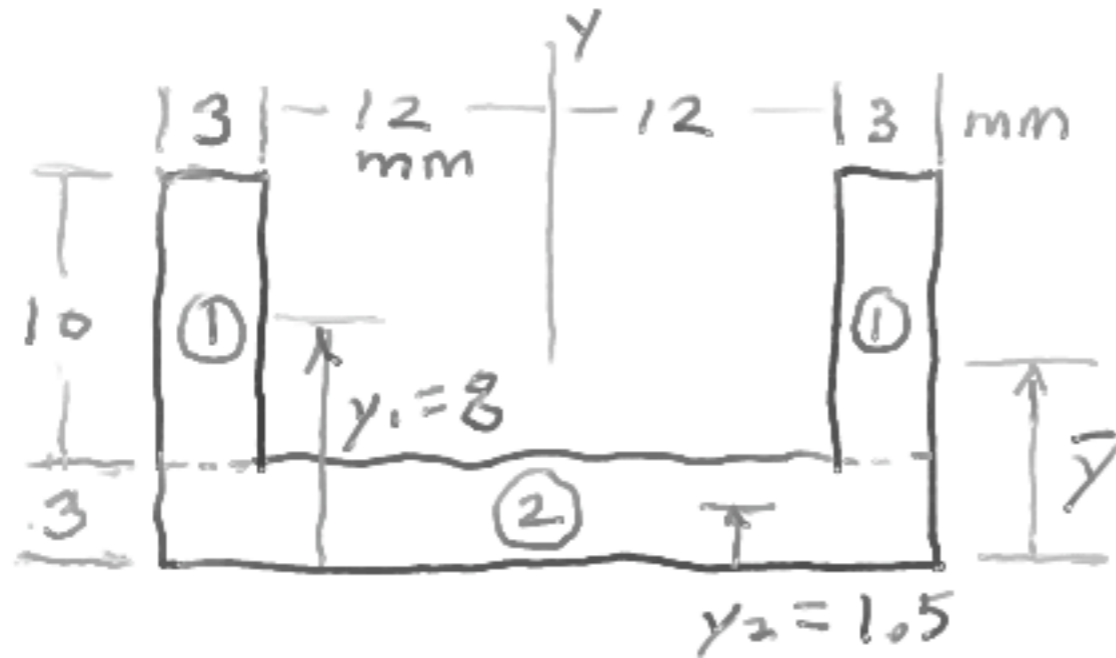


HOMEWORK PROBLEMS - Set #3

6-24



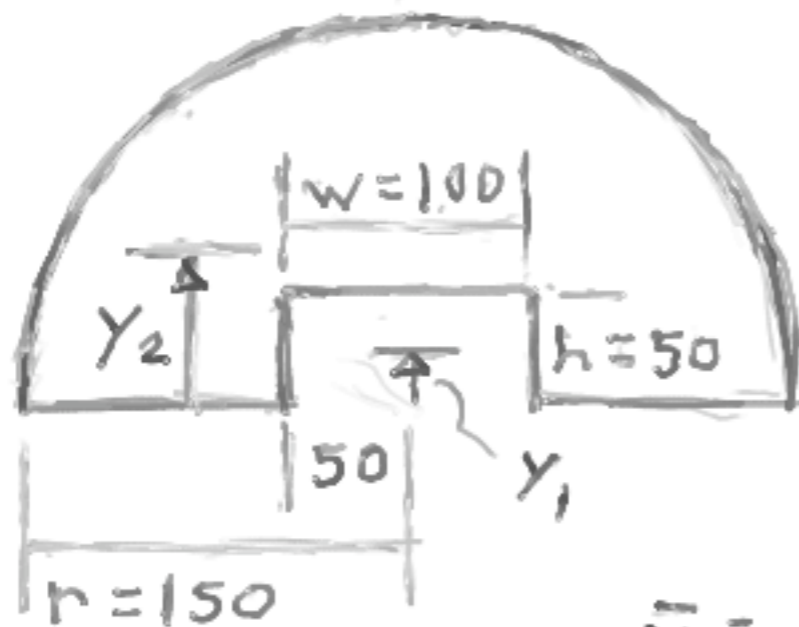
$$\bar{y} = \frac{\sum (y A)_i}{\sum A_i}$$

$$A_1 = 3 \times 10 = 30 \text{ mm}^2$$

$$A_2 = 30 \times 3 = 90 \text{ mm}^2$$

$\bar{x} = 0$ from symmetry
around y-axis

6-25

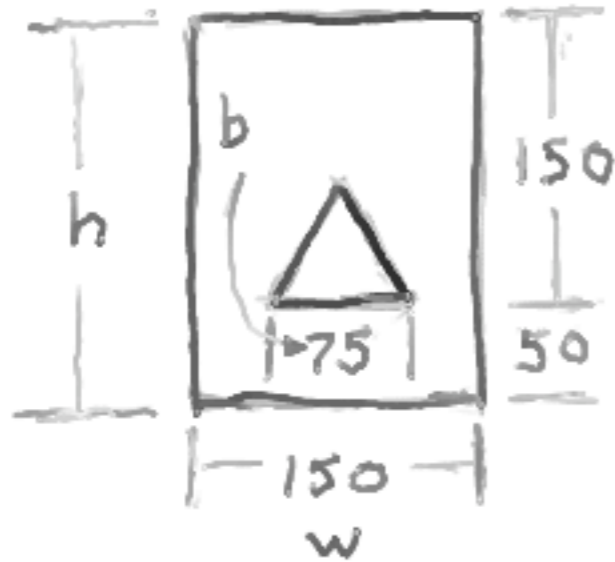


Use result from Prob. 6-3

$$\begin{aligned} \bar{y} &= \frac{y_2 A_2 - y_1 A_1}{A_2 - A_1} \\ &= \frac{\frac{4r}{3\pi} \frac{1}{2} \pi r^2 - \frac{1}{2} h \cdot hw}{\frac{1}{2} \pi r^2 - hw} \end{aligned}$$

$\bar{x} = 0$ from symmetry

6-26

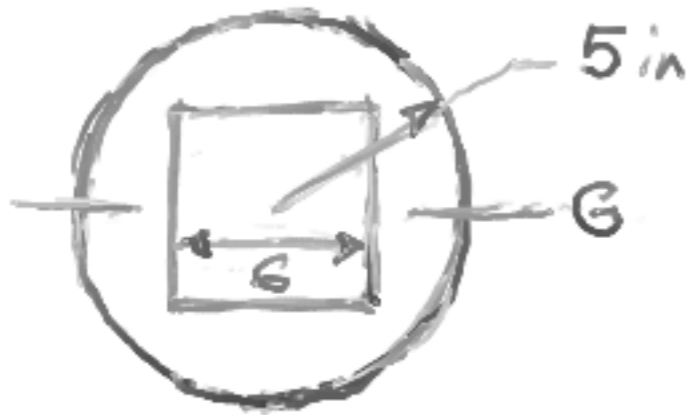


$$\bar{y} = \frac{y_1 A_1 - (50 + y_2) A_2}{A_1 - A_2}$$

$$= \frac{\frac{1}{2} h (wh) - (50 + y_2) \frac{1}{2} b h}{wh - \frac{1}{2} b h}$$

$75 \cos 30^\circ$
 $y_2 = \frac{1}{3} h$

6-30



$$I_G = I_{\text{CIRCLE}} - I_{\text{SQUARE}}$$

see next slide

2nd Moment of the Area for a circle

$$I_{xx} = \int y^2 dA$$

$$y = r \sin \theta$$

$$dA = r d\theta dr$$

$$= \int_0^{\theta} \int_0^r r^2 \sin^2 \theta r d\theta dr$$

$$= \int_0^{\theta} \int_0^r r^3 \sin^2 \theta d\theta dr$$

$$= \int_0^{\theta} 1/4 r^4 \sin^2 \theta d\theta$$

$$= 1/4 r^4 \int_0^{\theta} \sin^2 \theta d\theta$$

$$= 1/4 r^4 \Big|_r \cdot (\theta/2 - 1/4 \sin 2\theta) \Big|_{\theta=0}^{\theta=2\pi}$$

when $\theta = 2\pi$ then $I_{xx} = \pi r^4/4$

2nd Moment of the Area for a rectangle

$$I_{xx} = \int y^2 dA$$

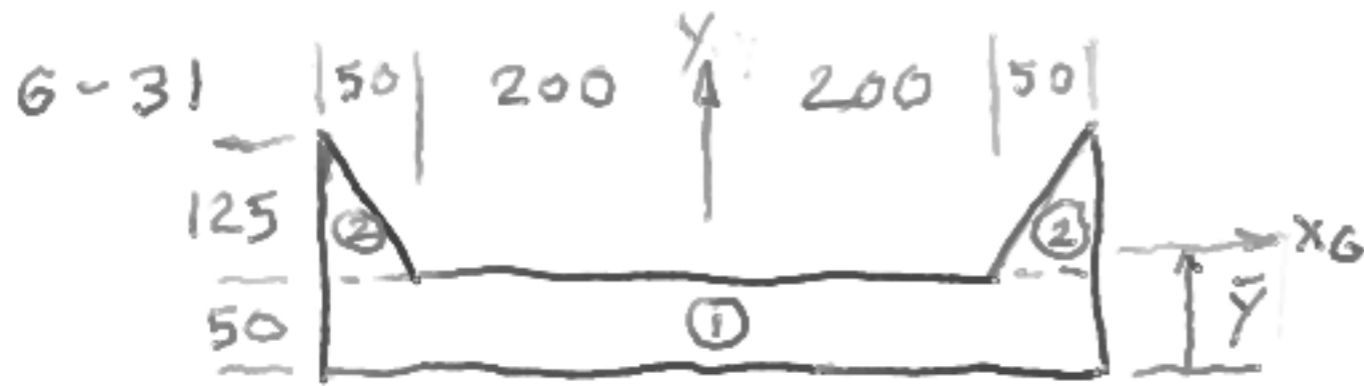
$$dA = b dy$$

$$= 2 \int_{-h/2}^{h/2} y^2 b dy$$

$$= 2/3 y^3 b \Big|_{y=-h/2}^{y=h/2}$$

$$I_{xx} = h^3 b / 12$$

Solve I_G for the circle | - square | by using $r=5$ in. and $h=b=6$ in.



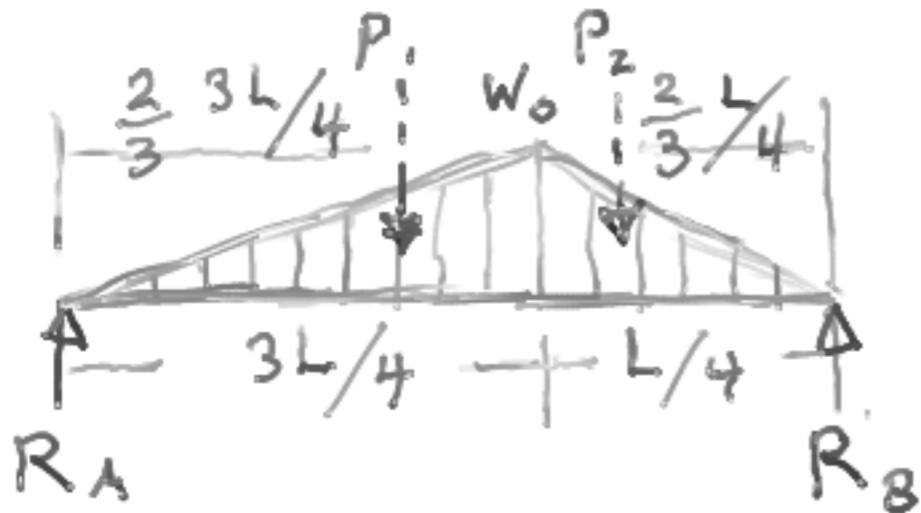
$$\bar{y} = \frac{\sum_1^2 y A}{\sum_1^2 A} = \frac{y_1 A_1 + 2 y_2 A_2}{A_1 + 2 A_2}$$

Parallel
Axis
Theorem

$$I_{xG} = \sum_1^2 I + \sum_1^2 A y'^2 = \frac{1}{12} b_1 h_1^3 + 2 I_2 + b_1 h_1 y_1'^2 + 2 \frac{1}{2} b_2 h_2 y_2'^2$$

where y' is the difference between \bar{y} and the centroid location for each shape.

6-33



$$P_1 = \frac{1}{2} \frac{3L}{4} w_0 \quad P_2 = \frac{1}{2} \frac{L}{4} w_0$$

$$\sum M_A = 0 \quad \text{solve for } R_B$$

$$\sum M_B = 0 \quad \text{solve for } R_A$$