Vedanta Resources Plc

Sustainability Governance System

Guidance Note GN25

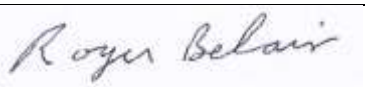
Civil Excavation:

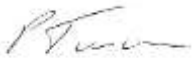
Excavations, Trenching and Shoring Safety

Document: VED/CORP/SUST/GN25
Version V.0

Guidance document title:	Civil Excavation: Excavations, Trenching and Shoring	**Date of revision:**	
Document:	VED/CORP/SUST/GN25	**Revision:**	V.0

Document Issue and Revision History		
DATE	**REVISION NUMBER**	**CHANGE SUMMARY**

Prepared by:	Roger Belair
Signature	
Position:	Group Head – Safety

Authorised by:	Phillip Turner
Signature	
Position:	Group Head – HSE

Confidentiality

Contents

1. INTRODUCTION

1.1 Who is this Guidance Note aimed at?

This Guidance Note is aimed at all Vedanta subsidiaries, operations and managed sites, including new acquisitions, corporate offices and research facilities and to all new and existing employees and contractor employees. This Guidance Note is applicable to the entire operation lifecycle (including exploration planning, evaluation, projects, construction, maintenance, operation and closure).

1.2 What is the aim of this Guidance Note?

The aim of this Guidance Note is to outline the company requirements which Vedanta SBUs are to implements in order to ensure that all Earthwork (excavations) carried out within Vedanta's operations is planned and performed in a safe manner.

1.3 What issues does this Guidance Note address?

This Guidance Note presents the framework for carrying out Excavation within Vedanta operations, showing the key technical activities that may apply in each of these contexts, and identifying the main decisions at each stage. This guidance note does not address other hazards associated with shuttering, shoring and concreting etc., and associated building/construction standards.

The focus of the Guidance Note is to provide preferred methods and outcomes rather than prescriptions whilst at the same time representing a practical "how to" guide for all Vedanta operators.

It is intended that the Guidance Notes will represent standard baseline guidance for all Vedanta staff within all the operations whilst recognizing the need for flexibility at a site depending upon specific circumstances or regulatory specific requirements. In this sense, Guidance Notes are not designed to be definitive text, nor are they designed to provide prescriptive methods and procedures for undertaking tasks.

1.4 How should this Guidance Note be used?

This Guidance Note is recommended and is intended to reflect good practice and provide the basis for continual improvement of sustainability issues across the Vedanta business. However, where this Guidance Note is not used, operations will need to demonstrate (and document) how an equivalent process is in place and how this ensures that excavation work is carried out safely.

In most cases there will also be national and/or local regulatory requirements governing excavation activities – operations must ensure that these requirements are identified and complied with.

The guidance focuses on general principles of excavation and some key themes in terms of operational control. It does not go into extensive detail on all aspects. Some aspects such as the use of proper slope, availability of soil report, physical inspection etc. are referred to but not addressed in detail. It is imperative that such activities are only undertaken by trained and competent persons - extensive guidance on these and other topics is available from national regulatory bodies and industry associations, and there are also numerous technical standards and specifications published by national and international standards bodies (some of the latter are listed at the end of this document, however users should always check the latest versions in force as this does change).

1.5 The guidance has been designed for baseline guidance for all Vedanta operations.

The following applies to all open excavations made on the Earth's surface, including trenches. Following the requirements will prevent or greatly reduce the risk of cave-ins and other excavation-related incidents.

2. DEFINITION AND IMPORTANT TERMINOLOGIES:

Excavation	Means a hole left in the ground by the process of removing earth, rock or other materials with tools, equipment. It includes earthwork, trenching, wall shafts, tunneling. A trench means an excavation where the excavation depth exceeds the excavation width. Excavations have a number of important applications including exploration, environmental restoration, mining and construction**.**
Confined Space	Most trenches, pits etc. are confined spaces, per Safety Performance Standard VSS4 on Confined Spaces. VSS4 should be reviewed for all excavations and applied as appropriate.
Hazardous atmosphere	Is an atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful may cause death, illness, or injury to persons exposed to it.
Ingress and Egress	Mean "entry" and "exit," respectively. In trenching and excavation operations, they refer to the provision of safe means for employees to enter or exit an excavation or trench.
Underground Installations	Include, but are not limited to, utilities (sewer, telephone, fuel, electric, water, and other product lines), tunnels, shafts, vaults, foundations, and other underground fixtures or equipment that may be encountered during excavation or trenching work.
Determining Soils Types	• Soil type 1 is hard, very dense and only able to be penetrated with difficulty by a small sharp object and can be excavated only by mechanical equipment. • Soil type 2 is very stiff, dense and can be penetrated with moderate difficulty by a small sharp object and has a damp appearance after it is excavated. • Soil type 3 is previously excavated soil and backfilled soil that exhibits signs of surface cracking and water seepage. It has a low degree of internal strength. • Soil type 4 is soft to very soft and very loose in consistency and upon disturbance is significantly reduced in natural strength and is wet or muddy.

3. EXCAVATION AND ITS TYPES

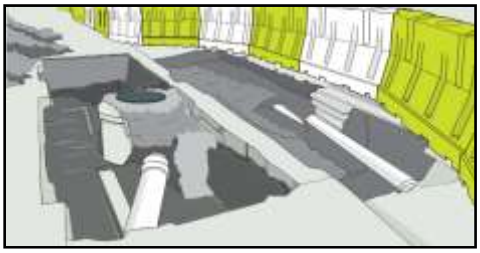
Excavation work generally means work involving removal of soil or rock from site to form and open face, hole or cavity, using tools, machinery or explosives

Excavation work includes:

- Open excavations
- Potholing
- Pit excavations
- Trenches and retaining walls

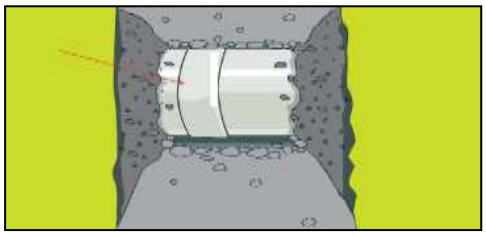
OPEN EXCAVATIONS

An excavation in open ground is called open excavation and can vary in shape and size.



POTHOLING

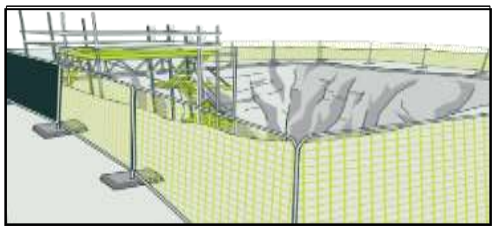
Potholing is usually a small excavation or inspection hole to find underground services.



PIT EXCAVATIONS

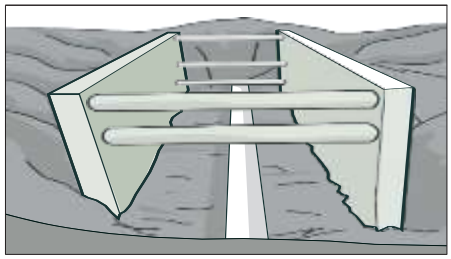
Pit excavations are usually four-sided and deeper than the narrowest horizontal dimension at the surface.

Pits are generally excavated to install manholes, pump stations, or underground tanks. They are also excavated to construct pile caps and other types of foundations or to access or locate existing services.

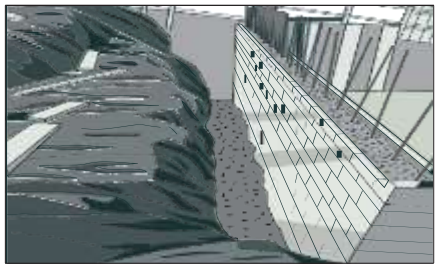


TRENCHES AND RETAINING WALLS

A trench is a long narrow excavation which is deeper than it is wide and open to surface along its length. They are generally excavated to install or maintain underground services or to investigate what is beneath the surface.



When a retaining wall is built, an open excavation becomes a trench formed by an excavated face on one side, and a retaining wall on the other. Usually workers need to access this trench to work, for example for waterproofing the retaining wall.



4. PLANNING & IMPLEMENTATION OF WORK:

The nature of the excavation work will affect the selection of an excavation method and a safe system of work. The ground conditions will have a significant impact on what excavation method to select and the controls to use.

A) Safe System of work

A safe system of work should include:

- Assigning responsibilities by use of a task analysis
- Consulting a competent person regarding any temporary works design
- Identifying any health and safety hazards and risks
- Carrying out a risk assessment
- Describing how you will control any identified risks
- Describing how controls will be implemented, monitored and reviewed
- Accident investigation and reporting methods
- Emergency procedures

SITE ISSUES	POSSIBLE FACTORS	MINIMUM CONSIDERATIONS
Ground conditions	Soil types Stability Ground water Other soil and rock properties Contaminated soils Potential for seismic hazards (such as fault rupture, liquefaction and rock fall)	Inspecting to find out what might affect the stability of the excavation (an excavation face can appear stable for 24 hours, but may be unstable) Weather conditions Dewatering plan Testing soil and water
Site conditions	Surcharges Underground and above ground services Ground slope Adjacent buildings and structures Water courses (including underground) Trees Local weather conditions Environmental conditions Proximity to existing trench lines	Checking with the Vedanta authorized Person whether you are working on a HAIL site Checking for underground services Barricade access to open excavation area Consents from service owners to de-energize buried electrical or natural gas lines Obtaining a Work Permit Conducting a Job Hazard Analysis. Isolation controls are in place
	Excavation depth Length of time the excavation will be open Ground support If excavation may be classified as a confined space The planned height of the excavated face If there will be other construction activity nearby that may cause vibration	Static and dynamic loads near the excavation Consulting a competent person Deciding on a support solution Identifying all existing overhead and underground services Managing pedestrians and traffic with a traffic management plan (TMP) Securing barriers or fencing to keep members of the public and other site workers away from the excavation site

The excavation Work methods	Specialized plant or work methods required (e.g. ground support) The method(s) of transport, haul routes and disposal What exposures might occur, such as noise, ultra-violet rays, falls or hazardous chemicals Workers will need to follow good practice for confined spaces safety Number of workers involved Possibility of unauthorized access to the work area Safe access and egress	Implementing a safe system of work or safety management system Identify hazards, assess and control risks Build in interaction with other trades Adequate facilities Emergency procedures Accident and incident procedures Contractor management Testing and checking for plant, equipment, and materials requirements Inducting and training all workers Exclusion zones where powered mobile plant will operate

When persons working inside excavation/ trench, which is more than 1.5 meter deep, shall always use a lifeline tied to a structure outside the excavation. This will help to exactly locate the person in case of soil collapse, as per the risk assessment and upon approval of competent person doing the design.

i) Pre- use inspection of excavated area

- Before entering excavated area/ trench always inspect condition of means of access, exit and excavated area
- Inspection should be done after any change in environmental conditions
- If any work is to be done in an excavation then a respective permit to work is required for that work.

A. Utility Services

Services include gas, water, storm water, sewerage, telecommunications and electricity supply, chemicals, fuel and refrigerant in pipes or lines. The competent person must identify and manage hazards and risks associated with underground and overhead services in the planning and design stages. In the first instance, contact the area in charge or service owner for approval prior to works commencing.

1. <u>Establish where the services are:</u>

Before any excavation takes place workers should know what is underground and what is overhead. Consider services present until it is proven they are not there.

- Liaise with all service owners as there are often multiple services and multiple owners.

- Some service owners provide on-site assistance to help identify services; use this assistance where available.
- Make sure plans and relevant locates and mark-outs are available, get plans and mark out the services.
- Accurately trace and mark out underground services. Drawings and service plans may be different from what is underground.
- Keep copies of current services plans on site.
- Use detection equipment that can detect services. There may be a need to use multiple types.
- Knowledge about what energy sources the services actually carry is essential. Service markings and colours can vary from current national standards and the service owner should be able to provide specific information.
- Check service depths as they may vary from the plan (e.g. the ground cover may have been altered since the service was laid). Pothole to determine service location and depth.
- Make sure mobile plant access and egress is safe by checking the proximity of overhead services and the ground strength for access routes (e.g. check for underground drainage pipes, service ducts, soak wells, and storage tanks).

2. <u>Have Process in Place</u>

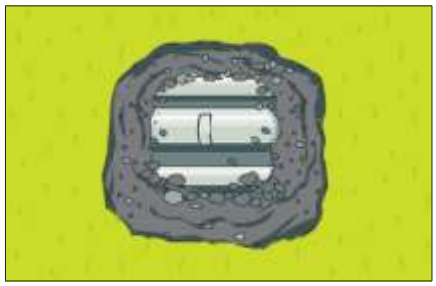
Check workers are competent to complete the tasks. This will includes giving a briefing and assessing that plant, equipment (including safety and protective equipment), tools, and procedures are fit- for-purpose.

- Workers should be supervised to make sure they carry out the work safely.
- Identify where consents and permits are required for closer work activities. This includes:
- Liaising with service owners.
- Sourcing the service owner's safety information and drawings.
- Understanding permit conditions.
- Making sure workers understand what they can and cannot do.
- Supervising and monitoring compliance.
- Update the service plan arrangements with the service owners.
- Reporting, emergency, and response procedures need to be in place for all identified risks and hazards.
- Put processes in place for reporting incidents, damage, and defects.
- Plan for emergency situations where there is incomplete information about services.
- Develop response plans for workers and others safety in the event of a service strike.

3. <u>What work Methods will we use</u>

- Is the work in proximity to overhead services?
- Will you expose underground services?

- How will you work with the service owner and get permission? This may be required to approach services using hand-held mechanical tools, or mechanical methods, and to backfill the excavation.
- You will need to provide underground service plans and related information to business partner, such as other workers operating mobile plant?
- Will you be backfilling?



Underground services exposed by 'potholing'

i) Nearby Building or Structures

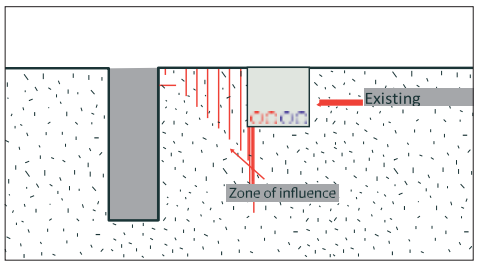
Excavation work may seriously affect the stability of any structure near the excavation. This may lead to structural failure, or ground collapse depending on the site's ground conditions.

Consider the excavation's zone of influence on the stability of any nearby structure and make sure the excavation does not remove any nearby structure's ground support.

The zone is normally at an angle from the base of the excavated face to the surface. The zone's angle will depend upon site-specific factors, for example soil strength and density.

A competent person should:

- Assess any excavation near or below the footing of any structure, including retaining walls
- Determine if any supports to brace the structure are required.
- Make sure other structures near the excavation site are not adversely affected by vibration or concussion during the work.



Existing services restriction

i. Securing the Work Area

When organizing site security and site access, consider:

- Installation of warning or hazard signs
- Supervising authorized visitors

- The risk of unauthorized access occurring (consider schools, parks, shops or other public places, or amenities and events nearby)
- Pedestrians and other members of public
- Other workers and mobile plant on site
- Vehicle traffic control within and near the excavation
- Delivery points, including vehicle access and egress
- Immobilizing/locking vehicles
- Assessing plant movement to avoid risks to other moving plant or vehicles outside the site's perimeter
- Control and storage of any contaminated materials from the excavation
- Safe and secure storage of materials (e.g. hazardous substances)
- Control of energy sources (e.g. temporary mains service boxes, fuel storage)
- Suitably designed and constructed physical barriers

ii) Confined Spaces

Most trenches, pits etc. are confined spaces, per Safety Performance Standard VSS4. A confined space is any area that is not a normal place of work and that could have a toxic, hazardous or low

oxygen atmosphere (or such atmosphere could develop) or people could be entrapped or engulfed by material. VSS4 should be reviewed for all excavations and applied as appropriate.

5. TRAINING & COMPETANCY:

All personnel doing excavation work shall complete the following training prior to start of work:

a. Excavation safety training

b. Review and sign off of SBU SOPs

c. Confined space training, if required

d. Emergency rescue training

e. Heavy equipment operators to have valid licenses specific to the equipment

COMPETENT PERSON

A competent person refers to the temporary works designer, who should be competent to assess and manage the risks relevant to the excavation's depth and have a working knowledge of this

guideline. A competent person is a person who has acquired through training, qualification or experience the knowledge and skills to carry out a task.

Competency is based on recent knowledge, training, understanding, and experience with a wide variety of considerations, some of which are:

- Soil type, weight and strength
- Ground water
- Sloping ground
- Surcharges or vibrations that could destabilize the excavation, such as vehicles, buildings or stockpiled materials
- The potential for the excavation to disturb or damage nearby structures, underground or overhead services
- Safe working methods and construction methodologies
- Availability and capacity of equipment and temporary works.
- Only a competent person should be designing temporary works. Before producing any final design documents and safety report, consider:
- The design of the shoring
- Any effects of the excavation on nearby structures
- Safe work methods
- Controls

EXCAVATION DEPTH AND TYPE RECOMMENDED COMPETENCY CONDITIONS	
Up to 3 m Shored, with benched and/or battered sides	Experienced temporary works designer able to judge whether it is safe Monitoring required
Over 3 m Requiring detailed analysis of site, significant structural design analysis and sound engineering judgement Shored, with benched and/or battered sides All sheet piled excavations (cantilevered, propped, or ground anchored), and excavations shored with H-pile shoring and lagging Shafts and drives framed with timber or steel with poling boards, lagging or laths. Supported by pre-cast concrete, steel caissons/plates etc. Confined space determination and	Experienced temporary works designer able to judge whether it is safe Monitoring required Implement Confined Space SOP requirements to prevent engulfment and entrapment Including the safe limits of approach area Number of signatories are required for competency of deeper excavation

applicability	

6. MEDICAL FITNESS:

All workers associated with excavation work shall have a valid medical fitness certificate and valid gate pass.

7. RISK ASSESSMENT

MANAGING RISK

Identify Hazard

The first step in the risk management process is to identify hazards which could injure or harm anyone. A good hazard identification process is the key to risk management.

Identify hazards and controls before the work starts. It may not be possible to control all hazards before work starts – so identify the controls and implement them when required.

For example, consider the hazards:

- Person/ vehicle falling into an excavation
- Person being trapped by the collapse of an excavation
- Person working in an excavation being struck by a falling object or spoil
- Person working in an excavation being exposed to contaminants that take oxygen from the environment.
- Fire / explosion due to rupture of underground pipeline
- Slip trip fall due to awkward ingress/ egress
- Confined space working risks
- Health and ergonomics risk due to manual excavation techniques

To manage the risks, consider all relevant matters including the:

- Nature of the excavation
- Nature of the excavation work, including the range of possible methods of carrying out the work
- Means of entry into and exit from the excavation.

Identify hazards by:

- Physical inspections
- Task analysis
- Engaging with workers
- Process analysis
- Consulting guidance and standards
- Hazard and operability analysis (HAZOP)
- Accident investigation analysis

Assess Risk

Risks to health and safety arise from people being exposed to hazards (sources of harm). Carry out a risk assessment when:

- It is uncertain a hazard may cause injury or illness
- A work activity involves different hazards, and the workers involved do not know how those hazards interact to produce new or greater risks
- Workplace changes may impact on the effectiveness of controls
- New or different risks are associated with a change in work systems or work location

A risk assessment will help to:

- Identify which workers or others are at risk

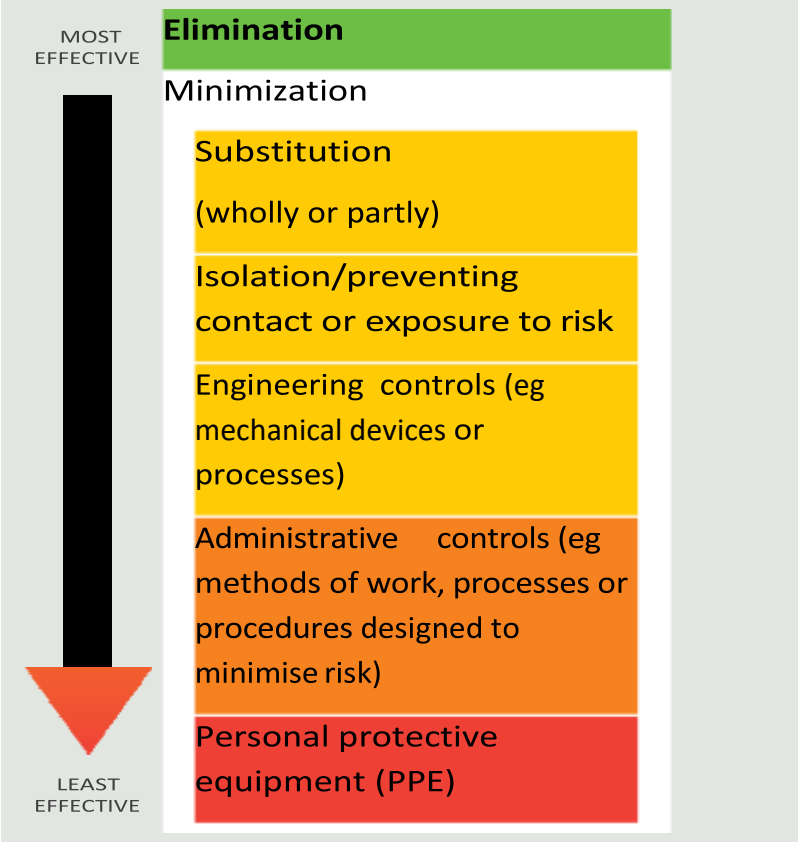
- Determine what sources and processes are causing that risk
- Determine the severity of the risk
- Identify if and what kind of controls should be implemented
- Check the effectiveness of existing controls.

Control Risk

Eliminating a risk is the most effective control. Competent person must always eliminate a risk if this is reasonably practicable.

If this is not reasonably practicable, competent person must minimize the risk by one or a combination of the following:

- Substitution: For example, using an excavator with a rock breaker rather than a manual method.
- Isolation: Isolate means preventing contact or exposure to the risk. For example, using concrete barriers to separate pedestrians and mobile plant.
- Engineering controls: For example benching, battering or shoring the sides of the excavation to reduce the risk of ground collapse.



Review Controls

Regularly review controls on site to make sure they are still effective.
Review, and if necessary revise controls:

- When the control is not effective in controlling the risk (e.g. if there has been an incident or near miss)
- Before a change at the workplace that is likely to give rise to a new or different health and safety risk that the control may not effectively control
- If a new hazard or risk is identified
- If the results of consultation indicate that a review is necessary
- If a health and safety representative or committee recommends a review.

Common review methods include workplace inspections, consultation, testing and analyzing records and data. When reviewing controls, review the safe system of work or task analysis.

If problems are found, go back through the risk management steps, review the information and make further decisions about controls

Controlling Excavation Risk

Ground Collapse

Ground collapse is one of the main risks of excavation work.

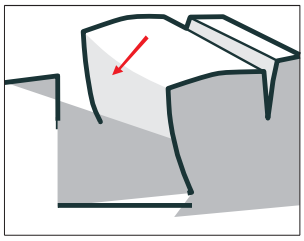
All excavations, no matter what depth, can be risky. Ground collapse can occur quickly and without warning, giving a worker virtually no time to escape, especially if the collapse is extensive. A buried worker is likely to die of suffocation before help arrives (either the head is buried, or the chest is so restricted by the ground's weight the worker cannot breathe).

Some types of ground collapse are:

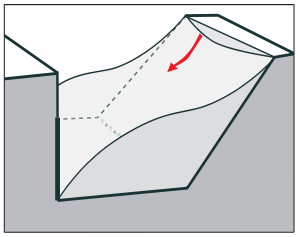
1. Tension Crack

Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the excavation, measured from the top of the vertical face of the excavation.

2. Sliding



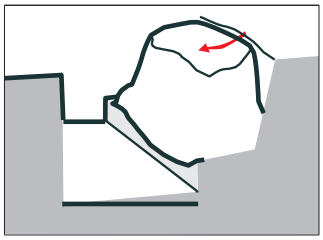
Sliding (or sloughing) may occur as a result of tension cracks.



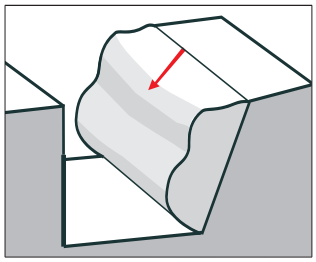
3. Toppling

In addition to sliding, tension cracks can cause toppling. Toppling occurs when a face shears along the tension crack line and topples into the excavation.

4. Subsidence and bulging



An unsupported excavation can create an unbalanced stress in the soil which, in turn, causes subsidence at the surface and bulging of the face. If uncorrected, this condition can cause face failure and trap workers in the excavation.



Stability of an Excavation

An excavated face's stability depends on the strength of the soil in the face being greater than any stresses. Some situations that increase soil stress in an excavated face and may lead to failure in bad weather, under extra load or vibration are:

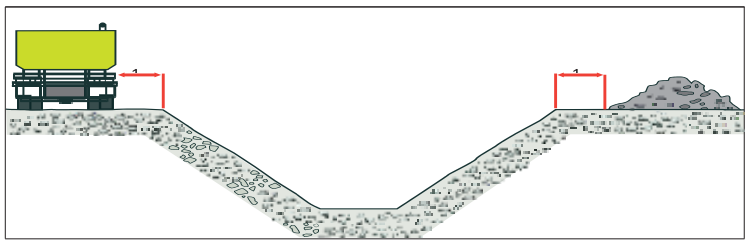
- Deep cuts and steep slopes, by removing the natural side support of the excavated material
- Loads on the ground surface near the top of the face, such as excavated material, digging equipment or other construction plant and material
- Shock and vibration, caused by pile-driving, blasting, passing loads or vibration producing plant (e.g. compacting and drilling plant)
- Water pressure from groundwater flow, which fills cracks in the soil, increases horizontal stresses and may undermine the excavation
- Saturated soil increasing the soil's weight and sometimes the volume
- Natural hazards like floods or earthquakes

Some conditions that may reduce soil strength are:

- Excess water pressure in sandy soil which may cause budging and saturate the soil and increase its plasticity
- Soil dryness may reduce cohesion in sandy soil and soils with high organic content, which then crumble easily
- Prolonged stress, may cause plastic deformity (squeezing or flowing)
- Prolonged inactivity at an excavation site; reassess the soil before work begins.

Ground Investigation

Weak, saturated, or otherwise unfavourable ground can have a significant effect on the construction and



performance of an excavation. Consider having ground investigations and geotechnical assessments for excavations that are complex or may affect nearby structures or harm workers and others nearby. The ground investigation and geotechnical assessments should include:

- Advice on the suitability of different sites or distinct areas of a site for placing structures or services
- Suitable and economic design of both temporary and permanent works
- A method to identify and evaluate possible problems in constructing temporary and permanent works
- A process to reduce the risk of unforeseen ground conditions. This will decrease
- The need for changes in design and construction methods.

Prevent Ground Collapse

If excavation work is planned without shoring, the continuing safety of the excavation will depend on the conditions arising during construction. If the conditions during construction are not as expected, or if conditions change during the course of the work (e.g. different soils, heavy rain/flooding) take immediate action to protect workers, other people and property.

Excavations shallower than 1.5 m have been known to collapse. If a worker is in the excavation and bending over or crouching down at the time of the collapse, he or she may suffer serious injury.

Managing the Risk

There are three main types of controls to prevent ground collapse. Make sure to use one or more of the following controls to support all sides of the excavation:

- Benching and battering is the horizontal stepping or sloping of the face, side, or wall of an excavation.
- Shoring prevents collapse by maintaining positive pressure on the sides of the excavation, protecting workers.
- Shields do not ensure ground stability but protect workers from ground collapse, by preventing the collapsing material falling onto them.

A combination of controls may be most effective, depending on the work environment and characteristics of the excavated material. In built-up areas or streets the excavation may have to be

fully or partly sheeted, or supported to prevent collapse due to localized vehicle movement and vibration.

If shoring is impracticable or unreasonable, make sure a competent person certifies any other safety precautions put in place as adequate. The competent person's advice should state the time period it applies to, and may be subject to a condition that specified natural occurrences may create a risk of collapse.

- A report from a competent person can provide information on the stability and safety of an excavation. The report should include:
- Details of the soil conditions
- Any shoring or excavation support requirements
- Dewatering requirements
- Any longer term effects on stability and safety of the excavation.

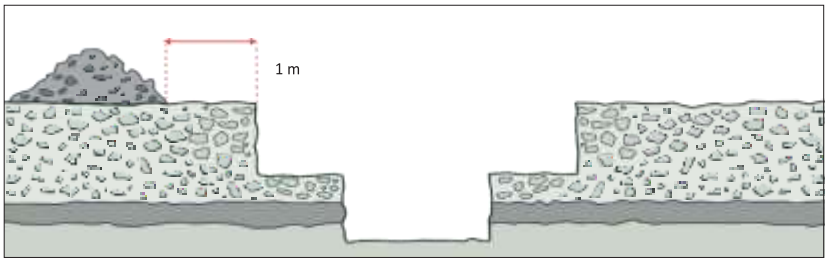
Regular Inspection

The condition of soil surrounding excavations can change quickly when the soil dries out, the water table changes or water saturates the soil. A competent person should frequently check the soil condition and the state of shoring, benching, battering, and excavated faces for signs of earth fretting, slipping, slumping, or ground swelling.

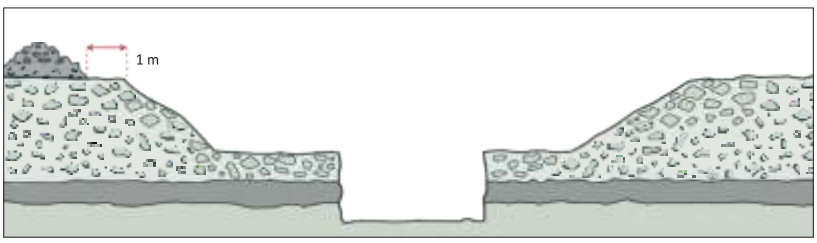
A competent person shall inspect the condition of ladders, ramps or any other means of egress before commencing of job

Safety Inspection: Operational procedures, work control arrangements and other requirements applicable to excavation and trenching activities shall be subject to periodic safety inspections. Frequency of such safety inspections shall be determined by authorized person

Benching & Battering: Benching is a method of preventing ground collapse by excavating the sides of an excavation to form one or more horizontal steps with vertical surfaces between levels.



Battering is where the wall of an excavation is sloped back to a predetermined angle to ensure stability. Battering reduces the risk of ground collapse by cutting the excavated face back to a safe slope.



Sometimes it may be appropriate to use a combination of benching and battering on an excavation.

Benching and battering of excavation walls can minimize the risk of soil or rock slipping onto the excavation.

A competent person should design controls considering:

- Soil type
- Soil moisture content
- Planned height of the excavated face
- Any surcharge loads acting on the excavated face

It is not necessary to bench or batter excavated faces which a competent person determines are in stable rock, or has assessed there is no risk of collapse. If benching or battering excavated walls, do not exceed the soil type's angle of repose unless designed by a competent person and certified in writing.

Benches should be wide enough to stabilize the slope to prevent spoil falling into the excavation. They should also be sloped to reduce the possibility of water scouring.

Shoring

Shoring provides support to excavated faces to prevent soil moving and ground collapsing. If the ground is not self-supporting, and benching or battering is not suitable, use shoring to manage the risk of a person being buried or trapped during excavation work
Involve a competent person when selecting what shoring to use. This is to make sure the shoring is fit for purpose. Otherwise, a competent person should design the shoring for the specific workplace conditions.

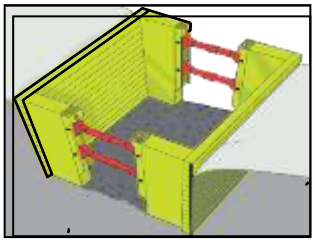
When using shoring, make sure:

- The soil is good enough for the excavation to stand when excavated
- To install support as soon as practicable
- To use a minimum of three sets of support with a maximum spacing of 1.5 m
- To minimise the length of time the excavation is open.

Types of Shoring:

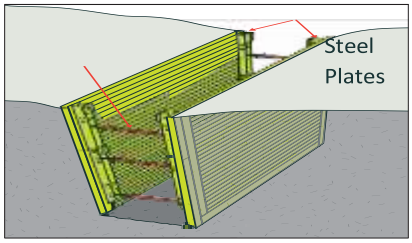
Trench-shoring boxes

A trench-shoring box is able to withstand the forces imposed by ground, water, or surcharge loads. It will protect workers within it, as well as prevent ground collapse. This is achieved by 'digging and pushing' the box into the ground as the excavation proceeds, maintaining positive pressure on the excavated faces at all times.



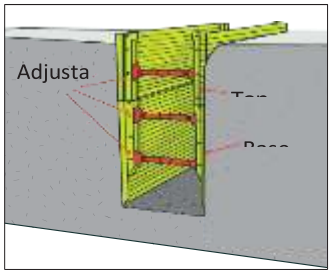
Manhole boxes

Manhole boxes are a subset of trench-shoring boxes. They are designed and constructed using the same methods and materials as trench- shoring boxes. Most manhole boxes are installed using the 'dig and drop' method. If ground conditions are poor enough that the dig and drop method is not practical, consider digging and pushing manhole box shoring, corner-slide rails or hydraulic brace and sheet systems.



Trench shields

Trench shields are different to trench-shoring boxes as they are only designed to protect workers if a collapse occurs. Trench shields are designed to be installed using the dig and drop method and dragged along as work progresses

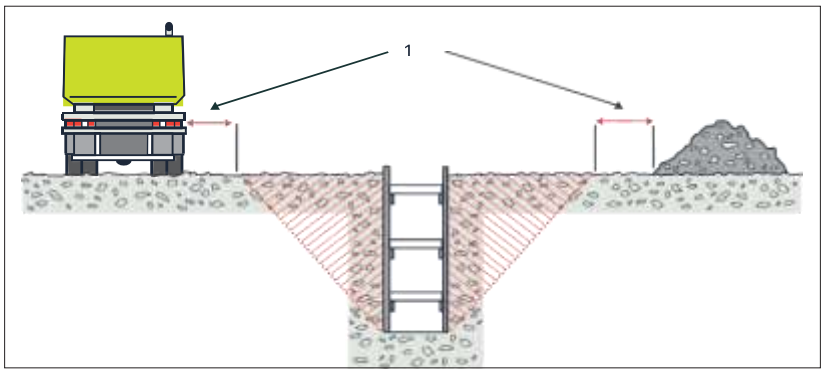


Excavated Material & Loads near Excavations

The influence of any loads near the excavation can cause ground collapse. Any excavated material and external actions applying a load to the ground nearby can affect the excavation's stability through the zone of influence. The zone is normally from the base of an excavated face to the surface. The zone's angle will depend on site-specific factors.

Mechanical plant, vehicles, spoil, or heavy loads should not be in the zone of influence plus 1 m from an excavation unless specific design can show it can support the surcharge load.

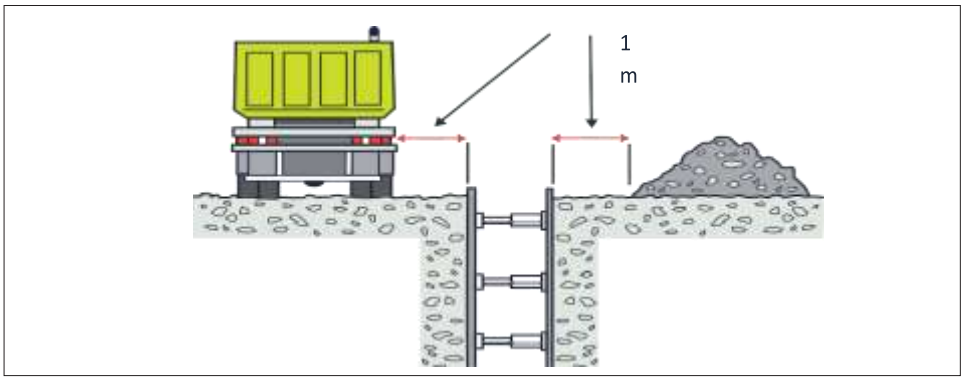
Placing or stacking spoil near an excavated face puts workers at risk because it adds an extra load where it is placed or stacked. For example, placing spoil near the excavated face may cause it to collapse.



If excavating in sloping ground decide which side of the excavation to place the excavated material.

Consider the following:

- Ground conditions
- Access to the excavation
- Existing underground services
- Needing earthmoving machinery or vehicles to work or move beside the excavation
- Service installation and backfilling requirements
- Manual work in the excavation



Standard Practices and Instructions:

Water Accumulation

Workers are not to work in excavation, where water has accumulated. If water removal equipment is being used to control or prevent water from accumulating, the operation shall be monitored by a competent person to ensure proper use. Methods for controlling standing water and water accumulation must be provided if employees are permitted to work in the excavation

Safe Access & Egress

Provide safe access and egress for all workers at all times. Keep the floor of the excavation clear of anything that would impede workers' safe egress in an emergency, including:

- debris
- loose spoil
- timber

- tools

Ladder

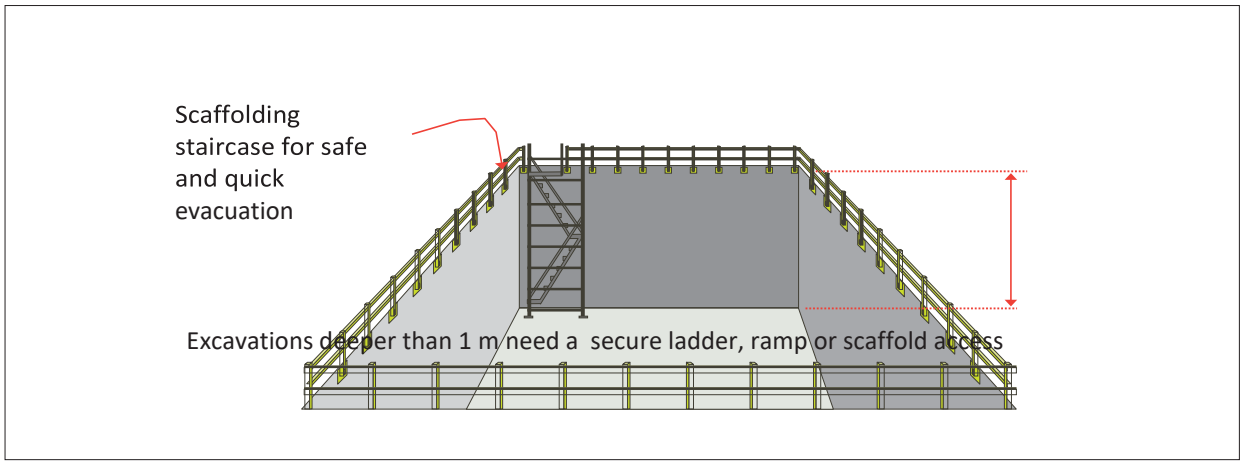
When portable ladders are used, the ladder side rails shall extend a minimum of one (1) metre above the upper surface of the excavation.

Ladders shall have nonconductive side rails if work will be performed near exposed energised electrical equipment or systems

Ladders will be inspected prior to use for signs of damage or defects

Ladders used for emergency exit from the excavations shall never be removed unless last worker is out from the excavation area

Ladder management trained to be provided on installation and use.



Manual Works

During excavation work, there will be circumstances that require some form of manual work including:

- Hand excavation
- Lifting
- Working in close proximity to plant and other workers

Tasks which may lead to manual handling injuries include:

- Potholing with sharp hand tools
- Spotting/exposing underground services in close proximity to excavator buckets
- Frequently accessing trenches around existing services
- Installing and removing shoring and fall protection
- Placing heavy pipes into the excavation
- Using compacting equipment
- Using breakers
- Using drills.

Manual excavation methods are generally used for small, shallow excavations (e.g. less than 1.5 m deep) in soft soils. For some excavations, manual work such as trimming by hand will be required. Trimming can often be accomplished from outside the excavation by shovelling or pushing the material with a long-handled tool or shovel to the bottom of the excavation, where it can be picked up by mobile plant.

Managing Risk controls includes:

- Creating exclusion zones around mobile plant and ground buckets – disengaging controls when spotters have to get close
- Keeping sites tidy and free from trip hazards and loose materials which may lead to slips
- Maintaining safe working spaces around workers
- Providing safe access and egress
- Rotating tasks and making sure workers take breaks
- Using correct lifting techniques to ensure solid footing
- Using plant to place and position shoring, props and plates, and remove compactors
- Wearing correct PPE.

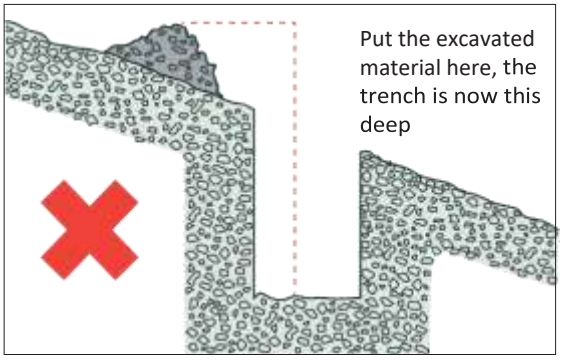
Overhead & Underground Services:

Workers and others nearby can be killed or seriously injured by striking services that are overhead or underground.

Avoid striking or undermining services. Good planning and supervision should identify and anticipate all overhead and underground services, which will help decide what activities will be allowed near the excavation work.

Mobile plant operators should:

- Know what overhead and underground services are in the vicinity
- Identify and mark out underground services
- Assume all services are live or in use unless the service owner formally advises in writing there are no risks with the service
- Know how far the mobile plant (e.g. excavator) can reach
- Know minimum approach distances (MADs)



SERVICE	DISTANCE AWAY
Cables, gas transmission or high pressure pipelines	2 m or more
Overhead power line	4 m or more
Pole or support stay	5 m or more
Tower	12 m or more

Overhead Power lines

Excavating too close to overhead service support structures such as wooden poles can cause these to lean or collapse, putting workers and others at risk. Breaking communications cables can also release laser light that can damage eyesight.

To minimize risk:

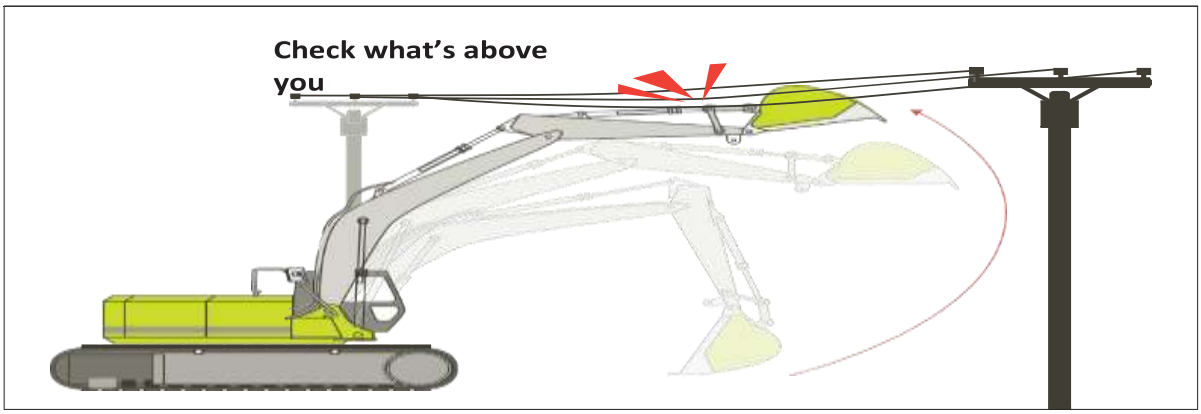
- carry out operator briefings to:
- clarify any MADs (minimum approach distance)
- understand the mobile plant's capability (i.e. knowing how far the mobile plant can reach)
- put signs or warning labels in the cab about the MADs
- temporarily earth the mobile plant
- use markers and spotters
- shield services
- electrical hazards to mobile plant near overhead power lines and electric cables
- String independently supported flag bunting 1.5 m below the span. The operator and spotter can use this as a guide. Consult the service owner to get consent before stringing any bunting.

If the service owner consents to excavating closer than the 4 m MAD:

- Protect operators (including operators of remote controlled plant) from electrical hazards.
- Keep people away from the mobile plant in case of electrical contact.
- Have emergency response procedures in place, if electrical contact does accidently happen

If there is contact with live power lines, make sure:

- The operator remains inside the excavator unless threatened by fire
- All workers keep well clear of the excavator and anything else in contact with electricity, and shuffle to clear the area
- To call the emergency service
- To initiate an emergency response, including with the service owner to shut down and isolate the affected service
- To restart work only when emergency service authorities and service owners authorize this.



Ground & Surface Water

Workers should not work in excavations where water has collected or is collecting, unless the necessary controls are in place.

Water may collect because of:

- A high groundwater table seeping into the excavation
- Nearby storm water drains
- Surface run-off after heavy rain
- A nearby swamp, dam, lake, or river.

Risk Controls may include:

- Shoring
- Dewatering techniques (i.e. water removal), improved by using:
  - Cut off walls
  - Grouting or an asphalt bund
  - Horizontal wells
  - Compressed air.

When selecting the most appropriate dewatering technique, consider:

- Available space within and around the excavation
- Depth to the existing groundwater and the necessary increase in this depth to permit access to the excavation
- Soil permeability in and around the excavation; note: this may vary across the site
- Structures or underground surfaces near the excavation that may be damaged because of dewatering induced ground settlement
- Potential for base heave.

COMMUNICATING RISKS

All personal involved in excavation and working inside excavated areas should be educated about hazards and controls in place. Management should ensure that there are procedure in place to communicate safe operating procedure

All work excavation job should be carried out followed by Pre Job Toolbox Talk, to communicate hazards and controls pertaining to specific job and awareness

Adequate safety displays should be provided on site to increase awareness among workforce.

8. PLANT AND EQUIPMENT

Various plant and equipment can carry out excavation work. Excavators in a range of sizes can:

- Extract soil from within an excavation
- Lift and move materials
- Install and remove shoring

Make sure to use an appropriate excavator for the excavation work and properly plan and risk assess any lifting operations by the excavator before carrying out the operation.

To use plant safely:

- Make sure the plant is operated by a competent operator
- Ft suitable guards and protective devices
- Display the working load limit and make sure any load measurement devices are operating correctly
- Maintain plant in accordance with the manufacturer/supplier's instructions or relevant standards
- Carry out regular planned inspections and maintenance in accordance with the manufacturer's recommendations to make sure the mobile plant works safely, whether leased, hired, or owned
- Conduct both mechanical and electrical testing
- Carry out the following checks:
- Daily pre-start checks on the general condition and maintenance of the plant
- Regular inspections by a competent person, in accordance with the manufacturer/supplier's specifications or relevant standards.

Checking Vehicle, Equipment & Materials

Check vehicle, equipment, and materials before arriving at the worksite. Make sure the vehicle and equipment are fit-for-purpose and in good working order

Check there is appropriate PPE for the job and it is in good condition. Correct PPE includes:

- High-visibility clothing
- Hard hat
- Safety footwear
- Hearing and eye protection

- Hand gloves

Using Vehicle

A wide range of powered mobile vehicle, including earthmoving machinery can carry out excavation work. To select suitable vehicle, consider:

- The task
- Site access and restrictions
- Type and depth of excavation
- Ground conditions
- The mobile plant's size and reach
- Hazards (e.g. overhead and underground services)
- The volume of material to be excavated and transported
- Where the excavated material is to be located and stored.

Excavation work exceeding 1.5 m deep is typically done by excavators or specialized vehicle such as tunnelling machines and raise- bores. Most of these types of vehicle have an element of mobility, although tunnelling machines typically have restricted movement.

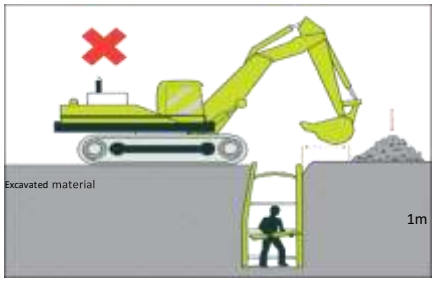
Other vehicle used in excavation work includes backhoes, rubber-tyred loaders, skid steer loaders (e.g. Bobcats), trench diggers, graders and tip trucks.

Plant & Vehicle Operation near Excavations

Powered mobile plant should not operate or travel near the edge of an excavation unless the shoring can support such loads.

Plant should approach end-on to excavations. If this is not practicable, make sure workers in the excavation get out when the plant is within the excavation's zone of influence or move away and stand further down the excavation.

Workers should never stand under a load being lifted over the excavation

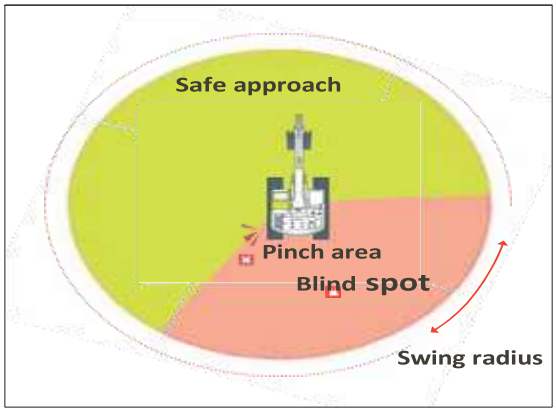


CONSIDER	EXAMPLE CONTROLS
Attachment failure	• use quick hitches to secure attachments
	• make sure the operator is familiar with and able to implement and manage any quick hitch used
	• make sure the operator checks any pins
Buried contaminants	• conduct a site assessment and carry out any remedial action (e.g. asbestos)
Lack of visibility	• make sure operators can see areas where people may be at risk from the operation of the machine
	• equip excavators with adequate visibility aids or use a spotter/s
Plant instability	• set up as per industry recommendations
Plant striking workers	• Keep people away from areas of plant operation. Most excavator related
	• deaths involve a person working in the vicinity of the excavator rather than the driver
	• use barriers, signage or a spotter

Safe approach zone for an excavator

Blind spot

Operators of powered mobile plant can often have severely restricted visibility of ground workers or nearby pedestrians, particularly those close to the plant.



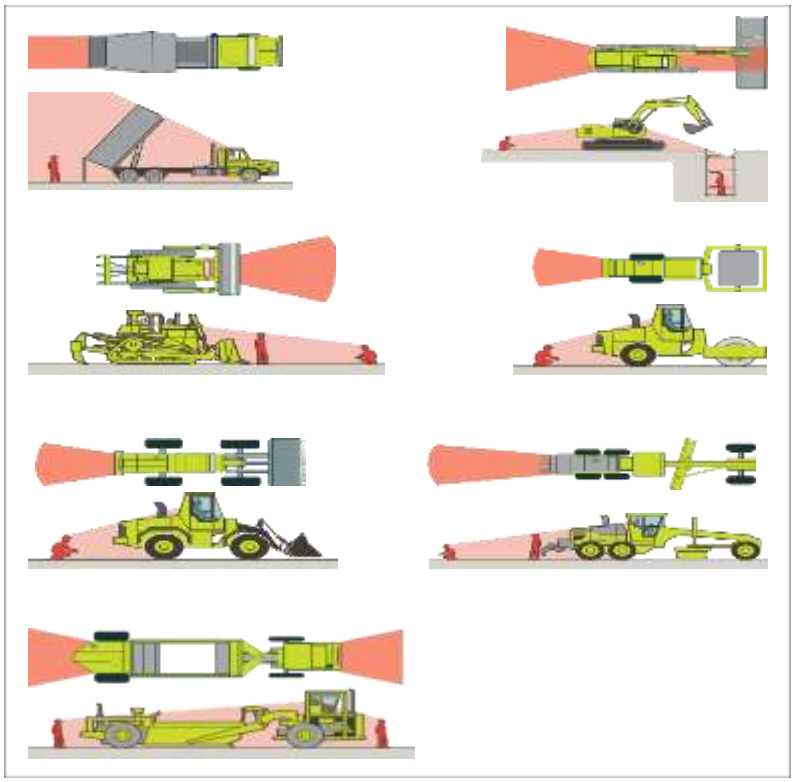
Operator Protection

Powered mobile plant should be equipped with an appropriate combination of operator protection devices, for example an enclosed cabin and seat belts, to prevent the operator from ejecting from the cab or being struck by falling objects.
Any earthmoving machinery weighing more than 700 kgs., not including attachments, and designed to have a seated operator, should have an appropriate operator protective structure fitted. These are either roll-over protective structures (ROPS), falling object protective structures (FOPS) or both, depending on the application. Self-propelled mechanical mobile plant must, so far as is reasonably practicable, be fitted with roll-over protection and seat belts.

Quick Hitches

Quick hitches allow a bucket or other attachment to be quickly and easily connected and disconnected from an excavator or backhoe arm, saving significant time during mobile plant operation.
A pin holds the attachment in place against the quick hitch and insures against accidental release. However, a manual quick hitch may still operate without the retaining pin in place and then suddenly, without warning, swing open or fall completely. If this happens when lifting over or close to a person the result is likely to be fatal.

- Risk Controls include:
- Using a suitable semi or fully automatic system instead of a manually operated quick hitch system
- Training excavator operators on the use of quick hitches
- Ensuring that excavator operators are competent to use the specific hitch for the machine they use
- Operators only using pins designed for this specific use (the manufacturer-specified retaining pin must be available on the machine)



- Attachment information clearly displayed or present with the machine identifying:
  - model and serial number
  - manufacturer's name
  - weight and maximum rated capacity
- Each lifting point's capacity
- Setting up a system for checking that the pin is in place before starting the work and every time a different attachment is fitted
- Conducting random checks to make sure precautions are implemented and followed.

Before operating the mobile plant the operator should:

- check the attachment size is suitable and compatible with the quick hitch
- check the quick hitch is kept in good working order
- physically check the safety pin is securely in place or the automatic system has engaged correctly:
  - before starting work, and
  - when fitting a different attachment
- Make sure an exclusion zone is set up when using the excavator and for attachment fitting or removal. If there are other workers on the construction site the exclusion zone applies to them, even if they are not involved in the excavator operation.

9. RESCUE MANAGEMENT

All Excavation activities should be thoroughly assessed of all potential emergency rescue situations which varies from type of excavation and job to be done.

Few of such rescue situation are,

- Engulfment
- Entrapment
- Hazardous atmosphere
- Fall from height

Before start of job, all such scenarios should be identified and mentioned in

Rescue Plan. There should be a rescue team informed before all excavation activity so as to respond to such emergencies promptly. Rescue plan should clearly identify all emergency controls in place and ensure if job can be carried out with identified controls in place.

Rescue team should be equipped with adequate respirator (SCBA) and other necessary rescue devises to respond to emergency

10. RELATED DOCUMENTS

Doc. Ref.	Document name
POL 06	HSE Policy
VSS	Civil Excavation
VED/CORP/SUST/MS 6	Competency, Training and Awareness
VED/CORP/SUST/TS 10	Safety Management
	SOP
GN 19	Permit to Work
VED/CORP/SUST/MS 1	Leadership, Responsibilities and Resources
VED/CORP/SUST/MS 9	Documentation and Record Management
VED/CORP/SUST/MS 11	Incident Reporting and Investigation
	Auditing and Assurance
VED/CORP/SUST/TS 13	Emergency and Crisis Management
VED/CORP/SUST/MS 14	Management Review and Continual Improvement
GN 01	Incident Investigation
GN 07	Risk Assessment
GN 10	PPE
GN 14	Health and Safety Management Systems
GN 33	Ladders and Platforms
VED/CORP/SUST/MS 13	Corrective and Preventive Action Management