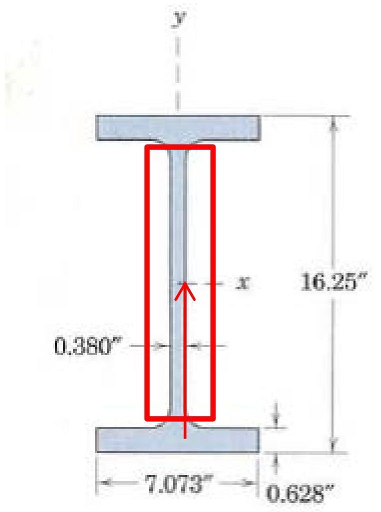
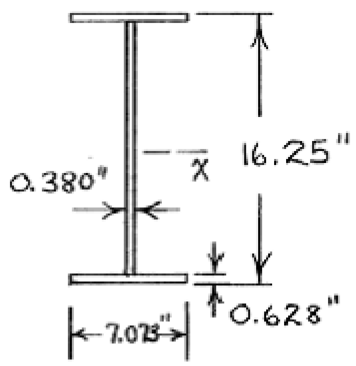
Problem 3

The cross-sectional area of a wide-flange I-beam has the dimensions shown. Obtain a close approximation to the handbook value of $I_x = 657\ \text{in}^4$. by treating the section as being composed of three rectangles.





Solution

$$I_x = \frac{1}{12}bh^3$$

$$I_x = \frac{1}{12}(0.380)[16.25 - 2(0.628)]^3 + 2\left\{\frac{1}{12}(7.073)(0.628)^3 + 7.073(0.628)\left[\frac{16.25}{2} - \frac{0.628}{2}\right]^2\right\} = 649\ \ in^4$$

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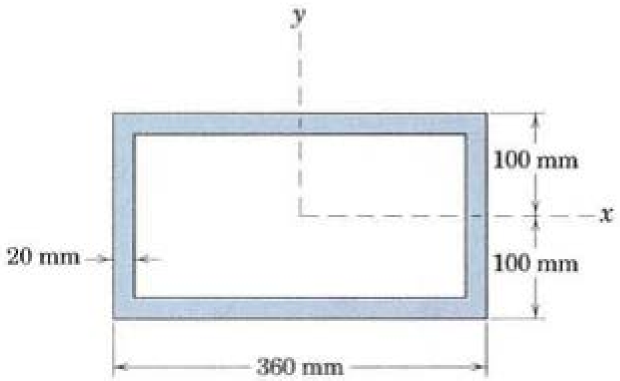
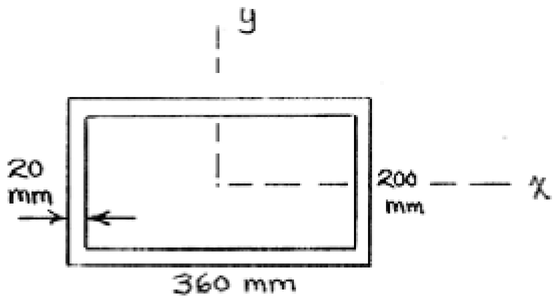
Problem 4

Determine the moment of inertia of the shaded area about the x -axis in two ways. The wall thickness is 20 mm on all four sides of the rectangle





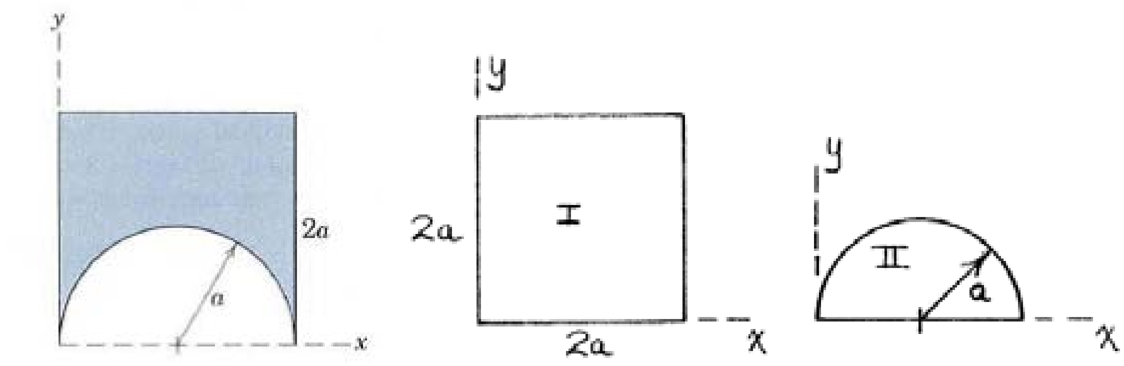
Solution

$$I_x = \frac{1}{12} b h^3$$

$$I_x = \frac{1}{12}(360)(200)^3 - \frac{1}{12}(320)(160)^3 = 130.8\ (10^6)\ mm^4$$

Problem 5

Determine the moments of inertia of the shaded area about the x - and y -axes.



Solution

Square: $I_x = I_y = \frac{1}{3}bh^3 = \frac{1}{3}(2a)(2a)^3 = \frac{16}{3}a^4$

Semicircle : $I_x = \frac{1}{8}\pi a^4$

$$I_y = \frac{1}{8}\pi a^4 + \frac{1}{2}\pi a^2(a^2) = \frac{5}{8}\pi a^4$$

Combined: $I_x = \frac{16}{3}a^4 - \frac{\pi}{8}a^4 = 4.94a^4$

$$I_y = \frac{16}{3}a^4 - \frac{5\pi}{8}a^4 = 3.37a^4$$