Lecture (1)

Definition of Descriptive Geometry: DG is a method to study 3D geometry through 2D images. The aim of Descriptive Geometry is to describe the three - dimensional objects by two - dimensional drawings so as to allow reconstituting their original forms.

The Theory of Projection

Projection is the representation on a plane surface of the image of an object as it is observed by a viewer and the plane on which the image is represented is known as the Plane of Projection.

If the eye is directed towards a body in a space, rays or projectors will come from the visible parts of the body and gathered at the eye in a point. The type of projection that produces the image in our eye is called **Central Projection**. The images produced by central projection convey the sensation of depth. If a plate ABCD as illustrated in figure (1) is placed in front of a plane of projection, and if we imagine that rays will pass from point (o) to the different points of the object, then the view *abcd* will be obtained. In this type of projection, point (o) is called the centre of projection.

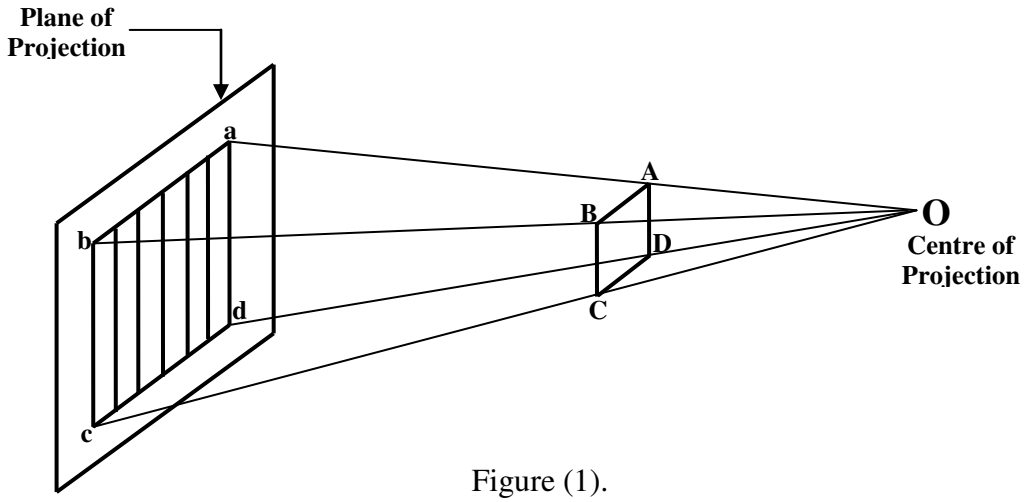

Figure (1).

Descriptive Geometry is based on another type of projection that is called **Parallel Projection** or **Orthographic Projection on Two Orthogonal Planes** which is one of the cases of the parallel projection in which the shape description of a three dimensional is represented on drawing paper which is a two dimensional plane surface, and If we imagine that point (o), the centre of projection goes far away to infinity, the rays or projectors will become parallel to each other and normal to the plane of projection, and the view obtained is orthographic as illustrated in figures (2) and (3).

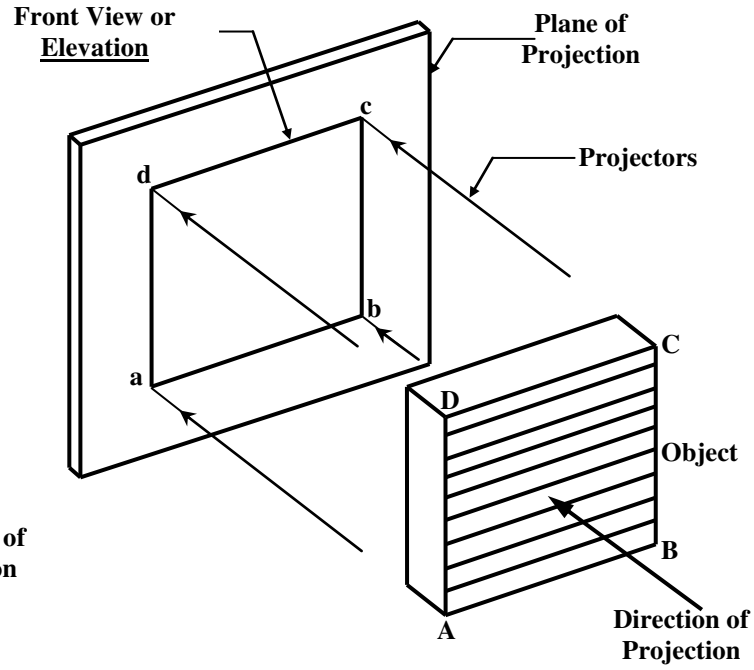

Figure (2).

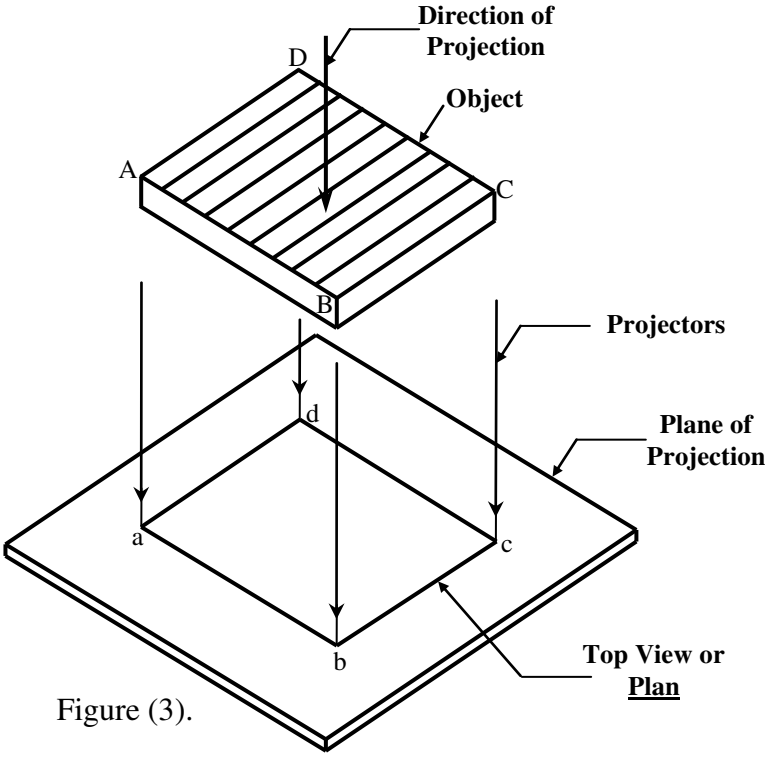

Figure (3).

In order to specify fully the shape of an object in orthographic projection at least two planes of projection are required. These principal planes are known as the **Horizontal Plane (HP)** and the **Vertical Plane (VP)**. Any plane other than these two planes is called **Auxiliary Plane (AP)**.

The two principal planes HP and VP intersect at right angles and divide the space into four quadrants or dihedral angles 1^{st}, 2^{nd}, 3^{rd}, and 4^{th} as shown in figure (4).

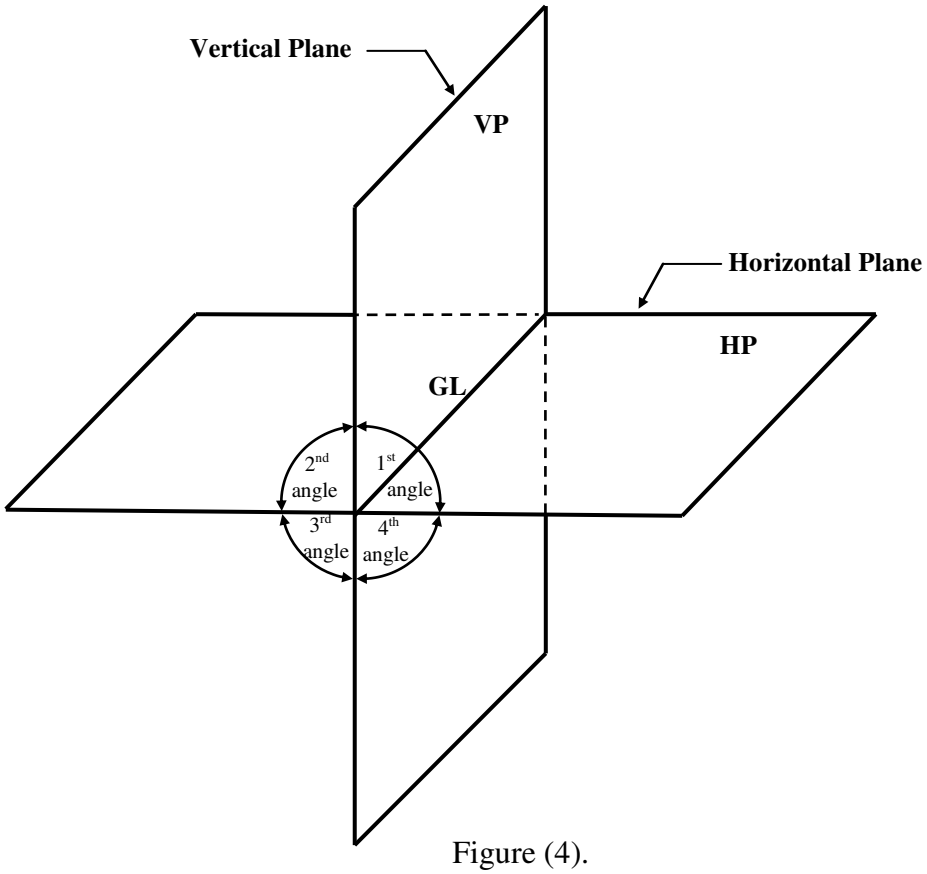

Figure (4).

The line of intersection of these two planes is called the **Ground Line (GL)**. The method of projection on two perpendicular planes is called **Monge's Projection Method** relative to the French scientist Gaspard Monge.

Consider an object situated in space relative to the principal planes as illustrated pictorially in figure (5).

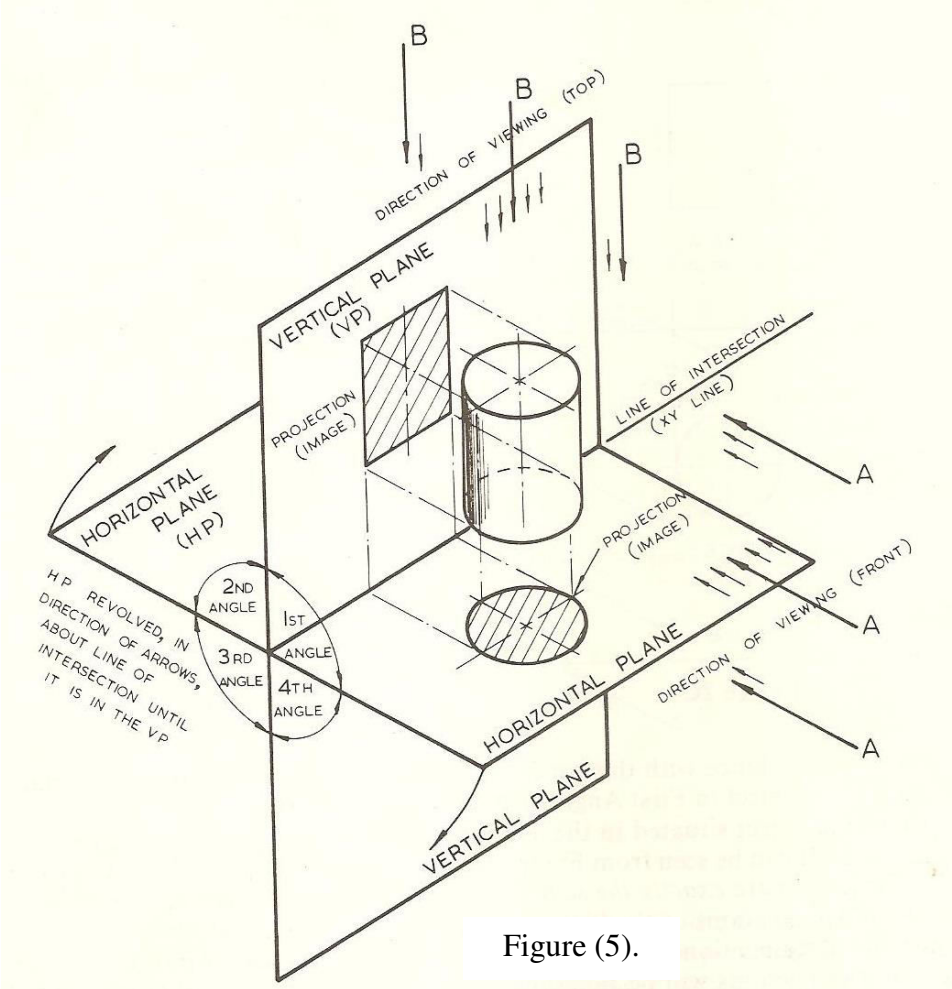

Figure (5).

The object as shown is in the first angle and the lines of sight are parallel, at right angles to the planes of projection and in general, the object is viewed from the top and front positions regardless of the quadrant or angle in which it is placed. The horizontal plane will be revolved about GL or XY line in the direction shown until it is coincident with the vertical plane. The projection on the VP is known as the **Front View** or **Elevation** and the projection on the HP is known as the **Top View** or **Plan**, and we can see the conversion of the object from the space (3D object) to the plane (2D views) in figure (6) that shows the Plan and Elevation of the object in First Angle Orthographic Projection**.**

Now consider the object situated in the 3rd dihedral angle or quadrant and apply the same rules that have been mentioned above. It can be seen that the views in Third Angle Orthographic Projection are exactly the same as in First Angle Orthographic Projection but the positions of the Plan and Elevation are different as in figure (7). The place of the object in 3rd angle is shown in figure (8).

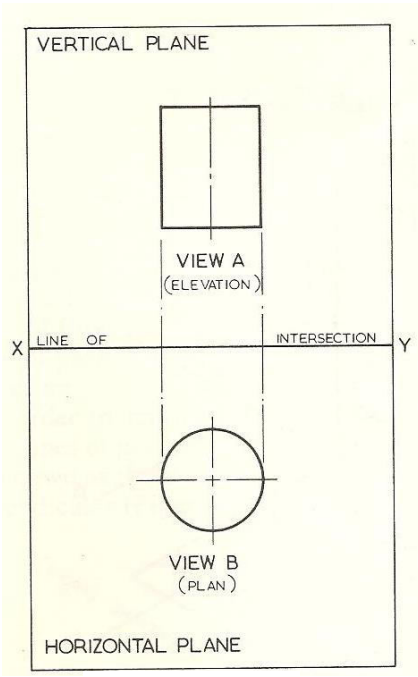

Figure (6).

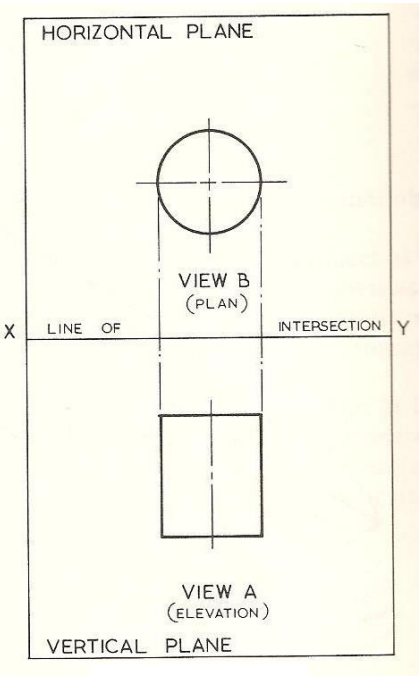

Figure (7).

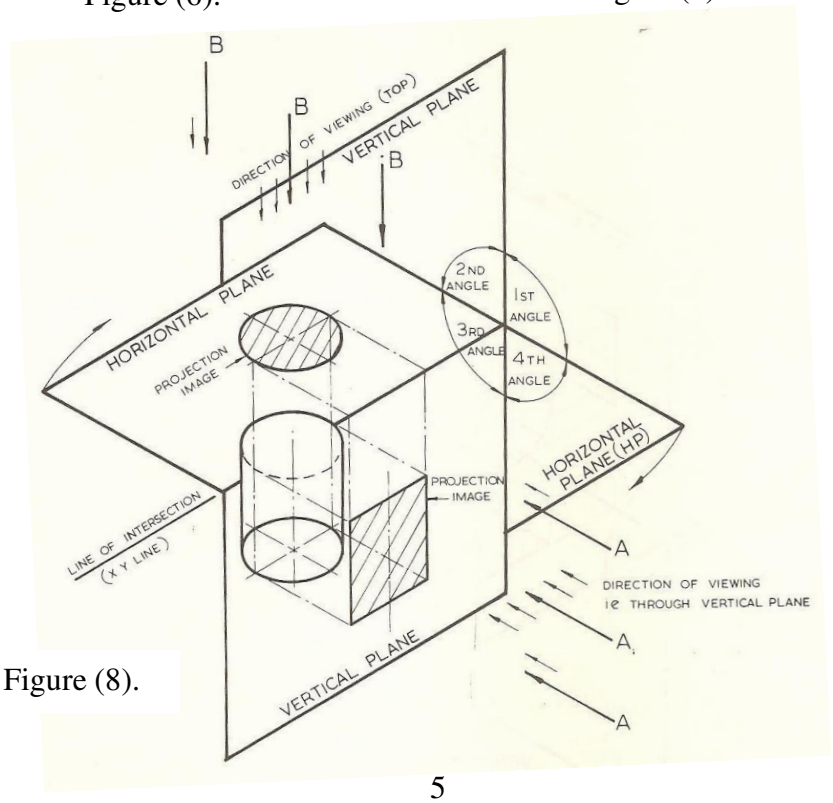

Figure (8).

Sometimes the two views obtained from the projection of an object on the two principal planes are insufficient for representing the object clearly, so we need a third plane perpendicular to both the HP and VP, and which is named an **Auxiliary Vertical Plane AVP**. Consider the cylinder positioned relative to the principal planes in the 1st dihedral angle as shown in figures (9). It can be seen that the Elevation and Plan are similar to each other; therefore, another view of the object is necessary to understand the complete shape, and for this purpose the third plane AVP is normally used. The projection on this third plane is called the **Side View** or **End View**. The system of projection used on a drawing should be indicated by the appropriate symbol. Figure (10) shows the symbol and the views (Elevation, Plan, and End View) for the projection in the 1st quadrant. The same thing is required when we consider the cylinder positioned relative to the principal planes in the 3rd dihedral angle. Figure (11) shows the place of cylinder in the third quadrant and the symbol and the views (Elevation, Plan, and End View) for the projection in the 3rd angle or quadrant as in figure (12).

It is noticed in First Angle Projection that the object to be represented appears between the observer and the planes of projection on which the object is orthogonally projected while in Third Angle Projection the plans of projection are placed between the object and the observer. On each projection plane, the object is represented as if it is seen orthogonally from in front of each plane.

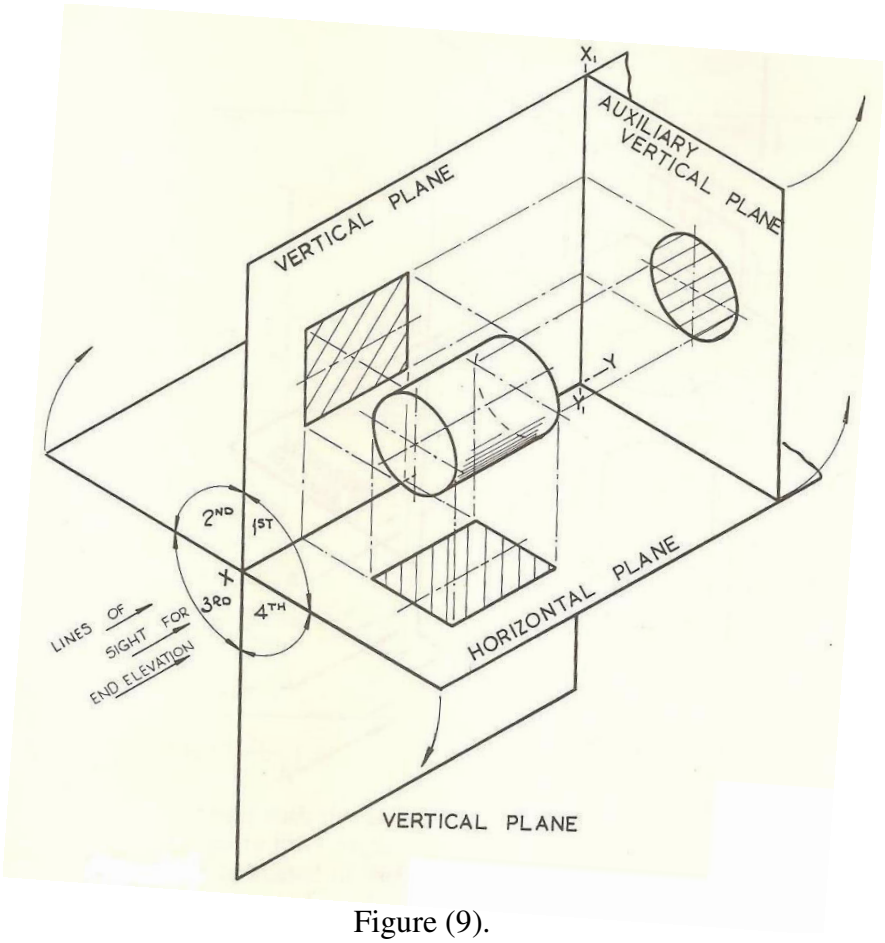

Figure (9).

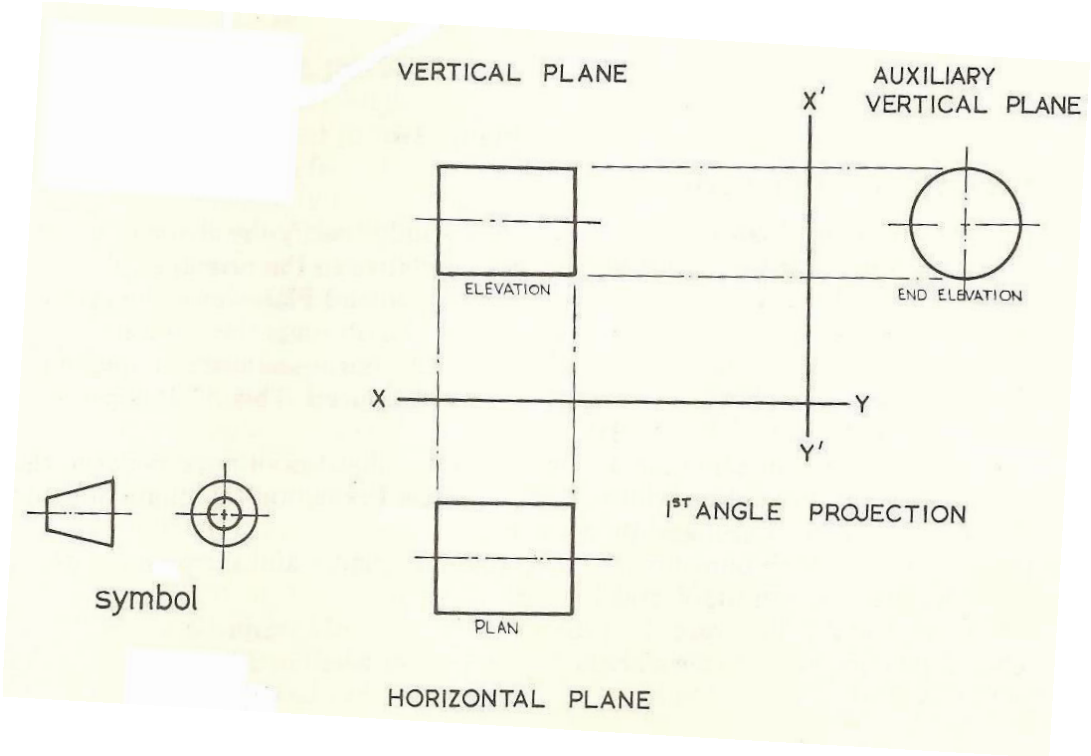

Figure (10).

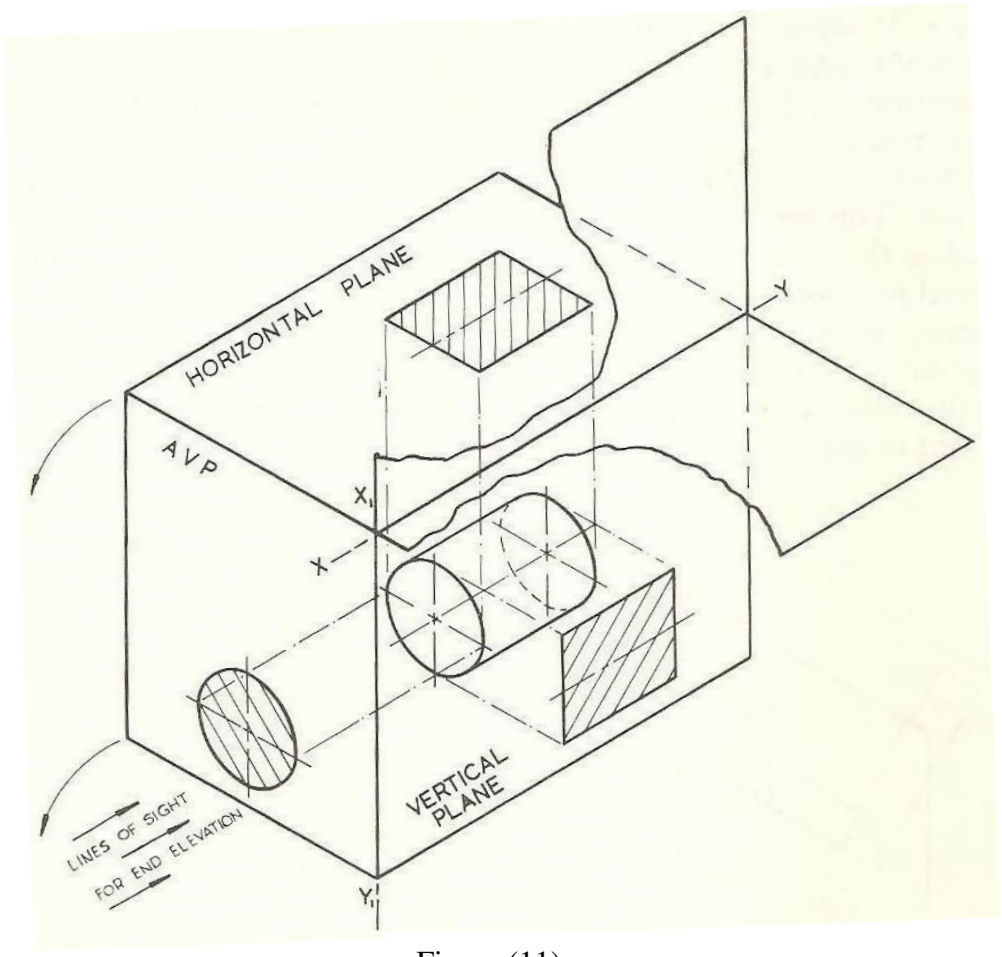

Figure (11).

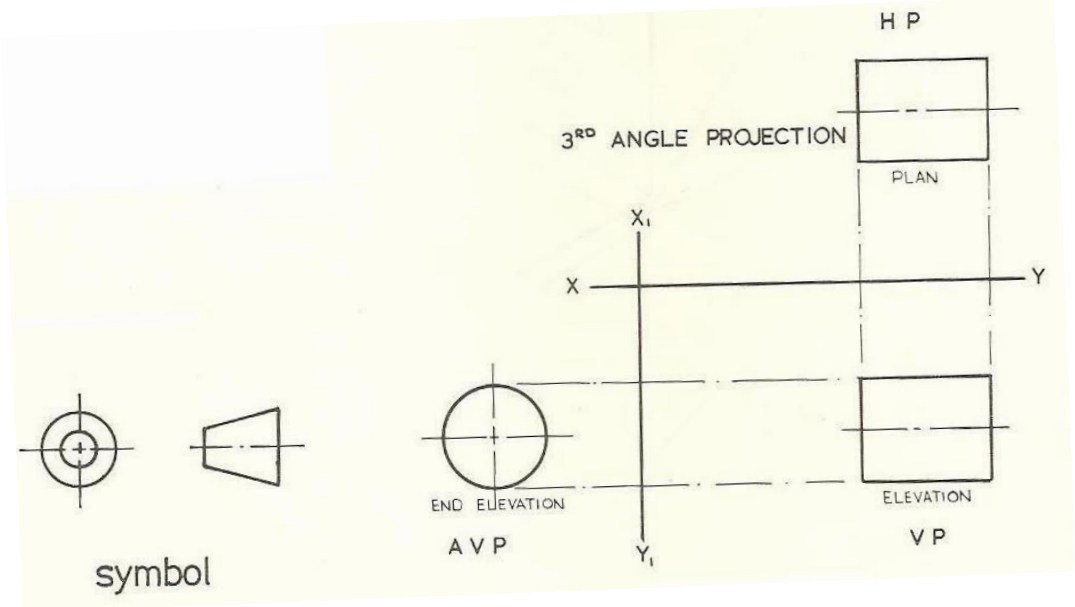

Figure (12).