ROHININ COLLEGE OF ENGINEERING AND TECHNOLOGY
Approved by AICTE & Affliated to anna university
Accredited with A^{+} grade by NAAC
DEPARTMENT OF MECHANICAL ENGINEERING

NAME OF THE SUBJECT: ENGINEERING MECHANICS

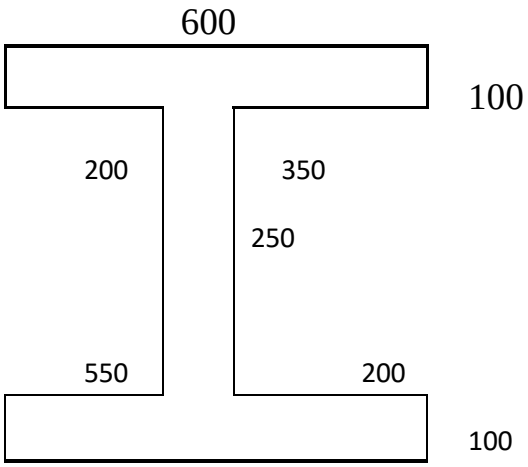
SUBJECT CODE : ME3351

REGULATION 2021

UNIT III: DISTRIBUTED FORCES

Centroid:

2. Locate the Centroid of the I section shown.



Soln:

$$\bar{X} = \frac{a_1x_1 + a_2x_2 + a_3x_3}{a_1 + a_2 + a_3}$$

$$\bar{Y} = \frac{a_1y_1 + a_2y_2 + a_3y_3}{a_1 + a_2 + a_3}$$

Section (1)

$$a_1 = 800 \times 100 = 80000mm^2$$

$$x_1 = \frac{800}{2} = 400mm$$

$$y_1 = \frac{100}{2} = 50mm$$

Section(2)

$$a_2 = 250 \times 100 = 25 \times 10^3 mm^2$$

$$x_2 = 550 + \frac{100}{2} = 600mm$$

$$y_2 = 100 + \frac{250}{2} = 225mm$$

Section (3)

$$a_3 = 600 \times 100 = 60 \times 10^3 mm^2$$

$$x_3 = 350 + \frac{600}{2} = 650mm$$

$$y_3 = 100 + 250 + \frac{100}{2} = 400mm$$

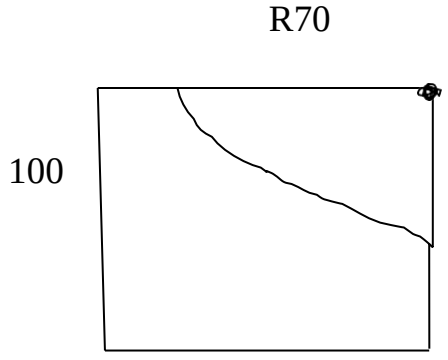
$$\bar{X} = \frac{(80\times10^3\times400)+(25\times10^3\times600)+(60\times10^3\times650)}{80\times10^3+25\times10^3+60\times10^3}$$

$$\bar{X} = 521.21mm$$

$$\bar{Y} = \frac{(80 \times 10^3 \times 50) + (25 \times 10^3 \times 225) + (60 \times 10^3 \times 400)}{80 \times 10^3 + 25 \times 10^3 + 60 \times 10^3}$$

$$\bar{Y} = 203.78mm$$

3. Locate the Centroid of the Area.

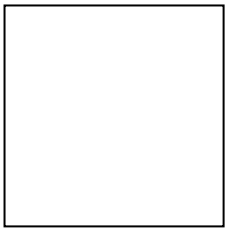


Soln:

$$\bar{X} = \frac{a_1 x_1 - a_2 x_2}{a_1 + a_2}$$

$$\bar{Y} = \frac{a_1 y_1 - a_2 y_2}{a_1 + a_2}$$

Section (1)



$a_1 = 100 \times 100 = 10 \times 10^3 mm^2$

$x_1 = \frac{100}{2} = 50mm$

$y_1 = \frac{100}{2} = 50mm$

Section (2)

$a_2 = \frac{1}{4} \times \pi r^2 = \frac{1}{4} \times \pi \times 70^2 = 38.48mm^2$

$x_2 = \frac{4r}{3\pi} = \frac{4 \times 70}{3\pi} = 70.29mm$

$y_2 = \frac{4r}{3\pi} = \frac{4 \times 70}{3\pi} = 70.29mm$

$$\bar{X} = \frac{a_1 x_1 - a_2 x_2}{a_1 + a_2}$$

$$\bar{X} = \frac{(10 \times 10^3 \times 50) - (3848 \times 70.29)}{10 \times 10^3 - 3848}$$

$\bar{X} = 37.3mm$

$$\bar{Y} = \frac{a_1 y_1 - a_2 y_2}{a_1 - a_2}$$

$$\bar{Y} = \frac{(10 \times 10^3 \times 50) - (3848 \times 70.29)}{10 \times 10^3 - 3848}$$

$\bar{Y} = 373mm$

Section (1)

$a_1 = 140 \times 120 = 16800mm^2$

$x_1 = \frac{140}{2} = 70mm$

$y_1 = \frac{120}{2} = 60mm$

Section (2)

$a_2 = 40 \times 40 = 1600mm^2$

$x_2 = \frac{b}{2} = \frac{40}{2} = 20mm$

$y_2 = 80 + \frac{40}{2} = 20mm$

Section (3)

$a_3 = \frac{1}{2}bh = \frac{1}{2} \times 60 \times 20 = 600mm^2$

$x_3 = 140 + \frac{b}{3} = 140 + \frac{60}{3} = 160mm$

$y_3 = \frac{h}{3} = \frac{20}{3} = 6.66mm$

Section (4)

$a_4 = \frac{1}{2} \times \frac{\pi}{4} \times d^2 = \frac{\pi}{4} \times (80^2) \times \frac{1}{2} = a_4 = 2513mm^2$

$x_4 = 20 + \frac{d}{2} = 20 + \frac{80}{2} = 60mm$

$y_4 = \frac{4r}{3\pi} = \frac{4 \times 40}{3\pi} = 16.97mm$

$\bar{X} = 81.97mm \qquad \bar{Y} = 60.97mm$