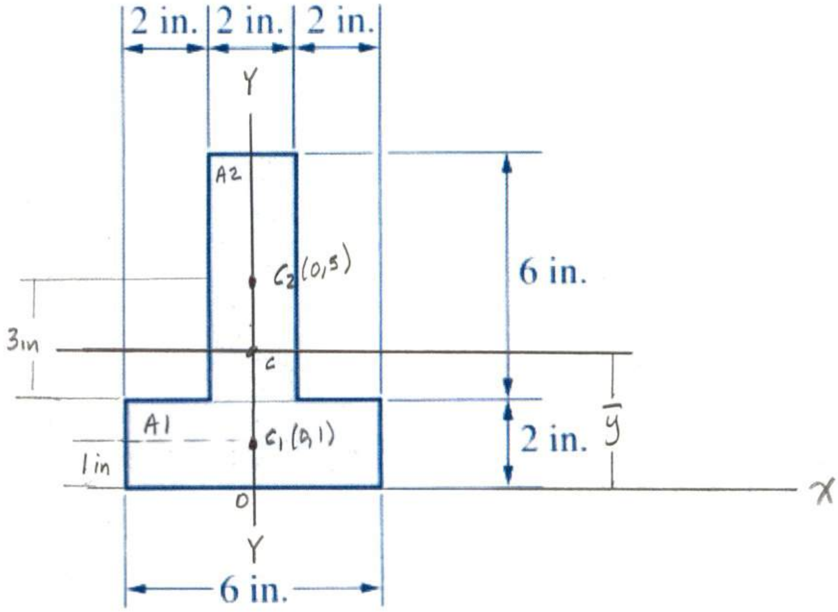
8-10. 8-10 to 8-17 For each composite area shown in Figs. P8-10 to P8-17, determine the moment of inertia of the area with respect to the horizontal centroidal axis.
Solution.



For rectangular area,

$$I_x = \frac{bh^3}{12}$$

Define Reference Axis. The area is symmetric about the Y-Y axis, therefore the centroid must lie on the y-axis

By Symmetry, $\bar{x} = 0$

Find $\bar{y}$

Shape	Area (in.^{2})	y (in.)	Ay (in.^{3})
A1	$6 \times 2 = 12$	1	12
A2	$2 \times 6 = 12$	$2+3=5$	60
Σ	24	Σ	72

$$\bar{y} = \frac{\Sigma Ay}{\Sigma A} = \frac{72\ \text{in}^3}{24\ \text{in}^2} = 3\ \text{in}$$

By the parallel-axis theorem,

$$I_x = \left[\bar{I}_1 + A_1(\bar{y}-y_1)^2\right] + \left[\bar{I}_2 + A_2(\bar{y}-y_2)^2\right]$$

$$= \frac{(6\text{in})(2\text{in})^3}{12} + 6\text{in}(2\text{in})(3\text{in}-1\text{in})^2 + \frac{2\text{in}(6\text{in})^3}{12} + 2\text{in}(6\text{in})(3\text{in}-5\text{in})^2$$

$$= 4\ \text{in}^4 + 48\ \text{in}^4 + 36\ \text{in}^4 + 48\ \text{in}^4$$

$$= \underline{\underline{136\ \text{in.}^4}}$$

Another approach to prob. 8-10 is to setup a table as shown below.

Step 1. Find $\bar{y}$

Shape	Area (in^2)	y (in)	Ay (in^3)	$(\bar{y}-y)^2$	$A(\bar{y}-y)^2$	I (in^4) $\frac{bh^3}{12}$
A1	$6 \times 2 = 12$	1	12	$(3-1)^2 = 4$	48	$\frac{6(2)^3}{12} = 4$
A2	$2 \times 6 = 12$	$2+3 = 5$	60	$(3-5)^2 = 4$	48	$\frac{2(6)^3}{12} = 36$
Σ	24	Σ	72	Σ	96 Σ	40

$$\bar{y} = \frac{\Sigma Ay}{\Sigma A} = \frac{72\ in^3}{24\ in^2} = 3\ in$$

$$\bar{I}_x = \Sigma I + \Sigma A(\bar{y}-y)^2$$

$$= 40\ in^4 + 96\ in^4$$

$$= \underline{\underline{136\ in^4}}$$