



# ENGINEERING GRAPHICS (ME1001)

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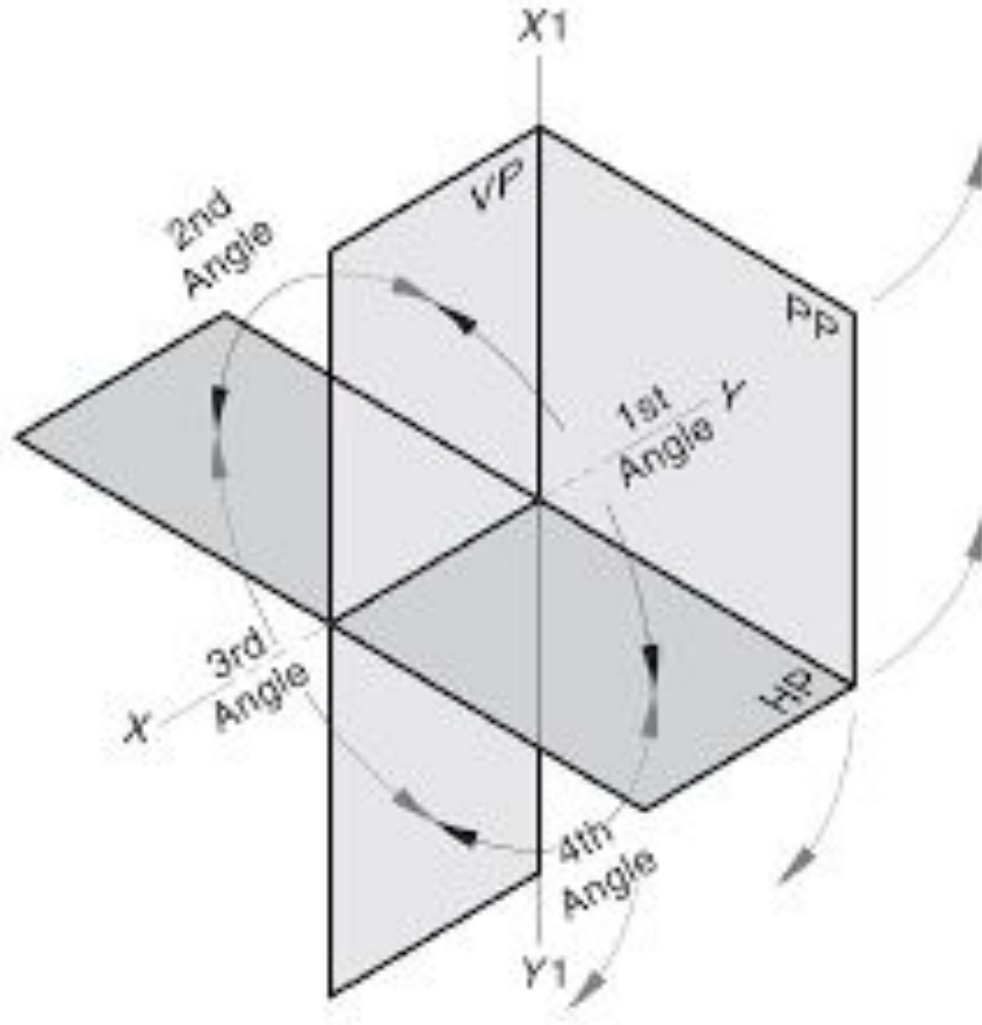
Department of Mechanical Engineering

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# PROJECTION

- A projection is defined as a representation of an object on a two dimensional plane.
- The following elements are to be considered while obtaining a projection.
  - The object
  - The plane of projection
  - The point of sight
  - The rays of sight.
- A projection is obtained by viewing the object from the point of sight and tracing in correct sequence, the points of intersection between the rays of sight and the plane to which the object is projected.

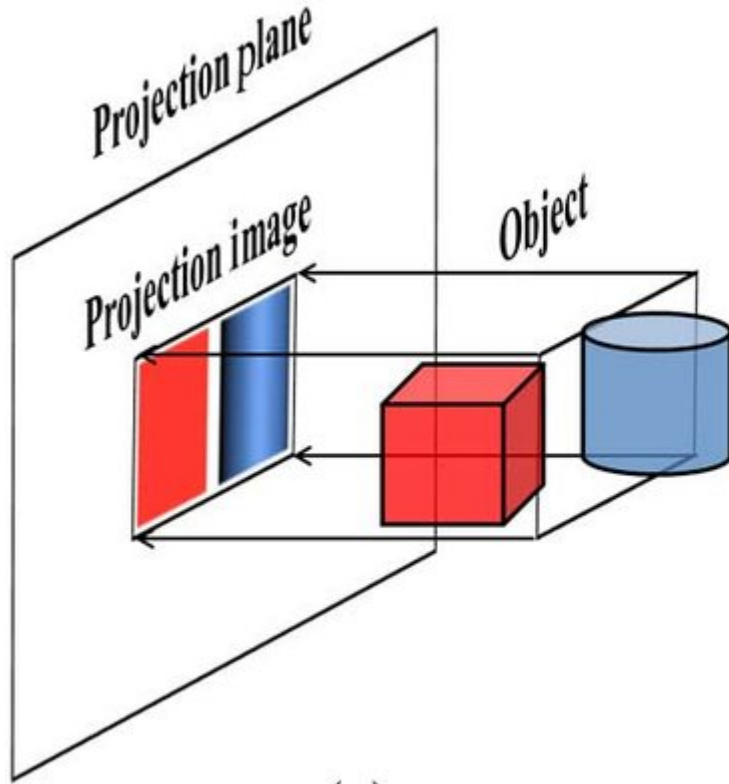
# PRINCIPAL PLANES OF PROJECTION



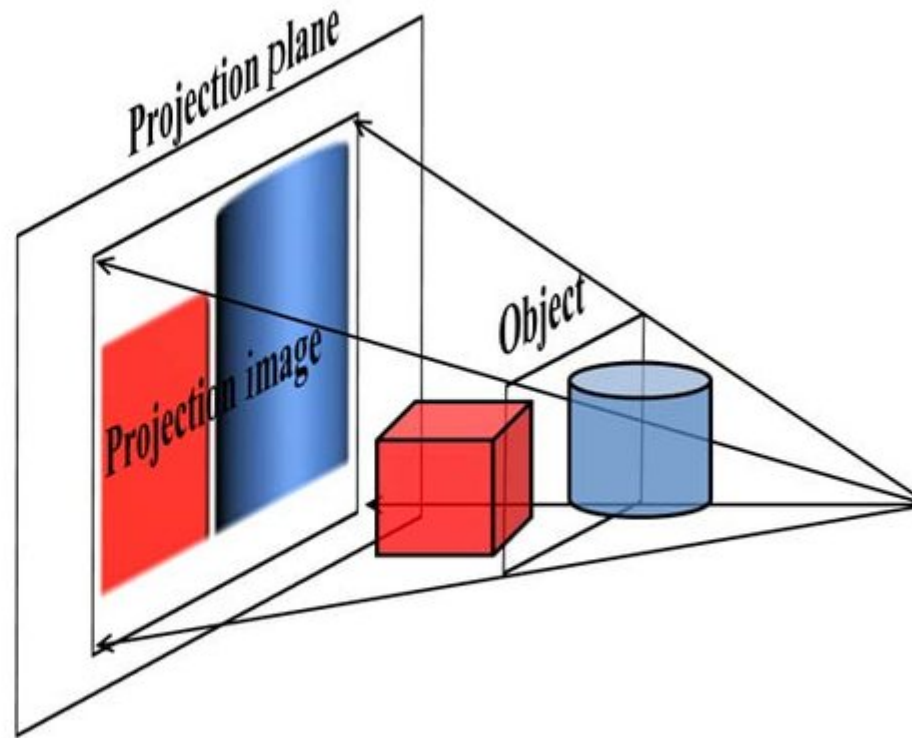
Four angles or systems of projection are first, second, third and fourth angle.

# ORTHOGRAPHIC PROJECTION

- A projection is called orthographic projection when the point of sight is imagined to be located at infinity so that the rays of sight are parallel to each other and intersect the plane of projection at right angles.



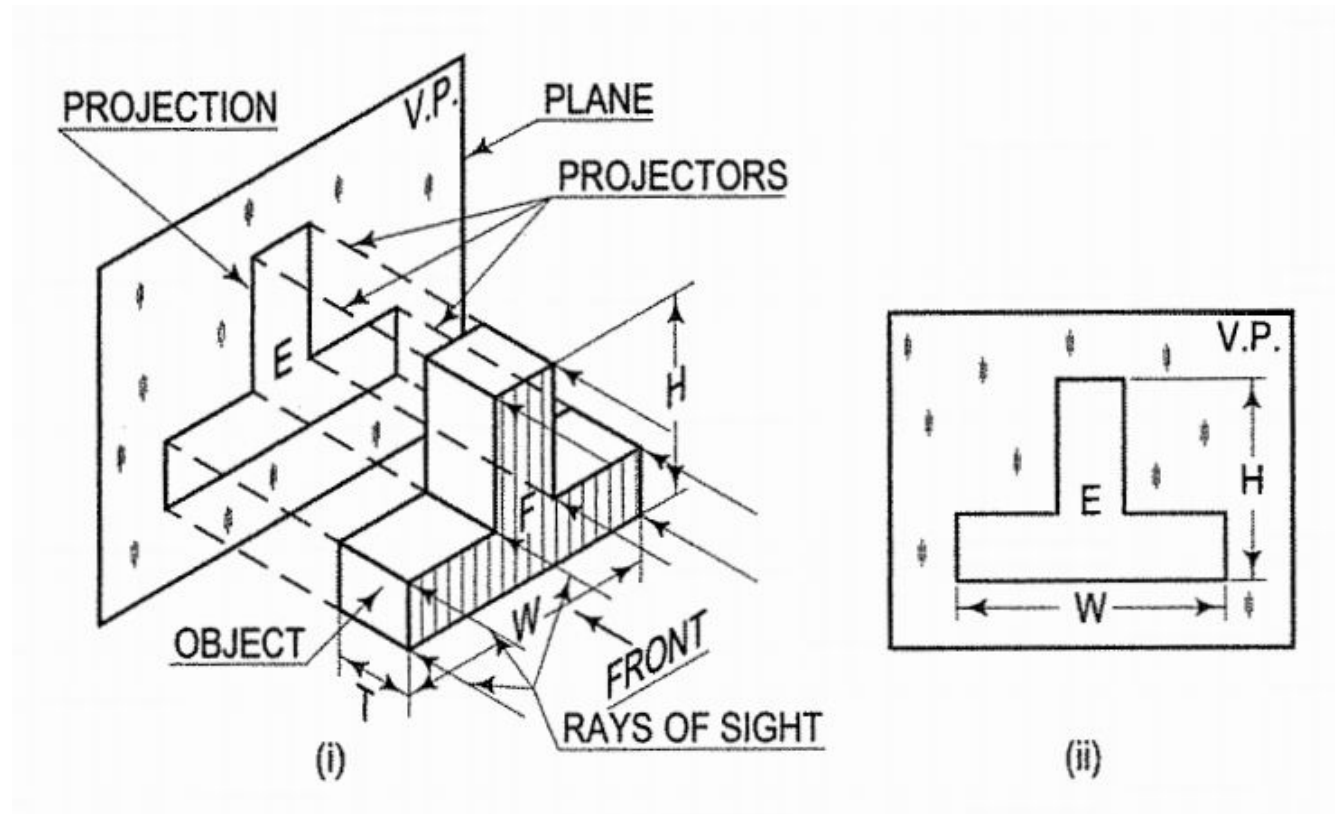
(a)



(b)

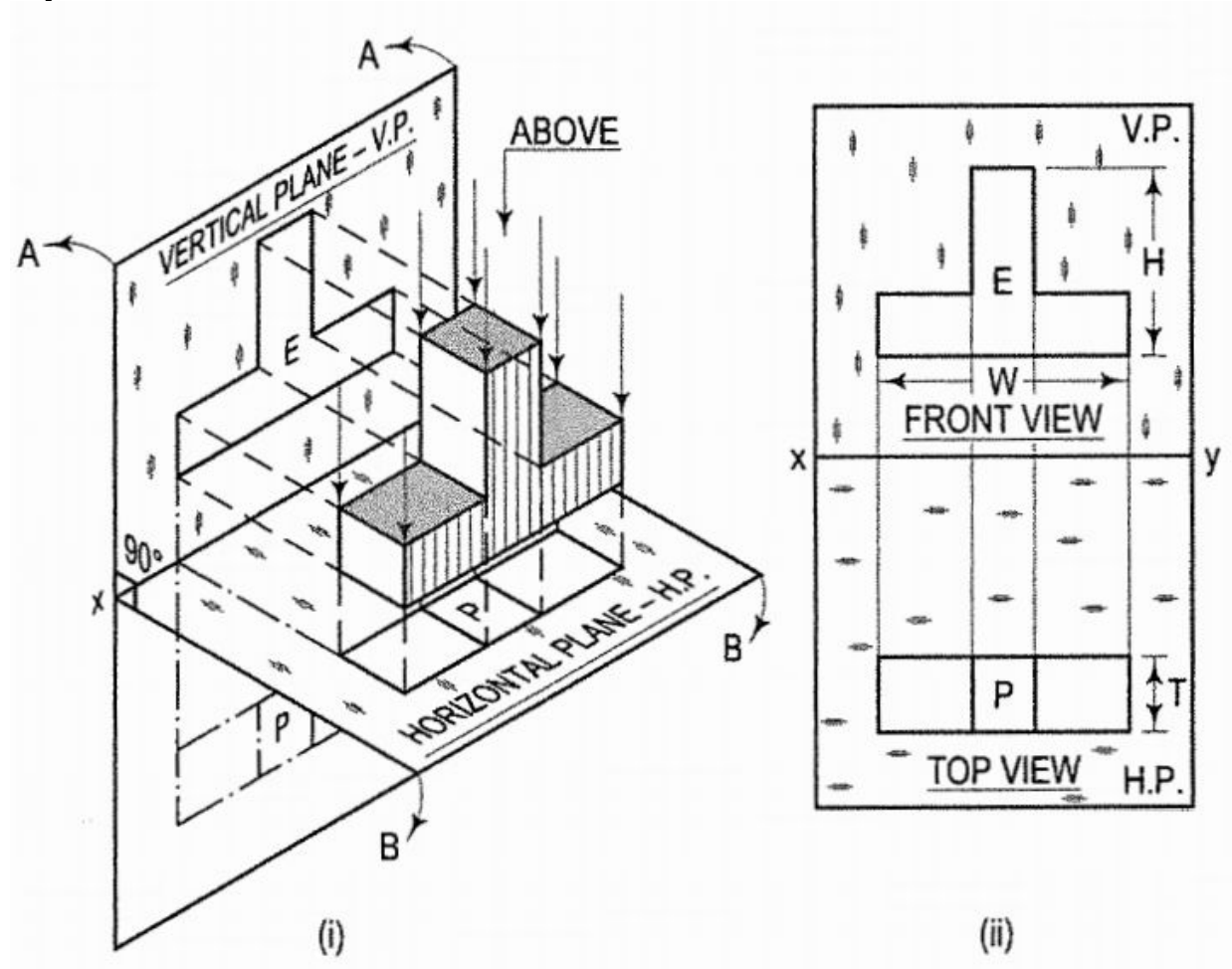
# FRONT VIEW or ELEVATION

- The front view of an object is the view that is obtained by projection on the vertical plane.



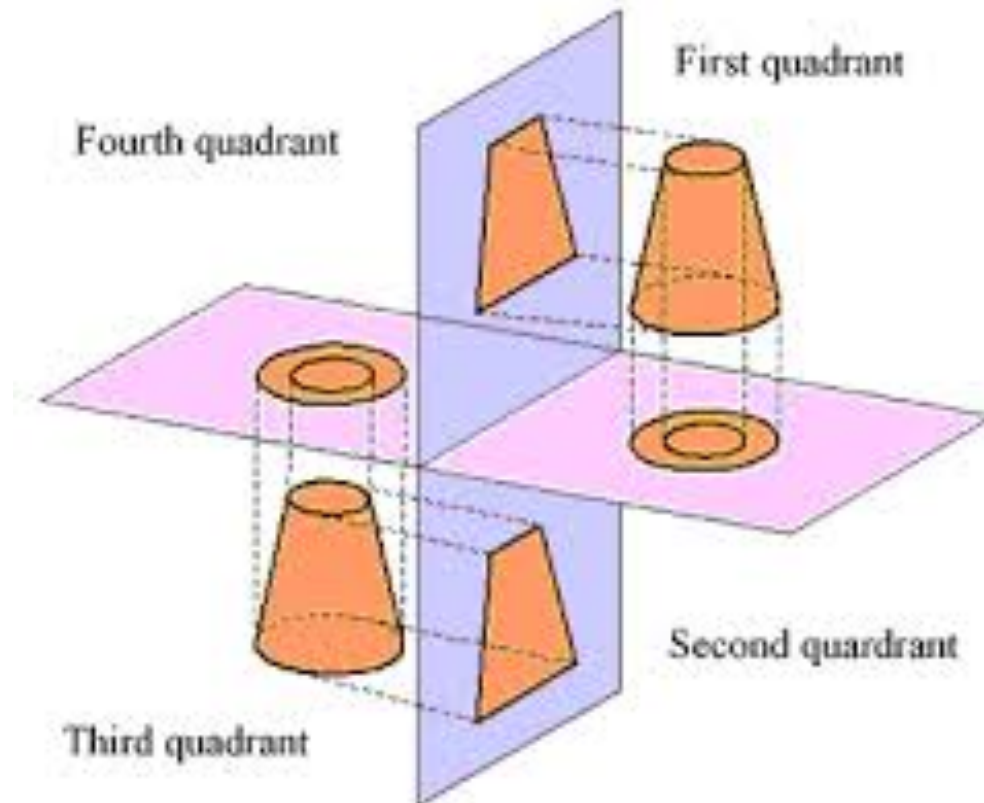
# TOP VIEW or PLAN

- The top view of an object is the view that is obtained by projection on the horizontal plane.



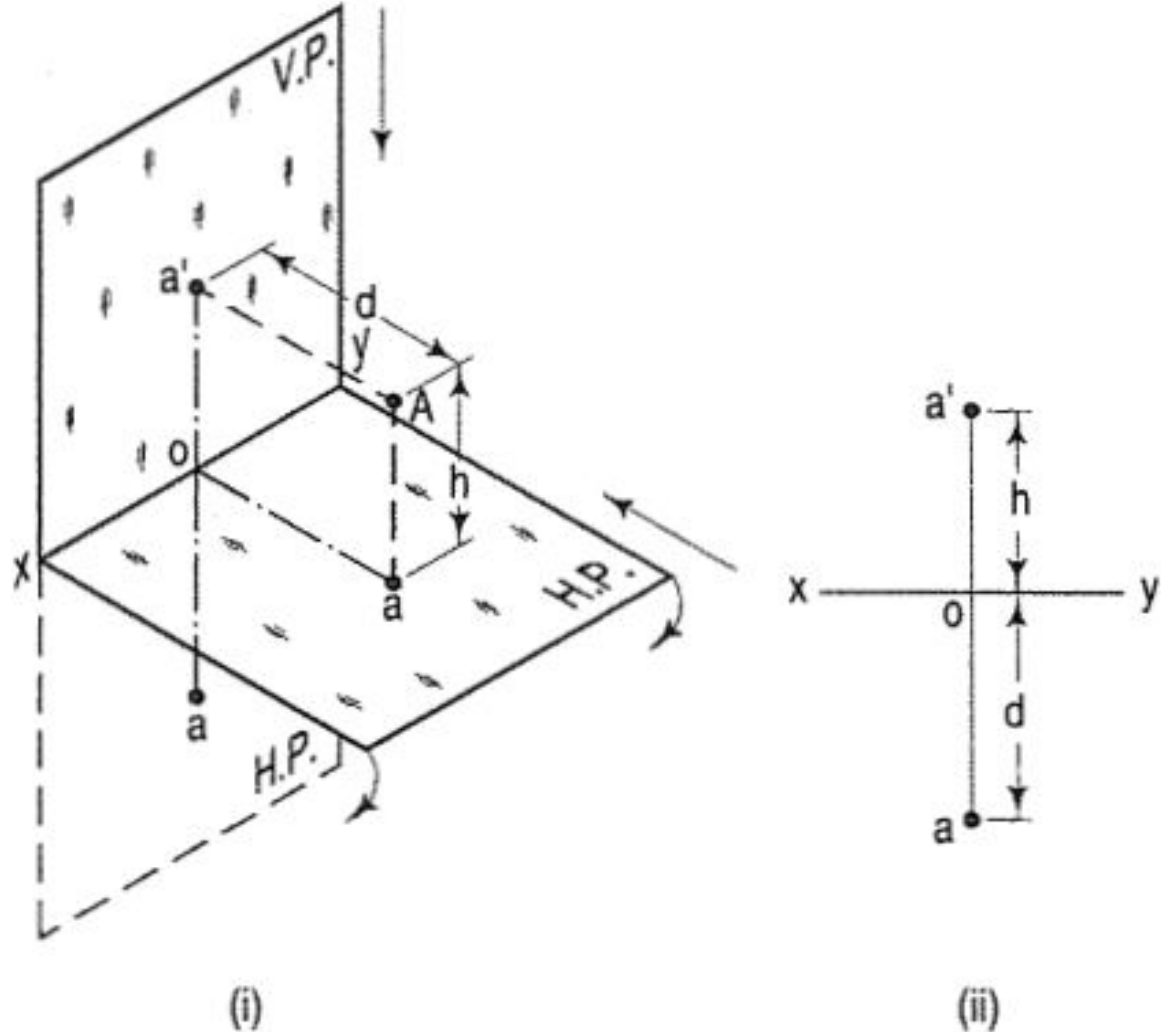
# FIRST ANGLE PROJECTION

- The object is imagined to be in the first quadrant.
- The object is in between the observer and the plane of projection.
- The object is imagined to be transparent.



# Point is in First Quadrant

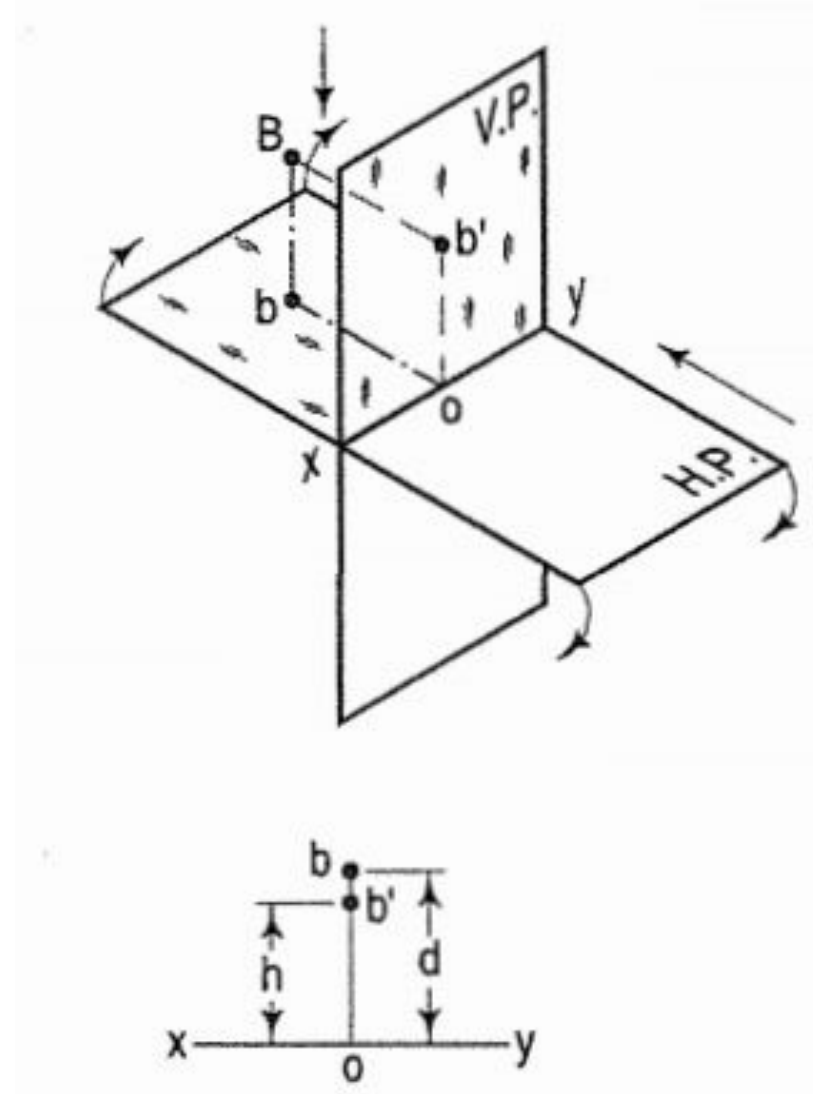
- Draw projections of the point on the two planes and rotate the HP by 90° in clockwise direction.





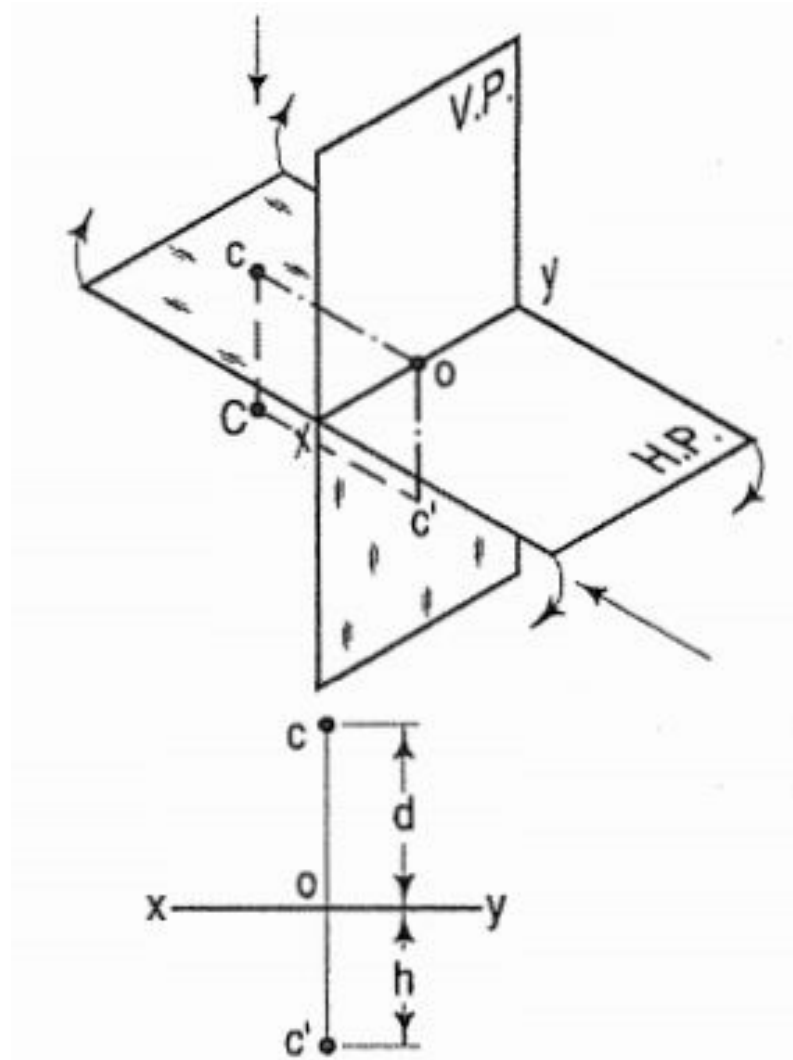
# Point is in Second Quadrant

- Draw projections of the point on the two planes and rotate the HP by 90 in clockwise direction.



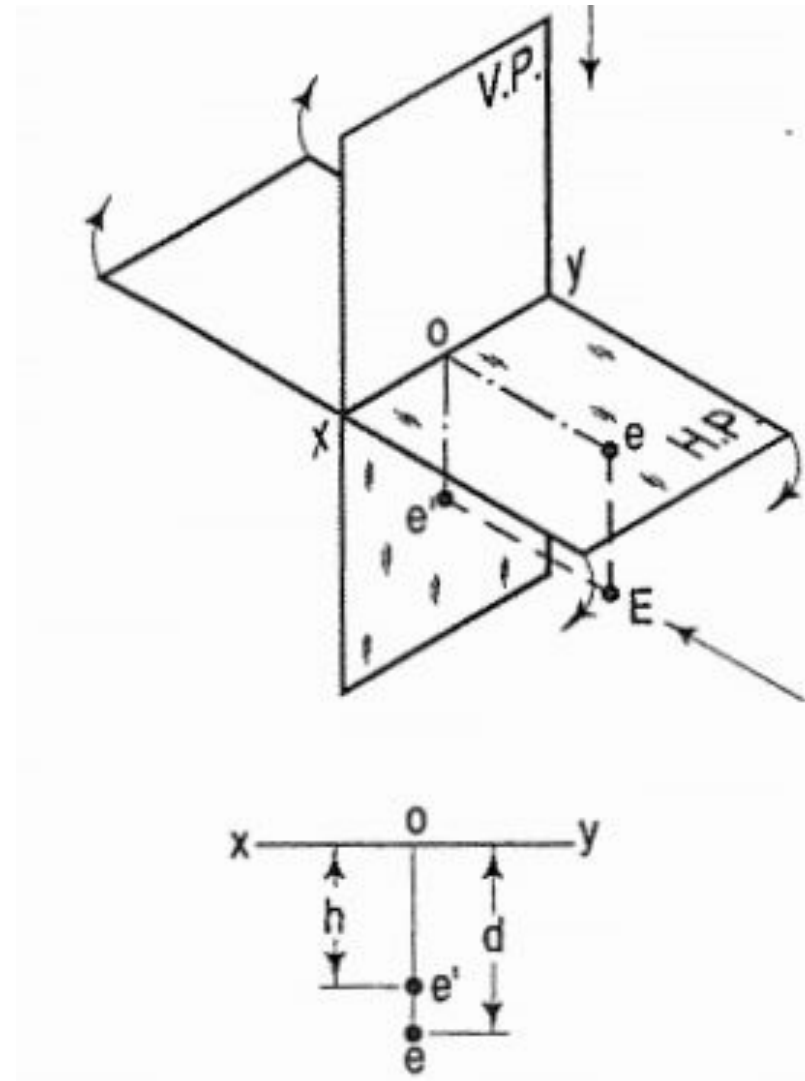
# Point is in Third Quadrant

- Draw projections of the point on the two planes and rotate the HP by 90° in clockwise direction.



# Point is in Fourth Quadrant

- Draw projections of the point on the two planes and rotate the HP by 90 in clockwise direction.



# Questions

1. Draw the projections of the following points on the same groundline, keeping the projectors 25 mm apart.

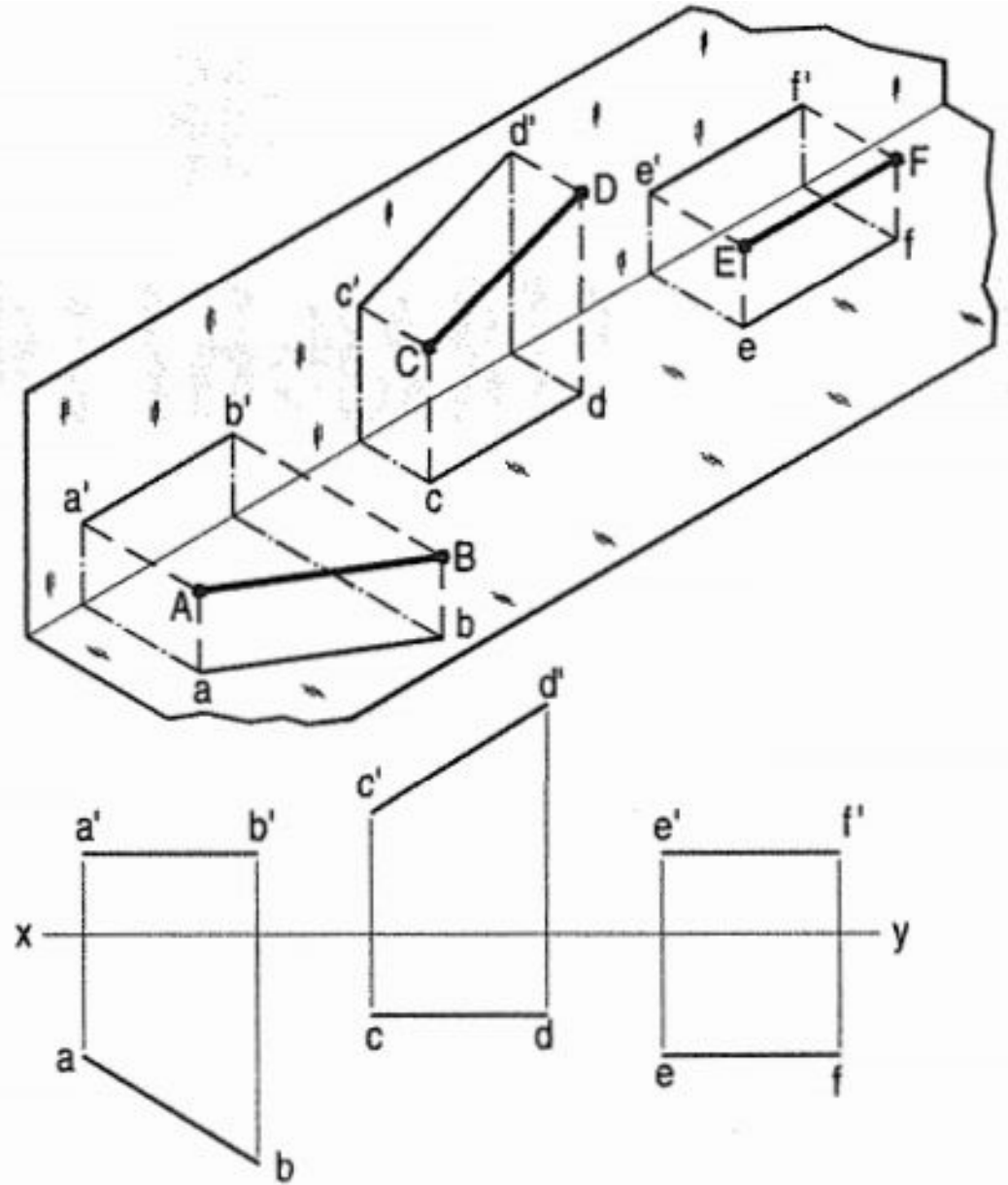
- A, in the H.P. and 20 mm behind the V.P.
- B, 40 mm above the H.P. and 25 mm in front of the V.P.
- C, in the V.P. and 40 mm above the H.P.
- D, 25 mm below the H.P. and 25 mm behind the V.P.
- E, 15 mm above the H.P. and 50 mm behind the V.P.
- F, 40 mm below the H.P. and 25 mm in front of the V.P.
- G, in both the H.P. and the V.P.

# Questions

2. Two points A and B are in the H.P. The point A is 30 mm in front of the V.P., while B is behind the V.P. The distance between their projectors is 75 mm and the line joining their top views makes an angle of  $45^\circ$  with xy. Find the distance of the point B from the V.P.
3. A point P is 20 mm below H.P. and lies in the third quadrant. Its shortest distance from xy is 40 mm. Draw its projections.

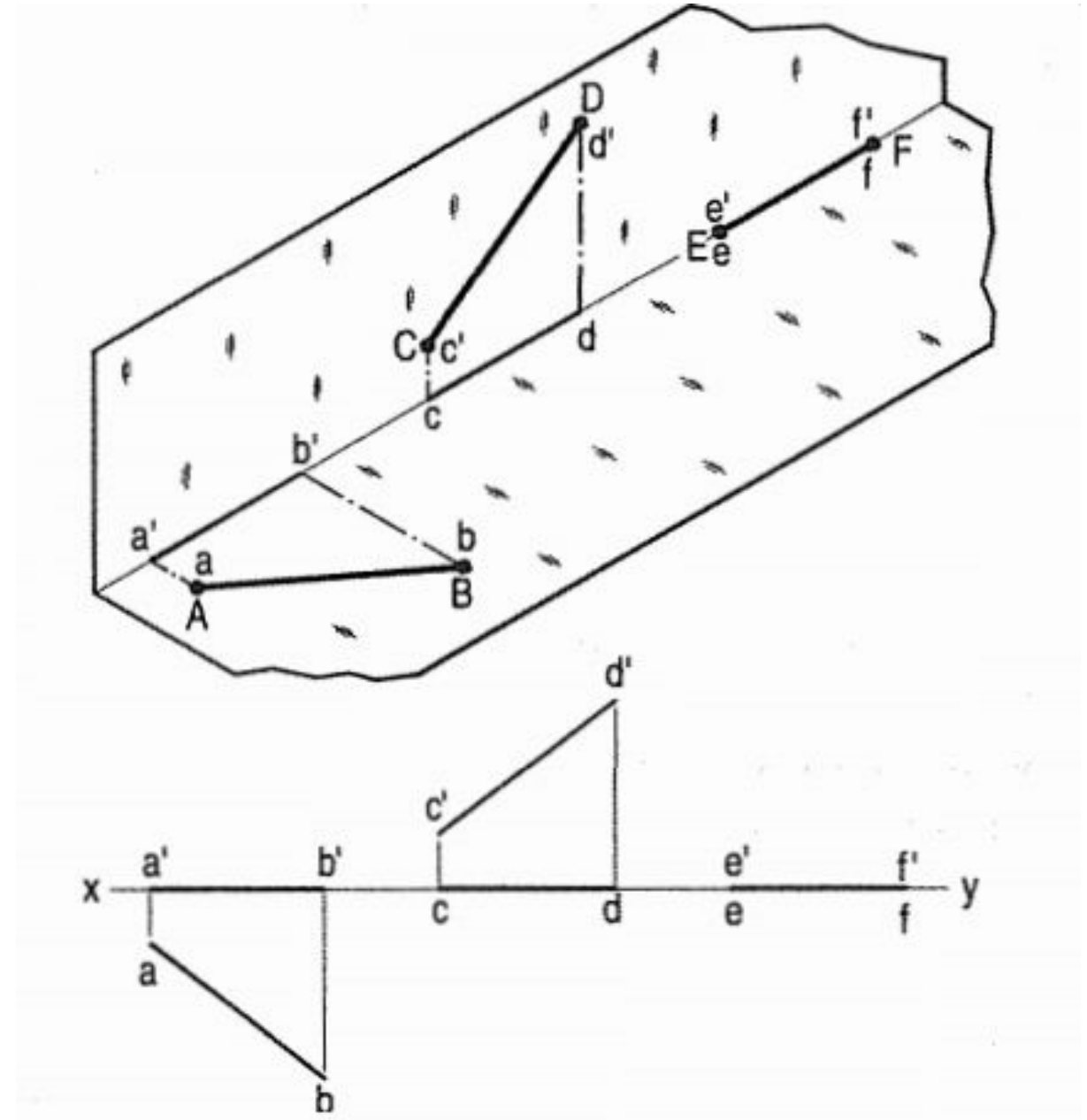
# Projection of Lines

- Line parallel to one or both planes.
- Line AB is parallel to?
- Line CD is parallel to?
- Line EF is parallel to?



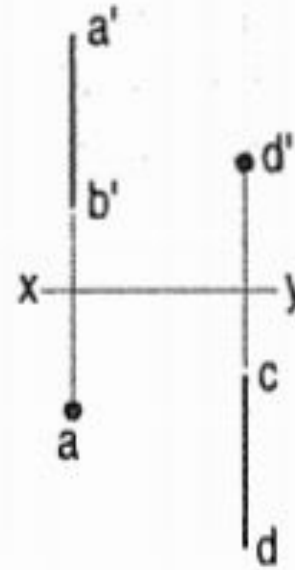
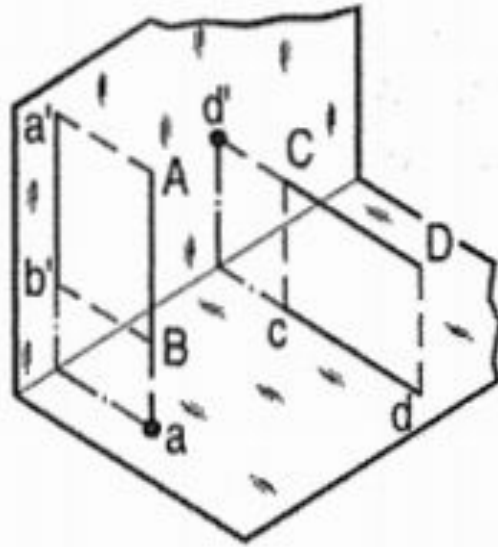
# Projection of Lines

- Line contained by one or both planes.
- Line AB is in?
- Line CD is in?
- Line EF is in?

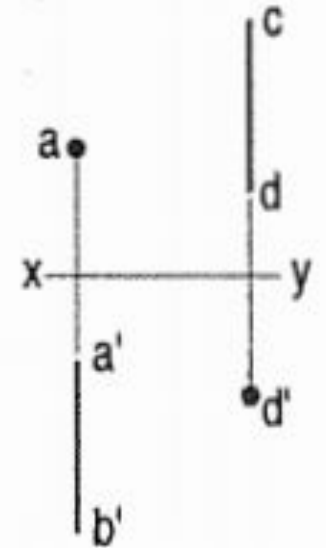


# Projection of Lines

- Line perpendicular to one of the planes.
- Line AB is perpendicular to?
- Line CD is perpendicular to?



(FIRST-ANGLE PROJECTION)

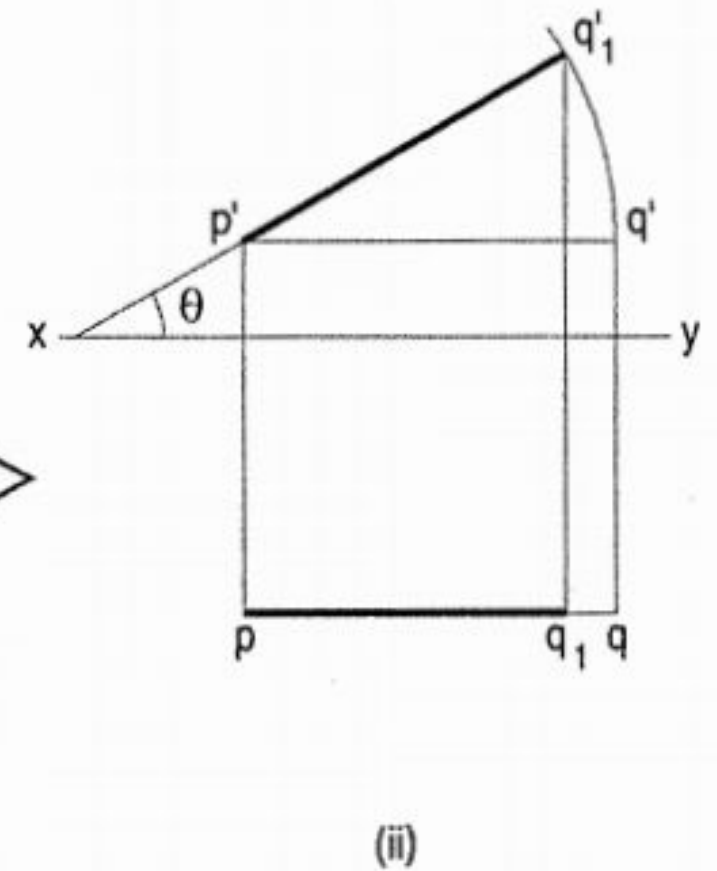
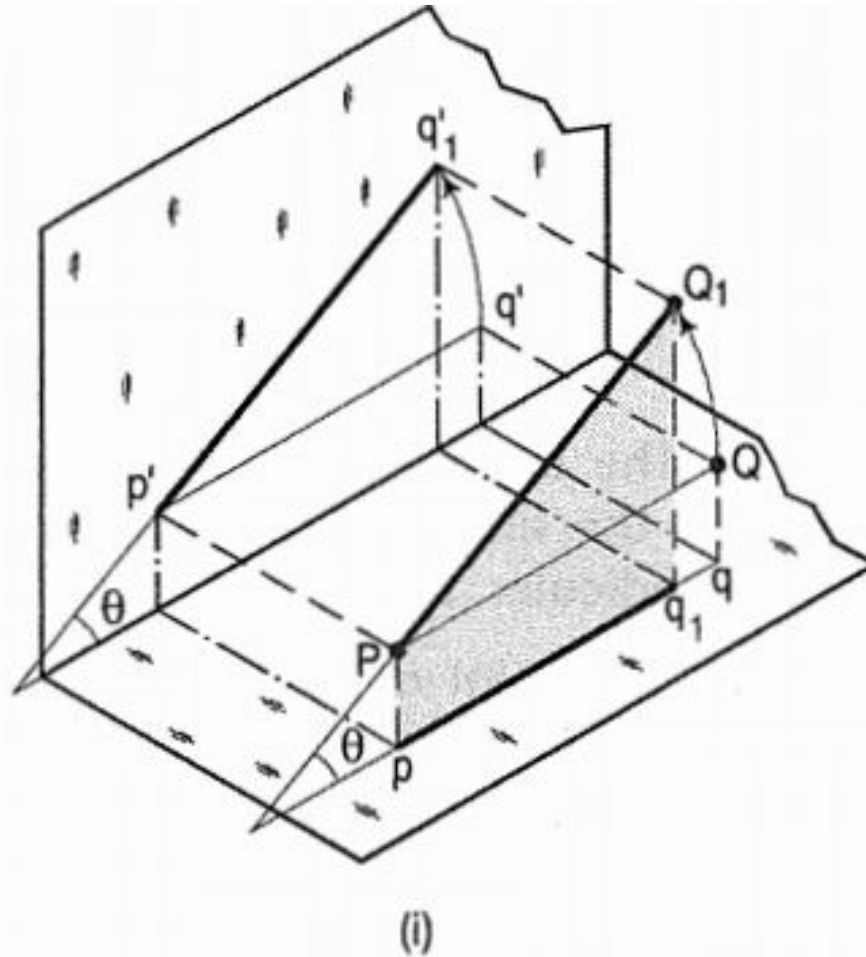


(THIRD-ANGLE PROJECTION)



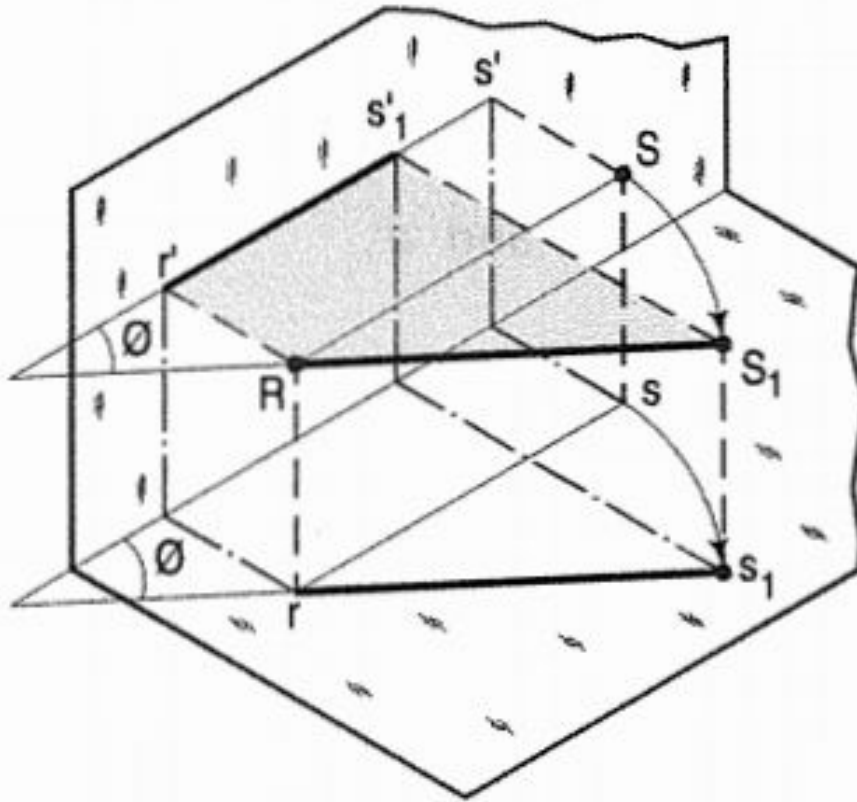
# Projection of Lines

- Line inclined to one plane and parallel to other. (Case 1)
- Line PQ1 is inclined to?

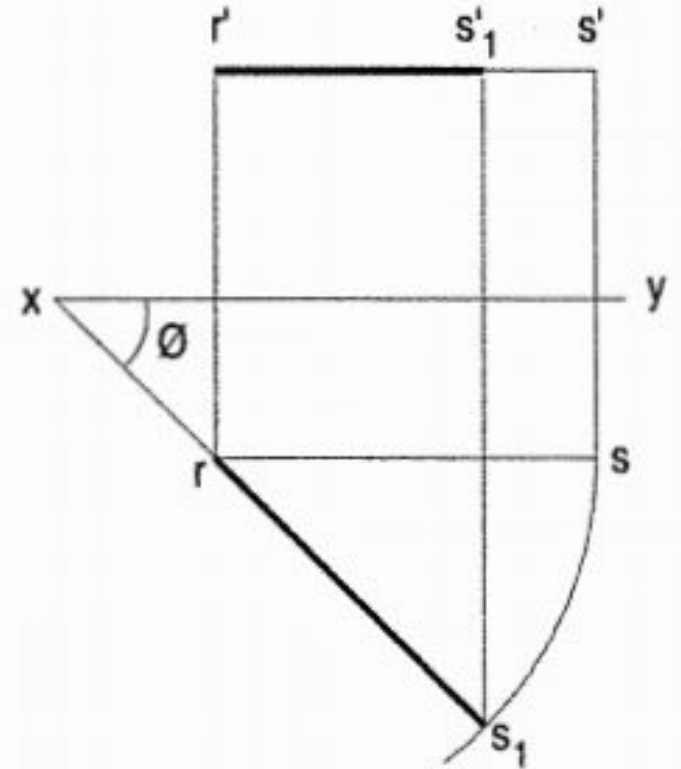


# Projection of Lines

- Line inclined to one plane and parallel to other. (Case 2)
- Line RS1 is inclined to?



(i)



(ii)

# Questions

1. A line PQ, 90 mm long, is in the H.P. and makes an angle of  $30^\circ$  with the V.P. Its end P is 25 mm in front of the V.P. Draw its projections.
2. The length of the top view of a line parallel to the V.P. and inclined at  $45^\circ$  to the H.P. is 50 mm. One end of the line is 12 mm above the H.P. and 25 mm in front of the V.P. Draw the projections of the line and determine its true length.
3. The front view of a 75 mm long line measures 55 mm. The line is parallel to the H.P. and one of its ends is in the V.P. and 25 mm above the H.P. Draw the projections of the line and determine its inclination with the V.P.

# Questions

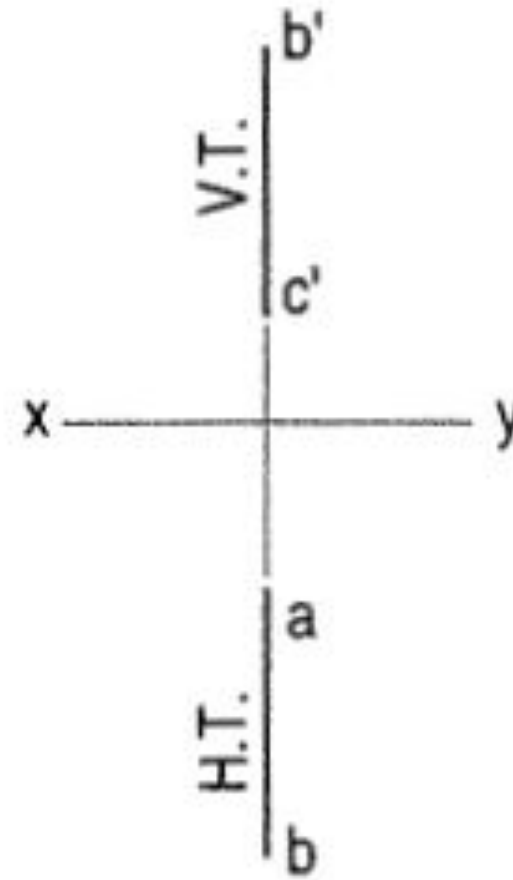
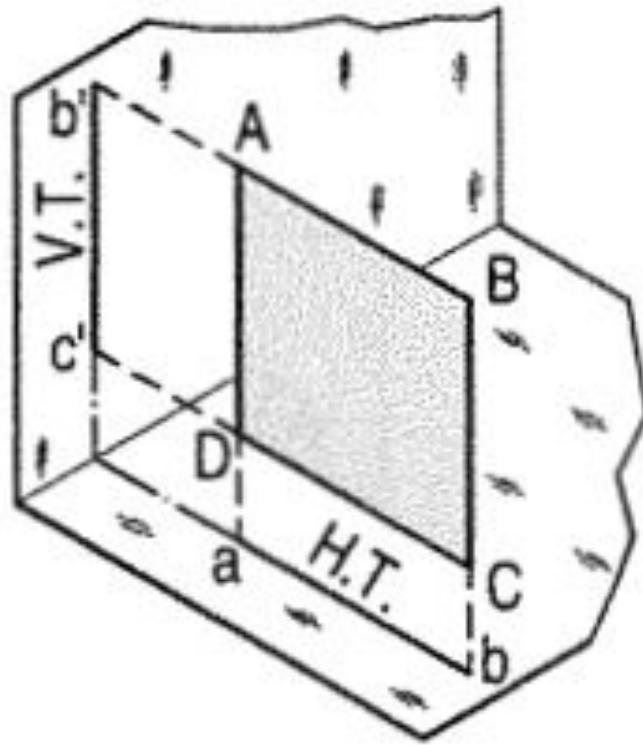
4. A vertical line AB, 75 mm long, has its end A in the H.P. and 25 mm in front of the V.P. A line AC, 100 mm long, is in the H.P. and parallel to the V.P. Draw the projections of the line joining B and C, and determine its inclination.
5. Two pegs fixed on a wall are 4.5 metres apart. The distance between the pegs measured parallel to the floor is 3.6 metres. If one peg is 1.5 metres above the floor, find the height of the second peg and the inclination of the line joining the two pegs, with the floor.

# Projection of Planes

- Planes can be of two types
- Perpendicular planes.
  - Perpendicular to both reference planes.
  - Perpendicular to one plane and parallel to other.
  - Perpendicular to one plane and inclined to other.
- Oblique planes.

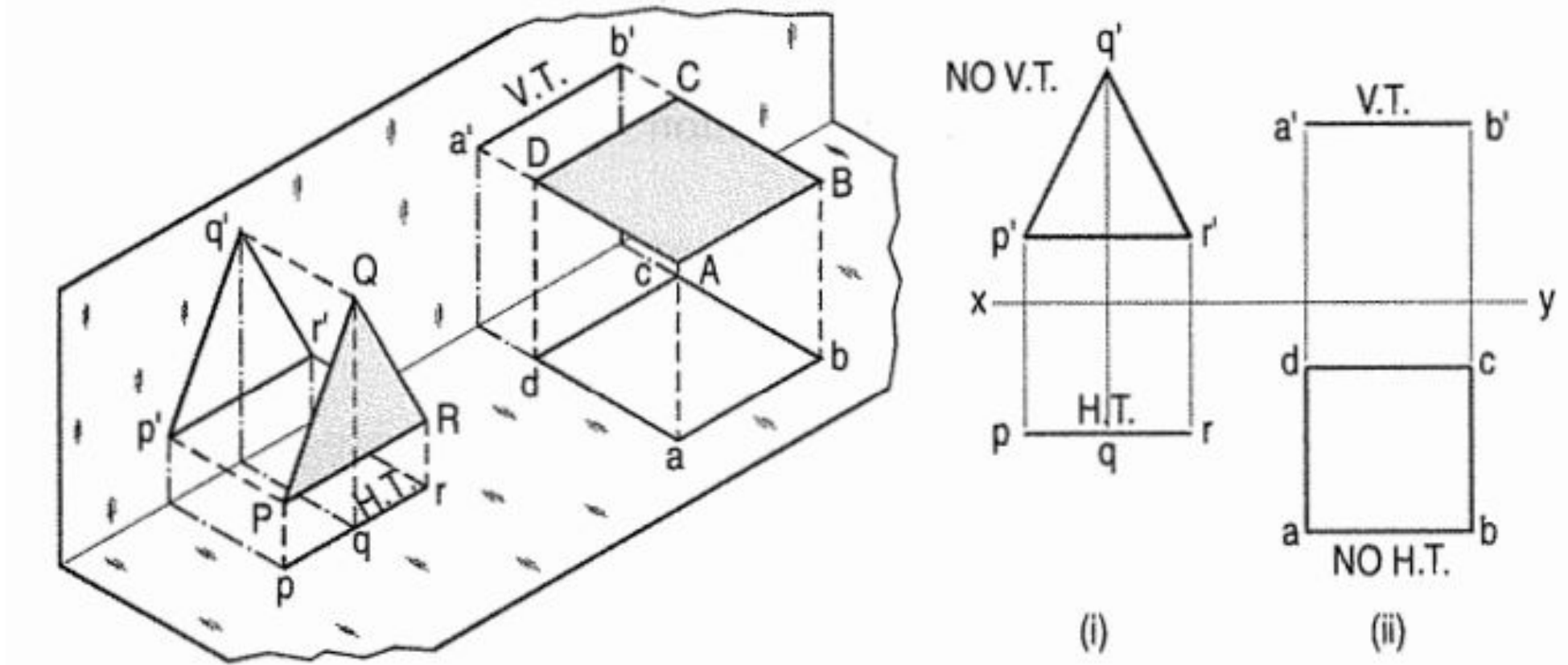
# Projection of Planes

- Plane perpendicular to both reference planes



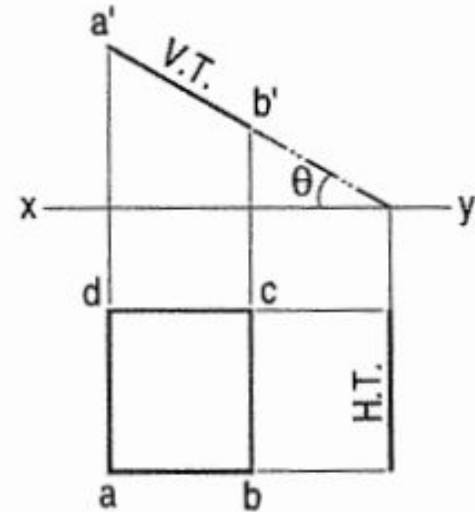
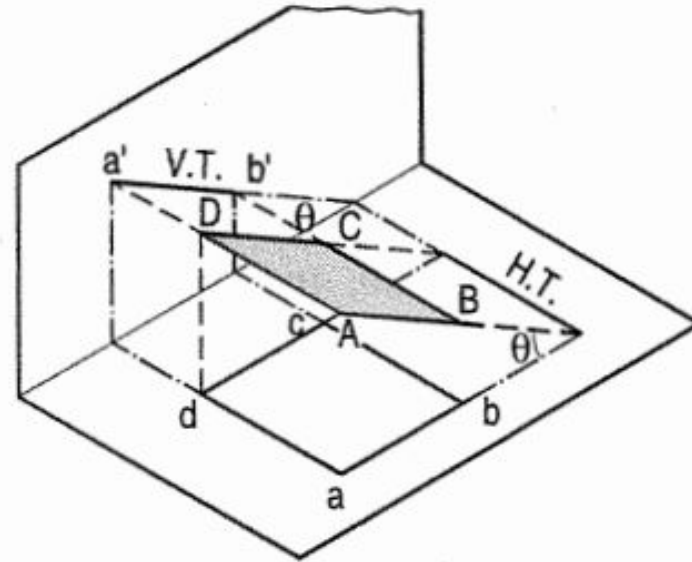
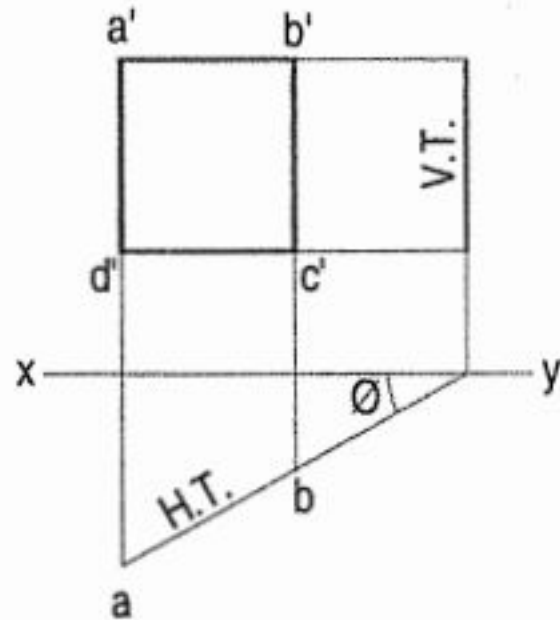
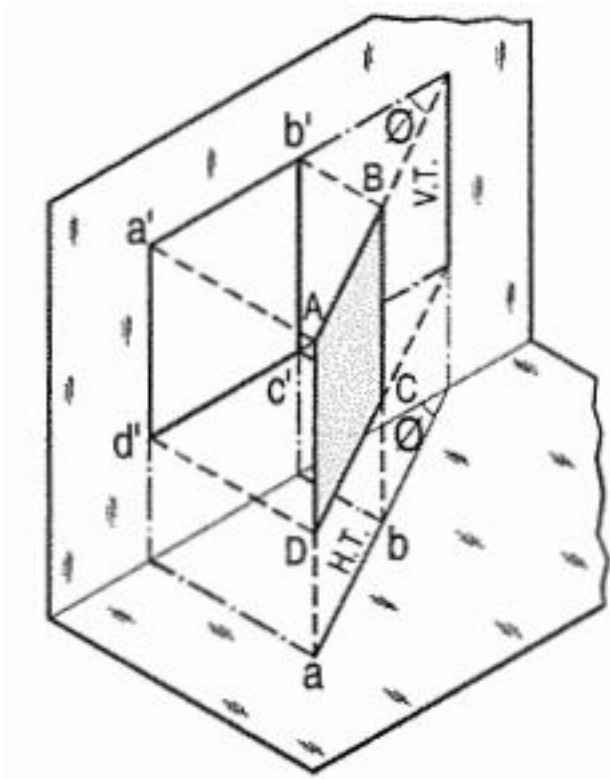
# Projection of Planes

- Plane perpendicular to one reference plane and parallel to other.



# Projection of Planes

- Plane perpendicular to one reference plane and inclined to other.





# Projection of Planes

- Oblique planes (surface inclined to one plane and an edge or a diameter or a diagonal parallel to that plane and inclined to other plane).
- Drawn in three stages: (surface inclined to H.P. and an edge/diagonal/diameter is parallel to the H.P and inclined to V.P.)
  - Assume plane is parallel to H.P. and an edge/diameter/diagonal perpendicular to V.P.
  - Then tilted to make required angle with H.P. (front view will be a line and top view will be smaller in size).
  - Change angle with V.P. (only position of top view will change, shape and size will not change).

# Projection of Planes

- A square ABCD of 50 mm side has its corner A in the H.P., its diagonal AC inclined at  $30^\circ$  to the H.P. and the diagonal BD inclined at  $45^\circ$  to the V.P. and parallel to the H.P. Draw its projections.

# Projection of Planes

- Draw the projections of a regular hexagon of 25 mm side, having one of its sides in the H.P. and inclined at  $60^\circ$  to the V.P., and its surface making an angle of  $45^\circ$  with the H.P.

# Projection of Planes

- Draw the projections of a circle of 50 mm diameter resting in the H.P. on a point A on the circumference, its plane inclined at  $45^\circ$  to the H.P. and
  - i. The top view of the diameter AB making  $30^\circ$  with the V.P.;
  - ii. The diameter AB making  $30^\circ$  with the V.P.

# Projection of Planes

- A thin 30°- 60° set-square has its longest edge in the V.P. and inclined at 30° to the H.P. Its surface makes an angle of 45° with the V.P. Draw its projections.

# Projection of Planes

- A circular plate of negligible thickness and 50 mm diameter appears as an ellipse in the front view, having its major axis 50 mm long and minor axis 30 mm long. Draw its top view when the major axis of the ellipse is horizontal.

# Projection of Planes

- An equilateral triangle ABC having side length as 50 is suspended from a point O on the side AB 15 mm from A in such a way that the plane of the triangle makes an angle of  $60^\circ$  with the V.P. The point O is 20 below the H.P. and 40 behind the V.P. Draw the projections of the triangle.

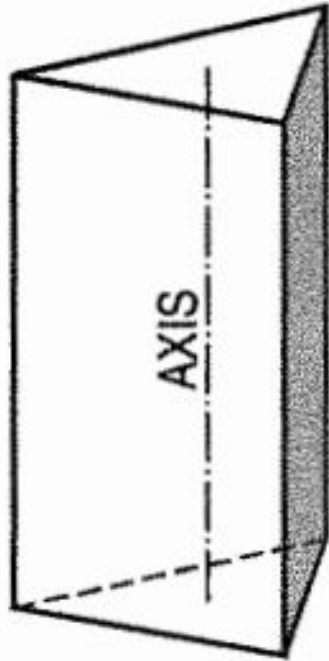
# Projection of Planes

- Top view of a plate, the surface of which is perpendicular to V.P. and inclined at  $60^\circ$  to H.P. is a regular hexagon of side 50, with an edge perpendicular to  $xy$ . (i) Find the true shape of the plate and (ii) draw the projections of the plate, when the edge of the regular hexagon whose top view was perpendicular to  $xy$  earlier, becomes parallel to V.P. while the surface is still inclined at  $60^\circ$  to H.P.

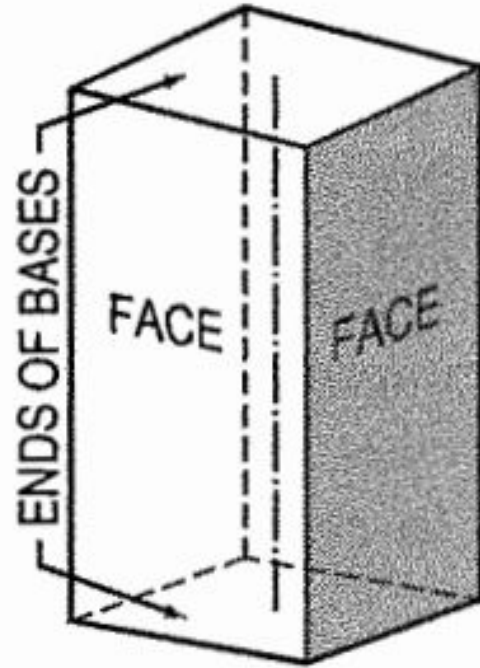


# Projection of Solids

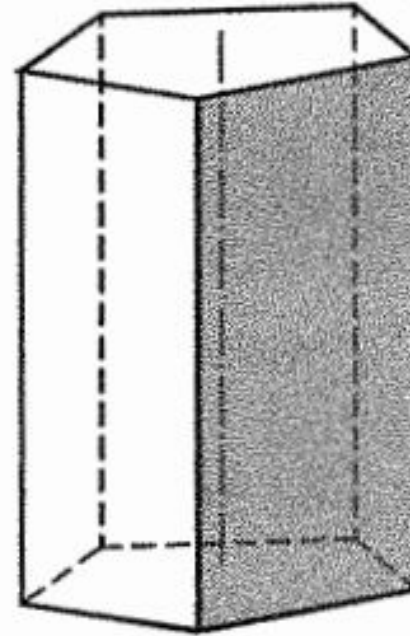
- Prisms



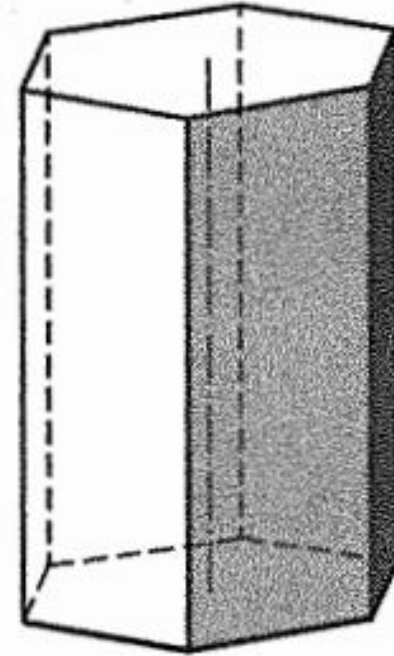
Triangular



Square



Pentagonal

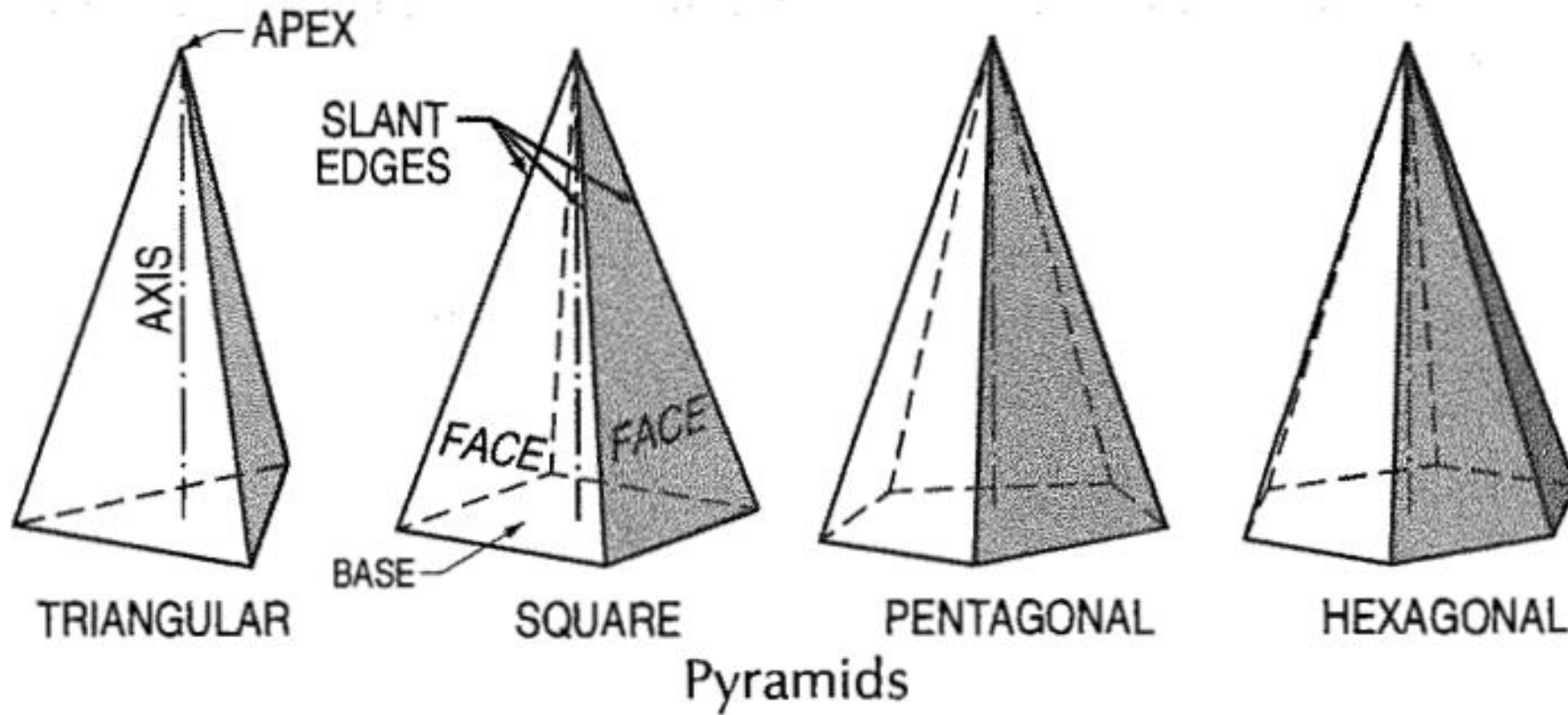


Hexagonal

Prisms

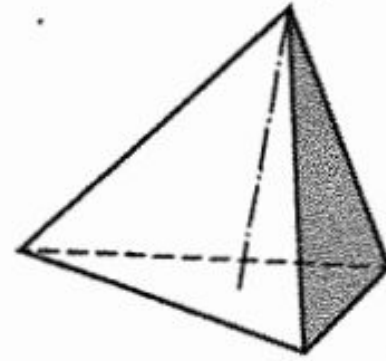
# Projection of Solids

- Pyramids

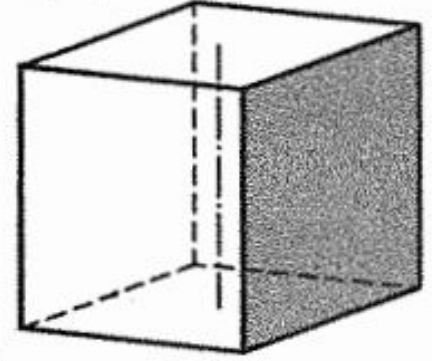


# Projection of Solids

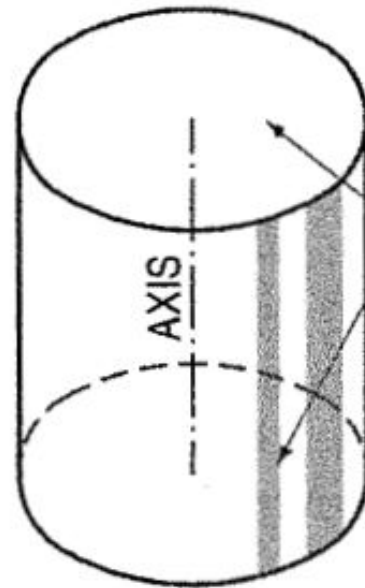
- Other Solids



Tetrahedron

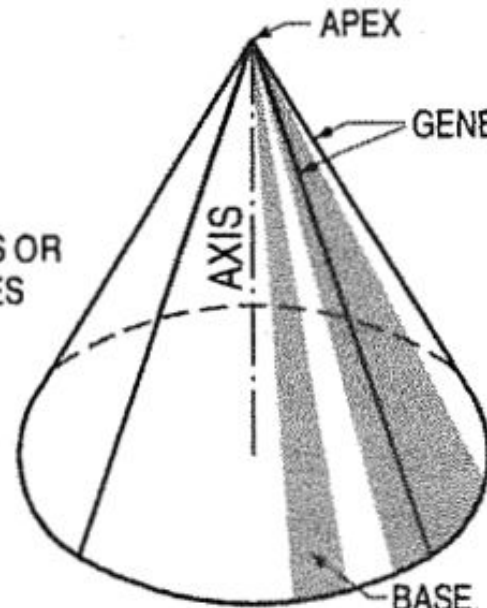


Cube



Cylinder

ENDS OR  
BASES



Cone

APEX

GENERATORS

BASE



Sphere

# Projection of Solids (Step 1)

- Draw the projections of a triangular prism, base 40 mm side and axis 50 mm long, resting on one of its bases on the H.P. with a vertical face perpendicular to the V.P.

# Projection of Solids (Step 1)

- Draw the projections of a pentagonal pyramid, base 30 mm edge and axis 50 mm long, having its base on the H.P. and an edge of the base parallel to the V.P. Also draw its side view.

# Projection of Solids (Step 1)

- A cube of 50 mm long edges is resting on the H.P. with its vertical faces equally inclined to the V.P. Draw its projections.

# Projection of Solids (Step 1)

- A hexagonal prism has one of its rectangular faces parallel to the H.P. Its axis is perpendicular to the V.P. and 3.5 cm above the ground. Draw its projections when the nearer end is 2 cm in front of the V.P. Side of base 2.5 cm long; axis 5 cm long.

# Projection of Solids (Step 1+Step 2)

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



# Projection of Solids (Step 1+Step 2)

- Draw the projections of a cylinder 75 mm diameter and 100 mm long, lying on the ground with its axis inclined at 30 degrees to the V.P. and parallel to the ground.

# Projection of Solids (Step 1+Step 2)

- A hexagonal pyramid, base 25 mm side and axis 50 mm long, has an edge of its base on the ground. Its axis is inclined at  $30^\circ$  to the ground and parallel to the V.P. Draw its projections.

# Projection of Solids (Step 1+Step 2)

- Draw the projections of a cone, base 75 mm diameter and axis 100 mm long, lying on the H.P. on one of its generators with the axis parallel to the V.P.

# Projection of Solids (Step 1+Step 2+Step 3)

- A square prism, base 40 mm side and height 65 mm, has its axis inclined at  $45^\circ$  to the H.P. and has an edge of its base, on the H.P. and inclined at  $30^\circ$  to the V.P. Draw its projections.

# Projection of Solids (Step 1+Step 2+Step 3)

- Draw the projections of a cone, base 45 mm diameter and axis 50 mm long, when it is resting on the ground on a point on its base circle with  
(a) the axis making an angle of  $30^\circ$  with the H.P. and  $45^\circ$  with the V.P.;  
(b) the axis making an angle of  $30^\circ$  with the H.P. and its top view making  $45^\circ$  with the V.P.

# Projection of Solids (Step 1+Step 2+Step 3)

- A pentagonal pyramid, base 25 mm side and axis 50 mm long has one of its triangular faces in the V.P. and the edge of the base contained by that face makes an angle of  $30^\circ$  with the H.P. Draw its projections.

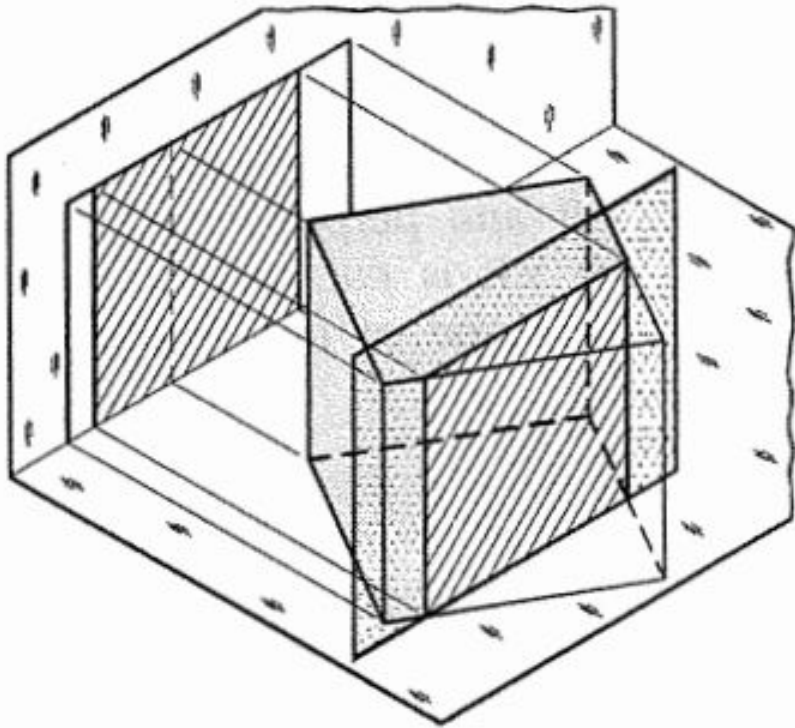
# Projection of Solids (Step 1+Step 2+Step 3)

- A square pyramid, base 38 mm side and axis 50 mm long, is freely suspended from one of the corners of its base. Draw its projections, when the axis as a vertical plane makes an angle of  $45^\circ$  with the V.P. When a pyramid is suspended freely from a corner of its base, the imaginary line joining that corner with the centre of gravity of the pyramid will be vertical.

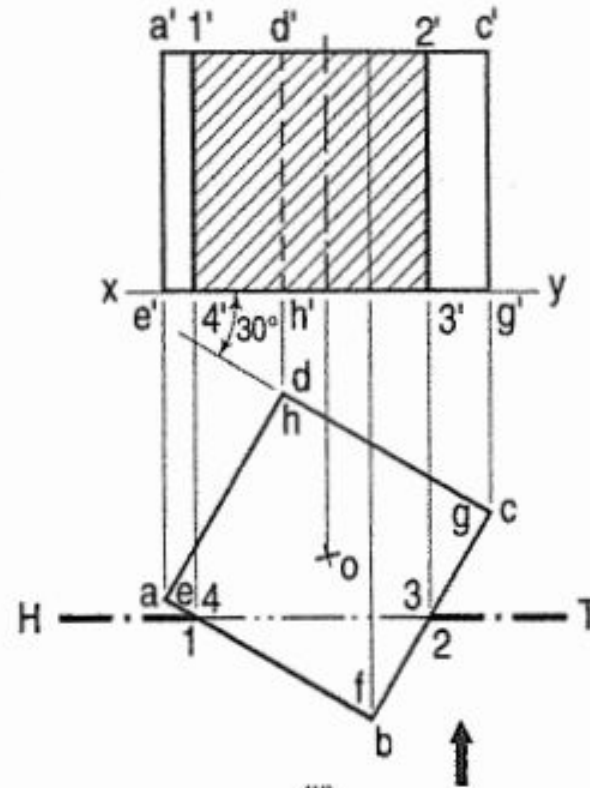
# Section of Solids

- Section planes

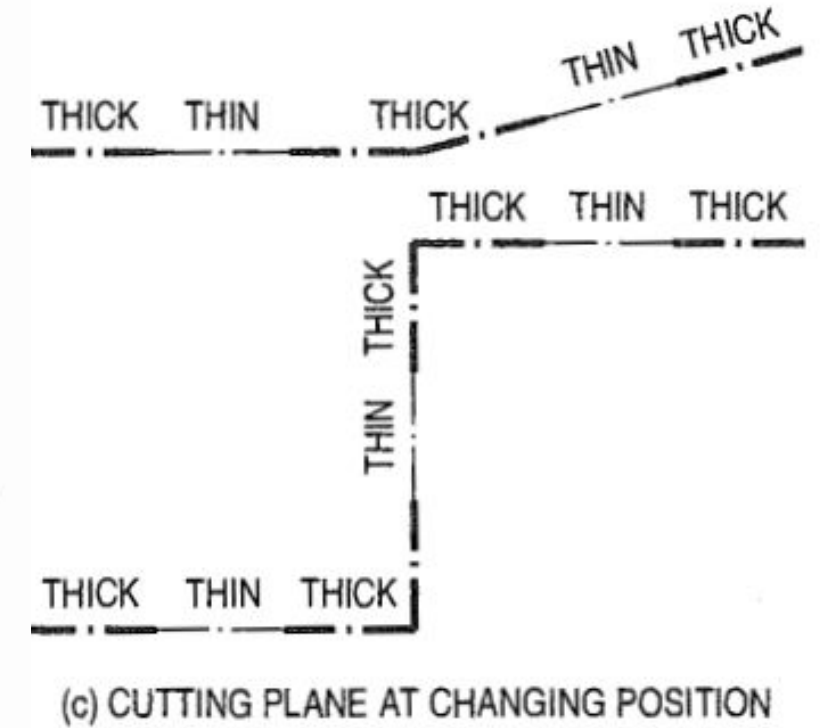
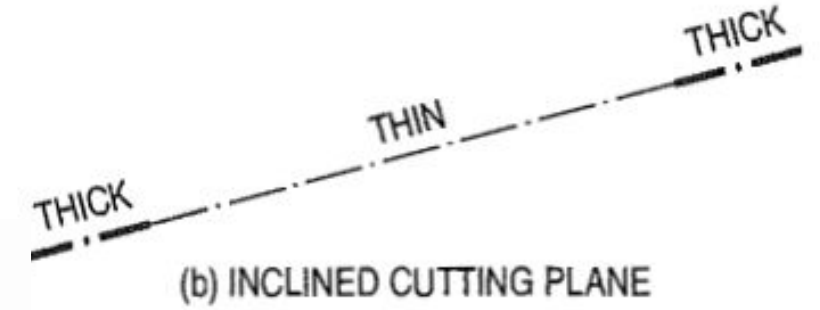
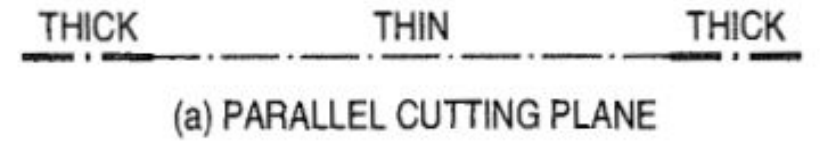
- Section plane parallel to a reference plane



(i)



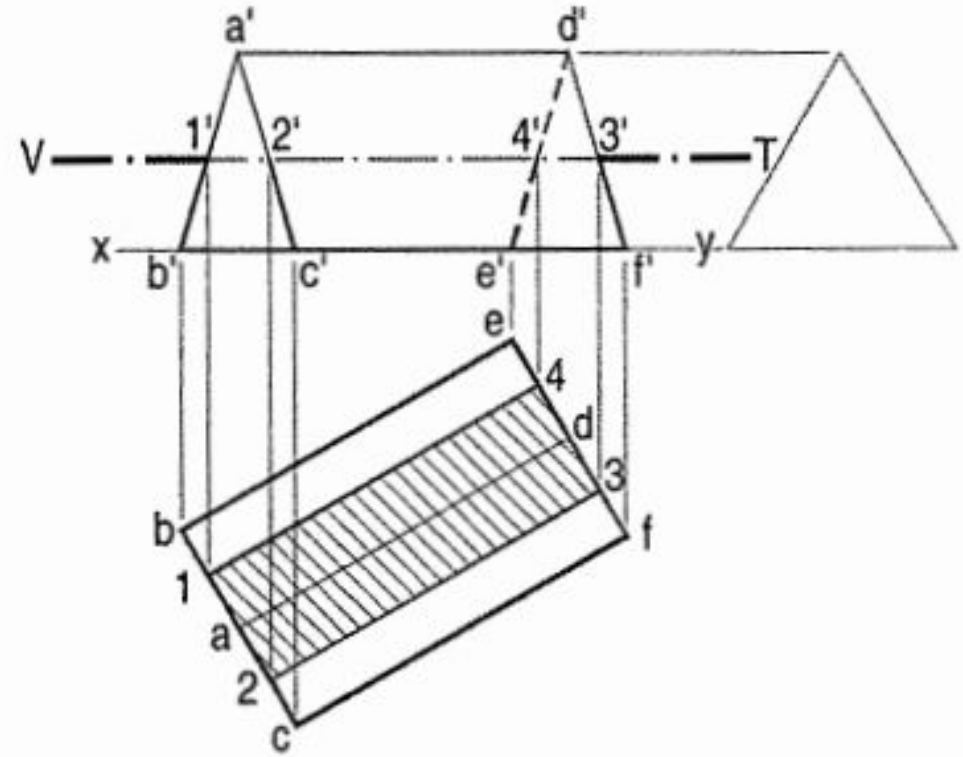
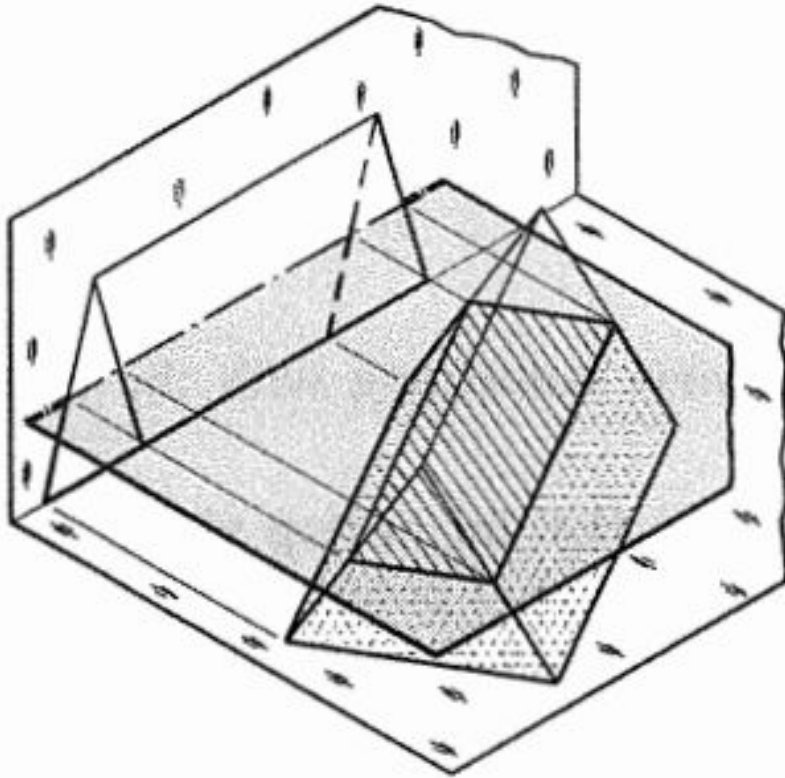
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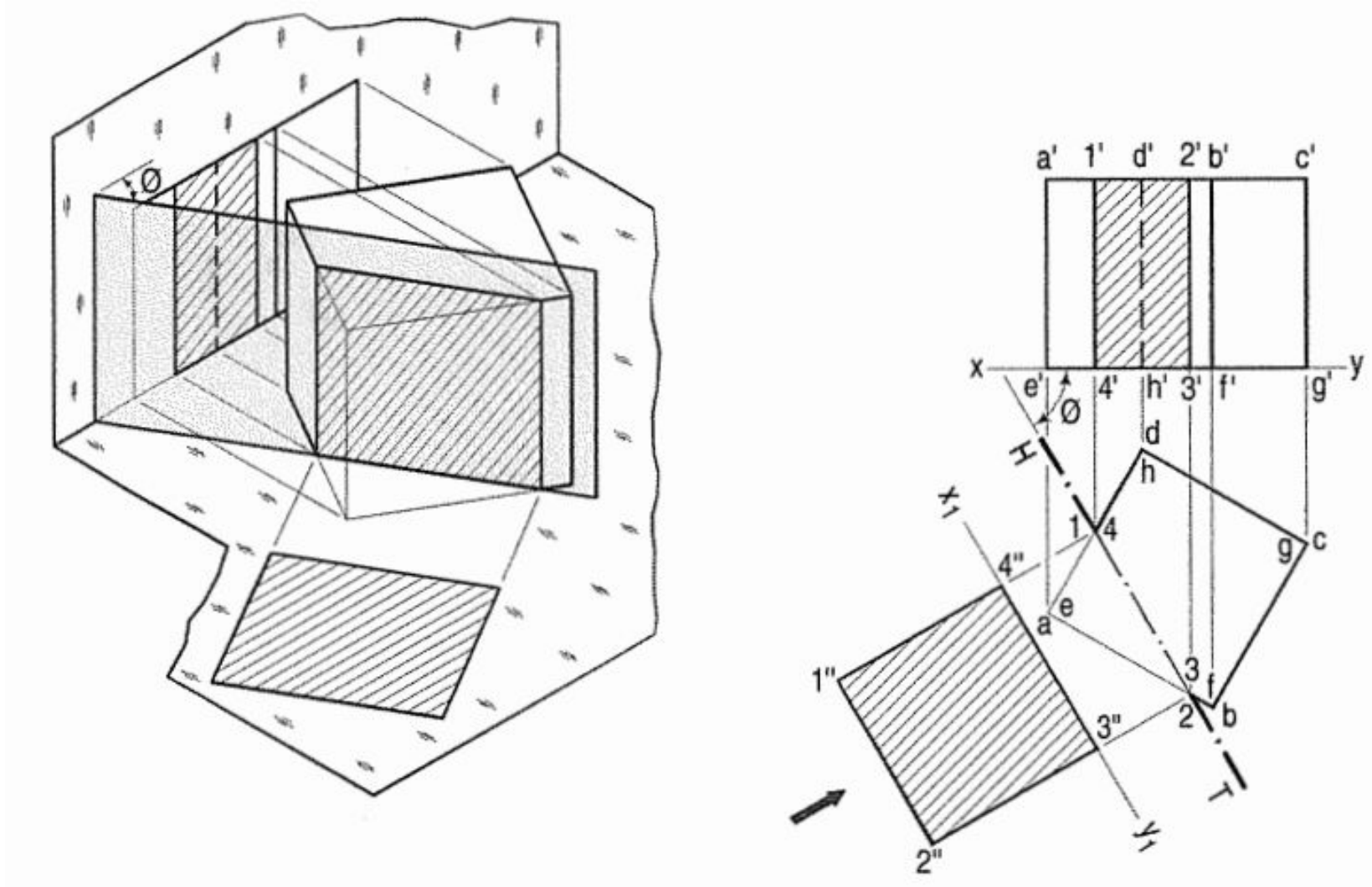
# Section of Solids

- Section plane parallel to a reference plane



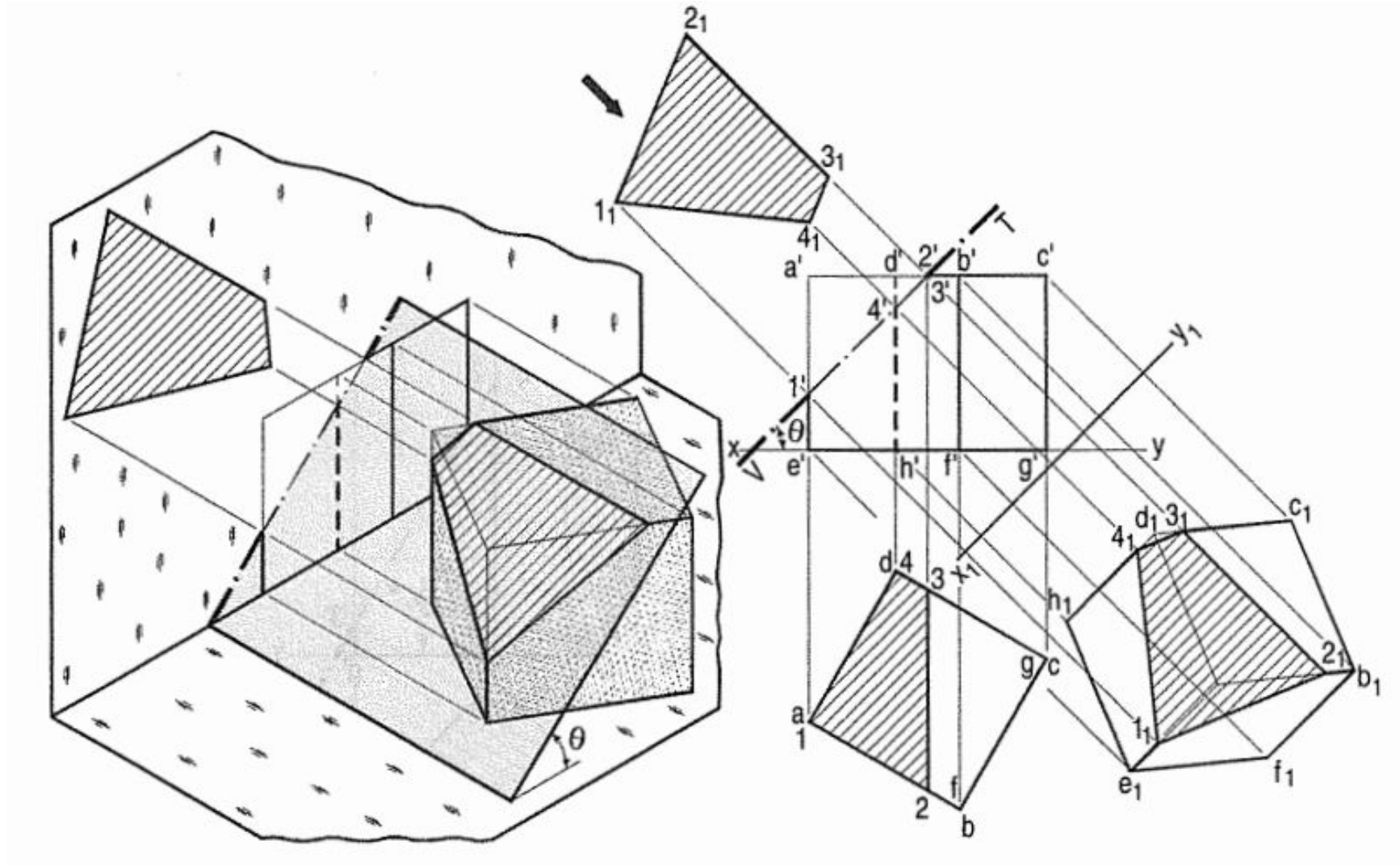
# Section of Solids

- Section plane perpendicular to H.P. and inclined to V.P.



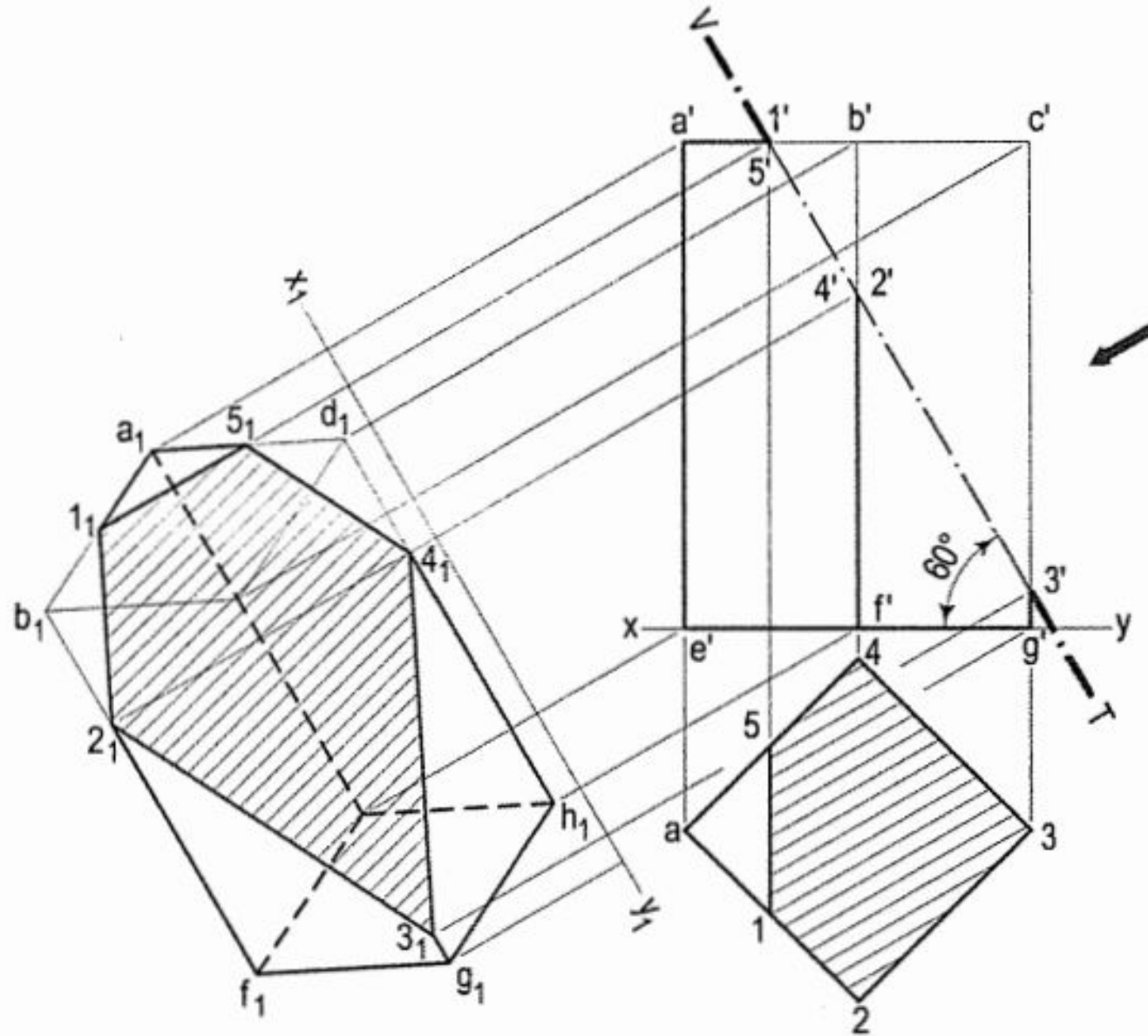
# Section of Solids

- Section plane perpendicular to V.P. and inclined to H.P.



# Section of Solids

- A square  
the H.P.  
perpendi  
through  
view, sec  
the secti

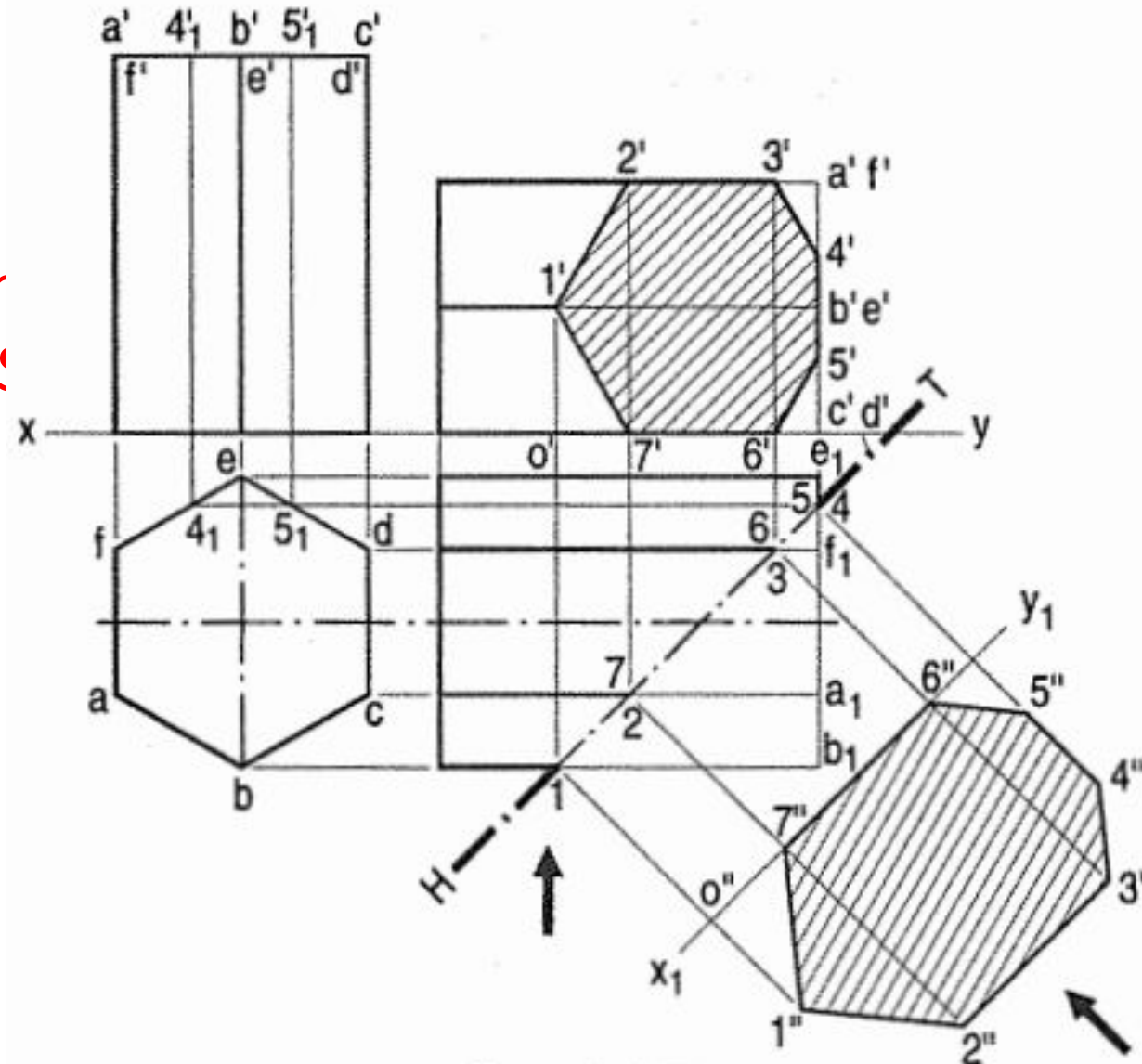


ts base on  
y a plane,  
d passing  
v its front  
parallel to



# Section of Solids

- A hexagonal  
V.P. It is cut  
angle of  $45^\circ$   
one of its edges  
the section.



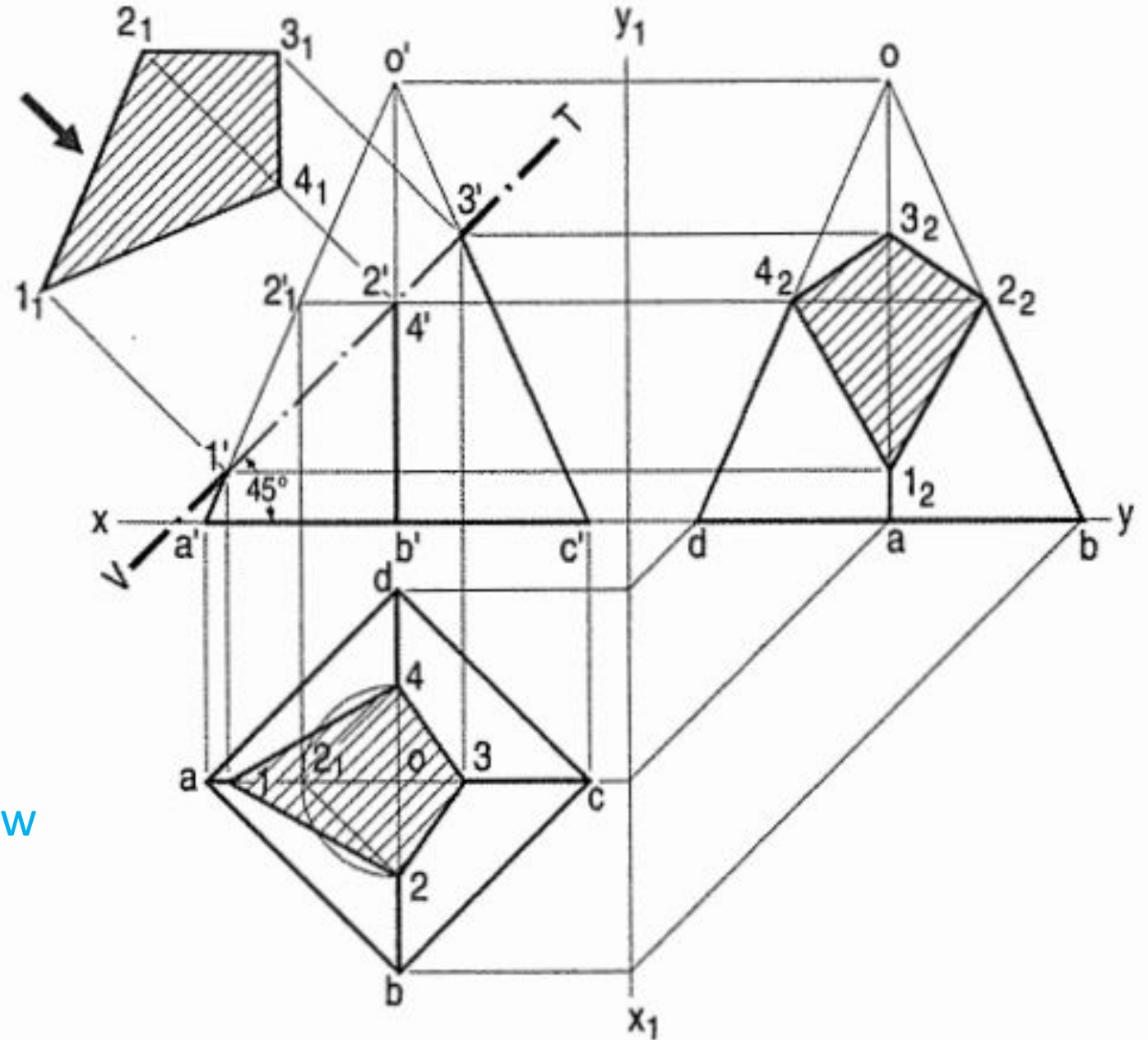
parallel to the  
rich makes an  
t 20 mm from  
true shape of

# Section of Solids

- A square pyramid, base 40 mm side and axis 65 mm long, has its base on the H.P. and all the edges of the base equally inclined to the V.P. It is cut by a section plane, perpendicular to the V.P., inclined at  $45^\circ$  to the H.P. and bisecting the axis. Draw its sectional top view, sectional side view and true shape of the section.

# Section of Solids

1. Assume horizontal section at  $2'$
2. Draw a line parallel to the base, cutting  $o'a'$  at  $2'_1$
3. Project  $2'_1$  to  $2_1$  on  $ao$ .
4. With  $o$  as centre and radius  $o2_1$ , draw an arc cutting  $ob$  at  $2$  and  $od$  at  $4$ .



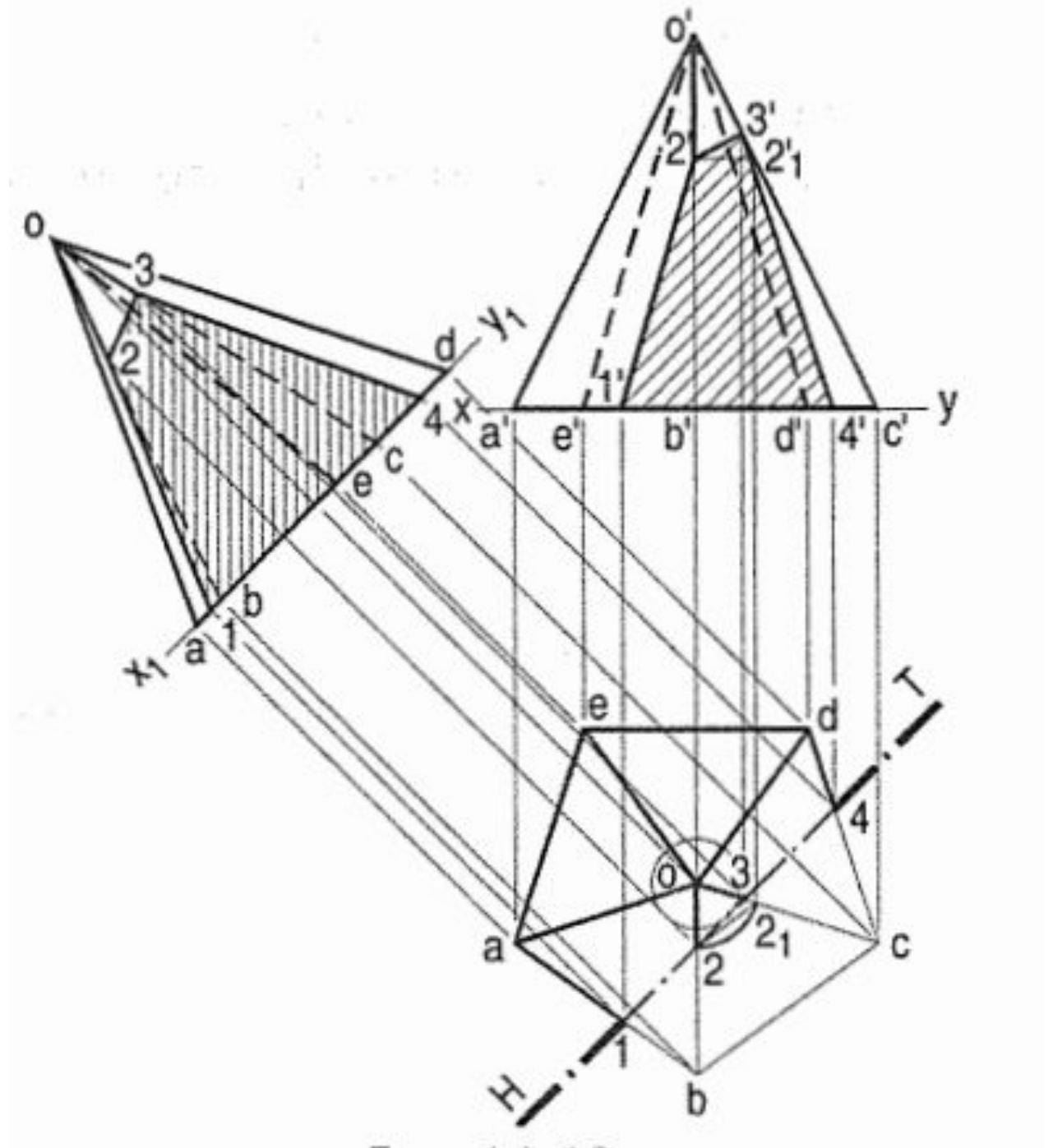
# Section of Solids

- A pentagonal pyramid has its base on the H.P. and the edge of the base nearer the V.P., parallel to it. A vertical section plane, inclined at  $45^\circ$  to the V.P., cuts the pyramid at a distance of 6 mm from the axis. Draw the top view, sectional front view and the auxiliary front view on an A.V.P. parallel to the section plane. Base of the pyramid 30 mm side; axis 50 mm long



# Section of Solids

1. With centre  $o$  and radius  $o2$  draw an arc cutting any one of the slant edges, say  $oc$  at  $2_1$
2. Project  $2_1$  to  $2_1'$  on  $o'c'$
3. Through  $2_1'$ , draw a line parallel to the base, cutting  $o'b'$  at  $2'$ .



# Section of Cylinders

- A cylinder of 40 mm diameter, 60 mm height and having its axis vertical, is cut by a section plane, perpendicular to the V.P., inclined at  $45^\circ$  to the H.P. and intersecting the axis 32 mm above the base. Draw its front view, sectional top view, sectional side view and true shape of the section.

# Section of Cylinders

