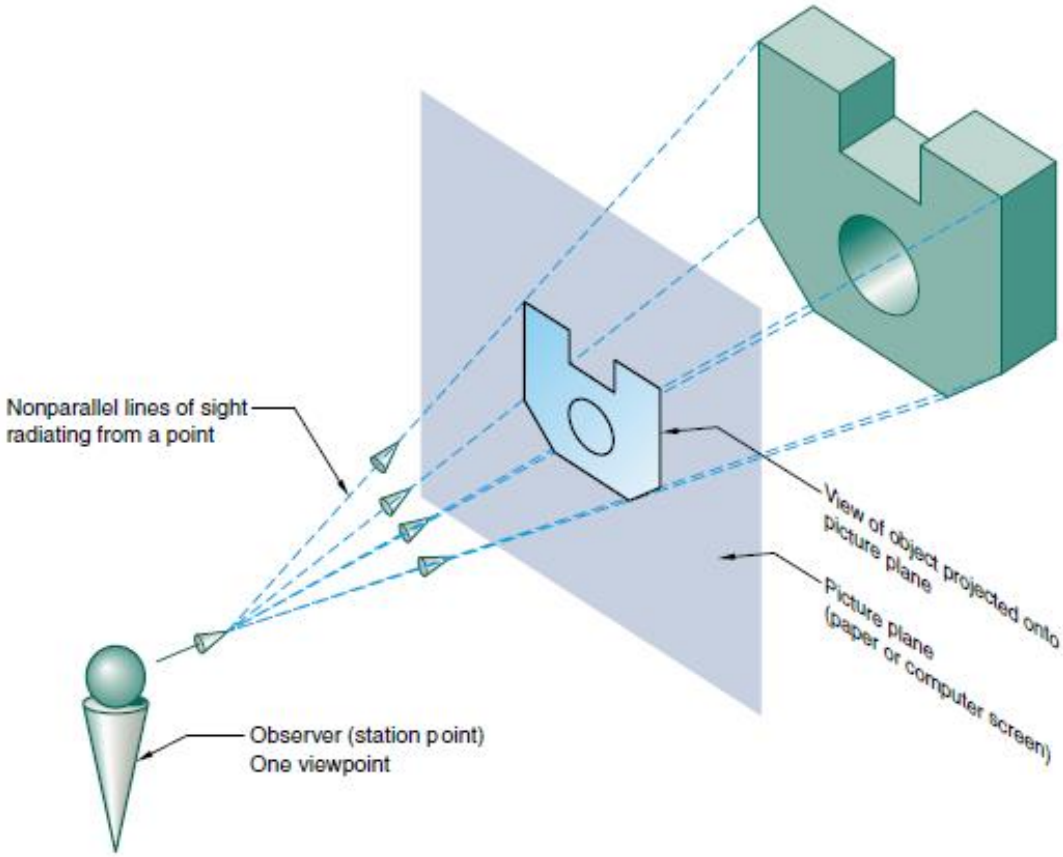
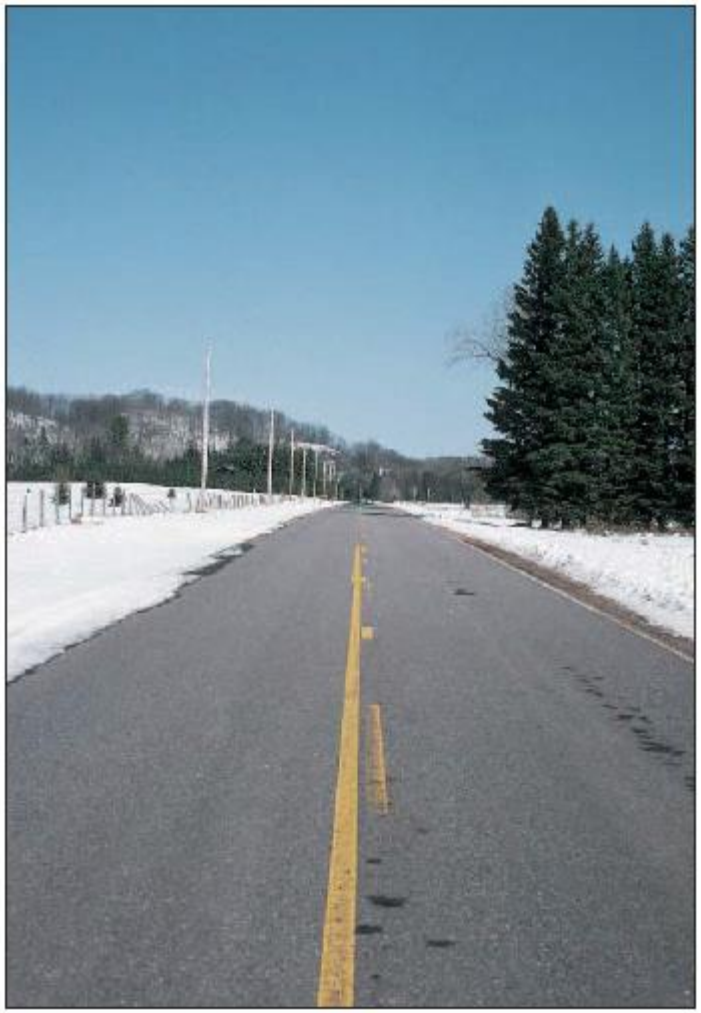
Projection of Points and Lines

ME 1480: Engineering Drawing – Lecture 3
Indian Institute of Technology Madras, Chennai

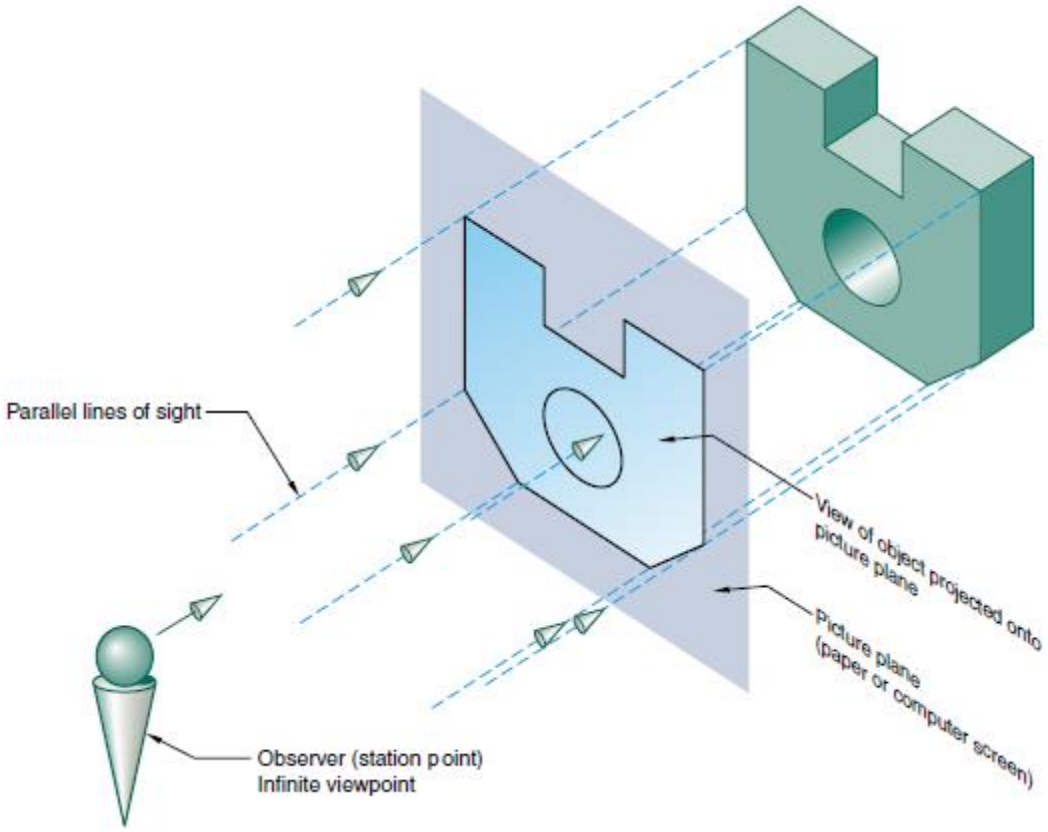
Perspective Projection



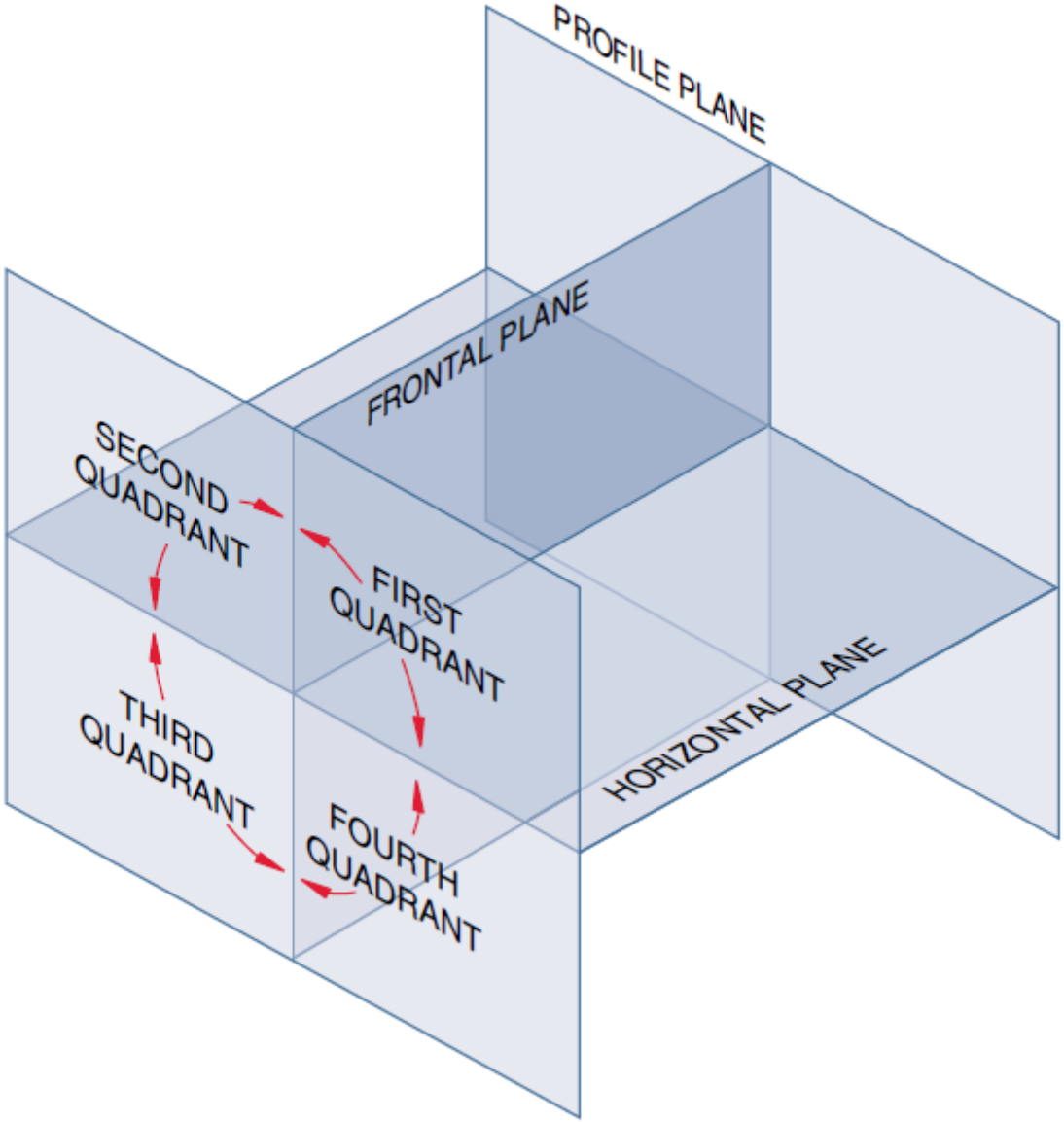


A camera captures views in perspective projection

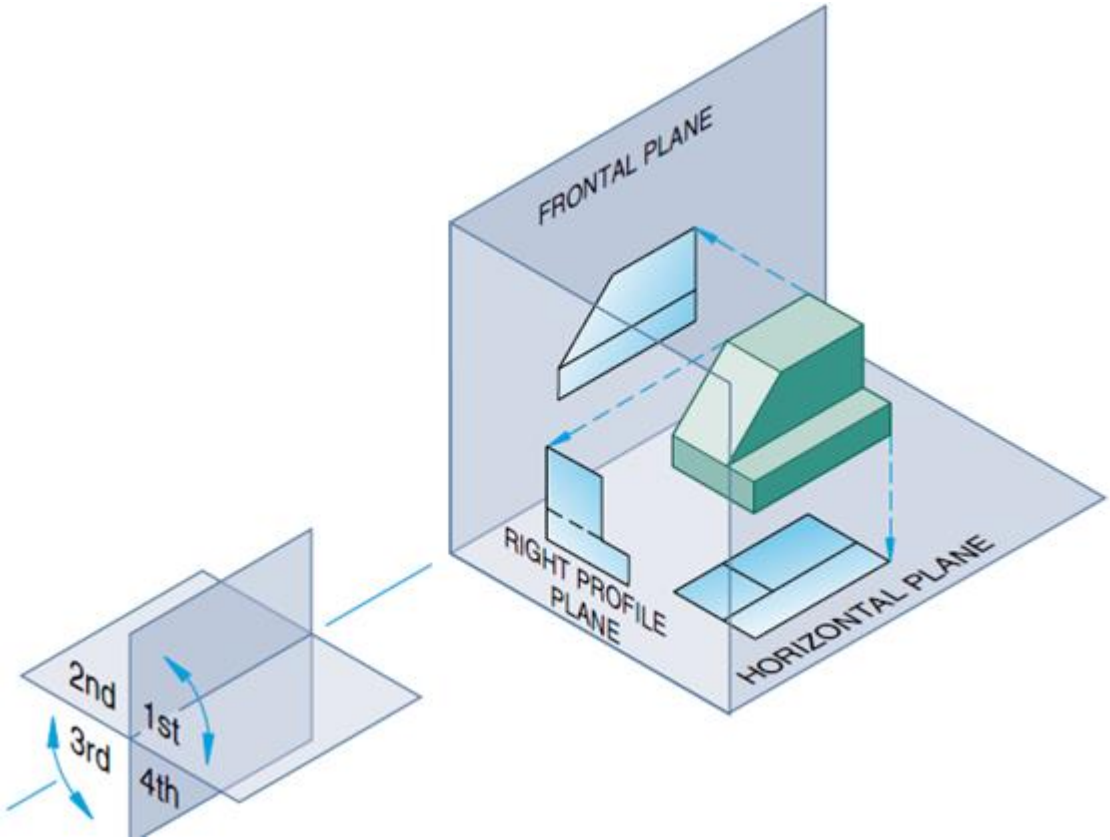
Parallel Projection

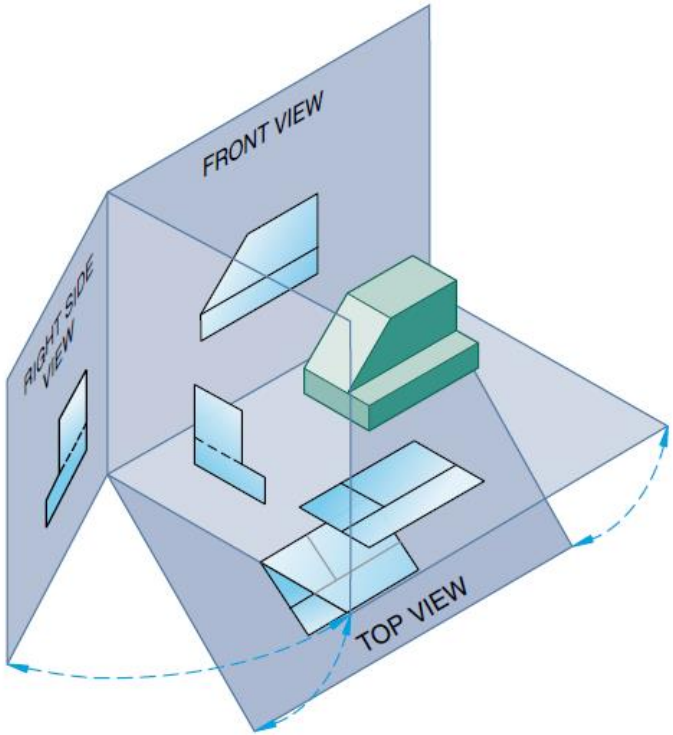


Principal Projection Planes

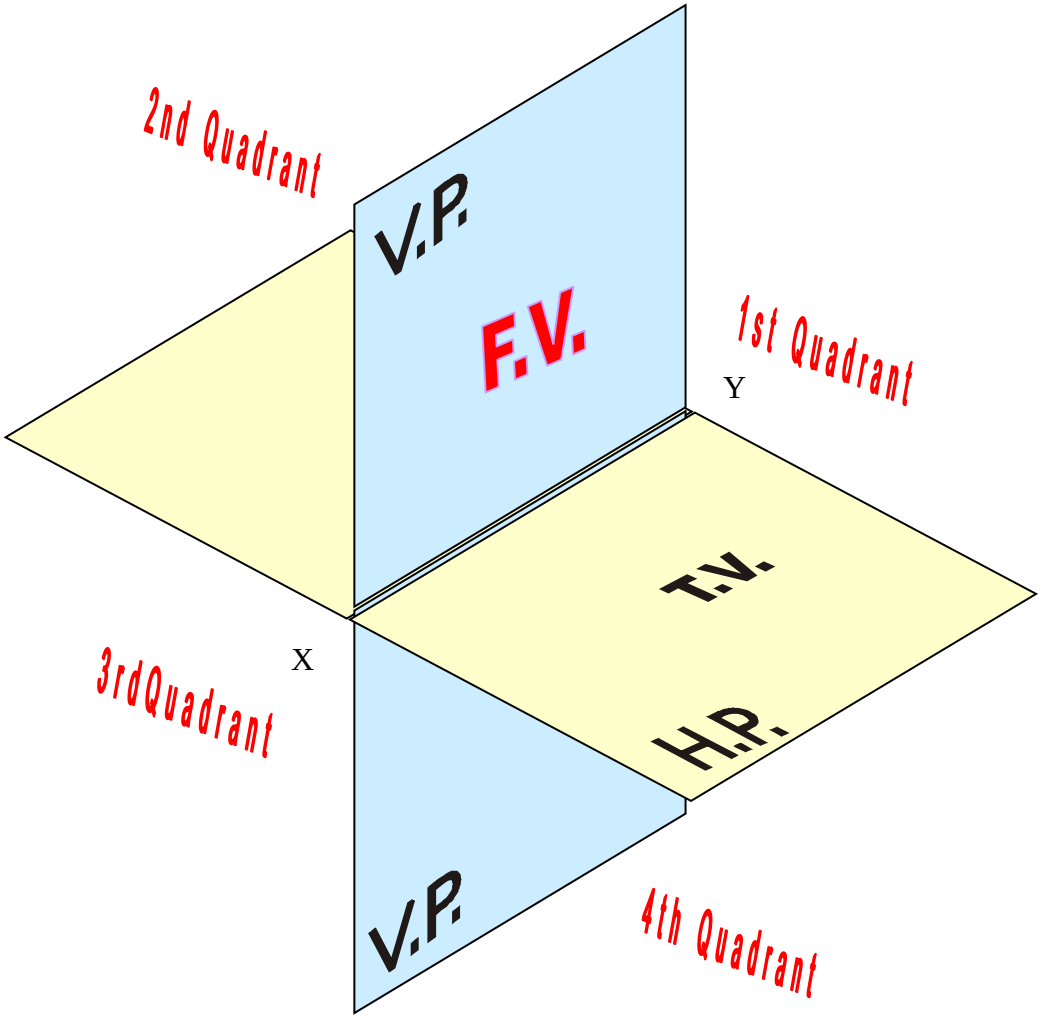


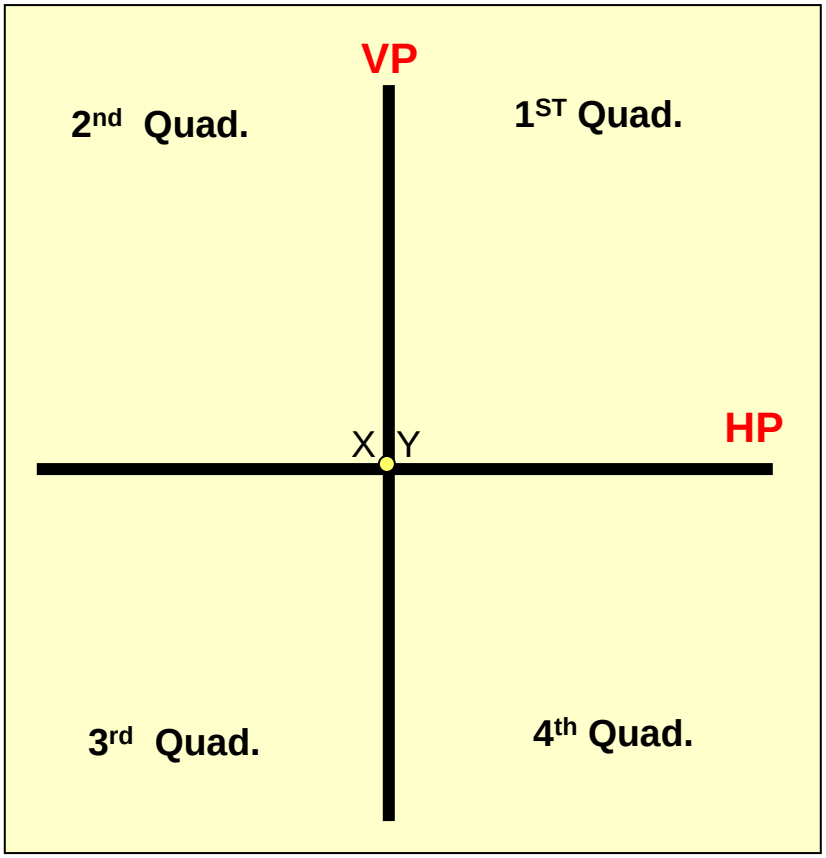
Orthogonal Projection





Orthogonal Projection





Observed along X-Y line

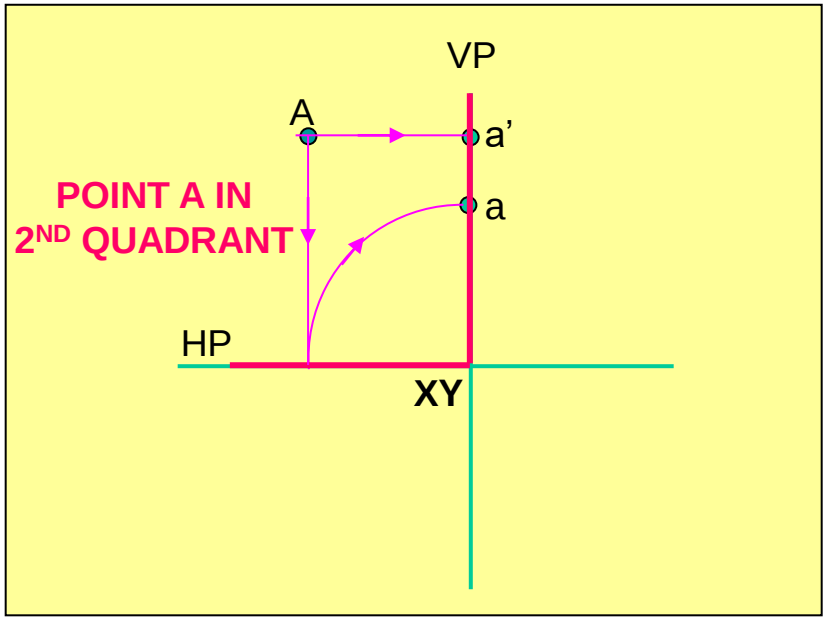
Projection of Points (Notation)

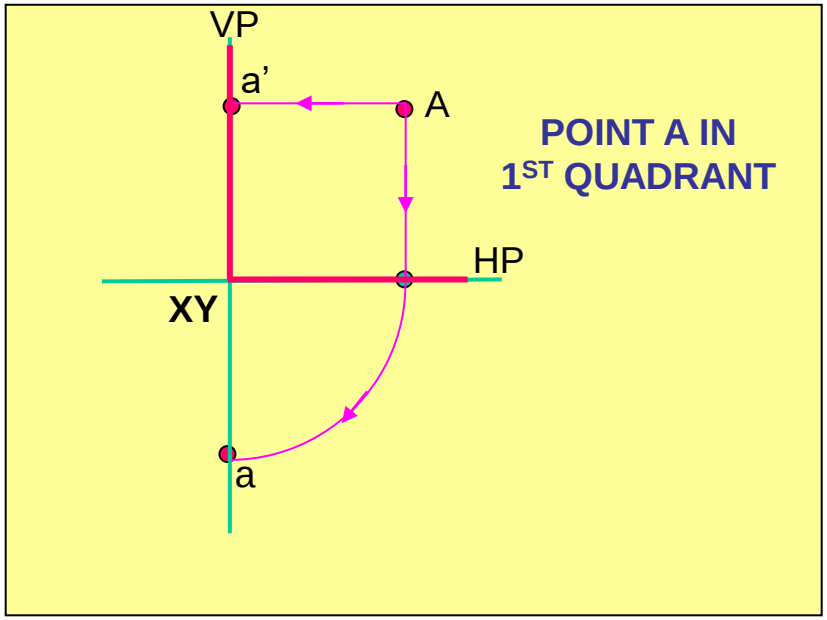
Notation to be followed for naming different views in orthographic projections.

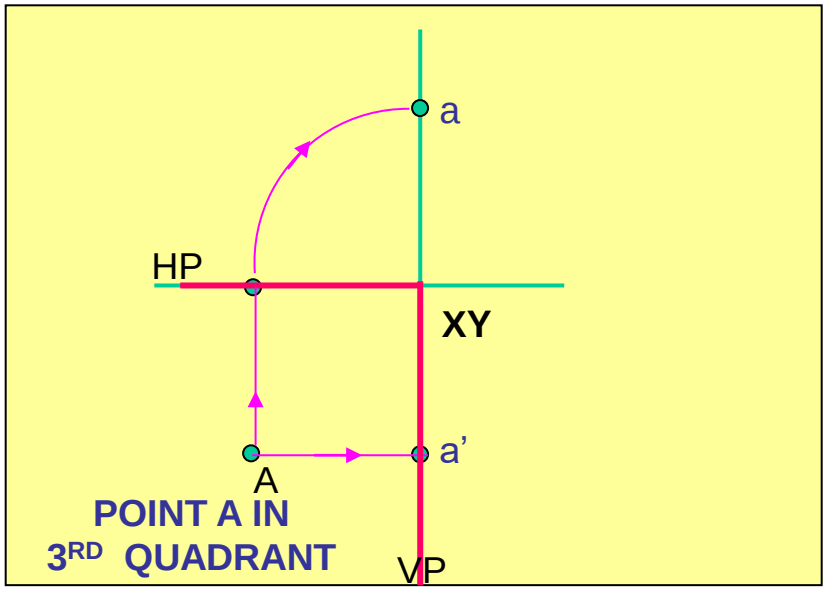
View (Object)	Point A	Line AB
Top	a	a b
Front	a’	a’ b’
Side	a’’	a’’ b’’

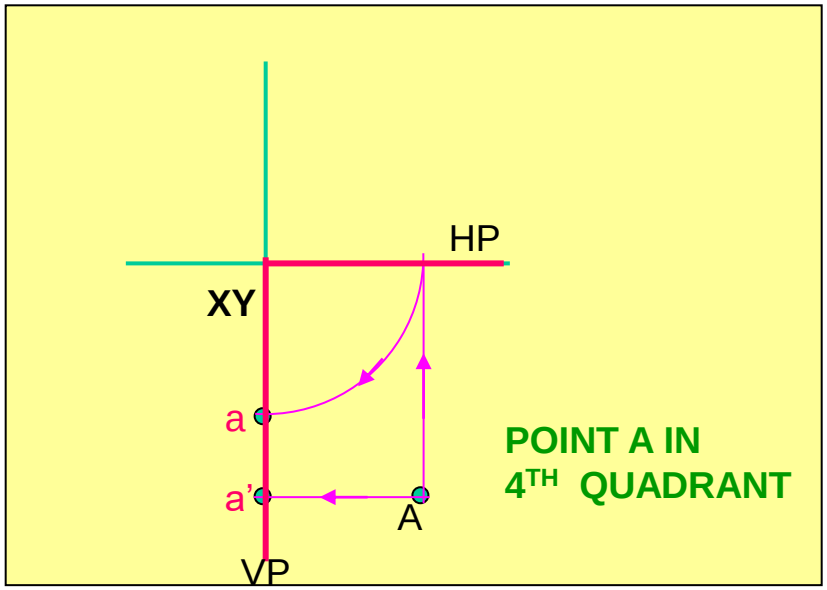
The same notation system is applicable to numbers (1,2,3…) as well.

Projection of Points









Projection of Points

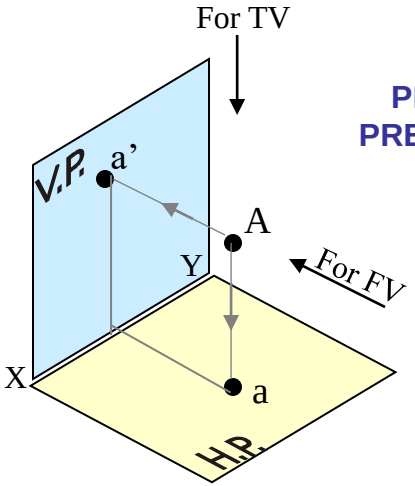
FV and TV of a point always lie in the same vertical line.

1. FV of a point ‘A’ is represented by a’. It shows position of the point with respect to HP.
   I. If the point lies above HP, a’ lies above the XY line.
   II. If the point lies in the HP, a’ lies on the XY line.
   III. If the point lies below the HP, a’ lies below the XY line.

2. TV of a point ‘A’ is represented by a. It shows position of the point with respect to VP.
   I. If the point lies in front of VP, a lies below the XY line.
   II. If the point lies in the VP, a lies on the XY line.
   III. If the point behind the VP, a lies above the XY line.

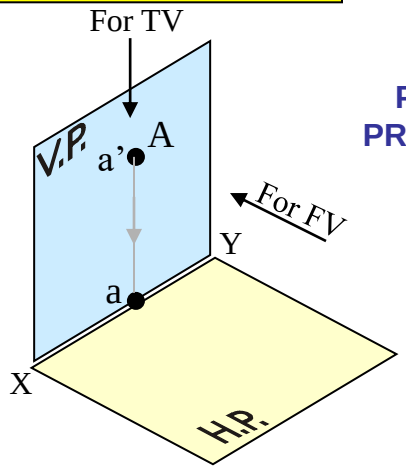
Example (A point in the 1st Quadrant)

POINT A ABOVE HP & IN FRONT OF VP



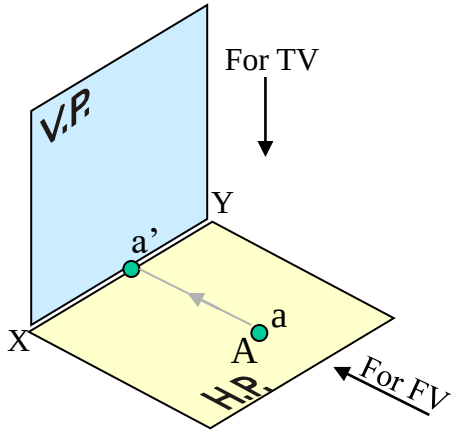
PICTORIAL PRESENTATION

POINT A ABOVE HP & IN VP



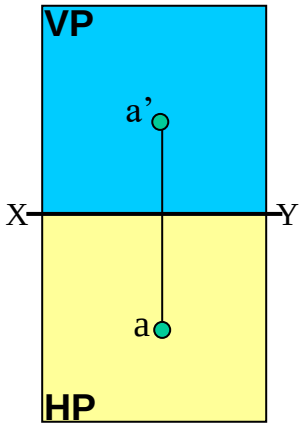
PICTORIAL PRESENTATION

POINT A IN HP & IN FRONT OF VP

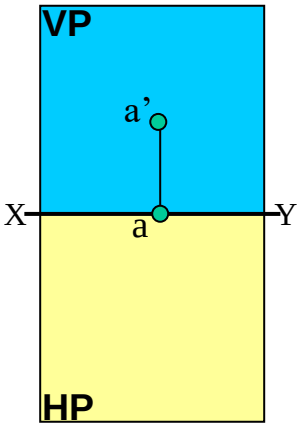


ORTHOGRAPHIC PRESENTATIONS OF ABOVE CASES

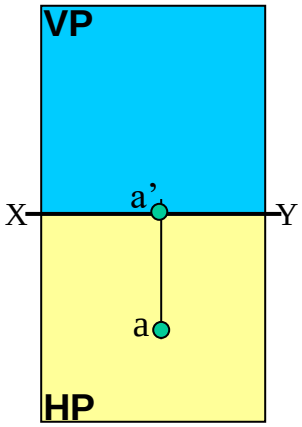
FV above XY, TV below XY.



FV above XY, TV on XY.

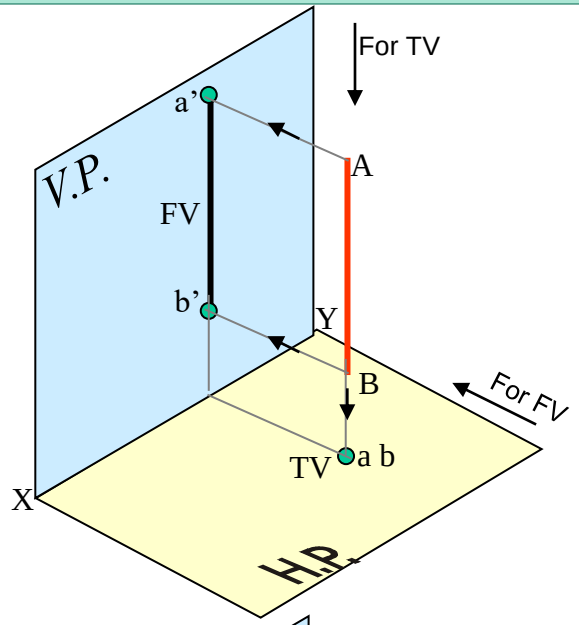


FV on XY, TV below XY.

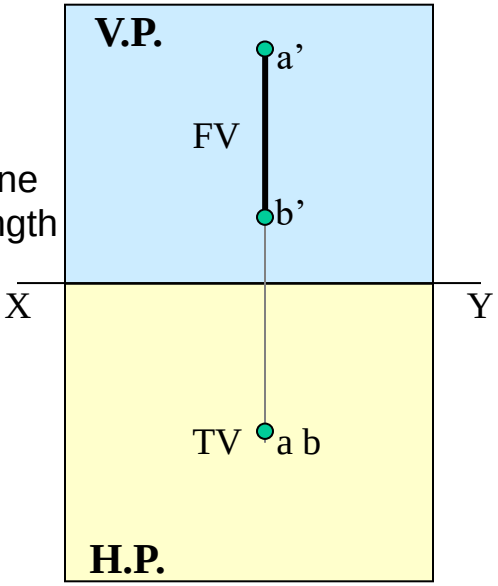


Projection of Lines

1. A line perpendicular to HP and parallel to VP



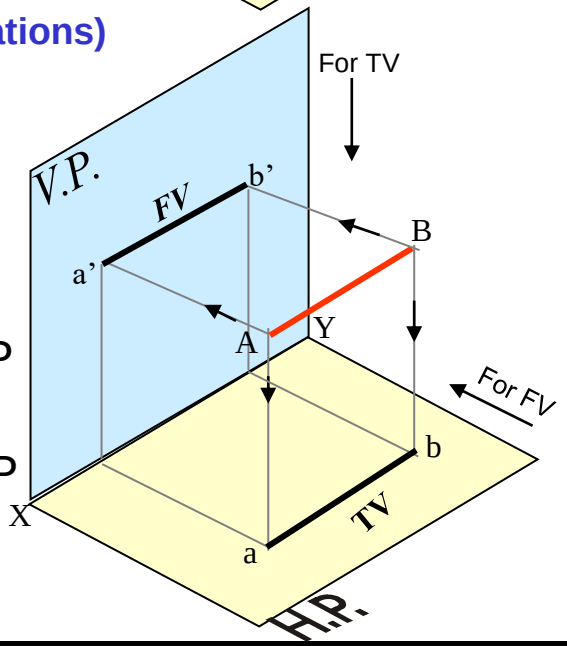
Note:
FV is a vertical line
Showing True Length
and
TV is a point.



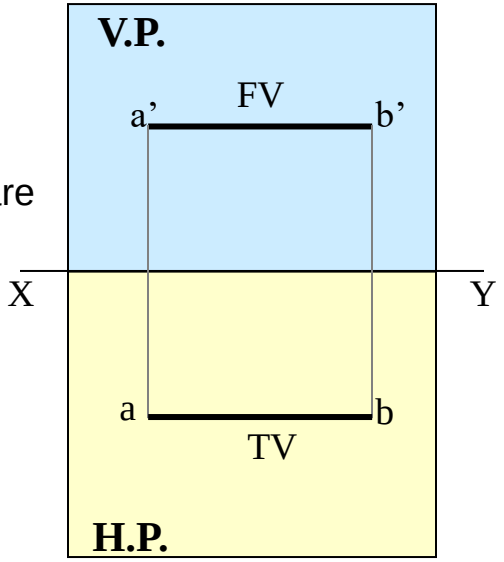
(Pictorial presentations)

Orthographic Projections

2. A line parallel to HP and parallel to VP



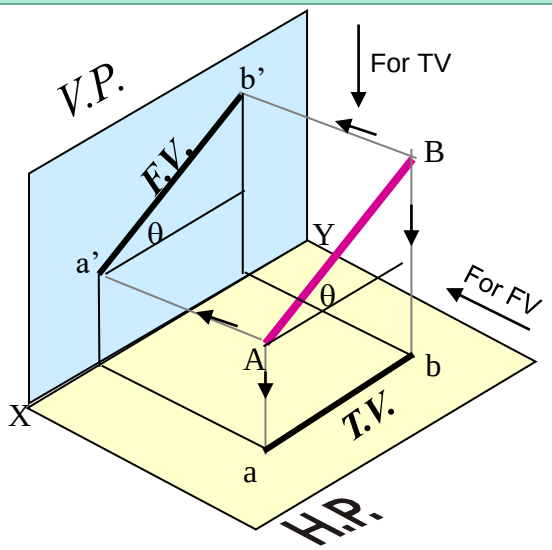
Note:
FV and TV both are
// to XY
and
both show
true length (TL)



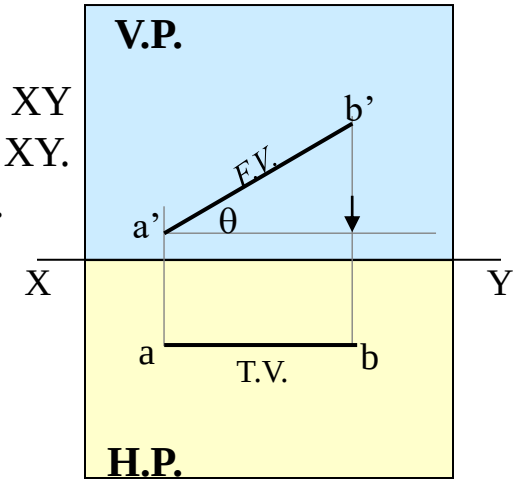
Projection of Lines

3.

A line inclined to HP
and
parallel to VP



Note:
FV inclined to XY
TV parallel to XY.
FV shows T.L.

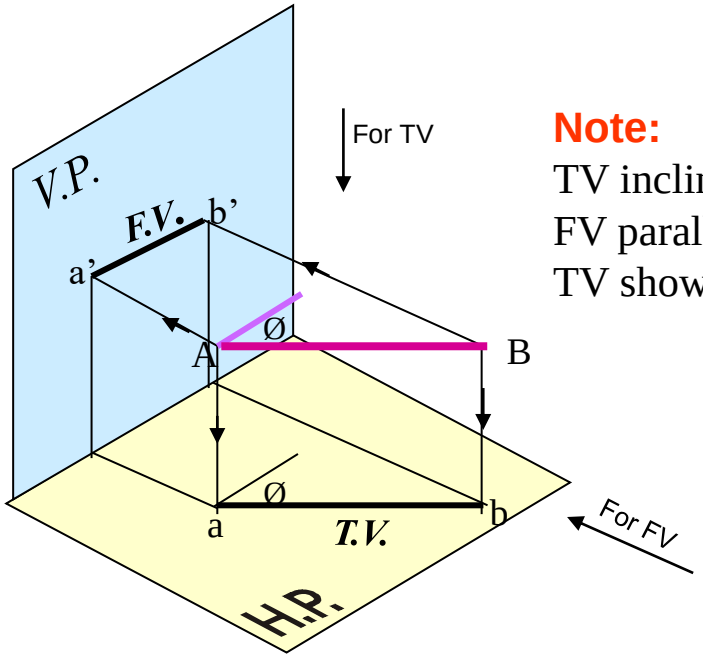


(Pictorial presentations)

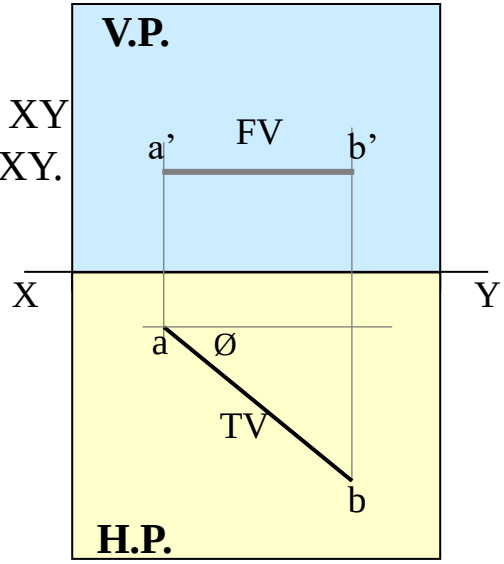
Orthographic Projections

4.

A line inclined to VP
and
parallel to HP

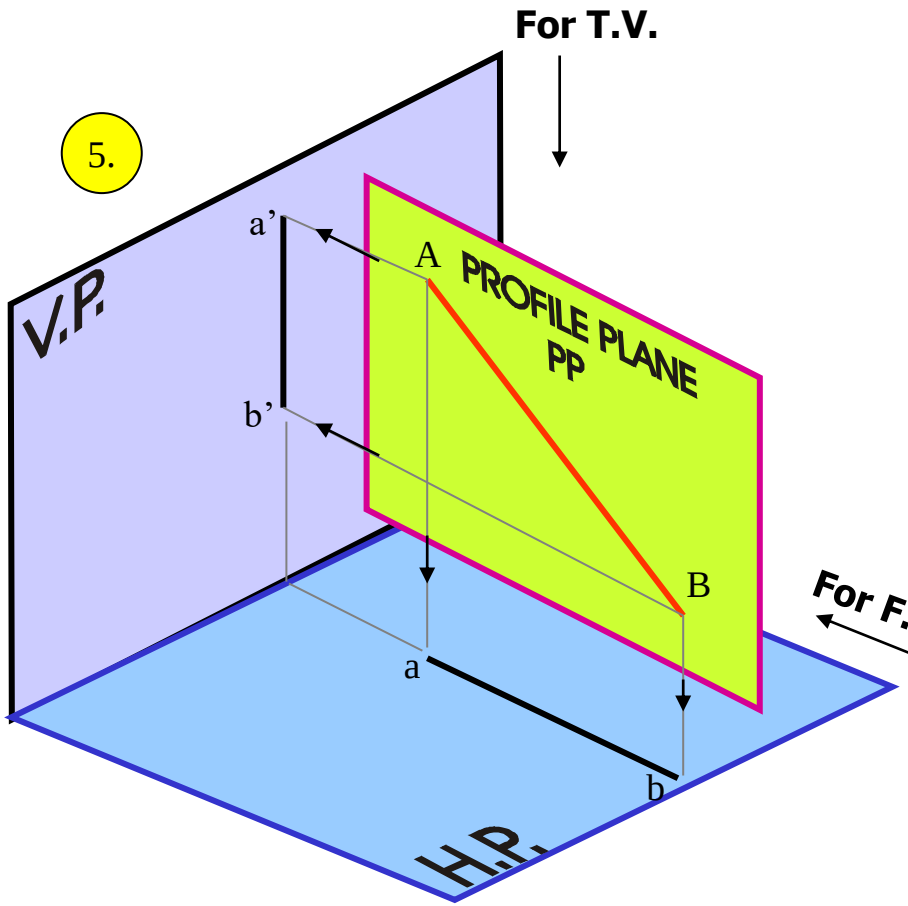


Note:
TV inclined to XY
FV parallel to XY.
TV shows T.L.



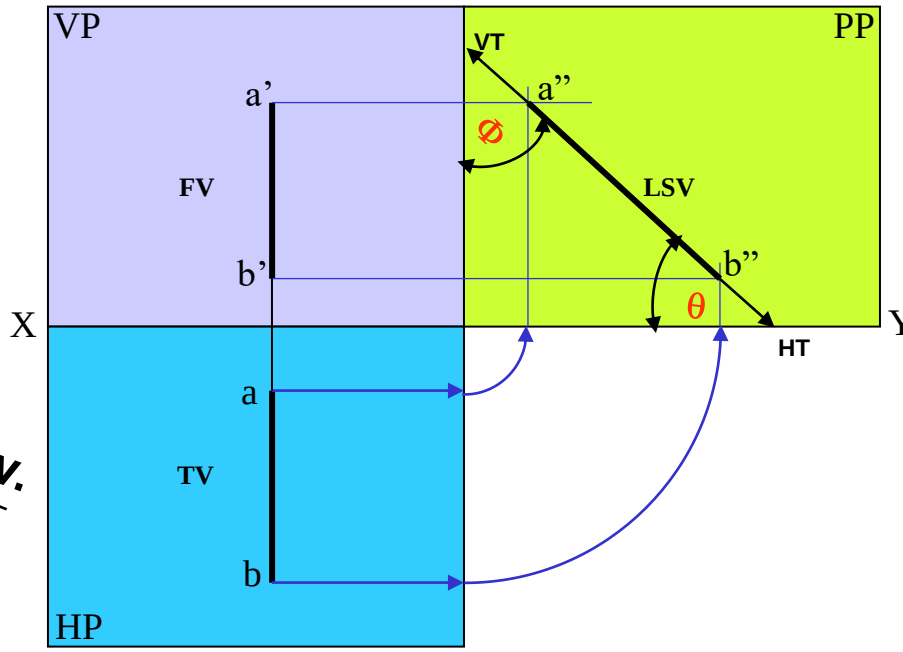
Projection of Lines

LINE IN A PROFILE PLANE (i.e., a plane perpendicular to both HP and VP)



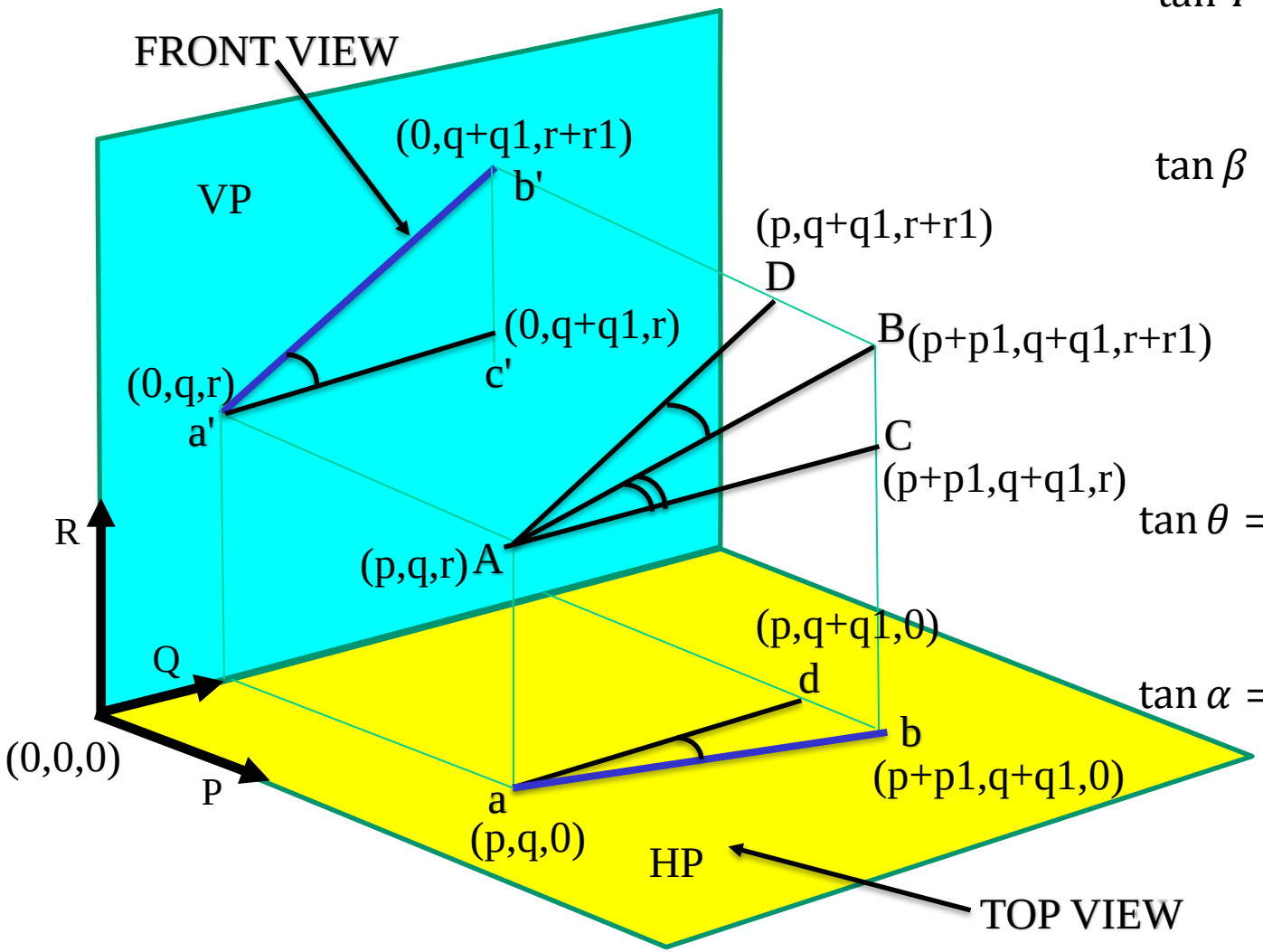
(Pictorial presentation)

ORTHOGRAPHIC PATTERN OF LINE IN PROFILE PLANE



Orthographic Projection

Projection of Lines



$$\tan\Phi = \frac{BD}{AD} = \frac{p1}{\sqrt{(q1)^2+(r1)^2}}$$

$$\tan\beta = \frac{bd}{ad} = \frac{p1}{q1}$$

$$\beta > \Phi$$

$$\tan\theta = \frac{BC}{AC} = \frac{r1}{\sqrt{(p1)^2+(q1)^2}}$$

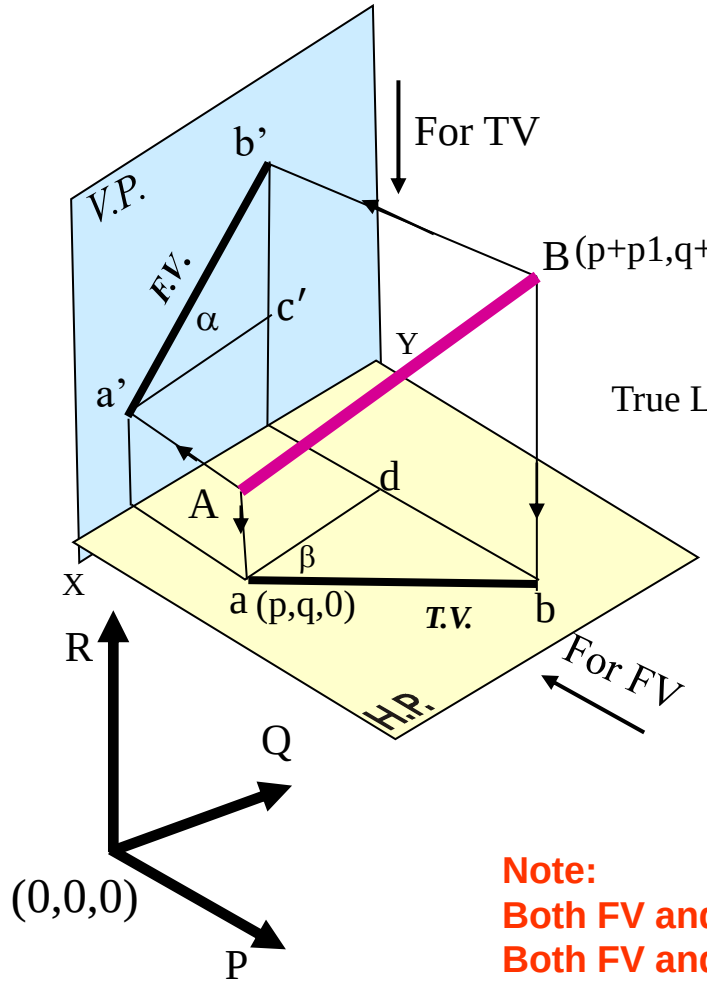
$$\tan\alpha = \frac{b'c'}{a'c'} = \frac{r1}{q1}$$

$$\alpha > \theta$$

Projection of Lines

6. A line inclined to both HP and VP

(Pictorial presentations)



$$b'c' = r1$$

$$a'c' = ad = q1$$

$$a'b' = \sqrt{(r1)^2+(q1)^2}$$

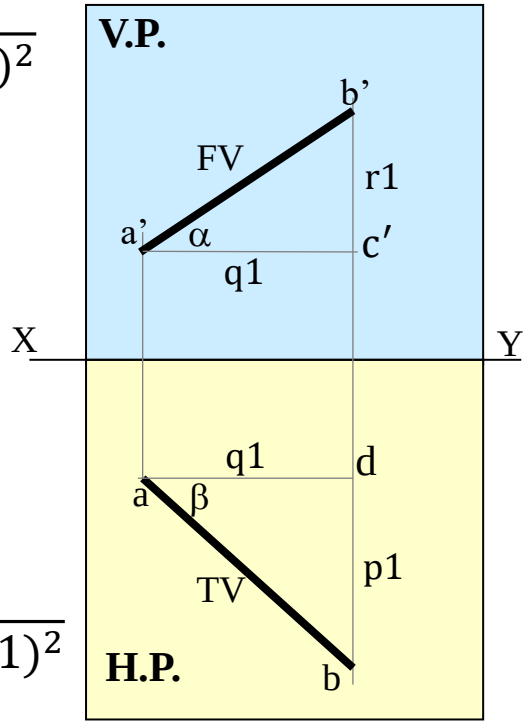
True Length (AB)= $\sqrt{(p1)^2+(q1)^2+(r1)^2}$

$$bd = p1$$

$$ad = q1$$

$$ab = \sqrt{(p1)^2+(q1)^2}$$

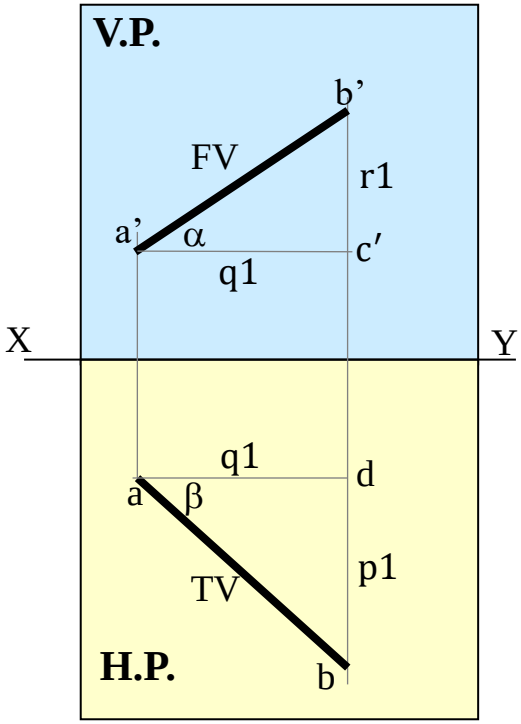
Orthographic Projections



Note:
Both FV and TV are inclined to XY. (No view is parallel to XY)
Both FV and TV are reduced lengths. (No view shows True Length)

Projection of Lines

Find the True Length and its inclinations with HP and VP when FV and TV are given?



$$a'b' = \sqrt{(r1)^2+(q1)^2}$$

$$ab = \sqrt{(p1)^2+(q1)^2}$$

True Length (AB)= $\sqrt{(p1)^2+(q1)^2+(r1)^2}$

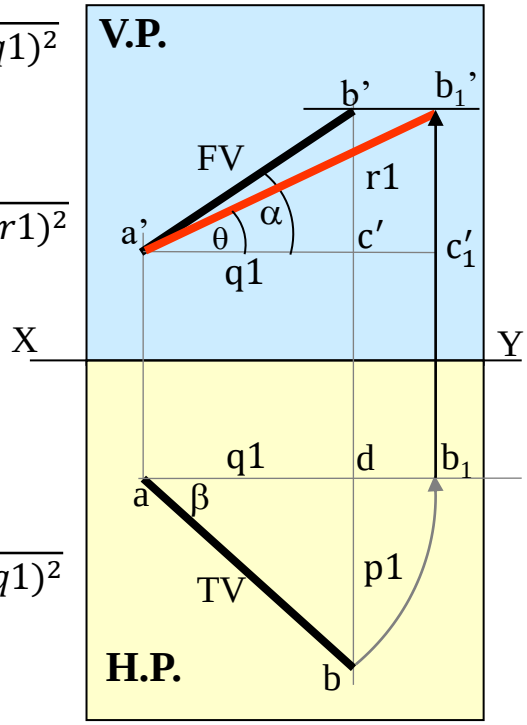
$$ab_1 = a'c_1' = \sqrt{(p1)^2+(q1)^2}$$

$$b'c' = b_1'c_1' = r1$$

$$TL = a'\,b_1' = \sqrt{(p1)^2+(q1)^2+(r1)^2}$$

$$\tan\theta = \frac{r1}{\sqrt{(p1)^2+(q1)^2}}$$

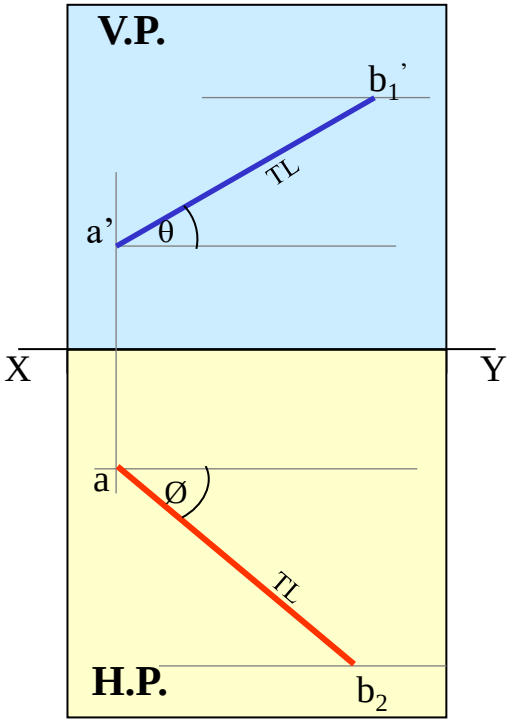
$$ab_1 = ab = \sqrt{(p1)^2+(q1)^2}$$



In this sketch, TV is rotated and made // to XY line. Hence its corresponding FV a' b_1' is showing True Length & True Inclination with HP.

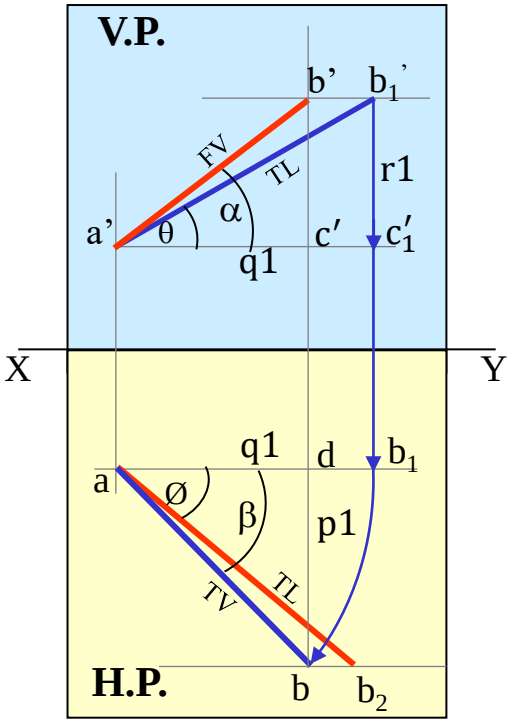
Projection of Lines

Find the FV and TV when the True Length and its actual inclinations are known?



$$\tan\theta = \frac{r1}{\sqrt{(p1)^2+(q1)^2}}$$

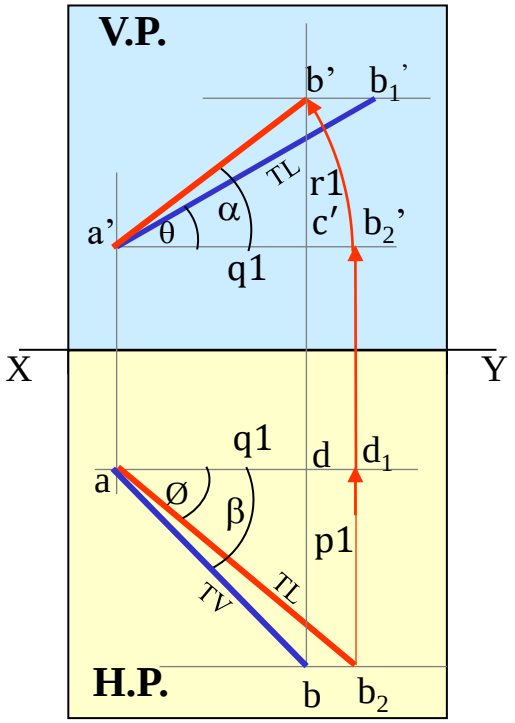
$$\tan\Phi = \frac{p1}{\sqrt{(q1)^2+(r1)^2}}$$



$$TL = a'\,b_1' = \sqrt{(p1)^2+(q1)^2+(r1)^2}$$

$$a'c_1' = ab_1 = \sqrt{(p1)^2+(q1)^2}$$

$$ab = ab_1 = \sqrt{(p1)^2+(q1)^2}$$



$$TL = ab_2 = \sqrt{(p1)^2+(q1)^2+(r1)^2}$$

$$ad_1 = a'b_2' = \sqrt{(q1)^2+(r1)^2}$$

$$a'b' = a'b_2' = \sqrt{(q1)^2+(r1)^2}$$

True Length is never rotated.

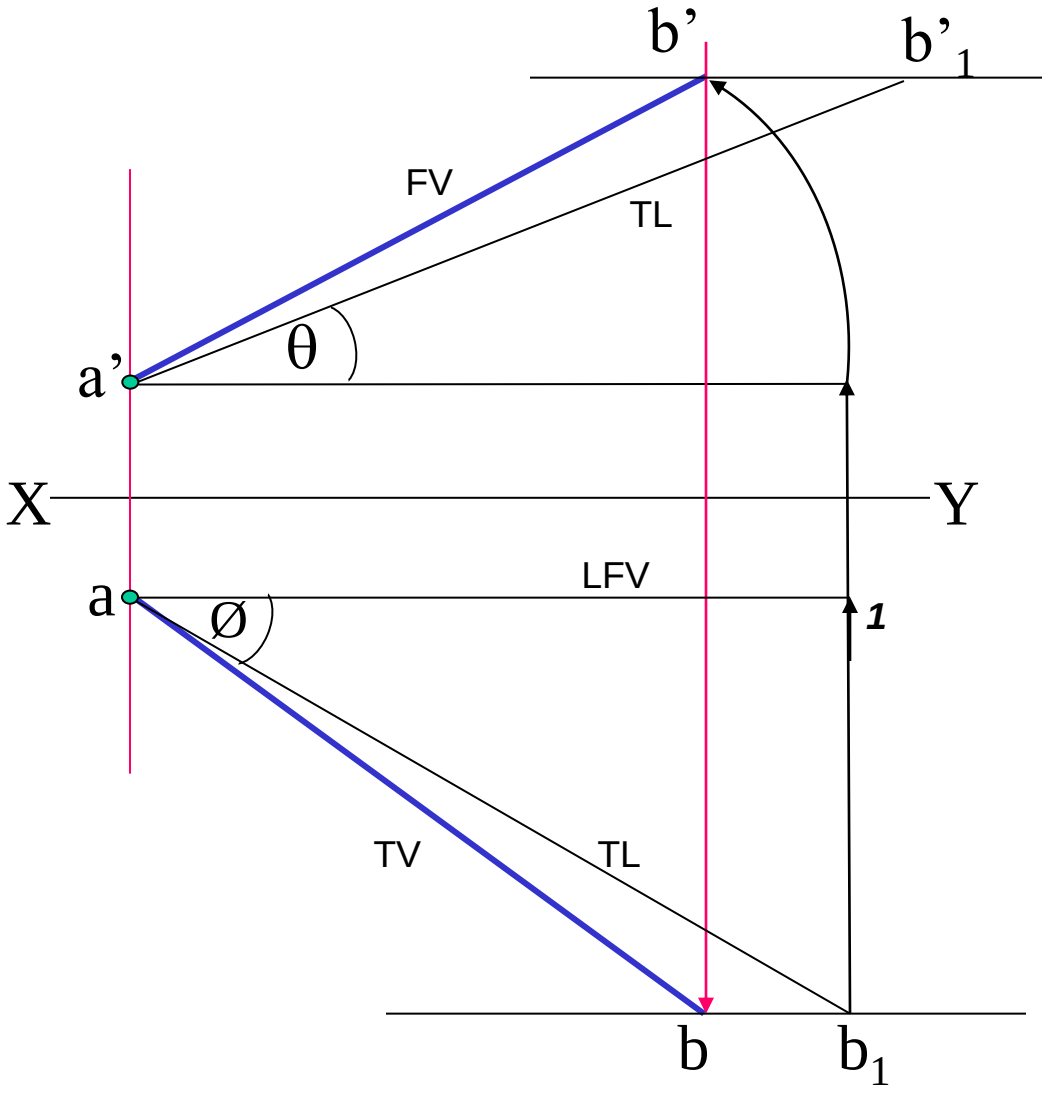
Its horizontal component is drawn, and it is further rotated to locate view.

Projection of Lines (Example 1)

Line AB is 75 mm long and it is inclined 30^0 and 40^0 to HP and VP, respectively. End A is 12 mm above HP and 10 mm in front of VP. Draw projections. Line is in 1st quadrant.

SOLUTION STEPS:

1. Draw XY line.
2. Locate *a'* 12 mm above XY line and *a* 10 mm below XY line.
3. Take 30^0 angle from *a'* and 40^0 from *a* and mark TL (i.e., 75 mm) on both lines. Name those points b_1' and b_1 respectively.
4. Join both points with *a'* and *a* resp.
5. Draw horizontal lines (Locus) from both points.
6. Draw horizontal component of TL *a* b_1 from point b_1 and name it *1*. (the length *a1* gives length of FV as we have seen already.)
7. Extend it up to locus of *a'* and rotating *a'* as center locate *b'* as shown. Join *a' b'* as FV.
8. From *b'* drop a projector downward & get point *b*. Join *a* & *b*, i.e., TV.

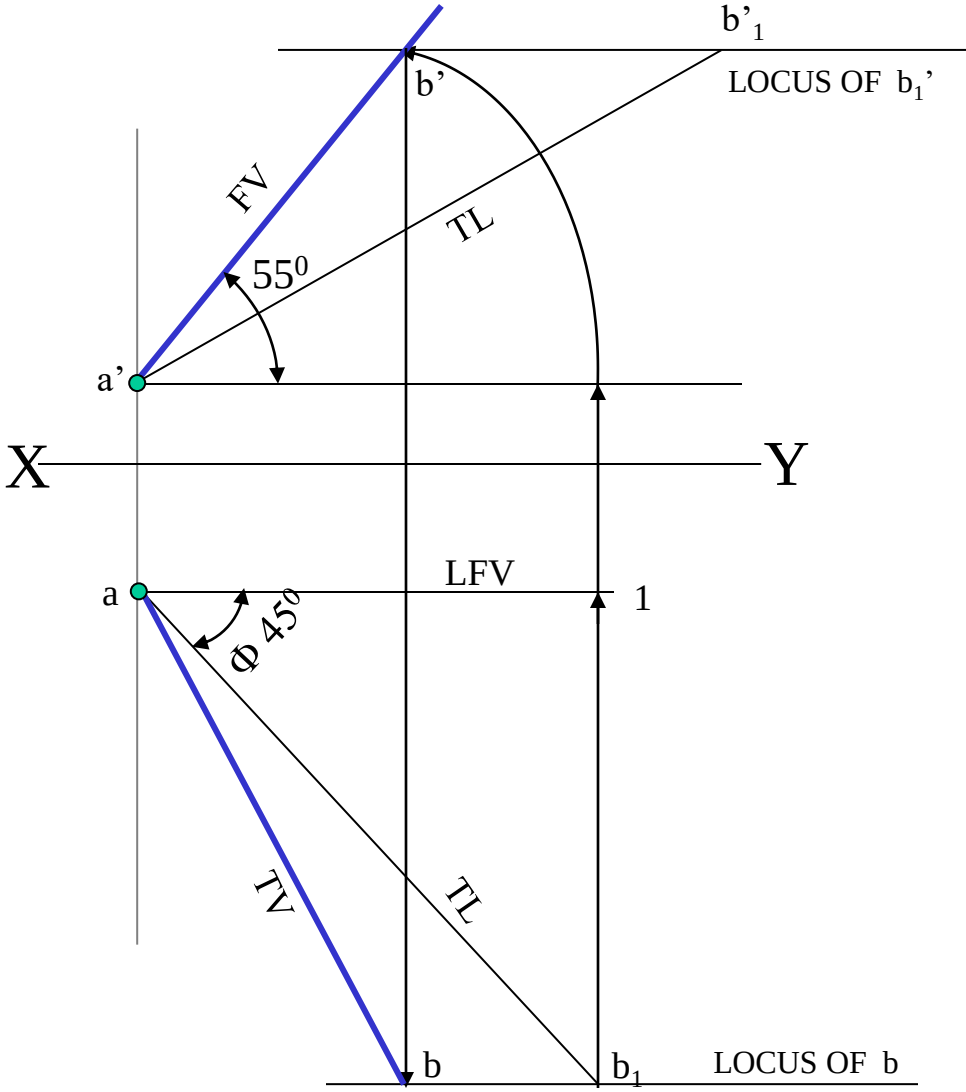


Projection of Lines (Example 2)

A line AB 75mm long makes 45^0 inclination with VP while its FV makes 55^0 with XY. End A is 10 mm above HP and 15 mm in front of VP. If the line is in 1^{st} quadrant draw its projections and find its inclination with HP.

SOLUTION STEPS:

1. Draw XY line.
2. Locate *a'* 10 mm above XY & *a* 15 mm below XY.
3. Draw a line 45^0 inclined to XY from point *a* and cut TL 75 mm on it and name that point *b1*. Draw locus from point *b1*
4. Take 55^0 angle from *a'* for FV above XY line.
5. Draw a vertical line from *b1* up to locus of *a* and name it *1*. It is horizontal component of TL & is LFV.
6. Continue it to locus of *a'* and rotate upward up to the line of FV and name it *b'*. This *a'b'* line is FV.
7. Drop a projector from *b'* on locus from point *b1* and name intersecting point *b*. Line *ab* is TV of line AB.
8. Draw locus from *b'* and from *a'* with TL distance cut point *b1'*
9. Join *a' b1'* as TL and measure its angle at *a'*. It will be true angle of line with HP.

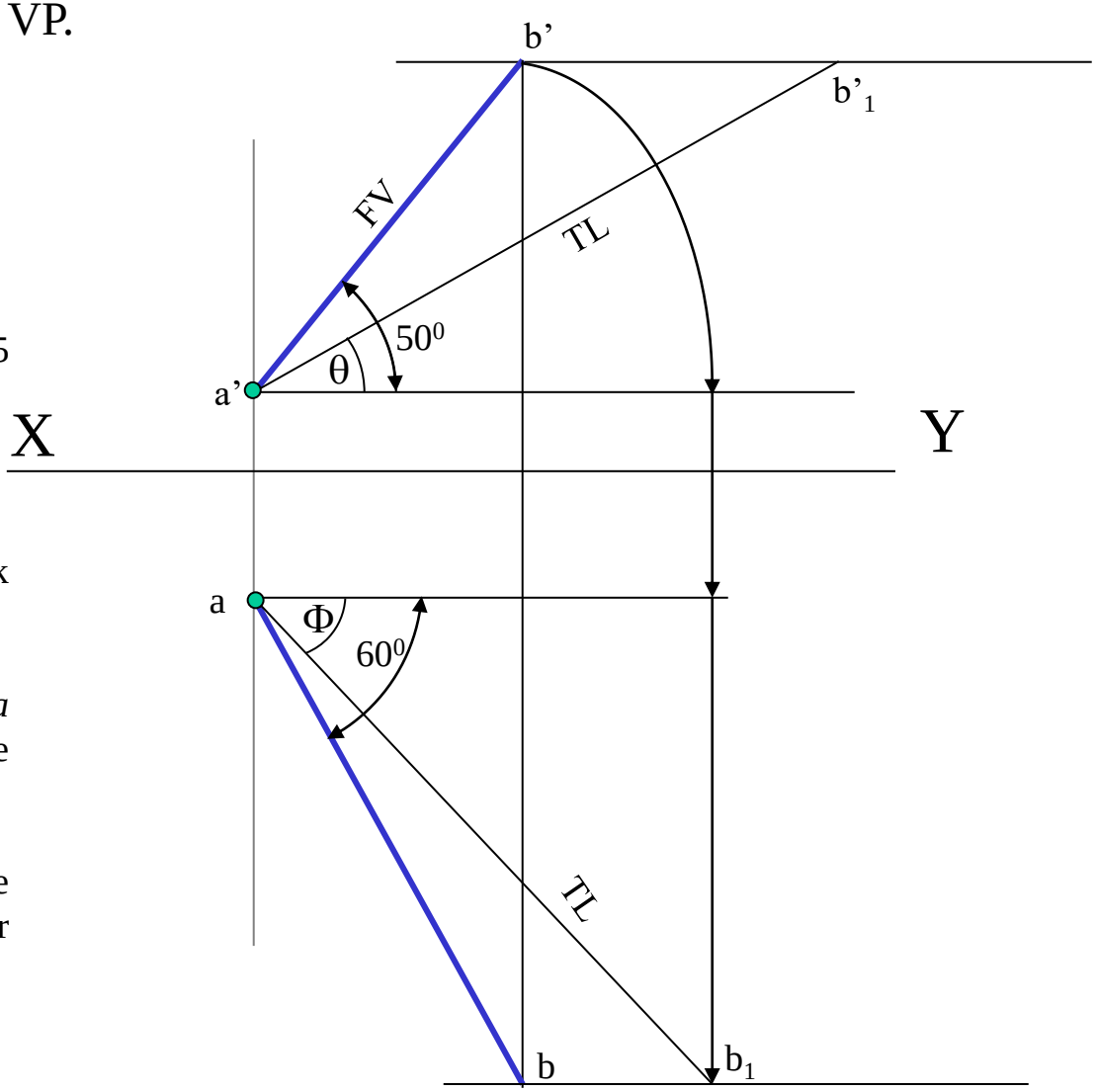


Projection of Lines (Example 3)

FV of a line AB is 50^0 inclined to XY and measures 55 mm long while its TV is 60^0 inclined to XY line. If end A is 10 mm above HP and 15 mm in front of VP, draw its projections, find TL, inclinations of line with HP & VP.

SOLUTION STEPS:

1. Draw XY line
2. Locate *a'* 10 mm above XY and a 15 mm below XY line.
3. Draw locus from these points.
4. Draw FV 50^0 to XY from *a'* and mark *b'* Cutting 55 mm on it.
5. Similarly draw TV 60^0 to XY from *a* and drawing projector from *b'*. Locate point b and join *ab*.
6. Then rotating views as shown, locate True Lengths ab_1 & $a'b_1'$ and their angles with HP and VP.

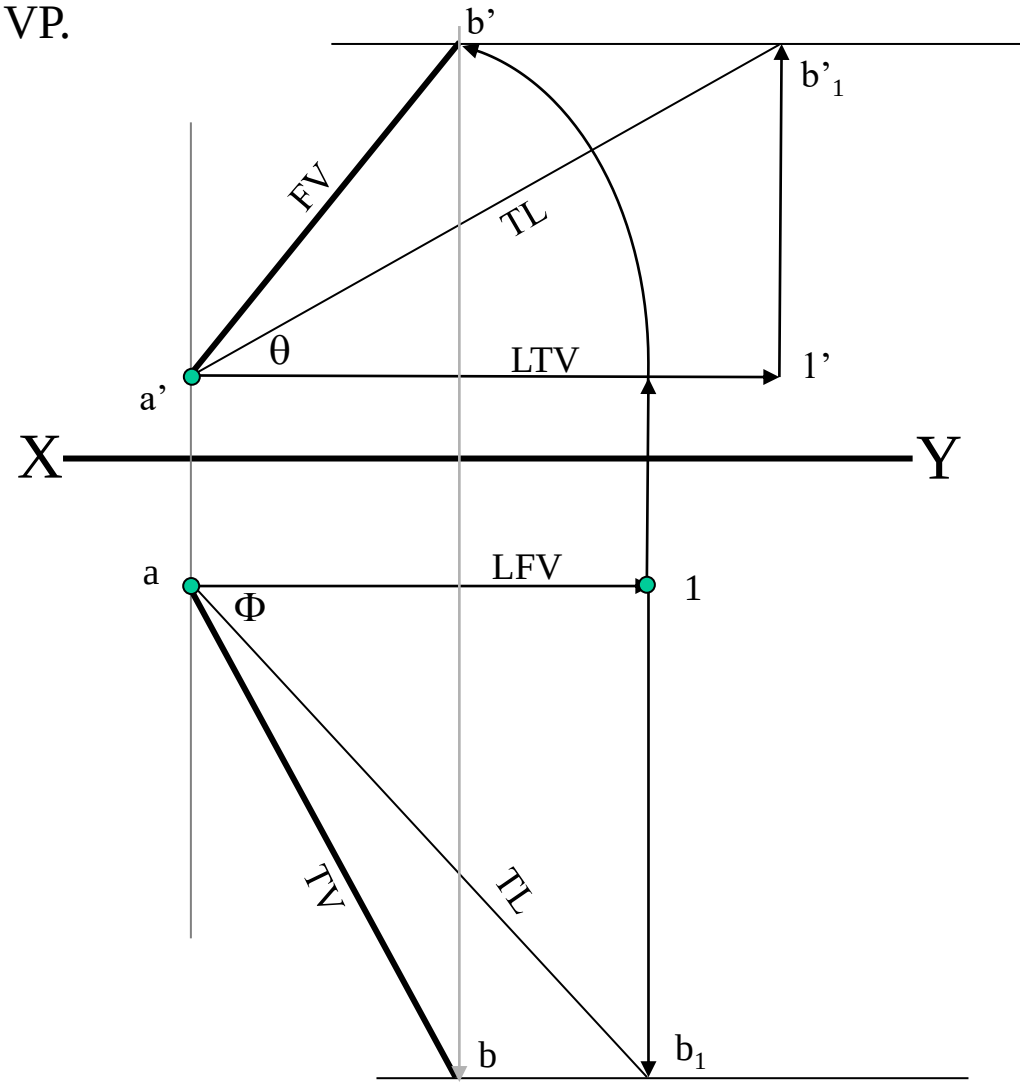


Projection of Lines (Example 4)

Line AB is 75 mm long. Its FV and TV measure 50 mm & 60 mm long respectively. End A is 10 mm above HP and 15 mm in front of VP. Draw projections of line AB, if end B is in first quadrant. Find its angle with HP and VP.

SOLUTION STEPS:

1. Draw XY line.
2. Locate *a'* 10 mm above XY and *a* 15 mm below XY line.
3. Draw locus from these points.
4. Cut 60 mm distance on locus of *a'* & mark 1' on it as it is LTV.
5. From *1'* draw a vertical line upward and from *a'* taking TL (75 mm) in compass, mark b'_1 point on it. Join $a'b'_1$ points.
6. Draw locus from b'_1 .
7. Similarly cut 50 mm on locus of *a* and mark point 1 as it is LFV.
8. With same steps below get b_1 point and draw also locus from it.
9. Now rotating one of the components i.e., *a1* locate *b'* and join a' with it to get FV.
10. Locate TV similarly and measure angles θ & Φ



Thank you