

LEARNER'S BOOK

CIVIL TECHNOLOGY

GRADE

9

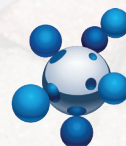


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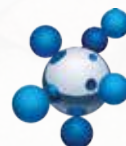


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Civil Technology Grade 9 Learner's Book

First published in 2023

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DRAFT

INTRODUCTION, CONTENT OVERVIEW

Civil Technology focuses on the concepts and principles in the built environment and on the technological process. It includes the practical skills and application of scientific ideas. The subject aims at the improvement of skills in the building environment.

Civil technology has the following specialisations namely:

- Plumbing (Civil Services)
- Bricklaying and Plastering (Construction)
- Woodworking and Timber (Woodworking)

Plumbing (Civil services) deals with supply of cold and hot water to buildings. Installation of sewerage systems and control of storm (rain) water. Plumbing also focuses on materials and the way they are used to provide water and sanitation on a site.

Bricklaying and Plastering (Construction) deals with concrete and brick structures in the building environment. E.g. Building of houses, malls and shopping complexes. It focuses on materials and the way they are used to provide infrastructures in the development of sites.

Woodworking and Timber deals with wood structures such as roof trusses, doors, windows and any part of a building that is made of timber. Woodworking works hand in hand with construction. It also focuses on providing temporary supporting to construct permanent structures such as suspended floors, stairs, arches and roofs.

Civil Technology prepares a person for the following career paths/choices:

- Plumber
- Drainlayer
- Carpenter and joiner
- Builder
- Teacher
- Building inspector
- Quantity surveyor
- Architect
- Draftsperson
- Building surveyor
- Engineering technician
- Engineering technologist
- Civil Engineer
- Handyman

Occupational Health and Safety

CHAPTER

1



LEARNING OUTCOMES

By the end of this chapter, learners should be able to use the civil technology workshop safely and follow all measures identified in the Occupational Health and Safety Act (OHSA), Act No. 85 of 1993. The following will be covered in this chapter:

- Learning about workshop rules and procedures
 - » Workshop safety
 - » Good housekeeping
 - » Definition of an accident
 - » Identifying unsafe acts and unsafe conditions
- Learning about workshop layout
 - » Demarcated areas, emergency stops, exits and first aid stations
- Learning about general safety rules
 - » Personal protective equipment (PPE)
 - » Safety signs
- Learning about fire prevention and protection
 - » Elements of fire
 - » Causes of fires

Introduction

The Occupational Health and Safety Act (OHS) is regulation number 85 which was introduced by the government in 1993. The Act aims at providing for the health and safety of people at work, people in connection with the use of plant and machinery and people other than those at work against the hazards arising from or in connection with the activities of people at work.

Workshop rules and procedures

All learners must adhere to the following rules in the workshop:

- Show the necessary respect to the teacher and other learners at all times.
- Do not run in a workshop.
- Ask first to use any tools in the workshop.
- No teasing other learners with tools or equipment.
- Do not throw any tool to your class mates.
- Always wear personal protective clothing in workshop.
- Never enter or leave the workshop without permission.
- Playing in the work shop is prohibited.
- Work only in the area allocated for you.
- Do not injure yourself and other learners.
- Never leave objects laying around.
- Clean the workshop and tools before you leave.

Workshop Safety

Good housekeeping

Housekeeping means there must be a place for everything and everything in its place all the time. A clean, orderly workshop is a safe workshop. Good housekeeping means working in an orderly way, and always returning tools and materials to their correct places. This practice ensures that the workshop is always kept clean and tidy, making it a better and safe place to work. Housekeeping is a crucial aspect of workplace safety as good housekeeping helps prevent accidents and reduces the severity or consequences of accidents.

Proper housekeeping:

- saves time
- eliminates potential accidents
- saves space
- can prevent fire hazards
- ensures that the workplace is safe.

Definition of Accident

An unplanned and uncontrolled event that occurs as a result of unsafe actions or conditions.

Causes of Accidents

| Workshop | Workplace |
|--|---|
| <ul style="list-style-type: none">• Not wearing personal protective equipment (PPE) in the workshop.• By not displaying safety rules and regulations in the workplace.• Working without the permission of the teacher/supervisor.• Playing or fooling around in the workshop.• Placing of tools, materials, etc. on the walkways in the workshop.• Using the tools or machines for the wrong purpose.• Adjusting or touching moving machinery.• Working at a dangerous speed.• Oil or other liquid spills that may cause slipping. | <ul style="list-style-type: none">• Not wearing personal protective equipment (PPE).• By not displaying safety rules and regulations in the workplace.• Not having first-aid kits at the workplace.• By operating faulty/malfunctioning machinery.• Oil or other liquid spills that may cause slipping.• Working with faulty tools & machines.• Working at unsafe speeds. |



Figure xx: Safety gloves



Figure xx: Safety boots



Figure xx: Overall



Figure xx: Hard hat



Figure xx: Safety goggles

Unsafe acts

Unsafe acts are committed by the worker.

- Working without permission
- Working at a dangerous speed
- Using machines for the wrong purpose
- Refusal to use or wear safety devices (PPE)
- Taking risks

Unsafe conditions

Unsafe conditions are hazards that have the potential to cause injuries or death. Some of those hazards include but not limited to:

- When tools and equipment are not well maintained
- Lack of ventilation
- Insufficient lighting
- Limited space in the workshop
- Lack of safety equipment

Requirements of OHS Act

The OHS act stipulates a number of requirements with regard to PPE, safety signs and first aid. We will look at some of these requirements.

Personal protective equipment

Personal Safety

Personal safety refers to the manner in which a person should behave in a work place. In order to avoid risks or injuries, people must make sure that protective clothing / gear is worn at all times.

Clothing

Clothing refers to the manner in which a person should dress in the workplace. Workers and learners must avoid wearing loose clothes, jewellery, and sandals. Long hair should be neatly tied at the back.

The following are some of the protective gear one should wear for protection:

- Hand gloves must be worn to protect your hands from sharp objects and splinters.
- Protective Boots to protect your feet from sharp objects and falling objects. They also protect you from slips.
- Overalls and Aprons must be worn at all times to protect your clothes.
- Head gear to protect the head from falling objects where applicable.
- Goggles should be worn in order to protect eyes from sparks and splinters/ wood chips.

- Ear muffs are used to cover the ears to protect hearing from loud noises.
- Dust mask or respiratory mask must be worn to protect your lungs | from dust.
- Face shield must be worn to protect your face from splinters or wood chips.

Safety signs


Purpose of safety signs:

Safety signs are graphics (pictures) that instruct people of what to do and what not to do in order to minimise accidents.

Identification of safety signs are grouped according to colour. There are five main categories of safety signs namely:

- Prohibition
- Mandatory
- Warning
- Safe conditions
- Fire Safety

Prohibition signs are red on white background, on a disc, meaning do not do or stop:

| | Meaning | Shape | Colour | Symbols | | |
|-------------|---------------------|--|--------|---|---|---|
| Prohibition | Stop. Do not do. |  Round | Red |  No entry |  No running |  No smoking |

Mandatory signs are white on blue background, on the round shape, meaning carry out the action given by the sign:

| | Meaning | Shape | Colour | Symbols | | |
|-----------|---|--|--------|--|---|---|
| Mandatory | Carry out the action given by the Sign. |  Round | Blue |  Wear boots |  Safety helmets must be worn in this area |  SAFETY GLASSES REQUIRED. |



Ear muffs



Dust mask



Respiratory mask



Face shield





Warning signs are black on a yellow background, on a triangular shape, meaning risk of danger or hazard ahead.

| | Meaning | Shape | Colour | Symbols | | |
|---------|-----------------|---|--------|---|---|---|
| Warning | Risk of danger. |  Triangular | Yellow |  |  |  |
| | | | | | | |

Safe conditions signs are white on green background, on a square shape, meaning you can or it is safe to do so.

| | Meaning | Shape | Colour | Symbols | | |
|-----------------|-----------------|---|--------|---|---|---|
| Safe conditions | The safe route. |  Square | Green |  |  |  |
| | | | | | | |

Fire safety signs are red on a square shape, meaning fire safety or fire gear.

| | Meaning | Shape | Colour | Symbols | | |
|-------------|--------------------------|---|--------|---|---|---|
| Fire Safety | Fire safety or fire gear |  Square | Red |  |  |  |
| | | | | | | |

Basic First Aid

First Aid is the emergency care or treatment given to an ill or injured person before professional medical aid arrives. It is the first and immediate assistance given to any person suffering from either a minor or serious illness or injury.

First aid includes initial intervention in a serious condition prior to professional medical help being available, such as performing cardiopulmonary resuscitation (CPR) while waiting for an ambulance, as well as the complete treatment of minor conditions, such as applying a plaster to a cut. First aid is generally performed by someone with basic medical training.



Figure1.1 Basic First Aid Kit

Fire prevention and protection:

Elements of fire

There are three elements of fire: Oxygen, Heat and Fuel. In order for a fire to ignite these elements are required.

- Oxygen- Is found in the air
- Heat- Is found from open flames, electric appliances, hot surfaces and static electricity.
- Fuel- Is found from anything that is used to keep a fire burning e.g. flammable solids such as wood, coal, paper, and gases and liquids such as paraffin, petrol etc.

Causes of fire

- Carelessness
- Inappropriate use and storage of fuel
- Faulty electrical appliances and extension cords
- Playing with fire
- Inadequate knowledge on storing and handling hazardous material or liquids

Occupational health and safety

Activity 1.1

- 1.1 List the five main categories of safety signs.
- 1.2 What does housekeeping mean?
- 1.3. Mention the names of the following Personal Protective Equipment?



Fig 1.2 Fire triangle

| Picture | Name |
|--|------|
| 1.3.1  | |
| 1.3.2  | |
| 1.3.3  | |
| 1.3.4  | |
| 1.3.5  | |
| 1.3.6  | |

1.4. Draw and label a fire triangle.

1.5. List TWO causes of fires.

1.6. Explain the term First Aid.

Graphics as Means of Communication

CHAPTER

2



LEARNING OUTCOMES

By the end of this chapter, learners should be able to use graphic communication and symbols such as images and drawings.

The following will be covered in this chapter:

- Defining graphic communication
- The purpose of graphic communication
- Safety precautions when using drawing instruments
- Correct use and care of drawing instruments
- Freehand drawing
- Lines and types of lines (SANS 0111 Guidelines)
- Dimensions, lettering and borders
- Scale drawing 1:1 and 1:2
- Orthographic projection
- Pictorial drawings

Introduction of Graphics Communication

What is graphic Communication

Graphic and communication is communication using graphic symbols such as images, drawings and photographs.

There are two kinds of drawings – artistic drawing and engineering drawing (drafting). Artistic drawing can be seen as a representation of something either imaginary or real, while drafting is aimed at creating a plan representing the construction of an object, so that it can be practically, technically, and very precisely realised.

The purpose of Graphics Communication

- To enable the learner to understand graphical drawings as a communication method.
- To enable the learner to read and interpret building plans
- To enable the learner to draw free hand drawings in order to communicate graphically on site
- Drawings are used to capture reality, ideas and designs on paper.

General drawing principles and correct use and care of drawing instruments

Uses of drawing instruments

The EGD drawing instruments consists of the following basic requirements:

Drawing paper/Sheet

Drawing papers/sheets can be obtained in sheets of various sizes.

Sizes are:

- A0 – 841mm × 1189mm
- A1 – 598mm × 841mm
- A2 – 420mm × 594mm
- A3 – 297mm × 420mm
- A4 – 210mm × 297mm

Drawing board

The drawing board provides a flat and smooth surface for the drawing sheet.

The drawing boards are available in various sizes and must always be larger than a drawing sheet. Try to keep your drawing boards clean and unscratched.



Figure 2.1 Drawing board

Clutch pencil

The drawing pencil is probably the most important tool that a draughtsman possesses. No drawing will be visible without a pencil. Pencil lead are available in leads indicated by various grades (HB, HHB, etc. always take care of tour pencil and keep the tip sharp.



Figure 2.2 Clutch pencil

Set square

A right-angled triangular plate for drawing lines, especially at 90° , 45° , 60° , or 30° .



Figure 2.3 Set squares

T-Square

The T-square is used primarily as a guide to draw horizontal lines. This instrument gets its name from its resemblance to the letter 'T'. A T-square can also be used in conjunction with a set square to draw vertical and angled lines.



Figure 2.4 T-square

Scale ruler

- The scale ruler is used to determine the dimensions of scale drawings. It is used for measuring lengths and transferring measurements at a fixed ratio.
- The most popular scale ruler is triangular and has six scales: 1:1, 1:2, 1:5, 1:10, 1:20 and 1:200.
- It is usually 300 mm long and made of plastic or metal.
- The measurements are in millimeters on one side and centimeters on the other side. The scale rule is used to determine the dimensions of scale drawings.



Figure 2.5 Scale ruler

Protractor

- This semi-circular instrument is made of transparent plastic. It is used to measure angles up to 360 degrees.



Figure 2.6 Protractor

Compass

- The compass is only used for drawing circles.
- The sharp end is positioned firmly on the paper and the leg containing the pencil is gently turned around on the paper.
- Always draw the circles in a clockwise direction and must lean forward.



Figure 2.7 Compass

Divider

- The divider is used to measure distances between two points.
- Each leg is placed on the point that you want to measure, and the distances is then measured by transferring the divider to a ruler.



Figure 2.8 Divider









Taking care of your drawing equipment:

Drawing instruments will last longer if you take care of them.

- The drawing board should be stored in a box after use, the instruments having been previously wiped with a small piece of chamois kept for this purpose.
- Pay particular attention to the pencils. Sharpen them regularly.
- Wipe the ruler, pens, pencils, compasses and set squares before and after use.
- The best wipes are pieces of old sheets or shirts that have been discarded.
- Store drawing instruments in a box or bag.

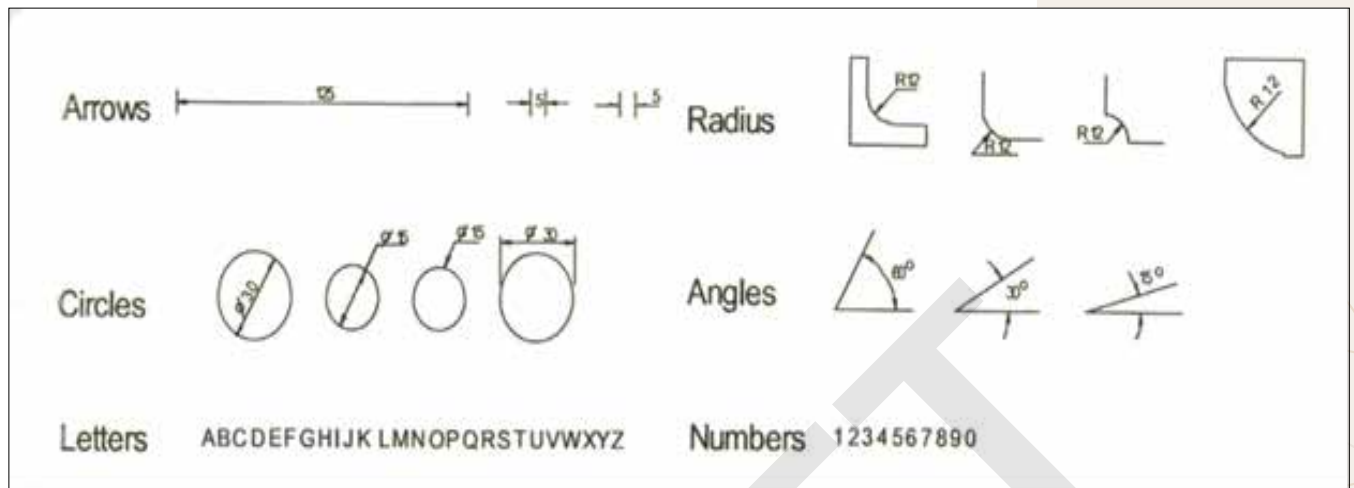
Lines (SANS110 guidelines) /Types of lines

Line work

| | Line type | Description | General application |
|---|---|-------------------------------|--|
| A |  | Continuous line dark. | Visible outlines and edges. |
| B |  | Continuous line light. | Dimension lines. Extension lines. Hatching lines. Leader lines. |
| C |  | Continuous line very light. | Construction lines. Projection lines. Guidelines for printing. |
| D |  | Dashed line light. | Hidden lines. |
| E |  | Chain line light. | Centre lines. Pitch lines and circles. Lines indicating symmetry. |
| F |  | Chain line light – dark ends. | Cutting planes. |
| G |  | Short break line light. | Irregular boundaries. |
| H |  | Long break line light. | Limits of views and sections, if the line is not an axis. |

Line types and line work

- Lettering and Dimensioning Techniques Examples



Freehand drawing

- This is a simple drawing done by hand without the aid of tools such as templates, stencils or tracing copies.
- Only pencils and eraser are used for free hand drawing.
- The technique can be mastered by practicing and drawing regularly

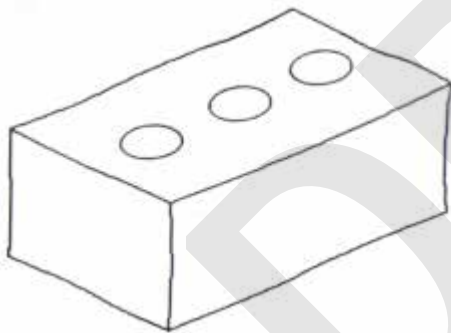


Figure xx free hand drawing of a brick

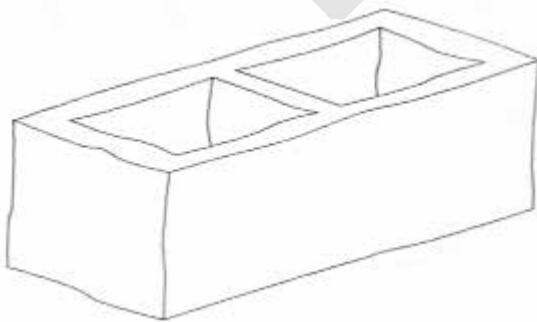


Figure xx free hand drawing of a brick block

Scale drawing 1:1 and 1:2

SCALE

All drawings are drawn to scale. The scale refers to the proportion or ratio between the dimensions adopted for the drawings and the corresponding dimensions of the object.

The following scales will be used in this regard:

Full Scale: 1: 1

Reducing Scales:

1: 2

1: 5

1: 10

1: 50

1: 100

Enlarging Scale:

2:1

5:1

Pictorial Drawings/Orthographic projection

Civil drawing

- Civil drawings are the drawings which are construction focused.
- They are mostly about brickwork and other features of construction, like doors and window frames and all drawings relevant to Civil technology.

First angle orthographic drawing

Scale, objects and Plane figures (Brick)

- The first angle orthographic simplifies every side of the object, example it gives the viewer the opportunity to individual Top View, Side View and Front View.

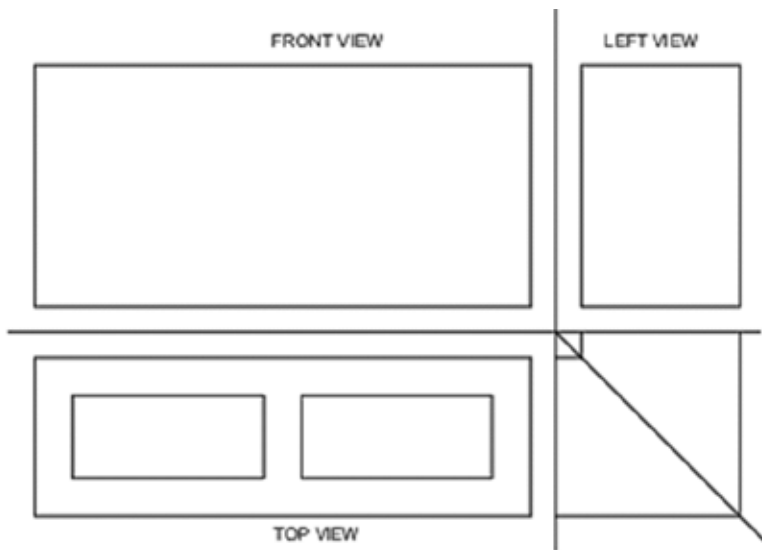


Figure 2.9 Drawing of a building block

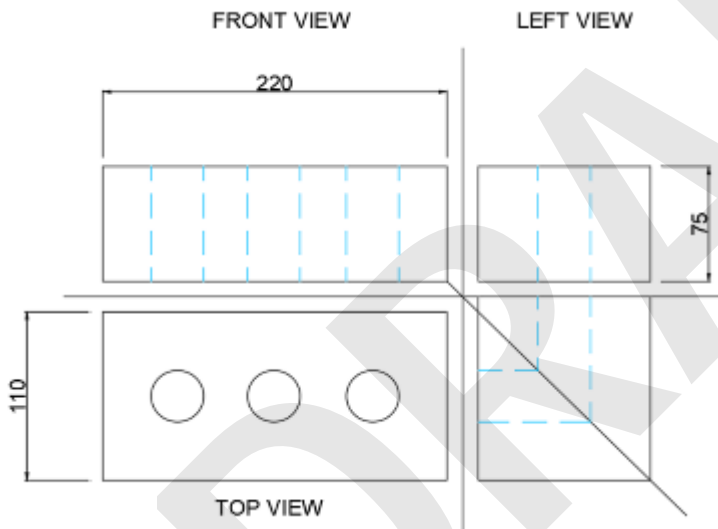
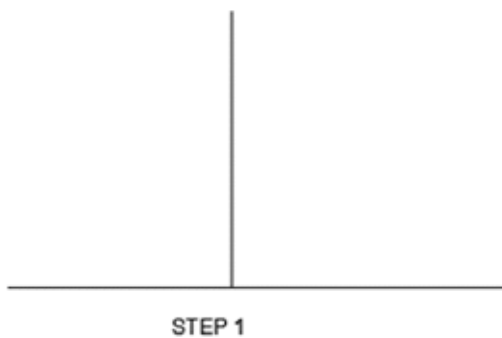
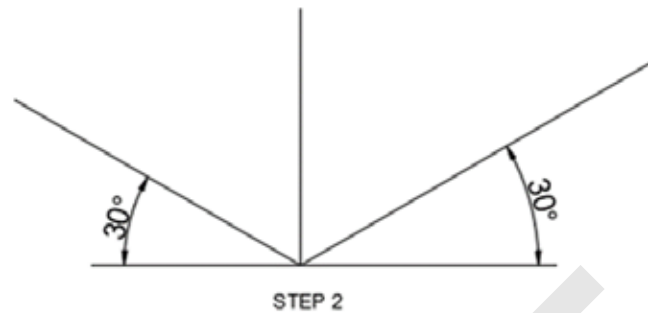


Figure 2.10 Drawing of a brick

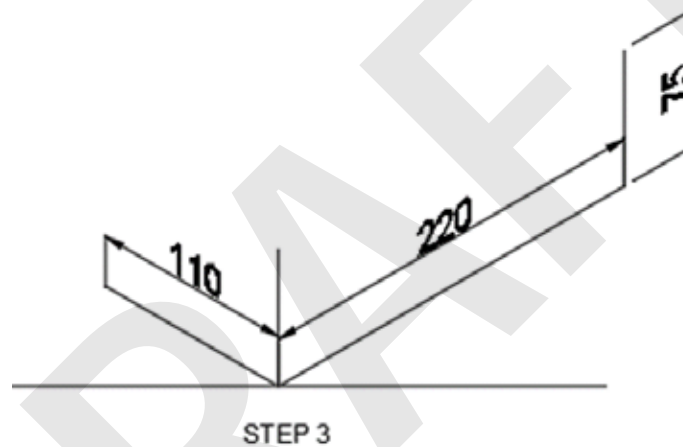
Isometric drawing



Step 1: start your isometric drawing by drawing a vertical line to meet the horizontal



Step 2: Use a 30 °Set square to draw two lines as shown above.

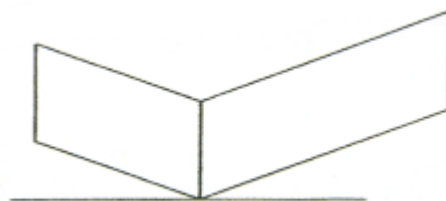


Step 3: Measure the horizontal dimensions of the brick along the two lines of the 30

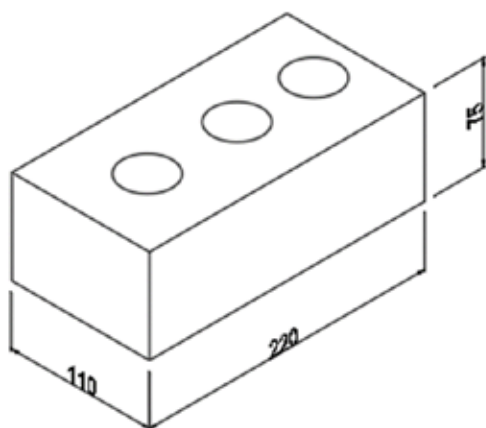
Length=220 mm

Breadth = 110 m

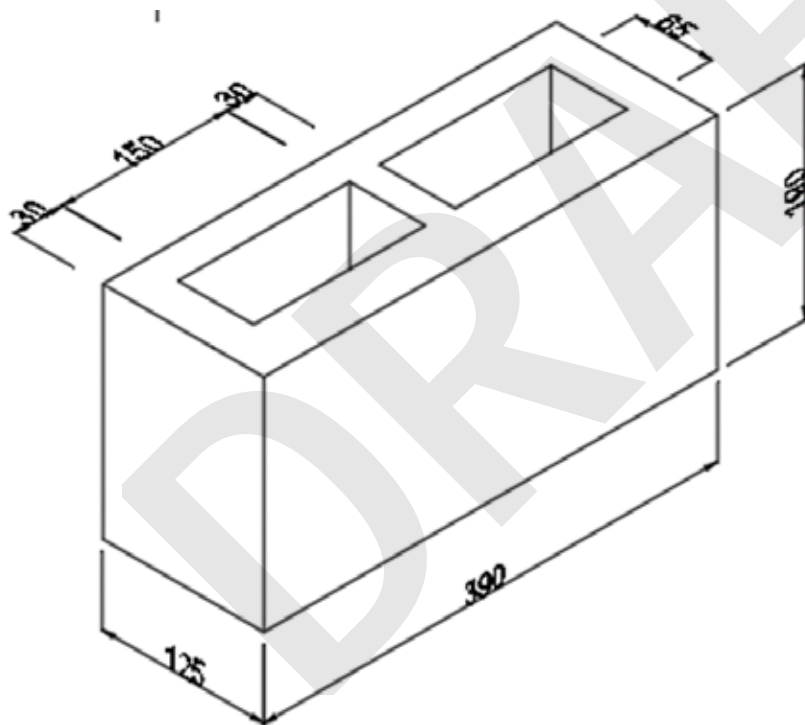
Height = 75 mm



Step 4: Draw the line parallel to the previously drawn lines as shown below.



Step 5: Complete the Isometric drawing by joining the lines to form a brick as shown above.



Graphic communication

Drawing exercise:

2.1 Setting up drawing sheets.

- » Schools will design their own layout of the title block.
- » The layout should meet the specific school's requirements.
- » The title blocks are drawn on the inside of the border line, at the bottom of the drawing sheet.

2.2 Drawing sheet with general name/ title block

- » Name block refers to the specific block where the name of the learner and surname, grade, date, title of the drawing, e.g. (scale 1:100)

2.3 Geometrical construction

- » To draw a shape, line, angle, or an arch accurately using a ruler, compass and set square

2.4 Simple Isometric drawing

- » A three-dimensional representation of an object on a 2-dimensional surface in which all three dimensions are equally emphasized.
- » In an Isometric drawing, all the lines are parallel to the major axes

Materials

CHAPTER

3



LEARNING OUTCOMES

By the end of this chapter, learners should be able to understand the use and properties of pipes and fittings and different types of building materials. The following will be covered in this chapter:

- Learning about the types and uses of pipes and fittings
 - » PVC pipes and fittings
 - » Copper water pipes and fittings
 - » Galvanised pipes and fittings
- Use and learn the properties of different types of building materials
 - » Sand
 - » Water
 - » Cement / Lime
 - » Fine/coarse aggregate
 - » Bricks
 - » Building blocks
 - » Concrete
 - » Mortar
 - » Screed
 - » Steel
 - » Wood/Timber

Introduction

The building industry makes use of a wide range of materials, such as concrete timber, bricks, metals, adhesives and synthetic materials for construction purposes. These materials should be of good quality, applied correctly, and handled appropriately. Selecting suitable building material for a project requires comprehensive knowledge regarding the properties of the material used in construction. The properties of materials differ as different material possess a variety of distinctive physical and mechanical properties. Only the general properties of materials, such as appearance, hardness or temper, strength, durability, and workability, will be discussed in this chapter.



Types and uses of pipes and fittings

Fittings are parts used to connect sections of pipe, tube, and hose of different materials, such as copper, brass, galvanised and PVC.






PVC (Polyvinyl chloride) Fittings:

| Fitting | Name | Uses |
|---|-----------------------|--|
|  | 90° elbow | To change the direction of soil water pipes from bath, sink, wash hand basin etc. around corners or angles of 90°. |
|  | 90° elbow with access | Connect from toilet (water closet) to drainage pipes. |
|  | 45° elbow with access | Change the direction of soil water pipe in 45° |
|  | 45° elbow | Change the direction of soil water pipe in 45° |

| Fitting | Name | Uses |
|---|------------------|---|
|  | Gully | Installed outside the kitchen or bathroom to receive water from sanitary fittings such as sink, basin, bath or shower, except water closet. |
|  | Coupler | Connects two pieces of soil water pipes in a straight line. |
|  | Equal Y junction | Connected in main soil water pipe to join the branch pipe from sanitary fittings. |
|  | Rodding eye | Installed at the end of the sewage pipe line to allow access in the pipe to remove blockage. |


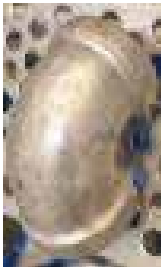



Copper fittings

Copper is the best material to use for water-pipe connections, but it is very expensive. Welding or capillary joints are the most common methods of joining copper tubing and fitting. No threading is required for copper pipes.

| Fitting | Name | Uses |
|---|------------------|---|
|  | Cross joint | Used where pipes need to go in four different ways/sides. |
|  | Tee – joint | To connect a branch pipe in the main pipe. |
|  | Straight coupler | To connect two lengths of the copper pipe in a straight line. |
|  | 90° elbow | To change the direction of copper pipe in 90° |
|  | 135° bend | To change the direction of copper pipe in 135° |

Galvanised fittings

Galvanised pipes are joined by screwing them together. When the joint is complete, one of the pipes must be moveable. If no lateral movement is possible, the flanges will not fit properly. If forced home, it will generate unacceptable tension on the pipe and even on the treads.

| Fittings | Name | Uses |
|---|------------------|--|
|  | 45° elbow | Used for connecting galvanised water pipes in different directions |
|  | 90° elbow | |
|  | T- piece | |
|  | Straight coupler | |
|  | Cross- piece | |

ACTIVITY 3.1

3.1 Redraw the table below, Identify the following types of materials and give one use of each material.

| Type | Name | Uses |
|--|------|------|
| 3.1.1  | | |
| 3.1.2  | | |
| 3.1.3  | | |
| 3.1.4  | | |

Building material

Building material is any material which is used for construction purposes. Many naturally occurring substances, such as clay, rock, sand, and wood, even twigs and leaves, have been used to construct buildings.

Many types of building materials are used in the construction industry to create buildings and structures.

| Name of material | Application/ Use | Properties |
|------------------|--|--|
| Building Sand | <ul style="list-style-type: none">Used in mortar for building purposes | <ul style="list-style-type: none">It should be clean, free from earth, clay or other vegetable matters like weeds, grass.It should be run through a sieve before being used and be evenly graded from fine to course.Sand is used together with cement for building and plastering purposes.It is also being used with cement and crushed stone for concrete purposes |
| Plastering sand | <ul style="list-style-type: none">Used in mortar for plastering purposes | |
| Fine aggregates | <ul style="list-style-type: none">Used in concrete for casting slabs, floors and foundation | |
| Water | <ul style="list-style-type: none">Water used for concrete or mortar should be clean, and free from impurities. | <ul style="list-style-type: none">Water used for concrete or mortar should be clean, and free from impurities.Ingredients for concrete or mortar should be mixed raw before water is being added.Only enough water should be added to make the mix a pliable mixture. |

| Name of material | Application/ Use | Properties |
|-------------------|---|--|
| Cement / Lime | <ul style="list-style-type: none"> • Cement is used as the binding factor in mortar or concrete • Lime is used in mortar as a primary binding agent | <ul style="list-style-type: none"> • Provides strength to masonry • Hardens early • Possesses good plasticity • Easily workable • Good moisture resistance |
| Coarse aggregates | <ul style="list-style-type: none"> • Used in concrete for casting slabs, floors and foundation | <ul style="list-style-type: none"> • Grading. • Durability. • Particle shape and surface texture. • Abrasion and skid resistance. • Unit weights and voids. • Absorption and surface moisture. |
| Bricks | <ul style="list-style-type: none"> • Used for building purposes | <ul style="list-style-type: none"> • Strength. • Absorption. • Weather resistant. • Fire resistant. • Durable. • Porous. • Efflorescent. • Sound Insulation. |
| Buiding blocks | <ul style="list-style-type: none"> • Used for building purposes | <ul style="list-style-type: none"> • high structural capacity • resistance to fire • resistance to water, • Variety of aesthetic possibilities • Insulating and acoustical advantages |

| Name of material | Application/ Use | Properties |
|------------------|---|--|
| Concrete | <ul style="list-style-type: none"> Building structures, foundations, pavements, bridges, pools, walls, fences, poles and even boats | <ul style="list-style-type: none"> Strength Consistency Uniformity Workability Finishing |
| Mortar | <ul style="list-style-type: none"> Used to join bricks of a wall into one solid mass | <ul style="list-style-type: none"> Workability Good bonding |
| Screed | <ul style="list-style-type: none"> Applied on top of concrete slab for finishing layer of floors | <ul style="list-style-type: none"> Strength Consistency Uniformity Workability Finishing |
| Steel | <ul style="list-style-type: none"> Gates, Bugler doors and windows Pillars Capots Reinforcement Making pipes Making household appliance like Fridge, Oven, Sink, etc. | <ul style="list-style-type: none"> Material that is most corrosion-proof Does not rust or stain when exposed to water Easy to clean Hard, strong and durable Fairly low thermal and electrical conductivity Malleable, ductile and pliable Magnetic to a certain extent |
| Wood/Timber | <ul style="list-style-type: none"> Making Houses Making furniture Making fire Making paper Flooring Fencing Boats and Ship construction Cladding | <ul style="list-style-type: none"> Hardness Strength Toughness Elasticity Durability |

Activity 3.2

Work on your own and answer the following questions.

3.2.1 The table below shows a list of materials, give **ONE** use and **ONE** property of each

| Name of material | Uses | Properties |
|------------------|------|------------|
| a. Cement / Lime | | |
| b. Bricks | | |
| c. Concrete | | |
| d. Mortar | | |
| e. Steel | | |

DRAFT

Tools and Equipment

CHAPTER

4



LEARNING OUTCOMES

By the end of this chapter, learners should be able to identify, use, handle and maintain basic site equipment, plastering tools, setting out tools, bricklaying tools, brick cutting tools, jointing tools, woodworking tools and plumbing tools. The following will be covered in this chapter:

- Basic site equipment:
 - » Round shovel
 - » Square shovel
 - » Steel Shaft Digging Spade
 - » Pick Axe
 - » Wheelbarrow
- Plastering tools:
 - » Wooden/plastic float
 - » Plastering trowel
 - » Hand hawk
 - » Straight edge
 - » Block brush
 - » Corner trowels (internal and external)
 - » Gauging
 - » Nose trowels
- Setting out tools:
 - » Steel square
 - » Folding rule
 - » Measuring tape
 - » Steel tape
 - » Metal pegs
 - » Building line
 - » Spirit level
 - » Straight edge
- Bricklaying tools:
 - » Brick trowel
 - » Line block/corner block
 - » Gauge rod
 - » Tingle
 - » Steel square
- Brick cutting tools:
 - » Brick hammer
 - » Bolster
 - » Club hammer
 - » Cold chisel
 - » Comb hammer

LEARNING OUTCOMES

- Jointing Tools:
 - » Long jointer
 - » Short jointer
 - » Pointing trowel
 - » Mastic trowel
- Woodworking tools:
 - » Sliding bevel
 - » Mortise gauge
 - » Tenon saw
 - » Coping saw
 - » Rip/Cross cut saw
 - » Planer
 - » Firmer chisel
 - » Pairing chisel
 - » Mortise chisel
 - » Wooden mullet
 - » Pincers
 - » Oil stone
 - » Wood rasps
 - » Boring, Drilling tools and Bits
 - » Electric hand drill
 - » Cordless hand drill
 - » Jig saw
 - » Portable circular/skill saw
 - » Orbital sander
 - » Router
- Plumbing tools:
 - » Tin snips
 - » Hack saw
 - » Pipe cutter
 - » Anvil
 - » Ball pein hammer
 - » Tri-square
 - » Steel ruler
 - » Gas torch
 - » Reamer
 - » Pop rivet gun
 - » Centre punch

LEARNING OUTCOMES

- » Scriber
- » Spring Divider
- » Plunger



Introduction

Building and construction tools include hand tools and power tools. Sound knowledge of these tools and how to use them forms an integral part of the skills you need in the building industry. The quality of your work depends not only on your craftsmanship, but also on your knowledge of tools and the condition of these tools. Tools are designed for a specific purpose and any tool should be used only for its intended purpose. When you use tools incorrectly, you can damage them and risk seriously injuring yourself or others. Do not use a tool unless you have been trained or taught how to use it safely and know its limitations and hazards. Also remember that tools need to be cleaned and stored in their proper place after use.




Tools which are used in the Civil Technology fields can be broadly categorised into basic site equipment, plastering tools, setting out tools, bricklaying tools, jointing tools, woodworking tools and plumbing tools.

Basic site equipment



| Name | Use | Storage, maintenance and handling |
|--|---|---|
|  <p>Round shovel</p> | <ul style="list-style-type: none"> Used for mixing concrete and mortar | <ul style="list-style-type: none"> Store in a dry location Clean and wipe down after every use Sharpen the edge regularly Season with oil to prevent rust |
|  <p>Square shovel</p> | <ul style="list-style-type: none"> Used for clearing loose material and rubble at building sites | <ul style="list-style-type: none"> Store in a dry location Clean and wipe down after every use Sharpen the edge regularly Season with oil to prevent rust |
|  <p>Steel Shaft Digging Spade</p> | <ul style="list-style-type: none"> Used for digging trenches | <ul style="list-style-type: none"> Store in a dry location Clean and wipe down after every use Sharpen the edge regularly Season with oil to prevent rust |

| Name | Use | Storage, maintenance and handling |
|---|--|---|
|  <p>Pick Axe</p> | <ul style="list-style-type: none"> Used to break up hard ground | <ul style="list-style-type: none"> Clean with water and wipe down after every use. Sharpen the edge and tip regularly Keep in a store room |
|  <p>Wheel barrow</p> | <ul style="list-style-type: none"> Used to transport mortar, concrete, filling and bricks | <ul style="list-style-type: none"> Clean with water and wipe down after every use. Turn it upright to dry Keep in a store room |





Plastering tools





| Name | Use | Care and maintenance |
|--|---|---|
|  <p>Wooden float</p> | <ul style="list-style-type: none"> To finish off plaster or concrete surfaces to achieve a finely textured surface | <ul style="list-style-type: none"> Wash off the excess mortar with clean water and wipe down with a cloth. Keep in a store room |
|  <p>Plastic float</p> | | |
|  <p>Plastering trowel</p> | <ul style="list-style-type: none"> To apply plaster to the wall For smoothing concrete and plaster | <ul style="list-style-type: none"> Wash off the excess mortar with clean water and wipe down with a cloth. Keep in a store room |

| Name | Use | Care and maintenance |
|--|--|---|
|  <p>Hand hawk</p> | <ul style="list-style-type: none"> To carry the plaster | <ul style="list-style-type: none"> Wash off the excess mortar with clean water and wipe down with a cloth. Keep in a store room |
|  <p>Straight edge</p> | <ul style="list-style-type: none"> To guide a plasterer for levelling of foundation, floors and plastering | <ul style="list-style-type: none"> Wash off the excess mortar with clean water and wipe down with a cloth. Keep in a store room |
|  <p>Block brush</p> | <ul style="list-style-type: none"> For wetting down walls before plastering and during the floating process | <ul style="list-style-type: none"> Wash off the excess mortar with clean water and wipe down with a cloth. Keep in a store room |
| <p>Corner trowels (internal and external)</p>  <p>Internal corner tool</p>  <p>I corner tool</p> | <ul style="list-style-type: none"> To finish off the corners of the plastering internally and externally | <ul style="list-style-type: none"> Wash off the excess mortar with clean water and wipe down with a cloth. Keep in a store room |



| Name | Use | Care and maintenance |
|--|--|---|
|  Gauging Nose trowel | <ul style="list-style-type: none"> For mixing small quantities of mortar for patching and laying on mouldings | <ul style="list-style-type: none"> Wash off the excess mortar with clean water and wipe down with a cloth. Keep in a store room |
|  Nose trowels | <ul style="list-style-type: none"> To point and smooth mortar joints where normal trowels cannot fit in. | <ul style="list-style-type: none"> Wash off the excess mortar with clean water and wipe down with a cloth. Keep in a store room |




Setting out tools

| Name | Use | Care and maintenance |
|---|--|--|
|  Steel square | <ul style="list-style-type: none"> To check the squareness of buildings Setting out of brickwork | <ul style="list-style-type: none"> Wash off the excess mortar with clean water and wipe down with a cloth. Keep in a store room |
|  Folding rule | <ul style="list-style-type: none"> Accurate measuring for less than 1m | <ul style="list-style-type: none"> Wash off the excess mortar and dirt with clean water and wipe down with a cloth. Keep in a store room |
|  Measuring tape | <ul style="list-style-type: none"> For fine and accurate measuring | <ul style="list-style-type: none"> Wipe off any dirt with a damp cloth. Keep in a dry place |
|  30m Steel tape | <ul style="list-style-type: none"> For setting out of large buildings | <ul style="list-style-type: none"> Wipe off any dirt with a damp cloth. Keep in a dry place |



| Name | Use | Care and maintenance |
|---|---|--|
|  <p>Metal pegs/Wooden pegs</p> | <ul style="list-style-type: none"> To indicate the foundation trenches and also to what level should be poured | <ul style="list-style-type: none"> Wash or rinse with water and wipe down with a cloth. Keep in a dry place |
|  <p>Building Line</p> | <ul style="list-style-type: none"> Laying out the area or foundations for building of straight courses | <ul style="list-style-type: none"> Wipe the excess mortar with a damp cloth Keep in a dry place |
|  <p>Spirit level</p> | <ul style="list-style-type: none"> For checking levels of brickwork horizontal and vertically | <ul style="list-style-type: none"> Wash off excess mortar and dirt with clean water and wipe down with a cloth. Keep in a store room |
|  <p>Straight edge</p> | <ul style="list-style-type: none"> To guide a plasterer for levelling of foundation, floors and plastering. | <ul style="list-style-type: none"> Wash off excess mortar and dirt with clean water and wipe down with a cloth. Keep in a store room |




Bricklaying tools

| Name | Use | Storage, maintenance and handling |
|--|--|---|
|  <p>Brick trowel</p> | <ul style="list-style-type: none"> For picking and spreading mortar | <ul style="list-style-type: none"> Wash off any excess mortar with clean water and wipe down with a cloth. Keep in a store room |
|  <p>Corner blocks</p> | <ul style="list-style-type: none"> Used with the building line which indicates a straight line to build against | <ul style="list-style-type: none"> Remove excess mortar and dirt with a wet cloth. The line should be rolled back on the block to avoid it getting tangled. Keep in a store room |





| Name | Use | Storage, maintenance and handling |
|--|--|---|
|  <p>Gauge rod/brick gauge</p> | <ul style="list-style-type: none"> For checking the accurate height of the courses of the brickwork | <ul style="list-style-type: none"> Remove excess mortar and dirt with a wet cloth. Keep in a store room |
|  <p>Tangle</p> | <ul style="list-style-type: none"> To keep the line straight between two corners which are far apart | <ul style="list-style-type: none"> Remove excess mortar and dirt with a wet cloth. Keep in a store room |
|  <p>Steel square</p> | <ul style="list-style-type: none"> To check the squareness of buildings Setting out of brickwork | <ul style="list-style-type: none"> Remove excess mortar and dirt with a wet cloth. Keep in a store room |

Brick cutting tools

| Name | Use | Storage, maintenance and handling |
|---|--|--|
|  <p>Brick hammer</p> | <ul style="list-style-type: none"> To cut bricks | <ul style="list-style-type: none"> Keep it clean and wipe down with a damp cloth Sharpen edge regularly Keep in a store room |
|  <p>Bolster</p> | <ul style="list-style-type: none"> To cut bricks accurately | <ul style="list-style-type: none"> Keep it clean and wipe down with a damp cloth Sharpen edges regularly Keep in a store room |

| Name | Use | Storage, maintenance and handling |
|--|--|--|
|  <p>Club Hammer</p> | <ul style="list-style-type: none"> Is used with a bolster and cold chisel to cut brick and brick work | <ul style="list-style-type: none"> Keep it clean and wipe down with a damp cloth Make sure hammer head fits snugly on the handle Keep in a store room |
|  <p>Cold Chisel</p> | <ul style="list-style-type: none"> For cutting concrete and brickwork | <ul style="list-style-type: none"> Keep it clean and wipe down with a damp cloth Keep the cutting end sharp Keep in a store room |
|  <p>Comb hammer</p> | <ul style="list-style-type: none"> To trim and cut bricks more accurately | <ul style="list-style-type: none"> Keep it clean and wipe down with a damp cloth Make sure hammer head fits snugly on the handle Keep in a store room |

Jointing tools





| Name | Use | Storage, maintenance and handling |
|--|--|--|
|  <p>Long Jointer</p> | <ul style="list-style-type: none"> Used to smoothen the joints between courses of the brickwork To ensure a good and consistent finish | <ul style="list-style-type: none"> Wash off the excess mortar and dirt with clean water and wipe down with a cloth. Keep in a store room |
|  <p>Short Jointer</p> | <ul style="list-style-type: none"> Used for upright joints between bricks | <ul style="list-style-type: none"> Wash off the excess mortar and dirt with clean water and wipe down with a cloth. Keep in a store room |
|  <p>Pointing Trowel</p> | <ul style="list-style-type: none"> Used to finish the mortar between bricks Used to apply tuck pointing | <ul style="list-style-type: none"> Wash off the excess mortar and dirt with clean water and wipe down with a cloth. Keep in a store room |
|  <p>Mastic Trowel</p> | <ul style="list-style-type: none"> Is used to form tuck pointing Used to fill up joints between windows and door frames | <ul style="list-style-type: none"> Wash off the excess mortar and dirt with clean water and wipe down with a cloth. Keep in a store room |

Activity 4.1


4.1.1 List FIVE classifications of tools used in bricklaying and plastering.





4.1.2 The table below shows pictures of hand tools that are used on construction sites and in workshops. Write down the NAME of the tool and ONE use of each tool

| Tool Name | Use |
|---|-----|
| A  | |
| B  | |
| C  | |
| D  | |
| E  | |


| Tool Name | Use |
|--|-----|
| F  | |
| G  | |
| H  | |
| I  | |
| J  | |

Woodworking tools

| Tool | Use | Storage, maintenance and handling |
|--|--|---|
|  <p>sliding bevel</p> | <ul style="list-style-type: none"> To measure bevels or angles from a pattern and then apply them to the work | <ul style="list-style-type: none"> Keep clean and wipe down with a cloth Ensure the blade slides smoothly. Oil lightly to prevent rust. Keep in a dry place |






| Tool | Use | Storage, maintenance and handling |
|--|--|---|
|  <p>Mortise Gauge</p> | <ul style="list-style-type: none"> To draw (mark out) mortise and tenon joints by drawing double lines on wood parallel to a straight surface. | <ul style="list-style-type: none"> Keep pins sharp Pins must not be too long or too short Keep clean and wipe down with a cloth Keep in a dry place |
|  <p>Tenon saw</p> | <ul style="list-style-type: none"> To cut out tenons For cutting against and along the grain of wood | <ul style="list-style-type: none"> Ensure that the blade teeth are sharp Ensure that the handle is fitted correctly and is stable. Keep clean and wipe down with a cloth Keep in a dry place |
|  <p>Coping saw</p> | <ul style="list-style-type: none"> Used to cut intricate external shapes and interior cut-outs in woodworking or carpentry. | <ul style="list-style-type: none"> Ensure that the blade is fitted properly and the teeth are facing in the correct direction Ensure that the handle is fitted correctly and is stable. Keep clean and wipe down with a cloth Keep in a dry place |
|  <p>Rip saw</p> | <ul style="list-style-type: none"> For ripping large sections of timber. | <ul style="list-style-type: none"> Ensure that the teeth are sharp. Ensure that the handle is fitted correctly and is stable. Keep in a dry place |
|  <p>Jack plane</p> | <ul style="list-style-type: none"> To smoothen timber surfaces and to straighten edges. Can be used to touch up joints to achieve a smooth flat surface. | <ul style="list-style-type: none"> Keep hands away from blade. Ensure that the blade is sharp. Keep clean and wipe down with a cloth Keep in a dry place |




Chisels

| Tool | Use | Storage, maintenance and handling |
|--|--|---|
|  <p>Firmer chisel</p> | <ul style="list-style-type: none"> For heavy duty use, with a mallet, for heavy chopping. | <ul style="list-style-type: none"> Make sure the handle is tight and stable. Do not use if the nose is broken. Keep in a dry place Sharpen edges regularly Keep clean and wipe down with a cloth |

| Tool | Use | Storage, maintenance and handling |
|---|---|--|
|  <p>Paring chisel</p> | <ul style="list-style-type: none"> For cleaning up the joint and to make it an accurate fit. | |
|  <p>Mortise chisel</p> | <ul style="list-style-type: none"> To cut away waste pieces of wood when making mortises. | |
|  <p>Wooden mallet</p> | <ul style="list-style-type: none"> To drive a chisel into wood. To knock wood joints together when assembling. | <ul style="list-style-type: none"> Make sure the hammer head fits snugly. Keep in a dry place Keep clean and wipe down with a cloth |
|  <p>Pincers</p> | <ul style="list-style-type: none"> To (pull) out nails without damaging the surface of the wood. It also cuts through thin nails or wire staples if they can't be pulled out. | <ul style="list-style-type: none"> Ensure that the teeth are in good shape. Keep in a dry place Keep clean and wipe down with a cloth |
|  <p>Oil stone</p> | <ul style="list-style-type: none"> To sharpen blades and edges of cutting tools. | <ul style="list-style-type: none"> Store safely away from oil and dust Keep clean |
|  <p>Rasps</p> | <ul style="list-style-type: none"> To remove parts of timber quickly. To shape concave and convex surfaces. | <ul style="list-style-type: none"> Do not use without a handle. Ensure that the handle fits tightly and is not damaged Do not use if blunt. Keep clean Store in a dry place |

Boring, drilling tools and bits

| Tool | Use | Storage, maintenance and handling |
|---|--|---|
|  <p>Countersink bits</p> | <ul style="list-style-type: none"> To enlarge and create a conical shape to keep screw heads on the same level or below the surface of the wood. | <ul style="list-style-type: none"> Use the correct bit for the job Do not use blunt bits Do not force bits onto material Keep clean Store in a dry place |
|  <p>Drill bit</p> | <ul style="list-style-type: none"> To drill through wood, plastic and steel. | |
|  <p>Drill bit</p> | <ul style="list-style-type: none"> To drill holes into/through wood. | |
|  <p>Spade bit</p> | <ul style="list-style-type: none"> For drilling holes through studs in walls for running wiring or pipes. Drilling into woodworking projects where the head of a screw/ bolt needs to be recessed. | |
|  <p>Forstner bit</p> | <ul style="list-style-type: none"> Used with a drill press to drill hinge holes. | |



| Tool | Use | Storage, maintenance and handling |
|--|--|-----------------------------------|
|  <p>Pozi-drive</p> | <ul style="list-style-type: none"> To improve on the torque and cam-out of the Phillips head. | |
|  <p>Phillips head screw</p> | <ul style="list-style-type: none"> For driving Phillips head screws into wood using a drilling tool. | |
|  | <ul style="list-style-type: none"> For driving screws with straight slotted heads using a drilling tool | |
|  | <ul style="list-style-type: none"> For driving screws with square slotted heads. | |
|  <p>Hole saw</p> | <ul style="list-style-type: none"> To cut perfectly round holes in all sorts of materials. | |

Activity 4.2



- 4.2.1. Explain the difference between a crosscut saw and a rip saw.
- 4.2.2. Explain the difference between a marking gauge and a mortise gauge.
- 4.2.3. Name three types of chisels.
- 4.2.4. Identify and mention the main use of the following tools





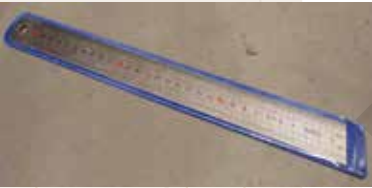


Power tools





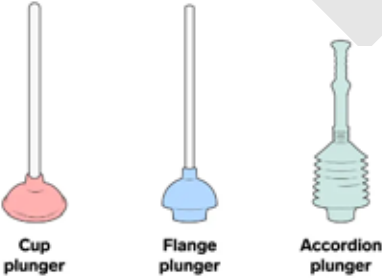
| Power tool | Use/ Care |
|--|--|
|  <p>Electric hand drill</p> | <ul style="list-style-type: none"> • Use • It is used for drilling round holes using different accessories. • It is fitted with a bit, either a drill or driver, depending on application, secured by a chuck. • Some powered drills also include a hammer function to make holes in a wall. |
|  <p>Cordless drill</p> | <ul style="list-style-type: none"> • Use • To drill hole on material such as wood, metal, masonry or plastic. • To screw or unscrew flat screws • To screw or unscrew Philips screws. • Safe handling/ care • Before commencing with the work make sure that the operating lever (reverse and forward) is facing the right direction, however the appropriate direction is clock-wise. |

| Power tool | Use/ Care |
|--|--|
| | <ul style="list-style-type: none"> • Use two hand to open the chuck of the machine • Make sure the chuck is well tightened before commencing with the work. • Select the correct speed for the right job. • Make sure you do not use force when operating the machine. |
|  <p>Jig saw</p> | <ul style="list-style-type: none"> • Use • To cut curves and complex shapes in wood. • To make short crosscuts on timber boards. • To finish inside corner cuts which you started with a circular saw. • Safe handling/ care • Do not force the blade through the material. • Make sure the blade is long enough for thicker materials. • Keep the extension cord away from the cutting path of the blade • Ensure the blade is not touching the wood when you turn the saw on. |
|  <p>Portable Circular/Skill Saw</p> | <ul style="list-style-type: none"> • Use • Used for rough cuts on any length of timber. • For cross cutting of timber and boards. • Mitre cutting of wood products • Safe handling/ care • Keep the power cord out of the way. • Ensure blade is sharp before using the saw. • Make sure all safety guards are attached. |

| Power tool | Use/ Care |
|---|--|
|  <p>Orbital sander</p> | <ul style="list-style-type: none"> • Use • To sand wood for a smooth finish. • Can be used to smooth surfaces such as rough metal, wood or plastic. They can also be used to remove paint or rust. • These sanders are best used on flat surfaces and should be held with even pressure across the face of the pad. • Safe handling/ care • It is safe and very easy to use if you choose the correct grit sandpaper. • Always wear eye protection and a sanding mask. |
|  <p>Router</p> | <ul style="list-style-type: none"> • Use • For edge cutting/ rebates for widening joints • For mould cutting on sides of timber • For engraving or carving in wood • Safe handling/ care • Wear safety goggles • Disconnect the power supply when replacing the router bits. • No adjustments may be made while the router bit is still rotating. • Keep the router bit away from the work piece while the router is turned on. • Ensure the work piece is firmly attached before working on it. |

| Tool | Use | Care |
|---|--|---|
|  <p>Tin snips</p> | <ul style="list-style-type: none"> • To make straight cuts and curves in sheet metal • Use snips for cutting soft metal only | <ul style="list-style-type: none"> • Oil all movable parts. • Store in dry area. • Use it only for the purpose it is designed for. • Use ordinary hand pressure for cutting |
|  <p>Hack saw</p> | <ul style="list-style-type: none"> • To cut metal • To cut plastics | <ul style="list-style-type: none"> • always use a sharp blade. • choose the right blade for the job. • hold the piece that you are cutting on the vice. • clean the saw blade after cutting. • avoid using too much pressure when cutting. |
|  <p>Pipe cutter</p> | <ul style="list-style-type: none"> • Cutting of pipes. | <ul style="list-style-type: none"> • Oil all movable parts. • Store in dry area. • Use it only for the purpose it is designed for. |
|  <p>Anvil</p> | <ul style="list-style-type: none"> • Used as a forging tool. | <ul style="list-style-type: none"> • Cover your anvil when you are not using it to prevent it from getting rusty. • Wiping the anvil with an oiled cloth after use should help clean it and keep it rust-free. |

| Tool | Use | Care |
|---|---|--|
|  <p>Ball peen hammer</p> | <ul style="list-style-type: none"> The ball peen hammer was originally designed for peening, or shaping metal materials by hammering. One end of the head is ball-shaped for this purpose. The other end is flat and is used for driving. Used to shape, move, or stretch metal. The peening face is useful for rounding off edges of metal pins and fasteners, such as rivets. | <ul style="list-style-type: none"> Keep it clean by wiping with a damp cloth after use Store in a dry area Make sure hammer head fits snugly on the handle |
|  <p>Tri-square</p> | <ul style="list-style-type: none"> Measuring boards, testing corners, and setting the bevel of boards and tools to various angles. | <ul style="list-style-type: none"> Don't bend the set square, it may break. Don't scratch or mark the set square. Keep clean by wiping with a cloth Store in a dry area |
|  <p>Steel ruler</p> | <ul style="list-style-type: none"> Measure rounded or cambered work. | <ul style="list-style-type: none"> Clean with water and dry with a cloth before storing. Store in a dry area |
|  <p>Gas torch</p> | <ul style="list-style-type: none"> To make straight cuts and curves in sheet metal Use snips for cutting soft metal only | <ul style="list-style-type: none"> Always make sure that the valve is closed when you are not using the torch. Wipe clean with a dry cloth Store upright in a store room |
|  <p>Reamer</p> | <ul style="list-style-type: none"> To cut metal To cut plastics | <ul style="list-style-type: none"> Store in cool dry area. Always keep a reamer in a proper safe place. Clean it with a dry cloth. Apply a thin machine oil on the reamer. |

| Tool | Use | Care |
|--|---|--|
|  <p>Pop rivet gun</p> | <ul style="list-style-type: none"> Cutting of pipes. | <ul style="list-style-type: none"> Store the tool in cool dry area. Clean with a cloth. |
|  <p>Centre punch</p> | <ul style="list-style-type: none"> Used as a forging tool. | <ul style="list-style-type: none"> Store in cool dry area. Make sure that the sharp point is always facing down when you are holding it in your hand. Wipe clean with a cloth after use |
|  <p>Scriber</p> | <ul style="list-style-type: none"> The ball peen hammer was originally designed for peening, or shaping metal materials by hammering. One end of the head is ball-shaped for this purpose. The other end is flat and is used for driving. Used to shape, move, or stretch metal. The peening face is useful for rounding off edges of metal pins and fasteners, such as rivets. | <ul style="list-style-type: none"> Store in cool dry area. Make sure that the sharp point is always facing down when you are holding it in your hand. Wipe clean with a cloth after use |
|  <p>Spring divider</p> | <ul style="list-style-type: none"> Measuring boards, testing corners, and setting the bevel of boards and tools to various angles. | <ul style="list-style-type: none"> Store in cool dry area. Make sure that the sharp point is always facing down when you are holding it in your hand. Wipe clean with a cloth after use |
|  <p>Cup plunger Flange plunger Accordion plunger</p> <p>Plunger</p> | <ul style="list-style-type: none"> Measure rounded or cambered work. | <ul style="list-style-type: none"> Clean and sanitize after use Store in a dry area |

Activity 4.5

4.5.1 Name the following hand tools:.



4.5.2 Match the columns. Match the most appropriate care of tool with the type of tool. Write the question number and the letter of the correct answer only e.g. 1 G.

| COLUMN A | COLUMN B |
|---------------------|--|
| TOOL | CARE |
| 1. divider | A. Make sure hammer head fits snugly on the handle |
| 2. gas torch | B. oil all movable parts |
| 3. plunger | C. always keep a reamer in a proper safe place |
| 4. tin snips | D. make sure that the sharp point is always facing down when you are holding it in your hand |
| 5. reamer | E. Always make sure that the valve is closed when you are not using it. |
| 6. ball pein hammer | F. Clean and sanitise after every use. |

Joining and Bonding

CHAPTER

5



LEARNING OUTCOMES

By the end of this chapter, learners should be able to understand soldering and apply joining methods to different types of pipes. They should also be able to identify and make freehand sketches of different types of joints. The following will be covered in this chapter:

- Learning about joining methods of the following types of pipes:
 - » Compression and capillary fittings for copper pipes
 - » Solvent welding of PVC pipes
 - » Compression fittings for galvanised pipes
- Practical
 - » Join two pieces of copper pipe by soldering them together
 - » Join two pieces of PVC pipe by using PVC weld
 - » Join two pieces of galvanized pipe by cutting thread and connecting them
- Soldering:
 - » Soldering iron
 - » Flux
 - » Soldering wire
 - » Sal-ammoniac block
- Identify and make a freehand sketch of the following woodworking joints:
 - » Butt joint
 - » Tongue-and-groove
 - » Mortise and Tenon
- Nails
 - » Wire nails
 - » Oval nails
 - » Panel pins
- Screws
 - » Countersunk screws
 - » Pozi drive screws
 - » Round head screws
 - » Drywall Screws
 - » Chipboard screws
 - » Cut screws (Phillips, pozi, square bit)
- Glue
 - » PVA glue (wood glue/ cold glue)
 - » Contact glue
- Brickwork bonds
 - » Type of bonds (stretcher and English bond)
 - » Draw Isometric sketches of stretcher and English brickwork bonds.

Introduction

Joining and bonding is the process that involves joining materials together, to produce more complex items. Materials can be joined by means of nails, screws, adhesives or glue, soldering, mortar, screed, pipe joints, etc.

Soldering: joining of copper pipes by means of soldering

Joining copper pipes (capillary)

When the temperature of the copper reaches the solder melting point, the solder wire you're holding against the copper will suddenly liquefy and flow into the joint. Hold the solder opposite the flame, the coolest point, to make sure all parts of the joint are hot enough.



Heat pipes and fitting with blow torch.



Add solder wire and applying heat at the correct temperature.



Solder continuously added to joint.

Joining PVC pipes

Joining two pieces of PVC pipe by means of using PVC weld

PVC weld is a strong, waterproof adhesive, specifically designed for bonding and sealing rigid PVC unplasticised PVC and ABS plastics, piping and fittings. It has good bond strength and is suitable for high pressure systems.

Surfaces must be clean, dry and free from all loose materials, dust, dirt, oil, rust and any other contaminants. Joints must be close fitting. Deburr both inner and outer surfaces to be bonded. Lightly abrade the surfaces to be bonded with sandpaper and degrease with a suitable solvent such as acetone or thinners.

Apply adhesive to both surfaces i.e. pipe and fitting.

Push the two parts to the full depth of the joint without twisting.

Hold for 1 minute and clean off excess adhesive.

Allow 30 minutes before handling. Allow 4 hours before putting into service for low pressure applications, and 24 hours for high pressure applications.



PVC pipes (soil and waste)

PVC pipes are available in different grades depending on the different needs or the situation. PVC pipes and fittings are engineered for the use of below or above ground installations to transfer fluids.

JOINING GALVANIZED PIPES

JOINING GALVANIZED PIPE BY CUTTING THREAD AND CONNECTING THEM.

- Joining galvanised fittings to galvanised pipe require two pipe wrenches.
- Make sure the pipe joint compound or tapes go into the threads, to ensure a water tight connection.

Galvanised pipe joint



Flux

Flux is used to connect copper pipe. Flux is a compound commonly used in plumbing applications where two joints are connected using solder.

Soldering wire

Solder wire, is a fusible metal alloy with a low temperature melting point used to permanently join copper pipe and copper fitting that have a higher melting point.



Figure xx Flux



Figure xx Soldering wire

Activity 5.1

- 5.1.1. List steps of joining copper pipe and copper fitting?
- 5.1.2 Describe the process of joining PVC soil water and waste water pipes and fittings by means of using PVC weld.
- 5.1.3 What is the use of flux?

WOODWORKING JOINING

It is part of woodworking that involves joining pieces of wood or timber, to produce more complex items. Some wood joints employ fasteners, bindings, or adhesives, while others use only wood elements.

Wood can be joined by means of nails, screws and adhesives. However, making the suitable woodwork joint will produce a neater, strong and solidly built joint.

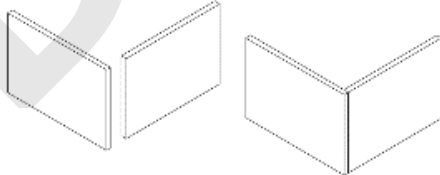
Main purpose of joining

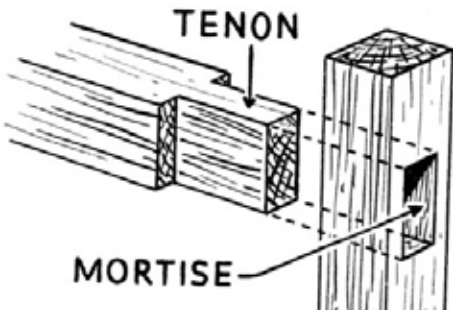
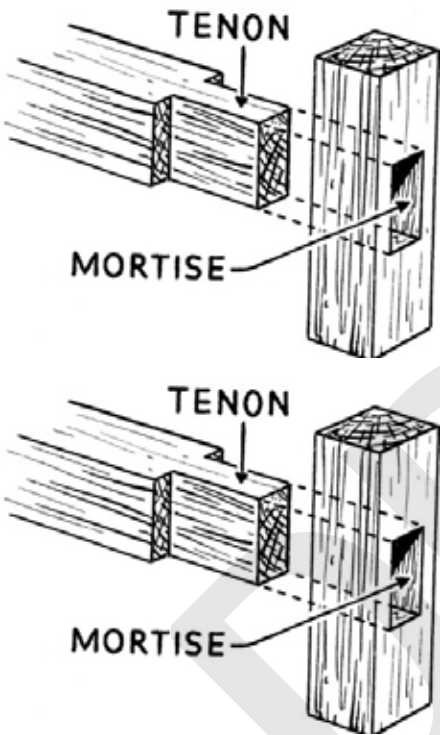
It is to join wooden parts together, their construction should be done carefully, so it would not weaken parts that are joining.

Characteristics of wooden joints


- Strength
- Flexibility
- Toughness
- Appearance etc.



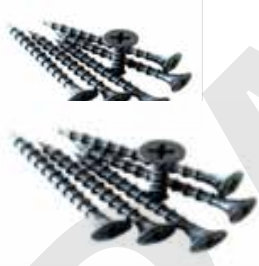

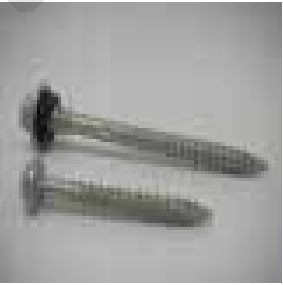
Types of basic joints in woodwork


| Name | Use |
|---|---|
|  Butt Joint | <ul style="list-style-type: none">• Butt joints is an easy woodworking joint.• It joins two pieces of wood by merely butting them together.• The butt joint is the simplest joint to make.• It is also the weakest wood joint unless some form of reinforcement is used. |

| Name | Use |
|---|---|
|  <p>Tongue and groove joint</p> | <ul style="list-style-type: none"> It is the method of fitting similar wood objects together edge to edge. Used to produce long boards from two or more pieces of short boards by joining them together. The tongue and groove is a third of the thickness of the timber and twice as deep as its width. The tongue is slightly shorter than the groove depth. |
|  <p>Mortise-and-Tenon Joint</p> | <ul style="list-style-type: none"> A mortise and tenon joint is used most often to join two pieces of wood at 90 degrees. It consists of two parts; the mortise hole and the tenon tongue. On the surface it seems like a very simple join but is one of the strongest there is |



Fasteners and fittings

| Name | Use |
|--|---|
|  <p>Round wire nail</p> | <ul style="list-style-type: none"> for rough carpentry work. |

| Name | Use |
|--|---|
|  Oval wire nails | <ul style="list-style-type: none"> • for cabinet making. |
|  Panel pin | <ul style="list-style-type: none"> • Used for cabinet making. • For fixing small moulding into place. |
|  Counter sunk screw | <ul style="list-style-type: none"> • Used where the head must flush with the surface of timber. • Mainly used to attach hinges and for general carpentry, |
|  Raised head screw (oval head) | <ul style="list-style-type: none"> • For sheet metal and • Decorative work. |
|  Cut screw | <ul style="list-style-type: none"> • Used in general construction work. • Cuts steel and wood easily |

| Name | Use |
|---|--|
|  <p>Dry wall screw</p> | <ul style="list-style-type: none"> To attach plaster board to walls and ceilings |
| <p>Chipboard screw</p> | <ul style="list-style-type: none"> For built-in cupboards. For cabinet making. |

GLUE

| Type | Name | Use |
|---|--------------------------------|--|
|  | PVA glue (wood glue/cold glue) | <ul style="list-style-type: none"> adhering wood pieces together because the adhesive absorbs well into the wood. |
|  | Contact glue | <ul style="list-style-type: none"> Contact adhesive is great for attaching large pieces of plastic, laminate, wood, plywood or canvas to each other |

Activity 5.2

5.2.1. Name 2 types of adhesives and give an example of one use each.

5.2.2. Describe and illustrate any two basic woodworking joints.

BRICKWORK BONDS

Bonding means to place bricks together in a particular way in order to obtain the greatest strength

Types of brickwork bonds

- Stretcher bond – is when bricks are laid with only their stretchers showing, overlapping midway with the courses of bricks below and above.
- English bond – Consists of alternate courses of headers and stretchers. It is a very strong bond.

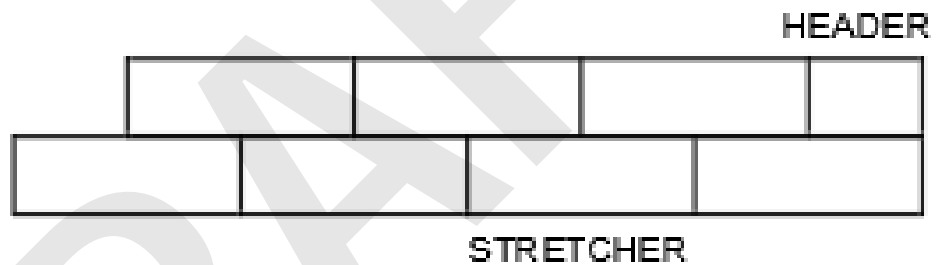


Figure xx Brick wall Stretcher bond



Figure xx Front and top elevation of one brick wall in Stretcher bond



Figure xx Front elevation



Figure xx Top elevation - first course

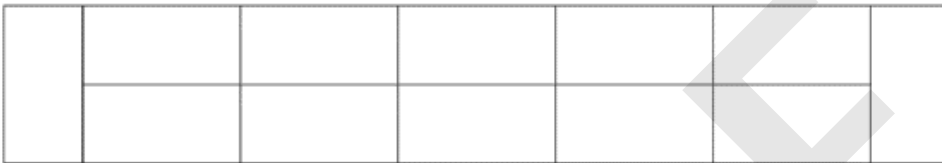


Figure xx Top elevation - second course

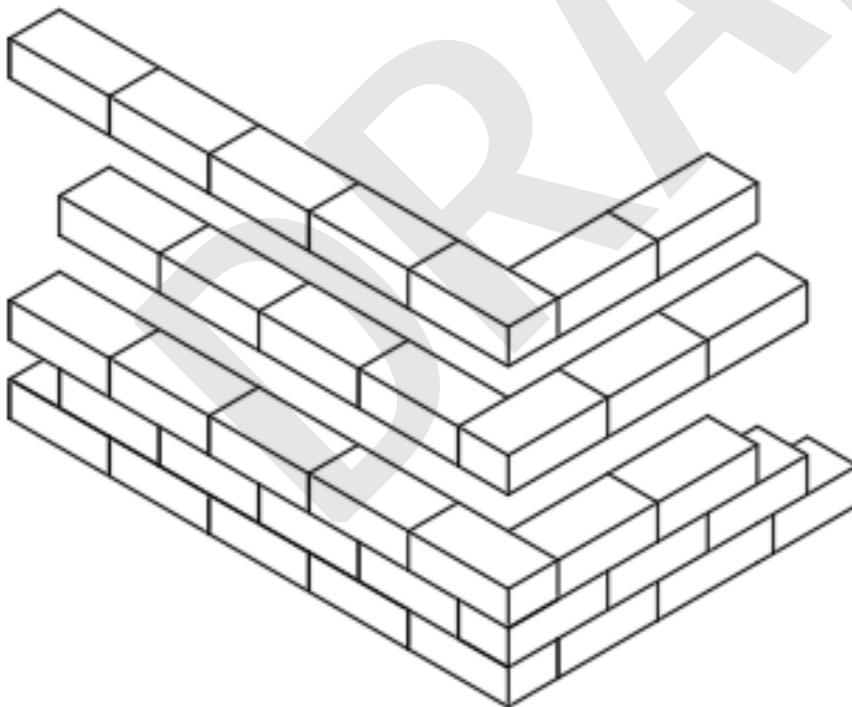


Figure xx Isometric view of a half brick wall corner built in stretcher bond.



Figure xx Brick wall English bond

The front and top elevation of 1 brick wall in English bond

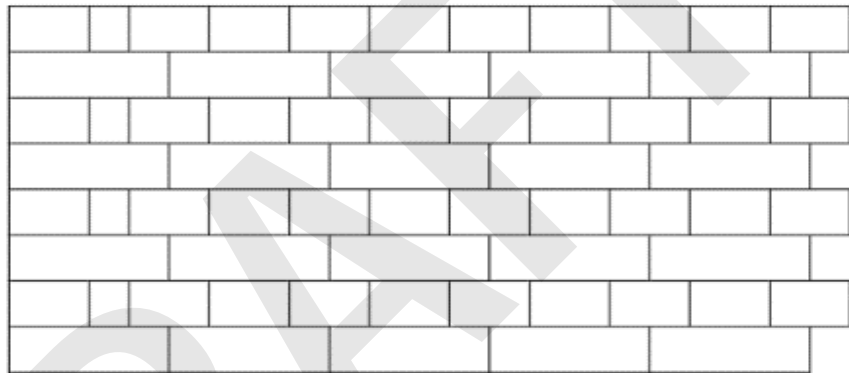


Figure xx Front elevation

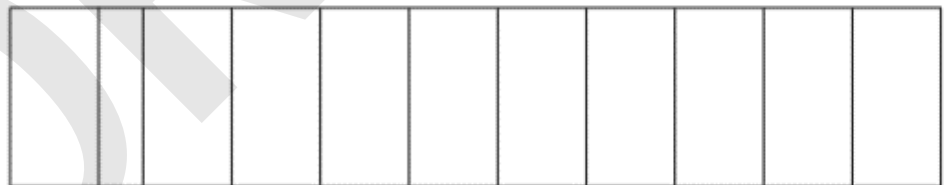


Figure xx Top elevation – first course

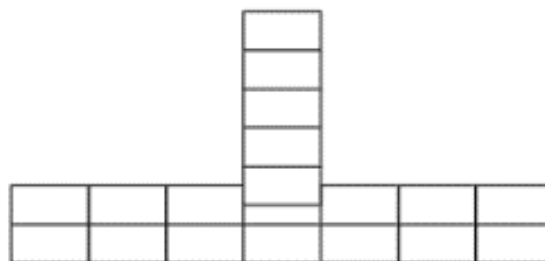


Figure xx Top elevation - second course

Activity 5.3

Individually build the following:

Alternating plan courses of right angle corner of one brick wall built in Stretcher bond with raking back on the one side and tothing on the other side.

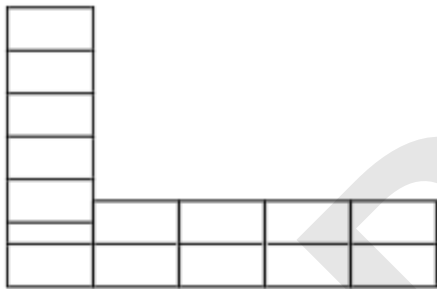
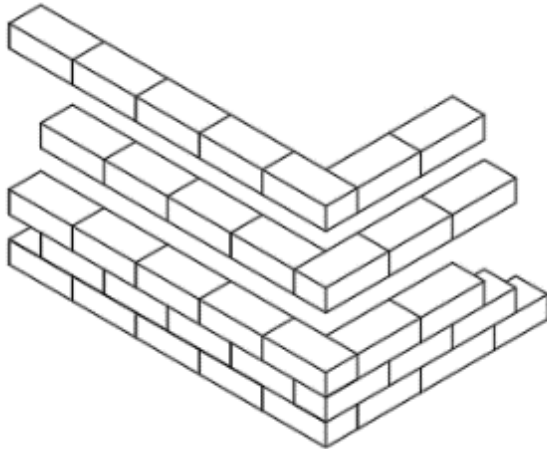


Figure xx First course

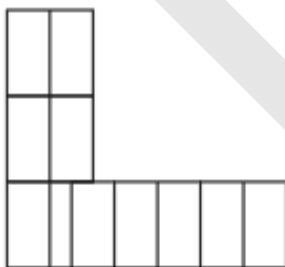


Figure xx Second course

Course

Alternate plan courses 1, 3, 5, 7 ----- Alternate plan courses 2, 4, 6, 8

Building the alternative T-Junction of one brick wall in English bond with raking back on the one side and toothing on the other side.

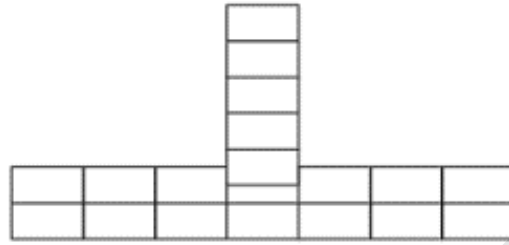


Figure xx Layer 1

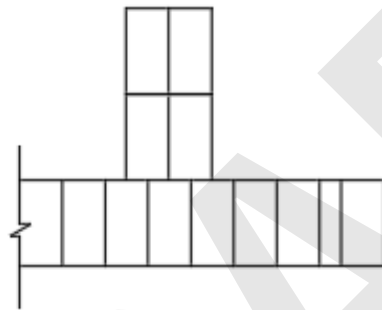


Figure xx Layer 2

Specifications:

- Height of the wall is 450 mm or 6 courses
- The length is 1 m x 1 m
- Bricks to be used, Face brick, same face bricks, and stock brick
- Use the correct tools
- Jointing of the wall
- Internal plastering

RESOURCES: TOOLS AND EQUIPMENT:

Basic site equipment: Round shovel, Spade, Wheel Barrow and Metal Pegs

Bricklaying tools: Brick trowel, Line block/Corner Block, Gauge Rod, Tingle, Pipe Level

Setting out tools: Line and Pins, Steel Square, Steel tape measure, folding rule 1m length, Wooden or steel pegs, straight edge, spirit level.

Jointing Tools: Long jointer, Short jointer,

Brick Cutting Tools: Comb hammer, Club hammer, Cold chisel, Bolster

MATERIALS: Ordinary Portland cement, Pit Sand,

Mortar and Concrete

CHAPTER

6



LEARNING OUTCOMES

By the end of this chapter, learners should be able to mix concrete and mortar in the correct ratios. The following will be covered in this chapter:

- Defining mortar and concrete
- Learning about the correct ratios for mixing concrete and mortar
- Hand mixing and machine mixing of mortar and concrete
- Learning about the advantages and disadvantages of concrete
- Curing of concrete

Introduction





Cement, concrete, and mortar are three different materials. The basic difference is that cement is a fine binding powder (which is never used alone), mortar is composed of cement and sand, and concrete is composed of cement, sand, and gravel.

Definition of Mortar / Dagha

Mortar (dagha) is a proportional mixture of cement, sand and water. Lime can be added to make it more workable. Mortar is used as a binding material when building with brick, block, and stone. Mortar is also used for plastering.

Preparation, mixing proportions of mortar and placing of mortar.

Mix proportions for mortar:

| Cement | Building Sand |
|---|--|
| 1 Part | 3 Part |
|  |  |
| Cup | Cups |
|  |  |
| Bucket | Buckets |

| 1 Part | 3 Part |
|---|--|
|  |  |
| Wheel Barrow | Wheel Barrows |

DEFINITION OF CONCRETE








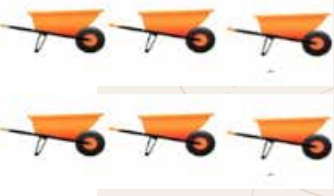
- Concrete is a mixture of cement, sand (fine aggregates), stones (coarse aggregates) and water

Concrete:

There are two methods of mixing concrete:

- Hand mixing
- Machine mixing

Mixing proportions of concrete:

| Cement | River Sand | Stone |
|---|--|--|
| 1 | 3 | 6 |
|  Cup |  Cups |  Cups |
|  Bucket |  Buckets |  Buckets |
|  Wheel Barrow |  Wheel Barrows |  Wheel Barrows |

Different ways of mixing concrete:

Hand mixing

STEPS

- Measure out the materials.
- Place the stone and sand into a pile on the ground
- Place the cement on top of the pile of sand and stone.
- Shovel the material in the pile to one side, creating a new pile and repeat three times.
- Make a deep hollow in the pile and add water.
- Fold the mix in from the sides.
- Continue to fold inwards and “chop” the pile to distribute water throughout the mix.



Figure xx Hand mixing process

Machine mixing

It is the process of mixing the ingredients of the concrete with a concrete mixer machine. It is highly effective for fulfilling the demands of short mixing time, optimum consistency and homogeneous quality of concrete.

STEPS

- Coarse aggregates are placed in the mixer first
- Followed by sand and cement
- Mix the materials in the dry state in the mixing machine for 1.5 to 3 minutes
- After proper mixing of materials, gradually add the correct quantity of water while the machine is in motion
- After adding the water, you must mix concrete for a minimum of two minutes in the drum



Figure xx Portable concrete mixer

READY- MIX CONCRETE (RMC)

Ready-mix concrete refers to concrete that is specifically batched or manufactured for customers' construction projects, and supplied to the customer on site as a single product. It is a mixture cement, water and aggregates: sand, gravel, or crushed stone



Figure xx Ready-mix concrete

ADVANTAGES OF CONCRETE

- Concrete can be cast to any design or form
- It handles easily
- Its strength, cleanliness and hygienic properties make it very useful
- It is not affected by water
- It has a long and durable life
- It can be finished smooth from the mould or left rough to take plaster

DISADVANTAGES OF CONCRETE

- Low tensile strength
- Low ductile(flexible)
- Concrete is susceptible to cracking

Curing of Concrete

Curing is the process of controlling the rate and extent of moisture loss from concrete during cement hydration.

Curing plays an important role on strength development and durability of concrete.

Curing takes place immediately after concrete placing and finishing.

Why is curing of concrete necessary?

Curing is the process where the concrete surfaces are kept wet for a certain period after the placing of concrete in order to promote the hardening of cement. Curing of concrete serves these main purposes:

- It retains moisture in the slab so that the concrete continues to gain strength.
- It improves durability by delaying drying shrinkage until the concrete is strong enough to resist shrinkage cracking.
- Properly curing concrete improves strength, durability, water tightness, and wear resistance.

METHODS USED FOR CURING

- Shading concrete work.
- Covering concrete surfaces with hessian or gunny bags.
- Sprinkling of water.
- Ponding method.
- Membrane curing.
- Steam curing.

Activity 6.1

In groups, write the difference between mortar and concrete. Redraw the table below to answer.

| | |
|--|--|
| | |
| | |

List TWO uses each of concrete and mortar.

| | |
|--|--|
| | |
| | |
| | |

Name TWO ways that is used to mix concrete.

Complete the table by filling in the ingredients of mortar and concrete.

| | |
|--|--|
| | |
| | |
| | |
| | |
| | |

Activity 6.2

1. Define the term mortar.
2. Name TWO methods used to mix concrete.
3. Describe the steps to mix mortar by hand.
4. Explain TWO advantages and disadvantage tabulate your answer.
5. Freshly cast concrete should be cured.
 - 5.1. Describe what may be used to cure freshly cast concrete.
 - 5.2. Explain the process of curing concrete

Foundations, Trenches and Setting Out

CHAPTER

7



LEARNING OUTCOMES

By the end of this chapter, learners should be able to define and identify foundations and trenches. The following will be covered in this chapter:

- Defining foundations and trenches
- Types of foundations
- Purpose of foundations
- Learning about hand compaction
- Setting out trenches using the theorem of Pythagoras or the 3-4-5 method
- Calculate the squareness of a structure using the theorem of Pythagoras or the 3-4-5 method.

Introduction

A foundation is a lower portion of building structure that transfers its gravity loads to the earth. To make a foundation, we normally dig a trench in the ground, digging deeper and deeper until we come to subsoil, which is more solid than the topsoil that is used to grow plants and crop.

Types of foundations

1. Strip foundation,
2. Stepped foundation.

PURPOSE OF A FOUNDATION


The main purpose of a foundation is to transmit the load of the superstructure (building) to the underlying soil or rock.

Strip foundations are normally used where light loading such as for a domestic dwelling are required. This type foundation consists of a continuous concrete strip cast in a trench.

Stepped foundations are used where the building site is not perfectly level. A stepped footing is made to compensate for the slope or inclination.



Figure XX Strip foundation



In this way, the whole foundation does not have to be excavated to the full depth or level. Care should be taken that the overlap is equal to the thickness so the footing and the height of the step should be in multiples of the thickness of a brick.

Hand compaction:

Hand compaction is the process which expels entrapped air from fresh placed concrete and packs the aggregate particles together so as to increase the density of concrete. It increases the ultimate strength of concrete significantly and enhances the bond with reinforcement.

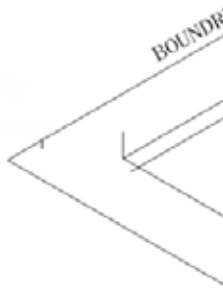
Purpose of compaction

- It increases the ultimate strength of concrete and enhances the bond with reinforcement.
- It also increases the abrasion resistance and general durability of the concrete, decreases the permeability and helps to minimize its shrinkage and creep characteristics.

Setting out of trenches

Setting out of building foundation trenches is the process of laying down the excavation line and centreline on the ground based on the foundation plan. The setting out process is also called as ground tracing that is performed before commencing the excavation process.

When the site clearance is completed, the setting out of the work may begin. Accurate setting out of a building is very important because if you build a house or building in the wrong position a building inspector may order it to be knocked down. Before any work can start, the exact position of the house or building must be marked out on the plot.



Setting out the corners

Plant pegs to show the corners of the building.

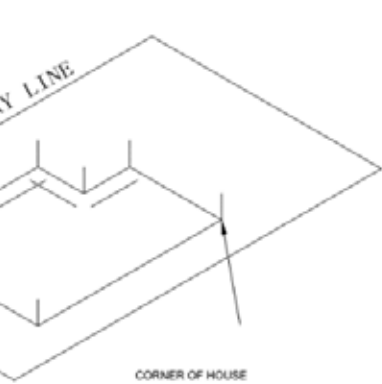
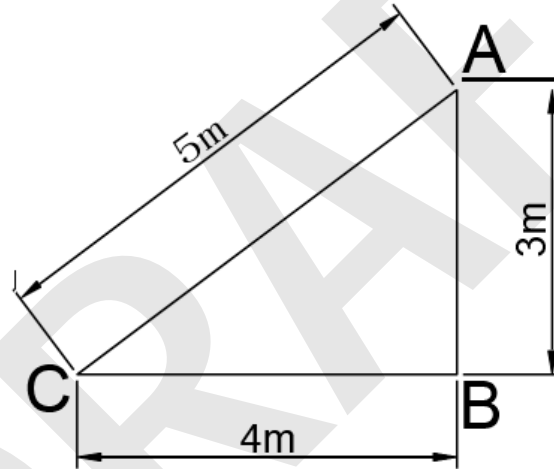


Figure XX Setting out of building foundation trenches

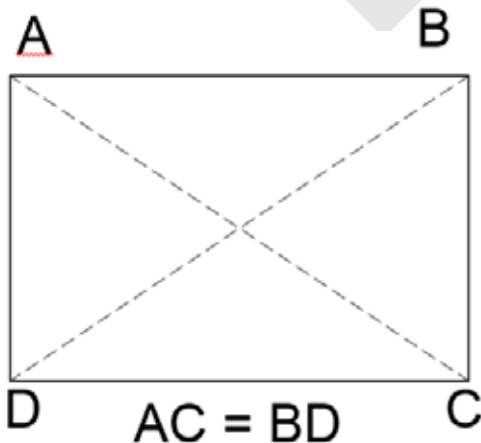
Squaring up

When you have marked the corners of the building, make sure the lines are square. This can be done using the 3-4-5 method. The 3-4-5 method is based on the theorem of Pythagoras and is also sometimes called the Pythagoras method.



Squareness check

Check that the building is square by measuring the diagonal lines from corners to corners. If the diagonal lines are the same length, the corners are square. If not check the side measurements, one or more may be wrong.



Activity 7.1

- 1.1 Explain the term foundation in your own words.
- 1.2 Discuss the main purpose of a foundation.
- 1.3 Differentiate between Strip and Step foundations.
- 1.4 Describe what is used to expel entrapped air from freshly placed concrete.
- 1.5 State the consequences of not compacting concrete.

Activity 7.2

- 1 Describe the 3-4-5 squaring up method to set out right angles.
- 2 Describe the squareness check.

Bricklaying

CHAPTER

8



LEARNING OUTCOMES

By the end of this chapter, learners should be able to define and apply different aspects of bricklaying. The following will be covered in this chapter:

- Learning about the definition, main groups and properties of bricks and building blocks
- Learning about the advantages of bricks with holes over solid bricks
- Learning about the different ways of cutting bricks
- Learn and apply stretcher bonds, corner joints and T-junctions of one brick walls.

Introduction

The job or activity of building walls or buildings using bricks and mortar is called bricklaying. Bricklaying is a skilled job. Typically, rows of bricks called courses are laid on top of one another to build up a structure such as a brick wall.

BRICKS AND BLOCKS

Definition of a brick

A brick is a solid unit of usually fired or sun-dried clay. Bricks can also be made from concrete. A cement brick is a type of building brick that is manufactured from concrete and not clay.

The longest side of a brick is known as the stretcher. The shortest side of a brick is called the header. The stretcher is usually 220 mm, the header is 110 mm and the thickness is 75 mm. The standard size of a brick is therefore 220 mm × 110 mm × 75 mm.

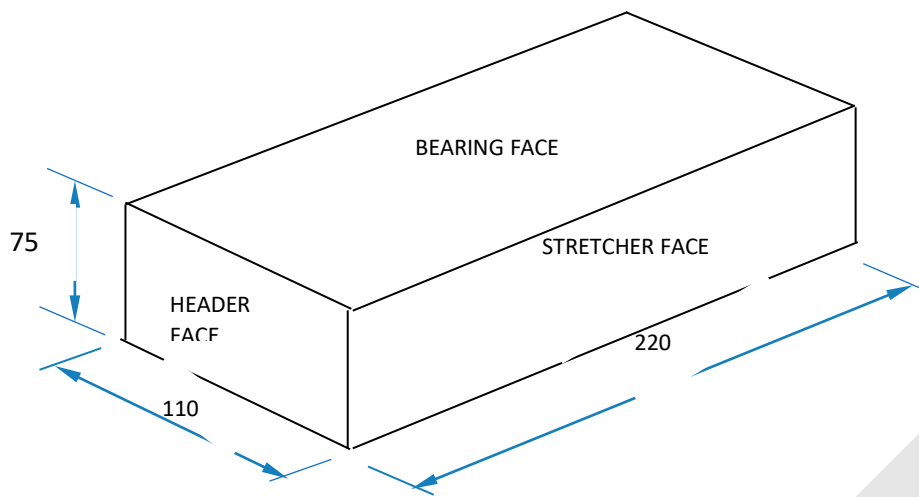


Figure 8.1 Standard brick

Two main groups of bricks

- Face bricks – Face bricks are heavy, solidly made and are used in the face of the wall
- Stock – Stock bricks are more brittle and can break easily.

Properties of bricks

- Strength
- Absorption
- Weather resistance
- Fire resistance
- Wear Resistance
- Porosity
- Efflorescence
- Sound Insulation

Building blocks

- Blocks are mainly made of concrete and are larger in comparison to bricks
- Blocks vary in size between 390 – 440 mm long × 50 – 65 mm wide × 190 – 215 mm thick.
- They come in various sizes and names, such as Maxi brick and concrete hollow blocks.

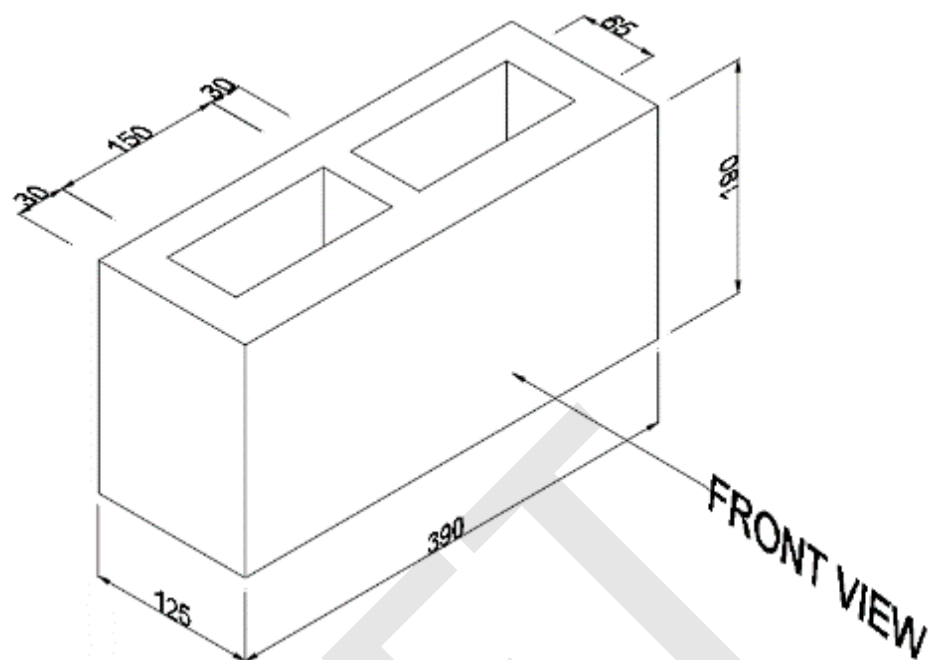
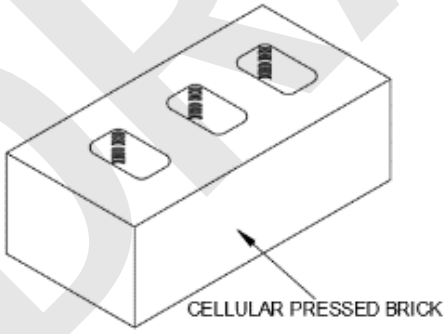
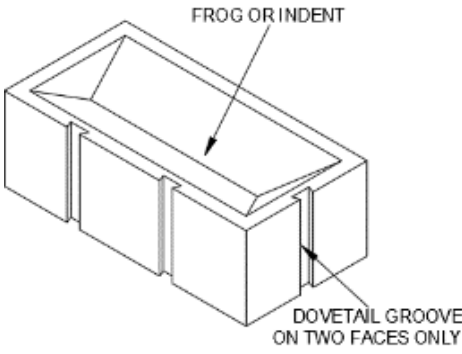


Figure 8.2 Building block

| Cellular Bricks | Keyed Bricks |
|---|---|
| Is a brick or block in which holes are closed at one end | Is a brick having a recess in one face usually of the dove tail joint used to provide a mechanical key for plaster work |
|  |  |

Advantages of bricks having holes over solid bricks

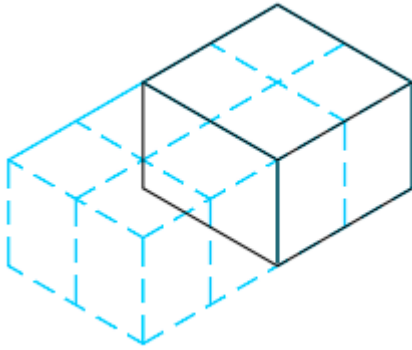
| Bricks with Holes | Solid Bricks |
|---|--|
| Holes make the brick lighter | Solid bricks are heavy |
| Good bonding between mortar and plaster | Low bonding between mortar and plaster |
| Cost effective/cheap | Expensive |

Different ways of cutting bricks

Bricks can be cut in any shape depending on the use. The following are different types of free hand drawings of cutting a brick.

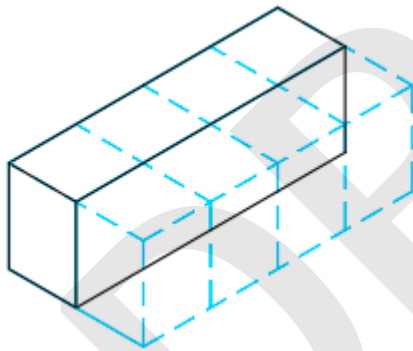
1 Half bat

- » A brick that has been cut into two equal (110 mm) halves along the length of both stretcher sides



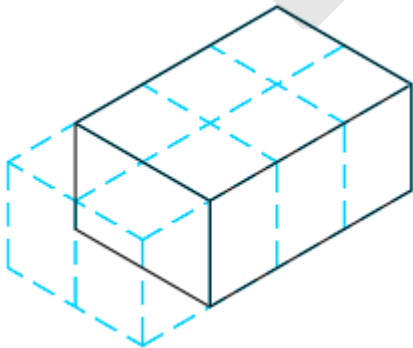
2 Queen closer

- » Is a brick of full length cut along the breadth so that the face of it measures 110 mm × 75 mm



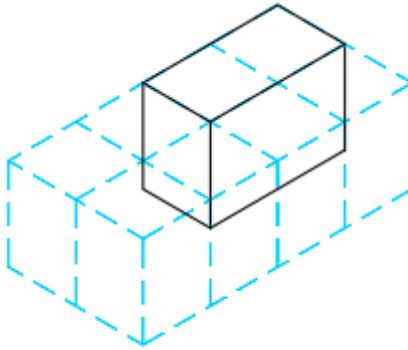
3 Three quarter bat

- » A brick with a portion of a quarter cut off



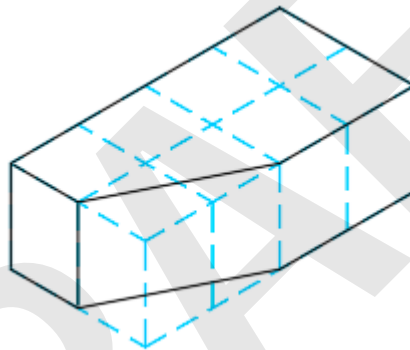
4 Queen closer quarter

- » Is a queen closer that is broken into two equal pieces



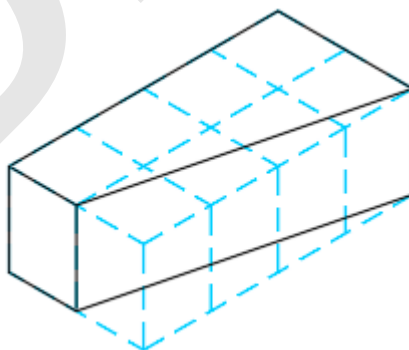
5 King closer

- » Is a closer bigger than half a brick specifically a brick with one corner cut away making the header at that end half the width of the brick.

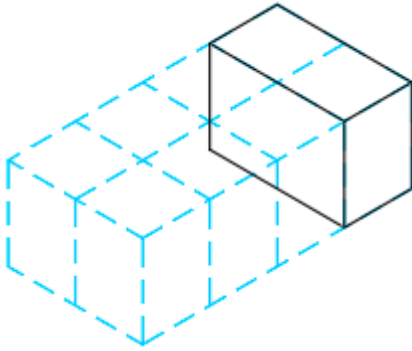


6 Bevelled closer

- » Is a form of king closer in which the whole length of the brick is bevelled in such a way that half width is maintained at one end and full is maintained at the other end



- 7 Quarter bat
- » A brick with a portion of a three quarter cut off



ACTIVITY 8

Work on your own. Answer the following questions.

1. Differentiate between cellular and keyed bricks

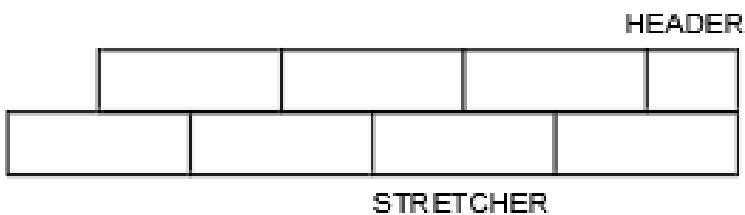
| Cellular Bricks | Keyed Bricks |
|-----------------|--------------|
| | |
| | |
| | |

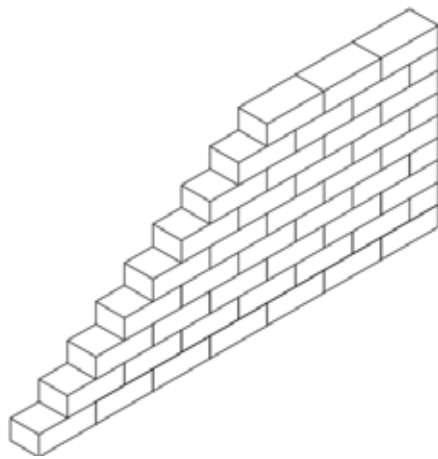
2. List the advantages of bricks having holes over solid bricks.

| Bricks with Holes | Solid Bricks |
|-------------------|--------------|
| | |
| | |
| | |
| | |

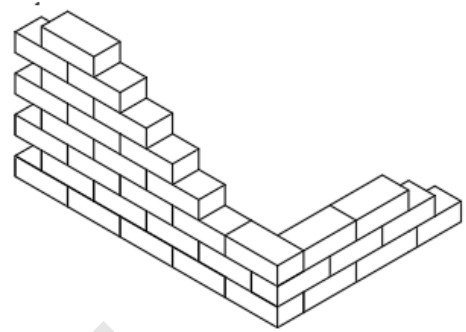
- a) Make a neat isometric drawing of the following bricks
- b) Queen closer
- c) Quarter bat

Bonded Wall (Stretcher bond)

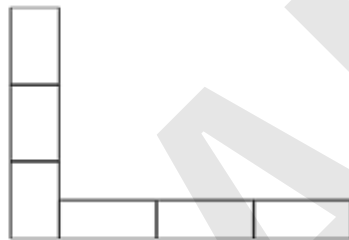




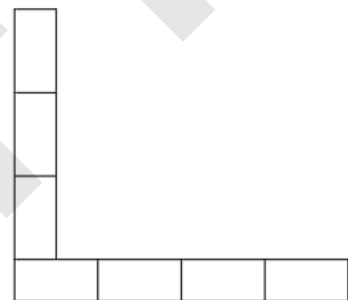
Brick wall built in stretcher bond



Isometric view of half brick corner in stretcher bond

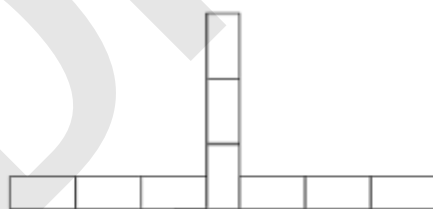


COURSE 1

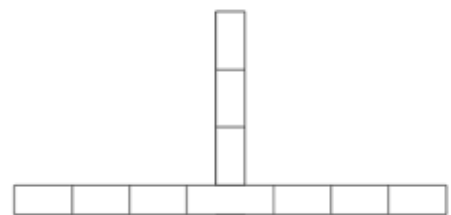


COURSE 2

A corner of a Half brick walls in stretcher bond



COURSE 1



COURSE 2

T-Junction of a half-brick wall in Stretcher bond

Cold Water Supply

CHAPTER

9



LEARNING OUTCOMES






By the end of this chapter, learners should be able to identify and apply different aspects of cold water supply and waste. The following will be covered in this chapter:

- Identify different types of taps, valves and the purpose of the following:
 - » Water meter
 - » Pillar tap
 - » Bib cock
 - » Non-return valve
 - » Stop cock
- Learning about joints and fittings used in cold water systems (PVC and Polycop, Galvanised and Copper)
 - » P- trap
 - » S-trap
 - » T- connection
 - » 90° Elbow
 - » Straight connector
 - » 45° bend
 - » Lock ring

Introduction

Cold Water Supply is the supply of fresh potable water to consumers by a water supplier. In this chapter of Civil Technology we will focus on the supply of cold water to a building. There are two parts to a home water system: The first part brings in clean water, the second takes away wastewater. The water comes in from the mains and is controlled with a series of valves and taps in and around the building.

Identify different types of valve, taps and the purpose

| Type | Valves | Taps | Purpose |
|---------------------|---|---|--|
| 1. Water meter |  | | Water meters are mechanical devices and measures the quantity and flow of water entering your home. |
| 2. Pillar tap | |  | With pillar tap pairs, the hot and cold water is delivered entirely separately. This means that you have direct control over the temperature of the water, helping to create the perfect hot/cold mix. |
| 3. Bib cock | |  | A bib tap is a wall-mounted tap that also offers the ability to connect a hose. The word "bib" refers to the shape and functionality of the tap: a faucet with a nozzle turned down that can be connected to a hose. |
| 4. Non-return valve |  | | A non-return valve allows water to flow in only one direction. |
| 5. Stop cock |  | | A stopcock is a tap that controls the mains water supply coming into your house. |

Joints and fittings used in cold water systems

| Type | PVC | Polycop | Galvanised | Copper |
|-----------------------|---|---|--|---|
| 1. P-trap |  | |  |  |
| 2. S-trap |  | | |  |
| 3. T-connection |  |  |  |  |
| 4. 90° Elbow |  |  |  |  |
| 5. Straight connector |  |  |  |  |
| 6. 45° bend |  | |  |  |
| 7. lock ring |  | |  | |

Activity 9.1

9.1 Identify the names of the following cold water supply devices and fittings.

| Type and Fittings | | |
|-------------------|---|--|
| 1. |  | |
| 2. |  | |
| 3. |  | |
| 4. |  | |
| 5. |  | |
| 6. |  | |

Geyser

CHAPTER

10



LEARNING OUTCOMES

By the end of this chapter, learners should be able to identify the different parts of a high pressure geyser.

The following will be covered in this chapter:

- Learning about different parts of a high pressure geyser.

Introduction

GEYSER (HOT WATER SUPPLY)

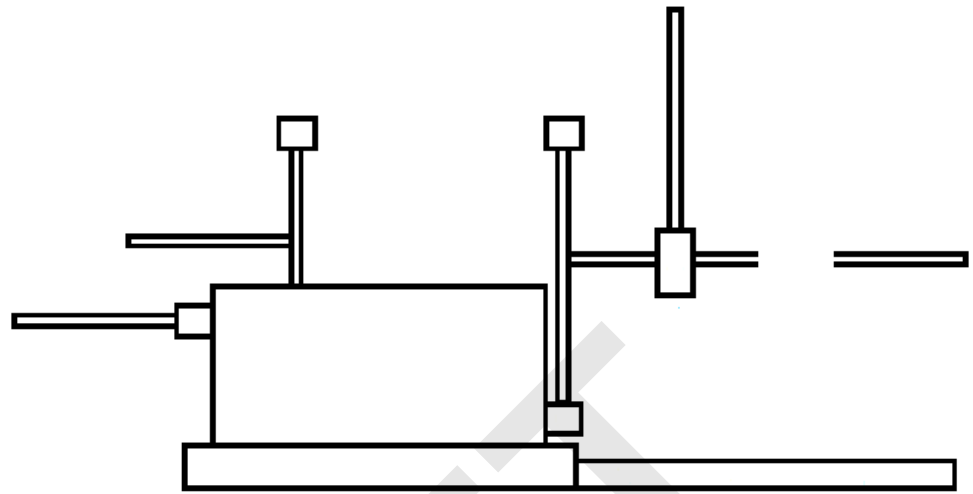
Ideally, all households should have hot-water systems in order to improve their quality of life. Water can be heated in various ways - electricity, gas or solar energy can be used.

The geyser consists of a water tank fitted with two main pipes – one for the inlet of cold water and the other for outlet of hot water. The water tank is fitted with a heating element which is controlled by a thermostat. The thermostat ensures that water is not heated above a set temperature value. The tank is normally covered with some insulating material and enclosed inside a metal casing.

A high pressure geyser use different pressure control valves.



A geyser consists of the following parts



| NUMBER | PART | USE |
|--------|--|--|
| 1 | Geyser | To store/keep hot water. |
| 2 | Pressure safety valves / vacuum breakers | Controls the pressure by releasing it if the pressure in the cylinder is too high. |
| 3 | Drip tray | Provide temporary storage for dripping water from the geyser. |
| 4 | Stop cock | To regulate the flow of water into the geyser. |
| 5 | Cold water inlet | Feeds cold water to the geyser. |

Pressure safety valve / Vacuum Breaker

A pressure safety valve is mounted on a 30cm length of pipe which stand vertically above the geyser. They prevent the water from siphoning out of the geyser when the cold water supply is stopped.

Thermostat

The thermostat regulates the water temperature inside the geyser. A good temperature for household use is 60 degrees Celsius.

Drip Tray

The geyser should sit in a tray made of plastic or steel. Since June 2001, the drip tray is not optional. The tray must be fitted with a 40 mm PVC waste pipe that drains the tray by piping the water out the house.

Timber Materials

CHAPTER

11



LEARNING OUTCOMES

By the end of this chapter, learners should be able to identify and describe different timber materials and components. The following will be covered in this chapter:

- Learning about sketching and labelling the cross-section of a tree trunk
- Learning about different conversion methods of timber
 - » Through and through method
 - » Square method
 - » Quarter method
- Learning about the characteristics of softwoods
 - » Pine
- Learning about the characteristics of hardwoods
 - » Meranti
- Learning about timber defects
 - » Heart shake
 - » Cup shake

Introduction

Timber is wood that is used for building material and making furniture. Timber can be classified as either softwood or hardwood, depending on the type of tree the timber comes from. Timber from hardwoods is normally more dense than softwoods.

Cross-sectional views of a tree trunk

- Horizontal section

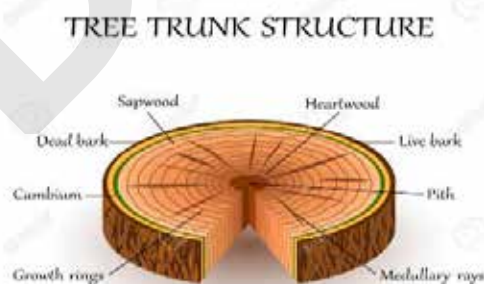


Figure 11.1 Tree trunk structure

- Vertical section

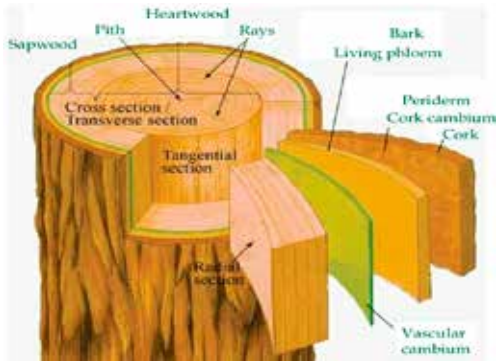


Figure 11.2 Vertical cross section of a tree trunk

Conversion of timber

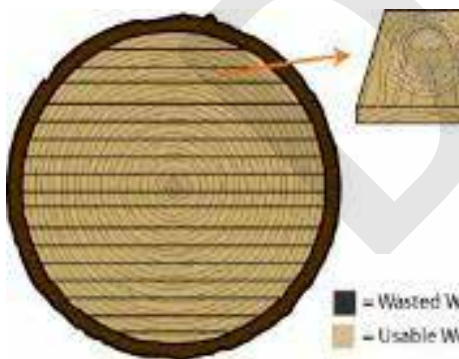
Conversion of timber means cutting of logs into slab sizes of timber suitable for use in the market place.

The method of cutting depends on the following:

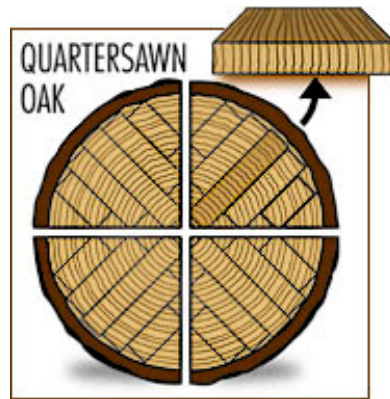
- Size required
- Quality of the logs.
- The kind of timber,
- Purpose for which the wood is to be used.

Methods of conversion

- Through and through/
Economical Or plain method
- Square method



- Quarter sawing method




Characteristics of softwood and hardwood

Soft wood:

South African Pine is an example of a soft wood


It is usually used in carpentry structures such as roofing, e.g. rafters.

| Wood | Characteristic |
|--|--|
|  | <ul style="list-style-type: none"> • Light to dark yellow in colour • Straight grain • Easy to work, using hand and power tools • Easy to finish using varnish and paint |

Hardwood:

Meranti is an example of a hard wood.

It is used for furniture, window frames, panelling etc.

| Wood | Characteristic |
|---|--|
|  | <ul style="list-style-type: none"> • It is yellowish to reddish brown in colour. • Medium coarse but even. • Easy to work, using both power tools and hand tools. • Easy to finish using varnish |

Timber defects:

Timber is a natural product and every natural product has some imperfections. Timbers are not excluded from that. Most of the defects in timber cause weakness in the wood that may cause it to be less useful.

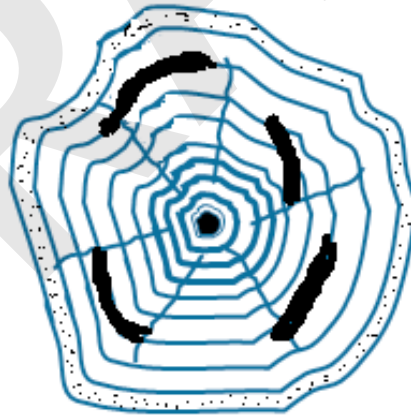
Shakes are timber defects that occur around the annual ring or growth ring of a timber. In other words, cracks or splits in the woods are called shakes. These defects include the following:

- a) Heart shake: In heart shake the pith of the tree rots as a result of insufficient food. Heart shakes starts spreading from the pith to the sapwood along the lines of medullary rays. Shrinkage of the interior part of the timber causes this crack.
- b) Cup shake: In cup shake the wood around the annual rings separate as the medullary rays do not bind the annual rings together. Cup shakes follow the annual growth ring. It is capable to separate the growth ring partially or completely. When the crack separates the annual ring completely, it is called ring shakes. So, all ring shakes are cup shakes, but all cup shakes are not a ring shape. Excessive frost action is the main reason for this type of crack.

These defects are shown in the diagrams below:



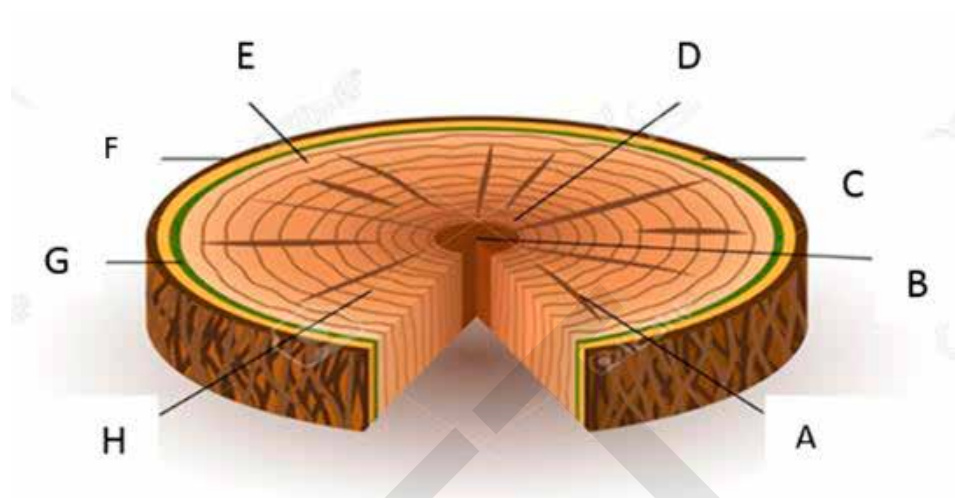
HEART SHAKE



CUP SHAKE

Activity 11

1.



Label the cross section of the tree trunk structure below.

- 1.2 State the methods that cutting of conversion depends on.
- 1.3 Name methods of conversion.
- 1.4 Mention TWO characteristic of softwood.
- 1.5 Distinguish between Heart shake and Cup shake of timber defects.

Manufactured Boards

CHAPTER

12



LEARNING OUTCOMES

By the end of this chapter, learners should be able to identify the characteristics and application of different types of manufactured boards. The following will be covered in this chapter:


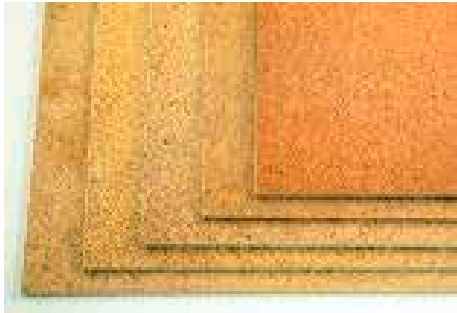
- Learning about types of manufactured boards
 - » Chipboard
 - » Supawood
 - » Plywood
 - » Soft board

Introduction

Board products are manufactured by processing wood. Due to the rising cost of solid or conventional wood, board products such as plywood, hardboard, and plywood are more generally used in construction these days.

TYPES OF MANUFACTURED BOARDS

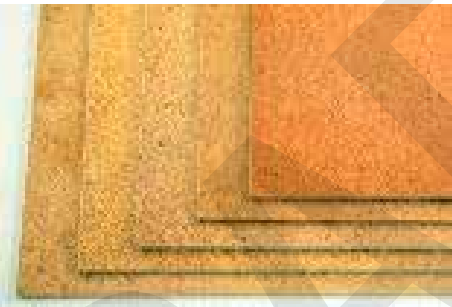

1.1 Identify the name and use of the following finishings.


| Boards | Characteristics |
|--|---|
|  Plywood | <ul style="list-style-type: none">• It consists of odd number of layers, starting from 3 to seven and more. (3 to 7 layers is called ply and more is called multi-ply)• It can be used internally and externally.• The layers alternate at an angle of 90 degrees• Very strong |
|  Hardboard | <ul style="list-style-type: none">• It is made from wood fibre, fine chips or pulped wood waste.• It cannot be used outside because it absorbs water.• The fibres are rearranged and compressed together to form a hard panel.• It is stronger than wood. |

| Boards | Characteristics |
|--|--|
|  <p>Chip board</p> | <ul style="list-style-type: none"> • Is a rigid board with a relatively smooth surface. • It is difficult to burn. • It is resistant to warping and will not splinter. |
|  <p>Supawood</p> | <ul style="list-style-type: none"> • Supawood is made by bonding fine wood fibres. • Easy to work with when using machine. • It can be shaped without chipping. |
|  <p>Soft boards</p> | <ul style="list-style-type: none"> • For insulation in the ceiling, and under floor boards • Good insulator for sound and heat • Used for notice boards and pin boards. |

ACTIVITY 12.1

1.1 Give TWO characteristics of each board in the table below.

| Boards | Characteristics |
|---|-----------------|
|  <p>Plywood</p> | |
|  <p>Hardboard</p> | |
|  <p>Chip board</p> | |
|  <p>Supawood</p> | |

| Boards | Characteristics |
|--|-----------------|
|  <p>Soft boards</p> | |

1. Explain why hardboard can not be used outside.
2. Which angle layers of plywood alternate?
3. Give TWO insulator applications of soft board.

Finishing

CHAPTER

13



LEARNING OUTCOMES

By the end of this chapter, learners should be able to identify and apply finishing and protective products to a range of items. The following will be covered in this chapter:

- Identify and use the following finishing and protective products:
 - » Sandpaper with attention to the different sandpaper grits
 - » Sanding sealer
 - » Linseed oil
 - » Polish / wax
 - » Varnish
 - » Stain
 - » Painting
 - » Plastering
 - » Galvanizing
 - » Powder coating

Introduction

What is finishing?

Finishing refers to the process of refining or protecting a material and applying decorative materials to structures to improve them.

Rough finishing

Entails identification and removal of defects in wood surfaces in preparation for painting. This is done by using rough finishing tools such as rasps and course sand paper.

Smooth finishing

Entails preparation of wood surfaces for varnishing. This is done by using smooth finishing tools such as files and fine sand paper.

Normal Grit Ranges

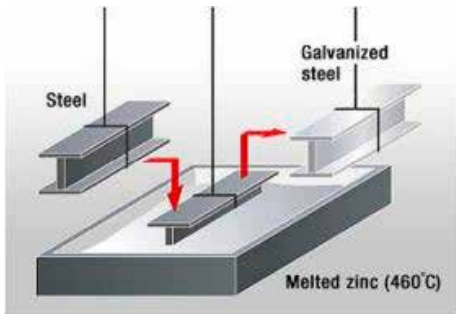

While you can find many differently graded sandpapers available, most sanding projects call for papers in the following grit ranges:

- 60–80 (coarse):
- 100–150 (medium):
- 180–220 (fine):
- 320 and up (ultra-fine):





| Name | Use |
|---|--|
|  <p>Sanding Sealer</p> | <ul style="list-style-type: none"> • Seals the timber so that a finish can be applied |
|  <p>Linseed oil</p> | <ul style="list-style-type: none"> • Wood finish • Anti – Termite • Oil Painting |
|  <p>Polish/ Wax</p> | <ul style="list-style-type: none"> • For a decorative appearance. • To improve durability. |
|  <p>Varnish</p> | <ul style="list-style-type: none"> • To preserve wood. • To help material to withstand different weather conditions and chemicals. |

| Name | Use |
|---|---|
|  <p>Clear Stain</p> | <ul style="list-style-type: none"> • To alter the shade of the timber • Using clear coat with seal will protect your wood from the possibility of water damage. |
|  <p>Solid Stain</p> | <ul style="list-style-type: none"> • To alter the shade of the timber • For use on exterior cedar trim and siding. |
|  <p>Paint</p> | <ul style="list-style-type: none"> • For interior and exterior objects. |
|  <p>Plastering</p> | <ul style="list-style-type: none"> • To provide a smooth finish. • To provide a protective or decorative finish. • To improve the durability of rough brickwork. |

| Name | Use |
|---|--|
|  <p>Galvanising</p> | <ul style="list-style-type: none"> To help protect metal against rust. |
|  <p>Powder coating</p> | <ul style="list-style-type: none"> To create a hard finish to material. |

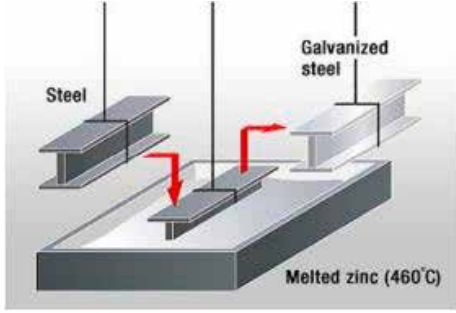

ACTIVITY 13.1

1.1 Identify the name and use of the following finishings.

| Name | Use |
|---|-----|
|  | |
|  | |

| Name | Use |
|---|-----|
|  | |
|  | |
|  | |
|  | |
|  | |



| Name | Use |
|---|-----|
|  | |
|  | |

1.2 Give the grit range for Medium and Ultra-fine sandpaper.

Quantities

CHAPTER

14



LEARNING OUTCOMES

By the end of this chapter, learners should be able to differentiate and do conversions between units used for measurement. Learners should be able to do simple calculations and calculate the number of bricks needed for a small building.

The following will be covered in this chapter:

- Learning about conversion of units
- Calculate the following:
 - » Volume of concrete for a straight trench
 - » Square metre of materials such as brick walls
 - » Dimensions of different materials
 - » Calculation of bricks in a square building
- Calculate the number of bricks needed for a small building:
 - » If a brick is 220mm x 110mm x 75mm, calculate the centre line for a one brick wall

Introduction

Units used for measurement:

In the Civil Technology industry there are a number of different objects and sites that have to be measured to make calculations. The main units of measurement that are used, are the following:

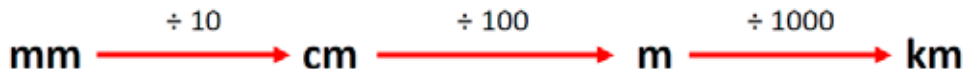
- metre (m)
- centimetre (cm)
- millimetre (mm)
- square metre (m²)
- cubic metre (m³)



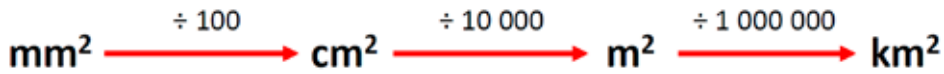
Simple calculations for volume and area

Basic calculation for area is measured in square units and for volume it is measured in cubed units. You need to make sure that the units used in a calculation are the same, i.e. convert all units to metre for example. The following table is useful to help with conversions.

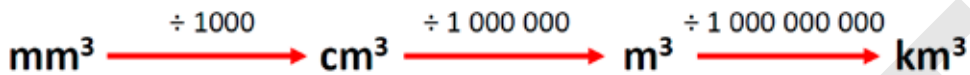
Length conversion



Area conversion



Volume conversion



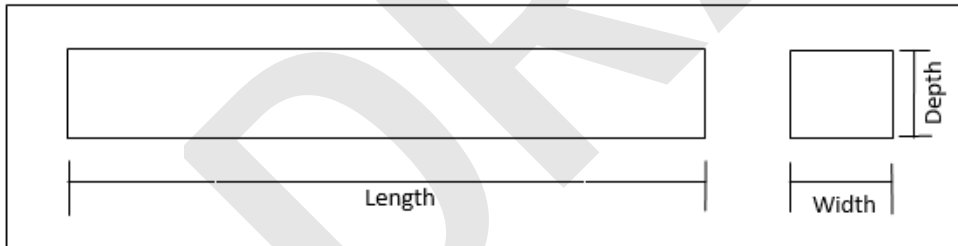
Note:

- To convert from a larger unit to a smaller unit, you multiply.
- To convert from a smaller unit to a larger unit, you divide.

Volume of concrete for a straight trench

In order to calculate the quantity of concrete needed for a foundation, you need to determine the volume of the trenches. The total length, width, and depth (thickness) of the foundation should be multiplied together. Remember that the volume of concrete is calculated in cubic metres (m^3).

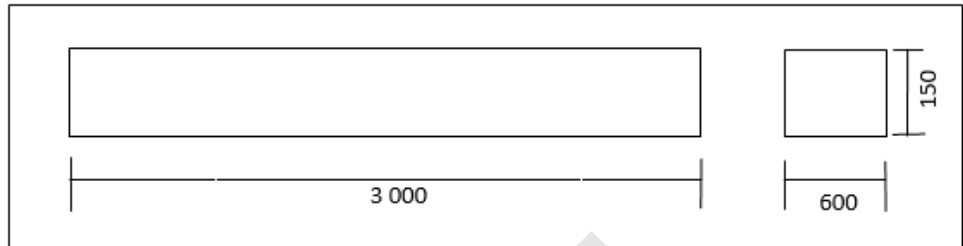
Use the following formula:



Volume = total length of the foundation x width of the foundation x depth (thickness) of the foundation.

Example

The diagram below shows the front and left views of one section of a concrete foundation needed to build a boundary wall. All measurements are in mm.



1. Determine the length of the concrete foundation in metres.
2. Determine the width of the concrete foundation in metres.
3. Determine the depth of the concrete foundation in metres.
4. Calculate the volume of concrete required for this foundation.
Round off your answers to TWO decimal places.

Solution:

1. $3\,000\text{ mm} = 3\text{ m}$
2. $600\text{ mm} = 0.6\text{ m}$
3. $150\text{ mm} = 0.15\text{ m}$
4. Quantity of concrete required
Volume = length of foundation \times width of foundation \times depth of foundation
 $= 3\text{ m} \times 0.6\text{ m} \times 0.15\text{ m}$ (units are converted to metres to simplify the calculation)
 $= 0.27\text{ m}^3$

Square metre of materials such as brick walls

The number of bricks per square metre is determined by the type of bricks used. It is, therefore, better to provide the brick supplier with the surface area dimensions of the walls which need to be built when buying bricks in bulk. Before bricks can be ordered, the surface area of the structure must be calculated. This means that the length and width of the areas must be known, i.e., either indicated on the plans or measured.



Figure 1 Square metre of brick wall

Formula used to calculate the area of brick walls:

Length x width for rectangular surfaces

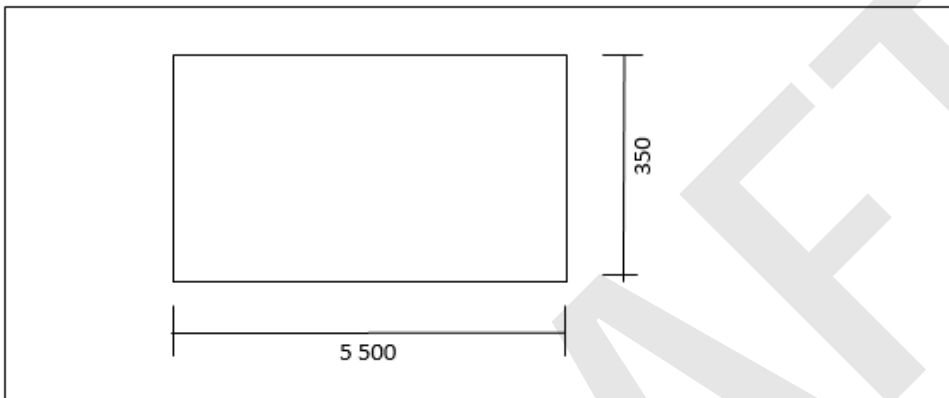
or

side x side for square surfaces

Example

The diagram below shows the front view of a 220 mm thick foundation wall. All dimensions in the diagram are in mm.

1. Calculate the total area of bricks required to build the wall.

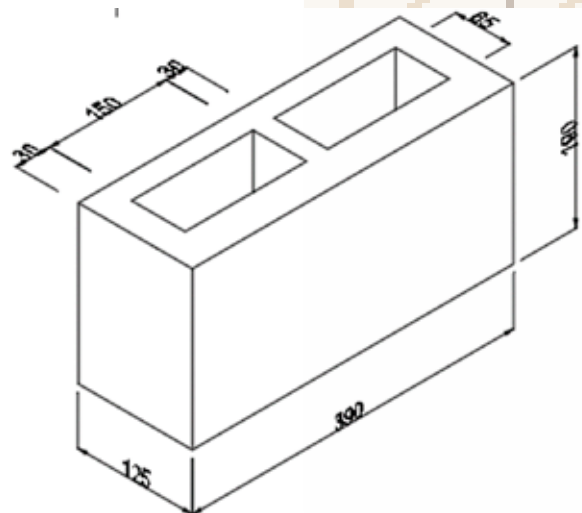
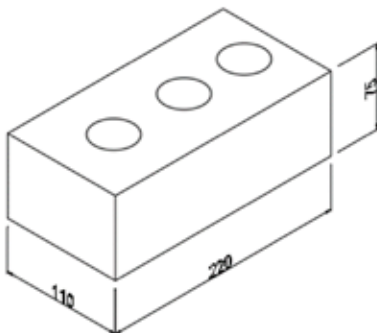


Solution:

1. Total area of bricks required
Area = length x width
= 5,5 m x 0,35 m
= 1,93 m² (always round off your answer to the second decimal)
2. Calculate the total area of bricks required to build the wall.

Dimensions of different materials

The dimensions of a standard brick and a standard building block are given in the diagrams.



Calculation of bricks in a square building

(Only substructure)

Calculate the number of bricks needed for a small building:

If a brick is $220 \times 110 \times 75\text{mm}$

The centre line will be provided for a half-brick wall

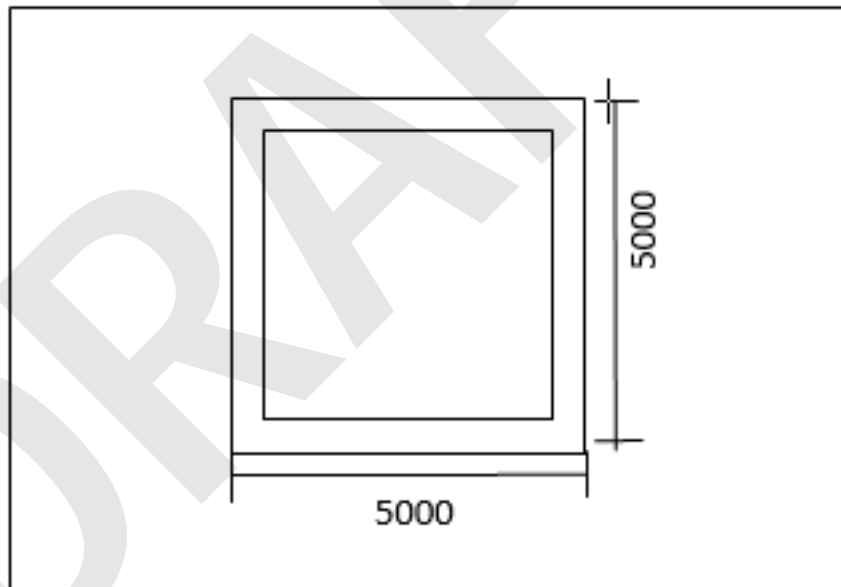
When calculating the number of bricks, the number of bricks per square metre will be:

- 50 bricks per square metre for a half-brick wall
- Parts/fractions of bricks should always be rounded up to the nearest whole brick.

Example 1

The diagram below shows the foundation wall of a small square structure.

Calculate how many bricks are needed to build the substructure.



Solution:

Centre line of a one-brick wall:

$$2 \times 5000 = 10\,000 \text{ mm}$$

$$2 \times 5000 = 10\,000 \text{ mm}$$

$$\text{Total} = 20\,000 \text{ mm}$$

$$\text{Minus } 4 \times 220 = 880$$

$$\text{Total centre line} = 19\,120 \text{ mm}$$

Number bricks required:

= Centre line x height of wall x number of bricks per square metre

$$= 19.12 \times 0.55 \times 100$$

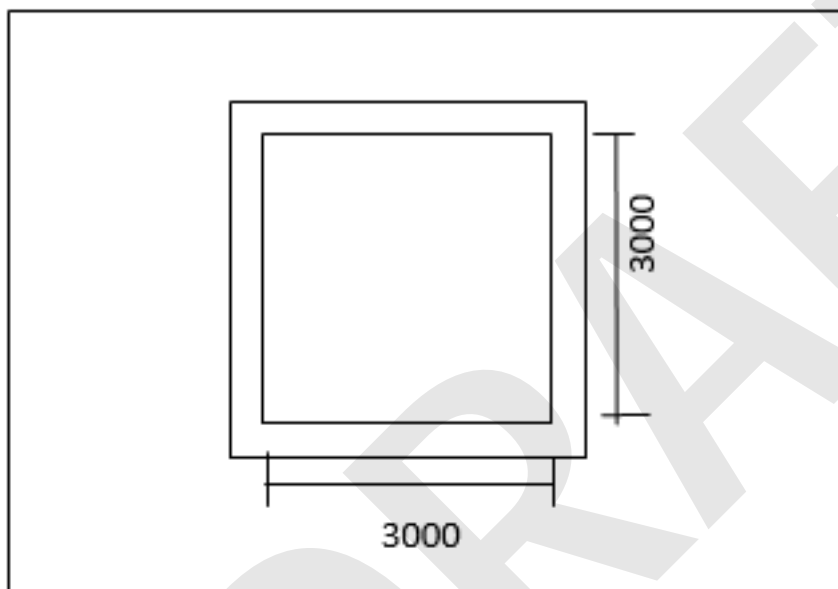
$$= 1051.6$$

$$= 1052 \text{ bricks needed}$$

Example 2

The diagram below shows the foundation wall of a small square structure.

Calculate how many bricks are needed to build the substructure.



Use the following specifications:

- The wall of the substructure is 220 mm thick.
- The height of the substructure measured from the foundation is 550 mm.
- Work on 100 bricks per square metre for a one-brick wall.

Solution:**Centre line of a one-brick wall:**

$$2 \times 3000 = 6000 \text{ mm}$$

$$2 \times 3000 = 6000 \text{ mm}$$

$$\text{Total} = 12\,000 \text{ mm}$$

$$\text{Minus } 4 \times 220 = 880$$

$$\text{Total centre line} = 11\,120 \text{ mm}$$

Number bricks required:

= Centre line \times height of wall \times number of bricks per square metre

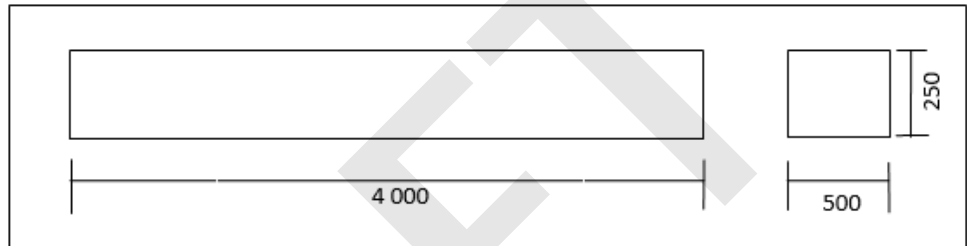
= $11.12 \times 0.45 \times 100$

=500.4

=501 bricks needed

ACTIVITY 14.1

1. The diagram below shows the front and left views of one section of a concrete foundation needed to build a boundary wall.

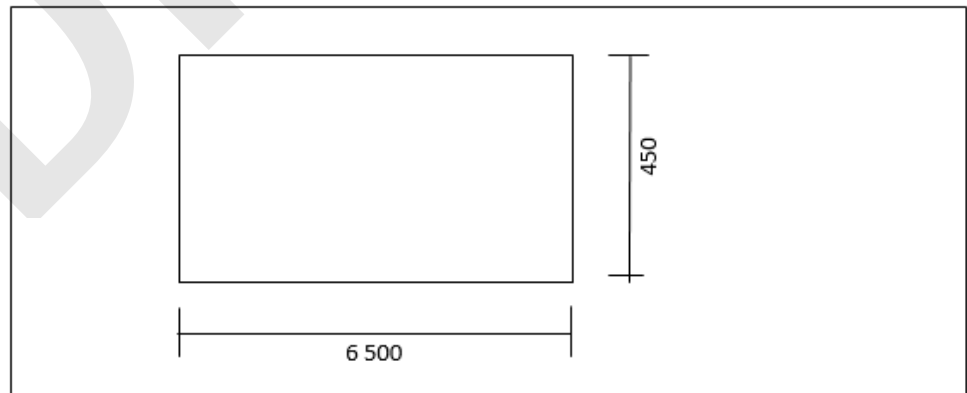


- a) Determine the length of the concrete foundation in metres.
- b) Determine the width of the concrete foundation in metres.
- c) Determine the depth of the concrete foundation in metres.
- d) Calculate the volume of concrete required for this foundation.

Round off your answer to ONE decimal.

ACTIVITY 14.2

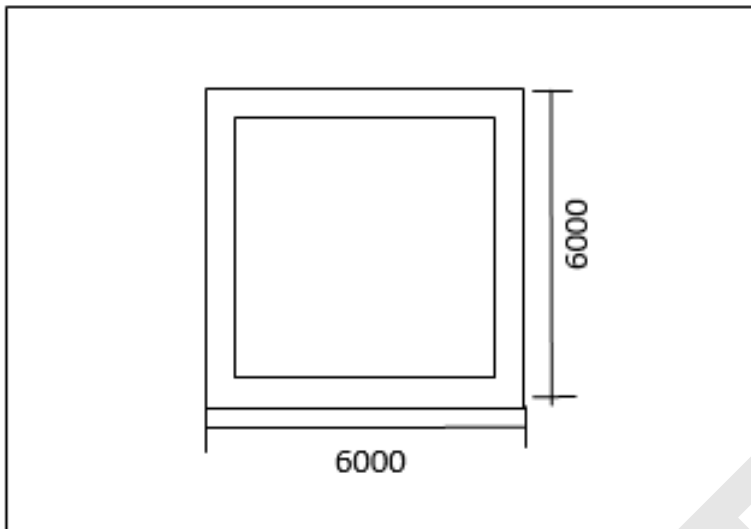
The diagram below shows the front view of a 220 mm thick foundation wall.



1. Calculate the total area of bricks required to build the wall in metres.

ACTIVITY 14.3

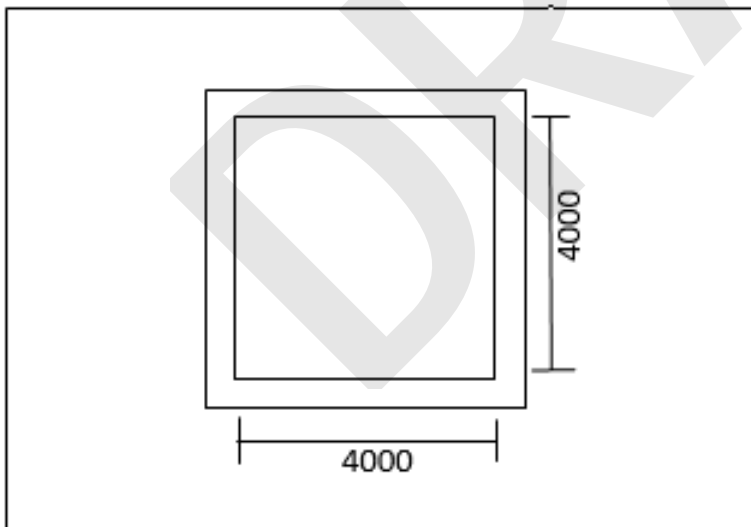
1. The diagram below shows the foundation wall of a small square structure.



Use the following specifications:

- The wall of the substructure is 220 mm thick.
 - The height of the substructure measured from the foundation is 550 mm.
 - Work on 100 bricks per square metre for a one-brick wall.
- a) Calculate how many bricks are needed to build the substructure.

- 1) The diagram below shows the foundation wall of a small square structure.



Use the following specifications:

- The wall of the substructure is 220 mm thick.
 - The height of the substructure measured from the foundation is 450 mm.
 - Work on 100 bricks per square metre for a one-brick wall.
- a) Calculate how many bricks are needed to build the substructure.

Entrepreneurship

CHAPTER

15



LEARNING OUTCOMES

By the end of this chapter, learners should be able to understand what entrepreneurship is. The following will be covered in this chapter:

- Who is an entrepreneur?
- Types of entrepreneurship
- Marketing and branding products
- Advertising on media platform
- Sourcing of funds
- Budget / Costing
- Business plan

Introduction


Who is an entrepreneur?

1. An entrepreneur is a starter. An entrepreneur is an initiator, a challenger and a driver. Someone that creates something new, either an initiative, a business or a company. He or she is the beginning (and sometimes the end) of a venture, project or activity. The entrepreneur might not be the idea-tor, but he or she is definitely the one that decides to make that idea a reality.
2. An entrepreneur is the driver. The entrepreneur is the person in charge, the leader and the person to look to for leadership. He or she is the one that pushes forward and inspires a team to follow. The entrepreneur is the one that sits in the driver's seat, and has the ability to change direction, accelerate, slow down or even stop a venture.
3. An entrepreneur is accountable and responsible. The entrepreneur is the ultimate responsible for the destiny of its venture, which can be a company, a project, or any other endeavour. The entrepreneur is the one that has the highest stakes at the venture, thus the one that needs to be empowered to fully direct the endeavour.

Types of Entrepreneurship

There are four types of entrepreneurship. Anyone interested in starting and running their own business should consider which entrepreneurial model they prefer:

- small business entrepreneurship,
- scalable start-up entrepreneurship,
- large company entrepreneurship, or
- social entrepreneurship.



Small business entrepreneurship. Small and medium sized enterprises (SMEs) makes up 98,5% of all businesses in South Africa. SMEs employs 25,8% of the private sector workforce. Examples of small business entrepreneurs include plumbers, carpenters, grocers, and pharmacy owners. Some small business entrepreneurs could be quite profitable, while others may be barely profitable. The number one motivator for entrepreneurship in South Africa is the need to earn a living, followed by the desire for wealth and income.

Scalable start-up entrepreneurship. A scalable start-up is one that aims to become an extremely high growth, profitable company but is only just beginning. The scalable start-up model requires external capital and risk in order to create demand and company expansions. Scalable businesses have high margins (over 50%), low support, and the minimum number of employees. Businesses that are easily scalable are software, subscription services, e-commerce, digital downloads, franchising, rental properties, and retail chain stores.

Large company entrepreneurship. This type of entrepreneurship happens within big existing companies that already have established a customer base and market share. Why would they need entrepreneurship? Over time, consumer tastes change, and products are no longer in vogue. If a large company doesn't innovate then it can slowly become obsolete. This form of entrepreneurship could include creating a new design or product in order to compete with new technologies and competitors. Large company entrepreneurship can be seen as an adaption to environment expansions.

Social entrepreneurship. Social entrepreneurship are focusing on forming new products and ideas in order to solve social dilemmas. Social entrepreneurship businesses are either non-profit organisations, or they blend for-profit goals with generating a positive 'return to society'. The goal of these companies is to, in their own words, make the world a better place. Social entrepreneurship is often associated with poverty alleviation, health care, and community development.

Marketing and branding products

Product marketing is the process of bringing a product to market, promoting it, and selling it to a customer. Product marketing involves understanding the product's target audience, using strategic positioning, and messaging to boost revenue and demand for the product. Product branding is a symbol or design that gives your products a proven identity in the marketplace.

Social media advertising

Social media advertising are advertisements served to users on social media platforms.

Examples of media platforms:

- Facebook
- Instagram
- Twitter
- TikTok
- Pinterest
- LinkedIn.

ENTREPRENEURSHIP

Activity 15.1

1. List and explain three different types of entrepreneurs. Give examples of each.
2. Briefly explain product marketing.
3. Briefly explain social media advertising.

Sourcing of funds

Financial planning gives an entrepreneur more leeway to seize opportunities, adapt to change and weather difficult times. It is important for any business to have access to funds in order to be profitable. The main sources of funds for a business are:

- Owner funding / personal investment
- Loans
- Equity capital

Budget / Costing

A business budget is a spending plan for a given period for the business based on income and expenses. It is an estimate of how much money the business will make and spend over a certain period of time, such as a month or a year.

A budget:

- Identifies available capital
- Estimates spending
- Helps to predict revenue
- Helps to plan business activities

Business plan

A business plan is a document which describes the company's goals, operations, industry standing, marketing objectives, and financial projections. The information in a business plan can be a helpful guide in running the company. It is also a valuable tool to attract investors and obtain financing.

Activity 15.2

1. Name 3 main sources of funding for a business.
2. What is a business budget?