Bar Bending & Concreting

Level-II

Learning Guide-#46

Unit of Competence: Lay Smooth and Rough Cement Screeds

Module Title: Laying Smooth and Rough Cement Screeds

LG Code: EIS BBC2 M13 1019 LO1-LG-46

TTLM Code: EIS BBC2 M13 TTLM 0919v1

LO1 Plan and prepare

Instruction Sheet	Learning Guide #46

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

- Planning/working drawing interpretation
- Identifying and applying necessary requirements
  - ✓ Safety requirements
  - ✓ Regulatory requirements
  - ✓ Environmental protection
- Types, characteristics and uses of materials, tools and equipment
- Calculating materials quantity requirements
- Measuring tools & equipment
- Materials handling and storage

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**:

- Work instructions, including plans, specifications, quality requirements and operational details are obtained, confirmed and applied
- OHS requirements are followed in accordance with safety plans and policies
- Signage/barricade requirements are identified and implemented
- Plant, tools and equipment selected to carry out tasks that are consistent with the requirements of the job, checked for serviceability and any faults are rectified or reported prior to commencement
- Material quantity requirements are calculated in accordance with plans and/or specifications
- Resource materials appropriate to the work application are identified, obtained, prepared, safely handled and located ready for use
- Environmental protection requirements are identified for the project in accordance with environmental plans and regulatory obligations and applied

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, and Sheet 3”.
4. Accomplish the “Self-check 1, Self-check t 2, and Self-check 3”
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ”.
6. Do the “LAP test” (if you are ready).

Information Sheet-1	Planning /working drawing interpretation

1.1. Plan/working drawing interpretation

A plans is a set of drawings or two-dimensional diagrams used to describe a place or object, or to communicate building or fabrication instructions. Usually plans are drawn or printed on paper, but they can take the form of a digital file. Construction drawings are necessary in most spheres of the building industry, as being the best means of conveying detailed and often complex information from the designer to all those concerned with the job. Building trades people should be familiar with the basic principles involved in understanding and reading drawings correctly.

Mistakes on either side – in design or interpretation of the design – can be costly, as drawings form a legal part of the contract between architect/client and builder. This applies even on small jobs, where only goodwill may suffer; for this reason, if a non-contractual drawing or sketch is supplied, it should be kept for a period of time after completion of the job, in case any queries should arise.

1.1 how to read engineering drawings

Engineering drawings are typically used as visual tools in the creation of homes, bridges, and other buildings. While these drawings can be quite straightforward to individuals who are skilled in the field of engineering or architecture, they can be quite difficult to interpret for laypeople. Knowing how to read engineering drawings will help provide you with a better idea of the building plans.

1.2.1 Familiarize yourself with the scale of the drawings.

Understanding how large or small certain items are essential when reading engineering drawings. While most engineering drawings are created in "scale" versions of 1/4-1/8 inches (.55-.275 centimeters) per foot, other scales may be used for very large creations. Always determine the scale of the drawing before examining it in detail. If the scale is not obviously evident on the drawing, consult with the engineer who drew it for clarification.

Fig. 1.1: scale of the drawings

1.2.2 Understand the basic symbols used in the engineering drawings.

As these drawings are done on such a small scale, the use of symbols is often required. While many symbols exist, understanding a few of the basics can be very helpful when reading engineering drawings. Some of the most common symbols used in these drawings include rectangles, circles, and triangles. As with determining the scale, consulting with the engineer who created the drawing can provide great insight as to the symbols used.

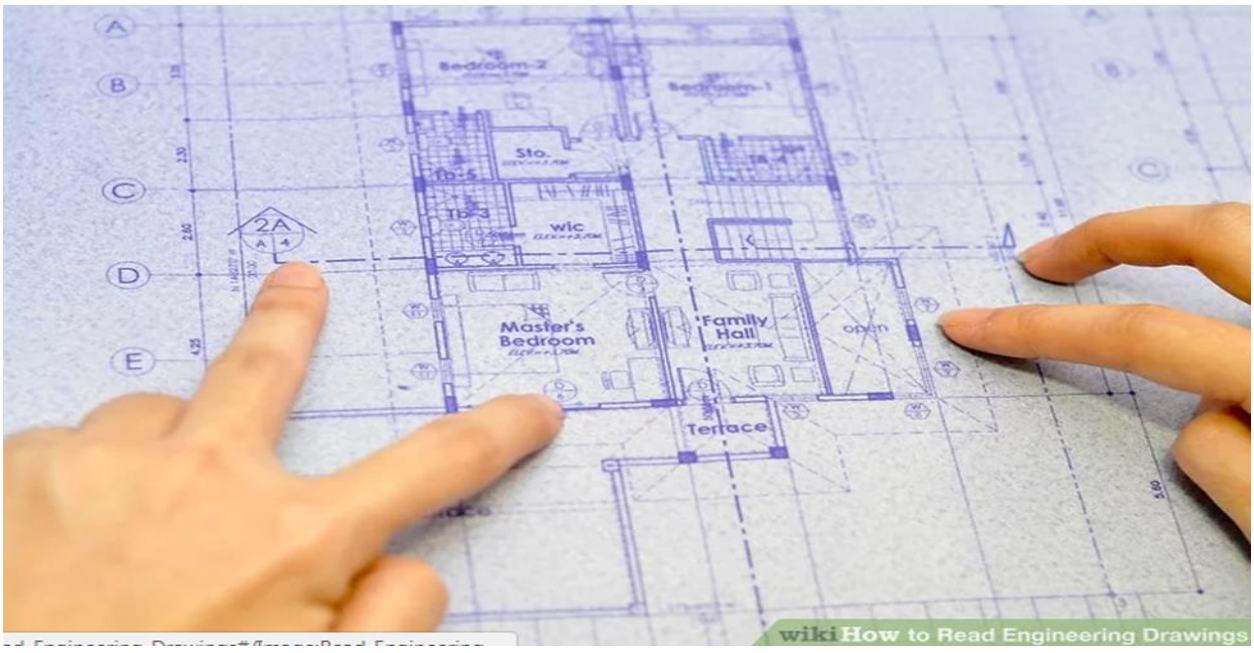

Fig.1. 2: Understand the basic symbols

1.2.3 Look for circled numbers.

As discussed previously, engineering drawings are typically done on a scale so small that creating detail is almost impossible. Because of this, engineers often add circled numbers to certain parts of the drawings. These circled numbers indicate that the area identified is shown in greater detail on another page.

Fig.1. 3: indicate that the area identified

1.2.4 Identify specific abbreviations.

Abbreviations are a useful tool for engineers. Like symbols, they can indicate shapes, processes, and even dimensions through a few letters. Some of the most common abbreviations used in engineering drawings include DP, which stands for depth, and DIA, which stands for diameter.

Fig. 1.4: the most common abbreviations

1.2.5 Work with colleagues.

When all else fails, consult with other professionals to better clarify the drawings. While it may be embarrassing to admit that you are having difficulty interpreting the drawing, those who regularly work with and understand the drawings will help you read them. Ask "in the know" individuals on the project to clarify anything you do not understand; better that this happens in the early stages of a project than to encounter a mistake farther into a project because of improperly reading engineering drawings.

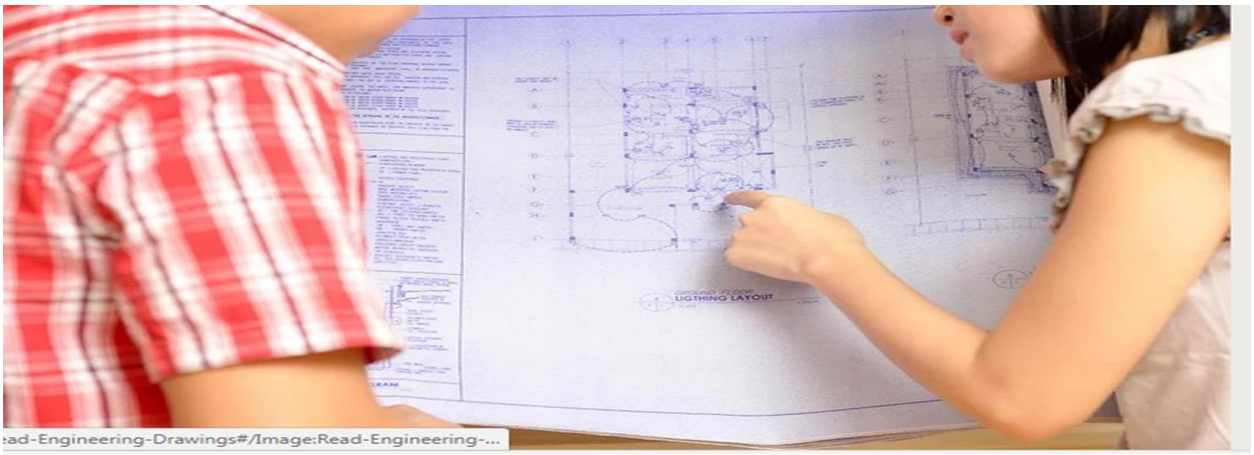

Fig. 1.5: understand the drawings will help you read them

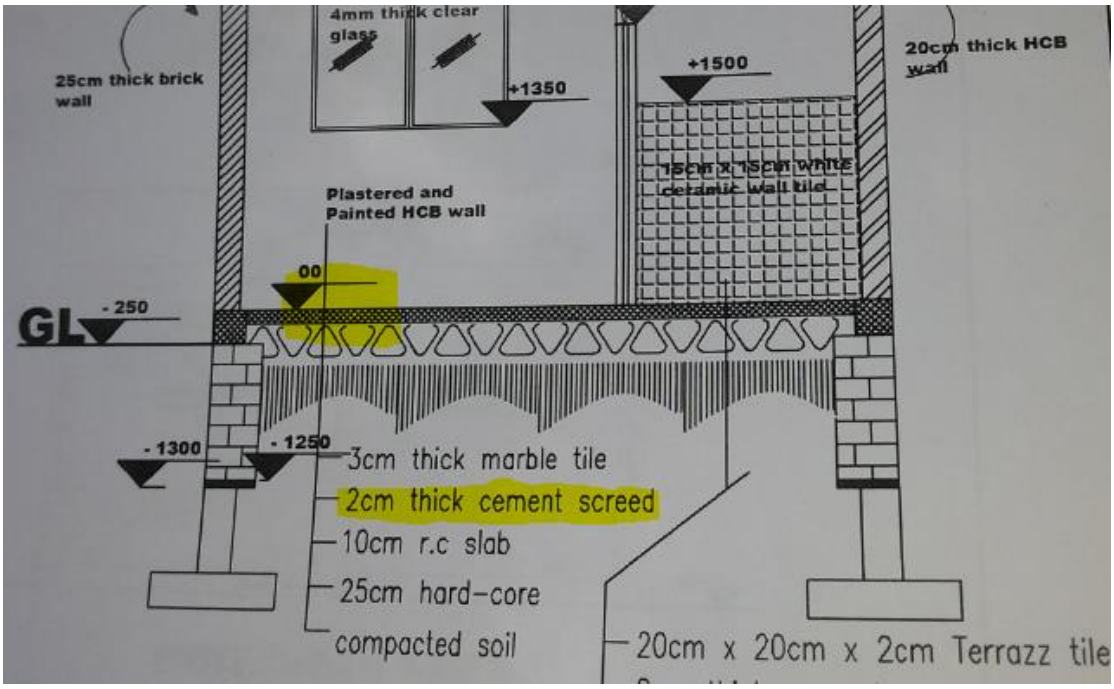

Fig. 1.1: section plan which shows flooring material.

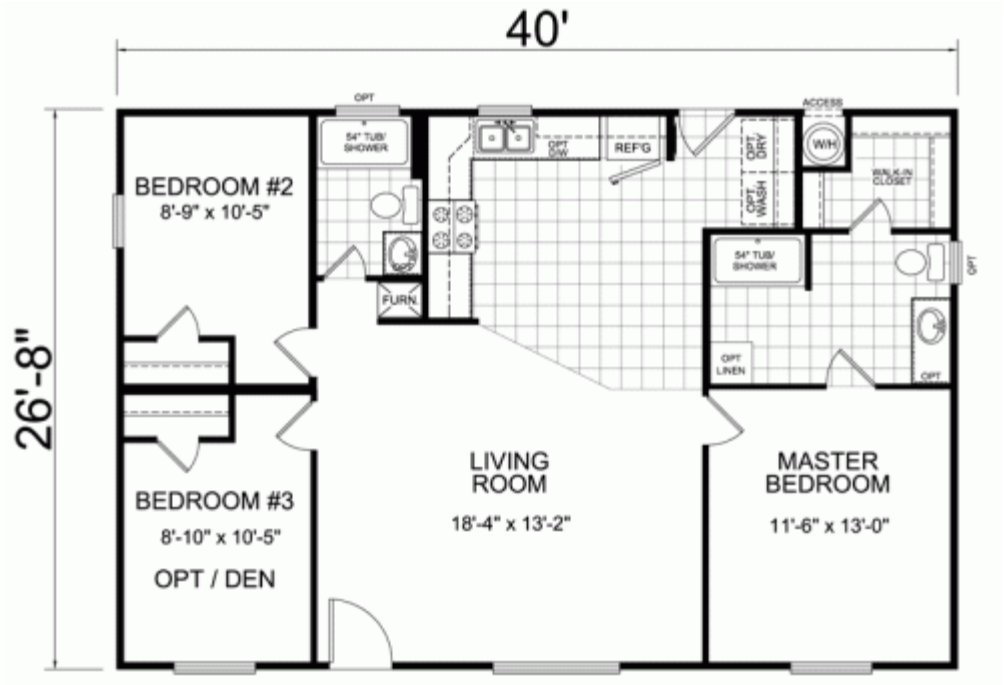

Fig. 1.2: floor plan which shows floor finishing material.

(for more refer Bar bending & concreting level II, Module 3: Reading & Interpreting Plans and specification)

2.2. Prepare for work

To plan and prepare for the work, the following information should be explored and interpreted. It is strongly recommended that this information is properly recorded.

- Location of the project.
- Floor areas concerned.
- Type(s) of screed to be laid, i.e. levelling/wearing, bonded/unbonded/floating, cementitious/calcium sulphate/proprietary.
- Relevant details of the concrete base.
- Preparation of the base surface to be carried out.
- Whether a new DPM/C is needed and how this is to be provided.
- If the floor is a floating floor, the type and thickness of the insulation.
- Mix details of the screed + polymer type and content if the screed is a polymer modified screed.
- Design thickness of the screed and minimum thickness to be achieved.
- Details of services to be incorporated within the screed.

- Details of any reinforcement to be included within the screed.
- Joint details and locations.
- Type of surface finish required.
- Details of curing to be carried out.
- Whether the contractor is to provide subsequent temporary protection for the screed surface.
- Details of any conformity testing to be carried out by the contractor.
- The curing period to remove the curing medium before the time

Self-Check -1	Written Test

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

1. List out the information interpreted to prepare for cement screed work at least five points. (5 points)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet- 2	Identifying and applying necessary requirements

2.1. Introduction

The minimum necessary standard, a key protection of the Privacy Rule, is derived from confidentiality codes and practices in common use today. It is based on sound current practice that protected health information should not be used or disclosed when it is not necessary to satisfy a particular purpose or carry out a function. The minimum necessary standard requires covered entities to evaluate their practices and enhance safeguards as needed to limit unnecessary or inappropriate access to and disclosure of protected health information

2.2. Safety requirements

The workplace is full of many types of health and safety hazards, and exposure to these hazards can be harmful, and sometimes fatal, to employees. OSHA, the U.S. Occupational Safety and Health Administration, mandates employers to adhere to regulated workplace safety requirements to eliminate hazards and maintain a safe, accident-free workplace.

- **Safety Signs**:

Many health and safety hazards can be eliminated through the use of proper signage. The Health and Safety Executive website explains that safety signs must be used at work whenever a safety hazard has not been able to be completely eliminated by the employer. The many types of warning and caution signs each have different implications. Danger signs, for instance, are used for more severely hazardous work areas, while caution signs are used to warn employees of potential risks.

OSHA explains that failure to use safety signs could lead to accidental injury, as well as property damage. Proper signage must be used with biological hazards, chemicals, heavy machinery and equipment, large vehicles and electrical devices. In office environments, caution signs should be put up whenever walking surfaces are wet or slippery, when parts of the building are under repair and on the bottles of cleaning agents, to illustrate what types of dangers the chemicals can cause.

- **Personal Protective Equipment:**

It is a workplace requirement, per OSHA, for employers to provide their staff with the appropriate personal protective equipment to keep employees safe when performing their jobs. Personal protective equipment ranges from goggles to cover the eyes to respiratory devices, and must be used whenever there are hazardous environments, or when employees are working with flying particles or objects, chemical hazards or mechanical irritants.

OSHA explains that employers must make sure that there is enough personal protective equipment for all employees, and that the equipment fits the employees properly. Goggles that are too loose, for instance, will not adequately shield and protect the eyes.

- **Sanitation Requirements:**

Employees have the right to a sanitary work environment, so OSHA has requirements that employers must abide by to ensure good housekeeping practices. Waste must be disposed of regularly and in a way that does not cause unsanitary conditions, including spills or odors in public areas. Offices or enclosed workspaces must be constructed in a way that prevents the entrance of vermin, as rodents and insects pose a health hazard to people. Toilet facilities must be kept tidy and cleaned regularly with chemical agents that disinfect bacteria. Spills and leaks must be mopped up and addressed immediately to avoid any toxicity hazards, as well as to avoid slip-and-fall accidents.

2.3. Personal Safety tools

Safety Helmet: -Protects head of the worker from any falling objects dropping from high level during construction.	
Overall Cloth:-Protects the normal clothes from dust, grease and other spilling materials.	

Safety shoe (boot):-Protects the worker form nail, sharp objects and heavy falling objects by hard-rolled leather shoes with metal toe caps. It must be Non-slip oil resistant shoe	
Rubber boot: - Protects the workers feet from colds, chemical, and mud in the working area.	
Mask: - Protects eyes of the worker from other endangering object and dust during construction.	
Goggle: - Protects eyes of the workers during welding of metal works and when placing reinforcement in the formwork.	
Glove: -Protects the workers from oils, chemicals, and dust and other dangerous material that affect the skin.	
Safety Belt: - Secures laborers working in a plane where the construction is done at high level.	

Fig. 2.1. personal safety tools

2.4. Regulatory requirements

Once recognized, all awarding organizations must comply with our regulatory requirements – the standards and rules we set for designing, delivering and awarding regulated qualifications – on an ongoing basis.

Because we take a risk-based approach to regulation, we target our work (including regulatory requirements) where it is most needed. This means that different requirements could apply to different qualifications, or to different awarding organizations.

In practice, the way we have structured our regulatory requirements means that there are two main types of requirements:

- ✓ requirements which apply to all awarding organizations, and all qualifications; and
- ✓ Qualification-specific requirements, which apply to particular types of qualification.

We also sometimes impose requirements on individual awarding organizations; we call these requirements Special Conditions. For example, we might choose to apply a special condition to make sure an awarding organization follows through on commitments they made when applying for recognition.

2.5. Environmental protection

Environmental protection is a practice of protecting the natural environment for the benefit of both the natural environment and humans. Due to the pressures of population and technology, the biophysical environment is being degraded, sometimes permanently. Academic institutions now offer courses, such as environmental studies, environmental management and environmental engineering, that teach the history and methods of environment protection. Protection of the environment is needed due to various human activities. Waste production, air pollution, and loss of biodiversity (resulting from the introduction of invasive species and species extinction) are some of the issues related to environmental protection.

It is the responsibility of all individuals to comply with environmental regulations and for preventing pollution of air, land and water. Many thousands of pollution incidents occur

each year and each one is an offence which can result in prosecution as well as environmental damage. Most cases however are avoidable given careful planning of operations, responsible waste management and suitable facilities to reduce the risk of spillage - along with simple precautions to deal with any spillages, should they occur.

- **Site Drainage** Across the site there are generally two types of drains, these are:
  - ✓ Surface Water or Storm Drains
  - ✓ Foul or Effluent Drains

In planning and carrying out any work, precautions must be taken to ensure the complete protection of watercourses and groundwater against pollution. These should include an investigation of past use of the site to ensure that the operations will not disturb contaminated land, and a survey of the siting and contents of all storage tanks and pipelines. It is the contractor's responsibility to ensure that all drainage systems are correctly identified prior to the commencement of works, to avoid the possibility of incorrect disposal of contaminated water. The drainage systems at Loughborough University are varied depending on location so advice should be sought prior to the commencement of works.

- **Pollutants**

Silt causes lasting damage to river life such as fish, insects and plants and can also build up to cause flooding. Water containing silt should never be pumped or allowed to flow directly into a river, stream or surface water drain. Silty water can arise from dewatering excavations, exposed ground, stockpiles, plant and wheel washing, site roads and disturbance of the riverbed. Where possible, silty water should be disposed of to the foul sewer with the prior agreement of the sewerage undertaker.

Concrete and cement are very alkaline and corrosive and can cause serious pollution in watercourses. It is essential to ensure that the use of wet concrete and cement in or close to any watercourse is carefully controlled so as to minimize the risk of any material entering the water, particularly from the washing of equipment. The use of quick setting mixes may be appropriate. For long- term projects involving on-site concrete production, careful initial siting of concrete mixing facilities is vital.

Oil / Fuel pollution is the main cause of pollution incidents, and care should be taken to prevent vandalism and the risk of damage by maneuvering vehicles on sites where oil or fuel is stored.

Herbicides – the use of herbicides in or near rivers is not permitted.

Detergents - Wash waters from mobile pressure washers should not be discharged to surface water drains, watercourses or soak ways.

Paints and varnishes

Pollution prevention – Contractors should undertake all precautions necessary to prevent pollution. Where vehicles carry liquids, the vehicles should be specifically designed for this purpose and/or liquids should always be carried in secondary containment, e.g. plastic boxes or trays. Vehicles which routinely carry liquids should carry spill kits / containment controls such as drain mats/covers and absorbent materials.

Self-Check -2	Written Test

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

1. List out Personal Safety tools at least five tools. (5 points)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet- 3	Types, characteristics and uses of materials, tools and equipment

Materials, tools and equipment commonly used to perform cement screed are listed below

3.1. **Tools**

- **Spirit level**

It is used to control the horizontal and vertical alignment of wall surface and edges. The length is at least 80 to 120cm long. It is made of metal, synthetic material or wood. It has two measuring bubbles: one is located at mid length is used to check horizontal positions. While the second one, at the end, is used to check vertical position. This tool requires always to be handled with care and needs to be checked from time to time weather it is still working accurate or not.

FIG. 3.1: Spirit level

- **Alignment string /masons' line/**

Alignment string /mason line/, sometimes called, Fish line, is a rope used to transfer horizontal & vertical alignments or lines, i.e., use to mark base line on the floor or vertical point alignments of wall. In other words, it is used to align the walling blocks, (stone, bricks, concrete blocks, hydra form etc). It is available in different thickness & sizes in the market.

FIG. 3.2: Mason line/alignment string

- **Hose level**

It is a transparent PVC hose. It is used to transfer or mark vertical levels on surface of wall when it is filled with water, but without any air bubbles. The water level in each end of the hose is equal. It is an instrument to mark equal levels on site. It is very accurate but not eases to handle.

FIG. 3.3: Hose level/water level

- **Wood float**

Used to smooth out concrete surface before the concrete fully cure. It is about 30cm long and 15 cm wide with a handle. Floating concrete is an operation of concrete finish work after drabbing on bull floating to remove slight imperfection, fill small holes, level etc. on the surface of concrete.

Fig. 3.4: wooden float

- **Metal float**

This does the same as wooden float except that it points a slick on the concrete. You may prefer this for patios and concrete slabs whenever smooth concrete surfaces are required.

fig. 3.5: metallic float

- **Edge float**

It is made of metal like the metal float, but it has bent – over at right angles to the flat part or at one edge. It is used along the edge of a walk a slab to polish and have, finished look to the work, it makes slightly rounded edges and border about 10 cm.

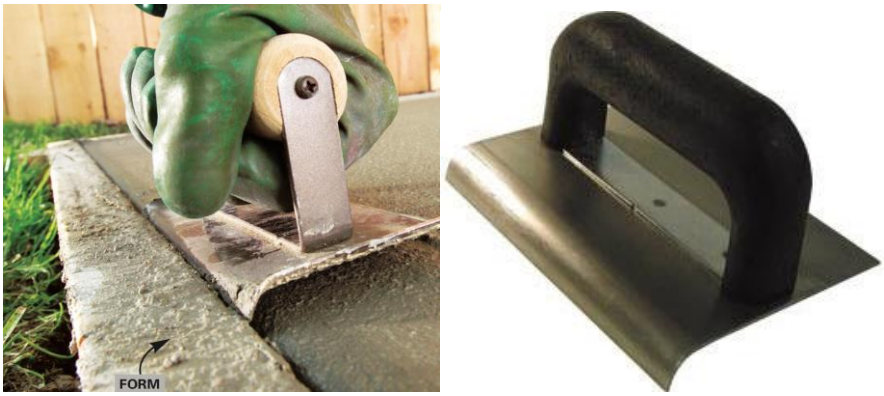

Fig.3.6: Concrete edging float

- **Darby**

Used for making smooth concrete surface on small area in places where it is difficult for ball float to reach, which as large slabs where there is constructions of pipes, reinforcement on other types of building components. It consists of a long flat rectangular piece of wood on aluminum from 7.5cm to 10cmon wide with a handle on the top.

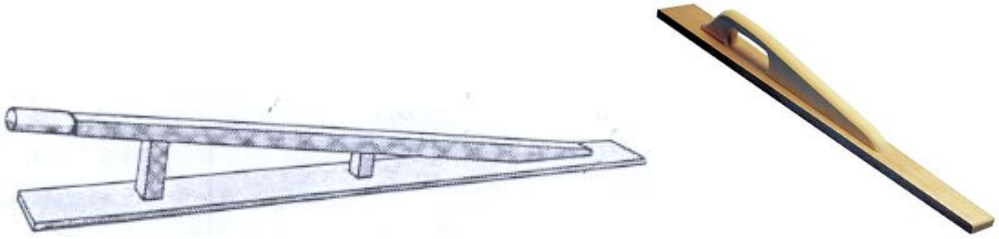

Fig.3.7: Darby

- **Bull float**

It is a large, flat rectangular piece of wood or aluminum usually 20cm wide and 100cm to 150cm long with a handle of 1.2 m to 4.8m long. It is used to make large area of concrete finishes. It is more commonly used outdoors where there is enough space to use the long handle.

fig. 3.8: bull float

- **Straight edge/Level/**

This is a perfectly straight metal/aluminium/ with all long and short edges parallel to its centreline. It is employed to check straight alignments of walls. Its length ranges from 2m up to 4m. Together with the sprit level, it can be used to bridge over the point to be checked. A straight edge/Level/ can also be made from a wooden plank with perfectly parallel edges.

fig. 3.9: Straight edge

- **Angle / mason square**

It is used to measure a right angle (90º) of a corner. Used inlaying masonry units or blocks at corners of masonry wall.

Fig. 3.10: Mason square

- **Measuring tape**

A tape measure, also called measuring tape, is a type of flexible ruler used to measure dimensions of building parts and distances in site. the term “tape measure” refers to a roll-up, self-retracting style tape measure that’s designed for carpentry. It is manufactured from steel, plastic or fibre in lengths of 1m, 2m, 3m, 5m, 30m, etc. and 50m. In using tapes for measurements, the two points should be aligned perfectly. In addition, when long horizontal measurements are needed, care should be taken to avoid sag on the tape meters.

Fig. 3.11: Measuring tape & proper adjustment of measuring tape

- **Mortar barrel/ drum**

This is used by mason, plasterer, tiller, etc, and serves to prepare small amount of mortar right at the working place. It is also used as temporary mortar storage, supplied from mixing station, and to control water ratio of the mix when it gets dry. Always, keep it workable and clean.

Fig. 3.12: Mortar drum

- **Water Bucket**

A Bucket is used to serve small amount of water or material and to take the tools after work.

Fig. 1.13: water Bucket

3.2. **Equipment/ Machinery**

- **Concrete/ Mortar Mixer**

Concrete mixers are available in from of different capacities. Small mixers can produce 250Lit of mortar or concrete and the big ones produces more and more, up to 6000Lit.

Widely used, small mixers up to a capacity of 1000Lit. Mixers are driven with diesel, benzene engine or electrical power.

Fig. 1.14: Mixer 250 lit

- **Wheelbarrow**

Wheelbarrow is used to dispose disposal materials from working place, to transport or serve materials and tools during construction activities in the site.

It is the most efficient way in transporting materials or items. ; In comparison to a barilla, (commonly used in the country), a wheelbarrow is much more efficient.

For this reason, it is operated by one person and can be carried up to 100 kg at once. So that it saves operation cost; it is time effective and therefore in general.

Fig 1.15: Wheelbarrow /85Lit

- **Graphite Pencil**

This is used for marking in wall construction. It is specially produced for this purpose in such a way that it will not wear out fast.

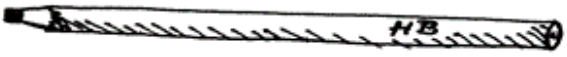

Fig. 1.16: Graphite pencil

- **Trowel**

This is a tool, which every mason needs. Used for picking up mortar out of the barrel, spreading mortar on the wall, bed joints and cutting off excess mortar. In addition to the picture shown, a Triangular and rectangular trowel are also used by the mason.

fig. 1.17: trowel

- **Hacksaw:** A hacksaw is a general tool on site

fig. 1.18: hack saw

- **Mixing Tools**

Spade: - Used to mix concrete materials manually in the construction site. The blasé should be made from high quality steel.

fig. 1.19: spade

Concrete mixing hoe: - Used to clean small area of the construction site from organic and mix concrete materials.

Fig. 1.20: Concrete mixing hoe

Mixing platform: - Used for hand mixing of concrete. Water tight platform at least 2m wide and 3.5 long should be provided. Such platform should preferably be made of boards 3 to 5cm thick, tongued and grooved so that points are tight and platform is rigid.

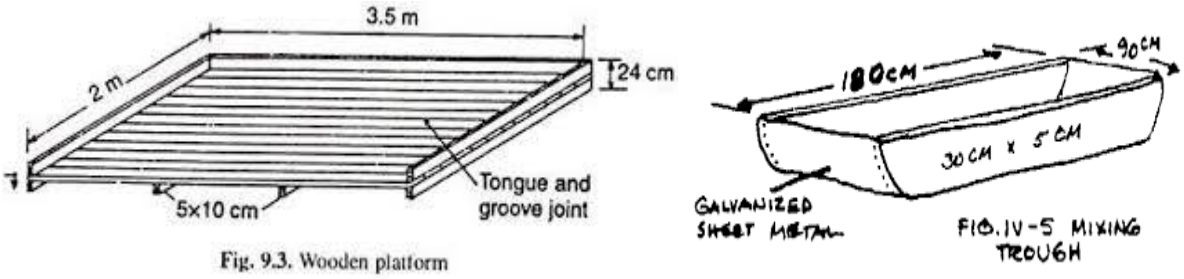

Fig. 9.3. Wooden platform

Fig. 1.21: Mixing platform

3.4. Materials for screeds

- **Sand**

The quality of the sand, i.e. its concrete-making properties, has a large influence on the quality of the resulting screed. It should be a “concrete” sand – not a “plaster” sand – but the largest particles should be removed by sieving the sand through a sieve with openings about 5 mm wide to facilitate finishing.

Where possible, the sand should be tested in a laboratory at site beforehand. To produce a mix that is easy to finish to a smooth surface, it may be necessary to blend two or more sands. Commonly a blend consisting of 4 parts of crusher sand, sieved as above, and 1 part of clean “plaster” sand, gives good results.

Fig. 3.22: Sand for Floor Screed

- **CEMENT**

The job to be done will determine the type of cement to select. Cement binds the concrete mix together. There are a number of types of cement. The most common, used for general construction, is called Type I Normal Portland cement.

Another variation used in construction is white Portland cement. It is light-colored and used chiefly for architectural effects. White Portland cement is made from carefully

selected raw materials and develops the same strength as the normal gray colored Portland cement.

Fig. 3.23: Cement for Screed Floor

Types of cement include:

- ✓ **Type I**, Normal Cement (most common)
- ✓ **Type II**, Moderate Sulfate Resistance (slow-reacting)
- ✓ **Type III**, High Early Strength (fast-setting)
- ✓ **Type IV**, Low Heat of Hydration (low heat generation)
- ✓ **Type V**, High Sulfate Resistance used to produce special types of concrete.
- ✓ **Type IV** is low heat generation for large construction building foundation projects, such as dams to speeding up construction works.

- **WATER**

In a correctly proportioned concrete mix, only about half of the mixing water is needed to hydrate the cement. The remainder acts as a lubricant to produce workability. When more water is actually needed for workability is added, the concrete is diluted, its density is reduced, and it is weakened. If the water is fit to drink, it is satisfactory to use in concrete. This is not to say that water to be used in concrete must be completely pure. Impurities in water may cause efflorescence, surface discolorations, corrosion of steel as well as affecting setting time and strength.

- **Admixtures**

Commercially available admixtures, especially of the water-reducing type, may be used, but preferably only on the recommendation of the laboratory which tests the sands, and only where adequate control of dosage on site can be guaranteed.

3.5. Mix Ratio of Sand-Cement Screed for Floors

Mix ratio of sand and cement screed for floor varies based on the intended use of the screed. Added to that, cement type, grade of aggregate and the method of storage of screed material influence the mix ratio to a certain extent. Therefore, a suitable type of cement shall be selected, and sand needs to be free of deleterious materials.

It is reported that for traditional screeds a mix proportion of 1:6 Portland cement: sand/aggregate is a normal range that is commonly used; mix proportions of 1:4 cement to sand is widely applied.

- **Material Selection for Sand-Cement Screed**

1. Cement

The British Standards set guidance with respect to the types of cement that are best suited for different kinds of screeds. It is important to choose the specified cement type for best results, as variations in cement quality can affect the strength development of the screed and its susceptibility to poor curing.

2. Sand

The size and shape of sand can have a considerable impact on the performance and appearance of a screed. It should be guaranteed that the presence of materials does not exceed the acceptable level. The size of aggregate is specified based on the function of the screed for instance for normal duty screed, the maximum size of sand is 4mm. However, for heavy duty screed, the maximum size of aggregate ranges from 6mm and 10mm.

3. Water

The quantity of water added to the mixture can be adjusted at site. Snowball test can be conducted to make sure that a suitable amount of water is added to the mixture.

Excess water should be avoided because it reduces strength and increases risk of cracking. A stiff mix with too little water does not allow full compaction, and the screed may crumble over time.

Self-Check -3	Written Test

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

1. _____ is used to serve small amount of water or material and to take the tools after work. (3 points)

   B. Wheelbarrow C. Local resources

   C. Bucket D. non

2. List out the materials required for cement screed work. (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- 4	Calculating materials quantity requirements

4.1. Mix Ratio for Sand-Cement Screed

The mix ratio varies dependent on the intended use of the screed. In addition to cement type, grade of aggregate and the method of storage of screed material that also influence mix ratio to a certain extend. It is reported that, for traditional screeds a mix proportion of 1:6 Portland cement: sand/aggregate is a normal range that is commonly used. However, mix proportions of 1:4 cement to sand is widely applied which comply with Ethiopian Building Code and standard (EBCS). Mix ratio should produce a plastic, easy-working, cohesive mortar of plastering consistence.

- **Quantity of Cement and Sand Calculation in Mortar**

Quantity of cement mortar is required for rate analysis of screed and plaster or estimation of masonry work for a building or structure. Cement mortar is used in various proportions, i.e. 1:1, 1:2, 1:3, 1:4, 1:6, 1:8 etc.

- **Calculation of quantity of cement mortar in screed and plaster:**

For the calculation of cement mortar, let us assume that we use $1m^3$ of cement mortar. Procedure for calculation is:

1. The dry volume of materials required for $1m^3$ cement mortar. Considering voids in sands, we assume that materials consists of 60% voids. That is, for $1m^3$ of wet cement mortar, $1.6m^3$ of materials are required.

2. The volume of materials used in cement mortar based on its proportions.

Let's say, the proportion of cement and sand in mortar is 1:X, where X is the volume of sand required.

Then, the volume of sand required for 1:X proportion of $1m^3$ cement mortar will be $\frac{1.6 \times X}{(1+X)}$

3. Volume of cement will be calculated as: $\frac{1 \times 1.6}{(1+X)}$

Since the volume of 1 bag of cement is 0.0347 m^3, so the number of bags of cement will be calculated as:

$$\frac{\left(\frac{1\times1.6}{(1+X)}\right)}{0.0347}$$

Example: For cement mortar of 1:6, the quantity calculated will be as below:

Sand quantity:

$\frac{1.6\times6}{(1+6)}=1.371m^3$, Quantity of cement (in bags): Volume of cement = $\frac{1.6}{(1+6)}$ = 0.22857

There number of bags required = $\frac{0.22857}{0.0347}$ = 6.58 bags.

Self-Check -4	Written Test

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

1. List common cement mortar proportions. (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	Measuring tools & equipment

5.1. Measuring tools & equipment

A **measuring instrument** is a device for measuring a physical quantity. In the physical sciences, quality assurance, and engineering, measurement is the activity of obtaining and comparing physical quantities of real-world objects and events. Established standard objects and events are used as units, and the process of measurement gives a number relating the item under study and the referenced unit of measurement. Measuring instruments, and formal test methods which define the instrument's use, are the means by which these relations of numbers are obtained. All measuring instruments are subject to varying degrees of instrument error and measurement uncertainty.

5.1 Measuring Tool

Batching Box: - Used for volume batching of concrete. The standard size of the box is 50cmx40cmx20cm, 50cmx40cmx18cm, 50cmx40cmx16cm its depth can vary depending on the grade of the concrete to be mixed.

$$\text{length} = \frac{\text{volume}}{\text{width} \times \text{depth}} = \frac{0{\cdot}033}{0{\cdot}3 \times 0{\cdot}3} = 0{\cdot}366\ \text{m}$$

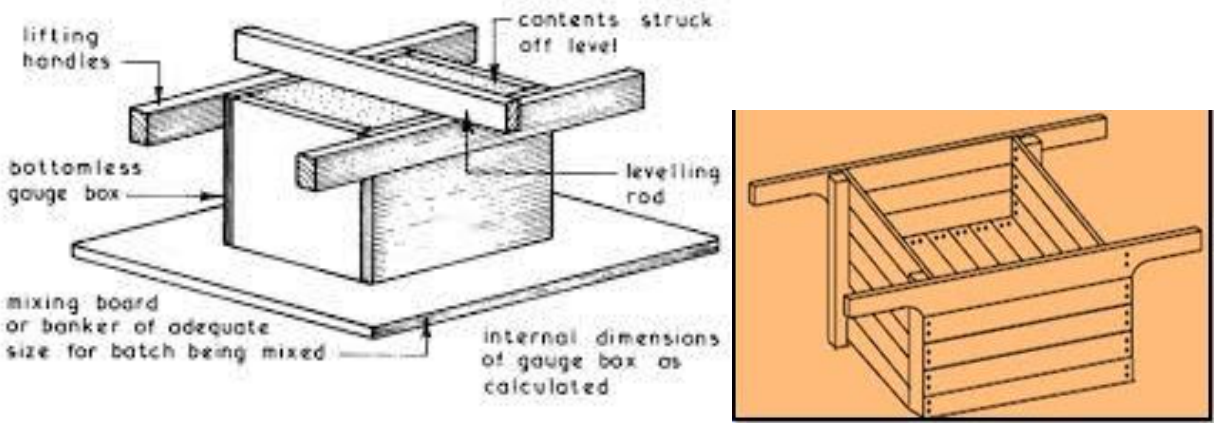

Fig.5.1: Batching box

Measuring bucket: - Used to measure quantity of water required for mixing. It can also be used for talking water which is applicable for mixing and caring purpose.

fig. 5.2: measuring bucket

Balance: - Used to weigh aggregate materials. It is possible to change the volume batching to weight by multiplying by densities of the material. Balances are available in different capacities.

5.2. Measuring equipment

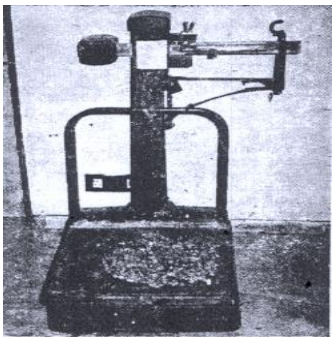

Fig. 5.3: Platform weighing machine

Scientists, engineers and other humans use a vast range of instruments to perform their measurements. These instruments may range from simple objects such as rulers and stopwatches to electron microscopes and particle accelerators. Virtual instrumentation is widely used in the development of modern measuring instruments.

Exact measurement is an absolute must for everyone who wants to guarantee precise and first-class work. That is why the best measuring instruments are necessary. We offer a broad range of products from the field of measuring instruments. PCE offers various types

Self-Check -5	Written Test

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

2. Write material measuring tools and equipment. (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- 6	Materials handling and storage

6.1. Materials handling and storage

Proper way of storing material should be considered in schoolwork shops and training area and this has to be adopted in the real work of construction sites. It is use full to keep materials in a proper manner, to preserve materials long lasting, to secure chemical character of the material, for easy access and handling etc. In general proper way of storing material saves time and money. Accordingly methods of storing for some materials and hand tools are described and illustrated below. Storing materials and tools depend up on the type, size, and product character, etc.

6.2. Standards for Material Handling and Storage

- **General Requirements for Storage of Materials**

Store materials in a planned and orderly manner that does not endanger employee safety. Store all materials on pallets to discourage rodent infestation. Immediately clean up spills and leaks that create such rodent habitat.

- **Requirements for Storing Materials Indoors**

Storing materials indoors requires attention to access, fire prevention and protection, floor loading, and overhead hazards. Buildings under construction require special precautions.

- ✓ **Access**. do not interfere with access ways, doorways, electrical panels, fire extinguishers, or hoist ways. Aisles must be wide enough to accommodate forklifts or firefighting equipment.
- ✓ **Fire Doors**. Maintain a 61cm clearance around the travel path of fire doors.
- ✓ **Sprinklers**. Maintain at least an 46cm clearance b/n stored materials and sprinkler heads.
- ✓ **Heating Appliances**. Maintain at least a 91cm clearance between stored materials and unit heaters,
- ✓ **Fire Protection**. Emergency fire equipment must be readily accessible and in good working order.

- ✓ **Floor Loading**. Conspicuously post load limits in all storage areas, except for floors or slabs on grade.

- **Requirements for Stacking Bagged Material**

Stack bagged materials by stepping back the layers and cross-keying the bags at least every 10 bags high.

- **Requirements for Storing Material in Bulk**

Ensure entry to bulk storage locations, such as silos, hoppers, tanks, or bins (which are also classified as confined spaces) complies with OSHA requirements and local operating procedures.

- **Requirements for Lumber Storage**

Stack lumber on level and solidly supported sills so that the stacks are stable. Do not pile lumber more than 16 feet high.

- **Requirements for Handling and Storing Cement and Lime**

Handling or storing cement or lime requires a job hazard analysis (JHA). Lime requires careful storage and handling procedures.

- ✓ **Cement and Lime**. Employees must wear appropriate personal protective equipment, hand cream, chemical barrier cream, or similar preparations for protection from dermatitis.
- ✓ **Lime**. Store unslaked lime in a dry area because it presents a fire hazard, separate it from other materials.

- **Requirements for Handling and Storing Reinforcing, Sheet, and Steel**

Stack steel to prevent sliding, rolling, spreading, or falling. Use lagging (sleeve) when steel is handled by a crane or forklift to aid safe rigging.

- **Requirements for Storing Sand, Gravel, and Crushed Stone**

Locate stockpiles to provide safe access for withdrawing material. Material or vertical faces must not overhang. Store material against walls or partitions only in an amount that will not endanger the stability of the wall or partition.

Self-Check -6	Written Test

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

1. Write Requirements for Handling and Storing Cement and Lime. (5 points)
2. Write Requirements for Storing Sand, Gravel, and Crushed Stone. (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

Operation Sheet 1	Materials handling and storage

1. Perform all materials handling and storage.

1.1. Steps to be followed while performing all materials handling and storage are:

Step 1: follow Requirements for Storing different types of materials

Step 2: follow PP&E requirements to handle materials

Step 3: perform material storing accordance with specific requirement

Operation Sheet 2	Calculating materials quantity requirements

2. Perform all material quantity calculation steps.

2.1. Steps to be followed while calculating the required material quantity for cement screed work are:

Steps 1- identify screed mix ratio/proportion:

Step 2- Calculate the dry volume of materials required:

Step 3- Calculate the volume of cement required:

Step 4- Calculate the volume of sand required:

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 1 hours.

Task 1: Perform all materials handling and storage.

Task 1: Calculating materials quantity requirements

Answer key LG46

Self-Check -1

Question #:

1.

- Location of the project.
- Floor areas concerned.
- Type(s) of screed to be laid, i.e. levelling/wearing, bonded/unbonded/floating, cementitious/calcium sulphate/proprietary.
- Relevant details of the concrete base.
- Preparation of the base surface to be carried out.

Self-Check -2

Question #:

1.

- Safety Helmet
- Overall Cloth
- Safety shoe
- Rubber boot
- Mask
- Goggle
- Glove
- Safety Belt

Self-Check -3

Question #:

1. B) Bucket
2.

- Sand
- CEMENT
- WATER
- Admixtures

Self-Check -4

Question #:

1. 1:1, 1:2, 1:3, 1:4, 1:6, 1:8 etc.

Self-Check -5

Question #:

1.

- Batching Box
- Measuring bucket
- Balance
- *Platform weighing machine*

Self-Check -6

Question #:

1. **Requirements for Handling and Storing Cement and Lime**

Handling or storing cement or lime requires a job hazard analysis (JHA). Lime requires careful storage and handling procedures.

- **Cement and Lime**. Employees must wear appropriate personal protective equipment, hand cream, chemical barrier cream, or similar preparations for protection from dermatitis.
- **Lime**. Store unslaked lime in a dry area because it presents a fire hazard, separate it from other materials

List of Reference Materials

1. http://www.level.org.nz/material-use/minimising-waste/reuse-and-recycling/
2. https://www.ccohs.ca/oshanswers/hsprograms/house.html
3. https://www.wikihow.com/Maintain-Construction-Tools
4. http://www.fao.org/3/x5744e/x5744e08.htm
5. https://theconstructor.org
6. https://civilseek.com/category/construction/
7. https://geniebelt.com/blog/blueprints

Prepared by: The trainers (who developed this outcome-based curriculum and TTLM)

N0	Name	Qualification	Region	E.mail
1	Tesfaye Assegidew	MSc in CoTM	SNNPR	tesfayeassegidew@gmail.com
2	Habtamu Wendmagegn	BSc in Civil Engineering	Dire Dawa	Joniyitna9@gmail.com
3	Yazachew Geneti	MSc in CoTM	BGRS	0917858176
4	Gebresilasie Jemal	BSc in Construction Technology	Addis Abeba	Gebrajemal@gmail.com
5	Getachew Mohammed	MSc in CoTM	Amhara	Gerimom07@gmail.com
6	Kibryisfaw Tulema	BSc in Construction Technology	Somalie	kibrutulema@gmail.com

The coordinator (during developing this *outcome based* curriculum & TTLM)

No	*Name*	*Profession*	*Mob. no*	*Region*	*College*
1	***Abere Dagnew***	***Cur. Expert***	***0918 01 41 11***	***Amhara***	
2	***Abdulahi Muktar***	***Health officer***	***0994 86 11 36***	***Somalie***	
3	***Tilahun Tesfaye***	***Cur. Expert***	***0940 65 18 23***	***Amhara***	

This model TTLM was developed at Adama, Ethiopia September, 2019