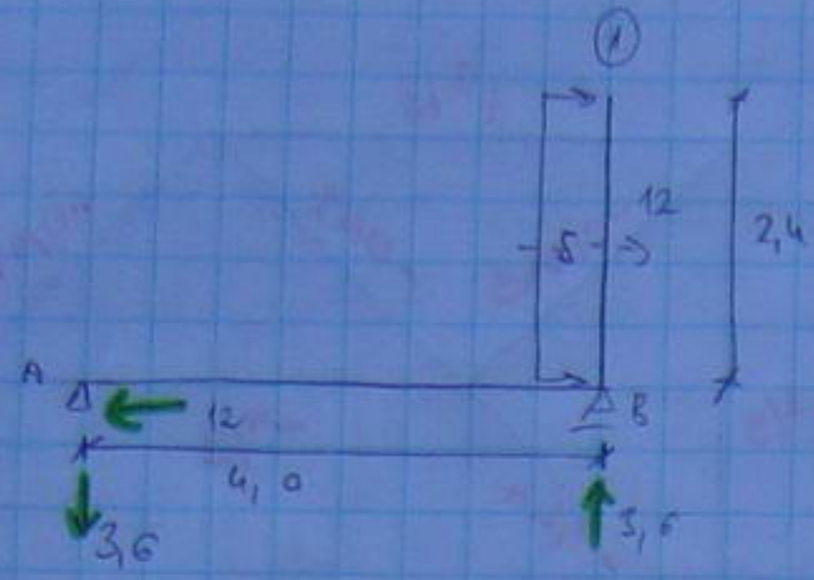
1.



$E = 210\ kN/mm^2$

$I = 2,14 \cdot 10^7\ mm^4$

$E \cdot I = 4,494 \cdot 10^9$

$\Sigma M_A = 0$

$12 \cdot 12 - 4B_y = 0$

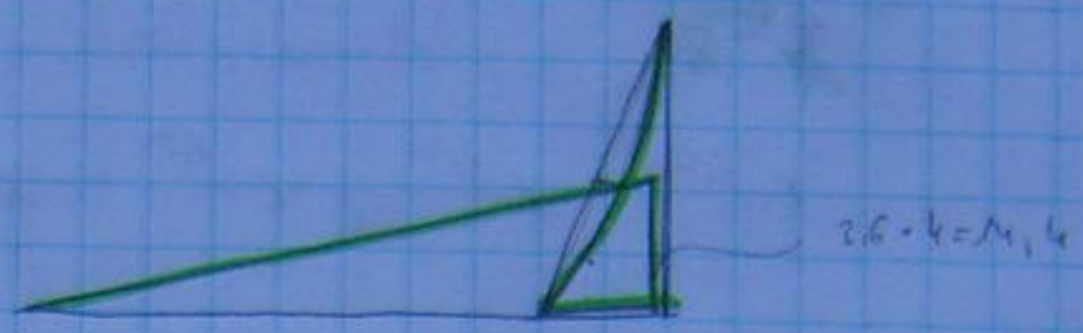
$B_y = 3,6\ kN$

$\Sigma M_B = 0$

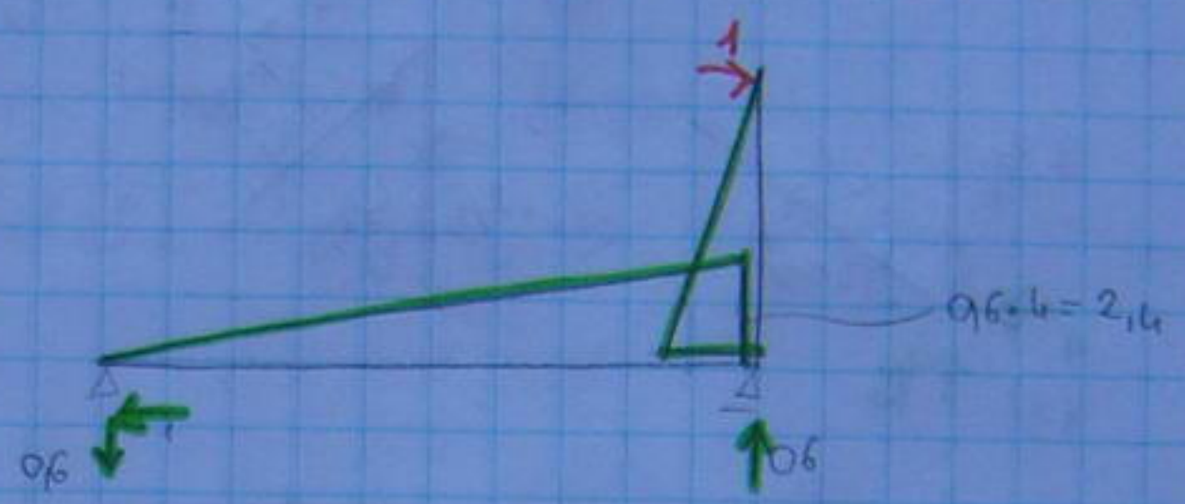
$12 \cdot 1,2 - 4A_y = 0$

$A_y = 3,6\ kN$

M_0



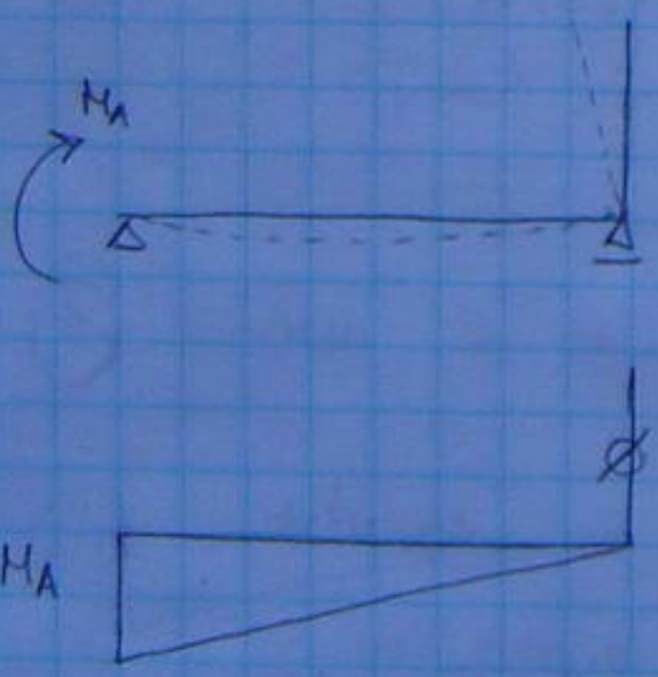
M_1



$\Sigma M_A = 0$

$1 \cdot 2,4 - 4B_y = 0 \rightarrow B_y = 0,6\ kN \quad A_y = 0,6\ kN$

$$u_1 = \frac{10^3}{E \cdot I}\left(\frac{14,4 \cdot 4}{2} \cdot \frac{2}{3} \cdot 2,4 + 14,4 \cdot 2 \cdot \frac{1}{3} \cdot \frac{3}{4} \cdot 2,4\right) = \frac{63,36 \cdot 10^3}{4,4184 \cdot 10^9} = 14,87\ mm \rightarrow$$

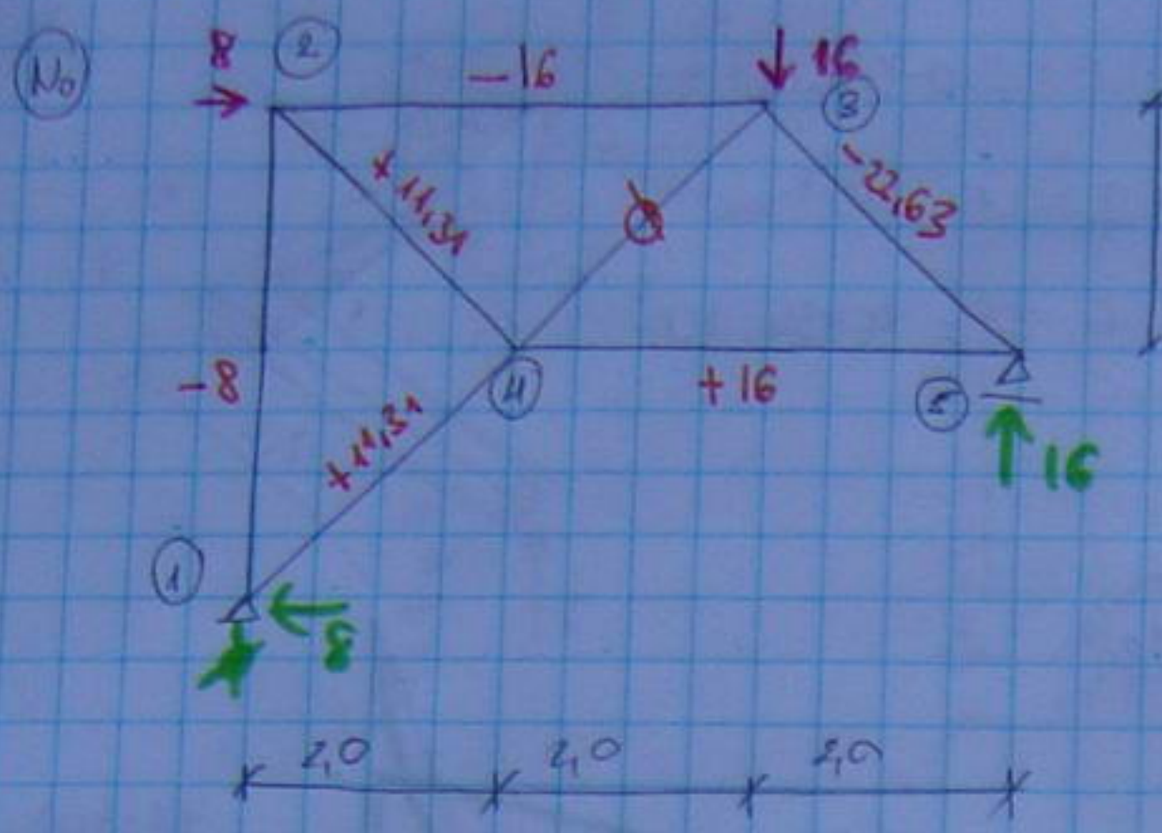


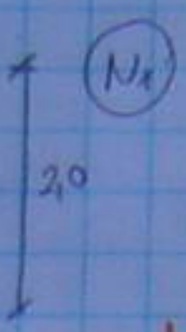
$$-14,87 = -\frac{10^3}{E \cdot I} \cdot \frac{M_A \cdot 4}{2} \cdot \frac{2,4}{3} = -0,355\ M_A$$

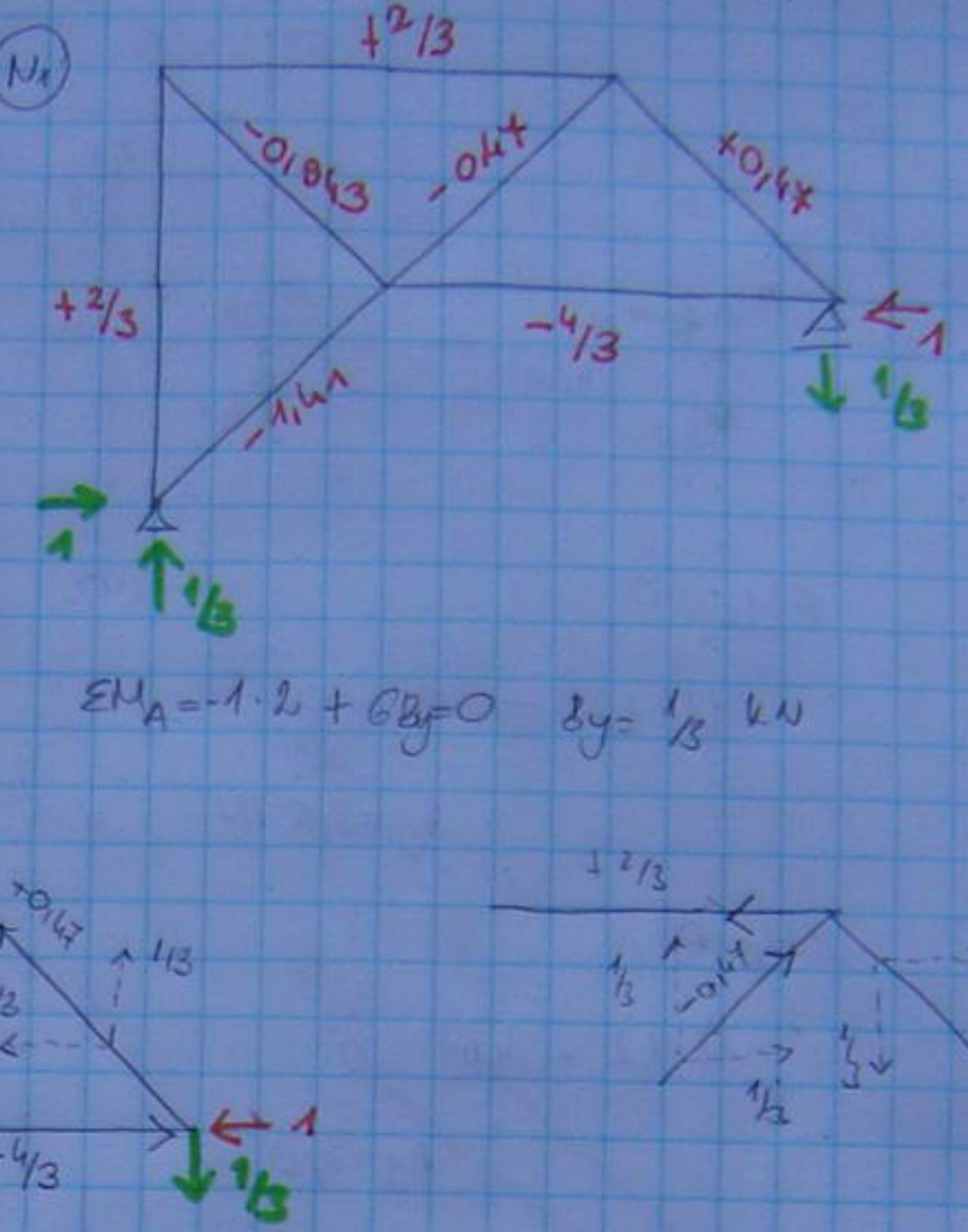
$$M_A = \frac{14,87}{0,356} = 41,76\ kNm$$

2.

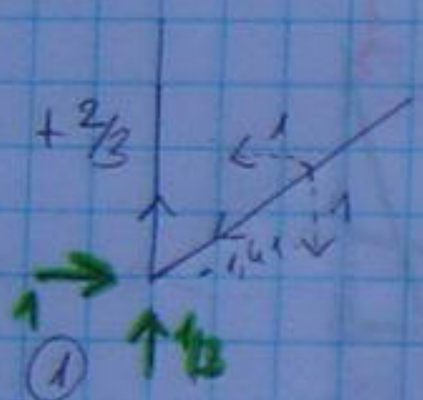
$E \cdot A = 8 \cdot 10^4$

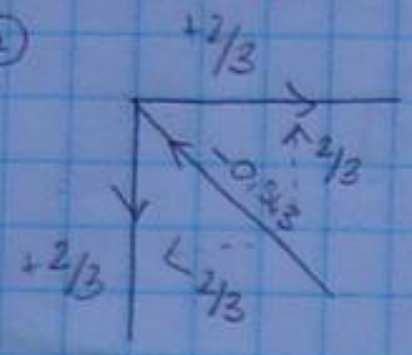






$\Sigma M_A = -1 \cdot 2 + 6B_y = 0 \quad B_y = 1/3 \text{ kN}$

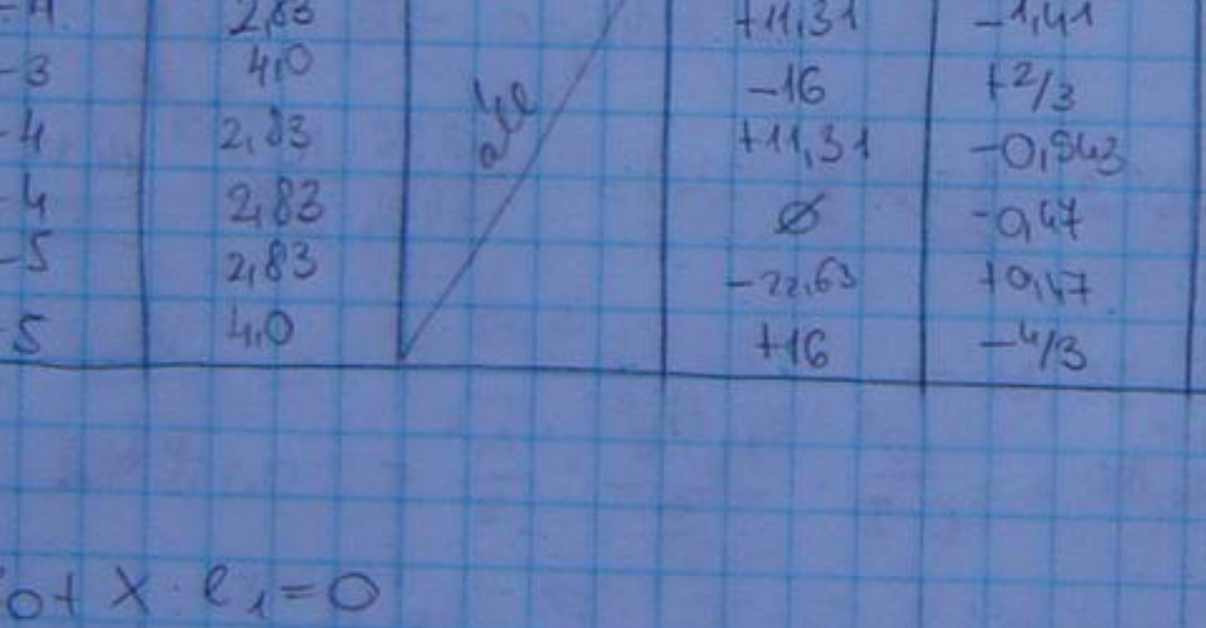




rúd	ℓ	E·A	N0	N1	$e_0 (N_0 N_1 \ell)$	$e_1 (N_1^2 \ell)$	x · N1	$N_1 \ell (N_0 + x \cdot N_1)$
1-2	4,0		-8	+2/3	-21,33	+1,78	+8,44	+0,44
1-4	2,83		+11,31	-1,41	-45,13	+5,68	-17,85	-6,54
2-3	4,0		-16	+2/3	-42,67	+1,78	+8,44	-7,56
2-4	2,83		+11,31	-0,943	-30,18	+4,5	-11,94	-0,63
3-4	2,83		∅	-0,47	∅	+0,625	-5,96	-5,96
3-5	2,83		-22,63	+0,47	-30,1	+0,625	+5,96	-16,64
4-5	4,0		+16	-4/3	-85,33	+7,12	-16,88	-0,88
					-254,74	+20,11		

$e_0 + X \cdot e_1 = 0$

$-254{,}74 + X \cdot 20{,}11 = 0 \rightarrow X = 12{,}66$



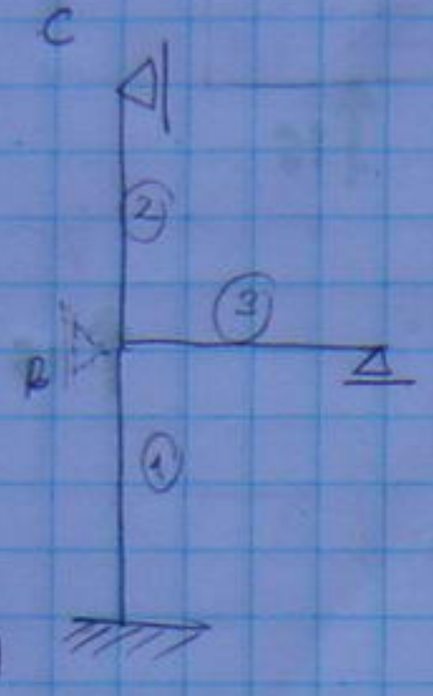
$B_x = 0 + 1 \cdot 12{,}66 = 12{,}66 \text{ kN}$

$B_y = 16 - 1/3 \cdot 12{,}66 = 11{,}78 \text{ kN}$

$A_y = 0 + 1/3 \cdot 12{,}66 = 4{,}22$

$A_x = 8 - 1 \cdot 12{,}66 = -4{,}66 \text{ kN}$

3.



$E = 200\ kN/mm^2$

$I_1 = I_2 = 3 \cdot 10^7\ mm^4$

$I_3 = 2 I_1 = 6 \cdot 10^7\ mm^4$

$k_1 = \frac{4 \cdot 1}{4} = 1$

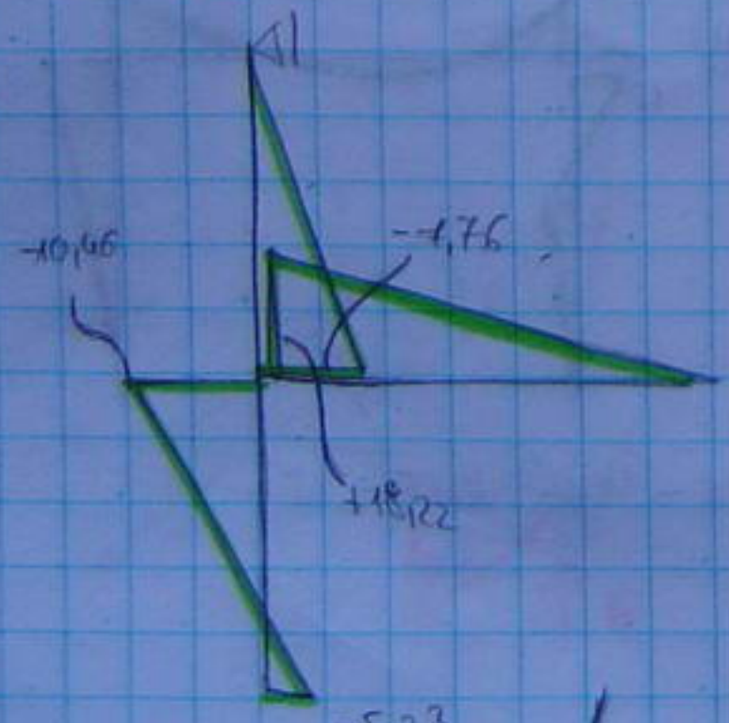
$k_2 = \frac{3 \cdot 1}{4} = 0{,}75$

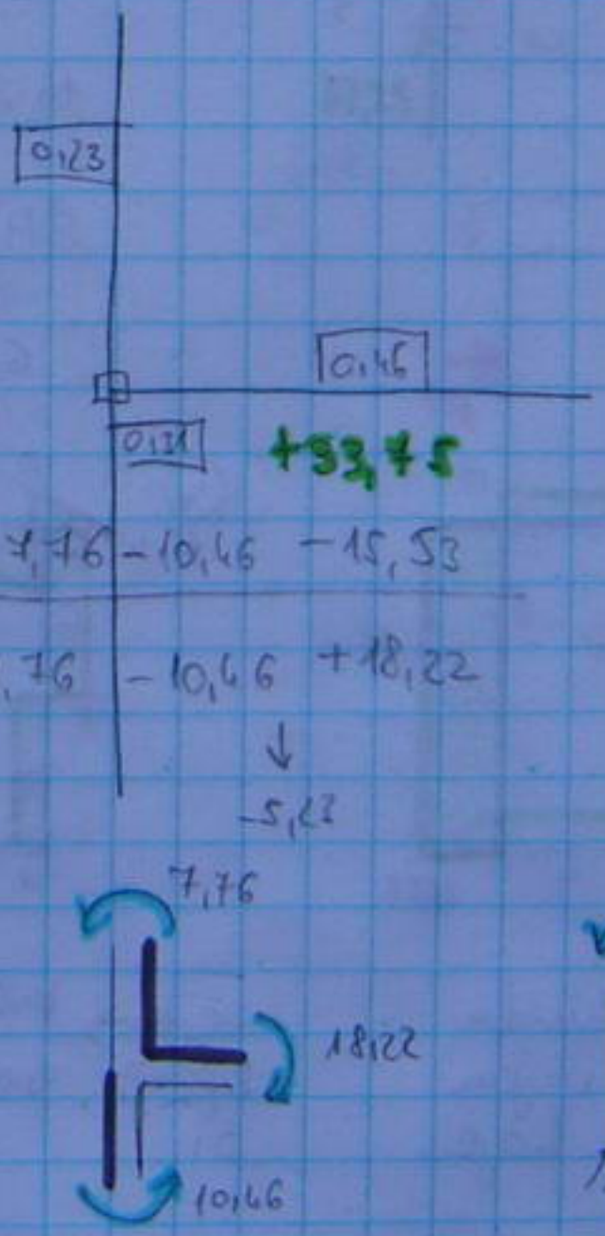
$k_3 = \frac{3 \cdot 2}{4} = 1{,}5$

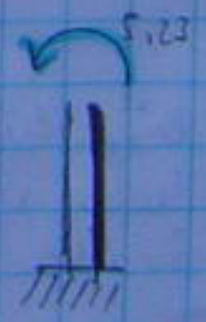
$\Big\}$ $\mu_{B1} = 0{,}51$; $\mu_{b2} = 0{,}23$; $\mu_{B3} = 0{,}46$

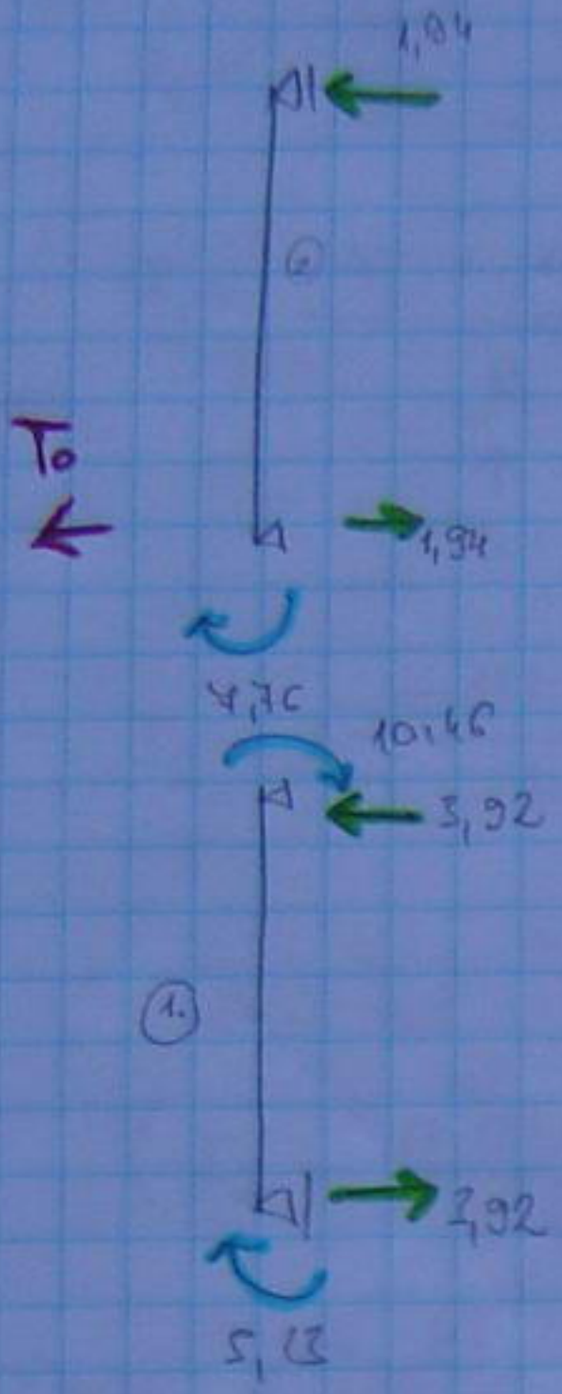
$$\mu_3 = \frac{3 \cdot 12 \cdot 10^3}{4000^2} = 2250\ \frac{kNmm}{m}$$

$$M^0_{b3} = \frac{2250 \cdot 15}{1000} = +33{,}75\ kNm$$



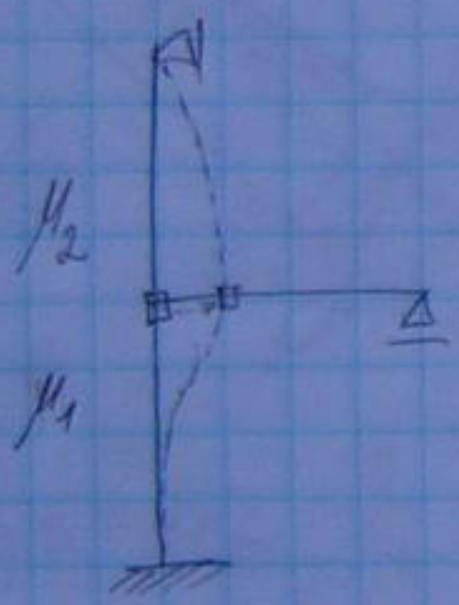






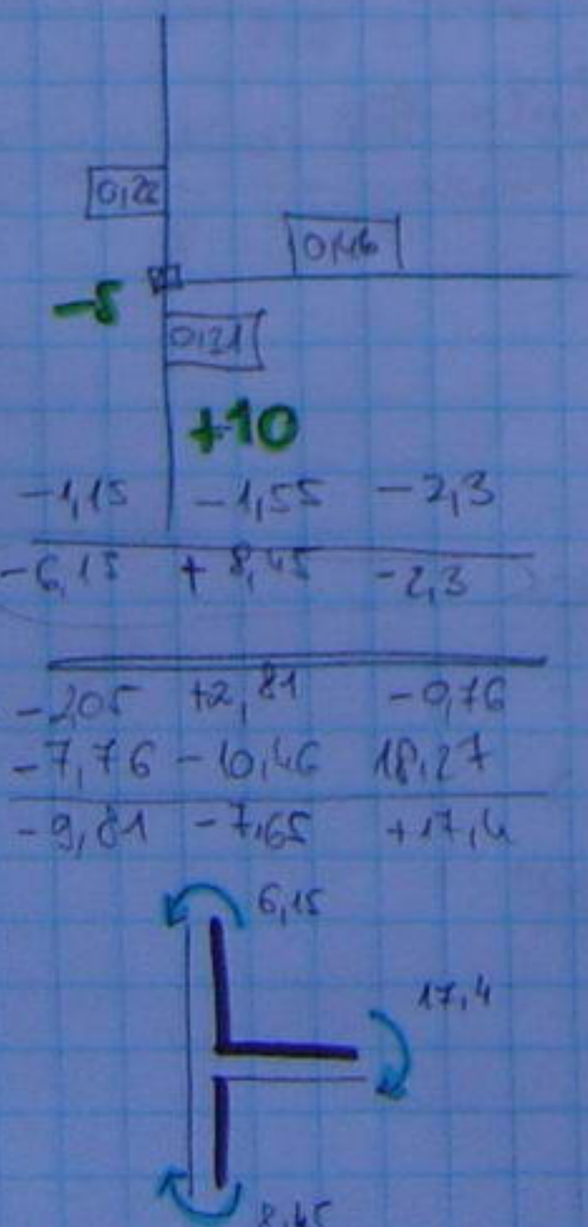
$T_o = 3,92 - 1,94 = \underline{1,98\ kN}$

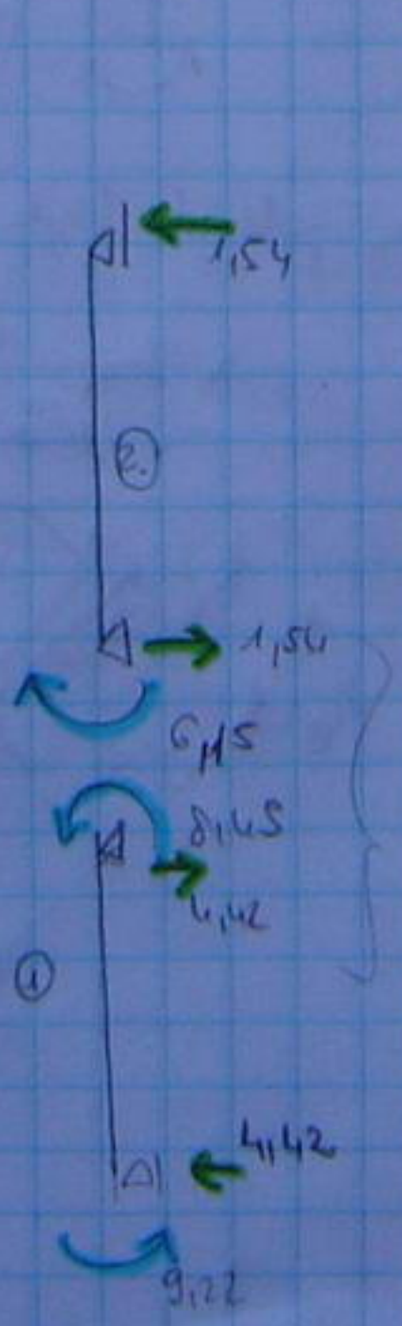
Elleneőrzés



$M_1 = \frac{6 \cdot 1}{4^2} \rightarrow +1,0\ kNm$

$M_2 = \frac{3 \cdot 1}{4^2} \rightarrow -5\ kNm$



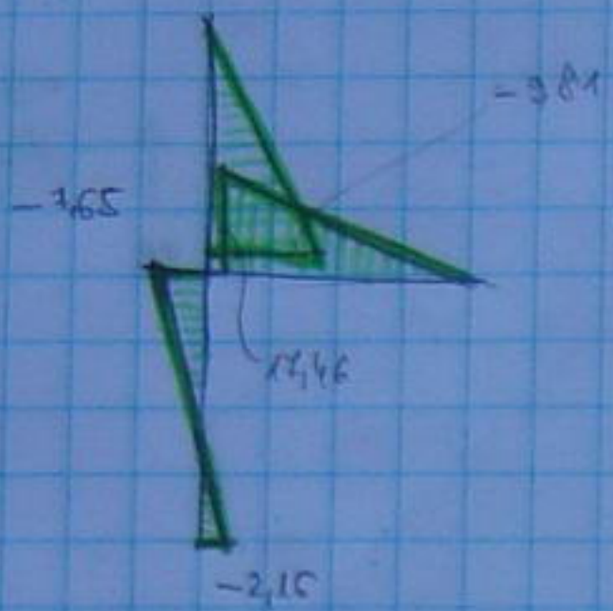


$\vec{T_A} = 1,54 + 4,42 = \underline{5,96\ kN}$

$$T_0 + c\,T_1 = 0$$

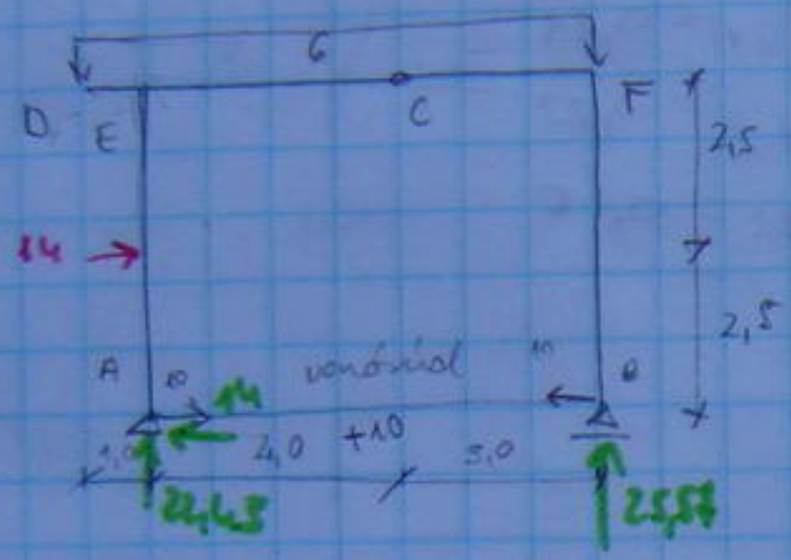
$$c = -\frac{T_0}{T_1} = \frac{1,98}{5,96} = 0,33$$

Mnożę



Szil 1

1.



$\Sigma M_A = 0$

$-6 \cdot 1 \cdot 0,5 + 6 \cdot 7 \cdot 3,5 + 14 \cdot 2,5 - 7 B_y = 0$ $\quad B_y = 25,57\,kN$

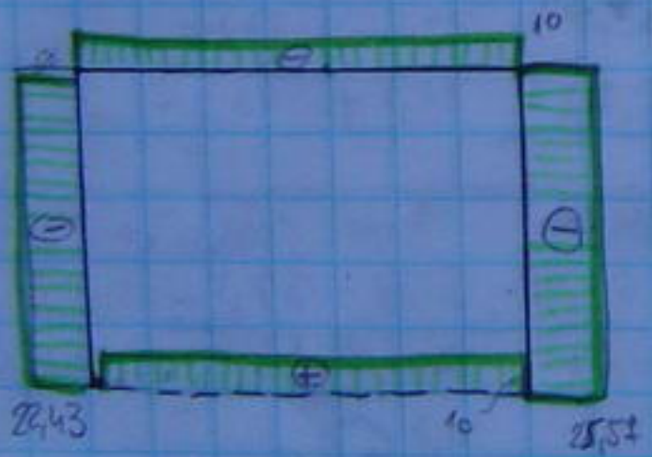
$\Sigma M_B = 0$

$14 \cdot 2,5 - 8 \cdot 6 \cdot 4 + 7 A_y = 0$ $\quad A_y = 22,43\,kN$

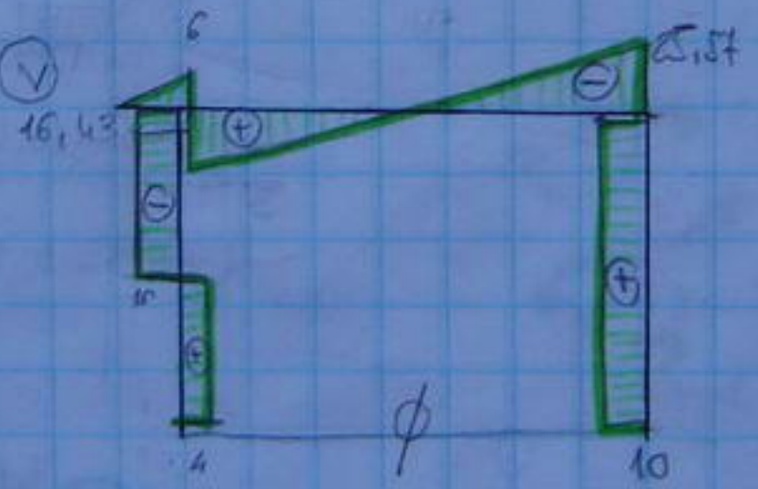
$\Sigma M_C^{jobb} = 0$

$6 \cdot 3 \cdot 1,5 - 3 \cdot 25,57 + 5 S_H = 0 \rightarrow S_H = 10\,kN$

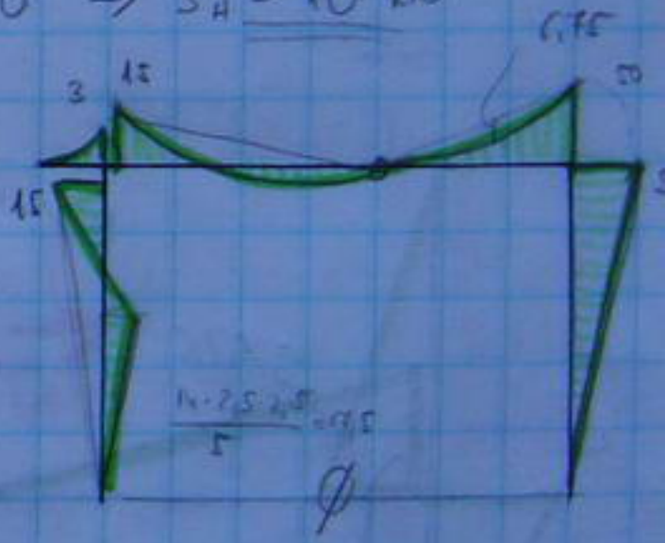
(N)



(V)



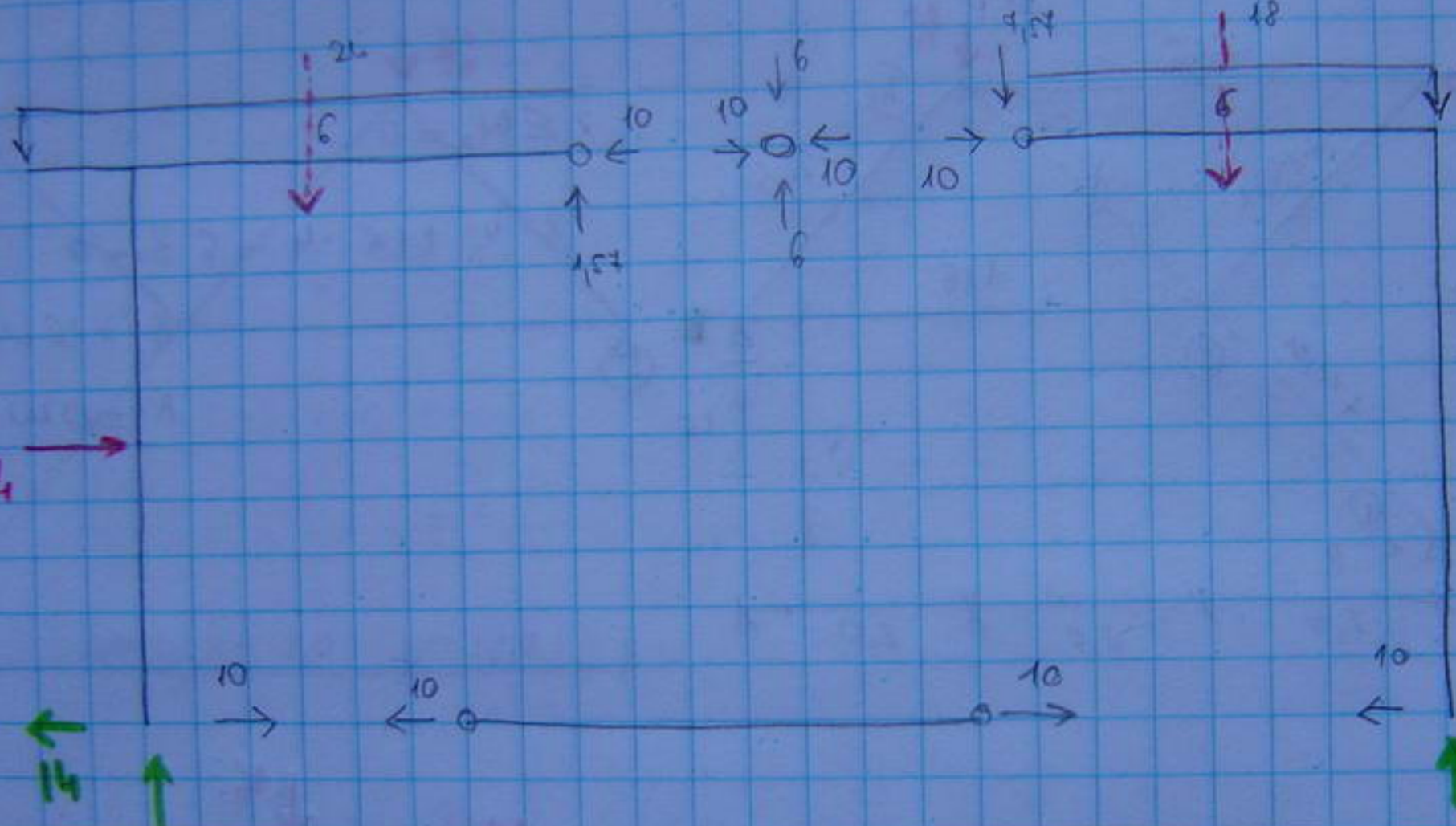
(M)



$14 \cdot 5 - 14 \cdot 2,5 - 10 \cdot 5 = 15$

AB → közp. húzás
AE → külp. nyom
DE → tiszta hajl.

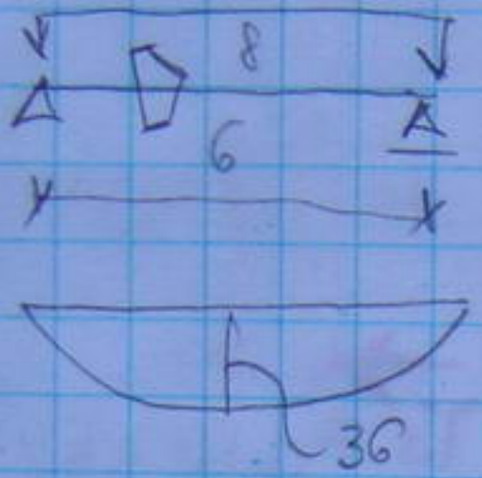
EC F → külp. nyom
BF → külp. nyom

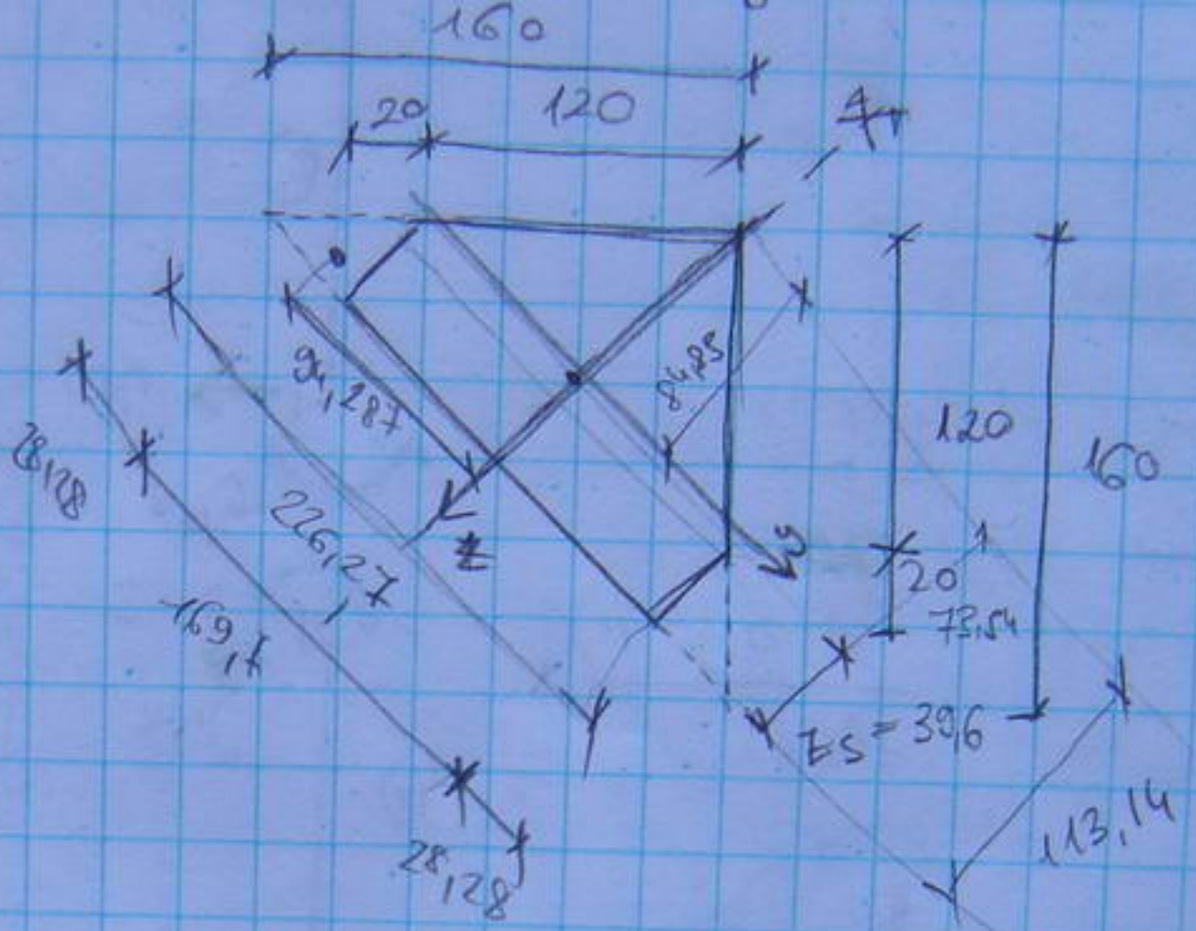


b.) $\sigma_d = 200 N/mm^2$ adott

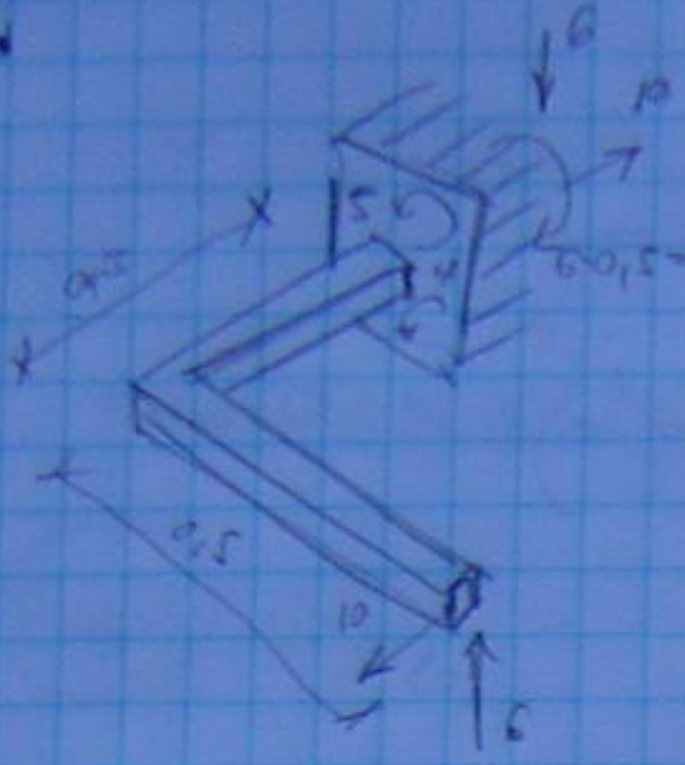
$$\sigma = \frac{F}{A} \rightarrow A = \frac{F}{\sigma} = \frac{10\,000}{200} = 50\,mm^2 \rightarrow r^2\pi = 50 \rightarrow d = 8\,mm$$

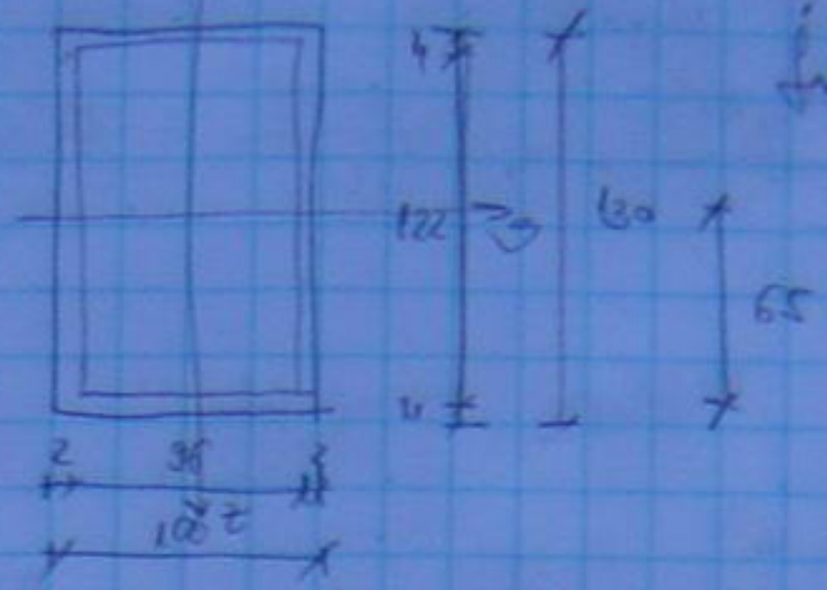
3)


8
6
A
36

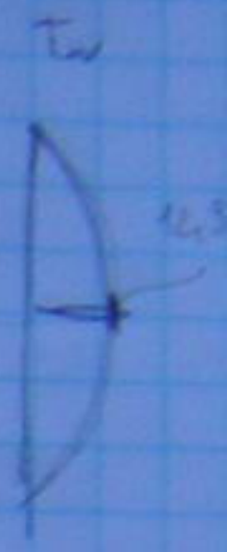

160
120
20
4
84,85
94,287
28,128
226,127
169,14
28,128
120
160
20
73,54
Zs = 396
113,14

3.

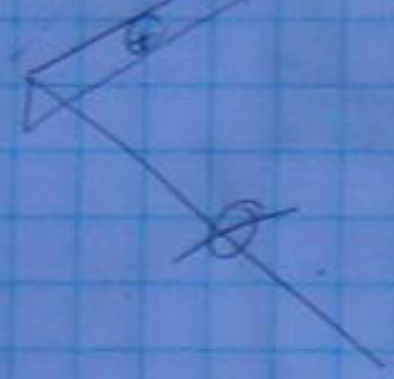




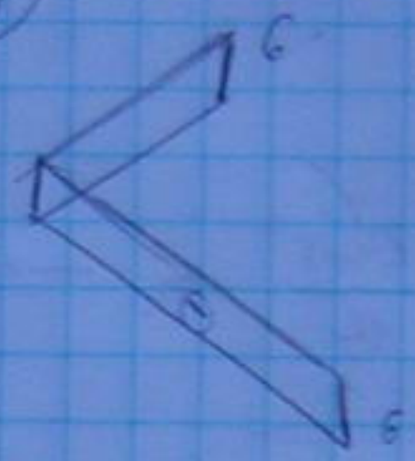
$f_{wd} = 135\ N/mm^2$



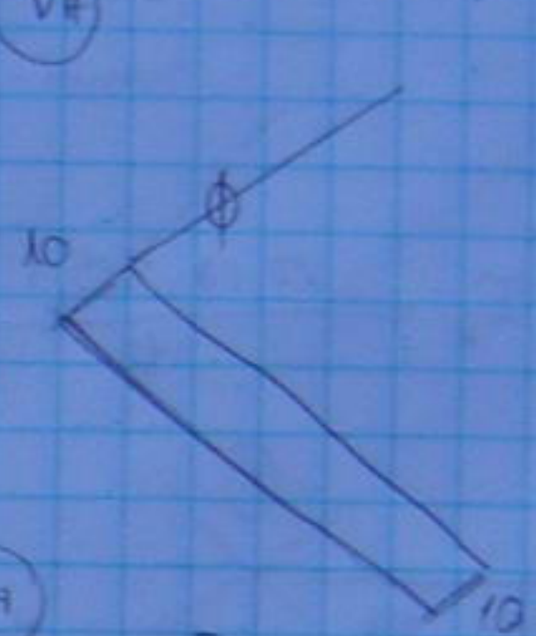
(U)



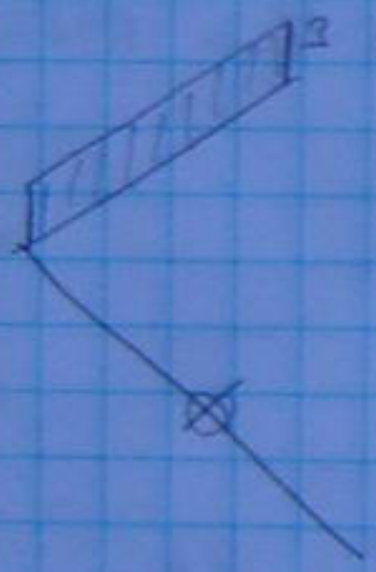
V_y



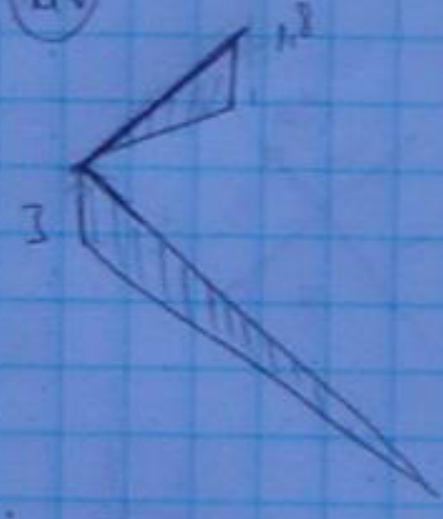
V_H



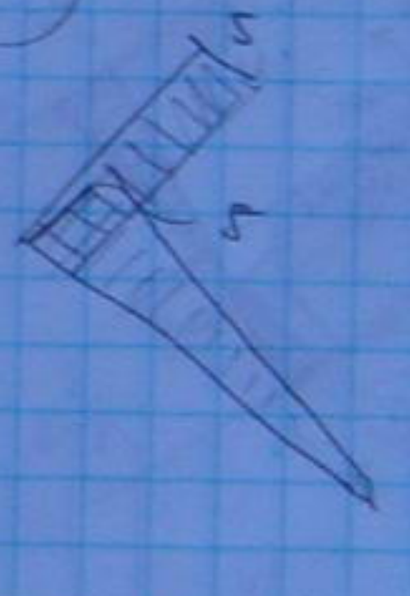
(T)



L_V



L_H



$$\tau_V = \frac{S_y \cdot V}{b \cdot I_y} = \frac{32\,662 \cdot 6000}{1 \cdot 2 \cdot 3{,}78 \cdot 10^6} = 12{,}95 \frac{N}{mm^2}$$

$$S_y = \frac{100 \cdot 65^2}{2} - 96 \cdot \frac{61^2}{2} = 32\,662\ mm^3$$

$$I_y = \frac{100 \cdot 130^2}{12} - \frac{96 \cdot 122^3}{12} = 3{,}78 \cdot 10^6\ mm^4$$

$$\tau_T = \frac{T}{2A_L \cdot t_{min}} = \frac{3 \cdot 10^6}{2 \cdot (98 \cdot 126) \cdot 2} = 60{,}76\ N/mm^2$$

A_L

$$\tau_{max} = \tau_V + \tau_T = 12{,}95 + 60{,}74 = 73{,}69\ N/mm^2$$