Problem 13.14 *A cone of base diameter 50 mm and axis 60 mm is resting on its base on the H.P. Draw the development of its lateral surface when it is cut by an auxiliary inclined plane inclined at 60° to the H.P. and bisecting the axis.*

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

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

Construction Refer to Fig. 13.15.

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. Draw V.T. of the cutting plane inclined at 60° to *xy* such that it passes through mid-point of the axis. Let V.T. cut the generators *c'o'* at *q'*, *d'o'* at r', *e'o'* at *s'*, *f'o'* at *t'*, *g'o'* at *u'* and base circle at *p'*.
3. Determine the subtended angle θ as 138°. Draw a sector *A-O-A* with included angle θ. Divide the sector into 12 equal parts and mark the generators as *OB*, *OC*, *OD*,..., etc.
4. Draw the horizontal lines from points *q'*, *r'*, *s'*, *t* and *u'* to meet line *OA* in the development at points *q''*, *r''*, *s''*, *t''* and *u''*, respectively. Draw arcs with centre *O* and radii *Oq''*, *Or''*, *Os''*, *Ot''* and *Ou''* to meet the corresponding generators at points *Q*, *R*, *S*, *T* and *U*, respectively.

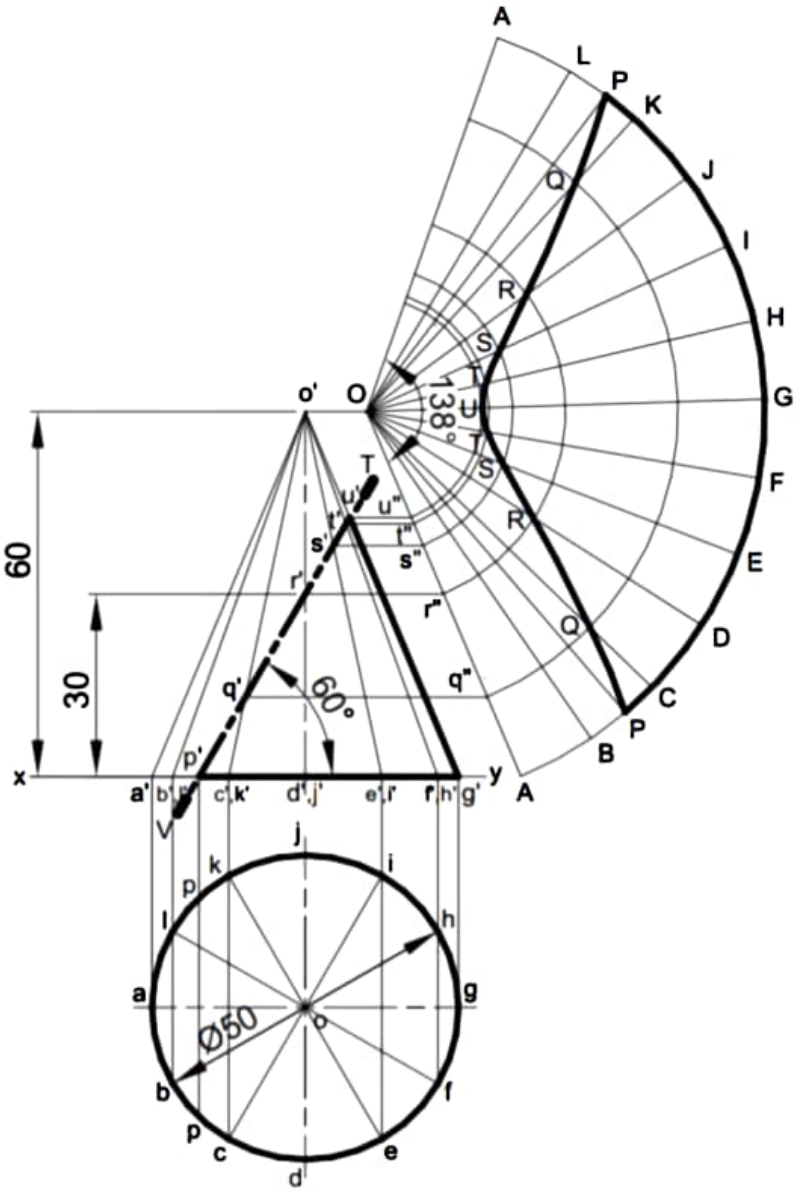


Fig. 13.15

5. Project point *p'* to meet the circle in the top view at point *p*. Locate point *P* in the development such that *BP* = *LP* = *bp*.
6. Join all the points obtained in the development with smooth curves. Darken the portion of the development that is retained after truncating the cone.

Problem 14.24 *A cylinder of base diameter 70 mm is resting on its base on the H.P. It is completely penetrated by a cone of base diameter 80 mm and axis 100 mm. The axes of the two solids are parallel to the V.P. and bisect each other at right angles. Draw three views of the combination and show curves of intersection.*

Construction Refer to Fig. 14.26.

1. Draw three views of the given cylinder and the given cone in their respective positions as shown.

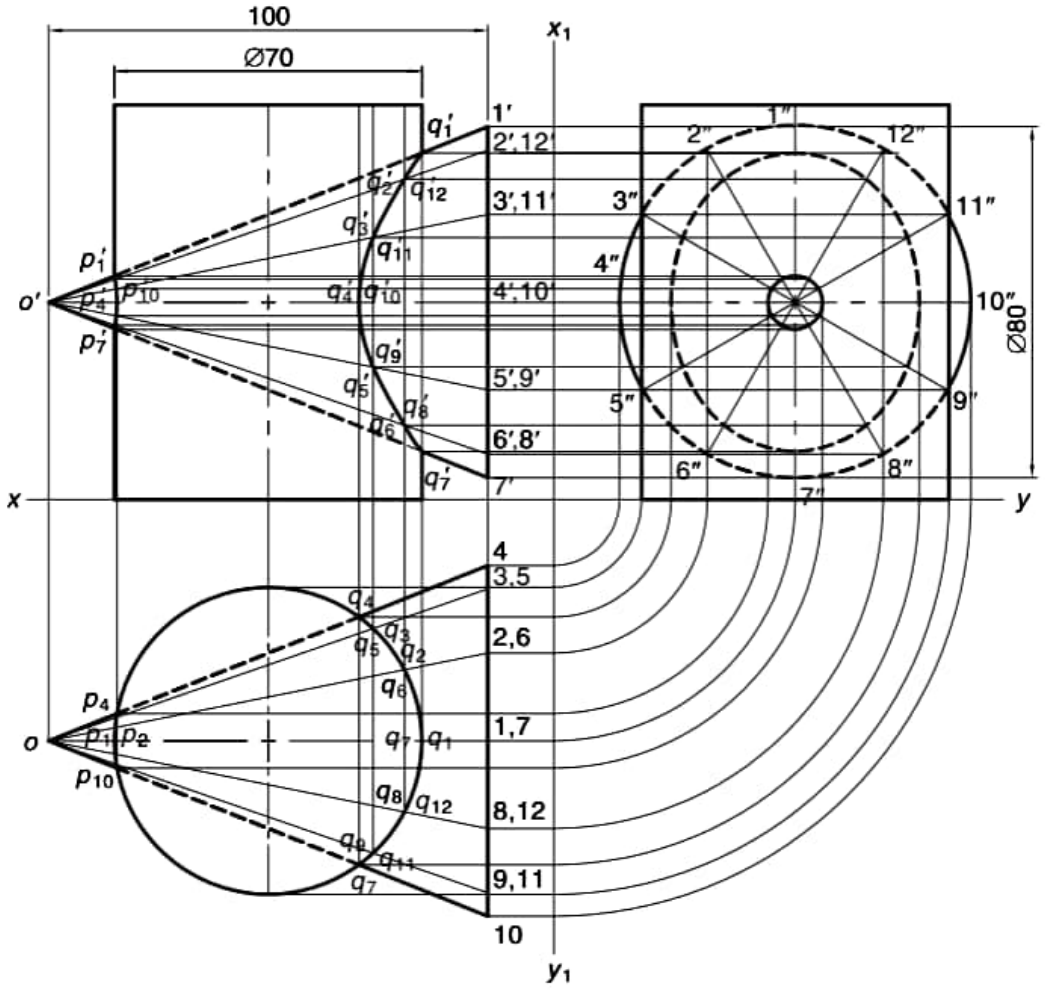


Fig. 14.26

2. Mark 12 generators on the cone in all the three views and label them.
3. Consider seven section planes, one by one, all perpendicular to V.P., passing through the apex and generators of the cone.
4. All these planes cut the cylinder and give the same circle in the top view. The sections of cone by these planes are isosceles triangles in the top view.
5. Mark the points of intersection of these triangles with the base circle of the cylinder in the top view.
6. Transfer these points to FV and SV at their respective positions and join them to get the desired curve of intersection in FV and SV.

Problem 13.10 *A cylindrical drum of base diameter 50 mm and axis 70 mm is resting on its base on the H.P. A square hole of side 40 mm is cut through the drum such that one of the faces of the square hole is inclined at 30° to the H.P. The axis of the hole is perpendicular to the V.P. and is 10 mm away from the axis of the cylinder. Draw the development of the retained cylinder.*

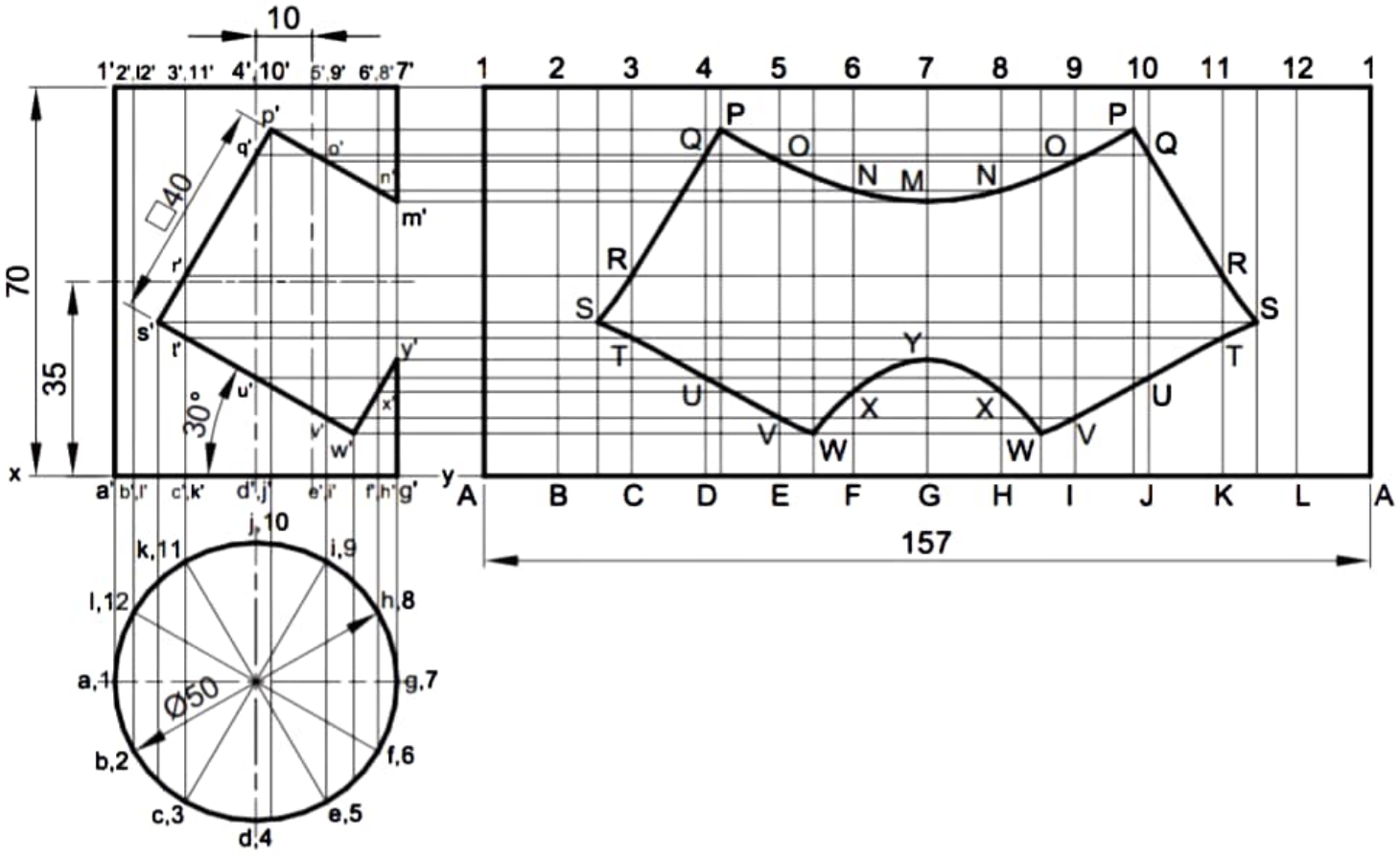


Fig. 13.11

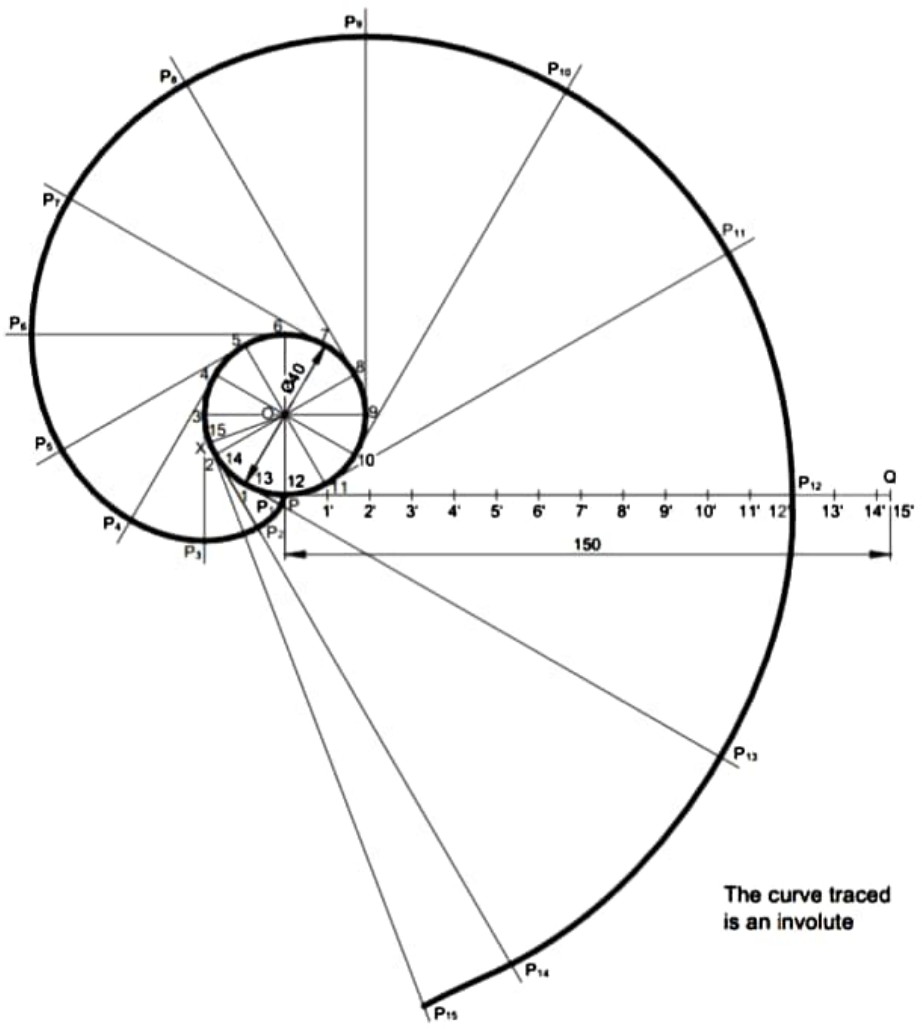
Construction Refer to Fig. 13.11.

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.
2. Draw a square of side 40 mm keeping $s'w'$ inclined at 30° to the horizontal as shown in Fig. 13.11. Name the point of intersection of generators with cutting plane as m', n', o', q', r', t', u', v', x' and y'.
3. Consider seam at $a'1'$. Stretch out lines 1-1 and A-A through the front view equal to the perimeter of the cylinder (157 mm). Divide 1-1 and A-A into 12 equal parts and join them to represent generators *B*2, *C*3, *D*4, *E*5, *F*6, *G*7, *H*8, *I*9, *J*10, *K*11 and *L*12.
4. Draw generators from the key points p', s' and w'. Project them to the top view. Obtain the corresponding generators in the development.
5. Draw horizontal lines from m', n', o', p', q', r', s', t', u', v', w', x' and y' to meet their corresponding generators at *M*, *N*, *O*, *P*, *Q*, *R*, *S*, *T*, *U*, *V*, *W*, *X* and *Y*.
6. Join *MNOP*, *PQRS*, *STUVW* and *WXY* with smooth curves. Dark the portion of the development that is retained after truncating the cylinder.

Problem 6.20 *Draw a path traced out by an end of a piece of thread when unwound to a length of 150 mm from a circle of diameter 40 mm, the thread being kept tight during unwound. Name the curve traced.*

Construction Refer to Fig. 6.26.

The length of thread is 150 mm. Therefore, the angle through which the thread should unwound is given by $\theta = \dfrac{\text{Length of thread}}{\pi D} \times 360° = \dfrac{150}{\pi \times 40} \times 360° = 429.7°$. Thus, thread should be unwound by 360° + 69.7° (i.e., one revolution + 69.7°)



14.11 MISCELLANEOUS PROBLEMS

Problem 14.22 *A hexagonal prism of base side 40 mm and axis 100 mm, is resting on its base on H.P. with a side of base parallel to V.P. It is penetrated by a horizontal cylinder of base diameter 50 mm and axis 100 mm such that their axes bisect each other at right angles. Draw three views of the combination and show the curves of intersection.*

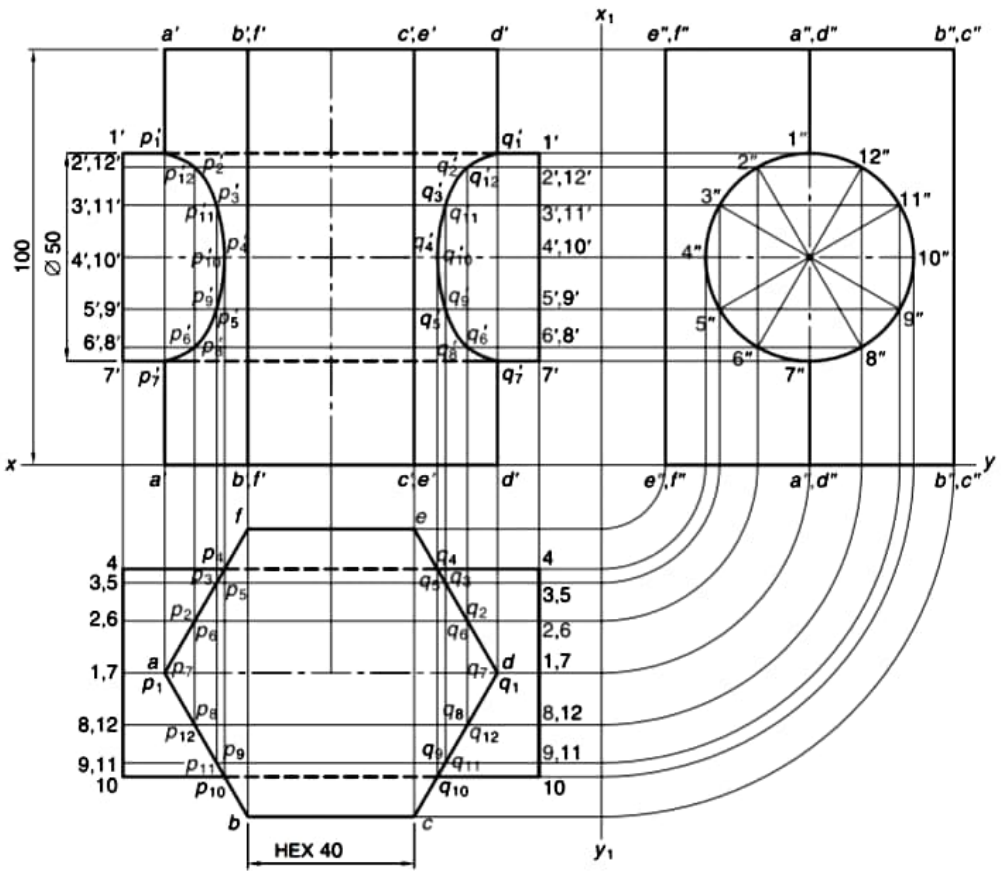


Fig. 14.24

Construction Refer to Fig. 14.24.

1. Draw a hexagon *abcdef* of side 40 mm to represent TV of the prism. Project its FV and SV with 100 mm long axis and label them.
2. Draw SV of the cylinder which is a circle of diameter 50 mm and the centre of which bisects the axis of the prism at right angles. Project this circle to get the FV and TV and label them as shown.
3. The faces of the prism are seen as lines in the TV. First locate the points of intersection in the TV of the generators 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 of the cylinder with the faces of the prism on left side as p_1, p_2, p_3, p_4, p_5, p_6, p_7, p_8, p_9, p_{10}, p_{11}, p_{12} and on right side as q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, q_{10}, q_{11}, q_{12}.

4. Project points p_1, p_2, p_3, p_4, p_5, p_6, p_7, p_8, p_9, p_{10}, p_{11}, p_{12} to FV to meet their corresponding generators 1′, 2′, 3′, 4′, 5′, 6′, 7′, 8′, 9′, 10′, 11′, 12′ at points p_1', p_2', p_3', p_4', p_5', p_6', p_7', p_8', p_9', p_{10}', p_{11}', p_{12}'. Similarly, project q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, q_{10}, q_{11}, q_{12} to FV and obtain points q_1', q_2', q_3', q_4', q_5', q_6', q_7', q_8', q_9', q_{10}', q_{11}', q_{12}'.
5. Join points $p_1'p_2'p_3'p_4'p_5'p_6'p_7'$ and $q_1'q_2'q_3'q_4'q_5'q_6'q_7'$ by continuous lines as shown. These lines show the curves of intersection.