Engineering Graphics and Design

Live session
Week 4-Tutorial 4
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Solids

A 3-D object having length, breadth and thickness and bounded by surfaces which may be either plane or curved, or combination of the two.

- **Regular polyhedron** – solid bounded only by plane surfaces (faces). Its faces are formed by regular polygons of same size and all dihedral angles are equal to one another.

- **Other polyhedra** – when faces of a polyhedron are not formed by equal identical faces, they may be classified into prisms and pyramids.
Regular polyhedra

**Tetrahedron** — four equal equilateral triangular faces

**Cube/hexahedron** — six equal square faces

**Octahedron** — eight equal equilateral triangular faces

**Dodecahedron** — twelve equal regular pentagonal faces
Prism – a polyhedron formed by two equal parallel regular polygon, end faces connected by side faces which are either rectangles or parallelograms.

Different types of prisms
Pyramids – a polyhedron formed by a plane surface as its base and a number of triangles as its side faces, all meeting at a point, called vertex or apex.
Solids of revolution – when some of the plane figures are revolved about one of their sides solids of revolution is generated.
Projections of solids placed in different positions

The solids may be placed in various positions

The way the axis of the solid is placed with respect to HP or VP or both

- Perpendicular to HP or VP
- Parallel to either HP or VP and inclined to the other
- Inclined to both HP and VP
Axis of the solid perpendicular to HP

A solid when placed on HP with its axis perpendicular to it, then it will have its base on HP. This is the simplest position in which a solid can be placed.

When the solid is placed with the base on HP position, in the top view, the base will be projected in its true shape.

Hence, when the base of the solid is on HP, the top view is drawn first and then the front view and the side views are projected from it.
Only one position in which a cylinder or a cone may be placed with its base on HP.
Four positions of a prism placed with its base on HP.
Various positions of a triangular pyramid placed with its base on HP
Axis of the solid perpendicular to Vertical plane (VP)

“When a solid is placed with its axis perpendicular to VP, the base of the solid will always be perpendicular to HP and parallel to VP.”

"Hence in the front view, base will be projected in true shape"

"Therefore, when the axis of the solid is perpendicular to VP, the front view is drawn first and then the top and side views are drawn from it."
When a cylinder rests on HP with its axis perpendicular to VP, one of its generators will be on HP.

When a cone rests on HP with its axis perpendicular to VP, one of the points on the circumference of the base will be on HP.
Prism placed with their axis perpendicular to VP in three different positions.
Pyramid placed with their axis perpendicular to VP in three different positions.
When the solid lies with an edge of base on HP
Top and the front views of a hexagonal pyramid when it lies on HP on one of its base edges with its axis or the base inclined to HP.
The top and front views of the pyramid when it rests on HP on one of its base corners such that the two base edges containing the corner on which it rests make equal inclinations with HP.
BASE EDGE

THIS TRIANGULAR FACE WILL BE ON HP IN THE NEXT STEP

TRIANGULAR FACE ON HP

a'f1
b'f2

o'

o
When a pyramid lies on one of its slant edges on HP

When a pyramid lies with one of its slant edges on HP, then two triangular faces containing the slant edge on which it rests make either equal inclinations or different inclinations with HP.
SOLID WITH AXIS INCLINED TO BOTH THE REFERENCE PLANES

Methods of drawing the projections of solids  Two methods

1. **Change of position method** - the solids are placed first in the simple position and then tilted successively in two or three stages to obtain the final position.

2. **Auxiliary plane method (Change of reference-line method)** – the solids are placed initially in the simple position and then one or two auxiliary planes are setup to obtain the views in the required position.
A cube of 30 mm side rests with one of its edges on HP such that one of the square faces containing that edge is inclined at 30° to HP and the edge on which it rests being inclined to 60° to VP.

Draw its projections.
Draw the top and front views of a rectangular pyramid of sides of base 40x 50 mm and height 70 mm when it lies on one of its larger triangular faces on HP. The longer edge of the base of the triangular face lying on HP is inclined at 60° to VP in the top view with the apex of the pyramid being nearer to VP.
A cone of base 80 mm diameter and height 100 mm lies with one of its generators on HP and the axis appears to be inclined to VP at an angle of $40^\circ$ in the top view. Draw its top and front views.
A cone of base 60 mm diameter and the axis 80 mm long lies on HP with its axis inclined at 45° and 30° to HP and VP, respectively. Draw the top and front views of the cone.
An object shown in Figure 1 has been oriented in two different orientations as shown in Fig 2. Draw two orthographic views (Front view and Top view) in each orientation.

Fig.1
Fig. 2