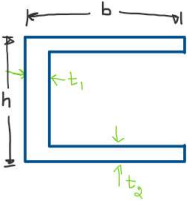


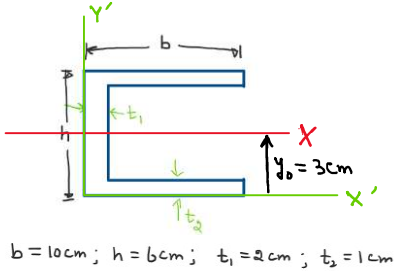
Solution of Moment of Inertia of a C section

Find the moment of Inertia I_x and I_y . x and y axis pass through the centroid (center of gravity).

$$b = 10\text{cm}; h = 6\text{cm}; t_1 = 2\text{cm}; t_2 = 1\text{cm}$$



Step-1: Find the center of gravity of hollow C section:



Symmetry about x -axis $\Rightarrow y_0 = \frac{h}{2} = \frac{6\text{cm}}{2} = 3\text{cm}$

$$x_0 = \frac{A_1 x_1 - A_2 x_2}{A_1 - A_2}$$

$\rightarrow A_1 = \text{Area of whole section (assumed all solid)}$
 $= h \times b = 6\text{cm} \times 10\text{cm} = 60\text{cm}^2$

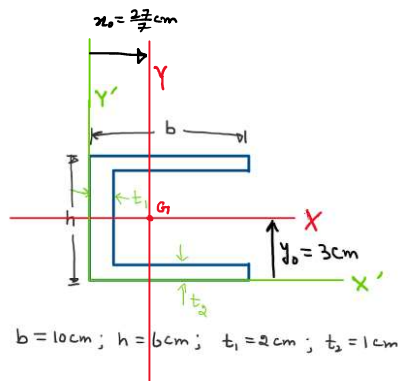
$\rightarrow x_1 = x$ coordinate of center of gravity of whole section
 $= \frac{b}{2} = \frac{10\text{cm}}{2} = 5\text{cm}$

$\rightarrow A_2 = \text{Area of hollow portion} = (b - t_1)(h - 2t_2)$
 $= (10 - 2)(6 - 2 \times 1) = 8 \times 4 = 32\text{cm}^2$

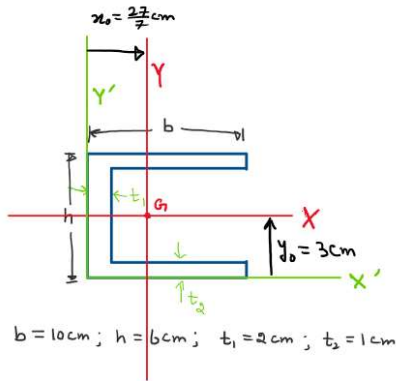
$\rightarrow x_2 = x$ coordinate of hollow portion $= t_1 + \frac{b - t_1}{2}$
 $= 2 + \frac{10 - 2}{2} = 2 + \frac{8}{2} = 2 + 4 = 6\text{cm}$

Plugging the values we get:

$$x_0 = \frac{27}{7}\text{cm} \approx 3.86\text{cm}$$



Step-2: Find I_x and I_y :

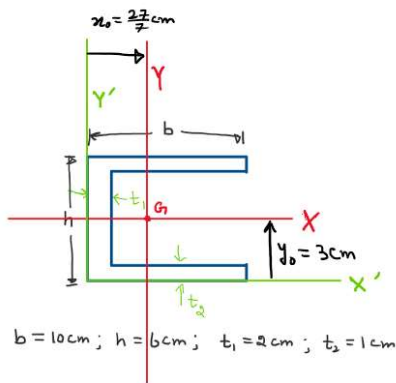


$$I_x = I_{1x} - I_{2x}$$

$$\rightarrow I_{1x} = \frac{bh^3}{12} = \frac{10 \times 6^3}{12} = 180 \text{ cm}^4$$

$$\rightarrow I_{2x} = \frac{(b-t_1)(h-2t_2)^3}{12} = \frac{(10-2)(6-2 \times 1)^3}{12} = \frac{128}{3} = 42.67 \text{ cm}^4$$

$$\rightarrow I_x = 180 - \frac{128}{3} = \frac{412}{3} \text{ cm}^4 \approx 137 \text{ cm}^4$$



$$I_y = I_{1y} - I_{2y}$$

$$\rightarrow I_{1y} = \frac{hb^3}{12} + \left[h \times b \times \left(\frac{b}{2} - x_0 \right)^2 \right] \text{ [Parallel axis theorem]}$$

$$= \frac{6 \times 10^3}{12} + \left[6 \times 10 \times \left(\frac{10}{2} - \frac{27}{7} \right)^2 \right] \approx 578.37 \text{ cm}^4$$

$$\rightarrow I_{2y} = \frac{(h-2t_2)(b-t_1)^3}{12} + \left[(h-2t_2)(b-t_1) \left(t_1 + \frac{b-t_1}{2} - x_0 \right)^2 \right]$$

$$= \frac{(6-2 \times 1)(10-2)^3}{12} + \left[(6-2 \times 1)(10-2) \left(2 + \frac{10-2}{2} - \frac{27}{7} \right)^2 \right]$$

$$= 317.6 \text{ cm}^4$$

$$\rightarrow I_y = 578.37 - 317.6 = 260.77 \text{ cm}^4$$

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