TVET CERTIFICATE V in CARPENTRY

ROOF CONSTRUCTION

CAPCR501 CONSTRUCT ROOF

Competence :

Learning hours 90

Credits: 9

Sector: CONSTRUCTION

Sub-sector: CARPENTRY

Module Note Issue date: November, 2020

Purpose statement

This module describes the skills, knowledge and attitude required to construct roof. At the end of this module learner will be able to prepare tools, materials and equipment, Fix roof frame, and apply roof covers equipment.

Table of Contents

LU&PCis linked in LO inside the content

Learning Unit 1 – **Prepare tools, materials and equipment Learning**

LO 1.1 – Select tools and equipment

1. INTRODUCTION TO ROOF CONSTRUCTION

1.1 Definition: The roof may be defined as the upper most part of a building.

1.2 **Functions of roof**

- To keep out rain, wind, snow and dust
- To prevent excessive heat loss in winter
- To keep the interior of the building cool in summer
- To accept movement due to change in temperature and moisture content
- To resist penetration of fire and spread of flame from external sources
- Strength: the roof structure must have adequate strength to carry its own weight together with the super imposed loads of wind, snow, and humans
- Appearance
- security

Content/Topic 1 **Classification of tools used for roof construction**

Identification of tools and equipment

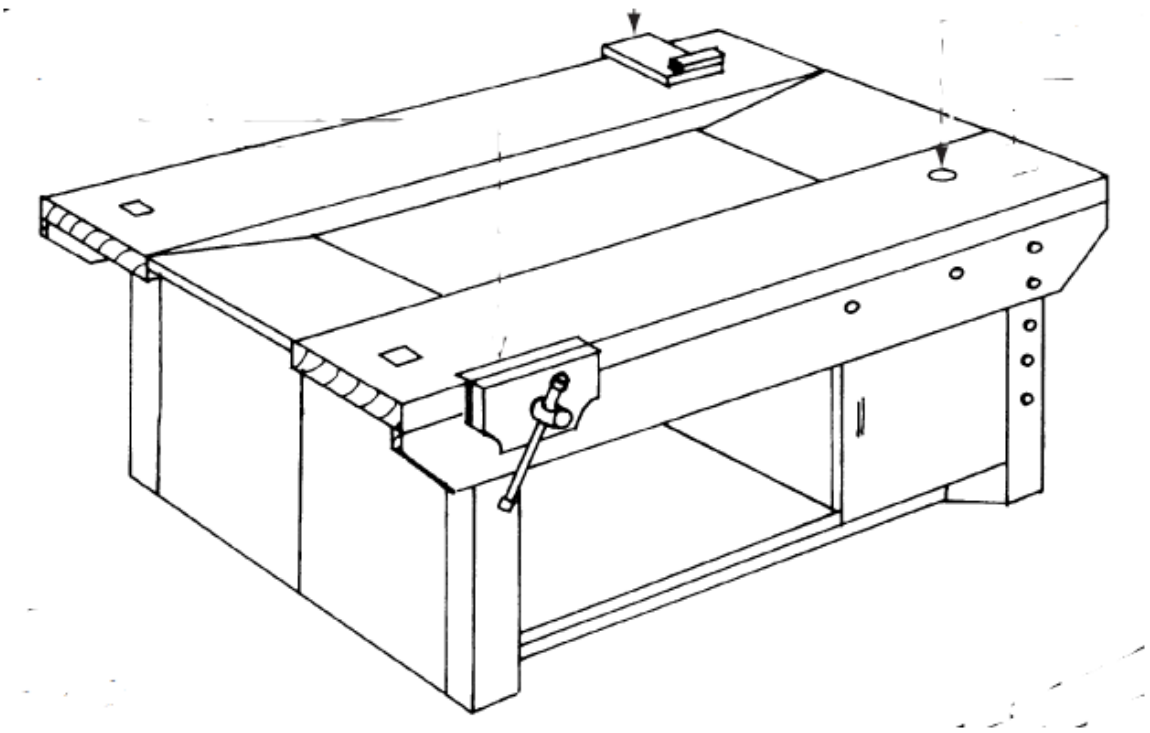
Type of tools

- Holding
- Setting out
- Shaving and cutting
- Boring
- Fixing
- Holding tools

1. **Holding tools**

Holding tools are general-purpose mechanical aids used in the preparation and assembly of timber components.

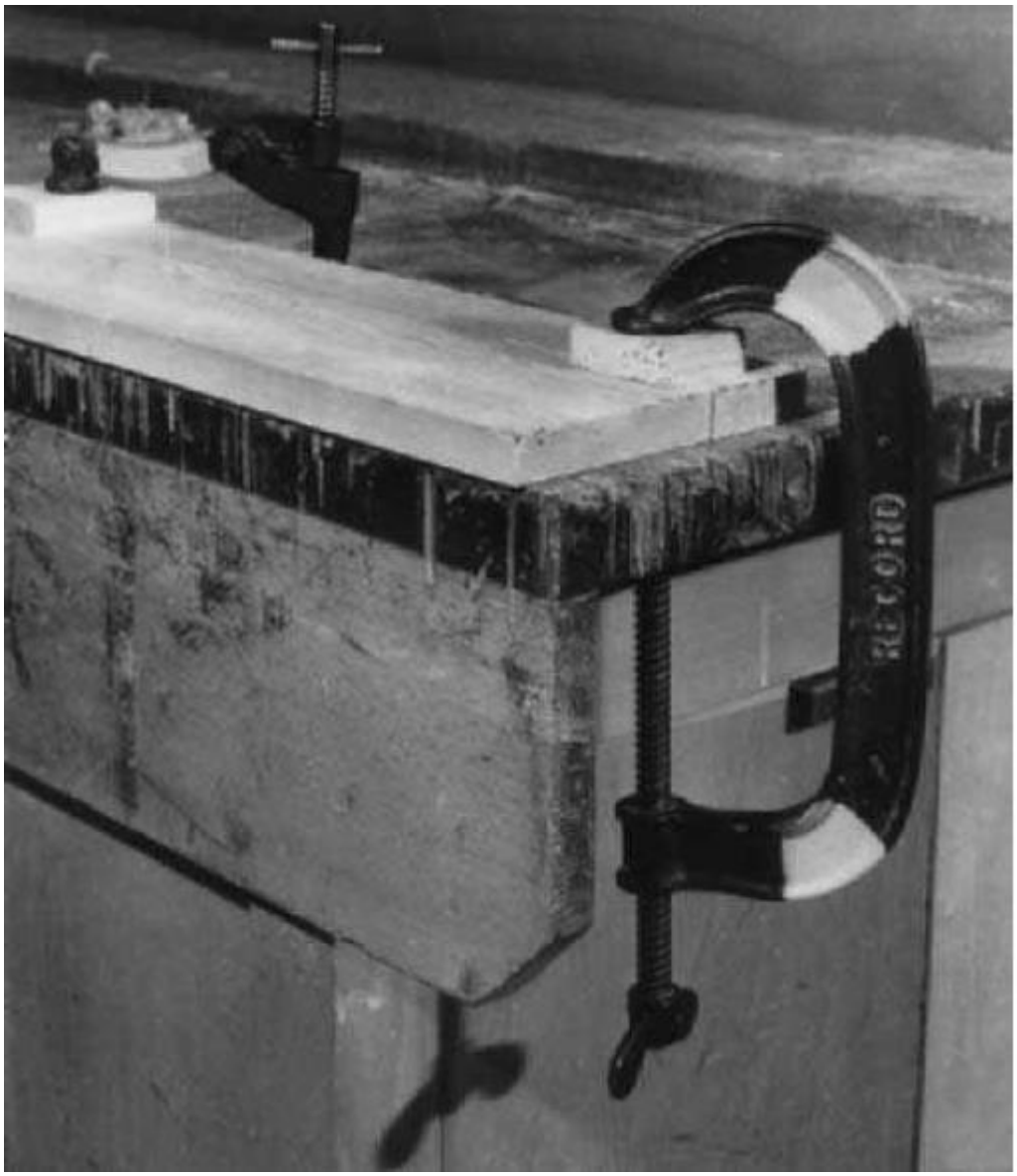
a. **Carpenters work bench or joiners work bench**



b. **Sash clamps:** Consists of two cramp shoes, one (the head shoe) is fixed to a screw spindle to provide adjustment over a limited length. The second shoe (tail shoe) can slide over the remaining length of the rectangular steel bar to a pre-determined length, any further movement to facilitate the cramping process being restricted by the insertion of a steel pin into any one of the holes in the bar.

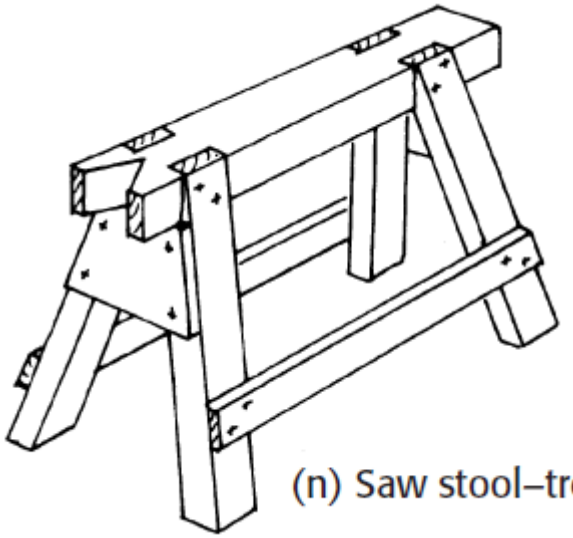
c. **T-bar clamps**: Works on the same principle as a sash cramp but in the main due to the 'T' profile of the bar it is much stronger. Lengthening 'T' bars are also available for those large jobs.

d. **G-clamps:** As the name implies it is ‘G’ shaped – different sizes are available with cramping depths of 50 mm to 300 mm.



e. **F- cramp**: Although not as strong as a 'G' cramp, they are often favoured for lighter work because of the effective quick clamping and release mechanism.

f. Support devices or trestles

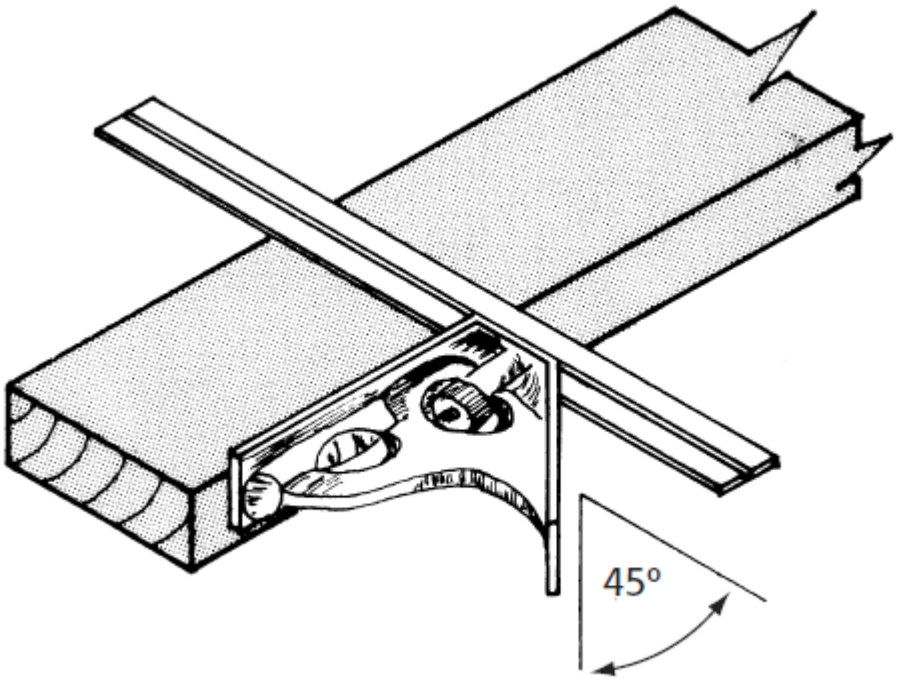


(n) Saw stool–trestle

2. **Setting out tools:**

Setting out tools: measuring, marking and testing tools

a) Marking gauge : Marking and mortise gauge .As can be seen from the diagram, these gauges are similar in appearance and function, i.e. scoring lines parallel to the edge of a piece of timber.
b) Try square: As their name suggests, these (try) test pieces of timber for squarenesss or for marking lines at right angles from either a face side or a face edge.
c) Combination square:This can be used as a try-square, but has the added advantage of being very versatile, in that it has many other uses. For example, as a mitre square, marking and testing angles of 45_, height gauge, depth gauge, marking gauge, spirit-level (some models only), and as a rule.
Long tape measures – measuring long distances
d) Site squares – setting-out large angles (usually 90_) using as a template, or optical **instrument.**
e) Spirit levels – for checking lines both horizontally and vertically.
f) Water levels – setting-out and checking lines and heights horizontally.
g) Optical levels – setting out and checking lines and heights horizontally.



Combination square

3. Cutting and shaving tools

They are divided into two groups:
I. Slicing and smoothing tools: planes, chisels and gauges

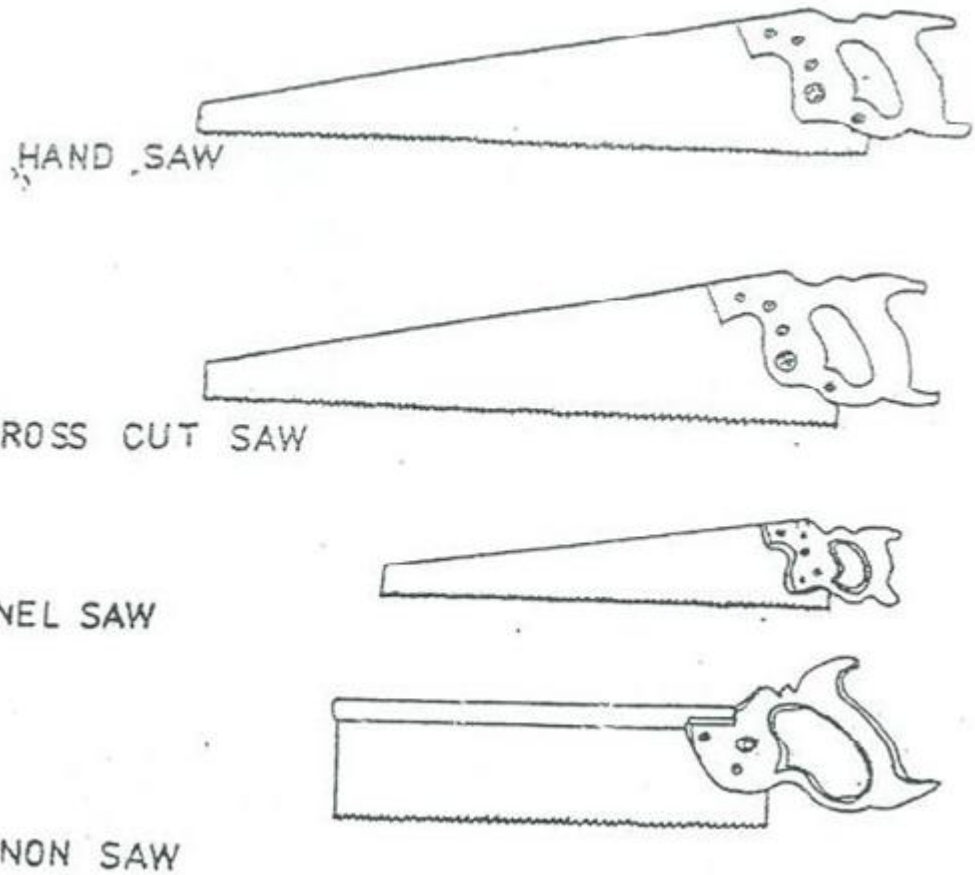
- **Planes**: -plane is its ability to remove waste wood rapidly – where accuracy is not at high level

- **Chisels** for chopping or paring Woodcutting chisels are designed to meet either general or specific cutting requirements.

II. **Parting and shaving tools:**

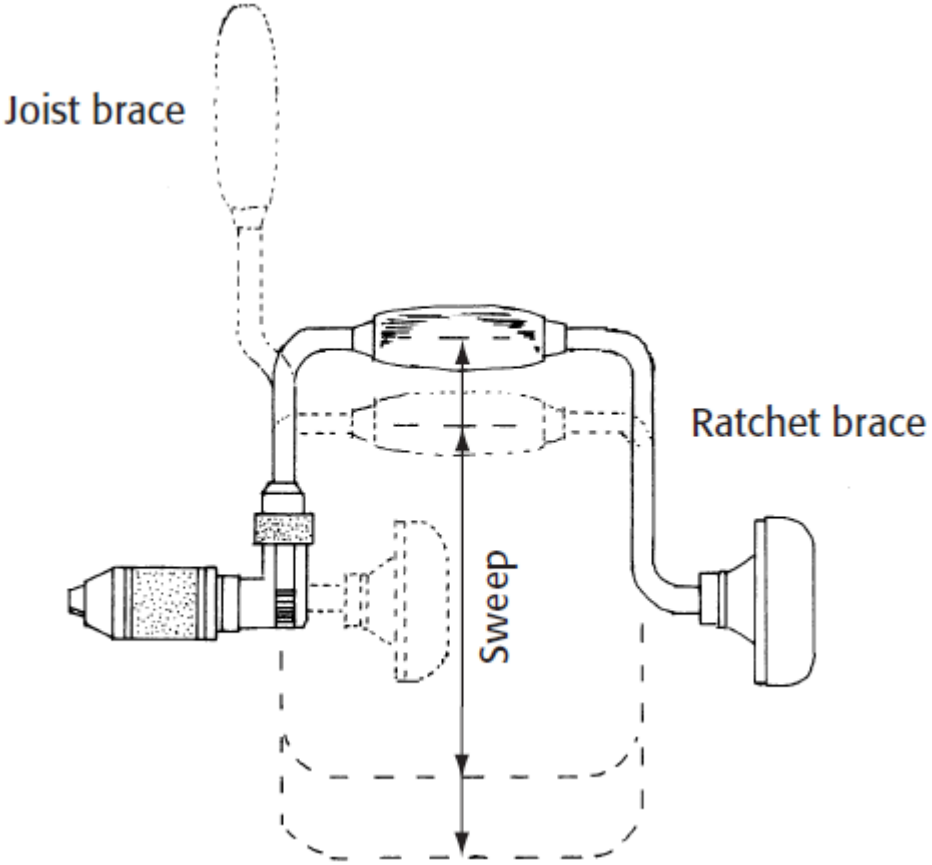
- **Saws**: - Saws are designed to cut both along and across the grain of wood, and the saw's efficiency will be determined by:

- The type and choice of saw,
- The saw's condition,
- The application,
- The material being cut.



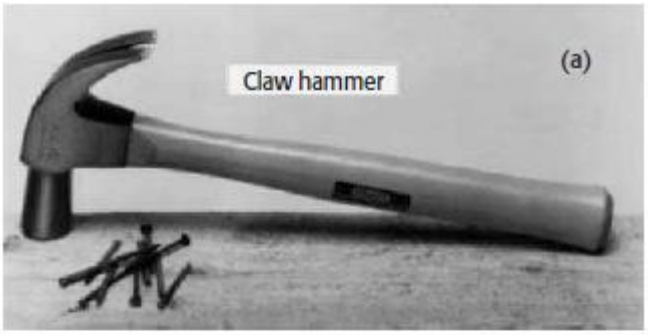
4. Boring tools: Boring tools are those tools that enable the cutting of circular holes of a predetermined size into and below the surface of a given material.

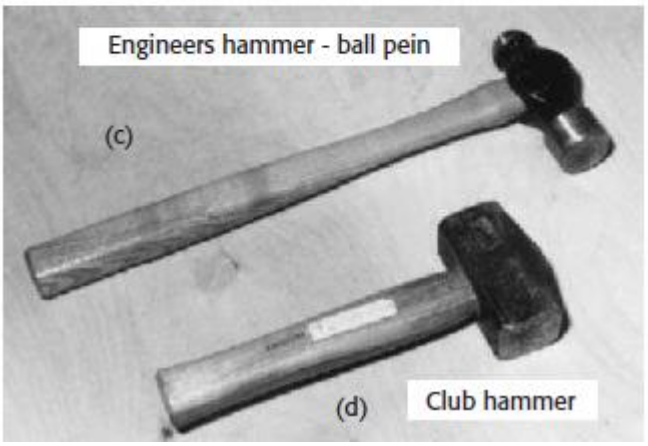
- **Carpenter's brace:** This has a two-jaw chuck, of either the alligatoror the universal type. The alligator type has beendesigned to take square-tapered shanks, whereasthe universal type takes round, tapered andstraight, as well as square tapered shanks. Theamount of force applied to the bit or drill willdepend largely on the sweepof the brace



5. Fixing or impelling tools: These tools have been designed to apply a striking or turning force to fixing devices or cutting tools. For example;

1. Wood or plastic mallet
2. Claw hammer: used for fixing and removing nails
3. Warrington hammer: although capable of driving large nails, this is better suited to the middle to lower range, where it's cross in enables nails to be started more easily.
4. Club hammer: used mainly by stone masons and bricklayers
5. Engineer's hammer: the larger sizes are useful as general purpose heavy hammers and can be used in conjunction with wall-plugging chisels





6. Pincers

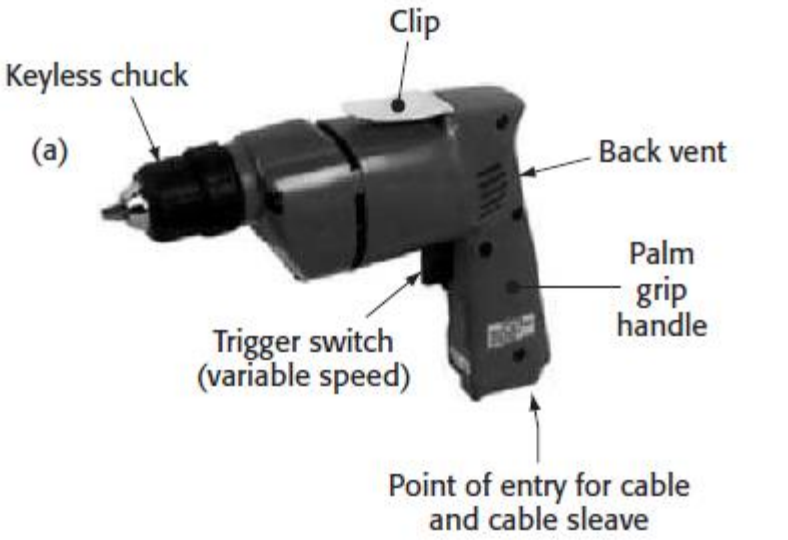
7. Screw drivers: The type and size of screwdriver used should relate not only to the type and size of screw butalso to the speed of application and the location and quality of the work.

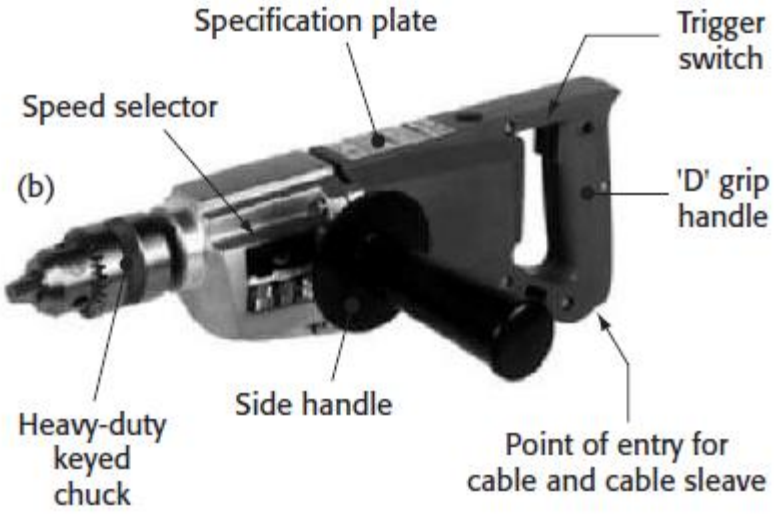
- Content/Topic 2 Classification of equipment:

Portable machines

Portable electric powered hand tools are available to carry out the following functions;

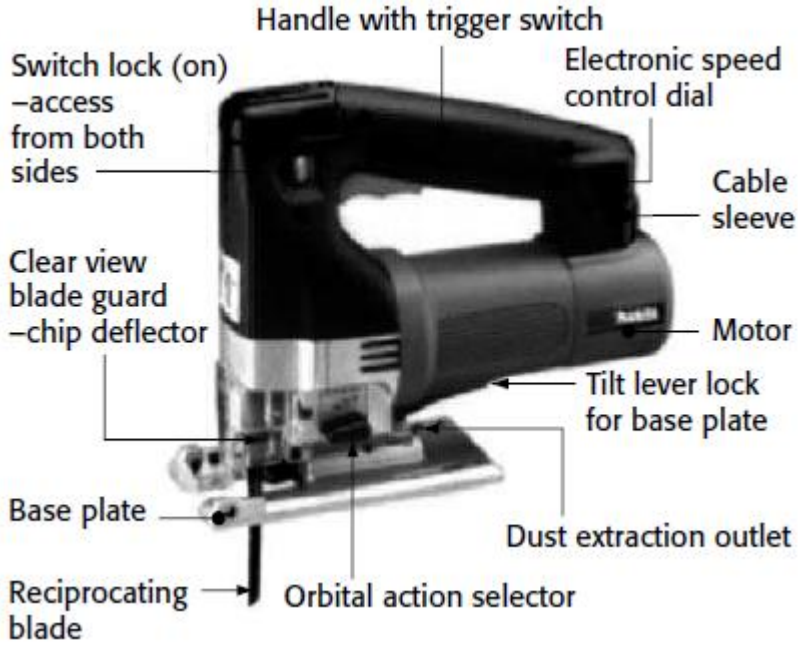
a. Drilling: portable drilling machine is used on the roof construction to drill the holes for receiving bolts and nut, screws….this machines vary in different shapes.



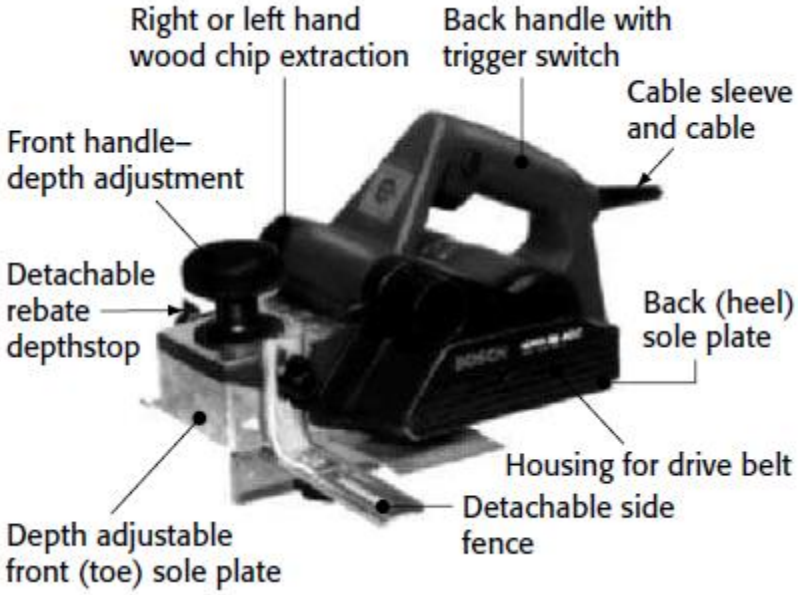


b. Sawing: Onthe site/field the small sawing or cutting is general operation done every time but while construct the roof, this machine is necessary on site.

Mitre saw
(table extension attachment available)



c. Planning: As other operations planning different materials made in timber is preliminary work in order to make the pieces to use smooth and clean.



d. Nail and staple guns

Hand and hammer staplers are well known for the quick effective way they can tack thin fabric and plastics to timber, or wood based boards.

e. Screw driving machine: This help the carpenters for fixing or removing the screws while constructing the roof frame, roof trusses, purlin, or fixing the covering materials .

General safety: Before a portable power tool is used, the operator must be confident that all necessary steps have been taken to ensure both his/her safety and that of any persons within close proximity of the operation to be carried out.

The precautions listed below should always be followed:

1 Never use a portable power tool until a competent person has instructed you in its use.
2 Only use a portable power tool after authorized approval (the tool in question may have been withdrawn from use or some reason of safety).
3 The manufacturer's handbook of instruction for the tool in question should be read and understood before use.
4 Always wear sensibly fitting clothes – avoid loose cuffs, ties, and clothes which are torn etc.
5 Wear eye protection where there is a risk of propelled debris or fume, dust or mist which may impair or damage your eyesight.
6 The correct type of Dust masks should be worn where the operative's health may be at risk.
7 Ear protections should be worn
8 Guards, where fitted, must always be used.
9 Never use blunt or damaged cutters.
10 Keep flexible cables away from the work piece, cutters, and sharp edges and also from trailing on the floor.
11 Before changing bits, abrasive sheets or making any adjustments, always disconnect the tool from the electric supply (remove the plug from its socket).
12 If a tool is damaged or found to be defective, return it to the stores or to the person responsible for it.
13 If injury should occur – no matter how minor – first aid must be applied immediately to avoid the risk of further complications.

Heavy machines

The aim is to help the student to become aware of the more common types of woodworking machinery that the carpenter and joiner may encounter, and to be able to recognize these machines by sight and to understand their basic function.

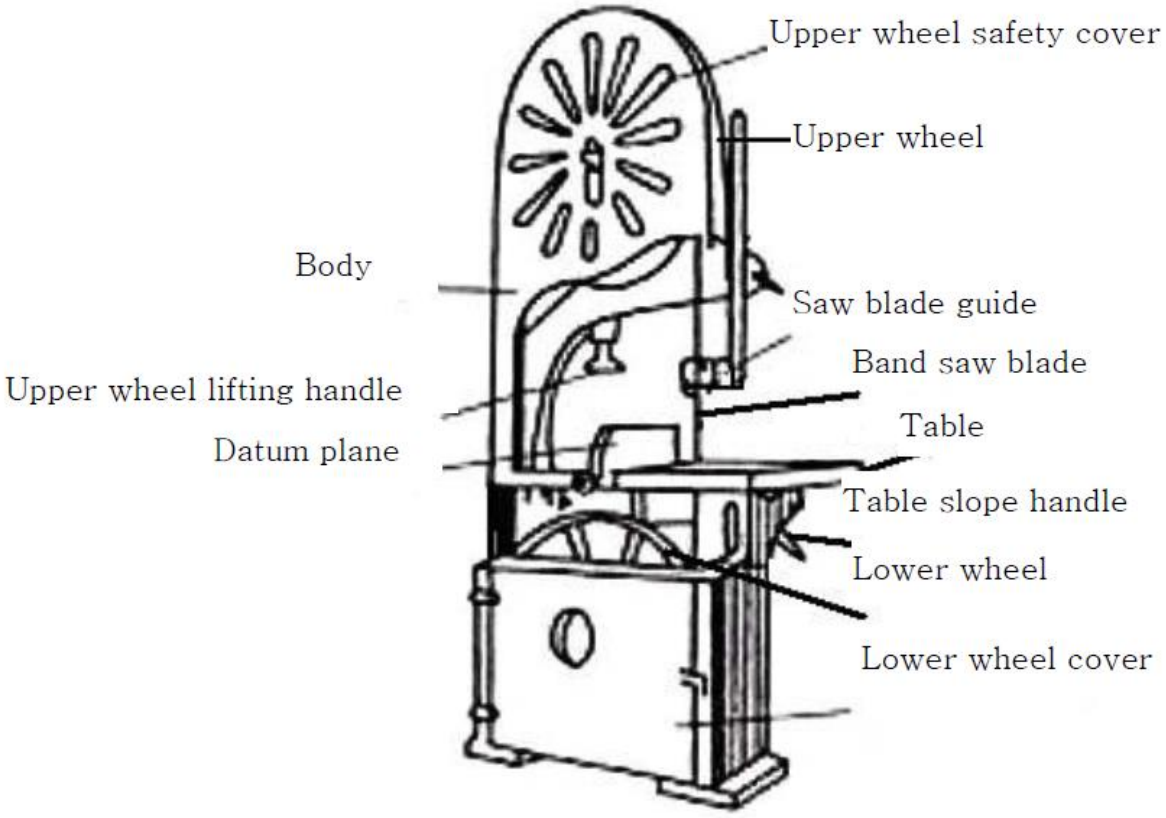
The following machines are covered

- Cross cutting machines
- Hand feed circular saw benches
- Planning machines
- Narrow band saw machines
- Mortising machines
- Grinding machines

1. **Narrow band saw machines**

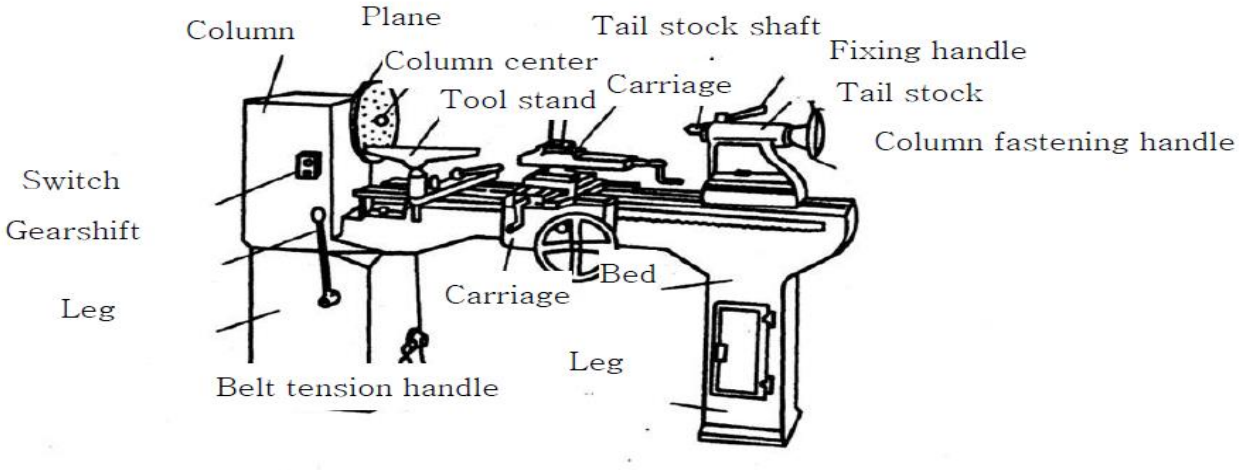
Use of band saw

Band saw is connected to 2 revolving wheels that are installed in the top and bottom of main body of machine, bottom wheel is revolved by power and band saw connected to top and bottom wheels plays the role of belt. As a machine to saw or cut material in a curved line, it can saw material by adjusting table up to an angle of 45°



Structure of band saw

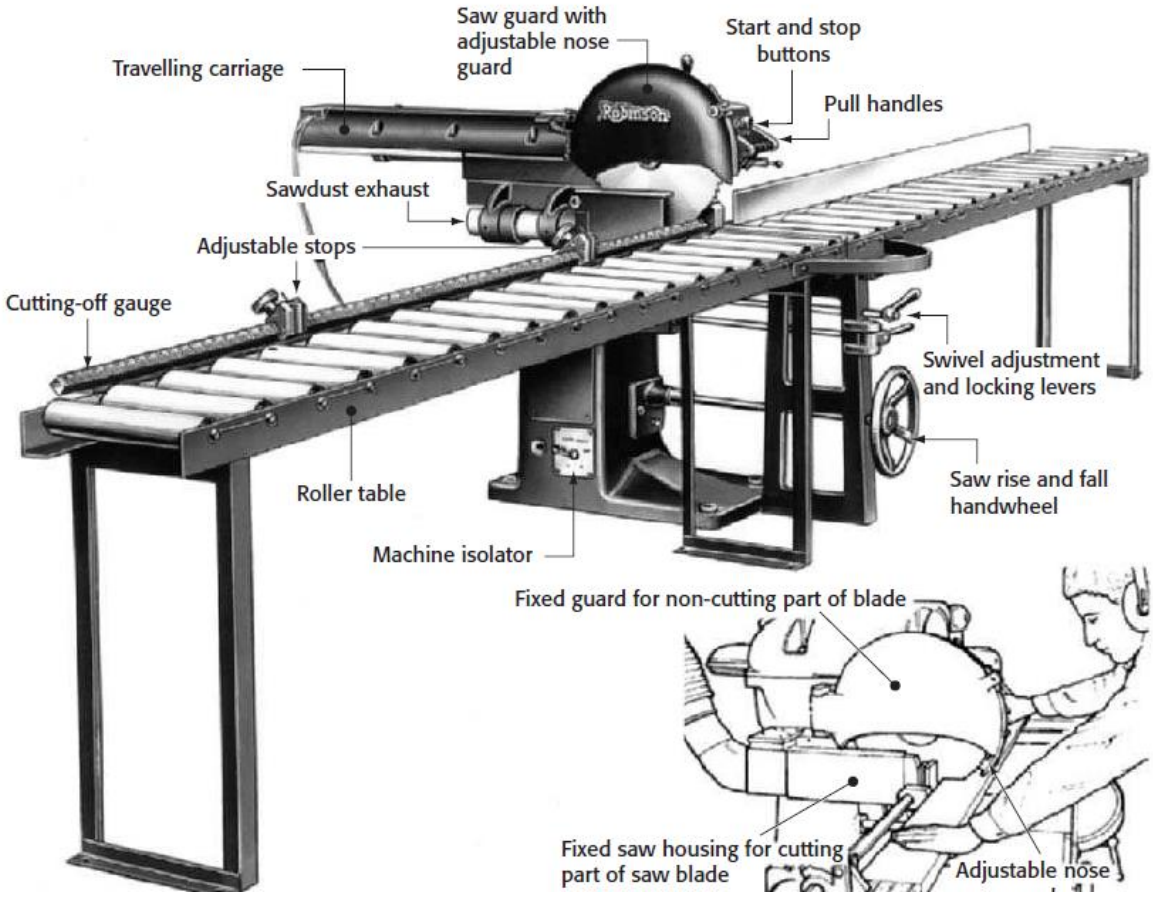
2. lathe



Picture 1 Structure of wood lathe

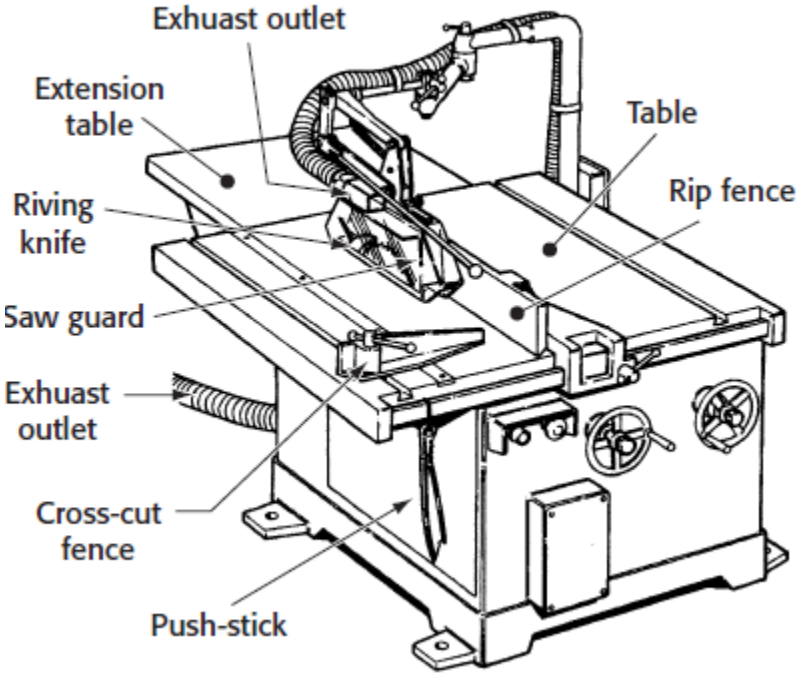
3. Crosscutting machines

These machines are designed to cut timber across its grain into predetermined lengths, with a straight, angled or compound-angular (angled both ways) cut. However, its primary function is to cut long lengths of timber into lengths that are more manageable.



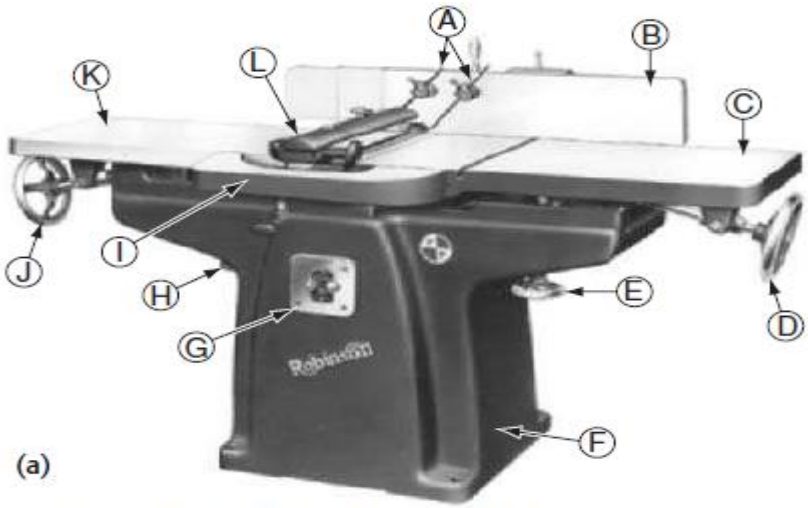
Hand feed circular saw benches

These are primarily used for resawing timber lengthwise in its width (ripping) or its depth (deep-cutting or Deeping). They can vary the depth at which the blade projects above the saw bench table.



5. Hand-feed surface planer

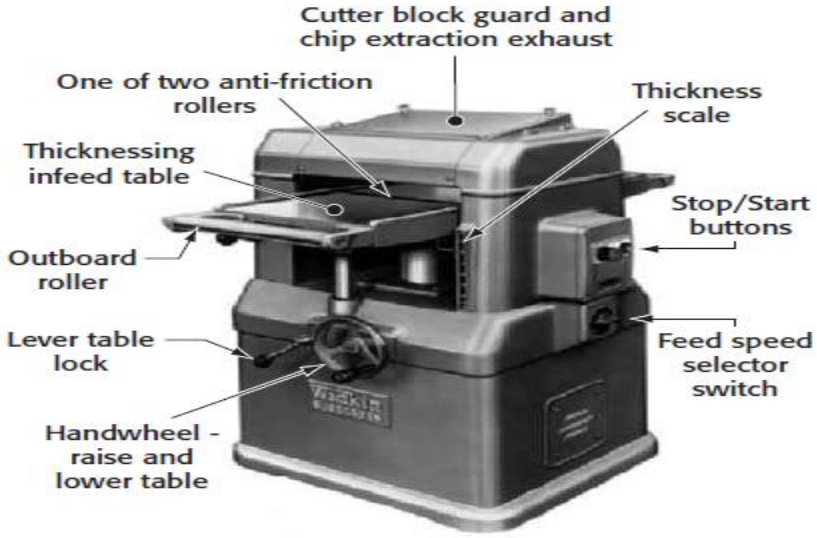
This is used for planning the face side and face edge.



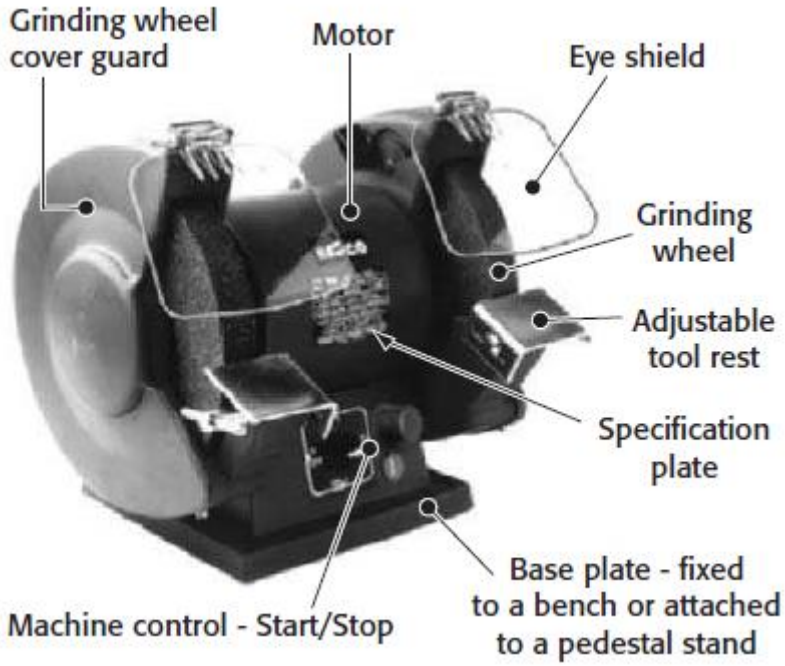
A - Pressure bars (holding down springs)
B - Adjustable fence (will tilt up to 45°)
C - Infeed table
D - Handwheel; infeed table height adjustment
E - Handwheel; infeed table lock
F - Main frame
G - Control; start and stop buttons
H - Handwheel; outfeed table lock
I - Side support table (extra support while rebating)
J - Handwheel; outfeed table height adjustment
K - Outfeed table (delivery table)
L - Telescopic bridge guard

6. Thicknesser

A thicknesser or panel planer such as the one illustrated in figure 9.22 is used for the final part of the planning process, i.e. reducing timber to its finished size.
After the table has been set to the required thickness, timber is placed into the infeed end where it is engaged by a serrated roller which drives it below a cutter block.



7. BENCH GRINDER



Grinding machines are used to:

- re-form the grinding angle on chisel and plane blades
- re-grind and sharpen hand and machine cutters
- re-shape screwdriver blades
- re-sharpen cold and plugging chisels

- **PPE (Personal Protective Equipment): Personal protective equipment is protective clothing other garments or equipment designed to protect the wearer's body from injury or infection.**

- Mask
- Goggle
- Safety shoes
- Overall
- Helmet
- Grooves
- Safety belt

LO 1.2 – SELECT MATERIALS

- Content/Topic 1: Roof materials:

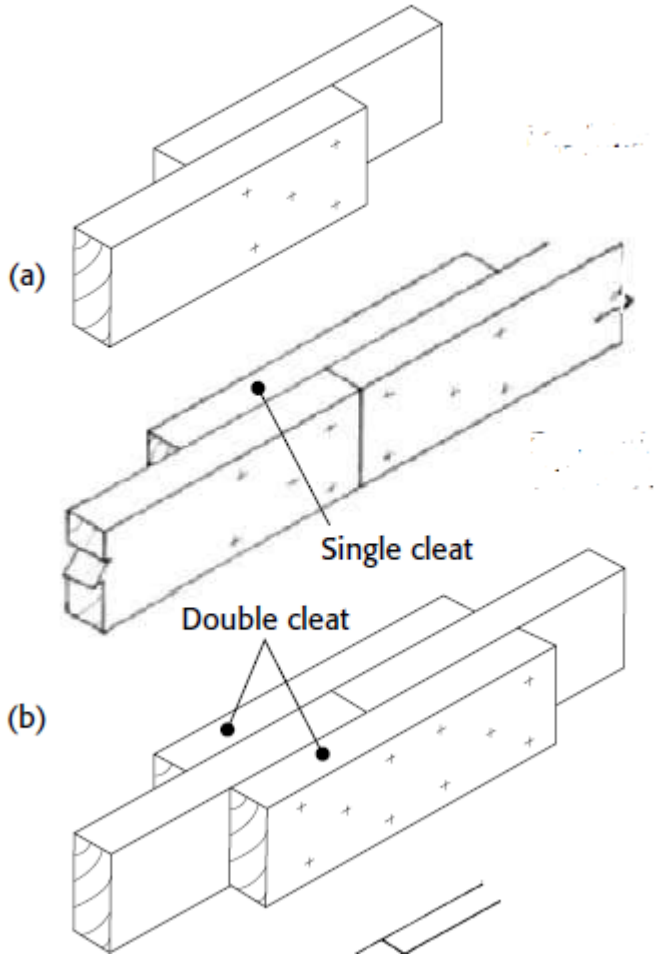
While constructing the roof, the materials to be used will have to fulfill the following major requirements:

i. To be sufficiently strong and stable
ii. To have a good fire resistance.
iii. It is not expensive
iv. It has a long life time (it will be used many times)
v. Available

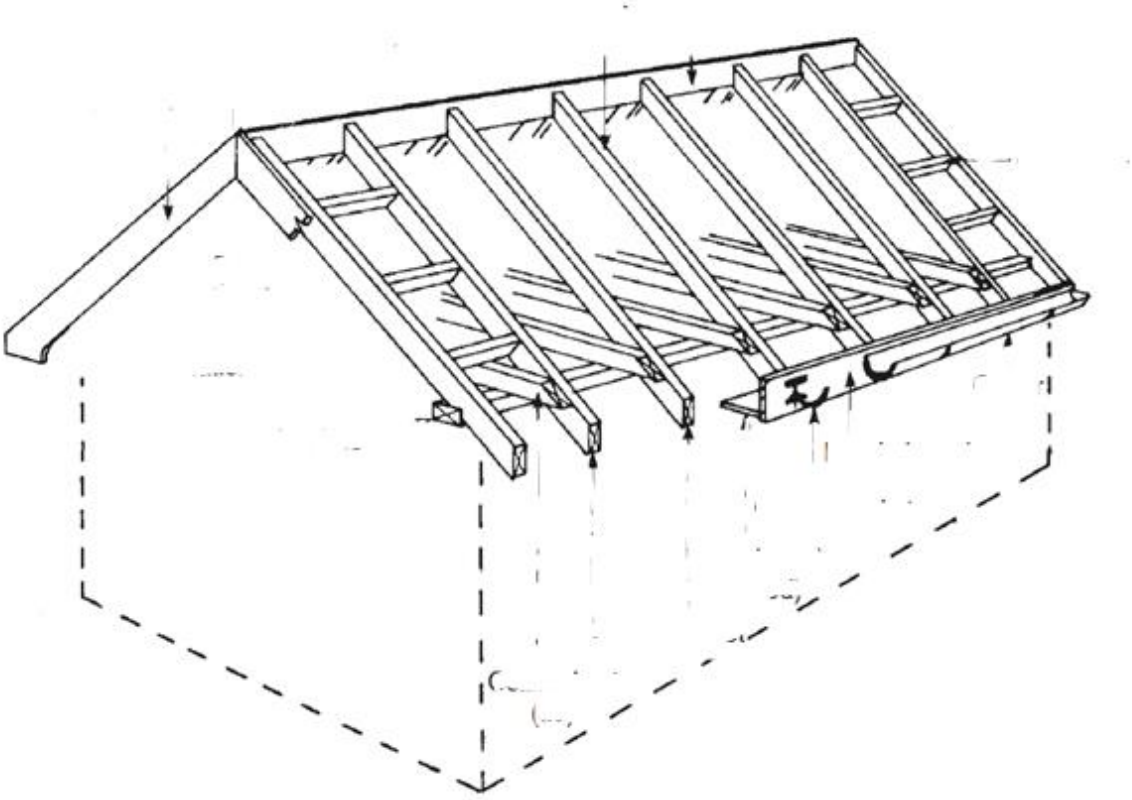
The materials used on roof construction are classified into two groups:

1. Materials used to make roof frame (roof truss)
2. Materials used to make roof covering

Materials used to make roof frame (roof truss): these materials are used to make roof trusses can be wood, metals and nails, screws, bolt and nut used to make different connection between different members of roof trusses. to the length of purlin, rafters…



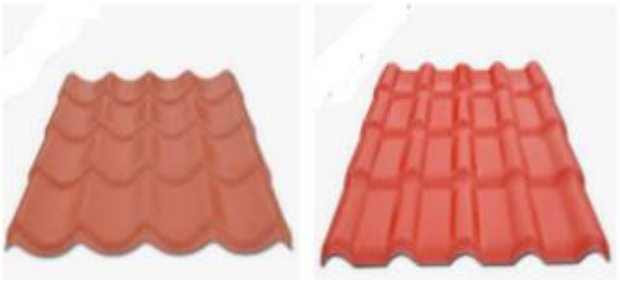
To increase the length of different members' screws, nail can be used.



Materials used to make roof covering/covering materials

Types of Roof Coverings

1. Thatch
2. Wood
3. Shingles
4. Tiles
5. Slates
6. Asphalt
7. Asbestos cement sheets
8. Corrugated iron sheets
9. Bituminous felt
10. Glass
11. Sheet metal roof coverings (copper, zink, etc.)



Preservative materials

i. Oil type
ii. Chemicals
iii. Solvents
iv. Water borne type

Except where timber is used in its natural state for practical or economical reasons, it is generally treated with paint, water-repellent stain, preservative, or special solutions to either reduce or retard the effects of:

a) Weathering (erosion and discoloration)
b) Exposure to sunlight
c) Moisture movement,
d) Fire; and to reduce or even eliminate the risk of:
e) Fungal attack,
f) Insect attack.

- **Organic-solvent preservatives**

Use a medium of organic solvents to transmit the toxic chemicals into the wood. After application, the solvents evaporate, leaving the wood toxic to insects and/or fungi.

- **Water-borne preservatives**

Use water to convey the toxic chemicals. These preservatives are non-flammable. Drying is always necessary after treatment. When dry treated timber can be painted over.

- **Tar-oil preservatives**

Derived from coal tar, and are ideal for preserving exterior work which is not to be painted.
They do not usually have any corrosive effect on metals, but they will stain most porous materials they contact.

Method of applying

- **Brushing** – Can be used for applying creosote, organic solvent, and some waterborne types of preservative but because of low penetration,

- **Spraying** – Similar penetration and conditions apply as for brushing.

- **Dipping** – the timber is submerged in a tank of preservative (coal-tar oils or organic-solvent types) for a short period,

- **Hot & cold (open tank treatment)** – The timber is submerged in a tank of preservative (coal-tar oil) which is heated.

LO 1.3 – Prepare frame materials

- Content/Topic 1 Types of roof:

Three main roof types

1. Pitched roof
2. Flat roof
3. Curved roof

1. FLAT ROOF

The term flat roof refers to any roof which has its upper surface inclined at any angle (slope) not exceeding 10^0.

As the name suggests, flat roofs appear to be completely flat with no pitch. However, they do have a slight pitch to allow for water run-off and drainage.

These roofs are generally used on industrial or commercial buildings. However, they can also be installed on residential houses in both high and low rainfall areas.

Most people don't consider the amount of available outdoor living space a flat roof can provide.

Flat roofs are easier to construct than pitched roofs and require fewer building materials, keeping costs down.

2. PITCHED ROOF

Definition: pitched roof is the roof which has its upper surface inclined at an angle (slope) greater than 10^0 not exceed 70^0.Above 70^0 considered as a wall:

a. Gable

b. Hipped roof

c. Mansard roof

d. Combination roof

e. Curved roof

f. Dome roof

g. Pyramid roof

a) HIPPED

A hip roof has slopes on all four sides. The sides are all equal length and come together at the top to form a ridge.

Hip roofs are more stable than gable roofs. The inward slope of all four sides is what makes it more sturdy and durable.

They are excellent for both high wind and snowy areas. The slant of the roof allows snow to easily slide off with no standing water.

Hip roofs are more expensive to build than a gable roof. It's a more complex design that requires more building materials.

b) GABLE

Also known as pitched or peaked roof, gable roofs are some of the most popular roofs. They are easily recognized by their triangular shape.

Gable roofs will easily shed water and snow, provide more space for the attic or vaulted ceilings and allow more ventilation. Their inherently simple design makes it easy to build them and cheaper than more complex designs.

Gable roofs can be problematic in high wind and hurricane areas. If the frames are not properly constructed with adequate supports, the roof can collapse. High winds can also cause materials to peel away from gable roofs. If there is too much of an overhang, winds can create an uplift underneath and cause the roof to detach from the walls.

If a gable roof is used in high wind areas, be sure proper braces are used and have the roof inspected after a large storm to ensure no damage occurred.

c) PYRAMID ROOF

A pyramid roof is a type of hip roof. All four sides come to a point at the top of the roof. There are no vertical sides or gables.

Pyramid roofs are mostly used for smaller buildings, such as bungalows and cabins. They are also used for auxiliary structures, such as pool houses, garages and storage buildings.

A pyramid roof is extremely resistant to strong winds. This makes it an excellent architectural choice for hurricane-prone and high-wind areas.

The cost of pyramid roofs is higher due to the complexity of the design.

d) MANSARD ROOF

A mansard roof, also known as a French roof, is a four-sided roof with a double slope on each side that meets forming a low-pitched roof.

The lower slope is much steeper than the upper. The sides can either be flat or curved, depending on the style.

Using wood or slate shingles in a diamond pattern is a way to make a mansard roof stand out. However, **overlapping composition shingles should not be used**. Asphalt shingles can still be used on a steeper portion of the roof in a regular pattern.

Most materials can be used for a mansard roof, but be aware of the low slope part of the roof. Ensure it is properly flashed and waterproofed to protect the roof's integrity.

e) DOME ROOF

A dome roof is polygonal with an inverted bowl shape. Dome roofs are great for adding unique and aesthetically pleasing features to any home. They are excellent choices for cupolas, gazebos or crow's nests.

Dome roofs are both beautiful in design as well as durable.

The complexity of a dome roof makes them expensive to construct. However, depending on the structure, a prefabricated one may be available..

f) COMBINATION ROOF:

A combination roof incorporates a design using various roofs on the same structure for aesthetic and practical reasons.

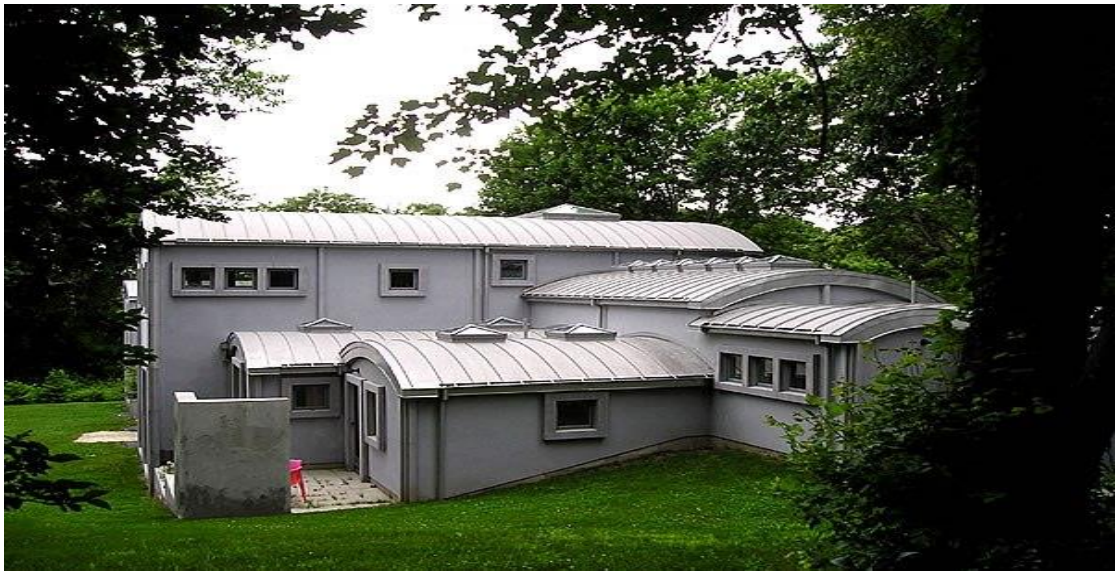
For example, a house may have a hip roof with a gable roof over dormers and a skillion over the porch.

The more complex the design, the more expensive it will be. Adding different pitches and roof types will require more building materials and labor costs.

Joining different roofs always adds valleys and ridges. These are the weakest areas of the roof where water can pool and leak.

3. **CURVED ROOF**

A curved roof is much like the Skillion, or Shed roof, but the planes are curved. It is very modern and provides a unique, creative roof design. The amount of curve can vary from slightly curved up to an arch shape.



Curved roofs are aesthetically pleasing and a way to have a home unlike any other. They also provide subtle shapes inside the home as well.

A curved roof can be used to cover the entire home or a single section, such as an arched entrance. Since curved roofs are designed by the architect or builder, it can be customized to be advantageous to the region the home is being built. For example, in high wind areas, a roof with a lower slope would be more durable than one with a higher slope. While in areas that receive more snow and rain can have more of an arch to allow water to run-off.

The cost of a curved roof will depend on the complexity of the design.

- Content/Topic 2 Roof components:

Roof components:

a) **Eaves:** the lower edge of the roof which overhangs the walls, thus giving the wall a degree of protection, It also provides the fixing medium for the rainwater gutter
b) **Gable:** the triangular end of a pitched roof, or triangular upper part of a wall that closes the gable end of the roof
c) **Hip:** the oblique line running from the ridge to eaves at the junction of two sloping roof surface at an external intersection
d) **Ridge:** the line of intersection of two sloping roof surfaces at their highest point
e) **Valley:** the oblique line running from ridge to eaves at the internal intersection of two sloping roof surfaces
f) **Valley rafter**: as hip rafters but forming an internal angle
g) **Verge:** the sloping edges of a gable roof which overhang the gable walls
h) **Binder**: horizontal members running at right angles and fixed above the ceiling joists at intermediate positions along their length

i) **Ceiling joist;** horizontal members running across the roof from wall plate to wall plate to carry out the ceiling and to act as a tie to the feet of the rafters

j) **Common rafters:** inclined members running from wall plate to ridge to give support to the roof covering

k) **Fascia board:** vertical member trim to the lower end of rafter

l) **Hanger:** vertical or near vertical member running from ridge or purlin to carry the ceiling beams(binders) in double or single roof

m) **Purlin:** a structural members running parallel to but at mid way or intermediate points between the ridge and wall plate and at right angles to the rafters to give them support

n) **Soffit board:** horizontal members trim fixed to the feet of rafter used in conjunction with the fascia board to box in the feet of the rafter

o) **Wall plate:** horizontal members secured to the top of the wall to give fixing and support to the ends of rafters and ceiling joists and to transfer the load from structure to the wall

p) **King post:** king piece, joggle post, in traditional timber roof construction is central vertical strut rising from a tie beam and carrying a ridge purlin

q) **Strut:** a secondary member on the roof construction carrying the thrust from purlin or otherwise adding support to the rafter

r) **Jack rafters:** these fulfil the same function as common rafters but span from ridge to valley rafter or from hip rafter to wall plate

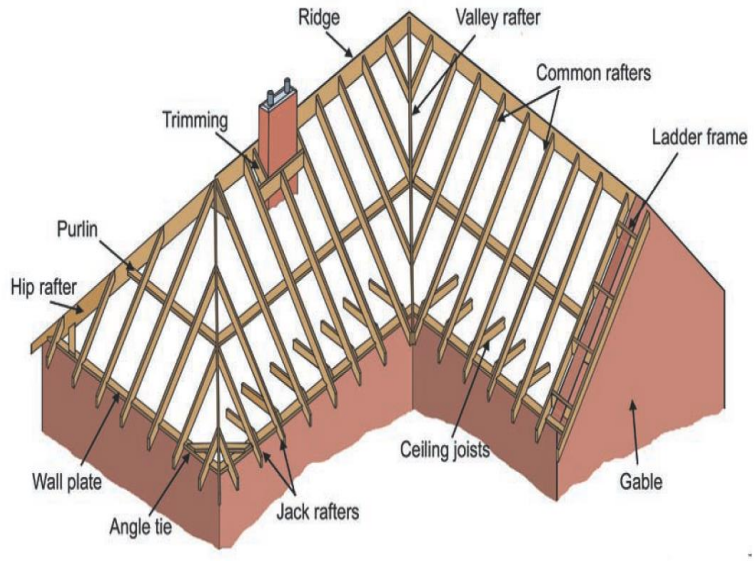
s) **Hip rafter:** similar to a ridge but forming the spine of an external angle and similar to a rafter spanning from ridge to wall plate

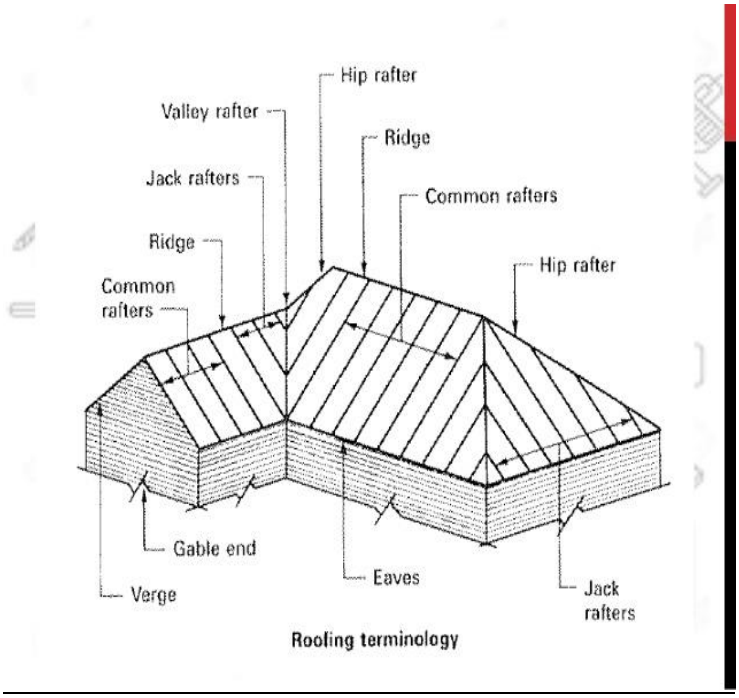
t) **Roof span**: the distance across the roof measured over the wall plates to their outer edge

u) **Rafter rise:** the vertical distance measured from the top of the wall to the intersection of rafters at the apex of the roof

v) **Roof pitch:** the slop of the roof expressed in degree, or ratio or fraction between rise and span

Pitch=rise/span





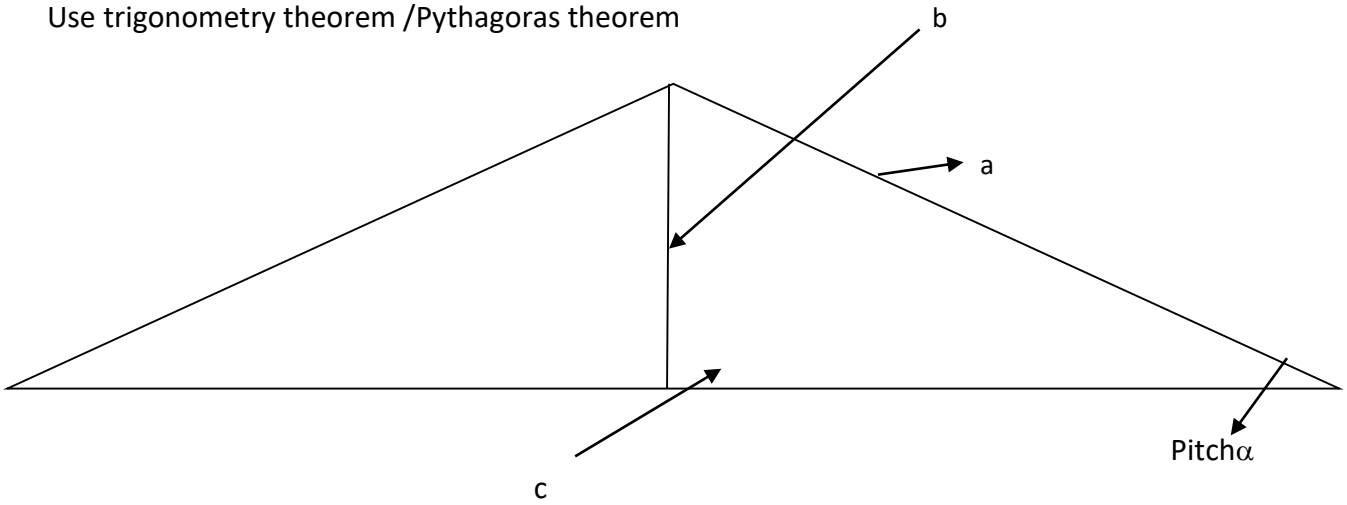
Roofing terminology

Types of roof trusses

1. King post truss
2. Queen post truss
3. Composite truss
4. Steel truss
5. Mansard truss

Rafter calculation

Use trigonometry theorem /Pythagoras theorem



Suppose that a: rafter

B: rise/king post

C: span

$A^2=B^2+C^2$

$C^2=A^2-B2$

$B^2=A^2-C^2$

$\sin\alpha=b/a$

$\cos\alpha=c/a$

Process of preparation for roof frame materials:

- **Planning**: is the first operation for preparing the pieces required to perform the work, that operation is needed the planning tools and planning machines.
- **Measuring**: Is the way of taking measurement from the site or from the house where you are going to construct its roof. This process is need the tape measure
- **Marking**: before cutting any member you must mark it at the required size.
- **Cutting cut to the final measurement after planning the different members of roof:** rafter, purlin, strut, cleats, etc
- **Joints**: this action is to assembly together the members of roof.

Learning Unit 2 – Fix Roof Frame

LO 2.1 – Level workplace and set out roof frame

- Content/Topic 1: Set out roof frame and connect the members of roof

Leveling tools:

1. **Plumb bob:** is a weight usually with appointed tip on the bottom, suspended from a string and used as a vertical reference line, or plumb-line.

2. **Hose pipe :used in levelling**
3. **Spirit level**: is used for determining horizontal and vertical levels .also to designed to indicate whether a surface is level on the horizontal or vertical planes.

4. **Building square**: perfect for determining the flatness of a surface plane or creating a true angle in cutting to size. Builders square is used where walls meet, calculating rafter angles, creating stairways, calculating octagons, etc

Leveling of workplace: this action help us to check the end of the house frame if is at the same level.

Methods of setting out of roof frame:

- **Direct setting out/lay out**: direct method is how to set the roof to the upper of the house frame.
- **Steel square method**: this method is high accuracy for checking the right angle comparing with the 3-4-5 method.
- **3,4,5 methods** : this method is how you set 3 and 4 unit as base and height and 5unit as diagonal in order to check the right angle at the roof construction.

LO 2.2 – Adjust roof trusses

- Content/Topic 1 Element considering for spacing roof trusses:

While fixing the different trusses of roof, these factors must be considered:

i. Types of roof
ii. Types of building
iii. Roof cover load
iv. Climatic condition (wind)
v. Types of roof trusses materials (metals, timber)

Checking roof trusses before applying roof cover is an advance because this may avoid the unequal of roof cover.Can be done by vertically, horizontally or by checking the angles.

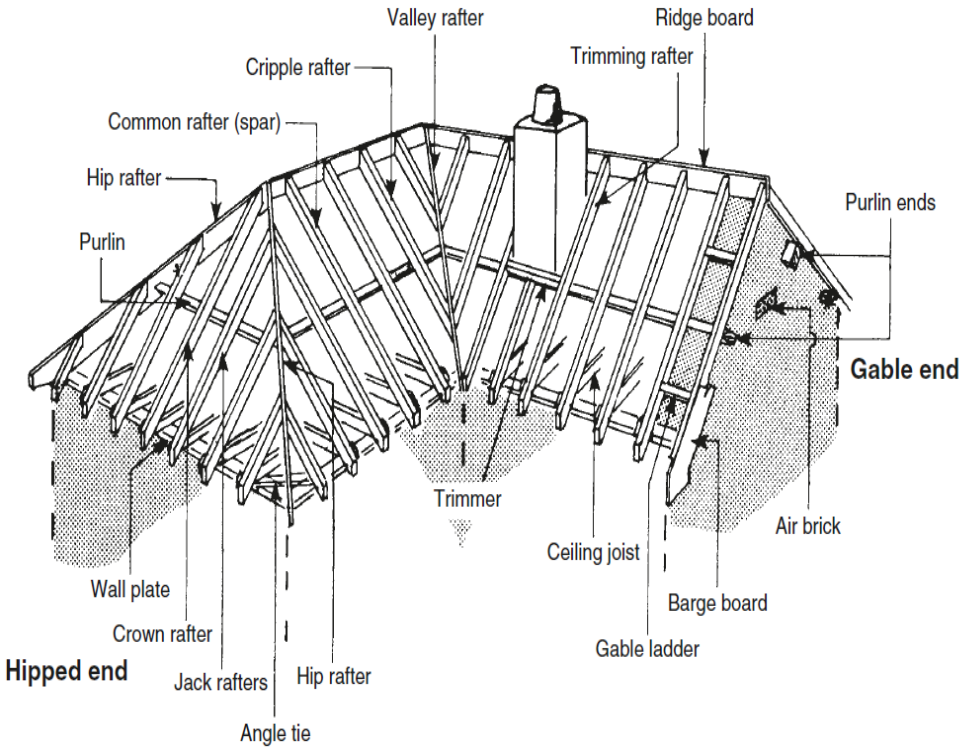
LO 2.3 – Connect and fix braces, purlins and ridge boards

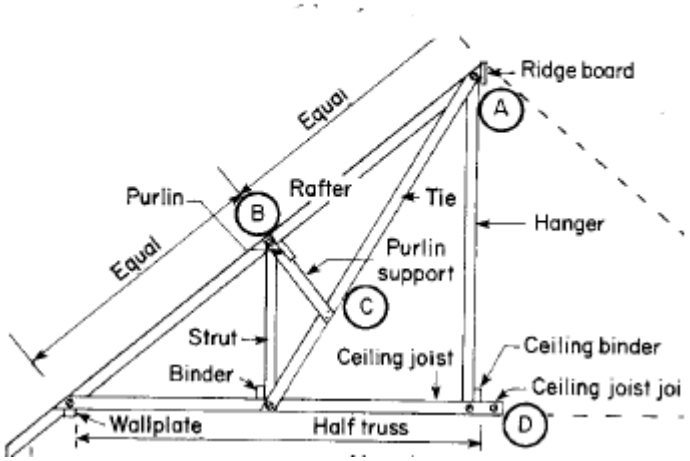
- Content/Topic 1 Fixing materials, Methods of fixing and Types of roof connectors:

Fixing materials of roof structure elements: fixing materials are used to connect together the different members of roof like: king post to tie beam, rafter to ridge and tie beam, purlin to rafters, strut rafters and tie beam, etc. These materials include:

- Nails
- Bolt and nut
- Screw

Roof structure elements





Methods of fixing:

- **Manual:** Manual method includes hand weeding and use of hand tools for example:

Assembly rafter to ridge with nails use hammer

- **Mechanical**: mechanical method on the other hand includes the application of mechanized or use of machine. For example as above use nail gun machine

Roof connectors

1. Metal gussets: a gusset or gussets plate is a triangular piece of timber or metal that is used to transfer stresses between connected members and help strengthen the joint between them.

is used to connect structural member that connect on the same plane.

i. Brackets
ii. Iron galvanized

Learning Unit 3 – **Apply roof covers**

LO 3.1 – Mark and cut sheets

- Content/Topic 1 Cutting sheet metals:

Marking tools: tools used to mark sheet metal to be cutted includes to the following tools:

a. Pencil
b. Charcoal
c. Marker
d. Nail
e. Carpenter chalk
f. Railroad chalk

Cutting tools: Are the tools used to cut to the final size sheet metal mark are as they follow:

i. Chisel
ii. Angle grinder
iii. Scissors
iv. Glass cutters

Process of sheet cutting:

I. Measuring: the first step is to measure to the dimensions required to the sheet metal and then mark.
II. Marking
III. Cutting : cutting to the final required size

Cutting tools

1. **Chisel:** these are flat chisel the most widely used to cut sheet metal.

2. **Angle grinder**: an angle grinder fitted with an abrasive metal-cutting disc works well to cut all kinds of metal, including bolts,angle iron, rebar and even sheet metal. But the discs wear down quickly, cut slowly and shrink in diameter as you use them.

3. **Scissors:** if you've got a lot of straight cutting to do, buy tin snips like the one gives you the best result. it cuts metal almost as easily as a scissors cuts paper. and the long blades make it easy to cut straight and leave a smooth edge. That tool is the best one used to cut sheet metal comparing with the others.

4. **Glass cutters**: a glass cutter may used to cut sheet metal but not quick.

Trimming methods:

a. Manual method
b. Automatic method

LO 3.2 – Lay and fix roof covers

- Content/Topic 1 Method of fixing roof covers:

The fixing cover can be in different method:

1. **Nailing method**: this method is most used on timber roof.
2. **Screwing method**: this method is used for metal roof construction.
3. **Bolting method**: is used with bolt and nut, this can be used for timber or metal roof.

Testing methods of roof: is the way used for checking the pitch/slope of the roof made.
the purpose of roof testing: regular inspection of building roof systems will lead to early detection of roof problems, protection of government capital assets, and maintenance of safe working environments for building occupants. to determine if the roof system is performing according to its intended function. Also to identify needed repairs.

1. **Water testing:** this method is to spread the water to the roof cover in order to check the **speed of water downward.**
2. **Gravel gradation**: Also this method it is like water testing but this method is used the gravel.
3. **Uplift testing:**The result of a dynamic wind uplift testing provides insight to estimate the structural resistance of a roofing system and ensures it meets wind load design requirements. it also helps to identify weakness in the roofing system, helping manufactures to address them before catastrophic failure occurs.

LO 3.3 – Clean tool,equipment and workplace

- Content/Topic 1 Cleaning procedures and storing guidelines

Introduction
After each work it is better to clean the workingplace, tools and equipment and storing them used in order to be safe or working areas and tools and equipment.

1. **Ways of handling waste material at the workplace:**

Burning/firewood: To undergo rapid combustion of the waste materials in order to be cleaned to the workplace these waste materials can be the firewood for domestic activities at home.
Decomposition: the separation of a substance into simpler substances or basic elements. the process of decaying or rotting.

2. **Cleaning procedures and techniques tools and equipment used to perform work :**
   a. **Brushing**: brush the tools used from the dust in order to be used again without damaging.
   b. **Oiling**: oil the tools used in order to avoid rust attack to them.
   c. **Re-sharpening**: to sharpen the damaged/blunt tools like chisel, saw, screw driver….

3. **Storing guidelines**: storing of tools and equipment better is the most important because it increases the strengthening of tools and equipment. **Always store tools in its proper place**. That proper place is where the tool will be protected from damage…. this will prevent other tools from getting coated with this substance rendering them not ready to use, if your tools are stored incorrectly, the bacteria you're trying to eliminate will grow right on or in them storing will be done by respecting the following guidelines:

   - Dry place
   - Shelves
   - Toolbox

Reference(s):

- ✓ Carpentry and joinery by Brian Porter third edition/volume 2
- ✓ Carpentry and joinery by Brian Porter third edition/volume 3
- ✓ www.roofingcalc.com
- ✓ www.staydryroofing.com