Projection of Lines and Planes Using Auxiliary Planes
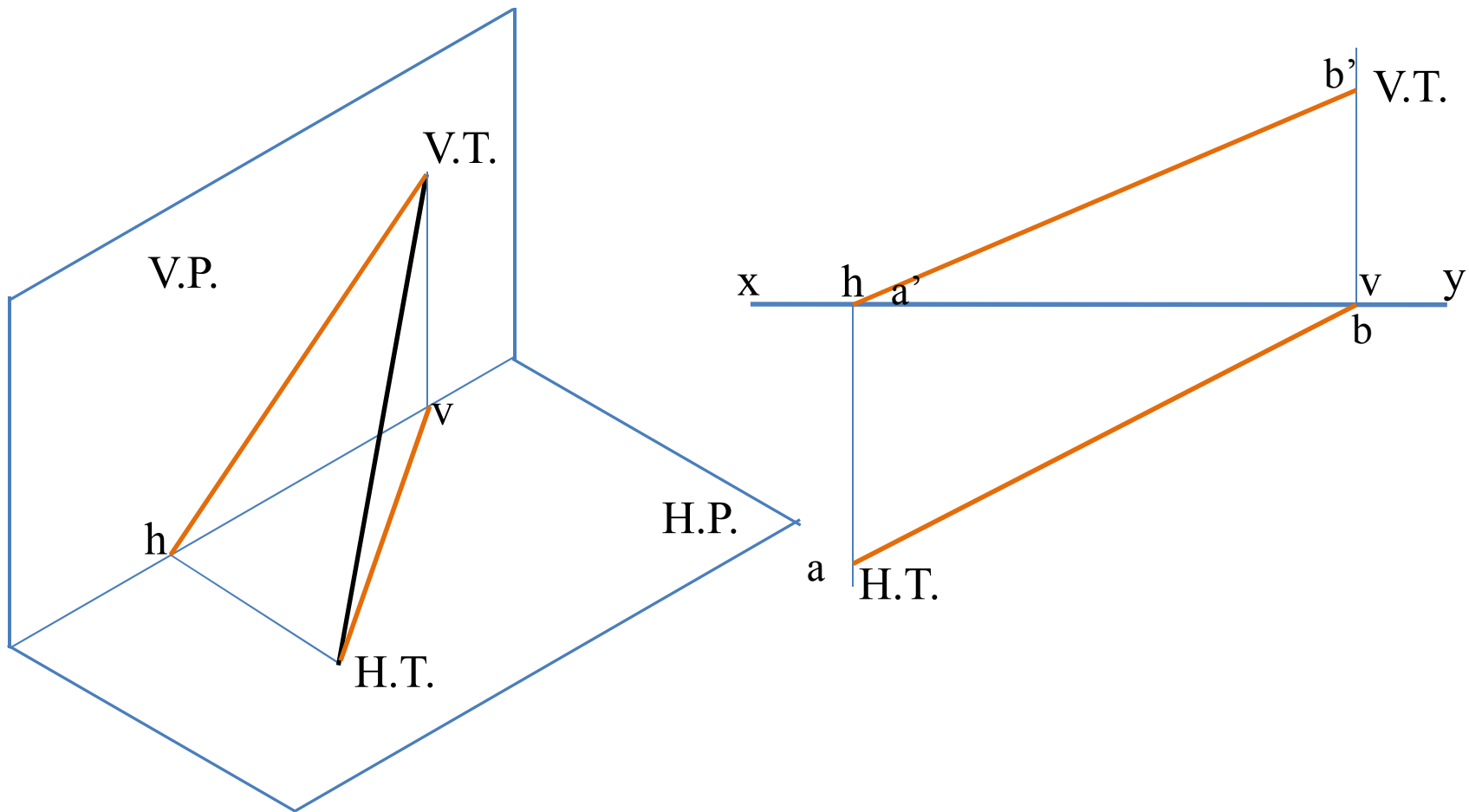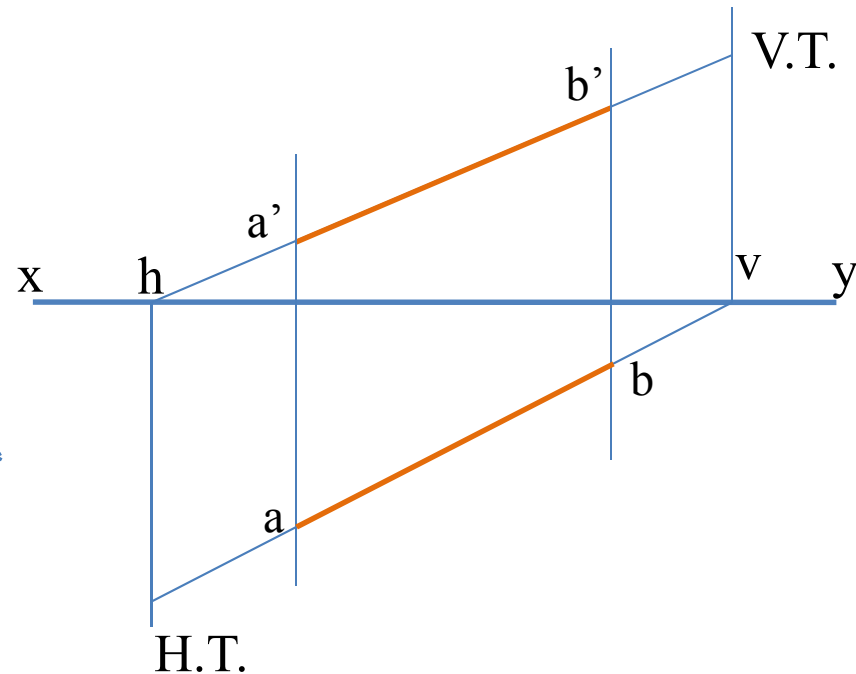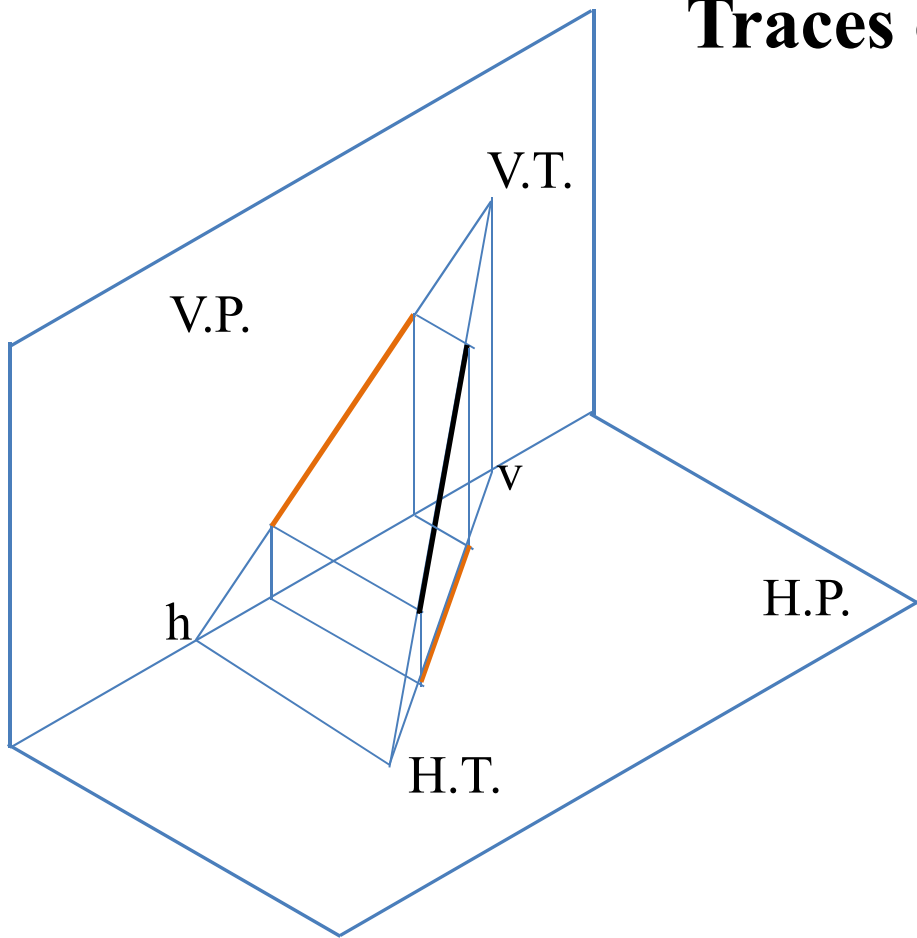## Lecture – 4

Adapted by Prof. Amitabh Bhattacharya from slides by Prof. Salil S. Kulkarni

Traces of a Line

- The point at which a line or a line-produced meets the plane is called the trace
- The point of intersection of the line with the H.P. is called the horizontal trace (H.T.)
- The point of intersection of the line with the V.P. is called the vertical trace (V.T.)

# Traces of a Line

- H.T. is front of the V.P.
- V.T. is above the H.P.

- H.T. lies at the intersection of the top view extended and the projector through point h – the point of intersection of the front view extended and the xy line
- V.T. lies at the intersection of the front view extended and the projector through point v – the point of intersection of the top view extended and the xy line
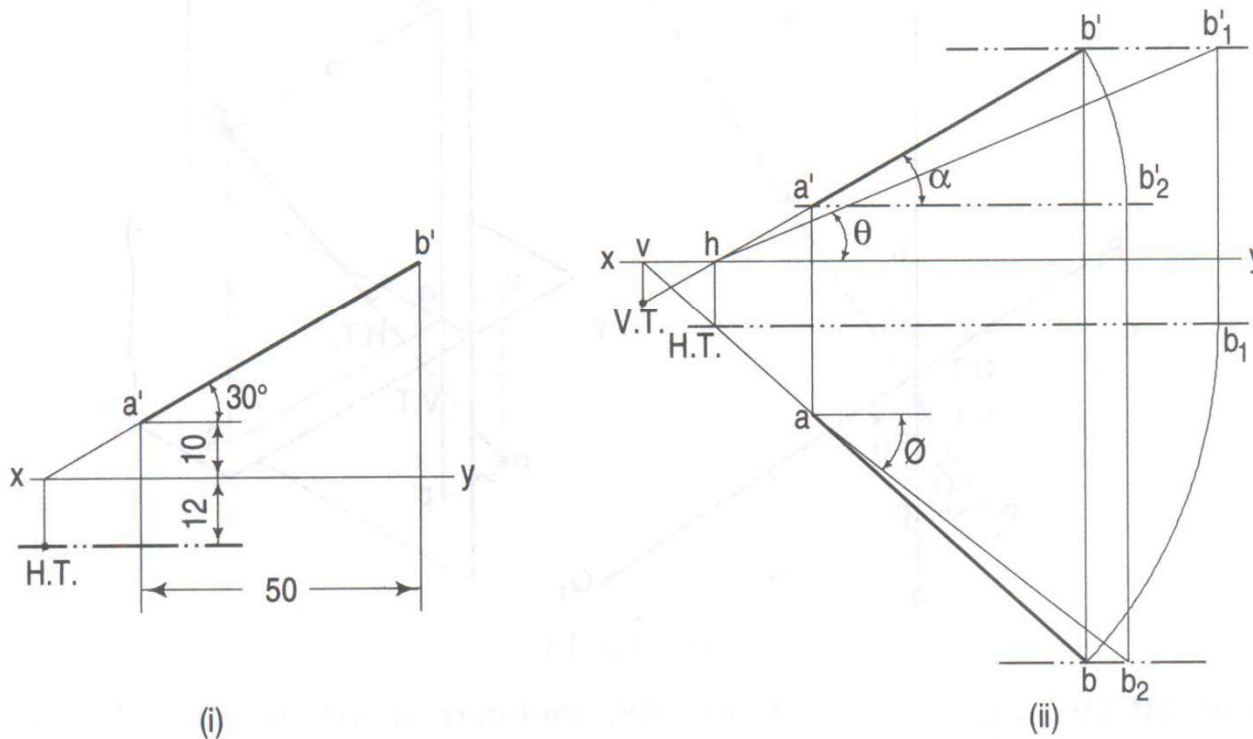
Representative Positions of the Traces
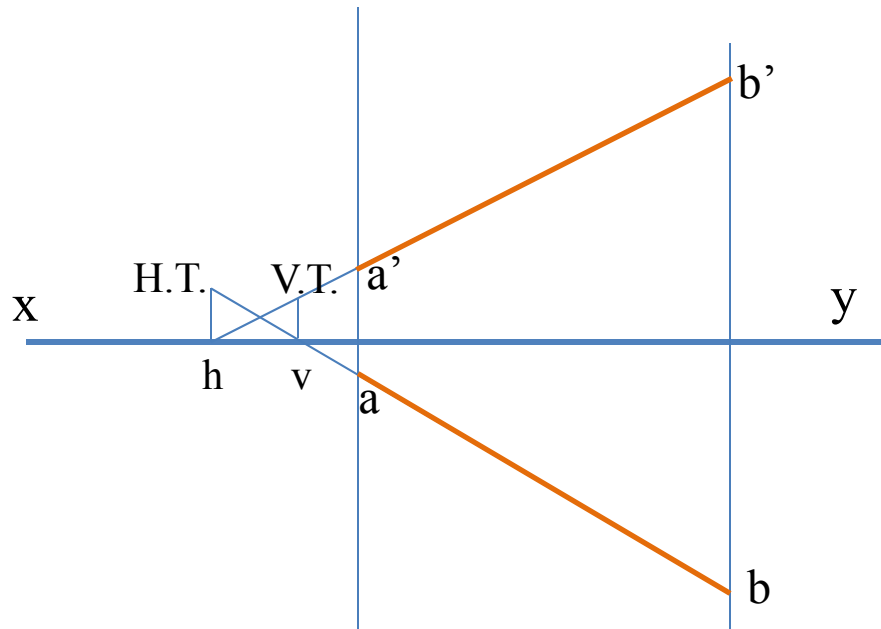
- H.T. is behind the V.P.
- V.T. is above the H.P.
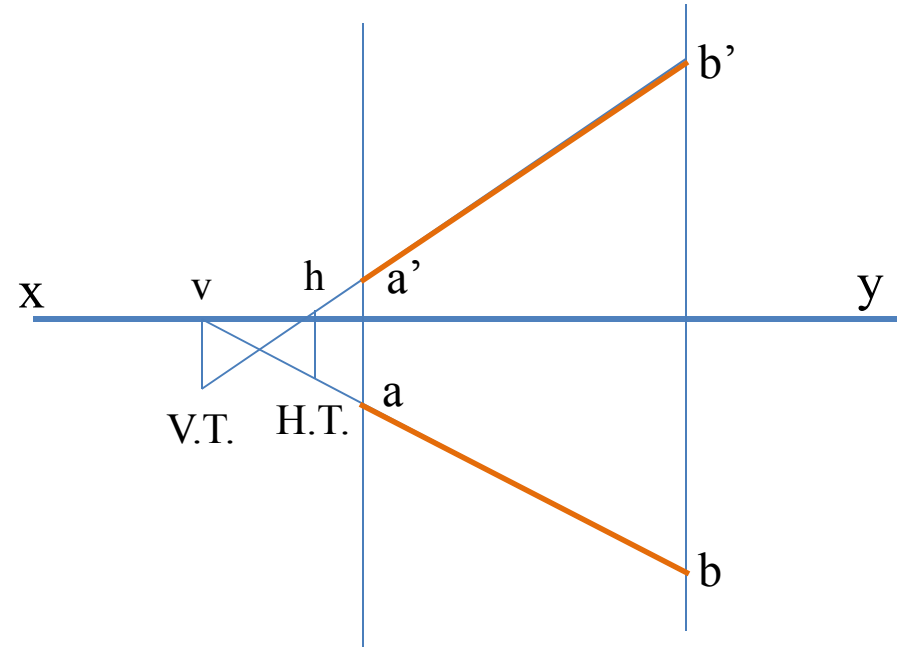
- H.T. is in front of the V.P.
- V.T. is below the H.P.

Example: Finding V.T.

Problem 10-20. (fig. 10-45): *The front view a'b' and the H.T. of a line AB, inclined at 23° to the H.P. are given in fig. 10-45(i). Determine the true length of AB, its inclination with the V.P. and its V.T.*



(i)   (ii)

- H.T. is fixed, so B is rotated around H.T. such that $\theta = 23$
- H.P. projection of B must lie on b'b
- Distance between H.T. and b_1 is same as distance between H.T. and b

5

Auxiliary Planes

- Horizontal Plane (H.P.), Vertical Plane (V.P.) and the Profile Plane (P.P.) are referred to as principal planes

- Projections on the principal planes are called as principal views

- Additional views called auxiliary views are obtained by projecting on planes called auxiliary planes.

- Auxiliary views help to convey additional information not conveyed by the principal views (e.g. true shape of a surface inclined to two or more principal planes)

- Sometimes auxiliary planes provide an easier method to solve problems involving projection -
    - Finding the true length of a line
    - Finding the inclination of the line with the H.P and the V.P.
    - Finding the shortest distance between two lines
    - Finding the true shape of a plane object

Types of Auxiliary Planes

- Auxiliary Vertical Plane (A.V.P.)
  It is perpendicular to the H.P. and inclined to the V.P.
  Projection on A.V.P. is called auxiliary front view
  Auxiliary front view and the front view have a common dimension (height)
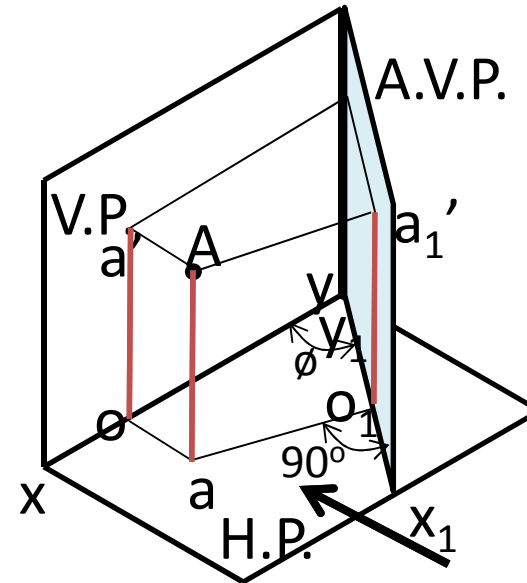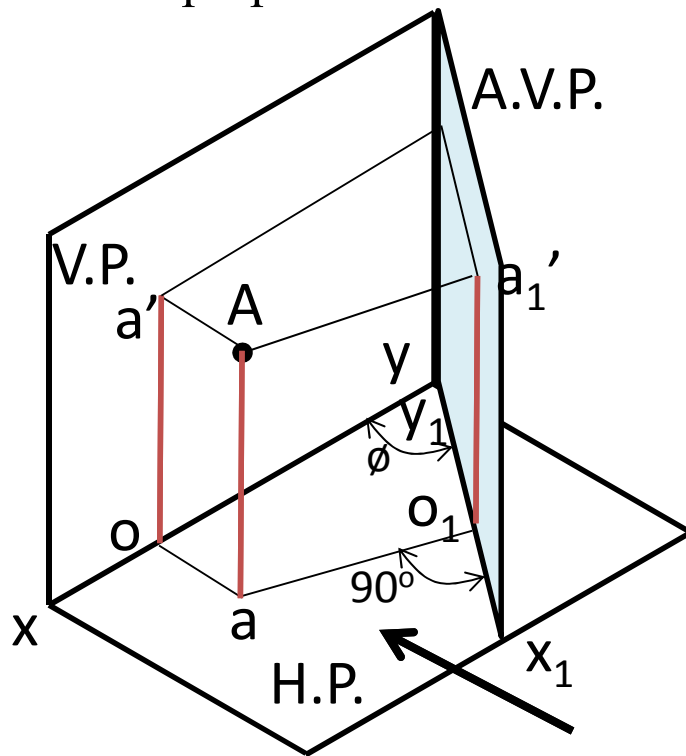
- Auxiliary Inclined Plane (A.I.P.)
  It is perpendicular to the V.P. and inclined to the H.P.
  Projection on A.I.P. is called auxiliary top view
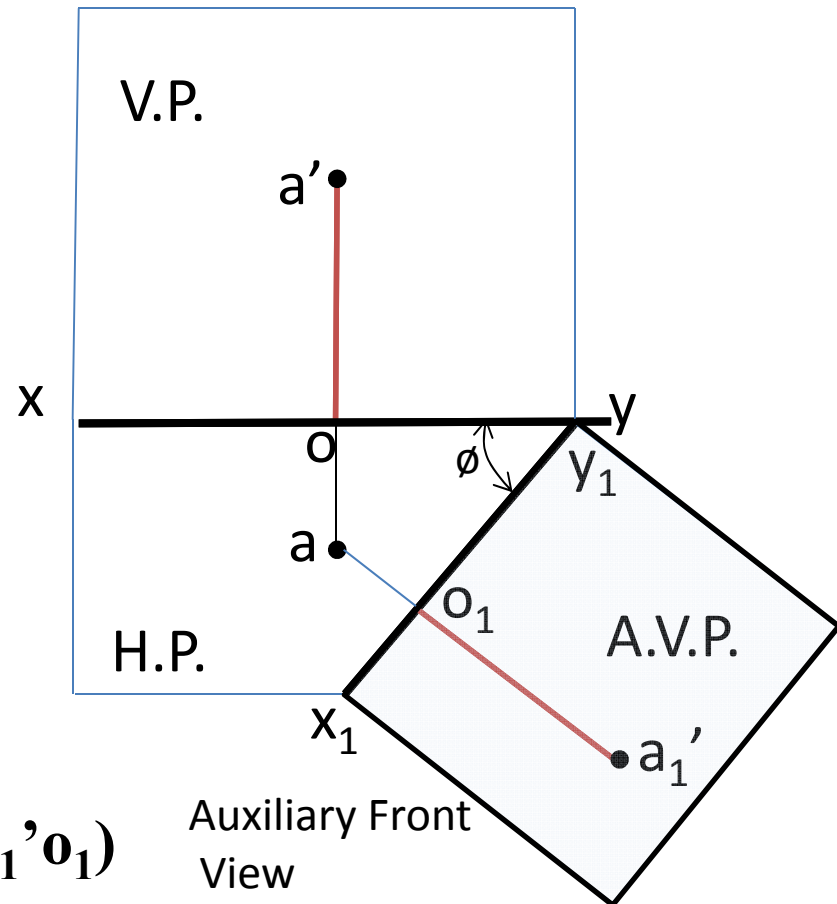 Auxiliary top view and the top view have a common dimension (depth)
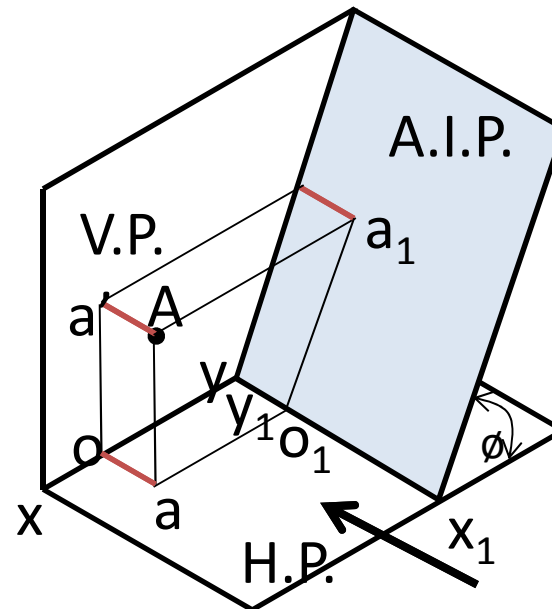
Projection of a Point on the A.V.P.

- A.V.P. is perpendicular to the H.P. and inclined to the V.P.

Height is preserved

$$l(a'o) = l(a_1'o_1)$$

Auxiliary Front View
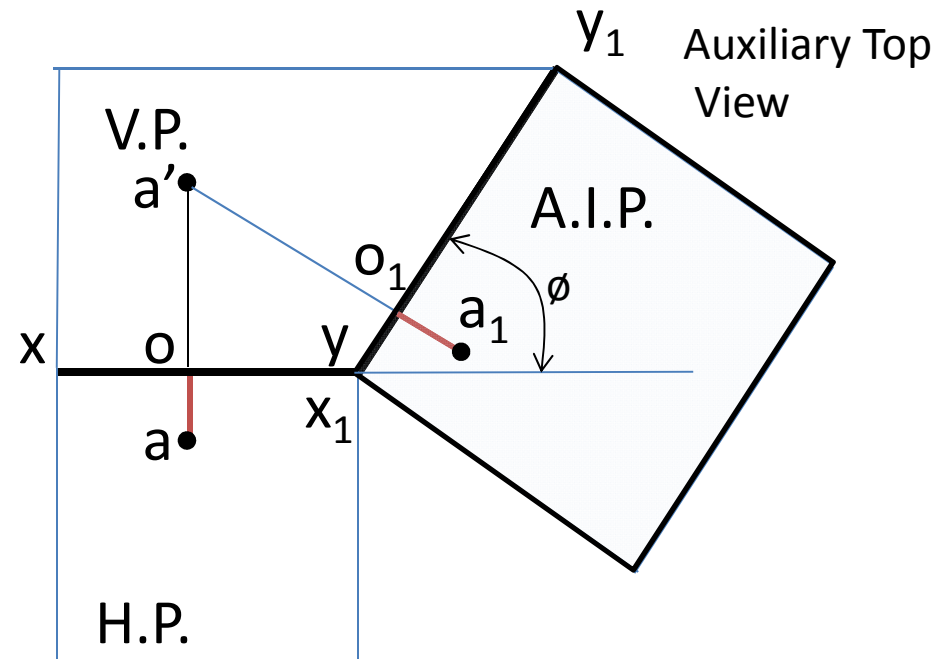
Auxiliary front view is drawn by rotating the auxiliary vertical plane about the line x_1y_1

Projection of a Point on the A.I.P.

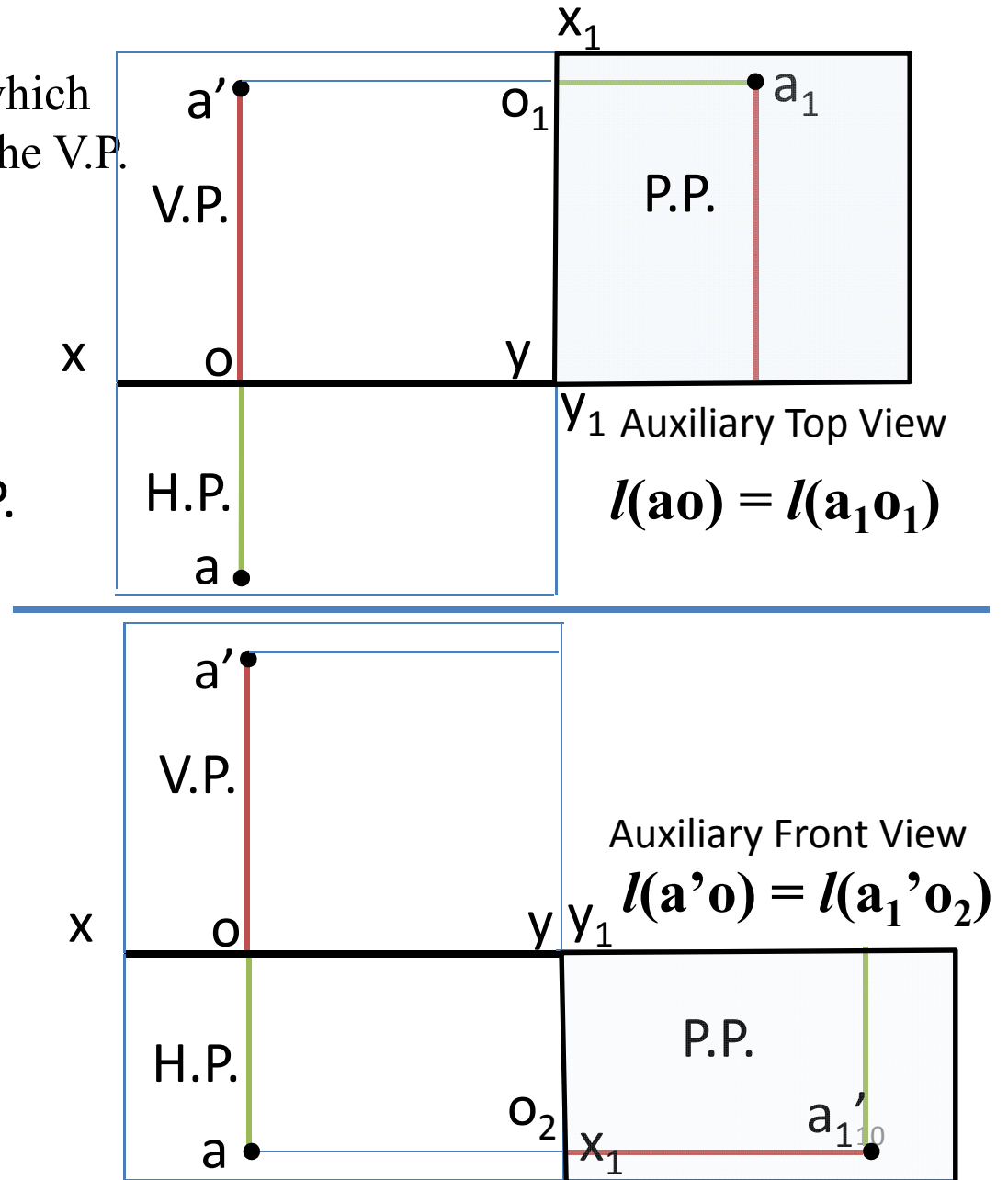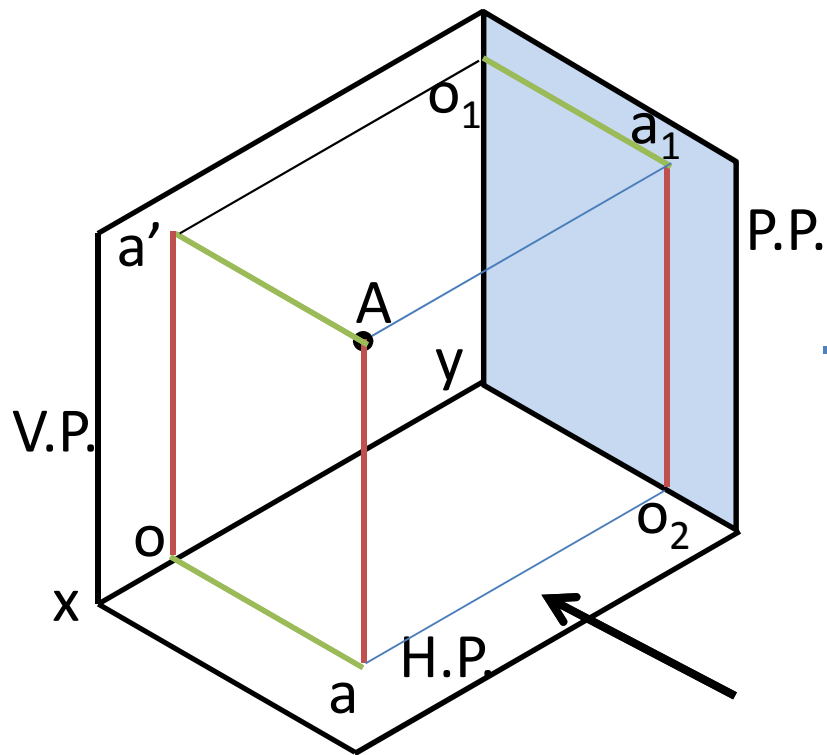- A.I.P. is perpendicular to the V.P. and inclined to the H.P.
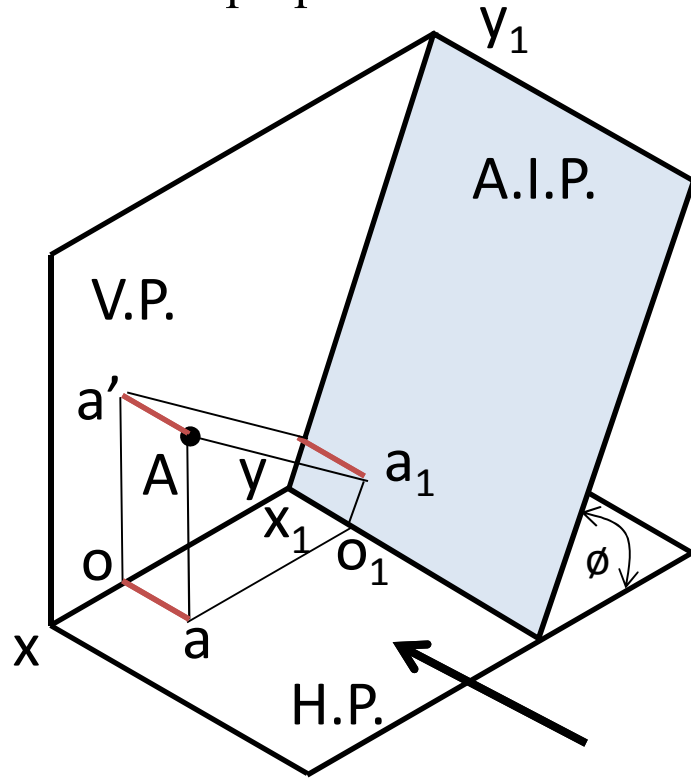
Depth is preserved $l(ao) = l(a_1o_1)$

Auxiliary top view is drawn by rotating the auxiliary inclined plane about the line x_1y_1

Profile Plane

Profile Plane (P.P.): Principal Plane which is perpendicular to both the H.P. and the V.P.

$$l(ao) = l(a_1 o_1)$$

Auxiliary Top View

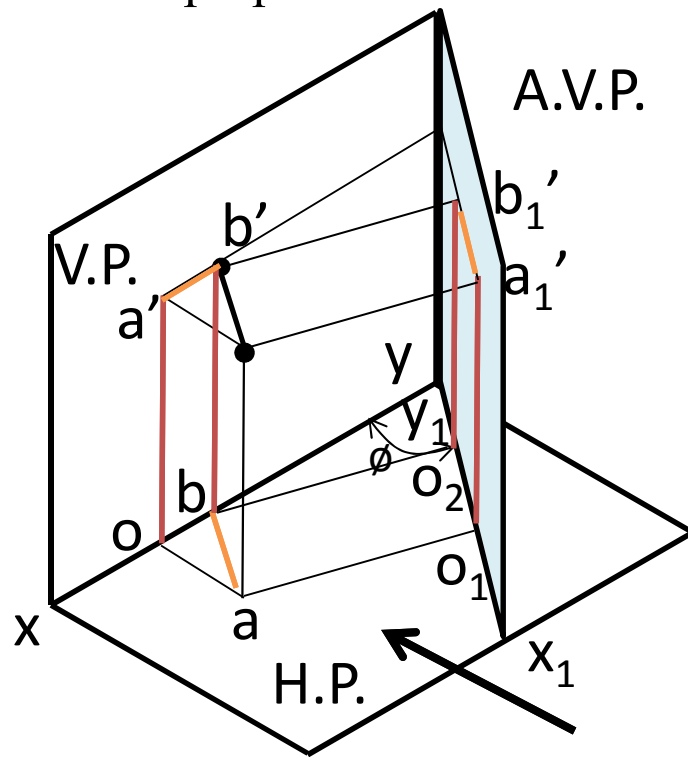$$l(a'o) = l(a_1'o_2)$$

Auxiliary Front View

Important Points to Remember

- The auxiliary top view of a point lies on a line drawn through the front view, perpendicular to the new reference line x_1y_1 and at a distance from it, equal to the distance of the first top view from own reference line xy

- The auxiliary front view of a point lies on a line drawn through the top view, perpendicular to the new reference line x_1y_1 and at a distance from it, equal to the distance of the first front view from own reference line xy

- The distances of all the front views of the same point (projected from the same top view) from their respective reference lines are equal

- The distances of all the top views of the same point (projected from the same front view) from their respective reference lines are equal

Projection of a Line Parallel to H.P. on the A.V.P.

- A.V.P. is perpendicular to the H.P. and inclined to the V.P.

$$l(a'o) = l(a_1'o_1)$$

$$l(b'b) = l(b_1'o_2)$$

Height is preserved

Auxiliary front view is drawn by rotating the auxiliary vertical plane about the line x_1y_1 .The true length of the line is seen in the A.V.P.
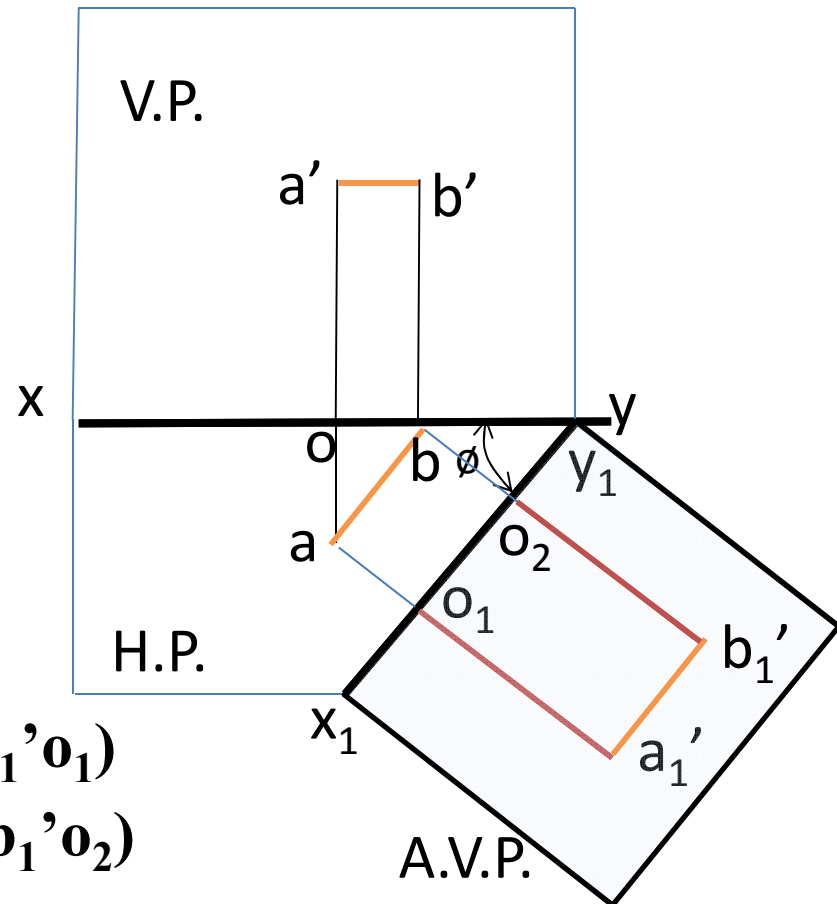
Projection of a Line Parallel to V.P. on the A.I.P.

- A.I.P. is perpendicular to the V.P. and inclined to the H.P.
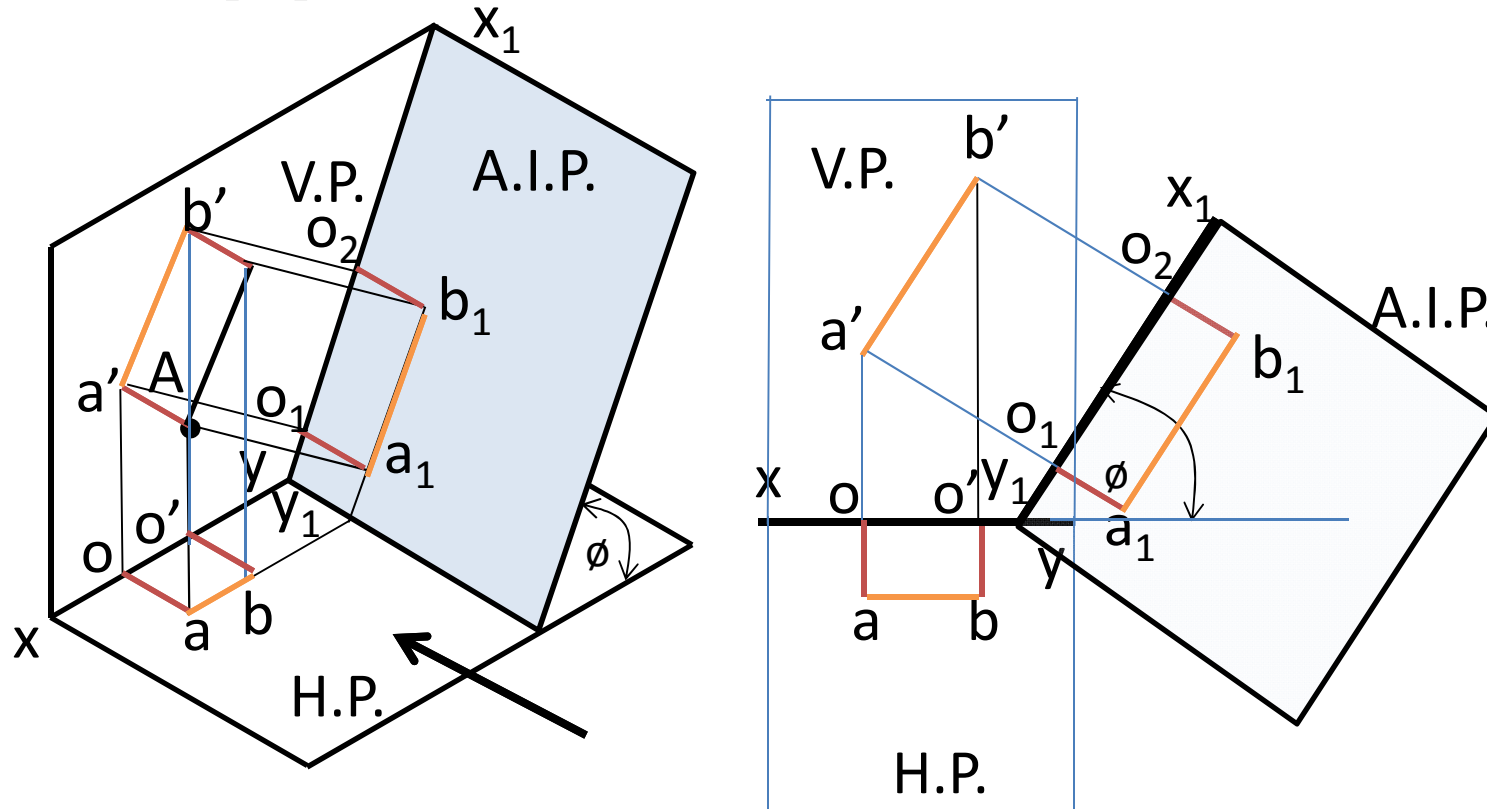

Depth is preserved

$$l(ao) = l(a_1o_1)$$
$$l(bo') = l(b_1o_2)$$

Auxiliary top view is drawn by rotating the auxiliary inclined plane about the line x_1y_1 . The true length of the line is seen in the A.I.P

Projections of a line inclined to both H.P. and the V.P.
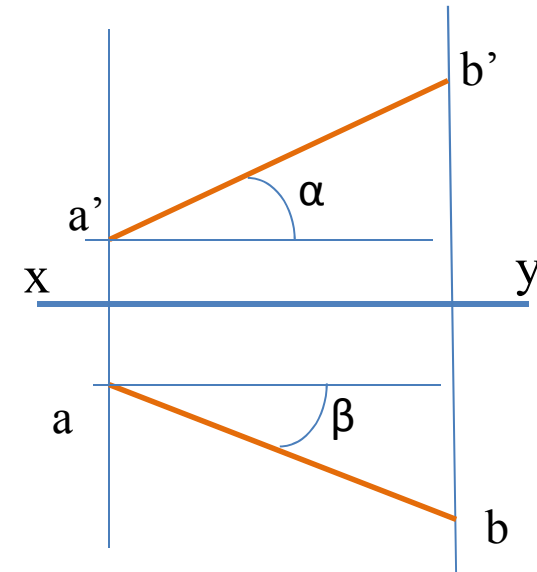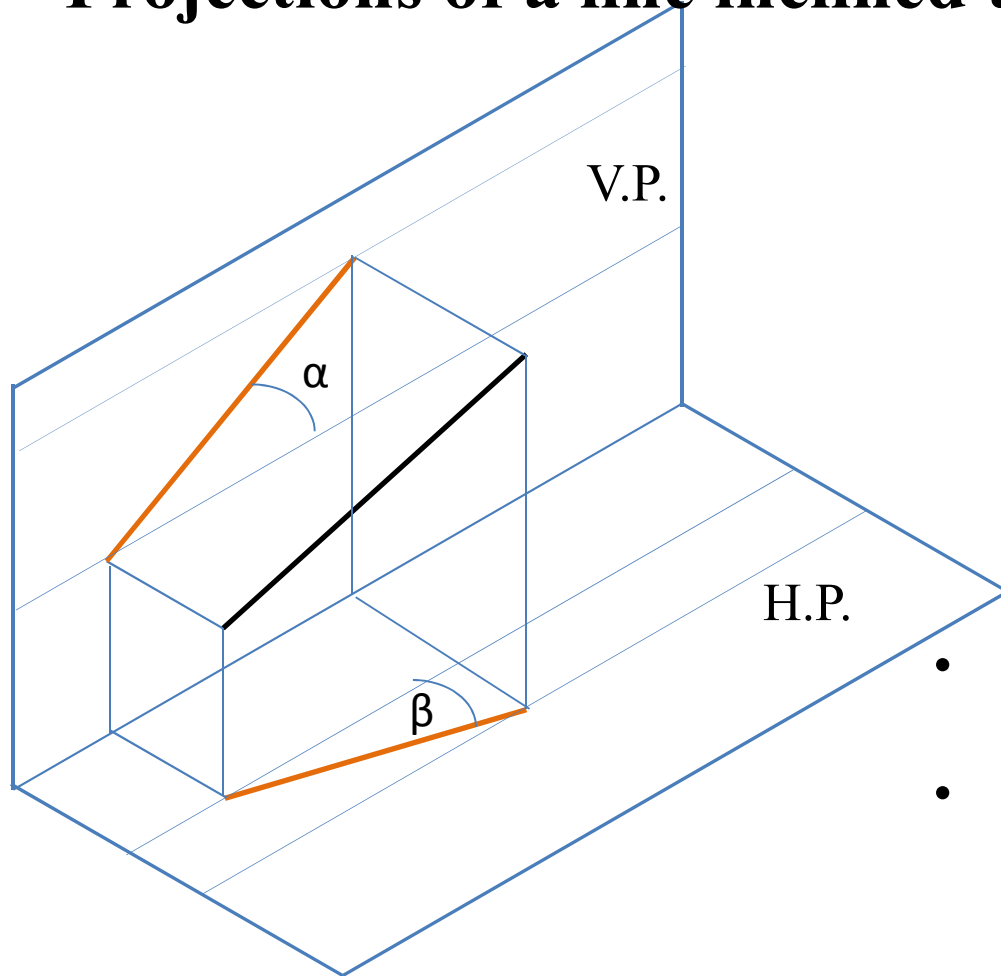
- The top view and the front view are inclined to the xy line
- The length of the line in the top view and the front view is less than the true length
- α and β are the apparent angle of inclination with the H.P. and the V.P. and are greater than the true angles of inclination

To find the True Length and True Angle of Inclination with the H.P. (θ)

Given: The front view and top view of the line AB

The true length of line can be observed by looking perpendicular to it
Line should be projected on a plane parallel to it

b'

a'

D_1

x

D_2

α

y

a

x_1

D_1

a_1'

β

b

θ

H.P.

V.P.

90°

True length

D_2

y_1

b_1'

Auxiliary front view
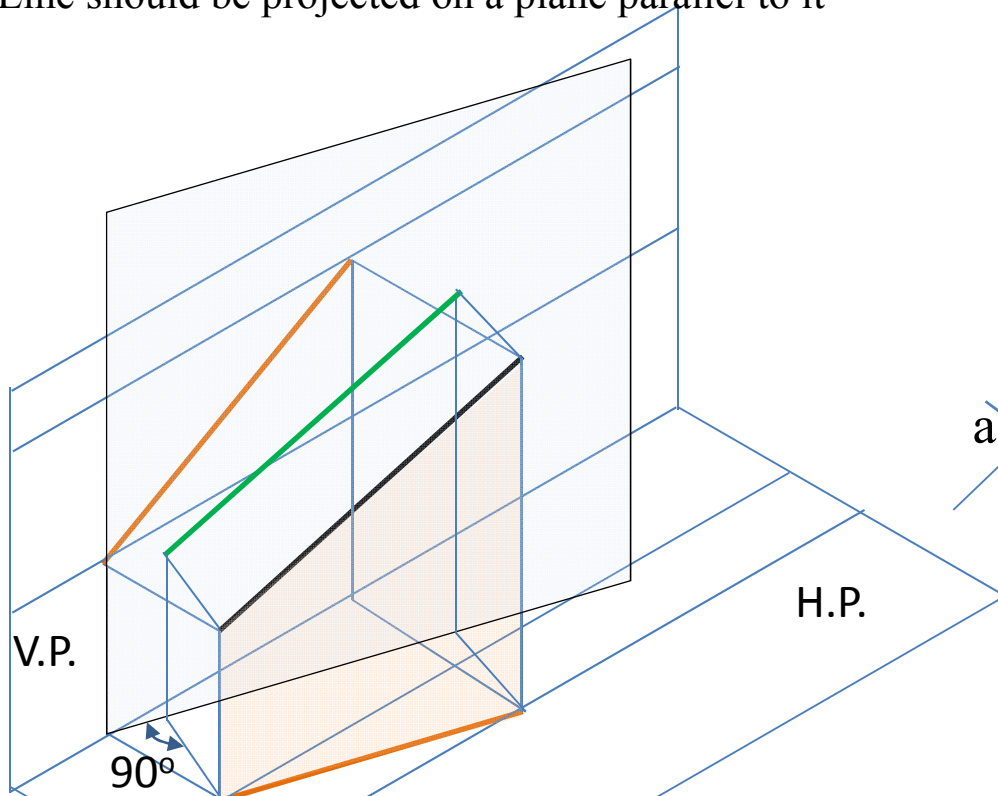
Construct a plane parallel to the top view i.e. ab (A.V.P)
This is represented by x_1y_1. Draw projectors from a and b
perpendicular to x_1y_1. Locate a_1' using a' and b_1' using b' i.e. by
transferring the height dimension

15

To find the True Length and True Angle of Inclination with the V.P. (ø)

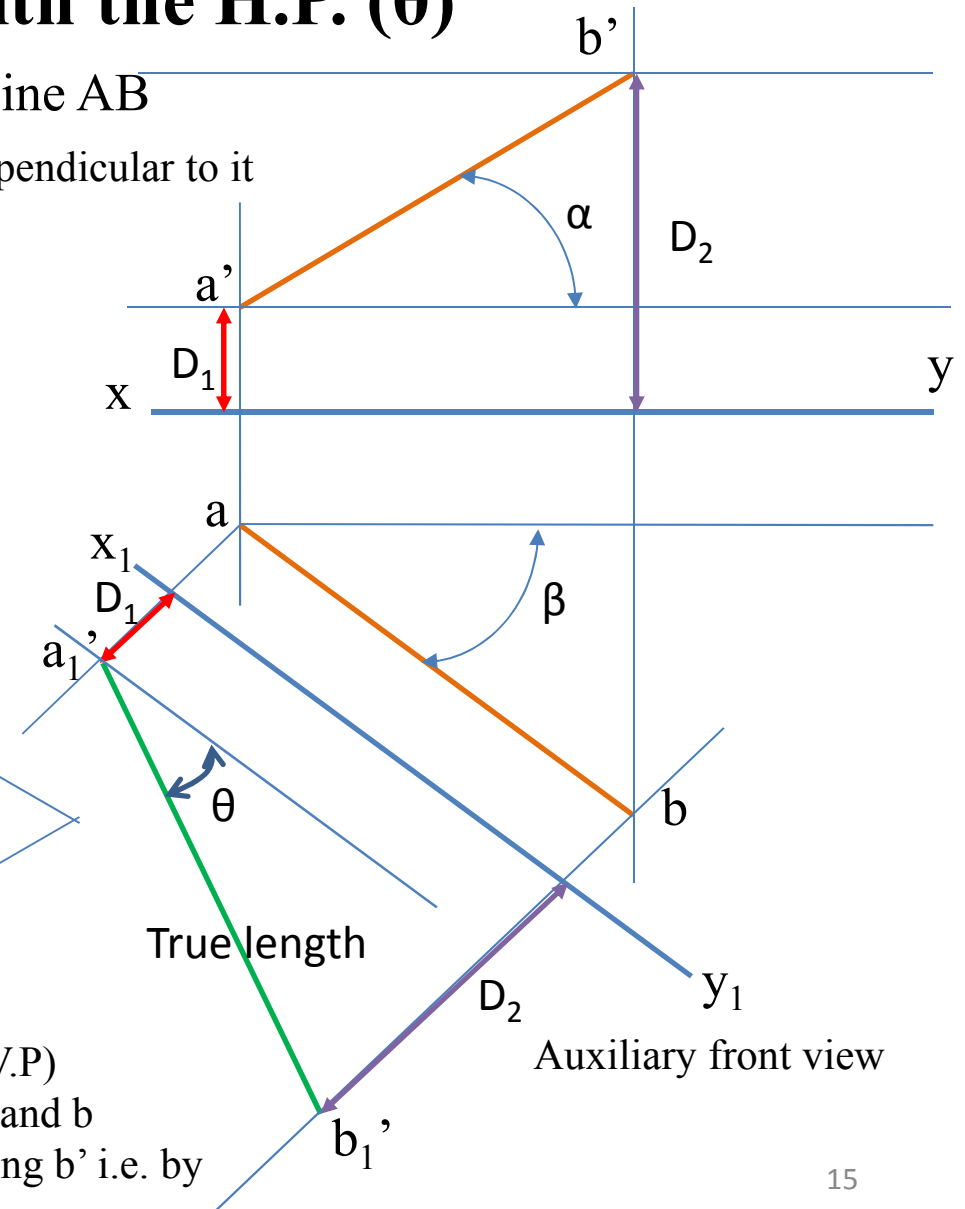Given: The front view and top view of the line AB

The true length of line can be observed by looking perpendicular to it
Line should be projected on a plane parallel to it

V.P.

H.P.

b_1

Auxiliary top view

D_4

True length

y_1

b'

ø

a_1

D_3

x_1

α

a'

y

x

D_3

a

β

D_4

b

Construct a plane parallel to the front view i.e. a'b' (A.I.P)
This is represented by x_1y_1. Draw projectors from a' and b'
perpendicular to x_1y_1. Locate a_1 using a and b_1 using b i.e. by
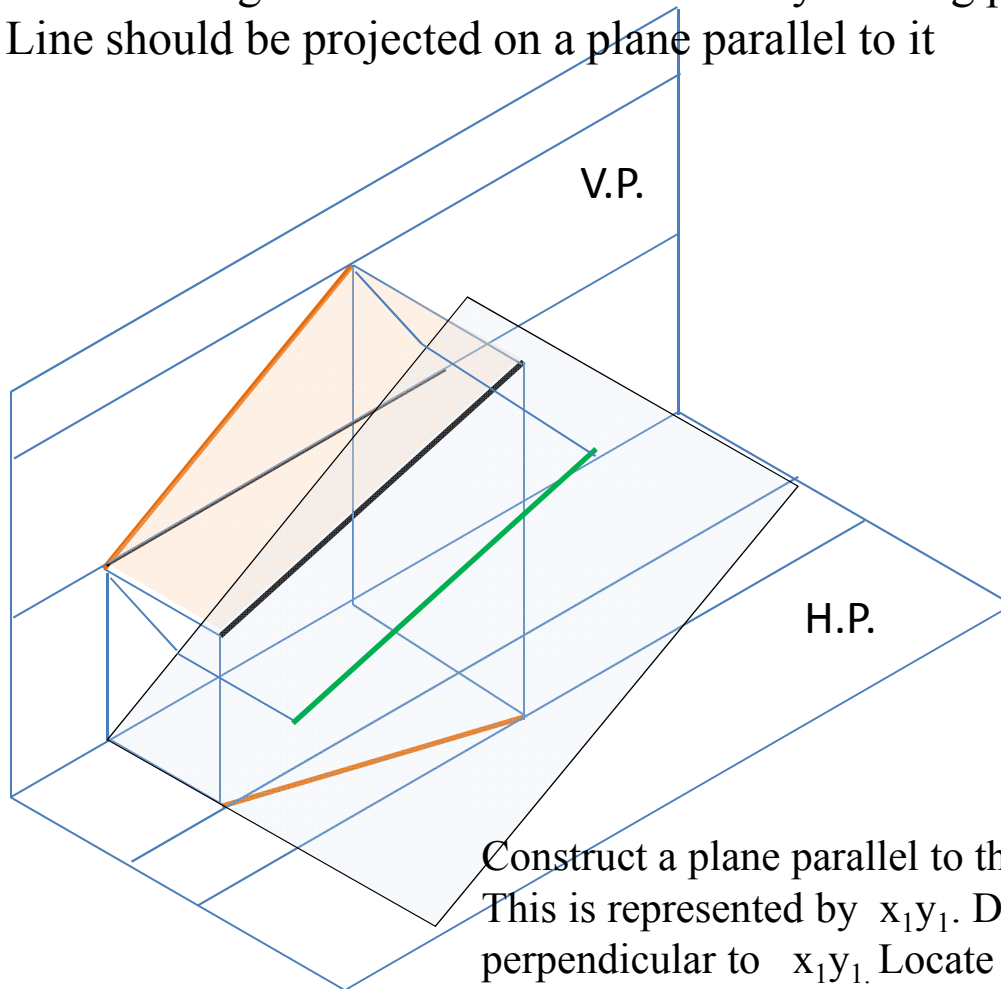transferring the depth dimension
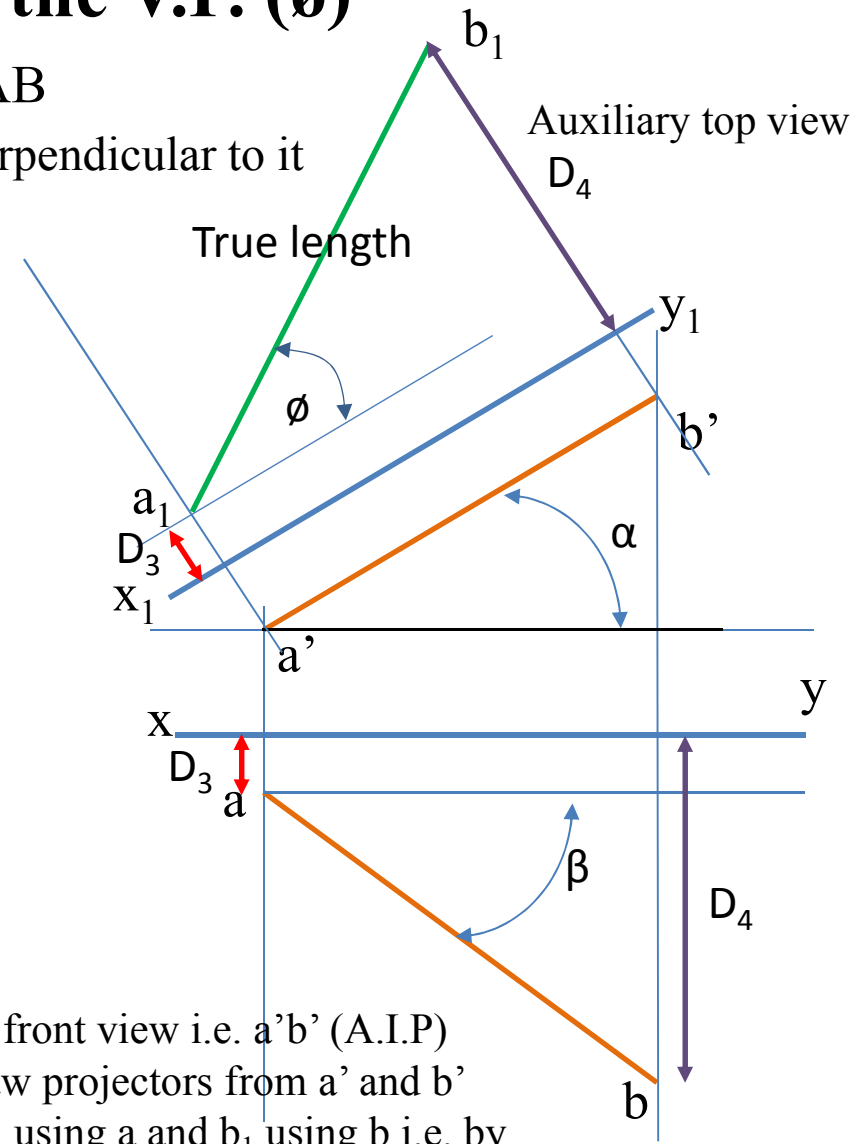
To Determine the Shortest Distance Between a Line and the XY Line

Given the front view and the top of a line AB, determine the shortest distance between the line and the xy line

The shortest segment is perpendicular to both the xy line and line AB. The profile plane is perpendicular to the xy line. Hence the shortest segment is parallel to profile plane. Therefore l(om) is the true length

l(om) is the required length
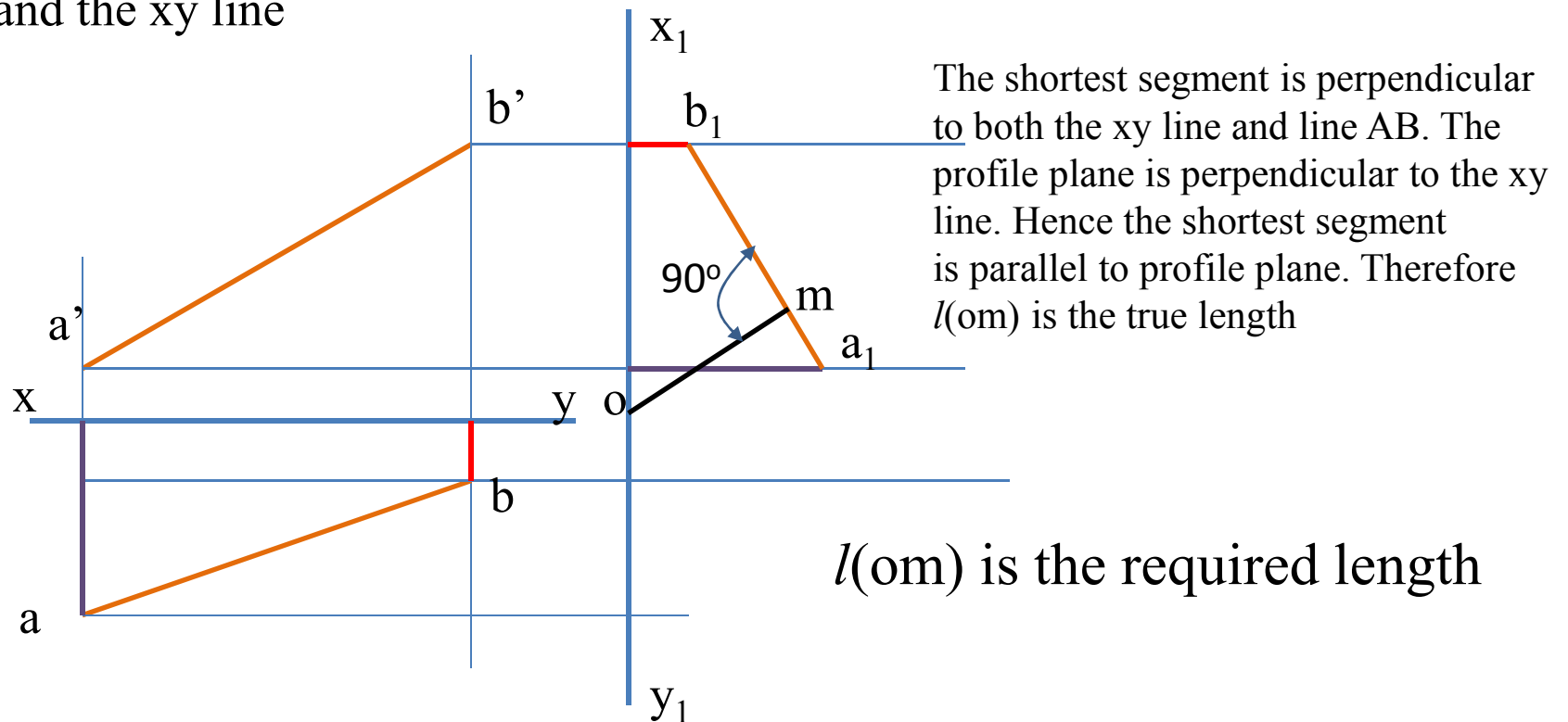
To determine the shortest distance between any two non-intersection lines, it is necessary to find the point view of one of the lines. In the above example 'o' is the point view of the xy line

To Find the Point View (Point Projection) of a Line

Given: The front view and top view of the line AB

Point view of line AB

A point view must always follow the true length view

-A line will show up as a point on a projection plane which is perpendicular to the line

-The perpendicular plane to the line is found by first finding the true length view of the line.

-Then a plane is constructed which is perpendicular to the true length view. This plane is perpendicular to the line and is represented by $x_2 y_2$

- Draw a projection line from a_1 , b_1 and transfer distance D_3 to locate a_1' and b_1' . This is the point view of the line AB

To Find the Shortest Distance Between a Line and a Point

Given: The front view and top view of the line AB and point P
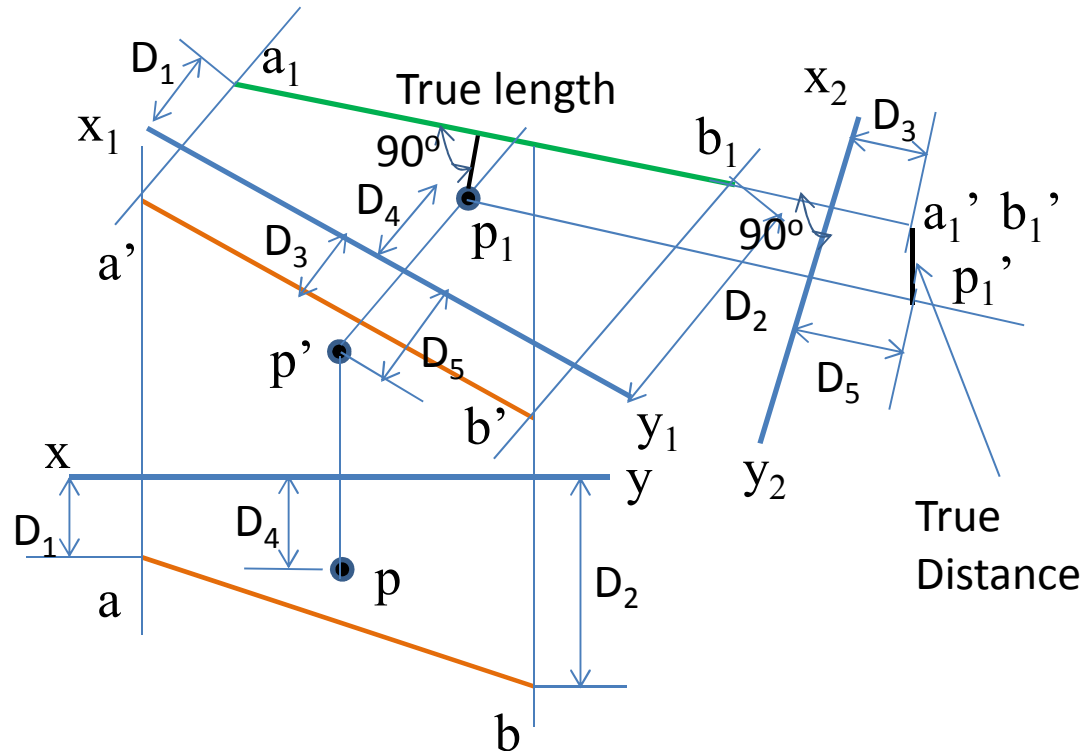
- The shortest distance between a given point and a given line is measured along the perpendicular drawn from the point to the line
- Lines that are perpendicular will have their projections shown perpendicular in a view showing either or both lines in true length

-Draw the true length view of the line AB
-Obtain the projection of the point P in the same view
-The segment which is perpendicular to the line from the point P, will appear perpendicular in this view as the true length of line AB is seen
-Draw a plane perpendicular to the true length view. This is represented by x_2y_2
-Locate the point view of line AB
-Since the segment from the point to the line is parallel to x_2y_2 , its projection in the other view will show its true length. This is the distance of the point P from the line AB

Important Points to Remember

- When one view of a line is parallel to a reference line, the other view represents the true length
- A line will appear as a point when it projected on a plane perpendicular to it
- The shortest distance between a given point and a given line is measured along the perpendicular drawn from the point to the line
- Lines that are perpendicular in space will have their projections perpendicular in any view which shows either or both of the lines in true lengths

END