$tonf := 1000kgf$

$f_c := 250\frac{kgf}{cm^2}$ $f_y := 4200\frac{kgf}{cm^2}$ $\varepsilon_{cu} := 0.003$ $\varepsilon_y := 0.0021$

$h := 50cm$ Altura de viga $rec := 40mm$

$b := 30cm$ Ancho de viga

$d := h - rec$ $d = 460 \cdot mm$

1. Flexión $M_u := 26.22tonf \cdot m$

$$\beta_1 := \begin{cases} 0.85 & \text{if } f_c < 30MPa \\ 0.65 & \text{if } f_c > 55MPa \\ 0.85 - 0.008 \cdot \left(\frac{f_c}{MPa} - 30\right) & \text{otherwise} \end{cases} \qquad \beta_1 = 0.85$$

Given

$\rho := 0.001$ $\phi := 0.9$

$$\frac{M_u}{b \cdot d^2} = \phi \cdot \rho \cdot f_y \cdot \left(1 - 0.588 \cdot \rho \cdot \frac{f_y}{f_c}\right)$$ $NL := Find(\rho)$ $\rho := NL$ $\rho = 0.012$

$$\rho_{min} := \max\left(\frac{0.25\sqrt{f_c \cdot MPa}}{f_y}, \frac{1.4 \cdot MPa}{f_y}\right) \qquad \rho_{min} = 3.399 \times 10^{-3}$$

$$\rho_b := 0.85 \cdot \beta_1 \cdot \frac{f_c}{f_y} \cdot \frac{\varepsilon_{cu}}{\varepsilon_{cu} + \varepsilon_y} \qquad \rho_b = 0.025 \qquad \rho_{max} := 0.75 \cdot \rho_b \qquad \rho_{max} = 0.019$$

$\rho_{req} := \max(\min(\rho, \rho_{max}), \rho_{min})$ $\rho_{req} = 0.012$ $A_{sreq} := \rho_{req} \cdot b \cdot d$ A_{sre}

2. Corte

$\phi := 0.75$

$V_u := 16.17tonf$ $f_{yt} := 420MPa$

$$V_c := 0.53 \cdot \sqrt{f_c \cdot \frac{kgf}{cm^2}} \cdot b \cdot d \qquad V_c = 11.564 \cdot tonf$$ (S. 11.1.3, Corte a Flexión pura)

$$\frac{\left(\frac{V_u}{\phi} - V_c\right)}{\left(f_{yt} \cdot d\right)} = 5.074 \cdot \frac{cm^2}{m}$$

$s := 20cm$ $\phi_v := 10mm$ $n := 2$ $A_v := n \cdot \frac{\phi_v^2 \cdot \pi}{4}$ $A_v = 1.571 \cdot cm^2$

$$V_s := \min\left(\frac{A_v \cdot f_{yt} \cdot d}{s}, 0.66 \cdot \sqrt{f_c \cdot MPa} \cdot b \cdot d\right) \qquad V_s = 15.473 \cdot tonf$$

$V_n := V_c + V_s$ $V_n = 27.038 \cdot tonf$ $\phi \cdot V_n = 20.278 \cdot tonf$

$q = 17.196 \cdot cm^2$