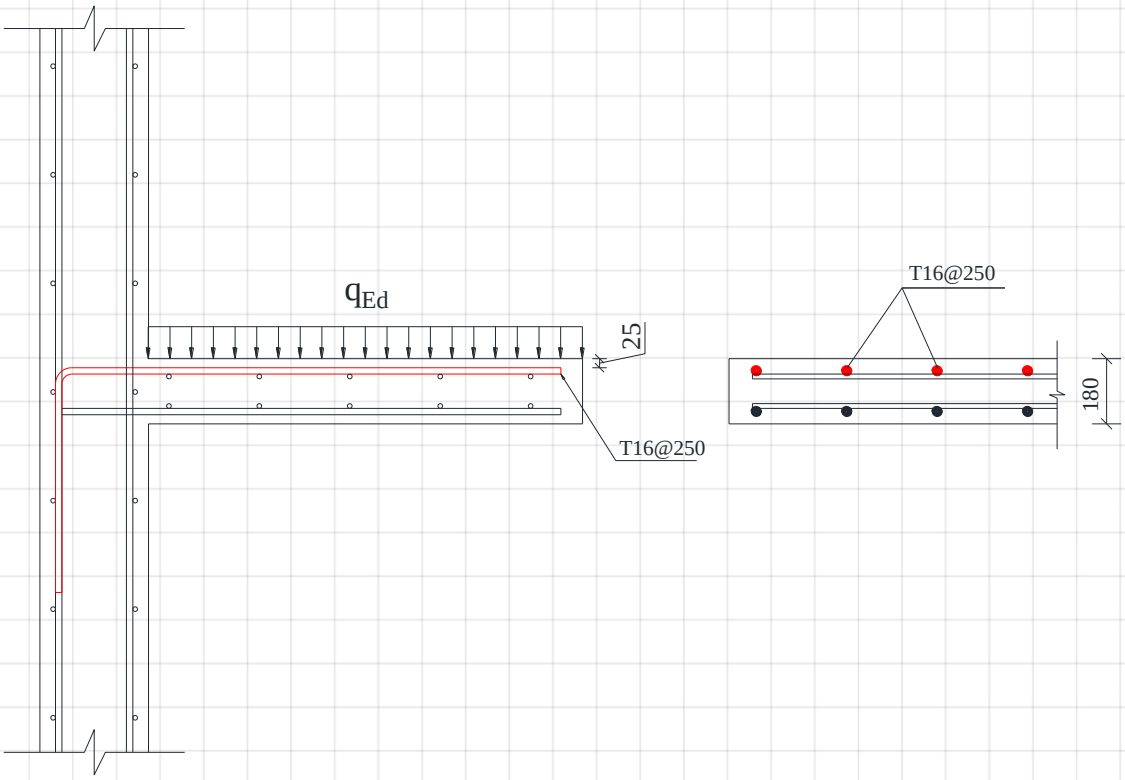
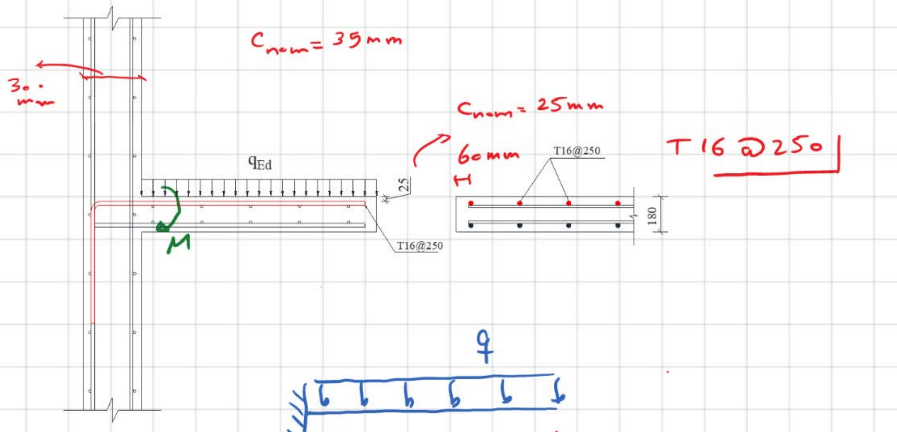
A cantilever 180mm thick slab is subjected to a distributed designed load, as shown in the figure below. The primary top reinforcement of the slab is T16@250, designed to be anchored in a 300mm thick wall. The concrete is from class C30/37, and the reinforcement class is AH500. The nominal cover in the wall and the slab is 35mm and 25mm, respectively. Determine the required anchorage length of the reinforcement according to Eurocode 1992-1-1 and clearly show from which point the anchorage length is defined.

The corner reinforcement of the slab is not shown in this figure. For more information, you can check Eurocode 1992-1-1 Clause 9.3.1.4





T16 @250

C 30/37

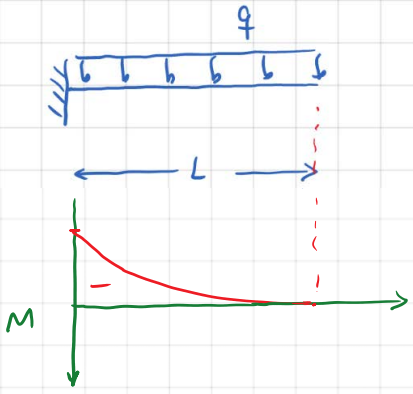
AH500 , f_y = 500 MPa

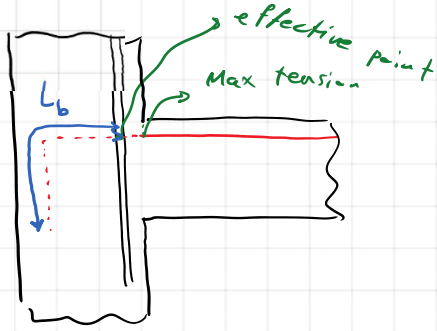
Slab t = 180 mm

wall t = 300 mm

c_{nom} (slab) = 25 mm

c_{nom} (wall) = 35 mm





$$L_{b,rqd} = \frac{\Phi}{4} \cdot \frac{\sigma_{sd}}{f_{bd}}$$

$\sigma_{sd} = f_{yd}$ ← full strength of rebar is insured

$$f_{yd} = \frac{f_y}{\gamma_s} = \frac{500\ MPa}{1.15} = 435\ MPa$$

$$f_{bd} = 2.25\ \eta_1 \cdot \eta_2 \cdot f_{ctd}$$

$$f_{ctd} = \alpha_{ct} \cdot \frac{f_{ctk;0.05}}{\gamma_c} = 1 \times \frac{2\ MPa}{1.5} = 1.33\ MPa$$ (C30/37)

Φ = 16 mm ≤ 32 mm → $\eta_2 = 1$

poor condition → $\eta_1 = 0.7$ → f_{bd} = 2.1 MPa

$$L_{b,rqd} = \frac{16\ mm}{4} \times \frac{435\ MPa}{2.1\ MPa} = 828\ mm \cong 830\ mm$$

Table 8.2: Values of α_1, α_2, α_3, α_4 and α_5 coefficients

Influencing factor	Type of anchorage	Reinforcement bar	
		In tension	In compression
Shape of bars	Straight	$\alpha_1 = 1,0$	$\alpha_1 = 1,0$
	Other than straight (see Figure 8.1 (b), (c) and (d)	$\alpha_1 = 0,7$ if $c_d > 3\phi$ otherwise $\alpha_1 = 1,0$ (see Figure 8.3 for values of c_d)	$\alpha_1 = 1,0$
Concrete cover	Straight	$\alpha_2 = 1 - 0,15\,(c_d - \phi)/\phi$ $\geq 0,7$ $\leq 1,0$	$\alpha_2 = 1,0$
	Other than straight (see Figure 8.1 (b), (c) and (d))	$\alpha_2 = 1 - 0,15\,(c_d - 3\phi)/\phi$ $\geq 0,7$ $\leq 1,0$ (see Figure 8.3 for values of c_d)	$\alpha_2 = 1,0$
Confinement by transverse reinforcement not welded to main reinforcement	All types	$\alpha_3 = 1 - K\lambda$ $\geq 0,7$ $\leq 1,0$	$\alpha_3 = 1,0$
Confinement by welded transverse reinforcement*	All types, position and size as specified in Figure 8.1 (e)	$\alpha_4 = 0,7$	$\alpha_4 = 0,7$
Confinement by transverse pressure	All types	$\alpha_5 = 1 - 0,04p$ $\geq 0,7$ $\leq 1,0$	-

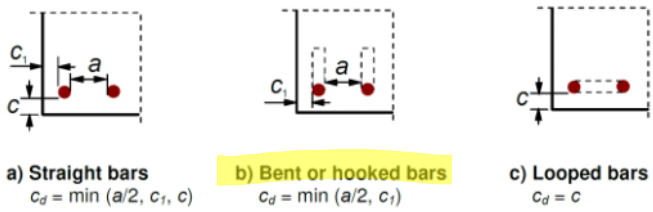


Figure 8.3: Values of c_d for beams and slabs

$c_1 = 60\,mm$

$a = 250\,mm - \frac{16 \times 1.1}{mm} = 232.4$

$c_d = \min\left\{\frac{232.4}{2}, 60\,mm\right\} = 60\,mm$

$\alpha_1 = 0.7$, $c_d = 60\,mm > 3 \times 16\,mm$ (OK)

$\alpha_2 = 1 - 0.15\left(\frac{60}{mm} - \frac{3 \times 16}{mm}\right)/\frac{16}{mm} = 0.89$ ≥ 0.7, ≤ 1

$\alpha_3 = \alpha_4 = \alpha_5 = 1$

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

$0.7 \quad 0.89 \quad 1 \quad 1 \quad 1 \quad 830\,mm$

$(\alpha_2 \alpha_3 \alpha_5 \geq 0.7)$

$\rightarrow \max\{0.3\, l_{b,rqd},\ 10\phi,\ 100\,mm\}$

$0.3\, l_{b,rqd} = 249\,mm$, $10\phi = 160\,mm$

$l_{bd} = 517\,mm \geq 249\,mm$ (OK) $\rightarrow$ $\boxed{l_{bd} = 550\,mm}$