Note 1: Line E,3 in plan will be parallel to 4,5. Also line 1,2 will be parallel to C,6 in plan.
Note 2: If the lines do not intersect they are extended until they do intersect.

To draw the shortest horizontal line to a plane from a given point P outside it, Fig. 9.81.
A = 75 75 10 B = 20 50 90
C = 40 5 115 D = 95 20 45
P = 110 45 80

(1) Draw an auxiliary showing the plane as an edge view. Project P onto this view.
(2) In the auxiliary draw the horizontal line from P to hit the plane at i. Project i to plan.
(3) Since the horizontal line from P to i in plan will be seen as a true length, then the line iP in plan must be the shortest distance from P to the line projected from the auxiliary elevation. Draw from P perpendicular to the projection lines to the auxiliary to find i.
(4) iP will be horizontal in elevation.

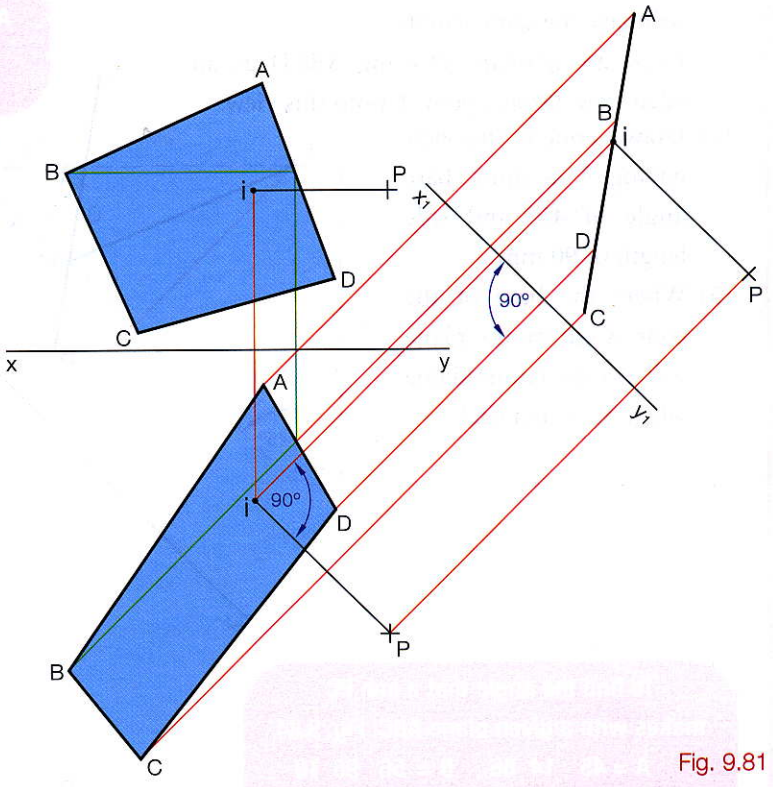


Fig. 9.81

To draw the perpendicular to a plane ABC from a point P outside it. Fig. 9.82
A = 120 88 2 B = 50 50 94
C = 160 20 84 P = 148 76 96

(1) Draw an auxiliary elevation showing the plane as an edge view and project point P onto this view.
(2) In the auxiliary, draw the perpendicular from P to the plane finding point q.
(3) It should be noted that **a perpendicular to a plane will appear perpendicular to the traces of that plane.** We can therefore draw the required line Pq in plan as it will appear perpendicular to the level line on the plane. The level line will be parallel to the HT line.
(4) Line Pq can be found in elevation as shown in Fig. 9.82.

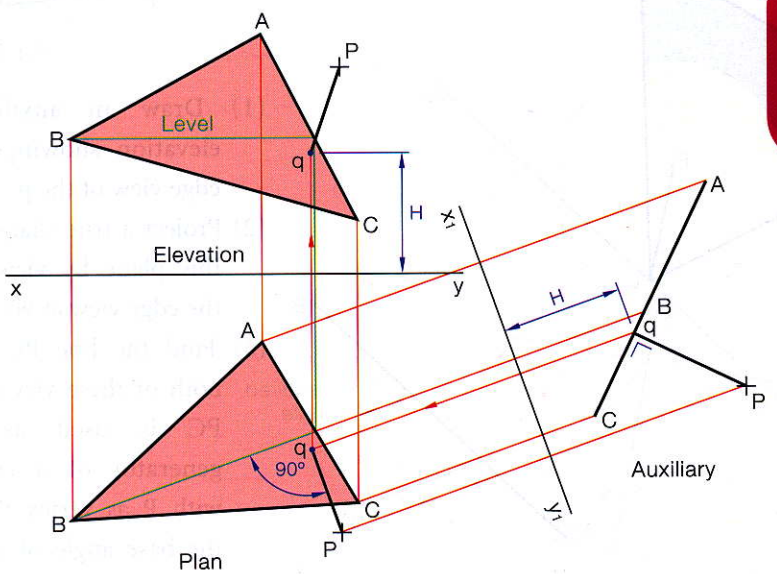


Fig. 9.82

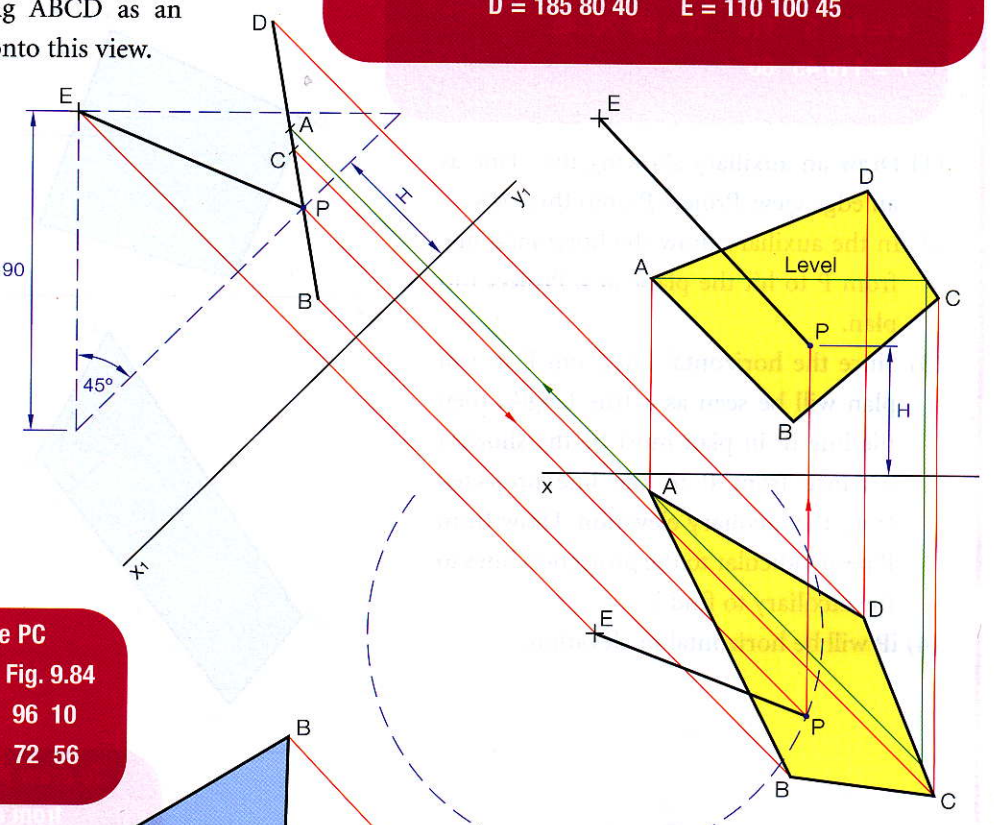
To draw the projections of a line drawn from a point E outside a plane that will touch the plane at a distance of 90 mm from E and that shall be inclined at an angle of 45° to the horizontal plane. Fig. 9.83

A = 125 55 5 B = 165 15 85 C = 205 50 90
D = 185 80 40 E = 110 100 45

(1) This problem is solved under the principle that any line generator on the surface of a right cone will have the same inclination to the horizontal plane as the cone base angle. Furthermore all generators on a right cone will have the same length.
Draw an auxiliary showing ABCD as an edge view. Project point E onto this view.

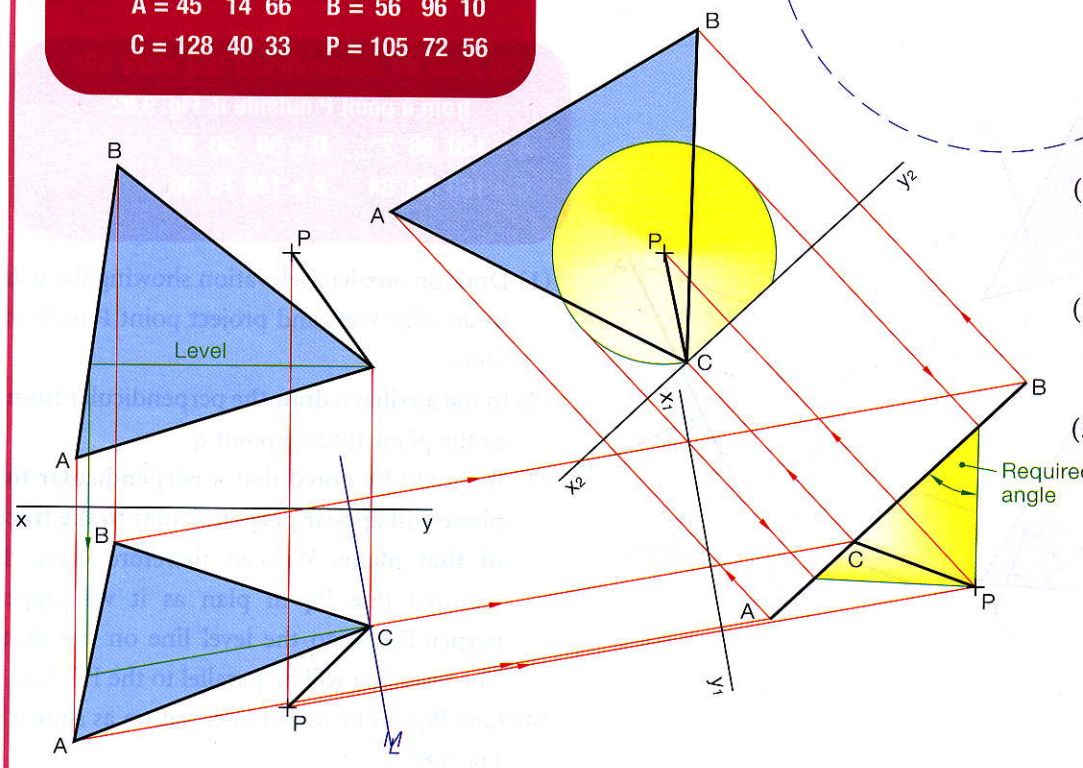
(2) Draw a cone in this view having E as apex, base angle of 45° and side length of 90 mm.

(3) Where the base of the cone is cut by the plane will give the required line when projected back.



To find the angle that a line PC makes with a given plane ABC. Fig. 9.84

A = 45 14 66 B = 56 96 10
C = 128 40 33 P = 105 72 56



(1) Draw an auxiliary elevation showing an edge view of the plane.

(2) Project a true shape of this plane by viewing the edge view at 90°.

(3) Find the line PC on both of these views. If PC is used as a generator of a cone with P as vertex then the base angle of that cone will equal the angle the line PC makes with the plane.

(4) With PC as radius and P as centre draw the plan of this cone in the second auxiliary plan. The edges of this circle produced back to the first auxiliary will give the required angle.

Given a plane ABC and a point E outside it. To draw a line from E that is 40 mm long, is parallel to the plane ABC and the vertical plane. Fig. 9.85
A = 110 15 105 B = 165 85 20 C = 50 70 85 E = 65 100 30

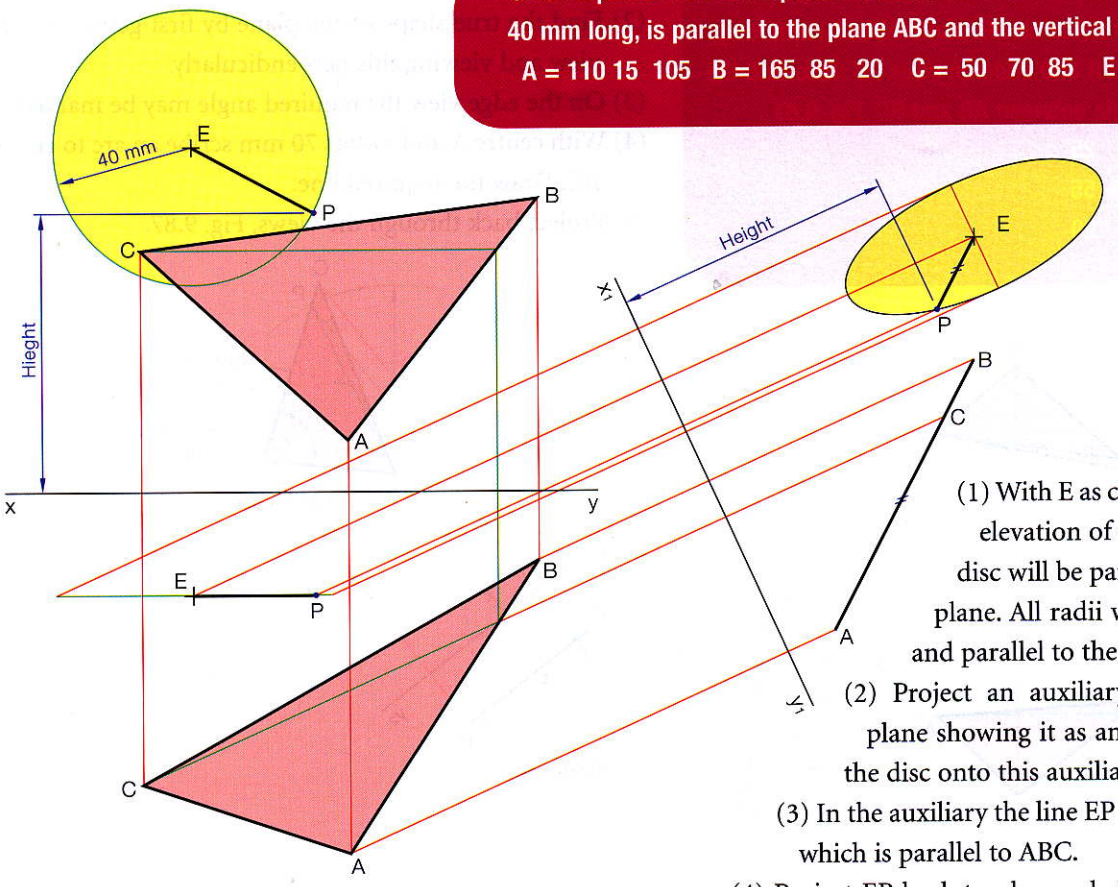


Fig. 9.85

(1) With E as centre draw a disc in elevation of 40 mm radius. The disc will be parallel to the vertical plane. All radii will be 40 mm long and parallel to the VP.

(2) Project an auxiliary elevation of the plane showing it as an edge view. Project the disc onto this auxiliary.

(3) In the auxiliary the line EP can be easily found which is parallel to ABC.

(4) Project EP back to plan and elevation. It satisfies all parameters.

Given the coordinates of a plane ABC. Draw the projections of a line on the plane ABC, that passes through A and makes an angle of 60° with the edge BC. Fig. 9.86
A = 125 85 30 B = 170 10 100 C = 80 75 65

(1) Draw the plan and elevation of the plane.

(2) Get an edge view of the plane in the usual way.

(3) By viewing perpendicular to the edge view we can project a true shape of the lamina.

(4) On the true shape draw the required line. Project point p back through the views to find the line in plan and elevation as shown in Fig. 9.86.

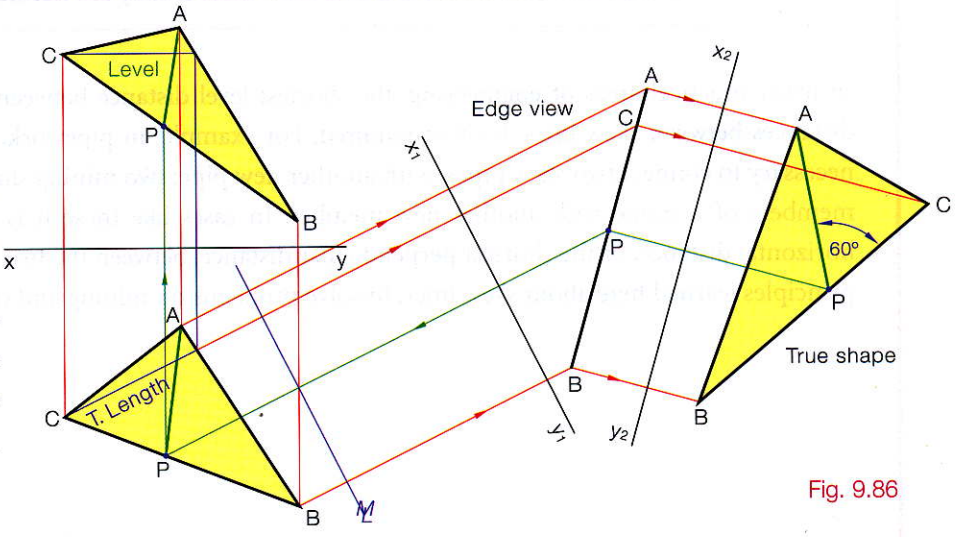


Fig. 9.86

Given the coordinates of a plane ABC. Draw the projections of a line on the plane ABC, 70 mm long, which starts at A and ends on edge BC. Also find the true angle between AB and BC. Fig. 9.87

A = 205 80 25
B = 175 105 55
C = 130 65 20

(1) Draw the plan and elevation of the lamina.
(2) Find the true shape of the plane by first getting the edge view and viewing this perpendicularly.
(3) On the edge view the required angle may be marked.
(4) With centre A and radius 70 mm scribe an arc to cut edge BC. Draw the required line.
(5) Project back through the views, Fig. 9.87.

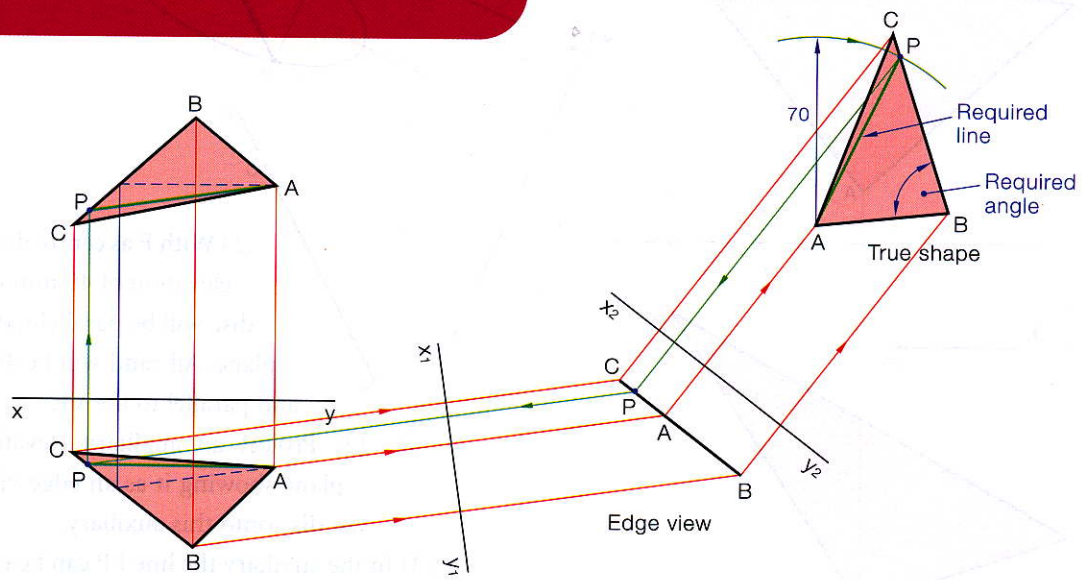


Fig. 9.87

Skew Lines

Definition: Two lines are called skew lines if they are neither parallel nor intersecting.

In many practical areas of engineering, the shortest level distance between skew lines or the shortest perpendicular distances between skew lines, is often required. For example, in pipework, mining, structural frames etc., it is often necessary to connect two skew pipes, with another new pipe; two mining shafts, with another new tunnel; or two skew members of a frame with another new member. In cases like these it is of great advantage to know the shortest horizontal distance, or the shortest perpendicular distance, between the two elements. At a later stage we will apply the principles learned here about skew lines, to solve problems on mining and on the hyperbolic paraboloid.