Course Code: ESC106A
Course Title: Construction Materials and Engineering Mechanics

Lecture No. 36:
Problems on Composite Areas

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Lecture Intended Learning Outcomes

At the end of this lecture, students will be able to:

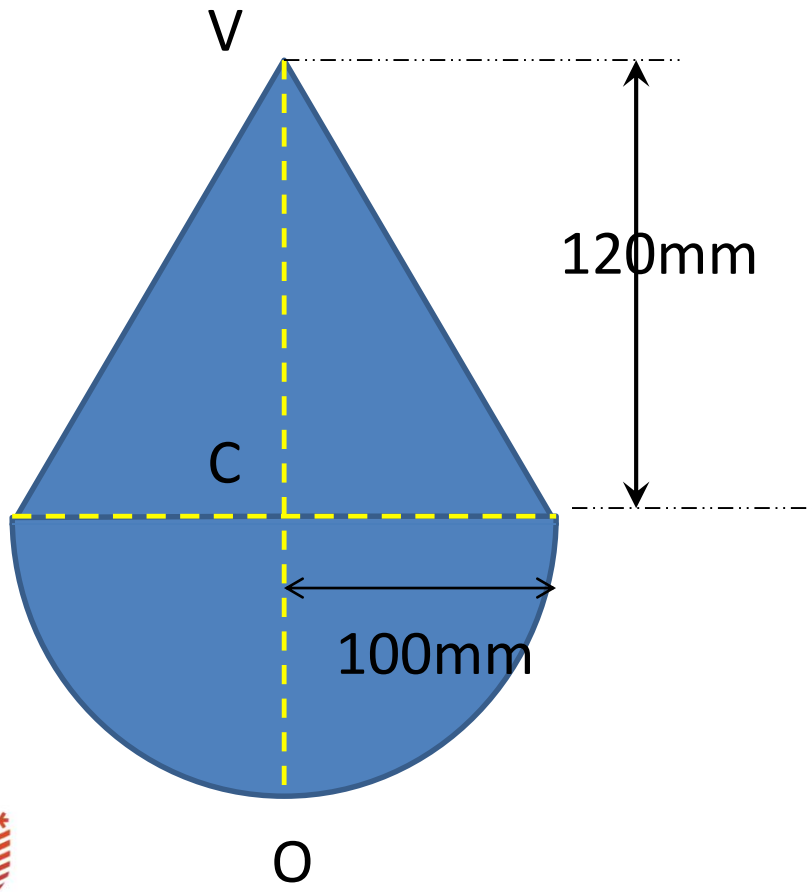
- Calculate the co-ordinates of the centre of gravity of complex sections by breaking down into simple areas.

Contents

Problems on center of Gravity

Centre of gravity

1. A body consists of a solid hemisphere of radius 100mm and a right circular solid cone of height 120mm. The hemisphere and cone have a common base and are made of the same material. Find the position of the cg of the compound body.



Solution:

Step 1.

Find the areas and moment of areas of the solid cone and hemisphere separately with respect to a reference axis.

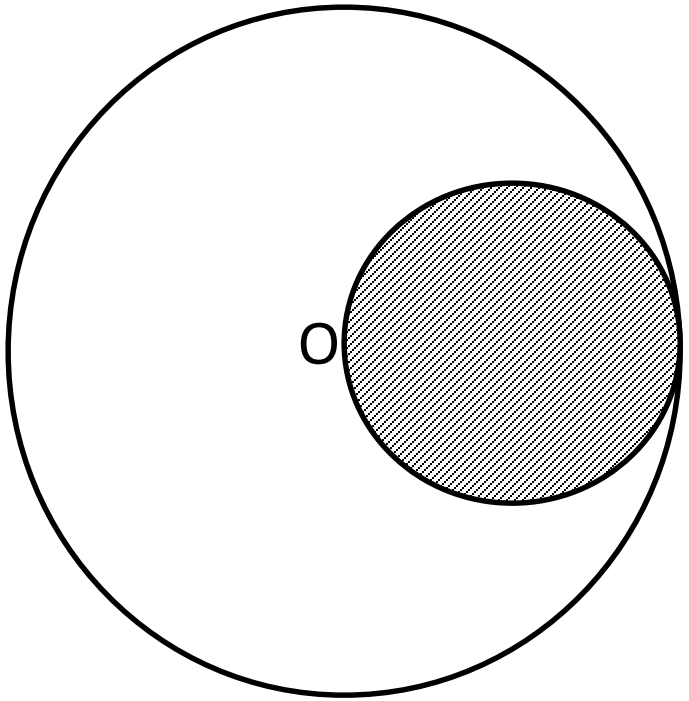
Step 2.

Divide the sum of moment of areas with the total area to get the CG of the compound body

Ans: $\bar{x} = 100mm;\ \bar{y} = 87.8mm$

Centre of gravity

2. From a circular plate of diameter 60mm, a circle whose diameter is equal to the radius of the plate is cut out as shown in the Figure. Find the CG of the remainder.



Solution:

Step 1.

Find the areas and moment of areas of the circular plate and the cutout portion separately with respect to a reference axis.

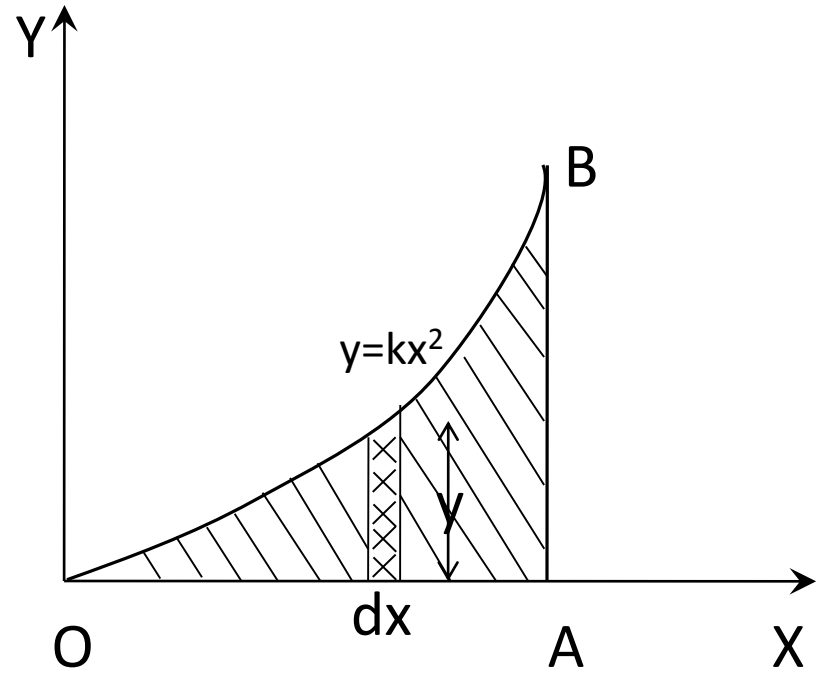
Step 2.

Divide the effective sum of moment of areas with the total effective area to get the CG of the compound body

Ans: $\bar{x} = 25mm;\ \bar{y} = 30mm$

Centre of gravity

3. Determine the co-ordinates of the CG of the area OAB shown in the Figure. The curve OB is represented by the equation of a parabola $y=kx^2$.
   Take OA = 6units ; OB = 4 units



Solution:

Step 1. Consider a strip parallel to y-axis

Step 2. Find the value of k from the boundary conditions given.

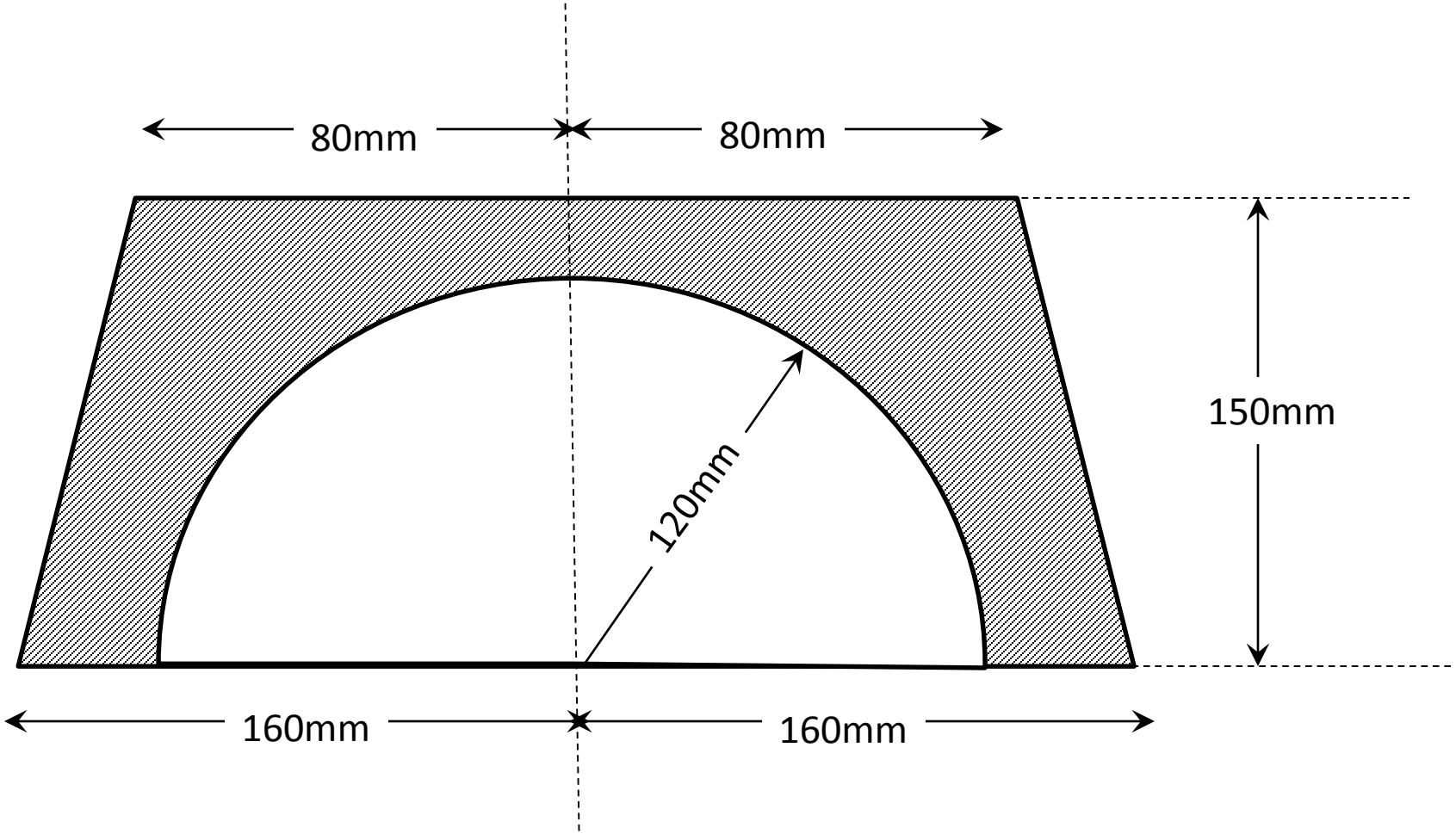
Step 3. Adopting integration method, find out moment of total area enclosed by the curve. Also find out the total area using integration.

Step 4. Find the co-ordinates of the CG of the enclosed area by dividing the moment of the area by the total area.

Ans: $\bar{x} = 4.5 units; \quad \bar{y} = 1.2 units$

Centre of gravity

4.Find the CG of the area shown shaded in the Figure.



Ans: $\bar{x} = 160mm; \quad \bar{y} = 93.3mm$

Summary

- The point at which the total area of a given section is assumed to be concentrated is known as centroid of that area.
- The centroid of composite sections are obtained by using the moment balance of the geometric elements.