

<5.10~5.11 >

5.94 $V = (100 \text{ mm})(90 \text{ mm})(19 \text{ mm}) = 171,000 \text{ mm}^3$

$$\bar{x} = \frac{1}{2}(100 \text{ mm}) = 50 \text{ mm}$$

$$V = (60 \text{ mm})(50 \text{ mm})(15 \text{ mm}) = 45,000 \text{ mm}^3$$

$$\bar{x} = (100 \text{ mm}) - \frac{1}{2}(15 \text{ mm}) = 92.5 \text{ mm}$$

$$V = \pi (11.5 \text{ mm})^2 (10 \text{ mm}) = 4,155 \text{ mm}^3$$

$$\bar{x} = (100 \text{ mm}) + \frac{1}{2}(10 \text{ mm}) = 105 \text{ mm}$$

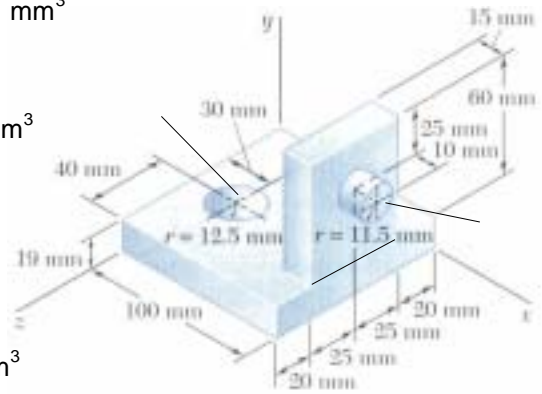
$$V = -\pi (12.5 \text{ mm})^2 (19 \text{ mm}) = -9,327 \text{ mm}^3$$

$$\bar{x} = 30 \text{ mm}$$

$$V = 171,000 + 45,000 + 4,155 + (-9,327) (\text{mm}^3) = 210,828 \text{ mm}^3$$

$$(\bar{x} V) = (50)(171,000) + (92.5)(45,000) + (105)(4,155) + (30)(-9,327) (\text{mm}^4) = 12,868,965 \text{ mm}^4$$

$$\bar{X} = \frac{\Sigma(\bar{x} V)}{\Sigma V} = \frac{12,868,965 \text{ mm}^4}{210,828 \text{ mm}^3} = 61.0 \text{ mm} \quad (\quad)$$



5.97 $V = (120 + 40 \text{ mm})(54 \text{ mm})(18 \text{ mm}) = 155,520 \text{ mm}^3$

$$\bar{y} = \frac{1}{2}(18 \text{ mm}) = 9 \text{ mm}$$

$$V = \frac{1}{2}(120 \text{ mm})(48 \text{ mm})(54 \text{ mm}) = 136,080 \text{ mm}^3$$

$$\bar{y} = (18 \text{ mm}) + \frac{1}{3}(60 - 18 \text{ mm}) = 32 \text{ mm}$$

$$V = \frac{1}{2}\pi (27 \text{ mm})^2 (18 \text{ mm}) = 20,612 \text{ mm}^3$$

$$\bar{y} = \frac{1}{2}(18 \text{ mm}) = 9 \text{ mm}$$

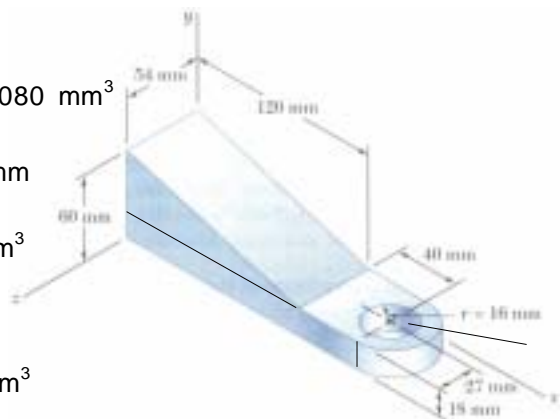
$$V = -\pi (16 \text{ mm})^2 (18 \text{ mm}) = -14,476 \text{ mm}^3$$

$$\bar{y} = 9 \text{ mm}$$

$$V = 155,520 + 136,080 + 20,612 - 14,476 (\text{mm}^3) = 297,736 \text{ mm}^3$$

$$(\bar{y} V) = (9)(155,520) + (32)(136,080) + (9)(20,612) + (9)(-14,476) (\text{mm}^4) = 5,809,464 \text{ mm}^4$$

$$\bar{Y} = \frac{\Sigma(\bar{y} V)}{\Sigma V} = \frac{5,809,464 \text{ mm}^4}{297,736 \text{ mm}^3} = 19.51 \text{ mm}$$



5.106

$$\bar{X} = \frac{1}{2}(680 \text{ mm}) = 340 \text{ mm}$$

$$A = (80 \text{ mm})(500 \text{ mm}) = 40,000 \text{ mm}^2$$

$$\bar{y} = \frac{1}{2}(80 \text{ mm}) = 40 \text{ mm}$$

$$\bar{z} = \frac{1}{2}(500 \text{ mm}) = 250 \text{ mm}$$

$$A = \frac{1}{4}\pi(500 \text{ mm})^2 = 196,349 \text{ mm}^2$$

$$\bar{y} = (80 \text{ mm}) + \frac{4}{3\pi}(500 \text{ mm}) = 292.2 \text{ mm}$$

$$\bar{z} = \frac{4}{3\pi}(500 \text{ mm}) = 212.2 \text{ mm}$$

$$A = (80 \text{ mm})(680 \text{ mm}) = 54,400 \text{ mm}^2$$

$$\bar{y} = \frac{1}{2}(80 \text{ mm}) = 40 \text{ mm}$$

$$\bar{z} = 500 \text{ mm}$$

$$A = \frac{1}{4}[2\pi(500 \text{ mm})](680 \text{ mm}) = 534,071 \text{ mm}^2$$

$$\bar{y} = (80 \text{ mm}) + \frac{2}{\pi}(500 \text{ mm}) = 398.3 \text{ mm}$$

$$\bar{z} = \frac{2}{\pi}(500 \text{ mm}) = 318.3 \text{ mm}$$

$$A = A = 40,000 \text{ mm}^2$$

$$\bar{y} = \bar{y} = 40 \text{ mm}$$

$$\bar{z} = \bar{z} = 250 \text{ mm}$$

$$A = A = 196,349 \text{ mm}^2$$

$$\bar{y} = \bar{y} = 292.2 \text{ mm}$$

$$\bar{z} = \bar{z} = 212.2 \text{ mm}$$

$$A = 2(40,000) + 2(196,349) + 54,400 + 534,071 = 1,061,169 \text{ mm}^2$$

$$(\bar{y}A) = 2(40)(40,000) + 2(292.2)(196,349) + (40)(54,400) + (398.3)(534,071) \\ = 332,842,835 \text{ mm}^3$$

$$(\bar{z}A) = 2(250)(40,000) + 2(212.2)(196,349) + (500)(54,400) + (318.3)(534,071) \\ = 300,525,315 \text{ mm}^3$$

$$\bar{Y} = \frac{\Sigma(\bar{y}A)}{\Sigma A} = \frac{332,842,835 \text{ mm}^3}{1,061,169 \text{ mm}^2} = 313.6 \text{ mm}$$

$$\bar{Z} = \frac{\Sigma(\bar{z}A)}{\Sigma A} = \frac{300,525,315 \text{ mm}^3}{1,061,169 \text{ mm}^2} = 283.2 \text{ mm}$$

$$= (340 \text{ mm}, 314 \text{ mm}, 283 \text{ mm})$$

