
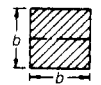
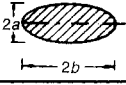
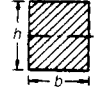

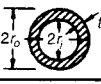
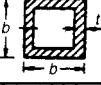
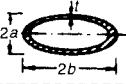
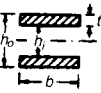
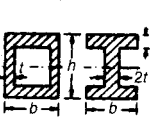
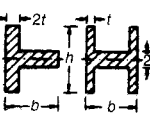



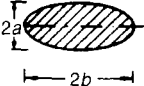
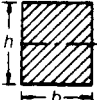




**Table 7.1** Moments of areas of sections for common shapes

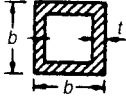
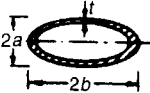
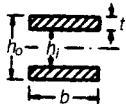
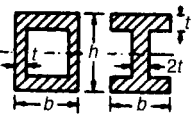




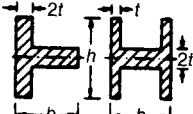




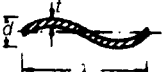
Section Shape	$A(m^2)$	$I_{xx}(m^4)$	$K(m^4)$	$Z(m^3)$	$Q(m^3)$
	$\pi r^2$	$\frac{\pi}{4} r^4$	$\frac{\pi}{2} r^4$	$\frac{\pi}{4} r^3$	$\frac{\pi}{2} r^3$
	$b^2$	$\frac{b^4}{12}$	$0.14b^4$	$\frac{b^3}{6}$	$0.21b^3$
	$\pi ab$	$\frac{\pi}{4} a^3 b$	$\frac{\pi a^3 b^3}{(a^2 + b^2)}$	$\frac{\pi}{4} a^2 b$	$\frac{\pi a^2 b}{2}$ ( $a < b$ )
	$bh$	$\frac{bh^3}{12}$	$\frac{b^3 h}{3} \left(1 - 0.58 \frac{b}{h}\right)$ ( $h > b$ )	$\frac{bh^2}{6}$	$\frac{b^2 h^2}{3h + 1.8b}$ ( $h > b$ )
	$\frac{\sqrt{3}}{4} a^2$	$\frac{a^4}{32\sqrt{3}}$	$\frac{a^4 \sqrt{3}}{80}$	$\frac{a^3}{32}$	$\frac{a^3}{20}$
	$\pi(r_o^2 - r_i^2)$ $\approx 2\pi r t$	$\frac{\pi}{4}(r_o^4 - r_i^4)$ $\approx \pi r^3 t$	$\frac{\pi}{2}(r_o^4 - r_i^4)$ $\approx 2\pi r^3 t$	$\frac{\pi}{4r_o}(r_o^4 - r_i^4)$ $\approx \pi r^2 t$	$\frac{\pi}{2r_o}(r_o^4 - r_i^4)$ $\approx 2\pi r^2 t$
	$4bt$	$\frac{2}{3} b^3 t$	$b^3 t \left(1 - \frac{t}{b}\right)^4$	$\frac{4}{3} b^2 t$	$2b^2 t \left(1 - \frac{t}{b}\right)^2$
	$\pi(a + b)t$	$\frac{\pi}{4} a^3 t \left(1 + \frac{3b}{a}\right)$	$\frac{4\pi(ab)^{5/2} t}{(a^2 + b^2)}$	$\frac{\pi a^2 t}{4} \left(1 + \frac{3b}{a}\right)$	$2\pi t(a^3 b)^{1/2}$ ( $b > a$ )
	$b(h_o - h_i)$ $\approx 2bt$	$\frac{b}{12}(h_o^3 - h_i^3)$ $\approx \frac{1}{2} bth_o^2$	—	$\frac{b}{6h_o}(h_o^3 - h_i^3)$ $\approx bth_o$	—
	$2t(h + b)$	$\frac{1}{6} h^3 t \left(1 + \frac{3b}{h}\right)$	$\frac{2tb^2 h^2}{h + b}$ (I) $\frac{2}{3} bt^3 \left(1 + \frac{4h}{b}\right)$ (□)	$\frac{h^2 t}{3} \left(1 + \frac{3b}{h}\right)$	$2tbh$ (I) $\frac{2}{3} bt^2 \left(1 + \frac{4h}{b}\right)$ (□)
	$2t(h + b)$	$\frac{t}{6}(h^3 + 4bt^2)$	$\frac{t^3}{3}(8b + h)$ (H) $\frac{2}{3} ht^3 \left(1 + \frac{4b}{h}\right)$ (T)	$\frac{t}{3h}(h^3 + 4bt^2)$	$\frac{t^2}{3}(8b + h)$ (H) $\frac{2}{3} ht^2 \left(1 + \frac{4b}{h}\right)$ (T)
	$t\lambda \left(1 + \frac{\pi^2 d^2}{4\lambda^2}\right)$	$\frac{t\lambda d^2}{8}$	—	$\frac{t\lambda d}{4}$	—

**Table 7.2** Values for the four shape factors

Section shape	Stiffness		Strength	
	$\phi_B^c$	$\phi_T^c$	$\phi_B^f$	$\phi_T^f$
	1	1	1	1
	$\frac{\pi}{3} = 1.05$	0.88	$\frac{2}{3}\sqrt{\pi} = 1.18$	0.74
	$\frac{a}{b}$	$\frac{2ab}{(a^2 + b^2)}$	$\sqrt{\frac{a}{b}}$	$\sqrt{\frac{a}{b}}$ ( $a < b$ )
	$\frac{\pi h}{3 b}$	$\frac{2\pi b}{3 h} \left(1 - 0.58 \frac{b}{h}\right)$ ( $h > b$ )	$\frac{2}{3}\sqrt{\pi} \left(\frac{h}{b}\right)^{1/2}$	$\frac{2}{3}\sqrt{\pi} \frac{(b/h)^{1/2}}{(1 + 0.6b/h)}$ ( $h > b$ )
	$\frac{2\pi}{3\sqrt{3}} = 1.21$	$\frac{2\pi}{5\sqrt{3}} = 0.73$	0.77	0.62
	$\frac{r}{t}$	$\frac{r}{t}$	$\left(\frac{2r}{t}\right)^{1/2}$	$\left(\frac{2r}{t}\right)^{1/2}$

(continued overleaf)

Table 7.2 (continued)

Section shape	$\phi_B^c$	Stiffness	$\phi_T^c$	$\phi_B^f$	Strength	$\phi_T^f$
	$\frac{\pi b}{6 t}$		$\frac{\pi b}{8 t} \left(1 - \frac{t}{b}\right)^4$	$\frac{2}{3} \sqrt{\pi} \left(\frac{b}{t}\right)^{1/2}$		$\frac{\sqrt{\pi}}{2} \left(\frac{b}{t}\right)^{1/2} \left(1 - \frac{t}{b}\right)^2$
	$\frac{a(1+3b/a)}{t(1+b/a)^2}$		$\frac{8(ab)^{5/2}}{t(a^2+b^2)(a+b)^2}$	$\left(\frac{a}{t}\right)^{1/2} \frac{(1+3b/a)}{(1+b/a)^{3/2}}$		$\frac{4a^{1/2}}{t^{1/2}(1+a/b)^{3/2}}$
	$\frac{\pi h^2}{2 bt}$		—	$\sqrt{2\pi} \frac{h}{(bt)^{1/2}}$		—
	$\frac{\pi h}{6 t} \frac{(1+3b/h)}{(1+b/h)^2}$		$\frac{\pi b^2 h^2}{t(h+b)^3}$	$\frac{\sqrt{2\pi}}{3} \left(\frac{h}{t}\right)^{1/2} \frac{(1+3b/h)}{(1+b/h)^{3/2}}$		$\frac{\sqrt{2\pi} h}{(bt)^{1/2}(1+h/b)^{3/2}}$
			$\frac{\pi t}{3 b} \frac{(1+4h/b)}{(1+h/b)^2}$			$\frac{\sqrt{2\pi}}{3} \left(\frac{t}{b}\right)^{1/2} \frac{(1+4h/b)}{(1+h/b)^{3/2}}$
	$\frac{\pi h}{6 t} \frac{(1+4bt^2/h^3)}{(1+b/h)^2}$		$\frac{\pi t}{6 h} \frac{(1+8b/h)}{(1+b/h)^2}$	$\frac{\sqrt{\pi}}{2} \left(\frac{h}{t}\right)^{1/2} \frac{(1+4bt^2/h^3)}{(1+b/h)^{3/2}}$		$\left(\frac{\pi t}{18 h}\right)^{1/2} \frac{(1+8b/h)}{(1+b/h)^{3/2}}$
			$\frac{\pi t}{3 h} \frac{(1+4b/h)}{(1+b/h)^2}$			$\frac{\sqrt{2\pi}}{3} \left(\frac{t}{h}\right)^{1/2} \frac{(1+4b/h)}{(1+b/h)^{3/2}}$
	$\frac{\pi d^2}{2 t \lambda}$		—	$\sqrt{\pi} \frac{d}{(t\lambda)^{1/2}}$		—