Data:

Type of loading application: C

Design transverse force: $F_{Ed} = 1415[kN]$

Thickness of the plate: $t_w = 0.015[m]$

Clear web depth between flanges: $h_w = 0.27[m]$

Flange width: $b_f = 0.3[m]$

The yield strength of the web: $f_{yf} = 355000.0[kN/m^2]$

Flange thickness:$t_f = 0.03[m]$

The yield strength of the web: $f_{yw} = 355000.0[kN/m^2]$

Security coeficient(recommended 1.1): $\gamma_{M1} = 1.1$

Elasticity module (recommended $200e6[kN/m^2]$): E=200000000.0 [kN/m^2]$

Longitudinal width of the load: $s_s = 0.3[m]$

Length of a stiffened or unstiffened plate: $a = 1.185[m]$

Distance (utilized exclusively when type C presented, see Figure 6.1): $c = 0.9[m]$

Calculation of Buckling coefficient using Figure 6.1 "Buckling coefficients for different types of load application" from article 6.1 basis

$$k_F = 6 + \frac{2(c + s_s)^2}{h_w^2}$$

$$k_F = 6 + 2 \cdot 0.27^{-2}(0.3 + 0.9)^2$$

$$k_F = 45.51$$

k_F must be smaller than 6.0, then k_F will take the value 6.0

Calculation of critical force using expression (6.5) from article 6.4 "Reduction factor χ_F for effective length for resistance"

$$F_{cr} = \frac{0.9 E k_F t_w^3}{h_w}$$

$$F_{cr} = 0.9 \cdot 0.015^3 \cdot 6.0 \cdot 0.27^{-1} \cdot 200000000.0$$

$F_{cr} = 13500.00[kN]$

Using expression (6.8) from article 6.5 "Effective loaded length", calculate m_1

$$m_1 = \frac{b_f f_{yf}}{f_{yw} t_w}$$

$$m_1 = 0.015^{-1} \cdot 0.3$$

$$m_1 = 20.00[m]$$

Using expression (6.9) from article 6.5 "Effective loaded length", calculate m_2

$$m_2 = \frac{0.02h_w^2}{t_f^2}$$

$$m_2 = 0.02 \cdot 0.03^{-2} \cdot 0.27^2$$

$$m_2 = 1.620[m]$$

Calculation of effective length l_e

$$l_e = \frac{Ek_F t_w^2}{2f_{yw}h_w}$$

$$l_e = \frac{0.015^2 \cdot 6.0 \cdot 0.27^{-1} \cdot 355000.0^{-1} \cdot 200000000.0}{2}$$

$$l_e = 1.408[m]$$

Using expression (6.10) from article 6.5 "Effective loaded length", calculate l_y

$$l_y = \min\left(l_e + t_f\sqrt{m_1 + m_2}, l_e + t_f\sqrt{\frac{l_e^2}{t_f^2} + \frac{m_1}{2} + m_2}\right)$$

$$l_y = 1.548[m]$$

Calculation of plastic web yielding mechanism, F_y, for non dimensional slenderness

$$F_y = f_{yw}l_y t_w$$

$$F_y = 0.015 \cdot 1.548 \cdot 355000.0$$

$$F_y = 8242.80[KN]$$

Calculation of λ_F, non dimensional slenderness using modification of expression (6.4) from article 6.4 "Reduction factor χ_F for efective lenght for resistance"

$$\lambda_F = \sqrt{\frac{F_y}{F_{cr}}}$$

$$\lambda_F = \sqrt{8242.8} \cdot \frac{1}{\sqrt{13500.0}}$$

$$\lambda_F = 0.781$$

Calculation of reduction factor χ_F for effective length for resistance using expression (6.3)

$$\chi_F = \frac{0.5}{\lambda_F}$$

$$\chi_F = 0.5 \cdot 0.781^{-1}$$

$$\chi_F = 0.6399$$

Calculation of design strength F_{Rd}

$$F_{Rd} = \frac{F_y \chi_F}{\gamma_{M1}}$$

$$F_{Rd} = 1.1^{-1} \cdot 0.6399 \cdot 8242.8$$

$$F_{Rd} = 4795.00[kN]$$

The section meets patch loading requirements with a safety factor of

$$\eta_2 = \frac{F_{Ed}}{F_{Rd}}$$

$$\eta_2 = 4795.0^{-1} \cdot 1415$$

$$\eta_2 = 0.295$$

"ES NECESARIO CALCULAR LA INTERACCIÓN AXIAL Y DE PATCH LOADING MEDIANTE EL ARTÍCULO 7.2:

$$(7.2) \quad \eta_2 + 0{,}8\,\eta_1 \leq 1{,}4$$

$$(4.15) \quad \eta_1 = \frac{N_{Ed}}{\frac{f_y\,A_{eff}}{\gamma_{M0}}} + \frac{M_{y,Ed} + N_{Ed}\,e_{y,N}}{\frac{f_y\,W_{y,eff}}{\gamma_{M0}}} + \frac{M_{z,Ed} + N_{Ed}\,e_{z,N}}{\frac{f_y\,W_{z,eff}}{\gamma_{M0}}} \leq 1{,}0"$$