ME 111: Engineering Drawing

Lecture Slides

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ME 111: Engineering Drawing

Lecture 7

19-08-2011

Projection of Lines and Projection of Planes

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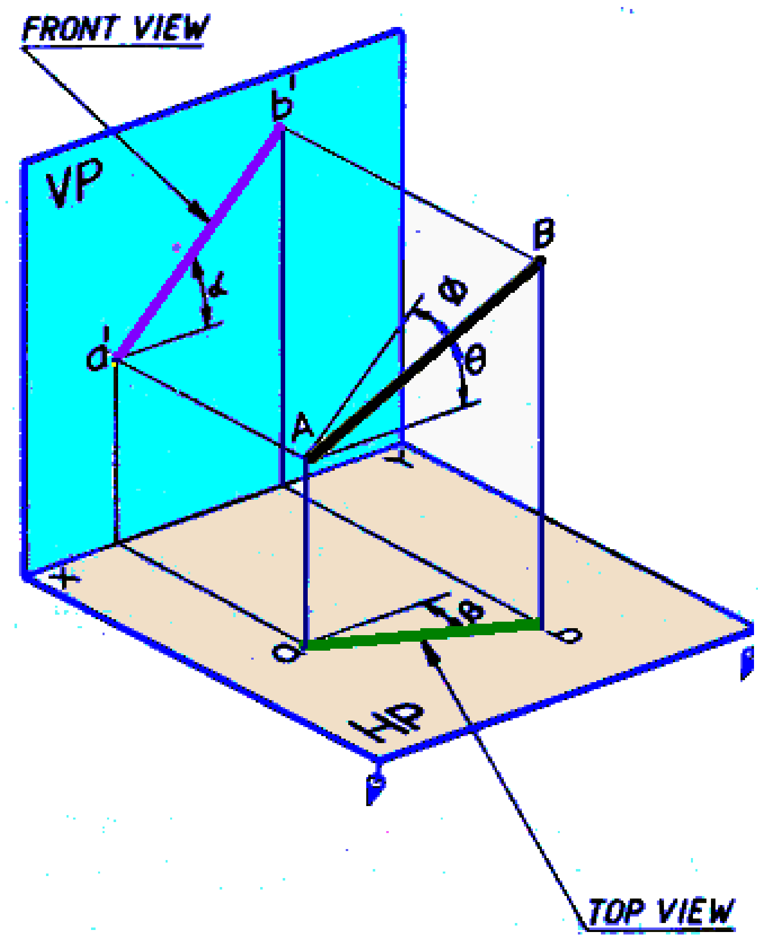
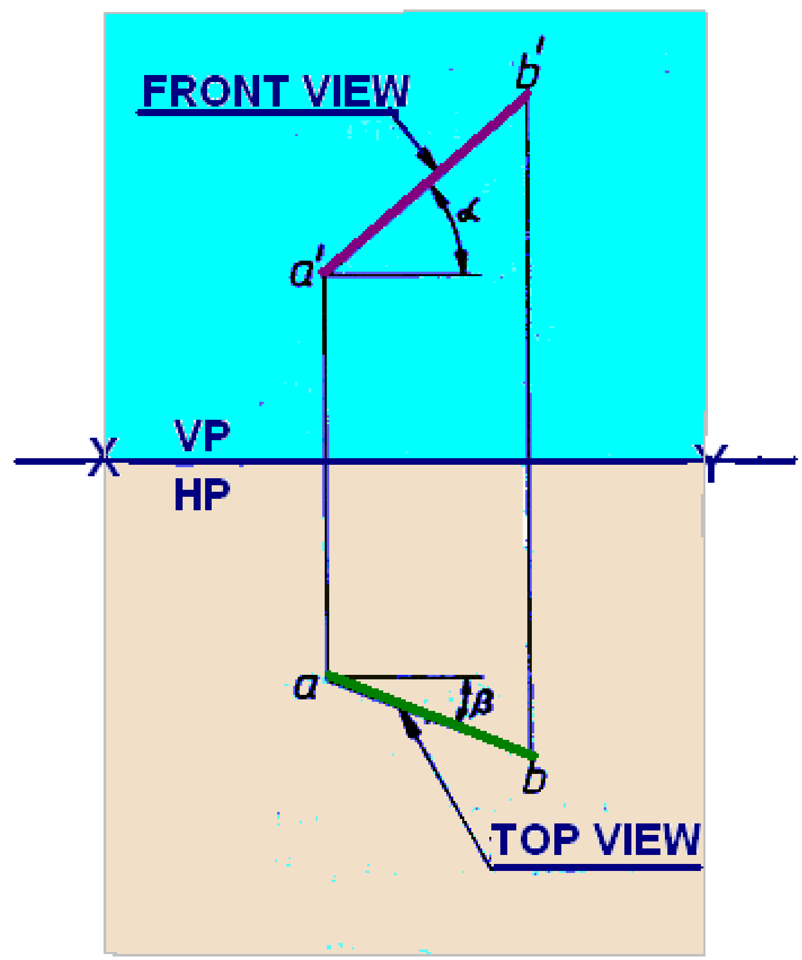
Projections of Lines

Line inclined to HP and VP

Apparent Inclinations: α and β

Apparent Lengths: ab, a´b´

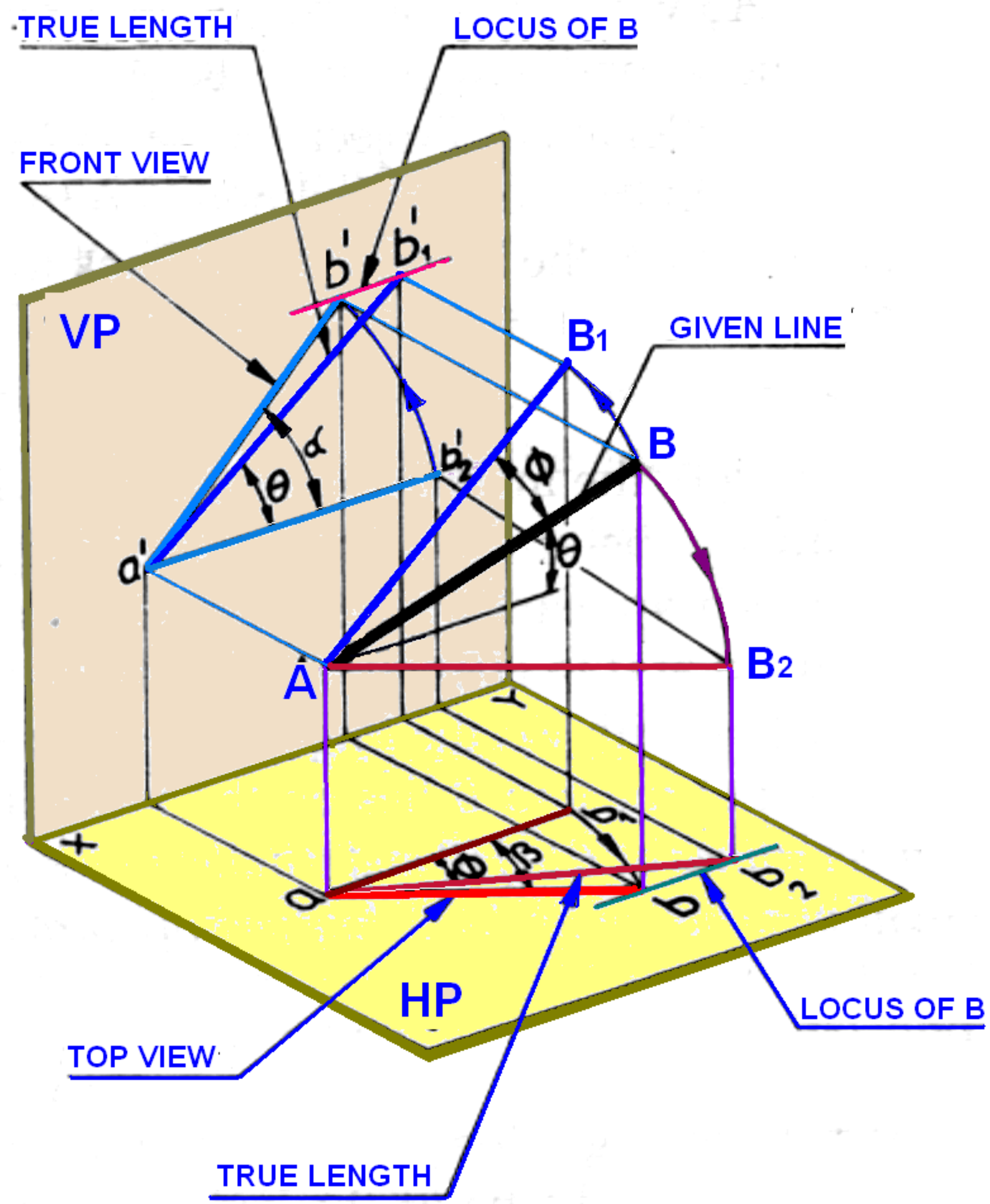




Line inclined to HP and VP…….

Draw the projections of a line AB inclined to both HP and VP, whose true length and true inclinations and locations of one of the end points, say A are given.

Since the line AB is inclined at θ to HP and ϕ to VP – its top view ab and the front view a´b´ are not in true lengths and they are also not inclined at angles θ to HP and ϕ to VP.



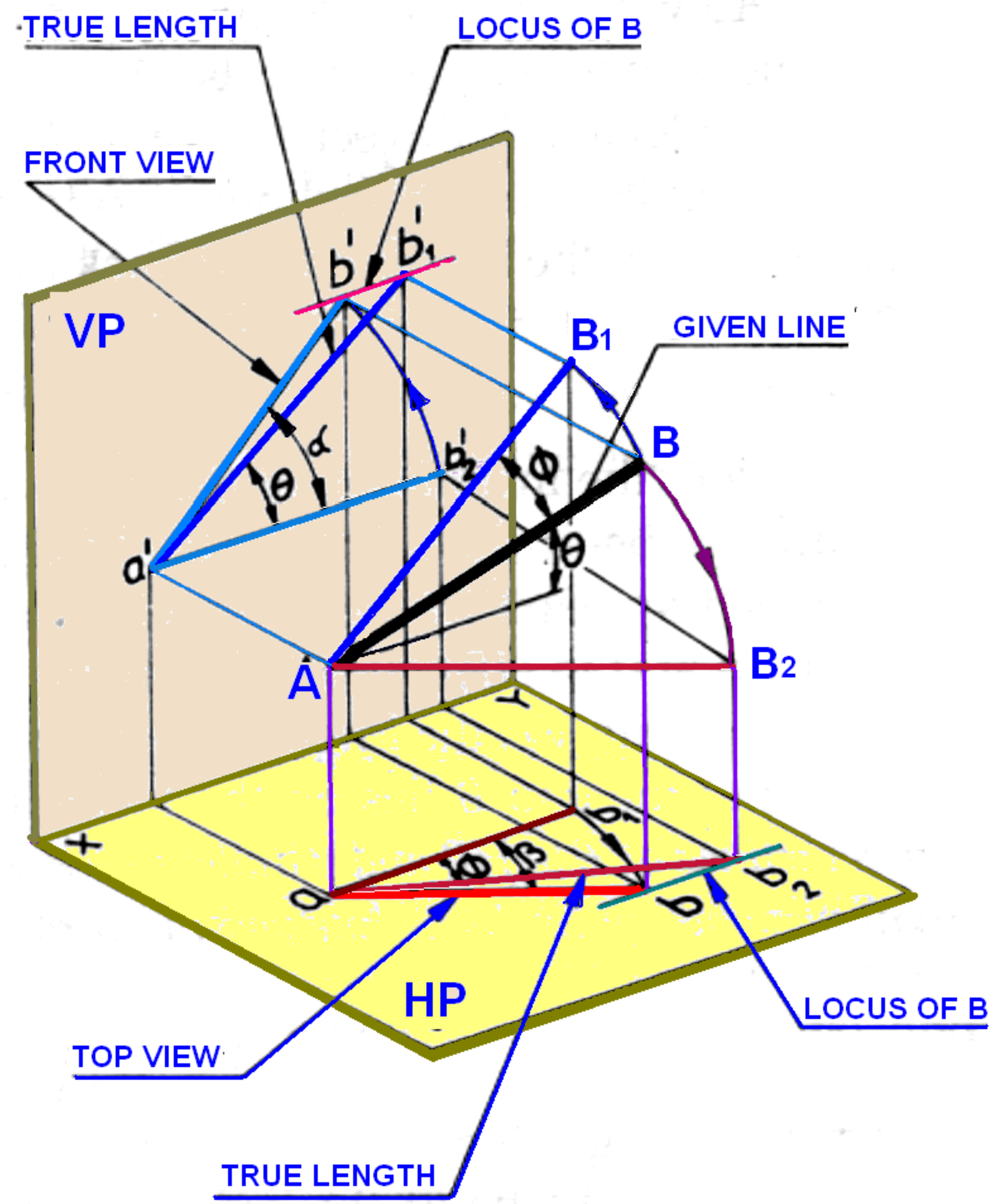
Line inclined to HP and VP…….

Step 1: Rotate the line AB to make it parallel to VP.

Rotate the line AB about the end A, keeping θ, the inclination of AB with HP constant till it becomes parallel to VP. This rotation of the line will bring the end B to the new position B1.

AB_1 is the new position of the line AB when it is inclined at θ to HP and parallel to VP.

Project AB_1 on VP and HP. Since AB_1 is parallel to VP, $a'b_1'$, the projection of AB_1 on VP is in true length inclined at θ to the XY line, and ab_1, the projection of AB_1 on HP is parallel to the XY line. Now the line is rotated back to its original position AB.



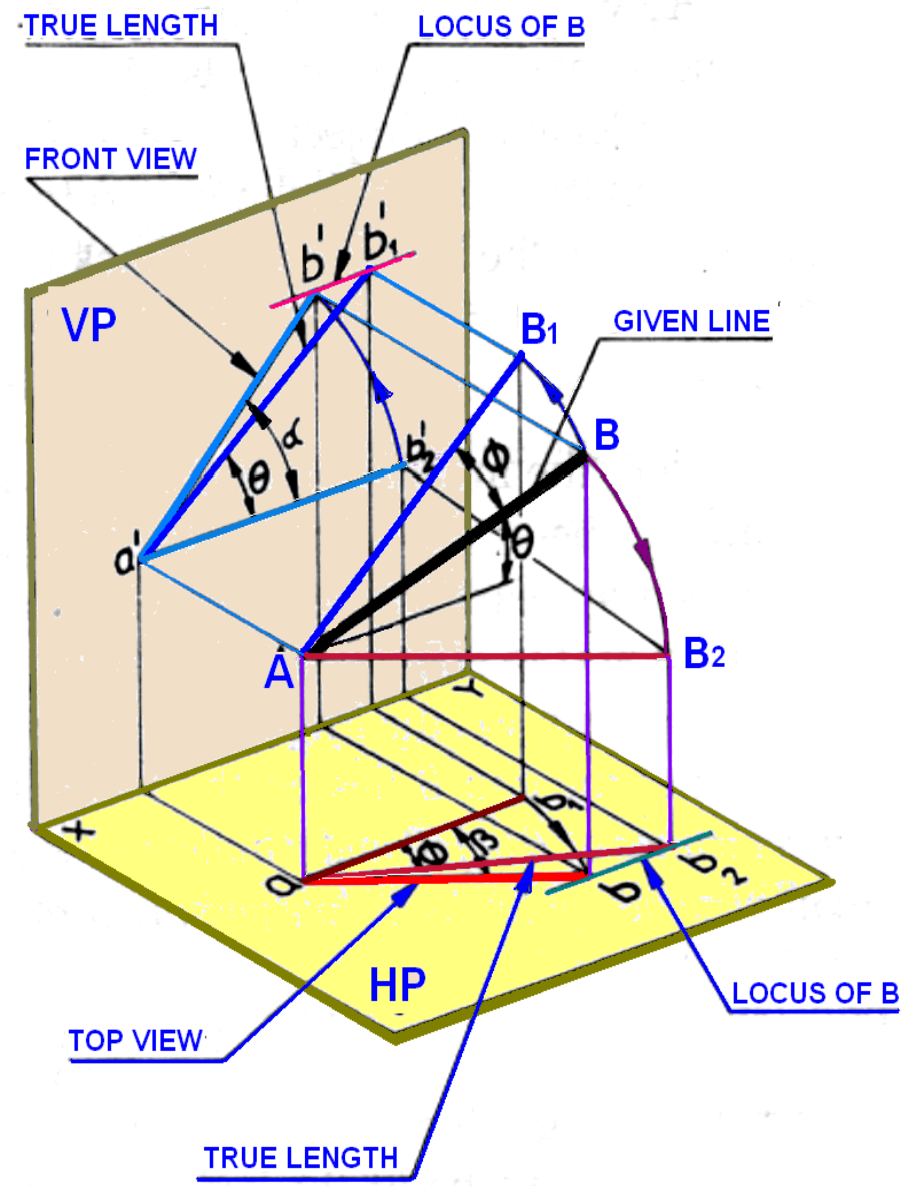
Line inclined to HP and VP…….

Step 2: Rotate the line AB to make it parallel to HP.

Rotate the line AB about the end A keeping ϕ the inclination of AB with VP constant, till it becomes parallel to HP. This rotation of the line will bring the end B to the second new Position B2.

AB_2 is the new position of the line AB, when it is inclined at ϕ to VP and parallel to HP.

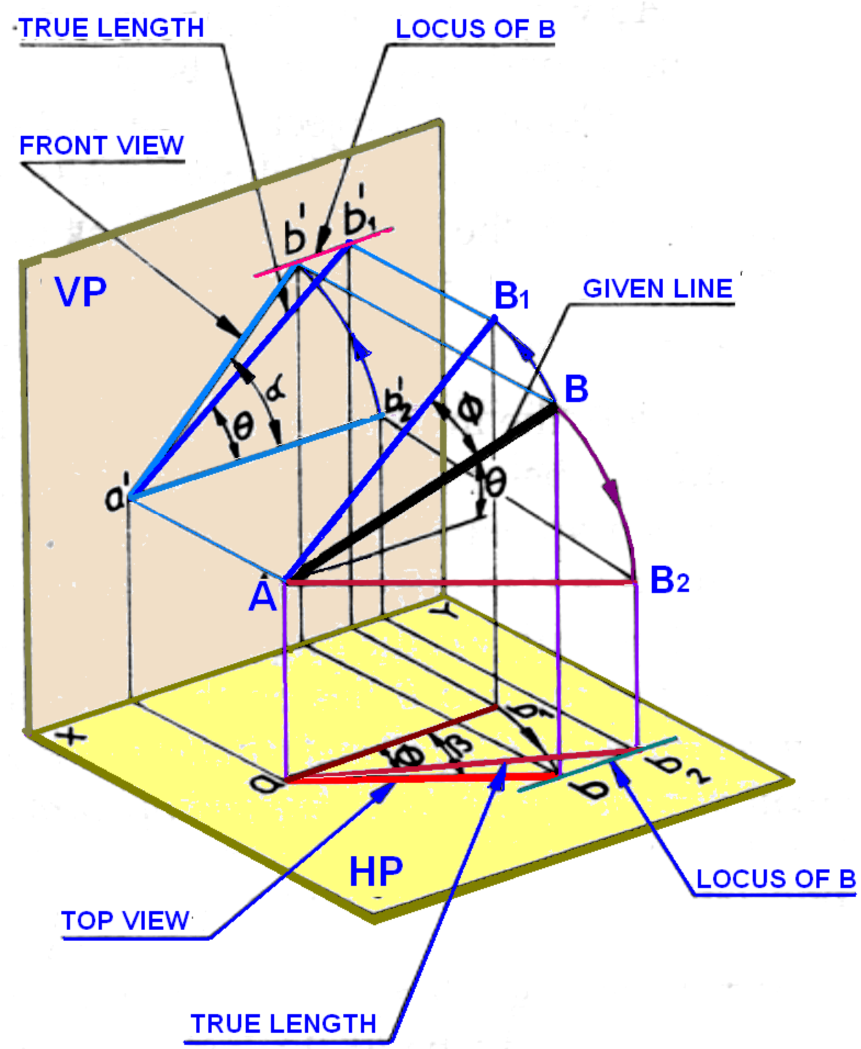
Project AB2 on HP and VP. Since AB2 is parallel to HP, ab2, the projection of AB2 on HP is in true length inclined at ϕ to XY line, and $a'b_2'$ the projection of AB_2 on VP is parallel to XY line. Now the line is rotated back to its original position AB.



Line inclined to HP and VP.......

Step 3: Locus of end B in the front view

When the line AB is swept around about the end A keeping θ, the inclination of the line with the HP constant, by one complete rotation, the end B will always be at the same vertical height above HP, and the locus of the end B will be a circle which appears in the front view as a horizontal line passing through b'.



As long as the line is inclined at θ to HP, whatever may be the position of the line (i.e., whatever may be the inclination of the line with VP) the length of the top view will always be equal to ab1 and in the front view the projection of the end B lies on the locus line passing through b1'.

Thus ab_1, the top view of the line when it is inclined at θ to HP and parallel to VP will be equal to ab and b´, the projection of the end B in the front view will lie on the locus line

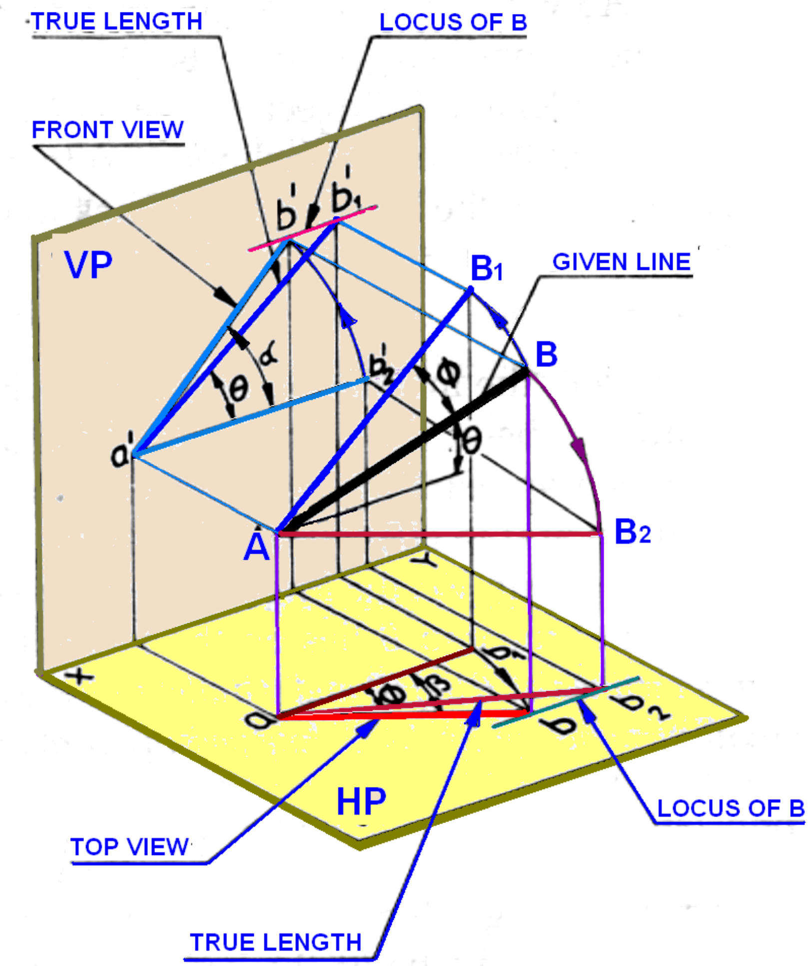
Line inclined to HP and VP…….

Step 4: Locus of end B in the top view

When the line AB is swept around about the end A keeping ϕ the inclination of the line with the VP constant, by one complete rotation, the end B will always be at the same distance in front of VP and the locus of the end B will be a circle which appears in the top view as a line, parallel to XY, passing through b.

As long as the line is inclined at ϕ to VP, whatever may be the position of the line (i.e., whatever may be the inclination of the line with HP), the length of the front view will always be equal to $a'b_2'$ and in the top view the projection of the end B lies on the locus line passing through b_2.

Thus $a'b_2'$ the front view of the line when it is inclined at ϕ to VP and parallel to HP, will be equal to a'b' and also b, the projection of the end B in the top view lies on the locus line passing through b_2.



Line inclined to HP and VP…….

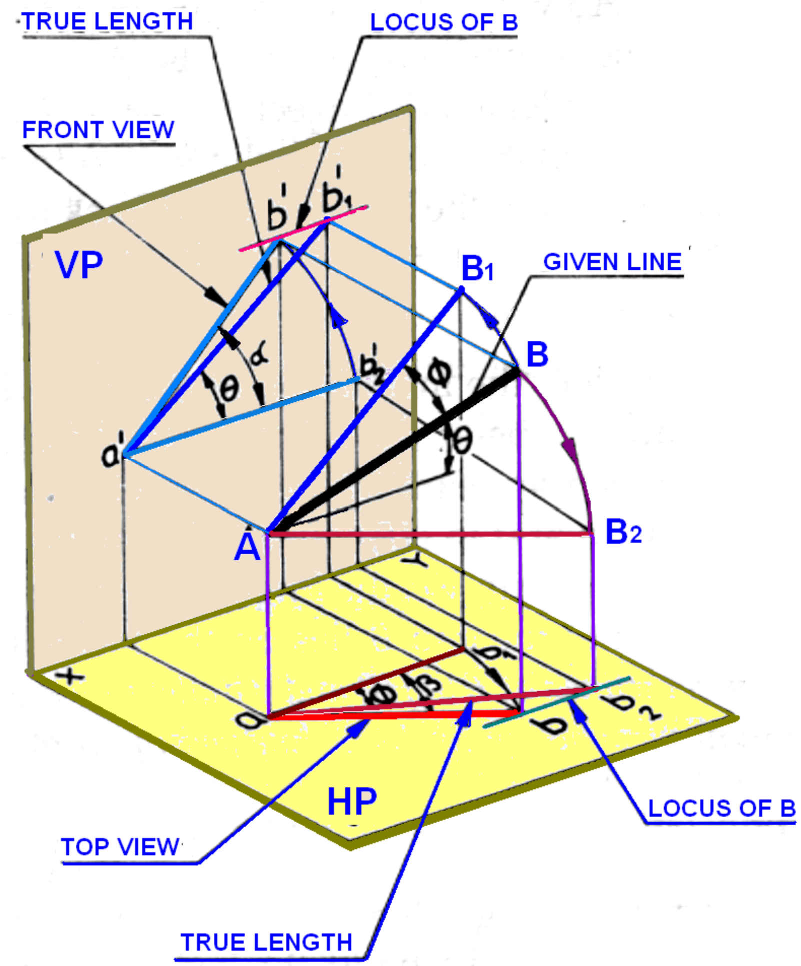
Step 5: To obtain the top and front views of AB

- From the above two cases of rotation it can be said that

(i) the length of the line AB in top and front views will be equal to **ab$_1$** and **a'b$_2$'** respectively and

(ii) the projections of the end **B**, (i.e., **b** and **b'**) should lie along the locus line passing through **b$_2$** and **b$_1$´** respectively.

- **With center a, and radius ab$_2$ draw an arc to intersect the locus line through b$_2$ at b. Connect ab the top view of the line AB.**
- Similarly with center **a'**, and radius **a'b$_2$'** draw an arc to intersect the locus line through **b$_1$'** at **b´**. Connect **a'b'** the front view of the line **AB**.

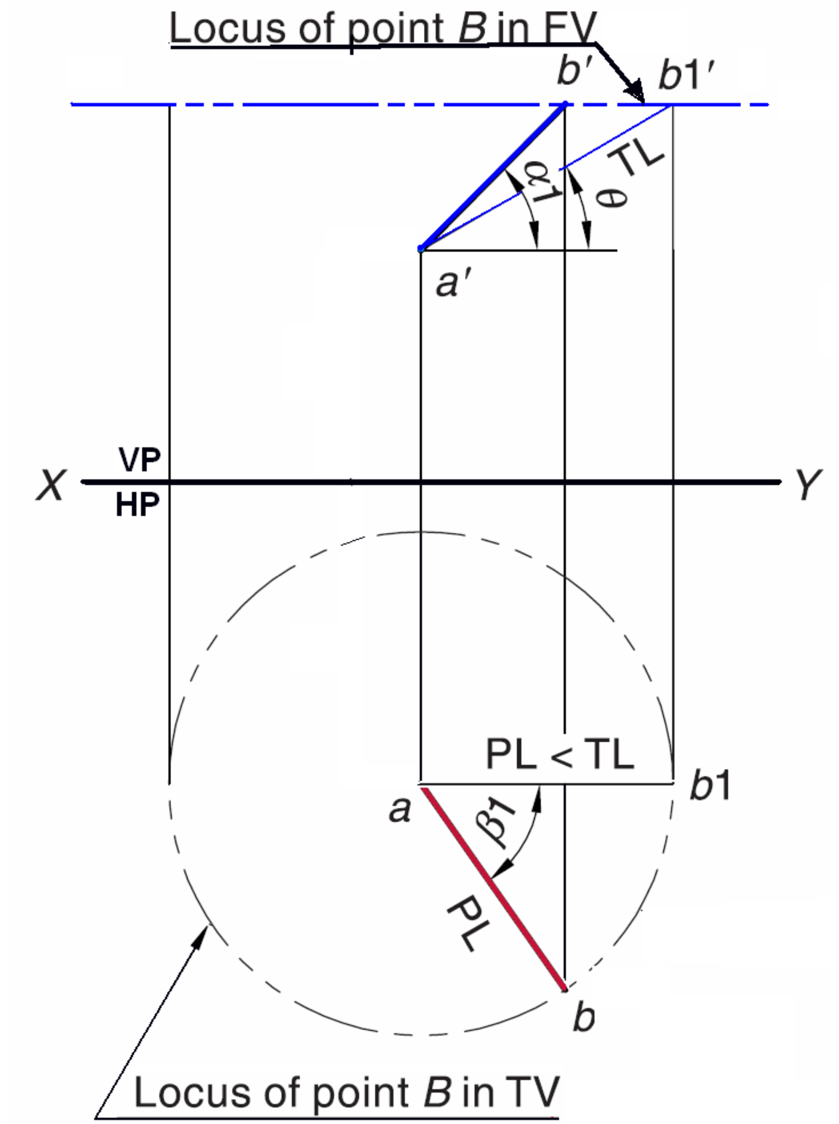


Line inclined to HP and VP

Orthographic projection

1. As the location of one of the end points (i.e. **A**) with respect to **HP** and **VP,** is given, mark **a** and **a´**, the top and the front views of point **A**.

2. Suppose the line **AB** is assumed to be made parallel to **VP** and inclined at **θ** to **HP**. The front view of the line will be equal to the true length of the line and also, the inclination of the line with HP is seen in the front view. Draw **a'b$_1$'** passing through **a'** at **θ** to **XY** line and equal to the true length of **AB**. a'b$_1$' is projected down to get ab$_1$, the top view parallel to the XY line.



Line inclined to HP and VP…….

Orthographic projection…..

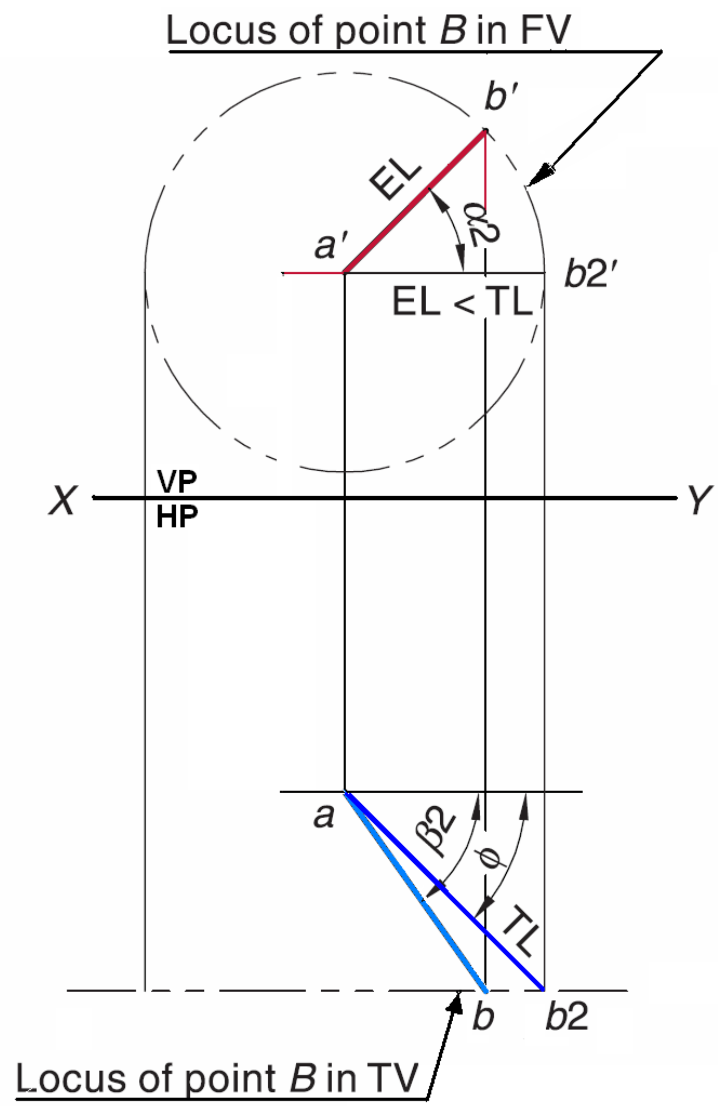
3. Now the line **AB** is assumed to be made parallel to **HP** and inclined at ϕ to **VP**. The top view of the line will be equal to the true length of the line and also ϕ, the inclination of the line with **VP** is seen in the top view.

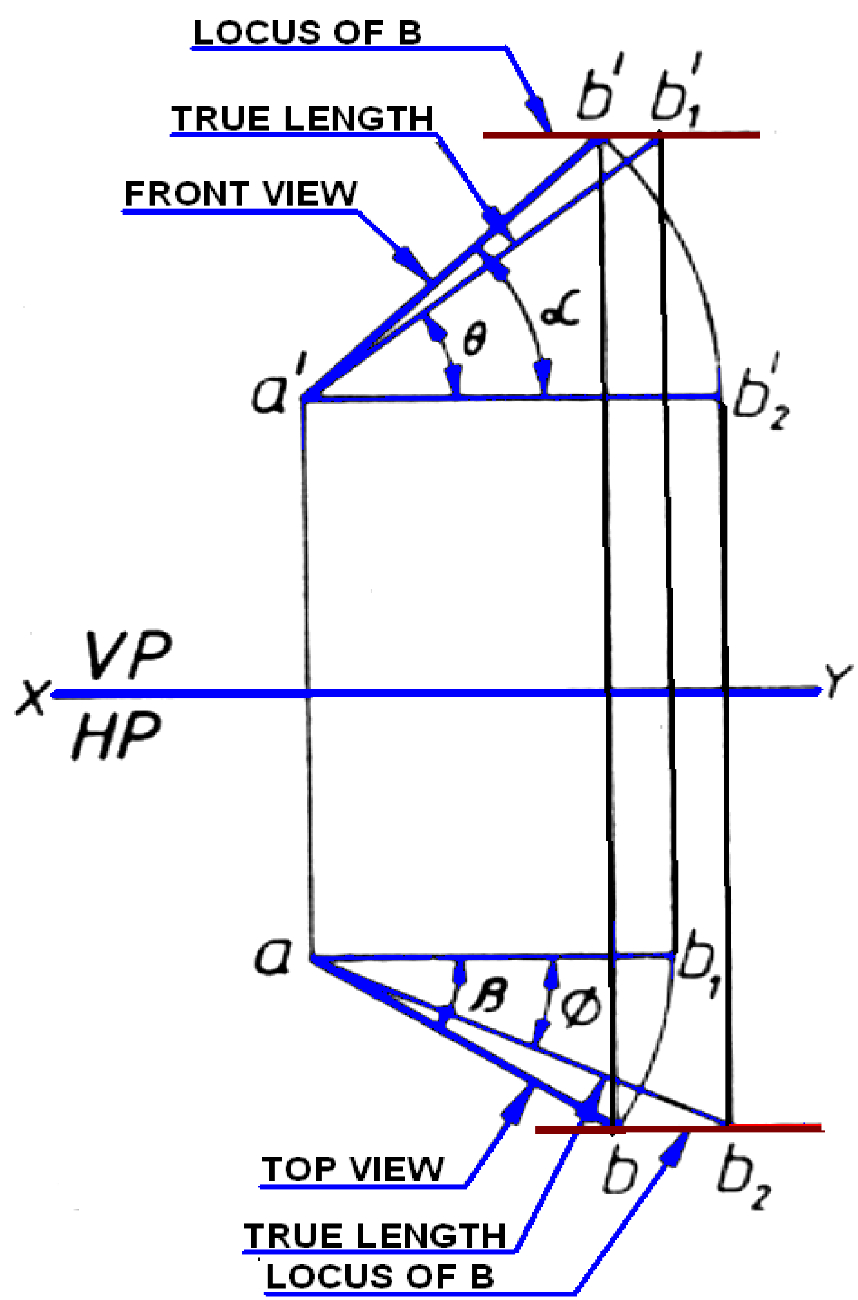
4. Draw $\mathbf{ab_2}$ passing through **a** at ϕ to the **XY** line and equal to the true length of **AB**. ab2, is projected up to get a'b2', the front view parallel to the XY line.

5. Draw the horizontal locus lines through b_2, and b_1'.

6. With center **a** and radius $\mathbf{ab_1}$, draw an arc to cut the locus line drawn through $\mathbf{b_2}$ at **b**. Connect **ab**, the top view of the line **AB.**

7. With center **a'** and radius $\mathbf{a'b_2'}$, draw an arc to cut the locus line drawn through $\mathbf{b_1'}$ at **b'.** Connect **a'b'**, the front view of the line **AB**.




LOCUS OF B
TRUE LENGTH
FRONT VIEW
b'
b_1'
θ
α
a'
b_2'
X
VP
HP
Y
a
b_1
β
Ø
TOP VIEW
TRUE LENGTH
LOCUS OF B
b
b_2

To Find True length and true inclinations of a line

- Given : The top and front views of a line are given
- This is of great importance since some of the engineering problems may be solved by this principle.

- The problems may be solved by
  (i) **Rotating line method** or
  (ii) Rotating trapezoidal plane method or
  (iii) **Auxiliary plane method**.

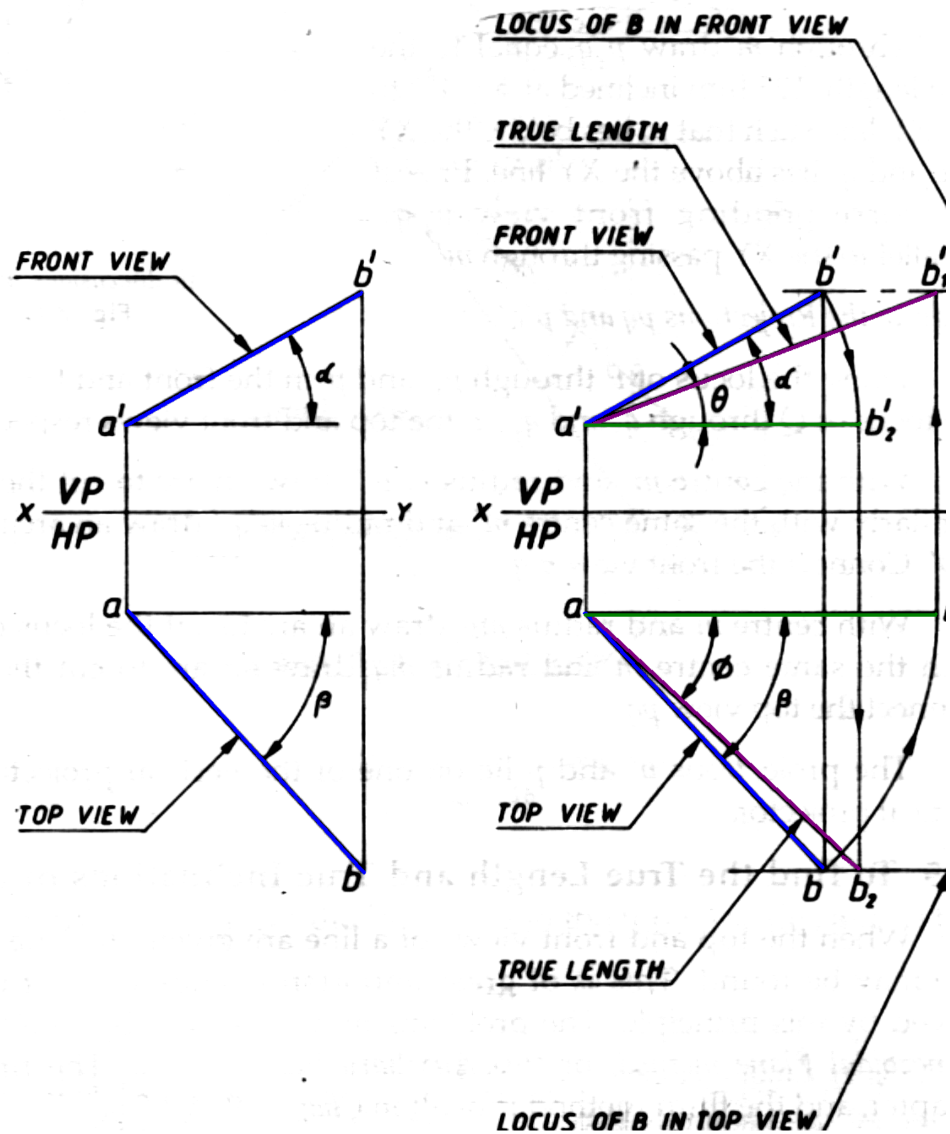
- The top and front views of the object can be drawn from the following data: (a) **Distance between the end projectors**, (b) **Distance of one or both the end points from HP and VP** and (c) **Apparent inclinations of the line.**

Rotating line method

The method of obtaining the top and front views of a line, when its true length and true inclinations are given.

When a view of a line is parallel to the XY line, its other view will be in true length and at true inclination.

By following the above procedure, in the reverse order, the true length and true inclinations of a line from the given set of top and front views can be found.



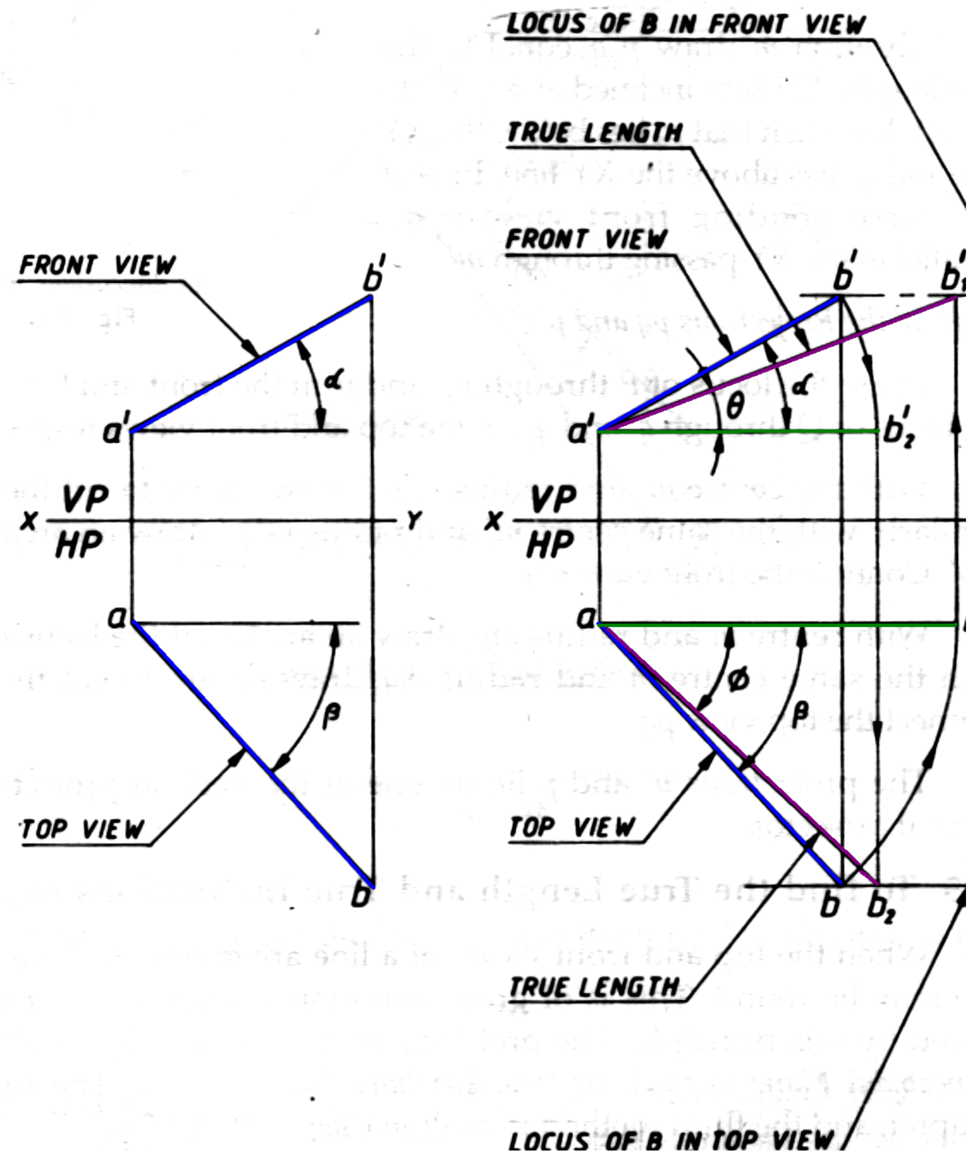
Step by Step Procedure

Top and front views

Draw the top view ab and the front view a'b' as given

2. Rotation of the top view

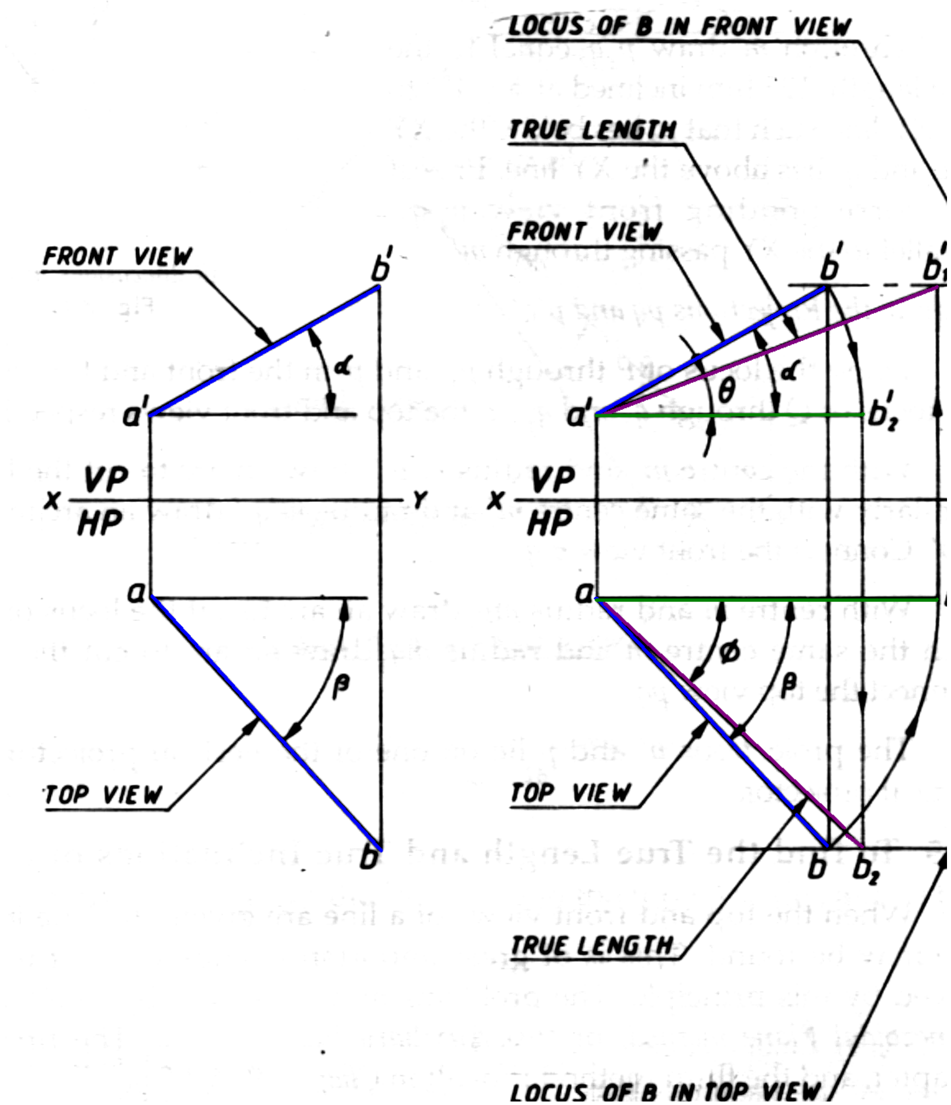
With center **a** and radius **ab** rotate the top view to the new position **ab_1** to make it parallel to the **XY line**. Since **ab_1** is parallel to the **XY** line, its corresponding front view will be in true length and at true inclination.



3. Rotation of the front view

Similarly, with center **a'** and radius **a'b'** rotate the front view to the new position **a'**$\mathbf{b_2}$**'** parallel to the **XY** line. Since **a'**$\mathbf{b_2}$**'** is parallel to the **XY** line, its corresponding top view will be in true length and at true inclination.

In this position, the line will be parallel to **HP** and inclined at ϕ to **VP**. Through **b** draw the locus of **B** in the top view. Project $\mathbf{b_2}$**'** to get $\mathbf{b_2}$**,** in the top view. Connect **a**$\mathbf{b}_2$ which will be in true length and true inclination ϕ which the given line **AB** makes with **VP.**



Traces of a line

The trace of a line is defined as a point at which the given line, if produced, meets or intersects a plane.

When a line meets HP, (or if necessary on the extended portion-of HP), the point at which the line meets or intersects the horizontal plane, is called horizontal trace (HT)of the line and denoted by the letter H.

When a line meets VP (or if necessary on the extended portion of VP), the point at which the line meets or intersects the vertical plane, is called vertical trace (VT) of the line and denoted by the letter V.

When the line is parallel to both HP and VP, there will be no traces on the said planes. Therefore the traces of lines are determined in the following positions of the lines.

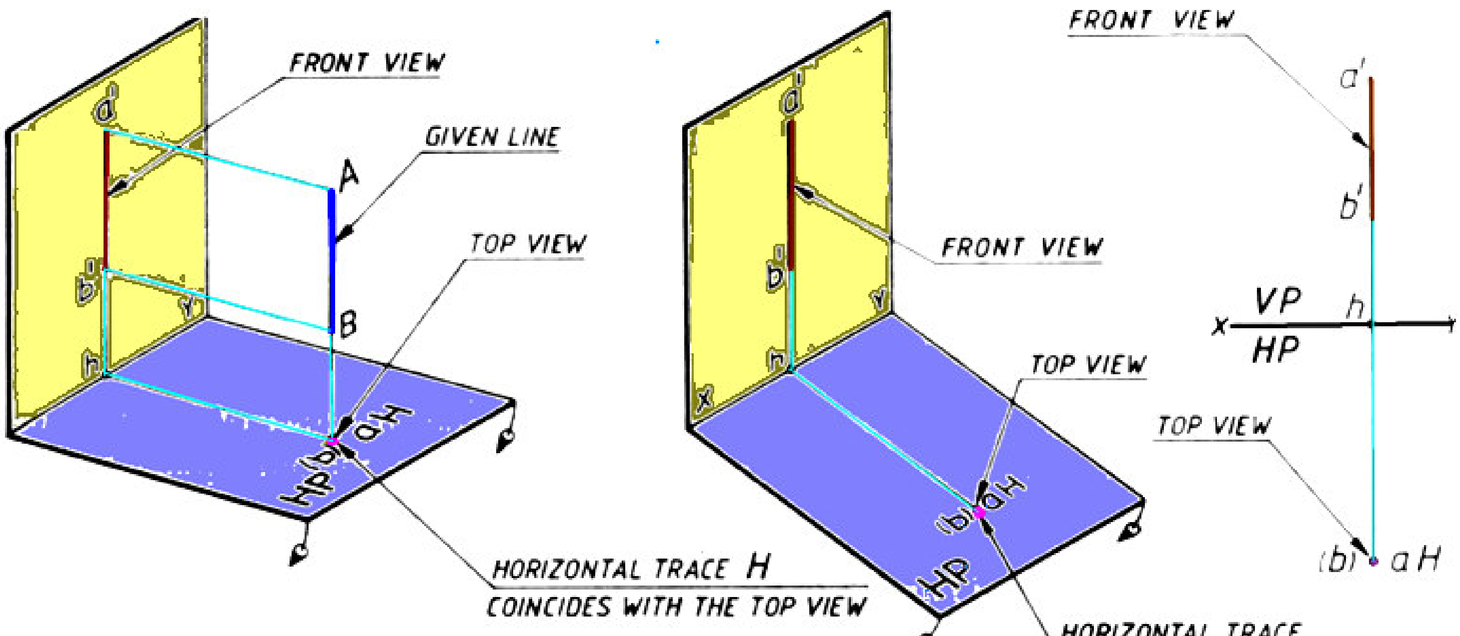
Lines perpendicular to one plane and parallel to the other.

Lines inclined to one plane and parallel to the other.

Lines inclined to both the planes.

Trace of a line perpendicular to one plane and parallel to the other

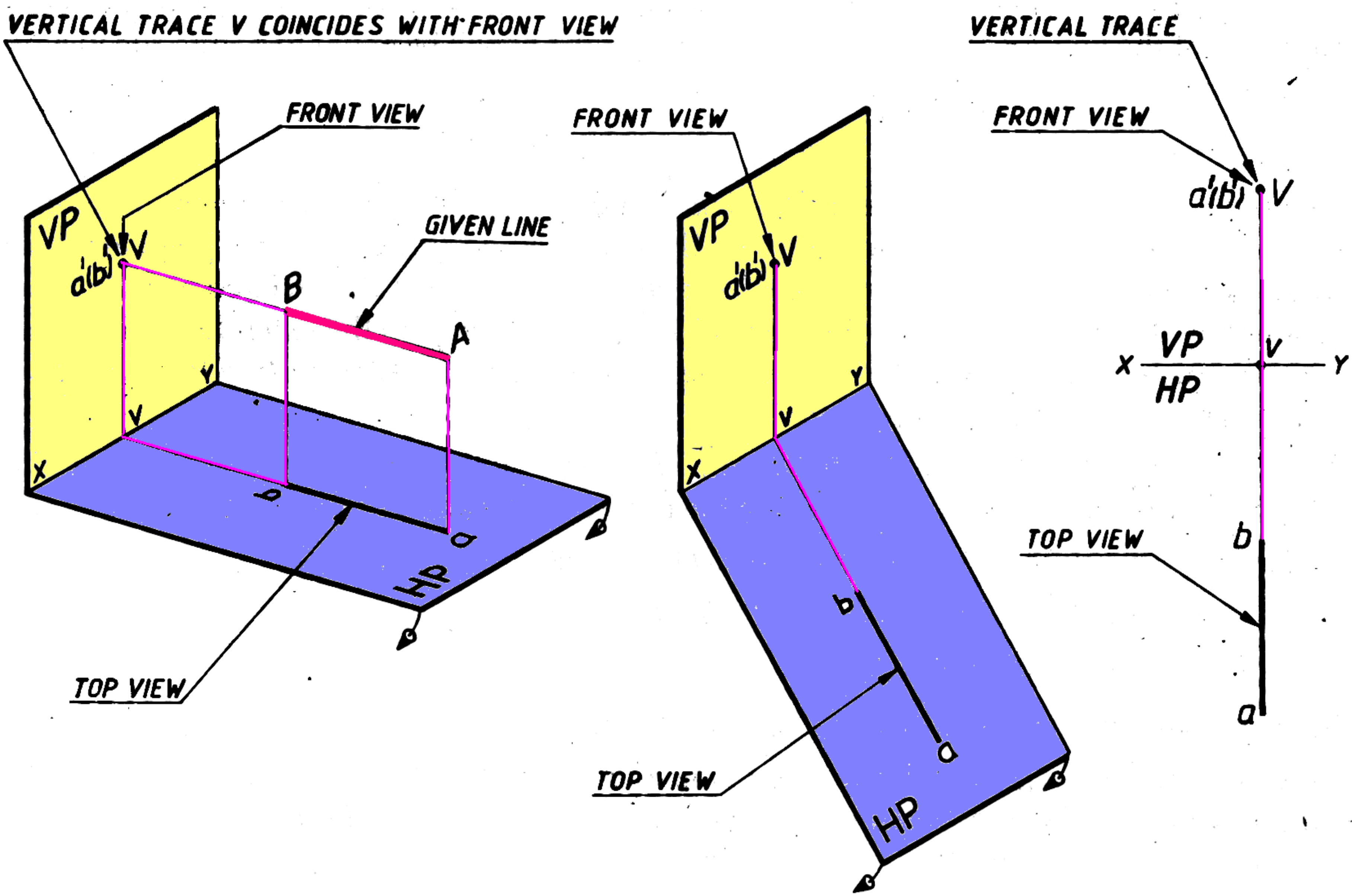
Since the line is perpendicular to one plane and parallel to the other, the trace of the line is obtained only on the plane to which it is perpendicular, and no trace of the line is obtained on the other plane to which it is parallel.



A

B

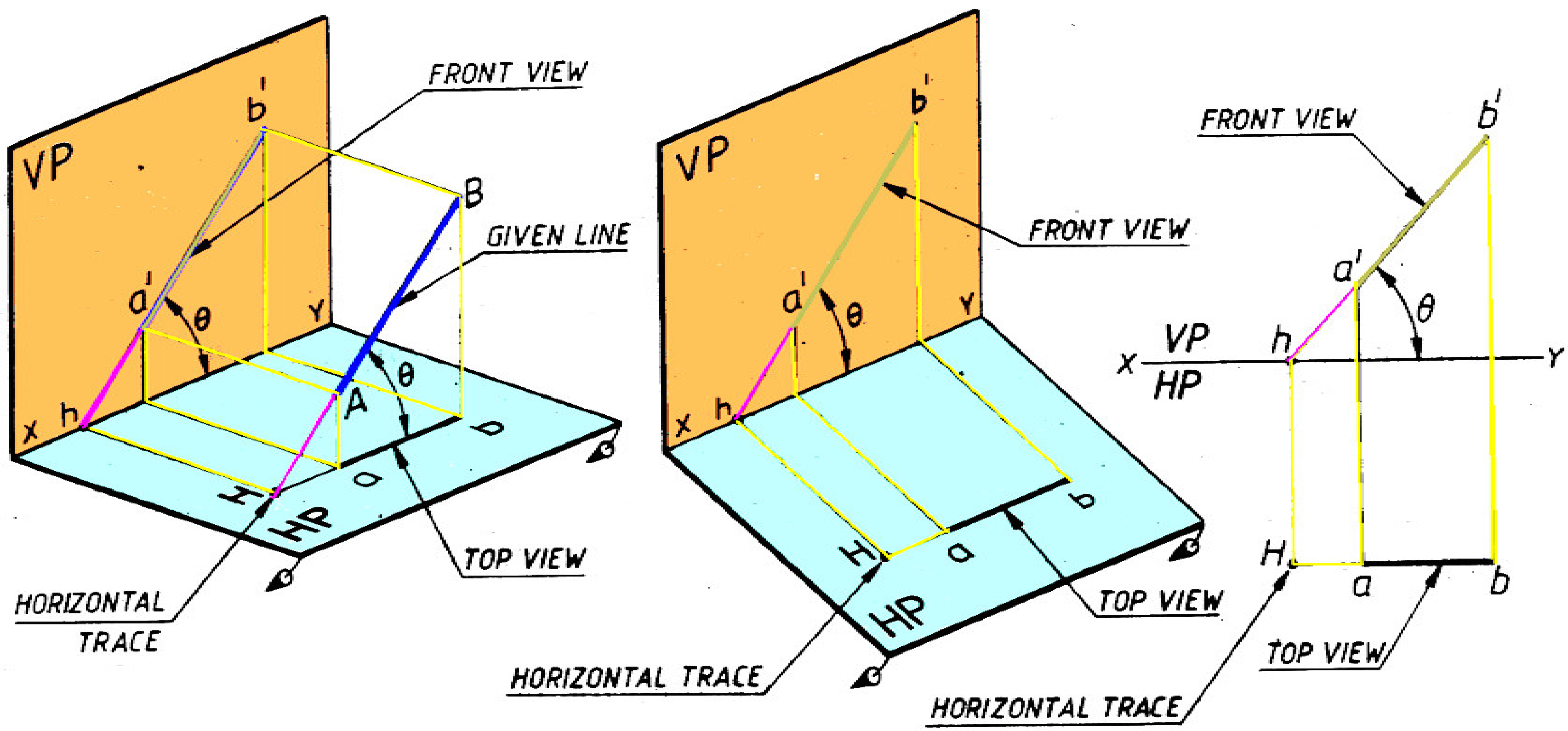
TRACE of the line perpendicular to the VP



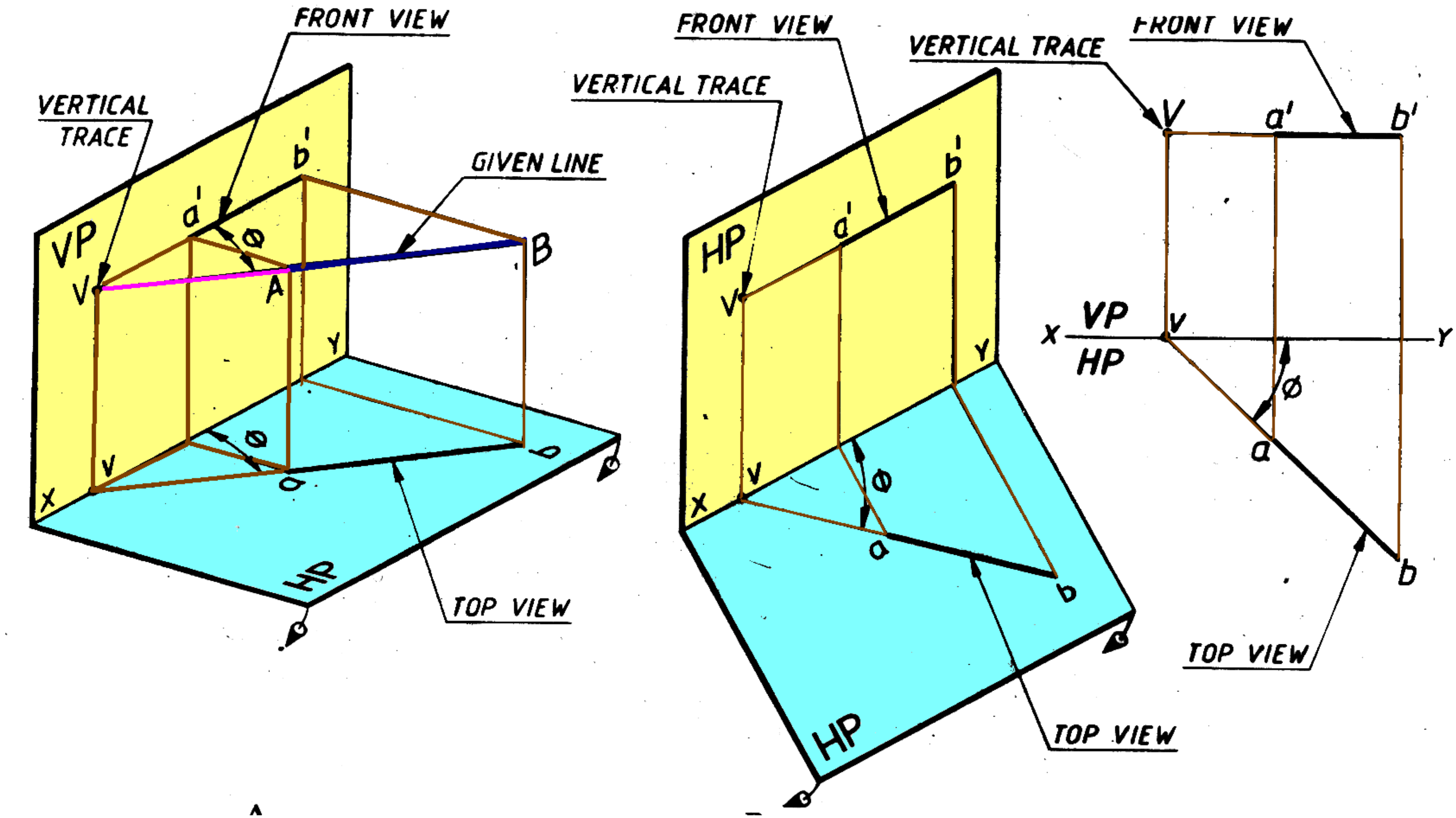
Traces of a line inclined to one plane and parallel to the other

When the line is inclined to one plane and parallel to the other, the trace of the line is obtained only on the plane to which it is inclined, and no trace is obtained on the plane to which it is parallel.

A. Line inclined at θ to **HP** and parallel to **VP**



Line inclined at ϕ to VP and parallel to HP

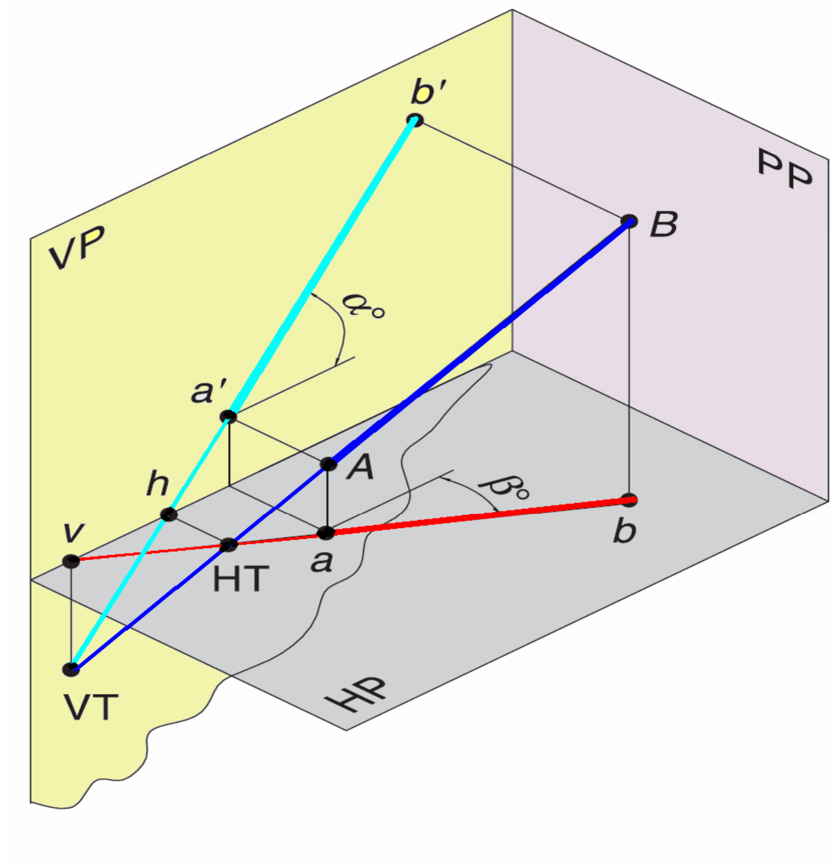


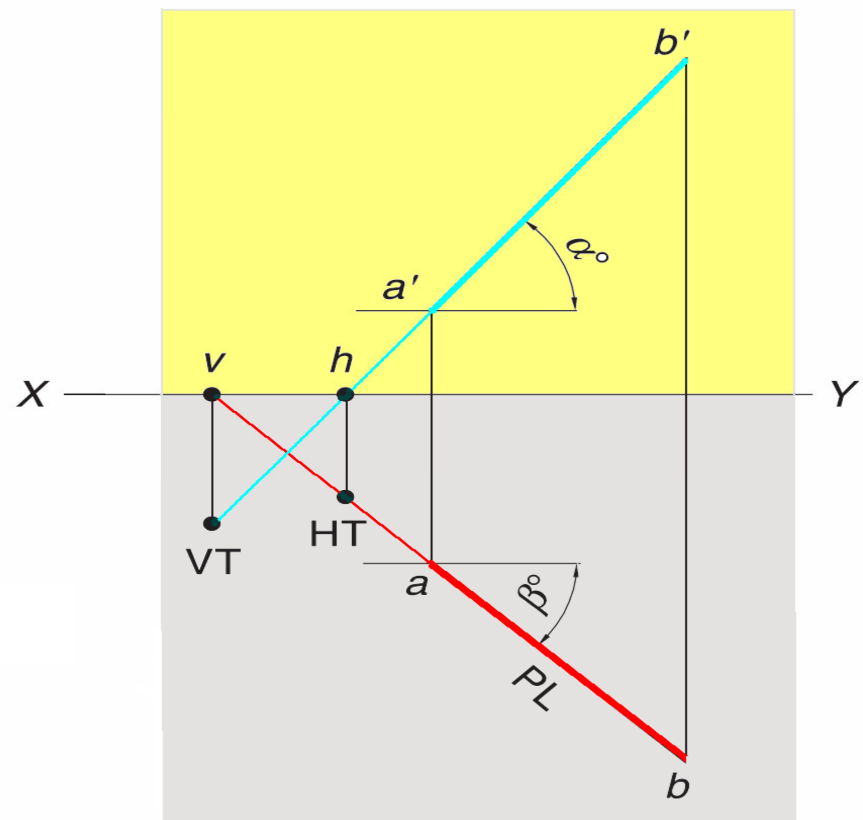
Traces of a line inclined to both the planes

Line inclined at θ to HP and φ to VP .

The line when extended intersects HP at H, the horizontal trace, but will never intersect the portion of VP above XY line, i.e. within the portion of the VP in the 1st quadrant. Therefore VP is extended below HP such that when the line AB is produced it will intersect in the extended portion of VP at V, the vertical trace.

In this case both HT and VT of the line AB lie below XY line.





Projection of Planes

Plane surface (plane/lamina/plate)

- A two dimensional surface having **length and breadth with negligible thickness**.
- Is formed when any three **non-collinear points** are joined.
- Is bounded by straight/curved lines and may be either a **regular figure** or an **irregular figure**.
- *Regular plane surface* - all the *sides are equal.*
- *Irregular plane surface - sides will be unequal.*

Positioning of a Plane surface

- **A plane surface may be positioned in space with reference to the three principal planes of projection in any of the following positions:**

  - *Parallel to one of the principal planes and perpendicular to the other two.*
  - *Perpendicular to one of the principal planes and inclined to the other two.*
  - *Inclined to all the three principal planes.*

Projections of a Plane surface

- A plane surface held *parallel* to a *plane of projection* - it will be *perpendicular* to the other two planes of projection.
    - The *view* of the plane surface projected on the plane of projection to which it will be perpendicular will be a *line*, called the *line view* of a plane surface.
    - *When a plane surface is held with its surface parallel to one of the planes of projection, the view of the plane surface projected on it will be in true shape because all the sides or the edges of the plane surface will be parallel to the plane of projection on which the plane surface is projected.*
- *A plane surface inclined to a plane of projection - the view of the plane surface projected on it will be in apparent shape, called apparent shape view of the plane surface.*

TERMS USED IN PROJECTIONS OF PLANES

- **True Shape** The actual shape of a plane is called its ***true shape***.
- **Inclination with the HP:** It is the acute angle the plane makes with the HP.
- **Inclination with the VP** It is the acute angle the plane makes with the VP.
- **Traces of the Plane** The traces of a plane are the lines of intersections of the plane with the RPs.
- A plane may have a horizontal trace or vertical trace or both.
- **Horizontal Trace (HT)** The real or imaginary line of intersection of a plane with the HP is called ***horizontal trace*** of the plane. HT is always located in the TV.
- **Vertical Trace (VT)** The real or imaginary line of intersection of a plane with the VP is called ***vertical trace*** of the plane. VT is always located in the FV.
- **Line View or Edge View** The view of a plane seen as a line is called ***line view*** or ***edge view*** of the plane. One view of a perpendicular plane is always an edge view.

A: Plane surface parallel to one plane and perpendicular to the other two

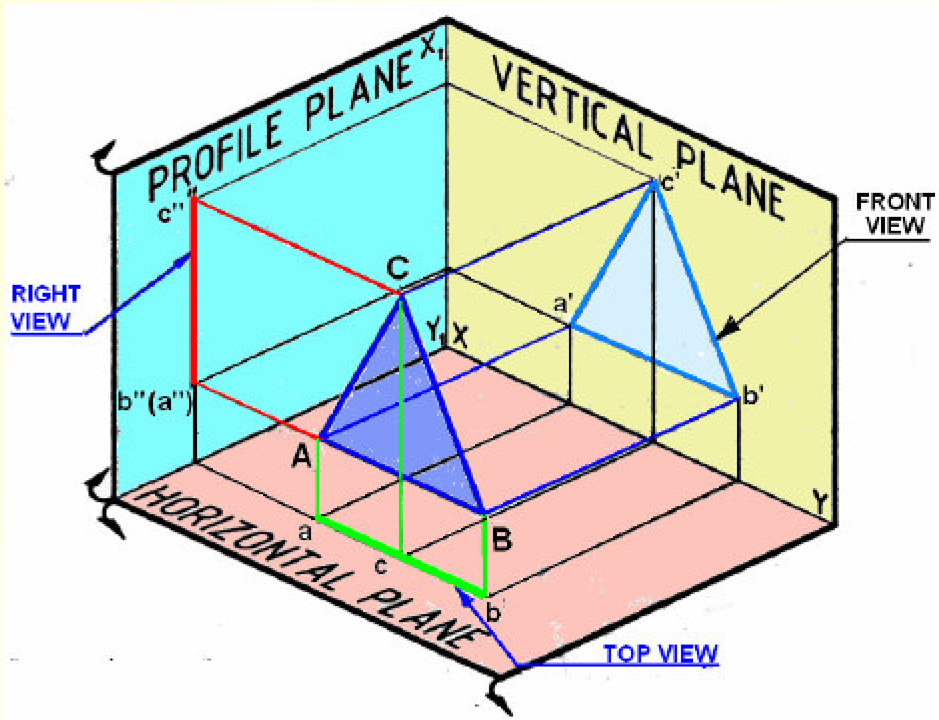
Plane parallel to VP and perpendicular to both HP and PP

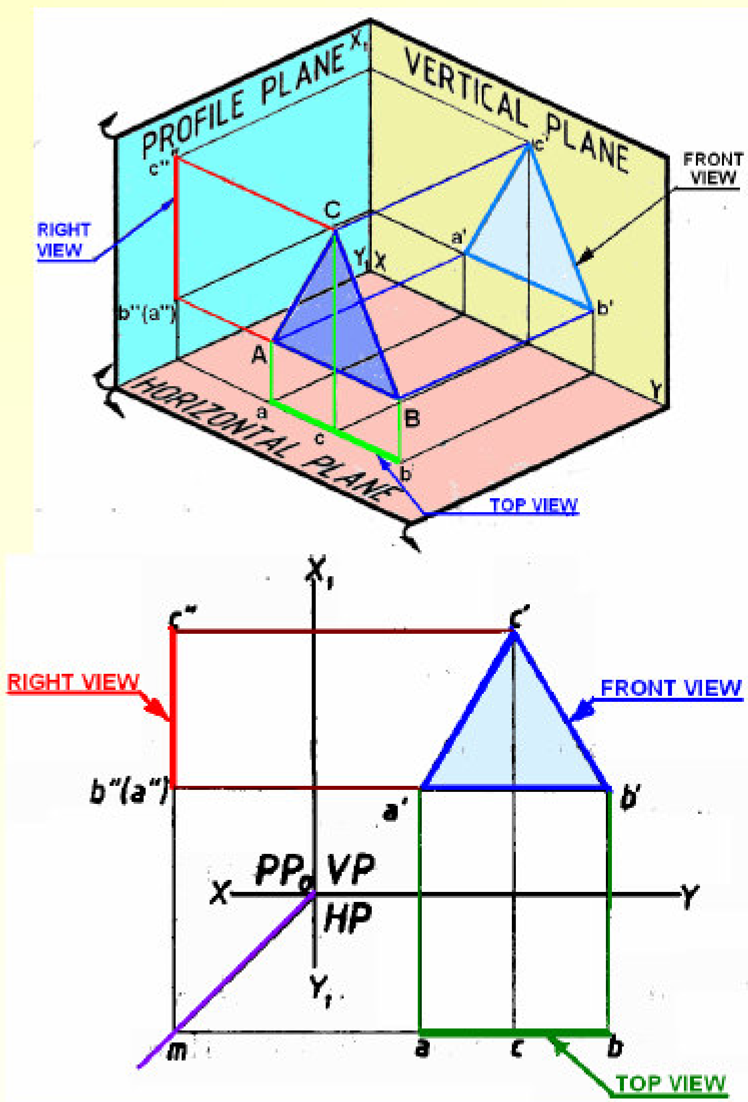
A triangular lamina (plane surface) placed in the first quadrant - its surface is parallel to VP and perpendicular to both HP and left PP.

a'b'c' **- front view,** ***abc*** **– top view and** ***a"b"c"*** **– side view**

Front view - ***a'b'c'*** **- in true shape – plane is** ***parallel to VP***

Top and side views - projected as lines – plane is perpendicular to ***HP*** **and** ***PP***





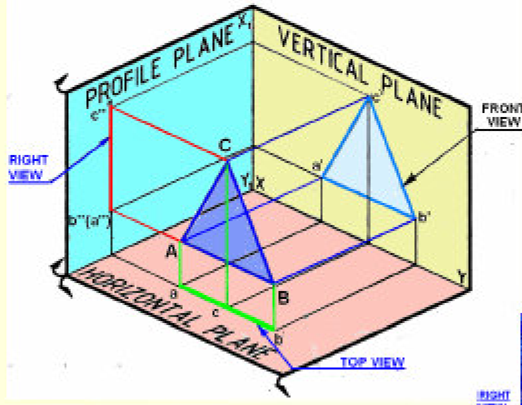
After projecting the triangular lamina on VP, HP and PP, both HP and PP are rotated about XY and X_1Y_1 lines till they lie in-plane with that of VP.

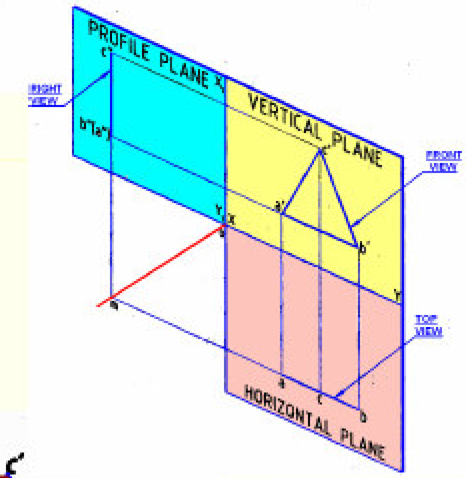
Orthographic projections

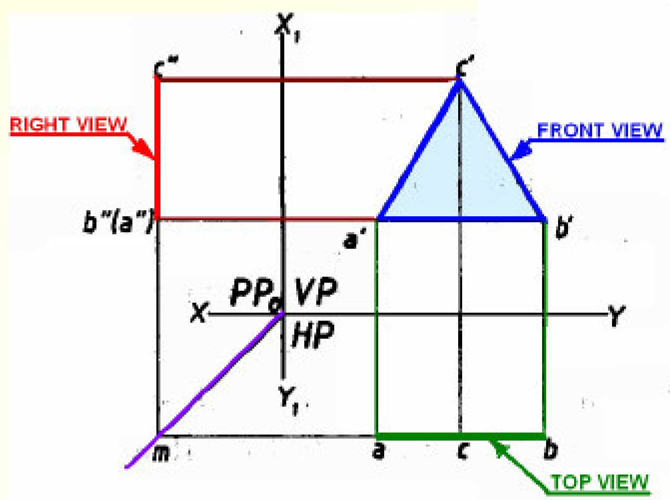
Draw XY and X_1Y_1 lines and mark *HP, VP* and left *PP*.

Draw the triangle *a'b'c'* in true shape to represent the front view at any convenient distance above the XY line.

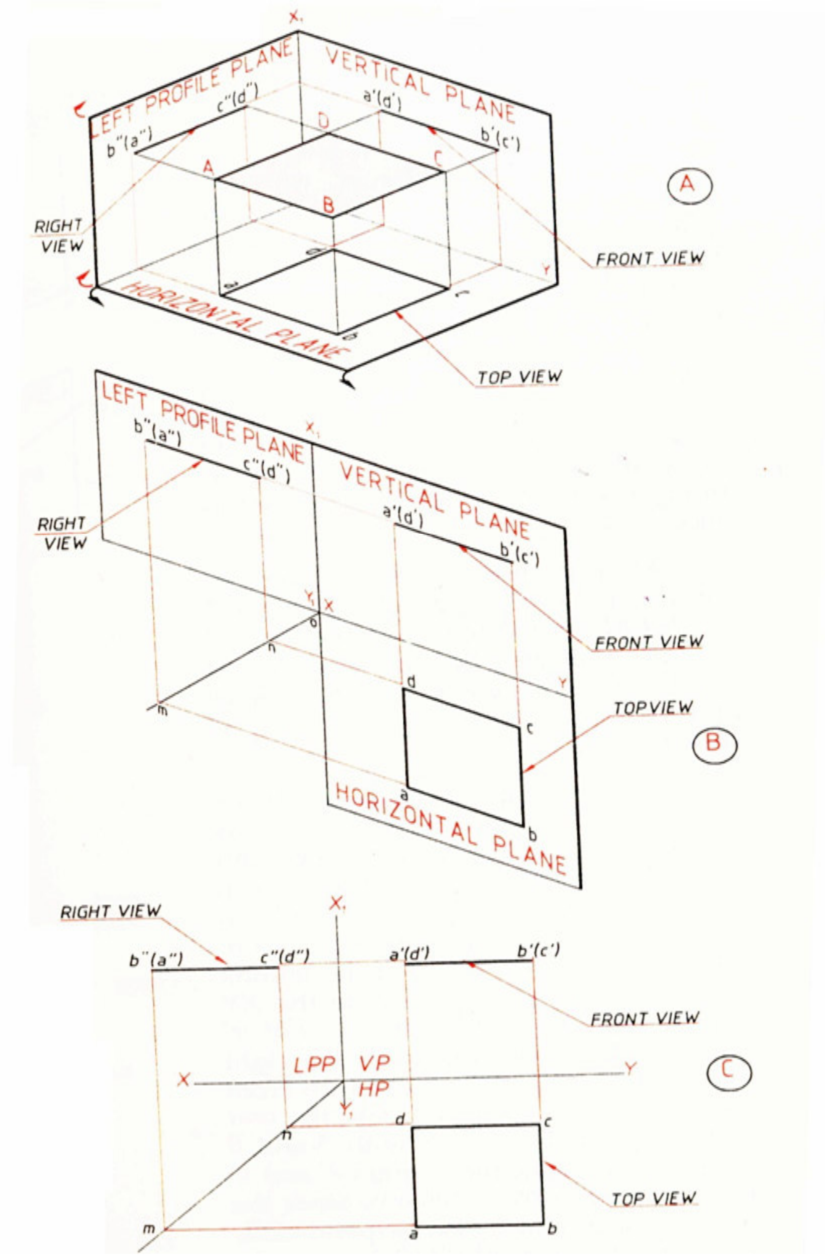
In the top view the triangular lamina appears as a line parallel to the XY line. Obtain the top view *acb* as a line by projecting from the front view at any convenient distance below the XY line.







2. Plane parallel to HP and perpendicular to both VP and PP



A square lamina (plane surface) placed in the first quadrant - its surface is parallel to HP and perpendicular to both VP and left PP.

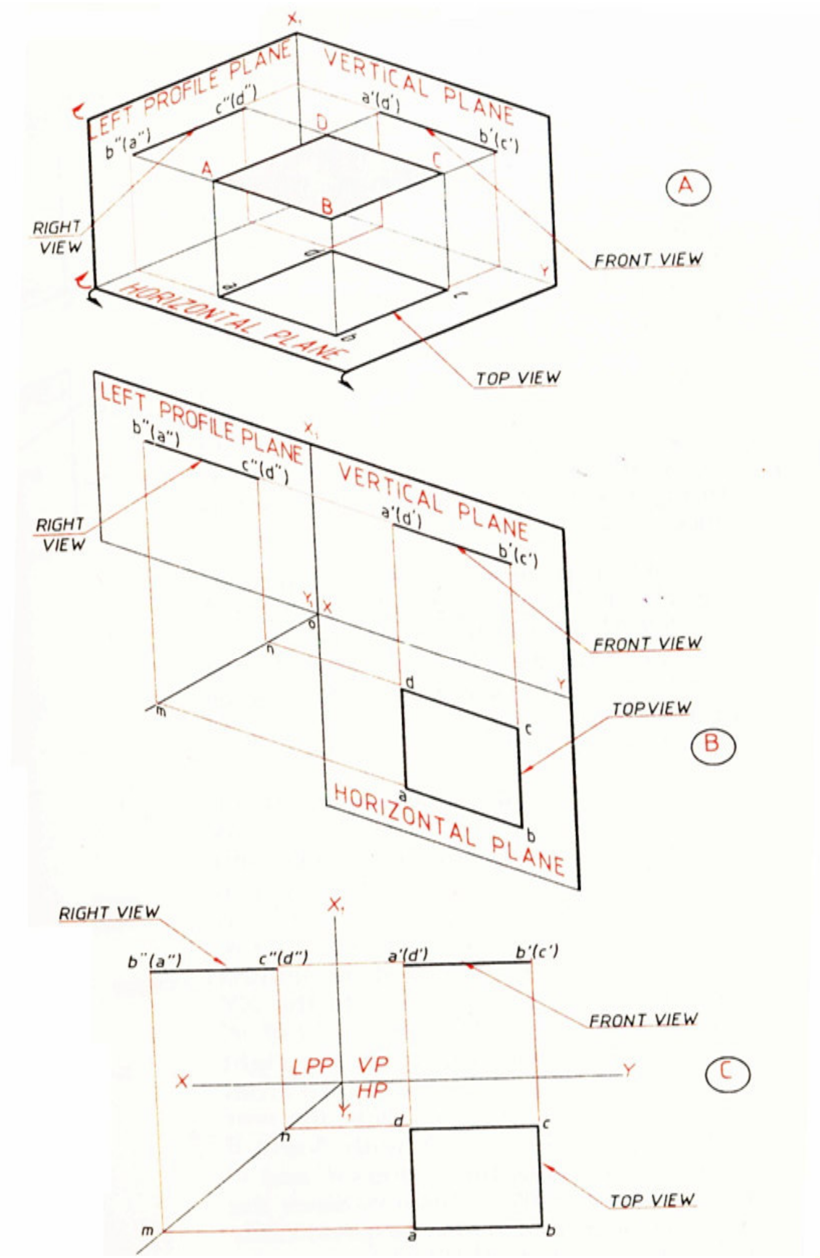
abcd – top view,

a'(d')b'(c') - front view, and

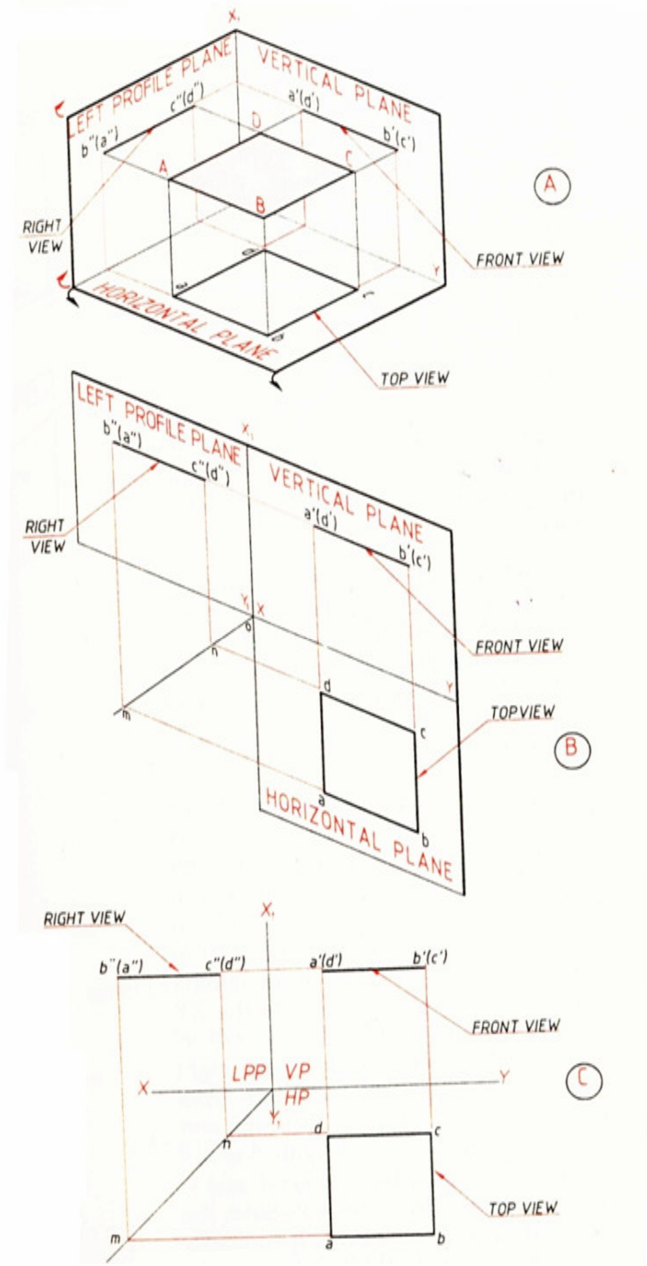
b''(a'')c''(d'') – side view

Top view – abcd - in true shape – plane is parallel to HP

Front and side views - projected as lines – plane is perpendicular to VP and PP



After projecting the square lamina on VP, HP and PP, both HP and PP are rotated about XY and X_1Y_1 lines till they lie in-plane with that of VP.



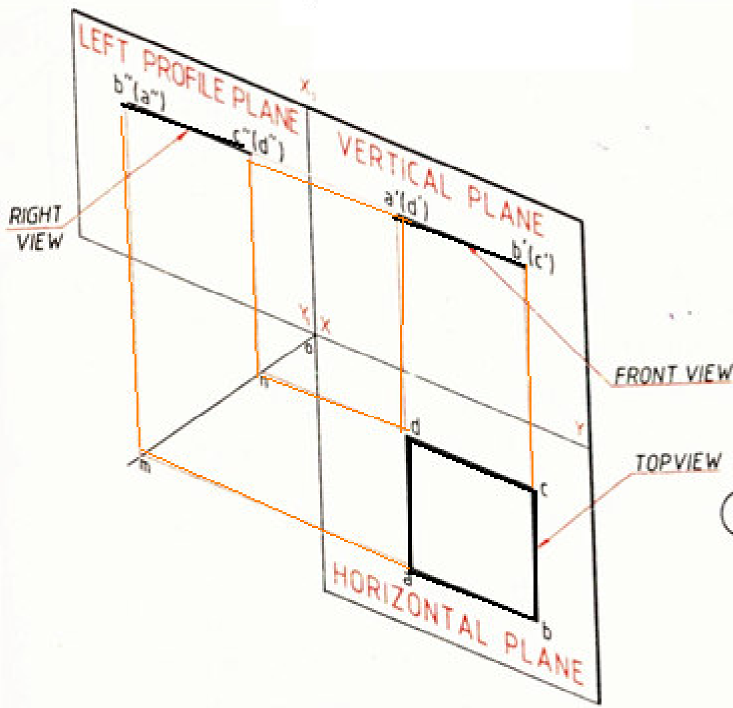
Orthographic projections

Draw **XY** and **X_1Y_1** lines and mark ***HP, VP*** and left ***PP*** .

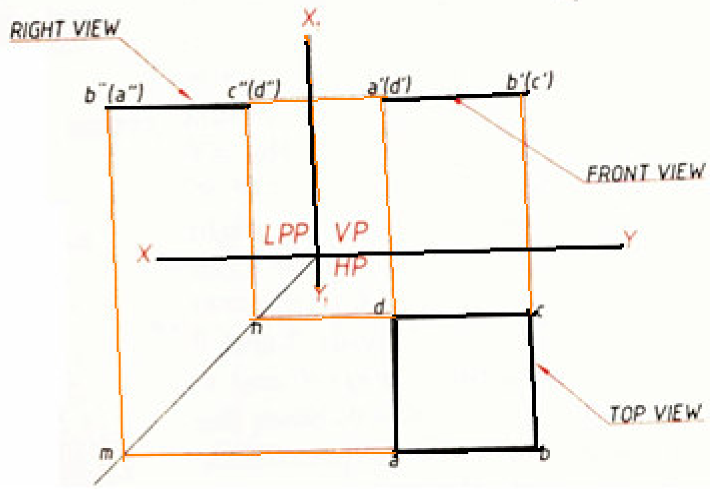
Draw the square **abcd** in true shape to represent the top view at any convenient distance below the **XY** line.

In the front view, the square lamina appears as a *line parallel* to the **XY** line. Obtain the front view as a line *a'(d')b'(c') by* projecting from the top view, parallel to the **XY** line at any convenient distance above it.

In the front view, the rear corners **D** and **C** coincide with the front corners **A** and **B**, hence **d'** and **c'** are indicated within brackets.



B



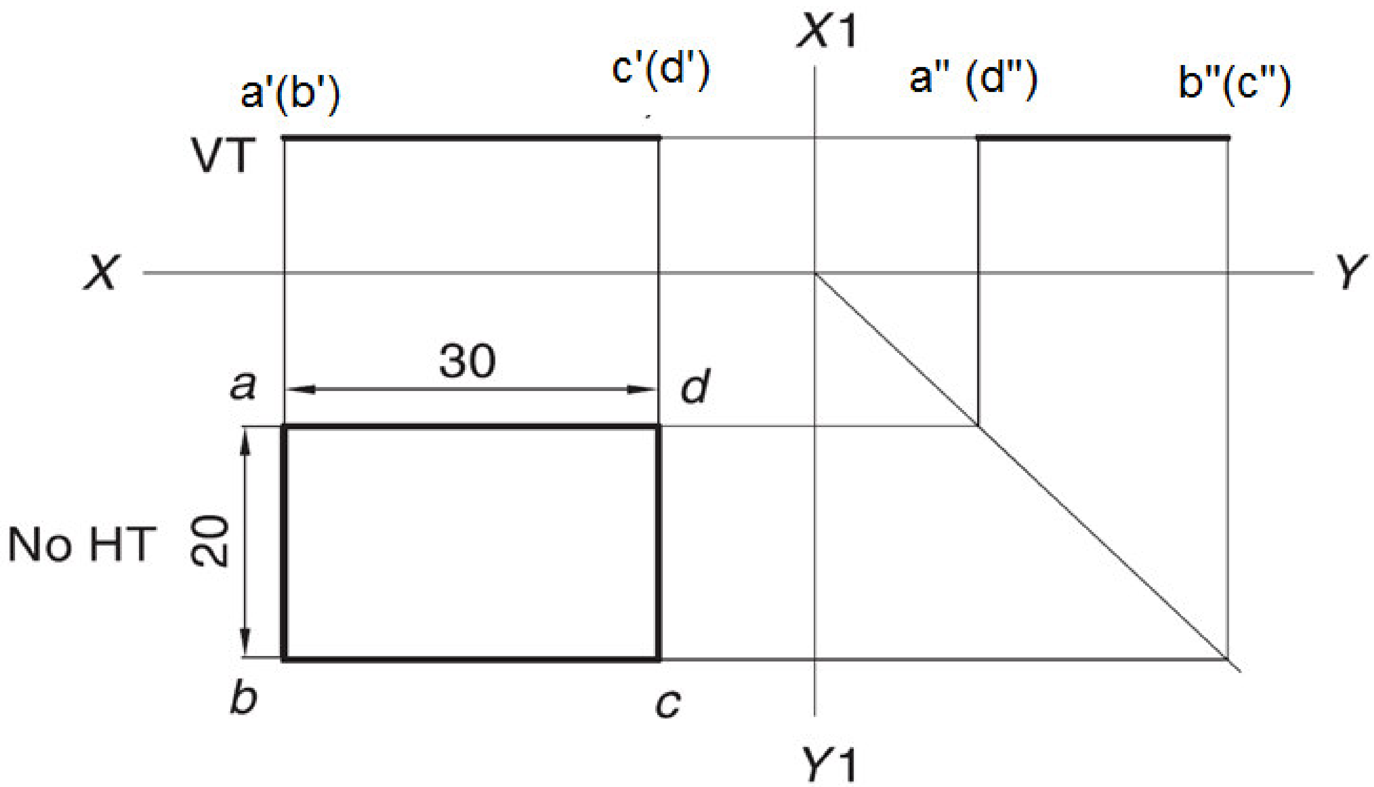
C

Since the square lamina is also perpendicular to left *PP,* the right view projected on it will also be a *line* perpendicular to X_1Y_1 line.

Project the right view as explained in the previous case. In right view, the corners A and D coincide with the corners B and C respectively, hence *(a')* and (d'), are indicated within brackets.

Example.1

A rectangle ABCD of size 30 mm x 20mm is parallel to the HP and has a shorter side AB perpendicular to the VP. Draw its projections




Have a blessed Day