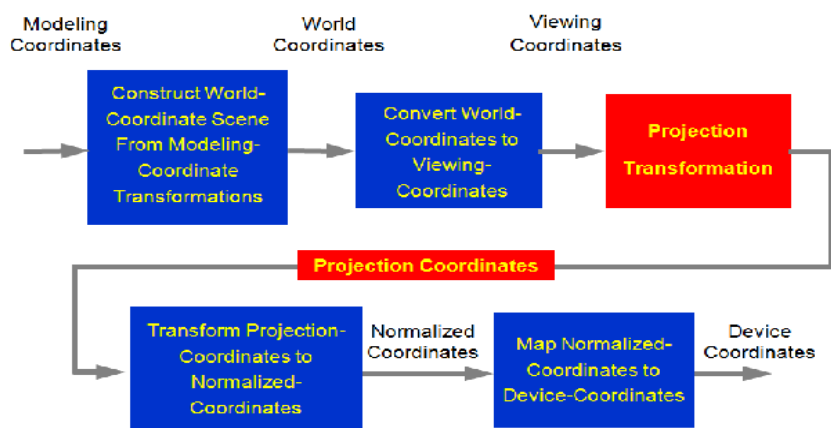


8. Three Dimensional Viewing

Contents

- 8.1 Viewing pipeline
- 8.2 Viewing coordinates
- 8.3 Parallel projection
- 8.4 Perspective projection
- 8.5 Concept of 3D clipping.

8.1 Viewing Pipeline

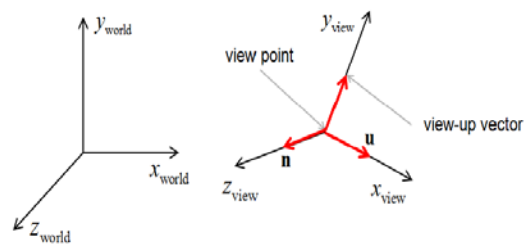


Processing Steps

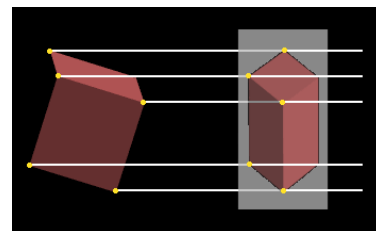
- Once the scene has been model, world coordinates position is converted to viewing coordinates.
- The viewing coordinates system is used in graphics packages as a reference for specifying the observer viewing position and the position of the projection plane.
- Projection operations are performed to convert the viewing coordinate description of the scene to coordinate positions on the projection plane, which will then be mapped to the output device.
- Objects outside the viewing limits are clipped from further consideration, and the remaining objects are processed through visible surface identification and surface rendering procedures to produce the display within the device viewport.

8.2 Viewing Coordinates

- A view of an object in 3D is similar to photographing the object.
- Whatever appears in the viewfinder is projected into the flat film surface.
- The type and the size of the camera lens determines which parts of the scene appear in the final picture.



- In parallel projection, the polygons are projected on to the viewing plane using parallel lines called projectors. In this case the direction of projection (DOP) needs to be defined.
- Parallel projection offers no sense of depth. As a line of fixed height moves away from the camera it is drawn as the same size.
- centre of projection infinitely far from view plane
- projectors will be parallel to each other
- need to define the direction of projection (vector)
- 2 sub-types



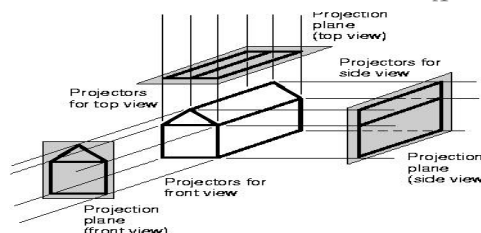
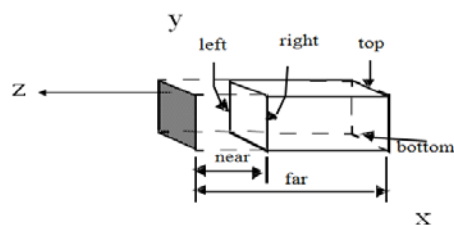
- orthographic - direction of projection is normal to view plane
 - oblique - direction of projection not normal to view plane
- better for drafting / CAD applications

Orthographic Parallel Projections -The direction of projection normal to the projection plane

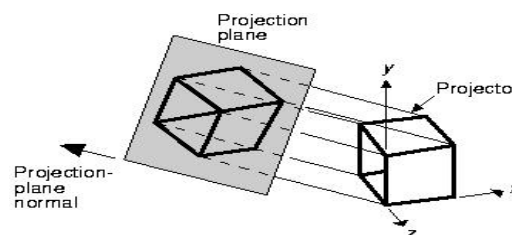
Oblique Parallel Projection-otherwise

Orthographic Parallel Projections

- Projection plane perpendicular to a principle axis
- Most common types
 - Front-elevation
 - Top-elevation (plane-elevation)
 - Side-elevation
- Used in engineering drawing (such as machine parts)
- Hard to deduce 3D nature
- Axonometric orthographic projections

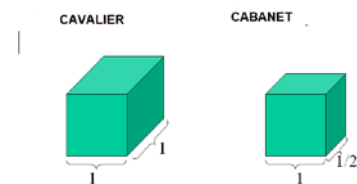


- Projection plane not normal to a principle axis
- Several faces of an object can be shown at once
- Parallelism reserved, distances can be measured
- Example: Isometric projection
 - $VPN = DOP = (dx, dy, dz)$, where $|dx| = |dy| = |dz|$ Where VPN=View-plane normal, DOP=Direction of projection
 - 8 directions



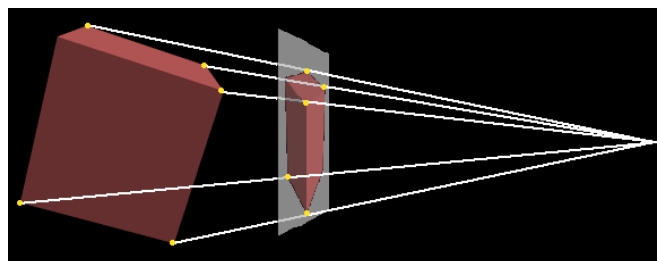
Oblique Parallel Projections

- Projection plane normal and DOP(Direction of projection) differ
- Projection plane is normal to a principle axis
- Measurement of distance and angle of faces parallel to the plane allowed
- Widely used (easy to draw)
- Cavalier
 - DOP makes 45 degree with projection plane
- Cabinet
 - DOP makes angle of $\arctan(2)$ with projection plane

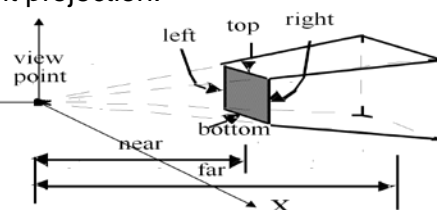


8.4 Perspective Projections

- If COP(centre of projection) is located at finite point in 3 space ,the result is prospective projection.
- In perspective projection, projectors are projected towards a point referred to as the centre of projection or the projection reference point (PRP). When a scene is rendered using perspective projection, a line of a fixed height will be drawn shorter as it moves away from the camera. Therefore this technique allows the viewer to perceive depth in a two dimensional image.

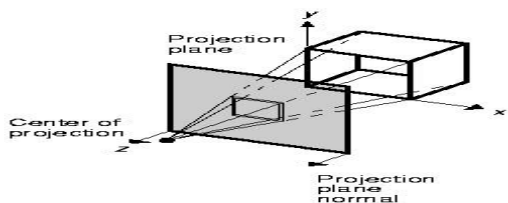


- Vanishing point: the perspective projections of any set of parallel lines that are not parallel to the projection plane converge to a vanishing point (a point at infinity) .
- If a set of lines is parallel to a coordinate axis, the vanishing point is called the principle vanishing point.
- Perspective projections are categorized by their number of principal vanishing points; current graphics projection only deals with the one point projection.
- centre of projection finitely far from view plane
- projectors will not be parallel to each other
- need to define the location of the centre of projection (point)
- classified into 1, 2, or 3-point perspective
- more visually realistic - has perspective foreshortening (objects further away appear smaller)



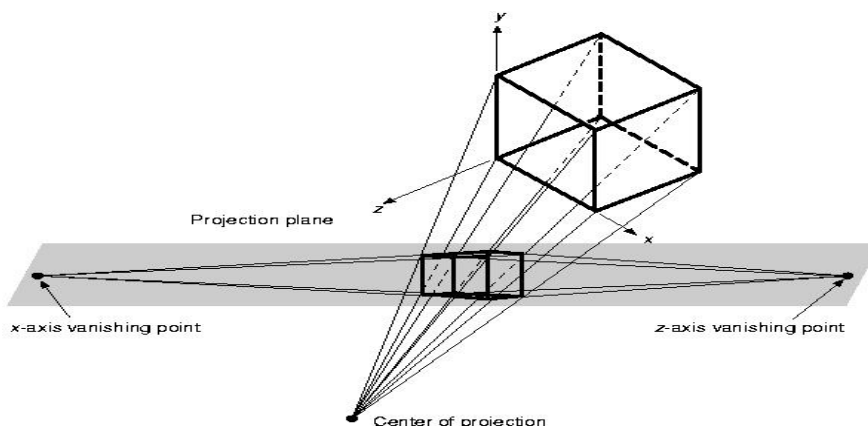
Number of Axis Vanishing Points

- One-point



Number of Axis Vanishing Points-Two point

- Commonly used in architecture, engineering, industrial design, and advertising drawings.



8.5 3D Clipping

- 3D Clipping, in graphics technology is used to speed up your rendering engine. The most common clipping method is the 2D clipping algorithm.
- 2D clipping is done at the last stage of rendering.
- The triangle-routine used to render the polygons onto the screen make sure that you don't draw outside the screen.
- This can be very fast, but increases the complexity of the triangle-filler.
- This clipping method works directly with two-dimensional screen-coordinates.
- In 3D clipping you do everything in 3D space.
- Map graphics are clipped to one side of an arbitrary clipping plane in one or more clipping stages.
- For example, to draw a hemisphere centred on a given point, the clipping plane passes through the centre of the sphere and has a normal vector that coincides with the given point.