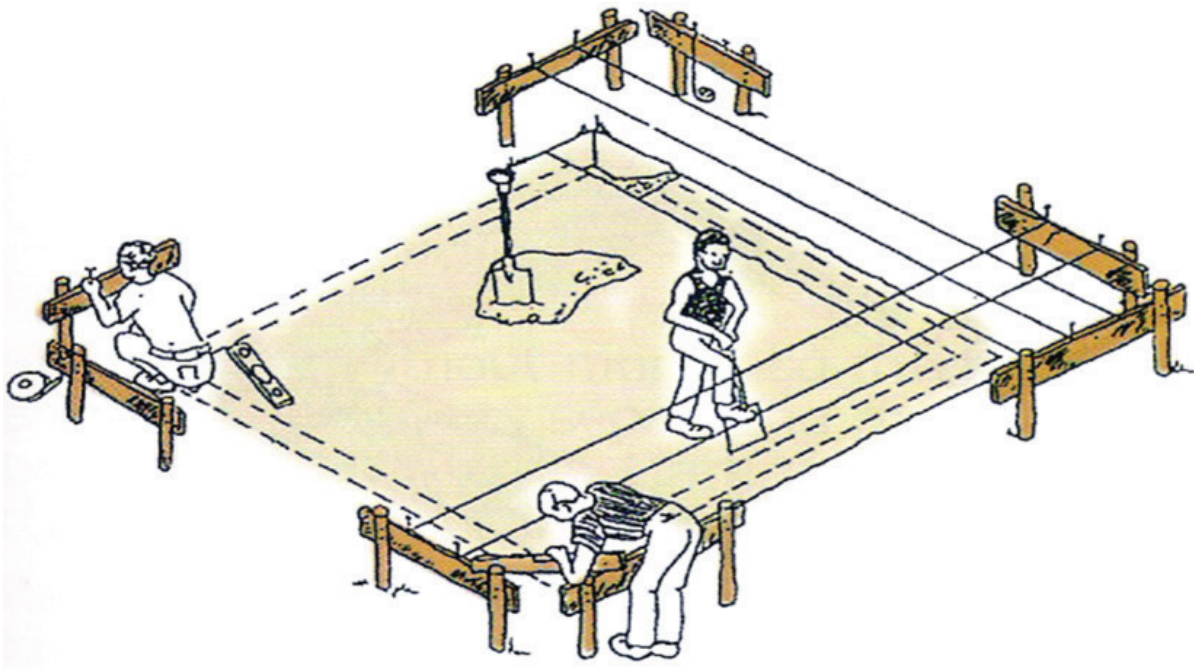




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Ministry of Labor and Skills

# Manufacturing Sanitation Product and Latrine Construction

**Advanced Short-Term Training**  
Based on May 2023, Curriculum Version I



**Module Title:** Setting out and Excavation

**Module code:** EIS SCW1 M03, 0523

**Nominal duration:** 8 Hours



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## ACKNOWLEDGMENT

The Ministry of Labor and skill would like to extend its gratitude to MoH, One WASH national Program, USAID, PSI, Regional Labor, and skill/training Bureaus, TVT College Deans, Instructors, and industry experts for their financial and technical support of Manufacturing Sanitation Product and Latrine Construction training module. Finally, MOLS extends its gratitude to the following instructors and experts who contributed to the development of curriculum.

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# INTRODUCTION TO THE MODULE

In construction of Latrine: Setting out is needed to perform excavation and construction as per the shape and size of a building. The details provided on the project plans and drawings are transferred to the ground on which the structure will be constructed. Like other tasks on construction project, trainees need to prepare by identifying and organizing the task detail and the work environment, the tools and material to be used and, safely and environmental requirements.

## **This module covers the units: Setting out and Excavation.**

- Planning and preparing for work and materials.
- Perform setting out.
- Executing excavations
- Restoring work site

## **Learning Objective of the Module (training outcome)**

- Plan, prepare of work and materials.
- Perform setting out.
- Execute excavations
- Restore work site.

## **Module Instruction**

For effective use of this module, trainees are expected to follow the following instruction:

1. Read the information written in each unit.
2. Accomplish the Self-checks at the end of each unit.
3. Perform Operation Sheets which were provided at the end of units.
4. Do the "LAP test" given at the end of each unit and
5. Read the identified reference book for Examples and exercise.

## Unit One: Planning and preparing for work and materials

This unit is developed to provide trainees the necessary information regarding the following content coverage and topics: -

- Work requirements
- Signage and barricade
- Tools and equipment
- Underground services

This unit will also assist trainees to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, trainees will be able to: -

1. Identify work requirements.
2. Identify signage and barricade.
3. Identify tools and equipment
4. Identify underground services.

## 1.1. Work requirements

### General Construction Requirements

- Government standard regulations and legal requirements
- Understanding the owner and the contractor/mason relationship
- Protection and safety of workers, peoples, and public utilities

### Construction (excavation works) Hazards.

- Caving/Collapse of pits
- Falling people/objects
- Dust/Dirt
- Damage of public utilities

### Construction Site Safety Requirement

Construction (depending on the scope of the project) premises shall have adequate fire, emergency or danger warning signs and safety instructions with standard colors visible always.

A visual alerting device in the form of a label, placard or other marking which advises the observer of the nature and degree of potential hazards which can cause injury or death should alert persons to the following:

- Specific Hazards
- Degree or Level of Seriousness
- Probable consequence of involvement with the hazards
- How hazards can be avoided

## 1.2. Signage and Barricade

Safety signs should be erected to warn people of specific hazards and to communicate precautionary measures and emergency actions. Safety signs should be erected in accordance with the National Work Health and Safety Standards, in relation to the following:

- Specific personal protective equipment (PPE) requirements
- Hazardous chemicals
- Fire protection equipment
- Restricted access
- Emergency and first aid information



Figure-1: Sample signage

### 1.3. Tools and equipment

The following are some equipment, tools and materials utilized in excavating, constructing, and restoring construction work sites. Excavation of soil can be done manually by hand tools or with machineries based on construction scope, type of soil or depth of excavation.

Common hand tools used for Soil Excavation and setting out are -

#### Setting out tools:

- Hammer
- Bowsaw
- Pencil
- Tri-square
- Sprit level
- String
- Tape meter
- Plum-bob
- Sluge-hammer
- Hose level

#### Excavation tools

- Spade
- Shovel
- Hoe
- Pickaxe
- Mattock

### 1.4. Underground services

Underground service refers to the installation of utility lines, such as electrical, gas, water, and telecommunications, underground rather than above ground.



These services should be protected by using the following methods:

- Mark the location of buried utility lines before excavation begins.
- Use specialized equipment to locate and avoid buried utility lines.
- Notify utility companies and obtain necessary permits before beginning excavation work.
- Regularly maintain and inspect underground service lines to ensure their continued safe operation.
- In the event of accidental damage to a utility line, immediately notify the appropriate utility company and take steps to ensure the safety of personnel and the public.
- Ask people about previous underground service are there.

### Self-Check 1

**Part-I: Choose the correct answer.**

1. Which one of the following is not construction Site Requirements?
  - a) Government standard regulations and legal requirements
  - b) Understanding the owner and the contractor/mason relationship
  - c) Protection and safety of workers, peoples, and public utilities
  - d) All
2. The following are construction tools except one.
  - a) Cement
  - b) Pix axe
  - c) Measuring tape
  - d) Spade
3. Safety signs should be erected to warn people of specific hazards and to communicate precautionary measures and emergency actions.
  - a) True
  - b) False
4. Shovel is tool which is used for the purpose of lifting of excavated soi?
  - a) True
  - b) False

**Part-II: Answer the following questions accordingly.**

1. List down at least four common Soil Excavation tools?
2. Explain some of the barricade basics to ensure a safe excavation?

**Note: Satisfactory rating - 75 % and above Unsatisfactory - below 75 %**

**You can ask your trainers for the copy of the correct answers.**

## Unit Two: Set out and Excavations

This unit to provide trainee the necessary information regarding the following content coverage and topics:

- 2.1. Set out different excavation.
- 2.2. Types of soil and excavation
- 2.3. Excavation collapse prevention methods
- 2.4. Barricade in excavation
- 2.5. Executing excavation work
- 2.6. Back fill and compaction

This guide will also assist trainee to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, Trainee will be able to:

- Set out different excavation.
- Explain types of excavation soil
- Explain trench collapse prevention methods.
- Identify barricade in excavation.
- Execute excavation work.
- Perform back fill and compaction.

## 2.1. Setting out Different Excavation

Setting out is the process of laying down the excavation lines and center lines, etc. on the ground before excavation is started. It brings the dimensions from a plan to the real situation. The activity consists of establishing the exact location and measurements of different excavation.

Basic materials used in setting out.

- **Pegs:** are short pointed wooden rods driving into the ground to mark an excavation, construction, line or a level. A nail driven in top of the peg usually shows the position of the point.
- **Batten boards (profile board):** is a horizontal board 150 mm by 25 mm cut to varying length. They are nailed to 100 mm x 50 mm x 50 mm square post, which have been pointed and driven into the ground. Batten board or profile board located about 0.5-1.0 m outside the limits of foundation wall. The lines defined by nails in the top of the profile boards are the outside faces. Mention local options with wooden pole latrine.
- **Hose level:** The hose level/ water tube level is a simple and ideal instrument to transfer and check levels on smaller building sites. Accurate measurements are possible, for example when lintels must be set on the same level, or when the floors must be cast on the same level one can mark the levels along the wall using the water tube.

There are three methods of setting out.

- **3,4,5 method** is a triangular method, which has sides of length 3 meters and side 4 meters also check diagonal point 5 meters measuring method.
- **Tray square method** is ensuring right angles (90 degrees) it is important when setting out to check corner simple tray square (90 degrees) measurement method.
- **Leveling instrument method** is setting out method it is check corner staff line leveling measurement. In those three-method pit excavation work used 3, 4, 5 method and tray square setting out methods.

### Procedure of setting out

Ensuring right angles (90 degrees) is important when setting out initial perimeter of the house this can easily be achieved using the 3:4:5 triangle method. A triangle, which has sides of length 3 meters and 4 meters and 5 meters, will always have a right angle between the 3-metres side and the 4-meter side. One can therefore construct a right angle using only a tape measure as follows:

1. Measure the length A to B of 4 meter of long the line from where a perpendicular line needs to be defined. Place pegs exactly at points A and B,
2. Hold the zero point of the tape measure on the peg A,
3. A second person holds the mark 8.0 meters on the tape measure on peg B,
4. A third person holds the tape measure on mark 5.0 meters, which will lead to point C when the tape measure is pulled tight. Set a peg on point C.
5. External the now perpendicular line from point B to point C to any length as required.

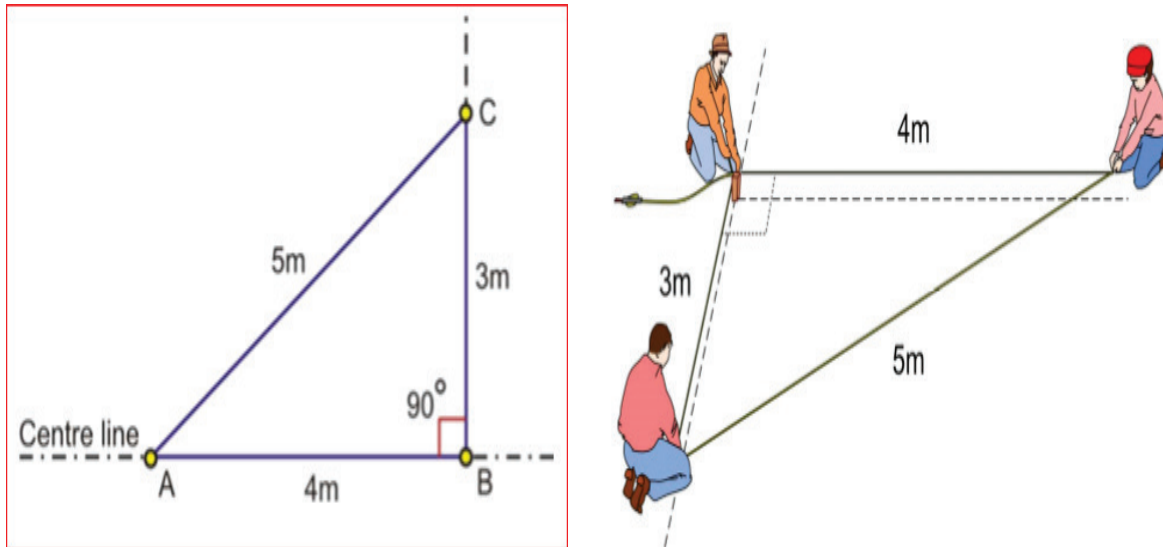


Figure 1: 3 - 4 - 5 method of setting out

### Work procedure

1. Clear the ground where the house will be located and ensure it is level.
2. Place solid pedestals on all corners, approximately 1.5 m away from the planned outside wall of the building
3. Ideally all pedestals should be of the same height and keep the string wall off the ground.
4. Mark the centre of the outer walls using a string line and tape measure. Fix the string tightly so it does not sag.
5. The string lines should cross each other at a right angle. Use the 3,4,5 string method to obtain the 90 degree angles for the house corners (ref. work sheet S1).
6. Check the diagonals. For a perfect layout they must be of equal length.

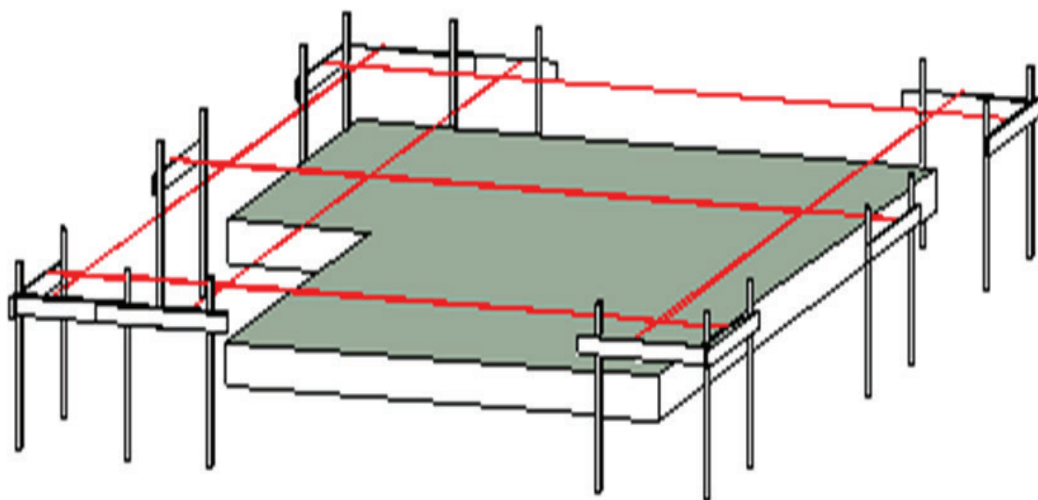


Figure-1: Setting out

## 2.2. Types of Soil and Excavation

### 2.2.1. Types of soil

Soil type may vary from site to site even in the same village. Information about soil type of site is important to choose the suitable latrine option and decide materials to be used for construction of substructure (below or above the ground), floor and for the superstructure. There are three major types of soil with distinctive characteristics namely, sand silt and clay.

#### **Sandy Soil:**

Sandy soil is loose (not sticky) with regular shape, has largest particle size ranging from 0.05mm– 2mm in diameter and rough on touching. There are huge spaces (porous) between sand particles and therefore cannot retain water. Such soil type is good to soak away liquid part of latrine content in the surrounding soil.

#### **Silt soil:**

Silt is slightly sticky with irregular shape, moderately absorb and retain water with particle size ranging from 0.002mm – 0.005mm in diameter.

#### **Clay soil:**

Clay soil is sticky and difficult to see particle size with naked eye, flat in shape, with high water absorption and retention capacity and particle size less than 0.002mm in diameter.

### 2.2.2. Excavation

#### **Topsoil Excavation /site clearing/**

The removal of the exposed or the topmost area of the earth's surface. This will remove vegetation, soil, and any other decaying material that could make the land unsuitable to bear structural loads.

#### **Trench excavation**

A specific type of excavation, that is deeper than it is its width. Unlike large excavations, trench is generally deeper than it is

#### **Pit Excavation**

Pit excavation is determined the depth of pit required, the total number of people who will use the facility and the desired operation period is needed. Latrine pit excavation is different size and shape excavated by need of people. Exm: circle and rectangular etc.

#### **Steps for pit excavation**

- Setting out pit excavation work
- To mark out the exact location of the pit
- To clearly mark out 90° corners in case of rectangular pits, and for circular pits a well-defined circumference.
- To excavate pit for storage of excreta



*Fig-5: Circle latrine pit excavation*

### 2.3. Excavation Collapse Prevention Methods

Trench and excavation collapses pose a significant risk to workers and can occur with little or no warning. The following factors may contribute to unstable conditions:

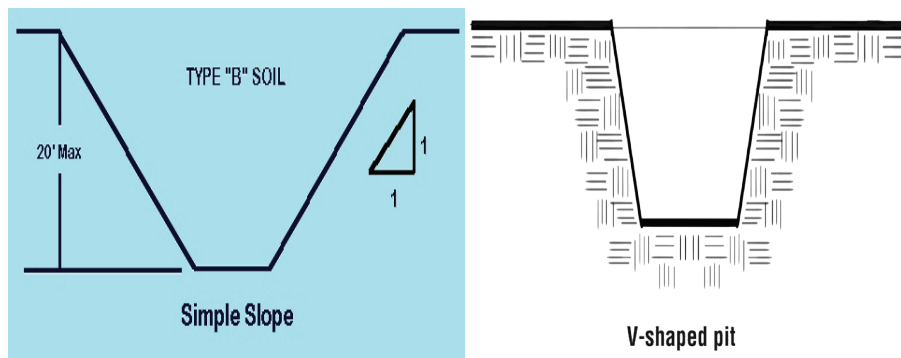
- The depth of the excavation.
- The nature of the ground or soil, including its reaction to the elements (e.g., ground Exposed to rain may become unstable).
- Slip planes in the soil and fractures/faults in rocks.
- Water content, including the inrush of water.
- The placement of and vibration from plant.
- The storage of excavated material near the edge of the excavation.
- The proximity of buildings and other structures.

#### Protective systems

The basic methods for protection of soil from collapse are sloping; install concrete ring, benching, shoring, and shielding. The method you should use depends on factors such as soil type and water content, excavation depth and width, the nature of the work, and nearby activities that could increase the risk of a cave-in. The competent person has the responsibility for considering these factors and for determining the appropriate protective system.

#### Latrine pit collapse prevention methods

- Use slope excavation.
- Benching,
- Shoring,
- Shielding.
- Construct masonry wall in the under ground
- Pit Lining (Concrete ring, Used Tyre, plastic ring, etc).



*Fig-6: Excavation collapse prevention slope method*



*Fig-7: Under ground masonry wall construction*



*Fig-8: Used tyre pit lining.*

### Concrete ring erection

Concrete ring is made up of cement, sand, gravel, and steel bar (optional) by using protection from soil collapse in excavation works. For latrine pits it can be erected in three methods;

- Concrete ring casted on pit and continue excavation.
- Using precast concrete ring and transport to site
- Cast onsite inside pit



a) Concrete ring cast on pit



Out site

Instoling



b) Precast concrete ring and transport to site



Figure-9: Cast on site inside pit.

## 2.4. Barricade in Excavation

Use barricades to indicate restricted access into areas that contain holes, excavations, openings, or areas in which a danger from falling objects is present. Anyone who creates a hole, opening or is working at height is responsible for erecting a barricade. The following points needs to be considered when excavating pits.



- Adequate barrier physical protection must be provided at all remotely located excavations.
- All openings such as wells, pits, and shafts must be barricaded or covered and when the work is complete any such temporary opening must be backfilled.



*Figure-10: Barricade in excavation*

## 2.5. Executing Excavation Work

### Working Procedure for Soil Excavation

The extent of soil and rock strata is found by making pits in the construction site. The excavation and depth are decided according to the following guidelines in the site.



*Figure-11: Excavation work*

### Steps/Techniques for excavation

- **Step 1:** Select and wear appropriate PPE.
- **Step 2:** Select and use appropriate tools and equipment.
- **Step 3:** Clear the site.
- **Step 4:** Obtain the architect or building plan.
- **Step 5:** Take note of the four corners where we have the proposed columns/pillars or as case might be.
- **Step 6:** Establishing the four corners in relation to the dimension of the building floor plan by pegging.
- **Step 7:** After establishing these four corners insert nails at the Centre- top of each peg and then run rope round the 4 pegs.

- **Step 8:** Taking just one side measure the setback from back offence to the end of building lines in that angle, then come to the front and measure the setback also as given on your drawing plan.
- **Step 9:** After this go back make them form a right angle or 90 degrees.
- **Step 10:** After this, nails peg at 3m interval round under the rope marking your building line, then nail tie rods (flat thin wood) on top round the entire area.
- **Step 11:** Establish each room measurement by nails ( you require four nails at each measurement, two to establish the two sides of block you are going to place later on then the other two at both ends to serve as the points where you will excavate ,the length of this is usually three times the width of the block you are using that is if you are using a 9" block then expect to excavate or dig a trench of wide.
- **Step 12:** From the plan details, the width of excavation to be done is also marked by line with pegs at appropriate positions. The excavation width is then marked by lime or by with furrow with spade.



*Figre-12: Trench excavation*



*Figre-13: Circle trench excavation*

## 2.6. Back Fill and Compaction

### Backfilling Excess Soil

Backfilling is one of the essential tasks in the construction industry. This is the process of putting in soil, whether reusing or replacing, after the construction of structural member took place. The material used during the backfilling should comply to design requirements which means it can withstand the load transferred, maintaining the stability of the structure and does not impose significant settlement over time. Factors byou need to consider during backfilling are choosing the right soil and the compaction of soil. Ideally, backfill should be of material should be of non expansive.

### Compaction

Compaction (Soil Compaction) is the process of applying energy to lose soil to consolidate it and remove any voids, thereby increasing the density and consequently its load-bearing capacity In order to have an increase in the amount of soil solids and water within the unchanged volume, there must be a reduction in voids. Again, compaction of a soil mass is shown to result in a reduction in soil voids specifically air voids.

### Objectives of soil compaction

- Increase bearing capacity.
- Increase durability.
- Increase resistance to deformation.
- Decrease frost damage.
- Increase stability.
- Decrease permeability.



*Fig-17: Manual Compaction*

### Self-Check 2

#### Part-I: Choose the correct answer.

1. -----is the process of laying down the excavation lines and center lines, on the ground before excavation is started?
  - a) Setting out
  - b) Excavation
  - c) Compaction
  - d) Backfill Excess Soil
2. ----- are short pointed wooden rods driving into the ground to mark an excavation, Construction, line, or a level?
  - a) Setting out
  - b) Excavation
  - c) Peg
  - d) Batten board
3. Which one of the following is not classification soil group?
  - a) Clay
  - b) Silt
  - c) Sand
  - d) Backfill Excess Soil
4. Which one of the following is type of excavation except?
  - a) Trench excavation
  - b) Site clearance

- c) Pit excavation
- d) Compaction

**Part-II: Answer the following questions accordingly.**

1. List down the excavation collapses protection methods?
2. Write and explain definition of compaction and backfill in excavation site?

**Note:** *Satisfactory rating – above 75%*      *Unsatisfactory - below 75%*

*You can ask your trainees for the copy of the correct answers.*

### Operation sheet 1: Setting out excavation work.

**Operation Title:** Set out excavation work.

**Purpose:** How to set out excavation work

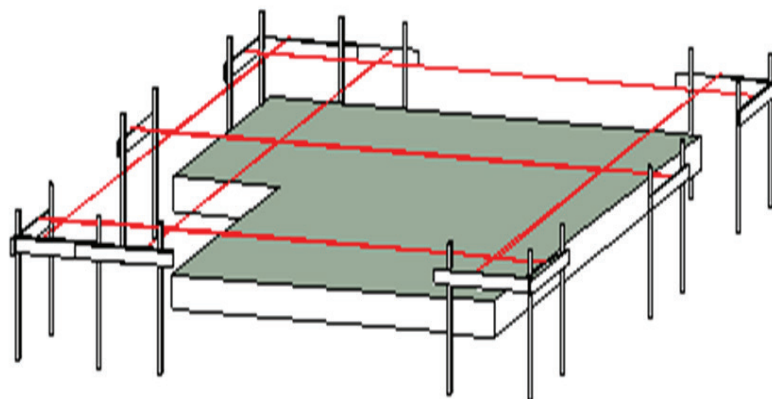
Equipment Tools and Materials:

- Try square.
- Sprat level
- String
- Pegs
- Tape
- Plum- bob
- Slag- hammer
- Profile board
- Mattock
- Pickaxe.

**Instruction:** - set out excavation work length 4m and width 6m.

#### Work procedures

- Step 1: Select and use appropriate tools and equipment.
- Step 2: Obtain the architect or building plan.
- Step 3: Take note of the four corners where we have the proposed columns/pillars or as case might be.
- Step 4: Establishing the four corners in relation to the dimension of the building floor plan by pegging.
- Step 5: After this go back make them form a right angle or 90 degrees.
- Step 6: After this, nails peg at 3m interval round under the rope marking your building line, then nail tie rods (flat thin wood) on top round the entire area.
- Step 7: Establish each room measurement by nails (you require four nails at each measurement, two to establish the two sides of block you are going to place later than the other two at both ends to serve as the points where you will excavate.
- Step 8: From the plan details, the width of excavation to be done is also marked by line with pegs at appropriate positions. The excavation width is then marked by lime or by with furrow with spade.



**Quality Criteria:** Assured performing of all the activities according to the procedures.

#### Precautions:

- Wearing proper clothes, eye glass, glove
- Make working area hazard free.
- Read and interpret manual which guide you how to use tools and equipment.

## Operation Sheet 2: Excavation Work

**Operation Title:** Pit excavation work

**Purpose:** To apply latrine pit excavate work

Equipment Tools and Materials:

- String
- Pegs
- Tape
- Plum- Bob
- Mattock
- Pickaxe
- Spade
- Hoe

**Instruction:** - apply circular latrine pit 1 mx1 m and with 3m.

Work Procedures: -

1. Setting out pit excavation work
2. To mark out the exact location of the pit.
3. To clearly mark out 900 corners in case of rectangular pits, and for circular pits a well- defined circumference.
4. To excavate pit for storage of excreta



**Quality Criteria:** Assured performing of all the activities according to the procedures.

**Precautions:**

- Wearing proper clothes, eye glass, glove
- Make working area hazard free.
- Read and interpret manual which guide you how to use tools and equipment.

### Operation sheet 3: Installation of Concrete Ring

**Operation Title:** Erecting concrete ring

**Purpose:** To erect concrete ring

Equipment Tools and Materials:

- String
- Sprat level
- Pegs
- Tape
- Plum- bob
- Mattock
- Pickaxe
- Spade
- Hoe

**Instruction:** - Erecting concrete ring

**Steps:** - Erecting concrete ring

1. Manufacture of concrete ring
2. Curing water 7 day
3. To mark out the exact location of the pit.
4. To check vertical and horizontal aliment of concrete ring.
5. To fix or install in the circular pit.



**Quality Criteria:** Assured performing of all the activities according to the procedures.

**Precautions:**

- Wearing proper clothes, eye glass, glove
- Make working area hazard free.
- Read and interpret manual which guide you how to use tools and equipment.

Lap Tests

**Instructions:** Given necessary templates, tools, and materials you are required to perform the following tasks accordingly.

Task 1: Perform set out

Task 2: Excavation work

Task 3: Erecting concrete ring

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