

9.0 Development of Surfaces (Using Solidworks)

SEMESTER: I/II

**COURSE TITLE: COMPUTER AIDED ENGINEERING
GRAPHICS**

COURSE CODE: 22MED13/23

Solution Manual

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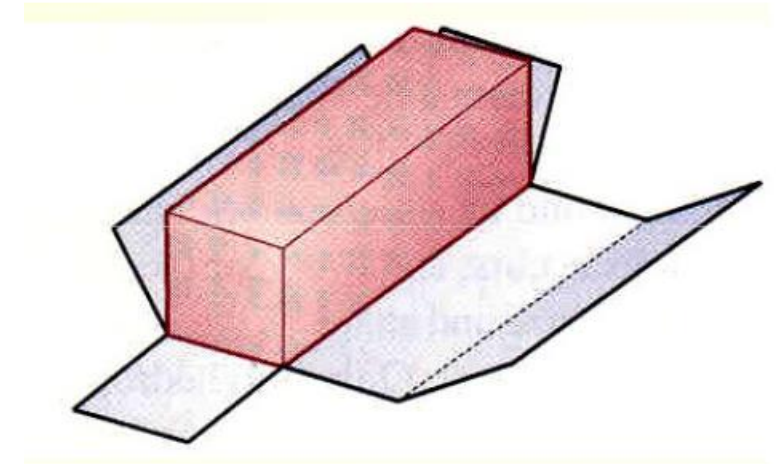
RVCE, Bengaluru

What is Development of surfaces?

A development is the unfold/unrolled flat / plane figure of a 3-D object. Called also a pattern, the plane may show the true size of each area of the object. When the pattern is cut, it can be rolled or folded back into the original object.

Methods of development of surfaces are:

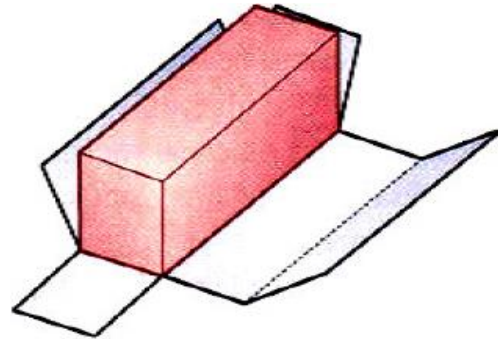
- Parallel line development (For prisms & cylinders)
- Radial line development (For pyramids & cones)
- Triangulation development (For Transition pieces)
- Approximate development (For Spheres)



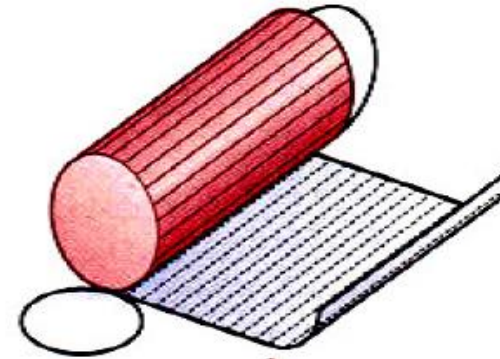
Practical applications of Development:

- Knowledge of development is very useful in sheet metal work, construction of pressure vessels, hoppers, chimneys, Aircraft body building, Air conditioning ducts, etc.
- Such components are manufactured from plates that are cut according to these developments and then properly bend into desired shapes. The joints are then welded or riveted.

Parallel line development uses parallel lines to construct the expanded pattern of each three-dimensional shape. The method divides the surface into a series of parallel lines to determine the shape of a pattern. **Example: Prism, Cylinder.**

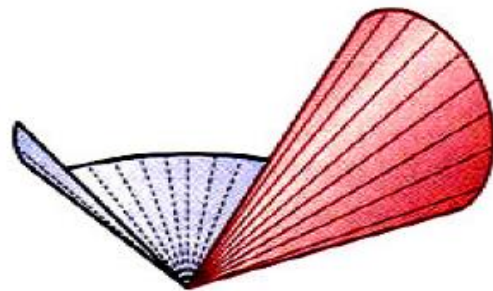


(A) Prism
(Parallel line development)

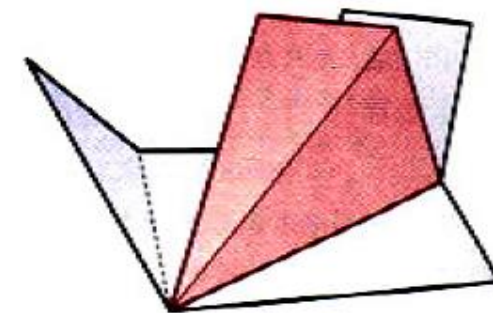


(B) Cylinder
(Parallel line development)

Radial line development uses lines radiating from a central point to construct the expanded pattern of each three-dimensional shape. **Example: Cone, Pyramid.**



(D) Cone
(Radial line development)



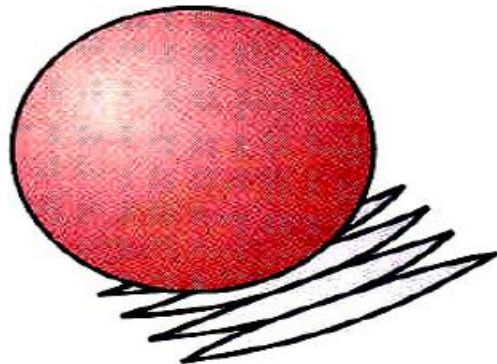
(C) Pyramid
(Radial line development)

Triangulation developments are used for components whose geometry changes from one end to another, such as circle to square, Rectangle to square, etc. (used in sheet metal hoppers)

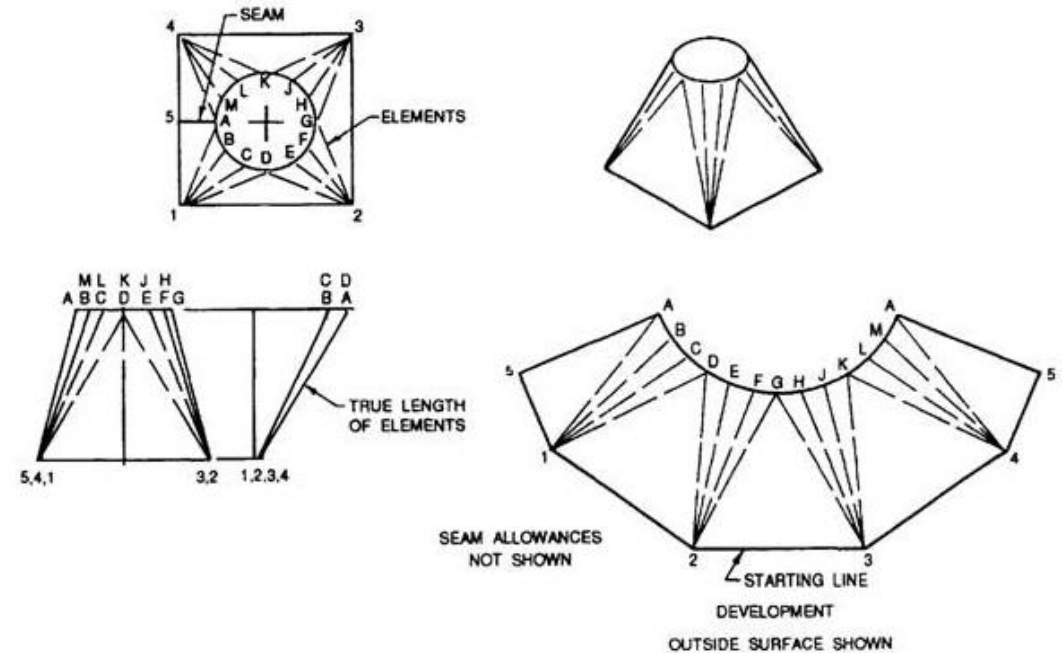


Approximate development (For Spheres):

In approximate development, the shape obtained is only approximate. After joining, the part is stretched or distorted to obtain the final shape.

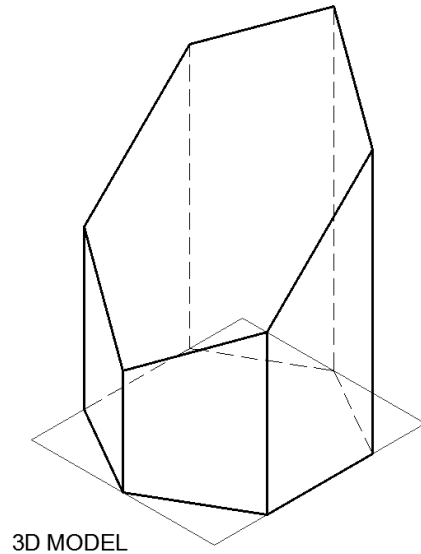


(E) Sphere
(Approximate development)

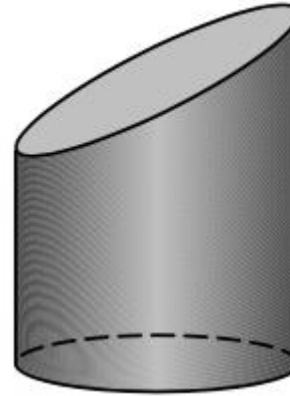


Note: Within the scope of our syllabus, only parallel line and radial line development are discussed.

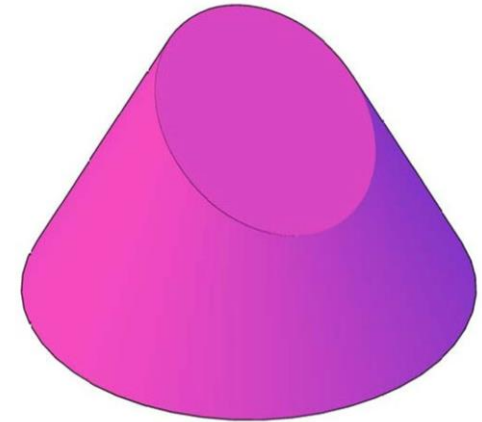
Truncated solid: When a solid is cut off by a plane inclined to the axis, it is called a truncated solid.



Truncated prism



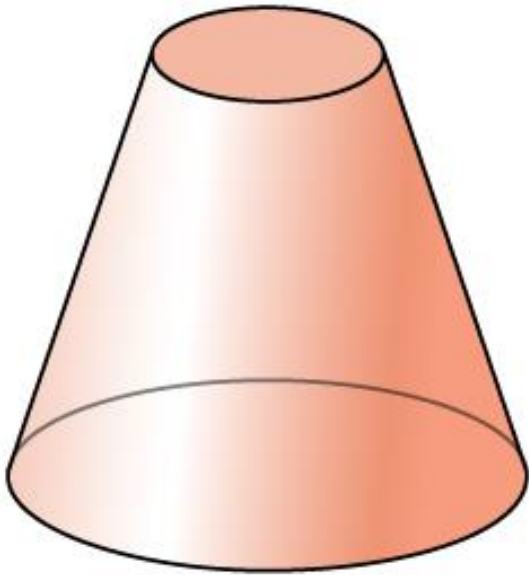
Truncated Cylinder



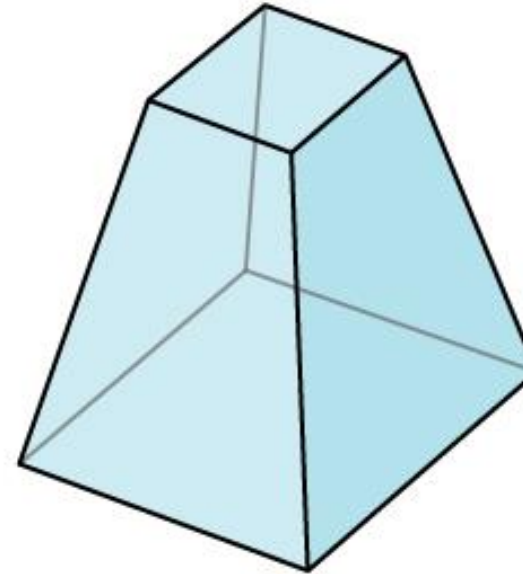
Truncated Cone

Frustum: When a pyramid or cone is cut off by a plane perpendicular to the axis,(or parallel to the base) it is called a frustum.

Frustum of a Cone

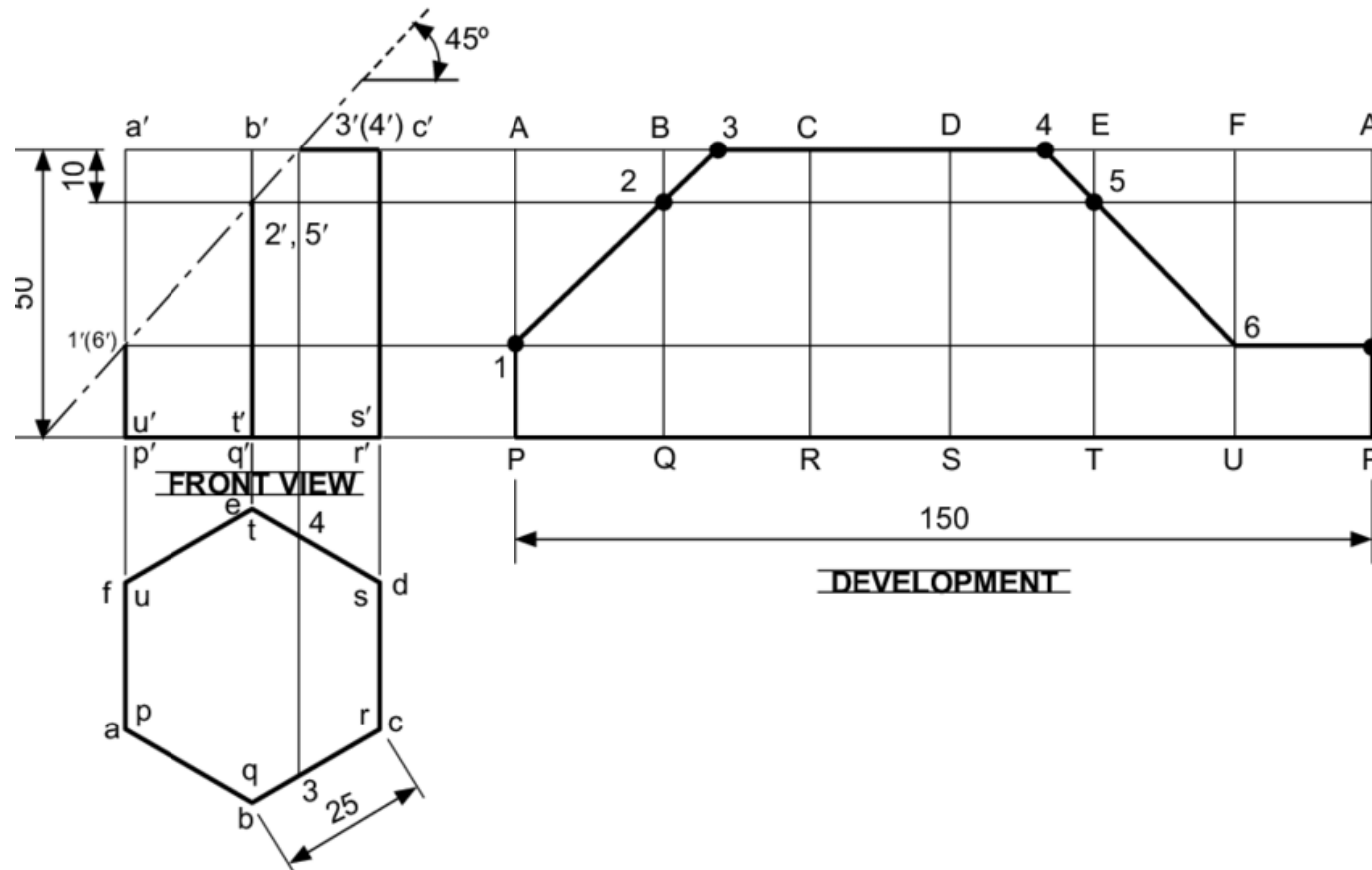


Frustum of a Pyramid



Parallel line development:

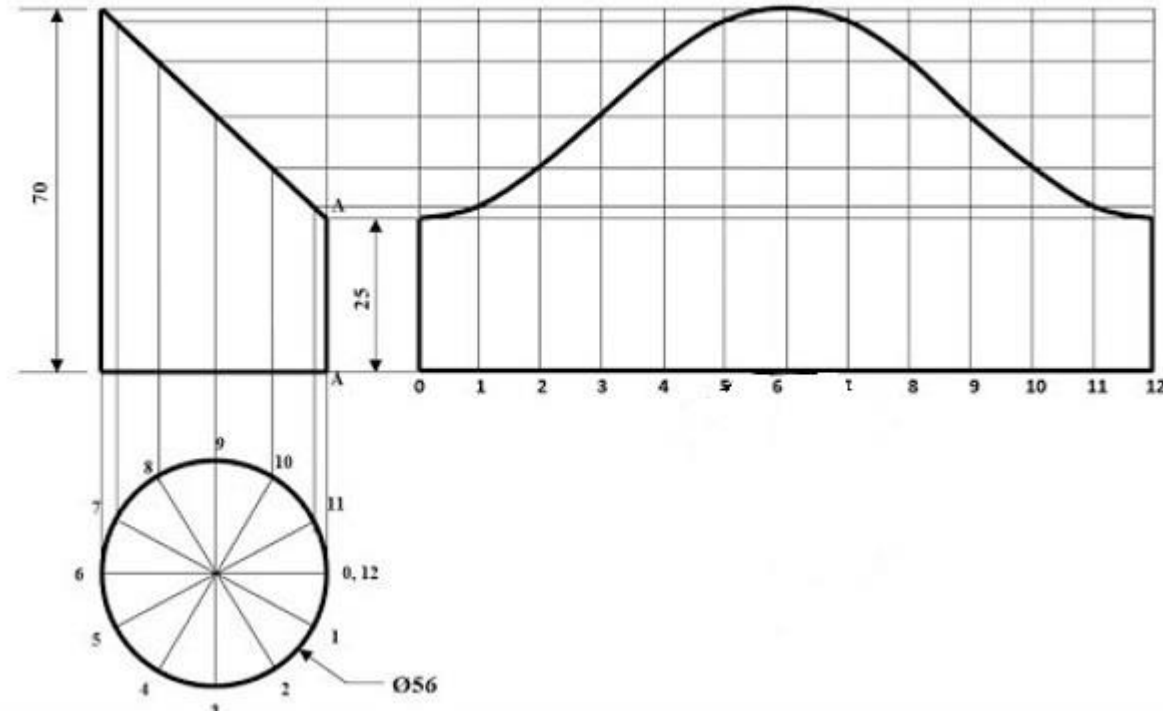
Prisms: The development of lateral surface of a prism consists of true shape of rectangular faces whose number is equal to the number of edges of top or bottom faces of the prism. However, if the solid is truncated, the section points may be marked on the development to obtain retained portion of the surface.



Parallel line development:

Cylinders: The development of lateral surface of a cylinder consists of a rectangle whose width is equal to the **circumference** of the circular face. However, truncation, if any will remove one portion of the cylinder and hence only the retained part will be shown in development.

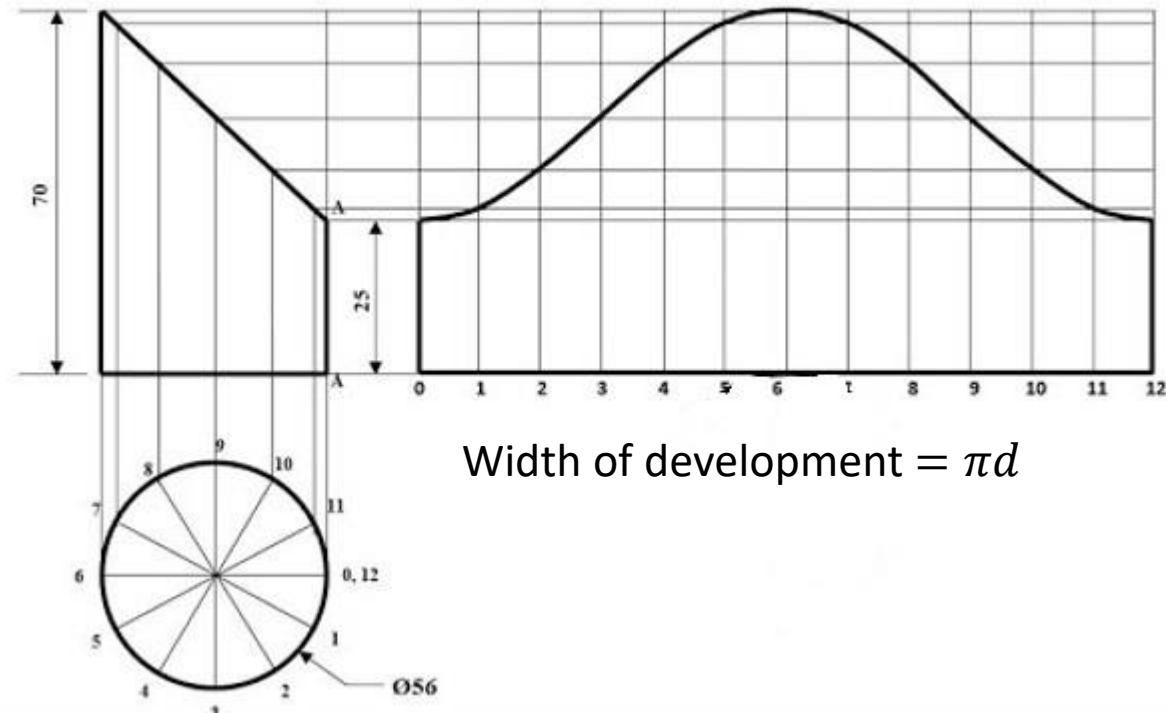
DEVELOPMENT OF A TRUNCATED CYLINDER



Parallel line development:

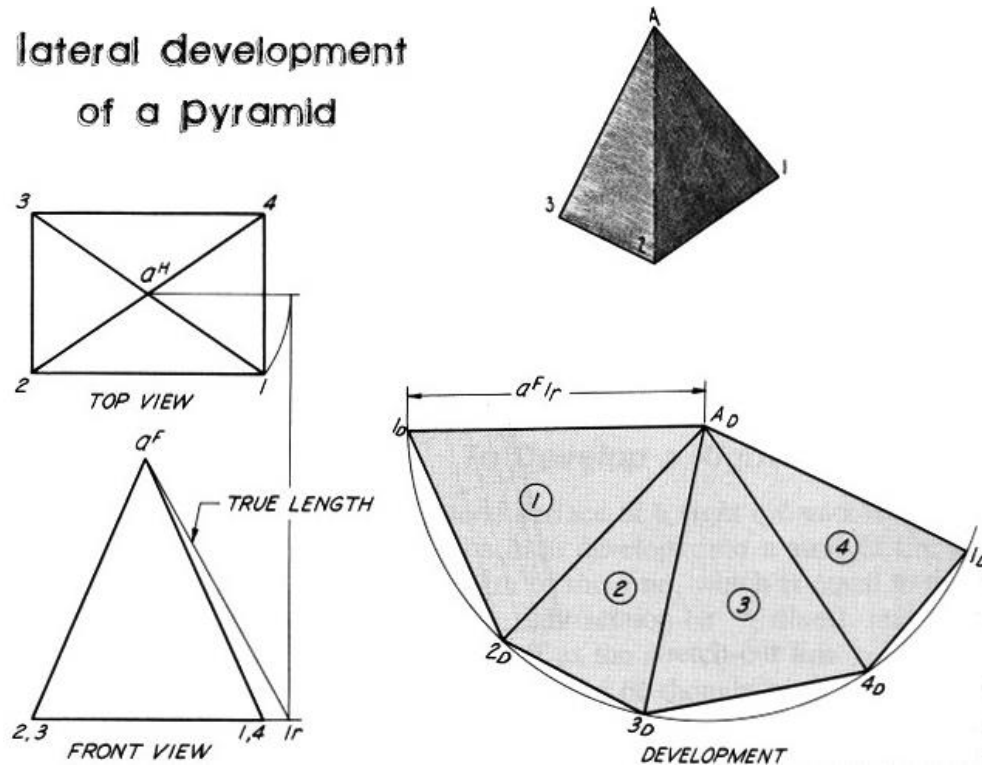
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DEVELOPMENT OF A TRUNCATED CYLINDER



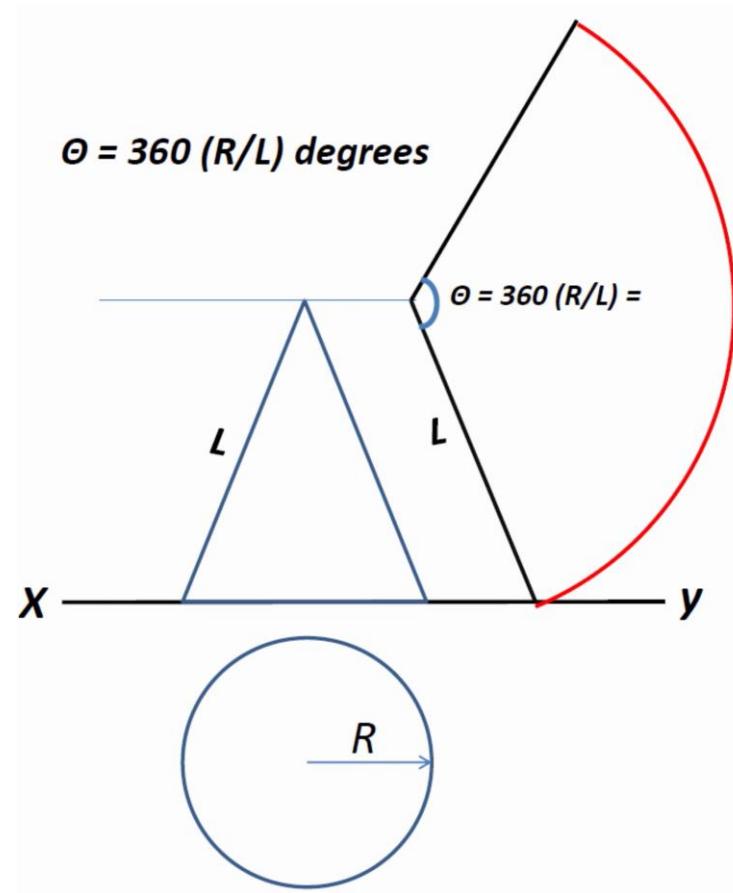
Radial line development:

Pyramids: The development of lateral surface of a pyramid consists of true shape of triangles whose sides are equal to the true length of the slant edges and base edges of the pyramid. The number of triangular faces will be equal to the number of sides of the base of the pyramid.

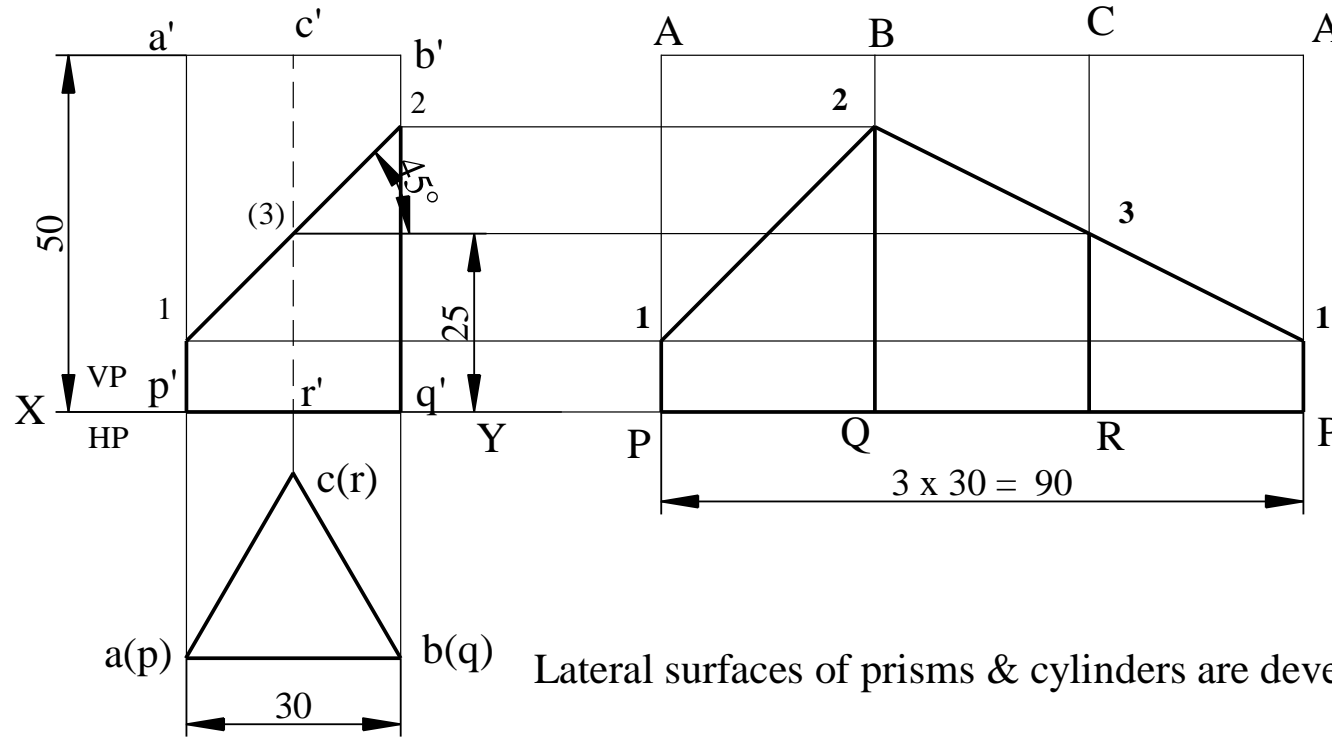


Radial line development:

Cones: The development of lateral surface of a cone consists of a sector of a circle whose radius is equal to the length of slant generator of the cone and included angle of sector is equal to $L/R \times 360$ degrees, where L = Length of slant generator, R = Radius of base of cone.



9.1 A triangular prism of base edge 30mm and height 50mm rests on HP with its axis vertical and a base edge parallel to VP and farther from it. A section plane perpendicular to VP and inclined at 45 deg to HP bisects the axis of the prism. Draw the development of lateral surface of retained portion of the solid.

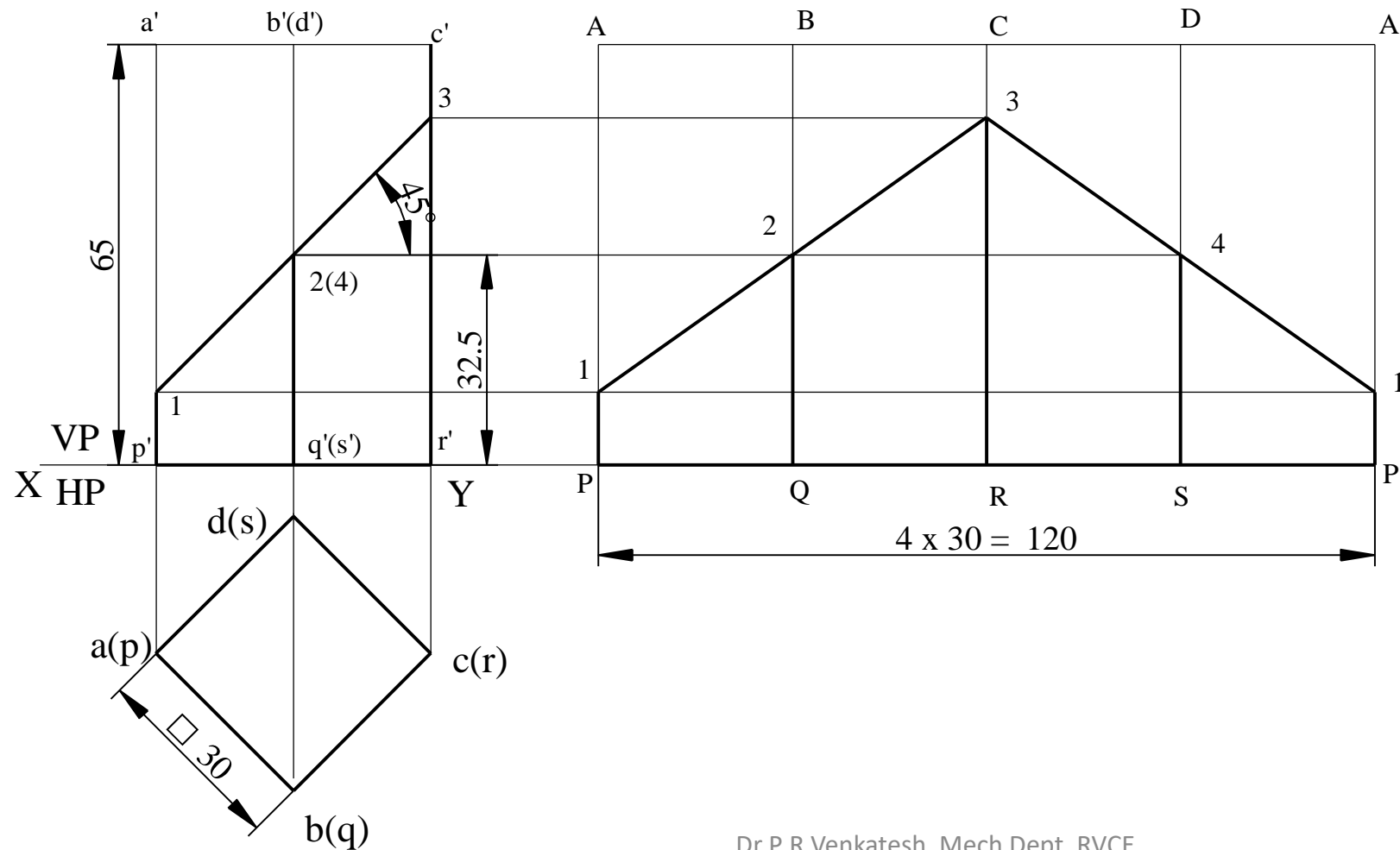


Lateral surfaces of prisms & cylinders are deveoped using parallel line development.

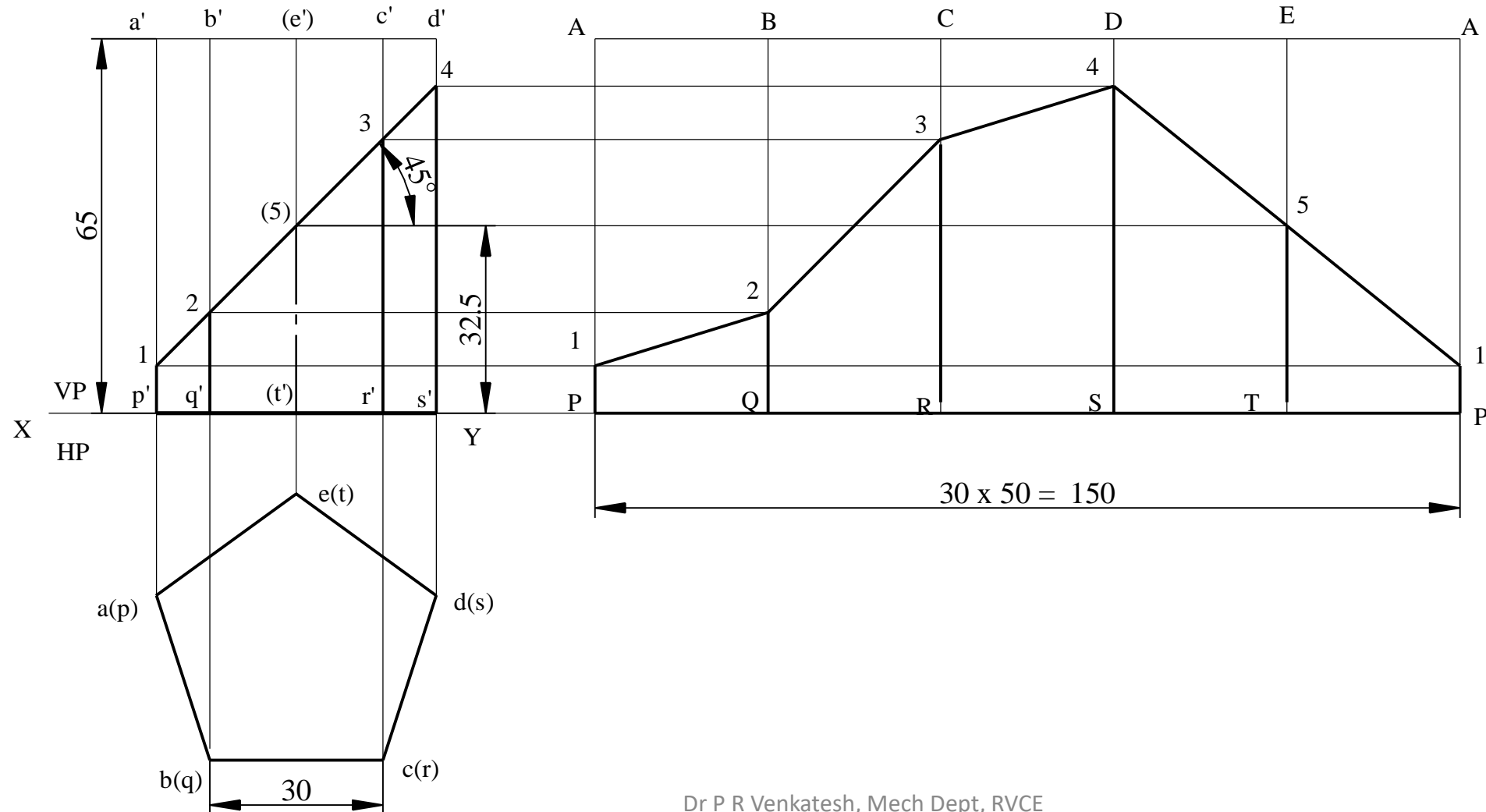
Truncation of a solid is sectioning of a solid at an angle to the axis of the solid.

The section points are marked in the order of visibility, and section points are marked for visible edges first and then in the reverse round, section points are marked for invisible edges.

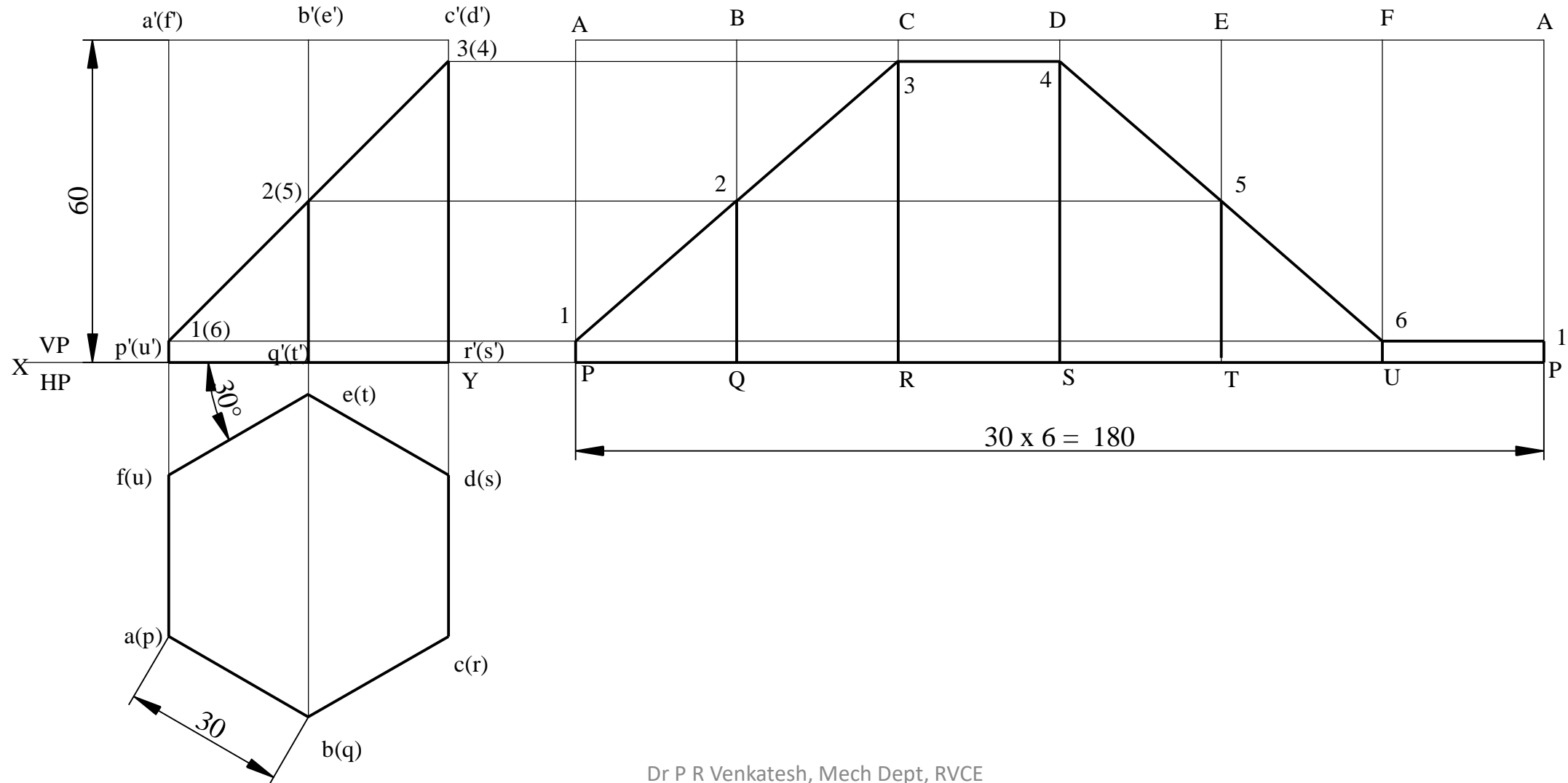
Q 9.2 A square prism of 30mm base edges and 65mm axis length rests on HP with its axis vertical and two of its lateral surfaces are equally inclined to VP. A section plane perpendicular to VP and inclined at 45 deg to HP bisects the axis of the prism. Draw the development of lateral surface of retained portion of the solid.



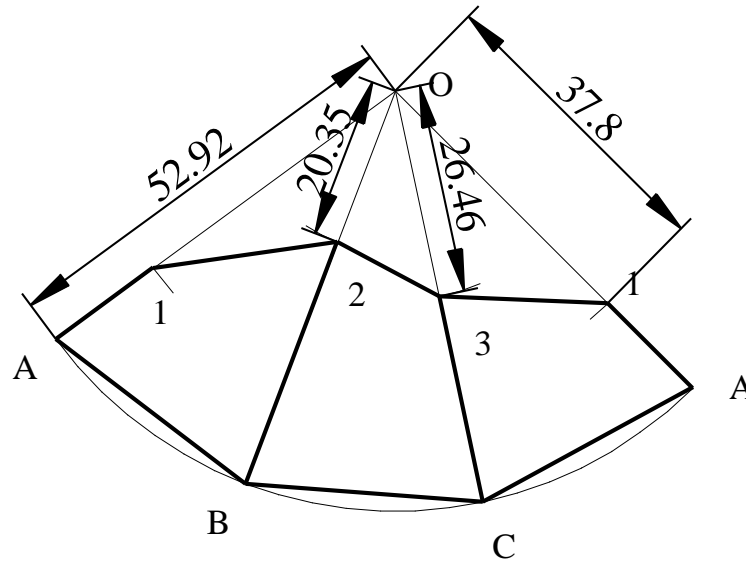
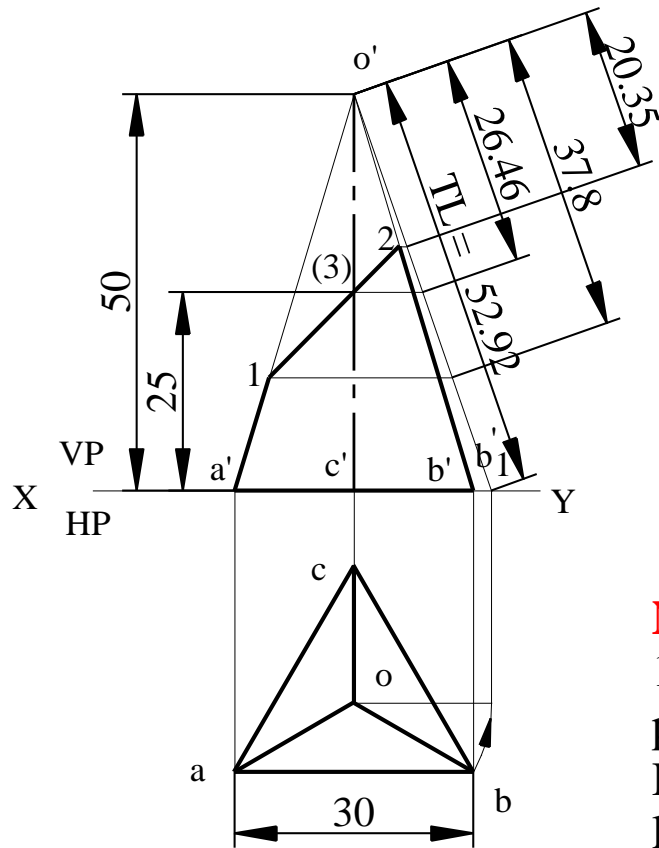
Q 9.3 A pentagonal prism of 30mm base edges and 65mm axis length rests on HP with two of its lateral surfaces are equally inclined to VP and nearer to it. A section plane perpendicular to VP and inclined at 45 deg to HP bisects the axis of the prism. Draw the development of lateral surface of retained portion of the solid.



9.4 A hexagonal prism of 30mm base edges and 60mm axis length rests on HP with its axis vertical and one of its lateral surfaces is inclined at 30 deg to VP and nearer to it. A section plane perpendicular to VP and inclined at 45 deg to HP bisects the axis of the prism. Draw the development of lateral surface of retained portion of the solid.



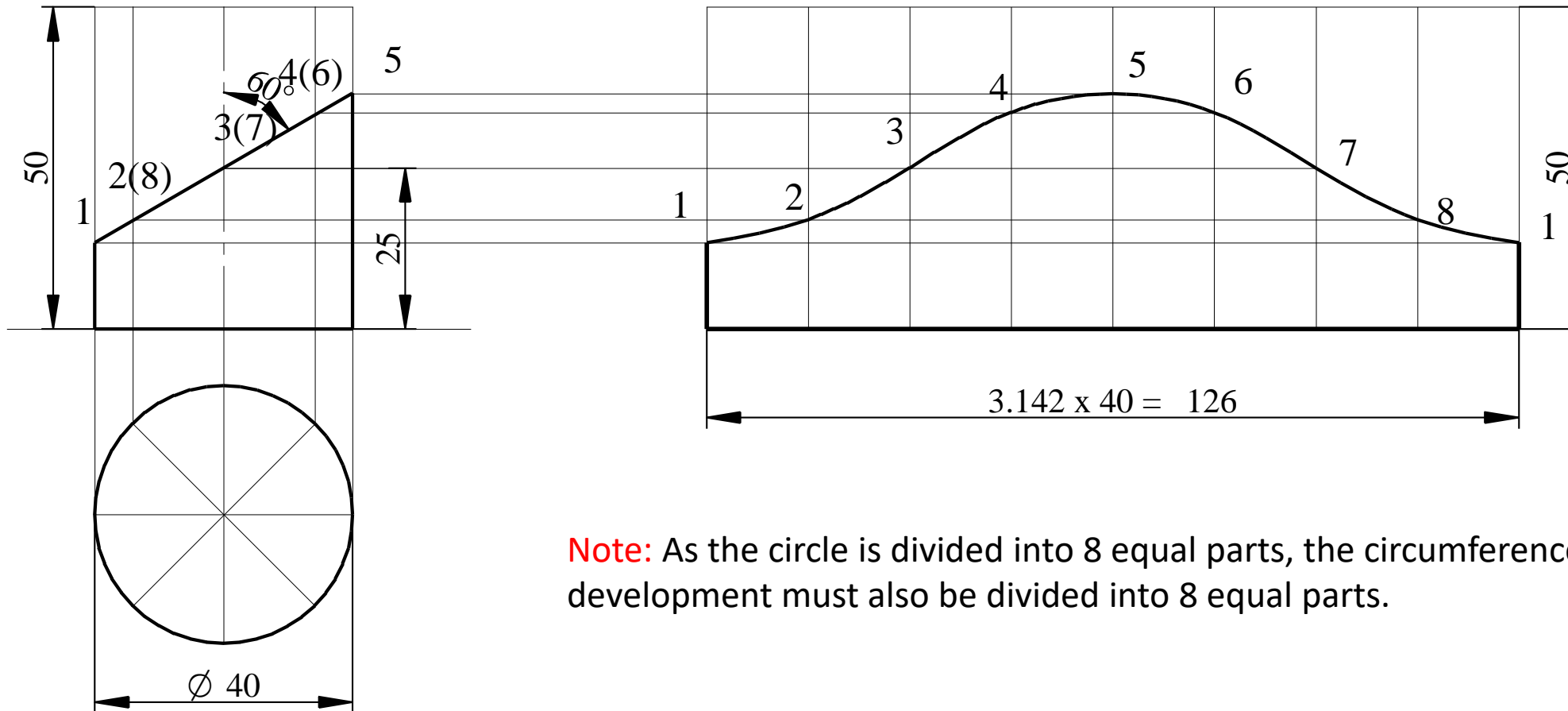
Q 9.5 A triangular pyramid of base edge 30mm and height 50mm rests on HP with its axis vertical and two of its base edges equally inclined to VP and nearer to it. A section plane perpendicular to VP and inclined at 45 deg to HP bisects the axis of the pyramid. Draw the development of lateral surface of retained portion of the solid.



Note:

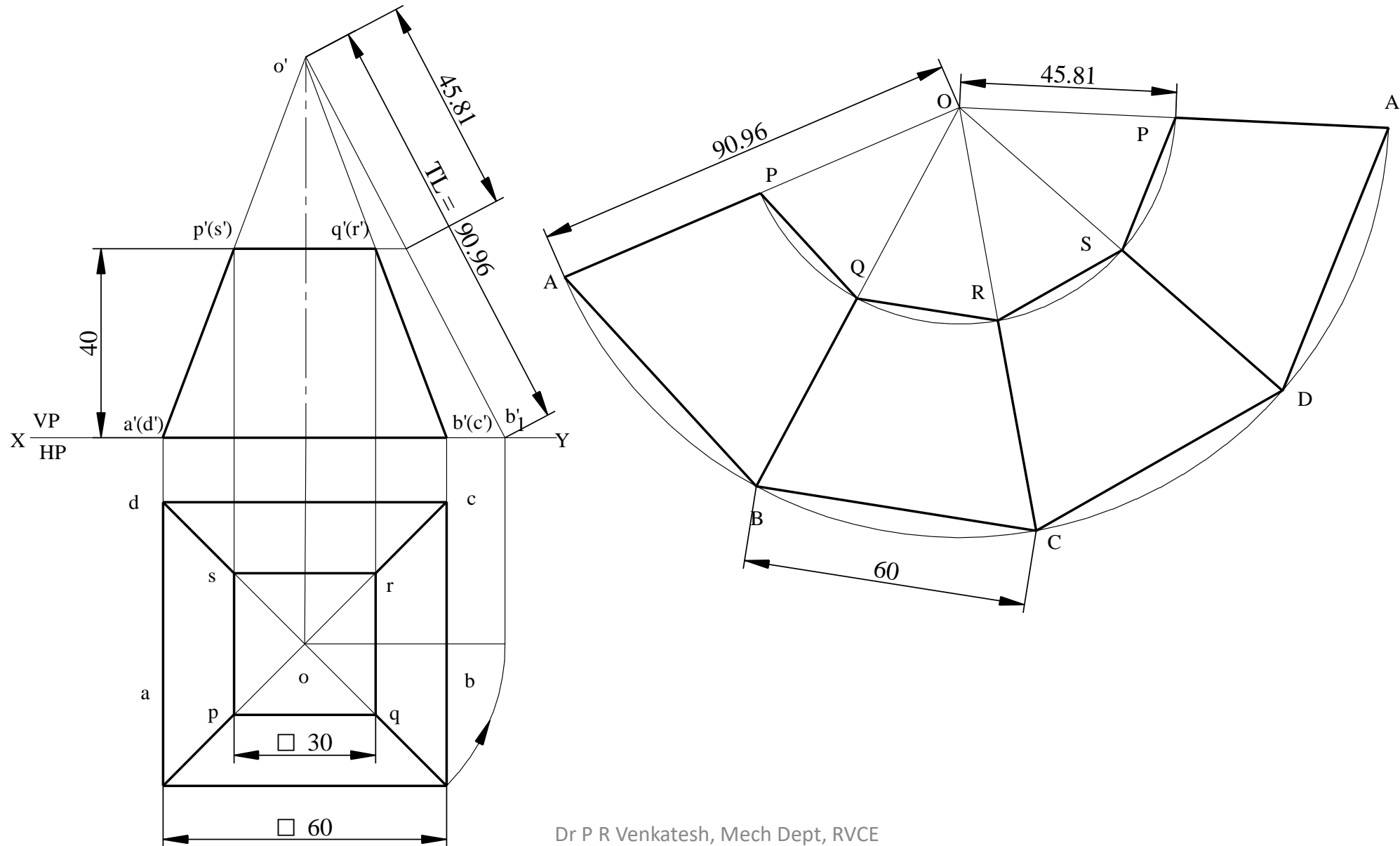
1. As none of the slant edges are parallel to VP in the top view, the front view of the pyramid does not show slant edge in true length. Hence make **oa** or **ob** parallel to XY line and project to the front view to obtain true length of the slant edge.
2. Also the true distance of the section points 1, 2 & 3 from apex may be obtained by projecting them horizontally to the true length line.

Q 9.6 Draw the development of the lateral surface of a truncated cylinder, 40 mm diameter of base and height 50 mm, if the truncated flat surface of the cylinder bisects the axis at 60 deg to it.

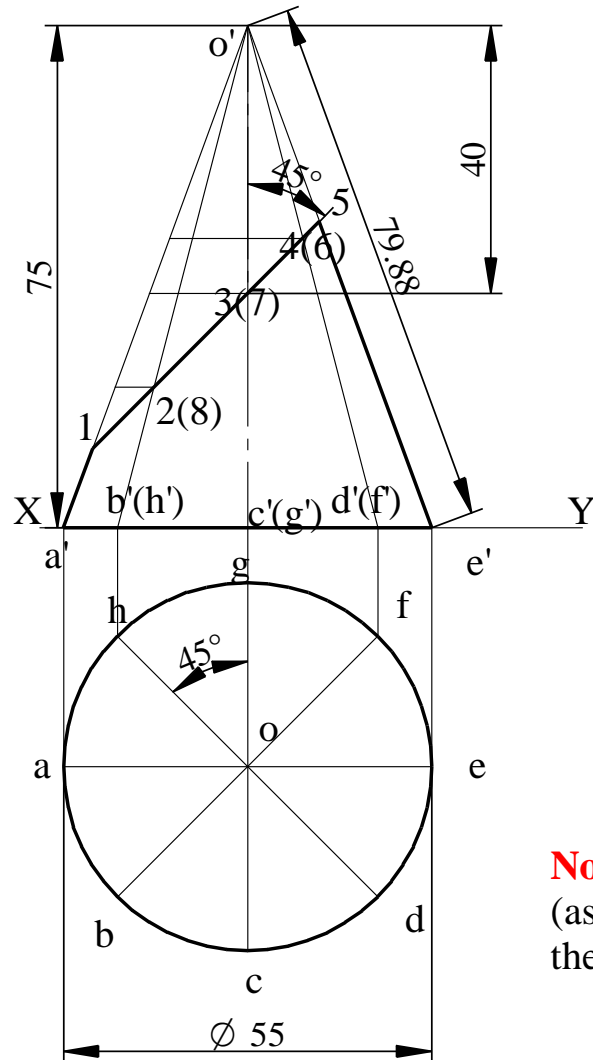


Note: As the circle is divided into 8 equal parts, the circumference (= 126 mm) in the development must also be divided into 8 equal parts.

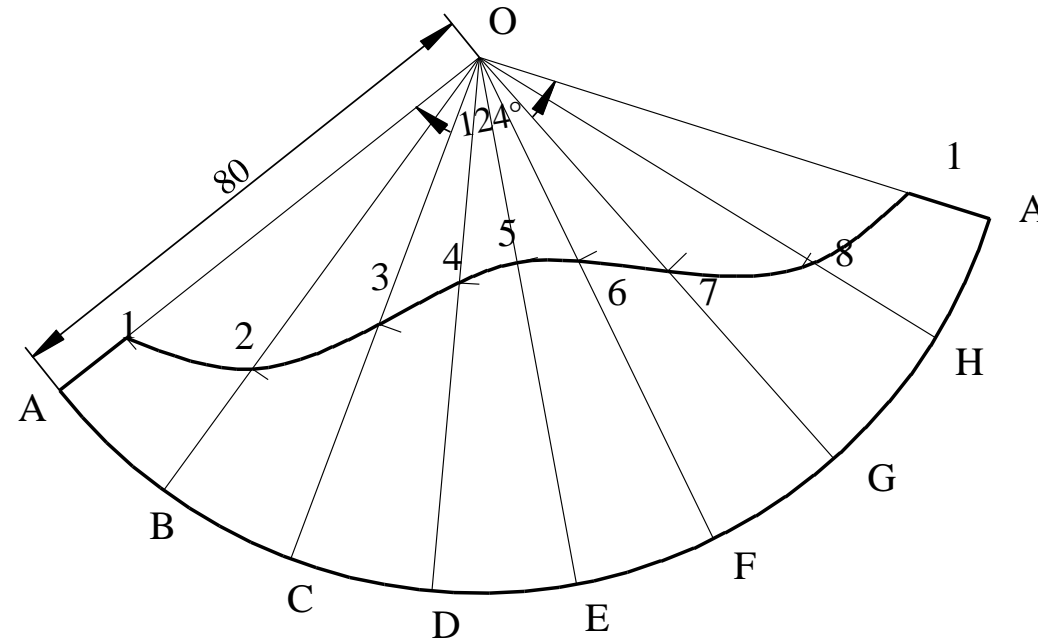
Q 9.7 The frustum of a square pyramid has its base 60mm sides, top face 30mm and height 40mm. Its axis is vertical and a side of base is parallel to VP. Draw the development of lateral surfaces.



Q 9.8 A right cone of 55 mm base diameter and 75 mm height stands on its base on HP. It is truncated with its surface inclined at 45 deg to the axis lying at a distance of 40 mm from the apex of the cone. Obtain the development of the lateral surface of the truncated cone

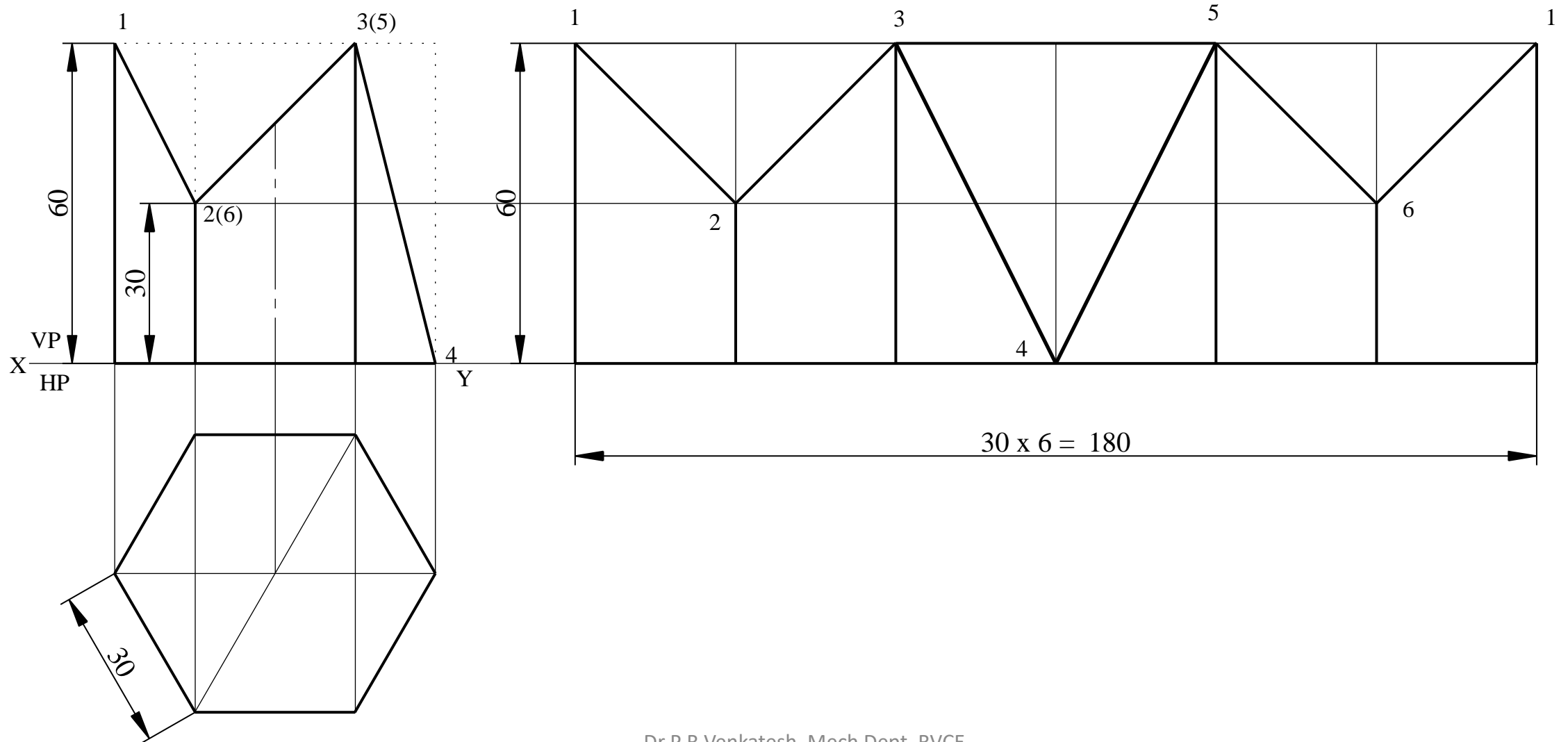


Here, $R = 27.5$ mm, $L = 79.88 = 80$ mm, $\theta = R/L \times 360 = 124$ deg



Note: Here, all the section points must be projected to the extreme slant generator (as they are in true length) and their distances must be measured from apex and then marked in the development.

Q 9.9 A hexagonal prism side of base 30mm and height 60mm is cut as shown in the Figure 9.1 Draw the development of the lateral surface of the prism.



Q 9.10 Draw the development of the lateral surface of the pyramid shown in Figure.

