5 Rotation and Inclination of Solids

SYLLABUS OUTLINE

Areas to be studied:

- Projection of right and oblique solids.

Learning outcomes

Students should be able to:

Higher and Ordinary levels

- Project views of right solids such that any face or edge of the solid may be on one of the principal planes of reference.

Higher level only

- *Project views of oblique solids (axis inclined to one of the principal reference planes only) such that any face or edge of the solid may be on one of the planes of reference or inclined to one of both planes of reference.*

Rotation and Inclination of Right Solids

The plan of a cube is shown in Fig. 5.1. Draw a front elevation, end elevation and plan of the cube when the bottom face is inclined at 25° to the horizontal plane and the edge bc rests on the horizontal plane.

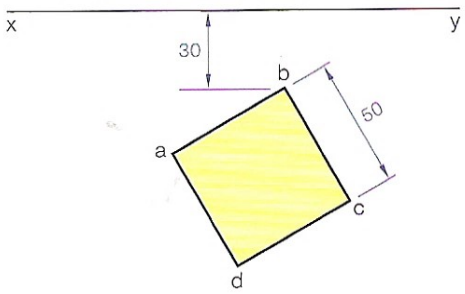

Fig. 5.1

(1) Draw the given plan.

(2) Edge bc will be the axis of rotation. Project an auxiliary elevation viewing along bc.

(3) In the auxiliary the cube is rotated to the required angle to the HP, Fig. 5.2.

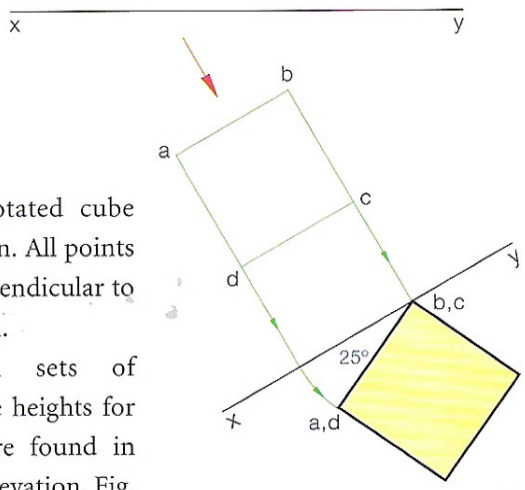

Fig. 5.2

(4) Project the rotated cube back to the plan. All points will move perpendicular to the axis in plan.

(5) Project both sets of elevations. The heights for the corners are found in the auxiliary elevation, Fig. 5.3.

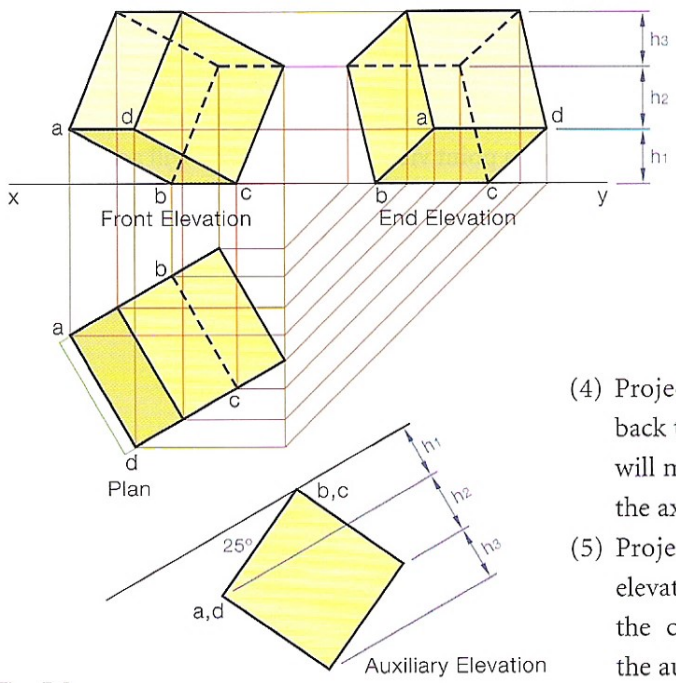

Fig. 5.3

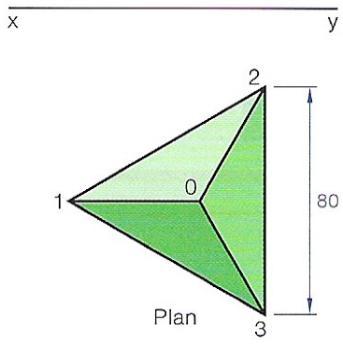

Fig. 5.4

(1) The construction is the same as the previous problem. View in the direction of edge 1,3.
(2) The edge 2,0 will be a true length in the auxiliary.
(3) Project the views back from the auxiliary and the heights are taken from the auxiliary, Fig. 5.5.

Fig. 5.4 shows the plan of a tetrahedron. Draw the front elevation, end elevation and plan of the solid when the base is rotated at 30° to the HP about the edge 1,3.

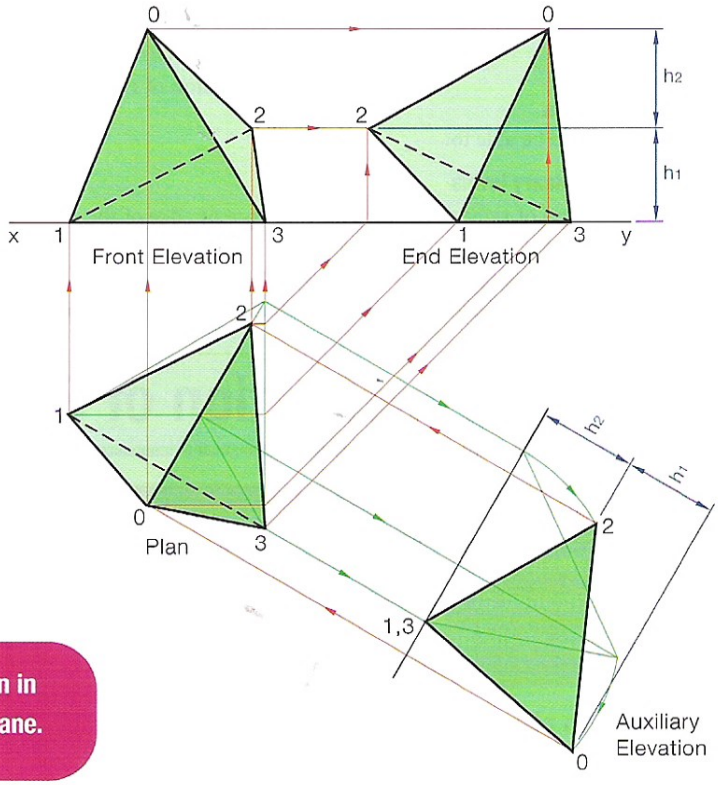

Fig. 5.5

Project views of the square-based pyramid shown in Fig. 5.6 such that surface A is on the horizontal plane.

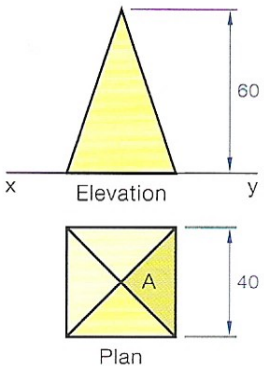

Fig. 5.6

(1) The solid is drawn in its normal position.
(2) Edge ab is a point view in elevation and will act as the axis of rotation. Rotate the apex about ab in elevation until point o intersects the xy line.

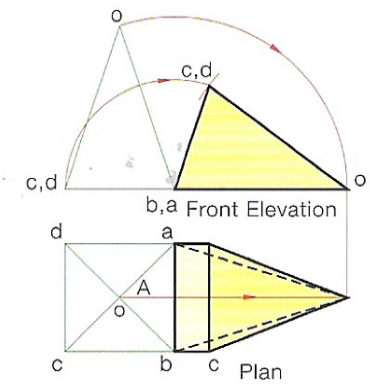

Fig. 5.7

(3) Rotate points c and d about ab in elevation.
(4) The length from o to cd in the original elevation is used in the new elevation to locate c and d in the new elevation, Fig. 5.7.

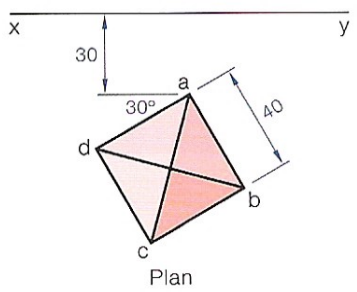

Fig. 5.8

Shown in Fig. 5.8 is the plan of a square-based pyramid of altitude 60 mm. Draw the front elevation and end elevation of the pyramid when its base is inclined at 45° to the horizontal plane and edge ad remains touching the horizontal plane.

(1) Draw the given plan. Edge ad will form the axis of rotation for the solid.
(2) Draw an auxiliary view of the pyramid looking along the line ad. Rotate the pyramid in this view about ad which is a point of view.
(3) Project the rotated pyramid to plan. Remember the points more perpendicular to the axis of rotation in plan.
(4) The front elevation is projected, with the heights being taken from the auxiliary, Fig. 5.9.

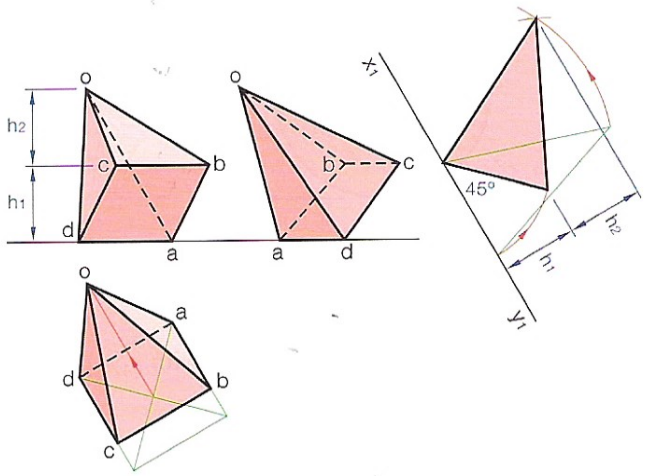

Fig. 5.9

Shown in Fig. 5.10 is the elevation of a right regular hexagonal-based pyramid which is inclined at an angle of 40° to the horizontal plane. Draw the given view, project a plan and an end elevation of the pyramid.

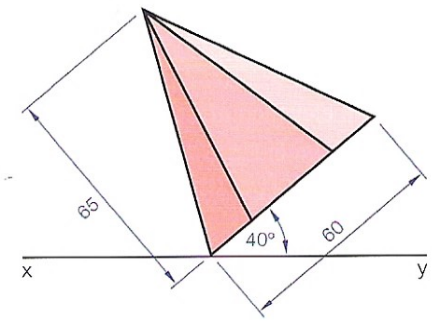

Fig. 5.10

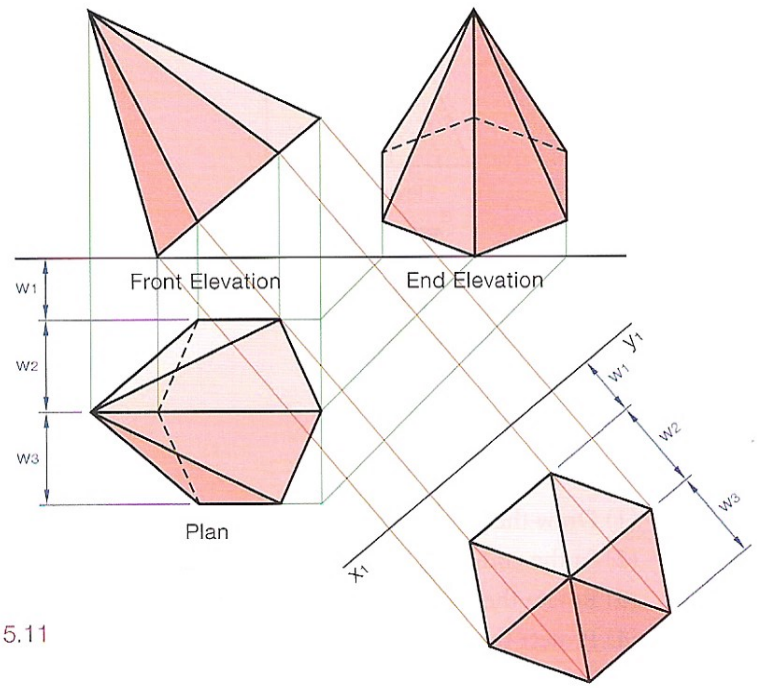

Fig. 5.11

(1) Draw the given elevation.
(2) Project an auxiliary plan to show the base as a true shape – a regular hexagon.
(3) The plan is projected down from the elevation with the widths being taken from the auxiliary plan.
(4) The end elevation is projected in the normal way, Fig. 5.11.

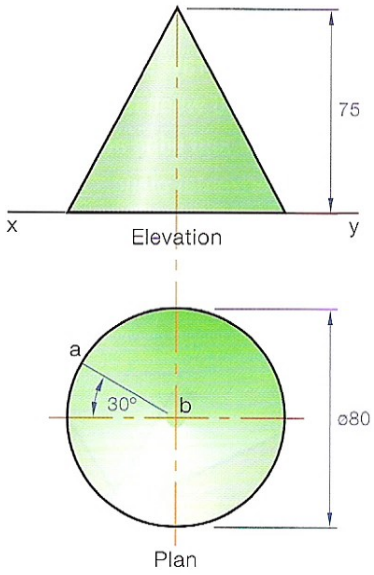

Fig. 5.12

(1) Draw the plan of the cone with the base on the horizontal plane.
(2) Draw an auxiliary elevation of the cone with x_1y_1 parallel to the generator ab.
(3) Rotate the cone in the auxiliary.
(4) The circular base is divided into parts and the points are projected through the views to locate the ellipses in all three views, Fig. 5.13.

Shown in Fig. 5.12 is a right cone. Draw the front elevation, end elevation and plan of the cone when the generator ab rests on the horizontal plane.

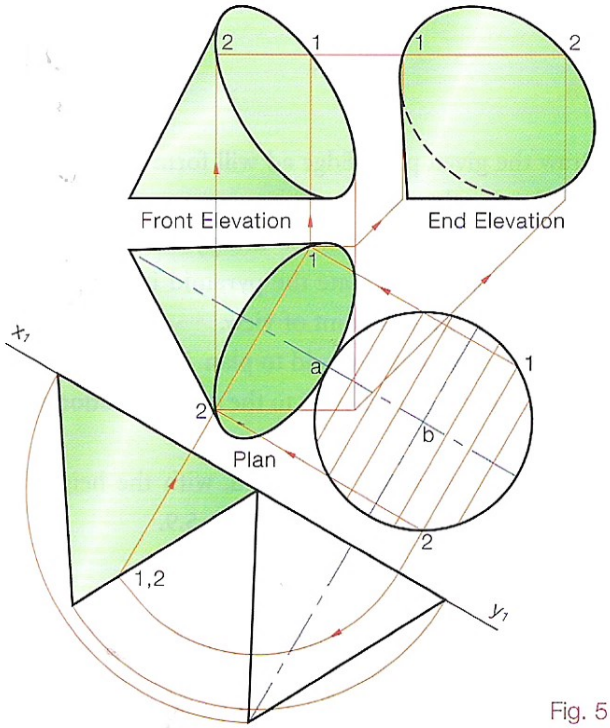

Fig. 5.13

The plan and elevation of a pentagonal-based right pyramid are shown in Fig. 5.14. Draw new views of the object when the surface abc is parallel to the vertical plane.

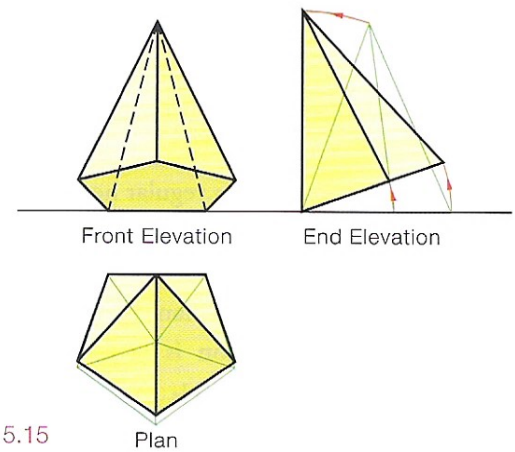

Fig. 5.15

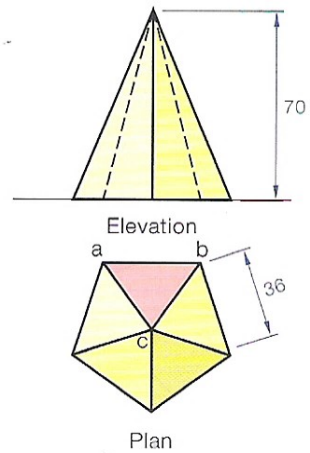

Fig. 5.14

(1) Draw the given plan and project the end view.
(2) In the end view, surface abc appears as an edge view.
(3) Rotate the pyramid until surface abc is vertical.
(4) Project the remaining views from the end view, Fig. 5.15.

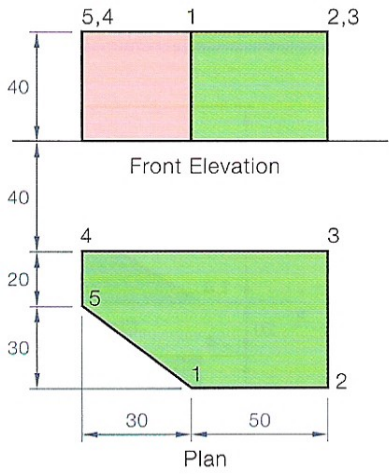

Fig. 5.16

(1) Draw the given plan.
(2) The plan may be rotated about any of its corners. The solution Fig. 5.17 is rotated about corner 1. Rotate 5 first until line 1,5 is parallel to the xy line.
(3) All subsequent points are found by triangulation. For example, point 2 is rotated about point 1. The distancee from 5 to 2 is taken on the plan. Place the compass on the new point 5 and scribe an arc to cut the arc from point 2.
(4) When the plan is complete, project the other views, Fig. 5.17.

Given in Fig. 5.16 are the plan and elevation of a block which has a section removed. Rotate the block so that the cut surface is parallel to the vertical plane.

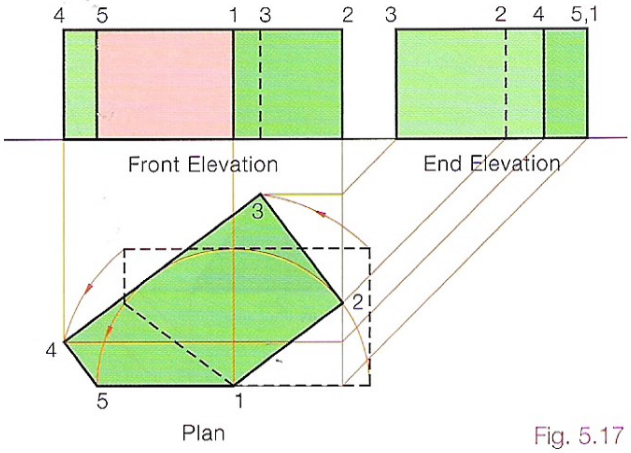

Fig. 5.17

The diagram, Fig. 5.18, shows the elevation of a cylinder which has been cut by a simply inclined plane. Draw the elevation and plan when the cylinder has been rotated so that the cut surface is parallel to the horizontal plane.

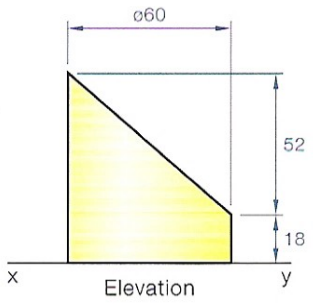

Fig. 5.18

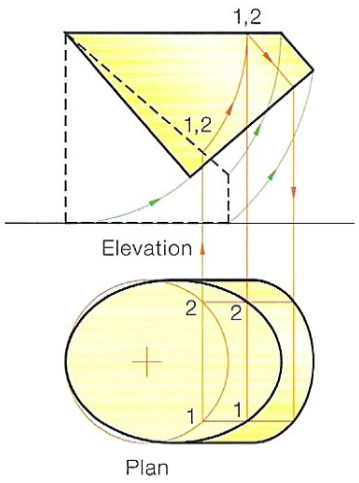

Fig. 5.19

(1) Draw the elevation and plan.
(2) Rotate the top surface until it is level.
(3) Build up the elevation by rotating the rest of the corners.
(4) Choose any point on the original circular plan, e.g. points 1 and 2.
Project points 1 and 2 to the cut surface of the original elevation.
(5) Rotate points 1 and 2 onto the horizontal surface.
(6) Project down and then across from the plan.
(7) Repeat with other points on the original circle to build up the shape of the cut surface, Fig. 5.19.