Guide to Excavation for Trenches

Guidance for Site Supervisors

WSHCOUNCIL

Tripartite Alliance for Workplace Safety and Health

Year of issue: 2021

Contents

1. Introduction

Excavation for trenches is commonly carried out over relatively long distances either at a construction site or along public places. The site conditions can vary in terms of available working space, width, depth of the trenches and ground conditions.

As the operations stretch over long distances, workers, operators, supervisors often have to perform their tasks independently.

Gathered from the experiences of a group of industry practitioners, this guide serves to assist them to understand their role in greater detail and provides guidance in the form of various good practices in excavation for trenches.

1.1 Objective

The purpose of this guide is to provide workers and supervisors with basic understanding of the common challenges encountered in trench excavation, and how to avoid and address these matters in the course of their work.

The information in this guide will assist workers and supervisors to be more aware of the risks involve before any trenching activities are carried out. This, we hope will help prevent the occurrence of accidents.

1.2 Scope

This guide covers excavation for trenches less than four metres (< 4m) deep.

Through the root cause analysis using the 5M model, this guide also identifies the major hazards related to cave-ins and collapse of unprotected trenches. For example, trenches may contain hazardous atmospheres; workers can drown in water, and have breathing difficulties due to the presence of toxic gases or chemicals in the trenches; and if working around underground utilities, workers may also face burns, electrocution or explosions from steam, hot water, gas, or electricity.

A cubic metre of soil weighs approximately 1.8 tons which is the weight of a small pickup truck. It is capable of inflicting very serious, disabling injuries and fatal injuries. When a trench caves in, the immense force exerted by the soil on unprotected workers can be fatal.

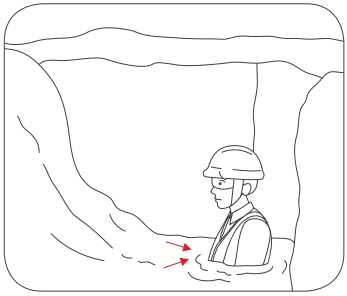


Figure 1: **Engulfment due to cave-ins/ slope failure.**

2. Common Hazards and Recommended Site Safety Practices

2.1 Physical Hazards in Excavation

2.1.1 Engulfment due to Cave-ins/Slope Failure	Recommended Site Safety/ Good Practices
Due to improper slope/steep slope/ over excavation.	**Method – Examples of Good Shoring and other Protective Systems** • Provide proper shoring methods as per Professional Engineer's (PE) design/drawing. • All shoring methods require a temporary works design by a competent Engineer who has sufficient experience in trench works and has knowledge of the various soil types and profile in Singapore.

Figure A: Site photo of improper slope.

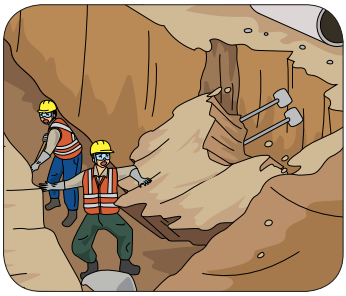


Figure B: Cave-ins/slope failure.

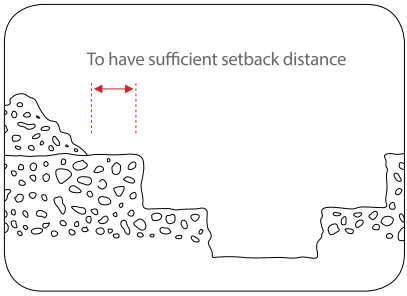


Figure 2: Benching control.

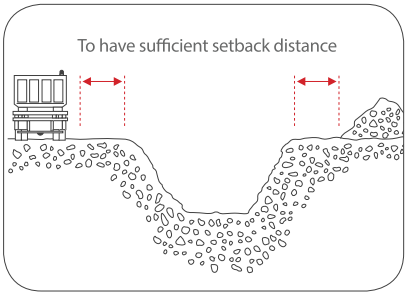


Figure 3: Battering control.

Method – Examples of Good Shoring and other Protective Systems - (continued from page 5)

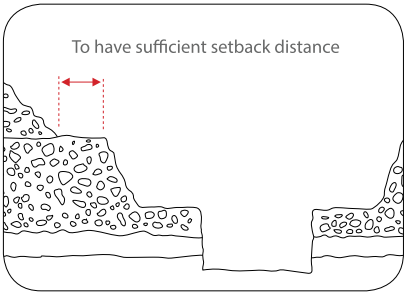


Figure 4: Combination of benching and battering controls.

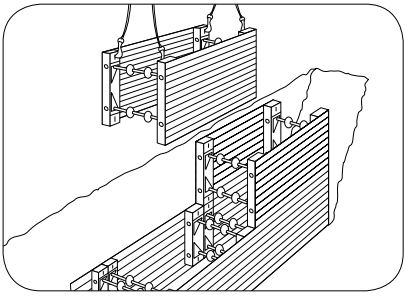


Figure 6: Trench box.

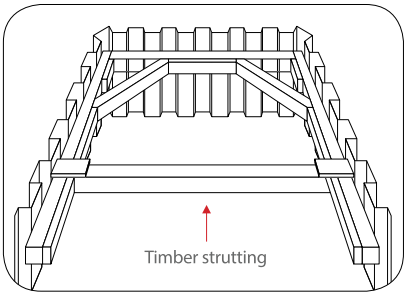


Figure 5: Cofferdam with timber strutting.

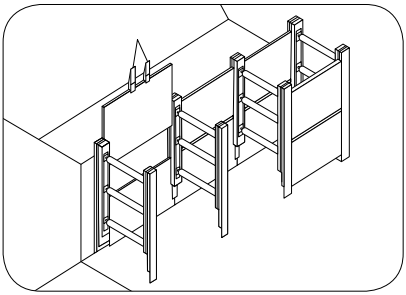


Figure 7: Plate lining system.

2.1.2 Struck by Falling Object

Due to positioning of machinery/ vehicle and/or storage of excavated material next to edge of excavation.

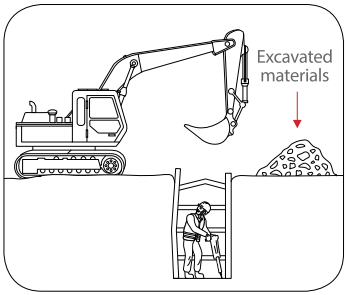


Figure C: Machinery movement near excavations.

Figure D: Various failures.

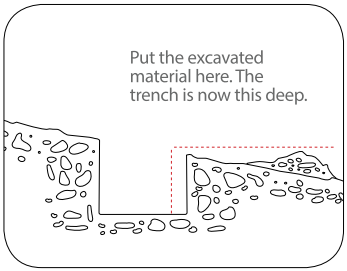


Figure E: Spoil placement on effective excavation depth.

Recommended Site Safety/ Good Practices

Method

- Ensure proper positioning of machinery such as having the excavator/vehicle at a safe distance from edge of excavation.
- Avoid work in excavation and any other overhead activity concurrently.
- Ensure proper placement of material.

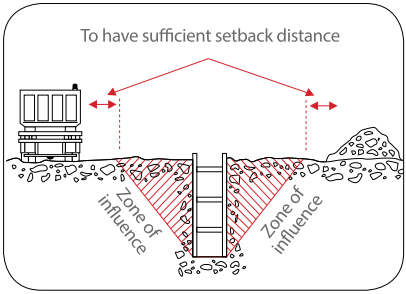


Figure 8: A shored excavation designed to carry soil loads only.

2.1.3 Soil Erosion

Due to inclement weather/ stagnant water/water seepage.

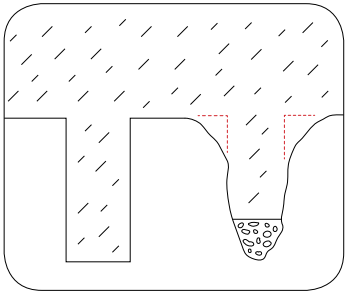


Figure F: Inclement weather.

Recommended Site Safety/ Good Practices

Machinery/Equipment

- Provide machinery/equipment such as a serviceable de-watering pump to remove excess water.

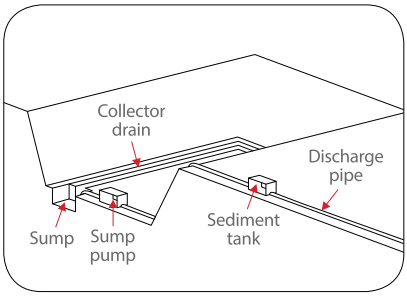
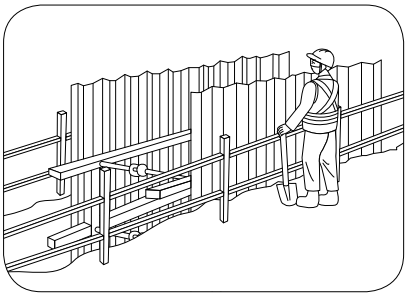
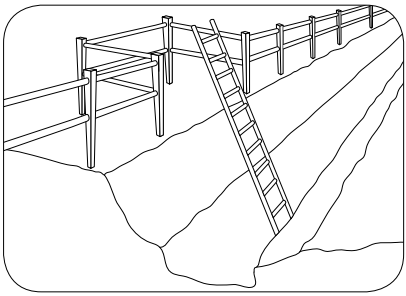


Figure 9: Traditional sump pumps control surface water at the excavation's base.

Environment

- Carry out dewatering of excavation to ensure no ponding of water.

2.1.4 Fall into Excavation/ Slip, Trip and Fall	Recommended Site Safety/ Good Practices
Due to open sides/missing edge protection.  Figure G: Open sides.	**Method** • Provide effective edge protection.  Figure 10: Effective edge protection.
Due to unsafe means of access/egress.  Figure H: Site photo of unsafe access/egress.	**Method** • Provide safe access and egress. Ensure they are sufficient in numbers and are installed in such locations so as to be readily accessible.  Figure 11: Safe access and egress.

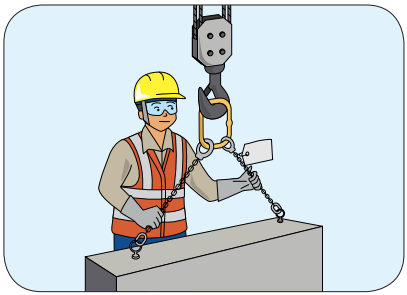
2.1.5 Damage to Existing Underground Services/Adjacent/ Nearby Building or Structures	Recommended Site Safety/ Good Practices
Due to electrical: • No knowledge of services underground. • Inadequate/no services detection done. • Inadequate/no protection of exposed existing services.	**Method** • Obtain plans for underground services from the various agencies (e.g. SP PowerGrid, PUB and SingTel). • Ensure services detection was carried out and services diverted where necessary.
Due to nearby building: • Inadequate/no survey of adjacent structures carried out. • Inadequate/no protection of adjacent structures that are affected by the excavation.	**Method** • Carry out pre-construction surveys. • Establish protection system for the affected adjacent structures. • Establish site specific instrumentation plan. **Environment** • Monitor site conditions due to environmental changes to ensure no excessive settlement/ movement/damage to adjacent structures.

2.2 Health Hazards

Health Hazards	Recommended Site Safety/ Good Practices
Due to: • Ergonomic issues. • Excessive noise. • Excessive vibration. • Dust. • Heat stress due to exposure to direct sunlight. • Exposure to toxic chemical such as sewer and contaminated soil.	Refer to the WSH Guidelines on Diagnosis and Management of Occupational Diseases available on www.wshc.sg or consult relevant experts in Occupational Hygiene and Occupational Medicine for advice.

2.3 Other Possible Hazards Associated with Excavation Works

2.3.1 Unsafe Operation of Machinery	Recommended Site Safety/ Good Practices
Overturning of machine due to unsafe lifting operations: • Overloading. • Unsafe manoeuvre. • No proper procedure.	**Method** • Conduct pre-operation checks on the lifting machine to confirm that it is in good working condition before use. **Man** • Ensure all personnel in the lifting team are adequately trained and competent. **Machine/Equipment** • Ensure the lifting machine has been examined and tested by an Authorised Examiner (AE). The lifting machine should be accompanied by a valid certificate of test and examination issued by the AE and should have a load chart. • Ensure the lifting machine has sufficient lifting capacity and reach to handle the intended load.  Figure 12: Load capacity chart. **If an excavator is to be used as a lifting machine, the following criteria must be met:** • The excavator is approved by its manufacturer/ supplier to function as a lifting machine. • The excavator is equipped with original hook(s) with safety catch for lifting purposes.

	• The excavator has a load chart furnished by its manufacturer/supplier. • The excavator is equipped with an accurate indicator which can clearly show the working radius and corresponding safe working load at all times, as well as give off a warning signal when working at an unsafe radius. • The safe working load of the excavator is less than 5 tonnes.
Improper rigging and failure of lifting gear.	**Man** • Ensure rigger is competent. **Method** • Ensure the load is rigged up in such a manner that it is stable, balanced and secured. **Machine/Equipment** • Ensure that the safe working load of the lifting gear used is sufficient for the load to be lifted. • Conduct a pre-operation check on the lifting gear to confirm that it is in good working condition before use. • Ensure all lifting gears used are examined and tested by an AE before use. All lifting gear should be accompanied by a valid certificate of test and examination issued by the AE.  Figure 13: Proper rigging.

- Struck by machinery.
- No demarcation of hazardous work areas.
- Excavator blind spot/ wrong positioning.

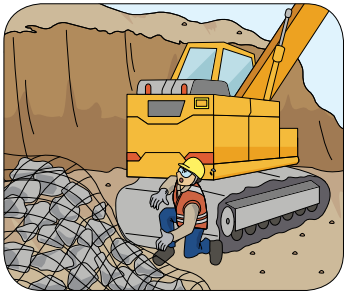


Figure I: Blind spot.

Method

- Provide adequate warning signages.

Environment

- Ensure proper demarcation of hazardous areas and zones.
- Provide adequate lighting.

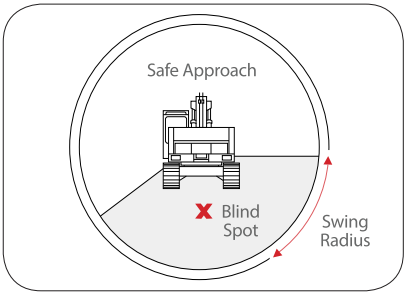


Figure 14: Proper demarcation of hazardous areas and zones.

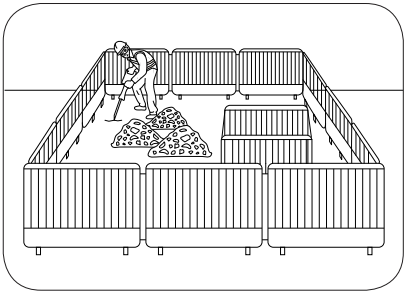


Figure 15: Proper demarcation.

Toppling of excavator due to poor access.

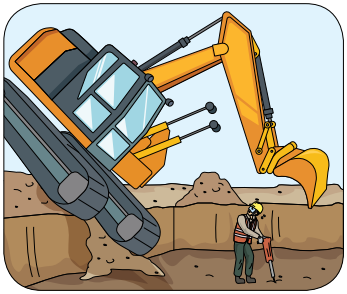


Figure J: Poor access to excavator.

Method

- Provide adequate safe access and egress for the excavator.

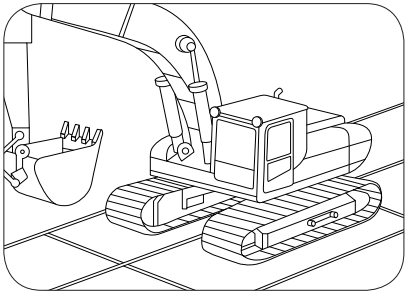


Figure 16: Adequate and safe access.

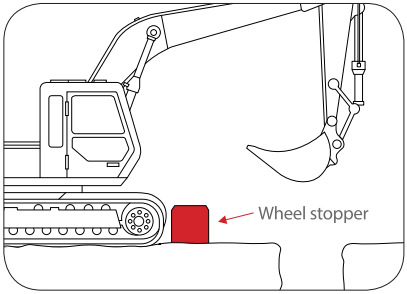


Figure 17: Wheel stopper restricting plant movements.

Vehicular Hazards

- Inadequate/no Traffic Management Plan established.
- Traffic Management Plan not implemented.

Man

- Ensure rigger is competent.
- Appoint Traffic Controllers/Banksman.

Method

- Establish site specific Traffic Management Plan.
- Provide adequate signages.

Environment

- Ensure proper demarcation of hazardous areas and zones.
- Provide adequate lighting.

Poor maintenance of machinery.	**Machine/Equipment** • Deploy serviceable excavator. • Ensure routine maintenance/servicing of equipment. • Check and report any abnormalities before use of excavator.

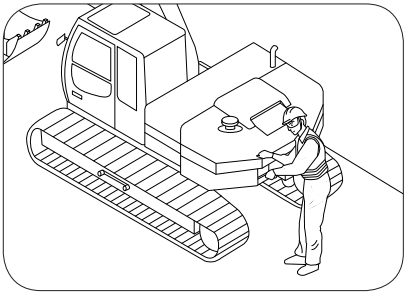


Figure 18: Ensure routine maintenance of equipment.

2.4 Administrative Control

2.4.1 Administrative Lapses	Recommended Site Safety/ Good Practices
• Incompetent personnel. • Unsafe method/sequence of works. • Inadequate site control. • Inadequate/ineffective supervision.	**Man** • Appoint Competent Excavator Operator/ Supervisor/Banksman. **Method** • Provide adequate and effective supervision. • Implement permit-to-work System/Risk Assessments/Safe Work Procedures. • Establish Method Statement. • Establish PE design/drawings and Certificate of Supervision (where applicable). **Environment** • Establish instrumentation/monitoring plan to ensure no excessive settlement/soil movement.

3. Supervision of Excavation Work

The duty of a site supervisor or site engineer for a project is to oversee the construction of the excavation and its backfilling. Their scope of work may include:

- Provide workers all the necessary equipment and tools for them to carry out the work in a safe manner.
- Prior to any excavation being dug, carry out a prior survey of the area to establish the presence of any underground utilities.
- Assess ground conditions, e.g. the type of ground involved such as clay and sand, compaction qualities (loose or disturbed) and water table.
- Identify the presence of any overhead lines and other obstructions.
- Identify the need for any permits that are required in the area and arrange for them.
- Brief workers on carrying out any adjacent operation that may impact the work, the presence of overhead and underground utilities.
- Conduct risk assessment for the work process mentioned above and their implementation.
- Communicate method statements clearly to concerned parties, workers and subcontractors.

The list above is non-exhaustive and serves as a guide for site supervisors. It is essential to provide training to all site supervisors and workers involved in the excavation for trenches. This is to ensure that they understand the hazards associated with the work environment and are aware of the measures to prevent and control these hazards, and the safety precautions and emergency procedures to take.

3.1 Training Courses Recommended

S/No	Training courses	Provider	Target audience	Remarks
1	WSQ in Supervise Construction Works for WSH	SSG ATOs	Supervisors inclusive of Site Engineers	
2	WSQ in Supervise Safe Lifting Operations	SSG ATOs	Lifting Supervisors	
3	Develop a Risk Management Implementation Plan (bizSAFE Level 2)	SSG ATOs	Supervisors inclusive of Site Engineers	
4	Registered Earthwork Supervisor (RES)	Administered by SP PowerGrid	Supervisors	Only Site Supervisors who have passed the Registered Earthwork Supervisor Course will be allowed to supervise worksites in the vicinity of high voltage cables and medium/high pressure gas pipelines.
5	Hydraulic Excavator Operation Course	Approved Training & Testing Centre (ATTC) administered by BCA	Excavator Operators	• Excavator operators are to be trained in Hydraulic Excavator Operation and Hydraulic Excavator as lifting machine. • Excavation in the vicinity of high voltage cables and medium/high pressure gas pipelines. Excavator operators must be a Registered Excavator Operator (REO) with SP Powergrid.

4. Emergency Response Procedures

4.1 Types of Emergency Situations

- Any fatality.
- Worker trapped due to cave-in/shoring failure/falling into excavation.
- Dangerous occurrences or toppling of excavator/lifting machine.

4.2 Emergency Response Procedures

S/No	Actions	Remarks (Intentionally left blank for users of this guide to enter any information they deem fit. E.g. person in-charge, contacts numbers.)
A	Sound the alarm by eyewitness.	
B	Eyewitness to notify the Supervisor.	
C	Supervisor to notify Project Manager, Site Safety Personnel and other relevant stakeholders, e.g. Professional Engineer (PE) who designed the slope or shoring.	
D	Project Manager/Site Safety Personnel to authorise/ activate the emergency evacuation procedure: • Protect the area from hazards. • Prevent further injury to the casualty.	
E	Activate external assistance as required, e.g. ambulance, SCDF: • Have someone to direct the ambulance or rescue unit to the accident scene.	
F	Evacuate all workers to designated emergency assembly point.	
G	Account for all personnel.	

H	Rescue any casualty if possible.	
I	Provide first aid treatment to any injured personnel by Competent First Aiders: • All projects must have a person qualified and certified to provide first aid.	
J	Stabilise the condition if possible, as advised by the PE to prevent further damages or injuries.	
K	Cordon-off the hazardous areas with physical barriers and warning signs.	
L	Assist in the rescue operation where possible/ as needed.	
M	Conduct internal investigation to identify root causes and establish additional risk controls/ preventive measures.	
N	Review at least the following to include the additional risk controls/preventive measures: • Risk Assessment. • Method Statement/Sequence of Works. • Safe Work Procedures. • Emergency Response Procedures.	
O	Communicate the changes to all personnel involved.	
P	Assist in the investigations by the authorities.	
Q	Maintain necessary record and documentation on site for audit purpose.	

NOTE

It is natural to try to rescue casualties caught in or buried by a cave-in. Care must be taken to prevent injury and death to rescuers, whether from a further cave-in or other hazards.

The following procedures may be suitable, depending on conditions:

1. Use a tarpaulin, fencing, plywood, or similar material that can cover the ground and will ride up over any further cave-in to reach the casualty.
2. Prevent a further cave-in by placing a backhoe bucket against the suspected area or excavating it.
3. Rescue workers should enter the trench with ropes and wear rescue harnesses if possible.
4. Remove the casualty by stretcher whenever possible to prevent further injury. Tarps or ladders can be used as a makeshift stretcher.
5. Stabilise the casualty by performing the following first aid actions in the following situations. (These are just some examples):

- Ensure the casualty is breathing. If not, open the airway and start artificial respiration immediately. Mouth-to-mouth resuscitation is the most efficient method.
- Control external bleeding by applying direct pressure, placing the casualty in a comfortable position and elevating the injured part if possible.
- An unconscious person may suffocate when left lying face up. If injuries permit, unconscious persons who must be left unattended should be placed in the recovery position (see Figure 19).

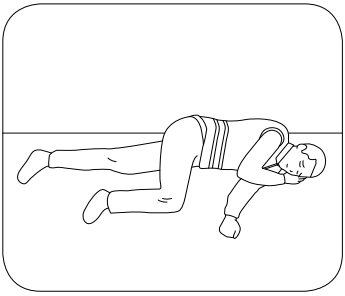


Figure 19: Recovery position.

5. References

- ACOP – Singapore Standard SS 562 – Code of practice for safety in trenches, pits and other excavated areas
- SS 576 : 2019 – Code of practice for earthworks in the vicinity of electricity cables
- Building Control (Amendment) Act 2012 and Regulations 2012: ERSS – Submission Requirements
- Excavation Safety, July 2016, WorkSafe New Zealand/Good Practice Guidelines
- Trench Support Best Practice Guidelines, February 2017, Christchurch City Council
- Excavation Work Code of Practice, October 2018, Safe Work Australia
- CIRIA Report 97 – Trenching Practice (Second Edition)
- Trenching Safety – Introduction to Trenching Hazards, Health and Safety Ontario. Infrastructure Health & Safety Association. www.ihsa.ca
- US Occupational Safety and Health Administration's Trenching and Excavation Safety Publications (https://www.osha.gov/pls/publications/publication.AthruZ?pType=Industry&pID=213)
- WSH Guidelines Anchorage, Lifelines and Temporary Edge Protection Systems
- Code of Practice on Safe Use of Excavators. Occupational Safety and Health Branch, Labour Department, Hong Kong SAR

6. Acknowledgements

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	Mr. Terence Lim
Workplace Safety and Health Council (WSHC)	Mr. Han Kin Sew
	Ms. Michelle Ho
	Mr. Muhammad Hafiz bin Md Jamil

We thank members of the working group and Management of SP Group for their assistance on the cover photo as well as all photos taken for illustration to improve clarity of intent within the context of this guidance document.

7. Annexes

Annex A: Risk Assessment

The primary objective of conducting a risk assessment is to protect workers at workplaces. All practicable steps shall be taken to prevent danger to any person to ensure that:

- Any excavation or part of an excavation does not collapse.
- No material from a side or roof of, or adjacent to, any excavation is dislodged or falls.
- No person is buried or trapped in an excavation by material which is dislodged or falls.
- No person (public or site personnel) falls from height into an excavation. In order to achieve this, edge protection must be ready for use as soon as the excavation is created.

To achieve this, suitable and sufficient steps must be taken to:

- Prevent any person, work equipment, or any accumulation of material from falling into any excavation.
- Prevent any part of an excavation or ground adjacent to it from being overloaded by work equipment or material.

Under the Workplace Safety and Health (Risk Management) Regulations, every workplace must conduct a Risk Assessment for all work activities. Workplace risks can be assessed in three simple steps:

STEP 1: Hazard Identification

Determine hazards associated with the activity of each work process, along with the potential accidents or ill-health that could result from these hazards. Person(s) who may be at risk as a result of being exposed to these hazards can also be identified.

STEP 2: Risk Evaluation

Estimate the risk levels of the identified hazards and their acceptability on:

- The severity of the hazard; and
- The likelihood of the incident.

STEP 3: Risk Control

Based on the outcome of the risk evaluation in STEP 2, risk controls should then be selected to reduce or confine the identified risk to an acceptable level.

These risk controls should be effective yet practicable. Control measures should be observed in accordance with the Hierarchy of Control to control hazards and reduce risks.

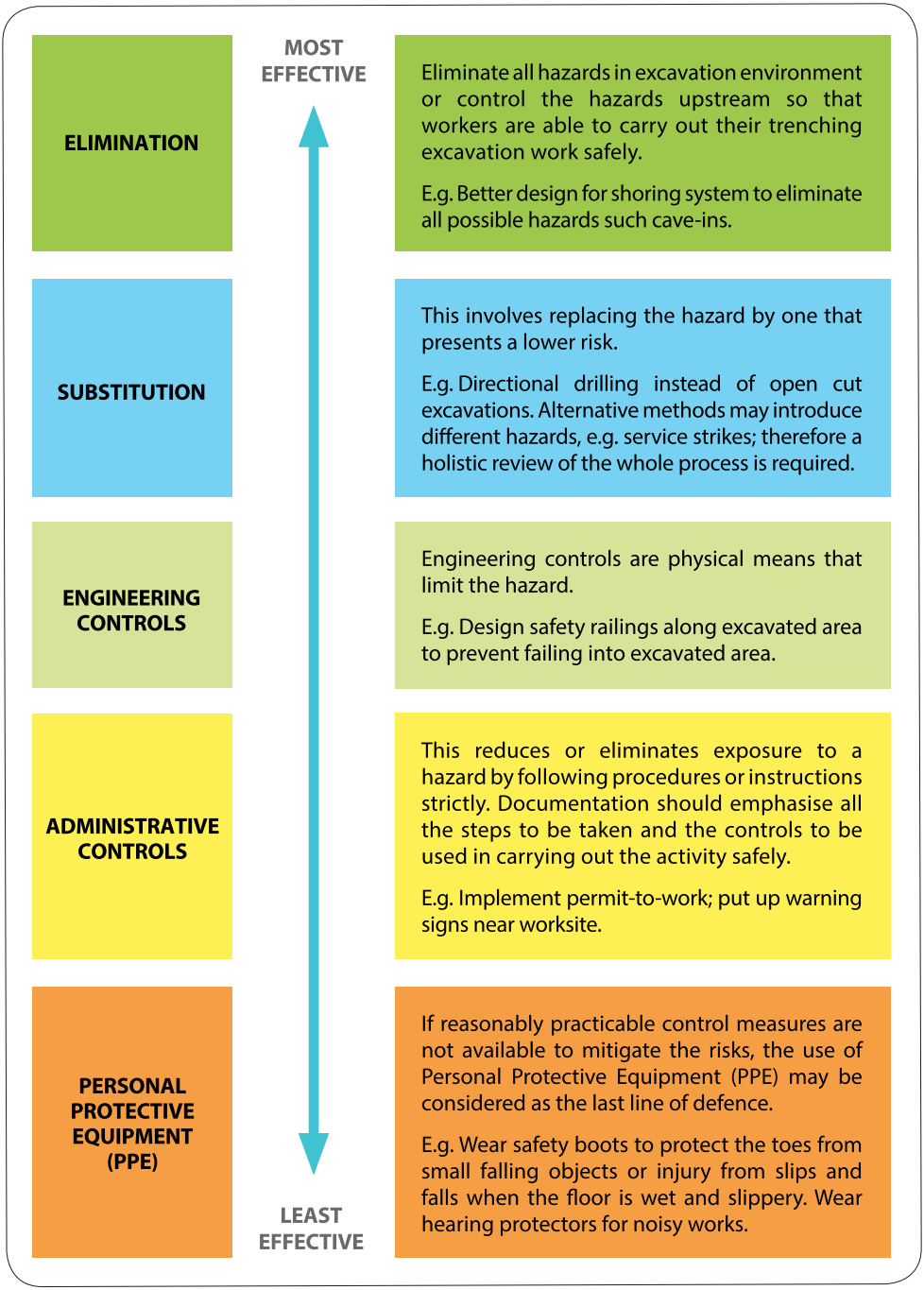

Diagram 1: Hierarchy of control.

The type of control measures in the Hierarchy of Control are ranked in order of effectiveness. As far as possible, priority should be given to upstream risk control measures.

These control measures are not usually mutually exclusive. It may be necessary to use more than one risk control measure to reduce risks to the lowest possible level if a single measure is insufficient. For example, engineering controls such as using safer equipment can be implemented together with administrative controls. For instance, training and Safe Work Procedures can be used to reduce a workplace risk.

For more information on risk management and risk assessment, refer to the Code of Practice on Workplace Safety and Health (WSH) Risk Management.

Refer to Annex A1 – A sample of Risk Assessment for trenching work as a reference. The workplace should prepare proper and appropriate risk assessment for each work activity to be carried out.

Annex A1: Sample of Risk Assessment

Project / Department		**RA Leader**		**Approved by**		**Reference Number**
Process		**RA Member 1**		**Signature**		
Activity / Location		**RA Member 2**				
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					
SN	Sub Activity	Hazard	Possible Injury /Ill-Health	Existing Controls	S	L	RPN	Additional Controls	S	L	RPN	Implementation Person	Remarks
1	Excavation/ Trenching Works (< 4m deep)	Physical Hazard - Excavation Failure (General) • Incompetent Personnel. • Unsafe Method/ Sequence of Works. • Inadequate Site Control. • Inadequate/ Ineffective Supervision.	Injury/ Death	Engineering Control Method – To design excavation slope /shoring system by Professional Engineer PE and issue necessary design calculations & drawings.	3	3	9	Not required as per defined Risk Matrices for Low and Medium Risk Activities.	NA	NA	NA	Project Manager/ Professional Engineer (Civil)	Before works
				Engineering Control Method – To inspect excavation slope/shoring system designed by Professional Engineer.								Project Manager/ Professional Engineer (Civil)	During works

				Engineering Control Environment – To establish instrumentation / monitoring plan to ensure no excessive settlement/soil movement.	3	3	9		NA	NA	NA	Project Manager/ Professional Engineer (Geo)	Before works
				Administrative Control Man – To appoint Competent (Trained with experience) Excavator Operator/ Supervisor/ Banksman.								Project Manager	Before work
				Administrative Control Method – To provide adequate and effective supervision.								Supervisor	During work
				Administrative Control Method – To establish and implement permit-to-work System.								Project Manager	Before/ During works

				Administrative Control Method – To establish and implement Method Statement.	3	3	9		NA	NA	NA	Project Manager	
				Administrative Control Method – To establish and implement Safe Work Procedures SWP.								Project Manager	
				Administrative Control Method – To communicate the hazards, approved risk controls and safe work procedures to all relevant site personnel to ensure compliance.								Supervisor/ Env Health & Safety Personnel	

Risk Matrices

Severity		
Level	**Numeric Rating**	**Description**
Catastrophic	**5**	Fatality, fatal diseases or multiple major injuries.
Major	**4**	Serious injuries or life-threatening occupational disease (includes amputations, major fractures, multiple injuries, occuational cancer, acute poisoning).
Moderate	**3**	Injury requiring medical treatment or ill-health leading to disability (includes lacerations, burns, sprains, minor fractures, dermatitis, deafness, and work-related upper limb disorders).
Minor	**2**	Injury or ill-health requiring first-aid only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort).
Negligible	**1**	Not likely to cause injury or ill-health.

Likelihood		
Level	**Numeric Rating**	**Description**
Almost Certain	**5**	Continual or repeating experience.
Frequent	**4**	Common occurrence.
Occasional	**3**	Possible or known to occur.
Remote	**2**	Not likely to occur under normal circumstances.
Rare	**1**	Not expected to occur but still possible.

Risk Level			
RPN (Severity X Likelihood)	**Description**	**Risk Acceptability**	**Recommended Actions**
1 ≤ RPN < 4	**Low**	Acceptable	• No additional risk control measures may be needed. • Frequent review and monitoring of hazards are required to ensure that the risk level assigned is accurate and does not increase over time.
4 ≤ RPN < 15	**Medium**	Tolerable	• A careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as reasonably practicable (ALARP) within a defined period. • Interim risk control measures, such as administrative controls or PPE, may be implemented while longer term measures are being established. • Management attention is required.
15 ≤ RPN ≤ 25	**High**	Not Acceptable	• High Risk Level must be reduced to at least Medium Risk before work commences. • There should not be any interim risk control measures. Risk control measures should not be overly dependent on PPE or appliances. • If practicable, the hazard should be eliminated before work commences. • Management review is required before work commences.

Annex B: Safe Work Procedures for Installing and Dismantling of a Typical Protective System

Excavation/Shoring Materials and Equipment

Timber Upright

Steel Strut

Walers (SHS)

Corrugated Sheet

Timber Planks

Excavator

Key work activities for excavation:

1. Mobilisation of equipment.
2. Excavation.
3. Installation of shoring.
4. Backfilling and removal of shoring.

Shoring Installation Sequence

Step	Action
1	Check services plans and carry out cable detection to confirm no services.
2	Mark the proposed cable route alignment on road.
3	Proceed to cut the road surface (premix) with road cutter.
4	Break the premix with breaker and remove the broken premix with excavator.
5	Proceed with excavation. Carry out progressive cable detection for every 500mm depth.
6	Once trench reaches 1m depth, insert the upright member at each of the four corners with toe-in on ground.

Step	Action
7	Install and tighten struts to the upright member.
8	Place Steel Hollow Section (SHS) or timber walers on the struts. (Note: Struts to be adequately tightened to support the weight of the waler. Avoid placing feet right below walers.)
9	Continue to install struts onto the walers.
10	Install corrugated zinc sheet or timber planks behind walers.
11	Proceed to excavate further with progressive cable detection at every 500mm depth. Look out for the presence of other services as well.
12	Continue excavation to desired depth. Subsequent layer of walers and struts are to be installed according to PE Design. Corrugated Zinc sheets or timber planks to be pressed down progressively under close supervision. Workers to stand clear during the pressing down.

13

14

Step	Action
13	Short end of the trench shall be shored or sloped at an angle recommended by PE.
14	Once the trench shoring is completed, further works can be carried out.

*The above information is provided courtesy of SP Group.

Annex C: Sample Checklist for Site Supervisor

The non-exhaustive checklist provides a reference for site supervisor.

S/No	Category	Check Items/ Risk Control Measures	When	Who/ Responsible Person
1	**Man**			
		Competent/Operator appointed and deployed	Before/ During	Project Manager
		Competent Supervisor appointed and deployed	Before/ During	Project Manager
		Competent Banksman appointed and deployed	Before/ During	Project Manager
		Competent Traffic Controllers appointed and deployed as required	Before/ During	Project Manager
2	**Machine/ Equipment**			
		Serviceable excavator deployed	During	Project Manager
		Serviceable de-watering pump available	During	Supervisor
3	**Material**			
		Correct soil type as per PE design	During	Project Manager/ Supervisor
4	**Method**			
		Valid Authority Permit	Before	Project Manager

		Approved Risk Assessment	Before	Project Manager/ Supervisor
		Approved Safe Work Procedures	Before	Project Manager/ Supervisor
		Approved Method Statement/ Sequence of Work/Protective System	Before	Project Manager/ Supervisor
		PE design - slope/shoring system	Before	Project Manager/ Supervisor
		Permit-to-work system implemented	Before	Project Manager/ Supervisor
		Service detection/diversion carried out	Before	Project Manager/ Supervisor
		Display adequate warning signages	During	Project Manager/ Supervisor
		Adequate/effective supervision	During	Project Manager/ Supervisor
		Proper placement/storage of materials away from the excavation site	During	Project Manager/ Supervisor
		Proper positioning of excavator	During	Project Manager/ Supervisor
		Proper housekeeping	During/ After	Project Manager/ Supervisor

		Last Minute Risk Assessment LMRA carried out	During	Operator/ Supervisor
5	**Environment**			
		Adequate and safe access and egress provided	During	Project Manager/ Supervisor
		Sufficient lighting provided	During	Project Manager/ Supervisor
		Effective edge protection	During	Project Manager/ Supervisor
		Proper demarcation of hazardous areas/zones	During	Project Manager/ Supervisor
		No stagnant water	During	Project Manager/ Supervisor
		No excessive settlement	During/ After	Project Manager/ Supervisor
		No excessive soil movement	During/ After	Project Manager/ Supervisor
		No presence of hazardous material/gas	During/ After	Project Manager/ Supervisor

Annex D: Permit-to-work

- A permit-to-work (PTW) system must be implemented for trenching/excavation work exceeding 1.5 metres in depth.
- PTW stakeholders, i.e. Applicant, Safety Assessor, Project Manager shall familiarise themselves with the relevant regulations, standards, codes of practice and guidelines before excavating the ground.
- The applicant for a PTW should be an authorised Competent Person (see Note 1) with appropriate experience and knowledge of similar trenching or excavation work for the application of different types of soil protection system suitable to the specific site conditions.
- The Competent Person shall consult the Qualified Person/Professional Engineer if the excavation is more than 1.5 metres and less than 4 metres.

Application and Approval of permit-to-work System

STAGE 1
Application

Application of permit by a competent person in charge of trenching/excavation works to main contractor before starting any excavation works.

↓

STAGE 2
Evaluation by Safety Assessor

Permit evaluation and assess by Safety Assessor such as WSH Officer or a competent person. Assessor inspects and makes assessment of work area to ensure that the workspace is safe for the work to be carried out. (Endorse if it is safe)

↓

STAGE 3
Approval by Project Manager

Final approval by Project Manager.

↓

STAGE 4
Posting of permit-to-work

Supervisor clearly posts the permit-to-work and ensures it is not removed throughout the work.

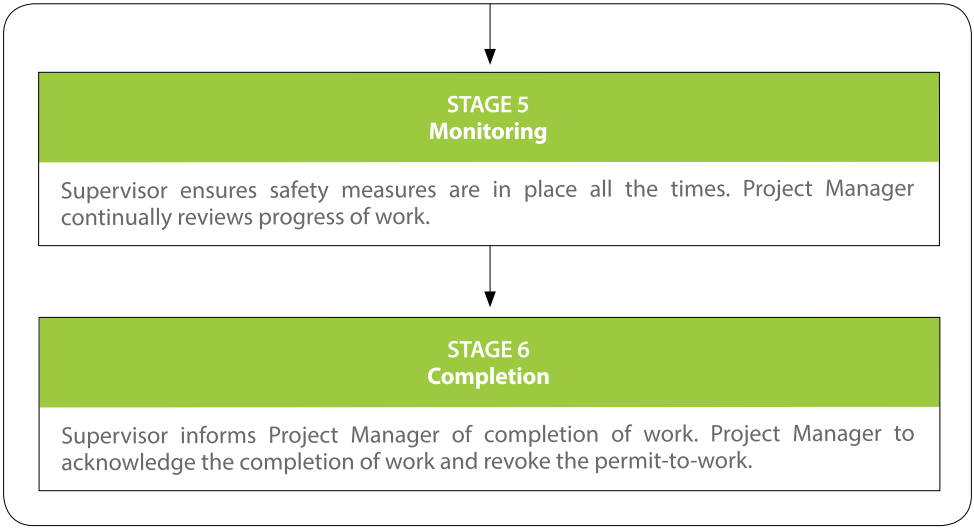

Figure 22: Flow chart on Application and Approval of permit-to-work System.

NOTE

- "Competent Person" means a person who has sufficient experience and training to perform the work required to be carried out and has passed such courses as the Commissioner may require for that work.
- For a sample of a project site permit-to-work application form, please refer to Annex A of SS 562.

Published in July 2021 by the Workplace Safety and Health Council in collaboration with the Ministry of Manpower.

This publication is available on the Workplace Safety and Health Council
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