safety harness and ropes, suitable rescue equipment and suitable reviving apparatus which are —

(i) kept readily available;

(ii) properly maintained; and

(iii) thoroughly examined by a competent person at least once a month or at such other intervals as the Commissioner may require.

6.3 Duties of occupier & Professional, Engineers

Duties of Professional Engineer

It shall be the duty of a professional engineer who designs the underpinning, sheet piling, bracing or other means of shoring:

- To ensure that his design can be executed safely by any person
- To provide all design documentation (including all relevant calculations, drawings and construction procedures) as is necessary
- To ensure that the structures adjoining or over areas to be excavated are safe
- To inspect the excavation shoring that it is constructed as per design
- To ensure that it is safe for use after completion

Duties of professional engineers on excavation

78. —(1) It shall be the duty of a professional engineer who designs the underpinning, sheet piling, bracing or other means of shoring as required under regulation 77(4) for an excavation to —

(a)take, so far as is reasonably practicable, such measures as are necessary to ensure that his design can be executed safely by any person constructing the underpinning, sheet piling, bracing or other means of shoring according to his design;

(*b*) provide to any person who is constructing or who is to construct the underpinning, sheet piling, bracing or other means of shoring all design documentation (including all relevant calculations, drawings and construction procedures) as is necessary to ensure that the underpinning, sheet piling, bracing or other means of shoring is constructed according to his design; and

(*c*) ensure that the structures adjoining or over areas to be excavated are safe to any person working on or near the structure by reason of such underpinning, sheet piling, bracing or other means of shoring.

(2) It shall be the duty of —

(a) the professional engineer who designs the underpinning, sheet piling, bracing or other means of shoring for an excavation; or

(b) any other professional engineer who is appointed by the occupier of a worksite to oversee the construction of the underpinning, sheet piling, bracing or other means of shoring in the worksite, to take, so far as is reasonably practicable, such measures as are necessary to ensure that the underpinning, sheet piling, bracing or other means of shoring —

(i) is constructed in accordance with the design of the professional engineer who designed it; and

(ii) is safe for its intended use when completely constructed and if so, issue a certificate stating that the underpinning, sheet piling, bracing or other means of shoring is safe for its intended use.

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Duties of Occupier

Stability of Tunneling Work

- Ensure stability of tunnel.
- To provide adequate clearance or refuge area from getting in to contact with any machines / equipment inside the tunnel.
- Ensure free from flooding.
-

Ventilation

- Shall provide appropriate ventilation system to ensure adequate supply of fresh air.
- To maintain Oxygen level between 19.5% and 23.5%
- Not to use the air that has passed through any underground oil or fuel storage.

Illumination Level

- Tunnel shall be adequately illuminated.
- Emergency generators are provided to ensure adequate illumination in the event of a failure of power supply.

Access to and Egress from Tunnel or Shafts

- Safe access and egress to be provided.
- An alternate means of egress from the shaft shall be provided for emergency purposes.
- Lift shall be provided for the transport of men and materials, if persons have to descend in a shaft which exceeds 24 metres in depth.

Training

Only persons who have received adequate Safety and Health training will be allowed to work.

Rescue Team

A rescue team in the following ratio to be deployed at work:

For 25 or more persons = 5 persons

For > 4 but < 24 persons = 2 persons

Fire-Fighting Facilities and Procedure

- A rescue team in the following ratio to be deployed at work:
- To provide adequate and appropriate fire-fighting systems in every tunnel.
- Fire alarm system connected to ground level.
- To conduct one joint exercise with SCDF at least once.
- To conduct fire drill for every 3 months.

6.4 Safety Measures for Excavation work

Causes of Accident :

- trapped and buried - collapse of sides
- struck and injured - material falling
- falling into the excavation
- unsafe means of access
- insufficient means of escape - flooding
- vehicles driven into excavation
- asphyxiation or poisoning eg. Exhaust fumes

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Planning:

- Evaluation must take into consideration of :
  - depth
  - variation in moisture content
  - loading imposed on the shoring
  - vibration / loading of equipment
  - traffic / pedestrian volume
  - slope side of excavation
- enough material to support
- timbering and sheeting > 1.5m
- close boarding or sheeting for unstable ground
- erect, alter and dismantle by competent worker under supervision
- excavate and shoring should proceed in stages for deep trench
- PE design for > 4m deep trench (*MOM Requirement, BCA requirement please see next page)*
- barriers to prevent fall - project trench support (at least 1m)

Factors to be considered:

- soil conditions
- soil stress
- soil compactness
- exposure to weather conditions
- surrounding activities
- adjoining buildings
- access
- lighting
- underground services

Design of Shoring:

- sheet pile - full load
- tie rods for anchor sheeting
- presence of ground water
- prevent excavated materials from falling back into the excavation
- load should be placed at least 610mm from the edge
- adequate strength of material for piling, shoring and bracing
- construct according to PE design for > 4m deep trench

Procedures in Excavation: (ERSS)

To Apply to BCA excavation permit

- Earth Retaining Structure – Any structure, structural system or other means used to maintain the shape of excavation during construction. earth filling or cutting.
- Submission requirement for excavation works within a building worksite
  - All excavation within a building worksite shall be submitted for plan approval except for excavation not deeper then 1.5 m(General excavation) or 2m (For localised excavation for pilecap, footing, sump , lift pit or trench where size of pile cap, footing, sump. Lift pit or trench does not exceed 1o square meter)

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Building and Construction Authority

Submission Requirement for ERSS

All permanent or temporary building works that involve	Appointments Required	
	Qualified Person (QP)	Accredited Checker (AC)
Excavation/ERSS ≤ 1.5 m** deep	Plan approval is not required	
1.5 m** < Excavation/ERSS ≤ 4 m deep	QP(ST)	AC is not required
4 m < Excavation/ERSS ≤ 6 m deep	QP(ST)	AC
Excavation/ERSS > 6 m deep and not classified as Geotechnical Building Works (GBW): e.g. excavation for sewer manhole associated with pipe diameter of 2 m or less	QP(ST)	AC
Excavation/ERSS > 6 m deep and classified as GBW. E.g. basement excavation.	QP(ST) QP(Geo)	AC AC(Geo)

Notes:
Plan approval is not required for insignificant building works listed on First Schedule of Building Regulation 3A.
** If the structure that retains earth is not constructed of reinforced concrete or steel, then the applicable depth is 1 m instead of 1.5 m.
Planning approval is no longer required for any retaining wall or earth-retaining structure for supporting the face of an excavation made for the purpose of constructing any pile cap, footing, sump, lift pit or trench, provided that the size of these structures does not exceed 10 square meters in area and 2 meters in depth.

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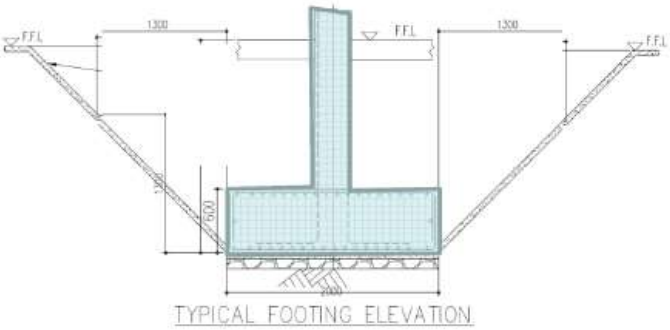
CASE 1

Plan area of footing = 6 m²

Excavation depth = 1.8 m

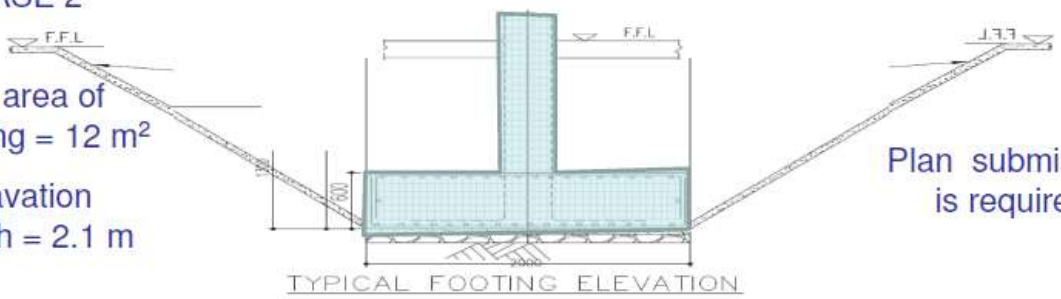


Plan submission is NOT required

CASE 2

Plan area of footing = 12 m²

Excavation depth = 2.1 m

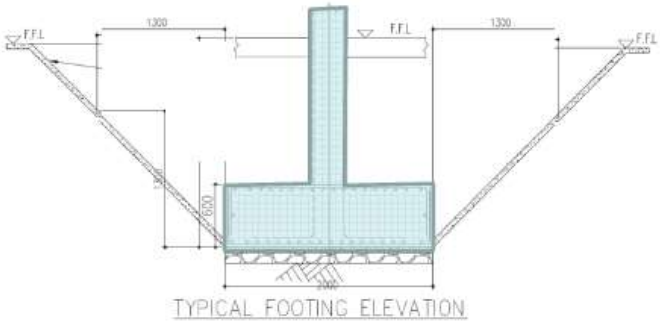


Plan submission is required

CASE 3

Plan area of footing = 6 m²

Excavation depth = 2.1 m

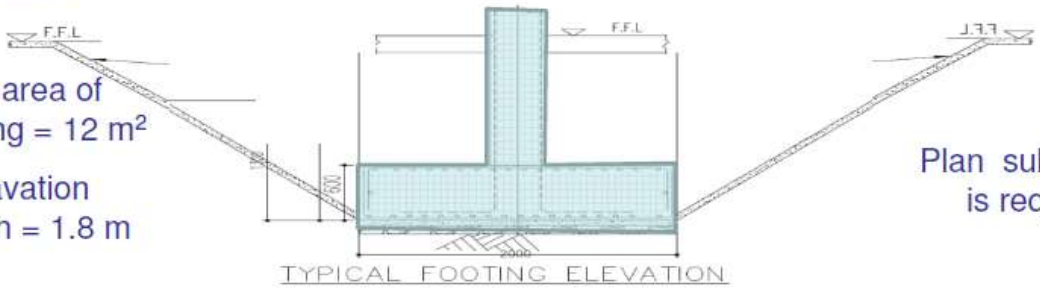


Plan submission is required

CASE 4

Plan area of footing = 12 m²

Excavation depth = 1.8 m



Plan submission is required

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Procedures in Excavation:

- exact depth and location of services - PUB, ENV, PWD or "Depth Locator"
- measure to be taken to protect services
- special safety precautions

Method of Support:

- sloping of sides
- shoring sheeting
- trench box

Procedures for removing shores:

- struts, walling and sheeting
- remove struts on the sides of trench, not inside

Backfilling:

- backfill as close as possible to excavation
- backfill immediately when job is completed
- avoid earth movement and persons falling

Removal of Ground Water:

- check ground water condition
- determine rate of flow
- sub-drains and well points for pump
- no water is allowed to accumulate in trench

Inspection & maintenance:

- daily inspection - shoring, bracing & underpinning
- rainstorms or other causes that affect the earth movement
- check for subsidence, cracks parallel to trench, spilling of soil from trench face
- remedial action for displaced strutting and displaced lacing
- an audible sound could be heard for timber under stress
- immediate replacement of any defect
- displaced or slanting sheeting may weaken the structure

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Compressed air environment

6.5 Legal requirement under WSH (Construction) Regulations 2007

Please also see Topic Three 3.11

Safe system of work

- No person shall enter, work in or leave the compressed air environment in the worksite except in accordance with a safe system of work which, so far as is reasonably practicable, is safe and without risk to health.

Warning notices

A notice shall be displayed at the entrance to the compressed air environment warning persons against unauthorized entry into the compressed air environment.

The warning notice shall highlight

- the danger of not undergoing proper compression and decompression;
- fire and explosion hazards; and
- the evacuation procedure in case of an emergency.

Use of bulkhead

- No bulkhead for retaining compressed air within a tunnel shall be used unless it has been approved by the Commissioner

Hot works

- No oxy-acetylene shall be used in the compressed air environment in the worksite

Air & Temperature

- There shall be an adequate supply of compressed air to a working chamber
- A reserve supply of compressed air shall be made available at all times for every man-lock and medical lock
- At least 2 low pressure feed lines with regulating valves shall be provided for every working chamber in a worksite and at least one of them shall extend to within 30metres of the working face of the tunnel.
- The temperature in any working chamber, man-lock or medical lock in a worksite shall not exceed 29°C and the relative humidity shall not exceed 85%.
- The concentrations of toxic airborne contaminants in a compressed air environment in a worksite shall not exceed the permissible exposure levels (PEL) in parts per million (ppm) as specified in the Workplace Safety and Health (General Provisions) Regulations

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6.6 Safety measures to be taken in compressed air environment

- Every person who is employed in a compressed air environment in the worksite shall spend not less than 12 consecutive hours at atmospheric pressure in any 24-hour period.
- No person shall carry out any work in a compressed air environment at a pressure exceeding 3.5 bars except in an emergency.

Man-locks

- Where work is carried out in any compressed air tunnel in a worksite, a suitably constructed and equipped man-lock shall be provided for each tunnel.
- The man-locks shall be sufficiently strong to withstand any air pressure, internal or external, to which the structure may be subjected whilst in use and in an emergency.

Medical locks

- Where persons are employed in a working chamber in a worksite at a pressure exceeding one bar, a suitably constructed and equipped medical lock shall be provided and maintained.
- Where more than 100 persons are employed in a compressed air environment in a worksite exceeding one bar, a medical lock shall be provided for every 100 persons or less.

Man-lock and medical lock attendants

- Attendant shall be appointed to be in-charge of man lock and medical lock
- Each man-lock attendant station in a worksite shall be provided with a first-aid box

Training of personnel

It shall be the responsibility of employer / principal to ensure that the persons involved in Compressed air environment of adequately trained on the safety and health hazards.

Penalties for non-compliance

Any person who contravenes any provision of these Regulations which imposes a duty on him shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $20,000 or to imprisonment for a term not exceeding 2 years or to both.

Learning Activity 6 – Individual Exercise

Objective: Identify Excavation and tunnelling hazards and their safety measures to prevent accident in excavation, tunnelling and compressed air works.

Learners to answer the following question individually.

1. Identify 5 hazards in excavation/ tunnelling works and recommend preventive measures.
2. List 3 PE's duties and responsibilities in regard to excavation shoring design?
3. List 3 safety consideration in excavation works.
4. Name 5 safety measures in compressed air working environment.
5. Explain 5 important thing to check before a project manager allow entry or work confined space.

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Lesson 7 - Occupational Health

PS4 Plan and implement an occupational health programme and risk assessment in accordance with general principles and requirements of related WSH Regulations and Guidelines

UK 7 Occupational Health

- WSH(GP) Regulations 2006 Part II General Provisions Relating to Health
- Identification, evaluation and control of occupational health hazards – chemical, physical, biological and ergonomic
- Occupational health programme
- Control of noise hazard under WSH (Noise) Regulations 2011
- Control of hazardous substances
- Control of corrosive chemicals & industrial dermatitis
- Control of cement hazard
- Control of solvents
- Control of carbon monoxide
- Safety in manual handling and lifting
- Control of vibration hazard
- Prevention of heat stress
- Control of radiation hazard
- Prevention of silica dusts
- WSH (Asbestos) Regulations
- WSH (Medical) Regulations

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Occupational Health

What is Occupational Health?
Occupational Health may be defined as the prevention amongst workers of departures from health caused by their working environment.
In 2013, there were 887 Occupational Diseases, including back injury.
The majority of OD cases (84%), excluding back injury, continued to be attributed to Noise-induced Deafness.

Basic Industrial Health and Hygiene
Definition
Industrial Hygiene has been defined as, "that science and art devoted to the anticipation, recognition, evaluation, and control of these environmental factors or stresses, arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort and inefficiency among workers or among the citizens of the community.

Industrial toxicology
"Industrial toxicology is the study of toxic or poisonous substance being used in industry and how they may affect people"

Recognition of Hazards
The scope of industrial hygiene begins with the recognition of health problems created within the industrial atmosphere. Some of the more frequently encountered causes of these problems are:

a) Chemical hazards arising from excessive air-borne concentrations of gas, vapours, mists, or solids that are in the form of dusts or fumes. In addition to the hazard of inhalation, many of these materials may act as skin irritants or may be toxic by absorption through the skin.

b) Physical hazards include excessive levels of radiation, noise, vibration, and extremes of temperature and pressure.

c) Biological hazards include insects, yeast, fungi, and bacterial contamination.

d) Ergonomic hazards include improperly designed tools or work areas. Improper lifting, poor visual conditions, or repeated motions in an awkward position.

Recognition of industrial health hazards involves knowledge and understanding of the various types of environmental stresses of the workplace and the effect of these stresses upon the health of the worker.

7.1 WSH (General Provisions) Regulations Part II General Provisions Relating to Health

<u>Infectious agents and bio hazardous material</u>
- Employer shall take effective measures to protect any person who is exposed to infectious agents or bio-hazards from their harmful effects.

<u>Overcrowding</u>
- Occupier shall ensure that the factory is not overcrowded to prevent safety and health risks to employees.

<u>Ventilation</u>
- Occupier shall ensure adequate ventilation is provided at the workplace.

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Lighting

- Occupier shall provide suitable and sufficient lighting where persons are at work or passing.

Drainage of Floors

- Occupier shall provide and maintain effective means for draining off the wet, where any process is carried on which renders the floor liable to be wet.

Sanitary Conveniences

- Occupier shall provide, maintain and keep clean, sufficient and suitable sanitary conveniences for persons at work.

Reduction of Vibration

- Occupier shall provide effective means to reduce vibration where persons at work are exposed to vibration.

Protection against excessive heat or cold and Harmful radiation

- Occupier shall take reasonably practicable measures to ensure that persons at work are protected from excessive heat, cold or radiation.

Special Provisions Relating to Health, Safety and Welfare

Permissible exposure levels of toxic substances

- Occupier shall ensure no person is exposed to the toxic substances specified in the First Schedule in excess of the permissible exposure levels specified.

Hazardous Substances

- All hazardous substances shall be placed under the control of a competent person.

Warning Labels

- Occupier shall ensure that containers of hazardous substances are affixed with warning labels that are easily understood by all persons at work.

Safety Data Sheet

Occupier shall obtain a SDS of any substance used and make available the SDS to all persons at work who are liable to be exposed to the substance.

- SDS is a basic hazard communication tool.
- SDS provides useful information on the hazards involved and the associated danger.
- SDS provides information to recognize the signs and symptoms of over-exposure.
- First-aid and other emergency procedures to be taken can also be obtained from SDS.

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- The chemical manufacturers/suppliers must provide SDS to their customers.
- Employers must assess the hazards associated with the chemicals and inform employees of the hazards and precautionary measures.
- Where any hazardous substance is used, handled or stored in a factory, occupier must assess the information in SDS and take precautionary measures to ensure safe use of the substance.
- SDS shall be made available to all persons who are liable to expose to the substance.
- Where any hazardous substance is sold to any person for use in a factory, the seller or any agent of the seller who caused or procured the sale shall provide the buyer with a safety data sheet for the substance, giving accurate and adequate.
- Emergency procedures and First aid measures;
- The precautions to be taken for safe handling and storage;
- Personal Protective Equipment to be used;
- Toxicological information;
- Ecological information;
- Disposal considerations;
- Transport information;
- Regulatory information: and
- Any other relevant information.

Content of SDS

- Emergency procedures and First aid measures;
- The precautions to be taken for safe handling and storage;
- Personal Protective Equipment to be used;
- Toxicological information;
- Ecological information;
- Disposal considerations;
- Transport information;
- Regulatory information: and
- Any other relevant information.

Penalties for Non-Compliance

Any seller or agent of any seller who fails to provide a safety data sheet or any person who provides inaccurate, inadequate or misleading information in a safety data sheet shall he guilty of an offence and shall be liable on conviction to a fine not exceeding $ 10,000.

Globally Harmonised System

What is the GHS?
GHS is the abbreviation for Globally Harmonised System of Classification and Labelling of Chemicals. It was developed by the United Nations for chemical hazard communication through standardised:

- Chemical hazard classification
- Chemical product labelling
- Safety data sheets (SDS)

What is the purpose of the GHS?
The purpose of the GHS is to:

- Enhance the protection of humans and the environment against hazardous chemicals
- Facilitate international trading of chemicals

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What are your roles in GHS implementation?

Chemical manufacturers and suppliers must classify and label their products, prepare the SDS, and provide information on the products to their customers or users.

Employers and workplace occupiers must obtain the SDS, label the containers and inform their employees about the hazards involved and the precautions to take.

Labeling of Containers

The classified chemicals are assigned a fixed set of GHS pictograms

CORROSIVE

ACUTE TOXICITY (SEVERE)

ENVIRONMENTAL TOXICITY

GASES UNDER PRESSURE

OXIDISER

EXPLOSIVE
SELF-REACTIVE
ORGANIC PEROXIDE

FLAMMABLE
SELF-REACTIVE
PYROPHORIC
SELF-HEATING
EMITS FLAMMABLE GAS

CARCINOGENICITY
RESPIRATORY SENSITISER
REPRODUCTIVE TOXICITY
TARGET ORGAN TOXICITY
MUTAGENICITY
ASPIRATION TOXICITY

IRRITANT
SKIN SENSITISER
ACUTE TOXICITY
NARCOTIC EFFECTS
RESPIRATORY TRACT IRRITATION

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Duty To Keep Register

Register of employees in hazardous occupation

The employer shall keep the report of such medical Examinations at least 5 years.

Provisions of First-Aid

- To provide adequate number of first aids boxes
- Appoint a first-aider for workplace employing more than 25 workers and at a ratio of one first-aider for every 100 workers
- First-aider to keep record of treatment
- To provide and maintain a first-aid room where there are more than 500 workers working
- To provide and maintain suitable facilities for quick drenching or flushing of the eyes and body, where the eyes or body of any person in a workplace may come into contact with toxic or corrosive substances

Provisions of First-Aid Boxes

Every first-aid boxes shall:

a) Contain first-aid items as per the First schedule;

b) Be properly maintained;

c) Be checked frequently to ensure it is fully equipped;

d) Be clearly identified;

e) Be placed in a well-lit location and accessible; and

f) Be under the charge of a person appointed by the occupier.

Every first-aid boxes shall:

a) Contain first-aid items as per the First schedule;

b) Be properly maintained;

c) Be checked frequently to ensure it is fully equipped;

d) Be clearly identified;

e) Be placed in a well lit location and accessible; and

f) Be under the charge of a person appointed by the occupier.

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Suggested Contents of First Aid Boxes

Contents	Box A	Box B	Box C
1. Individually wrapped sterile adhesive dressings	20	40	40
2. Crepe bandage 5 cm	1	2	4
3. Crepe bandage 10 cm	1	3	6
4. Absorbent gauze (packet of 10 pieces)	5	10	15
5. Hypoallergenic tape	1	1	2
6. Triangular bandages	4	4	6
7. Scissors	1	1	1
8. Safety pins	4	4	6
9. Disposable gloves (pairs)	2	2	4
10. Eye shield	2	4	6
11. Eye Pad	2	4	6
12. Resuscitation mask (one-way)	1	1	2
13. Sterile water or saline in 100ml disposable containers (only where tap water is not available	1	3	3
14. Torch light	1	1	1

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First - Aiders

Trained first-aiders shall be provided in the workplace where more than 25 persons are employed. One first-aider for every 100 workers employed

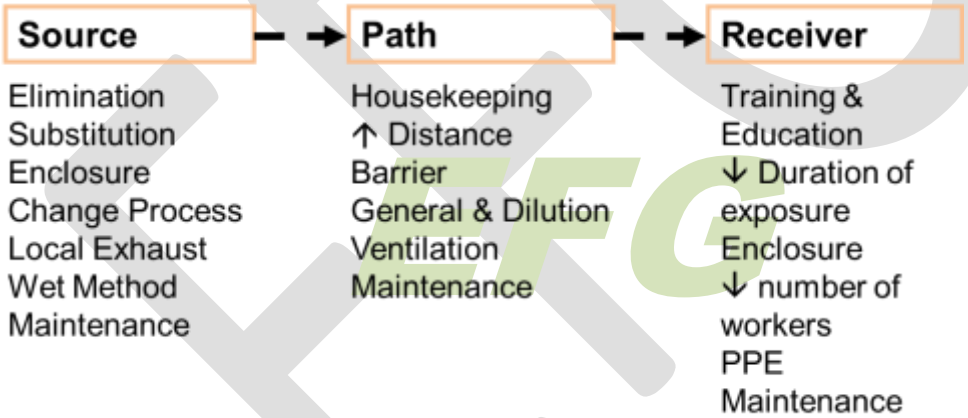
Shift work – similar to normal shift

- First-aiders shall maintain a treatment record.
- A notice shall be affixed in every workplace stating the names of the first-aiders.
- First aid room shall be provided where more than 500 persons are employed.
- Any occupier or first-aider who contravenes these regulations shall be liable on conviction to a fine not exceeding $5,000.

7.2 Identification, evaluation and control of occupational health hazards – chemical, physical, biological and ergonomic

Classification of Health Hazards

1. Physical hazards
2. Chemical hazards
3. Biological hazards
4. Bio-mechanical hazards



Recognition of Hazards

The scope of industrial hygiene begins with the recognition of health problems created within the industrial atmosphere. Some of the more frequently encountered causes of these problems are

- Chemical hazards arising from excessive air-borne concentrations of gas, vapours, mists, or solids that are in the form of dusts or fumes.
- Physical hazards include excessive levels of radiation, noise, vibration, and extremes of temperature and pressure.
- Biological hazards include insects, yeast, fungi, and bacterial contamination.
- Ergonomic hazards include improperly designed tools or work areas. Improper lifting, poor visual conditions, or repeated motions in an awkward position.

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Control of Physical Health Hazards

- ✓ Control at the Design Stage
- ✓ Control after the Design Stage
  - Elimination
  - Substitution
  - Changing the process
  - Ventilation

- ✓ isolation on Segregation
- ✓ maintenance and Housekeeping
- ✓ education and Training
- ✓ personal Protection Equipment
  - selection
  - fitting
  - maintenance
  - education and training

Control of Chemical Health Hazards

Chemical Hazards and Routes of Entry
Chemical Hazards
Chemical hazards can be classified into the following types:

Flammable Gases - LPG
- Acetylene
- Hydrogen
- Methane

Toxic Gases and Vapours - Ammonia
- Hydrogen Sulphide
- Benzene
- Trichloroethylene
- Toluene
- Xylene
- Carbon Monoxide

Corrosive Substances
- Caustic soda
- Sulfuric Acid

Inert Gases
- Nitrogen
- Carbon Dioxide
- Argon

Important Parameters
Parts per million – ppm
The concentration of a gas or vapour is usually expressed as parts of the gas or vapour per million parts of air.

Milligram per metre cube – mg/m3
The concentration of fumes, dust, mists and of gas or vapour on occasion, is expressed as mg of the contaminant per m3 of air.

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Chemical Exposure standards

Permissible Exposure Limits (PELs)
PEL - LT : Long Term Exposure Level
PEL - ST : Short Term Exposure Level

Toxic substance

- Irritants – e.g ammonia
- Simple asphyxiants – e.g. inert gases
- Chemical asphyxiants – e.g. CO
- Lung scaring agents – e.g. silica dust
- Narcotic agents – e.g. alcohol
- Blood damaging – e.g. benzene
- Hepatic agents – e.g. trichloroethylene
- Nephrotoxic agents – e.g. cadmium
- Systemic poisons- e.g. benzene, lead
- Carcinogens – e.g. asbestos

Action of toxic substances

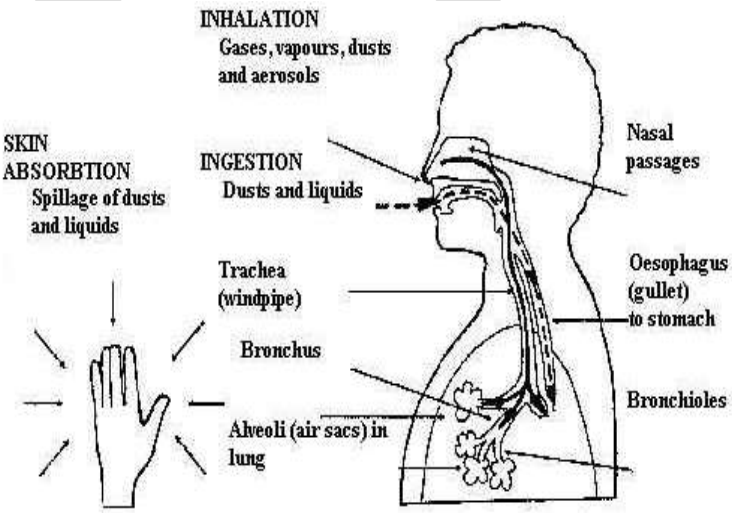
Acute Effects:

- Are short exposures to high concentrations of a toxic substance may result in illness, irritate the eyes, nose and throat or even death.

Chronic Effects:

- Are long term exposure to relatively low concentrations may result in chronic disease or poisoning.
- Long term exposure to most solvents can cause tiredness, mood changes and forgetfulness.
- Contact with the skin can cause dry and flaky skin

Routes of Entry



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Inhalation

- Inhalation for Industrial exposures to chemicals, the most important route of entry is inhalation. i.e. through the nose.
- Anything that is airborne can be inhaled. Only particles smaller than about 5 micrometers are likely to enter the lung.
- The total amount of chemicals absorbed via the respiratory system depends upon its concentration in the air, the duration of exposure, and pulmonary ventilation rate.

Ingestion

- Chemical enters the body through the mouth when we drink or eat with dirty hands which have been exposed to chemicals or eating at work areas where chemicals are present.
- Ingestion of inhaled materials can also occur because contaminants deposited in the respiratory tract can be carried out to the rest of the respiratory tract.

Absorption

Chemicals, especially solids and liquids, enter our body through the pores of the skin
Contact of a substance with skin results in four possible actions:

- the skin can act as an effective barrier,
- the substance can react with the skin and cause primarily irritation only,
- the substance can produce skin sensitization, and
- the substance can penetrate in to the blood vessels under the skin and
- enter the bloodstream.

Circulation In The Body

After entering the body, the toxic substance is subject to the body's processes.

- Some remain in the vicinity of penetration and cause damage at the site of entry e.g. The skin or lungs;
- others are absorbed into the blood stream and carried to various organs-and tissues, such as, the liver, kidney, bones, or nervous system etc.
- Some of them are involved in the body's metabolism whereby they may be converted or changed into other products which are usually less toxic.

Later, the majority of toxic substances are then disintegrated and eliminated through the breath, urine, faces or sweat.

Control of Chemical Hazards
Principles of Control of Chemical Hazards

- At the source - substitution with a less harmful material, change of process, enclosure or isolation or process, wet methods, local exhaust ventilation.
- Along the path - general ventilation, dilution ventilation, housekeeping, increase distance between source and receiver.
- At the receiver - enclosure of workers, rotation of workers, training and education, personal protective devices

Where the risk of exposure to chemicals is found not acceptable, suitable control measures such as:

- Elimination or Substitution;
- Engineering Controls;
- Administrative Controls;
- PPE;

Must be implemented to minimize the exposure so as to safeguard the safety and health of the workers.

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Elimination/Substitution

- If possible, the use of a certain chemical should be eliminated.
- If not possible to eliminate the use of the chemical, then the hazardous chemical should be substituted with a less hazardous chemical.

Engineering Controls

- The following engineering controls should be implemented to reduce exposure:

1. Enclosures of the hazardous processes;
2. Mechanical ventilation – LEV;
3. Isolation/Segregation of hazardous processes;

Administrative Controls

- Conduct Risk Assessment;
- Establish safe work procedures;
- Worker training;
- Safety data sheets for chemicals;
- Display safety signs;
- Exposure monitoring;
- Medical surveillance;
- Permit-to-work system.

Personal Protective Equipment

- PPE, ex. Respirators, gloves, etc. should be issued and worn by affected workers.
- Selection of the PPE should be based on the type of chemicals used and the safety data sheet can provide the information on the type of PPE required.

Storage of Chemicals

- All chemicals should be properly stored.
- Chemicals should be stored in proper containers and the containers labeled.
- Storage area should be adequately lighted and ventilated.
- Incompatible chemicals should not be stored together
- inventory of hazardous chemicals should be kept to a minimum
- Provisions for safety showers and eyewash must be available

Biological Hazards

Health Hazards:
Confined spaces
Grain silos can harbour bacteria and fungi that can cause adverse health effects.
Exposure to zoonotic diseases from animals living in confined spaces, e.g. psittacosis from pigeon droppings. Infections can also be caused by bacteria and viruses, e.g. Leptospirosis, which can be transmitted by the urine of an infected animal e.g. rats, mice and cats. It can eventually lead to liver damage.

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Precautionary Measures:

- Good hygiene practices
- Wear boots and gloves
- Wash your hands and all exposed parts of the body with soap and water thoroughly after working and before consuming food.
- Wash all work clothes worn for work before wearing it again.
- Clean and apply antiseptic dressing immediately for any scratch or cut.

Ergonomic Hazards

OSHA defines ergonomics as the science of "designing the job to fit the worker, instead of forcing the worker to fit the job."
May be defined as:

- job design with the worker in mind;
- fitting the job to the worker
  - Ideally, ergonomics:
  - Makes the job safer by preventing injury and illness
  - Makes the job easier by adjusting the job to the worker
  - Makes the job more pleasant by reducing physical and mental stress
  - Saves money

Ergonomic hazards impact employers and workers and their families. Poor workplace design, awkward body mechanics or postures, repetitive movements, and other ergonomic hazards induce or contribute to a staggering number of cumulative trauma disorders.

Cumulative trauma disorders (CTD) affect hands, wrists, elbows, arms, shoulders, the lower back, and the cervical spine area. Structures involved include tendons, muscles, bones, nerves, and blood vessels. One can plan strategies for abatement by learning to recognize the hazards that contribute to CTD.

A companywide ergonomic assessment should be developed, followed by a well written ergonomic plan. Ergonomic abatement will decrease the costs associated with CTD and ultimately impact the corporate "bottom line."
Ergonomics is the scientific study of people at work. The goal of ergonomics is to reduce stress and eliminate injuries and disorders associated with the overuse of muscles, bad posture, and repeated tasks.

This is accomplished by designing tasks, work spaces, controls, displays, tools, lighting, and equipment to fit the employee´s physical capabilities and limitations.
Ergonomic controls are used to help fit the workplace to the worker. They seek to place the body in a neutral position and reduce the other ergonomic risk factors. These controls must accommodate the widest range of personnel.

Ergonomic controls are grouped into three main categories. These are listed by order of preferred method for preventing and controlling ergonomic risk factors.

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Control of ergonomic hazards

Engineering Controls are the most preferred method for controlling ergonomic risk factors because they are more permanent and effective.

I) **Engineering controls** include modifying, redesigning or replacing:
- work stations and work areas
- materials/objects/containers design and handling
- hand tools & equipment

Engineering Controls are the heart of ergonomics: changing the work place to fit the worker. The design should accommodate the wide range of people assigned to the task

II) **Administrative Controls** deal with how work is structured.

Some examples of administrative controls include:

- Proper maintenance and housekeeping
  Proper housekeeping can reduce or eliminate awkward posture associated with extended reaches, bending or twisting when handling materials, tools or other objects

- Job rotation and enlargement
  This involves rotating workers through different jobs or enlarging jobs to rest the different muscle groups of the body, reduce repetition, and reduce mental demands.

- Work scheduling
  Work scheduling can help avoid excessive overtime or extended workdays. It should take into account the fact that shift work can cause fatigue and thereby increase the risk of ergonomic related injury.

- Sufficient breaks
  Instituting work-rest cycles with adequate recovery time can reduce fatigue and risk of ergonomic related injury. Short work/break cycles are best to reduce fatigue.

- Work practice
  Work practice focuses on the way work is performed. Examples of work practice controls include:
  - modifying work procedures and practices
  - gradual introduction to work for new and returning employees.
  - worker controlled pace and organization to reduce worker fatigue

III. Personal Protective Equipment (PPE) should be used as the principal means of control only as a last resort when neither engineering nor administrative controls are possible, or in the event of emergencies. It is considered the least effective form of control.

PPE does not eliminate the hazard or reduce the time of exposure.PPE simply reduces the amount of hazardous exposure by placing a barrier between the hazard and the worker.

7.3 Occupational Health Programme

Objectives of Occupational Health Programme
The main objectives are to protect workers and public from health hazards relevant to construction industry such as noise, dust, toxic gases and wastes, vapors and radiation.

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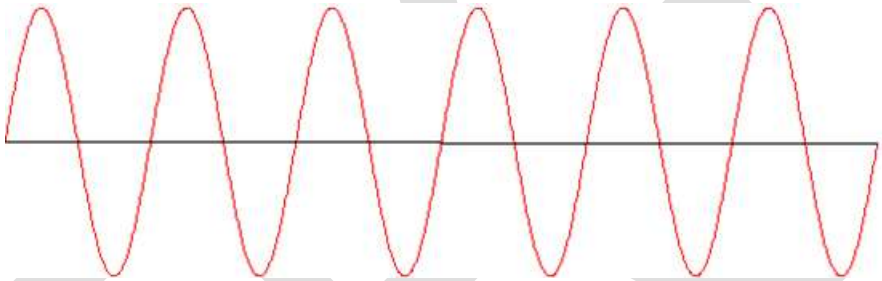
Example of Health Programme

- Hearing conservation programme
- Respiratory protection programme
- Control of radioactive safe work practices
- Prevention of industrial dermatitis
- Prevention of work-related back injuries and strains
- General clinical examination for signs and symptoms of compressed air illness and fitness for work in a compressed air environment

7.4 Control of noise hazard under Factories (Noise) Regulations

WHAT IS SOUND?

- Sound is a fluctuation in air pressure. It is a series of compression waves that moves through air or other material including water and steel.



- Sound does not travel through a vacuum or in outer space.
- Sound waves are created by the vibration of objects, Such as radio, speakers, power tools, etc.
- Sound pressure levels or its loudness/volume are measured in units called 'decibels' (dB).
- Sound will move at a same speed of about 330m/s.

What is Noise?

Noise is basically sound that is loud, unpleasant and unwanted.

What is noise induced deafness?

- Noise Induced Deafness is the result of prolonged exposure to excessive noise, i.e. >85dB.
- NID is also known as a silent disease.
- NID is not curable and irreversible

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WSH (Noise) Regulations 2011

Application
These regulations shall apply to all factories and workplaces where any machinery, equipment or process used is likely to expose any person to excessive noise.

Duties of Occupier and Employer

- Occupier or employer must take all reasonably practicable measures to reduce or control noise at the workplace.
- The occupier or employer must appoint a qualified person to advise him on noise control measures where 50 or more persons employed in the workplace are exposed to or are likely to be exposed to excessive noise.

Noise Monitoring

The occupier or employer must cause noise monitoring to be carried out where 10 or more persons are exposed or likely to be exposed to excessive noise.
The noise monitoring must be done at least once every 3 years or earlier if any change in process, machinery or equipment.

Hearing Protection

- The occupier or employer must provide suitable hearing protectors to all persons who are exposed or likely to be exposed to excessive noise.
- The occupier or employer must display warning signs at all entrances to areas with excessive noise.

Training

- The occupier or employer must establish a training programme for persons exposed or likely to be exposed to excessive noise.

PERMISSIBLE EXPOSURE LIMITS FOR NOISE (First Schedule)

Sound Pressure Level, dB(A)	Maximum duration/day
85	8 hours
86	6 hours 21 minutes
87	5 hours 2 minutes
88	4 hours
89	3 hours 11 minutes
90	2 hours 31 minutes
91	2 hours
92	1 hour 35 minutes
93	1 hour 16 minutes

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Common Noise Sources

Common noise sources in Industries:

- Air Compressors;
- Powered tools;
- Grit blasting;
- Hydro-jetting;
- Compressed air;
- Grinding works, hammering, etc.

Factors Affecting Hearing

- Overall Noise Level
- Duration of Exposure
- Frequency
- Daily Time Distribution
- Individual Susceptibility

Noise Hazard Management Program

- Monitoring
- Engineering and Administrative Controls
- Use of Personal Protective Equipment
- Hearing Tests
- Education

Noise Control Measures

Noise control can be implemented using the following measures:

- Segregation
- Substitution
- Enclosure
- Barrier or partition wall
- Pneumatic silencers
- Vibration isolation and damping
- Increase distance
- Maintenance

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Engineering Control

1. Eliminating Noise at the source:

a) Quieting the noise source directly will often be the most efficient way to reduce exposures.

b) There are a variety of ways to reduce noises at the source:
   - Install mufflers on engines.
   - Use silencers wherever gases are being released,

- particularly on the exhaust from compressed air equipment
- Keep equipment in good operating condition, no squeaking parts, no ratting parts, etc.
- Move workstations further away from noise sources.

2. Noise Enclosures and Barriers

- The most effective way to intercept the sound as it travels from the noise source to the workers is to install an enclosure around the equipment or worker.
- Enclosing the sound source should also include adding acoustic insulation to absorb the sound being generated to make the enclosure as effective as possible

3. Noise Barriers

- Barriers may be simple walls or curtains of acoustic materials.
- Barriers have limited effectiveness unless they are very near either the noise source or the employee to be protected, otherwise, the sound tends to simply travel around the barrier.

Administrative Control

1. Hearing Conservation Programme

Implement a HCP at the workplace consisting of the following key elements:

- Noise monitoring and control;
- Annual Audiometric examination;
- Training;
- Hearing Protection.

2. Training

The occupier or employer must establish a training programme for persons exposed or likely to be exposed to excessive noise.
The training must be conducted

- within 3 months of commencement of works
- And at least once every 12 months

3. Safety Signs

Display safety signs at areas with high noise levels.

4. Medical Surveillance Program

Workers exposed to excessive noise at the workplace shall be sent for annual audiometric examination.

Personal Protective Equipment

- If not possible to control noise at the source through engineering controls, then workers exposed to excessive noise at the workplace should be issued with hearing protection, either ear plugs or ear muffs.

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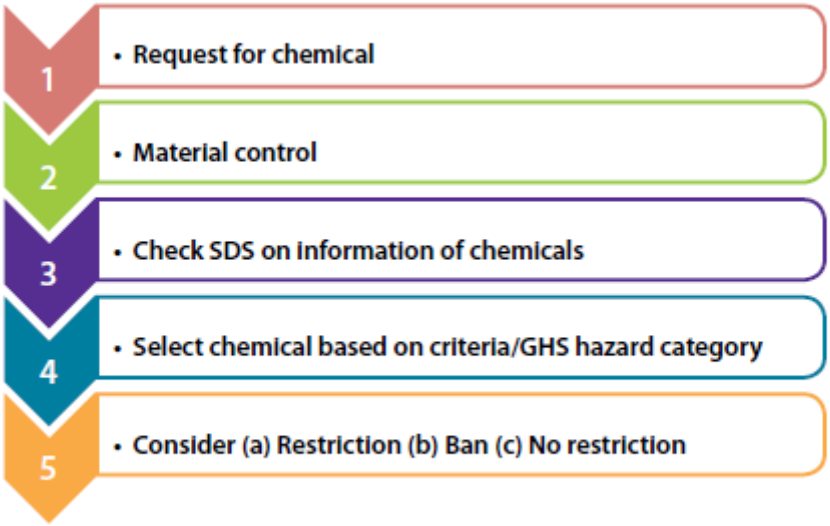
7.5 Control of hazardous substance

Chemical Hazard Management Program

- Policy and Strategy
- Competent person in charge
- Register
- Material safety data sheets
- Labeling of containers
- Storage
- Hazard assessment
- Engineering control
- Safe work practices
- Personal protection
- Emergency and First-aid
- Training and Education
- Medical monitoring

Register of Chemicals and Safety Data Sheets

A register of all hazardous chemicals which are produced, stored, used or handled should be kept. The register should contain information on the inventory (i.e., amount stored), supplier of each chemical, application and location of the chemicals, and movement of the chemicals. It should also indicate the persons who are at risk or liable to chemical exposure.



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Toxic Substances

- Persons who are likely to be exposed to toxic substances shall be warned of the hazards involved and the precautionary measures to be taken.
- Labels easily understood by persons shall he affixed to containers of toxic substances to warn them of the hazards involved and the precautionary measures to be taken.
- The atmosphere of any workplace in which toxic substances are used or given off shall be tested regularly by a competent person.

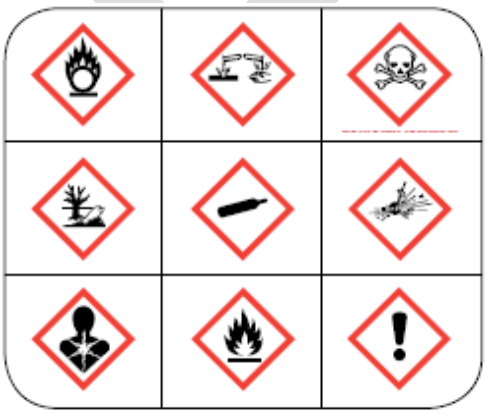
Hazardous Substances

- The occupier shall ensure that hazardous substances are placed under the control of a competent person who has adequate knowledge of the properties of the hazardous substances and their dangers.
- The occupier shall ensure that adequate warning notices in languages understood by the persons at work specifying the nature of the danger of the hazardous substances are placed at all entrances to any workroom: and at appropriate locations where the hazardous substances are used or present.
- The occupier shall warn persons at work who are liable to be exposed to hazardous substances of the hazards involved and the precautionary measures to be taken.
- The occupier shall keep, store, use, handle or dispose of hazardous substances in such a manner as not to pose a risk to the health and safety of any person at work.
- No person shall willfully or recklessly do any act that may result in any other person being exposed to hazardous substances.

Labelling and Warning Signs

All packaged containers containing hazardous chemicals should be labelled in accordance with the GHS. Refer to Annex B for a summary of GHS hazard classes.

The label should indicate the identity of the chemical, its hazards and the precautions to take. Persons who are required to handle chemicals should be aware of the hazards and the precautionary measures. Warning signs or notices specifying the nature of the danger of the hazardous chemicals should be prominently displayed in areas where such substances are used or handled. These warning labels should be available in various languages that can be understood by the



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9 classes of Hazmat sign

7.6 control of corrosive chemicals & industrial dermatitis

Corrosive Chemicals
Acids (e.g. sulphuric acid) and alkalis (e.g. caustic soda) are used for cleaning. They can cause severe skin burns in concentrated form. Inhalation of acid mist can cause irritation.
Safe Use of Corrosive Chemicals

- keep acids and alkalis in closed containers and label them
- wear appropriate safety gloves, boots, face shields and suitable aprons when handling corrosive chemicals
- always add acid to water, use pumps if necessary, and do not use mouth to suck from the siphon.
- avoid skin contact; avoid breathing acid fumes or mists.
- Wear suitable respiratory mask when necessary.
- Rinse off immediately with water when contact with the skin (for at least 15 minutes).
- Do not wear contact lens when working with chemicals.

Corrosive Chemicals & Industrial dermatitis

- Dermatitis is an inflammation or irritation of the skin caused by exposure to chemical substances found at the workplace.
- There are many causes of industrial dermatitis.
- The most common cause is the exposure to chemicals.

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Causes of industrial dermatitis

Some of the common chemicals that cause dermatitis:

- Coolants and cutting oils
- Cement
- Solvents
- Insulation material

Prevention of occupational dermatitis

- Eliminate the use of the hazardous chemical if possible.
- Substitute hazardous chemicals with less hazardous ones.
- Obtain and refer to Safety Data Sheets of all chemicals used at the workplace.
- Provide adequate ventilation to remove chemical fumes, dust, vapours at the source.
- Provide workers with the training on the hazards and proper handling of chemicals.
- Provide adequate washing facilities including emergency equipment such as eye wash and shower.
- Provide affected workers with the proper safety gloves and body protection and train them on the proper use and maintenance of these PPE.

7.7 Control of Cement Hazards

Cement

Lime (calcium oxide) irritate skin; cobalt and chromium salts allergic skin reaction; gypsum irritation, skin rash; sand, silica and clay abrasive action; others e.g. acid and asbestos

Effects on skin

- Allergic contact dermatitis
- Irritant contact dermatitis

Effects on Respiratory System

- Inflammation of nasal mucous membrane
- Chronic cough
- Chest/Lung function abnormalities

Precautions

- Wet batching or mixing
- Use tools and equipment
- PPE
- Washing Facilities

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7.8 Control of solvents

Solvents are chemicals that are used at the workplaces as cleaning and degreasing agents and as ingredients in paints, inks glues and other surface coating materials.
Most solvents are volatile and flammable chemicals and can:

- cause narcotic effect when inhaled;
- cause skin disease;
- cause eye and respiratory irritation;
- cause fire and explosion.

TYPES OF SOLVENTS

- Xylene
- Toluene
- Turpentine
- Naptha
- Methyl Ethyl Ketone
- Methyl Isobutyl Ketone
- Acetone

Precautions

- PPE (gloves, respirators)
- Cover containers
- No smoking/ignition sources
- Not use solvents (thinners) to clean body parts
- Personal hygiene

7.9 Control of Carbon Monoxide

Carbon Monoxide

Carbon Monoxide

- Is a by-product of incomplete combustion.
- Source – engine exhaust, welding, etc.
- Has no color or smell
- Is a toxic gas that cause asphyxiation
- PEL 25 ppm

Short Term Effects

- headache, dizziness, nausea
- cyanosis
- unconsciousness and death
- Long Term Effects
- lower blood capacity to carry oxygen
- worsen heart conditions and blood disorder

Precautions

- Never use petrol, diesel or LPG engines in confined spaces
- Direct exhaust pipe to outside
- Locate internal combustion engines in well ventilated areas
- Ensure engines well-tuned
- Monitoring atmosphere
- Ventilation

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PPM	Effect	Time
25	Permissible Exposure Level	8 Hours
200	Slight headache, discomfort	2 - 3 Hrs
400	Headache, nausea	1 - 2 Hrs
800	Headache, dizziness, nausea, Collapse and possibly death	45 Min to 2 Hrs
1600	Headache, dizziness, Unconsciousness and danger of death.	20 Min to 2 Hrs

7.10 Safety in manual handling and lifting

What is Manual Handling?

- Manual handling refers to any activity requiring the use of human force to lift, lower, push, pull, carry.
- Since most jobs involve some form of manual handling, the workers are at risk of manual handling related injuries.
- Manual lifting is when an object is lifted and moved from its initial position upwards, downwards and/or horizontally.

Types of Injuries Related to Manual Handling

Unsafe manual handling can result in the following types of injuries:

- Muscle sprains and strains;
- Back injuries;
- Injuries to tendons, tissues, ligaments in the wrist, arms, neck, shoulders or legs;
- Abdominal hernias.

Proper Method of Handling Load

- Observation of load and passage
- Proper grip
- Keep back straight and use leg muscles
- Load close to body
- Do not exceed limit
- Where it is not possible to carry a load alone, get help from colleague.

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Manual Handling of Loads may Cause:
Cumulative disorders due to gradual and cumulative deterioration of the musculoskeletal system through continuous lifting/handling activities. e.g. low back pain. Acute trauma such as cuts or fractures due to accidents.

There are several risk factors that make Manual Handling Labour(MHL) hazardous and thereby increase the possibility of injury. Particularly for back injury, they are related to four aspects of MHL:
Some individual factors might affect the risk of back injury:

- Lack of experience, training and familiarity with the job.
- Age - the risk of low back disorders increases with age and with the number of years at work.
- Physical dimensions and capacity such as height, weight and strength.
- Prior history of back disorders.

Preventive Measures for Material Handling
Accidents and ill health can be prevented by eliminating or at least reducing MHL risks.
The following hierarchy of prevention measures should be used:
Elimination
Consider whether MHL can be avoided, for example by using powered or mechanical handling equipment such as conveyers or lift trucks.

Technical Measures
If MHL cannot be avoided, consider the use of supporting devices such as hoists, trolleys and vacuum lifting devices.

The following hierarchy of prevention measures should be used:
Organisational measures such as job rotation and the introduction of breaks of sufficient length should only be considered if elimination or reduction of MHL risks is not possible.
Provide information on the risks and negative health effects of MHL, and training in the use of equipment and correct handling techniques.

Workers and their representatives' involvement is essential when tackling workplace hazards.

7.11 Control of vibration hazards

Vibration at the workplace can be categorized into two basic types:

1. **Whole Body Vibration;**
   - Low frequency vibration from heavy machinery.
   - Effects of whole body vibration includes giddiness, nausea and discomfort.
2. **Hand-Arm Vibration;**
   - High frequency vibration caused by the use of powered hand tools.
   - Effects include white fingers (numbness and swelling).

What is Vibration White Fingers?

- It refers to a repetitive stress injury where the small blood vessels in the fingers periodically spasm.
- The spasms cause constriction of the blood supply to the fingertips turning the fingers white.

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The following measures will help in the protection against vibration hazards:

- Isolators for machinery to reduce vibration;
- Anti-vibration safety gloves;
- Preventive Maintenance program for equipment;
- Reducing RPM of equipment;
- Work-rest regime.

7.12 Prevention Of Heat Stress

Heat exposures and symptoms of heat related illness

Heat Related Disorders

Thermal Extremes is another common health hazard.

Workers work in hot conditions especially in confined spaces where the temperatures can rise during a hot day.

Following are some common heat related disorders:

1. Heat Stroke
2. Heat Exhaustion
3. Heat Cramps

Heat Stroke

- Body unable to regulate body temperature and causes the body temperature to rise to dangerous levels.
- Heat stroke is the most critical disorder and occurs when the body temperature rises above 41degree C and can be fatal.

Symptoms of Heat Stroke

- Confusion
- Dry, hot skin
- Heavy breathing
- Rapid pulse
- Nausea and vomiting
- An extra high body temp.

Call 995

Heat Exhaustion

Body loses fluids and causes dehydration.

Symptoms of Heat Exhaustion

- The face is pale
- Headache
- Loss of appetite
- Drowsiness
- Cramps of the limbs
- Abdominal muscles
- Faintness or unconsciousness

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Heat Cramps

When body loses excessive salt through sweating, worker will experience muscle cramps.

Symptoms

- Painful muscle spasms, which occur in the extremities, back, and abdomen of individuals who drink large quantities of water but fail to replace the salt (electrolyte) lost during sweating.
- Cramps may occur during or after work hours, last a few minutes, and then
- disappear spontaneously
- Body temperature is normal unless heat cramps are accompanied by heat exhaustion

Preventive Measures

- Work under shading wherever possible
- Drink plenty of water to keep the body cool and hydrated
- During breaks, move to a cooler place to rest
- If you feel giddy or get cramps, immediately move to a cool place and rest.
- Work with a partner and look out for each other
- Wear loose fitting and light colored clothing when working in hot environment.
- Inform supervisor if not feeling well

Prevention Of Heat Stress

- **Heat stress**
- Work in hot environment can result in heat stress
- Drink sufficient quantity of water at frequent intervals

Heat stress

- Effects on eyes, e.g. Cataracts
- Effects on skin, e.g. sunburn, skin cancer

Factors causing heat stress

- High Air Temperature
- High Humidity
- Low air movement
- Strong radiant heat
- Heavy physical work
- Thick clothing

Precautions-Reduce Exposure through:

- schedule work times
- work in shaded areas
- wear light-coloured, loose fitting clothes
- wear hats and sun glasses
- drink enough water

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7.13 control of radiation hazards

Radiation can be classified into two types:

1. **Ionizing Radiation**

   Refers to radiation that have enough energy to remove electrons from atoms, thus creating ions. Common types of ionizing radiation:

   - X-rays
   - Gamma rays
   - Alpha, Beta particles.

2. **Non-Ionizing Radiation**

   Refers to radiation that do not have enough energy to remove electrons from atoms. Types of non-ionizing radiation:

   - Infra-red
   - Microwave
   - Lasers
   - Radio waves

Common types of radiation

- Gamma rays or X-rays are used in industries and medical fields.
- The piece to be radio graphed is placed between the source and a photographic film in a cassette. After a certain exposure time, the film is developed and it shows internal defects of the material if there are any.

Health effects of radiation

- Exposure to high doses of ionizing radiation can cause skin burns and radiation sickness.
- Exposure to low doses of ionizing radiation causes cancer, tumors and genetic damage.
- Sunburn is one of the effects of ionization.

Protection from radiation

- **Reduce the exposure time or duration;**
- **Distance –** increase distance from source.
- **Shielding –** Barriers of lead, concrete can provide protection against radiation.
- **Containment –** Store radioactive materials in proper closed facilities.
- Display safety warning signs and barricade affected area to warn others to stay clear during radiation activities.
- Workers involved with the radiation activities are monitored for radiation exposure with the use of pocket sized dosimeters.

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7.14 control of silica dust

Hazards
- Irritation of eyes, nose and throat
- Long term effects
- Silicosis (scaring and stiffening of lungs)

SILICOSIS
- Silicosis is caused by inhalation of free silica or silicon dioxide.
- The silica dust is retained inside the lungs and causes fibrosis.
- Silicosis takes many years to develop.

Precautions
- Engineering controls - built-in dust extraction or wet method
- Water spray
- Dust respirators
- Safety Glasses

7.15 workplace safety and health (asbestos) Regulations 2014

These Regulations may be cited as the Workplace Safety and Health (Asbestos) Regulations 2014 and shall come into operation on 30th May 2014

Part I Preliminary
1 Citation and commencement
2 Definitions

Part II Ascertaining presence of asbestos or asbestos-containing materials at workplace
3 Survey of workplace
4 Conduct of survey
5 Submission and keeping of survey report

Part III General provisions for work involving asbestos
6 Training for persons carrying out work involving asbestos
7 Personal protective equipment for persons carrying out work involving asbestos
8 Restricting access to asbestos work area
9 Measures to minimise release or spread of asbestos during work
10 Decontamination of materials, etc., that are contaminated with asbestos
11 Cleanliness of asbestos work area
12 Storage and disposal of asbestos waste and contaminated matter

Part IV Asbestos-removal work
13 Asbestos-removal work to be undertaken by approved asbestos-removal contractor
14 Notification of Commissioner of asbestos-removal work
15 Appointment and duties of competent person for asbestos-removal work

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What is asbestos?

- Asbestos refers to a group of naturally occurring minerals.
- Asbestos material has very good resistance to:

  - heat, fire and chemicals.
- There are three basic types of asbestos:

  1. Crocidolite – Blue Asbestos
  2. Chrysotile – White Asbestos
  3. Amosite – Brown Asbestos

Common uses of asbestos

- Thermal insulation - Pipe and boiler lagging;
- Conveyor belts;
- Tiles, roofing, wallboards;
- Gaskets, brake lining.

Asbestos related lung diseases

Asbestosis

- Usually develops after 5-10 years of asbestos exposure.
- It can progress even after the exposure has stopped.
- Asbestos fibres cause scarring of the lungs.

Signs and Symptoms of Asbestosis

- Shortness of breath;
- Persistent cough – expels mucus;
- Chest tightness and pain;
- Loss of appetite;
- Dry, crackling sound in the lungs while inhaling.

Breathing in asbestos fibers does not cause immediate effects but will remain in the lungs and cause lung cancer or asbestosis after many years.

Occupations at risk:

- insulation work;
- renovation and demolition work;
- mechanics repairing asbestos brake linings.

Lung Cancer

- Asbestos causes cancer of the lung- similar to that caused by smoking.

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Signs and Symptoms of Lung Cancer

- Cough with blood;
- Wheezing;
- Shortness of breath;
- Persistent chest pain;

Medical surveillance - asbestos

- No person shall be employed in any hazardous operations unless he has been examined by a designated factory doctor and certified fit to work in those operations.
- Workers exposed to asbestos shall be sent for medical surveillance once in every 3 years.

Summary of Workplace Safety & Health (Asbestos) Regulations

These regulations apply to all factories / workplaces where asbestos works are carried out.

- Before a person undertakes any process involving asbestos in a factory, he shall give not less than 7 days' notice to the Commissioner for Workplace safety and health
- Asbestos-removal work to be undertaken by approved asbestos-removal contractor
- Appointment and duties of competent person for asbestos-removal work
- Asbestos-removal plan of work
- Training of workers – once every 12 months

Removal of Asbestos:

- Survey of Workplace
- Restricting access to asbestos work area
- Measures to minimise release or spread of asbestos during work
- Decontamination of materials, etc., that are contaminated with asbestos
- Storage and disposal of asbestos waste and contaminated matter

Measures to minimise the release of asbestos into the air arising from the work involving asbestos:

(*a*) a wet method;

(*b*) engineering control such as a local exhaust ventilation system or containment;

(*c*) any other safe and appropriate work method or work practice designed to minimise the release of asbestos

Protective Equipment

- Persons employed in the workplace into which asbestos dust is liable to escape, shall be provided with
  - *a)* Suitable respiratory protective equipment; and
  - b) Disposal Protective clothing.
- Affected persons shall properly maintain and use the respiratory protective equipment and clothing.
- Affected persons must be trained in the proper use of these equipment.

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Cleanliness of asbestos area:

All affected workplaces where asbestos works are carried out shall be free from asbestos waste and dust.

- there is no accumulation of dust or debris in the asbestos work area while the work involving asbestos is being carried out
- after the completion of the work or at the end of each working day, that asbestos work area is thoroughly cleaned so as to eliminate all dust and debris

7.16 WSH (Medical Examination) Regulations 2011

Application

These regulations shall apply to all workplaces in which persons are employed in any hazardous occupation involving-

a) the use or handling of or exposure to the fumes, dust, mist, gas or vapour of arsenic, cadmium, lead, manganese or mercury or any of their compounds;
b) the use or handling of or exposure to the liquid, fumes or vapour of benzene, perchloroethylene, trichloroethylene, organophosphates or vinyl chloride monomer
c) the use or handling of or exposure to tar, pitch, bitumen or creosote;
d) the use or handling of or exposure to the dust of asbestos, raw cotton or silica;
e) exposure to excessive noise; or
f) any work in a compressed air environment.

Persons fit for employment

Persons to be medically certified fit for the employment

- No person shall be employed in the any hazardous occupation (Reg 4 – WSH (medical examination) regulation) unless he has been medically examined by a designated factory doctor and certified fit to work.
- The medical examinations shall have been carried out and certified fit within 30 days before he is to commence employment in the any hazardous occupation

Periodic medical examination

- Every affected person shall be periodically examined by a designated factory doctor, as specified in the Schedule of the regulations.

Medical Expenses to be borne by employers

- All medical examinations and investigations required shall be arranged by the employer and shall be borne by him.

Report of Medical Examinations Results

- Designated factory doctor shall report the results of the medical examinations to the employer.

Medical examinations

The WSH (Medical Examinations) Regulations

Arsenic	Excessive Noise
Asbestos	Organophosphates
Benzene	Perchloroethylene
Cadmium	Silica
Raw Cotton	Tar, pitch, Bitumen, Creosote
Manganese	Trichloroethylene
Lead	Vinyl Chloride Monomer
Mercury	Compressed air environment

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Learning Activity Seven

Objective: Identify health hazards in construction site and their safety measures to prevent accident

Break into group of five, discuss, pens down and present to the class

1. Identify health hazards in confined space and preventive measures.
2. Explain meaning of the following acronyms, terms & Sign
   - PEL , NID, SDS, asphyxiation

3. Explain route of entry of toxic substances.
4. The work nature of your construction requires your site to store toxic chemical.

   Explain what are the WSH requirement in storing these substances.
5. Explain ways to control noise hazards at your site.

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Lesson 8
OVERVIEW OF RISK MANAGEMENT

PS5. Plan and implement risk management for all construction activities in accordance with general principles and requirements of related WSH Regulations and Guidelines

UK 8 An overview of Risk Management

- Legal requirement of WSH (Risk Management) Regulations 2006 and penalties
- Duties of employer, self-employed person and principal
- Risk management process
- Preparation work
  - Hazard identification
  - Risk evaluation
  - Risk control – Hierarchy of Controls, Safe Work Procedures
  - Implementation and review – risk communication
  - Record keeping
- Worked examples on risk assessment

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8.1 Legal requirement of WSH (Risk Management) Regulations and penalties

Risk assessment

3.—(1) In every workplace, the employer, self-employed person and principal shall conduct a risk assessment in relation to the safety and health risks posed to any person who may be affected by his undertaking in the workplace.

(2) The Commissioner may determine the manner in which the risk assessment referred to in paragraph (1) is to be conducted.

Elimination and control of risk

4.—(1) In every workplace, the employer, self-employed person and principal shall take all reasonably practicable steps to eliminate any foreseeable risk to any person who may be affected by his undertaking in the workplace.

(2) Where it is not reasonably practicable to eliminate the risk referred to in paragraph (1), the employer, self-employed person or principal shall implement —

(*a*)such reasonably practicable measures to minimise the risk; and

(*b*)such safe work procedures to control the risk.

(3) The measures referred to in paragraph (2)(*a*) may include all or any of the following:

(*a*)substitution;

(*b*)engineering control;

(*c*)administrative control;

(*d*)provision and use of suitable personal protective equipment.

(4) The employer, self-employed person or principal shall specify the roles and responsibilities of persons involved in the implementation of any measure or safe work procedure referred to in paragraph (2).

Provision of information

6.—(1) In every workplace, the employer, self-employed person and principal shall take all reasonably practicable steps to ensure that any person in the workplace who may be exposed to a risk to his safety and health is informed of —

(*a*) the nature of the risk involved; and

(*b*) any measure or safe work procedure implemented under regulation 4(2).

(2) The employer, self-employed person and principal shall comply with paragraph (1) whenever any risk assessment referred to in regulation 3(1) is revised, or where any measure or safe work procedure implemented under regulation 4(2) is changed.

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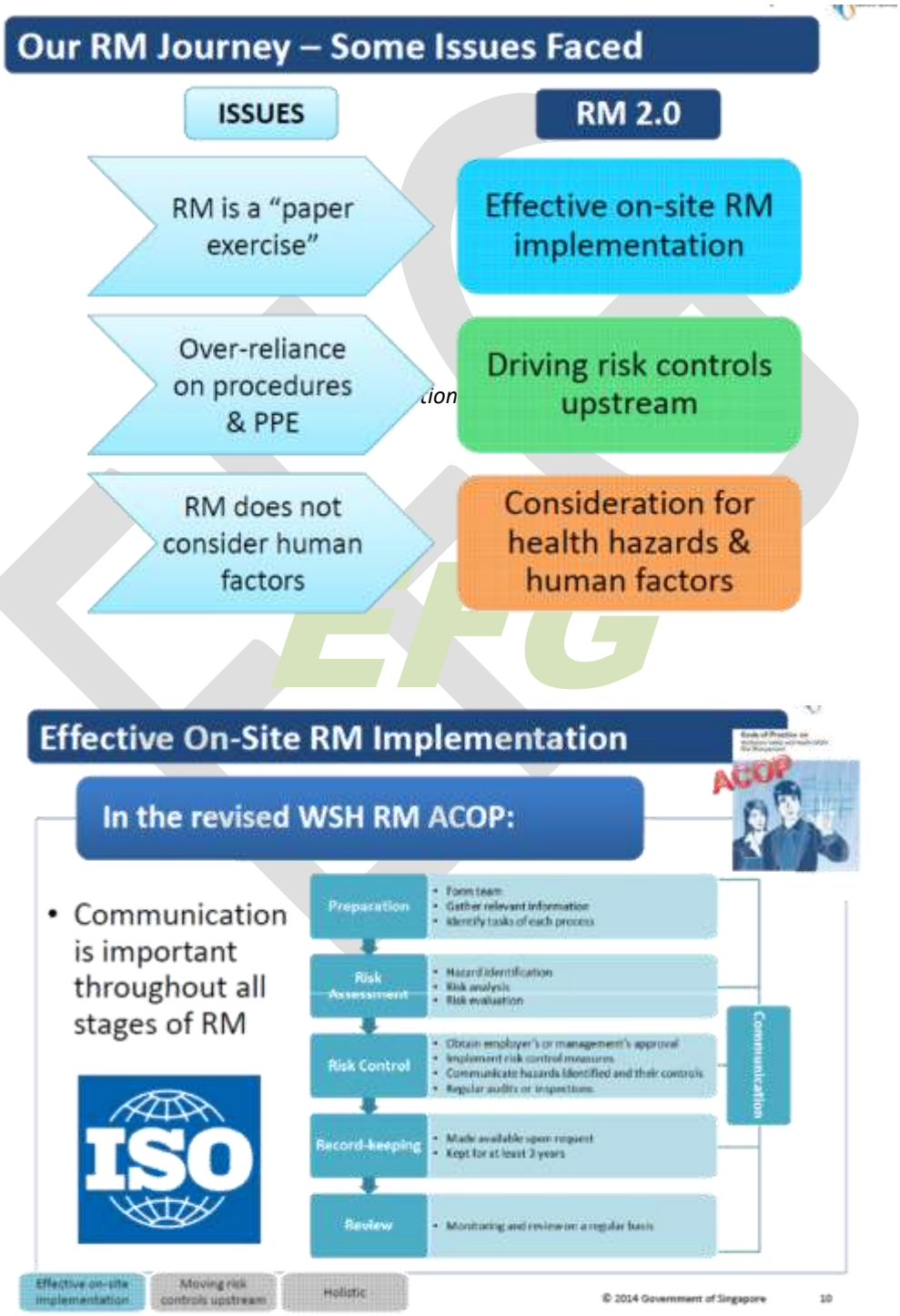
Offences

8. Any employer, self-employed person or principal who contravenes regulation 3(1), 4(1), (2) or (4), 5, 6 or 7 shall be guilty of an offence and shall be liable on conviction —

(*a*) for a first offence, to a fine not exceeding $10,000; and

(*b*) for a second or subsequent offence, to a fine not exceeding $20,000 or to imprisonment for a term not exceeding 6 months or to both.

Risk Management 2.0



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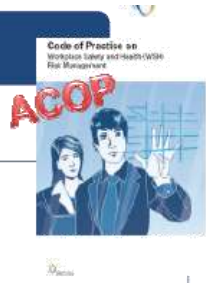
Holistic RM



In the revised WSH RM ACOP:

- Work organisational factors, *such as*
  - Excessive workload
  - Prolonged working hours
  - Lack of adequate training
  - Inadequate acclimatisation
- Individual health risk factors, *such as*
  - Consider key attributes, from health assessments or medical examinations or other sources, required for safety critical tasks or high risk work activities
  - Individual susceptibility to certain health risks
  - Smoking as risk factor for many diseases
  - Alcohol misuse

Effective on-site implementation | Moving risk controls upstream | Holistic

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Effective On-Site RM Implementation

Outcomes:

- Persons at work are able to articulate:
  - Hazards: What the potential dangers are
  - Precautions: Controls provided to make safe the job
- Risk controls are implemented on ground
- Corporate RM are consistently implemented across all sites

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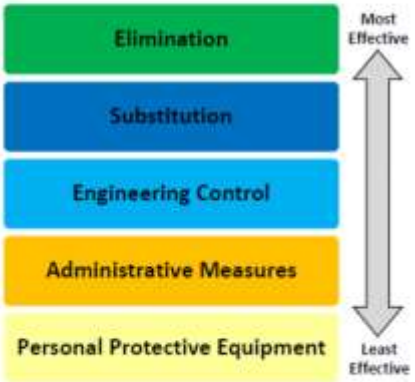
Driving Risk Controls Upstream

Outcome: **Reducing Risk at Source**

- Apply Hierarchy of Control to reduce risks at source
- The closer to source, risk reduction is more effective and least influenced by human error
- A combination of measures is generally more effective than relying on a single control



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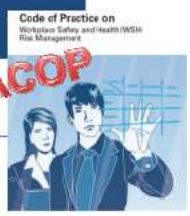
Holistic RM



In the revised WSH RM ACOP:

- Work organisational factors, *such as*
  - Excessive workload
  - Prolonged working hours
  - Lack of adequate training
  - Inadequate acclimatisation
- Individual health risk factors, *such as*
  - Consider key attributes, from health assessments or medical examinations or other sources, required for safety critical tasks or high risk work activities
  - Individual susceptibility to certain health risks
  - Smoking as risk factor for many diseases
  - Alcohol misuse

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Holistic RM: *Examples*

Organisational Factors: Workload Management (Fatigue)

- Worker resting on ground of open yard was run over by a seven-tonne forklift.
  - Driver did not notice the worker was in his path
  - both worker and forklift driver had been working beyond 14 hours that day.
  - Forklift driver had worked beyond 20 hours on two separate days the week before.
- Long working hours induced fatigue in workers and forklift driver had reduced alertness
- Employer may put in place:
  - policy on workload management to prevent workers' fatigue
  - appointment of multi-functional team to implement Fatigue Management plan.

Source _ Bizsafe convention 2015 presentation slides

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Risk Evaluation for Health hazards

- RM must consider health hazards
- Relevant risk factors are to be considered for different health hazards
- Exposure assessments should be conducted where possible to estimate employees' exposure to health hazards
  - Conducted by competent persons using recognised methods, acceptable standard procedures and standard calibrated equipment
- Exposure estimates compared with established health exposure standards

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Role of Human Resource Manager*

- Recruit suitable candidates able to meet both position requirements and WSH obligations
- Ensure employees given appropriate and sufficient orientation and WSH training
- Support employer to ensure effective RM communications to all employees and consider WSH outcomes in appraisals
- Put in place programmes that support and maintain employees' safety, health and wellbeing

*In the absence of a HR Manager in the organisation, the equivalent person undertaking such a work profile of the HR Manager should execute the duties mentioned above

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Overview of Risk Management

Key Points on the Revised WSH RM ACOP:

RAs should consider organisational culture and human factors which could compromise work ability and safety, leading to workplace accidents

Work organisational factors, such as

– Excessive workload

– Prolonged working hours

– Lack of adequate training

– Inadequate acclimatisation

Individual health risk factors, such as

– Consider key attributes, from health assessments or medical examinations or other sources, required for safety critical tasks or high risk work activities

– Individual susceptibility to certain health risks

– Smoking as risk factor for many diseases

– Alcohol misuse

Risk control measures can be implemented to take into account varying perceptions and behaviour.

In addition to human factors, other factors to consider when identifying hazards:

– Proximity between hazardous activities

– Compatibility of work activities

– Non-routine work activities and situations

– Environmental conditions e.g. haze or lightning storms

Risk Evaluation for Health Hazards

RM must consider health hazards

Relevant risk factors are to be considered for different health hazards

Exposure assessments should be conducted where possible to estimate employees' exposure to health hazards

– Conducted by competent persons using recognised methods, acceptable standard procedures and standard calibrated equipment

Exposure estimates compared with established health exposure standards

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8.2 Duties of employer, self-employed person and principal

- Appoint, designate a qualified person to be the RM leader to lead the RA / RM team.
- Ensure that RA is conducted for all his activities
- Support the implementation of risk control measures
- Ensure that risk register is available and maintained in the workplace.
- Ensure that RA records are kept for a minimum period of 3 years from date of approval.
- Monitor the effectiveness of control measures.
- Review the RA once in 3 years or as required by the regulation.

Define roles and responsibilities

It is important to define roles and responsibilities for successful implementation of risk management. Authority, accountability, and resource allocation should be clearly identified, defined and communicated.

Employer

- Ensure that RA is conducted on WSH risks associated with any activity in the workplace.
- Require its workplace to take measures to control the risk and support the implementation of risk control measures
- Require the RM Leader to provide regular updates of the RA done and risk control measures
- Ensure that a Risk Register (Appendix 2) is available and maintained at the workplace
- Ensure that RA records, including but not limited to RA forms and control measures records, are kept for at least three years from RA approval date
- Review and, if necessary, revise the RA
- Monitor the effectiveness of the risk control measures

Manager

- Ensures that RA is carried out and risk control measures are implemented
- Approve the RA conducted for the area he /she manages
- Ensures that:
- No “High Risk” activity is approved
- Risk control measures are implemented without delay
- All operations have established SWPs, where applicable
- All persons affected by the risks are informed of the nature of the risk and control measures
- Effectiveness of the risk control measures is monitored
- Revise the RA if the risk control is inadequate and ineffective after the implementation
- Maintain RA documentation with measures and SWP implemented.

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Employees

- Adhere measures stipulated in RA, e.g. safe work procedures (SWP)
- Inform supervisors of any shortcoming in SWP or risk control measures

Contractors/suppliers

- Whenever necessary, work with Company RM/RA Team to conduct RA
- Before commencement of work Conduct RA on their own work, take measures to control risks, submit RA to Company person-in-charge for review
- Inform Company of any changes that may affect the RA
- Report accident / incident

Appointment of RM Team

The Employer shall:

- Appoint a RM Team Leader ("RM Leader")
- Appoint RM Team members ("RM Members")
- Ensure that RM Team is trained and competent in risk management
- Engage RM Consultant to assist RM Team if further assistance is required

The RM or RA Leader shall

- Lead and coordinate RM implementation
- Provide regular updates to the Employer, preferably monthly but no less than once a year, regarding appropriate risk control measures implemented to reduce or eliminate risks identified.
- Obtain approval from the Employer or the designated Manager for the implementation of risk control measures.
- Assist the Employer to ensure that the Risk Register and risk register cover sheet is prepared.

RM Members

- With good knowledge of work activities
- Competent in RM
- Attended RM course
- Comprise staff/workers from different levels, discipline and work areas

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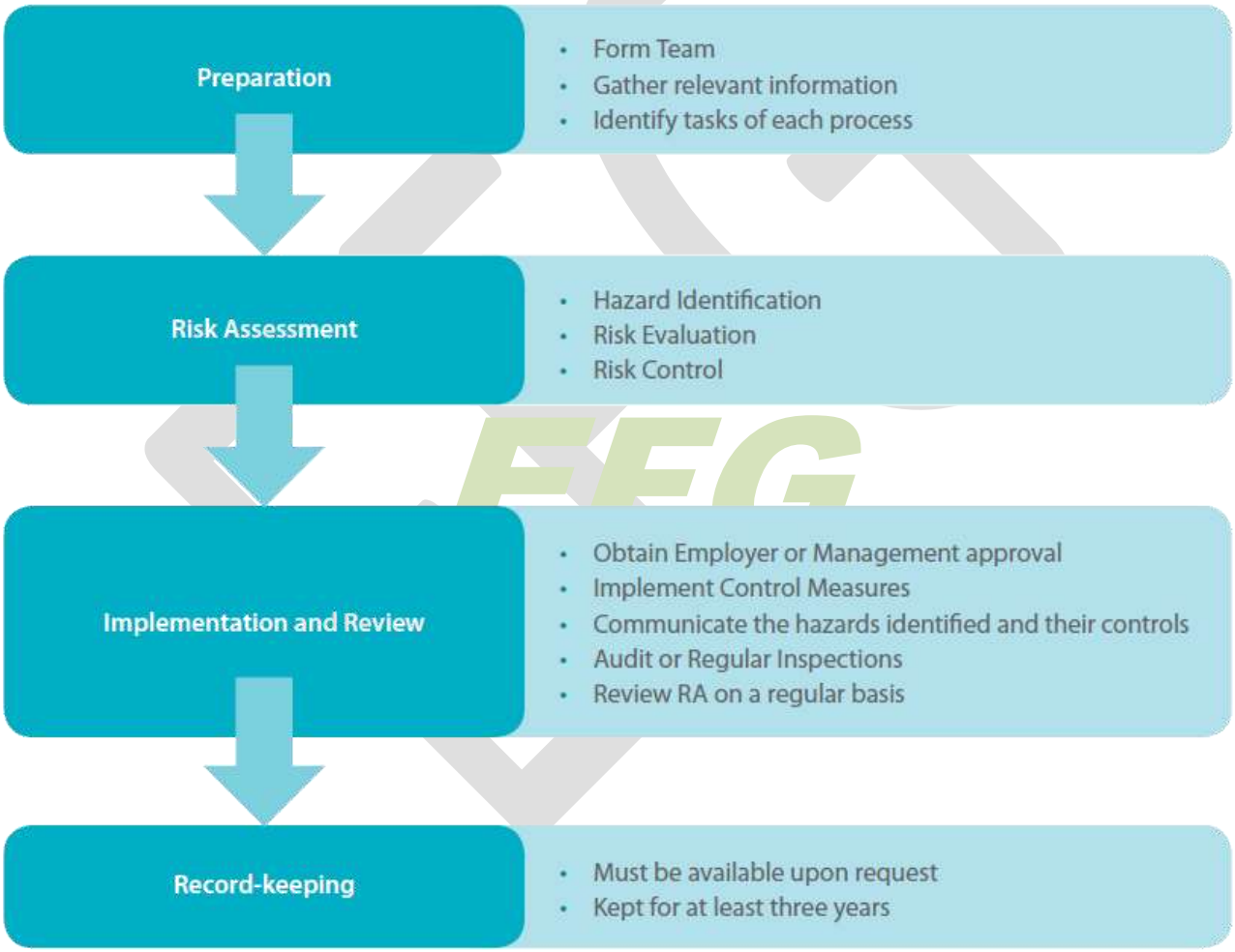
8.3 RISK MANAGEMENT PROCESS

What is Risk Management

It is a process to :

1. Identify the hazards;
2. Assess the risks;
3. Determine the control measures;
4. Communicating these risks to all persons involved such risks.

Appendix A: Risk Management Process



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Components of Risk Management

1. Preparation
2. Hazard Identification
3. Risk Evaluation
4. Risk Control
5. Implementation And Review
6. Record Keeping

What is Risk Assessment?

Process of evaluating the probability and consequences of injury or illness arising from exposure to an identified hazard, and determining the appropriate measures for risk control.
Risk Assessment is an important step in protecting everyone at the workplace as well as complying with the law.

RISK = SEVERITY X LIKELIHOOD (PROBABILITY)

Components of Risk Assessment

Risk Assessment is the main component of Risk Management and consist of the following elements –

1. Preparation
2 Hazard identification
3. Risk evaluation
4. Risk control

Risk Assessment Templates

Under MOM's Risk Assessment Guidelines, there are two types of Risk Assessment Templates

1. ACTIVITY BASED
2. TRADE BASED

DIFFERENCE BETWEEN ACTIVITY BASED AND TRADE BASED RISK ASSESSMENT:

- Trade Based not as detailed as Activity based.
- Trade Based does not follow the 3 X 3 or 5x 5 matrix.
- Trade Based is just an overview.

Activity Based RA Template

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Company:		Conducted by: (Names, designations) (Date)			
Process/ Location:					
Approved by: (Name, designation) (Date)		Last Review Date:		Next Review Date:	

1. Hazard Identification				2. Risk Evaluation				3. Risk Control	
1a.	1b.	1c.	1d.	2a.	2b.	2c.	2d.	3a.	3b.
No.	Work Activity	Hazard	Possible Accident / Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control Measures	Action Officer, Designation (Follow-up date)

Severity \ Likelihood	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Almost Certain (5)
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

Table 3: Recommended 5x5 Risk Matrix with numeric ratings

Trade Based RA Template

Company:		Conducted by: (Names, designations) (Date)			
Job:					
Approved by: (Name, designation) (Date)		Last Review Date:		Next Review Date:	

1. Hazard Identification	2. Risk Evaluation	3. Risk Control Actions	
1.	2.	3a.	3b.
Hazards associated with trade	Is hazard likely to harm someone?	List of risk control measures Tick if it is an existing measure	Implementation date & Action officer / Remarks
	☐Yes ☐ No	☐	
		☐	
		☐	
	☐Yes ☐ No	☐	
		☐	
		☐	
	☐Yes ☐ No	☐	
		☐	
		☐	

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8.3 Risk Management Process

8.3.1 Preparation Stage

Step1 Form a Team

Step 2 Gather information

- Information gathered by the team for the RA:

  - MSDS

  - Drawings, operation manual

  - Process flow charts

  - Details of equipment/tools used

  - Accident/Inspection records

  - Safety and Health Audit reports

  - Existing risk control measures

  - Existing safe work procedures

  - Relevant Legislations and CPs.

Step3 Risk Assessment Team to prepare Inventory of Work Activity

- Prepare Inventory of Work Activity form for areas assigned by RM Team
- Inventory of Work Activity form to include activity inventory, location, process and activity
- Identify tasks of each process
- Set Risk Assessment scope
- Divide the workplace into few a distinct areas
- Assign Risk Assessment Team for each distinct area

Step 4: Selecting Jobs for Risk Assessment

The following information will help in selecting jobs to conduct the risk assessment-

- High risk jobs first
- Indications used to select jobs:

  a) frequency rate of accidents

  b) severity rate of accidents

  c) new jobs

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8.3.2 : Identifying Hazards

The first and the most important step in the

Risk Assessment process is-

"IDENTIFICATION OF HAZARDS."

WHAT IS HAZARD?

- A '***hazard***' is anything with the potential to cause an injury or illness.

WHAT IS HAZARD IDENTIFICATION?

- Is the process of identifying all hazards in the workplace where people may be exposed to injury or illness?
- Hazards that are not identified can't be controlled.

TYPES OF HAZARDS

Hazards can be grouped into the following basic types:

1. Physical Hazards
2. Chemical Hazards
3. Ergonomic Hazards
4. Biological Hazards
5. Other Hazards - Human Factors

1. Types of Physical Hazards

- Electrical Hazards
- Mechanical Hazards
- Noise
- Thermal Conditions – Hot/Cold
- Radiation

2. Types of Chemical Hazards

- Handling chemicals
  - Vapours/fumes – from welding, solvents
  - Gases such as LPG, acetylene, CO, etc
  - Corrosive, toxic
  - Flammable, explosive.

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3. Types of Ergonomic Hazards:

- Poor lighting
- Poorly designed workstations
- Manual lifting
- Poor work posture
- Repetitive movements

4. Types of Biological Hazards

- Blood or body fluids
- Fungi
- Bacteria/viruses

5. Other Hazards – Human Factors

- Fatigue/long working hours
- Stress
- Working alone
- New employees/trainees
- Lack of training/supervision

Common WSH hazards

Physical (e.g. fire, noise, ergonomics, heat, radiation and manual handling)

- Struck by / against objects
- Contact with / by agents
- Caught in between
- Fall at same level
- Fall from Work at heights
- Overexertion

Electrical Hazards

- Contact with power lines
- Lack of ground-fault protection
- Path to ground missing or discontinuous
- Equipment not used in prescribed manner
- Improper use of extension and flexible cords
- Wires come into contact with water

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Electrical Hazards

Types of injuries

- Shock
- Burns
- Overheating
- Ignition of combustibles
- Inadvertent activation
- Operating of unsafe failure
- Explosion, electrical

Machine hazards

- Shear points
- Pinch points
- Wrap points
- Crush points
- Nip points
- Sharp edges or points
- Rotating equipment
- Reciprocating equipment
- Pinch points
- Weights to be lifted
- Stability / Toppling tendency
- Ejected parts or fragments

Types of injuries from Mechanical hazards

– Cuts

– Punctures

– Bruises

– Broken bones

– Particles in eyes

– Crushing

– Strains

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Fire & Explosion hazard

- Types of explosions
- Types of fires
- Chemistry of fire
- Causes of fire and explosion
- Flammability
- Explosion limits
- Flash points
- Overloaded electricity
- Overheated generator
- Leaking of gases
- Improper fuel storage
- Improper use of welding or gas cutting machines

Noise hazards

- Excessive noise from construction works such as concrete hacking, demolition, grinding, drilling
- Noise generation and types of noise
- Frequency, wavelength and velocity
- Sound pressure level, sound power level, sound intensity
- Combined sound pressure level
- Sound fields
- Directivity factor, room constant,
- Relationship between sound pressure level and sound power level
- Characteristics of vibration and vibration criteria exposure
- Equivalent noise level
- Health hazards due to noise and vibrations

Ergonomic hazards

- Components of ergonomics
- Task design
- Workplace design
- Work organisation
- Shift work
- Fatigue
- Manual handling

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Identify hazards related to Human Factor

Human Factors

- Delivery driver with poorly managed diabetes may develop complications such as blurred vision, impaired senses
  - May compromise driver's ability to respond to dangerous situations on the road, posing a hazard to other drivers, passengers, pedestrians, including themselves.
  - Not a problem if diabetes is under control
- Employers can put in place health programmes to help employees manage their health
  - Allowing medical service provider to offer optional detailed medical screening services at corporate rates to employees
  - Provide healthier food options at the staff canteen
  - Encourage off-the-job health and safety

Source _ Bizsafe convention 2015 presentation slides

Chemical Hazards

- Routes of exposure/entry
- Acid / Base
- Corrosive
- Flammable

Confined space hazards

Occupational health hazards

- Occupational diseases
- Dusts and other air-borne contaminants

Other WSH Hazards

Thermal Hazards

- High temperatures due to works such as welding and hot works
- Working in adverse climate condition such as under hot sun
- Sources of heat
- Mode of heat transfer through:
- Conduction
- Convection
- Radiation
- Thermal Stresses
- Cold stress
- Heat stress and Heat strain
- Heat disorders
- Acclimatization
- Metabolic heat
- Evaporative heat

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Radiation Hazard

- Ionising radiation
- Alpha particles
- Beta particles
- X-ray
- Gamma-rays
- Activity of radioactive materials
- Radiation doses
- Hazards due to exposure to ionising radiation
- Detecting and monitoring
- Transport of radioactive materials
- Radiation incidents
- Emergency procedures
- Guidelines of the International Commission on Radiological
- Protection
- Guidelines for exposure to Ionising radiation
- Non-ionising radiation
- Microwave radiation
- Infrared radiation
- Visible radiation
- Ultraviolet radiation
- Laser
- Ultrasound radiation

Hazards and Threat identified by SG Secure

SGSecure Activities

- Armed Assailant attack
- Biological Agent release
- Vehicle attack
- Attack with Weapons
- Toxic Gas release
- Arson
- Suicide bomber
- Parang Attack
- Bomb attack
- Causing power outage
- Radioactive substance release
- Sniper shooting
- Chemical attack

How to Identify Hazards?

- Inspection of the workplace,
- Observation and audits,
- Accident/incident (near miss) records,
- Talk and get feedback from workers at the workplace,
- Process information,
- Industry bulletins and published information

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8.3.3 Risk Evaluation

- *Risk* is the *likelihood or probability* that an exposure to a hazard may result in an injury or illness.
- The process of estimating the risk levels for the hazards and their acceptability.
- used as a basis for prioritizing actions to control these hazards and minimize safety and health risks.

Risk evaluation consists of:

- Assessing the potential severity of the hazards;
- Determine the likelihood of occurrence; and
- Assessing the risk level based on the severity and likelihood
- These are remaining risks that the controls are not able to remove.

Example:

- If a worker is working at height and fails to anchor his safety harness/belt, then this is considered as a residue risk.
- A further control measure to address residue risk can be Administrative control such as training.

Existing Risk Controls

- Identify the existing risk controls that are already in place.
- Based on these existing risk controls, evaluate the severity and the likelihood of an injury.
- Existing risk control measures should not be regarded as adequate simply because an incident hasn't occurred.

Recommended 5x5 matrix with numerical rating

Likelihood / Severity	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Almost Certain (5)
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

Table 3: Recommended 5x5 Risk Matrix with numeric ratings

Source of table and guiding notes : ACOP Risk Management WSHC

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When using 5x5 matrix, the following guideline from Table ACOP could be use.

Severity is classified into five categories: Catastrophic, Major, Moderate, Minor, and Negligible.

Level	Score	Severity	Description
5	5	Catastrophic	Fatality, fatal diseases or multiple major injuries
4	4	Major	Serious injuries or life-threatening occupational disease (includes amputations, major fractures, multiple injuries, occupational cancer, acute poisoning)
3	3	Moderate	Injury requiring medical treatment or ill-health leading to disability (includes lacerations, burns, sprains, minor fractures, dermatitis, deafness, work-related upper limb disorders)
2	2	Minor	Injury or ill-health requiring first-aid only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort)
1	1	Negligible	Not likely to cause injury or ill-health

Table 1: Severity rating and scoring

LIKELIHOOD of occurrence of an accident, incident or ill health is also classified into five categories: Rare, Remote, Occasional, Frequent, and Almost Certain (Table 5)

Level	Score	Likelihood	Description
1	1	Rare	Not expected to occur but still possible
2	2	Remote	Not likely to occur under normal circumstances
3	3	Occasional	Possible or known to occur
4	4	Frequent	Common occurrence
5	5	Almost Certain	Continual or repeating experience

Table 2: Likelihood rating and scoring

Source of table and guiding notes: ACOP Risk Management WSHC

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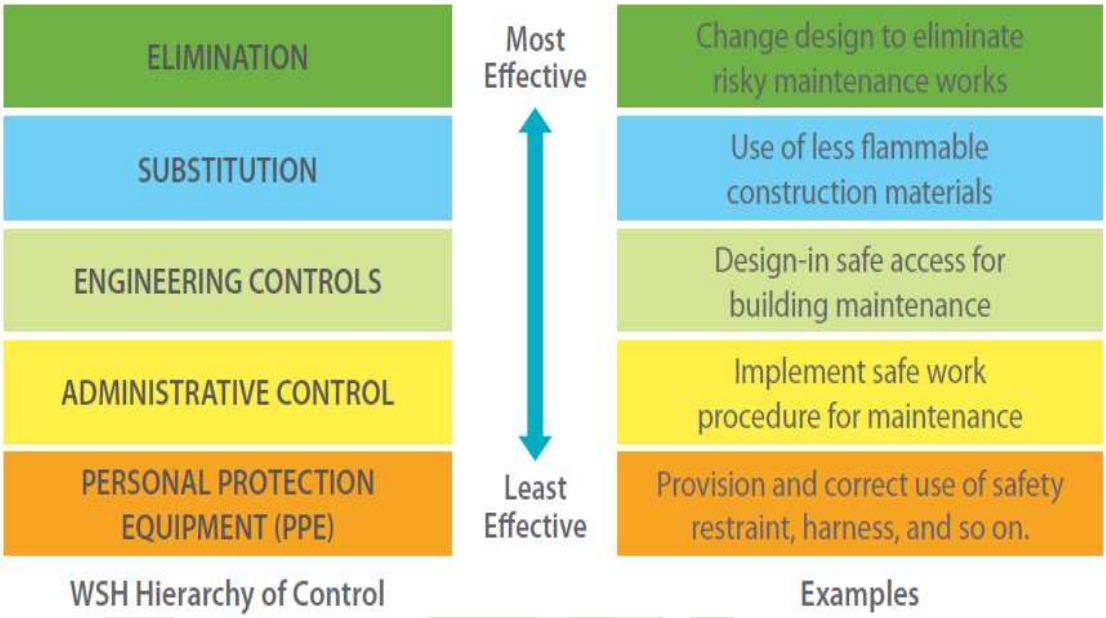
8.3.4 Risk control – Hierarchy of Controls, Safe Work Procedures

- The process by which the risks associated with each of the hazards present in the workplace are reduced to an acceptable level.
- The control of hazards and the reduction of risks can be accomplished by the following Hierarchy of control measures.
- More than one type of control measures can be implemented can be implemented together.

Hierarchy of Risk Control



Elimination:
Removal of source of hazard(s) from work area.
Most preferred method as it effectively makes all identified possible accidents and ill health impossible.
Permanent solution which should be attempted in first instance.
If hazard is removed, all other management controls, such as workplace monitoring and surveillance, training, safety auditing, and record keeping will no longer be required.

- **Elimination is most effective solution**
- **Removal of the hazard or the system of work which presents the risk**

Example Eliminate WAH Activities

Site supervisor or management shall look for any alternatives if the task can be performed in another way
Avoid the need to work at height wherever possible and avoid exposing persons to any fall hazards
e.g.1) painting the ceiling using long stick roller brush
2) Use of suction hose or blower to clear the roof gutter
3) Prefabrication of roof at the ground level

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Risk Control/Substitution

- Substitution means the replacement of any hazardous material, process, operation, equipment or device with less hazardous ones which present no or lower level of risk.

Substitute spray painting with brush painting

Example 1:

Example 2:

Substitute asbestos insulation with less hazardous insulation material such as rock wool/fibreglass, etc.

Risk Control/Engineering Controls

- Application of physical means or measures to any work process, equipment or the work environment such as- the installation of any barrier, enclosure, guarding, interlock or ventilation system.
- Machine guarding
- Ventilation systems (Dilution and LEV)
- Automation
- ELCB
- Noise enclosures
- Guardrails/toe boards

Risk Control/Engineering Controls

Providing barrier

To protect with plastic cover on the sharp edge

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Risk Control/Administrative Controls
Examples of administrative controls

- Job rotation
- Permit to work
- Safe work procedures
- Training & supervision
- Safety signs
- Medical Surveillance program
- Pre-employment medical examination
- Implementing IH monitoring program
- Continuous monitoring of work environment

Safe Work Procedure
A safe working procedure should be written when:
- designing a new job or task,
- changing a job or task,
- introducing new equipment or substances / or
- reviewing a procedure when problems have been identified, eg. from an accident or incident investigation.

Risk Control/Personal Protective Equipment
- Least effective control measure because the worker may not use it (residue risk) or use it wrongly.
- PPE are equipment or devices to provide a protective barrier between the worker and the hazard but does not remove the hazard
- Safety glasses, goggles, face shields etc
- Respiratory protective equipment
- Fall arrest systems
- Safety gloves
- Safety boots/shoes etc
- Protective overalls, aprons etc

Risk Control/Human Factor
- Violating procedures
- Taking short-cuts
- Not using or misuse of Personal Protective Equipment
- Unauthorized use of equipment
- Misuse of equipment
- Horseplay

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Sample Risk Assessment Form

SAFETY AND HEALTH HAZARD LOG

ACTIVITY-BASED RISK ASSESSMENT FORM											
Company :				Activity/Process :				Location of work :			
Conducted By (RA team members) :	Name	Designation	Date	Reviewed By :	Name	Designation	Date	Approved By :	Name	Designation	Date
Last Review Date :				Next Review Date :							

S/No	Description of Work Activity	Hazards Identified	Risk	Existing Control Measures	Initial Risk Index			Additional Control Measures	Residual Risk Index			Risk Owner (Action Officer)		
					F	S	R		F	S	R	Name	Designation	Follow-up Period

Note: F – Frequency of Occurrence; S – Severity of Hazard; R – Risk Index

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Risk Assessment Form

Department:	RA Leader:	Approved by	Reference Number
Process:	RA Member 1:		
Process/Activity Location:	RA Member 2:	Signature:	
Original Assessment date:	RA Member 3:	Name:	
Last review date:	RA Member 4:	Designation:	
Next review date:	RA Member 5:	Date:	

HAZARD IDENTIFICATION				RISK EVALUATION				RISK CONTROL						
Ref	Work Activity	Hazard	Possible injury/ill-health	Existing risk controls	S	L	RPN	Additional Controls	S	L	RPN	Implementation Person	Due Date	Remarks
1														
2														
3														
4														
5														
6														
7														
8														

Notes:

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8.3.5 Implementation and review – Risk communication

- Management commitment (corporate policy) to communicate "risk assessment information" to the employees, relevant and interested parties, including visitors, contractors, and affected neighbourhood
- Suitable arrangements to be established to ensure effective communication of the above information.
- Risk Assessment Team
- Various meetings, including Workplace Safety & Health Committee Meetings and tool box meetings
- Company newsletters and circulars
- Safety & Health Notice board
- Activities such as safety & health talks, contests and campaigns.
- Feedbacks from employees and other parties should be encouraged
- Direct observation and discussion (Aware of the concerns of persons at work on their risks at work) (Most Effective Method)
- Suggestion forms
- Reminder through Tool Box Meetings

Who shall be communicated?

- All personnel involved in work activities shall be communicated on nature of hazards and risks involved and control measures or safe work procedures.
- Contractors / vendors, temporary and loaned employees shall also be covered under this communication.
- The above communication shall be done after
  - Conducting the risk assessment initially.
  - Every revision of risk assessment register.
  - Every review of risk assessment register.
- Records of above communication shall be documented and maintained.
- Personnel involved in work shall comply with measures or safe work procedures as stated under risk assessment report and safe work procedure.

Implementation by Action Officers

- Once the risk control measures are selected, the action officers responsible for the implementation of these control measures must be identified.
- Indicate the follow up dates under the 'Action Officer' column as well.
- The employer should as far as is practicable, implement the recommended risk control measures as soon as possible.
- An action plan should be prepared to implement the risk control measures

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Implementation Actions

As far as is practicable, the Manager is to implement the recommended risk control measures as soon as possible.

The Manager shall ensure that:

- an action plan is prepared to implement the measures.
- the plan is monitored regularly until all the measures are implemented.
- all persons exposed to the risks are informed of:
  - The nature of risks; and
  - Any measures or SWP implemented.
- regular inspections and process audits are carried out to ensure that risk control measures have been implemented and are functioning effectively.

Review of Control Measures

- Risk assessment is a continual process.
- Risk assessments should be subject to periodic formal review to confirm the validity of the assessment and whether risk controls are still effective and adequate. Where conditions have changed improvements should be made as necessary.
- Whatever control measures and SWP are used, they should be reviewed if there is reason to suspect that they are no longer effective, or if there has been a significant change in the matters to which they relate.
- Irrespective of the schedule for formal review, if conditions change to the extent that hazards and risks are significantly affected, then risk assessments should be reviewed.

Reviewing Risk Assessments

- Risk assessments are only effective if they are reviewed and updated periodically.
- Trigger points are –

  a) when accidents occur
  b) when the job process changes
  c) after accidents/near misses
  d) employee concerns
  e) legislative requirements

8.3.6 Record Keeping

- Keep for at least 3 years.
- Risk assessment form could be used for risk assessment and recording
- Risk assessment records should be concise and kept in a register.

Records should include the following:

- Names and designations of risk assessment team members.
- Inventory of trades and / or work activities by process or location, associated with machinery, equipment and chemicals.
- Hazards identification for each work activity, and possible types of accident or incident.
- Existing risk control measures.
- Risk level for each hazard.
- Recommendations on additional risk controls required.
- Persons involved in implementing the measures on risk reduction.
- Signatures, date and designations of the persons conducting risk assessment.
- Signature, date and designation of management approving or endorsing the assessment

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8.4 Worked examples on risk assessment

Scenario – Working at height

Example:

The work involves painting of the house exterior side using a ladder. Prepare a risk assessment for the above task.

Though the task involves many activities like mobilizing paint, mixing of paint, painting work, cleaning etc., the assessment is shown only to the activity involving working at height as a reference.

So, the Learners need to assess all the activities in the actual scenario.

RISK ASSESSMENT FORM

Company:	ABC Company	Conducted by: Names, designations (Date)	Tan Ah Lee, Supervisor, Ong Huat Ling, Worker Tan Ai Ling, Worker, 1 Aug 2007
Process / Location:	Painting / 1st Floor of House, exterior		
Approved by: (Name, designation)	Salim Bin Samat, Manager 5 Aug 2007	Last Review Date: 5 Aug 2007	Next Review Date: 5 Aug 2010

No	Work Activity	Hazard	Possible Accidents / Ill Health & Persons at Risk	Existing Risk Control (If any)	Severity	Likelihood	Risk Level	Additional Risk Controls	Action Officer, Designation (Date)
1	Accessing and exiting work area using a ladder	Fall from height	Injury or death	• Ladder is checked every 6 months for defects by a competent person. • Ladder is visually checked before usage. • Training provided to worker to ensure that 3 point contact to be maintained by worker while climbing the ladder. • Tools are not to be carried by hand, a belt pouch had been provided for this purpose.	High	Occasional	Medium	Ladder is secured at the top using rope or footed at the bottom before usage. An alternative is that another worker can be assigned to hold the ladder firmly in place during climbing.	Tan Ah Lee Supervisor (Jan 2008)
2	Other work activities	...	...	...	...	...	...	...	...

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Sample RA for SG Secure

Risk Assessment Form

Department:	Main Office and labs	RA Leader:	Damos (WSH Consultant)	Approved by	Reference Number
Process:	SG Secure at work	RA Member 1:	Kelvin (HR Manager)		RA-010v01
Process/Activity Location:	Whole premises	RA Member 2:	Clement (FSM)	Signature:	
Original Assessment date:	27 Feb 2019	RA Member 3:	Sean Lee (Safety MR)	Name: Mr. Sam Kee	
Last review date:	28 Feb 2019	RA Member 4:	May Chua (SG Secure Rep)	Designation: General Manager	
Next review date:	26 Feb 2022	RA Member 5:		Date: 28 Feb 2019	

HAZARD IDENTIFICATION				RISK EVALUATION				RISK CONTROL						
Ref	Work Activity	Hazard	Possible injury/ill-health	Existing risk controls	S	L	RPN	Additional Controls	S	L	RPN	Implementation Person	Due Date	Remarks
1	Handling suspicious package	toxic, explosive	Multiple Fatalities	Nil	5	3	15 (H)	1. Staff trained in recognition of suspicious package 2. Staff trained to leave package alone and report accordingly 3. Authorities to be notified 4. Staff trained in the SWP 5. To conduct table top exercise and Drill	5	1	5 (M)	Clement - FSM	30-04-2019	
2	Handling Terror attack	gunshot, knife slash	Multiple Fatalities	Nil	5	3	15 (H)	1. Lab/office access control 2. Staff trained in "RUN, HIDE, TELL" and "PRESS, TIE, TELL" 3. Staff encouraged to install the SGSecure app 4. Staff trained in SGSecure SWP	5	1	5 (M)	Siva - HR Mgr	30-04-2019	
3	Handling of hazardous chemicals	Chemical theft - splash on others	Chemical burns	Nil	5	3	15 (H)	1. Lab/office access control 2. Chemicals stored in secure cabinets 3. Staff briefed on chemical safety and SGSecure SWP 4. To install CCTV	5	1	5 (M)	Robby - WSHO	30-06-2019	
4	Unauthorized Vehicle movement into workplace	Vehicle Attack	Multiple fatality	Nil	5	4	20 (M)	1. Security Personnel and barrier at entrance 2. To install CCTV 3. Security staff briefed on SG Secure SWP	5	3	15 (H)	Kenny - Security Mgr	30-06-2019	

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Sample RA for Painting

RISK ASSESSMENT FORM									
Company:	XYP Co Pte Ltd			Conducted by: (Names, designations) (Date)		Ho Beng Long, Plant Manager; Ong Huat Teng, Supervisor; Tan Ah Lim, Spray Painter. 01 September 2004			
Process/ Location:	Spray Painting / Workshop								
Approved by: (Name, designation) (Date)	Song Heng Poh General Manager 01 September 2005			Last Review Date:	01 Sep 2004	Next Review Date:	01 Sep 2007		
1. Hazard Identification				2. Risk Evaluation				3. Risk Control	
1a.	1b.	1c.	1d.	2a.	2b.	2c.	2d.	3a.	3b.
No.	Activity	Hazard	Possible Accident / Ill Health & Persons-at-Risk	Existing Risk Control	Severity	Likeli-hood	Risk Level	Additional Risk Control Measures	Action Officer, Designation (Follow-up date)
1	Moving metal drums to spray booth	Falling object	Worker's feet can be crushed by metal drum causing injury	Safety shoes	Moderate	Frequent	High	Provide mechanical lifting devices e.g. forklift for moving metal drums to spray booth	Ho Beng Long, Plant Manager (15/12/2004)
		Unsafe work practice	Manual handling of 15 kg drum can cause back injury	Training	Moderate	Occasional	Medium		
2	Preparing and mixing paint	Toxic solvent vapours	Exposure to spray paint solvents can cause ill health	Organic vapour respirators; Safe work procedures; Local exhaust ventilation system for spray booth	Moderate	Remote	Low	Substitute solvent-based paint with high-solids coatings or use airless spray method; Keep minimum quantity of flammable liquids in	Ho Beng Long, Plant Manager (02/01/2006); Tan Ah Lim, Operator; Ong Huat Teng, Supervisor,
		Flammable	Fire from solvents	Safe work	Major	Remote	Medium		

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Sample RA for forklift operation

1. Hazard Identification				2. Risk Evaluation				3. Risk Control		Reference
No.	Task Step	Hazard	Possible Accident / Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)	Document for Reference
1	Transporting painting equipment by forklift to worksite	Moving vehicle	• Collision • Topple • Fatality	• Assign trained forklift operator • Check and ensure green tag, proper maintenance, check list, follow speed limit • Do not overload • Ensure adequate lighting	5	1	M		Immediate Supervisor	
		Falling object	Strike by falling spray pump, hose and paint drum	Secure equipments properly	2	2	M		Immediate Supervisor	
2	Lifting up equipment on board vessel by crane	Falling object	• Strike by falling object • Struck by moving object	• Assign trained signaler and rigger • Assign trained crane operator • Check and inspect all lifting devices before use • Materials secured properly • No obstruction	2	2	M		Immediate Supervisor	

Source COP for RM

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Sample RA for Lifting Operation

Risk Assessment Form

Company:	Group 4	Conducted by: (Date)	
Task:	Transportation of Scaffold Material from Berth Side to Vessel		
Approved by: (Date)		Next Review Date:	

1. Hazard Identification				2. Risk Evaluation				3. Risk Control		Reference
No.	Task Step	Hazard	Possible Accident / Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)	Document for Reference
1	Check the weight of the staging material and SWL of the crane used	• Toppling of crane due to overload • Falling objects • Wrong assessment	• Fatality • Body injuries	• Compliance to SWP • Competent and experienced person to perform assessment	5	1	M	Mark the weight of the load	Lifting Supervisor	Safe Work Procedure for lifting operation
2	Secure staging material to lifting rack	Falling objects	• Fatality • Hand / finger injuries	• Qualified rigger • Check bar stability of load before lifting • Tug line must be secured to rack	5	1	M	Barricade the surrounding	Lifting Supervisor Riggers Signalman	Safe Work Procedure for lifting operation
3	Barricade the surrounding (if necessary)	Falling objects	Fatality	Ensure no one is walking below the suspended load	5	1	M	Put in sentry to inform other workers to prevent them from coming near the lifting	Riggers and Signalman	Safe Work Procedure for lifting operation

Source: WSH Management for Marine

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Sample RA for Lifting Operation

Risk Assessment Form										
1. Hazard Identification				2. Risk Evaluation				3. Risk Control		Reference
No.	Task Step	Hazard	Possible Accident / Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)	Document for Reference
4	Lifting operation	• Hit by swinging load • Fall and caught by suspended load • Crane failure • Falling load	• Body injuries • Property damage	• Center the crane prior to lifting • Use proper tug line • Deploy qualified riggers, signalmen and crane operator • Follow SWP • Wear appropriate PPEs • Check condition of lifting gears prior to lifting • Nobody must be under the suspended load	5	1	M	• Keep clear the lifting zone from unauthorised personnel • Deploy additional watchman • Ensure load is suspended for a few minutes to make it stable before moving	Supervisor Rigger/ Signalman Watchman Crane Operator Rigger / Signalman Supervisor Watchman	Safe Work Procedure for lifting operation
5	Load in position, removal of lifting gears	• Falling from height (if rigging is required to be performed at height) • Falling lifting gears • Improper handling	Hand / finger injuries	Use proper PPE	1	4	L	Lifting supervisor to conduct safety briefing	Rigger and Signalmen on site	Safe Work Procedure for lifting operation

Source: WSH Management for Marine

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Sample RA for Hotwork

Risk Assessment Form

Company:	Group 8	Conducted by: (Date)	Group 8 (21/6/2006)
Task:	Partial Renewal of Funnel Casing		
Approved by: (Date)	21/06/2006	Next Review Date:	20/06/2009

1. Hazard Identification				2. Risk Evaluation				3. Risk Control		Reference
No.	Task Step	Hazard	Possible Accident / Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)	Document for Reference
1	Check or mark hot work area	Falling	Minor injuries / sprain	• Safe staging with checklist • Wear safety belt • Provide ventilation	2	1	L			
		Overcome by CO_2	May become unconscious	Gas check	3	1	L			
		Contact with hot surface	Burn injuries	Wear hand gloves	2	1	L			
2	Prepare - hot work / lifting / hand tools	Trip or fall	Body injuries / sprain	• Good housekeeping • Safe staging with checklist	2	1	L M			
		Caught in between	Finger injuries	• Safe manual handling • Wear leather gloves	2	3	M	Tool box briefing	Supervisor	
3	Cut and remove the plate as marked	Fire	Body injuries	Hot work permit	5	1	M	Cordon off area	Supervisor	
		Fall	Body injuries	Safe staging	2	1	L			
		Hit by	Body injuries	Use hand gloves	2	2	L			

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Learning Activity Eight – Risk Assessment

Objective: Conduct a risk assessment and put up RA report
Group Discussion and complete a risk assessment form

- Form RA team with groups of 5 to discuss the common works in a construction site
- Identify the hazards and evaluate the risk level using a 5 x 5 matrix in work activities shown in training resource.
- Identify is there any existing control measure
- Recommend control measures
- Write down your risk evaluation and control measures on the RA form given and nominate a spokesperson from each group to share the findings with the class.

Types of construction work (Each group to select TWO for discussion and exercise)

1. Excavation
2. Piling
3. Reinforcement Fixing
4. Formwork installation
5. Laying of electrical wire
6. Lifting of Precast unit
7. Erection of Scaffold
8. Installation of lift
9. Entry into confined space
10. External wall painting
11. Installation of curtain wall
12. Installation fire sprinkler system
13. Installation of plumbing and pipe fitting
14. Laying of tiles
15. Roof work
16. Working at Height

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Lesson 9
Accident Prevention and Investigation

PS6

Establish the procedures for incident reporting, accident prevention and investigation in accordance with general principles and requirements of related WSH Regulations and Guidelines

UK 9 Accident Prevention and Investigation

Accident causation theories
- Heinrich's Domino Theory
- Multi-causation Theory
- Typical approach in accident prevention

WSH (Incident Reporting) Regulations
- Reportable accidents, dangerous occurrence and occupational disease
- Penalties
- Incident reporting procedures in worksite

WSH (First Aid) Regulations 2006
- First-aid box
- First Aiders

Accident investigation
- Objectives of investigation
- Investigation flowchart
- Investigation procedures
- Accident case study

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9.1 Accident Causation Theories

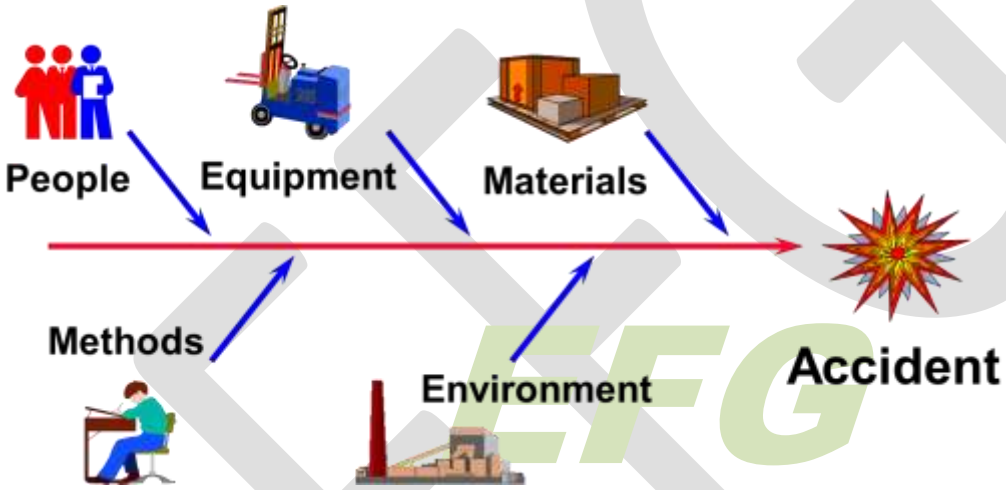
Definition Of Accident

Accident:
An unwanted or undesired event that result in an injury, illness or damage to property, environment or plant.

Incident:
Incident is defined as an undesired event, which under slightly different circumstances, could have resulted in an accident. Sometimes it is also known as 'Near-Miss'.

Safety:
Safety is defined as "the control of accidental losses".

The 5 sources of loss



Causes of Workplace Accidents

- Majority of the workplace accidents are caused by Sub-standard acts of employees.
- Secondary cause of workplace accidents are Sub- standard conditions.

Sub-Standard Acts

Examples:

- Taking short cuts-not using proper access way
- Unauthorized operation of equipment, machines
- Using damaged tools or faulty equipment
- Tampering with safety devices; (e.g. Removing safety guards)
- Speeding with forklift
- Overloading lifting equipment
- Not following safe work procedures
- Not wearing PPE or wearing wrong PPE
- Standing under suspended load

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Sub-Standard Acts- Why?

- Lack of supervision
- Lack of training/knowledge
- New employees
- Fatigue/stress
- Peer pressure
- Want to finish job fast
- Lack of safety enforcement

Sub-Standard Conditions

Examples:

- Missing/damaged machine guards
- Faulty machines, equipment and tools
- Material on floor – poor housekeeping
- Exits/stairways/passageways obstructed.
- Unguarded opening
- Slippery/wet floor
- Inadequate lighting/ventilation

Effects Of Accidents

<u>Injured Worker</u>

Direct Effects – injury
- Psychological effects of the injury

Indirect Effects
- Loss of earnings
- Disrupted family life
- Disrupted personal life

<u>Organization</u>

Direct Effects
- loss of human resource
- property damage to tools, material equipment, etc.

Indirect Effects
- loss of business
- poor customer relations
- negative media coverage
- poor reputation and higher insurance costs

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Accident Causation Models

Many models of accident causation have been proposed, such as:

a) Heinrich Domino Theory;

b) Multi-causation theory.

9.1.1 Heinrich Domino Theory

'The Origin of Accidents' (1928), Herbert Heinrich examined 75,000 industrial accidents and attributed 88% of the accidents to 'unsafe human acts' or 'Sub-standard Acts'.

Underlying principle that people and not things cause accidents.

There are five factors or stages in sequence of events:

- **Ancestry and social environment** - leading to
- **Fault of person** - constituting the reason for
- **An unsafe act or unsafe condition** - which results in
- **An Accident** - which leads to
- **Injury.**

The Injury is caused by the Action of Preceding Factors
Unsafe act and condition constitute the central factor in the accident sequence.
Removal of the central factor makes the action of proceeding factors ineffective.

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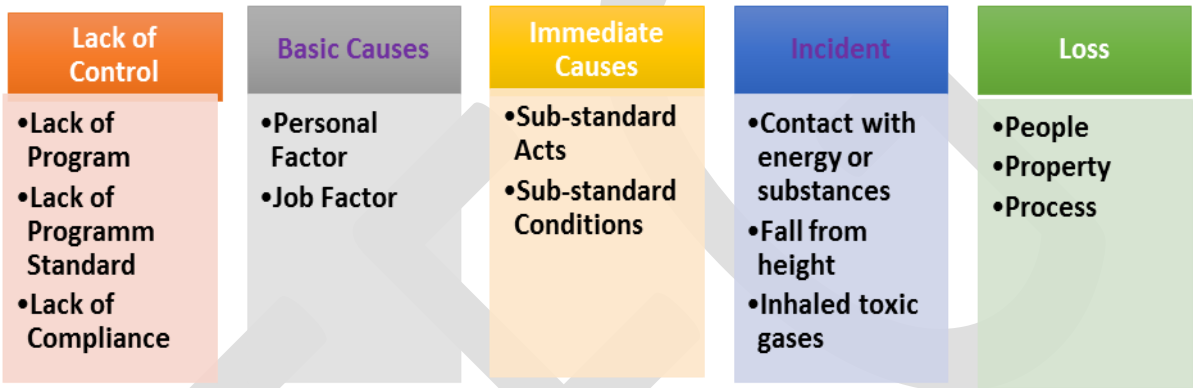
9.1.2 Multi-Causation Theory

This theory recognizes that behind every accident, there are a number of contributing factors.
To prevent the accident from occurring again, all these factors must be identified and control measures put in place.

Frank Bird Accident Causation Model
Frank E. Bird, Jr. in hit hook "Practical Loss Control Leadership", proposed a similar accident causation model. These are a relatively simple model yet contain all the necessary key points for a manager to understand how accidents are caused.
Most important of all, the model allows management to trace back systematically all causes of accident and arrive at the point where management control is required, instead of stop short at the removal of unsafe conditions and unsafe acts.

Causes Of Workplace Accidents



Loss
As the model indicates, losses can involve people, property, process, or the environment. The loss could be a personal injury, an occupational illness, damage to equipment or facilities, waste or contamination of materials, disruption of work, environment pollution, etc. In any case, the type and degree of loss are matters of both chance and the actions taken to limit or minimize the loss.

Incident (Contacts)
In the loss causation model, the event that leads to the loss is the incident. This is the undesired contact with a source of energy or substance above the threshold limit of the body or structure, if there is no barrier to stop the exchange, there is a transfer of energy or substance above the threshold limit to the body or structure.
If the level is too high, and is above the limit of the body or structure of that particular form of energy or substance, there would be injury or damage. Forms of energy commonly found at construction sites are kinetic energy, electrical energy, acoustic energy, thermal energy, radiant energy and chemical energy.

Immediate Causes
The "immediate causes" of accidents arc the
Circumstances that immediately precede the contact. They usually can be seen or sensed. Frequently, they are called 'unsafe acts" and "unsafe conditions", in this model the terms substandard practices and substandard conditions are used. Immediate causes are symptoms of the problems but not the root of it.

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Immediate Causes

SUB-STANDARD CONDITIONS	SUB-STANDARD ACTS
Inadequate Ventilation/lighting	Removing machine Guarding
Inadequate Guards/Barriers	Operating defective machine
Excessive Noise	Service equipment in operation
Defective tools/equipment	Horseplay
Poor House Keeping	Failure to use PPE

Basic Causes/Root Cause

Basic causes are the diseases or real causes behind the symptoms; the reasons why the substandard acts and conditions occurred; the factors that, when identified, permit meaningful management control. Just as it is helpful to consider two mayor categories of immediate causes (substandard practices and substandard conditions), so it is helpful to think of basic causes in two major categories:

Personal Factors and Job Factors. Basic causes arc the origins of substandard practices and conditions. However, they arc not the beginning of the causes and effect sequence. What starts the sequence, ending in loss, is 'lack of control".

Personal Factors	Job Factors
Inadequate Physical Capability	Inadequate Leadership/Supervision
Lack of Knowledge	Inadequate Maintenance
Lack of skill	Inadequate Work Standards
Improper Motivation	Abuse or Misuse e.g. Unsafe act condoned by supervisor

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9.1.3 Typical approach in accident prevention

Lack of Control

Control is one of the four essential management functions:
Plan, organize, lead, and control. Without adequate management control, the accident cause and effect sequences started and, unless corrected in time, leads to losses.
There are three common reasons for lack of control:

- Inadequate program:
- Inadequate program standards; and
- Inadequate compliance with standards

Inadequate Program:

A safety program may be inadequate because of too few program activities.

Inadequate Program Standards:

A common cause of confusion and failure is a standard that is not specific enough, not clear enough, and/or not high enough.

Inadequate Compliance with Standards:

Lack of compliance with existing standards is a common reason for lack of control; in fact, most managers agree that this is the single greatest reason for failure to control accident loss.

Corrective action – Action taken to eliminate the cause(s) of an existing nonconformity or other undesirable situation

Preventive action – Addresses inadequate "conditions" which may produce non-conformances. Preventive actions are usually taken so as to prevent reoccurrence of the problem.

ALARP stands for "as low as reasonably practicable", and is a term often used in the milieu of safety-critical and safety-involved systems. The ALARP principle is that the residual risk shall be as low as reasonably practicable

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9.2 Workplace Safety And Health (Incident Reporting) Regulations

Reportable accidents, dangerous occurrence and occupational disease

Workplace Safety And Health (Incident Reporting) Regulations

Duty to notify and report accident leading to death

- The employer shall, as soon as is reasonably practicable, notify the commissioner and submit a report not later than 10 days.
- Where any accident leads to the death of any person who is not at work or of any self-employed person, the occupier of the workplace shall notify the commissioner and submit a report not later than 10 days.

Duty to report accident leading to injury

- Where an employee meets with an accident and he –

a) is granted more than 3 days of sick leave; or
b) is admitted in a hospital for at least 24 hours for observation or treatment, the employer of that employee shall submit a report to the commissioner not later than 10 days after the accident.

Duty to notify and report dangerous occurrence

- Occupier to notify commissioner where any dangerous occurrence occurs at a workplace.
- Occupier shall submit a report to the commissioner not later than 10 days after the occurrence.

Duty to report occupational disease

The employer and the registered medical practitioner who diagnoses any employee with an occupational disease, shall each submit a report to the commissioner not later than 10 days after the diagnosis.

Duty to keep records

Employer and occupier shall keep accident records for a period of 3 years.

Failure of Notification-Offences

Penalties

WSH (Incident Reporting) Regulations

Any employer or occupier who fails to comply with these regulations shall be guilty of an offence and shall be liable on conviction –

a) for a first offence, to a fine not exceeding $5,000; and

b) for a second or subsequent offence, to a fine not exceeding $10,000 or to imprisonment for a term not exceeding **SIX** months or to both.

Work Injury Compensation Act

Accidents must report in manner as described.
Failure to do so is a contravention of Section 12 of Workmen Compensation Act and employer is liable, upon conviction to a fine not exceeding $2,000.

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Dangerous Occurrences & Occupational Diseases

Examples of Dangerous Occurrences: (Ref. Second schedule of WSHA)

1. Bursting of a revolving vessel, wheel, grindstone etc.
2. Collapse or failure of a crane, derrick, etc.
3. Explosion or fire damage to the structure of any room or place in which persons are at work

Examples of Occupational Diseases: (Ref. Third schedule of WSHA)

1. Anthrax
2. Arsenical poisoning
3. Noise Induced Deafness
4. Asbestosis

What Accidents to be reported to MOM?

Accident Reporting

- Loss of life
- Disable person from working for more than 3 days
- Hospitalization for at least 24 hours
- Dangerous occurrence
- Any Occupational diseases

Actual employer, instead of the occupier shall submit the incident report to MOM through e-notification system

Incident reporting procedures in worksite

- In case of serious accidents that result in amputation of limbs or death, employer shall as soon as is reasonably practicable, call the Police and notify the Commissioner immediately. Commissioner can be reached by telephone 63171111 or fax 63171446.
- Employer shall submit the report to Commissioner within 10 days using i-Report System from the date of accident. i-Report can be accessed through link: http://www.mom.gov.sg/iReport
- No alteration or addition shall be made to the scene of a fatal accident or a dangerous occurrence without the consent of the Commissioner.

Why must Accidents be reported?

- All serious accidents shall be reported to Ministry of Manpower (MOM).
- MOM will initiate investigation as soon as possible.
- MOM needs:
  - To find out causes and circumstances leading to more serious accidents.
  - To make an analysis of accidents that can be so that hazardous areas can be pinpointed and necessary preventive and remedial measures can be taken to prevent similar mishaps. – To make early assessments of compensation payable to injured workman or dependants of deceased workmen.

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Incident Reporting Procedure

1. All the incidents are to be reported to the supervisor immediately
2. The Supervisor to inform the occupier's safety department for further follow up.
3. Safety personnel accompanied with or without emergency response team will rush to the accident scene and take control.
4. If the injury is minor it would be treated internally by the workplace first aider / medic
5. If major, ambulance will be activated by the ERT leader.
6. If it involves any fire or other dangerous occurrence, SCDF will be activated.
7. Initial report to be submitted by the company supervisor involved in the accident within 24 hours of the accident
8. An investigation team will be formed to investigate in to this accident
9. A detailed report will be prepared by the occupier based on the investigation findings.
10. Basic causes & Root causes for the accident will be identified from the investigation study.
11. Corrective and Preventive actions will be proposed by the occupier for handling future accidents, if any.
12. This will be communicated to all the site personnel through tool box meetings and safety committee meetings for information and compliance
13. The incident should be reported to MOM through online reporting system by "EMPLOYER" of the company involved in the accident with in10 days of the accident if it is a reportable accident.

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Incident Investigation and Reporting
Accident Investigation – Investigator, Procedure & Report

Incident	Who should report	What to do
A workplace accident that causes the death of an employee.	The employer of the injured worker.	· Notify the Commissioner immediately · Submit the incident report within 10 days of the accident
A workplace accident that causes injury to an employee, who is then: · Given more than three days of medical leave; or · Hospitalised for at least 24 hours.	The employer of the injured worker.	· Submit the incident report within 10 days of the accident · If the employee subsequently dies from the injury, the employer must notify the Commissioner as soon as he/she knows of the employee's death.
A workplace accident that involves a self-employed person or member of public, causing him/her to: · Die; or · Sent to hospital for treatment of injury.	The workplace occupier	· Notify the Commissioner immediately · Submit the incident report within 10 days of the accident
A dangerous occurrence -	The workplace occupier	· Notify the Commissioner immediately · Submit the incident report within 10 days of the accident
An occupational disease	·The doctor who diagnosed the disease; and ·The employer of the person with the disease	· Submit the incident report within 10 days of diagnosis (Doctor) · Submit the incident report within 10 days of receiving the written diagnosis (Employer)

Liability for Failure to Report Accidents

Work Injury Compensation Act:
- Accidents must report in manner as described.
- Failure to do so is a contravention of section 12 of Work Injury Compensation Act and employer is liable, upon conviction to a fine not exceeding $2,000

WSH (Incident Reporting) Regulations:
- Failure by an occupier/ employer to report an accident or dangerous occurrence to commissioner is a contravention of WSH (Incident Reporting) Regulations and he is liable to a conviction not exceeding $ 5,000 for first offence and for second or subsequent offence, to a fine not exceeding $ 10,000 or imprisonment for a term of not exceeding 6 months or both.

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9.3 WSH (First Aid) Regulations

Provisions of First-Aid

To provide adequate number of first aids boxes.

- Appoint a first-aider for workplace employing more than 25 workers and at a ratio of one first-aider for every 100 workers.
- First-aider to keep record of treatment.
- To provide and maintain a first-aid room where there are more than 500 workers working.
- To provide and maintain suitable facilities for quick drenching or flushing of the eyes and body, where the eyes or body of any person in a workplace may come into contact with toxic or corrosive substances.

First Aid box

Every first-aid boxes shall:

- be adequately equipped;
- be properly maintained;
- be checked frequently to ensure that it is adequately equipped and that all the items in it are usable;
- be clearly identified as a first-aid box;
- be placed in a location that is well-lit and accessible; and
- be under the charge of a person appointed by the occupier of the workplace.

First-Aiders

- Trained first-aiders shall be provided in the workplace where more than 25 persons are employed. It should be in the ratio of one first-aider for every 100 employees
- First-aiders shall maintain a treatment record.
- A notice shall be affixed in every workplace stating the names of the first-aiders.
- First aid room shall be provided where more than 500 persons are employed.

Offences

- Any occupier or first-aider who contravenes these regulations shall be liable on conviction to a fine not exceeding $5,000.

- First Aid box Content

- Deletion of First and Second Schedules

- The First and Second Schedules to the principal Regulations are deleted.

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9.4 Accident Investigation

What is Accident Investigation?

It is a methodical effort to collect and interpret facts and to establish corrective measures that should be taken to prevent recurrence of the accident.

All incidents such as:

a) Near miss

b) First aid cases

c) Lost – Time injuries

d) Fatal Accidents

e) Dangerous occurrences &

f) Occupational diseases should be investigated

Who is to Investigate?

For Non-Fatal:

Supervisor assisted by WSHO or WSH Coordinator

For Fatal, dangerous occurrence and Occupational diseases:

WSHO or WSH Coordinator, Project Manager & WSH Committee

When the site has no WSHO:

- WSH Committee shall investigate
- WSH Committee is also required to inspect work site after accident or dangerous occurrence

9Objectives of investigation

Why Accidents need to be investigated?

The primary objective of investigating accidents is to establish the ***'Root Cause'*** followed by the implementation of corrective measures to prevent the accident from happening again.

Its purpose should not be to assign blame or push the responsibility to someone else.

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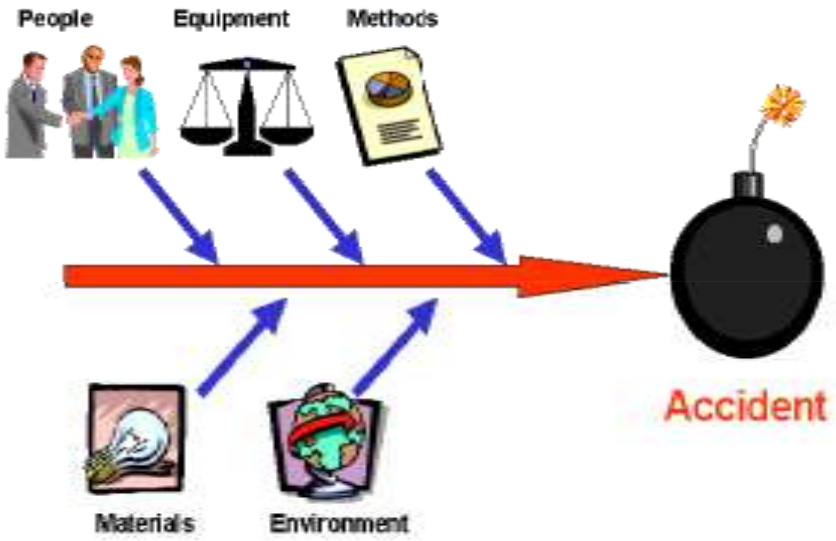
Root Cause Analysis?

Root cause analysis is an analysis that identifies underlying deficiencies in a safety management system that, if corrected, would prevent the same or similar accidents from occurring.



Root cause analysis

People

This element includes not just the workers that are working at the site. We should also look at other human element including the management, sub-contractors' supervisors and workers, clients, visitors, suppliers, and the public.

Let's look at the following examples:

- A careless worker who failed to use safety helmet at the work site bumped his head against a steel bar hanging from the ceiling;
- The project manager is not aware that scaffold system at the work site has to be inspected by a qualified scaffold supervisor once in every seven days. As a result, the scaffold collapsed due to overloading; and
- A supplier deliveryman drove his truck into a deep excavation at the site because he was not familiar with the site layout and condition.

Equipment

This element includes all the tools, machinery, and plants that people work near or with. Fixed machines, vehicles, material handling equipment, powered and hand tools, and so on.

Take note that sub-contractors' and rented equipment, such as air-compressors brought in by painting contractors and mobile cranes hired for a few days usage are equally capable of causing accident, as such they must also be put in proper control.

Unsafe operation of construction equipment is one of the major causes of accident at the work sites. Supervisors should pay particular attention to equipment including tower crane (during erection, operation, and dismantling stage), mobile and crawler cranes, heavy plant and equipment, and hoist.

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Materials

This clement includes any material such as construction materials, chemical, debris that is produced during the construction process, and excavated materials from the site.

Hazardous materials have gained greater attention in recent years. As we are more aware of the health hazards that can he brought by these materials. Information such as the Material Safety Data Sheets (MSDS), safe handling and proper storage procedures should be readily available to effectively control hazards caused by the use of materials

Environment

This element includes all parts of the site and its surrounding:

- building (above and below ground) and enclosure that surround people:
- equipment and materials, the surfaces on which things stand and moves;
- fluids and air which surround other elements:
- chemical hazards such as mists, vapor, gases, fumes and dusts; weather and atmospheric phenomena:
- Biological hazards such as molds, fungi. bacteria and viruses; and
- Physical conditions such as light, noise, heat, cold, pressure, humidity and radiation.

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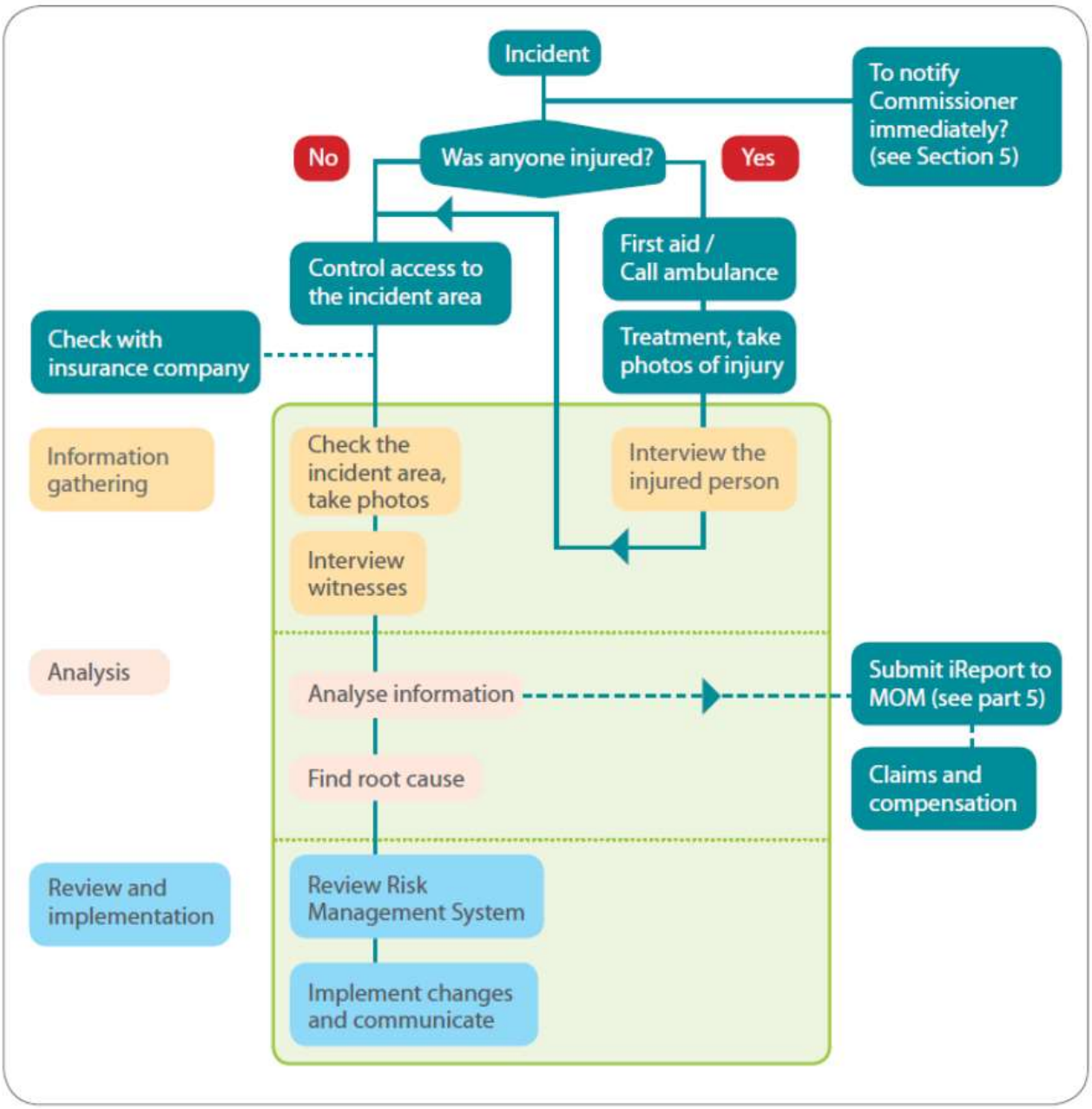
Investigation Flow Chart



Source: WSHC

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Investigation procedures

Steps In Incident Investigation

The accident investigation process involves the following steps:

1) Form accident investigation team
2) Investigate accident/incident
3) Identify the causes
4) Establish corrective measures
5) Report the findings and corrective measures

1) Form Investigation team

Prior to investigating an accident/incident, a team comprising competent persons shall be formed. Ideally, the investigation shall be done or led by someone experienced and trained in accident investigation techniques, such as a Workplace Safety and Health Officer.

The accident/incident investigation team may include the following members:

- Workplace Safety & Health Officer/Supervisor
- Safety committee members
- Trade Supervisors/foreman
- Department heads

2) Investigate the accident

a) Physical Evidence

- Take steps to preserve evidence and identify all witnesses.
  - Take photographs before anything is moved
  - Do not disturb the accident scene

Scene investigation

- Most effective method of investigating incident is to incident is to investigate at exact location of occurrence.
- Examine the accident scene
- Things like tire tracks, footprints, spills, scattered or broken parts, splits, cracks around the area where accident occurred should be noted carefully which may help during investigation.
- Distances, sizes, pressures and temperatures are noted along with the location of all pertinent items in the scene diagram.
- Items which will no remain, or which can be cleaned up has to be photographed.
- Details in the training records, equipment, maintenance records and accident records should be checked

b) Interview Witnesses

- Keep witnesses apart
- Interview witnesses as soon as possible. If witnesses have the opportunity to discuss the event among themselves, individual perceptions may be lost
- Interview witnesses alone
- The purpose of interviewing the witnesses is to establish what happened.
- Witness statement is very important in finalizing root cause for accident

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Do's (at Interview)

- put the witness at ease
- emphasize the real reason for the interview- to determine what happened and why
- let the witness talk
- make short notes
- ask open-ended questions that cannot be answered by simply 'yes' or 'no'
- close on a positive note

Don'ts (at Interview)

- intimidate the witness
- interrupt
- prompt
- ask leading questions
- jump to conclusion

Sample Questions to Ask Witnesses

- Ask open-ended questions such as:

- What is your name?
- What did you see?
- What were you doing before the accident happened?
- Tell me more about what happened.\
- What do you think was the main cause of the accident?

- Avoid leading questions.
- A leading question contains or implies the desired answer.
- Once you ask a leading question, you are suggesting what the witness saw, for example: **Was the light flashing?**

3) **Identify the Causes**

Having gathered evidence from the accident/incident site, the team shall now evaluate these evidences and establish the causes that resulted in the accident/incident, such as the immediate causes and most importantly the root causes.

4) Establish Corrective Measures

Having identified the root causes, the team, shall recommend corrective measures to prevent the recurrence of the accident/incident.

5) Report Findings and Corrective Measures

The purpose of reporting is to document the facts of the accident/incident and to monitor the progress of the corrective measures implemented. The findings and the Topics learnt shall also be shared with all affected persons working on the site.

Communicating corrective actions

1. Safety Bulletins
2. Safety Talks (Organization basis)
3. Safety Committee Meetings
4. Intranet
5. Safety Training (Induction training, OJT, etc.)

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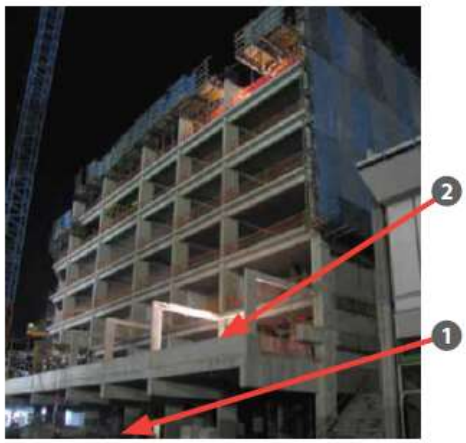
Accident case studies

Case 1: A Worker Fall Together with Formwork Structure

Description of Incident

The deceased was tasked to install barricades to the open sides of a system table formwork structure. While he was standing on top of the table formwork, the structure suddenly toppled and fell over the edge of the building. The deceased landed on a protruding slab on the second floor. He was sent to the hospital where he later succumbed to his injuries.



1. Location the table formwork structure landed.
2. Location deceased landed.

Findings

The table formwork was erected for construction of the building's eighth storey floor slab. It was supported by means of six vertical floor props with two innermost props lashed to anchor points casted within the slab.

Background

While the deceased was on top of the table formwork structure, another worker was below adjusting a misaligned floor prop. The floor prop was adjusted by means of hitting with a mallet.

After hitting the floor prop, the entire table formwork started to tilt and eventually toppled over the edge of the building.

It was likely that during the process of adjusting the floor props, the lashing straps were not tensioned and/or connected to the anchor points casted within the slab.

Management

The risk assessment (RA) conducted did not put in control measures to ensure that no one should be on top of the table formwork structure while the floor props are being adjusted.

Causal Analysis

Evaluation of loss	One worker killed
Type of contact	Fall from heights
Immediate cause(s)	Worker fell together with a toppled formwork structure.
Basic cause(s)	• Failure to identify presence of incompatible work activities • Failure of WSH management system • Failure to ensure effective communication to inform relevant parties regarding incompatible works. • Failure to provide WSH training with regards to formwork

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Recommendation.

Risk Assessment

- Conduct proper RA before start of any work activity. In this case, the work activities are installation of barricade on the table formwork and adjustment of the supporting

- Other than identifying hazards and control measures for each work activity, the RA process must also recognise presence of incompatible works. In this case, installation of barricade on the table formwork and adjustment of supporting floor props are two incompatible work activities taking place simultaneously at the same location.

Planning and coordination

- Ensure that suitable means of communication and monitoring are in place so that work processes are carried out in the appropriate sequence. Where applicable, establish and implement a Fall Prevention Plan (FPP) and Permit-to-Work (PTW) system for all WAH activities where worker is liable to fall.
- Where safety harnesses are to be used, ensure that proper and secured lifelines or anchorage points are provided for workers working at heights.

Safe Work Procedure

- Ensure that all formwork structures are properly secured in place to prevent unwanted displacement.
- Ensure that no one is on top of formwork structure while adjustments are being made to its supporting floor props.

Training and awareness

- Ensure that all personnel (including formwork supervisors and workers) involved in formwork activities have received adequate safety and health training with regards to hazards associated with construction, erection, alteration or dismantling of formwork structures.
- Ensure that workers understand importance of using the relevant Personal Protective Equipment (PPE) such as a safety harness.

Legislative requirements

- Ensure that all formwork structures and related work activities complies with requirements stated in Regulation 9 of the WSH (Construction) Regulations and SS580:2012 (Code of Practice for Formwork).

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Case 2: Mis-Communication

What Happened?

The worker was dismantling the caustic live hose to do maintenance. Suddenly, the caustic soda splashed out of the live line and hit the worker's face.

The worker was wearing a pair of spectacles and some caustic soda enter his eyes. He suffered chemical burns in his eyes.

What caused the accident?

1. Miscommunication between worker & his assistant.
2. Pumps & lines were not tag or for identification.
3. Worker did not follow general safety guidelines on disconnection of hoses.
4. No proper eye goggle.

Topic Learnt

1. Clear & proper communication must be maintenance with co-workers on the work done.
2. Follow procedures & instructions.
3. PPE must be worn and used properly.

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Accident Case Study 3
Case 3: A sewer worker died when earth collapsed on him in a trench

Causes:

- no or inadequate shoring
- surcharge or overburden weight
- soil condition & type of soil
- surface water control
- shoring materials inferior
- design of shoring inadequate

Prevention:

- provide adequate shoring
- provide proper drainage
- use trained and experience workers only
- proper supervision
- defined escape route

Case 4 Electrical accident case study
Description of Accident
A worker was carrying out welding work in a factory premises to erect a mezzanine floor.
He was found dead on the metal structure of the mezzanine floor that was being erected. He was holding a welding electrode holder in his right hand and it was resting on his chest. The autopsy reported that the worker died of electrocution.
A metal jaw and part of the metal upper handle of the electrode holder was exposed as the plastic insulation covering had broken off.
The worker was probably electrocuted when his body came into contact with the energised exposed metal part of the electrode holder.

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Case 5 Collapse of wall

Collapse of Wall at the XYZ Building

On 11 Aug 2000 at about 3.00 pm, a partition wall that was being hacked at the XYZ Building collapsed, killing one shopper, Mr. Lim Ah Seng, and injuring four others. The incident occurred at the ground floor of the building. The building was undergoing some internal renovation works and some minor external works. The work was being carried out by ABC Construction.

Description of Incident

The witness, Mr. Tan Ah Hock saw the whole scene. His interview report is as follows: "A worker was hacking the partition wall using a pneumatic hacker at the time of incident. He hacked the lower portion of the wall and while he was in the process of hacking it, the wall gave way. The wall collapsed and fell onto the shoppers who were seated on benches adjacent to it."

Cause of Accident

The wall that was being hacked was a free-standing wall that was supported by a stiffener column located at its mid-span. When its lower portion was hacked, the wall's stability was affected and this resulted in its collapse.

The collapsed portion of the building was not a structural part of the building. As such, its collapse did not affect the structural integrity of the building.

Partition wall was a brick wall with dimensions 490cm (H) x 600cm (W) x 28cm (thickness). Wall was 1.8m away from timber hoarding dividing worksite from business area.

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Learning Activity Nine- Accident case study

Objective: Conduct an incident investigation and put up an incident report

Discussion and presentation topic
Discuss the incident and identify direct and indirect cause of accident, recommend corrective measure and preventive measure

Work out an Action Plan for implementation
(Facilitator will issue to each group an accident case, group to dis discuss the follow and present to class)

1) DESCRIPTION AND OBSERVATION (What happened, activities carried out at the time, how it happened and what responses were taken)

2) DIRECT CAUSES (What substandard actions and conditions caused or could cause the incident).

3) ROOT CAUSES ALNALYSIS (What human, job factors caused or other factor could have caused the incident. Candidate could use Fish bone diagram or 5 W method.

4) RECOMMENDED CORRECTIVE AND PREVENTIVE ACTIONS (What should be done to control the causes identified)

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Lesson 10
Safety and Health Management System

PS7. Establish and implement Safety and Health Management System in worksite in accordance with general principles and requirements of related WSH Regulations and Guidelines

UK 10 Safety and Health Management System

- Legal requirement
- BCA's requirement for Contractors Registry
- Safety Management Certification System for small and medium construction firms
- SS 506: 2009 Occupational Safety and Health Management System and OHSAS 18001(ISO45001)
- Effective implementation of OHSMS using PDCA cycle
- Cp 79: 1999 Code of Practice for Safety Management System for Construction Sites
- Objectives of the elements of the Safety and Health Management System
- Characteristics of the elements of the Safety and Health Management System
- Practical applications of the elements of the Safety and Health Management System

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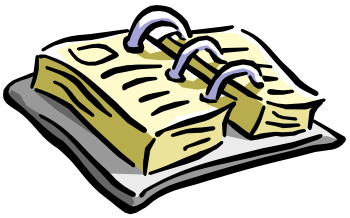
What Is Safety Management System?

Safety and health management system (SHMS) is a systematic process for managing workplace safety and health. The system features:

- Setting goals.
- Planning.
- Measuring performance.
- Managing commitments and direction.



Workplaces must also audit or review their SHMS regularly to ensure continual improvements.

10.1 Legal Requirement

Workplace Safety and Health (Safety and Health Management System and Auditing) Regulations 2009

Implementation of safety and health management system
8.—(1) It shall be the duty of the occupier of every workplace specified in the Second Schedule to implement a safety and health management system for the purpose of ensuring the safety and health of persons at work in the workplace.
(2) The safety and health management system referred to in paragraph (1) shall be implemented in accordance with any relevant Singapore Standard relating to safety and health management systems or such other standards, codes of practice or guidance issued or approved by the Workplace Safety and Health Council.

Workplaces to Implement Safety and Health Management System

1. Any premises which is a worksite.
2. Any premises which is a shipyard.
3. Any factory engaged in the manufacturing of fabricated metal products, machinery or equipment and in which 100 or more persons are employed.
4. Any factory engaged in the processing or manufacturing of petroleum, petroleum products, petrochemicals or petrochemical products.
5. Any premises where the bulk storage of toxic or flammable liquid is carried on by way of trade or for the purpose of gain and which has a storage capacity of 5,000 or more cubic metres for such toxic or flammable liquid.
6. Any factory engaged in the manufacturing of —
   (a) Fluorine, chlorine, hydrogen fluoride or carbon monoxide; and
   (b) Synthetic polymers.
7. Any factory engaged in the manufacturing of pharmaceutical products or their intermediates.
8. Any factory engaged in the manufacturing of semiconductor wafers.

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Audit & Internal Review Requirement of SMS
Workplaces requiring audits

Full SHMS requirements
For the full SHMS requirements, refer to:

Singapore Standard SS506 Part 1: 2009, Occupational Safety and Health (OSH) Management System – Requirements
Singapore Standard SS506 Part 3: 2013, Occupational Safety and Health (OSH) Management System – Requirements for the Chemical Industry
SS ISO 45001: 2018 Occupational health and safety management systems – Requirements with guidance and use

Workplaces requiring audits
You must get an approved workplace safety and health auditor to conduct regular audits if your workplace is one of the following:

Type of workplace	How often to audit
Any worksite with a contract sum of $30 million or more	At least once every 6 months

Workplaces requiring SHMS internal review
Your workplace needs to conduct a periodic internal reviews on the SHMS if the following applies:

Type of workplace	How often to audit
Any worksite with a contract sum of less than $30 million	At least once every 6 months

What is an SHMS internal review?
An internal review is an audit.

You should engage a SAC accredited WSH auditing organisation or WSH auditor to conduct internal reviews.

Alternatively, you can assign a staff who has minimally passed an established audit course to conduct the internal reviews. Such audit course can be the ISO 45001 internal audit training course.

Your internal review must:

- Produce the same outcomes of a developed SHMS.
- Suit to your work activities.
- Effectively implemented at your workplace.
- The internal review report must be:

Kept as record.

- Produced upon MOM Inspector's requests.

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10.2 BCA's Requirement for Contractors registry

Contractor Registry
There are 6 major groups of registration heads namely,

1) Construction Workheads (CW)
2) Construction Related Workheads (CR)
3) Mechanical & Electrical Workheads (ME)
4) Maintenance Workheads (MW)
5) Supply Workheads (SY) and
6) Regulatory Workheads (RW)

For specific registration requirements under each category, refer
http://www.bca.gov.sg/ContractorsRegistry/contractors_registration_requirements.html

Under BCA – Management System (S) Certification

What is BCA Safety Management Certification (SMC) system?
SMC consists of 4 basic requirements:

1. Occupational Health & Safety Policy

2. Planning
   Planning for hazard identification, risk assessment and risk control

   Legal and other requirement
3. Implementation and Operation
   -Structure and responsibility
   -Training, awareness and competence
   -Document control
   -Operation control
   -Emergency preparedness and response

4. Checking and Corrective Action
   -Performance monitoring
   -Accidents, incidents, non-conformances and prevention

The company
Has developed a Quality (Q) and /or Environmental (E) and /or Occupational Health & Safety Management m system (QHSMS) in compliance with the requirements of ISO 9000 and /or ISO 14000 and / or OHSAS 18001**(ISO 45001 three years from 2018**)

Has fully implemented the said SMS and had carried out internal audit and management review of the system; and

Has produced a Quality and /or Environmental and / or OSHMS manual.

BCA will carry out Management System(s) Audit and/ or Surveillance Audits and/or Continuous Registration Audits.

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10.3 Safety Management Certification System for small and medium construction firms

In line with the Joint MND-MOM Review Committee on Construction Safety to extend safety awareness and promote safety culture in small and medium construction firms, BCA has introduced a simplified version of the OHSMS Management system called the 'Safety Management Certification System for Small and Medium Construction Firms (SMC)'.

The SMC was developed to help the small and medium contractors to plan for safety and manage their construction operations in a simple and systematic manner. The SMC enable firms to have clear assignment of responsibilities for their project staff and workers. Firms are required to formulate standard safety procedures on site including regular site and work areas inspections, emergency preparedness, safety training and awareness.

BCA contractors registered in grades C1, C2 as well as L2 to L6 for CR08 (Piling), CR10 (Precast Concrete Products) and CR12 (Soil Investigation & Stabilization) are required to obtain the BCA SMC certification to remain in these grades.

The SMC certification requirement is now extended to contractors registered in grades L2 to L6 for the following workheads:

a) ME01 (Air-Conditioning, Refrigeration & Ventilation Works)
b) ME02 (Building Automation, Industrial & Process Control Systems)
c) ME05 (Electrical Engineering)
d) ME06 (Fire Prevention & Protection Systems)
e) ME11 (Mechanical Engineering)
f) ME12 (Plumbing & Sanitary Works)
g) MW02 (Housekeeping, Cleansing, Desilting & Conservancy Service)
h) MW03 (Landscaping)
i) MW04 (Pest Control)

Companies that are certified with a valid OHSAS 18000 (ISO45001)are exempted from the SMC certification.

SMC consists of 4 basic requirements:

Occupational Health & Safety Policy

Planning

- Planning for hazard identification, risk assessment and risk control
- Legal and other requirement

Implementation and Operation

- Structure and responsibility
- Training, awareness and competence
- Document control
- Operation control
- Emergency preparedness and response

Checking and Corrective Action

- Performance monitoring
- Accidents, incidents, non conformances and prevention

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Development of the SMC System

SCAL provides a 2-day workshop to help firm to develop the SMC system. At the end of the workshop, firms will have an understanding of the requirements of the SMC's requirements, complete drafting the SMC manual and ready to implement the SMC system. The workshop will guide the firms to develop the SMC manual. The aim of this manual is to help the contractors to facilitate easy implementation, meet the minimum requirement of the SMC and to keep the documentation and records to a minimum.

Firms will usually take 3-5 months to implement the system in their projects after the workshop. During this period, firms should implement the system, review their system and gauge the effectiveness of the system. If the firm is satisfied the SMC is in-place, the firm can proceed to submit the application to BCA to arrange for the SMC certification audit.

For more information on the workshop, please contact SCAL at Tel: 62729986

SMC Certification Audit

Upon receipt of the application, BCA will arrange with the firm on the audit date. The applicant firm shall submit its SMC Occupational Health & Safety Manual/Procedures with the application form.

The objective of the audit is to confirm that of the applicant firm conforms to all requirements of the BCA SMC requirements.

During the audit, non-conformity and/or observation reports may be issued. The applicant firm should clarify and understand fully the non-conformities raised before acknowledging them.

All non-conformities shall be closed out within the specified time frame. A recommendation for either the award or non-award of the certificate will then be made.

Should major non-conformities be raised during the audit, the applicant firm will have to go through a re-audit. The lead auditor will determine the number of man days required for the re-audit. The applicant firm shall pay to BCA all costs incurred for the re-audit.

Surveillance Audit

Yearly surveillance audits will be conducted to ensure the certified firm continues to comply with the requirements of the SMC. BCA reserves the right to conduct additional audits as it deems fit.

Firms certified under the BCA SMC Certification Scheme can combine both quality and environmental Management system routine surveillance audits.

Renewal of certificate

The SMC certificate will be renewed every three years if the firm continued to meet the SMC requirements.

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10.4 SS 506: 2009 Occupational Safety and Health Management System and OHSAS 18001
The OHSAS 18001 standard (will be ported to ISO 45001)

Safety Management System

- The Safety Management System (SMS) is a systematic process for managing workplace safety and health.
- It provides for goal setting, planning and measuring performance.
- It sets out clear management commitments, direction and approaches for workplace safety and health.
- The system needs to be periodically audited or reviewed to ensure continual improvement.

- based on the Plan-Do-Check-Act (PDCA) methodology
- specifies the requirements for an appropriate WSH policy, objectives, and procedures that accommodate legal, regulatory, customer and organisational requirements

Singapore Standards (SS) 506 Occupational Safety and Health Management System

- Part 1 – Requirements
- Part 2 – Guidelines for the implementation of SS 506: Part 1 : 2009
- Part 3 – Requirements for the chemical industry

Elements of WSH management systems

1. OSH Policy

- provide leadership and visible commitment
- to improve safety and health performance
- essential to continual improvement of safety and health in a workplace

2. Planning

- Planning for hazard identification, risk assessment and risk control
- Legal requirements
- Objectives
-
- OSH management programme(s)

3. Implementation and operation

- Structure and responsibility
- Training, awareness and competence
- Consultation and communication
- Documentation
- Document and data control
- Operational control
- Emergency preparedness and response

4. Checking and corrective action

- Performance measurement and monitoring
- Accidents, incidents, non-conformances and corrective and preventive action
- Records and records management
- Audit

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5. Management Review

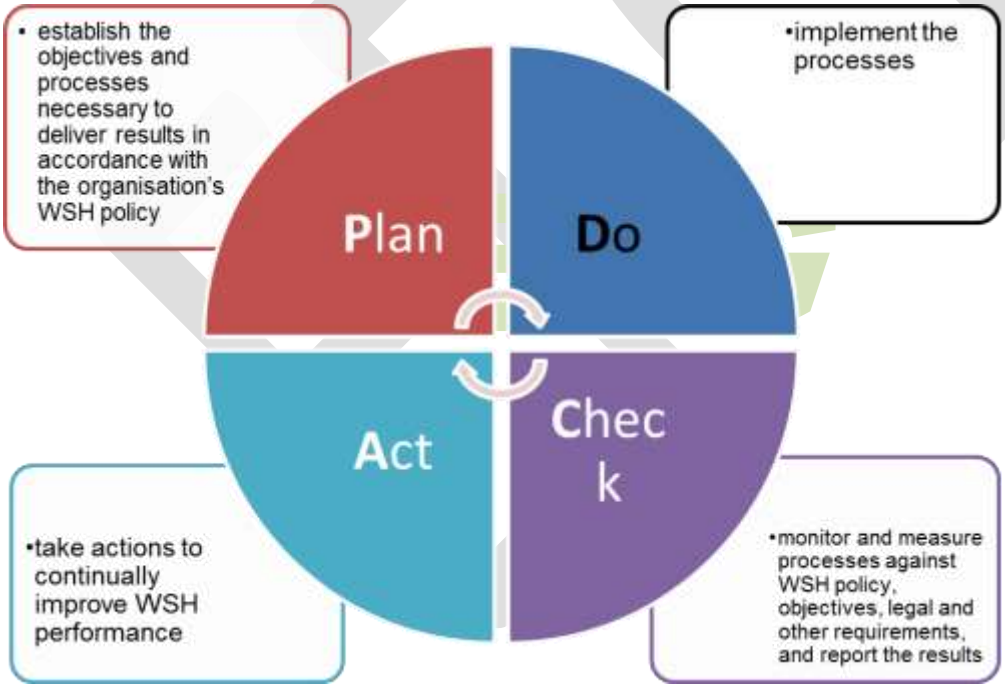
- be reviewed, at regular interval, to ensure its suitability, adequacy and effectiveness.
- review include whether WSH policy is still appropriate, update of objectives, risks level and adequacy of control measures, evaluation of performance, and whether changes to the element of management system are required

10.5 Effective implementation of OHSMS using PDCA cycle

SS 506 Occupational Safety and Health Management System

The four phases in the Plan-Do-Check-Act Cycle involve:
Plan: Identifying and analyzing the problem.
Do: Developing and testing a potential solution.
Check: Measuring how effective the test solution was, and analyzing whether it could be improved in any way.
Act: Implementing the improved solution fully.

SS 506 Occupational Safety and Health Management System



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Elements of SS506: Part 3 2006

- 4.2 OSH Policy
- 4.3 Planning
  - 4.3.1 Planning for hazard identification, risk assessment and determining control
  - 4.3.2 Legal and other requirements
  - 4.3.3 Objectives and targets
  - 4.3.4 OSH management programme(s)

Elements of SS506: Part 3 2006

- 4.4 Implementation and Operation
  - 4.4.1 Structure, responsibility, authority and in-house OSH rules and regulations
  - 4.4.2 Training, awareness and competence
  - 4.4.3 Consultation and communication
  - 4.4.4 Documentation
  - 4.4.5 Control of documents
  - 4.4.6 Operational control
  - *4.4.7 Occupational health*
  - 4.4.8 Emergency preparedness and response

Elements of SS506: Part 3 2006

- 4.5 Checking and corrective action
  - 4.5.1 Performance measurement and monitoring
  - 4.5.2 Evaluation of compliance
  - 4.5.3 Incidents, accidents, nonconformity, corrective action and preventive action
  - 4.5.4 Control of records
  - 4.5.5 Internal Audit
  - 4.6 Management review

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10.6 CP 79: Code of Practices for Safety Management system

Safety And Health Management System Elements

- ELEMENT 1 – Safety Policy
- ELEMENT 2 – Safe Work Procedures
- ELEMENT 3 – Safety Training
- ELEMENT 4 – Group Meetings
- ELEMENT 5 – Incident Investigation and Analysis
- ELEMENT 6 – In-House Safety Rules & Regulations
- ELEMENT 7 – Safety Promotion
- ELEMENT 8 – System for Evaluation, selection and control of contractors
- ELEMENT 9 – Safety Inspection
- ELEMENT 10 – Maintenance Regime
- ELEMENT 11 – Risk Assessment
- ELEMENT 12 – Control of Movement and use of hazardous substance
- ELEMENT 13 – Occupational Health Programme
- ELEMENT 14 – Emergency Preparedness

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10.7 Objectives of the elements of Safety and Health Management System

10.8 Characteristics of the elements of Safety and Health Management System

Element 1: Safety Policy

Objective

To establish and maintain a written safety policy, which spells out management's commitment towards safety and the principles that govern safety and health decisions in the workplace.

An effective Safety Policy shall demonstrate the management commitment towards safety and health improvement, its objectives and directions, including goal setting.

The safety policy shall include the following:

- Accountability for the safety and health function by top management.
- Allocation and delegation of duty and responsibility for safety and health from the top management to the line staff.
- The safety policy shall be signed by the senior management of the workplace
- The safety policy shall be effectively communicated to all employees
- The safety policy should be reviewed at defined intervals and updated

Element 2. Safe Work Practices

Objective:

To ensure that all works are carried out in a safe manner so as to eliminate or minimise occurrence of incidents

Occupier must :

- establish & maintain procedures for the safe execution of works
- consult relevant standards and codes of practices
- document work procedures, method statements or permit-to-work system
- take public safety into consideration

Safe Work Practices shall include

- specific work processes such as piling and excavation.
- use of plant, equipment & machinery.
- erection and use of temporary structures and installation.

Application of Safe Work Practices

Following stages should be considered

- design and approval
- mobilisation
- construction
- de-mobilisation

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Permit-To-Work System

- works at height (eg. works on scaffold)
- works in confined space
- works involving excavation and trenching
- works involving hazardous materials
- works in hazardous environment
- hot-work.

Statutory requirements on SWP:

- establish and maintain a list of statutory requirements
- See 2.6 of CP 79
- have procedures to update this listing

Element 3. Safety Training

Objective:

- To equip employees at all levels with knowledge, skills and attitudes which will enable them to perform their duties in a safe & efficient manner.

General:

- establish procedures to identify training needs
- provide adequate safety training including refresher training
- proper training records are documented & maintained
- training is given in *languages* understood by the trainees Identification of training needs
- Statutory training requirements
- other safety training

Training should be provided for

- management personnel
- supervisory personnel
- workers

Training records

- documented and maintained

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Element 4. Group Meetings

Objective:

To inform & formally address issues & take appropriate actions to achieve the worksite safety & health management objectives

Safety Committee:

Establish a mechanism whereby decisions & actions can be effectively communicated

- clearly defined functions and responsibilities
- minutes should be recorded and maintained
- decisions and follow-up actions should be clearly documented

Safety Committee should include:

- the chairman who shall be the most senior manager on site
- the secretary who shall be the safety officer
- sufficient representatives to ensure all aspects of operation are adequately covered

Tool box meetings and safety briefings

- TBM conducted at stipulated intervals within work groups, to effectively communicate and coordinate work instructions
- safety briefings conducted regularly for larger cohorts

Co-ordination meeting

- Work operations are properly coordinated
- to eliminate hazards arising from poor management of work operations

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Element 5. Incident Investigation and Analysis

Objective:

To establish causes of incidents & to prevent recurrence

Procedures should be established to:

- Identify
- Record
- Investigate
- Analyse

Incidents at work with objective of implementing specific corrective actions to prevent recurrence

Procedures be established to:

- ensure implementation of follow-up actions
- reports of incidents by all personnel including contract workers & sub-contractors to designated person

Investigation of incidents:

- types of incidents to be investigated
- prompt reporting of incidents to designated persons
- competent persons responsible for the investigation
- investigation procedures
- identification of root causes
- recommendation and implementation of follow-up actions

Analysis of incidents statistics:

Establish procedures to monitor and analyse incident trend and provide preventive actions for multiple projects or projects with long contract period

- types of incidents
- agency of incidents
- causes of incidents
- human elements
- incident frequency rate and incident severity rate

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Element 6. In-house Safety Rules and Regulations

Objective:

To ensure all personnel know their obligations and responsibilities & comply to the rules & regulations

Rules and Regulations should be established to give clear instructions on:

- provision and use of PPE
- safe operation / maintenance of plant, machinery & equipment
- safe handling, storage & use of materials
- reporting of hazards and incidents
- general housekeeping of worksite
- removal of fire hazards

Rules and regulations should be conform to the WSH Act and its subsidiary legislations and all other statutory requirements

Training and review

- Training - communicated to all through safety promotion, training or other means
- Review - establish procedures to ensure its suitability and effectiveness. Records of reviews should be maintained

Safety Signs

- establish a system of colour coding and safety signs to draw attention and provide information on potential hazards
- colour coding and safety signs should conform to the existing standards such as SS 217.

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Element 7. Safety Promotion

Objective:

To develop and maintain awareness among all personnel

General:

- Establish and maintain programs to promote safety
- Demonstrate the management's commitment
- Promotional activities should:
- 1. Display of safety policy
- 2. Display of incident statistics and pictures
- 3. Display of safety banners and posters
- 4. Distribution of safety handbooks and brochures
- 5. Participate in external safety activities
- 6. Conduct of in-house safety exhibition and safety talks
- 7. Demonstration of safe work procedures
- 8. Screening of safety videos or slides
- 9. Setting up of safety improvement teams
- 10. Demonstration of first-aid drills
- 11. Conduct of emergency drills and exercise

Safety bulletin boards

- provide, erect and maintain at suitable locations
- display safety information such as safety policy, safety news, safety posters

  Recognition of good safety performance
- establish procedures to recognise, acknowledge and reward individuals and teams

Records of promotion activities

- properly documented and maintained

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Element 8. Selection, Evaluation and Control of Sub-contractors

Objective:

To ensure that subcontractors are fully aware of their obligations and only subcontractors who can meet these obligations are employed at the worksite

General:

- set up a system to evaluate the safety performance of subcontractor
- only competent subcontractor should be selected
- subcontractor should be provided with full understanding of all safety requirements and expectations before commencement of works
- subcontractors should meet these requirement and expectations at all times during the construction phase

Evaluation of subcontractor

- establish procedures
- results of evaluations should be used for future selection

Selection of subcontractor

- establish procedures
- written contract agreement should stipulate performance of the subcontractor including specific safety requirements for the works

Control of subcontractor

- establish procedure to ensure that the safety requirements in the contract agreement are implemented effectively during construction phase

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Element 9. Safety Inspection

Objective:

To verify that safety provisions & practices conform to worksite rules & regulations & relevant statutory requirements.

General:

Establish and maintain documented procedures for safety inspections to ensure that unsafe conditions and practices at the worksite are identified and corrective measures are implemented promptly and effectively

Types of inspections

- General regular inspection
- safety committee inspection
- Plant, machinery and equipment inspection
- Special inspection

Special Inspections

- incident occurrence
- hazard analysis
- specialised operations & equipment
- specified inspections as required by authorities

Competency of safety inspection

- competent persons
- conversant with safe work practices, in-house safety rules, and statutory requirements

Inspection methodology

- Safety inspection including non-statutory, to be carried out at a specified frequency & thoroughness commensurate with environment changes
- Suitable safety checklist to facilitate the inspection
- Results of the inspection should be recorded in the checklist and reported to the responsible person

Follow-up system

Establish procedures for the implementation of corrective and preventive actions

  - investigation of the cause of unsafe practices and conditions
  - determination of actions needed to eliminate the cause of non-conformities
  - application of controls to ensure that corrective and preventive actions are taken and that they are effective
  - monitoring the implementation of the corrective actions

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Element 10. Maintenance Regime

Objective:

To ensure all hand tools, plant, machinery and equipment used at the worksite are regularly maintained so that they do not present any hazard due to lack of repair and maintenance

The Occupier to:

- Establish maintenance program to ensure safe & efficient operation of hand tools, plant, machinery and equipment used at worksite.
- Should apply to hand tools, plant, machinery and equipment owned by all sub-contractors and suppliers

The Maintenance Program should include:

- listing of hand tools, plant, machinery and equipment
- schedule of inspection and maintenance
- procedure for breakdown and repair
- record of inspection and maintenance

Competency of maintenance Personnel:

- trained and competent
- repairs and maintenance carried out by outside agents should conform to the manufacturer's recommendations and specifications and worksite's in-house rules and regulations

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Element 11. Hazard Analysis

Objective

Identify and manage existing minimise the risk of incidents in a way that eliminates or reduces to an acceptable level, the risk of an incident occurring

General:

- Establish procedures to identify and analyse all existing and potential hazards.
- The procedures should include the development and implementation of hazard analysis plan.

Hazard Analysis Plan:

- formation of hazard analysis team
- duty and responsibility of team members
- hazard analysis method
- hazard analysis report
- implementation of control measures

Hazard Analysis Method:

- identification and record of existing and potential hazards
- identification of persons exposed to the hazards
- analysis and assessment of the risk involved
- elimination or prevention of the risk

Hazard Analysis Report:

- record of all existing and potential hazards
- findings of analysis and assessment
- development and implementation of control measures

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Element 12. Control of Movement and Use of Hazardous Substances / Chemicals

Objective:

To ensure that the storage, movement, use and disposal of hazardous substances and chemicals are managed to minimize occurrence of incidents

The Occupier shall establish procedures to ensure:

- *receipt*
- *storage*
- *distribution*
- *use*
- *final disposal*
- of hazardous substances and chemicals which shall include flammable, toxic or corrosive substances are managed properly

Occupier should maintain a register of hazardous materials compiled from MSDS or other analysis which should show:

- composition, physical & chemical characteristics
- instruction of safe handling, storage, use and disposal

Occupier should ensure that personnel involved in the storage, handling and use of hazardous materials are

- competent & trained
- fully aware of the safeguards & measures

Occupier should establish procedures for labelling, issue, distribution and use of hazardous substances

Communication of hazards associated with the hazardous materials by the competent person to the users

- safety training and instruction to the users
- personal protective equipment
- suitable identification tag to be worn by the users handling the materials

Designated storage areas should be:

- appropriate for the materials
- secured against unauthorised access
- Materials should be returned to designated storage areas when not in use
- The procedures for disposal of hazardous materials should be carried out in accordance with statutory requirements or manufacturer's recommendations

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Element 13. Emergency Preparedness

Objective:

To ensure emergency situations can be managed effectively to minimise loss

- The occupier should establish emergency plans to respond to emergency situations
- The plans should be reviewed or tested regularly to ensure its effectiveness and suitability

Types of emergency situations:

- fire
- explosion
- failure and collapse of structure
- failure and collapse of heavy machinery and equipment
- leakage of hazardous materials
- adverse weather and flooding
- any other incident resulting in mass loss

Emergency plan:

- formation of emergency team and their duties and responsibility
- appointment of emergency coordinator
- procedure for notification and raising of alarms
- initial response procedures and site layout plans
- an effective evacuation plan
- communication to relevant authorities (SCDF, PUB, Police)
- procedures and means of controlling and containing loss such as provision of first aid

Emergency team should comprise:

- emergency coordinator
- first aider
- site safety personnel
- designated fire wardens and rescuers
- specialist operators

Emergency drills and exercise:

- conduct drills at defined intervals to test the effectiveness
- records should be maintained for evaluation

First aid program:

- to provide first aid and emergency treatment to victims
- adequate first aid facilities and trained first-aider

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Element 14. Occupational Health Programme

Objective:

To protect workers from health hazards relevant to construction industry such as noise, dust, toxic gases, vapours & radiation.

Occupier should:

Plan & implement occupational health programmes on:

(1) hearing conservation

(2) respiratory protection.

Occupier should:

Provide education and training to all workers on:

(1) relevant health hazards;

(2) safe work practices; and

(3) proper use of personal protective equipment.

Different between CP 79, SS506 and OSHA 1800

CP 79	SS506	OSHA 18000(ISO45001)
Based 14 elements	Based on PDCA cycle	Based on PDCA cycle
Local standard for construction	Local standard for all industry	International standard for all industry
Audit is not one of the element	Pay attention to Audit and continuous improvement	Pay attention to Audit and continuous improvement
Local requirement	A certification system	A certification system

10.9 Practical applications of the elements of Safety and Health Management System

See Learning Activity 10

Learning Activity Ten

Objective: Describe practical implementation for element of safety management system

Discussion and presentation topic

- Discuss and list down the Practical application of the element of Safety and health Management System
- Group to choose 2 elements from below list of element and present to the class.

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Lesson 11
Safety and Health Audits

PS8.Plan and participate in safety and health audit and review in worksite in accordance with general principles and requirements of related WSH Regulations and Guidelines

UK 11 Safety and Health Audits

- Legal requirement of audit and review under WSH (Construction) Regulations 2007 and WSH (Safety and Health Management System and Auditing) Regulations 2009
- Objectives and benefits of audits
- Audit methodology
- Audit process
  - Pre-audit activities
  - On-site audit activities – document review, personnel interview and physical inspection
  - Post audit activities
- Construction Safety Audit Scoring System (ConSASS)
- bizSAFE programme
- WSH Awards

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Safety & Health Audits

11.1 Legal requirement of audit and review under WSH (Safety and Health Management System and Auditing) Regulations 2009

It shall be the duty of the occupier of any workplace specified in the Third Schedule to appoint a workplace safety and health auditor to audit the safety and health management system of the workplace at a frequency as specified in that Schedule.

Workplace Safety and Health (Safety and Health Management System and Auditing) Regulations 2009

Implementation of safety and health management system
8.—(1) It shall be the duty of the occupier of every workplace specified in the Second Schedule to implement a safety and health management system for the purpose of ensuring the safety and health of persons at work in the workplace.

(2) The safety and health management system referred to in paragraph (1) shall be implemented in accordance with any relevant Singapore Standard relating to safety and health management systems or such other standards, codes of practice or guidance issued or approved by the Workplace Safety and Health Council.

Audit & Internal Review Requirement of SMS

Workplaces requiring audits
You must get an approved workplace safety and health auditor to conduct regular audits if your workplace is one of the following:

Workplaces requiring audits
You must get an approved workplace safety and health auditor to conduct regular audits if your workplace is one of the following:

Type of workplace	How often to audit
Any worksite with a contract sum of $30 million or more	At least once every 6 months

Workplaces requiring SHMS internal review
Your workplace needs to conduct a periodic internal reviews on the SHMS if the following applies:

Type of workplace	How often to audit
Any worksite with a contract sum of less than $30 million	At least once every 6 months

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11.2 Objectives and Benefits of Audit

Objectives

a) To evaluate the SHMS against WSH Act and its Subsidiary legislation

b) To verify the effectiveness of SHMS implementation in the workplace

c) To identify any non-conformances against the legal requirements and in-house requirements

Benefits

a) To make changes and related improvements in the procedures and current practices in the workplace as well as within the organization from audit reports.

b) To evaluate company's SHMS

c) To comply with the law

11.3 Audit methodology

- Audit must be conducted by at least 2 approved WSH Auditors and Audit protocol should comprise

a) Opening meeting

b) Familiarization tour

c) Assessment of written SHMS

d) Verification of implementation including physical inspection, document verification and interviewing of personnel

e) Evaluation of findings and

f) Exit meeting

11.4 Audit Process

The audit process involves the following

- Pre-audit activities
- On-site audit activities
    - a) Document review
    - b) Personnel interview
    - c) Physical inspection
- Post audit activities

11.4.1 Pre-audit activities

- The Lead auditor of the auditing organization should establish contact with the auditee's organization.
- Date and duration of audit shall be agreed and finalised.
- Details of contact person, venue etc. are to be confirmed.
- An audit programme shall be sent by the lead auditor as an official confirmation

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11.4.2 On-site audit activities

This consists of 3 parts

The audit will commence with an opening meeting involving key personnel followed by

(a)Document review

The documents covering the scope of audit will be checked for compliance against legal as well as company's requirements.

(b) Personnel interview

-Interviewing personnel is part of the audit process.

-Key personnel from main contractor and sub-contractor will be chosen.

-They will be interviewed by the auditors to check and understand the process and effectiveness of site implementation of various safety systems.

(c) Physical inspection

Physical inspections are carried out to verify the site implementation of the Safety and Health management system

To verify the safety promotions and good safety practices implemented in the workplace.

11.4.3 Post audit activities

-Upon completion of audit, there will be a closing meeting.

-The audit findings will be made known to the auditee management including good practices observed and non-conformities identified during audit

- Two copies of audit report will be handed over to the auditee management for signature and one copy will be collected back as an acknowledgement.
- The auditee company will be asked to prepare an action plan on the audit findings and document it for implementation and follow up.

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11.5. Construction Safety Audit Scoring System (ConSASS)

- The Construction Safety Audit Scoring System (ConSASS) is an audit tool which provides an independent assessment of the safety and health management system at a worksite
- Construction companies with a worksite contract sum of $30 million or more need to submit their workplace's safety and health management system (SHMS) audit using the Construction Safety Audit Scoring System (ConSASS).
- ConSASS provides a profile of the development status and maturity level of each component of a worksite's safety and health management system.

The Construction Safety Audit Scoring System (ConSASS) is a standardised audit tool which provides an independent assessment of the safety and health management system (SHMS) at a worksite

ConSASS comprises of a standardised audit checklist and score card that can be used to evaluate the effectiveness and development status of the worksite's safety and health management system (SHMS).

- ConSASS checklist encompasses approximately 330^{+} questions.
- Interview checklist comprising 51 interview questions for site personnel from all levels.
- They are structured based on "Plan - Do – Check – Act (PDCA)" cycle

At a glance

Who can submit	Company's workplace safety and health (WSH) auditor and company representative.
When to submit	After an audit is completed.

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ConSASS checklist sample

Construction Safety Audit Scoring System (ConSASS) Audit Checklist

Dated: 18 May 2007

BAND	S/No.	Guidance notes and standard specifications	Audit Question	DR /PR	Ref Yes	Ref No	Ref NA	Auditor's Remarks
	1		OSH Policy					
I	1.1	The policy shall be documented, implemented and maintained *(SS506:Specifications - 4.2a)* The occupier's management with executive or site responsibility shall define and document its policy for safety including objectives for its commitment to safety. *(CP79 - Section 1.2)*	Is there a documented OSH policy? Check for documented policy (if no, proceed to next section)	DR				
I	1.2	There shall be an occupational safety and health policy authorised by the organisation's top management that clearly states overall safety and health objectives and a commitment to improving safety and health performance. *(SS506:Specifications - 4.2)* *Top management refers to the higher levels of the organisation's management. E.g. CEO, COO, Vice president or General Mangers in large organisations.*	Is the OSH Policy authorised by the organisation's top management? Check policy for for the above requirement. *Top management refers to the higher levels of the organisation's management. E.g. CEO, COO, Vice president or General Mangers in large organisations.*	DR				Final Score: /2
II	1.3		Does the OSH Policy include the following key points or characteristics?					

ConSASS Scoring Card

CONSTRUCTION SAFETY AUDIT SCORING SYSTEM - SCORE CARD **APPENDIX 2**

Name of Company: _____ **Audit Date:** _____

S/No.	System Elements	BAND I	BAND II	BAND III	BAND IV	Score in the failed band (%)
1	OSH Policy					
2.1	Planning for hazard identification, risk assessment and risk control					
2.2	Legal and other requirements					
2.3	Objectives					
2.4	OSH Management Programme(s)					
3.1	Structure and responsibility					
3.2	Training, awareness and competence					
3.3	Consultation and communication					
3.4	Documentation					
3.5	Document and data control					
3.6	Operational control					
3.7	Emergency preparedness and response					
4.1	Performance measurement and monitoring					
4.2	Accidents, incidents, non-conformances and corrective and preventive action					
4.3	Records and records management					
4.4	Audit					
4.5	Management review					
	Total Elements in band:					

Name of Lead Auditor: _____ **Signature of Lead Auditor:** _____

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ConSASS Scoring Banding

S/No.	System Elements	Band 1	Band 2	Band 3	Band 4
1	OSH Policy	2	6	4	4
2.1	Planning for hazard identification, risk assessment and risk control	6	6	5	3
2.2	Legal and other requirements	2	2	1	1
2.3	Objectives	2	5	7	5
2.4	OSH Management Programme(s)	3	3	3	2
3.1	Structure and responsibility	1	6	4	4
3.2	Training, awareness and competence	7	15	9	6
3.3	Consultation and communication	6	10	12	7
3.4	Documentation	1	4	4	2
3.5	Document and data control	2	6	4	1
3.6	Operational control	8	11	13	5
3.7	Emergency preparedness and response	3	7	4	3

A Great Workforce A Great Workplace

Maturity Band Example

- Element '2.1 – Planning for hazard identification, risk assessment and risk control'
- Start from Band I, 6 questions
- Verified that the SHMS was able to satisfy 5 out of 6 questions in the band.

$$\text{Percentage attained} = \frac{\text{No. of qns satisfied}}{\text{No. of qns in band}} \times 100\% = \frac{5}{6} \times 100\%$$
$$= 83\% \rangle 70\% \text{ (passing percentage)}$$

- Proceed to check questions in Band II.
- SHMS was able to satisfy 4 out of 6 questions in Band II.

$$\text{Percentage attained} = \frac{\text{No. of qns satisfied}}{\text{No. of qns in band}} \times 100\% = \frac{4}{6} \times 100\%$$
$$= 67\% \langle 70\% \text{ (passing percentage)}$$

- Audit stops as the result is lower than the passing percentage of 70%. Element 2.1, Band II is graded as 67%.

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ConSASS enhancement 2013

Enhancements – ConSASS Checklist

PAST VERSION	NEW VERSION
• Generally requires 4 Man-days	• Retained
• Elements are structured in the P-D-C-A cycle	• Retained
• 336 Questions based on CP79, UAI and **SS506: 2004**	• 348 Questions based on CP79, UAI and **SS506: 2009**
• Questions are band according to increasing maturity levels	• Questions are banded according to increasing maturity levels based on a distinct framework.

Enhancements – ConSASS Checklist

- **Band I:** Questions evaluate whether the OSHMS has a particular provision.
- **Band II:** Questions evaluate whether the content of the particular provision is sufficiently comprehensive.
- **Band III:** Questions check whether the particular provision is well-implemented on site.
- **Band IV:** Questions evaluate whether the company/ site has implemented selected industry best practices.

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Enhancements – Score Card

PAST VERSION

S/No.	System Elements	BAND				Score in the failed band (%)
		I	II	III	IV	
1	OSH Policy				x	
2.1	Planning for Hazard Identification, Risk Assessment and Risk Control			x		33%
2.2	Legal and Other Requirements				x	
2.3	Objectives			x		40%
2.4	OSH Management Program(s)		x			67%
3.1	Structure and Responsibility			x		50%
3.2	Training, Awareness and Competence		x			56%
3.3	Consultation and Communication		x			58%
3.4	Documentation			x		50%
3.5	Document and Data Control			x		
3.6	Operational Control		x			66%
3.7	Emergency Preparedness and Response			x		67%
4.1	Performance Measurement and Monitoring	x				67%
4.2	Accidents, Incidents, Non-conformance and Corrective and Preventive Action			x		34%
4.3	Records and Records Management			x		50%
4.4	Audit			x		67%
4.5	Management Review	x				38%
	Total Elements in band	2	4	9	2	

NEW VERSION

S/No.	System Elements	BAND			
		I	II	III	IV
1	OSH Policy	100%	100%	100%	100%
2.1	Planning for hazard identification, risk assessment and risk control	100%	75%	60%	
2.2	Legal and other requirements	100%	100%	100%	100%
2.3	Objectives	100%	100%	50%	
2.4	OSH Management Programme(s)	100%	100%	80%	50%
3.1	Structure and responsibility	100%	100%	100%	100%
3.2	Training, awareness and competence	75%	60%	71%	
3.3	Consultation and communication	100%	62%	73%	
3.4	Documentation	100%	100%	100%	100%
3.5	Document and data control	100%	100%	100%	100%
3.6	Operational control	100%	76%	88%	33%
3.7	Emergency preparedness and response	100%	70%	88%	100%
4.1	Performance measurement and monitoring	100%	89%	100%	60%
4.2	Accidents, incidents, non-conformances and corrective and preventive action	100%	83%	67%	
4.3	Records and records management	100%	100%	100%	100%
4.4	Audit	100%	75%	83%	67%
4.5	Management review	100%	83%	80%	50%
	No of Total element score 70% and above	17 / 17	15 / 17	12 / 17	7 / 17
	% of Total element score 70% and above:	100%	88%	71%	41%

Construction Safety Audit Scoring System (ConSASS)

<u>Benefits of ConSASS</u>

1) A source of motivation to strive for improvement in managing safety and health risks
2) Allows cross comparison of worksites' effectiveness in managing safety and health risks
3) Provides a standardized audit protocol and scoring system for the auditors

4) Results can be taken into consideration when awarding projects by the developers
5) Helps management to better allocate resources in order to elevate standard and improve the effectiveness in managing a worksite's safety and health risks

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11.6 BizSAFE Programme

BizSAFE is a five-step programme to assist SMEs build up their WSH capabilities in order to achieve quantum improvements in safety and health standards at the workplace.

a) BizSAFE Level 1

Demonstrate top management commitment by attending a BizSAFE Workshop for CEOs / Top Management (half day).

b) BizSAFE Level 2

Acquire Risk Management capability by nominating a Risk Management (RM) Champion to attend and complete a BizSAFE course on Risk Management (2 full days).

c) BizSAFE Level 3

Implement Risk Management and have it assessed by an approved independent MOM WSH Auditor. Subject to the auditor's report that the enterprise has met the requirements of the WSH (RM) Regulations, the enterprise may then be recognised as BizSAFE Level 3.

d) BizSAFE Level 4

Acquire capability in managing WSH systematically by selecting a Workplace Safety and Health Management System (WSHMS) Programme Lead to attend the BizSAFE course on WSHMS (4 full days).

e) BizSAFE Level 5 (STAR)

Deliver excellence in WSH Management System through achieving SS 506 / OHSAS 18001:2007 certification.

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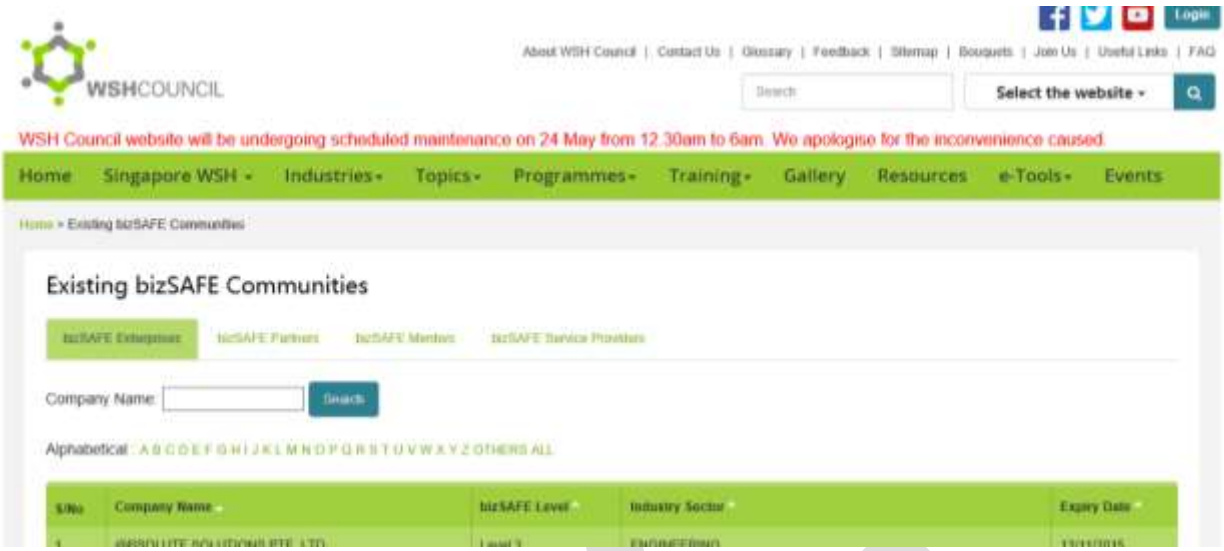
BizSAFE community

1) Companies in the BizSAFE community are listed on the WSH Council's website



2) Companies can proudly display the BizSAFE logo on their business collaterals (such as letterheads, name cards etc) as a reflection of their commitment to safety.

3) A company enjoys other business privileges and advantages offered by BizSAFE partners

4) BizSAFE allows SMEs to be able to meet contractual requirements by BizSAFE partners

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11.7 WSH Awards

Presented by the Workplace Safety and Health (WSH) Council and supported by the Ministry of Manpower

The Awards recognises organisations and individuals who have contributed to achieving excellence in workplace safety and health.

The national awards provide various categories to recognise supervisors, WSH officers and companies with innovative WSH practices and excellent WSH performance.

The Award categories are

1) WSH Developer Awards
2) WSH Performance Awards
3) Safety and Health Award Recognition for Projects (SHARP)
4) WSH Risk Management (RM) Awards
5) WSH Officer Awards
6) WSH Supervisor Awards
7) WSH Innovation Award

----------End ----------