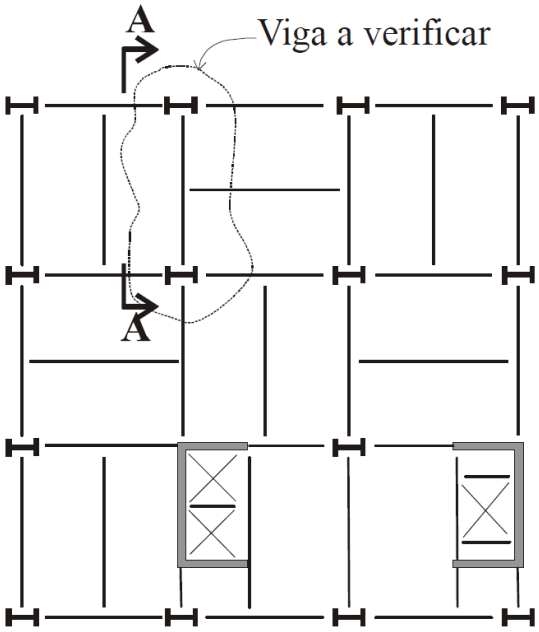
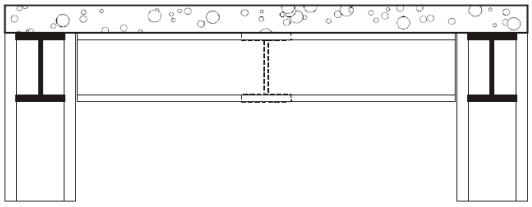


Planta



Corte A-A

$L := 7\ m$ $L_b := 3.5\ m$

Cargas:

$q_D := 3\ \frac{kN}{m^2}$ $q_L := 2\ \frac{kN}{m^2}$

Acero: ASTM A36

$F_y := 250\ MPa$ $F_u := 420\ MPa$ $E := 200000\ MPa$

$q_u := 1.2\ q_D + 1.6\ q_L = 6.8\ \frac{kN}{m^2}$

$M_u := \left(q_u \cdot \frac{3\ L}{4}\right) \cdot \frac{L^2}{8} = 219\ kN \cdot m$ $\phi := 0.9$

$Z_{min} := \frac{M_u}{\phi \cdot F_y} = 971.833\ cm^3$

Intentemos IN 50x85,7

$d := 500\ mm \quad b_f := 200\ mm \quad t_w := 8\ mm \quad t_f := 18\ mm$

$A_g := 109\ cm^2$

$I_x := 48500\ cm^4 \quad r_x := 21.1\ cm \quad S_x := 1940\ cm^3 \quad Z_x := 2170\ cm^3$

$I_y := 2400\ cm^4 \quad r_y := 4.69\ cm \quad S_y := 240\ cm^3 \quad Z_y := 367\ cm^3$

$C_w := 1390000\ cm^6 \quad J := 86\ cm^4$

(i) Esbeltez de la sección

$\lambda_f := \frac{b_f}{2\ t_f} = 5.6 \qquad \lambda_{pf} := 0.38 \cdot \sqrt{\frac{E}{F_y}} = 10.7$

$\lambda_w := \frac{d - 2\ t_f}{t_w} = 58 \qquad \lambda_{pw} := 3.76 \cdot \sqrt{\frac{E}{F_y}} = 106.3$

Entonces, sección compacta.

(ii) Límitez de arriostramiento lateral

$L_p := 1.76\ r_y \cdot \sqrt{\frac{E}{F_y}} = 2335\ mm$

$r_{ts} := \sqrt{\frac{\sqrt{I_y \cdot C_w}}{S_x}} = 55\ mm$

$c := 1$

$h_o := d - t_f = 482\ mm$

$L_r := 1.95\ r_{ts} \cdot \frac{E}{0.7\ F_y} \cdot \sqrt{\frac{J \cdot c}{S_x \cdot h_o}} \cdot \sqrt{1 + \sqrt{1 + 6.76 \cdot \left(\frac{0.7\ F_y}{E} \cdot \frac{S_x \cdot h_o}{J \cdot c}\right)^2}} = 7063\ mm$

Entonces Lb está entre Lp y Lr

(iii) Resistencia nominal

(a) Plastificación $\qquad M_p := F_y \cdot Z_x = 543\ kN \cdot m \qquad M_{n1} := M_p$

(a) Volcamiento

$$M(x) := \left(\frac{L}{2} \cdot x - \frac{x^2}{2}\right) \frac{3\ L\ q_u}{4}$$

$$M_{max} := M\left(\frac{L}{2}\right) = 219\ \boldsymbol{kN \cdot m}$$

$$M_A := M\left(\frac{L_b}{4}\right) = 96\ \boldsymbol{kN \cdot m} \qquad M_B := M\left(\frac{L_b}{2}\right) = 164\ \boldsymbol{kN \cdot m} \qquad M_C := M\left(\frac{3\ L_b}{4}\right) = 205\ \boldsymbol{kN \cdot m}$$

$$C_b := \frac{12.5\ M_{max}}{2.5\ M_{max} + 3\ M_A + 4\ M_B + 3\ M_C} = 1.3$$

Como Lb está entre Lp y Lr

$$M_{n2} := C_b \cdot \left(M_p - \left(M_p - 0.7\ F_y \cdot S_x\right) \left(\frac{L_b - L_p}{L_r - L_p}\right)\right) = 640\ \boldsymbol{kN \cdot m}$$

Entonces

$$M_n := min\left(M_{n1}, M_{n2}\right) = 543\ \boldsymbol{kN \cdot m}$$

$$\frac{M_u}{\phi \cdot M_n} = 0.448$$

(iv) Deformaciones

Se impone una condición de deformación límite para condiciones de servicio

$$\Delta_{max} := \frac{L}{300} = 23\ \boldsymbol{mm} \qquad \frac{d}{L} = 0.071 \qquad \frac{1}{50} = 0.02$$

La deformación de la viga es

$$q := q_D + q_L = 5\ \boldsymbol{kPa}$$

$$\Delta := \left(\frac{3\ L\ q}{4}\right) \frac{5\ L^4}{384\ E \cdot I_x} = 8\ \boldsymbol{mm}$$