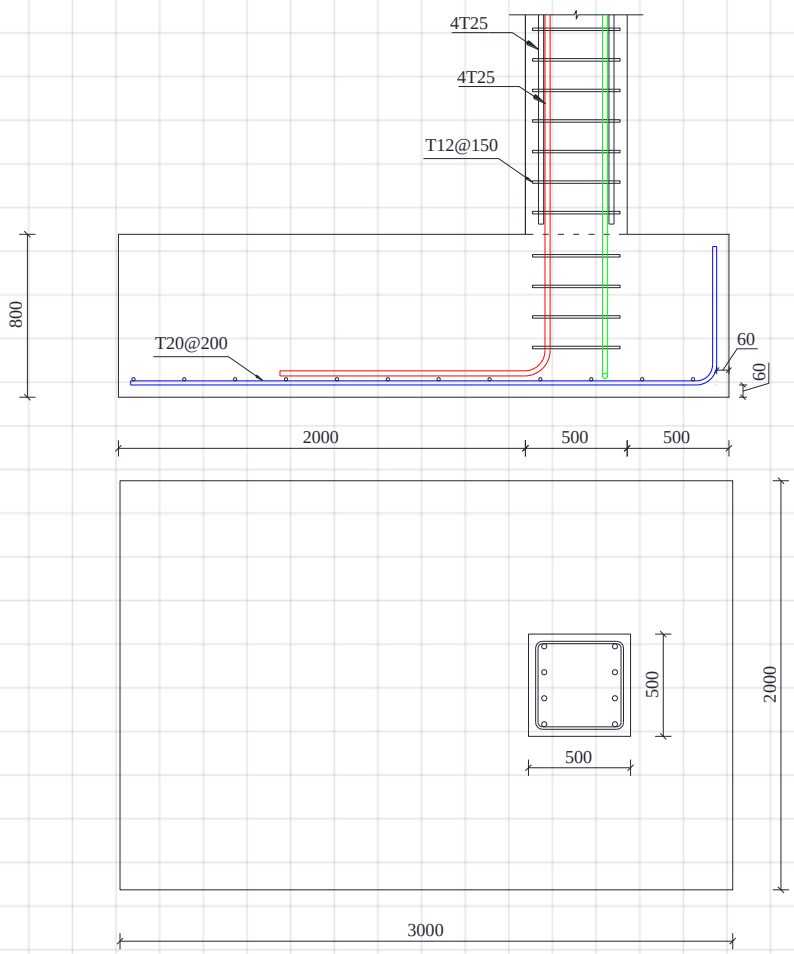
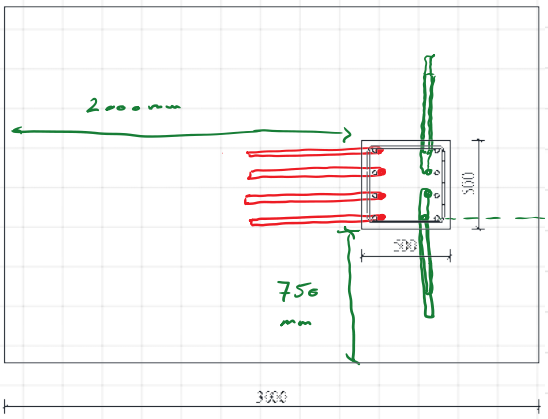
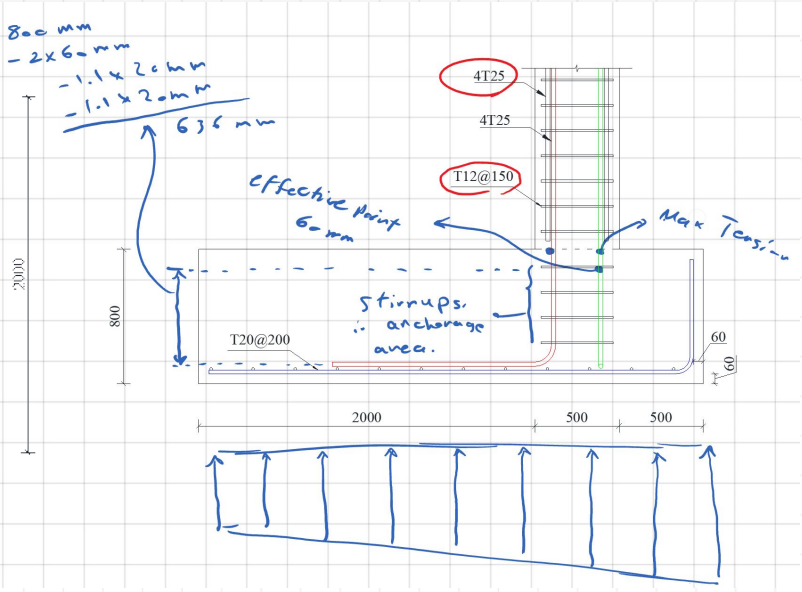
A concrete column is rigidly connected to a foundation. The foundation designed for this column has a dimension of 3mx2m with a depth of 800mm. Due to limitations in the plot, the footing cannot be centered on the column. As a result, the column is not in the foundation's center, as shown in the figure below. 4T25 on each side of the column is designed for the column, and due to the bending moment on the column base, the reinforcement needs to be anchored in the footing. Also, the designed reinforcement on the lower side of the foundation is T20@200. The concrete is from the class of C35/45 reinforced by AH500. The nominal cover in the foundation is 60mm.

a) Determine the required anchorage length of the column reinforcement for the left and right rebars. (The difference is the free space for the reinforcement to be anchored)
b) Determine the required anchorage length of the foundation reinforcement to be anchored on the shorter side.
c) Sketch the anchorage length based on the calculation above.







C35/45, $f_y = 500$ MPa, T25 } red & green
T25
T20 → blue

$$l_{b,rqd} = \frac{\phi}{4} \cdot \frac{f_{yd}}{f_{bd}}$$

C35/45 → T3.1 → $f_{ctk,0.05} = 2.2$ MPa → $f_{ctd} = \alpha_{ct} \cdot \frac{f_{ctk,0.05}}{\gamma_c} = 1 \times \frac{2.2}{1.5}\ \text{MPa} = 1.47$ MPa

$$f_{bd} = 2.25\,\eta_1 \cdot \eta_2 \cdot f_{ctd} = 3.3 \text{ MPa}$$

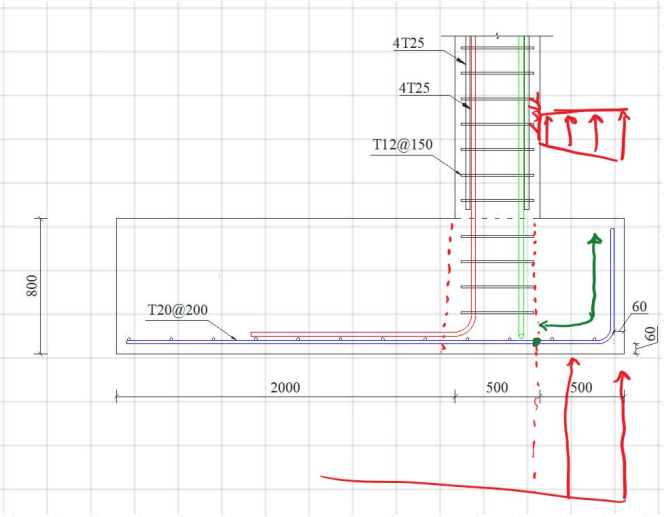
($\eta_1 = 1$, $\eta_2 = 1$)

$$l_{b,rqd} = \frac{\phi}{4} \cdot \frac{f_{yd}}{f_{bd}} = \frac{25\text{mm}}{4} \times \frac{435\text{MPa}}{3.3\text{ MPa}} = 824 \text{ mm}$$

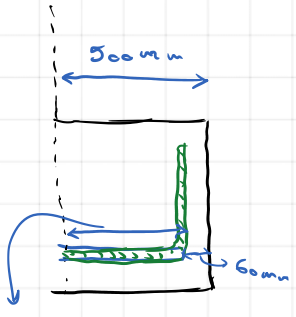
$$l_{bd} = \underbrace{\alpha_1 \alpha_2 \alpha_3 \alpha_4 \alpha_5}_{1}\ \underbrace{l_{b,rqd}}_{824} \geq l_{b,min}$$

$l_{b,min} = \max\{0.3\, l_{b,rqd},\ 10\phi,\ 100\text{mm}\}$

→ $\boxed{l_{bd} = 850 \text{ mm}}$



$$l_{b,req} = \frac{\Phi}{4} \cdot \frac{f_{yd}}{f_{bd}} = \frac{20}{4} \times \frac{435}{3.3} \approx 660\,mm \quad (\Phi: mm,\ f_{yd}: MPa,\ f_{bd}: MPa) \rightarrow l_b = 660\,mm$$



$l_{available} = 440\,mm$