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The highest part of a building that spans its surrounding external walls is called a roof.

The purpose of a roof is to protect the building from the elements, i.e. wind, rain, snow and the heat of the sun.

A roof usually consists of an external weatherproof material and an inner layer of thermal insulating material all of which are supported on a framework of timber rafters and beams.

Roofs are regarded as pitched or flat depending upon the amount of slope the surface of the roof has.

**Definitions of roofs**

*Flat roofs* – a flat roof is any roof which has a slope of less than 10°.

*Pitched roof* – is any roof with a slope of more than 10°.

**Types of roofs**

There are many different types of roofs, and they are classified according to their shape and design.

*Flat roof* – This is any roof which has a slope of less than 10°. This type of roof is associated with garages and small house extensions. The waterproof covering is usually bitumen felt although the new innovation is a glass fibre covering. Which is much more expensive?

*Lean-to roof* – This roof is similar to a flat roof except the slope of the roof exceeds 10°. This type of roof always abuts another higher wall. The covering of this roof must match the covering of the main roof of the building.

![Lean-to roof](image1.png) ![Flat roof](image2.png)
**Gable roof** – A gable is a straight wall with a triangular upper part which supports the roof. The roof has two sloping surfaces, or pitches, which slope from the ridge to the eaves.

**Hipped roof** – This is a roof where the slope of the roof is returned around one or both ends.

**A mono-pitched roof** – This is a roof which has one sloping surface and does not abut against another wall or building. The other surface of the roof is perpendicular.

**Mansard or Dutch roof** – This type of roof has each sloping surface pitched at two different angles. The gable ends of the building are straight. If the roof is hipped, it is usually the upper sloping portions that are hipped. This roof is sometimes referred to as a Dutch barn roof because of its shape.
Roof Components and Terminology

Components and elements are shown in the drawing below:

Elements of a roof

**Gable** – The triangular end of a pitched roof, or the triangular upper part of the gable wall.

**Hip** – The edge of a hipped roof that runs from the ridge to the eaves. It is formed when two sloping surfaces intersect.

**Eaves** – This is the lower edge of the roof surface that overhangs the walls.

**Soffit** – This is the underside of the eaves that is fixed to the back of the fascia and the wall. It forms an enclosed element all around the building.

**Ridge** – This is the uppermost line of the roof and is formed at the intersection of two sloping surfaces.

**Valley** – This is the line formed at the internal intersection of two sloping surfaces. It runs from the ridge to the eaves.

**Verge** – This is the underside surface of the eaves and the soffit of a gable roof which overhangs the gable wall.
The components of a roof

Wall plates – The timber component which sits upon the top of the walls of a building and to which the foot of the roof rafters are fixed

Fascia board – A vertical timber or plastic trim which is fixed to the feet of the rafters and, along with the soffit, encloses the eaves

Soffit board – A timber or plastic trim which is horizontally fixed to the underside of the rafters and which, along with the fascia encloses the eaves

Barge board – A vertical timber or plastic trim which is fixed to the face of the last common rafter at the end of a gable roof

Common rafter – A rafter that runs from the ridge to the wall plate

Jack or cripple rafters – These are short rafters that run from the hip rafter to the wall plate. These short rafters form the lower portion of a valley or hip.

Hip rafter – This is the main rafter of hip roof. It is to this rafter that all jack or cripple rafters are fixed to form the hip.

Gable ladder – This is a framework comprising two common rafters and noggins. The noggins and the rafters form a ladder frame which is built into the top of the gable wall and extends beyond the gable wall to form the gable eaves and to which the barge board is fixed.

Purlin – This is a strong, large sectioned timber member which, is fixed to the common rafters midway between the ridge and the wall plate and runs parallel to the wall and the ridge. On gable roofs, the ends of the purlin are built into the gable walls. This component gives added strength to the roof structure and allows heavier roof coverings to be used.

Joist hangers – These are metal hangers by which ceiling joists are fixed to the wall plate, or they may be built into the supporting walls.

Ceiling joists – These are timber components which span from wall to wall and to which the ceiling covering is fixed.

Roof binder – These are horizontal timber components which span from wall to wall and which are fixed to the feet of common and jack rafters.

Roof struts – These are angled components which are fixed to the common rafters and roof ties. The strut is usually fixed at right angles to the common rafter to offer greater strength.

Roof hangers – Hangers are vertical timber components similar in size and cross section to a common rafter and are fixed to the top of the common rafter close to the ridge and the ceiling joist or roof binders.
Roof Structures

*Types of roof structure*

Traditional roofs can be divided into three main types of structure:

- Single roofs.
- Double roofs.
- Trussed roofs.

Modern construction methods make use of another type of roof structure and this is known as trussed rafter roofs (*see trussed rafter roofs*).
Single roofs
Rafters of single roofs do not require any intermediate support. This type of roof has a number of limitations. It can only be used for small spans. If greater spans are required, larger roof sections would be needed. If the feet of the rafters are not tied together by means of a binder or roof joist, then this type of roof will have a tendency, under weight, to push the supporting walls outwards at the top causing structural failure of the walls.

Single roofs can be categorised as follows:

**Couple roof** – These can be used for building with a clear span of not greater than 3m and pitches less than 40º.

**Collar roof** – These can be used for buildings with a clear span not exceeding 4mm.

**Close couple roof** – These can be used for buildings with a clear span not exceeding 5.5mm and with pitches less than 25º.

**Couple roof**
This type of roof structure is very limited in its use. The roof consists of common rafters fixed at the ridge and at the wall plate. When subjected to any type of load or force acting vertically downwards the rafters will move outwards at their feet thus exerting thrust to the walls forcing them outwards and causing possible failure of the wall structure.
Collar roof

A collar roof incorporates a horizontal roof member positioned approximately one third of the distance from the ridge to the wall plate line. This extra roof member helps prevent the rafters from spreading when under load; this allows this type of roof structure to be used for greater spans than the couple roof. This design also gives a greater ceiling height if required.

Close couple roof

This roof incorporates a main tie which is secured to the feet of each rafter and spans the width of the building. This added member forms a triangle which introduces the triangulation of forces within the structure. To stop the ceiling joist from sagging, a hanger is fixed to the rafter at the top and the ceiling joist at the bottom.

To further increase the strength of this structure, a binder is fixed to each ceiling joist and hanger. This binder runs parallel with the main wall and at right angles to the ceiling joist. This type of structure ensures that this type of roof can be used for great spans without the fear of the roof spreading under loads.
Pitches, Spans and Rises

When setting out a roof, there are certain essential factors that must be considered.

These are:

- **Roof span** – This is the distance across the roof and measured to the outer edges of the wall plates.
- **Roof height or rise** – This is the vertical height of the roof at its highest point and is measured from the top of the wall plates to the intersection of the rafters at the top of the roof. When measuring rafters, the length is taken as a straight line running through the centre of the rafter.
- **Roof pitch** – This is the angle or slope of the roof and can be expressed in degrees or as a fraction or ratio found by dividing the rise by the span.

Example. If a roof has a span of 6m and a rise of 3m then the pitch would be:

\[
\text{Pitch} = \frac{\text{Rise}}{\text{Span}} = \frac{3}{6} = \frac{1}{2} \text{ pitch}
\]

Since the rise is half the span, the angle of the roof would be 45°.
Common Rafter Length and Bevels

When determining the lengths and bevels of common rafters, it is normal to consider them as single lines rather than rafters of a certain width or thickness. If the rise and the span are known, it is a simple procedure to determine the length of the common rafter and its main bevels.

The roof section can be set out full size or to scale. Once the section has been set out the length of the common rafter can be determined by drawing the rise and the span as a right angle joined together by the hypotenuse which will determine the slope of the roof.

The rafter is seated upon the wall plate by means of a notch or birdsmouth joint which is cut one third into the rafter. The angle at which the notch is cut is called the seat cut. The top angle or bevel is called the plumb cut.

Once the bevels have been determined, a sliding bevel can be set to the angle required or in some cases, a piece of plywood can be cut to each bevel and used as a template for all the other rafters.

When determining the length of the rafter, an allowance is made for the thickness of the ridge and the length of the overhang at the eaves.
Verge Details and Ladder Frame

The construction of the verge of a gable roof is shown below. The roof extends over the gable wall to give a suitable overhang. To achieve this is a simple frame called a ladder frame is constructed. This frame consists of the last two rafters joined together by means of noggings nailed to the inside of the rafters. The brickwork of the gable extends through this frame to finish the wall level with the top of the rafters.

A finishing trim called a barge board is then nailed to the last rafter. This barge board is sufficiently wider than the rafters to cover the entire end rafter including the tilting fillet.

A soffit is then fixed to the underside to match the soffit under the eaves. The barge board is also fixed to the fascia. The fascia can be mitred to the barge board at the foot while the top of the barge board at the apex of the roof is mitred to the matching barge board on the other side.
Eaves Details and Fascias

There are various ways of constructing the eaves of a gable roof. Below are two examples:

- **Flush eaves.**
- **Boxed or closed eaves.**

![Flush eaves details](image)

![Closed or boxed eaves details](image)
Flush eaves
In this method of finishing off the lowest edge of the roof, the rafter feet are cut plumb, and project 25mm from the face of the outer brickwork. This will allow a ventilation gap to be formed so that a continuous flow of air can circulate throughout the roof space.

The fascia board is nailed directly to the rafter feet to form a face trim. It is to this fascia board that the guttering is fixed.

Closed or boxed eaves
This is a more complex method of finishing the lowest edge of the roof. The rafter feet are allowed to overhang the face of the outer brickwork. The overhang can vary in size but usually the distance is stipulated on the working drawings, or is at a distance that can accommodate a proprietary ventilation soffit.

The soffit is supported by a cradling bracket or, in some cases, a piece of plywood cut to shape.

The roof space can be ventilated by using a proprietary vermin proof ventilation strip or the soffit can be drilled with a series of holes into which plastic ventilators are fixed.

Roof ventilation
Roof ventilation is essential to reduce the likelihood of condensation within the roof space as required by the Building Regs 1985.

The regulations state that all roofs must be cross-ventilated at eaves level by permanent vents and these must have an equivalent area equal to a continuous gap along both sides of the roof of 10mm, or 25mm where the pitch of the roof is less than 15°.

This ventilation requirement can be achieved by:
- Leaving a gap between the outer wall and the soffit.
- Using a proprietary ventilation strip.
- Using circular plastic ventilators set into the soffit board.

There are many types and designs of proprietary ventilators available all of which have been designed to give sufficient ventilation to the roof space if used and incorporated into the structure correctly.
Double Roofs

A double roof is a roof whose rafters are of such a length that they require an intermediate support. This support is usually a beam which is secured under the rafters at a point half way between the ridge and the wallplate. This beam is known as a purlin.

In gable roofs, the purlin is built into the gable wall to provide added support. In double pitched roofs, the purlin is fixed to the rafters in a continuous length, jointed at all the internal and external corners of the roof.

In traditionally constructed roofs, the roof may also require added support in the form of roof trusses. This will depend upon the size of the roof and the type of roof covering the roof has to support.

In modern double roof construction, the whole of the roof is constructed of lightweight roof trusses called trussed rafters (See Module 4).

**Double roof with hipped end**

There are many designs and combinations of double roofs. The design of the roof will depend upon the size and shape of the ground floor plan of the building.

The drawing shows a partly hipped roof with one hipped end and one gable end. A fully hipped roof has no gables, and the eaves run round the perimeter of the roof. The eaves are usually of the boxed or enclosed type.

*Hipped and gable roof components and terminology*
Valley construction using lay board

Alternate valley construction using valley rafter
Setting out and determining roof bevels
There are a number of ways that the length and angle of members can be determined. The roof pitch is always defined in degrees while the lengths of the members are defined in metres.

Since all roof member bevels are based on the right angle triangle principle, they can be determined by:
- The use of scaled drawings in orthographic projection.
- The use of a roofing square (simple tool based on the right angle principle and calibrated in degrees and millimetres and the length of inclined roof members).

Determining roof member lengths and bevels using orthographic projection.
Determining roof member lengths and bevels using orthographic projection

Roofing angles and true lengths

The geometry to determine the length and bevels of each individual roof member will be covered in more detail with your trainer.
Determining roof member lengths and bevels using a roofing square.

A roofing or framing square is a steel square which consists of two arms set at right angles to each other. One of the arms is wider and longer than the other; this is known as the blade. The shorter, thinner arm is known as the tongue.

The length of the blade is 620mm and the tongue 450mm.

The square is calibrated in millimetres and degrees, and both sides contain a set of tables which give the rafter and hip lengths in metres run for various rises in degrees.

To use the square, the rise of the roof is set on the tongue, and the run of the rafter is set on the blade.

Example. Consider a common rafter of a roof with a rise of 3m and a rafter run of 4.50m.

To accommodate the use of the square, the sizes are scaled down or reduced by.

Therefore:
- Rise \( \frac{3.00m}{10} = 300mm \)
- Run \( \frac{4.50m}{10} = 450mm \)

Steel roof square

Steel roofing square with adjustable fence
Use of steel roofing square

Below is an example of how the square is applied. The lengths will be to scale and will need to be converted to full size.

The drawing shows how the length and angles are set off for a common rafter. The same procedure can be used to obtain all the other rafter lengths and angles using the following combinations.

- Common rafter run + common rafter run = Hip run.
- Hip run + rise = Hip length and cuts.
- Hip length + rise = Hip backing bevel.
- Hip length + hip run = Hip edge cut.
- Common rafter length + common rafter run = Purlin edge cut.
- Common rafter length + rise = Purlin side cut.
Trussed Rafters

The majority of double roofs that are constructed today make use of trussed rafters.

Trussed rafters are manufactured in factories, under strict quality control.

They are designed to be lightweight while, at the same time, able to support calculated roof loads. For those reasons they are manufactured in a variety of shapes and sizes to suit the needs of the builder.

Below are a few of the many popular designs available:
Trussed rafters construction

The trusses are manufactured in factories and are assembled using adjustable jigs. The assembly procedure has strict quality controls to ensure that all trusses meet the design requirements. All the timber used is stress graded softwood and the sizes of the roof members will vary according to the load that the truss has to support and the span of the roof. Usually, the cross section sizes vary between 35mm x 75mm and 145mm x 45mm.

The individual roof members are butted together and jointed by the use of:

- Nailed plywood gussets.
- Nailed galvanised steel plates.
- Galvanised steel punched plates.
**Truss rafter roof construction**

The roof is constructed of a number of truss rafters spaced at centres between 400mm and 600mm. The trusses are designed to sit directly onto a prefixed wall plate and are fixed in place by the use of truss clips and supported by galvanised wall straps or restraints to provide extra strength.

![Types of truss clips](image)

- **Types of truss clips**
  - Rafter
  - Ceiling joist
  - Truss clip fixed to truss and wallplate
  - Wallplate
  - Blockwork
  - Outer brickwork

![Truss rafter fixed to wallplate](image)

- **Truss rafter fixed to wallplate**
  - Roof truss
  - Wallplate
  - Tie down straps
Typical truss
The hipped end of a double truss rafter roof can be formed by either:
• Traditional cut rafters and ceiling joists.
or
• Tailor-made trusses which are assembled on site to form the hip.

Typical 'W' truss rafter
Traditional cut rafters and ceiling joists to form hipped end

Hipped end detail
Roof Truss Spacing and Layout

Permanent and temporary bracing to support roof

Lateral restraint straps tying roof trusses to gable
Water Tank Platform

In most modern domestic housing, the water tank which supplies the house is housed in the roof space. To support and distribute the weight of a full water tank, a platform is built.

The platform is usually placed centrally in the roof space and the load spread over at least three truss rafters. The platform consists of a sheet of 18mm plywood supported on three bearers fixed to the truss rafter ceiling joist.

Trimming to Openings

Where there are openings intended for such things as Velox windows, loft hatches or chimney stacks, the openings are trimmed. The trimmers are nailed to the rafters at the required dimensions to accommodate the item.
Handling and Moving Truss Rafters

When handling or moving truss rafters, care must be taken not to exert strain on the joints.

The rafters should be lifted and carried from the eaves and should be kept upright. When lifting the trusses into position, they can be manhandled using a team of workers. This will involve the use of extra scaffolding within the building to support the operative and assist in the movement of the trusses. When lifting the trusses to a great height, a crane is used, and the trusses are lifted in sets using a set of slings. To prevent the trusses from swinging, a guide rope is used to control the trusses. This guide rope is held by an operative at ground level.
The Procedure for the Erection of Truss Rafters

The diagram shows the position of truss rafters and the position of relevant bracings and binders used to stabilize and strengthen the roof.

**Erection procedure**
- The positions of the trusses are marked off on the wall plate.
- The rafters are lifted into place and stacked in an upright position at one end of the roof.
- The first rafter is placed into position and secured with truss clips. It is plumbed and temporarily braced using diagonal braces and binders.
- The remaining rafters are slid into position, secured and braced temporarily.
- Once all the rafters are in place, the diagonal braces and the longitudinal braces are secured.
- All relevant strapping and restraints are secured in place.
Truss rafter being erected and fixed in place
Flat Roofs

The definition of a flat roof is any roof which has a slope of less than 10° or a fall ratio of 1:6. This type of roof is associated with garages and small house extensions. The waterproof covering is usually bitumen felt although the new innovation is a glass fibre covering, but it is much more expensive than traditional bitumen felt.

Roof falls

The direction of the slope of the roof is called the fall. There are three common methods of producing the fall and these are shown in the sketches below.
Roof Falls

The fall of the roof will depend upon:
- The type of roof construction and its covering.
- The location of the building.
- The position of any surface water drain.

The amount of fall should be sufficient to clear away any water and direct it to any surface water outlet pipe. If the fall is insufficient to accomplish this, the water may form pools which can increase the weight of the roof or lead to water penetration.

Construction methods used to obtain the roof fall
There are three basic methods of obtaining the fall of a flat roof. The chosen method will depend upon the type and use of the building and the internal ceiling finish required.

Sloping roof joists
In this type of construction, the slope or fall is obtained by sloping the roof joists. This type of construction is used where there is no level ceiling required.

Tapered furring pieces
In this type of construction the slope or fall is obtained by attaching tapered pieces of timber to the roof joists. This type of construction will produce a level ceiling.

Deepened joists (parallel fittings)
This type of construction involves parallel furring pieces, the firings are diminished section and are nailed at right angles to the fall of the roof.
Roof Joists

All the roof joists used in the construction of flat roofs must comply with the requirements of current building regulations.

These regulations govern:
- The sectional sizes and grades of timber.
- Dead loads imposed upon sectional areas of roof.
- Maximum clear span for imposed loadings.
- Spacing of joists in relation to covering and imposed loads.

NOTE:
The spacing of roof joists is always shown as a distance relating to the centre of one joist to the centre of another. When determining the centres of the joists, the ceiling material such as plasterboard must also be taken into consideration. It is good practice to ensure that all unsupported edges of the roof covering, as well as the edges of the ceiling material, are supported by means of noggings nailed to the inside of the joists.

Sometimes solid noggings are used. These have the added advantage of stiffening the joists and preventing twisting.
Supporting Joists

Depending upon the slope of the roof, joist ends must be supported at:
- The eaves.
or
- The verge.
or
- Where the joists abut to another building.

**Dimensions required to obtain joist sizes**

To determine the size of the joists, there are certain dimensions required. The drawing above shows the dimensions the building regulations relate to determine the size, grade and section of the joists to carry certain imposed dead loads.

Two of the most important dimensions are the clear span of the joist and the centres at which they are fixed.

**Methods of supporting joists**

There are various methods of supporting joists. The method adopted usually depends on the position of the building and the fall of the roof.

The methods that can be used are:
- Joists built into walls.
- Supported by steel beams.
- Supported by joist hangers built into walls.
- Supported by timber bearers and a supporting fillet.
- Supported by timber bearer and framing anchor.
- As part of a frame held together by framing anchors and joist hangers.
Methods of Supporting Joists

**Built in**
Ends of joist built into wall. The ends must be treated with a preservative to prevent rot.

**Attached to steel beam**
This occurs where there is an opening in the wall and a steel lintel has been inserted.

**Joist hanger**
Joist hanger built into wall to accommodate the joist.

**Wall bearer and fillet**
A timber wall piece is fixed to the wall, and a fillet is fixed to the bearer. Joist is notched over the fillet.

**Framing anchor**
The drawing below shows the construction of the flat roof to the garage of the bungalow in Section 2: Technical Drawing Skills.

All the details shown in the following sheets pertain to this roof. The roof is a flat roof abutted to the gable end of the bungalow. The front wall of the garage has a parapet, which is capped with a brick on edge finish. The joists span the shortest distance and are built into the gable wall and extend over the eaves and rear verge to form an overhang. The decking is of cement bonded chipboard and covered with layers of bitumen felt with a final coating of bitumen bedded chippings.
Roofs

Detail of joists parallel to parapet wall of garage

- Brick on edge
- Cover flashing
- Angle fillet
- Waterproof covering
- Decking
- Joists with firings above
- Thermal insulation
- Plasterboard ceiling
- Lintel above garage door opening
- Front face of garage wall
- Felt turned over drip batten
- Fascia
- Ladder frame
- Rear wall
- Waterproof covering
- Decking
- Joists with firings above
- Thermal insulation
- Plasterboard ceiling
Eaves detail

Eaves detail for cavity wall construction

Eaves detail of front wall (cavity wall)
Box Gutter

An alternative to an external gutter construction is a box gutter. A box gutter is a gutter formed within the overhang of the eaves. It is an integral part of the roof construction and gives a neat appearance to the fascia. However it is much more costly and time consuming to form this type of gutter. The rainwater downpipe includes a cover to prevent any debris flushing down the pipe and blocking it.
Types of Roof Decking

The sheet material used to cover a flat roof is called ‘decking’. Decking must conform to the requirements of current building regulations and must be able to withstand imposed loads such as:

**Dead loads** – the imposed loads associated with the weight of the roofing materials as well as snow and ice.

**Live loads** – the imposed loads of people working and walking on the structure.

**Wind loads** – the imposed loads of strong winds.

There are numerous types of decking materials that can be used. The chosen material will depend upon the type of construction and the thermal insulation qualities required.

The most common types of decking are:

- Tongued and groove boarding.
- Plywood sheets.
- Chipboard sheets.
- Strand board (OSB).
- Preformed metal sheeting.
- Composite boards.

**Tongued and grooved boarding**

Tongued and grooved boarding is very rarely used as a decking material. It is costly compared with chipboard or plywood. It also has the disadvantage of shrinking, warping and cupping when in contact with moisture and sun, making it an unsuitable material on which to lay a protective waterproof membrane. If the boards are laid across the fall of the roof, they can form small hollows which can accumulate pools of rainwater thus preventing the flow of water from the roof surface.

**Plywood sheets**

There are many types and grades of plywood, but only roofing grade (WBP) must be used as a decking material for roofs. The sheet sizes are usually 1.2 x 2.4m but larger sheets are available. The sheets can be laid in any direction, but all the edges must be supported.

This material is an ideal material for decking as it is strong and durable, but compared to chipboard it is costly.

**Chipboard**

This is the most common decking material used today. There are many types and grades including sheets which are tongued and grooved around all the edges, but only the types with water resistant qualities should be used.
This sheet material is also available with a covering of bituminous felt bonded to one surface. When these sheets are fixed into position, and the joints sealed, they will offer temporary protection against rain. As with plywood, all the edges of the sheet must be supported. The sheets are further protected with layers of bituminous felt topped with a sand coated final layer.

*Strand board (OSB)*
Oriented strand board is similar to chipboard and is manufactured in a similar manner except that the sheet consists of strands of timber glued and pressed together under factory conditions.

This material is more stable than chipboard, but only roofing grades should be used and, as with chipboard, all the edges must be supported.

*Preformed metal sheeting*
These are preformed profiled sheets of galvanised steel or aluminium with various protective coatings applied to the surface. This sheeting material is very rarely used for domestic housing, but innovations in design have resulted in a sheet material which consists of a sheet of expanded polyurethane or polystyrene sandwiched between two sheets of profiled aluminium. The result is a sheet material which is lightweight and strong and suitable as a decking material.

*Composite boards*
This type of decking consists of an insulation material sandwiched between two sheets of decking material such as WBP plywood or bitumen impregnated chipboard. The insulation material varies, but the most common is expanded polyurethane or polystyrene. This type of decking offers a weather proof surface with thermal insulation qualities suitable for warm deck construction.

*Roof insulation*
The main function of any thermal insulation is to prevent heat from leaving or entering a building. All good insulating materials have a cellular structure that traps air within it and air is an excellent thermal insulator. There are many good insulating materials available in the form of a rigid sheet or as a semi-rigid slab or quilt.

The more common types are expanded polyurethane or polystyrene slabs, mineral wool, or glass wool quilt.
The position and way the insulation material is incorporated within the roof structure will determine whether the roof is classified as either a ‘warm roof’ or ‘warm deck construction’ or a ‘cold roof’ or ‘cold deck construction’ (See Sheet 41).

There are types of flat roof construction that have the insulating material placed on the top of the weatherproof membrane. This type of construction is known as an ‘inverted roof construction’ and is used for a flat roof that is to be used as a balcony, and the insulating material will be a hard wearing material such as tiles, concrete slabs or gravel.
Types of Flat Roof Deck Construction

**Cold deck construction**
In this type of construction, the thermal insulation material is placed at the ceiling level to retain any heat within the structure. A vapour barrier is positioned at the warm side of the insulation to prevent water vapour from passing through the insulation and coming in to contact with colder air which will condense any vapour, turning it into water droplets. To further prevent any other dampness occurring, the joist spaces are ventilated.

**Warm deck construction**
In this type of construction, the thermal insulation material is positioned at decking level. A vapour barrier is placed on the warmer under side of the decking, and there is no need to ventilate the joist spaces.

**Inverted deck construction**
This type of construction is usually associated with concrete balconies and roofs. The impervious insulation material is placed on top of the waterproof membrane.
• The highest part of a building that spans its surrounding external walls is called a roof.
• The purpose of a roof is to protect the building from the elements, i.e. wind, rain, snow and the heat of the sun.
• A definition of a flat roof is any roof which has a slope of less than 10°.
• A definition of a pitched roof is any roof will a slope of more than 10°.
• A lean-to roof is similar to a flat roof except that the slope of the roof exceeds.
• A gable is the triangular end of a pitched roof, or the triangular upper part of the gable wall.
• The hip is the edge of a hipped roof that runs from the ridge to the eaves. It is formed when two sloping surface intersect.
• The eaves are the lower edge of the roof surface that overhangs the walls.
• The soffit is the underside of the eaves that is fixed to the back of the fascia and to the wall. It forms an enclosed element all around the building.
• The ridge is the uppermost line of the roof and is formed at the intersection of two sloping surfaces.
• The valley is the line formed at the internal intersection of two sloping surfaces. It runs from the ridge to the eaves.
• The verge is the underside surface of the eaves, and the soffit of a gable roof which over hangs the gable wall.
• Wall plates are the timber component which sits upon the top of the walls of a building and to which the foot of all roof rafters are fixed.
• The fascia is the vertical timber or plastic trim which is fixed to the feet of the rafters and along with the soffit encloses the eaves.
• The soffit is the timber or plastic trim which is horizontally fixed to the underside of the rafters and, along with the fascia, encloses the eaves.
• The barge board is the vertical timber or plastic trim which is fixed to the face of the last common rafter at the end of a gable roof.
• Common rafters are rafters that run from the ridge to the wall plate.
• Jack rafters are the short rafters that run from the hip or valley rafter to the wall plate. It is these rafters that form the lower portion of a hip or a valley.
• A hip is the main rafter of a hip roof. It is to this rafter that all jack or cripple rafters are fixed to form the hip.
• A gable ladder is a framework comprising two common rafters and noggings. The noggings and the rafters form a ladder frame which is built into the top of the gable wall and extends beyond the gable wall to form the gable eaves and to which the barge board is fixed.
• The direction of the slope of the roof is called the fall.
• A purlin is a strong large sectioned timber member which is fixed to the common rafters midway between the ridge and the wall plate and runs parallel to the wall and the ridge. On gable roofs, the ends of the purlin are built into the gable walls. This component gives added strength to the roof structure and allows heavier roof coverings to be used.

• Joist hangers are metal hangers by which ceiling joists are fixed to the wall plate or are built into the supporting walls.

• Ceiling joists are timber components which span from wall to wall and to which the ceiling covering is fixed.

• Roof binders are horizontal timber components which span from wall to wall and are fixed to the feet of common and jack rafters.

• Roof struts are angled components which are fixed to the common rafters and roof ties. The strut is usually fixed at right angles to the common rafter to offer greater strength.

• Roof hangers are vertical timber components similar in size and cross section to a common rafter and are fixed to the top of the common rafter close to the ridge and the ceiling joist or roof binders.

• Traditional roofs can be divided into three main types of structures:
  2. Double roofs.
  3. Trussed roofs.

• Single roofs can be categorised as follows:
  > Couple roof – These can be used for building with a clear span of not greater than 3.00m and pitches less than 40°.
  > Collar roof – These can be used for buildings with a clear span not exceeding 4.00m.
  > Couple close roof – These can be used for buildings with a clear span not exceeding 5.50m and with pitches less than 25°.

• A double roof is a roof whose rafters are of such a length that they require an intermediate support.

• A trussed rafter roof is a roof constructed of pre-made framed rafters called trusses.

• The roof span is the distance across the roof and measured to the outer edges of the wall plates.

• The roof height or rise is the vertical height of the roof at its highest point and is measured from the top of the wall plates to the intersection of the rafters at the top of the roof. When measuring rafters, the length is taken as a straight line running through the centre of the rafter.

• The roof pitch is the angle or slope of the roof and can be expressed in degrees or as a fraction or ratio found by dividing the rise by the span.

• When handling or moving truss rafters, care must be taken not to exert strain on the joints.
• The direction of the slope of a roof is called the fall.
• The fall of the roof will depend upon:
  > The type of roof construction and its covering.
  > The location of the building.
  > The position of any surface water drain.
• All roof timber must conform to current building regulation requirements.
• The decking material of a flat roof must support both live and dead loads.
• The main function of any thermal insulation is to prevent heat from leaving or entering a building.
• There three types of flat roof construction:
  > Warm deck construction.
  > Cold deck construction.
  > Inverted deck construction.
The following knowledge test is a means of assessing your comprehension and underpinning knowledge of roofs.

The test may involve you working alone or in a small group. Whatever task you are assigned, you must retain all the finished work and draft copies of the reference documents that you have used to complete your assignment. These documents are evidence of your competence.

Before commencing this test, read through all the material to ensure that you fully understand what you must do. If in doubt, ask your tutor.

1. What is the difference between a flat roof and a pitched roof?

_________________________________________________________________________________
_________________________________________________________________________________

2. What is the main purpose of any type of roof?

_________________________________________________________________________________
_________________________________________________________________________________

3. Traditional roofs can be divided into three main types of construction. What are they?

_________________________________________________________________________________
_________________________________________________________________________________

4. By means of sketches, define the difference between a single roof and a double roof.
5. Fill in the blanks of the following statements:

a) The ____________ ____________ is the vertical timber or plastic trim which is fixed to the face of the last common rafter at the end of a gable roof.

b) The ____________ is the underside surface of the eaves and the soffit of a gable roof which over hangs the gable wall.

c) A ____________ is a strong large sectioned timber member which is fixed to the common rafters midway between the ridge and the wall plate and runs parallel to the wall and the ridge.

d) The ____________ is the line formed at the internal intersection of two sloping surfaces. It runs from the ridge to the eaves.

e) A ____________ ____________ is a framework comprising of two common rafters and noggings.

f) ____________ ____________ are horizontal timber components which span from wall to wall and are fixed to the feet of common and jack rafters.

g) A ____________ ____________ is a roof whose rafters are of such a length that they require an intermediate support.

h) ____________ ____________ are angled components which are fixed to the common rafters and roof ties.

i) The ____________ ____________ is the angle or slope of the roof and can be expressed in degrees or as a fraction or ratio found by dividing the rise by the span.

j) The ____________ ____________ is the distance across the roof and measured to the outer edges of the wall plates.

k) The direction of the slope of a roof is called the ____________.

l) All ____________ ____________ must conform to current ____________ ____________ ____________.

m) The main function of any ____________ ____________ is to prevent heat from leaving or entering a building.
6. Produce sketches to show the use and position of joist hangers.

7. Produce sketches to show the method of forming the following types of eaves finish.
   a) Flush eaves.
   b) Open eaves.
   c) Closed eaves.
8. What is the purpose of providing roof ventilation?

_________________________________________________________________________________

_________________________________________________________________________________

9. What is the purpose of angle fillets and drip battens used in the construction of a flat roof?

_________________________________________________________________________________

_________________________________________________________________________________

10. Why are the ends of roof timber treated with a preservative?

_________________________________________________________________________________

_________________________________________________________________________________

11. Using the information below, calculate the total length of fascia required for the roof.

```
7m  12.5m  5.67m
6.35m
```


12. If a flat roof measures 4.20 x 3.00m, how many sheets of 1.20 x 2.40m chipboard decking will be required to cover the roof?
13. Find the hidden words:

- Span
- Eaves
- Soffit
- Gable
- Angle fillet
- Rafter
- Thermal quilt
- Condensation
- Wallplate
- Preservative
- Joist hanger
- Beam
- Brace
- Ventilator
- Ladder
- Truss
- Gutter
- Membrane
- Decking

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B H A G D T H E R M A L J Q U I L T
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A V S T E O E O O N K N X S A R E G
M K Z T Y F M N I K H G Z P L E N A
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R A F V B T A N B K A X R E L R L E
U S P R E V N S H D V F E V A V A L
S W Z D V S E A A E P I T E T A T U
S K M H S B R T N C E L L E E T O F
F W A H Q X W I G K C L U M R I R N
A G X P N Z H O E I O E K R T V E O
S B R A C E V N R N Z T S F E E O N
G L A D D E R G V G Z I B U E Z R L
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# Roofs

## KNOWLEDGE TEST

### Knowledge Test Marking Sheet

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