Q14. The object shown in Fig. 9.59 is to be cut by the oblique plane VTH.

(i) Draw the plan and elevation of the cut solid.

(ii) Draw the true shape of the cut solid.

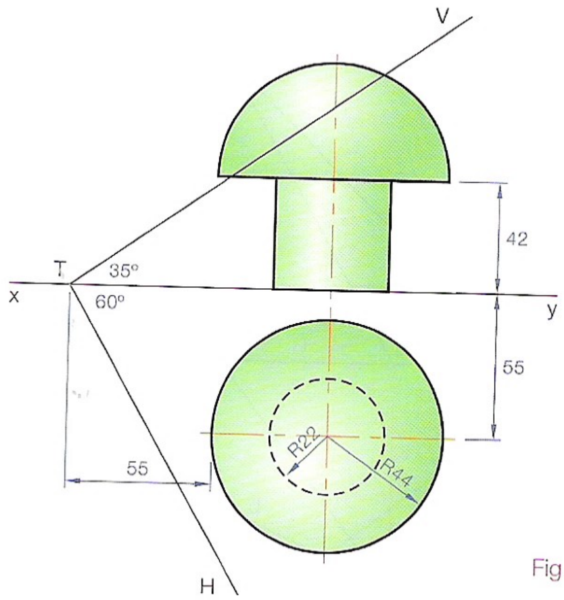

Fig. 9.59

Given two planes VTH and $V_1T_1H_1$. Find the line of intersection between the planes. Determine the dihedral angle between the two planes. Fig. 9.60

(1) Find the line of intersection in plan and elevation.

(2) Find the true length of the line of intersection.

(3) At any point c on the true length draw a perpendicular to the length giving cab. The line cab represents the edge view of the triangle which fits between the planes and measure the dihedral angle.

(4) Rebat the triangle onto the horizontal plane by rotating vertex c as shown. Edge ab is perpendicular to the plan of the line of intersection.

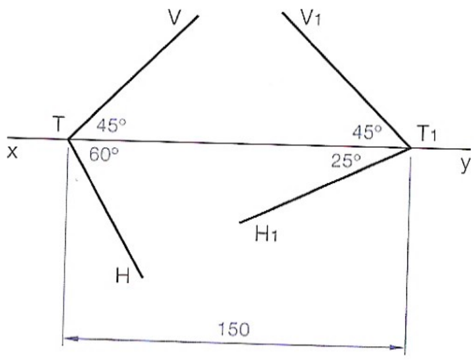

Fig. 9.60

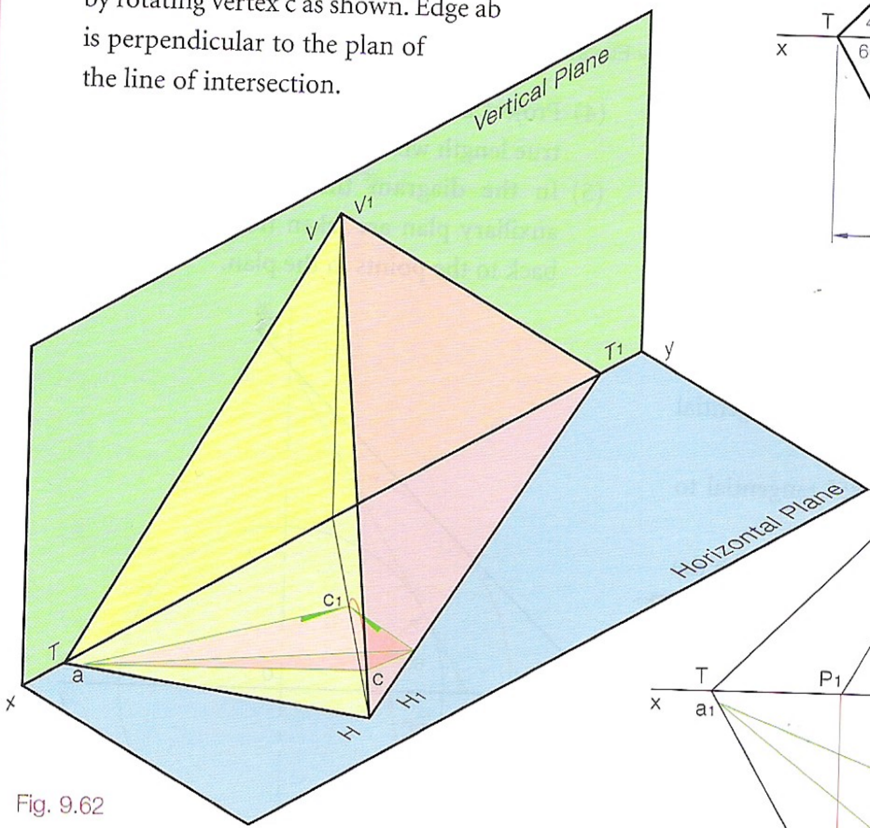

Fig. 9.62

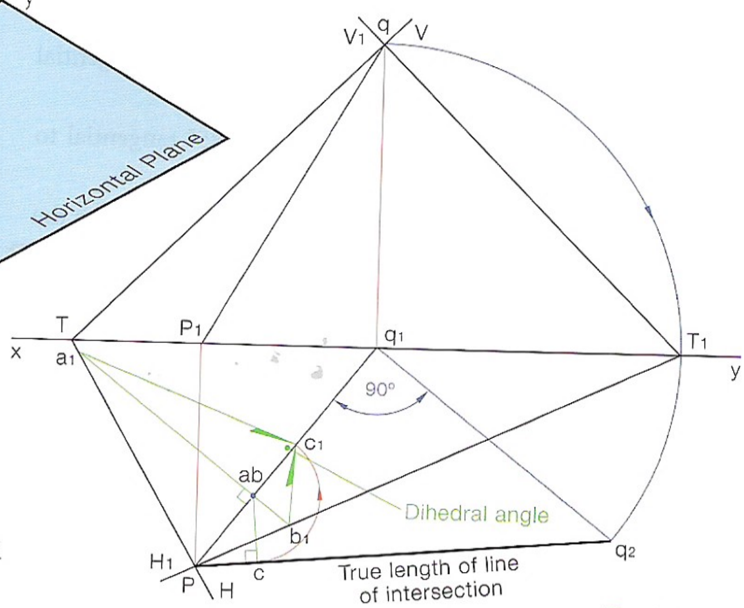

Fig. 9.61

(5) Angle acb is the required dihedral angle, Figures 9.61 and 9.62.

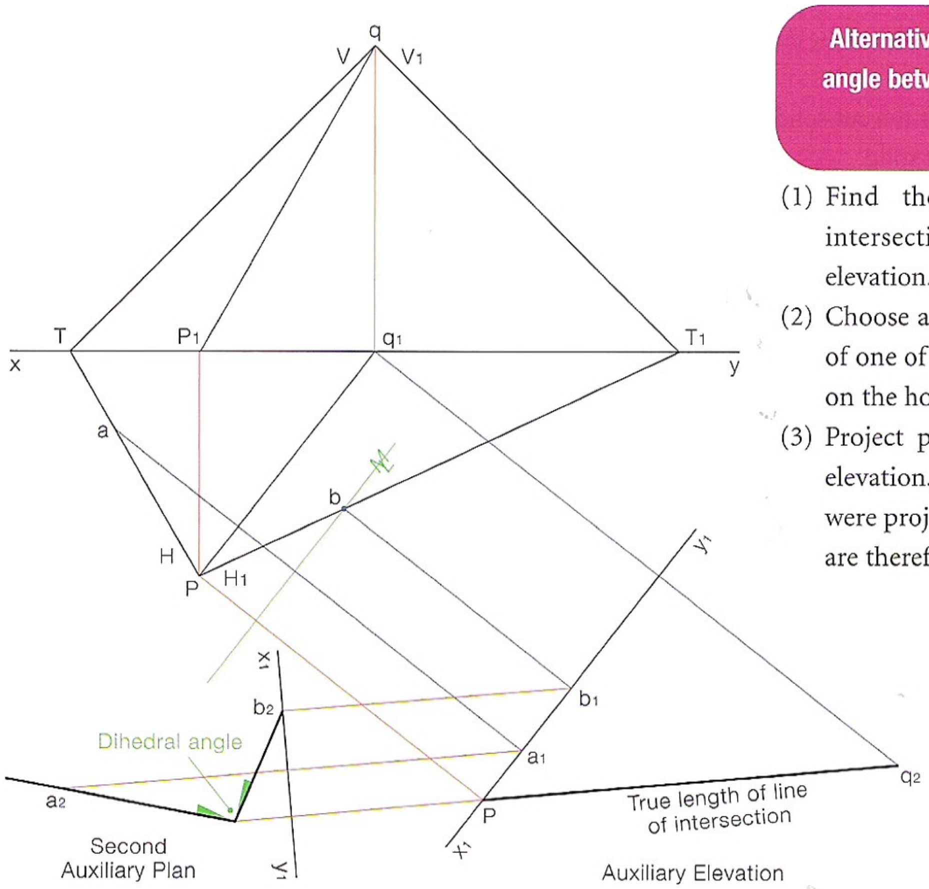

Fig. 9.63

Alternative method of finding the dihedral angle between two oblique planes VTH and $V_1T_1H_1$. Fig 9.63

(1) Find the true length of the line of intersection, pq, by using an auxiliary elevation.

(2) Choose any point 'a' on the horizontal trace of one of the planes and choose any point 'b' on the horizontal trace of the other plane.

(3) Project points a and b onto the auxiliary elevation. Both points rest on the x_1y_1 as they were projected from the horizontal trace and are therefore on the horizontal plane.

(4) Project a second auxiliary plan viewing along the true length which will show pq as a point view.

(5) In the diagram the distances for the second auxiliary plan are taken from the measuring line back to the points in the plan.

To draw the traces of a plane VTH given the inclination to the horizontal plane as 60° and the inclination to the vertical plane as 45°. Fig. 9.64

(1) Draw a circle having its centre on the xy line.

(2) Draw a cone in elevation of base angle 60°, tangential to this sphere. Draw the cone in plan.

(3) Draw a cone in plan of base angle 45° tangential to the sphere.

(4) The traces of the required plane will pass through the vertex of each cone and be tangential to the base of each cone.

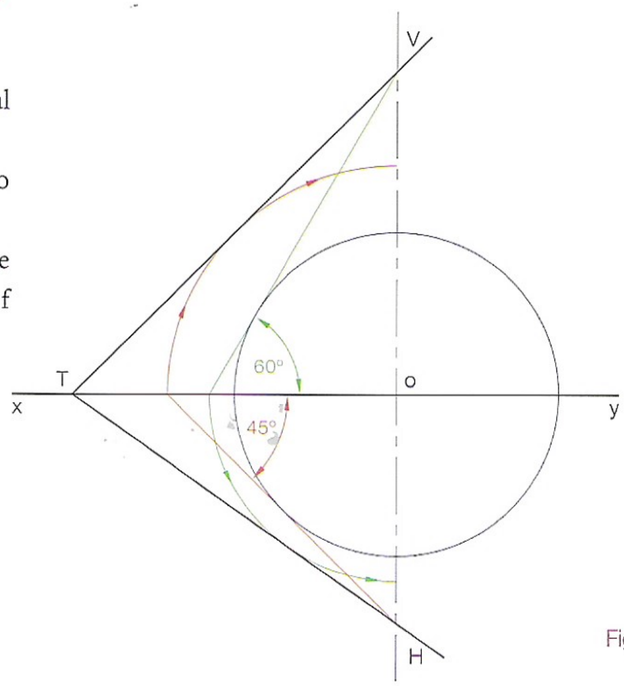

Fig. 9.64

Given the plan and elevation of a point P. Find the traces of a plane that contains point P and is inclined at 60° to the HP and 45° to the VP. Fig. 9.65

(1) Using P as the apex of the cone in elevation draw a cone with base angle of 60°.

(2) Draw the plan of this cone. The horizontal trace must be tangential to this cone in plan.

(3) Draw the hemisphere that fits under this cone and is tangential to it. Find the plan of the hemisphere.

(4) The angle required to the vertical plane is 45°. Draw a line at 45° to the xy line in plan that is tangential to the plan of the hemisphere. This line intersects the centre line of the cone and hemisphere at point s. Point s is a point on the HT line

(5) Draw the HT from s, tangential to the plan of the cone.

(6) The VT line can be found by projecting the cone apex parallel to the HT to xy. Then vertically and horizontally across in elevation to find a point on the vertical trace.

(7) Alternatively the VT line can be found by drawing it tangentially to the 45° angle rotated about point o, Fig. 9.66.

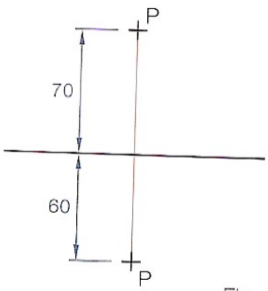

Fig. 9.65

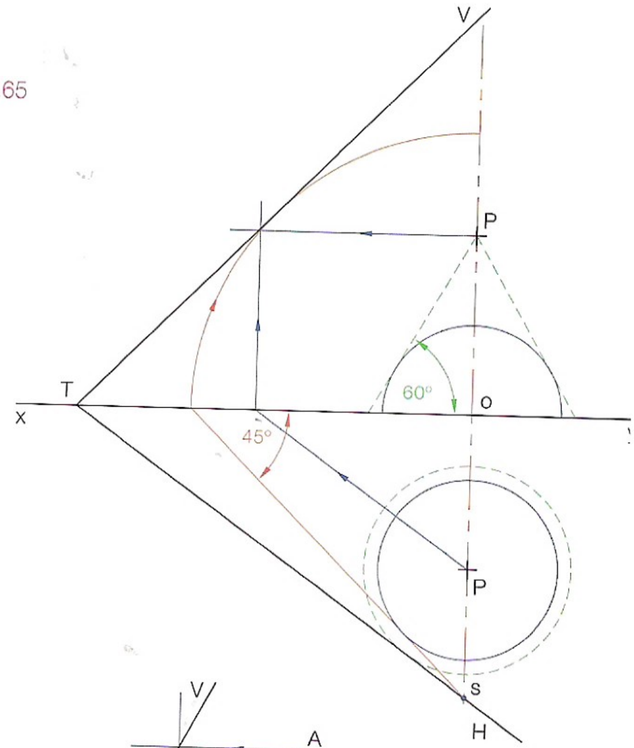

Fig. 9.66

Given the projections of a line AB. Find the traces of the oblique plane that contains line AB and is inclined at 70° to the horizontal plane. Fig. 9.67

(1) Draw the plan and elevation of the line as given.

(2) Draw the plan and elevation of a cone of base angle 70°, resting on the horizontal plane and having its vertex at A.

(3) Draw a similar cone having B as vertex.

(4) The HT line will be tangential to the cones in plan.

(5) The VT line is found by projecting the vertex of either cone parallel to the HT as far as the xy line. Then projecting vertically and across horizontally in elevation to find a point on the VT which can then be drawn in, Fig. 9.68.

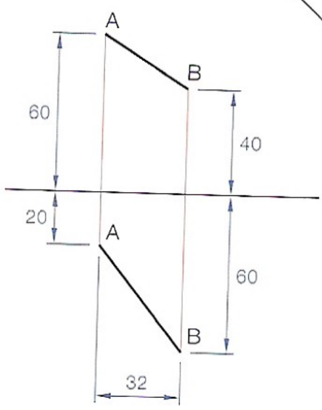

Fig. 9.67

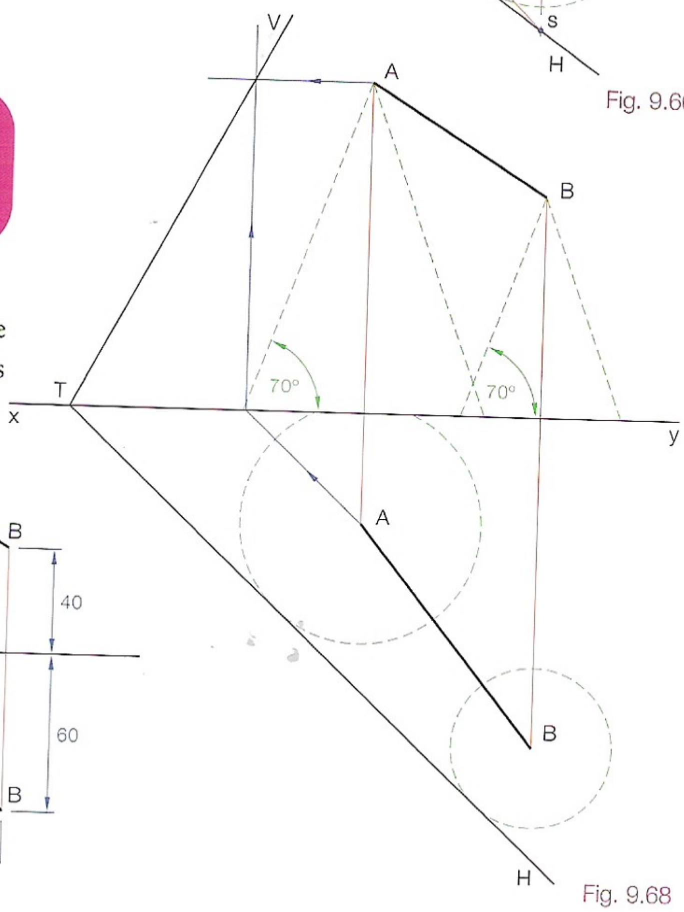

Fig. 9.68

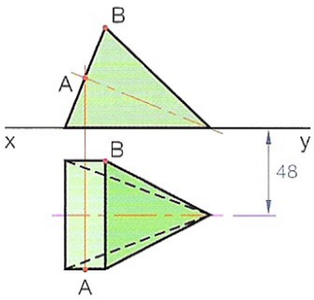

Fig. 9.69

(1) Draw the plan and elevation of the solid resting on its base.
(2) Rotate the solid onto its side.
(3) Locate points A and B in plan and elevation.
(4) Draw cones of base angle 60° having A as apex and B as apex.
(5) The horizontal trace will be tangential to the base circles in plan.
(6) The vertical trace is then found in the usual way, Fig. 9.70.

Fig. 9.69 shows the projections of a right square-based pyramid resting on the horizontal plane as shown. The pyramid is to be cut by an oblique plane which is inclined at 60° to the horizontal plane and passes through points A and B. Draw the projections of the cut pyramid.
Pyramid base = 60 mm, Altitude = 75 mm.

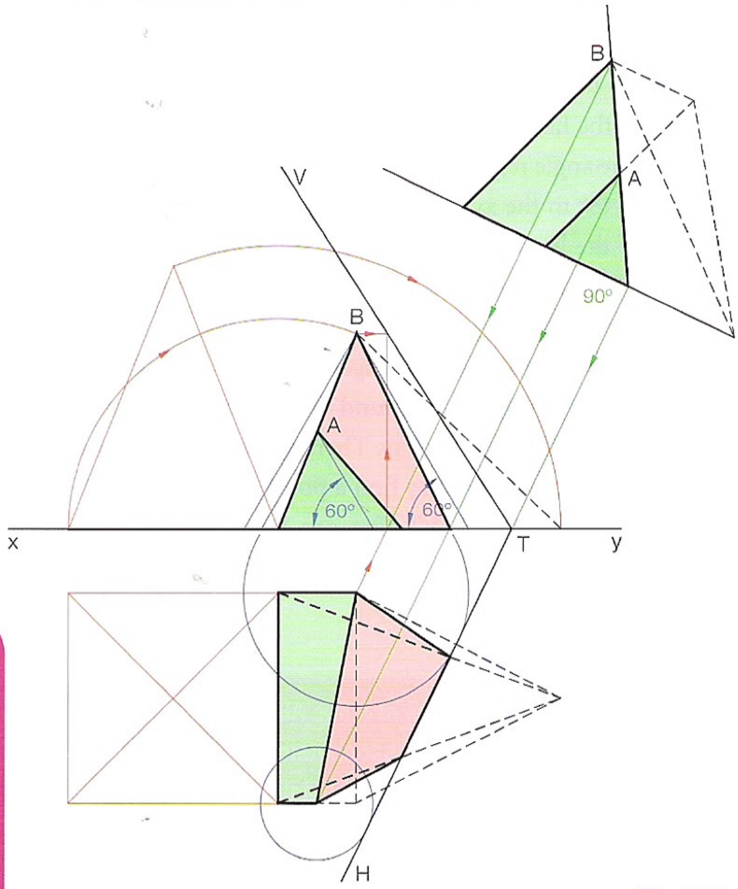

Fig. 9.70

Fig. 9.71 shows the plan of a triangular pyramid abco resting on the horizontal plane. The three sloping surfaces of the pyramid are inclined at 60° to the horizontal plane and the cut surface is inclined at 30° to the horizontal plane.

(i) Draw the plan and elevation of the cut solid.

(ii) Find the dihedral angle between the cut surface and surface S.

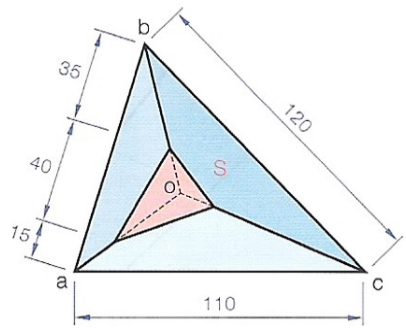

Fig. 9.71

(1) Draw the plan outline. Since the three sloping surfaces of the pyramid have equal inclinations to the HP the lines ao, bo and co will bisect the angles.
(2) The height of the pyramid is found by drawing an auxiliary to show an edge view of one of the surfaces and using the given inclination and the projection of the apex o. Draw the elevation.
(3) Locate points 1 and 2 in plan and elevation, Fig. 9.72.
(4) Place cones, of base angle 30°, underneath points 1 and 2 and having them at their apex.
(5) The horizontal trace of the cut surface will be tangential to the cone base circles. Project an auxiliary viewing along the HT line. This will show the cut point 3 on the line co. Complete the plan and elevation.

(6) The dihedral angle is found by finding a point view of line 2,3. The height of point 1 in the auxiliary elevation must be taken from the front elevation. A measuring line was introduced to shorten all the distances in the second auxiliary plan.

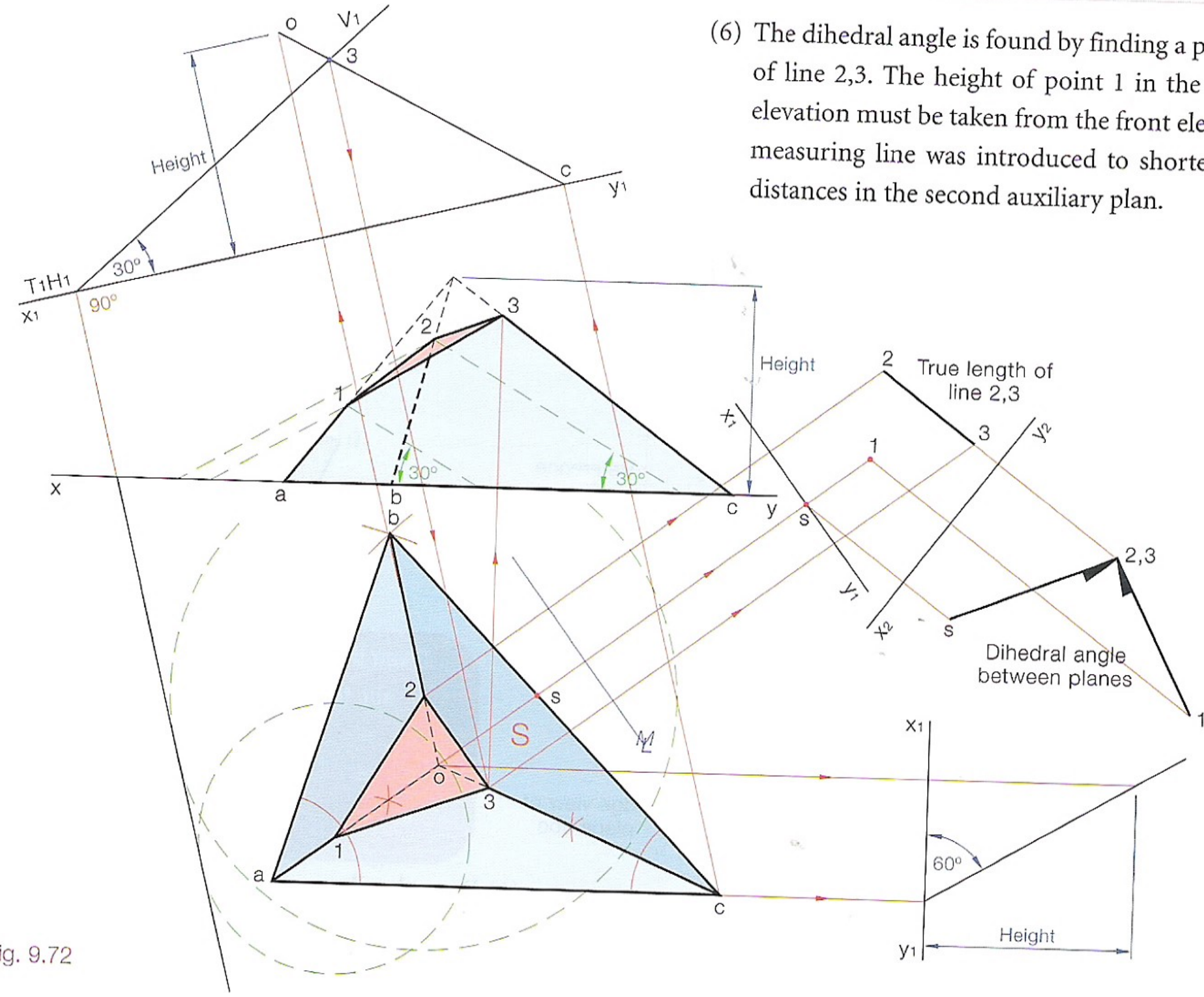

Fig. 9.72

Spatial Coordinates

All points in space can be defined by their coordinates. When dealing with three dimensions it is necessary to define a point using three coordinates, x, y and z. With reference to Fig. 9.73 we can see how point P can be established relative to a datum line, the horizontal plane and the vertical plane.

The first coordinate, coordinate x, refers to the distance to the right of the datum line. The second coordinate, coordinate y, refers to the distance the point P is above the horizontal plane. The third distance, coordinate z, refers to the distance point P is in front of the vertical plane.

Since we can define points in space using coordinates we can also define lines and planes using the same method.

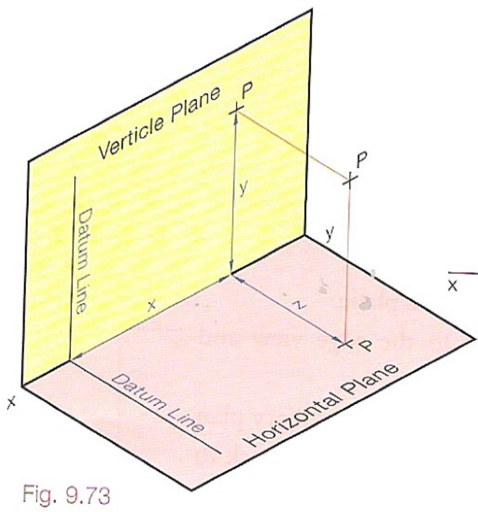

Fig. 9.73

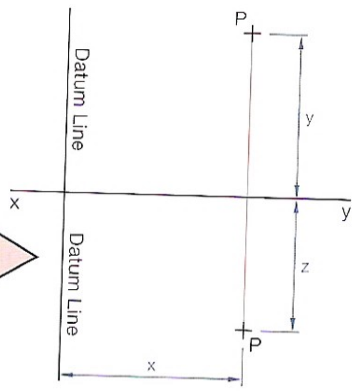

Fig. 9.74

HIGHER LEVEL

Given the coordinates of a laminar surface. To draw the plan and elevation of that surface Fig. 9.75

A	=	120	48	12
B	=	72	15	30
C	=	84	43	54

(1) Draw the xy line and a vertical reference line.

(2) To find point A measure 120 mm to the right of the reference line and draw a light vertical.

(3) Measure 48 mm above the xy line and mark A in elevation.

(4) Measure 12 mm below the xy line and mark A in plan.

x	y	z
120	48	12
→	↑	↓

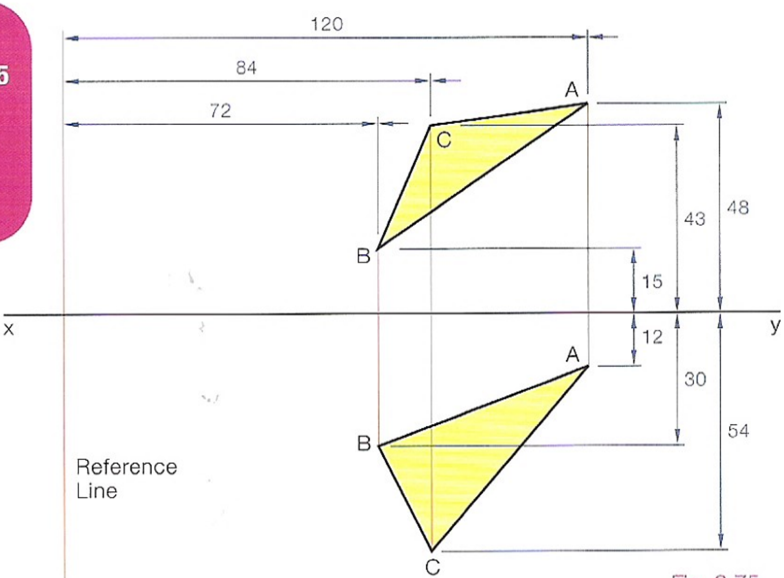

Fig. 9.75

Given the coordinates of a laminar plane abc to find its edge view. Fig. 9.76

a	=	45	30	60
b	=	96	63	12
c	=	114	9	30

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

(2) Draw a level line in elevation and project to plan.

(3) The level line in elevation will project as a true length in plan. View in the direction of the true length and project an auxiliary elevation. The plane will appear as an edge view.

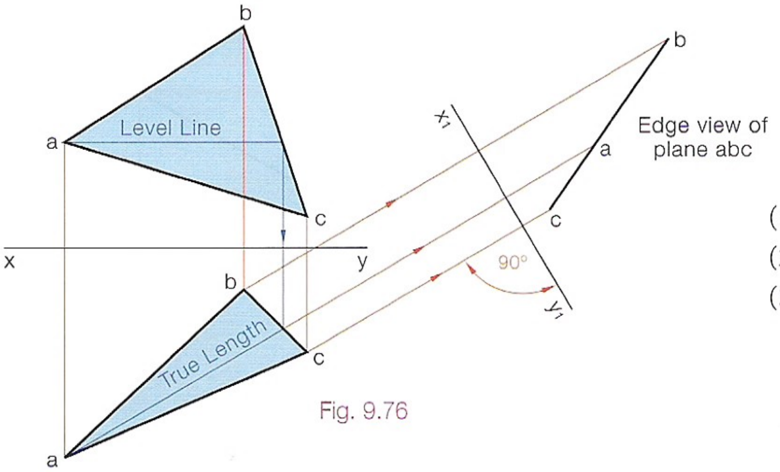

Fig. 9.76

Given the coordinates of a laminar plane abc, to find its true shape. Fig. 9.77

a	=	33	33	6
b	=	66	8	8
c	=	108	45	36

(1) Draw the plan and elevation.

(2) Find an edge view of the plane.

(3) Draw x_2y_2 parallel to the edge view and project the three points.

(4) The distances for the second auxiliary plan are found by measuring from x_1y_1 back to the plan or from a measuring line which is parallel to the x_1y_1 back to the plan.

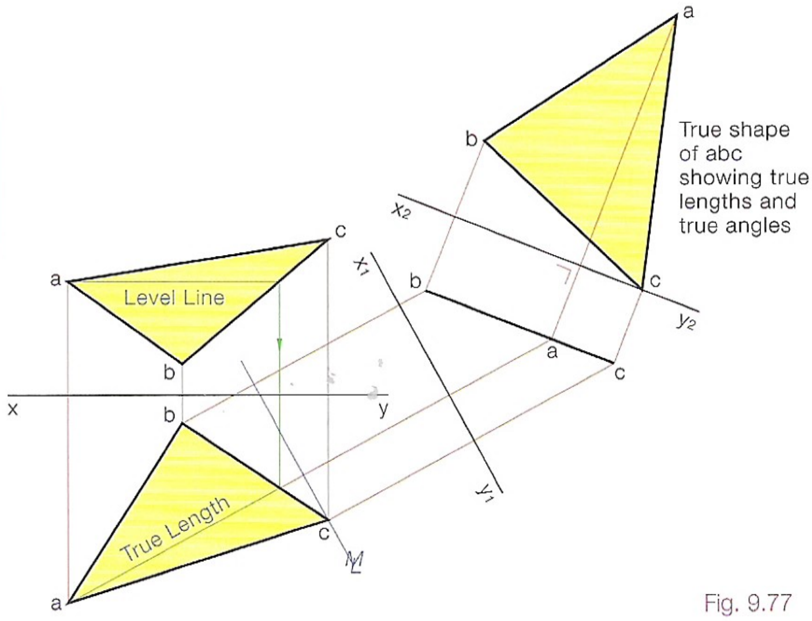

Fig. 9.77

Line of Intersection and Dihedral Angles for Triangular Lamina

When given the coordinates of meshing lamina it is often necessary to find the line of intersection between the planes and hence find the dihedral angle between the planes. There are three possible ways this problem can be presented:

(1) Given the line of intersection.

(2) Given one point on the line of intersection.

(3) Given no point on the line of intersection.

HIGHER LEVEL

(1) GIVEN THE LINE OF INTERSECTION

Given the coordinates for two planes ABC and ABDE. Determine the dihedral angle between the planes, Fig. 9.78.

A = 35 5 115 B = 90 20 45

C = 105 45 80 D = 70 75 10

E = 15 50 90

Here we are given the line of intersection.

(1) Project an auxiliary view from plan showing the true length of the line of intersection between the planes. View perpendicular to AB in plan.

(2) Project from this auxiliary viewing down along the true length. The x_2y_2 will therefore be perpendicular to the true length found. Both planes will be seen as edge views thus showing the dihedral angle. Note that the distances for the second auxiliary are taken from the x_1y_1 back to the plan or from a suitable measuring line.

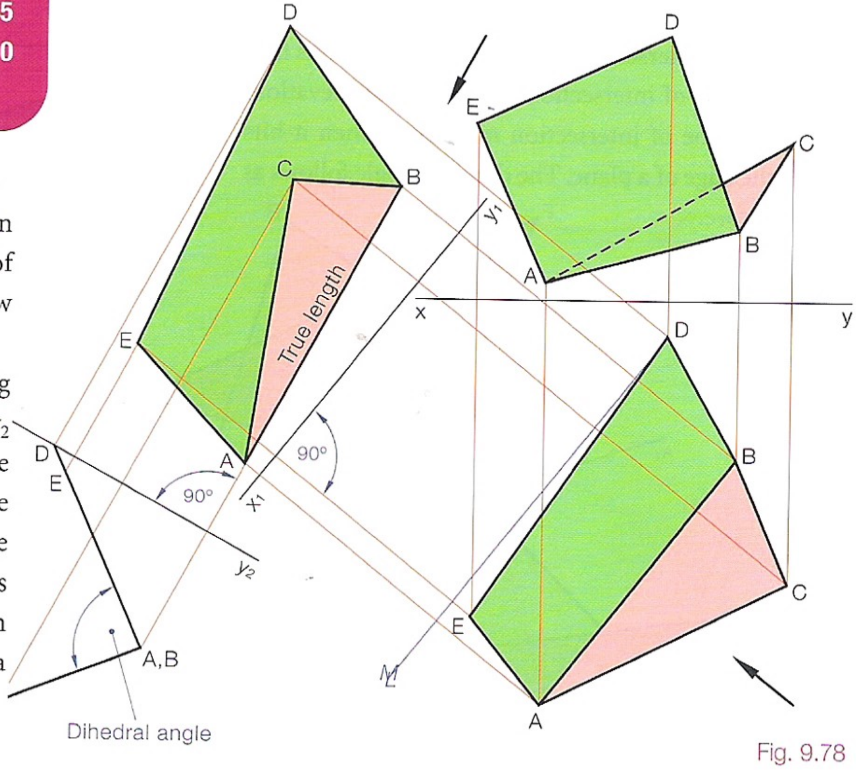

Fig. 9.78