Basic Infrastructure Operations

NTQF Level I

Learning Guide # 50

Unit of Competence: Conduct Simple Sampling and Testing

Module Title: Conducting Simple Sampling And Testing

LG Code: CON BIO1 M13 LO1-LG-50

TTLM Code: CON BIO1 TTLM 1019v1

LO 1: Prepare for sampling

Instruction Sheet	Learning Guide #50

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

- Applying work instruction quality requirements.
- Applying safety requirements
- handling construction materials
- Selecting tools and equipment
- Applying environmental protection

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Obtain and confirm Work instructions, including plans, specifications, quality requirements and operational details to the allotted task
- obtain Safety requirements from the working place safety plan and organizational policies and procedures, confirmed and applied to the allotted task
- handle Construction materials to be used according to specifications and procedures to be employed are determined
- Select Plant, tools and equipment to carry out tasks are consistent with the requirements of the job.
- Apply Environmental protection requirements identified from the organization environmental management plan,

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 Sheet 4,and Sheet 5”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -5, 8, 11, 14 and 16** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -.**
6. Do the “LAP test” **in page –** (if you are ready).

Information Sheet-1	Applying work instruction quality requirements.

1.1. definition of terms

The term work instruction is a description of the specific tasks and activities within an organization. Work instruction is a document that provides specific instructions to carry out an activity.

1.2. Purpose of work instruction

A work instruction in road construction activity will generally out line all of the different jobs needed for the operation of the firm in great detail and is a key element to running a construction activity smoothly.

1.3. Applying work instruction quality requirements.

Work Instructions are extracts from Procedures which describe in more detail how specific tasks that are mentioned in the Procedures are carried out. Typically, one job function is described.

Work instructions, including plans, specifications, quality requirements and operational details are obtained, confirmed and applied in line with workplace procedures.

Work instructions are simple work activities may be summarized as simply as possible, for example in bullet point form and more complex activities may be structured in sections.

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Work Instruction is a specific detail of how a single activity is performed. More detailed explanations of how specific tasks mentioned in the Procedures are carried out. Simple work activities may be summarized as simply as possible, for example in bullet point form and more complex activities may be structured in sections.

This template is designed to provide a standard outline and format for work instructions. It's also designed to provide standard sections that are used in all or most work instructions, and direction to provide tailoring and section-content guidance for those who generate or update work instructions.

Work instruction (WI) documents are an important link between engineering and manufacturing. They travel from design centers, where engineers create the instructions, to production floors around the world, where operators consume this information to do their jobs.

Instructions from the Client or the Engineer must be given in writing and may change the specifications or drawings. If a verbal instruction is given, you must ask for it to be put in writing so that it is recorded and so that no one can make mistakes by forgetting part of the instruction. Before starting on new work, you should ask if instructions have been received about that work. Read them carefully and discuss them with your supervisor if you are not completely clear about the meaning and implications of the instructions.

Organizations may document their activities in a different way if they wish, provided that there is an identifiable quality manual at the center of the system. Work Instruction is a specific detail of how a single activity is performed. More detailed explanations of how specific tasks mentioned in the Procedures are carried out.

1.4 Manufacturer's guidelines and specifications

A specification often refers to a set of document requirements to be satisfied by specification writers frequently meet with manufacturers of road materials, and hand held equipment.

1.5 Ethiopian standards

Ethiopian road authority is the custodian of a series of technical manuals, standard specifications and bidding documents that are written for practicing engineer in Ethiopia. Proposed amendments other documents such as the ERA manual , geometric design manual, flexible pavement manual, specifications and bidding documents that are written for the participating engineer in Ethiopia. The series describes current and recommended practice and set out the national standards road and bridges

Self-Check -1

Directions: Answer the questions listed below. Use the Answer sheet provided in the Page:

1. ----------is a specific task and activities within an organization **(3 points)**
   A. procedure
   B. specification
   C. work instruction
   D. quality requirement

2. work instruction is a key element to running a construction activity **(2 points)**

   A. True
   B. False

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Applying safety requirements

2.1 Concepts of safety

- **Safety**- safety means knowing the correct or safe thing to do and the do accordingly.

  Safe work include

- Identification of hazards applicable to work places.
- Basic risk assessment
- Safety: - is the protection of people from physical injury. The borderline between health and safety is ill-defined and the two words are normally used together to indicate concern for the physical and mental well-being of the individual at the place of work.
- **Follow safe work practices**

  - ✓ Work instruction are confirmed and applied
  - ✓ Safety requirement are obtained from
  - ✓ Site safety plan
  - ✓ Regulatory specification
  - ✓ Legal obligation

- Organizational duties are performed in accordance with enterprise procedures. Safety sign and symbols are identified and followed
  - ✓ Hazard in the work area are identified, assessed and reported to designated personnel.
  - ✓ Safe work place procedures and work instruction are followed for controlling risks. If you don't Care about safety, you will hurt not only yourself but other people also.
  - ✓ Safe and effective use of tools and equipment's objectives- after completing the learning element the trainee will be able to wear safety working clothes, shoes etc.

2.2 Safety requirements

Health and Safety safe work practices and procedures, and creating an understanding of what is required for a healthy work environment, are absolutely essential. As students begin to work with tools and equipment, safety and practice procedures must be introduced and reinforced throughout. Correct safety practices must be established as soon as students begin their studies in technology education and must be maintained throughout the curriculum. It is essential that teachers address the following questions before, during, and after an activity

- ✓ Has the instruction been sequenced progressively to ensure safety?

- ✓ Have students been given specific instruction about how to use and handle equipment and tools correctly?
- ✓ Have students been given specific instruction on how to use, handle, and dispose of hazardous materials?
- ✓ Are the tools and equipment in good repair, suitably arranged, and appropriately sized for students?
- ✓ Are students being properly supervised?
- ✓ Do the facilities provide adequate lighting and ventilation for the activity?
- ✓ Have students been made aware of hazards in the facility area?
- ✓ Have students been made aware of appropriate school-based and industrial safety standards and procedures? Trainers should select safe activities, techniques, and projects and ensure that the safety practices are implemented.

The following is not an all-inclusive list, but a guide to help establish a safe environment. Students should:

- wear appropriate attire and safety equipment
- follow established rules and routines
- select tasks that are within their abilities
- show self-respect for the safety of themselves and others
- Recognize hazards in work areas.

2.3 Regulatory requirements

These regulations specify general provisions for ensuring safety of places of work, safe means of access to and egress from places of work and that no person gains access to any place on the site where any hazardous conditions are present.

Self-Check -2

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

1. ---------- means knowing the correct of safe thing to do **(3 points)**
   A. Legal obligation
   B. Work instruction
   C. Safety
   D. Regulatory specification
2. Safety is the protection of people from physical injury? **(2 points)**

   A. True
   B. False

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	handling construction materials

3.1 Construction materials handling

Handling and storing materials involve diverse operations such as hoisting tons of steel with a crane; driving a truck loaded with concrete blocks; carrying bags or materials manually; and stacking palletized bricks or other materials such as drums, barrels, kegs, and lumber. The efficient handling and storing of materials are vital to construction industry. In addition to raw materials, these operations provide a continuous flow of parts and assemblies through the workplace and ensure that materials are available when needed. Unfortunately, the improper handling and storing of materials often result in costly injuries.

3.2 Precautions should take when moving materials manually

When moving materials manually, workers should attach handles or holders to loads. In addition, workers should always wear appropriate personal protective equipment and use proper lifting techniques. To prevent injury from oversize loads, workers should seek help in the following:

- When a load is so bulky that employees cannot properly grasp or lift it,
- When employees cannot see around or over a load, or
- When employees cannot safely handle a load.

  - ➢ Using the following personal protective equipment prevents needless injuries when manually moving materials:
  - ✓ Hand and forearm protection, such as gloves, for loads with sharp or rough edges.
  - ✓ Eye protection.
  - ✓ Steel-toed safety shoes or boots.
  - ✓ Metal, fiber, or plastic metatarsal guards to protect the instep area from impact or compression.

3.3 Precaution should workers take when moving materials mechanically

Using mechanical equipment to move and store materials increases the potential for employee injuries. Workers must be aware of both manual handling safety concerns and safe equipment operating techniques. Employees should avoid over loading equipment when moving materials mechanically by letting the weight, size, and shape of the material being moved dictate the type of equipment used. All materials handling equipment has rated capacities that determine the maximum weight the equipment can safely handle and the conditions under which it can handle that weight. Employers must ensure that the equipment-rated capacity is displayed on each piece of equipment and is not exceeded except for load testing.

Although workers may be knowledgeable about powered equipment, they should take precautions when stacking and storing material. When picking up items with a powered industrial truck, workers must do the following:

- Center the load on the forks as close to the mast as possible to minimize the potential for the truck tipping or the load falling,
- Avoid overloading a lift truck because it impairs control and causes tipping over,
- Do not place extra weight on the rear of a counter balanced forklift to allow an overload,
- Adjust the load to the lowest position when traveling,
- Follow the truck manufacturer's operational requirements, and
- Pile and cross-tier all stacked loads correctly when possible

3.4 Precautions must workers take to avoid storage hazards

Stored materials must not create a hazard for employees .Employers should make workers aware of such factors as the materials' height and weight, how accessible the stored materials are to the user, and the condition of the containers where the materials are being stored when stacking and piling materials. To prevent creating hazards when storing materials, employers must do the following.

- Keep storage areas free from accumulated materials that cause tripping, fires, or explosions, or that may contribute to the harboring of rats and other pests;
- Place stored materials inside buildings that are under construction and at least 6 feet from hoist ways, or inside floor openings and at least 10 feet away from exterior walls;
- Separate non compatible material; and
- Equip employees who work on stored grain in silos, hoppers, or tanks, with lifelines and safety belts.

In addition, workers should consider placing bound material on racks, and secure it by stacking, blocking, or interlocking to prevent it from sliding, falling, or collapsing

Self-Check -3

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

1. Keeping tools properly storing, cleaning, and maintaining is **not** saves time and money **(3 points)**

   A True B False

2. ----------involve diverse operations such as hosting of steel, carrying bag, stocking materials? **(2 points)**

   A. handling
   B. storing
   C. A &b are answer
   D. Work procedure

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

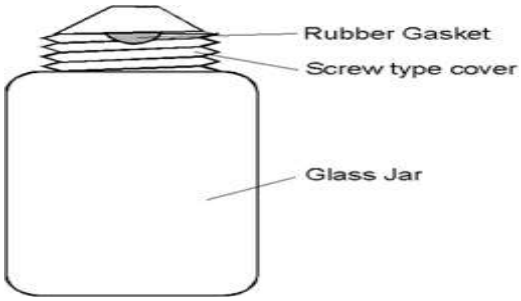
Information Sheet-4	Selecting tools and equipment

4.1. Selection of Plant, tools and equipment

Construction material testing tools and equipment's special which are recommended to be provided for the road project laboratory are listed in the below tables. Thought these are not the only tools and equipment's used in road construction laboratory work.

Table 1.tools and equipment

	Type	Use
Sieve shaker		Sieve shaker is helps for grain size analysis. Grain size analysis is carried out to determine the relative percentages of different sizes of particles in the sample. These sizes control the mechanical behavior of coarse grained soil.
digital balance		.This equipment helps to weigh the sample of different tests
Oven dry		This equipment helps to dry the sample of different tests depends on the required temperature

Pycnometer with its cap	  	Helps to get specific gravity of solid particles
Slump cone		Used to test workability of concrete
Atteberg limit or casagrandels apparatus		It helps to determine the consistency of soil particles, like Liquid limit and plastic limit.

Self-Check -4

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

1. Which one of the following equipment helps to grain size analysis**(2 points)**

   A. Procter test
   B. Metal try
   C. Oven dry
   D. Sieve shaker

2. Which one of the following equipment helps to dry the sample **(2 points)**

   A. Casagrnades apparatus
   B. Metal try
   C. Oven dry
   D. Sieve shaker

3. Which one of the following equipment helps to determine liquid limit and plastic limit **(2 points)**

   A. Procter test
   B. Metal try
   C. Casagrnades apparatus
   D. Sieve shaker

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-5	Applying environmental protection

5.1 concept of environmental protection

Environmental protection is the practice of protecting the natural environment by individuals, organization and governments.

5.2 Techniques for environmental protection

- **replacement of soils and vegetation**

Re vegetation is the process of replanting and rebuilding the soil of disturbed land. This may be a natural process produced by plant colonization and succession, manmade re wilding projects, accelerated process designed to repair damage to a landscape due to wildfire, mining, flood, or other cause. Originally the process was simply one of applying seed and fertilizer to disturbed lands, usually grasses or clover. The fibrous root network of grasses is useful for short-term erosion control, particularly on sloping ground. Establishing long-term plant communities requires forethought as to appropriate species for the climate, size of stock required, and impact of replanted vegetation on local fauna.[1] The motivations behind re vegetation are diverse, answering needs that are both technical and aesthetic, but it is usually erosion prevention that is the primary reason. Re vegetation helps prevent soil erosion, enhances the ability of the soil to absorb more water in significant rain events, and in conjunction reduces turbidity dramatically in adjoining bodies of water. Re vegetation also aids protection of engineered grades and other earthworks.

5.3 disposals of hazardous waste materials

Surplus materials should be disposed properly no to pollute the environment. Soil samples should always be handled with care.

- All excess material should not be wasted, but used or safely removed from site according to appropriate legislation.
  - ✓ Identify the waste types that are likely to be produced and aim to reduce the amount of waste as much as possible, through identifying routes to reuse or recycle materials.
  - ✓ Control access to storage areas to minimize risk of theft or damage.
  - ✓ Set up a dedicated store for timber, from which workers can re-use supplies
  - ✓ .Store any materials away from sensitive locations in fenced off areas.
  - ✓ Label all waste storage and skips, detailing the type of waste.

5.4 recycling of non-hazardous wastes

- Consider using recycled materials and recycle any materials used on site rather than disposing of them

Self-Check -5

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

1. Re vegetation is prevent soil erosion **(3 points)**
   A True B False
2. Environmental protection is the practice protecting the natural environment by ----------**(2 points)**

   A. individuals
   B. government
   C. organization
   E. All

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Reference

- ✓ ETHIOPIAN TVET system handout on test road construction materials
- ✓ National Rural Road Development Agency, Equipment and Test Procedures, India Volume I, (May 2007).
- ✓ Global source.com

Basic Infrastructure Operations

NTQF Level I

Learning Guide # 51

Unit of Competence: Conduct Simple Sampling and Testing

Module Title: Conducting Simple Sampling and Testing

LG Code: CON BIO1 M13 LO2-LG-51

TTLM Code: CON BIO1 TTLM 1019v1

LO 2: Take sample

Instruction Sheet	Learning Guide #51

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

- Preparing container and sampling tools
- Taking sample
- Handling sample
- OHS procedures for controlling hazard and risk
- Reporting sample

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Obtain suitable clean containers and sampling tools
- Take sample in accordance with job instructions/standards
- Handle, label and store sample
- Obtain OHS procedures
- Accomplished necessary reports and documentation

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 Sheet 4and Sheet 5”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -29, 41, 44,46 and 49** respectively.
5. f you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, ” **in page -42.**
6. Do the “LAP test” **in page – 50**(if you are ready).

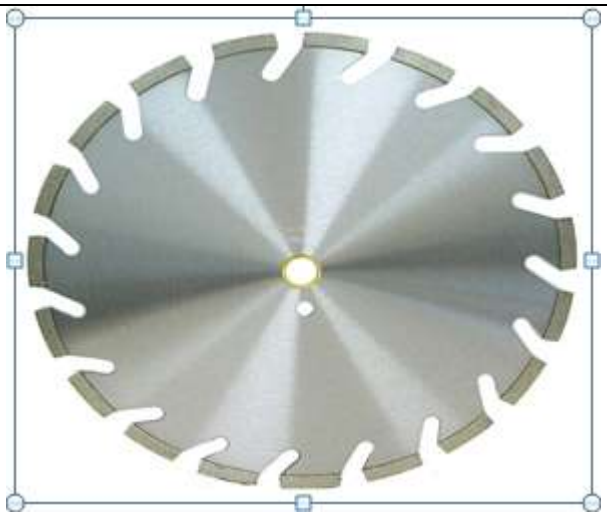
Information Sheet-1	Preparing container and sampling tools

1.1 Sampling tools and equipment

Type		Use
Shovel		Shovel is used to stir the mortar paste,soils prepared in the barrel or drums and keeps the mix to right and uniform consistency.
Pickaxe		The digging out purposes like excavation work and for agricultural.
Wheel borrow		Wheelbarrow is used to dispose disposal materials from working place, to transport or serve materials and tools during construction

		activities in the site.
Auger		An *auger* is a drilling device, or drill bit, used for making holes in or in the ground. ... *Augers*
Excavators		Excavators are heavy construction equipment consisting of a boom, dipper, bucket and cab on a rotating platform known as the “house” the house sits atop an undercarriage with tracks or wheels.

Backhoes		Backhoe also called rear & back actor. Is a type of excavating equipment, or digger, consisting of a digging bucket on the end of a two part articulated arm.
Loaders		Usually wheeled vehicles with a hydraulically operated scoop in front for excavating and loading loose material - Called also front end Loader.
Metal screen		to be separated into a range of sizes

Wooden screen		to be separated into a range of sizes
Diamond saw		For cutting concrete, asphalt, and granite with attachment of pavement cutter
Sledge hammer		For breaking up large size particles
Crusher .		Used to reducing particle sizes of rocks and ores

Ultrasonic cleaner		Is use of sound waves to remove decontamination from surface
Hydraulic rock splitter		Used in demolition job which involve breaking large blocks of concrete or rocks
electrostatic separator .		is a device for separating particles by mass in a low energy

isodynamic magnetic separator		Used to separate materials have magnetic property. can be easily separate from other minerals with a magnet since they will stick to the pole of the magnet .
Hand magnet		to separate materials have magnetic property
mechanical gravity separator		Separating two components, either suspension ,or dry granular mixture where separating components with gravity.

sterile containers .		Designed for collecting biological specimens
Pipettes		These small tubes transfer liquids from one container to another in exact and measurable amount.
disposable spoons		used in material samples preparation to measure ,mix, stir and toss ingredients
Stainless Steel Bailers		are suitable for sampling virtually any potential contaminants while maintaining sample integrity. Threaded bottom check valve allows for easy disassembly and cleaning.

weighted sample bottles		used for precise weighing of solids
• **plastic/metal containers and disposable buckets**		used to dispose contaminated liquids
• **sample thief**		To take very small volume **samples** of free flowing powders and granules. The Micro Thief is easily adjusted so that the operator can vary the size of the **sample** being taken

• **sampling tubes**		the tool intended for general chemical work

Self-Check -1

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

1. _____ is used for digging out purpose .(2 points)

A. Pick axe C. wheel barrow

B. shovel D. loader

2. ----------is used to dispose disposal material from working place to transport.(2 points)

A. Pick axe C. Wheel barrow

B. shovel D. loader

3. ----------is used for making holes in the ground

A. Auger C. Wheel barrow

B. shovel D. loader

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Taking sample

2.1 purpose of sampling

- Samples is more Sampling serves many purposes when investigating foundations and evaluating construction materials.
- Samples are required to accurately identify and classify soil or rock.
- Samples are essential for obtaining:-
  - in-place density and moisture content,
  - for performing laboratory tests on earth and rock materials,
  - for testing potential concrete sand and aggregate deposits,
  - for designing concrete mixes, and
  - for testing potential riprap sources.
- Data obtained from laboratory testing of samples are used to finalize:-
  - ✓ the design of foundations and embankments and
  - ✓ To select construction materials for use in earth and concrete dams and in other structures.
- The importance of obtaining representative samples cannot be overemphasized. Samples that are not truly representative of in-place subsurface conditions can result in erroneous conclusions that affect the design of the structure.
- Sample recovery requires considerable care to avoid altering in-place conditions of natural deposits.
- Obtaining representative samples from accessible
  - ✓ trenches,
  - ✓ test pits, or
  - ✓ Tunnels are relatively easy because in-place material can be visually inspected to determine the best method of sampling by hand.
- However, in boreholes, visually inspecting in-place material is not possible; consequently, the recovery of representative difficult.

2.2 Classification of sample

- disturbed or
- Undisturbed

- ✓ **Disturbed samples** do not reflect the in-place condition of the soil or rock. Obtaining
- ✓ **Undisturbed samples** requires significant experience and meticulous care to maintain in-place material conditions. Even using the most careful procedures, undisturbed soil or rock samples are changed from their in-place condition because removing them from parent material changes stresses which confine the sample.

2.3 Sampling methods

- Hand sampling
- Mechanical sampling

  Both **hand** and **mechanical** sampling methods commonly used to recover disturbed and undisturbed.

Fig2.1.1 Auger sampling.

2.4 Types of samples

- **soils**
  Soils are commonly classified on the basis of how they have been created and based on which minerals they contain. For the purpose of civil works it is more important to establish their composition and the engineering properties of each of the ingredients. In this respect, soils are classified according to the size and shape of the individual particles, which make up the soil. For road building purposes it is the four fundamental groups consisting of clay, silt, sand and gravel that are commonly referred to.
- **rocks**
  Rocks from which building stones are obtained are classified on the basis of:
  A. Their geological nature
    - **Igneous rocks** are the product of heat and pressure, such as that caused by volcanic activity and pressure exerted by the shifting of the earth's surface.
    - **Sedimentary rocks** are formed as a result of sedimentation either from the Disintegration produced derived from decayed rocks or from accumulations of Organic origin. e.g.:-Sand stone, Limestone

- **Metamorphic rocks** are formed by the gradual change in the character and Structure of igneous and sedimentary rocks. e.g.:- Marble
-

B. Their chemical composition

Chemically, rocks are classified on the basis of their major constituent mineral

- Argillaceous rocks are composed of primarily of alumina (Al_2O_3)
- Calcareous rocks are those where the constituents lime (CaC_3)
- Siliceous rocks are composed primarily of silica (SiO_2)

- **minerals**
  Is usually reserved for mineral species crystalline compounds with a fairly well defined chemical composition and specific crystal structure .
  Example opal, quartz
- **fossils**
  Is any preserved remains, impression, or trace of any once living thing from a past geological age. examples include bones, shells, stone, imprints of animals, oil, coal
- **hydrocarbons**
  Any of a class of organic chemical compounds composed only of the element carbon(c) and hydrogen (H) the carbons atoms joined together to form the frame work of the compound and the hydrogen atoms attach to them in many different Configurations. Hydrocarbons are the principal constituents of petroleum and natural gas .they serve as fuel and lubricants as well as raw materials for the production of plastic, fibers rubbers, solvent explosives and industrial chemicals.
- **drill core**
  Core sample is a cylindrical section of (usually) a naturally occurring substance. Most core samples are obtained by drilling with special drills in to the substance.
  Example sediment of rock
- **stream sediment**
  the collection and analysis of the silt ,sand, mud, clay, in a stream or river bed
- gas or air samples
  Atmospheric or airborne contaminant
- water, wastewater, storm water, sewage, sludge
- construction materials
- solid wastes
- raw materials
- final products
- hazardous materials and/or dangerous goods

This method describes the taking of samples from a test pit with vertical sides, at least one meter square and which has been excavated in a natural deposit of gravel, soil or sand by means of a pickaxe and shovel or any mechanical excavator or large auger The samples may be needed for the center line survey of the natural information or for any of the following proposed uses:

- ✓ **Gravel:** for subgrade, selected layer, sub base, base course, asphalt and coarse aggregate for concrete.

- ✓ **Soil:** for subgrade, selected layer, sub base and binder.
- ✓ **Sand:** for subgrade, selected layer, as a stabilizing agent for clayey materials and as fine aggregate for concrete and bituminous mixes.

2.5 The minimum amounts of samples required for testing in laboratory

Sampling it requires skill and care. The sample should be packed and tied and the following information shall be included: -

- ✓ Client /contractor's name/
- ✓ Project name
- ✓ project location/ sample location
- ✓ Date of sampling

- **Sampling of soil /aggregate mixture/**
  - ✓ Shall be representative i.e. coarse and fire shall be proportional.
  - ✓ The amount of sample depend up on size of the soil /aggregate./
  - ✓ If the sample is soil, it should be sealed properly in order not to lose moisture.

Nominal max size (mm)	**50 mm**	**25 mm**	**20 mm**	**10 mm**	**2 mm**
Sample weight (kg)	100 kg	75 kg	50 kg	25 kg	10 kg

- **<u>Sampling of fine /coarse aggregates/</u>**
  - ✓ It requires skill and care
  - ✓ For sampling use scoop or shovel.
  - ✓ Sampling from heaps of aggregates should be removed
  - ✓ Take the top 15 cm surface, or penetrate the scoop 15m.

Nominal size of Aggregates	Type of test	Approximate minimum mass (kg)
> 25mm 4.75-25mm < 4.75mm	Sieve analysis, abrasion, unit weight, specific gravity ACV,10% fines, soundness	50Kg 25 Kg 10 Kg
a. Sand b. Gravel	Mix design for one batch	100 Kg 150 Kg

- **<u>Samples required for visual classification of soil and rock</u>** minimum amounts of sample.

Max. particle size (mm)	**4.75mm**	**9.5mm**	**38.10mm**	**38mm**	**75mm**
Minimum amount	100gm	200gm	100gm	800gm	60kg

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of sample					

2.6 Sampling Frequency

Common investigations should cover basic data collection, such as depth and nature of soils (sub-grade and embankment materials), and should be limited to test pits and hand augers. The common investigations can be for new roads and/or existing roads. Once the alignment of a new road is finalized, investigations for soil sampling along the alignment can be initiated. The frequency of sampling depends on the field conditions. As a standard guideline, at least one representative soil sample should be collected per kilometer of the proposed roadway alignment, with more frequent samples where there are significant changes in soil type. Significant changes are those which affect the general classification of the soils as well as their bearing strength (CBR). The sampling location may be alternatively on the left and right edge of the proposed roadway. This frequency may be altered depending on the variations in soil types along the alignment. Spacing in specific locales may (and should) be increased where indications are that the sub-grade exhibits a fair degree of homogeneity, and conversely be decreased where variations become evident or are suspected, or when problem soils (e.g. expansive soils) or design problems are encountered.

Table 1-Sampling Frequency

Investigation Stage	Test Description	Frequency of Cumulative Sampling
Feasibility/Preliminary	Identification CBR	1 Km 2 -5Km
Final	Identification CBR	0.5 Km 1 Km

Notes:-

1. The frequency of sampling is cumulative, i.e. the frequency indicated in the final stage is a cumulative total of both the preliminary stage and final stage sampling.

2. The sampling should insure at least two tests per each soil group along the alignment.

2.7 Sample preparation methods

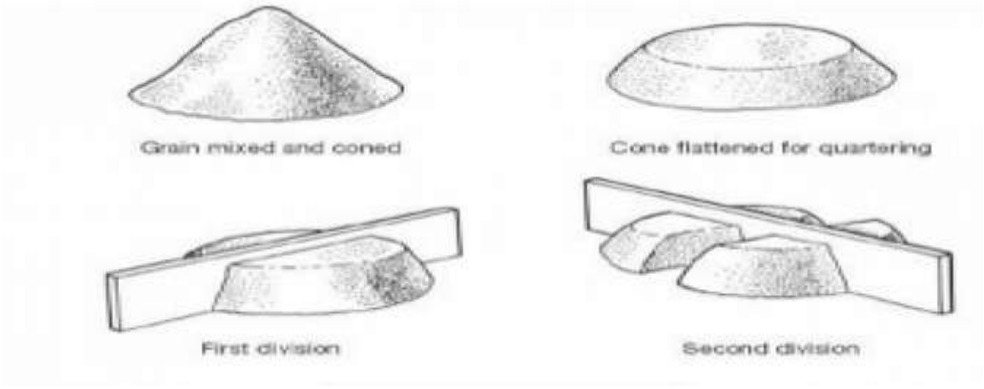
Sampling is the first and arguably the most important step in the analytical process. Obtaining representative and reliable samples of any bulk materials for analysis is of the at most importance.

General principles of good sampling, practice is based on an intensive literature survey conveying a wide range of materials, offers on guidance on particle size reduction of solids, and look at requirements for suitable containers and storage prior to analysis

Sample preparation method and laboratory sampling

2.7.1 Coning and quartering

The method which is used for sampling large quantities of material say 20kg.consist of pouring or forming the material in to a conical heap on a solid surface (e,g steel plate) and relaying on radial symmetry to give four quarters when the heap is divided by a cross two opposite corners are taken as the sample the other two set a side. the portion chosen may be further reduced by a repetition of the process ,until the required size of sample is obtained



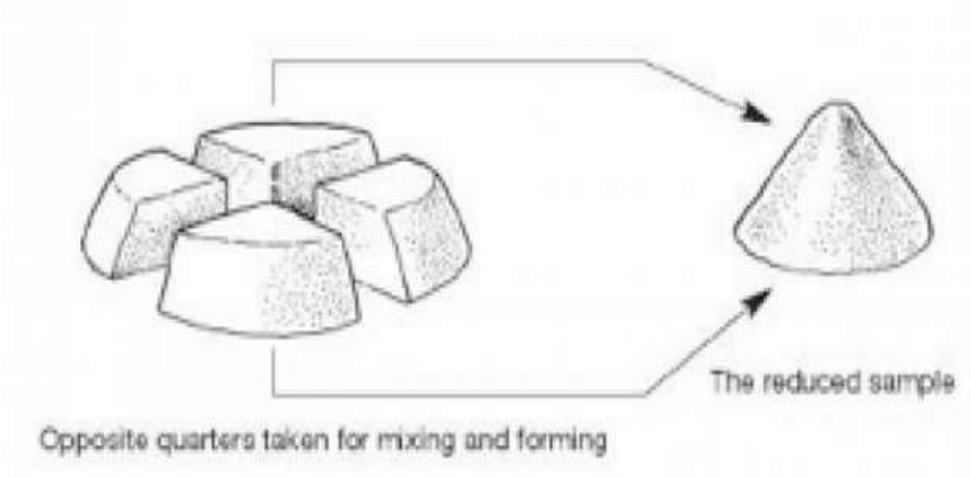


Fig 2.1.2 quartering of sample

2.7.2 Riffle splitter in a sample preparation

This sample splitter is an open v shaped container under which a serious of chutes are at right angle to the long a axis, giving a serious of rectangular slots of equal area. these alternatively feed to collection trays. The sample whose particular size allows free movement through the slots (the largest particles being one third the riffle opening) is poured in to the feeder and becomes split in to equal portion. After repeated cycles the desired sample size is obtained.

Fig2.1.3 sample splitter

2.7.3 Grab sampler/mechanical digger

Large loads of materials, up to several thousand tons ,are easier to sample at set intervals during loading or unloading ,using a grab sampler attached to a crane. the grab sampler can be set to remove samples at specific intervals. if large increments need to be taken then a mechanical digger is more appropriate.

2.7.4 Sub sampling solids

The process of sub sampling procedures relatively small representative material from a large bulk of materials.at one or more stages, the sample has to be further reduce in weight or sub sampled. For representative sub sampling, it may be necessary to reduce the particle size of materials. the procedure and implements used for sub sampling and to reduce the particle size will depend on various factors such as the nature ,the quantity, the particle size of the materials, and the required particle size after milling.

2.7.5 Method of rotating sample dividing

The main requirement is that the gross sample should be dry and free falling. Several different types and size of rotary samples are commercially available. This sampling device is suitable for all types of samples including segregates and fine materials .the materials feed to the rotating distributer a cross a vibratory feed assembly. The sample material can be subdivided in to two or more portions the speed of the divider is low at 60-120 r.p.m and permits a continuous dividing process producing representative portion.

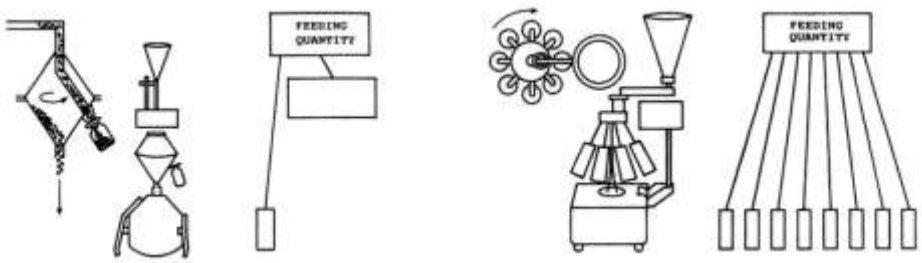


Fig2.1.4 rotating sample dividing

2.7.6 Sieve or screens

A wide range of shaker available for use hand sieve, sieved particles is collected in a bin or plastic sheet. The motor driver shaker imparts a circular and tapping motion on the sample.

With all sieves and screens some loss of materials occur which collect in sharp comers and crevices. The loss is unlikely to affect the sample being examined, but it may contaminate a subsequent sample. Sieves should be thoroughly cleaned by brushing, by ultrasonic cleaning, or with a blast of air

2.7.7 Cone crusher

Crushing or size reduction may be achieved by applying a constant pressure impact or grinding.

Cone crusher has a vertical cone revolving inside a conical crushing chamber wall.

These crushers have are rarely used in sampling application in a large scale because of their high cost. The loss of moisture as a result of crushing is generally low but, excessive heat may be evolved with difficult material crushing moisture losses and possible decomposition.

2.8 SAMPLING OF AGGREGATES (NATURAL, ARTIFICIAL)

These methods are intended to apply to the sampling of aggregates used in acceptance and quality control for Minimum Materials Sampling and Inspection for the following items:-

- ✓ Structure Backfill, Filter Material, Bed Course Material
- ✓ Aggregate Base Course
- ✓ Aggregate for Portland Cement, Treated Base
- ✓ Aggregates for Hot Mix Asphalt
- ✓ Cover Coat Material
- ✓ Aggregate for Portland Cement, Concrete Pavement
- ✓ Aggregate for Structural Concrete
- ✓ Aggregate for Concrete Sidewalk, Bituminous Sidewalk, Concrete, Bikeways and Bituminous Bikeways
- ✓ Aggregate for Concrete Curbing and Bituminous Curbing
- ✓ Aggregate for Median Cover Material

- **General**

  Where practicable, a minimum of one sample per stockpile to be tested for quality shall be obtained from the finished product. Samples from the finished product to be tested for abrasion loss shall not be subject to further crushing or manual reduction in particle size in preparation for the abrasion test, unless the size of the finished product is such that it requires further reduction for testing purposes.

- ***Sampling Equipment***

  Provide suitable equipment needed for proper sampling.

- ***Sampling from a Flowing Aggregate***

Stream - Samples shall be selected from all of the material produced using CP 75. Use extreme care to avoid segregation when sampling. Sampling the initial discharge or the final few tons from a bin or conveyor belt increases the chances of obtaining segregated material and should be avoided.

2.8.1 Belt Discharge using Hand Tools -

If it is safe and practical to sample directly from the belt discharge, hand tools may be used. Obtain one or more approximately equal increments, selected at random. Combine to form a field sample whose mass equals or exceeds the minimum recommended amount.

2.8.2 Belt Discharge using an Automatic

Belt discharge samples may be taken using an automatic belt sampler designed to cut the full discharge of the belt without loss of any portion of the material. Take one or more field samples whose combined mass equals or exceeds the minimum recommended in Section

2.8.3 Belt Discharge using Power

A belt discharge sample may be taken by positioning a front-end loader bucket, truck, or similar equipment beneath the belt discharge. The material obtained shall be placed in a separate, small sampling pile and sampled according standard procedures. Obtain a field sample whose mass equals or exceeds the minimum recommended amount.

Bin Discharge - Test results obtained using bin discharge samples shall not be used for acceptance.

Dry Batch - When sampling a dry batch, an initial dry batch must be wasted. A second batch may then be sampled as follows. A front end loader bucket, truck, or similar equipment is positioned under the pug mill to obtain a large sample in one increment. Sample the material according to Section 4.3.3.2. Extreme care must be used to avoid segregation and loss of dust sized particles from the sample.

2.8.4 Sampling from the Stopped Conveyor Belt

Samples shall be selected from all of the material being produced and obtain one or more approximately equal increments and combine to form a field sample whose mass equals or exceeds the minimum recommended amount.

2.8.5 Sampling from Stockpiles

When sampling from stockpiles, it may be difficult to obtain representative samples. Sampling from stockpiles should only be done by or under the direction of experienced personnel. When sampling stockpiles of coarse or coarse and fine aggregates, power equipment, when available, should be utilized.

When using power equipment, develop separate, small sampling pile composed of materials drawn from various levels and locations in the main pile as follows. Remove material from the sides of stockpiles to expose a representative face for sampling.

Judgment must be used to determine the number and locations of areas in the big pile to sample in order to represent the stockpile as accurately as possible. The number of portions required will depend on the size of the stockpile, the method of stockpiling and the visual degree of segregation. Channel the faces thus exposed from bottom to top and sample the material obtained The power equipment should combine the material obtained in a separate small sampling pile.

2.8.6 Sampling from Roadway (Bases and Sub bases)

Select material to be sampled from all of the material produced (e.g. A station or tonnage). Obtain at least three approximately equal increments, selected at random from the unit being sampled, and combine to form a field sample whose mass equals or exceeds the minimum recommended amount. Using a flat, square end scoop or shovel, take all sample increments from the roadway for the full depth of the material, wherever possible, taking care to exclude any underlying material.

2.8.7 Sampling Aggregates from Processed

Select material to be sampled from all of the material produced. For processed material containing sufficient moisture to maintain a near vertical face, remove material from one side toward the center to the full depth until a representative face is exposed. Channel the face just exposed from bottom to top and obtain a sample whose mass equals or exceeds the minimum recommended amount by combining portions from at least three equally spaced locations on the exposed face. Use a flat, square end shovel and, exercising care, remove the portions making sure that particles do not roll off the shovel.

2.8.8 Sampling Aggregates from a Cover Coat

Material Spreader - Select material to be sampled from all of the material produced. Using a flat scoop or flat square ended shovel cut three or more approximately level bottomed trenches at least 1 ft. (0.3 m) in width and 1 ft. (0.3m) in depth below the surface at points that will, from visual appearance, give a reasonable estimate of the characteristics of the load. Obtain a minimum of one portion from each of the three trenches by pushing the scoop or shovel downward into the material in the hopper of the spreader. Combine the portions obtained into one sample whose mass equals or exceeds the minimum recommended amount. Exercise care to avoid segregation of the material when selecting the three portions. Sample the aggregate at the last possible location. If there is a belt transfer device on the spreader, the sample may be taken by removing a representative sample from the belt when the machine is at rest .The aggregate maybe taken from the stockpile alongside the road.

- ***Numbers and Mass of Field Samples***

The minimum number of field samples required is specified in the Field Materials Manual under the Schedule for Minimum Materials Sampling, Testing, and Inspection. The sample must be large enough to include representative portions of each component of the material. The mass must be predicated on the type and number of tests to which the material is to be subjected and with sufficient material obtained to provide for the proper execution of these tests.

2.9 SHIPPING SAMPLES

Transport aggregates in bags or other containers so constructed as to preclude loss or contamination of any part of the sample, or damage to the contents from mishandling during shipment. Do not ship more than 60 lbs. (30 kg) per bag to allow for easier handling of samples. When moisture content is being measured in the aggregate sample, the

Self-Check -2

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

1. Purpose of sampling is? (2 points)

   A. Obtaining in place density

   B. for performing laboratory work

   C. For designing concrete mix

   D. all

2. Obtaining representative sample is from----------. 2 points)

   A. trenches

   B. test pits

   C. tunnels

   D. all

3. Which method is used in sample preparation? (2 points)

   A. coning

   B. quartering

   C. riffle splitter

   D. all

Note: **Satisfactory rating - 4 and 6 points** **Unsatisfactory - below 4 and 6points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet 1	Taking sample

1.1 Procedure of coning and quartering an approximate 50 kg sample

Step 1- starting sample weight (approximately 50 kg)

Step 2- set up adjacent work area

Step 3- clean steel plate

Step 4- spread out sample and mix thoroughly in to conical heap

Step 5- quarter

Step 6- repeat quartering

Step 7- bag sample –replace container to storage with excess sample

1.2 Procedure of the riffle

Step 1- set up sample and riffle, ensuring that the riffle initially clean

Step 2- rifle once

Step 3- repeat refilling, discarding every alternate sample

Step 4- bag sample and label

Step 5- clean rifle

Information Sheet-3	Handling sample

3.1 Sampling handling and labeling

Soil samples should always be handled with care. They should be stored in a suitable environment, and their receipt, movement and use in the laboratory should be recorded.

Every sample or portion of sample, taken for inspection or test should be fully identified with its reference number.

Specimens for test must be properly representative, and prepared in accordance with correct procedures.

Disturbance, imperfections, loss of material or any other features should he recorded at t the time of observation.

Untested samples or portions should be properly resealed and returned to the stores. Tested material should be labeled as such and segregated from unused samples. Surplus materials should be disposed properly no to pollute the environment.

Sampling tool is the tool helps in the collection of sample from the site. This should be performed carefully and labeled properly. Labeling is the process of recording sample name, time, date and place of sample is collected. This is very essential and never be missed throughout sample collection. Otherwise it's difficult to get the right test result.

Testing sample should be properly handled to protect its natural properties when taken to the laboratory for the testing. Also the tools which help to collect the sample should be free from moisture and other chemicals which change the property the sample. Also it should be stored in a safe area where not exposed to the atmosphere to keep the sample moisture.

Self-Check -3

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

1. Soil sample should be always be handled with care(3 points)
   A. True
   B. False
2. Sampling tools is the tools is the tool helps in the collection of sample from the site.(2 points)
   A. True
   B. False

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 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	OHS procedures for controlling hazard and risk

4.1 OHS procedures

Construction is a potanshalilly hazards occupation envollevining deferent phase and parties Successful businesses increasingly encourage active participation of the workforce in the management of health and safety. Make sure that health and safety is not viewed as a separate function, but as an integral part of productivity, competitiveness and profitability and that our health and safety risks are recognized as part of our business risks. Sample tools and equipment.

Self-Check -4

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

a. _____ are assets in a community that help meet certain needs for those around them.(3 points)

A.

B.

C.

b. List out the purposes of mobilizing local resources at least five points.(5 points)

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 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-5	Reporting sample

5.1 Recording and Reporting of Data

Documentation.-

- Site data are documented on drawings (and associated notes) generated during the study.
- The drawings fall into two general categories-
  - ✓ working drawings and
  - ✓ Final drawings.
- Working drawings serve as tools to evaluate and analyze data as they are collected and to define areas where additional data are needed. Analysis of data in a three-dimensional format is the only way the geologist can arrive at an understanding of the site geology, and it is critical these drawings be generated early in the study and continuously updated as the work progresses. These drawings are used for preliminary data transmittals. Scales used for working drawings may permit more detailed descriptions and collection of data that are not as significant to the final drawings.
- Final drawings are generated late in the mapping program after the basic geology is well understood. Although working drawings may be finalized, many times, new maps and cross sections are generated to illustrate specific data that were not available or well understood when the working drawings were made. These drawings serve as a record of the investigations for special studies, specifications, or technical record reports. Site mapping documentation is developed in phases: preliminary surface geologic mapping and detailed surface geologic mapping.
- Good notes and records of outcrop locations and data are important to minimize re-examination of previously mapped areas.
- Photography is a highly useful tool at this stage in the investigation, as photos can be studied in the office for additional data. Only after reasonably accurate surface geology maps have been compiled can other investigative techniques such as trenching and core drilling be used to full advantage.

5.2 Laboratory Report writing procedures

1. Title
2. Objective
3. Theory
4. Apparatus
5. Procedure
6. Sample calculation
7. Conclusion
8. Engineering significance

Self-Check -5

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

1. Laboratory report writhing procedure must be include (3 points)

A. title

B. objective

C. procedure

D. all

2. Working drawing serve as tools to evaluate and analyze data .(2 points)

A. true

B. false

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 30min-1 hours.

Task 1: take sample

1. Reference

- ✓ Department of the Army U.S. Army Corps of Engineers, Engineering Design – Soil Sampling, Washington, D.C., 30 September 1996.
- ✓ National Rural Road Development Agency, Equipment and Test Procedures, India Volume I, (May 2007).
- ✓ Department for International Development, Guidelines on the Selection and Use of Construction Material, Jr Cook and Cs Gourley.
- ✓ www.911metallurgist.com/blog/labratory methods -method-of sample preparation
- ✓ AACRA Manual
- ✓ Labor Based Road Works (Zambia Hand Book)
- ✓ ERA Manual
- ✓ Global source.com

Basic Infrastructure Operations

NTQF Level I

Learning Guide # 52

Unit of Competence: Conduct Simple Sampling and Testing

Module Title: Conducting Simple Sampling and Testing

LG Code: CON BIO1 M14 LO3-LG-52

TTLM Code: CON BIO1 TTLM 0919v1

LO 3: Conduct material testing

Instruction Sheet	Learning Guide #52

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

- Hazards of testing and safe operating techniques
- Basic concepts of field and laboratory test
- Apply testing methods and procedures
- Report and documentation methods and procedures

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Identify hazards associated with testing operations
- Identify operating techniques in the use of testing equipment's
- Carrying out operations of field and laboratory tests

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information "Sheet 1, Sheet 2, Sheet 3 and Sheet 4".
4. Accomplish the "Self-check 1, Self-check t 2, Self-check 3 and Self-check 4" **in page - 59, 67, 76 and 87** respectively.
5. If you earned a satisfactory evaluation from the "Self-check" proceed to "Operation Sheet 1, " **in page -77.**
6. Do the "LAP test" **in page – 88** (if you are ready).

Information Sheet-1	Hazards of testing and safe operating techniques

1.1 Hazardous materials

A hazardous material can be a liquid, solid, or gas and may exhibit one or more potentially dangerous physical or chemical properties. The following types of hazardous materials are:

- ✓ **Corrosive Liquids/Solids:** Materials that cause visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.
- ✓ **Oxidizers:** A material, which is not necessarily combustible, but can readily undergo an oxidation or reduction reaction that may contribute to the combustion of other materials
- ✓ **Flammable/Combustible Solids:** A material that may ignite or explode under normal conditions. Examples include sulfur, activated carbon, phosphorus, magnesium, and oily rags.
- ✓ **Compressed Gas:** Liquefied, non-liquefied, and dissolved gases or mixtures of gases stored under high pressures. Hazardous gases include flammable, nonflammable, oxidizing, reactive, as well as poisonous gases. Examples of compressed gases include helium, argon, hydrogen, acetylene, propane, nitrogen, nitrous oxide, and anhydrous ammonia.
- ✓ **Radioactive:** Materials that emit ionizing radiation. Refer to the Radiation Protection Program for additional information on radioisotopes and the handling, storage, and disposal of these materials.
- ✓ **Explosives:** Materials that contain stored energy that can produce an explosion and must be handled with extreme caution. Explosives should never be shaken or dropped and should be kept away from open flames. Examples include acetylene, tri nitrobenzene, asides, and perchlorates of heavy metals.
- ✓ **Toxic Materials:** This category includes chemicals with inhalation hazards, poisons, and infectious substances. Swallowing, bodily contact, or inhalation of gases released by toxic substances may cause irritation of skin and mucous membranes, or in more severe cases, serious illness. Some examples include lead, mercury, acetone, and formaldehyde.

- ✓ **Organic Liquids/Solids:** Animal, plant-produced, or synthetic substances containing mainly carbon, hydrogen, nitrogen, and oxygen which may be solid or aqueous. Examples of organic liquids include benzene, toluene, and xylene compounds such as paint thinners.
- ✓ **Inorganic Liquids/Solids:** Materials of mineral origin and which typically do not have a carbon structure. Examples include hydrogen peroxide, sodium sulfide, and silver nitrate

1.2 Characteristics of Hazardous Materials

Hazardous materials may exhibit one or more of the following characteristics:

- ✓ I**gnitability**: A material's ability to ignite.
- ✓ **Corrosively:** The ability for a material to destroy metal.
- ✓ **Reactivity**: The ability of a chemical to create explosions and/or toxic fumes, gases, and vapors when mixed with water or other materials.
- ✓ **Toxicity**: The measure of the adverse effect exerted on the human body by a poisonous material.
- ✓ **Ecotoxicity:** The potential to cause biological, chemical, or physical stressors when released to an ecosystem.
- ✓ **Volatility**: The measure of a material's ability to vaporize.
- ✓ **Radioactivity**: The measure of particle emission due to nuclear instability.
- ✓ **Chemical Instability**: The inability of a substance to be handled and stored without undergoing unwanted chemical changes.
- ✓ **Shock-Sensitive**: Materials that may explode when subjected to shock or friction.
- ✓ **Incompatibles**: Materials that react dangerously when mixed with certain other materials. A table of chemical compatibility is included in Appendix
- ✓ **Water Reactive:** The ability for a chemical to react with water to produce a flammable or toxic gas or other hazardous conditions. Examples of water reactive chemicals include alkali metals such as lithium, sodium, and potassium, acid anhydrides, and acid chlorides.
- ✓ **Light-Sensitive**: The ability for a material to degrade in the presence of light, often forming new compounds which may be hazardous, or resulting in conditions such as pressure build-up inside a container which may be hazardous.
- ✓ **Pyrophoric:** Materials that may ignite spontaneously upon contact with air. Examples of pyrophoric materials are silicon tetrachloride, and white (also called yellow) phosphorus.

1.3 Hazards of testing

1.3.1 Powders and Dusts

Suspensions of oxidizable particles (e.g., flour, coal dust, magnesium powder, zinc dust, carbon powder, and flowers of sulfur) in the air constitute a powerful explosive

mixture. These materials should be used with adequate ventilation and should not be exposed to ignition sources. Some solid materials, when finely divided, spontaneously combust if allowed to dry while exposed to air. These materials include zirconium, titanium, Raney nickel, finely divided lead (such as prepared by pyrolysis of lead tartrate), and catalysts such as activated carbon containing active metals and hydrogen.

1.3.2 Explosive Boiling

Not all explosions result from chemical reactions; some are caused physically. A dangerous explosion can occur if a hot liquid or a collection of very hot particles comes into sudden contact with a lower boiling-point material. Sudden boiling eruptions occur when a nucleating agent (e.g., charcoal, “boiling chips”) is added to a liquid heated above its boiling point. Even if the material does not explode directly, the sudden formation of a mass of explosive or flammable vapor can be very dangerous.

1.3.3 Ultraviolet, Visible, and Near-Infrared Radiation

Ultraviolet, visible, and infrared radiation from lamps and lasers in the laboratory can produce a number of hazards. Medium-pressure Hanovia 450 Hg lamps are commonly used for ultraviolet irradiation in photochemical experiments. Ultraviolet lights used in biosafety cabinets, as decontamination devices, or in light boxes to visualize DNA can cause serious skin and corneal burns. Powerful arc lamps can cause eye damage and blindness within seconds. Some compounds (e.g., chlorine dioxide) are explosively photosensitive.

When incorrectly used, the light from lasers poses a hazard to the eyes of the operators and other people present in the room and is also a potential fire hazard. Depending on the type of laser, the associated hazards can include mutagenic, carcinogenic, or otherwise toxic laser dyes and solvents; flammable solvents; ultraviolet or visible radiation from the pump lamps; and electric shock from lamp power supplies.

1.3.4 Radio Frequency and Microwave Hazards

Radio frequency (rf) and microwaves occur within the range 10 kHz to 300,000 MHz and are used in rf ovens and furnaces, induction heaters, and microwave ovens. Extreme overexposure to microwaves can result in the development of cataracts or sterility or both. Microwave ovens are increasingly being used in laboratories for organic synthesis and digestion of analytical samples. Only microwave ovens designed for laboratory or industrial use should be used in a laboratory. Use of metal in microwave ovens can result in arcing and, if a flammable solvent is present, in fire or explosion. Superheating of liquids can occur. Capping of vials and other containers

used in the oven can result in explosion from pressure buildup within the vial. Inappropriately selected plastic containers may melt.

1.3.5 Electrical Hazards

The electrocution hazards of electrically powered instruments, tools, and other equipment are almost eliminated by taking reasonable precautions, and the presence of electrically powered equipment in the laboratory need not pose a significant risk. Many electrically powered devices are used in homes and workplaces in the United States, often with little awareness of the safety features incorporated in their design and construction. But, in the laboratory these safety features should not be defeated by thoughtless or ill-informed modification. The possibility of serious injury or death by electrocution is very real if careful attention is not paid to engineering, maintenance, and personal work practices. Equipment malfunctions can lead to electrical fires. If there is a need to build, repair, or modify electrical equipment, the work should ideally be performed or, at a minimum, inspected by a trained and licensed electrician or electrical expert. All laboratory personnel should know the location of electrical shutoff switches and circuit breaker switches and should know how to turn off power to burning equipment by using these switches. Laboratory equipment should be correctly bonded and grounded to reduce the chances of electric shock if a fault occurs.

1.3.6 Sharp Edges

Among the most common injuries in laboratories are cuts from broken glass. Cuts can be minimized by the use of correct procedures (e.g., the procedure for inserting glass tubing into rubber stoppers and tubing, which is taught in introductory laboratories), through the appropriate use of protective equipment, and by careful attention to manipulation. Glassware should always be checked for chips and cracks before use and discarded if any are found. Never dispose of glass in the general laboratory trash. It should only be placed in specific glassware disposal bins. This will reduce the chance of anyone changing the trash receiving a cut.

Other cut hazards include razors, box cutters, knives, wire cutters, and any other sharp-edged tool. When working with these tools, it is important to wear appropriate eye protection and cut-resistant gloves. Follow basic safety procedures when using a cutting tool:

- ✓ Inspect the tool prior to use. Do not use it if it is damaged.
- ✓ When cutting, always use a tool with a sharp edge. Dull edges are more likely to slip and cause harm.
- ✓ Keep hands out of the line of the cut.
- ✓ Stand off-line from the direction of the cut.
- ✓ If using a box cutter or other tool with a mounted blade, ensure that the blade is well seated before use.
- ✓ Never use a cutting tool for a task for which it was not designed, for example, as a screwdriver or lever for opening a container.

- ✓ Never submerge a sharp object in soapy or dirty water. It can be difficult to see and poses a risk to the dishwasher.

1.3.7 Slips, Trips, and Falls

Other common injuries in the laboratory arise from slipping, tripping, or improper lifting. Spills resulting from dropping chemicals not stored in protective rubber buckets or laboratory carts can be serious because the laboratory worker can fall or slip into the spilled chemical, thereby risking injury from both the fall and exposure to the chemical. Chemical spills resulting from tripping over bottles of chemicals stored on laboratory floors are part of a general pattern of bad housekeeping that can also lead to serious accidents. Wet floors around ice, dry ice, or liquid nitrogen dispensers can be slippery if the areas are not carpeted and if drops or small puddles are not wiped up as soon as they form.

Attempts to retrieve 5-gallon bottles of distilled water, jars of bulk chemicals, and rarely used equipment stored on high shelves often lead to back injuries in laboratory environments. Careful planning of where to store difficult-to-handle equipment and containers (because of weight, shape, or overall size) reduces the incidence of back injuries.

1.3.8 Explosives

An explosive is any chemical compound or mechanical mixture that, when subjected to heat, impact, friction, detonation, or other suitable initiation, undergoes rapid chemical change, evolving large volumes of gases that exert pressure on the surrounding medium. The term applies to materials that either detonate or deflagrate. Heat, light, mechanical shock, and certain catalysts initiate explosive reactions. Hydrogen and chlorine react explosively in the presence of light. Acids, bases, and other substances catalyze the explosive polymerization of acrolein, and many metal ions can catalyze the violent decomposition of hydrogen peroxide. Shock-sensitive materials include acetylides, azides, nitrogen triiodide, organic nitrates, nitro compounds, perchlorate salts (especially those of heavy metals such as ruthenium and osmium), many organic peroxides, and compounds containing diazo, halamine, nitroso, and ozonide functional groups.

Self-Check -1

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

1. _____ Materials that emit ionizing radiation..(3 points)

A. radioactive
B. organic
C. Toxic
D. explosive

2. _____Is the potential of the adverse effect exerted on the human body ..(3 points)

A. toxicity
B. volatility
C. Reactivity
D. iginblity

3. A hazardous material can be ..(3 points)

A.liquid
B.solid
C. Gas
D. All

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Basic concepts of field and laboratory test

2.1 Basic concepts of field and laboratory test

2.1.1Field Testing

In many cases the best test of the suitability of a stone from a local quarry or other source is its previously successful use in structures in the area which have been subjected to the local climate for a long period of time. Enquiries to local builders and contractors may gain knowledge regarding the best sources of building stone, and any local characteristics. This information can be supplemented by additional tests as required.

- **Field tests**

a. Structure test
b. Water absorption test
c. Organic soils test
d. Vibration test
e. Settling test
f. Cohesion test
g. Shrinkage test
h. Dry strength test
i. Bite and Grit Test
j. Sedimentation test
k. Slump test
l. Compaction test (Relative test)

a. Structure test

The structure of a stone from sedimentary rock sources can be tested by immersing small pieces in clear water in a glass jar for about an hour and then shaking them vigorously. If the water discolors, the stone is not well cemented and should not be used.

b. Water absorption test

The water absorption of a stone is a measure of its porosity and of its liability to frost damage.

$$w = \frac{W_w}{W_s} x100$$

The water absorption of a stone can be assessed by

- ✓ Weighing it when dry
- ✓ Immersing it in water for 24 hours at ambient temperature
- ✓ Weighing it again after removing excess surface moisture.

The difference in weight should not exceed 5-10% of the initial weight.

c. Vibration test

The test consists of first placing a dry sample on a board or a piece of cardboard. When lifting the board at the end and tapping it slightly, the particles separate since the difference in weight causes the finer once to stay high and the coarser once to move downward

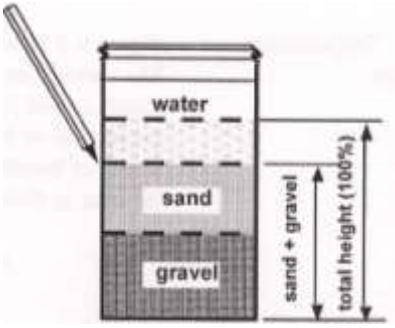
If there are a lot of different fractions between the largest and the smallest, the sample is well graded. If only a few sizes can be seen, the sample is single sized or poorly graded. Single-sized materials do not compact well, because there are no suitably small-sized particles to fill the empty voids between the bigger particles.

d. Settling test

The settling test provides a simple method to determine the proportions of the various soil fractions. A sample is placed in a glass jar with straight sides. Approximately half the jar is filled with a sample of the soil. Add water until the jar is three-quarters full.

Adding some salt to the water speeds up the settling of the finer material. Shake the jar, and then let it settle.

The gravel and coarse sand fractions will settle immediately. The finer sand settles more slowly, taking approximately half a minute. The silt fractions will remain in suspension for as much as an hour before settling, while the clay fraction remains in suspension for a longer time. The approximate quantities of each size can be seen as layers in the sample.

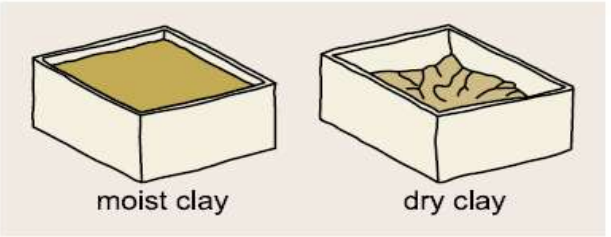


e. Cohesion test

To determine whether a soil contains a high quantity of silts or clays, a handful of moistened soil is molded into a ball. When silts or clays are present, the ball stays together and your hands are stained. If the sample contains only fine sand, the ball will stick together but crumbles easily when applying pressure. If the sample contains only coarse sand and gravel, the material cannot be moulded at all

f. Shrinkage test

A matchbox is filled with a well moistened sample of fines and allowed to dry out. If there is high clay content in the soil, the sample will crack and shrink when it dries. Silt will not shrink, but tends to crumble after it has dried.



g. Slump Test

Check and control the consistency of the concrete during each pour. According to Specification the slump test is a measure of the consistency of the concrete. The consistency therefore is a measure of the water content of the concrete. The water content controls and affects the cement content of the concrete. Since the slump test is important, do not substitute a guess for an actual test. The added water to increase the slump cannot exceed the design water by more than 4% percent. Guidelines for the approximate changes in water content, in percent, for various changes in

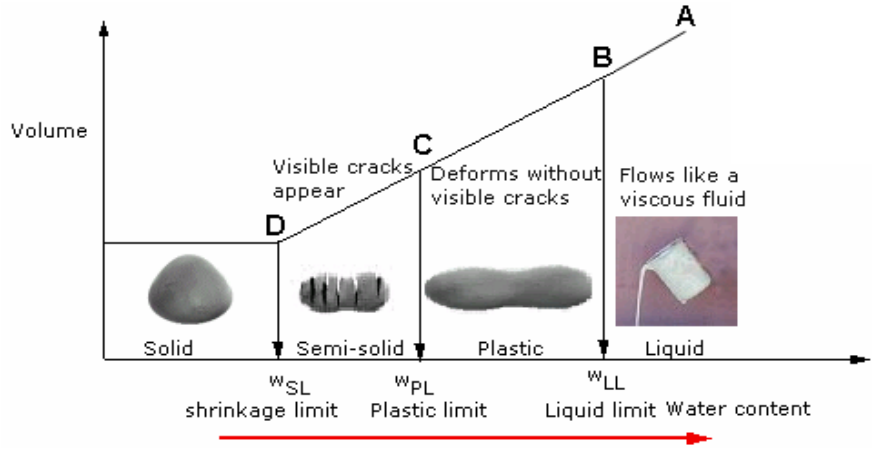
2.1.2 Simple Laboratory test

a) Consistency and plasticity
b) Optimum moisture content
c) Maximum dry density
d) Average least dimension (ALD)
e) Dynamic cone penetrometer (DCP)
f) Particle size distribution test
g) CBR
h) CBR swell

a) Consistency and plasticity of fine-grained soils

The properties of a fine-grained soil are considerably influenced by the water content (i.e. ratio of the mass of water in the soil to the mass of solid soil particles). At particular water content, the physical state of a fine- grained soil is termed “consistency” of the soil. Depending on the water content, a soil may exist in liquid, plastic, semi-solid or solid state. The three water contents at which the transition takes place for a given fine-

grained soil from liquid to plastic; from plastic to semi-solid and from semi-solid to solid state are significant in the reflecting the properties of the soil. These three water content and the changes in total volume of the soil that take place with varying moisture content are shown in figure below.



Aterberg limits (Consistency limits)

- ♣ Liquid limit
- ♣ Plastic limit
- ♣ Shrinkage limit

Liquid limit (LL) is the minimum water content at which the soil can flow under its own weight (has no strength). Using Casagrande apparatus, it is defined as the moisture content at which 25 blows in the standardized liquid limit determination device, will just close a specification groove in a sample of soil.

Plastic limit (PL) is the minimum water content at which the soil can be rolled into a thread 3mm in diameter, without breaking.

Shrinkage limit (SL) is the water content at which further loss of moisture does not cause a decrease in the volume of the soil.

Plasticity index (PI) is defined as the water content range over which the soil exhibits plastic behavior. It is the numerical difference between the liquid and plastic limits of a soil.

$$PI = LL - PL$$

b) Optimum moisture content (OMC) is the moisture at which maximum dry density is attained. Optimum moisture content is determined from moisture-density relationship tests during Standard Compaction.

The optimum moisture content of a soil (gravel) is that amount of moisture required, to lubricate the material sufficiently to obtain maximum density of the material for a specific compaction effort.

Too much water will keep the particles of gravel apart and reduce density, while too little water will not lubricate the particles. This will increase the friction/roughness between the particles of gravel and reduce the density accordingly.

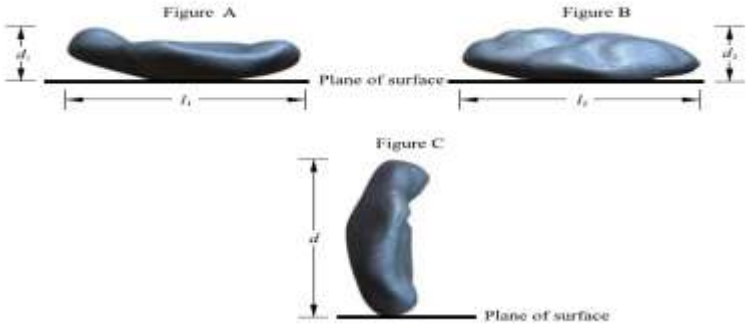
c) Maximum Dry Density (MDD) : Maximum dry density as determined in the laboratory using Standard Compaction.

d) Average Least Dimension

This expression is used as one of the characteristics for stone (aggregate) used in bituminous seals for surfacing and is of importance when determining the rate at which the aggregate must be spread to prevent over or under application of the aggregate.

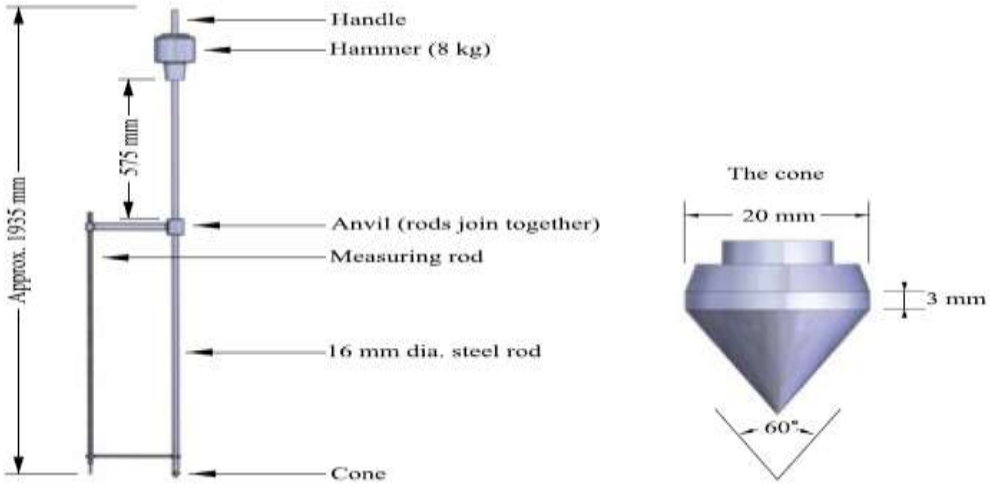
The ALD can be described as follows:

Any particle of aggregate that is not perfect in shape i.e. a 19 mm aggregate is not 19 mm in all directions, it has long and short sides. If dropped on a surface it will always fall on the surface with its smallest dimension vertical to the plane of the surface. It does not matter what the shape of the particle of aggregate is, it will always fall on the road with d_1 and d_2 (the figures below) i.e. the least or smallest dimension vertical to the road surface; e.g. a sample, if dropped in the road, will never come to rest on the road in this position where (d) the maximum dimension is vertical to the road surface.



e) Dynamic cone penetrometer (DCP)

The dynamic cone penetrometer (DCP) is an instrument used to measure the resistance of a soil to penetration, by a standard cone under impact; by a standard weight (hammer) falling a standard distance onto an anvil by measuring the distance the cone penetrates into the soil.



f) California bearing ratio (CBR)

CBR is a relationship between the bearing capacities of crushed stone aggregate and the natural gravel, both compacted in a standard would with a standard compaction effort, soaked for four days in water, and then penetrated with a standard plunger at a specific rate.

The 'bearing' results of the stone is taken as 100% and the natural gravel 'bearing' result is compared with the stone as a percentage of 100%, giving the CBR of the gravel or soil. It is an indication of the ability of the material to carry a certain design load transmitted through the wheels of a vehicle.

g) CBR swell

While the compacted samples for the CBR test are being soaked in water for four days, the swell of the sample in the mold is measured and expressed as a percentage of the 150 mm deep mold. This also gives a measure/indication of the stability of the material.

h) Particle size distribution or gradation

✓ Maximum size of an aggregate is the mesh size of the smallest size through which 100% of the material will pass.

✓ **Dry sieve analysis** is generally suitable for testing of graded coarse aggregate.

✓ **Wet (washes) sieve analysis** is carried out for aggregate contains fine dust or clay sticking to the coarse aggregate.

2.1.3 Chemical tests

- **Specific ion test**

Chloride ions on steel surface increase the probability that corrosion of the steel will take place even if a protective coating is applied .chloride ions trapped under a coating in the presence of steel and moisture will form a corrosion cell. this corrosion process will result in premature failure of the protective coating and may cause blistering of coating in immersion service. **Chloride, sulphate and nitrate kit elcometer** designed to accurately measure surface chloride, sulphate and nitrate ions.

- **Electrical conductivity test**

For conductivity testing the standard testing method for determining the resistivity and electrical conductor materials is ASTM B 193-87.conductivity is calculated from the measured resistance and dimensions of the specimen. The accuracy and convenience with which resistance can be measured depend on the actual resistance of the specimen. Along, thin specimen may be required if the specimen is a very good electrical conductor. Electrical resistance can be measured directly using an Ohm meter when the resistance of the specimen is more than one Ohm and contact resistance to the specimen is negligible.

- **Colorimetric**

Colorimetric is a device used in colorimetric. The device that measures the absorbance of particular wavelength of light by specific solution. This device commonly used to determine the concentration of a known solute in a given solution by the application of the beer-lambert law, which states that the concentration of a solute is proportional to the absorbance.

- **Gravimetric**

Gravimetric analysis describes asset of method used in analytical chemistry for the quantitative determination of an analytic (the ion being analyzed) based on its mass. the principle behind this type of analysis is that once an ions mass has been determined that known measurement can then be used to determine the same analyt mass in a mixture as long as the relative quantities of the other constituents are known. The four main types of this method of analysis are

- Precipitation
- Volatilization
- Electro analytical
- Miscellaneous physical method

Self-Check -1

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

1. _____ is the minimum water content at which the soil can flow under its own weight.3 points)

C. Liquid limit C. shrinkage limit

D. Plastic limit D. plastic index

2. _____ is the moisture at which maximum dry density is attained.(3 point)

A. plastic limit C. Maximum dry density

B. optimum moisture content D. iginblity

3. Which one of the following doesn't included in field test(3 points)

A. vibration test C. Slump test

B. cohesion test D. CBR

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	Applying testing methods and procedures

3.1 Operations of field and laboratory tests

3.1. 1Soil Particle Size (Sieve Analysis)

Purpose

- Grain size analysis is carried out to determine the relative percentages of different sizes of particles in the sample. These sizes control the mechanical behavior of coarse grained soil.
- Dry method of sieving is used
  - for coarser fractions(gravel) retained on 4.75mm sieve and
  - for finer fractions(sand) retained on 75micron sieve and
  - silt used for fra4.1ctions passing 75 micron(0.075mm sieve) and retained on 0.002mm
  - clay used for fractions passing 0.002mm

Apparatuses

- ✓ A full set of sieves [from 3inch (75mm) to No.200 (0.075mm)]
- ✓ Balance (with accurate to 0.01 g)
- ✓ Timing device
- ✓ Beaker (250ml capacity)
- ✓ Containers

Fig 3.1 sieve

3.1.2 Moisture Content And Index Tests

The mass of water which can be removed from the soil and aggregate by heating (oven drying) at 105 - 110^{0}c expressed as a percentage of the dry mass.

Apparatus

- ✓ Moisture can (container)
- ✓ Balance
- ✓ Oven
- ✓ Spatula
- ✓ Pan

Calculation:-

The moisture content of a soil or aggregate is expressed as a percentage of its dry mass.

$$\text{Moisture content} = \frac{A - B}{B - C}$$

Where A. Weight of wet sample + Container

B. Weight of dry sample + Container

C. Weight of Container

3.1.3 Specific gravity determination

- The specific gravity of solid particles (G) is defined as the ratio of the mass of an equal volume of water at 4^o C. Thus the specific gravity is given by;

- The specific gravity of solids for most natural soils falls in the general range of 2.65 to 2.80, the small values are for coarse grained soils.

The specific gravity of solids for most natural soils falls in the general range of 2.65 to 2.80, the small values are for coarse grained soils.

Table 3.1 Typical values of specific gravity (G)

S.No	Soil Type	Specific Gravity
1	*Gravel*	*2.65-2.68*
2	*Sand*	*2.65-2.68*
3	*Silty sands*	*2.66-2.70*

4	*Silt*	*2.66-2.70*
5	*Inorganic soil*	*2.68-2.80*
6	*Organic soils*	*Variable,may fall below 2.00*

Apparatus

- ✓ pycnometer with its cap
- ✓ Balance and weight, balance to measure to an accuracy of 0.1 g
- ✓ Oven to maintain temp± 5°C.
- ✓ Wire basket.
- ✓ A container for filling water with an arrangement for suspending basket.
- ✓ A shallow tray and two dry absorbent cloths.
- ✓ Wash bottle
- ✓ Filter paper and funnel

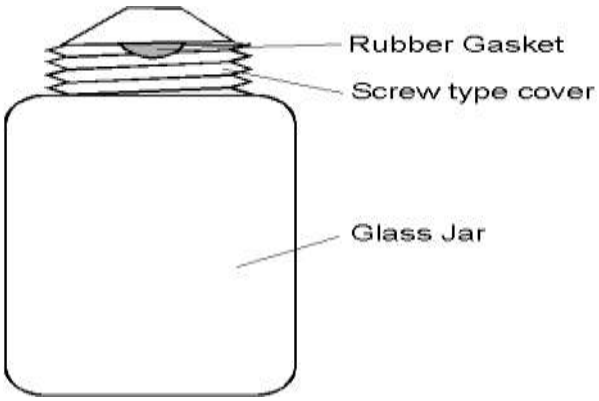


Figure 3.1.2 Pycnometer

Format for specific gravity

Description	Sample no	
	1	2
Weight of sample taken(g)		
Weight of saturated and surface dry aggregate (C) g		
Weight of sample + pycnometer + water(A) g		
Weight of pycnometer + water(B) g		
Weight of oven dry sample(D) g		
$Specific\ gravity = \frac{D}{C-(A-B)}$		

$APPARENT\ Specific\ gravity = \frac{D}{D-(A-B)}$		
water absorption ,percentage dry weight $WATER\ ABSORPTION\ OF\ FINE\ AGGREGATE = \frac{C-D}{D} * 100\%$		

Average value	Specific gravity	
	APPARENT Specific gravity	
	$WATER\ ABSORPTION\ OF\ FINE\ AGGREGATE$	

3.1.4 Atteberg limit or casagrandes apparatus

- ✓ It helps to determine the consistency of soil particles.
- ✓ As Atteberg mentioned that a fine grained soil can exist in four steps. Namely:
  - i) liquid limit,
  - ii) plastic limit,
  - iii) semi-solid state and
  - iv) Solid state.

Plasticity characteristics of the soil

- ✓ Te plasticity of a soil is its ability to undergone deformation without cracking or rupturing.
- ✓ Plasticity is an important index property of fine grained soils, especially clayey soil.
- ✓ Plasticity in soil is due to presence of clay minerals.

- **Consistency limit**
  - ✓ The consistency of a fine grained soil is the physical state in which it exists. It used to denote the degree of firmness of a soil.
  - ✓ Consistency of a soil is indicated by terms as soft, firm or hard.
  - ✓ The water content at which the soil changes from one state to the other are known as consistency limit or Atteberg limit.
    A soil containing higher water content is a *liquid state*.
  - ✓ It offers no resistance to shear deformation and therefore, the shear strength is equal to zero.

- **Liquid limit**

- ✓ The water content at which the soil changes from the liquid state to plastic state is known as liquid limit(LL, WL)
- ✓ At this the soil cease(stop) to be liquid
- ✓ The liquid limit of the soil is depends up on the clay mineral present.

i. <u>Plastic limit</u>

- ✓ as the water content is decreases or reduced, the plasticity of the soil is decreases ultimately,
- ✓ at this level the soil passes from the plastic state to the semi-solid state when it stops behaving the plastic.
- ✓ It cracks when molded.
- ✓ The water content at which the soil become semi- solid is known as the plastic limit (PL, WP).
- ✓ In other word the plastic limit is the water content at which the soil jus fails to behave plastically.
- ✓ The soil remains plastic when the water content is b/n the liquid limit and plastic limit.

ii. Semi-solid state

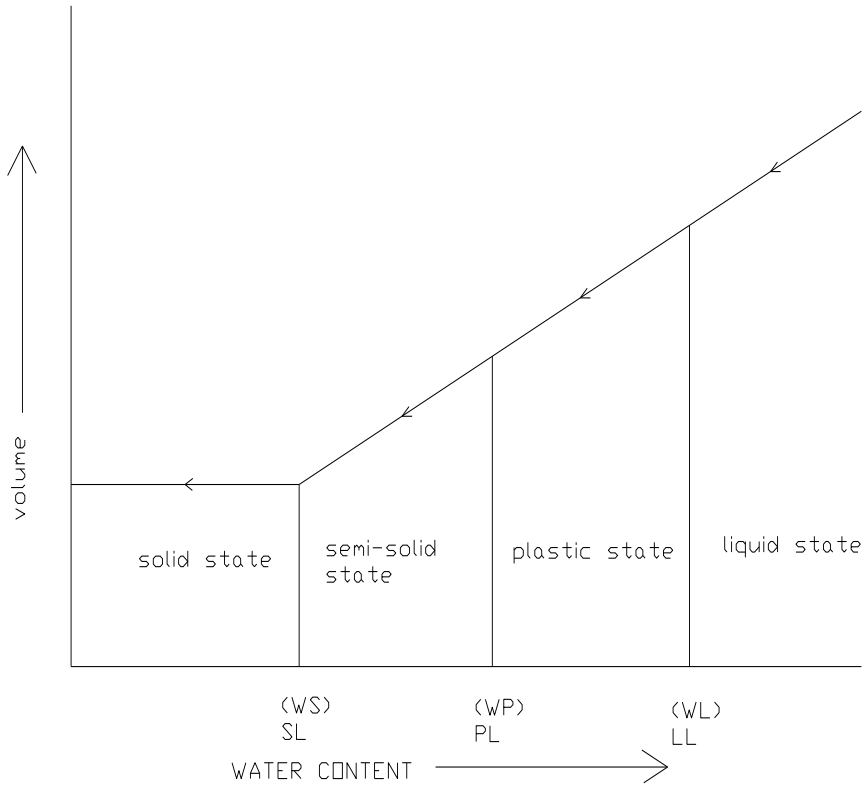
- ✓ When the water content is reduced below the plastic limit, the soil attains the semi-solid state.
- ✓ The soil cracks when molded.
- ✓ In semi-solid state, the volume of the soil decreases with decreases of water content.
- ✓ The water content at which the soil changes from the semi-solid state to the solid state is known as shrinkage limit (SL,WS)

iii. Solid state

☞ When the soil ceases to behave semi-solid state.

- ➢ The numerical difference b/n the liquid limit and the plastic limit is known as plasticity index (PI, IP).
- ➢ plasticity index of good soil is found b/n 6%-12%

Thus, PI = L.L – P.L



Consistency limit chart

1- Liquid limit test

Apparatuses

- ✓ Liquid limit device
- ✓ Grooving tool
- ✓ Balance (with accuracy to 0.01g)
- ✓ Evaporating dish
- ✓ Spatula
- ✓ Oven dry
- ✓ Containers
- ✓ No. 40 (0.425mm) sieve

Liquid Limit Device

1) Plastic limit test

- ✓ A plastic limit of a soil is the water content of the soil below which it ceases to be plastic.
- ✓ It begins to be crumble when rolled into threads of 3mm diameter.
- ✓ Plastic limit is obtained by average of moisture content

Apparatus

- ✓ Flat glass plate 450mm square and 10mm thick.
- ✓ Metallic rod , 3mm diameter and 10mm length.
- ✓ Oven dry
- ✓ Spatula
- ✓ Moisture content can

ELECTRIC OVEN

Fig 3.1.3 oven dry

DIGITAL BALANCE

Fig 3.1.4 digital balance

Field density test

DETERMINATION OF FIELD DENSITY OF SOIL BY SAND REPLACEMENT METHOD

Sand replacement test method is used to determine the field density or in-place density of earth embankments, road fills, sub-grade, sub-base or any of compacted material.

This method serves as base upon which one can accept the density of a compacted material to a specified magnitude or to a percentage of maximum unit dry density determined as proctor.

As we know that moisture content of the soil vary from time to time and hence the field density also, so we are required to report the test result in terms of dry density. In order to determine the dry density we must have to examine the moisture content in the soil by using general method.

Self-Check -3

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

1. ---------- is carried out to determine the relative percentages of different sizes of particles.(3 points)

A. Specific gravity C. Grain size analysis

B. crushing D. plastic index

2. The specific gravity of solids for most natural soils falls in the general range of. (3 point)

A. 0.65 to 2.80 C. 2.65 to 3.80

B. 2.65 to 2.80 D. 1.65 to 2.80

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet 1	Applying testing methods and procedures

1.1Procedure for sieve analysis

Step 1- Prepare the sample and Weigh 500g by drying it in air or oven and bring it to room temperature.
Step 2- Clean all the sieves to be used.
Step 3- Weigh each sieve and record
Step 4- Place the sieves over a clean tray one over the other in the ascending order of size.
Step 5- Pour the sample over the upper sieve.
Step 6- Tie the bolt on both belt
Step 7- Set the sieve shaker on two minute
Step 8- Start the sieve by pressing green button on the sieve shaker.
Step 9- After it stops by itself weigh the sieve plus sample.
Step 10- Then calculate

- ☞ Mass retained
- ☞ Percentage retained
- ☞ Cumulative percentage retained
- ☞ Percentage finer

Example 1- The result at a sieve analysis of a soil are given below

Given – total mass of sample is 785g

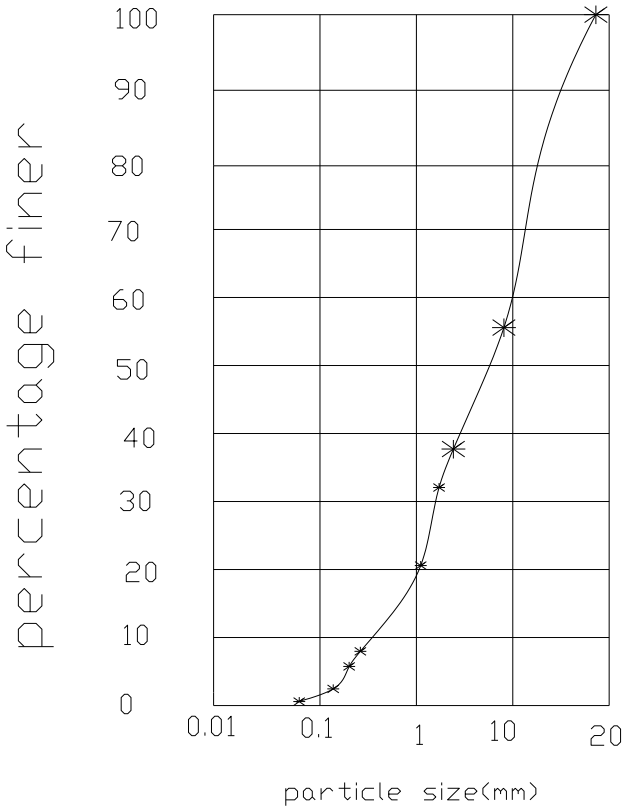
Sieve	19mm	9.5mm	4.5mm	2.36mm	1.8mm	600 μm	300 μm	150 μm	75 μm	pan
Massof soil retained(gm	35	40	80	150	150	140	55	35	25	75

Soln

Sieve	Mass retained(gm)	Percentage retained	Cummulative percentage retained	Percentage finer
19mm	35	4.46	4.46	95.54
9.5mm	40	5.1	9.56	90.44
4.5mm	80	10.19	19.75	80.25
2.36mm	150	19.11	38.86	61.14
1.8mm	150	19.11	57.97	42.03
600μm	140	17.83	75.8	24.2
300μm	55	7.01	82.81	17.19
150μm	35	4.46	87.27	12.73

75μm	25	3.18	90.45	9.55
Pan	75	9.55	100.00	----
Total	785g	100		

Grading chart



Example -2- the following data is obtained from the laboratory to identify fine, medium and coarser sand. Then determine the ff;

a) Complete the blank space of the table
b) Find the fineness modulus of the sand
c) Make a fine aggregate grading chart

Given- Total mass of sample is 500g

Standard fine aggregate

Sieve	ASTM (AMERICAN STANDARD TESTING MACHINE)	percentage passing
9.5mm	$\frac{3}{8}$ INCH	100
4.5mm	NO 4	95-100
2.36mm	NO 8	80-100

1.8mm	NO 16	50-85
600μm	NO 30	25-60
300μm	NO 50	10-30
150μm	NO 100	2-10

Finess modulus= $\frac{\Sigma commulative\ percentage\ coarser}{100}$

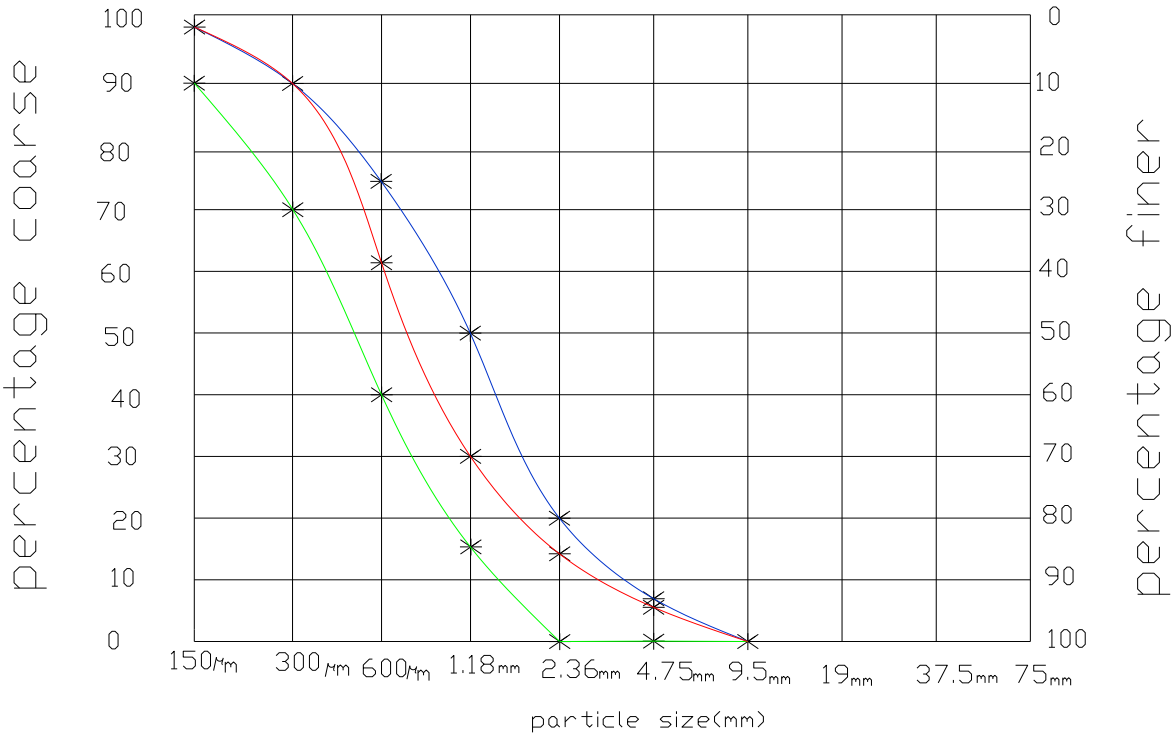
soln

Sieve	Mass(weight) retained(gm)	Percentage retained	Cummulative percentage retained(coarser)	Cummulative percentage passing(finner)
9.5mm	0	0	0	100
4.5mm	30	6	6	94
2.36mm	40	8	14	86
1.8mm	80	16	30	70
600μm	160	32	62	38
300μm	140	28	90	10
150μm	40	8	98	2
Pan	10	2	----	----
Total	500g	100		300

Finess modulus= $\frac{\Sigma commulative\ percentage\ coarser}{100} = \frac{300}{100} = 3$

☞ So the result indicate coarser sand b/c its greater 2.90.

Fine aggregate chart


percentage coarse
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
percentage finer
150µm
300µm
600µm
1.18mm
2.36mm
4.75mm
9.5mm
19mm
37.5mm
75mm
particle size(mm)

1.2 Procedure of Moisture Content determination

Step1 Weigh each container and record. Place the wet sample in the Container, the mass of sample to be used as follows:

- ✓ Mass of soil sample 50-300 gm
- ✓ Mass of aggregate sample 300-500 gm

Step 2 Weigh wet of sample + container and record

Step 3 Place the wet sample + container in the over. Maintain the required temperature normally 105-110^{0}c for 12 - 24 hours.

Step 4 Remove the sample from the oven and allow in the air to cool at least 10-15min.

Step 5 Weigh the dried sample + container and record.

1.3 Procedure for Specific gravity

Step 1- Take 500g of air dried soil
Step 2- Place the sample pycnometer
Step 3- Fill the pycnometer with water on the sample until it become full
Step 4- Stir the sample in the pycnometer until it uniformly mixed
Step 5- Again fill the water if there is space
Step 6- Shake pycnometer to avoid the air from it.
Step 7- Again fill the water using wash bottle.
Step8 - Dry the outside of the pycnometer by cleaning cloth.
Step 9- Weigh the pycnometer + water + sample
Step 10- Pour the sample on the tray and clean the pycnometer
Step 11- Fill the pycnometer by clean water at the same level with previous and weigh it
Step 12- The clean the external part the pycnometer by clean cloth
Step 13- The water on the step 9 removed from the sample
Step 14- The soil in this removed sample must be filtered with filtering paper, the retard the sample the previous sample
Step 15- Then the sample entered in the oven dry by 110 +_ 5 for 24hour.
Step 16- Weigh the oven dried sample
Step 17- Then determine specific gravity, apparent specific gravity and water absorption of fine aggregate depends on the formula.

Example: the following data is obtained from the lab test to determine specific gravity, apparent specific gravity and water absorption of the sample.

- ☞ Weight of saturated sample (C) in gm = 500g
- ☞ Weight of pycnometer + sample + water (A) in g = 1826g
- ☞ Weight of pycnometer + water (B) in gm = 1514
- ☞ Oven dried soil (D) in gm = 496g

Soln:

Use the format to solve

Description		Sample no	
		1	2
Weight of sample taken(g)		2000	
Weight of saturated and surface dry aggregate (C) g		500	
Weight of sample + pycnometer + water(A) g		1826	
Weight of pycnometer + water(B) g		1541	
Weight of oven dry sample(D) g		496	
$Specific\ gravity = \frac{D}{C-(A-B)} = \frac{496}{500-(1826-1541)}$		2.64	
$APPARENT\ Specific\ gravity = \frac{D}{D-(A-B)} = \frac{496}{496-(1826-1541)}$		2.70	
water absorption ,percentage dry weight $WATER\ ABSORPTION\ OF\ FINE\ AGGREGATE = \frac{C-D}{D} * 100\%$ $\frac{500-496}{496} * 100\%$		0.80%	
Average value	Specific gravity	$\frac{SA\ 1 + SA\ 2}{2}$	
	APPARENT Specific gravity	$\frac{SA\ 1 + SA\ 2}{2}$	
	$WATER\ ABSORPTION\ OF\ FINE\ AGGREGATE$	$\frac{SA\ 1 + SA\ 2}{2}$	

1.4 Procedure Atteberg limit

Step 1- Adjust the height of the cup to give a drop of exactly 10mm on the point of contact the base

Step 2- Take about 100g of dried soil sample passing 425 micrometer sieve or 0.425mm sieve.

Step 3- Mix it thoroughly with water to form a uniform paste.

Step 4- Put some the paste in the cup spread it with a spatula to level and at the same time trimmed to a depth of 10mm at the point of maximum thickness.

Step 5- Cut a groove in the sample by grooving tool holding the tool perpendicular to the cup.

Step 6- Rotate the handle at a rate of 2 revolution per second and count the blow until parts of the soil sample come into contact at the bottom of groove along the distance of 13mm.

Step 7- Take about 15g of soil near the closed groove,

Step 8- Determine the water content

Step 9- The remaining soil mixed and continues the same procedure

$$w = \frac{\mathrm{Mw}}{\mathrm{ms}} * 100\%$$

Note:

- First blows is ranges from 15-20
- second blows is ranges from 20-25
- third blows is ranges from 25-30
- The moisture content of the liquid limit is obtained at 25blows.

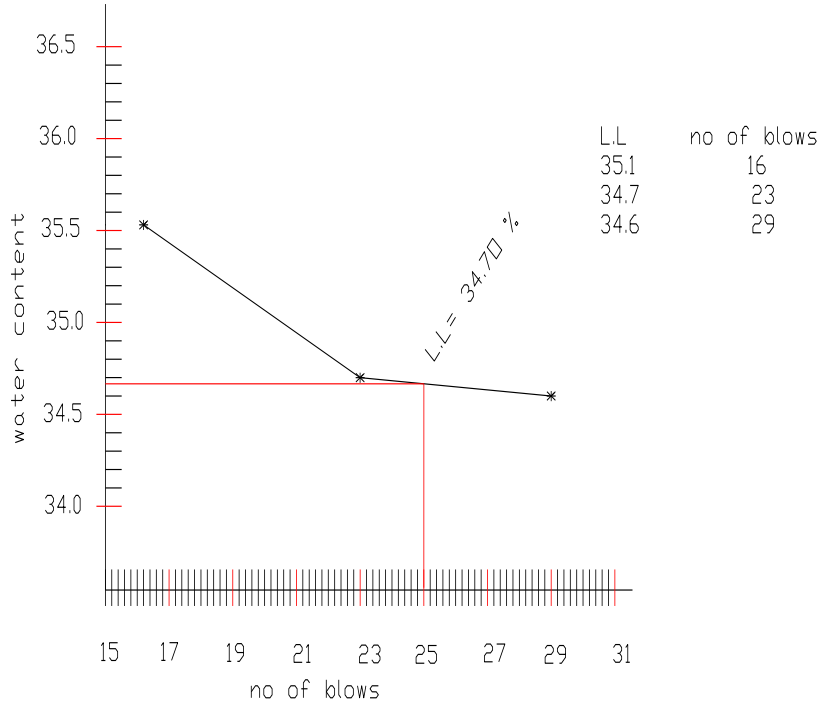
Format for liquid limit test

Observation sheet

Liquid limit	1	2	3	Remark
No of blows				
Container no				
Mass of wet soil + container(A) g				
Mass of dry soil + container (B) g				
Mass of container (C) g				
Mass of water (A-B) g				
Mass of dry soil (B-C) g				
Moisture content $w = \frac{(\mathrm{A}-\mathrm{B})}{(\mathrm{B}-\mathrm{C})} * 100\%$				

Example 1: a lab test data of liquid limit is as follows

Liquid limit	1	2	3	Remark
No of blows	16	23	29	
Container no	A1	A2	A3	
Mass of wet soil + container(A) g	43.7	36.4	30.4	
Mass of dry soil + container (B) g	34	31.3	26.7	
Mass of container © g	17.9	16.6	16	
Mass of water (A-B) g	6.7	5.1	3.7	
Mass of dry soil (B-C) g	19.1	14.7	10.7	
Moisture content $w = \frac{(A-B)}{(B-C)} * 100\%$	35.09	34.7	34.6	



1.5 Procedure plastic limit test

Step 1- Take about 30g of air –dried soil sample from a thoroughly mixed sample of the soil passing 0.425mm.
Step 2- Mix the soil with distilled water on glass plate to make it plastic enough to shape into small ball.

Step 3- Leave the plastic soil mass for some time for maturing. For some fat clay, this period may be even to 24hrs.
Step 4- Take about 8g of plastic soil and roll it with fingers on a glass plate. The rolling should be about 80 to90 strokes per minute to form a thread of 3mm diameter.
Step 5- Collect the pieces of the crumble soil thread in a moisture content container.
Step 6- Repeat the procedure at least twice with samples of plastic soil each time.

Format for liquid limit test

Observation sheet

Plastic limit	1	2	Remark
Container no			
Mass of wet soil + container(A) g			
Mass of dry soil + container (B) g			
Mass of container © g			
Mass of water (A-B) g			
Mass of dry soil (B-C) g			
Moisture content $w = \frac{(A-B)}{(B-C)} * 100\%$			

Example 2: depends on the data which is obtained from lab test determine plastic limit and also plasticity index.

Soln:

Plastic limit	1	2	Remark
Container no	A1	A2	
Mass of wet soil + container(A) g	24.1	25.1	
Mass of dry soil + container (B) g	22.3	23.2	
Mass of container © g	16.4	16.4	
Mass of water (A-B) g	1.8	1.9	
Mass of dry soil (B-C) g	5.9	6.8	
Moisture content $w = \frac{(A-B)}{(B-C)} * 100\%$	30.5	27.9	
AVERAGE = P.L 1/P.L 2	29.2%		

L.L =34.8%

P.L = 29.2%

P.I = L.L – P.I

34.8% - 29.2% = 5.6%

Information Sheet-4	Report and documentation methods and procedures

Report and documentation methods and procedure

Internally Generated Supporting Documents

- Lists of suppliers
- Controlled document master lists
- Controlled record master lists

External Documents

- Control after arrival
  Example
  - Contracts
  - Standards
  - Regulations

Document for the Needs of Organisation

- Some options:
  - Combine Quality Manual, Procedures
  - Different Quality Manuals different sites

Who Should Document?

- Users where possible
  - Expertise
  - Ownership
  - Writing versus authorisation
  - Guidelines on style
  - quality manager overview

"All documents to the extent necessary to ensure the quality of the test…results must be reported to target person."

Good Reasons to Document

- Standardising work
- Induction and other training
- Instructions
- as needed
  - Defining what is done
  - responsibility to client
  - Meeting requirements of standards
  - Clarifying what is important
  - Public relations
- where appropriate

Results of Bad Documentation

- Documentation not useful
- Documentation not used
- Documentation not updated
- Unnecessary non-conformances

Some General Points

- Change only what is necessary or useful
- Names do not matter
- Standards adaptable for organisations of different sizes
- Fit documentation to organisation

- not organisation to documentation
  - Use existing documents and systems wherever possible and appropriate
  - No need to use numbers in standard(s)
- can cross-reference standards
  - No need to use jargon of standard(s)

Self-Check -4

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

1. document to the extent necessary to ensure the quality of the test .(3 points)

   A. True B. False

2. not updated document results of bad documentation .(5 points)

   A True B. False

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4ours-8 hours.

Task 1: Apply test methods and procedures of

- ✓ **Sieve analysis**
- ✓ **Water content determination**
- ✓ **Specific gravity**
- ✓ **Liquid limit**
- ✓ **Plastic limit**

Reference

- ✓ Ethiopian tvet system hand out on test road construction materials.
- ✓ Addis Ababa University Department of Earth Sciences, Lecture Notes – Advanced Engineering Geology, Compiled by Dr. Tarun K.Raghuvanshi.
- ✓ Contractor's Handbook, Roads Training School, Zambia
- ✓ Guideline for Quality Assurance Procedures and Specifications for Labor-Based Road Works
- ✓ http//www.trl.com/electrical property testing/
- ✓ AACRA Manual
- ✓ Labor Based Road Works (Zambia Hand Book)
- ✓ ERA Manual
- ✓ Global source.com

Basic Infrastructure Operations

NTQF Level I

Learning Guide # 53

Unit of Competence: Conduct Simple Sampling and Testing

Module Title: Conducting Simple Sampling and Testing

LG Code: CON BIO1 M13 LO4-LG-53

TTLM Code: CON BIO1 TTLM 0919v1

LO 4: **Conduct preparation of stabilized construction materials**

Instruction Sheet	Learning Guide #53

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

- Site hazards and safe operational techniques
- Handling of construction materials and stabilizers
- Stabilizer preparation techniques

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Use proper handling of construction materials and additives (stabilizers).
- Identify site hazards associated with the preparation of stabilized construction materials.
- Identify preparation techniques for stabilized construction materials.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check 2,and Self-check 3” **in page -93, 96, and 101** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -.**
6. Do the “LAP test” **in page –** (if you are ready).

Information Sheet-1	Site hazards and safe operational techniques

1.1 Site Hazard

Hazard is defined as anything that has the potential to cause harm, ill health and injury, damage to property, products or the environment, production losses or increase liabilities

1.2 Safe operational techniques

- **Isolate the hazard**: separate the hazard from the workplace or people, for example;
  - ✓ Chemical store room, or a laboratory kept locked except to an Authorized person.
  - ✓ Lock out procedures on faulty equipment.
  - ✓ Appropriate guarding for machinery.
- **Administrative Procedures**: develop work methods or procedures to Reduce the conditions of risk, for example:
  - ✓ Written Safe Operating Procedures
  - ✓ Job rotation to restrict hours worked on difficult jobs.
  - ✓ Staff trained in the correct operating procedures.

1.3 Use Personal Protective Equipment (PPE) and training in its use:

Offer the lowest level of protection and should only be used as a last resort to deal with the hazard, where the hazard cannot be removed or reduced by any other means, for example:

- ✓ Handling of chemicals – gloves, safety glasses, aprons.
- ✓ Protecting eyes from flying particles.
- ✓ Protecting feet – safety boots

Self-Check -1

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

1. What are the causes of hazard in working place.(3 points)

   A. Ill health C. injury

   B. property damage D. all

2. Isolating hazard is protecting peoples from injury (2 points)

   A. true C. false

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Handling of construction materials and stabilizers

3.1 Handling construction material

- ✓ Samples of soil and of rock are collected for visual examination so that a log of the test hole may be prepared for preservation as representative samples in support of the descriptive log, for testing to determine index properties, and for laboratory testing to determine engineering properties.
- ✓ When drilling core holes, the total material recovered as core is collected and stored in core resalable boxes.
- ✓ In addition, samples of soil should be collected and placed in sealed pint jars or resalable plastic bags to preserve the natural water content representative of each moist or wet stratum.
- ✓ Samples representative of the various types of material found in the area under investigation should be collected as the work progresses.
- ✓ If a wide variation in material quality exists, samples representative of the ranges of the material should be collected.

The movement of row material from their native site to the point of use in manufacturing, their subsequent manipulation in production, process, and the transfer of finished products from crusher site and their distribution to user.

Example Storage of cement does not set unless exposed to humidity It is, therefore, advisable to store cement in a shed, preferably without windows. A boarded floor or wooden platform above the ground is advisable. Bags:

- Should not be stocked above man-height,
- Should not touch the walls of the shed so that air can freely circulate
- Must be off-loaded by hand in order to keep the paper bags unbroken, and
- Should be used up in rotation (first stocked - first used).
- Hardened lumps found when opening the bag should be removed by sieving the cement.

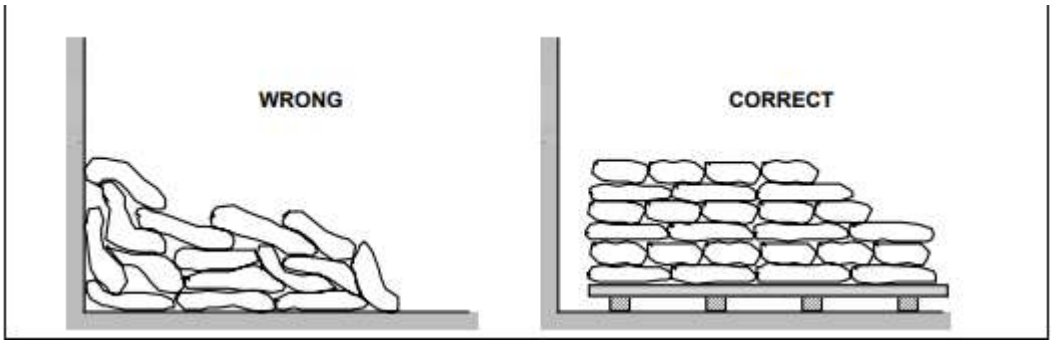


Figure 1. Handling of row material

Handling stabilizers

In general cement and lime should be stored in a way that it does not come in contact with moisture. As soon as it gets moisture, setting starts, which render it, unfit for future use. In order to avoid this cement and lime should:

- ✓ Be stored in storage sheds with raised damp proof floors.
- ✓ Be stored about 60cms away from external walls.
- ✓ Be stacked up to reasonable height for ease of handling and for avoiding cooling (not more than 10 bags be stocked over one another)
- ✓ Not be stored in rainy season and long periods of storing should be avoided
- ✓ Be stored in *silos or bins*, if stored in bulk form.
- ✓ Be used on first in first out basis.

Self-Check -2

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

1. Proper handling of construction material can save time.(3 points)

   A.TRUE B.FALSE

2. Cement and lime should be stored in contact with moisture. (3points)

   A.TRUE B.FALSE

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 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	Stabilizer preparation techniques

3.1 Introduction

- Stabilization of soils and gravels for road building is carried out to achieve the following main objectives:
  - ✓ To increase strength and bearing capacity.
  - ✓ To control volume change when moisture content changes.
  - ✓ To increase the resistance to erosion, weathering or traffic usage.
  - ✓ To reduce the permeability of the stabilized soil.

Many natural materials can be stabilized to make them suitable for road pavements but this process is only economical when the cost of overcoming a deficiency in one material is less than the cost of importing another, which is satisfactory without stabilization.

The simplest method of increasing the strength is to stabilize it mechanically. Compaction is an inexpensive and effective method of providing a dense layer with improved load bearing capacity. In areas where good quality materials are not readily available it may be possible to blend two otherwise unsuitable materials to produce an acceptable product.

Chemical stabilization involves the incorporation of relatively small percentages of lime, cement or pozzolans. These stabilizers are called hydraulic binders, which 'set' in the presence of water. They can dramatically increase the strength of unbound materials making them suitable for use in the main load bearing layer of a road pavement, or they can be mixed with soils in small amounts which merely 'modify' the physical characteristics of the soil rather than to significantly strengthen it.

3.2 Mechanical Stabilization

- **Compaction**

Compaction is the simplest method of stabilization. Well-graded soils can be compacted to high densities at the optimum moisture content that can be determined using standard compaction tests. BS 1924: Part 2: 1990 describes four such tests, each has its merits and the one that is most closely related to field conditions will depend on the type of material that is being compacted.

- **Blending**

The blending of materials has two main uses. These are;

- ✓ Improving the stability of cohesive soils of low strength by adding coarse material.
- ✓ Improving the stability of otherwise unstable granular materials by adding a fine material which will provide binding.

The grading of the mixture is important to ensure that after compaction the air void content is low (<5%). The maximum density grading is given by an equation originally derived by Fuller (1952)

$$P = 100(d/D)^{0.5}$$

Where:

P = Percentage by weight of the total sample passing any given sieve size.
d = Aperture of that sieve (mm).
D = Size of the largest particle in the sample (mm).

A modification of this equation is used by the Australian Road Research Board (Lay, 1985) such that:

$$P = 100\,(d/D)^{n}.$$

Where:
P = Percentage of material smaller than d in diameter
d = Aperture of that sieve (mm).
D = Size of the largest particle in the sample (mm).
n = An exponent ranging from 0.35 to 0.50

Mechanical stabilization of clay soils, by the addition of non-cohesive granular material, needs sufficient granular material to be added to ensure that the granular fragments are in contact and form a particle-particle contact fabric.

Mechanical stabilization might occasionally be carried out to produce an improved upper fill or capping layer or, more commonly, to produce sub-base and base materials. Care must be taken to ensure that the plasticity of the fines fraction is controlled.

3.3 Bitumen Stabilization

Bitumen has strong adhesive and waterproofing properties. It can be made in suitable forms for stabilization either as a 'cut-back' when blended with kerosene and/or diesel fuel; as an emulsion or in a foaming technique where specialized equipment adds water to the hot bitumen at the point of mixing. These binders are most satisfactory when used in hot dry climates, which ensures rapid drying out of solvents or water. However, the use of emulsions is likely to be restricted to stabilizing more granular materials

3.4 *Chemical Stabilization*

- **General**

Stabilization of a material by the addition of a chemical additive can enhance the properties of road materials and give pavement layers the following attributes:

- ✓ A substantial proportion of the strength is retained when they become saturated with water.
- ✓ Surface deflections are reduced.
- ✓ Resistance to erosion is increased.
- ✓ Materials in the supporting layer cannot contaminate the stabilized layer.
- ✓ The elastic moduli of granular layers constructed above stabilized layers are increased.
- ✓ Lime-stabilization can be used to produce a capping layer or working platform with wet or unsuitable in situ materials.
- ✓ Characteristics such as plasticity, compressibility and permeability can be reduced.

Additives can also be used to waterproof a material rather than to directly increase its strength.

- **Portland cement as a Stabilizer**

Cement can be used to stabilize most soils. Exceptions are those with a high organic content, which retards the hydration process, and those with a clay content outside the normal specification, where it is difficult to mix the soil/cement mixture evenly. Addition of cement to base materials results in a reduction in plasticity and swell, and an increase in strength and bearing capacity. CBR values well in excess of the minimum requirement for un stabilized gravels (usually 80 per cent, soaked at the required field density) normally result.

- **Lime as a Stabilizer**

When lime is added to a plastic material, it first flocculates the clay and substantially reduces the plasticity. Addition of 2 per cent of lime can increases the plastic limit of a wet and sticky soil changing it from one, which is impossible to compact, and impassable to traffic, to one which is workable. The removal of water and the increase in plastic limit cause a substantial and rapid increase in the strength and traffic ability of the wet material. The effect of lime on the liquid limit is much less marked but the overall effect is usually a considerable reduction in the plasticity index.

Self-Check -3

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

1. Which one of the following technique used for soil and gravel stabilization.(3 points)

   A. Mechanical stabilization C. bitumen stabilization

   B. chemical stabilization D. A&b are answer

2. Stabilization of soil and gravel for road building carried out to achieve .(3 points)

   A. increase bearing capacity C. reduces permeability of soil

   B. resistance to erosion D. All

3. ----------is the simplest method of Stabilization.(3 points)

   A. compaction C. chemical

   B. bleading D. All

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

2. Reference

- ✓ Department of the Army U.S. Army Corps of Engineers, Engineering Design – Soil Sampling, Washington, D.C., 30 September 1996.
- ✓ National Rural Road Development Agency, Equipment and Test Procedures, India Volume I, (May 2007).
- ✓ Addis Ababa University Department of Earth Sciences, Lecture Notes – Advanced Engineering Geology, Compiled by Dr. Tarun K.Raghuvanshi.
- ✓ Department for International Development, Guidelines on the Selection and Use of Construction Material, Jr Cook and Cs Gourley.
- ✓ Adama University, Building Material Handout, 2006 .
- ✓ Quality Assurance Handbook for Rural Roads, Volume I & II, National Rural Roads Development Agency, India
- ✓ Contractor's Handbook, Roads Training School, Zambia
- ✓ Guideline for Quality Assurance Procedures and Specifications for Labor-Based Road Works
- ✓ AACRA Manual
- ✓ Labor Based Road Works (Zambia Hand Book)
- ✓ ERA Manual
- ✓ Global source.com

Basic Infrastructure Operations

NTQF Level I

Learning Guide # 54

Unit of Competence: Conduct Simple Sampling and Testing

Module Title: Conducting Simple Sampling and Testing

LG Code: CON BIO1 M14 LO5-LG-54

TTLM Code: CON BIO1 TTLM 0919v1

LO 5: Identify hazards and risks

Instruction Sheet	Learning Guide #54

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

- Types of hazards and risk control
- Accident contingency measures

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Clarify safety regulations and workplace safety and hazard control practices and procedures.
- identify hazards/risks in the workplace and their corresponding indicators
- Recognize contingency measures during workplace accidents, fire and other emergencies.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check 2, ” **in page -107, and 109**respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -.**
6. Do the “LAP test” **in page –** (if you are ready).

Information Sheet-1	Types of hazards and risk control

1.1 Definition of hazard Hazard

Anything that has the potential to cause harm, ill health and injury, damage to property, products or the environment, production losses or increase liabilities.

1.2 Types of Hazard At workplace categorized:

- Physical
- Chemical
- Biological

- **Chemical**
  - ✓ Hydrocarbon under pressure
  - ✓ Smoke
  - ✓ Toxic material
  - ✓ Volatile fluids in tanks
- **Physical**
  - ✓ Moving road tankers / vehicles
  - ✓ Elevated objects
  - ✓ Noise
  - ✓ People working at heights
  - ✓ High voltage
- **Biological**
  - ✓ Toxicological lab

1.3 Consequence of hazard

Consequence is defined as an event or chains of events that results from the hazard being released

- **Consequences - examples**

  - ✓ Serious injury
  - ✓ Death
  - ✓ Latent illness or disease which has long gestation period
  - ✓ Property damage - own or public
  - ✓ Environmental damage
  - ✓ Loss of reputation leading to loss in current and Prospective business
  - ✓ Loss of revenue - paying for compensation, medical Expenses, production loss or deferment

1.4 Identification of hazard

- **In order to identify hazards the following are recommended**
  - ✓ Past incidents/accidents are examined to see what happened and whether the incident/accident could occur again.

.

  - ✓ Employees be consulted to find out what they consider are safety issues, I.e. ask workers about hazards near misses they have encountered as part of their work. Sometimes a surveyor questionnaire can assist workers to provide information about workplace hazards
  - ✓ Work areas or work sites be inspected or examined to find out what is happening now. Identified hazards should be documented to allow further action. The work environment, tool and equipment as well as tasks and procedures should be examined for risks to
  - ✓ Information about equipment (e.g. plant, operating instructions) and Material Safety Data Sheets be reviewed to determine relevant safety precautions
  - ✓ Welcome creative thinking about what could go wrong takes place, i.e. what hazardous event could take place here?

1.5 Risk Control: Taking actions to eliminate health and safety risks so far as is reasonably practicable. Where risks cannot be eliminated, then implementation of control measures is required, to minimize risks so far as is reasonably practicable. A hierarchy of controls has been developed and is described below to assist in selection of the most appropriate risk control measure/s.

- **Elimination,**
  - ✓ Discontinue use of the hazardous substance or procedure altogether.
- **Substitution, replacing the chemical by a less hazardous one.**
  - ✓ Substituting benzene by methylbenzene (toluene)
  - ✓ Substituting a different physical form of the chemical e.g. powder to pellet will also minimise dissemination.
- **Engineering controls.**

  E.g. total enclosure, partial enclosure, local exhaust ventilation (LEV) such as a fume cupboard

Self-Check -1

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

1. What are the causes of hazard in working place. (3 points)

   A. Ill health C. injury

   B. property damage D. all

2. Types of at work place categorized.(3 points)

   A. physical C. biological

   B. chemical D. all

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Accident contingency measures

2.1 Hazard control measures

The measure to be taken against the hazards can be classified into two groups:

- Proactive measures- actions to be taken in advance, precautionary measure and its implementation
  - ✓ Safety training
  - ✓ Safety program
  - ✓ Inspection and checklist
  - ✓ Personal protective equipment(PPE)
- Reactive Measures- action to be taken after accident occurs
  - ✓ Medical aid
  - ✓ Accident reporting and analysis

2.1 Accident control

- Administrative Controls-
  - ✓ Establish procedures.
  - ✓ Monitoring of Contaminants.
  - ✓ . Organizing Hazardous Operations when small numbers of people are present.(e.g., between shifts or after working hours
  - ✓ Rotation of workers to reduce exposure to a particular hazard
- **Engineering Controls-**
  - ✓ General design of workplace, plant or equipment.
  - ✓ Installation of additional lighting.
  - ✓ Use of automation and mechanical devices.
  - ✓ Isolation- isolates hazardous activities from large groups of workers. (e.g., storage of materials, noise enclosure, guards, warning devices and interlocks.
  - ✓ Containment Remove contaminants by air movers-" containing the hazard at its source."
  - ✓ Limitation- Limit the effect of a potential hazard: safety valves installed, using low voltage, low power or batteries.

Personal Protective Equipment- Only effective when all other options are not satisfactory or practical. Or in normally hazardous operations such as welding, spraying or confined space. Orin emergency situations or confined space entry when hazards are unknown.

Self-Check -2

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

1. Reactive measures is taken before accident is occur. (3 points)

   A.TRUE B.FALSE

2. Proactive measures is taken after accident is occur. (3points)

   A.TRUE B.FALSE

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Reference

- ✓ National Rural Road Development Agency, Equipment and Test Procedures, India Volume I, (May 2007).
- ✓ Quality Assurance Handbook for Rural Roads, Volume I & II, National Rural Roads Development Agency, India
- ✓ Contractor's Handbook, Roads Training School, Zambia
- ✓ Guideline for Quality Assurance Procedures and Specifications for Labor-Based Road Works
- ✓ AACRA Manual
- ✓ Labor Based Road Works (Zambia Hand Book)
- ✓ ERA Manual
- ✓ Global source.com

Basic Infrastructure Operations

NTQF Level I

Learning Guide # 55

Unit of Competence: Conduct Simple Sampling and Testing

Module Title: Conducting Simple Sampling and Testing

LG Code: CON BIO1 M13 LO6-LG-55

TTLM Code: CON BIO1 TTLM 1019v1

LO 6: Control hazards and risks

Instruction Sheet	Learning Guide #55

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

- applying OHS procedures
- using PPE
- Basic concept on hazards and risks control techniques, practices, procedures and contingency measures

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Follow occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace.
- Follow procedures for dealing with workplace accidents, fire and emergencies
- Use personal protective equipment (PPE).
- provide appropriate assistance in the event of a workplace emergency

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check 2, Self-check 3 a” **in page -118, 121, and 125** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -.**
6. Do the “LAP test” **in page –** (if you are ready).

Information Sheet-1	applying OHS procedures

1.1 Safety Requirement

"**Safety first**" is a good slogan at any time especially in the workshop and on site work.

"OHS" Occupational health and safety

i. **Health: -** is the protection of the bodies and minds of people from illness resulting from the materials, processes or procedures used in the workplace.

ii. **Safety: -** is the protection of people from physical injury. The borderline between health and safety is ill-defined and the two words are normally used together to indicate concern for the physical and mental well-being of the individual at the place of work.

iii. **Accidents: -** is defined as an unexpected and desirable event resulting in damage.

1.1.1 Protective clothing and equipment

Personal protective equipment (PPE) is protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. Protective equipment may be worn for job-related occupational safety and health purposes, as well as for sports and other recreational activities. "Protective clothing" is applied to traditional categories of clothing, and "protective gear" applies to items such as pads, guards, shields, or masks, and others.

Benefits of PPE

The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering controls and administrative controls are not feasible or effective to reduce these risks to acceptable levels. PPE is needed when there are hazards present. PPE has the serious limitation that it does not eliminate the hazard at the source and may result in employees being exposed to the hazard if the equipment fails.

Type of PPE		Use
SAFETY HELMET		Safety helmets/hard hats are used to protect the head from falling objects and to prevent the head from striking off objects. They should be replaced periodically.
SAFETY BOOT/HI-VIS		Safety boots are required on all construction sites. They should have steel toecaps and sole protection to prevent the toes from being crushed and any object from penetrating the sole. High-visibility vests and high-visibility jackets help to ensure that a worker can be seen by drivers and operators of plant and other vehicles.
EYE PROTECTION		Eye protection in the form of glasses/goggles/visors protects the eyes from dust, flying objects, and splashes (e.g. when cutting and grinding).
SAFETY GLOVES		Safety gloves protect the hands from cuts and from contact with harmful substances, sharp objects, etc.
EAR PROTECTION		Ear protectors help to protect hearing from loud sudden noise or from continuous loud noise. There are two action levels. Where noise exposure is at or exceeds 80 dBA (decibels), individual hearing protectors must be made available. Where noise exposure is at or exceeds 85 dBA.
DUST MASKS		Dust masks protect workers from inhaling harmful dusts
RESPIRATORY EQUIPMENT		Respiratory equipment protects workers by filtering out harmful substances from the air breathed in. To work effectively, they must be well maintained
FACE PROTECTION		Face-protection visors protect the face from flying objects, sparks, and splashes from hot or harmful substances.

1.1.2 Use of tools and equipment

Always use the right tool for each job.

- Before using a tool make sure it has been properly maintained and repaired to avoid increased vibration caused by faults or general wear.
- Make sure cutting tools are kept sharp so that they remain efficient.
- Reduce the amount of time you use a tool in one go, by doing other jobs in between.
- Store tools so that they do not have very cold handles when next used.
- Encourage good blood circulation by keeping warm and dry (when necessary, wear gloves, etc.).
- Massage and exercise your fingers during work breaks.

1.1.3 Handling of materials

The movement of row material from their native site to the point of use in manufacturing, their subsequent manipulation in production, process, and the transfer of finished products from crusher site and their distribution to user.

Example Storage of cement does not set unless exposed to humidity It is, therefore, advisable to store cement in a shed, preferably without windows. A boarded floor or wooden platform above the ground is advisable. Bags:

- Should not be stocked above man-height,
- Should not touch the walls of the shed so that air can freely circulate
- Must be off-loaded by hand in order to keep the paper bags unbroken, and
- Should be used up in rotation (first stocked - first used).
- Hardened lumps found when opening the bag should be removed by sieving the cement.

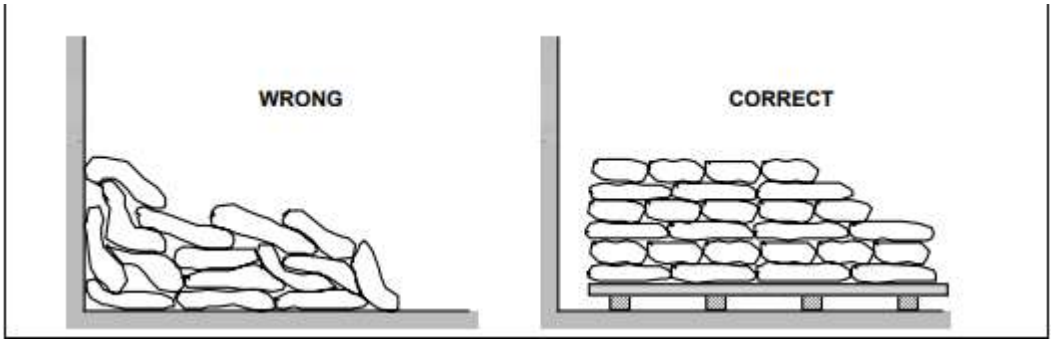


Figure 1. Handling of row material

1.1.4 Use of fire fighting equipment

When it comes to purchasing a fire extinguisher, look for one that is tested by an independent testing laboratory. Also, look for one labeled A-B-C as it can be used on most fires that would occur in your home. You want to be sure the the type of fire extinguisher you use is the right one for the fire you are dealing with. The types of Fire extinguishers are:

- TYPE A: - extinguishers are for use on fires that contain ordinary combustibles such as paper, wood, cloth, plastics, etc.
- TYPE B: - extinguishers are for use on fires containing flammable liquids like oil, gasoline, etc.
- TYPE C: - extinguishers are for fires involving electrical equipment such as tools or appliances.
- TYPE D: - extinguishers are for use on combustible metals. This type of extinguisher is generally only found in factories that work with these particular metals.
- TYPE K: - extinguishers are for use on fires involving combustible cooking liquids such as animal oils, vegetable oils and fats. This type of extinguisher is most likely to be found in a commercial kitchen.

Figure 2. Fire extinguisher equipment type

1.1.5 Use of First Aid equipment

First-aid equipment must be provided and maintained, and be easily accessible. At least one first aider should be available if the site-specific Risk Assessment shows that this is necessary. A trained first aider should generally be available to all road workers.

Cuts, scrapes and burns are common injuries to expect so prepare a first aid kit with the appropriate supplies. ... First aid kits are designed to manage all types of injuries including basic cuts, scrapes and burns. Save yourself money and keep a stocked first aid kit close.

Figure 3. First aid kit

1.1.6 Hazard control and hazardous materials and substances

Construction workers are likely to suffer ill health as a result of their work in the industry after exposure to both harsh working conditions and hazardous substances. Ill health can result from:

- **Asbestos**: Exposure to asbestos can cause serious respiratory diseases such as asbestosis and cancer.

- **Manual handling**: Lifting heavy and awkward loads causes back and other injuries. Some injuries can result from a single lift, but more commonly, long-term injury develops as a result of repeated minor injury due to repetitive lifting.
- **Noise and vibration**: High levels of noise can cause hearing loss and repeated use of vibrating tools can cause hand-arm vibration syndrome (damage to nerves and blood vessels – most commonly in the hands and fingers).
- **Chemicals**: Exposure to materials such as cement and solvents can cause skin problems such as dermatitis. (Health and safety in construction, 3rd ed., 2006, Health and Safety Executive)

Type of Hazards	Cause of hazard	Description
Chemical Hazards	Dusts, fumes, fibers (solids) Liquids, mists Gases, vapors	
Physical Hazards	Noise Vibration Temperature extremes Radiation	
Biological Hazards	Soil Waste water Insects (mosquitoes, ticks) Bird, bat droppings Animals Structures	

Management of any construction firm has the responsibility of developing a **comprehensive and written safety program** that is performance oriented. The information should include the **basics of personal protective equipment's, the proper equipments, use safe work of practice, tools company policy and on power safety, safety responsibilities, emergency procedure**, etc.
An accident is any unforeseen or unexpected event that may or may not result in injury or damage to property or equipment. Become out of usage so for this problem must provide, Always use the appropriate tool for the appropriate job.

Self-Check -1

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

1. Comprehensive and written safety program is protecting form accidents?
   A. True B. False

2. Your employer has a duty to inform you of any significant risks associated with a work activity?
   A. True B. False

3. Provide adequate information and training is not important to employees?
   A. True B. False

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 and 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-2	• **using PPE**

2.1 Protective clothing and equipment

Personal protective equipment (PPE) is protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. Protective equipment may be worn for job-related occupational safety and health purposes, as well as for sports and other recreational activities. "Protective clothing" is applied to traditional categories of clothing, and "protective gear" applies to items such as pads, guards, shields, or masks, and others.

Benefits of PPE

The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering controls and administrative controls are not feasible or effective to reduce these risks to acceptable levels. PPE is needed when there are hazards present. PPE has the serious limitation that it does not eliminate the hazard at the source and may result in employees being exposed to the hazard if the equipment fails.

Table 1 Personal protective equipment

Type of PPE		Use
SAFETY HELMET		Safety helmets/hard hats are used to protect the head from falling objects and to prevent the head from striking off objects. They should be replaced periodically.
SAFETY BOOT/HI-VIS		Safety boots are required on all construction sites. They should have steel toecaps and sole protection to prevent the toes from being crushed and any object from penetrating the sole. High-visibility vests and high-visibility jackets help to ensure that a worker can be seen by drivers and operators of plant and other vehicles.
EYE PROTECTION		Eye protection in the form of glasses/goggles/visors protects the eyes from dust, flying objects, and splashes (e.g. when cutting and grinding).
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FACE PROTECTION		Face-protection visors protect the face from flying objects, sparks, and splashes from hot or harmful substances.

Self-Check -2	Written Test

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

1. ----------is used to protect the head from failing objects . (3 points)

   A. gloves B. dust mask

   A. helmet B. all

2. ----------is used to protect the hand from cut . (3 points)

   A. gloves B. dust mask

   A. helmet B. all

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	• **Basic concept on hazards and risks control techniques**

3.1 Definitions

Hazard: Anything (e.g. condition, situation, practice, behavior) that has the potential to cause harm, including injury, disease, death, environmental, property and equipment damage. A hazard can be a thing or a situation.

3.2 Hazard Identification:

This is the process of examining each work area and work task for the purpose of identifying all the hazards which are “inherent in the job”. Work areas include but are not limited to machine workshops, laboratories, Office areas, stores and transport, maintenance and grounds, ,and lecture theatres and teaching spaces. Tasks can include (but may not be limited to) using screen based equipment, audio and visual equipment, industrial equipment, hazardous substances and/or teaching/dealing with people, driving a vehicle, dealing with emergency situations, construction. This process is about finding what could cause harm in work task or area.

3.3 Risk Assessment:

- **Risk**: The likelihood, or possibility, that harm (injury, illness, death, damage etc) may occur from exposure to a hazard

  Risk assessment Is defined as the process of assessing the risks associated with each of the hazards identified so the Nature of the risk can be understood. This includes the nature of the harm that may result from the hazard, the severity of that harm and the likelihood of this occurring

3.4 Risk Control: Taking actions to eliminate health and safety risks so far as is reasonably practicable. Where risks cannot be eliminated, then implementation of control measures is required, to minimize risks so far as is reasonably practicable.

3.4.1 Hazard control and hazardous materials and substances

Construction workers are likely to suffer ill health as a result of their work in the industry after exposure to both harsh working conditions and hazardous substances. Ill health can result from:

- **Asbestos**: Exposure to asbestos can cause serious respiratory diseases such as asbestosis and cancer.

- **Manual handling**: Lifting heavy and awkward loads causes back and other injuries. Some injuries can result from a single lift, but more commonly, long-term injury develops as a result of repeated minor injury due to repetitive lifting.
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Management of any construction firm has the responsibility of developing a **comprehensive and written safety program** that is performance oriented. The information should include the **basics of personal protective equipment's, the proper equipment's, use safe work of practice, tools company policy and on power safety, safety responsibilities, emergency procedure**, etc.

An accident is any unforeseen or unexpected event that may or may not result in injury or damage to property or equipment. Become out of usage so for this problem must provide, Always use the appropriate tool for the appropriate job.

Monitoring and Review: This involves ongoing monitoring of the hazards identified, risks assessed and risk control processes and reviewing them to make sure they are working effectively.

Self-Check -3

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

1. What are the causes of hazard in working place? (3 points)

   A. Ill health C. injury

   B. property damage D. all

2. Types of at work place categorized. (3 points)

   A. physical C. biological

   B. chemical D. all

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer key

Conducting Simple Sampling and Testing
LO1: Prepare for sampling
LO2: Take sample
LO3: Conduct material testing
LO4: Conduct preparation of stabilized construction materials
LO5: Identify hazards and risks
LO6: Control hazards and risks

Answer for LO1: Prepare for sampling

Self-check 1

1. C work instruction

2. A true

Self-check 2

1. C safety

2. B true

Self-check 3

1. A true

2. C A&B is answer

Self-check 4

1. D. Sieve shaker

2. C Oven dry

3. **C** Casagrnades apparatus

Self-check 5

1. A true

2. D. all

Answer for LO2: Taking sample
Self-check 1

1. A Pick axe

2. C Wheel barrow

3. A Auger

Self-check 2

1. D. All is answer

2. D. All is answer

3. **D**. All is answer

Self-check 3

1. A true

2. A true

Self-check 4

1.

2.

Self-check 5

1. D all is answer

2. A true

Answer for LO 3 Conduct material testing

Self-check 1

1. C radioactive

2. A toxicity

3. D. All

Self-check 2

1. A. Liquid limit

2. B. optimum moisture content

3. **D**. CBR

Self-check 3

1. C. Grain size analysis

2. B. 2.65 to 2.80

Self-check 4

1. A. True

2. A. True

Answer for LO 4 Conduct preparation of stabilized construction materials
Self-check 1

1. D. all is answer

2. A. True

Self-check 2

1. A. True

2. B. false

Self-check 3

1. D. A&B is answer

2. D. All is answer

3. D. All is answer

Answer for LO 5 Identify hazards and risks

Self-check 1

1. D. all is answer

2. D. all is answer

Self-check 2

1. B. false

2. B. false

Self-check 3

1. D. A&B is answer

2. D. All is answer

3. D. All is answer

Answer for LO 6 Control hazards and risks

Self-check 1

1. A True

2. A True

2. B false

Self-check 2

1. B. helmet

2. A. gloves

Self-check 3

1. D. All is answer

2. D. All is answer

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- ✓ ERA Manual
- ✓ Global source.com

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