ENGINEERING GRAPHICS (BITS F110)

BITS Pilani
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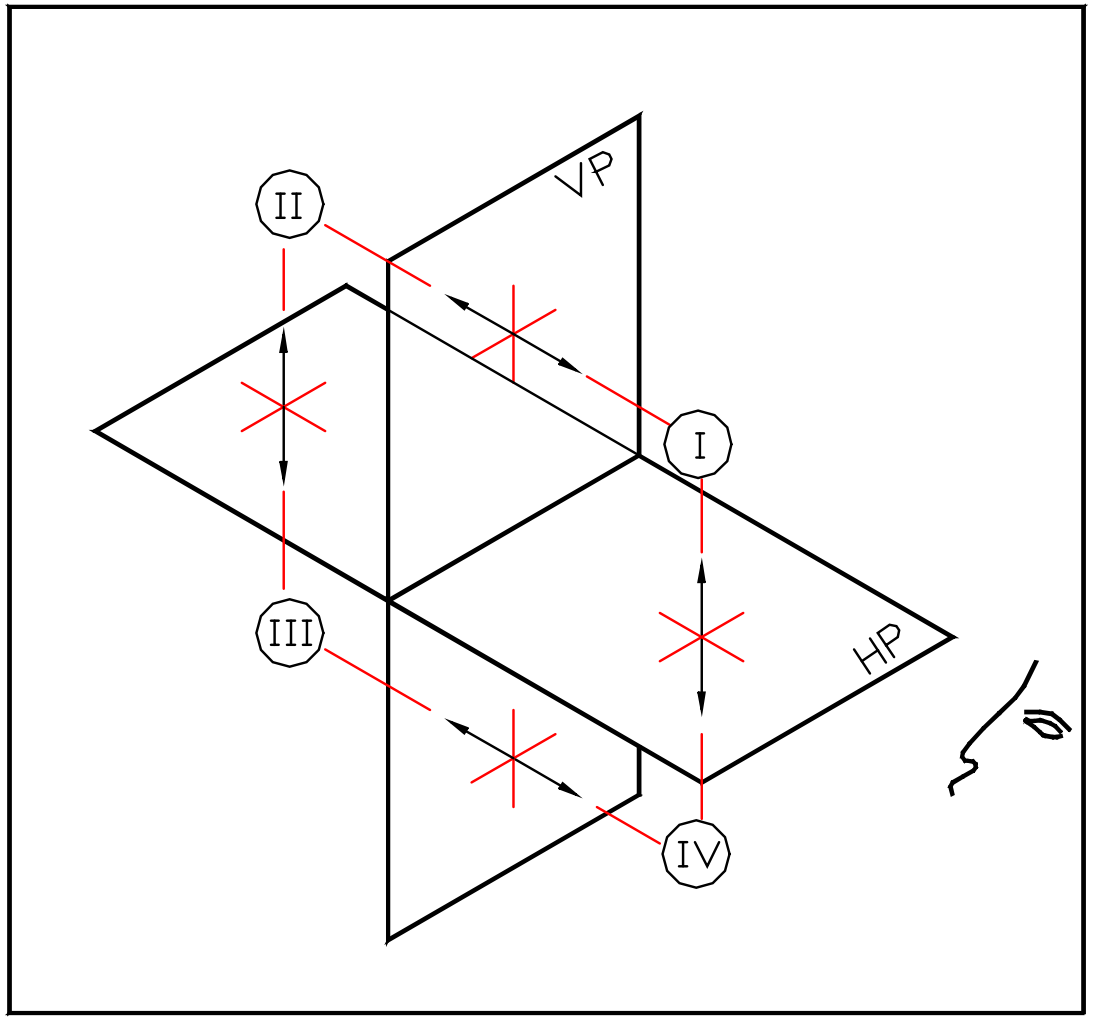
CHAPTER- 9
PROJECTIONS OF STRAIGHT LINES

Learning Objectives

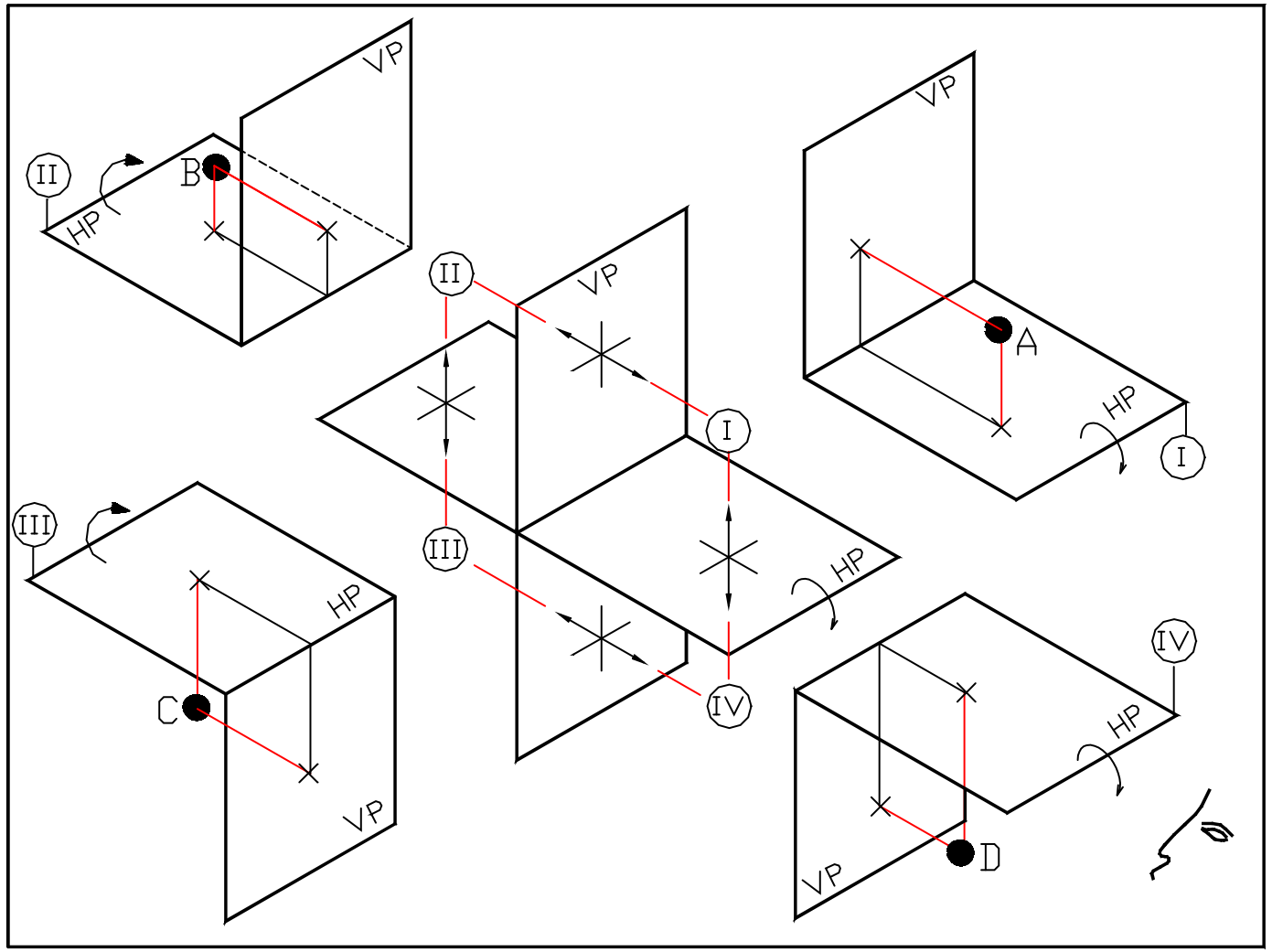
- Learn the description of quadrant on a plane paper
- Learn the projection of point
- Learn the projection of straight lines in a 3-D space
- Learn the projection of intersection of planes and straight lines

Object in Four Quadrant

- Above HP and in-front of VP, if it is in I-quadrant.
- Above HP and behind VP, if it is in II-quadrant.
- Below HP and behind VP, if it is in III-quadrant.
- Below HP and in front of VP, if it is in IV-quadrant.

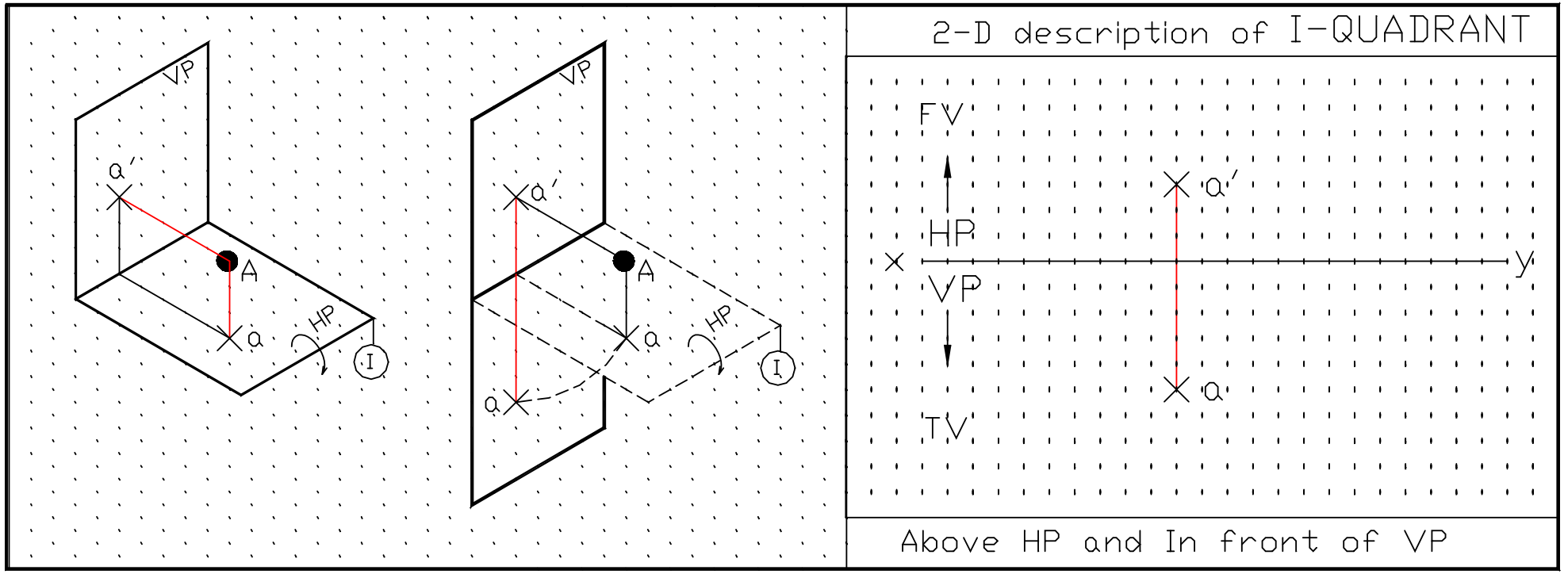


Projection of Point in I, II, III and IV Quadrant



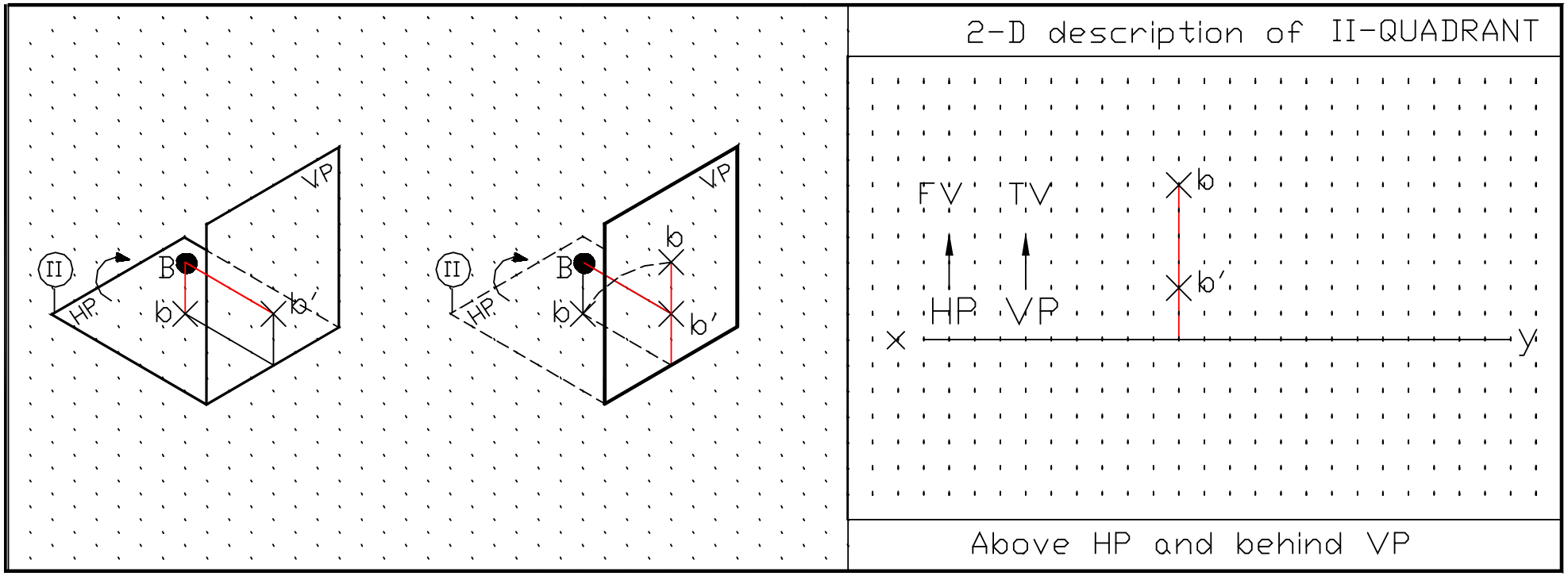
Case-1: Point *A* is in I Quadrant

Point '*A*' is located 75 mm above HP and 125 mm in front of VP. It's TV (a) appears on HP and FV (a') appears on VP. Orthographic view shows FV above x-y line and TV below x-y line after the rotation of HP through 90º.



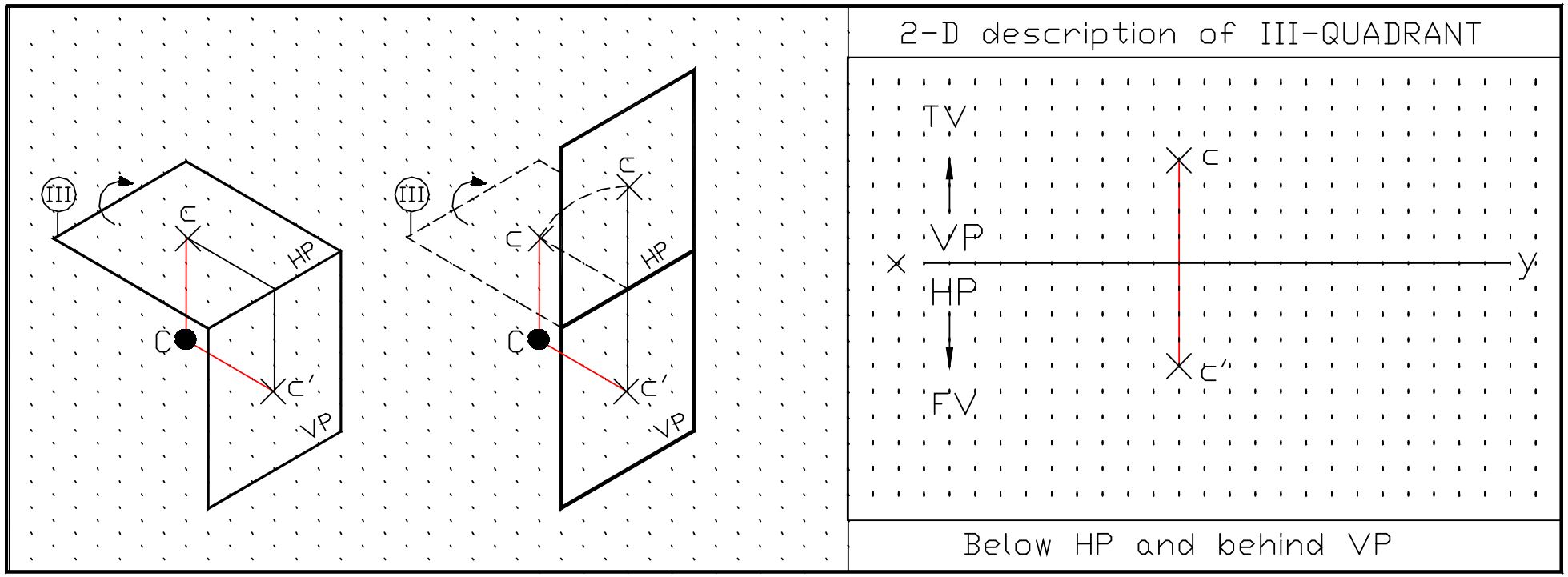
Case-2: Point *B* is in II Quadrant

Point '*B*' is located 50 mm above HP and 150 mm behind VP. It's TV (b) appears on HP and FV (b') appears on VP. Orthographic view shows FV as well as TV are above x-y line after the rotation of HP through 90º.



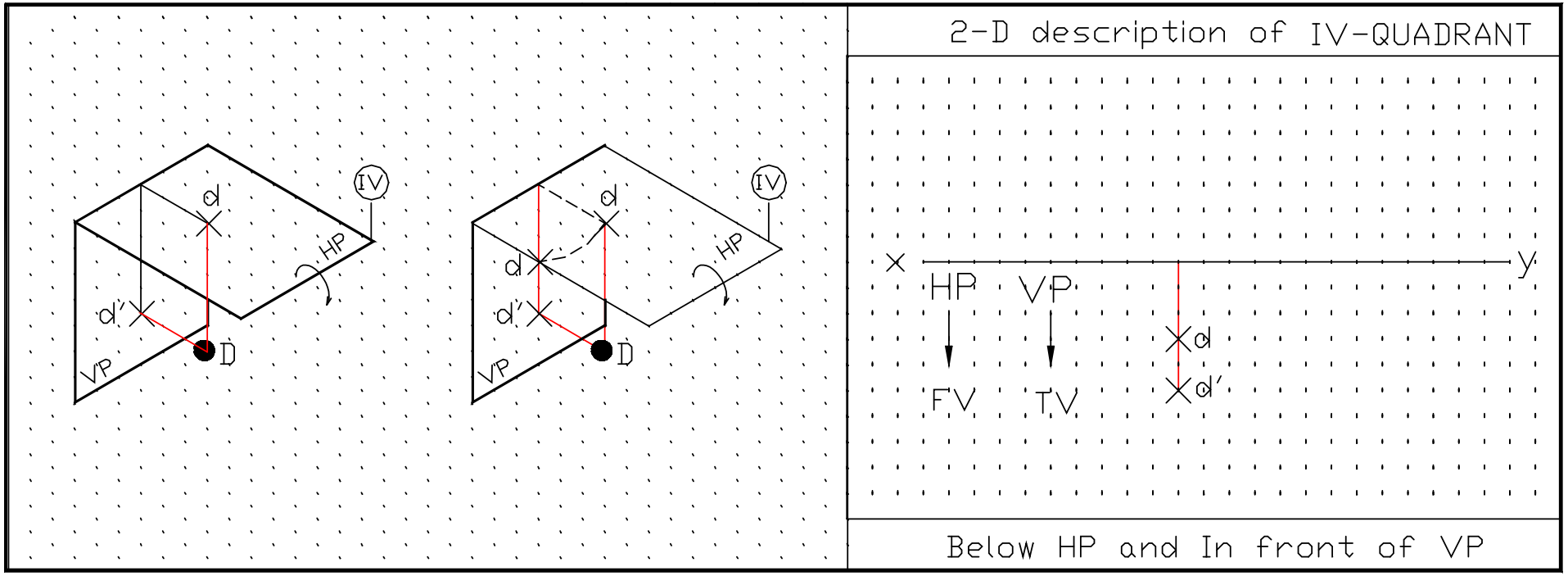
Case-3: Point *C* is in III Quadrant

Point '*C*' is located 100 mm below HP and 100 mm behind VP. It's TV (c) appears on HP and FV (c') appears on VP. Orthographic view shows TV above x-y line and FV below x-y line after the rotation of HP through 90º.

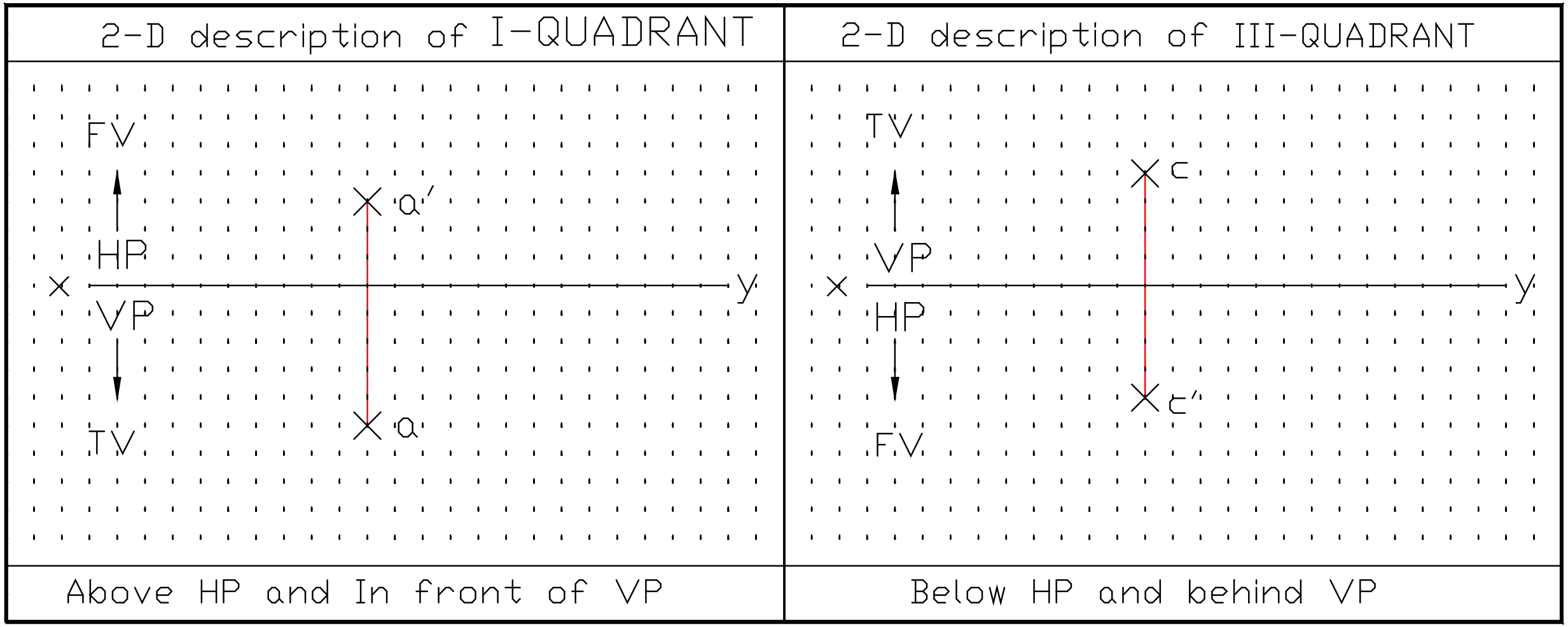


Case-4: Point *D* is in IV Quadrant

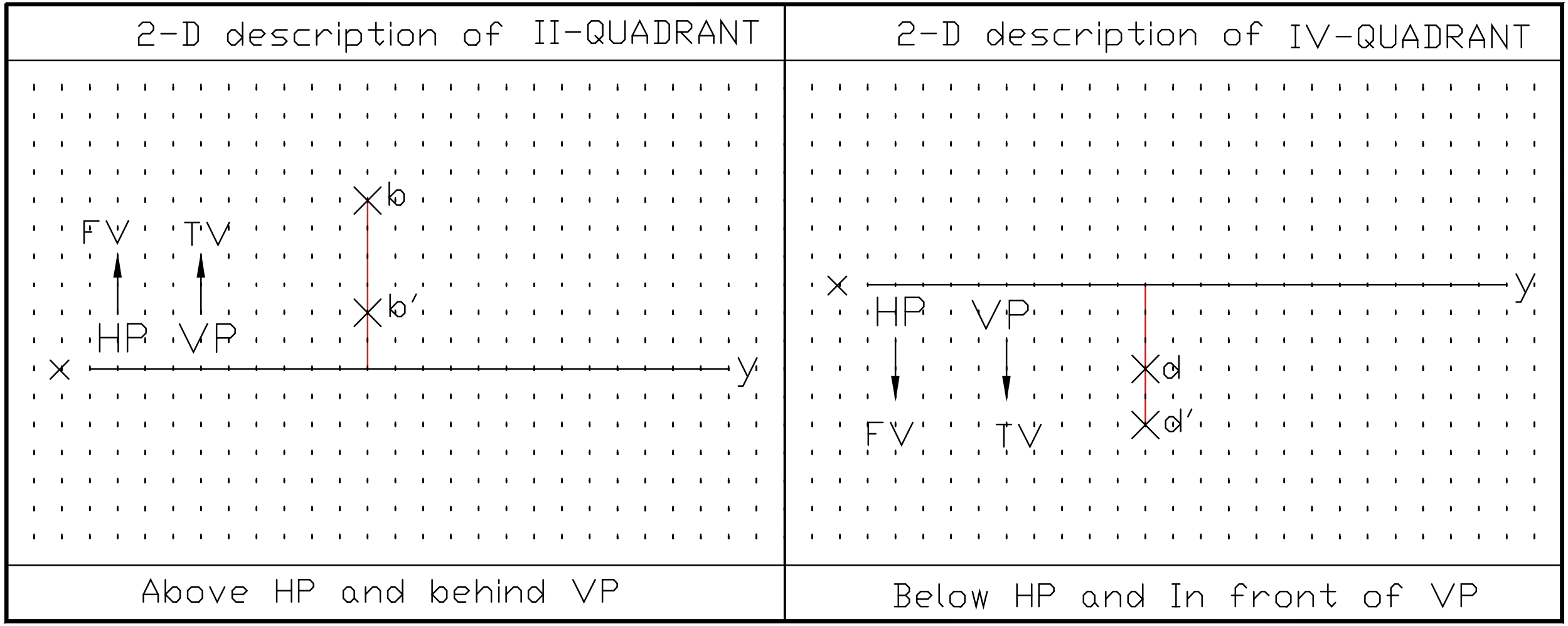
Point '*D*' is located 125 mm below HP and 75 mm in front of VP. It's TV (d) appears on HP and FV (d') appears on VP. Orthographic view shows FV as well as TV are below x-y line after the rotation of HP through 90º.



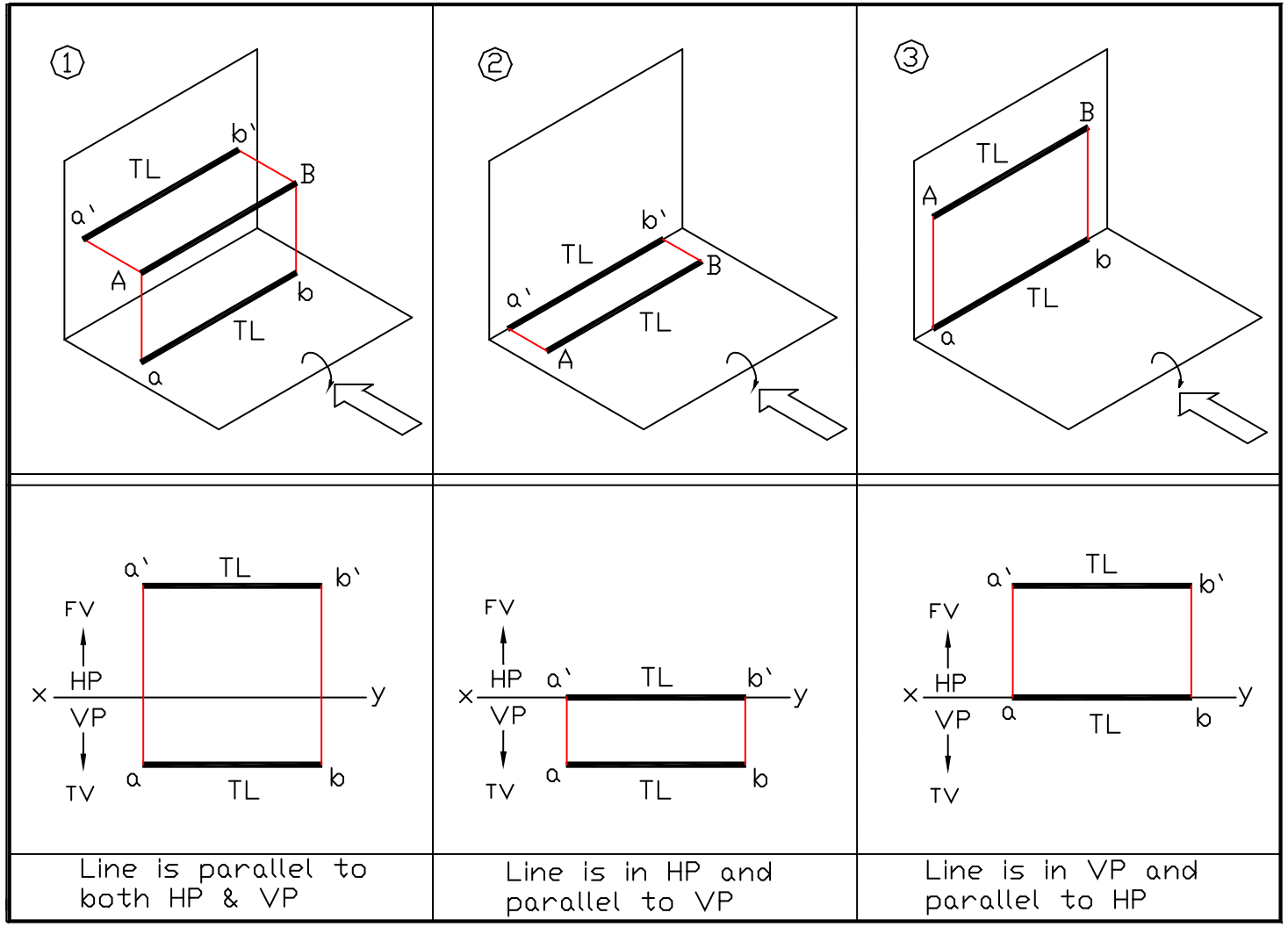
Comparison of I and III Quadrant



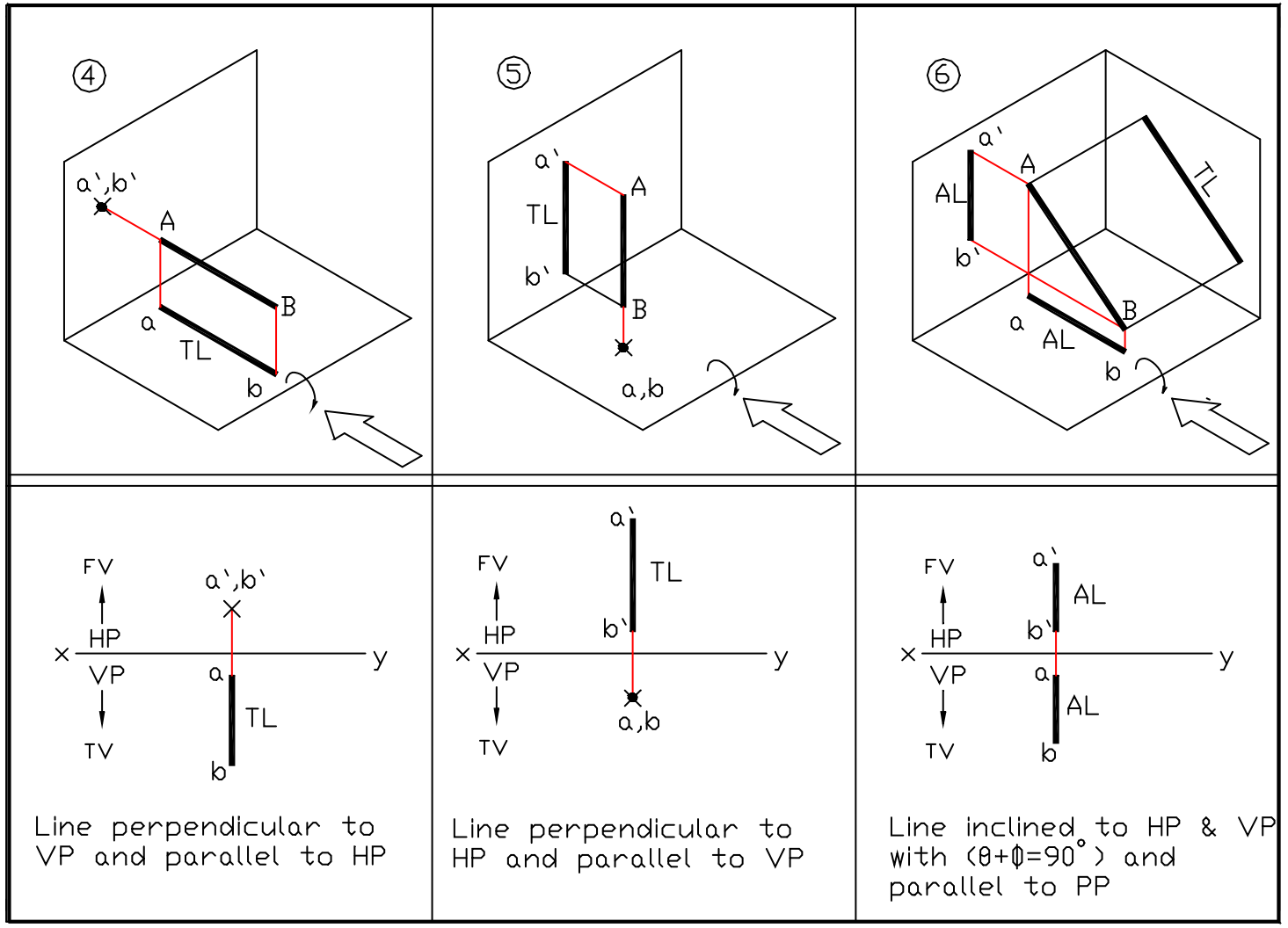
Comparison of II and IV Quadrant



Various Positions of Straight Lines *wrt* Principal Planes



Various Positions of Straight Lines *wrt* Principal Planes

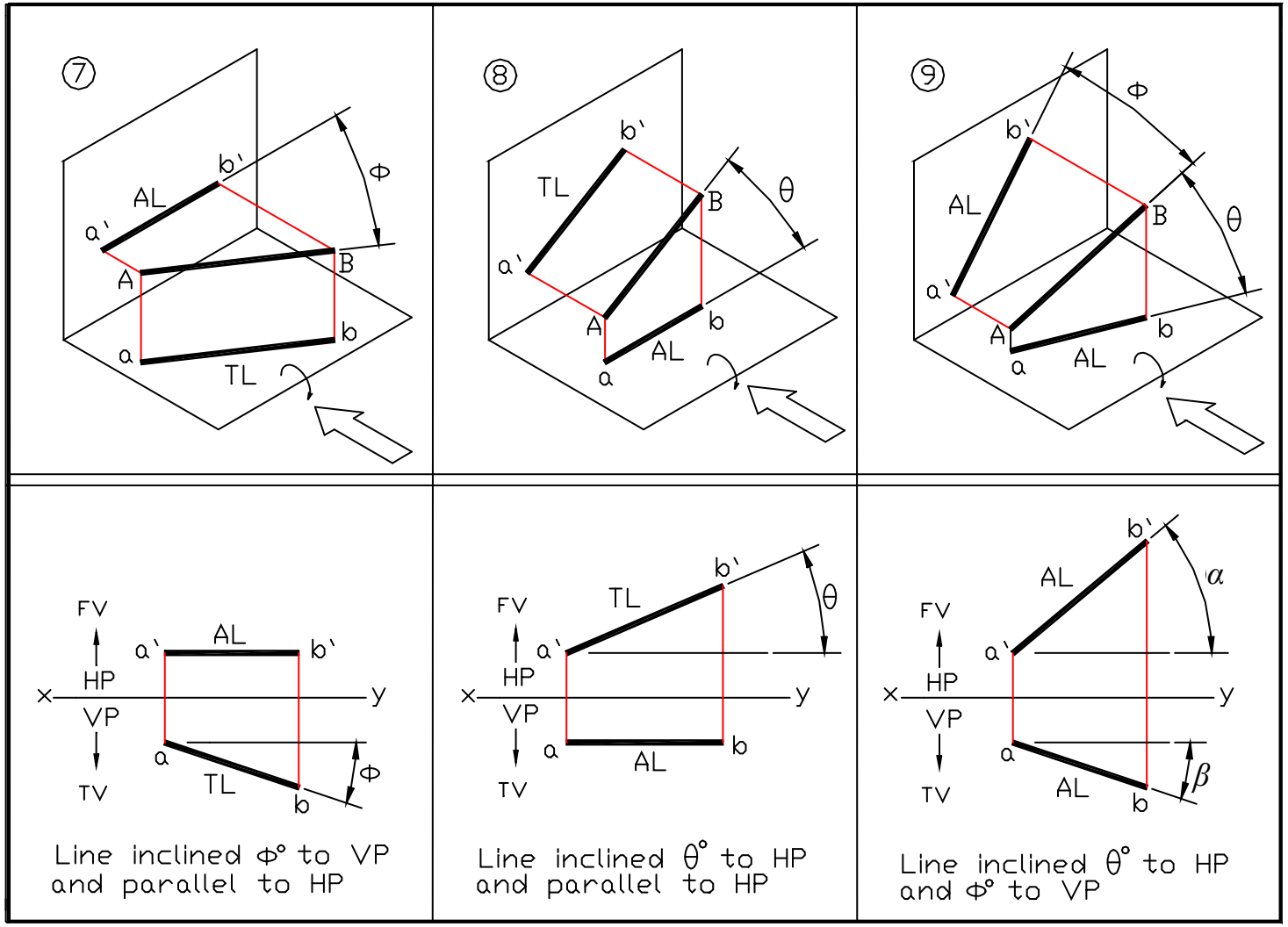


Line perpendicular to VP and parallel to HP

Line perpendicular to HP and parallel to VP

Line inclined to HP & VP with ($\theta+\phi=90^\circ$) and parallel to PP

Various Positions of Straight Lines *wrt* Principal Planes



Notations for Straight Line Problems

TL	True length
AL	Apparent length
TI	True inclination
AI	Apparent inclination

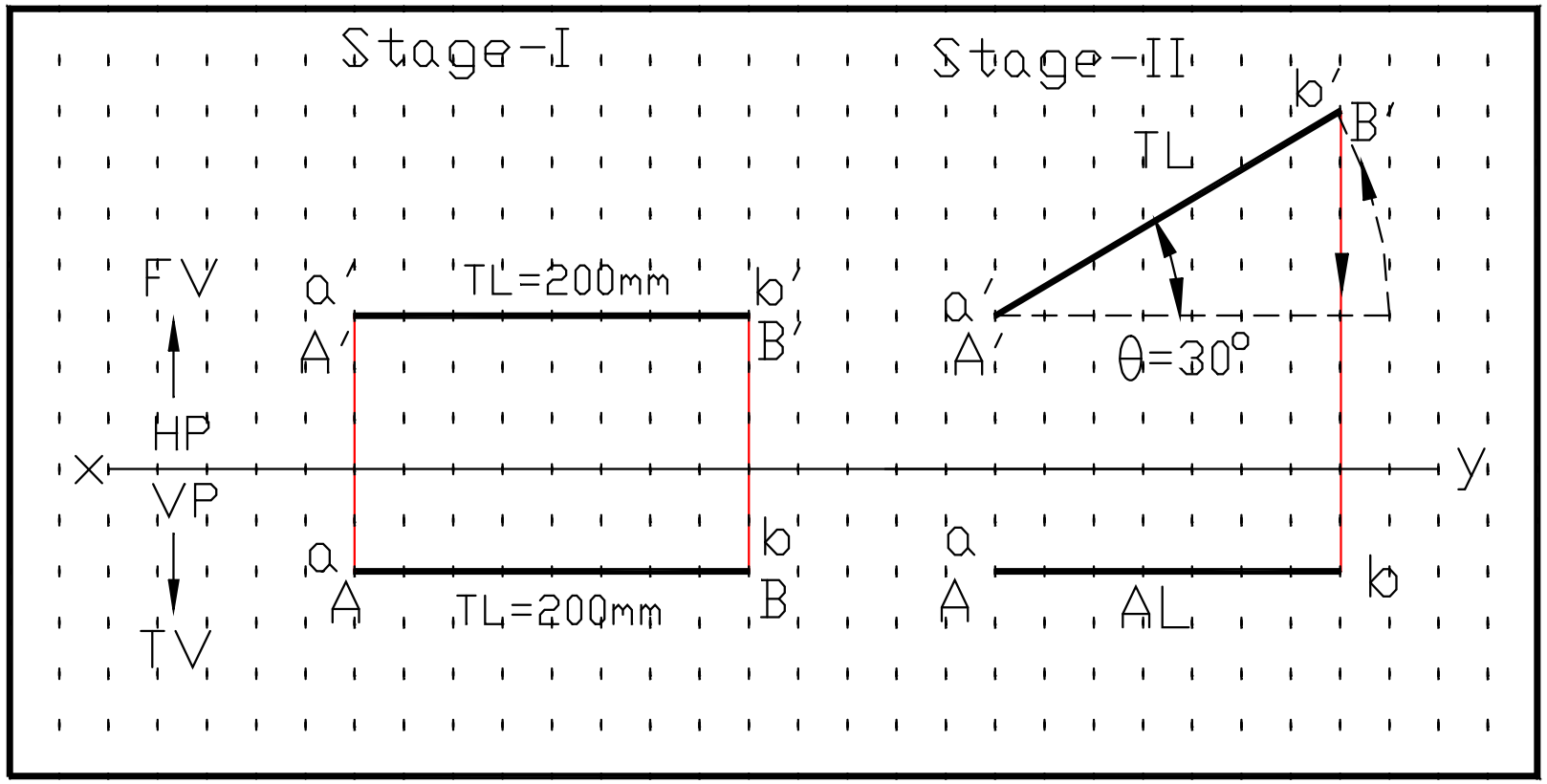
Lengths	**TL**	**AL**
TV	*AB*	*ab*
FV	*A'B'*	*a'b'*

Angles	**TI**	**AI**
HP	θ	α
VP	ϕ	β

Inclined Line

(Line inclined to one plane and parallel to other plane)

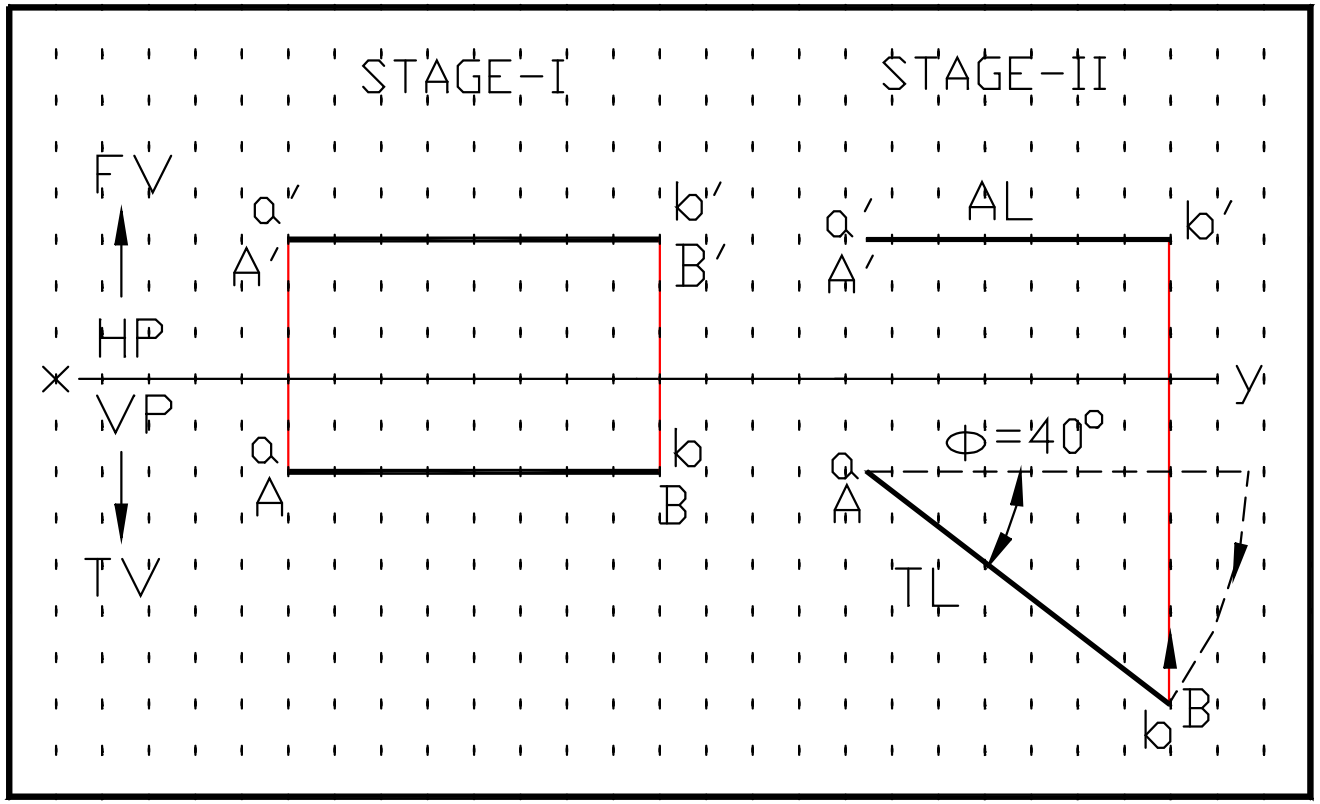
Line *AB* 200 mm long has its end *A* 75 mm above HP and 50 mm in front of VP. End point B is in I quadrant. The line is parallel to VP and makes an inclination of 30º to HP. Draw projections of the straight line *AB*.



Inclined Line

(Line inclined to one plane and parallel to other plane)

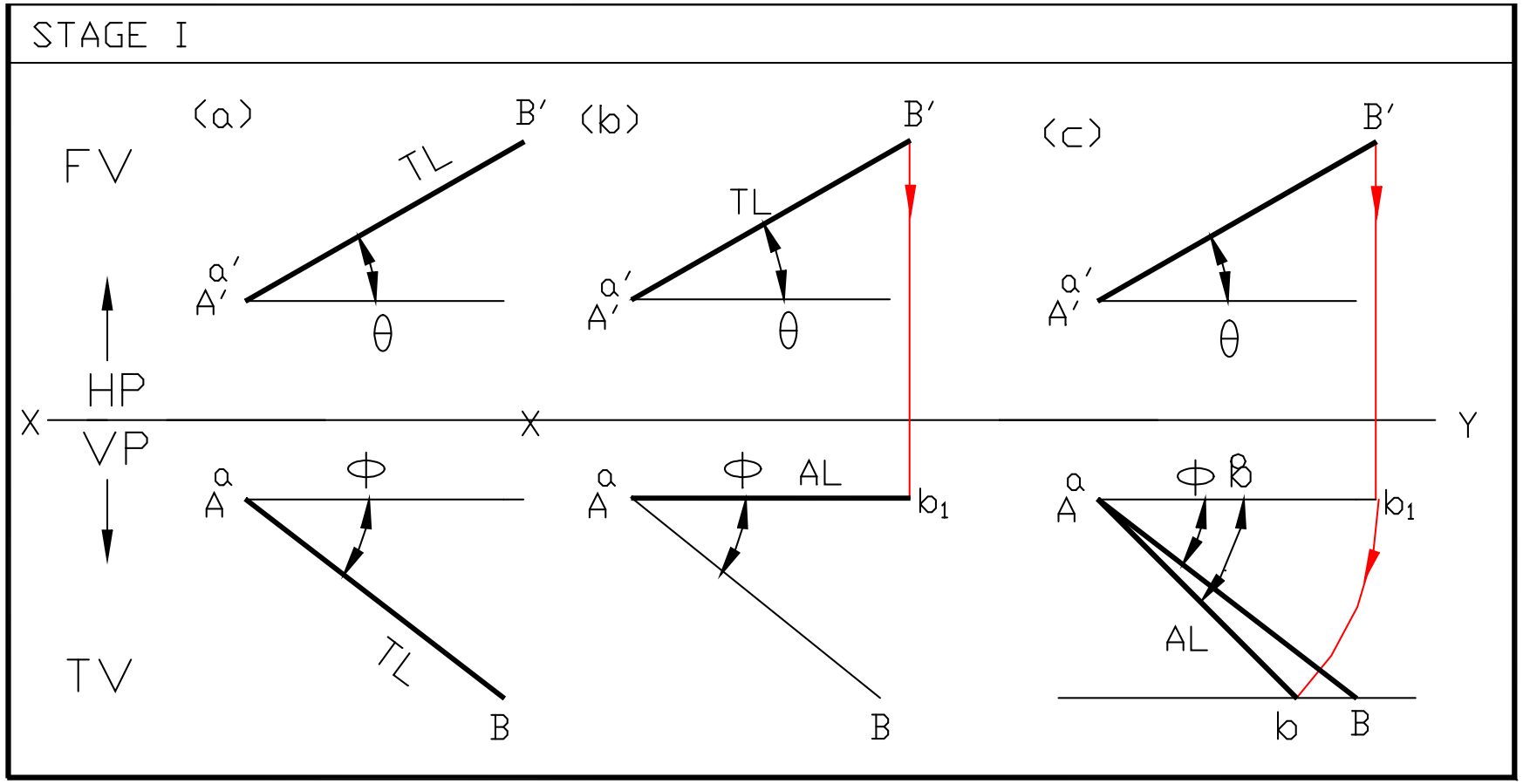
Line *AB* 200 mm long has its end *A* 75 mm above HP and 50 mm in front of VP. End point *B* is in I quadrant. The line is parallel to HP and makes an inclination of 40º to VP. Draw projections of the straight line *AB*.



Skew Line: (Line inclined to both HP and VP)

TYPE-A

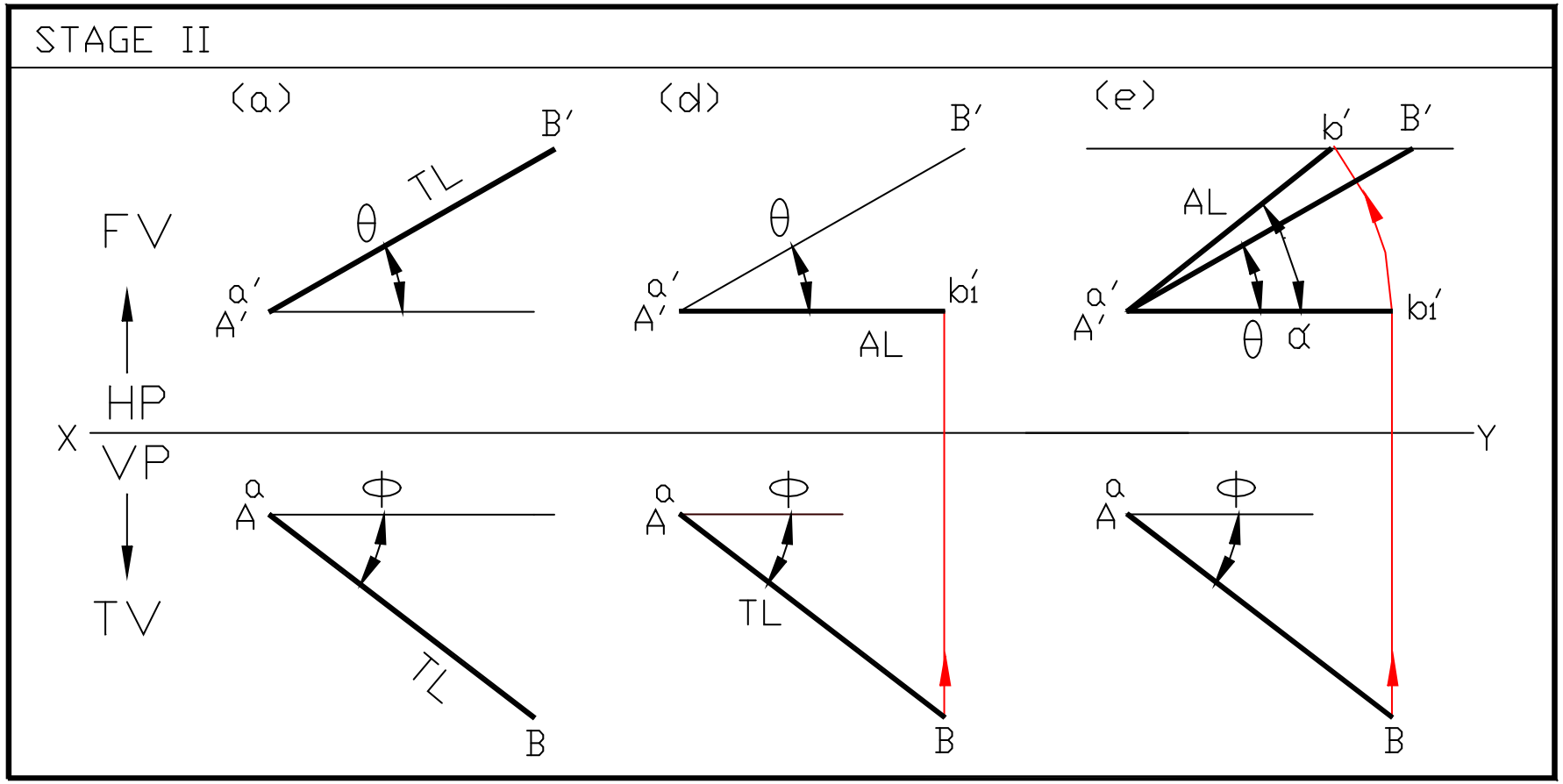
True lengths and true inclinations are given. Find out apparent length and apparent inclinations



Skew Line: (Line inclined to both HP and VP)

TYPE-A

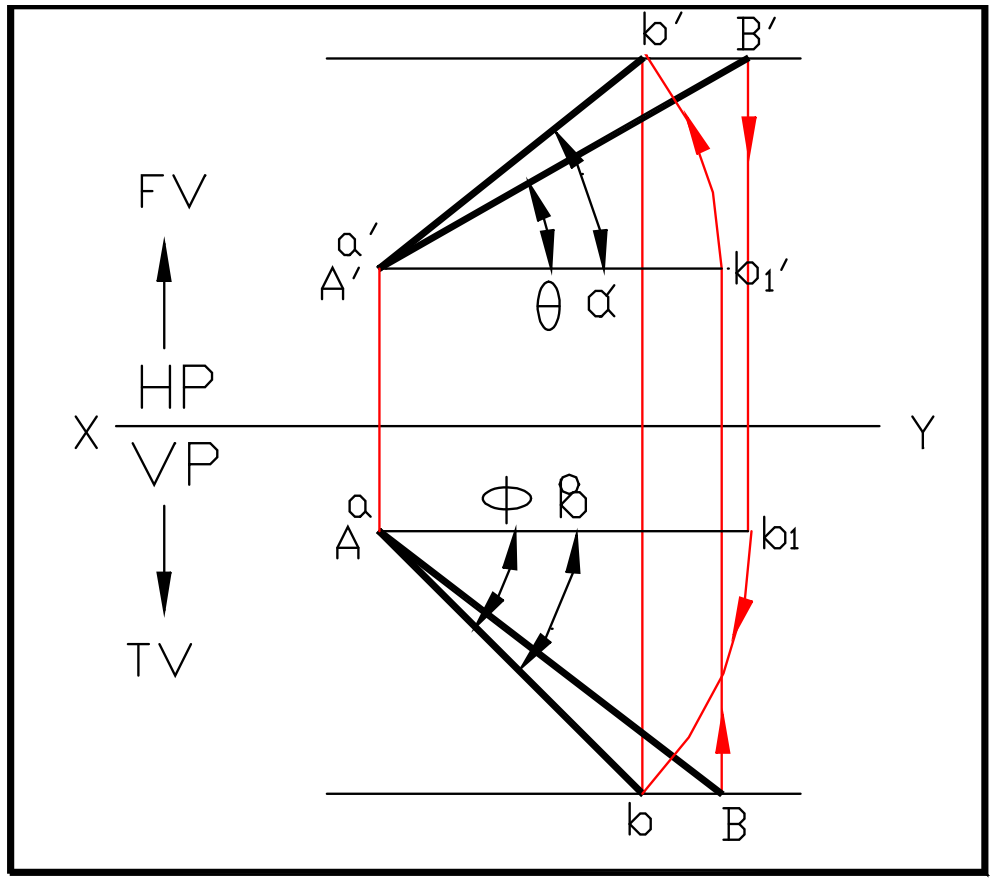
True lengths and true inclinations are given. Find out apparent length and apparent inclinations



Skew Line: (Line inclined to both HP and VP)

TYPE-A

True lengths and true inclinations are given. Find out apparent length and apparent inclinations. Stage-I and Stage-II are combined.



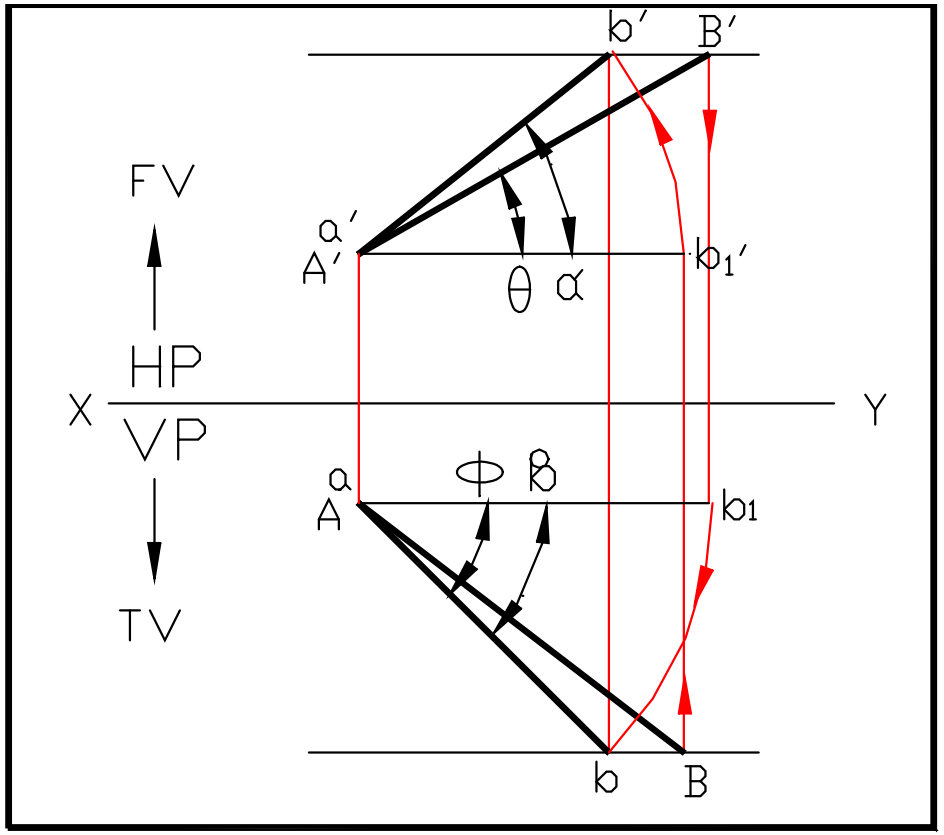
Skew Line: (Line inclined to both HP and VP)

TYPE-A

innovate achieve lead

IMPORTANT OBSERVATIONS

- The projections (apparent lengths: *ab* and *a'b'*) have got common end projectors *a'-a* and *b'-b*.
- The apparent angles are greater than the true angles. i.e. $\alpha > \theta$ and $\beta > \phi$.
- The path to obtain TV of *B* i.e. *b* is
  {***B'*** – [Projection up to a locus line passing through a] – $\boldsymbol{b_1}$ – [Rotation] – ***b***}
- The path to obtain FV of *B* i.e. *b'* is
  {***B*** – [Projection up to a locus line passing through a'] – $\boldsymbol{b'_1}$ – [Rotation] – ***b'***}



Skew Line: (Line inclined to both HP and VP)

TYPE-B

Apparent lengths and apparent inclinations are given. Find out true length and true inclinations.

- Follow a reverse order of solution given for **Type- A**.
- In this type, we are known *b* and *b'* and we are required to find *B* and *B'*.
- The path to obtain *B'* is

  {***b*** – [Rotation] – $\boldsymbol{b_1}$ – [Projection up to a locus line passing through *b'*] – ***B'***}.
- The path to obtain *B* is

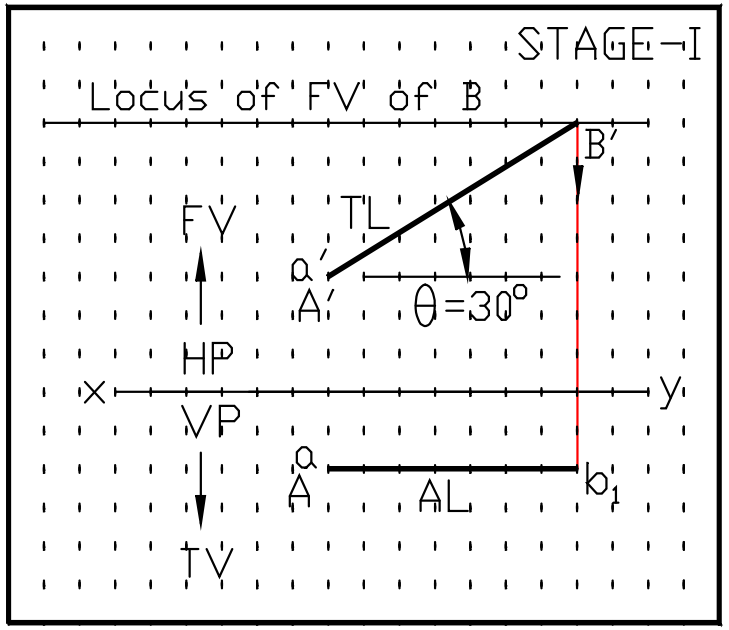
  {***b'*** – [Rotation] – $\boldsymbol{b'_1}$ – [Projection up to a locus line passing through *b*] – ***B***}.

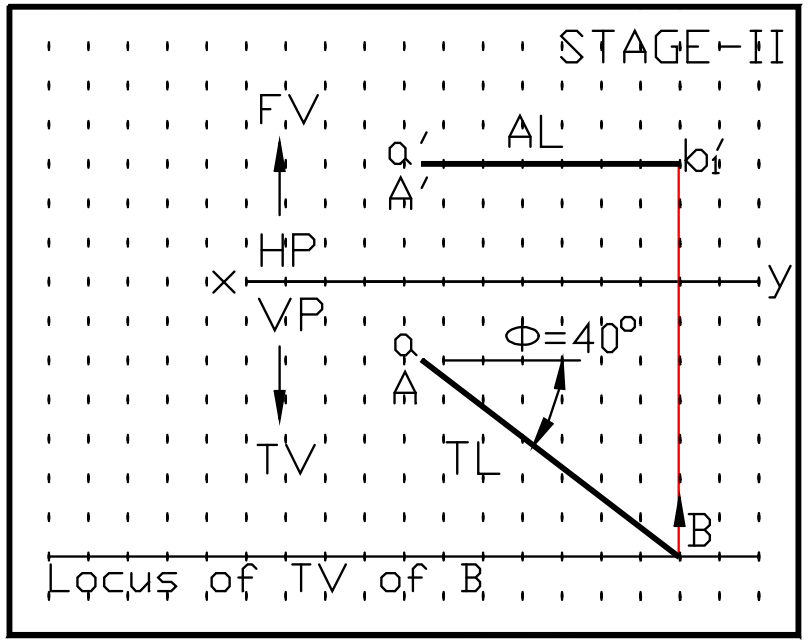
Skew Line: (Line inclined to both HP and VP)

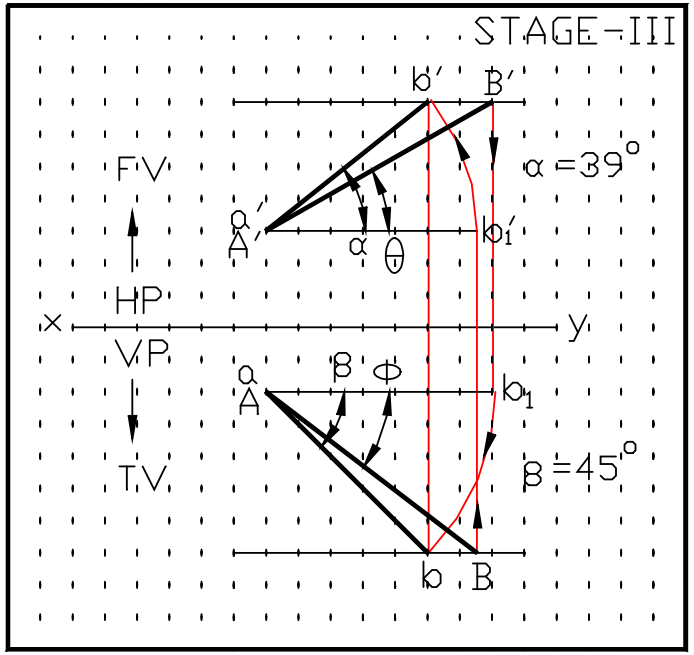
innovate achieve lead

EXAMPLE

Line *AB* 200 mm long has its end *A* 75 mm above HP and 50 mm in front of VP. End point *B* is in I quadrant. The line makes an angle of 30º to HP and 40º to VP. Draw the projections of the straight line *AB* and find apparent inclinations.

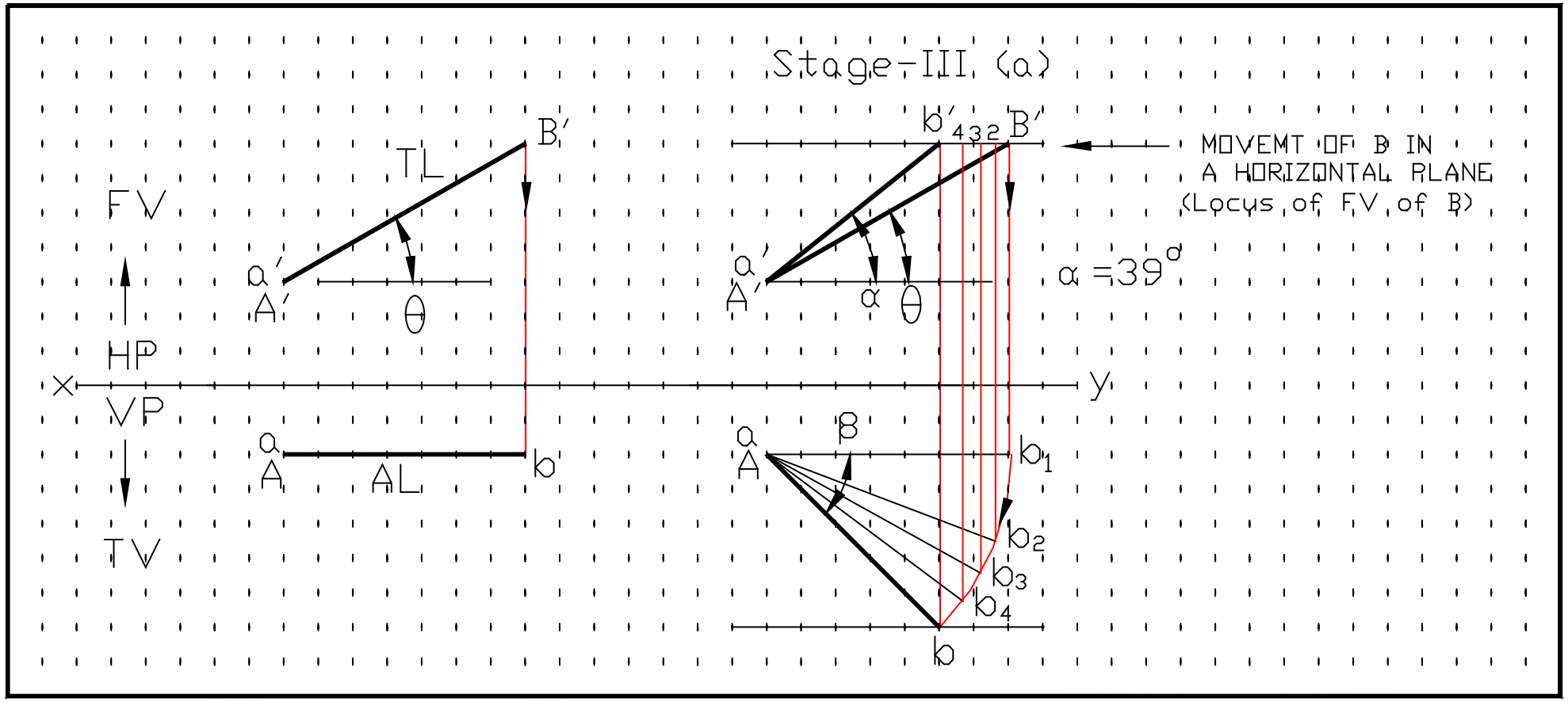






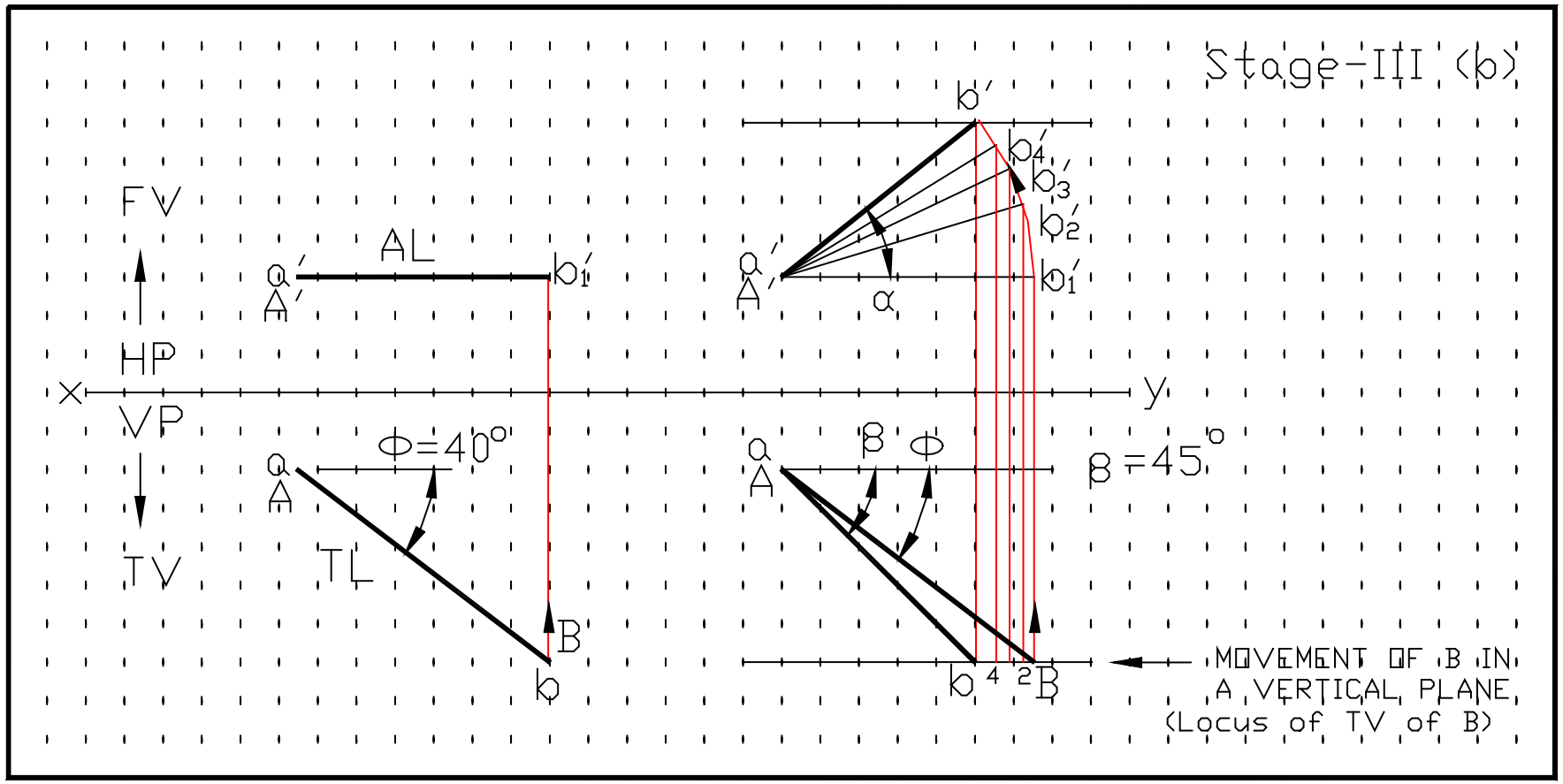
Method

First imagine the line is θº to HP and parallel to VP



Method

Now imagine the line is ϕ^o to VP and parallel to HP

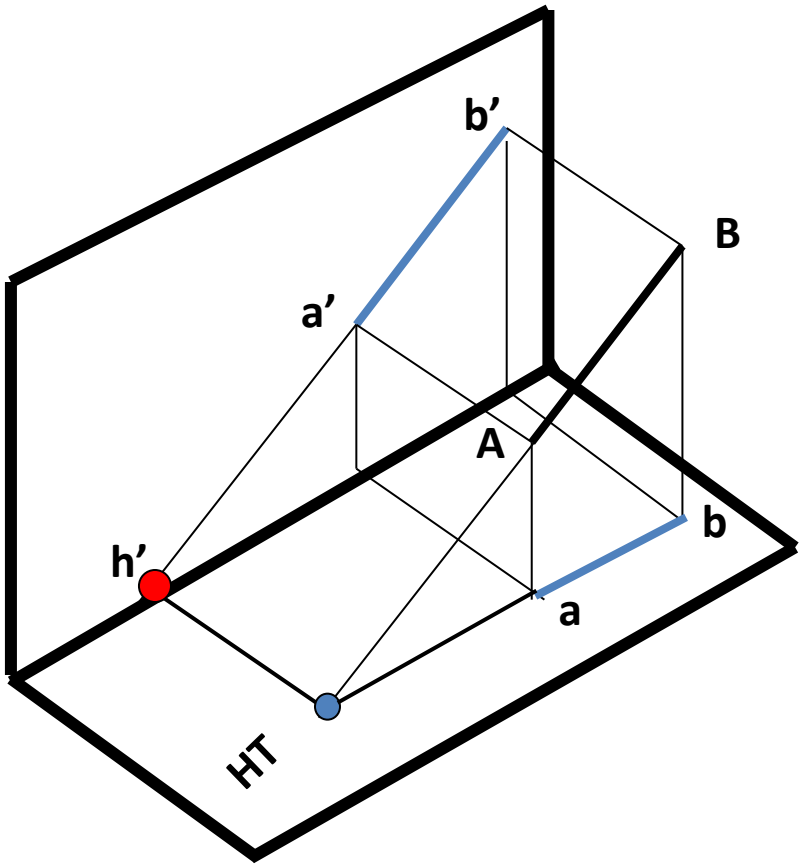


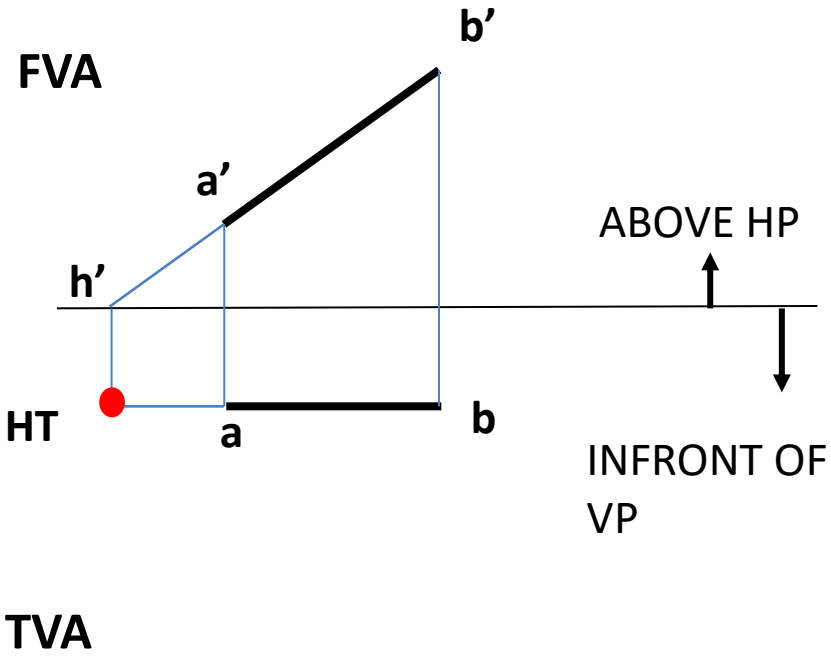
Traces of line

The point of intersection of the line with the HP is called the horizontal trace (HT) and with the VP is called the vertical trace (VT).

Traces of line

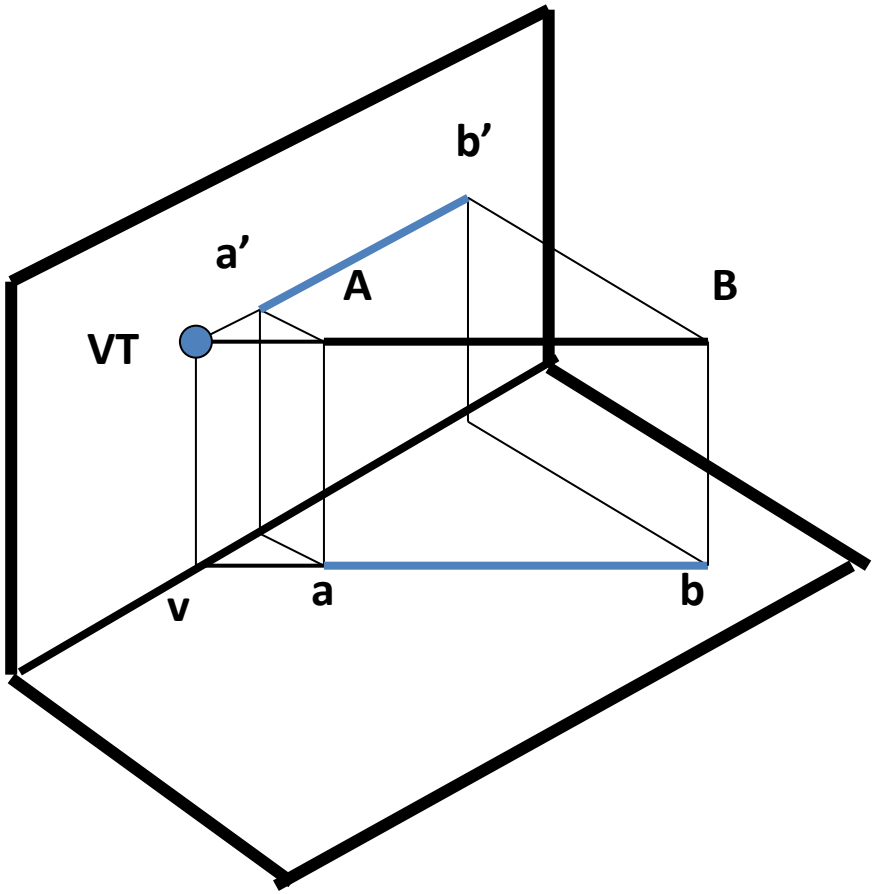
Line is inclined to HP and parallel to VP



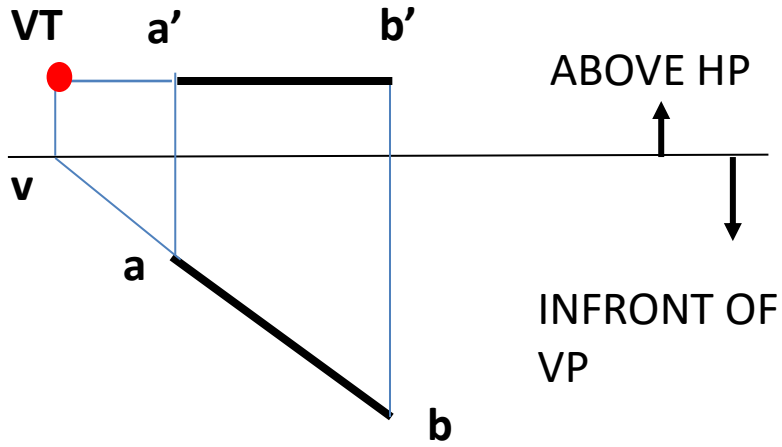


Traces of line

Line is parallel to HP and inclined to VP



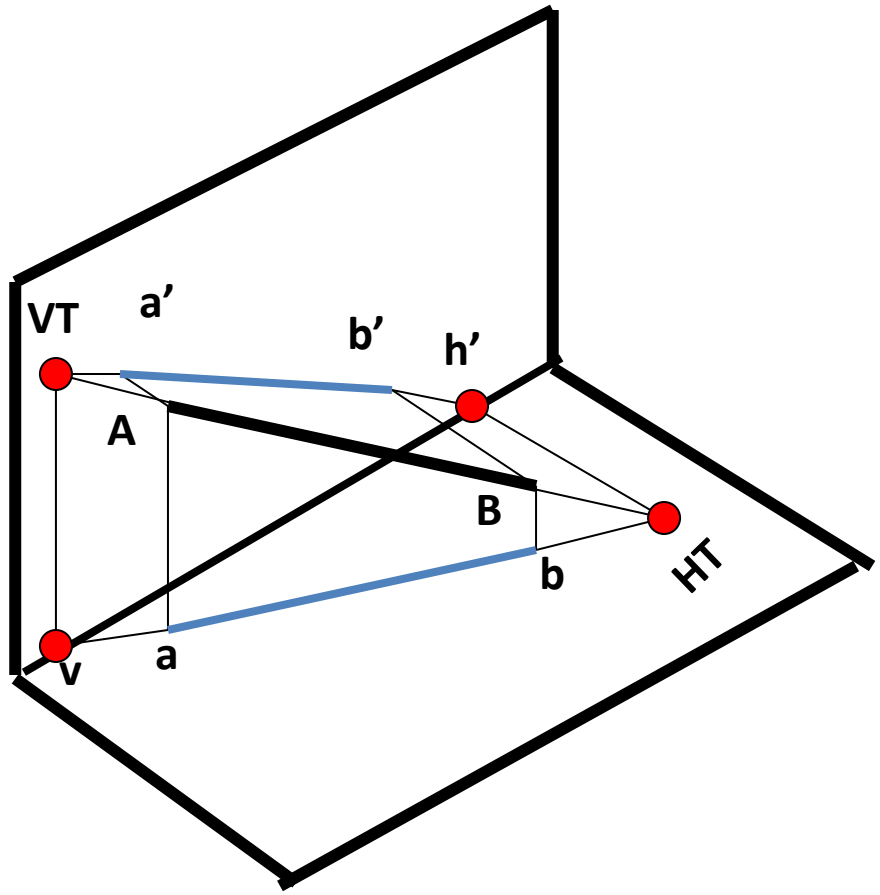
FVA

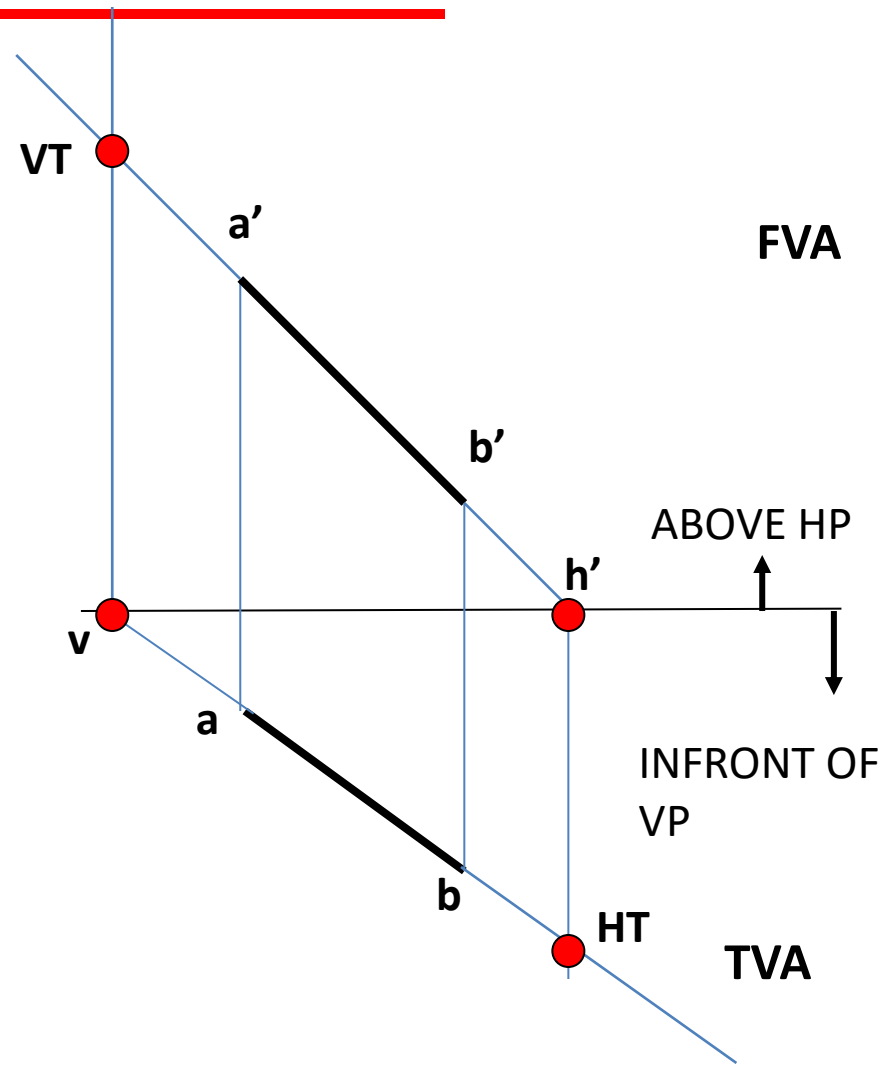


TVA

Traces of line

Line is inclined to HP and VP





Traces of line

CONCLUDING REMARKS

1. FV of HT will lie on x-y line

   i.e. h’

2. TV of VT will lie on x-y line

   i.e. v

3. All TV points lie on same line

   i.e. HT, v, a, b

4. All FV points lie on same line

   i.e. VT, h’, a’, b’

Traces of line

Example: The TV and FV of a line AB measure 150 mm and 100 mm respectively. The line is inclined 30 deg to HP. The end A is 50 mm above HP and 25 mm in front of the VP. The other end B is in first quadrant. Draw the projections and locate the traces.

Solution

Simplification of Problem

A ---- h1= 50 mm above HP

d1 = 25 mm in front of VP

A is in I quadrant

B is in I quadrant

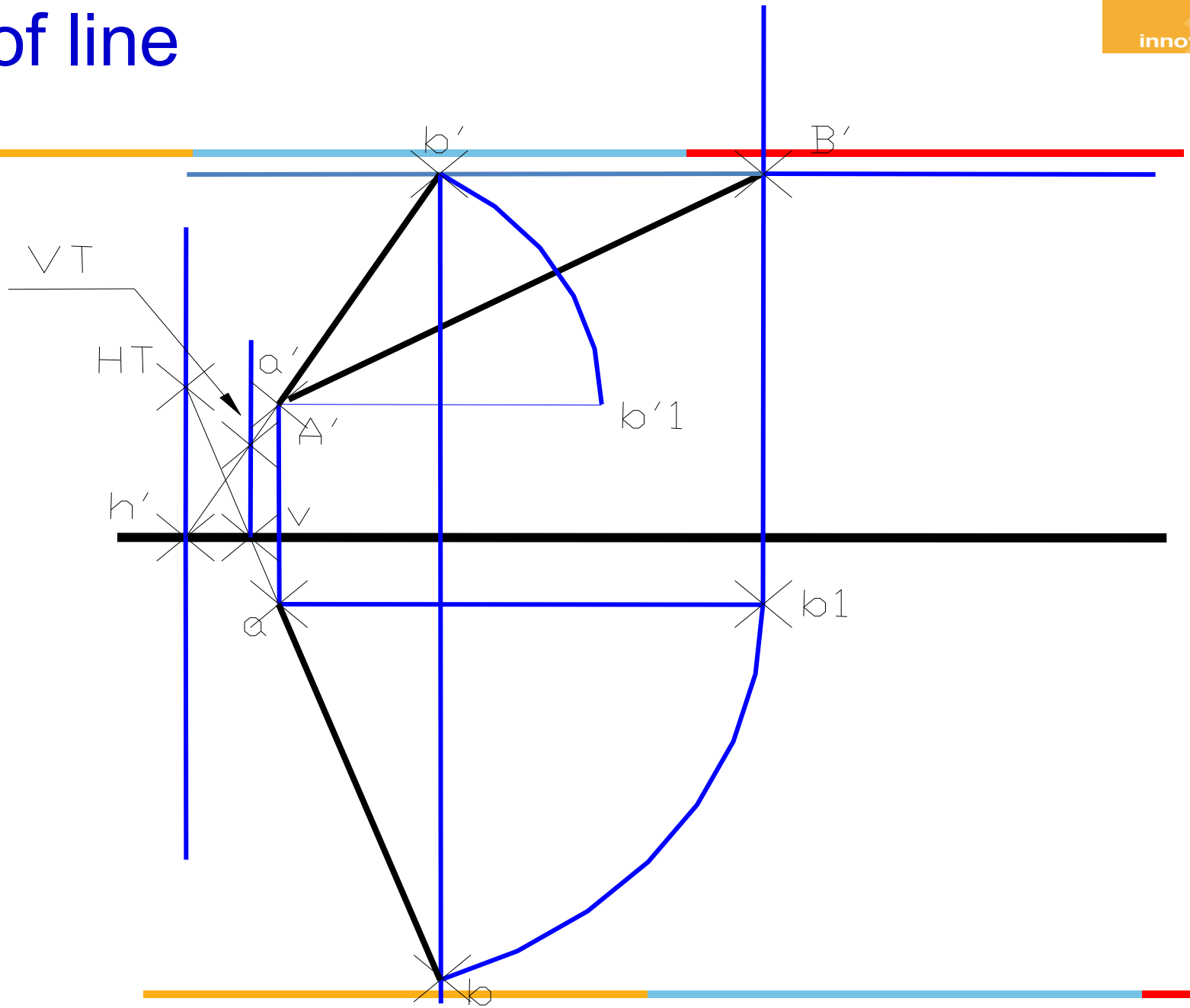
Line is in I quadrant

FV of a line 100 mm

TV of a line = 150 mm

Inclination of line with HP = $\theta = 30^0$

Traces of line

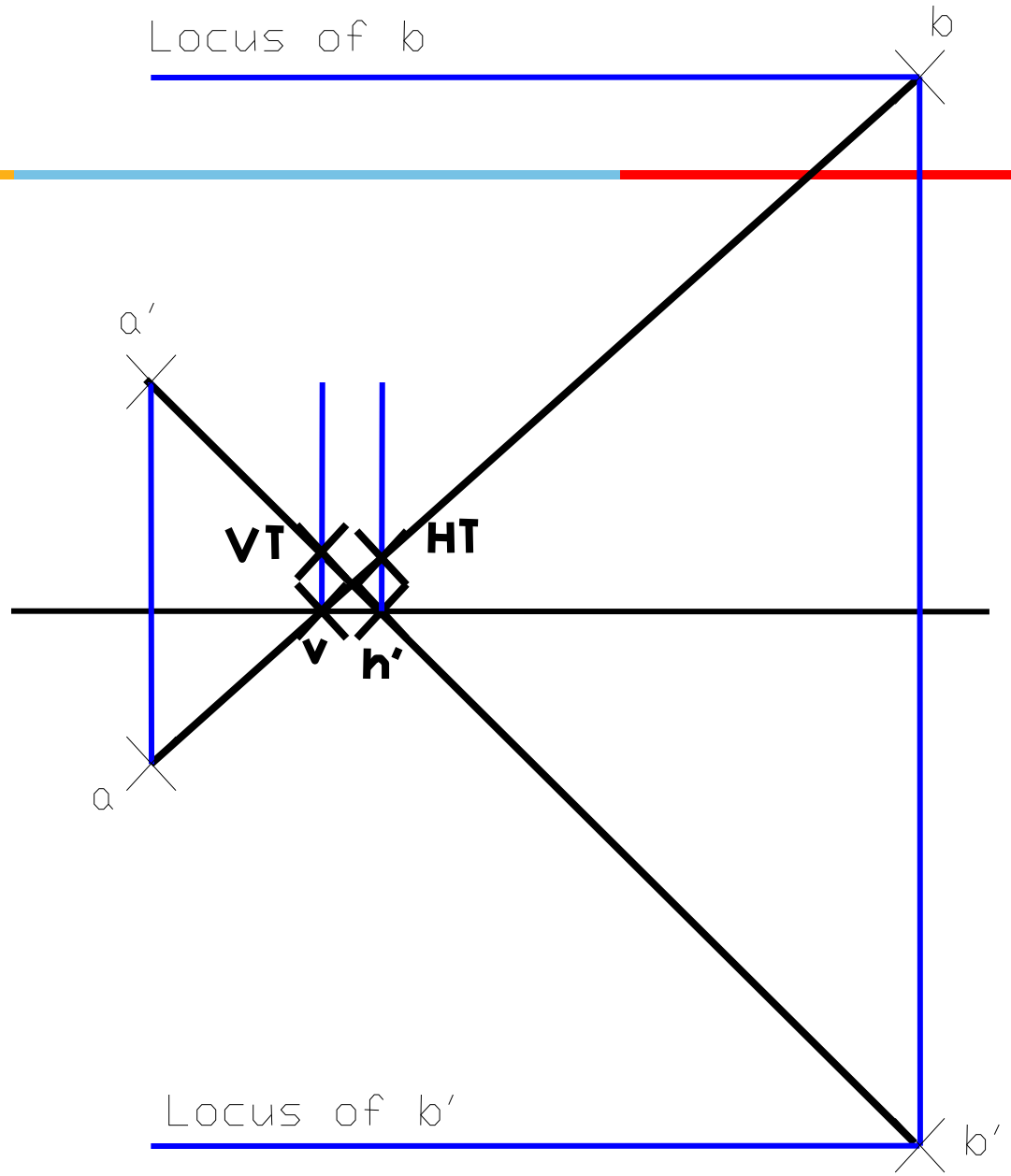


Traces of line

Example:

Line AB has its end A 75 mm above HP and 50 mm in front of VP. The other end B is 175 mm below HP and 175 mm behind of VP. the distance between end projectors is 275 mm. Draw projections of line AB. Obtain HT and VT.

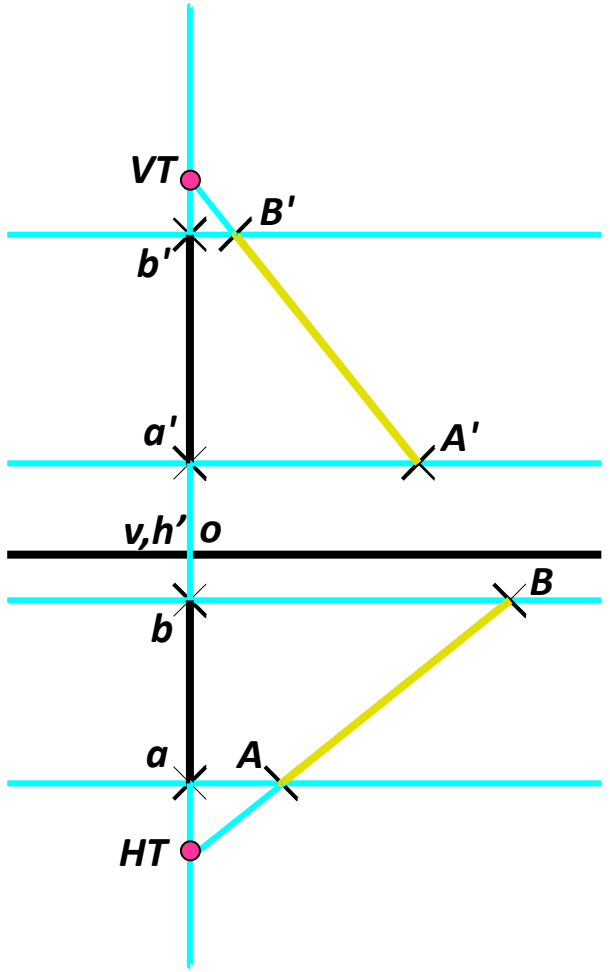
Traces of line



Traces of line

Example:

Line AB has its end A 50 mm above HP and 125 mm in front of VP. The other end B is 175 mm above HP and 25 mm in front of VP. The line AB is parallel to PP. Draw projections of line AB. Obtain HT and VT.

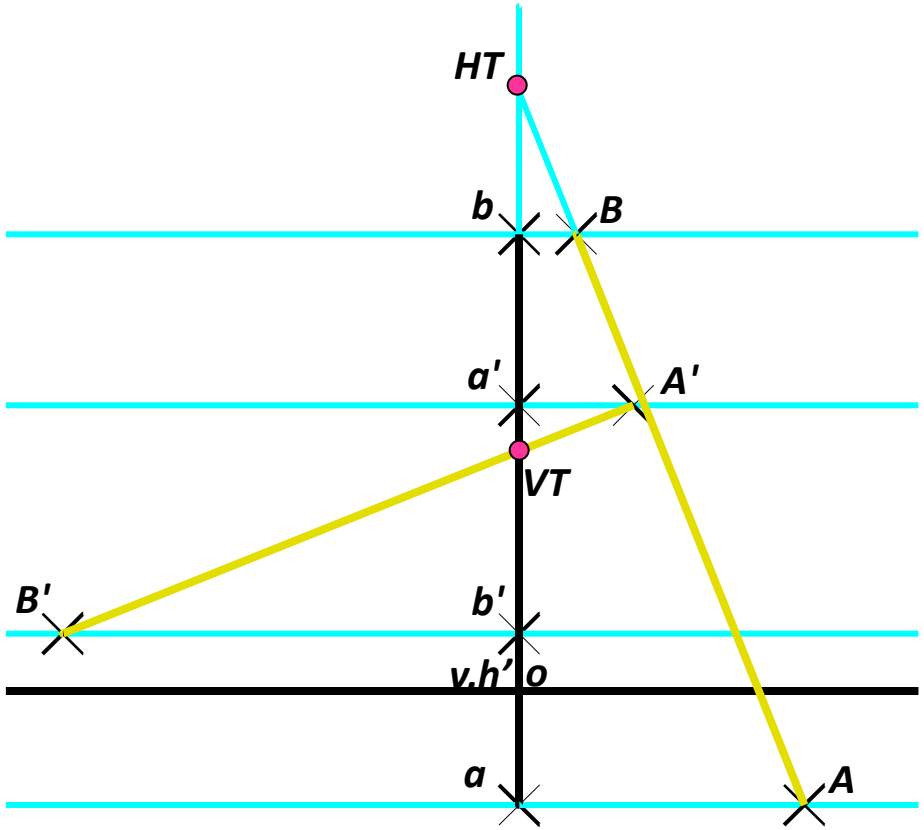


A'a' = oa
B'b' = ob
Aa = oa'
Bb = ob'

Traces of line

Example:

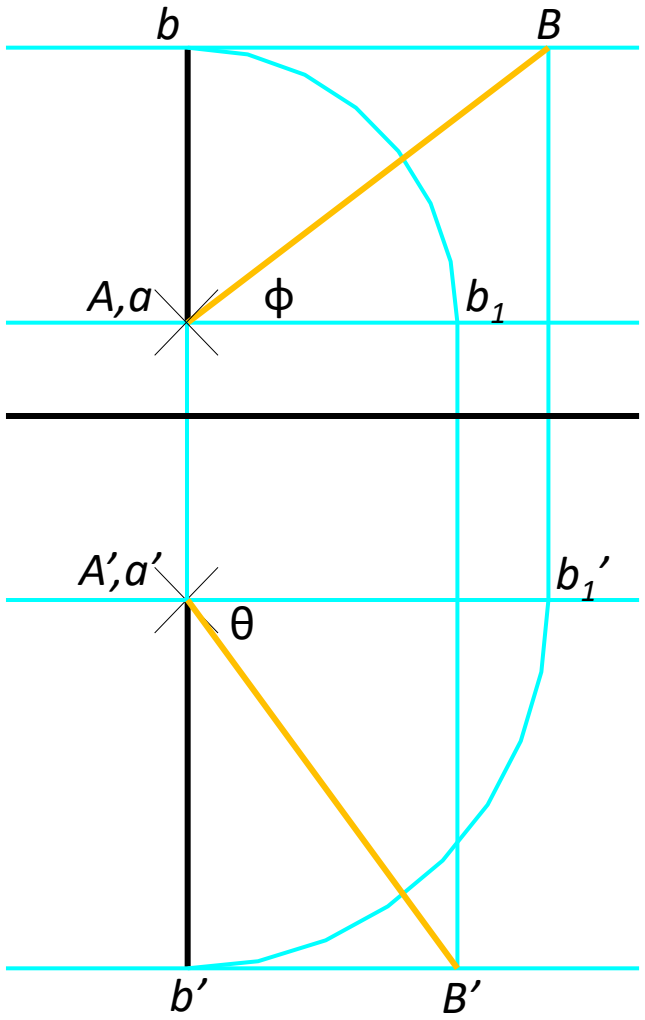
Line AB has its end A 125 mm above HP and 50 mm in front of VP. The other end B is 25 mm above HP and 200 mm behind the VP. The line AB is parallel to PP. Draw projections of line AB. Obtain HT and VT.



Additional problems on line

Line AC has its TV and FV on the single projector line with the FV 100 mm long and TV 75 mm long. Endpoint A is 25 mm behind the VP and 50 mm below the HP. Draw its projections and find the true length and true inclinations. (Consider the line in III-quadrant).

Additional problems on line



TL = 125mm

Θ = 53°

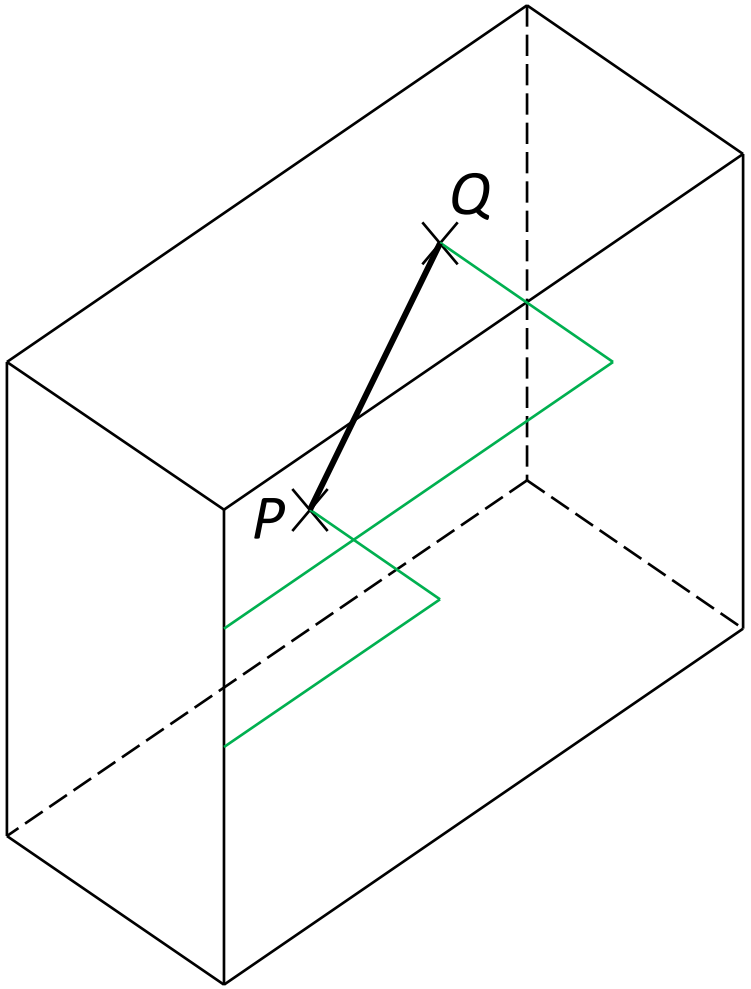
Φ = 37°

Additional problems on line

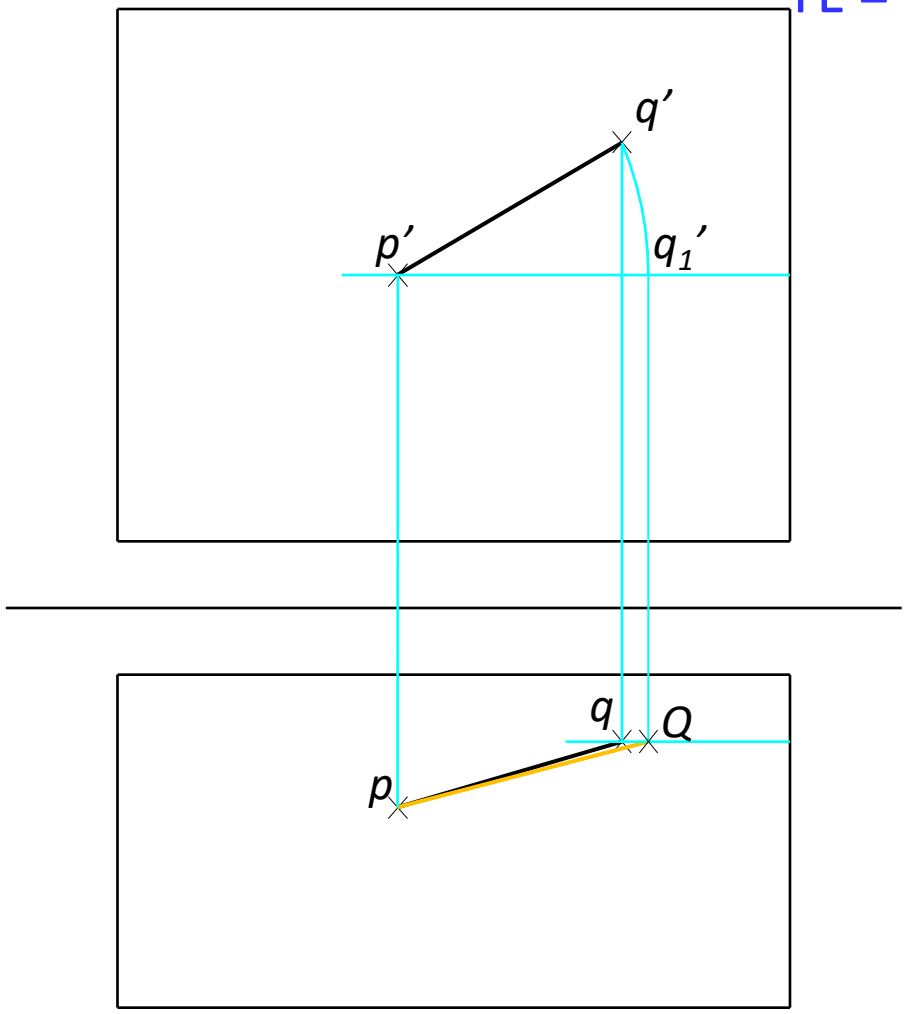
Two fan motors *P* and *Q* are hung from a ceiling of a hall 12 m length L X 5 m depth D X 8 m height H at a height of 4 m and 6 m, respectively from the floor. The motors are 5 m and 9 m from the left end wall, 3 m and 4 m from the front wall, respectively.

(a) Draw the projections of these fan motors with reference to their location from the end wall and front wall. (b) Determine graphically, the distance between the two motors. [Solve using the I-quadrant. Scale: 0.25 AutoCAD unit (1 grid spacing) = 1 m].

Additional problems on line



TL = 1.15 m



Thank You!