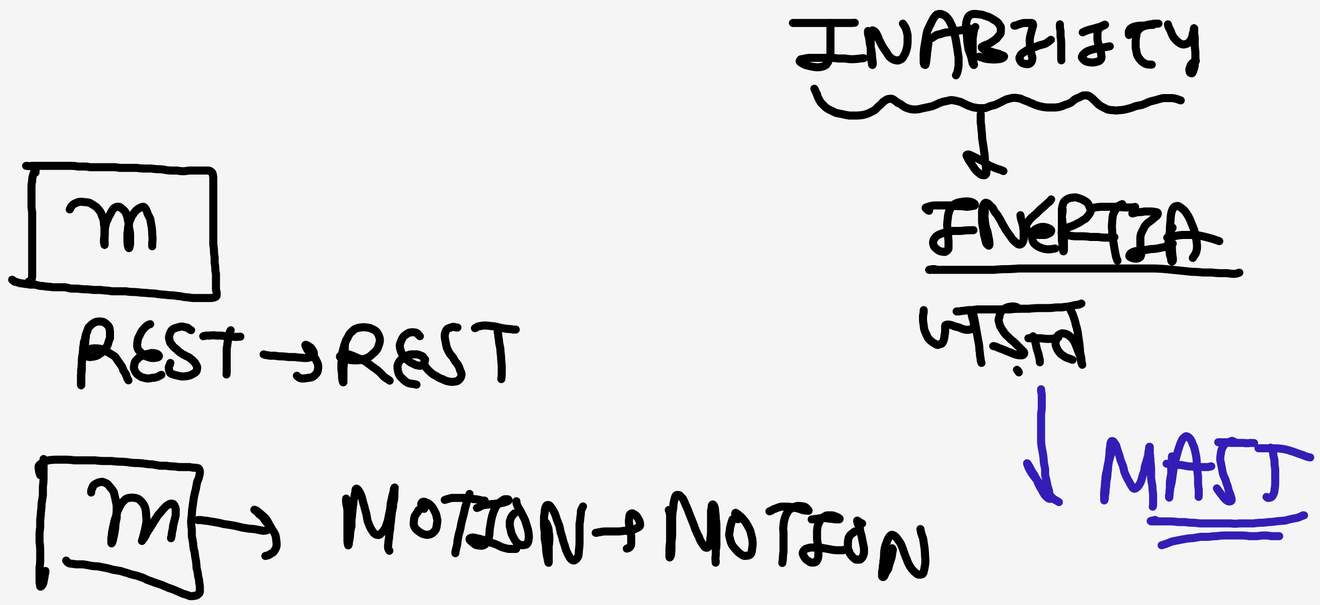
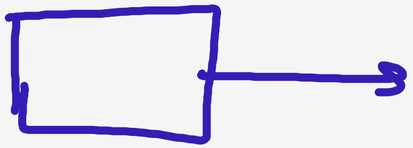
MOMENT OF INERTIA



INABILITY → INERTIA



LINEAR MOTION

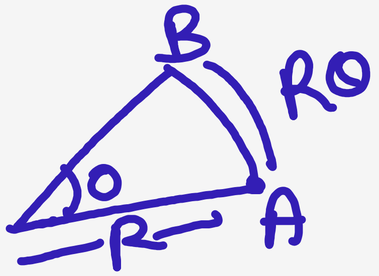
ROTATIONAL INERTIA

MOMENT OF INERTIA

$V = R\omega$

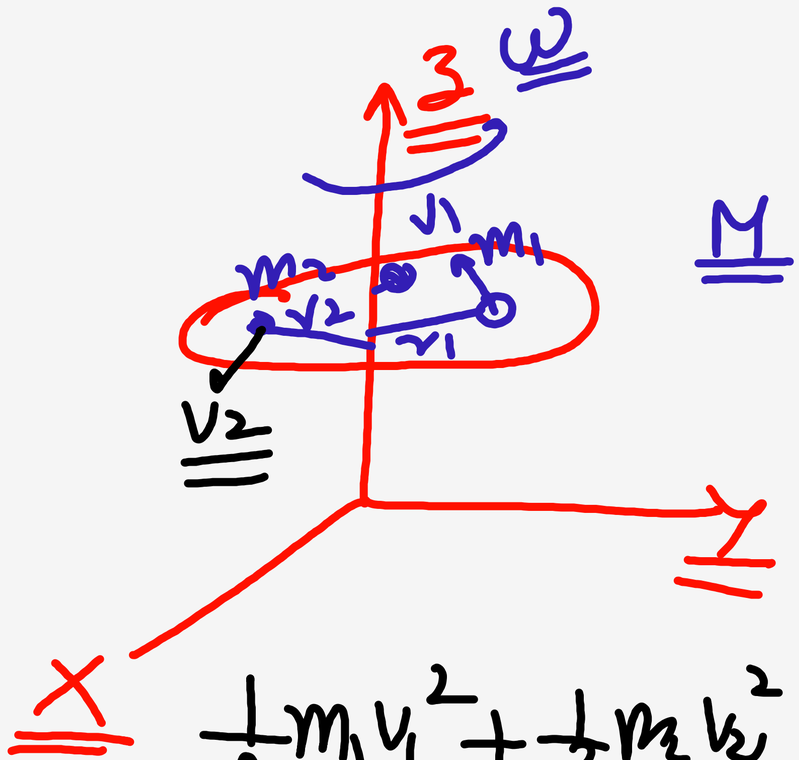
$m \rightarrow V$

$\frac{1}{2}mv^2$

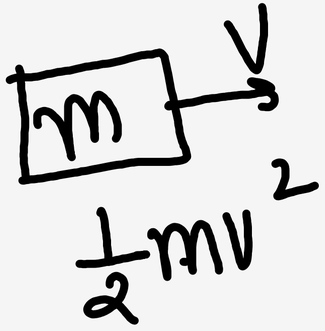


$V = \frac{R\theta}{t}$ $\omega = \frac{\theta}{t}$

$V = R\omega$



$\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

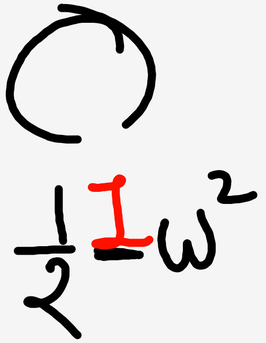


$\frac{1}{2}mV^2$

$\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 + \frac{1}{2}m_3v_3^2 + \cdots\cdots + \frac{1}{2}m_nv_n^2$

$\frac{1}{2}m(r_1\omega)^2 + \frac{1}{2}(m_2)(r_2\omega)^2 + \cdots\cdots + \frac{1}{2}(m_n)(r_n\omega)^2$

$\frac{\omega^2}{2}\left(mr_1^2 + m_2r_2^2 + \cdots\cdots + m_nr_n^2\right) = \frac{1}{2}I\omega^2$

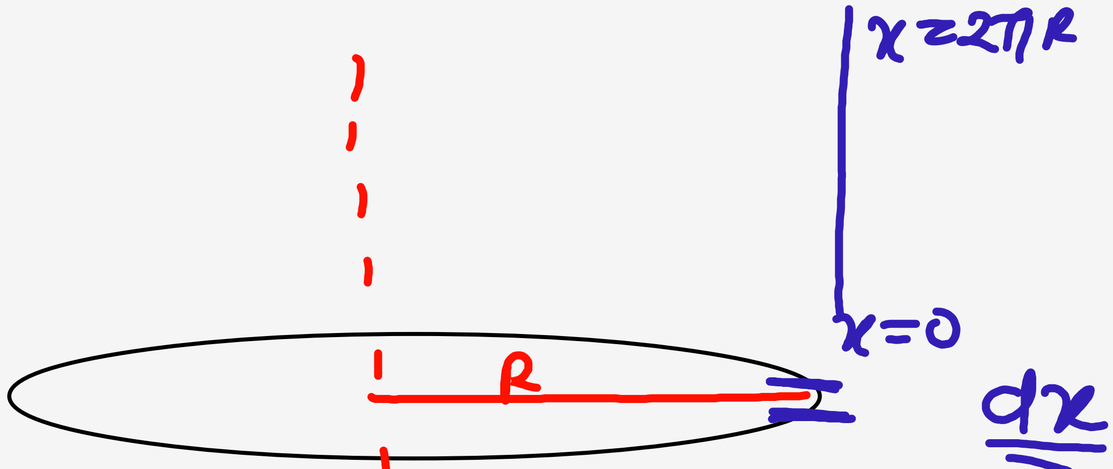


$\frac{1}{2}I\omega^2$

$I = m_1r_1^2 + m_2r_2^2 + \cdots\cdots + m_nr_n^2$

$$I = \sum_{i=1}^{n} m_i r_i^2$$

MASS MOMENT OF INERTIA



$M \rightarrow 2\pi R$

$1 \rightarrow \frac{M}{2\pi R}$

$dx \rightarrow \frac{M}{2\pi R}(dx)$

M, R

$x=2\pi R$ $dm \cdot R^2$

$\frac{M}{2\pi R} \cdot R^2 \cdot dx$

$x=0$

$\frac{MR}{2\pi}(x)_0^{2\pi R}$

$\frac{MR}{2\pi}(2\pi R)$

MR^2

DISC

$M \to \pi R^2$

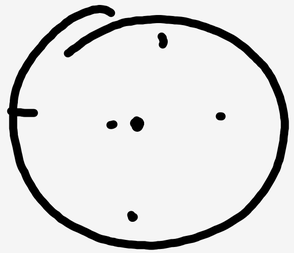
$\frac{M}{\pi R^2} \times 2\pi x\,dx$

$dm \cdot x^2$

$\frac{M}{\pi R^2} \times 2\pi x\,dx \times x^2$

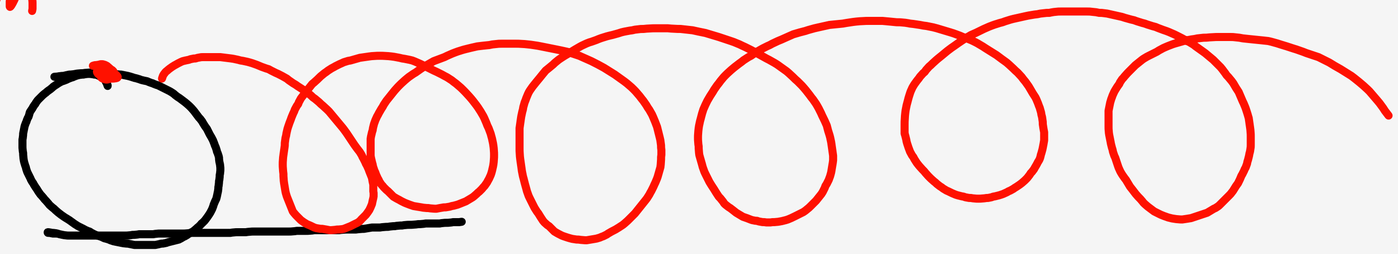
$\frac{2M}{R^2} \int_{x=0}^{x=R} x^3\,dx$

COM :-



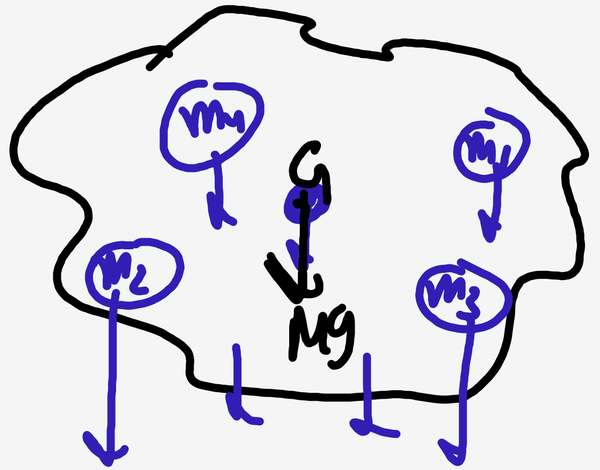
$F = m a_{cm}$

$P = m V_{cm}$



COG :-

Mg



$$I = \sum_{i=1}^{i=n} A \cdot \gamma^2$$

X

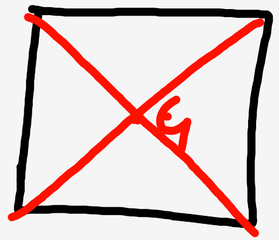
Center of Gravity

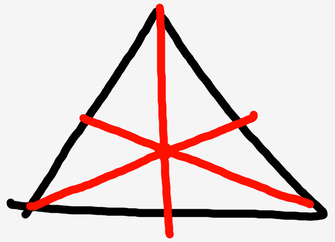
- The center of gravity is the point at which the whole weight of the body is supposed to be acting.
- A weight distribution of the body around COG is uniform. That is if we pass an axis through the COG, than the weight acting to the left is equal to the weight acting at right.
- The Center of gravity changes with the change in the force of gravity

mg

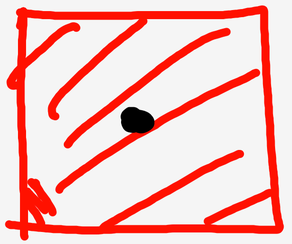
CENTROID

2-D



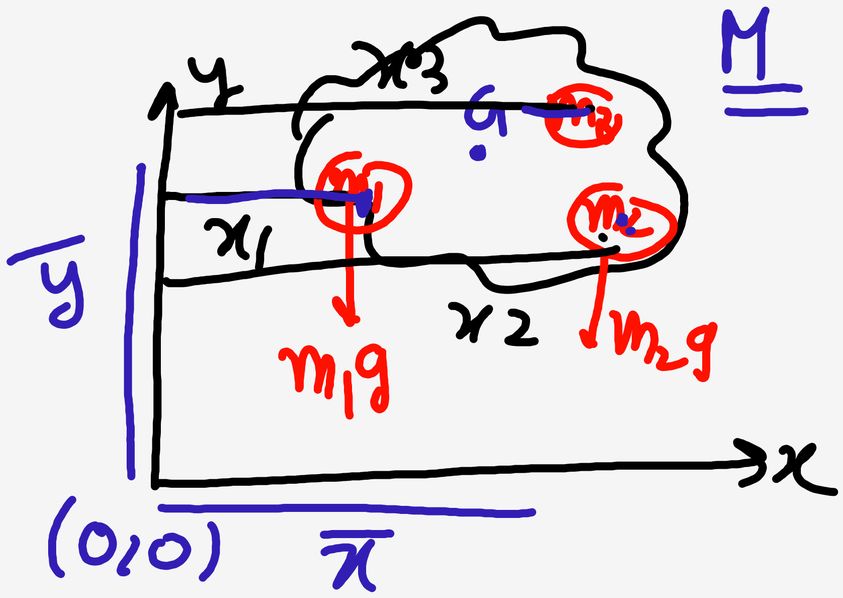


COG



Log :→ $\bar{x} = ?$

$\bar{y} = ?$



$m_1 g x_1 + m_2 g x_2$

$+ m_3 g x_3 + \dots + m_n g x_n = (Mg)\bar{x}$

$$\bar{x} = \frac{m_1 x_1 + m_2 x_2 + m_3 x_3 + \dots}{m_1 + m_2 + m_3 + \dots}$$

$$\bar{y} = \frac{m_1 y_1 + m_2 y_2 + \cdots}{m_1 + m_2 + \cdots}$$

PLANE FIGURE :-

$$\bar{x} = \frac{A_1 x_1 + A_2 x_2 + \cdots}{A_1 + A_2 + \cdots}$$

$$\bar{y} = \frac{A_1 y_1 + A_2 y_2 + \cdots}{A_1 + A_2 + \cdots}$$

Center of Mass

- The center of mass is the point at which the whole mass of the body is assumed to be concentrated.

- The mass distribution around the COM is uniform

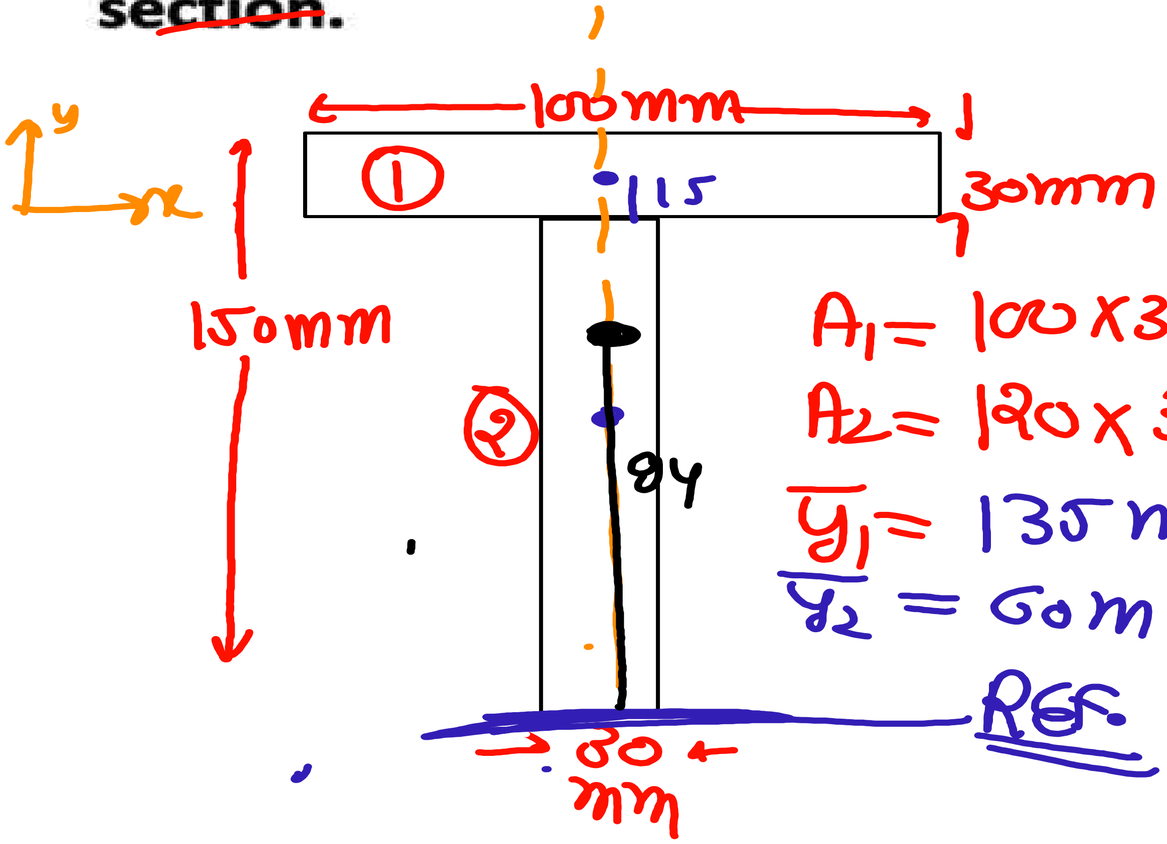
Centre of gravity is the point where the total weight of the body acts while centroid is the geometric centre of the object.

Centre of gravity or centre of mass is the point where the whole mass of the body is concentrated.

This is where the gravitational force (weight) of the body acts for any orientation of the body.

Centroid is the centre of gravity for objects of uniform density.

Find the centre of gravity of a 100 mm × 150 mm × 30 mm T-section.

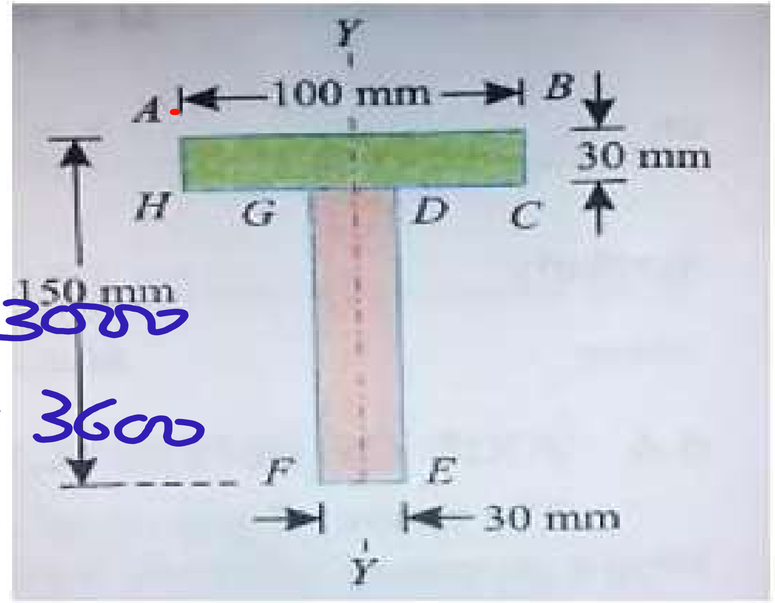


$A_1 = 100 \times 30 = 3000$

$A_2 = 120 \times 30 = 3600$

$\bar{y}_1 = 135$ mm

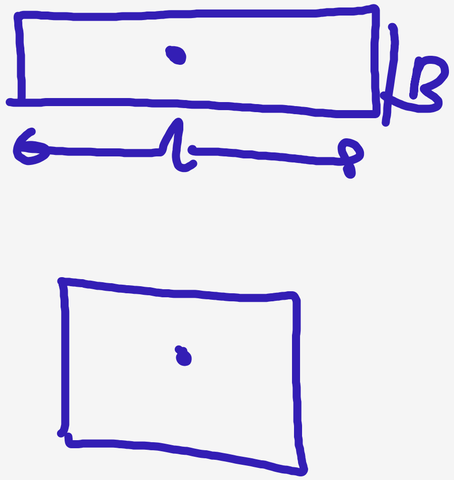
$\bar{y}_2 = 60$ mm



y

$\bar{y} = ?$

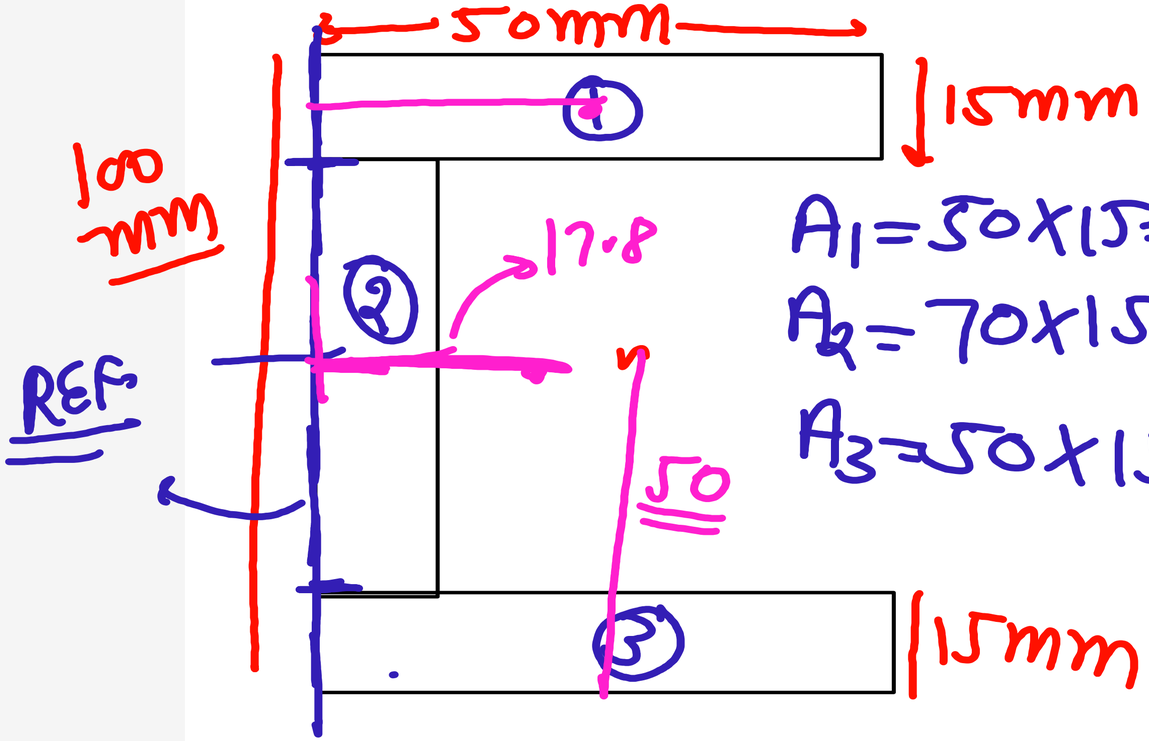
x की TENSION छोड़ दो।



$$\bar{y} = \frac{A_1\bar{y}_1 + A_2\bar{y}_2 + \cdots}{A_1 + A_2 + \cdots}$$

$$\bar{y} = \frac{3000(135) + 3600(60)}{3000 + 3600} = 94.1\,mm$$

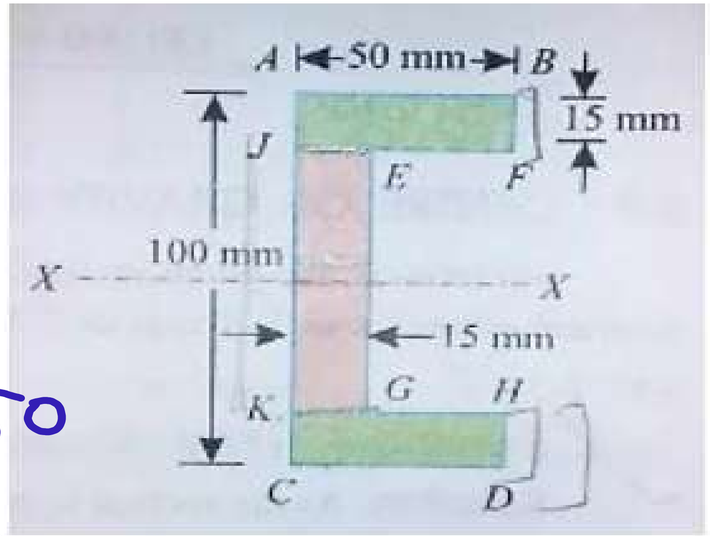
Find the centre of gravity of a channel section 100 mm × 50 mm × 15 mm.



$A_1 = 50 \times 15 = 750$

$A_2 = 70 \times 15 = 1050$

$A_3 = 50 \times 15 = 750$



$\bar{x}_1 = 25$

$\bar{x}_2 = 7.5\,mm$

$\bar{x}_3 = 25\,mm$

$\bar{x}$ → ही TENSION

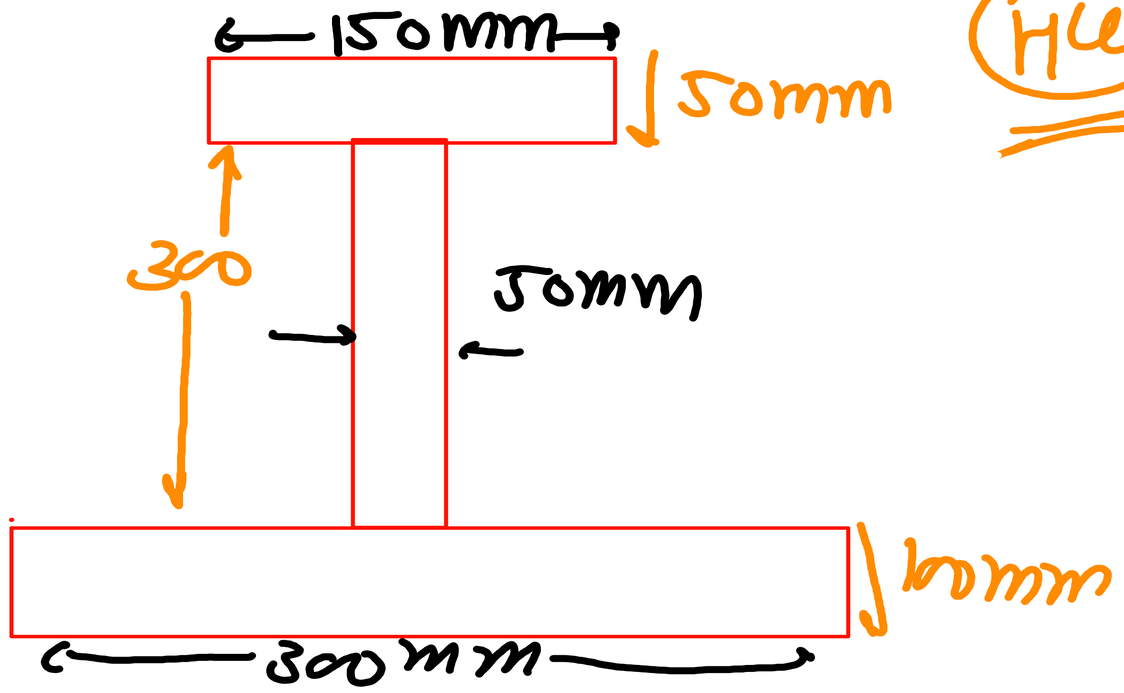
$\bar{y}$ → ही TENSION

$$\bar{x} = \frac{A_1\bar{x}_1 + A_2\bar{x}_2 + A_3\bar{x}_3}{A_1 + A_2 + A_3}$$

$$= \frac{750(25) + 1050(7.5) + 750(25)}{750 + 1050 + 750}$$

$$\bar{x} = 17.8 \text{ mm}$$

An I – section has the following dimensions in mm units:
Bottom flange = 300 × 100
Top flange = 150 × 50
Web = 300 × 50
Determine mathematically the position of centre of gravity of the section.



HW