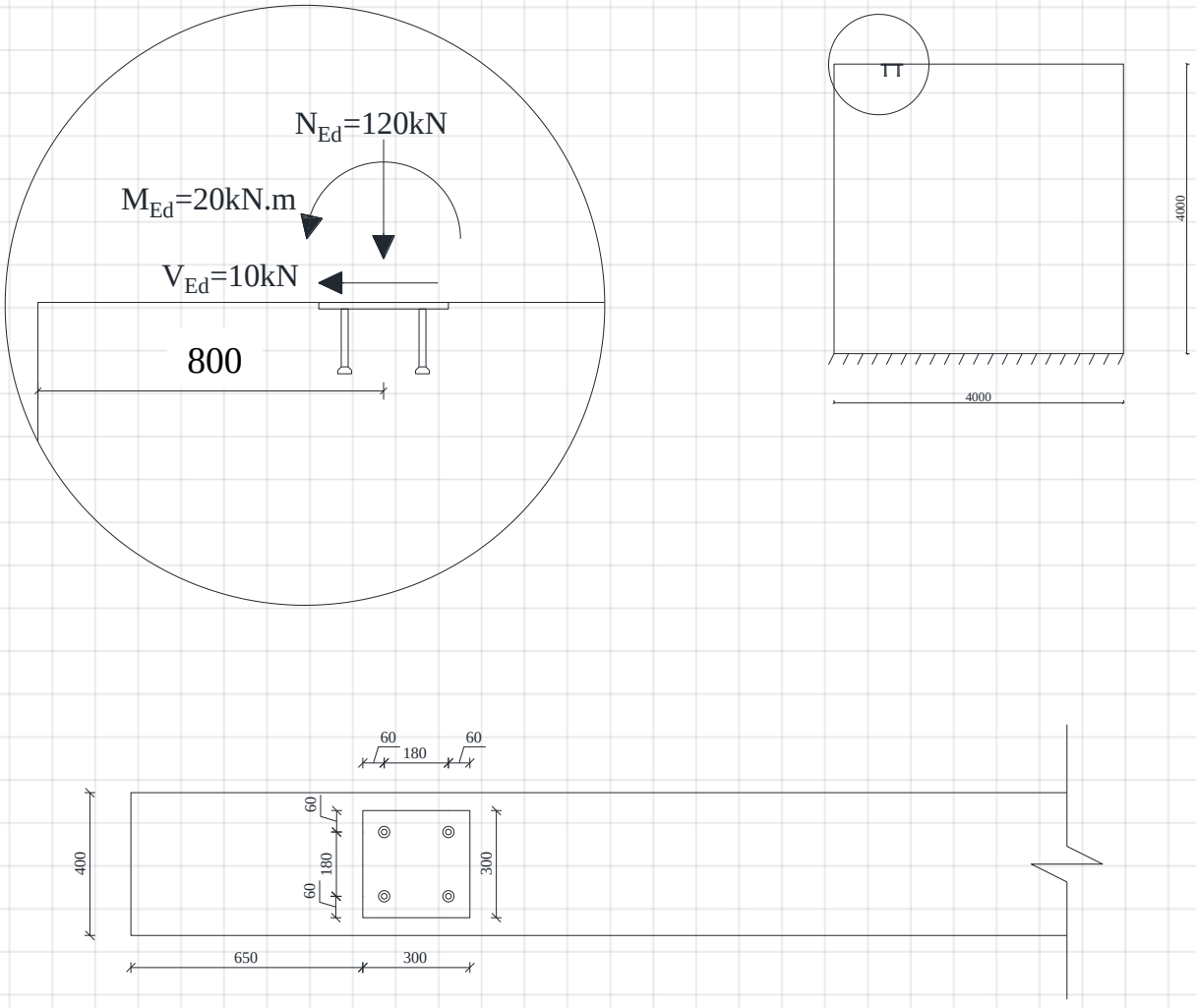
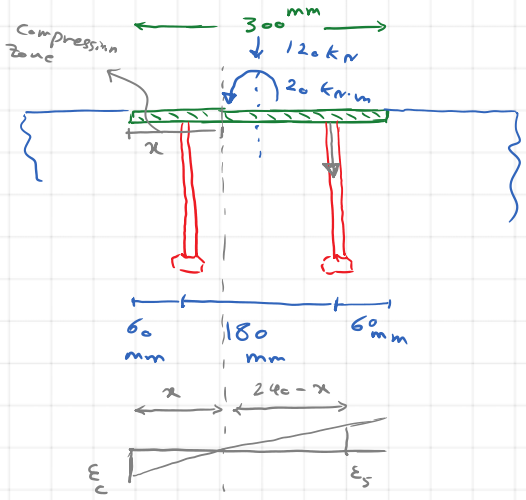
The given embedded plate is selected from Peikko Welda-300x300x165. Determines the tension forces in the anchor bolts and the plate length under compression.

The wall thickness is 400mm made of C30/37 concrete class. The loads applied to the plate are given in design format (Ed), as shown in the figure. Dimensions are provided in mm.





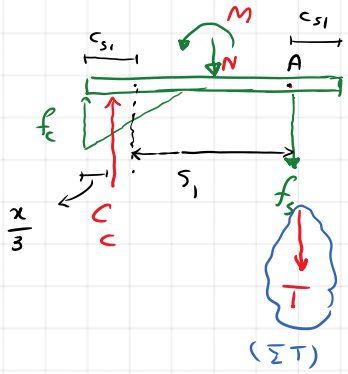
$$\frac{\varepsilon_c}{x} = \frac{\varepsilon_s}{240 - x}$$

$$\varepsilon_c = \frac{f_c}{E_c} \qquad \varepsilon_s = \frac{f_s}{E_s}$$

$$\frac{f_c}{E_c \cdot x} = \frac{f_s}{E_s (240 - x)} \Rightarrow f_s = \frac{E_s}{E_c} \cdot \frac{240 - x}{x} \cdot f_c$$

$$\circledast \quad T = f_s \cdot A_s = \frac{E_s}{E_c} \cdot \frac{240 - x}{x} \cdot f_c \cdot \frac{\pi \times (16\,mm)^2}{4} \qquad \Phi_s = 16\ mm$$

$$C_c = 0.5 f_c \cdot b \cdot x$$



(ΣT)

$$\begin{cases} \Sigma F_y = 0 \Rightarrow C_c - T = N \\ + \circlearrowleft \Sigma M_A = 0 \Rightarrow M + N \cdot \frac{s_1}{2} - C_c \cdot \left(s_1 + c_{s1} - \frac{x}{3} \right) = 0 \end{cases}$$

$f_s(f_c, x) := \frac{E_s}{E_c} \cdot \frac{s_1 + c_{s1} - x}{x} \cdot f_c$

$T_s(f_c, x) := f_s(f_c, x) \cdot A_s$

$C_c(f_c, x) := 0.5 \cdot f_c \cdot b_p \cdot x$

$b_p := 300\ mm$ $\quad l_p := 300\ mm$

$s_1 := 180\ mm$ $\quad s_2 := 180\ mm$

$c_{s1} := \frac{l_p - s_1}{2}$ $\quad c_{s2} := \frac{b_p - s_2}{2}$

$\Phi_s := 16\ mm$ $\quad n_{s1} := 2$

$A_s := \frac{\pi \cdot \Phi_s^2}{4}$

$f_{ck} := 17\ MPa$

$E_s := 210\ GPa$

$E_c := 33\ GPa$

Guess Values

$x_g := \frac{1}{3} \cdot b_p$

$f_{c.g} := 0.5 \cdot f_{ck}$

Constraints

$C_c(f_{c.g}, x_g) - n_{s1} \cdot T_s(f_{c.g}, x_g) = N_{Ed}$

$M_{Ed} + N_{Ed} \cdot \frac{s_1}{2} - C_c(f_{c.g}, x_g) \cdot \left(s_1 + c_{s1} - \frac{x_g}{3} \right) = 0$

Solver

$Ans := \text{Find}(f_{c.g}, x_g)$

$f_c := Ans_0 = 9.455\ MPa$

$x := Ans_1 = 106.129\ mm$

$x \geq c_{s1} = 1$

$T_s(f_c, x) = 15.26\ kN$

$N_{Ed} := 120\ kN$

$M_{Ed} := 20\ kN \cdot m$

$V_{Ed} := 10\ kN$