PROJECTION OF SOLIDS

Introduction:

A solid has three dimensions, the length, breadth and thickness or height. A solid may be represented by orthographic views, the number of which depends on the type of solid and its orientation with respect to the planes of projection. solids are classified into two major groups. (i) Polyhedral, and (ii) Solids of revolution

POLYHEDRAL

A polyhedral is defined as a solid bounded by plane surfaces called faces. They are: (i)Regular polyhedral (ii) Prisms and (iii) Pyramids

Regular Polyhedral

A polyhedron is said to be regular if its surfaces are regular polygons. The following are some of the regular polyhedral.

SOLIDS

Prisms: A prism is a polyhedron having two equal ends called the bases parallel to each other. The two bases are joined by faces, which are rectangular in shape. The imaginary line passing through the centers of the bases is called the axis of the prism.

A prism is named after the shape of its base. For example, a prism with square base is called a square prism, the one with a pentagonal base is called a pentagonal prism, and so on (Fig) The nomenclature of the prism is given in Fig.

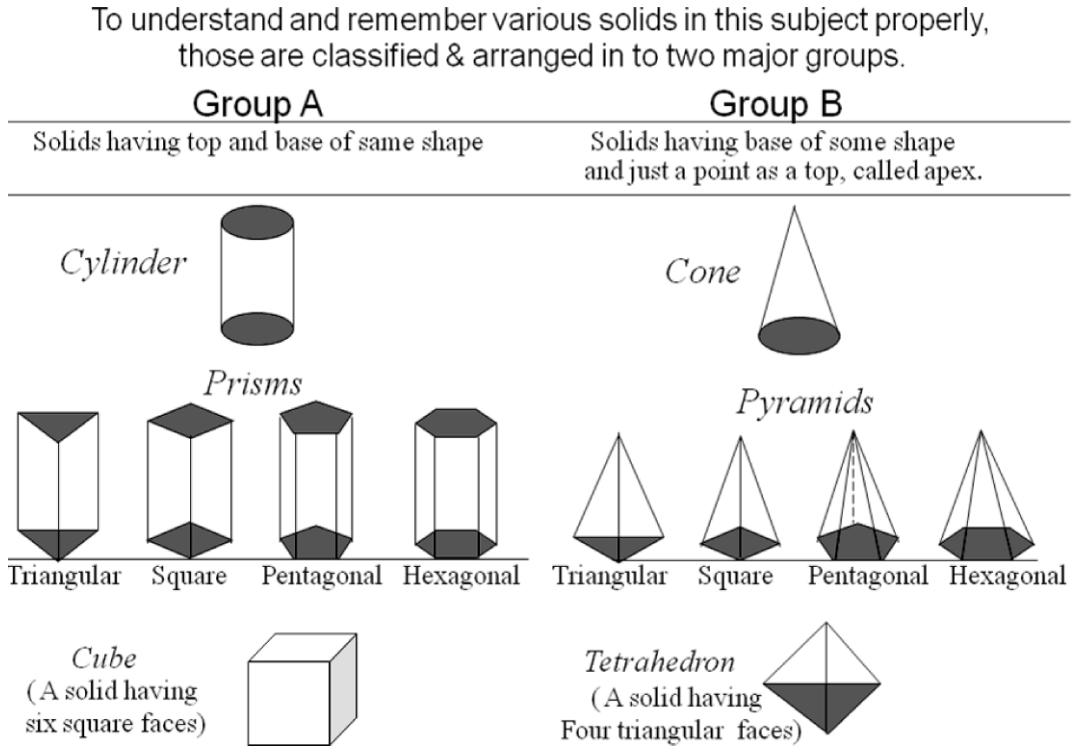


Figure 3.18

(a) **Tetrahedron:** It consists of four equal faces, each one being a equilateral triangle.
(b) **Hexa hedron(cube):** It consists of six equal faces, each a square.
(c) **Octahedron**: It has eight equal faces, each an equilateral triangle.
(d) **Dodecahedron**: It has twelve regular and equal pentagonal faces.
(e) **Icosahedrons**: It has twenty equal, equilateral triangular faces.

Pyramids: A pyramid is a polyhedron having one base, with a number of isosceles triangular faces, meeting at a point called the apex. The imaginary line passing through the centre of the base and the apex is called the axis of the pyramid.

The pyramid is named after the shape of the base. Thus, a square pyramid has a square base and pentagonal pyramid has pentagonal base and so on. The nomenclature of a pyramid is shown in Fig.

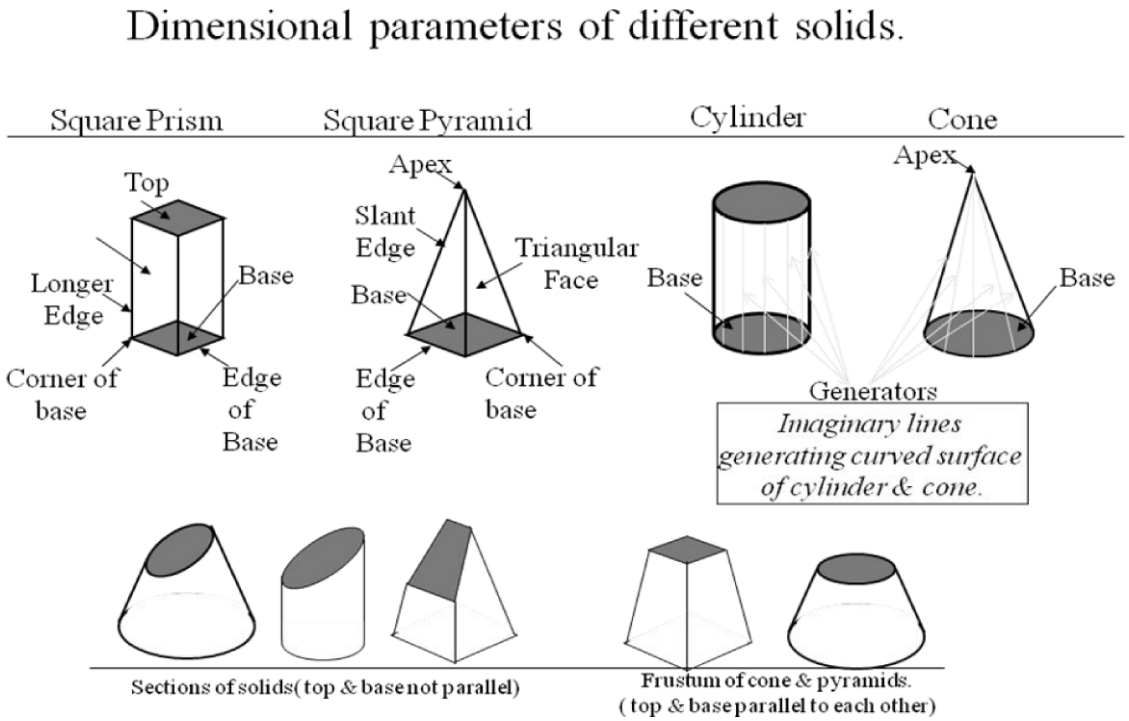


Figure 3.19

Types of Pyramids:

There are many types of Pyramids, and they are named after the shape of their base.
These are Triangular Pyramid, Square Pyramid, Pentagonal pyramid, hexagonal pyramid and tetrahedron

Solids of Revolution: If a plane surface is revolved about one of its edges, the solid generated is called a solid of revolution. The examples are (i) Cylinder, (ii) Cone, (iii) Sphere.

Frustums and Truncated Solids: If a cone or pyramid is cut by a section plane parallel to its base and the portion containing the apex or vertex is removed, the remaining portion is called frustum of a cone or pyramid

Prisms Position of a Solid with Respect to the Reference Planes: The position of solid in space may be specified by the location of either the axis, base, edge, diagonal or face with the principal planes of projection. The following are the positions of a solid considered.

1. Axis perpendicular to HP
2. Axis perpendicular to VP
3. Axis parallel to both the HP and VP
4. Axis inclined to HP and parallel to VP
5. Axis inclined to VP and parallel to HP
6. Axis inclined to both the Planes (VP. and HP)

The position of solid with reference to the principal planes may also be grouped as follows:
1. Solid resting on its base.
2. Solid resting on anyone of its faces, edges of faces, edges of base, generators, slant edges, etc.
3. Solid suspended freely from one of its corners, etc.

1. Axis perpendicular to one of the principal planes:

When the axis of a solid is perpendicular to one of the planes, it is parallel to the other. Also, the projection of the solid on that plane will show the true shape of the base.

When the axis of a solid is perpendicular to H.P, the top view must be drawn first and then the front view is projected from it. Similarly when the axis of the solid is perpendicular to V.P, the front view must be drawn first and then the top view is projected from it.

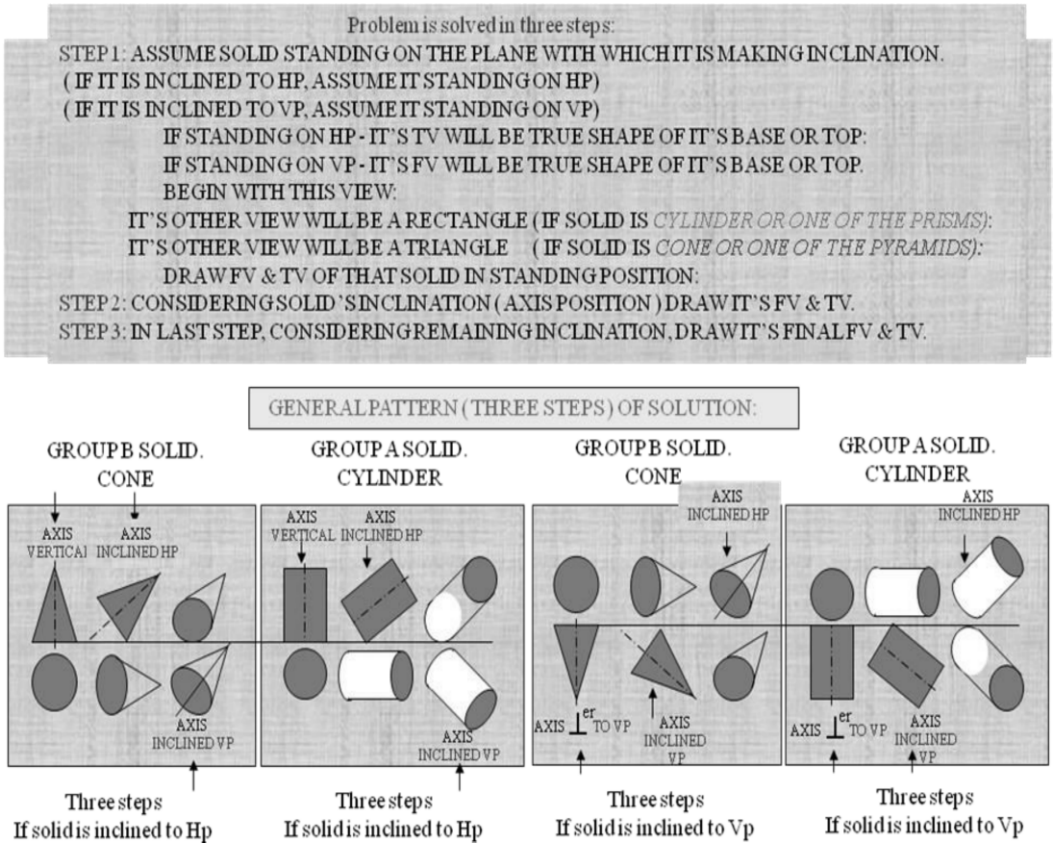


Figure 3.20

Simple Problems:

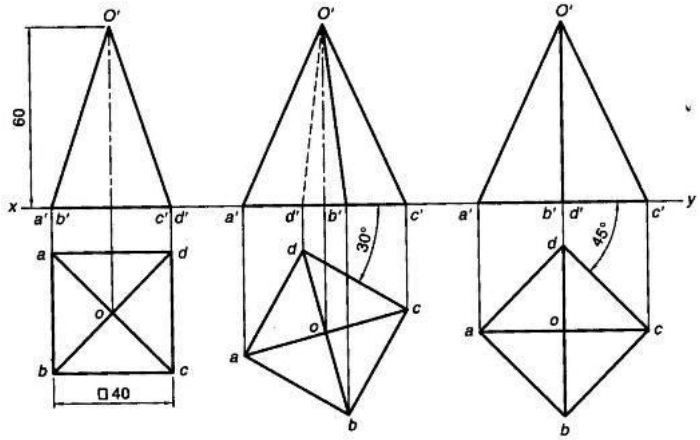
When the axis of solid is perpendicular to one of the planes, it is parallel to the other. Also, the projection of the solid on that plane will show the true shape of the base. When the axis of a solid is perpendicular to H.P, the top view must be drawn first and then the front view is projected from it. Similarly when the axis of the solid is perpendicular to V.P, the front view must be drawn first and then the top view is projected from it.

1. Axis perpendicular to HP

Problem:

A Square Pyramid, having base with a 40 mm side and 60mm axis is resting on its base on the HP. Draw its Projections when (a) a side of the base is parallel to the VP. (b) A side of the base is inclined at 30^0 to the VP and (c) All the sides of base are equally inclined to the VP.

Solution:



(a) *(b)* *(c)*

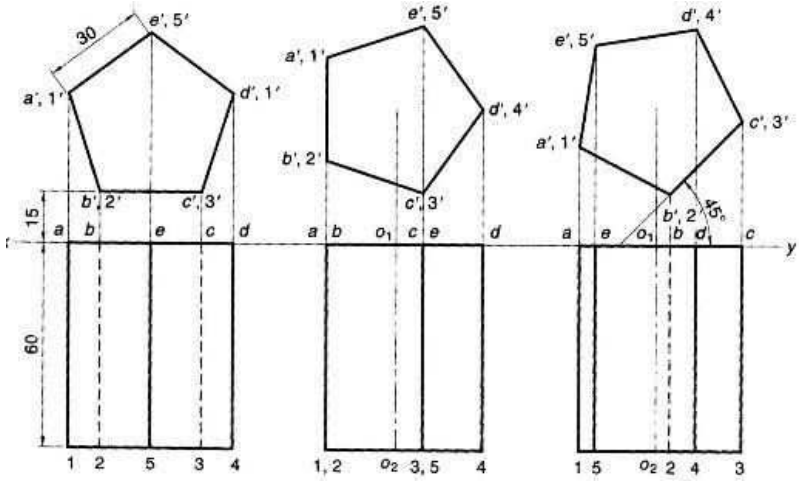
Figure 3.21

2. Axis perpendicular to VP

Problem:

A pentagonal Prism having a base with 30 mm side and 60mm long Axis, has one of It's bases in the VP. Draw Its projections When (a)rectangular face is parallel to and 15 mm above the HP (b) A rectangular face perpendicular to HP and (c) a rectangular face is inclined at 45^0 to the HP

Solution:



(a) *(b)* *(c)*

Figure 3.22

3. Axis parallel to both the HP and VP

Problem:
A pentagonal Prism having a base with a 30 mm side and 60mm long axis, is resting on one of its rectangular faces on the HP. with axis parallel to the VP. Draw its projections?

Solution:

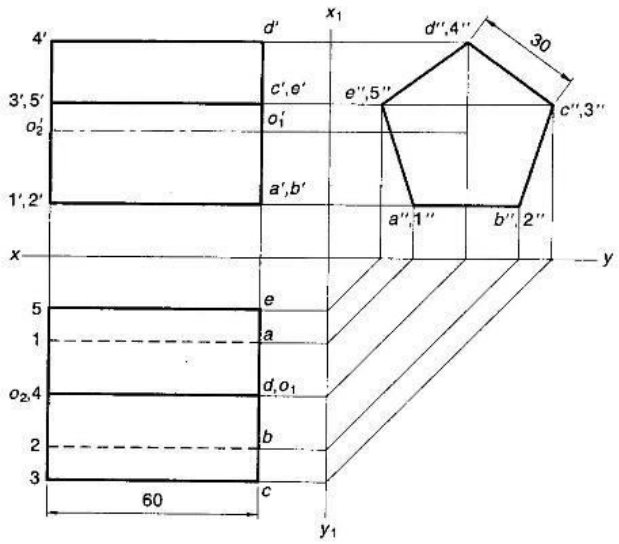


Figure 3.23

4. Axis inclined to HP and parallel to VP

Problem:
A Hexagonal Prism having a base with a30 mm side and 75 mm long axis, has an edge its base on the HP. Its axis is Parallel to the VP and inclined at 45^0 to the HP Draw its projections?

Solution:

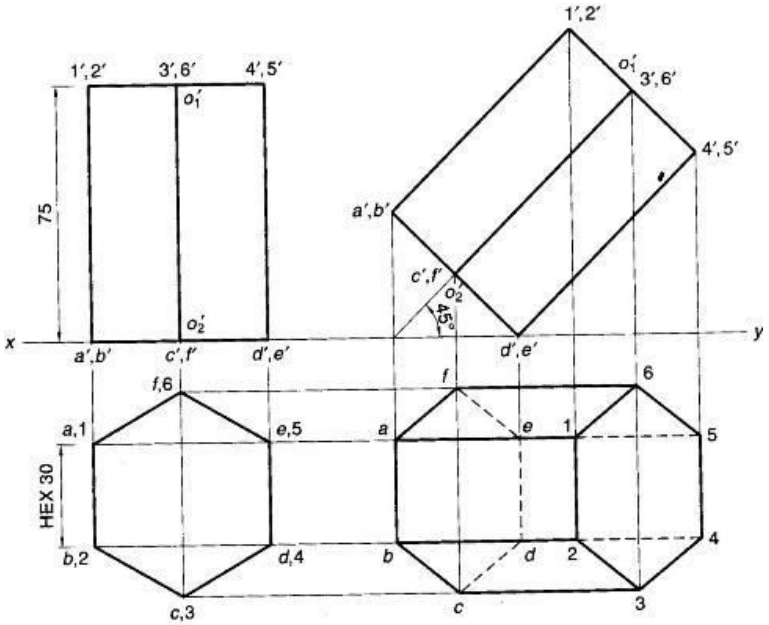


Figure 3.24

5. Axis inclined to VP and parallel to HP

Problem:

An Hexagonal Prism, having a base with a 30 mm side and 65 mm long axis, has an edge it's base in the VP Such that the axis is inclined at 30^0 to the VP and Parallel to the HP. Draw its Projections?

Solution:

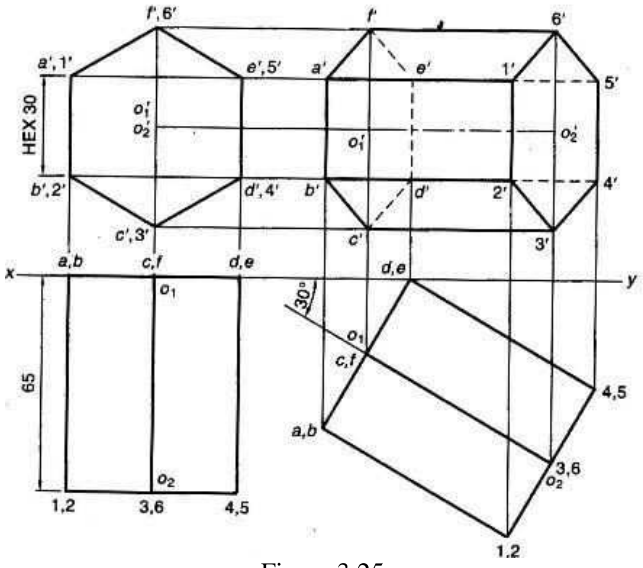


Figure 3.25

6. Axis inclined to both the principal planes (HP and VP)

A solid is said to be inclined to both the planes when (i) the axis is inclined to both the planes, (ii) the axis is inclined to one plane and an edge of the base is inclined to the other. In this case the projections are obtained in three stages.
Stage I: Assume that the axis is perpendicular to one of the planes and draw the projections.
Stage II: Rotate one of the projections till the axis is inclined at the given angle and project the other view from it.
Stage III: Rotate one of the projections obtained in Stage II, satisfying the remaining condition and project the other view from it.

Problem:

A cube of 50 mm long edges is so placed on HP on one corner that a body diagonal is Parallel to HP and perpendicular to VP. Draw it's projections.

Solution Steps:

1.Assuming standing on HP, begin with TV, a square with all sides equally inclined to xy .Project Fv and name all points of FV & TV.
2. Draw a body-diagonal joining c' with 3' (This can become Parallel to xy)
3. From 1' drop a perpendicular on this and name it p'
4. Draw 2nd Fv in which 1'-p' line is vertical means c'-3' diagonal must be horizontal. .Now as usual project TV..
5. In final TV draw same diagonal is perpendicular to VP as said in problem. Then as usual project final FV.

Solution:

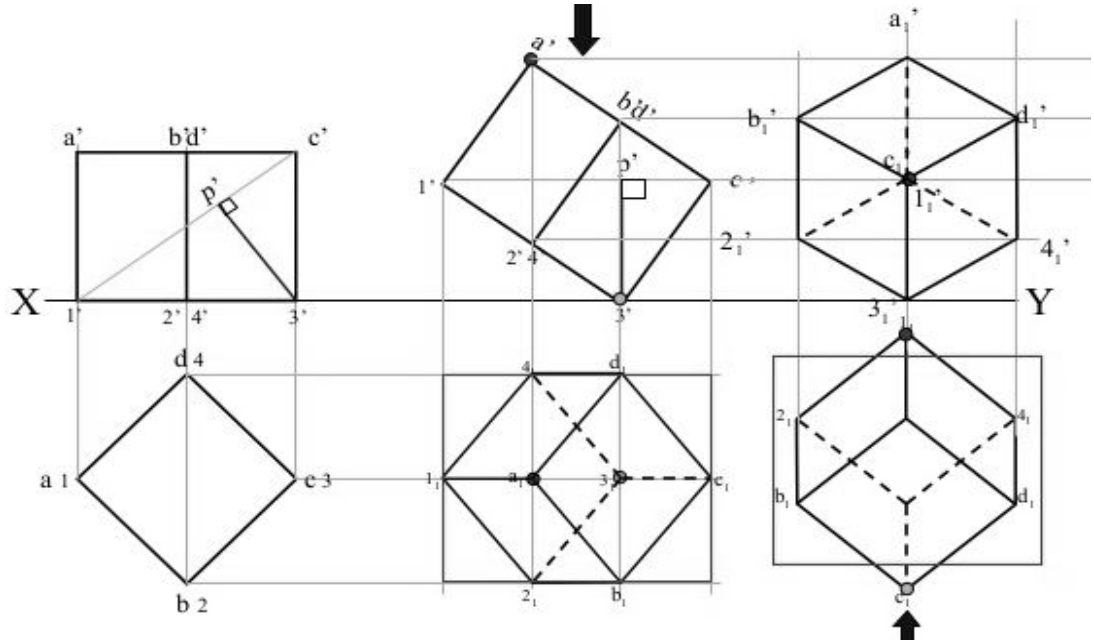


Figure 3.26

Problem:

A cone 40 mm diameter and 50 mm axis is resting on one of its generator on HP which makes 30^0 inclinations with VP. Draw it's projections?

Solution Steps:

Resting on HP on one generator, means lying on HP

1. Assume it standing on HP.
2. It's TV will show True Shape of base(circle)
3. Draw 40mm dia. Circle as TV& taking 50 mm axis project FV. (a triangle)
4. Name all points as shown in illustration.
5. Draw 2nd FV in lying position I.e. o'e' on xy. And project it's TV below xy.
6. Make visible lines dark and hidden dotted, as per the procedure.
7. Then construct remaining inclination with VP (generator o_1e_1 30^0 to xy as shown) & project final FV.

Solution:

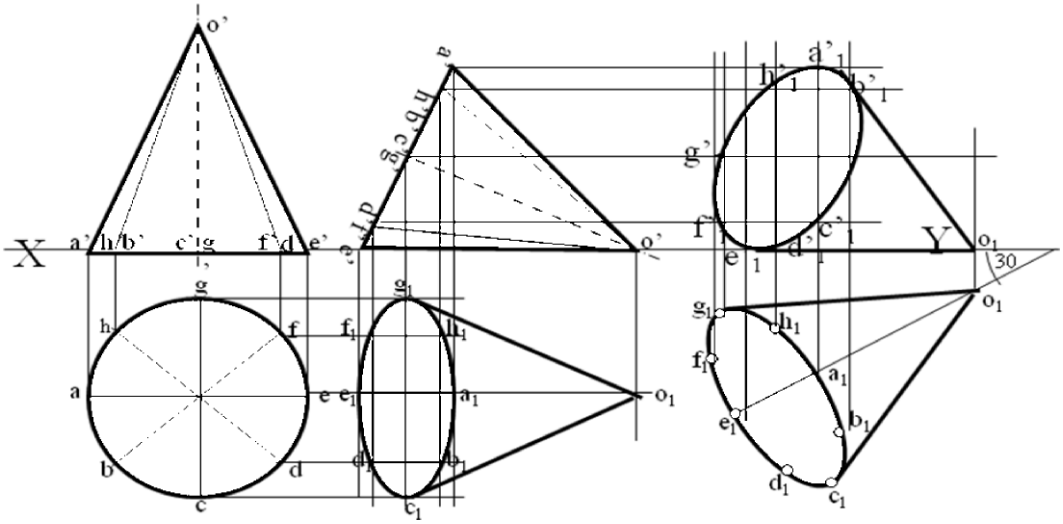


Figure 3.27

Problem:

A cube of 50 mm long edges is so placed on HP on one corner that a body diagonal through this corner is perpendicular to HP and parallel to VP. Draw it's three views.

Solution Steps:

1.Assuming it standing on HP begin with TV, a square of corner case.
2.Project corresponding FV.& name all points as usual in both views.
3.Join a'1' as body diagonal and draw 2nd FV making it vertical (I' on xy)
4.Project it's TV drawing dark and dotted lines as per the procedure.
5.With standard method construct Left-hand side view.(Draw a 45^0 inclined Line in Tv region (below xy).Project horizontally all points of Tv on this line and reflect vertically upward, above xy.After this, draw horizontal lines, from all points of Fv, to meet these lines. Name points of intersections and join properly.For dark & dotted lines locate observer on left side of Fv as shown.)

Solution:

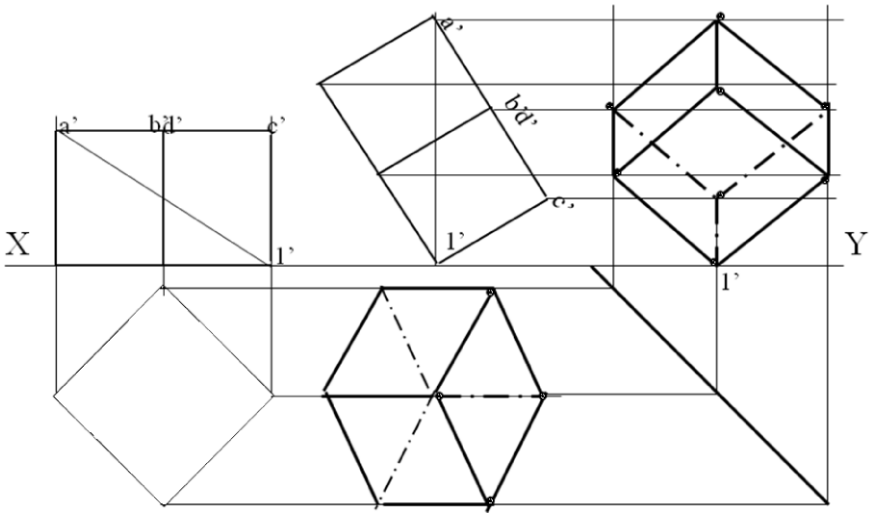


Figure 3.28

Problem:

A circular cone, 40 mm base diameter and 60 mm long axis is resting on HP, on one point of base circle such that it's axis makes 45^0 inclination with HP and 40^0 inclination with VP. Draw it's projections.

Solution:

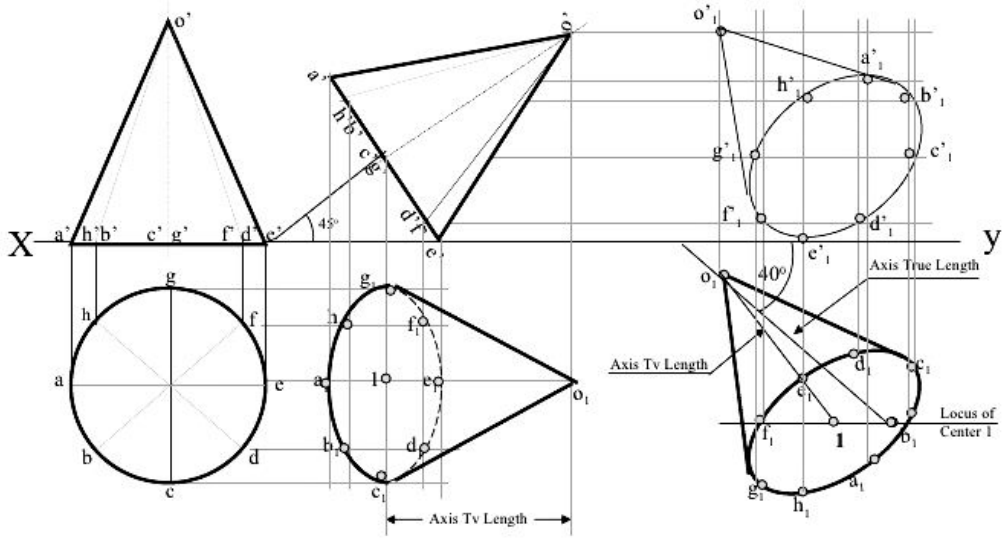


Figure 3.29

Problem:

A hexagonal prism, having a base with a 30mm side and an 80mm long axis, rests on one of its base edges in the H.P such that the axis is inclined at 30^0 to the HP and 45^0 to the VP. Draw its projections?

Solution:

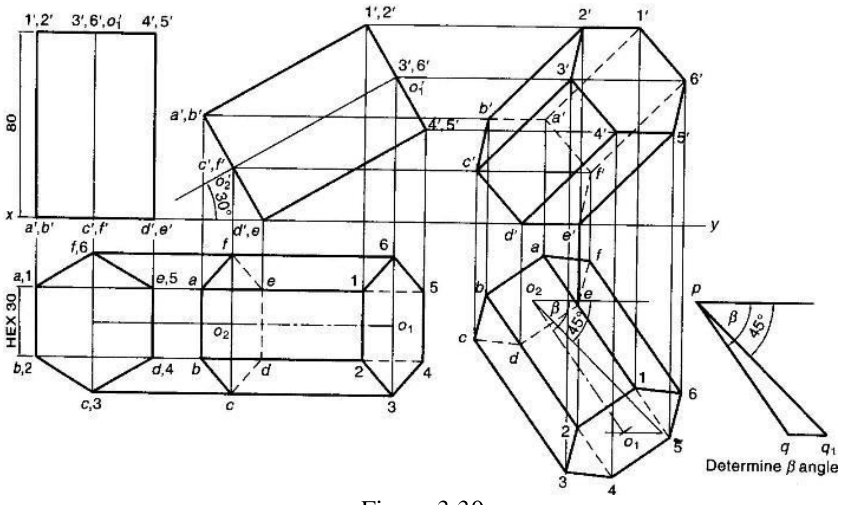


Figure 3.30

Problem:

A Square prism, having a base with a 35mm side and an 60mm long axis, rests on one of its base edges in the HP such that the axis is inclined at 45^0 to the HP and 45^0 to the VP. Draw its projections, if the resting edge makes an angle of 30^0 with VP?

Solution:

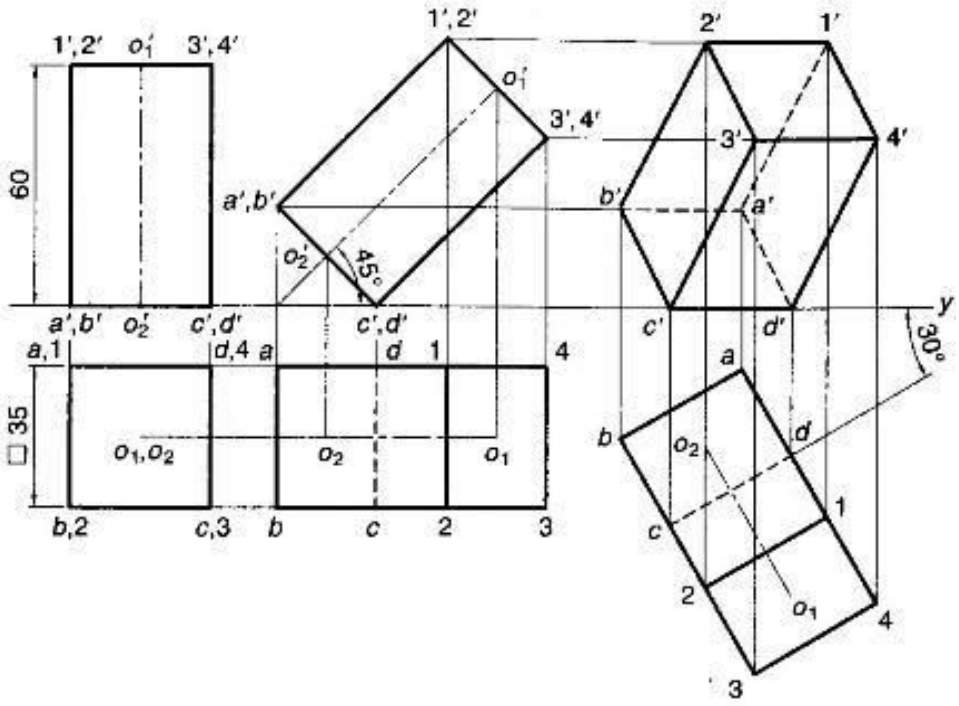


Figure 3.31

Problem:

A cylinder 40 mm diameter and 50 mm axis is resting on one point of a base circle on VP while it's axis makes 45^0 with VP and FV of the axis 35^0 with HP. Draw its projections.

Solution Steps:

Resting on VP on one point of base, means inclined to VP:

1. Assume it standing on VP
2. It's FV will show True Shape of base & top(circle)
3. Draw 40mm dia. Circle as FV & taking 50 mm axis project TV. (a Rectangle)
4. Name all points as shown in illustration.
5. Draw 2nd TV making axis 45^0 to xy and project it's FV above xy.
6. Make visible lines dark and hidden dotted, as per the procedure.
7. Then construct remaining inclination with HP (FV of axis i.e. center line of view to xy as shown) & project final.

Solution:

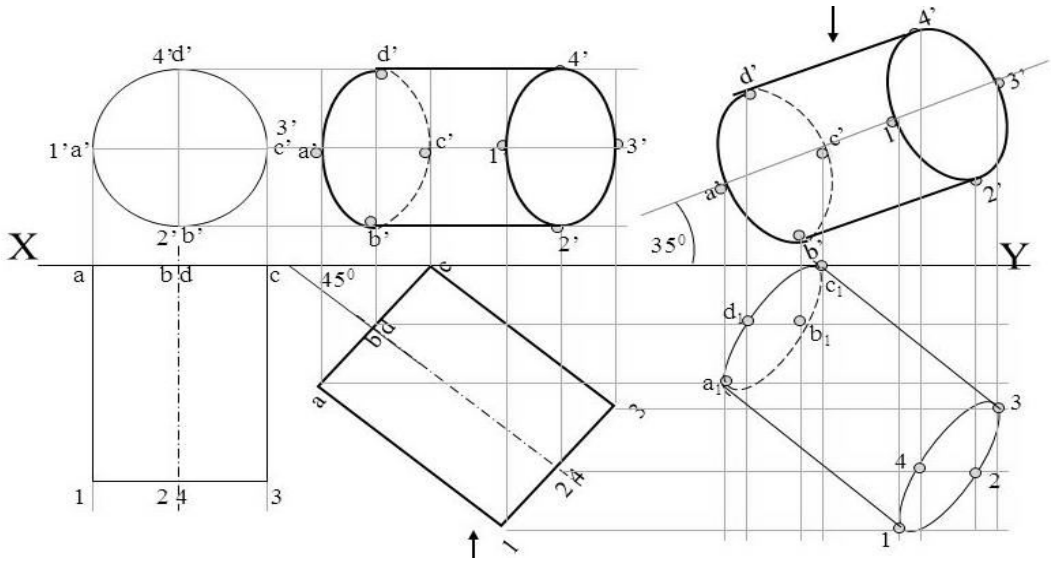


Figure 3.32

Problem:

A hexagonal prism of base side 30 mm long and axis 40 mm long, is standing on HP on it's base with one base edge parallel to VP.A tetrahedron is placed centrally on the top of it. The base of tetrahedron is a triangle formed by joining alternate corners of top of prism. Draw projections of both solids. Project an auxiliary TV on AIP 45^0 inclined to HP

Solution:

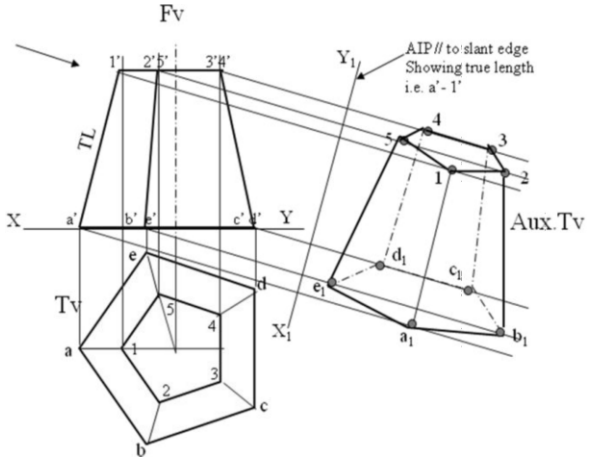


Figure 3.33

Tips &Shortcuts:

1.Axis inclined to HP and Parallel to VP ⟶ have to solve in two stages
Stage(i) assume axis perpendicular to HP then draw Top and Front view
Stage(ii) Tilt the Front view according to given angle. Then project all the points will get Final Top view

2 Axis inclined to VP and Parallel to HP ⟶ have to solve in two stages
Stage(i) assume axis perpendicular to VP then draw front and Top view
Stage(ii) Tilt the Top view according to given angle. Then project all the points will get Final Front view

Previous paper questions and Important Problems:

1. A cone of base diameter 40 mm and axis height 60 mm rests on the ground on a point of its base circle such that the axis of the cone is inclined at 40^0 to the HP and 30^0 to the VP. Draw its front and top views.

2. A hexagonal prism of base of side 40 mm and axis length 80 mm rests on one of its base edges on the HP. The end containing that edge is inclined at 30^0 to the HP and the axis is parallel to VP. It is cut by a plane perpendicular to the VP and parallel to the HP. The cutting plane bisects the axis. Draw its front and the sectional top views.

3. A square pyramid of base side 30 mm and altitude 50 mm lies on one of its triangular faces on the HP with its axis parallel to the VP. It is cut by a vertical plane inclined at 30^0 to the VP and meeting the axis at 40 mm from the vertex measured in the plan. Draw the top view, sectional front view and the true shape of the section.

4. A cone, diameter of base 50 mm and axis 65 mm long. is lying on the HP. on one of its generators with the axis parallel to the VP. It is cut by a horizontal Section plane 12mm above the ground. Draw its front view and sectional top view.

5. Draw the projections of a hexagonal pyramid of side of base 30mm and axis 60mm long resting on one of its base edges in HP with its axis inclined at 30^0 to HP. and the top view of axis is 45^0 to VP.

6. A square prism having a base with a 40mm side and a 60 mm long axis rests on its base on HP. such that one of the vertical faces makes an angle of 30 degrees with VP. A section plane perpendicular to the VP. Inclined at 45 degrees to the HP. and passing through the axis at a point 20 mm from its top end cuts the prism. Draw its front view, sectional top view.

7. A hexagonal prism, side of base 35mm and height 75mm is resting on one of its corners on HP. with a longer edge containing that corner inclined at 60 degrees to the HP. and rectangular face parallel to the VP. A horizontal section plane cuts the prism into two halves. Draw the sectional top view of the cut prism and front view.

8. Draw the projections of a pentagonal prism, base 25 mm side and axis 50 mm long resting on one of its rectangular faces on HP, with the axis inclined at 45 degrees to VP.