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

Unit-III

PROPERTIES OF SURFACES AND SOLIDS

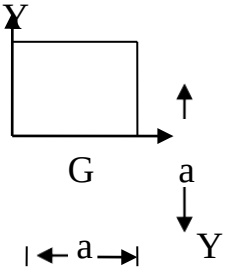
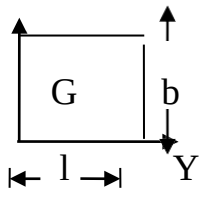
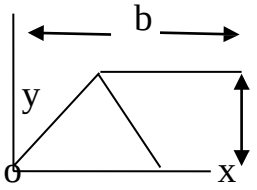
Centroid:

Centroid is defined as a point on a surface the whole area of the surface acts.

Centre of gravity:

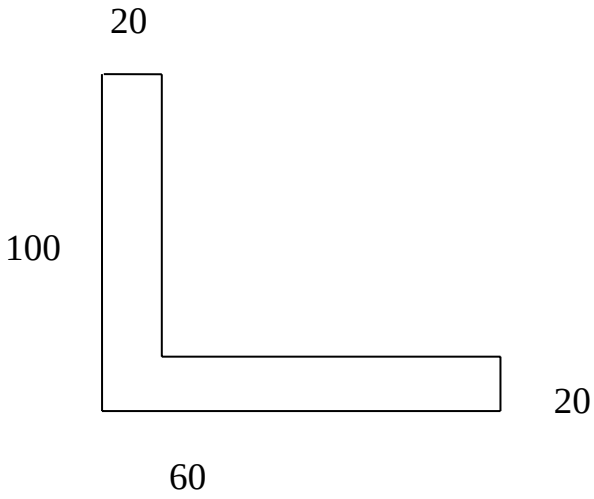
Centre of gravity is defined as the point through which the entire weight of the body acts.

Centroid of simple plane figure:

Sl.No	Name	Shape	X	Y	Area
1.	Square		$\frac{a}{2}$	$\frac{a}{2}$	a^2
2.	Rectangle		$\frac{l}{2}$	$\frac{l}{2}$	lb
3.	Triangle (Isosceles)		$\frac{b}{2}$	$\frac{h}{3}$	$\frac{1}{2}$bh

Problem 1:

Determine the Centroid of L section



Centroid

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

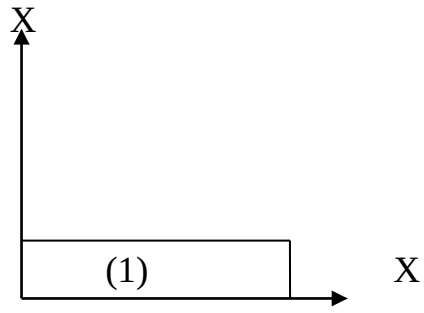
$$\bar{Y} = \frac{a_1 y_1 + a_2 y_2}{a_1 + a_2}$$

Section (1)

$$a_1 = 60 \times 20 = 1200mm^2$$

$$x_1 = \frac{60}{2} = 30mm$$

$$y_1 = \frac{20}{2} = 10mm$$

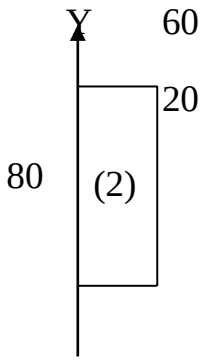


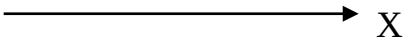
Section (2)

$$a_2 = 20 \times 80 = 160mm^2$$

$$x_2 = \frac{20}{2} = 10mm$$

$$y_2 = 20 + \frac{80}{2} = 60mm$$





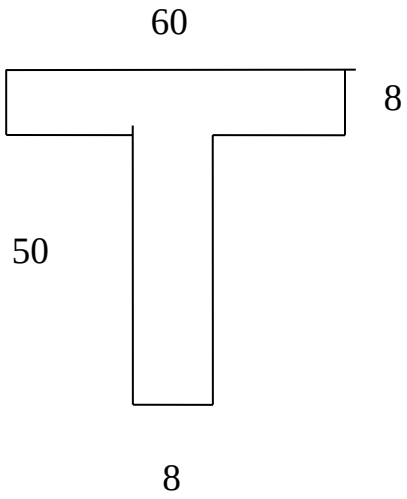
$\bar{X} = \frac{a_1x_1 + a_2x_2}{a_1 + a_2} = \frac{1200 \times 30 + 1600 \times 10}{1200 + 1600}$

$\bar{X} = 18.57mm$

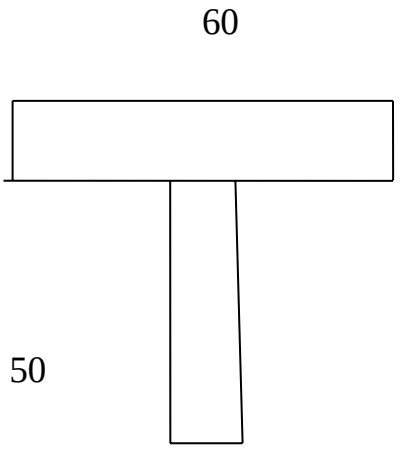
$\bar{Y} = \frac{a_1y_1 + a_2y_2}{a_1 + a_2} = \frac{1200 \times 10 + 1600 \times 60}{1200 + 1600}$

$\bar{Y} = 38.57mm$

2. Find the Centroid of T section



Section (1)



$a_1 = 8 \times 50 = 400mm^2$

$x_1 = 26 + \frac{8}{2} = 30mm$

$y_1 = \frac{50}{2} = 25mm$

Section(2)

$a_2 = 60 \times 8 = 480mm^2$

$x_2 = \frac{60}{2} = 30mm$

$$y_2 = 50 + \frac{8}{2} = 54mm$$

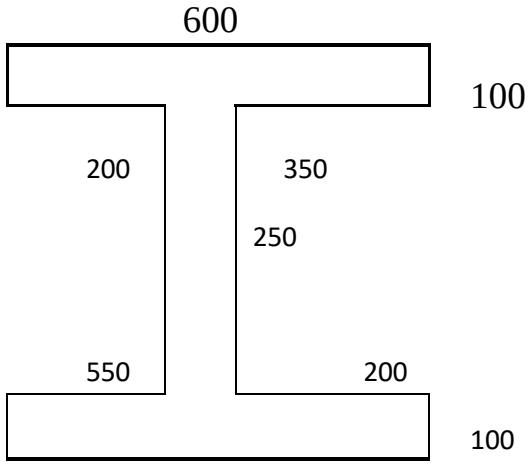
$$\bar{X} = \frac{a_1x_1 + a_2x_2}{a_1 + a_2} = \frac{400 \times 30 + 480 \times 300}{1200 + 480}$$

$$\bar{X} = 30mm$$

$$\bar{Y} = \frac{a_1y_1 + a_2y_2}{a_1 + a_2} = \frac{400 \times 25 + 480 \times 54}{400 + 480}$$

$$\bar{Y} = 40.81mm$$

3. 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)

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

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

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

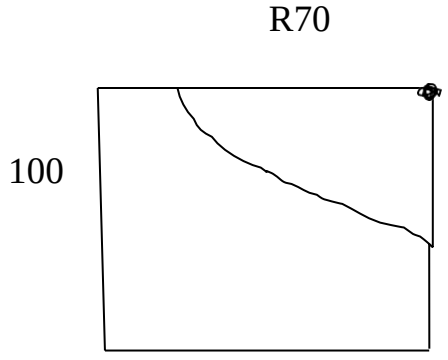
$$\bar{X} = \frac{(80\times10^3\times400)+(25\times10^3\times600)+(60\times10^3\times650)}{80\times10^3+25\times10^3+60\times10^3}$$

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

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

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

4. Locate the Centroid of the Area.

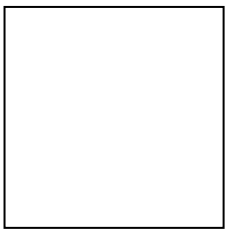


Soln:

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

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

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)

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

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

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

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

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

$\bar{X} = 37.3mm$

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

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

$\bar{Y} = 373mm$