

$$P_D := 30 \text{ kN}$$

Acero A572 Gr.65

$$P_L := 120 \text{ kN}$$

$$F_y := 65 \text{ ksi} = 448 \text{ MPa}$$

$$L := 4 \text{ m}$$

$$E := 200000 \text{ MPa}$$

$$L_b := L$$

$$P_{Ldis} := 1.25 \cdot P_L + 0.25 P_D$$

$$P_u := 1.2 P_D + 1.6 \cdot P_{Ldis} = 288 \text{ kN}$$

$$M_u := \frac{P_u \cdot L}{4} = 288 \text{ kN} \cdot \text{m}$$

$$Z_{min} := \frac{M_u}{0.9 F_y} = 714.032 \text{ cm}^3$$

$$r_{ymin} := \frac{L_b}{1.76} \cdot \sqrt{\frac{F_y}{E}} = 10.758 \text{ cm}$$

Probando H350x200x46,9

$$d := 350 \text{ mm} \quad b_f := 200 \text{ mm} \quad t_w := 6 \text{ mm} \quad t_f := 10 \text{ mm}$$

$$A_g := 5980 \text{ mm}^2$$

$$I_x := 13400 \text{ cm}^4 \quad r_x := 14.9 \text{ cm} \quad S_x := 763 \text{ cm}^3 \quad Z_x := 843 \text{ cm}^3$$

$$I_y := 1330 \text{ cm}^4 \quad r_y := 4.72 \text{ cm} \quad S_y := 133 \text{ cm}^3 \quad Z_y := 203 \text{ cm}^3$$

$$C_w := 385000 \text{ cm}^6 \quad J := 15.8 \text{ cm}^4$$

(i) Limites de esbeltez

$$h := d - 2 t_f = 330 \text{ mm}$$

$$k_c := \frac{4}{\sqrt{\frac{h}{t_w}}} = 0.539$$

$$\lambda_{rf} := 0.95 \cdot \sqrt{\frac{k_c \cdot E}{0.7 F_y}} = 17.616$$

$$\lambda_{pf} := 0.38 \cdot \sqrt{\frac{E}{F_y}} = 8.028$$

$$\lambda_f := \frac{b_f}{2 t_f} = 10 \quad \text{entonces ala no compacta}$$

$$\lambda_{rw} := 5.7 \cdot \sqrt{\frac{E}{F_y}} = 120.413$$

$$\lambda_{pw} := 3.76 \cdot \sqrt{\frac{E}{F_y}} = 79.43$$

$$\lambda_f := \frac{b_f}{2 t_f} = 10 \quad \text{entonces ala no compacta}$$

$$\lambda_w := \frac{h}{t_w} = 55 \quad \text{entonces alma compacta}$$

(ii) Esbletez global

$$L_p := 1.76 r_y \cdot \sqrt{\frac{E}{F_y}} = 1.755 \text{ m}$$

$$r_{ts} := \sqrt{\frac{\sqrt{I_y \cdot C_w}}{S_x}} = 5.446 \text{ cm}$$

$$c := 1$$

$$h_o := d - t_f = 340 \text{ mm}$$

$$L_r := 1.95 r_{ts} \cdot \frac{E}{0.7 F_y} \cdot \sqrt{\frac{J \cdot c}{S_x \cdot h_o}} \cdot \sqrt{1 + \sqrt{1 + 6.76 \cdot \left(\frac{0.7 F_y}{E} \cdot \frac{S_x \cdot h_o}{J \cdot c} \right)^2}} = 4.657 \text{ m}$$

(iii) Resistencia nominal

(a) Plastificacion

$$M_p := F_y \cdot Z_x = 377.798 \text{ kN} \cdot \text{m}$$

$$M_{n1} := M_p$$

(b) Volcamiento

$$C_b := \frac{12.5}{2.5 + \frac{3}{2} + 4 + \frac{3}{2}} = 1.316$$

$$M_{n2} := C_b \cdot \left(M_p - (M_p - 0.7 F_y \cdot S_x) \cdot \frac{L_b - L_p}{L_r - L_p} \right) = 356.208 \text{ kN} \cdot \text{m}$$

(c) Pandeo local del ala comprimida

$$M_{n3} := \left(M_p - (M_p - 0.7 F_y \cdot S_x) \cdot \frac{\lambda_f - \lambda_{pf}}{\lambda_{rf} - \lambda_{pf}} \right) = 349.321 \text{ kN} \cdot \text{m}$$

$$M_n := \min(M_{n1}, M_{n2}, M_{n3}) = 349.321 \text{ kN} \cdot \text{m}$$

$$\phi_b := 0.9$$

$$\frac{M_u}{\phi_b \cdot M_n} = 0.916$$