Assignment 5

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Reduce support moments

Shift the envelope by $a_l = \frac{z}{2} \cdot ctg\theta$

$a_{l,a} = 0,5 \cdot 372,6 \cdot 1,5 = 279,5 \text{ mm}$

$a_{l,b} = 0,5 \cdot 398,5 \cdot 1,5 = 298,9 \text{ mm}$

$a_c = 0,5 \cdot 336,4 \cdot 1,5 = 252,3 \text{ mm}$

Anchorage length

Basic anchorage length: $l_{b,req} = \frac{\phi}{4} \cdot \frac{\sigma_{sd}}{f_{bd}}$

$\sigma_{sd} = f_{yd}$

$f_{bd} = 2,25 \eta_1 \cdot \eta_2 \cdot f_{ctd}$

$\eta_1 = \eta_2 = 1$

$f_{ctd} = \frac{f_{ctk,0.05}}{1,5} = \frac{1,8}{1,5} = 1,2 \text{ MPa}$

$f_{bd} = 2,25 \cdot 1,2 = 2,7 \text{ MPa}$

$l_{b,req}^a = l_{b,req}^b = \frac{16}{4} \cdot \frac{434,78}{2,7} = 644 \text{ mm}$

$l_{b,req}^c = \frac{20}{4} \cdot \frac{434,78}{2,7} = 805 \text{ mm}$

Minimal anchorage length:

$l_{b,min} = \max(0,3 l_{b,req}; 10\phi; 100 \text{mm})$

a) $l_{b,min}^a = \max(0,3 \cdot 644; 160 \text{ mm}; 100 \text{ mm}) = 193,2 \text{ mm}$

b) $l_{b,min}^b = l_{b,min}^a = 193,2 \text{ mm}$

c) $l_{b,min}^c = \max(0,3 \cdot 805; 200 \text{ mm}; 100 \text{ mm}) = 241,5 \text{ mm}$

Design anchorage length: $l_{b,d} = \max(\alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \cdot l_{b,req};\ l_{b,min})$

(assume $\alpha_i = 1$)

a) $l_{b,d}^{a} = \max(644\,mm;\ 193{,}2\,mm) = 644\,mm$

b) $l_{b,d}^{b} = l_{b,d}^{a} = 644\,mm$

c) $l_{b,d}^{c} = \max(805\,mm;\ 241{,}5\,mm) = 805\,mm$

Anchorage length for bottom reinforcement – extend min $10\,\phi \Rightarrow 160\,mm$

Column shear reinforcement

1) Column ties

Diameter: $\phi_{tie} \geq \max\left(\frac{\phi_s}{4};\ 6\,mm\right) = \max(5\,mm;\ 6\,mm) = 6\,mm$

Basic spacing: $s_1 \leq \min(20\,\phi_s;\ \min(b_c;\ h_c);\ 400\,mm) =$

$= \min(400\,mm;\ 250\,mm;\ 400\,mm) = 250\,mm$

Spacing in lapping area and below and above beam (in the distance of $\max(250\,mm;\ 350\,mm)$): $s_2 \leq 0{,}6\,s_1$

Design $\phi_{tie} = 8\,mm$; $s_1 = 220\,mm$

$s_2 \leq 0{,}6 \cdot 220 = 132\,mm \Rightarrow s_2 = 120\,mm$

2) Lapping length

$l_{0,d} = \max(\alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \cdot \alpha_6 \cdot l_{b,req};\ l_{0,min})$; $\alpha_6 = 1{,}5$

$l_{b,req} = \frac{20}{4} \cdot \frac{434{,}78}{2{,}7} = 805\,mm$

$l_{0,min} = \max(0{,}3 \cdot \alpha_6 \cdot l_{b,req};\ 15\,\phi_s;\ 200\,mm) =$

$= \max(362{,}25\,mm;\ 300\,mm;\ 200\,mm) = 362{,}25\,mm$

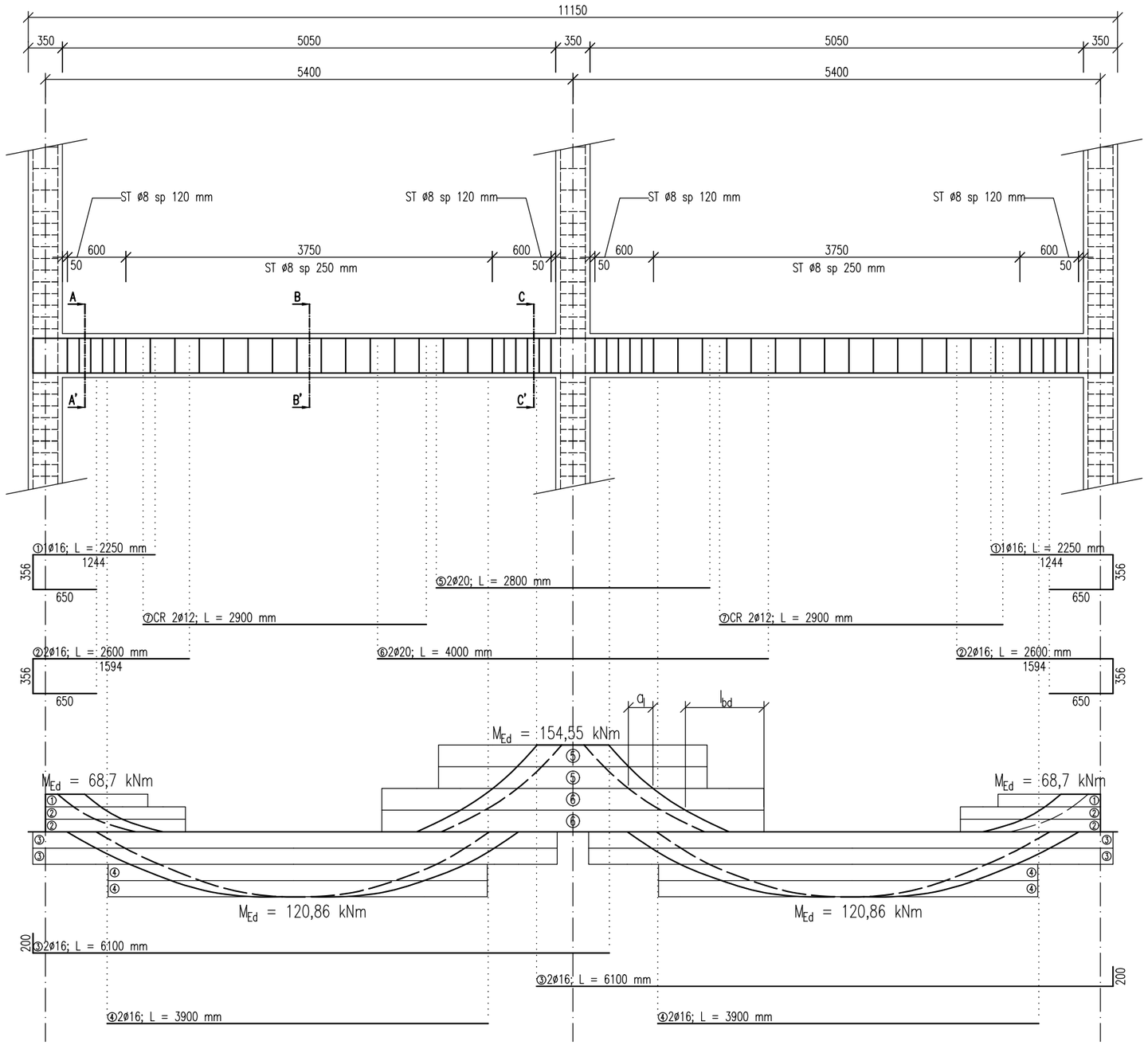
$\Rightarrow l_{0,d} = \max(1{,}5 \cdot 805;\ 362{,}25\,mm) = \max(1207{,}5\,mm;\ 362{,}25\,mm) = 1207{,}5\,mm$

3) Tie ends

The closing end length $\approx 10\,\phi$

column : 80 mm

beam : 80 mm



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	SCALE:	1:50
CONTENT: BEAM REINFORCEMENT DESIGN	DATE:	10/2024
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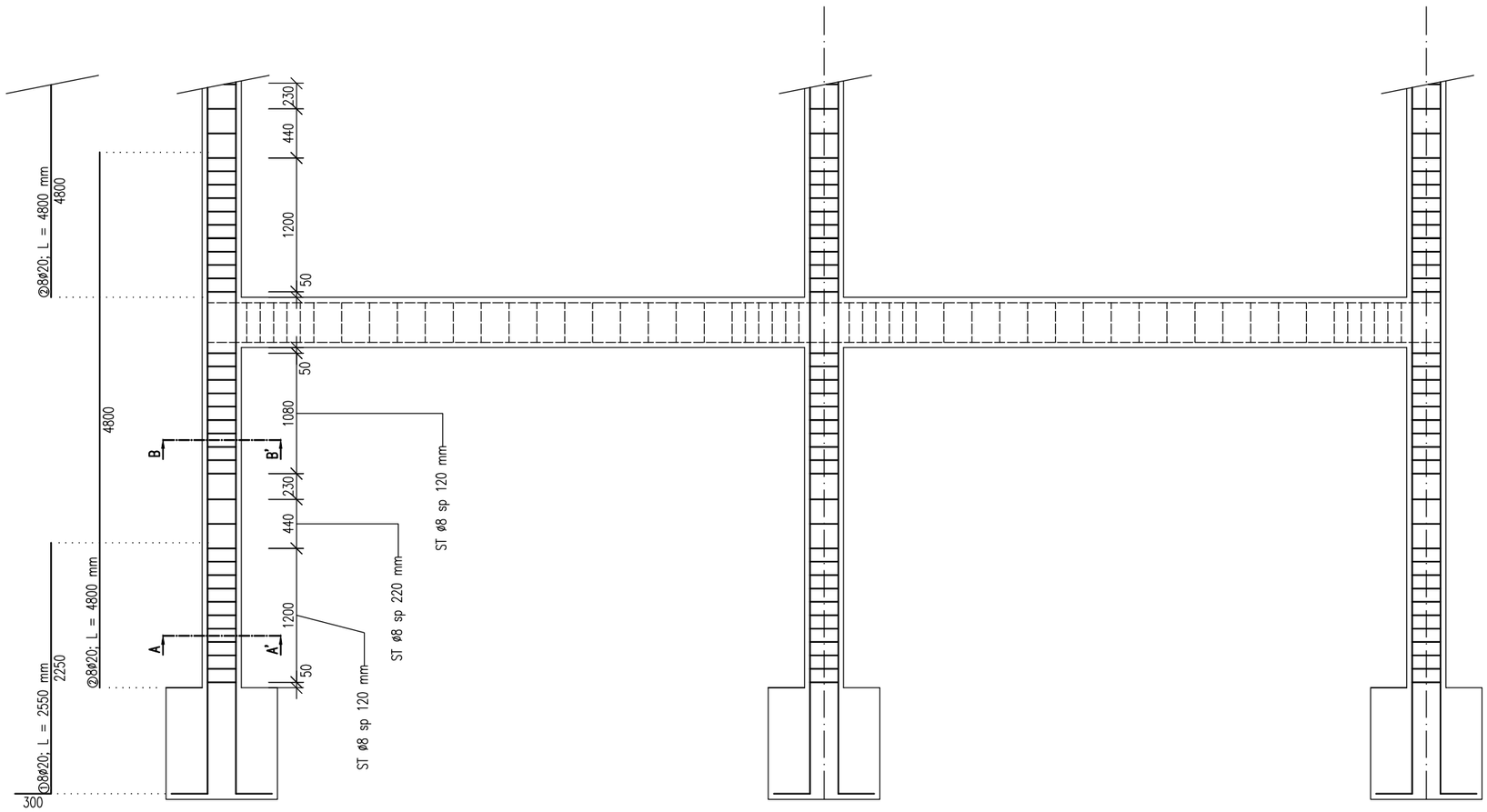
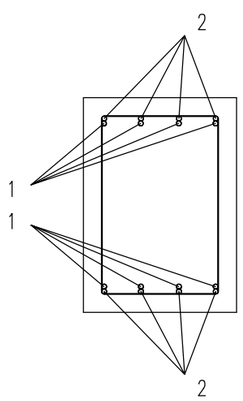
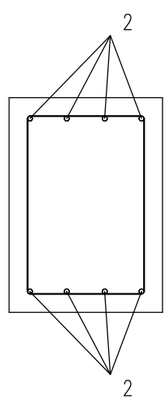
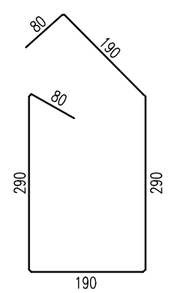


SECTION A – A' 1:10



SECTION B – B' 1:10





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CONTENT: COLUMN REINFORCEMENT DESIGN	DATE:	11/2024
	ASSIGNMENT:	1