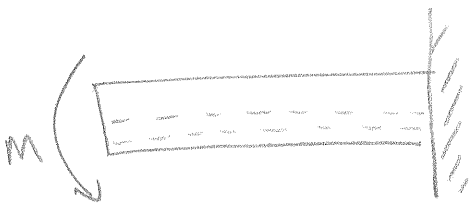
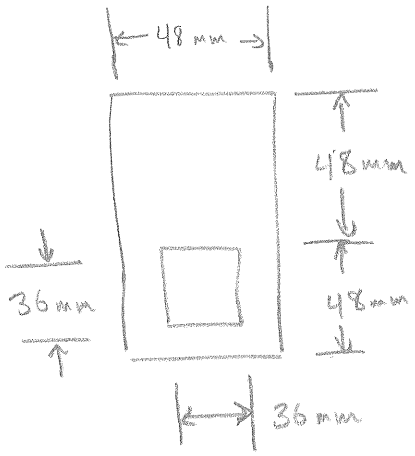
11.17) What is M_{max}?



FBD



Compression $\Rightarrow \sigma_{max} = -150\ MPa$

tension $\Rightarrow \sigma_{max} = 120\ MPa$

from bottom of CS,

$$\bar{y} = \frac{2(48mm)^2(48mm) - (36mm)^2\left(48mm - \frac{36mm}{2}\right)}{2(48mm)^2 - (36mm)^2} = 55.0\ mm$$

$$I = \frac{1}{12}(48mm)(96mm)^3 + (48mm)(96mm)(55mm - 48mm)^2 - \frac{1}{12}(36mm)^4 - (36mm)^2\left(55mm - (48mm - 18mm)\right)^2$$

$$I = 2.815 \cdot 10^6\ mm^4 = 2.815 \cdot 10^{-6}\ m^4$$

$$\sigma = \frac{My}{I} \quad \text{w/ } y \text{ measured from } \bar{y}$$

$\Rightarrow$ max compressive stress will be at bottom of beam

$$M_{max} = \left(-150 \cdot 10^6 \frac{N}{m^2}\right)\left(\frac{2.815 \cdot 10^{-6}\ m^4}{-55 \cdot 10^{-3}\ m}\right) = 7.68 \cdot 10^3\ Nm$$

$\Rightarrow$ max tension stress will be at top of beam

$$M_{max} = \left(120 \cdot 10^6 \frac{N}{m^2}\right)\left(\frac{2.815 \cdot 10^{-6}\ m^4}{96 \cdot 10^{-3}\ m - 55 \cdot 10^{-3}\ m}\right) = 8.24 \cdot 10^3\ Nm$$

maximum allowable couple $\Rightarrow M_{max} = 7.68\ kNm$