

5

ORTHOGRAPHIC PROJECTIONS

5.1. INTRODUCTION

The art of representing an object or scene on a piece of paper is called **projection**. While drawing the projection of an object following items exist.

1. The object to be projected.
2. The plane of projection. On plane of projection we are drawing the projection of an object. It is also called view plane.
3. The projectors. The projectors are lines from object and intersecting at plane of projection.
4. The centre of projection. The centre of projection is basically the observer's eye. It is also termed as station point or view point.

5.2. TYPES OF PROJECTION

In engineering drawing, to represent an object we use various kind of projection. The classification of projections is given below :

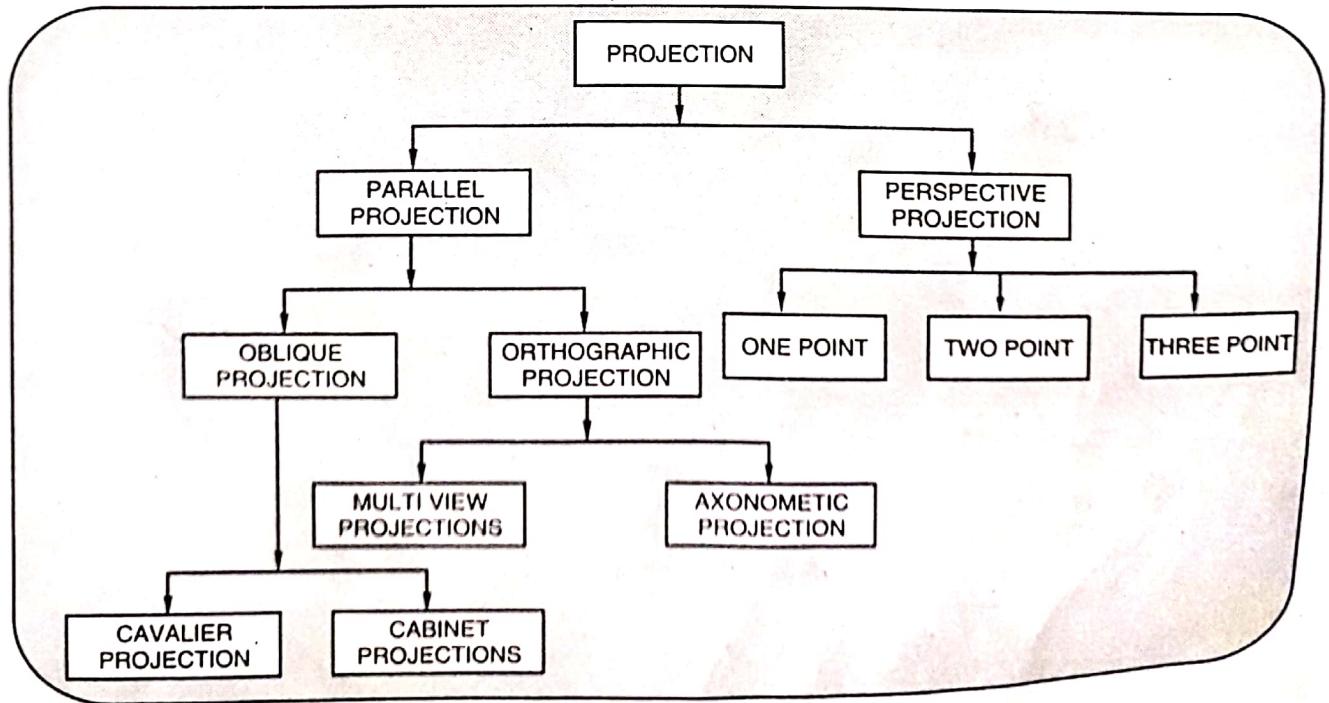


Fig. 5.1. Classification of projections.

5.3. ORTHOGRAPHIC PROJECTIONS

The term orthographic is derived from the word *orthos* which means perpendicular. An observer is consider to look at the given object from an infinite distance such that the rays of sight from the eyes are parallel to each other and perpendicular to the plane of projection. These rays of sight are called projectors. Thus, the orthographic projections are drawing in which the projectors are parallel to each other and perpendicular to the plane of projection. In orthographic projections, multi-views that show only two dimensions of the pictorial (three-dimension) object in each view.

5.4. BASIC TERMS USE IN ORTHOGRAPHIC PROJECTIONS

1. Reference plane/Principal plane. Multi-view drawing (also called orthographic projections) are made on three mutually perpendicular plane namely ; horizontal vertical and profile plane.

- (a) **Horizontal plane.** A plane parallel to the surface to the earth is called horizontal plane. It is denoted by H.P.
- (b) **Vertical plane.** A plane perpendicular to the horizontal plane is called vertical plane. It is denoted by V.P.
- (c) **Profile plane.** A plane perpendicular to both the H.P. and V.P. is called profile plane. The plane on the right end of the planes is called right profile plane while the plane on the left end is called left profile plane.

2. Reference line. The line of intersection between the horizontal plane and vertical plane is called reference line. It is denoted by xy line.

3. Front view. If we look an object from the front side and the projection drawn on the vertical plane (V.P.), such type of projection is called front view. It is also known as elevation.

4. Top view. If we look the object from the top side and the projection drawn on the horizontal plane (H.P.), such type of projection is called top view. It is also called plan.

5. Side view. If we look the object from the left-hand side or right-hand side and the projection drawn on the Profile plane (P.P.), such type of projection is called side view. It is also called end view.

5.5. QUADRANTS/ANGLE PROJECTION

Orthographic projections are mainly obtained on two principal planes—namely vertical plane (V.P.) and horizontal plane (H.P.) as shown in Fig. 5.4. The line of intersection of V.P. and H.P. is known as reference line. The V.P. and H.P. are perpendicular to each other and they divide the space into four quadrants or segments. They are also called angles.

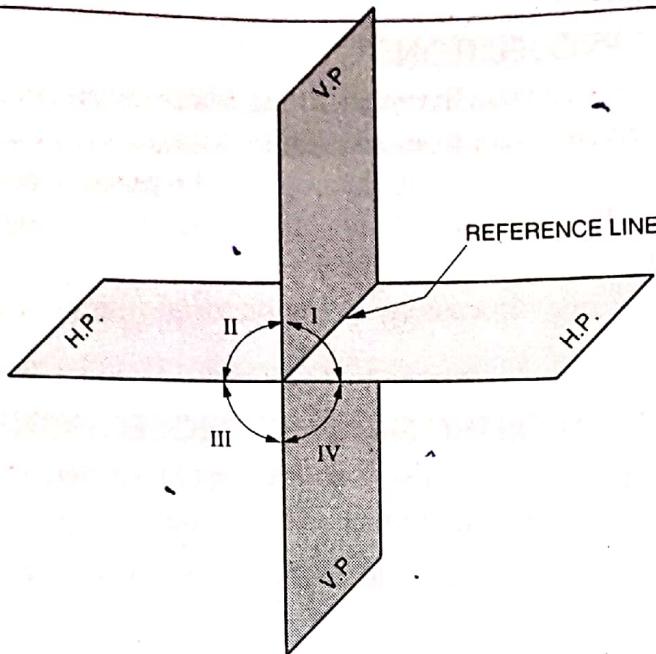


Fig. 5.4. Quadrants.

1. First quadrant/first angle projection. The space which lies above H.P. and in front of V.P. is called the first angle. In first angle projection, the object is considered to lie in the first angle. The observer who is theoretically at infinite distance looks at the object from the front. The projectors are parallel to each other and perpendicular to the V.P. The view obtained on the V.P. of the front face is called front view or elevation.

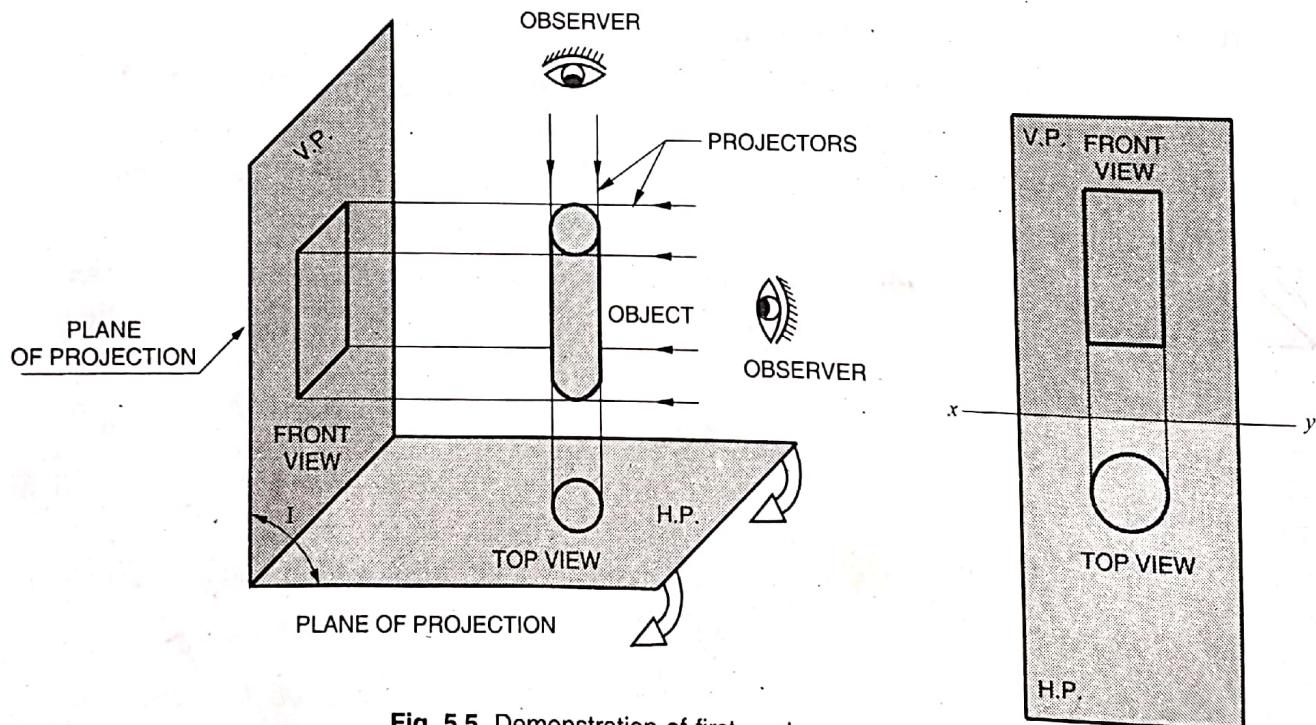


Fig. 5.5. Demonstration of first angle projection.

It may be noted that the front view show only the length and height of the object. It does not indicate the width. Similarly the observer look at the object from the top such that the projectors are parallel to each other and perpendicular to the H.P. The view obtained on the H.P. of the top face is called top view or plan. The top view shows only the length and width of the object. It does not indicate the height.

We assume that vertical plane remain vertical and horizontal plane is rotated at an angle of 90° about the reference line in clockwise direction. In this manner in first angle projection the V.P. lies above the reference line and the H.P. lies below the reference line. Thus we always get the front view on the V.P. and top view on H.P.

In 1991, B.I.S. (Bureau of Indian Standards) recommended the use of first angle projection in India. The first angle projection is also used in Europe and most of world.

2. Second quadrant/second angle projection. The space lies above H.P. and behind V.P. is called the second angle. In second angle projection, the object is considered to lie in the second angle. As we know that vertical plane remains vertical and horizontal plane is rotated at an angle of 90° about the reference line.

In this manner both the V.P. and H.P. overlap and lies above the reference line. Thus we get overlaped top view and front view on the single plane which make our drawing complicated. So that is the reason we do not use second angle projection in practical.

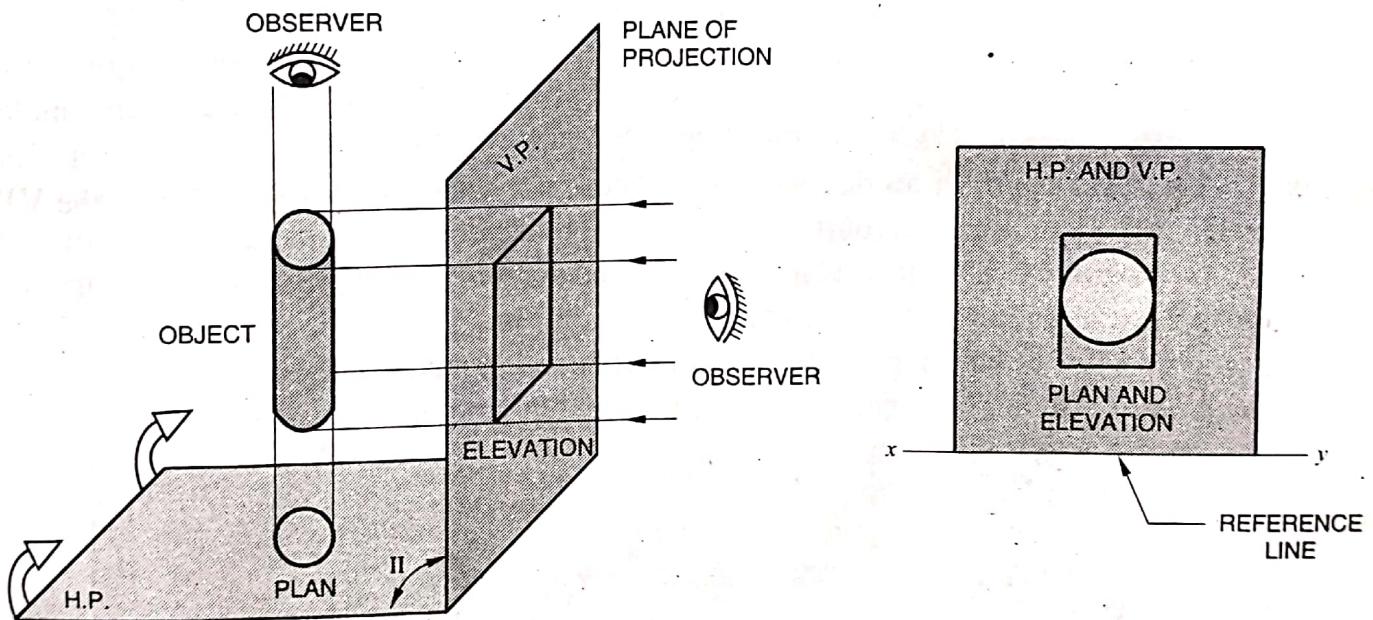


Fig. 5.6. Demonstration of second angle projection.

3. Third quadrant/third angle projection. The space which lies below H.P. and behind V.P. is called third angle. In third angle projection, the object is considered to lie in third angle. In the third angle projection, the plane of projection lie between the object and observer. So in third angle projection the plane of projection must be transparent otherwise the object will not be visible. Now in the same way the V.P. is fixed and H.P. is rotated about the reference line by an angle of 90° . Hence the V.P. lies below reference line and H.P. lies above the reference line.

The third angle projection is used in U.S.A. (United States of America) and Australia.

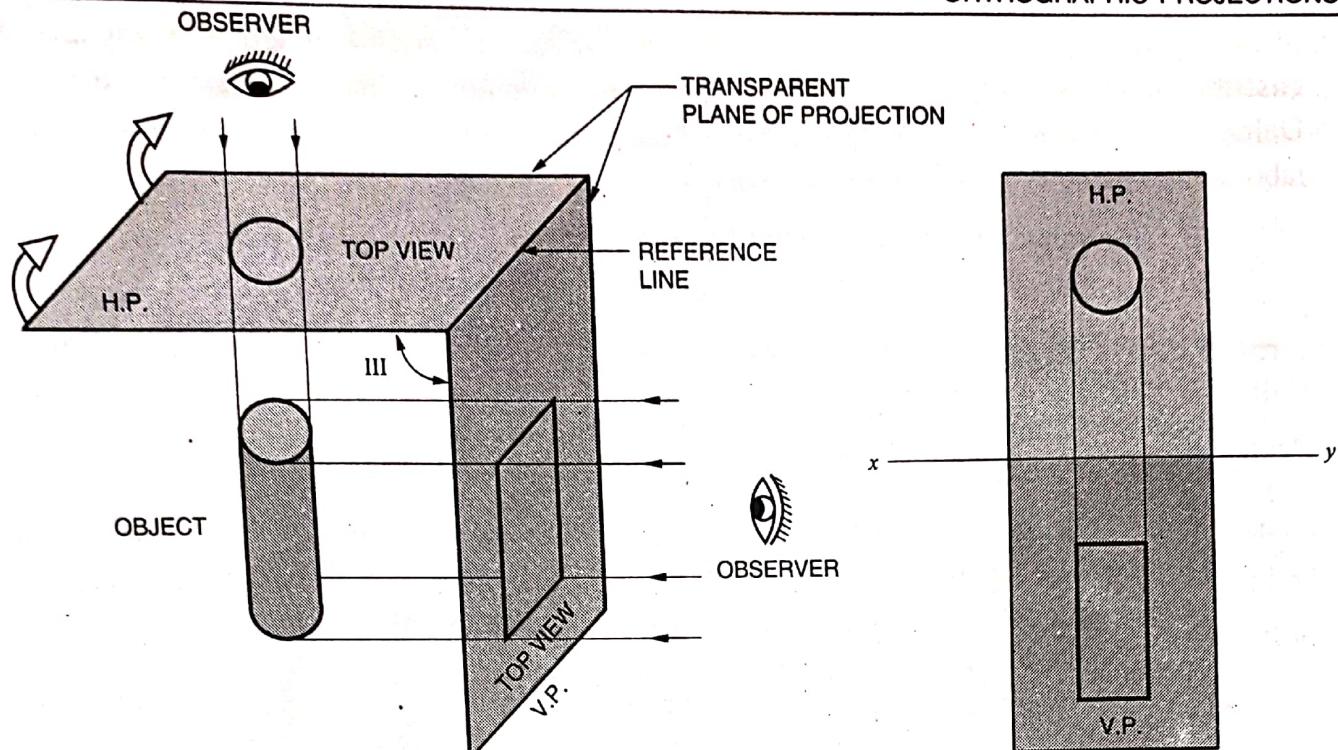


Fig. 5.7. Demonstration of third angle projection.

4. Fourth quadrant/fourth angle projection. The space which is below H.P. and in front of V.P. is called the fourth angle. In fourth angle projection, the object is considered to lie in fourth quadrant. As we know that vertical plane remain fixed and horizontal plane is rotated about the reference line by an angle of 90° in clockwise direction. In this manner both the V.P. and H.P. overlap and lie below the reference line. Thus we get overlapped front view and top view lie on same plane. So fourth angle projection is also not used in practice.

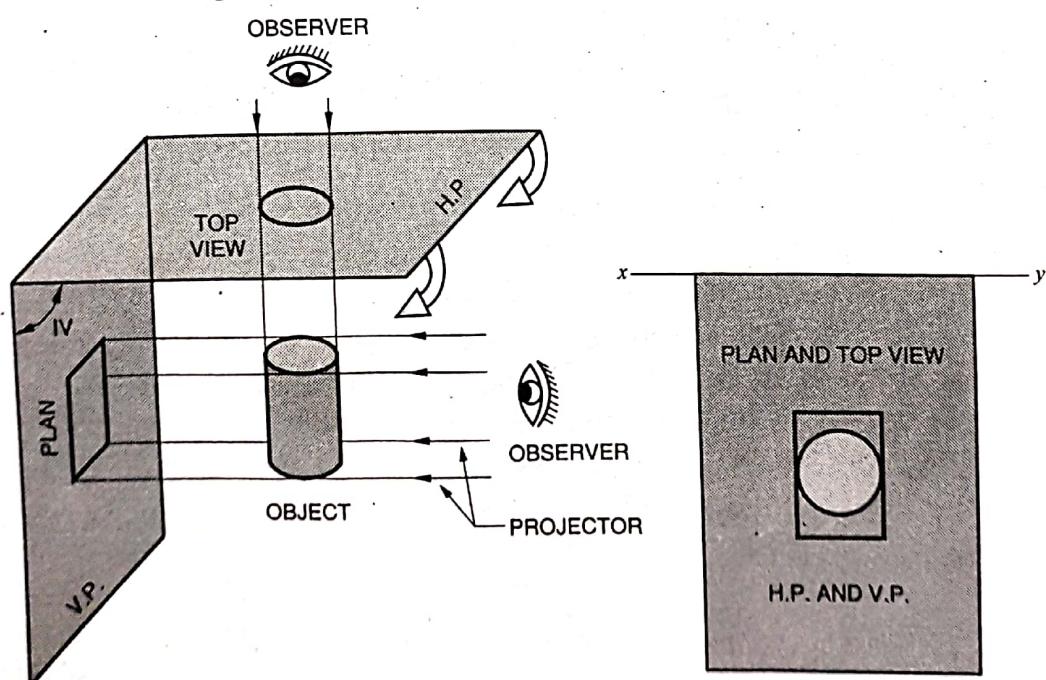


Fig. 5.8. Demonstration of fourth angle projection.

5.6. BUREAU OF INDIAN STANDARDS (BIS)

The Bureau of Indian Standards (BIS) was set up as a statutory organization under the Bureau

of Indian Standards Act, 1986 taking over the assets and liabilities of the **Indian Standards Institution (ISI)** that came into existence in 1947. The Bureau has its Headquarters in New Delhi. It has a network of 05 regional offices, 34 branch offices, 04 inspection offices and 08 laboratories which act as effective link between BIS, government, industry and consumers. Bureau has made steady progress in various fields of its key activities namely Standards formulation, Product certification, Management system certification and Hallmarking.

Problem 5.1. Pictorial view of an object is shown in Fig. 5.9. Using first angle projection and third angle projection, draw its (a) front view, (b) top view and (c) left side view.

Solution. First angle projection :

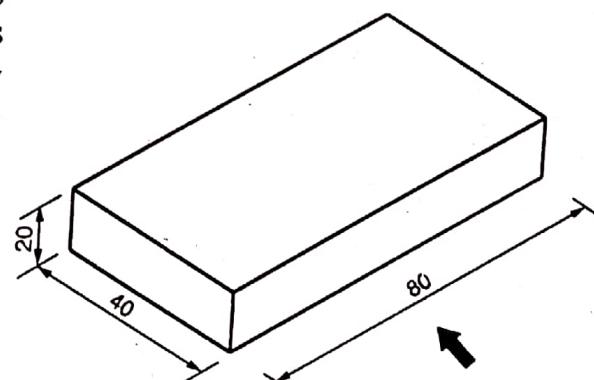


Fig. 5.9. Pictorial view.

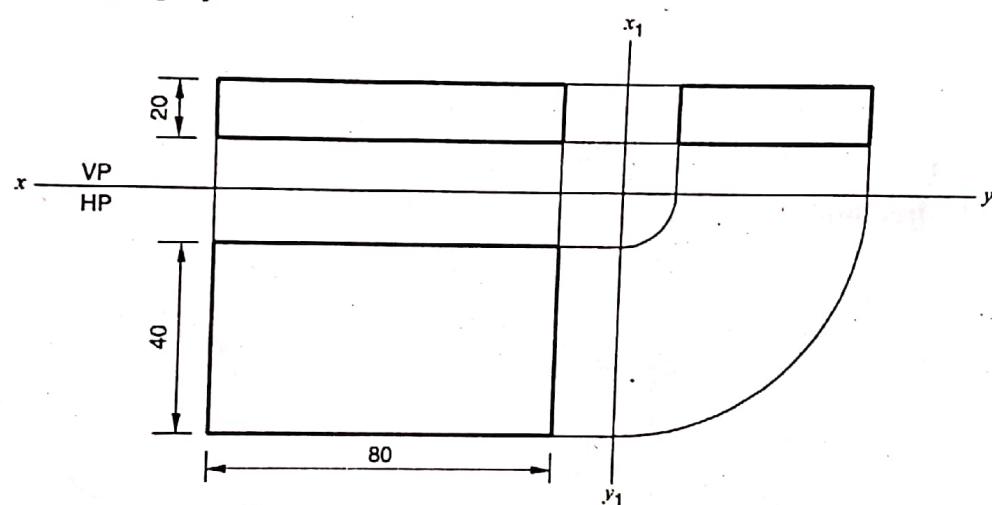


Fig. 5.10. Orthographic view in first angle projection.

Third angle projection :

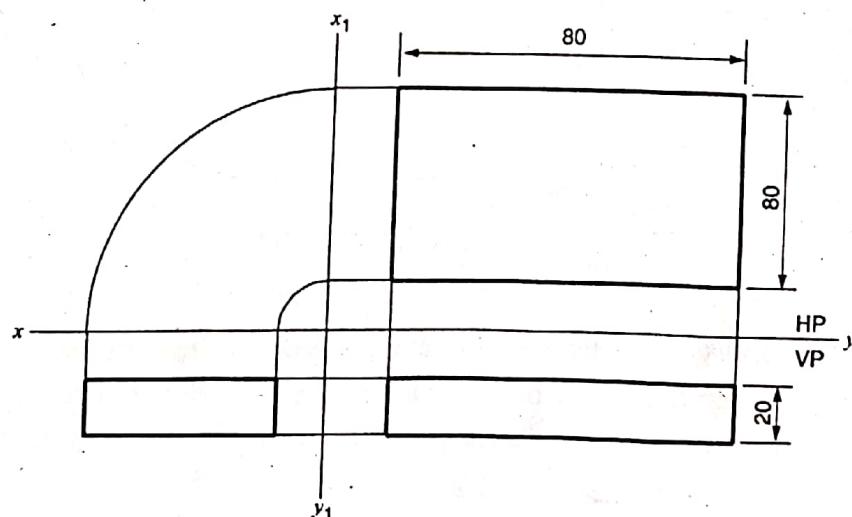


Fig. 5.11. Orthographic views in third angle projection.

5.7. SYMBOLS FOR FIRST ANGLE PROJECTION AND THIRD ANGLE PROJECTION

The top view and the front view do not overlap and give the clear picture when an object is placed in either the first angle or the third angle. Thus, only first and third angle projection are adopted for orthographic projections.

The angle of projection is indicated in the title block of the drawing sheet with the help of orthographic projections drawn for the frustum of a cone shown in Fig. 5.12. The diameters of the frustum of the cone are in the ratio of 1 : 2 and the length is equal to the diameter of the bigger end.

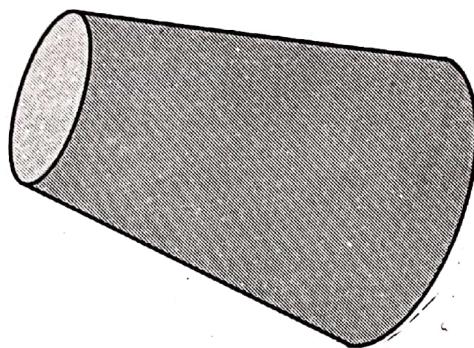


Fig. 5.12. Frustum of a cone.

First Angle Projection :

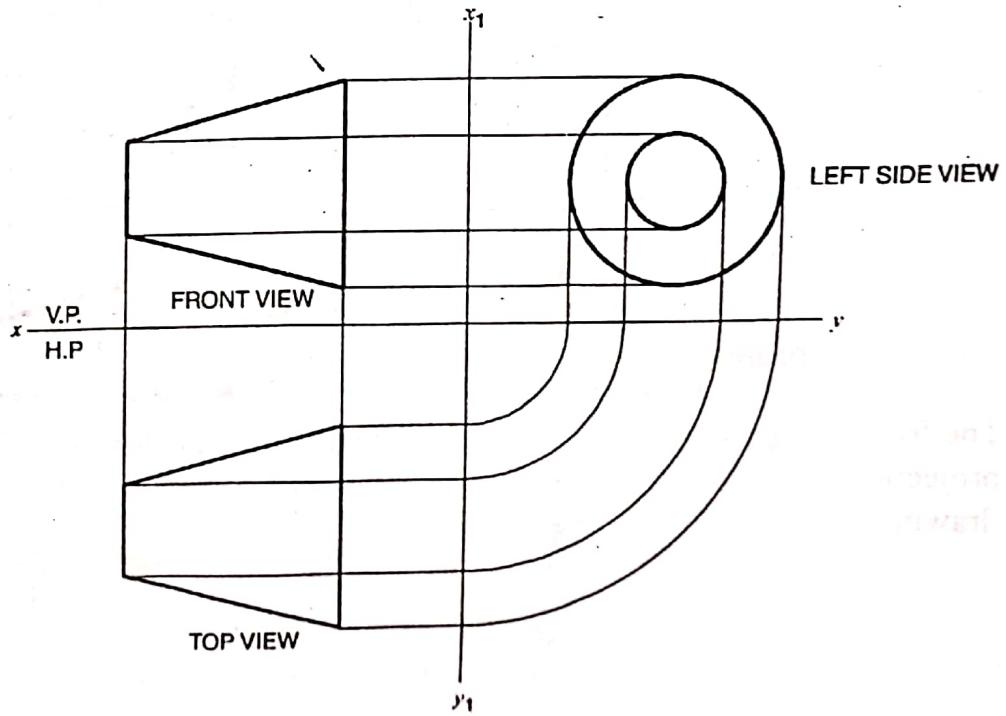


Fig. 5.13. Orthographic projections of a frustum in first angle projection.

The front view and the left side view of the frustum are considered as symbol for first angle projection and should be drawn in the space provided for the purpose in the title block of the drawing sheet.

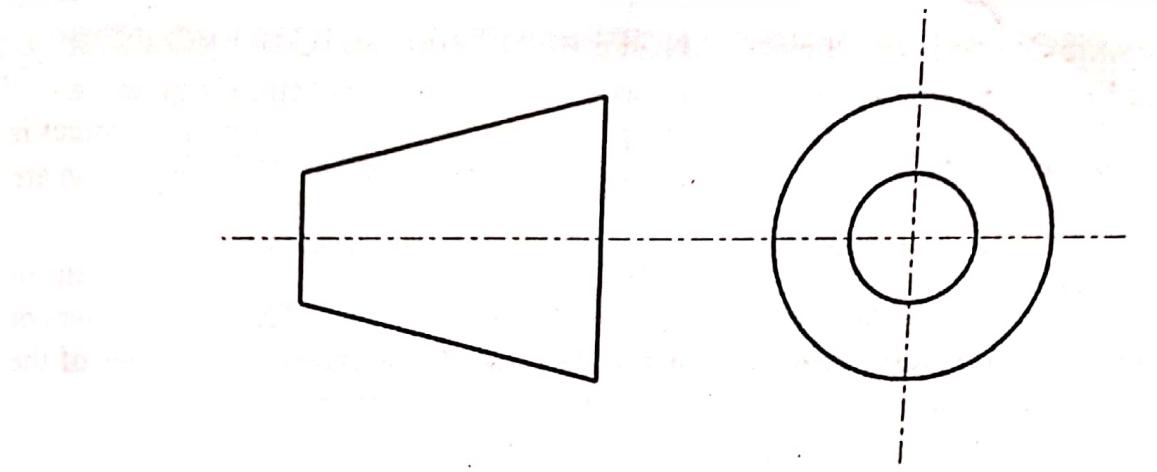


Fig. 5.14. Symbol for first angle projection.

Third angle projection :

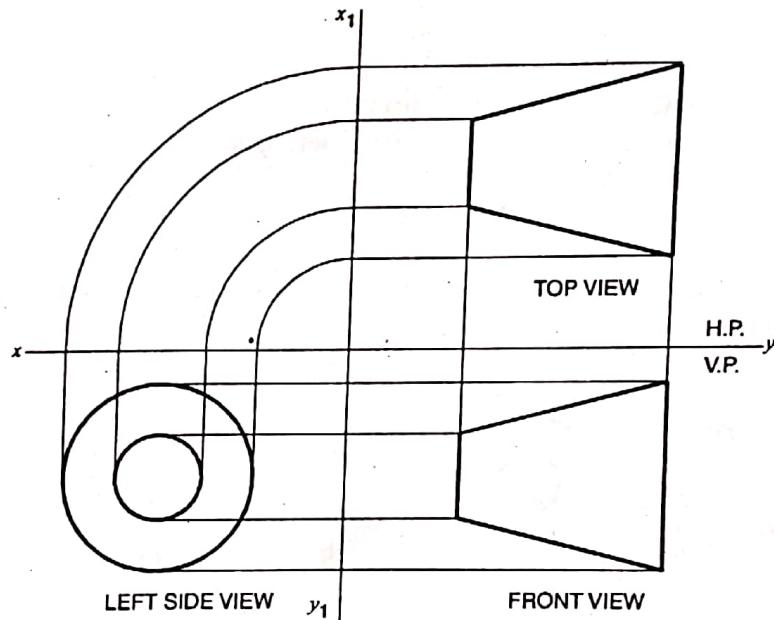


Fig. 5.15. Orthographic projections of a frustum in third angle projection.

The front view and the left side view of the frustum are considered as symbol for third angle projection and should be drawn in the space provided for the purpose in the title block of the drawing sheet.

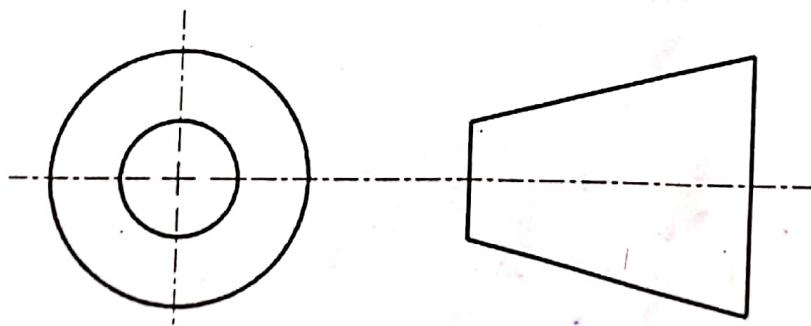
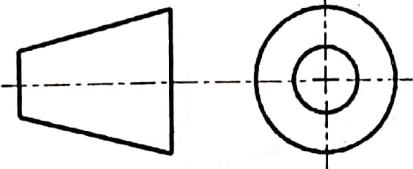
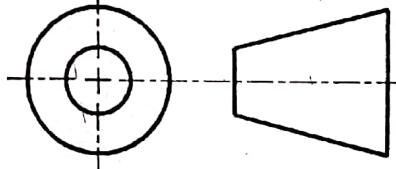


Fig. 5.16. Symbol for third angle projection.

5.8. COMPARISON BETWEEN FIRST ANGLE AND THIRD ANGLE PROJECTIONS

The comparison between the first angle projection and third angle projection is given below :

S.No.	First angle projection	Third angle projection
1.	The object is assumed to be placed in first quadrant.	The object is assumed to be placed in third quadrant.
2.	The object lies in between the observer and the plane of projection.	The plane of projection lies in between the observer and the object.
3.	The plane of projections may not be transparent.	The plane of projections must be transparent otherwise the object will not visible.
4.	In this method, when the views are drawn in their relative positions, the top view comes below the front view, the view of the object as observed from the left hand side view is drawn to the right hand side of the front view.	In this method, when the views are drawn in their relative position, the top view comes above the front view, left hand side view is drawn to the left hand side of the front view.
5.	First angle projection is represented by a symbol shown below	Third angle projection is represented by a symbol shown below.
		
6.	This method of projection is recommended by the BIS (Bureau of Indian Standards) from 1991. It is also used in Europe and most of world.	This method of projection is used in U.S.A. and Australia.

Problem 5.2. Pictorial view of an object is shown in Fig. 5.17. Using first angle projection, draw its (a) front view, (b) top view, (c) left hand side view.

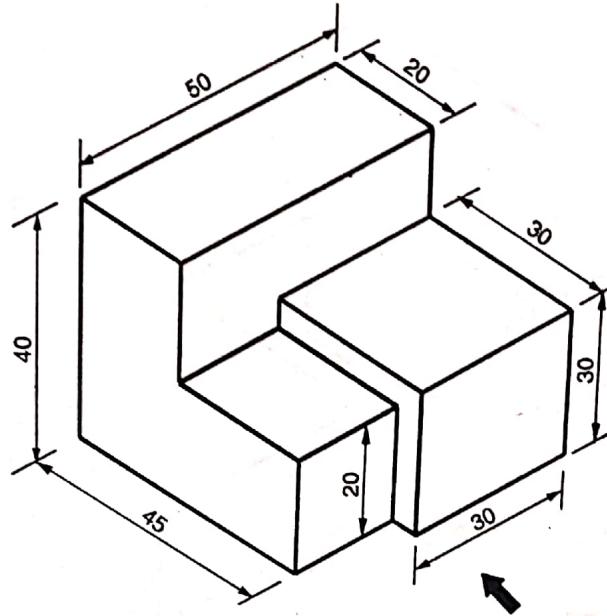


Fig. 5.17. Pictorial view.

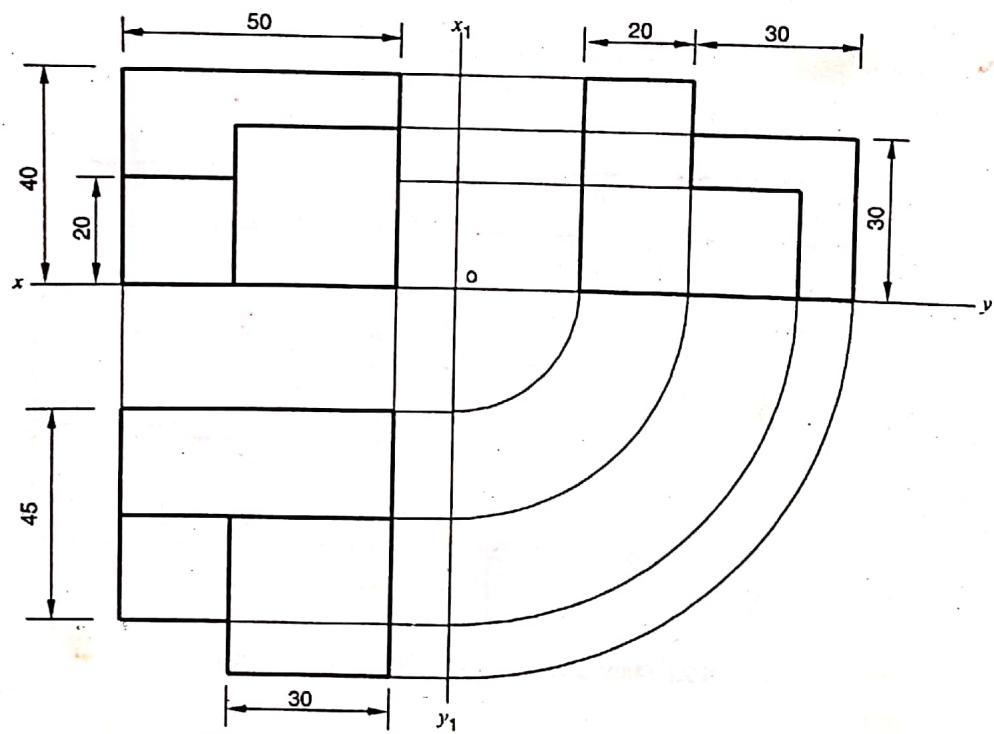
Solution.

Fig. 5.18. Orthographic views in first angle projection.

Problem 5.3. Pictorial view of an object is shown in Fig. 5.19. Using first angle projection, draw its (a) front view (b) top view, and (c) right hand side view.

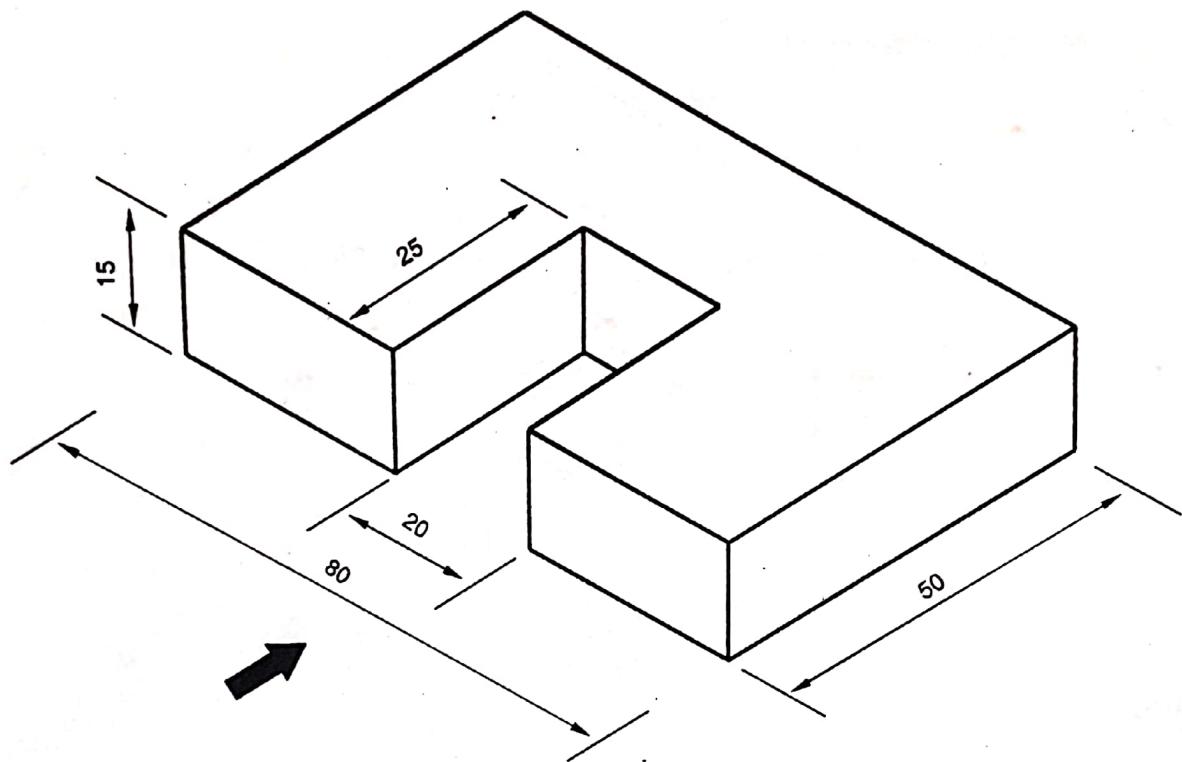


Fig. 5.19. Pictorial view.

Solution.

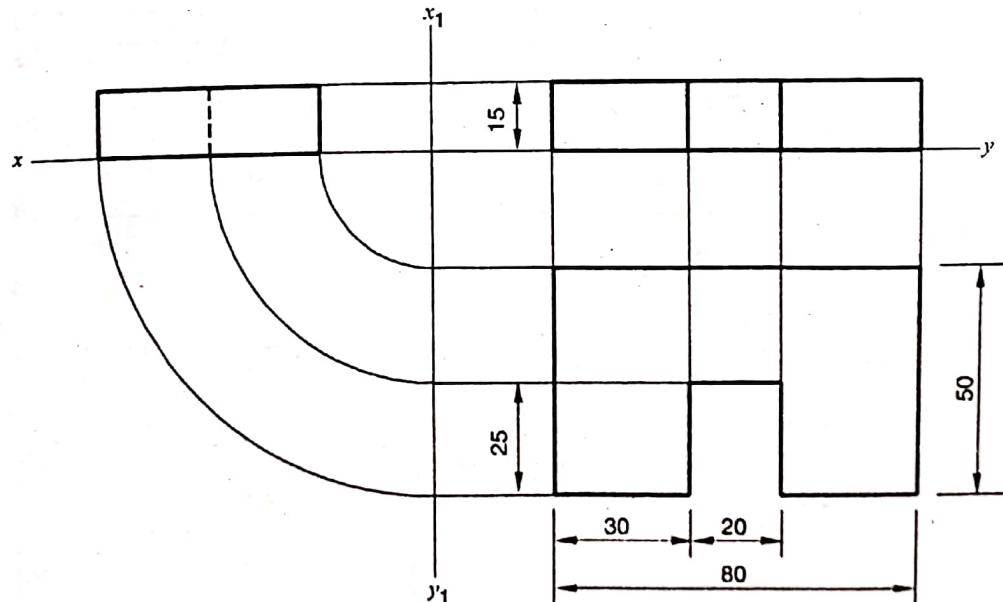


Fig. 5.20. Orthographic views in first angle projection.

Problem 5.7. Pictorial view of an object is shown in Fig. 5.27. Using first angle projection, draw its (a) front view, (b) top view and (c) right-hand side view.

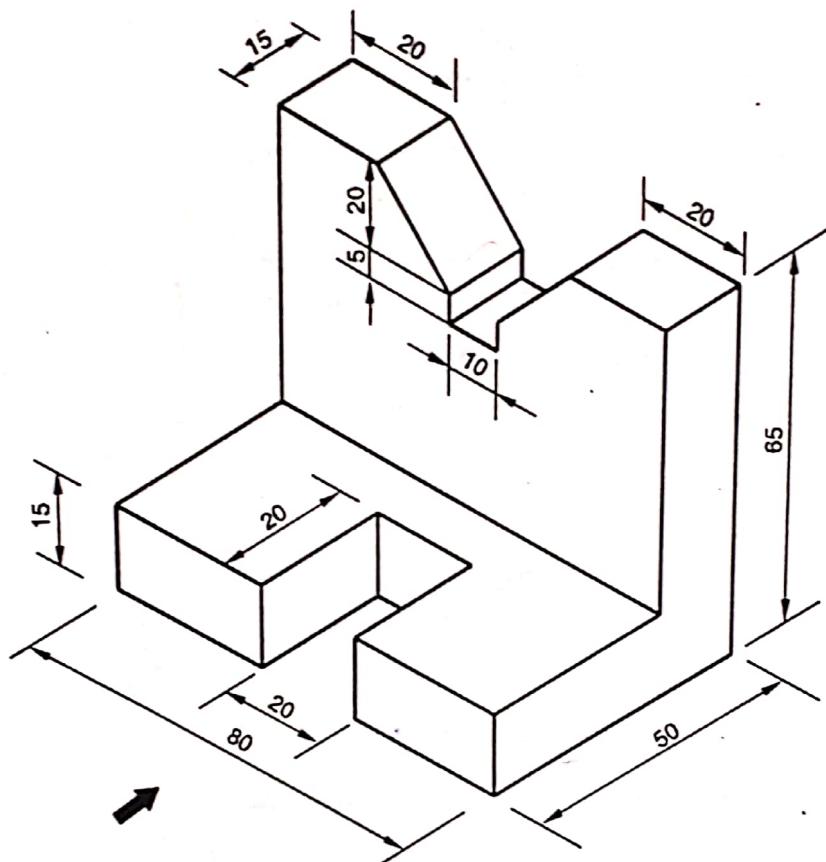


Fig. 5.27. Pictorial view.

Solution.

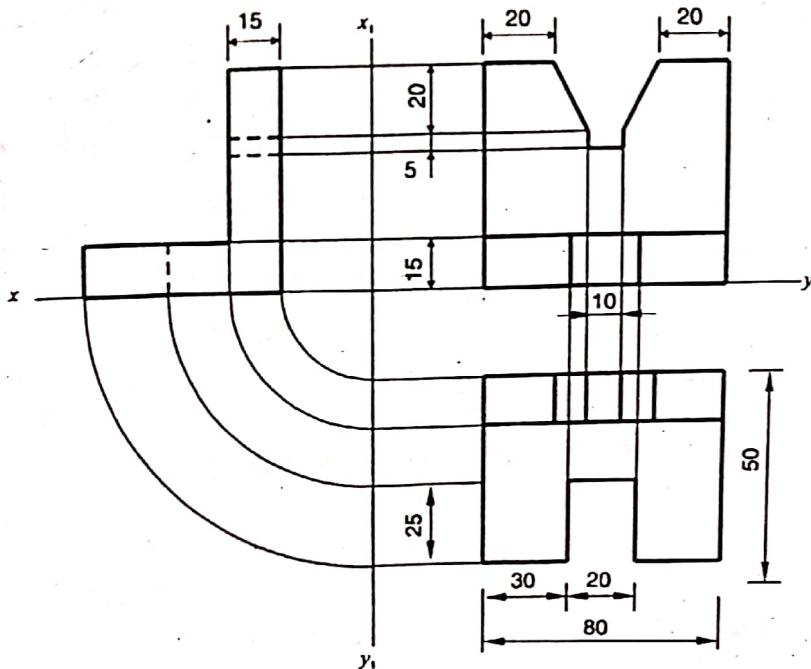


Fig. 5.28. Orthographic views in first angle projection.

5-18

Problem 5.9. Pictorial view of an object is shown in Fig. 5.31. Using first angle projection, draw its (a) front view (b) top view and (c) left-hand side view.

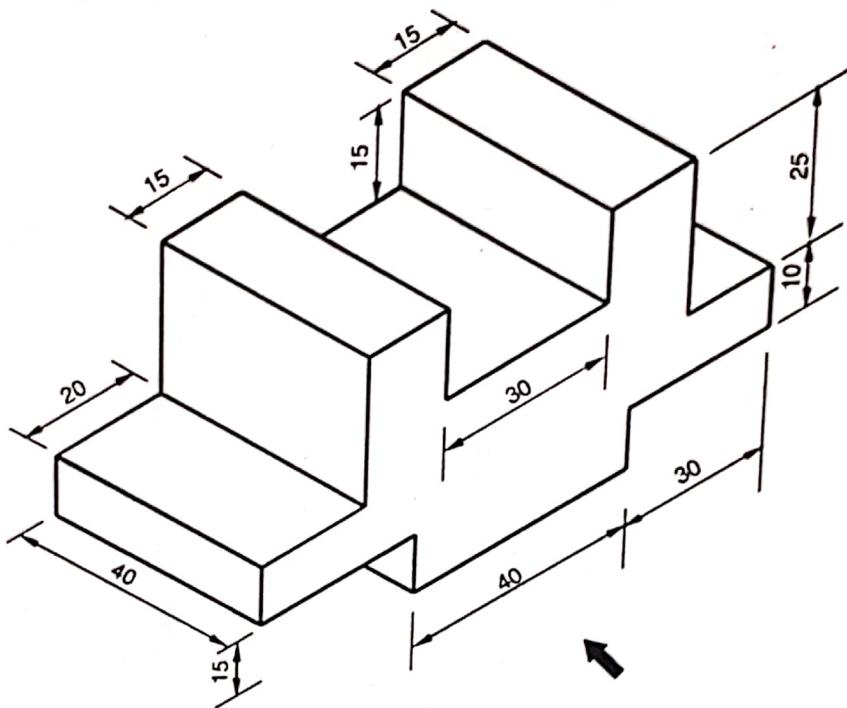


Fig. 5.31. Pictorial view.

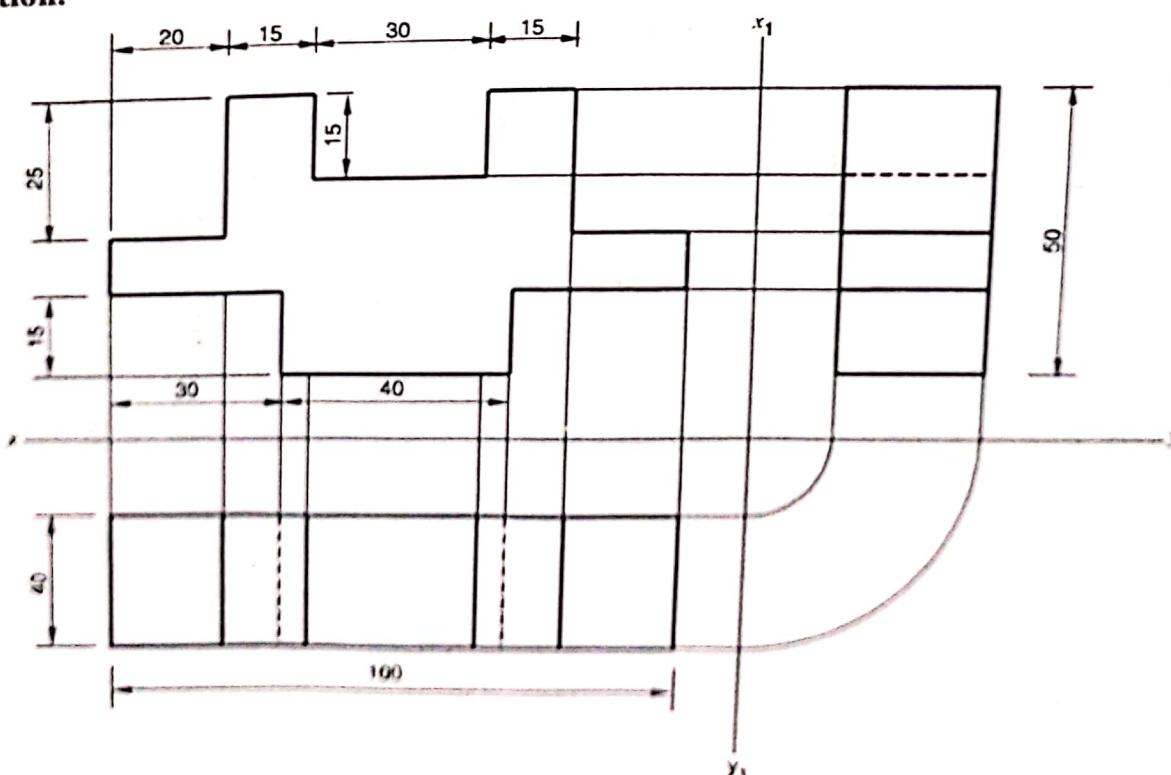
Solution.

Fig. 5.32. Orthographic views in first angle projection.

Problem 5.10. Pictorial view of an object is shown in Fig. 5.33. Using first angle projection, draw its (a) front view (b) top view and (c) left-hand side view.

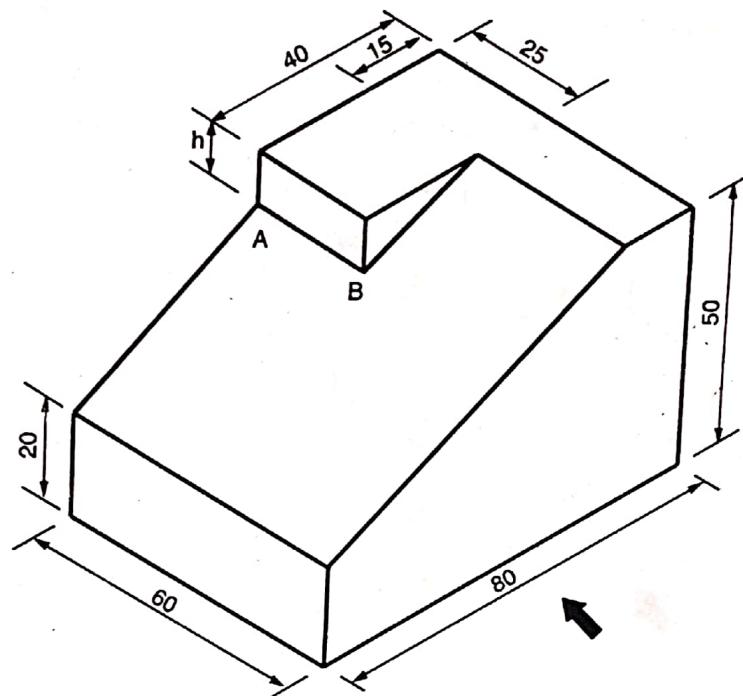


Fig. 5.33. Pictorial view.

Solution.

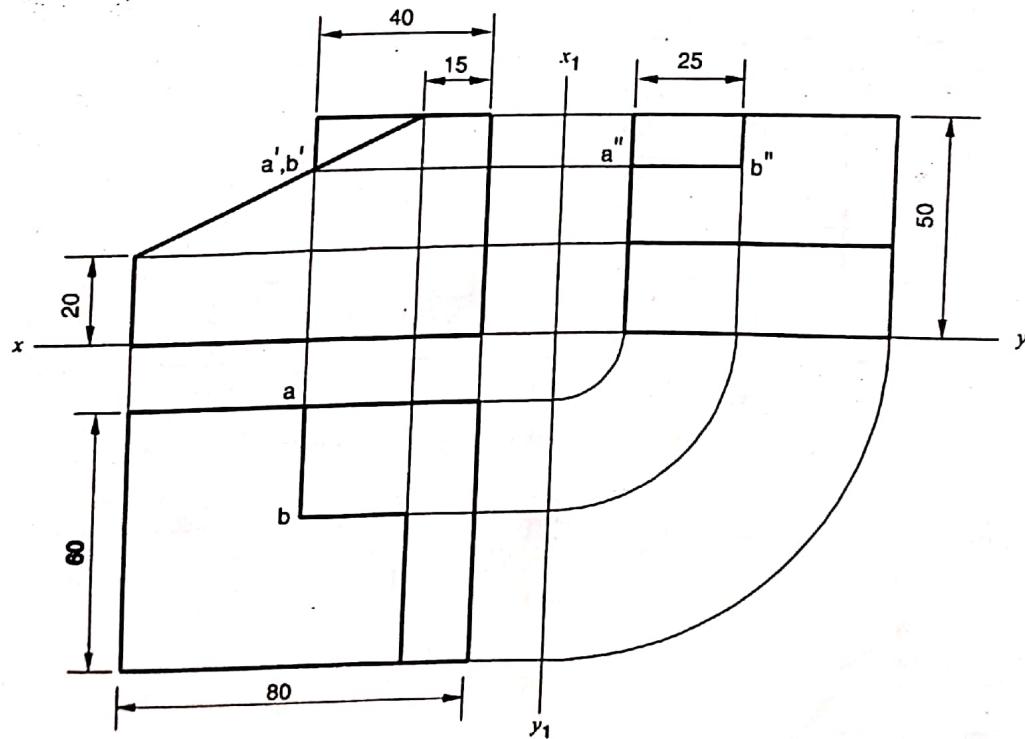


Fig. 5.34. Orthographic views in first angle projection.

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Problem 5.11. Pictorial view of an object is shown in Fig. 5.35. Using first angle projection, draw its (a) front view, (b) top view and (c) right-hand side view.

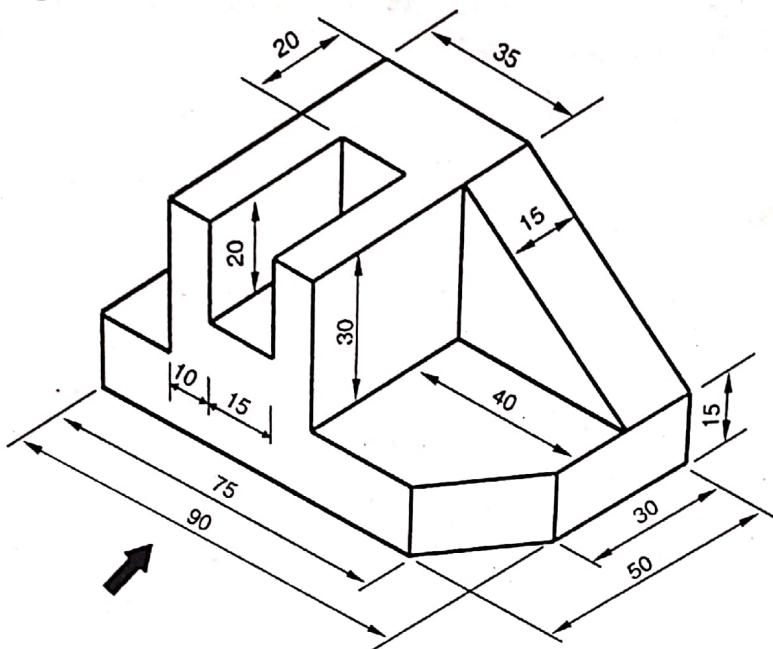


Fig. 5.35. Pictorial view.

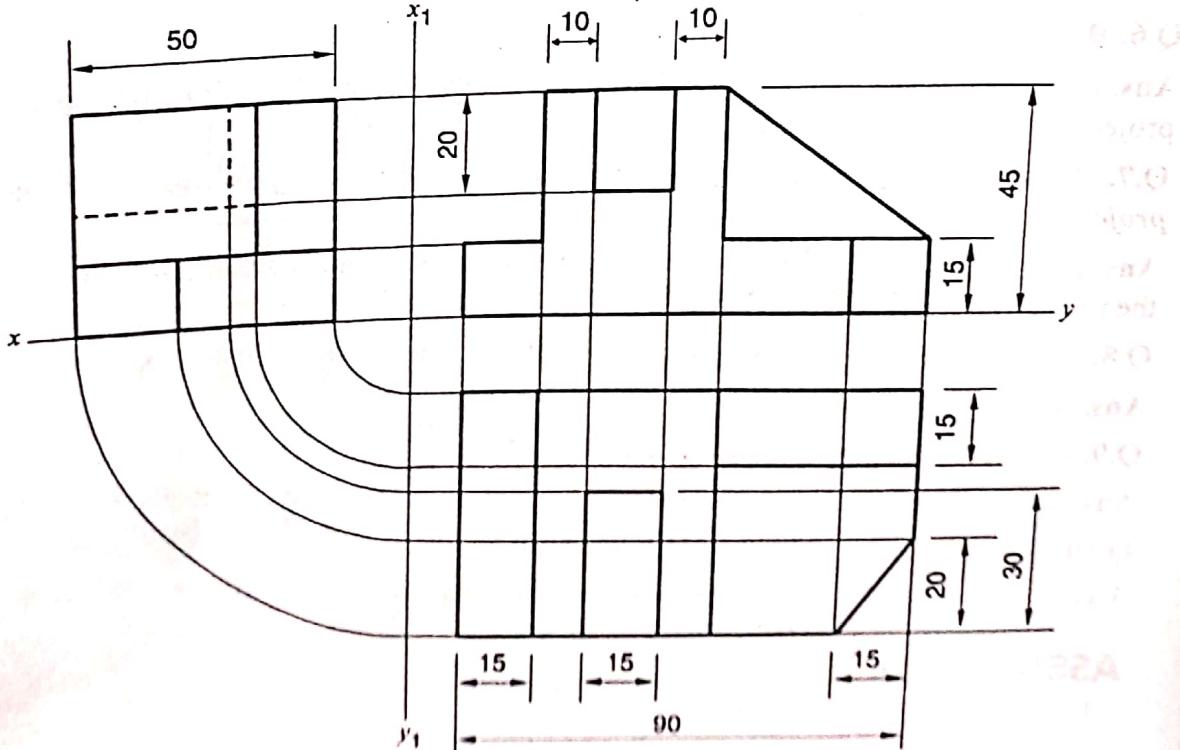
Solution.

Fig. 5.36. Orthographic views in first angle projection.