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.

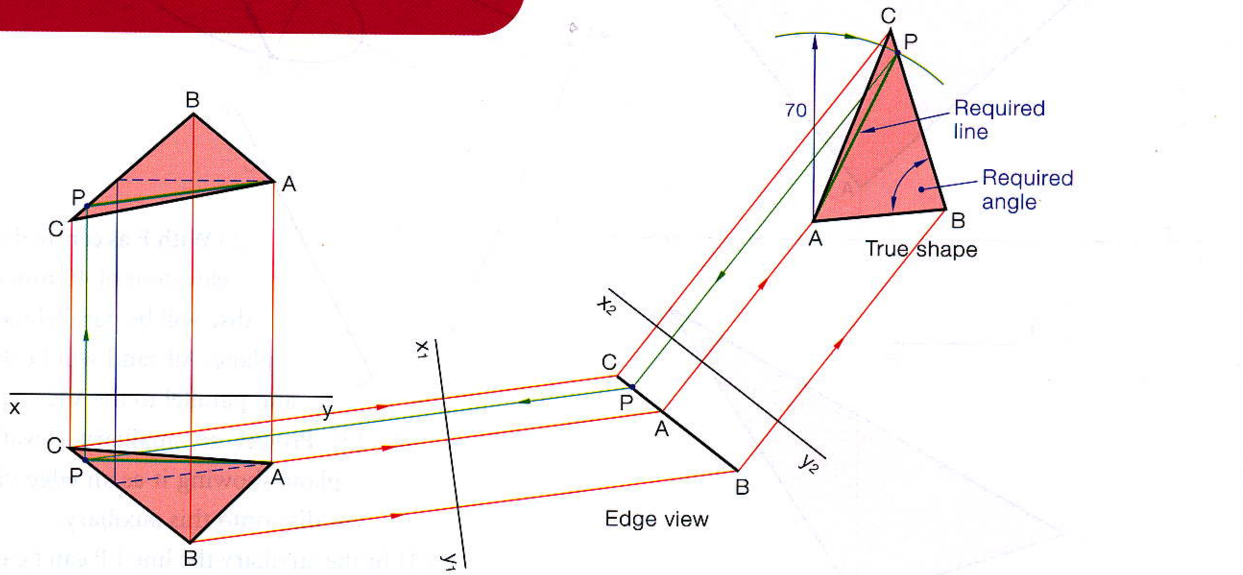

Fig. 9.87

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.

If we produce a plane that contains one of the lines and has an edge that is parallel to the other line, then an edge view of that plane will show both lines as parallel.

To find the shortest horizontal distance between two skew lines AB and CD. Fig. 9.88

A = 45 55 5 B = 105 80 40

C = 30 100 45 D = 85 15 15

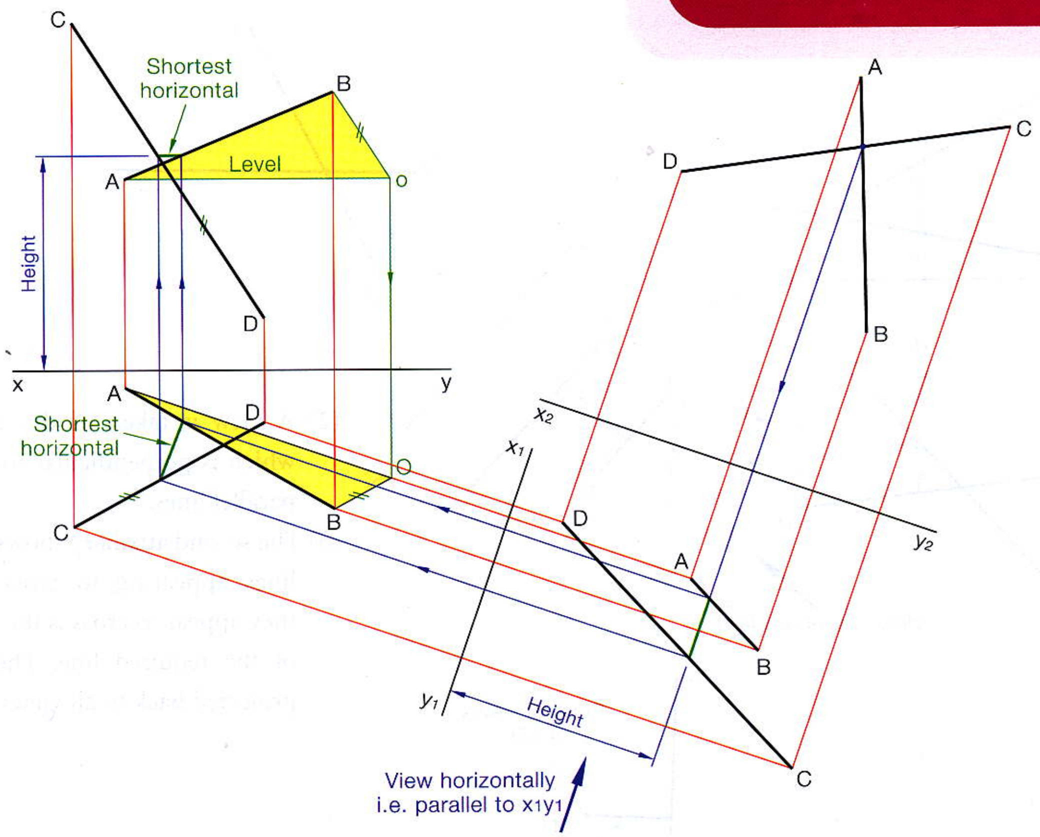

Fig. 9.88

(1) Draw the plane to contain AB and be parallel to CD. Draw a level line from A in elevation. From B draw a line parallel to the other skew line CD. These two lines intersect at O. This completes the plane in elevation.
(2) Drop O to plan.
(3) From B in plan draw a line parallel to CD in plan. This line intersects the line dropped from O in elevation to give point O in plan.
(4) Join O back to A thus completing the plan of the plane.
(5) An auxiliary elevation viewing along AO will show both lines as parallel.
(6) Project a second auxiliary plan by projecting horizontally, i.e. parallel to the x_1y_1. Both lines appear to cross. Where they appear to cross is the location of the shortest horizontal line.
(7) Project the line back through the views as shown.

To find the shortest distance (shortest perpendicular distance) between two skew lines. Fig. 9.89

A = 170 5 55 B = 250 20 65

C = 175 55 90 D = 230 25 30

(1) The initial part of this problem is solved in the same way as the previous example up to the stage of projecting an auxiliary showing the two lines appearing parallel.

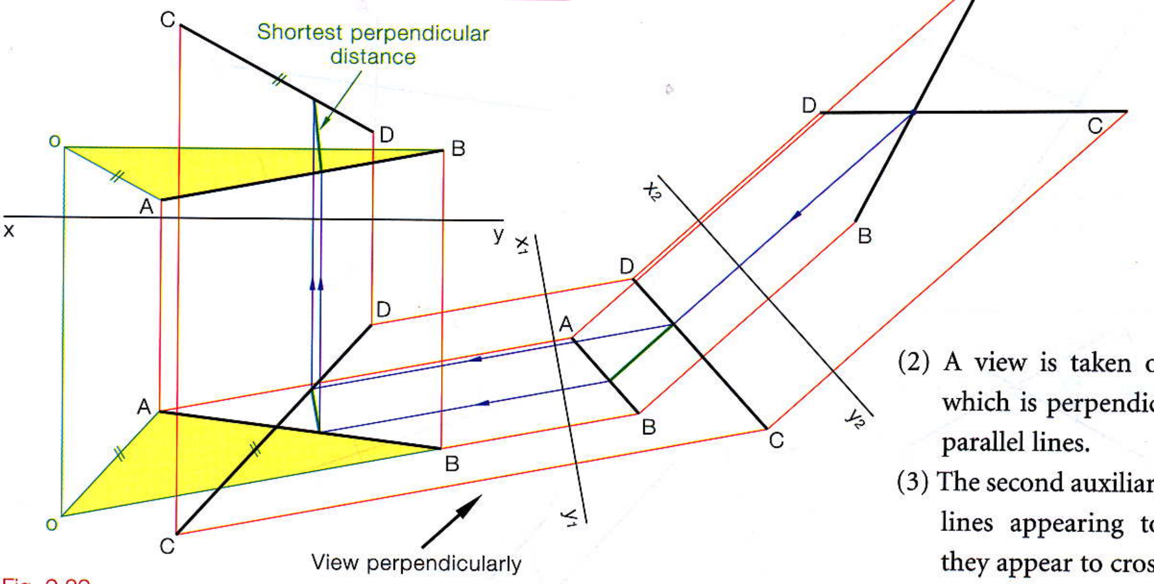

Fig. 9.89

(2) A view is taken of this auxiliary which is perpendicular to the two parallel lines.

(3) The second auxiliary shows the two lines appearing to cross. Where they appear to cross is the location of the required line. The line is projected back to all views.

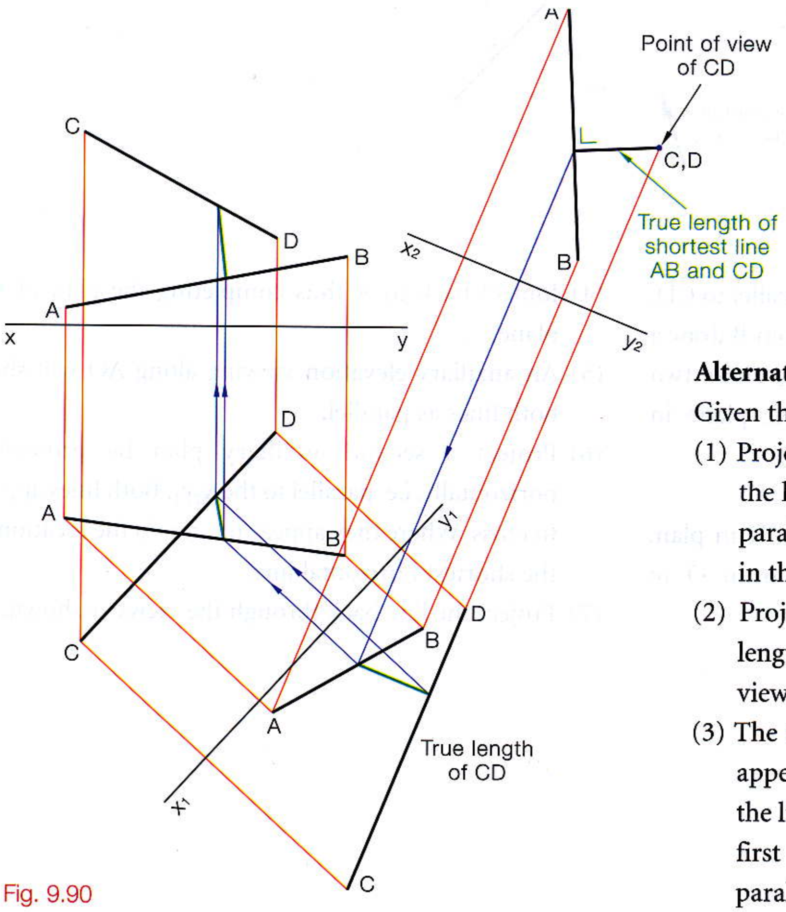

Fig. 9.90

Alternative Method: Line Method

Given the same problem.

(1) Project an auxiliary from plan that will show one of the lines as a true length. Fig. 9.90 shows x_1y_1 drawn parallel to CD thus showing line CD as a true length in the auxiliary elevation.

(2) Project a second auxiliary viewing along the true length line. This new auxiliary shows CD as a point view.

(3) The shortest line between two skew lines will always appear as a true length in a view that shows one of the lines as a true length. When projected back to the first auxiliary the shortest line must therefore be parallel to the x_2y_2 line.

(4) Project back to all views.

HIGHER LEVEL

Given the coordinates of the centre lines of two 15 mm diameter pipes. Determine the clearance between them using the line method. Fig. 9.91

A = 125 55 80 B = 175 10 10

C = 100 25 10 D = 165 75 50

The construction is as in the previous example. The pipes need only be drawn in the secondary auxiliary view.

(1) Draw the plan and elevation of the centre lines.

(2) Find the true length of one of these, e.g. CD, by auxiliary projection.

(3) Project a second auxiliary viewing along the true length CD.

(4) A point view of centre line CD is found. Draw in the pipe details which will show clearly the clearance between the pipes.

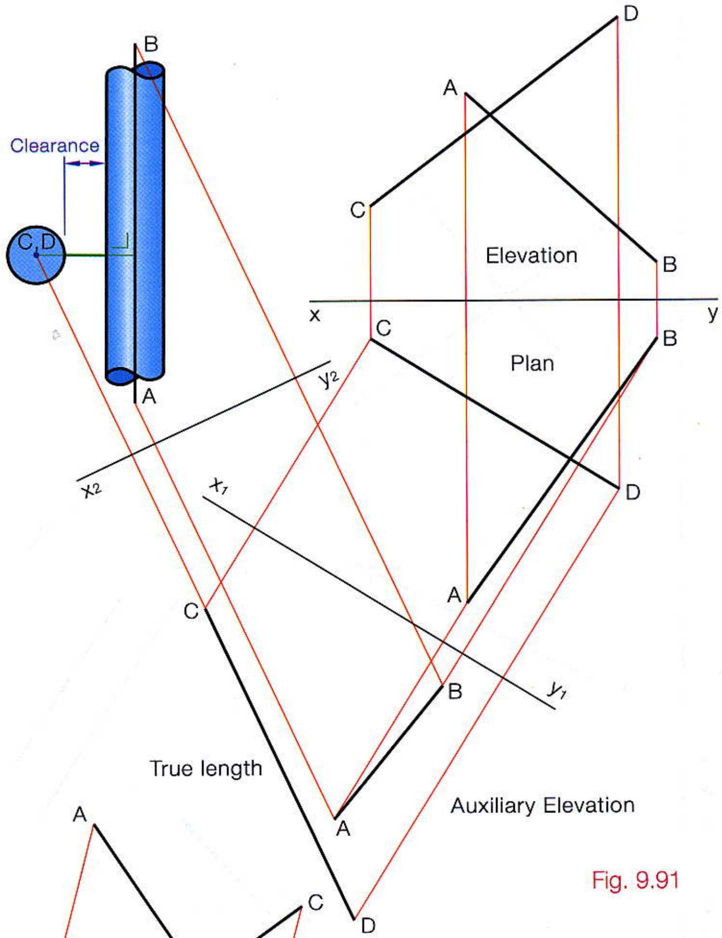

Fig. 9.91

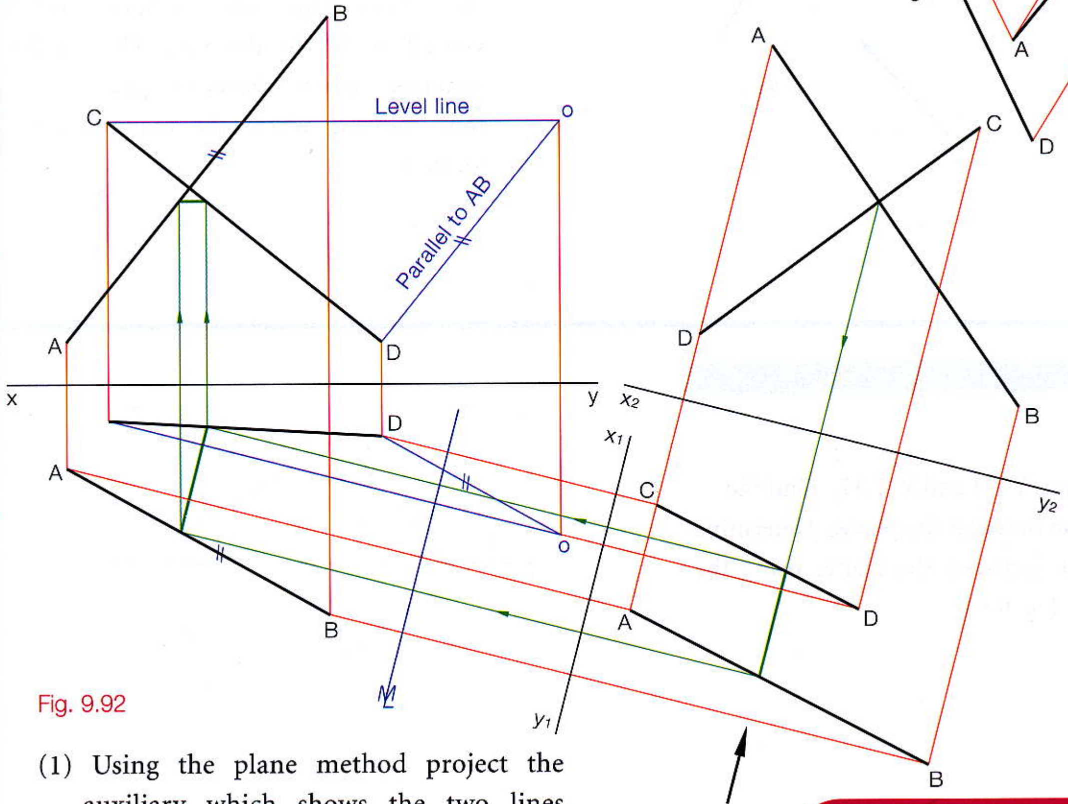

Fig. 9.92

(1) Using the plane method project the auxiliary which shows the two lines appearing parallel.

(2) View parallel to x_1y_1 (horizontally) for the second auxiliary. The lines appear to cross which is the location of the required brace.

(3) Project back through the views.

Given the coordinates of two struts. Show the projections of the shortest horizontal brace strut between them. Fig. 9.92

A = 30 8 16 B = 80 70 44

C = 38 50 7 D = 90 8 10

Given the coordinates of two skew lines. To find the shortest distance between them at 30° to the HP. Fig. 9.93

A = 120 9 33 B = 48 60 69

C = 60 25 16 D = 96 65 65

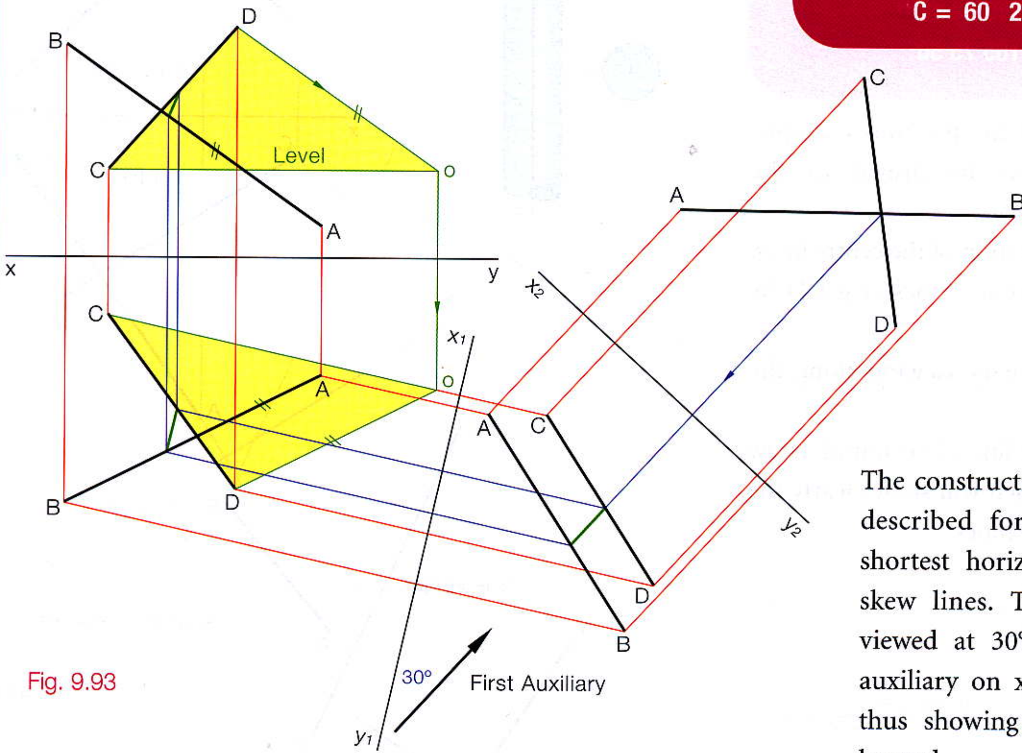

Fig. 9.93

The construction is nearly identical to that described for shortest perpendicular or shortest horizontal distance between two skew lines. The first auxiliary must be viewed at 30° to the x_1y_1. The resulting auxiliary on x_2y_2 shows the lines crossing thus showing where the required line is located.

HIGHER LEVEL

Activities

DIHEDRAL ANGLE

Q1. Given two planes VTH and $V_1T_1H_1$. Find the line of intersection between the planes. Determine the dihedral angle between the planes using the triangle method, Fig. 9.94.

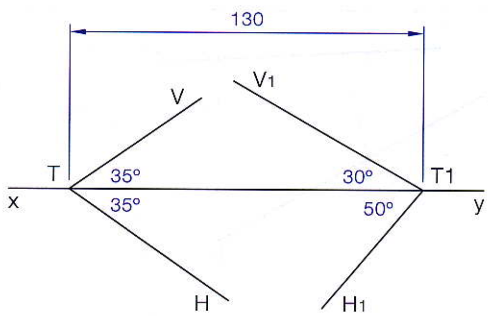

Fig. 9.94

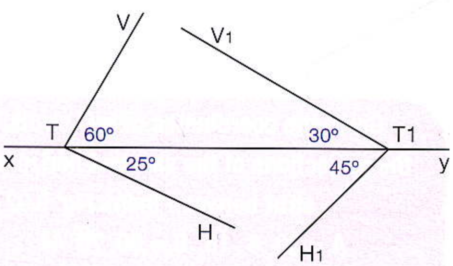

Fig. 9.95

Q2. Given two planes VTH and $V_1T_1H_1$. Find the line of intersection between the planes. Determine the dihedral angle between the planes using the point view method, Fig. 9.95.