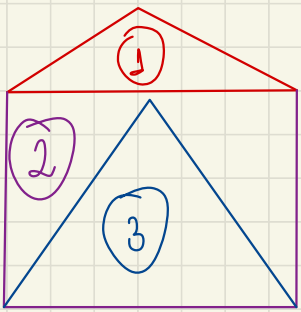
Q1) a) Por simetria, $\boxed{S_G = 4\,cm}$

Cálculo de r_G:



Elemento 1 $r_{G1} = 7\,cm$

$A_1 = \frac{8 \cdot 3}{2} = 12\,cm^2$

$I_1 = \frac{8 \cdot 3^3}{36} = 6\,cm^4$

Elemento 2: $r_{G2} = 3\,cm$

$A_2 = 8 \cdot 6 = 48\,cm^2$

$I_2 = \frac{8 \cdot 6^3}{12} = 144\,cm^4$

Elemento 3: $r_{G3} = 2\,cm$

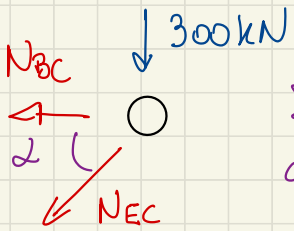
$A_3 = \frac{8 \cdot 6}{2} = 24\,cm^2$ $I_3 = \frac{8 \cdot 6^3}{36} = 48\,cm^2$

$$r_G = \frac{A_1 r_{G1} + A_2 r_{G2} - A_3 r_{G3}}{A_1 + A_2 - A_3} = 5\,cm$$

$$I_y = I_1 + A_1 (r_{G1} - r_G)^2 + I_2 + A_2 (r_{G2} - r_G)^2 - I_3 - A_3 (r_{G3} - r_G)^2$$

$$\boxed{I_y = 126\,cm^4}$$

Q2 a)



$\sin\alpha = 0,6$

$\cos\alpha = 0,8$

$\Sigma F_y = 0 \Rightarrow N_{EC}\sin\alpha = -300$

$\Leftrightarrow \boxed{N_{EC} = \frac{-300}{0,6} = -500\,kN}$

$\Sigma F_x = 0 \Rightarrow N_{BE} + N_{EC}\cos\alpha = 0$

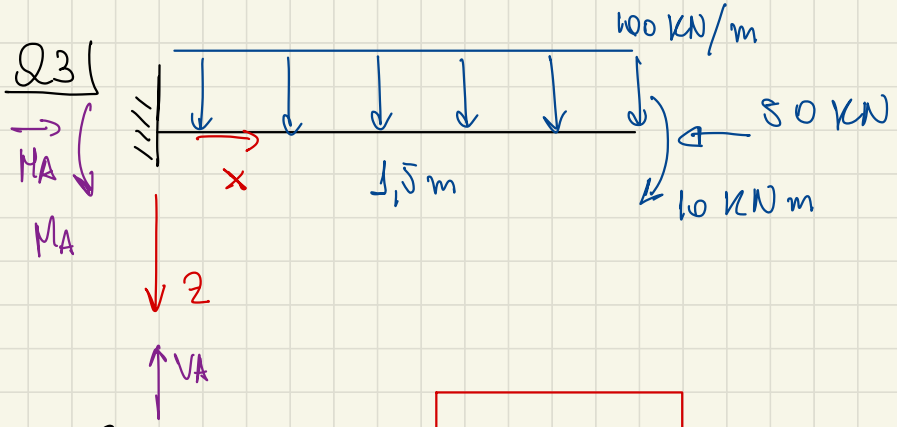
$\Leftrightarrow \boxed{N_{BE} - N_{EC}\cos\alpha = 400\,kN}$

b) EC: $\frac{|N_{EC}|}{A_{EC}} = \bar{\sigma} = 20.10^6 \Leftrightarrow A_{EC} = \frac{500.10^3}{20.10^6}$

$\boxed{A_{EC} = 25.10^{-3}\,m^2 = 0,025\,m^2}$

BE: $\frac{|N_{BE}|}{A_{BE}} = \bar{\sigma} = 20.10^6 \Leftrightarrow \boxed{A_{BE} = \frac{400.10^3}{20.10^6} = 20.10^{-3}\,m^2}$

Q3)



a) Reações de apoio

$H_A = 50\,KN$

$V_A = 150\,KN$

$M_A = \frac{100 \cdot 1,5^2}{2} + 10 = 122,5\,KN\,m$

$= 12250\,KN\,cm$

b) $\sigma = \frac{N}{A} + \frac{Mz}{I_y} = \frac{-50}{40.20} - \frac{12250}{106,666} \cdot z$

$\sigma = -0,0625 - 0,1148\,z \quad \frac{KN}{cm^2}$

c) $\sigma = 0 \Rightarrow z = -\frac{0,0625}{0,1148} = -0,544\,cm$

d) A máxima tensão de tração ocorre para $z = -20\,cm$

$\sigma(z=-20) = 2,2335\ KN/cm^2$