

**TEMA 1****DATOS****IPE 400**

$$J_{x\_IPE} := 23130 \text{ cm}^4$$

$$J_{y\_IPE} := 1320 \text{ cm}^4$$

$$d\_IPE := 400 \text{ mm}$$

$$bf\_IPE := 180 \text{ mm}$$

$$tf\_IPE := 13,5 \text{ mm}$$

$$tw\_IPE := 8,6 \text{ mm}$$

$$Ag\_IPE := 84,5 \text{ cm}^2$$

**UPN 300**

$$J_{x\_UPN} := 8030 \text{ cm}^4$$

$$J_{y\_UPN} := 495 \text{ cm}^4$$

$$d\_UPN := 300 \text{ mm}$$

$$bf\_UPN := 100 \text{ mm}$$

$$tf\_UPN := 15 \text{ mm}$$

$$tw\_UPN := 10 \text{ mm}$$

$$Ag\_UPN := 58,8 \text{ cm}^2$$

$$ey\_UPN := 2,70 \text{ cm}$$

$$P := 100 \text{ kN}$$

$$\tau_{B\_adm} := 15 \frac{\text{kN}}{\text{cm}^2}$$

$$dB := \frac{3}{4} \text{ in} = 19,05 \text{ mm}$$

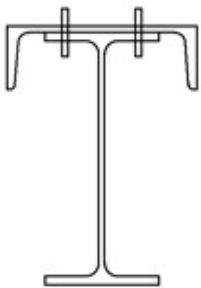
$$\eta := 2$$

$$\lambda := 474 \text{ mm}$$

$$d\_IPE + tw\_UPN = 410 \text{ mm}$$

$$zg\_IPE := \frac{d\_IPE}{2} = 200 \text{ mm}$$

$$zg\_UPN := d\_IPE + tw\_UPN - ey\_UPN = 383 \text{ mm}$$



$$zG := \frac{\frac{d\_IPE}{2} \cdot Ag\_IPE + (d\_IPE + tw\_UPN - ey\_UPN) \cdot Ag\_UPN}{Ag\_IPE + Ag\_UPN}$$

**Medido desde la base:**

$$zG = 275,09 \text{ mm}$$

$$zG := 275 \text{ mm}$$

$$zG - \frac{d\_IPE}{2} = 75,09 \text{ mm}$$

$$d\_IPE + tw\_UPN - ey\_UPN - zG = 107,91 \text{ mm}$$

$$J_y := J_{x\_IPE} + \left( \left( zG - \frac{d\_IPE}{2} \right)^2 \cdot Ag\_IPE \right) + J_{y\_UPN} + \left( (d\_IPE + tw\_UPN - ey\_UPN - zG)^2 \cdot Ag\_UPN \right)$$

$$J_y = 35236,5454 \text{ cm}^4$$

**b) Tensión máxima (en G --> S máx).**

$$S1 := bf\_IPE \cdot tf\_IPE \cdot \left( zG - \frac{tf\_IPE}{2} \right) = 652,0663 \text{ cm}^3$$

$$S2 := tw\_IPE \cdot (zG - tf\_IPE) \cdot \left( \frac{zG - tf\_IPE}{2} \right) = 294,2462 \text{ cm}^3$$

$$S_{max} := S1 + S2 = 946,3124 \text{ cm}^3$$

$$\tau_{max} := \frac{P \cdot S_{max}}{J_y \cdot tw\_IPE} = 3,1228 \frac{\text{kN}}{\text{cm}}$$

**c) Resistencia de los bulones.**

$$S\_UPN := Ag\_UPN \cdot (d\_IPE + tw\_UPN - ey\_UPN - zG) = 634,5107 \text{ cm}^3$$

$$F\_S := \frac{P \cdot S\_UPN}{J_y} \cdot \lambda = 85,354 \text{ kN}$$

$$F\_R := \tau_{B\_adm} \cdot \left( \frac{\pi \cdot dB^2}{4} \right) \cdot \eta = 85,5069 \text{ kN}$$

$$\lambda := \frac{J_y}{P \cdot S\_UPN} \cdot \tau_{B\_adm} \cdot \left( \frac{\pi \cdot dB^2}{4} \right) \cdot \eta = 474,849 \text{ mm}$$

$$F\_S < F\_R = 1$$

Se verifica la condición de resistencia de los bulones.