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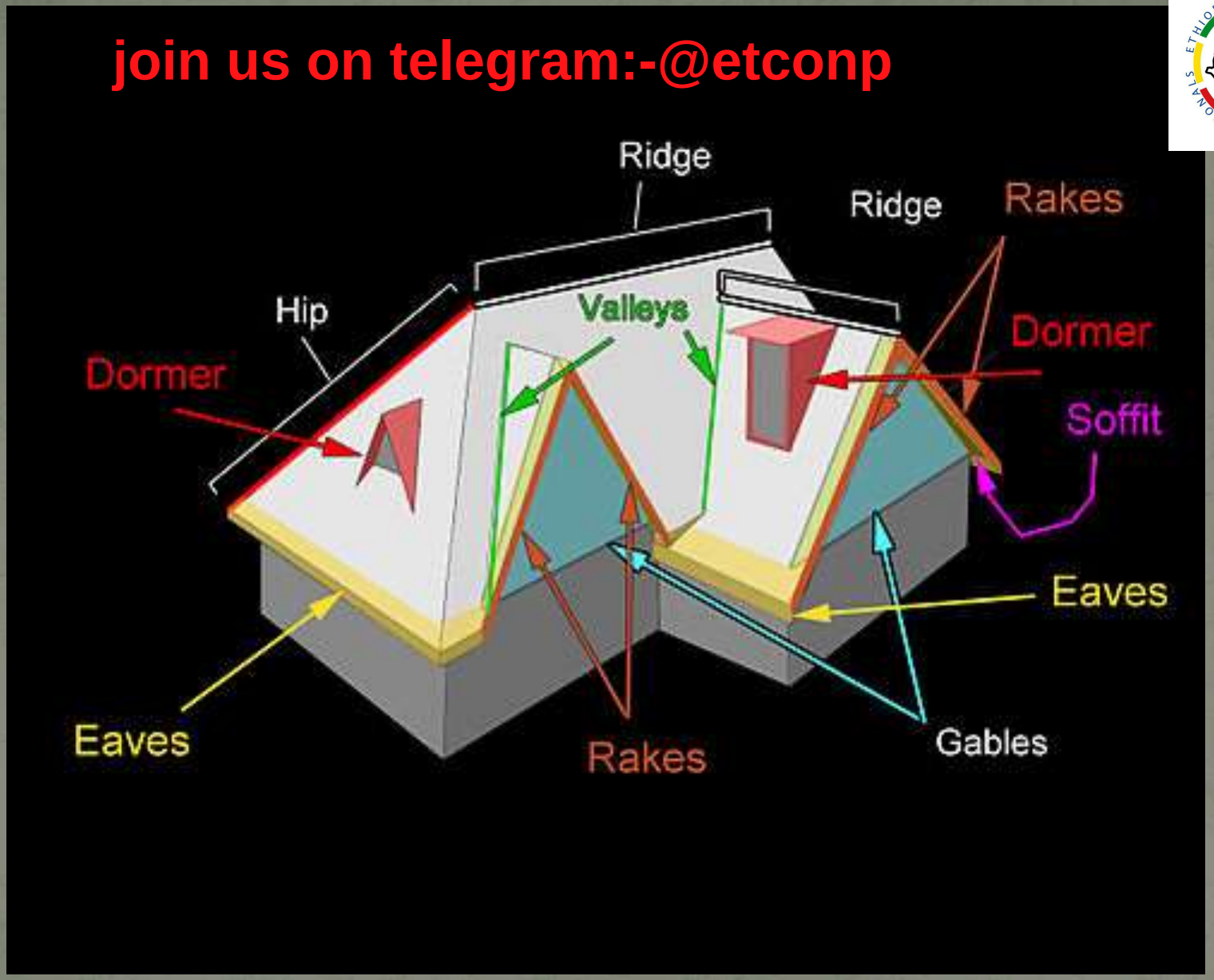
PITCHED ROOFS

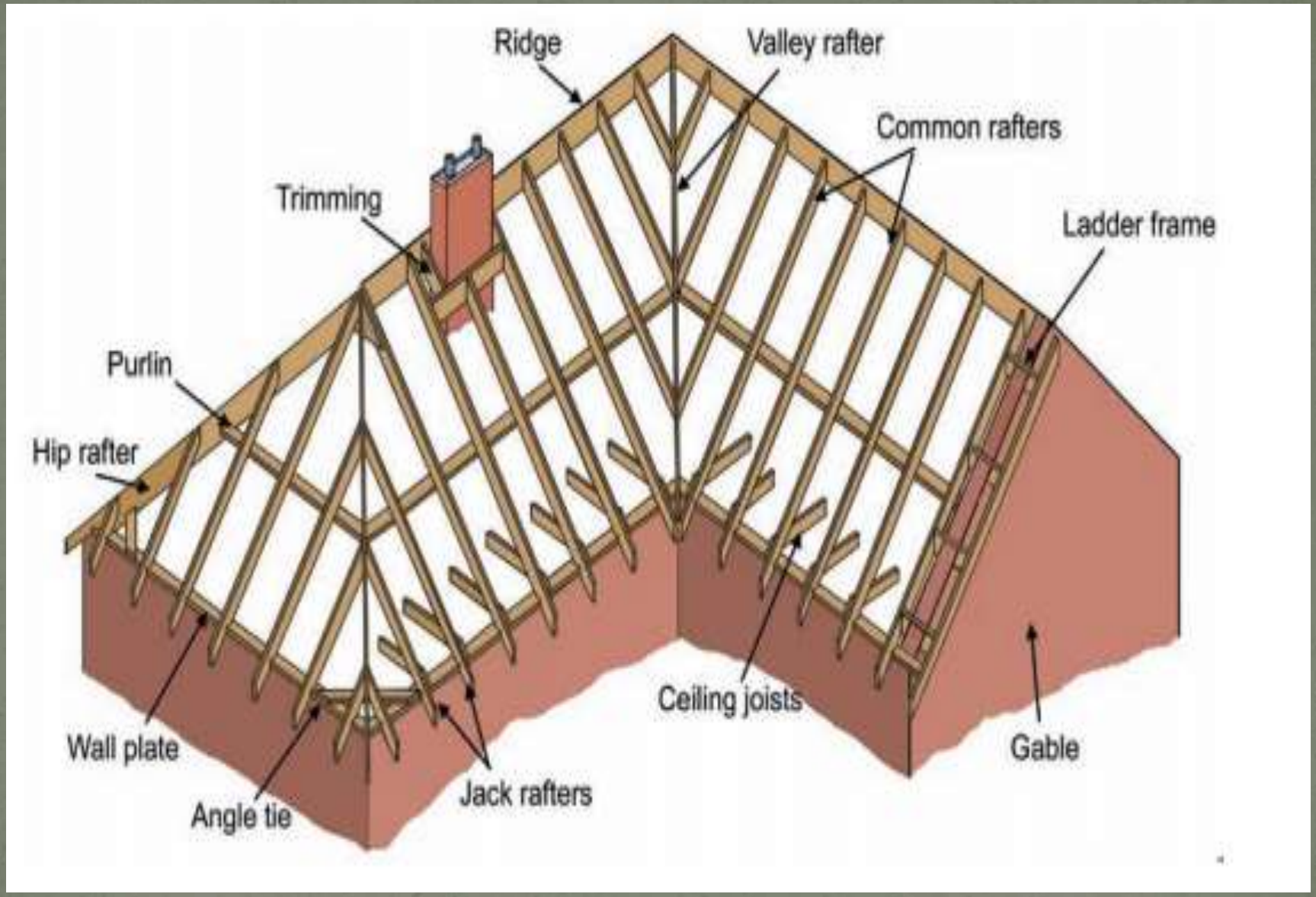
ANAND.T
ASSISTANT PROFESSOR
CIVIL ENGG-KCT



BUILDING CONSTRUCTION

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Ridge
Valley rafter
Common rafters
Trimming
Ladder frame
Purlin
Hip rafter
Ceiling joists
Wall plate
Gable
Angle tie
Jack rafters

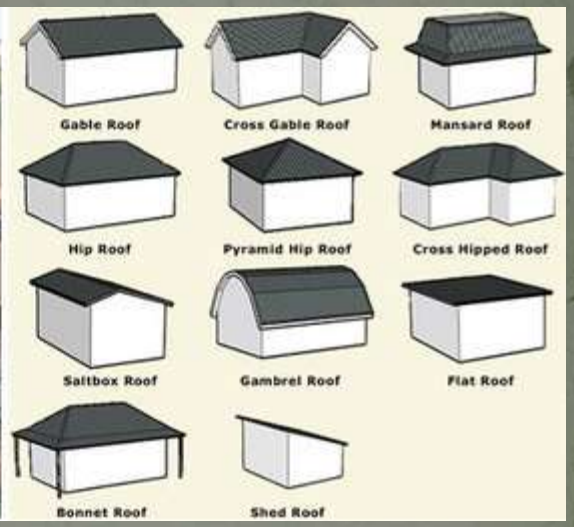
PITCHED ROOFS

- A roof with sloping surface is known as **pitched roof.**

- **BASIC ELEMENTS:**

a. **Lean to roof**
b. **Gable roof**
c. **Hip roof**
d. **Gambrel roof**
e. **Mansard or curb roof**
f. **Deck roof**





LEAN-TO-ROOF

- Simplest type
- Small span rooms or for verendah
- Slope only on one side





GABLE ROOF

- Common type
- Slopes in two directions
- Slopes meet at ridge
- A vertical triangle is formed at end face





Basic Roof Designs

Gable Roof

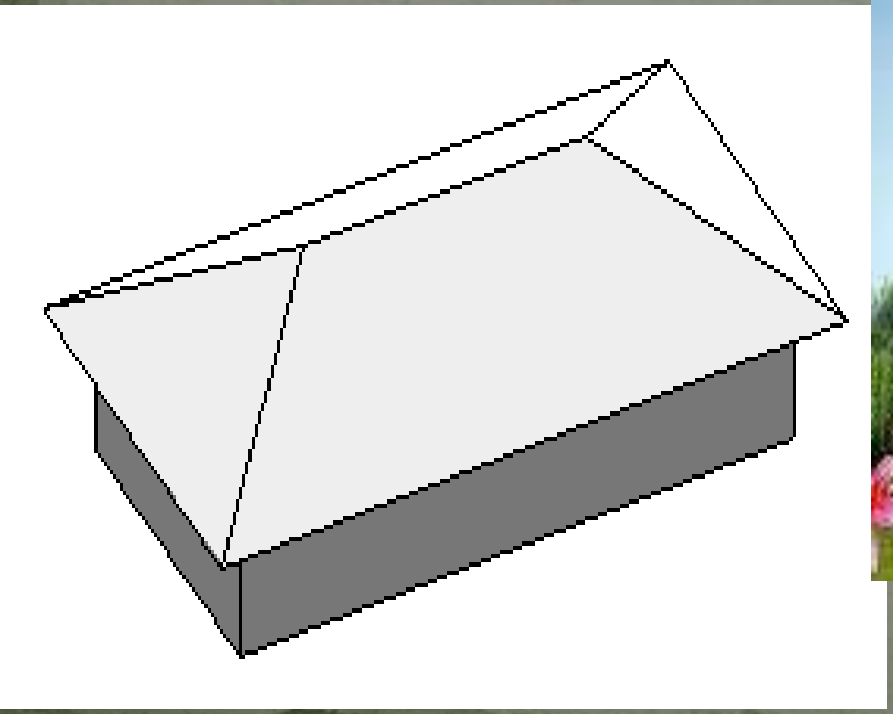
Hip Roof





HIP ROOF

- Four sloping surfaces in four directions
- Sloped triangles are formed at end faces





GAMBREL ROOF

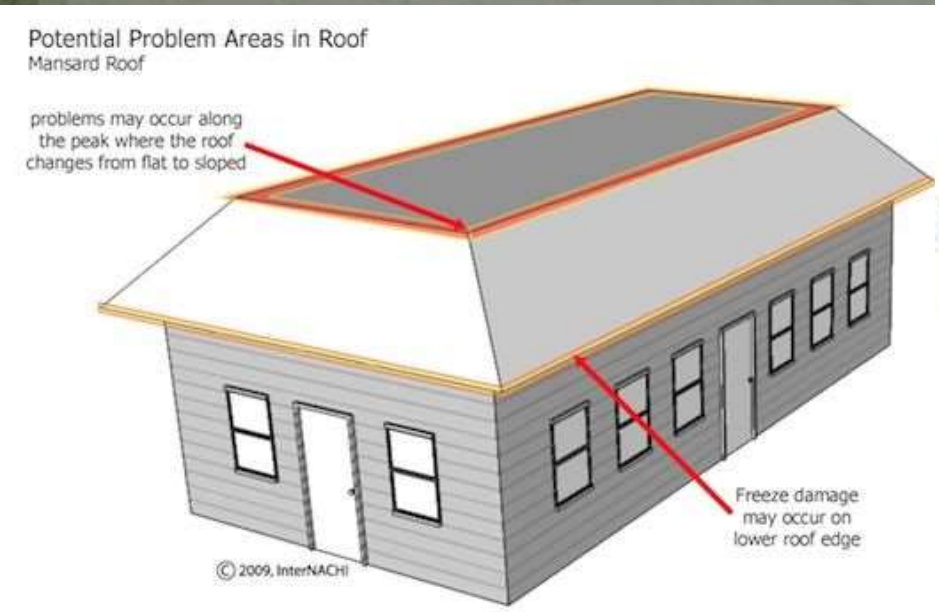
- Similar to gable roof
- Slopes in two direction but there is a break in each slope
- A vertical face is formed at each end.





MANSARD ROOF

- Similar to hip roof
- Slopes in four direction but each slope has a break
- Thus sloping ends are obtained





DECK ROOF

- Similar to hip roof - slopes in all the four directions
- A deck or plane surface is formed at the top.





TYPES OF PITCHED ROOFS

- (a) Single roofs
  - Lean to roof (verendah roof)
  - Couple roof
  - Couple close roof
  - Collar beam roof or collar tie roof
- (b) Double or purlin roofs
- (c) Triple membered or framed or trussed roofs
  - King post roof truss
  - Queen post roof truss
  - Combination of king post and queen post truss
  - Mansard roof truss
  - Truncated roof truss
  - Bel-fast roof truss or latticed roof truss
  - Composite roof truss
  - Steel sloping roof trusses

SINGLE ROOFS

- Consists of only common rafters secured at the ridge and wall plate.
- Small span where no intermediate support is required for the rafters

DOUBLE ROOF

- Here purlins are introduced to support common rafters at intermediate point
- Used when span exceeds 5m.

- FUNCTION OF PURLIN
- To tie the rafters together
- To act as an intermediate support to the rafters

TRIPLE MEMBERED OR TRUSSED ROOFS

- 3 sets of memebers: (i) common rafters, (ii) purlins and (iii) trusses.
- Purlin gives intermediate support to the rafters.
- A trussed roof is provided when
- The span of the room is greater than 5 metres
- When the length of the room is large i.e., (where there are no internal walls or partitions to support the purlins)

SINGLE ROOFS-LEAN-TO-ROOF

- Simplest type and suitable upto max span of 2.5 m.
- Rafters slope on one side only (usual slope 30 degree)
- Also known as pent roof or aisle roof
- Wall on one side is higher than the other side
- Wooden wall plates supported by corbel provided at 1m centre to centre.
- Common rafters are nailed to wooden wall plate at their upper end and nailed to wooden post plate at their lower end.
- Iron knee straps and bolts are also used to connect the rafters.
- Applicable for sheds, out-houses attached to main building.

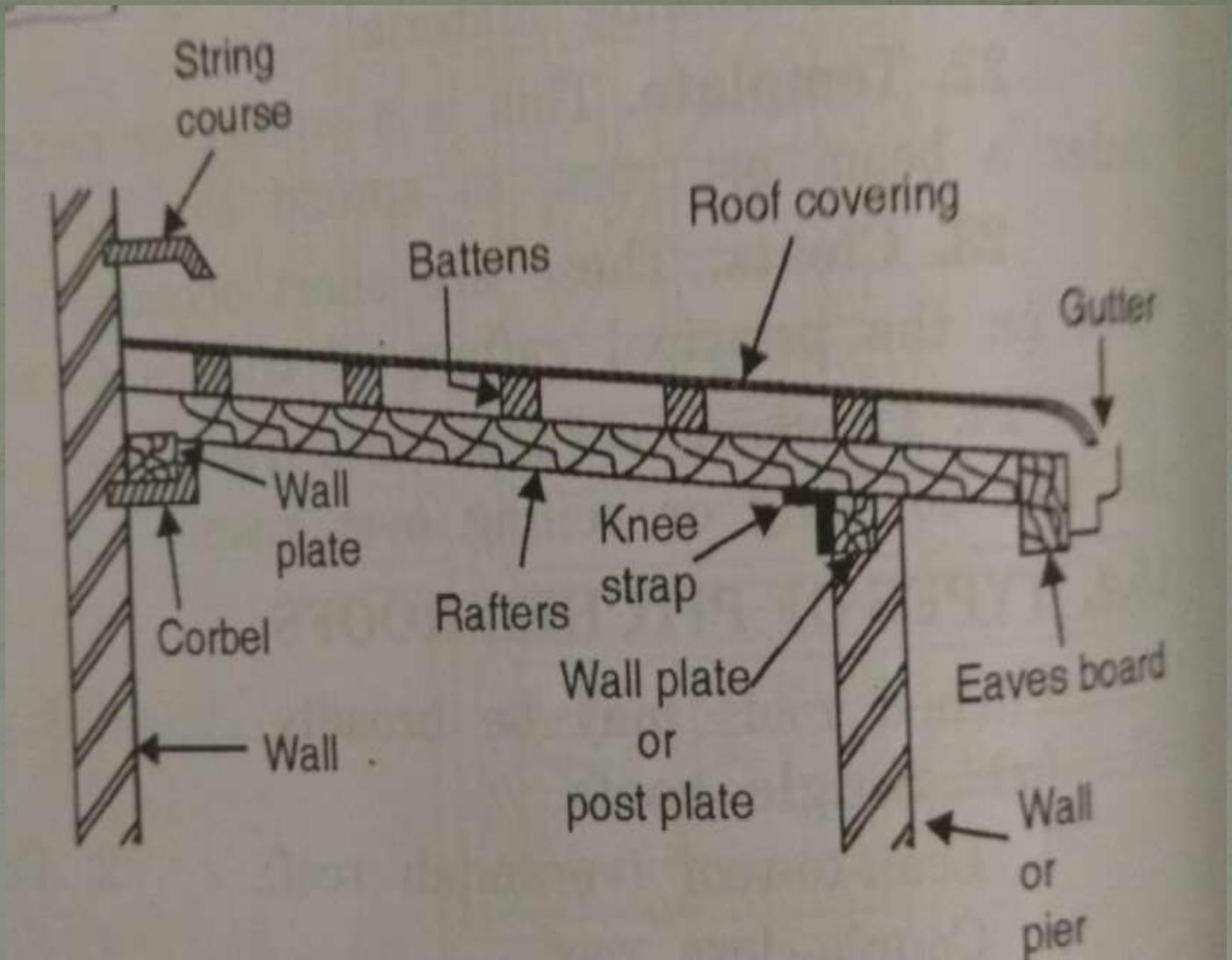
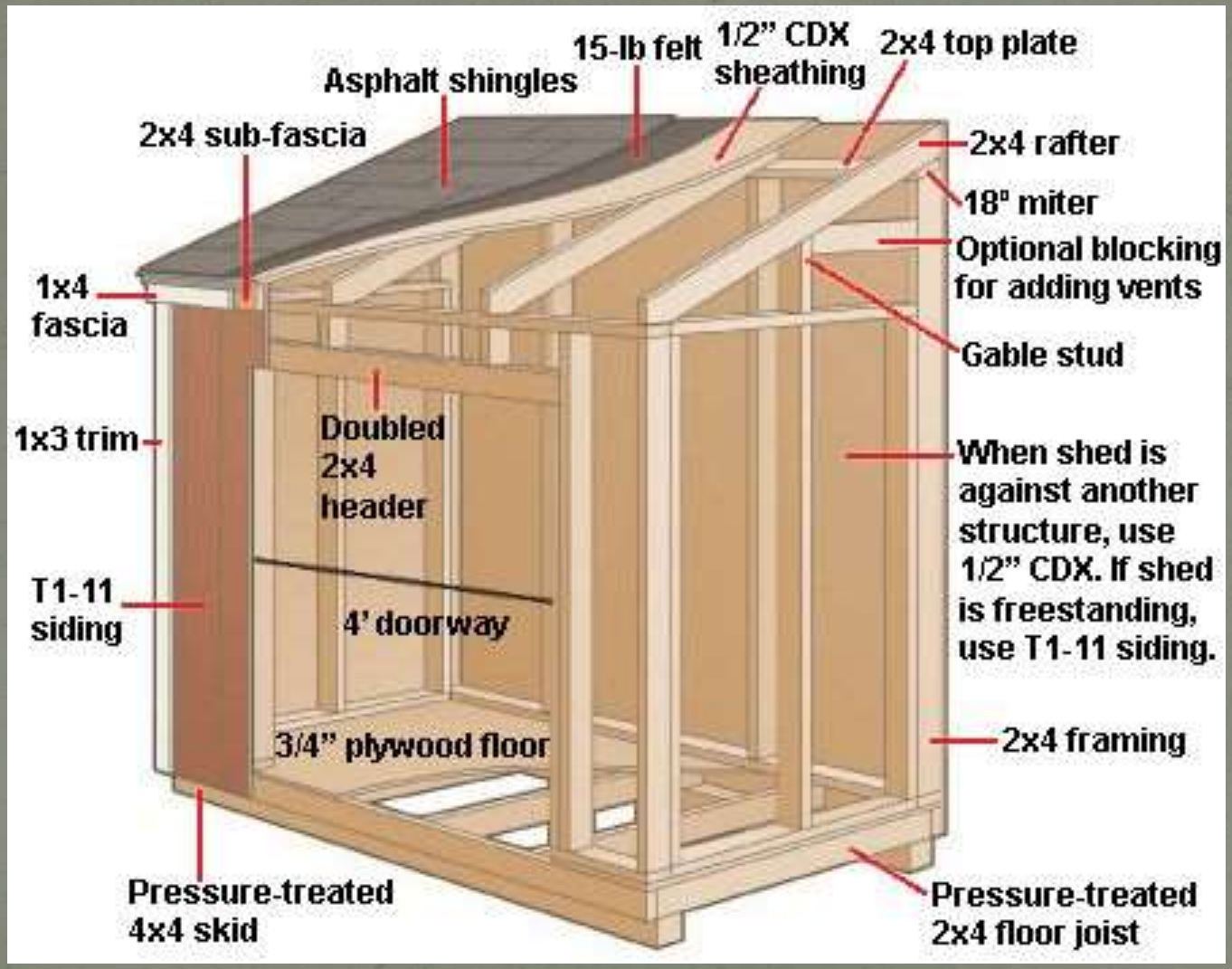


FIG. 15.4. LEAN-TO-ROOF.


15-lb felt
1/2" CDX sheathing
2x4 top plate
Asphalt shingles
2x4 sub-fascia
2x4 rafter
18° miter
Optional blocking for adding vents
1x4 fascia
Gable stud
Doubled 2x4 header
1x3 trim
When shed is against another structure, use 1/2" CDX. If shed is freestanding, use T1-11 siding.
T1-11 siding
4' doorway
3/4" plywood floor
2x4 framing
Pressure-treated 4x4 skid
Pressure-treated 2x4 floor joist

COUPLE ROOF

- Formed by pair of rafters which slope to both the sides of the ridge of the roof.
- Upper ends of rafter nailed to a common ridge and lower ends nailed to the wooden wall plates.
- Applicable for span upto 3.6 m.
- It has a tendency to spread out at the feet (wall plate level) and thrust out the walls supporting the wall plates.

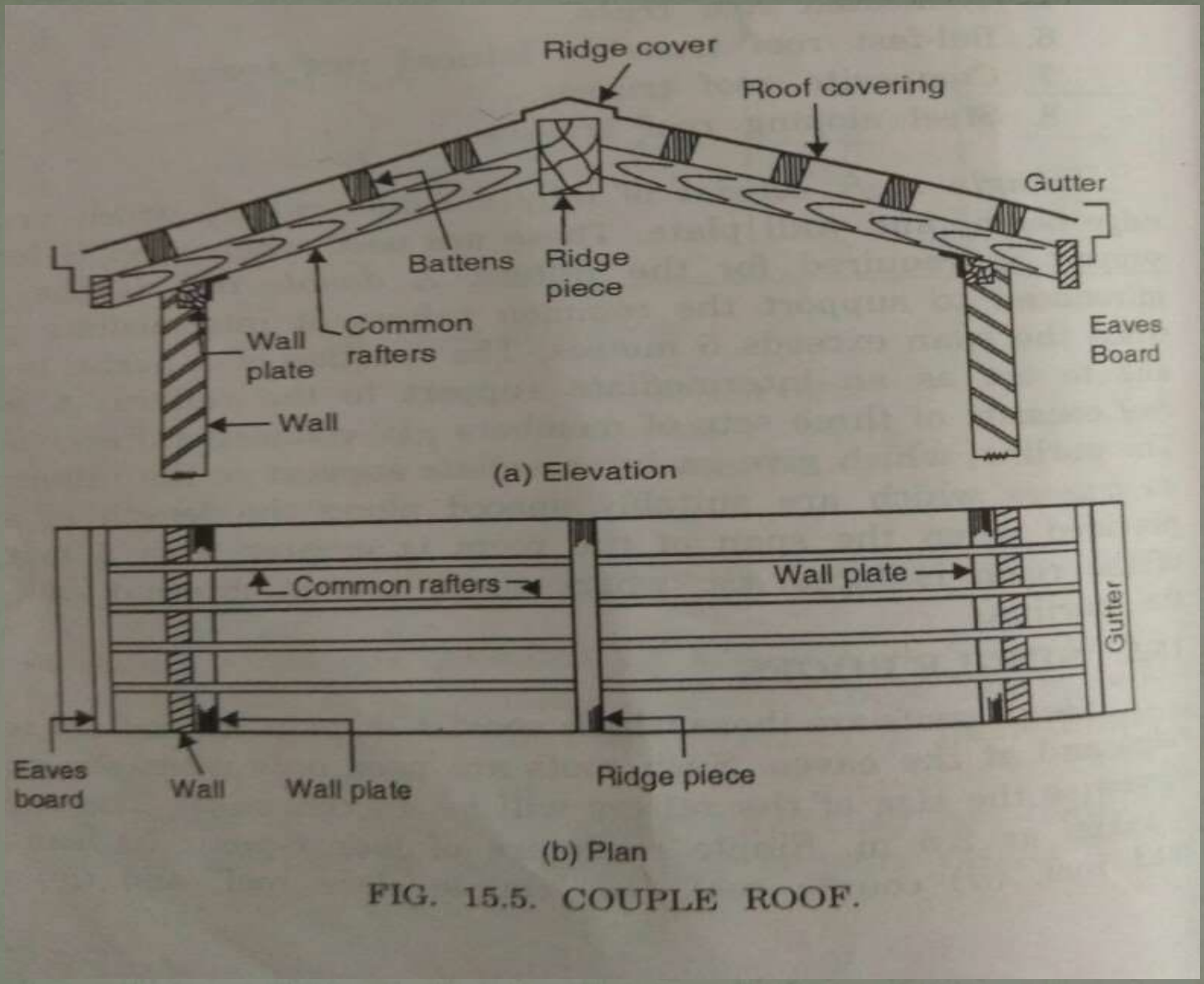
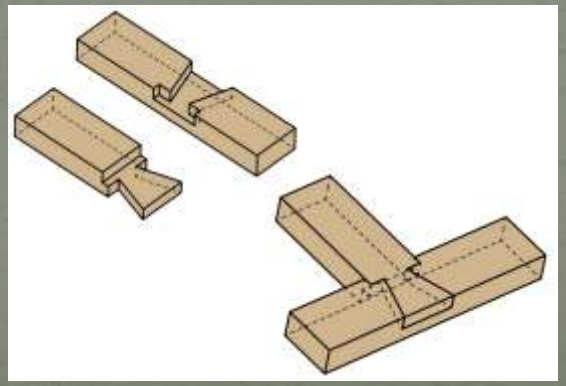


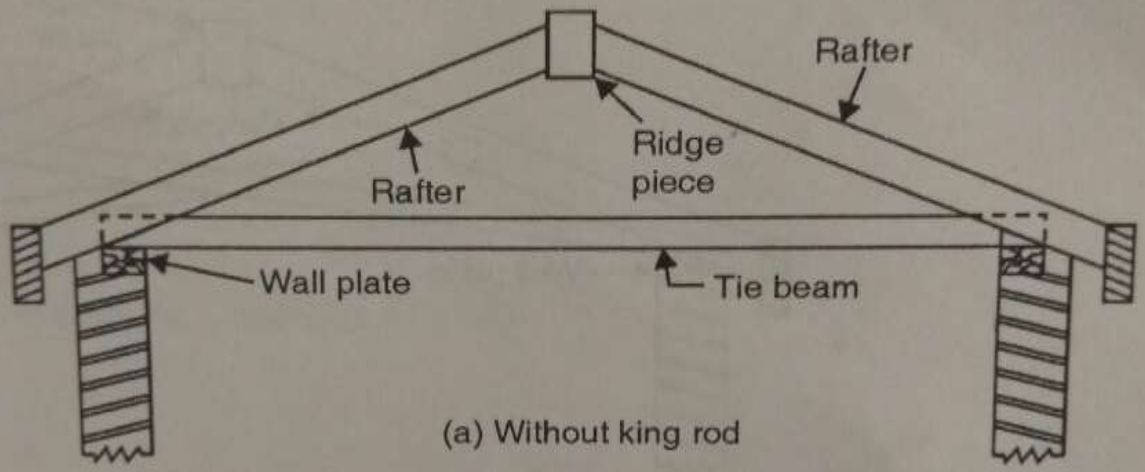
FIG. 15.5. COUPLE ROOF.

COUPLE CLOSE ROOF

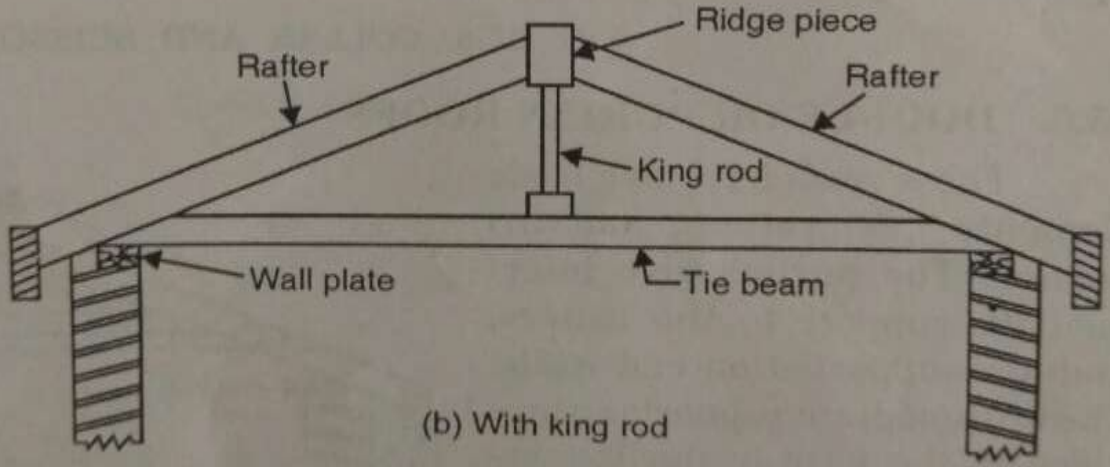
- To prevent the rafters from spreading and thrusting out of the wall, the ends of the couple of common rafters are connected by a horizontal member called ‘tie beam’.
- It may be a wooden member or a steel rod.
- The connection between wooden tie and feet of rafters is obtained by DOVE TAIL HALVED JOINT.



- One tie for each pair of rafters.
- Tie beams also acts as ceiling joists when required.
- Economically suitable for spans upto 4.2 m.
- For increased span or for greater loads, the rafters may sag in the middle. In order to overcome that, a central vertical rod called as king rod or king bolt is used to connect ridge piece and tie beam.



(a) Without king rod



(b) With king rod

FIG. 15.6. CLOSE COUPLE ROOF.

COLLAR BEAM ROOF

- When the span increases or when the load is more, the rafters of the couple close roof have the tendency to bend.
- This is avoided by raising the tie beam and fixing it at one-third to one-half of the vertical height from wall plate to the ridge. This raised beam is known as the collar beam or collar tie.
- Suitable for span upto 5 m.

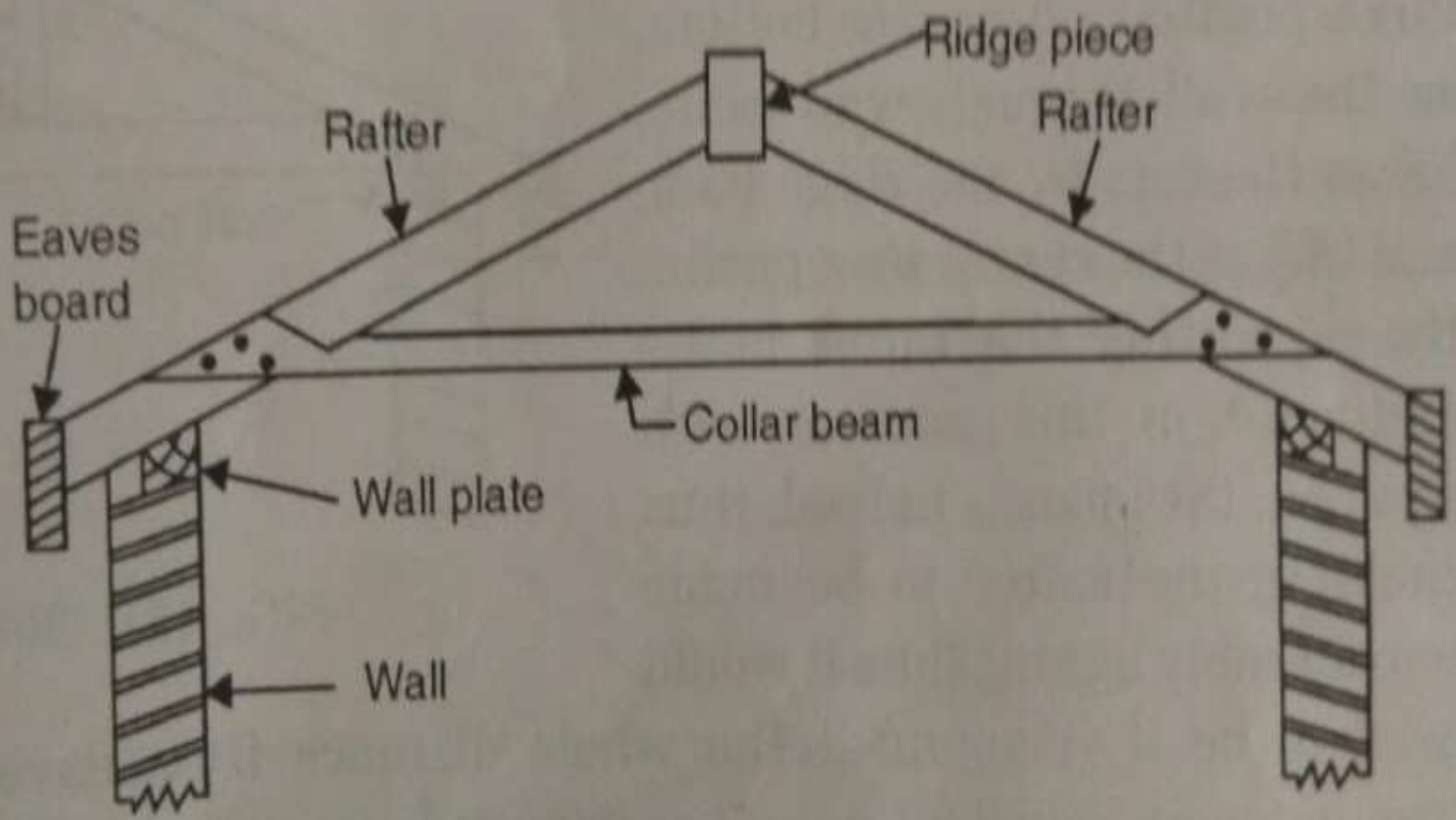


FIG. 15.7. COLLAR BEAM ROOF.

COLLAR AND SCISSORS ROOF

- Similar to collar roof
- Except that two collar beams crossing each other to have an appearance of scissors is provided.

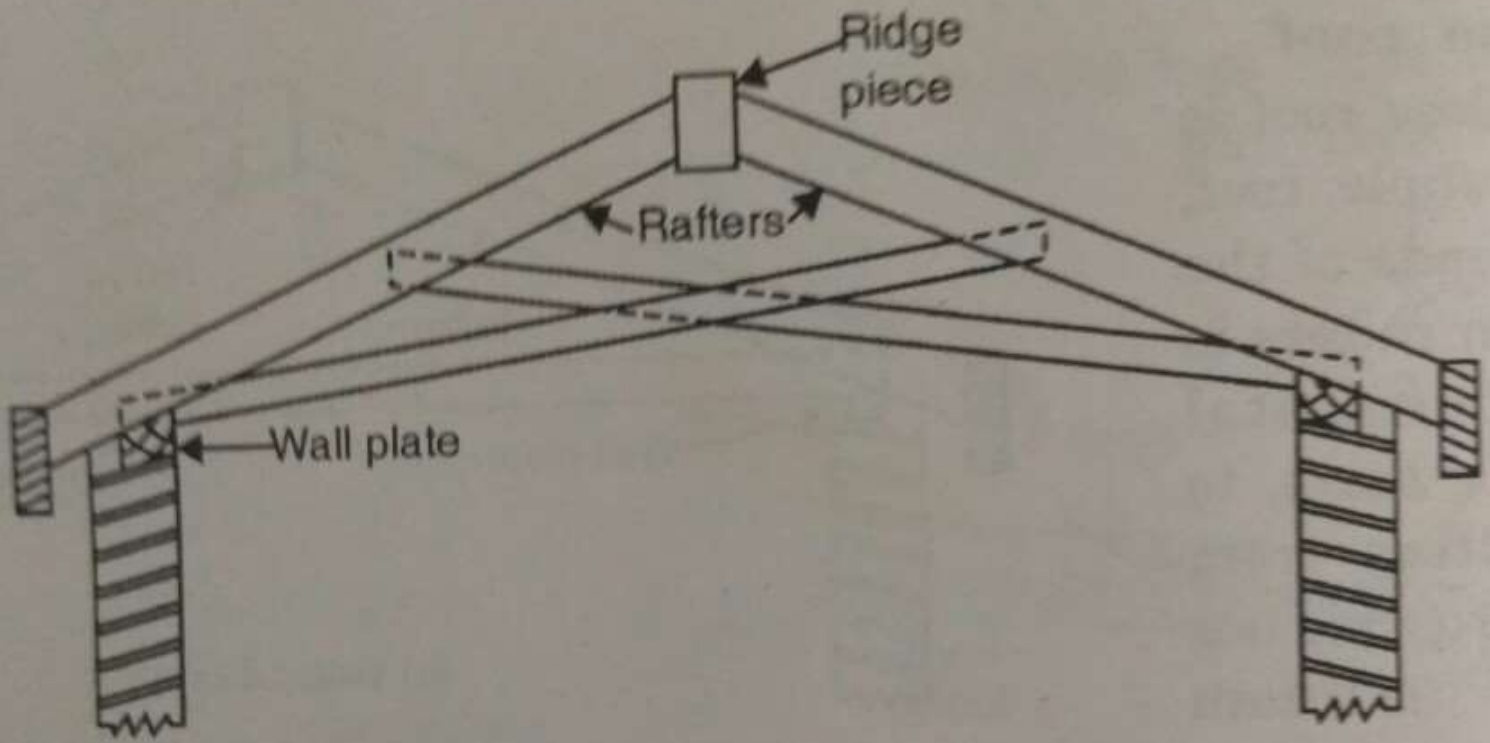


FIG. 15.8. COLLAR AND SCISSORS ROOF.

DOUBLE OR PURLIN ROOFS

- These roofs have two basic elements: (i) rafters and (ii) purlins.
- Purlin gives intermediate support to the rafters which in turn reduces the size of the rafters to the economical range.
- It is also known as rafter and purlin roof.
- The rafters are provided at 20 to 40 cm c/c spacing.
- Each rafter is supported at three points: ridge, purlin and wall plate.
- For larger roofs, two or more purlins may be provided to support each rafter.

OFS

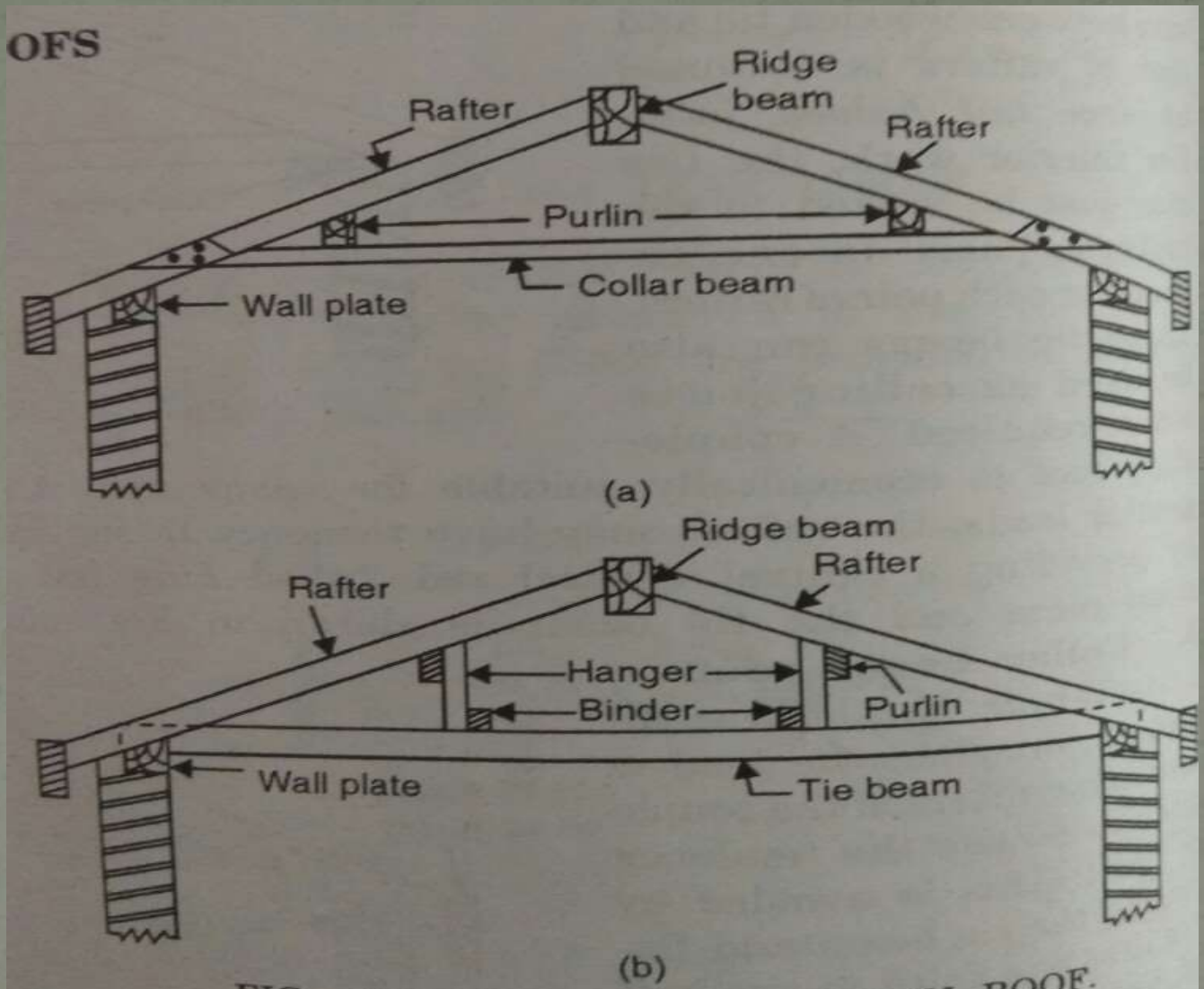


FIG. 15.9. RAFTER AND PURLIN ROOF.

TRUSSED ROOFS

- When the span of the roof exceeds 5 m and where there are no inside walls to support the purlins then trusses are provided at suitable intervals along the length of the beam.
- Spacing is limited to 3 m for wooden trusses.
- In this system, the roof consists of 3 elements:

a) Rafters to support the roofing material
b) Purlins to provide intermediate suppport to rafters
c) Trusses to provide support to the ends of purlins.

TYPES OF TRUSSES

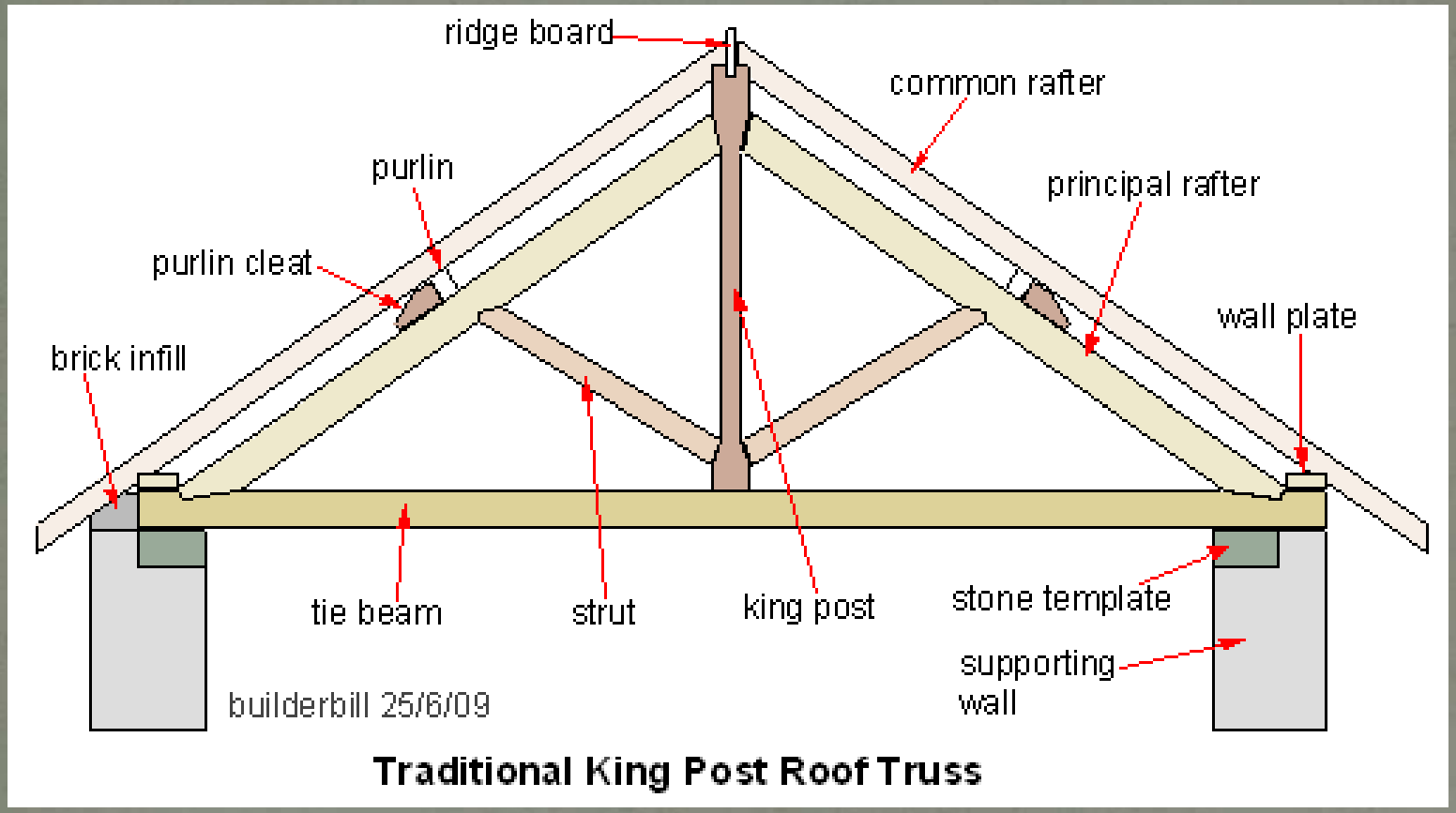
- King-post truss
- Queen-post truss
- Combination of king-post and queen-post trusses
- Mansard truss
- Truncated truss
- Bel-fast truss
- Steel trusses
- Composite trusses

KING POST TRUSS

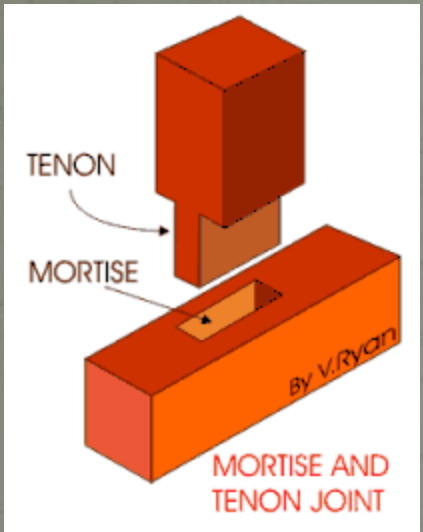
- Components: (i) Lower tie beam, (ii)two inclined principal rafters, (iii)two struts, (iv)a king post.
- Principal rafters support the purlins.
- The purlins support the closely spaced common rafters which have same slope as principal rafters.
- The common rafters support the roof covering .
- Spacing limited to 3 m centre to centre.
- Suitable for spans varying from 5 to 8 m.
- Tie beam prevents the wall from spreading out due to thrust.

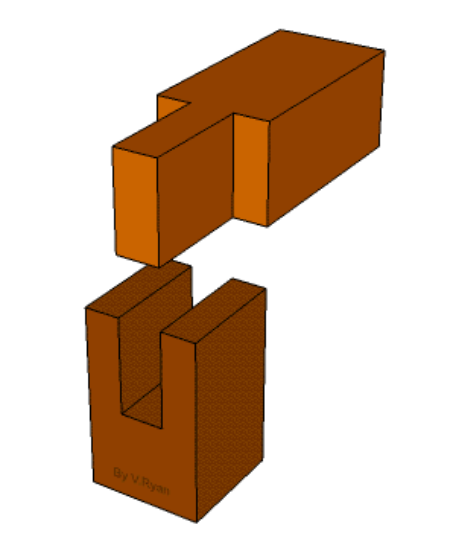
- The king post prevents the tie beam from sagging at its centre of span.
- The struts connected to the tie beams and the principal rafters in inclined direction, prevent the sagging of principal rafters.
- Ridge beam provide end support to the principal rafters
- The trusses are supported on the bed blocks of stone or concrete, embedded in the supporting walls so that load is distributed to a greater area.
- Cleats fixed on principal rafter, prevents the purlins from tilting.

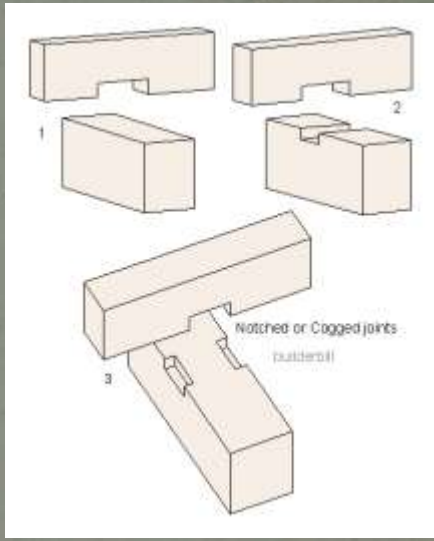
- JOINTS:
- Principal rafter to tie beam-------tenon joint or bridle joint.
- Strut to principal rafter----------oblique mortise and tenon joint.
- King post to tie beam--------mild steel or wrought iron strap.
- King post to principal rafters-------tenon and mortise joint.
- Purlins to principal rafters-------cogged joints and cleats.



Traditional King Post Roof Truss


TENON
MORTISE
By V.Ryan
MORTISE AND
TENON JOINT

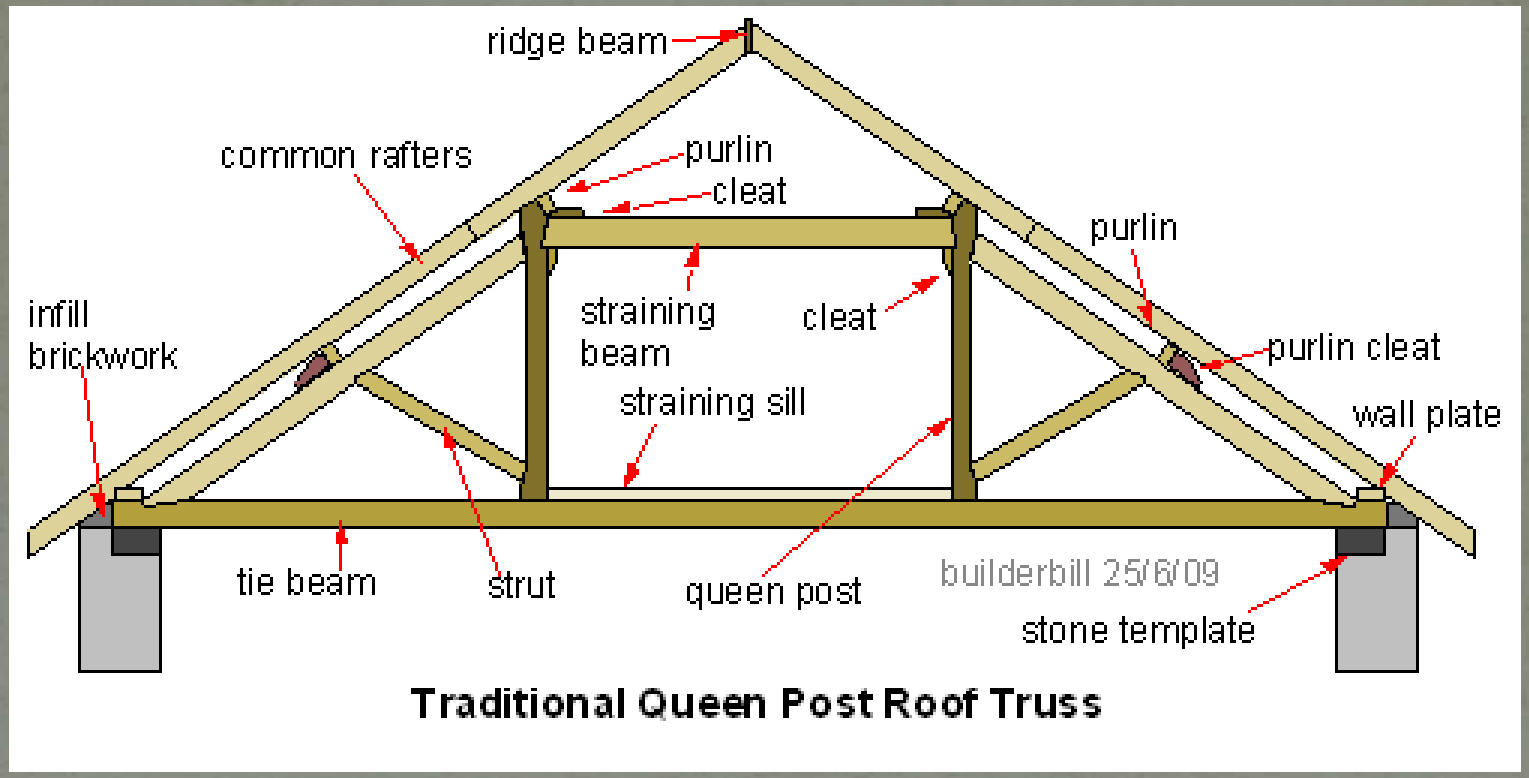

By V.Ryan


1
2
3
Notched or Cogged joints

QUEEN POST TRUSS

- A queen post (vertical posts) differs from a king post truss in having two vertical posts rather than one.
- The tops are connected by a horizontal piece known as straining beam.
- Two struts are provided to join the feet of each queen post to the principal rafter.
- Suitable for spans between 8 to 12 m.
- A straining sill is introduced on tie beam to counteract the thrust from inclined members which are in compression.(in absence pushes the queen post inwards).

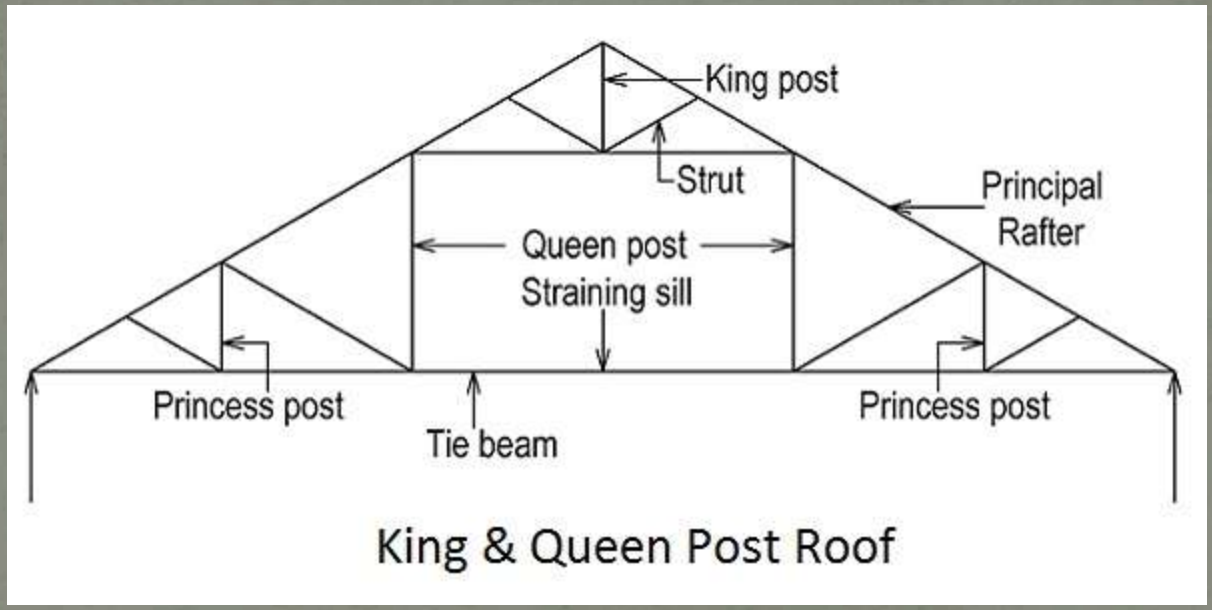
- Joint at the head of queen post is formed due to the junction of two compression members (principal rafters and straining beam) and one tension member(queen-post).
- The head and feet of queen post are widened for better load distribution.
- The joints are strengthened by stirrup straps and bolts.



Traditional Queen Post Roof Truss

COMBINATION OF KING-POST AND QUEEN-POST TRUSSES

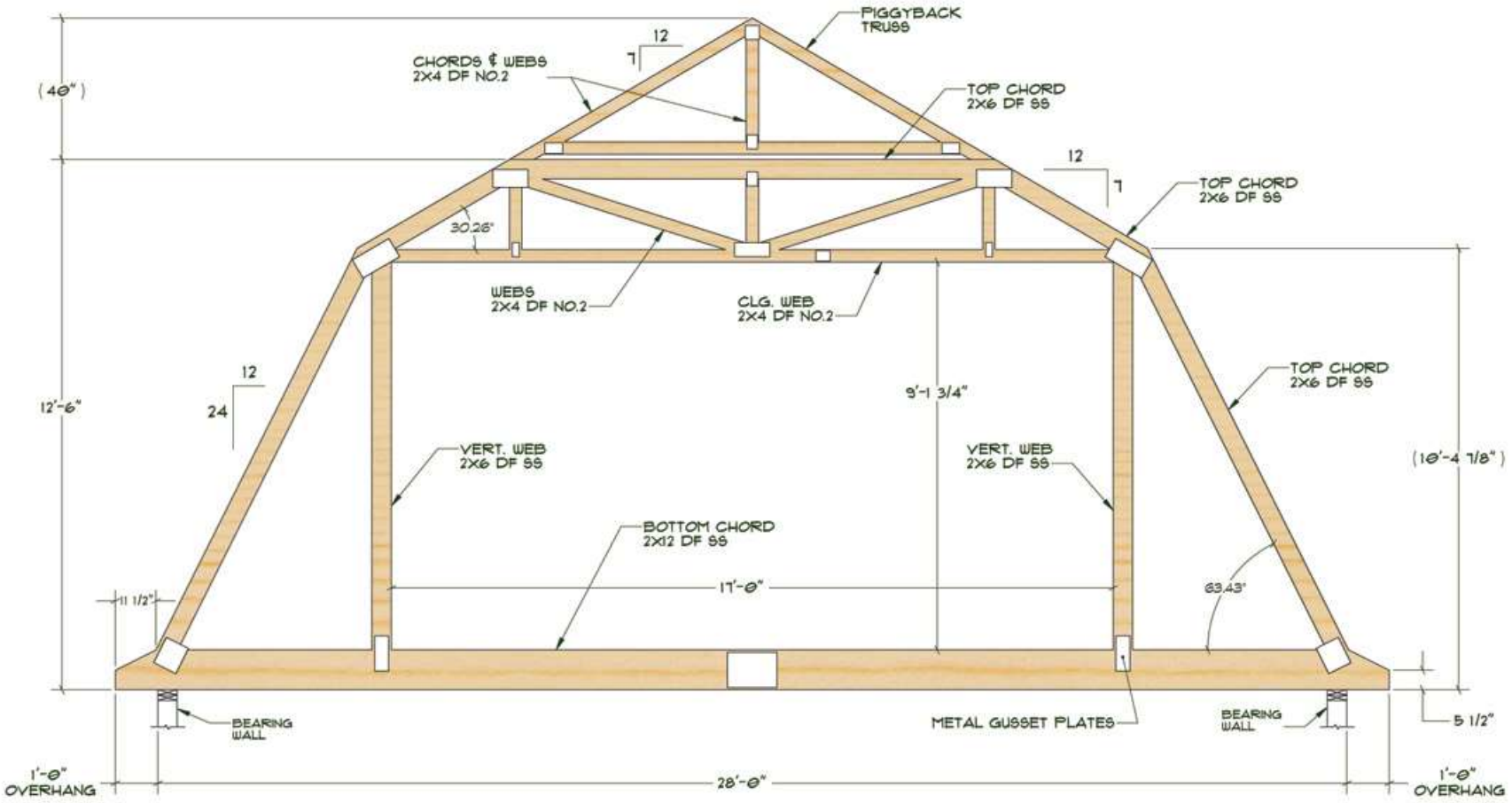
- For greater spans upto 18 m, the queen post truss can strengthened by one more upright member, called princess-post to each side.



King & Queen Post Roof

MANSARD ROOF TRUSS

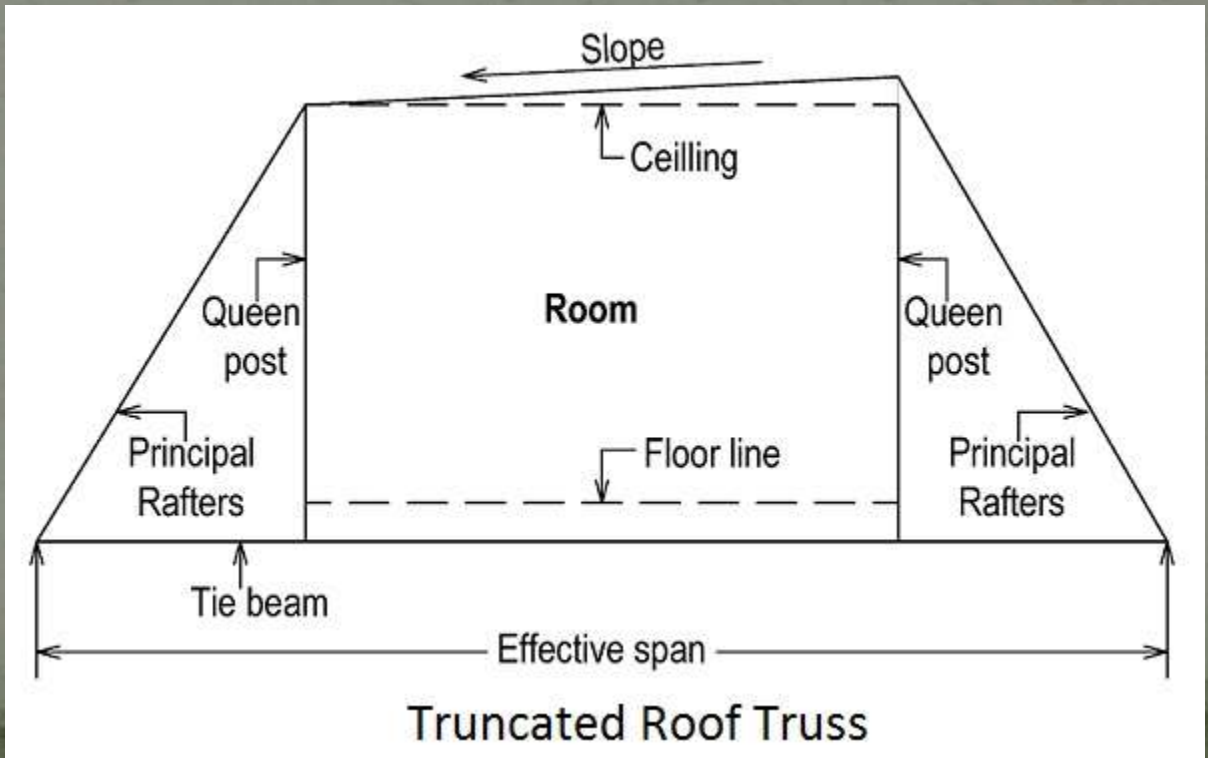
- Designer-Francois Mansard (French architect)
- It is a two storeyed truss, with upper portion consisting of king-post truss and the lower portion of queen post truss.
- The entire truss has two pitches.
- The upper pitch(king post truss) varies from 30 to 40 degree while lower pitch (queen truss) varies from 60 to 70 degree.
- The use of this truss results in economy in space, since a room may be provided between the two queen-posts.



28'GAMBREL ATTIC TRUSS W/ PIGGYBACK

TRUNCATED TRUSS

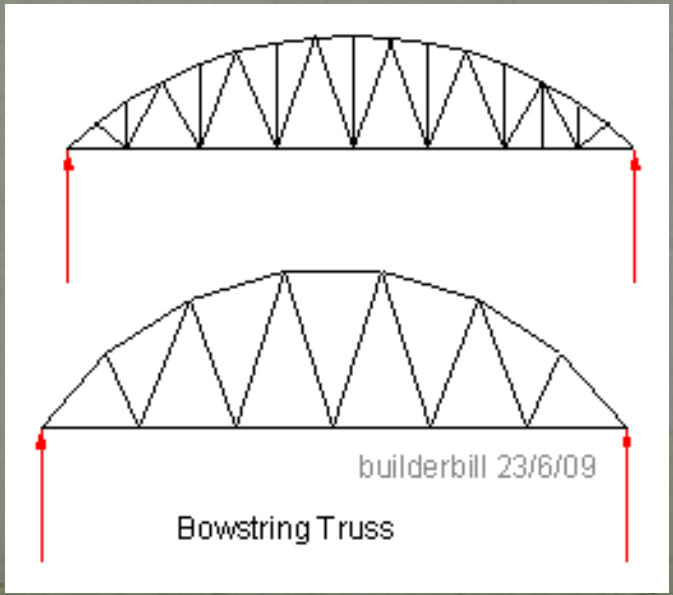
- A truncated truss is similar to mansard truss, except that its top is formed flat, with a gentle slope to one side.
- This type of truss is used when it is required to provide a room in the roof between the two queen posts of the truss.



Truncated Roof Truss

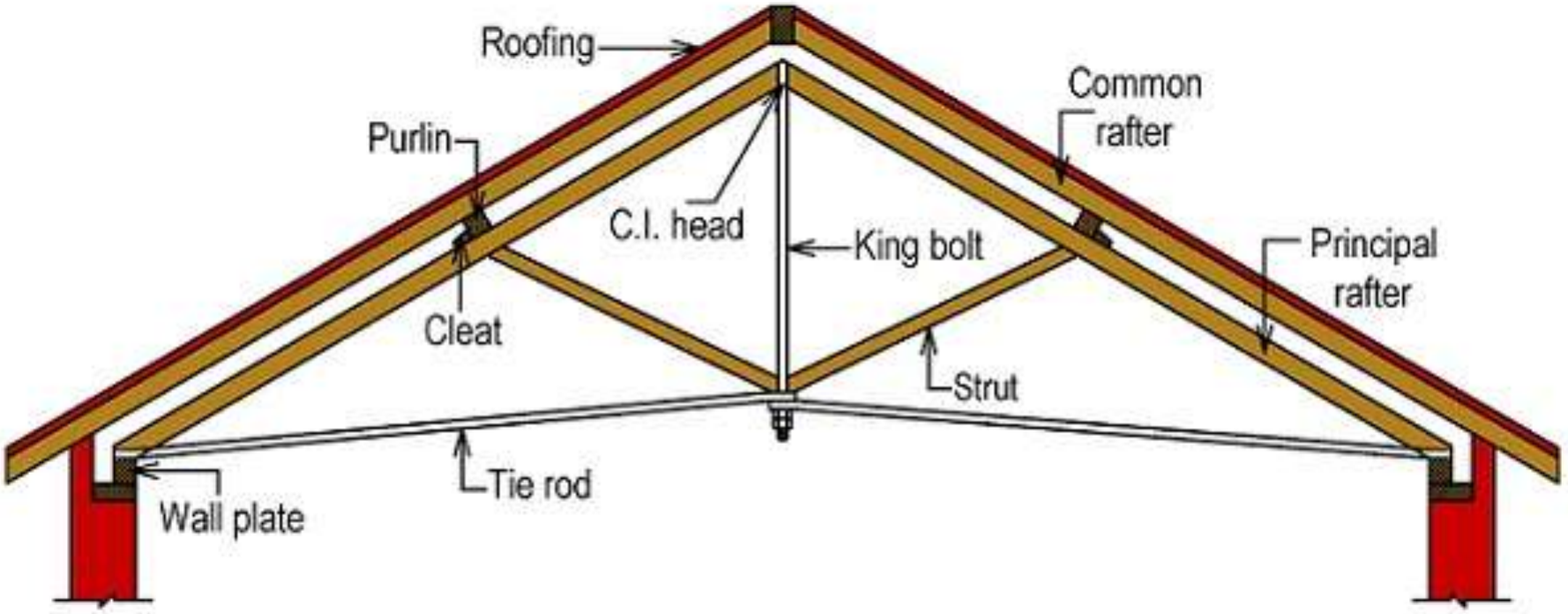
BELFAST ROOF TRUSS(BOW STRING TRUSS)

- This truss in the form of a bow, consists of thin sections of timber, with its top chord curved.
- If the roof covering is light, this roof truss can be used upto 30 m span.
- This roof truss is also known as latticed roof truss.



COMPOSITE ROOF TRUSS

- Roof trusses made of two materials, such as timber and steel are known as COMPOSITE ROOF TRUSSES.
- In a composite truss, tension members are made of steel, while compression members are made of timber.
- If tension members are made of timber, their section becomes very heavy because of reduction of section at the joints.
- Special fittings are required at the junction of steel and timber members.
- The joints in composite trusses should be such that cast or forged fittings can be easily used.



Composite Roof Truss

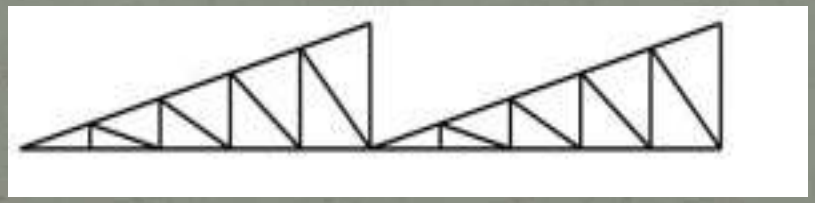
STEEL ROOF TRUSSES

- When span exceeds 10 m, timber trusses become heavy and uneconomical.
- Steel trusses are more economical for longer spans.
- They are fabricated from rolled steel structural members such as channels , angle sections etc
- Trusses are designed in such a way that members are either in compression or in tension & bending stress is not allowed to develop them
- Most of the roof trusses are angle sections, because they can resist both tension & compression effectively.
- They are commonly used these days for all spans, since they are economical, easy to fabricate, fire proof, more rigid, permanent & suitable for speedy construction.

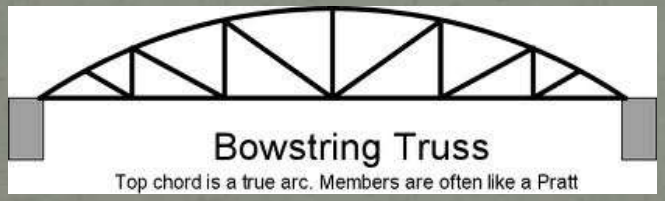
STEEL TRUSSES CLASSIFICATION

- Open Trusses
- North Light Trusses
- Bow String Trusses
- End Raised Trusses

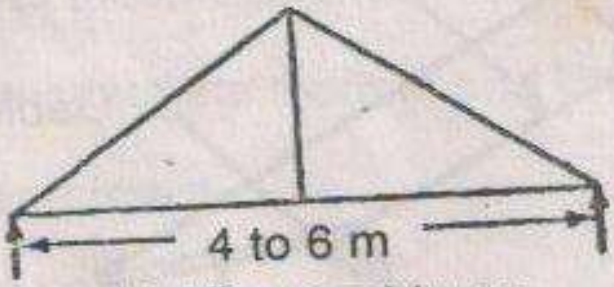
- Open trusses are ordinary trusses with straight bottom
- North light trusses are trusses facing North direction



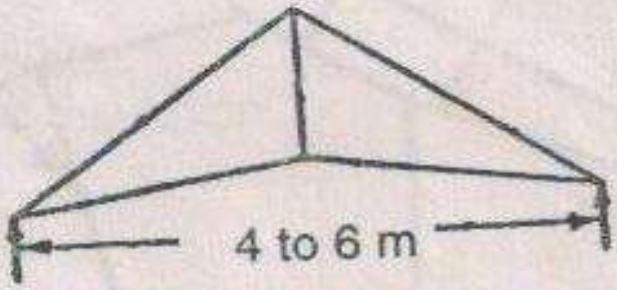
- Bow String trusses have its top chord curved



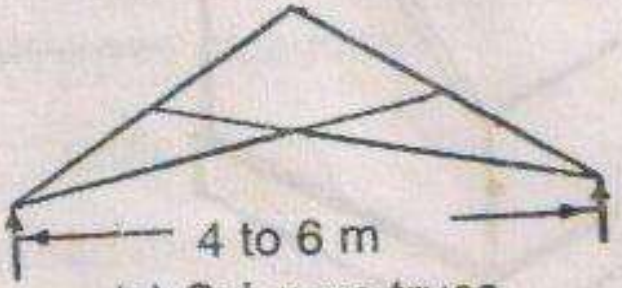
- End Raised will have their a rise at ends



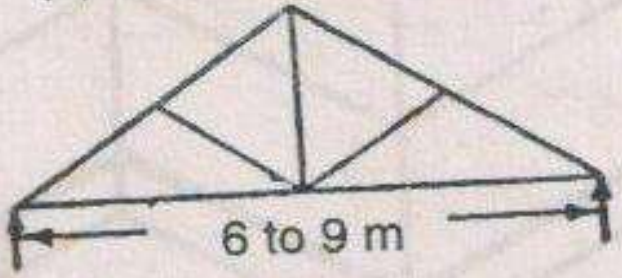
(a) King post truss



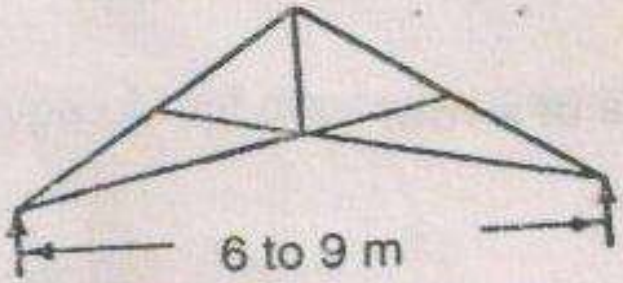
(b) Raised chord truss



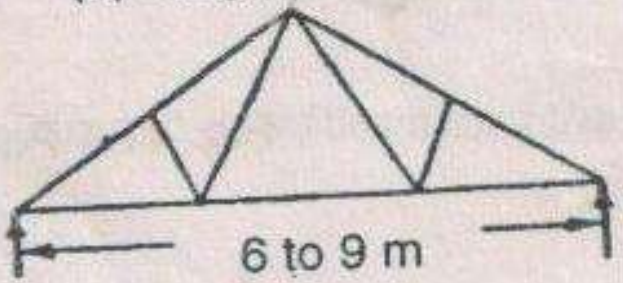
(c) Scissors truss



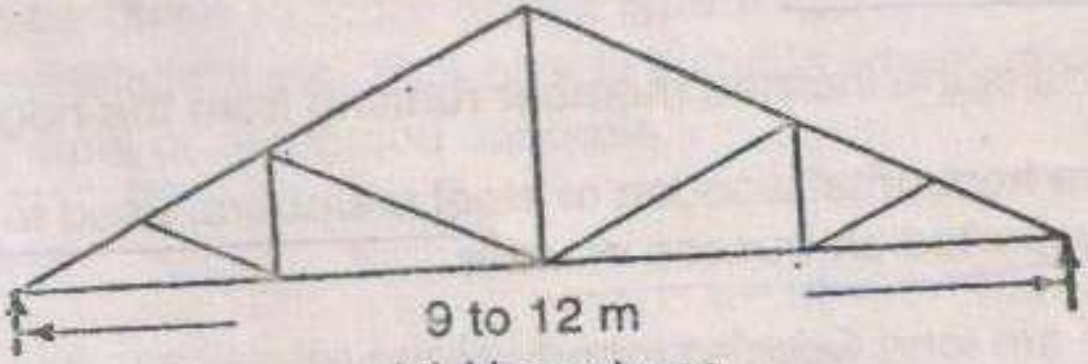
(d) King post truss



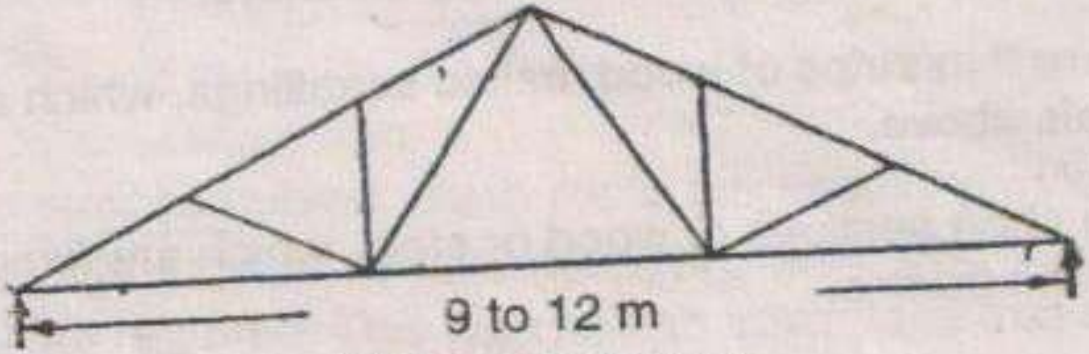
(e) Raised chord truss



(f) Simple fink truss

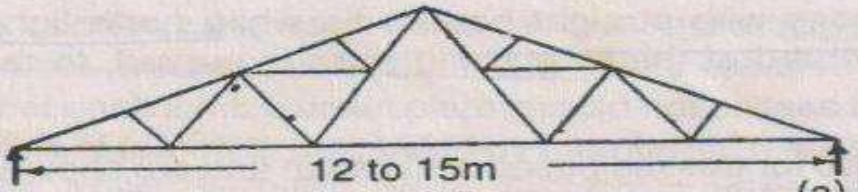


(g) Howe truss

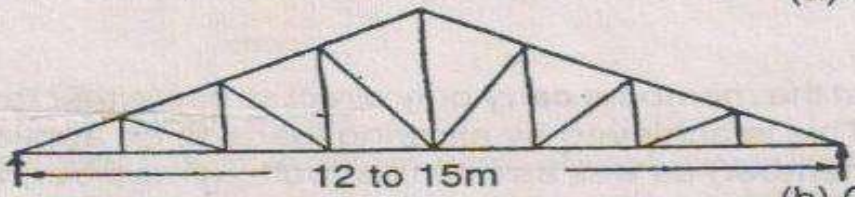


(h) Fan - fink truss

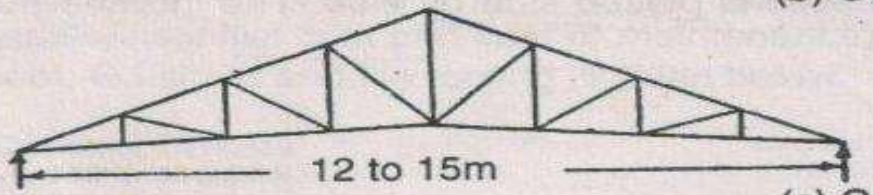
Fig. 14.1 (a) Steel roof trusses



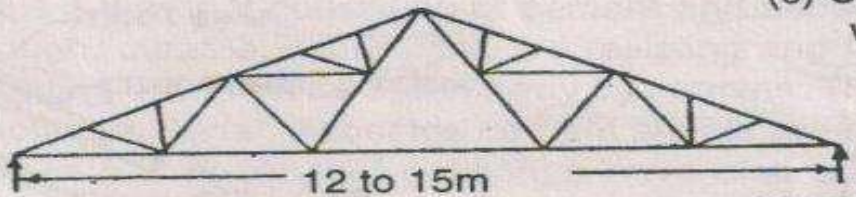
(a) Compound fink truss



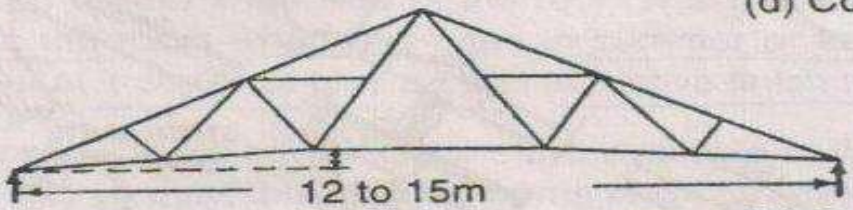
(b) Compound howe truss



(c) Compound howe truss with raised chord

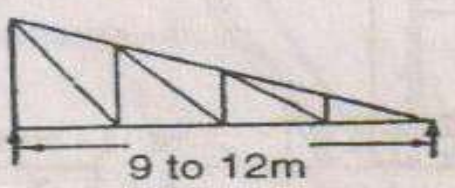


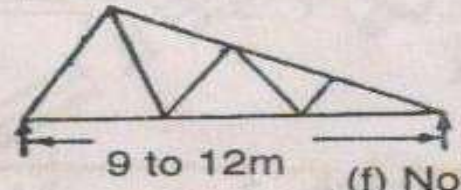
(d) Compound fan fink truss



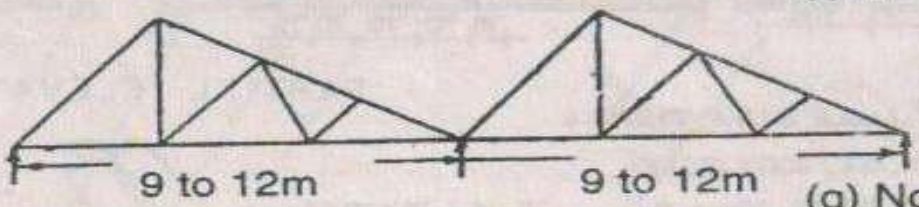
(e) Cambered fink or French truss

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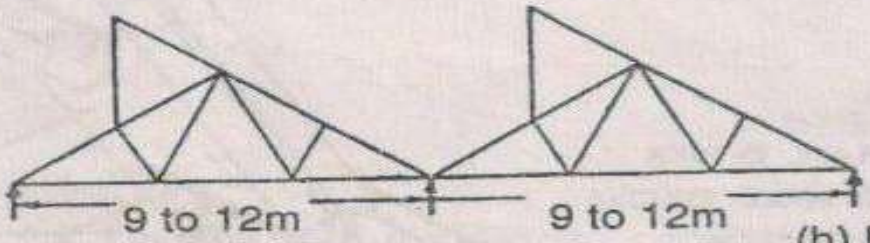




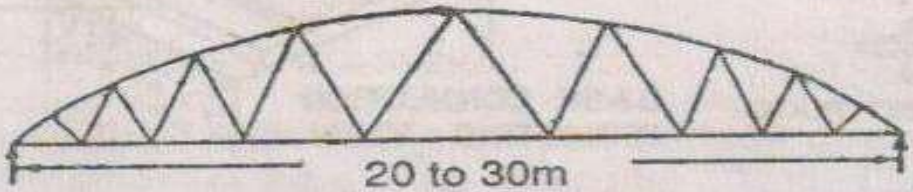
(f) North light truss



(g) North light or saw - tooth truss



(h) Modified north light truss



(i) Bow string truss

Fig.11.2 (b) Steel roof trusses

Advantages of steel truss over timber trusses

- readily available in the required dimension, resulting in minimum wastage of material
- light in weight and can be fabricated into any shape depending upon the structural and architectural requirement
- stronger and more rigid. The members are strong in tension and in compression
- Long life
- Termite proof and fire proof
- Can be used over any span ,while timber trusses are available only upto a span of 15m

THANK YOU!!!