Engineering Graphics (MEC103)

Unit 6 - Development of Surfaces

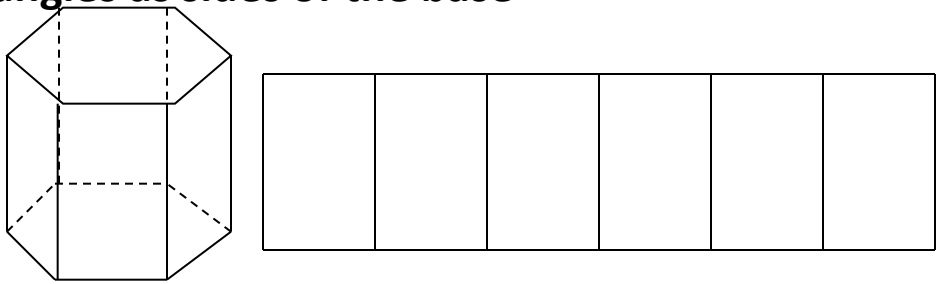
Development is a graphical method of obtaining the area of the surfaces of a solid. When a solid is opened out and its complete surface is laid on a plane, the surface of the solid is said to be developed. The figure thus obtained is called a *development of the surfaces of the solid* or simply *development*. Development of the solid, when folded or rolled, gives the solid.

Examples

Prism – Made up of same number of rectangles as sides of the base

One side: Height of the prism

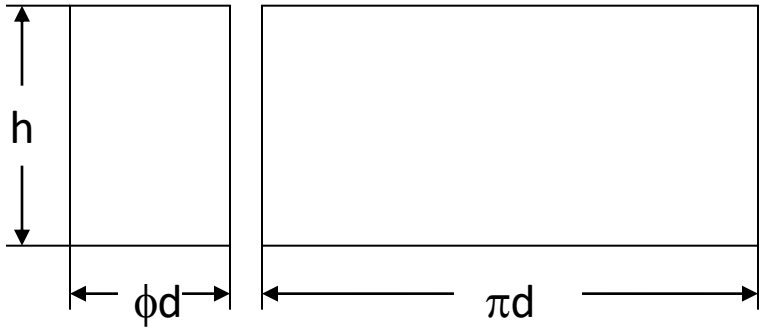
Other side: Side of the base



Cylinder – Rectangle

One side: Circumference of the base

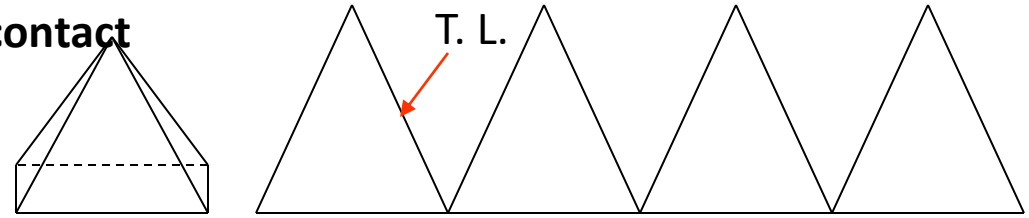
Other side: Height of the cylinder



Pyramid – Number of triangles in contact

The base may be included

if present



Methods used to develop surfaces

1. **Parallel-line development: Used for prisms, cylinders etc. in which parallel lines are drawn along the surface and transferred to the development.**

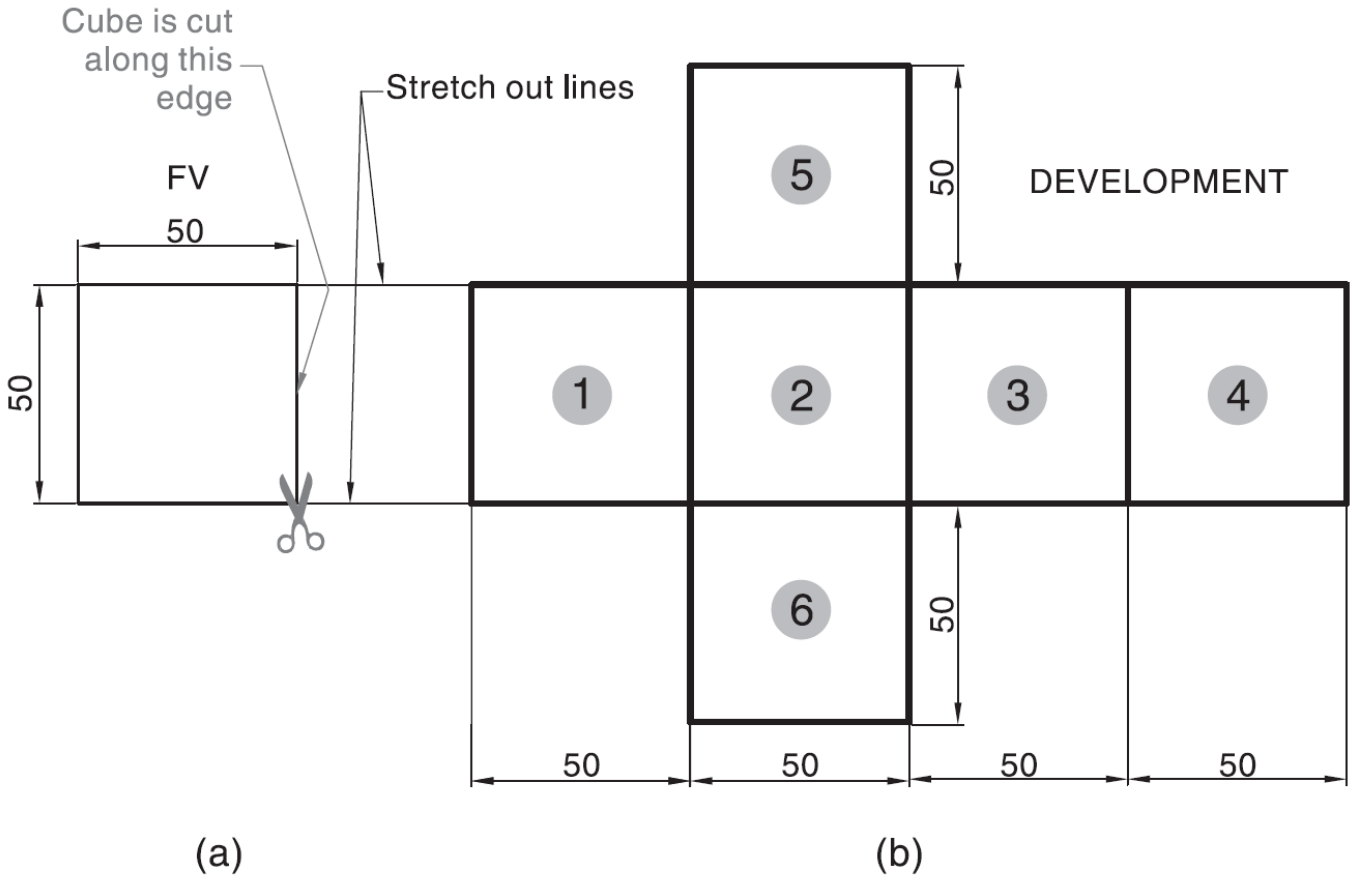
2. **Radial-line development: Used for pyramids, cones etc. in which the true length of the slant edge or generator is used as radius.**

3. **Triangulation development: Complex shapes are divided into a number of triangles and transferred into the development (usually used for transition pieces).**

4. **Approximate method: Surface is divided into parts and developed. Used for surfaces such as spheres, paraboloids, ellipsoids etc.**

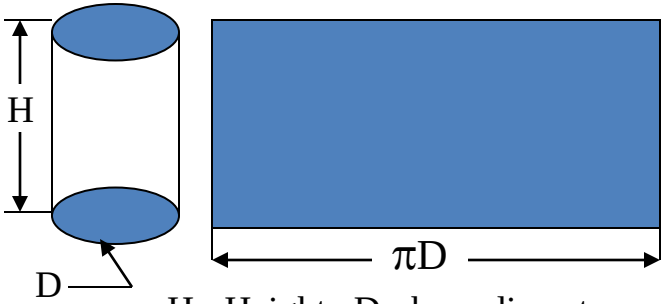
Note:- The surface is preferably cut at the location where the edge will be smallest such that welding or other joining procedures will be minimal.

Parallel line development: This method is employed to develop the surfaces of prisms and cylinders. Two parallel lines (called *stretch-out lines*) are drawn from the two ends of the solids and the lateral faces are located between these lines.



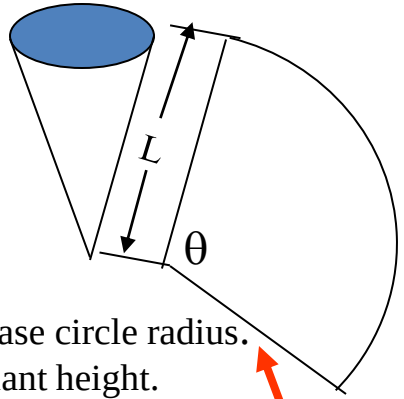
Development of lateral surfaces of different solids.
(Lateral surface is the surface excluding top & base)

Cylinder: A Rectangle



H= Height D= base diameter

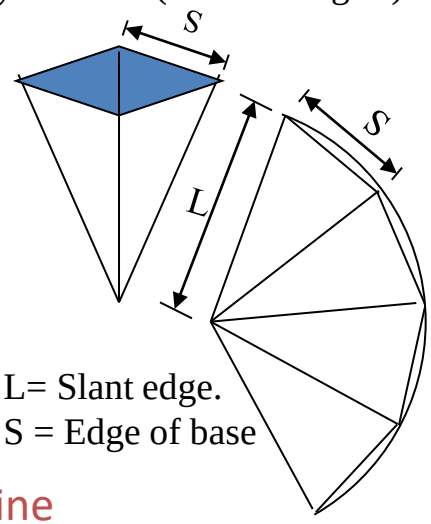
Cone: (Sector of circle)



R=Base circle radius.
L=Slant height.

$$\theta = \frac{R}{L} \times 360^0$$

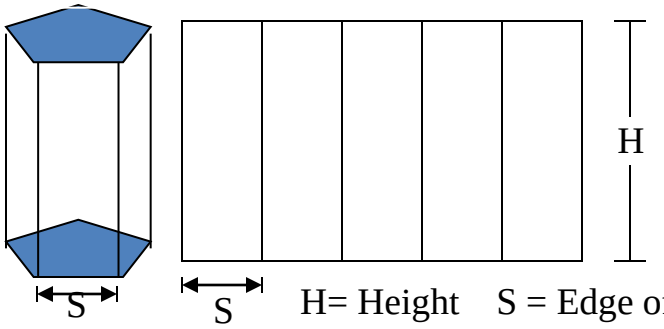
Pyramids: (No.of triangles)



L= Slant edge.
S = Edge of base

Radial-line development

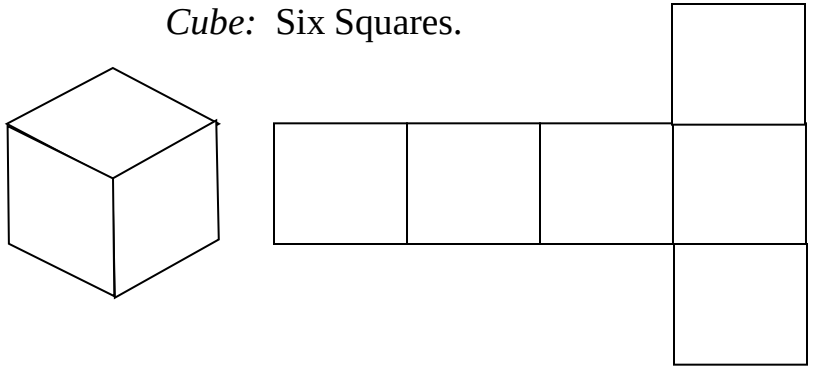
Prisms: No.of Rectangles



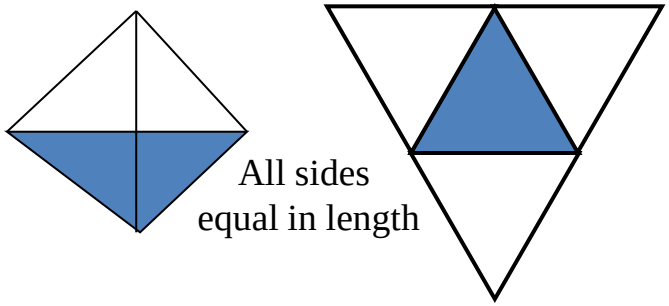
H= Height S = Edge of base

Parallel-line development

Cube: Six Squares.



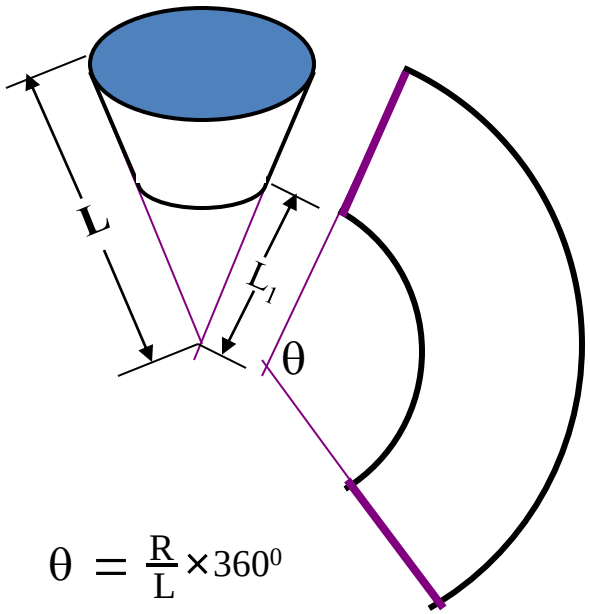
Tetrahedron: Four Equilateral Triangles



All sides equal in length

FRUSTUMS

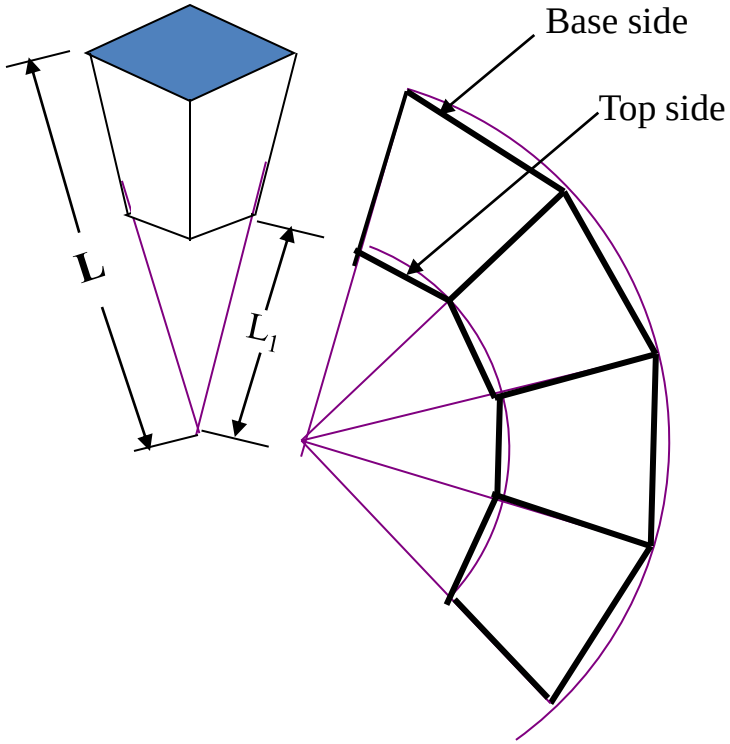
DEVELOPMENT OF FRUSTUM OF CONE



$$\theta = \frac{R}{L} \times 360^0$$

R= Base circle radius of cone
L= Slant height of cone
L_1 = Slant height of cut part.

DEVELOPMENT OF FRUSTUM OF SQUARE PYRAMID

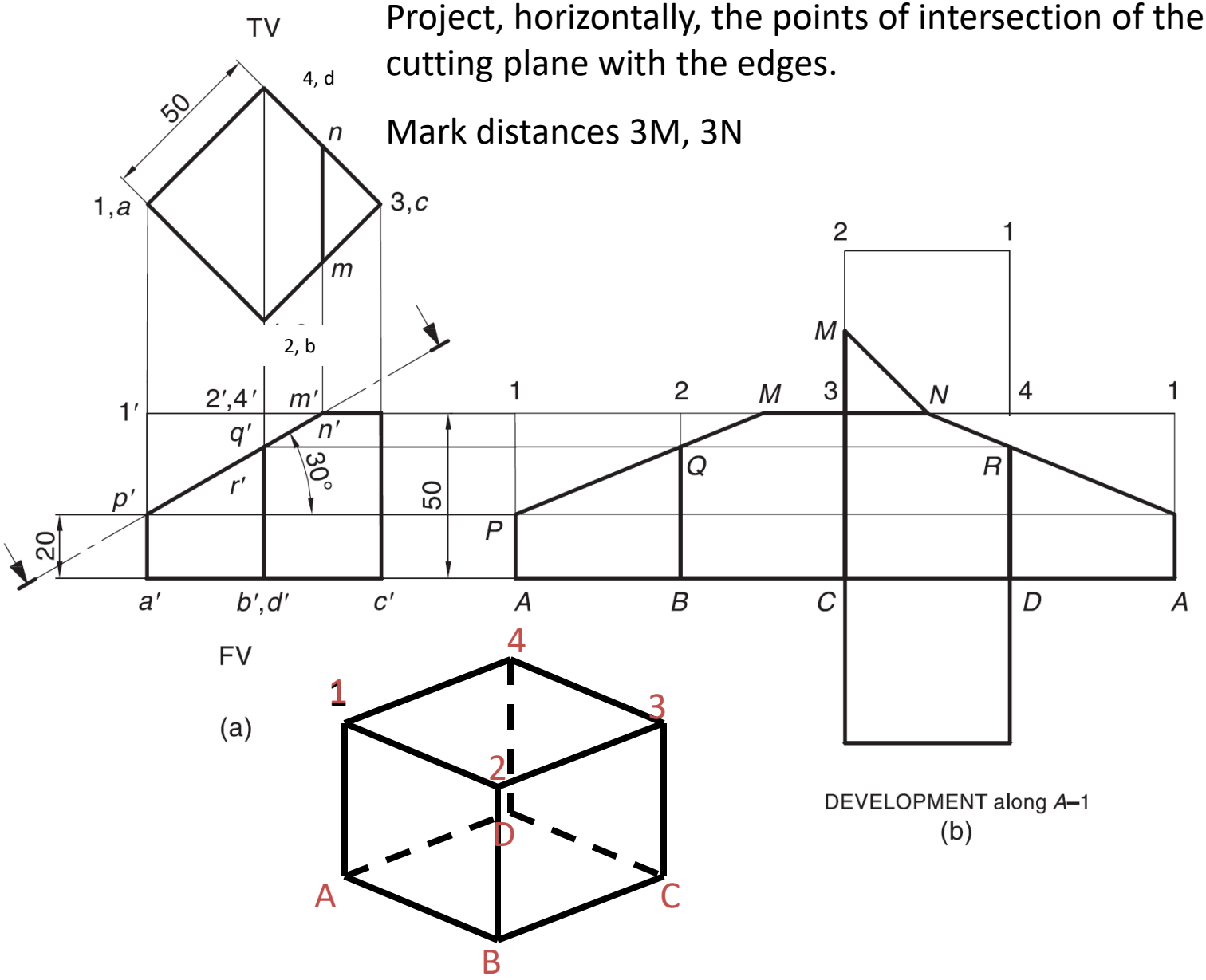


L= Slant edge of pyramid
L_1 = Slant edge of cut part.

Cube cut by section plane

Project, horizontally, the points of intersection of the cutting plane with the edges.

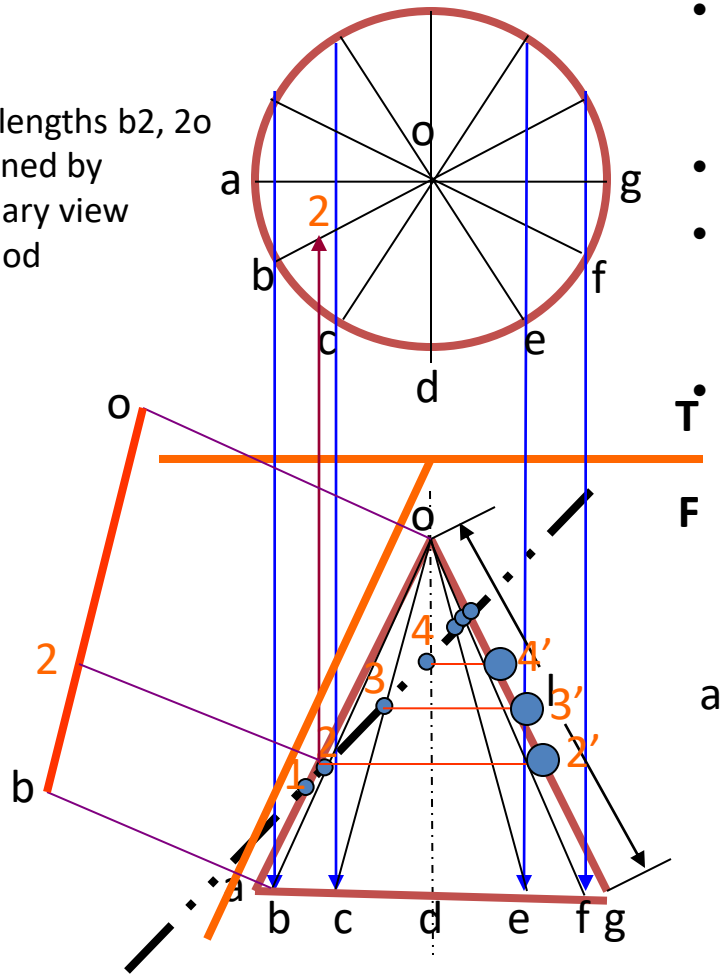
Mark distances 3M, 3N



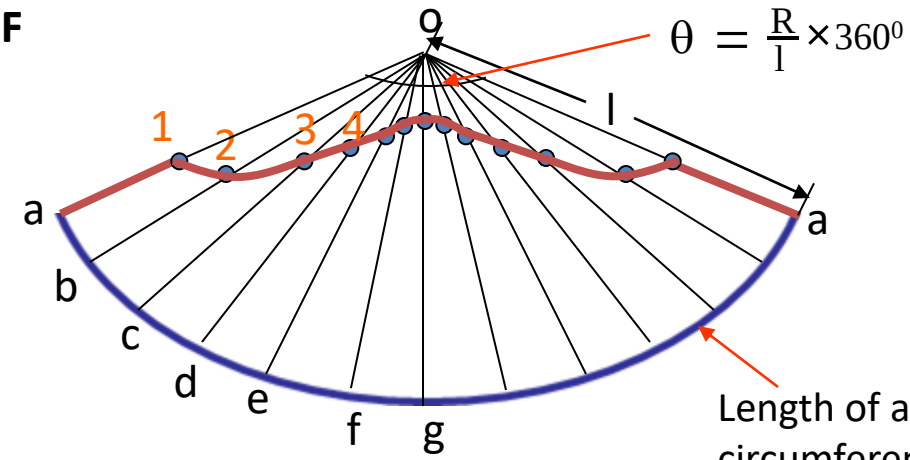
Draw the development of the lower portion of the cone surface cut by a plane. Cone base diameter is 40 mm and height is 50 mm. The cutting plane intersects the cone axis at an angle of 45° and 20 mm below the vertex

Radius of cone = R

True lengths b2, 2o obtained by auxiliary view method

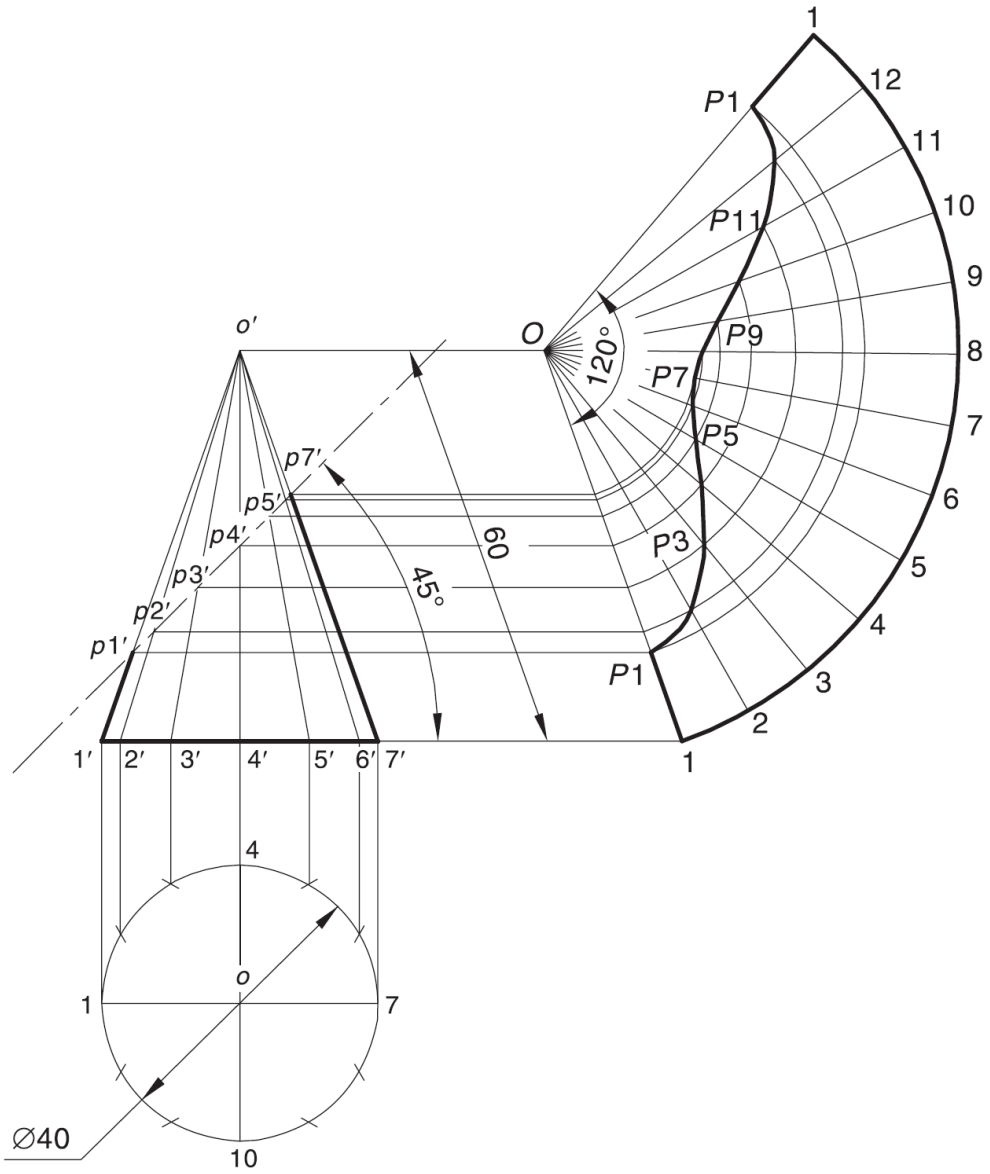


- Divide the cone in the top view and project the corresponding generator lines in the front view
- Develop the complete surface of the cone by drawing an arc with radius = length of side generator of cone and length of arc = circumference of cone base
- Draw the corresponding generator lines
- Obtain true lengths of o1, o2 etc. by auxiliary view, rotation method OR by projecting onto one of the side generators (which are in true length)
- Mark the distances (true lengths) o1, o2…etc. in the development and join them to get the development of the lower portion of the cone



Length of arc = circumference of base of cone

True length of (o2, o3) = (o2', o3') etc.



If $R = 2r$ then $\theta = 180°$, i.e., if the slant height of a cone is equal to its diameter of base then its development is a semicircle of radius equal to the slant height.

THANKS