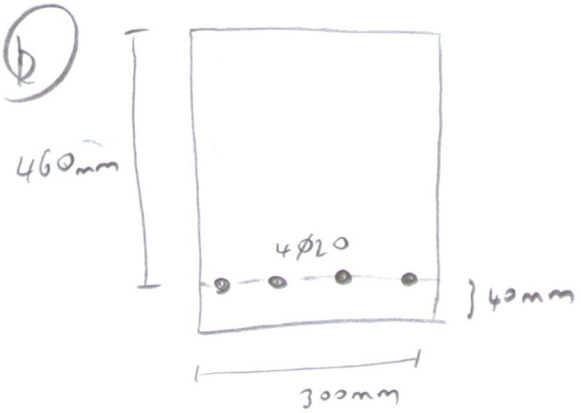
(b)



Determine the bending moment capacity, M_R and specify the expected failure type; tension or compression fail?

$$A_{steel} = 4\left(\frac{\pi 20^2}{4}\right) = 1256,63$$

the area that I calculated above ($4\Phi20$) is smaller than the area value calculated in part (c) = 2275,91, which means under-reinforced, so steel is SURELY yielded.

Force equilibrium

$$F_C = F_T$$

$$0,85 \times c_b * 0,85 \times \frac{20}{1,5} * 300 = 1256,63 * \frac{420}{1,15}$$

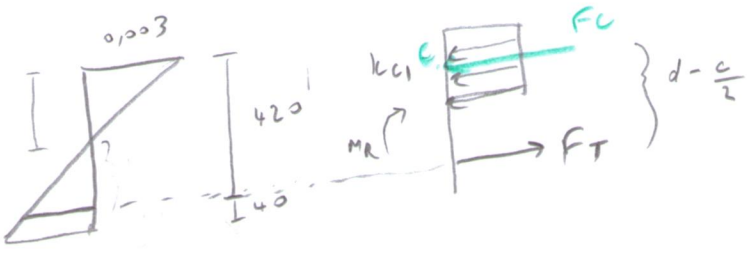
→ I know steel has yielded

$$\Rightarrow c_b = 158,80$$

check if steel really yielded or not

$$\frac{0,003}{158,80} = \frac{\varepsilon_s}{460-158,80} \Rightarrow \varepsilon_s = 0,0057 > 0,0021 \quad \checkmark\checkmark$$

failure type is tension failure since $\varepsilon_s > \varepsilon_{sy}$



$$\curvearrowleft \Sigma M_C = 0$$

$$M_R - F_T \cdot \left(d - \frac{k_1 c}{2}\right) = 0$$

$$\Rightarrow M_R = 1256,63 * \frac{420}{1,15} * \left(460 - \frac{158,80 \times 0,85}{2}\right) \Rightarrow$$

$$M_R = 180,4 \text{ kN.m}$$

(c)