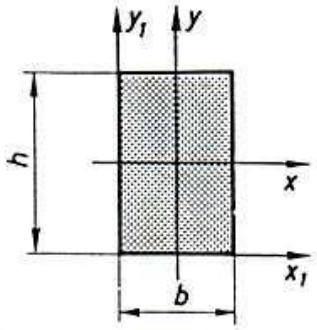
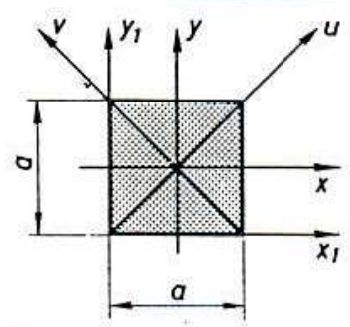
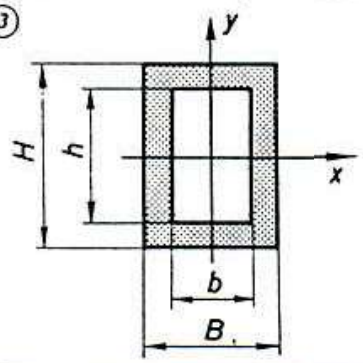
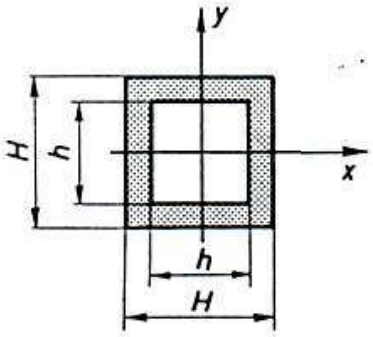
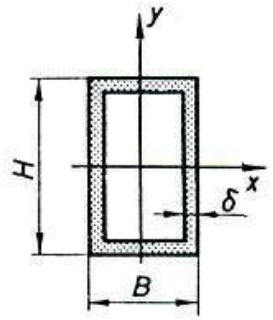
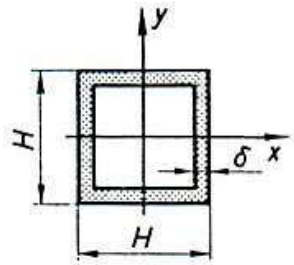
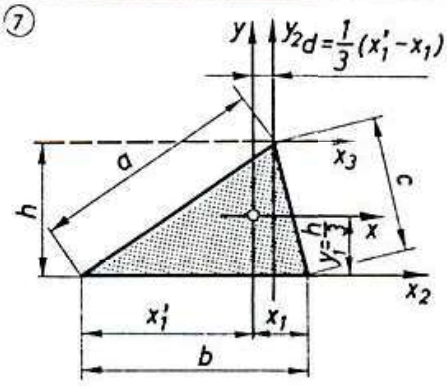
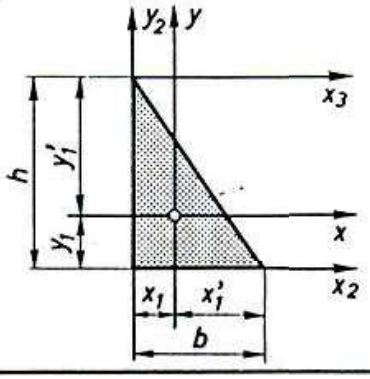
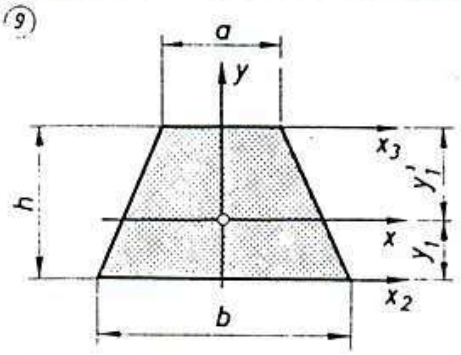
Tabela 2. Težišta, momenti inercije i otporni momenti, za neke karakteristične presjeke

① 	$I_{x_1} = \frac{bh^3}{3}$; $I_{y_1} = \frac{hb^3}{3}$; $I_{x_1y_1} = \frac{b^2h^2}{4}$ $I_x = \frac{bh^3}{12}$; $I_y = \frac{hb^3}{12}$ $W_x = \frac{bh^2}{6}$; $W_y = \frac{hb^2}{6}$
② 	$I_x = I_y = \frac{a^4}{12}$ $W_x = W_y = \frac{a^3}{6}$ $I_u = I_v = \frac{a^4}{12}$ $W_u = W_v = \frac{\sqrt{2}}{12} a^3 = 0.118\, a^3$
③ 	$A = BH - bh$ $I_x = \frac{BH^3 - bh^3}{12}$; $I_y = \frac{HB^3 - hb^3}{12}$ $W_x = \frac{BH^3 - bh^3}{6H}$; $W_y = \frac{HB^3 - hb^3}{6B}$
④ 	$A = H^2 - h^2$ $I_x = I_y = \frac{H^4 - h^4}{12}$ $W_x = W_y = \frac{H^4 - h^4}{6H}$

⑤ 	$A = 2\delta(B+H);\ \delta < \frac{H}{15}$ $I_x = \frac{\delta H^3}{6}\left(3\frac{B}{H}+1\right)$ $I_y = \frac{\delta B^3}{6}\left(3\frac{H}{B}+1\right)$ $W_x = \frac{\delta H^2}{3}\left(3\frac{B}{H}+1\right)$ $W_y = \frac{\delta B^2}{3}\left(3\frac{H}{B}+1\right)$
⑥ 	$A = 4H\delta;\ \delta < \frac{H}{15}$ $I_x = I_y = \frac{2}{3}H^3\delta$ $W_x = W_y = \frac{4}{3}H^2\delta$
⑦ 	$A = \frac{bh}{2};\ I_x = \frac{bh^3}{36};\ I_{x_2} = \frac{bh^3}{12};\ I_{x_3} = \frac{bh^3}{4}$ $I_y = \frac{bh(b^2-x_1'x_1)}{36};\ I_{y_2} = \frac{h[(x_1')^3+x_1^3]}{12}$ za $a=c$: $I_y = I_{y_2} = \frac{hb^3}{48}$ $W_x = \frac{bh^2}{12}$ $W_{y_d} = \frac{bh(b^2-x_1'x_1)}{36x_1};\ W_{y_l} = \frac{bh(b^2-x_1'x_1)}{36x_1'}$ za desna vlakna za lijeva vlakna
⑧ 	$I_x = \frac{bh^3}{36};\ I_{x_2} = \frac{bh^3}{12};\ I_{x_3} = \frac{bh^3}{4}$ $I_y = \frac{hb^3}{36};\ I_{y_2} = \frac{hb^3}{12};\ I_{xy} = \frac{-b^2h^2}{72}$ $I_{x_2y_2} = \frac{b^2h^2}{24};\ I_{x_3y_2} = \frac{-b^2h^2}{8}$ $W_x = \frac{bh^2}{12};\ W_y = \frac{hb^2}{12}$

(9)



$$A = \frac{1}{2} h (a + b)$$

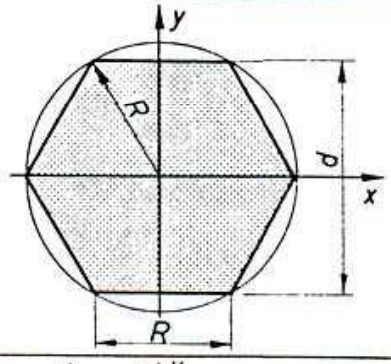
$$y_1 = \frac{b + 2a}{3(b+a)} h ; \quad y_1' = \frac{2b + a}{3(b+a)} h$$

$$I_x = \frac{h^3 (b^2 + 4ab + a^2)}{36 (a + b)}$$

$$I_{x_2} = \frac{h^3 (3a + b)}{12} ; \quad I_{x_3} = \frac{h^3 (a + 3b)}{12}$$

$$W_x = \frac{h^2 (b^2 + 4ab + a^2)}{12 (2a + b)}$$

(10)



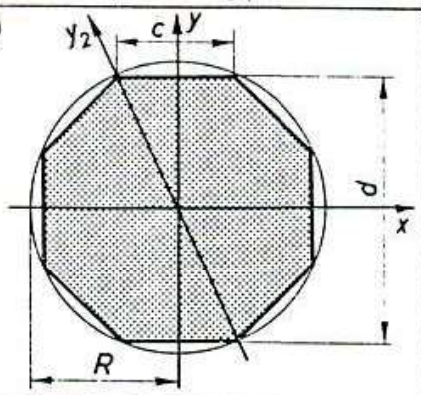
$$A = 0{,}866\, d^2 = 2{,}598\, R^4 = \frac{3\sqrt{3}}{2} R^4$$

$$I_x = I_y = \frac{5\sqrt{3}}{16} R^4 \approx 0{,}5413 R^4 \approx 0{,}06 d^4$$

$$W_x = \frac{5}{8} R^3 = 0{,}12 d^3$$

$$W_y = \frac{5\sqrt{3}}{16} R^3 = 0{,}06 d^3$$

(11)



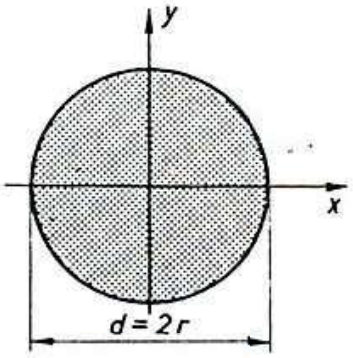
$$A = 0{,}828\, d^2 = 4{,}828\, c^2 = 2{,}828\, R^2$$

$$I_x = I_y = I_{y_2} = \frac{1 + 2\sqrt{2}}{6} R^4 = 0{,}638 R^4 = 0{,}0547 d^4$$

$$W_x = W_y = 0{,}6906\, R^4 = 0{,}1095 d^4$$

$$W_{y_2} = 0{,}638\, R^3 = 0{,}1012 d^3$$

(12)



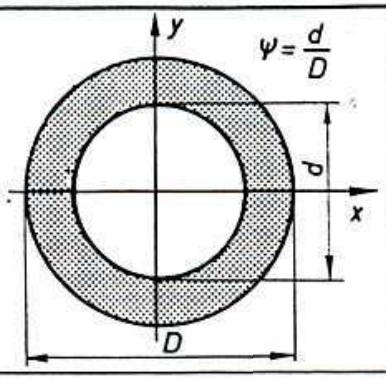
$$A = r^2 \bar{u} = \frac{d^2 \bar{u}}{4} = 0{,}785\, d^2$$

$$I_x = I_y = \frac{r^4 \bar{u}}{4} = \frac{d^4 \bar{u}}{64} = 0{,}05 d^4 = 0{,}785 r^4$$

$$W_x = W_y = \frac{r^3 \bar{u}}{4} = \frac{d^3 \bar{u}}{32}$$

$$i_x = i_y = \frac{r}{2}$$

(13)



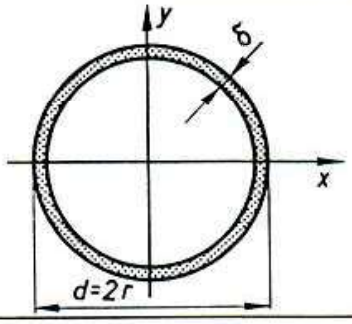
$$\psi = \frac{d}{D}$$

$$A = \frac{\bar{u}(D^2 - d^2)}{4} = \frac{\bar{u} D^4}{4}(1 - \psi^2)$$

$$I_x = I_y = \frac{\bar{u}(D^4 - d^4)}{64} \approx 0{,}05\, D^4(1 - \psi^4)$$

$$W_x = W_y = \frac{\bar{u}(D^4 - d^4)}{32 D} \approx 0{,}1 D^3(1 - \psi^4)$$

(14)



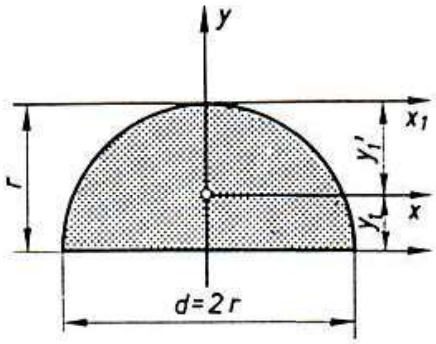
$$A = \bar{u} \cdot \delta \cdot d$$

$$I_x = I_y = \frac{\bar{u}}{8} \cdot \delta \cdot d^3 = \bar{u} \cdot \delta \cdot r^3 = 0{,}393\, d^3 \cdot \delta$$

$$W_x = W_y = \frac{\bar{u} \cdot \delta \cdot d^2}{4} = \bar{u} \cdot \delta \cdot r^2 = 0{,}789\, d^2 \cdot \delta$$

$$i_x = i_y = \frac{\sqrt{2}}{2} r = 0{,}0 \ldots 3\, d$$

(15)



$$A = \frac{\bar{u} d^2}{8} = \frac{\bar{u} \cdot r^2}{2} = 0{,}393\, d^2$$

$$y_1 = \frac{4r}{3\bar{u}} = 0{,}4244\, r; \quad y_1' = 0{,}576\, r$$

$$I_x = \frac{d^4}{16}\left(\frac{\bar{u}}{8} - \frac{8}{9\bar{u}}\right) = 0{,}00686\, d^4 = 0{,}11\, r^4$$

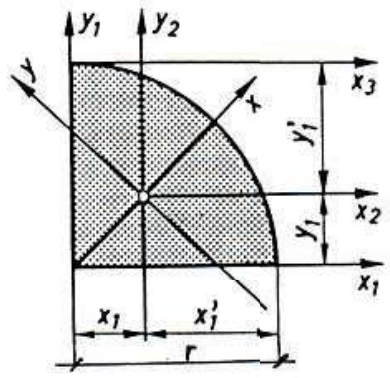
$$I_y = I_{x_2} = \frac{\bar{u} d^4}{128} = \frac{\bar{u} \cdot r^4}{8} = 0{,}0246\, d^4$$

$$W_x \approx 0{,}0239\, d^3 \approx 0{,}191\, r^3$$

$$W_y = \frac{\bar{u} d^3}{64} = \frac{\bar{u} r^3}{8} \approx 0{,}05\, d^3 \approx 0{,}393\, r^4$$

$$i_x = 0{,}132\, d; \quad i_y = \frac{d}{4}$$

(16)



$$A = \frac{\bar{u} r^2}{4} \approx 0.785\, r^2; \quad x_1 = y_1 = \frac{4r}{3\bar{u}} = 0{,}4244 r; \quad x_1' = y_1' = 0{,}576 r$$

$$I_x = 0{,}0714\, r^4; \quad I_y = 0{,}0384\, r^4$$

$$I_{x_1} = I_{y_1} = \frac{\bar{u} r^4}{16} = 0{,}0123\, d^4; \quad I_{x_3} = 0{,}3155\, r^4$$

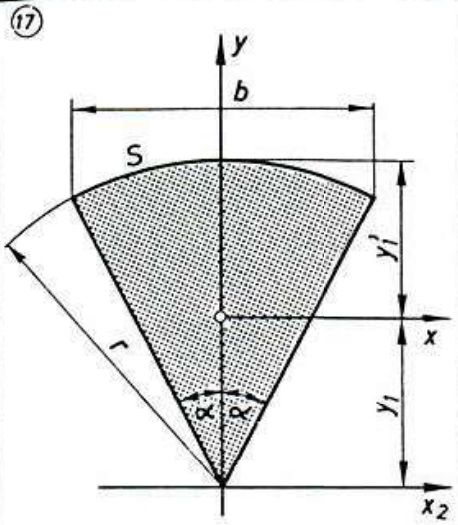
$$I_{x_2} = I_{y_2} = r^4\left(\frac{\bar{u}}{16} - \frac{4}{9\bar{u}}\right) = 0{,}0549\, r^4$$

$$I_{x_1 y_1} = \frac{r^4}{8}; \quad I_{x_2 y_2} = r^4\left(\frac{1}{8} - \frac{4}{9\bar{u}}\right) = -0{,}0165\, r^4$$

$$W_{x_2} = W_{y_2} = 0{,}923\, r^3$$

$$i_x = 0{,}302\, r; \quad i_y = 0{,}221\, r$$

(17)



$$A=\frac{S\cdot r}{2}=\alpha r^2;\ S=2r\alpha;\ \alpha=\frac{\bar{u}\alpha^\circ}{180}$$

$$b=2r\sin\alpha;\ y_1=\frac{2}{3}\frac{rb}{S}=\frac{2r\sin\alpha}{3\widehat{\alpha}}=38{,}2\frac{r\sin\alpha}{\alpha^\circ}$$

$$y_1'=r\left(1-\frac{2}{3}\cdot\frac{\sin\alpha}{\alpha}\right)$$

$$I_x=\frac{r^4}{8}\left(2\alpha+\sin 2\alpha-\frac{32\sin^2\alpha}{9\alpha}\right)$$

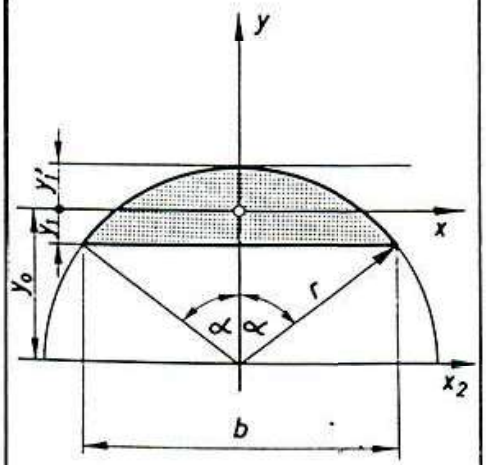
$$I_{x_2}=\frac{r^4}{8}(2\alpha+\sin 2\alpha);\ I_y=\frac{r^4}{8}(2\alpha-\sin 2\alpha)$$

$$W_x=\frac{3r^2\alpha}{16\sin\alpha}\left(2\alpha+\sin 2\alpha-\frac{32\sin^2\alpha}{9\alpha}\right)$$

$$W_y=\frac{r^3(2\alpha-\sin 2\alpha)}{\sin\alpha};\ i_y=\frac{r}{2}\sqrt{1-\frac{\sin 2\alpha}{2\alpha}}$$

$$i_x=\frac{r}{2}\sqrt{1+\frac{\sin 2\alpha}{2\alpha}-\frac{16\sin^2\alpha}{9\alpha^2}}$$

(18)



$$A=\frac{r^2}{2}(2\alpha-\sin 2\alpha);\ \alpha=\frac{\bar{u}\alpha^\circ}{180}$$

$$b=2r\sin\alpha;\ y_0=\frac{2r\sin^3\alpha}{3(2\alpha-\sin 2\alpha)}$$

$$y_1=r\left(\frac{4}{3}\cdot\frac{\sin^3\alpha}{2\alpha\sin 2\alpha}-\cos\alpha\right)$$

$$y_1'=r\left(1-\frac{4}{3}\cdot\frac{\sin^3\alpha}{2\alpha-\sin 2\alpha}\right)$$

$$I_x=\frac{r^4}{8}(2\alpha-\sin 2\alpha+4\cos\alpha\sin^3\alpha)$$

$$I_y=\frac{r^4}{8}\left(2\alpha-\sin 2\alpha-\frac{4}{3}\cos\alpha\sin^3\alpha\right)$$

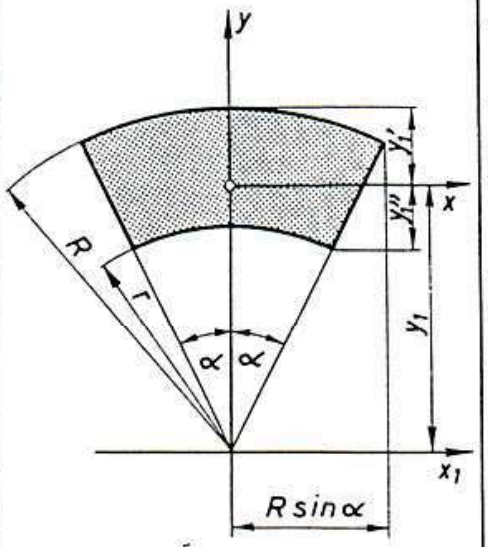
$$I_{x_2}=\frac{r^4}{8}(2\alpha-\sin 2\alpha\cos 2\alpha);\ W_x=\frac{I_x}{y_1'}$$

$$W_y=\frac{r^3}{8\sin\alpha}\left(2\alpha-\sin 2\alpha-\frac{4}{3}\cos\alpha\sin^3\alpha\right)$$

$$i_x=\frac{r}{2}\sqrt{1+\frac{4\cos\alpha\sin^3\alpha}{2\alpha-\sin 2\alpha}}$$

$$i_y=\frac{r}{2}\sqrt{1-\frac{4}{3}\cdot\frac{\cos\alpha\sin^3\alpha}{2\alpha-\sin 2\alpha}}$$

(19)



$$A = \alpha(R^2 - r^2) = \alpha R^2(1 - \psi^2)\,;\ \psi = \frac{r}{R}$$

$$y_1 = \frac{2}{3}\,\frac{R^3 - r^3}{R^2 - r^2}\cdot\frac{\sin\alpha}{\alpha} = \frac{2}{3}\cdot\frac{R\sin\alpha}{\alpha}\cdot\frac{1-\psi^3}{1-\psi^2}$$

$$y_1' = R\left(1 - \frac{2}{3}\cdot\frac{\sin\alpha}{\alpha}\cdot\frac{1-\psi^3}{1-\psi^2}\right)$$

$$y_1'' = \frac{2R\sin\alpha}{3\alpha}\left(\frac{1-\psi^3}{1-\psi^2} - \frac{3}{2}\,\psi\alpha\,\mathrm{cotg}\,\alpha\right)$$

$$I_x = \frac{R^4}{8}(1-\psi^4)\cdot\left[2\alpha + \sin 2\alpha - \frac{32\sin^2\alpha}{9\alpha}\right]$$

$$I_{x_1} = \frac{R^4}{8}(1 - \psi^4 2\alpha + \sin 2\alpha)$$

$$I_y = \frac{R^4}{8}\left[1 - \psi^4(2\alpha - \sin 2\alpha)\right]$$

$$W_x = \frac{I_x}{y_1'} \quad \text{(za gornja vlakna)}$$

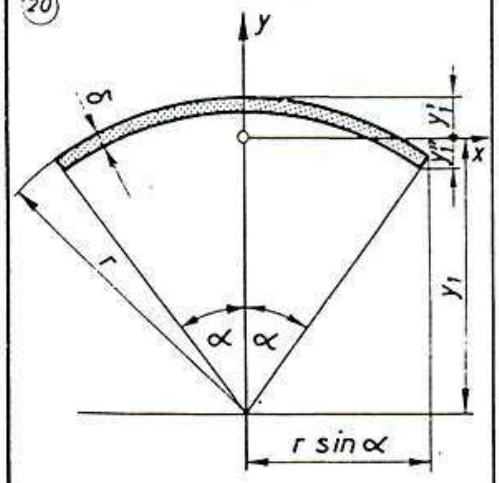
$$W_x = \frac{I_x}{y_1''} \quad \text{(za donja vlakna)}$$

$$W_y = \frac{R^3}{8}(1-\psi^4)\cdot\frac{2\alpha - \sin 2\alpha}{\sin\alpha}$$

$$i_x = \frac{R}{2}\sqrt{(1+\psi^2)\cdot\left(1 + \frac{\sin 2\alpha}{2\alpha}\right) - \frac{16\sin^2\alpha}{9\alpha^2}}$$

$$i_y = \frac{R}{2}\sqrt{(1+\psi^2)\cdot\left(1 - \frac{\sin 2\alpha}{2\alpha}\right)}$$

(20)



$$A = 2\alpha\cdot r\cdot\delta\,;\ y_1 = r\cdot\frac{\sin\alpha}{\alpha}\,;$$

$$y_1' = r\left(1 - \frac{\sin\alpha}{\alpha}\right);\ y_1'' = r\left(\frac{\sin\alpha}{\alpha} - \cos\alpha\right)$$

$$I_x = \frac{\delta\cdot r^3}{2}\left(2\alpha + \sin 2\alpha - \frac{4\sin^2\alpha}{\alpha}\right)$$

$$I_y = \frac{\delta\cdot r^3}{2}(2\alpha - \sin 2\alpha)$$

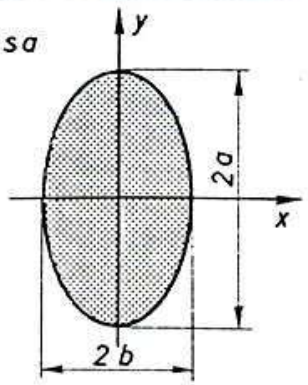
$$W_x \approx \frac{\delta r^2}{2}\cdot\left(\frac{2\alpha + \sin 2\alpha - 4\dfrac{\sin 2\alpha}{2\alpha}}{1 - \dfrac{\sin\alpha}{\alpha}}\right) \text{ za gornja vlakna}$$

$$W_x \approx \frac{\delta r^2}{2}\cdot\left(\frac{2\alpha + \sin 2\alpha - \dfrac{4\sin 2\alpha}{2\alpha}}{\dfrac{\sin\alpha}{\alpha} - \cos\alpha}\right) \text{ za donja vlakna}$$

$$W_y \approx \frac{\delta r^2}{2}\,\frac{2\alpha - \sin 2\alpha}{\sin\alpha}$$

$$i_x = \frac{r}{2}\sqrt{2 + \frac{\sin 2\alpha}{\alpha} - \frac{4\sin^2\alpha}{\alpha^2}}\,;\ i_y = \frac{r}{2}\sqrt{2\,\frac{\sin 2\alpha}{2}}$$

(21) Elipsa



$$A = a \cdot b \cdot \bar{u} \; ; \quad \frac{a}{b} > 1$$

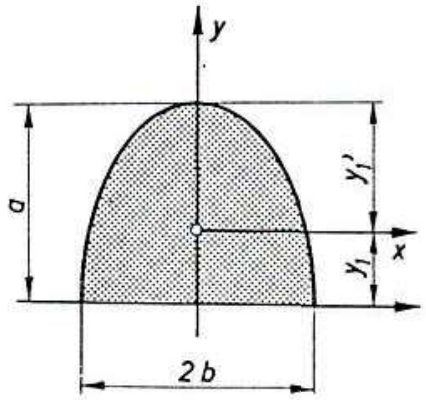
$$I_x = \frac{\bar{u} \cdot a^3 b}{4} \approx 0{,}785\, a^3 b$$

$$I_y = \frac{\bar{u} \cdot a \cdot b^3}{4} \approx 0{,}785 \cdot a \cdot b^3$$

$$W_x = \frac{\bar{u} \cdot a^2 b}{4} \approx 0{,}785 \cdot a^2 b \qquad i_x = \frac{a}{2}$$

$$W_y = \frac{\bar{u} \cdot a \cdot b^2}{4} \approx 0{,}785 \cdot a \cdot b^2 \qquad i_y = \frac{b}{2}$$

(22) Poluelipsa



$$A = \frac{a \cdot b \cdot \bar{u}}{2} \; ; \; y = \frac{4a}{3\bar{u}} \; ; \; y = \left(1 - \frac{4}{3\bar{u}}\right) \cdot a$$

$$I_x = b \cdot a^3 \left(\frac{\bar{u}}{8} - \frac{8}{9\bar{u}}\right) \; ; I = \frac{\bar{u} \cdot a \cdot b^3}{8}$$

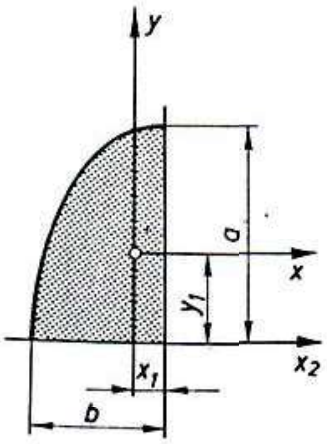
$$W_x = \frac{3}{4}\, b \cdot a^2 \left(\frac{\bar{u}^2}{8} - \frac{8}{9}\right) \quad \text{za donja vlakna}$$

$$W_x = \frac{b \cdot a^2 \left(\frac{\bar{u}}{8} - \frac{8}{9\bar{u}}\right)}{1 - \frac{4}{3\bar{u}}} \quad \text{za gornja vlakna}$$

$$W_y = \frac{\bar{u} \cdot a \cdot b^2}{8} \approx 0{,}329 \cdot a \cdot b^2$$

$$i_x = \frac{a}{2}\sqrt{1 - \left(\frac{8}{3\bar{u}}\right)^2} \; ; \; i_y = \frac{b}{2}$$

(23) Četvrtina elipse



$$A = \frac{a \cdot b \cdot \bar{u}}{4} \; ; \; x_1 = \frac{4b}{3\bar{u}} \; ; \; y_1 = \frac{4a}{3\bar{u}}$$

$$I_x = b \cdot a^3 \left(\frac{\bar{u}}{16} - \frac{4}{9\bar{u}}\right) = 0{,}0549\, a^3 b$$

$$I_y = a \cdot b^3 \left(\frac{\bar{u}}{16} - \frac{4}{9\bar{u}}\right) = 0{,}0549\, a \cdot b^3$$

$$|I_{xy}| = 0.017\, a^2 \cdot b^2$$

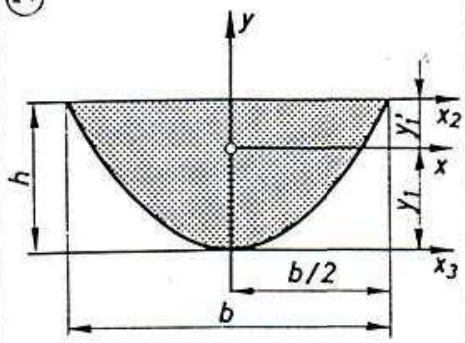
$$I_{x_2} = \frac{1}{16} \cdot \bar{u} \cdot a^3 b \; ; \quad I_{y_2} = \frac{1}{16}\, \bar{u} \cdot a \cdot b^3$$

$$|I_{x_2 y_2}| = \frac{a^2 b^2}{8} \; ; \quad W_{x\min} = \frac{3}{4}\, b \cdot a^2 \left(\frac{\bar{u}^2}{16} - \frac{4}{9}\right)$$

$$W_{y\min} = \frac{3}{4} \cdot a \cdot b^2 \cdot \left(\frac{\bar{u}^2}{16} - \frac{4}{9}\right)$$

$$i_x = \frac{a}{2}\sqrt{1 - \left(\frac{8}{3\bar{u}}\right)^2} \; ; \; i_y = \frac{b}{2}\sqrt{1 - \left(\frac{8}{3\bar{u}}\right)^2}$$

(24)



$$A = \frac{2}{3} \cdot b \cdot h \; ; \; y_1 = \frac{3}{5} \cdot h \; ; \; y_1' = \frac{2}{5} h$$

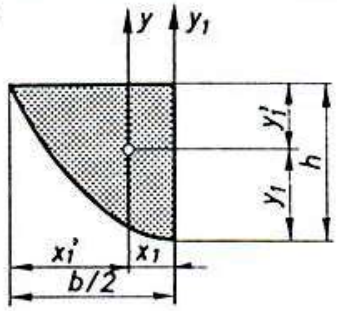
$$I_x = \frac{8}{175} b \cdot h^3 ; \; I_{x_2} = \frac{16}{105} \cdot b \cdot h^3 ; \; I_{x_3} = \frac{2}{7} b \cdot h^3$$

$$I_y = \frac{h \cdot b^3}{30}$$

$$W_x = \frac{8}{105} b \cdot h^2 ; \; W_y = \frac{b^2 \cdot h}{15}$$

$$i_1 = \frac{2}{5} h \sqrt{\frac{3}{7}} \; ; \; i_2 = \frac{b}{2\sqrt{5}}$$

(25)



$$A = \frac{b \cdot h}{3} \; ; \; x_1 = \frac{3}{16} \cdot b \; ; \; x_1' = \frac{5}{16} b$$

$$y_1 = \frac{3}{5} \cdot h \; ; \; y_1' = \frac{2}{5} \cdot h$$

$$I_x = \frac{4}{175} \cdot b \cdot h^3 ; \; W_x = \frac{2}{35} \cdot b \cdot h^2$$

$$i_x = \frac{2 \cdot h}{5} \cdot \sqrt{\frac{3}{7}}$$

(26)

$$A = 0{,}215\, r^2 ; \; x_1 = y_1 = 0{,}223\, r$$

$$x_1' = y_1' = 0{,}777\, r$$

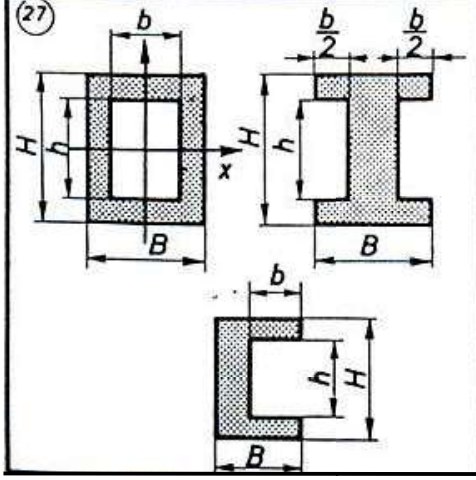
$$I_x = I_y = 0{,}00755\, r^4$$

$$I_{x_2} = 0{,}003\, r^4$$

$$I_{x_3} = I_{y_3} = 0{,}0181\, r^4 ; \; I_{y_2} = 0{,}0121\, r^4$$

$$i_{x_{min}} = 0{,}187\, r \; ; \; W_{x_2} = 0{,}0097\, r^3$$

(27)



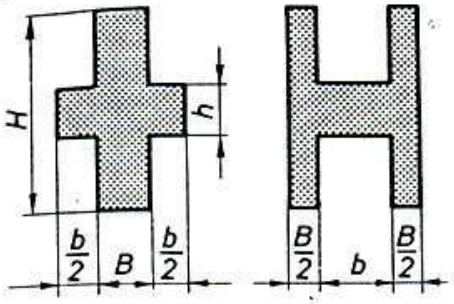
$$A = B \cdot H - b \cdot h \; ; \; y_1 = \frac{H}{2}$$

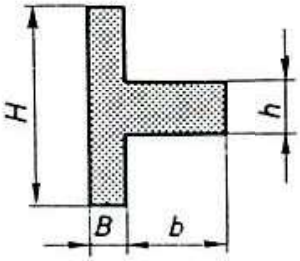
$$I_x = \frac{B \cdot H^3 - b \cdot h^3}{12}$$

$$W_x = \frac{B \cdot H^3 - b \cdot h^3}{6H}$$

$$i_x = \frac{BH^3 - b \cdot h^3}{12(BH - bh)}$$

(28)





$$A = BH + bh$$

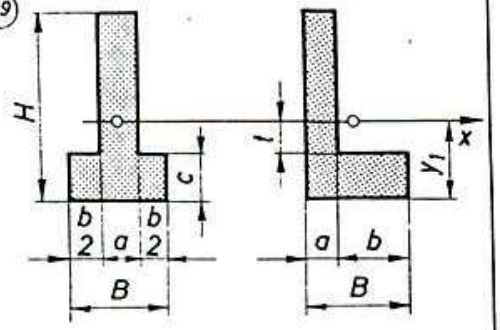
$$y_1 = \frac{H}{2}$$

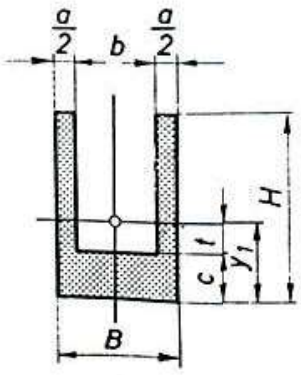
$$I_x = \frac{BH^3 + bh^3}{12}$$

$$W_x = \frac{BH^3 + bh^3}{6H}$$

$$i_x = \sqrt{\frac{BH^3 + bh^3}{12(BH + bh)}}$$

(29)





$$A = a \cdot h + b \cdot c$$

$$y_1 = \frac{aH^2 + bc^2}{2(aH + bc)}$$

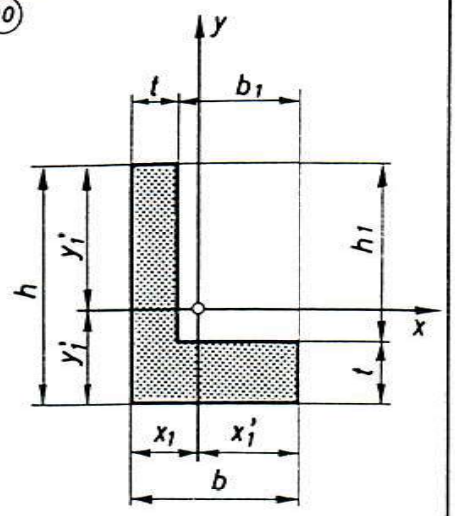
$$y_1' = H - y_1$$

$$I_x = \frac{1}{3}\left[B \cdot y_1^3 - b \cdot t^3 + a \cdot (y_1')^3\right]$$

$$W_x = \frac{I_x}{y_1'}$$

$$i_x = \sqrt{\frac{I_x}{A}}$$

(30)



$$A = t(b + h_1) = t(h + b_1)$$

$$x_1 = \frac{b^2 + h_1 t}{2(b + h)}; \quad y_1 = \frac{h^2 + b_1 t}{2(h + b)}$$

$$y_1' = h - y_1 = \frac{h^2 + b_1(2h - t)}{2(h + b_1)}$$

$$I_x = \frac{1}{3}\left[t(h - y_1)^3 + b \cdot y_1^3 - b_1(y_1 - t)^3\right]$$

$$I_x = \frac{1}{3}\left[t(b - x_1)^3 + h \cdot x_1^3 - h_1(x_1 - t)^3\right]$$

$$I_{xy} = -\frac{b \cdot b_1 \cdot h \cdot h_1 \cdot t}{4(b + h_1)} = \frac{b \cdot b_1 \cdot h \cdot h_1 \cdot t}{4(h + b_1)}$$

$$W_x = \frac{I_x}{y_1'}; \quad W_y = \frac{I_y}{x_1'}$$

$$i_x = \sqrt{\frac{I_x}{A}} = 0.29\,h; \; i_y = \sqrt{\frac{I_y}{A}} = 0,32\,b$$