# Envelopments

As explained earlier, the word 'development' describes the process of opening out the surfaces of an object. 'Envelopment' can be seen as the opposite, the closing over of a development to create the object.

**Given the incomplete development of a solid. Draw the front elevation, end elevation and plan of the solid and complete the development.**
**Fig. 11.36a**

(1) The base must be rectangular as alternate sides are equal in length. The solid must also be a prism as the development is made up of parallel height lines.
(2) Decide which face of the development will form the front of the object. Draw the front elevation in line with the development.
(3) Project the plan which will equal the base in size.
(4) Draw the end elevation and complete the development, Fig. 11.36b.

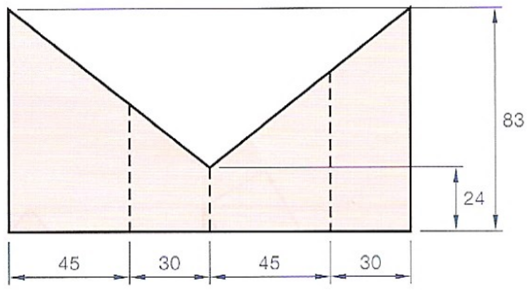



Fig. 11.36a

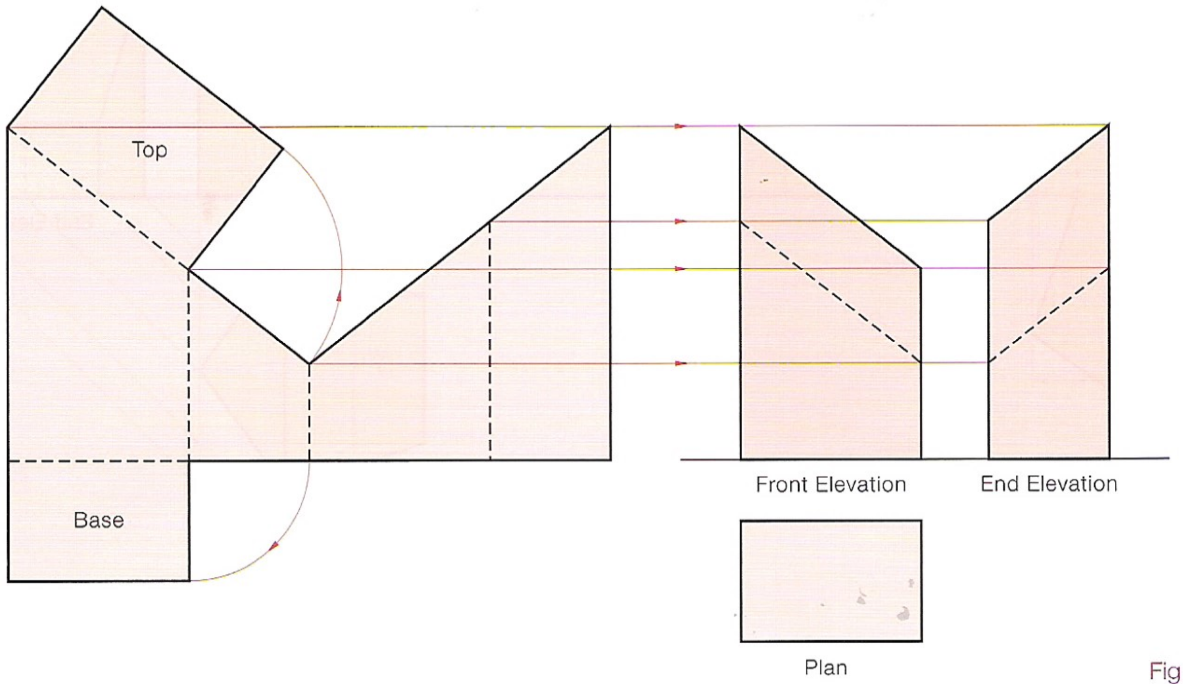



Fig. 11.36b

**Given the partial development of a solid. Draw the front elevation, end elevation and plan of the solid. Complete the development.**
**Fig. 11.37a**

The solid must be a pentagonal prism because it has five equal sides and parallel height lines. The prism must also be truncated because of the variation in heights.

(1) Draw the development.

(2) Draw the base of the development and the plan.

(3) Project the elevation from the plan and from the development.

(4) Project the end view.

(5) Find the true shape of the cut surfaces by taking widths from the plan and lengths from the elevation, Fig. 11.37b.

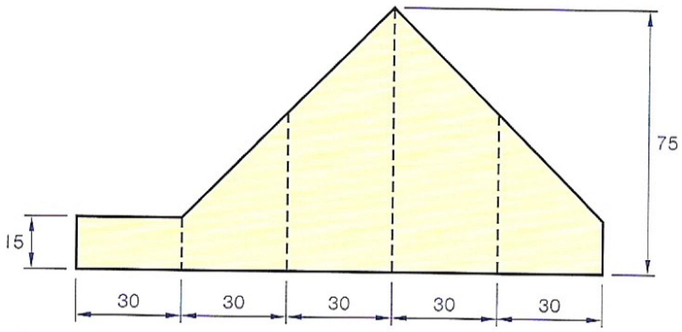



Fig. 11.37a

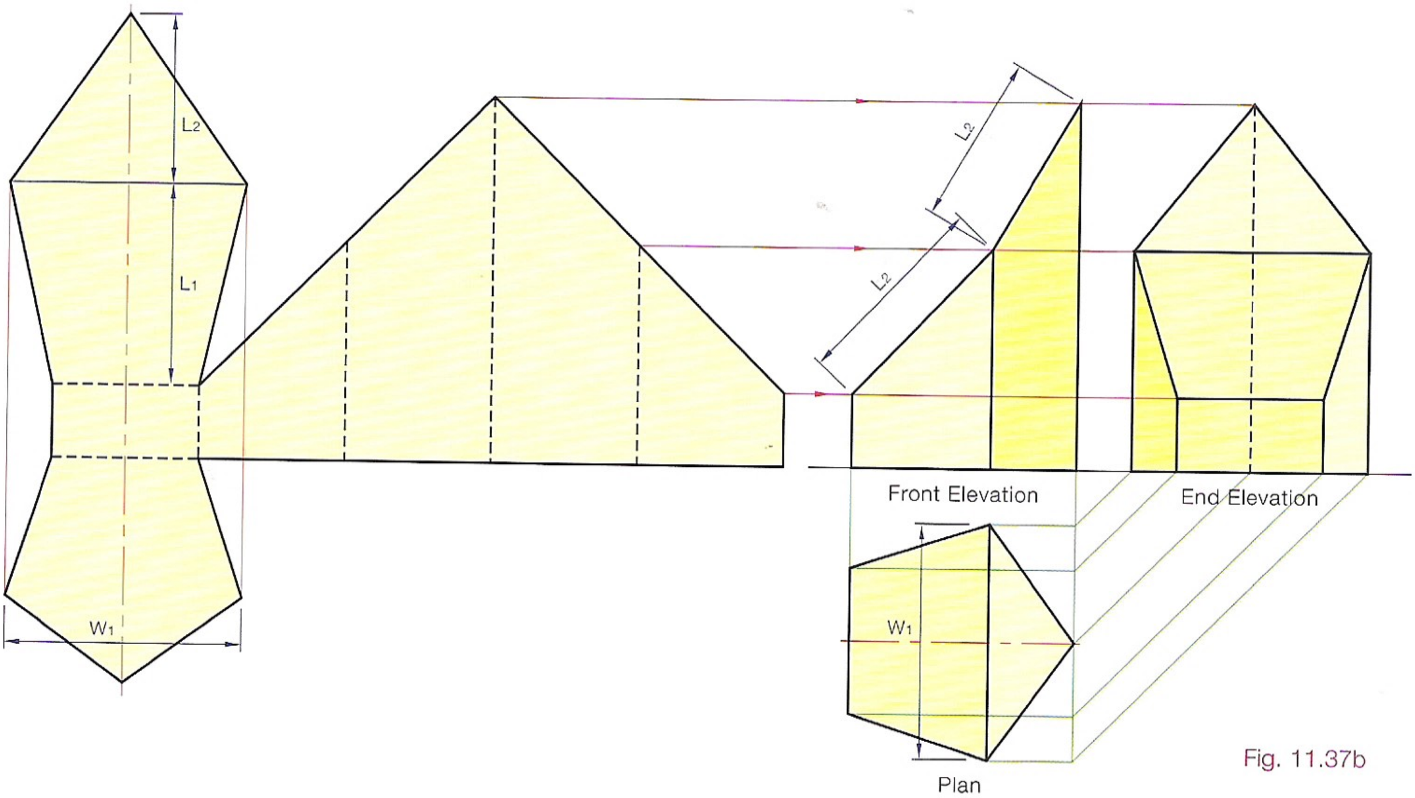



Fig. 11.37b

**The development of a cylinder which is open at both ends is shown. Draw a front elevation and plan of the object. Fig. 11.38a**

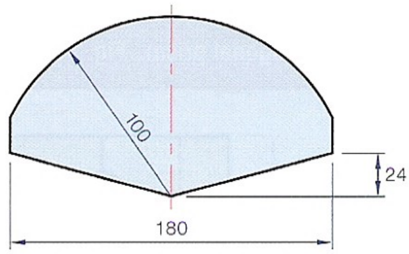



Fig. 11.38a

(1) The length of the development must equal the circumference of the cylinder

$$2\pi R = 180 \text{ mm} \Rightarrow R = 28.6 \text{ mm}$$

(2) Draw the plan of the cylinder as a circle of radius 28.6 mm.

(3) Divide this circle into twelve.

(4) Divide the development into twelve equal parts.

(5) Complete by projection, Fig. 11.38b.

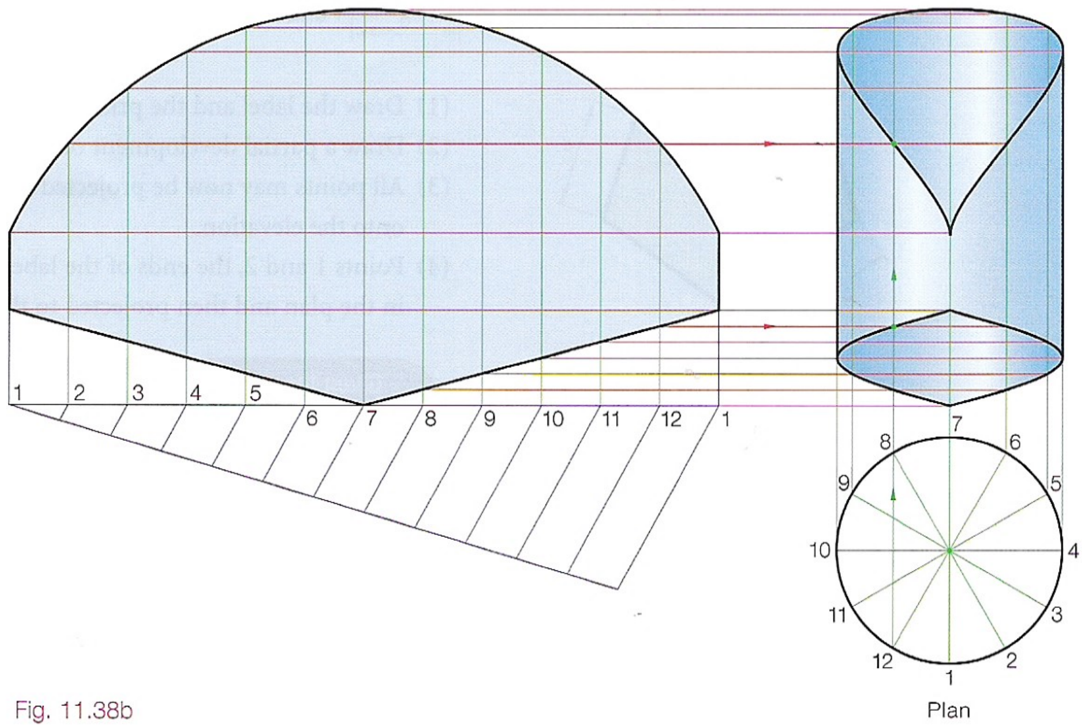



Fig. 11.38b

# Partial Envelopments

A partial development is when a label or sticker is wrapped around a solid. The label can be much more complicated in appearance when developed out than it would suggest when wrapped around the jar or bottle.

## Given a label, draw it in position wrapped around a pentagonal prism. Fig. 11.39

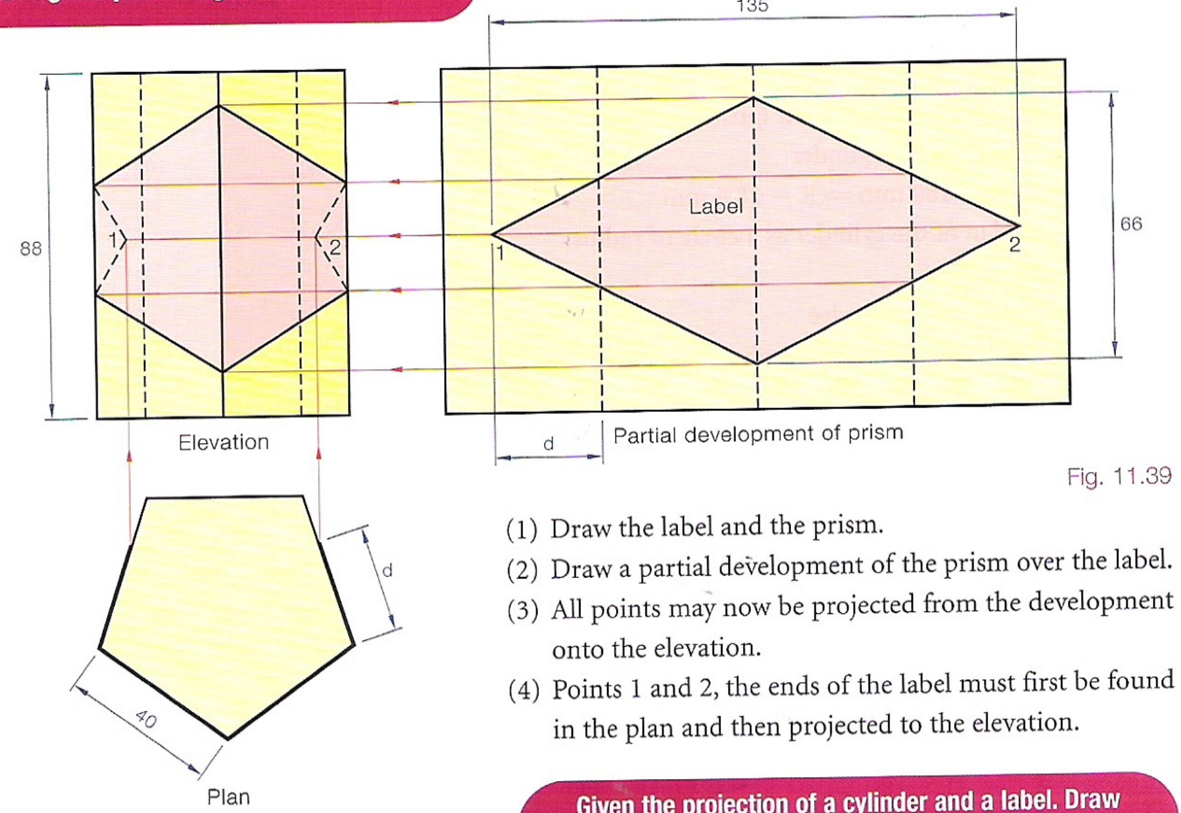



Fig. 11.39

(1) Draw the label and the prism.
(2) Draw a partial development of the prism over the label.
(3) All points may now be projected from the development onto the elevation.
(4) Points 1 and 2, the ends of the label must first be found in the plan and then projected to the elevation.

## Given the projection of a cylinder and a label. Draw the elevation of the cylinder when the label is wrapped around it. Fig. 11.40a

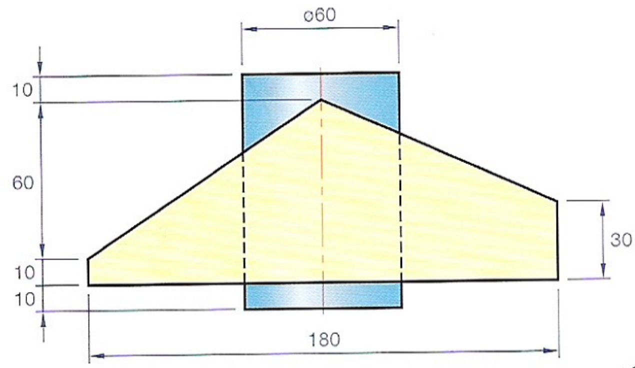



Fig. 11.40a

(1) Draw the given view and draw the plan.
(2) Draw the stretched-out label in plan.
(3) Divide the plan into twelve equal parts.
(4) From the centre line of the label step-off the divisions to the left and right and index.
(5) Draw the generators in elevation.
(6) Project across the heights from the label to the generators in elevation.
(7) The ends of the label must be found in plan first and then in elevation, Fig. 11.40b.

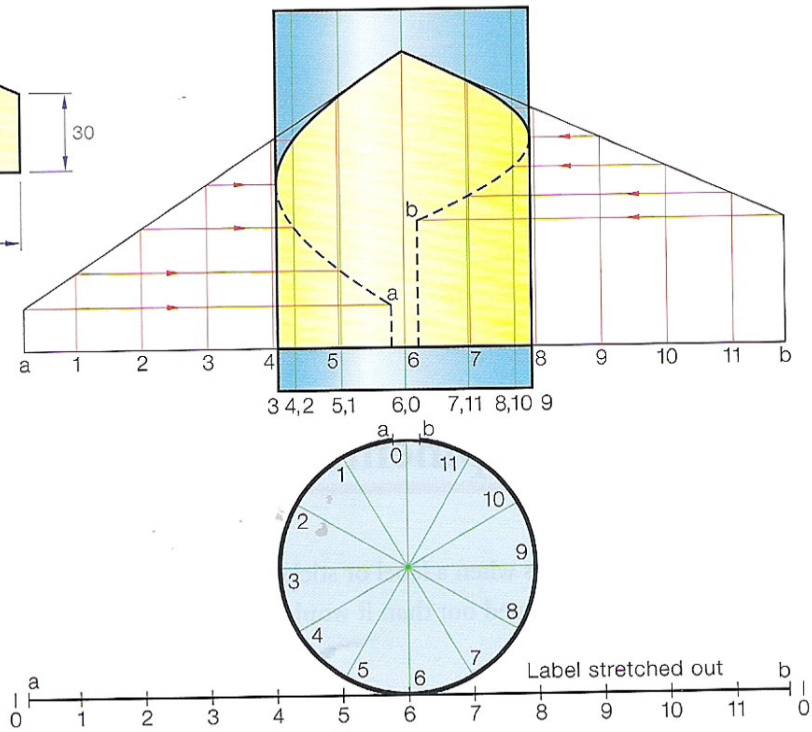



Fig. 11.40b

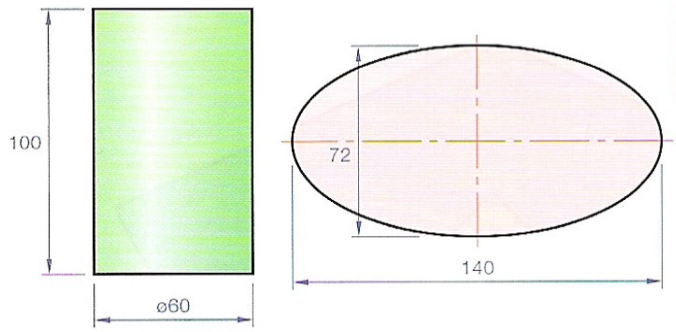



Fig. 11.41a

**Given the elevation of a cylinder and the development of an elliptical label. Draw the elevation of the cylinder when the label is wrapped around it.**
**Fig. 11.41a**

(1) The construction is the same as in the previous example. Drawing the developed label to the side produces a less complex drawing and is a neater presentation.

(2) The ends of the label, points a and b, will fall between 5 and 6 on the cylinder. They are found in plan first and then projected to elevation,

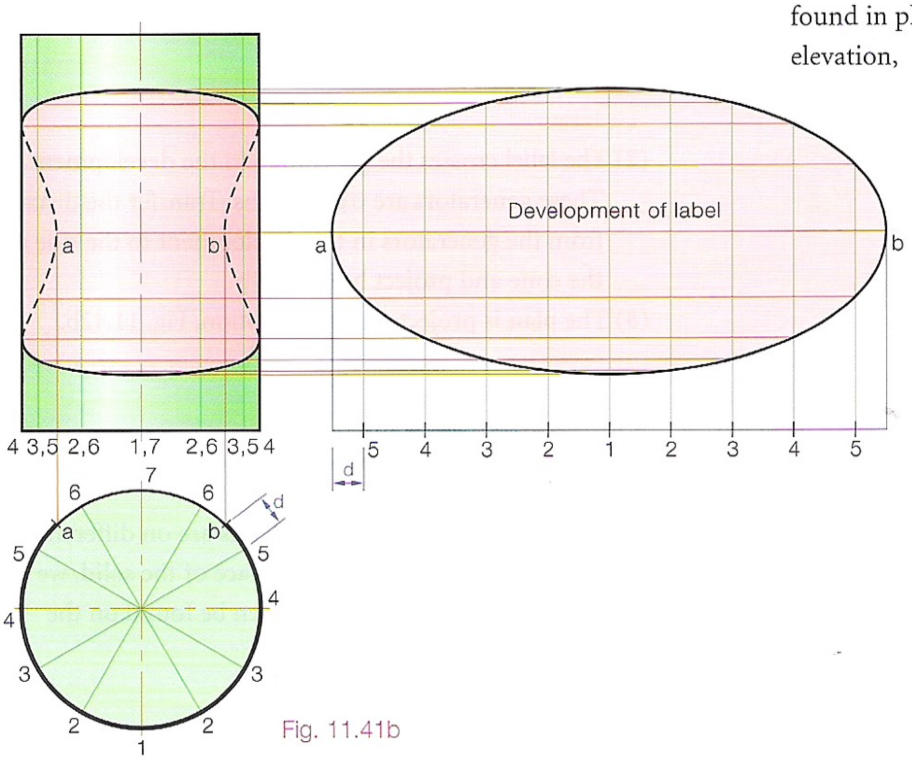



Fig. 11.41b

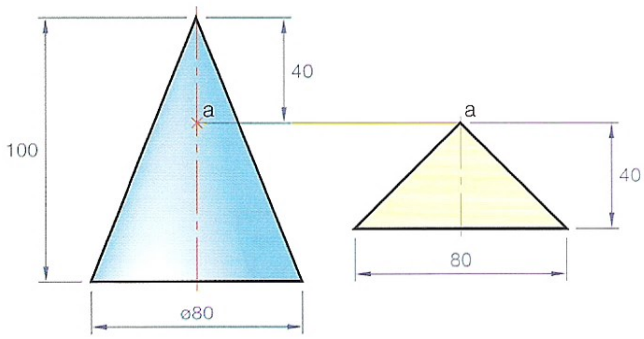



Fig. 11.42a

**Given the projection of a cone and the development of a triangular label. Draw the elevation and plan of the cone when the label is wrapped around it.**
**Fig. 11.42a**

(1) Develop the surface of the cone and place the label in position.

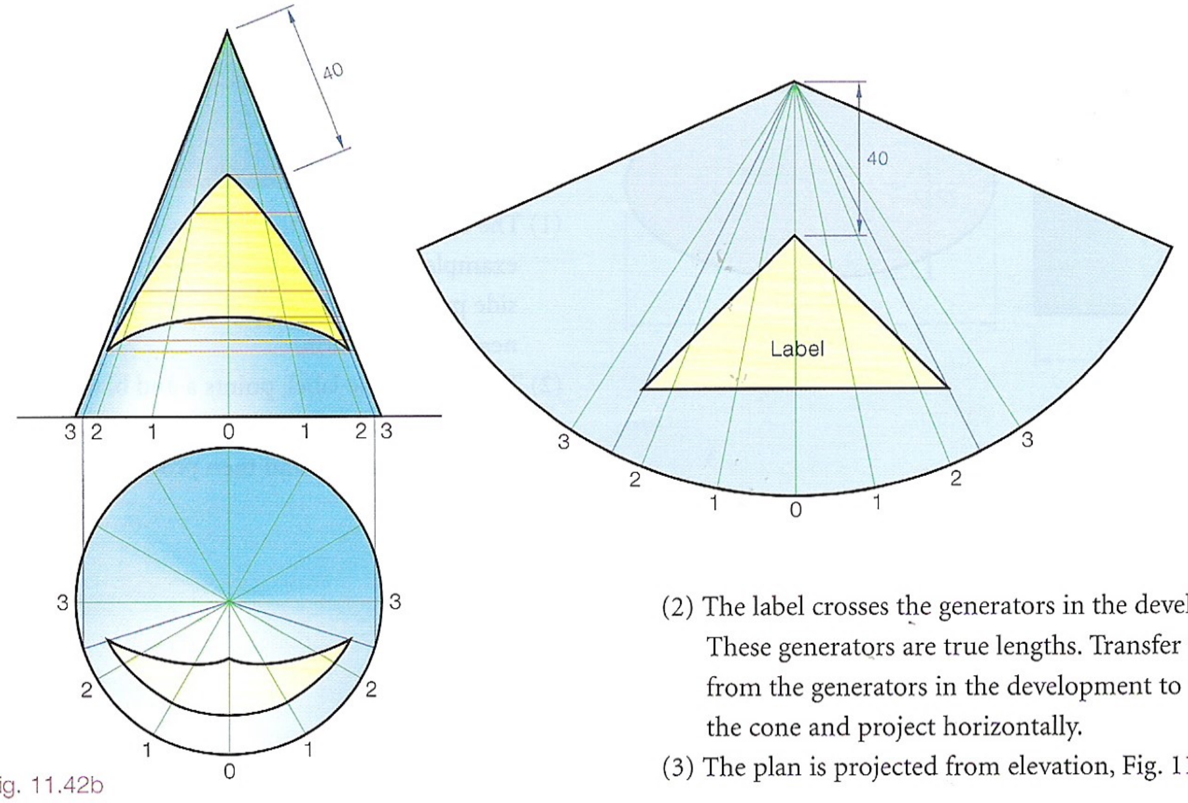



Fig. 11.42b

(2) The label crosses the generators in the development. These generators are true lengths. Transfer the distances from the generators in the development to the side of the cone and project horizontally.

(3) The plan is projected from elevation, Fig. 11.42b.

# Shortest Distance

The shortest distance between two points on the same plane is a straight line. When the two points are on different surfaces of the same solid and we wish to find the shortest distance between them along the surface of the solid, we develop the surface of the solid and join the points with a straight line. This straight line can then be found on the projections of the solid.

**Given the plan and elevation of a cylinder and two points p and q on its surface. Draw the projection of the shortest distance between these two points along the surface of the cylinder.**
**Fig. 11.43a**

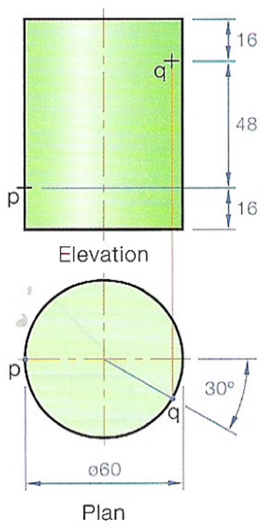



Fig. 11.43a

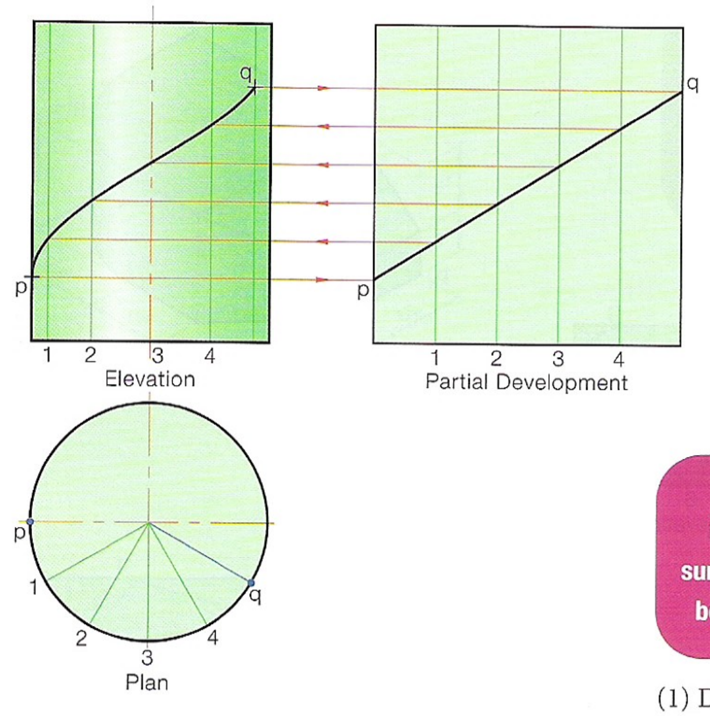



Fig. 11.43b

(1) Develop the surface of the cylinder between p and q.

(2) Project p and q onto the development and join with a straight line.

(3) Project this line back to elevation. The line joining p and q in elevation forms part of a helical curve, Fig. 11.43b.

**The front elevation and plan of a solid are shown in Fig. 11.44a. Also shown are two points p and q on the surface of the solid. Draw the path of the shortest distance between these two points along the surface of the solid.**

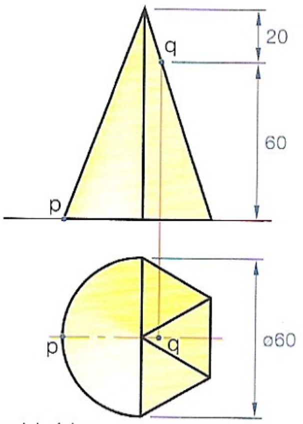



Fig. 11.44a

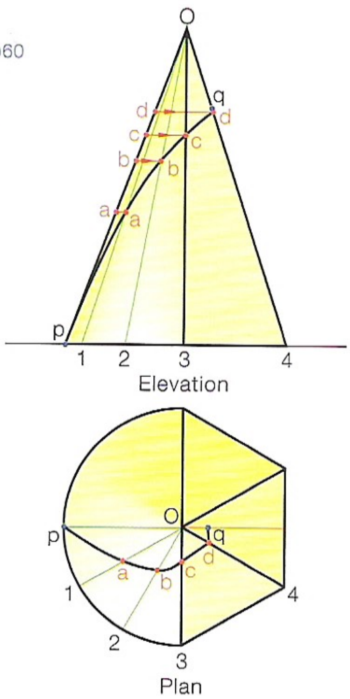
(1) Draw the given plan and elevation and locate points p and q on its surface.

(2) Develop the surface of the solid and locate p and q on the development.

(3) Join p and q with a straight line on the development.

(4) Distances Oa, Ob, Oc and Od are true lengths on the development and are stepped down on generator Op in elevation because it too is a true length.

(5) The elevation and plan are finished by projection, Fig. 11.44b.



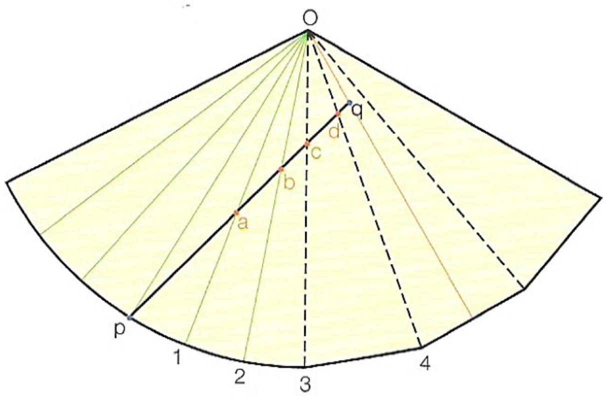




Fig. 11.44b

**Given the isometric projection of a solid having two points, p and q, on its surface. Draw the front elevation, end elevation and plan of the solid showing the shortest path between points p and q.**
**Fig. 11.45a**

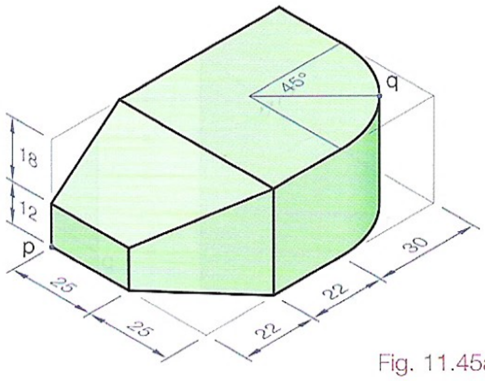



Fig. 11.45a

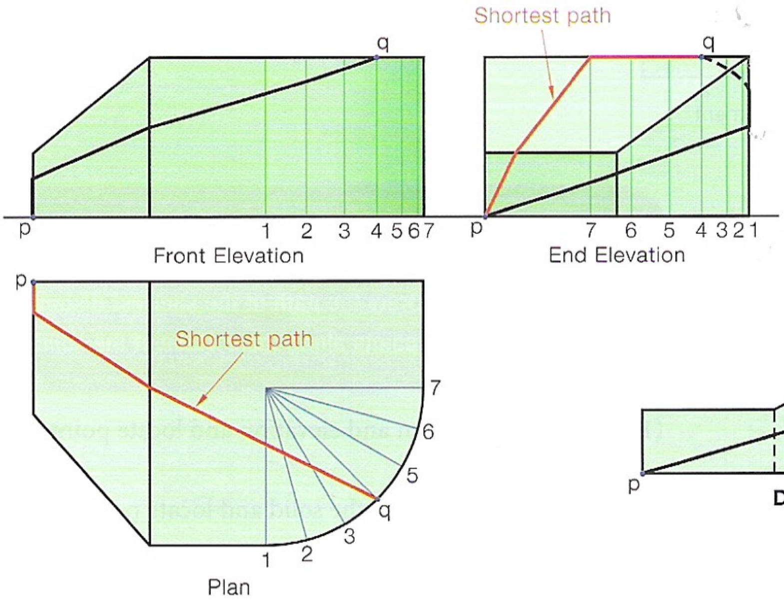



Fig. 11.45b

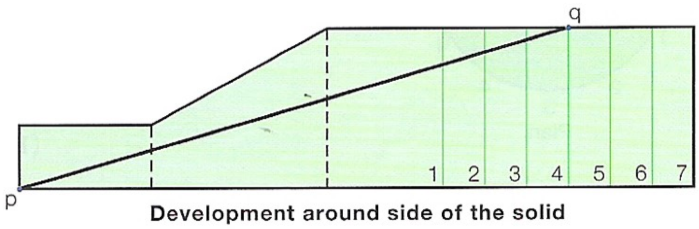



Fig. 11.45c

In this example it is unclear which route would be the shorter, across the top or around the side. A development is drawn to show both paths and it is clear from these that the route across the top is the shortest one, Fig. 11.45d.

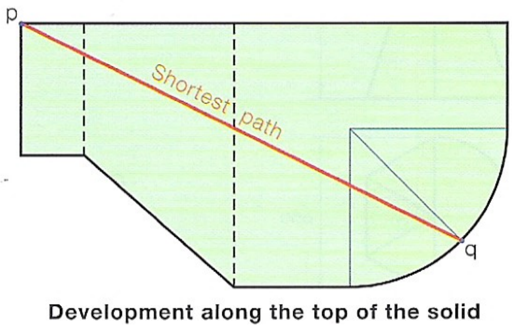



Fig. 11.45d