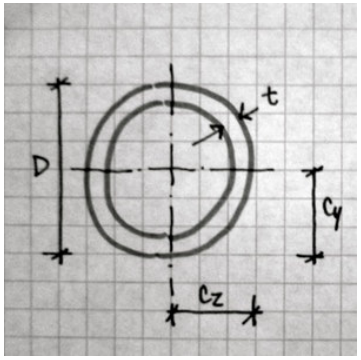
Tube



Input: $D := 508 \cdot mm$ $t := 20mm$

$$Ax := \frac{\pi}{4} \cdot \left[D^2 - (D - 2 \cdot t)^2 \right] \qquad Ax = 3.066 \times 10^4 \cdot mm^2$$

$$Iy := \frac{\pi}{64} \cdot \left[D^4 - (D - 2 \cdot t)^4 \right] \qquad Iy = 9.143 \times 10^8 \cdot mm^4$$

$$r := \sqrt{\frac{Iy}{Ax}} \qquad r = 172.679 \cdot mm$$

$$J := \frac{\pi \cdot (D - t)^3 \cdot t}{4} \qquad J = 1.825 \times 10^6 \, m \cdot mm^3$$

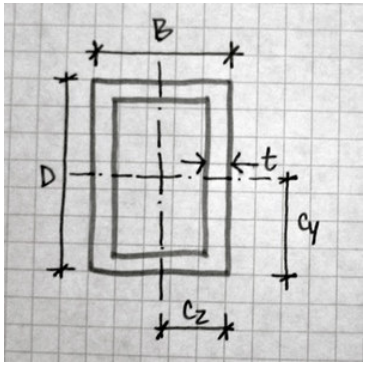
$$Cy := \frac{D}{2} \qquad Cy = 254 \cdot mm$$

$$S := \frac{Iy}{Cy} \qquad S = 3.6 \times 10^6 \cdot mm^3$$

$$Z := \frac{1}{6} \cdot \left[D^3 - (D - 2 \cdot t)^3 \right] \qquad Z = 4.766 \times 10^6 \cdot mm^3$$

$$SF := \frac{S}{Z} \qquad SF = 0.755$$

Hollow box



Input: $B := 200\cdot mm$ $D := 430\cdot mm$ $t := 12mm$

$Ax := B\cdot D - (B - 2\cdot t)\cdot(D - 2\cdot t)$ $Ax = 1.454\times 10^{4}\cdot mm^{2}$

$Iy := \frac{B\cdot D^{3} - (B - 2\cdot t)\cdot(D - 2\cdot t)^{3}}{12}$ $Iy = 3.436\times 10^{8}\cdot mm^{4}$

$Iz := \frac{D\cdot B^{3} - (D - 2\cdot t)\cdot(B - 2\cdot t)^{3}}{12}$ $Iz = 1.022\times 10^{8}\cdot mm^{4}$

$K := (B - t)\cdot(D - t)^{2}\cdot t$ $K = 3.942\times 10^{8}\cdot mm^{4}$

$ry := \sqrt{\frac{Iy}{Ax}}$ $rz := \sqrt{\frac{Iz}{Ax}}$ $ry = 153.698\cdot mm$ $rz = 83.833\cdot mm$

$Sy := \frac{Iy}{\left(\frac{D}{2}\right)}$ $Sz := \frac{Iz}{\left(\frac{B}{2}\right)}$ $Sy = 1.598\times 10^{6}\cdot mm^{3}$ $Sz = 1.022\times 10^{6}\cdot mm^{3}$

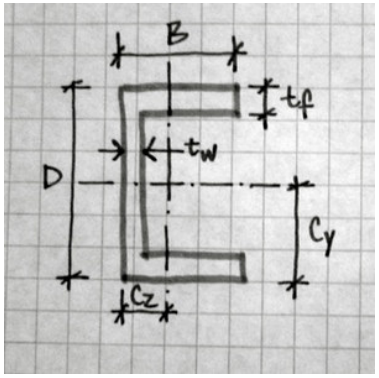
$Zy := \frac{B\cdot D^{2} - (B - 2\cdot t)\cdot(D - 2\cdot t)^{2}}{4}$ $Zy = 1.992\times 10^{6}\cdot mm^{3}$

$Zz := \frac{D\cdot B^{2} - (D - 2\cdot t)\cdot(B - 2\cdot t)^{2}}{4}$ $Zz = 1.156\times 10^{6}\cdot mm^{3}$

$SFy := \frac{Zy\cdot D}{2\cdot Iy}$ $SFz := \frac{Zz\cdot B}{2\cdot Iz}$ $SFy = 1.247$ $SFz = 1.131$

Input: $B := 120\cdot mm$ $D := 375\cdot mm$ $tf := 12mm$ $tw := 9mm$

Channel



$$Ax := B\cdot D - (D - 2\cdot tf)\cdot(B - tw) \qquad Ax = 6.039\times 10^{3}\cdot mm^{2}$$

$$Cy := \frac{D}{2} \qquad Cy = 187.5\cdot mm$$

$$Cz := \frac{2\cdot B^{2}\cdot tf + (D - 2\cdot tf)\cdot tw^{2}}{2\cdot B\cdot D - 2\cdot(D - 2\cdot tf)\cdot(B - tw)} \qquad Cz = 30.968\cdot mm$$

$$Iy := \frac{B\cdot D^{3} - (B - tw)\cdot(D - 2tf)^{3}}{12} \qquad Iy = 1.273\times 10^{8}\cdot mm^{4}$$

$$Iz := \frac{2\cdot tf\cdot B^{3} - (D - 2\cdot tf)\cdot tw^{3}}{12} + 2\cdot B\cdot tf\cdot\left(\frac{B}{2} - Cz\right)^{2} + tw\cdot(D - 2\cdot tf)\cdot\left(Cz - \frac{tw}{2}\right)^{2} \qquad Iz = 8.075\times 10^{6}\cdot mm^{4}$$

$$ry := \sqrt{\frac{Iy}{Ax}} \qquad rz := \sqrt{\frac{Iz}{Ax}} \qquad ry = 145.212\cdot mm$$

$$Zz := \text{if}(cn \le rs, zza, zzb) \qquad Zz = 1.578\times 10^{5}\cdot mm^{3}$$

$$Zy := \frac{D^{2}\cdot tw}{4} + tf\cdot(B - tw)\cdot(D - tf) \qquad Zy = 7.999\times 10^{5}\cdot mm^{3}$$

$$cn := 2\cdot tf\cdot(B - tw)$$

$$rs := D\cdot tw$$

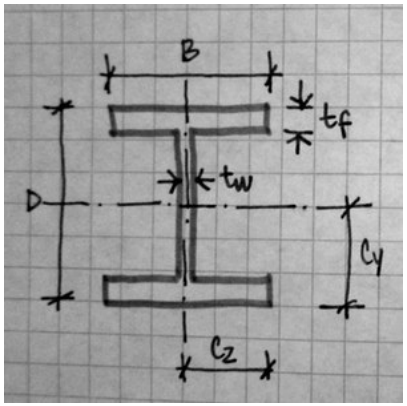
$$zza := \frac{tf\cdot(B - tw)^{2}}{2} - \frac{D^{2}\cdot tw^{2}}{8\cdot tf} + \frac{D\cdot tw\cdot B}{2}$$

$$zzb := \frac{tw^{2}\cdot D}{4} + tf\cdot(B - tw)\cdot\left[B - \frac{tf\cdot(B - tw)}{D}\right]$$

$$Sy := \frac{Iy}{Cy}\,8\times 10^{6}\cdot mm^{3}$$

$$Sz := \frac{Iz}{Cz}\,2\times 10^{6}\cdot mm^{3}$$

I section (Equal)



Input: $B := 220\cdot mm$ $D := 400\cdot mm$ $tf := 12mm$ $tw := 9mm$

$d := D - 2\cdot tf$

$b := B - tw$

$Ax := B\cdot D - b\cdot d$ $\quad Ax = 8.664\times 10^{3}\cdot mm^{2}$

$Iy := \frac{B\cdot D^{3} - b\cdot d^{3}}{12}$ $\quad Iy = 2.386\times 10^{8}\cdot mm^{4}$

$Iz := \frac{D\cdot B^{3} - d\cdot b^{3}}{12}$ $\quad Iz = 6.059\times 10^{7}\cdot mm^{4}$

$K := \frac{2\cdot B\cdot tf^{3} + D\cdot tw^{3}}{3}$ $\quad K = 3.506\times 10^{5}\cdot mm^{4}$

$ry := \sqrt{\frac{Iy}{Ax}}$ $\quad rz := \sqrt{\frac{Iz}{Ax}}$ $\quad ry = 165.967\cdot mm$ $\quad rz = 83.626\cdot mm$

$Sy := \frac{Iy}{\left(\frac{D}{2}\right)}$ $\quad Sz := \frac{Iz}{\left(\frac{B}{2}\right)}$ $\quad Sy = 1.193\times 10^{6}\cdot mm^{3}$ $\quad Sz = 5.508\times 10^{5}\cdot mm^{3}$

$Zy := \left(\frac{tw\cdot d^{2}}{4}\right) + B\cdot tf\cdot(d + tf)$ $\quad Zz := \left(\frac{tf\cdot B^{2}}{2}\right) + \left(\frac{d\cdot tw^{2}}{4}\right)$ ım $\quad Zy = 7.999\times 10^{5}\cdot mm^{3}$

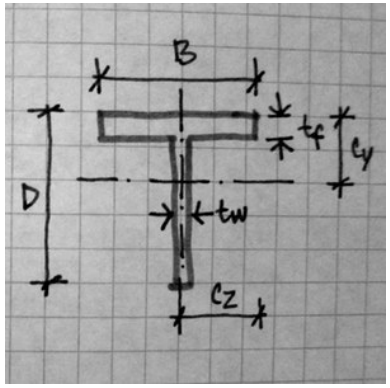
$Zz = 2.98\times 10^{5}\cdot mm^{3}$

$SFy := Zy\cdot\frac{\left(\frac{D}{2}\right)}{Iy}$ $\quad SFz := Zz\cdot\frac{\frac{B}{2}}{Iz}$

$SFy = 1.247$

$SFz = 0.541$

T section



Input: $B := 220 \cdot mm$ $D := 400 \cdot mm$ $tf := 12mm$ $tw := 10mm$

$d := D - tf$

$$Cy := \frac{B \cdot tf^2 + tw \cdot d \cdot (2 \cdot tf + d)}{2 \cdot B \cdot tf + d \cdot tw}$$

$Cy = 177.974 \cdot mm$

$$Cz := \frac{B}{2}$$

$Cz = 110 \cdot mm$

$Ax := B \cdot tf + d \cdot tw$

$Ax = 6.52 \times 10^{3} \cdot mm^{2}$

$$Iy := \frac{tw \cdot Cy^3 + B \cdot (D - Cy)^3 - (B - tw) \cdot (D - Cy - tf)^3}{3}$$

$Iy = 1.729 \times 10^{8} \cdot mm^{4}$

$$Iz := \frac{tf^3 \cdot B + tw^3 \cdot D}{3} \qquad ry := \sqrt{\frac{Iy}{Ax}} \qquad rz := \sqrt{\frac{Iz}{Ax}}$$

$Iz = 2.601 \times 10^{5} \cdot mm^{4}$

$ry = 162.847 \cdot mm$

$rz = 6.315 \cdot mm$

$$Sy := \frac{Iy}{Cy} \qquad Sz := \frac{Iz}{Cz}$$

$Sy = 9.715 \times 10^{5} \cdot mm^{3}$

$Sz = 2.364 \times 10^{3} \cdot mm^{3}$

$$K := \frac{tf \cdot B^3 + d \cdot tw^3}{3}$$

$K = 4.272 \times 10^{7} \cdot mm^{4}$