

# Module 5

## Development of Surfaces

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# Introduction

## **DEVELOPMENT OF SURFACES OF SOLIDS.**

### **MEANING:-**

ASSUME OBJECT HOLLOW AND MADE-UP OF THIN SHEET. CUT OPEN IT FROM ONE SIDE AND UNFOLD THE SHEET COMPLETELY. THEN THE **SHAPE OF THAT UNFOLDED SHEET IS CALLED DEVELOPMENT OF LATERAL SURFACES** OF THAT OBJECT OR SOLID.

**LATERAL SURFACE** IS THE SURFACE EXCLUDING SOLID'S TOP & BASE.

### **ENGINEERING APPLICATION:**

THERE ARE SO MANY PRODUCTS OR OBJECTS WHICH ARE DIFFICULT TO MANUFACTURE BY CONVENTIONAL MANUFACTURING PROCESSES, BECAUSE OF THEIR SHAPES AND SIZES.

**THOSE ARE FABRICATED IN SHEET METAL INDUSTRY BY USING DEVELOPMENT TECHNIQUE. THERE IS A VAST RANGE OF SUCH OBJECTS.**

### **EXAMPLES:-**

Boiler Shells & chimneys, Pressure Vessels, Shovels, Trays, Boxes & Cartons, Feeding Hoppers, Large Pipe sections, Body & Parts of automobiles, Ships, Aeroplanes and many more.

**WHAT IS  
OUR OBJECTIVE  
IN THIS TOPIC ?**

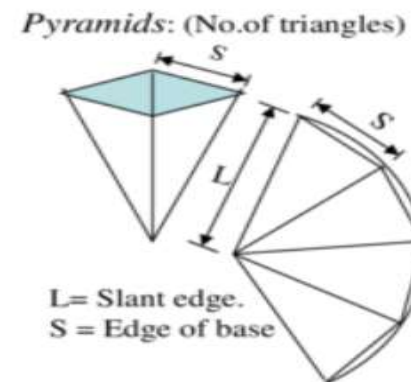
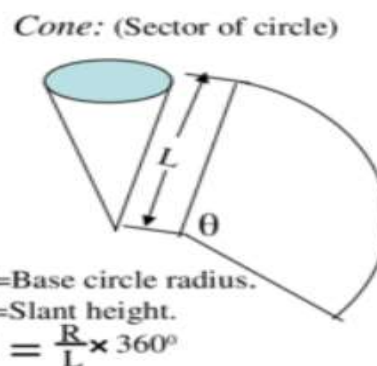
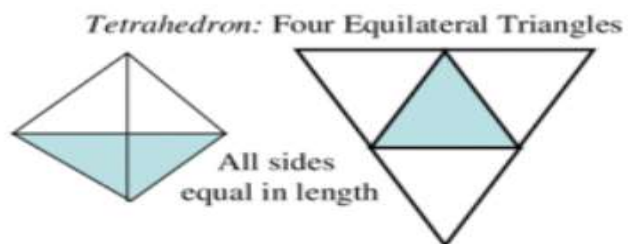
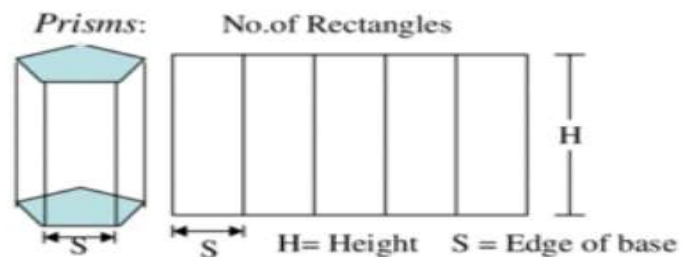
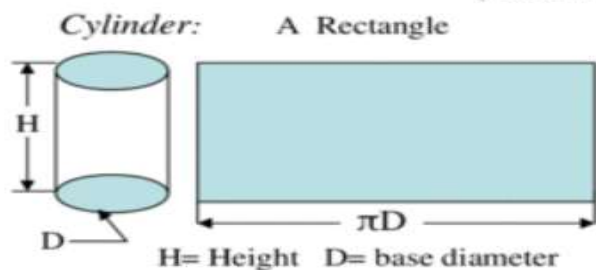


**To learn methods of development of surfaces of different solids, their sections and frustums.**

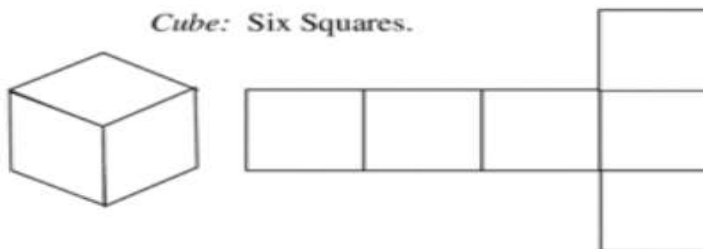
*But before going ahead,  
note following  
Important points.*

- 1. Development is different drawing than PROJECTIONS.**
- 2. It is a shape showing AREA, means it's a 2-D plain drawing.**
- 3. Hence all dimensions of it must be TRUE dimensions.**
- 4. As it is representing shape of an un-folded sheet, no edges can remain hidden And hence DOTTED LINES are never shown on development.**

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

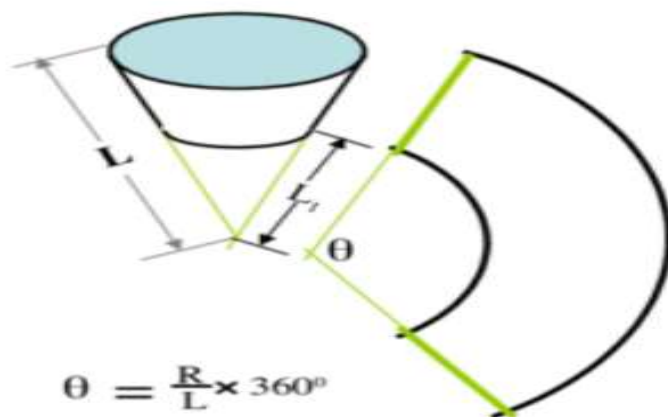


**Cube:** Six Squares.



## FRUSTUMS

### DEVELOPMENT OF FRUSTUM OF CONE



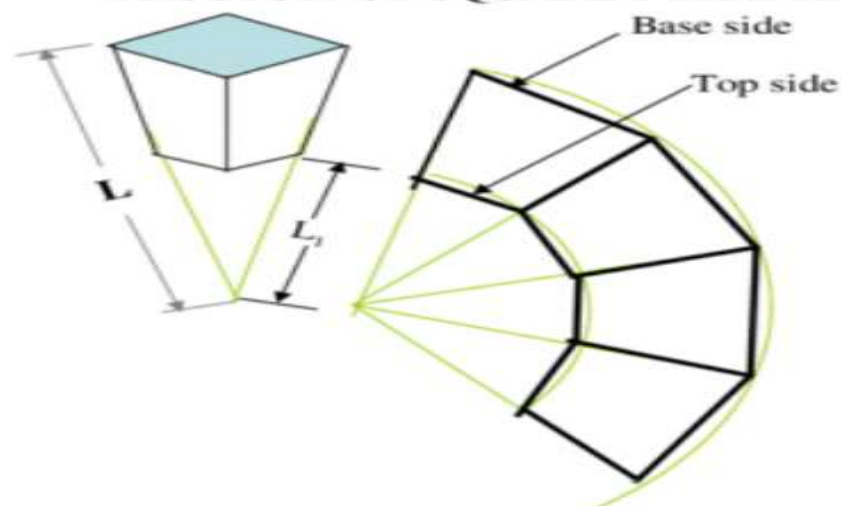
$$\theta = \frac{R}{L} \times 360^\circ$$

R = Base circle radius of cone

L = Slant height of cone

L<sub>1</sub> = Slant height of cut part.

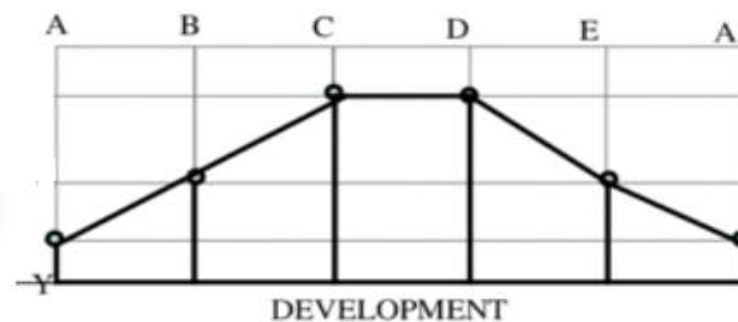
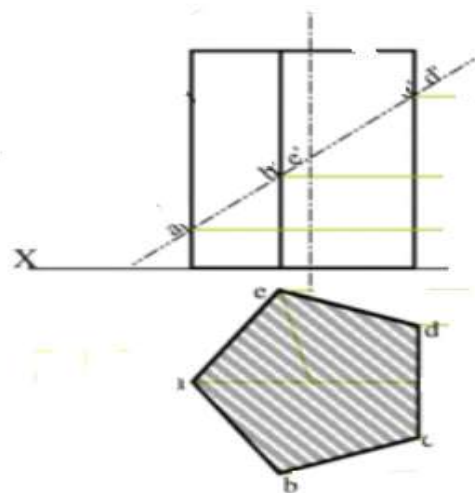
### DEVELOPMENT OF FRUSTUM OF SQUARE PYRAMID



L = Slant edge of pyramid

L<sub>1</sub> = Slant edge of cut part.

Q. A Pentagonal prism, 30 mm side of base and 50 mm axis is standing on HP on its base with one of the side of base perpendicular to VP. It is cut by a sectional plane inclined at  $40^\circ$  to the HP, through midpoint of axis. Draw the F.V, T.V and development of the surface of the remaining solid.

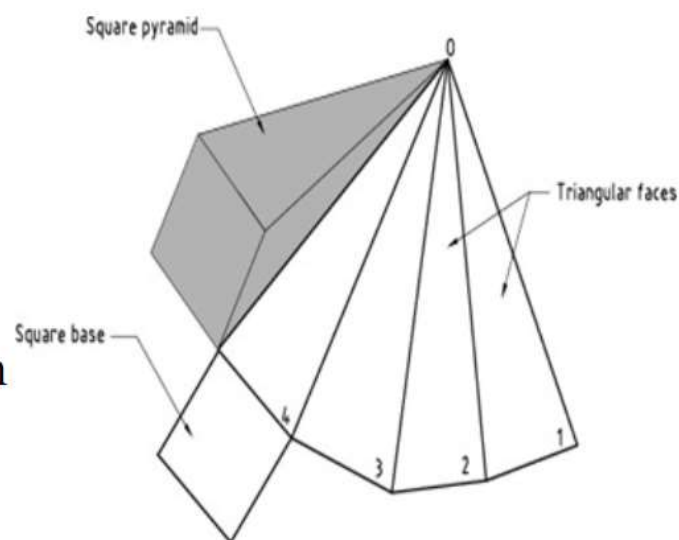


**For Development:**

Draw development of entire solid. Name from cut-open edge i.e. A. in sequence as shown. Mark the cut points on respective edges. Join them in sequence in st. lines. Make existing parts dev. dark.

## Development of a pyramid

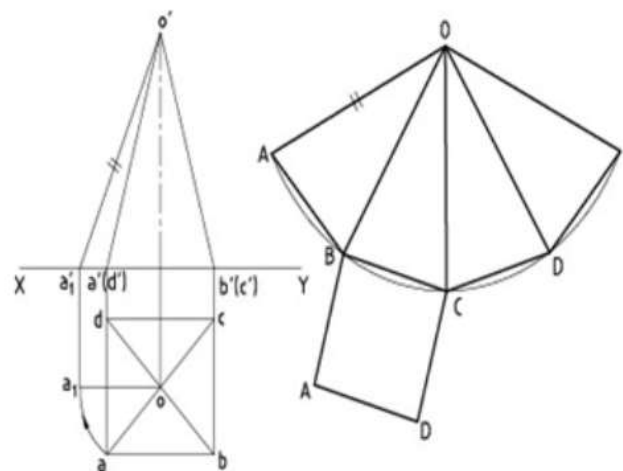
- Consider a square pyramid, when the slant triangular faces are opened out, its faces are seen as four triangles of same size and shape, the base is a square as shown in fig.
- Radial line method is used to draw development of pyramids and cone.





## Radial Line Method

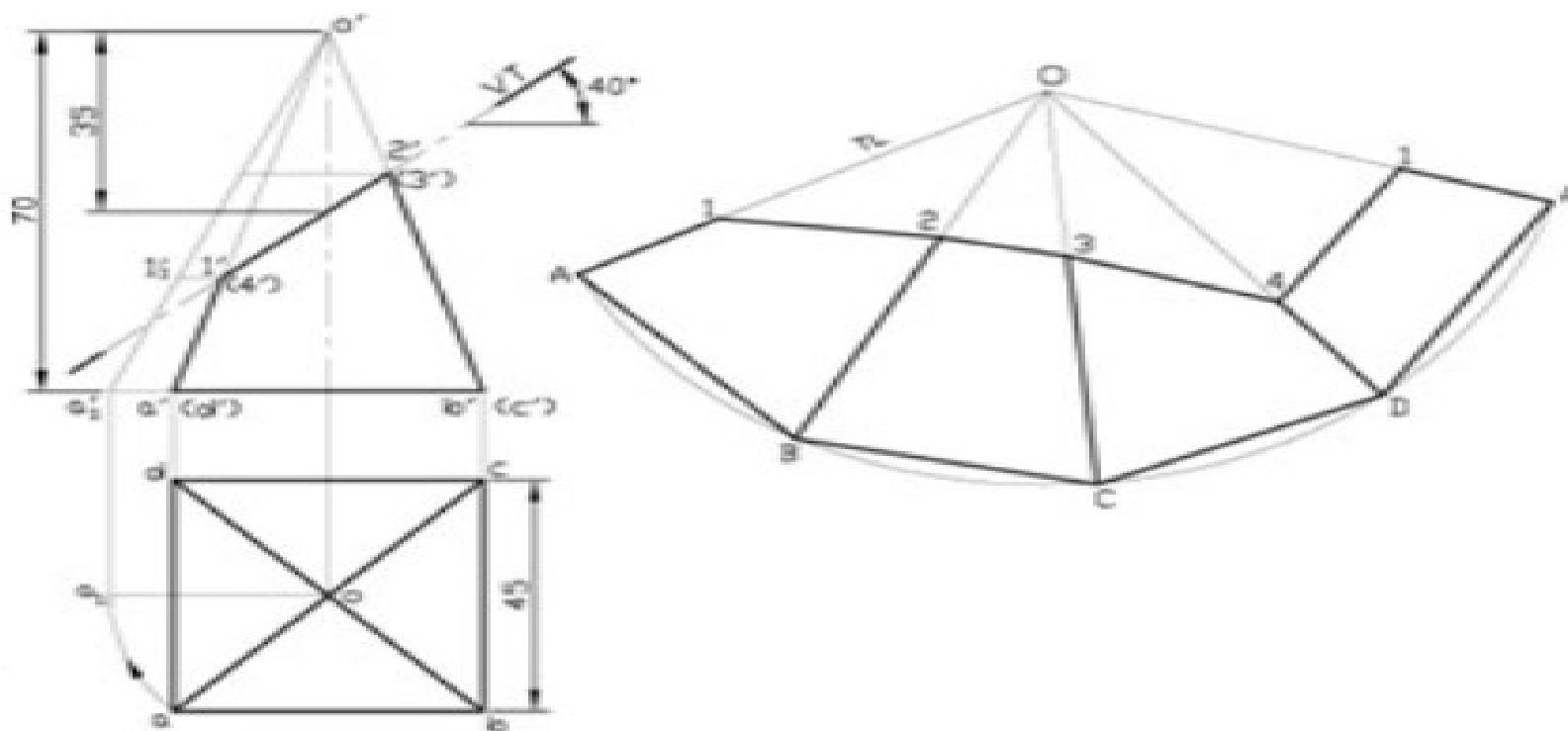
- For example, consider a square pyramid and its development shown in fig.
- An arc with true length of slant edge as radius and  $o$  as center is drawn. The base sides are marked along the arc and the triangular faces are drawn.
- The base is opened out and drawn in an arbitrary position as shown.



A square pyramid of side of base 45 mm, altitude 70 mm and resting with its base on *HP* with two sides of the base parallel to *VP*. The pyramid is cut by a section plane which is perpendicular to *VP* and inclined at  $40^\circ$  to the *HP* and bisects the axis of the pyramid. Draw the development of lateral surface of the truncated pyramid.

- Draw TV, project FV of prism, the draw cutting plane and mark new corners.
- An arc with true length of slant edge as radius and *O* as center is drawn. The base sides are marked along the arc and the triangular faces are drawn.
- Measure true distance of new corners from *o'* and mark from *O* to complete development of remaining portion of lateral surfaces.





A cone of base diameter 40 mm and axis length 50 mm is resting on *HP* on its base cut by a plane inclined at  $30^\circ$  to *HP* and perpendicular to *VP* and is passing through a point on the circumference of the base. Draw the development of the remaining upper portion of the cone.

- Draw TV and divide 8 parts, project FV and draw the cutting plane at  $30^\circ$  to XY. Mark the new corners on the generators. An arc with true length of generator as radius and *o* as center is drawn for the subtended angle as given below.

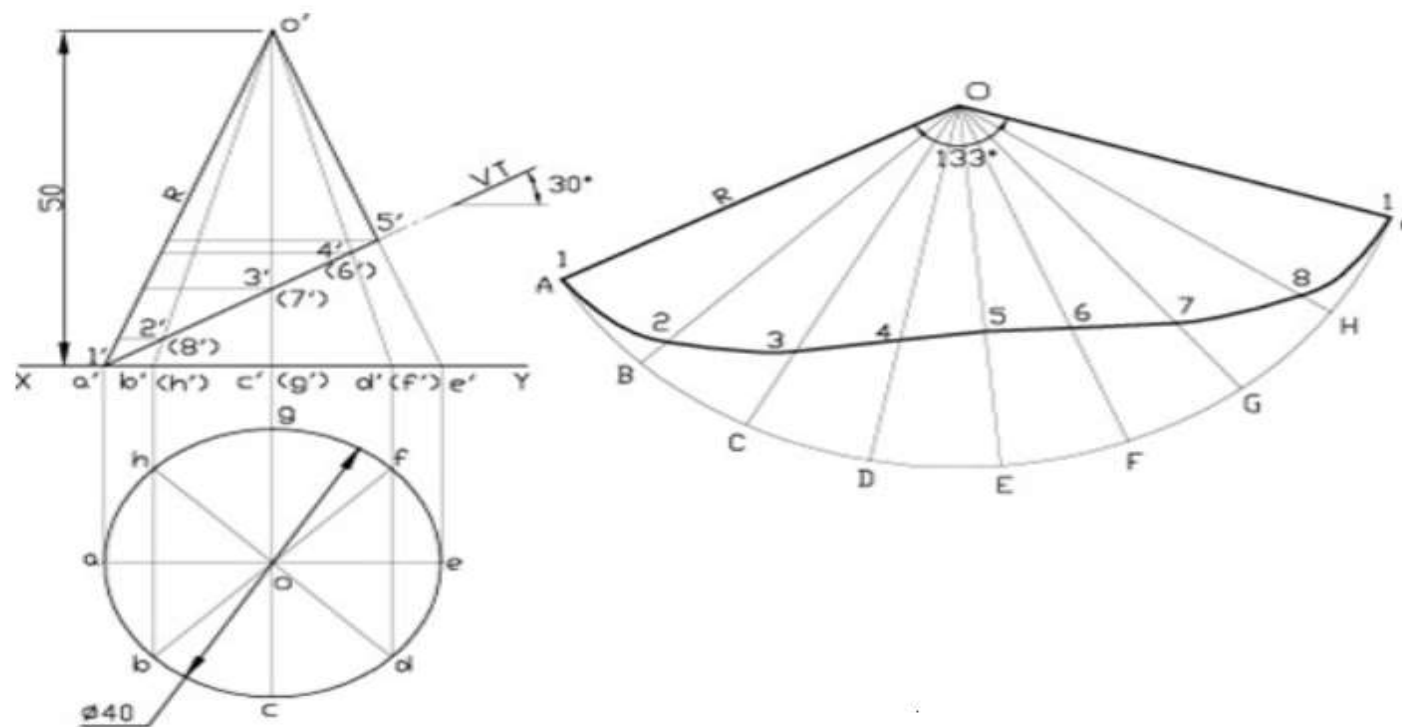
$$\text{Subtended angle } \theta = \frac{r}{R} \times 360^\circ$$

where  $r$  = base circle radius in mm

$R$  = true length of generator in mm ( $o'a'$  length)

$$\theta = \frac{20}{54} \times 360^\circ = 133^\circ$$

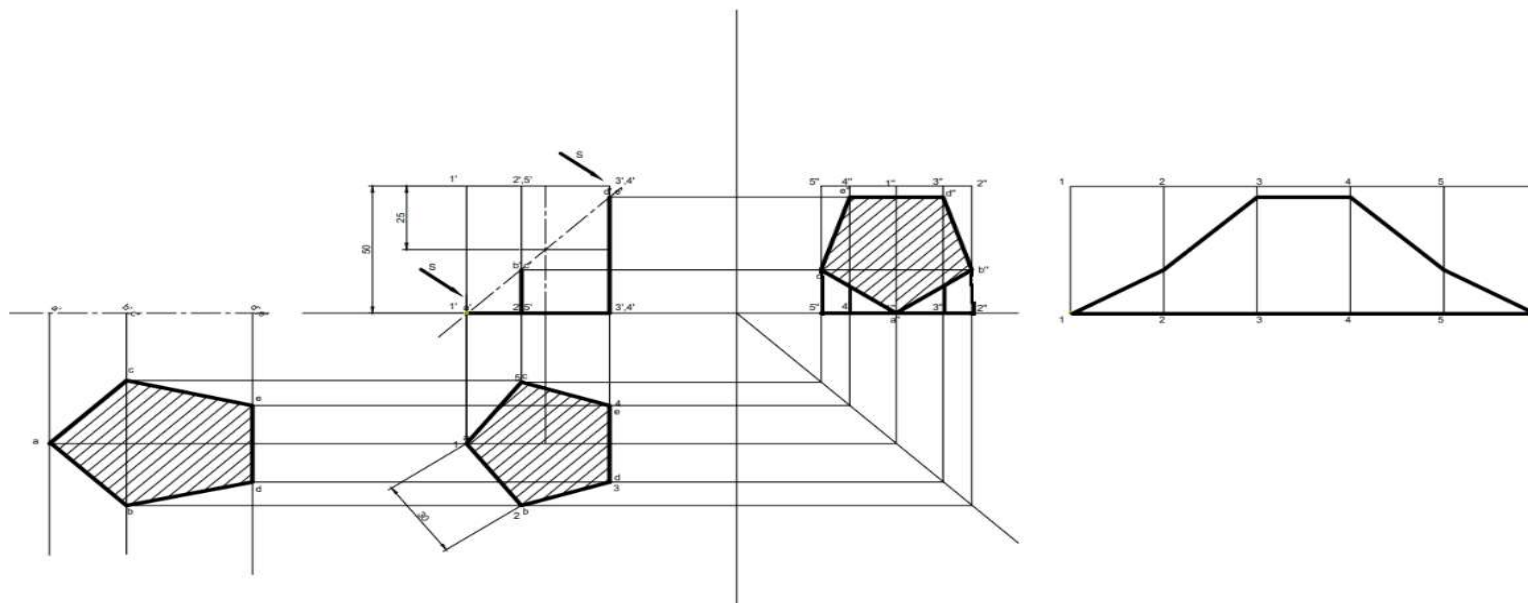
- The chord length of each segment is marked along the arc and draw the generators.
- Measure true distance of new corners from  $o'$  and mark from  $O$  to complete development of remaining portion of lateral surfaces.



Questions having section and development together



Q. A Pentagonal prism, 30 mm side of base and 50 mm axis is standing on HP on its base whose one side is perpendicular to VP. It is cut by a section plane  $45^\circ$  inclined to HP, through the midpoint of axis. Draw F.V, Sectional T.V and Sectional S.V. Also draw true shape of section and development of surface of remaining solid.



Q. A cone , 50 mm base diameter and 70 mm axis is standing on its base on H.P. It is cut by a section plane  $45^\circ$  inclined to H.P through base end generator. Draw projections , sectional views, true shape of section and development of surfaces of remaining solid.

