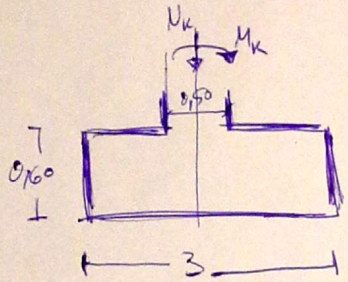
Ejercicio 5



$N_k = 1500\ kN \Rightarrow N_d = 1{,}5\,N_k = 2250\ kN$

$M_k = 600\ kN\,m \Rightarrow M_d = 1{,}5\,M_k = 900\ kN\,m$

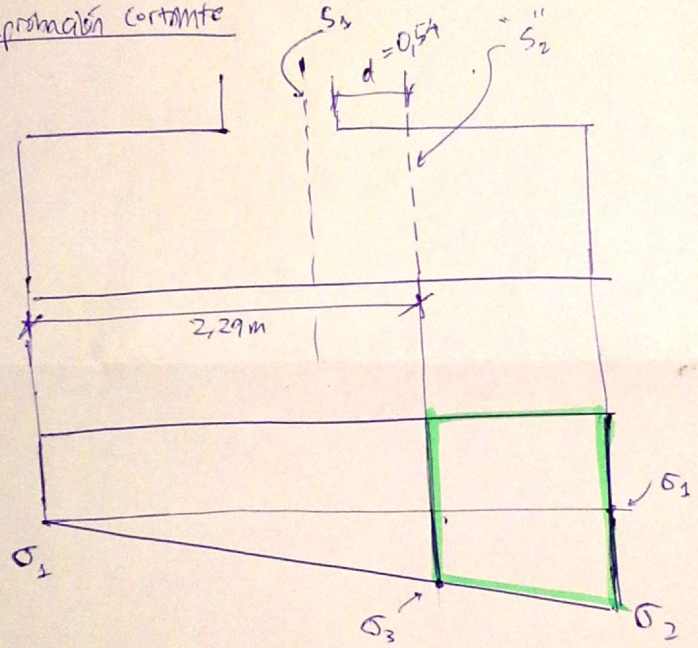
$f_{ck} = 30\ MPa$

$f_{yk} = 500\ MPa$

rec. mec. $= 5\,cm$ (5+1 cm) $\Rightarrow d = 0{,}6 - 0{,}06 = 0{,}54\ m$

(puedo tomar $d = 0{,}6 - 0{,}05\ m$ también)

Comprobación cortante



$$\sigma_1 = \frac{N_d}{A} - \frac{M_d\, 3m/2}{(3m)^4/12} = \frac{2250\,kN}{(3m)^2} - \frac{900\,kN\,m\ 3m/2}{(3m)^4/12} = (250 - 200)\ \frac{kN}{m^2}$$

$\sigma_1 = 0{,}05\ MPa$

$\sigma_2 = 250 + 200 = 450\ \frac{kN}{m^2} = 0{,}45\ MPa$

$$\frac{\sigma_3 - \sigma_1}{2{,}29\,m} = \frac{\sigma_2 - \sigma_1}{3m} \Rightarrow \sigma_3 = \frac{(0{,}4\ MPa)\ 2{,}29}{3} + 0{,}05\ MPa = 0{,}355\ MPa$$

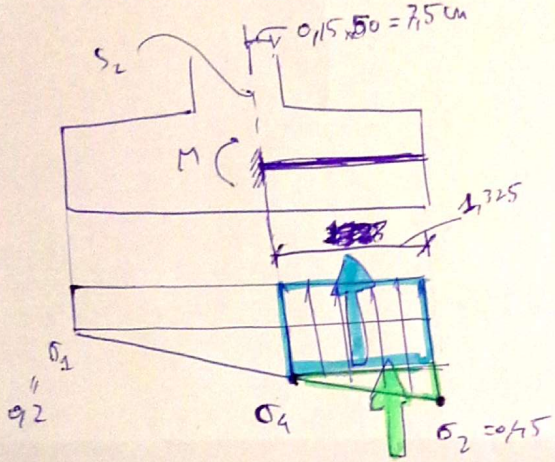
$\Rightarrow V_d$ en S_2: $V_d = \dfrac{(\sigma_2 + \sigma_3)(3m - 2{,}29m)}{2} \times 3m$ (profundidad) $= 857{,}7\ kN$

(trapecio)

$V_{cu,min} = \left(\frac{0{,}075}{1{,}5}\ \xi^{3/2}\ f_{cv}^{1/2}\right) b d = 897{,}9\ kN > V_d$ ✓

$\xi = 1{,}6$

Diseño A_s "longitudinal"



$\frac{\sigma_4 - \sigma_1}{3 - 1{,}325} = \frac{\sigma_2 - \sigma_1}{3} \Rightarrow \sigma_4 = 0{,}273\ MPa$

$M = \left[\sigma_4\ 3m \times 1{,}325m \times \frac{1{,}325m}{2}\right] + \left[\frac{(\sigma_2 - \sigma_4)\ 3m \times 1{,}325m \times \frac{2}{3}\ 1{,}325m}{2}\right]$

$M = 719{,}8\ kNm + 310{,}7\ kNm = 1030{,}5\ kN\,m \Rightarrow$

$\mu = \frac{M}{b\,d^2\,f_{cd}} = 0{,}058 \Rightarrow \omega = 1 - \sqrt{1 - 2\mu} = 0{,}061 = \frac{A_s\,f_{yd}}{b d f_{cd}}$

$A_s = 45{,}3\ cm^2 \Rightarrow 23\phi 16\ (46{,}2\ cm^2) \rightarrow sep. \simeq 13\ cm$

* Falta diseñar armadura en otro sentido (y demás verificaciones)
* Falta verificar punzonamiento.