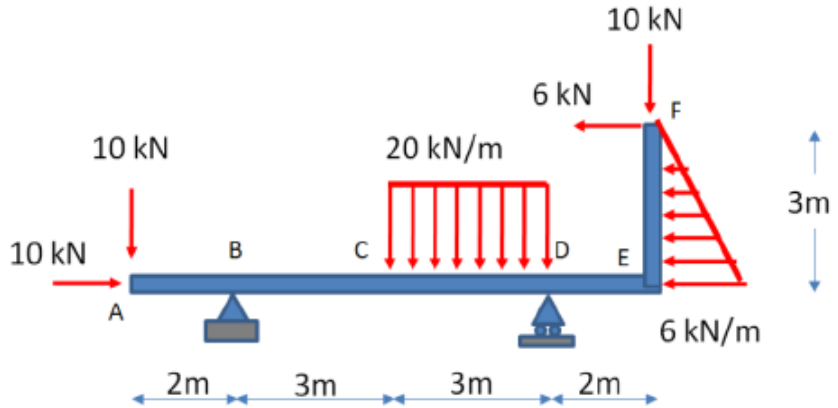
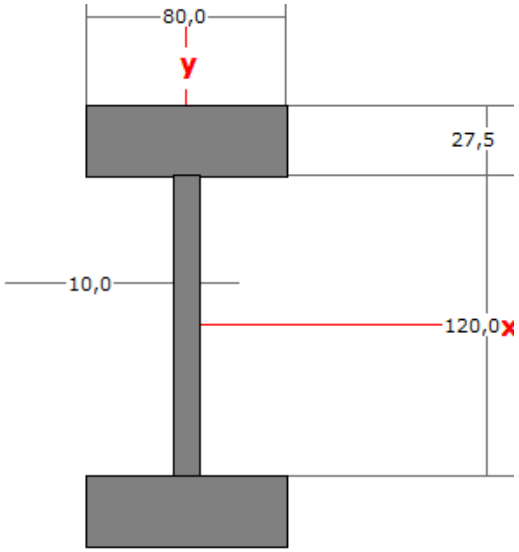
Determine the maximum normal stresses of the next cross section located in the weakest point of the beam.

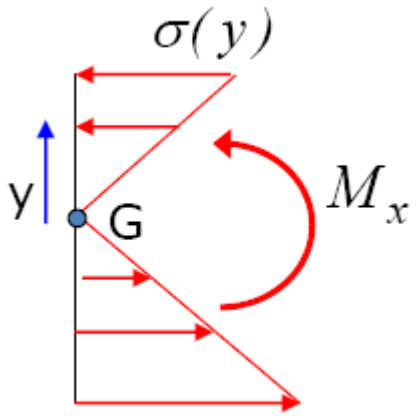
$$\sum_{Rincon}^{El} \sqrt[del]{Ingeniero}$$

http://www.elrincondelingeniero.com/



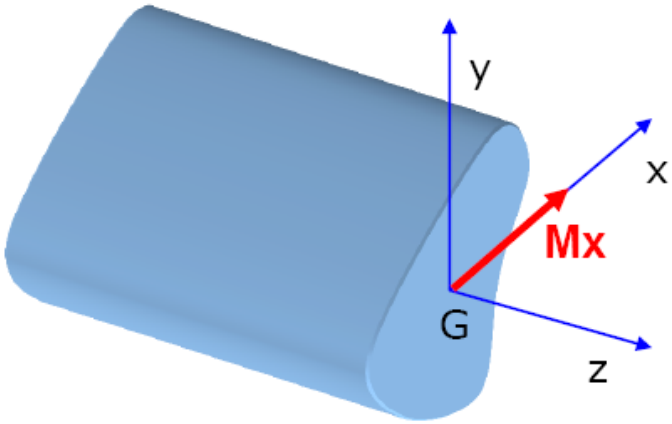
$$\sigma_z(y) = \frac{N}{A} + \frac{M_x \cdot y}{I_G}$$

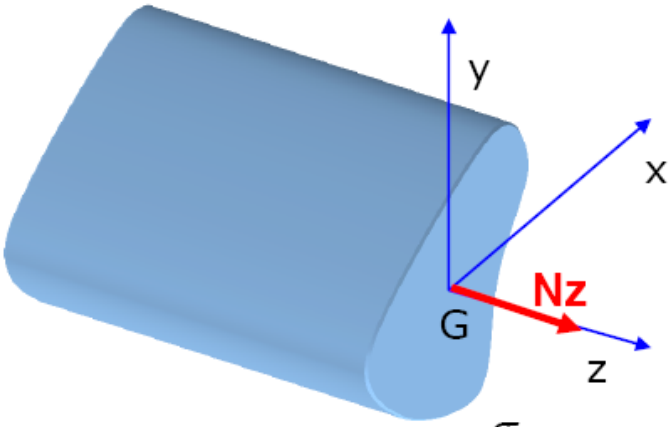




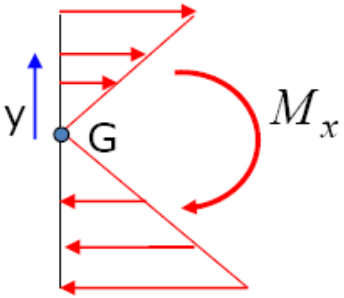
BENDING MOMENT AND AXIAL FORCE. NORMAL STRESSES

Normal stresses to the XY plane produced by Nz y Mx

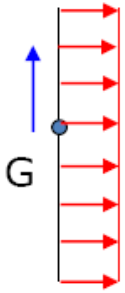




$$\leftarrow\square\rightarrow \quad \sigma_z(y) = \frac{\downarrow\square\downarrow\ M_x \cdot y}{I_G}$$



$$\leftarrow\square\rightarrow \quad \sigma_z = \frac{N}{A}$$



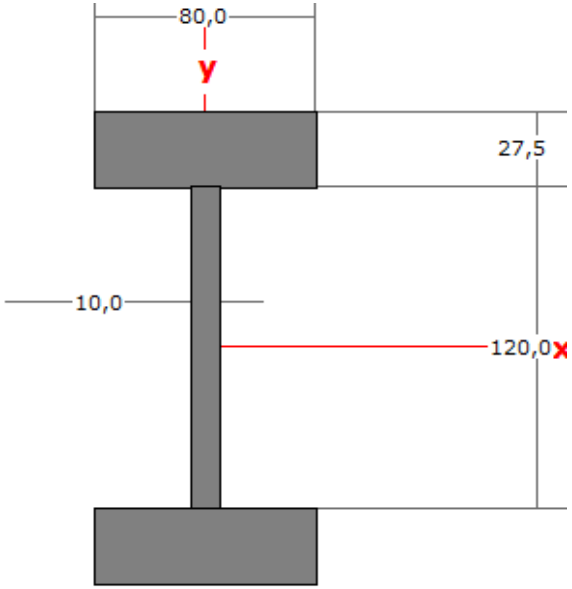
By superposition principle:

$$\leftarrow\square\rightarrow \quad \sigma_z(y) = \frac{\downarrow\square\downarrow\ M_x \cdot y}{I_G} + \frac{N}{A}$$

The position of the neutral axis is different to y=0, it can be determined by:

$$\leftarrow\square\rightarrow \quad \sigma_z(y) = 0$$

Mass geometry



$$(x_{com}, y_{com}) = (0, 87{,}5\ )mm$$

$$I_x = \frac{1}{12}80.175^3 - 2.\left(\frac{1}{12}35.120^3\right)$$

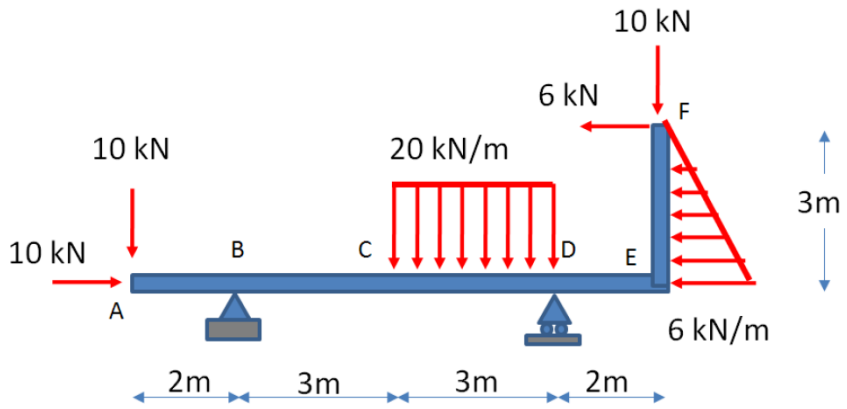
$$\mathbf{I_x = 25{,}64.10^6\ mm^4}$$

$$I_y = \frac{1}{12}80^3.175 - 2.(\frac{1}{12}35^3.120 +$$

$$+120.35.22{,}5^2)$$

$$\mathbf{I_y = 2{,}35.10^6\ mm^4}$$

Force Laws



$$V_D = 50{,}5\ kN$$

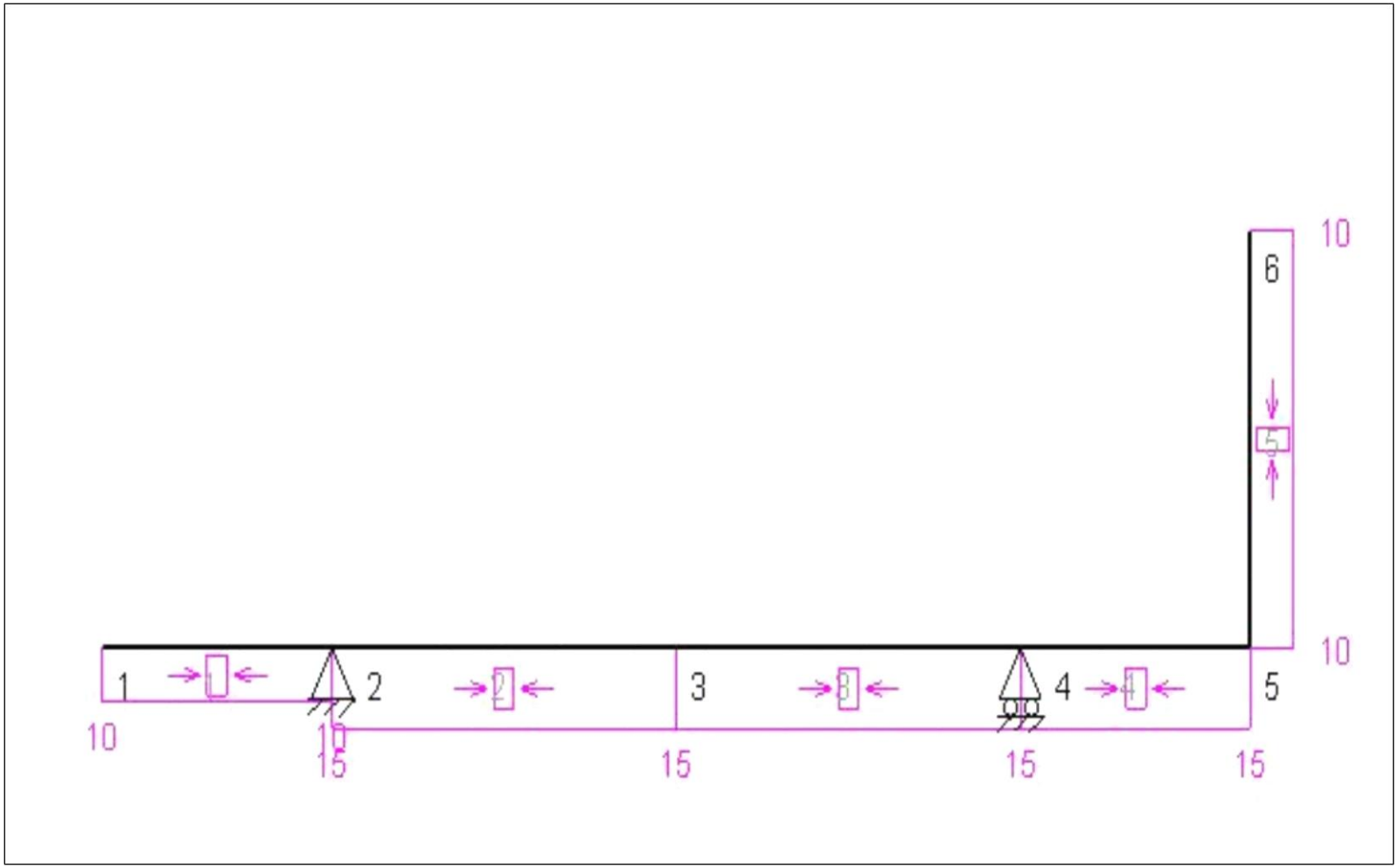
$$V_B = 29{,}5\ kN$$

$$H_D = 5{,}00\ kN$$

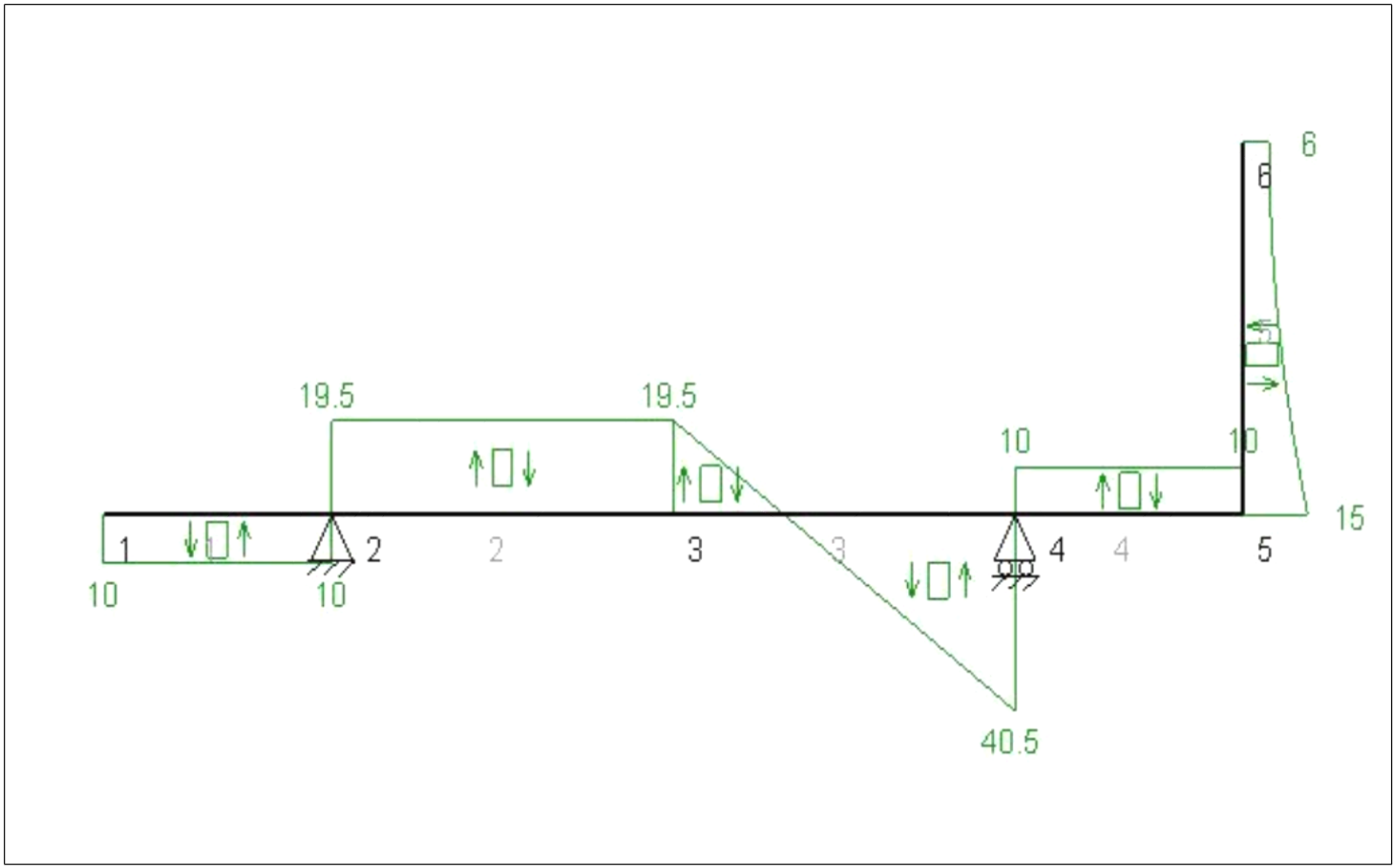
Force laws

Y	X	N	V(x,y)	M(x,y)
0	0-2	-10	10	$-10x$
0	2-5	-15	-19,5	$19{,}5x - 59$
0	5-8	-15	$20x - 119{,}5$	$-10x^2 + 119{,}5x - 309$
0	8-10	-15	-10	$10x - 73$
0-3	10	-10	$-6 - y^2$	$6y + y^3/3$

Normal forces diagram



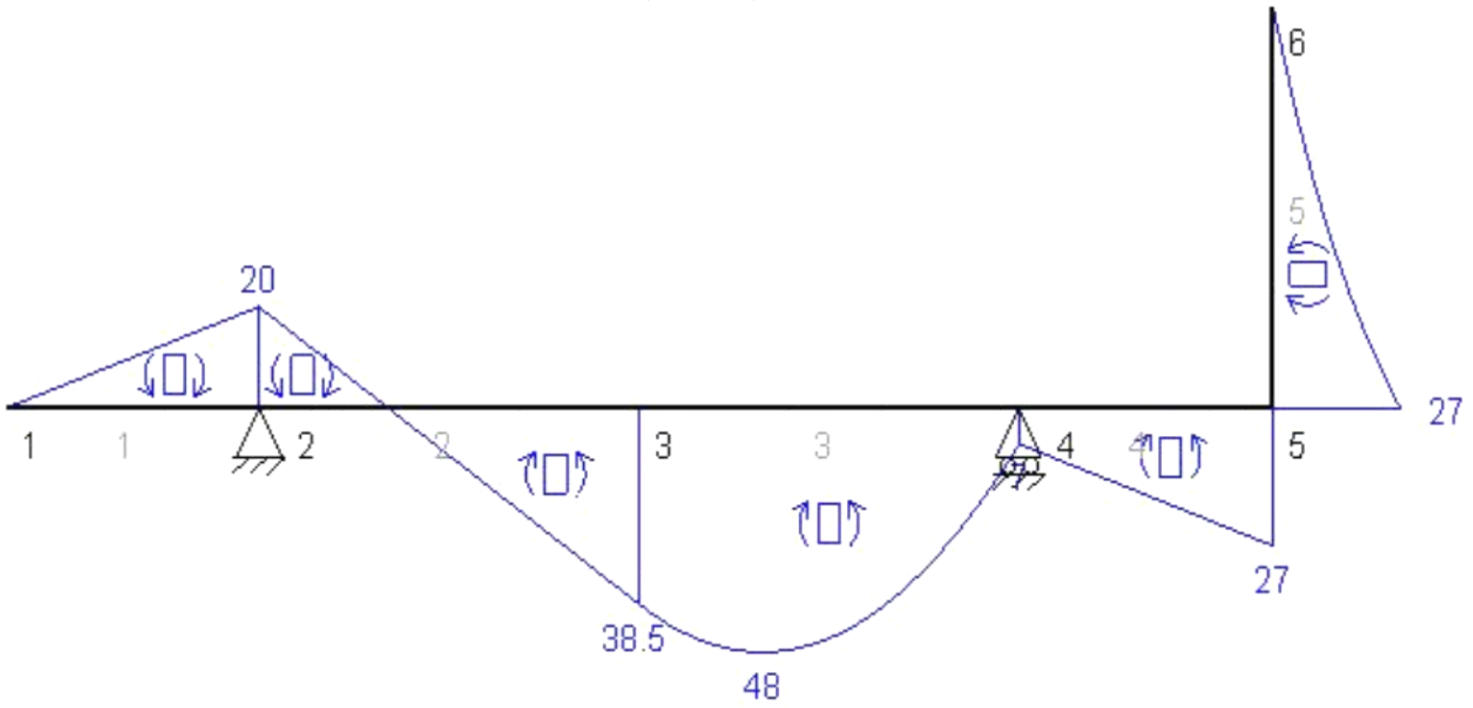
Shear forces diagram



Bending moments diagram

$$M_{max} = \frac{dM(x)}{dx} = V(x)$$

$$20x - 119{,}5 = 0 \rightarrow x = 5{,}975 \rightarrow -10(5{,}975)^2 + 119{,}5.(5{,}975) - 309 = 48\ kNm$$

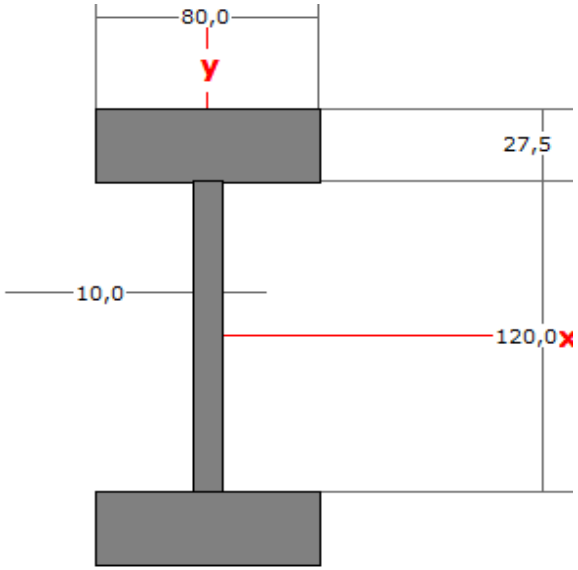


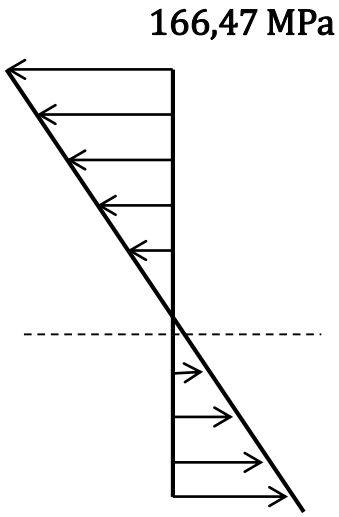
Normal Stress

$$\sigma_z(y) = \frac{N}{A} + \frac{M_x \cdot y}{I_G}$$

$$\sigma_{sup}^{C} = \frac{N}{A} + \frac{M_{max}(x) y_{max}}{I_X} = \frac{15.10^3 N}{5600.10^{-6} m^2} + \frac{48\ kN.m.0{,}0875m}{25{,}64.10^{-6}\ m^4} = 2{,}67 + 163{,}8 = 166{,}47\ MPa\ (C)$$

$$\sigma_{inf}^{C} = \frac{N}{A} - \frac{M_{max}(x) y_{max}}{I_X} = \frac{15.10^3 N}{5600.10^{-4} m^2} - \frac{48\ kN.m.0{,}0875m}{25{,}64.10^{-6}\ m^4} = 2{,}67 - 163{,}8 = 161{,}13\ MPa\ (T)$$





166,47 MPa compressive

161,63 MPa tensile