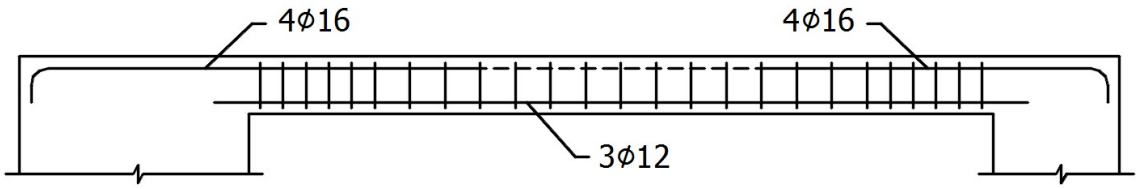
Ejercicio 1

$$A_{s,nec}^{sup} = 6{,}87\ cm^2 \rightarrow 4\emptyset 16$$

$$A_{s,nec}^{inf} = 3{,}24\ cm^2 \rightarrow 3\emptyset 12$$



Ejercicio 2

a) $A_{s,nec} = 6{,}93\ cm^2 \rightarrow 7\emptyset 12$

b) x = 6,28 cm

c) $Dominio\ 2\text{: } \varepsilon_{s1} = 10‰\ \ ,\ \ \varepsilon_c = -1{,}62‰$

d) $z = 42{,}49\ cm \ \rightarrow\ z/h \cong 0{,}85$

e) Curvatura: $1/r = 25{,}82\ km^{-1}$

Ejercicio 3

$$M_{d,lim} = 358{,}43\ kNm \ \rightarrow\ A_{s,nec} = 22{,}36\ cm^2 \rightarrow 5\emptyset 25$$

$$Dominio\ 3\text{: } \varepsilon_{s1} = 4{,}28‰\ \ ,\ \ \varepsilon_c = -3{,}5‰$$

$$z = 36{,}9\ cm \ \rightarrow\ z/h \cong 0{,}74$$

$$\text{Curvatura: } 1/r = 17{,}28\ km^{-1}$$

Ejercicio 4

Viga doblemente armada,

$$A_{s1,nec} = 27{,}62\ cm^2 \rightarrow (4+2)\emptyset 25\ doble\ capa$$

$$A_{s2,nec} = 5{,}27\ cm^2 \rightarrow 5\emptyset 12$$

$$Dominio\ 3\text{: } \varepsilon_{s1} = 4{,}28‰\ \ ,\ \ \varepsilon_c = -3{,}5‰$$

$$\text{Curvatura: } 1/r = 17{,}28\ km^{-1}$$

$$C_c = T_{s1}^{'} = 972\ kN \ \ ,\ \ C_{s2} = T_{s1}^{''} = 228{,}9\ kN$$

Ejercicio 5

$$M_u = 503{,}62\ kNm$$

$$Dominio\ 3{:}\ \varepsilon_{s1} = 3{,}06‰\ \ ,\ \ \varepsilon_c = -3{,}5‰$$

$$x/d = 0{,}53$$

Ejercicio 6

Esquema de cálculo :

Espesor de pilares : $t_i = 0.3 < h$ →Viga simplemente apoyada

$L_{calc} = 6.5 + 0.15 + 0.15 = 6.8m$

$q_{pp} = 0.3m * 0.65m * 25kN/m^3 = 4.875kN/m$

$q_{SCU} = 65kN/m$

$q_d = 1.35 * q_{pp} + 1.50 * q_{SCU} = 104.08kN/m$

Solicitaciones de diseño :

$M_d = q_d * \frac{L^2}{8} = 601.59kNm$

Cálculo :

$$\mu = \frac{M_d}{b * d^2 * f_{cd}} = \frac{601.59kNm}{0.3m * (0.6m)^2 * (\frac{25MPa}{1.5})} = 0.334 > 0.295 \rightarrow Viga\ doblemente\ armada$$

Impongo $\xi = \frac{x}{d} = 0.45 \rightarrow\ \mu_c = 0.8 * \xi * (1 - 0.4\xi) = 0.295\ \rightarrow\ \omega_{\lim} = 1 - \sqrt{1 - 2\mu_c} = 0.360$

$\delta' = \frac{d'}{d} = \frac{0.05}{0.6} = 0.083$

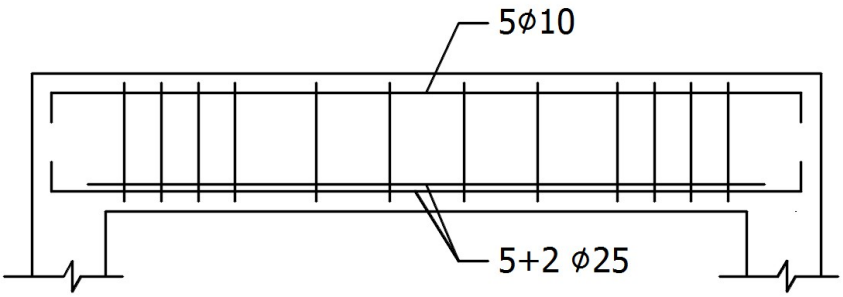
Entonces sabiendo :

$$\mu = \mu_c + (1 - \delta') * \omega_2\ \rightarrow\ \omega_2 = \frac{\mu - \mu_c}{1 - \delta'} = \frac{0.334 - 0.295}{1 - 0.083} = 0.0426$$

Se tiene entonces el área de acero $A_{s2} = \omega_2 * b * d * f_{cd}/f_{yd} = 3.50cm^2\ \rightarrow\ 5Ø10$

Para obtener la armadura inferior :

$\omega_1 = 0.36 + \omega_2 = 0.403\ \rightarrow A_{s1} = \omega_1 * b * d * f_{cd}/f_{yd} = 33.07cm^2 \rightarrow (5 + 2)Ø25\ doble\ capa$



Ejercicio 7

Solución exacta,

$$M_u = 108{,}62\ kNm$$

$$Dominio\ 2: \varepsilon_{s1} = 10{,}0‰\ \ ,\ \ \varepsilon_c = -2{,}26‰$$

$$x/d = 0{,}185$$

Solución aproximada despreciando colaboración de armadura superior,

$$M_u = 107{,}70\ kNm$$

$$Dominio\ 2: \varepsilon_{s1} = 10{,}0‰\ \ ,\ \ \varepsilon_c = -2{,}80‰$$

$$x/d = 0{,}219$$