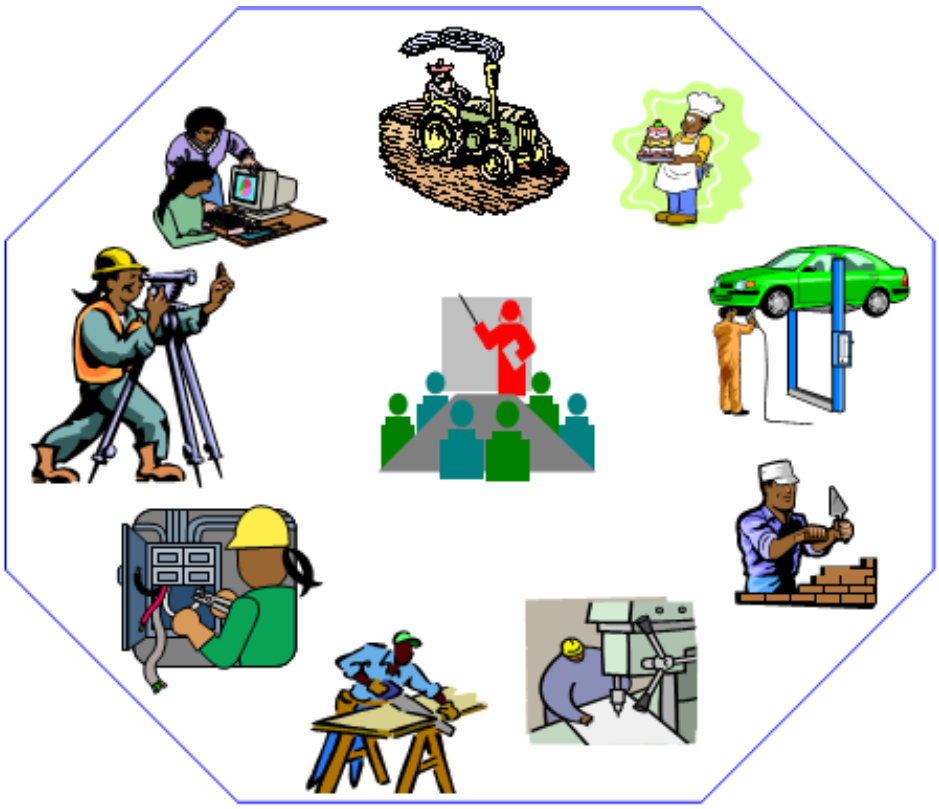
Mineral Resources Infrastructure Work

Level I

Based on Version 2

December, 2018 OS and April 2021, V1 Curriculum



Module Title: Carrying out manual excavation

LG Code: MIN MRI1 M11 LO (1-4) LG(38-41)

TTLM Code: MIN MRI1 TTLM 0421v1

April,2021

Adama, Ethiopia

Table of content

LG #38	LO #1- Prepare for work

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Accessing, interpreting and applying compliance documentation
- Obtaining and applying safety requirements
- Identifying and implementing signage requirements
- Selecting appropriate tools, plant and equipment
- Identifying and applying environmental protection requirements

Identifying and reporting breaches in site safety This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Access, interprete and apply compliance documentation
- Obtain and apply safety requirements
- Project traffic management plan
- Identify and implement signage requirements
- Select appropriate tools, plant and equipment
- Identify and apply environmental protection requirement

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. If your performance is satisfactory proceed to the next learning guide,

5.If your performance is unsatisfactory, see your trainer for further instructions or go back to “information sheet”

Information Sheet 1- Accessing, interpreting and applying compliance documentation

1.1. Introduction

The purpose of the Health and Safety policies and procedures is to guide and direct all employees to work safely and prevent injury, to themselves and others.

All employees are encouraged to participate in developing, implementing, and enforcing Health and Safety policies and procedures. All employees must take all reasonable steps to prevent accidents and never sacrifice safety for expedience.

Excavation work should be carefully planned before work starts so it can be carried out safely. Planning involves identifying the hazards, assessing the risks and determining appropriate control measures in consultation with all relevant persons involved in the work including the principal contractor, excavation contractor, designers and mobile plant operators. Structural or geotechnical engineers may also need to be consulted at this stage.

Consultation should include discussions on the:

- nature and/or condition of the ground and/or working environment
- weather conditions
- nature of the work and other activities that may affect health and safety
- static and dynamic loads near the excavation
- interaction with other trades
- site access
- SWMS
- management of surrounding vehicular traffic and ground vibration
- type of equipment used for excavation work
- public safety
- existing services and their location
- the length of time the excavation is to remain open
- provision of adequate facilities, and
- procedures to deal with emergencies.

Further information on amenities and emergencies is available in the Code of Practice: Managing the work environment and facilities

A permit to dig must be issued by an appointed person and be available at the work location.

1.2 Compliance Documentation

Documentation is essential to all aspects of every worksite. From environmental plans through to mining plans, documentation exist that will outline what to do, when to do it and the manner in which the task is to be done.

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the WHS Act and the Work Health and Safety Regulations (the WHS Regulations).

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the WHS Act, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks that may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the WHS Act and Regulations. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Compliance with the WHS Act and Regulations may be achieved by following another method, such as a technical or an industry standard, if it provides an equivalent or higher standard of work health and safety than the code.

An inspector may refer to an approved code of practice when issuing an improvement or prohibition notice.

This Code of Practice has been developed by Safe Work Australia as a model code of practice under the Council of Australian Governments' Inter-Governmental Agreement for Regulatory and Operational Reform in Occupational Health and Safety for adoption by the Commonwealth, state and territory governments.

Scope and application

This Code provides practical guidance for persons conducting a business or undertaking on how to manage the health and safety risks associated with excavation work. This Code applies to all types of excavation work including bulk excavations more than 1.5 metres deep, trenches, shafts and tunnels.

The guidance in this Code is relevant to excavation contractors as well as persons conducting a business or undertaking who have management or control of workplaces where excavation work is carried out, such as principal contractors.

Persons who have duties in relation to excavation work should also refer to the Code of Practice: mininig work.

How to use this code of practice

In providing guidance, the word 'should' is used in this Code to indicate a recommended course of action, while 'may' is used to indicate an optional course of action.

This Code also includes various references to provisions of the WHS Act and Regulations which set out the legal requirements. These references are not exhaustive. The words 'must', 'requires' or 'mandatory' indicate that a legal requirement exists and must be complied with.

Where workers are required to enter an excavation or trench, a safe means of access and egress must be provided.

When establishing access and egress arrangements, the following should be considered:

- where an excavation or trench cannot be easily walked into, ladder access must be provided (refer to the Prevention of Falls Procedure for requirements associated with the safe use of ladders)
- ladders must be provided at a maximum of nine metre intervals for the length of the excavation or trench
- ladders must extend at least one metre above the edge of the trench
- no person shall be present in an excavation or trench where there is a risk of harm from plant falling into the occupied area.

A safe system of work sets out how a piece of work or a project will be completed safely and in compliance with relevant legislation.

Implement a safe system of work before excavation work starts to make sure the excavation happens in the right location with the right plant and equipment on site and with the right workers with relevant competencies.

Make sure to engage with workers carrying out the excavation work and their representatives, and if you are working with other PCBUs, co-operate, co-ordinate and consult with them so far as is reasonably practicable.

A safe system of work should include:

assigning responsibilities

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.In the event of any reactive excavation work, establish a safe system of work and communicate this to workers.

Interpreting and Applying Compliance Documentation

Interpretation of compliance documentation will allow you to make the right decisions for each situation or task. Interpretation understands what is required of you and how you are

expected to perform the tasks. When interpreting documents, it is vital that you understand the difference between words such as ‘should’, ‘consider’ and ‘must’.

In order to understand and interpret compliance documentation you may need to use a range of mediums, including reading the documentation, using computers, following charts and diagrams and speaking with experienced supervisors or personnel/workers.

Applying the information in these documents is simply following the directions in the documents.

Make sure you have access to all relevant compliance documentation within your workplace. Be careful to interpret them correctly, understand their implications and apply them to workplace operation effectively. All WHS documentation should be up-to-date with current standards and practices. If you are in any doubt as to what you should do after reading the documentation, it is essential you speak with your supervisor or other designated person, for further instructions or clarifica

Self-check 1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Define Compliance documentation?(3 points)
2. What is the function of Safety Data Sheets? (4 points)
3. Why we Interpreted compliance documentation? (3 points**)**

Score = _____

Rating: _____

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Obtaining and applying safety requirements

A written permit setting out the minimum safety conditions may be required for such work as: construction of buildings; placement of fence posts; drain construction and cleaning; any excavation; any permanent service; removing earth cover; blasting; operating heavy machinery over a pipeline; or any work which could damage or endanger the pipeline.

The qualifications of equipment operators and the conditions of the excavating equipment must comply with safety regulations. In addition to concerns about safe excavating equipment and equipment operation, there are specific items of safety associated with excavation that must be addressed. Trench excavation Trench excavation refers to any excavation with vertical or near vertical walls and is a major safety concern in any earthwork construction operation due to the potential for sloughing and poor air quality in confined working conditions. Trench excavation must comply with Occupational Safety and Health Administration (OSH) regulations, and the contractor's plan to comply with these regulations should be reviewed and discussed with all employees. Trenching operations should be supervised by a competent person. Material removed from the trench should be placed a safe distance from the excavation (a minimum distance of 2 ft is recommended) to prevent excessive loading on the trench walls

. To reduce excavation hazard potential, limit the amount of excavation to no more than can be maintained.

Excavated slopes that are steep or unsupported and vertical trench walls are prone to sloughing and caveins. Fluctuations in soil moisture can cause an otherwise stable excavation to cave in. In cold weather, freezing and thawing of the ground can result in excavation instability. Placing a surcharge load, such as spoil material, on the bank above an excavation can lead to the collapse of the excavated slopes. Material that falls into the excavation from a surcharge pile could strike an employee. Equipment operating in or near excavations can also cause surcharge loads or

ground vibration that may contribute to slope failures. Any change to soil conditions, spoil locations, and location of equipment operations

should be monitored by a competent person and necessary measures taken to immediately reduce hazard potential.

The owner should have an excavation safety plan that identifies the hazards and provides for a means to protect workers. The plan should be reviewed and discussed with all employees. The plan must include emergency action items made known to all employees. OSH requires that workers operating in excavations greater than 5 feet deep be protected from sloughing or cave-in by a system designed by a qualified engineer. OSHA offers guidelines for sloping, shoring, and worker protection that may be used in lieu of a custom-designed system. The inspector's responsibilities related to excavation safety and trench excavation include verifying:

- qualifications of equipment operators and the conditions of the excavating equipment comply with safety regulations
- the contractor's excavation safety plan is reviewed and discussed with all employees
- all employees have been informed of what to do in emergency situations
- contractor operations comply with OSHA regulations related to excavations.
- trenching operations are supervised by a competent person
- spoil materials are placed a safe distance (2 ft minimum) from top of excavated slopes
- confined space air quality is considered where applicable
- the amount of trench excavated at any one time is limited to no more than can be maintained
- shoring, trench boxes, and trench access ladders are installed per OSHA requirements
- consideration is given to changing soil conditions of moisture and freeze/thaw, surcharge loads, equipment operation, and other conditions that may cause excavations to be unstable.

No manhole, chamber or other structure should be built over, around or under a gas pipe and no work should be carried out which results in a reduction of cover or protection over a pipe, without first consulting the gas service owner.

Safety Policy and Procedures

The Safety Procedure includes: Safety measures

1. Keep a well-stocked, up-to-date first aid kit in an accessible area.

2. Always wear appropriate protective gear. Train workers thoroughly Your site is a workplace and you are responsible for the health and safety of workers and visitors. Inexperienced workers are much more likely to be injured in job site accidents.

You can prevent injuries in many ways:

- Supervise inexperienced workers at all times.
- Make sure your workers are thoroughly trained in equipment operation and safety.
- Keep all equipment in good repair.
- Warn workers of potential hazards and insist they use equipment safely.
- Only allow a worker to perform a task when you are confident they can handle it.
- Keep visitors well away from operating machinery such as grinders and wet saws and warn them of potential hazards.

Protect children from accidents Children account for one in seven job site related fatalities and children under the age of sixteen account for one in four job site related deaths. You can protect children from harm in many ways:

A Site-Specific Safety Plan is a requirement of the OSHA Standard for mining . this plan is designed to identify, evaluate, and control health and safety hazards for the purpose of protecting employees.

The plan provides for emergency response activities at the jobsite as well as covering site hazard analysis, training requirements, engineering controls, materials handling, safe mining operations, and safety specifications outlined for this project.

This Site-Specific Plan is intended to provide guidance and information in dealing with the hazards that may be faced on the job by Mass excavation.

This plan is a site specific document. technical, Contract and/or Operational Managers are responsible for ensuring all aspects of employee safety are addressed in this plan. Health and safety personnel are available to assist management with the contents of the plan. The health and safety personnel help ensure the plan complies with all applicable federal, state, and corporate regulations and policy. the health and Safety department has final authority for this plan's contents and provisions.

Policy collection has a strong commitment to providing a safe and productive workplace. in keeping with this commitment collection intends to maintain a positive Safety Program and a Substance-Abuse Program. employees conduct themselves and work in a safe manner with good mining practices.

It's important communication is kept open at all times. For this reason, management practices an open-door policy. Employees who notice hazards or other safety problems or feel they need additional training must notify their supervisor.

Job appreciation

The next step is for the field supervisor and the project engineer to discuss all aspects of the job, including those things noted during the site inspection. These aspects would include: Availability of labour - skilled and unskilled Availability of plant and equipment, from either the contractor's or the department's plant fleet or from plant hire organisations Availability of materials for both temporary and permanent works Climate and weather conditions expected during the construction period Likely industrial problems and possible corrective action (effectiveness of communication)

Work to be done by subcontractors and availability of suitable subcontractors Supervisory staff requirements, i.e. plant supervisors, soil testers, surveyors, foremen and site supervisors, etc. Limitations imposed by other bodies, i.e. public utilities, local authorities, Telstra, etc. Availability of public utility authorities to carry out service alterations

Decisions are needed at this stage to establish the job program, such as:

- The starting date
- The organisation to be used
- Construction methods to be used
- Plant, material and manpower required

- The sequence to be used for job activities

SpecificRequirements

At a minimum, the following items shall be reviewed and implemented as required to the specific excavation and trench operation:

- Removal of all support encumbrances located near the surface of the excavation or trench.
- Underground utility installations located.
- Access and egress from the excavation or trench provided.
- Any employee exposure to vehicular traffic and employees provided with visible warning vest or garments.
- Employees protected from falling loads while in the excavation or trench.
- A warning system provided when mobile equipment nears the edge of the excavation or trench.
- Hazardous atmospheres evaluated prior to entry and during work based on containment(s) present.
- Water hazards associated with excavation or trench are evaluated and controlled.
- The stability of any adjacent structures is evaluated and controlled.
- Loose rock or soil is kept back from excavation or trench by at least 2 feet.
- Walkways are provided where employees or equipment are permitted to cross over excavation.
- Daily inspections shall be done of excavations, adjacent areas, and protective systems by the Competent Person.


The Planning Process
Perception Of Oppournuties
Establishment of Objectives
Planning premises
Identification of alternative
Evaluation Of Alternatives
Choice of alternative
Formulation Of Supporting Plan
Establishing sequence of activities

A safe work procedure should identify: the steps that are to be undertaken that pose risk. any control measures that have been built into these tasks. any training or qualification required to undertake the task.

Work instructions are created to guide workers in four key quality areas: training, reference, problem solving and continuous improvement. Use these four reasons to write useful work instructions

Self-Check – 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Define **isolation**? (2 point)
2. Define **Hazard**? (2 point)
3. Write the common tags used on work site.At least 3. 3 points
4. List at least four common Energy sources for Hazard? 3 points

Test II:Say true or false

1.Removal of all support encumbrances located near the surface of the excavation or trench is pre requirement for excavation.

2.ground utility installations is located during pitting.

3.Access and egress from the excavation or trench provided for trenching

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 3- Identifying and implementing signage requirements

Introduction

Whenever mining operations are carried out on the mining site warning signs should be placed before each end of the work site also when moving around work site you need to be aware of the specific rules regarding plant and equipment, pedestrians, signage and devices and no go zones. Become familiar with the main locations, access routes and especially restricted zones, the Traffic Management Plan will identify these areas.

Barricades are required around all construction sites and all excavations, holes, openings in floors or roofs, raised platforms, for certain types of overhead work, restriction of access areas and wherever it is necessary to warn people against the potential of falling. Barricades must be suitable for each area of use. Examples of barricades are plastic safety fencing, temporary cyclone fencing and portable manhole barricades. Yellow caution tape and/or cones are not considered acceptable barricades and should be used only temporary until suitable barricades are erected. Signs and illumination should be used appropriately.

The following are examples of activities where barricades may be required:

Wherever construction debris is dropped without the use of an enclosed chute.

Areas with temporary wiring operating at more than 600 volts.

Work areas for electrical equipment with exposed energized parts.

The swing radius of the rotating superstructure of cranes or other equipment.

Wherever equipment is left unattended near a roadway at night.

Excavations. Areas used for the preparation of explosive charges or blasting operations.

Street openings – manholes.

Construction areas in energized electrical substations.

Responsibilities

Contractors are responsible for providing all barrier materials for both interior and exterior application including but not limited to appropriate street closing barricades and signage that meet DOT requirements, and all local, state and federal laws.

1) The Contractor/mining campany shall ensure the general construction/mining area is protected; barricades must be erected before any excavation, extended as the excavation progresses and maintained until the project is completed.

2) The Contractor shall furnish, erect, and maintain all the necessary signs, barricades, lighting, fencing, bridging, and flaggers that conform to the requirements set forth by OSHA.

3) Barricaded areas which contain an opening or hole for access must be protected during working hours and must be secured at the end of each day.

4) All holes or openings through floors or decking at all elevations must be immediately covered or barricaded. Material or equipment must never be stored in an excavation cover or inside an excavation area.

5) Hole covers must be secured or cleated so they CANNOT slip, and must extend adequately beyond the edge of the hole.

6) Barricades shall not create a trip hazard.

7) The type of barricading system, whether it is fencing, caution tape, or some other means, the Contractor must discuss the barricades system to be used with the EH&S office to ensure protection for the campus community.

8) Warning signs should be placed on barricades/fences for the duration of the construction project.

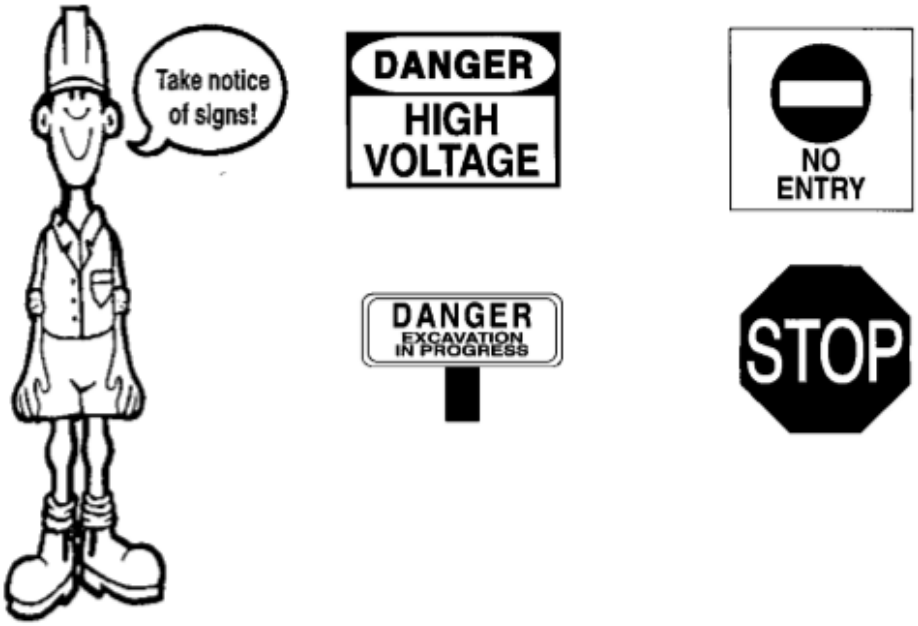
9) Upon completion of the project, barricades shall be removed promptly when no longer

Workplace Signage

Safety in and around excavations should be considered as part of the job planning from the commencement of a project. Awareness of hazards should be part of the planning, design and cost estimating process.

Particular hazards should be noted at the start of the job as this will help maintain awareness of them throughout the project.

A common approach to this task by all concerned is to erect barriers and signs that warn of possible danger.



BARRICADES

There are two types of barricades used on a construction site;

- Warning Barricades and,
- Protective Barricades.

Warning Barricades

Safety in and around excavations should be considered as part of the job planning from the commencement of a project. Awareness of hazards should be part of the planning, design and cost estimating process.

Particular hazards should be noted at the start of the job as this will help maintain awareness of them throughout the project.

A common approach to this task by all concerned is to erect barriers and signs that warn of possible danger.

Below a definite Fail – no shoring, deeper that 1500mm & no ladder for egres
well as materials store close to excavation, an accident waiting to happen!!

call your attention to a hazard but offer no physical protection. They can consist of star piquets with plastic barrier mesh, hessian webbing, flicker tape or proprietary products, i.e. plastic moulded inter-locking barriers.

Protective Barriers provide physical protection and are generally constructed of pre cast concrete and can be bolted together to increase physical entry.

Placement of Safety Signs Signs should be located where they are clearly visible to all concerned, where they can easily be read, and so that they will attract attention. If lighting is not adequate, use illuminated signs. Signs should not be located where materials and equipment are likely to be stacked in front of them, or where other obstructions could cover them (e.g. doors opening over them). They should not be placed on movable objects such as doors, windows or racks so that when the object is moved they are out of sign or the intention of the sign is changed. The best height for signs is approximately 1500mm above floor level. This is at the normal line of sign of sign for a standing adult. The positioning of the sign should not cause the sign itself to become a hazard to pedestrians or machine operators. Regulation and hazard-type signs should be positioned in relation to the hazard to allow a person plenty of time to view the sign and take notice of the warning.

This distance will vary: for example, signs warning against touching of electrical equipment should be placed close to the equipment, whereas signs on construction work may need to be placed far enough away to permit the warning to be understood before the hazard is reached. Care should be taken where several signs are intended to be displayed close together. The result could be that so much information is given in one place that little or no notice is taken of it, or that it creates confusion.

t

Self-Check – 3	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write the common signage of work site?5 points
2. What contains Site Information?5 points

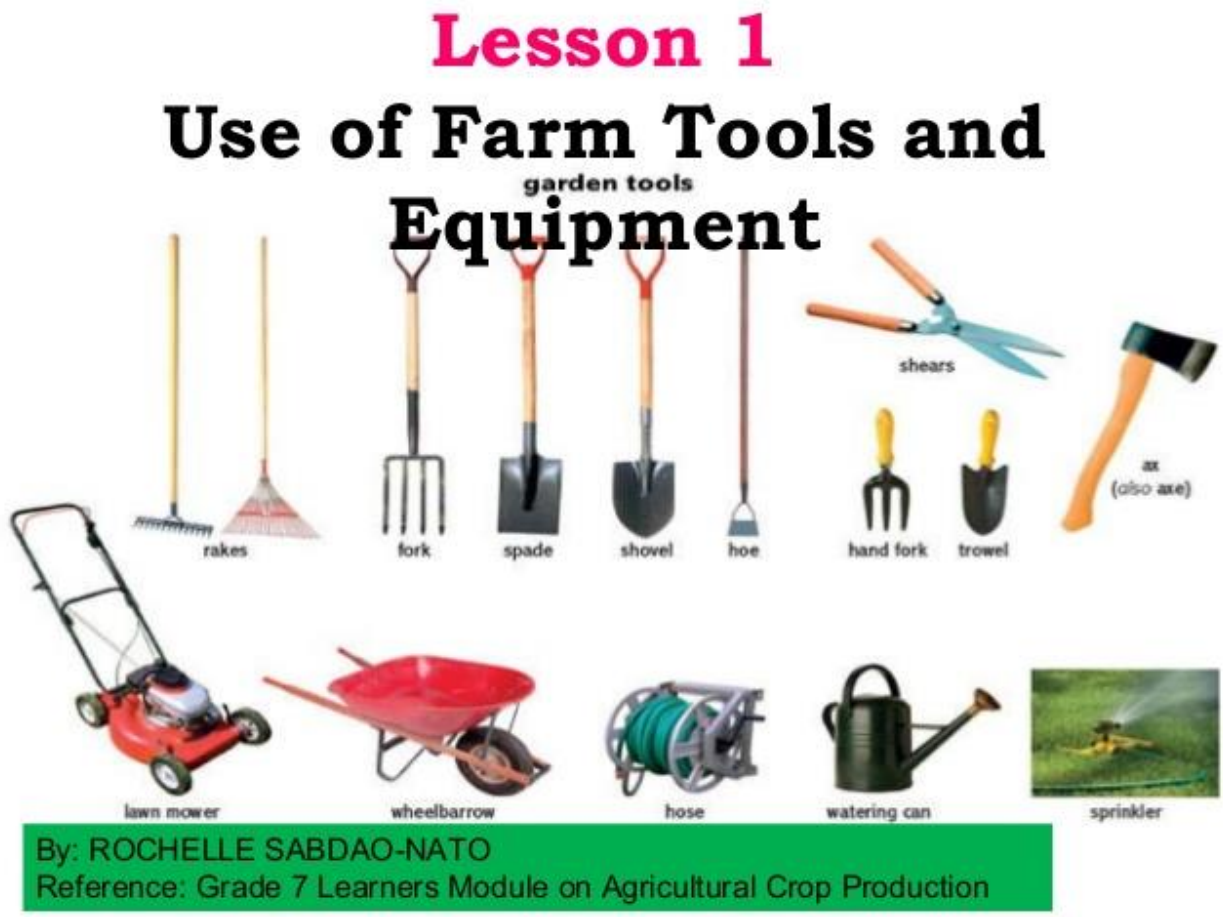
Score = _____

Rating: _____

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Information Sheet - 4	Selecting appropriate tools, plant and equipment



A)Hand tools

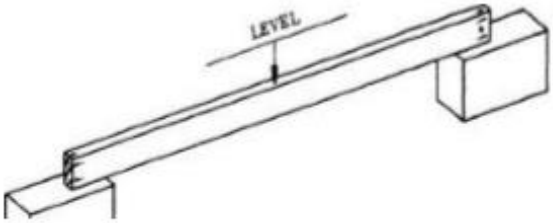
Steel tape Steel tapes vary in length from 3 to 30 metres long. You can use them to measure distances, such as when you are setting out and checking wall and building sizes**.**

Spirit Level Spirit levels vary in length and quality. A trade's person usually purchases a reputable brand that guarantees a long life and remains accurate. Cheap levels will rarely provide a long accurate life. Different types of spirit levels may be used by carpenters, stonemasons, bricklayers, other building trades workers, surveyors, millwrights and other metalworkers, and in some photographic or video graphic work.



Straight Edges

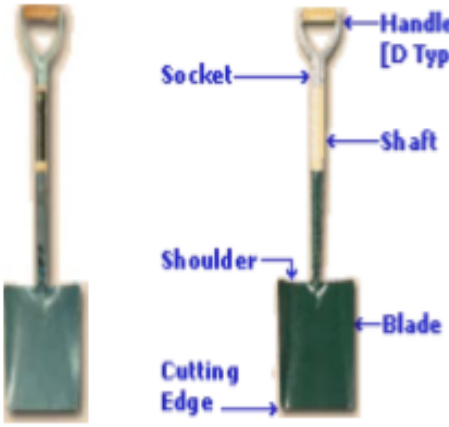
Straight edges are used to align materials, mark pencil lines and transfer heights, to extend the length of a spirit level and many other uses. They need to be handled carefully so as not to cause damage to the edges or face of the straight edge. Straight edges are very useful to check the alignment of wall framing members. It is recommended to have at least two straight edges so that it is possible to use the tool in restricted work areas.



We use a fairly wide variety of tools in the paving, drainage and groundwork's trades. Some are regular 'everyday' tools that might be found on the back of a wagon or Ute belonging to a General Builder or in the shed of a keen do it yourselfer, while others are a little more esoteric and may not be familiar to anyone outside the trade. Below are some of the more useful hand tools

Tapermouth shovel

If I could have only one digging tool, this would be it. The tapermouth is, probably, the best digging shovel available. It gets its name because the blade tapers slightly, so it's narrower at the cutting edge than it is at the shoulder. A great, all-round tool.



Handles

There are two main types of handle, and they are illustrated opposite. On the left is the D-handle, also known as a Y-handle, because of the way it forks, and on the right, the T-handle. There's little to choose between the two, although my personal preference is for the D-handle, which I have found to be more comfortable, stronger and less likely to break than the T-handle. On some spades, the T-piece has worked loose when wrenched with a twisting force, whereas the D-handle seems better able to cope with such stress.

Spades

Spades are made in many shapes and sizes, for a variety of different functions and jobs. There are many different designs used in spade manufacturing. The term shovel is sometimes used interchangeably with spade, but shovels generally are broad-bottomed and better suited for moving loose materials, whereas spades tend to be pointed for use as a digging tool. The most common spade is a garden spade, which typically has a long handle, is wide, and is treaded (has rests for the feet to drive the spade into the ground). Spades are used by some pavers to push rows of pavers in one direction by inserting the spade between the pavers and pulling back on the handle. A couple of rows of pavers will move. This process is continued until all pavers are correctly aligned. Of course this is not necessary if every brick is laid to correctly set out string

Picks

A pick is another essential tool in the ground worker's armoury. Ideal for breaking up tough ground, ripping up old pavers, smashing up concrete, levering and other

grubbing jobs. Picks are one of the oldest known human tools - the earliest examples were formed from deer antlers and used to grub out edible roots from the ground. The modern pick consist of a hardwood shaft, with a tough, forged steel head.

Wheelbarrows

The wheelbarrow is one of the most useful and economic forms of transportation over short distances (usually not exceeding 150 metres). wheelbarrows can be of many different types and qualities. A good wheelbarrow should take a big load (struck capacity approximately 70 litres) and be easy to balance, push and tip. Unfortunately, many of the wheelbarrows which are made are small, of poor quality and difficult to push. a wheelbarrow consists of a body or tray which rests on a chassis with attached handles and a wheel. It also has a stand.

The strongest and most comfortable wheelbarrows have pneumatic rubber wheels and a tray made of 1.6 mm steel sheet. The tray should be reinforced around the rim and attached to

the chassis with bolts, nuts and washers. The clearance between wheel and tray should be minimum 50 mm.

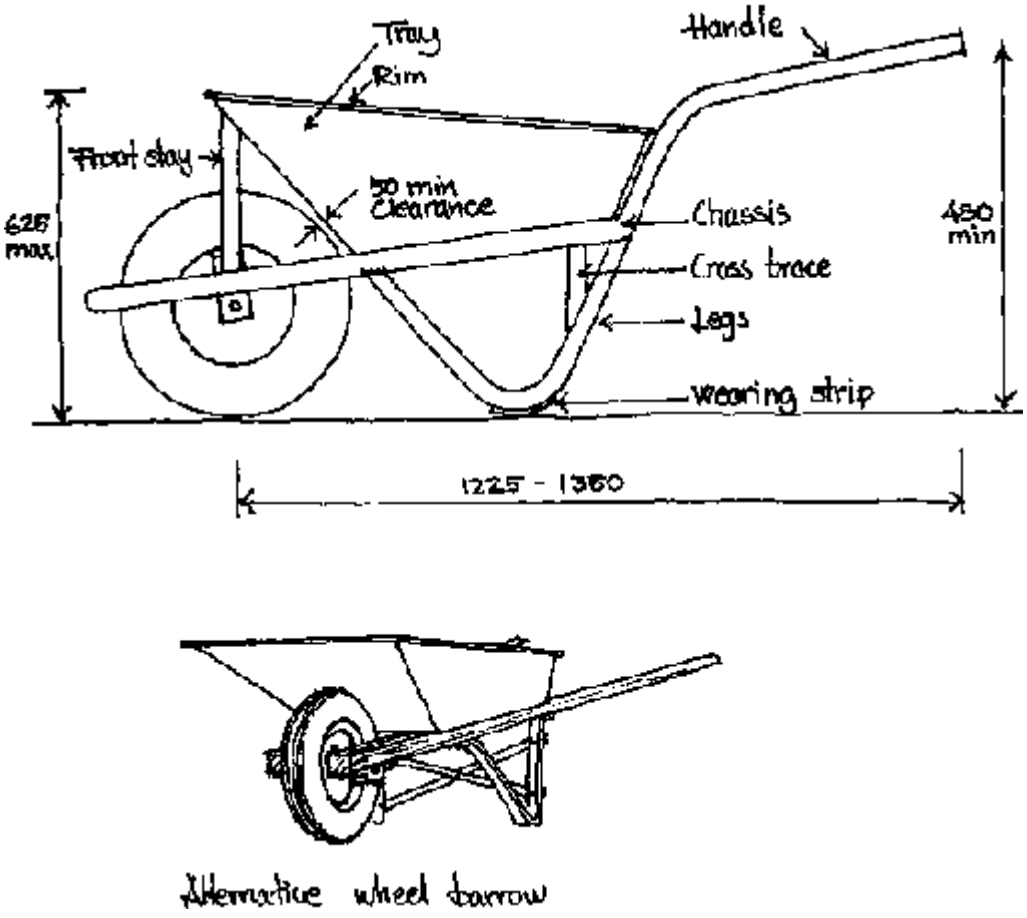
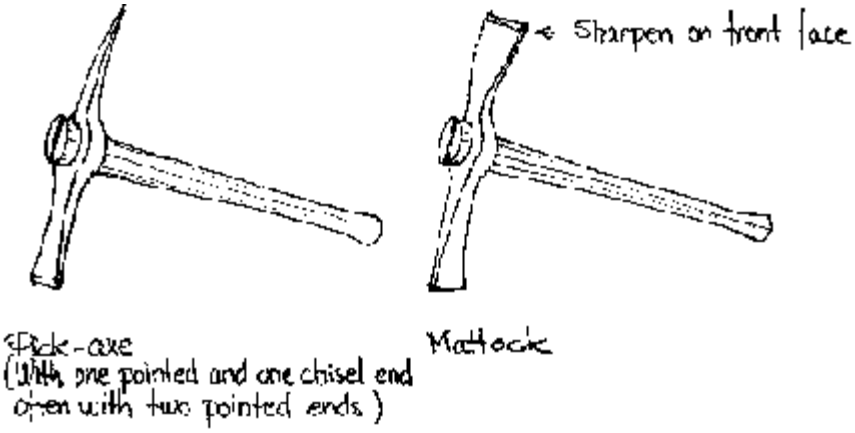


Figure wheel barrow

Pickaxes, mattocks and crowbars

Pickaxes and mattocks are also tools for excavation. They are more specialised for construction work than hoes and suitable for excavation in more stony soils. many different designs of pickaxes and mattocks are produced. The most common for road works are, however:



These tools always have an oval eye. Both the pickaxe and the mattock are rather heavy; the pickaxe usually between 2.7 and 3.6 kg and the mattock between 1.8 and 2.7 kg.

Hoes

The hoe is probably the most useful and widely used hand tool in the world. It is mostly used in agriculture for tilling virgin land, preparing the soil for planting and for weeding and harvest. But the hoe is also a very important and useful tool for road workers and in all other kinds of work which involves excavation.

The hoe consists of a blade and a handle. The blade can be fastened to the handle with an eye or a spoke.

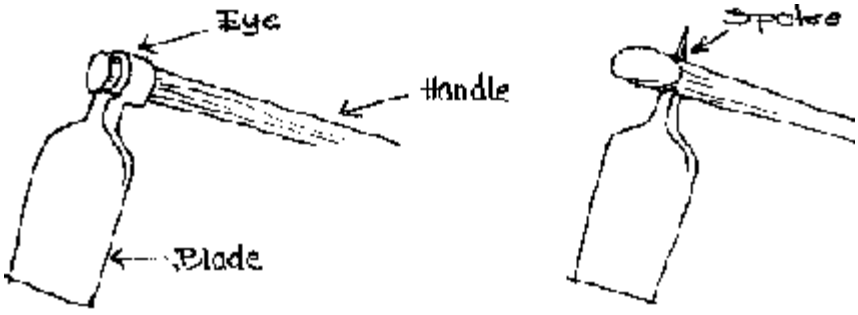
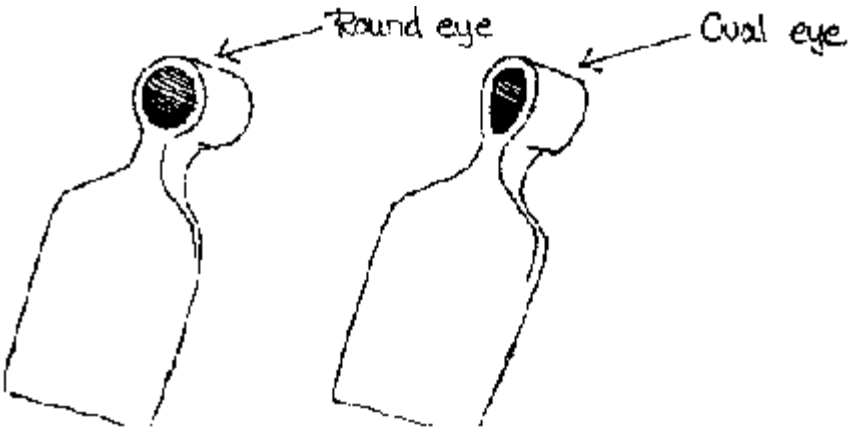


Fig. 1.

The eyes can be of different types: round or oval.



The round eye makes it easier to replace the handle but cannot hold the handle in place very well - the handle tends to rotate.

Oval eyes need oval-shaped handles which means more work in making the handle. But the oval handle prevents the blade from twisting and the handle itself will not twist in the hands of the worker. Oval eyes and handles are therefore preferable.

The blade of the common hoe has a straight cutting edge and is usually forged.

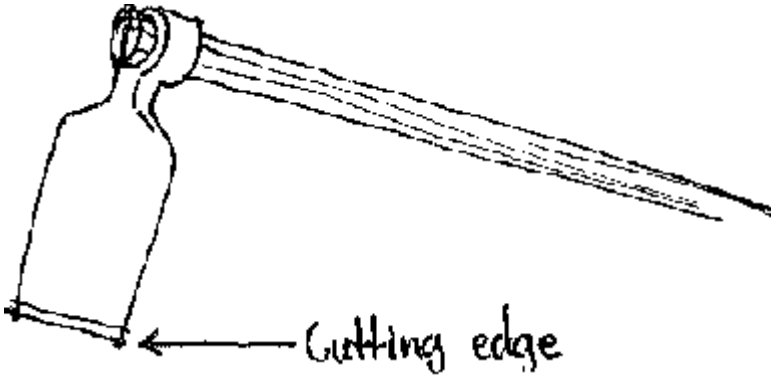
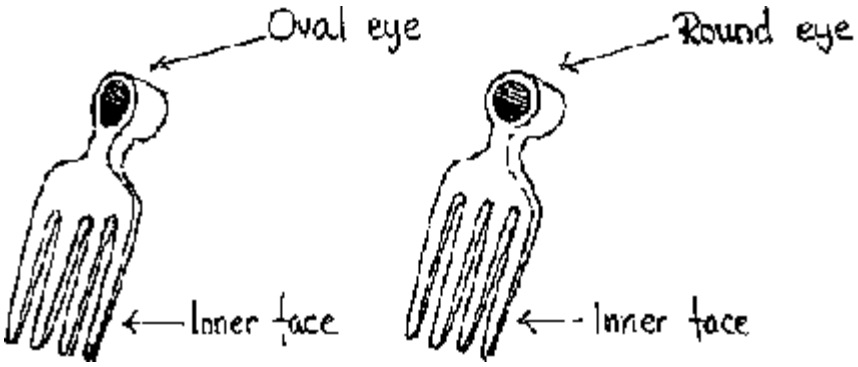


Fig. hose

Forked hoes

The forked hoe is a special type of hoe. Instead of a blade it has a number of prongs which can penetrate a cohesive or hard/stony soil easier than a blade.



The fastening of the handle is done in the same way as for the plain hoe.

When the prongs have become blunt, they should be sharpened on the inner face. This cannot easily be done in the field since a forge or grinding wheel is necessary. Keep a grinding wheel in the site store and instruct the storekeeper to inspect the tools at regular intervals and to sharpen them when necessary.

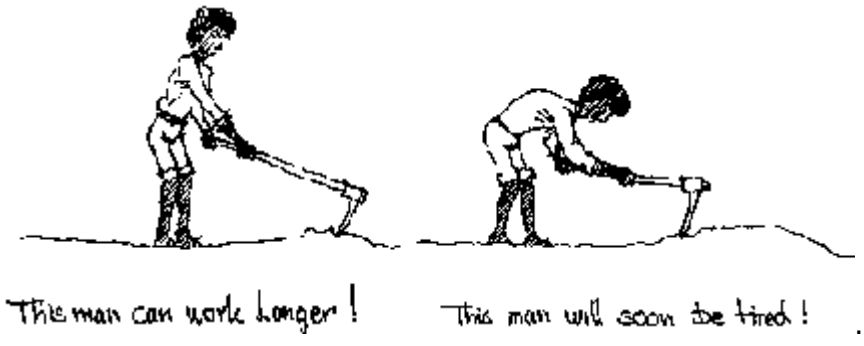
Using the hoe

Hoes can be effective in:

-excavation;
- spreading.

In excavation the plain hoe is best for rather soft soils with only little or no stones, while forked hoes are better on cohesive or hard and more stony soils.

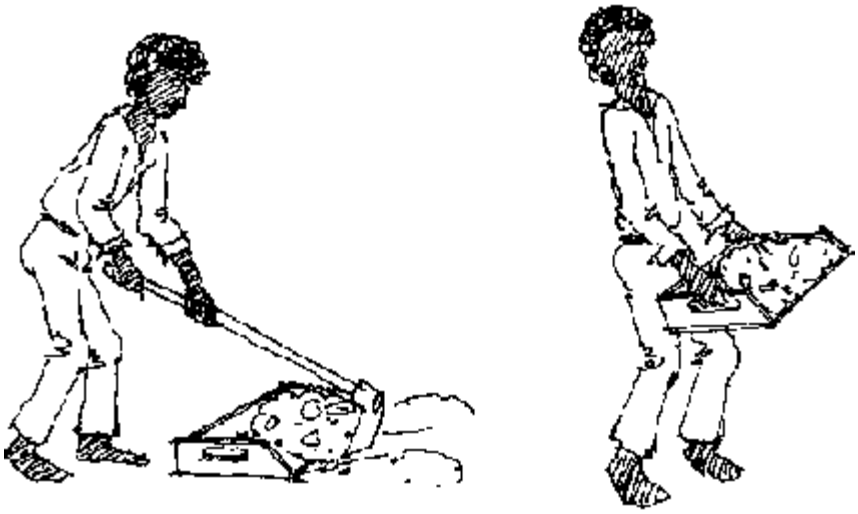
When excavating it is least exhausting to work if one does not have to bend the back all the time.



The handle of the hoe should therefore be around 1 metre long and one should try to stand a bit lower than the level which is excavated.

Loading with the hoe is not so common but can be done when shovels are not available. It is then necessary to have a tray or basket which is rather flat.

The tray or basket is placed on the ground and soil or gravel raked onto it with the hoe.



The tray is then carried to the place where the soil should be placed, i.e. in a trailer, wheelbarrow or directly onto a fill.

Shovels, spreaders and rammers

Shovels and spades

The shovel is effective for scooping up material and throwing it either onto a trailer, truck or wheelbarrow or directly to where the material is needed.

Contrary to a shovel a spade can also be used for loosening the soil. Spades have stronger blades than shovels. The blades are curved only in one direction. The handle should be long

enough to allow the worker to throw the soil with little effort. For workers with an average stature a length of 65-70 cm is recommended.

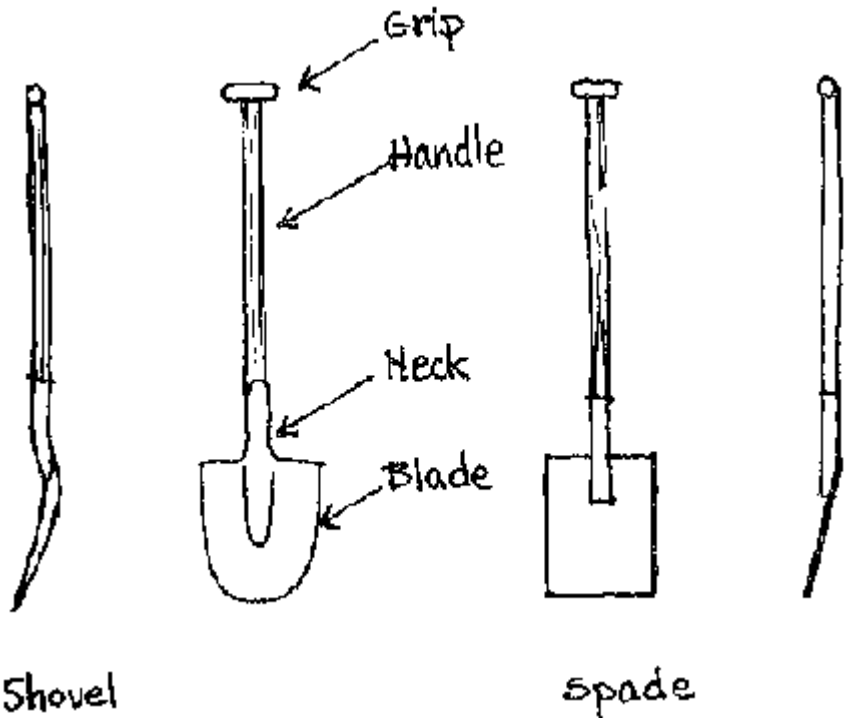


Fig. 19. Shovel and spede

Shovels and spades should not have sharp rivets or joints which damage the hands of the user. When buying shovels or spades ensure that the joint blade/handle is smooth.

B)Selecting serviceable tools, plant and equipment

Selecting tools, equipment and plant

A range of plant and equipment may be used for excavation work including:

- powered mobile plant
- air compressors
- electric generators
- jack hammer
- hydraulic jacks
- oxy-acetylene (gas cutting/welding)
- scaffolding
- ladders, and
- many types of handheld plant such as shovels, picks, hammers, hydraulic jacks
- and pinch/lever bars.

To produce products or services business systems utilize various facilities like plant and machineries, ware houses etc. Facilities can be broadly defined as buildings where people, material, and machines come together for a stated purpose – typically to make a tangible product or provide a service.

The facility must be properly managed to achieve its stated purpose while satisfying several objectives. Such objectives include producing a product or producing a service

- at lower cost,
- at higher quality,
- using the least amount of resources.

Plant selection

The principles of selection

The need for selection of mining equipment can arise from a number of situations, which vary according to the nature and size of the organization.

During any mining work, there will be requirements for items of plant and equipment in order to carry out the work in a more cost-effective manner. This involves site staff initially in making a technical selection using the following criteria:

(1) Comparing mechanization with other more labour-intensive methods of working.

(2) Comparing alternative plant methods for a particular operation. Bulk earth moving may be carried out either with tractors and loading shovels/excavators depending on the outputs required.

Tools and equipment Selection procedures

This selection process can be broken down into six separate stages:

(1) task identification;

(2) preliminary selection;

(3)machine output estimation;

(4) machine matching;

(5) outputcosting;

(6) final selection.

C)Rectifying and reporting faults

Reporting faults

Some jobs require paperwork to be done as part of the organisation's requirements. Paperwork is important for the following reasons.

1.provides a record of work done

It gives the organization an overview of the cost and efficiency of the work and shows where most of the resources and effort have gone.

2.helps to identify problem areas

Problem areas or faults that are reported or repaired are identified from the reporting process. This helps to identify maintenance and quality issues, work procedures and equipment problems.

3.helps monitor equipment performance

Having a written history of the performance of equipment allows you to identify and avoid problems and take planned maintenance action to prevent downtime. Regular performance monitoring also allows you to make adjustments where and when it is necessary to maintain efficiency.

Types of documents

The types of documents used to collect this information might include:

• Shift reports

• Log books

- Timesheets
- Pre-start checklists
- Maintenance checklists

Self-Check – 4	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List the tools used for manual hand excavation:?(6pts)
2. List the uses of the hand tools ?(2points)
3. List tools selection steps(2 points)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Information sheet 5-Identifying and applying environmental protection requirements

Definition of Environmental Protection

Environmental Management Team Provide advice, guidance and support on the management of any environmental risks associated with trenching, excavation or penetration work, including any requirements for environmental permits or licences.

12.2. Environmental protection requirements

A competent person who fully understands the dangers and necessary precautions should inspect the excavation at the start of each shift. Excavations should also be inspected after any event that may have affected their strength or stability, or after a fall of rock or earth.

Structural stability during excavations

The law says you must prevent danger to workers in or near excavations. To maintain the required precautions, a competent person must inspect excavation supports or battering at the start of the working shift and at other specified times. No work should take place until the excavation is safe.

Commercial clients must provide certain information to contractors before work begins. This should include relevant information on:

- Ground conditions
- underground structures or water courses; and
- the location of existing services.
- This information should be used during the planning and preparation for excavation work.

Environmental Considerations

All workers are committed to observing and practicing environmental management in all aspects of their job and in undertaking activities in compliance with all statutory legislation and other legal requirements

Environmental protection on the excavation site Environmental protection begins at the excavation site with the air workers have to breathe. They should be protected from any fumes from machinery, as well as fumes from excavation waste or materials which need to be carefully separated and properly recycled or disposed of when the job is complete, the soil should be treated as a valuable asset and left unpolluted.

promote Sustainable Futures: including

- planning for climate change;
- encouraging environmental sustainability,
- supporting environmental innovation, and developing strategies
- policies to achieve an environmentally sustainable future

Whether they are large, medium or small, excavation sites can be a significant source of noise, vibration, dust and fumes. Traffic movements of men, machinery, materials and waste can add to these problems. Good project management should ensure that these pollution impacts are properly assessed and have mitigation plans. By agreement of site operating hours, the types of plant and equipment in use, mitigation measures for noise and dust emissions , the general public can be protected from unnecessary inconvenience and disturbance. In practice, smaller excavation sites where "prior consent" has not been sought can cause problems to immediate neighbours.

Common Hazards

- Cave in of ground
- Collapse of Trench walls
- Instability of adjoining structures
- Contaminated environment
- Contact with services
- Inrush of water
- Hazardous atmosphere
- Falling loads
- Placement of loads
- Hazardous materials
- Falls
- Dust

Water is fundamental to our health, our way of life and our environment. It underpins growth in population and our economy.

Heat Stress – Your work environment can be deadly! You can become seriously ill or die if you do not take the proper precautions while working in high temperatures and humidity. Heat can reduce physical performance, as well as mental alertness, causing more accidents.

Sediment and Erosion Control

There are two parts to an effective water quality management strategy for an urban development. The first phase involves the installation of erosion and sediment control measures during excavation, when the sediment export potential is at its greatest. The second phase of a management strategy involves the excavation of treatment trains to improve the quality of post development runoff. Sediment

research, points to the following water quality and ecological processes in Ethiopian waters: Systems heavy in suspended solids, with adsorbtion of nutrients, metals and pesticides attached to surfaces of suspended solids.

Turbidity associated with suspended solids blocking light and absorbing solar radiation that exacerbates temperature stratification in water bodies. Low organic carbon levels and a high proportion of refractory carbon, limiting microbial-driven nutrient release. Highly variable flows, with significant events driving major exports of pollutants, followed by extended period of low flows. Sediments as the major store of pollutants, and the moderator of water quality in the water column. Poor mixing of water caused by periods of low flow and high temperatures, creating sharp temperature gradients. Poor mixing conditions depressing oxygen transfer, exacerbating sediment nutrient release processes. Time-based interception, storage and remobilisation of flow constituents, often associated with land use and management practices.

Soil Conservation

The key protector of soils is vegetation. Erosion is generally high wherever the vegetation has been disturbed and rainwater is concentrated. The problem increases as 'marginal' lands are developed as urban centres grow. Most land degradation associated with mining development results from erosion by water, salinity and acid sulphate soils. Wind is a factor on sandy soils in exposed coastal zones. The damage from poor conservation practices is easily recognisable. However, environmental damage tends to accumulate slowly. It is often only after scientific evidence brings to light the loss of flora and fauna species that community concern is raised and action is taken.

Soil erosion has particular consequences for aquatic environments, causing:

- Degradation of marine habitats.
- Increased turbidity in streams and water bodies.

- Increased salinity on land and in water bodies.
- Increased frequency and damage caused by flooding.
- Reduced aesthetic values of bush land and water bodies

Soil Loss

Storm water managers and designers can calculate the anticipated soil loss which is likely to occur during development, and use this information to take protective measures to contain the problem. These calculations can assist in assessing the erosion risk, selecting controls, sizing of sediment and retarding basins, and provide comparative catchment analysis. Sediment Traps Sediment traps are temporary control measures used to retain coarse suspended particles. Finer particles and soluble materials pass through them. Sediment traps are easy to construct, relatively inexpensive and easily moved as construction work proceeds. The most common forms of sediment traps are straw bales and sediment fences using geotextile fabrics.



Brush and Straw Mulches

A variety of innovative proprietary methods have been developed by organisations specialising in soil erosion protection. Commonly these systems are spray applied, use organic materials, and are bound with emulsions which slowly degrade. These systems generally use brush or straw, and can be applied at controlled thicknesses, depending upon the slope and erodibility of the soil.

Wind Erosion

Wind erosion can cause soil particles to become airborne and then settle out as dust where it will be washed into storm water systems in the next downpour. In Australia, intense rainfall immediately after bushfires can result in the flow of large sediment and organic ash loads into water bodies. Vegetation Stabilisation Vegetation stabilisation can reduce potential soil loss by reducing raindrop impact, storm runoff velocity and wind erosion. Techniques include: Sub-soil Drainage Sub-soil drainage systems can take a variety of forms.

Common types are:

- Rubble drains.
- Perforated or slotted pipes.
- Strip drains with a cellular core wrapped in a geo-textile filter fabric.

Sub-soil drainage can be used to assist with storm water surface flow management and infiltration control. It can improve the environment for growing protective vegetation and improve soil stability on steep slopes. Sub-soil drainage is increasingly being used in Water Sensitive Urban Design to underlay grassed swales in streetscapes and carry storm water to settling and reuse treatment ponds and wetlands.

Street Sweeping/Vacuum

Cleaning Traditionally, street sweeping as a treatment-based control measure for removing litter and reducing overall heavy metal loads and coarse sediments, has not been a very cost efficient management system.

However, recent technical advances in vacuum suction cleaning have made it more competitive. In the future, pollution on some high use freeway and road systems may require vacuum cleaning to protect sensitive local water bodies, if other measures cannot be designed in or retrofitted. Storm water runoff from road surfaces is one of the many contributors to the non-point source pollution load. Tiny particles are proving difficult to capture in current storm water pollution devices. The storm water load contains significant quantities of heavy metals, which are a threat to aquatic environment

Environmental Policy

Typical Company Statement As worker of Company you have to be conscious of the potential damage caused by activities in the workplace impacting on the human and global environment. workers of Company have an obligation to ensure the work they do is managed and prevented from causing damage. To do this they must: Ensure the required Environmental licensing is registered and current for all involved

activities undertaken at that workplace. Ensure the Environmental Impact Management Plan (IMP) required, is developed, registered and followed by the project of initiation.

Ensure the physical environmental controls are managed to prevent a breach of:

1. Erosion and sediment control
2. Flora and fauna waste
3. Culture and heritage
4. Environmental noise and vibration and
5. Contaminated land management

Any inspection forms have to be filled in is filled out by the competent person who carries out theinspection. Aspects/parts of the excavation works that should be inspected, include, but are not limited to:

1**. Surface Conditions**

- Cracks
- Spoil heaps not set near or close to excavations
- No equipment or materials stored near edge
- No standing water in excavation

2. Banks and sides of slope/bench

- Cracks
- Change in soil type
- Slope of side/bank

3. Access and egress

- Stairs, ladders, ramps as appropriate

4. Shoring and Shielding

- In place properly, functioning correctly
- Wedges tight

5. Existing utilities

- Support adequate
- Loose materials

6. PPE

- Hi-visibility vests, hard hats, steel-toe shoes, etc. as specified

Protective System

Key issues are:

- Collapse of excavations
- Falling or dislodging material
- Falling into excavations
- Inspection

Control the Risk

The department's Competent Person shall evaluate and select the type of employee protective system to use and shall inspect it prior to the start of the work and as needed during the shift. At a minimum, daily inspections shall be done of

excavations, the adjacent areas, and protective systems used. Whenever the competent person determines that a hazard to the excavation or trench exists, exposed employees shall be removed immediately from the area until the hazard(s) has been corrected.

All employees using the excavation or trench shall use it as instructed by the Competent Person and report any problems immediately to the competent person.

Once a hazard has been identified and reported in the workplace, it is important to take the necessary steps to control the risk. This might include:

- Removing the hazard from the work environment
- Replacing the hazard with a safer alternative
- Improving the organisation of work routines
- Improving workplace layout
- Making changes to the workplace
- Training of employees in risk minimization

Preventing ground collapse

Ground collapse is one of the primary risks to be controlled when undertaking excavation or trenching work. Ground collapse can occur very quickly and without warning, giving a worker virtually no time to escape, especially if the collapse is extensive. A buried worker may die from suffocation before they can be extracted from the collapsed area. One or a combination of the following risk control measures must be implemented prior to any person entering an excavation or trench with a depth of 1.5 metres or more, or, regardless of depth, for excavations or trenches dug in poor soil conditions where there is a risk of engulfment:

• Benching (maximum bench height must not exceed 1.5 m unless designed and certified in writing by a site engineer

• Battering (angle of repose must not exceed 45 degrees unless designed and certified in writing by a site engineer

• shoring, trench boxes or other ground support systems

• written assessment from a engineer warranting that there is no risk of collapse.

Controlling sediment run-off

Sediment run-off as a result of undertaking excavation or trenching work can cause significant environmental and safety issues. All disturbed soil must be managed to reduce the risk of sediment run-off entering drains, catchments and waterways or spreading across paths and roadways.

The following risk controls must be used to prevent or mitigate the effects of sediment run-off when undertaking excavation or trenching:

• do not place any materials (e.g. spoil, sand, gravel) in gutters or drains

• use barriers if spoil is being left exposed for periods greater than 24 hours or if rain is forecast (e.g. sediment fence, geo-textile filter, hay bales)

• where possible, leave a strip of grass between any disturbed soil and gutters, drains or waterways

• use rubble strips or wash-down areas at the exit points from excavation or trenching works to reduce the export of soil from the site on vehicle tyres.

Following completion of trenching and excavation work, sediment controls must remain in place and be maintained until such time as all disturbed soil is protected from erosion (i.e. turf is laid and established, grass seed is sown and established at the excavation area, hydro mulch is laid).

Contaminated atmosphere

Excavations and trenches may become contaminated with gases that create a hazardous atmosphere (i.e. suffocation risk, poisoning risk, explosion risk, etc.).

Excavations and trenches may become contaminated from the following

• contamination from exhaust gasses

• contaminated soil

• sewer leaks

• use of substances in or near the excavation

naturally occurring emissions from disturbed soils i.e. acid sulphate soil.

Where gas monitoring or risk assessment outcomes indicate there is a potential for an excavation or trench to contain an unsafe atmosphere, the excavation or trench must be

treated as a confined space and risk controls must be implemented in accordance with the Confined Space

Controlling dust

The generation of dust as a result of undertaking excavation or trenching work can cause significant environmental and safety issues. All work areas must be managed to eliminate or reduce the generation of dust.

The following risk controls must be used to prevent or mitigate the effects of dust when undertaking excavation or trenching:

- use water trucks or water hoses to reduce dust generation
- where possible, use established roadways to move around excavation or trenching sites
- develop traffic management plans to restrict access to and control movement within the excavation and trenching site (including speed limits).

plants

Landowners, including all landowning state agencies, have legal obligations to control plants on land under their management. Workers must consult with the Seqwater Catchment Biosecurity Team prior to undertaking any excavation or trenching work in an area where forest /plants have been identified. Any plant or vehicles used to undertake excavation or trenching activities must be cleaned and inspected to ensure that all plant material and soil has been removed before the plant or vehicle leaves the excavation or trenching site.

Cultural heritage

When planning to undertake excavation or trenching activities in an area not previously subject to significant ground disturbance or in an area where a Cultural Heritage Management Plan (or other cultural heritage agreement) is in place, workers must consult with the Officer to identify the likelihood of harm to cultural heritage in the area to be disturbed.

Protection of Existing River Banks, Channel and Embankment Slopes

The Contractor shall not disturb the river banks, channel and embankment slopes outside of the excavation

limits or beyond the profile shown on the Drawings.

The Contractor will not be allowed to dispose of excavated material within the project limits.

If the Contractor can demonstrate conclusively that there is no alternative to disturbing the banks, slopes, orchannel, permission may be granted by the Engineer provided that the Contractor shall be responsible for restoring the banks, slopes and channel to the original profile and compaction at his own expense.

Self-Check – 5	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List Aspects/parts of the excavation works that should be inspected?(3pts)
2. List Protective System Key issues ?(3points)
3. List Preventing ground collapse steps(3points**)**

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

LG #39	LO #2 Dig small excavations by hand

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Basic principles of soil technology for civil works
- Confirming location and specifications of the excavation area
- Identifying service markers or taped areas
- Determining location of underground services to avoid damage
- Using hand tools
- Undertaking trench collapse prevention procedures
- Placing barricades around the excavation

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify workplace environmental and resource efficiency issues
- Identify resources used in own work role
- Document and measure current usage of resources using appropriate techniques
- Record documentation measuring current usage
- Identify and report workplace environmental hazards

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,

Information Sheet 1- Basic principles of soil technology for civil works

Soil mechanics is a discipline of civil engineering that predicts the soil performance characteristics utilizing the engineering techniques of dynamics, fluid mechanics, and other technologies. Soil mechanics includes the study of soil composition, strength, consolidation, and the use of hydraulic principles to deal with issues concerning sediments and other deposits. Soil mechanics is one of the major sciences for resolving problems related to geology and geophysical engineering.

Soil mechanics studies are very important for civil engineers because based on the findings of soil mechanics studies, engineering structures are constructed. The type of construction, type of equipment to be used, type of foundation, support material, and many other aspects of construction works are largely affected by the soil mechanics studies. Basically we study about soil formation modes, physical and

chemical properties of soil, dynamic loading of soils, permeability, consolidation, etc. In the subsequent sections of this article, we will discuss in detail about major aspects of soil mechanics studies.

Formation of Soils

Soil is a combination of minerals and organic elements that are in solid, gaseous, and aqueous form. Soil consists of particle layers that are different from the original materials in their physical, mineralogical, and chemical properties because of the interactions between the atmosphere and hydrosphere and other reasons. The particles of the soil are created from broken rocks that have been changed due to the chemical and environmental effects, including weather and erosion. Particles of soil are filled loosely, creating a soil formation that consists of pore spaces. Studying soil formation modes is important because it helps in determining properties of soil. Cohesiveness, adhesiveness, acidity of soil, and other related factors can easily be determined by knowing about the type of soil w have to deal with. We cannot draw any concrete conclusions merely by conducting soil studies but we surely can narrow our research parameters by studying the basic characteristics of soil like color, texture, and nature of soil.

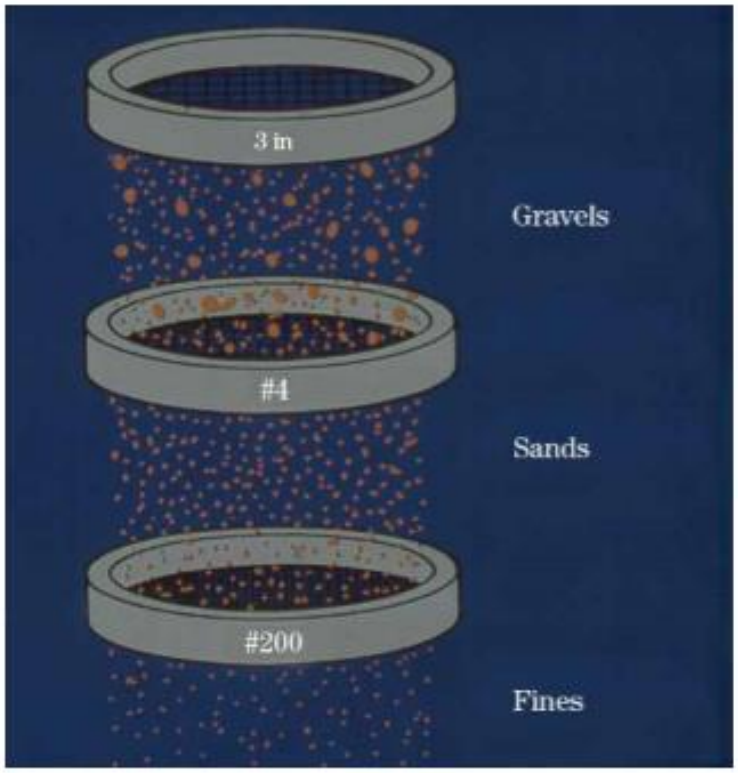
Basic Characteristics of Soils

Soil consists of different phases of solid, liquid, and gas and its characteristics depend on the interacting behavior of these phases, and on the stress applied. The solid phase includes clay, non-clay minerals, and organic matter. These elements are categorized by their size as clay, sand, and gravel.

The liquid phase is composed of water that contains organic compounds available from chemical spills, wastes, and ground water, while the gas phase is normally air. The size, form, chemical properties, compressibility, and load carrying capability of

the soil particles are determined by soil mineralogy, which is a science related with the chemistry, structure, and physical properties of minerals. The structure of a soil depends upon the arrangement of particles, particle groups, pore spaces, and the composition. These basic characteristics determine the type of structure to be built and what external support measures, if any, has to be taken to make the structure last long and bear the effects of earthquake, water seepage, and other external factors.

Figure 7–8 Major types of soils based on grain size



Self-check 1	**Written test**

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1.list basic characteristics of soil ?(5pts)

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 2- Confirming location and specifications of the excavation area

2.1. Site Preparation

A. Prior to commencing any excavation work, the Contractor shall establish a horizontal and vertical survey, record existing ground elevations and stake the location of trenches to be excavated.

B. The Contractor shall prepare the site for construction by clearing, removing and disposing of all items not indicated on the Drawings to remain or so defined by the Engineer.

C. The Contractor shall obtain relevant excavation and road cutting permits as required to commencing work.

i) Existing Subsurface Structures and Utilities

For all works required to deal with existing subsurfaces and utilities refer to General Section of these Specifications.

ii) Clearing, Grubbing and Grading

A. The Contractor shall perform the clearing and grubbing (if any), of top soil consisting mainly of loose soil, vegetable and organic matters, drift sand, unsuitable soil and rubbish by scarifying the areas to be excavated and sidewalks to a minimum depth of 300 mm from the natural ground level. All materials resulting from the above operations shall be removed from the site, loaded and transported and off loaded, spread and leveled to approved dumps as directed by the Engineer.

B. The Contractor shall include for grading the route to provide access for his equipment and personnel, executing all cuttings to remove the high point of rises in terrain and in all respects prepare the route for pipe laying operations, all in accordance with the requirements of good pipeline construction practice.

2.3 Setting-Out

The Contractor shall stake-out the work as shown on the Drawings and secure the Engineer's approval of his stake-out before proceeding with construction. If, in the opinion of the Engineer, modification of the line or grade is advisable before or after stake-out, the Engineer will issue detailed instructions in writing to the Contractor for such modification and the Contractor shall revise the stake-out for further approval in accordance with the relevant Clause of the Conditions of Contract.

2.4 Excavation

A. The Contractor shall perform all excavation true to lines, widths and depths shown on the

Drawings or to such further lines, depths or dimensions as may be directed by the Engineer.

When You Start Work

- Wherever possible, hand dig near buried services. Spades and shovels are safer than picks, pins or forks.

- Check that any cable or pipe which is embedded in concrete and has to be broken out has been made dead before work starts, or that another safe way of working has been agreed with the service owner.
- Watch out for signs of services as work continues.
- Backfill around services with a fine material. DO NOT use rocks, bricks, mass concrete or similar material.
- Report any damage to a cable, pipe or pipe coating. Even if there is no immediate danger, damage could lead to danger at a later date.
- Do not use hand-held power tools within 500 mm of the marked position of a cable or pipe (unless the number of services present makes it impossible, or surface obstructions reduce the space available).
- • Do not use hand-held power tools directly over the marked line of a cable or pipe unless:

Guide for Safety with Underground Services

You have already found the cable or pipe at that position by careful hand digging beneath the surface and it is at a safe depth (at least 300 mm) below the bottom of the surface to be broken; or - Physical means have been used to prevent the tool striking it.

- Do not use a mechanical excavator within 500 mm of a cable or pipe. If an excavator is used near an electricity cable or gas pipe, keep everyone clear of the bucket while it is digging.
- Do not use exposed services as a convenient step or handhold
- Do not handle or attempt to alter the position of an exposed service.
- Do not install plant close to an existing service. Ask your supervisor to tell you what the separation should be.
- Do not build existing services into a manhole or other structure, or encase them in concrete.

If You Suspect a Gas Leak

- Remove everyone from the immediate area of the escape.

- Remember that if a service connection to a building has been damaged, it may cause a leak in the building. Warn the occupants of the building, and of the adjoining buildings, to leave.
- Telephone the local gas authority immediately.
- Ban smoking and naked flames within 5 metres of the leak. Do not operate electrical switches or devices.
- Assist the gas authority, police or fire service as requeste

B. Excavation work will be done in all kinds of soils.

i) Road along the line.

A. Wherever necessary the Contractor shall prepare a road along the line at such distance from the line that the traffic on the road will in no way interfere with pipe laying work. The Contractor shall also prepare access roads from the highway or other public roads to the said access road.

B. The road along the line and the access roads shall permit the normal movement of trucks and other vehicles and all equipment and plant required for the execution of the works.

C. The employer's employees shall at times have the use of the roads prepared by the Contractor free of charge.

D. The Contractor shall maintain the road along the line and the access roads in a good and serviceable condition and shall make all repairs that may be necessary during the whole period of construction.

ii) Excavation to reduce levels.

A. Wherever shown on the drawings, the Contractor shall reduce the ground level on the trench site, prior to commencement of trench excavation. Before starting excavation for reducing of levels the Contractor shall move the marking of the alignment to such a distance that the marks will not be destroyed and will not interfere with the execution of the work.

B. Excavation for reducing levels shall be done to the lines and levels shown on the drawings.

Where the depth of excavation is not so shown it shall be done to a line parallel to the trench bottom in the section concerned.

iii) Storing of Suitable Excavated Material

During excavation, materials suitable for backfill and fill will be stockpiled on the site at sufficient distance from the sides of the excavation to avoid over-loading and prevent cave-ins or mixing with the concrete.

iv) Disposal of Unsuitable and Surplus Excavated Material

Upon the order of the Engineer, all unsuitable and surplus materials shall be immediately removed, loaded and transported off the Site area by the Contractor to approved dumps and he shall abide by the relevant local regulations.

v) Unauthorized Excavation

If the bottom of any excavation is taken out beyond the limits indicated or prescribed, the resulting void shall be backfilled by well graded material at the Contractor's expense with thoroughly compacted to an acceptable proctor as directed by the Engineer, if the excavations are for a structure or a manhole , then the void should be filled by class C15 concrete.

Self-Check -2	Written Test

I.Choose the correct answer for the following question(10 points)

1. Site Preparation----------
2. Excavation to reduce levels----------
3. Unauthorized Excavation----------
4. Guide for Safety with Underground Services----------
5. Clearing, Grubbing and Grading----------

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet 3-Identifying service markers or taped areas

3.1.Understanding Locating and Marking Practices

Operator markings of utilities include the appropriate color for the type of facility, their company identifier (name, initials, abbreviation) when other companies are using the same color, the number and width of their installations, and a description of the underground utility.

A combination of paint and flags are used to identify the operator's installations at or near an excavation or drill site.

Additional Warning Signs

When an excavator arrives at a jobsite after contacting the local one-call center to get the jobsite located, the first step is to look for signs of underground utilities. These signs should be obvious—look for marking flags, paint, pedestals, fire hydrants, and other above-ground indicators.

Even though these indicators may signal there are no underground utilities within the dig area or drill site, be alert to additional warning signs as you start the excavation. If you see any visual signs of a buried utility while excavating or drilling, stop immediately and hand dig until the utility is exposed. Contact the utility owner as necessary and do not proceed until the utility is fully exposed and identified.

Assume the presence of services when digging, even though nothing is shown on plans

Use detection devices and keep a close watch for signs of buried services, such as marker tape or tiles. Cables may be laid directly in the ground without markings, in cement-bound sand, in plastic or earthenware pipes or ducts, or may have a layer of tiles, boards or coloured plastic tape placed above them and this highlights the importance of adopting safe procedures

COLOUR MAKER / WARNING TAPE

RED	ELECTRIC
YELLOW	GAS, OIL, STEAM
ORANGE	COMMUNICATIONS
BLUE	POTABLE WATER
PURPLE	RECLAIMED WATER
GREEN	SEWER / DRAINAGE
PINK	SURVEY MARKS
WHITE	PROPOSED EXCAVATION

Note: Markers such as plastic tape, tiles, slab or battens may have been displaced and will not indicate the exact location of the buried service!

Self-Check -3	Written Test

1.Write all about service markers or taped areas(5 ponts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

information Sheet 4- Determining location of underground services to avoid damage

4.1.Safe Digging And Avoiding Danger Near Underground Services

Location of underground services

Information requirements The following information relating to underground services must be obtained before any excavation or trenching work is undertaken:

- the type of services
- the exact location, depth and direction of the services
- isolation points for the services (where required / available)
- confirmation of whether services can be de-energised during the work
- any specific restrictions to be followed during the work.
- whether underground services exist in the area

On-site location / confirmation of underground services The following steps must be taken to positively identify the location of underground services prior to commencing excavation or trenching on a brownfield site:

- Detailed review of all available site plans, drawings and 'Dial Before You Dig' information relevant to the planned excavation area.
- A physical inspection of the planned excavation site and surrounding areas must be undertaken to assess the working environment and identify any other visual indicators of buried services.

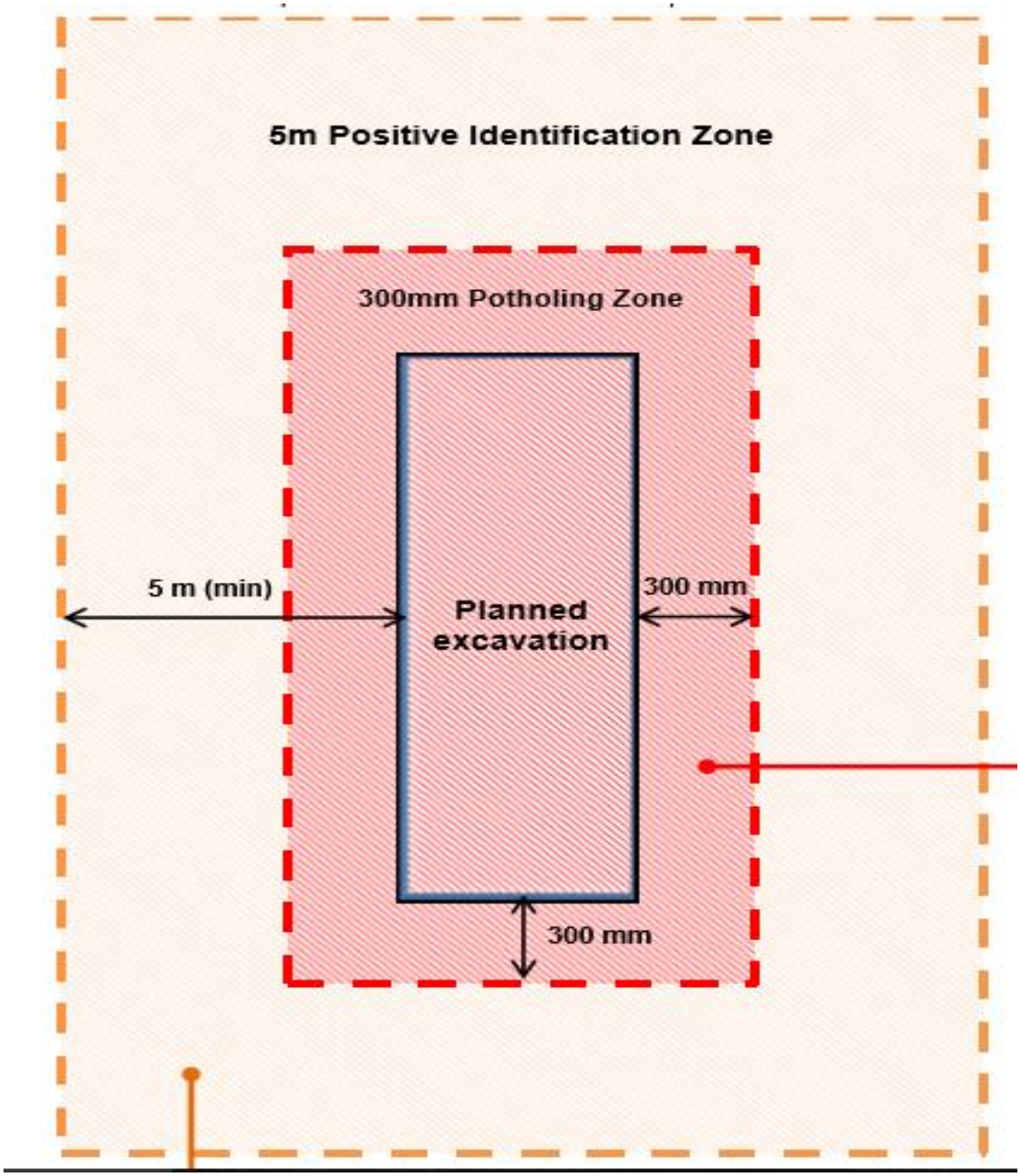
he following factors should be considered as part of this process: -

the location of the services in relation to known, fixed assets (i.e. buildings, pits, powered infrastructure such as access gates, lighting etc.).

evidence of previous excavations (sunken areas, different soil type, previous line marking, cuts to paths and roadways, etc.).

consultation with workers that may have specific information or knowledge regarding underground services at the plant or workplace.

4.2.Guidelines for Underground Service Location



4.3.5m Positive Identification Zone:

Known services with potential to encroach within minimum 5 m of the planned excavation must be positively identified using non-destructive methods and clearly

marked on the ground for as long as they remain within the 5m radius1. Positive identification includes the use of non-destructive methods to verify the location, depth and direction of buried services (this includes verifying the exact point where service change direction or intersect). Such methods may include the use of vacuum excavation (max pressure of 2000psi), ground penetrating radar/technology, insulated prodder, cable locators or hand digging. Once the location of services is confirmed, their location should be clearly marked on the ground using one or more of the following methods:

• High visibility marking paint (refer Appendix A for colour code requirements); and/or

• Pothole markers (potholes should be dug and marked as per requirements detailed right and Figure 2 overleaf).

300mm

Any service encroaching within 300 mm of the planned excavation must be visually verified by potholing (vacuum excavation or hand digging). Unless services have been fully exposed within the planned excavation, potholing must be applied to the following minimum requirements:

• Multiple potholes must be dug to confirm depth and direction of each service;

• The exact point where services change direction or intersect must be visually verified;

• Above ground markers showing the type and depth of each service must be installed;

• Distance between potholes (and markers) should not exceed 3m on high risk sites1 and 5m in other areas; \

.Pressure setting of vacuum excavation device must not exceed 2000 psi.

4.4.Additional Precautions for Seqwater High Risk Sites:

One or more of the following additional precautions must be applied before commencing mechanical excavation on a Seqwater high risk site. These precautions apply irrespective of whether plans/drawings have identified buried services near the planned excavation.

1. Precautionary slit trench around the perimeter of the planned excavation using non-destructive methods (recommended where practicable giving due regard to the scale of planned excavation	To be applied: • Around the perimeter of the planned excavation; • To a depth at least equal to the lesser of the: - planned excavation; or - maximum range of the vacuum device (recommended min depth of 2 – 2.5m)
2. Precautionary investigation using ground penetrating radar / technology	To be applied: • In a continuous line along the planned excavation; • To a depth 300mm deeper than the planned excavation (or max range of detection device). • In a pattern that spans at least 300mm from all sides of the planned excavation

4.5.Preventing Damage to Underground Utilities

You must have a plan so accidents are avoided and services are not disrupted The possibilities of damaging underground utilities exist at every drilling site. Inadvertently severing an underground power line. Rupturing a natural gas line.

Doing damage to underground utilities can result in costly consequences—disrupting essential services, requiring repairs, downtime, and potentially serious injuries or death.

To prevent such incidents, it is critical to first understand the possible causes and industry practices in place. The Occupational Safety and Health Administration has specific requirements designed to protect employees and prevent accidental damage to underground installations. These include establishing the location of underground installations prior to beginning excavation activities.

Underground utilities can be located by many methods—owner records, other sources of information, and utility locating techniques. However, some methods can result in more uncertainty.

The root cause category for damages “Location Practices Not Sufficient” includes areas where no locating or marking of the utility was completed prior to excavation activities; areas where utility markings or locations were insufficient; the type of utility, its depth, or lack of records prevented locating the installation; and incorrect utility records and maps led to an incorrect location.

Of the events that included utility damages and for which a locate request was made, the majority (68%) had visible but incorrect markings and 29% had markings that were not visible.

The root cause category “Excavation Practices Not Sufficient” includes actions where clearances were not maintained while using power equipment; hand tools were not used where required; markings became deteriorated and not maintained; test holes were not used to verify exact location of buried lines; exposed utility lines were unsupported; and improper materials or compaction were used in backfilling

Call Before You Dig

The first step in preventing contact with underground utility lines is to call 811—the number the Federal Communications Commission has designated as the national toll-free “Call Before You Dig” number for the United States.

representative will take information about your project and notify appropriate utility companies to locate and mark buried lines they own at the location specified in the call ticket.

The call must be placed at least 48 hours before work is scheduled to begin.

Utility locations and markings are often made in utility easements only, not on private property. Therefore, if any drilling or other intrusive activities will be performed outside easements, underground lines will not be marked.

There are also many other variables in locating and marking underground utility lines. Among them:

- Some utility owners feel a service line belongs to the property owner.
- Power and communications cable and water/sewer lines serving buildings of educational institutions, government complexes, and office parks are on private property and are not covered by one-call.
- One-call information does not provide depth, but rather a window of horizontal space where utilities are estimated to be buried.

White-Lining the Dig Site

White-lining is a best practice endorsed by the Common Ground Alliance (CGA 2015). Physical white-lining requires the excavator or drilling contractor to pre-mark the dig or drill site with white paint or an equivalent.

While this practice is known to reduce damages, it may add costs to a job. The product Virtual WhiteLine™ is a recent development allowing the landscape and boundaries of the dig area or drill site to be viewed remotely through high resolution aerial imagery

Utility Locating Techniques

As was mentioned, underground utilities can be found by looking at existing utility owner records or, when needed, using a utility locating service. The source of information and methods used to locate underground utilities could impact the reliability and accuracy of identifying and locating underground lines.

In addition to power lines, there are phone lines, gas lines, water lines, and sewer lines running underground. Different detection techniques need to be used for different types of buried lines. For instance, detection of metal cables and pipes can be done using electromagnetic devices consisting of a transmitter and a receiver. Radiolocation devices use radio waves to find a location and are used for detecting non-ferrous lines (plastic or concrete).

Since there are different types of materials used in underground utilities, not all types can be detected using conventional methods. Non-conventional utility locating techniques include acoustic locating, ground penetrating radar (GPR), and magnetic locators or metal detectors.

GPR detection is an electromagnetic method often used to enhance other locating techniques. It can generate 3D underground images of pipes, power lines, sewer lines, and water mains.

Magnetic locators or metal detectors and magnetometers are often used to locate buried metal objects other than pipes. An acoustic locator most often detects and traces nonmetal water lines and can also be used in identifying the locations of plastic gas lines.

Current utility locating technology cannot assure 100% detection of every underground utility line and pipe. There are limitations with each utility locating technique, which must be considered.

The following colour codes / conventions apply to:

- Marking the location of underground services on the ground following positive identification; and
- The installation of marker tape within an excavation/trench to visually indicate the presence of an underground service.

Note: *The colour codes/conventions below are taken from AS/NZS 2648.1.1995 Underground Marking Tape – Non-detectable tape*

Underground Service	Line marking / Tape Colour
Gas	Yellow
Water	Green
Communications	White
Fire-fighting	Red
Sewerage	Cream
Reclaimed Water	Purple
Electricity	Orange

Self-Check – 4	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Define the following Questions

1. Preventing Damage to Underground Utilities----------(6pts)
2. Utility Locating Techniques----------(3 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Information Sheet 5- using hand tool

There are different types of soil excavation tools and machines used in construction. Excavation of soil is necessary in construction point of view and it should be done by hand tools or machineries based on the area of the land or depth of excavation. By the process of excavation, the land is cleaned from tree roots, strums, organic impurities etc., which should harm to the foundation. Types of Soil Excavation Tools and Machines:

Now a days, for the soil excavation there are so many equipment's are there and these are classified into two types.

- Hand tools
- Machineries Hand tools for Soil Excavation:

These are generally used for smaller depths of excavations in small areas. Man power is required to operate these tools. The tools come under this category are explained below. Spade Spade is a tool which consists metal plate having sharp edges, the plate is attached to long handle which is generally made up of wood. Because of its sharp edges the soil can be dig easily. The metal plate having less curvature in the spade so, we cannot lift the soil by spade. Shovel Shovel is tool which is used for the purpose of lifting of excavated soil.

It is also similar to spade the difference between spade and shovel is the difference in leading edge. The curvature of metal plate of shovel is generally higher when compared to spade so we can hold the soil easily and lifted it. Shovel can also be used for digging purpose in case of soft soils, sand etc

Hoe is an excavating tool which consists a metal plate attached to a long handle with acute angle. The plate having sharp edge is used to excavate the soil. For small work of excavation it is widely preferred tool. Sometimes metal plate is replaced by fork type plate. Trowel Trowel is hand sized tool which is generally used to dig the small trenches in soil or to remove the shallow roots in soil. Rake Rake is a tools

which is having a horizontal rod having metal teeth and is used to remove the small layers of soil.

Pick axe Pick axe consists hard spike attached perpendicular to handle. They are used for excavating small trenches in soil.

Pick axe can cut the soil even if the soil is of hard type. The metal spike is pointed on one side and wide blade is provided on the other side. Mattock This looks like pickaxe. But serious digging is not possible with mattock. Generally it is used as lifting tool because of its curve shapes metal at its bottom.

Hand trenching tools and shovels and tips

Homeowners often do manual or shovel trenching because the short run of trench they need for their project does not justify a rental trencher. But even professional trenching crews get out the hand tools when they need to trench in area where their trencher will not fit, or to clean out the loose soil from the bottom of the trench.There are four types of hand tools used for trenching. They are the SharpShooter Shovel (or Drainage Spade), a couple different types of Trenching Shovels, the new Bottom Digger clean-out scoop, and the surprising Trenching Hoe (also called a Grub Hoe). We will explore all four below, and we can supply you with all of these tools.

Easy Digging is a retailer of the hand tools shown below, including the HISCO line of shovels and spades. These are professional grade tools, made in the USA, for the construction, utility, and landscaping industry. They feature very strong, reinforced fiberglass handles and thick steel blades. We are now making these available to everyone, because everyone deserves great tools. They are a little more expensive at first, but just one of these shovels will easily withstand the kind of use and abuse that will destroy half a dozen inexpensive wooden hardware store shovels.

Drainage Spad ....also called a Sharp Shooter shovel, or aTile spade. The drainage spade is made for digging shallow rough trenches up to about 12 inches deep and 5 inches wide.

HISCO drain spade with long and short handles using a Sharp Shooter shovel to dig a long trench

The narrow round point is great for penetrating sod, hard soil, and dirt with rocks. The long length of the blade makes it easy to dig shallow trenches for drainage and utility lines. The long handled version is more popular with construction and landscaping crews, while the short handled version is more popular with homeowners and plumbers. Here at Easy Digging we do sell both versions, with professional strength fiberglass handles and thick steel blades.

Note that it creates a trench with a rough rounded bottom. This is OK for laying flexible utility lines like sprinkler tubing and low voltage wiring. It is also OK for shallow drainage pipes used to move downspout water away from your house, and for the common black corrugated drainage pipe. But for deeper trenches that require a smooth flat bottom, you should use a Trench Shovel or a Trenching Hoe. (both are explained further below)

Trenching Hoe

.The trenching hoe is made for digging flat-bottomed trenches up to about 24 inches deep and 5 inches or more wide.

The method of using a trenching hoe is best described using these pictures. It is the same action that a power trencher uses, just in a slower "one-bite-at-a-time" fashion. A power or chain trencher cuts an angled ramp in the soil, then constantly abrades it

and drags the loose soil up and out. Trenching with a grub hoe is the same action, just replace the word "abrades" with "chops".

Trenching Shovels

Trench Digging Shovels and Clean Out Shovels.

Trench Digging Shovels are used for digging narrow flat-bottomed trenches 4 inches wide, and up to 18 inches deep. They are also called step-trench shovels because the upturned back surface lets you push down (step on) the shovel with the toe of your boot while it is in the trench. Their handles have high lift angles, which helps when raising soil up out of the trench, but also make them a little awkward to use. For digging deeper trenches, see the "Manual Trenching Tips" section below.

Digging Shovel

Clean Out Shovels are used to remove the loose soil (also called crumbs or spoil) that is left in the bottom of any trench that was cut with a power trencher. This is done to provide a level solid surface for drainage or water pipes to rest on. A good clean-out shovel has a very high handle angle to reduce bending while reaching the bottom of the trench, and a head with side walls to lift a good amount of soil up and out without spillage. There are two types: the shovel style (shown here), and the scoop style (see Bottom Digger below).

Trench clean-out shovel blade or head

The patented Bottom Digger clean-out tool is also used to remove the loose soil that is left in the bottom of any trench after being made with a powered trencher. What makes it different is that it uses a pull & lift action to collect and remove loose soil

from the bottom of the trench. This makes it much faster, more ergonomic, and less likely to cause back injuries than a shovel type clean-out tool

This tool is often described as a "little backhoe bucket on a stick". Be sure to watch The Race video below to see the remarkable advantages of the Bottom Digger.

Self-Check – 5	**Written test**

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Define the following terms

1. Hand trenching tools and shovels and tips ----------(2points)
2. Digging Shovel_____(2points)
3. Trench clean-out shovel blade or head_____ (2points)
4. Hand tools _____(2points)

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answer

Score = _____
Rating: _____

Information sheet 6- Undertaking trench collapse prevention procedures

Working in trenches and excavations is potentially one of the most hazardous types of work in the construction and utility industries.

Many people don't appreciate the enormous weight of soil. One cubic yard of soil can weigh almost 4,000 pounds .the weight of a small car or pickup truck. When a trench or excavation caves in on unprotected workers, it usually means a serious injury or death, even in a very shallow trench. Here are five simple steps you can take to protect your workers.

Step 1 – Have a Trained and Authorized "Competent Person" On Site

In an attempt to reduce the number of deaths and serious injuries that occur in trenches and excavations, OSHA requires that a "competent person" be on site whenever workers are exposed in an excavation. OSHA defines a competent person as one who:

is capable of identifying existing or predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and has the authority to take prompt corrective measures to eliminate them.

OSHA goes on to say that the competent person must have specific training in, and be knowledgeable of, the requirements of the OSHA standard 29 CFR 1926, Subpart P; soil analysis; and the use of protective systems.

Related: Skimping on Safety Can Severely Hurt Your Bottom Line

The on-site presence of the competent person is crucial in maintaining a safe working environment.

Step 2 – Follow OHS's General Requirements

The general requirements section of OSH, addresses several common-sense items related to trenches and excavations:

Surface Encumbrances: These are described as telephone poles, trees, fire hydrants, street signs, sidewalks, curbs and gutters, and similar objects adjacent to an excavation. They should be removed or supported to ensure their stability and to safeguard workers.

Underground Installations: These include underground utilities such as sewer, gas, water, and telephone and electric lines. Prior to the start of actual excavation work, utility companies must be contacted with adequate, established, or customary local lead times, then advised of the proposed work and asked to determine the location of the utilities. All underground utilities must be protected, supported, or removed to protect workers.

Access and Egress: These are just fancy words for entering and exiting an excavation. Trenches and excavations deeper than 4 feet require a means of access and egress. Also, each worker must be within 25 feet of a ladder, ramp, or stair. Each means of access and egress must be within a protected area.

Vehicular Traffic: Workers exposed to traffic must be provided with, and must wear, warning vests or other highly visible garments. Signs, signals, barricades, and/or flagmen may also be required.

Falling Loads: Workers are not permitted underneath overhead loads. In addition, employees must stand away from equipment being loaded or unloaded from vehicles.

Warning Systems for Mobile Equipment — When mobile equipment is operated near the edge of an excavation, and the equipment operator does not have a clear and direct view of that edge, warning systems such as barricades, spotters, or stop logs — are required.

Hazardous Atmospheres: This section of the OSHA standard is designed to protect workers from so-called “bad air.” Concerns include too little oxygen, too much oxygen, flammable gases such as methane and natural gas, and toxic gases such as hydrogen sulfide and carbon monoxide. Atmospheric testing, along with the use of ventilation equipment, are two of the most common and important methods of addressing hazardous or potentially hazardous atmospheres.

Water Accumulation: Workers must not work in trenches or excavations where there is accumulated water, or where water is accumulating, unless adequate precautions are taken. If the excavation work interrupts the natural flow of surface water, then diversion ditches, dikes, or other means may be required to keep water out.

Adjacent Structures: The stability of sidewalks, streets, adjoining buildings, walls, and other structures can be reduced by excavation operations. Specialized shoring systems, bracing, and/or underpinning may be required to ensure the stability of these structures and to protect workers.

Loose Soil or Rock : Spoil piles (and equipment) must be set back at least 2 feet from the edge of a trench or excavation.

Fall Protection: Walkways with standard guardrails are required when employees or equipment crosses over excavations. Wells, pits, shafts, etc., must be barricaded or covered.

Paying close attention to each of these important potential dangerous circumstances will help ensure worker safety, as well as help contractors and utilities stay legal with OSHA.

Step 3 – Carefully Analyze the Soil

Related: 14 Steps to Ensure Safety In and Around Trenches and Excavations — Part 1

An important responsibility for the competent person is soil analysis. Even when sloping, soil analysis is the very first step in choosing a protective system.

There are hundreds of different types of soil. OSH is concerned with only four – Stable Rock, Type A, Type B and Type C.

OSHA says the competent person must perform at least one visual and one manual test of the soil that is excavated. But the competent person can also take a worst-case-scenario approach and assume all the soil is Type C. In fact, many contractors and utilities take this position.

Step 4 – Use a Protective System

With one exception, OSH requires the use of protective systems in all trenches and excavations that are deeper than 5 feet. The exception involves trenches or excavations in stable rock. In those situations, it's "legal" to work with vertical walls, but stable rock is extremely rare.

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And if a trench or excavation is less than 5 feet deep, a protective system is still required if there's potential for a cave-in. Note that in some states, local laws require use of protective systems in all trenches that are 4 feet or more deep. Always check your state regulations.

There are five options for protective systems:

Sloping and Benching: This procedure calls, first, for classifying the soil, then referring to the charts and illustrations in the OSHA standard to determine the correct angle of the sloping or benching.

Soil Type	**Angle of Bank**
Stable Rock	**Vertical wall**
Type A	**53 degrees**
Type B	**45 degrees**
Type C	**34 degrees**

Timber Shoring: This is a system of wooden walers, cross braces, and uprights that support the walls of a trench or excavation. The OSHA standard specifies the sizes

of timbers, based on the various types of soil, the depth of the trench or excavation, and the type of timber used to build the structure (oak or Douglas fir).

Aluminum Hydraulic Shoring: Hydraulic shoring systems have replaced a lot of timber shoring. Developed in California in the late 1950s, there are two main types of hydraulic shoring systems: vertical shores and horizontal walers. Both employ aluminum rails and hydraulic cylinders that apply pressure to the walls of a trench, creating an "arching" effect in the adjacent soil that prevents the walls from collapsing.

Trench Shields: Trench shields are aluminum or steel structures designed to protect workers by withstanding the forces of a cave-in. Regardless of the material they are made of, the principles for trench shields are the same.

Site-Specific Engineered Systems: Occasionally the charts in the OSH standard are not appropriate. There may be job site conditions or other factors that prevent the use of all these systems. In that case, a registered professional engineer must design a system specifically for the job. The engineer has to be registered in the state where the system will be used, and

will have to "stamp" the design. There are additional requirements, as well, all of which are covered in the OSH standard.

Step 5 – Inspect the Excavation

The properly trained and authorized competent person must inspect excavations daily for:

- indications of possible cave-ins,
- failure of protective systems,
- hazardous atmospheres, and
- other hazardous conditions.

Inspections must be conducted prior to the start of work, and also as needed throughout each shift, after rainstorms, and after other potential hazard-increasing events. The competent person must also check adjacent areas and protective

systems (before and during use), and always look for indications of possible cave-ins and hazardous or potentially hazardous conditions.

Self-Check – 6	**Written test**

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List Inspect the Excavation:? (6pts)
2. List five options for protective systems(3points)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Information 7-Placing barricades around the excavation

7.1.brades

Collisions with construction equipment and other vehicles, pedestrians falling into open excavation work, driving into open excavation work, driving into work areas and losing control of a vehicle because of minor road repairs and soft shoulders are the major causes of accidents in highway construction or maintenance. You can minimize the likelihood of such accidents by using barricades and other warning devices.

In some instances, signs will be sufficient deterrents. Signs should conform in shape, size and color to recommended specifications. Use them freely to designate approaches to the site. Use secondary approach warnings, such as one-lane traffic and speed limit signs, where appropriate.

Other instances call for the use of barricades. An open trench can be a hazard not only to the workers on the site, but also to the public. The OSHA standard states, “Each employee at the edge of an excavation six feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, or barricades when the excavations are not readily seen because of plant growth or other visual barriers.”

There are two types of barricades – the horse type and the fence type. Use the fence barricade around heavy equipment and as a roadblock. Use the horse type for all other purposes. Barricades should be properly striped for visibility – six inches wide and inclined at an angel of 45 degrees from the horizontal.

Below are some barricade basics to help ensure a safe excavation site:

Install warning systems prior to excavation.

Install barricades, guardrails or fences around excavations adjacent to walkways, roads, paths or other traffic areas.

Install standard guardrails on walkways or bridges used by the general public to cross excavations.

Install barricades or other means of protection from underground utilities left in place during excavation.

Install a barricade or fence on any excavation left unattended to protect against accidental pedestrian entry.You can use posts and warning tape as a barricade if the excavation is in a remote location where visitation by residents is unlikely.

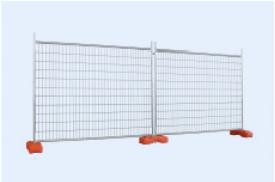
Use a physical barrier such as a fence to isolate an excavation in a highly traveled area.

Install barricades around the site to help control vehicular and pedestrian traffic.

Install a warning system such as a barricade, hand or mechanical signal or stop logs when operating mobile equipment adjacent to the edge of an excavation.

These are just a few precautions you can take to protect workers and the public around excavations. Each situation will be different; therefore, a competent person must assess the hazards associated with the specific excavation to determine the most appropriate plan of action.

Barricades	Details / Requirements / Uses
Star Pickets 	• Set at a maximum interval of 2 meters. • Must have protective capping. • Secured firmly in the ground (if penetrating more than 150mm an Excavation Permit is required). • Must be used in conjunction with demarcation tape and information tag.
Mesh Barriers 	• Mesh barriers can be erected between existing structures or framework. • Can be used with star pickets and/or barricade stands. • Mesh shall be installed with the top edge at a height between 900mm -1200mm. • Must be used in conjunction with demarcation tape and information tag.
Safety Cone and Double Sided Floor Stand 	• Plastic double sided stands or safety cones are used to identify ground related hazards where caution is required, for example, *where spills have occurred or cleaning is in progress.* • Cones and stands shall be placed in a prominent position.
Traffic Cones 	• The maximum distance between warning cones should be 1.5 meters. • Used to demarcate areas where work is taking place on roads and ground, for example, *cleaning up spills, survey marking, around mobile plant.* • Persons requiring access must familiarise themselves with the hazards, risk assess the situation, and only proceed into the area if it is safe to do so.

Barricades	Details / Requirements / Uses
Barricade Stand / Orange Bollard 	• Barricade stands are used to demarcate areas where there is no structure to fix demarcation tape or chains. • Can be used where the barricade needs to be moved to allow mobile plant and equipment into the demarcated area. • Used in conjunction with demarcation tape and information tag.
Temporary Fence 	• Temporary fencing is used to demarcate areas where there is no structure to fix demarcation tape or chains. • Used in conjunction with demarcation tape and information tag.

Self-Check – 7	**Written test**

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is mean by Installing warning systems prior to excavation?(4pts)
2. Define brades.(2 ponts)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

LG #40	LO #3 Complete and isolate the excavation

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics: • Cleaning loose material out of excavation • Checking excavation as per work instruction This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able t**o learn • Clean loose material out of excavation • Check excavation as per work instruction
Learning Instructions:

1.Read the specific objectives of this Learning Guide.

2.Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.

3.Accomplish the “Self-checks” which are placed following all information sheets.

4.If your performance is satisfactory proceed to the next learning guide,

5.If your performance is unsatisfactory, see your trainer for further instructions or go back to “information sheet”

Information Sheet 1- Cleaning loose material out of excavation

1.1. Basic definitionsClearing loose material

Loose material often consists of sandy soil types, gravel soils, or a mixture of both gravel and sand in an excavation area.Loose material is a layer of loose, heterogeneoussuperficial deposits covering solid rock.

Clearing of lose material refers to the removal of all excavated rocky, soil material from excavation area, while **grubbing** is the removal of roots that may remain in the soil. This includes the removal of all logs, brush, and debris, as well as grinding and removal of stumps. Once completed, the site is ready for grading and drain installation.

1.2. Types of loose of Materials.

(A) Unsuitable Material. Soils that cannot be properly compacted, or soils that have roots or other organic matter, garbage. Debris, junk, or any deleterious matter on the surface of buried.

(B) Excavated Material. All material excavated from project site for trench/pit.

(C) Selected Material. Suitable excavated material for specific use from areas within the excavation right-of-way.

1.3 Edge of excavation?

Edge an excavation is of the outside limit of a trench, pit and hole, area, or surface. Look the figure below to understand edge of excavation and loose materials produced from excavation.

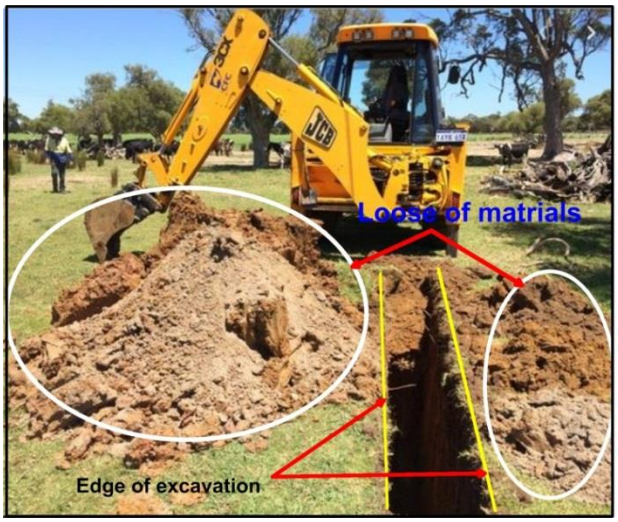


Fig 1.1. Edge of trench with its loose material

1.3. Importance of clearing loose material fromthe edge of excavation

- To prevent excavation collapse
- To have safe and suitable working environment
- To prevent backfilling of the excavated soil to the excavated pit
- To prevent sample contamination

1.4. Method of clearing materials from edge excavation

- ✓ Manually by using hand tools (loppers, pruners, hand saws, shovels, pickaxes, rakes and hoes.)
- ✓ By using machineries like excavator, dozer and loader ,Bulldozers

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is edge of excavation? **2pts**
2. What is clearing loose material? **2pts**
3. List some Importance of clearing loose material from the edge of excavation. **3pts**
4. What challenges will faced if you are not clear the loose materials from an excavated trench/pit? **2pts**

Note: **Satisfactory rating –4.5 points** **Unsatisfactory - below 4.5points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Note !Refer Mineral infrastructure level 1n module 11 Lo 4 LG 41 page 51

information Sheet 2 Checking excavation as per work instruction

2.1.ISOLATE AREA

A person conducting a business or undertaking who proposes to excavate a trench at least 1.5 m deep, must ensure, so far as is reasonably practicable, that the work area is secured from unauthorised access, including inadvertent entry. (Excavation Work Code of Practice, Regulation 306).

In securing the trench or excavation, you must consider:

" Risks to health and safety arising from unauthorised access to the work area, and "

The likelihood of unauthorised access occurring.

This requirement aims to protect other workers on site who may be at risk by restricting access to the excavation area. It applies in addition to the duty that the person with management or control of the construction site has to ensure, so far as is reasonably practicable, that the site is secured from unauthorised access from

members of the public, for example when the site is near schools, parks, shops or other public places.

On completion of the task ensure that remove loose material out of excavation using hand tools and ensure the excavation is completed to specification. Barricade the excavation so no one can fall or drive into it. Do another risk assessment on the completed product.

1.For a permanent reinstatement, before it is left, the site must be returned to the condition it was in before the reinstatement took place.

Steps to take include:

- removal of excess materials
- restoration of all permanent signs (some additional signs may be required)
- reinstate all road markings, coloured surfacings and other surface treatments correctly
- reinstate any specialised footways, footpaths, and cycle track features (e.g. tactile paving)
- restore street furniture to original position
- ensure that the surface is in a clean and serviceable condition
- pack away equipment and tools
- check that all signs, cones, barriers and lamps have been removed

2. For an unattended site, the site must be left in a safe and secure condition.

Steps to take include:

- stockpile excess material safely
- check the condition of all temporary signs, barriers and lamps
- ensure that the road, footway, footpath or cycle track is in a clean, safe and serviceable condition
- visit the site on a regular basis, to ensure that the site remains in a safe condition

A competent person must inspect excavations:

- At least once in every day during which persons are at work there
- If more than 2 metres deep, at the start of each shift before work begins
- After any event likely to have affected the strength or stability of the excavation or the shoring
- After any accidental fall of rock, earth or other material
- At least once every 7 days where persons are not at work there

Structural stability during excavations

The law says you must prevent danger to workers in or near excavations. To maintain the required precautions, a competent person must inspect excavation supports or battering at the start of the working shift and at other specified times. No work should take place until the excavation is safe.

Commercial clients must provide certain information to contractors before work begins. This should include relevant information on:

- Ground conditions
- underground structures or water courses; and
- the location of existing services.
- This information should be used during the planning and preparation for excavation work.

Fig service marker

Self-Check – 2	**Written test**

Name…… ID…… Date…….

Directions: *Answer all the questions listed below. Use the Answer sheet provided in the next page*

. 1. define Structural stability during excavations(6points)

2.List all competent person must has to inspect during excavations?(3 points)

3. Define Isolate area.(4 points)

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

You can ask you teacher for the copy of the correct answers.

LG #41	**LO #4- Clean up**
Instruction sheet	
This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics: • clearing loose material from the edge of excavation • clearing work area and recycling or disposing materials • cleaning, checking, maintaining and storing tools and equipment This guide will also assist you to attain the learning outcomes stated in the cover page.	

Specifically, upon completion of this learning guide, you will be able to:

- cleare loose material from the edge of excavation
- cleare work area and recycling or disposing materials
- clean, check, maintain and store tools and equipment

Learning Instructions:

1.Read the specific objectives of this Learning Guide.

2.Follow the instructions described below.

3.Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.

4,Accomplish the “Self-checks” which are placed following all information sheets.

5.Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

6.If your performance is satisfactory proceed to the next learning guide,

Information Sheet-1	clearing loose material from the edge of excavation

2.1. Basic concept of clearing the work area

Clearing the work area involves **clearing** a **site** of any machinery or equipment, unwanted surplus materials, rubbish, and so on. **Site clearance** may also involve **clearing** away vegetation and surface soil, and leveling and preparing the ground for the planned **excavation** works.

Clearing work area

- ✓ Is removing from the site trees, brush, shrubs, down timber, rotten wood, and rubbish, other vegetation as well as fences, and incidental structures necessary to allow for new construction.

(1) Remove all trees, stumps and roots within 10' of any structure or pipeline.

(2) Stumps of trees, other than the above, to be left in place shall be cut off shall be left not more than 6" above original grade. Remove all stumps unless in a fill section greater than 5 feet.

- ✓ Clearing work shall be restricted to area within rights-of-way or easements or within "Construction Limits" indicated on Contract Drawings.
- ✓ Clean up debris resulting from site clearing operations continuously with the progress of the work.
- ✓ Remove all waste material from site.
- ✓ Remove debris from site in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt and debris at all times

Fig 2.1. Working area clearance

2.1.1. Purpose of clearing work area

The main **purpose of site clearance** is to remove existing weathered rocks, waste, vegetation and, most importantly, the surface layer of soil referred to as topsoil. It is necessary to remove this layer of soil, as it is unsuitable to build on.

Before setting up the work area you will first need to clear it.

Start by removing all unwanted excavation materials away from the work area. Place them in a secure area where they won't get damaged.

Fig 2.2. Transporting all unwanted excavation materials

Dispose of unwanted materials in the following way.

- Place soil and rocky materials, recyclable plastic, paper and cardboard in the appropriate recycling bins.
- Stack timber off cuts in a firewood pile.
- Store hazardous materials such as adhesives/paints for collection by the local council.
- Place general rubbish in rubbish bins.

Fig 2.3. Dispose of rubbish materials

If you are working inside, sweep the floors to remove all dust and debris from the work area.

Fig 2.4. Cleaning of rubbish materials

•

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the clearing of work area? What is the importance of clearing of work area?**2pts**
2. Discus the steps of setting work area before starting the work. **3pts**

Information Sheet-2	cleare work area and recycling or disposing materials

Before the earthwork is started, the whole area where the work is to be done shall be cleared of grass, roots of trees and other organic matter. Site preparation shall consist of clearing grubbing and removal of any and all inappropriate materials.

The excavation shall be carried out in accordance with the dimension shown on the drawings. If the soil at the specified depth is found to be unsuitable, then it shall be dug to a depth at which a stratum of good hard soil is found as directed by the consultant. Besides digging the earth, the word excavation signifies the all the works related such as dressing of the sides, ramming of bottom, disposing of any soil not required out of site, and keeping the outer edge of excavation. Sides of the trenches shall be vertical and its bottom shall be perfectly levelled, both longitudinally and transversely. The Contractor shall dispose off all surplus excavated soil at his own cost as directed by the Consultant. Materials deemed not necessary or appropriate for the project shall be removed at the time of excavation. No material excavated from foundation trenches, shall be placed nearer than one meter to the outer edge of the excavation.

The excavation shall be carefully executed as per the dimensions and elevations on drawing and the established ‘Benchmark’ at the site. The contractor accepts full responsibility to alien the building and slabs in reference to these given elevations. Should any of the excavation be taken below the specified levels, the Contractor shall fill such excavation at his own expense with concrete well rammed in position until it is brought up to the proper levels; filling in with excavated materials will not be allowed for this purpose. If foundations are made broader or longer than directed, the extra length and breadth shall be filled in after the foundations are built with earth rammed and compacted, at the Contractor’s expense.

If the excavation is in earth, the bottom of the trenches shall be sprinkled with sufficient water to bring the soil to its optimum moisture and compacted to meet stated percentage of compaction. Any excess digging or any patches of bad soils or hollows shall be removed by placing concrete or shall be subject to any other special treatment .

Where the soil is soft, loose or slushy the trench shall be widened for allowing steps on either sides or the sides sloped or shored up. During excavation if rocks or rocky soils are found, (if approved as suitable for foundation), those shall be levelled as far as possible and the small spaces which are difficult to level shall be filled in with concrete.

Water in trenches must be bailed or pumped out and where it is apprehended that the sides may fall down arrangements shall be made for adequate timber shoring. The Contractor shall at his own expense, make provision for all extra excavation in slope, pumping, dredging or bailing out water from the trenches and keep free of water during the laying of foundation works. When it is specified that the work is to be carried out without removing pipes, cables, sewers etc. all of them shall be temporarily shored and saved from any damage. The materials or valuable found during excavation shall be the property of the Government. The cost of all materials and labour required for fencing in and protection against risk of accidents due to open excavation shall be borne by the contractor. Care shall be taken in the disposal of water from the excavation to limit any damage to existing infrastructures or joining properties.

2.2. Recycling or disposing materials

Waste management (or **waste disposal**) is the activities and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process.

Waste disposal. Removing and destroying or storing damaged, used or other unwanted domestic, agricultural or industrial products and substances. **Disposal** includes burning, burial at landfill sites or at sea, and recycling.

2.4.Waste disposal methods

1. **Preventing or reducing waste generation:** Extensive use of new or unnecessary products is the root cause of unchecked waste formation.
2. **Recycling:**Recycling serves to transform the wastes into products of their own genre through industrial processing. Paper, glass, aluminum, and plastics are commonly recycled. It is environmentally friendly to reuse the wastes instead of adding them to nature. However, processing technologies are pretty expensive
3. **Incineration:** Incineration features combustion of wastes to transform them into base components, with the generated heat being trapped for deriving energy.

Fig 2.5.Waste disposal methods (reducing waste generation, recycling and Incineration)

4. **Composting:** It involves decomposition of organic wastes by microbes by allowing the waste to stay accumulated in a pit for a long period of time.
5. **Sanitary Landfill:** This involves the dumping of wastes into a landfill. The base is prepared of a protective lining, which serves as a barrier between wastes and ground water, and prevents the separation of toxic chemicals into the water zone. Waste layers are subjected to compaction and subsequently coated with an earth layer. Soil that is non-porous is preferred to mitigate the vulnerability of accidental leakage of toxic chemicals. Landfills should be created in places with low groundwater level and far from sources of flooding. However, a sufficient number of skilled manpower is required to maintain sanitary landfills.

6. **Disposal in ocean/sea:** Wastes generally of radioactive nature are dumped in the oceans far from active human habitats. However, environmentalists are challenging this method; as such an action is believed to spell doom for aquatic life by depriving the ocean waters of its inherent nutrients.

Fig 2.6.Waste disposal methods (Composting, Sanitary Landfill andDisposal in ocean /sea)

2.5. Importance of recycling:

- To Make Environment Clean
- Conservation of Materials
- To Save Energy

Reduce Garbage in Landfills

Self-Check -2	Written Test

I. Short answer

1. *Write steps before excavation*
2. What is Waste management? What is waste disposal? What is the importance of recycling? **3pts**
3. Discus Waste disposal methods.**3pts**

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	cleaning, checking, maintaining and storing tools and equipment

3.1. Cleaning tools and equipment

Equipment of all types should be cleaned at the location of last use before being moved to a new location.Different types of materials require different cleaning methods

Pre clearing, by removing heavy accumulations of soil and debris with appropriate tools, will save water during later washing operations. Effective cleaning to eliminate invasive species materials and prevent their spread can be accomplished by thoroughly removing soil and debris using pressurized water. In certain situations, cleaning with compressed air, rather than water, could prevent damage to certain equipment areas such as engine wiring systems and vehicle cabs.

Personnel who use equipment during cleaning operations are responsible for properly using Personal Protective Equipment (PPE) that is appropriate to the cleaning activity. Using cleaning and disinfectant chemicals, power washers, air compressors, and other types of cleaning equipment may present unique working hazards. PPE items may be required to protect hearing, skin, eyes, respiration, and other body resources. For example, certain types of cleaning equipment may require electrical power and may present electrical hazards to the operator.

Even the most careful cleaning of any equipment, however, will not guarantee that the equipment is absolutely free of contamination. Successful cleaning is dependent upon many factors, such as the amount of care taken during the cleaning operation, the type of cleaning equipment being used, the level of training of the cleaning operator, the type of equipment being cleaned, and the particular invasive species.

After decontamination, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be

moved away (preferably upwind) from the decontamination area to prevent re-contamination. If the equipment is not to be immediately re-used it should be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

3.2. Checking of Equipment and Tools

This is designed to encourage all staff to check equipment and tools regularly for faults and condition and report defects to management immediately and not to use defective tools or equipment.

Outcomes required

The overall intention is to raise awareness of using faulty tools or equipment and that all are aware of their duty of care to themselves and others of ensuring they do not. Also the empowerment they have in not conducting unsafe acts by using and also in confidently raising with management issues with equipment and tools supplied by the company.

3.3. Equipment maintenance

Tools and equipment must be maintained if they are to be operated in a safe and effective manner. Elements of good maintenance requirements include:

- Inspection of the tools and equipment at must occur checkout or start-up of the job. This can include such items as a visual inspection of the power cord to make sure it is not damaged, visual inspection to make sure equipment parts are securely attached, and inspection for cleanliness.
- Inspection of tools and equipment must also occur at check in or at completion of the job. This should include cleaning the tools after use, reporting any problem with the tool or equipment while in use, draining any excess fuel or flammable fluids from the equipment.
- Routine maintenance as per the manufacturer's requirements should be carried out.

3.3.1 Important of maintenance of equipment

Normal wear and tear can result in lower **machine** efficiency. Preventive **maintenance** assures optimal working conditions and conserves the life span of the **equipment**. A planned preventive **maintenance** may cause small hindrance for production, but that is nothing compared to actual downtime caused by a breakdown.

3.4.Proper Storage of Tools and Equipment:

To ensure that tools and equipment remain in good condition and last for a long time, store them properly. Properly stored tools and equipment will be easy to find when needed and are less likely to be lost.

Example: Good practices for mechanical room

Parts should be properly stored and labeled	
Tools should be properly placed on the board, and labeled. Consider drawing the shapes of the tools on the board so that they always get put back in the same position.	
Use bins for storing small parts	
Consider making an individual (or individuals) responsible for the good maintenance of tools and parts.	

3.4.1.Benefits of Proper Storage of Tools and Equipment:

- Tools and parts are kept in good condition and are easy to find
- Costs are reduced
- Productivity is increased because time is not lost looking for tools, parts and equipment
- Workshop staff develop a sense of responsibility and pride in their work

How?

- ✓ Workshop staff identify tools, parts and equipment
- ✓ Workshop staff develop a system for labeling and storing tools, parts and equipment

Steps of cleaning;

1.Sort

2.Set

3. Shine

For farther information Refere module 12 Lo 3 LG 44 page 71

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is cleaning tools and equipment? 2pts
2. What is the benefit of proper storage of tools and equipment? 3pts
3. What is the importance of maintain Tools and equipment? 3pts

II. Define the following 3s

1. *Set* _____
2. *Shine* _____
3. *Sort* _____

Note: **Satisfactory rating –4 points** **Unsatisfactory - below 4 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

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Aknowledgement

We would like to express our appreciation to the TVET instructors and experts of Amhara Regional TVET Bureau, Oromia Regional TVET Bureau, TVET College/institutions, Geological survey of Ethiopia, Ministry of Mines and Petroleum and Federal Technical and Vocational Education and Training Agency (FTA) who made the development of this training materials with required standards and quality possible.

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