PART 2: GABLE ROOFS

The gable roof is classified as being double-pitched and one of the simplest roof forms, due to the fact that all rafters in the roof are exactly the same length and have the same bevels. Gables are best suited for use on buildings or structures with a simple quadrilateral shape, which is typical of the freestanding car garage, most outbuildings, lychgates (or lychgate), portico’s, etc.
They may also be used in a modified form, such as a gablet, to enhance the surface of any other roof type or may also be used as a means of providing light and ventilation to a room or roof space. Many modern roof designs use dummy gables to enhance plain designs or to break up large areas of straight roof surface.

In a conventionally pitched gable roof there are many individual members, which have specific structural roles to perform. Each member is reliant on the next to form an unyielding structure and at the same time provide a framework for the roof covering.

PARTS, PROPORTIONS and DEFINITIONS

Span: This is the horizontal width of the roof, measured overall the wall plates.

Half span or Run of rafter: This is the horizontal distance measured from the centre of the ridge to the outside of the wall plate. It is also the plan length of the rafter.

Centre line length of rafter: This is measured along the top edge of the rafter taken from the centre of the ridge to plumb over the outside of the wall plate. It is equal to the length of the hypotenuse of the right-angled triangle formed by the rise and half span.

Hypotenuse: This is the sloping length of a right-angled triangle.

Rise: This is the vertical distance between the ‘X-Y’ line and where the hypotenuse meets the centre of the ridge.

X-Y line: This is an imaginary horizontal line, which passes through the position where the outside of the walls is plumbed up to meet the hypotenuse or top edge of the rafter. It is used to identify the centre line positions to calculate rafter set out length and the rise of the roof.

Plumb bevel: This is the angle found at the top of the right-angled triangle, formed by the rise, half span and top of rafter edge. This bevel is used for the angled cut on the top end of the common rafters.

Level bevel: This is the angle found at the bottom of the right-angled triangle, formed by the rise, half span and top of rafter edge. This bevel is used for the angled cut on the foot of the common rafters, where they rest on the wall plates.
Fig 22: Section through a gable roof

- Half span or Run
- Top Plate Ceiling
- Common Rafter
- Strut
- Ceiling Plate Line
- Centre-line Length of Rafter
- Rise
- Height
- Level Bevel
- Plumb
- Ridge
- Detail at Ridge Board
- Detail at Plate
- Birdsmouth notch not greater than D/3
- Depth
- Centre-line
- Rise
- Height
- Gauge Line
STRUCTURAL ROOF MEMBERS

COMMON RAFTERS
These are the main sloping members, which all have the same length, running from the wall plate to either side of the ridge. They are spaced at 450 to 600 mm centres for tiled roofs, and up to 900 mm centres for sheet roofs. They support the roof battens, which in turn support the roof covering.

The rafters may be set out using a variety of methods, which include use of the steel square, full size set out and by calculating length.

Since the rafters are all the same lengths, they are usually set out from a pattern. This pattern has the cutting length, plumb cuts and birdsmouth marked on it to allow for consistent accuracy during repetitive mark transfer.

Note: Section size, timber species and stress grades for rafters may be obtained from AS 1684.
RIDGE

Usually a deep and narrow member, it is the highest member of the roof, which runs horizontally for the length of the roof. It must be level and parallel to wall plates, for the length of the roof with the rafters being nail-fixed onto it on opposite sides. Gable roofs may be very long, therefore the ridge may require one or more joins to create a continuous length, as shown below:

Before the roof is erected, the ridge is set out (usually on one side only) to suit the position of the rafters. The easiest way to set out the ridge is to lay the ridge on top of the completed ceiling frame, over the external wall plate, and transfer the rafter positions onto the ridge board.

This ensures the rafters will be parallel and consistent with the positions marked along the wall plate.
WIND BRACING

Wind bracing is designed to prevent any movement of the roof, or racking out of plumb. Wind forces on the gable ends usually cause racking.

Effect of racking of the roof

Bracing of the roof frame may be done by having two opposite 45° timber braces from the ridge onto an internal load-bearing wall, normally using 75 mm square timber.

Alternatively, the roof frame may be permanently braced using metal speed bracing over the surface of the frame.

Temporary bracing may also be inclined, as shown, or be diagonally fixed under the rafters from the ridge to the external wall plate.
PURLINS

Purlins, also called underpurlins, are fixed to the underside of the rafters parallel to the ridge and wall plates. They provide continuous support under the rafters, similar to bearers under joists in a floor frame. They are normally spaced at 2100 mm centres, but this will depend on the section size and stress grade, including the section size and stress grade of the rafters.

Purlins are supported by struts at 2100 mm centres, depending on the section size and stress grade, with an additional strut under any join. The most common method of joining is to half-lap and nail together. Joints may also be cleated to prevent spreading by using timber or metal connector plates.

Purlins are positioned by measuring up from the wall plate, the desired spacing, on the underside of the end rafters, and marking the top side of the purlin thickness. A string line or chalk line is run through and a temporary 75 mm nail driven into the underside of every third rafter. The purlin is lifted into position and pulled hard up against the temporary nail, clamped and double skew nailed.

**Note:** Each rafter is sighted for straight before being nailed to the purlins.
STRUTS

These members are placed under the purlins to transfer the roof load to the internal load-bearing walls, strutting beams or between other struts or supports. There are several strutting systems used for roofing, as follows:

Inclined and Flying or Fan struts
These struts are cut around the purlin and run at 90º, or as near as possible, to the underside of the purlin to the top of a load-bearing wall or strutting beam. Chocks are placed behind the foot of the strut to prevent it sliding under load. Flying or Fan struts are chocked at the top as well by fixing blocks onto the face of the purlin, on the outside edge of the strut. Alternatively, they may be bolted through the purlin or have a spreader bolted across the face to prevent them sliding apart under load. Solid timber struts are normally 75 x 75 mm, however this will depend on the stress grade, length of strut and imposed roof load. The following table provides a guide for imposed roof loads, which will assist in the selection of strutting material:

### TABLE 1

#### MASS OF ROOF MATERIALS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MATERIAL</th>
<th>Approx. MASS in kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel sheet</td>
<td>0.76 mm thick</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>0.55 mm thick</td>
<td>6.0</td>
</tr>
<tr>
<td>Aluminium sheet</td>
<td>1.2 mm thick</td>
<td>5.0</td>
</tr>
<tr>
<td>Roof tiles</td>
<td>Terra-cotta</td>
<td>58.0</td>
</tr>
<tr>
<td></td>
<td>Concrete</td>
<td>54.0</td>
</tr>
<tr>
<td></td>
<td>Pressed metal</td>
<td>7.5</td>
</tr>
<tr>
<td>Fibre cement (F.C.)</td>
<td>Corrugated sheet</td>
<td>16.0</td>
</tr>
<tr>
<td></td>
<td>Flat shingles</td>
<td>15.0</td>
</tr>
<tr>
<td>Unseasoned hardwood</td>
<td>38 x 75 battens at 900 mm c/c</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>25 x 50 battens at 330 mm c/c</td>
<td>3.8</td>
</tr>
<tr>
<td>Seasoned pine</td>
<td>35 x 35 battens at 330 mm c/c</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Average mass of metal roof covering and battens is approx. 15 kg/m²; and Average mass of tiled roof covering and battens is approx. 60 kg/m².

**Note:** The size of struts should be based on AS 1684 - 1999 Part 2
Fitting struts to various angles

It may not be possible to fit the struts at exactly 90° to the underside of the purlin, therefore the following adjustments may be made:

**STRUT PERPENDICULAR TO RAFTER**

- **A’** Not less than 44 mm
- **B’** Not less than 25 mm and not over 38 mm measured at bottom of purlin

**STRUT VERTICAL OR ‘PLUMB’ TO RAFTER**

- **C’** Not less than 38 mm
- **D’** Not over 12 mm

**LOW ANGLE FLAT STRUT**

- 2/2.5 x 75 mm nails
- Not less than 5 nails
- Top of strut must reach at least to top edge of purlin

**FLAT STRUTTING**

- **E’** Not less than 38 mm, but not more than ½ width of strut.

**STEEP ANGLE PERPENDICULAR STRUT**

- Not less than 3 nails
- Perpendicular or steep angle strutting

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Fig. 32 Methods of fitting struts
Supporting struts over internal walls

It is preferable to position struts directly over studs, however as this is not always possible the load must be distributed in an alternative way. This may be achieved by strengthening the plate either between or over the studs with additional blocking.

Also, where struts are placed at a low or flat angle, it will be necessary to fit a block, referred to as a *chock*, behind the foot of the strut to prevent it from sliding under load.

**NOTE**: Avoid strutting between studs

**NOTE**: Avoid strutting over openings

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**Fig. 33** Methods of reinforcing top wall plates for struts
Scissor struts
These struts consist of deep-sectioned timber members supported over external walls and bolted where they cross in the centre of the roof space. They are designed to transfer the roof load to the external walls where there are no internal walls for support or the internal walls are non load-bearing.

If there is internal support available, but would cause an inclined strut to be too flat to be effective, then a half scissor may be used.

Note: The foot of the scissor struts must be bolted to a rafter, and preferably a ceiling joist as well, and bolted together where they cross over in the centre of the roof. If ceiling joists are not full length they should also be bolted together where they lap over a wall, to prevent the external walls spreading under load.
Section sizes and stress grades should be taken from AS 1684 - 1999 Part 2
Strutting beams

An alternative to using scissor struts over large room spans would be the use of large timber or steel strutting beams.

They are usually placed parallel to the ceiling frame hangers, but must not rest on any part of the ceiling frame. To achieve this the ends must be packed up at least 25 mm above the ceiling joists, which allows for any deflection.

In some situations the hanger and strutting beam may be the one member, but the member should comply with AS 1684 tables or be designed by a structural engineer to cater for the additional load.

The following materials may be used for strutting beams:
- Solid timber (hardwood or softwood with the correct stress grade);
- Horizontally laminated timber (similar to Glulam beams);
- Vertically laminated timber (similar to L.V.L. beams);
- Boxed beams (made from plywood); and
- Steel beams (either Universal channels, U.C., or Universal beams, U.B.)

Note: Refer to AS 1684 for section sizes and stress grades of timber members. If deep solid timber is used, it should be seasoned to reduce the risk of shrinkage. Most timber species over 175 mm deep will shrink excessively.

An alternative position for the strutting beam is directly under the rafters, which are notched over it as if it were another wall plate. The plumb struts under it would then rest on an internal load-bearing wall.
PATENT TYPE STRUTTING

Super Barap
This is a patent type of strutting system used where conventional strutting methods cannot be used or it will be too expensive to use them. These patent struts consist of steel saddle brackets at either end connected by a 12 mm diameter steel rod and a centrally located adjustable fulcrum. They may be used under purlins, rafters, hips or valleys to provide the required support where sagging or excessive deflection of the member has or may occur.
This system operates similar to a truss as it is made up of ties, which are in tension, and a strut, which is in compression. They may be purchased through hardware stores or direct from the manufacturer.
Note: See manufacturers brochure and specification for further details and fitting instructions.

Cable truss
This is another very effective patent type system, similar to the Super Barap, which uses two tensile steel cables instead of a solid steel rod. Each cable is made up of 7/1.6 mm Ø wire strands. The truss may also be fitted with an additional adjustable fulcrum or strut for use on longer members. The ends of the cables must be bolted within 200 mm Max. of the end supports.
To calculate the length of the truss, measure the distance between the bolted ends and add 80 to 150 mm to allow for the cables to run over the single or double fulcrums.
Note: See manufacturers brochure and specification for further details and fitting instructions.
COLLAR TIES

They are light sectioned horizontal members used for additional support, like spreaders, to prevent the rafters from sagging at the purlin position. These are fixed to alternative pairs of rafters, i.e. at 900 to 1200 mm spacings, and placed on top of the purlins running parallel to the ceiling joists. They may be half scarfed around the face and edge of the rafters and nail fixed with 2/75 mm nails.

Alternatively, they may be run past the face of the rafters and be bolted to them at both ends using a single 10 mm Min. mild steel, cuphead bolt.

**Note:** The size of collar ties depends on the stress grade and length of timber used. As a guide, they are normally 75 x 50 or 125 x 38 F5 to F7 up to 4200 mm long, and 100 x 50 or 125 x 38 F5 to F7 over 4200 mm long. Refer to AS 1684 for specific details.
**GABLE ENDS**

There are three main methods used to finish the ends of gables:

1. Flush gable with no eaves;
2. Flush gable with raked eaves; and

**Flush gables (no eaves)**

The end of the gable is flush or in-line with the outside face of the end wall. The end of the roof has no overhanging eaves, only a barge fixed flush with the outside of the end wall. This finish may be applied to timber framed cottages, where the walls are clad with boards or sheeting, or to brick veneer and cavity brick cottages, where the brickwork runs to the underside of the roof covering.

The triangular section formed between the top of the standard wall frame and the underside of the rafters is framed with stud material, spaced at the same centres as the wall frames, fixed on flat or on edge.
Flush gables with raked eaves

The gable finish for this type is similar to that of a gable with no eaves. The main difference is the end of the roof frame is extended past the end wall to form an eaves overhang, which is lined on the rake. The ridge and top wall plates may be extended to provide support for the gable rafters. Where the overhang is particularly wide or the length of the gable rafters is excessive, the purlins may also be extended to provide additional support.

Where the raked ends are required to adjoin level side eaves, the ends of the eaves are usually boxed to allow the raked section to terminate neatly.

Fig. 45 Flush gable with raked eaves

Fig. 46 Framing for eaves lined on-the-rake
Framing variations for raking eaves

The top wall plates may be extended to take the gable rafters. It is only necessary where the ends of the side eaves are to be boxed, which will allow the raked gable eaves to terminate neatly.

Note: It is necessary to extend the ridge for this method as well.

When the eaves width at the gable ends is excessive, i.e. say greater than 450 mm, or the unsupported length of the gable rafter is excessive for the section size of rafter, then it may be necessary to extend the purlins on both sides to support the mid length of the gable rafters.

Also, with some roof design or when the eaves are lined on top of the rafters, it is desirable to expose the framing members. (this was a typical method used for the ‘Bungalow’ style of cottage during the Federation period)

To provide continuous raked eaves with no framing members visible, it will be necessary to place cantilevered trimmers to support the gable rafters.

These trimmers, also known as outriggers, are either checked into the rafters on their flat or will be supported on-edge over the gable end wall frame, which has raking top plates. Short rafter trimmers are then cut between them to provide fixing for tile or roof sheet battens.
Boxed gable

A boxed gable occurs where it is desirable to have level eaves on both sides and ends of the roof. The face of the boxed gable may be clad with the same material as the end wall, but may also be featured by cladding with an alternative material finish.

The fascia may be returned level around the corner or the barge may extend to the outside of the gutter and have a small timber ‘bellcast’ added to the top edge.

The end of the boxed gable is framed up with gable studs, eaves trimmers and a full width bottom chord or tie, to allow for fixing of the cladding and eaves soffit lining.

Fig. 50 Boxed gable

Fig. 51 Framing for a boxed gable
Verge finishes
The verge is the section at the end of the gable roof where the roof surface meets the barge or verge board. The type of finish will depend on the roofing material used and the finish required. Tiled roofs may have a coloured mortar pointed verge, which is laid on a narrow fibre cement (F.C.) strip, it may be covered with purpose made barge cover tiles or the tiles may be cut against a pre-formed ‘barge soaker’. In recent times, the Colorbond barge soaker has become the preferred method of finishing the verge as it does not require any maintenance. Metal sheet roofs may also have a barge soaker or may be fitted with a covering pre-formed Colorbond barge capping.

Fig. 52  Metal barge capping profiles

Fig. 53  Pointed verge

Fig. 54  Barge tiled verge

Fig. 55  Metal barge capping to verge

Fig. 56  Matching barge and gutter
‘Colorbond®’ patent verge finishes

In recent years the method of finishing the verge for gable roofs has changed. New metal fascia and barge profiles provide an alternative to using primed fascia boards. They are attached directly to the ends of the rafters or outriggers, using special brackets, and the gutter or barge soaker is attached to them.

The benefits of using these Colorbond® products is that they do not require painting, they are not susceptible to decay caused by leaking gutter joints, they do not cup or twist, they are available in a full range of popular colours and they are relatively simple to fit.

The Colorbond® metal barge is attached using barge rafter brackets and then the Colorbond® metal barge soaker is placed over the top. The benefit of using the barge soaker removes the need to bed and point the verge, which eventually cracks and becomes loose over time.

The following details were supplied courtesy of ACE GUTTERS PTY LTD.

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![Fig. 57 Barge, soaker, and accessories](image-url)
CALCULATING ‘DROP-OFF’

The finished height of the brickwork is determined by the height of the timber frame and the drop-off needed to give the eaves width required. In turn the pitch of the roof and the head height of the windows influence the eaves width and drop-off. Where eaves soffit finishes above the head of the windows, the space may be infilled with brickwork or with timber framing and cladding material. The drop-off measurement is taken vertically from the top of the wall plate to finished height of the brickwork. The purpose of the drop-off measurement is to provide the bricklayer with a finished height, in relation to the height of the wall frame, to allow an even gauge to be set out on the storey rod.

Note: In a brick veneer cottage with a suspended timber floor, the brickwork is normally completed to the underside of the bearer and then the brick gauge is calculated to drop-off level.

Fig. 58 Details showing how drop-off affects the width of the eaves