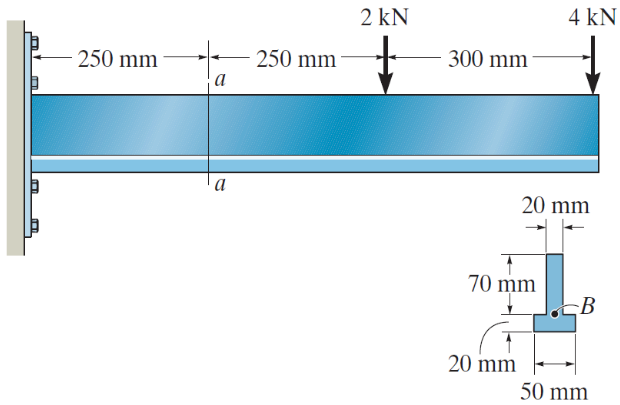
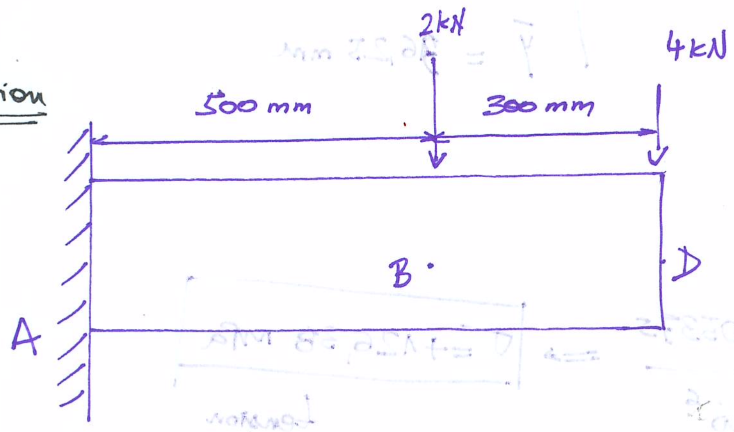
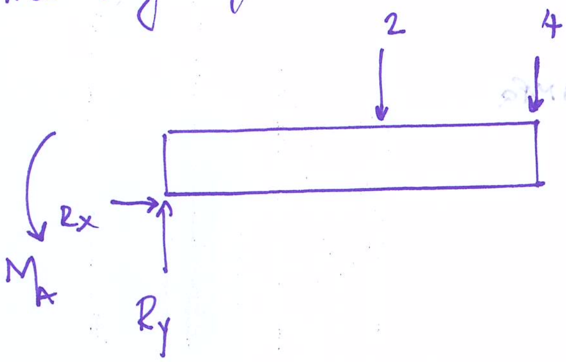
Determine the maximum bending and shear stress acting on of the cantilevered beam. Also, draw how the normal and shear stresses vary in magnitude along the cross section of the beam.



solution



free body diagram:



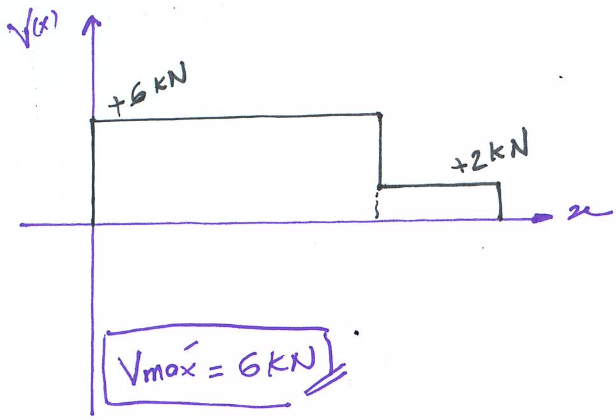
$\Sigma F_x = 0 \rightarrow R_x = 0$

$\Sigma F_y = 0 \rightarrow R_y = 6\ kN$

$\Sigma M_A = 0 \rightarrow +M_A - 2.0{,}5 - 4.0{,}8 = 0$

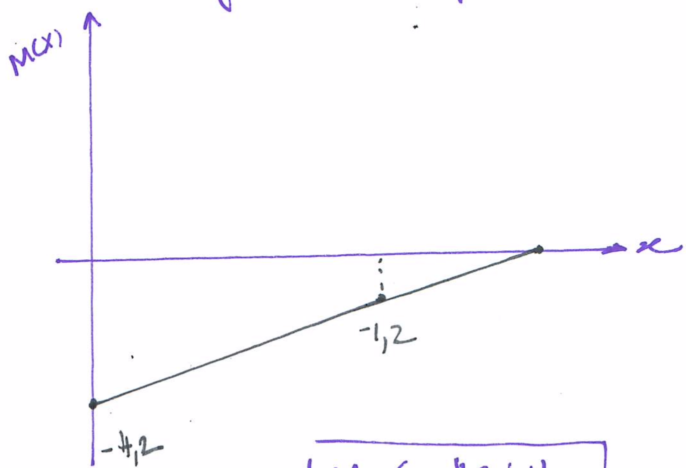
$M_A = 4{,}2\ kN.m$

Shear Diagram:



$\boxed{V_{max} = 6\ kN}$

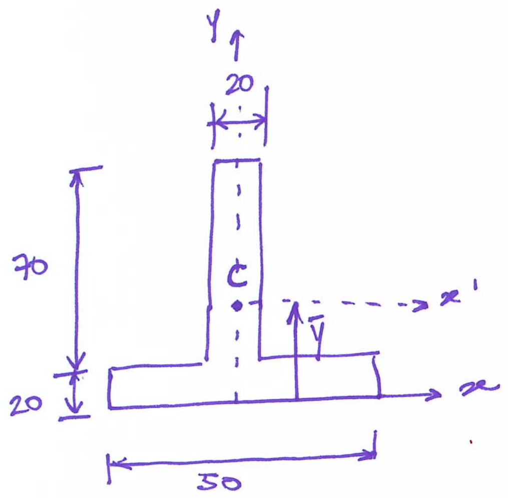
Bending Moment Diagram



$\boxed{M_{max} = 4{,}2\ kN.m}$

Then, the maximum bending stress occurs at the fixed end:

$$\sigma = \frac{M.y}{I}$$



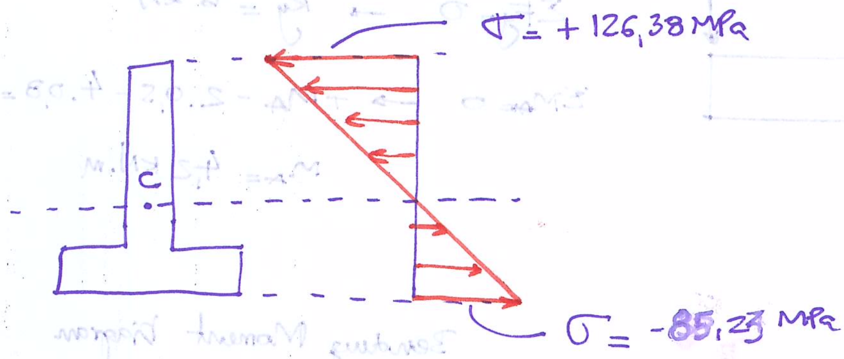
from elementar statics:

$$\begin{cases} I_{x'} = 1{,}78625 . 10^{6} \ mm^4 \\ \bar{y} = 36{,}25 \ mm \end{cases}$$

Thus: $\sigma = \dfrac{4{,}2 . 10^{3} \times 0{,}05375}{1{,}78625 . 10^{-6}} \Rightarrow \boxed{\sigma = +126{,}38 \ MPa}$

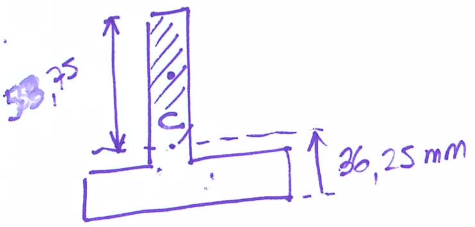
tension

The stress distribution is:



The maximum shear stress occur along AB beam length:

$$\tau = \frac{VQ}{It}, \quad \text{where } Q = y'A$$



$$Q = \left(\frac{53{,}75}{2}\right) \cdot 53{,}75 \cdot 20$$

$$Q = 28{,}89 \cdot 10^{3} \ mm^{3}$$

$$\tau = \frac{6 \cdot 10^{3} \cdot 28{,}89 \cdot 10^{-6}}{1{,}78625 \cdot 10^{-6} \cdot 0{,}020} \quad \therefore \quad \tau = 4{,}85 \ MPa$$

The shear stress distrubution in the cross section is: