SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE
www.sathyabama.ac.in

SCHOOL OF COMPUTING

SCHOOL OF BIO AND CHEMICAL ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

DEPARTMENT OF INFORMATION TECHNOLOGY

DEPARTMENT OF CHEMICAL ENGINEERING

DEPARTMENT OF BIOTECHNOLOGY

DEPARTMENT OF BIOMEDICAL ENGINEERING

UNIT – V - DEVELOPMENT OF SURFACES AND ORTHOGRAPHIC PROJECTION – SMEA1102

Development of surfaces

A layout of the complete surface of a three dimentional object on a plane is called the development of the surface or flat pattern of the object. The development of surfaces is very important in the fabrication of articles made of sheet metal.

The objects such as containers, boxes, boilers, hoppers, vessels, funnels, trays etc., are made of sheet metal by using the principle of development of surfaces.

In making the development of a surface, an opening of the surface should be determined fIrst. Every line used in making the development must represent the true length of the line (edge) on the object.

The steps to be followed for making objects, using sheet metal are given below:

1. Draw the orthographic views of the object to full size.
2. Draw the development on a sheet of paper.
3. Transfer the development to the sheet metal.
4. Cut the development from the sheet.
5. Form the shape of the object by bending.
6. Join the closing edges.

Methods of Development

The method to be followed for making the development of a solid depends upon the nature of its lateral surfaces. Based on the classillcation of solids, the folloiwing are the methods of development.

1. Parallel-line Development

It is used for developing prisms and single curved surfaces like cylinders in which all the edges / generators of lateral surfaces are parallel to each other.

2. Radial-line Development

It is employed for pyramids and single curved surfaces like cones in which the apex is taken as centre and the slant edge or generator (which are the true lengths)as radius for its development.

Development of Prism

To draw the development of a square prism of side of base 30mm and height 50mm.

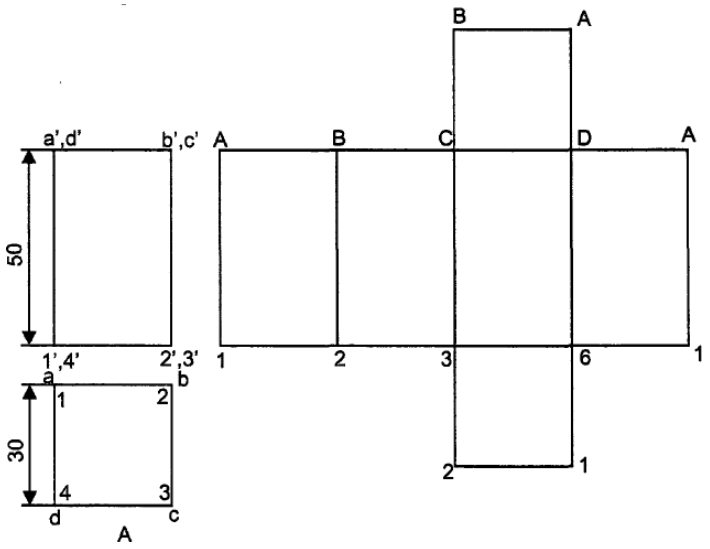


Figure 5.1

1. Assume the prism is resting on its base on H.P. with an edge of the base pallel to V.P and draw the orthographic views of the square prism.

2. Draw the stretch-out line 1-1 (equal in length to the circumference of the square prism) and mark off the sides of the base along this line in succesion ie 1-2,2-3,3-4 and 4-1.

3. Errect perpendiculars through 1,2,3 etc., and mark the edges (folding lines) I-A, 2-B, etc., equal to the height of the prism 50 mm.

4. Add the bottom and top bases 1234 and ABCD by the side of an)' of the base edges.

Development of a square pyramid with side of base 30 mm and height 60 mm.

Construction

1. Draw the views of the pyramid assuming that it is resting on H.P and with an edge of the base parallel to V.P.

2. Determine the true length o-a of the slant edge.

Note:

In the orientation given for the solid, all the slant edges are inclined to both H.P and V.P. Hence, neither the front view nor the top view provides the true length of the slant edge. To determine the true length of the slant edge, say OA, rotate oa till it is parallel to xy to the position.oal. Through a l ' draw a projector to meet the line xy at all' Then Oil all represents the true length of the slant edge OA. This method of determining the true length is also known as rotation

method.

3. with centre 0 and radius olal draw an arc.

4. Starting from A along the arc, mark the edges of the base ie. AB, BC, CD and DA.

5. Join 0 to A,B,C, etc., representaing the lines of folding and thus completing the development.

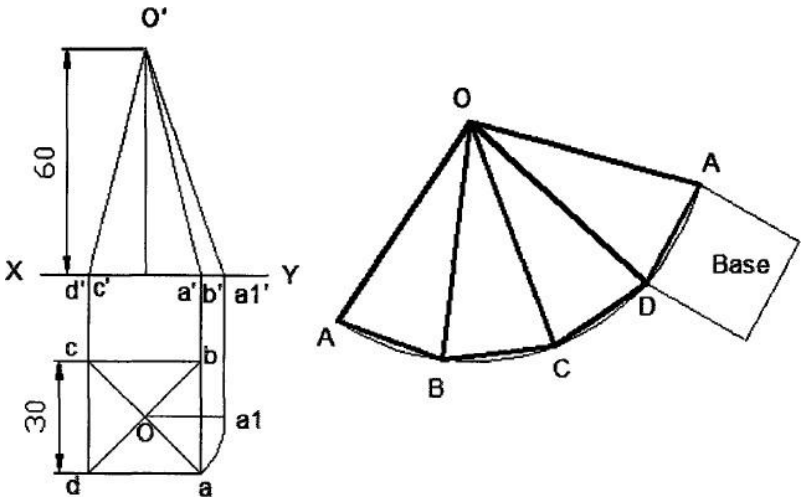


Figure 5.2

Problem: A Pentagonal prism of side of base 20 mm and height 50 mm stands vertically on its base with a rectangular face perpendicular to V.P. A cutting plane perpendicalar to V.P and inclined at 600 to the axis passes through the edges of the top base of the prism. Develop the lower portion of the lateral surface of the prism.

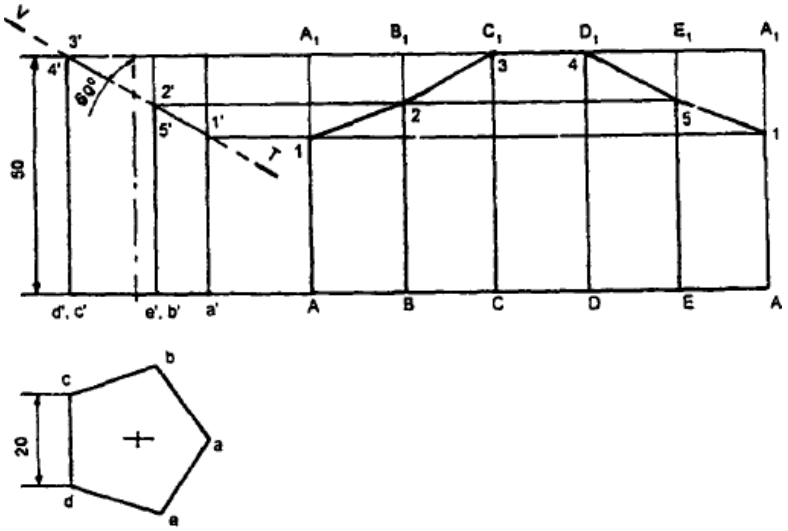


Figure 5.3

1. Draw the projections of the prism.

2. Draw the trace (V.T) of the cutting plane intersecting the edges at points 1,2,3, etc.

3. Draw the stretch-out AA and mark-off the sides of the base along this in succession i.e., AB,

BC, CD, DE and EA.

4. Errect perpendiculars through A,B,C etc., and mark the edges AA1

, BB I' equal to the height of the prism.

5. Project the points 11,21,31 etc., and obtain 1,2,3 etc., respectively on the corresponding edges in the development.

6. Join the points 1,2,3 etc., by straight lines and darken the sides corresponding to the truncated portion of the solid.

Problem: A hexagonal prism of side of base 30 mm and axis 70 mm long is resting on its base on HP. such that a rectangular face is parallel to v.P. It is cut by a section plane perpendicular to v.p and inclined at 300 to HP. The section plane is passing through the top end of an extreme lateral edge of the prism. Draw the development of the lateral surface of the cut prism.

1. Draw the projections of the prism.

2. Draw the section plane VT.

3. Draw the developmentAAI-AIA of the complete prism following the stretch out line principle.

4. Locate the point of intersectiion 11,21 etc., between VT and the edges of the prism.

5. Draw horizontal lines thrugh 11,21 etc., and obtain 1,2, etc., on the corresponding edges in the development.

6. Join the points 1,2, etc., by straight lines and darken the sides corresponding to the retained portion of the solid.

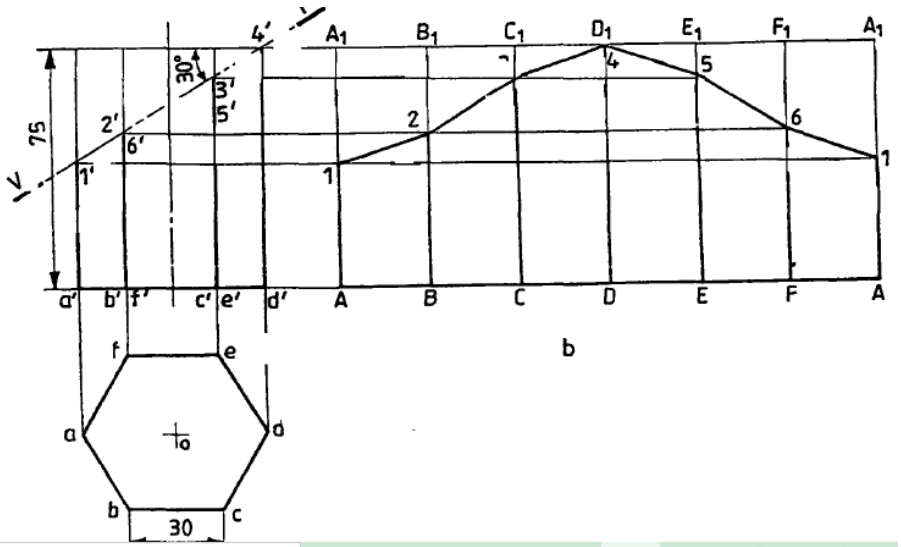


Figure 5.4

Problem: Draw the development of the lateral surface of the frustum of the square pyramid of side of base 30 mm and axis 40 mm, resting on HP with one of the base edges parallel to v.P. It is cut by a horizontal cutting plane at a height of 20 mm.

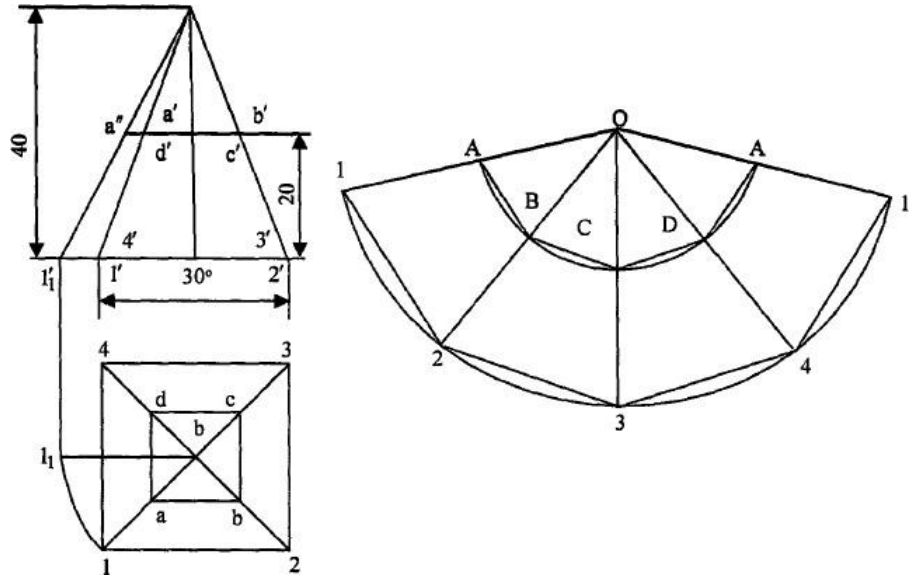


Figure 5.5

1. Draw the projections of the square pyramid.
2. Determine the true length. o-a of the slant edge.
3. Draw the trace of the cutting plane VT.
4. Locate the points of instersection of the cutting plane on the slant edges a1b1c1dl of the pyramid.
5. With any point 0 as centre and radius equal to the true length of the slant edge draw an arc of the circle.
6. With radius equal to the side of the base 30 mm, step-off divisions on the above arc.
7. Join the above division points 1,2,3 etc.,jn the order with the centre of the arc o. The full development of the pyramid is given by 0 12341.
8. With centre 0 and radius equal to oa mark-offthese projections atA, B, C, D, A. JoinA-B, B-C etc. ABCDA-12341 is the development of the frustum of the square pyramid.

Problem: A hexagonal pyramid with side of base 30 mm and height 75 mm stands with its base on RP and an edge of the base parallel to v.P. It is cut by a plane perpendicular to v.p, inclined at 45° to H.P and passing through the mid-point of the axis. Draw the (sectioned) top view and develop the lateral surface of the truncated pyramid

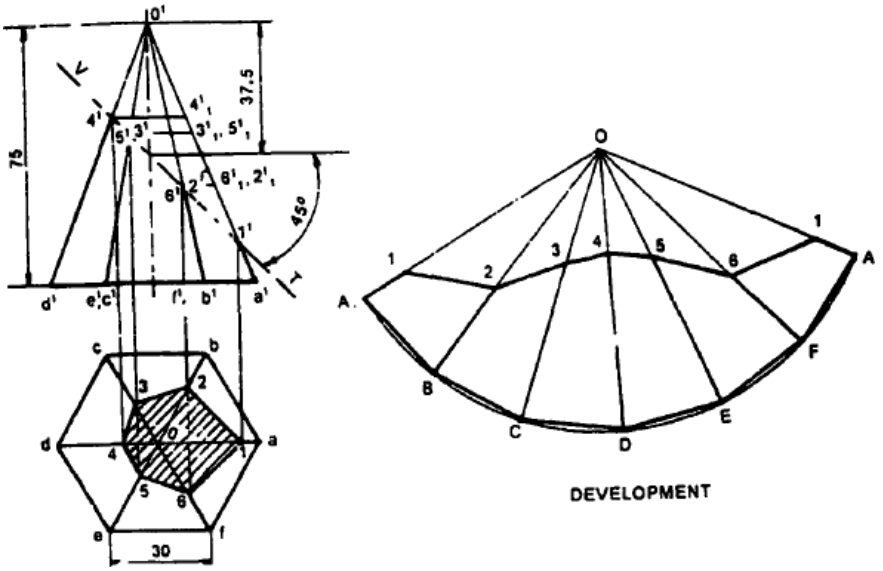


Figure 5.6

1. Draw the two views of the given pyramid and indicate the cutting plane.
2. Locate the points of interseciton 11,21,31,41,51 and 61 between the slant edges and the cutting plane.
3. Obtain the sectional top view by projecting the above points.
4. With 0 as centre and radius equal to the true length of the slant edge draw an arc and complete the total development by following construction of Fig. 7 .8.
5. Determine the true length 0I21}, 013\, etc., of the slant edges 0121, 0131, etc.

ORTHOGRAPHIC PROJECTION

Projection: Projection is defined as an Image or drawing of the object made on a plane. The lines form the object to the Plane are called projectors.

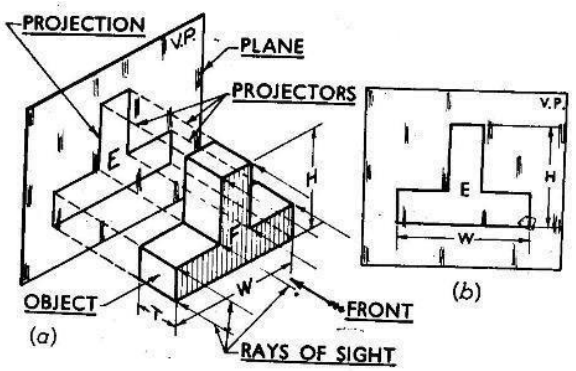


Figure 5.7

Methods of Projections: In Engineering drawing the following four methods of Projection are commonly used they are

- Orthographic Projection
- Isometric projection
- Oblique projection
- Perspective Projection

In orthographic projection an object is represented by two are three views on the mutual perpendicular projection planes each projection view represents two dimensions of an object. In iso, oblique and perspective projections represents the object by a pictorial view as eyes see it. In these methods of projects in three dimensional object is represented on a projection plane by one view only.

Orthographic Projection

When the Projectors are parallel to each other and also perpendicular to the plane the projection is called orthographic Projection

Example: Orthographic projection of a car shown in below figure.

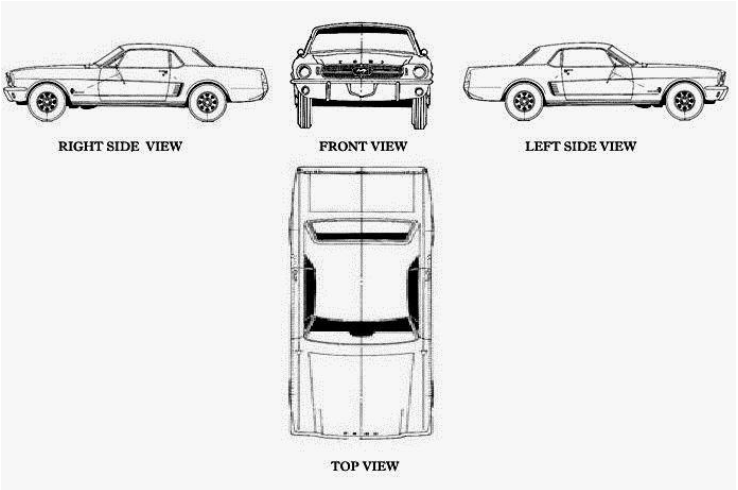


Figure 5.8

We can represent in orthographic projection two to three views enough as shown in below figures

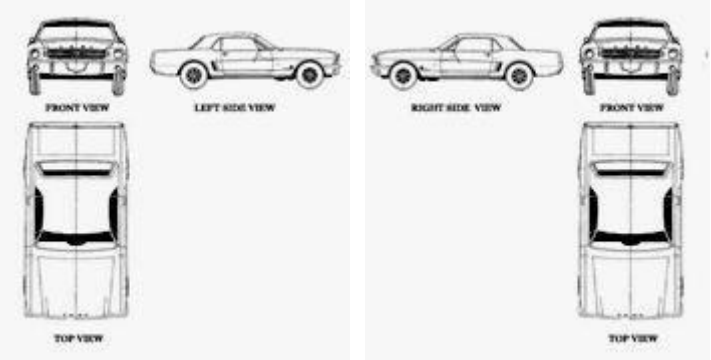


Figure 5.9

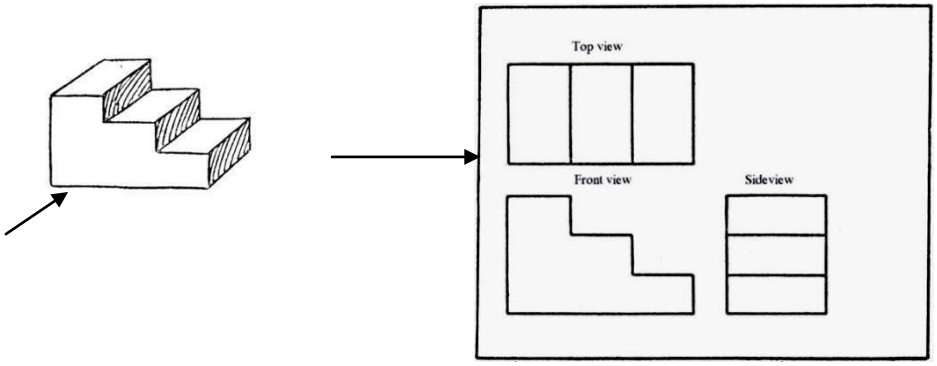


Figure 5.10

Orthographic projection of given object

Orthographic Projection is a way of drawing an 3D object from different directions. Usually a front, side and plan view is drawn so that a person looking at the drawing can see all the important sides. Orthographic drawings are useful especially when a design has been developed to a stage whereby it is almost ready to manufacture.

Plane of projection: Two planes employed for the purpose of orthographic projections are called reference planes or planes of projection. they are intersect each other at right angle to each other the vertical plane of projection is usually denoted by the letters VP and the other Plane is horizontal plane of Projection is denoted by HP . The line in which they intersect is termed as the reference line and is denoted by the letters xy.

Four quadrants:

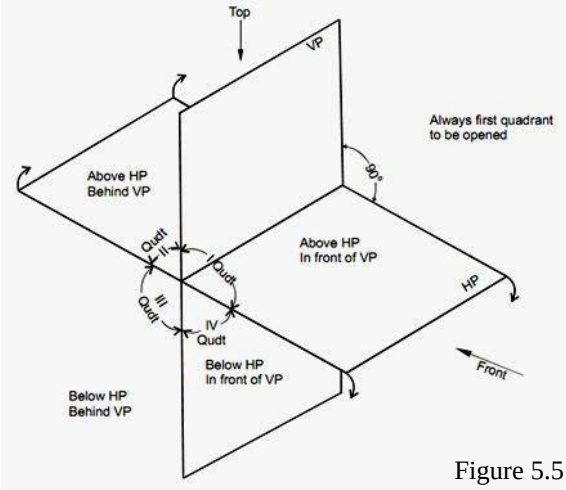


Figure 5.5

Figure 5.11

The intersection of mutual perpendicular Planes i.e Vertical Plane and Horizontal Plane Form Four quadrants as shown above figure 5.11. Here planes to be assumed transparent here the object may be situated any one of four quadrants. The projections are obtained by drawing perpendiculars from the object to the planes, i.e by looking from the Front and Top. It should be remembered that the first and third quadrants always opened out while rotating the planes. The position of views with respect to the reference line will change according to quadrant in which object may be situated as shown in below figures.

First angle Projection:

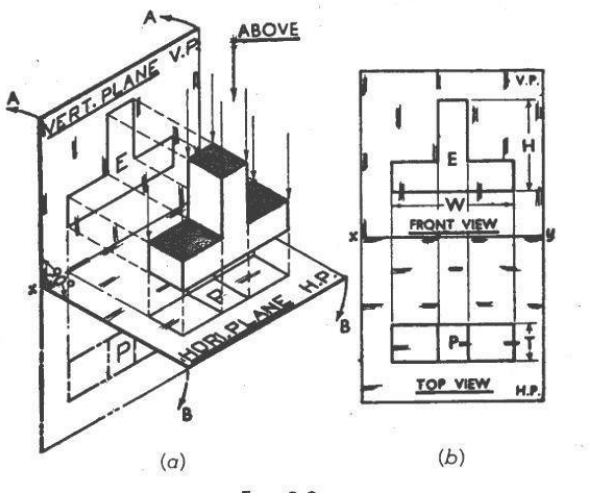


Figure 5.12

We have assumed the object to be situated in front of the VP and above the HP i.e First quadrant and then projected it on these planes, the method of projection is known as First angle projection method.

Here object lies between observer and plane of projection. In this method when the views are drawn in their relative positions the Top view comes below the front view.

Third angle Projection:

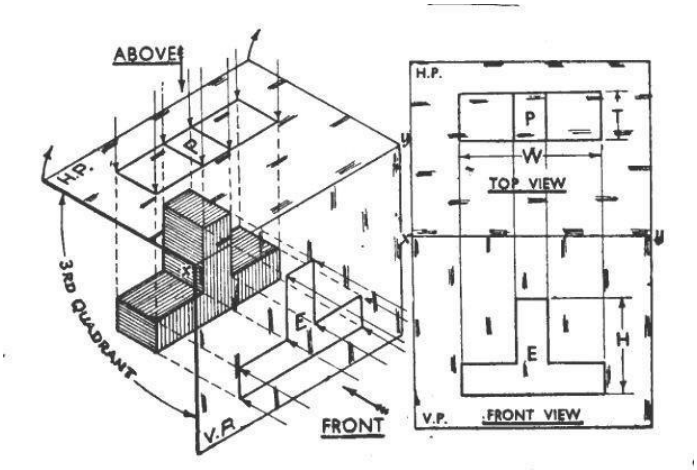


Figure 5.13

Here the object is assumed to be situated in third quadrant, here Plane of projection assumed to be transparent. It lies between Object and the observer. In this method when the views are drawn in their relative positions the Top view comes below the front view.

Reference Line:

While representing Projections it can be seen that while considering the front view which is seen from front the HP coincides with the line xy in their words xy represents HP.

Similarly while considering Top view which view obtained by looking from above, the same line xy represents the VP hence, when the projections are drawn in correct relationship with each other xy represents both the HP and VP this is called as Reference line.

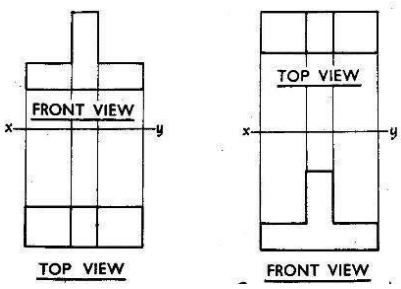


Figure 5.14

Note: There are two ways of drawing in orthographic - First Angle and Third Angle. They differ only in the position of the plan, front and side views.

Problems:

Draw the front view, Top view and Side view of the given figure?

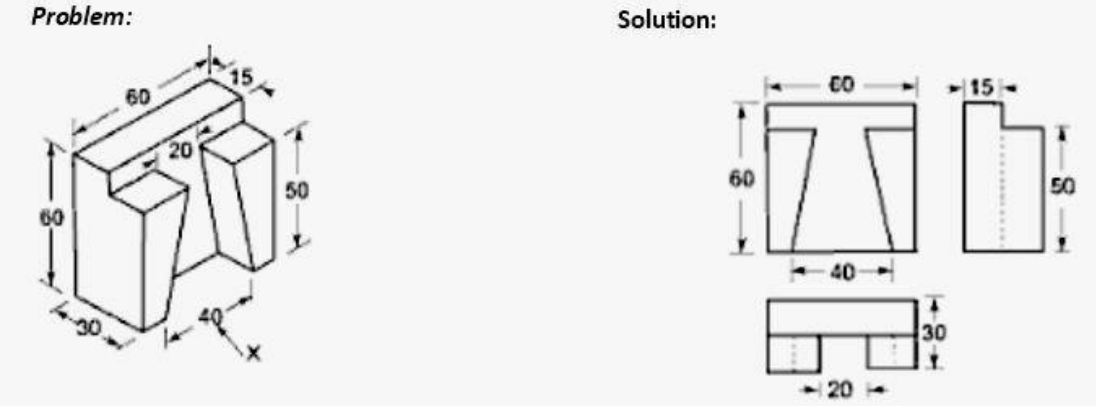


Figure 5.15

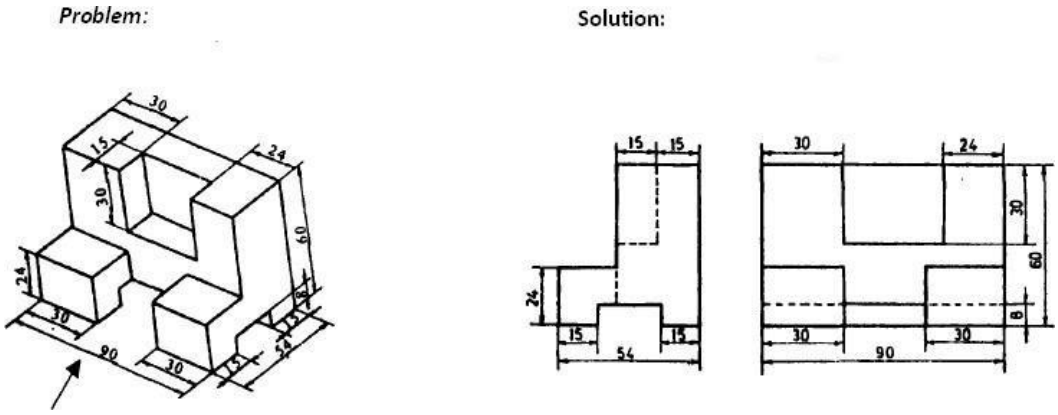
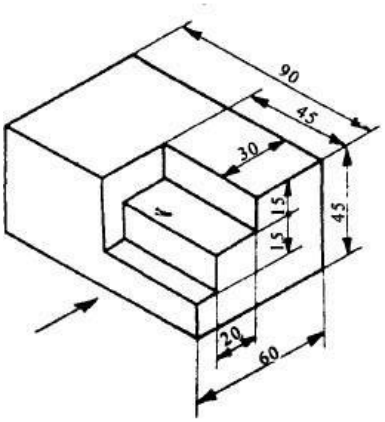


Figure 5.16

Problem:



Solution:

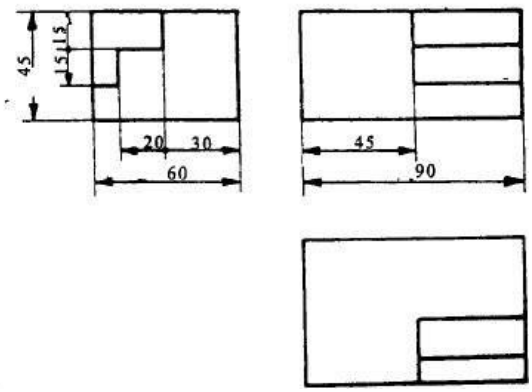
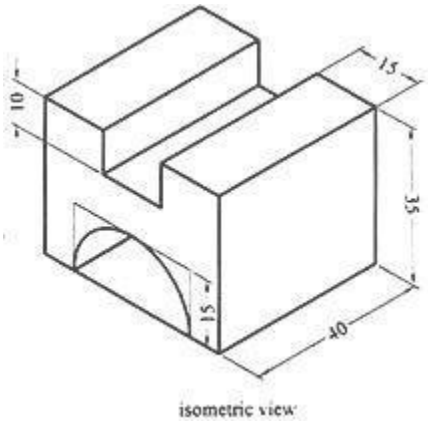


Figure 5.17

Problem



Solution

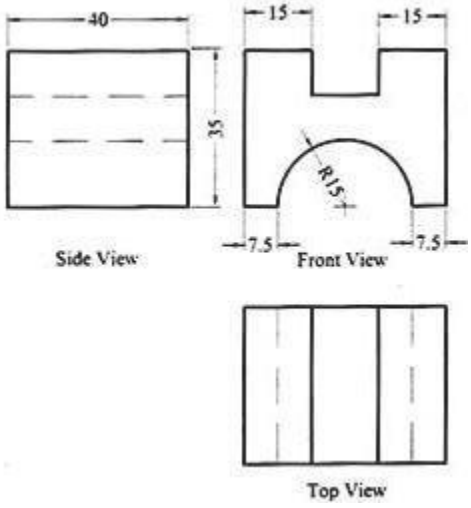
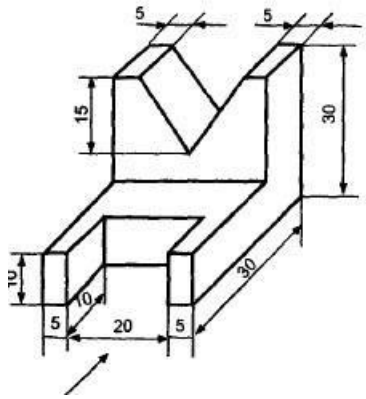


Figure 5.18

Problem:



Solution:

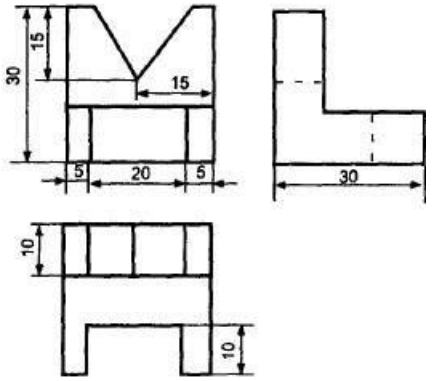
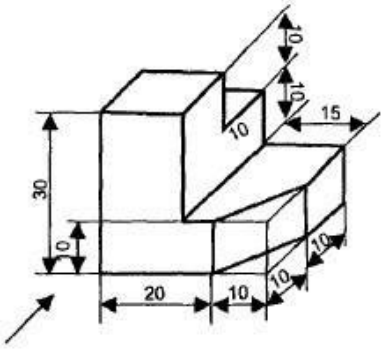


Figure 5.19

Problem:



Solution:

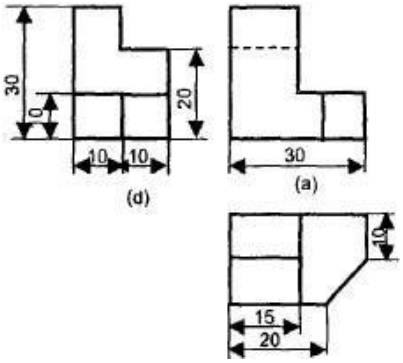
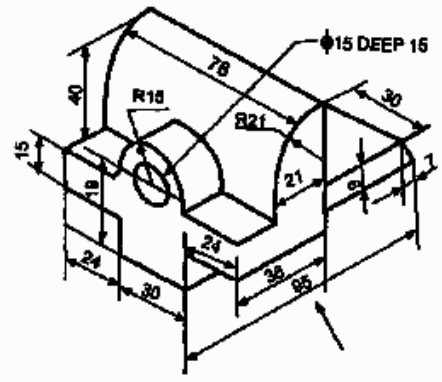


Figure 5.20

Problem:



Solution:

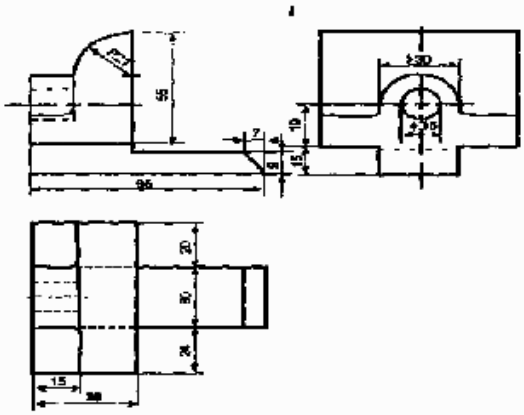


Figure 5.33

Problem: Solution:

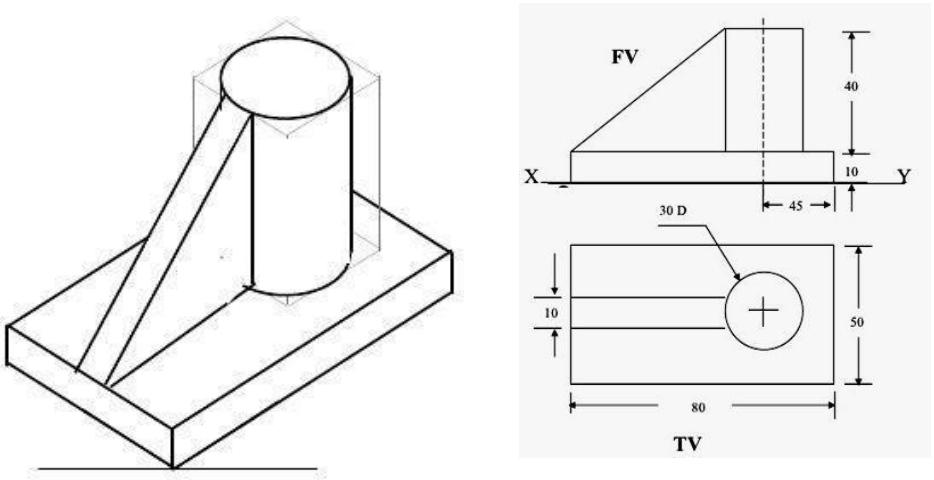


Figure 5.22

Problem: Solution:

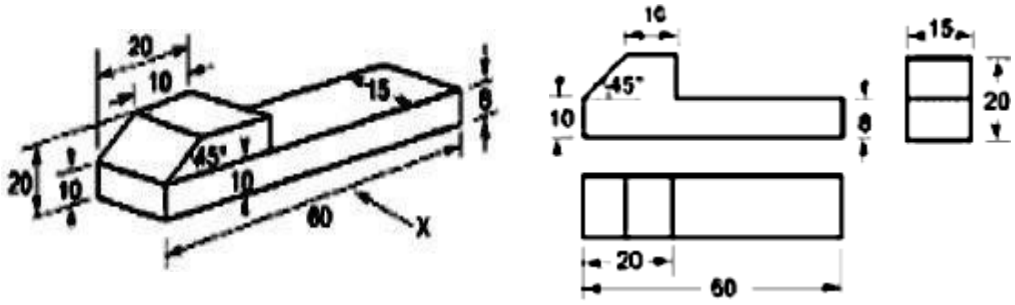


Figure 5.23

Problem: Solution:

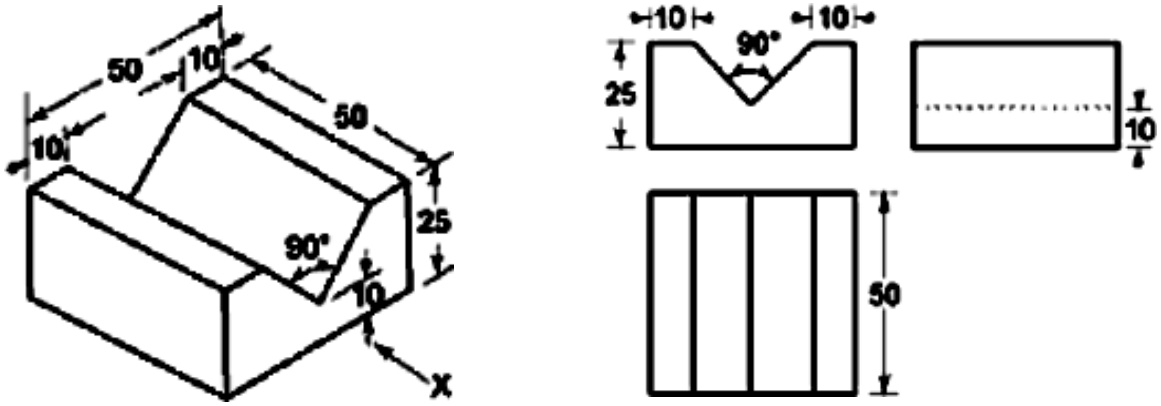


Figure 5.33

Problem: Solution

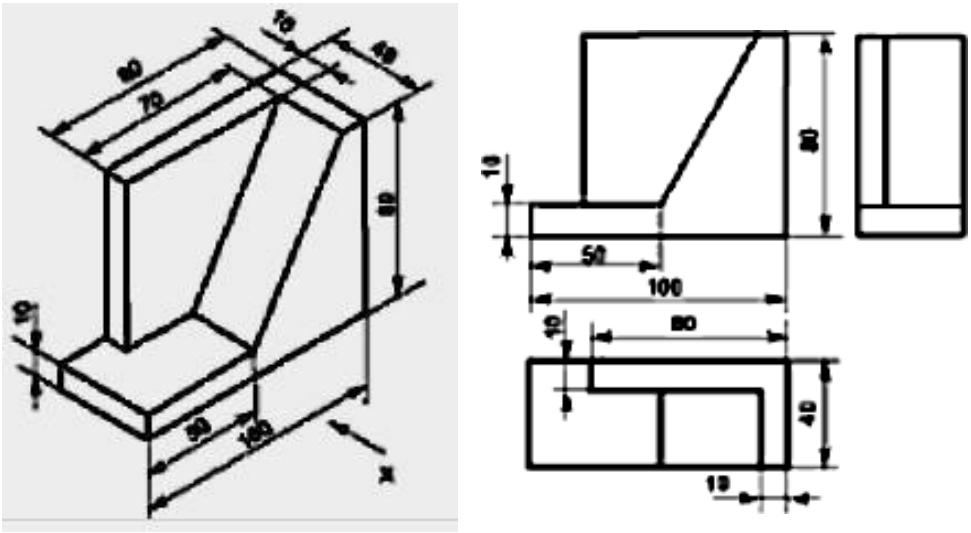


Figure 5.25

Problem: Solution:

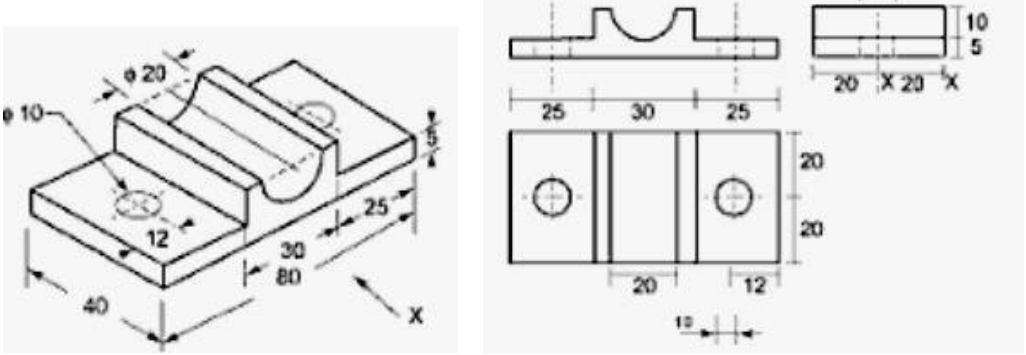


Figure 5.26

Problem: Solution:

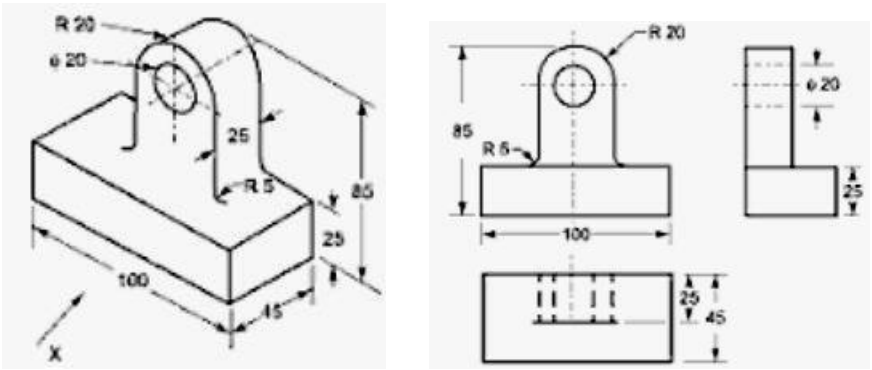


Figure 5.33

Problem: Solution:

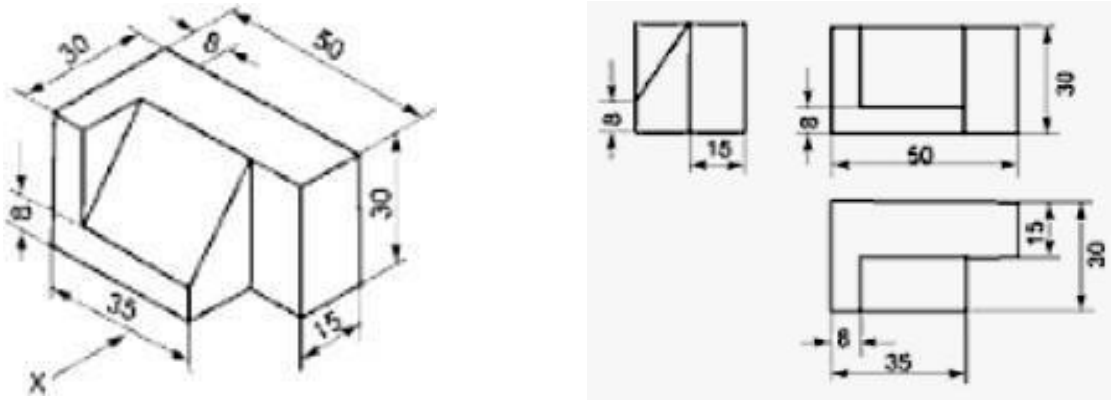


Figure 5.28

Problem: Solution:

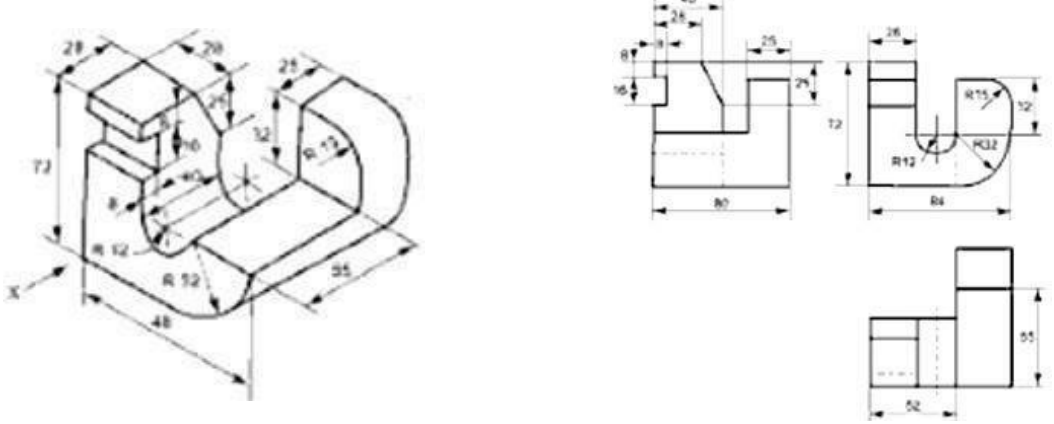


Figure 5.29

Problem: Solution:

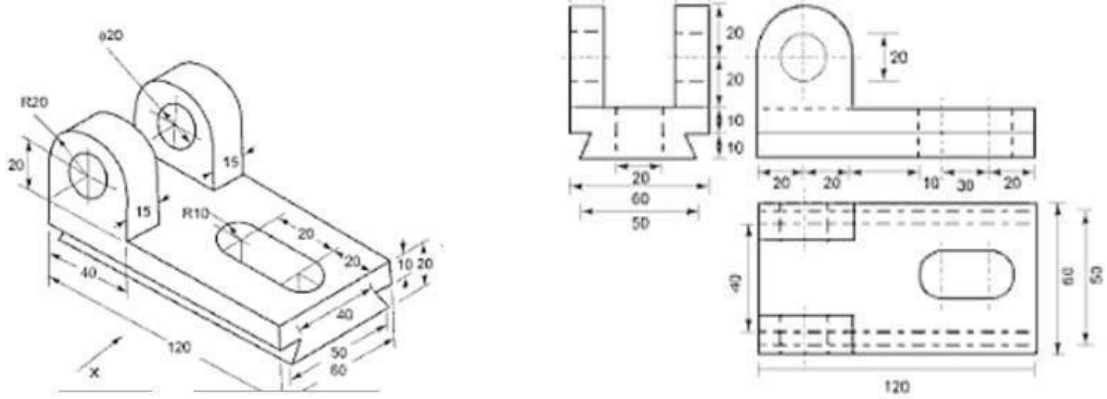


Figure 5.33

Problem: Solution:

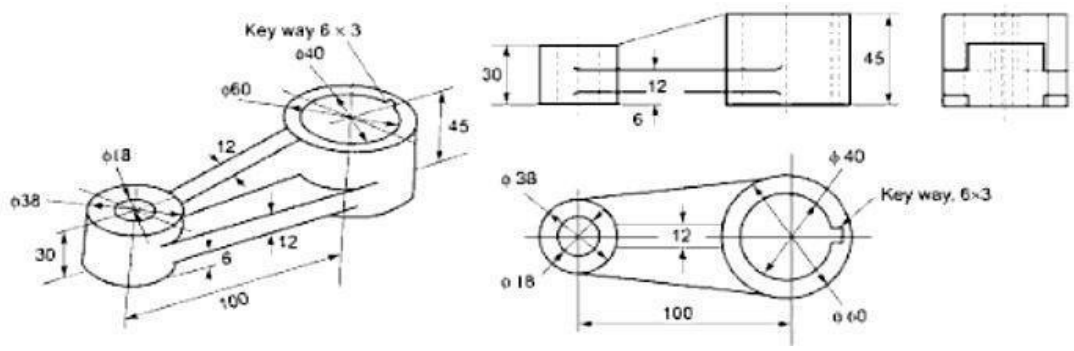


Figure 5.31

Problem: Solution:

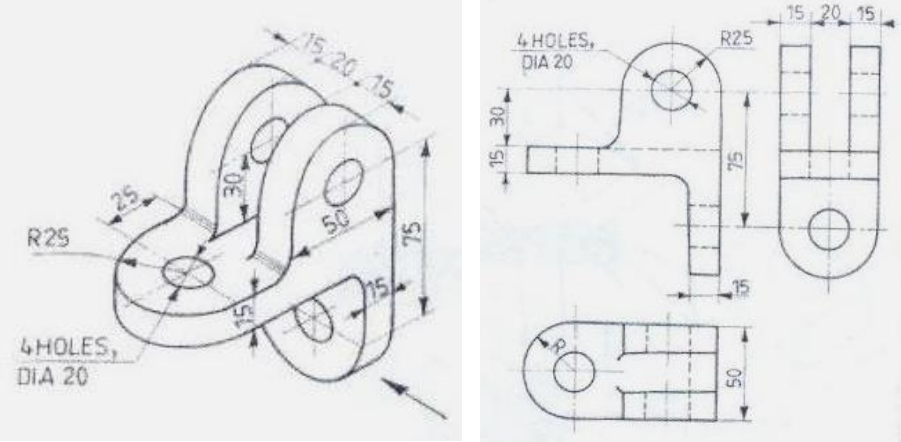


Figure 5.32

Problem: Solution:

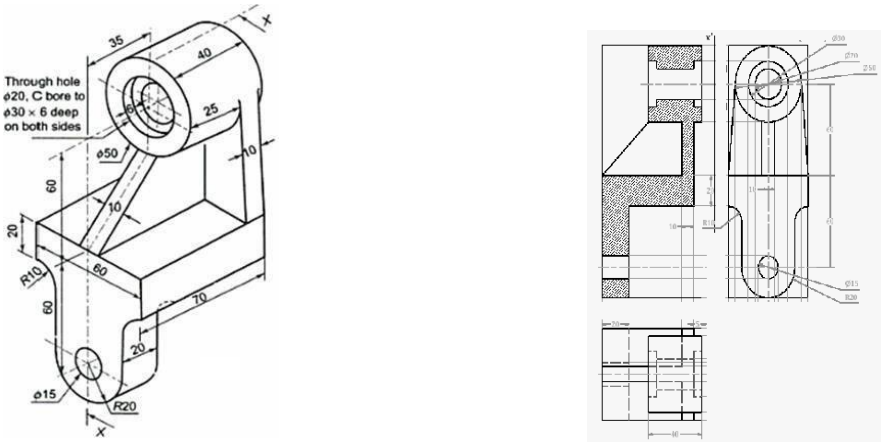


Figure 5.33