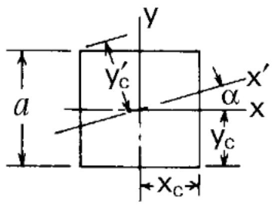
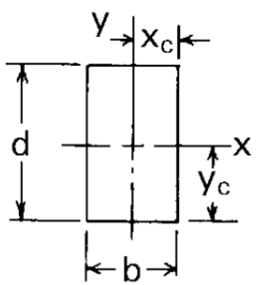
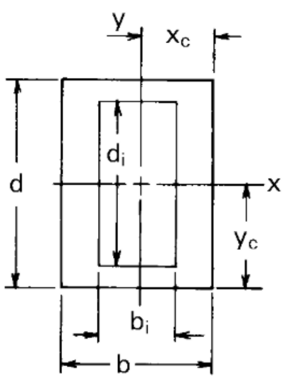
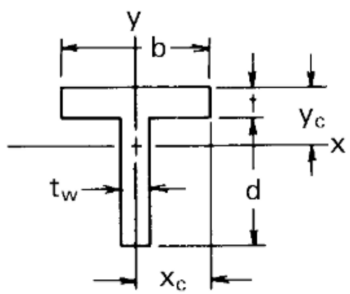
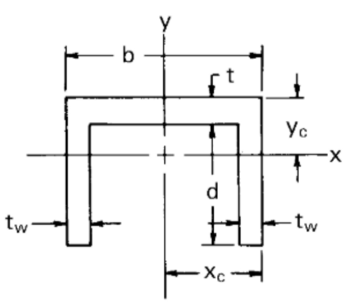
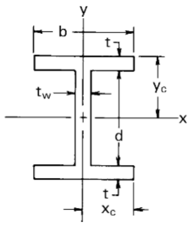
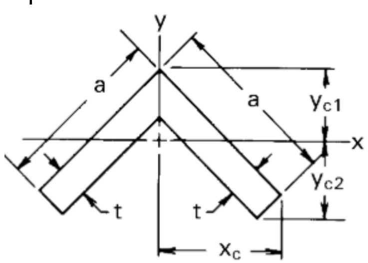
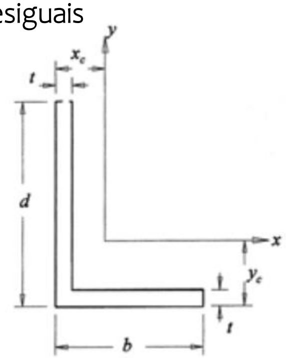
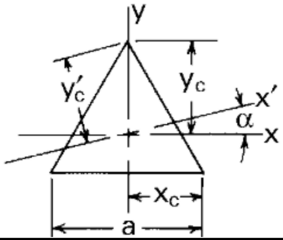
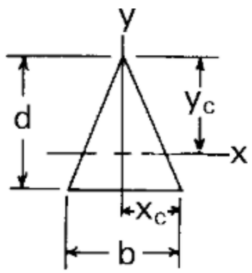
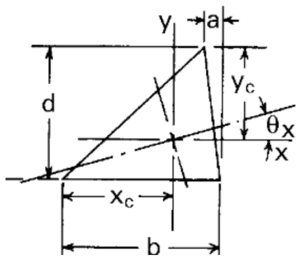
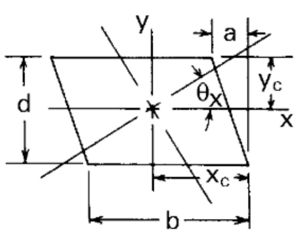
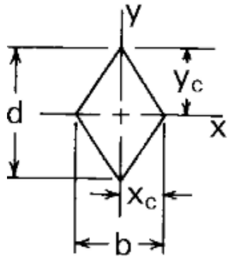
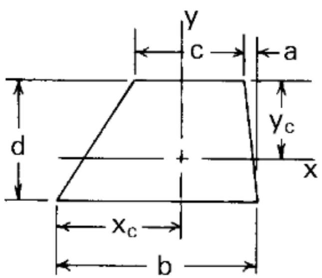
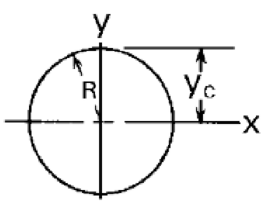
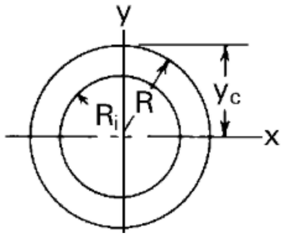
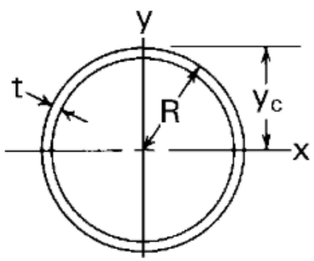
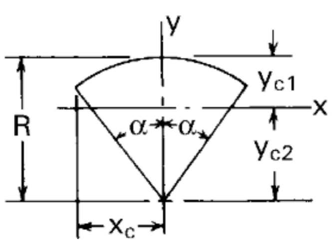
Seção Transversal	Áreas e coordenadas do centroide	Momentos de Inércia e Raios de Giração	Módulo Resistente Plástico (Z), fator de forma (SF) e coordenadas da Linha Neutra Plástica
Quadrado 	$A = a^2$ $y_c = x_c = \dfrac{a}{2}$ $y'_c = 0.707a\cos\left(\dfrac{\pi}{4} - \alpha\right)$	$I_x = I_y = I'_x = \frac{1}{12}a^4$ $r_x = r_y = r'_x = 0.2887a$	$Z_x = Z_y = 0.25a^3$ $\mathrm{SF}_x = \mathrm{SF}_y = 1.5$
Retângulo 	$A = bd$ $y_c = \dfrac{d}{2}$ $x_c = \dfrac{b}{2}$	$I_x = \frac{1}{12}bd^3$ $I_y = \frac{1}{12}db^3$ $I_x > I_y \quad \text{if } d > b$ $r_x = 0.2887d$ $r_y = 0.2887b$	$Z_x = 0.25bd^2$ $Z_y = 0.25db^2$ $\mathrm{SF}_x = \mathrm{SF}_y = 1.5$
Retângulo oco 	$A = bd - b_i d_i$ $y_c = \dfrac{d}{2}$ $x_c = \dfrac{b}{2}$	$I_x = \dfrac{bd^3 - b_i d_i^3}{12}$ $I_y = \dfrac{db^3 - d_i b_i^3}{12}$ $r_x = \left(\dfrac{I_x}{A}\right)^{1/2}$ $r_y = \left(\dfrac{I_y}{A}\right)^{1/2}$	$Z_x = \dfrac{bd^2 - b_i d_i^2}{4}$ $\mathrm{SF}_x = \dfrac{Z_x d}{2I_x}$ $Z_x = \dfrac{db^2 - d_i b_i^2}{4}$ $\mathrm{SF}_y = \dfrac{Z_y b}{2I_y}$

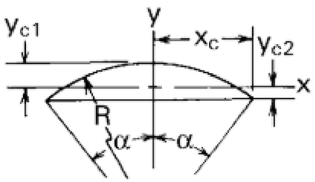
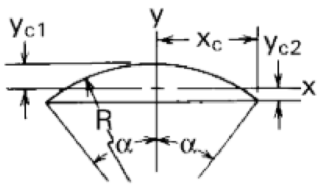
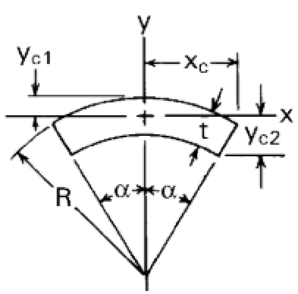
Seção T 	$A = tb + t_w d$ $y_c = \frac{bt^2 + t_w d(2t+d)}{2(tb + t_w d)}$ $x_c = \frac{b}{2}$	$I_x = \frac{b}{3}(d+t)^3 - \frac{d^3}{3}(b - t_w) - A(d+t-y_c)^2$ $I_y = \frac{tb^3}{12} + \frac{dt_w^3}{12}$ $r_x = \left(\frac{I_x}{A}\right)^{1/2}$ $r_y = \left(\frac{I_y}{A}\right)^{1/2}$	If $t_w d \geqslant bt$, então $Z_x = \frac{d^2 t_w}{4} - \frac{b^2 t^2}{4t_w} + \frac{bt(d+t)}{2}$ O eixo neutro x esta localizado a uma $(bt/t_w + d)/2$ distancia da parte inferior If $t_w d \leqslant bt$, então $Z_x = \frac{t^2 b}{4} + \frac{t_w d(t + d - t_w d/2b)}{2}$ O eixo neutro x esta localizado a uma $(t_w d/b + t)/2$ distancia do topo $\mathrm{SF}_x = \frac{Z_x(d+t-y_c)}{I_1}$ $Z_y = \frac{b^2 t + t_w^2 d}{4}$ $\mathrm{SF}_y = \frac{Z_y b}{2I_y}$
Seção C 	$A = tb + 2t_w d$ $y_c = \frac{bt^2 + 2t_w d(2t+d)}{2(tb + 2t_w d)}$ $x_c = \frac{b}{2}$	$I_x = \frac{b}{3}(d+t)^3 - \frac{d^3}{3}(b - 2t_w) - A(d+t-y_c)^2$ $I_y = \frac{(d+t)b^3}{12} - \frac{d(b-2t_w)^3}{12}$ $r_x = \left(\frac{I_x}{A}\right)^{1/2}$ $r_y = \left(\frac{I_y}{A}\right)^{1/2}$	If $2t_w d \geqslant bt$, then $Z_x = \frac{d^2 t_w}{2} - \frac{b^2 t^2}{8t_w} + \frac{bt(d+t)}{2}$ O eixo neutro x está localizada a uma distancia $(bt/2t_w + d)/2$ De baixo If $2t_w d \leqslant bt$, então $Z_x = \frac{t^2 b}{4} + t_w d\left(t + d - \frac{t_w d}{b}\right)$ O eixo neutro x esta localizado a uma $t_w d/b + t/2$ distancia do topo $\mathrm{SF}_x = \frac{Z_x(d+t-y_c)}{I_x}$ $Z_y = \frac{b^2 t}{4} + t_w d(b - t_w)$ $\mathrm{SF}_y = \frac{Z_y b}{2I_y}$

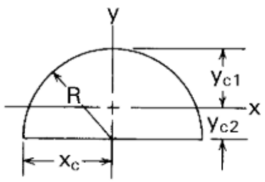
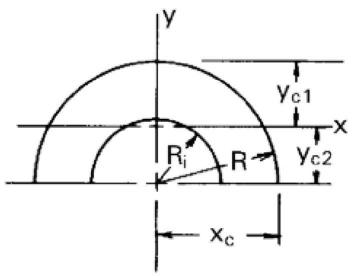
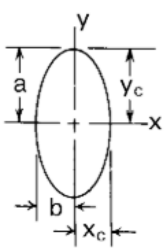
Seção Transversal	Áreas e coordenadas do centroide	Momentos de Inércia e Raios de Giração	Módulo Resistente Plástico (Z), fator de forma (SF) e coordenadas da Linha Neutra Plástica
Feixe de flange largo com flanges iguais 	$A = 2bt + t_w d$ $y_c = \frac{d}{2} + t$ $x_c = \frac{b}{2}$	$I_x = \frac{b(d+2t)^3}{12} - \frac{(b-t_w)d^3}{12}$ $I_y = \frac{b^3 t}{6} + \frac{t_w^3 d}{12}$ $r_x = \left(\frac{I_x}{A}\right)^{1/2}$ $r_y = \left(\frac{I_y}{A}\right)^{1/2}$	$Z_x = \frac{t_w d^2}{4} + bt(d+t)$ $\mathrm{SF}_x = \frac{Z_x y_c}{I_x}$ $Z_y = \frac{b^2 t}{2} + \frac{t_w^2 d}{4}$ $\mathrm{SF}_y = \frac{Z_y x_c}{I_y}$
Ângulo de pernas 	$A = t(2a - t)$ $y_{c1} = \frac{0.7071(a^2 + at - t^2)}{2a - t}$ $y_{c2} = \frac{0.7071a^2}{2a - t}$ $x_c = 0.7071a$	$I_x = \frac{a^4 - b^4}{12} - \frac{0.5ta^2b^2}{a+b}$ $I_y = \frac{a^4 - b^4}{12}$ Onde $b = a - t$ $r_x = \left(\frac{I_x}{A}\right)^{1/2}$ $r_y = \left(\frac{I_y}{A}\right)^{1/2}$	Seja y_p a distância vertical do canto superior até o eixo neutro plástico. Se $y_p = a\left[\frac{t}{a} - \frac{(t/a)^2}{2}\right]^{1/2}$ $Z_x = A(y_{c1} - 0.6667y_p)$ If $t/a \leqslant 0.4$, then $y_p = 0.3536(a + 1.5t)$ $Z_x = Ay_{c1} - 2.8284y_p^2 t + 1.8856t^3$
Ângulo de pernas desiguais 	$A = t(b + d - t)$ $x_c = \frac{b^2 + dt - t^2}{2(b + d - t)}$ $y_c = \frac{d^2 + bt - t^2}{2(b + d - t)}$	$I_x = \frac{1}{3}[bd^3 - (b-t)(d-t)^3] - A(d - y_c)^2$ $I_y = \frac{1}{3}[db^3 - (d-t)(b-t)^3] - A(b - x_c)^2$ $I_{xy} = \frac{1}{4}[b^2d^2 - (b-t)^2(d-t)^2] - A(b - x_c)(d - y_c)$ $r_x = \left(\frac{I_x}{A}\right)^{1/2}$ $r_y = \left(\frac{I_y}{A}\right)^{1/2}$	

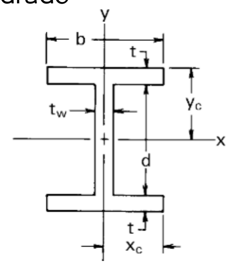
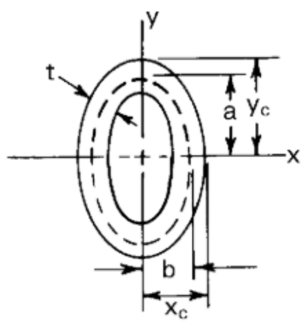
Triângulo Equilátero 	$A = 0.4330a^2$ $y_c = 0.5774a$ $x_c = 0.5000a$ $y'_c = 0.5774a\cos\alpha$	$I_x = I_y = I_{x'} = 0.01804a^4$ $r_x = r_y = r_{x'} = 0.2041a$	$Z_x = 0.0732a^3, \quad Z_y = 0.0722a^3$ $\mathrm{SF}_x = 2.343, \quad \mathrm{SF}_y = 2.000$ O eixo neutro x está a 0:2537a da base.
Isosceles triangle 	$A = \dfrac{bd}{2}$ $y_c = \frac{2}{3}d$ $x_c = \dfrac{b}{2}$	$I_x = \frac{1}{36}bd^3$ $I_y = \frac{1}{48}db^3$ $I_x > I_y \quad \text{if } d > 0.866b$ $r_x = 0.2357d$ $r_y = 0.2041b$	$Z_x = 0.097bd^2, \quad Z_y = 0.0833db^2$ $\mathrm{SF}_x = 2.343, \quad \mathrm{SF}_y = 2.000$ O eixo neutro x está a 0:2929d da base.
Triângulo 	$A = \dfrac{bd}{2}$ $y_c = \frac{2}{3}d$ $x_c = \frac{2}{3}b - \frac{1}{3}a$	$I_x = \frac{1}{36}bd^3$ $I_y = \frac{1}{36}bd(b^2 - ab + a^2)$ $I_{xy} = \frac{1}{72}bd^2(b - 2a)$ $\theta_x = \dfrac{1}{2}\tan^{-1}\dfrac{d(b-2a)}{b^2 - ab + a^2 - d^2}$ $r_x = 0.2357d$ $r_y = 0.2357\sqrt{b^2 - ab + a^2}$	
Paralelogramo 	$A = bd$ $y_c = \dfrac{d}{2}$ $x_c = \frac{1}{2}(b + a)$	$I_x = \frac{1}{12}bd^3$ $I_y = \frac{1}{12}bd(b^2 + a^2)$ $I_{xy} = -\frac{1}{12}abd^2$ $\theta_x = \dfrac{1}{2}\tan^{-1}\dfrac{-2ad}{b^2 + a^2 - d^2}$ $r_x = 0.2887d$ $r_y = 0.2887\sqrt{b^2 + a^2}$	

Seção Transversal	Áreas e coordenadas do centroide	Momentos de Inércia e Raios de Giração	Módulo Resistente Plástico (Z), fator de forma (SF) e coordenadas da Linha Neutra Plástica
Diamante 	$A = \frac{bd}{2}$ $y_c = \frac{d}{2}$ $x_c = \frac{b}{2}$	$I_x = \frac{1}{48} bd^3$ $I_y = \frac{1}{48} db^3$ $r_x = 0.2041d$ $r_y = 0.2041b$	$Z_x = 0.0833bd^2, \quad Z_y = 0.0833db^2$ $\mathrm{SF}_x = \mathrm{SF}_y = 2.000$
Trapézio 	$A = \frac{d}{2}(b+c)$ $y_c = \frac{d}{3}\frac{2b+c}{b+c}$ $x_c = \frac{2b^2+2bc-ab-2ac-c^2}{3(b+c)}$	$I_x = \frac{d^3}{36}\frac{b^2+4bc+c^2}{b+c}$ $I_y = \frac{d}{36(b+c)}[b^4+c^4+2bc(b^2+c^2) - a(b^3+3b^2c-3bc^2-c^3) + a^2(b^2+4bc+c^2)]$ $I_{xy} = \frac{d^2}{72(b+c)}[c(3b^2-3bc-c^2) + b^3 - a(2b^2+8bc+2c^2)]$	
Círculo sólido 	$A = \pi R^2$ $y_c = R$	$I_x = I_y = \frac{\pi}{4}R^4$ $r_x = r_y = \frac{R}{2}$	$Z_x = Z_y = 1.333R^3$ $\mathrm{SF}_x = 1.698$

Diamante  	$A = \pi(R^2 - R_i^2)$ $y_c = R$	$I_x = I_y = \frac{\pi}{4}(R^4 - R_i^4)$ $r_x = r_y = \frac{1}{2}\sqrt{R^2 + R_i^2}$	$Z_x = Z_y = 1.333(R^3 - R_i^3)$ $\mathrm{SF}_x = 1.698\frac{R^4 - R_i^3 R}{R^4 - R_i^4}$
Trapézio  	$A = 2\pi R t$ $y_c = R$	$I_x = I_y = \pi R^3 t$ $r_x = r_y = 0.707R$	$Z_x = Z_y = 4R^2 t$ $\mathrm{SF}_x = \mathrm{SF}_y = \frac{4}{\pi}$
Círculo sólido  	$A = \alpha R^2$ $y_{c1} = R\left(1 - \frac{2\ \mathrm{sen}\,\alpha}{3\alpha}\right)$ $y_{c2} = \frac{2R\,\mathrm{sen}\ \alpha}{3\alpha}$ $x_c = R\ \mathrm{sen}\ \alpha$	$I_x = \frac{R^4}{4}\left(\alpha + \quad \alpha\cos\alpha - \frac{16\,\mathrm{sen}^2\alpha}{9\alpha}\right)$ $I_y = \frac{R^4}{4}(\alpha - \mathrm{sen}\,\alpha\cos\alpha)$ (*Note*: If α is small, $\alpha - \mathrm{sen}\,\alpha\cos\alpha = \frac{2}{3}\alpha^3 - \frac{2}{15}\alpha^5$) $r_x = \frac{R}{2}\sqrt{1 + \frac{\mathrm{sen}\,\alpha\cos\alpha}{\alpha} - \frac{16 \quad ^2\alpha}{9\alpha^2}}$ $r_y = \frac{R}{2}\sqrt{1 - \frac{\mathrm{sen}\ \alpha\cos\alpha}{\alpha}}$	If $\alpha \leqslant 54.3°$, então $Z_x = 0.6667R^3\left[\sin\alpha - \left(\frac{\alpha^3}{2\tan\alpha}\right)^{1/2}\right]$ O eixo neutro x está localizado a uma $R(0.5\alpha/\tan\alpha)^{1/2}$ do vértice If $\alpha \geqslant 54.3°$, então $Z_x = 0.6667R^3(2\sin^3\alpha_1 - sen\ \alpha)$ onde o expressão $2\alpha_1 - sen\ 2\alpha_1 = \alpha$ é resolvido para o valor $de\ \alpha_1$. O eixo neutro x está localizado a uma distância $R\cos\alpha_1$ de o vértice . If $\alpha \leqslant 73.09°$, então $\mathrm{SF}_x = \frac{Z_x y_{c2}}{I_x}$ If $73.09° \leqslant \alpha \leqslant 90°$, então $\mathrm{SF}_x = \frac{Z_x y_{c1}}{I_x}$ $Z_y = 0.6667R^3(1 - \cos\alpha)$ If $\alpha \leqslant 90°$, então $\mathrm{SF}_y = 2.6667\,sen\,\alpha\frac{1 - \cos\alpha}{\alpha - sen\,\alpha\cos\alpha}$ If $\alpha \geqslant 90°$, então $\mathrm{SF}_y = 2.6667\frac{1 - \cos\alpha}{\alpha - sen\,\alpha\cos\alpha}$

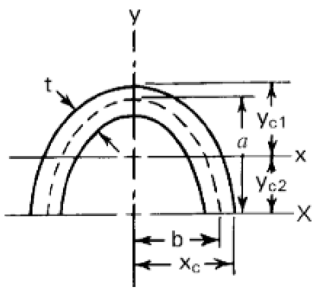
Seção Transversal	Áreas e coordenadas do centroide	Momentos de Inércia e Raios de Giração	Módulo Resistente Plástico (Z), fator de forma (SF) e coordenadas da Linha Neutra Plástica
Segmento de círculo sólido (*Note:* If $\alpha \leqslant \pi/4$, *usar* expressões do caso 20)  	$A = R^2(\alpha - sen\,\alpha\cos\alpha)$ $y_{c1} = R\left[1 - \frac{2\,sen^3\,\alpha}{3(\alpha - sen\,\alpha\cos\alpha)}\right]$ $y_{c2} = R\left[\frac{2\,sen^3\,\alpha}{3(\alpha - sen\,\alpha\cos\alpha)} - \cos\alpha\right]$ $x_c = R\,sen\,\alpha$	$I_x = \frac{R^4}{4}\left[\alpha - sen\,\alpha\cos\alpha + 2\,sen^3\,\alpha\cos\alpha - \frac{16\,sen^6\,\alpha}{9(\alpha - sen\,\alpha\cos\alpha)}\right]$ $I_y = \frac{R^4}{12}(3\alpha - 3\,sen\,\alpha\cos\alpha - 2\,sen^3\,\alpha\cos\alpha)$ $r_x = \frac{R}{2}\sqrt{1 + \frac{2\,sen^3\,\alpha\cos\alpha}{\alpha - sen\,\alpha\cos\alpha} - \frac{16\,sen^6\,\alpha}{9(\alpha - sen\,\alpha\cos\alpha)^2}}$ $r_y = \frac{R}{2}\sqrt{1 - \frac{2\,sen^3\,\alpha\cos\alpha}{3(\alpha - sen\,\alpha\cos\alpha)}}$	
Segmento de círculo sólido (Nota: Não use se if $\alpha > \pi/4$)  	$A = \frac{2}{3}R^2\alpha^3(1 - 0.2\alpha^2 + 0.019\alpha^4)$ $y_{c1} = 0.3R\alpha^2(1 - 0.0976\alpha^2 + 0.0028\alpha^4)$ $y_{c2} = 0.2R\alpha^2(1 - 0.0619\alpha^2 + 0.0027\alpha^4)$ $x_c = R\alpha(1 - 0.1667\alpha^2 + 0.0083\alpha^4)$	$I_x = 0.01143R^4\alpha^7(1 - 0.3491\alpha^2 + 0.0450\alpha^4)$ $I_y = 0.1333R^4\alpha^5(1 - 0.4762\alpha^2 + 0.1111\alpha^4)$ $r_x = 0.1309R\alpha^2(1 - 0.0745\alpha^2)$ $r_y = 0.4472R\alpha(1 - 0.1381\alpha^2 + 0.0184\alpha^4)$	
Setor de círculo oco (Note: If t/R é pequeno, uma lata exceda p para formar um anel sobreposto)  	$A = \alpha t(2R - t)$ $y_{c1} = R\left[1 - \frac{2\,sen\,\alpha}{3\alpha}\left(1 - \frac{t}{R} + \frac{1}{2 - t/R}\right)\right]$ $y_{c2} = R\left[\frac{2\,sen\,\alpha}{3\alpha(2 - t/R)} + \left(1 - \frac{t}{R}\right)\frac{2\,sen\,\alpha - 3\alpha\cos\alpha}{3\alpha}\right]$ $x_c = R\,sen\,\alpha$	$I_x = R^3t\left[\left(1 - \frac{3t}{2R} + \frac{t^2}{R^2} - \frac{t^3}{4R^3}\right) \times \left(\alpha + sen\,\alpha\cos\alpha - \frac{2\,sen^2\,\alpha}{\alpha}\right) + \frac{t^2\,sen^2\,\alpha}{3R^2\alpha(2 - t/R)}\left(1 - \frac{t}{R} + \frac{t^2}{6R^2}\right)\right]$ $I_y = R^3t\left(1 - \frac{3t}{2R} + \frac{t^2}{R^2} - \frac{t^3}{4R^3}\right)(\alpha - sen\,\alpha\cos\alpha)$ $r_x = \sqrt{\frac{I_x}{A}}, \qquad r_y = \sqrt{\frac{I_y}{A}}$	

	Nota: Se a for pequeno $\frac{sen\,\alpha}{\alpha} = 1 - \frac{\alpha^2}{6} + \frac{\alpha^4}{120}$, $\alpha - sen\,\alpha\cos\alpha = \frac{2}{3}\alpha^3\left(1 - \frac{\alpha^2}{5} + \frac{2\alpha^4}{105}\right)$, $\frac{sen^2\,\alpha}{\alpha} = \alpha\left(1 - \frac{\alpha^2}{3} + \frac{2\alpha^4}{45}\right)$ $\cos = 1 - \frac{\alpha^2}{2} + \frac{\alpha^4}{24}$, $\alpha + sen\,\alpha\cos\alpha - \frac{2\,sen^2\,\alpha}{\alpha} = \frac{2\alpha^5}{45}\left(1 - \frac{\alpha^2}{7} + \frac{\alpha^4}{105}\right)$		
Semicírculo sólido 	$A = \frac{\pi}{2}R^2$ $y_{c1} = 0.5756R$ $y_{c2} = 0.4244R$ $x_c = R$	$I_x = 0.1098R^4$ $I_y = \frac{\pi}{8}R^4$ $r_x = 0.2643R$ $r_y = \frac{R}{2}$	$Z_x = 0.3540R^3$, $Z_y = 0.6667R^3$ $SF_x = 1.856$, $SF_y = 1.698$ O eixo neutro plástico x está localizado a uma distância 0:4040R da base.
Semicírculo oco  Note: $b = \frac{R + R_i}{2}$ $t = R - R_i$	$A = \frac{\pi}{2}(R^2 - R_i^2)$ $y_{c2} = \frac{4}{3\pi}\frac{R^3 - R_i^3}{R^2 - R_i^2}$ or $y_{c2} = \frac{2b}{\pi}\left[1 + \frac{(t/b)^2}{12}\right]$ $y_{c1} = R - y_{c2}$ $x_c = R$	$I_x = \frac{\pi}{8}(R^4 - R_i^4) - \frac{8}{9\pi}\frac{(R^3 - R_i^3)^2}{R^2 - R_i^2}$ or $I_x = 0.2976tb^3 + 0.1805bt^3 - \frac{0.00884t^5}{b}$ $I_y = \frac{\pi}{8}(R^4 - R_i^4)$ or $I_y = 1.5708b^3t + 0.3927bt^3$	Seja y_p a distância vertical da base até o eixo neutro de plástico $y_p = (0.7071 - 0.2716C - 0.4299C^2 + 0.3983C^3)R$ $Z_x = (0.8284 - 0.9140C + 0.7245C^2$ $- 0.2850C^3)R^2t$ where $C = t/R$ $Z_y = 0.6667(R^3 - R_i^3)$
Elipse sólida 	$A = \pi ab$ $y_c = a$ $x_c = b$	$I_x = \frac{\pi}{4}ba^3$ $I_y = \frac{\pi}{4}ab^3$ $r_x = \frac{a}{2}$ $r_y = \frac{b}{2}$	$Z_x = 1.333a^2b$, $Z_y = 1.333b^2a$ $SF_x = SF_y = 1.698$

Seção Transversal	Áreas e coordenadas do centroide	Momentos de Inércia e Raios de Giração	Módulo Resistente Plástico (Z), fator de forma (SF) e coordenadas da Linha Neutra Plástica
Quadrado  	$A = \pi(ab - a_i b_i)$ $y_c = a$ $x_c = b$	$I_x = \frac{\pi}{4}(ba^3 - b_i a_i^3)$ $I_y = \frac{\pi}{4}(ab^3 - a_i b_i^3)$ $r_x = \frac{1}{2}\sqrt{\frac{ba^3 - b_i a_i^3}{ab - a_i b_i}}$ $r_y = \frac{1}{2}\sqrt{\frac{ab^3 - a_i b_i^3}{ab - a_i b_i}}$	$Z_x = 1.333(a^2 b - a_i^2 b_i)$ $Z_y = 1.333(b^2 a - b_i^2 a_i)$ $\mathrm{SF}_x = 1.698\frac{a^3 b - a_i^2 b_i a}{a^3 b - a_i^3 b_i}$ $\mathrm{SF}_y = 1.698\frac{b^3 a - b_i^2 a_i b}{b^3 a - b_i^3 a_i}$
Nota: Neste caso, os perímetros interno e externo são elipses e a parede espessura não é constante. Para uma seção transversal com espessura de parede constante, consulte caso 26			
(mostrado tracejado)perímetro é *uma elipseA espessura médiaespessura de parede constante t.Elipse oca com* $0.2 < a/b < 5$  Veja a nota sobre máximo espessura da parede no caso 27	$A = \pi t(a+b)\left[1 + K_1\left(\frac{a-b}{a+b}\right)^2\right]$ where $K_1 = 0.2464 + 0.002222\left(\frac{a}{b} + \frac{b}{a}\right)$ $y_c = a + \frac{t}{2}$ $x_c = b + \frac{t}{2}$	$I_x = \frac{\pi}{4}ta^2(a+3b)\left[1 + K_2\left(\frac{a-b}{a+b}\right)^2\right]$ $+\frac{\pi}{16}t^3(3a+b)\left[1 + K_3\left(\frac{a-b}{a+b}\right)^2\right]$ $K_2 = 0.1349 + 0.1279\frac{a}{b} - 0.01284\left(\frac{a}{b}\right)^2$ $K_3 = 0.1349 + 0.1279\frac{b}{a} - 0.01284\left(\frac{b}{a}\right)^2$ Para I_y troque a e b nas expressões por $I_x, K_2,$ *e* K_3	$Z_x = 1.3333ta(a+2b)\left[1 + K_4\left(\frac{a-b}{a+b}\right)^2\right] + \frac{t^3}{3}$ *onde* $K_4 = 0.1835 + 0.895\frac{a}{b} - 0.00978\left(\frac{a}{b}\right)^2$ *e K4.* Z_y *·a Zy troque a e b na expressão p*Z_x*·a Zx* K_4

Semielipse oca com
espessura de parede constante t.
A espessura média
perímetro é uma elipse
(mostrado tracejado).

$$0.2 < a/b < 5$$



Observação: há um limite de espessura máxima da parede permitido neste caso. Cúspides se formará no perímetro em as extremidades do eixo maior se esse máximo for excedido.

If $\dfrac{a}{b} \leqslant 1$, então $t_{\max} = \dfrac{2a^2}{b}$

If $\dfrac{a}{b} \geqslant 1$, então $t_{\max} = \dfrac{2b^2}{a}$

$$A = \frac{\pi}{2} t(a+b)\left[1 + K_1\left(\frac{a-b}{a+b}\right)^2\right]$$

onde

$$K_1 = 0.2464 + 0.002222\left(\frac{a}{b} + \frac{b}{a}\right)$$

$$y_{c2} = \frac{2a}{\pi} K_2 + \frac{t^2}{6\pi a} K_3$$

onde

$$K_2 = 1 - 0.3314C + 0.0136C^2 + 0.1097C^3$$

$$K_3 = 1 + 0.9929C - 0.2287C^2 - 0.2193C^3$$

Usando $C = \dfrac{a-b}{a+b}$

$$y_{c1} = a + \frac{t}{2} - y_{c2}$$

$$x_c = b + \frac{t}{2}$$

$$I_X = \frac{\pi}{8} t a^2 (a+3b)\left[1 + K_4\left(\frac{a-b}{a+b}\right)^2\right] + \frac{\pi}{32} t^3 (3a+b)\left[1 + K_5\left(\frac{a-b}{a+b}\right)^2\right]$$

onde

$$K_4 = 0.1349 + 0.1279\frac{a}{b} - 0.01284\left(\frac{a}{b}\right)^2$$

$$K_5 = 0.1349 + 0.1279\frac{b}{a} - 0.01284\left(\frac{b}{a}\right)^2$$

$$I_x = I_X - A y_{c2}^2$$

Para I_y use metade do valor de I_y no caso 26.

eixo y_p *neutro de plásticoSeja yp a distância vertical da base até o*

$$y_p = \left[C_1 + \frac{C_2}{a/b} + \frac{C_3}{(a/b)^2} + \frac{C_4}{(a/b)^3}\right]a$$

onde se $0.25 < a/b \leqslant 1$, *então*

$$C_1 = 0.5067 - 0.5588D + 1.3820D^2$$

$$C_2 = 0.3731 + 0.1938D - 1.4078D^2$$

$$C_3 = -0.1400 + 0.0179D + 0.4885D^2$$

$$C_4 = 0.0170 - 0.0079D - 0.0565D^2$$

ou se $1 \leqslant a/b < 4$, *então*

$$C_1 = 0.4829 + 0.0725D - 0.1815D^2$$

$$C_2 = 0.1957 - 0.6608D + 1.4222D^2$$

$$C_3 = 0.0203 + 1.8999D - 3.4356D^2$$

$$C_4 = 0.0578 - 1.6666D + 2.6012D^2$$

onde $D = t/t_{\max}$ *e onde* $0.2 < D \leqslant 1$

$$Z_x = \left[C_5 + \frac{C_6}{a/b} + \frac{C_7}{(a/b)^2} + \frac{C_8}{(a/b)^3}\right]4a^2 t$$

onde se $0.25 < a/b \leqslant 1$, *então*

$$C_5 = -0.0292 + 0.3749D^{1/2} + 0.0578D$$

$$C_6 = 0.3674 - 0.8531D^{1/2} + 0.3882D$$

$$C_7 = -0.1218 + 0.3563D^{1/2} - 0.1803D$$

$$C_8 = 0.0154 - 0.0448D^{1/2} + 0.0233D$$

ou se $1 \leqslant a/b < 4$, *então*

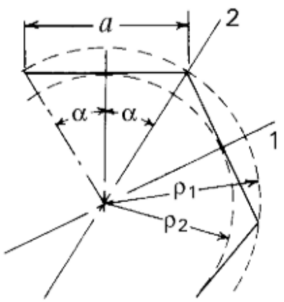
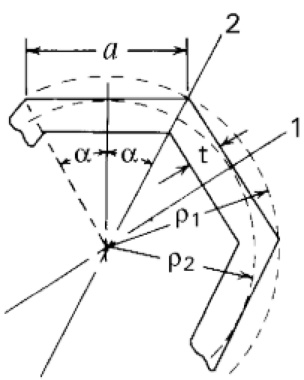
$$C_5 = 0.2241 - 0.3922D^{1/2} + 0.2960D$$

$$C_6 = -0.6637 + 2.7357D^{1/2} - 2.0482D$$

$$C_7 = 1.5211 - 5.3864D^{1/2} + 3.9286D$$

$$C_8 = -0.8498 + 2.8763D^{1/2} - 1.8874D$$

Para Z_y *use metade do valor de* Z_y *no caso 26*

Seção Transversal	Áreas e coordenadas do centroide	Momentos de Inércia e Raios de Giração	Módulo Resistente Plástico (Z), fator de forma (SF) e coordenadas da Linha Neutra Plástica
Polígono regular com n lados  	$A = \frac{a^2 n}{4 \tan \alpha}$ $\rho_1 = \frac{a}{2 \operatorname{sen} \alpha}$ $\rho_2 = \frac{a}{2 \tan \alpha}$ Se n é ímpar $y_1 = y_2 = \rho_1 \cos\left[\alpha\left(\frac{n+1}{2}\right) - \frac{\pi}{2}\right]$ Se n = 2 é ímpar $y_1 = \rho_1, \qquad y_2 = \rho_2$ Se n = 2 é ímpar $y_1 = \rho_2, \qquad y_2 = \rho_1$	$I_1 = I_2 = \frac{1}{24} A(6\rho_1^2 - a^2)$ $r_1 = r_2 = \sqrt{\frac{1}{24}(6\rho_1^2 - a^2)}$	Para n=3, veja caso 9. para n= 4, veja casos 1 e 13 para n=5, $Z_1 = Z_2 = 0.8825\rho_1^3$. Para um eixo perpendicular ao eixo 1, $Z = 0.8838\rho_1^3$. A localização deste eixo A localização deste eixo é 0,7007a do lado perpendicular ao eixo 1. ao eixo 1. Para n⩾6, utilizar a seguinte expressão para um eixo neutro de qualquer inclinação: $Z = \rho_1^3\left[1.333 - 13.908\left(\frac{1}{n}\right)^2 + 12.528\left(\frac{1}{n}\right)^3\right]$
Polígono regular oco com n lados  	$A = nat\left(1 - \frac{t \tan \alpha}{a}\right)$ $\rho_1 = \frac{a}{2 \operatorname{sen} \alpha}$ $\rho_2 = \frac{a}{2 \tan \alpha}$ Se n é ímpar $y_1 = y_2 = \rho_1 \cos\left(\alpha \frac{n+1}{2} - \frac{\pi}{2}\right)$ Se n = 2 é ímpar $y_1 = \rho_1, \qquad y_2 = \rho_2$ Se n = 2 é ímpar $y_1 = \rho_2, \qquad y_2 = \rho_1$	$I_1 = I_2 = \frac{na^3 t}{8}\left(\frac{1}{3} + \frac{1}{\tan^2 \alpha}\right) \times \left[1 - 3\frac{t \tan \alpha}{a} + 4\left(\frac{t \tan \alpha}{a}\right)^2 - 2\left(\frac{t \tan \alpha}{a}\right)^3\right]$ $r_1 = r_2 = \frac{a}{\sqrt{8}} \times \sqrt{\left(\frac{1}{3}\right) + \frac{1}{\tan^2 \alpha}\left[1 - 2\frac{t \tan \alpha}{a} + 2\left(\frac{t \tan \alpha}{a}\right)^2\right]}$	