Engineering Drawing - Lecture 10

Revolution And Development

Revolution:

In many Descriptive Geometry problems, the axis about which a point revolves does not appear in its true length in either the plan or front elevation views. There fore, a new view must be drawn which will show the true length of the axis, then an additional view will show the point view of the axis.

In Fig. 7-2, the oblique line axis is shown in both the plan and front elevation views.

Point X which revolves about this axis is also located in the two given views.

Using the "change-of-position" method, a new view is drawn which shows the axis, AB

, in its true length and the point X located at a fixed distance from the axis.

Inclined view 2 determines the point view of the axis and the circular path of point X as it revolves about the axis

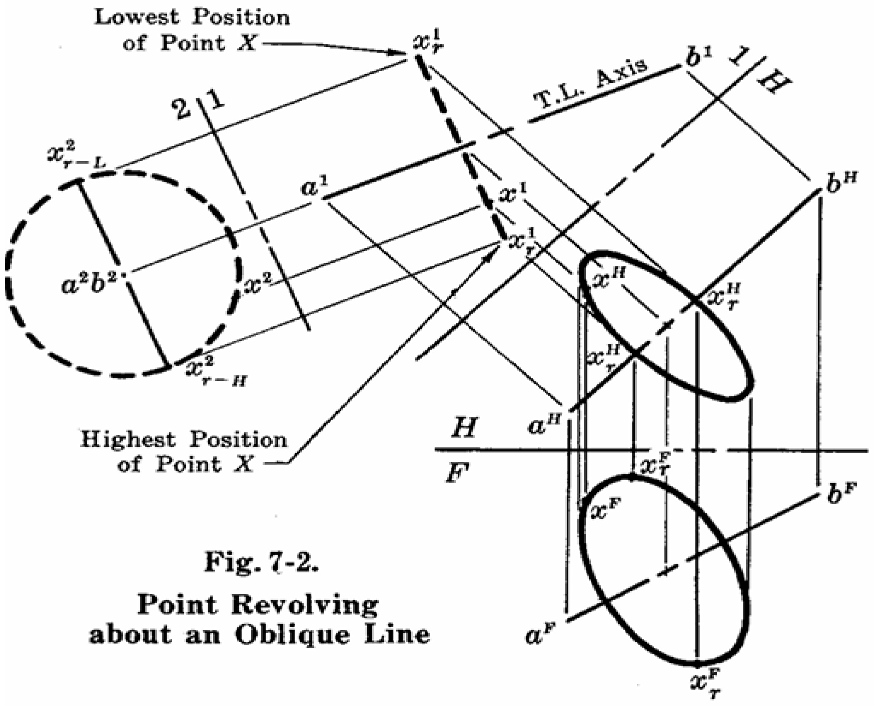


Fig. 7-2.

Point Revolving about an Oblique Line

To FIND the TRUE LENGTH of a LINE:

Analysis:

If a line is parallel to a projection plane, it will be projected on that plane in its true length.

Therefore, if a line in space is revolved about an axis until it lies parallel to a projection plane, it will then appear in its true length.

Example:

In Fig.below, the oblique line AB appears in both the plan and front elevation views.

Using a vertical axis through point A in the plan view,

point B should be revolved until line AB lies parallel to the frontal plane.

It will then appear in its true length in the front view.

Note that the revolving of point B does not alter its elevation.

The true slope of the line can also be seen in the front view .

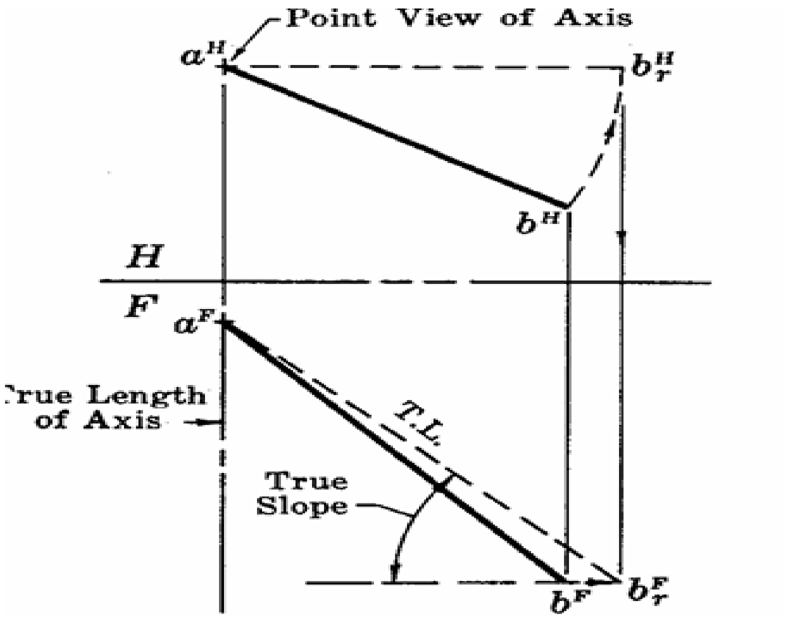


Fig. below shows the same oblique line being revolved about a horizontal axis.

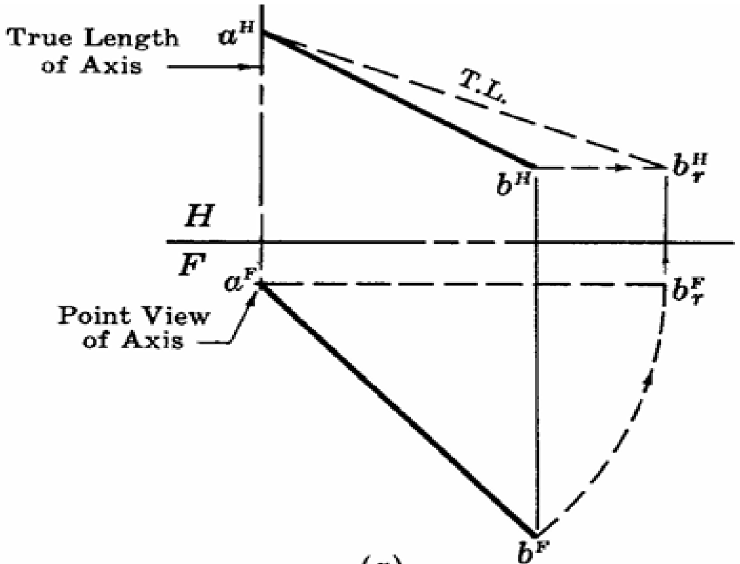
At (a) the axis passes through one end of the line and,

at (b) the axis passes through the mid-point of the line.

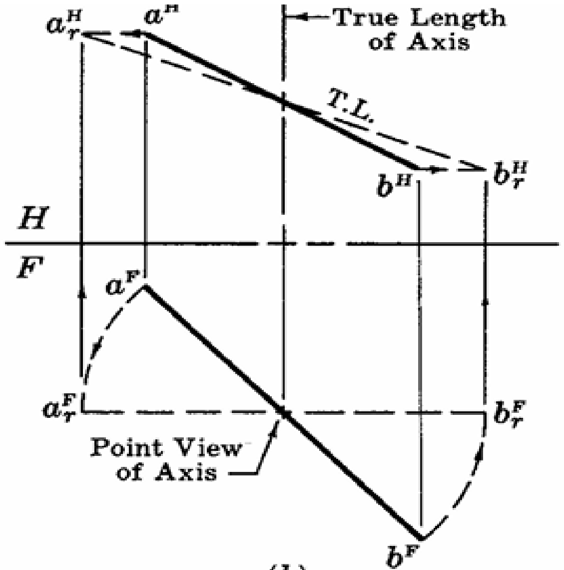
In general, the axis can pass through any point of the line.

For convenience, it is usually better to pass the axis through one of the end points of the line.

In this case only one point needs to be revolved to show the true length of the line as shown in Figures



(a)



(b)

To FIND the TRUE SIZE of a PLANE:

Analysis:

Two conditions must be met for a plane to be revolved into its true size.

First, it must revolve about an axis which lies on the plane.

Second, the axis about which the plane revolves must lie parallel to the image plane upon which the plane is projected.

Therefore, if the plane is to be revolved so that it will appear true size in the plan view,

it must be revolved about a level line axis on the plane.

After determining the location of the axis, each point on the plane is revolved until the plane is level.

Example: In Fig., the plane ABC is to be revolved until it lies parallel to the horizontal plane.

A horizontal axis is drawn in the front elevation view which will appear in its true length in the plan view and as a point in the auxiliary elevation view 1.

The plane is revolved about the point view of the axis in view 1 until it lies parallel to the horizontal plane.

Project the revolved points Band C to the plan view until they intersect the projections of points Band C drawn parallel to the H-l folding line.

Connect these revolved points Band C in the plan view to point A in order to determine the true size of the plane.

It should be noted that a plane will appear as an edge in the view which shows the axis as a point.

This edge view, being an elevation view, also shows the true slope· of the plane.

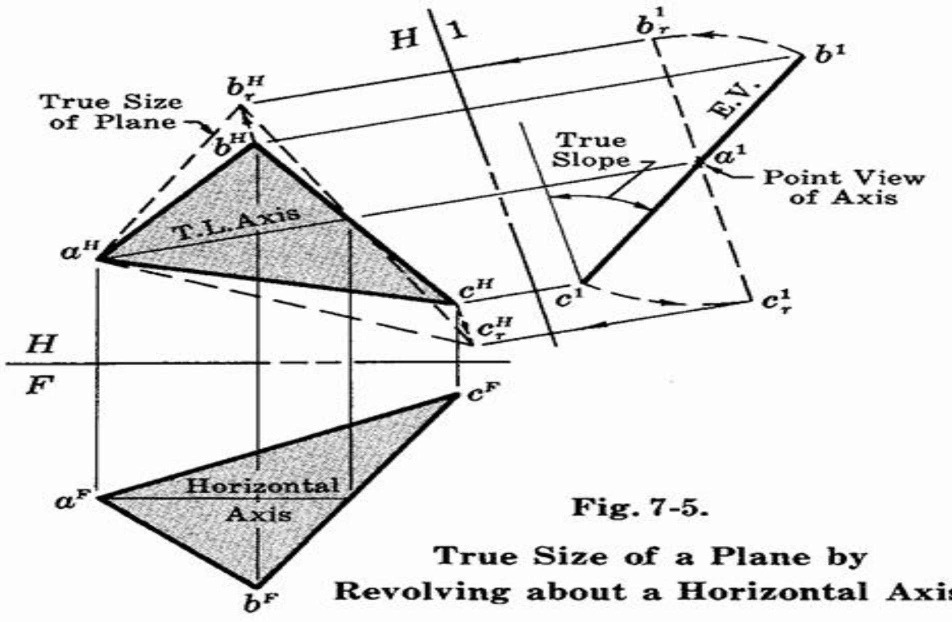


Fig. 7-5.

True Size of a Plane by Revolving about a Horizontal Axis

To FIND the DIHEDRAL ANGLE:

Analysis:

A cutting plane which is passed perpendicular to the intersection of two planes determines the dihedral angle between the two planes.

After determining the line of intersection between the two planes, a cutting plane is passed at a right angle to this line of intersection and the intersection of the cutting plane with the two given planes is thus determind.

The plane of the angle formed by these two intersection lines is revolved to a position in which its true size is shown.

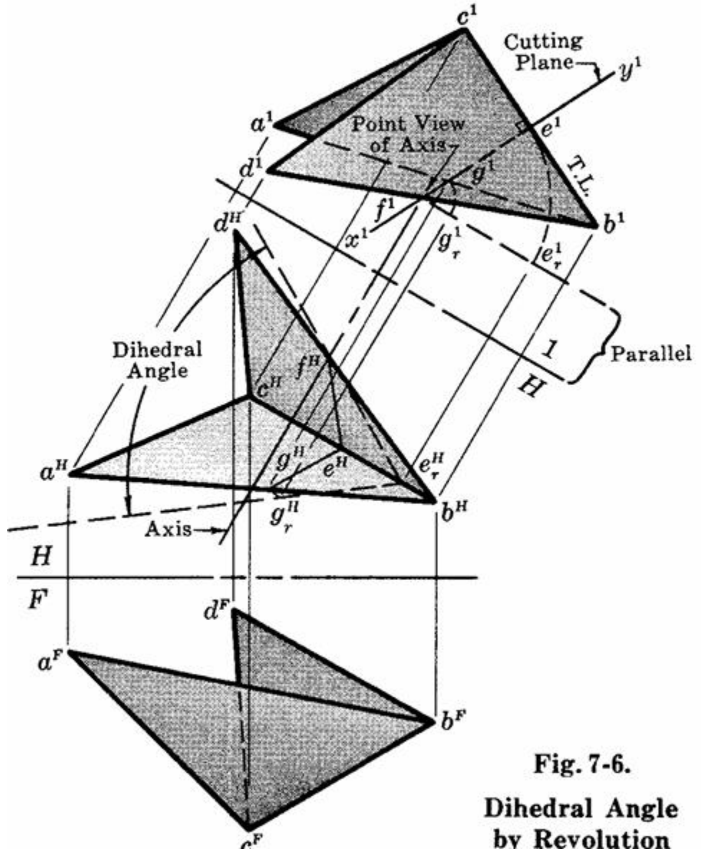


Fig. 7-6.
Dihedral Angle by Revolution

Example:

In Fig. 7-6, the plan and front elevation views of planes ABC and BCD are given.

An auxiliary elevation view is drawn showing both planes with their common line of intersection BC appearing in its true length.

A cutting plane xy is drawn perpendicular to line BC at any point, in this case E.

The cutting plane cuts the two given planes at F, E, and G.

Project these points back to the plan view.

These points determine the dihedral angle which now must be revolved about a level-line axis through a point such as F.

The axis appears as a point in view 1.

Revolve points G and E through the horizontal axis at F until they lie in a plane parallel to the horizontal image plane.

The dihedral angle now revolved to a horizontal plane will appear in its true size in the plan view.

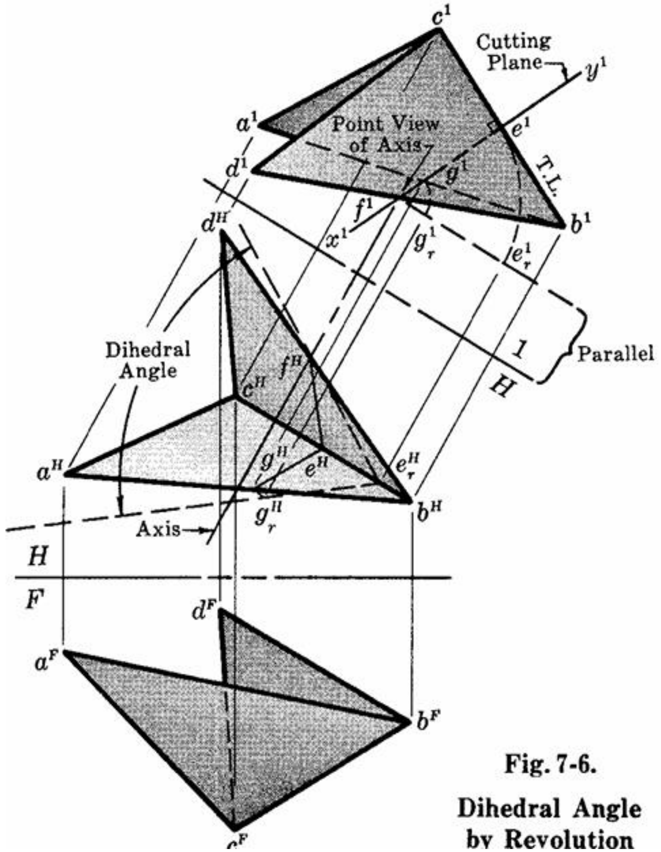


Fig. 7-6.
Dihedral Angle by Revolution

To FIND the ANGLE BETWEEN a LINE and a PLANE :

Analysis:

To determine the angle between a line and a plane by revolution, the line must be revolved about an axis which is perpendicular to the plane.

Revolution about any other axis will not show the true angle desired.

A view showing the true size of the plane will also show the axis as a point.

Therefore, the axis will appear in its true length in the view showing the plane as an edge

and will be perpendicular to this edge view of the plane.

The line is revolved until it appears in its true length in the view showing the plane as an edge.

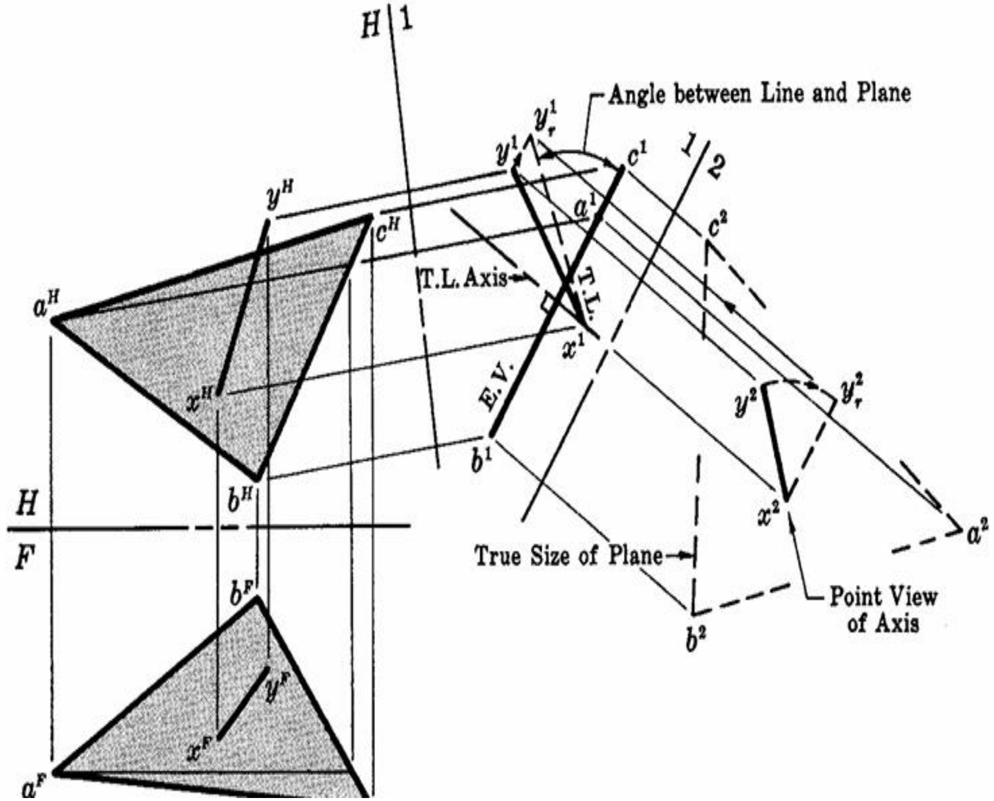
The true angle between the line and the plane is measured in this view.

Example:

In Fig. below, the plane ABC and the line XY are given in both the plan and front elevation views. An auxiliary elevation view 1 is drawn showing the line XY and the edge view of the plane ABC.

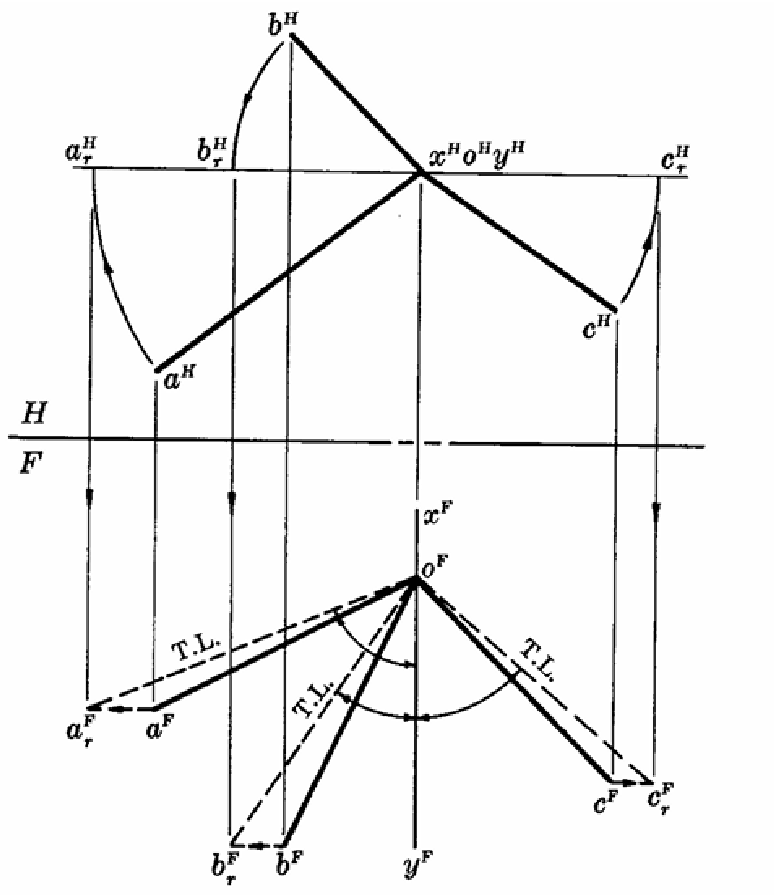
An inclined view is then drawn which would show the true size of the plane, but drawing the true size of the plane in this view will serve no useful purpose since we are only interested in showing the point view of the axis about which the line XY will revolve.

The line XY is revolved until it appears in its true length in the auxiliary elevation view 1 where the angle can be measured.



Given: Three guy wires, A, B, and C, are attached at point 0 located 2' below the top of a mast, XY. A(2.5, 3, 5.5) B(3.5 , 2, 8) C(6, 2.5 , 6) X(4.5, 4.5, 7) Y(4.5, 2, 7). Refer to Fig.. Scale:1" = 1'-0".

Problem: Determine the true length of each guy wire by the method of revolution. Also determine the angle each guy wire makes with the mast.



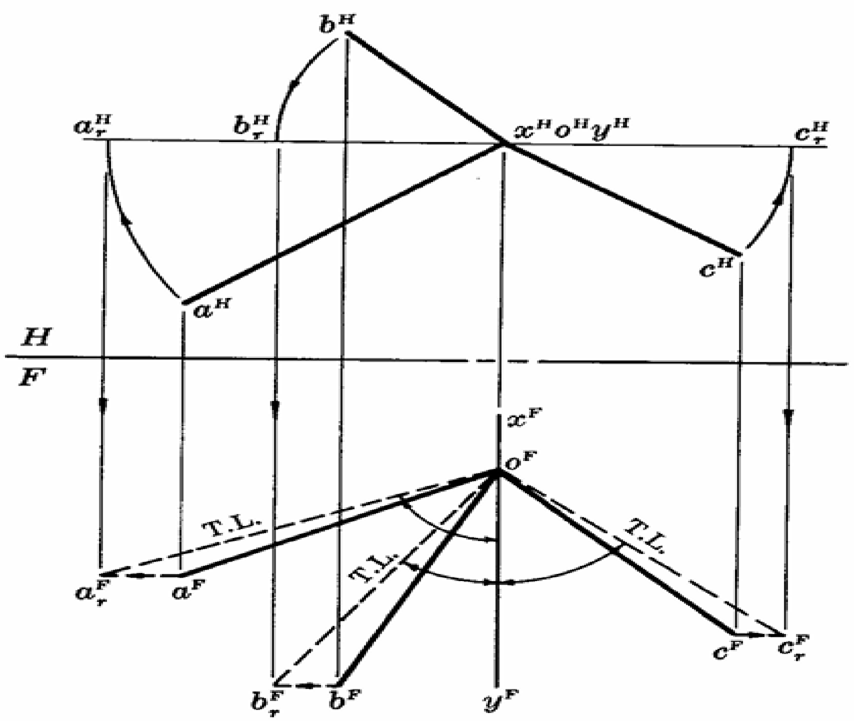
Solution: draw the guy wires and mast in both the plan and front elevation.

In the plan view, using the mast as a vertical axis, revolve points A, B, and C until they lie in a plane parallel to the frontal plane.

From points A , B, and C in the front view, draw level lines until they inter sect the projections of A, B, C, revolved. Connect each of these intersecting points to point 0 in the front view.

Both the true length of each guy wire and the angle it makes with the mast can be measured in this front elevation view.

Ans. Guy wire *AO*: T.L. = 10′–9½″ Angle = 68°
Guy wire *BO*: T.L. = 9′–10″ Angle = 35°
Guy wire *CO*: T.L. = 9′–5″ Angle = 50°



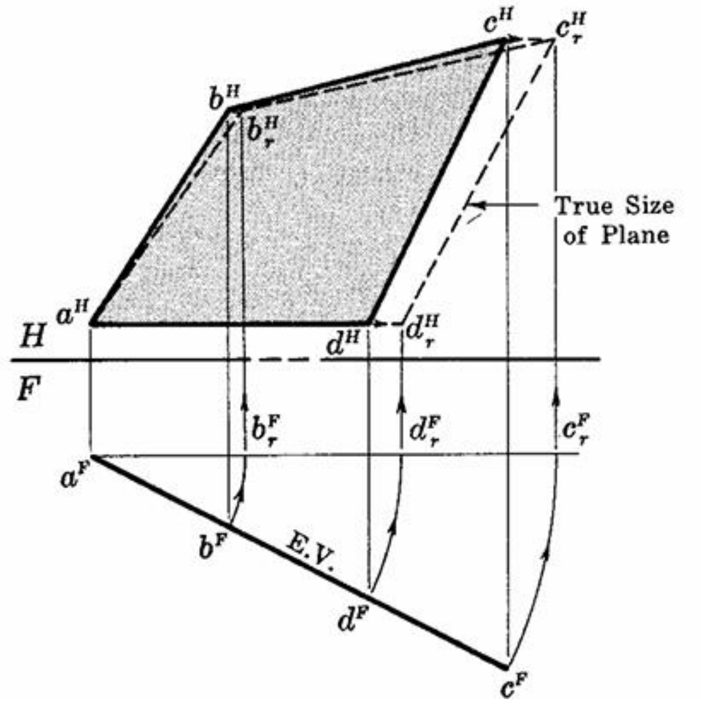
Given: Plane ABCD. Point B is located I" east,1.5" north of A and -1" below A.

Point C is located 3" east, 2" north of A and 1.5" below A.

Point D is located 2" due east of A and I" below A.

Scale: 0.5" = I".

Problem: By the method of revolution, show the true size of the plane in the plan view.



Solution:

Draw the plan and front elevation views of plane ABCD.

Since the front view shows the edge view of the plane,

a level axis is assumed through point A in the front view and points B, C, and D are then revolved until they lie in a horizontal plane.

From points B, C, and D in the plan view, frontal lines are drawn until they intersect the projections of B, C, and D revolved.

Connect the three points of intersection as shown to obtain the true size of the plane.

Given: Plane ABC. Point B is located 5' east, 6' north of A and 6' below A.

Point C . is located 10' east, 5' north of A and 4' below A.. Scale: 1/8" = 1'-0".

Problem: Determine the true size of each plane angle by the methods of revolution.

Solution:, construct the plan and front elevation views of plane ABC.

Draw auxiliary elevation view 1 to show the plane as an edge.

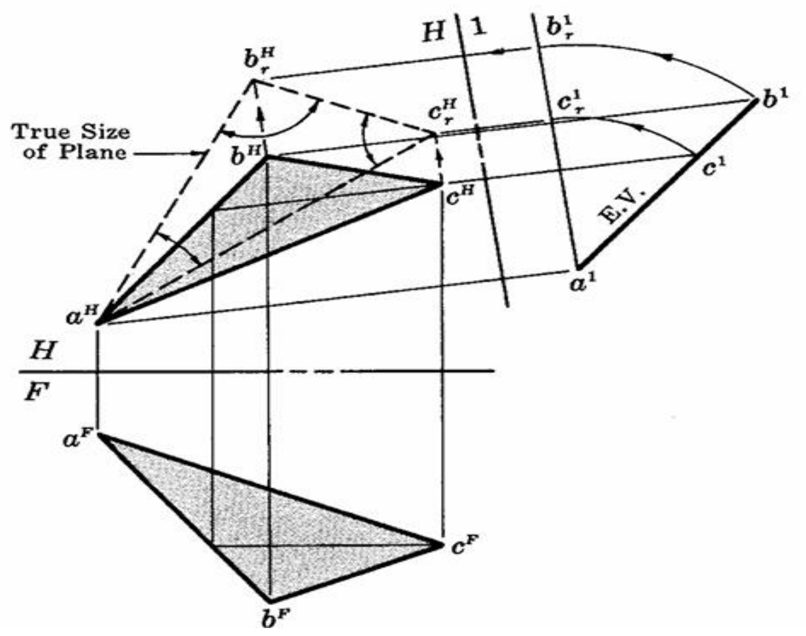
Assume a level axis through point A in view 1 and revolve points Band C until they lie in a horizontal plane.

Project points B and C into the plan view until they intersect the projections of B and C drawn parallel to the H-1 folding line in the plan view.

These intersections determine the positions of points B and C revolved, thus showing the true size of the plane.

Each of the plane angles can be measured in this view.

Ans. Angle A = 28°, Angle B = 97°, Angle C = 55°



Given: Plane ABC is located as follows : Point B is 5' east, 4' north of A and 5' above A. Point C is located 9' east, 4' south of A and 2' above A.. Scale:1" = 1'-0".

Problem: Using the methods of revolution , determine the **diameter of the largest circle** to be drawn within the limited plane, ABC.

Solution: draw the plan and front elevation views of plane ABC.

Draw auxiliary elevation view 1 to show the plane as an edge.

Assume a level axis through point A and

revolve points Band C in view 1 until they lie in a horizontal plane.

From points B and C in the plan view,

draw lines parallel to the H-1 folding line

until they intersect the projections from view 1 of points Band C revolved.

Connect these points of intersection to the plan view of point A .

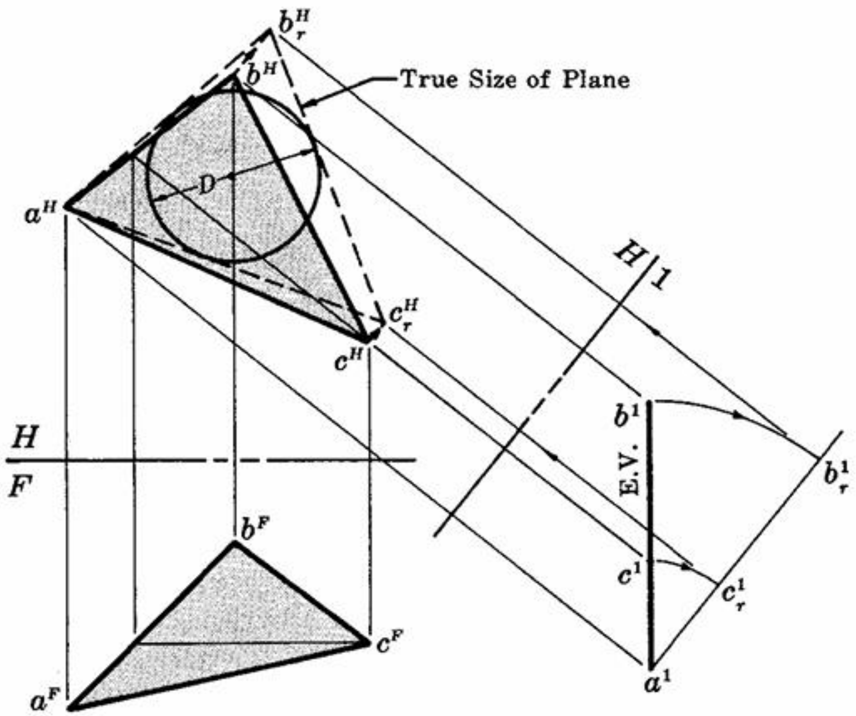
The true size of the plane ABC is now established.

Angle bisectors will determine the center for the largest circle

to be inscribed within the limited plane ABC.

Draw the circle

Ans. Diameter = 5'-2" circle and measure the diameter using the given scale.



Given: Two water lines from points A and B converge at a common point C as shown in Fig. below.

Point A is 30' west, 30' north of C and 30' above C.

Point B is located 20' east, 20' north of C and 40' above C.

Scale: I" = 30'.

Problem:

Using revolution, determine the true length of each water line and

the true size of the angle between them.

Solution:

draw the plan and front elevation views of both water lines.

Draw auxiliary elevation view 1 to show the edge view of plane ABC.

Assume a level axis through point C and revolve points A and B in view 1 until they lie in a horizontal plane.

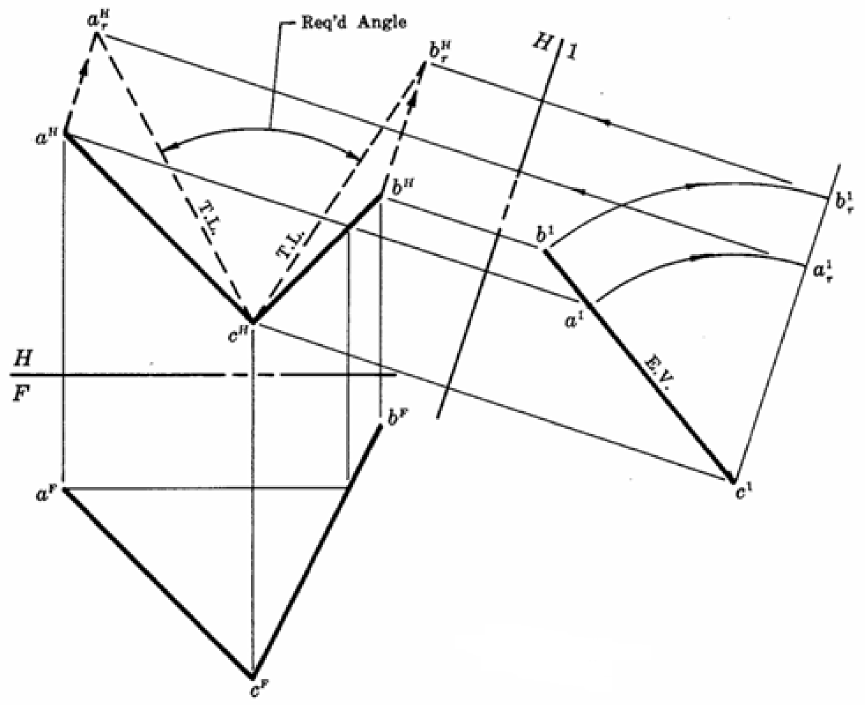
From points A and B in the plan view,

draw lines parallel to the H-1 folding line until they intersect the projections from view 1 of points A and B revolved.

Connect these points of intersection to point C in the plan view and measure the required angle.

The plan view will also show each water line in its true length.

Ans. T.L. AC = 52'-0", T.L. BC = 49'-4", Angle ACB = 61 °30'



Development and Intersection of Solids:

Development of surfaces in engineering drawing is the process of unfolding or unrolling all lateral surfaces of a 3D object onto a 2D plane to create a flat pattern,

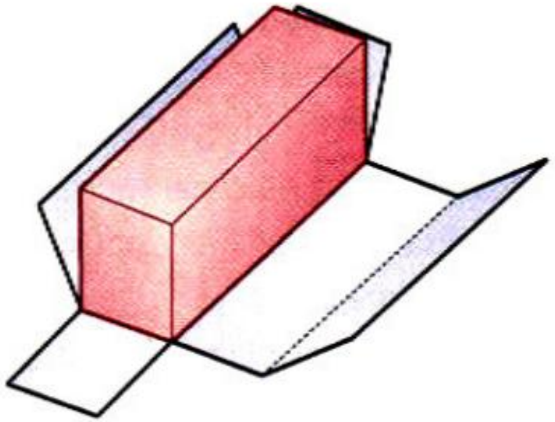
used extensively in sheet metal fabrication.

This pattern shows the true lengths of all edges and surfaces

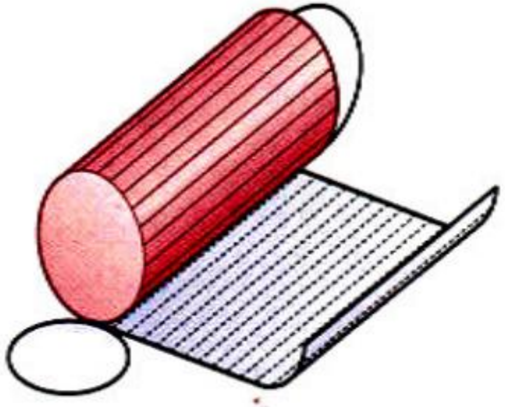
enabling accurate cutting, folding, and welding of materials into shapes like cones, pyramids, or pipes. .

***ENGINEERING APLICATION*:**

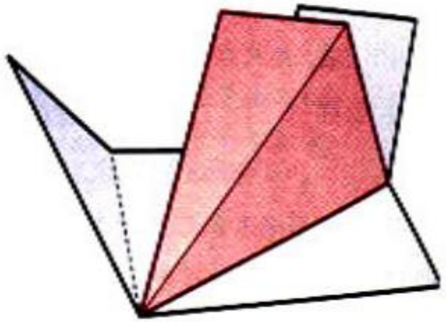
THERE ARE SO MANY PRODUCTS OR OBJECTS WHICH ARE DIFFICULT TO MANUFACTURE BY CONVENTIONAL MANUFACTURING PROCESSES, BECAUSE OF THEIR SHAPES AND SIZES.
THOSE ARE FABRICATED IN SHEET METAL INDUSTRY BY USING DEVELOPMENT TECHNIQUE. THERE IS A VAST RANGE OF SUCH OBJECTS.



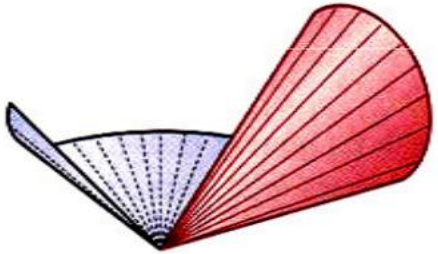
(A) Prism
(Parallel line development)



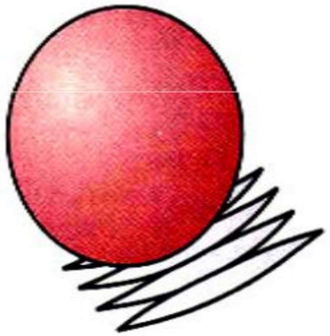
(B) Cylinder
(Parallel line development)



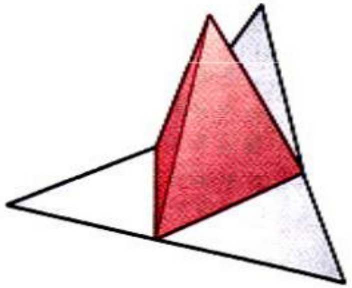
(C) Pyramid
(Radial line development)



(D) Cone
(Radial line development)



(E) Sphere
(Approximate development)

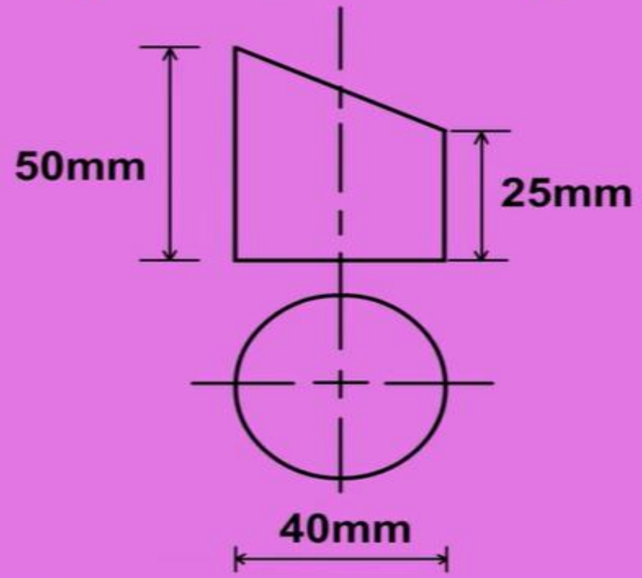


(F) Tetrahedron
(Triangulation development)

Examples of Developments

QUESTION

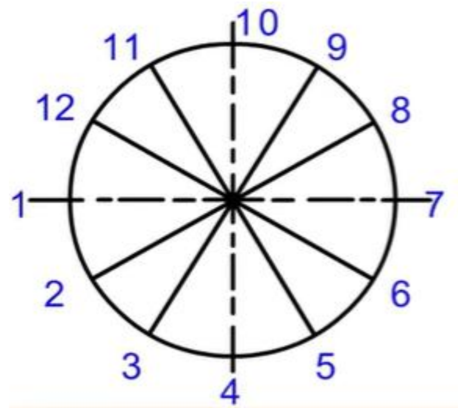
Draw the surface development of the object below *(one end opened)*



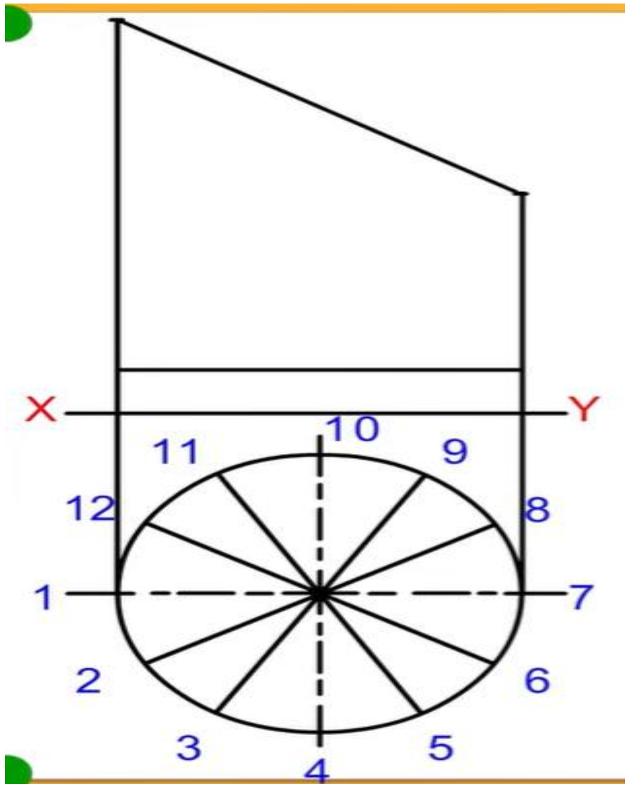
PROCEDURES

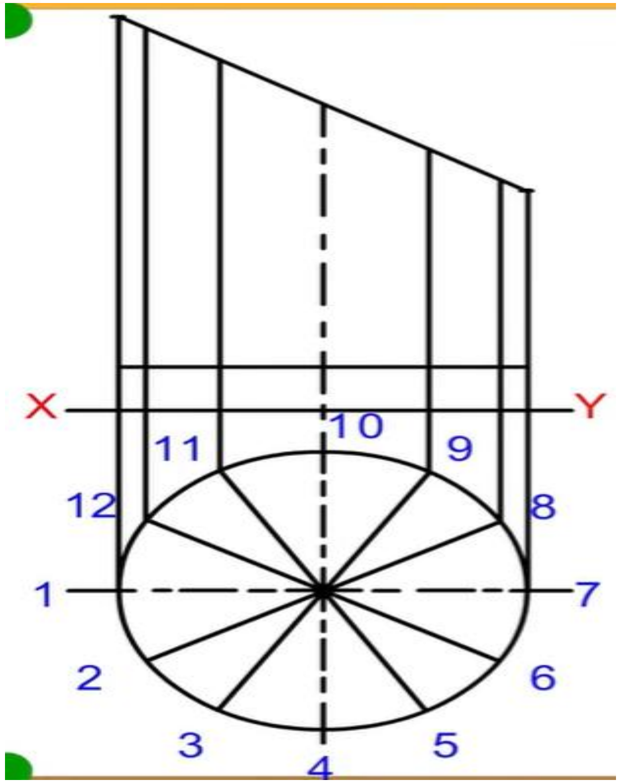
1. Draw the plan and divide it into equal number of parts (example, 12).
2. Project points 1 and 7 to obtain the elevation of the frustum.
3. Project the labelled points unto the elevation.
4. Project lines from the bottom of the frustum to the truncated surface.
5. Draw horizontal lines from the surface of the frustum.
6. With the pair of compasses or pair of dividers, take the distance between the points and step off 12 times on the sideline.
7. Project vertical lines to intersect the parallel lines from the surface of the frustum.
8. Join the points to obtain a smooth curve.
9. Draw the base (closed end).
10. Outline the work.

1. Draw the plan and divide it into equal number of parts (example, 12).

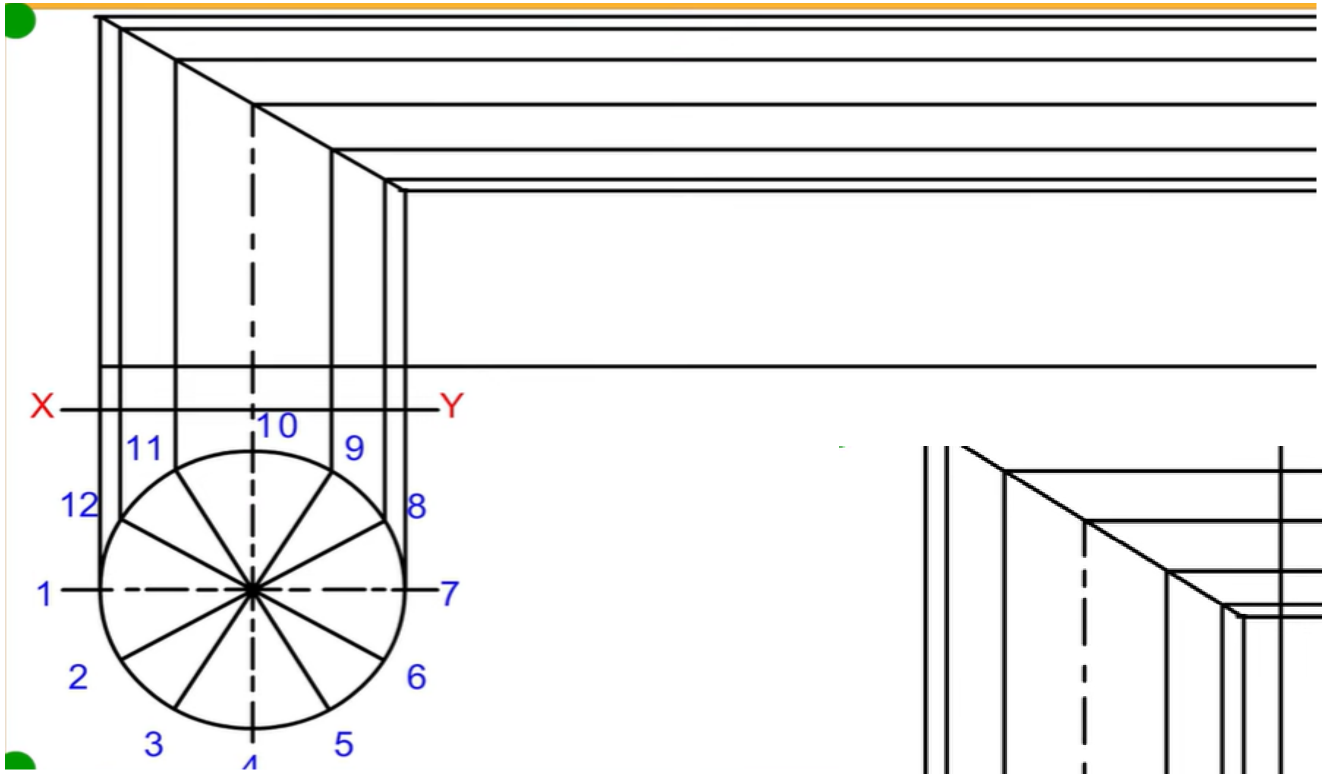


2. Project points 1 and 7 to obtain the elevation of the frustum.



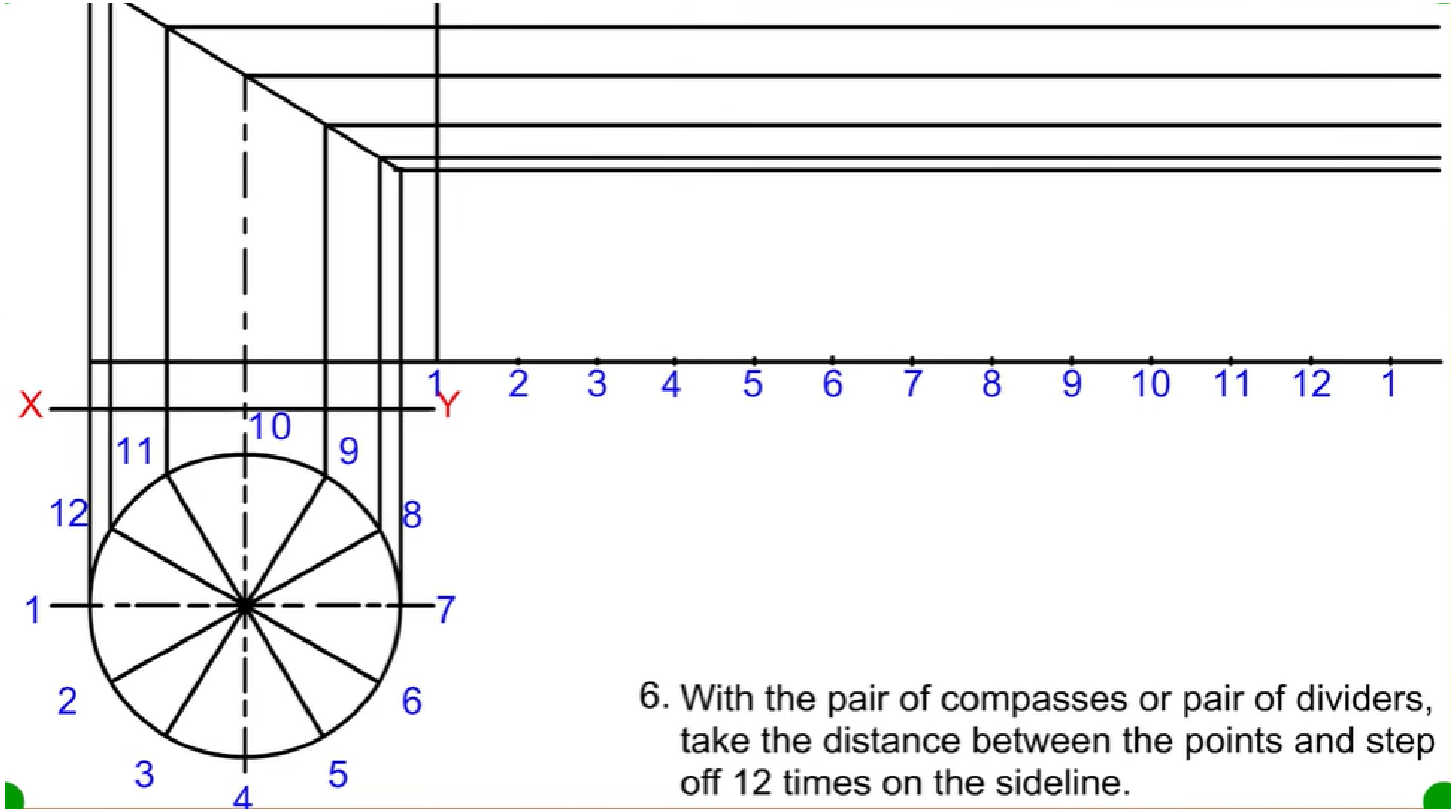


3project the labeled points into theelevation

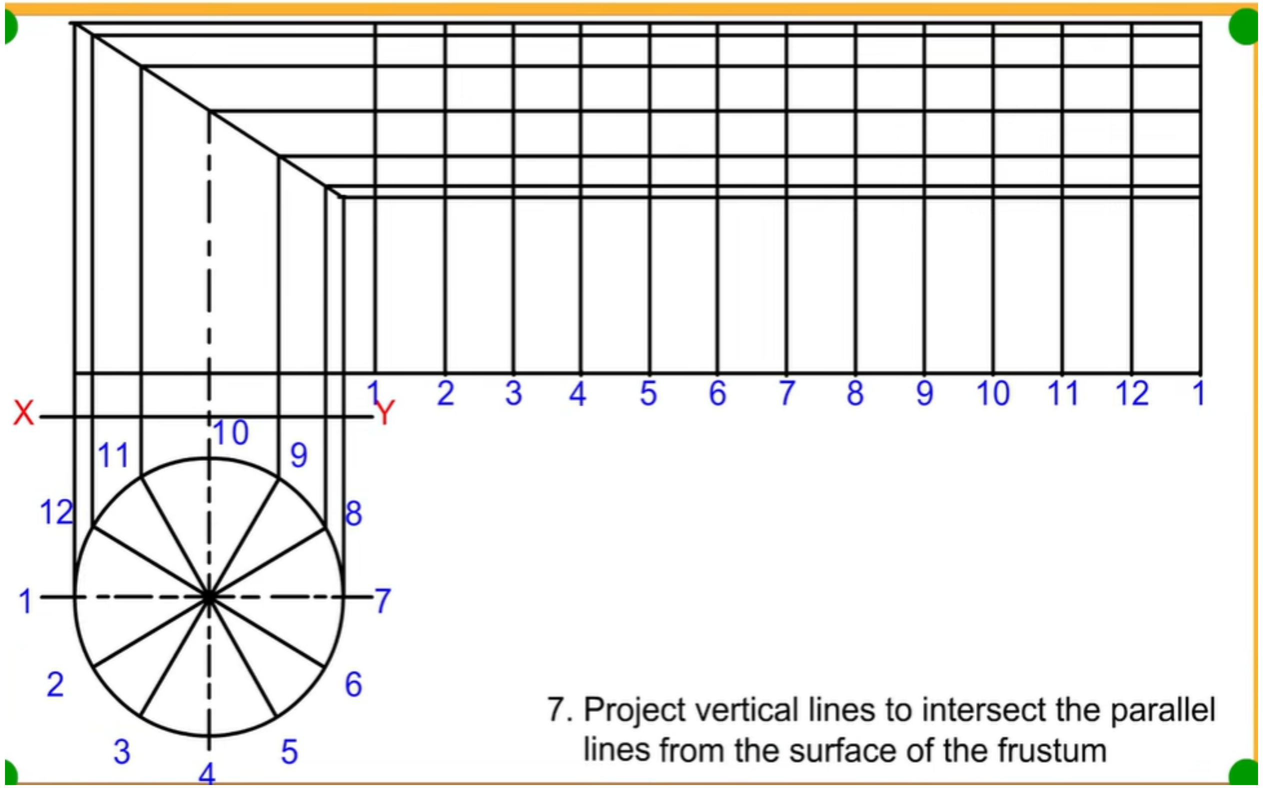


4. Project lines from the bottom of the frustum to the truncated surface.

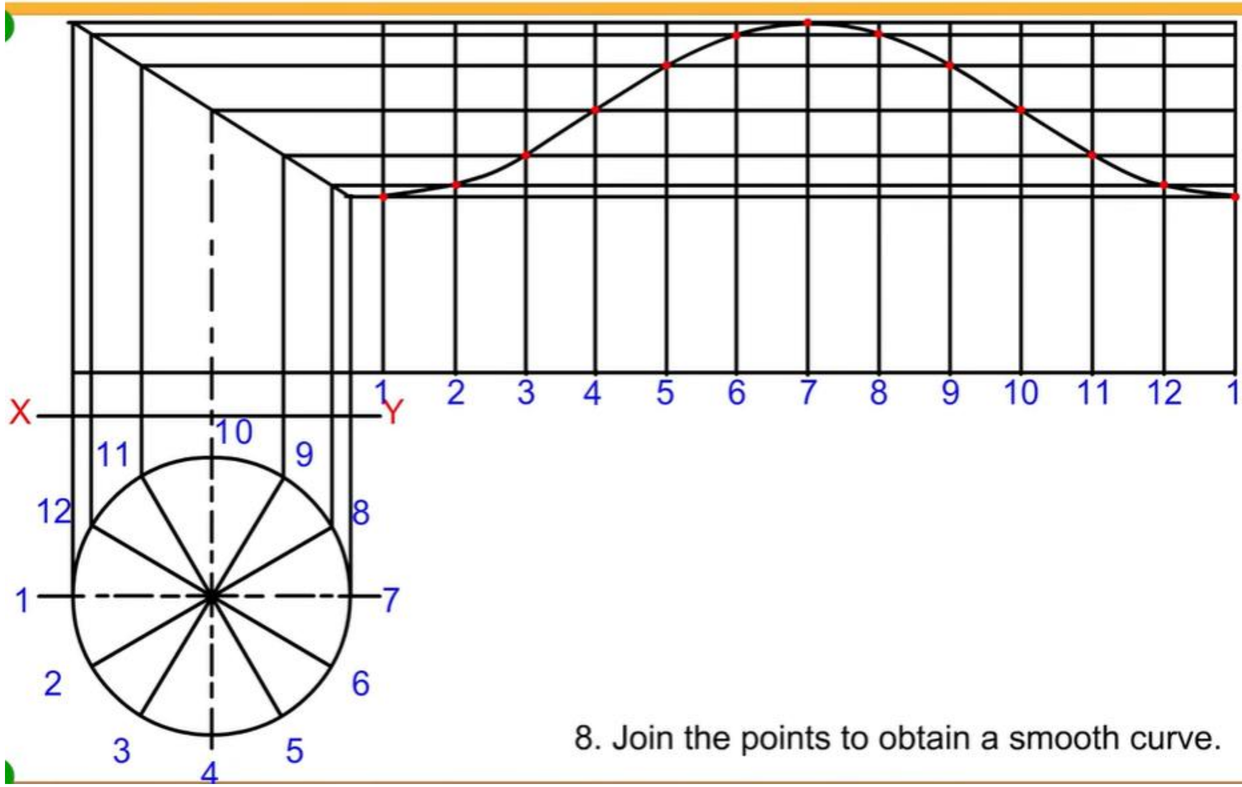
5. Draw horizontal lines from the surface of the frustum.



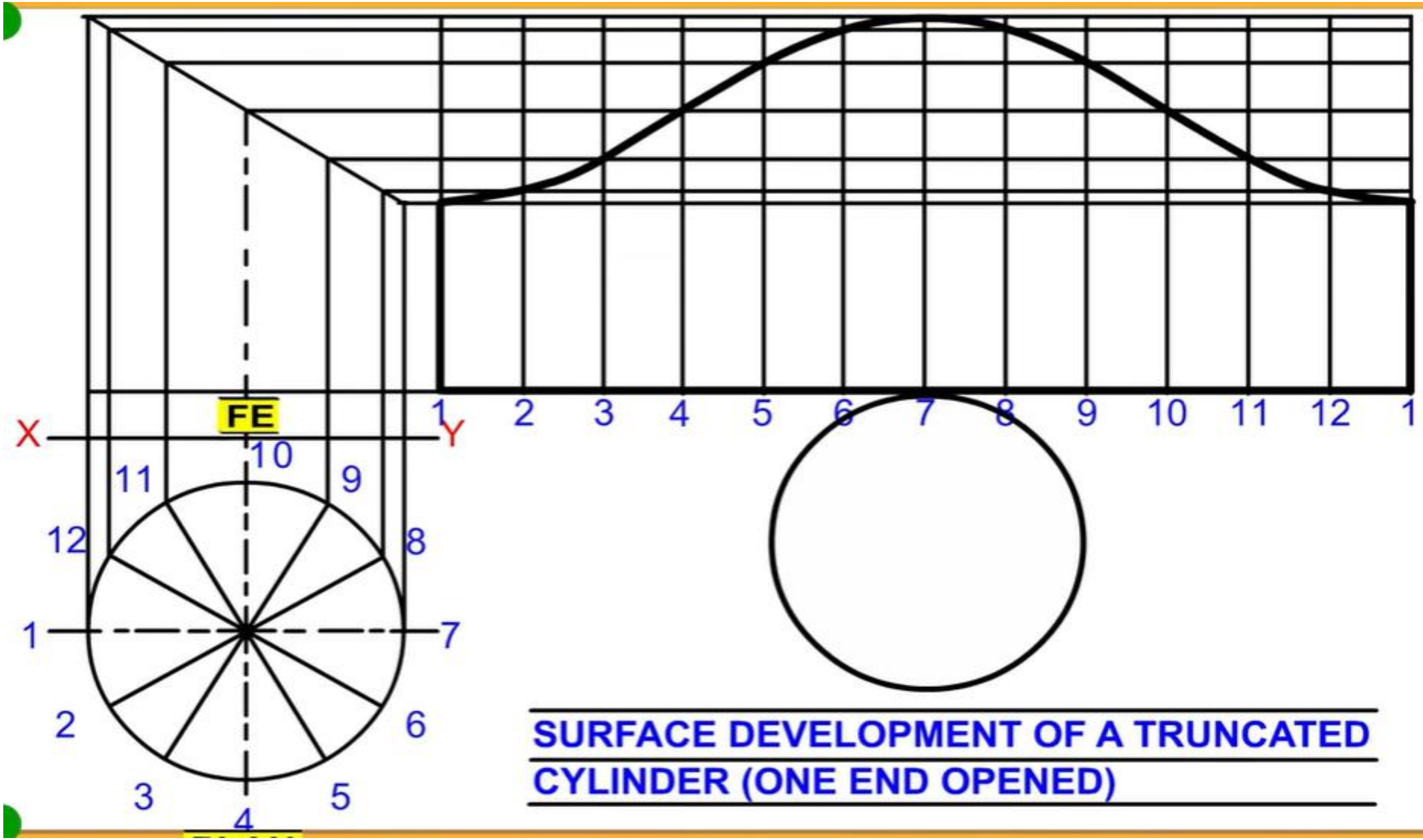
6. With the pair of compasses or pair of dividers, take the distance between the points and step off 12 times on the sideline.



7. Project vertical lines to intersect the parallel lines from the surface of the frustum

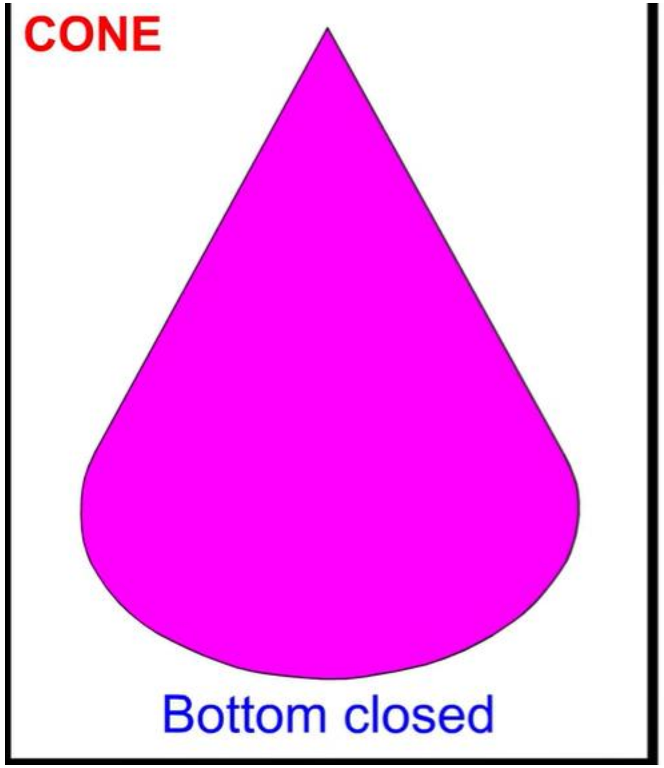


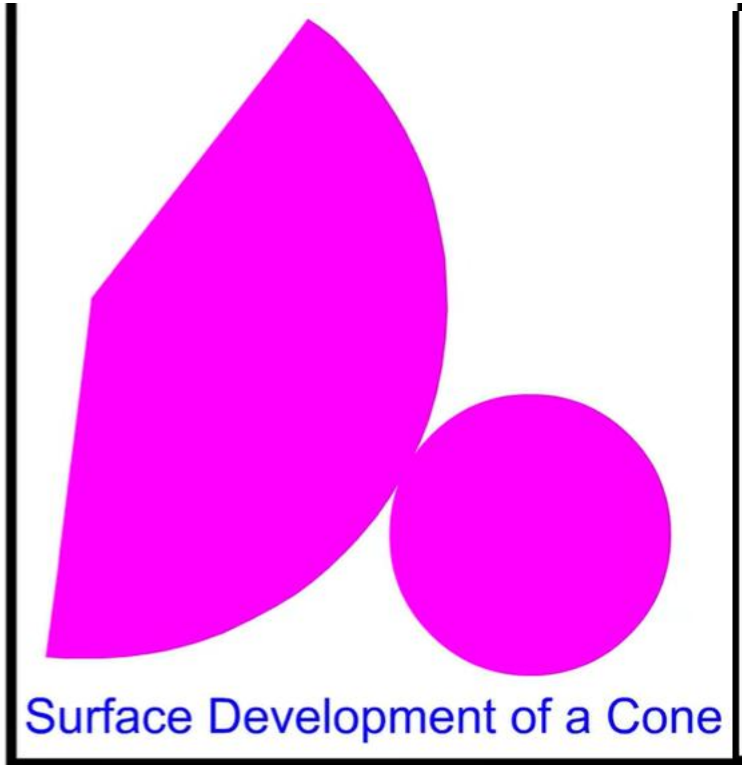
8. Join the points to obtain a smooth curve.

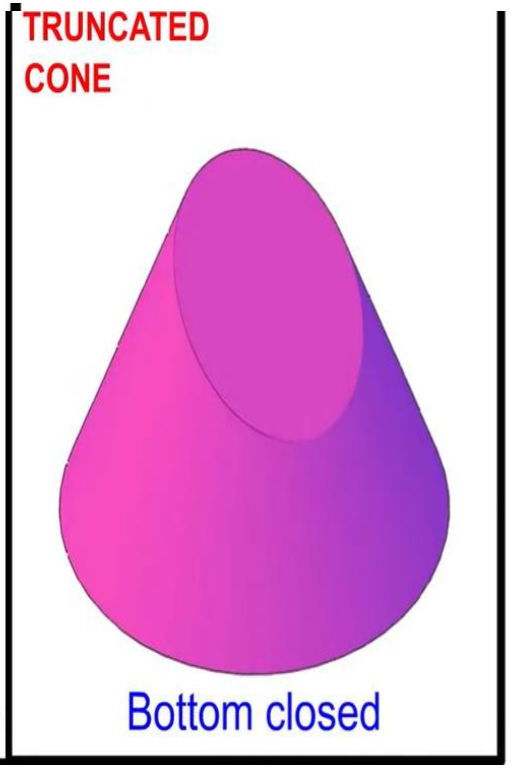


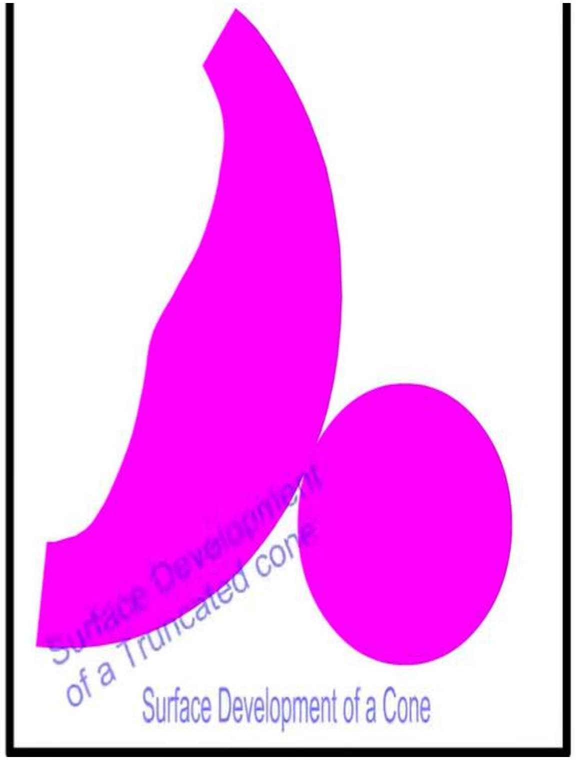
SURFACE DEVELOPMENT OF A TRUNCATED CYLINDER (ONE END OPENED)

How to Draw Surface Development of a Truncated Cone | Bottom Closed |



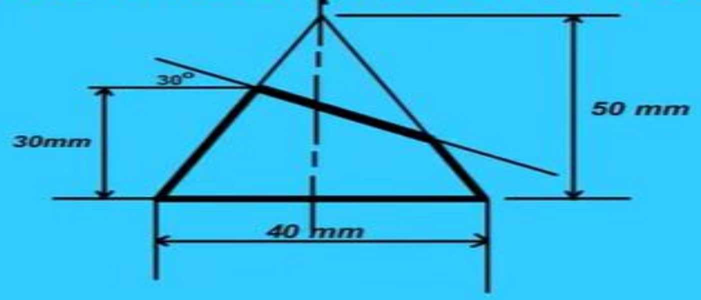






Question

The figure below shows front elevation of a truncated cone (bottom closed)



Draw the full size of the following:

-the plan

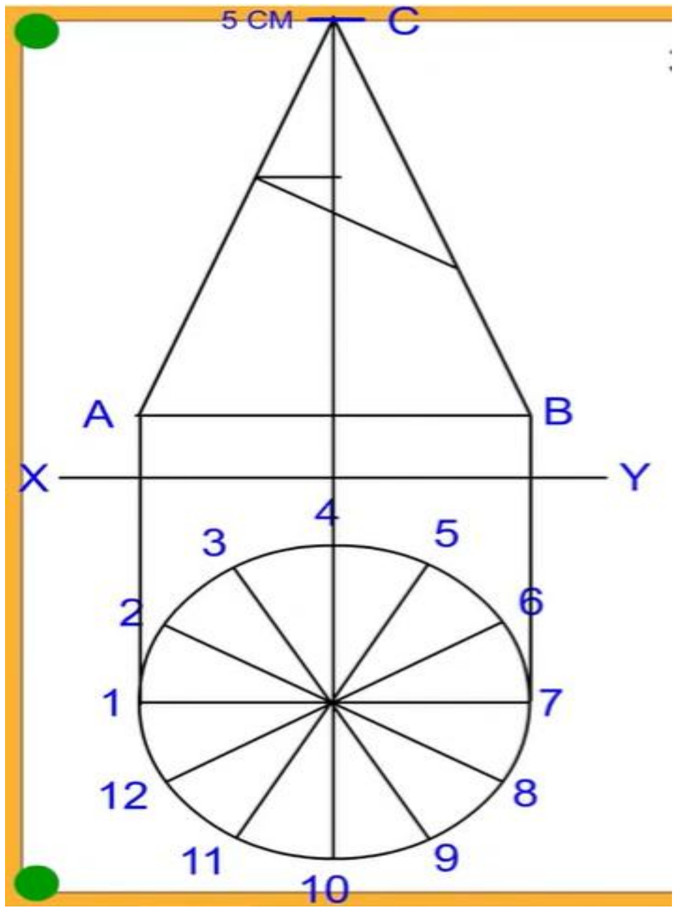
-the front elevation

-the surface development

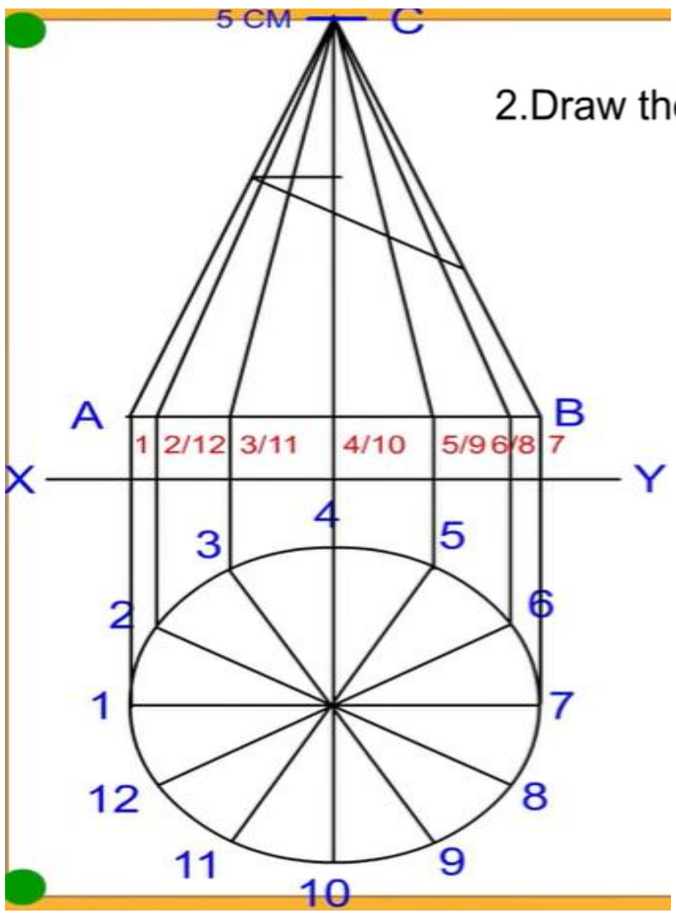
SURFACE DEVELOPMENT OF A TRUNCATED CONE (BOTTOM CLOSED)

PROCEDURES:

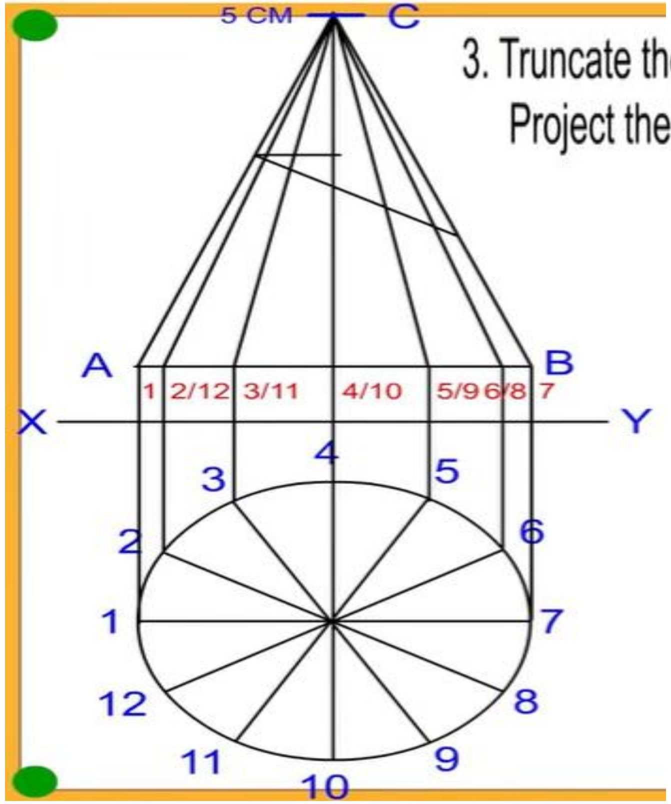
1. Draw the plan of the cone and divide it into 12 equal parts.
2. Draw the front elevation.
3. Truncate the cone at the given height and angle. Project the points onto the front elevation.
4. Project the points from the section onto side BC.
5. Project the points from the section onto the plan to align with the labeling on the plan, join these points to obtain the section
6. With the slant height as radius, draw an arc.
7. Measure the distance between two points and step off 12 times on the arc.
8. Transfer distances from the slant height onto their corresponding lines. Locate the points and draw a smooth curve to obtain the development.
9. Draw the circular base.
10. Outline the work



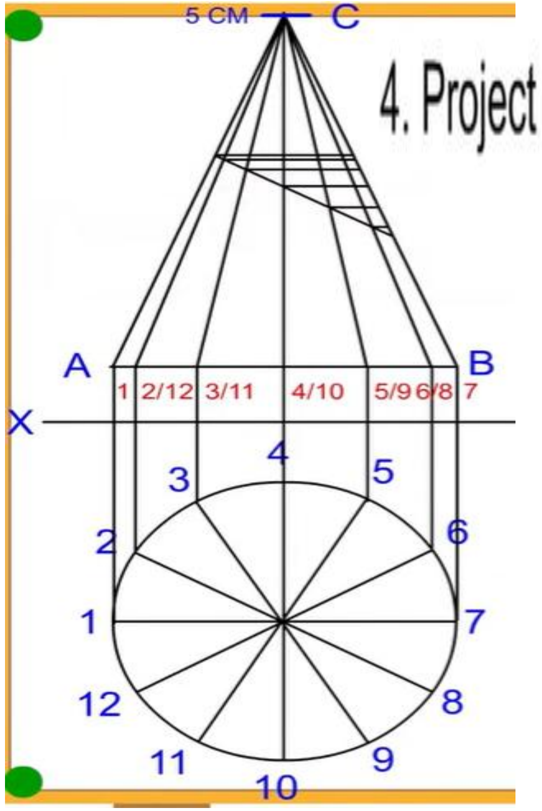
1. Draw the plan of the cone and
   divide it into 12 equal parts.



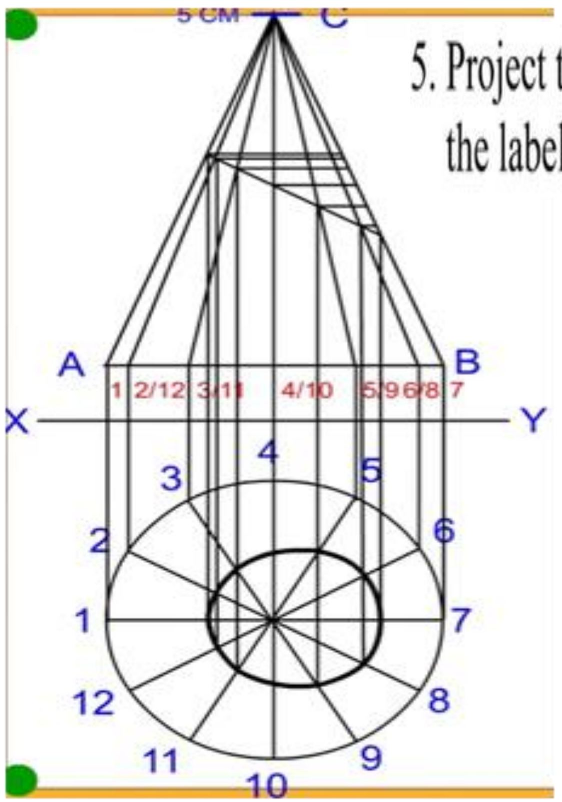
2.Draw the front elevation.



3. Truncate the cone at the given height and angle.
Project the points onto the front elevation.

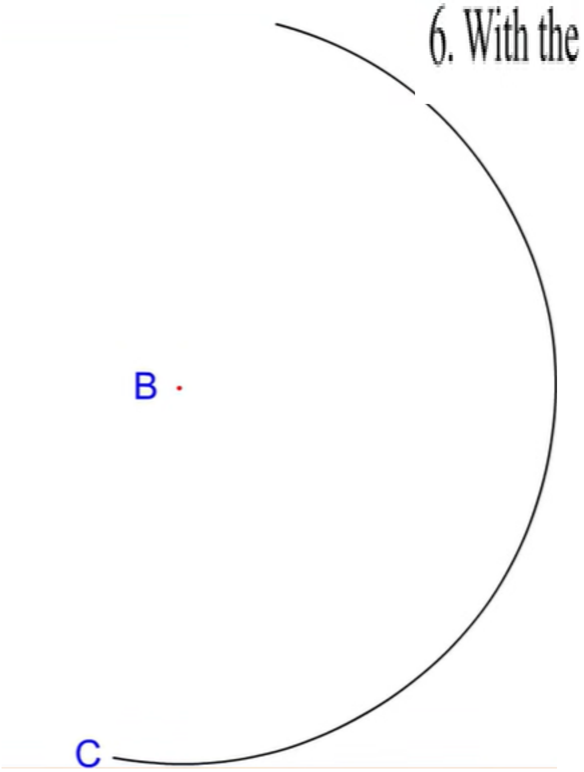


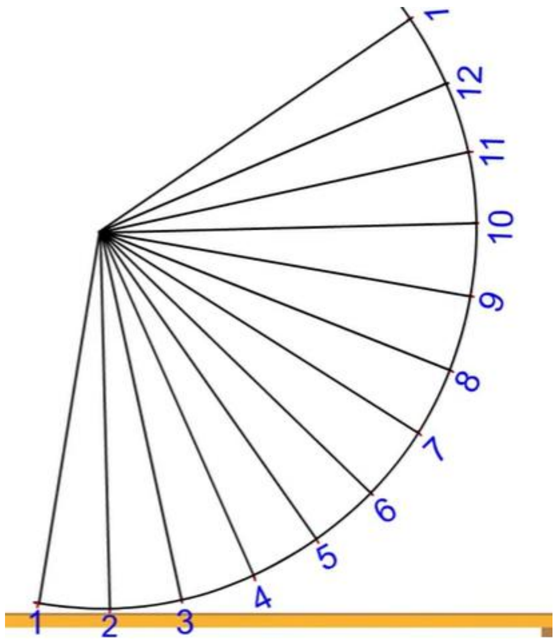
4. Project the points from the section onto side BC



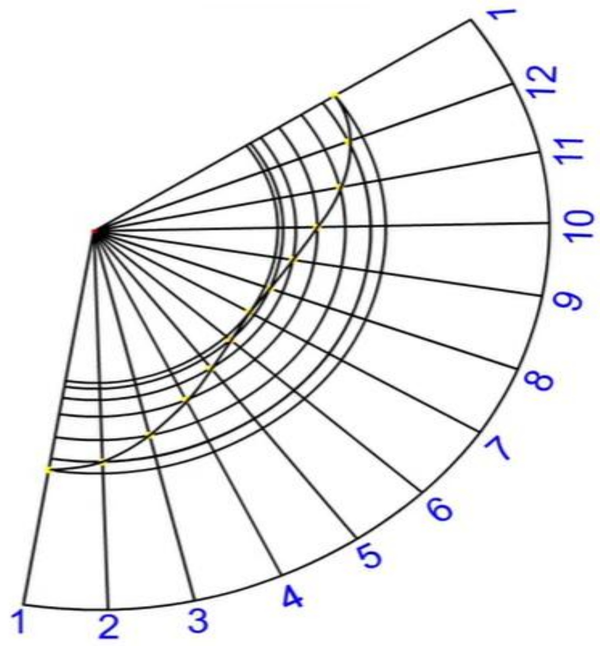
5. Project the points from the section onto the plan to align with the labeling on the plan, join these points to obtain the section

6. With the slant height as radius, draw an arc.

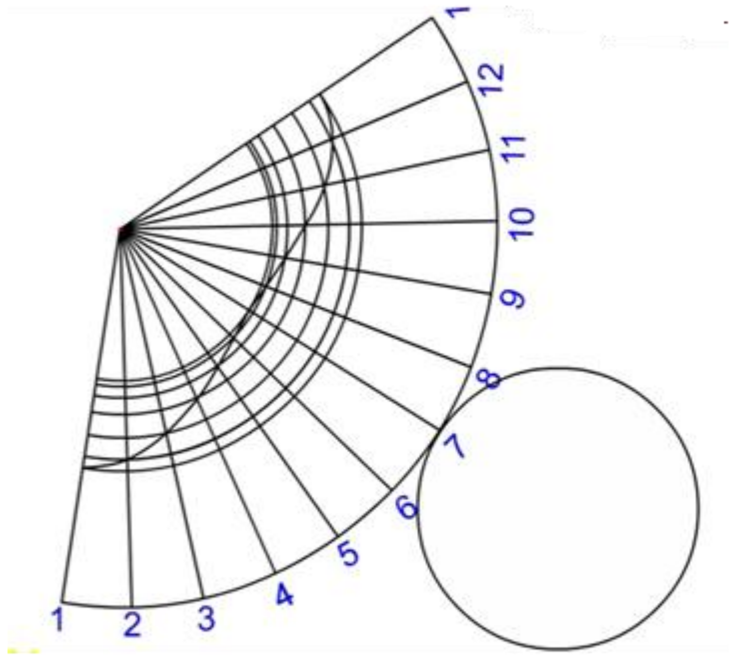




7. Measure the distance between two points and step off 12 times on the arc.

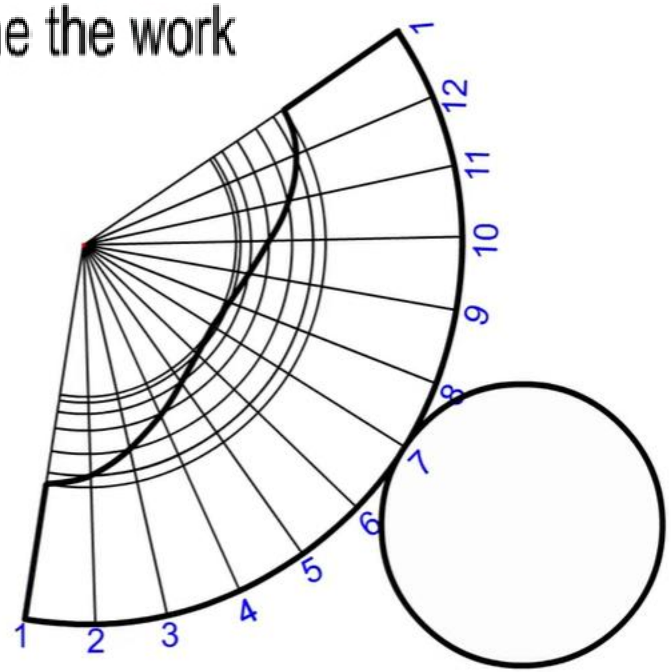


8. Transfer distances from the slant height onto their corresponding lines. Locate the points and draw a smooth curve to obtain the development.



9 Outline the work

10 Clear Outline the work



PYRAMID

Draw the development of the lateral surface of a square pyramid, side of base 30 mm and height 50 mm, resting with its base on H.P. All edge of the base are equally inclined to V.P.