



Orthographic Projections

7.1 INTRODUCTION

Any object has three dimensions *i.e.*, length, breadth and thickness. In graphic language, the shape of an object is described by projection which is the image of the object formed by rays of sight, taken in same particular direction from the object into a picture plane, as it appears to an observer stationed at the point from or towards which the projection is made. The following are the elements to be considered while drawing a projection :

- (i) The object
- (ii) The plane of projection
- (iii) The point of sight
- (iv) The lines of sight

7.2 METHODS OF PROJECTIONS

In an engineering drawing, four methods of projections are generally used which are as follows :

- (i) Orthographic Projections
- (ii) Axonometric Projections
- (iii) Oblique Projections
- (iv) Perspective Projections

In the orthographic projections, an object is represented by two or more than two views on the mutual perpendicular planes of projections or picture planes. Each view represents two dimensions of an object. For the complete description of the three dimensional object, atleast two views are required.

In the other three methods, the objects are represented by a pictorial view only. In these methods of projections, a three dimensional object is represented on a projection plane by single view only.

7.3 PLANES OF PROJECTION

The plane on which the projection is taken is called as plane of projection or picture plane. In orthographic projections, three planes are used for getting the different views of an object. One is set-up in the vertical position is called the vertical plane (VP) or frontal plane (FP). The second, set up in horizontal position *i.e.* perpendicular to the VP, is called horizontal plane (HP). The third plane, set up perpendicular to both HP and VP is called profile plane (PP).

Both horizontal and vertical planes, which are called as principal planes, divide the whole space on one side of the profile plane in four parts, called the four dihedral angles or quadrants as shown in Fig. 7.1. The lines of intersection of these three planes are called coordinate axes. The line of intersection of HP and VP is commonly called as reference line and is generally denoted by the letters xy . The projection on VP is called the front view or elevation of the object. The projection on HP is called the top view or plan of the object. The projection on the PP is called the side view or end view or end

elevation of the object. The point of intersection of the three coordinate planes is called the origin. In this book, actual points, ends of lines, corners of solids etc. in space are denoted by capital letters *A, B, C* etc. Their top views or plan are marked by corresponding small letters *a, b, c* etc., and front views or elevation by small letters with dashes *a', b', c'* etc. The side views or end elevation are denoted by small letters with double dashes *a'', b'', c''* etc. These are the standard conventions that will be used throughout in this book.

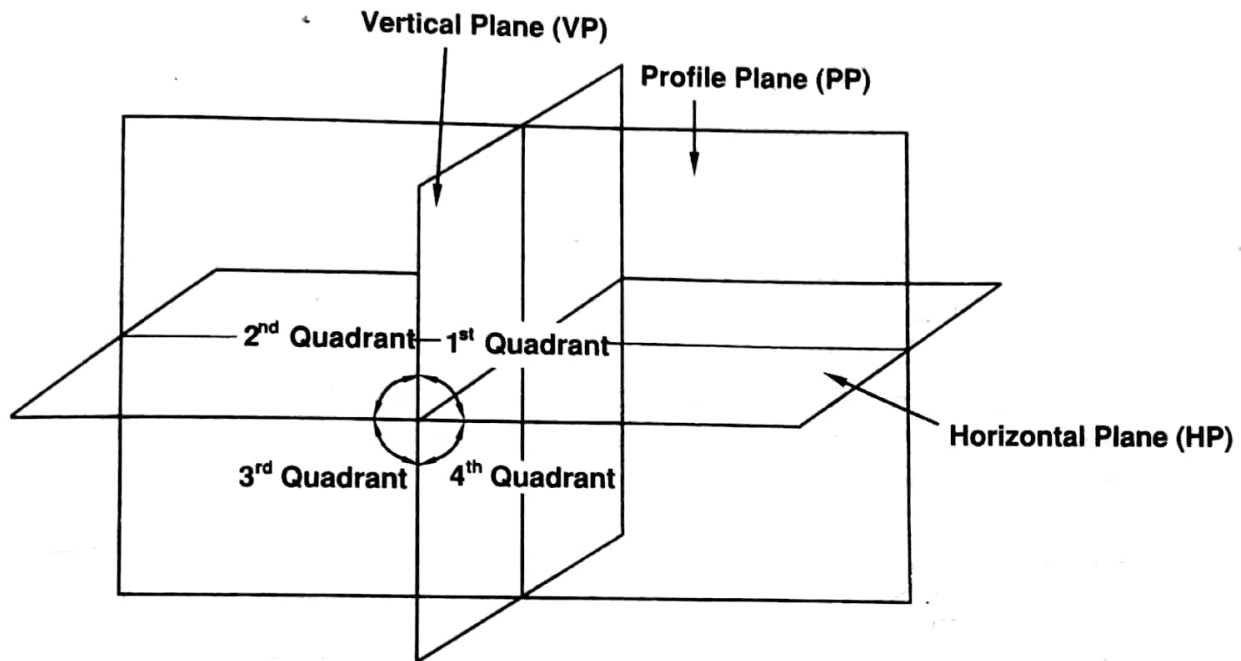


Fig. 7.1 Three planes of projections

7.4 FOUR QUADRANTS

When the planes of projections are extended beyond the line of intersection, they form four quadrants or dihedral angles, which may be numbered as shown in Fig. 7.2. The object may be situated in any one of the quadrants, its relative position to the planes being described as 'above or below the HP' and 'infront of or behind the VP'.

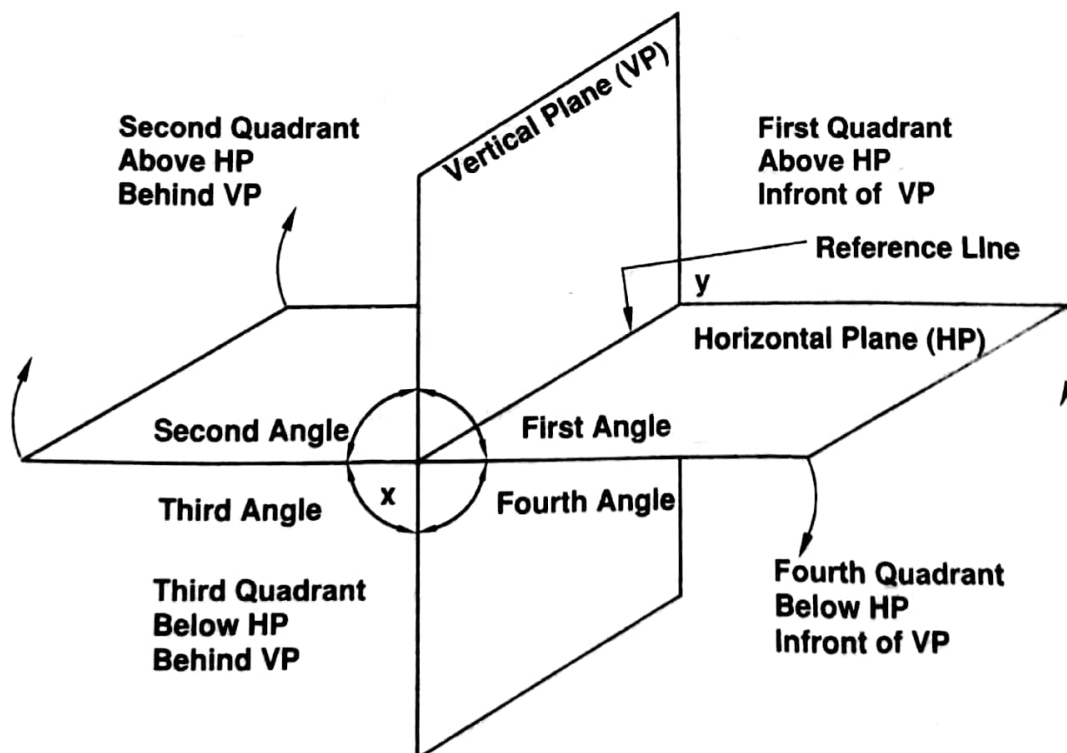


Fig. 7.2 Four quadrants

A projection is said to be the first angle, second angle, third angle or fourth angle when the object is imagined to be either in first quadrant, second quadrant, third quadrant or fourth quadrant respectively. The two principal planes are made to lie in one plane by holding VP and rotating HP through 90° , clockwise. However, only two systems *i.e.*, the first and third angle projections are being followed, because only first and third quadrants are always opened out while rotating the planes. The positions of views donot overlap in these quadrants. Whereas in second and fourth quadrants, the positions of views overlap. That is why second and fourth angle projections are not used.

7.5 FIRST-ANGLE PROJECTION

In first-angle projection, an object is imagined to be positioned in first quadrant. The front view is obtained by looking at the object from right side of quadrant. In this case, the object will be in between observer and plane of projection.

Similarly, top view and side view are obtained by looking at the object, normal to its surface. As there are two sides for an object (left side and right side), so two possible views from the side *i.e.* left side view and right side view may be obtained for any object.

In the first-angle projection, a left side view is obtained on the profile plane by placing it to the right side of the object. Thus, in first-angle projection any view is so placed that it represents the side of the object away from it, as shown in Fig. 7.3.

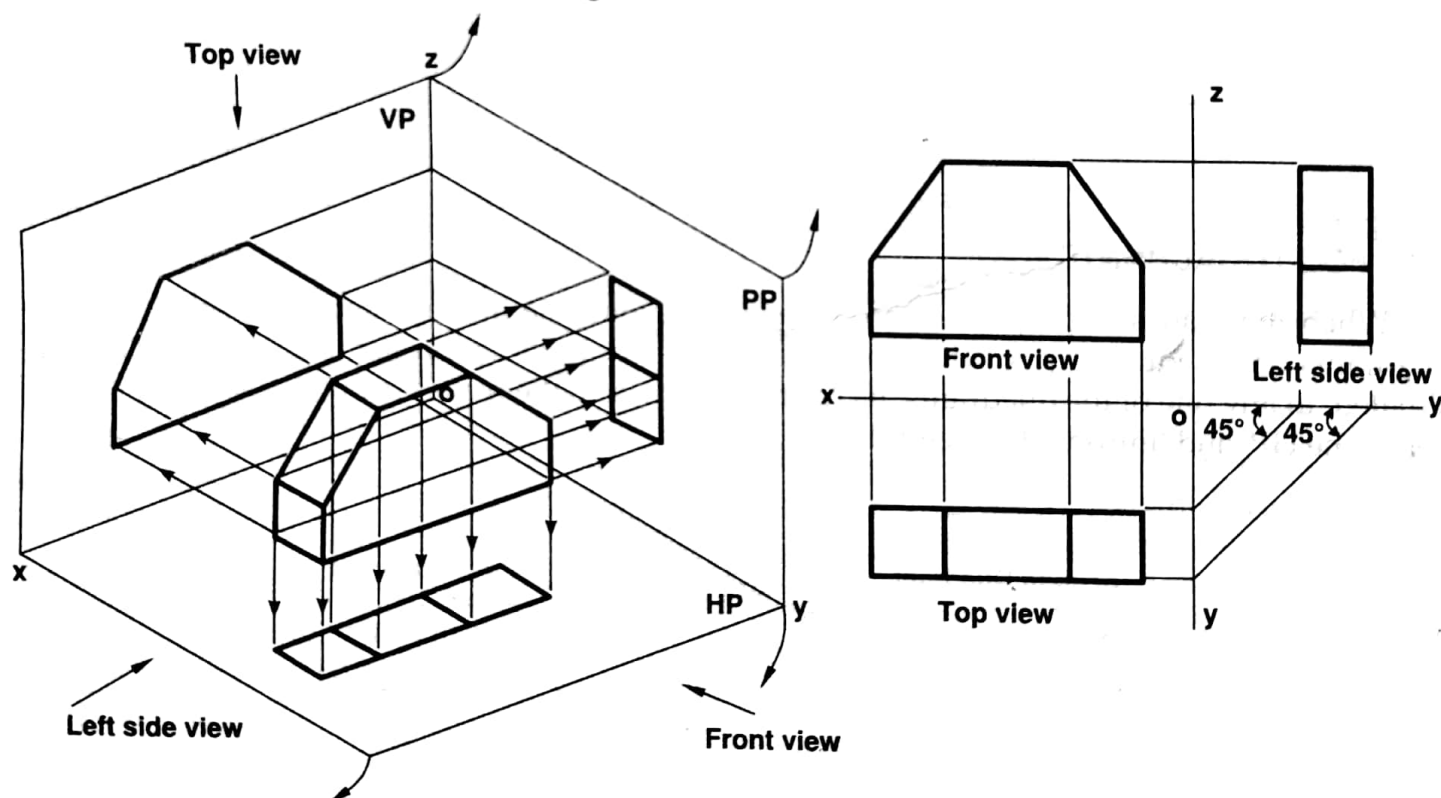


Fig. 7.3 Presentation of orthographic views in first angle projection

7.6 THIRD-ANGLE PROJECTION

In third-angle projection, an object is imagined to be positioned in third quadrant. The front view is obtained by looking at the object from right side of quadrant. In this case, the plane of projection is in between the object and observer. The plane of projection is imagined to be transparent and rays of sight pass through it and then reach the object.

Similarly, its top view and side view are obtained by looking at the object, normal to its surface. It may be noted that in third-angle projection, a left side view is obtained by placing the profile plane to the left side of the object. Thus in third-angle projection any view is so placed that it represents the side of the object nearer to it, as shown in Fig. 7.4.

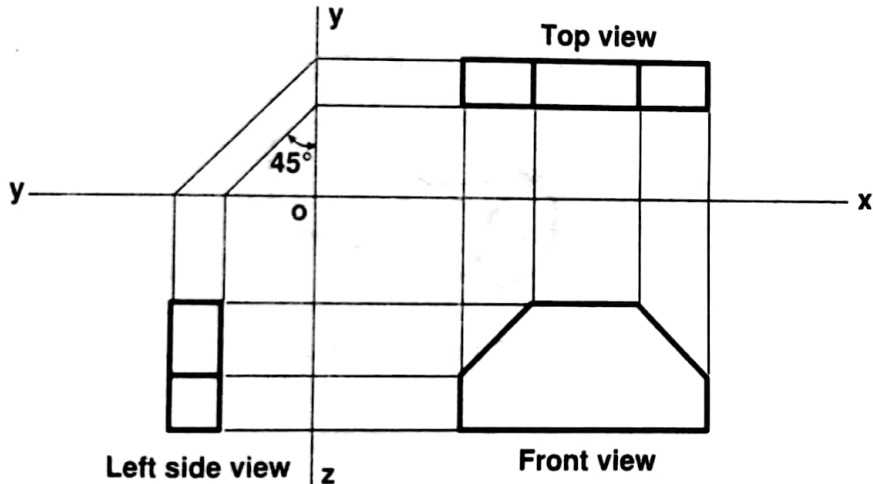
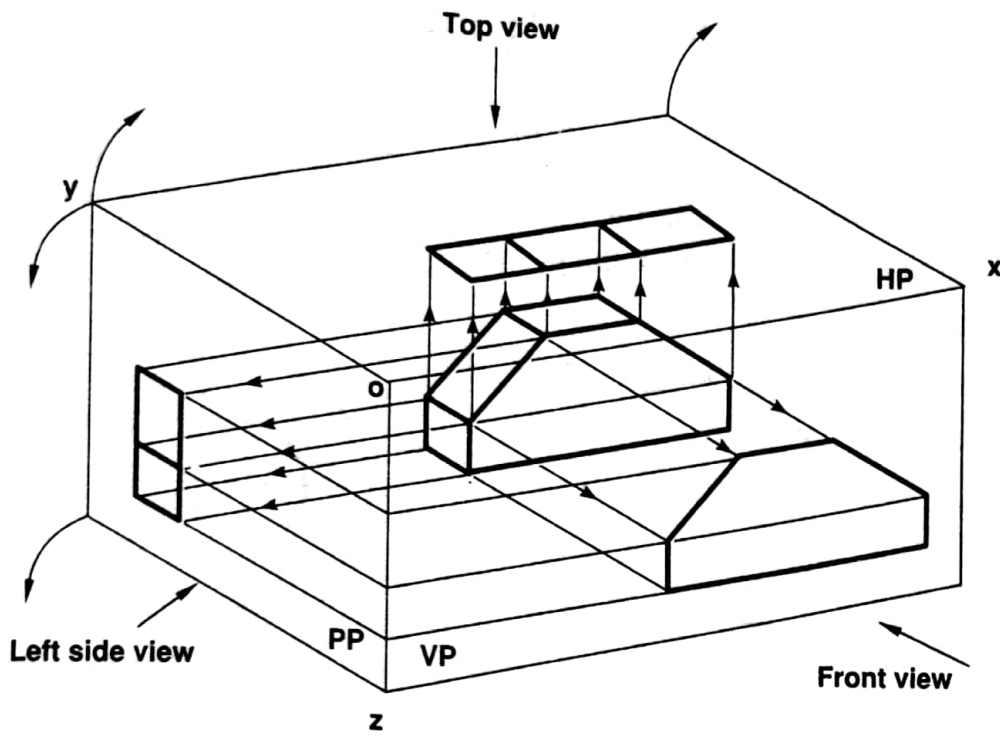


Fig. 7.4 Presentation of orthographic views in third-angle projection

Table 7.1 Difference between first-angle projection method and third-angle projection method

S. No.	Common point	First-angle projection method	Third angle projection method
1.	Quadrant	The object lies in the first quadrant.	The object is <u>assumed to lie</u> in the third <u>quadrant</u> .
2.	Octant	The object lies in the <u>first octant</u> .	The object lies in the <u>seventh octant</u> .
3.	Position of object	The object lies in between the observer and plane of projection.	The plane of projection lies in between the object and the observer.
4.	Plane of projection	The plane of projection is assumed to be <u>non-transparent</u> .	The plane of projection is <u>assumed to be transparent</u>
5.	Position of views	In this method, front view or elevation lies above the xy, top view or plan below the xy and left side view is drawn to the right of elevation.	In this method, front view or elevation lies below the xy, top view or plan above the xy and left side view is drawn to the left of elevation.
6.	Commonly Used Countries	This method is commonly used by the <u>Bureau of Indians Standards (BIS)</u> and <u>European countries</u> .	This method is commonly used in <u>USA</u> and <u>other countries</u> .

7.7 SYMBOLS USED FOR FIRST-ANGLE PROJECTION METHOD AND THIRD-ANGLE PROJECTION METHOD

For every drawing, it is absolutely essential to indicate the method of projection adopted. This is done by means of a symbolic figure drawn on a title block. The symbol drawn for first-angle projection method is shown in Fig. 7.5, while that for the third-angle projection method is shown in Fig. 7.6. These symbols are actually obtained from the projections of frustum of a cone as shown in Fig. 7.7.

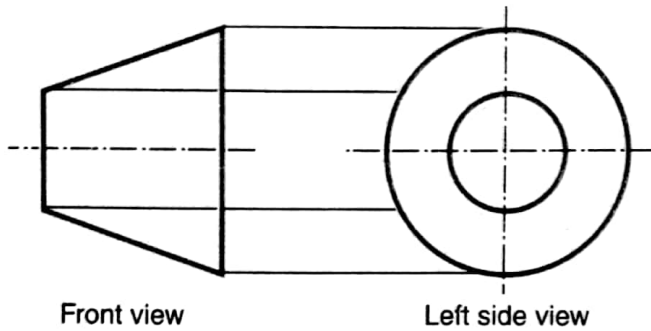


Fig. 7.5 Symbol for first-angle projection method

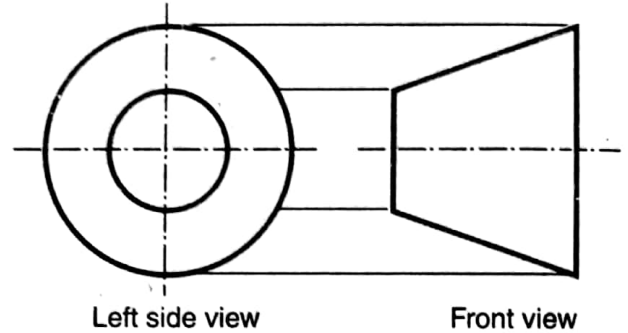


Fig. 7.6 Symbol for third-angle projection method

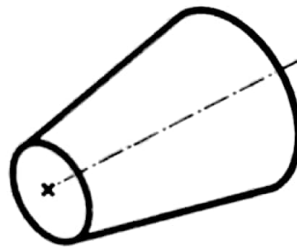


Fig. 7.7 Frustum of a cone

EXERCISES

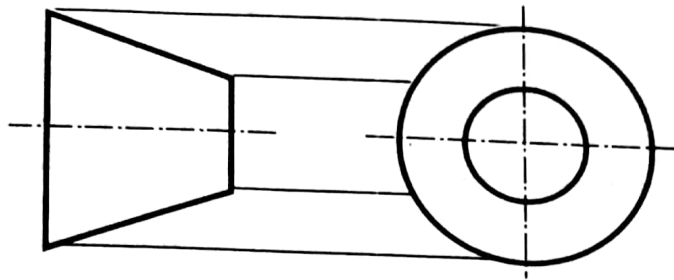
- 7.1 What do you mean by orthographic projection. Describe briefly the method of obtaining the orthographic projection of an object ?
- 7.2 Explain with the help of neat sketches, the difference between first-angle projection method and third-angle projection method ?
- 7.3 Why the projections of an object are not drawn in second and fourth quadrants ?
- 7.4 Write short notes on

(i) Principal planes	(ii) Reference line	(iii) Projection
(iv) Front view	(v) Top view	(vi) Side view

OBJECTIVE QUESTIONS

- 7.1 In projection, the object is positioned in between the observer and the plane of projection.
- 7.2 In third angle projection, the is positioned in between the observer and object.
- 7.3 Draw the symbols for first-angle projection method and third-angle projection method.
- 7.4 A surface of an object appears in its true shape, when it is to the plane of projection.
- 7.5 What is a plane of projection ?
- 7.6 In orthographic projection the lines of sight are to the plane of projection.
- 7.7 The three planes of projection are, and

- 7.8 Following symbol represents first or third angle projection.
 7.9 What is the full name of 'HP' and 'VP' ?
 7.10 Distinguish between the terms 'Projector' and 'Projection' by means of suitable sketches.
 7.11 What is a profile plane and state its use ?



ANSWERS

- | | | |
|--|--|----------------------------|
| 7.1 First-angle | 7.2 Plane of projection | 7.4 Parallel |
| 7.6 Perpendicular | 7.7 Horizontal, vertical, profile planes | 7.8 Third-angle projection |
| 7.9 HP → Horizontal plane, VP → Vertical plane | | |