Pauta Ejercicio 3 CI52K Primavera 2009

Datos gemétricos de la viga

$h := 1220 \cdot mm$ $\quad hft := 150 \cdot mm$

$bw := 355 \cdot mm$ $\quad L := 24 \cdot m$

$b := 1780 \cdot mm$

Propiedades gemétricas:

$Ac := b \cdot hft + (h - hft) \cdot bw$ $\quad Ac = 6.469 \times 10^5 \cdot mm^2$

$$yb := \frac{b \cdot hft \cdot \left(h - \frac{hft}{2}\right) + (h - hft) \cdot bw \cdot \frac{(h - hft)}{2}}{Ac} \qquad yb = 786.789 \cdot mm$$

$yt := h - yb$ $\quad yt = 433.211 \cdot mm$

$$Ic := \frac{b \cdot hft^3}{12} + b \cdot hft \cdot \left(h - \frac{hft}{2} - yb\right)^2 + \frac{bw \cdot (h - hft)^3}{12} + (h - hft) \cdot bw \cdot \left(\frac{h - hft}{2} - yb\right)^2$$

$Ic = 9.508 \times 10^{10} \cdot mm^4$

$r := \sqrt{\frac{Ic}{Ac}}$ $\quad r = 383.398 \cdot mm$

$Wt := \frac{Ic}{yt}$ $\quad Wt = 2.195 \times 10^8 \cdot mm^3$

$Wb := \frac{Ic}{yb}$ $\quad Wb = 1.208 \times 10^8 \cdot mm^3$

$c1 := yt$ $\quad S1 := Wt$

$c2 := yb$ $\quad S2 := Wb$

Cargas:

$\gamma c := 25 \frac{kN}{m^3}$

$qo := Ac \cdot \gamma c$ $\quad qo = 16.171 \frac{kN}{m}$ $\quad Mo := \frac{qo \cdot L^2}{8}$

$qd := 5.8 \frac{kN}{m}$ $\quad Md := \frac{qd \cdot L^2}{8}$

$ql := 17.5\frac{kN}{m}$ $\qquad Ml := \frac{ql \cdot L^2}{8}$

$Mt := Mo + Md + Ml$

$qu := 1.2 \cdot (qo + qd) + 1.6 \cdot ql$

$Mu := \frac{qu \cdot L^2}{8}$ $\qquad Mu = 3.914 \times 10^3 \cdot kN \cdot m$

Materiales:

Hormigón: $\qquad fc := 35 \cdot MPa$ $\qquad fcip := 25 \cdot MPa$

$Ec := 4700 \cdot \sqrt{fc \cdot MPa}$

$\varepsilon cu := 0.003$

$$\beta 1 := \begin{cases} 0.85 & \text{if } fc \le 30MPa \\ 0.85 - 0.008 \cdot \left( \frac{fc}{MPa} - 30 \right) & \text{if } 30MPa \le fc \le 55MPa \\ 0.65 & \text{if } fc \ge 55MPa \end{cases} \qquad \beta 1 = 0.81$$

Acero para hormigón armado

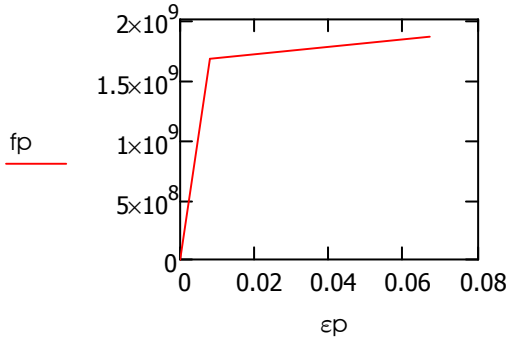
$fy := 420MPa$

Cables: $\qquad fpu := 1860 \cdot MPa$ $\qquad fpy := 1674 \cdot MPa$ $\qquad R := 0.85$

$\varepsilon pu := 0.067$ $\qquad \varepsilon py := 0.008$

$Ep := \frac{fpy}{\varepsilon py}$ $\qquad Ep = 2.092 \times 10^5 \cdot MPa$

$$\varepsilon p := \begin{pmatrix} 0 \\ \varepsilon py \\ \varepsilon pu \end{pmatrix} \qquad fp := \begin{pmatrix} 0 \\ fpy \\ fpu \end{pmatrix}$$



## Área tentaiva de cable

$Mn := \frac{Mu}{0.9}$ $Mn = 4.349 \times 10^3\ kN \cdot m$

$rec := 100mm$

$Z := h - rec - \frac{hft}{2}$ $Z = 1.045 \times 10^3\ mm$

$Apt := \frac{Mn}{0.9 \cdot fpu \cdot Z}$ $Apt = 2.486 \times 10^3\ mm^2$

## Sección comprimida

$a := \frac{Mn}{b \cdot \beta 1 \cdot fc \cdot Z}$ $a = 82.475\,mm$

$Ver1 := if(a \le hft, "viga\ rectangular", "viga\ T")$

$Ver1 = "viga\ rectangular"$

$Zr := h - rec - \frac{a}{2}$

## Excentricidad del cable

$e := h - c1 - rec$ $e = 686.789\,mm$

## Fuerza de pretensado

$Pe := \frac{(qo + qd)}{8 \cdot e} \cdot L^2$ $Pe = 2.303 \times 10^3\ kN$

$Pi := \frac{Pe}{R}$ $Pi = 2.71 \times 10^3\ kN$

## Calcular área del cable

$fpadm := \min(0.74 \cdot fpu, 0.82 \cdot fpy)$ $fpadm = 1.373 \times 10^3\ MPa$

$Ap := \frac{Pi}{fpadm}$ $Ap = 1.974 \times 10^3\ mm^2$

$Apd := \max(Apt, Ap)$ $Apd = 2.486 \times 10^3\ mm^2$

## Tensiones admisibles

$fci := -0.6 fcip$ $fci = -15 \cdot MPa$

$fti := 0.25 \cdot \sqrt{fcip \cdot MPa}$ $fti = 1.25 \cdot MPa$

$fcs := -0.6 \cdot fc$ $\quad fcs = -21 \cdot MPa$

$fts := 0.625 \cdot \sqrt{fc \cdot MPa}$ $\quad fts = 3.698\,MPa$

## Cálculo de tensiones

### Estado inicial

$$f1i := \frac{-Pi}{Ac} + Pi \cdot \frac{e}{S1} - \frac{Mo}{S1} \qquad f1i = -1.015\,MPa$$

$$f2i := \frac{-Pi}{Ac} - Pi \cdot \frac{e}{S2} + \frac{Mo}{S2} \qquad f2i = -9.955\,MPa$$

### Estado de servicio

$$f1s := \frac{-Pe}{Ac} + Pe \cdot \frac{e}{S1} - \frac{Mt}{S1} \qquad f1s = -9.302\,MPa$$

$$f2s := \frac{-Pe}{Ac} - Pe \cdot \frac{e}{S2} + \frac{Mt}{S2} \qquad f2s = 6.865\,MPa$$

$Ver2 := if(f1i \geq fci, "Ok", "No cumple")$

$Ver2 = "Ok"$

$Ver3 := if(f2i \geq fci, "Ok", "No cumple")$

$Ver3 = "Ok"$

$Ver4 := if(f1s \geq fcs, "Ok", "No cumple")$

$Ver4 = "Ok"$

$Ver5 := if(f2s \leq fts, "Ok", "Verificar ancho grieta")$

$Ver5 = "Verificar ancho grieta"$

## Determinación de armaduras

$$Tu := \frac{Mu}{Zr \cdot 0.9} \qquad fps := 0.9 \cdot fpu$$

$$As := \frac{Tu - Apd \cdot fps}{fy} \qquad As = -310.138\,mm^2$$

No requiere armadura a tracción

$MPa := 10^6 \cdot Pa$

$kN := 10^3 \cdot N$