S/No	Name of experiment	Date	Remark	Signature
1.	Draw sketches of different types of bolts.			
2.	Draw sketches of different types of lap and butt bolted joints.			
3.	Design and draw various axially loaded tension members.			
4.	Design and draw various axially loaded compression members.			
5.	Design and draw M.S. Slab base with concrete pedestral.			
6.	Sketching of gusseted base.			
7.	Design and draw laterally supported beams.			
8.	Draw different types of trusses.			
9.	Working drawing of steel roof truss with details of joints.			

Experiment-01

Aim- Draw sketches of different types of bolts.

Introduction- There are several types of bolts used to connect the structural elements. However, the commonly used bolts are unfinished bolts and high-strength bolts.

Unfinished Bolts-Fig. 5.3 Unfinished bolts are also called ordinary, common, rough or black bolts. These are used for light structures subjected to static loads and for secondary members such as purlins, bracings, etc., and for roof trusses. They are not recommended for connections subjected to impact load, vibration and fatigue.

The high-strength bolts- Fig. 5.3 (a)They are made from bars of medium carbon heat treated steel and from alloy steel. Their high strength is achieved through quenching and tempering processes or by alloying steel.

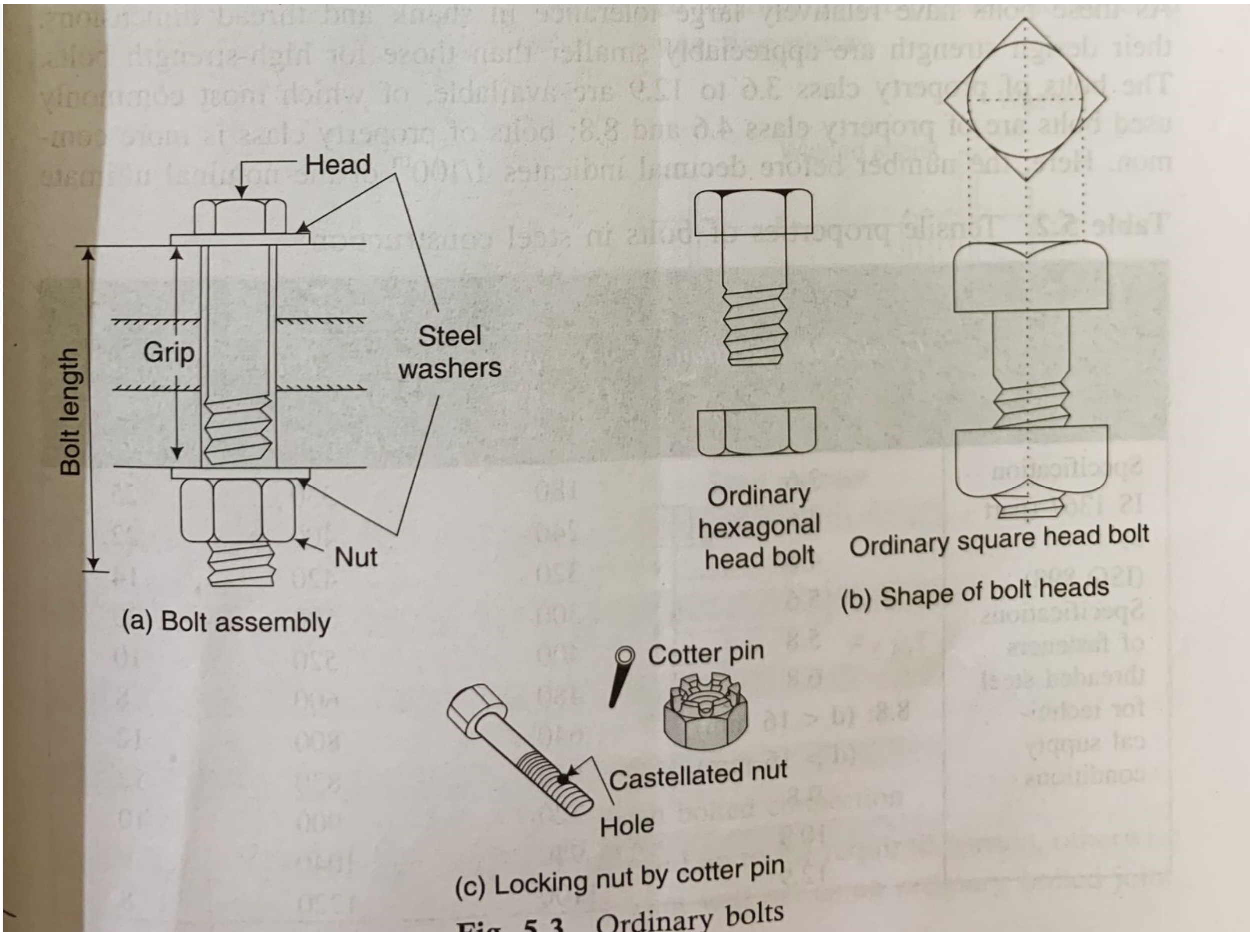
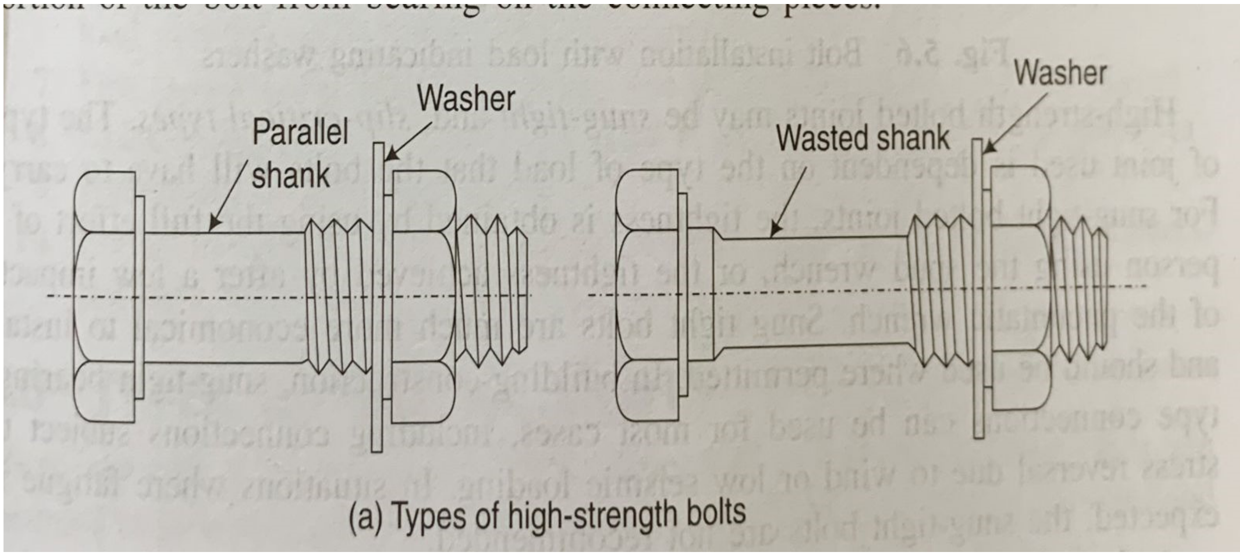


Fig. 5.3 Ordinary bolts



(a) Types of high-strength bolts

Fig 5.3 (a)

Experiment-02

Aim- Draw sketches of different types of lap and butt bolted joints.

- Introduction-

TYPES OF BOLTED JOINTS: There are two types of bolted joints subjected to axial forces (the loads are assumed to pass through the center of gravity of the group of bolts):

- Lap joint
- Butt joint

- Lap joint- The two members to be connected are overlapped and connected together. Such a joint is called lap joint as shown in Fig. 5.7 (a). A single bolted lap joint and a double bolted lap joint are shown in Figs. 5.7 (b and c) respectively.

  The load in the lap joint has eccentricity, as the centre of gravity of the load in one member and the centre of gravity of load in the second member are not in the same line, as shown in Fig. 5.7 (d). Therefore, a couple is formed which causes undesirable bending in the connection and the bolts may fail in tension. To minimize the effect of bending in lap joints at least two bolts in a line should be provided.

- Butt Joint- The two members to be connected are placed end to end. Additional plate/plates provided on either one or both sides, called cover plates, are placed and are connected to the main plates as shown in Figs. 5.7 (e and h). If the cover plate is provided on one side as in Figs. 5.7 (e, f and g), it is called a single cover butt joint but if the cover plates are provided on both sides of the main plates, it is called a double cover butt joint as shown in Figs. 5.7 (h, i and j).

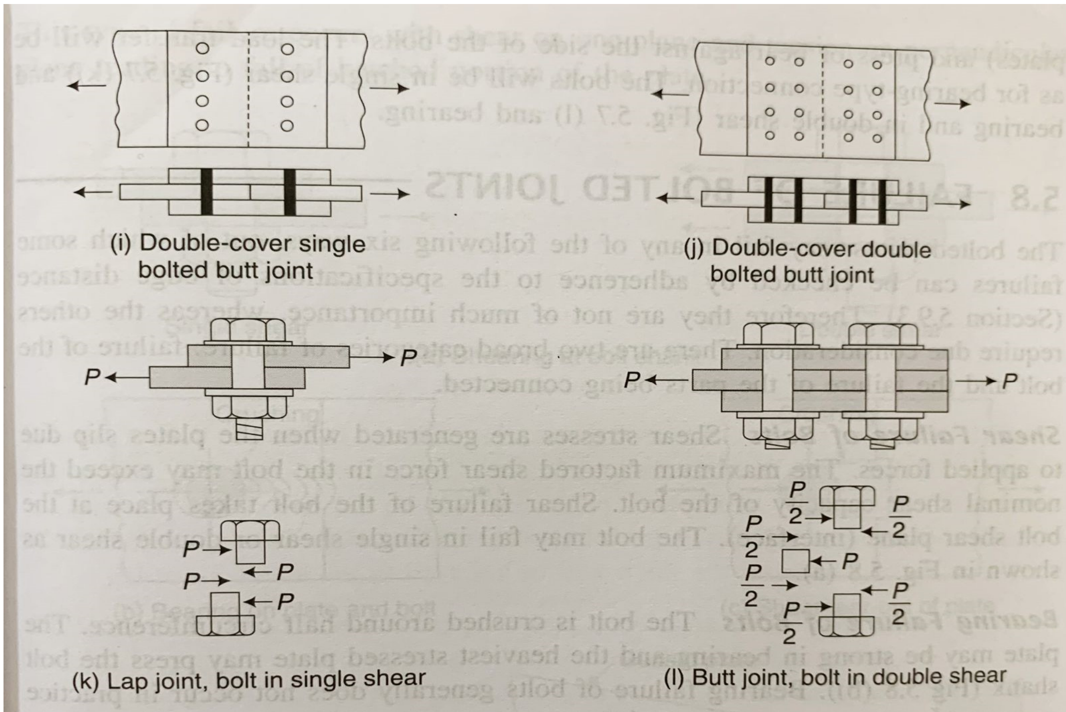
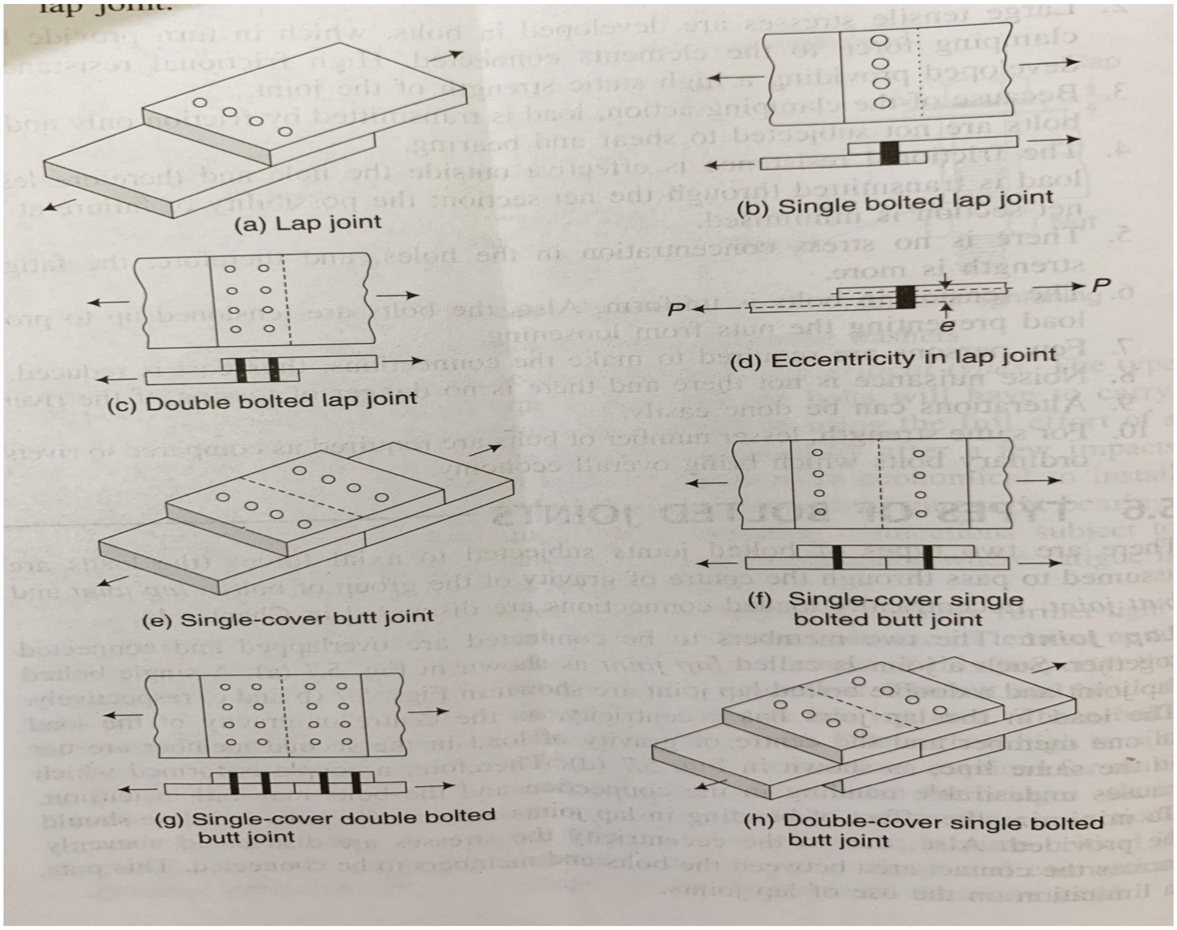


Fig. 5.7 Types of bolted joints

•



Experiment -3

Aim- Design and draw various axially loaded tension members.

- Design Steps:

An initial estimate of the area is made from the following conditions (1) and (2) and the larger one is taken as the initial size estimate.

Gross section yielding:

$$T_{dg} = A_g * f_y / Y_{mO}$$

2. Net section fracture:

For plates and threaded rods

$$T_{dn} = 0.9 A_n * f_u / Y_{m1}$$

For angles, etc.

$$T_{dn} = a * A_n * fu / Y_{m1}$$

Once the trial shape is selected, the section is checked for slenderness ratio limit, gross section yielding, net section fracture, and block shear failure. The step-by-step procedure for the design of tension member subjected to axial load is as follows:

1. The net area required A, to carry the factored load T is obtained by,

$$An = T / 0.9 f_u / Y_{m1}$$

Where T is the factored design load, fu is the ultimate strength of the material, An is the net area of cross section and $Y_{m1} = 1.25$.

2. The net area calculated thus is increased suitably (10% - 25%) to compute the tentative gross sectional area.

3. The trial gross area is also determined from its yield strength by

$Ag = T / F_y / Y_{mo}$

Where F_y is the yield strength of the material and $Y_{mo} = 1.1$.

4. From IS Handbook No.1, a suitable rolled section/built-up section providing a cross-sectional area matching with the computed gross sectional area matching with the computed gross-sectional area is selected.

5. The number of bolts (or weld) required to make the connection is calculated. These are arranged in a suitable pattern and the net area of the section provided is calculated. 6. The design

strength T_d of the trial section is calculated. This will be minimum of the strengths T_{dg} Eq. (6). T_{dn} Eq. (8) and T_{db} Eq. (10) and (11). The design strength T_d should be more than the factored design load.

7. The slenderness ratio of the member is checked as per the IS specification.

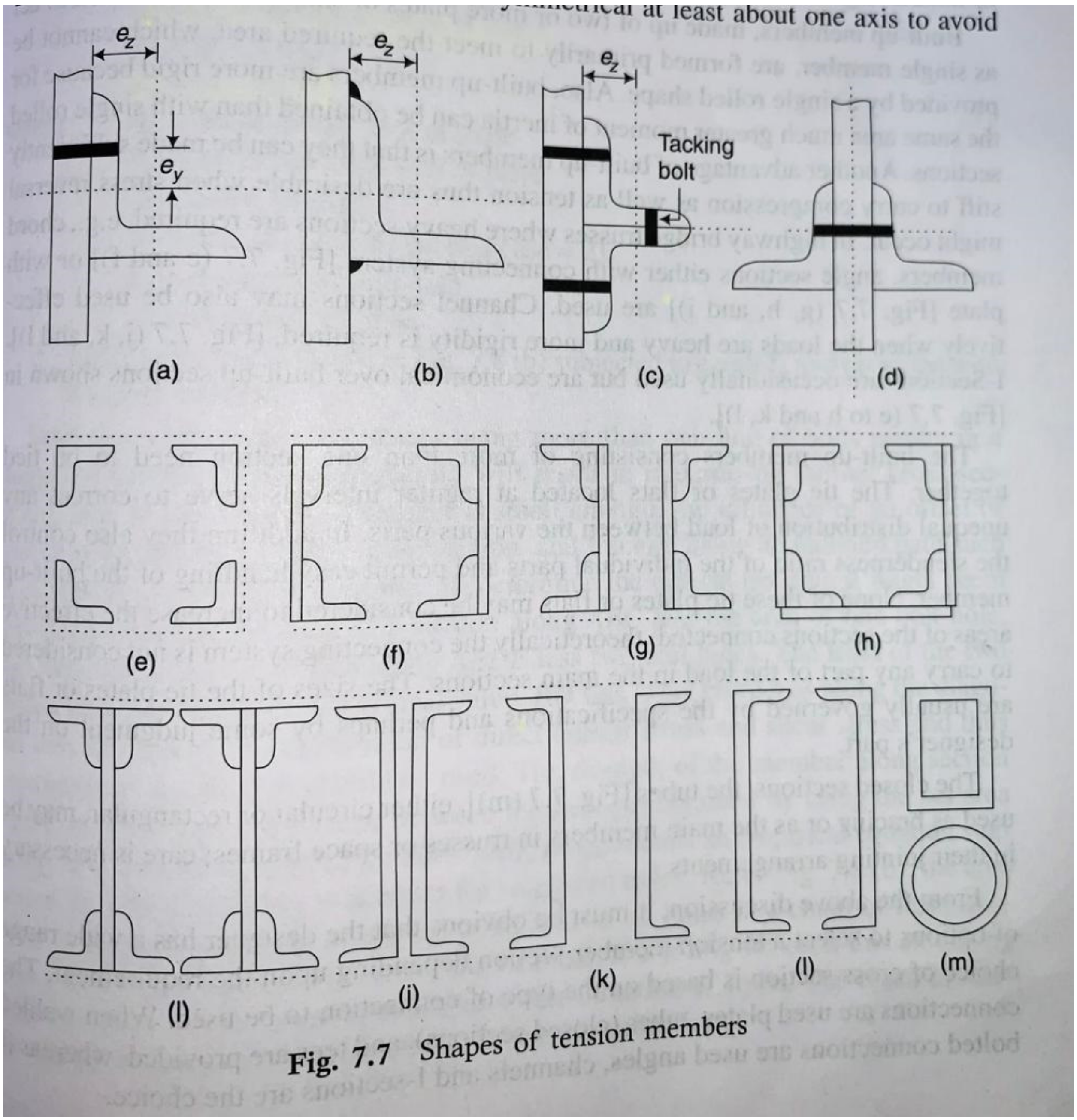


Fig. 7.7 Shapes of tension members

EXPERIMENT-04

AIM- Design and draw various axially loaded Compression members.

- Design steps:

Step 1. From the actual length of the compression member and the support conditions of the member, which are known, the effective length of the member is computed.

Step 2. From the radius of gyration about various axes of the section given in section tables, the minimum radius of gyration (r_{min}) is taken. r_{min} for a built up section is calculated.

Step 3. The maximum slenderness ratio (l/r_{min}) is determined for the compression member.

Step 4. The allowable working stress (σ_{ac}) in the direction of compression is found corresponding to the maximum slenderness ratio of the column from IS:800-1984.

Step 5. The effective sectional area (A) of the member is noted from structural steel section tables. For the built up members it can be calculated.

Step 6. The safe load carrying capacity of the member is determined as $P=(\sigma_{ac}.A)$, where P=safe load

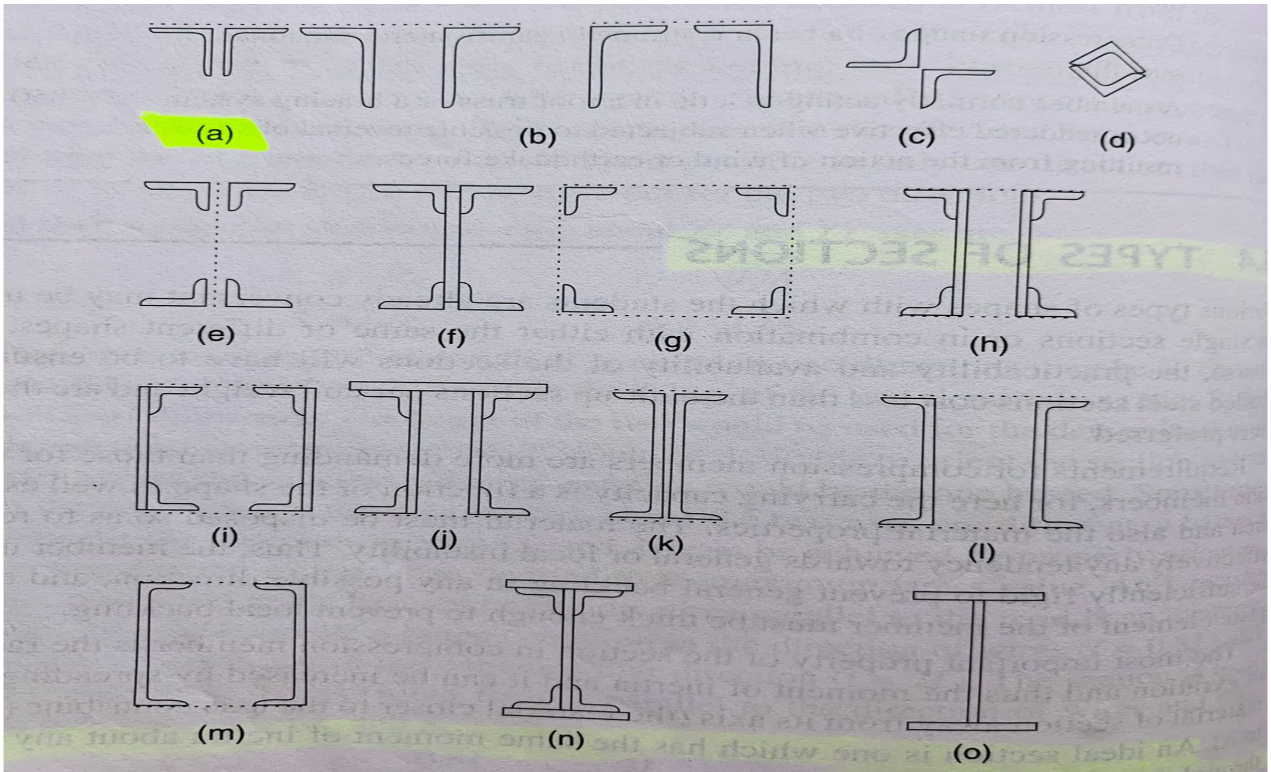


Fig. 8.6 Shapes of compression members

Experiment-05

Aim- Design and draw M.S. Slab base with concrete pedestral.

- Design steps:

a. Effective span of slab: Effective span of slab shall be lesser of the two

1. l = clear span + d (effective depth)
2. l = Center to center distance between the support

b. Depth of slab: The depth of slab depends on bending moment and deflection criterion. The trail depth can be obtained using:

• Effective depth d= Span / ((l/d)Basic x modification factor)

• For obtaining modification factor, the percentage of steel for slab can be assumed from 0.2 to 0.5%

• The effective depth d of two way slabs can also be assumed using cl.24.1,IS 456 provided short span is ≤ 3.5m and loading class is < 3.5KN/m2

OR

The following thumb rules can be used

• One way slab d= (l/22) to (l/28).

• Two way simply supported slab d= (l/20) to (l/30)

• Two way restrained slab d= (l/30) to (l/32)

c. Load on slab: The load on slab comprises of Dead load, floor finish and live load.

The loads are calculated per unit area (load/m^2)

Dead load = D x 25 kN/m^2 (Where D is thickness of slab in m) Floor finish (Assumed as)= 1 to 2 kN/m2 Live load (Assumed as) = 3 to 5 kN/m2 (depending on the occupancy of the building)

5. DETAILING REQUIREMENTS AS PER IS 456:2000

a. Nominal Cover:

For Mild exposure – 20 mm

For Moderate exposure – 30 mm However, if the diameter of bar do not exceed 12 mm, or cover may be reduced by 5 mm.

Thus for main reinforcement up to 12 mm diameter bar and for mild exposure, the nominal cover is 15 mm

b. Minimum reinforcement: The reinforcement in either direction in slab shall not be less than

- 0.15% of the total cross sectional area for Fe-250 steel
- 0.12% of the total cross sectional area for Fe-415 & Fe-500 steel.

c. Spacing of bars: The maximum spacing of bars shall not exceed

- Main Steel – 3d or 300 mm whichever is smaller
- Distribution steel –5d or 450 mm whichever is smaller Where,'d' is the effective depth of slab

Note: The minimum clear spacing of bars is not kept less than 75 mm (Preferably 100 mm) though code do not recommend any value.

d. Maximum diameter of bar: The maximum diameter of bar in slab, shall not exceed D/8, where D is the total thickness of slab

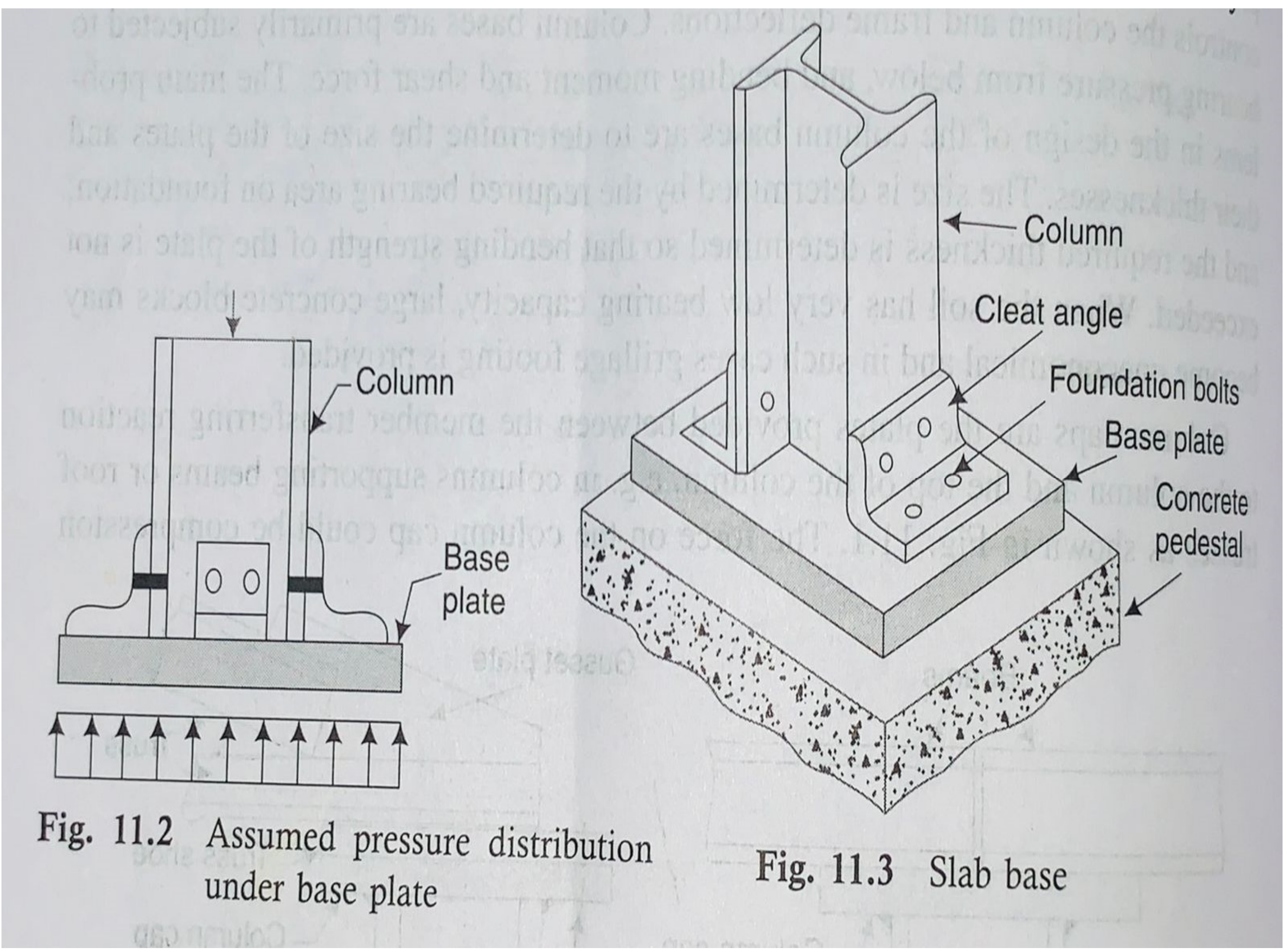


Fig. 11.2 Assumed pressure distribution under base plate

Fig. 11.3 Slab base

Experiment-06

AIM- Sketching of gusseted base.

Gusseted base- When the load on the column section is too large or when the axial load is accompanied by bending moments, usually a gusset base is provided. It consists of a base plate, two gusset plates and two gusset angles when bolted connections are made. The gusset plates and angles are placed on flanges as shown in Fig. 11.11.

Gusset materials used in the base increase the bearing area, consequently reducing the thickness of the base plate as compared to the slab base. Also, the gusset material supports the base plate against bending and consequently results in still less thicker base plate. This kind of base may be considered to be rigid.

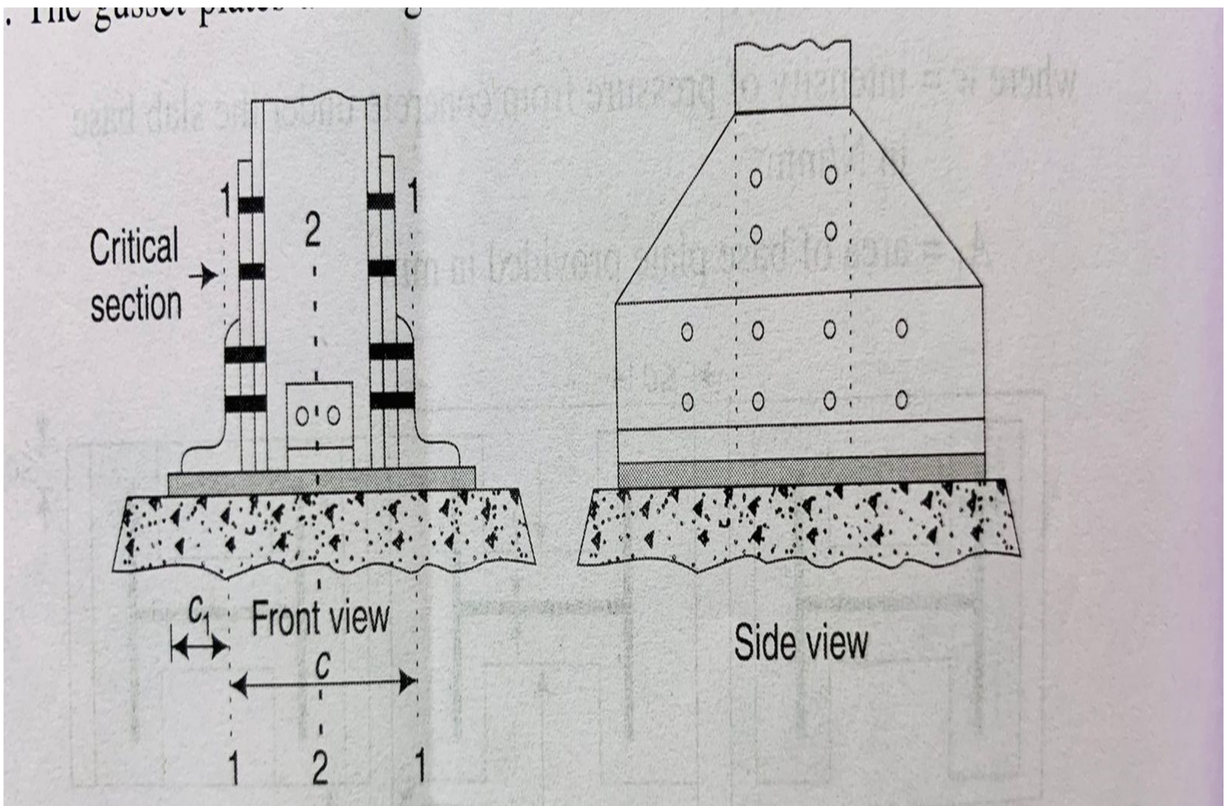


Fig. 11.11 Gusset base

Experiment-07

AIM- Design and draw laterally supported beams.

- Design steps:

LATERALLY SUPPORTED:

STEP 1: FIND OUT ULTIMATE LOAD ON BEAM.
Factored Ultimate Load (Factored Load) w = 1.5 × Working Load

STEP 2: FIND OUT MAXIMUM BENDING MOMENT (M) AND SHEAR FORCE (V) ON BEAM.

STEP 3: CALCULATE PLASTIC SECTION MODULUS REQURIED FOR TRIAL SECTION.

$$Z_P(required) = M\gamma_0/fy$$

STEP 4: SELECT SUITABLE SECTION BASED ON Zp

(FROM IS: 800: 2007, PAGE NO. 138, 139. WRITE DOWN SECTIONAL PROPERTIES.)

STEP 5: SECTION CLASSIFICATION.
Find out value of b/t_f and d/tw
(Refer Figure. 2, Page no. 18 & 19, IS 800: 2007 to find b and d)

STEP 6: CHECK FOR SHEAR. (Clause no. 8.4.1., Page no. 59, IS 800: 2007)

STEP 7: CHECK FOR WEB BUCKLING AT SUPPORT (Clause no. 8.7.3.1, Page no. 67, IS 800:2007)

STEP 8: CHECK FOR WEB CRIPPLING (Clause no. 8.7.4, Page no. 67, IS 800: 2007)

STEP 9: CHECK FOR DEFLECTION.

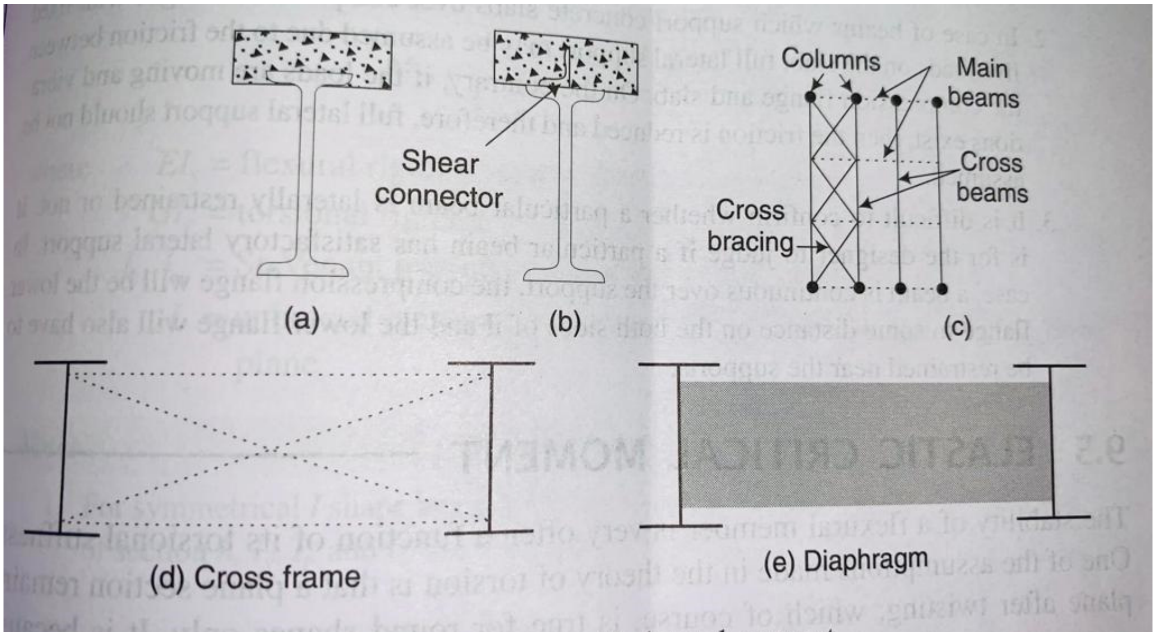
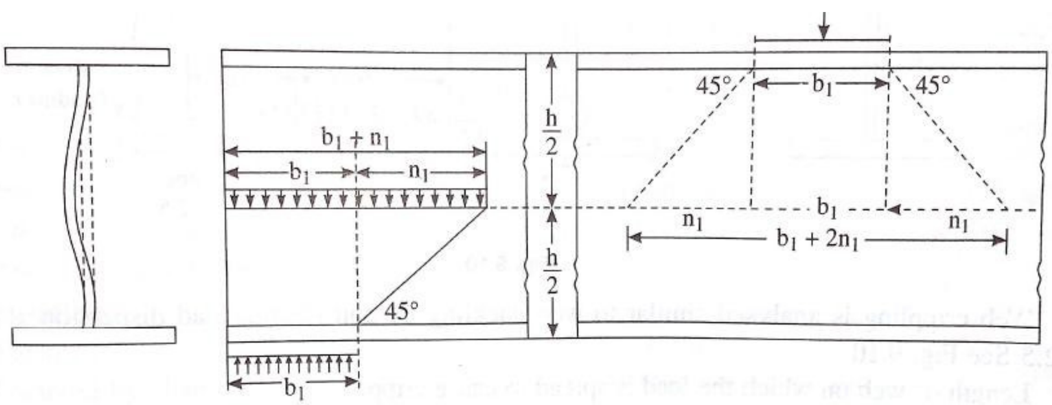


Fig. 9.4 Beams with lateral support

Web buckling:



Experiment-08

Aim- Draw different types of trusses.

Truss-A truss consist of a triangular network of compression and tension meembers.Some typical trusses are following here:

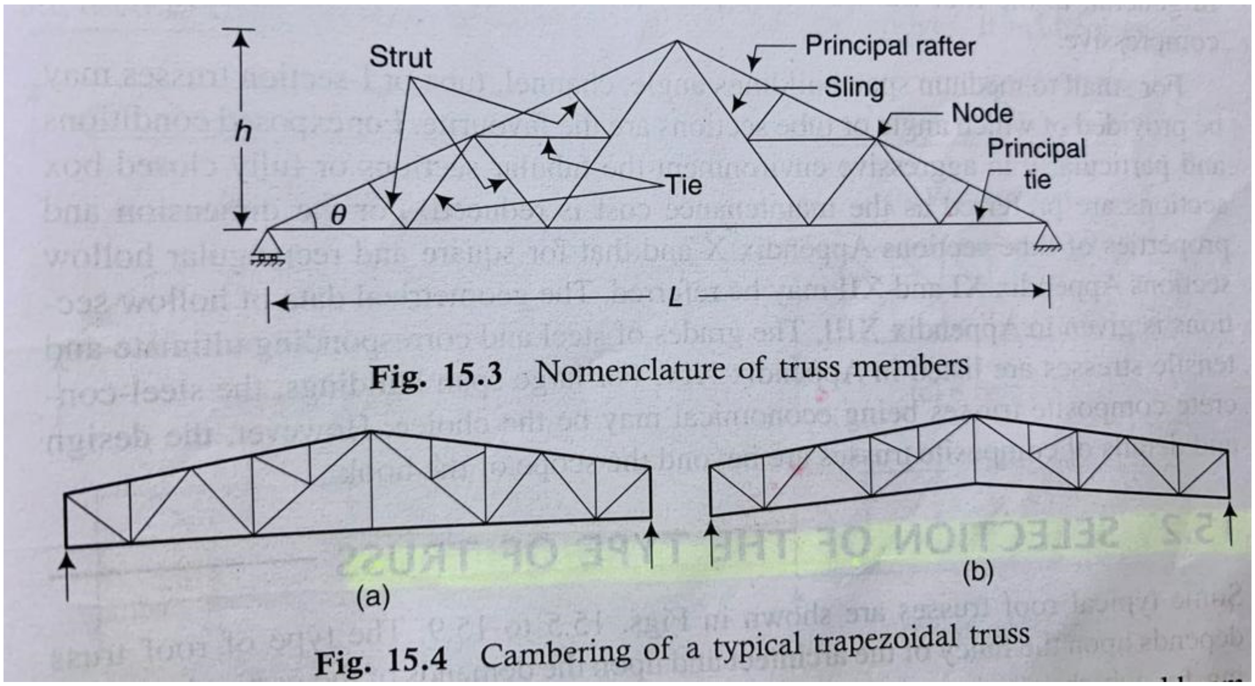


Fig. 15.3 Nomenclature of truss members

Fig. 15.4 Cambering of a typical trapezoidal truss

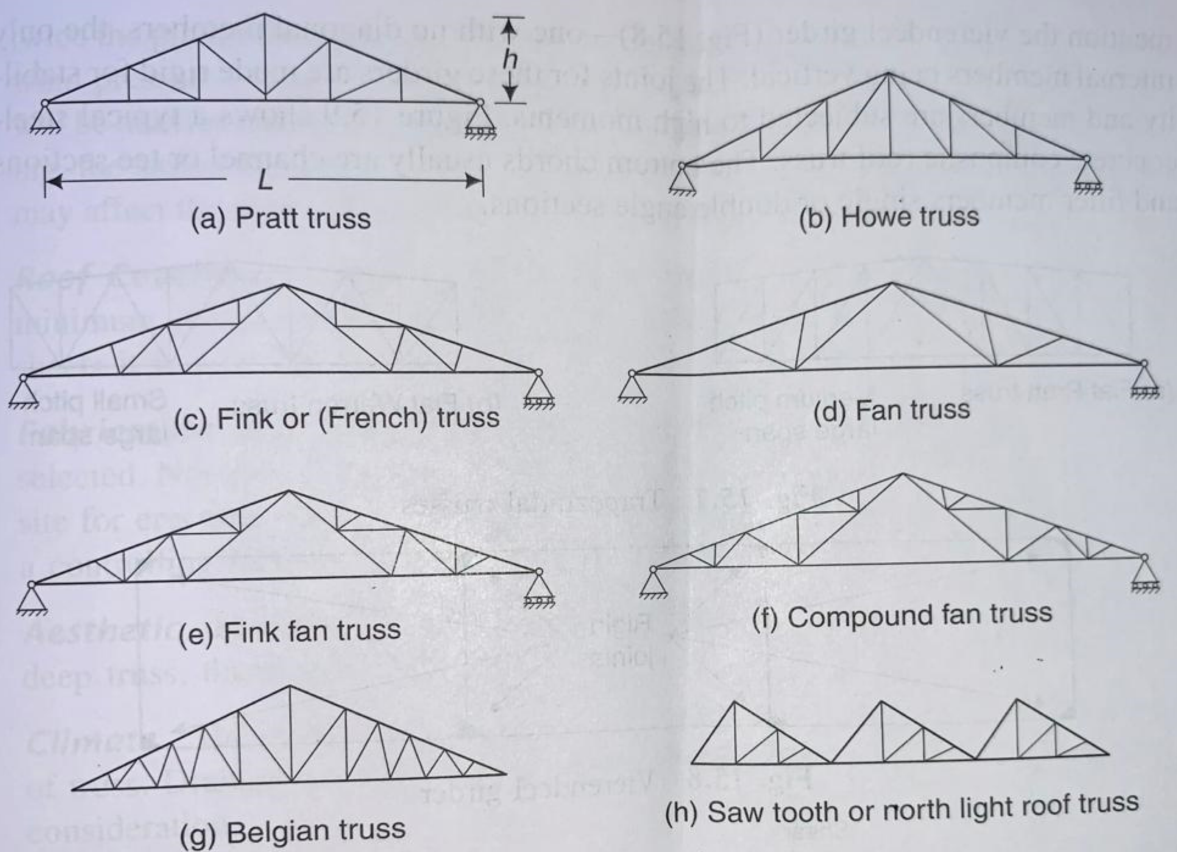


Fig. 15.5 Pitched roof trusses

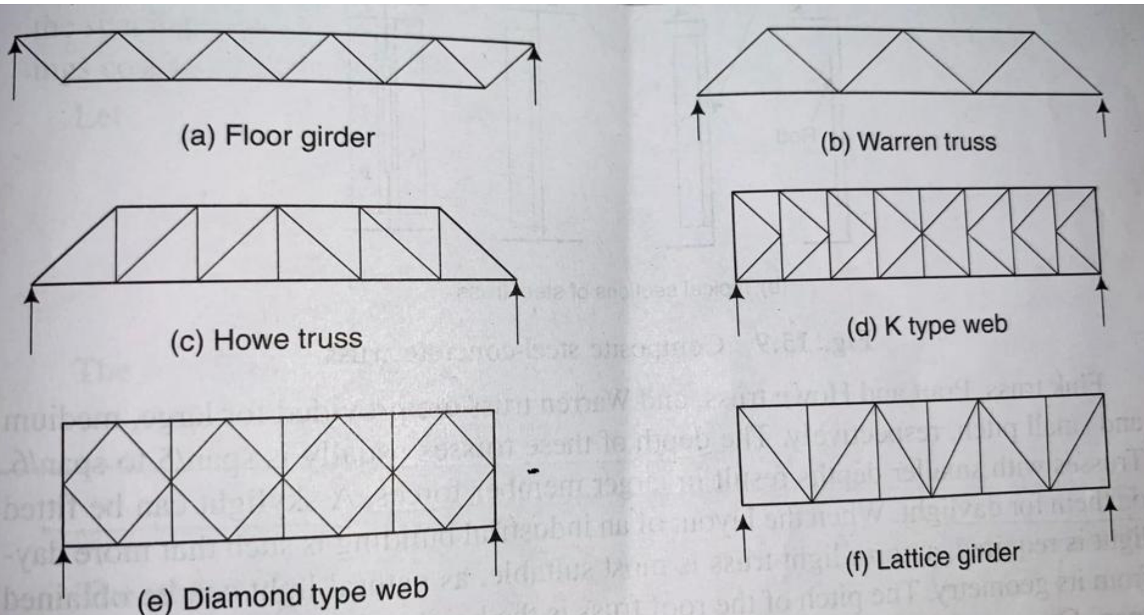


Fig. 15.6 Parallal chord (lattice) trusses/girders

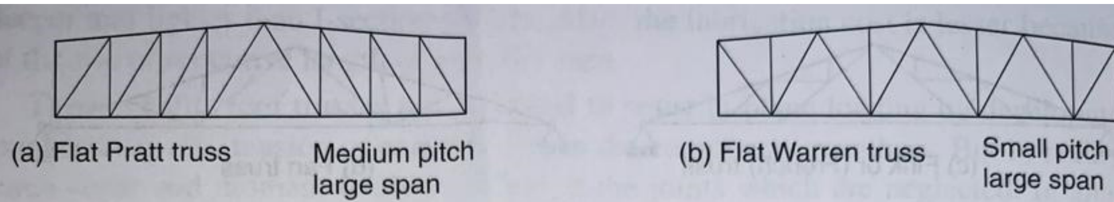


Fig. 15.7 Trapezoidal trusses

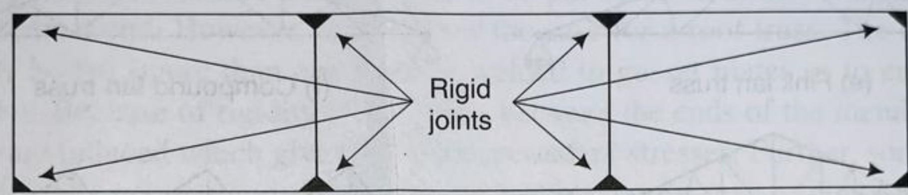
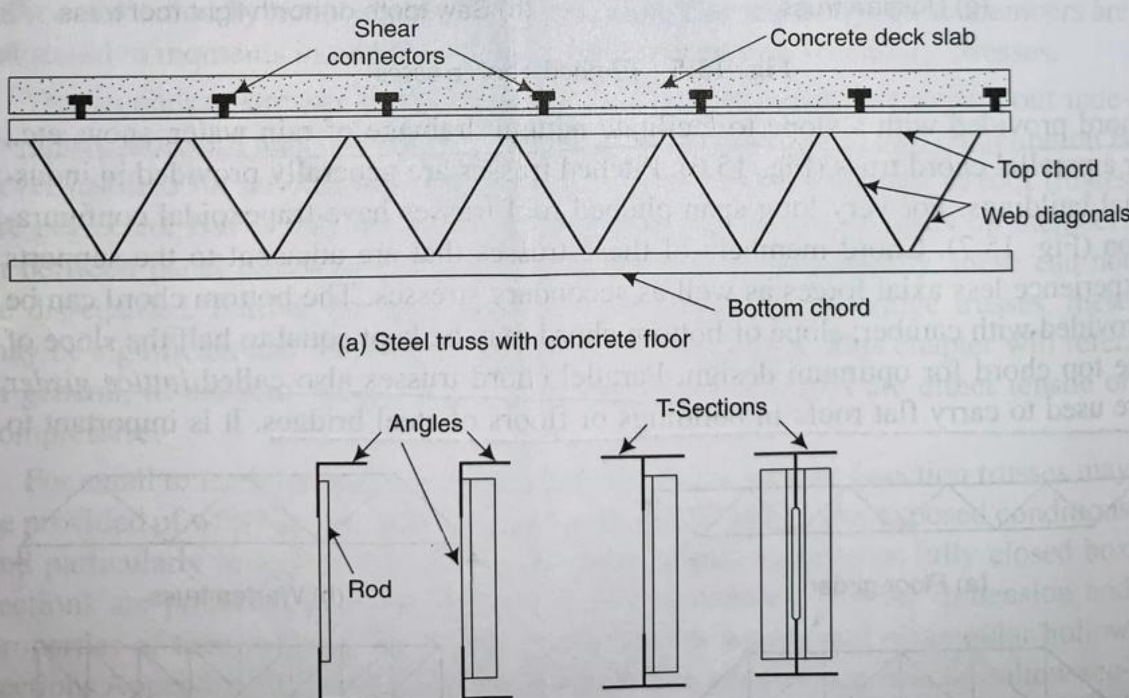


Fig. 15.8 Vierendeel girder



(a) Steel truss with concrete floor

(b) Typical sections of steel truss

Fig. 15.9 Composite steel-concrete truss

Experiment-09

Aim- Working drawing of steel roof truss with details of joints.

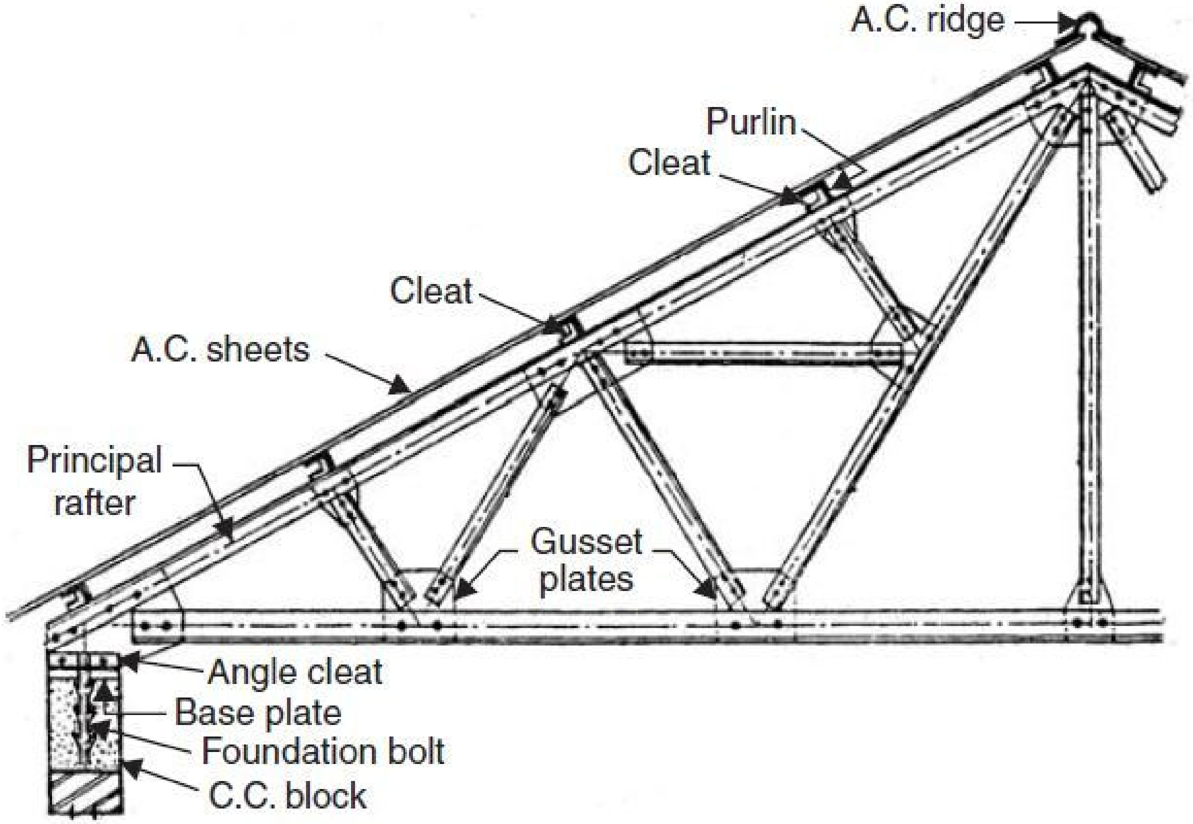


Fig. 8.17. Steel roof truss