

<9.6~9.7절>

$$9.31\&32 \quad A_1 = (12+12 \text{ mm})(6 \text{ mm}) = 144 \text{ mm}^2$$

$$A_2 = (8 \text{ mm})(24+24 \text{ mm}) = 384 \text{ mm}^2$$

$$A_3 = (24+24 \text{ mm})(6 \text{ mm}) = 288 \text{ mm}^2$$

$$A = A_1 + A_2 + A_3$$

$$= 144+384+288 \text{ mm}^2 = 816 \text{ mm}^2$$

$$I_{x1} = \bar{I}_{x1} + A_1 d_1^2$$

$$= \frac{1}{12}(12+12 \text{ mm})(6 \text{ mm})^3 + (144 \text{ mm}^2)(3+24 \text{ mm})^2$$

$$= 432 + 104,976 \text{ mm}^4 = 105,408 \text{ mm}^4$$

$$I_{x2} = \frac{1}{12}(8 \text{ mm})(24+24 \text{ mm})^3 = 73,728 \text{ mm}^4$$

$$I_{x3} = \bar{I}_{x3} + A_3 d_3^2 = \frac{1}{12}(24+24 \text{ mm})(6 \text{ mm})^3 + (288 \text{ mm}^2)(3+24 \text{ mm})^2$$

$$= 864 + 209,952 \text{ mm}^4 = 210,816 \text{ mm}^4$$

$$I_x = I_{x1} + I_{x2} + I_{x3}$$

$$= 105,408 + 73,728 + 210,816 \text{ mm}^4 = 389,952 \text{ mm}^4$$

$$\Rightarrow I_x = 390,000 \text{ mm}^4 = 390 \times 10^3 \text{ mm}^4 = 0.390 \times 10^6 \text{ mm}^4$$

$$k_x = \sqrt{\frac{I_x}{A}} = \sqrt{\frac{389,952 \text{ mm}^4}{816 \text{ mm}^2}} = 21.86 \text{ mm}$$

$$\Rightarrow k_x = 21.9 \text{ mm}$$

$$I_{y1} = \frac{1}{12}(6 \text{ mm})(12+12 \text{ mm})^3 = 6,912 \text{ mm}^4$$

$$I_{y2} = \frac{1}{12}(24+24 \text{ mm})(8 \text{ mm})^3 = 2,048 \text{ mm}^4$$

$$I_{y3} = \frac{1}{12}(6 \text{ mm})(24+24 \text{ mm})^3 = 55,296 \text{ mm}^4$$

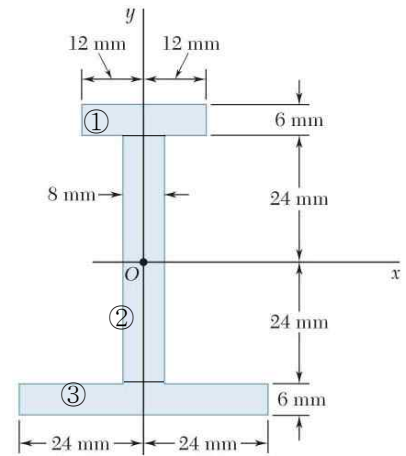
$$I_y = I_{y1} + I_{y2} + I_{y3}$$

$$= 6,912 + 2,048 + 55,296 \text{ mm}^4 = 64,256 \text{ mm}^4$$

$$\Rightarrow I_y = 64,300 \text{ mm}^4 = 64.3 \times 10^3 \text{ mm}^4$$

$$k_y = \sqrt{\frac{I_y}{A}} = \sqrt{\frac{64,256 \text{ mm}^4}{816 \text{ mm}^2}} = 8.874 \text{ mm}$$

$$\Rightarrow k_y = 8.87 \text{ mm}$$



9.36  $a = 20 \text{ mm}$

① 직사각형, ② 반원

$$(I_x)_1 = \frac{1}{12}(2a)(2a)^3 = \frac{4}{3}a^4 = \frac{4}{3}(20 \text{ mm})^4$$

$$= 0.21333 \times 10^6 \text{ mm}^4$$

$$(I_x)_2 = \left[ \frac{\pi}{8}a^4 - \frac{\pi}{2}a^2\left(\frac{4a}{3\pi}\right)^2 \right] + \frac{\pi}{2}a^2\left(a + \frac{4a}{3\pi}\right)^2$$

$$= \left( \frac{\pi}{8} - \frac{8}{9\pi} + \frac{\pi}{2} + \frac{4}{3} + \frac{8}{9\pi} \right) a^4$$

$$= \left( \frac{5\pi}{8} + \frac{4}{3} \right) a^4 = 3.297 a^4$$

$$= 3.297 (20 \text{ mm})^4 = 0.52752 \times 10^6 \text{ mm}^4$$

$$I_x = (I_x)_1 + 2 (I_x)_2$$

$$= [0.21333 + 2 (0.52752)] \times 10^6 \text{ mm}^4$$

$$= 1.268 \times 10^6 \text{ mm}^4$$

$$(I_y)_1 = \frac{1}{12}(2a)(2a)^3 = \frac{4}{3}a^4 = \frac{4}{3}(20 \text{ mm})^4 = 0.21333 \times 10^6 \text{ mm}^4$$

$$(I_y)_2 = \frac{\pi}{8}a^4 = \frac{\pi}{8}(20 \text{ mm})^4 = 0.06283 \times 10^6 \text{ mm}^4$$

$$I_y = (I_y)_1 + 2 (I_y)_2$$

$$= [0.21333 + 2 (0.06283)] \times 10^6 \text{ mm}^4$$

$$= 0.339 \times 10^6 \text{ mm}^4$$

