General parameters

Material: $f_y := 235 \cdot \frac{N}{mm^2}$

Elasticity modulus: $E := 210000 \cdot \frac{N}{mm^2}$

Shear modulus: $G := 81000 \cdot \frac{N}{mm^2}$

ASCEM Fig 3.3: $C_1 := 1.348$

ASCEM Fig 3.3: $C_2 := 0.630$

Alabeo en el extremo: $k_w := 1$

Effective length: $k := 1$

Load-shear center distance: $z_g := 0\ mm$

Coefficient of imperfection 1: $\alpha_{LT} := 0.34$

Partial safety coefficient: $\gamma_{M0} := 1.05$

$$M_{cr}(I_z, I_w, I_t, L) := C_1 \cdot \frac{\pi^2 \cdot E \cdot I_z}{(k \cdot L)^2} \left(\sqrt{\left(\frac{k}{k_w}\right)^2 \cdot \frac{I_w}{I_z} + \frac{(k \cdot L)^2 \cdot G \cdot I_t}{\pi^2 \ E \cdot I_z} + (C_2 \cdot z_g)^2} - C_2 \cdot z_g \right)$$

$$\lambda_{LT}(I_z, I_w, I_t, L, W_{ply}) := \sqrt{\frac{W_{ply} \cdot f_y}{M_{cr}(I_z, I_w, I_t, L)}}$$

$$\phi_{LT}(I_z, I_w, I_t, L, W_{ply}) := 0.5 \cdot \left(1 + \alpha_{LT} \cdot (\lambda_{LT}(I_z, I_w, I_t, L, W_{ply}) - 0.2) + (\lambda_{LT}(I_z, I_w, I_t, L, W_{ply}))^2\right)$$

or in a better way:

$$\phi_{LT}(I_z, I_w, I_t, L, W_{ply}) := \left\| \begin{array}{l} \lambda \leftarrow \lambda_{LT}(I_z, I_w, I_t, L, W_{ply}) \\ 0.5 \cdot (1 + \alpha_{LT} \cdot (\lambda - 0.2) + \lambda^2) \end{array} \right|$$

$$X_{LT}(I_z, I_w, I_t, L, W_{ply}) := \frac{1}{\phi_{LT}(I_z, I_w, I_t, L, W_{ply}) + \sqrt{\phi_{LT}(I_z, I_w, I_t, L, W_{ply})^2 - \lambda_{LT}(I_z, I_w, I_t, L, W_{ply})^2}}$$

better:

$$X_{LT}(I_z, I_w, I_t, L, W_{ply}) := \left\| \begin{array}{l} \phi \leftarrow \phi_{LT}(I_z, I_w, I_t, L, W_{ply}) \\ \frac{1}{\phi + \sqrt{\phi^2 - \lambda_{LT}(I_z, I_w, I_t, L, W_{ply})^2}} \end{array} \right|$$

$$M_{Rd}(I_z, I_w, I_t, L, W_{ply}) := X_{LT}(I_z, I_w, I_t, L, W_{ply}) \ \frac{W_{ply} \cdot f_y}{\gamma_{M0}}$$

Profile	I_z (mm^4)	W_{ply} (mm^3)	I_t (mm^4)	I_w (mm^6)	L (m)	M_{sd} $(kN \cdot m)$
"IPE240"	$283.4 \cdot 10^4$	$73.92 \cdot 10^3$	$12.88 \cdot 10^4$	$37.39 \cdot 10^9$	3.2	45
"IPE360"	$1043 \cdot 10^4$	$1019 \cdot 10^3$	$37.32 \cdot 10^4$	$313.6 \cdot 10^9$	6.1	135

"HEA140"	$389.3 \cdot 10^4$	$84.85 \cdot 10^3$	$8.13 \cdot 10^4$	$15.06 \cdot 10^9$	4.7	52.1
"HEB240"	$3923 \cdot 10^4$	$498.4 \cdot 10^3$	$102.7 \cdot 10^4$	$486.9 \cdot 10^9$	5.9	68.3

$\lambda_{LT}(400 \cdot cm^4, 5 \cdot 10^4\ cm^6, 4\ cm^4, 5\ m, 100\ cm^3) = 0.594$

$M_{Rd}(400 \cdot cm^4, 5 \cdot 10^4\ cm^6, 4\ cm^4, 5\ m, 100\ cm^3) = 18.807\ kJ$

Type in profile name $prof := \text{"IPE360"}$

$idx :=$ try { $match(prof, Profile)_{ORIGIN}$ } on error { $ORIGIN$ }

$I._z := I_{z_{idx}}$ $W._{ply} := W_{ply_{idx}}$

$I._t := I_{t_{idx}}$ $I._w := I_{w_{idx}}$

$L. := L_{idx}$

$ProfileName := Profile_{idx}$

$X._{LT} := \lambda_{LT}(I._z, I._w, I._t, L., W._{ply})$

$\lambda._{LT} := \lambda_{LT}(I._z, I._w, I._t, L., W._{ply})$ $\phi._{LT} := \lambda_{LT}(I._z, I._w, I._t, L., W._{ply})$

$ProfileName = \text{"IPE360"}$ $I._z = (1.043 \cdot 10^7)\ mm^4$ $W._{ply} = (1.019 \cdot 10^6)\ mm^3$

$I._t = (3.732 \cdot 10^5)\ mm^4$ $I._w = (3.136 \cdot 10^{11})\ mm^6$ $L. = 6.1\ m$

$\lambda._{LT} = 1.033$ $\phi._{LT} = 1.033$ $X._{LT} = 1.033$

$$\overrightarrow{\lambda_{LT}(I_z, I_w, I_t, L, W_{ply})} = \begin{bmatrix} 0.356 \\ 1.033 \\ 0.523 \\ 0.412 \end{bmatrix} \qquad \overrightarrow{M_{Rd}(I_z, I_w, I_t, L, W_{ply})} = \begin{bmatrix} 15.603 \\ 131.41 \\ 16.594 \\ 102.766 \end{bmatrix} kJ$$

$$\overrightarrow{\phi_{LT}(I_z, I_w, I_t, L, W_{ply})} = \begin{bmatrix} 0.59 \\ 1.175 \\ 0.692 \\ 0.621 \end{bmatrix}$$

$$\overrightarrow{X_{LT}(I_z, I_w, I_t, L, W_{ply})} = \begin{bmatrix} 0.943 \\ 0.576 \\ 0.874 \\ 0.921 \end{bmatrix}$$

Vectorization ist done to be on the safe side but would only be necessary for M_{Rd} here.