

Single vertical post load bearing in long term-duration loading

Wood type:	C24
Width of wooden element:	$b := 45 \text{ mm}$
Height of wooden element:	$h := 95 \text{ mm}$
Buckling length about x axis:	$l_x := 2.886 \text{ m}$
Buckling length about y axis:	$l_y := 0.962 \text{ m}$
Factor for support condition at the ends of the element:	$\mu_x := 1 \quad \mu_y := 1$
Factor for solid timber straightness:	$\beta_c := 0.2$
Charac. wood compression strength parallel to the grain:	$f_{c.0.k} := 21 \text{ MPa}$
Charac. wood modulus of elasticity parallel to the grain:	$E_{0.05} := 7400 \text{ MPa}$
Factor for duration loading and service:	$k_{mod} := 0.6$
Partial factor for material properties:	$\gamma_M := 1.30$

Design wood compression strength:

$$f_{c.0.d} := \frac{k_{mod} \cdot f_{c.0.k}}{\gamma_M} = 9.692 \frac{\text{N}}{\text{mm}^2}$$

Cross-sectional area:

$$A := b \cdot h = 42.75 \text{ cm}^2$$

Second moment of area:

$$I_x := \frac{h^3 \cdot b}{12} = 321.516 \text{ cm}^4 \quad I_y := \frac{h \cdot b^3}{12} = 72.141 \text{ cm}^4$$

Radius of gyration:

$$i_x := \sqrt{\frac{I_x}{A}} = 27.424 \text{ mm} \quad i_y := \sqrt{\frac{I_y}{A}} = 12.99 \text{ mm} \quad i := \min(i_x, i_y) = 12.99 \text{ mm}$$

Design element length:

$$l_{ef,x} := \mu_x \cdot l_x = 2.886 \text{ m} \quad l_{ef,y} := \mu_y \cdot l_y = 0.962 \text{ m}$$

Slenderness ratio:

$$\lambda_x := \frac{l_{ef,x}}{i_x} = 105.236$$

$$\lambda_y := \frac{l_{ef,y}}{i_y} = 74.055$$

$$\lambda := \max(\lambda_x, \lambda_y) = 105.236$$

Relative slenderness:

$$\lambda_{rel} := \frac{\lambda}{\pi} \cdot \sqrt{\frac{f_{c,0,k}}{E_{0.05}}} = 1.784$$

Instability factor:

$$k := 0.5 \cdot (1 + \beta_c \cdot (\lambda_{rel} - 0.3) + \lambda_{rel}^2) = 2.241$$

$$k_c := \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}} = 0.278$$

Design buckling strength:

$$k_c \cdot f_{c,0,d} = 2.696 \frac{N}{mm^2}$$

Compressive stress/Design buckling strength equation :

$$N_{c,k} := f_{c,0,k} \cdot A \cdot k_c = 24.968 \text{ kN}$$

$$N_{c,d} := f_{c,0,d} \cdot A \cdot k_c = 11.524 \text{ kN}$$

