Example 11.1 (Fig. 11.1)

A square prism of 40 mm side of base and 80 mm long axis is resting on its base on H.P. such that a rectangular face of it is parallel to V.P. Draw the development of the prism.

[RGPV Feb. 2010]

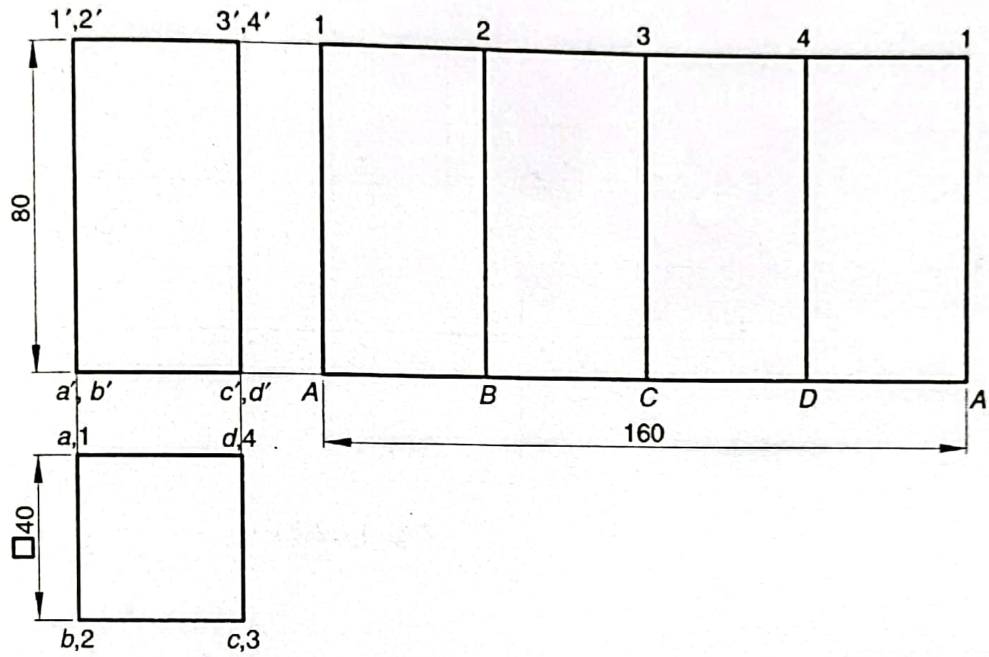

Fig. 11.1

Visualisation: The lateral surface of the given prism comprises of four rectangles of 80 mm × 40 mm sides.

Construction: Fig. 11.1

1. Draw a square *abcd* keeping *ad* parallel to *XY* to represent the top view. Project all the points to obtain rectangle *a′d′*4′1′ as the front view.
2. Stretch out lines 1-1 and *A*-*A* from the front view, equal to the perimeter of the base.
3. Divide 1-1 and *A*-*A* in four equal parts and name their intermediate points as 2, 3, 4 and *B*, *C*, *D* respectively. Join vertical edges 1*A*, 2*B*, 3*C* and 4*D* in the development.

Note 1: In development of the lateral surfaces of the closed objects, the first and the last edge have same name.

Note 2: Usually, development of the lateral surfaces of the object is drawn and the ends are omitted from the development. They can easily be added whenever required.

3. Stretch out lines 1-1 and *A-A* and draw 1*A*, 2*B*, 3*C*, 4*D*, 5*E* and 6*F* to complete the development of the uncut prism.
4. Project points q' and u' vertically downwards and obtain points q and u in the top view. In the development draw locus at a distance aq and dt from points A and D respectively.
5. Draw horizontal lines through points h', i', j', k', l', and p', q', r', s', t', u', v' to meet their corresponding locus lines or generators and obtain H, I, J, K, L and P, Q, R, S, T, U, V. Join them to obtain the development as shown.

11.5 DEVELOPMENT OF CYLINDER

Cylinders are also developed by parallel-line method in a way similar to the prisms. Here, the length of stretch line is equal to the circumference of the base circle of the cylinder.

Example 11.7 (Fig. 11.7)

A cylinder of 40 mm diameter of base and 55 mm long axis is resting on its base on H.P. It is cut by a section plane perpendicular to V.P. and inclined at 45° to H.P. The section plane is passing through the top end of an extreme generator of the cylinder. Draw the development of the lateral surface of the cut cylinder. [RGPV June 2008(o), Aug. 2010]

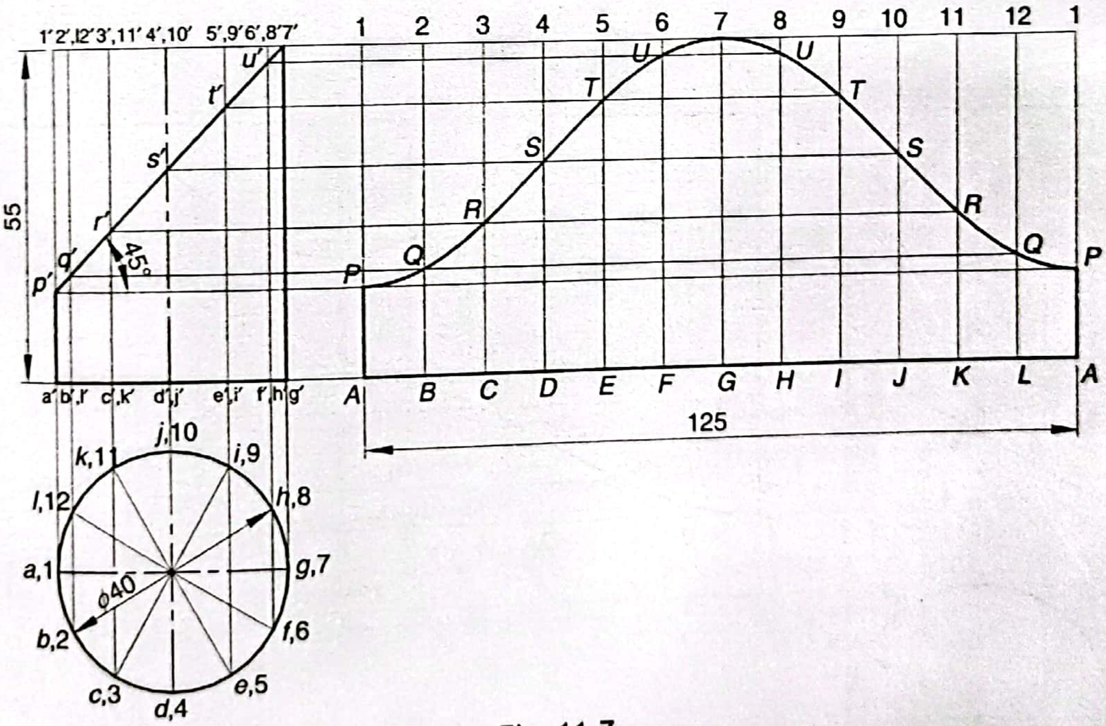

Fig. 11.7

Construction: Fig. 11.7

1. Draw a circle *adgj* to represent the top view and divide it into 12 equal parts. Project all the points to obtain $a'g'7'1'$ as the front view.

Construction: Fig. 11.10

1. Draw a circle *abcd* to represent the top view. Project all the points to obtain $a'b'g'e'$ as the front view.
2. Draw a square $1'4'7'10'$ such that all the edges are inclined at 45° to *XY* keeping the centre 35 mm above the *XY*. On the edges of the square consider some more points as $2'$, $3'$, $5'$, $6'$, $8'$, $9'$, $11'$ and $12'$.
3. Stretch out lines *A-A* and *E-E* equal to the perimeter of the cylinder. Divide 1-1 and *A-A* into 4 equal parts and join all the generators.
4. Project all the points of the square vertically downwards and obtain points 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 in the top view.
5. In the development, draw locus corresponding to 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 such that $A1$ = acr $a1$, $A2$ = arc $a2$, $A3$ = arc $a3$ and so on.
6. Draw horizontal lines from points $1'$, $2'$, $3'$, $4'$, $5'$, $6'$, $7'$, $8'$, $9'$, $10'$, $11'$ and $12'$ to meet their corresponding locus lines or generators in the development at points 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 respectively.
7. Join all the points with smooth curves. Darken the portion of the development which remains after truncation of the cylinder.

Note: In the development of cylinder the cutting lines converges to form arc. Therefore, in the development 1-4, 4-7, 7-10 and 10-1 are arcs of circles.

11.6 DEVELOPMENT OF A CONE

Development of lateral surface of a cone is obtained by radial-line method. In this method, the development is in the form of sector of a circle, the radius of which is equal to the slant height of the cone. The subtended angle θ of this sector is calculated by $\theta = \frac{r}{R} \times 360°$ where r = the radius of the base circle, and R = the slant height of the cone. In an approximate method, subtended angle θ can be determined by transferring arc of length, $\frac{1}{12}$th of the base circle in the top view, twelve times over the sector of the circle in the development.

Example 11.11 (Fig. 11.11)

Draw the development of lateral surface of the cone whose base diameter is 50 mm and axis is 60 mm long. The cone is resting on H.P. on its base.

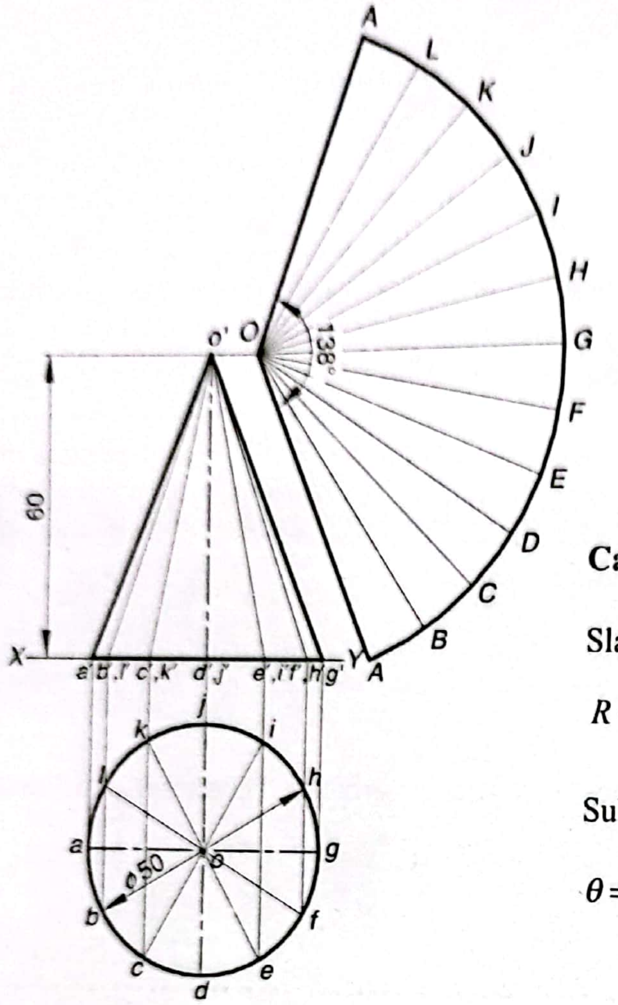

Fig. 11.11

Calculation of θ

Slant height of cone

$$R = o'g' = \sqrt{r^2 + h^2} = \sqrt{25^2 + 60^2} = 65 \text{ mm}$$

Subtended angle

$$\theta = \frac{r}{R} \times 360° = \frac{25}{65} \times 360° = 138° \text{ (approx.)}$$

Construction: Fig. 11.11

1. Draw a circle *adgj* as the top view and divide it into 12 equal parts. Project all the points and obtain *a′o′g′* as the front view.
2. The end generators *o′a′* and o′g′ gives the true length of the generators because their top views are parallel to *XY*. Therefore, mark *OA* parallel to *o′g′*.
3. Determine the subtended angle θ of the development.
4. Draw a sector *A-O-A* with included angle θ. Divide sector into 12 equal parts and mark the generators as *OB*, *OC*, *OD*,…, etc. This is the required development of the cone.

Example 11.12 (Fig. 11.12)

A cone base of 50 mm diameter and 60 mm long axis rests with its base on H.P. A section plane perpendicular to V.P. and inclined at 45° to H.P. bisects the axis of the cone. Draw the development of the lateral surface of the remaining portion of the cone. [RGPV Aug. 2010]

Construction: Fig. 11.16

1. Draw a circle 1-2-3-4 as the top view. Project all the points and obtain $1'o'3'$ as the front view.
2. Draw a square $a'd'g'j'$ such that all the edges are inclined at 45° to XY and it centre lies at a distant of 25 mm above the XY. On the edges of the square mark some more points as b', c', e', f', h', i', k' and l', which may not be equidistant.
3. Determine the subtended angle θ as 134°. Draw a sector 1-O-1 with included angle θ.
4. Draw generator through the critical points a' and g'. Also draw generators through points b', c', e', f', h', i', k' and l'. Project them to the top view as a, b, c,... etc.
5. Mark the generators in the development as OA_1, OB_1, OC_1,... etc., such that $1A_1$= arc $1a$, $1B_1$ = arc $1b$, $1C_1$ = arc $1c$, etc. They represent the locus line for points A, B, C,... etc.
6. Draw horizontal lines from the points a', b', c', e', f', g', h', i', k' and l' to meet OA at points a'', b'', c'',... etc. Draw arcs with O as the centre and radii Oa'', Ob'', Oc'',... etc to meet the corresponding generators at points A, B, C,... etc.
7. Join all the points to obtain the required development as shown. It may be noted that the cutting edges of the square converges in the development to form arc. Therefore, AD, DG, GJ and JA are arcs of circles.

11.7 DEVELOPMENT OF PYRAMID

Development of lateral surface of pyramids consists of a series of isosceles triangles. It can be drawn using radial line method, similar to that of the cone. The following examples illustrate the development of the lateral surface of the pyramids.

Example 11.17 (Fig. 11.17)

Draw the development of lateral surface of a square pyramid with a 40 mm base side and a 60 mm long axis, resting on its base in the H.P., such that all the sides of the base are equally inclined to the V.P.

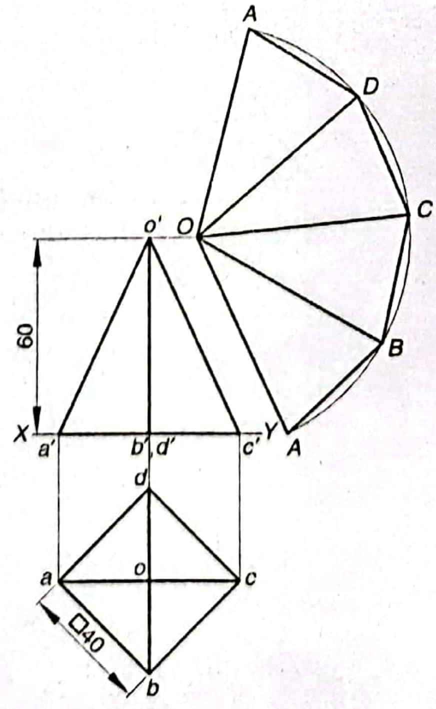

Fig. 11.17

Construction: Fig. 11.17

1. Draw a square *abcd* with side *ab* inclined at 45° to *XY*. Also, draw the diagonal lines of the square. This represents the top view. Project all the corners to obtain triangle $a'o'c'$ as the front view. Consider seam at $o'a'$.
2. Slant edges $o'a'$ and $o'c'$ in the front view represents the true length because their top views are parallel to *XY*. Therefore, draw a line *OA* parallel to $o'c'$.
3. Draw an arc with *O* as the centre and radius *OA*. Step off a distance of 40 mm on the arc to obtain *B*, *C*, *D* and *A*. Thus, $AB = BC = CD = DA = 40$ mm.
4. Join the base sides *AB*, *BC*, *CD*, *DA* and slant edges *OA*, *OB*, *OC*, *OD*, *OA*. This is the required development of the pyramid.

Example 11.18 (Fig. 11.18)

Draw the development of lateral surface of a square pyramid with a 40 mm base side and a 60 mm long axis, resting on its base in the H.P. such that a side of the base is parallel to the V.P.

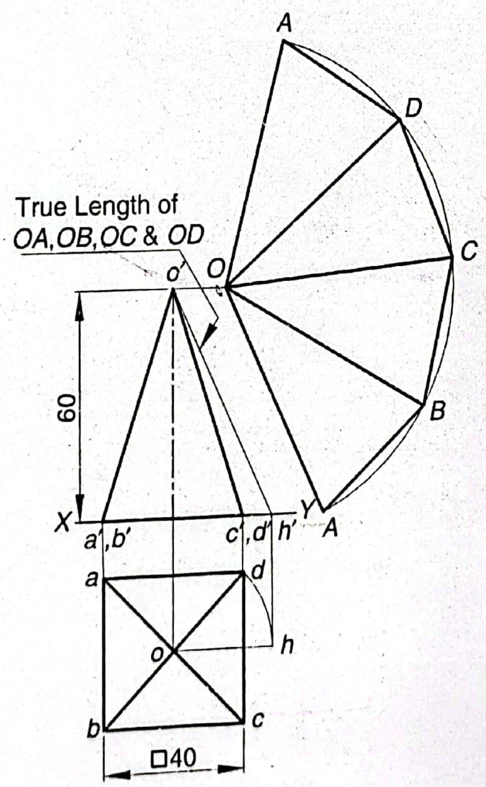

Fig. 11.18

Construction: Fig. 11.18

1. Draw a square *abcd* with side *ad* parallel to *XY*. Also, draw the diagonal lines of the square. This represents the top view. Project all the corners to obtain triangle $a'o'c'$ as the front view. Consider seam at $o'a'$.