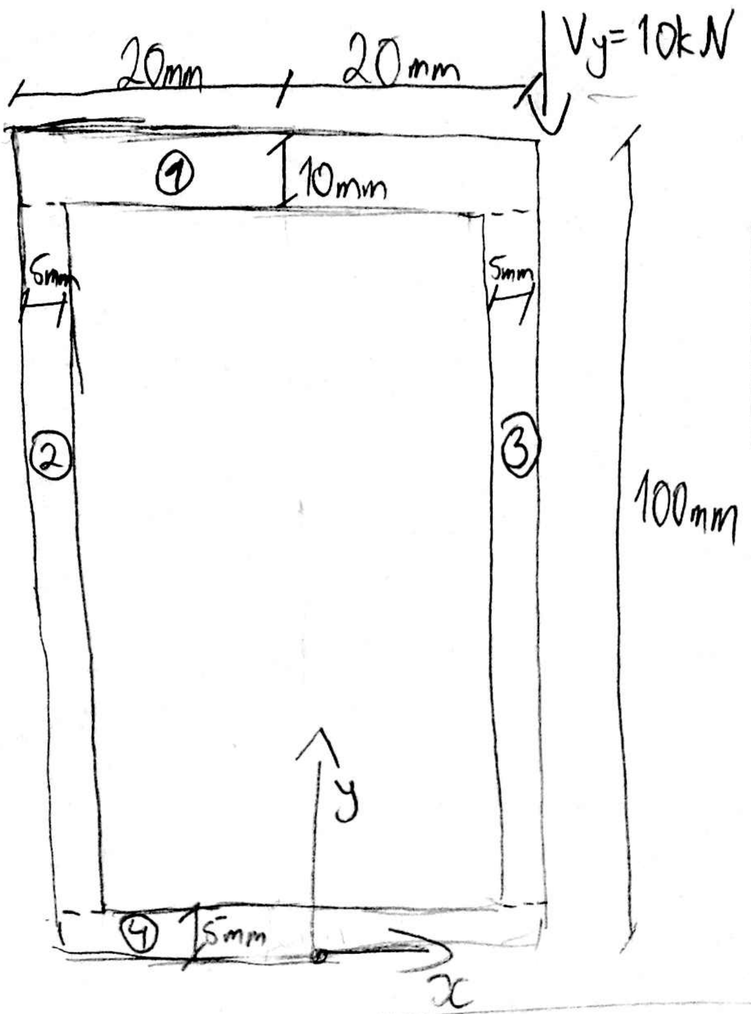


$$\bar{y}_c = \frac{S_x}{A}$$

$$A_{TOTAL} = 40(10) + 5(85) + 5(85) + 5(40) = 1{,}450\,mm^2$$

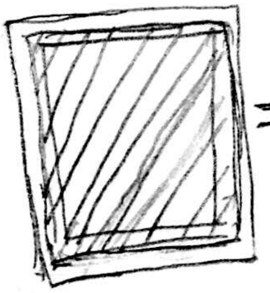
$$S_{x\,TOTAL} = 400(95) + 425(50) + 425(50) + 200(2.5) = 81{,}000\,mm^3$$

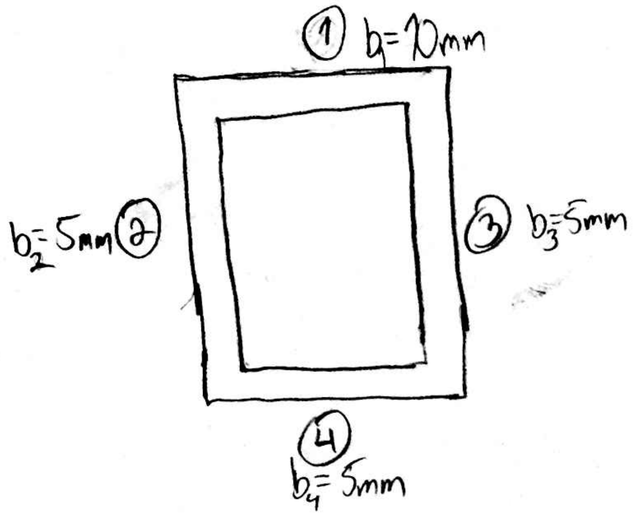
$$\bar{y}_c = \frac{81{,}000}{1{,}450} = 55.86\,mm$$

$$\text{Centroid} = (\underset{x}{0}, \underset{y}{55.86})$$

$M_t = Vd = 10(20) = 200\ kN\cdot mm$

Bredt formula for torsion: $\tau_z = \dfrac{M_t}{2\Omega b}$

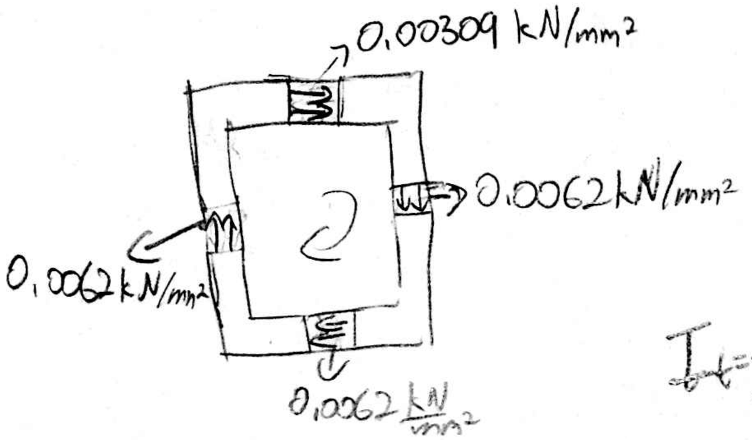
$\Omega =$  $= (92.5)(35) = 3237.5\,mm^2$



$$Mt = 200\,kN\cdot mm \qquad \Omega = 3237.5\,mm^2$$

$$\tau_{z_1} = \frac{Mt}{2\Omega b_1} = \frac{200}{2(3237.5)(10)} = 0.00309\,\frac{kN}{mm^2}$$

$$\tau_{z_2} = \tau_{z_3} = \tau_{z_4} = \frac{200}{2(3237.5)(5)} = 0.0062\,\frac{kN}{mm^2}$$

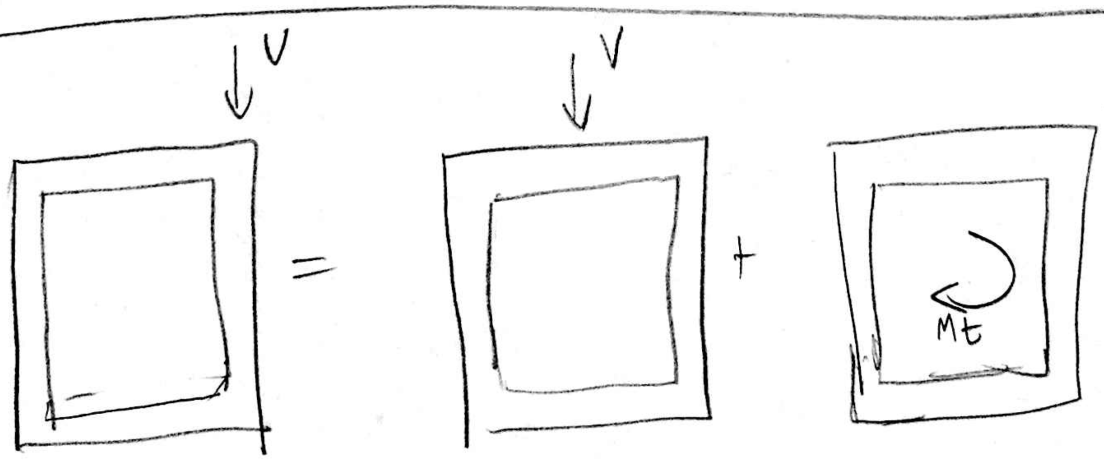


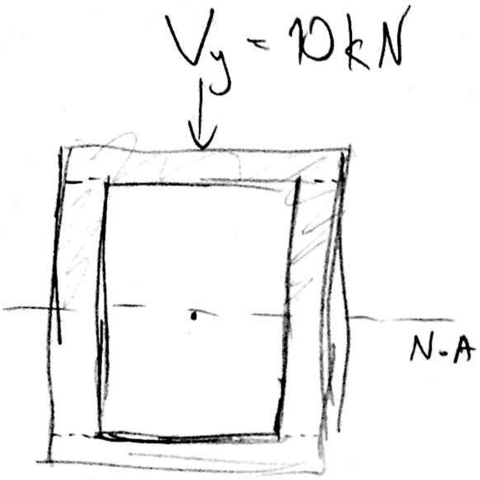
$$\tau_{z_{max}} = \frac{Mt}{It}\cdot b$$

$$It = \frac{1}{3}\sum^{m} ab^3 = \frac{1}{3}\left[40(10^3) + 85(5^3) + 85(5^3) + 40(5^3)\right]$$
$$= \frac{1}{3}\left(40{,}000 + 10{,}625 + 10{,}625 + 5{,}000\right)$$
$$= 20583.33\,mm^4$$

$$\tau_{z(b=10)} = \frac{200}{20583.33} \times 10 = 0.097\,kN/mm^2$$

$$\tau_{z(b=5)} = \frac{200}{20583.33} \times 5 = 0.049\,kN/mm^2$$





$$\tau_{N.A} = \frac{VQ}{Ib} \ldots \quad V = 10kN$$

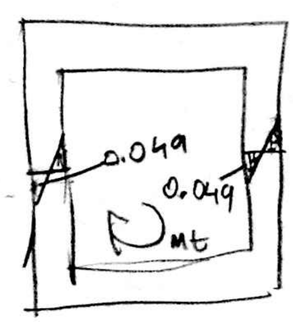
$$I_{TOTAL} = \Big[\frac{1}{12}40\cdot10^3 + 400(39.14)^2 + (2)\frac{1}{12}\cdot5\cdot85^3 + (2)425\cdot5.8\ldots$$
$$+ \frac{1}{12}40\cdot5^3 + 200(53.36)^2\Big]$$
$$= 652775.84 + 540959.5 + 569874.5\ldots$$
$$= 1,763,609.93\ mm^4$$

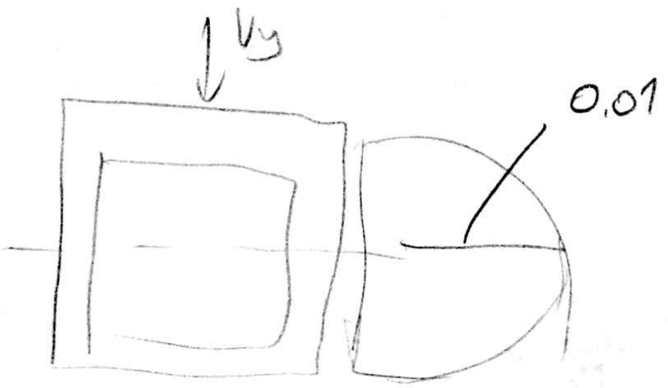
N.A = 55.86

$$Q = \sum A y' = (2)(34.14)(5)(5.86) + (40)(10)(39.14)$$
$$= 17,656.6\ mm^3$$

$b = 2 \times 5 = 10mm$

$$\tau_{N.A} = \frac{10 \times 17,656.6}{1,763,609.93 \times 10}$$
$$= 0.01\ kN/mm^2$$





$$0.049 + 0.049 + 0.01 = 0.1089\ kN/mm^2$$