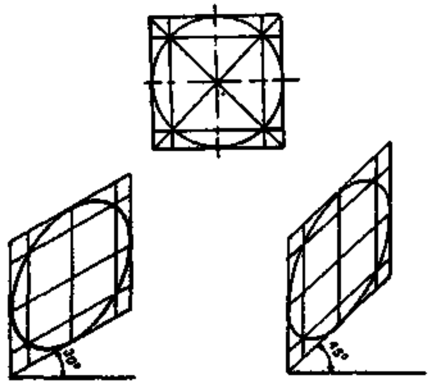


Fig. 10.4

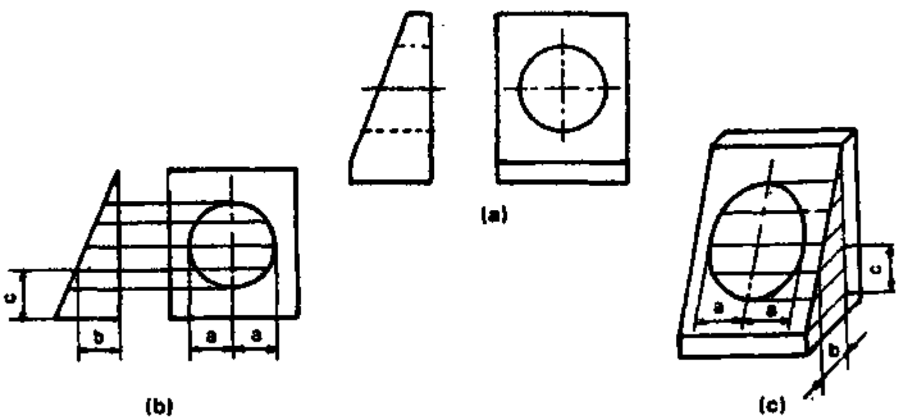


Fig. 10.5

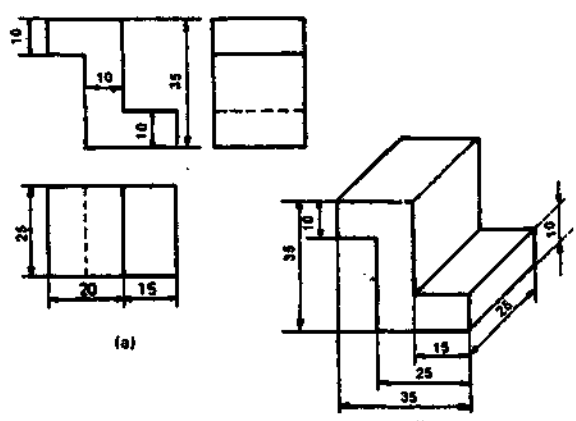


Fig. 10.6

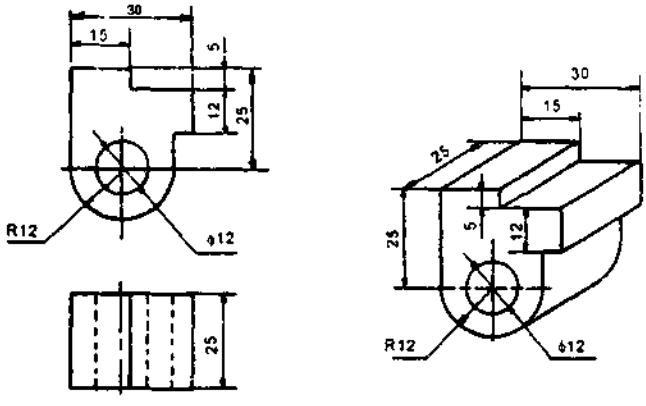


Fig. 10.7

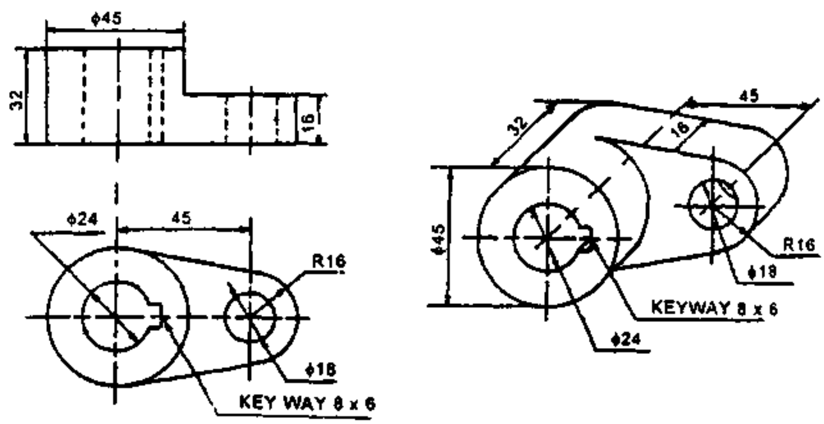


Fig. 10.8

10.5 Perspective Projection

Perspective projection is a method of graphic representation of an object on a single plane called picture plane as seen by an observer stationed at a particular position relative to the object. As the object is placed behind the picture plane and the observer is stationed in front of the picture plane, visual rays from the eye of the observer to the object are cut by the picture plane. The visual rays locate the position of the object on the picture plane. This type of projection is called perspective projection. This is also known as scenographic projection or convergent projection.

Method of preparing a perspective view differs from the various other methods of projections discussed earlier. Here, the projectors or visual rays intersect at a common point known as station point. A perspective projection of a street with posts holding lights, as viewed by an observer from a station point, is shown in Fig. 10.9. The observer sees the object through a transparent vertical plane called picture plane as shown in Fig.10.9(a). The view obtained on the picture plane is shown in Fig. 10.9(b). In this view, the true shape and size of the street will not be seen as the object is viewed from a station point to which the visual rays converge. This method of projection is theoretically very similar to the optical system in photography and is extensively employed by architects to show the appearance of a building or by artist-draftman in the preparation of illustrations of huge machinery or equipment.

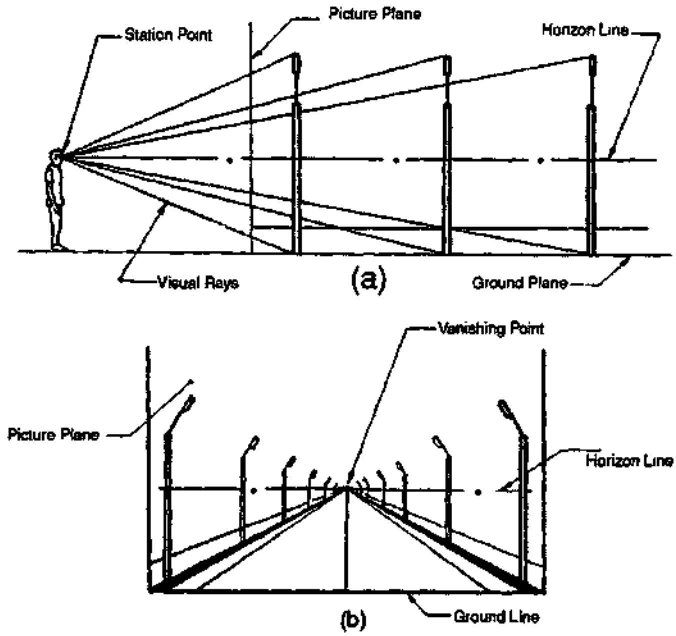


Fig. 10.9 Perspective view of a street

10.5.1 Nomenclature of Perspective Projection

The elements of perspective projection are shown in Fig. 10.10. The important terms used in the perspective projections are defined below.

1. Ground Plane (G.P.): This is the plane on which the object is assumed to be placed.
2. Auxiliary Ground Plane (A.G.P): This is any plane parallel to the ground plane (Not shown in Fig. 10.10)
3. Station Point (S.P.): This is the position of the observer's eye from where the object is viewed.
4. Picture Plane (P.P.): This is the transparent vertical plane positioned in between the station point and the object to be viewed. Perspective view is formed on this vertical plane.
5. Ground Line (G.L.): This is the line of intersection of the picture plane with the ground plane.
6. Auxiliary Ground Line (A.G.L.): This is the line of intersection of the picture plane with the auxiliary ground plane.

7. Horizon Plane (H.P.): This is the imaginary horizontal plane perpendicular to the picture plane and passing through the station point. This plane lies at the level of the observer.
8. Horizon Line (H.L.): This is the line of intersection of the horizon plane with the picture plane. This plane is parallel to the ground line.

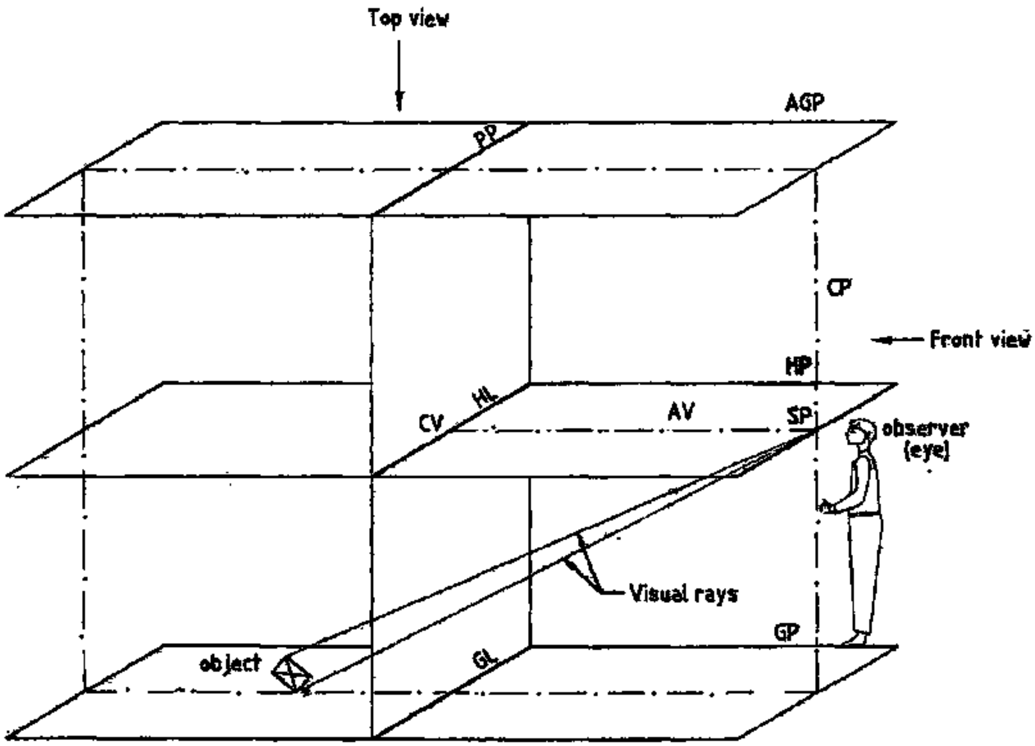


Fig. 10.10 Elements of perspective view

9. Axis of Vision (A.V.): This is the line drawn perpendicular to the picture plane and passing through the station point. The axis of vision is also called the line of sight or perpendicular axis.
10. Centre of Vision (C.V.): This is the point through which the axis of vision pierces the picture plane. This is also the point of intersection of horizon line with the axis of vision.
11. Central Plane (C.P.): This is the imaginary plane perpendicular to both the ground plane and the picture plane. It passes through the centre of vision and the station point while containing the axis of vision.
12. Visual Rays (V.R.): These are imaginary lines or projectors joining the station point to the various points on the object. These rays converge to a point.

10.5.2 Classification of perspective projections

Perspective projections can be broadly classified into three categories.

1. Parallel perspective or single point perspective.
2. Angular perspective or two point perspective.
3. Oblique perspective or three point perspective.

These perspective projections are based on the relative positions of the object with respect to the picture plane. All the three types of perspectives are shown in Fig. 10.11.

Parallel perspective or single point perspective

If the principal face of the object viewed, is parallel to the picture plane, the perspective view formed is called parallel perspective. Such a perspective view is shown in Fig. 10.11(a). In parallel perspective views, the horizontal lines receding the object converge to a single point called vanishing point (V.P.). But the vertical and horizontal lines on the principal face and the other faces of the object, do not converge, if these lines are parallel to the picture plane. Because the lines on the faces parallel to the picture plane do not converge to a point and the horizontal lines receding the object converge to a single vanishing point, the perspective projection obtained is called parallel or single point perspective. Single point perspective projection is generally used to present the interior details of a room, interior features of various components, etc.

Angular perspective or two-point perspective

If the two principal faces of the object viewed are inclined to the picture plane, the perspective view formed is called angular perspective. Such a perspective is shown in Fig. 10.11(b). In angular perspective views, all the horizontal lines converge to two different points called vanishing point left (V.P.L.) and vanishing point right (V.P.R.). But the vertical lines remain vertical. Because the two principal faces are inclined to picture plane and all the horizontal lines on the object converge to two different vanishing points, the perspective view obtained is called angular or two point perspective. Two point perspective projection is the most generally used to present the pictorial views of long and wide objects like buildings, structures, machines, etc.

Oblique perspective or three point perspective

If all the three mutually perpendicular principal faces of the object viewed, are inclined to the picture plane, the perspective view formed is called oblique perspective. Such a perspective view is shown in Fig. 10.11(c). In oblique perspective views, all the horizontal lines converge to two different points called vanishing point left (V.P.L.) and vanishing point right (V.P.R.) and all the vertical lines converge to a third vanishing point located either above or below the horizon line. Because all the three principal faces are inclined to the picture plane and all the horizontal and the vertical lines on the object converge to three different vanishing points, the perspective view obtained is called oblique or three point perspective.

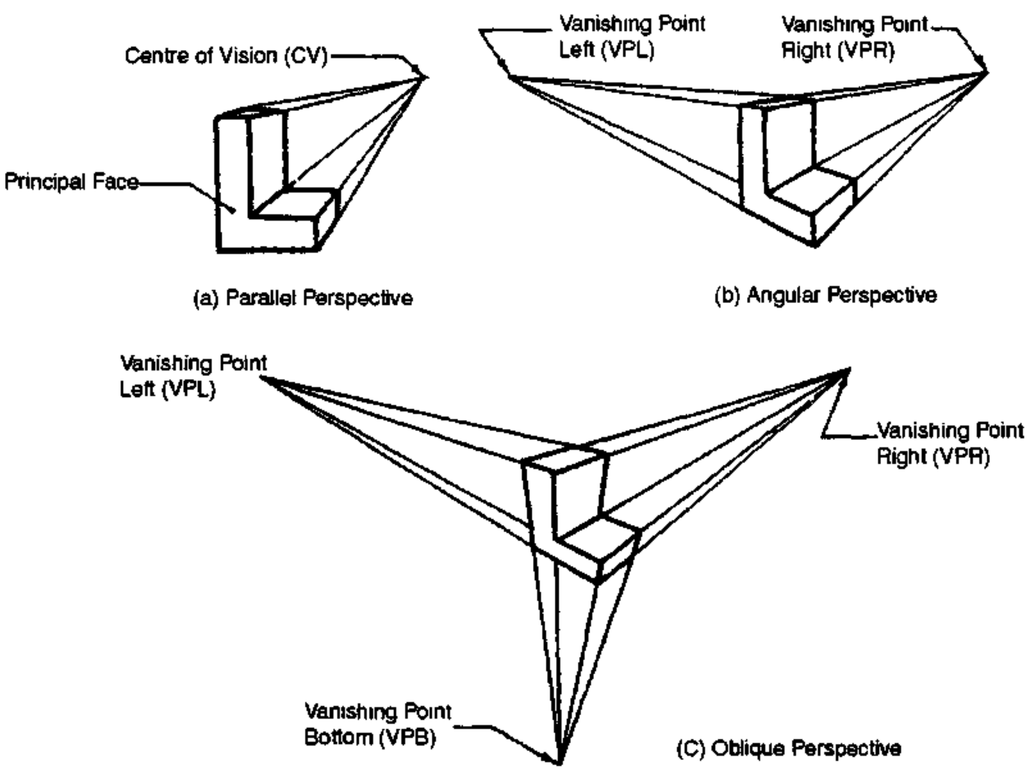


Fig. 10.11 Classification of perspective projections

Three point perspective projection may be used to draw pictorial views of huge and tall objects like tall buildings, towers, structures, etc. If the station point is near by the ground plane, the vertical lines will vanish at a point above the horizon line. If the station point is located above the object, all the vertical lines will vanish at a point below the horizon line. Oblique perspective projection is seldom used in practice.

Orthographic Representation of Perspective Elements

Figure. 10.12 shows orthographic views of the perspective elements in Third Angle Projection.

Top View: GP, HP and AGP will be rectangles, but are not shown. PP is seen as a horizontal line. Object is above PP. Top view SP of station point is below PP. Top view of center of vision is CV Line CV-SP represents the Perpendicular Axis CP

Front View: It shows GL and HL representing GP and HP respectively. CV, SP coincide each other on HL.CP is seen as a vertical line through SP^1. PP will be seen as a rectangle, but is not shown.

Perspective projection, when drawn, will be seen above / around GL. Mark any convenient distance between PP and GL, i.e., greater than (x + y) as shown.

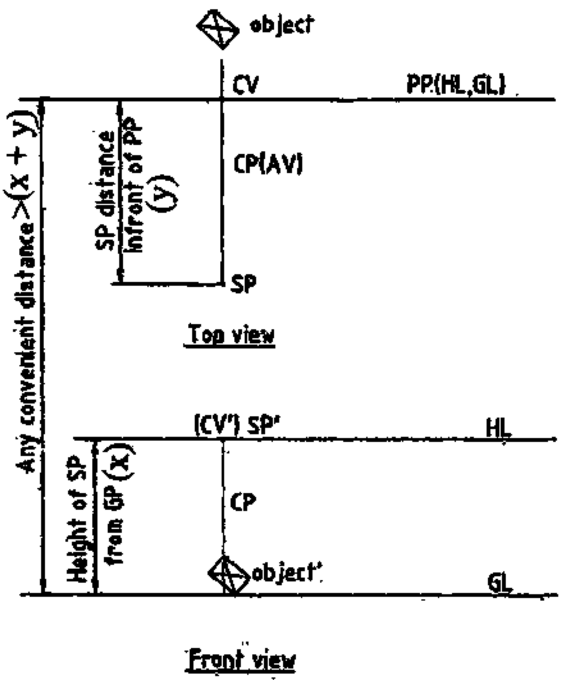


Fig. 10.12 Orthographic representation

10.5.3 Methods of Perspective Projection

Visual Ray Method

In this method, points on the perspective projection are obtained by drawing visual rays from SP to both top view and either front view or side view of the object. Top and side views are drawn in Third Angle Projection.

Perspective projection of a line is drawn by first marking the perspective projection of its ends (which are points) and then joining them. Perspective projection of a solid is drawn by first obtaining the perspective projection of each corner and then joining them in correct sequence.

Vanishing Point Method

Vanishing Point: It is an imaginary point infinite distance away from the station point. The point at which the visual ray from the eye to that infinitely distant vanishing point pierces the picture plane is termed as the Vanishing Point.

When the observer views an object, all its parallel edges converge to one/two/three points depending on the locations of the object and the observer.

Perspective Projection of Points

Problem 1: (Fig. 10.13)

Draw the perspective projection of a point. A situated 20 mm behind the picture plane and 15 mm above the ground plane. The station point is 30 mm in front of the picture plane, 40 mm above the ground plane and lies in a central plane which is 35 mm to the left of the given pint.

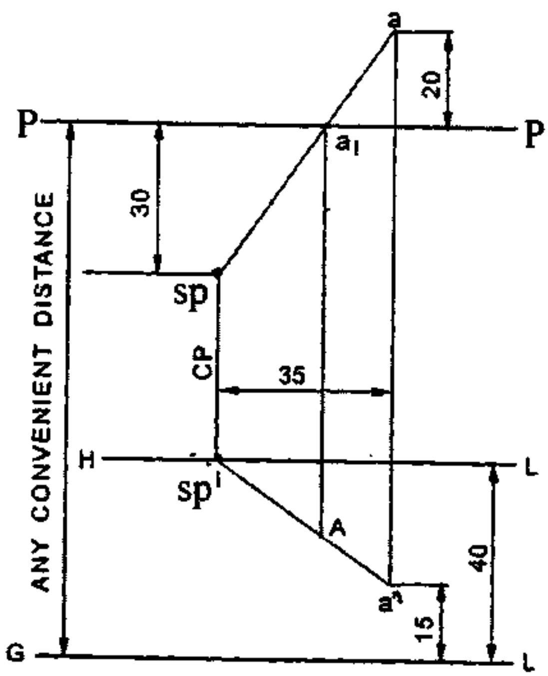


Fig. 10.13

Visual Ray Method

Top view

1. Draw a horizontal line pp to represent the top view of the picture plane.
2. The point A is 20 mm behind PP. Hence mark a 20 mm above PP.
3. Station point SP lies in a central plane CP which is 35 mm to the left of point A. Therefore, draw a vertical line to represent the top of CP at 35 mm to the left of a.
4. SP is 30 mm in front of PP. Therefore on CP, mark sp 30mm below PP.
5. Join a and sp to represent the top view of the visual ray. It pierces the PP at A,

Front view

6. Draw a horizontal line GL at any convenient distance below PP to represent the ground line.
7. To avoid over lap of visual rays and get a clear perspective, select GL such that HL lies below sp^1

8. sp^1 is 40 mm above GP. Therefore draw HL 40 mm above GL.
9. Further CP also represents front view of the CP. Hence mark sp^1 at the intersection of CP with HL.
10. Join a^1 sp^1, the front view of the visual ray.
11. From the piercing point a_1 erect vertical to intersect a^1 sp^1 point A, which is the required perspective projection.

Perspective Projection of Straight Lines

In Visual Ray Method, perspective projection of a straight line is drawn by first marking the perspectives of its end points and then joining them.

Problem 2: (Fig 10.14)

Draw the perspective projection of a straight line AB, 60mm long, parallel to and 10 mm above the ground plane and inclined at 45° to PP. The end A is 20 mm behind the picture plane. Station point is 35 mm in front of the picture plane and 45mm above the ground plane and lies in a central plane passing through the mid-point of AB.

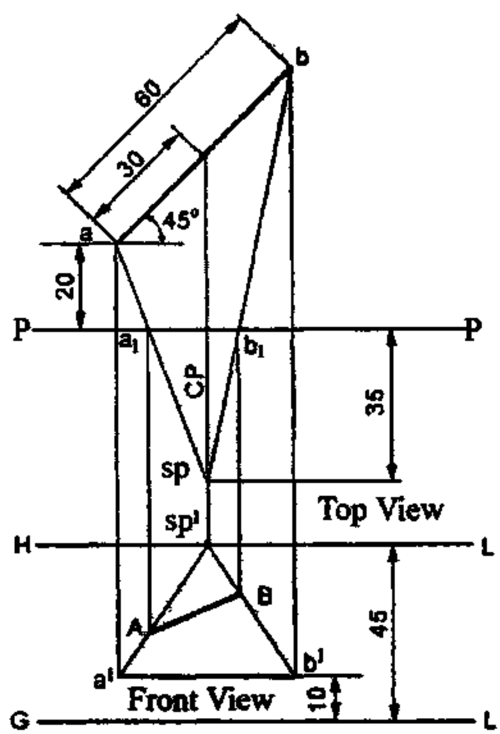


Fig. 10.14

Top View

1. Draw PP and mark a 20 mm above it.
2. Draw ab = 60 mm (True length of AB) inclined at 45° to PP
3. From the mid-point of ab erect a vertical line to represent the CP.
4. Along the central plane mark sp 35 mm below pp.
5. Join an and b with sp to represent the top view of the visual rays.
6. Mark the piercing points a and b on asp and bsp respectively.

Front View

7. Draw GL at any convenient distance below PP.
8. Draw a^1 b^1 parallel to and 10 mm above GL.
9. Draw HL 45 mm above GL.
10. Mark sp^1 at the intersection of CP & HL.
11. Join SP^1 with a^1 and b^1,
12. From a_1 and b_1 (piercing points) erect verticals to intersect sp^1 a^1 and sp^1 b^1 (the front view of the visual rays) at A and B respectively.
13. AB is the required perspective projection.

Perspective Projection of Plane Figures

Problem 3: (Fig. 10.15)

A square lamina of 30 mm side lies on the ground plane. One of its corners is touching the PP and edge is inclined at 60° to PP. The station point is 30 mm in front of PP, 45 mm above GP and lies in a central plane which is at a distance of 30 mm to the right of the corner touching the PP.

Draw the perspective projection of the lamina.

Visual Ray Method: (Fig. 10.15a)

Top View

1. Draw the top view of the lamina as a square of 30 mm side that the corner b is touching PP and the edge bc inclined at 60° to PP.
2. Draw CP, 30 mm from b on right side. Along CP mark sp 30 mm below PP.
3. Join sp with all the four corners of the square lamina in the top view.
4. Obtain the corresponding pierrcing points on PP.

Front View

5. Draw GL and obtain the front view of the lamına on it ($a^1d^1b^1c^1$).
6. Draw HL 45 mm above GL and obtain sp^1 on it.
7. Joint sp^1 with all the corners of the lamina in the front view.

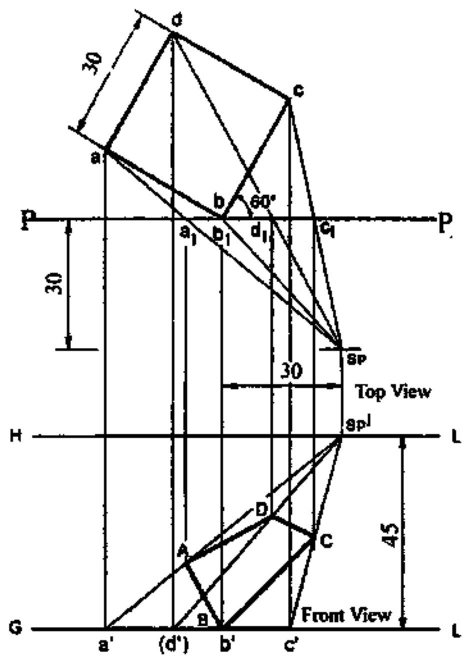


Fig. 10.15(a) Visual ray method

Perspective Projection

8. Since the corner b touches the picture plane, its perspective will be in its true position.
9. Since the lamina lies on the ground plane, b^1 is on GL and is also the perspective projection of B.
10. From a_1 draw vertical to intersect a^1 sp^1 at A.
11. Similarly obtain B, C and D.
12. Joint ABCD and complete the perspective projection.

Vanishing Point Method (Fig. 10.15b)

1. Draw the top view as explanted in Steps 1 to 4 in the above method.
2. Draw GL and HL as shown.

Vanishing Points

3. From sp draw a line parallel to bc to intersect PP at VR
4. Erect vertical from VR to intersect HL at vanishing point VR^1
5. Similarly from sp draw a line parallel to ba to cut PP at VL.
6. Erect vertical from VL and obtain the other vanishing point VL^1 on HL.

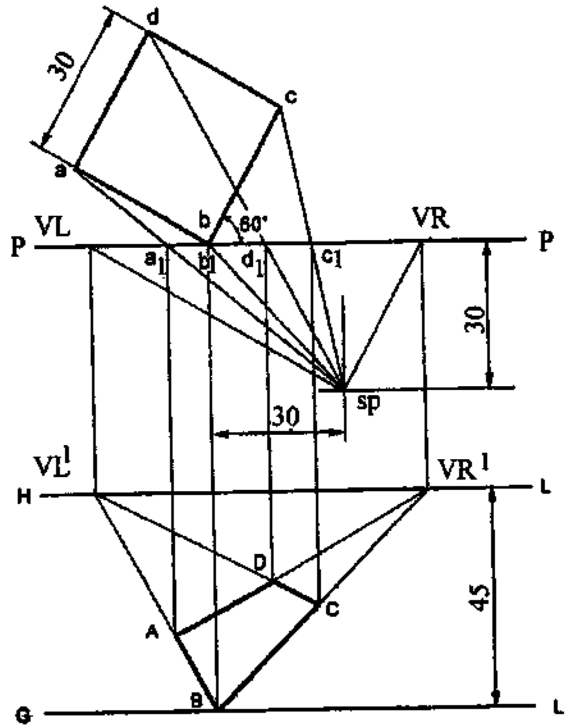


Fig. 10.15 (b) Vanshing point method

Perspective Projection

7. Since b touches PP, draw a vertical line from b and obtain B on GL.
8. Join B with VR^1 and VL^1

Note: The perspective projection of any point lying on bc will be on BVR^1 and any point on ba will be on BVL^1.

9. Hence from c_1 erect a vertical line to intersect BVR^1 at C.
10. Similarly from a_1 erect a vertical line and obtain A on BVL^1.
11. Joint A with VR^1.
12. Since ad is parallel to bc, the perspective projection of any point lying on ad will lie on AVR^1. Therefore from d_1 erect a vertical to meet AVR^1 at D.
13. Note that when C and VL^1 are joined, D will also lie on CVL^1.
14. Joint ABCD and complete the perspective.

Problem 4: (Figure 10.16)

A pentagonal lamina of 40 mm side lies on the ground. The corner which is nearest to PP is 15 mm behind it and an edge containing that corner is making 45° with PP. The station point *is 40 mm in front of PP, 50 mm above GP and lies in a central plane which is at a distance of 70 mm to the left of the corner nearest to the PP.*

Draw the perspective projection of the lamina.

Perspective projection is drawn by Visual Ray Method using top and front views

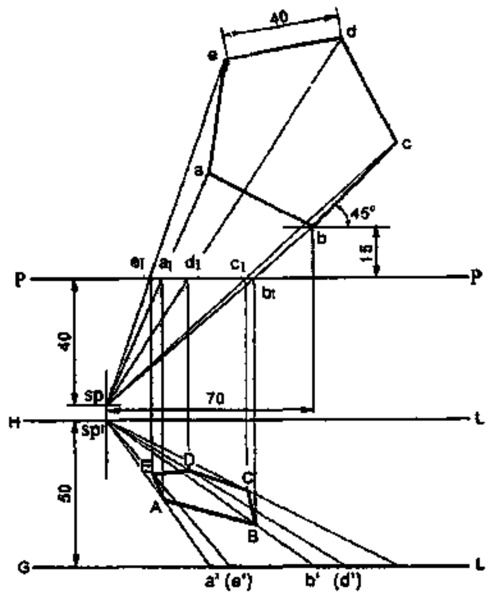


Fig. 10.16 Visual ray method

Perspective Projection of Solds

Problem 5: (Fig 10.17)

A square prism, side of base 40 mm and height 60 mm rests with its base on the ground such that one of its rectangular faces is parallel to and 10 mm behind the picture plane. The station point is 30 mm in front of PP, 88 mm above the ground plane and lies in a central plane 45 mm to the right of the centre of the prism.

Draw the perspective projection of the square prism.

Visual Ray Method (Fig. 10.17)

Top View

1. Draw the top view of the prism as a square of side 40 mm such that ab is parallel to and 10 mm above PP.
2. Locate sp and draw the top view of the visual rays.
3. Mark the piercing points.

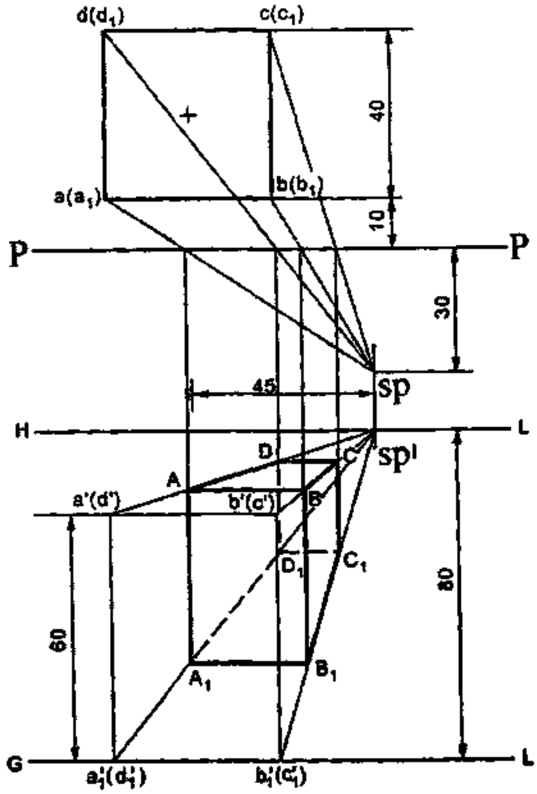


Fig. 10.17 Visual ray method

Front View

4. Draw front view of the prism for given position.
5. Locate sp' and draw front view of the visual rays.
6. From piercing points erect vertical lines to cut the corresponding visual rays in the front view. Thus obtain all corners in the perspective projection.

To mark the visible and invisible edges in the perspective

7. Draw the boundary lines as thick lines.
8. The faces ab (b_1) (a_1) and bc (c_1) (b_1) are nearer to s and visible. Hence draw BB_1, BA and BC as thick lines.
9. Edge d(d_1) is farther away from sp. Hence draw DD_1, D_1A_1 and D_1C_1 as dashed lines.

Problem 6 : *A square prism 30 mm side and 50 mm long is lying on the ground plane on one of its rectangular faces in such a way that one of its square faces is parallel to 10mm behind the picture plane. The station point is located 50 mm in front of the picture plane and 40mm above the ground plane. The central plane is 45mm away from the axis of the prism towards the left. Draw the perspective view of the prism.*

The perspective view shown in Fig. 10.18 is developed from the top and front views.

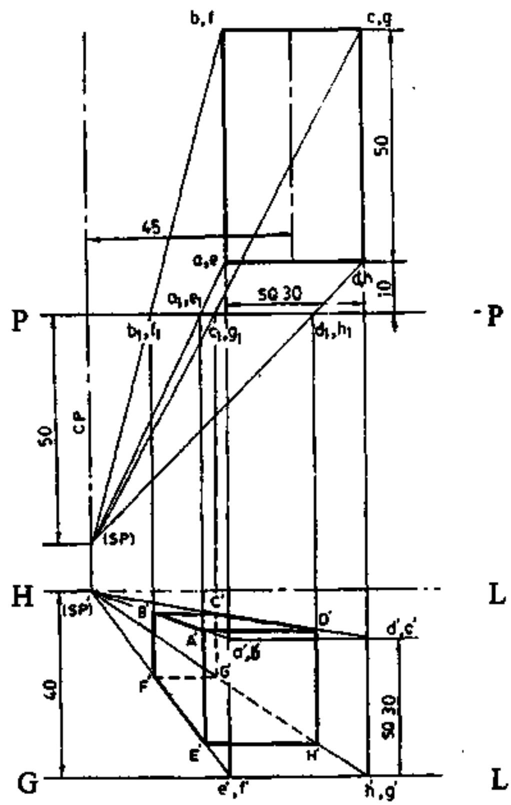


Fig. 10.18 Visual ray method of parallel perspective (from the top and front views)

1. Draw the top view of the picture plane (P.P.) and mark the ground line (G.L.) at a convenient distance from the line P.P. Draw the horizon line (H.L.) at a distance of 40mm above the G.L.
2. Draw the top view of the square prism keeping the face adhe parallel to and 10mm behind the P.P. Mark the central plane (C.P.) 45 mm away from the asix of the prism towards the left side. Locate the top view of the station point (S.P.) at a distance of 50mm infornt of the P.P. and on C.P. Also mark the front view of the station point (S.P.) on the H.L.
3. Draw visual rays from (S.P.) to the various corners of the top view of the prism, piercing the P.P. at a_1, b_1, c_1, etc
4. Draw the front view of the prism a`d`h`e` on the G.L. and visual rays (V.R.) from (S.P.)` to all corners of the front view.
5. Draw vertical lines from the points a1,b1,c1, etc. to intersect the corresponding visual rays drawn from a`,b`,c`, etc. from the front view to get the points A`B`C`, etc. Join the points to get the required perspective.

Note: If the hidden edges are to be shown, they should be represented by short dashes. In the figure, F'G', C'G' and G'H' are hidden. If square faces of an object are parallel to P.P., in the perspective view these square faces will also be square but of reduced dimensions.

Problem 7: (Fig. 10.18)

A square pyramid of base edge 40 mm and altitude 50 mm, rests with its base on the ground plane such that all the edges of the base are equally inclined to the PP. One of the corners of the base is touching the PP. The station point is 60 mm in front of the PP, 80 mm above the ground plane and lies in a central plane which passes through the axis of the pyramid.

Draw the perspective projection.

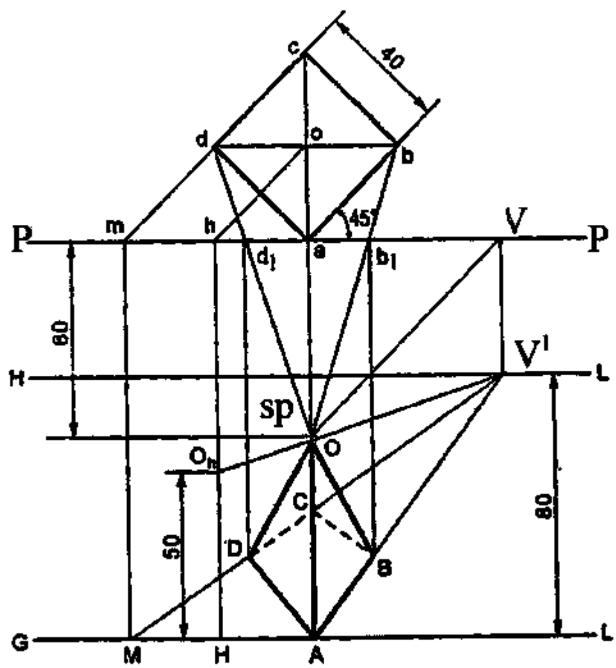


Fig. 10.18 Vanishing point method

Vanishing Point Method

1. Draw the top view of the square pyramid and the visual rays.
2. From sp draw a line parallel to ab.
3. Obtain the vanishing point V on HL.

To obtain the perspective projection

4. Corner A is touching the PP and on the ground. Hence erect a vertical line from a and mark the perspective of A on GL.
5. Join A with V.

6. As edge AB is on the ground, obtain the perspective of B on AV.
7. To obtain the perspective of D of C extend cd to meet PP at m.
8. Draw the measuring line Mm.
9. Since the edge DC is on the ground, joint M with V.
10. Obtain the perspective of D and C on this line MV.
11. To mark the perspective of apex O, draw a line parallel to ab and passing through o to meet the picture plane at h.
12. Draw another measuring line Hh.
13. On this line mark the height of the apex as OhH=50 mm.
14. Join Oh with V.
15. Obtain the perspective of O on this line.
16. Then complete the perspective as shown.

Problem 8: Figure 10.19(a) gives an isometric view of an object. Draw its parallel perspective following the visual ray method. The object is viewed from a point at a distance of 70mm from the front face F which is on the picture plane. Also, the viewing point is 40 mm above the plane on which the object is placed and the central plane is located at a distance of 80mm towards the right side of the object.

Solution: (Fig 10.19)

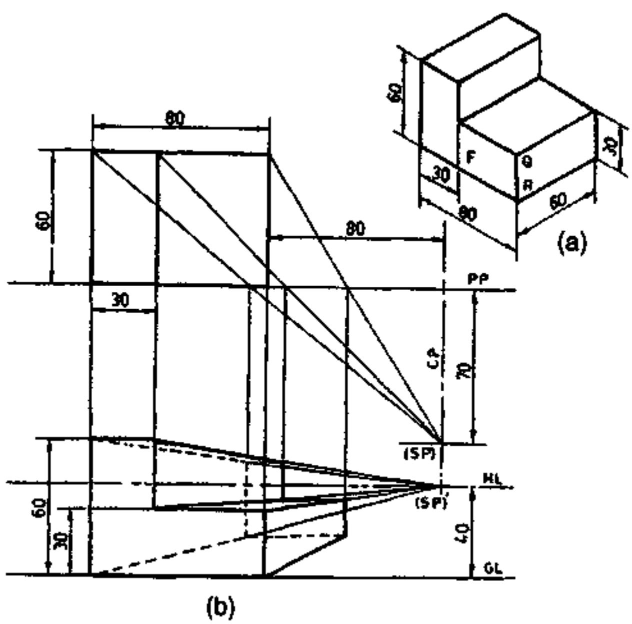


Fig. 10.19 Visual ray method of parallel perspective (from top and front views)

As the face F is on the P.P., the front view and perspective view of the face F will coincide. Following the procedure explained in the problem 6 the perspective views of the object is drawn and it is shown in Fig. 10.19.

Problem : 9

Fig. 10.20(a) shows isometric view of an object. Draw the angular perspective of it when the object is resting on the ground plane keeping the face F inclined 30° to and the edge QR 20mm behind the picture plane. The station point is 120 mm in front of the picture plane, 80mm above the ground plane and lies in the central plane which passes through the edge QR.

Solution: (Fig 10.20)

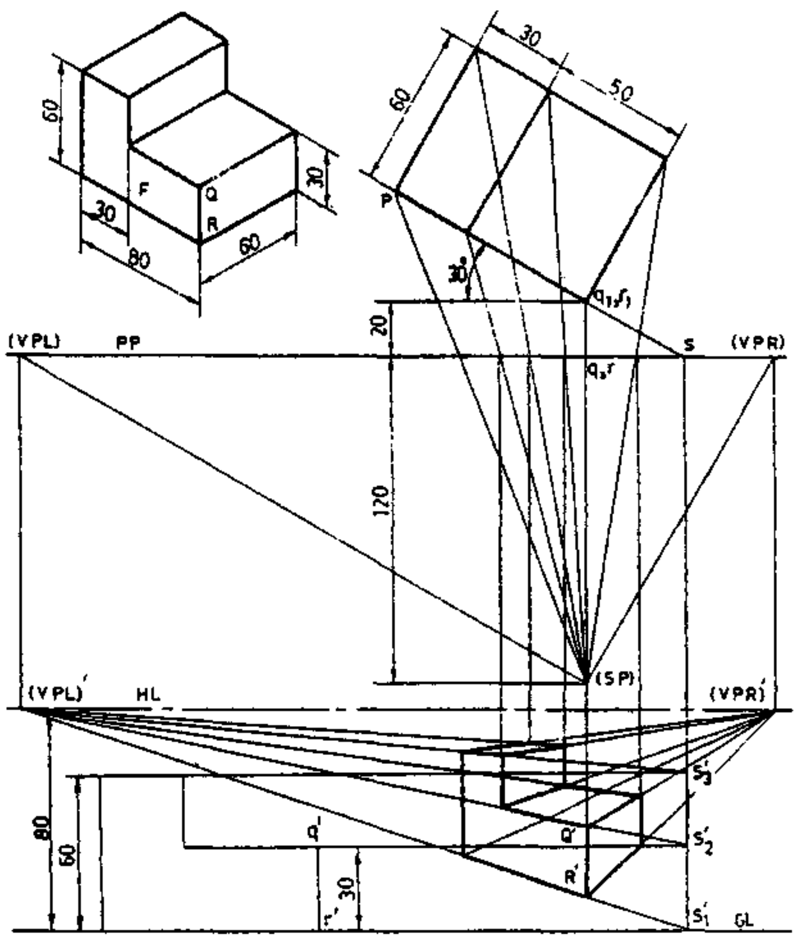


Fig. 10.20 Vanishing point method of angular perspective.

EXERCISES

1. A point P is situated 15 mm behind the picture plane and 10 mm above the ground plane. The station point is 25 mm in front of the picture plane, 20 mm above the ground plane and lies in a central plane 10 mm to the right of the point. Draw the perspective projection of the point P.
2. A straight line AB 60 mm long haw has its end A 15 mm above GP and 25 mm behind PP. It is kept inclined 35^0 to PP and parallel to GP. The station point in 70 mm in front of PP and 50 mm above GP and lies in the central plane which passes through the mid point of the line AB. Draw the perspective projection of the line.
3. Draw the top view of the object, station point (S.P.) and the vanishing points (V.P.R.) and (V.P.L.) on the picture plane (P.P.) Draw the ground line (G.L.) and the horizon line (H.L.) Mark the front views of the vanishing points (V.P.R.) and (V.P.L.) on H.L. as shown in Fig. 10.15.
4. As the object is placed behind P.P., in the perspective view no edge of the object will have true size. To obtain the reduced size, extend the plane containing any one of the principal faces to the P.P. In the top view, the face F is represented by the line pq. Extend pq to intersect the P.P. at s, the piercing point. Draw a vertical line from s to meet the G.L. at $s^l{}_t$. Mark true height of the object on this line.

   Points showing the true heights can be easily located by drawing horizontals from the front view drawn at a convenient place on G.L.
5. Join $s^l{}_1$ and $s^l{}_2$ with (V.P.L.)' Draw a vertical from q_1 to intersect the above lines at R^l and Q^l respectively. The line R'Q' represents the perspective view of the vertical edge QR. Proceed further as explained in the Figure 10.11 to obtain the required angular perspective view of the object.
6. A square lamina of 30 mm side rests on one of its sides on the ground touching the picture plane. The station point is 40 mm above the ground plane, 30 mm in front of picture plane and lies in a central plane 20 mm to the right of the center of the square. Draw the perspective projection of the square.
7. A circular lamina of diameters 50 mm in lying on the ground plane touching the picture plane. The station point is 50 mm above the ground plane, 60 mm in front the picture plane and contained in the central plane which passes at a distance of 40 mm from the central of the circle. Draw the perspective projection of the circle.
8. Draw the perspective projection of a rectangular block of 300 mm x 200 mm x 100 mm resting on a horizontal plane with one side of the rectangular plane making an angle 45^0 with VP. The observer is at a distance of 600 mm from the picture. Assume eye level as 100 mm.
9. A square prism of 30 cm side and 50 cm length is lying on the ground plane on one of its rectangular faces, in such a way that one of its square faces is parallel to an 10 cm behind the picture plane. The station point is located 60 cm in front of the picture plane and 40 cm above the ground plane. The central plane is 50 cm away from the axis of the prism towards the left. Draw the perspective projection of the prism.

10. A cube of edge 30 mm rests with one of the faces on the ground plane such that a vertical edge touches the picture plane. The vertical faces of the cube are equally inclined to the PP and behind it. A station point is 40 mm in front of the PP, 50 mm above the ground plane and lies in a central plane 15 mm to the right of the axis of the cube.Draw the perspective projection of the cube.
11. A rectangular pyramid, sides of base 55 mm x 20 mm and height 60 mm rests with its base on the ground plane such that one of the longer edges of the base is parallel to and 20 mm behind the picture plane. The station point is 40 mm in front of the picture plane, 60 mm above the ground plane and lies in a central plane which passes through the axis of the pyramid. Draw the perspective projection of the cube.

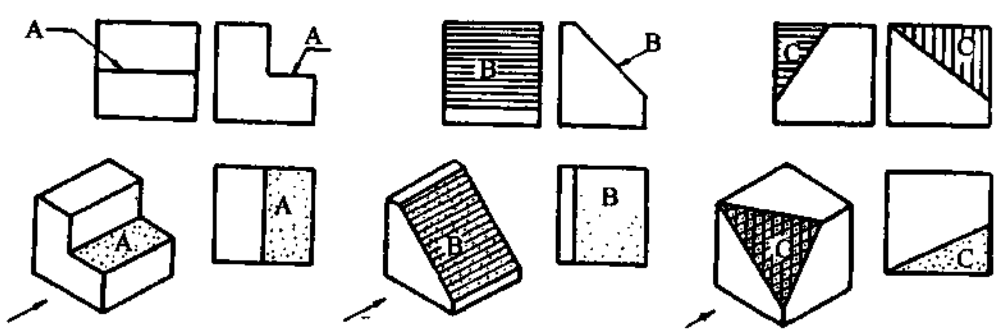
CHAPTER 11

Conversion of Isometric Views to Orthographic Views and Vice Versa

11.1 Introduction

The following principles of orthographic views are considered in making the above drawings :

1. In first angle projection; the **Front view** on the above and the **Top view** at the bottom are always in line vertically.
2. The **front view** and the **side view** are always in line horizontally.
3. Each view gives two dimensions; usually the front view gives lengh and height, top view gives length and width and side view gives hight and width.
4. When the surface is parallel to a plane its projection on that plane will show its true shape and size.
5. When the surface is inclined its projection will be foreshortened as shown.(Fig.11.1)



(a) - True Shaped Surface - A (b) - Foreshortened Surface - B (c) - Oblique Surface - C

Fig. 11.1 Representation of Surfaces

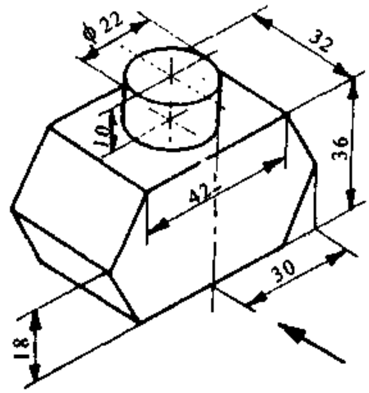
11.2 Selection of views

1. The number of orgthographic views required for clear description of the object is taken as the criteria to select the views. As far as possible least number of views are drawn.

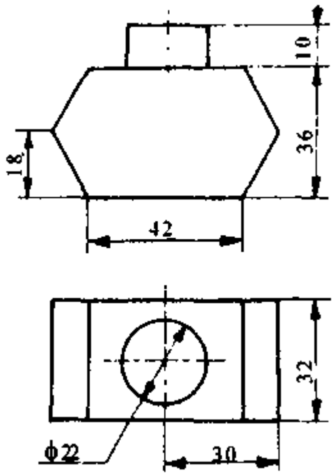
2. While selecting the views; the object is placed in such a way the number of hidden lines are kept to minimum.
3. Front view is drawn seeing the object in a direction is which its length is seen. It is also chosen such that the shape of the object is revealed. The direction of the view is indicated by arrows.

Examples

The isometric views of some objects and their orthographic views are shown from Figure 11.2 to Fig.11.15 in the following pages drawn as per the principles indicated above.

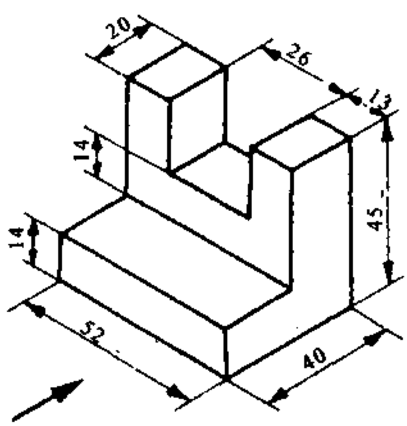


(a)

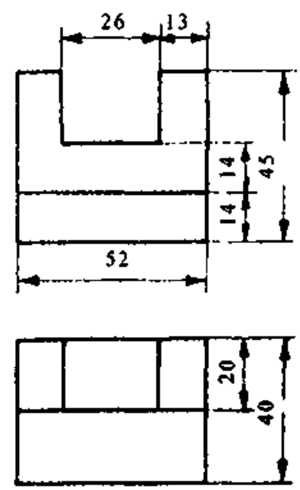


(b)

Fig. 11.2



(a)



(b)

Fig. 11.3

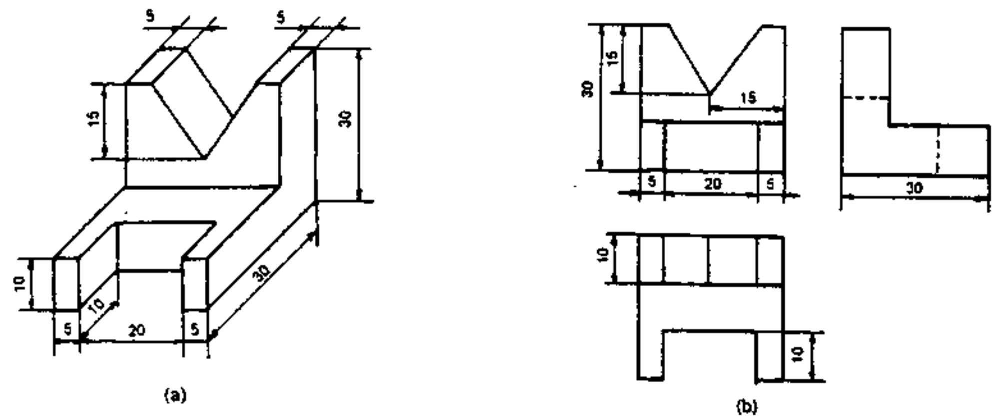


Fig. 11.4

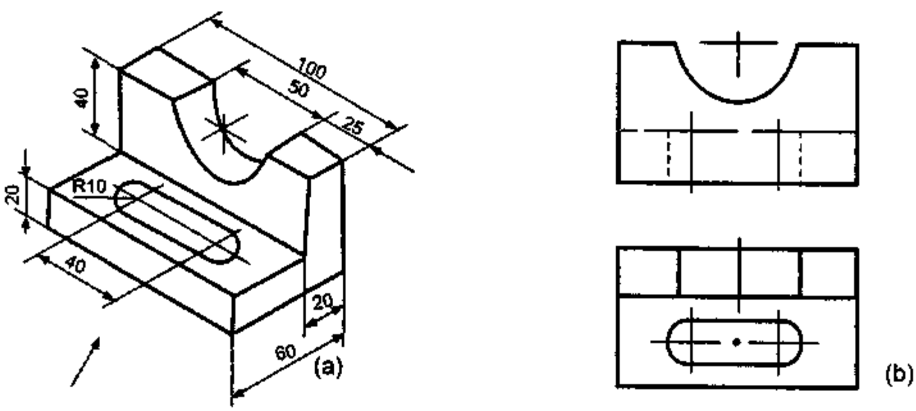


Fig. 11.5

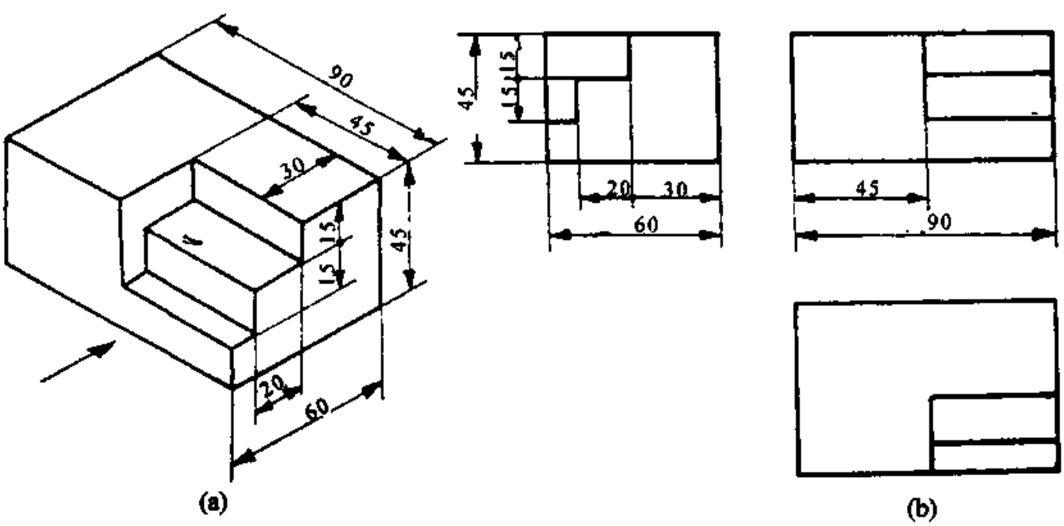
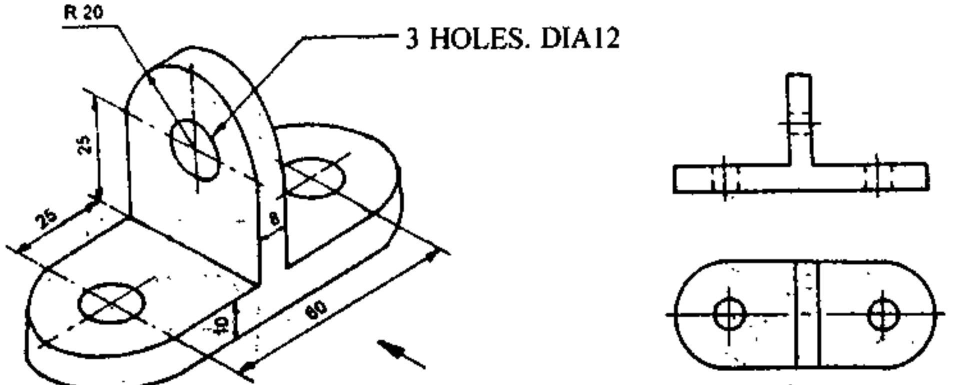
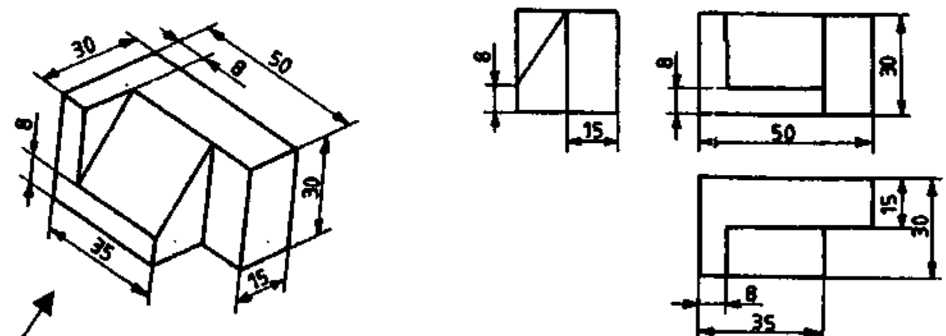


Fig. 11.6



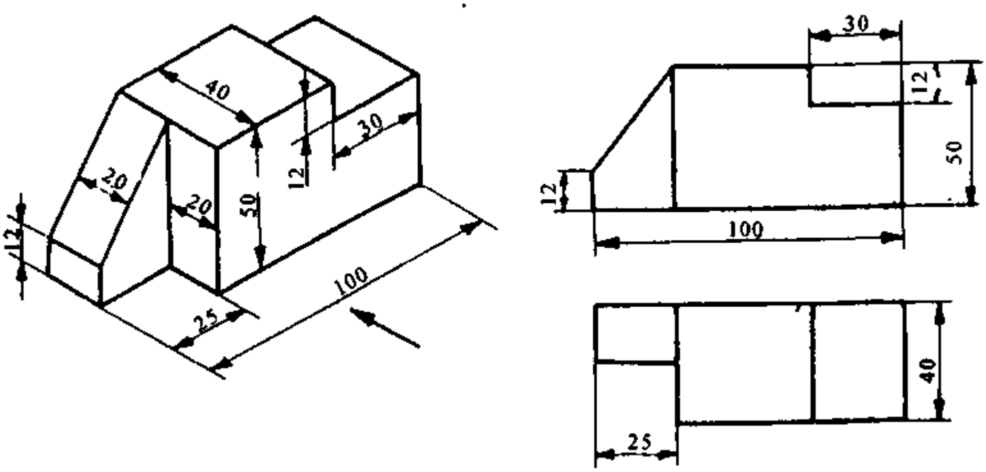
(a) (b)

Fig. 11.7



(a) (b)

Fig. 11.8



(a) (b)

Fig. 11.9

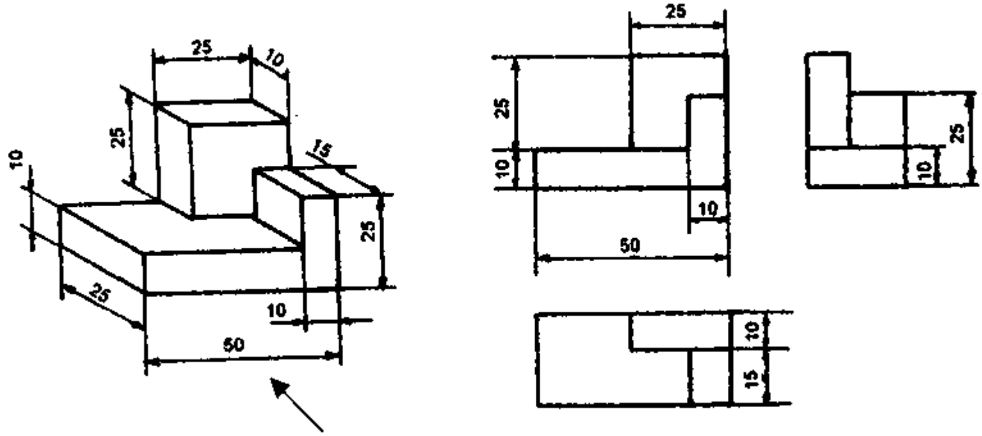


Fig. 11.10

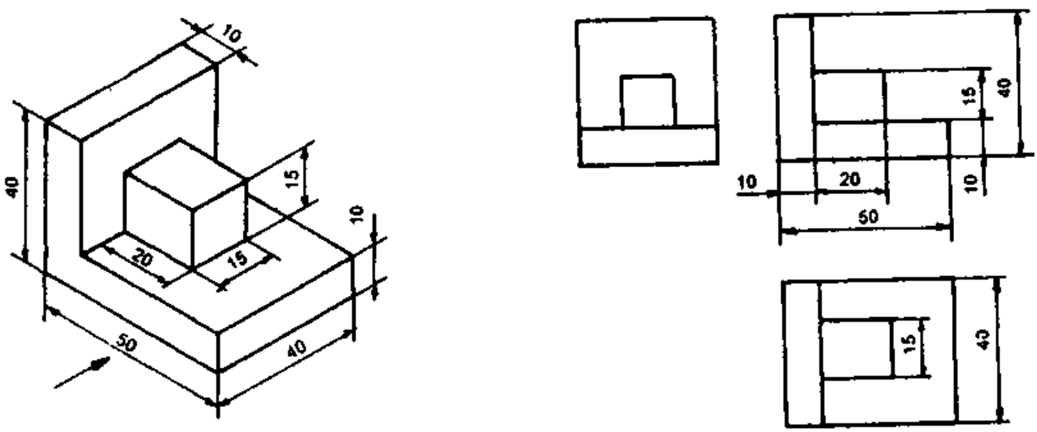


Fig. 11.11

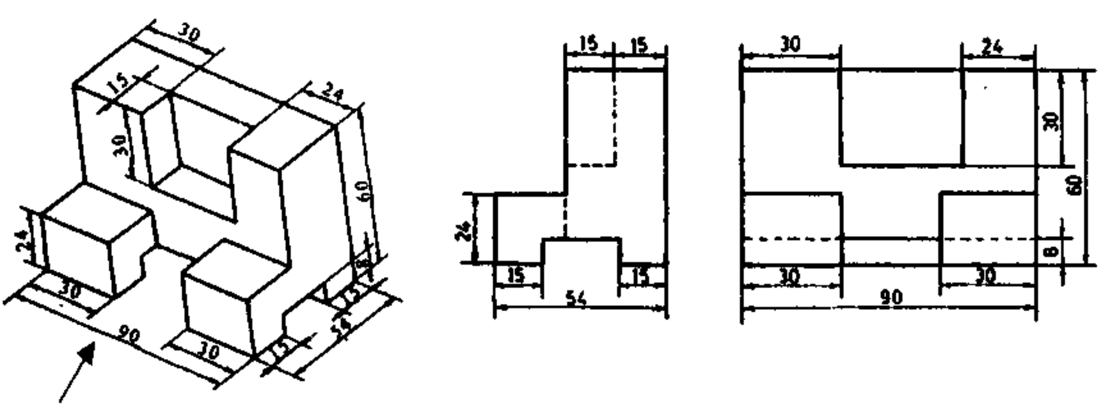


Fig. 11.12