Trade of Metal Fabrication	
Module 6:	Fabrication Drawing
Unit 12:	Structural Drawing
	Phase 2

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Document Release History

Date	Version	Comments
23/02/07	First draft	
12/12/13	SOLAS transfer	

Module 6 – Fabrication Drawing

Unit 12 – Structural Drawing

Duration – 10 Hours

Learning Outcome:

By the end of this unit each apprentice will be able to:

- Draw orthographic projections of structured joints, detail pitch and edge distances

Key Learning Points:

Rk Sk	Introduction to structural steel drawings and terminology.
Rk Sk	Structural steel sections.
Rk Sk	Dimensions and properties of structural steel sections.
Rk Sk	Standard back mark and cross centres.
Rk Sk	Bolted and welded joints.
P	Quality of work, presentation.

Training Resources:

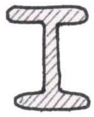
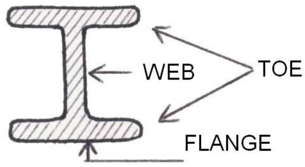
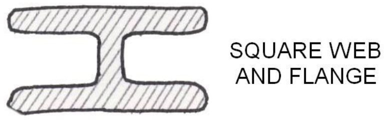
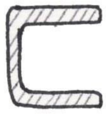
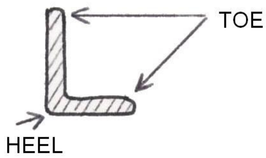
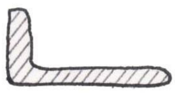
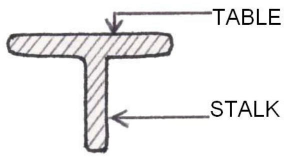
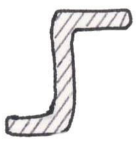
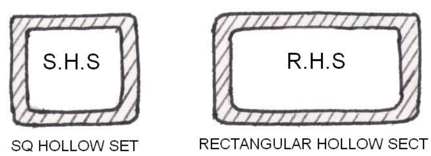
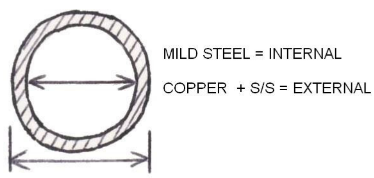
- Classroom, drawing board, tee square, scale rule, full set of drawing instruments and equipment
- A2 drawing paper

Key Learning Points Code:

M = Maths D= Drawing RK = Related Knowledge Sc = Science

P = Personal Skills Sk = Skill H = Hazards

Structural Steel

RSJ = Rolled Steel Joist	
BSUB = British Standard Universal Beam	
BSUC = British Standard Universal Column	
RSC = Rolled Steel channel	
BSEA = British Standard Equal Angle	
BSUA = British Standard Unequal Angle	
RST = Rolled Steel Tee	
Zed Beams ('Z' Channel)	
Rolled Hollow Section	
Circular (Round) Hollow Section	

Back Marks and Cross Centres

A ‘back mark’ is the distance from the heel of an angle or channel section to the centre of a hole in a flange.

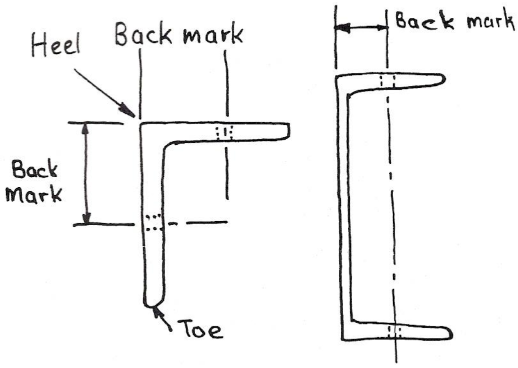


Figure 1 - Back Mark

A ‘cross centre’ is the distance between two holes in a flange of a Universal column, beam, rolled steel joist or Tee section.

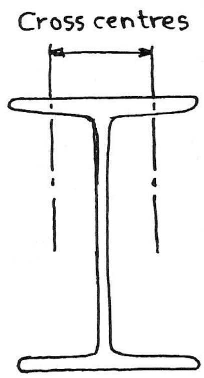


Figure 2 - Cross Centre 1

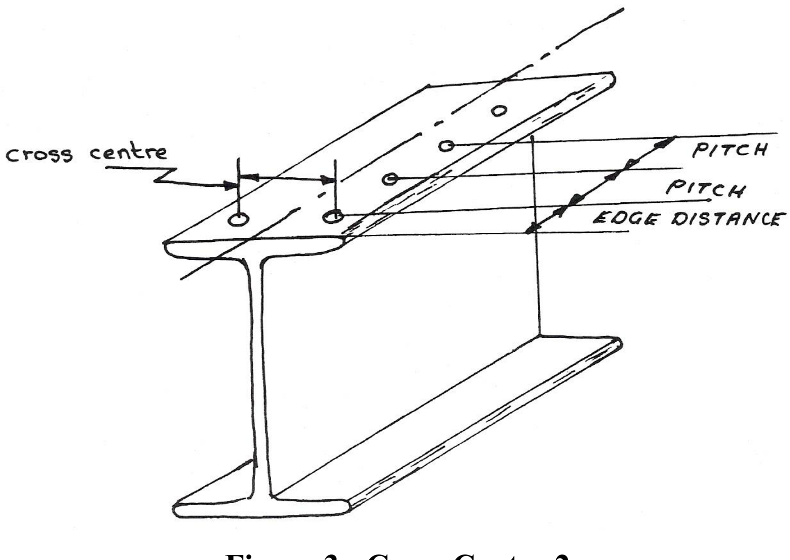


Figure 3 - Cross Centre 2

Pitch Circle Diameter (PCD)

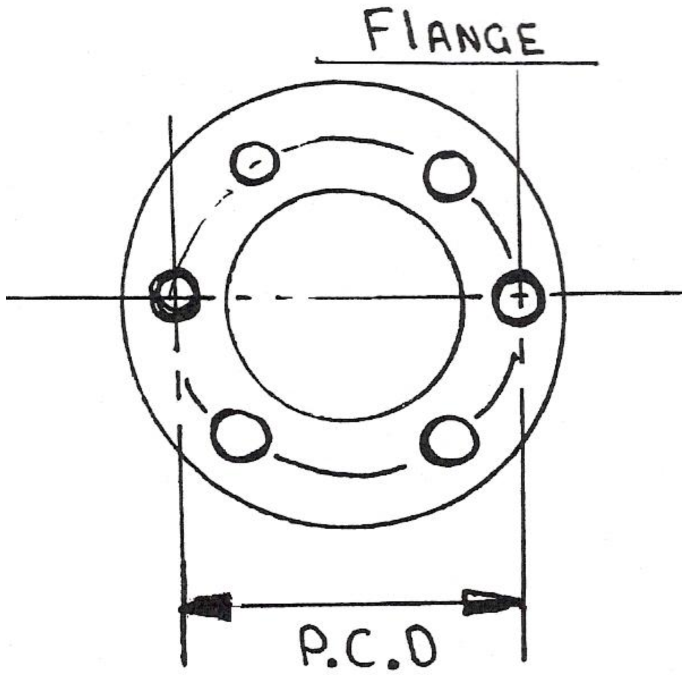


Figure 4 - Pitch Circle Diameter

Splice Plate or Fish Plate

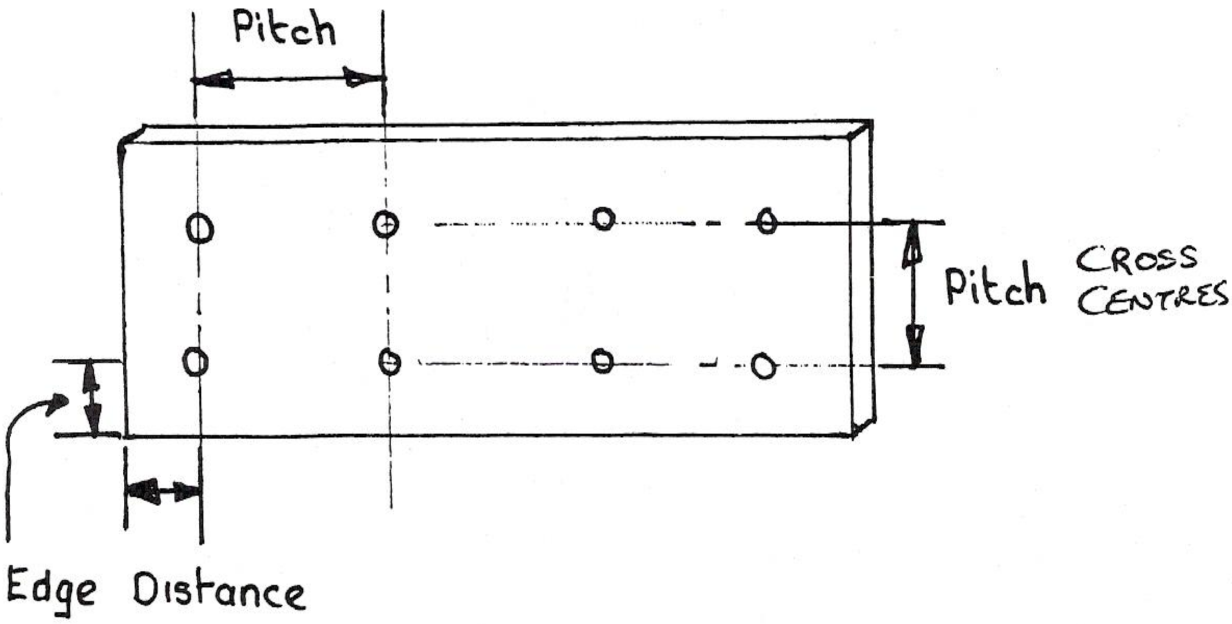


Figure 5 - Splice Plate

Drifts

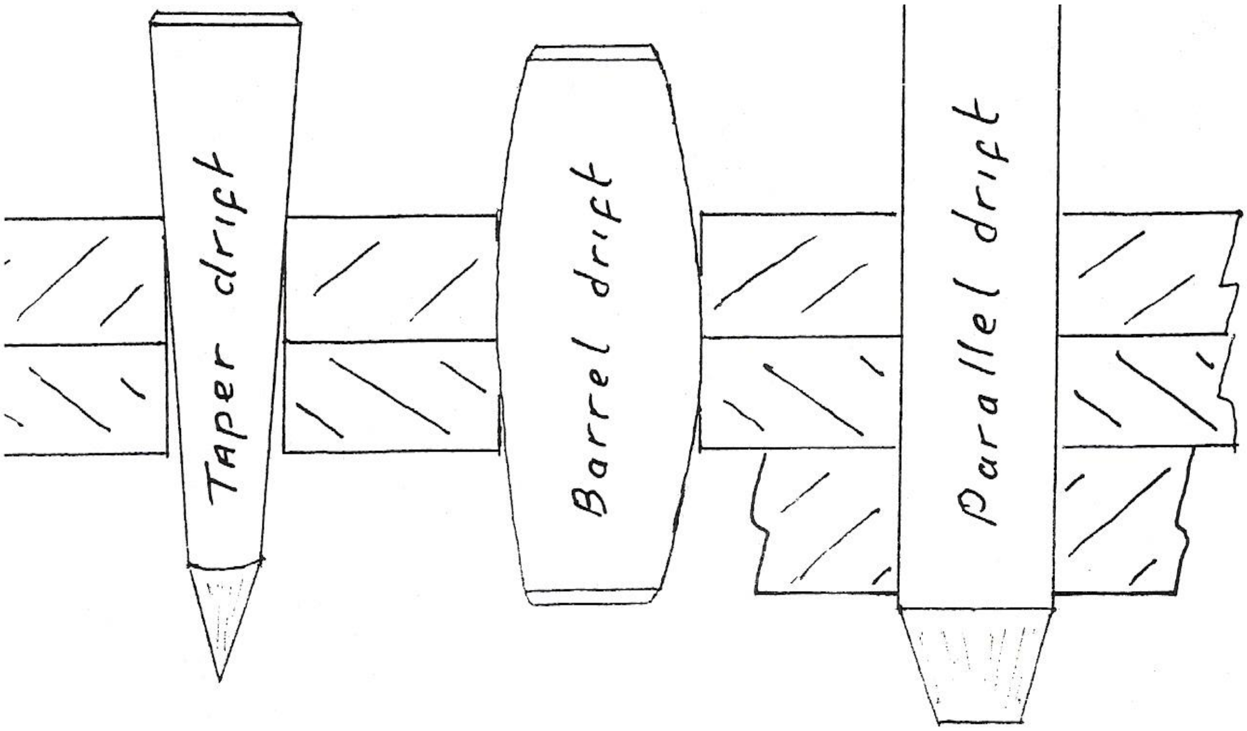


Figure 6 - Drifts

Taper Drift: used for 'fairing' or aligning holes. The plates move together to the correct position as the drift is hammered into the holes.

Barrel Drift: used for 'fairing' or aligning holes in confined spaces. The drift is hammered until it passes through the holes.

Parallel Drift: made approximately 0.75mm less than the size of the hole, used to 'fair' or align solid drilled work. The work being reassembled after separating for cleaning - de-burring etc.

Portal Frames

A portal frame is a type of arch construction in which the roof member, whether a horizontal beam or pitched rafters is joined rigidly at the eaves to the stanchion to form a continuous plane frame. The pitched roof portal frame has the greater advantage of providing clear working space from floor to rafter level unobstructed by ties or bracing members. Portal frames can be of solid or open web construction.

The portal frame depicted in Figure 7 is one suitable for spans up to about 18m with height to eaves of about 5m arranged at centres up to 4.5m. The site joint at the apex would be unnecessary for spans less than about 12m.

The base detail is that normally adopted as pinned or hinged for such portals.

At site the frame is assembled on the ground, using high strength friction grip bolts, before erection.

Larger portal frames may require strengthening at eaves and ridge and this is usually achieved by haunching and deepening of the section respectively.

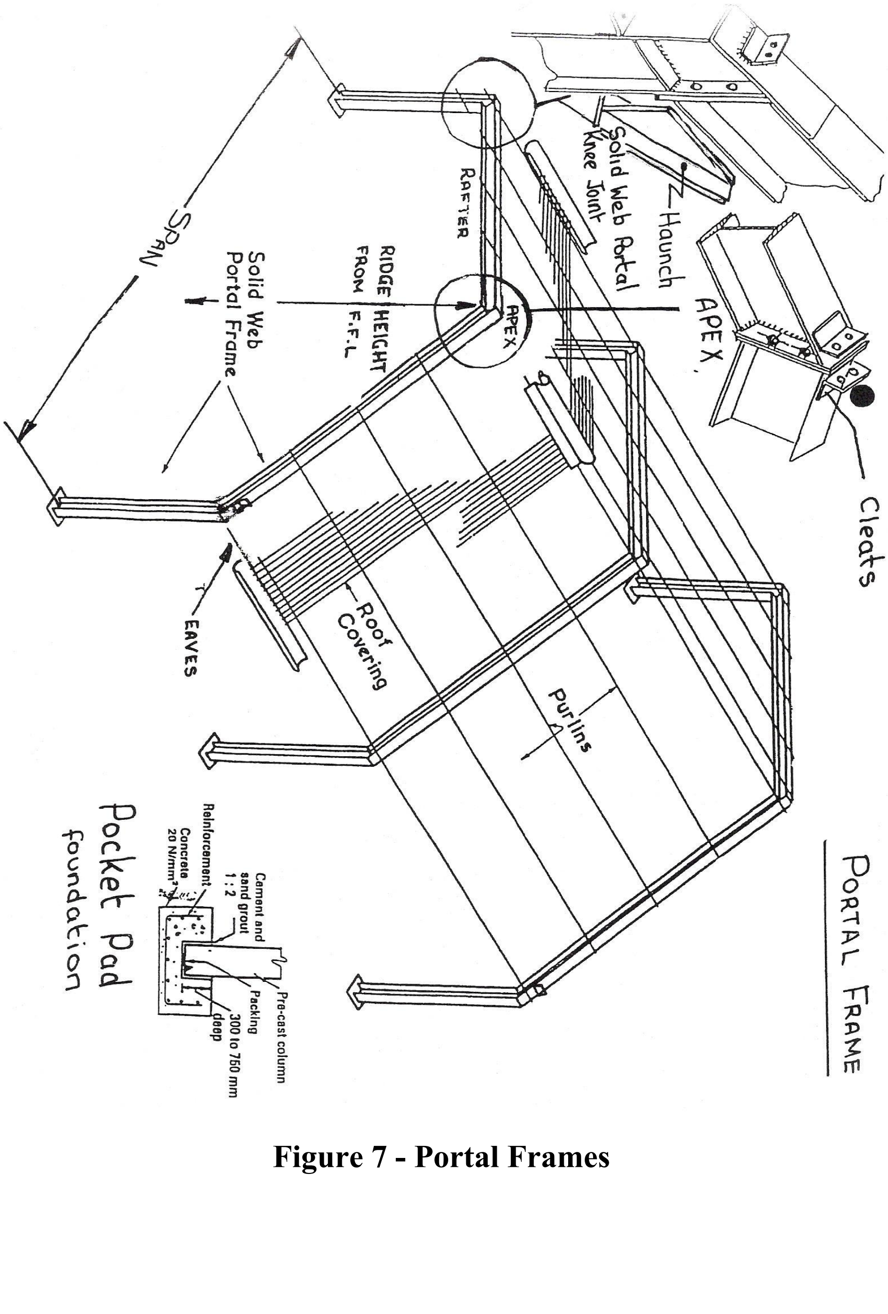


Figure 7 - Portal Frames

Roof Truss Construction

Since hot rolled mild steel sections were first produced in 1873 lattice steel roof trusses have been the most commonly used structures for medium and long span roofs. They comprise triangular lattice frames of light steel sections riveted, bolted or welded together to support light section steel purlins, which in turn support the roof and roof covering. These trusses are spaced at from 3M to 7.5M apart supported on steel columns or loadbearing brick walls. Figure 8 is an illustration of the skeleton frame of a typical symmetrical pitch lattice steel roof. This type of roof framing is the cheapest available for spans of up to 15M.

The pitch is designed, primarily, to suit standard corrugated asbestos cement sheets, which are bolted to and supported by the steel purlins fixed to the rafters of the lattice steel trusses. The pitch of a roof is determined by the type of roof covering used, a pitch of 22%°, 25°, 30° degrees being common for asbestos cement sheets.

The spacing of the purlins is determined by the maximum centres at which the roof covering can safely be supported, which in turn is determined by the depth and number of the corrugations of the sheet roof coverings. The spacing of the purlins determines the arrangement of the members of the lattice inside each truss. Common practice is to provide a strut that is a vertical or near vertical member, under every other purlin along the length of the rafters of the truss, struts being connected by tie members to form a rigid triangular frame. Figure 9 illustrated some typical arrangements of the members of lattice steel trusses.

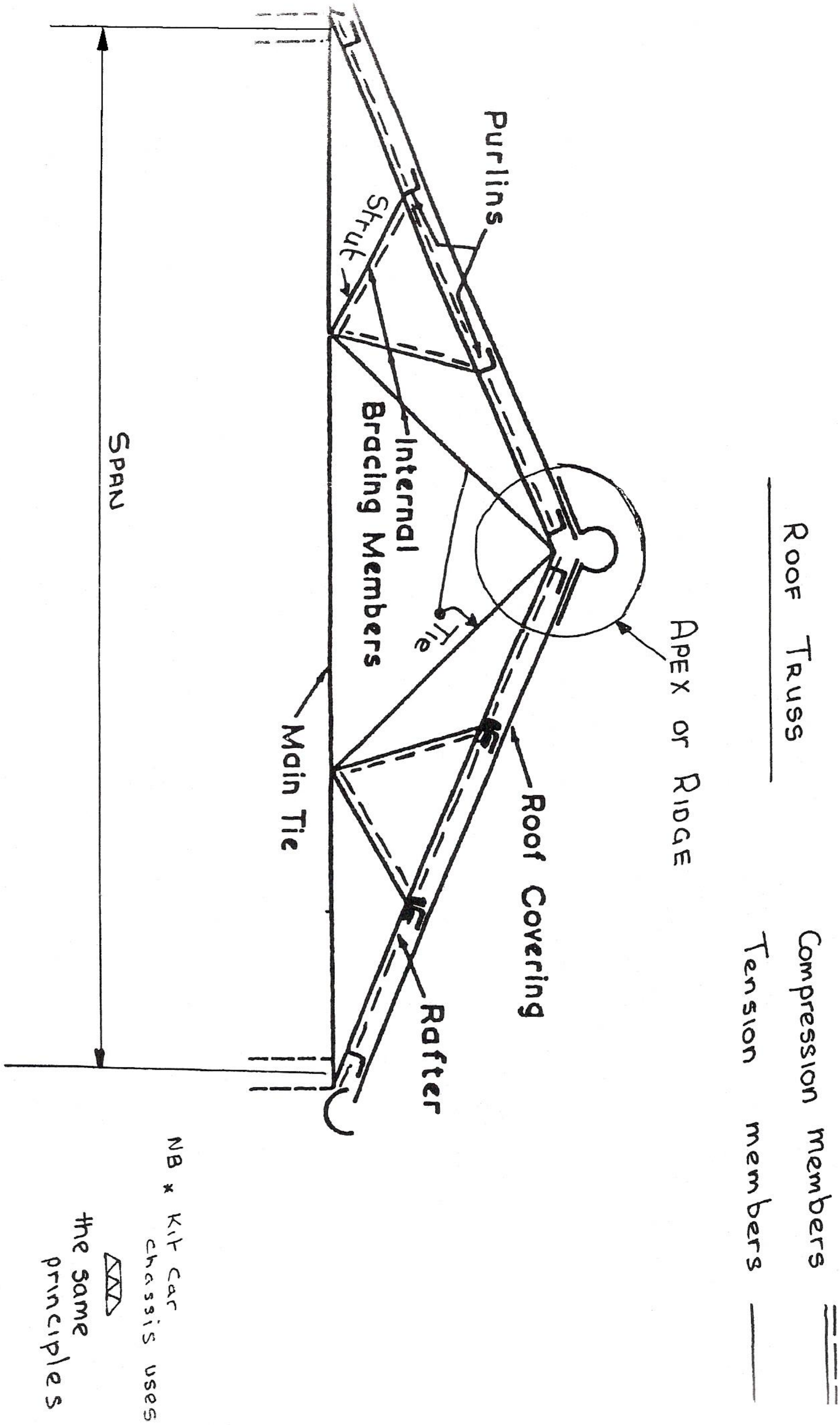


Figure 8 - Roof Truss

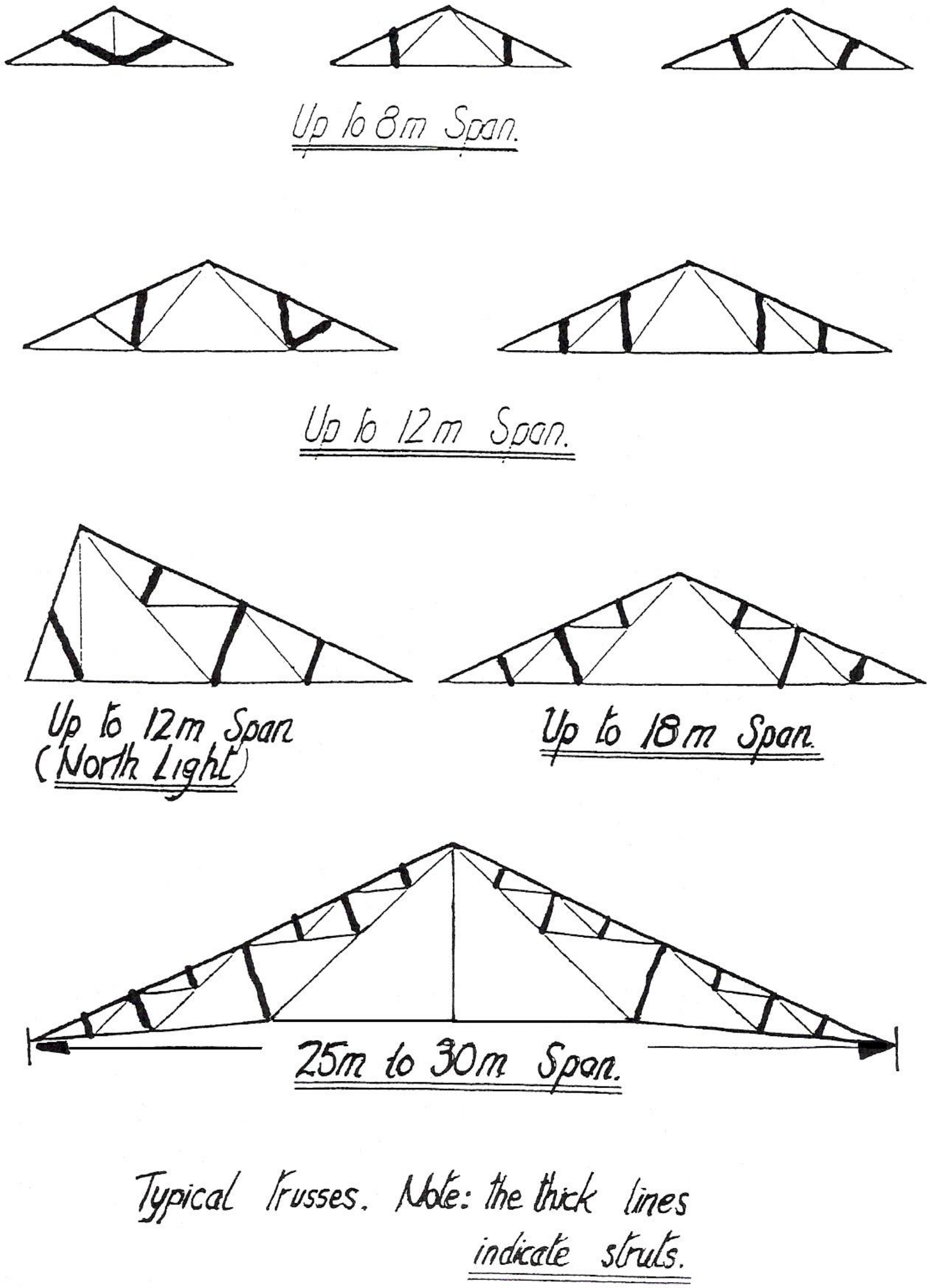


Figure 9 - Typical Trusses

Lattice Girders

Lattice girders, also sometimes called trusses, are plain frames of open web construction, usually having parallel chords or booms when used for roofs, and with internal web bracing members. They are extremely useful in long span construction in which their small depth/span ratio, generally from about 1/10 to 1/14, gives them a distinct advantage over roof trusses.

There are two main types of lattice girder, the N type shown in Figure 10 and the Warren type shown in Figure 10. It will be seen that in the case of the N girder the diagonal bracing members are arranged so that they act as ties. (If reversed they would become struts and the shorter, vertical members would be ties).

As with roof trusses, the framing of a lattice girder should be triangulated, taking into account the span and the spacings of the applied loads. That is to say, the booms are divided into panels of equal length and, as far as possible the panel points are arranged to coincide with the applied loads. This means that in the case of a lattice girder supporting roof trusses, the panel lengths would be such that the trusses connect at panel points.

If loading unavoidably occurs between panel points secondary framing can be introduced to prevent local bending in the boom members (Figure 10).

Where it is essential to omit diagonal members, the Vierendeel girder can be used. In this type of frame the internal members are all vertical and the joints are made rigid (Figure 10).

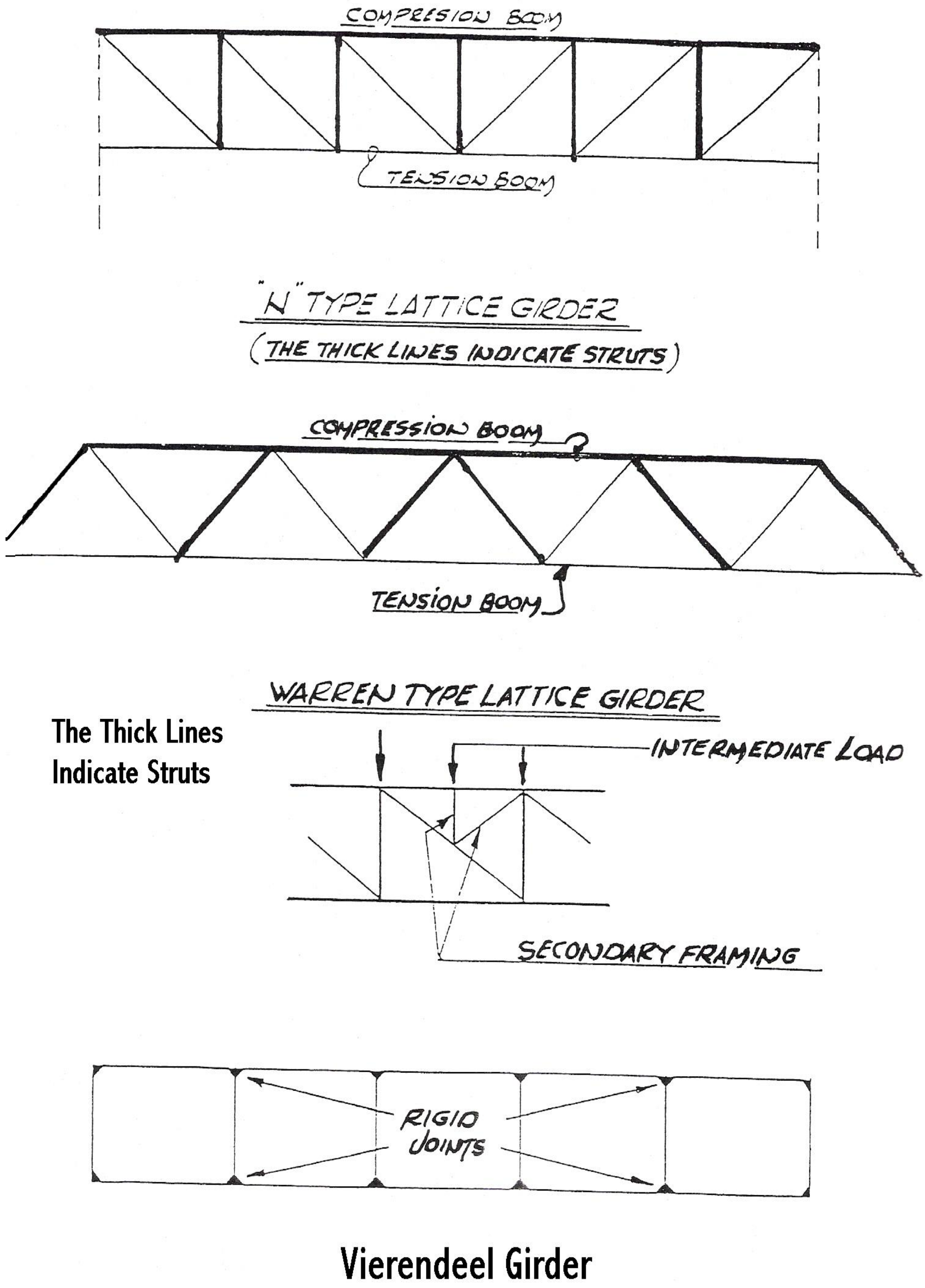


Figure 10 - Lattice Girders

Castellated Beams

This open web beam section is made by cutting the web of a hot rolled joist along a castellated line. The two halves so produced are then welded together to form the section illustrated in Figure 11.

The castellated beam is one and a half times the depth of the member from which it was cut, and therefore suffers less deflection under load. This section is economical for lightly loaded floors and the openings in the web are convenient for electrical and heating services.

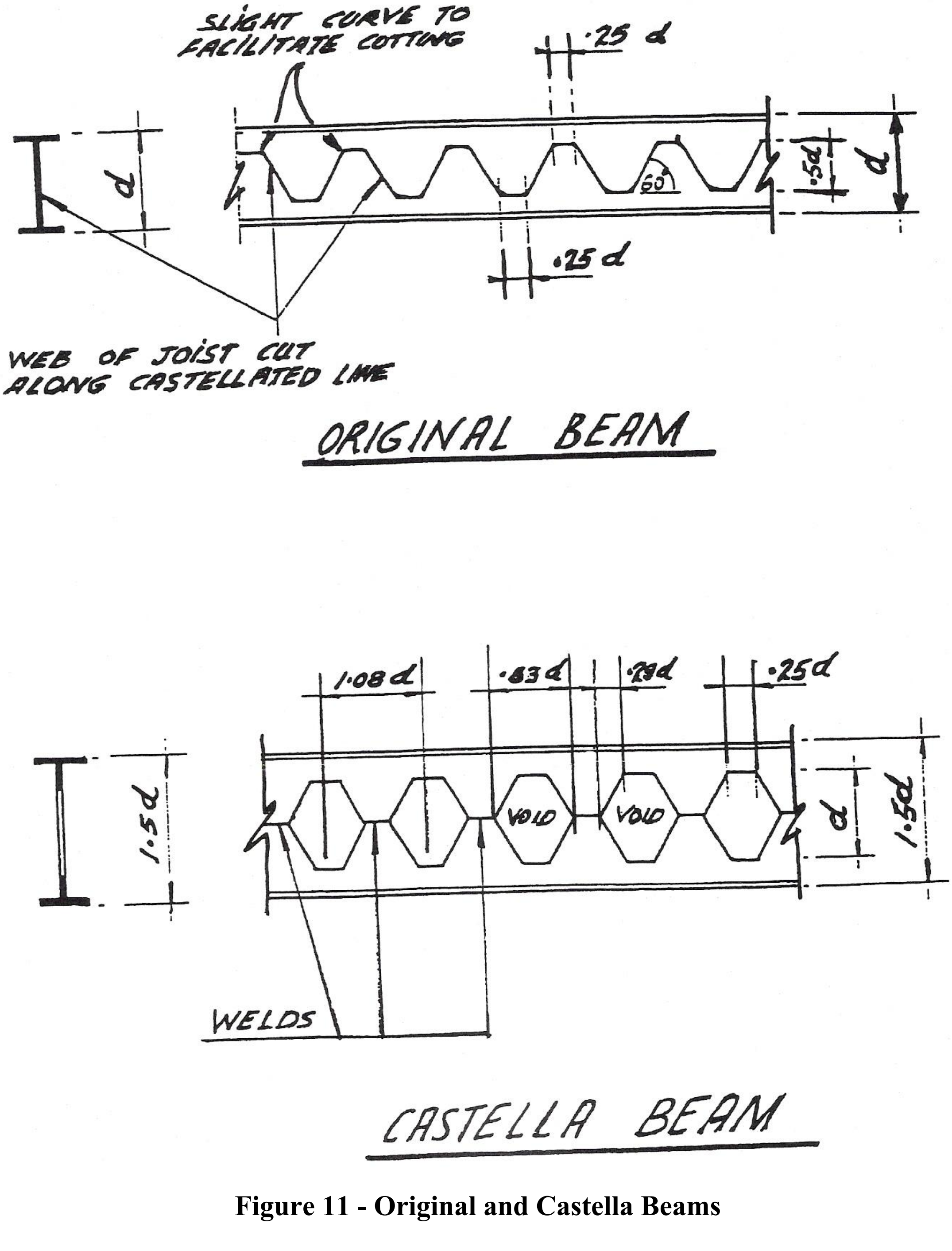


Figure 11 - Original and Castella Beams

Serial Size – Actual Size

When referring to beams, columns, joists and channels the depth: overall distance from flange to flange is given first, followed by the breadth: width of the flange, followed by the mass per metre and finally the length required.

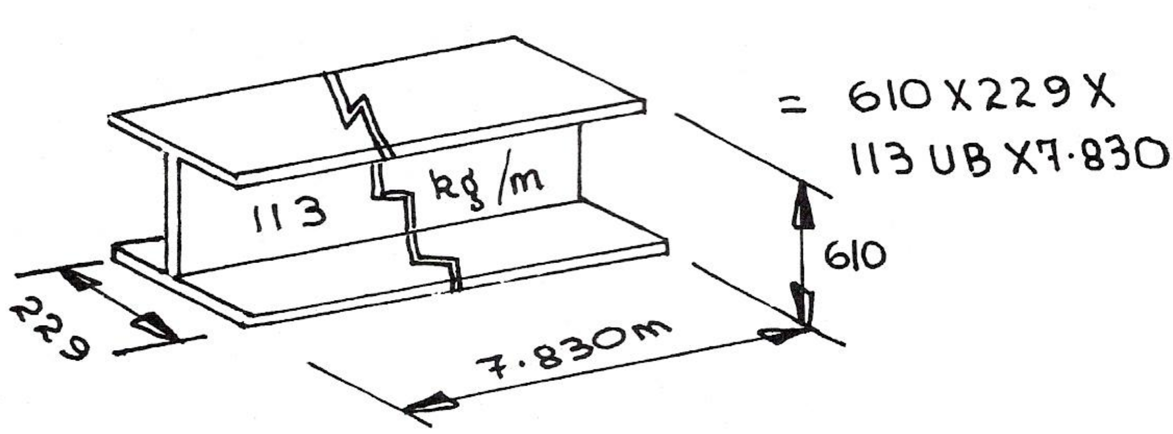


Figure 12 - Serial Size - Actual Size

Although the serial sizes are always referred to on drawings, the actual size of beams, columns etc. can vary considerably. BS41 gives dimensions for serial sizes of sections with mass per metre/actual depth and breadth/ and thickness of web and flange.

It will be seen that up to seven variations of a serial size is rolled and that the dimensions inside the flanges are constant, while the thickness of the web and flanges vary hence the variation in serial size and actual size.

Self Assessment

Questions on Background Notes – Module 6.Unit 12

1. In diagram form draw a standard Round Flange and show where the Pitch Circle Diameter (P.C.D) is taken from.

2. Draw a Splice Plate and show the following:

a. Pitch Distance.
b. Cross Centres.
c. Edge Distance.

3. What is the difference between Serial Size and Actual Size?

4. List the three types of Lattice Girders.

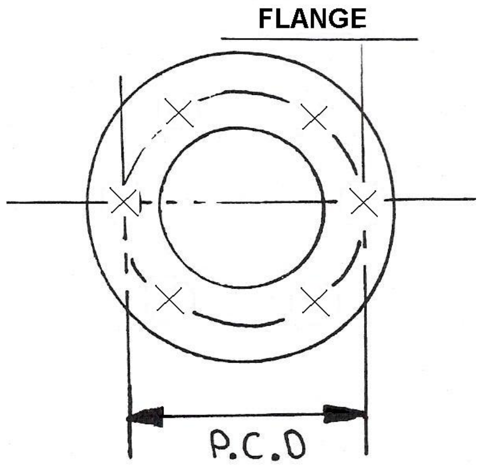
5. Sketch a Portal Frame and show the following:

- **a.** Apex.
- **b.** Eaves.
- **c.** Purlins.
- **d.** Ridge Height.

Answers to Questions 1-5. Module 6. Unit 12

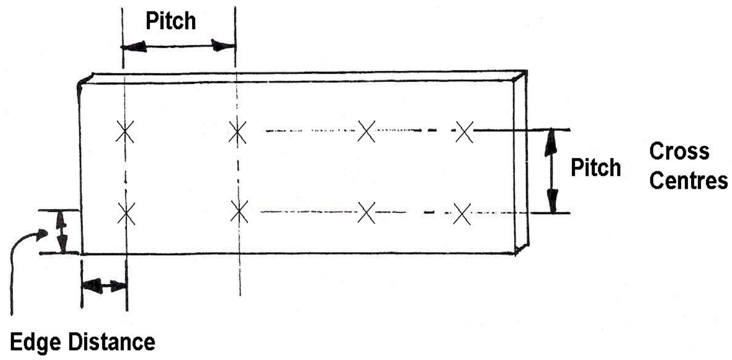
1.

Figure 24: Pitch Circle Diameter.



2.

Figure 25: Splice Plate.

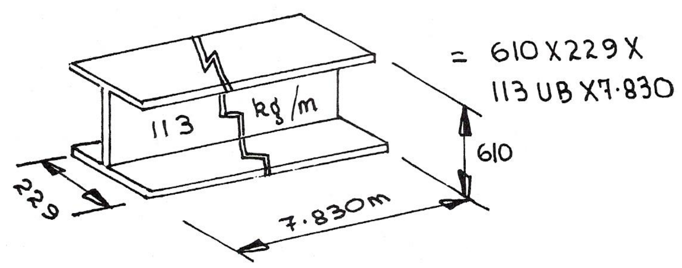


3.

Serial Size – Actual Size

When referring to beams, columns, joists and channel depth the overall distance from the flange is given first, followed by the breadth, width of the flange, followed by the mass per metre and finally the length required.

Figure 26:



Although the serial sizes are always referred to on drawings, the actual size of beams, columns etc. can vary considerably. BS41 gives dimensions for serial sizes of sections with mass per metre/actual depth and breadth and thickness of web and flange.

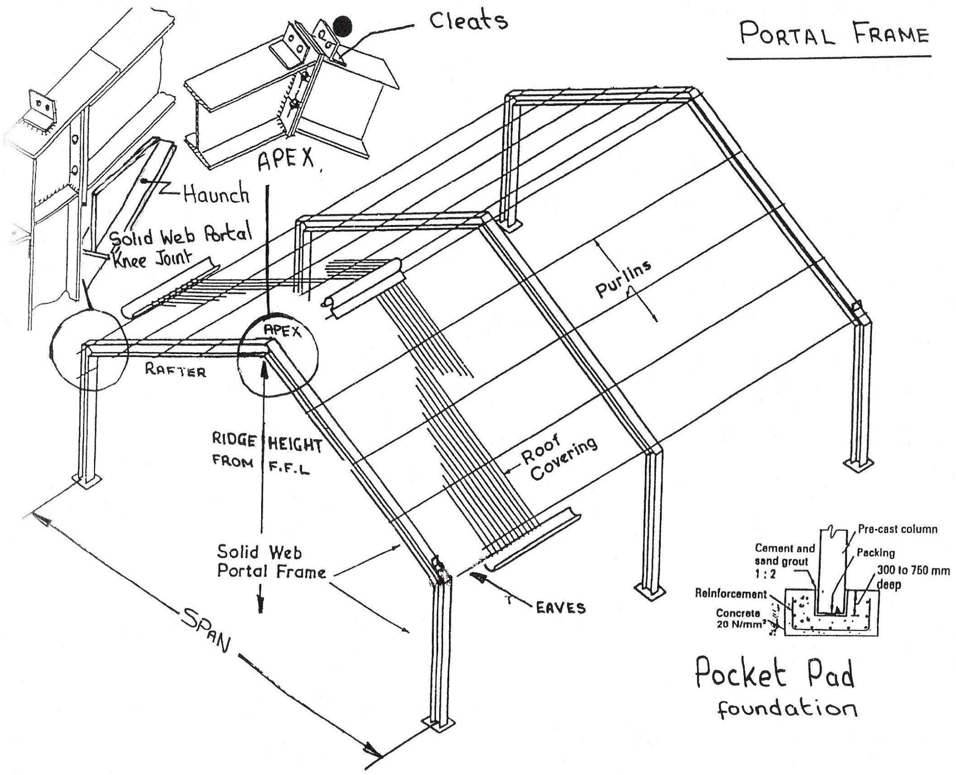
4.

Lattice Girders:

- N Type Girder.
- Warren Type Girder.
- Vierendeel Girder.

5.

Figure 27: Portal Frame.



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