line AB inclined at an angle ϕ to the VP and an angle ψ to the PP, and having its end A at known distances from the co-ordinate planes.

Locate **a′**, **a** and **a″** for the given end A, *Fig. 10.50 (b)*. Draw the projections of the given line AB, first assuming it to be parallel to the VP and inclined at an angle ψ to the PP. Then $\mathbf{a'b_1'}$ is the elevation and it is TL. Profile view corresponding to $\mathbf{a'b_1'}$ is $\mathbf{a''b_1''}$ and is parallel to the YZ line.

Next draw the projections, elevation and profile view, of the line AB assuming it to be parallel to the PP and inclined at an angle ϕ to the VP. Then $\mathbf{a''b_2''}$ is the profile view and is TL, whereas, $\mathbf{a'b_2'}$ is its corresponding elevation and is parallel to the YZ line.

Lines drawn through $\mathbf{b_1'}$ and $\mathbf{b_2''}$ parallel to YZ line give the locus of the end B in elevation and profile or side view. As $\mathbf{a''b_1''}$ is equal to the length of the profile view with **a″** as centre and $\mathbf{a''b_1''}$ as radius strike an arc to intersect the locus of B in profile view at **b″**. Join **a″** to **b″** to obtain the required profile view.

As the elevation **b′** and profile view **b″** of a point B lie on the projector drawn perpendicular to YZ line, therefore, through **b″** draw a projector, perpendicular to YZ line, to meet the locus of end B in elevation in point **b′**. Join **a′** to **b′**. Then **a′b′** is the required front view (elevation) of the line AB.

After drawing the elevation and profile view, top view can be drawn as illustrated.

Projections can alternatively be drawn by striking an arc with **a′** as centre and $\mathbf{a'b_2'}$ as radius to cut the locus of end B in **b′**. Joining **a′**, to **b′** we can get the elevation. Then a projector through **b′** and drawn perpendicular to YZ line meets the locus of end B in profile view at **b″**. Then **a″b″** gives the profile view.

Note: Various principles developed in theory discussed so far in this chapter, can be best understood by studying and drawing the following illustrative problems.

ILLUSTRATIVE PROBLEMS

PROBLEM 10.1. *A line AB , 60 mm long has its end B 20 mm away from HP and 40 mm away from VP. The line is parallel to both the principle planes. Draw its projections in all the four quadrants.*

SOLUTION: *Fig. 10.51* I to IV.

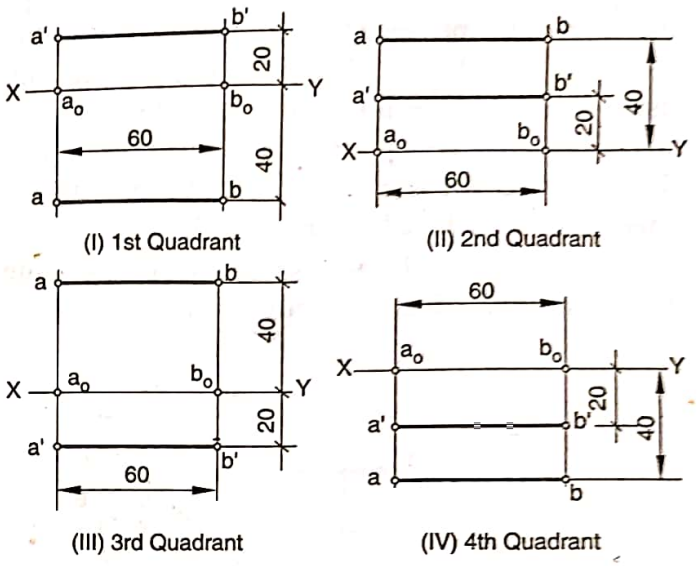

Fig. 10.51. Line parallel to both the Principal Planes

1. Draw the XY line and draw a projector perpendicular to it.
2. Plot **b** and **b′** along the projector.
3. Through **b′** and **b** draw horizontal lines and cut each of these 60 mm (TL) to locate **a′** and **a**. Join **a′** to **a**, to get the projector through end A.
4. Then **a′b′** and **ab** are the required elevation and plan, respectively.

The procedure is applicable to all the four quadrants. The line has no trace.

PROBLEM 10.2. *A line AB, 60 mm long, has its end B 30 mm away from HP and 20 mm away from VP. The line is parallel to the HP and is inclined at 30° to the VP. Draw its projections, in all the four quadrants, when the whole line lies in the same quadrant. Also locate its traces.*

SOLUTION: *Fig. 10.52*, I to IV.

1. Draw XY line and draw a projector normal to it.
2. On this projector locate **b′** and **b**, 30 mm and 20 mm away from the XY line, respectively.
3. Through **b** in plan (top view) draw a line **ab** inclined to the XY line at 30° and cut along it **ba** = 60 mm (TL).
4. Through **a** draw a projector normal to XY, and through **b′** draw a horizontal line cutting this projector at **a′**.

5. Then **a′b′** and **ab** are the desired elevation and plan, respectively.
6. The line does not have HT. Its VT is located as shown in *Fig. 10.52*, I to IV.

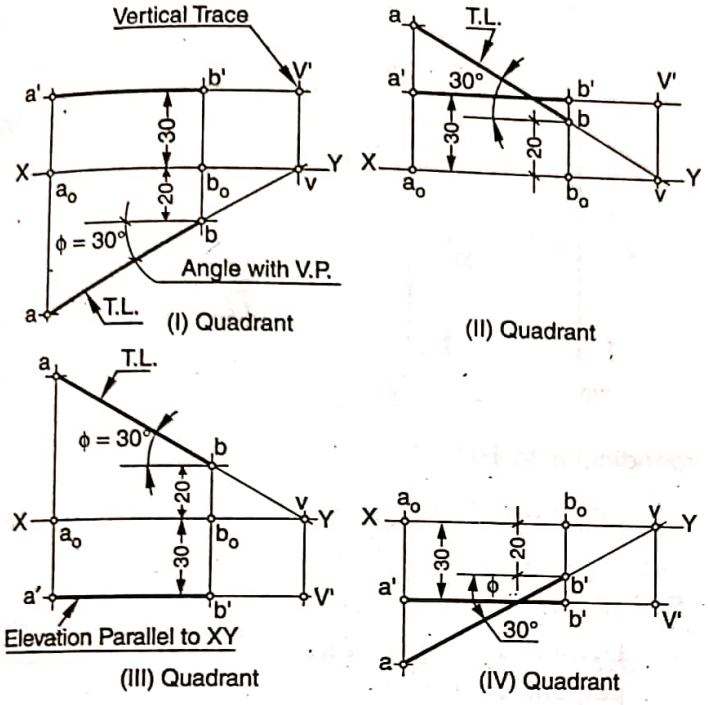

Fig. 10.52. Line parallel to HP and Inclined to VP

PROBLEM 10.3. *A line AB, 60 mm long, has its end B 20 mm from HP and 30 mm from VP. The whole line lies in one quadrant. Draw its projections in all the four quadrants if it is inclined to the HP at 32° and is parallel to the VP. Also locate the traces.*

SOLUTION: *Figure 10.53.*

1. Draw XY line.
2. Draw a projector perpendicular to the XY line and on this projector locate **b′** and **b**, as given.
3. Through **b′** (in elevation) draw a line inclined to the XY at 32° in such a direction that the elevation **a′b′** keeps on one side of the XY line.
4. Cut **b′a′** = 60 mm (TL).
5. Through **a′** draw a normal projector to the XY line.
6. Through **b** draw a line parallel to the XY which cuts the projector through **a′** at **a**. Then **ab** is the required plan and **a′b′** the required elevation.
7. As the line is parallel to the VP it will not have any VT.
8. Produce **a′b′** to cut the XY line at **h′**. Draw a normal to the XY line at **h′**.
9. Produce the top view **ab** to cut this normal in H. Then H is the horizontal trace of the line AB.

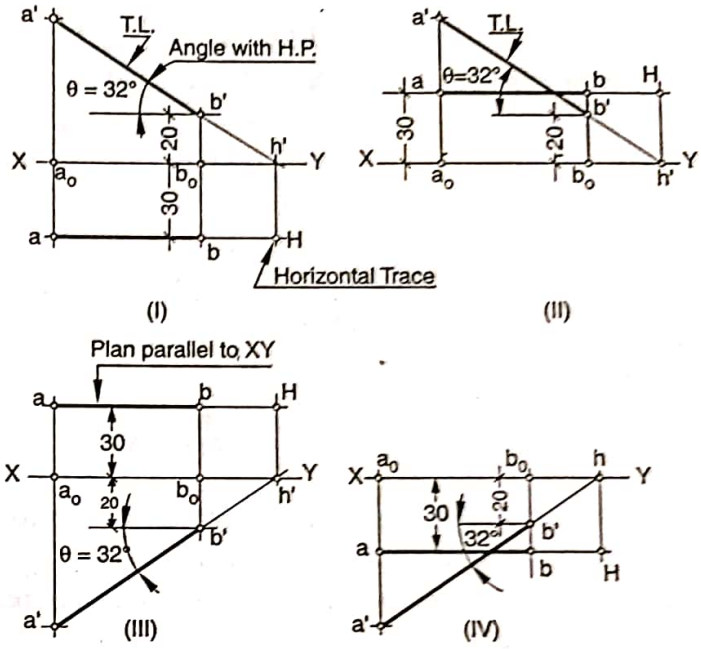

Fig. 10.53. Line Parallel to VP and Inclined to HPI,' II, III and IV are the Quadrants

PROBLEM 10.4. *A line AB, 35 mm long, is perpendicular to VP and its end B is 15 mm from HP and 10 mm from the VP. The extremities of the line lie in same quadrants. Draw its projecitons in all the four quadrants. Also locate its traces.*

SOLUTION: Refer *Fig. 10.54*, I to IV.

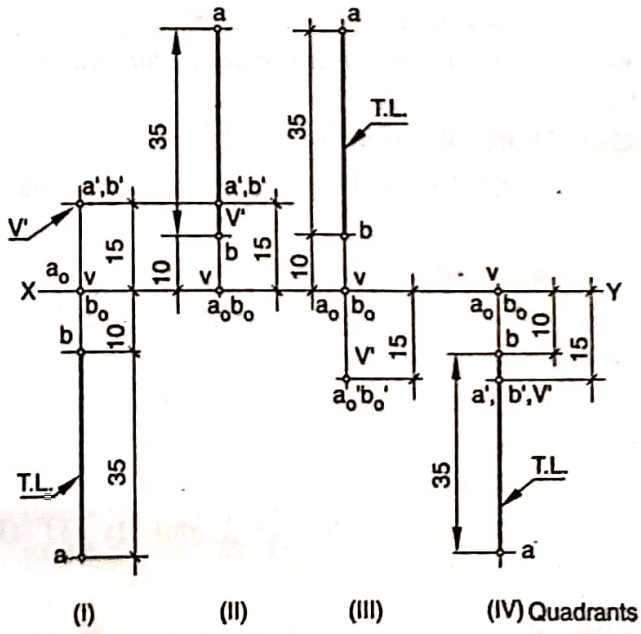

Fig. 10.54. Line Perpendicular to VP

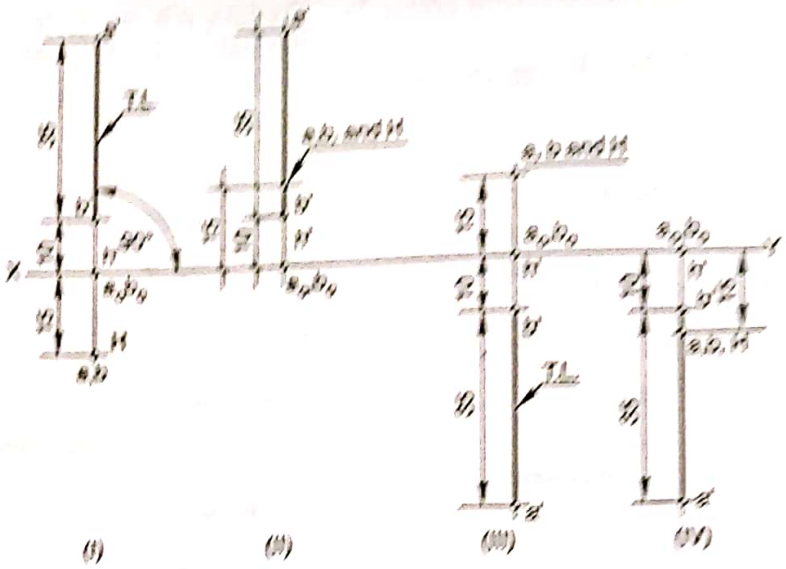

Fig. 10.55. Line Perpendicular to HP

1. Draw XY line and draw a projector perpendicular to it. Locate b′ and b on it.
2. As the line is perpendicular to the VP therefore, it is parallel to HP.
3. Mark point a, along the projector b′b and 35 mm away from b, on the same side of XY as b, to obtain the plan ab (or top view) of the line.
4. a′ coincides with b′.
5. The line has no HT while its VT (V′) is coincident with a′, b′.

PROBLEM 10.5. *A line AB, 35 mm long, is perpendicular to HP and its end B is 10 mm from the HP and 15 mm from VP. If the whole line lies in one quadrant draw its projections in all the four quadrants. Also locate its traces.*

SOLUTION: *Refer Fig. 10.55,* I to IV.

1. Draw XY line and a projector perpendicular to it.
2. Locate b′ and b on this projector.
3. As the line is perpendicular to the HP its projection on it is a point, *i.e.,* a and b coincide.
4. As the line is parallel to the VP its projection on it will be true length, *i.e.,* a′b′ = 35 mm and is perpendicular to the XY line.
5. The line has no VT (V′) and its HT (H) coincides with a and b.

PROBLEM 10.6. *A line EF, 50 mm long, parallel to HP and inclined at 45° to VP, has its end E 10 mm behind the VP and 15 mm below the HP. Assuming the line to be in third quadrant, draw its projections.*

Solution: *Refer Fig. 10.56.*

1. Draw XY line and a light projector perpendicular to it

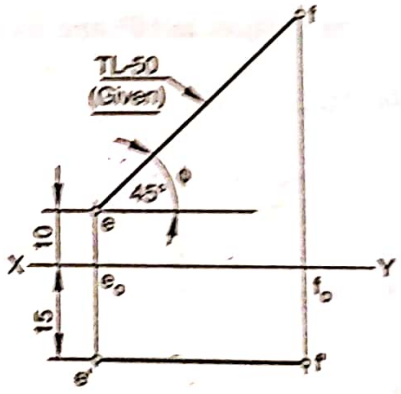

Fig. 10.56.

2. Plot the projections e′ and e of the given end E along the projector, as shown.
3. As the given line is parallel to HP, its projection on the HP will be TL, *i.e.,* 50 mm long and will make the given angle ϕ (45°) with the XY line. Therefore, through e draw a line inclined at 45° to the XY line and along it mark a point f at a distance of 50 mm from e. Then ef is the top view of the given line EF.
4. As the line is given to be parallel to the HP, the distances of its extremities E and F from HP will be equal. Therefore, its elevation e′f′ will be parallel to the XY line. Thus, to obtain the elevation of the line draw a line parallel to the

XY line, through e'. Then draw a projector through f intersecting this line at f'. Then e'f' is the required elevation of the given line EF.

PROBLEM 10.7. *Line AB, 50 mm long, parallel to HP and inclined to VP at 30°, has its end A 15 mm below the HP and in the VP. Assuming the line to be in third quadrant, draw its projections.*

Solution: Refer *Fig. 10.57.*

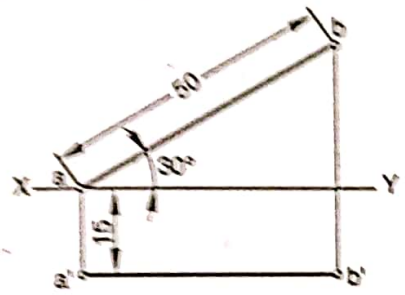

Fig. 10.57.

1. Draw the XY line. Then draw a projector perpendicular to it.
2. As the end A is in the VP, its top view, **a**, will be on the XY line and its front view, **a'**, will be 15 mm below the XY line, on the same projector.
3. Through **a** draw a line **ab**, 50 mm, inclined at 30° to the XY line. This is the required top view of the line AB.
4. Through **a'**, draw a line parallel to the XY line and project from **b**, downwards, to intersect this line at **b'**. Then **a'b'** is the front view of the line AB.

PROBLEM 10.8. *Plan ab, of a line AB, measures 40 mm. The line is parallel to VP and inclined to HP at 30° and its end A is 10 mm below the HP and 20 mm behind the VP. Draw the projections of the line and determine its true length. Assume the line to be in third quadrant.*

Solution: Refer *Fig. 10.58.*

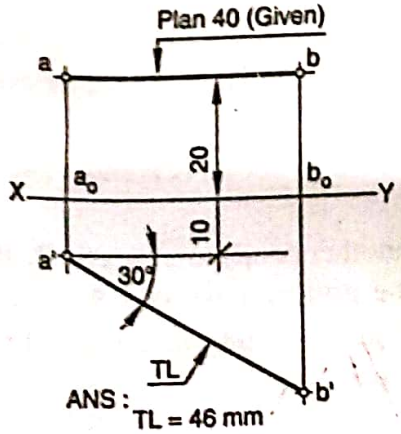

Fig. 10.58.

1. Draw the XY line and on a projector, drawn perpendicular to it, plot the top and front views (**a**, **a'**) of the end A.
2. As the given line AB is parallel to the VP, its projection **ab** on the HP (plan) will be parallel to the XY line and the front view, **a'b'**, will show true length and true inclination, θ°, of AB with the HP. Therefore, draw a line through **a**, parallel to the XY line and cut **ab** = 40 mm, the given length of plan.
3. Through **a'** draw a line inclined to the XY line at 30° and mark point **b'** along it where the vertical projector through **b** cuts it. Then **a'b'** is the required front view and it gives TL of the line AB, measure it.

PROBLEM 10.9. *A line AB has its end A 15 mm away from HP and 55 mm away from the VP, end B is 45 mm from the HP and 10 mm from the VP. The line lies in a profile plane. Draw the projections of the line, assuming it to be in: (a) third quadrant, (b) first quadrant.*

Solution: Refer *Fig. 10.59, 10.60.*

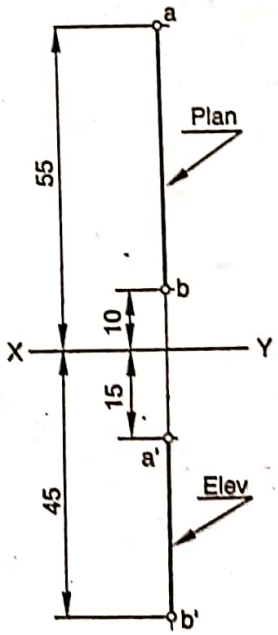

Fig. 10.59. Line in Third Quadrant

1. As the line lies in a profile plane, the end projectors will coincide in this case. Thus, both the front and top views will be along the same vertical projector.
2. Draw the XY line and a light projector perpendicular to it.
3. Mark along this projector front views **a'**, **b'** and top views **a**, **b** of the two extremities of the line AB.

4. Join a′ to b′ and a to b to obtain the required front and top views of the line, respectively.

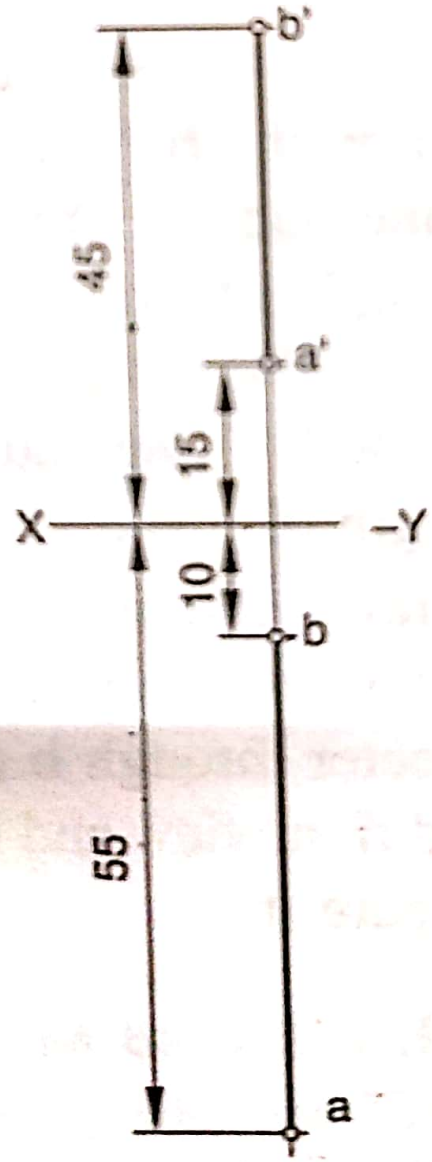

Fig. 10.60. Line on First Quadrant