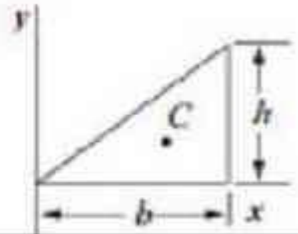
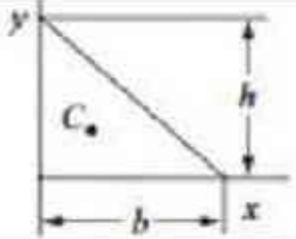
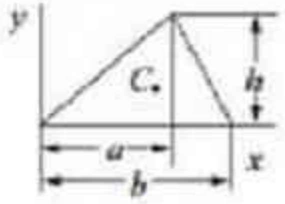
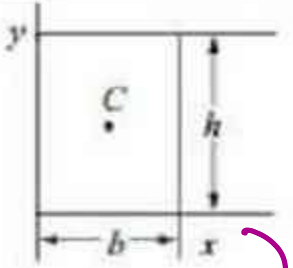
Figure	Area & Centroid	Area Moment of Inertia	(Radius of Gyration)^2	Product of Inertia
	$A = bh/2$ $x_c = 2b/3$ $y_c = h/3$	$I_{x_c} = bh^3/36$ $I_{y_c} = b^3h/36$ $I_x = bh^3/12$ $I_y = b^3h/4$	$r_{x_c}^2 = h^2/18$ $r_{y_c}^2 = b^2/18$ $r_x^2 = h^2/6$ $r_y^2 = b^2/2$	$I_{x_c y_c} = Abh/36 = b^2h^2/72$ $I_{xy} = Abh/4 = b^2h^2/8$
	$A = bh/2$ $x_c = b/3$ $y_c = h/3$	$I_{x_c} = bh^3/36$ $I_{y_c} = b^3h/36$ $I_x = bh^3/12$ $I_y = b^3h/12$	$r_{x_c}^2 = h^2/18$ $r_{y_c}^2 = b^2/18$ $r_x^2 = h^2/6$ $r_y^2 = b^2/6$	$I_{x_c y_c} = -Abh/36 = -b^2h^2/72$ $I_{xy} = Abh/12 = b^2h^2/24$
	$A = bh/2$ $x_c = (a+b)/3$ $y_c = h/3$	$I_{x_c} = bh^3/36$ $I_{y_c} = [bh(b^2 - ab + a^2)]/36$ $I_x = bh^3/12$ $I_y = [bh(b^2 + ab + a^2)]/12$	$r_{x_c}^2 = h^2/18$ $r_{y_c}^2 = (b^2 - ab + a^2)/18$ $r_x^2 = h^2/6$ $r_y^2 = (b^2 + ab + a^2)/6$	$I_{x_c y_c} = [Ah(2a-b)]/36$ $= [bh^2(2a-b)]/72$ $I_{xy} = [Ah(2a+b)]/12$ $= [bh^2(2a+b)]/24$
	$A = bh$ $x_c = b/2$ $y_c = h/2$	$I_{x_c} = bh^3/12$ $I_{y_c} = b^3h/12$ $I_x = bh^3/3$ $I_y = b^3h/3$ $J = [bh(b^2 + h^2)]/12$	$r_{x_c}^2 = h^2/12$ $r_{y_c}^2 = b^2/12$ $r_x^2 = h^2/3$ $r_y^2 = b^2/3$ $r_p^2 = (b^2 + h^2)/12$	$I_{x_c y_c} = 0$ $I_{xy} = Abh/4 = b^2h^2/4$

Our Case

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Objective of the lecture (Rectangular section)

1. Estimate moment of interia For x axis passing by c.g Using parallel axis theory

2. Estimate I about y axis passing by c.g by parallel axis theory.

3. Radius of Gyration For I_x, I_y.

A: area

$$K_x^2 = \frac{I_x}{A} \quad \& \quad K_y^2 = I_y / A$$

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Objective of the lecture For Rectangle.

4. Estimate product of Inertia.

5. Polar moment of Inertia - J_o.

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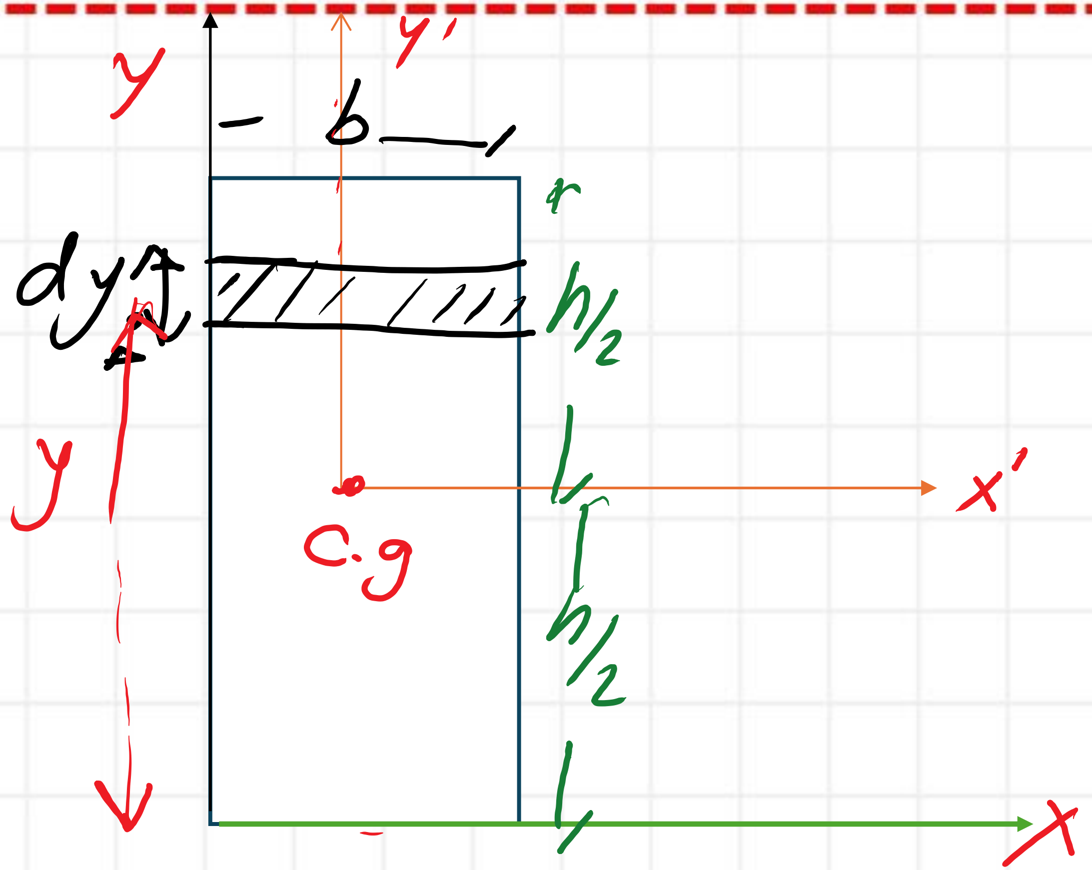
Rectangular Section (I_x)

① Strip dA hL. strip For I_x Estimation.

② x, y Two axes at the Corner of rectancle.

③ x', y' Two axes at the c.g



$x_G = c.g = b/2$, $y_{c.g} = h/2$, $A = bh$

$dA = b\,dy$

y is the vertical distance From dA c.g to x axis

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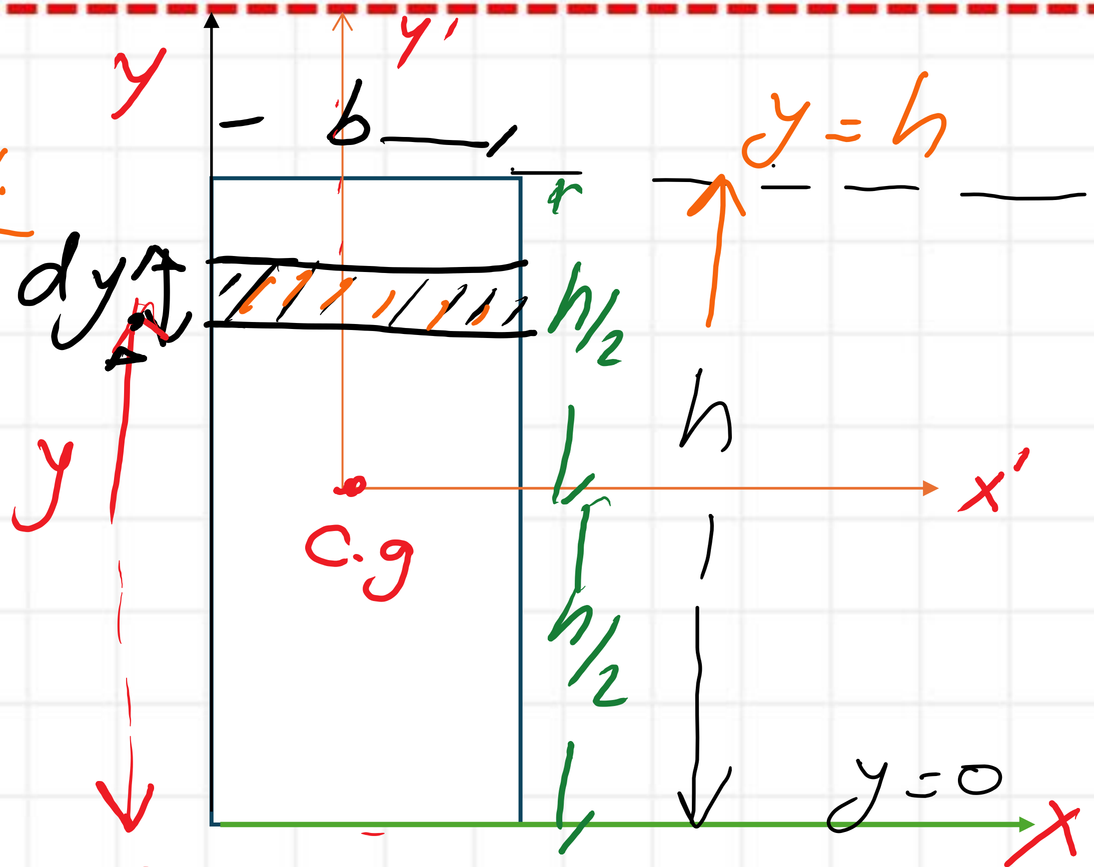
Rectangular Section (I_x) at outer-X

$$I_x = \int_0^h dA \cdot \bar{y}^2 \quad \Big\} \text{ HL Strip}$$

$$= \int_0^h b(y^2)\,dy$$

$$= \left. \frac{b\,y^3}{3} \right|^h = b\left[\frac{h^3}{3} - 0\right) = \frac{bh^3}{3}$$



$$I_{x_G} = I_x^{o} - A\bar{y}^2 = \frac{bh^3}{3} - bh\left(\frac{h}{2}\right)^2 = \frac{(8-6)\,bh^3}{24} = \frac{bh^3}{12}$$

$I_{x'}$ for a rectangle at C.g

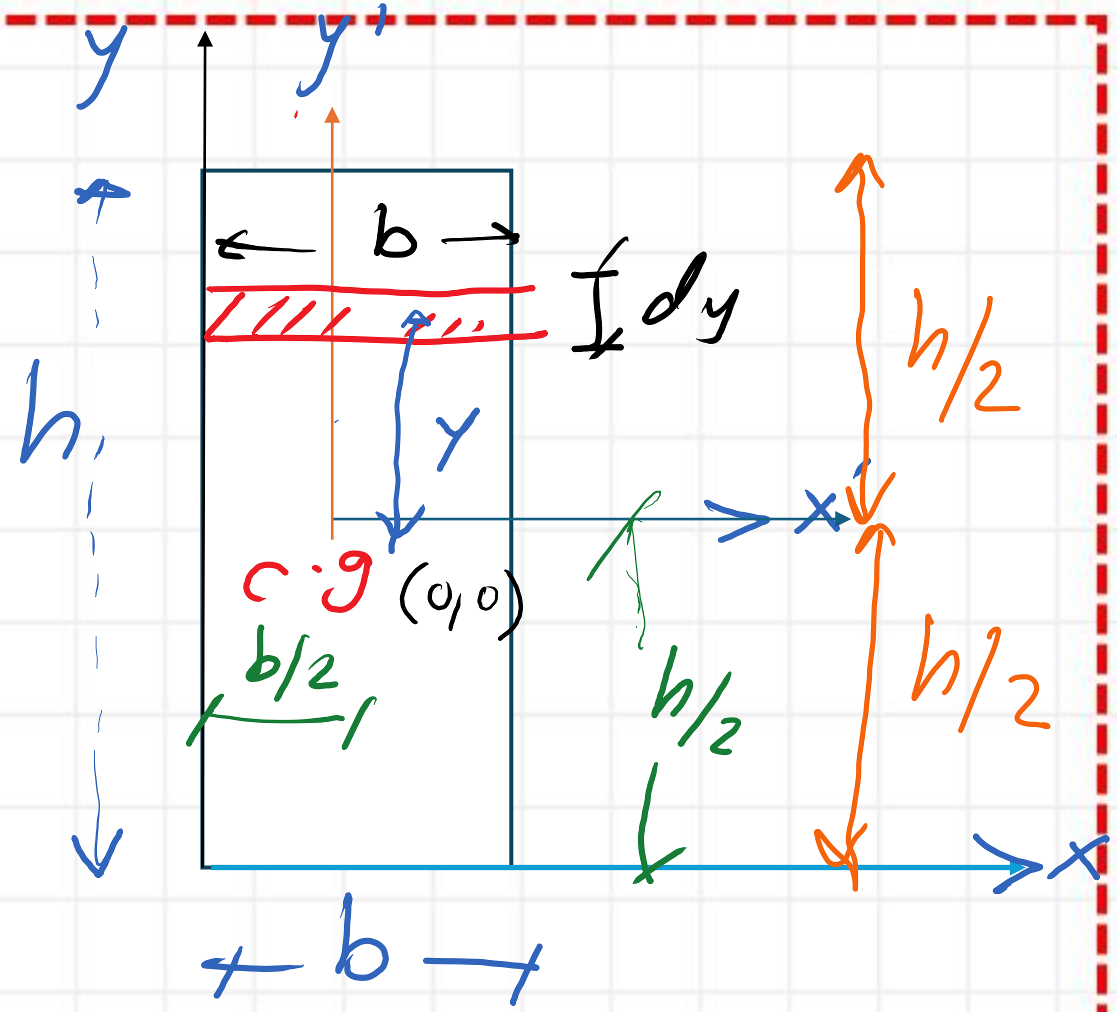
There is another way to estimate — use a H.L strip

$I_{x'}$ at C.g

$$I_{x'} = \int_{-h/2}^{+h/2} dA \cdot y^2 = \int_{-h/2}^{+h/2} (\underbrace{b \cdot dy}_{dA})(y^2)$$

$$I_{xG} = \frac{b y^3}{3} \Big|_{-h/2}^{+h/2} = \frac{b}{3}\left[\frac{h^3}{(2)^3} - \left(-\frac{h^3}{8}\right)\right]$$

$$= \frac{bh^3}{3} \cdot \frac{2}{8} = \frac{bh^3}{12}$$



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The radius of Gyration

$$K_x = \sqrt{\frac{I_x}{A}}$$

$$A = bh$$

$$I_{cg} = \frac{bh^3}{12}$$

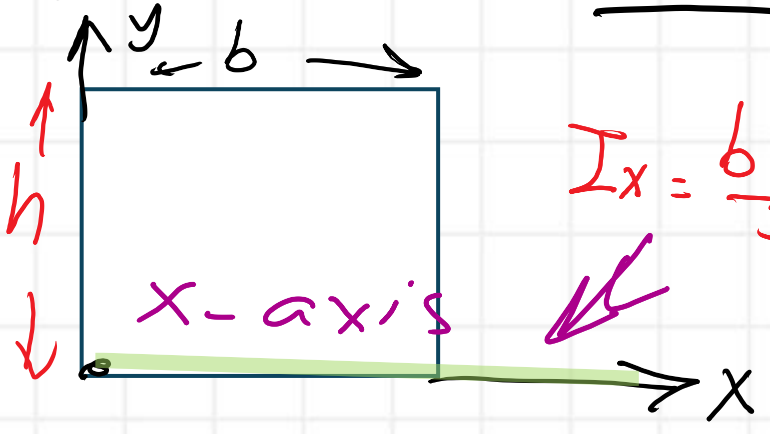
$$K_{x_G} = \left(\frac{bh^3}{12} \Big/ bh\right)^{1/2} = \left[\frac{h^2}{12}\right]^{1/2} = \frac{h}{2\sqrt{3}}$$

$$K_{x\,etc} = \sqrt{\frac{I_x}{A}}$$

$$I_x = \frac{bh^3}{3}$$

$$K_x = \sqrt{\frac{bh^3}{3}\left(\frac{1}{bh}\right)} = \frac{h}{\sqrt{3}}$$ 3

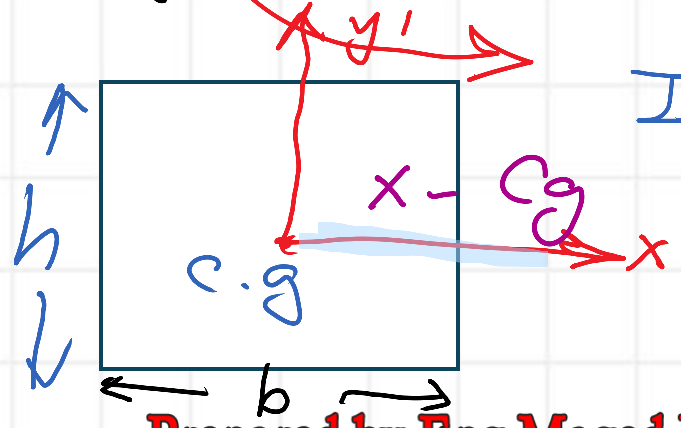
I_{xG} can be = $\dfrac{\text{parallel dim to (x)} \times (\perp\text{er distance in y})}{12}$



$$I_x = \frac{bh^3}{3}$$

$$K_x = \frac{h}{\sqrt{3}}$$

External



$$I_{xG} = \frac{bh^3}{12}$$

$$K_{xG} = \frac{h}{2\sqrt{3}}$$

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