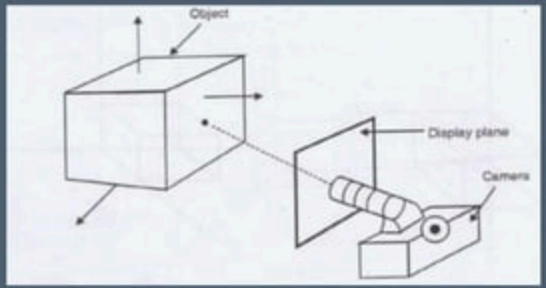
3D Display Methods

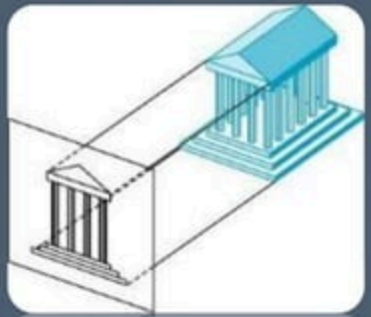
What is 3d display methods in computer graphics?

- ✓ 3D computer graphics (in contrast to 2D computer graphics) are graphics that utilize a three dimensional representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images.Such images may be for later display or for real-time viewing.



Parallel Projection

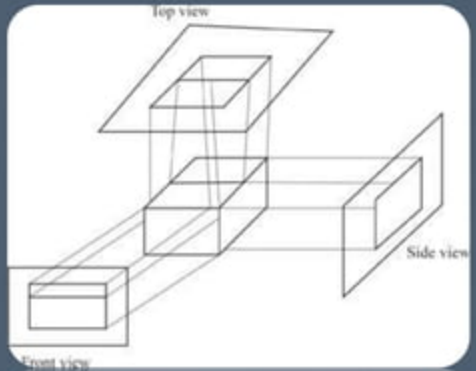
- ✓ A parallel projection is a projection of an object in three-dimensional space onto a fixed plane, known as the projection plane or image plane, where the rays, known as lines of sight or projection lines, are parallel to each other.



Parallel Projection

- ✓ In parallel projection, z co-ordinate is discarded and parallel, lines from each vertex on the object are extended until they intersect the view plane.

- ✓ We connect the projected vertices by line segments which correspond to connections on the original object.As shown in next slide a parallel projection preserves relative proportions of objects but does not produce the realistic views



Parallel Projection

- Project points on the object surface along parallel lines onto the display plane.
- Parallel lines are still parallel after projection.
- Used in engineering and architectural drawings.
- Views maintain relative proportions of the object.

Parallel Projection(Oblique Projection)

In oblique projection, the direction of projection is not normal to the projection of plane. In oblique projection, we can view the object better than orthographic projection.

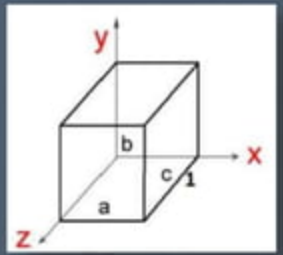


Fig: Cavalier projection(45°)

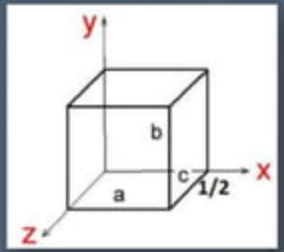
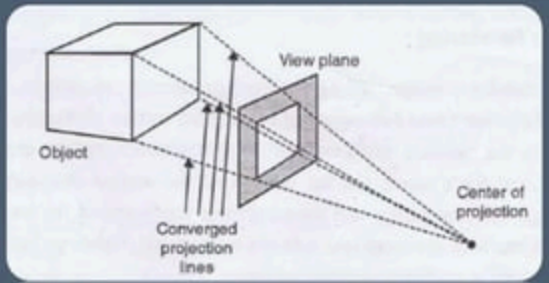


Fig: Cabinet projection (63.4°)

Perspective Projection

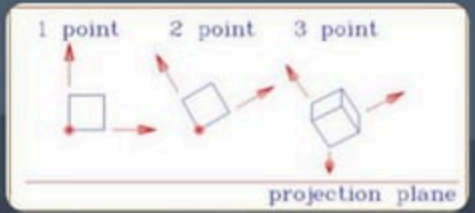
- ✓ The perspective projection, on the other hand, produces realistic views but does not preserve relative proportions. In perspective projection, the lines of projection are not parallel. Instead , they all converge at a single point called the `center of projection' or `projection reference point'.
- ✓ The perspective projection is perhaps the most common projection technique familiar to us as image formed by eye or lenses of photographic flim on perspective projection.



Perspective Projection

The distance and angles are not preserved and parallel lines do not remain parallel. Instead, they all converge at a single point called **center of projection** or **projection reference point**. There are 3 types of perspective projections:-

- **One point** perspective projection is simple to draw.
- **Two point** perspective projection gives better impression of depth.
- **Three point** perspective projection is most difficult to draw.



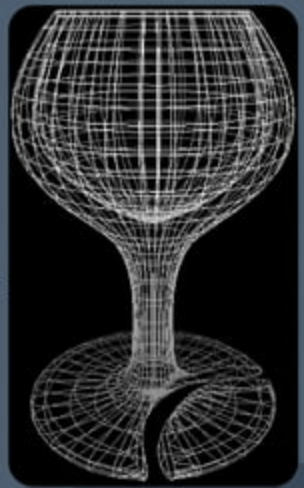
Perspective Projection

- The perspective projection conveys depth information by making distance object smalls than near one.
- This is the way that our eyes and a camera lens form images and so the displays are more realistic.
- The disadvantage is that if object have only limited variation , the image may not provide adequate depth information and ambiquity apears.

Depth Cueing

- Depth cueing is implemented by having objects blend into the background color with increasing distance from the viewer. The range of distances over which this blending occurs is controlled by the sliders.

- To create realistic image, the depth information is important so that we can easily identify, for a particular viewing direction, which is the front and which is the back of displayed objects. The depth of an object can be represented by the intensity of the image. The parts of the objects closest to the viewing position are displayed with the highest intensities and objects farther away are displayed with decreasing intensities. This effect is known as `depth cueing'.

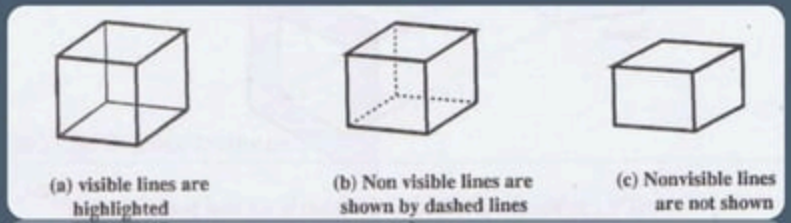


Depth Cueing

- To easily identify the front and back of display objects.
- Depth information can be included using various methods.
- A simple method to vary the intensity of objects according to their distance from the viewing position.
- Eg: lines closest to the viewing position are displayed with the higher intensities and lines farther away are displayed with lower intensities.

Visible line and surface identification

- ✓ It is possible to clarify the depth relationships in a wire frame display by identifying visible lines.The visible line can be displayed by dashed lines or not display at all. This is illustrated in Figure.



Visible line and surface identification

- ✓ The visible surface identification can be done with ***visible surface algorithms***.
- ✓ They establish visibility pixel by pixel across the viewing plane or determine surfaces for object as a whole.
- ✓ Once the visible, surfaces are identified we can apply surface rendering techniques on them to obscure the hidden surfaces.

Visible line and surface identification

1. Hidden-surface problem

There are two approaches for removing hidden surface problems

1.1 Object-Space method (physical coordinate system) and

1.2 Image-space method. (physical coordinate system)

- **Depth Buffer (Z-Buffer) Method**
- **Scan-Line Method**
- **Area-Subdivision Method**
- **Back-Face Detection**
- **A-Buffer Method**
- **Depth Sorting Method**
- **Binary Space Partition (BSP) Trees**

When we want to display a 3D object on a 2D screen, we need to identify those parts of a screen that are visible from a chosen viewing position.

Visible line and surface identification

- Highlight the visible lines or display them in different color
- Display nonvisible lines as dashed lines
- Remove the nonvisible lines

Surface Rendering

- ✓ Surface rendering involves setting the surface intensity of objects according to the lighting conditions in the scene and according to assigned surface characteristics. The lighting conditions specify the intensity and positions of light sources and the general background illumination required for a scene .

- ✓ On the other hand the surface characteristics of objects specify the degree of transparency and smoothness or roughness of the surface; usually the surface rendering methods are combined with perspective and visible surface identification to generate a high degree of realism in a displayed scene.

Surface Rendering

- Set the surface intensity of objects according to
  - ✓ Lighting conditions in the scene
  - ✓ Assigned surface characteristics
- Lighting specifications include the intensity and positions of light sources and the general background illumination required for a scene.
- Surface properties include degree of transparency and how rough or smooth of the surfaces