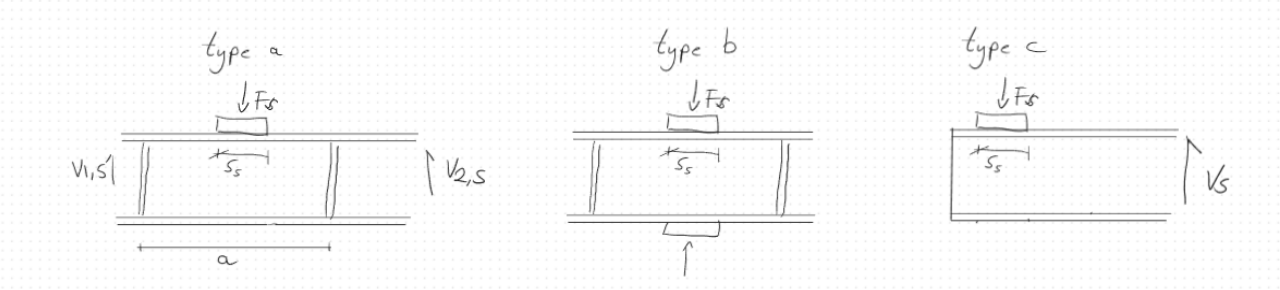
Resistance to transverse forces

NS-EN 1993 - 1 - 5, kapittel 6

$F_S := 890\ kN$

F

$type := "a"$



$h_w := 400\ mm$ $t_w := 11.5\ mm$

$t_f := 14.6\ mm$ $b_f := 190\ mm$

$f_{yw} := 355\ MPa$ $\gamma_{M1} := 1.05$ $E := 210000\ MPa$

$f_{yf} := f_{yw}$

$a := 250\ mm$

$s_s := 250\ mm$

$c := 0\ mm$

$$k_F := \text{if } type = "a" \quad = 11.12$$
$$6 + 2 \cdot \left(\frac{h_w}{a}\right)^2$$
$$\text{else}$$
$$\text{if } type = "b"$$
$$3.5 + 2 \cdot \left(\frac{h_w}{a}\right)^2$$
$$\text{else}$$
$$\text{if } type = "c"$$
$$\max\left(\left[\begin{matrix} 2 + 6 \cdot \left(\frac{s_s + c}{h_w}\right) \\ 6 \end{matrix}\right]\right)$$
$$\text{else}$$
$$"No\ valid\ type"$$

$$m_1 := \frac{f_{yf} \cdot b_f}{f_{yw} \cdot t_w} = 16.5217$$

$$m_{2.initialguess} := 0.02 \cdot \left(\frac{h_w}{t_f}\right)^2 = 15.0122$$

0 if λ.F < 0.5, checking after conservative appproach

$$l_{y.a.b} := \min\left(\left[\; s_s + 2 \cdot t_f \cdot \left(1 + \sqrt{m_1 + m_{2.initialguess}}^{\,a}\right)\right]\right) = 250 \text{ mm}$$

$$l_e := \frac{k_F \cdot E \cdot t_w^{\,2}}{2 \cdot f_{yw} \cdot h_w} = 1087.4303 \text{ mm}$$

$$l_{y.c} := \min\left(\left[\begin{array}{c} l_e + t_f \cdot \sqrt{\frac{m_1}{2} + \left(\frac{l_e}{t_f}\right)^2 + m_{2.initialguess}} \\ l_e + t_f \cdot \sqrt{m_1 + m_{2.initialguess}} \end{array}\right]\right) = 1169.4167 \text{ mm}$$

$$l_{y.initialguess} := \begin{array}{l} \text{if } (type = \text{"a"}) \vee (type = \text{"b"}) \quad = 250 \text{ mm} \\ \quad l_{y.a.b} \\ \text{else} \\ \quad \text{if } type = \text{"c"} \\ \quad\quad l_{y.c} \\ \quad \text{else} \\ \quad\quad \text{"No valid type selected"} \end{array}$$

$$F_{cr} := 0.9 \cdot k_F \cdot E \cdot \frac{t_w^{\,3}}{h_w} = 7990.9814 \text{ kN}$$

$$\lambda_F := \sqrt{\frac{l_{y.initialguess} \cdot t_w \cdot f_{yw}}{F_{cr}}} = 0.3574$$

Recalculating using initial λ.F

$$m_2 := \begin{array}{l} \text{if } \lambda_F > 0.5 \quad = 0 \\ \quad 0.02 \cdot \left(\frac{h_w}{t_f}\right)^2 \\ \text{else} \\ \quad 0 \end{array}$$

$$l_{y.a.b} := \min\left(\left[\; s_s + 2 \cdot t_f \cdot \left(1 + \sqrt{m_1 + m_2}^{\,a}\right)\right]\right) = 250 \text{ mm}$$

$$l_{y.c} := \min\left(\begin{bmatrix} l_e + t_f \cdot \sqrt{\frac{m_1}{2} + \left(\frac{l_e}{t_f}\right)^2} + m_2 \\ l_e + t_f \cdot \sqrt{m_1 + m_2} \end{bmatrix}\right) = 1146.7748\ \text{mm}$$

$$l_y := \begin{array}{l} \text{if } (type = \text{"a"}) \vee (type = \text{"b"}) \\ \quad l_{y.a.b} \\ \text{else} \\ \quad \text{if } type = \text{"c"} \\ \quad\quad l_{y.c} \\ \quad \text{else} \\ \quad\quad \text{"No valid type selected"} \end{array} = 250\ \text{mm}$$

$$\lambda_F := \sqrt{\frac{l_y \cdot t_w \cdot f_{yw}}{F_{cr}}} = 0.3574$$

$$\chi_F := \min\left(\begin{bmatrix} 1 \\ \frac{0.5}{\lambda_F} \end{bmatrix}\right) = 1$$

$$L_{eff} := \chi_F \cdot l_y = 250\ \text{mm}$$

$$F_{Rd} := \frac{f_{yw} \cdot L_{eff} \cdot t_w}{\gamma_{M1}} = 972.0238\ \text{kN}$$

$$\eta_{unstiffened} := \frac{F_S}{F_{Rd}} = 0.9156$$