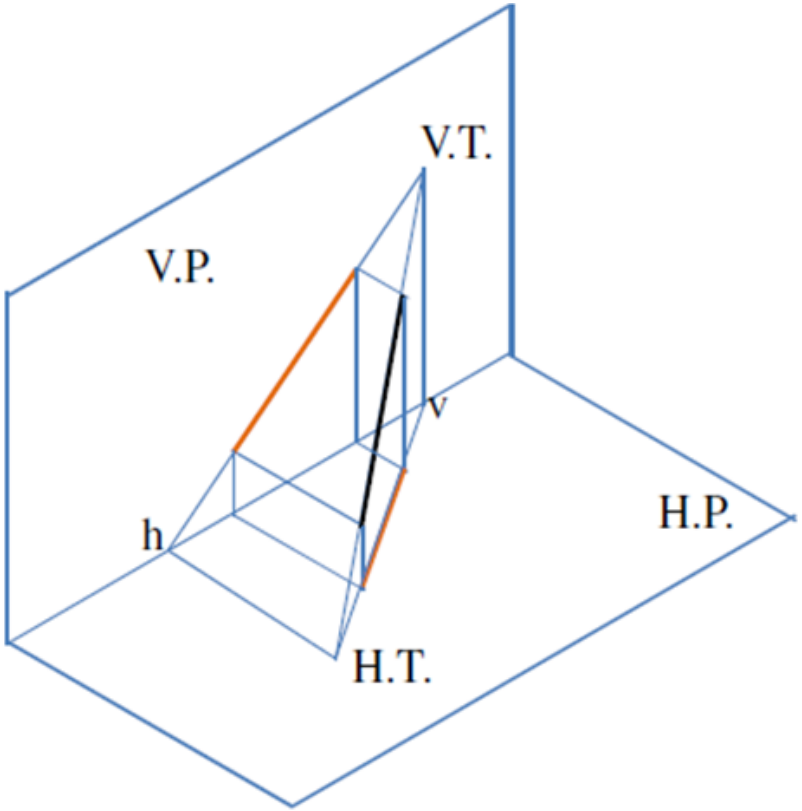
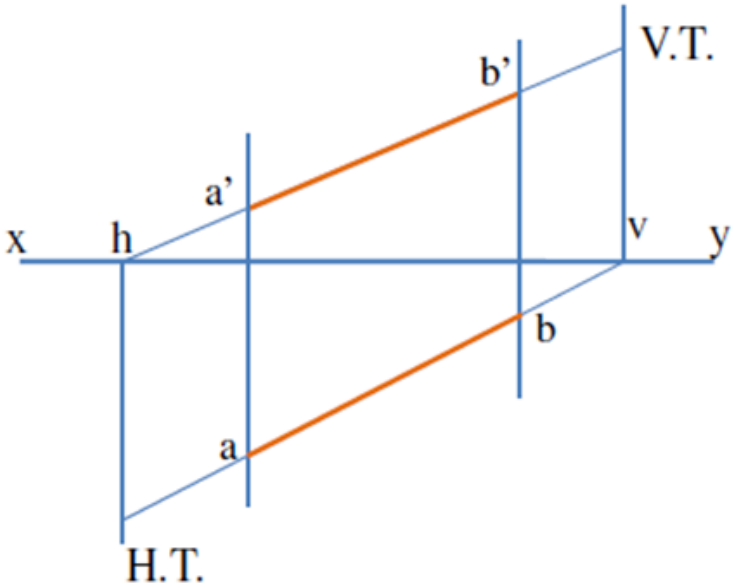
Projection of Lines with Traces

ME 1480: Engineering Drawing – Lecture 4
Indian Institute of Technology Madras, Chennai

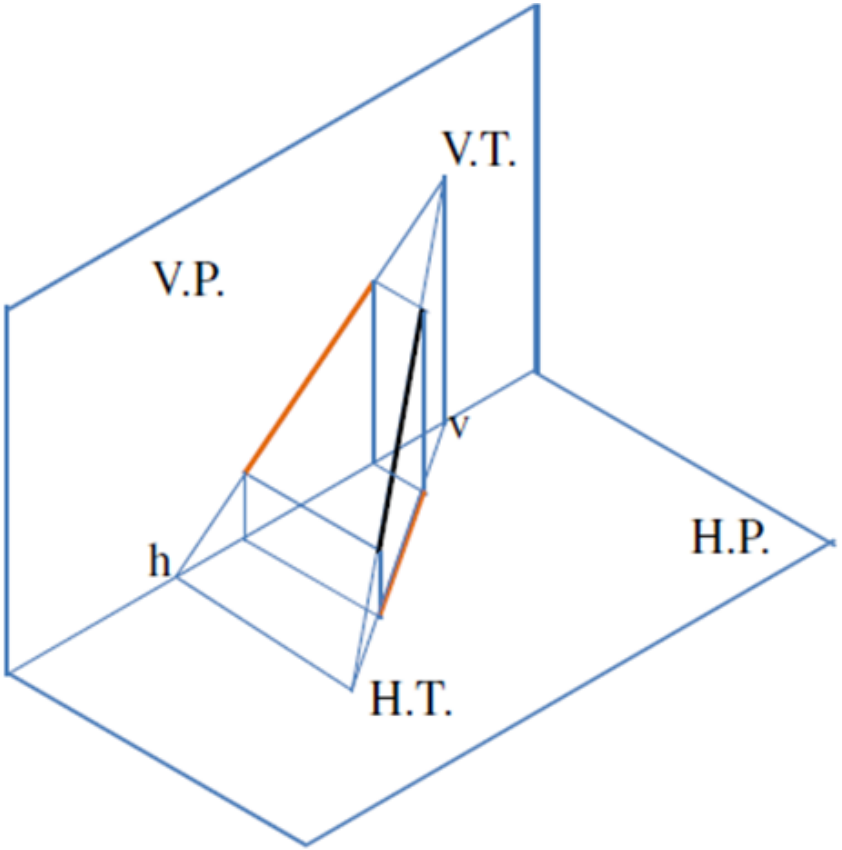
Traces of a line

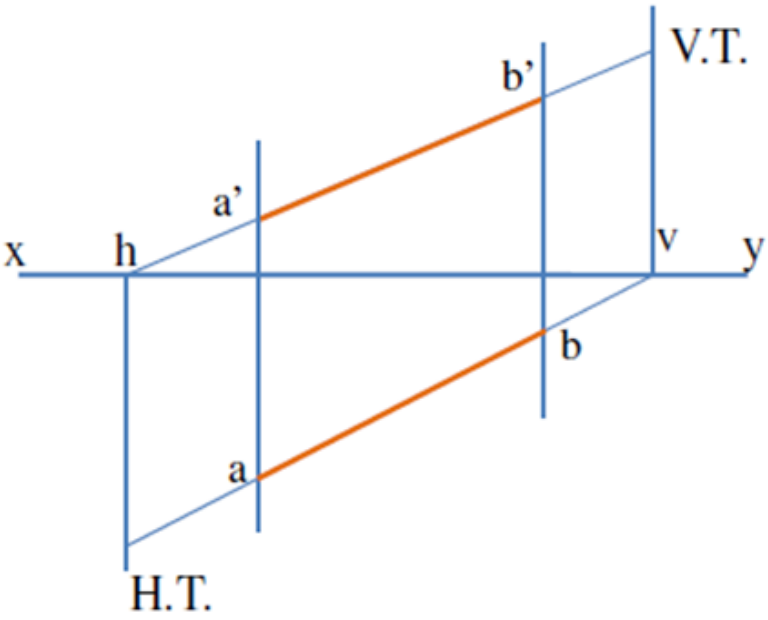




- The points of intersection of a line or its extension with the respective reference planes are called **Traces**.
- A line or its extension intersects the *H.P.* at the trace of the line on *H.P.* (called *Horizontal Trace*).
- A line or its extension intersects the *V. P.* at the trace of the line on *V.P* (called *Vertical Trace*) .

Traces of a line

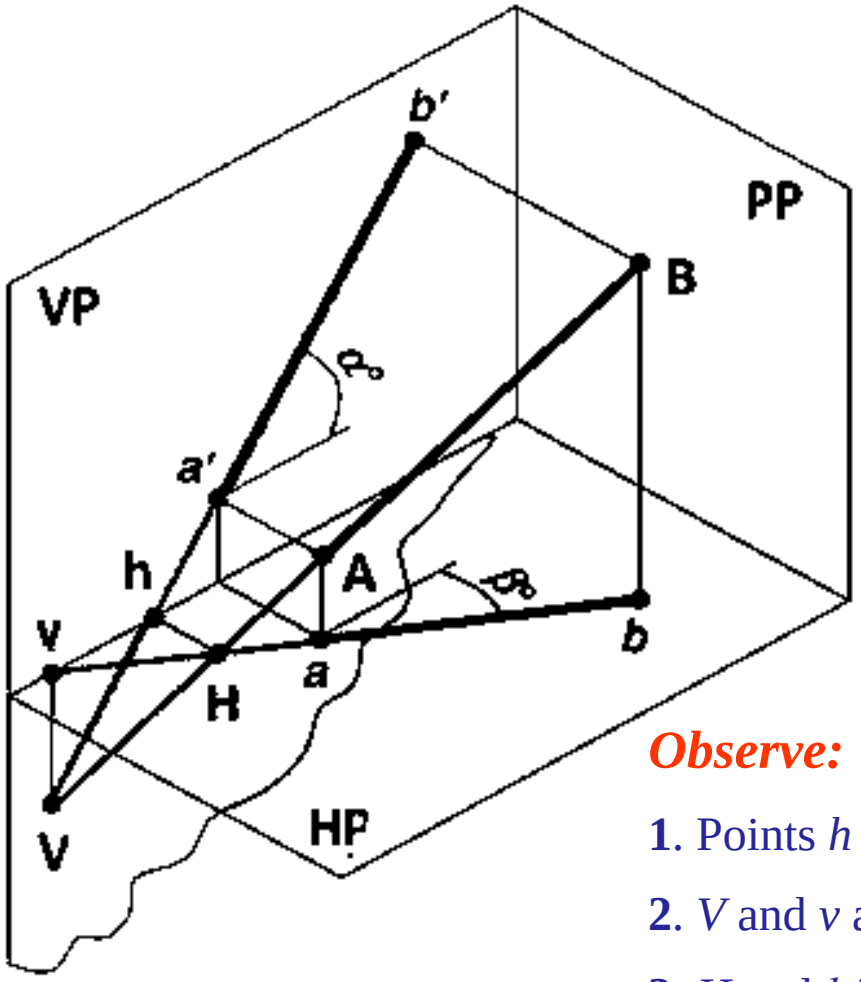




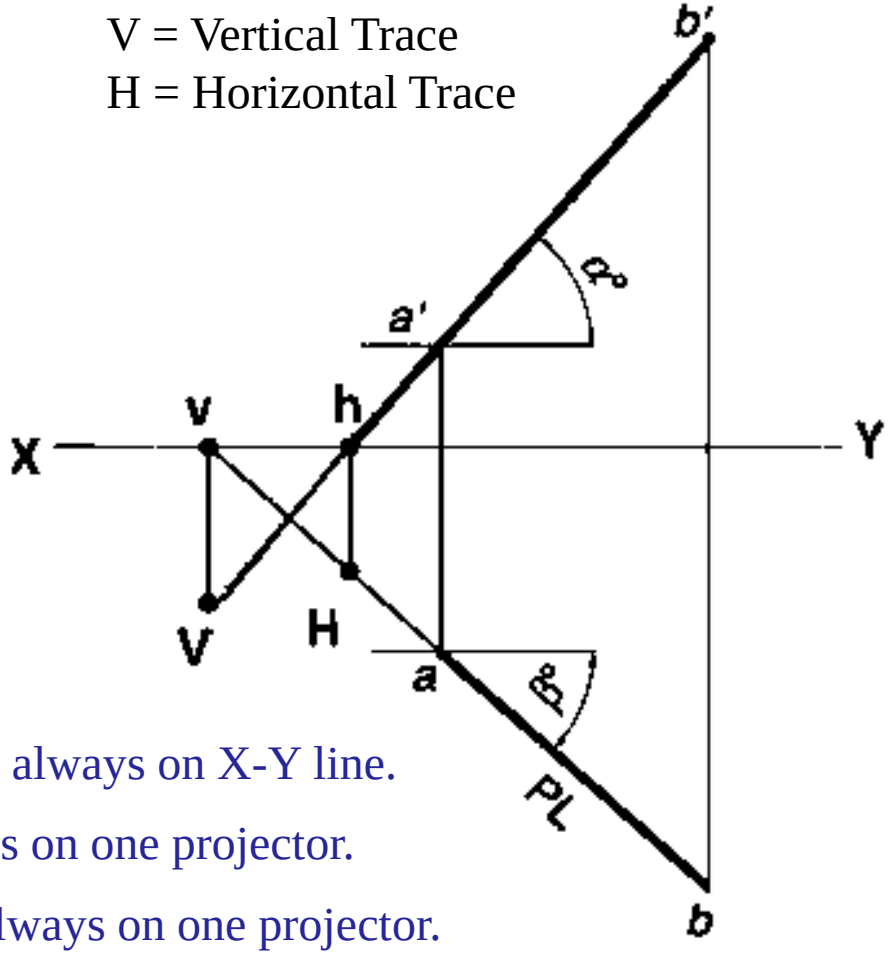
Horizontal Trace:
It is a point on the **H.P.**
Hence, its ***FV*** appears on **XY line**
(named ***h***)

Vertical Trace:
It is a point on the **V.P.**
Hence, its ***TV*** appears on XY line
(named ***v***)

Traces of a line



V = Vertical Trace
H = Horizontal Trace



Observe:

1. Points *h* and *v* always on X-Y line.

2. *V* and *v* always on one projector.

3. *H* and *h' (h)* always on one projector.

4. FV-*h*-*V* (VT) always co-linear.

5. TV-*v*–*H (HT)* always co-linear.

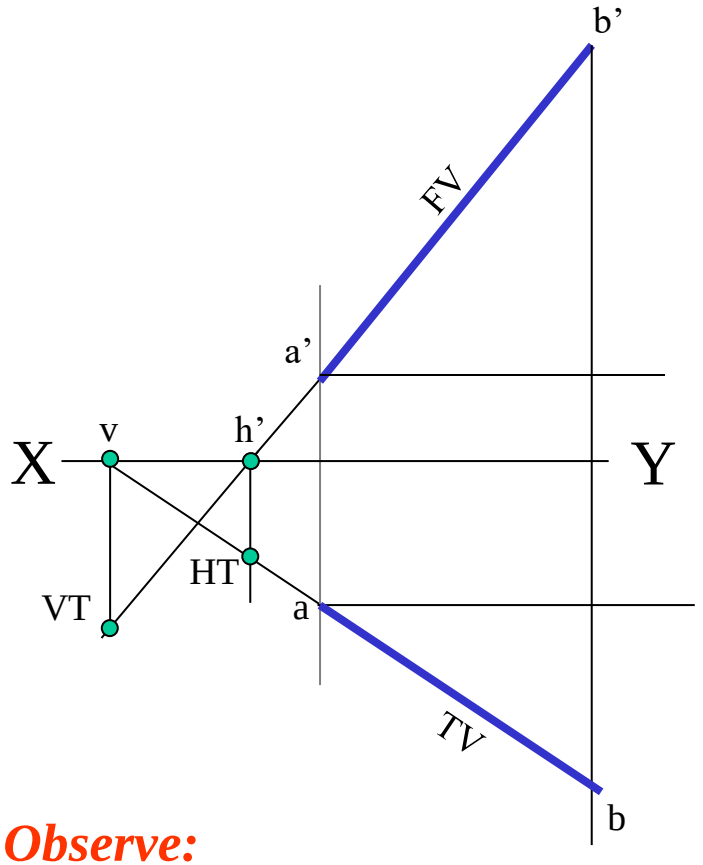
Traces of a Line (Steps)

STEPS TO LOCATE HT.
(When projections are given)

1. **Begin with FV. Extend FV up to XY line.**
2. **Name this point *h'***
   (as it is a FV of a point in the HP)
3. **Draw one projector from *h'*.**
4. **Now extend TV to meet this projector.**
   This point is the HT.

STEPS TO LOCATE VT.
(When projections are given)

1. **Begin with TV. Extend TV up to XY line.**
2. **Name this point *v***
   (as it is a TV of a point in VP)
3. **Draw one projector from *v*.**
4. **Now extend FV to meet this projector.**
   This point is VT.



Observe:

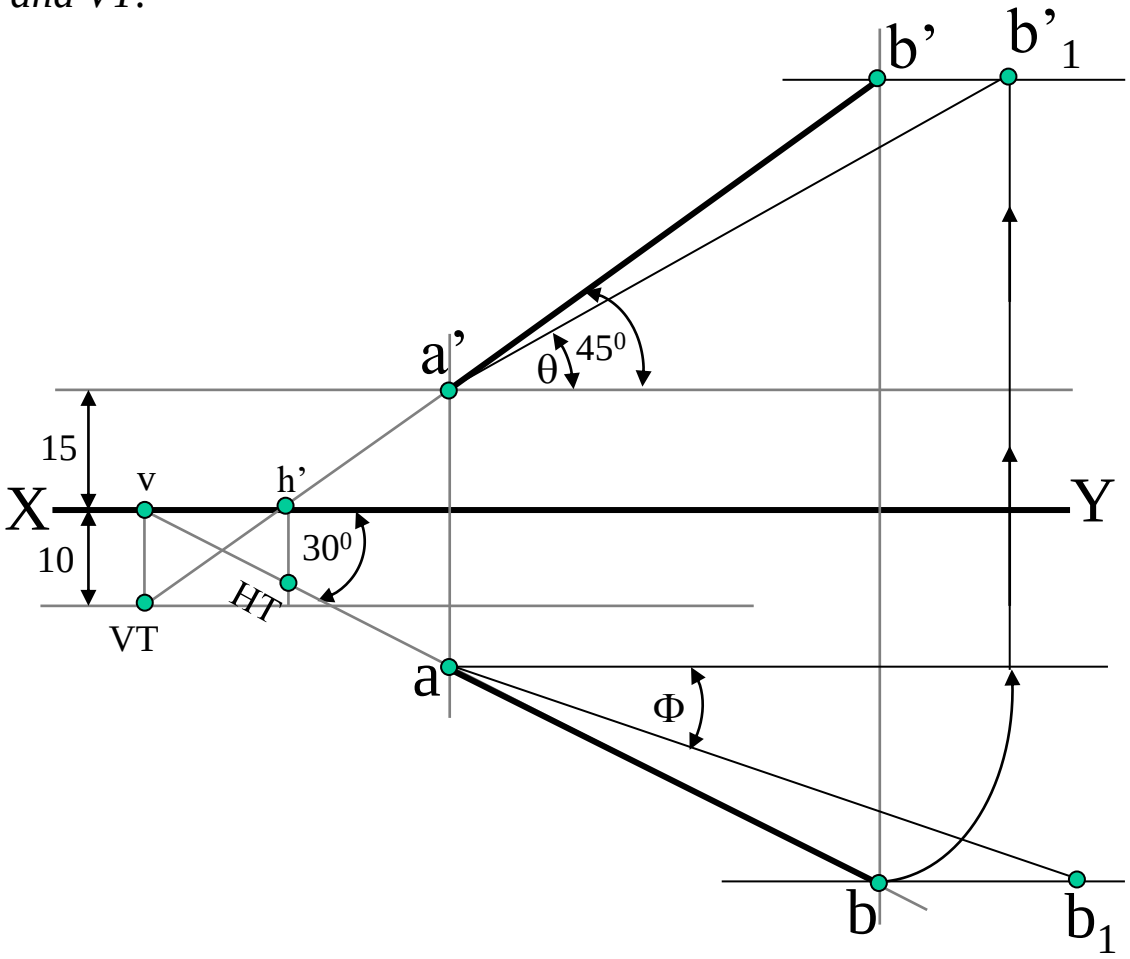
1. Points *h* and *v* always on X-Y line.
2. *V* and *v* always on one projector.
3. *H* and *h' (h)* always on one projector.
4. FV-*h*-*V* (VT) always co-linear.
5. TV-*v*–*H (HT)* always co-linear.

Traces of a Line (Example 1)

The *FV* of line *AB* makes 45^0 angle with *XY* line and measures 60 mm. Line's *TV* makes 30^0 with *XY* line. End *A* is 15 mm above *HP* and its *VT* is 10 mm below *HP*. Draw projections of line *AB*. Determine inclinations with *HP and VP* and locate *HT and VT*.

SOLUTION STEPS:

1. Draw XY line, one projector and locate FV *a'* 15 mm above XY.
2. Take 45^0 angle from *a'* and marking 60 mm on it locate point *b'*.
3. Draw locus of VT, 10 mm below XY and extending FV to this locus locate VT.
4. Note FV-h'-VT are colinear.
5. Draw projector from VT, locate v on XY.
6. From *v* take 30^0 angle downward as TV and its inclination can begin with *v*.
7. Draw projector from b' and locate *b*, i.e., TV point.
8. Name extension of FV, touching XY as *h'* and below it, on extension of TV, locate HT.
9. Now rotating views as usual TL and its inclinations can be found.

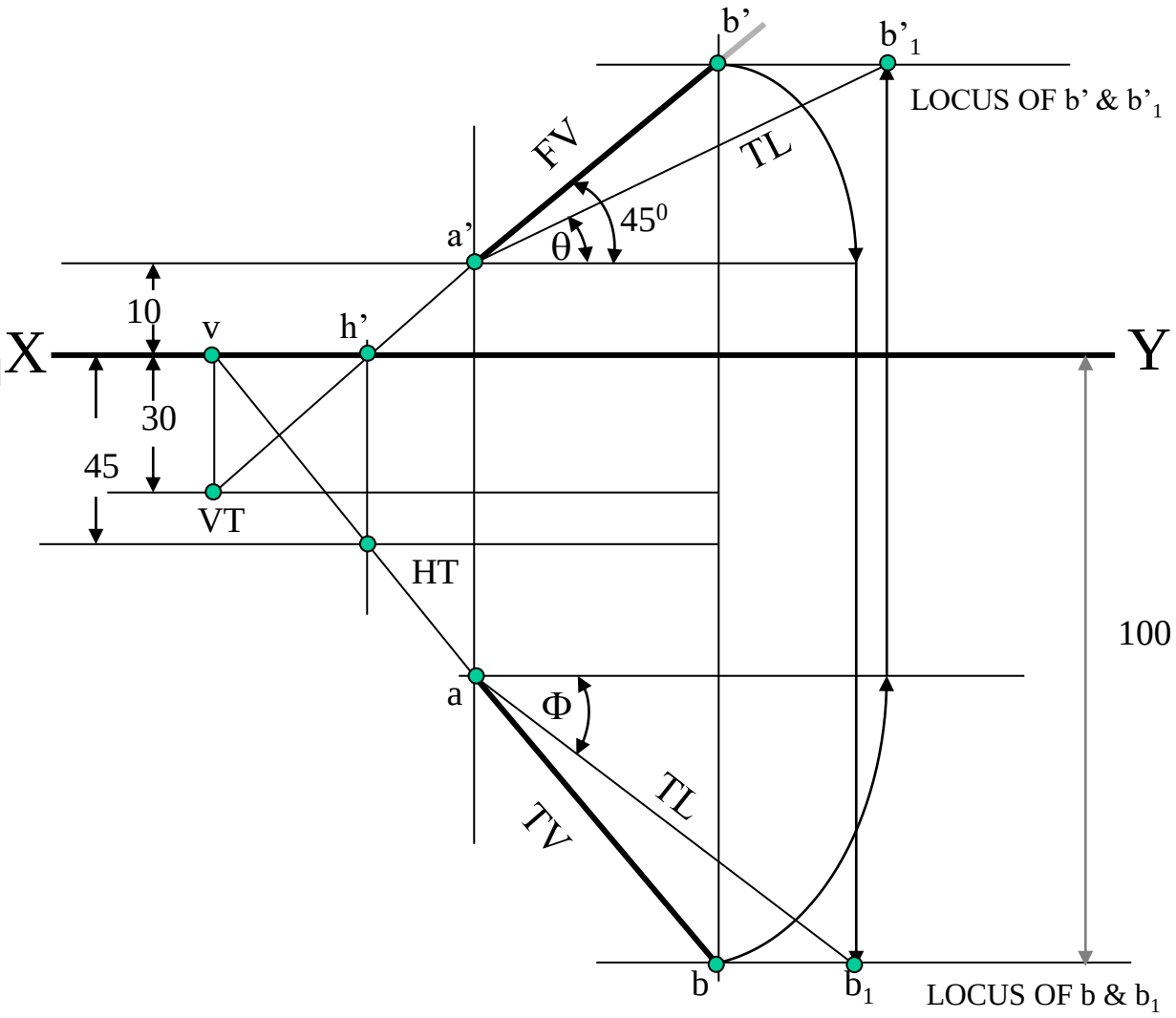


Traces of a Line (Example 2)

One end of line *AB* is 10 mm above *HP* and other end is 100 mm in front of *VP*. Its *FV* is 45^0 inclined to XY while its *HT* and *VT* are 45 mm and 30 mm below *XY*, respectively. Draw projections and find *TL* with its inclinations with *HP and VP*.

SOLUTION STEPS:

1. Draw XY line, one projector and locate *a'* 10 mm above XY.
2. Draw loci for VT and HT, 30 and 45 mm below XY, respectively.
3. Take 45^0 angle from *a'* and extend the line backward to locate *h'* and VT, and locate *v* on XY above VT.
4. Locate HT below *h'* as shown.
5. Draw locus 100 mm below XY for points *b* and b_1
6. Join *v* – HT and extend to get top view end *b*.
7. Draw projector upward and locate *b'*. Make *a b* and *a'b'* dark.
8. Rotate views to find TL and its inclinations.

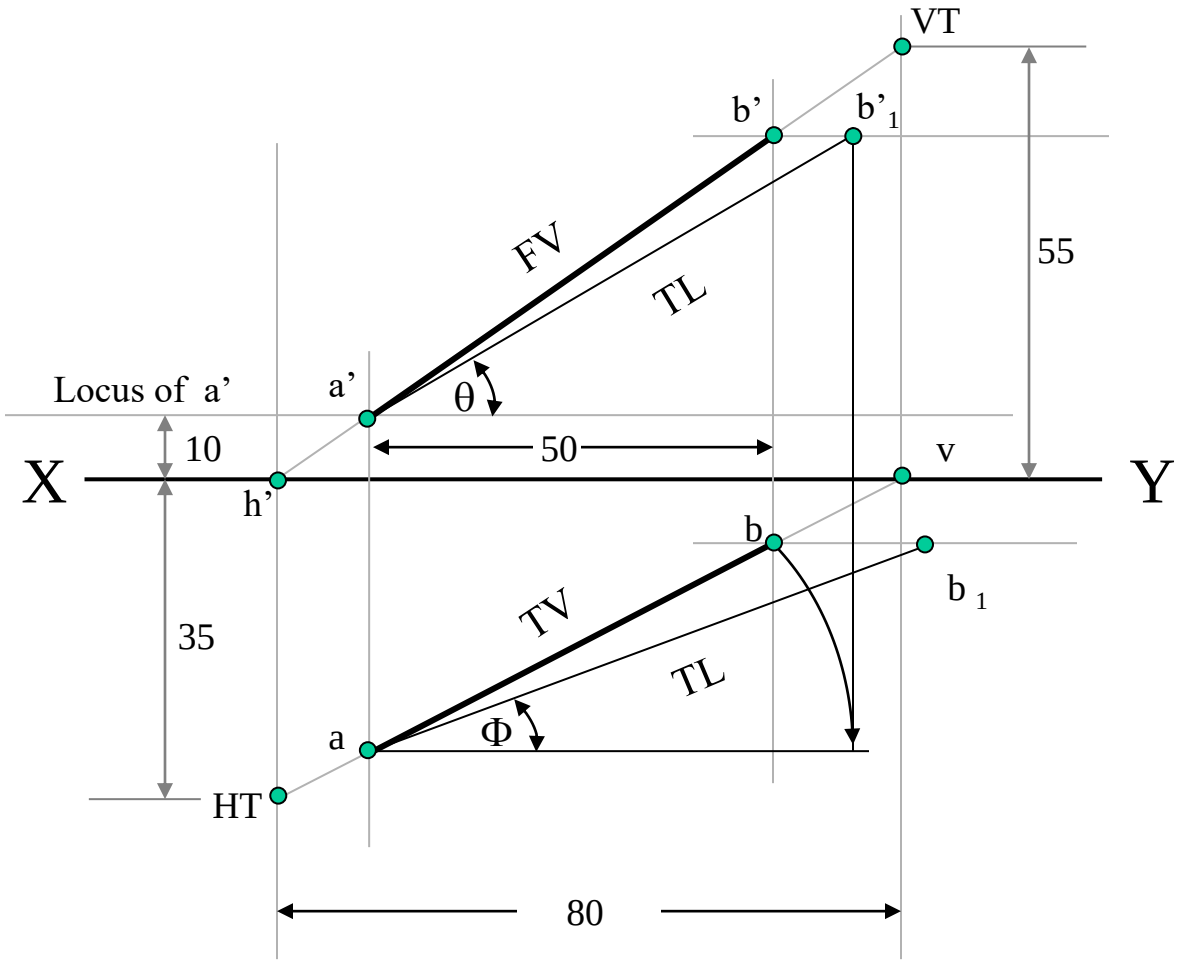


Traces of a Line (Example 3)

Projectors drawn from *HT* and *VT* of a line *AB* are 80 mm apart and those drawn from its ends are 50 mm apart. End *A* is 10 mm above *HP*, *HT* is 35 mm below *XY* while its *VT* is 55 mm above *XY*. Draw projections, locate traces and find *TL* of line and inclinations with *HP* and *VP*.

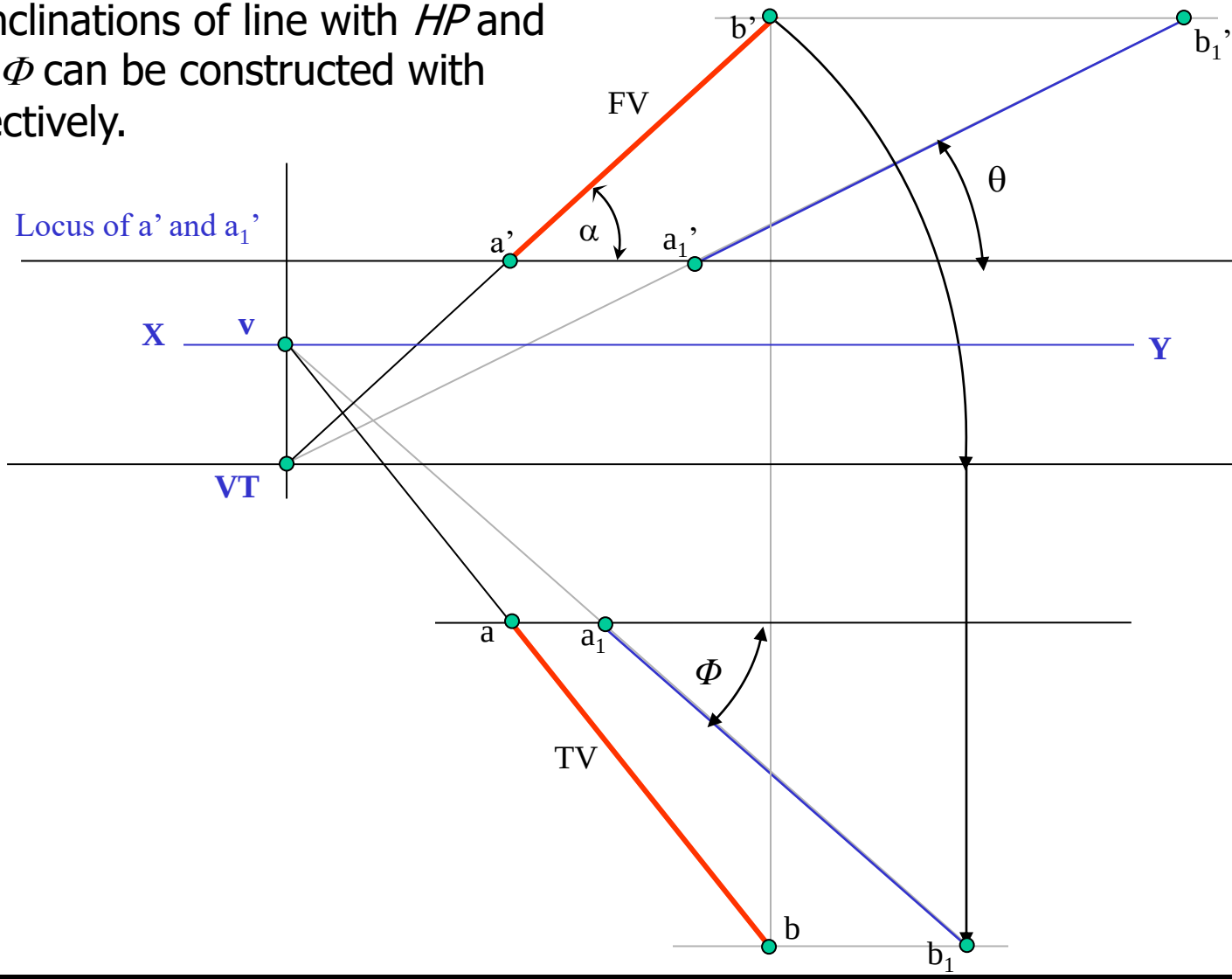
SOLUTION STEPS:

1. Draw XY line and two projectors, 80 mm apart and locate HT and VT 35 mm below XY and 55 mm above XY, respectively on these projectors.
2. Locate *h'* and *v* on XY as usual.
3. Now just as in previous two problems, extending necessary lines, complete FV and TV and as usual find TL and its inclinations.



Traces of a Line (Alternate Method)

Instead of considering *a* and *a'* as projections of the first point, if *v* and *VT* are considered as the first point, then true inclinations of line with *HP* and *VP*, i.e., angles θ and Φ can be constructed with points *VT* and *v*, respectively.



Traces of a Line (Alternate Method)

$$VTb' = VTa' + a'b' = VTa' + \sqrt{{q_1}^2 + {r_1}^2}$$

$$ve_1 = VTa' + \sqrt{{q_1}^2 + {r_1}^2}$$

$$ve_1 = vo_1 + a_1e_2 = VTa' + \sqrt{{q_1}^2 + {r_1}^2}$$

So, if we can prove $\dfrac{vo_1}{a_1e_2} = \dfrac{VTa'}{\sqrt{{q_1}^2 + {r_1}^2}}$

then $a_1e_2 = \sqrt{{q_1}^2 + {r_1}^2}$

So a_1b_1 will be TL

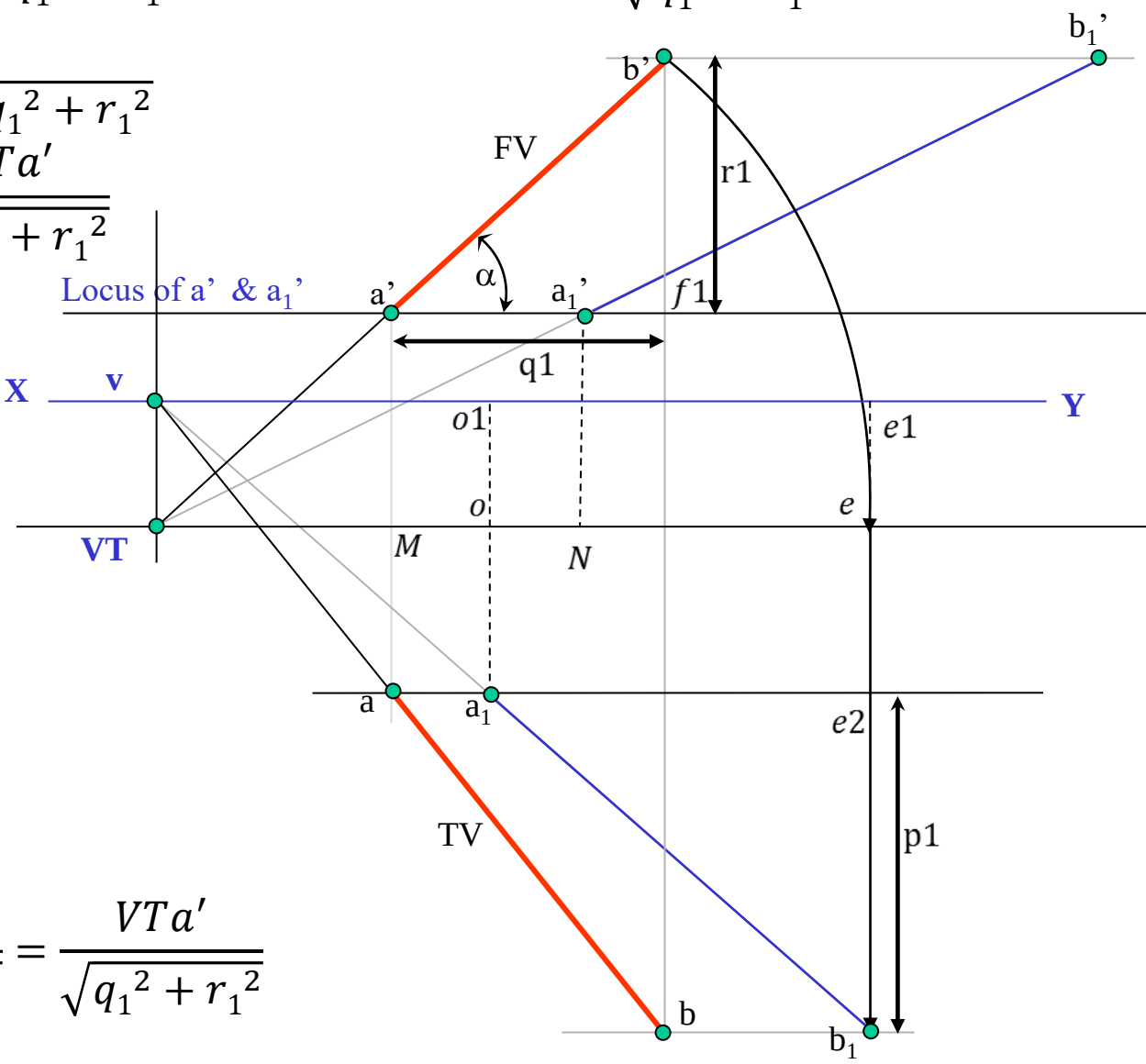
$$\sin\alpha = \frac{a'M}{VTa'} = \frac{r_1}{\sqrt{{q_1}^2 + {r_1}^2}}$$

$$a'M = \frac{(r_1)VTa'}{\sqrt{{q_1}^2 + {r_1}^2}}$$

$$a_1'N = a'M = \frac{(r_1)VTa'}{\sqrt{{q_1}^2 + {r_1}^2}}$$

$$\frac{VTa_1'}{a_1'b_1'} = \frac{a_1'N}{b'f_1} = \frac{(r_1)VTa'}{r_1\sqrt{{q_1}^2 + {r_1}^2}} = \frac{VTa'}{\sqrt{{q_1}^2 + {r_1}^2}}$$

$$VTe = VTa' + \sqrt{{q_1}^2 + {r_1}^2}$$



Traces of a line (Alternate Method)

$$\frac{VTa_1'}{a_1'b_1'} = \frac{VTa'}{\sqrt{{q_1}^2 + {r_1}^2}}$$

As per the method, $vb_1 = VT\ b_1'$ and $a_1b_1 = a_1'b_1'$

Therefore, $va_1 = VT\ a_1'$

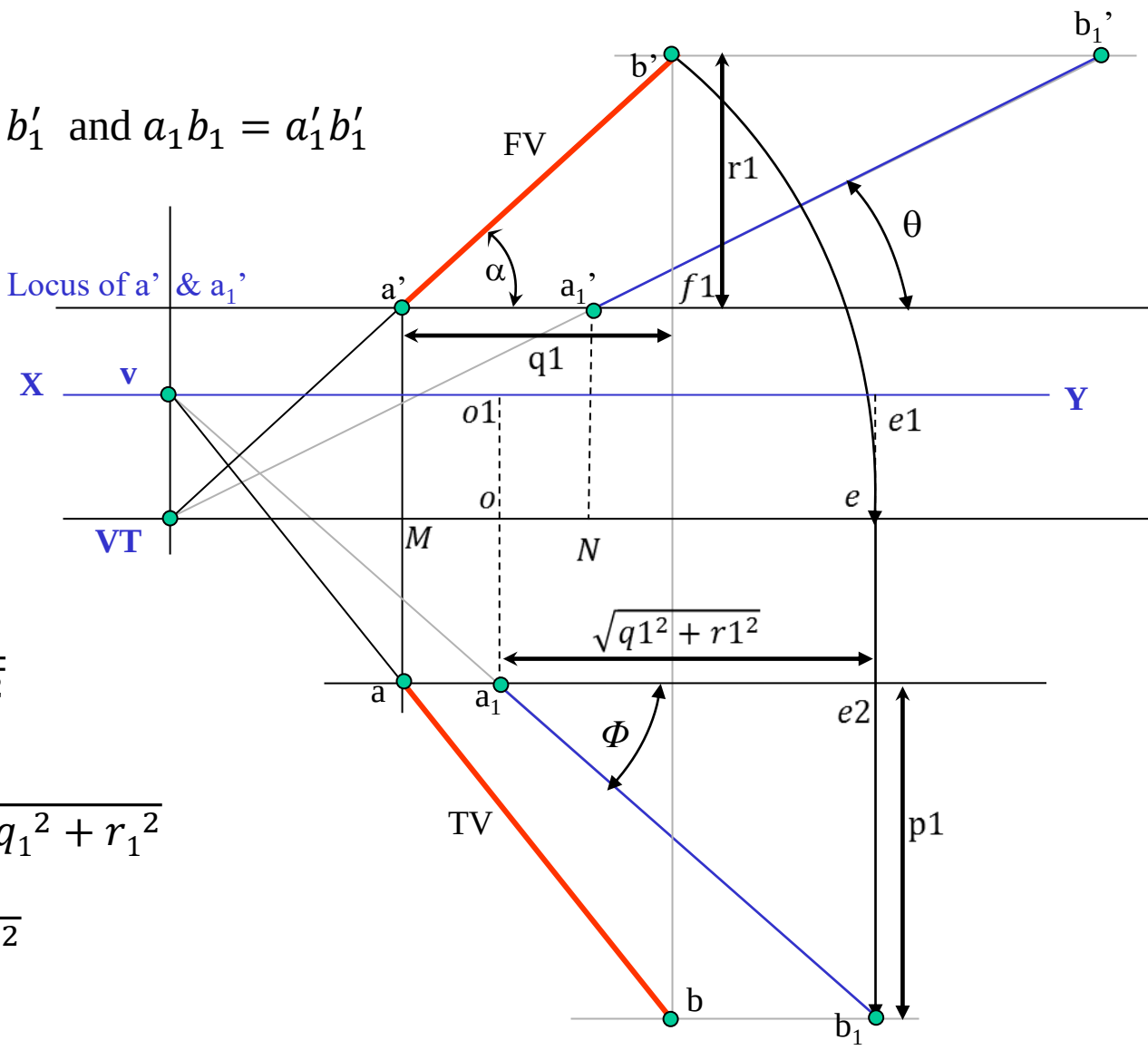
$$\frac{va_1}{a_1b_1} = \frac{VTa_1'}{a_1'b_1'}$$

$$\frac{va_1}{a_1b_1} = \frac{VTa'}{\sqrt{{q_1}^2 + {r_1}^2}}$$

$$\frac{vo_1}{a_1e_2} = \frac{va_1}{a_1b_1} = \frac{VTa'}{\sqrt{{q_1}^2 + {r_1}^2}}$$

$ve_1 = vo_1 + a_1e_2 = VTa' + \sqrt{{q_1}^2 + {r_1}^2}$

Therefore, $a_1e_2 = \sqrt{{q_1}^2 + {r_1}^2}$

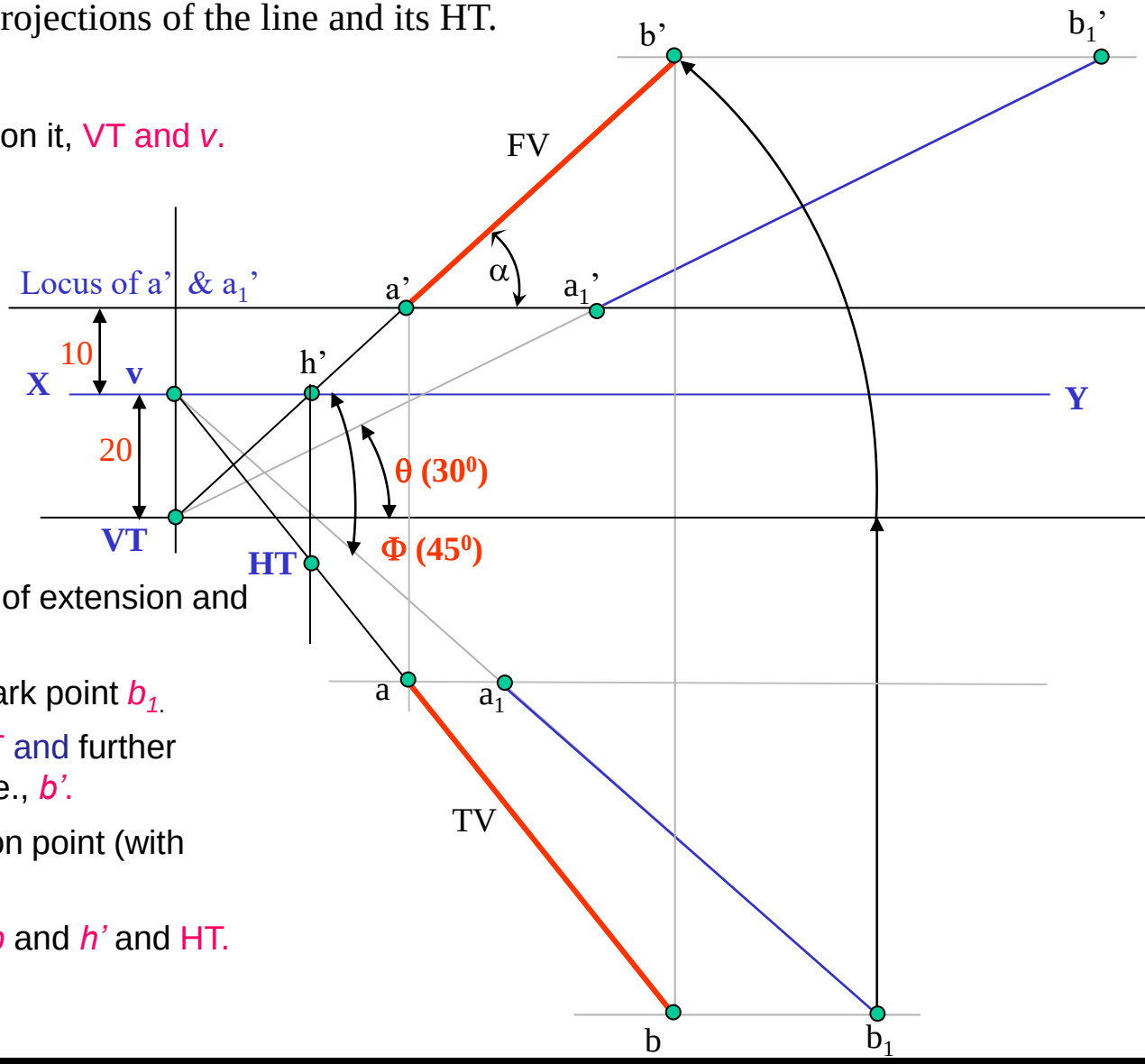


Traces of a line (Alternate Method, Ex. 4)

Line *AB* 100 mm long is 30^0 and 45^0 inclined to *HP and VP,* respectively. End *A* is 10 mm above *HP* and its VT is 20 mm below HP. Draw projections of the line and its HT.

SOLUTION STEPS:-

1. Draw XY, one projector and locate on it, VT and *v*.
2. Draw locus of *a'* 10 mm above XY.
3. Take 30^0 from VT and draw a line. Where it intersects with locus of *a'* name it a_1' as it is TL of that part.
4. From a_1' cut 100 mm (TL) on it and locate point b_1' .
5. Now from *v* take 45^0 and draw a line downwards and mark on it, distance VT- a_1' i.e., TL of extension and name it a_1
6. Extend this line by 100 mm and mark point b_1.
7. Draw its component on locus of VT and further rotate to get the other end of FV, i.e., *b'*.
8. Join it with VT and mark intersection point (with locus of a_1') and name it *a'*.
9. Now as usual locate points *a* and *b* and *h'* and HT.



Exercise Problem

End ‘A’ of a line AB is 35 mm above HP and 20 mm in front of VP. The line makes an angle of 35° with HP. End ‘B’ is in 3rd quadrant. The portion of true length in 3rd quadrant is 25 mm. The top view makes an angle of 40°. Draw the projection of the line, find its true length, angle with VP and locate the traces. Also find the length of the true line in 2nd quadrant.

Hint: 2 ways; find HT first and h’ then b’

or

Find b’ first and then HT and h’….

Thank you