

{5.10~5.11 }

5.94

$$V = (45+30+30 \text{ mm})(30+30 \text{ mm})(10 \text{ mm})$$

$$= 63\,000 \text{ mm}^3$$

$$\bar{y} = -\frac{1}{2}(10 \text{ mm}) = -5 \text{ mm}$$

$$V = \frac{1}{2}\pi(30 \text{ mm})^2(10 \text{ mm})$$

$$= 14\,137 \text{ mm}^3$$

$$\bar{y} = -5 \text{ mm}$$

$$V = -\pi(19 \text{ mm})^2(10 \text{ mm})$$

$$= -11\,341 \text{ mm}^3$$

$$\bar{y} = -5 \text{ mm}$$

$$V = (30+30 \text{ mm})(30 \text{ mm})(15 \text{ mm}) = 27\,000 \text{ mm}^3$$

$$\bar{y} = \frac{1}{2}(30 \text{ mm}) = 15 \text{ mm}$$

$$V = -\frac{1}{2}\pi(19 \text{ mm})^2(15 \text{ mm}) = -8\,505 \text{ mm}^3$$

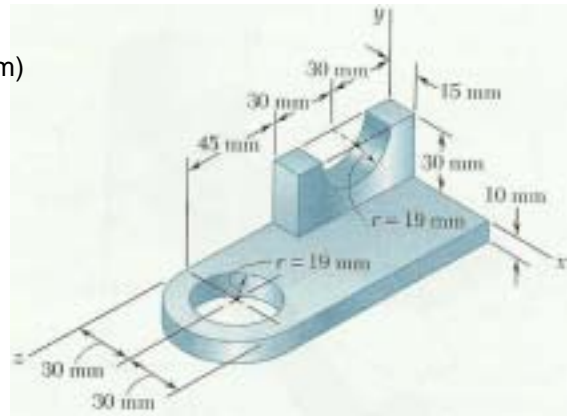
$$\bar{y} = (30 \text{ mm}) - \frac{4}{3\pi}(19 \text{ mm}) = 21.94 \text{ mm}$$

$$V = 63\,000 + 14\,137 + (-11\,341) + 27\,000 + (-8\,505) \text{ mm}^3 = 84\,291 \text{ mm}^3$$

$$(\bar{y}V) = (-5)(63\,000) + (-5)(14\,137) + (-5)(-11\,341) + (15)(27\,000)$$

$$+ (21.94)(-8\,505) \text{ mm}^4 = -110\,580 \text{ mm}^4$$

$$\bar{Y} = \frac{\Sigma(\bar{y}V)}{\Sigma V} = \frac{-110,580 \text{ mm}^4}{84,291 \text{ mm}^3} = -1.312 \text{ mm}$$



5.104

(symmetry)

$$\bar{X} = \frac{1}{2} (0.5 \text{ m}) = 0.25 \text{ m}$$

$$A = \frac{1}{2} (0.14 \text{ m})(0.14 \text{ m}) = 0.0098 \text{ m}^2$$

$$\bar{y} = \frac{1}{3} (0.14 \text{ m}) = 0.04667 \text{ m}$$

$$\bar{z} = \frac{1}{3} (0.14 \text{ m}) = 0.04667 \text{ m}$$

$$A = (0.5 \text{ m})(0.14 \text{ m}) = 0.07 \text{ m}^2$$

$$\bar{y} = \frac{1}{2} (0.14 \text{ m}) = 0.07 \text{ m}$$

$$\bar{z} = 0$$

, 1/4

$$A = \frac{1}{4} \pi (0.9 \text{ m})^2 = 0.6362 \text{ m}^2$$

$$\bar{y} = -\frac{4}{3\pi} (0.9 \text{ m}) = -0.3820 \text{ m}$$

$$\bar{z} = (0.9 \text{ m}) - (0.3820 \text{ m}) = 0.5180 \text{ m}$$

, 1/4

$$A = -\frac{1}{4} \pi (0.76 \text{ m})^2 = -0.4536 \text{ m}^2$$

$$\bar{y} = -\frac{4}{3\pi} (0.76 \text{ m}) = -0.3226 \text{ m}$$

$$\bar{z} = (0.9 \text{ m}) - (0.3226 \text{ m}) = 0.5774 \text{ m}$$

1/4

$$A = \frac{1}{4} [2\pi (0.9 \text{ m})](0.5 \text{ m}) = 0.7069 \text{ m}^2$$

$$\bar{y} = -\frac{2}{\pi} (0.9 \text{ m}) = -0.5730 \text{ m}$$

$$\bar{z} = (0.9 \text{ m}) - (0.5730 \text{ m}) = 0.3270 \text{ m}$$

$$A = 2(0.0098) + 0.07 + 2(0.6362) + 2(-0.4536) + 0.7069 \text{ m}^2 = 1.1617 \text{ m}^2$$

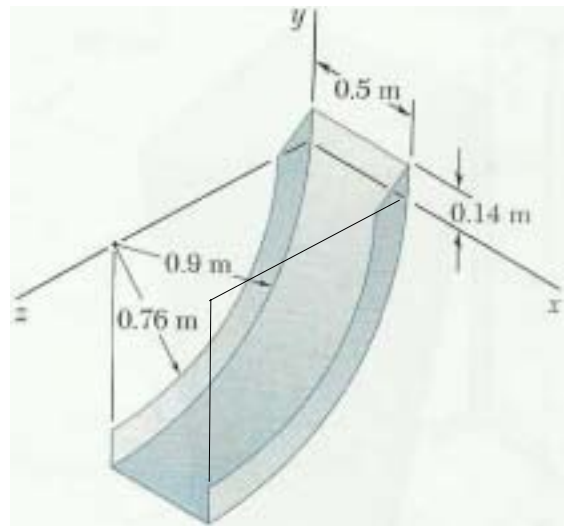
$$(\bar{y}A) = 2(0.04667)(0.0098) + (0.07)(0.07) + 2(-0.3820)(0.6362) + 2(-0.3226)(-0.4536) + (-0.5730)(0.7069) \text{ m}^3 = -0.5926 \text{ m}^3$$

$$(\bar{z}A) = 2(0.04667)(0.0098) + (0)(0.07) + 2(0.5180)(0.6362) + 2(0.5774)(-0.4536) + (0.3270)(0.7069) \text{ m}^3 = 0.3674 \text{ m}^3$$

$$\bar{Y} = \frac{\Sigma(\bar{y}A)}{\Sigma A} = \frac{-0.5926 \text{ m}^3}{1.1617 \text{ m}^2} = -0.5101 \text{ m}$$

$$\bar{Z} = \frac{\Sigma(\bar{z}A)}{\Sigma A} = \frac{0.3674 \text{ m}^3}{1.1617 \text{ m}^2} = 0.3162 \text{ m}$$

$$= (0.250 \text{ m}, -0.510 \text{ m}, 0.316 \text{ m})$$



5.111

(symmetry)

$$\bar{Z} = \frac{1}{2} (1.8 \text{ m}) = 0.9 \text{ m}$$

$$L = 2 [2(1.5) + 2(2.1)] \text{ m} = 14.4 \text{ m}$$

$$\bar{x} = \frac{1}{2} (2.1 \text{ m}) = 1.05 \text{ m}$$

$$\bar{y} = \frac{1}{2} (1.5 \text{ m}) = 0.75 \text{ m}$$

$$L = 2 [\pi (0.9 \text{ m})] = 5.655 \text{ m}$$

$$\bar{x} = \frac{1}{2} (1.2 \text{ m}) = 0.6 \text{ m}$$

$$\bar{y} = (1.5 \text{ m}) + \frac{2}{\pi} (0.9 \text{ m}) = 2.073 \text{ m}$$

$$L = 2 (1.8 \text{ m}) = 3.6 \text{ m}$$

$$\bar{x} = 0.6 \text{ m}$$

$$\bar{y} = 1.5 \text{ m}$$

$$L = 1.8 \text{ m}$$

$$\bar{x} = 2.1 \text{ m}$$

$$\bar{y} = 1.5 \text{ m}$$

$$L = 14.4 + 5.655 + 3.6 + 1.8 \text{ m} = 25.455 \text{ m}$$

$$(\bar{x}L) = (1.05)(14.4) + (0.6)(5.655) + (0.6)(3.6) + (2.1)(1.8) \text{ m}^2 = 24.453 \text{ m}^2$$

$$(\bar{y}L) = (0.75)(14.4) + (2.073)(5.655) + (1.5)(3.6) + (1.5)(1.8) \text{ m}^2 = 30.623 \text{ m}^2$$

$$\bar{X} = \frac{\Sigma(\bar{x}L)}{\Sigma L} = \frac{24.453 \text{ m}^2}{25.455 \text{ m}} = 0.9606 \text{ m}$$

$$\bar{Y} = \frac{\Sigma(\bar{y}L)}{\Sigma L} = \frac{30.623 \text{ m}^2}{25.455 \text{ m}} = 1.2030 \text{ m}$$

$$= (0.961 \text{ m}, 1.203 \text{ m}, 0.900 \text{ m})$$

$$\left(\bar{Y} \right)$$

