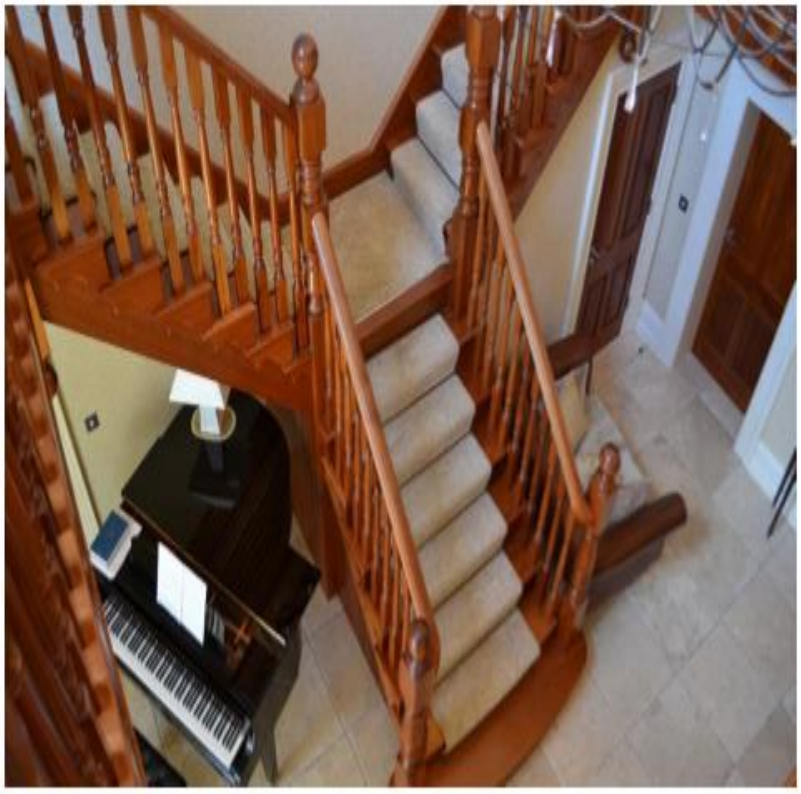
RQF LEVEL 5



TRADE: CARPENTRY

MODULE CODE:CAPWC501

TEACHER'S GUIDE

Module name: WOODEN STAIRCASE CONSTRUCTION

Contents

Acronyms

RTB: Rwanda Tvet Board

LU: learning units

LO: learning outcome

R: rise

G: going

RFE: right face edge

RFS: right face surfaces

ORFE: opposite right face edge

ORFS: opposite right face surfaces

M: meter

Mm: millimeter

Cm: centimetre

Introduction

A **stair** is a series of steps, each elevated a measured distance, leading from one level of a structure to another. When the series is a continuous section without breaks formed by landings or other constructions, the terms flight of stairs or run of stairs are often used. Other terms that can be properly used include stairway and staircase.

Stair construction requires a high degree of skills. The quality of the work should compare with that found in fine cabinetwork. The parts for main stairways are usually made in millwork plants and then assembled on the job. Even so, the assembly work must be performed by a skilful carpenter who understands the basic principles of stair design and knows layout and construction procedures.

Module Code and Title: CAPWC501 Construct wooden stair case

Leaning units

LU1: Prepare tools, materials and equipment

LU2: Prepare workplace

LU3: Fix wooden stair components

LU4: Perform finishing

Learning Unit 1: Prepare tools, materials and equipment

STRUCTURE OF LEARNING UNIT

Learning outcomes:

LO.1.1: Select tools and equipment

LO.1.2: Select and calculate materials

LO.1.3: Prepare materials

LO.1.4: Set out OF string for treads and rise as per requirements of stair design

LO.2.1: Determine exist and ground finish levels

LO.2.2: Proper setting out of newel posts and footings and placed to layout of designed stairs, job drawings and specifications.

LO.2.3: Cut stringers and housed or fix into the newel posts and/or landing.

LO.3.1: Locate and fix strings into position

LO.3.2: Construct landings as per specification

LO.3.3: Fix treads and risers to strings

LO.3.4: Fit and fix handrails and balusters or bracing and lateral ties in accordance with regulations

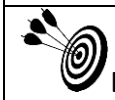
LO.4.1: Sand wooden stair case

LO.4.2: Polish wooden stair case

LO.4.3: Clean, check, maintain and store tools and equipment

Learning outcome 1.1 Select tools and equipment

 **Duration: 5hrs**

 **Learning outcome 1 objectives :**

By the end of the learning outcome, the trainees will be able to:

1. describe properly tools and equipment to perform tasks.

2. making properly selection of tools and equipment related to the job

3. use correctly tools and equipment in right way

4.know properly safety requirement while using tools and equipment

 **Resources**

Equipment	**Tools**	**Materials**
ppe Portable machines Heavy duty machine	- Holding tools - Setting out tools - Cutting and shaving tools - Boring tools - Fixing tool	Timber Nails Vices Varnish Brush Glue

		Paints Sand paper

Advance preparation:

. arrangement

. maintenance

. checking and setting

Indicative content 1.1: Select Tools and Equipment

Classification of tools used for stair construction:

Holding tools: The heading gives the meaning to the activities with which the tools are doing.
Carpenters work bench or joiners work bench
Bench hook
Sash clamps
T-bar clamps
G-clamps
Hand screw clamps or L clamp
Support devices or trestles
Miter boxes
Kit bench box (or bench tools box)
Setting out tools: measuring, marking and testing tools
Tape measure
Folding rule
Marking gauge
Marking knife
Pencil

Spirit level
Callipers
Dividers
Straight edges
Plumb bob
Parallel strips
Try square
Diagonal rods
Meter square
Building square
Sliding bevel

Cutting and shaving tool:

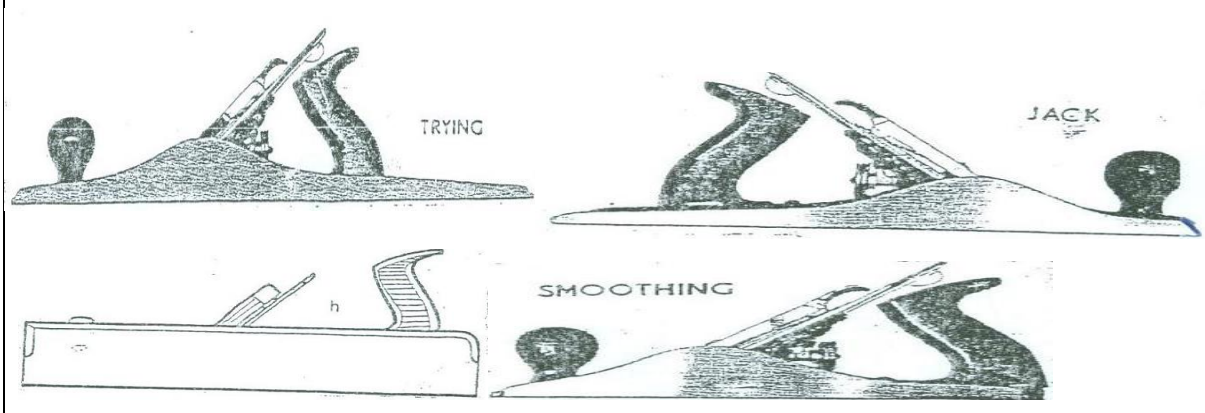
Cutting and shaving tools

They are divided into two groups:

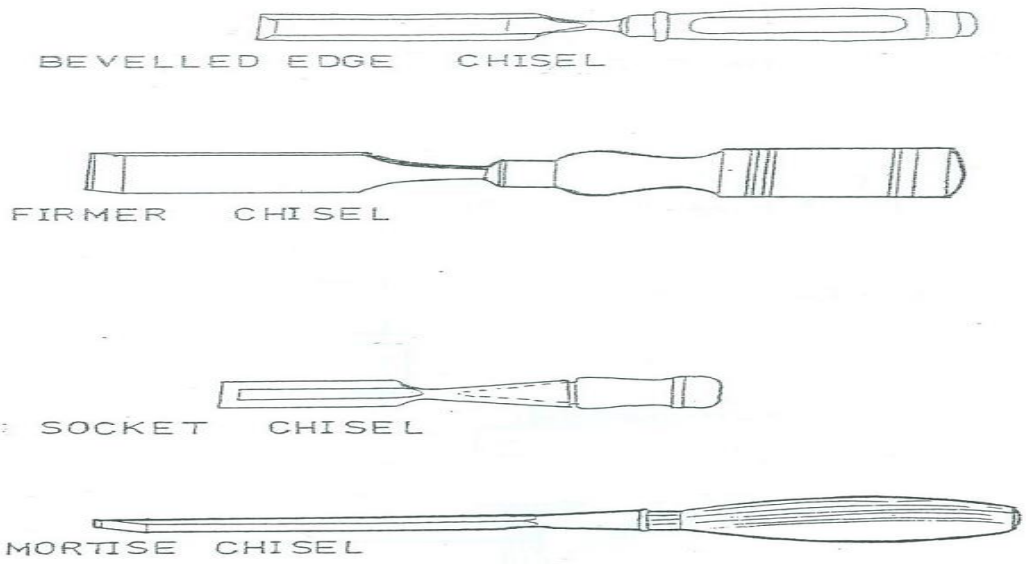
Slicing and smoothing tools: planes, chisels and gauges

Steel or wooden jointing plane N°6 for jointing
Wood or steel jack plane N° 5 (for planing)
Wood or steel smoothing plane N°4 (for smoothing)
Wood or steel rebet plane for rebeting
Plough plane for grooving
Compass plane for planing hollow or rounds
Router plane for making moulding
Spoke shave for planing rounds
Bullnose plane for planing dadoes or housing
Chisels for choping or paring
Gauges for turning in wood lathe are thick and heavier , the ordinary are used for chopping in grooving works curvings

(a)Planes



(b)Chisels



Parting and shaving tools:

Saws:

Ripping saws cut following the direction of the fibres
Cross cut saws cut wood across
Ripping saws 66-71 cm long
3-5 teeth @ 25mm or 1 in
Cross cut saws 51-66 cm long
7-8 teeth @ 25mm or 1 in or 6-11 teeth 25mm long or 1 in for fine saws
Hand saws for ripping and also cross cutting made to fit both groups
Tenon saws for cutting Tenon, and Tenon shoulders
Key hole saw or compass saw for cutting cylinder holes because of its sharp point
Back saws for fine joinery works
Pad saw is similar to key hole saw but the difference is the adjustment which can be used to the handle to fit various types of saws
Copping saws for cutting rounds
Jack saw for falling down trees and cut logs across. 1-1.5m long cross cut saw
Pit saw for log sawing- ripping saws

Boring tools:

1. Single brace
2. Ratchet brace
3. Hand drill or Wheel drill
4. Drill bits
5. Twist bits
6. Auger bits
7. Fastener bits
8. Dowel bits
9. Gimlet bits
10. Turn screw bit to fit brace, hand drill
11. Expansion bits
12. Shell boring bits for mortices

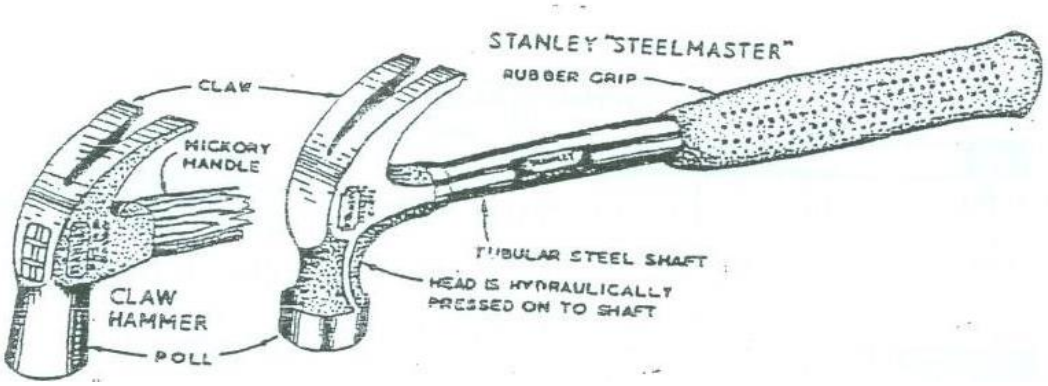
13. Counter sink bits
14. Dowel sharpener bits

Fixing tools:

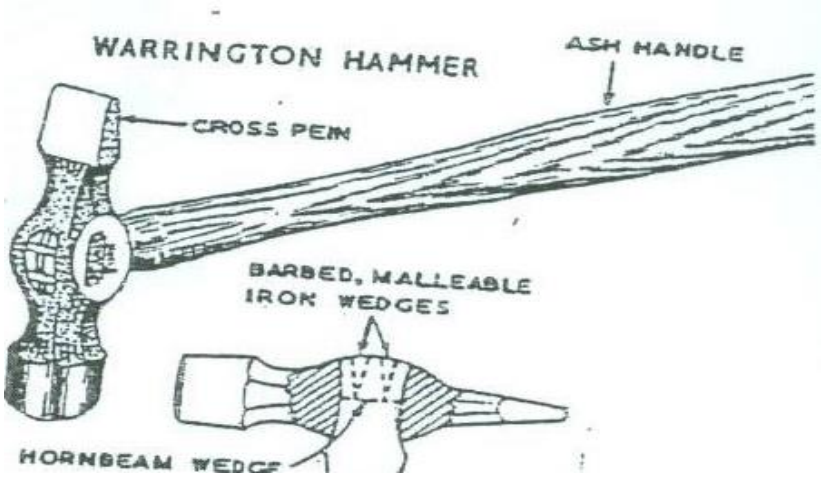
(The tools which gives force to others)

1. Wood or plastic mallet
2. Claw hammer
3. Warrington hammer
4. Panel pin hammer
5. Pincers
6. Pliers
7. Screw drivers (ordinary or flat screw driver)
8. Star screw driver
9. Spiro screw driver
10. Nail punch
11. Spanners
12. Claw bars

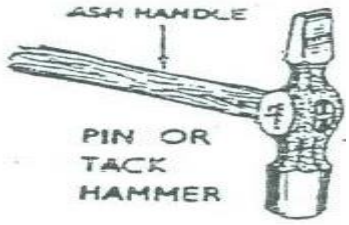
Claw hammer



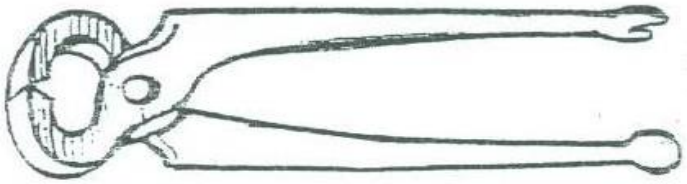
Warrington hammer



Panel pin hammer



Pincers



N.B: Re-sharpening of tools

Grinding angle: 20-25^{o}

Re-sharpening angle: 25-30^{o}

TOOLS RESHARPENING

Why is it necessary to reshape tools?

Answer: Tools are sharpened because when they are used they become blunt.

Which problems will you come across when you use blunt tools?

You will not get good quality work

You will spend a lot of time on small jobs

You will get rough work

You can't get much money on your work

You will use a lot of forces when working

You will get tired

You will destroy some of the tools,

Tools which needs reshapening are as follows:

Plane knives or cutters

Chisels

Saws

Scrapers

Definitions

Hand plane cutters and chisels are resharpened on tool called **Resharpening stone**

It has got two faces rough and fine

Tools and equipment serviceability and safety requirement

Everyone must know where the safety switches are allocated in the workshop.

Don't operate a machine which you don't know, and understand how it functions.

Don't switch on the machine without permission from the instructor.

Make sure that the area of the machine is clean from dust, waste pieces, etc…

Don't put on loose clothes when working on the machine.

put on safety shoes.

Don't put on hanging ties unless well fixed and proper dressed.

Make sure you don't keep long nails because you may have stuck somewhere and get injured.

Never make jokes with someone working on a machine.

Never do setting when the machine is revolving.

Make sure that before switching on the machine the required safety devices are on the machine table.

Before planning the timber, it must be inspected (free from sand, nails, loose knots, danger loose shakes, etc…)

Clean your timber with wire brush to remove stuck stones, dust etc…
Enough ventilation is required in every workshop.
Workshop floor must be rough not fine because of avoiding slippery.
Never use blunt tools.
Make sure to use a proper tool for a proper work or operation.
Every workshop must have fire extinguisher.
Everyone in the woodworking machines workshop must make the use of individual machine safety one precautions. You must use your own common sense with the aid of safety measures.

MACHINE OPERATIONS

There are three major processes involved in manufacturing of wooden working machines as follows:
Cutting out and planing to size.
Jointing and shaping
Finishing

THE CUTTING HEADS

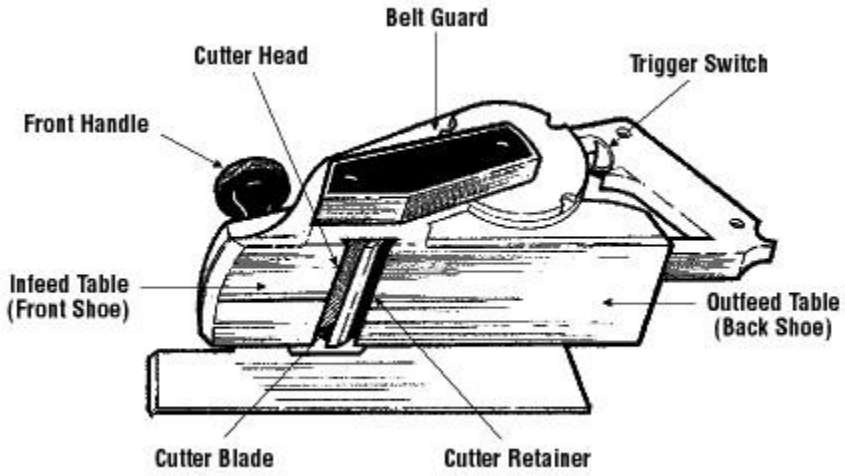
The majority cutting units of woodworking machines in joinery classified as follows:
Saws
Cutter blocks

The saws are classified as follows:
Circular saws
Band saw blades

Classification of equipment:

PORTABLE MACHINES

Ever one must know the general safety to be taken when using machines in general and the specific safety for each machine particularly
According to the name of the machine it explains its self what it was conceived to do.
Portable hand planer machine.
Main parts:
Body
Motor
Switch
Knob (raising and lowering the D/C deep of cut)
Infeed table
Cutter block
Out feed table



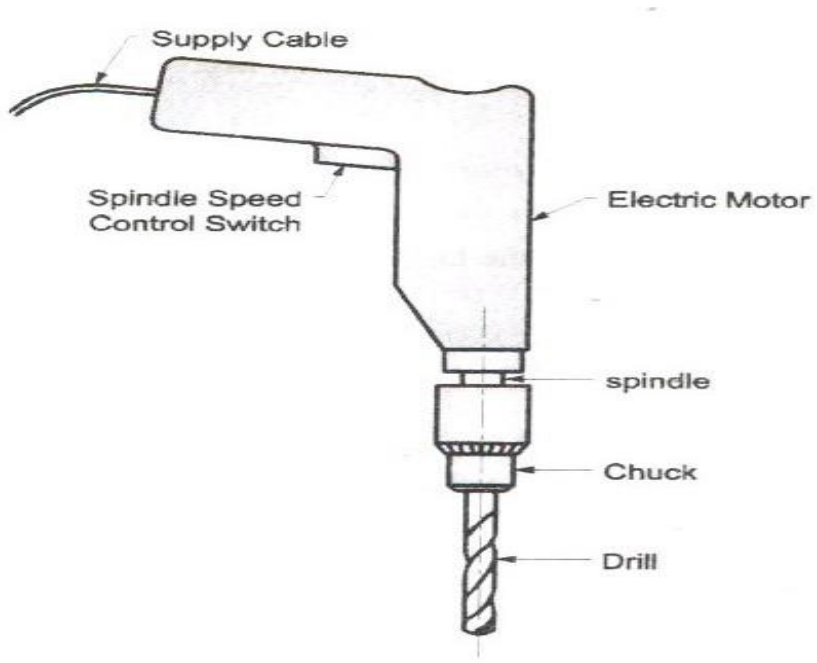
Main operations:
Planning RFS,RFE,ORFS,ORFE
Rebeting
Chamfering
Beveling
Portable circular saw machine

Main parts:
Body
Motor
Switch
Ripping fence
Tilting handle (1-45 degrees)
Raising and lowering handle

Main operations

Ripping
Cross cutting
Grooving
Rebating
Housing
Dovetail housing
Tenoning
Open mortising, Tenon shoulder cutting, Tenon shoulder scribing

Portable hand drill machine



Main parts;

Body
Motor
Switch
Three jaw chuck
Key chuck
Handle

Main operations

Drilling various sizes of holes
use it as a screw driver:
screwing
unscrewing

Portable hand grooving machine

Main functions:

It is used for grooving, rebating

It has various types of cutters.eg Grooving cutter, drunken saw

5. Portable hand freezing machine (or router)

Main operations:

Mouldings of various types

Mortising

Grooving

Rebating

Dado housing

Single dado housing

6

portable nail gun machine

is a type of tool used to drive **nails** into **wood** or some other kind of material. It is usually driven by **electromagnetism, compressed air (pneumatic),** highly flammable gases such as **butane** or **propane,** or, for **powder-actuated tools,** a small **explosive charge**. Nail guns have in many ways replaced **hammers** as tools of choice among builders.

Operation

This machine is used for nailing and various sizes of nails are used (special nails for the particular machine)

portable pin stapler machine

Main operation

It is used for stapling pins to wood (not papers)

portable hand sanding machines

Main operation

It is used for sanding by using a sand paper fixed in the machine.

portable hand angle grinder machines

Main operations

It is used for -cutting and grinding metal

-sanding timber by changing the metal cutter and grinder with a sanding timber and a sanding paper.

portable hand bloom

Main operation

It is used for cleaning dust.

Main operations

Cross cutting

Ripping

cutting to patterns

Portable electric sanding machine

Operations

Sanding edges

sanding surfaces

Sanding hollow surfaces

Sanding rounds

HEAVY DUTY MACHINE

Circular saw machine
Jointing or surface planer machine
Thickness planer machine
Boring machine (Bench drill machine)
Band saw machine
Spindle moulding machine or shaper
Drilling machine
Resharpening machine
Table sanding machine
Miter saw machine
Jig saw machine
Pneumatic hollow mortise machine
Sliding table machine

CIRCULAR SAWS MACHINE

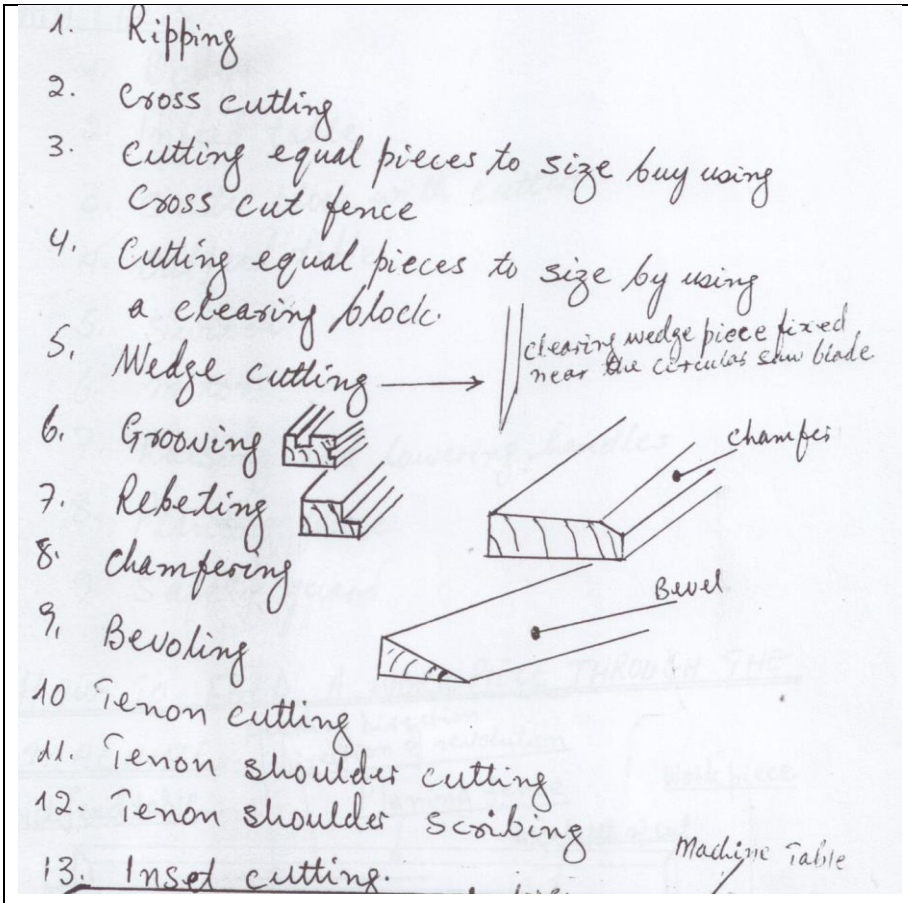
CIRCULAR SAWS:

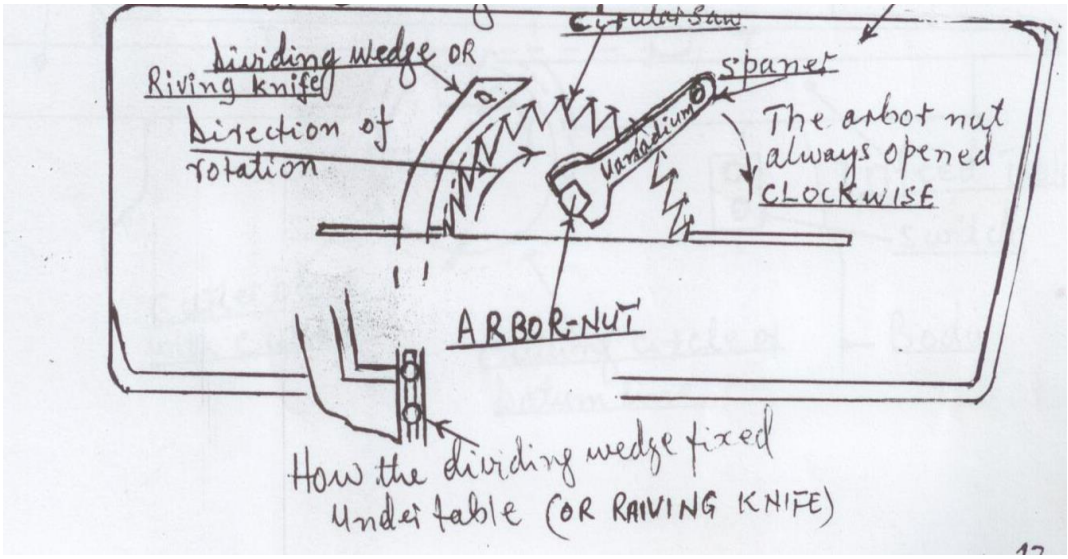
The circular saw blades are divided into two main parts:
a) Ripping saws: are saws, which are used to cut the wood, following the direction of the wood fibres.
Ripping saws have bigger teeth at the distance of 25 mm or 1 inch
b) Cross cut saws: are special blades, which are circular, narrower at the centre and wider to the outer edges.
After sharpening the saw blade, there is no need of saw setting because the saw blade is wider at the cutting edge, it gives enough clearance to the saw kerfs.
The setting has been done direct from the manufacturer.
The setting is called SWAGE SET

MAIN PARTS OF A CIRCULAR SAW MACHINE

Body
Table
Switch
Motor
Ripping fence
Circular saw blade
Dividing wedge
Dust cover
Cross cutting fence
Angle cutting fence
Raising and lowering handle
Tilting handle

MAIN OPERATIONS





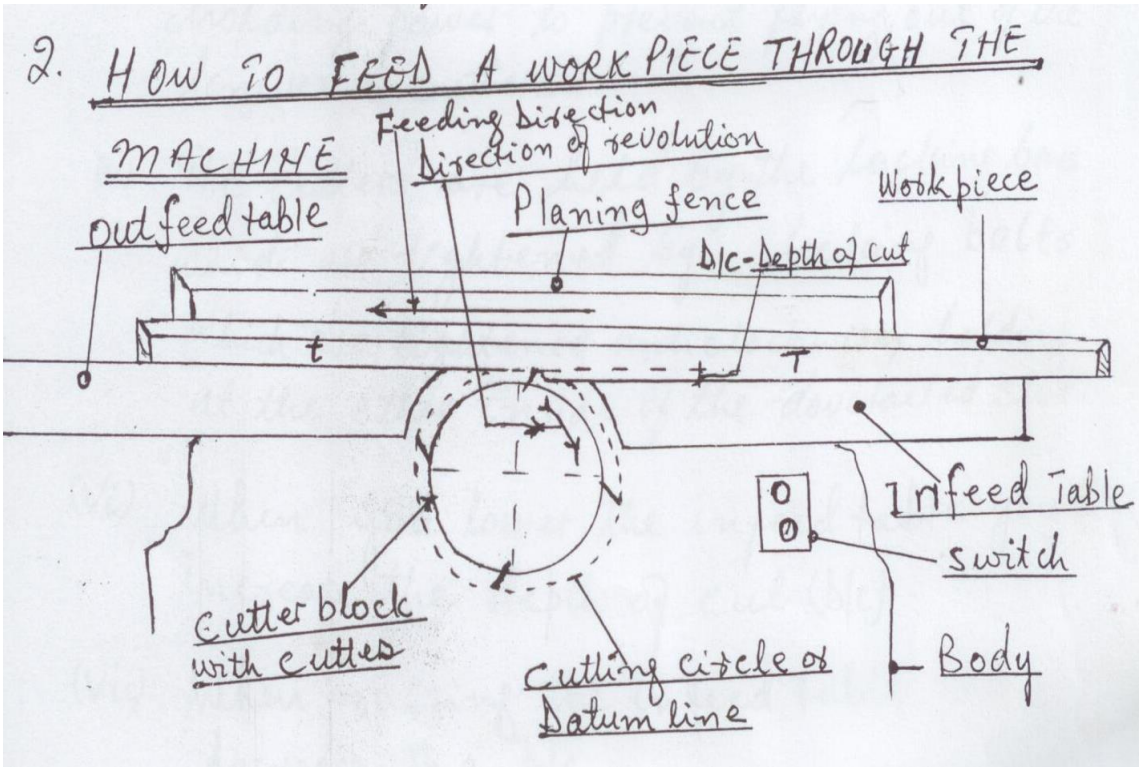
SURFACE OR JOINTER PLANER MACHINE

MAIN PARTS:

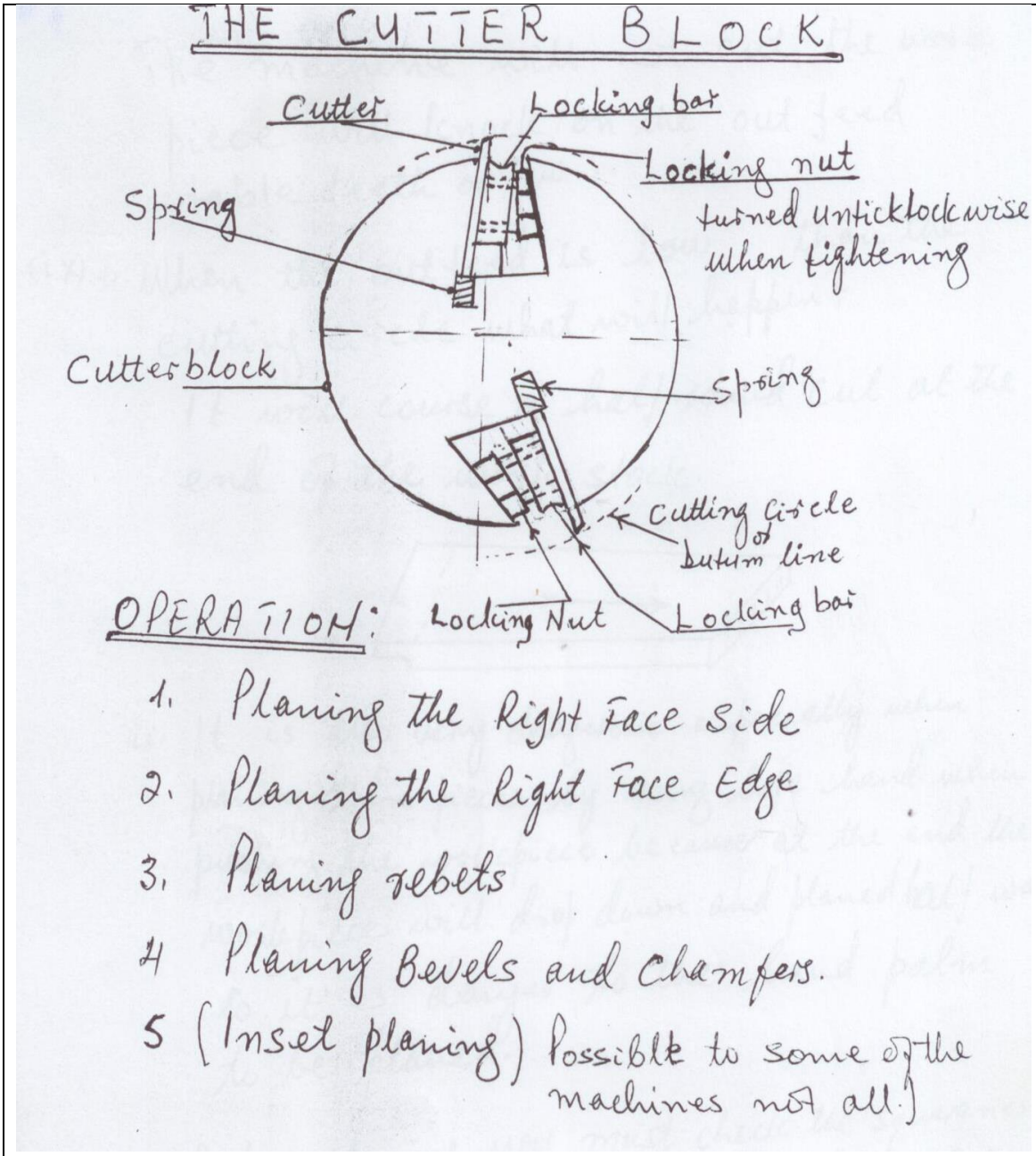
Body
In feed table
Cutter block with cutters
Out feed table
Switch
Motor

Raising and lowering handles
Planning fence

How to feed a work piece through the surface planer machine?



working with this machine the cutter block is under the work piece.
When planning you have to plane against the revolution of the cutter block that means in the direction of turning of the cutter block is where the operator is standing and feed against.
These machines can have two, three, and four cutters in a cutter block.
The slots where the cutters are fixed are made in a dovetail shape in order to have enough holding power to prevent flying out of the knives or cutters.
The cutters are held by the locking bars, which are tightened by locking bolts, which are tightened anticlockwise, holding at the other inside of the dovetail slot.
When you lower the in-feed table you increase the depth of cut (D/C).
When you raise the in-feed table you decrease the D/C.



OPERATIONS:

Planing right face side

Planing the right face edge

Planing rebets

Planing bevels and chamfers

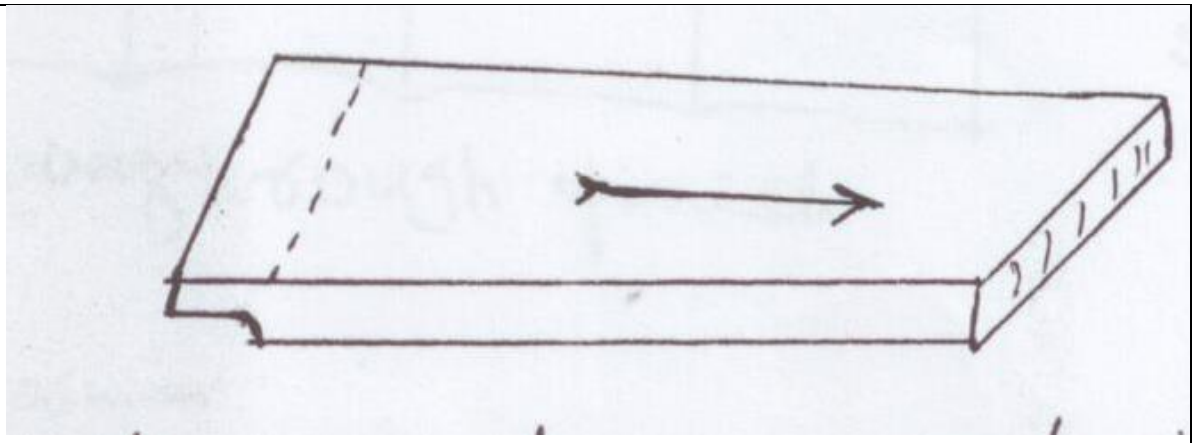
In set planing:(possible to some of the machines not all)

When the out feed table is higher than the cutting circle what will happen?

The machine will not cut; the work piece will knock on the out feed table teeth or jaw.

When the out feed table is low than the cutting circle what will happen?

It will cause a half round cut at the end of the work stock.



It is also very dangerous especially when planning thin pieces by using hand when pushing the work piece because at the end the work piece will drop down and planed half way. So, it is danger to the hand palm to be planed.
Before planning you must check the squareness of the planning fence. (check whether it is 90 degrees.
Inspect the timber which need to be planned because it must be free from nails, stucking stones, loose knots and severe shakes.
Use wire brush to clean dust and stucking stone on the surfaces and edges of timber to be planned.

THICKNESS PLANER MACHINE

Main parts:

Body
Thickening table
Antic kicks back bars or grippers.
In feed rollers (rough)
pressure bars
Cutter block with cutters
Out feed roller (fine)
Switch
Motor
Raising and lowering handle
Dust cover

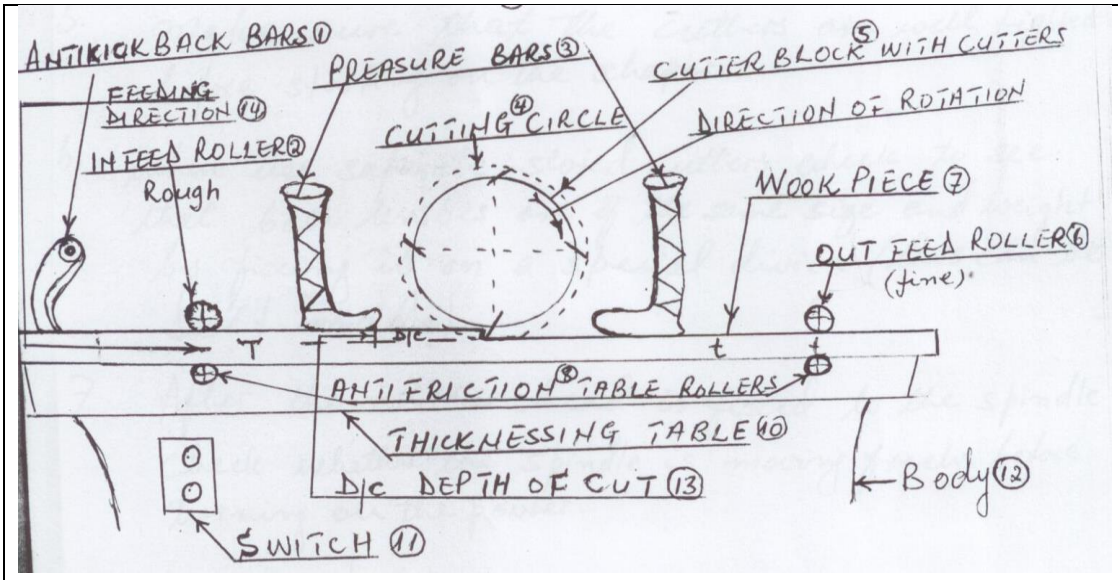
What is a thickness planer machine?

It is a wood working machine which is used to plane timber to thickness and width or planning the opposite right face side and opposite right face edge. It is the second machine which plane the same timber with right face side and right face edge planed on the surface planer machine.

MAIN OPERATIONS:

To plane the O R FS: Opposite Right Face Side
To plane the O R F E: Opposite Right Face Edge

How the work piece is fed through the thickness planing machine?



SPINDLE MOULDER OR SHAPER MACHINE

Safety rules for the shaper

Make all adjustments while the power is off

Check all the adjustments whether if there are well tightened.

Keep the safety guard and hold down the devices, which will be required for the operation.

Make sure that the cutters are well tightened before starting on the shaper.

Make sure that the cutters to be used are sharp.

When using separate slotted cutters check whether both knives are of the same size.

After the cutter head is fixed to the spindle check whether the spindle is moving freely before turning on the power.

Make sure that all tools used for setting out the machine E.g. Spanners, special tools removed from the machine table before switching on the power.

Set the cutter head on the spindle that unused part of the cutter head must be under the table for safety during operation.

NB: This is possible if the machine is equipped with a reversing switch.

When the shaper is having a reversing switch make sure that, the direction of the feed will oppose the direction of rotation.

Always feed into the cutting edge.

Maintain a well-balanced position when operating the machine.

Hold the board firmly against the fence and the table for straight work.

For working stop mouldings make sure special device must be used in order to avoid flying back of the work piece and cause accidents.

Thin boards from 250mm-300mm wide should be shaped on the ends unless proper safety devices are on use.

Shut off the power and don't leave the shaper until the motor has come to a complete stop.

What is a spindle moulder or shaper machine?

It is a machine, which is used for a straight machining and curved machining or mouldings works.

Main parts:

Body
Table
Motor
Vertical shaft
Slotted cutter head
Solid cutter head
Saw blades
Rings
switch
Moulding fence
Raising and lowering handle
Cross cutting fence

OPERATIONS

Straight planning
Round planning
Rebating
Tenoning
Chamfering
Bevelling
Various types of moulds
Open mortising
Tenon cutting

Tenon shoulder cutting
Tenon shoulder scribing
Grooving
Tonguing

POINTS:

The cutter spindle on which the tool is mounted is power driven
The spindle can be raised or lowered by using a raising and lowering **wheel**.
The spindle can be tilted from 1degree-45 degrees by using a tilting wheel depending on the operation.
The spindle can turn into two directions clockwise or anticlockwise depending on the operation.
The speed can be changed from approximately 2500-1200 rpm. (revolution per minute).
When the spindle speed is too slow, the cut will be rough.
When the speed is too high the friction of the knife or cutter will burn the wood.
The determination of the speed, number of cutters in cutter block, and cutter advance is important to achieve the OPTIMUM SURFACE QUALITY.

EXAMPLE:

A shaper is operated at N =6000rpm, with a two blades tool.
Speed*number of cutters (N*S) =12,000 rpm gouge quality surface can be achieved with a cutter advance of 0.5mm.
The feed is K=6m/minute
P=cutter advance in mm
K=Feed in rpm
S=Number of cutters

5. Tools WOOD LATHER MACHINE

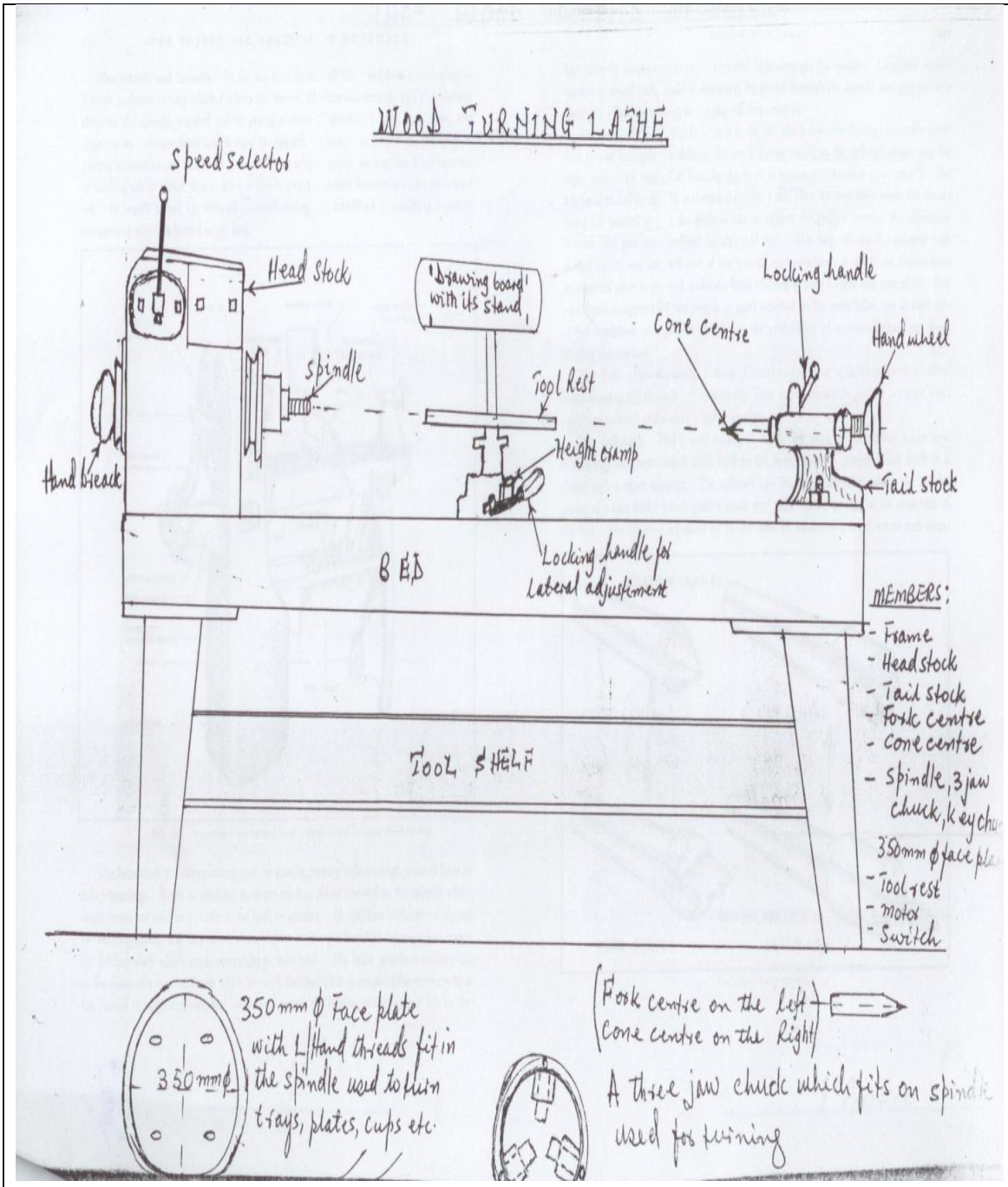
Gauges of various sizes

Chisels:

Edged chisel
Tapered chisel
Square edge chisel
Parting chisel
Clearance chisel

Main parts:

Body
Switch
Motor
Spindle
Tool rest with its devices
Tail stock
cone center fixed at the tail stock
Cup center
Three jaw chuck fixed at the spindle
Fork center
Screw center


WOOD TURNING LATHE
Speed selector
Head Stock
Drawing board with its stand
Locking handle
Cone centre
Hand wheel
spindle
Tool Rest
Hand wheel
Height clamp
Tail stock
BED
Locking handle for Lateral adjustment
TOOL SHELF
MEMBERS:
- Frame
- Head stock
- Tail stock
- Fork centre
- Cone centre
- spindle, 3 jaw chuck, k ey ch
350mm ϕ face pl
- Tool rest
- motor
- Switch
350mm ϕ
350mm ϕ Face plate with L.Hand threads fit in the spindle used to turn trays, plates, cups etc.
Fork centre on the left
Cone centre on the Right
A three jaw chuck which fits on spindle used for turning

BAND SAW MACHINE

DEFINITION:

It is one of the machines which use a blade consisting of a continuous band of metal with teeth along one edge to cut various work pieces. The band usually rides on two wheels rotating in the same plane, although some band saws may have three or four wheels. Band sawing produces uniform cutting action as a result of an evenly distributed tooth load. Band saws are used for woodworking, metalworking, or for cutting a variety of other materials, and are particularly useful for cutting irregular or curved shapes, but can also be used to produce straight cuts. The minimum radius of a curve that can be cut on a particular saw is determined by the width of the band and its Timber cutting

A band saw machine can be found from heavy duty, medium and small size depending on the production.

The machine is made from heavy duty or medium cast-iron frame which is the body of the machine.

The wheels are fastened to the shafts which are mounted on rollers or ball bearings on the frame.

The two wheels are stationed directly above the other, the upper one is covered by the casting called GOOSENECK.it can be moved up and down to allow fixing of the steel revolving saw blade or tensioning and loosing of the blade.

The lower wheel is not adjusted it is fixed direct to the shaft or spindle direct to the motor and both wheels are covered by steel covers for security.

The table is fixed to the frame and it can be tilted one way to45 degrees and other side 10 degrees.

From one edge of the table there is a slot where by the steel blade saw can be slotted in to the centre where there is a finishing plug made from either soft metal, plastic, or wooden which help to cover the hole

Most band saw machines have got ripping fence and others have designs having groove of dovetail housing on the table which helps to use as a cross cutting fence and meter cuttings.

In order to keeps the blade revolving straight and keep it preventing jump off from the wheels.

When sawing the two guards are used one above the table and the other under the table. The guard is called side rollers with a steel back wheel.

Around the wheels there is a strong rubber which glued in order to save the following:

The blade teeth from distortion

To reduce vibration

Main parts:

Body

Switch

Motor

Upper wheel with cover

Lower wheel with cover

Table

Band saw blade

Ripping fence

Cross cutting fence& mitre fence adjustable

Upper blade guard

Lower blade guard
Saw blade cover or guard fixed on top of the table

BAND SAW SAFETY PRECAUTIONS

Make all the adjustment while the power is off
Check the tensturerion of the blade following the manufacture's specifications.
Keep safety guards fastened firmly
Examine the blade frequently to make sure it is free from cracks or rhythmic clinks, or the joint is not well soldered or jointed.
Keep using sharp and set blades
Make sure to use a correct blade for the proper operation.
Check the rotation of the blade, the teeth should be free from the rubber otherwise you will smell rubber burning when switching on the machine.

OPERATIONS:

Ripping
Cross cutting
Round cutting
Shaping cutting
Open mortise cutting
Tenon cutting
Tenon shoulder cutting
Tenon shoulder scribing
Chamfering
Beveling
Log or Round cutting by using Templates or patens (self-made)

MITER SAW MACHINE

It is a machine used to make accurate **crosscuts** and **mitres** in a work piece.

A power miter saw, also known as a *chop saw* or *drop saw*, is a power tool used to make a quick, accurate **crosscut** in a work piece, at 45 degrees precisely is mostly used for softwoods. Common uses include **framing** operations. Most miter saws are relatively small and portable, with common blade sizes ranging from eight to twelve inches.

The miter saw makes cuts by pulling a spinning **circular saw blade** down onto a work piece in a short, controlled motion. The work piece is typically held against a *fence*, which provides a precise cutting angle between the blade and the longest work piece edge. In standard position, this angle is fixed at 90°.

A primary distinguishing feature of the miter saw is the *miter index* that allows the angle of the blade to be changed relative to the fence. While most miter saws enable precise one-degree incremental changes to the miter index, many also provide "stops" that allow the miter index to be quickly set to common angles (such as 15°, 22.5°, 30°, and 45°).

Briefly, it is used for two main operations:

Crosscutting

Miter cut

Cutting to various angles

Grooving

Tenoning

Tenon shoulder cutting

BENCH DRILL MACHINE

The work piece is held stationary i.e. Clamped in position and the drill rotates to make a hole.

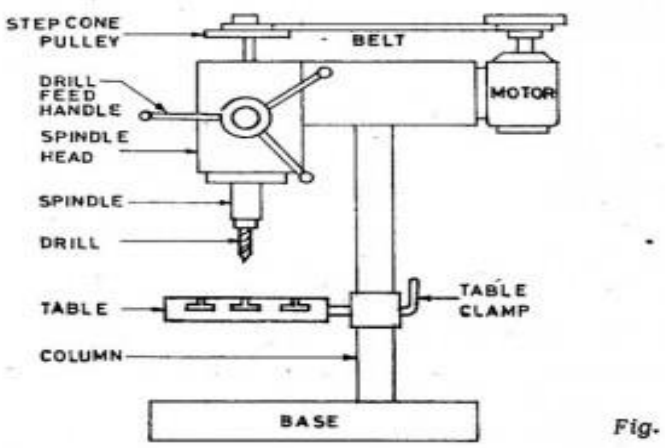


Fig.

Specification:

Drill holes from 1.5 to 15mm

Operator senses the cutting action so sensitive drilling machine

Operations

Counter sinking

Drilling

Tapping

Boring

Reaming

9. SLIDING TABLE

Main Operations
Cross cutting
Ripping
Beveling
Grooving
Chamfering
7.Tenoning
8.Tenon shoulder cutting
9.Tenon shoulder scribing
10.Rebeting
11.Mitering
12.Cutting to various angles

Theoretical learning Activity

Brainstorming/or group discussion on tools and equipment

Group discussion on setting of tools and equipment

Practical learning Activity

Practical exercises on serviceability of tools and equipment

Points to Remember (Take home message)

Proper selection of tools and equipment Class of tools and equipment

Learning outcome 1.1 formative assessment

Written assessment

Q. 1) the following are tools /equipment used for constructing staircase work except

1) scissor and shears
2) trowel and spade
3) PPE
4) claw hammer
5) step ladder
6)Sound meter
6) tap measure
7) screw driver
8) sprit level
9) pan /bucket
10) try squire

Answers: **1) scissor and shears**

6)Sound meter

Q.2) List four (4) materials used for constructing stair/

Answers: metal, timber, nails, boards, preservatives materials

Q.3) identify class of tools use in wooden stair construction

Answers:

Holding tools: Workbench, bench vice, bench hook

Setting out tools: Pencil, tape measure, try square,

Cutting and shaving tools: saws, planes, chisels

Boring tools: bits, braces etc

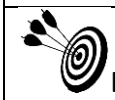
Fixing tools: Hammers, mallets, nail punches etc

Practical assessment

Checklist	Score	
	yes	no
Classification of varieties tools		
Setting out tools		
Cutting and shaving tools		
Boring tools		
Fixing or impelling tools		
Classification of varieties Equipment		
Portable machine		
Heavy duty machine		
Methods of maintaining tools & equipment		
Cleaning		
Topping		
Setting		
Re-sharpening		
Oiling		
Personal safety rules while handling tools and equipment		
Observation		

Learning outcome 1.2 Select and calculate materials

Duration: 5hrs



Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. know properly stair construction materials.

2. know properly Quality requirements of timber stair

3. calculate correctly of required quantity of materials for a stair case members

4.know properly all Stair components

5. describe correctly Stair construction sequences

Resources

Equipment	Tools	Materials
		Timber Nails Vices Varnish Brush Glue Paints Sand paper preservative materials

Advance preparation:

. selection of materials

. preparation of materials

. measuring and calculation

Indicative content 1.2: Select and calculate materials

Stair construction materials

Preservative materials
Hard wood
Panels
Varnishes

Metal: Use of hard metal in order to get strong roof

Wood: use of hard wood in order to get strong roof

Nails: use of appropriate nails in order to get strong roof. E.g no 10/12/15

Bolt and nut: use of appropriate bolt and nut to get strong roof

Screws: use of appropriate screws and depends to the sizes to get strong roof.

Quality requirements of timber
stairs, Terms and definitions
Stability
Strength
Durability
Appearance
Adequate measurement
the points should be considered in locating stairs in a building
They should be located near the main entrance to the building.
There should be easy access from all the rooms without disturbing the privacy of the rooms.
There should be spacious approach.
Good light and ventilation should be available

Stair components:

Balustrade: is a set baluster, newel post and handrail
Nosing: the exposed edge of a tread

Riser: the vertical portion of a step which provides a support to the tread**.**
Rise: height or distance between two consecutive tread

Hand rail: an inclined member of timber or steel fixed at the top of balusters, for facilitating the user to put his hand while he is using the stair.
The purpose of hand rail is to provide the protection to the user against falling down from the stair
Line of nosing: the imaginary line parallel to the string and tangential to the nosing. It is parallel to the hand rail.
Baluster: a vertical member of wood or metal supporting the hand rail.
Step: a portion of stair which permits the ascent and descent. A step is comprised of tread and riser. A stair is composed of a set of steps**.**
Head room: minimum clear vertical distance between two treads and the overhead structure.
It is the vertical distance between the step and another structure immediately above the concerned step.

Newel: post forming the junction of flight of stairs with landing
Pitch or slope: the angle which the line of nosing of the stair makes with the horizontal plane.
It is the angle which the string makes with the horizontal plane.
Pitch is the angle of inclination that the string makes with the horizontal plane.
Tread*: This is the wide horizontal member* between strings to form the top of the step.

Tread: the upper horizontal portion of a step, upon which the foot is placed while ascending or descending
Going: is the horizontal distance between two consecutive risers.
is horizontal distance on the tread between two successive riser faces.

Run: the total length of a stair in the horizontal plane, including all landings.
String or stringers: sloping members which support the steps of the stair.
Outer string: is a string parallel to the wall
Wall string: is a string fixed in the wall
Tread: is the upper surface of a steps on which the foot is placed.
Landing: a leveled platform at the top or bottom of a flight between the floors.
The main purpose of Landing is:
To facilitate to change the direction
To provide an opportunity for taking rest during the use of the stair(**breaking)**
To provide the entrance
Header: horizontal structural member supporting the stair stringer or landing.
Newel Riser
Bracket
Carriage
Spindle frame/panelling
Three main stair types:
Curved stair
Straight stair
Turning stair:
Turning stair they include:
quarter-turn stairs,
half-turn stairs,
three-quarter turn stairs,
newel stairs and
geometrical stairs

DEFINITIONS - Stair Types
Bracketed stair: Also referred to as 'Cut and bracketed', it is a stair with strings having the shape of treads and risers cut out on the top edge and fitted with an ornamental bracket, or fret work, underneath.
Circular stair: A stair with or without a central well having steps, which radiate from a common center.
Closed stair: A stair, which has side walls or partitions on both sides and is usually closed by a door at one end. It may also be referred to as a 'Boxed stair', or an 'Enclosed stair'.
Closed string stair: A stair in which the treads are not visible in a side view of the stair flight**.**
Dogleg stair: Also referred to as a *'Half-turn stair'*, it is a stair with two flights between storeys, which are connected by a rectangular half landing for a 180° turn. The outer strings of each flight are housed into a common newel post, which does not allow for any stairwell.

Geometric stair: A continuous sweeping or flying stair, with no newel posts or landings, having a continuous curved string and handrail. It may be designed to fit a semi-circular or elliptical stairwell.
Helical stair: A stair with a circular plan where all the treads are winders. This stair is also known as a *'Spiral stair'* or *'Winding stair'*.
Open newel stair: An open stairwell with two landings between floors, short flights between landings, and newel posts at the corners.
Open riser stair: A stair consisting of strings and treads with no riser boards between treads, thus leaving the risers open.
Open stair: A stair, which is not enclosed by walls or separated from the space where it is placed.
Open string stair: A stair with a cut string to the shape of the risers and treads, on one or both sides, facing the stairwell.
Quarter turn stair: A stair with two flights at right angles to each other with a quarter space landing between them.
Return flight stair: A dogleg stair where the outer strings of each flight are vertically above each other.
Spine string stair: An open riser steel stair with a single central spine (spine string) and welded tread supports.
Winding stair: A circular or curved stair, which changes direction by means of winders, with or without landings
COMMON STAIR TYPES
Stairs may be designed in a variety of forms to provide practicality, function, decoration and/or aesthetic appeal. Some of the types available are as follows:

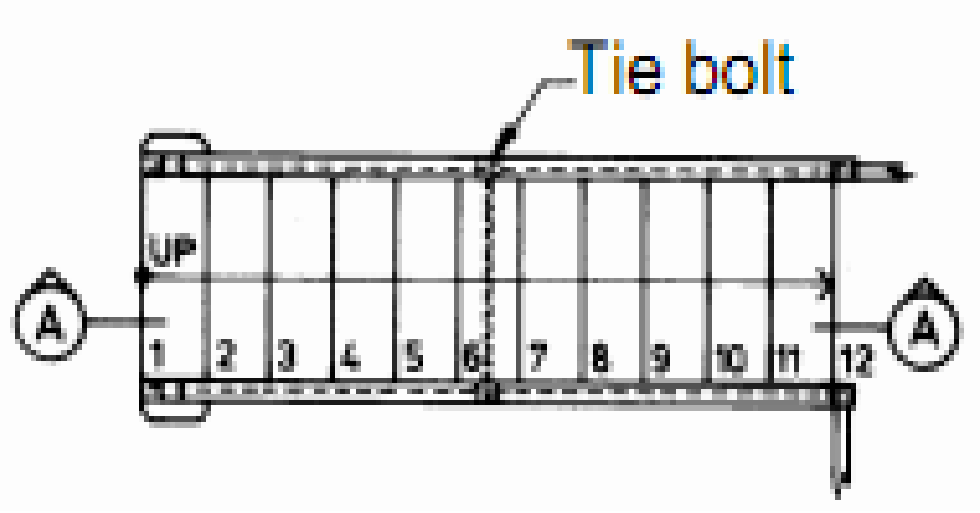


Fig. 2 Straight open-riser

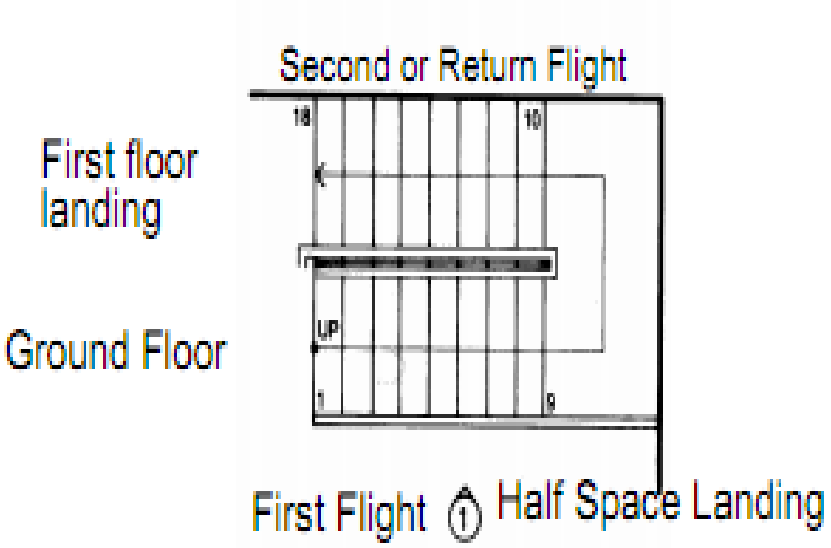


Fig. 3 Dogleg

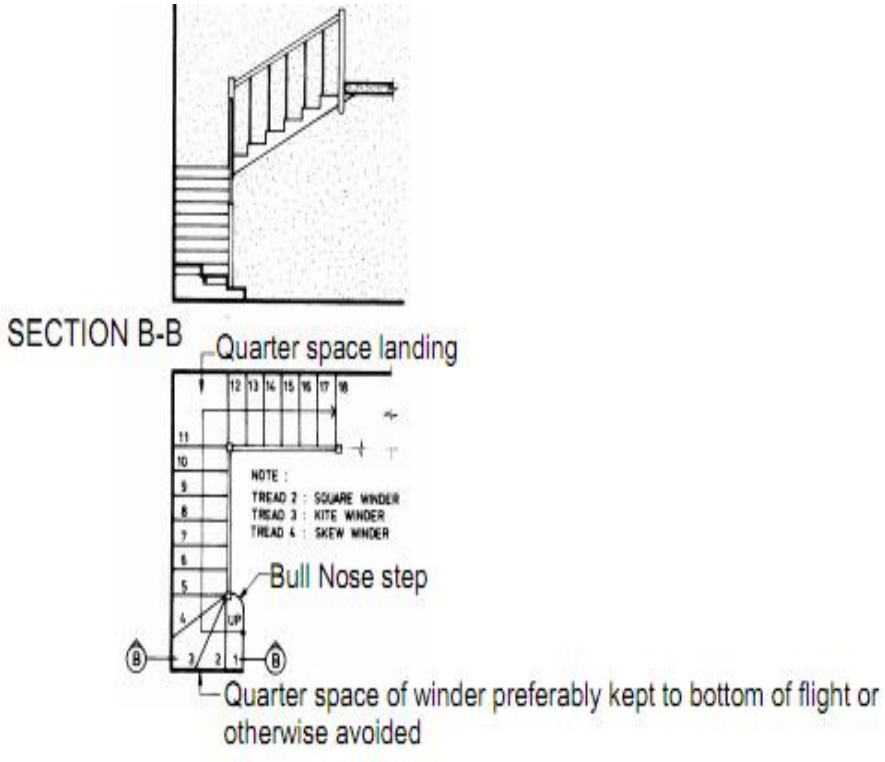
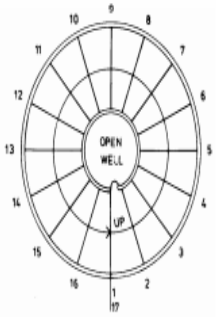
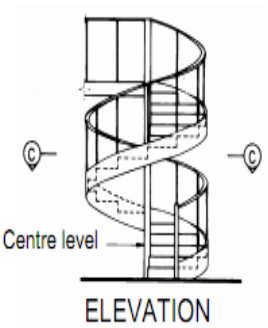


Fig. 4 Quarter turn



All treads are winders in circular and spiral stairs

Fig. 5 Geometrical circular



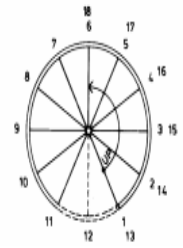


Fig. 6 Spiral or Helical

TIMBER STAIRS

Timber stairs are probably the most common form of stair found in a residential building. They comprise of strings, treads, risers, landings and handrails and are normally closed riser construction, for internal use, and open riser construction for external use.
Where the treads and risers are to be covered with carpet the base material may be of structural particleboard or MDF (Medium Density Fibreboard).

Due to the position of their support, four basic types of timber stairs may be produced:
Closed string stairs
Cut strings or carriages
Mono-carriage or spine beam stairs
Hanging stairs

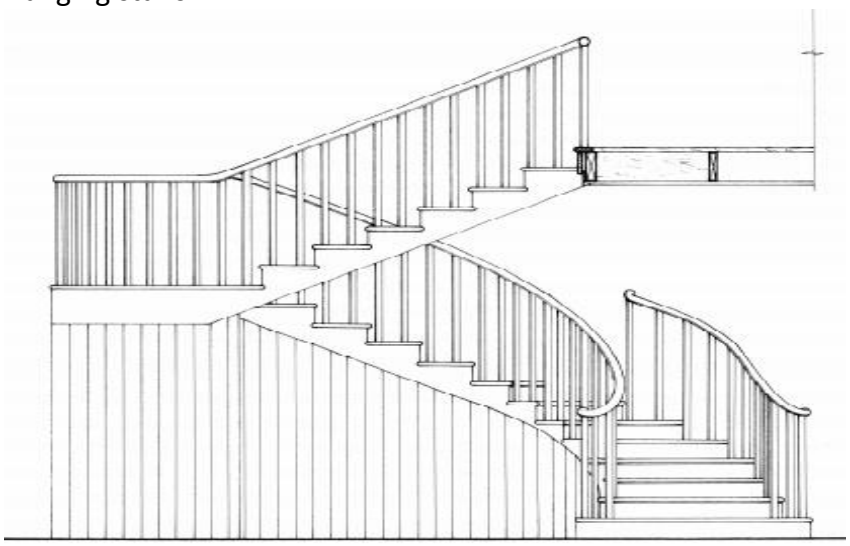
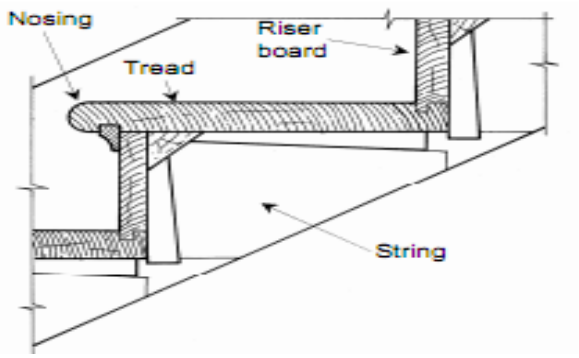


Fig. 13 Timber stairs for residential construction

PARTS OF TIMBER STAIRS

String: *There may be one or two strings to* a flight, which are the inclined sides of the stairs designed to carry the load transferred from the treads and risers.

Tread: This is the wide horizontal member between strings to form the top of the step.

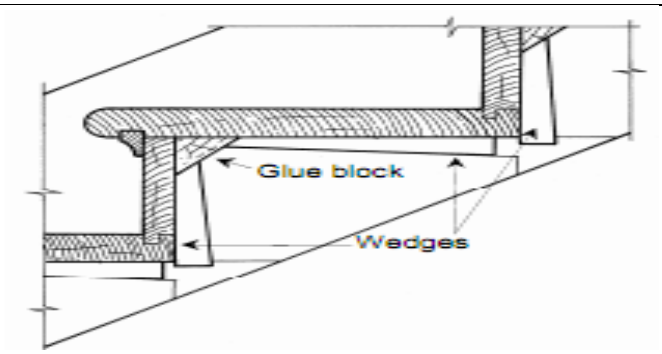


Nosing: *This is the rounded front edge of* the tread, which projects past the face of the riser board. Its purpose is to finish the tread edge and widen the tread to prevent the riser from being kicked or scraped**.**

Glue blocks: *Triangular blocks of timber* fitted under the back of the tread/riser connection to hold the two together.

Wedge: T*hese are tapered lengths of timber* driven into prepared tapered housings in the string, placed behind the riser and under the tread to ensure a tight top side gap-free fit**.**

Newel post: *This is an upright post, to* which the strings and handrail are attached.



Handrail: *A rail fixed between newel posts* parallel to the top edge of the string, to provide a safety rail for stair users.
Balusters: *These are the small sectioned* vertical members, with a **landing balustrades.**Max. 125mm opening size placed between the handrail and string.
Balustrade: *This is the whole framing,* which comprises of a handrail, balusters, newel posts and string or kick plate for
Spandrel: *This is the triangular shaped* space formed between the underside of the string and the floor.

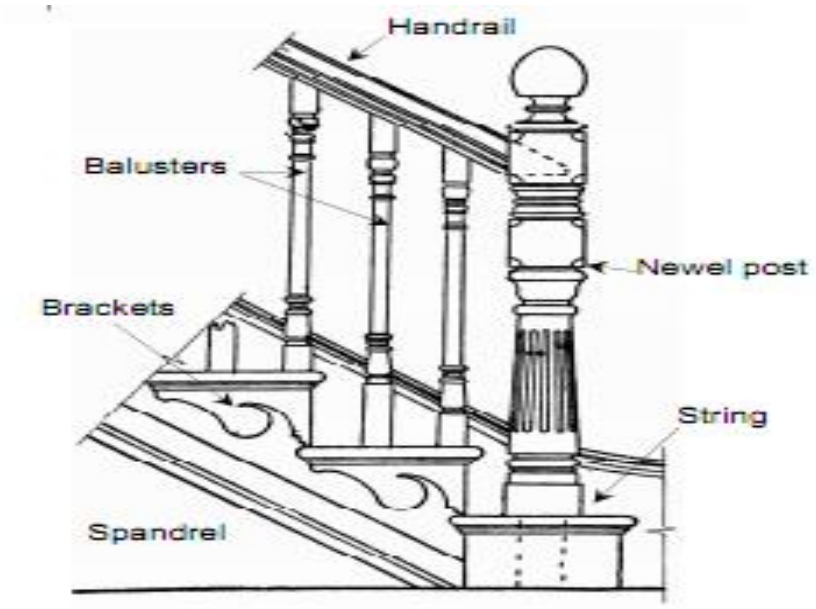


Fig. 14 Parts of the stairs

Winders: are tapering steps such as those which radiate from a point usually situated at the Centre of a newel; because of its shape the center part three winders is called a kite winder.
LANDINGS
A flight of stairs is limited to 18 risers, before it must have a break. This break may be in the form of another floor level or a *landing. A landing may take the following forms:*
Half–space landing: This is a landing formed between flights at 180° to one another, often referred to as a *'Dogleg' stair.*

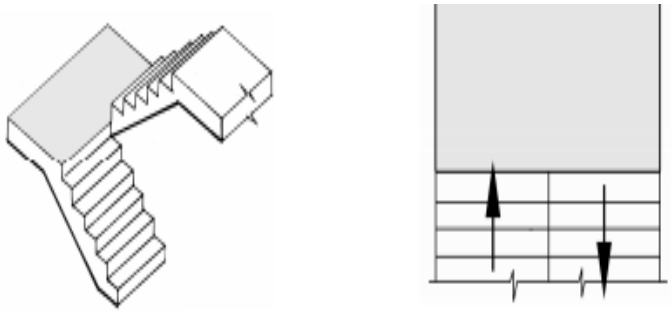


Fig. 15 Half-space landing

Quarter–space landing: *This is a landing formed* between flights at 90° to one another, often referred to as a *'Quarter-turn' stair.*
The length of the landing is equal to the width of the flight and the width of the landing is also equal to the width of the flight.

Intermediate landing: This is a landing formed between flights running in the same direction.
The length of the landing is equal to at least the width of the flight and the width is equal to the width of the flights.

i.

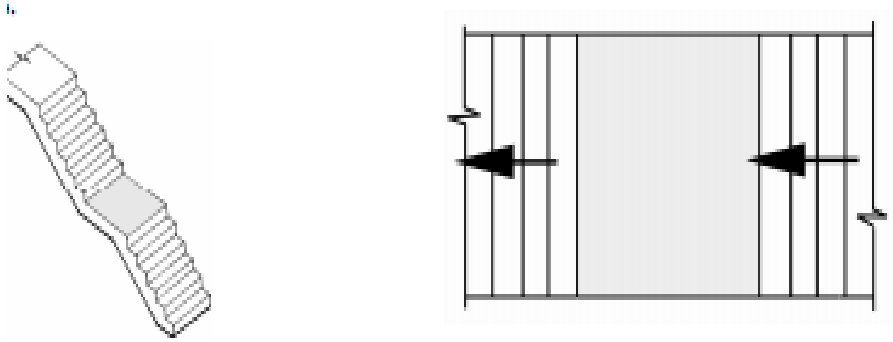


Fig. 17 Intermediate landing

4.5.2: Turning stairs

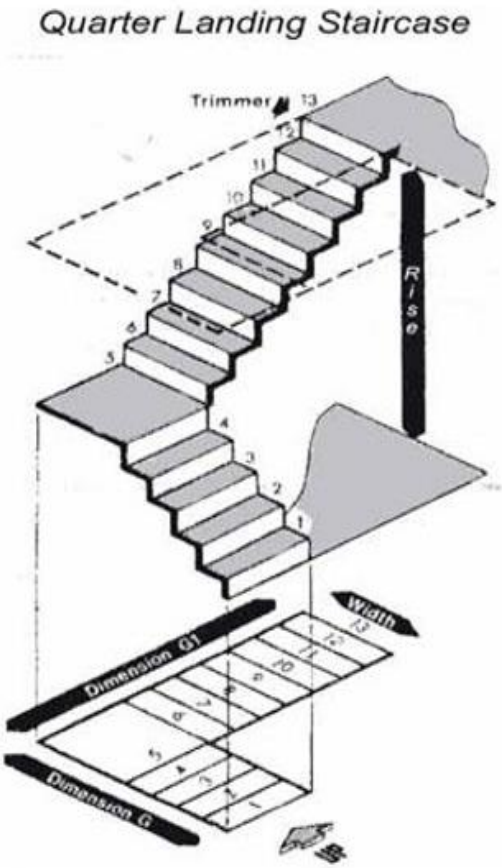
They are stairs which do not follow a straight line and whose direction changes either to the or to the right hand side. Its flight(s) changes the direction as well.

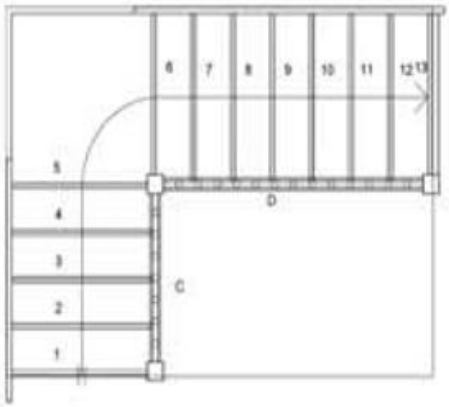
Turning stairs are divided into four different more types:

1. **Quarter turn stair**
2. **Half turn stair**
3. **Three quarter turn stair**
4. **Bifurcated stair**
5. **Continuous stair**

4.5.2.1: Quarter turn stairs

A quarter turn stair is the one whose direction turns to the left or right hand side at right angle. The turn that is made is 90^0.

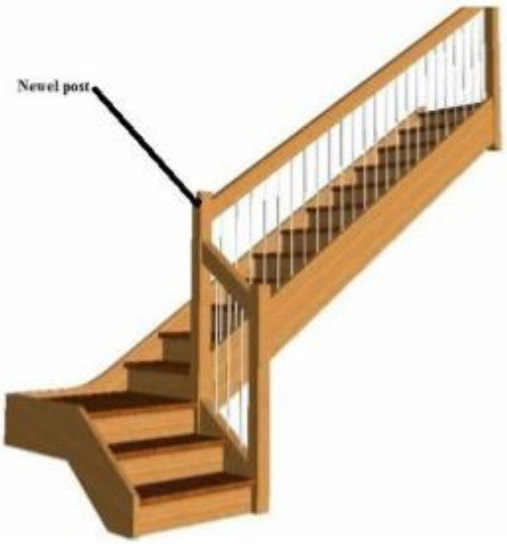




The turn is affected by introduction of a quarter space landing. The quarter turn stairs are of the following types:

1. Newel quarter turn stair
2. Geometrical quarter turn stair

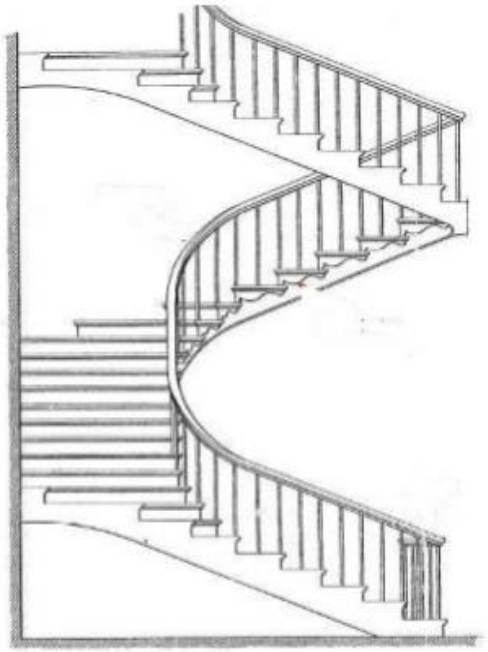
1. Newel Quarter Turn Stair



It is the quarter turn stair which has a newel p
the beginning and at the landing.

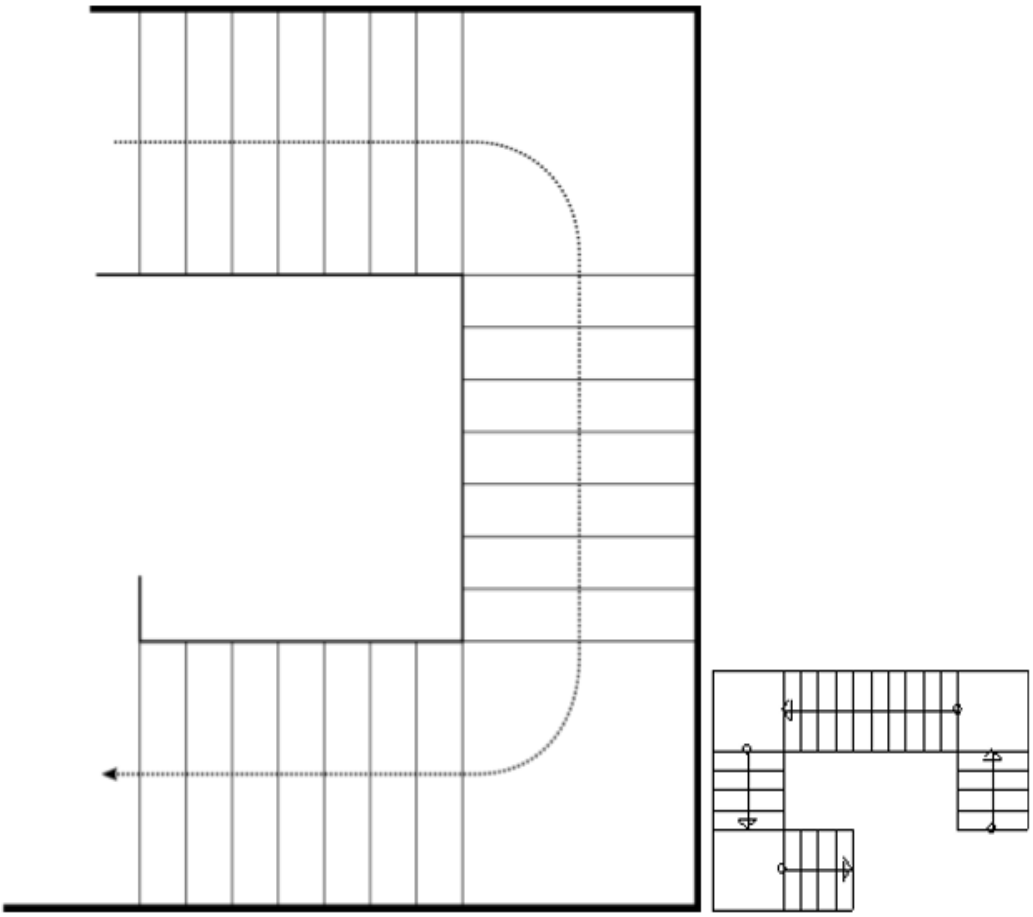
2. Geometrical Quarter Turn Stair

This is the quarter turn stair which does not have the newel post at the beginning, or at th
landing. The stringer is continuous.



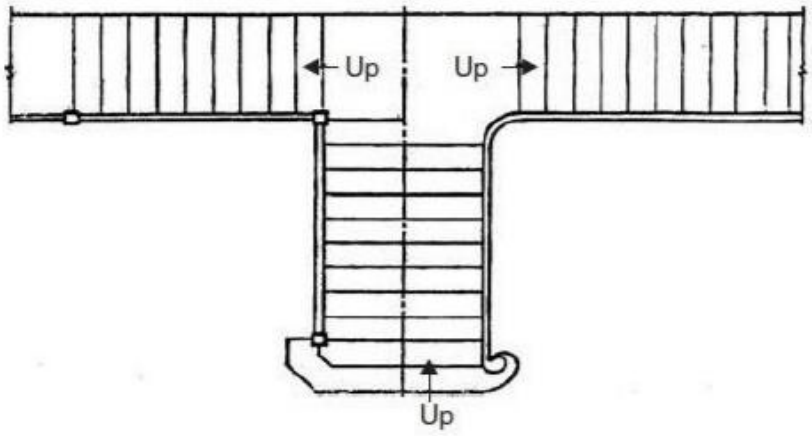
4.5.2.3: Three quarter turn stairs

A three quarter turn stair is the one which has its direction changed three times without its upper flight crossing the bottom one. It is used when the length of the staircase is limited and the vertical distance between the two floors is high.



4.5.2.4: Bifurcated stairs

This is the stair having a wide flight at the bottom divided into two small flights on the landing: **one turning to the left hand side and another one turning to the right hand side.** This type of stair is used in public buildings and at the entrance hall.

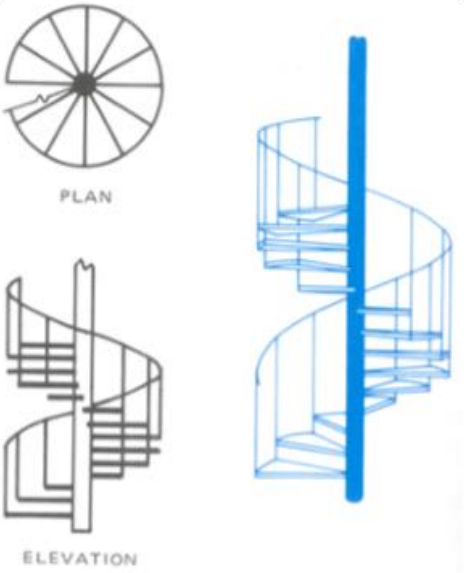


4.5.2.5: Continuous stairs

They are stairs do not have **newel posts and landing.** They are divided into three types

a. Circular stair
b. Spiral stair
c. Helical stair

They are used where there is a limited space. Nevertheless; they are difficult to construct especially when they have to be in reinforced concrete.

♦ **Circular stairs have the form of a regular uniform circle.**	♦ **Spiral stairs have the outer part larger than the inner part in the closed circle.**
	

♦ **Helical stairs are turning but not exactly closed like a spiral stair.**

Calculation of required quantity of Materials for a stair case member:

design of stairs Steps:
Risers
Run
Going
String
DETERMINING STEP PROPORTIONS
The accepted formula for calculating riser and tread dimensions for stairs, often referred to as *'Easy going stairs', is twice the rise plus one going, or*
(2R +G). *The result of* this calculation must fall between 550mm and 700mm, known as the *Slope Relationship.*

ACCEPTABLE PROPORTIONS FOR STAIRS

RISER (R) (mm)		GOING (G) (mm)		SLOPE RELATIONSHIP (2R+G) (mm)	
Min.	Max.	Min.	Max.	Min.	Max.
115	190	240	355	550	700

Common riser for different types of stairs

stair	Riser
Garden and open air stair	12to 16 cm
Stair in public building	16 to 18 cm
Stair in flats and dueling (residential)	17 to 19 cm
Stair of minor importance	Up to 21 cm

Calculating Rise and Going for a Flight

METHOD 1

The following steps outline the method adopted to calculate the rise and going for a given flight of stairs with an *'unrestricted' going:*

STEP 1 Obtain the rise of the flight;

STEP 2 Assume a suitable rise, when the average rise is (190 + 115) ÷ 2 = 153mm;

STEP 3 Establish the number of risers by dividing the assumed rise into the rise of the flight;

STEP 4 Establish the length of the going by using the average slope relationship measurement, i.e. (550 +700) ÷ 2 = 625mm, substitute the average rise measurement for 'R' in the formula, then transpose the formula to find 'G'.

Example 1:

Using *'Method 1', calculate the number and size of the rises and goings for a flight of stairs* with a rise of flight of 2.650m and an unrestricted going of flight.

STEP 1 Rise of flight = 2650mm

STEP 2 Assume a rise, say average = (190 + 115) ÷ 2 = 153mm

STEP 3 Number of risers = 2650 ÷ 153 = 17. 320 risers

There must be full equal-sized risers, therefore round off to 17 risers.

The height of each riser = 2650 ÷ 17 = 155.882, say 156mm

STEP 4 The number of goings will be one (1) less than the risers, therefore 16 goings.

The size of the goings will be based on the average slope relationship measurement = (550+ 700) ÷ 2 = 625mm.

Now substitute the known measurements for the formula symbols: = (2R+G) = 625 = (312 + G) = 625

Now transpose the formula to find the value of 'G':

'G' = 625 – 312 = 313mm
Therefore, there will be 17 risers at 156mm and 16 goings at 313mm.
Note: The total length of the flight going will be 16 x 313 = 5.008m

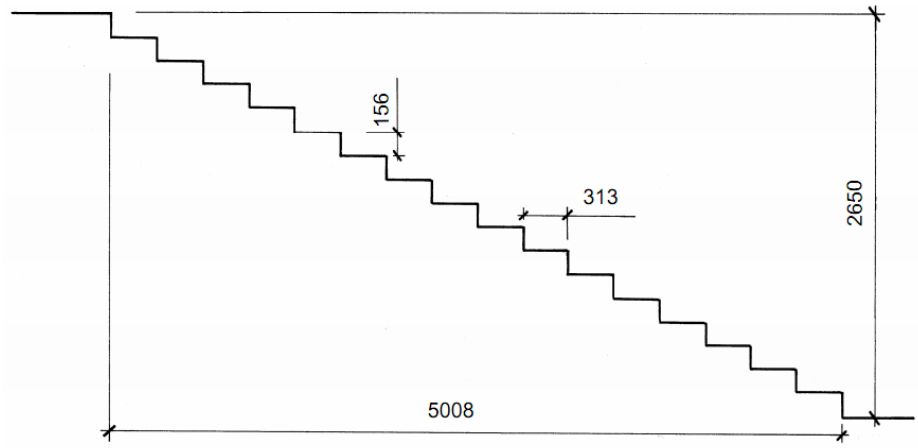


Fig. 22 Layout of stairs for an unrestricted flight

METHOD 2
The following steps outline the method adopted to calculate the rise and going for a given flight of stairs with a *'restricted' going:*
STEP 1 Obtain the rise of the flight;
STEP 2 Assume a suitable rise, when the average **rise is (190 + 115) ÷ 2 = 153mm**;

STEP 3 Establish the number of risers by dividing the assumed rise into the rise of the flight;
STEP 4 Establish the length of the going by dividing the assumed rise into the restricted flight going. Check to see if both the rise and going measurements comply, by substituting them for **'R' and 'G'**, and apply the formula **(2R + G).**

Example 2:
Using *'Method 2', calculate the number and size of the rises and goings for a flight of stairs*
with a rise of flight of 1.900m and a restricted going of flight of 3.350m.
STEP 1 Rise of flight = 1900mm
STEP 2 Assume a rise, say average **= (190 + 115) ÷ 2 = 153mm**
STEP 3 Number of risers = **1900 ÷ 153 = 12.418 risers**
There must be full equal-sized risers, therefore round off to 12 risers.
The height of each riser = 1900 ÷ 12 = 158.333, say 158mm

STEP 4 The number of goings will be one (1) less than the risers, **therefore 11 goings**.
The size of the goings will be based on the length of the flight going divided by the number of goings:
= 3350 ÷ 11 = 304.5, say 305mm
Therefore, there will be 12 risers at 158mm and 11 goings at 305mm.
Check formula for compliance with BCA (2R + G) = (between 550 and 700mm) = 316 + 305 = 621mm, therefore it complies.

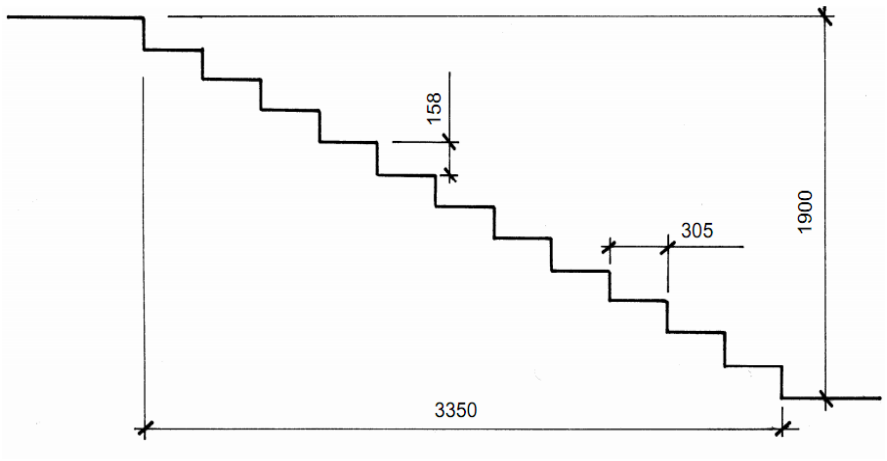


Fig. 14.23 Layout of stairs for a restricted flight

We need to establish a stair between two floors separated by 2.7m of a public building. The stringer is inclined by 30^0 from the horizontal plane. Using the relation 2R+G=60cm
calculate the number of rises(steps)
calculate the size of rise
calculate the size of going
calculate number of going
calculate total run

Given data:

Pitch (α) $=30^0$

Height between the floors (H) =2.7m

2R+G=60cm

Required:

- Number of steps=?
- Rise=?
- Run=?
- Going=?

Tan. $\alpha = \frac{R}{G}$ this is to mean R=G×Tan. α

2R+G=60

$2R+\frac{R}{Tan\,\alpha} = 60$

$\frac{2R\,Tan\alpha+R}{Tan\,\alpha}=60$ $2R\times Tan\,\alpha+R=60Tan\,\alpha$

$R(2Tan\,\alpha+1)=60\,Tan\,\alpha$ $R=\frac{60Tan\,\alpha}{2Tan\,\alpha+1}$

$$\mathbf{R=\frac{60Tan\,\alpha}{2Tan\,\alpha+1}}$$

$R=\frac{60\times Tan\,300}{(2\times Tan\,300)+1}=\frac{60\times 0.577}{(2\times 0.577)}=\frac{34.62}{1.154+1}$ $R=\frac{34.62}{2.154}$ $R=16.07cm$

- Number of steps$=\frac{H}{R}=\frac{270}{16.07}=16.8\ steps\cong 17\ steps$
- Final rise (R) $=\frac{H}{NUMBER\ OF\ STEPS}=\frac{270}{17}=15.88cm$

$2R+G=60$

$(2\times 15.88)+G=60$

$G=60-31.76$

$G=28.24cm$

- Number of treads= number of rises-1
  $=17-1=16steps$
- Number of rise= number of steps (because each step has the tread)
- Run=going×number of treads
  $=28.24\times 16=451.84cm$

Stair construction sequences:
Setting out
Preparation of stair members
Assembly of stair members
Bottom step
Balustrade

Theoretical learning Activity

Brainstorming on Stair building materials

Discussion on Stair building materials

Group work on factors considered while estimating quantity of materials

Practical learning Activity

Practical exercices on calculation of required quantity of materials

Points to Remember (Take home message)

Stair construction materials Class of tools and equipment Calculation of required quantity of materials for a stair case member Stair components Three main stair types Stair construction sequences

Learning out come 1. 2 formative assissent

Written assessment

Q. 1) A total rise of 3.215 m, using the regulation formula, would be divided by 220, which is the maximum rise allowed on a step.

Answers: Rise $= \frac{3215mm}{220mm} =$ 14.61364 Rises

Because you cannot find a half rise, rise will be 15 rises

Q2. Define the flowing part of stair:

a) string

b) tread

c) going

d) landing

answer:

a) **string**: sloping members which support the steps of the stair. It is an inclined member on which steps are formed. The string makes the slope with the horizontal plane.

b) **tread**: the upper horizontal portion of a step, upon which the foot is placed while ascending or descending:

c) **going**: horizontal distance on the tread between two successive riser faces

d) **landing**: a leveled platform at the top or bottom of a flight between the floors:

Reference: learning unit 1

Q3. List dawn the factors to consider when selecting the types of stair to be installed in a specific building.

answer:

The location of the building

The type of the building

The use of the building

Q4. In order to construct a stair for joining two floors; the admitted slope being 35^0 and the height between the two floors is 2.8m. Calculate:

a) Rise

b) Going

c) Number of steps

d) Run Tan. A

answer:

Given data:

Slope (α) =35^0

Height between the two floors (H) =2.8m =280cm

Adopt **2R+G=60cm** (as this relationship is not given in the problem, we take any given value from those allowed by the standards. This is why we can take either 2R+G=60cm, 61cm, 62cm,63cm, 64cm,or 65cm. for this problem we take 2R+G=60cm.)

a. $R=\frac{60\,Tan\,35}{(2Tan\,35)+1}=\frac{60\times0.700}{(2\times0.700)+1}=\frac{42}{2.4}$ **R=17.5cm**

b. 2R+G=60cm

(2×17.5)+G=60cm

G=60-(2×17.5) Thus G=60-35 **Then G=25cm**

c. Number of rise=$\frac{height\ betwee\ 2\ floors}{rise}=\frac{280}{17.5}=16Rises$

d. Number of goings=number of rises-1

= 16-1= 15 goings

e. Run=number of treads× $going$

=15× 25 =375cm

Practical assessment

Checklist	Score	
	yes	no
Quality required for stair materials		
Stability		
Strength		
Durability		
Appearance		
Adequate measurement		
Stair components to be Calculated		
Steps		
Risers		
Run		
Going		
String		
Observation		

Learning outcome 1.3 Prepare materials

Duration: 5hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. should know properly preparation techniques of wooden material

2. should know properly mixing techniques of adhesive and painting material

Resources

Equipment	Tools	Materials
Wood working machines ppe	- Cutting tools - Marking tools - Measuring tools - Holding tools - Shaving tools	- Wood - Nails - Glues - Bolt and nut - Preservative materials - Brushes - Filler - Paints

Advance preparation:

. measuring

. planning

. marking

. cutting to dimension

. boring

Indicative content 1.3: Prepare materials

Preparation techniques of wooden materials:
Measuring: denoting an instrument or device used to ascertain the size, amount, or degree of something.

Planing : is a manufacturing process of material removal in which the workpiece reciprocates against a stationary cutting tool producing a plane or sculpted surface.
Cutting to the Dimensions: is a action of to cut timber to size.
Boring
Preservation
Molding
Mixing techniques of adhesive and painting materials :
Mechanical: mixing by using machine
Manual: mixing by hand

Theoretical learning Activity

Groupe discussion

Brainstorming

Practical learning Activity

Practical exercises on timber preparation

mixing adhesive and painting materials

Points to Remember (Take home message)

Preparation techniques of wooden materials
Mixing techniques of adhesive and painting materials

Learning out come 1.3 formative assissent

Written assessment

Q. 1) list down Preparation techniques of wooden materials

Answer:

Measuring

Planing

Cutting to the Dimensions

Boring

Preservation

Molding

Q. 2) Give and explain the method or techniques of mixing of adhesive and painting materials

Answer:

Mechanical: mixing by using machine

Manual: mixing by hand

Practical assessment

Checklist	Score	
	yes	no
Preparation techniques of wooden materials:		
Dimensions		
Squareness		
Shape		
Smoothness		
Diluted wooden glue		
Diluted paints		
Mixing methods of adhesive ingredients		
Manual		
Mechanical		
Observation		

Learning outcome 1.4 Set out string

Duration:5hrs

Learning out come 1 objectives :

By the end of the learning outcome, the trainees will be able to:

1.make Properly setting out of string according to stair design.

2.use correctly any setting out method.

3.use properly setting out instrument and equipment.

Resources

Equipment	Tools	Materials
- Boring machine - Cutting machine	- Building Square - Hammer - Split level - Plumb bob	- Building Square - Nails - Pegs

Advance preparation:

. prepare workplace

. prepare tools, materials and equipment

Indicative content 1.4: Set out string

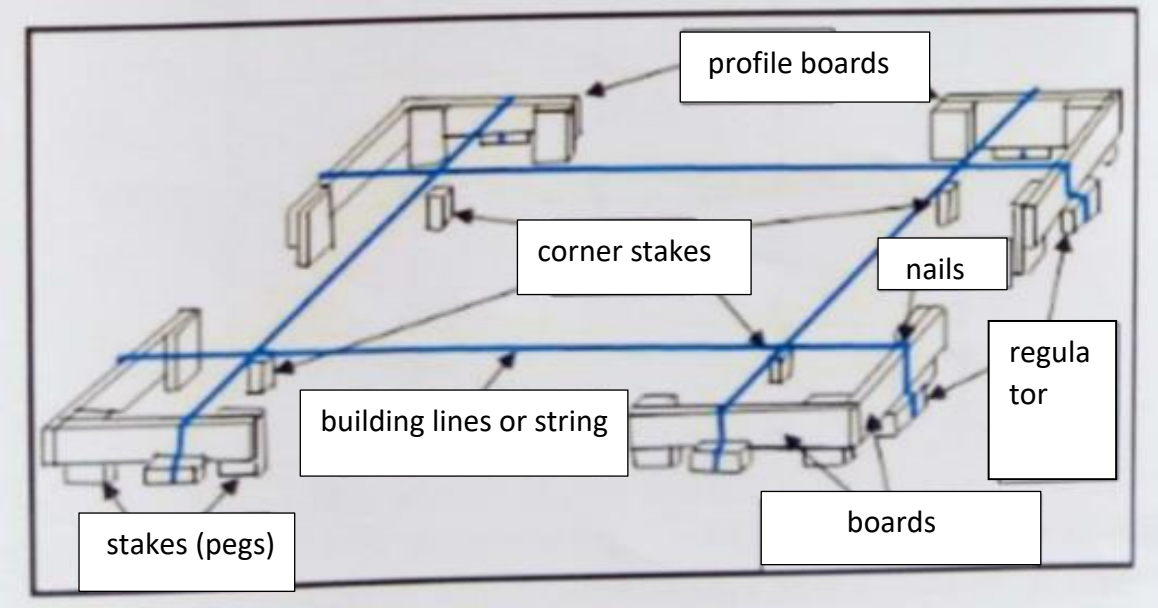
Setting out: is the process of transferring architectural proposals from drawings into the ground. It establishes the location points for site boundaries, foundations, columns, Centre-lines of walls and other necessary structural parts.

setting out methods:

Square method
3,4,5 method
Instrument method
Diagonal method

Setting out process

Margin line
Leveling of string, rise and tread



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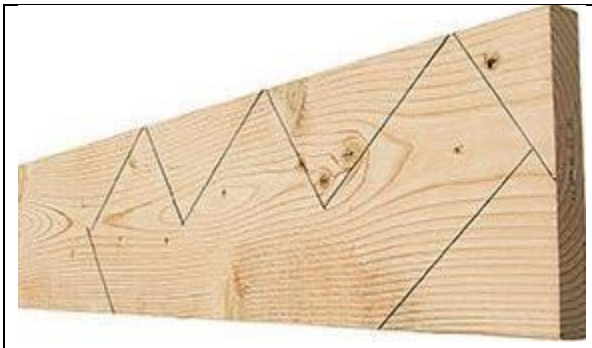
Levelling of string, rise and tread

The essence of laying out stair stringers is straightforward. You use a framing square to draw the stair's notches on the stringer, then you cut them out. If you've done the math and the layout right, the tread cuts will be level and the riser cuts plumb.

Step-by-step



Clamp a guide to the square.
To make it easy to align the framing square on the stringer consistently, clamp a straight wood strip to the square. On the outer edges of the square, align the strip with the run dimension on one leg and the rise dimension on the other.
Find the crown.
Sight down the edge of the stringer stock to determine if it crowns. If it does, lay out the stringer so that the crown on the completed stair will face upward.
Lay out the first tread and the second riser.
Hold the square so that the leg with the tread dimension is closest to the end of the stringer stock but far enough from the end to allow for a riser below. Try to lay out the notches so that cutting them gets rid of knots and defects.

4. Lay out the second tread and the third riser.
Slide the square up, and carefully align the tread dimension with where the riser line below intersects the edge of the stringer. Continue up the stringer until **you've laid out as many treads as are needed**.
Mark the back of the top tread.
You don't have to lay out the upper riser; just make a mark so you know exactly where the tread ends.

Mark the plumb cut at the top of the stringer.
Flip the square around to the bottom of the stringer, and mark a cutline from the back of the top tread to the bottom of the stringer.
Lay out the bottom riser.
Holding the guide tight to the stringer, align the riser dimension with where the first tread intersects the stringer, and mark the first riser. Extend this line all the way.

Adjust the first riser height.
Deduct one tread thickness from the first riser, or that step will be higher than the rest. Add the thickness of the finished floor to the riser if the flooring isn't installed.
Don't overcut the notches.
Stop the circular saw at the back of the notch, and finish the cuts with a handsaw. Cutting beyond the notch with the circular saw is faster, but it **weakens the stringer**.
Use the first stringer as a template.
To lay out subsequent stringers, align the cut stringer with the edge of the stringer stock, and draw lines. Make the cut, removing the pencil line.

Theoretical learning Activity

Group discussion

Practical learning Activity

Practical exercises on setting out of stairs while respecting the drawing.

Points to Remember (Take home message)

setting out methods Setting out process

Learning outcome 1. 4 formative assissent

Written assessment

Q. 1) answer **true** or **false**

ppe is used for levelling string

diagonal method is used for setting out string stair

Setting out is the process of transferring architectural proposals from drawings into the ground.

Grinder machine is instrument used in setting out string stair

Answer:

A: false

B: true

C: true

D: false

Q. 2) choose the correct answer.

The following tools are used in setting out of string stair except:

Chisel

Tape measure

Spirit level

Plumb bob

Folding rule

Answer: Chisel

Practical assessment

Checklist	Score	
	yes	no
Stair setting out methods		
Diagonal method		
3,4,5 method		
Setting out process		
Margin line		
Leveling of string, rise and tread		
Observation		

Learning Unit 2: Prepare workplace

STRUCTURE OF LEARNING UNIT

Learning outcomes:

2.1. Determine exit and ground finish levels

2.2. Set out newel posts and footings

2.3. Cut stringers and house or fix into the newel posts and/or landing.

Learning outcome 2.1: Determine exit and ground finish levels

Duration: 7hrs

Learning outcome 1 objectives :

By the end of the learning outcome, the trainees will be able to:

1.identify properly types of stair required

2. determine correctly total rise of the stair and available going

3. identify properly position of any landing

4. Preparation correctly ground and exist level of stair

Resources

Equipment	Tools	Materials
-Wheelbarrows	- Hoes - Rammers - Plans -Tape measure - Pencils - Squares - Levels - Spades - Pick axe	-building line -pegs

Advance preparation:

. prepare drawings

. prepare tools

. prepare work place

Indicative content 2.1: Determine exit and ground finish Level

Site study
The types of stair required
The total rise of the stair
The total available going
The number of steps in the flight
The position of any landing
Preparation of ground and exist level of stair:
Ground clearing
Leveling: Horizontal and vertical

Theoretical learning Activity

Group discussion on site study

Practical learning Activity

Practical exercises on preparation of ground level and exit determination

Points to Remember (Take home message)

Why site study is necessary
Preparation of ground and exist level of stair

Learning outcome 2.1 formative assessment

Written assessment

Q1) Chose the correct answer

While making site study when we determine exit and ground finish levels

The following criteria are needed.

The types of materials required

The total number of tools required

The total available resources

The number of timbers in the flight

The position of any landing

No correct answer

Answer:

the correct answer is **6**The position of any landing

Q2) what are the processes of Preparation of ground and exist level of stair

Answer:

Ground clearing

Leveling:

Horizontal

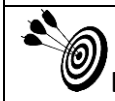
vertical

Practical assessment

Checklist	Score	
	yes	no
Element of field study		
Types of stair		
Number of rises		
Total available going		
Number of steps		
Position of any landing		
Method of ground level preparation		
Ground clearing		
Leveling		
Observation		

Learning outcome 2.2: Set out stair footing

Duration: 7hrs



Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. explain properly Elements affecting setting out of Stair footings
2. perform correctly setting out processes
3. setting correctly any types of stair footings

Resources

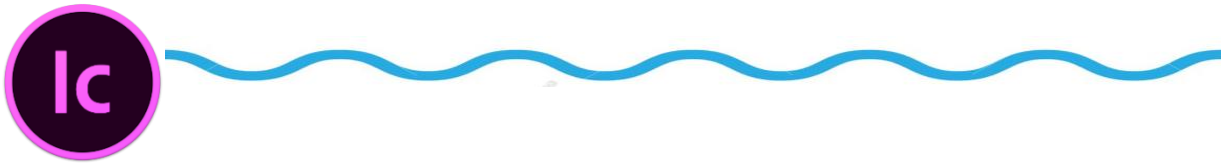
Equipment	**Tools**	**Materials**
	- Tape measure - Pencils - Tape measure - Squares - Levels	

Advance preparation:

. prepare materials and tools

. prepare drawings

. Prepare workplace



Indicative content 2.2: Set out stair footing

Elements affecting setting out of Stair footings:
Loads to be applied
The types of stair required
The total rise of the stair
The total available going
The number of steps in the flight
The position of any landing

Setting out process
Prepare materials, tools and
Prepare materials, tools and Workplace
Measuring
Margin lining
Leveling (horizontal, Vertical and Angle)
Verification

Theoretical learning Activity

Documentary research on setting out process of stair

Interpretation of working drawings, plans and specifications

Brainstorming/or group discussion on setting out process.

Practical learning Activity

Practical exercises on setting out process.

Points to Remember (Take home message)

Elements affecting setting out of Stair footings Setting out process

Learning outcome 2.2 formative assessment

Written assessment

Q1) GIVE 4 Elements affecting setting out of Stair footings

Answer:

The total rise of the stair

The total available going

The number of steps in the flight

The position of any landing

Q2) list the sequences of Setting out process

Answer:

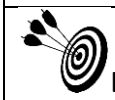
- ✓ Prepare materials, tools and
- ✓ Prepare materials, tools and Workplace
- ✓ Measuring
- ✓ Margin lining
- ✓ Leveling (horizontal, Vertical and Angle)
- ✓ Verification

Practical assessment

Checklist	Score	
	yes	no
Setting out process		
Prepare materials, tools and workplace		
Measuring		
Margin lining		
Leveling (Horizontal, Vertical and angle)		
Verification		
Elements affecting setting out of Stair footings		
Loads to be applied		
The types of stair required		
The total rise of the stair		
The total available going		
The number of steps in the flight		
Observation		

Learning outcome 2.3: Cut stringers and housedor fix into the newel posts and/or landing.

 **Duration: 6hrs**

 **Learning outcome 3 objectives:**

By the end of the learning outcome, the trainees will be able to:

1. perform correctly Cutting process of stringers

2. fix properly of stringers into the newel posts and/or landing

 **Resources**

Equipment	**Tools**	**Materials**
- PPE - Wood working machine	- Hand out - Internet - Cutting tools - Marking tools - Measuring tools	- Glues - Bolts and nuts - Nails - Panels

Advance preparation:

. prepare materials, tools and equipments

. prepare drawings

. Prepare workplace

Indicative content 2.3: Cut stringers and housedor fix into the newel posts and/or landing.

Cutting process of stringers
Measuring
Marking
cutting
Fixing methods of stringers into the newel posts and/or landing
Nailing
Screwing with iron corners and connectors
Bolting
Jointing

Theoretical learning Activity

Group discussion on cutting methods to be used

Practical learning Activity

Practical exercises on cutting stringers by using hand and machines

Points to Remember (Take home message)

Cutting process of stringers Fixing methods of stringers into the newel posts and/or landing

Learning outcome 2.3 formative assessment

Written assessment

Q1) what are cutting process of stringers

Answer:

Measuring

Marking

cutting

Q2) give methods of fixing stringers into the newel posts and/or landing

Answer:

Nailing

Screwing with iron corners and connectors

Bolting

Jointing

Practical assessment

Checklist	Score	
	yes	no
Cutting process of stringers		
Measuring		
Marking		
Cutting		
fix of newel posts on string		
Nailing		
Screwing with iron corners and connectors		
Bolting		
Jointing		
Observation		

STRUCTURE OF LEARNING UNIT:3. Fix wooden stair components

Learning outcomes:

3.1 Locate and fix strings

3. 2 Construct landings

3. 3 Fix treads and risers to strings

3. 4 Fit and fix handrails and balusters or bracing and lateral ties to the newel post

3. 5 Locate and secure tie bolts

Learning outcome 3.1 Locate and fix strings

Duration:17hrs

Learning outcome 3.1 objectives :

By the end of the learning outcome, the trainees will be able to:

1. Identify the characteristics of area where the strings will be fixed

2. fix the string of stair

Resources

Equipment	Tools	Materials
Wood working machine PPE	Cutting tools Levelling tools Boring tools Holding tools Set out tools	Wooden materials Stringer boards Connectors

Advance preparation:

Prepare area

Set out of string

Lay string members

Fit and fix string members

Level string

Indicative content : Fix wooden stair components

Characteristics of area where the strings will be fixed:
Strong
Stability
Plane
compacted

Procedures involve for fitting and fixing string:
Prepare area
Set out of string
Lay string members
Fit and fix string members
Level string

 **Theoretical learning Activity**

Brainstorming on characteristics of area to fix strings.

Group discussion on characteristics of area

 **Practical learning Activity**

Practical exercises on fit and fixing string

Points to Remember (Take home message)

Characteristics of area where the strings will be fixed
Procedures involve for fitting and fixing string

Learning outcome 3.1 formative assessment

Written assessment:

Q1) Give Procedures involve for fitting and fixing string

Q2) Characteristics of area where the strings will be fixed

Choose the incorrect answer:

Strong

Stability

Compacted

Plane

Answers: Q1) Procedures involve for fitting and fixing string:

Set out of string

Lay string members

Fit and fix string members

Level string

Prepare area

Q2) no answer

Practical assessment

checklist	Score yes	no
Characteristics of area		
Strong		
Stability		
Plane		
Procedures involve for fitting and fixing string		
Prepare area		
Set out of string		
Lay string members		
Fit and fix string members		
Level string		
Observation		

Learning outcome 3.2: Construct landings

Duration: 15hrs

Learning outcome 3.2 objectives :

By the end of the learning outcome, the trainees will be able to:

1. know the Standard requirements of stair landings

2. Construct the steps of stair landings

Resources

Equipment	Tools	Materials
Ppe **Wood working machines**	Handtools: Fixing tools Holding tools Cutting tools Setting tools	Timber Nails connectors

Advance preparation:

Prepare landing area

Measure rise of stairs

Calculate the number of steps and the treads

Determine height of the landing

Build the landing

Cut the stringers

Complete bottom stairway

Attach the top stairway

Indicative content 3.2 Construct landings

A flight of stairs is limited to 18 risers, before it must have a break. This break may be in the form of another floor level or a landing. A landing may take the following forms:
Half–space landing: This is a landing formed between flights at 180° to one another, often referred to as a 'Dogleg' stair.
The length of the landing is equal to the width of the flight and the width of the landing is equal to twice the width of the flight, plus a stairwell if required

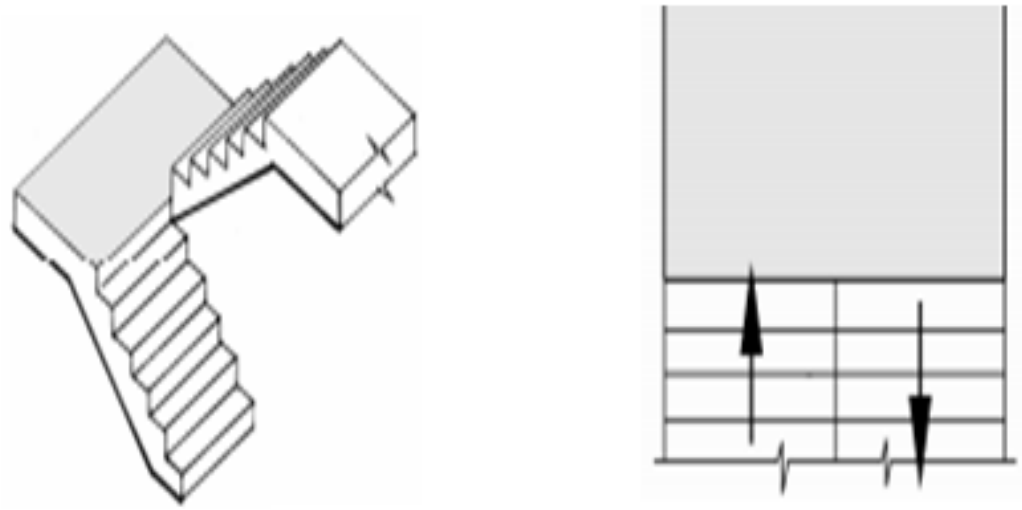


Fig: **Half–space landing**

Quarter–space landing: This is a landing formed between flights at 90° to one another, often referred to as a 'Quarter-turn' stair.
The length of the landing is equal to the width of the flight and the width of the landing is also equal to the width of the flight.

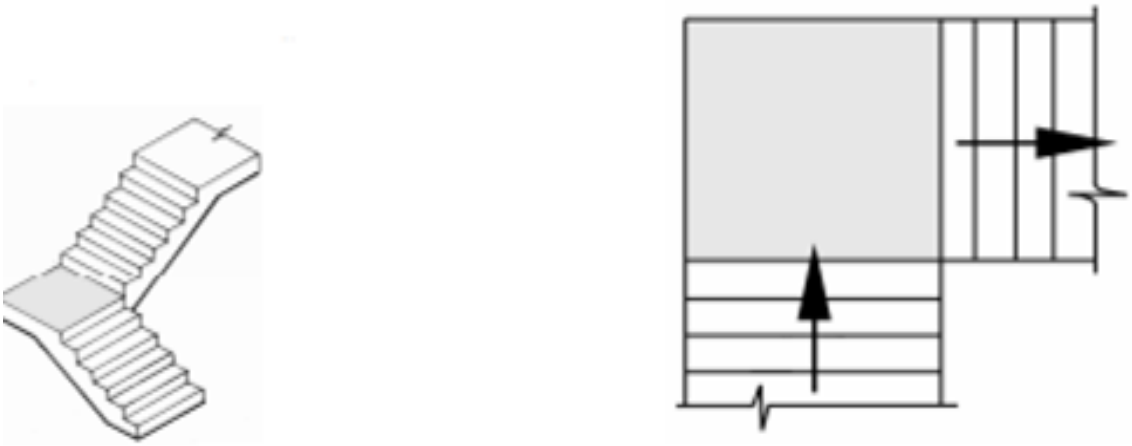


Fig: **Quarter–space landing**

Intermediate landing: This is a landing formed between flights running in the same direction.
The length of the landing is equal to at least the width of the flight and the width is equal to the width of the flights.

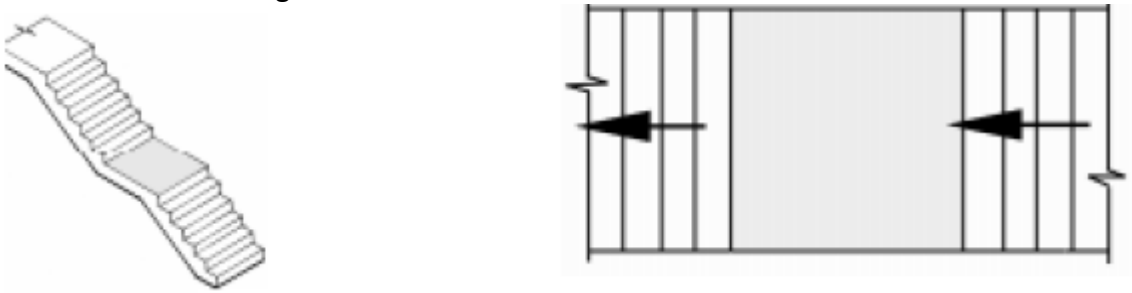


Fig: **Intermediate landing**

Standard requirements of stair landings
Sizes and location
Strength and stability
Shape
Construction steps and stair landings:
Prepare landing area
Measure rise of stairs
Calculate the number of steps and the treads
Determine height of the landing
Build the landing
Cut the stringers
Complete bottom stairway
Attach the top stairway

Theoretical learning Activity

Group discussion on requirements of stair landings

Practical learning Activity

Practical exercises on constructing of stair landings

Points to Remember (Take home message)

Standard requirements of stair landings
Construction steps and stair landings

Learning outcome 3.2formative assessment

Written assessment:

Q1. State three (3) The main purpose of Landing

Q2. Give the Construction steps and stair landings

Answer: Q1)

To facilitate to change the direction

To provide an opportunity for taking rest during the use of the stair.

To provide the entrance

Q2)

Prepare landing area

Measure rises of stairs

Calculate the number of steps and

the treads

Determine height of the landing

Build the landing

Cut the stringers

Complete bottom stairway

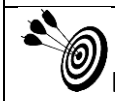
Attach the top stairway

Practical assessment

checklist	Score yes	no
Standard requirements of stair landings		
Sizes and location		
Strength and stability		
Shape		
Construction steps and of stair landings		
Prepare landing area		
Measure rise of stairs		
Calculate the number of steps and the treads		
Determine height of the landing		
Build the landing		
Cut the stringers		
Complete bottom stairway		
Attach the top stairway		
Observation		

Learning outcome 3.3: Fix treads and risers to strings

 **Duration:15hrs**

 Learning outcome 3.3 objectives :

By the end of the learning outcome, the trainees will be able to:

1. Describe the fixing materials

2. know the fixing Methods of treads and risers to string Width

Resources

Equipment	Tools	Materials
Portable machines: Hand drill Nail gun	Fixing tools: Hammer braces	Nails Dowels Screws Bolt and nuts Iron corners Corner taps

Advance preparation:

Preparation of fixing materials

Arrangement, maintenance of tools and equipment

Indicative content 3.3: Fix treads and risers to strings

Fixing materials:
Nails
Dowels
Screws
Bolt and nuts
Iron corners
Corner taps

Fixing Methods of and risers to string Width:
Nailing
Screwing
Doweling
Bolting
These methods all are included in the following methods:
Manual methods: by using hand tools
Mechanical methods: by using machines

Theoretical learning Activity

- Documentary research on fixing techniques of treads and risers to strings
- Demonstration on measuring, marking, levelling and fixing treads and risers to strings

Practical learning Activity

- Practical exercises on measuring, marking, levelling and fixing treads and risers to strings
- Field visit of a nearby site on construction of treads and risers

Points to Remember (Take home message)

Fixing materials

Fixing Methods of and risers to string Width

Learning outcome 3.3 formative assessment

Written assessment:

Q.1 what are the Fixing Methods of treads and risers to string Width?

Q.2 Give the materials use to fix treads and risers to strings

Answer: Q1. the Fixing Methods of treads and risers to string Width:

Nailing

Screwing

Doweling

Bolting

Q2. the materials use to fix treads and risers to strings:

Nails

Dowels

Screws

Bolt and nuts

Iron corners

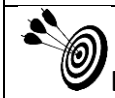
Corner taps

Practical assessment

checklist	Score yes	no
Fixing materials		
Nails		
Dowels		
Screws		
Bolt and nuts		
Iron corners		
Corner taps		
Fixing materials		
Nailing		
Screwing		
Doweling		
Bolting		
Observation		

Learning Outcome 3.4: Fit and fix handrails and balusters or bracing and lateral ties to the newel post

 **Duration: 18 hrs**

 **Learning outcome 3.4 objectives :**

By the end of the learning outcome, the trainees will be able to:

1. Know the Laying process of handrails, braces and balusters
2. know Techniques of fixing handrails, braces and balusters
3. know Safety and security requirements of stair

Resources

Equipment	Tools	Materials
Portable machines	Hand tools	Bolts and nuts Screws Timber nails

Advance preparation:

Marking

Cutting

Jointing

Laying

Levelling

IC

Indicative content 3.4 Fit and fix handrails and balusters or bracing and lateral ties to the newel post

Laying process of handrails, brace and balusters:
Marking
Cutting
jointing
Laying
Levelling

Techniques of fixing handrails, braces and balusters:
Nailing
Bolting
Screwing
Doweled
Jointing

Safety and security requirements of stair:
Stability
Strength
Durability

Theoretical learning Activity

- Group discussion on the Safety and security requirements of stair

Practical learning Activity

- Practical exercises on fixing handrails and balusters
- Practical exercises on fixing bracing and lateral ties to the newel post

Points to Remember (Take home message)

Laying process of handrails, brace and balusters

Techniques of fixing handrails, braces and balusters

Safety and security requirements of stair

Learning outcome 3.4 formative assessment

Written assessment:

Q1. A) what are element affecting setting out of stair footings

B) What are the methods and techniques used for fixing handrails, balusters or bracing and lateral to the newel post?

C) what are the safety and security requirement of stair?

Answer:

1.A) Fit and fix handrails and balusters or bracing and lateral ties to the newel post

Laying process of handrails, brace and balusters:

Marking

Cutting

jointing

Laying

Levelling

Techniques of fixing handrails, braces and balusters:

Nailing

Bolting

Screwing

Doweled

Jointing

d) what are the safety and security requirement of stair?

Stability

Strength

Durability

Practical assessment

Checklist	Score	
	yes	no
Laying process of handrails, braces and balusters		
Marking		
Cutting		
jointing		
Laying		
Levelling		
Safety and security requirements of stair		
Stability		
Strength		
Durability		
Observation		

Learning Unit 4: Perform finishing

STRUCTURE OF LEARNING UNIT

Learning outcomes:

4.1. Sand wooden stair case

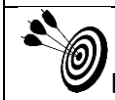
4.2. Polish wooden stair case

4.3. Clean, check, maintain and store tools and equipment

4.4. Clean work place and dispose the materials

Learning outcome 4.1 Sand wooden stair case

 **Duration: 6hrs**

 **Learning outcome 1 objectives:**

By the end of the learning outcome, the trainees will be able to:

1. differentiate properly sander paper according to the sizes

2. perform correctly all sanding methods of wooden stair case

 **Resources**

Equipment	Tools	Materials
Sander machine	- Hand tools - Reference books - Hand out - Internet	-Sanding papers

 **Advance preparation:**

. prepare tools, materials and equipment

. prepare work place

Indicative content 4.1 Sand wooden stair case

Sand wooden stair case.

Sandpaper is sized in grits, the most common grits ranging from 40 – 400 grit. The lower numbers paradoxically signify the larger, coarser grits, and the larger numbers indicate a finer, less abrasive sandpaper.

Sandpaper is measured by the number of holes per square inch. For example, a piece of 150-grit sandpaper uses abrasive particles that were sieved through a screen with 150 holes per square inch.

To easily identify the grit of the sandpaper, the number is almost always clearly printed on the back of each piece.

Sizes of sander papers:

P50
P60
P80
P120
P150
P180
P320

40 – 80 Grit (Coarse Sandpaper)
Coarse grit sandpaper is ideal for:
Shaping wood
Removing old paints, blemishes(imperfections) and finishes
Rough lumber
Shallow scratches
Saw blade burns

100 – 180 Grit (Medium Sandpaper)
Medium grit sandpaper is ideal for:
Prepping for polyurethane and enamel paints
Surface irregularities
Sanding of soft woods

200 – 280 Grit (Fine Sandpaper)
Fine grit sandpaper is ideal for:
Prepping for latex, acrylics and wood stains
Begin surface finishing
Raised wood grain fibers

320 – 400 Grit (Extra Fine Sandpaper)
Extra fine grit sandpaper is ideal for:
Sanding between coats
Wet sanding
Smoothing topcoats
Prepping for finishing oils
Metal and other hard surfaces

Sanding methods of wooden stair case:
Manual method: Sand paper /Sand stone: means use hand with hand sand paper
Mechanical method: means using machine example grinder

Theoretical learning Activity

- Group discussion on the size of sander papers

Practical learning Activity

- Practical exercises on sanding.

Points to Remember (Take home message)

Sizes of sander papers
Sanding methods of wooden stair case

Learning outcome 4.1 formative assessment

Written assessment

Q1) answer question **true** or **false**

You have the job of making sanding of wooden staircase by using 80 and 120 sandpaper size.

Better to start with 120 sandpaper size after use 80 sand paper size

Better to start with 80 sandpaper size after use 120 sand paper size

Answer:

Better to start with 120 sandpaper size after use 80 sand paper size(**false**)

Better to start with 80 sandpaper size after use 120 sand paper size(**true**)

NB: when we make sanding, we need smooth surface means is better to start from coarse sanding paper to fine sanding paper.

Q2) give 2 Sanding methods of wooden stair case

Answer:

Manual method

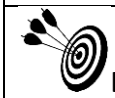
Mechanical method

Practical assessment

Checklist	Score	
	yes	no
Sizes of sander papers		
P60		
P80		
P120		
P120		
P150		
P180		
P320		
Sanding methods of wooden stair case		
Manual methods		
Mechanical methods		
Observation		

Learning outcome 4.2 Polish wooden stair case

Duration: 8hrs



Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. perform properly all kind of finishes such as: Paints, Varnishes and Stains

2. perform correctly all methods of applying finishes such as: Brushing method and Spraying method

3. make properly finishing surfaces which smoothness

Resources

Equipment	Tools	Materials
Polishing machine	- Hand tools - Polishing tools - Reference books - Hand out - Internet	-Paints -varnish

Advance preparation:

. prepare tools, materials and equipment

. prepare work place

Indicative content 4.2 Polish wooden stair case

Polish wooden staircase

Polishing is the process of creating a smooth and shiny surface by rubbing it or by applying a chemical treatment, leaving a clean surface with a significant specular reflection.

Types of finishes:

Paints: Paint is any pigmented liquid, liquefiable, or solid mastic composition that, after application to a substrate in a thin layer, converts to a solid film.

Varnishes: Varnish is a clear transparent hard protective coating or film.

Stains: A timber stain is a fluid that is used to color a surface by penetrating into the substrate without obscuring it.
Normally, it is applied to bare(undecorated) **timber** to enhance the beauty of the natural grain or to improve the appearance of lower grade timbers to imitate higher grade timbers.
The different types of stains are:

Water stain: this is made up of vegetable dyes dissolved in boiling water. Modern water stains use acrylic resin.
Spirit stain: is made up of spirit soluble dyes in a solution of industrial alcohol.
Oil stain: is made up of ground semi-transparent pigments that are mixed with linseed oil and thinned with turpentine.
Varnish stain: is a pigmented hard varnish, which when applied leaves a coating on the substrate surface.
Surface finishes:
Moisture-Cure Urethanes
Water-Based finishes
Varnish, Shellac and Lacquer finishes
Polymer finishes
Paint removers
Oil-based finishes

Methods of applying finishes:
Brushing method: this method uses hand brushes
Spraying method**:** this method uses spraying machines

Theoretical learning Activity

Group discussion on types of paints and polishing steps of wooden stair

Practical learning Activity

Practical exercises on painting and varnishing using hand tools and machines

Practical exercises on polishing wooden stair using hand tools and machines

Points to Remember (Take home message)

Types of finishes The different types of stains are Methods of applying finishes

Learning outcome 4.2 formative assessment

Written assessment

Q1) give 3 types of types of finishes

***Answer*:** paints, varnishes and stains

Q2) give 4 different types of stains

***Answer*:** Water stain, Spirit stain, Oil stain and Varnish stain

Q3) choose the correct answer

The Methods of applying finishes is:

Painting

Varnishing

Spraying

Oiling

Sanding

Brushing

6 and 3 are correct

***Answer:* 7.** 6 and 3 are correct

Practical assessment

Checklist	Score	
	yes	no
Surface finishe		
Moisture-Cure Urethanes		
Water-Based finishes		
Varnish, Shellac and Lacquer finishes		
Polymer finishes		
Paint removers		
Oil-based finishes		
Sanding methods of wooden stair case		
Brushing method		
Spraying method		
Observation		

Learning Outcome 4.3: Clean, check, maintain and store tools and equipment

Duration: 6hrs

Learning outcome 4.3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. know Methods of cleaning of workplace, serviceability of tools and equipment
2. know Techniques of Waste disposal
3. know Guidelines in storing tools and equipment securely

Resources

Equipment	**Tools**	**Materials**
Portable machines: Hand blower Heavy machine Store room	Storage box/ shelf Hand tools: Broom Dust collector	Cleaning materials Lubricant oils brush

Advance preparation:

Blooming method

Brushing method

Oiling method

Use of machine

Re-sharpening

Indicative content 4.3: Clean, check, maintain and store tools and equipment

Methods of cleaning of workplace, serviceability of tools and equipment: Blooming method Brushing method Oiling method Use of machine Re-sharpening Techniques of Waste disposal: Burning Decomposition Guidelines in storing tools and equipment securely: Dry place Shelves Toolbox

Theoretical learning Activity

Group discussion on cleaning and storing tools and equipment hands/machine

Practical learning Activity

Practical exercises on cleaning and storing tools and equipment hands/machine

Points to Remember (Take home message)

Methods of cleaning of workplace, serviceability of tools and equipment Techniques of Waste disposal Guidelines in storing tools and equipment securely

Learning outcome 4.3 formative assessment

Written assessment:

Q1. Enumerates five (5) methods of cleaning of workplace, serviceability of tools and equipment

Q2. As carpenter by following guidelines in storing tools and equipment securely choose incorrect answer

Burning

Decomposition

Dry place

Shelves

Toolboxes

Answer:

Q1. Methods of cleaning of workplace, serviceability of tools and equipment:

Blooming method

Brushing method

Oiling method

Use of machine

Re-sharpening

Q2. Incorrect answer:

Burning

Decomposition

Practical assessment

Checklist	Score	
	yes	no
Methods of cleaning of workplace, serviceability of tools and equipment		
Blooming method		
Brushing method		
Oiling method		
Use of machine		
Re-sharpening		
Oil-based finishes		
Storing of tools and equipment		
Temperature		
Shelf(ves)		
Toolbox		
Observation		

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17. Assessment and training package for carpenter and joiner level 1&2 (First edition)
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19. Carpentry and joinery course grade iii skill level
20. Carpentry & Joinery (book2) by DAVID R. BATES.
21. Manual of First and Second Fixing Carpentry by LES GORING.
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