Note :

1. Inclination of a line with V.P is always denoted by ϕ.
2. when a line is paralel to H.P and inclined at an angle of ϕ to V.P, this inclination ϕ is seen in the top view and hence top view is drawn first to get the true length of the line.

4. Line inclined to both the planes

When a line is inclined to both H.P and V.P, it is called an oblique line. The solution to this kind of problem is obtained in three stages, as described below.

Problem : To draw the projections of a line inclined at θ to H.P and ϕ to V.P, given the position of one of its ends.

Construction (Fig.5.21). The position of the line AB is shown in Fig. 5.21a.

Stage 1 Assume the line is inclined to H.P by θ^0 and parallel to V.P. (Fig.5.21b)

1. Draw the projections $a^1b^1_1$ and ab_1 of the line AB_1(=AB), after locating projections and **a** from the given position of the end A.

   Keeping the inclination θ constant rotate the line AB_1 to AB, till it is inclined at ϕ^0 to V.P.

   This rotation does not change the length of the top view ab_1 and the distance of the point B_1=(B) from H.P. Hence, (i) the length of $\mathbf{ab_1}$ is the final length of the top view and (ii) the line f-f, parallel to xy and passing through $\mathbf{b_1^1}$ is the locus of the front view of the end of point B.

Stage II Assume the line is inclined to VP by ϕ and parallel to H.P(Fig.5.21c)

2. Draw the projections ab_2 and ab of the line AB_2(=AB), after locating the projections $\mathbf{a^1}$ and **a**, from the given position of the end A.

   Extending the discussion on the preceding stage to the present one, the following may be concluded. (i) The length ab is the final length of the front view and (ii) the line t-t, parallel to xy and pasing through b_2 is the locus of the top view of the end point B.

Stage III Combine Stage I and Stage II (Fig.5.21d),

3. Obtain the final projections by combining the results from stage 1 and II as indicated below:

(i) Draw the projections $a^1b^1_1$ and ab_2 making an angle θ and ϕ respectively with xy, after location of the projections a^1 and a, from the given position of the end point A.

(ii) Obtain the projections $a^1b_2^1$ and ab_1, parallel to xy, by rotation.

(iii) Draw the lines f-f and t-t the loci parallel to xy and passing through b_1^1 and b_2 respectively.

(iv) With centre a^1 and radius $a^1b_2^1$, draw an arc meeting f-f at b^1.

(v) With centre a and radius ab_1, draw an arc meeting t-t at b.

(vi) Join a^1,b^1, and a,b forming the required final projections. It is observed from the figure 4.21 c that:

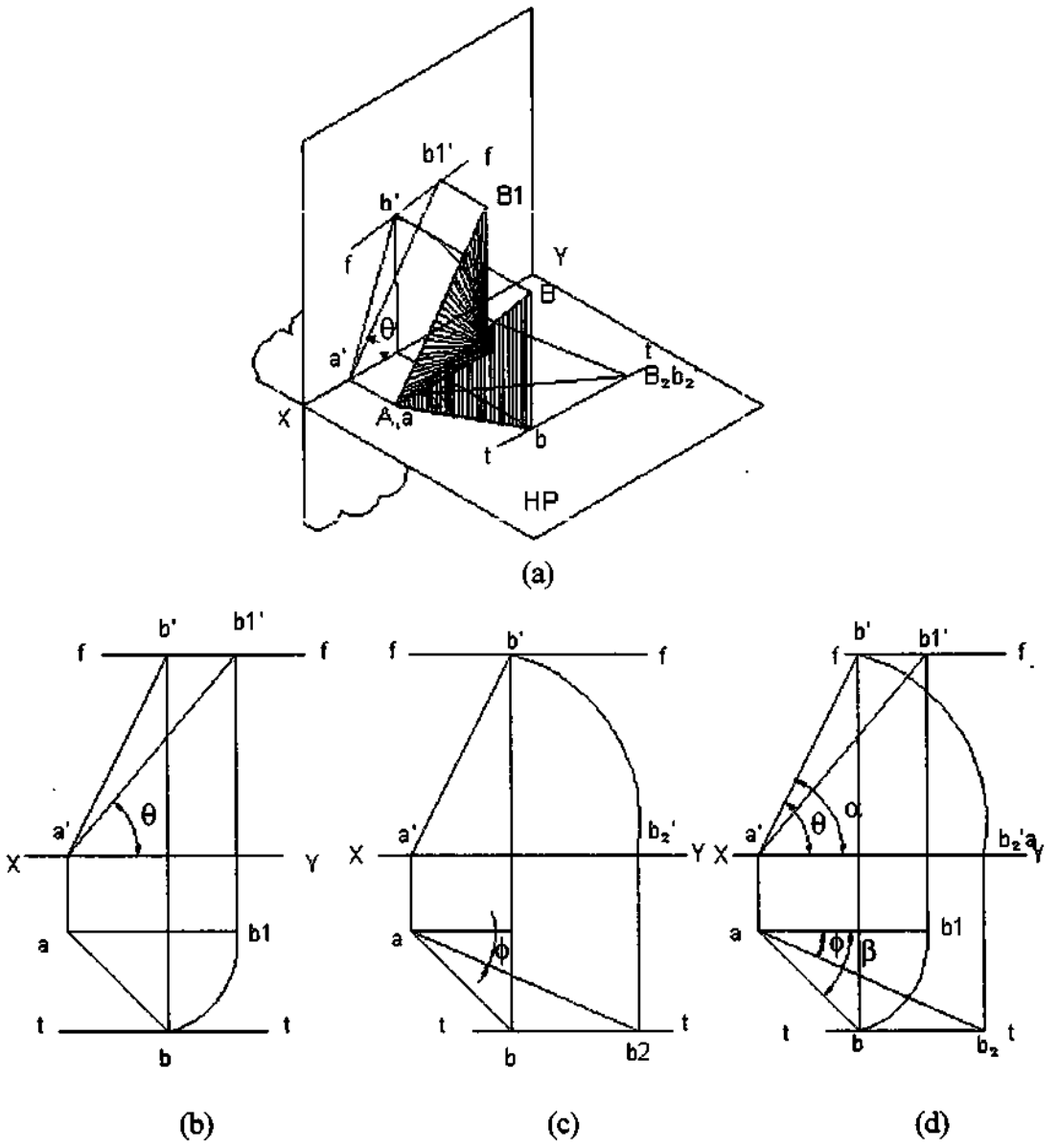


Fig. 5.21 Line Inclined to both the Planes

1. The points b' and b lie on a single projection
2. The projections a'b' and ab make angles α and β with xy, which are greater than θ and ϕ. The angles α and β are known as apparent angles.

To determine the true length of a line, given its projections - Rotating line method

In this, each view is made parallel to the reference line and the other view is projected from it. This is exactly reversal of the procedure adopted in the preceding construction.

Construction : (Fig.5.22)

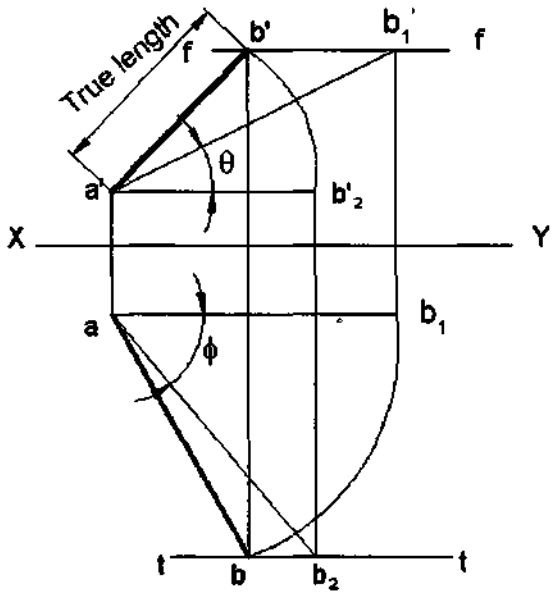


Fig. 5.22 Obtaining true length

1. Draw the given projections a^1b^1 and ab.
2. Draw f-f and t-t, the loci passing through b^1 and b and parallel to xy.
3. Rotate a^1 b^1 to a^1 b_2^1, parallel to xy.
4. Draw a projector through b_2^1 to meet the line t-t at b_2.
5. Rotate ab_1 parallel to xy.
6. Draw a projector through b_1, to meet the line f-f at b_1^1.
7. Join a^1, b_1^1 and a, b_2.
8. Measure and mark the angles θ and ϕ

The length $a^1b_1^1$ (=ab_2) is the true length of the given line and the angles θ and ϕ, the true inclinations of the line with H.P and V.P. respectively.

5.7 Projection of Planes

A plane figure has two dimensions viz. the length and breadth. It may be of any shape such as triangular, square, pentagonal, hexagonal, circular etc. The possible orientations of the planes with respect to the principal planes H.P and V.P of projection are :

1. Plane parallel to one of the principal planes and perpendincular to the other,
2. Plane perpendicular to both the principal planes,
3. Plane inclined to one of the principal planes and perpendclicular to the other,
4. Plane inclined to both the principal planes.

1. Plane parallel to one of the principal planes and perpendicular to the other

When a plane is parallel to V.P the front view shows the true shape of the plane. The top view appears as a line parallel to xy. Figure 5.23a shows the projections of a square plane ABCD, when it is parallel to V.P and perpendicular to H.P. The distances of one of the edges above H.P and from the V.P are denoted by d_1 and d_2 respecively.

Figure 5.23b shows the projections of the plane. Figure 5.23c shows the projections of the plane, when its edges are equally inclined to H.P.

Figure 5.24 shows the projections of a circular plane, parallel to H.P and perpendicular to V.P.

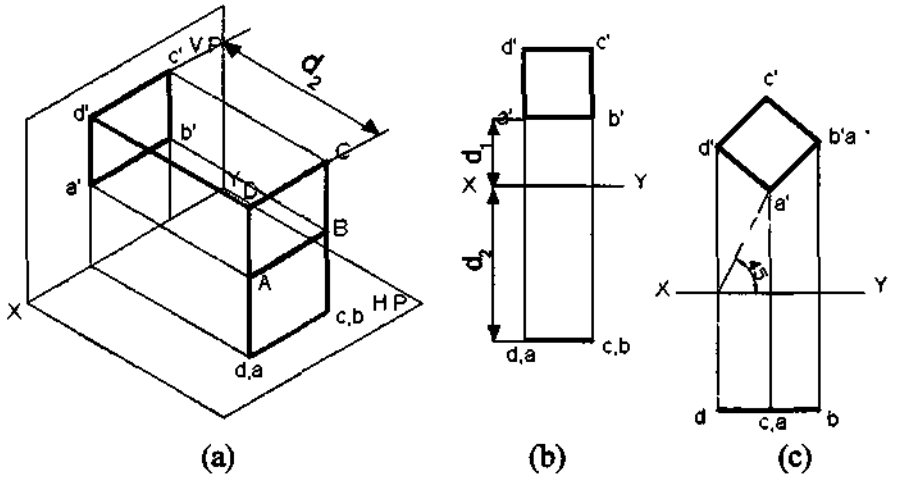


Fig. 5.23

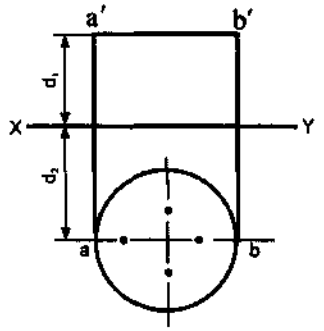


Fig. 5.24

2. Plane perpendicular to both H.P and V.P.

When a plane is perpendicular to both H.P. and V.P, the projections of the plane appear as straight lines. Figure 5.25 shows the projections of a rectangular plane ABCD, when one of its longer edges is parallel to H.P. Here, the lengths of the front and top views are equal to the true lengths of the edges.

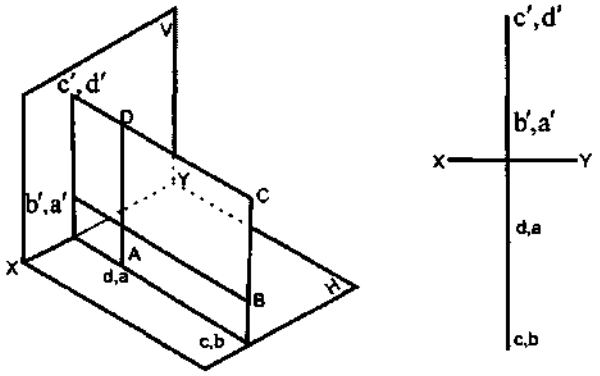


Fig. 5.25

3. Plane inclined to one of the principal planes and perpendicular to the other

When a plane is inclined to one plane and perpendicular to the other, the projections are obtained in two stages.

Problem :

(i) Projections of a pentagonal plane ABCDE, inclined at ϕ to H.P and perpendicular to V.P and resting on one of its edges on H.P.

Constructon : (Fig.5.26)

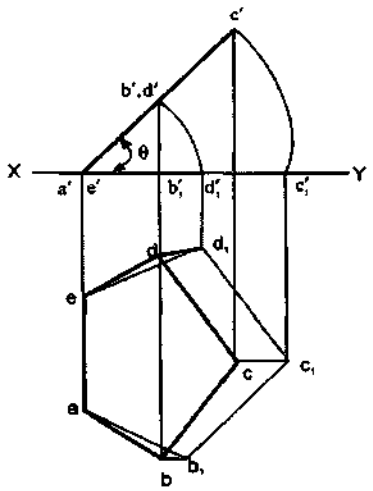


Fig. 5.26

Stage 1 Asume the plane is parallel to H.P (lying on H.P) and perpendicular to V.P.

1. Draw the projections of the pentagon ABCDE, assuming the edge AE perpendicular to V.P. $a_1'e_1' b_1'd_1' c_1'$ on xy is the front view and $ab_1\ c_1d_1e$ is the top view.

Stage II Rotate the plane (front view) till it makes the given angle with H.P.

2. Rotate the front view till it makes the given angle θ with xy which is the final front view.
3. obtain the final top view abcde by projection.

Problem : *Following the method similar to the above, the projections are obtained in Fig.5.27 for hexagonal plane, inclined at ϕ to V.P and perpendicular to H.P, with the edge parallel to H.P.*

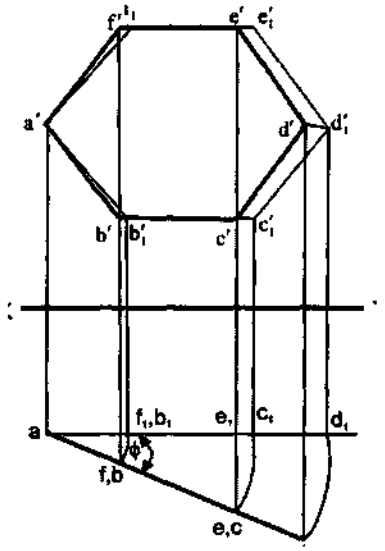


Fig. 5.27

Plane inclined to both H.P and V.P

If a plane is inclined to both H.P and V.P, it is said to be an oblique plane. Projections of oblique planes are obtained in three stages.

Problem : *A rectangular plane ABCD inclined to H.P by an angle θ, its shorter edge being parallel to H.P and inclined to V.P by an angle ϕ. Draw its projections.*

Construction (Fig.5.28)

Stage 1: Assume the plane is parallel to H.P and a shorter edge of it is perpendicular to V.P.

1. Draw the projections of the plane.

Stage II : Rotate the plane till it makes the given angle with H.P.

2. Redraw the front view, making given angle θ with xy and then project the top view.

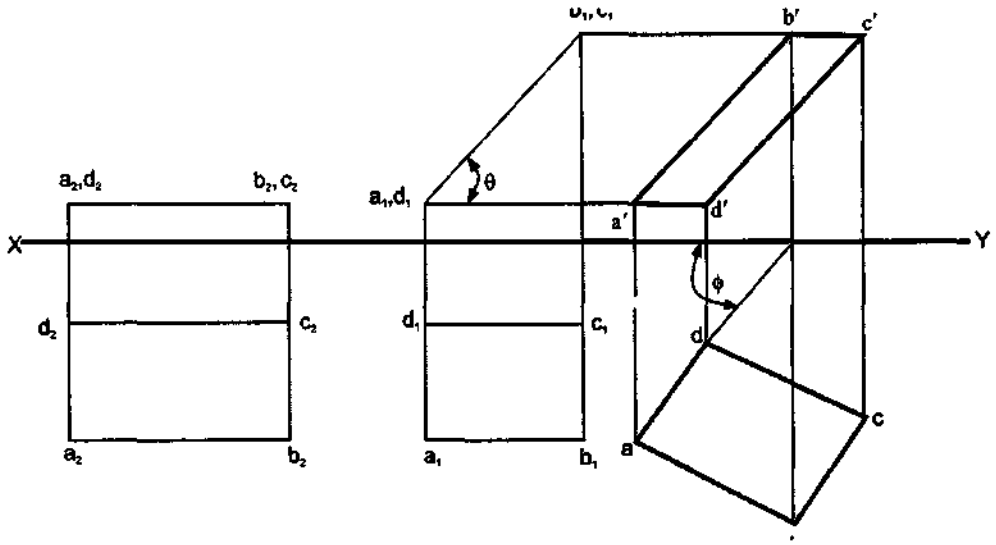


Fig. 5.28 Plane inclined to both the planes

Stage III : Rotate the plane till its shorter edge makes the given angle ϕ with V.P.

3. Redraw the top view abcd such that the shorter edge **ad**, is inclined to xy by ϕ.
4. Obtain the final front view $a^1b^1c^1d^1$, by projection.

Examples

Problem : *A line AB of 50 mm long is parallel to both H.P and V.P. The line is 40 mm above H.P and 30 mm in front of V.P. Draw the projections of the line.*

Solution : (Fig.5.29)

Fig.5.29a shows the position of the line AB in the first quadrant. The points a^1, b^1 on V.P and a, b on H.P are the front and top views of the ends A and B of the line AB. The lines a^1b^1 and ab are the front and top views of the line AB respectively.

Fig. 5.29 b shows the relative positions of the views along with the planes, after rotating H.P, till it is in-line with V.P. Fig. 5.29c shows the relative positions of the view only.

Problem : *A line AB of 25 mm long is perpendicular to H.P and parallel to V.P. The end points A and B of the line are 35 mm and 10 mm above H.P respectively. The line is 20 mm in front of V.P. Draw the projections of the line.*

Solution **: (Fig.5.30)**

Fig. 5.30a shows the position of the line AB in the first quadrant. As the line is parallel to V.P, the length of the front view is equal to the true length of the line and the top view appears as a point.Figure 4.2b shows the projection.

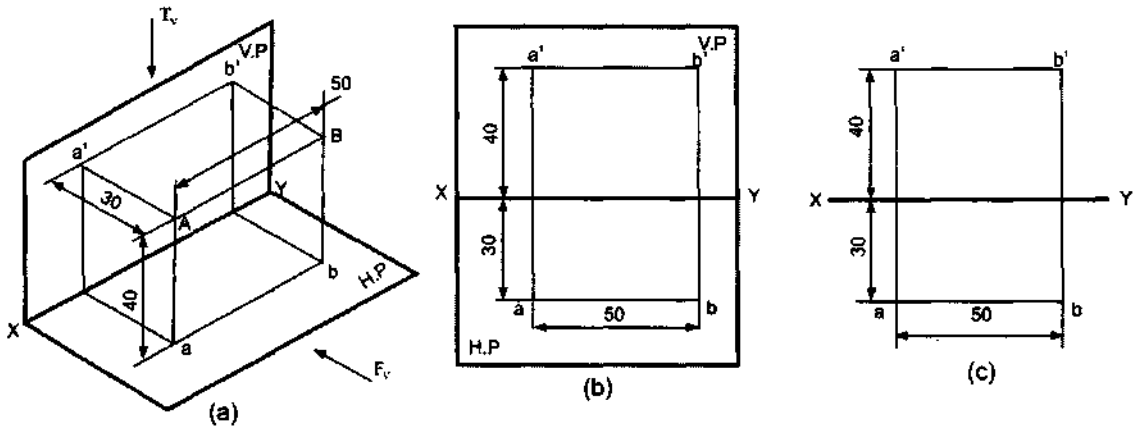


Fig. 5.29

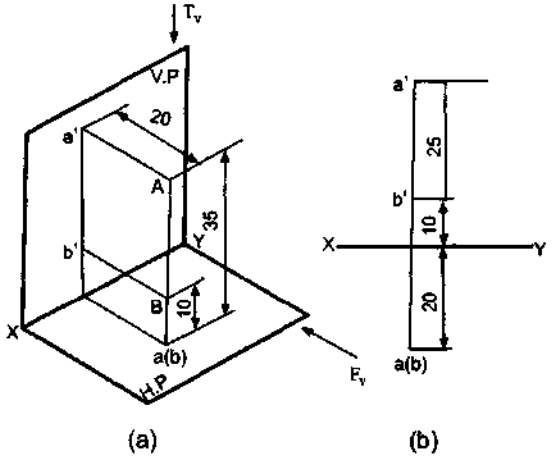


Fig. 5.30

Problem : *A line AB of 25 mm long is perpendicular to V.P and parallel to H.P. The end points A and B of the line are 10 mm and 35 mm in front of V.P respectively. The line is 20 mm above H.P. Draw its projections.*

Solution : **(Fig.5.31)**

Fig.5.31a shows the position of the line AB in the first quadrant. As the line is parallel to H.P., the length of the top view is equal to the true length of the line and the front view appears as a point. Figure 5.31b shows the projection of the line.

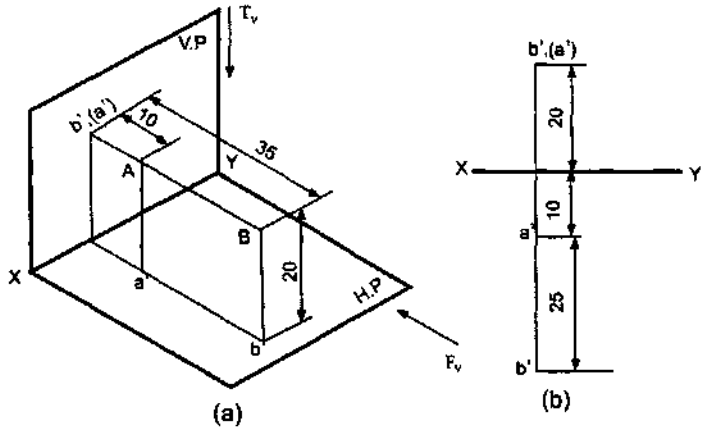


Fig. 5.31

Problem : A line AB 50 mm long is parallel to V.P. and inclined at an angle of 30° to H.P. The end A is 15 mm above H.P. and 20 mm in front of V.P. Draw the projections of the line.

Solution : (Fig.5.32)

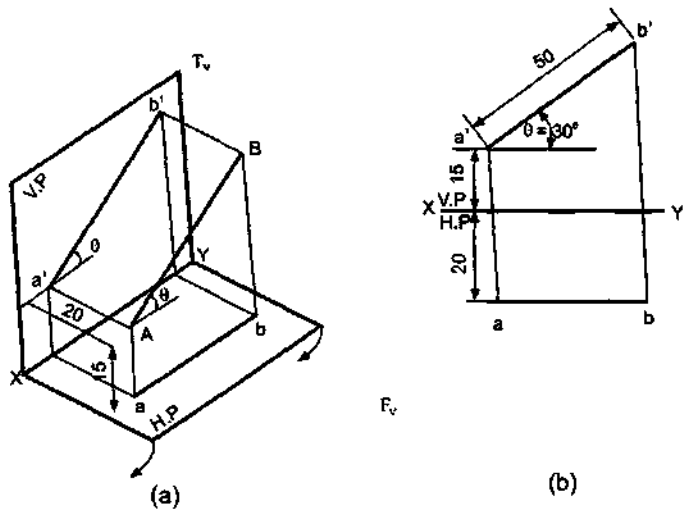


Fig. 5.32

1. A is 15 mm above H.P. Hence mark **a'** 15 mm above xy.
2. A is 20 mm in front of V.P. Hence mark **a** 20 mm below xy.

To obtain the front view a'b', look from the front (Fv):

3. As AB is parallel to V.P. and inclined at an angle of 30° to H.P., **a'b'** will be equal to its true length and inclined at an angle of 30° to xy.

Note : When a line is parallel to V.P. and inclined at an angle of θ to H.P., this inclination θ will be seen in the front view. θ **denotes always the true inclination with H.P.**

3. Therefore from a^1 draw a line at an angle of 30^0 to xy and mark b^1 such that a^1b^1 50mm = true length.

To obtain the top view ab look from the top T_V:

Since the line is inclined to H.P., its projection on H.P. i.e., the top view will be in reduced length.

4. From b^1 draw a projector to intersect the horizontal line drawn from a at b, ab is the top view of AB.

Problem : A line EF 60 mm long is parallel to VP and inclined 30^0 to HP. The end E is 10 mm above HP and 20 mm in front of VP. Draw the projections of the line.

Solution **:** (Fig.5.33).

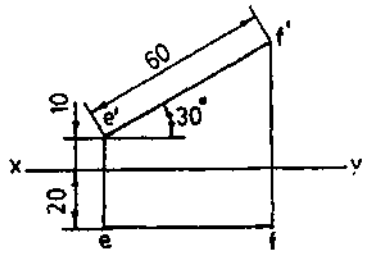


Fig. 5.33

Problem : The length of the fromt view of a line CD which is parallel to HP and inclined 30^0 to VP, is 50 mm. The end C of the line is 15 mm in front of VP and 25 mm above HP. Draw the projections of the line and find its ture length.

Solution **:** (Fig.5.34).

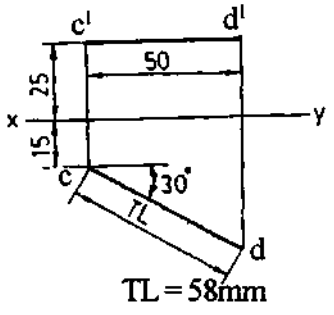


Fig. 5.34

Problem : A line CD 40 mm long is in V.P. and inclined to H.P. The top view measures 30 mm. The end C is 10 mm above H.P. Draw the projections of the line. Determine its inclination with H.P.

Solution : (Fig. 5.35).

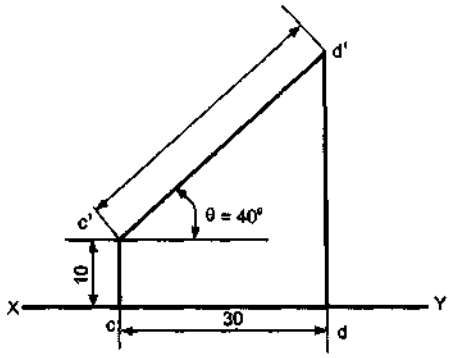


Fig. 5.35

Problem : A line AB 45 mm long is in H.P. and inclined to V.P. The end A is 15 mm in front of V.P. The length of the front view is 35 mm. Draw the projections of the line. Determine its inclination with V.P.

Solution : (Fig. 5.36).

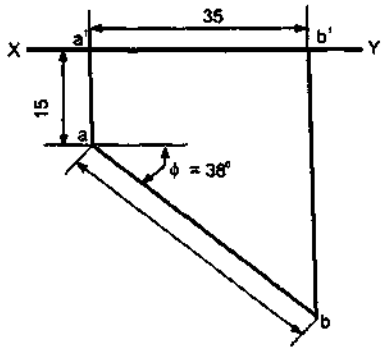


Fig. 5.36

Problem : A line AB, 50mm long, has its end A in both the H.P. and the V.P. It is inclined at 30° to the H.P. and at 45° to the V.P. Draw its projections.

Solution : (Fig. 5.37).

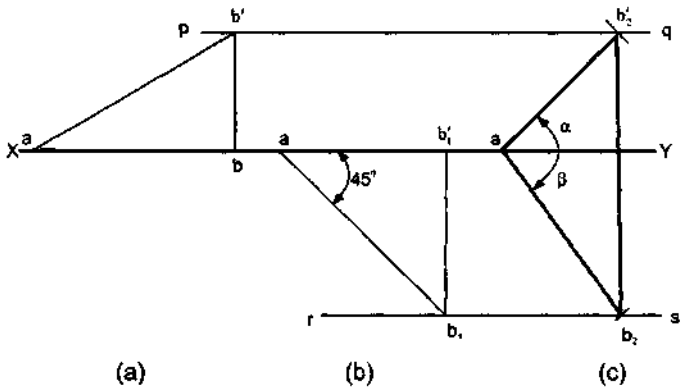


Fig. 5.37

Problem : A top view of a 75 mm long line AB measures 65 mm, while the length of its front view is 50 mm. Its one end A is in the H.P. and 12 mm in front of the V.P. Draw the projections of AB and determine its inclinatiion with H.P. and the V.P.

Solution : (Fig.5.38)

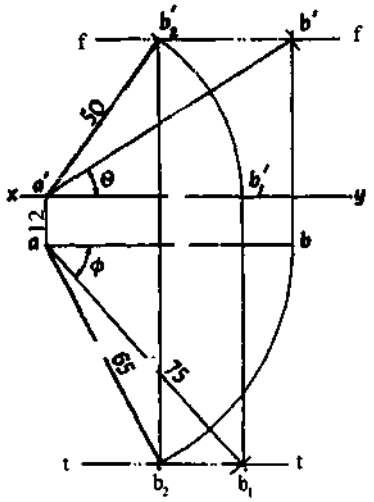


Fig. 5.38

1. Mark the front view a^1 and the top view **a** of the given end A.
2. Assuming AB to be parallel to the V.P draw a line **ab** equal to 65 mm and parallel to xy. With a^1 as centre and radius equal to 75 mm, draw an arc cutting the projector through **b** at b^1. The line **f f** through b^1 and parallel to xy, is the locus of B in the view and θ is the inclination of AB with the H.P.

3. Similarly, draw a line $a'b'_1$ in xy equal to 50 mm and with **a** as centre and radius equal to AB draw an arc cuting the projector through b'_1 at b_1. The locus of B is t t in the top view and ϕ is the inclination of AB with the V.P.
4. With a' as centre and radius equal to $a'b'_1$, draw an arc cutting ff at b'_2. With **a** as centre and radius equal to **ab**, draw an arc cutting tt at b_2, a' b'_2 and ab_2 are the required projections.

Problem : A line AB, 90 mm long, is inclined at 30° to the H.P. Its end A is 12 mm above the H.P. and 20 mm in front of the V.P. Its front view measures 65 mm. Draw the top view of AB and determine its inclination with the V.P.

Solution : (Fig.5.39)

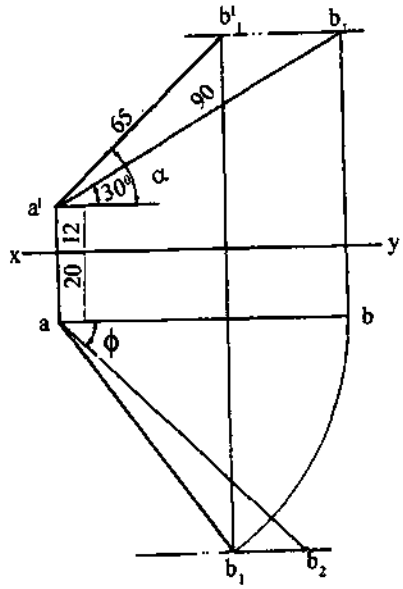


Fig. 5.39

1. Mark **a** and a' the projections of the end A. Through a'_1 draw a line $a'b'$ 90 mm long and making an angle of 30° with xy.
2. With a' as centre and radius equal to 65 mm, draw an arc cutting the path of b' at b'_1. $a'b'_1$ is the front view of AB.
3. Project b' to b_1 so that ab is parallel to xy. ab is the length of AB in the top view.
4. With a as centre and radius equal to ab_1 draw an arc cutting the projector through b'_1 at b_1. Join **a** with b_1. ab_1 is the required top view.

Problem : *A line AB of 70 mm long, has its end A at 10 mm above H.P and 15 mm in front of V.P. Its front view and top view measure 50 mm and 60 mm respectively. Draw the projections of the line and dermine its inclinations with H.P. and V.P.*

Solution : (Fig. 5.40)

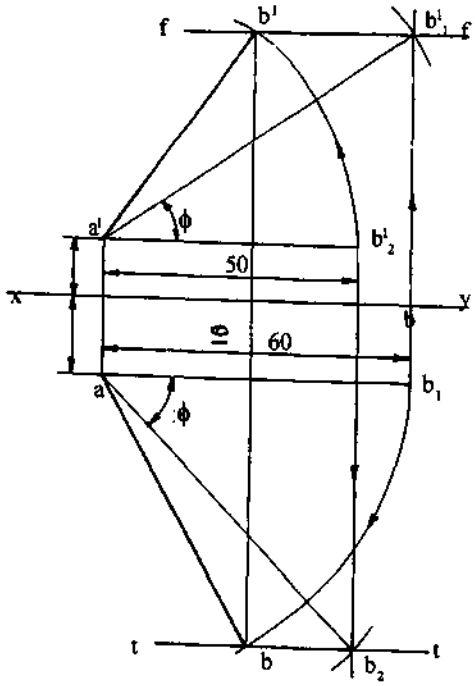


Fig. 5.40

1. Draw the reference line xy and locate the projections **a**, **a'** of the end A.
2. Draw **a'b'$_2$=50 mm**, parallel to xy, representing the length of the front view.
3. With centre **a** and radius 70 mm (true length), draw an arc intersecting the projector through **b'$_2$ at b$_2$**.
4. Join **a, b$_2$**.
5. Draw ab$_1$ (=60 mm), parallel to xy, representing the length of the top view.
6. With centre **a'** and radius 70 mm (true length), draw an arc intersecting the projector through **b$_1$** at **b$_1$'**.
7. Through **b$_1$'**, draw the line f-f, representing the locus of front view of B.
8. Through **b$_2$**, draw the line t-t, representing the locus of top view of B.
9. With centre **a** and radius **a b$_2$'** , draw an arc intersecting f-f at **b'**.
10. Join **a'**, **b'**, representing the front view of the line.
11. With centre **a** and radius **ab$_1$**, draw an arc intersecting t-t at **b**.
12. Join **a,b** repesenting the top view of the line.

5.8 TRACES

Traces of a line

When a line is inclined to a plane, it will meet that plane when produced if necessary. The point at which the line or line produced meets the plane is called its trace.

The point of intersection of the line or line produced with H.P. is called Horizontal Trace (H.T) and that with V.P. is called Vertical Trace (V.T).

To find H.T. and V.T. of a line for its various positions with respect to H.P. and V.P.

1. Line parallel to H.P. and perpendicular to V.P.

Problem : *A line AB 25 mm long is parallel to H.P. and perpendicular to V.P. The end is 10 mm in front of V.P. and the line is 20mm above H.P. Draw the projections of the line and find its traces.*

Solution : (Fig.5.41)

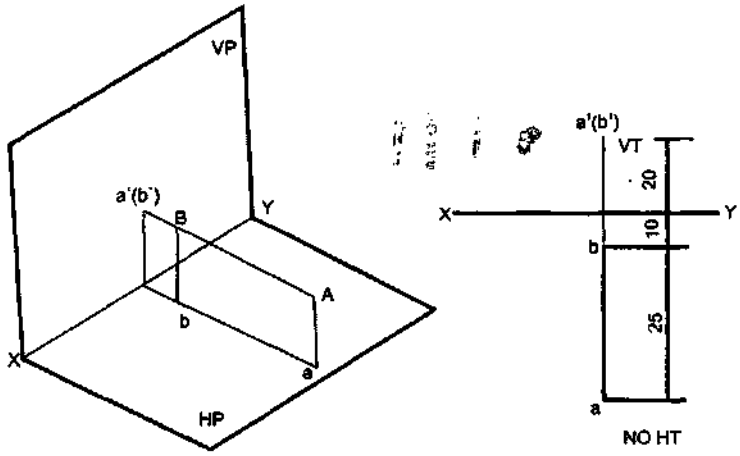


Fig. 5.41

1. Draw the front view a^1 (b^1) and top view ab.
2. AB is perpendicular to V.P.

Therefore mark V.T. in the front view to coincide with $a^1(b^1)$.

3. AB is parallel to H.P. Therefore it has no H.T.

2. Line parallel to V.P. and perpendicular to H.P.

Problem : A *line CD 25 mm long is parallel to V.P. and perpendicular to H.P. End C is 35 mm above H.P. and 20 mm in front of V.P. End D is 10 mm above H.P. Draw the projections of the line CD and find its traces.*

Solution : (Fig. 5.42)

1. Draw the front view a^1b^1 and top view ab.
2. Produce b^1a^1 to meet XY at h^1. From h^1 draw a projector to intersect ba produced at H.T.
3. CD is parallel to V.P. Therefore it has no V.T.

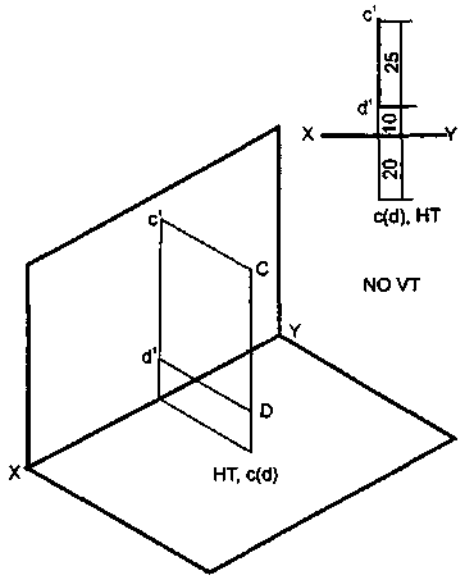


Fig. 5.42

3. Line parallel to V.P and inclined to H.P.

Problem : A line AB 40 mm long is parallel to V.P. and inclined at 30o to H.P. The end A is 15 mm above H.P. and 20 mm in front of V.P. Draw the projections of the line and find its traces.

Solution **:** (Fig. 5.43)

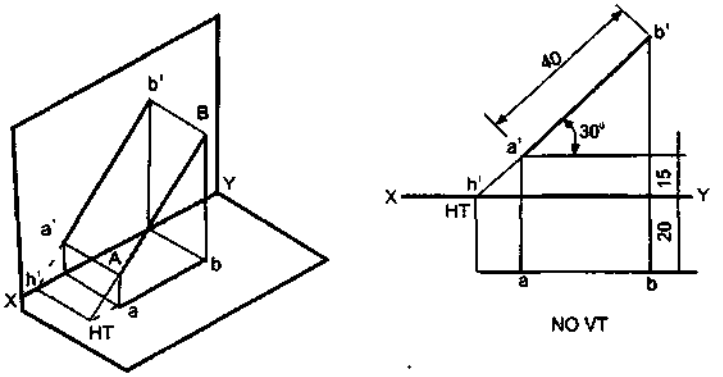


Fig. 5.43

1. Draw the front view a1b1 and top view ab.
2. Produce **b'a'** to meet XY at **h'**. From **h'** draw a projector to intersect **ba** produced at H.T.
3. AB is parallel to V.P. Therefore it has no V.T.

4. Line parallel to H.P. and inclined to V.P.

Problem : Draw the projections of a straight line CD 40 mm long, parallel to H.P. and inclined at 35° to V.P. The end C is 20 mm above H.P. and 15 mm in front of V.P. Find its traces.

Solution : (Fig. 5.44)

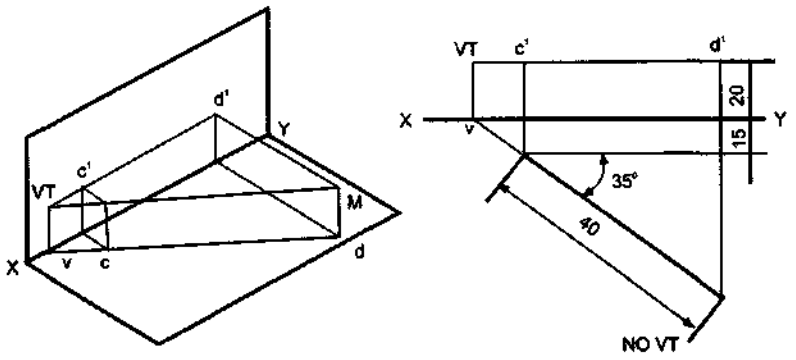


Fig. 5.44

1. Draw the front view **c'd'** and top view **cd.**
2. Produce **dc** to meet XY at v. From v draw a projector to intersect d'c' produced at V.T.
3. CD is parallel to H.P.
4. Therefore it has no H.T.

5. Line parallel to both H.P. and V.P.

Problem : *A line AB 40 mm long is parallel to both the planes. The line is 20 mm above H.P. and 15 mm in front of V.P. Draw the projections and find its traces.*

Solution : (Fig. 5.45)

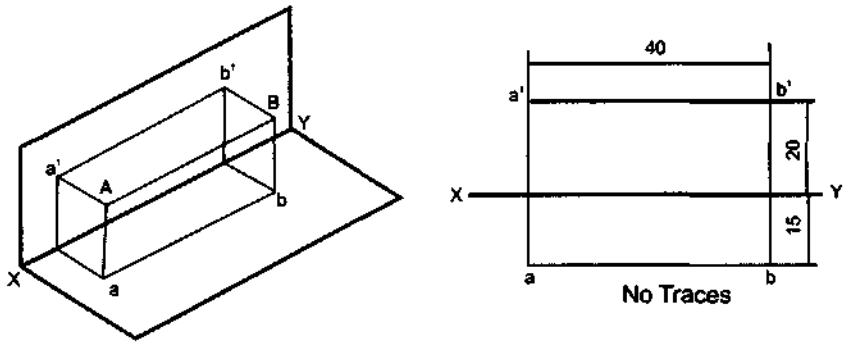


Fig. 5.45

1. Draw the front view **a'b'** and top view **ab.**
2. The line AB is parallel to both the planes when the line is extended, it will not meet both H.P. and V.P., since it is parallel to both the planes. Therefore it has no H.T. and V.T.

Problem : A pentagonal plane ABCDE of 35 mm side has its plane inclined 50° to H.P. Its diameter joining the vertex B to the mid point F of the base DE is inclined at 25° to the xy-line. Draw its projections keeping the corner B nearer to VP.

Solution : (Fig.5.46)

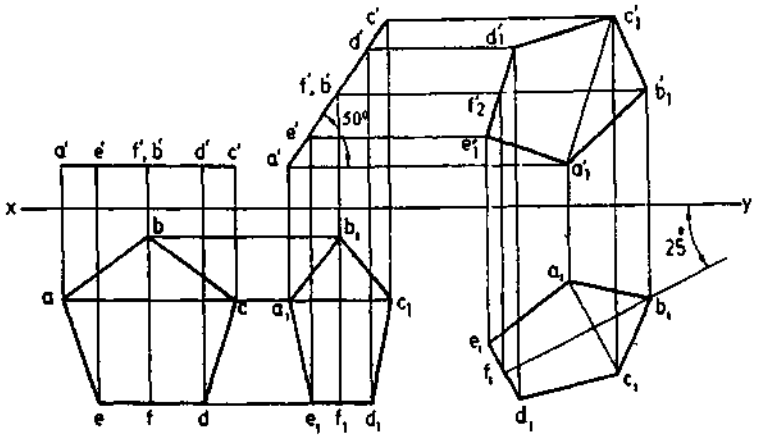


Fig. 5.46

Problem : A regular pentagon ABCDE, of side 25 mm side has its side BC on ground. Its plane is perpendicular to H.P and inclined at 45° to the V.P. Draw the projections of the pentagon and show its traces when its corner nearest to V.P is 15 mm from it.

Solution : (Fig.5.47)

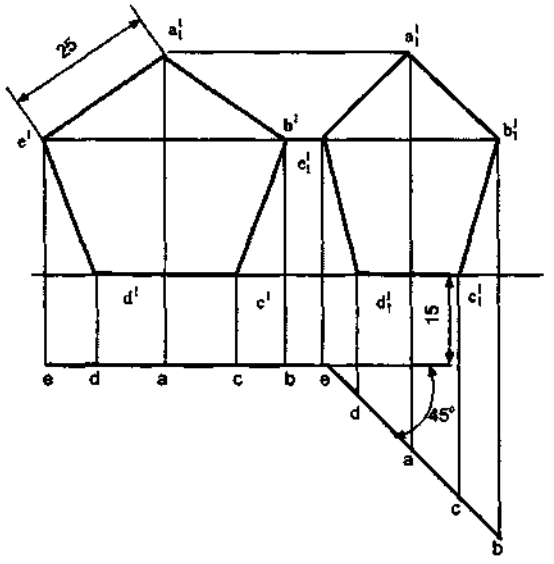


Fig. 5.47

Exercises

1. Draw the projections of a point A which is at 40 mm above HP and 25 mm in front of VP.
2. A point A is at 55 mm above HP and 40 mm behind VP. Draw its projection.
3. A point A is lying at 30 mm behind VP and 60 mm below HP. Draw its projections.
4. Draw the projections of a point A which lies at 40 mm below the HP and 70 mm in front of VP.
5. Draw the projections of a straight line 70 mm long when it is parallel to both HP and VP. It is 15 mm in front of VP and 40 mm above HP.
6. A straight line of length 70 mm is parallel to VP and perpendicular to HP. It's one end is 20 mm below the HP and 50 mm behind VP. Draw its orthographic projections.
7. A line of length 70 mm is parallel and 20 mm in front of VP. It is also inclined at 45^0 to HP and one end is on it. Draw its projections.
8. A line 75 mm long is inclined at 50^0 to VP and one of the ends is on it. It is parallel to HP and 40 mm below it. The line is behind VP. Draw its projections.
9. A straight line AB 70mm long has one of its ends 25 mm behind VP and 20 mm below HP. The line is inclined at 30^0 to HP and 50^0 to VP. Draw its projections.
10. A pentagonal plane of side 40 mm is perpendicular to HP and makes an angle of 45^0 with VP. Draw its projections.
11. A regular hexagon of side 20 mm has one of its sides inclined at 30^0 to VP. Its surface makes an angle of 60^0 with the ground. Draw its projections.
12. A line MN 50 mm long is parallel to VP and inclined at 30^0 to HP. The end M is 20 mm above HP and 10 mm in front of VP. Draw the projections of projections of the line.
13. A line PQ 40 mm long is parallel to VP and inclined at an angle of 30^0 to HP. The end P is 15 mm above HP and 20 mm in front of VP. Draw the projections of the line.

CHAPTER 6

Projection of Solids

6.1 Introduction

A solid has three dimensions, the length, breadth and thickness or height. A solid may be represented by orthographic views, the nuber of which depends on the type of solid and its orientation with respect to the planes of projection. solids are classified into two major groups. (i) Polyhedra, and (ii) Solids of revolution

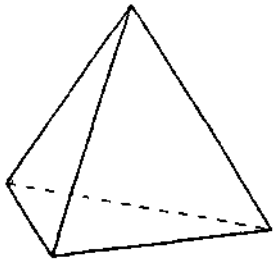
6.1.1 Polyhedra

A polyhedra is defined as a solid bounded by plane surfaces called faces. They are :

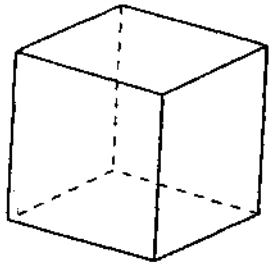
(i) Regular polyhedra (ii) Prisms and (iii) Pyramids.

6.1.2 Regular Polyhedra

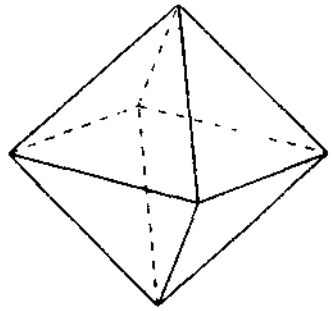
A polyhedron is said to be regular if its surfaces are regular polygons. The following are some of the regular plolyhedra.



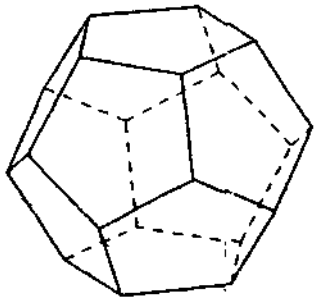
(a) Tetrahedron



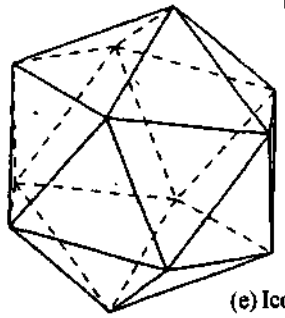
(b) Hexahedron(cube)



(c) Octahedron



(d) Dodecahedron



(e) Icosahedron

Fig. 6.1

(a) Tetrahedron: It consists of four equal faces, each one being a equilateral triangle.

(b) .'Hexa hedron(cube): It consists of six equal faces, each a square.

(c) Octahedron : It thas eight equal faces, each an equilateral triangle.

(d) Dodecahedron : It has twelve regular and equal pentagonal faces.

(e) Icosahedron : It has twenty equal, equilateral triangular faces.

6.2 Prisms

A prism is a polyhedron having two equal ends called the bases prallel to each other. The two bases are joined by faces, which are rectangular in shape. The imaginary line passing through the centres of the bases is called the axis of the prism.

A prism is named after the shape of its base. For example, a prism with square base is called a square prism, the one with a pentagonal base is called a pentagonal prism, and so on (Fig.6.2) The nomenclature of the prism is given in Fig.6.3.

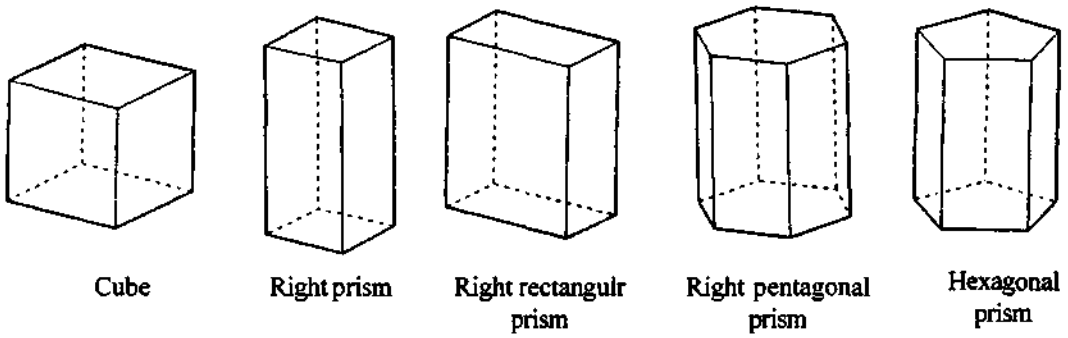


Fig. 6.2

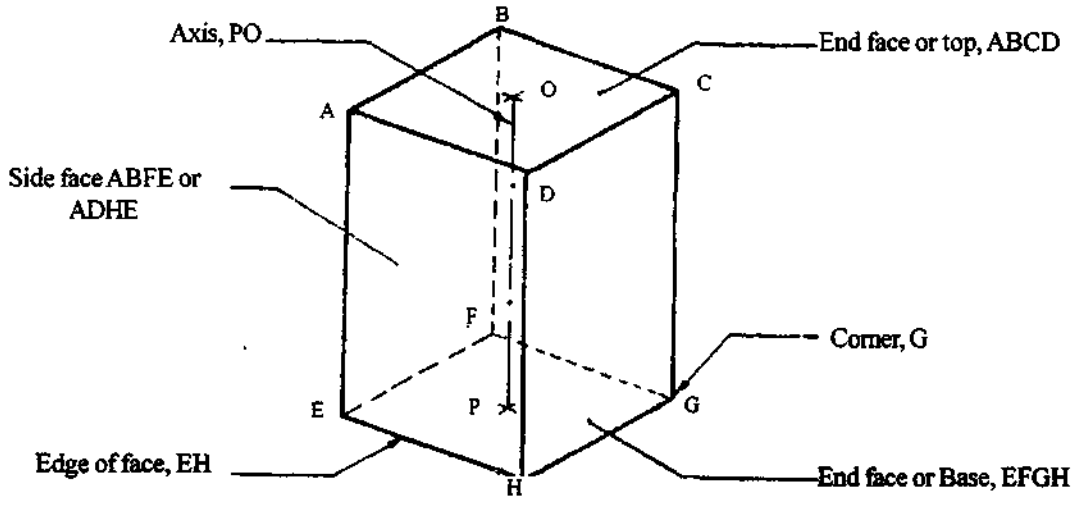


Fig. 6.3 Nomenclature of a Square Prism

6.3 Pyramids

A pyramid is a polyhedron having one base, with a number of isosceles triangular faces, meeting at a point called the apex. The imaginary line passing through the centre of the base and the apex is called the axis of the pyramid.

The pyromid is named after the shape of the base. Thus, a square pyramid has a square base and pentagonal pyramid has pentagonal base and so on (Fig.6.4(a)). The nomenclature of a pyramind is shown in Fig.6.4(b).

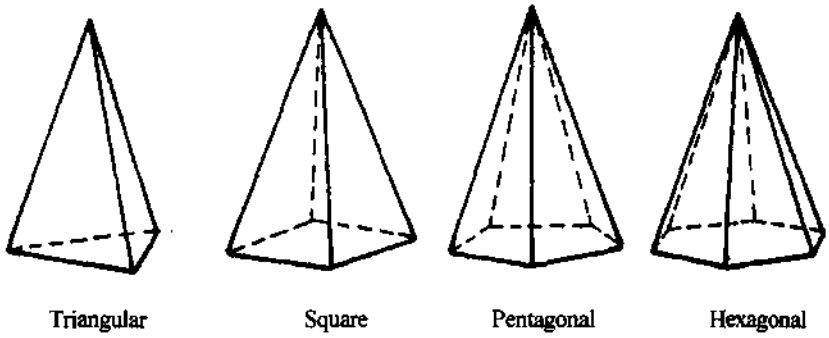


Fig. 6.4(a) Pyramids

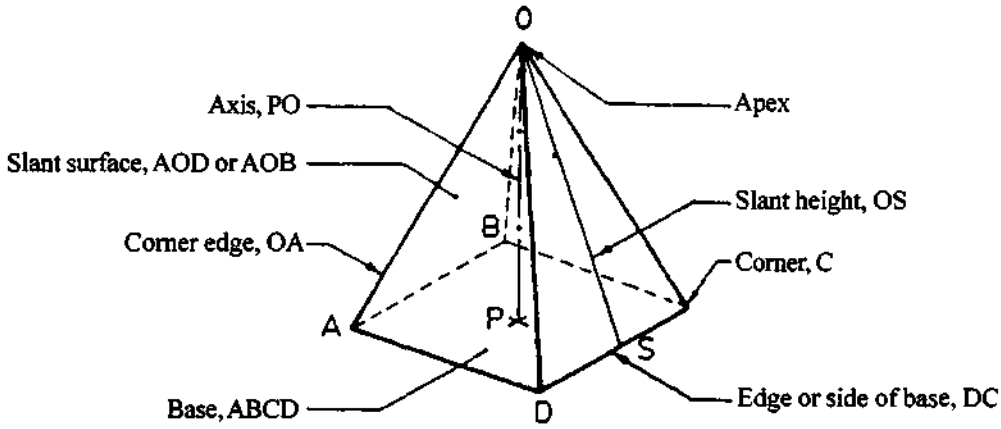


Fig. 6.4(b) Nomenclature of a Square Pyramid

6.4 Solids of Revolution

If a plane surface is revolved about one of its edges, the solid generated is called a solid of revolution. The examples are (i) Cylinder, (ii) Cone, (iii) Sphere.

6.5 Frustums and Truncated Solids

If a cone or pyramid is cut by a section plane parallel to its base and the portion containing the apex or vertex is removed, the remaining portion is called **frustum** of a cone or pyramid

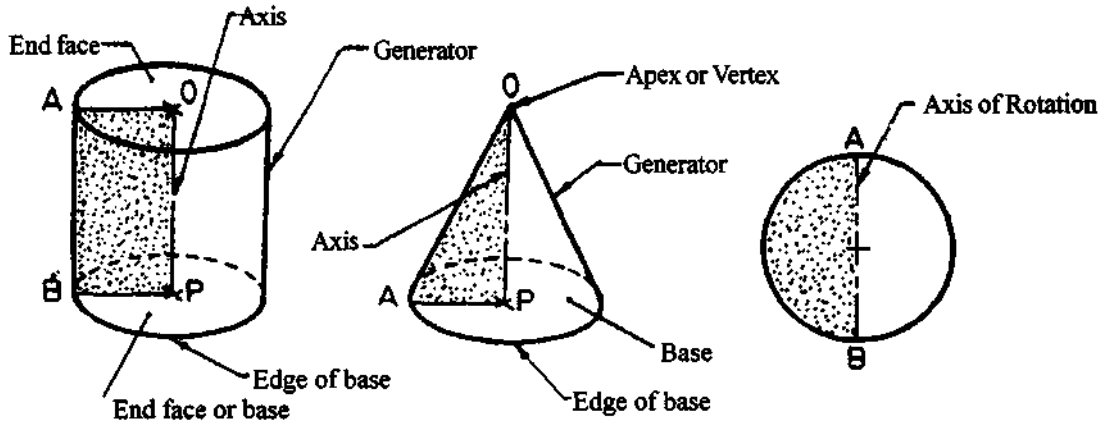


Fig. 6.5 Solids of Revolution

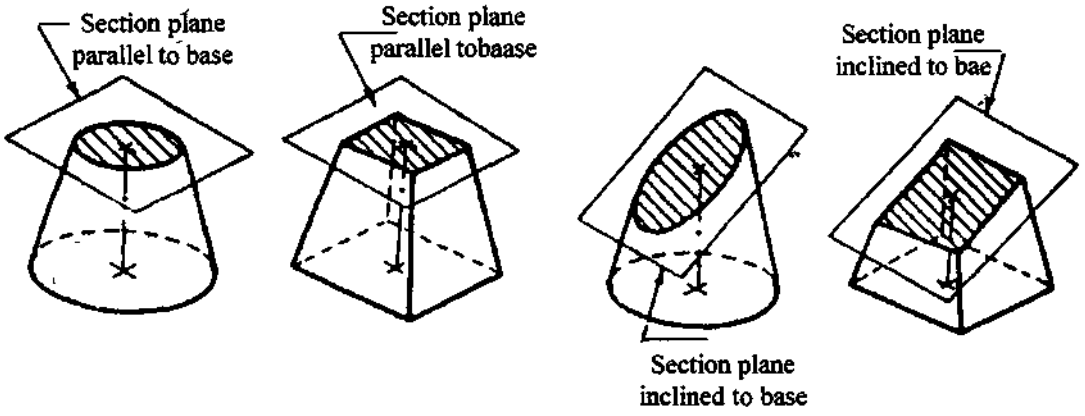


Fig. 6.6 Frustum of a Solid and Truncated Solids

6.6 Prisms (Problem) Position of a Solid with Respect to the Reference Planes

The position of solid in space may be specified by the location of either the axis, base, edge, diagonal or face with the principal planes of projection. The following are the positions of a solid considered.

1. Axis perpendicular to one of the principal planes.
2. Axis parallel to both the principal planes.
3. Axis inclined to one of the principal planes and parallel to the other.
4. Axis inclined to both the principal planes.

The position of solid with reference to the principal planes may also be grouped as follows:

1. Solid resting on its base.

2. Solid resting on any one of its faces, edges of faces, edges of base, generators, slant edges, etc.
3. Solid suspended freely from one of its corners, etc.

1. Axis perpendicular to one of the principal planes

When the axis of a solid is perpendicular to one of the planes, it is parallel to the other. Also, the projection of the solid on that plane will show the true shape of the base.

When the axis of a solid is perpendicular to H.P, the top view must be drawn first and then the front view is projected from it. Similarly when the axis of the solid is perpendicular to V.P, the front view must be drawn first and then the top view is projected from it.

Problem : *Draw the projections of a cube of 35mm side, resting on one of its faces (bases) on H.P., such that one of its vertical faces is parallel to and 10mm in front of V.P.*

Construction (Fig.6.7b)

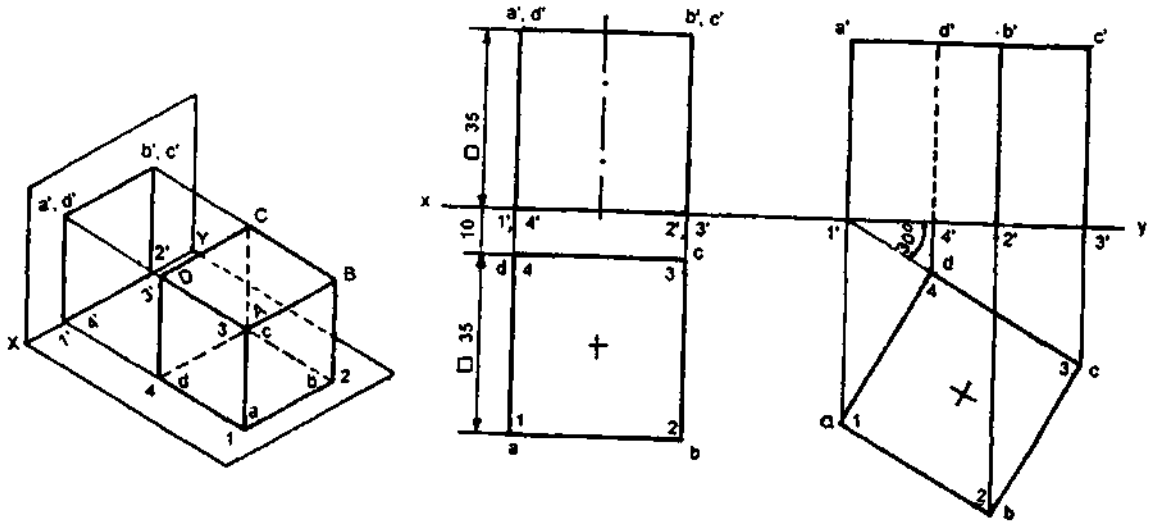


Fig. 6.7

Figure 6.7a shows the cube positioned in the first quadrant.

1. Draw the top view such that one of its edges is 10mm below xy.
2. Obtain the front view by projecrtion, keeping one of its bases on xy.

Note : (i) For the cube considered ABCD is the top base and 1234 the bottom base, (ii) Figure 6.7c shows the projections of a cube, resting on one of its bases on H.P. such that an edge of its base is inclined at 30° to V.P.

Problem : A square prism with side of base 35mm and axis 50mm long, lies with one of its longest edges on H.P such that its axis is perpendicular to V.P. Draw the projections of the prism when one of its rectangular faces containing the above longer edge is inclined at 30° to H.P.

Construction (Fig.6.8)

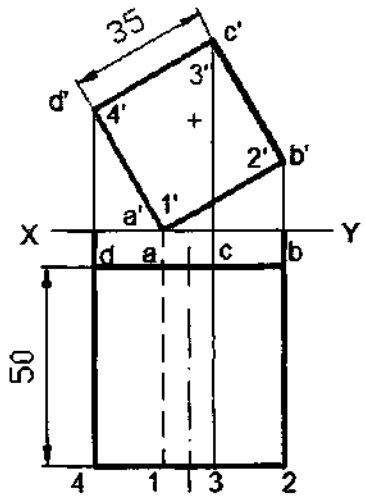


Fig. 6.8

1. Draw the front view which is a square of 35mm such that one of its corners is on xy and a side passing through it is making 30° with xy.
2. Obtain top view by projection, keeping the length as 50mm.

Note : The distance of the base nearer to V.P is not given in the problem. Hence, the top view may be drawn keeping the base nearer to xy at any convenient distance.

Problem : *A triangular prism with side of base 35mm and axis 50mm long is resting on its base on H.P.Draw the projections of the prism when one of its rectangular faces is perpendicular to V.P and the nearest edge parallel to V.P is 10mm from it.*

Construction (Fig.6.9)

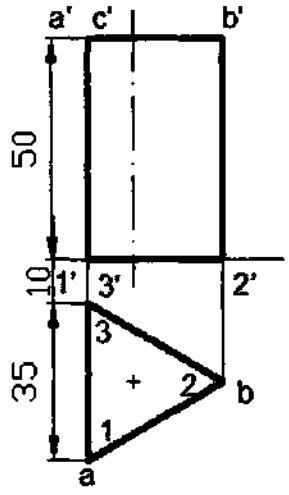


Fig. 6.9

1. Draw the top view keeping one edge perpendicular to xy and one corner at 10mm from xy.
2. Obtain the front view by projection, keeping the height equal to 50mm.

Problem : *A pentagonal prism with side of base 30mm and axis 60mm long is resting on its base on H.P such that one of its rectangular faces is parallel to VP and 15mm away from it. Draw the projections of the prism.*

Constructon (Fig.6.10)

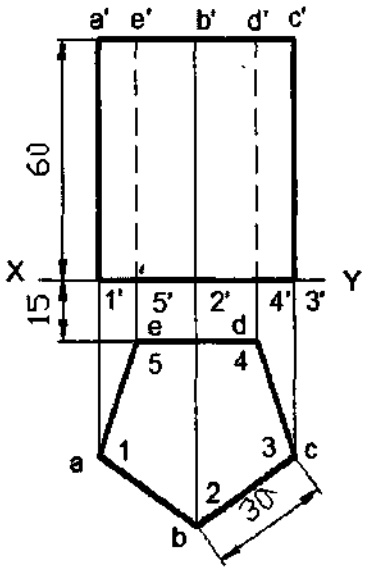


Fig. 6.10

1. Draw the top view keeping one edge of the base parallel to xy and 15mm away from it.
2. Obtain the front view by projection keeping the height equal to 60mm.

Problem : *A hexagonal prism with side of base 30mm and axis 60mm long lies with one of its longer edges on H.P such that its axis is perpendicular to V.P.Draw the projections of the prism when the base nearer to V.P is at a distance of 20mm from it.*

Construction (Fig.6.11)

1. Draw the front view keeping one corner on xy and one side making an angle of 30^0 with xy.
2. Obtain the top view by projection, keeping its length equal to 60mm and one of its bases 20mm from xy.

2. Axis parallel to both the principal planes

when the axis of solid is parallel to both the planes, neither the front view nor the top view reveal the true shape of the base. In such case, the side view must be drawn first which shows the true shape of the base, The front and top view are then projected from the side view.

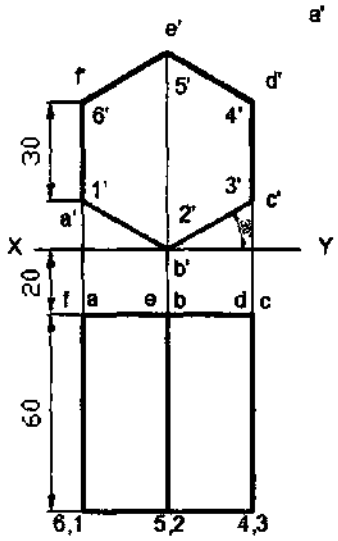


Fig. 6.11

Problem : *A hexagonal prism with side of base 25mm and axis 60mm long is lying on one of its rectangular faces on H.P. Draw the projections of the prism when its axis is parallel to both H.P and V.P.*

Construction (Fig. 6.12)

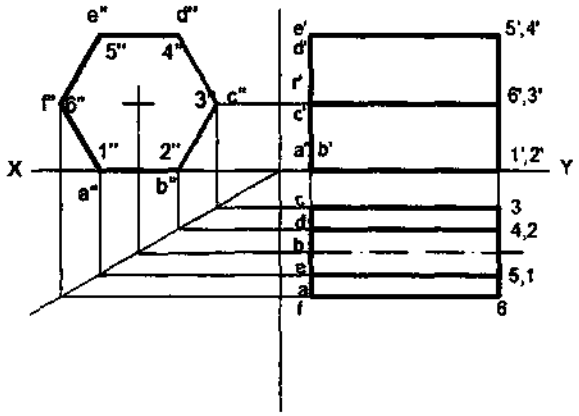


Fig. 6.12

1. Draw the right side view of the hexagon, keeping an edge on xy.
2. Draw the second reference line x_1y_1 perpendicular to xy and to the rigtht of the above view at any convenient location.
3. Obtain the front view by projection, keeping its length equal to 60mm
4. Obtain the top view by projecting the above views.

Problem : *Draw the three views of a triangular prism of side 25mm and length 50mm when its axis is parallel to H.P.*

Construction (Fig. 6.13)

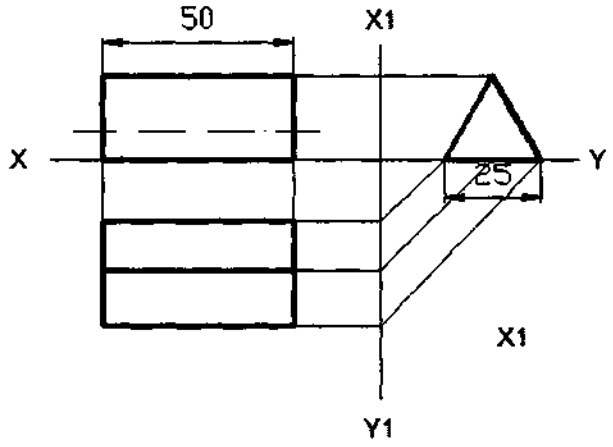


Fig. 6.13

1. Draw the left side view, an equilateral triangle of side 25mm, keeping one edge on xy.
2. Draw the reference line x_1y_1 perpendicular to xy and to the left of the above view at any convenient location.
3. Obtain the front view by projection, keeping its length equal to 50mm.
4. Obtain the top view by projecting the above two views.

Note : Rules to be observed while drawing the projections of solids.

(i) If a solid has an edge of its base on H.P or parallel to H.P, that edge should be kept perpendicular to V.P. If the edge of the base is on V.P or parallel to V.P, that edge should be kept perpendicular to H.P.

(ii) If a solid has a corner of its base on H.P, the side of the base containing that corner should be kept equally inclined to V.P. If a solid has a corner of its base on V.P, the sides of the base containing that corner should be kept equally inclined to H.P.

3. Axis inclined to one of the principal planes and parallel to the other.

When the axis of a solid is inclined to any plane, the projections are obtained in two stages. In the first stage, the axis of the solid is assumed to be perpendicular to the plane to which it is actually inclined and the projections are drawn. In second stage, the position of one of the projections is altered to statisfy the given condition and the other view is projected from it. This method of obtaining the projections is known as the change of position method.

Problem : *A pentagonal prism with side of base 30mm and axis 60mm long is resting with an edge of its base on H.P, such that the rectangular face containing that edge is inclined at 60^0 to H.P. Draw the projections of the prism when its axis is parallel to V.P.*

Construction (Fig.6.14)

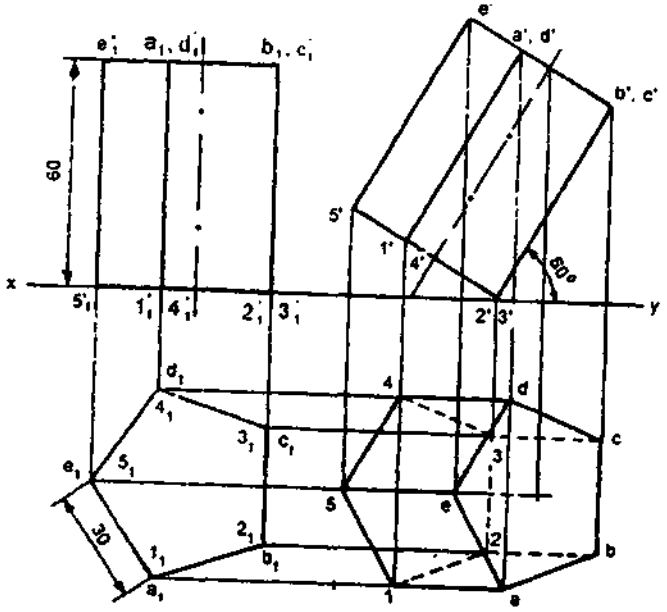


Fig. 6.12

Stage 1

Assume that the axis is perpendicular to H.P.

1. Draw the projections of the prism keeping an edge of its base perpendicular to V.P.

Stage 2

1. Rotate the front view so that the face containing the above edge makes the given angle with the H.P.
2. Redraw the front view such that the face containing the above edge makes 60° with xy. This is the final front view.
3. Obtain the final top view by projection.

Note : For completing the final projections of the solids inclined to one or both the principal planes, the following rules and sequence may be observed.

(i) Draw the edges of the visible base. The base is further away from xy in one view will be fully visible in the other view.

(ii) Draw the lines corresponding to the longer edges of the solid, keeping in mind that the lines passing through the visible base are invisible.

(iii) Draw the edges of the other base.

Problem : *Draw the projections of a pentagonal prism of base 25mm side and 50mm long.The prism is resting on one of its rectangular faces in V.P with its axis inclined at 45° to H.P.*

Construction (Fig.6.15)

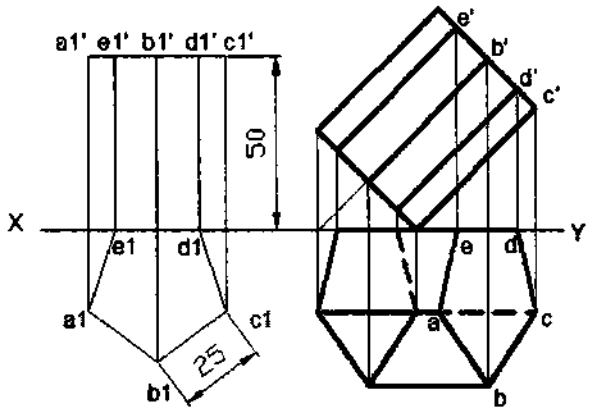


Fig. 6.15

Stage 1

Assume that the axis is perpendicular to H.P.

1. Draw the projections of the prism keeping one of its bases on H.P and a rectangular face in V.P.

Stage 2

1. Rotate the front view so that the axis makes the given angle with H.P.
2. Redraw the front view such that the axis makes 45° wth xy. This is the final front view.
3. Obtain the final top view by projection.

Problem : *A pentagonal prism with side of base 25mm and axis 50mm long lies on one of its faces on H.P., such that its axis is inclined at 45° to V.P. Draw the projections.*

Construction (Fig.6.16)

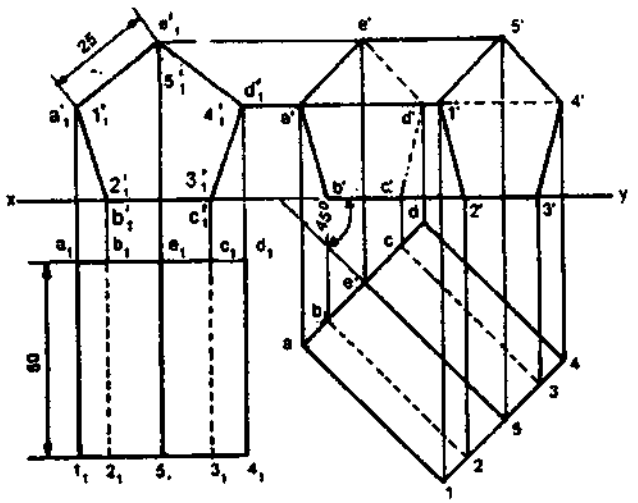


Fig. 6.16

1. Assuming that the axis is perpendicular to V.P, draw the projections keeping one side of the pentagon coinciding with xy.
2. Redraw the top view so that the axis is inclined at 45° to xy. This is the final top view.
3. Obtain the final front view by projection.

Problem : *A hexagonal prism with side of base 25mm and 50mm long is resting on a corner of its base on H.P. Draw the projections of the prism when its axis is making 30° with H.P and parallel to V.P.*

Construction (Fig. 6.17)

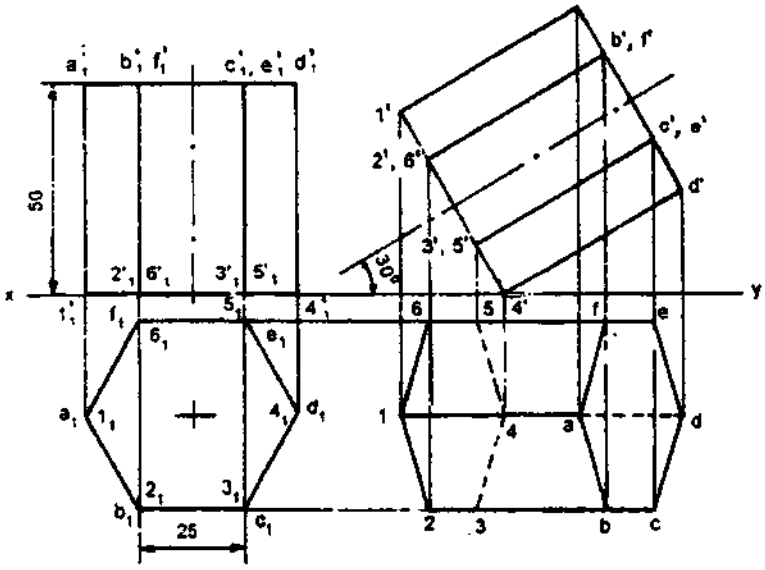


Fig. 6.17

1. Assuming that the axis is perpendicular to H.P, draw the projections of the prism, keeping two sides of the base containing the corner in the top view equally inclined to xy.
2. Redraw front view so that the axis makes 30° with xy and the corner 4| lies on xy. This is the final front view.
3. Obtain the final top view by projection.

Problem : *A Hexagonal prism with side of base 25mm and axis 60mm long is resting on one of its rectangular faces on H.P. Draw the projections of the prism when its axis is inclined at 45° to V.P.*

Construction (Fig.6.18)

1. Draw the projections of the prism assuming that the axis is perpendicular to V.P, with one of its rectangular faces on H.P.
2. Redraw the top view such that the axis makes 45° to xy. This is final top view.
3. Obtain the final front view by projection.

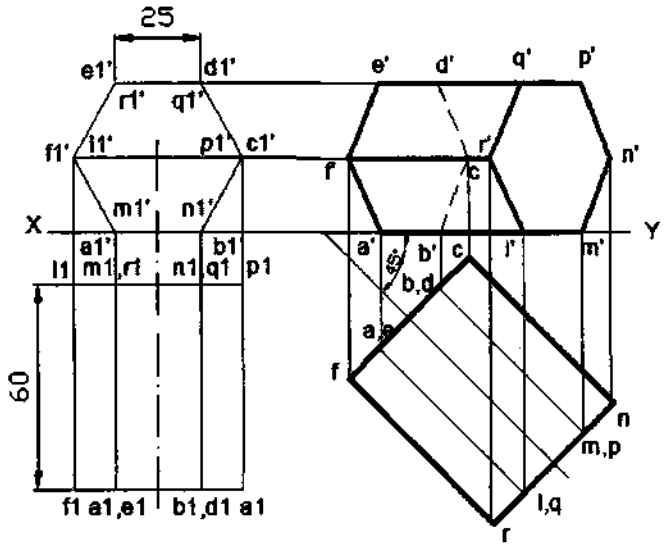


Fig. 6.18

4. Axis inclined to both the priciplal planes

A solid is said to be inclined to both the planes when (i)the axis is inclined to both the planes, (ii)the axis is inclined to one plane and an edge of the base is inclined to the other. In this case the projections are obtained in three stages.

Stage I

Assume that the axis is perpendicular to one of the planes and draw the projections.

Stage II

Rotate one of the projections till the axis is inclined at the given angle and project the other view from it.

State III

Rotate one of the projections obtained in Stage II, satisfiying the remaining condition and project the other view from it.

Problem : *A square prism with side of base 30mm and axis 50mm long has its axis inclined at 60⁰ to H.P., on one of the edges of the base which is inclined at 45⁰ to V.P.*

Construction (Fig.6.19)

1. Draw the projections of the prism assuming it to be resting on one of its bases on H.P with an edge of it perpendicular to V.P.
2. Redraw the front view such that the axis makes 60⁰ with xy and project the top view from it.
3. Redraw the top view such that the edge on which the prism is resting on H.P is inclined at 45⁰ to xy. This is the final top view.
4. Obtain the final front view by projection.

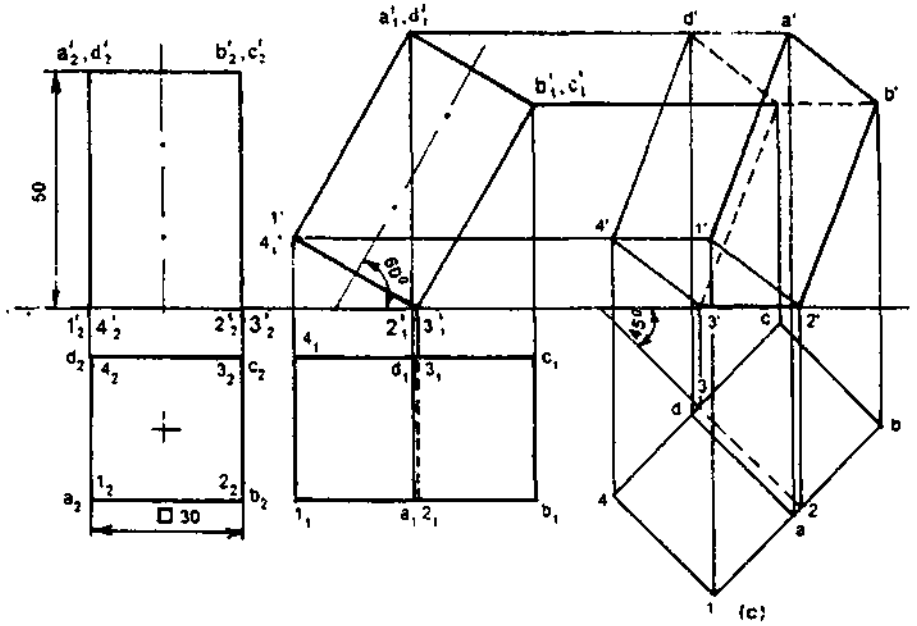


Fig. 6.19

Problem : *Draw the projections of a cube of 50mm side when it has one face in V.P and an adjacent face inclined at 30° to H.P. The longer edge of the later face is on H.P.*

Construction (Fig.6.20)

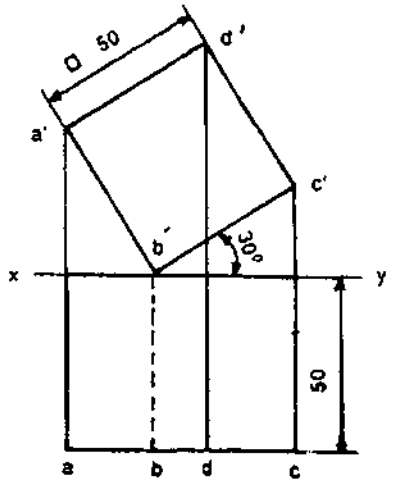


Fig. 6.20

1. Draw the front view such that one of its corners is on xy and
2. Obtain the top view by projections, keeping one of its bases on xy.

Problem : *A pentagonal prism of side of base 25mm and axis 40mm long is resting on H.P on a corner of its base. Draw the projections of the prism, when the base is inclined at 60° to H.P., and the axis appears to be inclined at 30° to V.P.*

Construction (Fig.6.21)

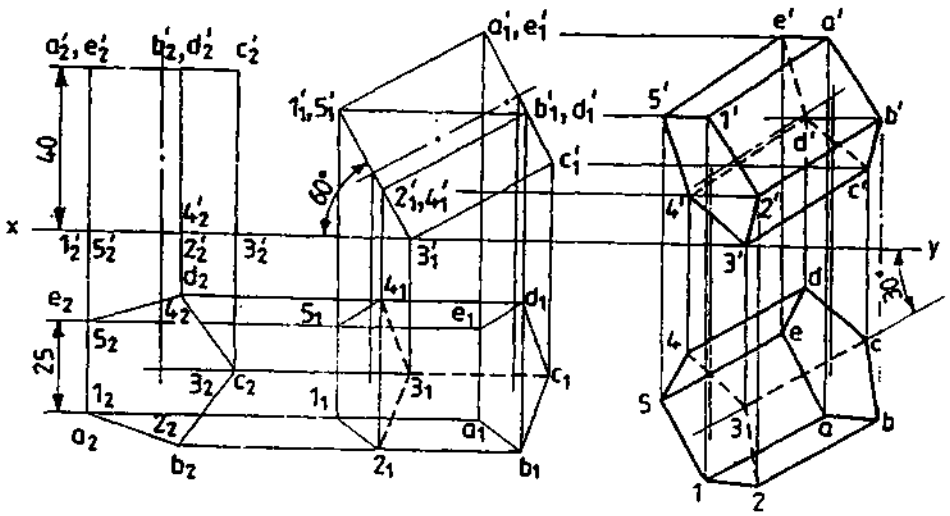


Fig. 6.21

1. Draw the projections of the prism assuming that it is resting on its base on H.P., with two adjacent edges of the base equally inclined to V.P.
2. Redraw the front view such that the corner 3^1 lies on xy and the front view of the base 1-2-3-4-5 makes an angle 60° with xy.
3. Obtain the second top view by projection.
4. Redraw the above top view such that its axis makes an angle 30° with xy.
5. Obtain the final view by projection.

Problem : *A hexagonal prism of base 25mm and 45mm long is positioned with one of its base edges on H.P such that the axis is inclined at 30° to H.P. and 45° to V.P. Draw its projections.*

Construction (Fig. 6.22)

1. Draw the projections of the prism assuming t at it is resting on its base on H.P. and with an edge of the base perpendicular to V.P.
2. Redraw the front view such that the front view of the base edge 3-4 lies on xy and the axis makes an angle 30° with xy.
3. Obtain the second top view by projection.
4. Determine the apparent angle β , the inclination the axis makes with xy in the final top view.
5. Redraw the top view such that its axis makes angle β with xy.
6. Obtain the final front view by projection.

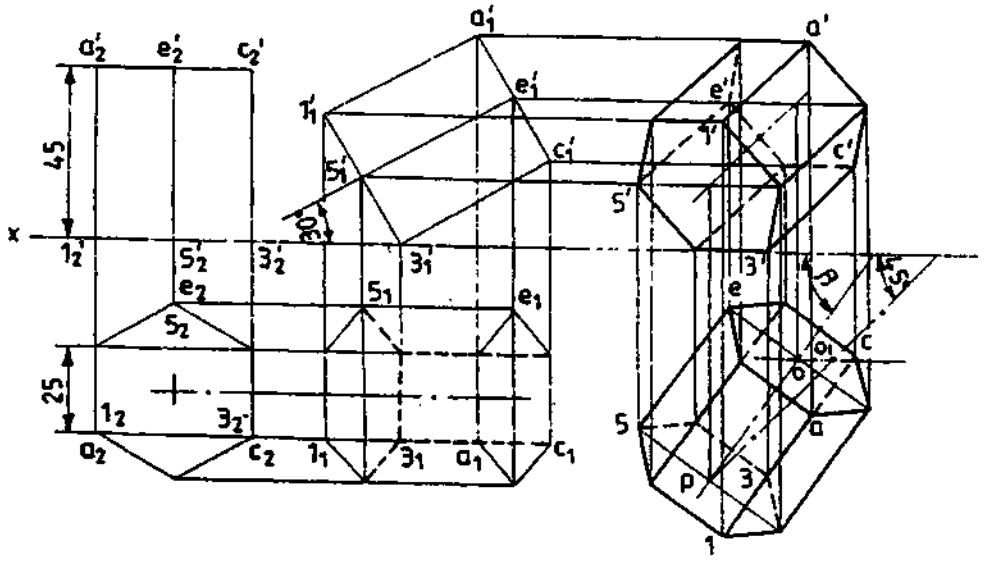


Fig. 6.22

Problem : A cube of edge 35mm is resting on H.P on one of its corners with a solid diagona' perpendicular to V.P. Draw the porjections of the cube.

Construction (Fig.6.23)

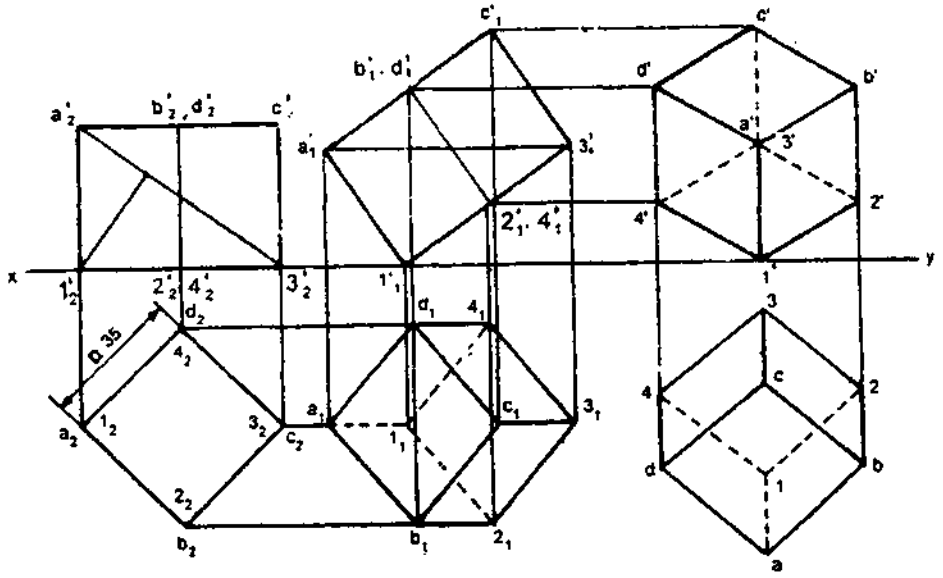


Fig. 6.23

1. Draw the projections of the cube assuming that it is lying on H.P on one of its bases and vertical faces and vertical faces are equally inclined to V.P.
2. Locate any solid diagonal say $a'_2\ 3'_2$

3. Redraw the front view so that the solid diagonal $a'_1 3'_1$ is parallel to xy.
4. Obtain the top view by projection.
5. Redraw the above view so that the solid diagonal a_3 is perpendicular to xy. This is the final top view.
6. Obtain the final front view by projection.

6.7 Pyramids

Problem : *A square pyramind with side of base 30mm and axis 50mm long is resting with its base on H.P. Draw the projections of the pyramid when one of its base edges is parallel to V.P. The axis of the pyramid is 30mm in front of V.P.*

Construction (Fig.6.24)

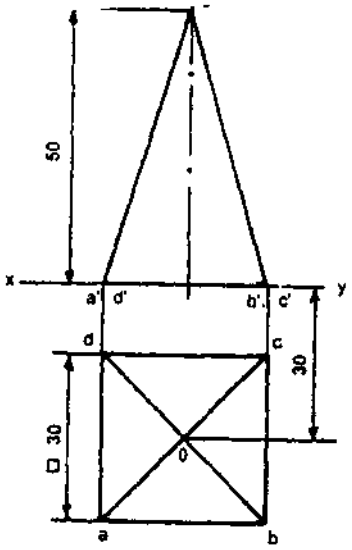


Fig. 6.24

1. Draw the top view, a square, keeping its centre at 30mm from xy and with an edge parallel to xy.
2. Obtain the front view by projection keping the height equal to 50mm and the base lying on xy.

Problem : *A tetrahedron of side 40mm is resting with one of its faces on H.P. Draw the projections when edge of the face lying on H.P is (i)perpendicular to V.P and (ii)parallel to and 10mm in front of H.P.*

(i) Construction (5.25(a))

1. Draw the top view keeping one side perpendicular to xy. The lines **oa, ob, oc** represent the slant edges of the tetrahedron. The line **ob** is the top view of the stant edge OB. As it is parallel to xy, the length of its front view represents the true length of the edge.
2. Project the front view of the base $a' b' c'$ on to xy.

3. Draw a projector through **o**.
4. With centre b'_1 and radius equal to the length of side draw an arc intersecting the above projector at o'.
5. Join o', a', (c') and o',b' forming the front view.

(ii) Construction (Fig.6.25b)

1. Draw the top view of the tetrahedron, keeping one side of the base parallel to and 10mm below xy.
2. Obtain the front view of the base $a'b'c'$ on to xy by projection.
3. Draw a projector through o.
4. Rotate ob about o to ob_1 prallel to xy.
5. Through b'_1 draw a projector to meet xy at b'_1.
6. With centre b'_1 and radius equal to the length of side, draw an arc meeting the projector through **o** at o'.
7. Join o'-a', o'-b', o'-c', forming the front view.

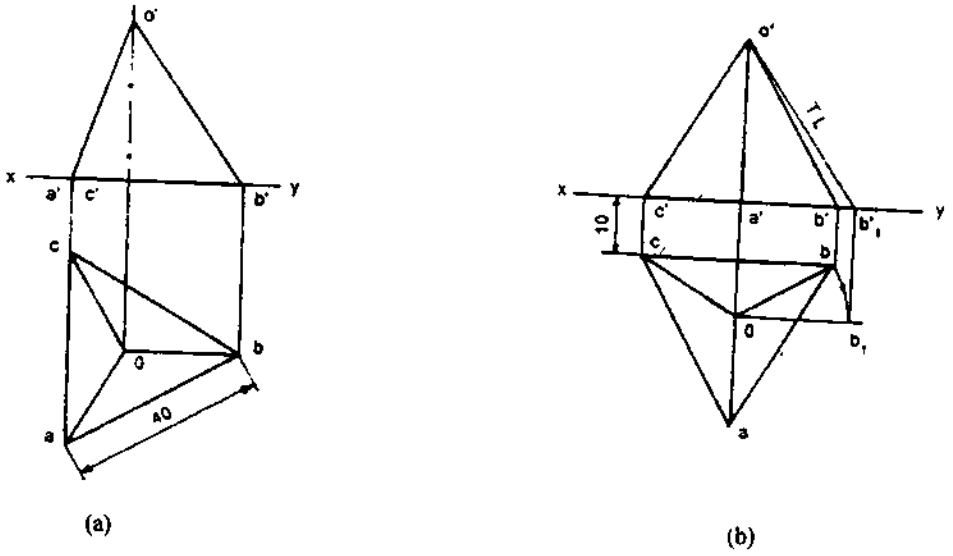


Fig 6.25

Problem : *Draw the projections of a pentagonal pyramid of side of base 30mm and axis 50mm long when its axis is perpendicular to V.P and an edge of its base is perpendicular to H.P.*

Construction (Fig. 6.26)

1. Draw the front view of the pyramind which is a pentagon, keeping one of its sides perpendicular to xy.
2. Obtain the top view by projection keeping the axis length equal to 50mm

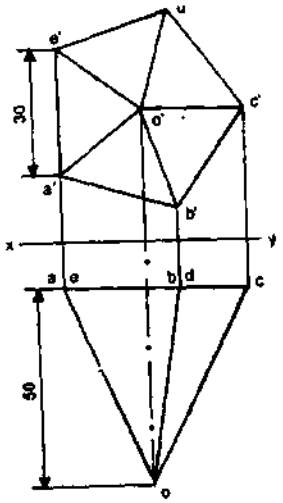


Fig. 6.26

Problem : *A pentagonal pyramid of base 30mm side and axis 50mm long has its apex in V.P and the axis perpendicular to V.P. a corner of the base is resting on the ground and the side of the base contained by the corner is inclined at 30° to the ground. Draw its projections.*

Construction (Fig.6.27)

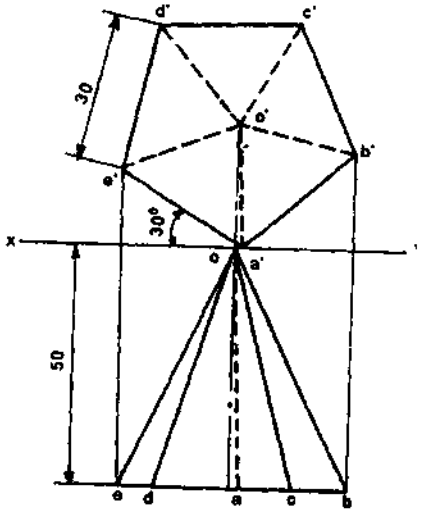


Fig. 6.27

1. Draw the front view of the pyramid which is a pentagon of side 30mm, keeping one of its corners on xy and an edge from that corner inclined at 30° with xy.
2. Obtain the top view by projection keeping the axis length equal to 50mm and the apex o lying on xy.

Problem : *A hexagonal pyramid with side of base 30mm and axis 60mm long is resting with its base on H.P., such that one of the base edges is inclined to V.P at 45⁰ and the axis is 50mm in front of V.P.*

Construction (Fig.6.28)

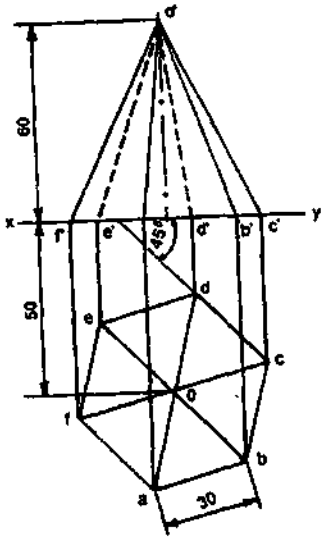


Fig. 6.28

1. Draw the top view, keeping one side of the base inclined at 45⁰ to xy and the centre of the hexagon at 50mm below xy.
2. Obtain the front view by projection, keeping the axis length equal to 60mm.

Problem : *A pentagonal pyramid with side of base 30mm and axis 60mm long rests with an edge of its base on H.P such that its axis is parallel to both H.P and V.P. Draw the projection of the solid.*

Construction (Fig.6.29)

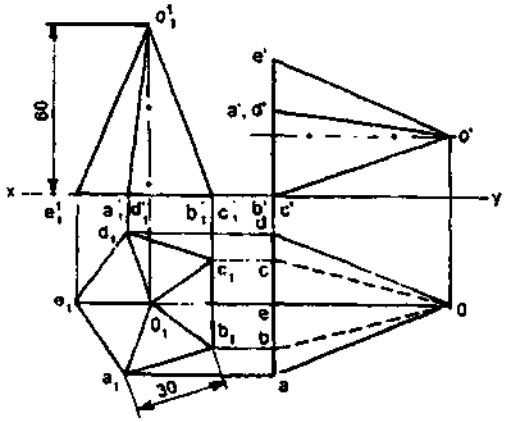


Fig. 6.29

1. Draw the projections of the pyramid with its base on H.P and an edge of the base (BC) perpendicular to V.P.
2. Redraw the front view such that b(c) lies on xy and the axis is parallel to xy which is the final front view.
3. Obtain the final top view by projection.

Problem : *A pentagonal pyramid with side of base 25 and axis 50mm long is resting on one of its faces on H.P such that its axis is parallel to V.P. Draw the projections.*

Construction (Fig.6.30)

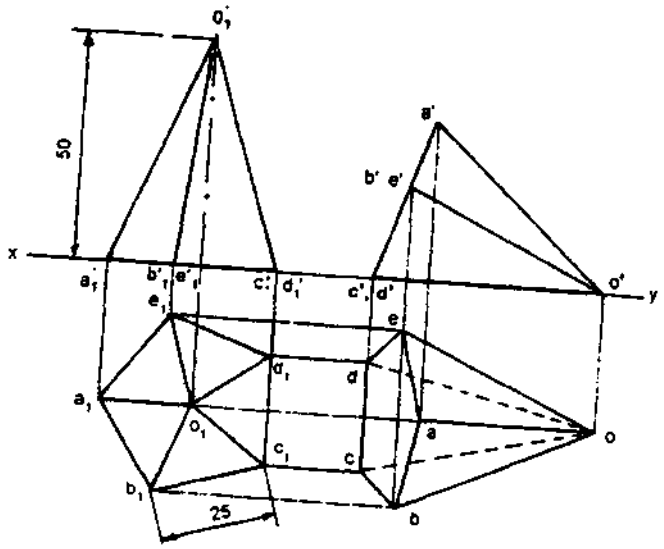


Fig. 6.30

1. Assuming the axis is perpendicular to H.P draw the projections keeping one edge of the base perpendicular to V.P.
2. Redraw the front view so that the line **o'-c(d)** representing the slant face, coincides with xy. This is the final front view.
3. Obtain the final top view by projection.

Problem : *A pentagonal pyramid with side of base 35mm and axis 70mm long is lying on one of its base edges on H.P so that the highest point of the base is 25mm above H.P., and an edge of the base is perpendicular to V.P.*

Construction (Fig.6.31)

1. Draw the projections of the pyramid, assuming that it is resting on its base on H.P and one edge of the base is perpendicular to V.P.
2. Redraw the front view so that the corner **c'** of the base is 25mm above xy forming final front view.
3. Obtain the final top view by projection.

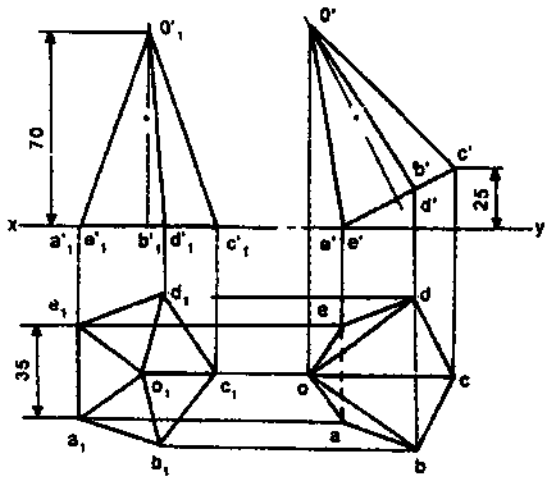


Fig. 6.31

Problem : *Draw the projections of a pentagonal pyramid with a side of base 30mm and axis 70mm long when (i)one of its triangular faces is perpendicular to H.P and (ii)one of its slant edges is vertical.*

Construction (Fig.6.32)

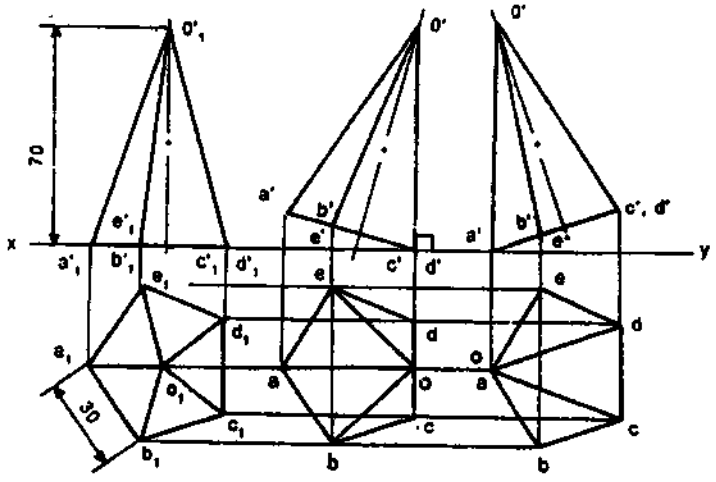


Fig. 6.32

1. Draw the projections of the pyramid assuming that it is resting on its base on H.P with an edge of the base perpendicular to V.P.

   Case (i)

2. Redraw the front view such that the front view of the face OCD is perpendicular to xy (the line $o'c'(d')$.

3. Obtain the top view by projection.

Case (ii)

4. Redraw the front view such that front view of the edge OA is perpendicular to xy (the line $o'a'$)
5. Obtain the top view by projection.

6.8 Cone and cylinder

Problem : *Draw the projection of a cone of base 40mm diameter, axis 60mm long when it is resting with its base on H.P.*

Construction (Fig. 6.33)

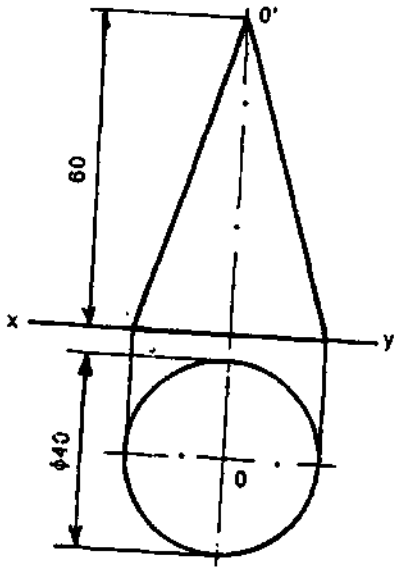


Fig. 6.33

1. Draw the reference line xy and locate o at a convemient distance below it.
2. With centre o and radius 20mm draw a circle forming the top view.
3. Obtain the front view by projection, keeping the height equal to 60mm and the base coinciding with xy.

Problem : *Draw the projections of a cone with diameter of the base as 40mm and axis 70mm long with its apex on H.P and 35mm from V.P. The axis is perpendicular to H.P.*

Construction (Fig.6.34)

1. Draw the reference line xy and locate o at 35mm below it.
2. With o as centre draw a circle of diameter 40mm which is the top view of the cone.
3. Obtain the front view by projection, keeping the height equal to 70mm and the apex o' on xy.

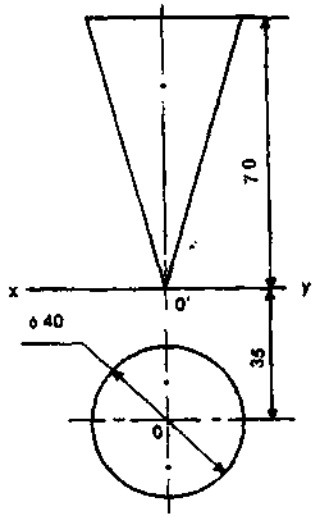


Fig. 6.34

Problem : *A cone with base 30mm diameter and axis 45mm long lies on a point of its base on V.P such that the axis makes an angle 45⁰ with V.P. Draw the projections of the cone.*

Construction (Fig.6.35)

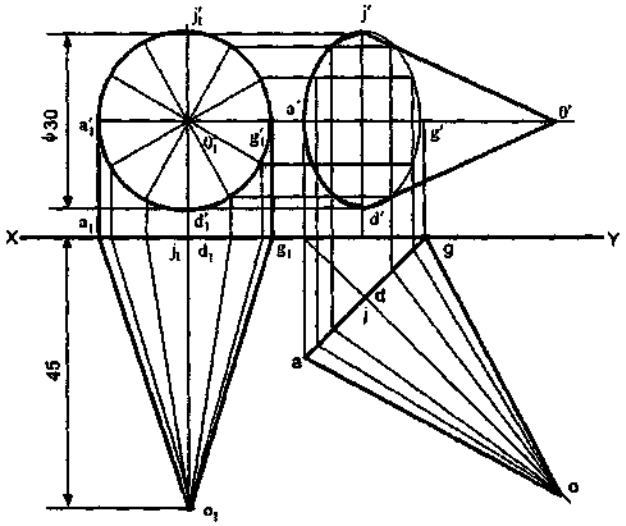


Fig. 6.35

1. Draw the projections of the cone assuming that the cone is resting with its base on V.P.
2. Divide the circle into a number of equal parts and draw the corresponding generators in the top view.
3. Redraw the top view so that the axis makes 45⁰ with xy. This is the final top view.
4. Obtain the final view by projection.

Problem : *Draw the projecitons of a cylinder of base 30mm diameter and axis 45mm long when it is resting with its base on H.P and axis 20mm in front of V.P.*

Construction (Fig.6.36)

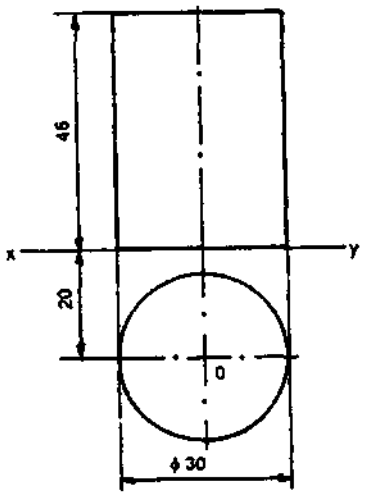


Fig. 6.36

1. Draw the reference line xy and locate o at 20mm below it.
2. With centre o and radius 15mm draw a circle forming the top view.
3. Obtain the front view by projection, keeping the height equal to 45mm and the base coinciding with xy.

Problem : *A cylinder with base 40mm diameter and 50mm long rests on a point of its base on H.P such that the axis makes an angle of 30° with H.P. Draw the projections of the cylinder.*

Construction (Fig.6.37)

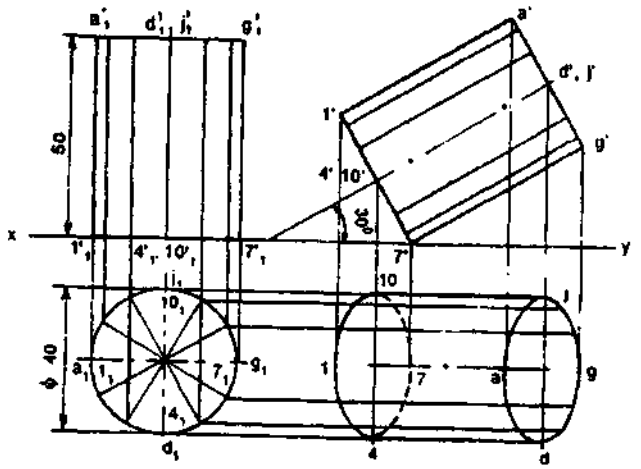


Fig. 6.37

1. Draw the projeciton of the cylinder assuming that the cylinder is resting with its base on H.P.
2. Divide the circle into a number of equal parts and obtain the corresponding generators in the front view.
3. Redraw the front view such that its axis makes 30^0 with xy. This is the final front view.
4. Obtain the final top view by projection.

Problem : *Draw the projections of a cylincder of 75mm diameter and 100mm long lying on the ground with its axis inclined at 30^0 to V.P. and parallel to the ground.*

Construction (Fig.6.38)

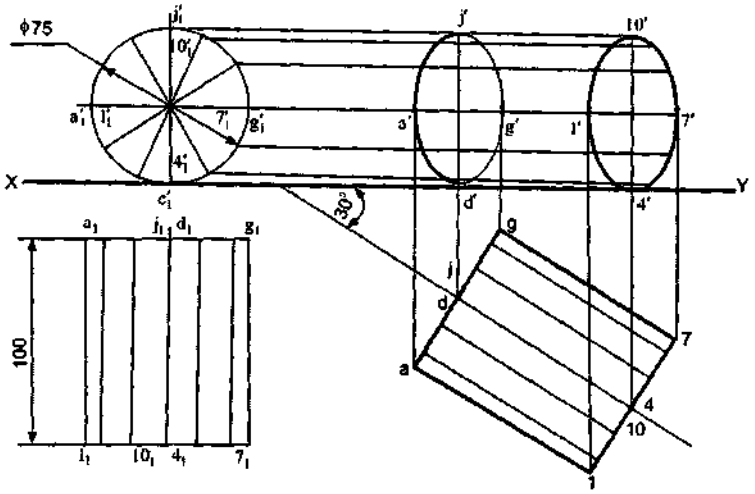


Fig. 6.38

1. Draw the projeciton of the cylinder assuming that the cylinder is resting on H.P. with its axis perpendicular to V.P
2. Redraw the top view such that its axis makes 30^0 with xy, This is the final top view.
3. Obtain the final front view by projection.

Problem : *A cylinder of base 30mm diameter and axis 45mm long is resting on a point of its base on H.P so that the axis is inclined at 30^0 with H.P. Draw the projections of the cylinder when the top view of the axis is inclined at 45^0 with xy.*

Construction (Fig.6.39)

1. Draw the projection of the cylinder assuming it to be resting on its base on H.P.
2. Redraw the front view so that the axis is inclined at 30^0 with xy.
3. Obtain the top view by projection.
4. Redraw the above view so that the top view of the axis is inclined at 45^0 with xy. This is the final top view.
5. Obtain the front view by projection.

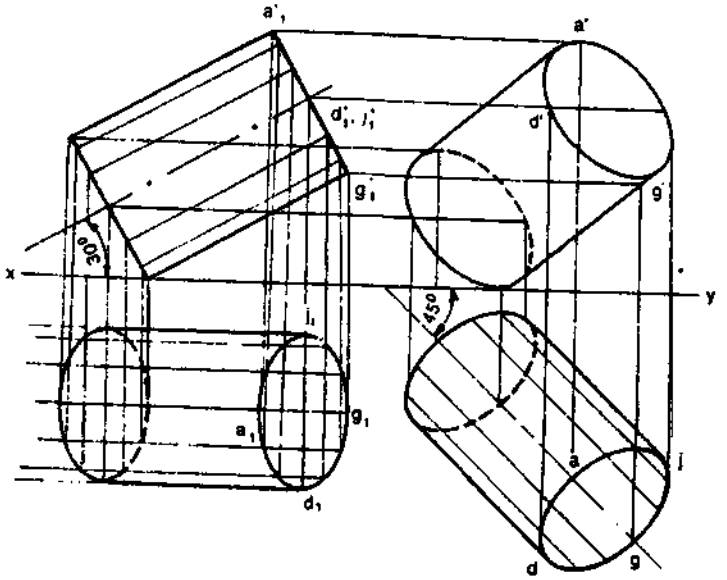


Fig. 6.39

Problem : Draw the projections of a hexagonal prism of base 25mm side and axis 60mm long, when it is resting on one of its corners of the base on H.P. The axis of the solid is inclined at 45° to H.P.

Solution : **(Fig.6.40)**

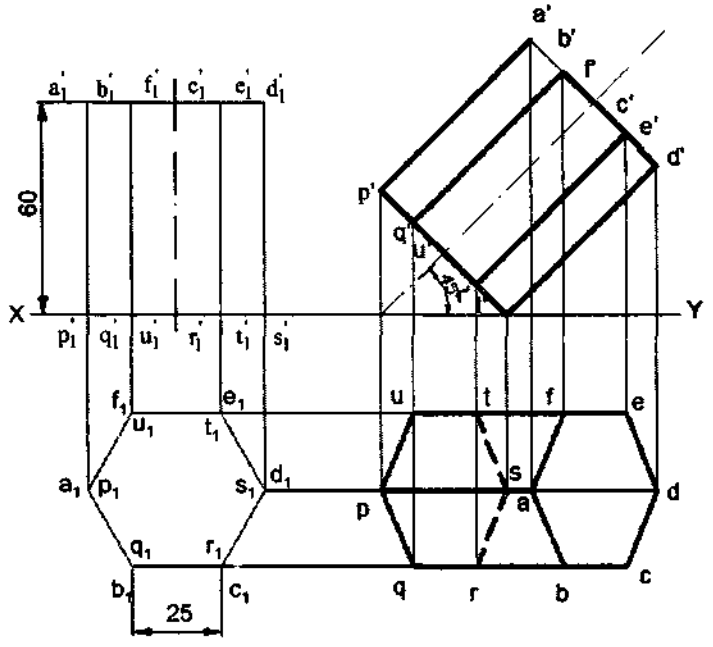


Fig. 6.40

Problem : A hexagonal prism of side of base 25mm and axis 60mm long lies with one of its rectangular faces on the H.P., such that the axis is inclined at 45° to the V.P. Draw its projections.

Solution : **(Fig.6.41)**

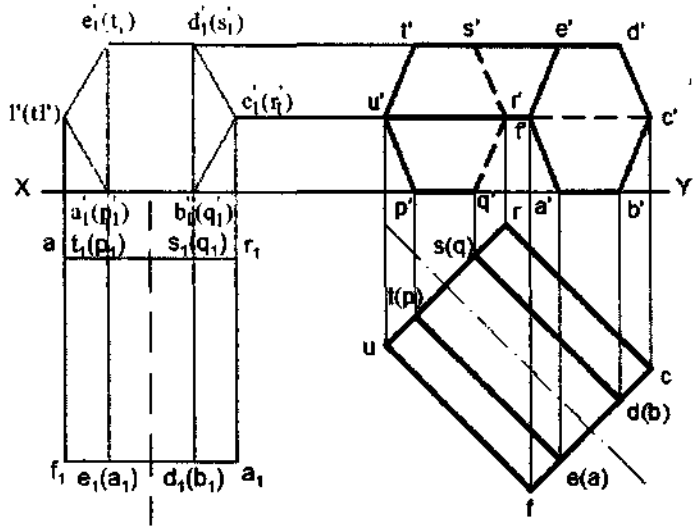


Fig. 6.41

Problem : Draw the projections of an hexagonal prism, side of base 20mm and altitude 50mm, when a side of base is on H.P and the axis is inclined at 60° to the H.P. The axis is parallel to V.P.

Solution : **(Fig.6.42)**

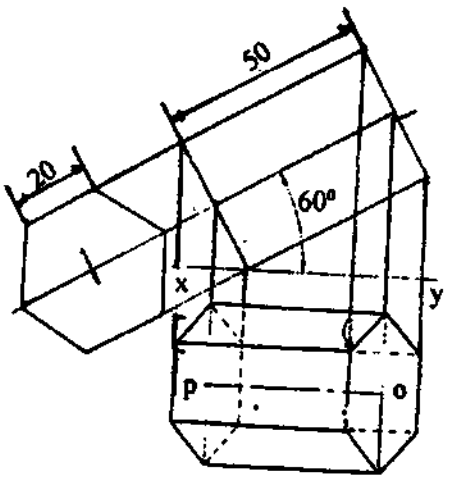


Fig. 6.42

Problem : Draw the projections of a cylinder of 40mm diameter and axis 60mm long, when it is lying on H.P, with its axis inclined at 45° to H.P and parallel to V.P.

Solution : **(Fig. 6.43)**

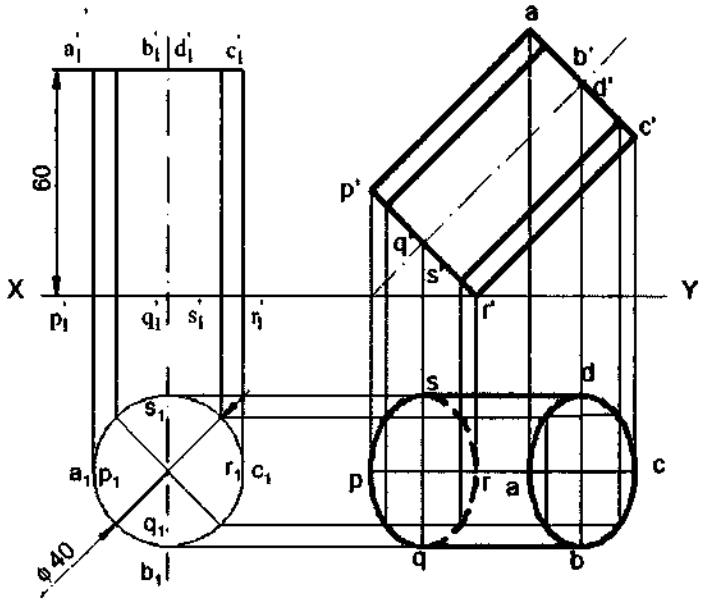


Fig. 6.43

Problem : A pentagonal pyramid, side of base 25mm and axis 50mm long, lies with one of its slant edges on H.P. such that its axis is parallel to V.P. Draw its projections.

Solution : **(Fig.6.44)**

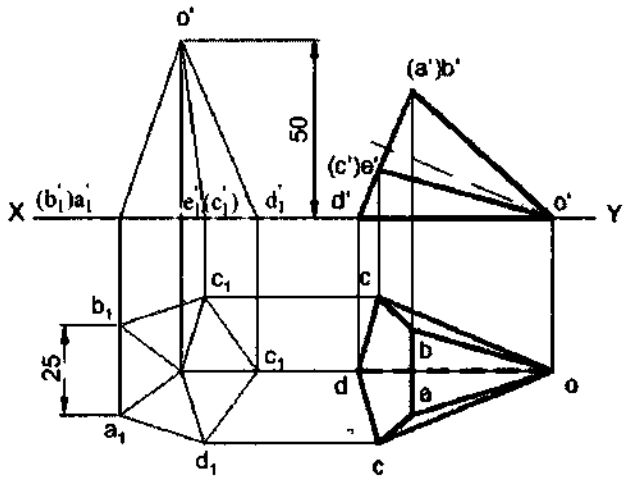


Fig. 6.44

Problem : A right circular cone 50mm base diameter and 80mm height rests on the ground on one of the points of the base circle. Its axis is inclined to H.P at 50° and to V.P at 30° . Draw the projections of the cone.

Solution : **(Fig.6.45)**

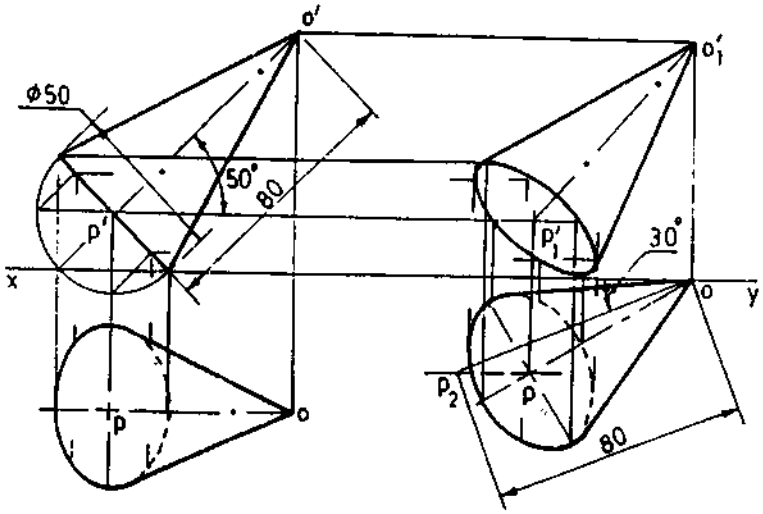


Fig. 6.45

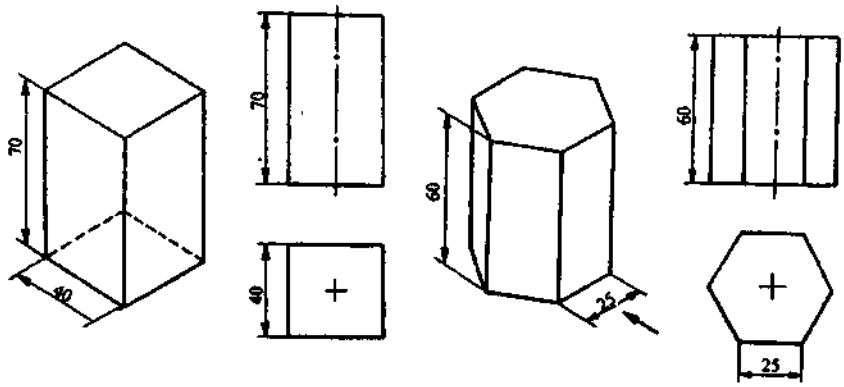
6.9 Application of Orthographic Projections

6.9.1 Selection of views

The number of views required to describe an object depends upon the extent of complexity involved in it. The higher the symmetry the lesser the number of views required to be drawn.

6.9.2 Simple solids

The orthographic views of some of the simple solids are shown in Fig.6.46. In some cases a solid can be fully described by one view, in some cases by two views.



(a) (b)

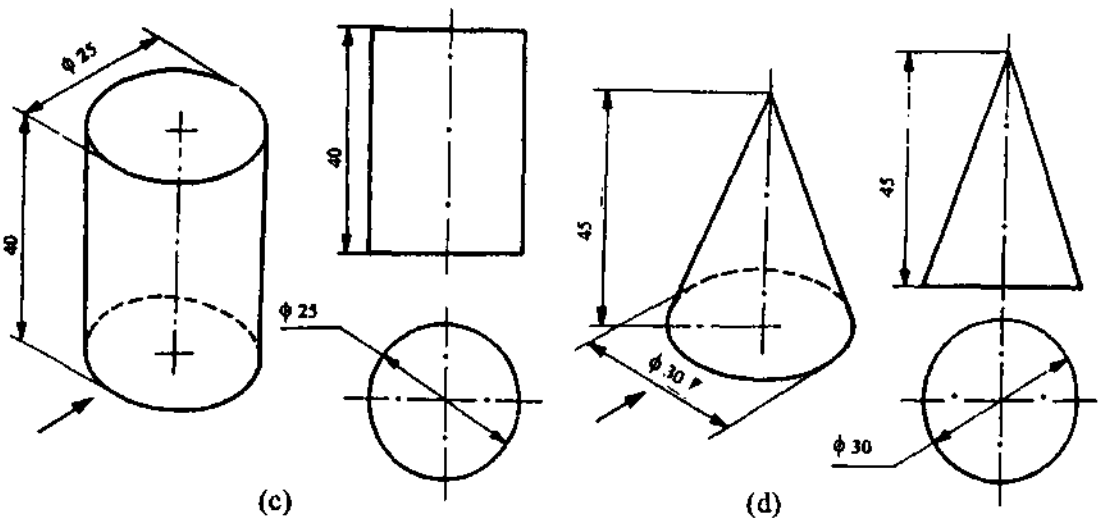


Fig. 6.46

6.9.3 Three View Drawings

In general, three views are required to describe most of the objects. In such cases the views normally selected are : the front view, top view and left or right side view. Fig.6.47 shows an example in which three views are essential to describe the object completely.

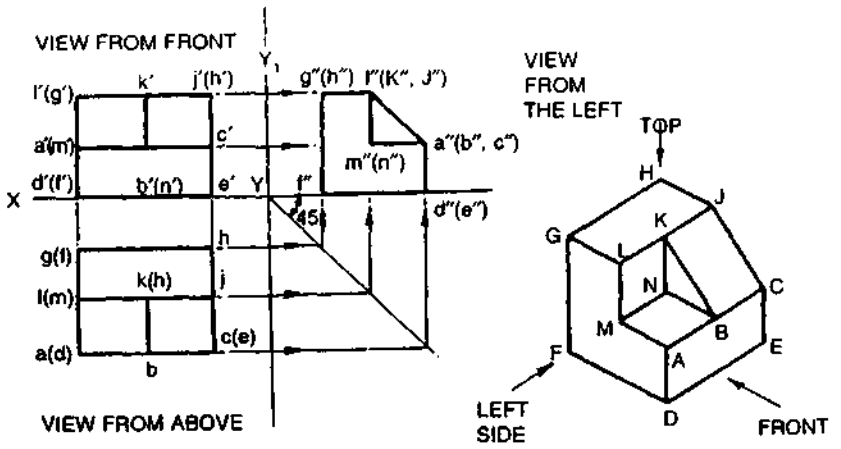


Fig. 6.47 Three View Drawing

6.9.4 Development of Missing Views

When two views of an object are given the third view may be developed by the use of mitre line as described in the following example.

(a) To develop the right side view from the given front and top views.

Construction (Fig. 6.48)

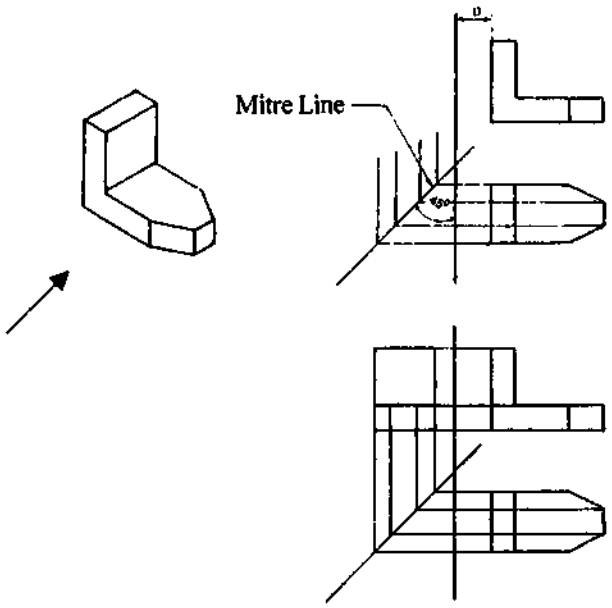


Fig. 6.48

1. Draw the given front and top views.
2. Draw projection lines to the left of the top view.
3. Draw a vertical reference line at any convement distancd D from the front view.
4. Draw a mitre line at 45^0 to the vertical
5. Through the points of intersection between the mitre line and the above projection lines draw vertical projection lines.
6. Join the points of intersection in the ordr and obtain the required view.

(b) Figure 5.49 illustrates the method of obtianing the top views from the given front and left side views.

(c) Figure 6.50 shows the correct positioning of the three orthographic views.

Examples

For examples given note the following:

Figure a - Isometric projection

Figure b - Orthographic projections

Direction of arrow - Direction to obtain the front view.

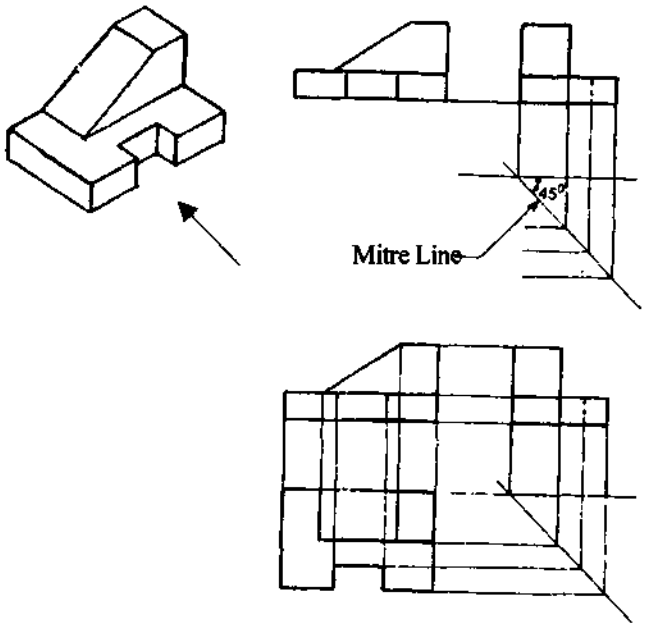


Fig. 6.49

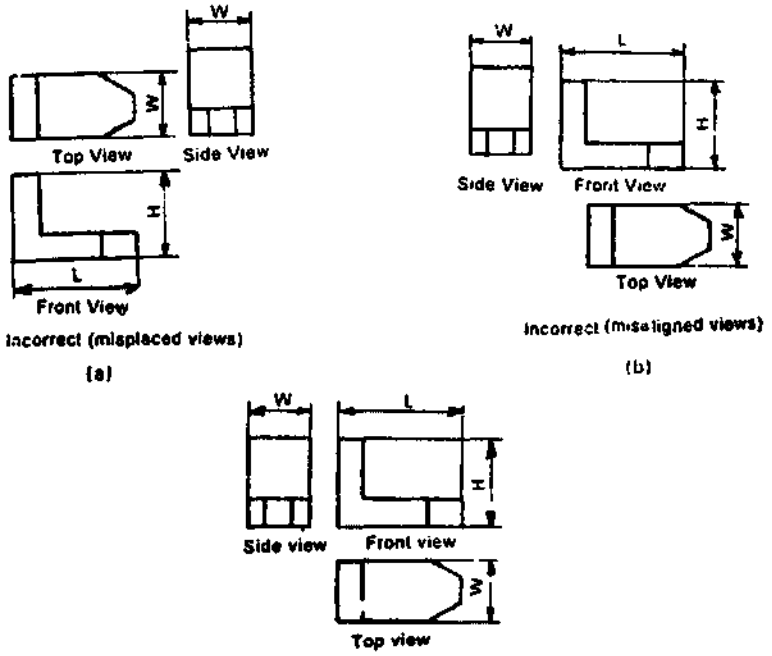


Fig. 6.50

Example 1

In the following figures form 6.51 to 6.72 the isometric projection of some solids and machine components are shown for which the three orthgraphic views are given in first angle projection.

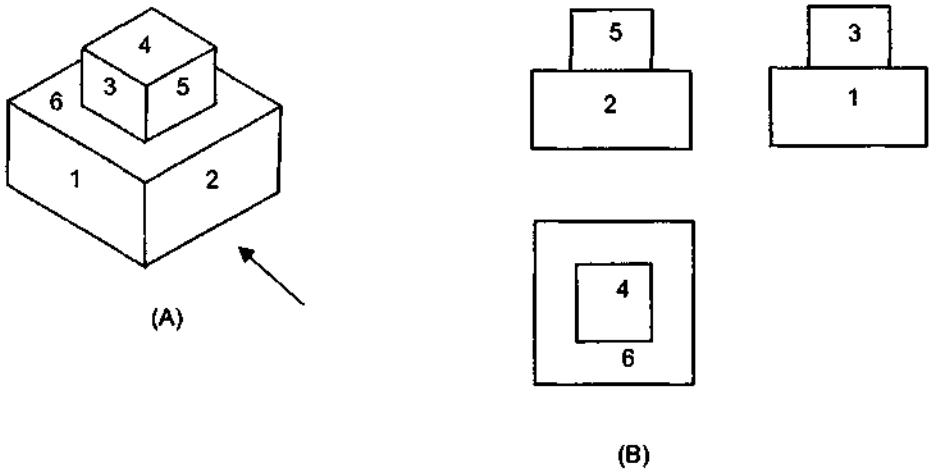


Fig. 6.51

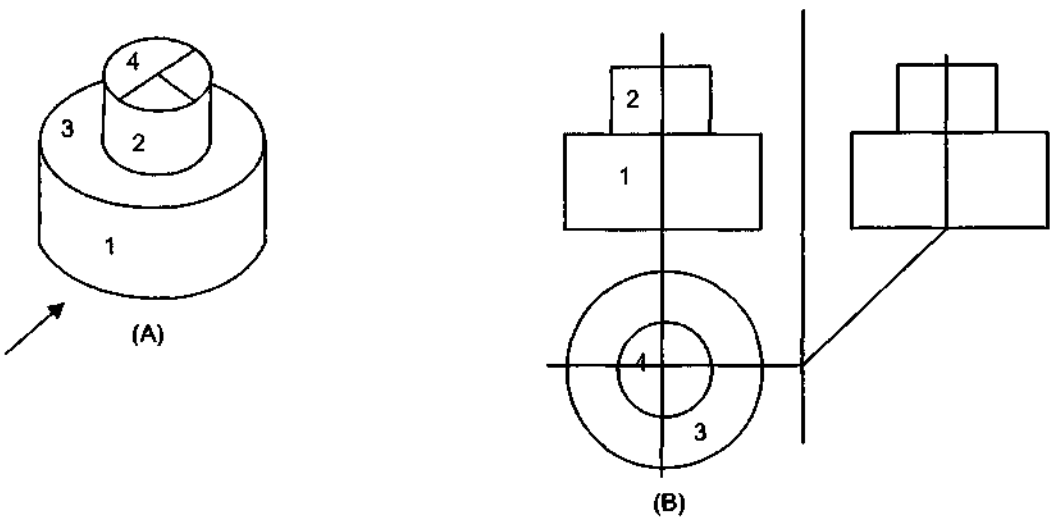


Fig. 6.52

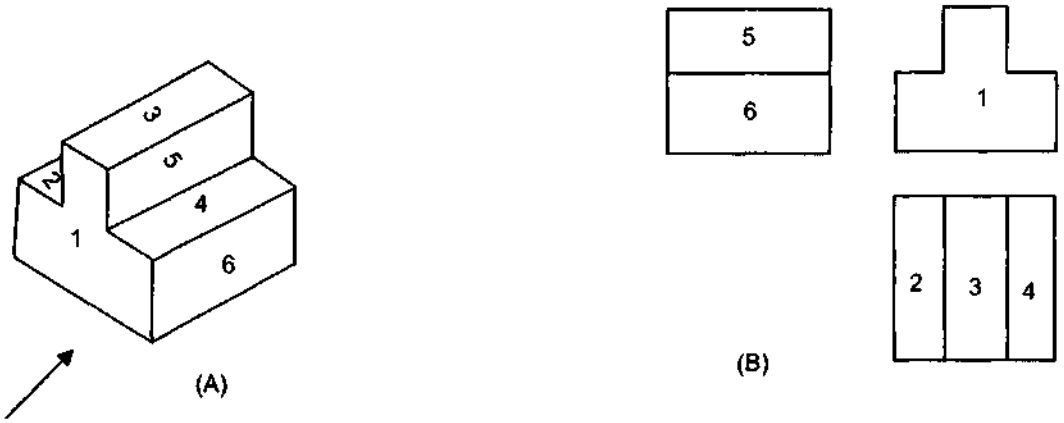


Fig. 6.53

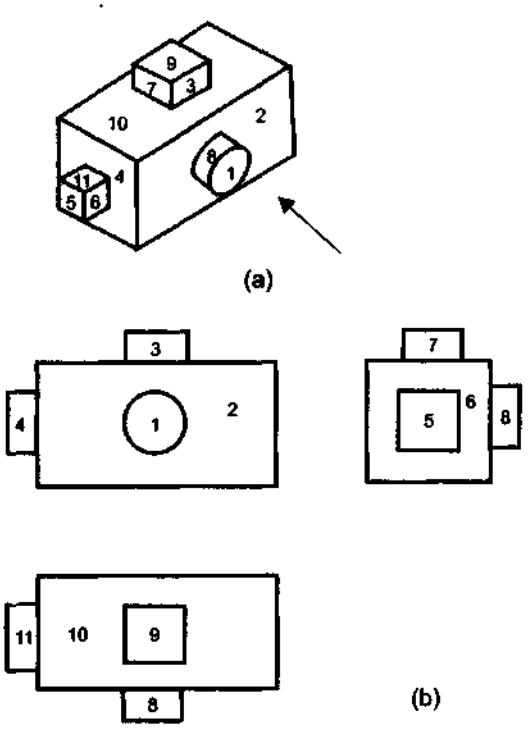


Fig. 6.54

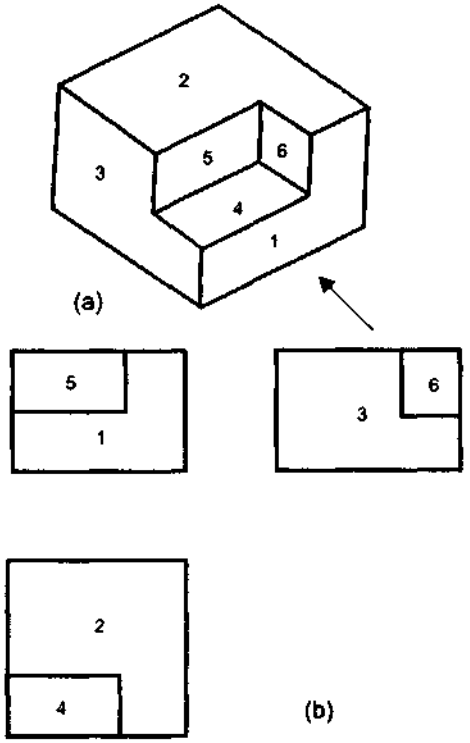


Fig. 6.55

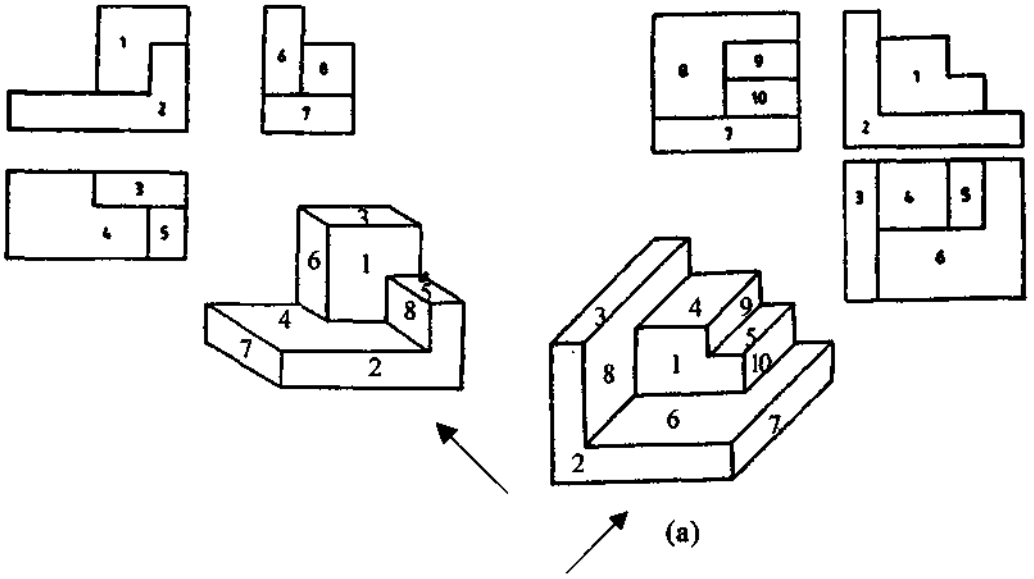


Fig. 6.56(a) & 6.57

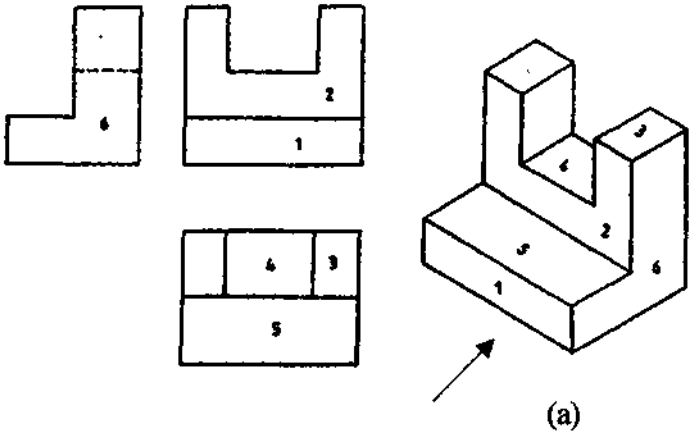


Fig. 6.58

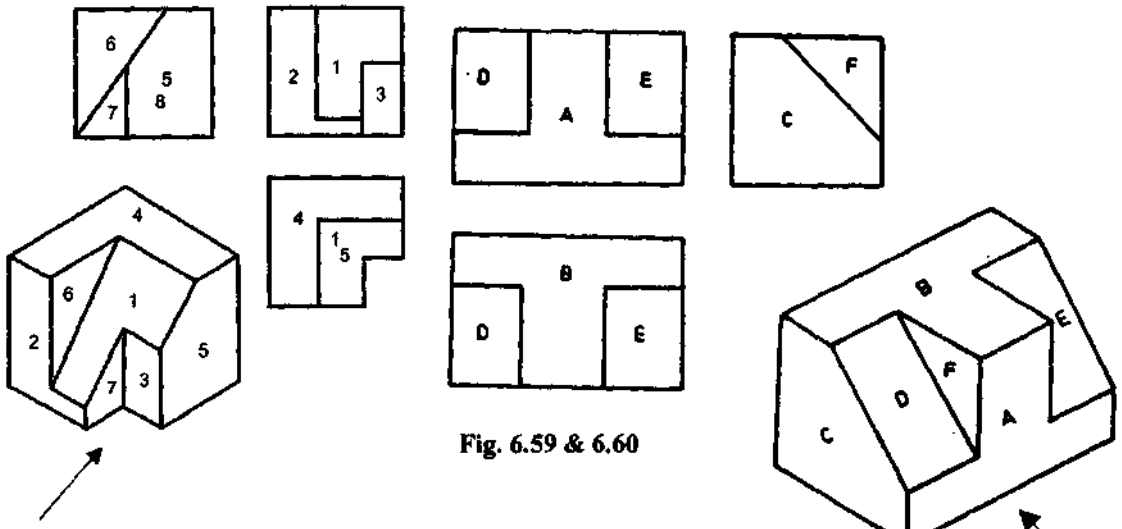


Fig. 6.59 & 6.60

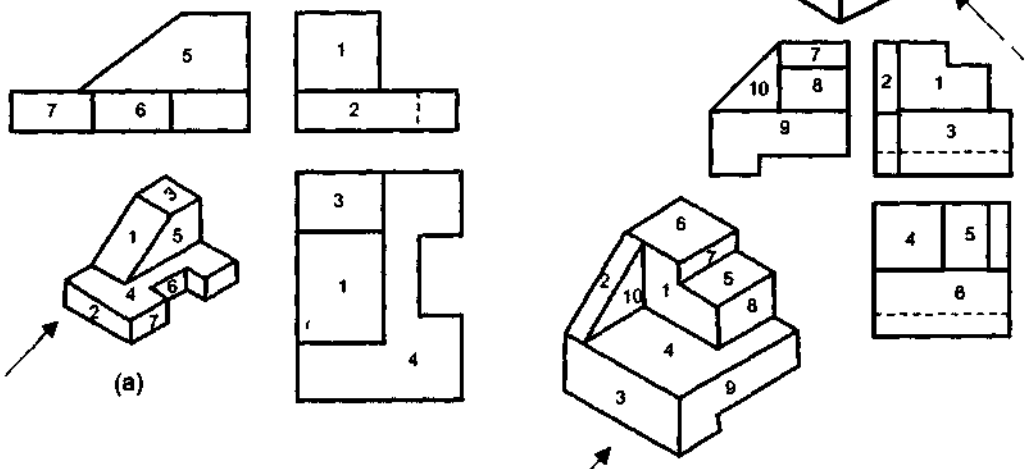


Fig. 6.61 & 6.62

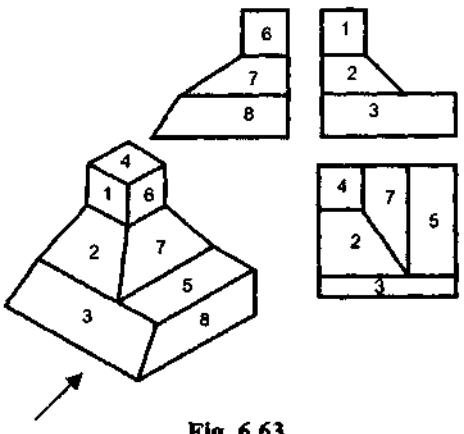


Fig. 6.63

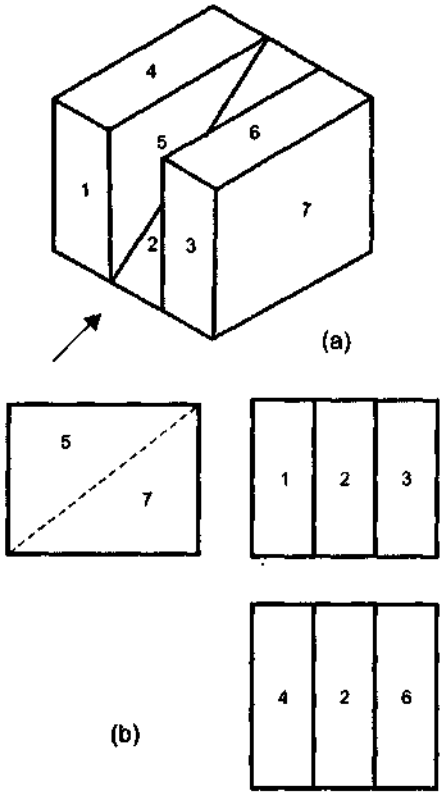


Fig. 6.64

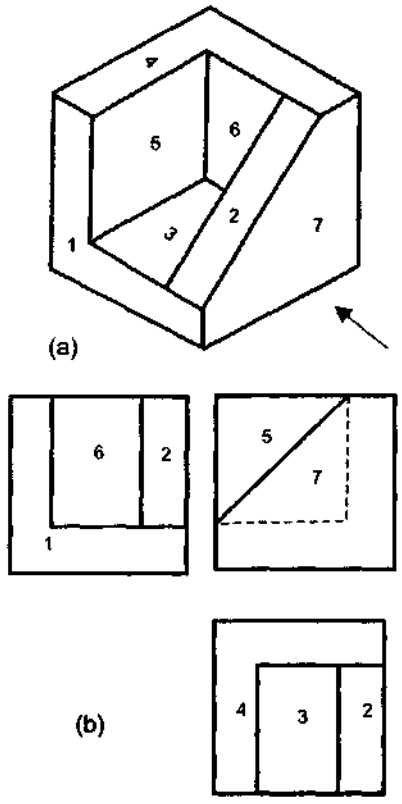
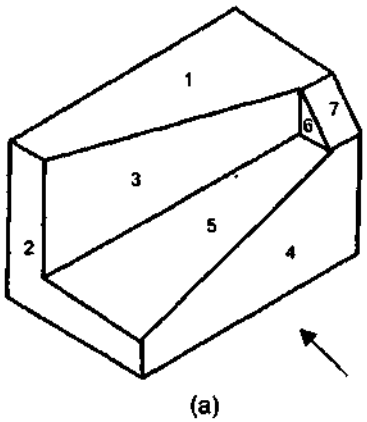


Fig. 6.65



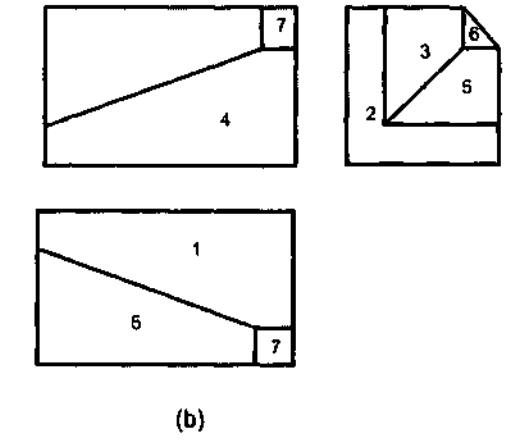


Fig. 6.66

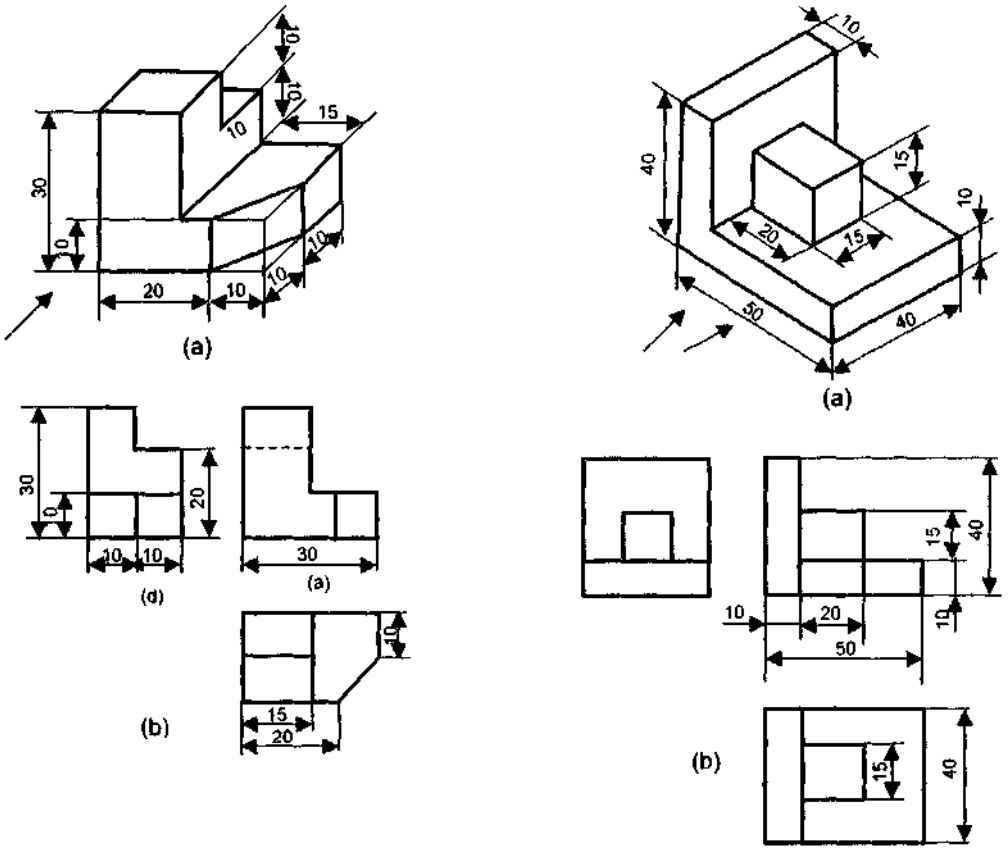


Fig. 6.67 & 6.68

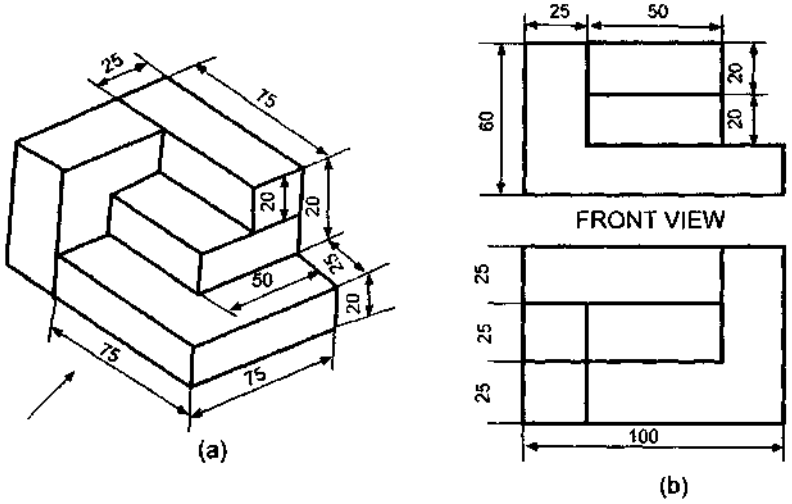
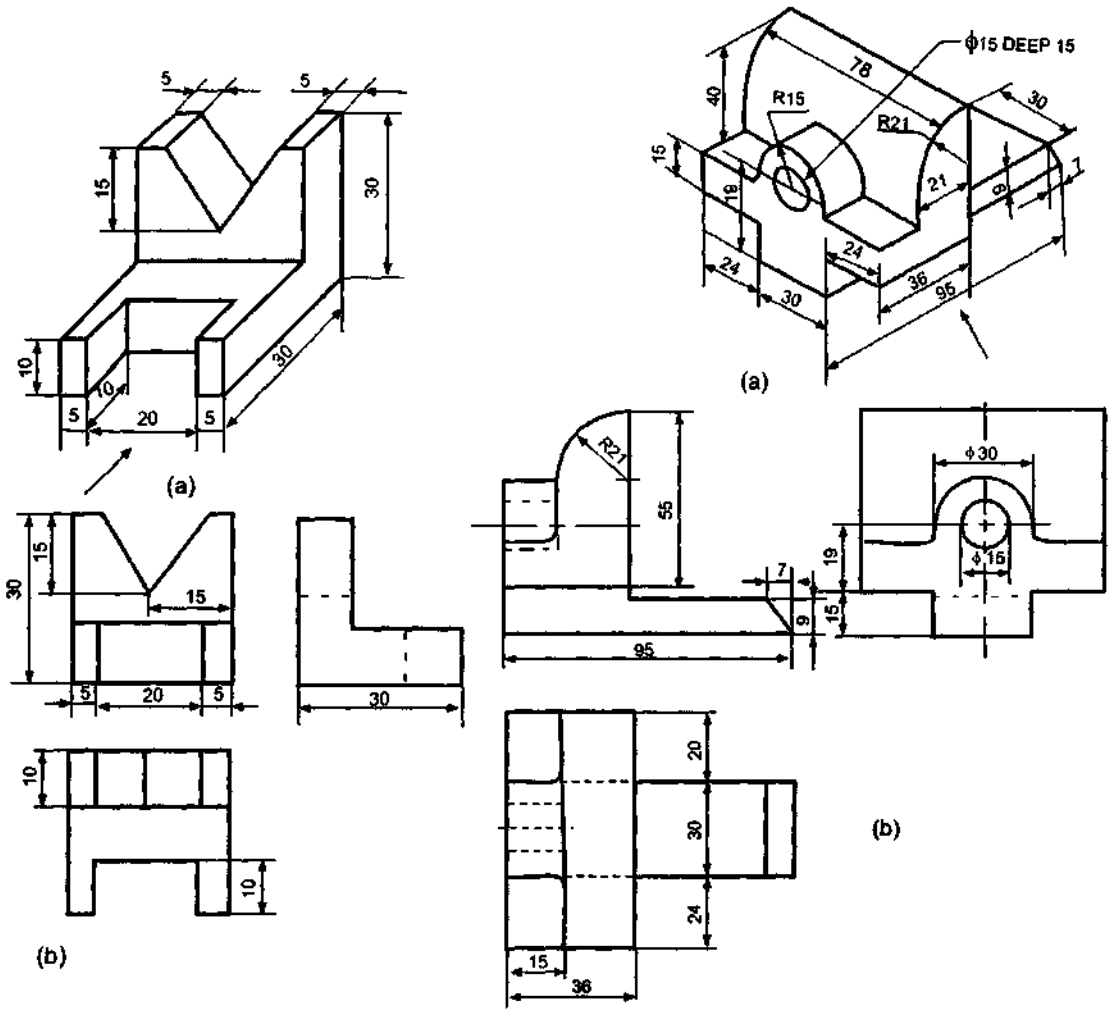


Fig. 6.69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(b)
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(a)
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ϕ16
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(b)

Fig. 6.70 & 6.71

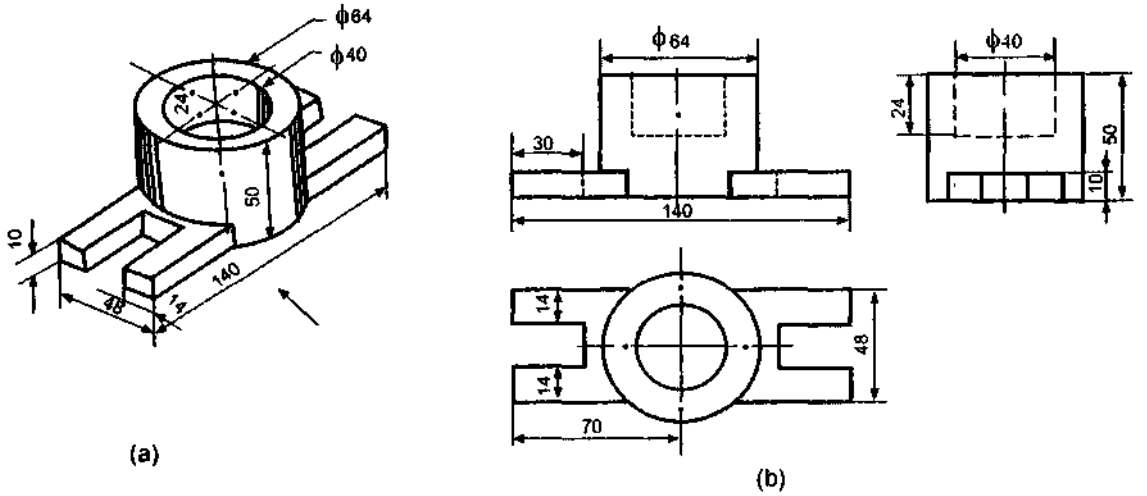

Fig. 6.72

Example 2

Figures 6.73 and 6.76 show the isometric views of cerstain objects A to H along with their orthographic views. Identify the front, top or side views of the objects and draw the third view.

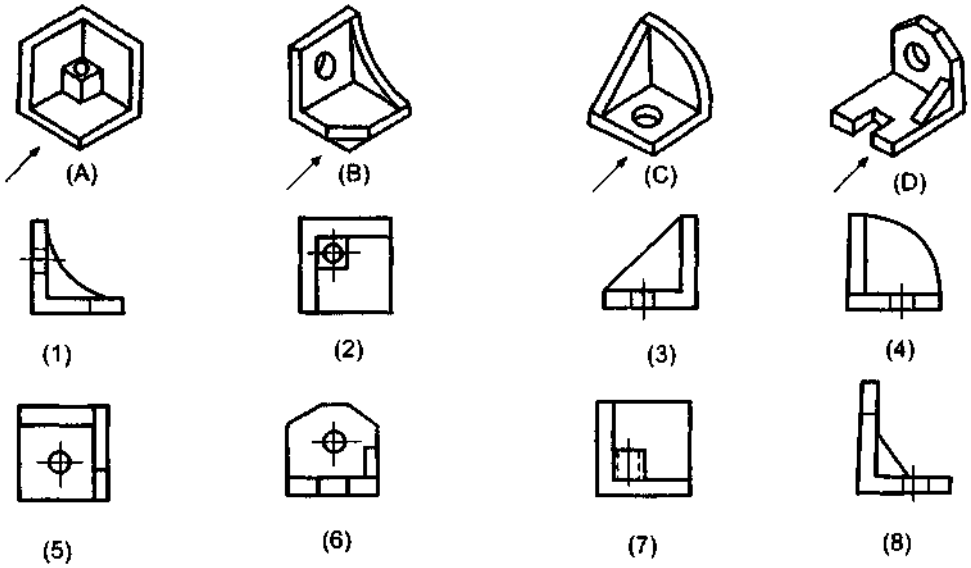

Fig. 6.73