Table A–18

Geometric Properties

Part 1 Properties of Sections

A = area

G = location of centroid

$I_x = \int y^2\, dA$ = second moment of area about x axis

$I_y = \int x^2\, dA$ = second moment of area about y axis

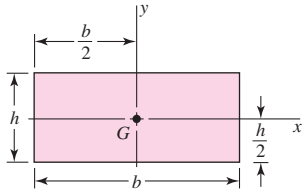
$I_{xy} = \int xy\, dA$ = mixed moment of area about x and y axes

$J_G = \int r^2\, dA = \int (x^2 + y^2)\, dA = I_x + I_y$

= second polar moment of area about axis through G

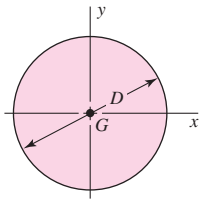
$k_x^2 = I_x / A$ = squared radius of gyration about x axis

Rectangle



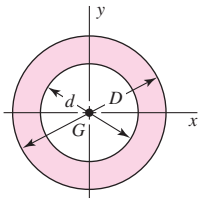
$$A = bh \qquad I_x = \frac{bh^3}{12} \qquad I_y = \frac{b^3 h}{12} \qquad I_{xy} = 0$$

Circle



$$A = \frac{\pi D^2}{4} \qquad I_x = I_y = \frac{\pi D^4}{64} \qquad I_{xy} = 0 \qquad J_G = \frac{\pi D^4}{32}$$

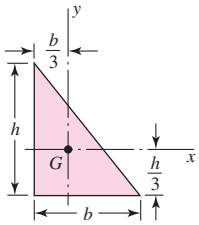
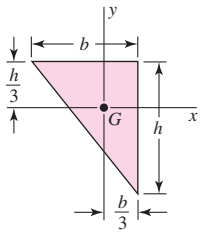
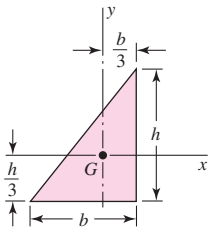
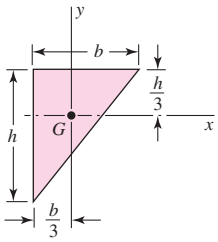
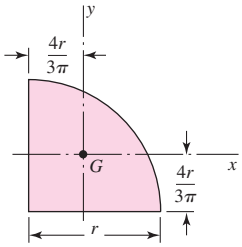
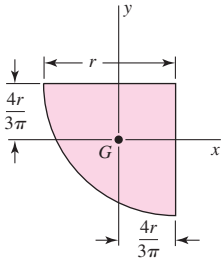
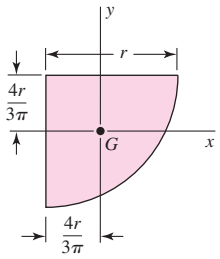
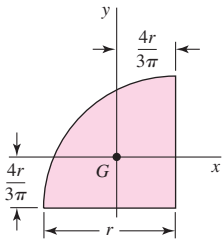
Hollow circle



$$A = \frac{\pi}{4}(D^2 - d^2) \qquad I_x = I_y = \frac{\pi}{64}(D^4 - d^4) \qquad I_{xy} = 0 \qquad J_G = \frac{\pi}{32}(D^4 - d^4)$$

Table A–18

Geometric Properties *(Continued)*

Right triangles			$A = \frac{bh}{2}$	$I_x = \frac{bh^3}{36}$ $I_y = \frac{b^3h}{36}$ $I_{xy} = \frac{-b^2h^2}{72}$
Right triangles			$A = \frac{bh}{2}$	$I_x = \frac{bh^3}{36}$ $I_y = \frac{b^3h}{36}$ $I_{xy} = \frac{b^2h^2}{72}$
Quarter-circles			$A = \frac{\pi r^2}{4}$	$I_x = I_y = r^4\left(\frac{\pi}{16} - \frac{4}{9\pi}\right)$ $I_{xy} = r^4\left(\frac{1}{8} - \frac{4}{9\pi}\right)$
Quarter-circles			$A = \frac{\pi r^2}{4}$	$I_x = I_y = r^4\left(\frac{\pi}{16} - \frac{4}{9\pi}\right)$ $I_{xy} = r^4\left(\frac{4}{9\pi} - \frac{1}{8}\right)$

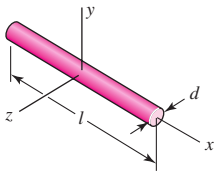
(continued)

Table A–18

Geometric Properties *(Continued)*

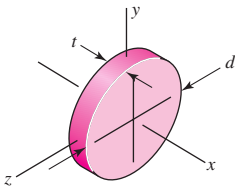
Part 2 Properties of Solids (ρ = Density, Weight per Unit Volume)

Rods



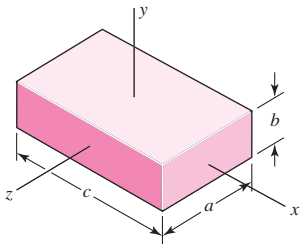
$$m = \frac{\pi d^2 l \rho}{4g} \qquad I_y = I_z = \frac{ml^2}{12}$$

Round disks



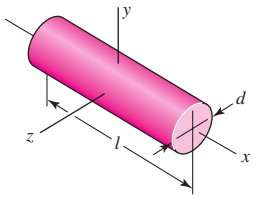
$$m = \frac{\pi d^2 t \rho}{4g} \qquad I_x = \frac{md^2}{8} \qquad I_y = I_z = \frac{md^2}{16}$$

Rectangular prisms



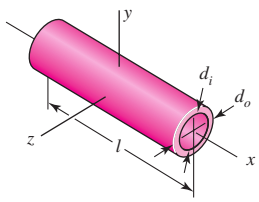
$$m = \frac{abc\rho}{g} \qquad I_x = \frac{m}{12}(a^2 + b^2) \qquad I_y = \frac{m}{12}(a^2 + c^2) \qquad I_z = \frac{m}{12}(b^2 + c^2)$$

Cylinders



$$m = \frac{\pi d^2 l \rho}{4g} \qquad I_x = \frac{md^2}{8} \qquad I_y = I_z = \frac{m}{48}(3d^2 + 4l^2)$$

Hollow cylinders



$$m = \frac{\pi\left(d_o^2 - d_i^2\right) l\rho}{4g} \qquad I_x = \frac{m}{8}\left(d_o^2 + d_i^2\right) \qquad I_y = I_z = \frac{m}{48}\left(3d_o^2 + 3d_i^2 + 4l^2\right)$$