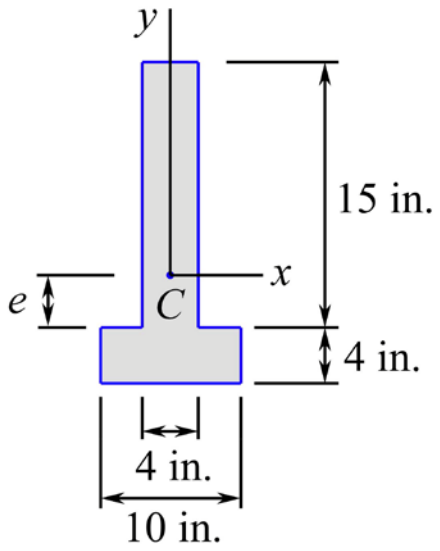
MEEG 2003 Quiz #7.m23.071

A shaded composite area is shown, where point C is its centroid. Determine (a) the value of the distance e, (b) the centroidal moments of inertia I_x and I_y, (c) the centroidal radii of gyration k_x and k_y.



$$A_1 = 60 \quad A_2 = 40 \quad C_1(0,\ 7.5-e) \quad C_2(0,\ -e-2) \quad C(0,0)$$

$$\bar{y}_1 = 7.5-e \qquad \bar{y}_2 = -(e+2) \qquad \bar{y} = 0$$

POM$_1$: $A = A_1 + A_2 = 100$

POM$_2$: $\bar{y}A = \bar{y}_1 A_1 + \bar{y}_2 A_2$

$$0(100) = (7.5-e)(60) - (e+2)(40)$$

$$\therefore \quad e = 3.7 \text{ in.} \quad ②$$

PAT: $I = \bar{I} + Ad^2$

$$I_x = \frac{1}{12}(4)(15)^3 + 60(7.5-e)^2 + \frac{1}{12}(10)(4)^3 + 40(e+2)^2$$

$$I_x = 3344.33 \quad \therefore \quad I_x = 3.34\times10^3 \text{ in}^4 \quad ②$$

$$I_x = k_x^2 A \qquad k_x = 5.783 \qquad \therefore \quad k_x = 5.78 \text{ in.} \quad ②$$

$$I_y = \frac{1}{12}(15)(4)^3 + \frac{1}{12}(4)(10)^3 = 413.333 \qquad I_y = 413 \text{ in}^4 \quad ②$$

$$I_y = k_y^2 A \qquad k_y = 2.033 \qquad \therefore \quad k_y = 2.03 \text{ in.} \quad ②$$