Basic infrastructure operation

NTQF Level I

Learning Guide-29

Unit Competence: Carry-out Measurements and Calculations

Module Title: Carrying-out Measurements and Calculations

LG Code: CON BIO1 M08 LO1-LG-29

TTLM Code: CON BIO1 TTLM 1019v1

LO1 Plan and prepare

Instruction Sheet	Learning Guide #29

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

- Safety, OHS regulation requirements and application
- Analyze compliance documentation
- Analyze and apply work instructions
- Type and function of measuring and calculating equipment

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 –

- Access, interpret and apply compliance documentation relevant to the work activity
- Confirm and apply work instructions
- Select measuring and calculating equipment to carry out tasks that are consistent with the requirements of the job, and check them for serviceability and any faults and rectify or report fault

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

Information Sheet-1	Safety, OHS regulation requirements and application

1. Working safely

Introduction

Work health and safety is everyone's responsibility. Working safely is covered thoroughly in the unit Carrying-out Measurements and Calculations *Apply OHS requirements, policies and procedures in the construction industry*, but a brief overview is included here.

All employees must take reasonable care of their own health and safety and that of others, and cooperate with employers in their efforts to comply with work health and safety (WHS) requirements.

As an employee, you must not:

- interfere with or misuse any item provided for the health, safety or welfare of people at work
- block or interfere with attempts to give aid or attempts to prevent a serious risk to the health and safety of a person at work
- refuse a reasonable request to help in giving aid or in preventing a risk to health and safety.

1.1. WHS induction training

It is a requirement under the relevant WHS Act of each state or territory that all workers carry out WHS induction training to familiarize themselves with:

- the reasons for WHS legislation
- the rights and responsibilities of employers and employees in relation to WHS legislation
- identification of common workplace hazards
- inspection of a workplace to assess risks
- identification of quality control measures to control hazards
- purpose and use of safe work method statements (SWMSs)
- identification of essential personal protective equipment (PPE)
- identification of barricades, hoardings and signs to highlight site hazards and to protect workers.

Each WHS Act requires the principal contractor and those who are self-employed to make sure that all employees have undertaken mandatory WHS induction. If they haven't, fines can be applied.

WHS induction cards are recognized from state to state and territory to territory. As long as

the training a worker has received meets existing standards and requirements, they will be permitted to carry out work on a construction site without having to undertake another WHS induction course in that state or territory.

1.2. Site induction

Workers who are going to be on site need to undertake a site induction before they enter the site. Any site-specific safety issues will be highlighted during the site induction, and you will also be taken through emergency procedures and other safety-related information relevant to the site.

1.3. Codes of practice

Codes of practice are used in conjunction with the WHS/OHS Act, but they are not classified as legal documents. However, you are still required to follow them.
The basic purpose of codes of practice is to provide workers in the building industry with practical, commonsense, industry-acceptable ways of following the WHS/OHS Act and working safely.
They are published by each state's and territory's WHS regulating authority, and cover areas such as electrical safety, roof tiling, form working, PPE, use of safety harnesses, construction and use of hoardings.

Self-Check -1	Written Test

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

1. Which of the following Verbal information Instructions received verbally form.

A. workman ship C.. clients

B. Employers D. all

2. one of the following basic steps of writing Work Instructions.

A. Know exactly how to do the task.

B. Plan how to write steps in order.

C. Write instructions beginning with a verb.

D. All are correct

3. typically focus on two major aspects; determining how long each activity will take to complete.

A. Construction schedules B. Preserve life

C. Specification D. none

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	Analyze compliance documentation

2.General Obligations

You are obliged to act responsibly and perform work safely. You are also expected to take reasonable care to protect the health and safety of yourself and others by:

- reporting to a supervisor or safety representative any unsafe conditions, activities, dangerous occurrences or injuries
- using correct Personal Protective Equipment (PPE)
- using your work site's lock and tag system (if applicable)
- reporting damaged or defective equipment for repair
- not attempting any task unless you are qualified, authorised, competent and confident to perform the task in a safe manner.

2.1.Legislation and Site Policies

You must access and understand government legislation and site guidelines to perform your work within the regulations. Compliance documentation may include:

- legislative acts and regulations
- employment and workplace health and safety procedures
- organisational and site requirements and procedures
- manufacturer guidelines and specifications
- national standards
- codes of practice.

2.2.Comply with Legislation and Site Procedures

During your general and site specific inductions you would have been familiarized with organizational and site policies and procedures. These have been developed in accordance with legislation and are designed to ensure that work is undertaken safely.

Gather and read all relevant documents and procedures for the task that you are doing. Ensure that you understand the documents and how they apply to your work.

2.3.Equipment Inspections

Do not use any equipment that is in an unsafe condition. You should aim to improve the general appearance, mechanical standard and operating efficiency by:

- carrying out inspections and pre-start checks
- completing detailed and accurate defect reports

- ensuring that all servicing is carried out as scheduled
- using the equipment according to manufacturer instructions
- keeping the equipment clean (dirt can hide defects).

Regular inspections will identify defects at an early stage, before they become a significant problem that may cause injury and equipment or environmental damage. You should inspect the equipment before using it and again after use before storage. Isolate any defective equipment and attach an Out of Service tag to the item. Report all damaged or defective equipment according to site procedures.

Self-Check -2	Written Test

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

1.Site is a permanent working place for :

A. Masons works C. quality control

B. Concrete workers D. 'A' and 'B' Answers

2'A building site should have a first aid box which as minimum contents(5point)

A. Plasters C. Ointments

B. Bandages 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: _____

Short Answer Questions

Information Sheet-3	Analyze and apply work instructions

3.Work instructions

Introduction

In the building industry, most of the information required by the people performing any of the work related to a construction project comes from project documentation. So it's extremely important for you to be able to read and interpret plans, drawings, details and specifications correctly

Plans and drawings are used to communicate great amounts of technical information between the designer and builder. This technical information must be able to be communicated without any misunderstandings, which can only happen if the technical language of plans and drawings is understood by everyone who uses them.
The technical language for plans and drawings uses standardized layouts, symbols and abbreviations, so that things look similar in any plan or drawing. With study, practice and experience, you'll get to know and understand this language and be able to follow work instructions.

3.1.Types of information

Before you begin a work task, it's important that you review and understand relevant information so that you can apply correct processes to the planning and preparation of a work activity.

Such information can come in either written or verbal form. Here are a few examples of the types of information you may need to plan and prepare for a task involving measurements and calculations.

3.1.1.Verbal information

Instructions received verbally from:

- clients
- workmates
- employers
- supervisors, builders, contractors and subcontractors
- architects.

3.1.2.Written information

Written instructions such as:

- plans, drawings and specifications
- manufacturers' instructions and specifications on plant, tools, equipment and materials
- maps on job location
- safety data sheets (SDSs)
- job safety analyses (JSAs)
- legislative requirements:
  - WHS/OHS Act
  - Regulations
- safe working procedures:
  - manual handling
  - noise
  - chemicals
- signs.

3.2.Types of plans and drawings

There are many types of plans and drawings that may be created for high way work and building project.
The size and complexity of the project will determine which ones are required. The minimum set usually includes:

- ordinance survey maps,
- plans,
- longitudinal section (profile),

- transverse sections (cross - sections)
- and detail drawings.
- a site plan
- a floor plan
- elevations
- sections.

Others that may be required, depending on the project, include:

- details
- electrical plans
- hydraulic plans
- engineering plans.

3.2.1.Users and uses

When plans and drawings of a proposed building or structure have been prepared, many copies are made for the people who will use them. The table on the next page shows who might use them and for what purpose.

Self-Check -3	Written Test

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

1._____are assets in a community that help meet certain needs for those around them.

A. Air spaces C. Local resources

B. Local maps D. Services

2.List out the purposes of mobilizing local resources at least five 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	Type and function of measuring and calculating equipment

4.Function of Measuring equipment

Introduction

Measurement is how we determine the exact capacity of something that is in solid, liquid or gas form.

For each type of measurement, there is a particular measuring instrument which is most suitable to do the job. It will be impossible to list all the possible measuring instruments, thus we will look at the most common instruments and welcome your knowledge and experience to enhance understanding of this section.
When using any measuring instruments, ensure that measurement is:

- accurate
- precise
- viewed squarely off the scale of the measuring instrument

Several pieces of equipment are available for measuring. Some are better suited than others to particular jobs.

Calculators

A general-purpose of calculator is required for calculations. It just needs to be a fairly small, inexpensive one that you can easily get the hang of to perform basic calculations. Later, in more detailed estimating, you'll use a scientific calculator to perform more complex calculations.

Figure 4. Calculator

Vernier Caliper

The vernier caliper is used to make semi- accurate measurements for inside, outside and depth dimensions. Standard vernier calipers are available in sizes 150mm to 250mm. Custom- made vernier calipers can be made to specifications if required. Graduations, (that determine the accuracy of the instrument) are usually 0,02mm or 0,05mm on the vernier scale.

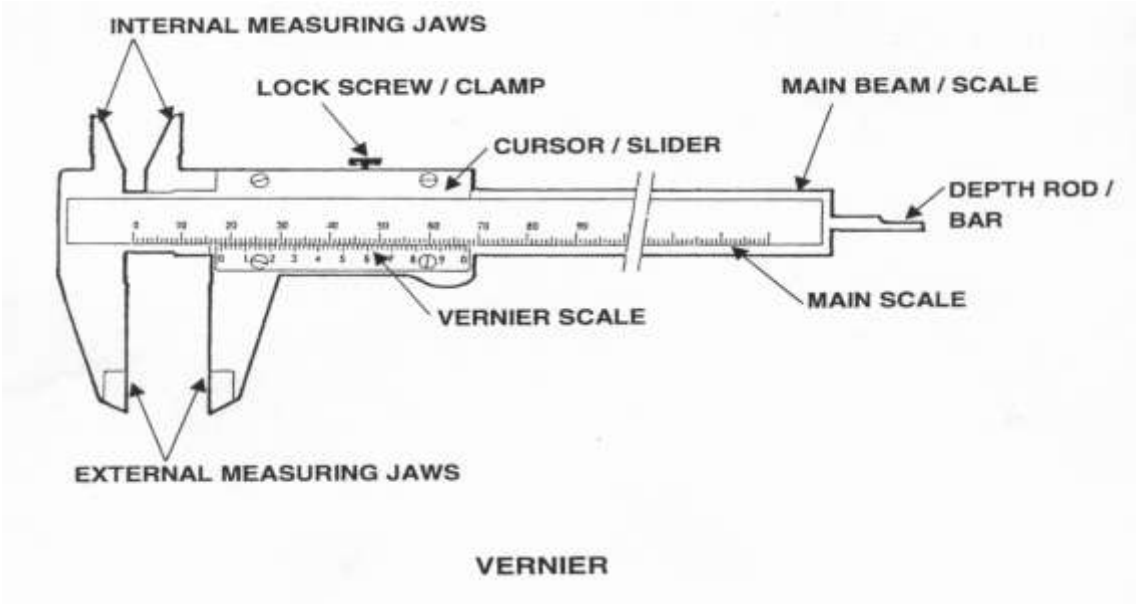
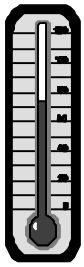


Figure 4.1 Vernier caliper

Thermometers



Temperature is measured using a thermometer. A thermometer is often filled with mercury and the higher the temperature rises, the more the mercury expands and shows the temperature reading.

In many workplaces, temperature gauges are used to replace thermometers, but essentially they do the same job.

The point, at which the coloured liquid or mercury ends, is where the measurement is taken.

Watches and Clocks

We can measure time on either an analogue or digital clock.

An analogue clock is marked in 12 hour intervals and the clock hands need to pass the 12 for the second time to indicate a 24 hour period

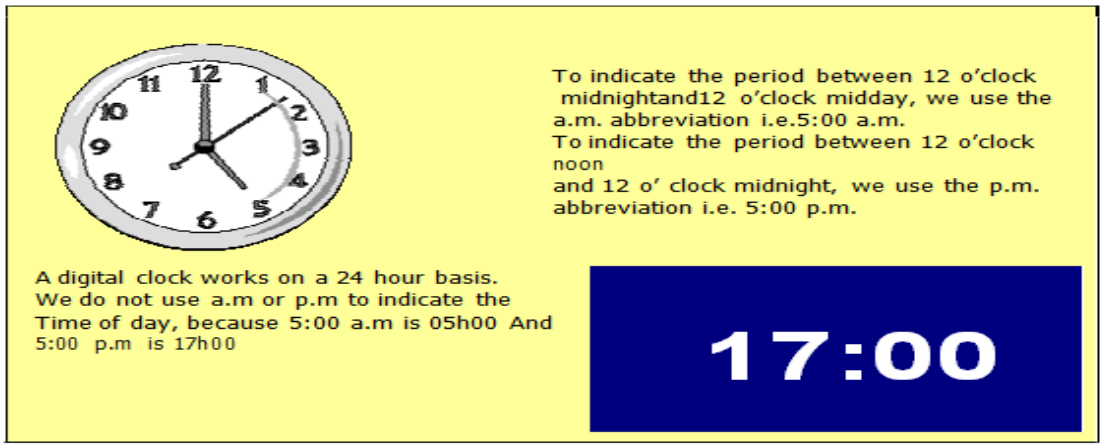


Figure 4.3 Watches and clocks

Scales

Spring or Kitchen Scales

When we need to find the mass of an item ,then we use a spring sale (as per the example on the left) or a kitchen scale.We measure in grams or kilograms how heavy something.

Electric Meters

Electric meters are instruments used to measure electrical values. The two most common meters are the ammeter (which measures ampere) and the voltmeter (which measures volts).
The ammeter and voltmeter are variations of the galvanometer. Inside a galvanometer is a small magnet that sets up a magnetic field. This magnetic field generates a force that we can measure when current flows through a coil.
Below, the meter mechanisms are shown schematically.

The ammeter diverts electricity through a coil via a shunt (illustrated beneath the device), measuring the amount of current flowing through the circuit in amperes. It is connected in series, or directly in the line of the circuit. The voltmeter is connected in parallel, so that the light bulb falls between its two connections into the circuit. It is designed to measure potential differences. To ensure that it removes a minimum of current from the circuit, the voltmeter's resistance (shown by the jagged black line beneath the device) must be very high. [1]

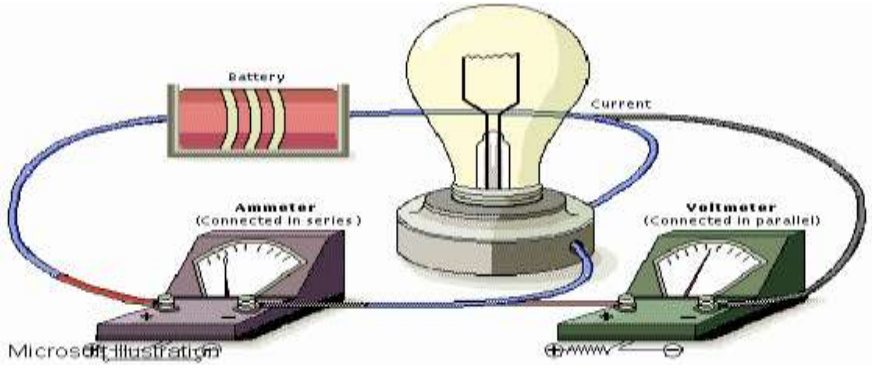


Figure 4.5. Electric meter

Measuring tapes

A measuring tape is made up of a flexible metal blade housed in a metal or plastic case. The blade is coiled, usually under the control of a strong spring. Tapes are used for measuring long distances with a reasonable degree of accuracy. They offer greater convenience than using a series of measurements made with a shorter steel ruler.Common types of measuring tapes can be from three to 10 metres long; however, longer lengths, such as 30 metres, are also available.

Figure 4.6. Measuring Tape

Retracting mechanisms

Smaller tapes normally retract (pull back) under spring tension once their locking button is released. Care should be taken when doing this, as the tape can snap back violently. To do it safely, hold the end of the tape in your hand, and guide it until it's fully coiled again.

Steel tapes

Steel tapes are used for measuring long distances. They are usually 10 or 30 metres long, but longer lengths are available.Steel tapes are returned into their case by operating a turning mechanism. The handle can be folded away when not in use.

Steel tape rules

Steel tape rules are available in two, three, five, seven, eight and 10 metre lengths. The three and five metre tapes are the most common.

Steel tape rules have a power return spring which automatically returns the tape blade into

the housing. Do not allow the tape to suddenly return, as the hook will break off. A lock is often included to hold the blade in the open position and to slow its return into the case.

Looking after measuring tapes

Measuring tapes will last for many years if you look after them properly.

- Don't be rough with the blade or the tape housing.
- Retract the blade gently.
- Keep the blade free from grit and moisture.
- Don't leave the measuring tape exposed for long periods to the direct rays of the sun. This can buckle the blade or degrade the housing.

Pictured below are some of the different ways measuring tapes can be used.

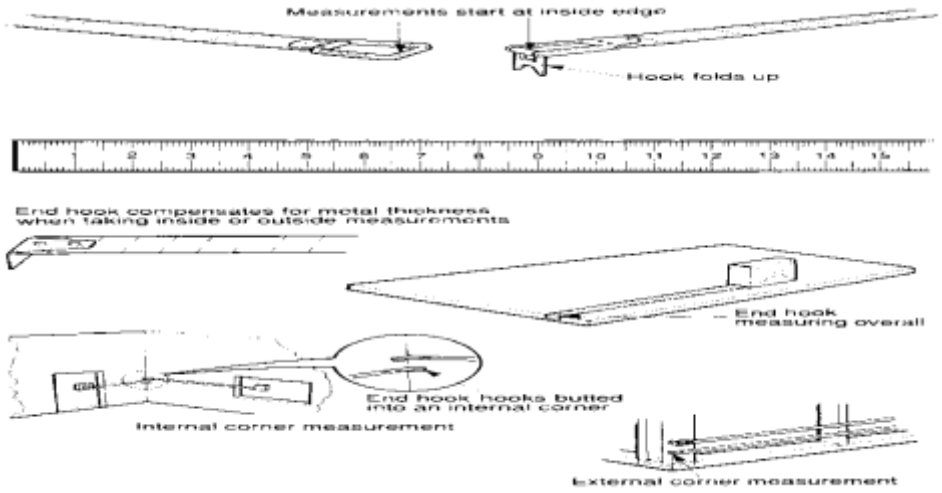


Figure 4.7. different ways measuring tapes

Using measuring tapes

Measuring tapes in Australia are marked in metric measurements. Markings are placed at 1 mm apart, and numbers are written every 10 mm. Major units are written every 100 mm.
A steel tape rule is used for all types of measuring and setting out, within the range of its length. A tape rule has an advantage over a solid steel rule which can give errors when used to measure distances greater than its length.
A steel tape can be used in most situations, but is best suited for on-site setting out and taking measurements on the building site.The fixed-end hook on a steel tape compensates for the thickness of the metal when taking inside or outside measurements, so it's important to place the tape correctly.

Reading a tape measure

Below are two readings from a tape measure for a door for a new home. The door is 2040 mm in length × 815 mm wide. When you convert the measurements into metres and move

the decimal point three places to the left, the tape measure reads 2.04 m × 0.815 m.

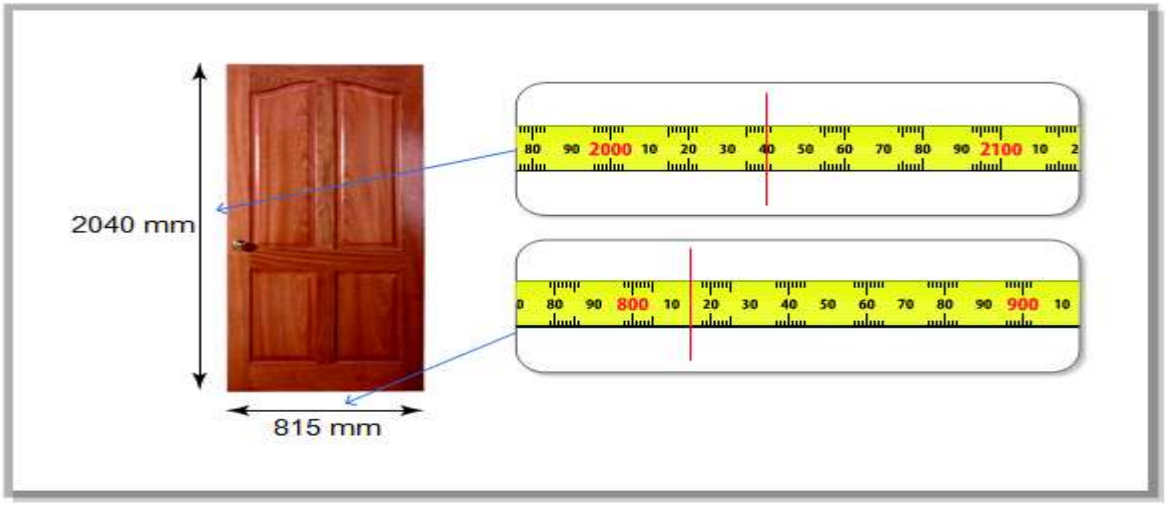


Figure 4.9. Reading a tape measure

To learn how to read the tape correctly, let's look at the first measurement taken on the door (2040 mm). Notice that the first major unit is 2000 mm. The next sub-unit is 40 mm, therefore:

2000 mm + 40 mm = 2040 mm

On the second measurement, the first major unit is 800 mm. The following sub-unit reads 10 mm. From the 10 mm to the end of the door, five minor increments are counted, giving a total reading of 815 mm.

800 mm + 10 mm + 5 mm = 815 mm

Four-fold ruler

Trades people in the construction industry are known to use the four-fold ruler. Markings are placed at 1 mm, and numbers are written every 10 mm. When fully extended, the total length of the ruler can measure up to 1 metre. When the ruler is folded, each section of the ruler has a length of 250 mm. The ruler itself is usually made from either plastic or boxwood, and has stainless steel or brass fittings.

Figure.4.10. Fold ruler

Reading a ruler

Below is an example of how to read a four-fold ruler using the black line as the end point. As with a tape measure, notice that from zero, the first major unit left of the black line is 30 mm, the second is 5 mm, then two increments have been counted from the five.

30 mm + 5 mm + 2 mm = 37 mm

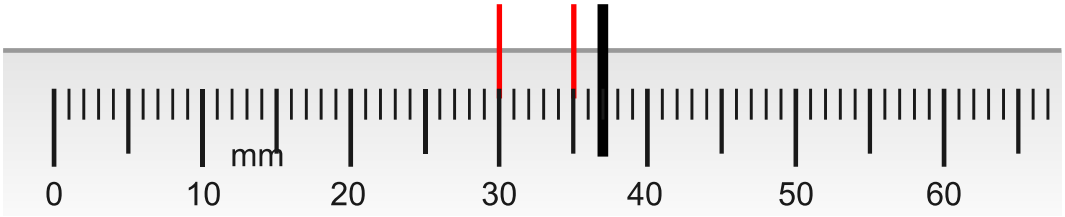


Figure 4.11. Reading ruler

Scale rules

A scale rule is a plastic rule of 150 or 300 mm in length used to scale off dimensions when they're not given on the drawing. They can be triangular or flat like a standard ruler.They have a different scale printed along each edge. Some have a single scale per edge, and others have two scales combined on one edge. Different brands may vary in the way the scales are grouped. The most common scales you'll see on a scale rule are 1:1, 1:5, 1:10, 1:20, 1:50, 1:100, 1:200 and 1:500.On the top edge of the rule below, the scales are 1:1 and 1:100, so the dimensions they show differ by a factor of 100.

Another scale rule edge is shown below. In this case, the dimensions differ by a factor of 10 (1:50 is 10 times larger than 1:500).

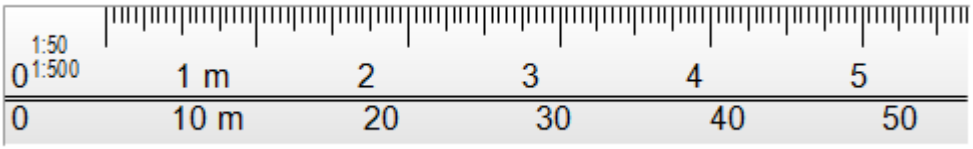


Figure 4.12. Scale rule

To measure something to scale, put the zero mark on the left-hand edge of what you're measuring, and read the length at the right-hand edge.

How to read scale

Reading scale is covered in A *Read and interpret plans and specifications*; however, we'll look at the basics here. By using a scale rule, a measurement can be determined from the plan provided to its actual size. If a drawing plan is set at a scale of 1:100, that means that

all items on the plan are one hundred times larger in reality.

Self-Check -1	Written Test

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

1. _____is measurement done by bringing the target into contact with the measurement system to read the length, height, or other aspect directly

A. Direct measurement C. Scale rules

B. How to read scale D. Indirect Measurement

2. _____is the act of determining a target's size, length, weight, capacity, or other aspect.

A. calculator B. Measurement C. scale D. none

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

1. ISO 14253-2:2013 Geometrical product specifications (GPS) - Inspection by measurement of work pieces and measuring equipment - Part 2:

ISO measuring equipment and in product verification - Technical Corrigendum 1 14253-2:2011/Cor 1:2013).

Chrisler Corporation, Measurement System Analysis, Reference Manual, , Ford Motor Company, General Motors Corporation, 1995.

3. General Motors Corp. GMPT Specification MS 1. Adam Opel AG Russelsheim, October 1998.

4. E. Dietrich, Measurement System Capability, Reference Manual, Q-DAS® GmbH, Birkenau, 2002.

5. ISO 14253-1:2013 Geometrical product specifications (GPS) - Inspection by measurement of work pieces and measuring equipment – Part 1: Decision rules for proving conformity or nonconformity with specifications.

Basic infrastructure operation

NTQF Level I

Learning Guide-30

Unit Competence: Carry out Measurements and Calculation

Module Title: Carrying-out Measurements and Calculations

LG Code: CON BIO1 M08 LO2-30

TTLM Code: CON BIO1 TTLM 1019v1

LO2. Perform measurements

Instruction Sheet	Learning Guide #30

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

- Selecting and applying method of measurement
- unit conversation
- Obtain measurements
- Confirming and record measurements

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**:

- Select and apply method of obtaining the measurement
- Obtain measurements using a rule or tape, accurate to 1mm
- Confirm and record measurements

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

1.Obtaining measurements

Introduction

Everyone involved in the construction industry needs to be able to understand, obtain and use measurements accurately in a variety of situations, whether you need to read a plan to find out the length or check the width of a road before it's loaded for delivery.

Figure 1Reading ruler

Being able to measure quickly, confidently and accurately is a valuable skill, as it will enable you to get the job done quickly and without mistakes – something all employers value.

11Types of measurements

Let's look at some of the different measurement types that you'll need to be familiar with.

Linear measurements

Linear measurements measure lines or distances between two points. Common linear measurements include length, width, depth and height.

Figure 1.1. Linear measurement

These are the most commonly used types of measurement in the construction industry. For example, wall and floor tilers use linear measurements to calculate the number of skirting tiles they need.

Perimeter

Perimeter is a boundary or outside edge. In the building industry it's used to refer to things like:

- fencing
- gutters
- external wall lengths.

Figure 1.2 Perimeter

Area

Area is the amount of space inside a boundary or outside edge. Square units are used for area measurements, such as metres squared (m²). In the road and building construction industry, area is used to determine things like the:

This term is mostly encountered in determining the area to be:

- ✓ Cleared
- ✓ Compacted
- ✓ Surfaced
- ✓ Grassed
- ✓ floor area of a building, as a way of describing the size of the building
- ✓ wall and ceiling area, for quantities of tiles required to cover the walls in bathrooms, or the number of plasterboard sheets needed to cover a ceiling
- ✓ floor area of individual rooms, to determine the quantities of flooring or floor coverings required, eg floor tiles, timber flooring and vinyl
- ✓ roof area, to determine the number of roof tiles or amount of sheet roofing required
- ✓ area of a building block, to determine the minimum and/or maximum coverage to meet building regulations.

The shelving unit to be installed on a wall measures 1 m × 1 m. This means that the total area the front of the unit will cover is 1 m².

Area measurements are also used for the calculation of the number of bricks required to construct a wall, or for the number of pavers required for a path or driveway.

Circumference, radius and diameter

The perimeter of a circle is called its **circumference** (c). The distance from the centre of a circle to any point on the circumference is called the **radius** (r). The distance across the

circle through the centre is called the **diameter** (d) and equals twice the radius.
Decorative brickwork or tiling often requires calculations to be made in order to find the circumference of an area.

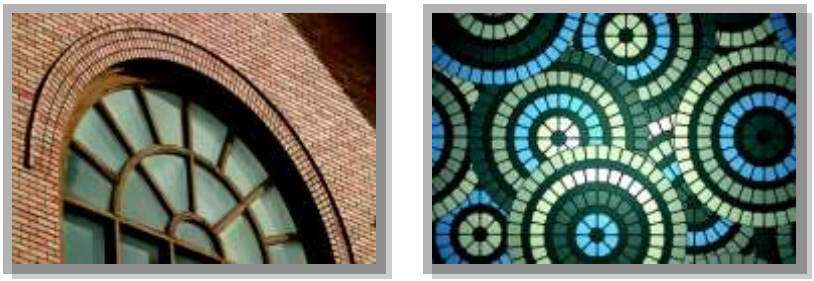


Figure 1.3 Decorative brickwork

Volume

The volume of an object is the amount of space it takes up in three dimensions. For example, when you buy a liter bottle of water, or order a truckload of sand, you're buying these items by volume.
To measure volume, we use three-dimensional units or cubic units, such as mm^3 and m^3.

The calculation of volumes is the most common calculation for road construction work. This is required to develop the bill of quantities, then to measure work for actual construction purposes (estimating resource requirements and time to complete work, material requirements, etc.), and finally to measure the completed work items.

Calculations of volume in the construction industry are used to determine things like the amount of:

- soil to be excavated
- tile adhesive required
- sand to use in bricklayer's mortar or a tiler's screed
- tins and/or buckets of paint
- tubes of fixative required for a job
- concrete required to pour a slab.

Figure 1.4 sample volume

Solid objects

For solid objects, volume is measured in cubic units, such as cubic meters (m^3).
The little 3 that follows the 'm' in meters represents the three dimensions of a solid object, namely:

- the length
- the width

- the height.

Look at this example of a crate.

The crate measures **1 m × 1 m × 1 m**.
This means that the volume of the box is one cubic metre (1 m^3).

Liquids

When measuring the volume of liquid, we use the litre (L) unit of measurement.

For example:

- Water
- Emulsion

Figure 1.5 A 10-litre bucket of tile adhesive. Four-liter tins of paint.

It would take 1000 liters of water to fill a 1 m^3 container.

Mass

Mass is what we often call weight, or how heavy something is. It is measured in units such as grams (g) and kilograms (kg). Mass is used for many items in various trades – from a 25 kg bag of cement to a 100 kg glass-panel bi fold door. Different objects or substances have different masses, even if they have the same volume.

Figure 1.6 sample mass

For example, if you had to push a wheelbarrow of something up a ramp, which would you rather push – a wheelbarrow full of bricks or a wheelbarrow full of feathers?

Lifting heavy objects can be dangerous. In building and construction, you'll be required to lift materials, tools and equipment on a regular basis. Knowing the mass (weight) of an object will help to make sure you carry out these tasks safely.

Self-Check -1	Written Test

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

1. _____is measurement done by bringing the target into contact with the measurement system to read the length, height, or other aspect directly

A. Direct measurement B. Scale rules

C. How to read scale D. Indirect Measurement

2. _____is the act of determining a target's size, length, weight, capacity, or other aspect.

3._____is made up of a flexible metal blade housed in a metal or plasticcase.

A. measuring tape B. ruler C. scale D. none

4. is the amount of space it takes up in three dimensions

A length B. volume C. area 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: _____

Short Answer Questions

Information Sheet-2	unit conversation

A.10 UNIT CONVERSIONS

Jnit Systen	Metric		Imperial + US			
	Metre (m)	Kilometre (km)	Inch (in)	Foot (ft)	Yard	Mile
Length	1	0.001	39.3701	3.28084	1.09361	0.00062
	1000	1	39370.1	3280.84	1093.61	0.62137
	0.0254	0.00003	1	0.08333	0.02778	0.00002
	0.3048	0.00030	12	1	0.33333	0.00019
	0.9144	0.00091	36	3	1	0.00057
	1609.34	1.60934	63360	5280	1760	1

Jnit Syst	Metric				Imperial + US	
	Square Metre (m2)	Are (a)	Hectare (h)	Square Kilometre (km2)	Square Yard	Acre
Area	1	0.01	0.0001	0.000001	1.19599	0.00025
	100	1	0.01	0.0001	119.599	0.02471
	10,000	100	1	0.01	11,960	2.47105
	1,000,000	10,000	100	1	1,196,000	247.105
	0.83613	0.00836	0.00004		1	0.00021
	4046.86	40.4686	0.40469	0.00405	4840	1

Jnit Systen	Metric		Imperial + US			
	Cubic Metre (m3)	Litre (lt.)	U.S. Gallon	Cubic Inch	Cubic Feet	Imperial Gallon
Volume	1	1,000	264.171	6,1023.7	35.3147	219.978
	0.001	1	0.26418	61.0255	0.03532	0.21998
	0.00379	3.78532	1	231.001	0.13368	0.83270
	0.00002	0.01639	0.00433	1	0.00058	0.00360
	0.02832	28.316	7.48048	1728	1	6.22883
	0.00455	4.54596	1.20095	277.42	0.16054	1

Jnit Systen	Metric			Imperial + US		
	Gram (g)	Kilogram (kg)	Ton (t)	Carat	Ounce (oz)	Pound (lb)
Weight	1	0.001		5	0.03527	0.00220
	1,000	1	0.001	5000	35.274	2.20462
	1,000,000	1,000	1	5,000,000	35274	2204.62
	0.2	0.0002		1	0.00705	0.00044
	28.3495	0.02835	0.00003	141.748	1	0.06250

Conversion Table

Example: to convert 10 miles to kilometres, find 1 mile in the 'length' table.
Numbers on that same horizontal are equal units to 1 mile, therefore 1 mile = 1.6094 km; 10 miles = 16.094 km.

Length

km	m	mm	mile	yard	ft	in	10^{-3} in
1	1000	10^6	0.6214	1094	3281	3.937×10^4	3.937×10^7
10^{-3}	1	1000	6.214×10^{-4}	1.0936	3.281	39.370	3.937×10^4
10^{-6}	10^{-3}	1	6.214×10^{-7}	1.094×10^{-3}	3.281×10^{-3}	3.937×10^{-2}	39.37
1.6094	1609.4	1.609×10^6	1	1760	5280	63360	6.336×10^7
9.144×10^{-4}	0.9144	914.41	5.682×10^{-4}	1	3	36	36000
3.048×10^{-4}	0.3048	304.8	1.894×10^{-4}	0.3333	1	12	12000
2.54×10^{-5}	0.0254	25.4	1.578×10^{-5}	2.778×10^{-2}	8.333×10^{-2}	1	1000
2.54×10^{-8}	2.54×10^{-5}	0.0254	1.578×10^{-8}	2.778×10^{-5}	8.333×10^{-5}	10^{-3}	1

Area

km^2	m^2	cm^2	mm^2	sq. mile	acre	yd^2	ft^2	in^2
1	10^6	10^{10}	10^{12}	0.38612	247.11	1.196×10^6	1.076×10^7	1.550×10^9
10^{-6}	1	10^4	10^6	3.86×10^{-7}	2.471×10^{-4}	1.1960	10.764	1550
10^{-10}	10^{-4}	1	100	3.86×10^{-11}	2.471×10^{-8}	1.196×10^{-4}	1.076×10^{-3}	0.1550
10^{-12}	10^{-6}	10^{-2}	1	3.86×10^{-13}	2.47×10^{-10}	1.196×10^{-6}	1.076×10^{-5}	1.550×10^{-3}
2.590	2.59×10^6	2.59×10^{10}	2.59×10^{12}	1	639.96	3.097×10^6	2.788×10^7	4.01×10^9
4.047×10^{-3}	4047	4.047×10^7	4.047×10^9	1.563×10^{-3}	1	4840	43560	6.273×10^6
8.36×10^{-7}	0.8361	8361	8.36×10^5	3.228×10^{-7}	2.066×10^{-4}	1	9	1296
9.29×10^{-8}	9.29×10^{-2}	929	92900	3.587×10^{-8}	2.296×10^{-5}	0.1111	1	144
6.45×10^{-10}	6.45×10^{-4}	6.4516	645.16	2.491×10^{-10}	1.594×10^{-7}	7.716×10^{-4}	6.944×10^{-3}	1

Volume

m^3	dm^3 (litre)	cm^3 (ml)	yd^3	ft^3	in^3	UK gallon	US gallon
1	10^3	10^6	1.3079	35.311	6102	219.97	264.17
10^{-3}	1	10^3	1.308×10^{-3}	3.531×10^{-2}	61.02	0.2200	0.2642
10^{-6}	10^{-3}	1	1.308×10^{-6}	3.531×10^{-5}	6.102×10^{-2}	2.199×10^{-4}	2.642×10^{-4}
0.7646	764.6	7.646×10^5	1	27	46650	168.19	201.99
2.832×10^{-2}	28.32	2.832×10^{-4}	3.704×10^{-2}	1	1728	6.229	7.481
1.639×10^{-5}	1.639×10^{-2}	16.387	2.144×10^{-5}	5.787×10^{-4}	1	3.605×10^{-3}	4.329×10^{-3}
4.546×10^{-3}	4.546	4.546×10^3	5.946×10^{-3}	0.1605	277.42	1	1.2008
3.785×10^{-3}	3.785	3.785×10^3	4.951×10^{-3}	0.1337	231	0.8327	1

Mass

Tonne (Mg)	kg	g	UK ton	US ton	cwt	lb	oz
1	1000	10^6	0.9842	1.1011	19.66	2.205×10^3	3.527×10^4
10^{-3}	1	1000	9.842×10^{-4}	1.101×10^{-3}	1.966×10^{-2}	2.2046	35.274
10^{-6}	10^{-3}	1	9.842×10^{-7}	1.101×10^{-6}	1.966×10^{-5}	2.204×10^{-3}	3.527×10^{-2}
1.016	1016	1.016×10^6	1	1.12	20	2240	35840
0.9081	908.1	9.081×10^5	0.8928	1	17.856	2000	32000
5.085×10^{-2}	50.85	5.085×10^4	0.05	0.0560	1	112	1792
4.536×10^{-4}	0.4536	453.6	4.46×10^{-4}	5×10^{-4}	8.92×10^{-3}	1	16
2.835×10^{-5}	2.835×10^{-2}	28.349	2.79×10^{-5}	3.125×10^{-5}	5.580×10^{-4}	6.25×10^{-2}	1

Density

Tonne/m³ Mg/m³ g/cm³	kg/m³	lb/in³	UK ton/yd³	US ton/yd³	lb/ft³
1	1000	0.03613	0.75247	0.8428	62.43
10^{-3}	1	3.613×10^{-5}	7.525×10^{-4}	8.428×10^{-4}	6.243×10^{-2}
27.680	27680	1	20.828	23.328	1.728×10^{3}
1.3289	1.328×10^{3}	4.801×10^{-5}	1	1.12	82.955
1.1865	1.186×10^{3}	4.287×10^{-2}	0.8929	1	74.074
1.602×10^{-2}	16.019	5.787×10^{-4}	1.205×10^{-2}	1.35×10^{-2}	1

Force and weight

MN	kN	N	kgf	tonf	lbf
1	1000	10^{6}	1.0196×10^{5}	100.4	2.248×10^{5}
10^{-3}	1	10^{3}	101.96	0.1004	224.82
10^{-6}	10^{-3}	1	0.10196	1.004×10^{-4}	0.2248
9.807×10^{-6}	9.807×10^{-3}	9.807	1	9.842×10^{-4}	2.2048
9.964×10^{-3}	9.964	9964	1016	1	2240
4.448×10^{-6}	4.448×10^{-3}	4.448	0.45455	4.464×10^{-4}	1

Pressure, stress and modulus of elasticity

MN/m² MPa	kN/m² kPa	kp kgf/cm²	bar	atm	m H_2O	ft H_2O	mm Hg	Ton/ft²	psi lbf/in²	lbf/ft²
1	1000	10.197	10	9.869	102.2	355.2	7500.6	9.320	145.04	20886
0.001	1	1.019×10^{-2}	0.0100	9.87×10^{-3}	0.1022	0.3352	7.5006	0.0093	0.14504	20.886
9.807×10^{-2}	98.07	1	0.9807	0.9678	10.017	32.866	735.56	0.9139	14.223	2048.1
0.100	100	1.0197	1	0.9869	10.215	33.515	750.06	0.9320	14.504	2088.6
0.1013	101.33	1.0332	1.0132	1	10.351	33.959	760.02	0.9444	14.696	2116.2
9.788×10^{-3}	9.7885	9.983×10^{-2}	9.789×10^{-2}	9.661×10^{-2}	1	3.2808	73.424	9.124×10^{-2}	1.4198	204.45
2.983×10^{-3}	2.9835	3.043×10^{-2}	2.984×10^{-2}	2.945×10^{-2}	0.3048	1	22.377	2.781×10^{-2}	0.43275	62.316
1.333×10^{-4}	0.1333	1.3595×10^{-3}	1.333×10^{-3}	1.315×10^{-3}	1.362×10^{-2}	4.469×10^{-2}	1	1.243×10^{-3}	1.934×10^{-2}	2.7846
0.1073	107.3	1.0942	1.0730	1.0589	10.960	35.960	804.78	1	15.562	2240
6.895×10^{-3}	6.895	7.031×10^{-2}	6.895×10^{-2}	6.805×10^{-2}	0.7043	2.3108	51.714	6.426×10^{-2}	1	144
4.788×10^{-5}	4.788×10^{-2}	4.883×10^{-4}	4.788×10^{-4}	4.725×10^{-4}	4.891×10^{-3}	1.605×10^{-2}	0.3591	4.464×10^{-4}	6.944×10^{-3}	1

Permeability

m/s	cm/s	m/year	Darcy	ft/yr	ft/day
1	100	3.156×10^{7}	1.04×10^{5}	1.035×10^{8}	2.835×10^{5}
0.01	1	3.156×10^{5}	1.04×10^{3}	1.035×10^{6}	2.834×10^{3}
3.169×10^{-8}	3.169×10^{-6}	1	3.28×10^{-3}	3.281	8.982×10^{-3}
9.66×10^{-6}	9.66×10^{-4}	304	1	1000	2.74
9.658×10^{-9}	9.659×10^{-7}	0.3048	10^{-3}	1	2.738×10^{-3}
3.527×10^{-6}	3.527×10^{-4}	111.33	0.365	365.25	1

Densities (at 20 °C) g/cm³

Pure Water	0.99820	Kerosene (approx)	0.80
Sea Water	1.04	Paraffin wax (m.p. 52-52 °C)	0.912
Mercury	13.546	Microcrystalline wax (m.p. 60-63 °C)	0.915

The Greek Alphabet

Capital	Small	Name
A	α	alpha
B	β	beta
Γ	γ	gamma
Δ	δ	delta
E	ε	epsilon
Z	ζ	zeta
H	η	eta
Θ	θ	theta
I	ι	iota
K	κ	kappa
Λ	λ	lambda
M	μ	mu
N	ν	nu
Ξ	ξ	xi
O	ο	omicron
Π	π	pi
P	ρ	rho
Σ	σ	sigma
T	τ	tau
Y	υ	upsilon
Φ	φ	phi
X	χ	chi
Ψ	ψ	psi
Ω	ω	omega

Multiplying Prefixes

Prefix symbol	Name	Multiplying factor
G	giga	1 000 000 000 = 10^{9}
M	mega	1 000 000 = 10^{6}
k	kilo	1 000 = 10^{3}
h	hecto*	100 = 10^{2}
da	deca*	10
d	deci*	10^{-1} = 0.1
c	centi*	10^{-2} = 0.01
m	milli	10^{-3} = 0.001
μ	micro	10^{-6} = 0.000 001
n	nano	10^{-9} = 0.000 000 01

* Not recommended in SI

Self-Check -2	Written Test

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

1. 2460 mm convert to meter.

   A 2.46 m C.0.2460m

   B.345m D.222m

2. _____are used for measuring long distances

   A. Steel tapes B. steel balance C A & B 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: _____

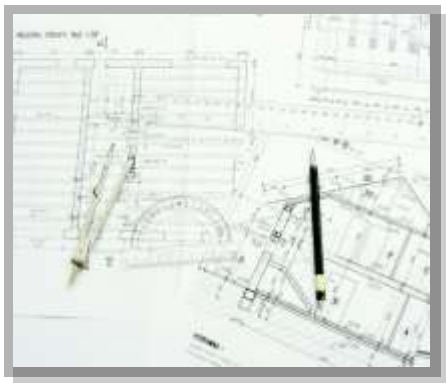
Name: _____ Date: _____

Short Answer Questions

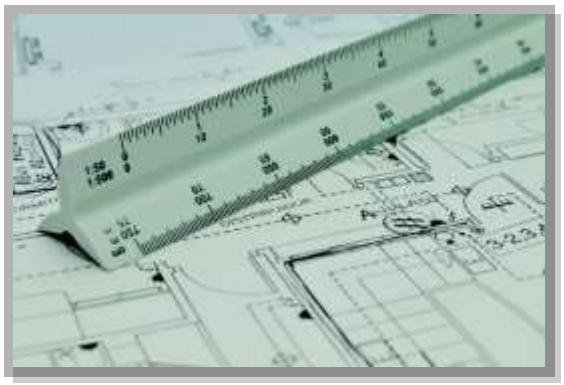
Information Sheet-3	Obtain measurements

Ways of obtaining measurements

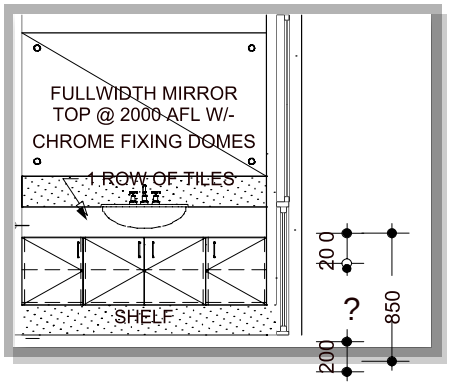
There are several ways to obtain measurements. You can:



• read them off a plan or drawing drawing



• measure them off a plan or using a scale rule



• calculate them using other known measurement

• measure them physically using the appropriate tape measure

• read them from the packaging manufacturer's instructions.

• read them from the

4.Measuring accurately

Measurement is carried out almost every day and by almost all trades people. Whether you're a carpenter, a wall and floor tiler, a bricklayer, a plasterer, a solid plasterer or a painter – or involved in any other kind of trades work within the building and construction industry, measurements will be required and performed no matter how big or small the job is.

Accurate measuring is very important, as incorrect measuring can result in wasted time which puts you behind schedule, wasted material which may cost you money to replace, or a less than aesthetic look on a completed job. For example, incorrectly sized tile cuts that are visible for all to see will not go over well with a client or employer.

Remember the saying, '**measure twice – cut once**', as this may save you time and money.

4.1.Rounding off

Rounding off is reducing the number of digits in a measurement or calculation to the nearest decimal point or whole number. Most of the time, rounding off to two or three decimal places will be accurate enough for the calculations performed in the construction industry.

Here are a few things to consider when you're rounding off.

- How many digits will be kept? (In construction usually two or three.)
- If the following digit is less than five (5), the preceding digit stays the same. (For example, 23.4532 rounded off to three decimal places would be23.453.)
- If the following digit is five (5) or higher, the last digit is increased by one. (For example, 24.4571 rounded off to two decimal places would be 24.46.)

4.2.Confirming measurements

Always check any measurements you've taken before you use them. That way if you've made a mistake, you can correct it before it's too late.

4.3.Recording measurements

How you record a measurement will depend on how it's going to be used. Different tasks and different workplaces will have different requirements.

The most important thing is that all measurements, calculations or totals need to be recorded clearly and accurately, including using the correct units. It's important that anyone reading the information can understand it and rely on it.

Self-Check -2	Written Test

Directions multiple chose item

Instruction chose the correct answer

1. _____is reducing the number of digits in a measurement or calculation to the nearest decimal point or whole number.

A. Rounding off B. Confirming measurements

C. Rounding up D. Rounding down

2. It is very important to have a methodical approach to getting measurements right by checking your calculations and not rushing what you are doing.

A. measuring tape B. accuracy

C. recording D. all

Note: Satisfactory rating - 3 out of 6 points Unsatisfactory - below 3 out of 6points
You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____ Date: _____

1. _____
2. _____

Basic infrastructure operation

NTQF Level I

Learning Guide-31

Unit of Competence: Carry-out Measurements and Calculations

Module Title Carrying-out Measurements and Calculations

LG Code: CON BIO1 M08 LO3-31

TTLM Code: CON BIO1 TTLM 1019v1

L03 Perform calculations

Instruction Sheet	Learning Guide #31

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

- Selecting appropriate calculation method
- calculating material quantities
- Confirm and record results

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 –

- Select appropriate calculation method for achieving the required result
- Correctly calculate material quantities for the project using the appropriate factors
- Confirm and record results

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

Information Sheet-1	Selecting appropriate calculation method

1.1 Using measurements in calculations

Introduction

We looked at linear measurements earlier in this guide. Linear measurements can be used as they are, or they can be used to calculate area and volume, the next two most frequently used measurements in the construction industry.

Properties of Geometric Shapes

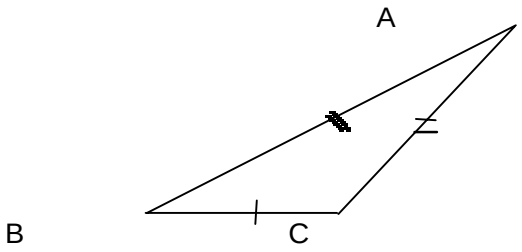
Each geometric shape has its own characteristics by which you can identify and recognize Geometry is the study of how lines interact with each other to form angles and shapes. It is necessary to appreciate the logical reasoning that goes with understanding the concepts of geometry so that its principles may be applied in various situations.
We start with definitions and axioms (fundamental principles) as our foundation, and build up to the more complex theorems step-by-step.

Triangles

When lines meet each other they create shapes. A shape made by three lines is called a triangle. Tri means three; therefore triangle means that there are three angles. Triangles always have three interior angles. Triangles have different characteristics by which we can identify the different triangles. Angles of a triangle always add up to 180^0.

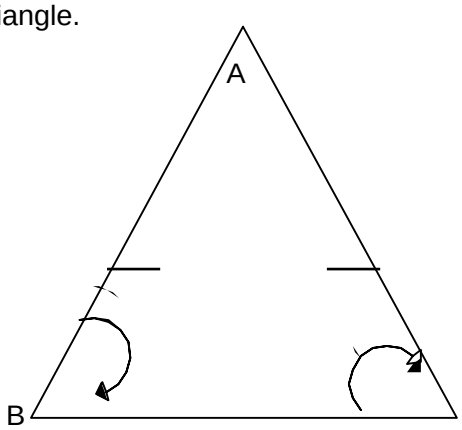
Scalene Triangle

A scalene triangle is a triangle of which each of the three sides is of different lengths. In other words AB ≠ BC ≠ AC



Isosceles Triangle

Any triangle of which two sides are equal in length and two interior angles are of equal size is called an isosceles triangle.



In Δ ABC:

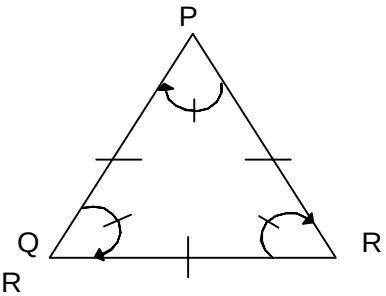
$AB = AC$

and $\angle B = \angle C$

N.B. Δ is a symbol for showing a triangle

Equilateral Triangle

An equilateral triangle is a triangle of which all three sides are of equal length and all three angles are of equal size.



In ΔPQR

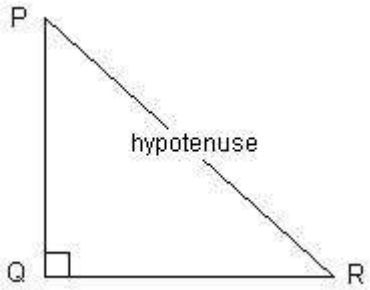
PQ = QR = PR

Therefore: All three interior angles are equal

$\angle P = \angle Q = \angle R = 60^0$

Right-angled Triangle

In a right-angled triangle, one of the angles is 90°.



In ΔPQR: $\angle PQR = 90°$ i.e. it is a right angle.

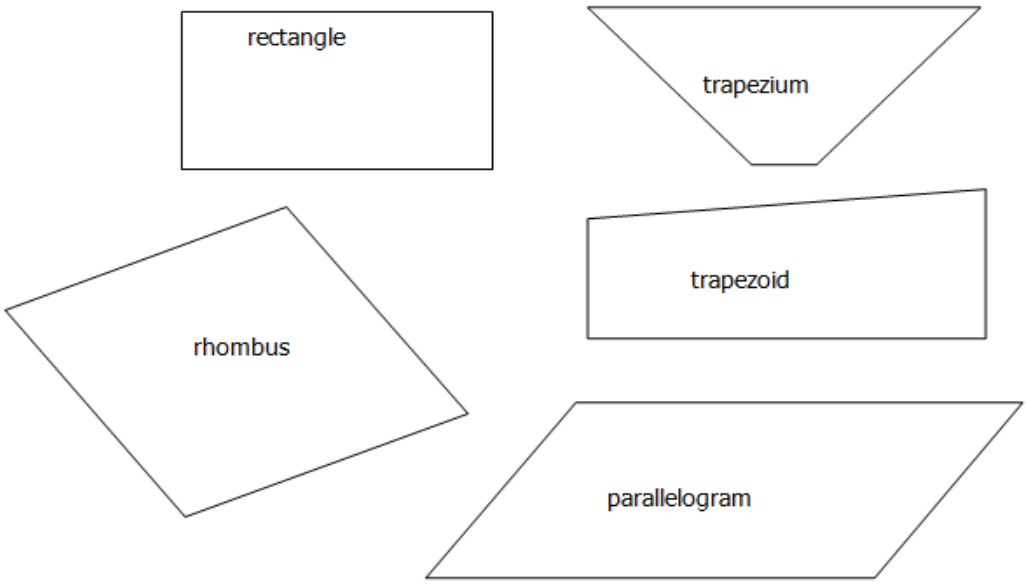
The longest side in any right-angled triangle is called a hypotenuse

$\therefore$ PR = Hypotenuse.

Remember that the angles of a triangle add up to 180^0

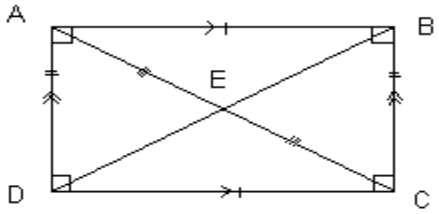
Quadrilaterals

Any shape that is formed when four lines meet at different points is called a quadrilateral. The points at which the lines meet are called vertices. We call it a quad for short. ('Quad' means four.) A quad will always have four interior angles because there will be four corners i.e.vertices to create four angles. The four angles always add up to 360^0.



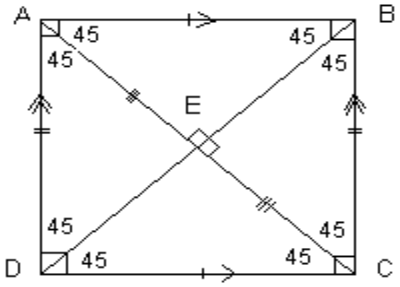
Rectangles

A quad with two pairs of opposite sides equal in length and also parallel to each other. All angles are 90 .



AB = DC And AD = BC Opposite sides are equal
AB // DC And AD // BC Opposite sides are parallel
Diagonals are equal in length
AC = DB
AE = EC And DE = EB Diagonals cut each other in half
∠A = ∠B = ∠C = ∠D = 90° All interior angles are 90^0

A rectangle with four sides equal in length and with all interior angles as right angles is called a square.

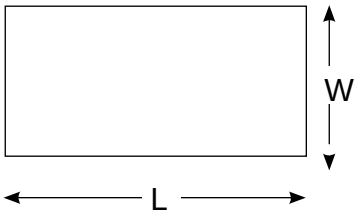


AB = DC And AD = BC Opposite sides are equal
AB // DC And AD // BC Opposite sides are parallel
Diagonals are equal in length
AC = DB
AE = EC And DE = EB Diagonals cut each other in half
∠AEB = 90^0 Diagonals cut each other at 90^0
∠A = ∠B = ∠C = ∠D = 90° All interior angles are 90^0
∠BAE = 45^0 Diagonals cut the interior angles in half

1.2.Calculations

Calculating the perimeter of a rectangle

A rectangle is any four-sided figure where all angles are 90°, and opposite sides are of equal length and parallel, as shown here.



For establishing formulas, we label the longer side L (for length) and the shorter side W (for width). If P stands for the perimeter, we can write:

P (rectangle) = L + W + L + W

= 2L + 2W

= 2(L + W)

Therefore, the formula for calculating the perimeter of a rectangle is:

P (rectangle) = 2(L + W)

Example 1

Find the perimeter of the following rectangle.

Solution:

P (rectangle) = 2(L + W)

= 2(140 + 60) mm

= 2(200) mm

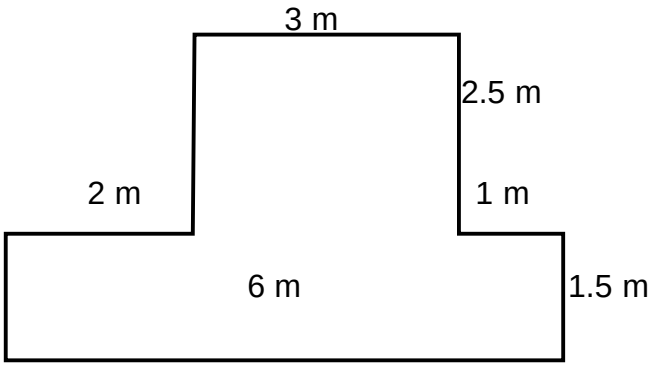
= 400 mm

Calculating more complex perimeters

Most houses aren't just a simple rectangle, but you can use the same method as you just learned to work out their perimeters too.

Example 1

Have a look at this example of a house drawing.



Solution:

Perimeter of rectangle = 2(L + W)

= 2(6 + 4) m

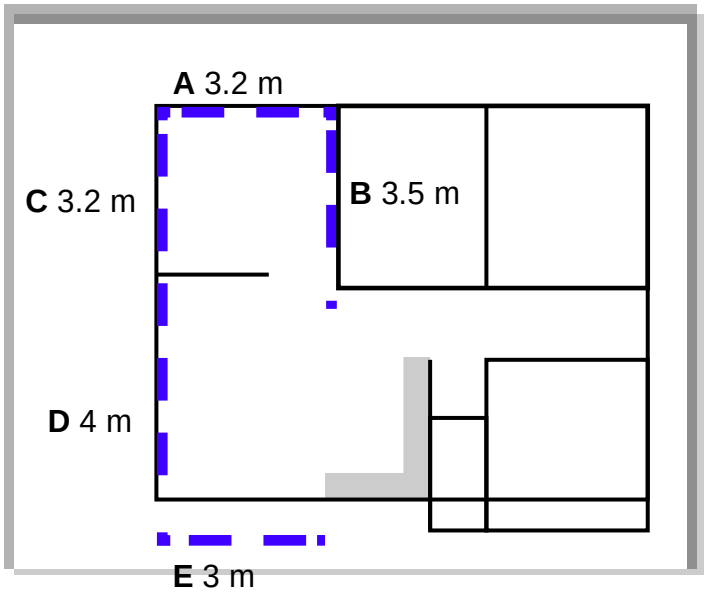
= 20 m

Have a look at the shape to see why this method works even though the shape is not a basic rectangle.

Linear measurements

Calculating linear measurements is very similar to calculating the perimeter of an area, except you calculate only the length of the object or area required instead of the total perimeter.

For example, a carpenter needs to measure up a specific area in a new house where timber skirting is to be fixed. On the following drawing, the dotted lines indicate where timber skirting is to be fixed.



To calculate the linear measurement, ie the total length of skirting required, you simply add up each of the lengths. So that looks like:

A 3.2 + **B** 3.5 + **C** 3.2 + **D** 4 + **E** 3

= 16.9 Lm (lineal meters)

The total can then be rounded off to 17 Lm of timber skirting required.
Always check any measurements you've taken before you use them. That way if you've made a mistake, you can correct it before it's too late.

Calculating the circumference of a circle

Whenever a circle is drawn, no matter the size, it's always the case that the circumference is approximately 3.1416 times the diameter. We refer to this figure as 'pi', the Greek letter π. The formula for finding the circumference of a circle is:

$$C = \pi \times d$$

where: C = circumference

d = diameter

π = 3.1416

So, if the radius (r) in the circle shown here is 30 mm, then the diameter (d) would be 60 mm (ie 2 × 30 mm).

Calculating the area of a rectangle

The formula for finding the area of a rectangle is:

$$A \text{ (rectangle)} = L \times W$$

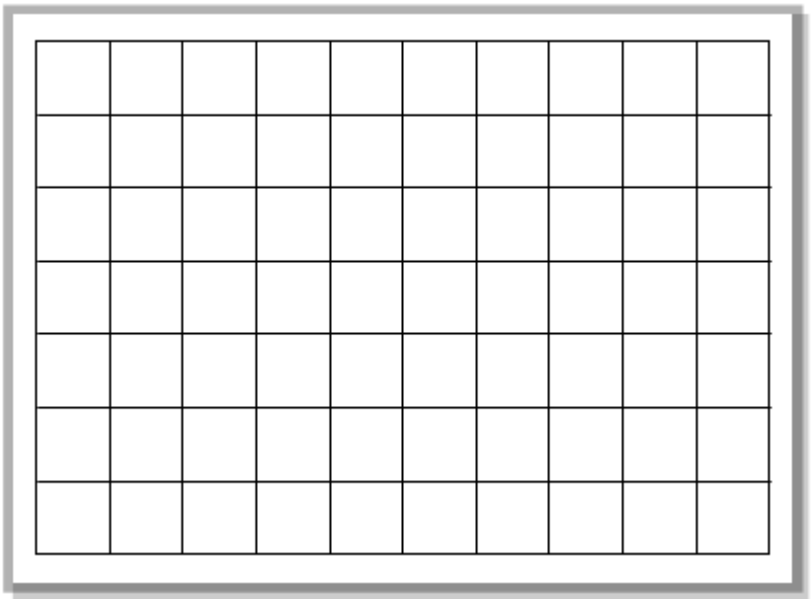
where: A = number of square units in the area

L = length

W = width

This is a 10 millimetre square.

This rectangle is 100 mm by 70 mm. So, if 100 × 70 = 7000, then the area of this rectangle is 7000 m^2.



Note: Length and width might also be called base and height, or length and breadth, depending on what the rectangle represents.
The length and the width must be measured in the same units.

Calculating the area of a circle

The formula for calculating the area of a circle is:

$$A \text{ (circle)} = \pi r^2$$

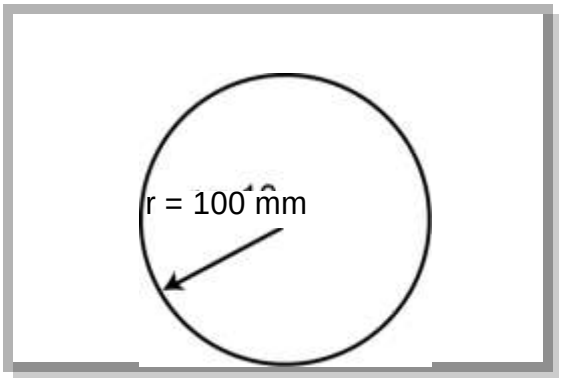
$$= 3.1416 \times r \times r$$

$$\text{or } \frac{\pi}{4} d^2$$

Example 1

Find the area of a circle with a radius of 100 mm.

Solution:



$A\ (circle) = \pi r^2$

$= (3.1416 \times 100 \times 100)\ mm^2$

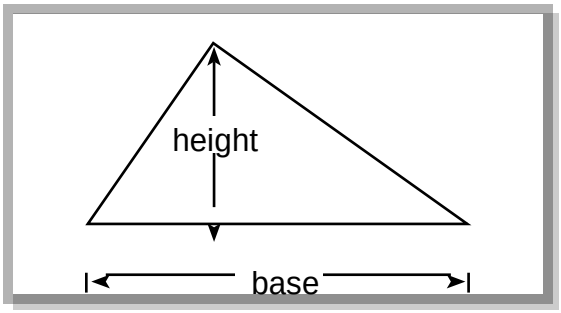
$= 31\ 416\ mm^2$

Calculating the area of a triangle

The formula for calculating the area of a triangle is:

$$Area = \text{½half of base} \times height$$

$$A = \frac{1}{2} B \times H$$

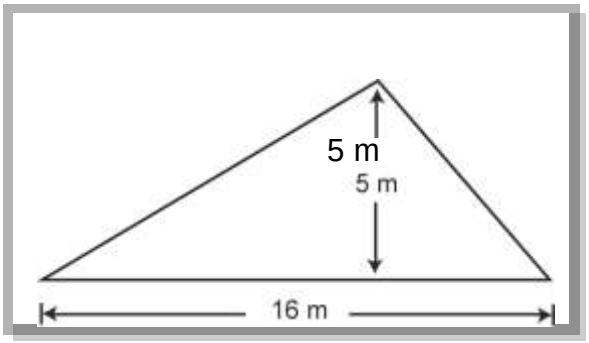


The base of a triangle may be on any of the three sides, but the height must be relative to the base at ninety degrees.

Example 1

Find the area of a triangle with a base of 16 m and a height of 5 m.

Solution:



$A\ (triangle) = \frac{B \times H}{2}$

$= \frac{16 \times 5}{2}\ m^2$

$= 80\ m^2$

$= 40\,m^2$

Here are some key points to remember when calculating the area of a triangle.

- Height (H) is the distance (at 90º) from the base to the top point of the triangle.
- Base (B) can be any one of the three sides of a triangle, but the height must always be at the right angle (90º).
- To calculate the area of a triangle use the formula

Calculating the hypotenuse of a triangle

The hypotenuse is the longest side of a right-angled triangle, opposite the right angle. The square of the hypotenuse is equal to the sum of the squares of the other two sides. This is useful to know, because once you have the lengths of the two sides of a right-angled triangle, you can work out the length of the longest side. But remember! This works only on right-angled triangles.

To calculate the hypotenuse, first square sides A and B, then add them together making C. To calculate C, we have to find its square root using a calculator.
To get to C^2, we have to find the square root of $A^2 + B^2$; however, calculating square root is very complex! Use the square root button (looks like √) on your calculator to get the answer you need.

$$\mathbf{C^2} = \sqrt{138.28}$$

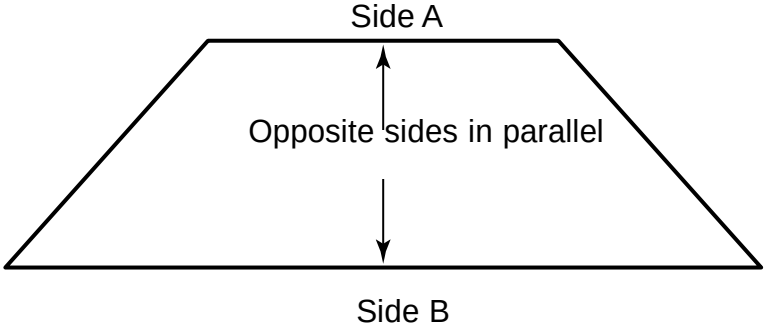
$$= 11.759251\ m$$

We round off the answer to three decimal places to get the hypotenuse of the triangle,namely 11.759 m.

Always round off your answer to **three** decimal places.

Calculating the area of a trapezium

A trapezium is a four-sided flat shape with straight sides. One pair of its opposite sides will be in parallel. In the trapezium pictured below, the parallel sides are indicated.



The area of a trapezium equals half the sum of the parallel sides, times the height between them. As a formula, this is:

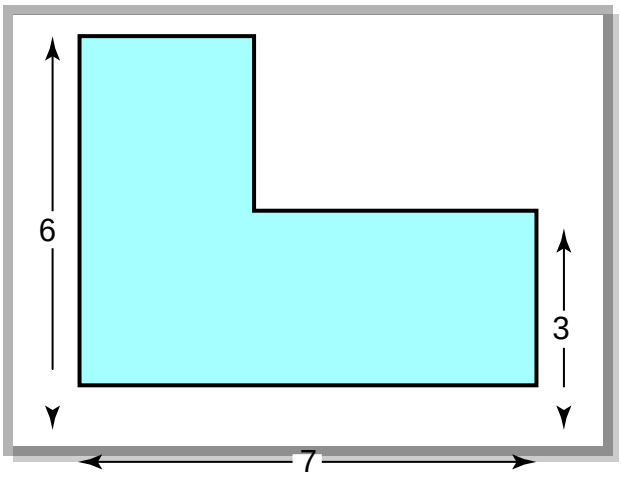
$$A = \frac{1}{2}(A + B) \times H$$

Calculating the area of compound shapes

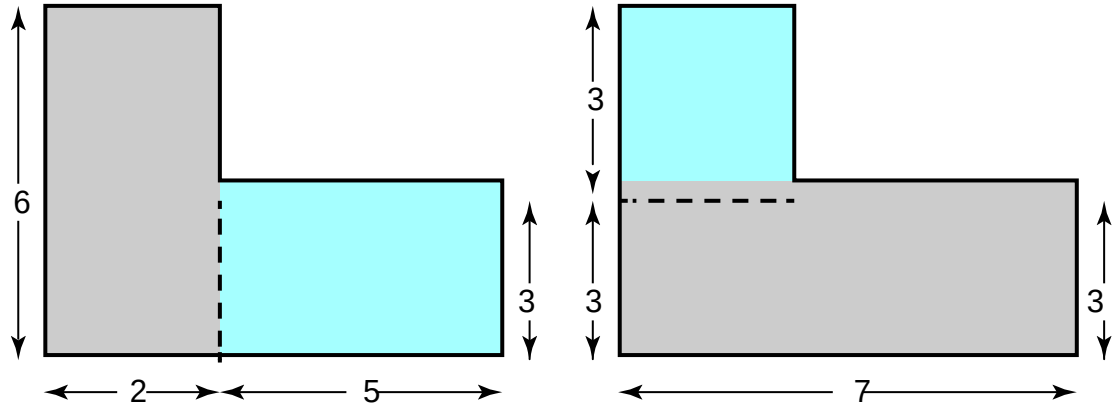
With contemporary home designs, you often have to calculate the area of more complex shapes in both interior and exterior areas. All homes have windows and doors; some may have triangular sections on roofs, while others may include design features in a range of shapes and sizes.

To calculate the area of more complex shapes, you need to divide them into shapes whose area can be calculated more easily, eg rectangles or squares.

Take a look at this floor plan. It's an L-shape which makes it difficult to calculate the area.



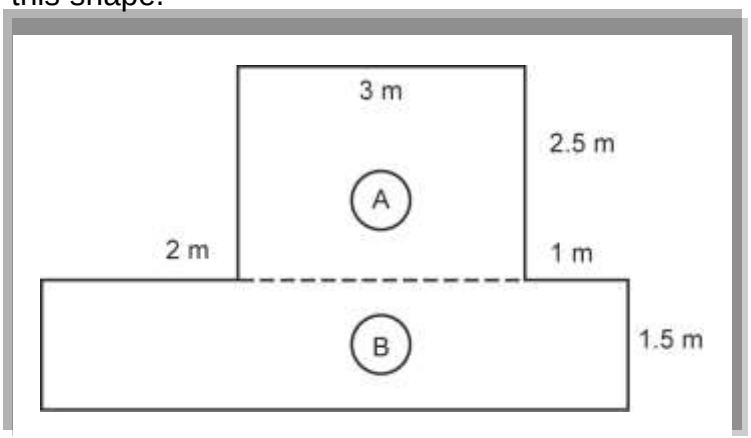
Divide the sections of shapes that are easier to work with. With this shape, there are two ways you can do that.



By dividing this complex shape into two simple shapes, it's now much easier to calculate the total area.

Example 1

Find the area of this shape.



Solution:

Area of rectangle A = width × height

$= (3 \times 2.5)\,m^2$

$= 7.5\,m^2$

Area of rectangle B = width × height

$= (6 \times 1.5)\,m^2$ (since the width = 2 + 3 +1 m)

$= 9\,m^2$

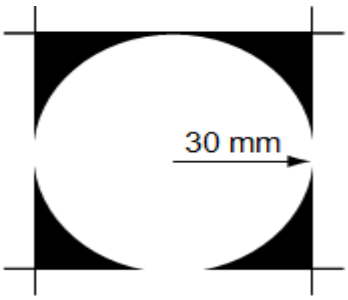
Total area of rectangles = A + B

$= (7.5 + 9)\,m^2$

$= 16.5\,m^2$

Example 2

Find the area of the shaded region in this shape.



Solution:

Since the circle has a radius of 30 mm, its diameter must be 60 mm.

Furthermore, since the diameter of the circle extends to the sides of the square, then the sides of the square must also be 60 mm long.

Area of square $= W \times H$

$= (60 \times 60)\,mm$

$= 3600\,mm^2$

Area of circle $= \pi r^2$

$= 3.1416 \times 30 \times 30\,mm$

$= 2827.44\,mm^2$

Area of shaded region = area of square - area of circle

$= (3600 - 2827.44)\,mm^2$

$= 772.56\,mm^2$

When the area of part of a region or shape is subtracted from the area of the overall region or shape, the answer is known as the **net surface area**. This is used for things like calculating the number of bricks required for a wall minus the area of the openings (windows and doors), or the paving required for a courtyard minus the area of garden beds.

Calculating volume

Calculations of volume in building and construction are used to determine things like the:

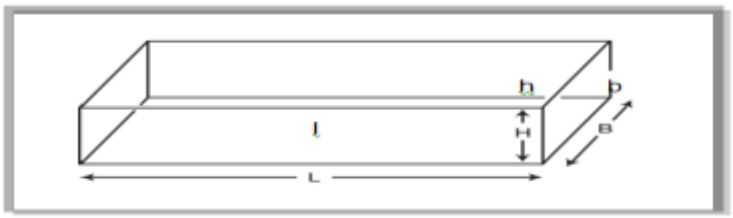
- volume of soil to be excavated from the foundation for footings
- volume of soil to be removed from a sloping site to provide a level area to build on
- amount of material required as fill, eg under floor slabs
- quantity of materials required for a particular job, eg cubic metres of sand for use in bricklayer's mortar
- volume of concrete needed for strip footings and slabs.

Calculating the volume of a prism

A prism is a solid shape with two identical ends that are the same size and shape and parallel to each other. Rectangles and squares are the most common prism shapes you'll deal with in building and construction. To calculate the volume of a prism, you multiply its area by its height. As a formula, it is:

$$V = A \times H$$

Volume is always in cubic metres (m^3).



For a rectangular solid, since the base is a rectangle:

$$A \text{ (rectangle)} = L \times W$$

$$\text{So } V \text{ (rectangular solid)} = L \times W \times H$$

Rectangular prism

You'll often need to calculate the volume of a rectangular solid. For example, let's look at a project where a large home theatre room is being built as an extension to an existing home. The new room is a rectangular shape, and you have to work out how much concrete will be required for the slab.

You already know that the formula used to calculate the area of a rectangle is **A = L × W**. The formula you use when calculating the volume of a rectangular solid is:

$$V = L \times W \times H$$

The slab in the new room has a length of 7 m, and a width of 3 m. Its height will be 170 mm, to fit with the existing house. To calculate the volume, your working out would be as follows.

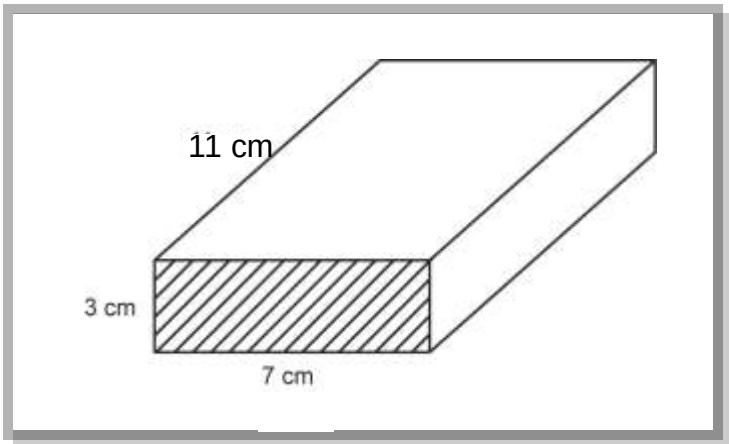
$$V = L \times W \times H$$

$$= 7 \times 3 \times 0.17$$

$$= 3.57\ m^3$$

Example 1

Calculate the volume of the rectangular box shown here.



Solution:

$V(\text{rectangular solid}) = L \times W \times H$

$= 3 \times 7 \times 11 \text{cm}$

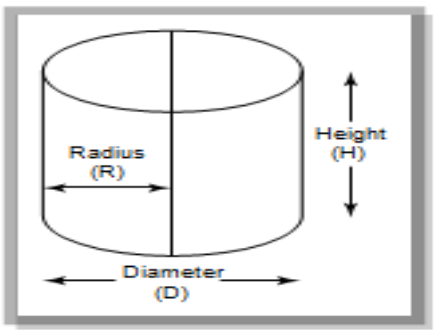
$= 231 \text{cm}^3$

Calculating the volume of a cylinder

You may be required at times to calculate the volume of a cylinder. For example, if a home has a portico with columns or pillars at the entrance, those are generally supplied as compressed cement hollow cylinders that have to be filled with cement then painted or rendered.

You already know that the formula used to calculate volume is **V = A × H**, and that to calculate the area of a circle, the formula is $\mathbf{A = \pi r^2}$.

The volume of a cylinder is worked out by pi × radius squared × height: As a formula, that's:



$$V = \pi r^2 \times H$$

Remember to halve the diameter to find the radius.

Calculating the volume of a pyramid

The calculation for finding the volume of a pyramid is the length × width × height then divide by three. As a formula, that's:

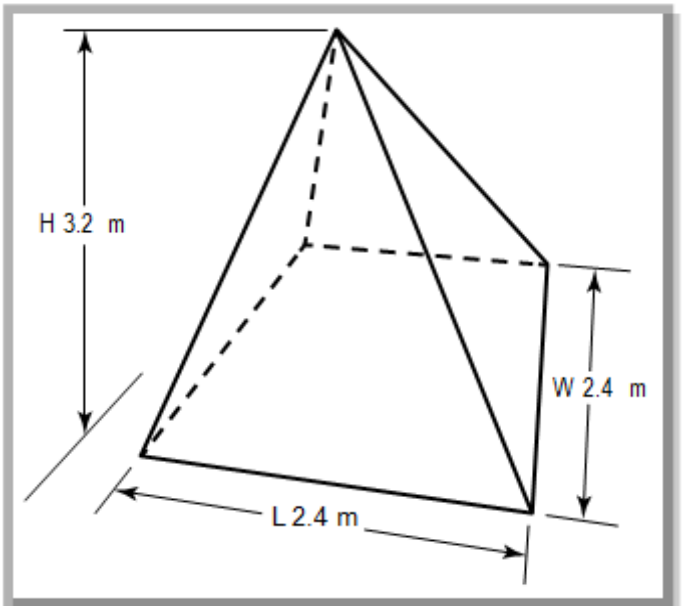
$$V = L \times W \times H \div 3$$

Example

$L \times W \times H \div 3$

$2.4\,m \times 2.4\,m \times 3.2\,m \div 3$

$= 6.144\,m^3$



Calculating mass

You may be required to calculate the mass of objects for the purpose of organizing lifting equipment. To do this, you would use the formula:

V × (mass of materials per cubic meter)

or

L × W × H × (mass of material per cubic meter)

Ratio

Ratio is used regularly in the building and construction industry. It is the relationship between two or more numbers or amounts, with the ':' representing 'to'. It can be expressed as:

- the ratio of **A** to **B** to **C**

  or

- **A**:**B**:**C**.

Ratios are used for things like:

- mixing mortar (bricklayers, wall and floor tilers, solid plasterers)
- expressing slope (degree of angle)
- drawing to scale
- thinning paint.

For example, the standard ratio for a mortar mix is 6:1:1. This means:

- six parts sand **to**
- one part lime **to**
- one part cement.

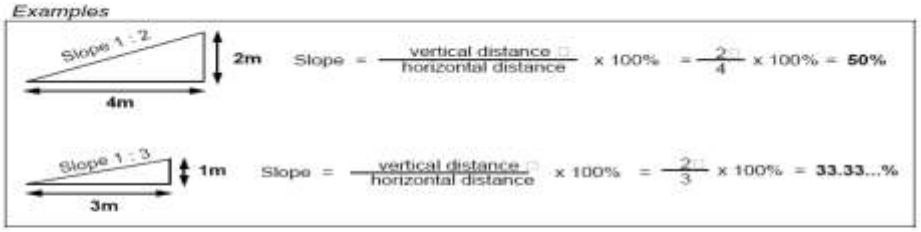
However, from this example you can see that the ratio doesn't tell you how much cement or sand to use in a mortar mix, or how much concrete is being made – just the relationship of the amount of cement to sand to lime.

1. SLOPES (as ratio and percentage)

Definition = the slope shows the steepness of an ascent or descent.

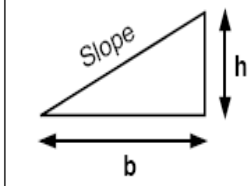
Slope given in **percentage (%)**:
Any fraction (ratio) can be expressed in % by dividing the result by 100%.

Examples



Formulas:

slope = height / base
height = base x slope
base = height / slope



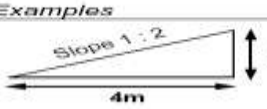
h = vertical distance
b = base = horizontal distance

$$\text{Slope} = \frac{\text{vertical distance}}{\text{horizontal distance}}$$

Slope calculation = slopes can be expressed as a ratio or in percentage.

Slope given in **percentage (%)**:
Any fraction (ratio) can be expressed in % by dividing the result by 100%.

Examples



$$\text{Slope} = \frac{\text{vertical distance}}{\text{horizontal distance}} \times 100\% = \frac{2}{4} \times 100\% = \mathbf{50\%}$$

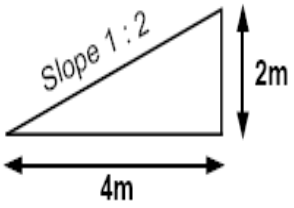
$$\text{Slope} = \frac{\text{vertical distance}}{\text{horizontal distance}} \times 100\% = \frac{2}{3} \times 100\% = \mathbf{33.33...\%}$$

Formulas:

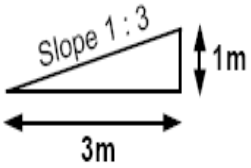
slope = height / base
height = base x slope
base = height / slope

Slope given as a ratio:

Examples



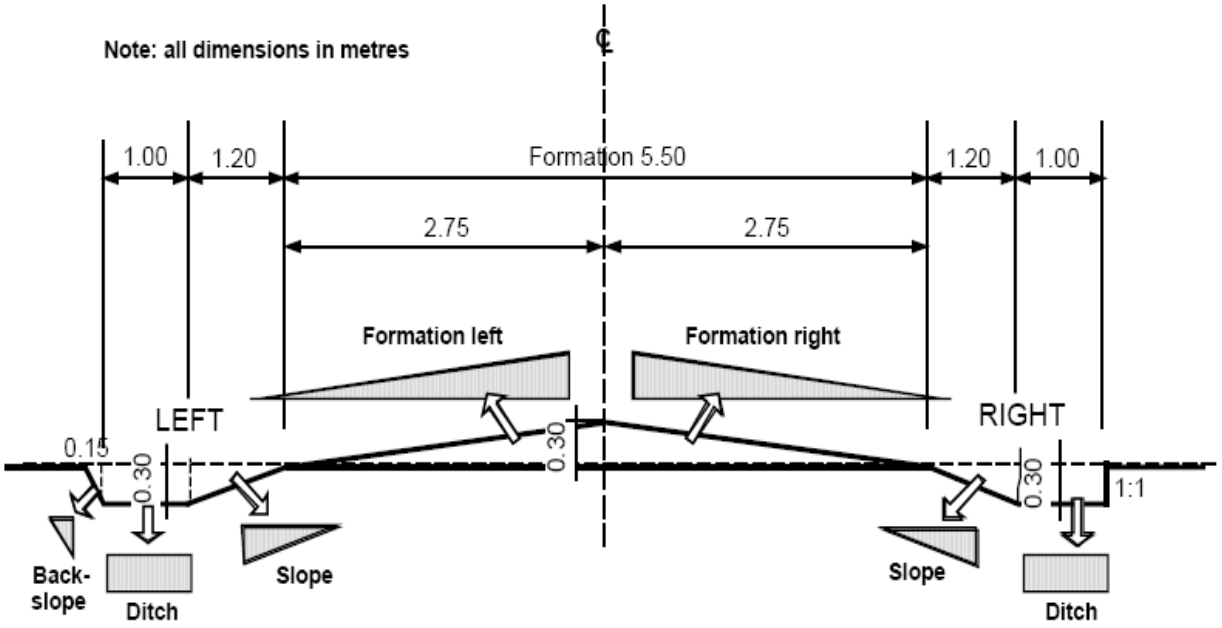
$$\text{Slope} = \frac{\text{vertical distance}}{\text{horizontal distance}} = \frac{2}{4} = \frac{1}{2} = 1:2$$

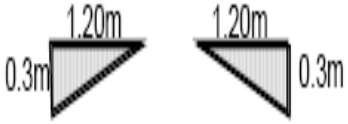
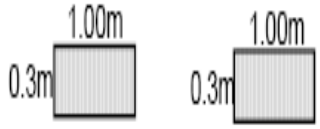


$$\text{Slope} = \frac{\text{vertical distance}}{\text{horizontal distance}} = \frac{1}{3} = 1:3$$

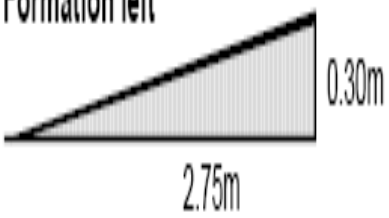
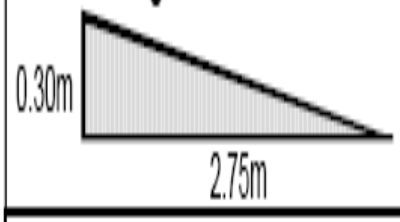
Note:

- The figure on top should always be the vertical distance and the figure below should always be the horizontal distance.



DITCH AREA BOTH SIDES	Part Area of Ditch	Formula	Calculation
	Slope left and right 	$\frac{a \times b}{2} \times 2$	$\frac{0.3m \times 1.2m}{2} \times 2 = 0.36m^2$
	Ditch left and right 	$a \times b \times 2$	$0.3m \times 1.0m \times 2 = 0.6m^2$
	Backslope left 	$\frac{h \times b}{2}$	$\frac{0.3m \times 0.15m}{2} = 0.0225m^2$
	Total Area of Ditch, Both Sides		$0.36m^2 + 0.6m^2 + 0.0225m^2 = 0.9825m^2$

Ditch Volume Both Sides for 100m Road	Total Area (m^2) x 100m	$0.9825m^2 \times 100m = 98.25m^3$

FORMATION	Area of Formation	Formula	Calculation
	Formation left 	$\frac{a \times b}{2}$	$\frac{2.75m \times 0.30m}{2} = 0.4125m^2$
	Formation right 	$\frac{a \times b}{2}$	$\frac{2.75m \times 0.30m}{2} = 0.4125m^2$
	Total Area of Formation		$0.4125m^2 + 0.4125m^2 = 0.825m^2$

Formation for 100m of Road	Total Area (m^2) x 100m	$0.825m^2 \times 100m = 82.5m^3$

Self-Check -1	Written Test

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

1. weight in kg per m3 volume in normal processed condition of the material.
   A Density: B. mass C length D. all
2. is the distance around a two dimensional shape, or the measurement of the distance around something; the length of the boundary.
   A. Lengths B**.** Perimeter C. Weight D. none

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

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Key answer

1._____
2._____

operation sheet #1	Find the perimeter of a rectangle

Objective:

To find the perimeter of a rectangle

Equipments:

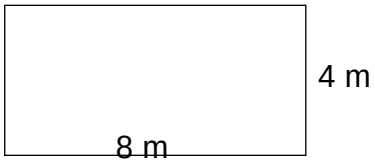
Tape , pencil,A4 paper

General procedure for Find the perimeter of a rectangle whose length is 8 m and whose width is 4 m.

Solution:

Step 1

Draw a diagram.



Step 2

Write down the appropriate formula. P (rectangle) = 2(L + W)

Step 3

Substitute numbers into the formula and calculate the answer.

P (rectangle) = 2(8 + 4) m

= 2(12) m

= 24 m

LAP Test # 1	Find the perimeter of a rectangle

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 30 minute.

Task 1: - Calculate the perimeter of rectangle.

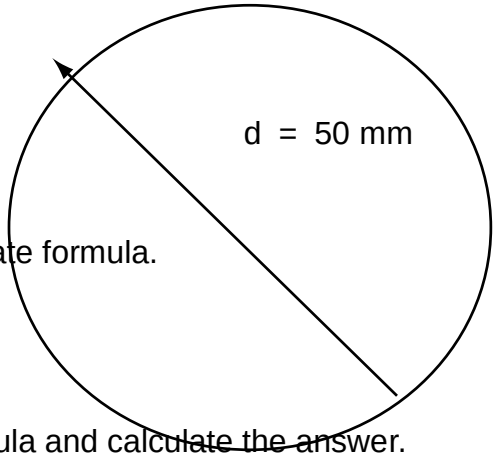
operation sheet #2	find the circumference of a grinding disc

Objective:
To find the circumference of a grinding disc
Equipments:
Tape ,pencil, A4 paper
General procedure for Find the circumference of a grinding disc of diameter 50 mm.

Solution:

Step 1

Draw a diagram.



Step 2

Write down the appropriate formula.

$C = \pi \times d$

Step 3

Substitute numbers into the formula and calculate the answer.

$C = 3.1416 \times 50\,mm$

$=157.08\ mm$

LAP Test # 1	find the circumference of a grinding disc

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 30 minute.

Task 1: - Calculate circumference of disc diameter 50mm.

Information Sheet-2	calculating material quantities

Introduction

Quantity is a term used in the building industry for the number or amount of materials required for a particular task. For instance, before constructing must be able to calculate the sizes, lengths and amount of material needed so that the correct quantities can be ordered from the supplier.
Now that you know how to take measurements for materials you might need to use, it's time to put it all together by calculating quantities.

For example concrete work

The unit of measurement for concrete is meter cube for thick surfaces such as ground floor slab. The data given below can be used to calculated materials required for making concrete, the materials needed depends on the grade of concrete as given on the data. General formula for calculating material list of concrete

Basic data

- Density of cement - - - - 1400 kg/m^3
- Density of Sand - - - - 1840 kg./m^3
- Density of Stone Aggregate - - - 2250 kg/m^3
- Density of Lime - - - - 1900 kg/m^3
- Density of Cement Mortar - - - - 2300 kg/m^3
- Density of Compo Mortar - - - - 1200 kg/m^3
- Density of Tracheae - - - - 2600 kg/m^3

Assume 30% Shrinkage and 5% wastage.

1) Concrete Mix = 1:3:6
Let volume of concrete = Zm^3

$$then\ \ a)\ Cement = \frac{1}{10} \times Zm^3 \times 1400 kg/m^3 \times 1.30\ shrinkage \times 1.05\ wastage$$
$$= 191 kg\ Z$$
$$= 0.41 m^3\ Z$$

$$b)\ Sand = \frac{3}{10} \times Zm^3 \times' 1840\, kg/m^3 \times 1.30\ shrinkage \times 1.05\ Wastage$$
$$= 754\, kg\ Z$$
$$= 0.41\, m^3$$

$$c)\ Aggregate = \frac{6}{10} \times Zm^3 \times 2250\, kg/m^3 \times 1.30\ Shrinkage \times 1.05\ Wastage$$
$$= 1843 kg \times Zm^3$$
$$= 0.82 \times Zm^3$$

Self-Check -2	Written Test

Directions: multiple choose item

Instruction choose the correct answer

1._____ is a term used in the building industry for the number or amount of materials required for a particular task.

A. Quantity B. Mortar C. Calculate brick quantity D. all

2. : The unit of area is

A.m^3 B .m^2 C.ml D, all

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer Questions

1. _____
2._____

Information Sheet-3	Confirm and record results

3.1 Confirming and recording Results

3.1.1 introduction of Results Recording

Once you have recorded and valuated the inspection results for a characteristic in the results recording function, you can also confirm the activities for the operation. Depending on the setting of the operation control key for an inspection operation, the system displays the dialog box for entering the activity times automatically or you must call it up manually:

- If the confirmation indicator for the operation control key is set to "milestone confirmation" or "confirmation required", the system automatically displays the dialog box Record Work Done.
- If the confirmation indicator is set to "confirmation possible, but not necessary," you must call up the dialog box for entering the activity times manually by choosing Edit ® Confirm activities in the overview screen for characteristics.
- In the dialog box Record Work Done, enter the values for the setup time, machine time or labor time, whichever is applicable. The dialog box also displays the activity times that have previously been recorded.
- Only one person can confirm activities for a specific QM order at any given time. If several people are trying to confirm activities for the same QM order, the system will display a message, indicating that the QM order is currently locked.
- After you have entered the activity times, choose Continue to close the dialog box and to return to the main screen in the results recording function.
- Save the data

3.1.2 Recording measurements

How you record a measurement will depend on how it's goingto be used. Different tasks and different workplaces will havedifferent requirements.

The most important thing is that all measurements, calculationsor totals need to be recorded clearly And accurately, includingusing the correct units. It's important that anyone reading the information can understand it and rely on it.

3.1.3 Tests Results Record

This is an important record to be maintained at construction site as a proof for construction quality. This record consists of tests of various materials such as cement, sand, aggregates, water, steel reinforcement used at construction site, test records of concrete cubes, concrete cylinders, slump tests etc.

These records are arranged as an index page with details of each material, page numbers of records etc. Individual pages consists of each materials, with their test dates, results etc.

All the tests carried out at site or in laboratory are recorded in the record book. Some of the tests carried out at construction sites for civil works are:

- Cube tests for concrete works for each location or structural members.
- Sieve analysis of coarse aggregates, impact or abrasion tests.
- Sieve analysis of coarse sand for concrete works, masonry sands for masonry works, plastering and pointing works etc.
- Tests for impurities of aggregates and sands.
- Bulking of sand test for concrete and masonry works.
- Slump tests and compacting factor tests for concrete works.
- Crushing strength test, tolerance, and water absorption test, efflorescence tests of bricks, stones or masonry work.
- Moisture contents of timber.
- Manufacturer tests reports provided by the vendors for admixtures, reinforcing steels etc.

Self-Check -3	Written Test

Directions multiple choose item

Instruction choose the best answer

1.How you record a measurement will depend on how it's goingto be used. Different tasks and differe nt workplaces will havedifferent requirements

A. Recording measurements C. Tests Results Record

B. Slump tests D. dialog box

2. are arranged as an index page with details of each material, page numbers of records etc. Individual pages consists of each materials, with their test dates, results etc.

A .report B. Records C. tests D. all

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer Questions

1. _____
2. _____

Basic infrastructure operation

NTQF Level I

Learning Guide-32

Unit of Competence: Carry-out Measurements and Calculations

Module Title: Carrying-out Measurements and Calculations

LG Code: CON BIO1 M08 LO4-LG32

TTLM Code: CON BIO1 TTLM 1019v1

Lo4 Estimate approximate quantities

Instruction Sheet	Learning Guide #32

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

- determine material requirements
- selecting appropriate formula
- estimate quantities
- confirm and record material quantities

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**:

- Take calculations for determining material requirements
- Select appropriate formulas for calculating quantities
- Estimate quantities from the calculations taken
- Calculate, confirm and record material quantities for the project within enterprise tolerances

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

Information Sheet-1	Determine material requirements

1.1.determining material requirements

Is a system for planning material requirements suitable for managing components needed to produce finished product. This technique is now widely used to plan production and procurement orders, taking into account market demand, bill of materials and production lead times.

This is all very well as long as demand is “regular”, but what happens when this is not the case? What happens if demand is concentrated into certain periods (when the finished product is placed into production) but then drops off entirely? The error is a basic one: demand for these materials cannot be predicted but must be calculated on the basis of demand for the finished product. Production must be scheduled according to the quantity of finished products to be produced, and from this quantity you can arrive at the actual requirements for materials that go into them.

1.2 Methods of calculation requirement

- **Calculating gross requirements**: Gross first-level component requirements are calculated using orders to be issued (or launched) for finished products that they contain. This calculation is cascaded down through to the end of the bill of materials: from the first-level component orders to be issued we obtain the gross requirements for second-level components, and so on.
- **Calculating net requirements:** you now need to calculate net requirements for each finished product, component, assembly and sub-assembly, taking into account how many of each of these you already have in stock. The net requirement is therefore obtained by subtracting stock in hand at the end of the previous period from the gross requirement. Gross and net requirements must be accurately linked to a point in time: the date on which the finished products have to be available comes from the production plan, whilst the dates for components must be calculated backwards taking into account production or procurement lead times.

Self-Check -1	Written Test

Directions: multiple choose item

Instruction choose the correct answer

1. Gross first-level component requirements are calculated using orders to be issued (or launched) for finished products that they contain.

   A. Calculating gross requirements C. Calculating

   B. Calculating net requirements D. material requirements

2. you now need for each finished product, component, assembly and sub-assembly, taking into account how many of each of these you already have in stock.

   A. the gross requirement C. calculate net requirements

   B. product D. none

Note*:* Satisfactory rating –above 3 points Unsatisfactory - below -3 points
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer Questions

1._____

2._____

Information Sheet-2	selecting appropriate formula

2.2 Formulas for calculating quantities.

The formulas & equations are essential for construction professionals to work out the quantities as well as cost & subtotals of building material. These formulas can be used in a wide array of construction projects and design applications which range from reinforced concrete, bridge construction, highway design etc.

A formula refers to equation demonstrating one variable as an amalgamation of other variable(s) with the use of algebraic operations like add, subtract, multiply, divide, raise to a power, apply the natural logarithm as well as the cosine, or other mixture of operations. Various issues related to construction can be easily resolved with proper application of these formulas.

This content takes you through some formula basics, including constructing simple arithmetic are :-**Masonry work :** determining 1) number of concrete hollow blocks used and 2) number of cement volume of sand for mortar.

Concreting work: determining volume of concrete (number of cement bags, etc.) for footings, wall footing, floor slab, concrete columns (circular, rectangular), concrete beams, concrete and stairs **Steel reinforcement:** determining 1) number of bars in for footings, floor slab, columns (circular, rectangular), beams, and stairs

Carpentry: determining 1) total board foot of a lumber, understanding the all-important topic of operator precedence, and moving worksheet formulas.

Self-Check -2	Written Test

Directions: multiple choose item

Instruction choose the correct answer

1. Gross first-level component requirements are calculated using orders to be issued (or launched) for finished products that they contain.

   A. Calculating gross requirements B. Calculating

   C. Calculating net requirements D. material requirements

2. you now need for each finished product, component, assembly and sub-assembly, taking into account how many of each of these you already have in stock.

A. the gross requirement B. calculate net requirements

C. product D. none

Note*:* Satisfactory rating –above 3 points Unsatisfactory - below -3 points
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer Questions

1._____

2._____

Information Sheet-3	estimate quantities

3.1 Estimating quantities from the calculations taken

3.1.1 introduction of estimating

Building construction estimating is the determination of probable construction costs of any given project. Many items influence and contribute to the cost of a project; each item must be analysed, quantified, and priced. Because the estimate is prepared before the actual construction, much study and thought must be put into the construction documents.

During the design process, the contractor prepares and maintains a cost estimate based on the current, but incomplete, design. In addition, the contractor may prepare estimates that are used to select between building materials and to determine whether the cost to upgrade the materials is justified. What all these estimates have in common is that the design is incomplete. Once the design is complete, the contractor can prepare a detailed estimate for the project.

3.1.2 Purpose of estimating

Is to give a reasonably accurate idea of the cost. .The **estimate** of a work and the past experience enable one to **estimate** quite closely the length of time required to complete an item of work or the work as a whole

The process of calculating the quantities (The quantity with reference to the measurement in the drawings, i.e. plans, elevation, section) and cost of various construction items i.e. excavation, concreting, masonry, plaster etc. of the project is called an “estimate”.

As the word suggests, it is an estimate of what the cost would be on completion. It can be based on “lump sum” i.e. thumb rule bases like plinth area or per sq ft rate at the conceptual stage. Once plans are decided it has to be in details for its methodical & scientific planning and execution or say for right construction management and selection of materials. It will form the bases of so many decision and documents and will play an important role in the choice/selection of material as well as /construction technology.

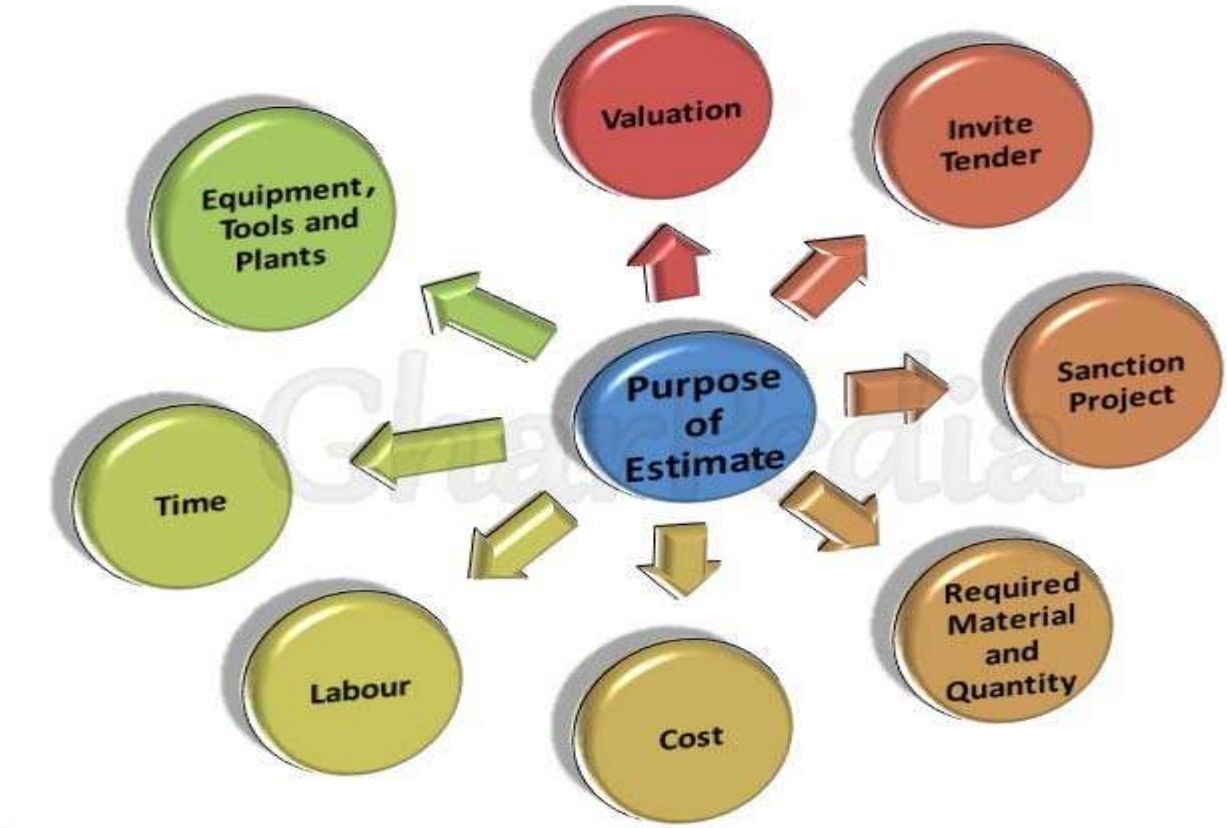


Figure 3.1 **Purpose of estimating**

3.1.3. Estimating methods

The required level of accuracy coupled with the amount of information about the project that is available will dictate the type of estimate that can be prepared. These estimating methods require different amounts of time to complete and produce different levels of accuracy for the estimate.

The different estimating methods are discussed below:-

- **Detailed Estimate:** - The detailed estimate includes determination of the quantities and costs of everything that is required to complete the project. This includes materials, labor, equipment, insurance, bonds, and overhead, as well as an estimate of the profit. To perform this type of estimate, the contractor must have a complete set of contract documents. Each item of the project should be broken down into its parts and estimated
- **Assembly estimating: -** In assembly estimating, rather than bidding each of the individual components of the project, the estimator bids the components in groups known as assemblies.

The components of an assembly may be limited to a single trade or may be installed by many different trades.

- **Parametric Estimates: -**Parametric estimates use equations that express the statistical relationship between building parameters and the cost of the building. The building parameters used in the equation may include the gross square footage, number of floors, length of perimeter, percentage of the building that is common space, and so forth. For an equation to be usable the parameters used in the equation must be parameters that can be deter-mined early in the design process; otherwise the equation is useless.
- **Square-Foot Estimates: -**Square-foot estimates are prepared by multiplying the square footage of a building by a cost per square foot and then adjusting the price to compensate for differences in the building heights, length of the building perimeters, and other building components. In some cases, a unit other than square footage is used to measure the size of the building. For example, the size of a parking garage may be measured by the number of parking stalls in the garage
- **Model Estimating: -**Model estimating uses computer models to prepare an estimate based on a number of questions answered by the estimator. Model estimating is similar to assembly estimating, but it requires **less input** from the estimator.
- **Project Comparison Estimates: -**Project comparison estimates are prepared by comparing the cost of a proposed project to a completed project. When preparing an estimate using this method, the estimator starts with the costs of a comparable project and then makes adjustments for differences in the project.

Self-Check -3	Written Test

Directions: multiple choose item

Instruction choose the correct answer

1.___ is the determination of probable construction costs of any given project. Many items influence and contribute to the cost of a project; each item must be analysed, quantified, and priced.

A. Building construction estimating B. quantity C. quality D. all

2. determination of the quantities and costs of everything that is required to complete the project. This includes materials, labor, equipment, insurance, bonds, and overhead, as well as an estimate of the profit.

A Model Estimating B. Detailed Estimate C. Parametric Estimates D. none

Note: Satisfactory rating –above 3 points Unsatisfactory - below -3 points
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer Questions

1._____
3. _____

Information Sheet-4	confirm and record material quantities

4.1 Calculating confirming and recording material quantities

4.1.1 introductions of material quantities

Construction Materials quantities seeks to publish original research and practice papers of the highest quality on procurement, specification, application, development, performance and evaluation of materials used in construction and civil engineering. Papers are particularly sought on metals, timbers, glass, ceramics, bricks, terracotta, stone, rubber, finishes, plastics, sealants, adhesives, bitumen and fabrics. Papers on innovative and recycled materials and novel applications of other materials such as concrete and cement are also encouraged. All aspects of a material's life are addressed including embodied energy, environmental impact, service life, refurbishment, recycling and reuse.

Records to be maintained at construction sites play important role in construction activities. It is a document required to prove any construction activity has taken place at site during billing or any other claims.

These records have all the data of various construction activities carried out at site. If any additional work has been carried out and it is claimed during billing, these documents need to be produced as a proof.

Maintenance of records also helps during audits of construction projects at any point of time. These documents helps to defend any claims such as liquidated damages or false claims or violations of any guidelines by authorities or clients.

Self-Check -4	Written Test

Directions: multiple choose item

Instruction choose the correct answer

1. The basic required drawings are.
   A. Architectural drawing
   B. Structural drawing
   C. Plumbing & sanitary drawing
   D. All are correct
2. All the orders given by clients to the contractors need be maintained with serial numbers, signatures and dates. These orders should be specific for works. This order should also have a compliance column.

   A. Work Orders Book B. Works Diary C. Contract Agreement D. all

Note Satisfactory rating – above 3 points Unsatisfactory - below -3 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer Questions

1. _____
2. _____

Operation Sheet 1	Taking measurement

1.1. The techniques for taking measurement;

Steps 1- select appropriate measuring tools

Step 2- check the measuring tools

Step 3- Implement the collection of information

Step 4- Define resource providers who are available to do the work from the list

Step 5- Send the completed documents to supervisor/ concerned body

The trainers (who developed the LEARNING GIDE)

No	Name	Level	Emil
1	**GirumTadesse**	**B**	**Girumtadesse2011gmail.com**
2	**Wegderesfwkadu**	**B**	**Meherete2009@gmail/com**
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4	**MohammedNurgeba**	**B**	**mnurgeba@yahoo.com**
5	**Tihtenatadele**	**B**	

The facilitator (who the LEARNING GIDE)

No	Name	Qualification level	TVET Bureau
1	AYELE ESHETE	A	(ADIS ABABA TVET Bureau)

Answer key lo 1

Self-Check 1	Written Test Answer key

1. B, Hard hat
2. A. mask

Self-Check 2	Written Test Answer key

1. C, Land tenure and approval for use
2. B, Geotechnical site investigation
3. A, true

Self-Check 3	Written Test Answer key

1. D, Bulldozer
2. C, Leveling
3. B, Excavator
4. A, Sieve and Pan

Self-Check 4	Written Test Answer key

1. C, Wastage material place
2. B, 200m
3. B, false
1. B, false

Self-Check 5	Written Test Answer key

1. B, Governmental taxation
2. A, True

Self-Check 6	Written Test Answer key

1. B, true
2. C. Quarry managers
3. A. False

Self-Check 7	Written Test Answer key

1. b, Water
2. a), Noise
3. d), Erosion

Answer key lo 2

Self-Check 1	Written Test Answer key

1. A, true
2. C, Geological information in population growth

Self-Check 2	Written Test Answer key

1. A, true

2. D, The quarry should contain sufficient

Self-Check 3	Written Test Answer key

1. A, false true
2. B, travelling speed over 80 km/h

Self-Check 4	Written Test Answer key

1. A, false
2. B, Determine manpower history

Self-Check 5	Written Test Answer key

1. A, true
2. B, false

Self-Check 6	Written Test Answer key

1. A, Unsuitability
2. B, false

Answer key lo 3

Self-Check 1	Written Test Answer key

1. B, false
2. E, all

Self-Check 2	Written Test Answer key

1. a. true
2. b. false

Self-Check 3	Written Test Answer key

1. C, Budget planning and control
2. B, Derived from the list of resources

Self-Check 4	Written Test Answer key

1. B, False
2. A, True

Self-Check 5	Written Test Answer key

1. C, Advise supervisor on labor allocation in the quarries
2. B, To give budget on the work to be done

Self-Check 6	Written Test Answer key

1. A, True
2. B, False
3. A, True