Unit 2 Projection

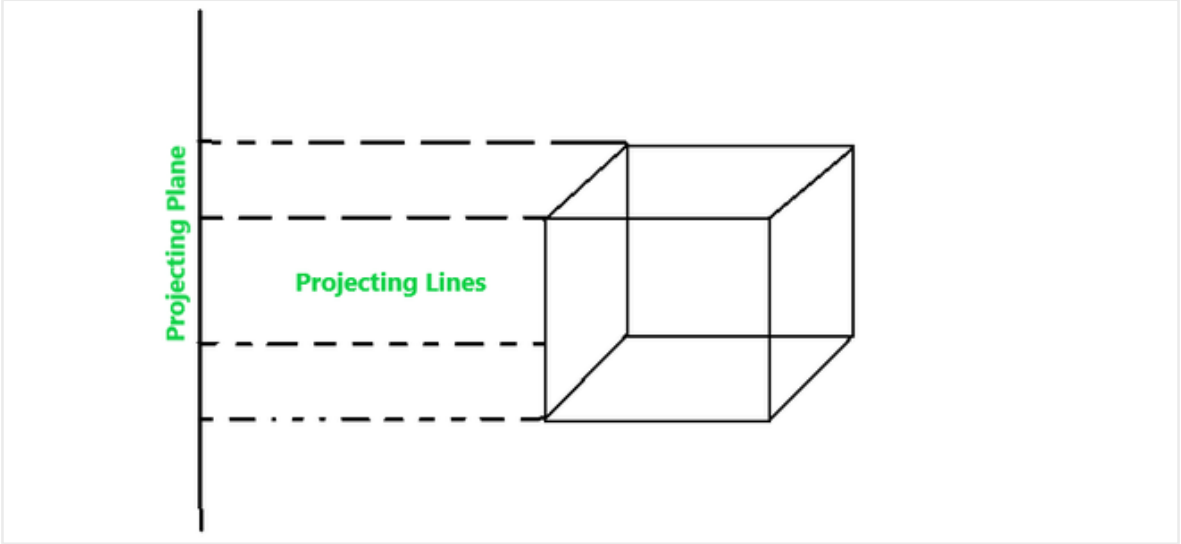
Parallel (Othographic & Oblique) Projection in Computer Graphics

Projection is a kind of phenomena that are used in computer graphics to map the view of a 3D object onto the projecting display panel where the viewing volume is specified by the world coordinate and then map these world coordinate over the view port.

Projection is of the following kind :

a) Parallel Projection **b) Perspective Projection**

Parallel Projection : Parallel projection is a kind of projection where the projecting lines emerge parallelly from the polygon surface and then incident parallelly on the plane. In parallel projection, the centre of the projection lies at infinity. In parallel projection, the view of the object obtained at the plane is less-realistic as there is no for-shortcoming. and the relative dimension of the object remains preserves.



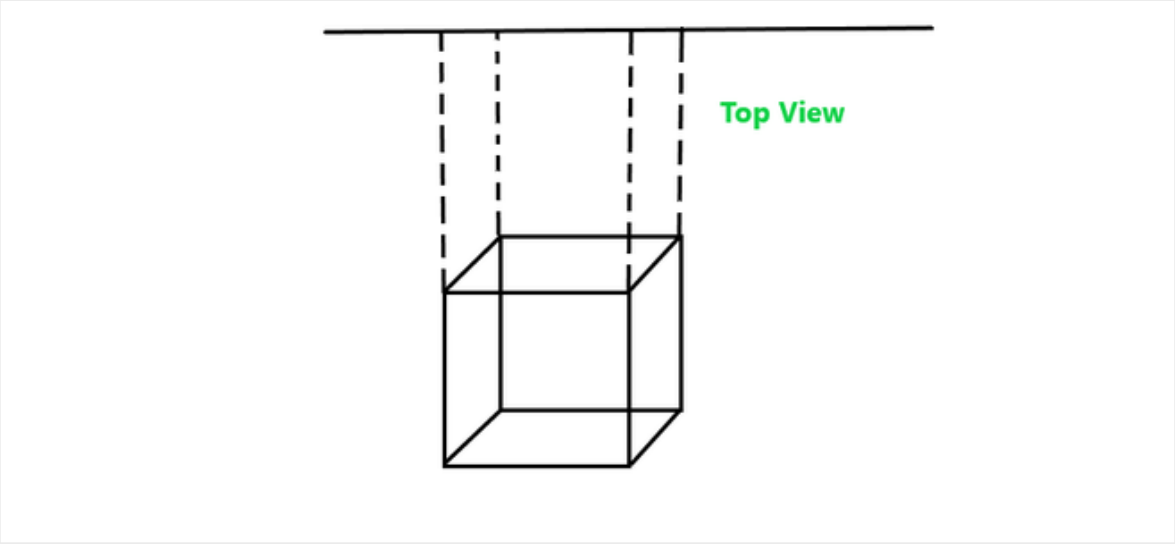
Parallel projection is further divided into two categories :

a) Orthographic Projection

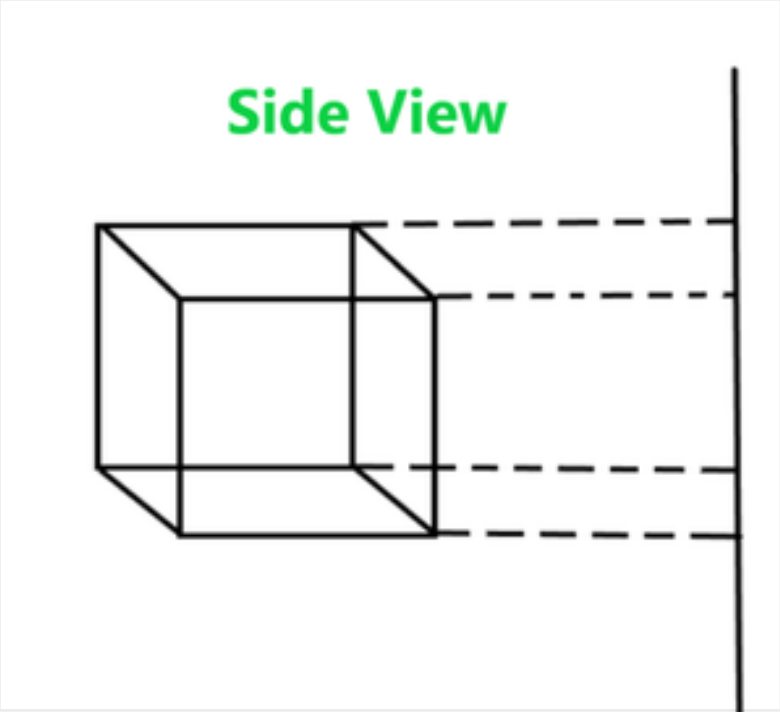
b) Oblique Projection

(a) Orthographic Projection : It is a kind of parallel projection where the projecting lines emerge parallelly from the object surface and

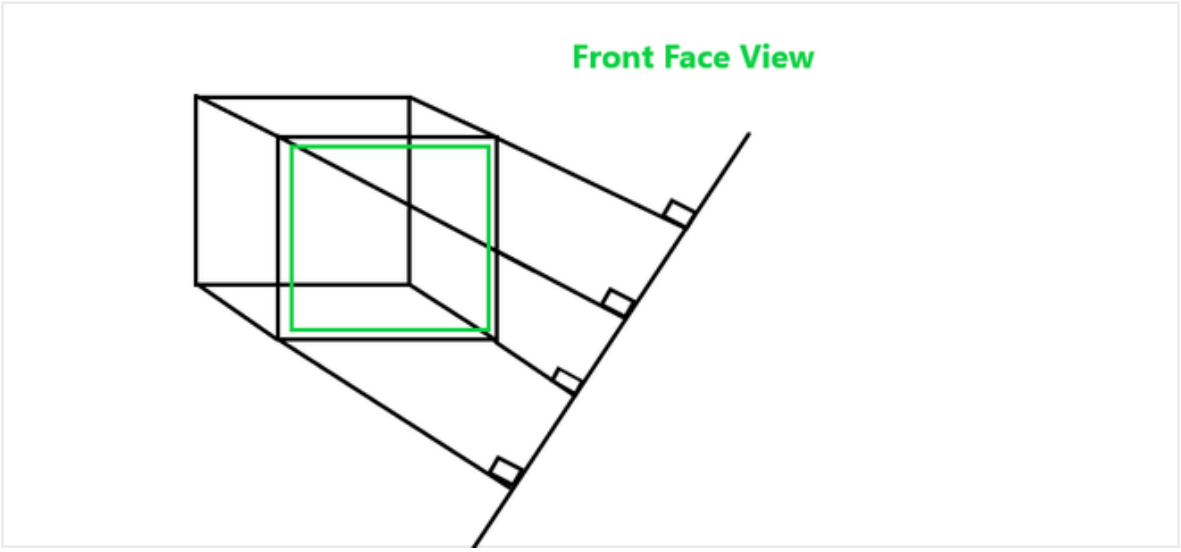
incident perpendicularly at the projecting plane.
Orthographic Projection is of two categories :
(a).1. Multiview Projection : It is further divided into three categories –
(1) Top-View : In this projection, the rays that emerge from the top of the polygon surface are observed.



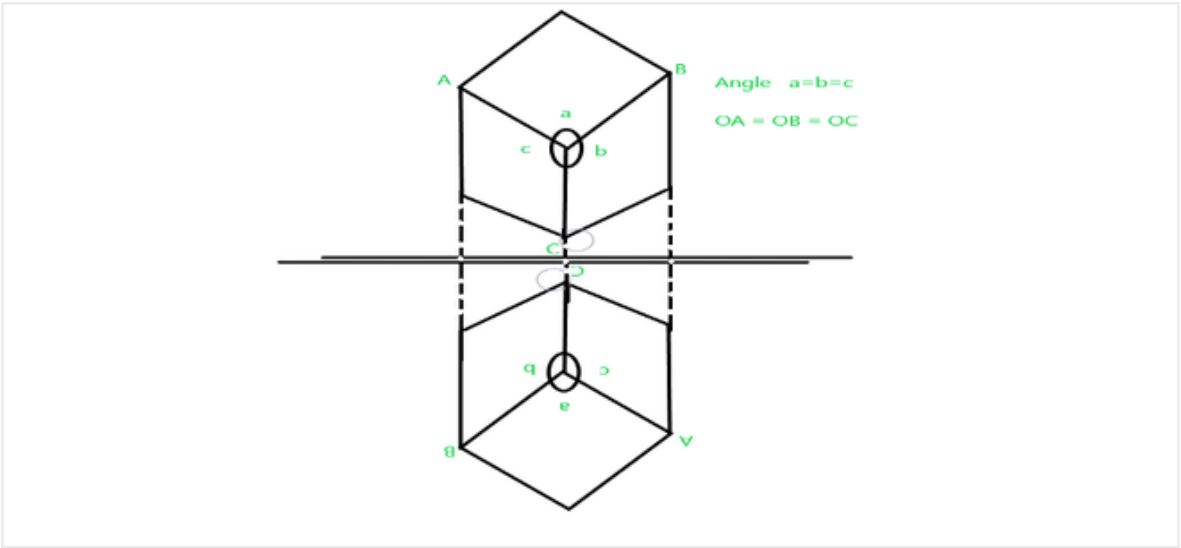
2) Side-View : It is another type of projection orthographic projection where the side view of the polygon surface is observed.



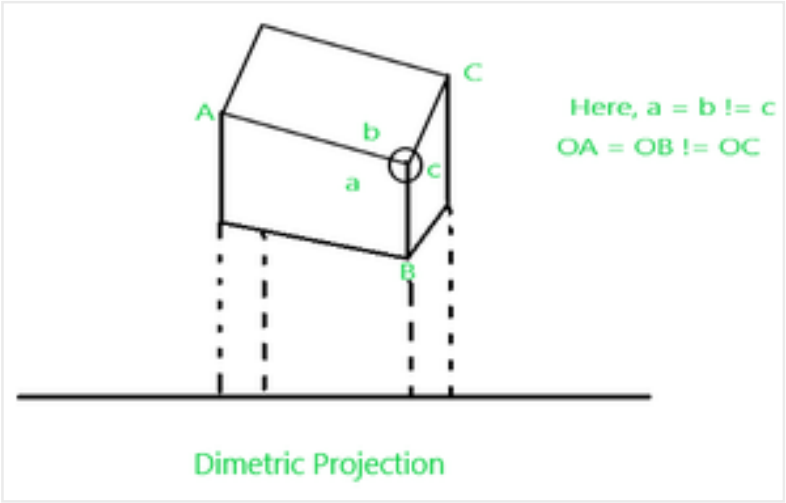
3) Front-view : In this orthographic projection front face view of the object is observed.



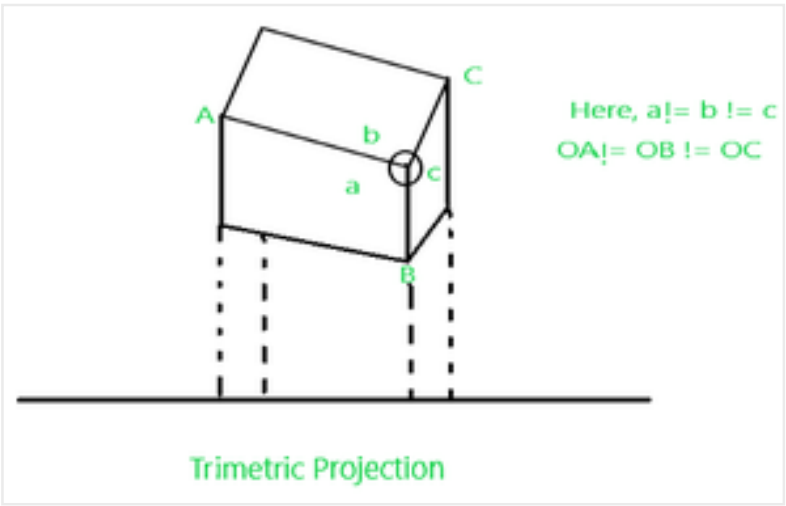
a.2) Axonometric : Axonometric projection is an orthographic projection, where the projection lines are perpendicular to the plane of projection, and the object is rotated around one or more of its axes to show multiple sides.
It is further divided into three categories :
(1) Isometric Projection : It is a method for visually representing three-dimensional objects in two-dimensional display in technical and engineering drawings. Here in this projection, the three coordinate axes appear equally foreshortened and the angle between any two of them is 120 degrees.



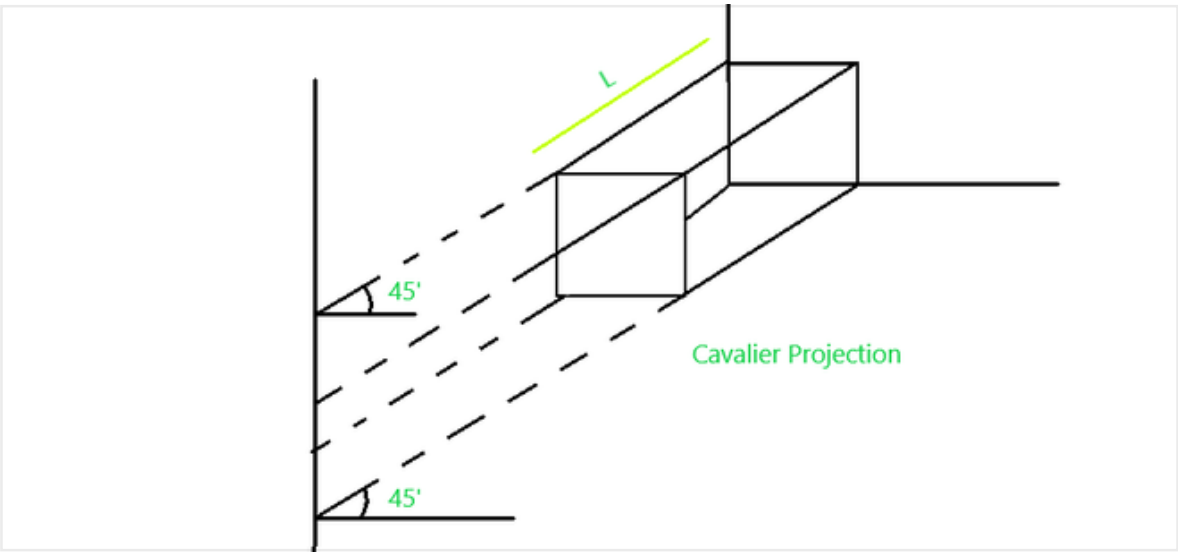
(2) Dimetric Projection : It is a kind of orthographic projection where the visualized object appears to have only two adjacent sides and angles are equal.



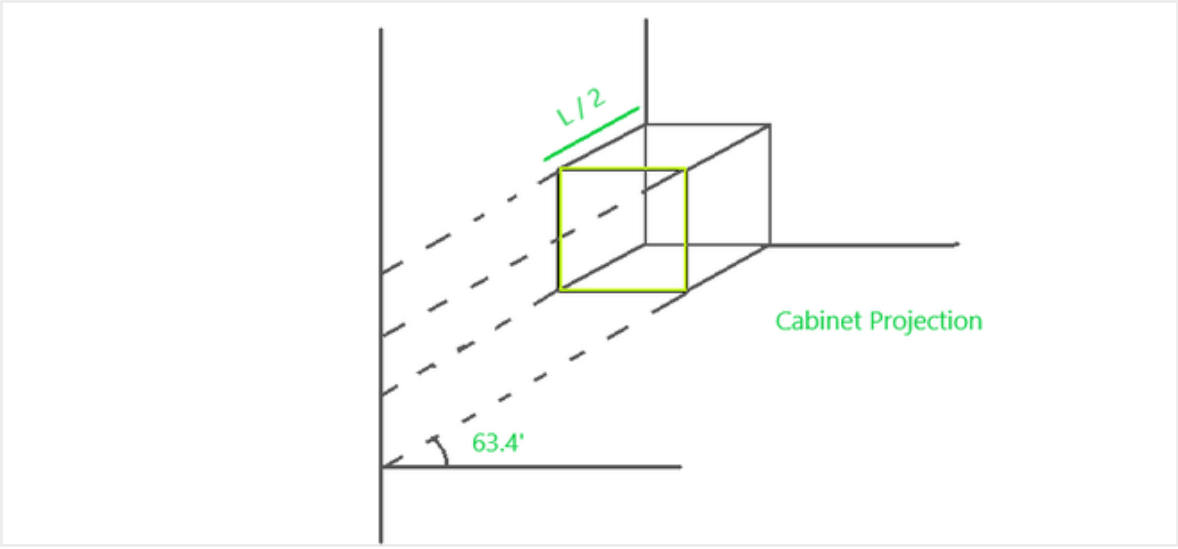
(3) Trimetric Projection : It is a kind of orthographic projection where the visualized object appears to have all the adjacent sides and angles unequal.



(b) Oblique Projection : It is a kind of parallel projection where projecting rays emerges parallelly from the surface of the polygon and incident at an angle other than 90 degrees on the plane.
It is of two kinds :
(b).1. Cavalier Projection : It is a kind of oblique projection where the projecting lines emerge parallelly from the object surface and incident at 45′ rather than 90′ at the projecting plane. In this projection, the length of the reading axis is larger than the cabinet projection.

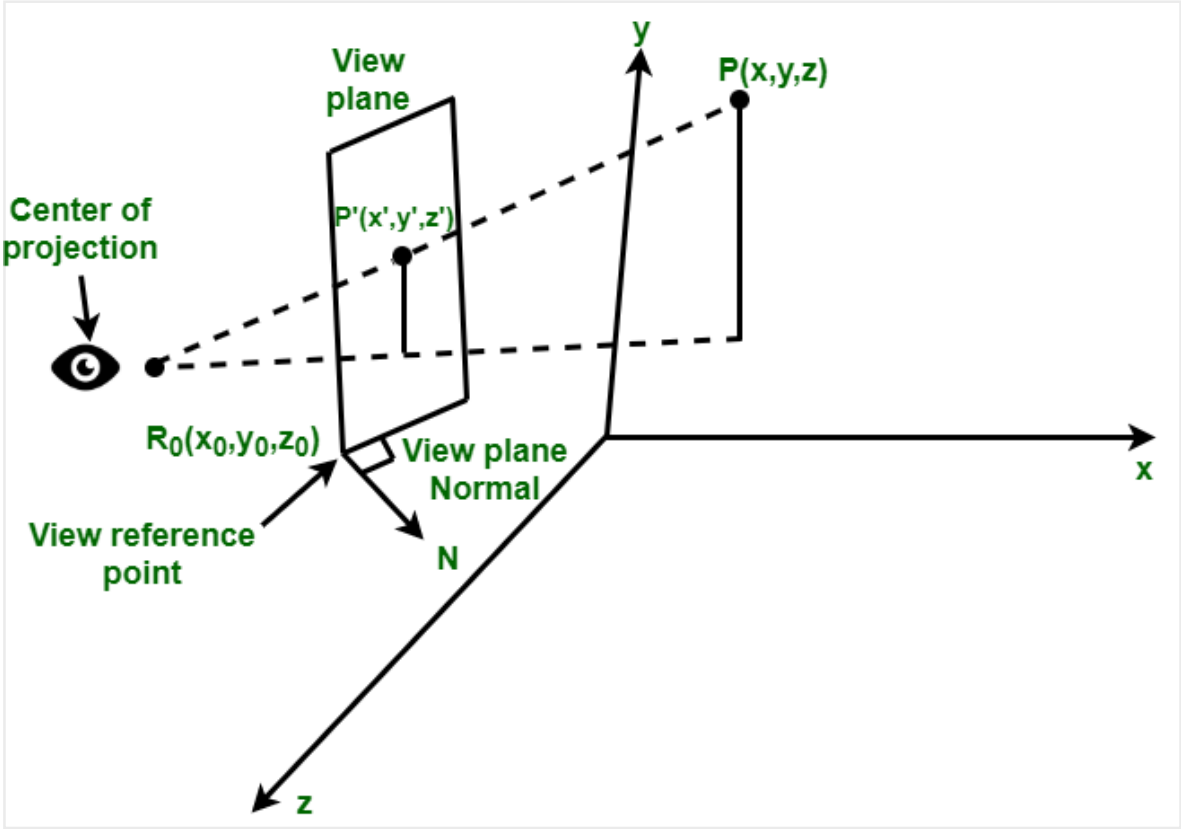


(b). 2. Cabinet Projection : It is similar to that cavalier projection but here the length of reading axes just half than the cavalier projection and the incident angle at the projecting plane is 63.4′ rather 45′.



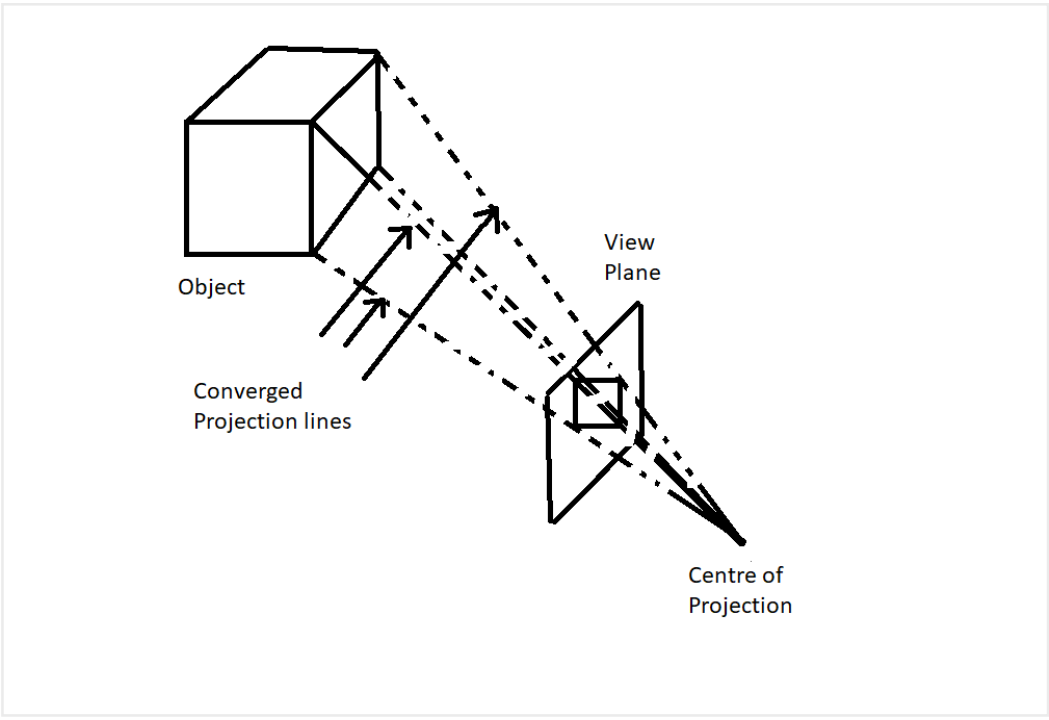
Perspective Projection and its Types

In Perspective Projection the **center of projection** is at finite distance from **projection plane**. This projection produces realistic views but does not preserve relative proportions of an object dimensions. Projections of distant object are smaller than projections of objects of same size that are closer to projection plane. The perspective projection can be easily described by the following figure:



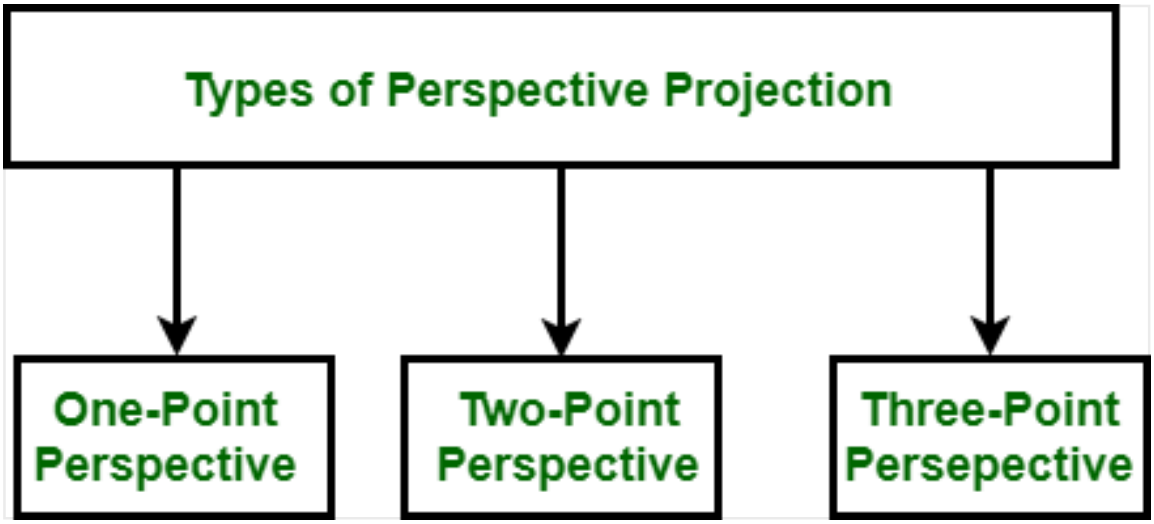
1. **Center of Projection –** It is a point where lines or projection that are not parallel to projection plane appear to meet.
2. **View Plane or Projection Plane –** The view plane is determined by :
   - View reference point $R_0(x_0, y_0, z_0)$
   - View plane normal.
3. **Location of an Object –** It is specified by a point P that is located in world coordinates at (x, y, z) location. The objective of perspective projection is to determine the image point P′ whose coordinates are (x′, y′, z′)

The perspective projection, on the other hand, produces realistic views but does not preserve relative proportions.
In perspective projection, the lines of projection are not parallel. Instead, they all converge at a single point called the center of projection or projection reference point.
The object positions are transformed to the view plane along these converged projection lines and the projected view of an object is determined by calculating the intersection of the converged projection lines with the view plane,as shown below figure

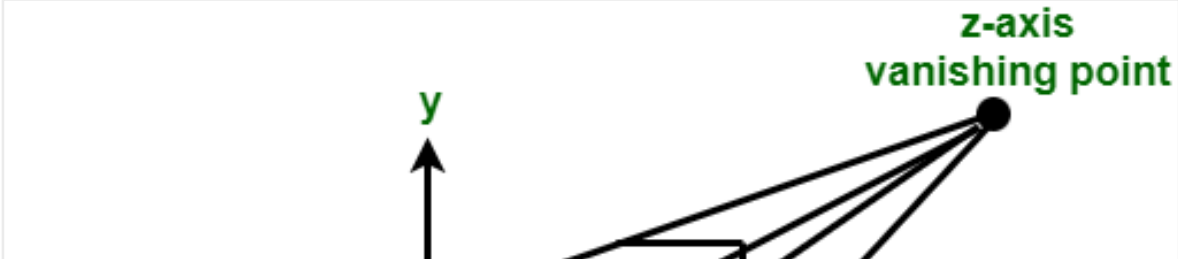


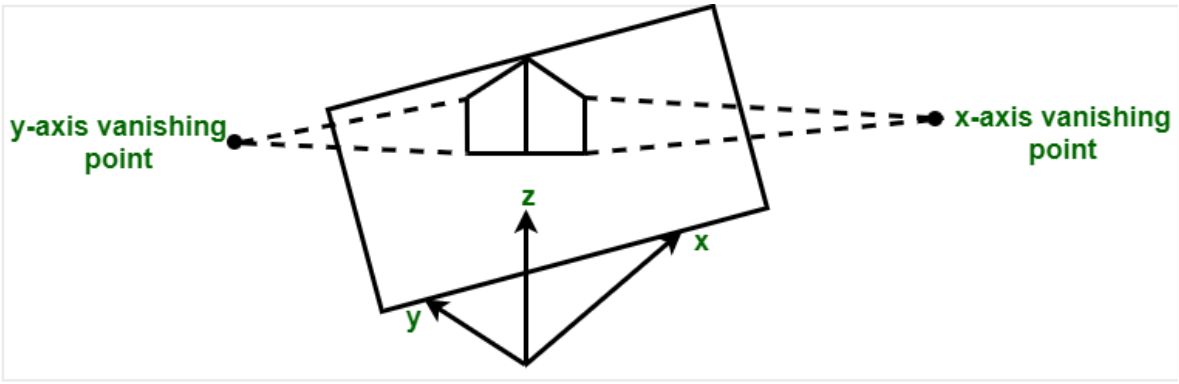
Perspective Projection of an object to the view plane

Types of Perspective Projection : Classification of perspective projection is on basis of vanishing points (It is a point in image where a parallel line through center of projection intersects view plane.). We can say that a vanishing point is a point where projection line intersects view plane. The classification is as follows :

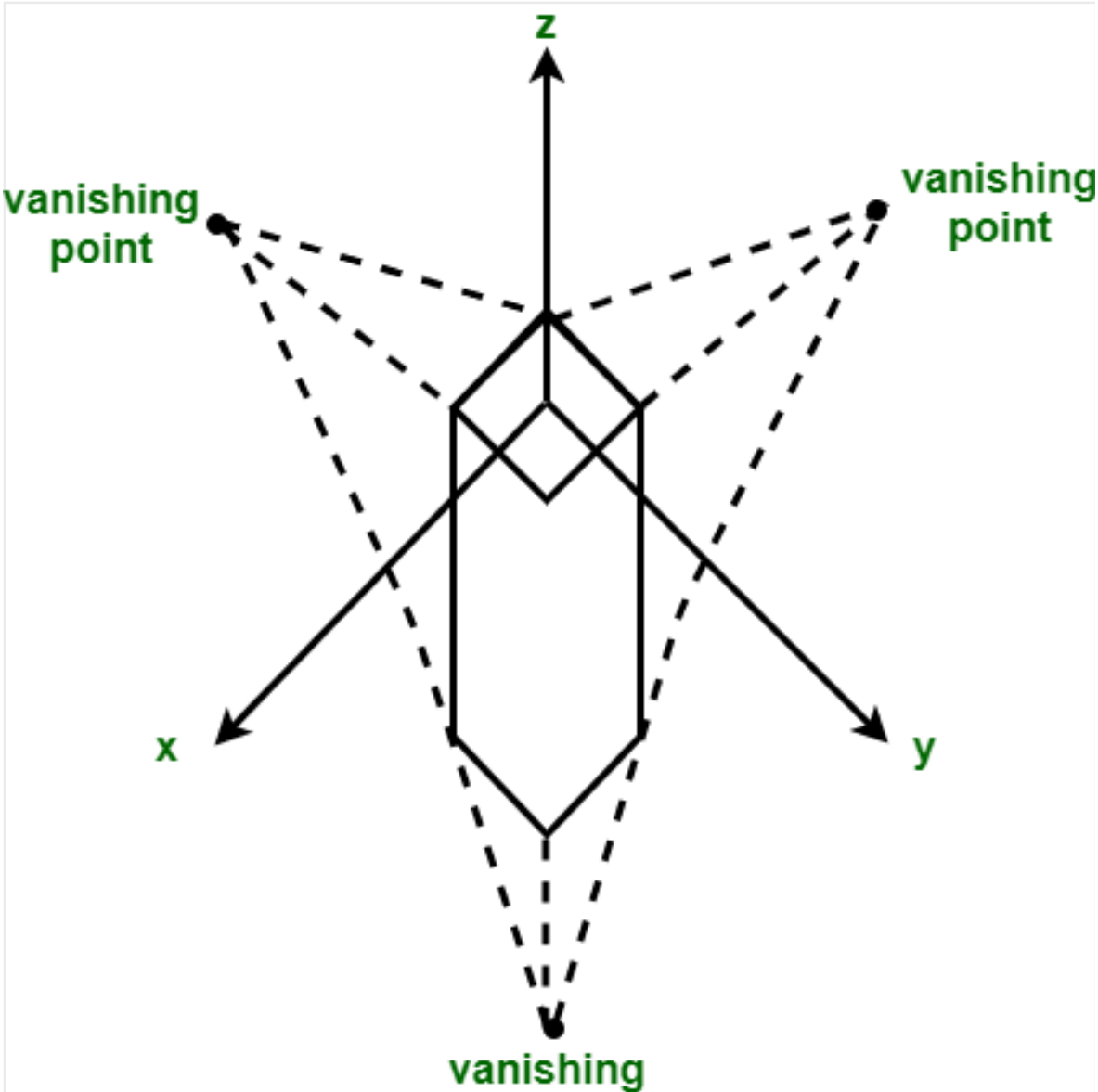


- **One Point Perspective Projection –** One point perspective projection occurs when any of principal axes intersects with projection plane or we can say when projection plane is perpendicular to principal axis.



- In the above figure, z axis intersects projection plane whereas x and y axis remain parallel to projection plane.
- **Two Point Perspective Projection –** Two point perspective projection occurs when projection plane intersects two of principal axis.
- 

- In the above figure, projection plane intersects x and y axis whereas z axis remains parallel to projection plane.
- **Three Point Perspective Projection –** Three point perspective projection occurs when all three axis intersects with projection plane. There is no any principal axis which is parallel to projection plane.



Application of Perspective Projection : The perspective projection technique is used by artists in preparing drawings of three-dimensional objects and scenes.