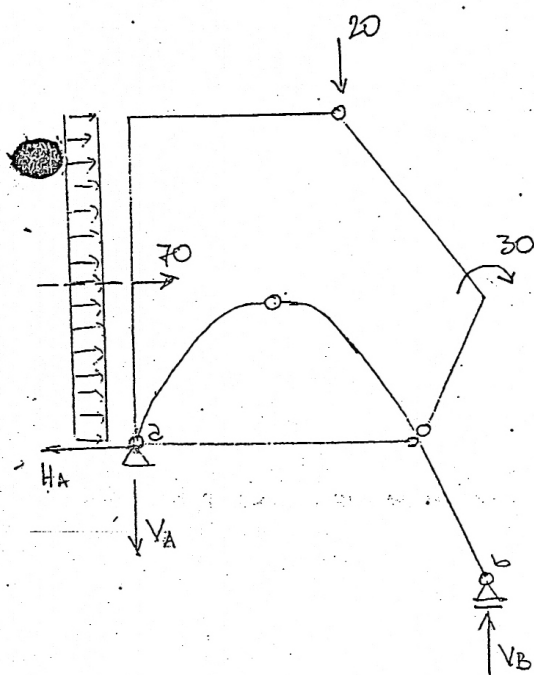
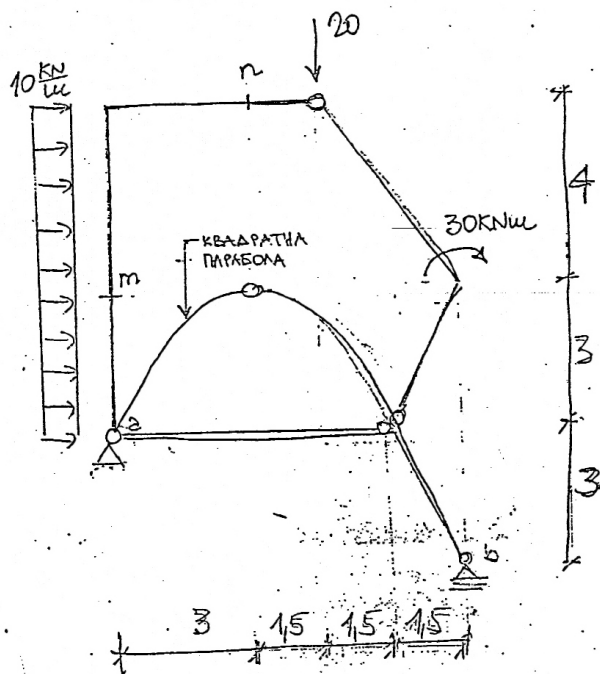


* ЗА ДАТИ НОСАЧ УСЛЕД ЗАДАТОГ ОПТЕРЕЋЕЊА :

1) НАЦРТАТИ ДИЈАГРАМЕ СИЛА У ПРЕСЕЦИМА
(НА ДЕЛУ НОСАЧА ЧИЈА СЕ ОСА МЕЊА ПО КВАДРАТНОЈ ПАРАБОЛИ,
ВРЕДНОСТИ ПРЕСЕЧНИХ СИЛА СРАЧУНАТИ НА СВАКИХ 1,5м ХОРИЗОНТАЛНЕ
ПРОЈЕКЦИЈЕ УСТАПА)

2) ОДРЕДИТИ РАЗМИЦАЊА ЧВОРОВА m и n
($EI = 10^5 \text{ kNm}^2$; $\frac{I}{F} \approx 0$; $\frac{I}{G} \approx 0$)



$$\sum M_a = 0 \quad 70 \cdot 3,5 + 20 \cdot 4,5 + 30 - V_B \cdot 7,5 = 0$$

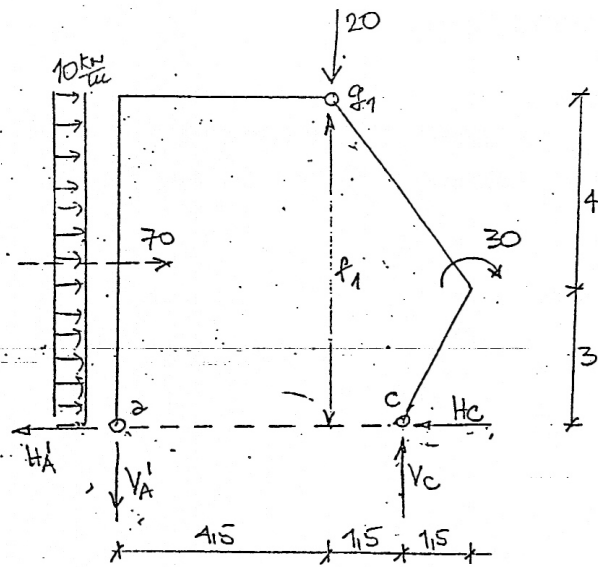
$$V_B = 48,6 \text{ kN}$$

$$\sum V = 0 \quad -V_A - 20 + V_B = 0$$

$$V_A = 28,6 \text{ kN}$$

$$\sum H = 0 \quad -H_A + 70 = 0$$

$$H_A = 70 \text{ kN}$$



$$\sum M_a = 0 \quad 70 \cdot 3.5 + 20 \cdot 4.15 + 30 - V_c \cdot 6 = 0$$

$$V_c = 60.83 \text{ kN}$$

$$\sum M_{g1} = 0 \quad 30 - V_c \cdot 1.15 + H_c \cdot 7 = 0$$

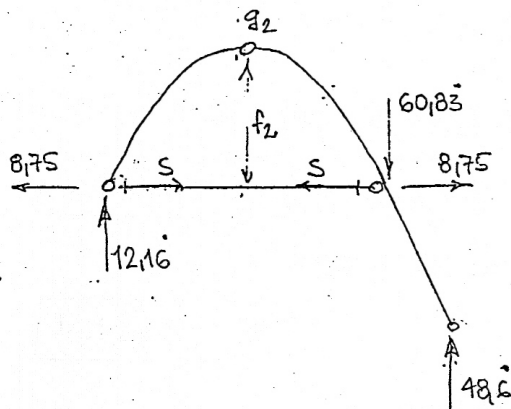
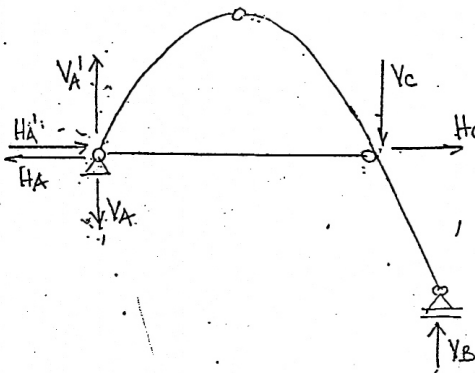
$$H_c = 8.75 \text{ kN}$$

$$\sum V = 0 \quad -V_a' - 20 + V_c = 0$$

$$V_a' = 40.83 \text{ kN}$$

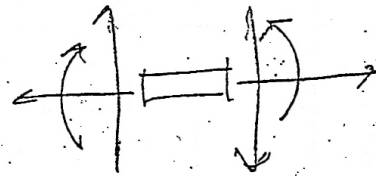
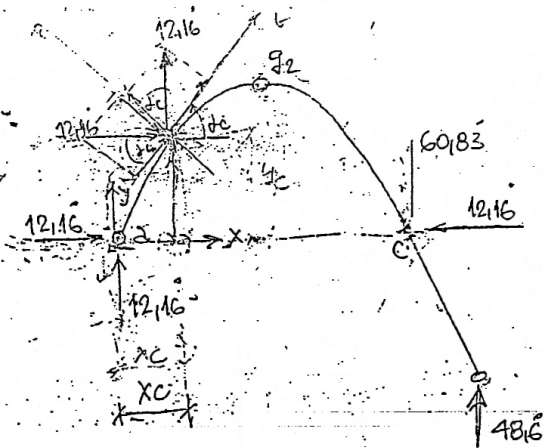
$$\sum H = 0 \quad -H_a' + 70 - H_c = 0$$

$$H_a' = 61.25 \text{ kN}$$



$$\sum M_{g2} = 0 \quad 8.75 \cdot 3 + 12.16 \cdot 3 - S \cdot 3 = 0$$

$$S = 20.916 \text{ kN}$$



ДЕО НОСАЧА КОЈИ СЕ МЕНЈА ПО КВАДРАТНОЈ ПАРАБОЛИ:

$$y = Ax^2 + Bx + C$$

$$y(0) = 0 \Rightarrow \boxed{0 = C}$$

$$y(3) = 3 \Rightarrow 3 = A \cdot 3^2 + B \cdot 3 \quad | : 3$$

$$1 = 3A + B \quad \dots (1)$$

$$y(6) = 0 \Rightarrow 0 = A \cdot 6^2 + B \cdot 6 \quad | : 6$$

$$0 = 6A + B \Rightarrow B = -6A \quad \dots (2)$$

$$(2) \rightarrow (1) \Rightarrow 1 = 3A - 6A \Rightarrow \boxed{A = -\frac{1}{3}}$$

$$\boxed{B = 2}$$

$$y = -\frac{1}{3}x^2 + 2x$$

$$y' = -\frac{2}{3}x + 2 \Rightarrow \tan \alpha_c = 2 - \frac{2}{3}x_c = \frac{2(3-x_c)}{3}$$

$$M_c = 12.16 \cdot x_c - 12.16 \cdot y_c$$

$$= 12.16 (x_c - y_c)$$

$$= 12.16 (x_c - (-\frac{1}{3}x_c^2 + 2x_c))$$

$$= 12.16 (\frac{1}{3}x_c^2 - x_c)$$

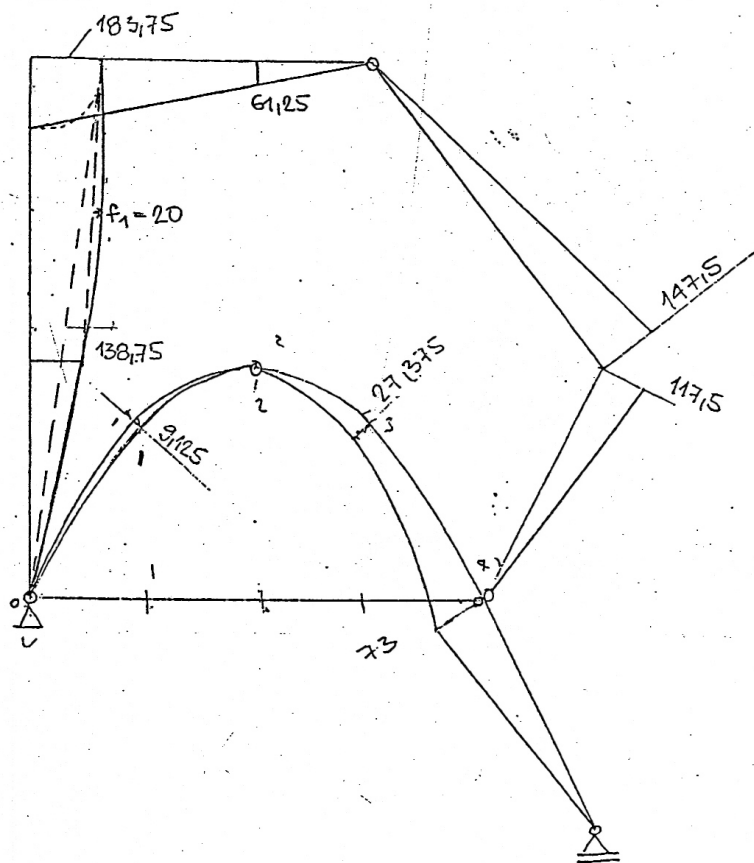
$$T_c = 12.16 \cos \alpha_c - 12.16 \sin \alpha_c$$

$$= 12.16 (\cos \alpha_c - \sin \alpha_c)$$

$$N_c = -12.16 \sin \alpha_c - 12.16 \cos \alpha_c$$

$$= -12.16 (\sin \alpha_c + \cos \alpha_c)$$

	x_c [m]	y_c [m]	$tg \alpha_c$	$sin \alpha_c$	$cos \alpha_c$	M_c [KNm]	T_c [KN]	N_c [KN]
0	0	0	$-\frac{1}{2}$	$\frac{2}{\sqrt{5}}$	$\frac{4}{\sqrt{5}}$	0	-5,441	-16,323
1	1,5	2,25	1	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	-9,125	0	-17,206
2	3	3	0	0	1	0	12,16	-12,16
3	4,5	2,25	-1	$-\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	27,375	17,206	0
4	6	0	-2	$-\frac{2}{\sqrt{5}}$	$\frac{1}{\sqrt{5}}$	73	16,323	5,441



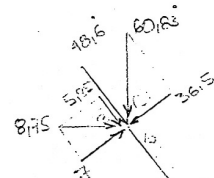
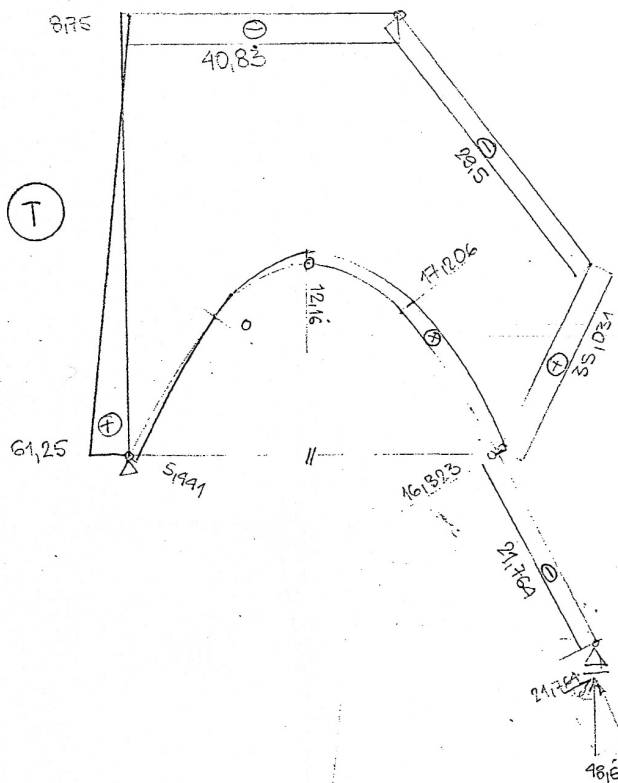
$$tg \alpha = \frac{a}{b}$$

$$sin \alpha = \frac{a}{\sqrt{a^2 + b^2}}$$

$$cos \alpha = \frac{b}{\sqrt{a^2 + b^2}}$$

(M)

(T)

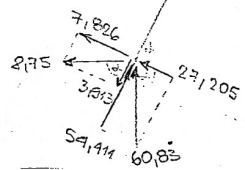


$$\begin{aligned} \tan \beta &= \frac{4}{3} \\ \sin \beta &= 0.8 \\ \cos \beta &= 0.6 \end{aligned}$$

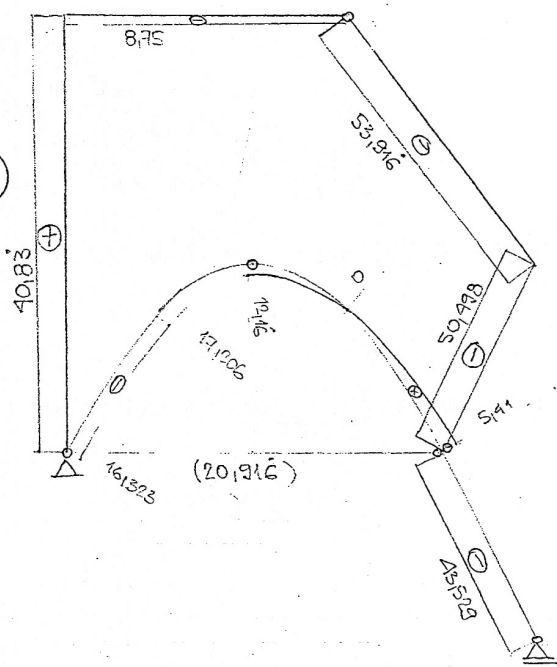
$$\tan \alpha = 2$$

$$\sin \alpha = \frac{2}{\sqrt{5}}$$

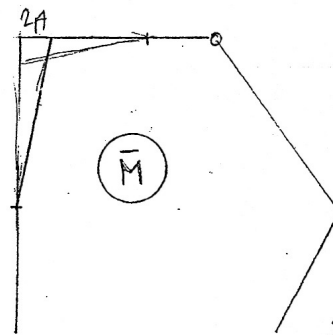
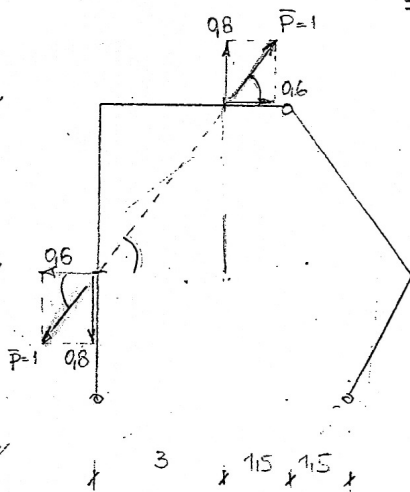
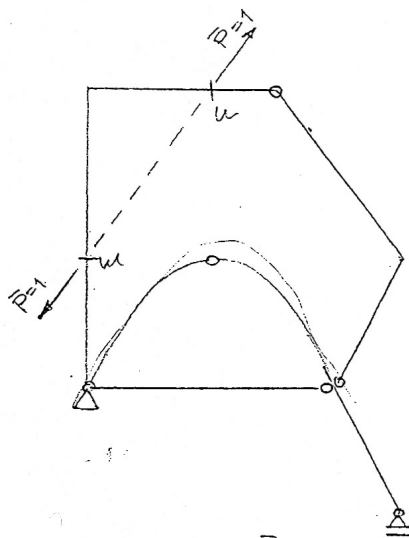
$$\cos \alpha = \frac{1}{\sqrt{5}}$$



(Z)



12)



или же $\frac{I_c}{F} = 0$
 обаячнат не
 востогие
 (или не востогие
 изогнутых а востогие
 изогнутых где же
 $\frac{I}{P} \approx 0.1$

$$\begin{aligned} \Delta l_{u-n} &= \frac{1}{EI_c} \cdot \int \left(\frac{I_c}{I} M \bar{M} + \frac{I_c}{F} N \bar{N} + K \frac{EI_c}{GF} T \bar{T} \right) ds + \int \left(\Delta t \cdot \epsilon \cdot \bar{N} + \Delta t \cdot \frac{\Delta t}{\alpha} \bar{M} \right) ds - \underline{\underline{\chi_{cc}}} \\ &= \frac{1}{EI_c} \cdot \int M \bar{M} ds \quad \underline{\underline{I = const}} \\ &= \frac{1}{10^5} \cdot \left[+ \frac{4}{6} \cdot 2.4 \cdot (138.75 + 2 \cdot 183.75) + \underline{\underline{\left(\frac{4}{3} \right) 2.4 \cdot 2.0}} + \frac{3}{6} \cdot 2.4 \cdot (2 \cdot 183.75 + 61.25) \right] \\ &= + 1383.5 \cdot 10^{-5} \text{ м} \end{aligned}$$

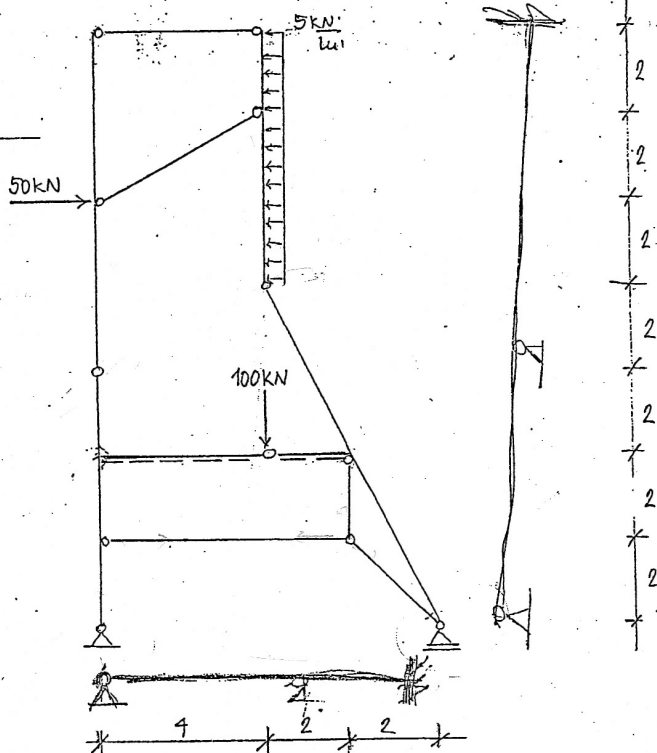
$\rightarrow \frac{l \cdot a \cdot c}{3}$



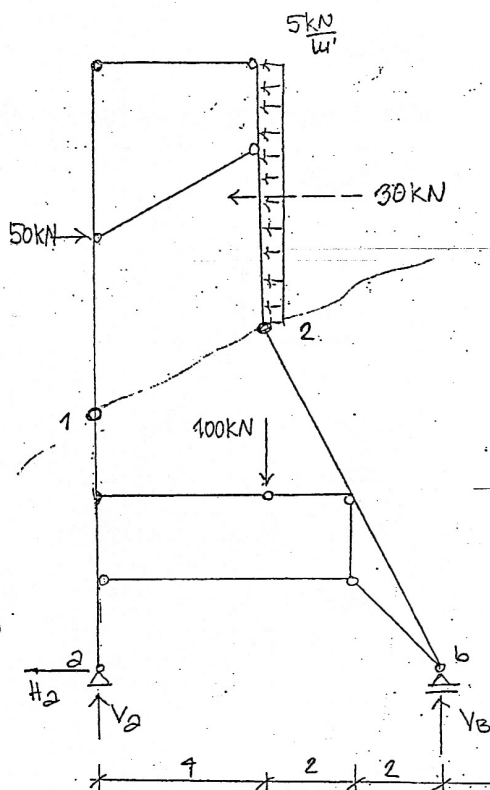
• ZA DATI NOSAČ USLED ZADATOG OPTEREĆENJA

1) NACRTATI DIJAGrame U PRESECIMA

2) NACRTATI DIJAGrame VERTIKALNOG POMERANJA OZNAČENOG POTEZA ŠTAPOVA SA ORDINATAMA U POLOVINAMA DUŽINA ODGOVARAJUĆIH ŠTAPOVA



Prislo jelema iH^L , a uvekod
 $2Mg^L$



$$\sum M_a = 0;$$

$$V_b \cdot 8 - 100 \cdot 4 + 30 \cdot 11 - 50 \cdot 10 = 0$$

$$V_b = 71,25 \text{ kN}$$

$$\sum Y = 0;$$

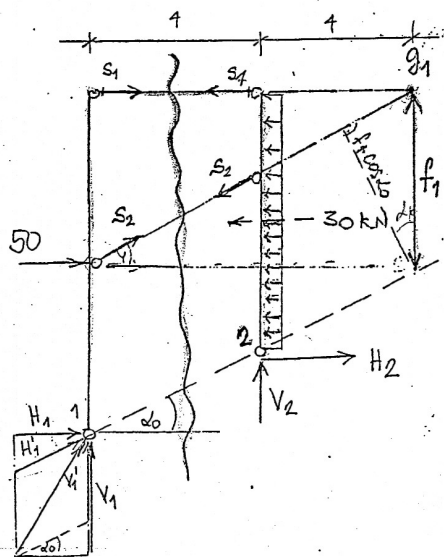
$$V_a - 100 + 71,25 = 0$$

$$V_a = 28,75 \text{ kN}$$

$$\sum H = 0;$$

$$H_a - 50 + 30 = 0$$

$$H_a = 20 \text{ kN}$$



$$\tan \alpha_0 = \frac{1}{2} \Rightarrow \cos \alpha_0 = \frac{2}{\sqrt{5}}, \sin \alpha_0 = \frac{1}{\sqrt{5}}$$

$$f_1 = 8 - 8 \cdot \tan \alpha_0 = 8 - 8 \cdot \frac{1}{2} = 4 \text{ m}$$

$$\sum M_2 = 0: 30 \cdot 3 - 50 \cdot 2 - V_1' \cdot 4 = 0$$

$$V_1' = -2,5 \text{ kN}$$

$$\sum M_{g_1}^L = 0: V_1' \cdot 8 - H_1' \cdot f \cdot \cos \alpha_0 - 50 \cdot 4 = 0$$

$$-220 - H_1 \cdot 4 = 0$$

$$H_1 = -55 \text{ kN}$$

$$V_1 = V_1' + H_1 \cdot \tan \alpha_0 = -2,5 - 55 \cdot \frac{1}{2}$$

$$V_1 = -30 \text{ kN}$$

$$\sum Y = 0: V_1 + V_2 = 0 \quad V_2 = 30 \text{ kN}$$

$$\sum H = 0: 50 - 30 + H_1 + H_2 = 0$$

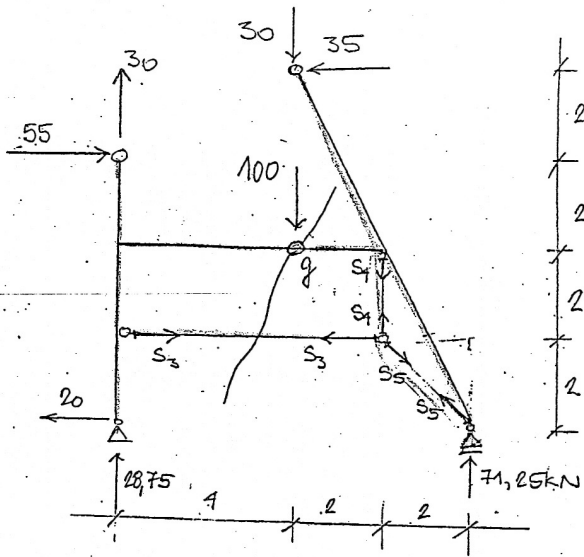
$$H_2 = 35 \text{ kN}$$

$$\sum V^L = 0: V_1 + S_2 \cdot \frac{1}{\sqrt{5}} = 0$$

$$S_2 = 30\sqrt{5} \text{ kN}$$

$$\sum H^L = 0: -H_1 + 50 + S_1 + S_2 \cdot \frac{2}{\sqrt{5}} = 0$$

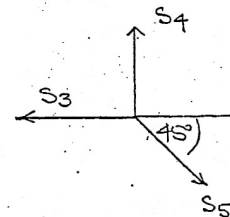
$$S_1 = -55 \text{ kN}$$



$$\sum M_g^2 = 0:$$

$$55 \cdot 2 + 30 \cdot 4 - S_3 \cdot 2 + 20 \cdot 4 + 28.75 \cdot 4 = 0$$

$$S_3 = 212.5 \text{ kN}$$

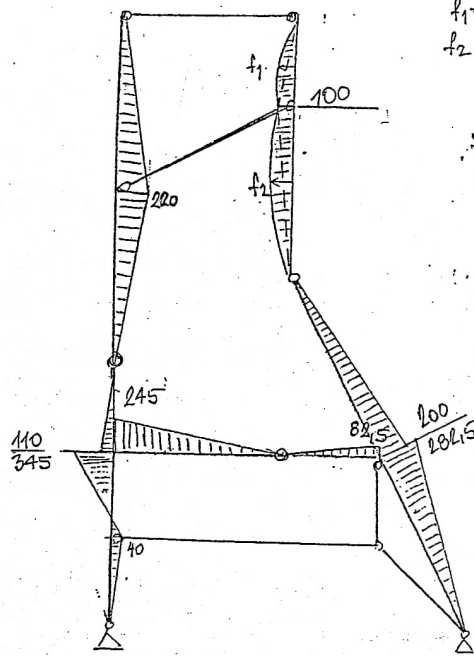


$$\sum H = 0: S_3 - S_5 \cdot \frac{1}{\sqrt{2}} = 0$$

$$S_5 = 212.5 \sqrt{2} \text{ kN}$$

$$\sum Y = 0: S_4 - S_5 \cdot \frac{1}{\sqrt{2}} = 0$$

$$S_4 = 212.5 \text{ kN}$$

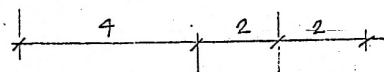
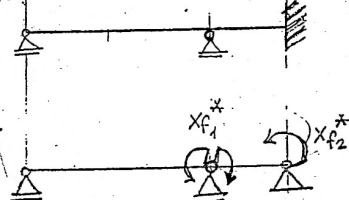
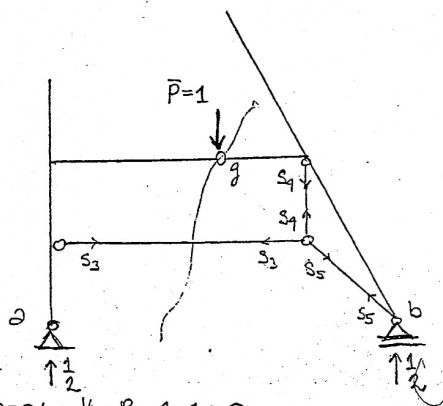


$$f_1 = \frac{1}{8} \cdot 5 \cdot 2^2 = 2.5 \text{ kNm}$$

$$f_2 = \frac{1}{8} \cdot 5 \cdot 4^2 = 10 \text{ kNm}$$

(M)

Зашто је
дешило да ни је истрек
путија горе или горе ?


$$\begin{array}{ccc} V_0 = 0 & Y_2 \neq 0 & Y_4 \neq 0 \\ P_0 \neq 0 & Y_2^L \neq Y_2^D \neq 0 & P_4 \neq 0 \\ M_{A,0} = 0 & M_{A,2} \neq 0 & M_{A,4} \neq 0 \\ T_{A,0} \neq 0 & T_{A,2}^L \neq T_{A,2}^D & T_{A,4} \neq 0 \end{array}$$

$$n=2$$


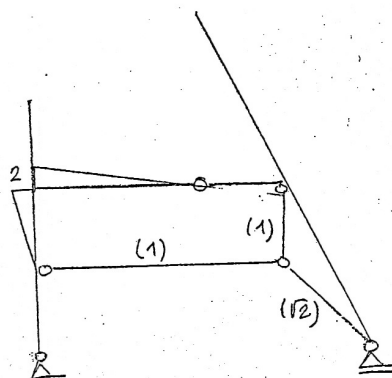
$$\Sigma M_B = 0: \quad V_b \cdot 8 - 1 \cdot 4 = 0$$

$$V_b = \frac{1}{2}$$

$$\sum M_g^L = 0: \quad \frac{1}{2} \cdot 4 - S_3 \cdot 2 = 0$$

$$S_3 = 1 \quad S_5 = \sqrt{2}$$

$$S_4 = 1$$

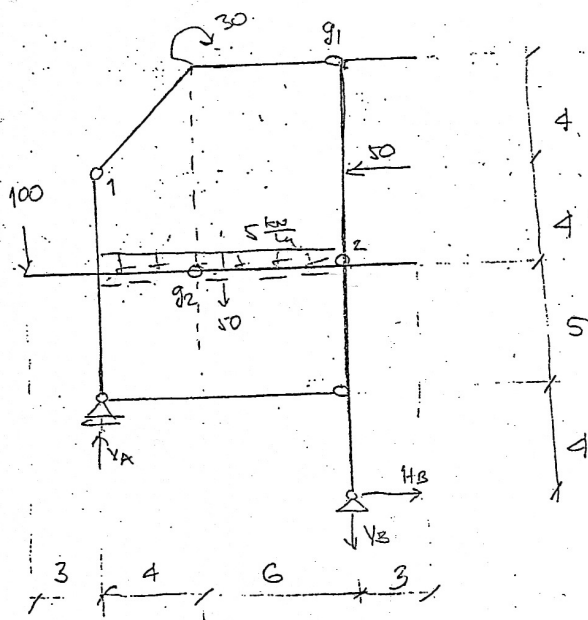


2) НАЦІОНАЛНА ДИПЛОМАТИЯ

б) ОПРЕДИТИ АКЗАТРАМ ВЕРТИКАЛНИХ
ПОКРЕТА ОЗНАЧЕНОГ ПОТЕСА. ШТАТОРА

ЗА ГРЕДНИ НОСАЧ $\frac{I}{E} = 0$

3.4. Процент утраты $\frac{I}{F} = 0.1$



$$\Sigma M_B = 0 \quad V_A \cdot 10 - 100 \cdot 13 + 30 \cdot 10 - 50 \cdot 13 - 50 \cdot 5 = 0$$

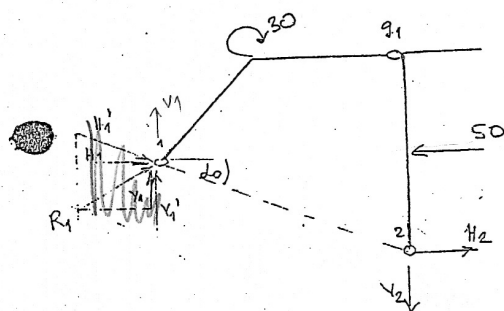
$$\sum V = 0 \quad V_A - 100 - 50 - V_B = 0$$

$$\sum H = 0 \quad H_B - 50 = 0$$

$$V_A = 217 \text{ kV}$$

$$V_B = 67 \text{ kN}$$

$$H_B = 50 \text{ kN}$$



$$\sum M_{B1}^d = 0 \quad 50 \cdot 4 - H_2 \cdot 8 = 0$$

$$H_2 = 25$$

$$\Sigma M_A = 0 \quad 30 + V_2 \cdot 10 - H_2 \cdot 4 = 0$$

$$V_2 = 77$$

$$\sum V = 0 \quad V_1 - V_2 = 0$$

$$V_1 = 7$$

$$\Sigma k=0 \quad \cdot \quad k_1 - 50 + k_2 = 0$$

$$H_1 = 25$$

$$f_1 = 8 \text{ m}, \quad t_{g20} = \frac{4}{10} = 0,4$$

$$\sum M_2 = 0 \quad V_1' \cdot 10 + 30 - 50 \cdot 4 = 0$$

$$V_1' = 17 \text{ kN}$$

$$\sum M_{g1} = 0 \quad V_1' \cdot 10 + 30 - H_1 \cdot 4 = 0$$

$$H_1 = 25 \text{ kN}$$

$$V_1 = V_1' - H_1 \tan \alpha_0 = 17 - 25 \cdot 0,4$$

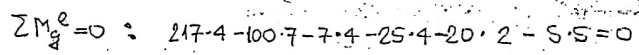
$$Y_1 = 7 \text{ KN}$$

$$\sum V = 0 \quad / \quad V_1 - V_2 = 0$$

$$V_2 = 7 \text{ kN}$$

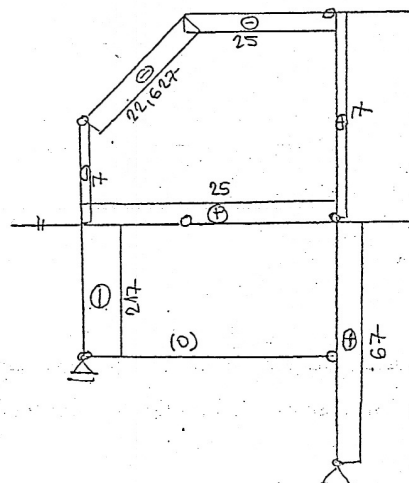
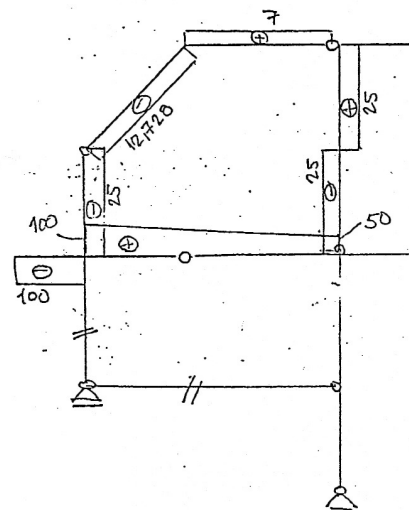
$$\Sigma H = 0 \quad H_1 - 50 + H_2 = 0$$

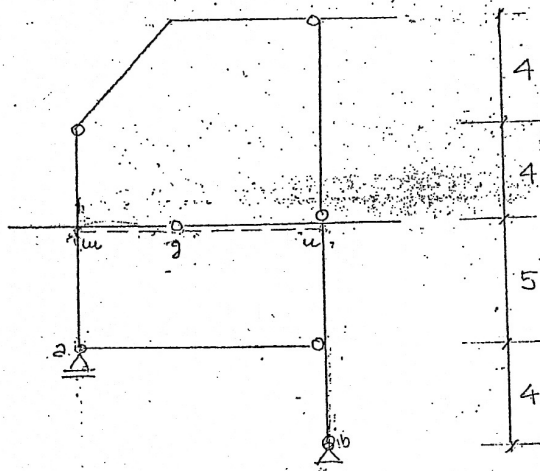
$$H_2 = 25 \text{ kN}$$



Hand-drawn diagram of a truss structure. The truss is supported by a pin support on the left and a roller support on the right. Dimensions and labels include:

- Top horizontal dimensions: 72, 42
- Left vertical dimensions: 300, 400
- Internal horizontal dimensions: 100, 100
- Right vertical dimensions: 450, 200
- Diagonal dimensions: $f_1 = 10$, $f_2 = 2245$
- A circled 'M' is located on the left side.

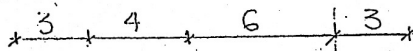




$$U \rightarrow M_f$$

$$\psi \rightarrow T_e$$

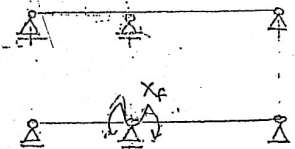
$$\frac{I}{r} = 0$$



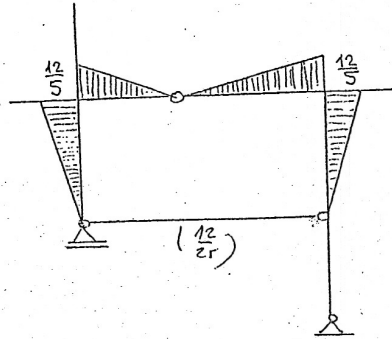
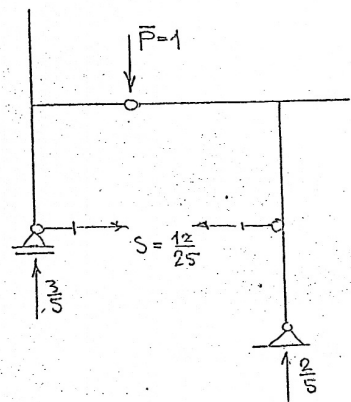
$$V_{u1} = 0, \\ V_{u2} \neq 0$$

$$V_{g1} \neq 0, \\ V_{g2} \neq 0$$

$$V_{u3} = 0, \\ V_{u4} \neq 0$$



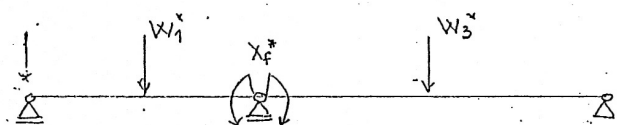
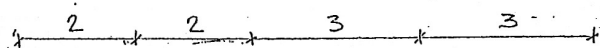
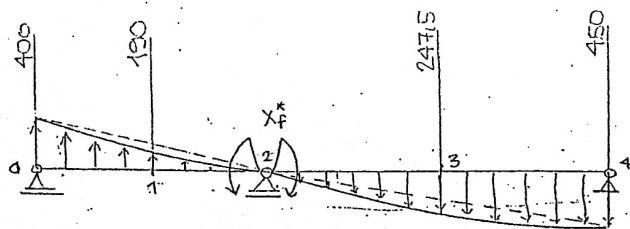
ФИКТИВНИ КОСАЧ ПЕ РЕДАН ПУТ СТАТИЧКИ НЕОДРЕЂЕТИ



(M)
(N)

$$X_f = \int \left(\frac{I}{r} M \bar{M} + \frac{I}{r} N \bar{N} \right) ds$$

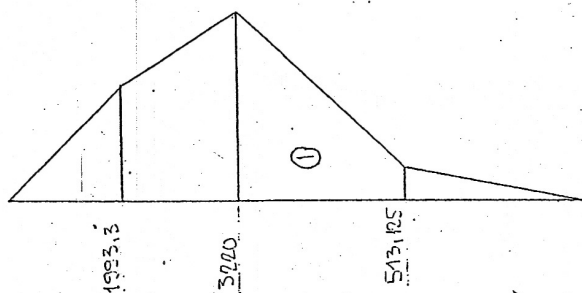
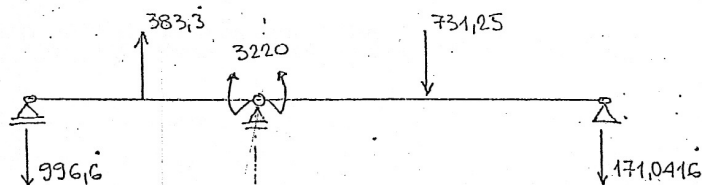
$$= \frac{4}{3} \cdot \frac{12}{5} \cdot (400 - 10) - \frac{5}{3} \cdot \frac{12}{5} \cdot (450 + 22.5) - \frac{5}{6} \cdot \frac{12}{5} \cdot (2 \cdot 450 + 200) = -3220$$



$$W_1^* = \frac{2}{12} \cdot (P_0 + 10P_1 + P_2) = -383,3$$

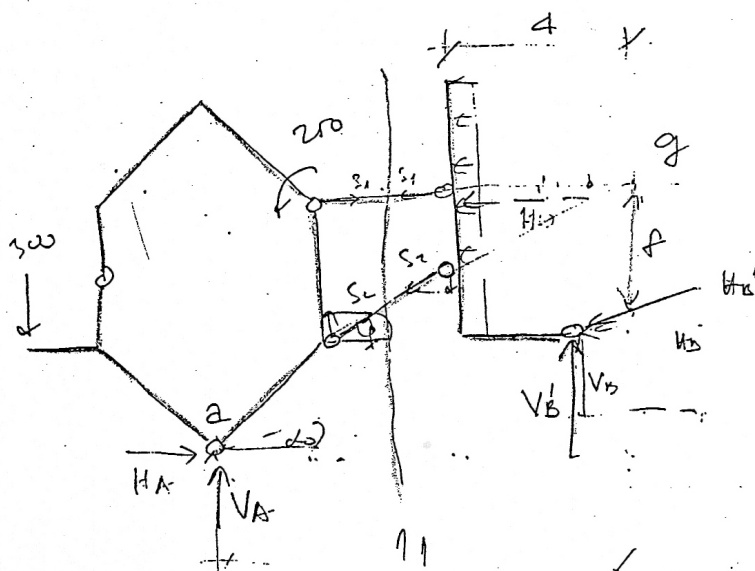
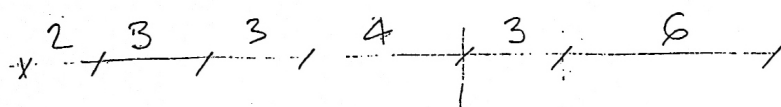
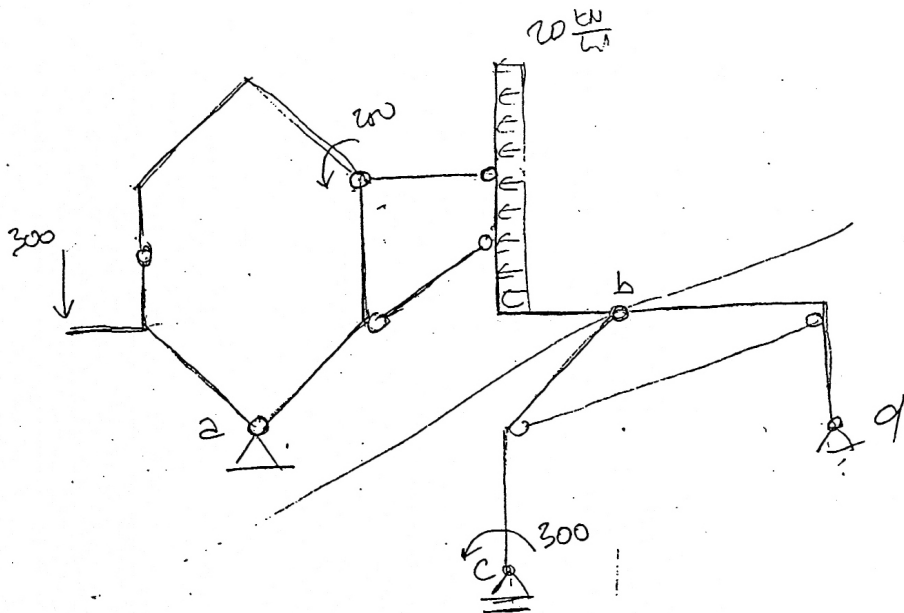
$$W_3^* = \frac{3}{12} (P_2 + 10P_3 + P_4) = 731,25$$

125,126 str. (P)



$$V \times EI_c$$

⇒ АНГАТРАМ ФЕРТКАЛЛОТ
ПОМЕРАТБА ?



$$t_{20} = \frac{3}{10}$$

$$\sum M_a = 0 \quad -300 \cdot 5 - 20 - 140 \cdot 6.15 - V_B' \cdot 10 = 0$$

$$V_B' = -266 \text{ kN}$$

$$f = 7 - 11 \cdot t_{20} = 3.7 \text{ m}$$

$$\sum M_g^d = 0 \quad 140 \cdot 0.15 + V_B' \cdot 1 + H_B' \cdot f \cdot t_{20} = 0$$

$$70 + (-266) \cdot 1 + H_B' \cdot 3.7 = 0$$

$$H_B' \cdot t_{20} = H_B$$

$$H_B = +52.972 \text{ kN}$$

$$V_B = V_B' - H_B \cdot t_{20} = -266 - 52.972 \cdot \frac{3}{10}$$

$$V_B = -281.35 \text{ kN}$$

$$\sum V = 0 \quad V_A - 300 + V_B = 0$$

$$V_A = 581,891 \text{ kN}$$

$$\sum H = 0 \quad H_A - H_B - 140 = 0$$

$$H_A = 192,972 \text{ kN}$$

$$\sum V^d = 0 \quad -S_{2V} + V_B = 0$$

$$S_{2V} = -281,891$$

$$S_{2H} = -281,891$$

$$S_2 = -281,891 \sqrt{5}$$

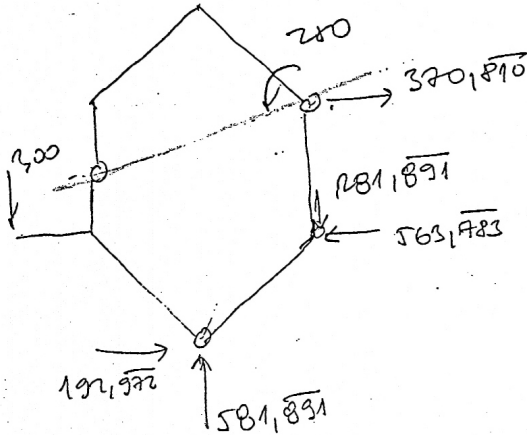
$$S_{2H} = S_2 \cdot \cos 45^\circ = -563,783 \text{ kN}$$

$$\tan 45^\circ = \frac{2}{4} = \frac{1}{2} \Rightarrow \sin 45^\circ = \frac{1}{\sqrt{5}} \quad \cos 45^\circ = \frac{2}{\sqrt{5}}$$

$$\sum H^d = 0 \quad -S_1 - S_{2H} - 140 - H_B = 0$$

$$-S_1 + 563,783 - 140 - 192,972 = 0$$

$$S_1 = 370,810 \text{ kN}$$



$$\textcircled{I} \quad \sum M_1 = 0 \quad -240 + V_2' \cdot 6 = 0$$

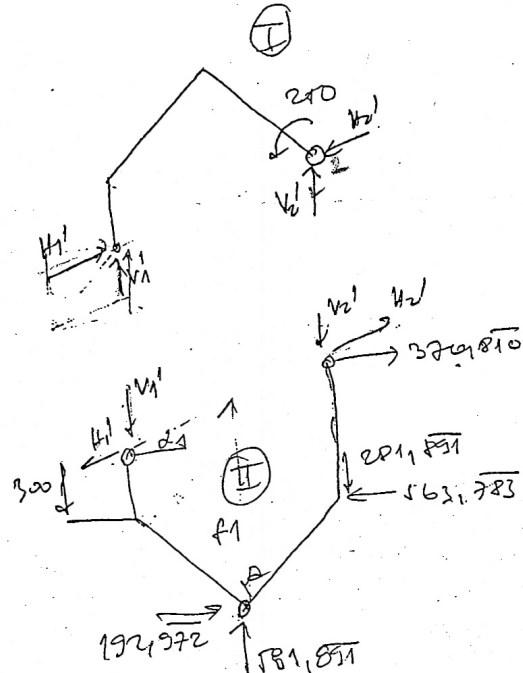
$$V_2' = -41,6 \text{ kN}$$

$$\sum M_2 = 0 \quad H_1' \cdot 6 - 240 = 0$$

$$H_1' = 41,6 \text{ kN}$$

$$\tan 45^\circ = \frac{2}{6} = \frac{1}{3}$$

$$f_1 = 5 + 3 \cdot \tan 45^\circ = 5 + 3 \cdot \frac{1}{3} = 6$$



$$\sum M_B^e = 0 \quad -300 \cdot 5 - V_1' \cdot 3 - \frac{H_1' \cdot f_1 \cdot \omega_1 \cdot l_1}{2} = 0$$

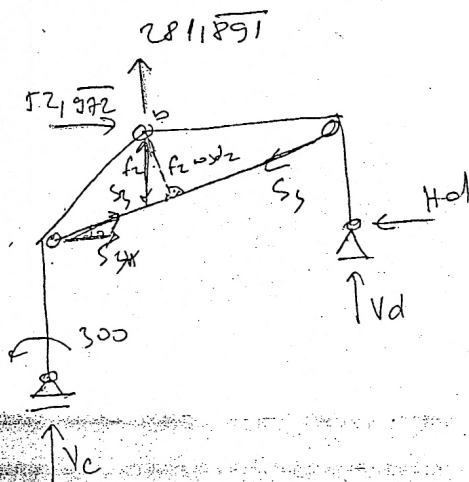
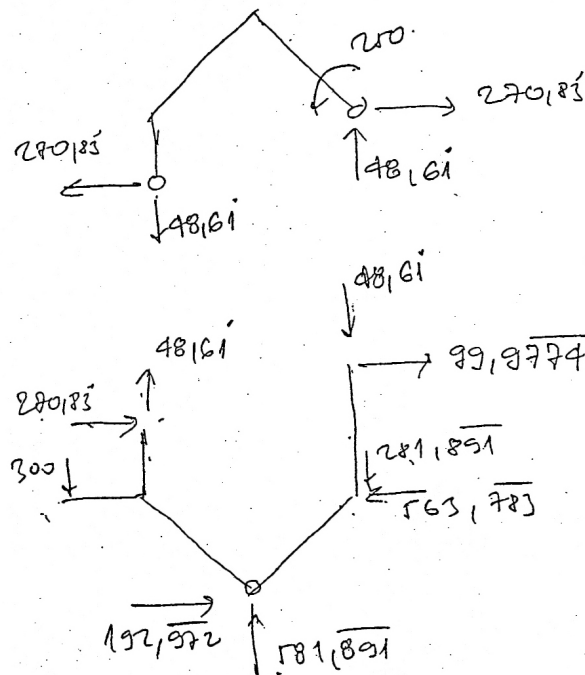
$$H_1' \cdot \omega_1 \cdot l_1 = H_1$$

$$-1100 - 41,6 \cdot 3 - H_1 \cdot 6 = 0$$

$$H_1 = -270,83 \text{ kN}$$

$$V_1 = V_1' + H_1 \cdot \frac{1}{2} = 41,6 + (-270,83) \cdot \frac{1}{2}$$

$$V_1 = -48,61 \text{ kN}$$



$$\sum M_d = 0 \Rightarrow V_c \cdot 9 - 300 + 52,972 \cdot 3 + 281,891 \cdot 6 = 0$$

$$V_c = -172,252 \text{ kN}$$

$$\sum V = 0 \quad V_c + V_d + 281,891 = 0$$

$$V_d = -109,639 \text{ kN}$$

$$\sum H = 0 \quad 52,972 - H_d = 0$$

$$H_d = 52,972 \text{ kN}$$

$$f_2 \cdot l_2 = \frac{1}{3}$$

$$f_2 = 3 - 3 \cdot f_2 \cdot l_2 = 2$$

$$\sum M_B^e = 0 \quad V_c \cdot 3 - 300 - S_3 \cdot f_2 \cdot \omega_2 \cdot l_2 = 0$$

$$-1100 - 52,972 - S_3 \cdot l_2 = 0 \quad S_3 = -402,728$$

$$S_{3H} = S_3 \cos \alpha_2$$

$$\Rightarrow S_3 = \frac{S_{3H}}{\cos \alpha_2}$$

$$+; \alpha_2 = -1;$$

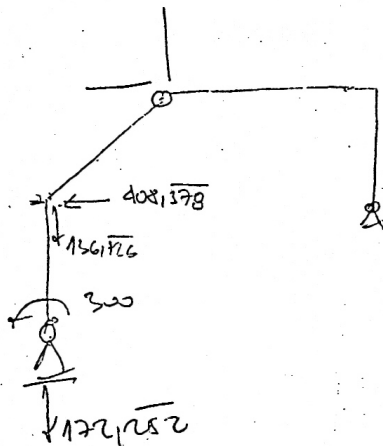
$$\sin \alpha_2 = \frac{3}{\sqrt{10}}$$

$$\cos \alpha_2 = \frac{3}{\sqrt{10}}$$

$$S_3 = -136,116 \sqrt{10}$$

$$S_{3V} = S_3 \sin \alpha_2$$

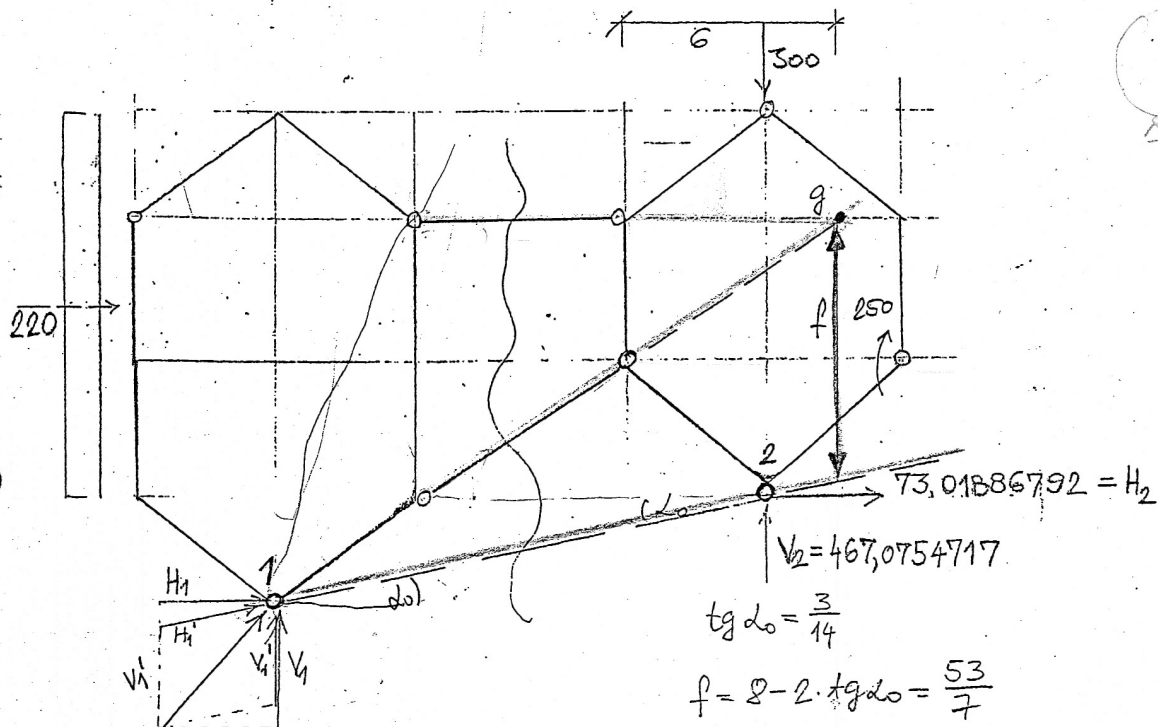
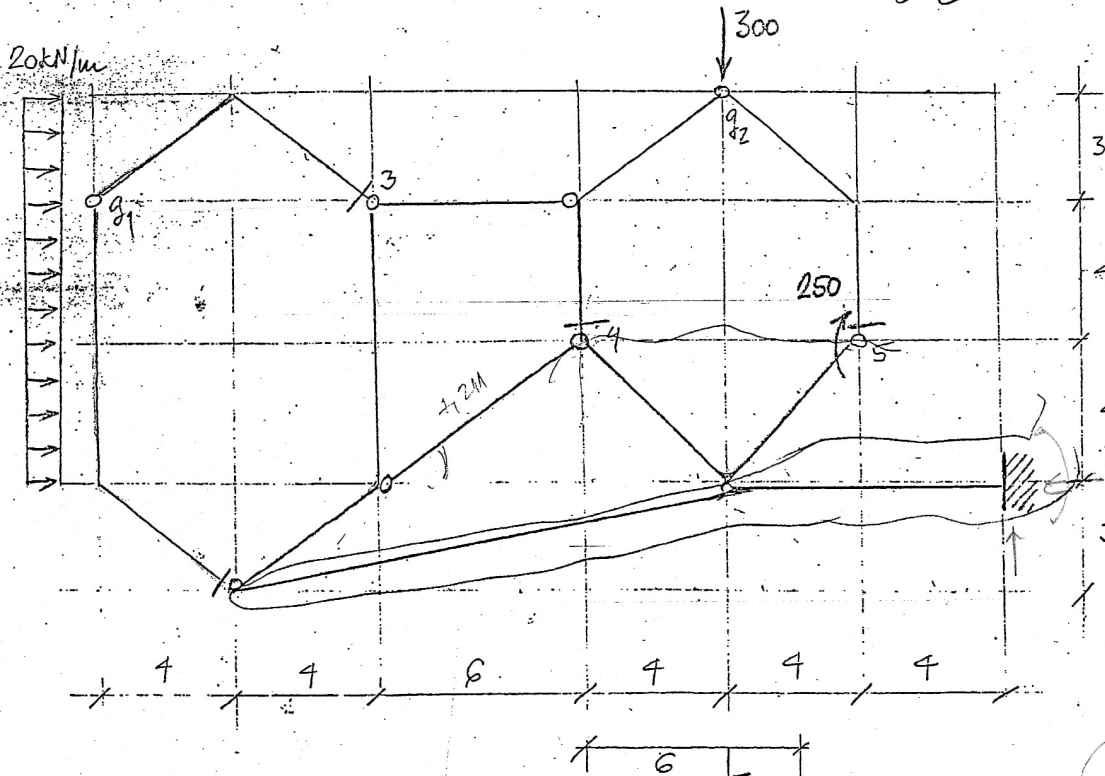
$$S_{3V} = -136,1126$$



$$\tan \alpha = \frac{a}{b} \Rightarrow$$

$$\sin \alpha = \frac{a}{\sqrt{a^2 + b^2}}$$

$$\cos \alpha = \frac{b}{\sqrt{a^2 + b^2}}$$



$$\sum M_2 = 0: V_1 \cdot 14 + 220 \cdot 5,5 - 7250 = 0$$

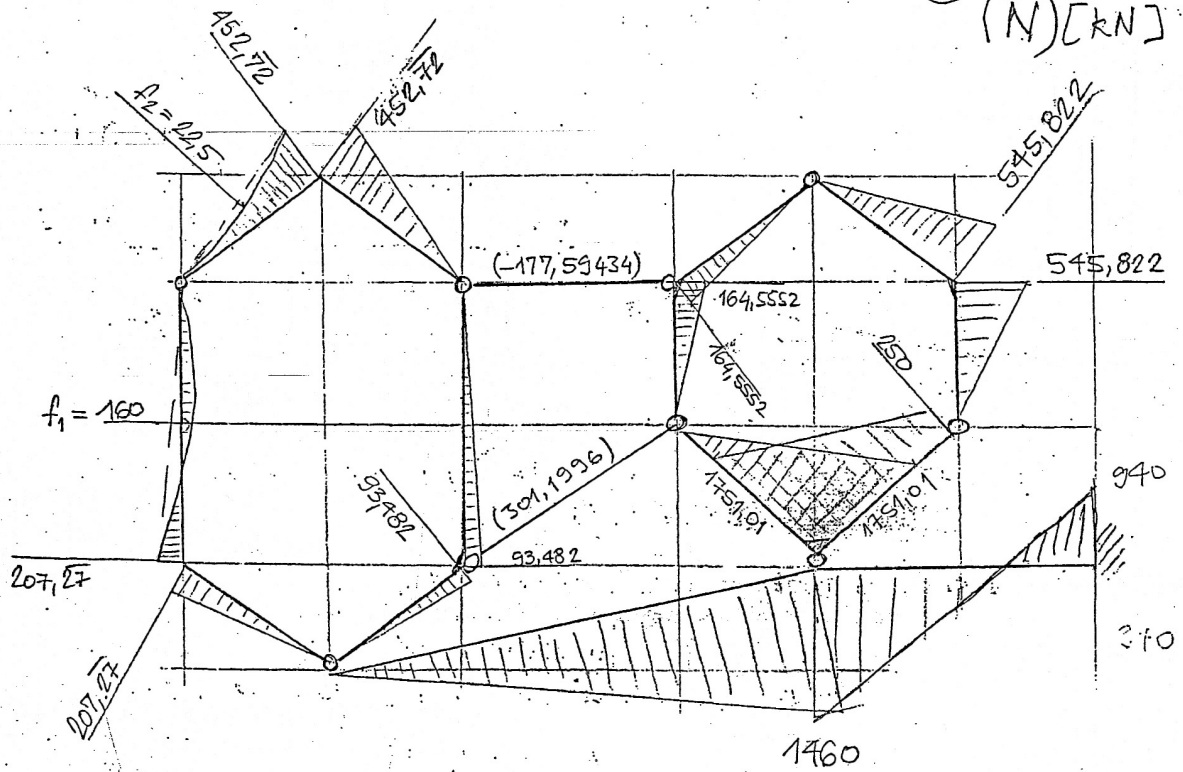
$$V_1 = - \frac{1460}{14}$$

$$\sum M_g^{left} = 0 \therefore V_1 \cdot 16 - 220 \cdot 2.5 - H_1 \cdot f \cdot \cos 40 = 0$$

$$H_1 = -293,0188679$$

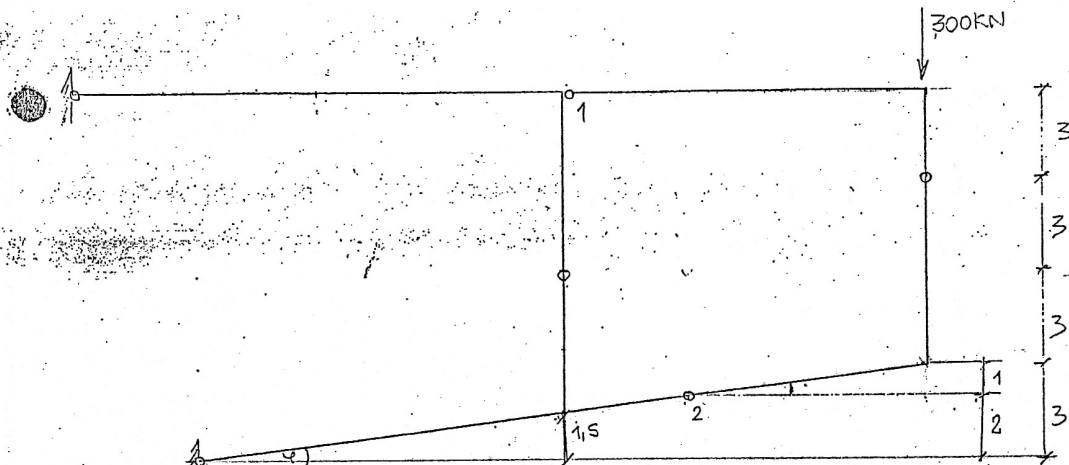
$$V_1 = V_1' + H_1 \cdot \tan \alpha_0 \Rightarrow V_1 = -167,0754717$$

M [kNm]
 (N) [kN]



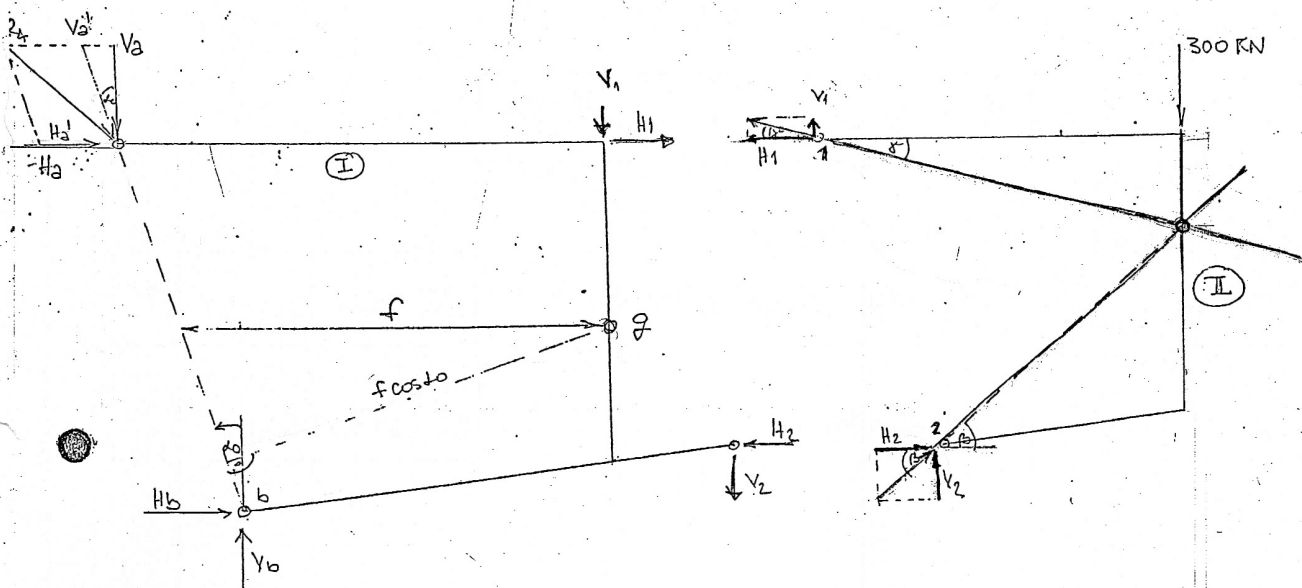
8.

Δοσται δοστα γ



$$\tan \gamma = \frac{3}{24} = \frac{1}{8}$$

$$\tan \gamma = \frac{x}{8} \Rightarrow x = 8 \cdot \frac{1}{8} = 1$$



$$\text{II} \quad \tan \beta = \frac{7}{8} = \frac{V_2}{H_2} \Rightarrow V_2 = \frac{7}{8} H_2$$

$$\tan \gamma = \frac{3}{12} = \frac{1}{4} = \frac{V_1}{H_1} \Rightarrow V_1 = \frac{1}{4} H_1$$

$$\sum H = 0 \quad H_1 - H_2 = 0 \Rightarrow H_2 = H_1$$

$$\sum V = 0 \quad V_1 + V_2 - 300 = 0 \Rightarrow \frac{1}{4} H_1 + \frac{7}{8} H_2 = 300$$

$$\frac{9}{8} H_1 = 300$$

система 2 уравн.

$$H_1 = H_2 = 266,6 \text{ kN}$$

$$V_1 = 66,6 \text{ kN}$$

$$V_2 = 233,3 \text{ kN}$$

①

$$\tan \alpha = \frac{4}{12} = \frac{1}{3}$$

$$f = 12 + 6 \cdot \tan \alpha = 12 + 6 \cdot \frac{1}{3} = 14 \text{ m}$$

$$\sum M_b = 0 \quad H_a' \cdot 12 + V_a' \cdot 12 + H_1 \cdot 12 + V_2 \cdot 16 - H_2 \cdot 2 = 0$$

$$H_a' \cdot 12 + 66,6 \cdot 12 + 266,6 \cdot 12 + 233,3 \cdot 16 - 266,6 \cdot 2 = 0$$

$$H_a' = -600 \text{ kN}$$

$$\sum M_g^{\text{fore}} = 0 \quad H_a' \cdot 6 - V_a' \cdot f \cos \alpha + H_1 \cdot 6 = 0$$

$$-600 \cdot 6 - V_a' \cdot f + 266,6 \cdot 6 = 0$$

$$V_a = -142,8571 \text{ kN} = -\frac{1000}{7}$$

$$H_a = H_a' + V_a \cdot \tan \alpha$$

$$= -600 + \left(-\frac{1000}{7}\right) \cdot \frac{1}{3}$$

$$H_a = -647,6190 \text{ kN} = -\frac{13600}{21}$$

ГРЕЙКА!

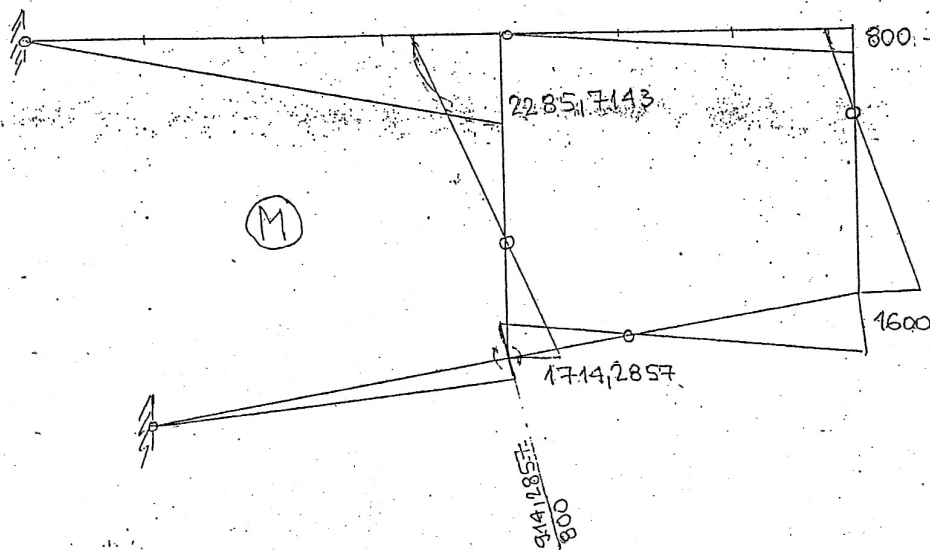
$$\sum V = 0 \quad -V_a - V_1 - V_2 + V_b = 0$$

$$\frac{1000}{7} - 66,6 - 233,3 + V_b = 0$$

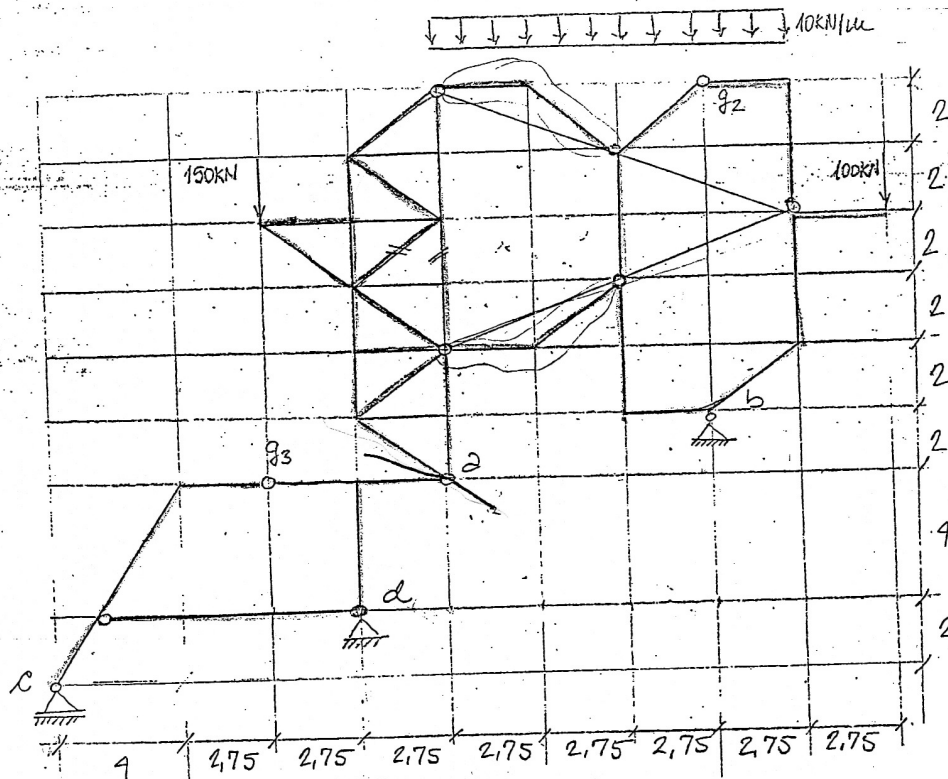
$$V_b = 157,1429 \text{ kN} = \frac{1100}{7}$$

$$\sum H = 0 \quad H_a + H_1 - H_2 + H_b = 0$$

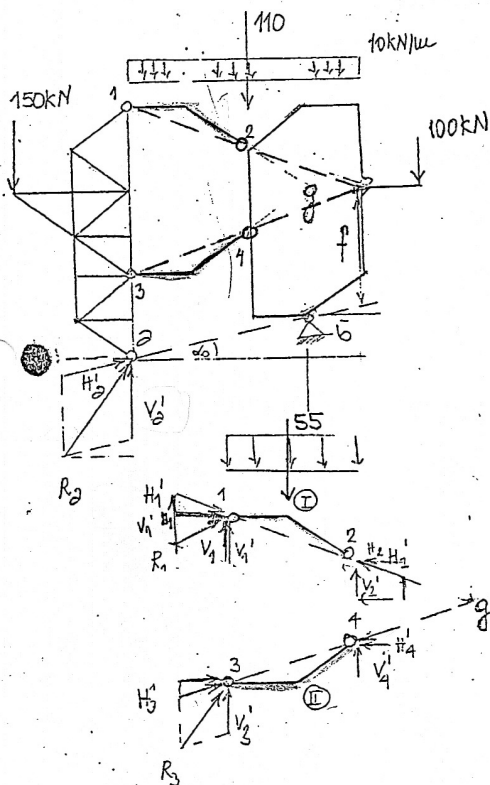
$$H_b = 647,6190 \text{ kN} = \frac{13600}{21}$$



1.



1) USLED ZADATOG OPTEREĆENJA, NACRTATI DIJAGrame M, T NA PUNOM DELU NOSAČA



$$\tan \alpha = \frac{2}{\frac{33}{4}} = \frac{8}{33}$$

$$f = 6 - 4.75 \cdot \frac{8}{33} = \frac{16}{3}$$

$$\sum M_b = 0: 150 \cdot 13.75 - V_2' \cdot 8.25 + 110 \cdot 2.75 - 100 \cdot 9.5 = 0$$

$$V_2' = 220 \text{ kN}$$

$$\sum M_g = 0:$$

$$\textcircled{I} \sum M_2 = 0: V_1' \cdot 5.5 - 55 \cdot 2.75 = 0 \quad V_1' = 27.5$$

$$\sum M_1 = 0: V_2' \cdot 5.5 - 55 \cdot 2.75 = 0 \quad V_2' = 27.5$$

$$\sum H = 0 \Rightarrow H_1 - H_2 = 0 \Rightarrow H_1 = H_2$$

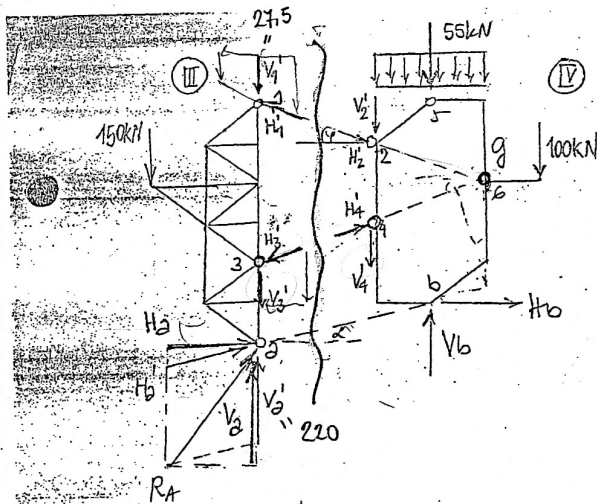
II) NEOPTEREĆEN DEO!

$$\sum M_4 = 0: V_3 = 0$$

$$\sum M_3 = 0: V_4 = 0$$

$$\sum H = 0: H_3 = H_4$$

Moja ga ce f. gnomice
ga du jega komo
u bap



Levo $\sum M_g = 0$

$$-220 \cdot 11 + 150 \cdot 16,5 + H_a \cdot f \cos \alpha_0 + 27,5 \cdot 11 = 0$$

$$H_a = -67,03125$$

$$V_a = V_a' + H_a \cdot \tan \alpha_0$$

$$= 220 - 67,03125 \cdot \frac{8}{33}$$

$$V_a = 203,75$$

CEO NOSAC:

$\sum V = 0$: $V_a - 203,75 + 150 + 100 = 0$

$$V_b = 156,25 \text{ kN}$$

$\sum H = 0$: $H_a + H_b = 0$

$$H_b = 67,03125$$

III $\tan \gamma = \frac{2}{5,5} = \frac{4}{11} \Rightarrow \sin \gamma = \frac{4}{11,37}$

$\cos \gamma = \frac{11}{11,37}$

$\sum M_3 = 0$: $H_1 \cdot 8 + 150 \cdot 5,5 - H_2 \cdot 4 = 0$

$$H_1 = -69,609375 \text{ kN}$$

$$\Rightarrow H_2 = -69,609375 \text{ kN}$$

$\sum H_4 = 0$: $-H_1 - H_3 + H_2 = 0$

$$69,609375 - H_3 - 67,03125$$

$$H_3 = 2,578125 \text{ kN}$$

$$\Rightarrow H_4 = 2,578125 \text{ kN}$$

Iz čvora 1: $V_1 = V_1' - H_1 \cdot \tan \gamma = 27,5 + 69,609375 \cdot \frac{4}{11}$

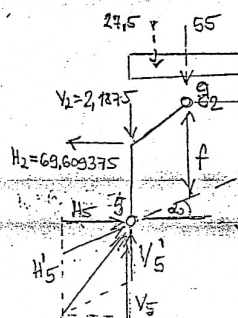
$$V_1 = 52,8125 \text{ kN}$$

Iz čvora 3: $V_3 = V_3' + H_3 \cdot \tan \gamma = 0 + 2,578125 \cdot \frac{4}{11}$

$$V_3 = 0,9375 \text{ kN}$$

Iz I: $\sum V = 0$: $V_1 + V_2 - 55 = 0 \Rightarrow V_2 = 2,1875$

Iz II: $\sum V = 0$: $V_3 + V_4 = 0 \Rightarrow V_4 = -0,9375$



$\sum M_6 = 0$: $V_5' \cdot 5,5 - 55 \cdot 2,75 - 2,1875 \cdot 5,5 - 69,609375 \cdot 2 = 0$

$$V_5' = 55$$

$$\tan \alpha_0 = \frac{2}{5,5} = \frac{4}{11}$$

$$\sin \alpha_0 = \frac{4}{11,37} = \frac{4}{11,37}$$

$\sum M_g = 0$: $27,5 \cdot 11,375 + 2,1875 \cdot 2,75 - 69,609375 \cdot 2 + 55 \cdot 2,75 + H_5' \cdot f \cos \alpha_0 = 0$

$$H_5 = 49,328125$$

$$V_5 = V_5' + H_5 \cdot \tan \alpha_0$$

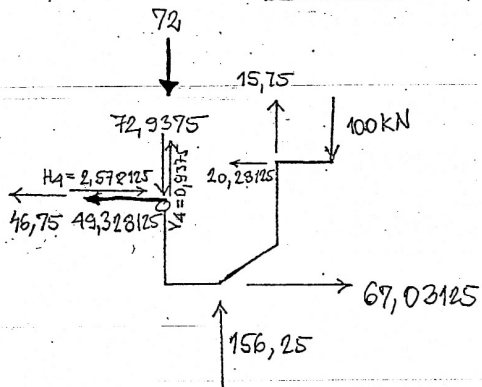
$$V_5 = 72,9375$$

$$\sum V = 0: -55 - 2,1875 + 72,9375 - V_6 = 0$$

$$V_6 = 15,75$$

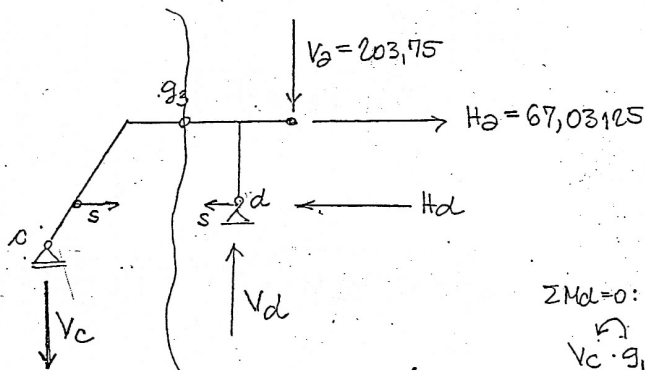
$$\sum H = 0: -69,609375 + 49,328125 + H_6 = 0$$

$$H_6 = 20,28125$$



$$\sum H = 0 \checkmark$$

$$\sum V = 0 \checkmark$$



обратн панелю ▽

Samo za spojnice opt.

$$\sum H = 0$$

$$\Rightarrow H_d = 67,03125$$

$$\sum M_d = 0:$$

$$V_c \cdot 9,5 - 203,75 \cdot 2,75 - 67,03125 \cdot 4 = 0$$

$$V_c = 87,20394737$$

$$\sum V = 0: -V_c - V_2 + V_d = 0$$

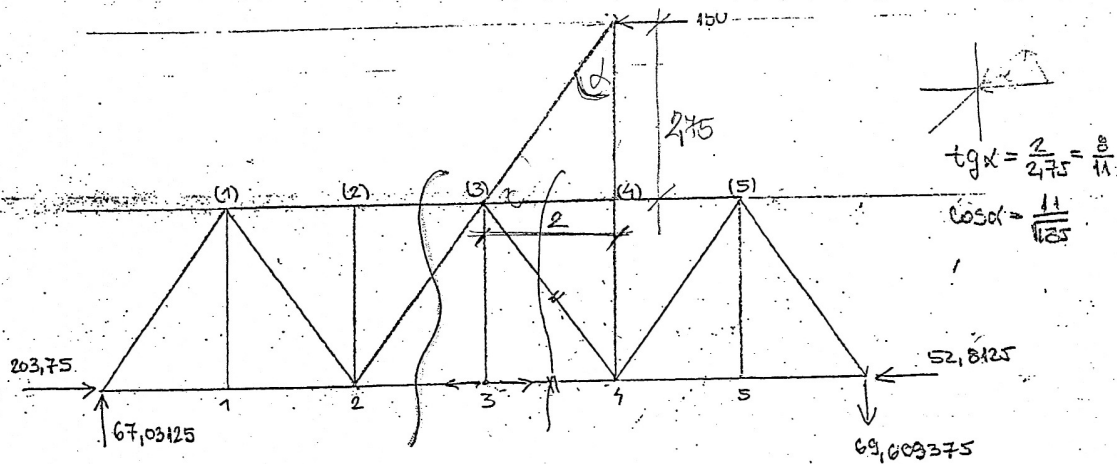
$$V_d = 290,9539474$$

za preseki:

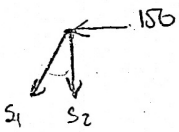
$$\sum M_{g3}^l = 0: V_c \cdot 6,75 + S \cdot 4 = 0$$

$$S = -147,156$$

2)



4BOPK



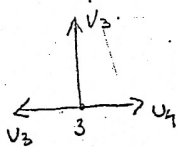
$$\sum X = 0: -150 - S_1 \cdot \cos \varphi = 0$$

$$S_1 \cdot \cos \varphi = -150$$

 $U_3 = ?$

$$\sum M(3) = 0: -150 \cdot 2.75 + 52.8125 \cdot 2.75 + 69.609375 \cdot 6 + U_3 \cdot 2.75 = 0$$

$$U_3 = -54.6875 \text{ kN}$$



$$\sum H = 0 \quad U_3 = U_4 \Rightarrow U_4 = -54.6875 \text{ kN}$$

 $D_4 = ?$

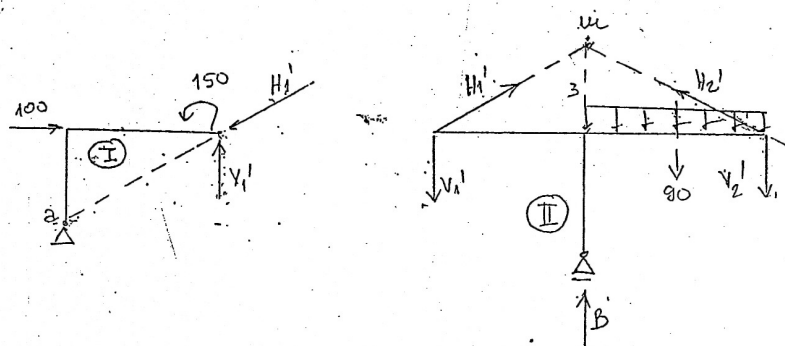
$$\text{tg } \beta_4 = \frac{8}{11} \Rightarrow \cos \beta_4 = \frac{11}{12.5}$$

$$\sum M(4) = 0: -150 \cdot 2.75 + 69.609375 \cdot 4 + 52.8125 \cdot 2.75 + U_4 \cdot 2.75 + D_4 \cdot \cos \beta_4 \cdot 2.75 - S_1 \cdot \cos \alpha \cdot 2.75$$

$$273.28125 + D_4 \cdot \cos \beta_4 \cdot 2.75 = 0$$

$$D_4 = - \frac{12.5}{11} \cdot \frac{273.28125}{2.75} = -122.8769211 \text{ kN}$$

$$D_4 = -122.8769211 \text{ kN}$$



$$\text{I} \quad \sum M_a = 0 \quad 100 \cdot 3 - 150 - V_1' \cdot 5 = 0$$

$$V_1' = 30 \text{ kN}$$

$$\text{II} \quad \sum M_{ui} = 0 \quad -V_1' \cdot 5 + 90 \cdot 3 + V_2' \cdot 6 = 0$$

$$V_2' = -20 \text{ kN}$$

III

$$t_{\theta} L_0 = \frac{3.5}{9}$$

$$f = 45 + 5 \cdot t_{\theta} L_0 = \frac{40}{9} \text{ m}$$

$$\sum M_k = 0 \quad V_2' \cdot 5 - V_d' \cdot 9 = 0$$

$$H_d = H_d' \cdot \cos \alpha_0$$

$$V_d' = -\frac{100}{9} \text{ kN}$$

$$\sum M_g^d = 0 \quad V_d' \cdot 4 - H_d' \cdot f \cos \alpha_0 = 0$$

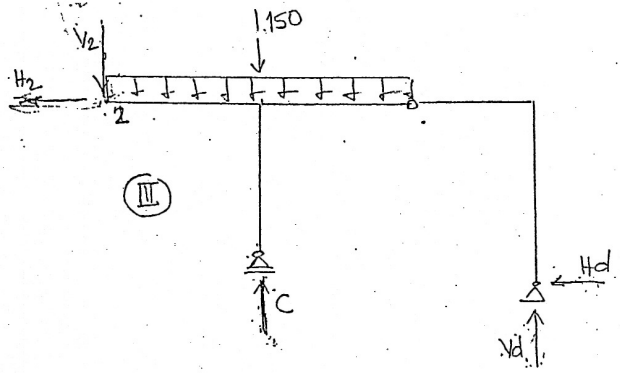
$$-\frac{100}{9} \cdot 4 - H_d' \cdot \frac{40}{9} = 0$$

$$H_d = -10 \text{ kN}$$

$$V_d = V_d' + H_d t_{\theta} L_0$$

$$= -\frac{100}{9} - 10 \cdot \frac{3.5}{9}$$

$$V_d = -15$$



$$\sum M_2 = 0 : 150 \cdot 5 - C \cdot 5 - V_d \cdot 14 + H_d \cdot 6 = 0$$

$$750 - 5 \cdot C - (-15) \cdot 14 - 10 \cdot 6 = 0$$

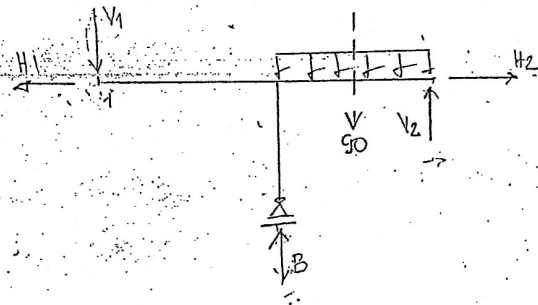
$$C = 180 \text{ kN}$$

$$\sum V = 0 \quad -V_2 - 150 + C + V_d = 0$$

$$V_2 = 15 \text{ kN}$$

$$\sum H = 0 \quad H_2 + H_d = 0$$

$$H_2 = 10 \text{ kN}$$



$$\sum M_A = 0: +B \cdot 5 + 90 \cdot 8 - V_2 \cdot 11 = 0$$

$$B = 111 \text{ kN}$$

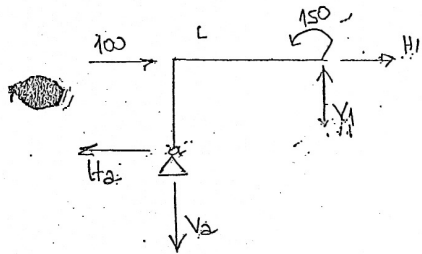
$$\sum V = 0: +V_1 + B - 90 + V_2 = 0$$

$$V_1 = 36 \text{ kN}$$

$$\sum H = 0$$

$$-H_1 + H_2 = 0$$

$$H_1 = 10 \text{ kN}$$



$$\text{КОНТРОЛЬ: } \sum M_A = 0: 100 \cdot 3 - 150 + V_1 \cdot 5 + H_1 \cdot 3 = 0$$

$$150 - 36 \cdot 5 + 10 \cdot 3 = 0$$

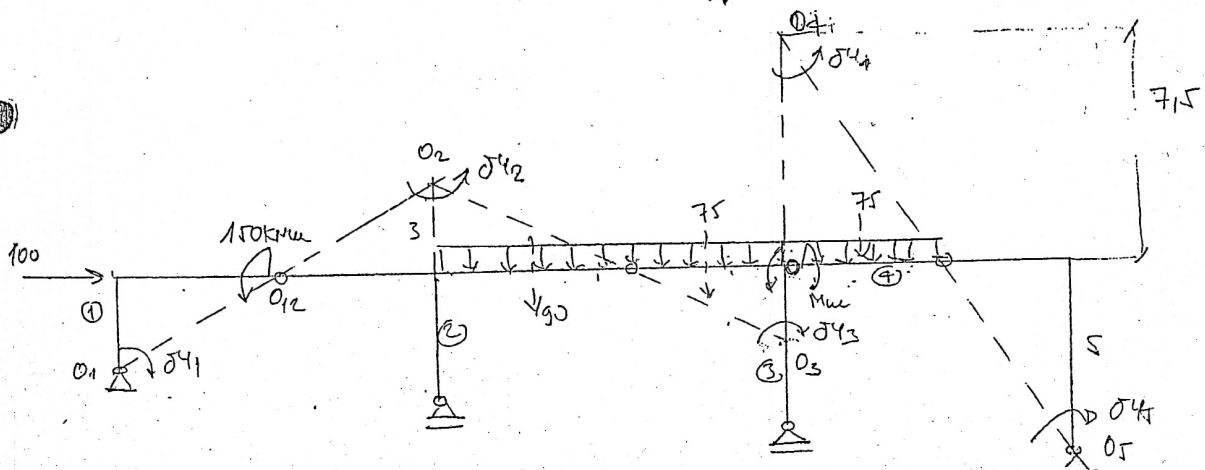
$$\sum V = 0: -V_2 + V_1 = 0$$

$$V_2 = 36 \text{ kN}$$

$$\sum H = 0: -H_2 + 100 + H_1 = 0$$

$$H_2 = 110 \text{ kN}$$

б) МОМЕНТ САЗИЖАЊА У ПРЕСЕКУ m ПРОВЕРИТИ ПРИМЕНОМ ПРИНЦИПА ВИРТУАЛНИХ ПОМЕРАЊА



$$\delta \varphi_1 \cdot \overline{O_1 O_{12}} = \delta \varphi_2 \cdot \overline{O_{12} O_2} \Rightarrow \delta \varphi_1 \cdot 5 = \delta \varphi_2 \cdot 5 \Rightarrow \delta \varphi_2 = \delta \varphi_1$$

$$\delta \varphi_2 \cdot \overline{O_2 O_{23}} = \delta \varphi_3 \cdot \overline{O_{23} O_3} \Rightarrow \delta \varphi_2 \cdot 6 = \delta \varphi_3 \cdot 5 \Rightarrow \delta \varphi_3 = \frac{6}{5} \delta \varphi_1$$

$$\delta \varphi_3 \cdot \overline{O_3 O_{34}} = \delta \varphi_4 \cdot \overline{O_{34} O_4} \Rightarrow \delta \varphi_3 \cdot 4.5 = \delta \varphi_4 \cdot 7.5 \Rightarrow \delta \varphi_4 = \frac{3}{5} \delta \varphi_1$$

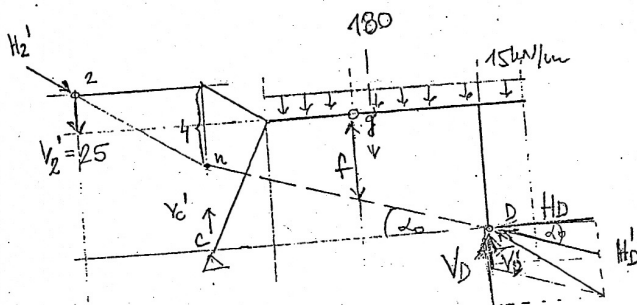
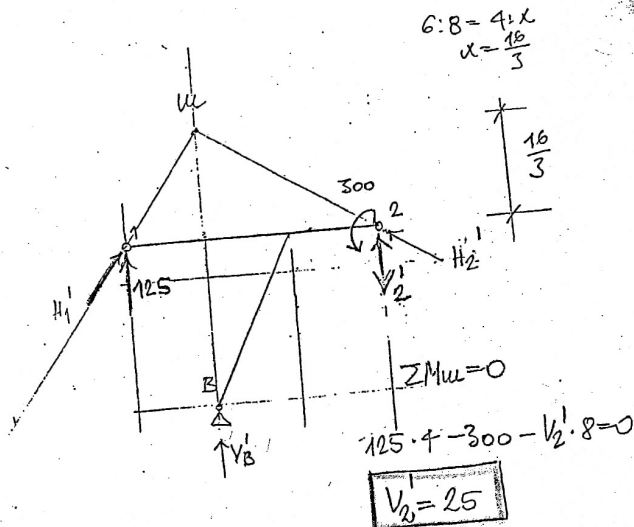
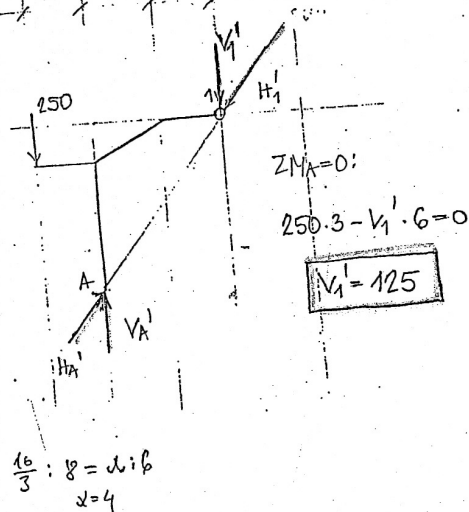
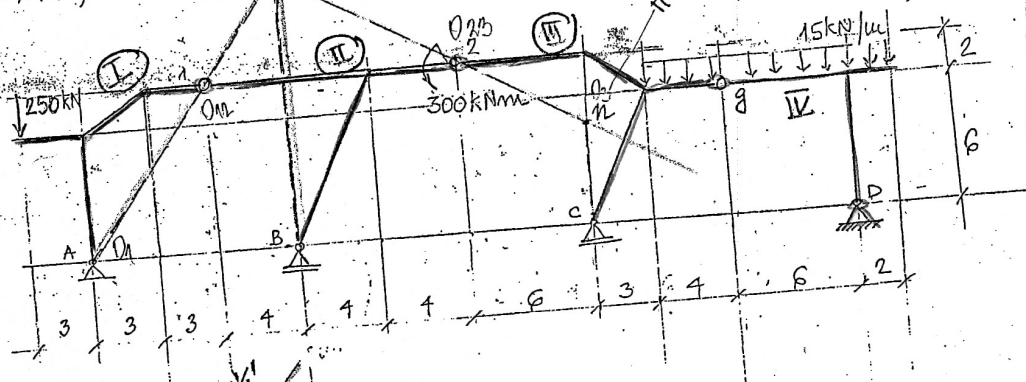
$$\delta A = 0 \quad 100 \cdot 3 \delta \varphi_1 - 150 \cdot \delta \varphi_1 - 90 \cdot 3 \delta \varphi_2 - 75 \cdot 2.5 \delta \varphi_3 - M_{11} \cdot \delta \varphi_3 - M_{11} \cdot \delta \varphi_4 - \dots$$

$$150 \delta \varphi_1 - 270 \cdot \delta \varphi_1 - 187.5 \cdot \frac{6}{5} \delta \varphi_1 - M_{11} \cdot \frac{6}{5} \delta \varphi_1 - M_{11} \cdot \frac{3}{5} \delta \varphi_1 = 0$$

$$-420 - \frac{8}{5} M_{11} = 0 \quad M_{11} = -262.5 \text{ kNm}$$

9.

KORISTEĆI POSTUPAK SVOĐENJA DATOG SISTEMA NA SISTEM SA FUNKCIJAMA
ZGLOBOVIHA; M, N, T.

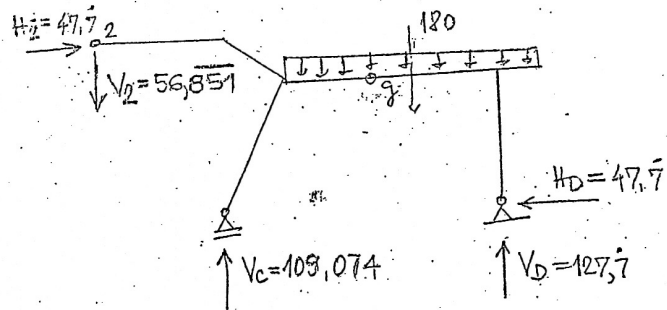


$$ZM_g^{demo} = 0: V_2' \cdot 6 - H_D' \cdot f \cdot \cos \alpha - 120 \cdot 4 = 0$$

$$H_D = 47,7$$

$$V_D = V_2' + H_D \cdot \tan \alpha \Rightarrow$$

$$V_D = 127,7$$



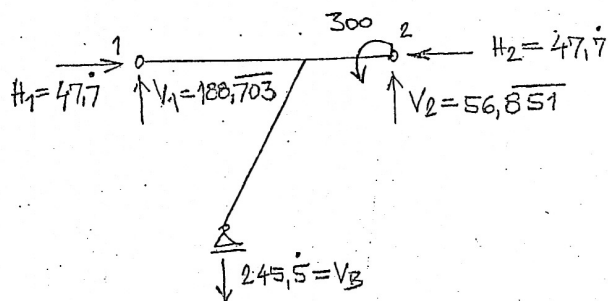
$$\sum M_2 = 0$$

$$180 \cdot 15 - V_D \cdot 19 + H_D \cdot 8 - V_C \cdot 6 = 0$$

$$V_C = 109,074$$

$$\Rightarrow \sum H = 0$$

$$\sum V = 0$$



$$\sum M_1 = 0$$

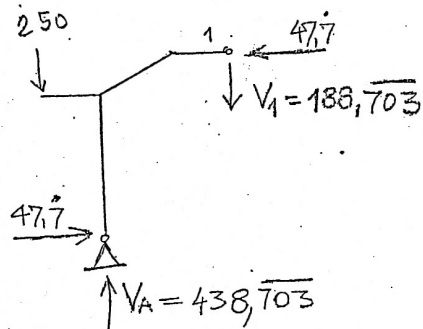
$$V_2 \cdot 12 - V_B \cdot 4 + 300$$

$$V_B = 245,5$$

$$\sum V = 0 \Rightarrow V_1 + 56,851 - 245,5 = 0$$

$$V_1 = 188,703$$

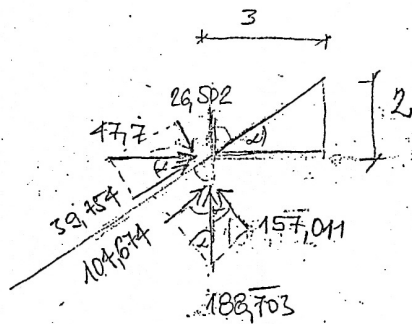
$$\sum H = 0 \Rightarrow H_1 = 47,7$$



$$\sum V = 0$$

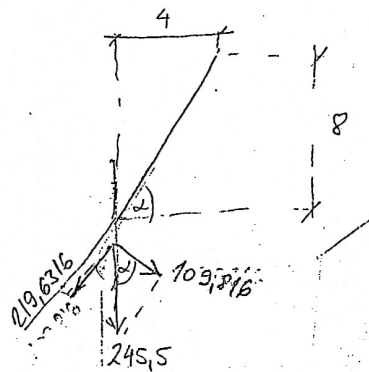
$$-250 - 188,703 + V_A = 0$$

$$V_A = 438,703$$



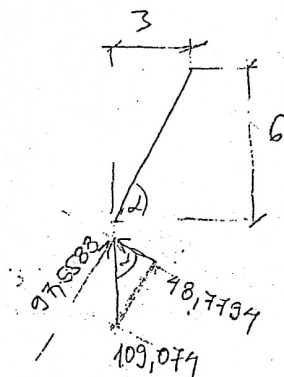
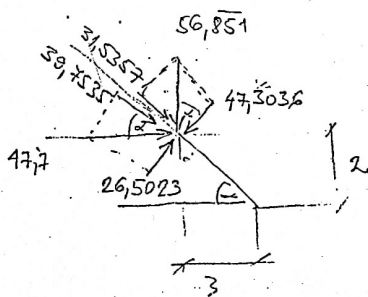
$$\operatorname{tg} \alpha = \frac{2}{3} \Rightarrow \sin \alpha = \frac{2}{\sqrt{13}}$$

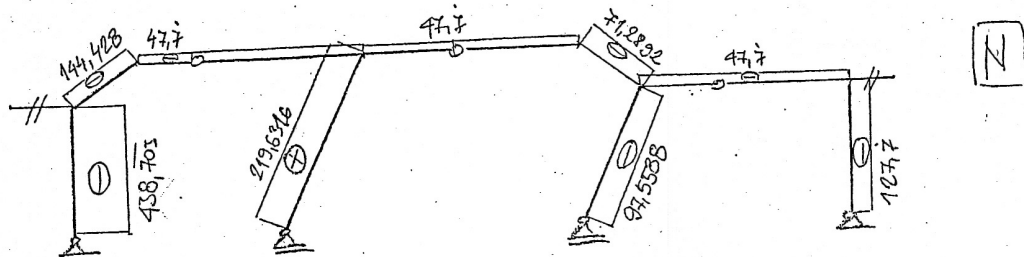
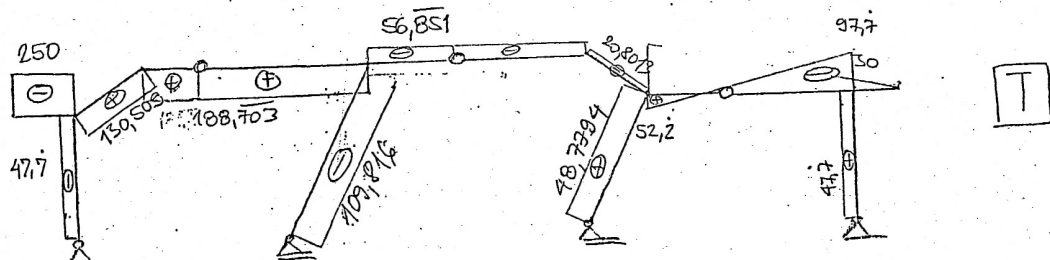
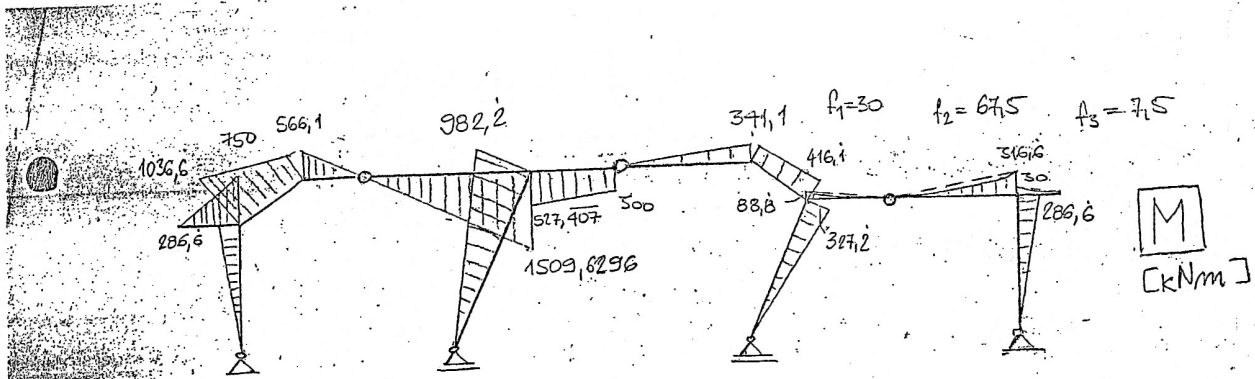
$$\cos \alpha = \frac{3}{\sqrt{13}}$$



$$\operatorname{tg} \alpha = 2 \quad \sin \alpha = \frac{2}{\sqrt{5}}$$

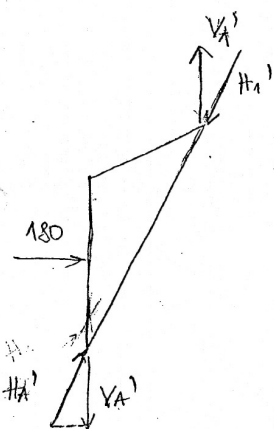
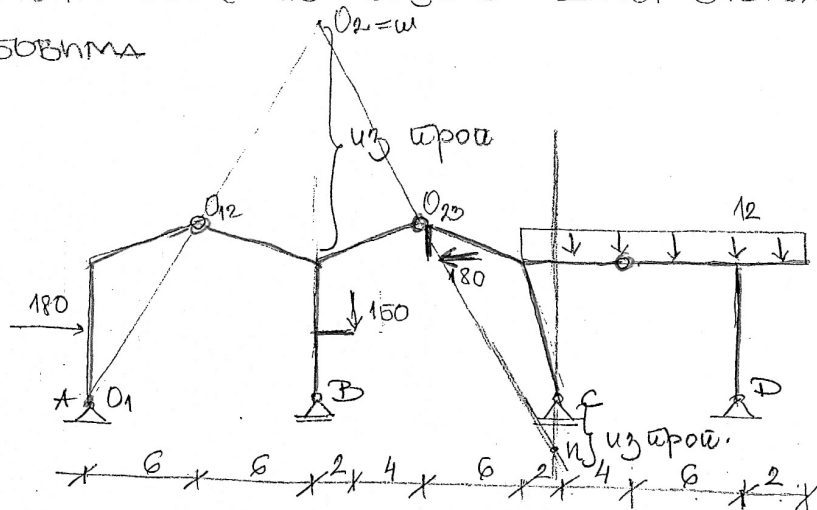
$$\cos \alpha = \frac{1}{\sqrt{5}}$$





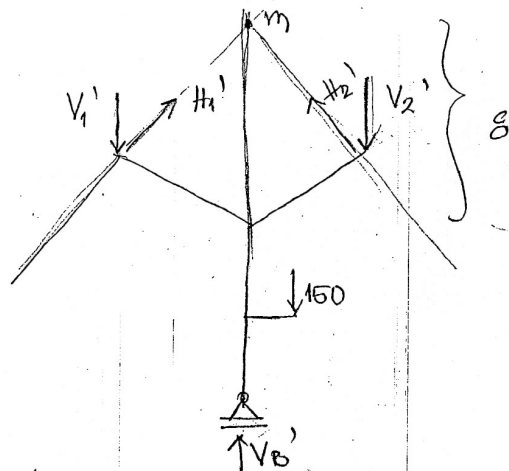
ΣΥΣΤΗΜΑ ΠΟΛΥΤΑΚΤΟ ΕΒΕΛΟΓΗΤΟ ΔΙΑΤΟΜΟ ΣΥΣΤΗΜΑ ΤΗΡ ΟΥΣΤΕΡΙΑ ΕΑ ΝΕΜΑΤΩΝ

ΣΥΛΛΟΓΗΜΑ



$$\sum M_A = 0: V_1' \cdot 6 - 180 \cdot 3 = 0$$

$$\boxed{V_1' = 90 \text{ kN}}$$

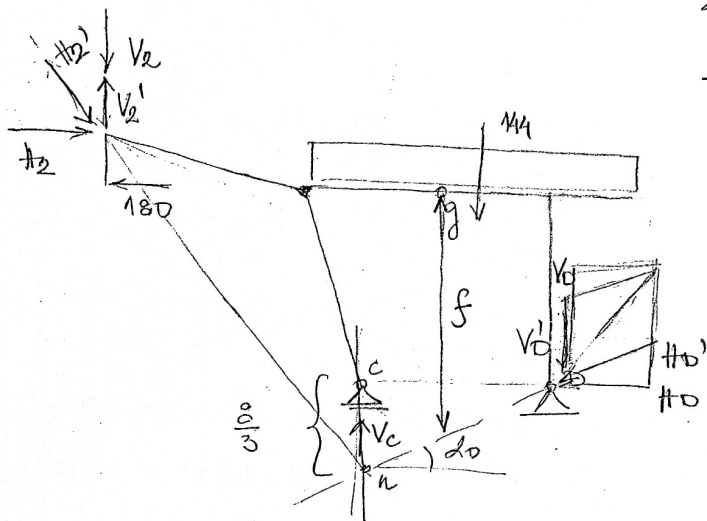


$$\sum M_w = 0:$$

$$-V_1' \cdot 6 + V_2' \cdot 6 + 150 \cdot 2 = 0$$

$$-90 \cdot 6 + 300 = -6V_2'$$

$$-240 = -6V_2' \Rightarrow \boxed{V_2' = 40}$$



$$f = 6 + 6 \cdot \tan 30^\circ = 7.16 \text{ m}$$

$$\sum M_n = 0: V_D' \cdot 10 + V_2' \cdot 8 - 180 \cdot \frac{2 \cdot 6}{3} + 144 \cdot 6 \Rightarrow \boxed{V_D' = 37.6 \text{ kN}}$$

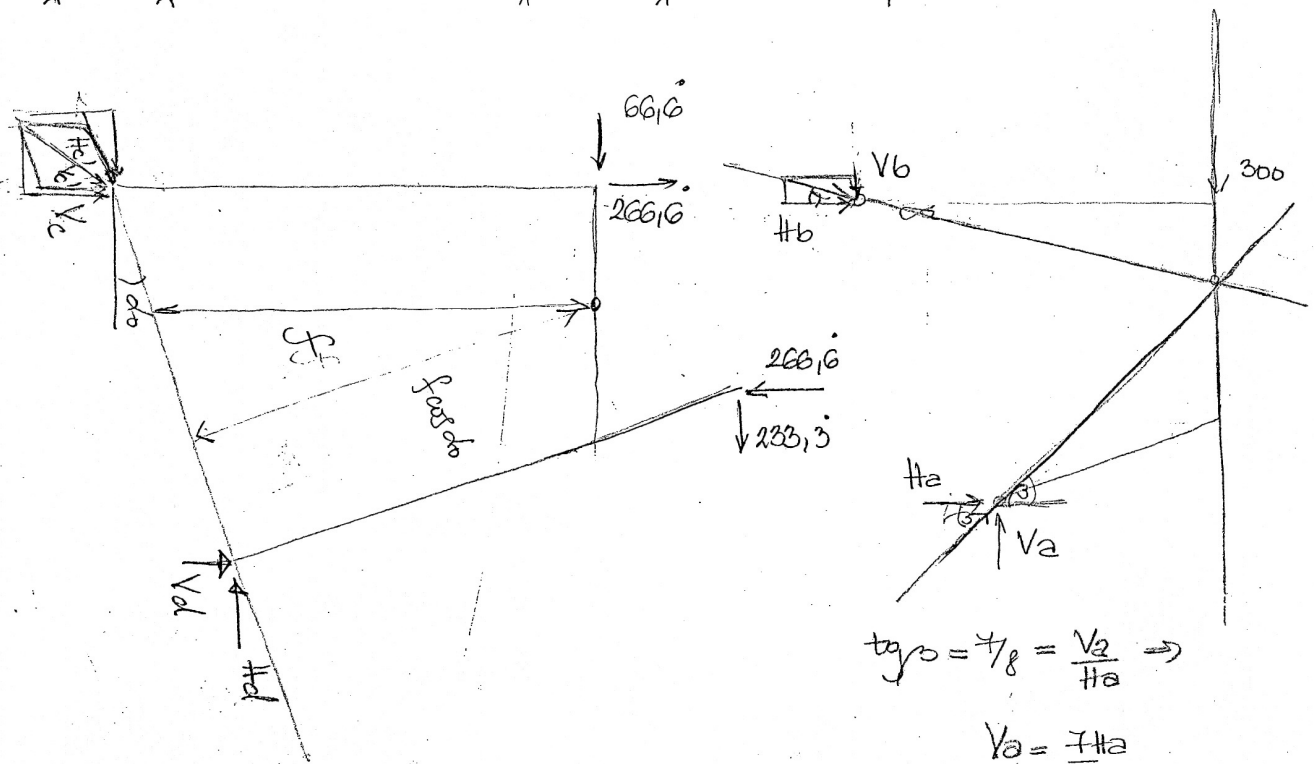
$$\tan 30^\circ = \frac{4}{15} = \frac{8}{3} \cdot \frac{1}{10}$$

$$\sum M_g^{\text{desuo}} = 0: 96 \cdot 4 + V_D' \cdot 6 + H_D' \cdot f \cos 30^\circ = 0$$

$$96 \cdot 4 + 37.6 \cdot 6 + H_D' \cdot f = 0$$

$$\Rightarrow H_D' = -80.21053$$

$$V_D = V_D' + H_D' \tan 30^\circ = 37.6 + 80.21053 \cdot \tan 30^\circ$$



$$V_a = \frac{7112}{8}$$

$$\operatorname{tg} \gamma = \frac{3}{12} = \frac{1}{4} = \frac{V_b}{H_b}$$

$$\sum M_b = 0: V_a \cdot 4 + H_a \cdot 10 - 300 \cdot 12 = 0$$

$$4.7/8 \text{ Ha} + \text{Ha} \cdot 10 = 3600$$

$$\frac{28+80}{8} H_2 = 3600$$

$$H_0 = 266,6$$

$$V_2 = 233,3$$

$$\sum \# = 0: \#b + \#a = 0$$

$$Hb = -266,6$$

$$\sum V = 0: V_a - V_b - 300 = 0$$

$$V_b = -66,6$$

$$H_b = V_{b.4}$$

$$b = -266,6$$

$$\begin{aligned} \sum M_d &= 0 \Rightarrow V_c \\ \sum M_g &= 0 \Rightarrow H_c \\ V_c &= V_c' + H \tan \alpha \\ \sum V &= 0 \Rightarrow \\ \sum H &= 0 \Rightarrow \end{aligned}$$

$\begin{array}{c} \text{M} \\ \text{F} \\ \text{O} \\ \text{O} \end{array}$
 $\begin{array}{c} \text{M} \\ \text{V} \\ \text{O} \\ \text{O} \end{array}$

30 000 000

$$V_C = V_C' + Hctg\delta_0$$

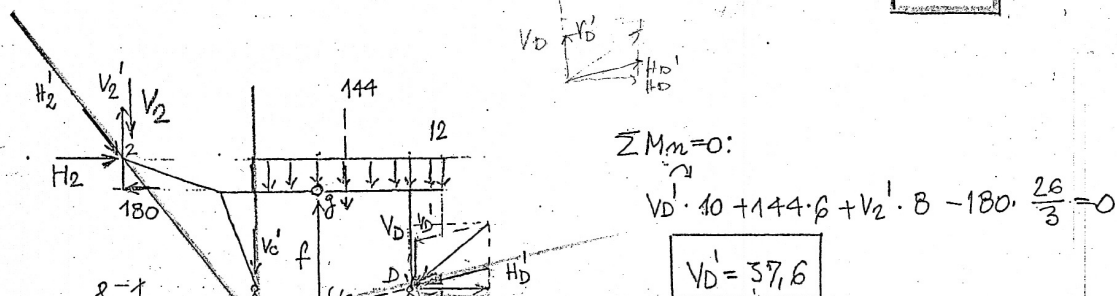
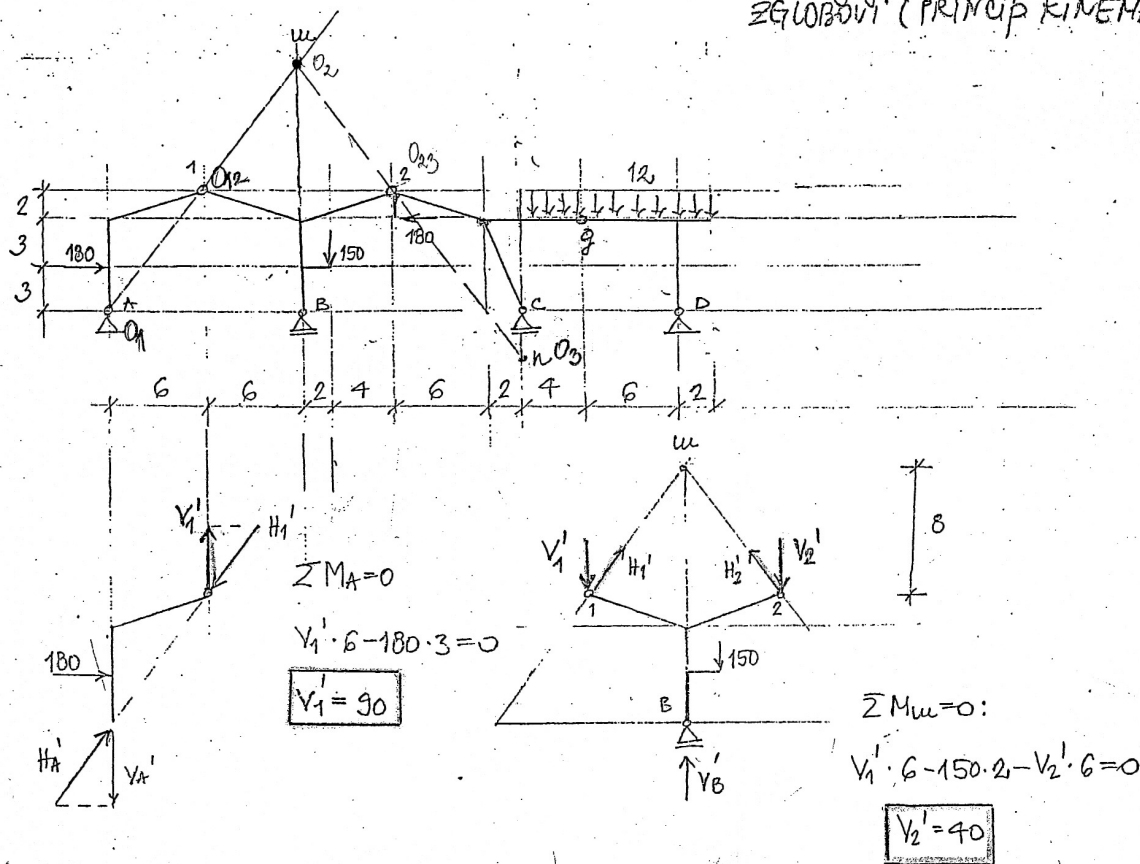
$$\mathbb{N} \times \mathbb{N} \rightarrow \mathbb{N}$$

$$\Sigma M_d = 0 \Rightarrow V_c$$

Spalte
 $\sum H = 0$
 $\sum V = 0$

W KORISTEĆI POSTUPAK SVOĐENJA DATOG SISTEMA NA SISTEM SA IMAGINARNIM ZGLOBOVIMA NACRTATI: M, T, N.

KADA NE MOŽE DA SE RASCEPA NOSAČ NA LUK NA 3 ZGLOBA, ONDA SE PRIMENJUJE IMAGINARNI ZGLOBOVI (PRINCIP KINEMAT.



$6:8 = 2:x$
 $x =$

POL KAO NEPOKRETNOSTI-
 T-KA JE TRETIRA
 KAO NEPOKRETNOST
 ODLONAC $\rightarrow$ LUK NA
 3 ZGLOBA

$\tan \alpha = \frac{8}{3} \cdot \frac{1}{10} = \frac{4}{15}$
 $f = 6 + 6 \cdot \tan \alpha = 7,6 \text{ m}$
 $\sum M_g^{\text{demo}} = 0$
 $36 \cdot 4 + V_D' \cdot 6 + H_D' \cdot f \cdot \cos \alpha = 0$
 $7,6 \cdot H_D = -609,6$
 $H_D = -80,21053$

$V_D = V_D' + H_D \cdot \tan \alpha$
 $= 37,6 - 80,21053 \cdot \frac{4}{15}$

$V_D = 16,2105$

$$\sum M_2 = 0: V_D \cdot 18 - H_D \cdot 8 + 144 \cdot 14 - V_C \cdot 8 + 180 \cdot 2 = 0$$

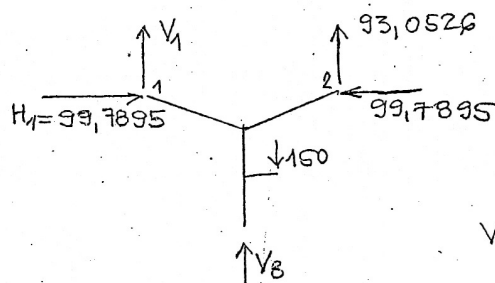
$$V_C = 253,2631$$

$$\sum V = 0: -V_2 + 253,2631 - 144 - 16,2105 = 0$$

$$V_2 = 93,0526$$

$$\sum H = 0: H_2 - 180 + 80,2105 = 0$$

$$H_2 = 99,7895$$



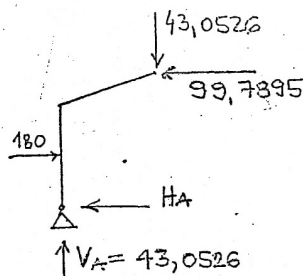
$$\sum M_1 = 0:$$

$$93,0526 \cdot 12 - 150 \cdot 8 + V_B \cdot 6 = 0$$

$$V_B = 13,8948$$

$$V_1 + 93,0526 + 13,8948 - 150 = 0$$

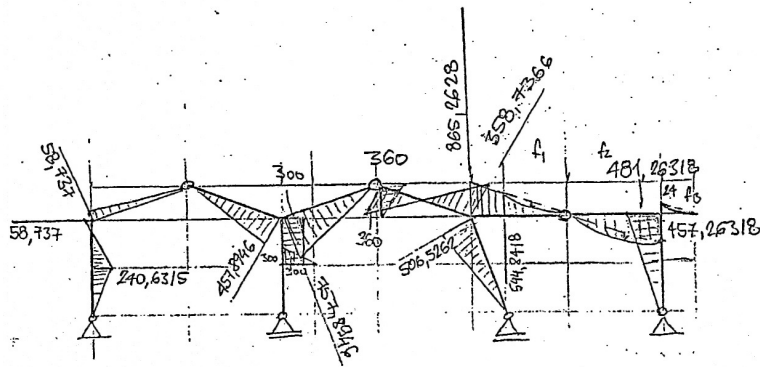
$$V_1 = 43,0526$$



$$\sum H = 0:$$

$$180 - 99,7895 - H_A = 0$$

$$H_A = 80,2105$$

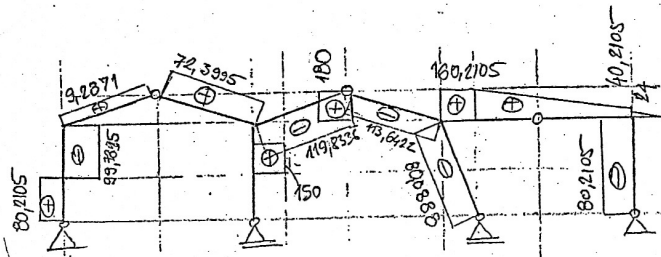


$$f_1 = 24 \text{ kNm}$$

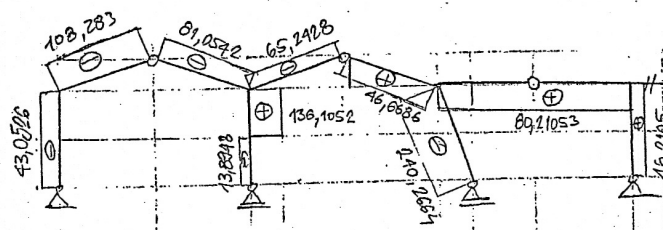
$$f_2 = 54 \text{ kNm}$$

$$f_3 = 6 \text{ kNm}$$

(M) [kNm]

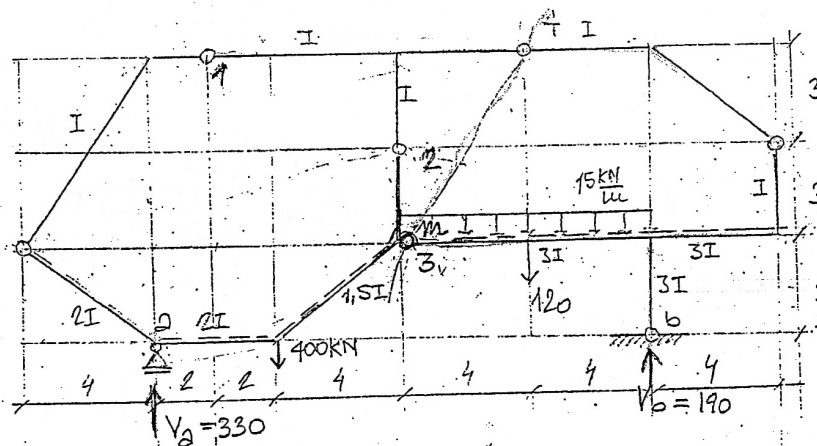


(T)



(N)

15. 20.4.02.

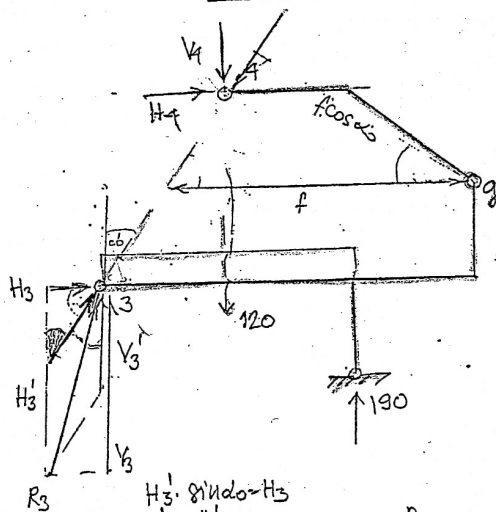


2) $\gamma_{mL}^L - \gamma_{mL}^D$

$\sum M_b = 0: 400 \cdot 12 + 120 \cdot 4 - V_2 \cdot 16 = 0$

$\sum V = 0 \Rightarrow V_b = 190 \text{ kN}$

$V_b = 330 \text{ kN}$



$\tan \alpha = \frac{4}{6} = \frac{2}{3} \quad f = 12 - 3 \cdot \frac{2}{3} = 10 \text{ m}$

$\sum M_4 = 0: V_3' \cdot 4 - 190 \cdot 4 = 0 \quad V_3' = 190 \text{ kN}$

$\sum M_g^a = 0:$

$H_3' \cdot f \cos \alpha + V_3' \cdot 12 - 120 \cdot 8 + 190 \cdot 4 = 0$

$H_3 \cdot f \cdot \tan \alpha = -2080$

$H_3 = -138,6 \text{ kN}$

$V_3 = V_3' + H_3 \cdot \tan \alpha$

$V_3 = -18 \text{ kN}$

$\sum V = 0$

$V_4 = 52 \text{ kN}$

$\sum H = 0$

$H_4 = 138,6 \text{ kN}$

$\tan \alpha = 1 = \frac{V_1}{H_1} \Rightarrow V_1 = H_1$

$\sum M_2 = 0:$

$330 \cdot 8 - 138,6 \cdot 3 - 4 \cdot 3 - V_1 \cdot 6 - 400 \cdot 4 = 0$

$9 H_1 = 624$

$H_1 = 69,3 \text{ kN}$

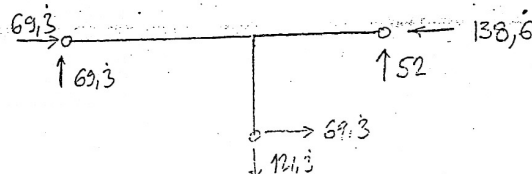
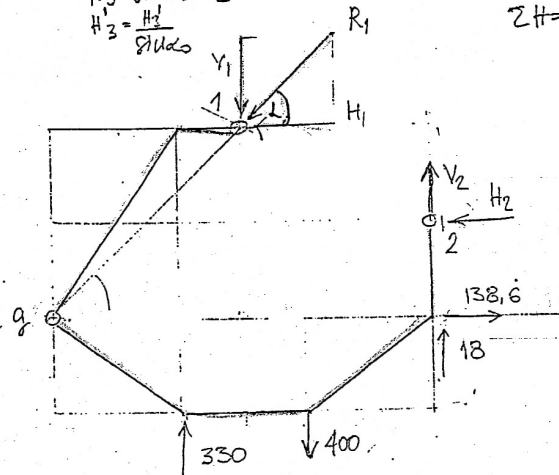
$V_1 = 69,3 \text{ kN}$

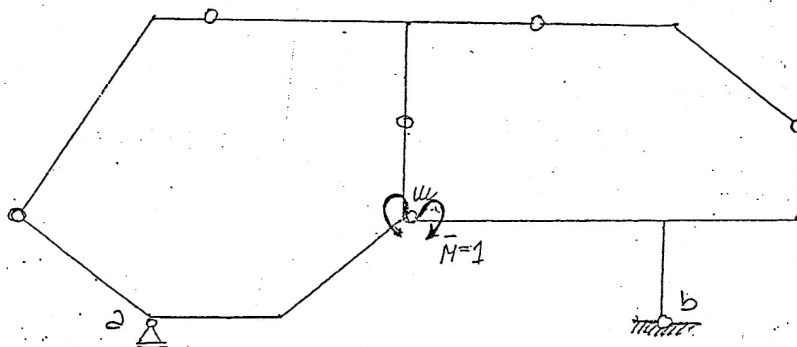
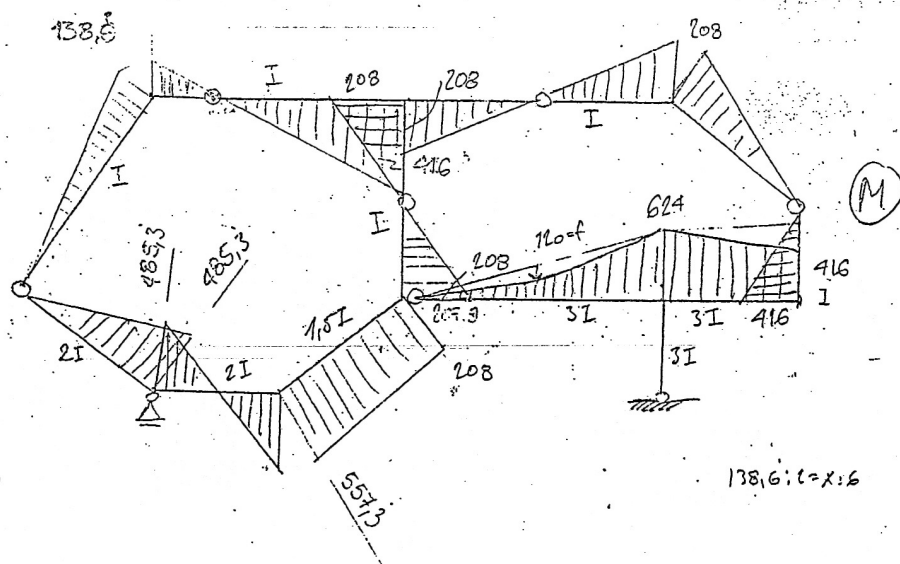
$\sum H = 0$

$H_2 = 69,3 \text{ kN}$

$\sum V = 0$

$V_2 = 121,3 \text{ kN}$





$$\begin{aligned}\sum M_b &= 0: V_2 = 0 \\ \sum V &= 0: V_b = 0 \\ \sum H &= 0: H_b = 0\end{aligned}$$

$$\sum M_3 = 0: 1 - H_4 \cdot 6 - \frac{1}{4} \cdot 4 = 0$$

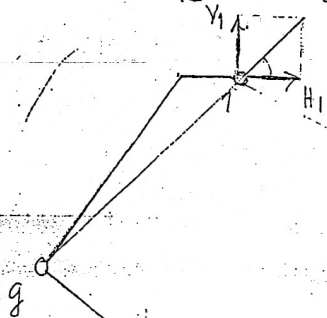
$$1 - H_4 \cdot 6 - \frac{3}{8} H_4 \cdot 4 = 0$$

$$1 - 7.5 H_4 = 0$$

$$H_4 = \frac{2}{15} \quad V_4 = \frac{1}{20}$$

$$\begin{aligned}\tan \alpha &= \frac{3}{8} = \frac{V_4}{H_4} \\ V_4 &= \frac{3}{8} H_4\end{aligned}$$

$$\begin{aligned}\frac{2}{15} &\rightarrow 3 \downarrow 1 \\ &\downarrow \frac{1}{20}\end{aligned}$$



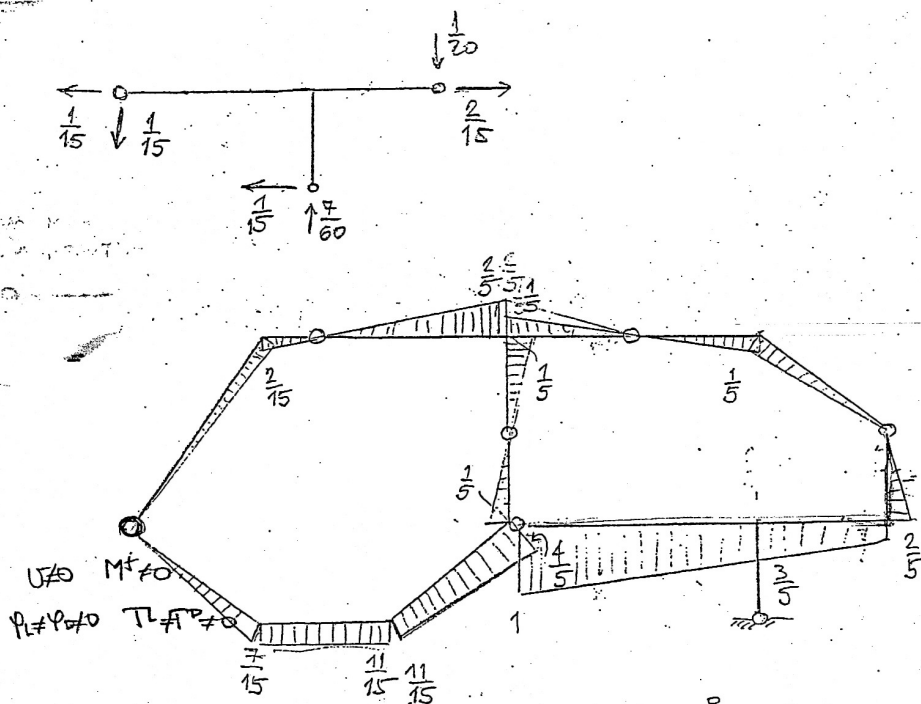
$$\begin{aligned}\frac{7}{60} &\downarrow \frac{1}{15} \\ 2 &\downarrow \frac{2}{15} \\ &\downarrow \frac{1}{20}\end{aligned}$$

$$\tan \alpha = 1 = \frac{V_1}{H_1} \Rightarrow V_1 = H_1$$

$$\sum M_2 = 0: 1 - 3 \cdot H_1 - V_1 \cdot 6 = \frac{2}{15} \cdot 3 = 0$$

$$1 - 9 H_1 - \frac{2}{5} = 0$$

$$\begin{aligned}H_1 &= \frac{1}{15} \\ V_1 &= \frac{1}{15}\end{aligned}$$



$$\varphi_w^L - \varphi_w^d = \frac{1}{EI_c} \left(\int \frac{I_c}{I} M \bar{M} ds + \frac{I_c}{F} N \bar{N} ds + k \cdot EI_c \frac{I_c}{6F} \right) ds$$

$$= \frac{1}{EI_c} \left[\frac{1}{2} \cdot 152 \cdot 138,6 \cdot \frac{2}{3} \cdot \frac{2}{15} - \frac{1}{2} \cdot 2 \cdot 138,6 \cdot \frac{2}{3} \cdot \frac{2}{15} - \frac{1}{2} \cdot 8 \cdot 916 \cdot \frac{2}{3} \cdot \frac{2}{5} - \frac{1}{2} \cdot 4 \cdot 208 \cdot \frac{2}{3} \cdot \frac{1}{5} \right. \\ - \frac{1}{2} \cdot 4 \cdot 208 \cdot \frac{2}{3} \cdot \frac{1}{5} - \frac{1}{2} \cdot 8 \cdot 208 \cdot \frac{2}{3} \cdot \frac{1}{8} - \frac{1}{2} \cdot 2 \cdot 208 \cdot \frac{2}{3} \cdot \frac{1}{5} - \frac{1}{2} \cdot 2 \cdot 208 \cdot \frac{2}{3} \cdot \frac{1}{5} \\ - \frac{1}{2} \cdot \frac{1}{2} \cdot 8 \cdot 485,3 \cdot \frac{2}{3} \cdot \frac{7}{15} + \frac{1}{2} \cdot \frac{7}{6} \cdot \left(\frac{7}{15} \cdot (-485,3 \cdot 2 + 557,3) + \frac{11}{15} (557,3 \cdot 2 - 485,3) \right) \\ + \frac{2}{3} \cdot \frac{1}{6} \cdot 5 \cdot \left(557,3 \left(2 \cdot \frac{11}{15} + \frac{4}{5} \right) + 208 \left(2 \cdot \frac{4}{5} + \frac{11}{15} \right) \right) - \frac{1}{3} \cdot \frac{8}{6} \cdot 624 \cdot \left(2 \cdot \frac{3}{5} + \frac{1}{5} \right) \\ \left. + \frac{1}{3} \cdot \frac{1}{3} \cdot 120 \left(1 + \frac{3}{5} \right) - \frac{1}{3} \cdot \frac{4}{6} \left(624 \left(2 \cdot \frac{3}{5} + \frac{2}{5} \right) + 416 \left(2 \cdot \frac{2}{5} + \frac{3}{5} \right) \right) \right]$$

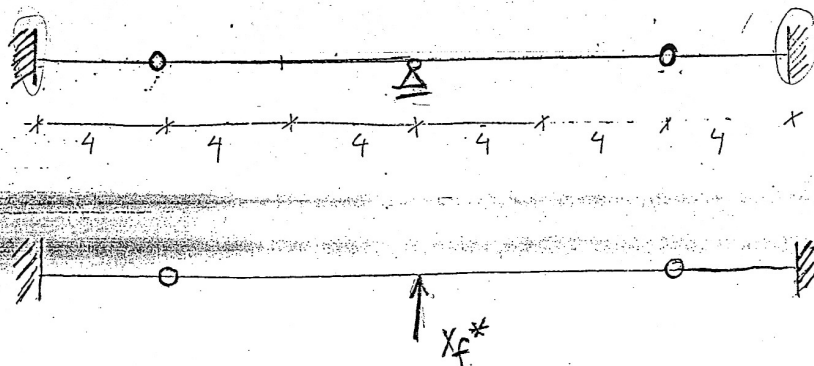
$$(\varphi_w^L - \varphi_w^d) / EI_c = -887,2664493$$

b) УТИЦАЈНА ЛИНИЈА ЗА $\varphi_w^L - \varphi_w^d$

ОДГОВАРАЈУЋИ ФИКТИВНИ НОСАО

$U=0$
 $U \neq P_d$

2x2
2 x (БР. УСТАПОВА У ЗГЛАСИ - 1)



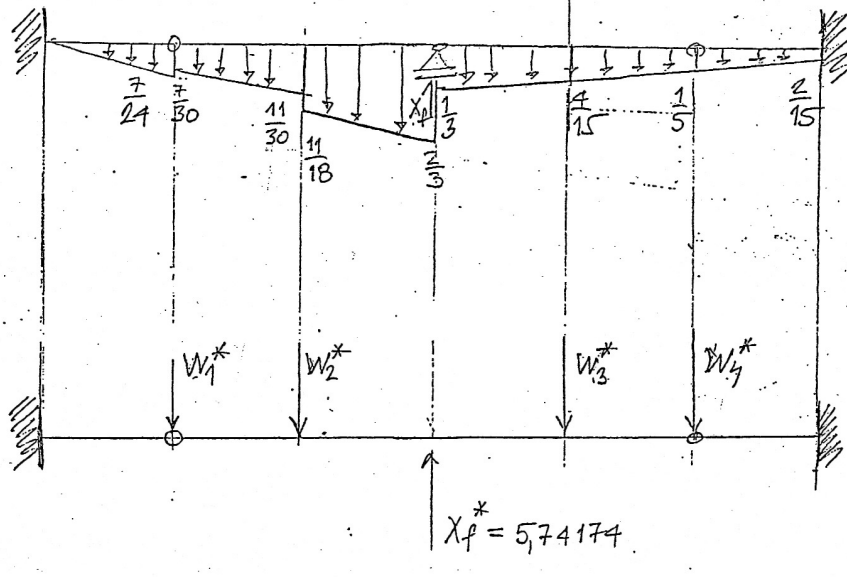
$$\chi_f^* = \frac{1}{EI_c} \cdot \int \frac{I_c}{I} M \bar{M} ds = \frac{1}{EI_c} \cdot \left[\frac{1}{2} \cdot 152 \left(\frac{2}{15} \right)^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 2 \cdot \left(\frac{2}{15} \right)^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 8 \cdot \left(\frac{2}{5} \right)^2 \cdot \frac{2}{3} \right. \\ \left. + \frac{1}{2} \cdot 4 \cdot \left(\frac{1}{5} \right)^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 4 \cdot \left(\frac{1}{5} \right)^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 5 \cdot \left(\frac{1}{5} \right)^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 8 \cdot \left(\frac{2}{5} \right)^2 \cdot \frac{2}{3} \right. \\ \left. + 2 \cdot \frac{1}{2} \cdot 3 \cdot \left(\frac{1}{5} \right)^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot \frac{1}{2} \cdot 5 \cdot \left(\frac{7}{15} \right)^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot \frac{4^2}{6} \cdot \left(\frac{7}{15} \left(\frac{7}{15} \cdot 2 + \frac{11}{15} \right) + \frac{11}{15} \left(2 \cdot \frac{11}{15} + \frac{7}{15} \right) \right) \right. \\ \left. + \frac{2}{3} \cdot \frac{5}{6} \cdot \left(\frac{11}{15} \left(2 \cdot \frac{11}{15} + \frac{4}{5} \right) + \frac{4}{5} \left(2 \cdot \frac{4}{5} + \frac{11}{15} \right) \right) + \frac{1}{3} \cdot \frac{12^2}{6} \cdot \left(1 \left(2 \cdot 1 + \frac{2}{3} \right) + \frac{2}{3} \left(2 \cdot \frac{2}{3} + 1 \right) \right) \right]$$

$$\chi_f^* EI_c = 5,741744805$$

$$\boxed{\phi^* = \frac{I_c}{I} \frac{M}{\cos \alpha}}$$

$$\phi^* = \left(\frac{M}{EI} + dt \frac{\Delta t}{h} \right) \cdot \frac{1}{\cos \alpha}$$

$$w^* = \left(\frac{N}{EF} + dt \Delta t \right) \tan \alpha + \frac{KT}{GF}$$



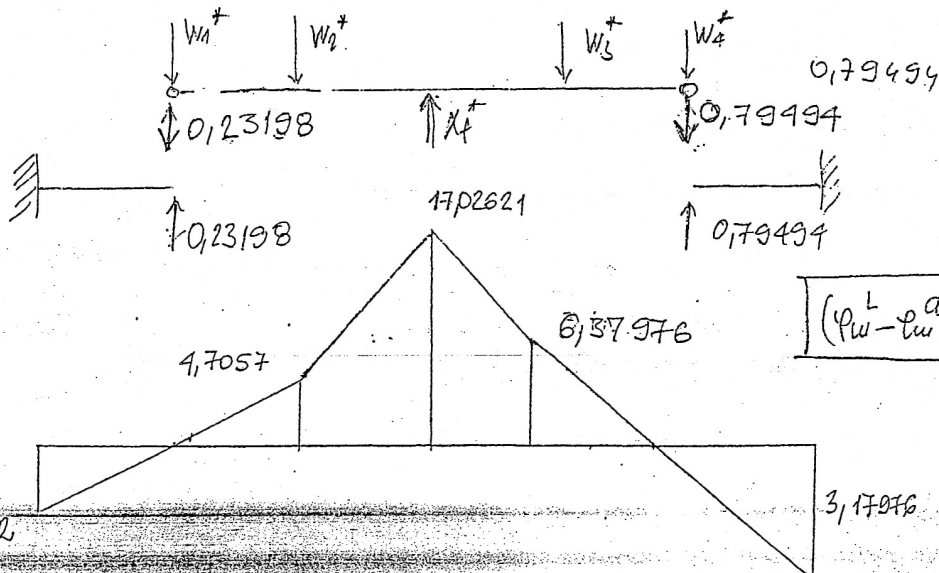
$$W_1^* = \frac{17}{18}$$

$$W_2^* = \frac{257}{135}$$

$$W_3^* = \frac{16}{15}$$

$$W_4^* = \frac{4}{5}$$

$$\frac{11}{81} = 0,6$$

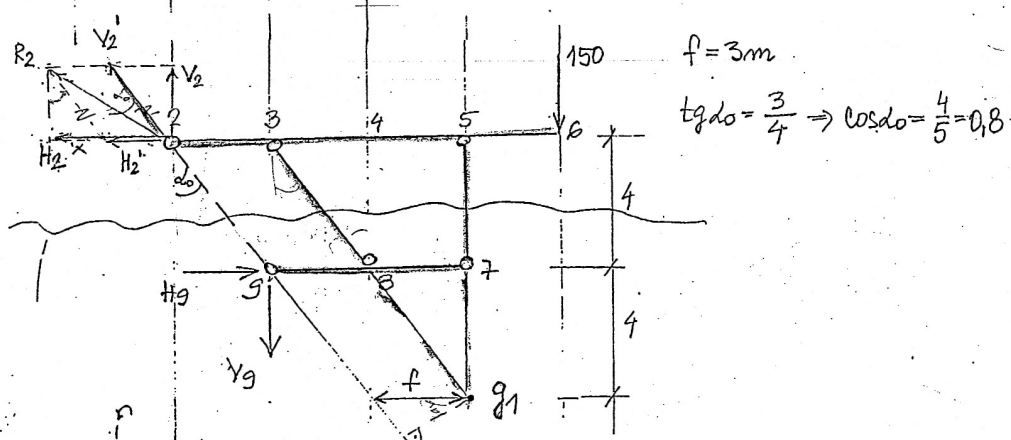
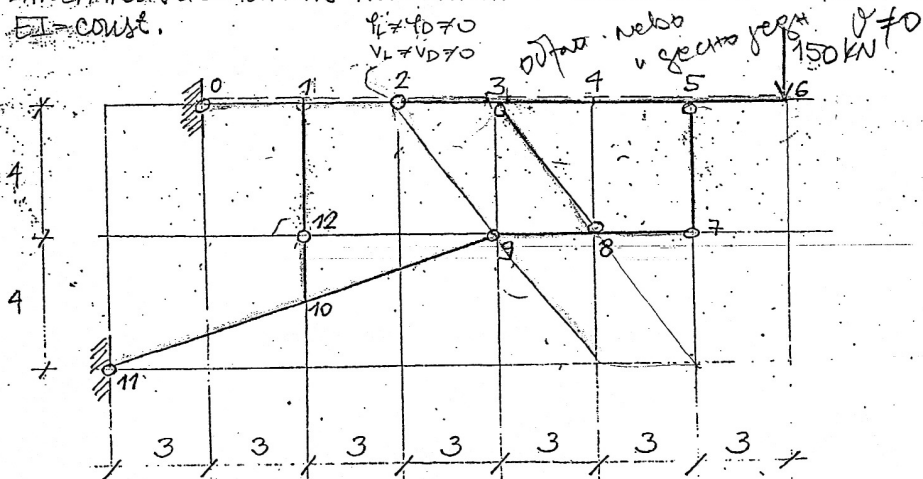


$$\boxed{(\phi_w^L - \phi_w^d) / EI_c}$$

4.

ZNAH DIREKCIJU

SRACUNATI I NACRTATI DIJAGRAM VERTIKALNIH POMERANJA ČVOROVA 0-6
ZANEHARUJUĆI UTICAJ NORMALNIH I TRANSVERZALNIH SILA NA VELIČINU POMERANJA
 $EI = \text{const.}$



$$\sum M_9 = 0 : H_2 \cdot 4 - 150 \cdot 9 = 0$$

$$H_2' = 337,5 \text{ kN}$$

$$\sum M_{g_1} = 0 : H_2' \cdot 8 - V_2' \cdot f \cdot \cos \alpha - 150 \cdot 3 = 0$$

$$337,5 \cdot 8 - V_2 \cdot 3 - 150 \cdot 3 = 0$$

$$V_2 = 750 \text{ kN}$$

$$V_2' = V_2 \cdot \cos \alpha$$

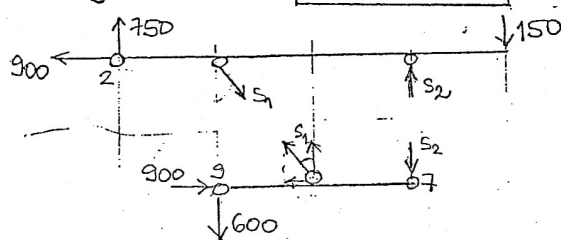
$$H_2 = H_2' + V_2 \cdot \tan \alpha = 337,5 + 750 \cdot \frac{3}{4} = 900 \text{ kN}$$

$$H_2 = 900 \text{ kN}$$

$$\left(\frac{x}{V_2} = \frac{3}{4} \Rightarrow x = V_2 \cdot \tan \alpha \right)$$

$$\sum H = 0 \Rightarrow H_2 - H_g = 0 \Rightarrow H_g = 900 \text{ kN}$$

$$\sum V = 0 \Rightarrow V_2 - V_g - 150 = 0 \Rightarrow V_g = 600 \text{ kN}$$

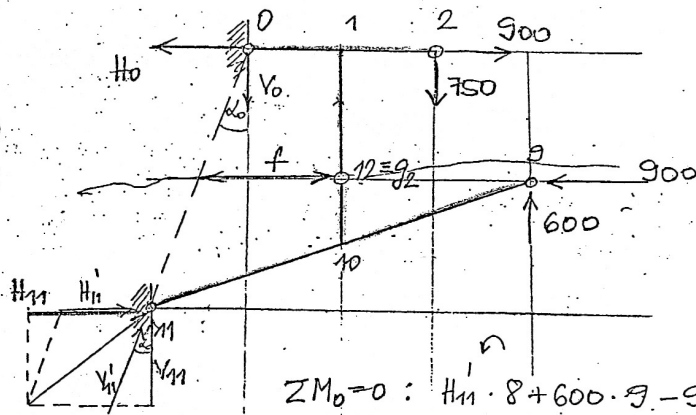


$$\sum M_7 = 0 : 600 \cdot 6 - S_1 \cdot \cos \alpha \cdot 3 = 0$$

$$S_1 = 1500 \text{ kN}$$

$$\sum M_g = 0 : -S_2 \cdot 6 + S_1 \cdot \cos \alpha \cdot 3 = 0$$

$$S_2 = 600 \text{ kN}$$



$$\operatorname{tg} \alpha = \frac{3}{4}$$

$$f = 3 + 4 \cdot \operatorname{tg} \alpha = 4,5$$

$$\sum M_0 = 0 : H_{11} \cdot 8 + 600 \cdot 9 - 900 \cdot 4 - 750 \cdot 6 = 0$$

$$H_{11}' = 337,5 \text{ kN}$$

$$\sum M_{g_2}^{\text{dole}} = 0 \Rightarrow H_{11}' \cdot 4 - V_{11}' \cdot f \cdot \cos \alpha + 600 \cdot 6 = 0$$

$$4 \cdot 337,5 - V_{11}' \cdot f + 600 \cdot 6 = 0$$

$$V_{11} = 1100 \text{ kN}$$

$$H_{11} = H_{11}' + V_{11} \cdot \operatorname{tg} \alpha = 337,5 + 1100 \cdot \frac{3}{4}$$

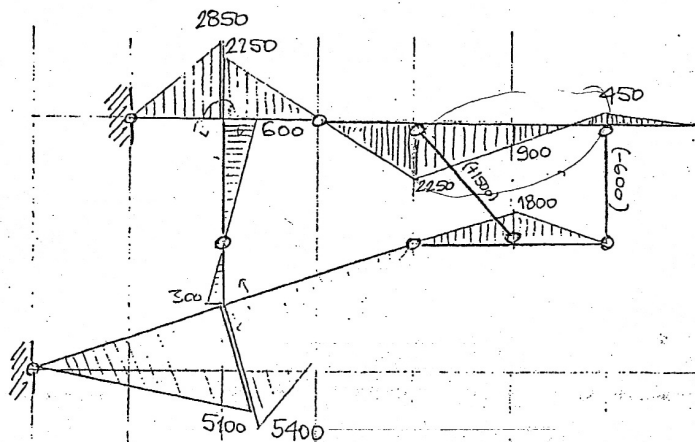
$$H_{11} = 750 \text{ kN}$$

$$\sum H = 0 : H_{11} - H_0 - H_3 + H_2 = 0$$

$$H_0 = 750 \text{ kN}$$

$$\sum V = 0 : V_{11} - V_0 + 600 - 750 = 0$$

$$V_0 = 950 \text{ kN}$$



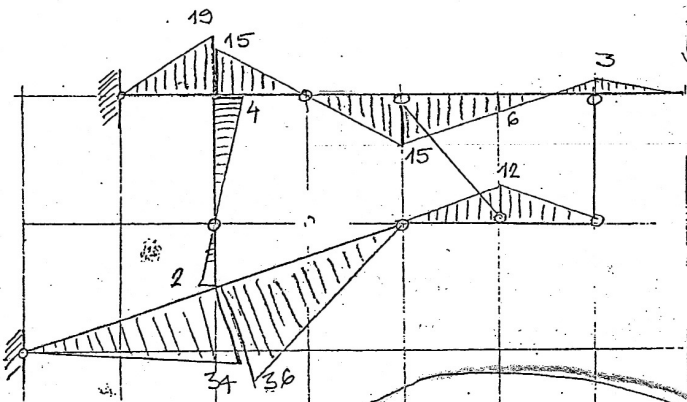
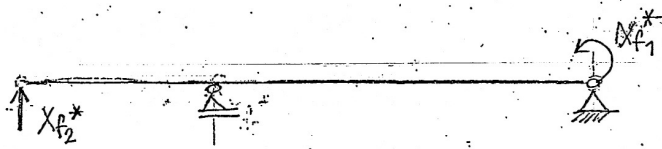
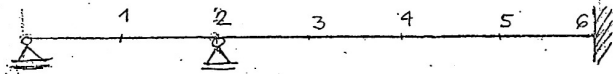
(M)

FIKTIVNI NOSAČ 0-6

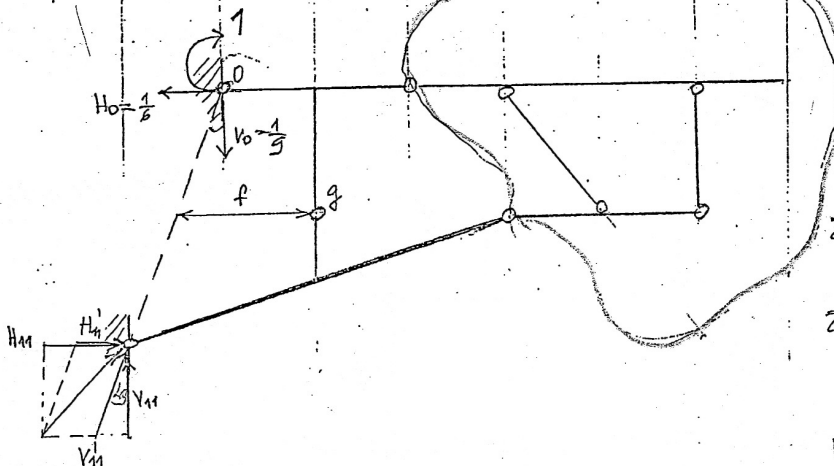
$T_F^L \rightarrow T_F^D$
 $M_F^L \rightarrow M_F^D$

OK.
PROVERBA
HEK-TN PODACHTN

$n=2$



$$\bar{M}_1 = \frac{M}{150}$$



OVAJ DEO JE
NE OPTEREĆEN,
PA NEMA REAKCIJA!

$$\sum M_H = 0: H_H' \cdot 8 - 1 = 0$$

$$H_H' = \frac{1}{8}$$

$$\sum M_g = 0: H_H' \cdot 4 - V_H' \cdot f \cos \alpha = 0$$

$$\frac{1}{8} \cdot 4 - V_H' \cdot f = 0$$

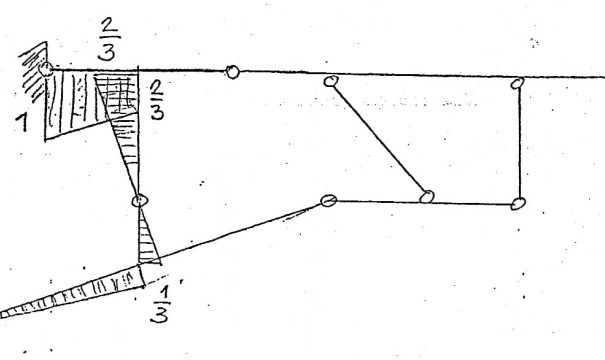
$$V_H' = \frac{1}{9}$$

$$H_H = H_H' + V_H' \cdot \tan \alpha$$

$$= \frac{1}{8} + \frac{1}{9} \cdot \frac{3}{8} \Rightarrow H_H = \frac{1}{6}$$

$$\sum H = 0 \Rightarrow H_0 = \frac{1}{6}$$

$$\sum V = 0 \Rightarrow V_0 = \frac{1}{9}$$



$$X_{f1} = \frac{1}{EI} \int M \bar{M}_1 ds = \frac{1}{EI} X_{f1}^*$$

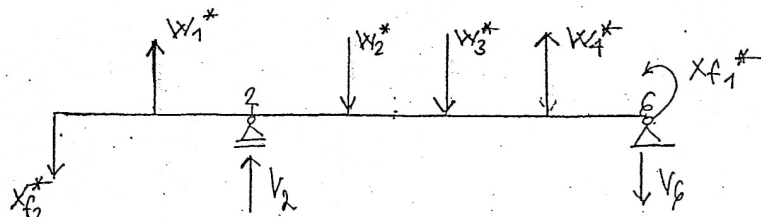
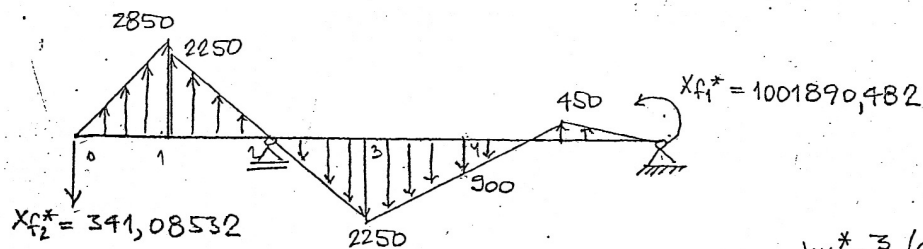
$EI = \text{const.}$

$$X_{f1}^* = \frac{1}{150} \int M^2 ds$$

$$= \frac{1}{150} \left[\frac{1}{2} \cdot 3 \cdot 2850^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 3 \cdot 2250^2 \cdot \frac{2}{3} \cdot 2 + \frac{3}{6} (2250(2 \cdot 2250 + 900) + 900(2250 + 2 \cdot 900)) + \frac{3}{6} (900(2 \cdot 900 - 450) - 450(900 - 2 \cdot 450)) \right. \\ \left. + \frac{1}{2} \cdot 3 \cdot 450^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 4 \cdot 600^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 2 \cdot 500^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 140 \cdot 5100^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 140 \cdot 5400^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 3 \cdot 1800^2 \cdot \frac{2}{3} \cdot 2 \right] \\ = 1001890,482$$

$$X_{f2} = \frac{1}{EI} \int M \bar{M}_2 ds = \frac{1}{EI} X_{f2}^*$$

$$X_{f2}^* = \int M \bar{M}_2 ds = \frac{1}{2} \cdot 140 \cdot \frac{1}{3} \cdot \frac{2}{3} \cdot 5100 - \frac{1}{2} \cdot 2 \cdot \frac{1}{3} \cdot \frac{2}{3} \cdot 300 \\ - \frac{1}{2} \cdot 4 \cdot \frac{2}{3} \cdot \frac{2}{3} \cdot 600 - \frac{3}{6} [2850(2 \cdot \frac{2}{3} + 1)] \\ = -341,08532$$



$$W_1^* = \frac{3}{6} (0 + 2 \cdot 2850 + 2 \cdot 2250 + 0) \\ = 5100$$

$$W_2^* = \frac{3}{6} (0 + 4 \cdot 2250 + 900) \\ = 4950$$

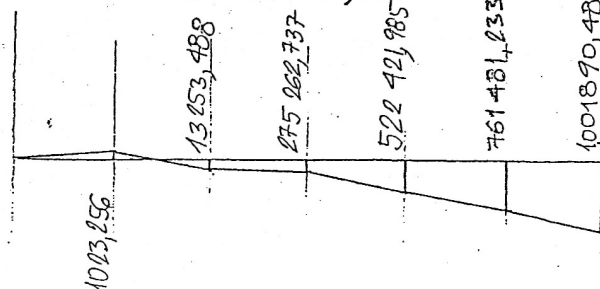
$$W_3^* = \frac{3}{6} (2250 + 4 \cdot 900 - 450) \\ = 2700$$

$$W_4^* = \frac{3}{6} (-900 + 4 \cdot 450 + 0) \\ = 450$$

$$\sum M_6 = 0: 341,08532 \cdot 18 - 5100 \cdot 15 - V_2 \cdot 12 + 4950 \cdot 9 + 2700 \cdot 6 - 450 \cdot 3 + 1001890,482 = 0$$

$$V_2 = 82577,5015$$

$$\sum V = 0 \Rightarrow V_6 = 80136,416$$



$V \times EI_e$

* ЗА ДАТИ НОВАЧ, УСЛА ЗАДАТОГ ОПТЕЧЕЊЕЊА СРАВНАТИ ДИЈАГРАМ
 ХОРИЗОНТАЛНОГ ПОМЕРАЊА ПОТЕЗА ШТАПОВА 0-1-2-3-4 СА ОРАКНАТАМА
 НА СВАГА 2м
 ЗАПЕМЕНИТИ УТИЦАЈ НОРМАЛНИХ И ТРАНСВЕРЗАЛНИХ СИЛА НА ДЕФОРМАЦИЈУ
 ПУНОГ НОСАЧА

$$E = 3 \cdot 10^7 \frac{\text{KN}}{\text{m}^2}$$

ГЕОМЕТРИСКЕ КАРАКТЕРИСТИКЕ
 ШТАПОВА :

$$0-1 : b/h = 0,5/1,2\text{m}$$

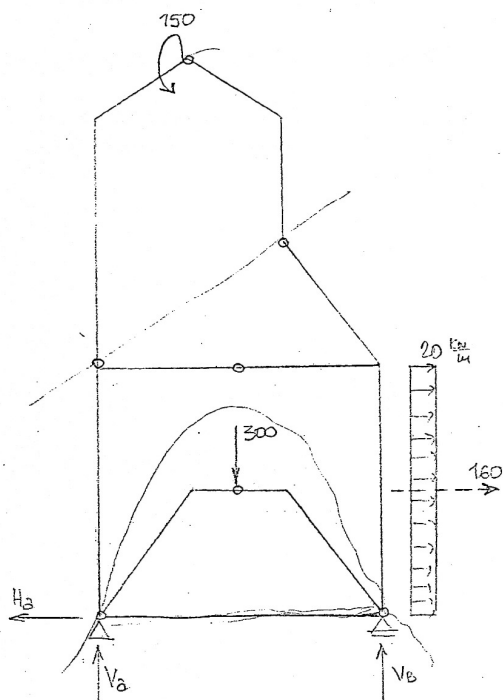
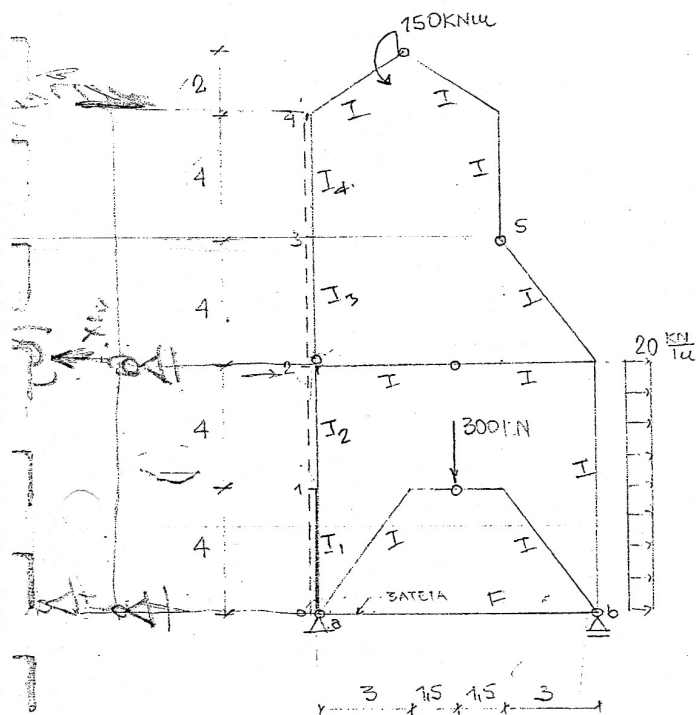
$$1-2 : b/h = 0,5/1,0\text{m}$$

$$2-3 : b/h = 0,5/0,8\text{m}$$

$$3-4 : b/h = 0,5/0,6\text{m}$$

$$\text{ЗАТЕГА} : b/h = 0,3/0,3\text{m}$$

$$\text{ОСТАЛИ ШТАПОВИ} : b/h = 0,5/0,5\text{m}$$



$$\sum M_A = 0 \quad -150 + 300 \cdot 4,5 + 160 \cdot 4 - V_B \cdot 9 = 0$$

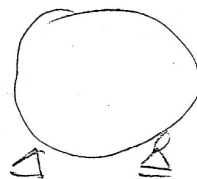
$$V_B = 204,4 \text{ KN}$$

$$\sum V = 0 \quad V_A + V_B - 300 = 0$$

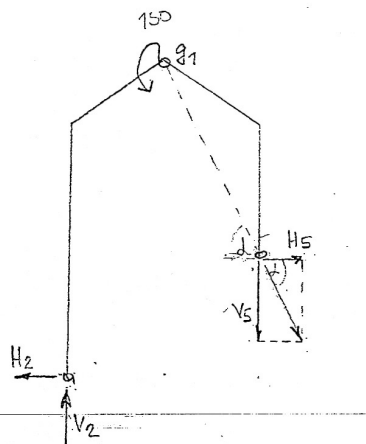
$$V_A = 95,5 \text{ KN}$$

$$\sum H = 0 \quad -H_A + 160 = 0$$

$$H_A = 160 \text{ KN}$$



17.7.18.



$$\tan \alpha = \frac{6}{3} = 2 = \frac{V_5}{H_5} \Rightarrow V_5 = 2H_5$$

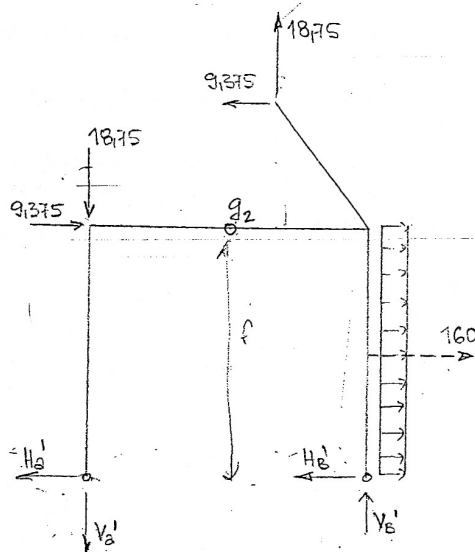
$$\begin{aligned} \sum M_2 = 0 & \quad -150 + V_5 \cdot 6 + H_5 \cdot 4 = 0 \\ & \quad -150 + (6 \cdot 2 + 4)H_5 = 0 \\ & \quad -150 + 16H_5 = 0 \end{aligned}$$

$$H_5 = 9,375 \text{ kN}$$

$$V_5 = 18,75 \text{ kN}$$

$$\sum V = 0 \quad V_2 - V_5 = 0 \quad V_2 = 18,75 \text{ kN}$$

$$\sum H = 0 \quad -H_2 + H_5 = 0 \quad H_2 = 9,375 \text{ kN}$$



$$\begin{aligned} \sum M_{a2} = 0 & \quad 9,375 \cdot 8 - 9,375 \cdot 12 - 18,75 \cdot 6 \\ & \quad + 160 \cdot 4 - V'_b \cdot 9 = 0 \end{aligned}$$

$$V'_b = 54,4 \text{ kN}$$

$$\sum V = 0 \quad -V'_a - 18,75 + 18,75 + V'_b = 0$$

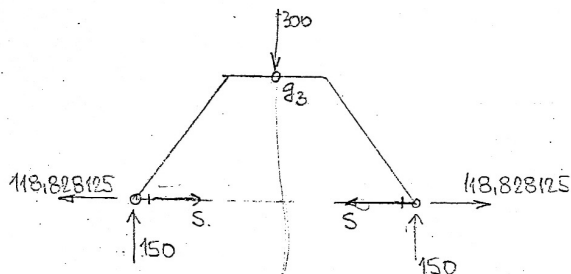
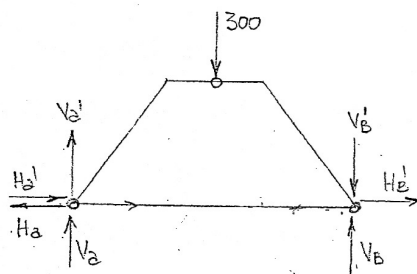
$$V'_a = 54,4 \text{ kN}$$

$$\sum M_{a2}^{ABO} = 0 \quad -18,75 \cdot 4,5 - V'_a \cdot 4,5 + H'_a \cdot 8 = 0$$

$$H'_a = 41,171875 \text{ kN}$$

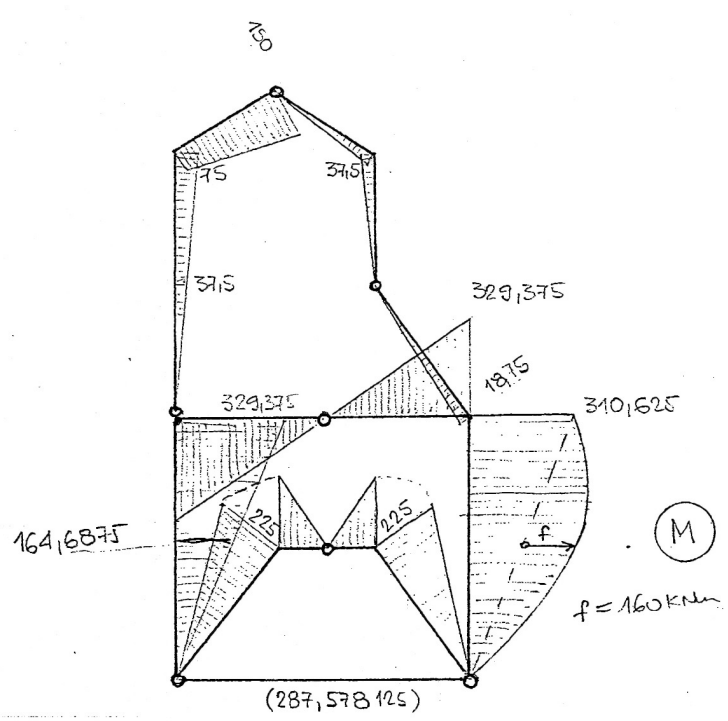
$$\sum H = 0 \quad -H'_a + 9,375 - 9,375 + 160 - H'_b = 0$$

$$H'_b = 118,828125 \text{ kN}$$



$$\sum M_{a3}^{ABO} = 0 \quad 150 \cdot 4,5 + 118,828125 \cdot 4 - S \cdot 4 = 0$$

$$S = 287,1578125 \text{ kN}$$



19.

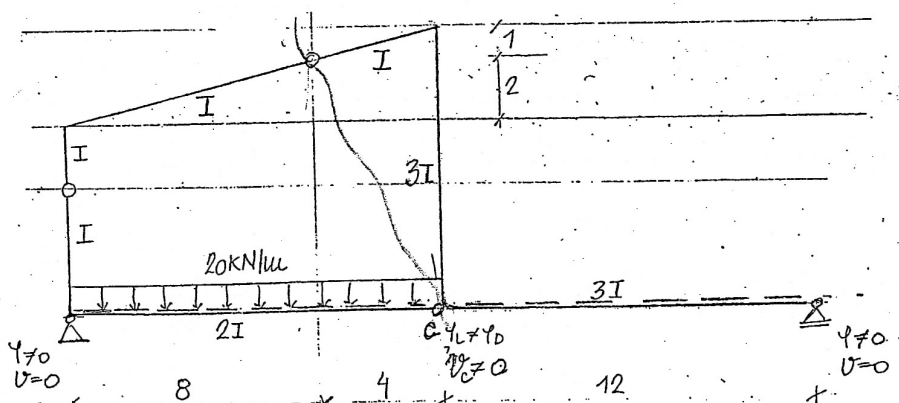
(ΔΑ ΜΗ ΟΕ ΤΡΕΒΑ ΔΑ ΟΥΔΕ ΤΕΔΗΑΚΟ ΟΕ
ΤΑ ΥΠΗΛΑΙΤΗΟΖ ΑΝΗΗΝΗ)

2.

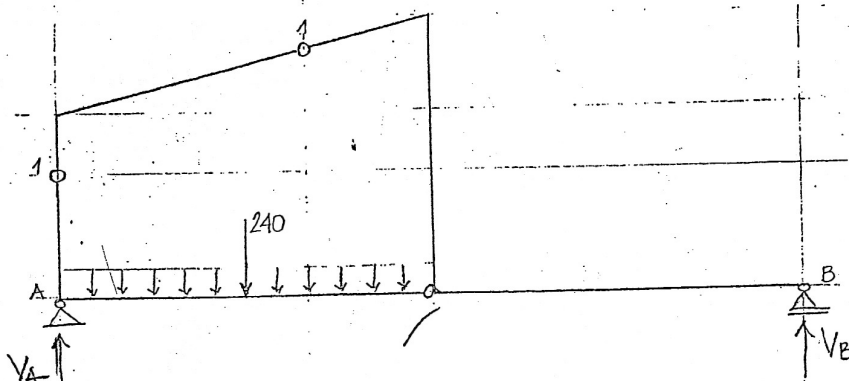
9.12.1972.

7

ΣΡΑΟΙΝΑΤΙ ΒΕΡΙΚΑΛΝΟ ΠΟΜΕΡΑΝΕ ΟΥΔΡΑ Ο ΠΡΙΜΕΝΟΜ ΠΡΙΝΟΙΡΑ
ΒΙΡΤΥΑΛΝΗΙ ΣΙΛΑ, ΔΟΒΙΤΕΝΙ ΡΕΖΥΛΤΑΤ ΠΡΟΒΕΡΙΤΙ ΡΥΤΕΜ ΟΤΙΟΑΙΝΕ ΛΙΝΙΕ



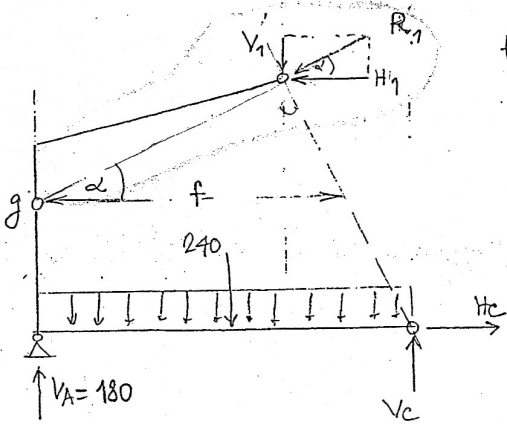
3
2
4
↓
οιωτερ. x
τοοβρμ. γυ'οορ
(γ'ω. μω. οω'ογ
οιωτερ.)



$$\sum M_A = 0 \Rightarrow V_B \cdot 24 - 240 \cdot 6 = 0$$

$$V_B = 60$$

$$\sum V = 0 \Rightarrow V_A = 180$$



$$\tan \alpha = \frac{4}{8} = \frac{V_1}{H_1} \Rightarrow V_1 = \frac{1}{2} \cdot H_1$$

$$\sum M_C = 0: 180 \cdot 12 - 240 \cdot 6 - V_1 \cdot 4 - H_1 \cdot 8 = 0$$

$$720 - \frac{H_1}{2} \cdot 4 - 8H_1 = 0$$

$$10H_1 = 720$$

$$H_1 = 72$$

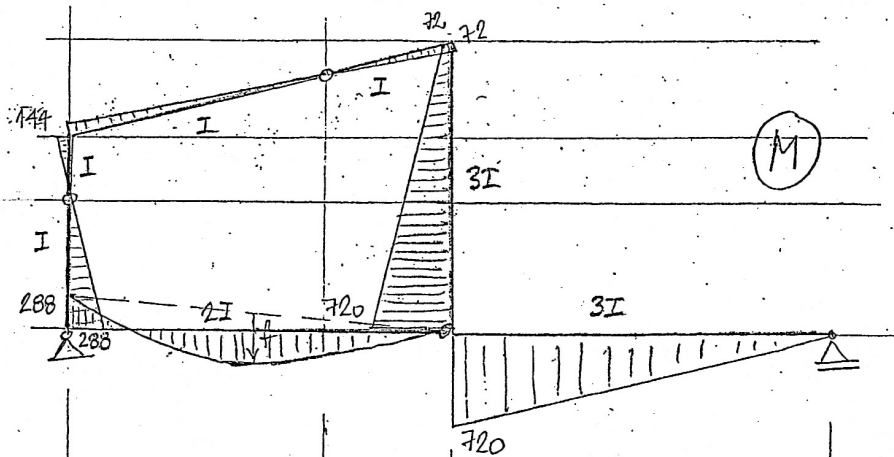
$$V_1 = 36$$

$$\sum H = 0 \Rightarrow H_c = 72$$

$$\sum V = 0: 180 - 240 + V_c - 36 = 0$$

$$V_c = 96$$

$$f = \frac{1}{8} \cdot 20 \cdot 12^2 = 360 \text{ kNm}$$

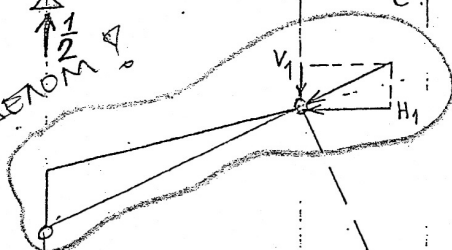


$$\sum M_A = 0:$$

$$1 \cdot 12 - V_B \cdot 24 = 0$$

$$V_B = \frac{1}{2}$$

φορά σε
θετική Δεξιά



$$V_1 = \frac{H_1}{2}$$

$$\sum M_C = 0:$$

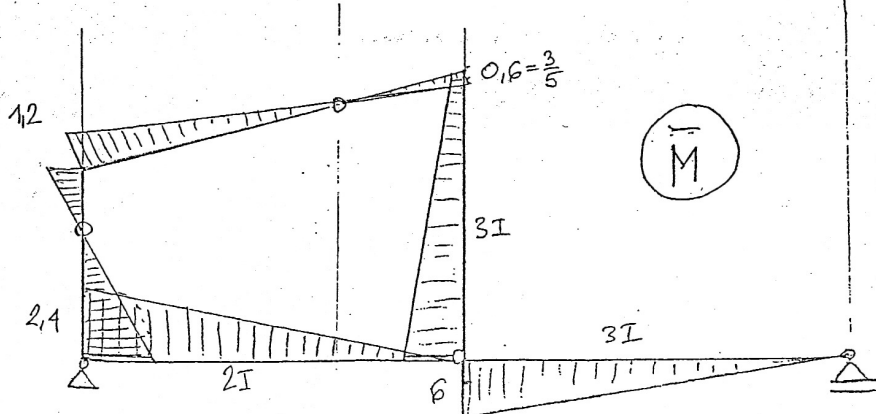
$$\frac{1}{2} \cdot 12 - V_1 \cdot 4 - H_1 \cdot 8 = 0$$

$$6 - \frac{H_1}{2} \cdot 4 - 8H_1 = 0$$

$$+10H_1 = 6$$

$$H_1 = \frac{3}{5}$$

$$V_1 = \frac{3}{10}$$



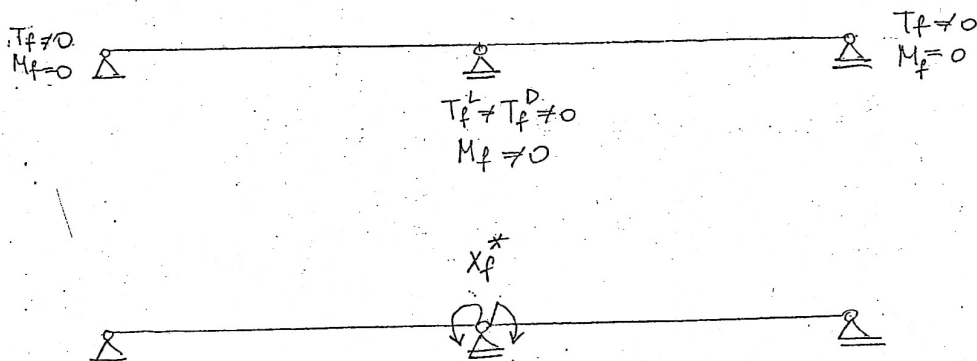
$$v_c = \frac{1}{EI} \int \frac{I_c}{I} M \bar{M} ds$$

$$\begin{aligned} EI \cdot v_c &= \frac{1}{2} \cdot 4 \cdot 288 \cdot \frac{2}{3} \cdot 2,4 + \frac{1}{2} \cdot 2 \cdot 144 \cdot \frac{2}{3} \cdot 1,2 + \frac{1}{2} \cdot 168 \cdot 144 \cdot \frac{2}{3} \cdot 1,2 \\ &+ \frac{1}{2} \cdot 117 \cdot 72 \cdot \frac{2}{3} \cdot 0,6 + \frac{1}{2} \cdot \frac{3}{6} \left[72 \cdot (2 \cdot 0,6 + 6) + 720 (0,6 + 2 \cdot 6) \right] \\ &+ \frac{1}{3} \cdot \frac{14}{2} \cdot 12 \cdot 720 \cdot \frac{2}{3} \cdot 6 + \frac{1}{2} \left[\frac{1}{2} \cdot 12 \cdot 288 \cdot \frac{2}{3} \cdot 2,4 \right. \\ &\left. - \frac{2}{3} \cdot 360 \cdot 12 \cdot \frac{1}{2} \cdot 2,4 \right] = 11780,75477 \end{aligned}$$

b) PROVERITI PUTEM UTIC.LINITE

FIKTIVNI NOSAČ:

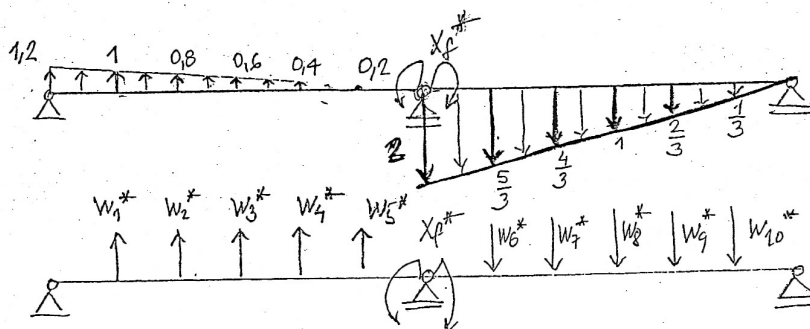
$$m=1$$



$$X_f^* = \int \frac{I_c}{I} \bar{M}^2 ds$$

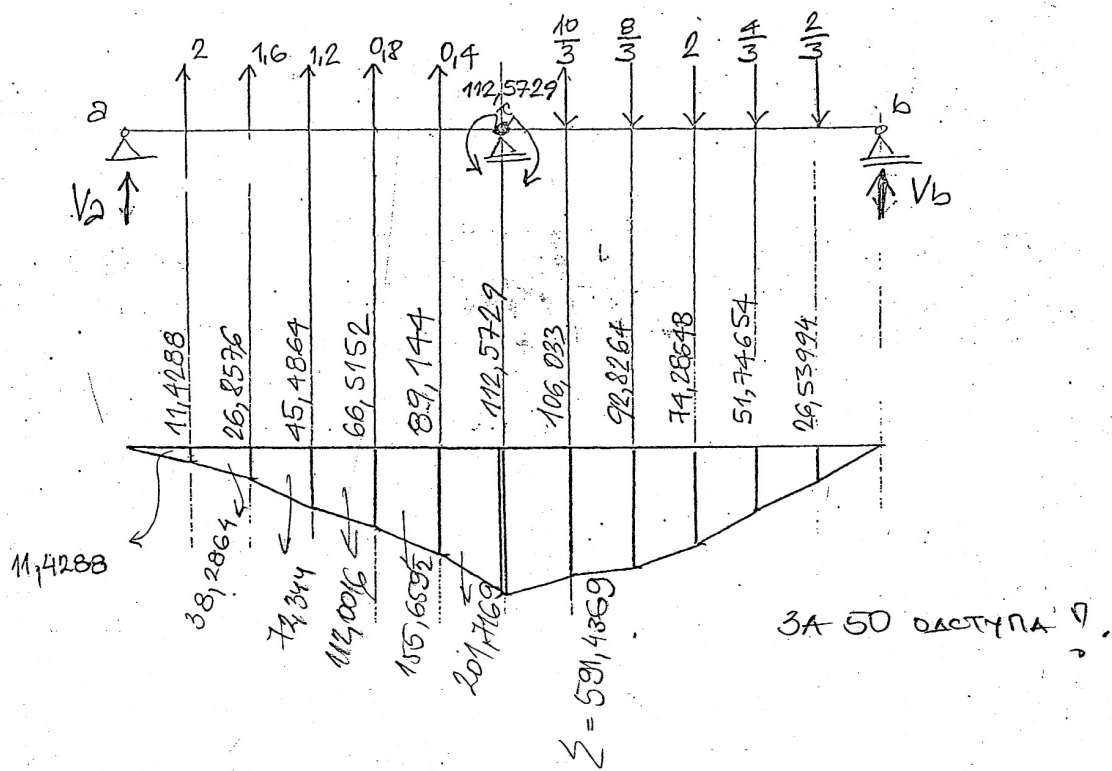
$$\begin{aligned} &= \frac{1}{2} \cdot 4 \cdot 2,4^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 2 \cdot 1,2^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 168 \cdot 1,2^2 \cdot \frac{2}{3} + \frac{1}{2} \cdot 117 \cdot 0,6^2 \cdot \frac{2}{3} \\ &+ \frac{1}{3} \left[\frac{3}{6} (0,6 (2 \cdot 0,6 + 6) + 6 (0,6 + 2 \cdot 6)) \right] + \frac{1}{2} \cdot \frac{1}{2} \cdot 12 \cdot 2,4^2 \cdot \frac{2}{3} \\ &= 112,5729541 \end{aligned}$$

$$p_f^* = \frac{I_c}{I} \cdot \frac{M}{\cos \alpha}$$



$$\begin{aligned}
 W_1^* &= \frac{2}{6} (1,2 + 4 \cdot 1 + 0,8) = 2 \\
 W_2^* &= \frac{2}{6} (1 + 4 \cdot 0,8 + 0,6) = 1,6 \\
 W_3^* &= \frac{2}{6} (0,8 + 4 \cdot 0,6 + 0,4) = 1,2 \\
 W_4^* &= \frac{2}{6} (0,6 + 4 \cdot 0,4 + 0,2) = 0,8 \\
 W_5^* &= \frac{2}{6} (0,4 + 4 \cdot 0,2 + 0) = 0,4
 \end{aligned}$$

$$\begin{aligned}
 W_6^* &= \frac{2}{6} (2 + 4 \cdot \frac{5}{3} + \frac{4}{3}) = \frac{10}{3} \\
 W_7^* &= \frac{2}{6} (\frac{5}{3} + 4 \cdot \frac{4}{3} + 1) = \frac{8}{3} \\
 W_8^* &= \frac{2}{6} (\frac{4}{3} + 4 \cdot 1 + \frac{2}{3}) = 2 \\
 W_9^* &= \frac{2}{6} (1 + 4 \cdot \frac{2}{3} + \frac{1}{3}) = \frac{4}{3} \\
 W_{10}^* &= \frac{2}{6} (\frac{2}{3} + 4 \cdot \frac{1}{3} + 0) = \frac{2}{3}
 \end{aligned}$$



$$\sum M_c^{levo} = 0:$$

$$-V_b \cdot 12 - 2 \cdot 10 - 1,6 \cdot 8 - 1,2 \cdot 6 - 0,8 \cdot 4 - 0,4 \cdot 2 + 112,5729541 = 0$$

$$V_b = 5,7144$$

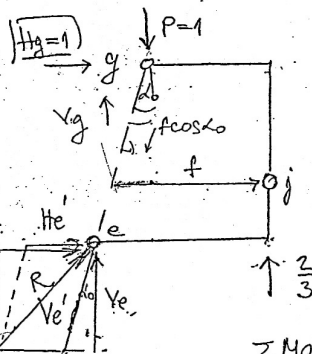
$$\sum M_c^{desno} = 0:$$

$$-V_b \cdot 12 + \frac{2}{3} \cdot 10 + \frac{4}{3} \cdot 8 + 2 \cdot 6 + \frac{8}{3} \cdot 4 + \frac{10}{3} \cdot 2 + 112,5729541 = 0$$

$$V_b = 13,26997$$

a) VERTIKALNO POMERANJE ZGLOBA g SA ORDINATAMA U OZNAČENIM PRESECI MA UZ ZANEHARIVANJE $N: T$ $EI = \text{const.}$

b) MOMENT SAVIJANJA U PRESEKU m



$$V_C + V_{D_{\text{sat}}} = 1$$

$$V_c = 1 - V_{de} \quad \therefore (2)$$

$$24 V_b = 8$$

$$V_b = \frac{1}{3}$$

$$V_C = \frac{2}{3}$$

$$\Sigma M_g = 0: \frac{2}{3} \cdot 8 + 11 \cdot 6 = 0$$

$$He^I = -\frac{16}{3} \cdot \frac{1}{6}$$

$$He^I = -\frac{\infty}{9}$$

$$\sum H_j = 0 : V_e' \cdot f \cdot \cos \alpha_0 - H_e' \cdot 2 = 0$$

$$V_e \cdot f + \frac{8}{2} \cdot 2 = 0$$

$$y_e = -\frac{16}{9} \cdot \frac{3}{32}$$

$$V_e = -\frac{1}{6}$$

$$He = He' + Ve' \text{ siendo}$$

$$= -\frac{8}{9} - \frac{1}{6} \cdot 2 = -\frac{8}{9} - \frac{1}{6} \cdot \frac{2}{3}$$

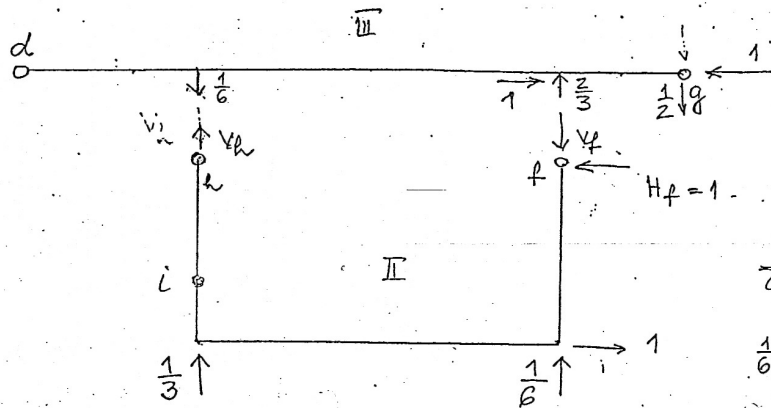
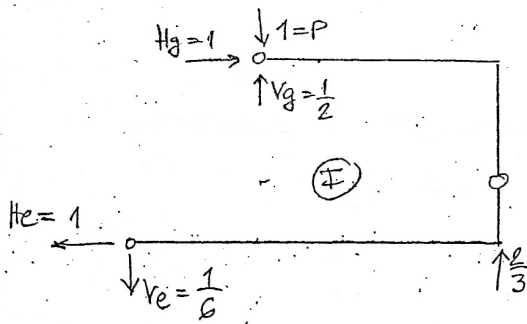
$$H_e = -1$$

$$\sum H = 0 \Rightarrow H_g = 1$$

$$\sum V = 0 \Rightarrow -P + Y_g + \frac{2}{3} + V_e = 0$$

$$V_d = 1 - \frac{2}{3} + \frac{1}{6} = \frac{1}{2}$$

$$V_g = \frac{t}{2}$$



$$\sum M_h = 0:$$

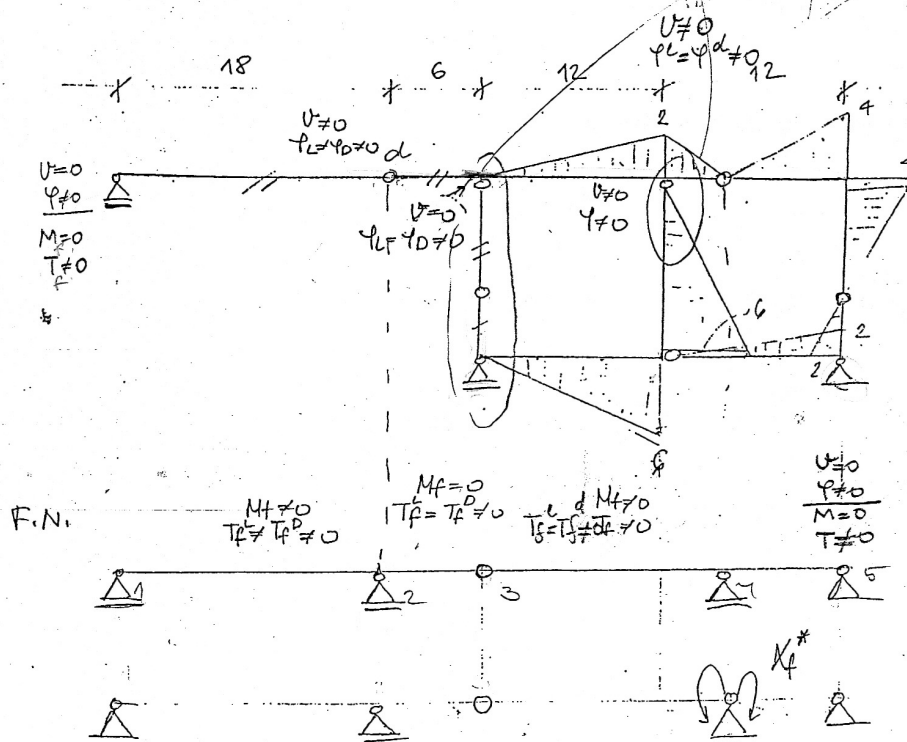
$$\frac{1}{6} \cdot 12 + 1 \cdot 6 - V_f \cdot 12 = 0$$

$$V_f = \frac{8}{12} = \frac{2}{3}$$

$$V_f = \frac{2}{3}$$

$$\sum V = 0: -V_h + V_f - \frac{1}{3} - \frac{1}{6} = 0$$

$$V_h = +\frac{1}{6}$$



$$M \equiv M!$$

1 STAT. NEODREĐENO

$$k=5$$

$$z_0 = 5$$

$$z_s = 4$$

$$11 - 10 = 1$$

$$z_u = 0$$

$$z_k = 2$$

$$X_f = \int \frac{M^2}{EI} ds / EI$$

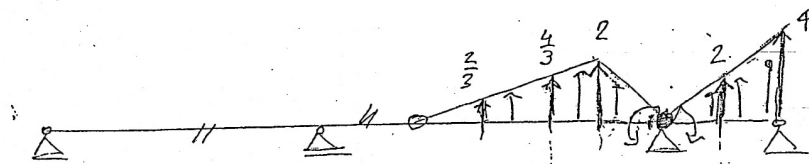
$$X_f = X_f^* EI$$

$$X_f^* = \frac{I_0}{I} \int M^2 ds$$

$$X_f^* = \frac{1}{EI} \int M^2 ds$$

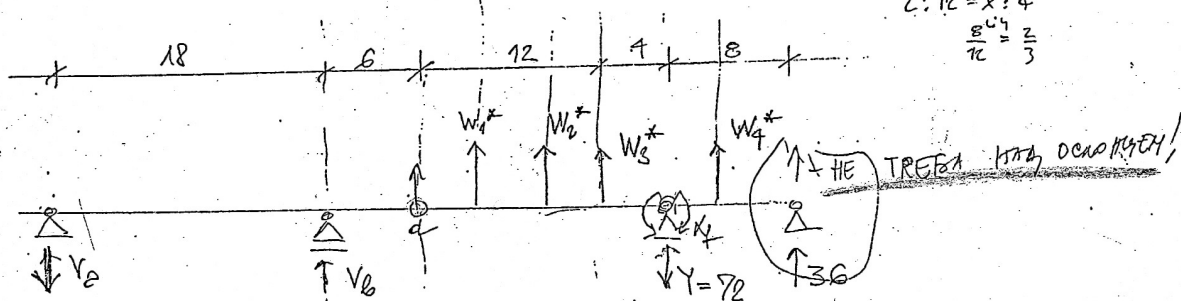
$$= \frac{1}{EI} \left[\frac{1}{2} \cdot 12 \cdot 2 \cdot \frac{2}{3} \cdot 2 + \frac{1}{2} \cdot 4 \cdot 2 \cdot \frac{2}{3} \cdot 2 + \frac{1}{2} \cdot 8 \cdot 4 \cdot \frac{2}{3} \cdot 4 \right. \\ \left. + \frac{1}{2} \cdot 4^2 \cdot \frac{2}{3} \cdot 4 + \frac{1}{2} \cdot 2^2 \cdot \frac{2}{3} \cdot 2 + \frac{1}{2} \cdot 6^2 \cdot \frac{2}{3} \cdot 6 + \frac{1}{2} \cdot 12 \cdot 2 \cdot \frac{2}{3} \cdot 2 \right. \\ \left. + \frac{1}{2} \cdot 12 \cdot 6^2 \cdot \frac{2}{3} \cdot 8 \right] = \frac{320}{EI}$$

$$p_f^* = \frac{I_0}{I} \cdot \bar{M} \cdot \cos \alpha = \bar{M}$$



$$2:12 = x:8 \\ \frac{16 \cdot 4}{12} = \frac{4}{3}$$

$$2:12 = x:4 \\ \frac{8 \cdot 4}{12} = \frac{2}{3}$$



$$W_1^* = -\frac{4}{6} \left[0 + 4 \cdot \frac{2}{3} + \frac{4}{3} \right] = -\frac{16}{6} = -\frac{8}{3} \quad Y = \frac{1}{10} \left[\frac{8}{3} \cdot 4 + \frac{16}{3} \cdot 8 + \frac{56}{9} \cdot 12 + 8 \cdot 20 + 36 \cdot 24 \right]$$

$$W_2^* = -\frac{4}{6} \left[\frac{2}{3} + 4 \cdot \frac{4}{3} + 2 \right] = -\frac{10}{3}$$

$$Y = 72$$

$$W_3^* = -\frac{4}{6} \left[\frac{4}{3} + 4 \cdot 2 + 0 \right] = -\frac{56}{9}$$

$$-V_b \cdot 24 + V_b \cdot 6 = 0 \quad | :6$$

$$+4V_b = V_b$$

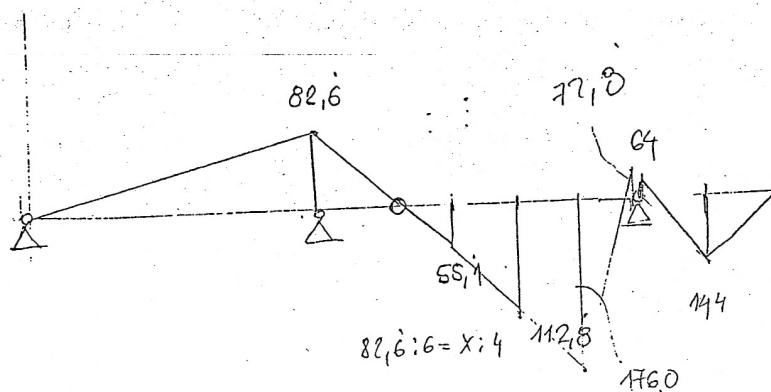
$$W_4^* = -\frac{4}{6} \left[0 + 4 \cdot 2 + 4 \right] = -8$$

$$\sum Y = 0: -V_b + 4V_b + W_1 + W_2 + W_3 + W_4 - 72 + 36$$

$$+3V_b = \frac{129}{9}$$

$$V_b = + \frac{129}{27}$$

$$Y_b = \frac{996}{27}$$



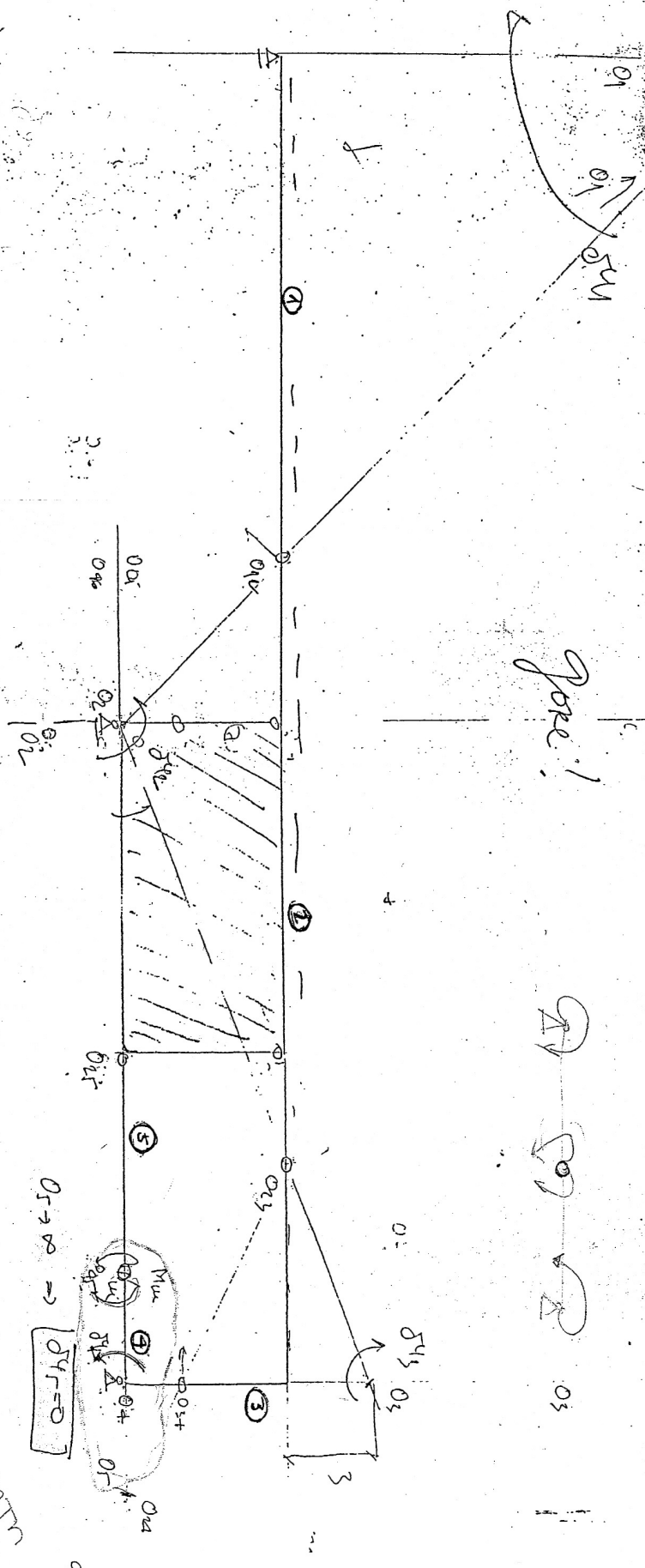
pre!

Q1

Q2

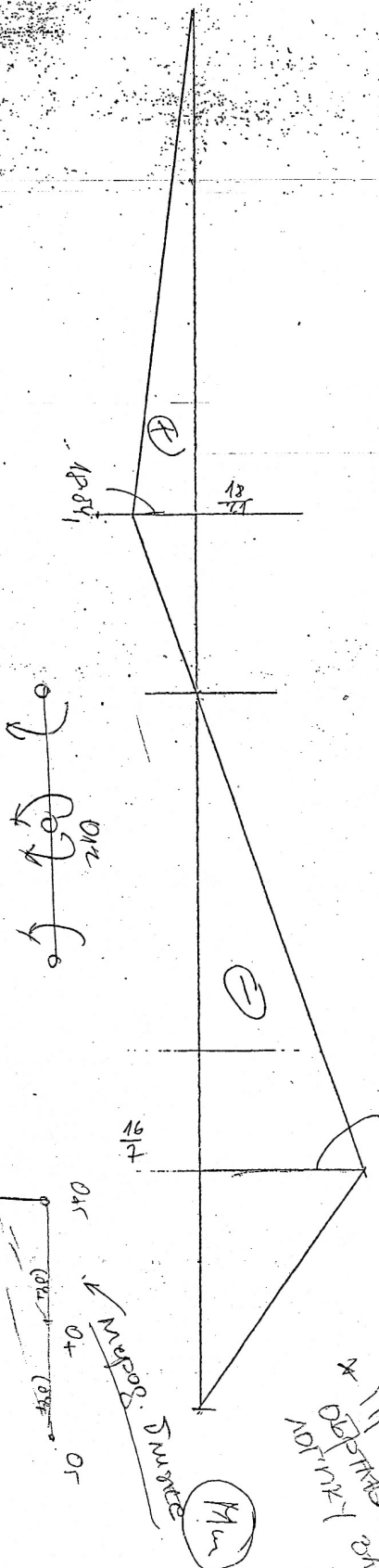
Q3

Q4



$$\delta u \rightarrow \infty \Rightarrow \delta u = 0$$

PROBATION
OPTIMA
10-11-12

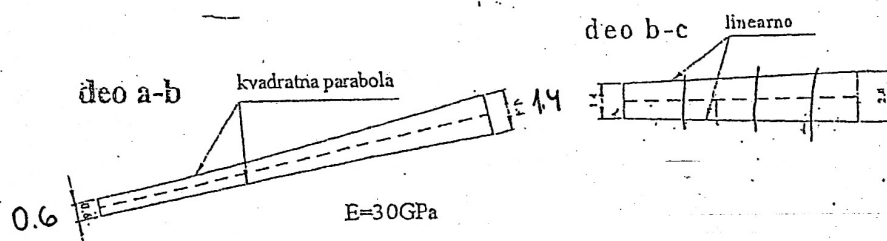
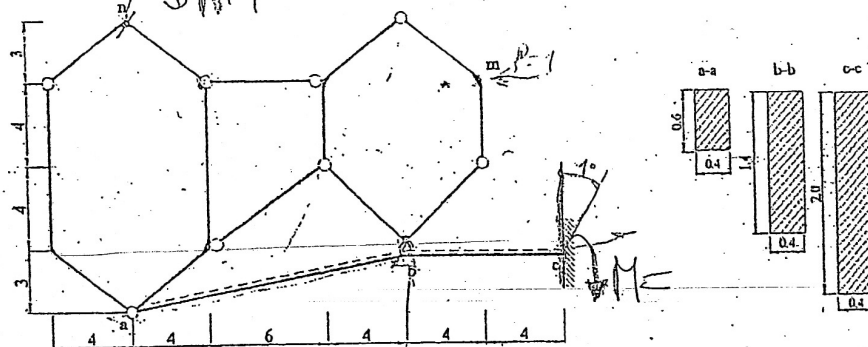


$$\delta u_{45} = \delta u_{44} - \delta u_{45} = 1$$

6.

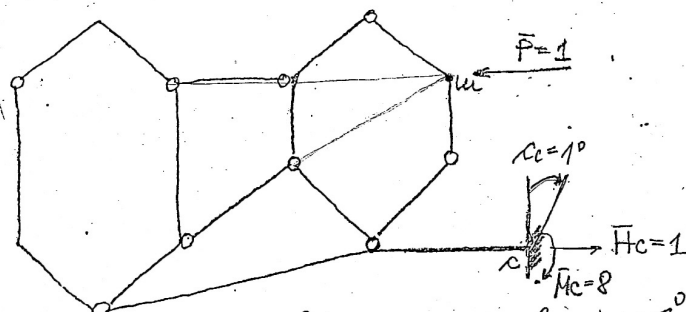
DRUGI ZADATAK

1.



- 1) Odrediti horizontalno pomeranje čvora m , ako se presek 'c' okrene za 1°
- 2) Sračunati i nacrtati uticajnu liniju za obrtanje preseka 'n' sa ordinatama na svaka 2m. Zanemariti uticaj N i T sila na deformaciju.

1)



$$u_m = \int \left(\frac{M\bar{u}}{EI} + \frac{N\bar{u}}{EF} + k \cdot \frac{T\bar{u}}{GF} \right) ds + \int \left(\bar{M} \frac{d\theta}{ds} + \bar{N} \frac{d\epsilon}{ds} \right) ds - \sum C_j \bar{\theta}_j$$

$$= -\bar{M}_c \cdot \alpha_c = -8 \cdot \frac{\pi}{180}$$

$$= 0.13962634 u$$

$$\sum H = 0: \quad 1 - H_c = 0 \quad H_c = 1$$

$$\sum M = 0: \quad 1 \cdot 8 - M_c = 0 \quad \bar{M}_c = 8$$

$$\alpha_j = \alpha_c = 1^\circ = \frac{\pi}{180} \text{ rad}$$

→ yčnog okrenu-trećerka
za 1° nemamo
povratu og
čubapri: ovrcep.

Jebovns
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$$M_{f,2} \neq 0$$

$$M_{fb} \neq 0$$

$$T_{fb}^L = T_{fb}^D \neq 0$$

$$M_{f,c} = 0$$
$$T_{f,c} = 0$$

$$P_f^* = \frac{I_c}{I} M \cdot \frac{1}{\omega_d}$$

$$\frac{I_c}{I} = ?$$

$$\frac{I_c}{I} = \frac{\frac{1}{12} b h c^3}{\frac{1}{12} b h^3} = \left(\frac{h_c}{h}\right)^3, \quad \underline{h_c = 0.6}$$

Diagram illustrating the geometry of the beam. The beam is inclined at an angle α to the horizontal. The horizontal distance is 14m, and the vertical height is 20.5m. The angle α is shown at the left end.

$$\bar{y} = A\bar{x}^2 + B\bar{x} + C$$

$$Y' = 2A\bar{X} + B$$

$$f'(0) = 0 \Rightarrow 2A \cdot 0 + B = 0 \Rightarrow \boxed{B = 0}$$

$$y(0) = 0,3 \Rightarrow A \cdot 0^2 + B \cdot 0 + C = 0,3$$

$$C = 0,3$$

$$\bar{y}(\sqrt{205}) = 0,7 \Rightarrow A \cdot 205 + 0,3 = 0,7$$

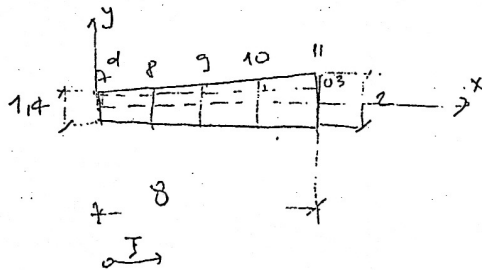
$$A = \frac{0.14}{205}$$

$$\hat{f} = \frac{0.4}{205} \cdot x^2 + 0.13$$

$$205 = l^2$$

$$\frac{I_c}{I} = \left(\frac{h_c}{h} \right)^3 = \left(\frac{0.16}{0.8\xi^2 + 0.6} \right)^3 = \left(\frac{1}{\frac{4}{3}\xi^2 + 1} \right)^3 \quad \frac{14.7}{4.6^2 + 3.45}$$

$\Delta E O \text{ b-c}$



$$y = k \cdot x + n$$

$$k = \frac{0.13}{8}$$

$$n = 0.17$$

$$y = \frac{0.13}{8} \cdot x + 0.17$$

$$l = 8$$

$$\xi = \frac{x}{l} = \frac{x}{8}$$

$$y = 0.13 \cdot \xi + 0.17$$

$$h = 24 = 0.16\xi + 1.14$$

$$\frac{I_c}{I} = \left(\frac{h_c}{h} \right)^3 = \left(\frac{0.16}{0.16\xi + 1.14} \right)^3 - \left(\frac{1}{\xi + \frac{1}{3}} \right)^3 \quad 345$$

	$\Delta E O \text{ a-b}$	$P_k = \frac{I_c}{I} \cdot M \cdot \frac{1201}{14}$							$\Delta E O \text{ b-c}$	$P_k = \frac{I_c}{I} \cdot M$			
ξ	0	$\frac{1}{7}$	$\frac{2}{7}$	$\frac{3}{7}$	$\frac{4}{7}$	$\frac{5}{7}$	$\frac{6}{7}$	1	0	$\frac{1}{4}$	$\frac{2}{4}$	$\frac{3}{4}$	1
$\frac{I_c}{I}$	1	$\left(\frac{147}{154} \right)^3$	$\left(\frac{147}{163} \right)^3$	$\left(\frac{147}{183} \right)^3$	$\left(\frac{147}{211} \right)^3$	$\left(\frac{147}{247} \right)^3$	$\left(\frac{147}{291} \right)^3$	$\left(\frac{147}{343} \right)^3$	$\left(\frac{12}{31} \right)^3$	$\left(\frac{12}{19} \right)^3$	$\left(\frac{12}{37} \right)^3$	$\left(\frac{3}{7} \right)^3$	
M	0	$\frac{1}{7}$	$\frac{2}{7}$	$\frac{3}{7}$	$\frac{4}{7}$	$\frac{5}{7}$	$\frac{6}{7}$	1	1	1	1	1	1
P_k	0	0.1348	0.2143	0.2872	0.1976	0.1540	0.1130	0.0805	0.0787	0.0680	0.0440	0.0341	0.027

$$W_1^* = \frac{2}{6} \cdot (P_0 + 4P_1 + P_2) = 0.2512$$

$$W_{10} = \frac{2}{6} \cdot (P_3 + 4P_{10} + P_{11}) = 0.0691$$

$$W_2^* = \frac{2}{6} \cdot (P_1 + 4P_2 + P_3) = 0.4064$$

$$W_{11} = \frac{2}{6} \cdot (P_{10} + 4P_{11}) = 0.0294$$

$$W_3^* = \frac{2}{6} \cdot (P_2 + 4P_3 + P_4) = 0.4402$$

$$W_4^* = \frac{2}{6} \cdot (P_3 + 4P_4 + P_5) = 0.3905$$

$$W_5^* = \frac{2}{6} \cdot (P_4 + 4P_5 + P_6) = 0.3089$$

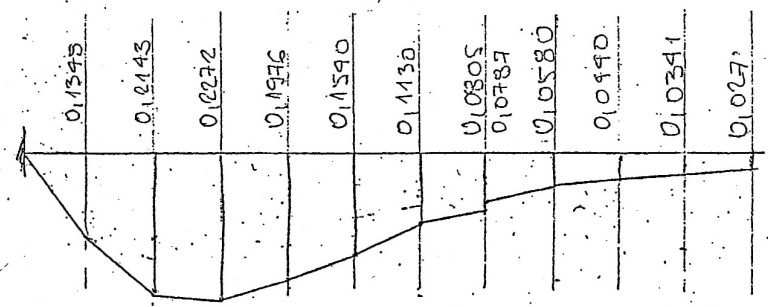
$$W_6^* = \frac{2}{6} \cdot (P_5 + 4P_6 + P_7) = 0.2288$$

$$W_7^* = \frac{2}{6} \cdot (P_6 + 2P_7^e + 2P_7^d + P_8) = 0.1631$$

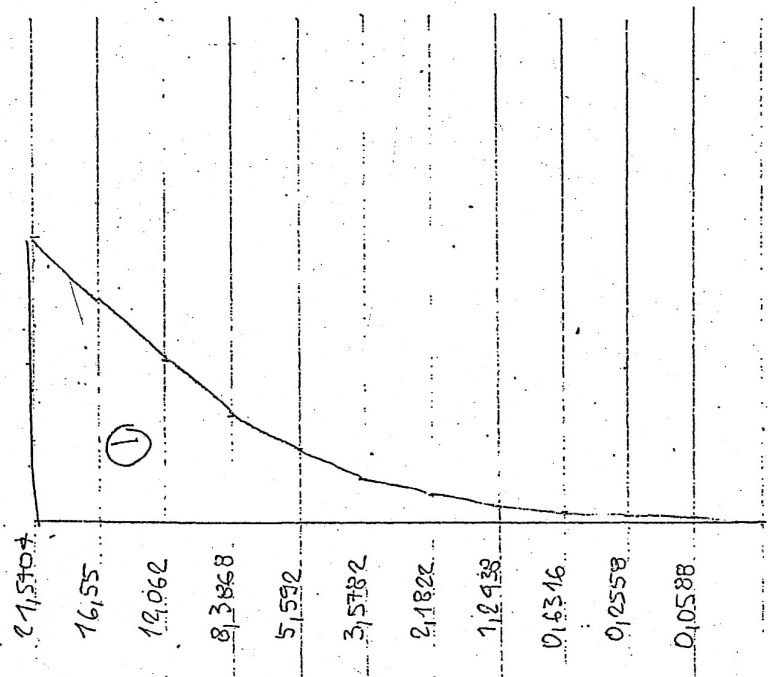
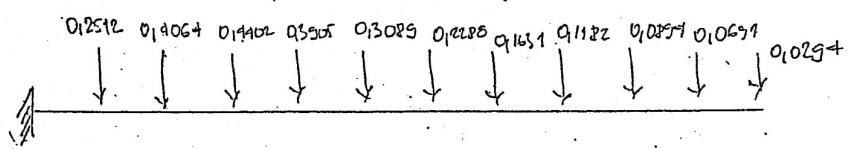
$$W_8^* = \frac{2}{6} \cdot (P_7^d + 4P_8 + P_9) = 0.1182$$

$$W_9^* = \frac{2}{6} \cdot (P_8 + 4P_9 + P_{10}) = 0.0894$$

0.015



(pf)



$\varphi_n \times EI_c$

РАБОТУ ОБРАТНА

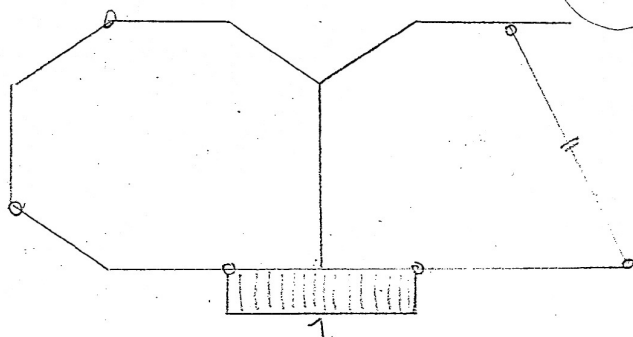
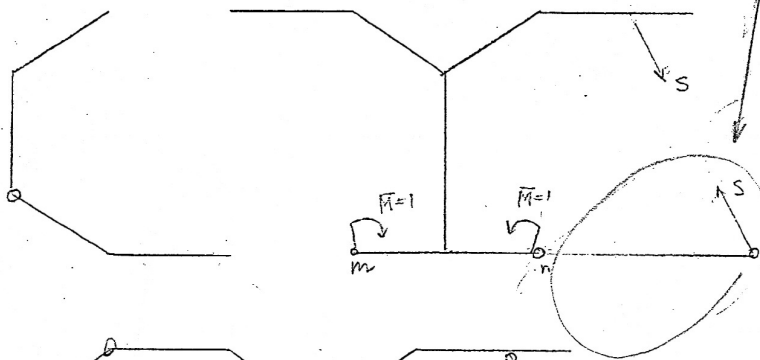
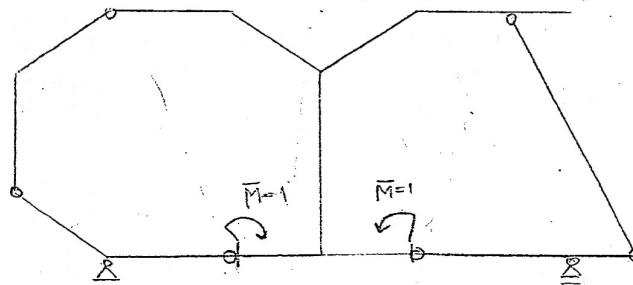
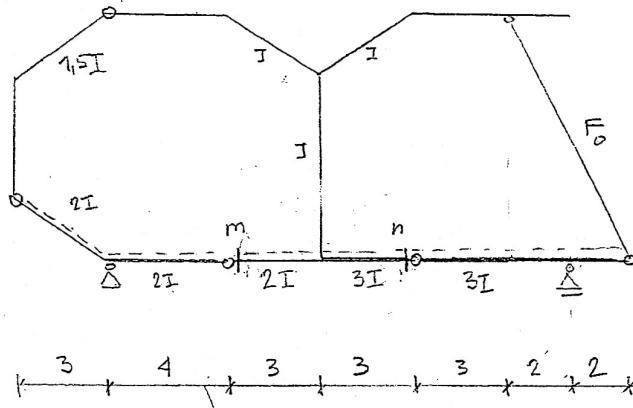
НАПРЯЖЕНИЯ УГЛУБЛЕНИЯ ЛИНИИ ЗА $\psi_m^{cl} - \psi_n^e$

А КОД УГЛУБЛЕНИЯ ЛИНИИ ДЕКОМ. РЕДКИ. ПЕР. СЛАС
У ПРАВИЛУ ТРАЖ. ДЕКОР.

$$EI = 10^5 \text{ kNm}^2$$

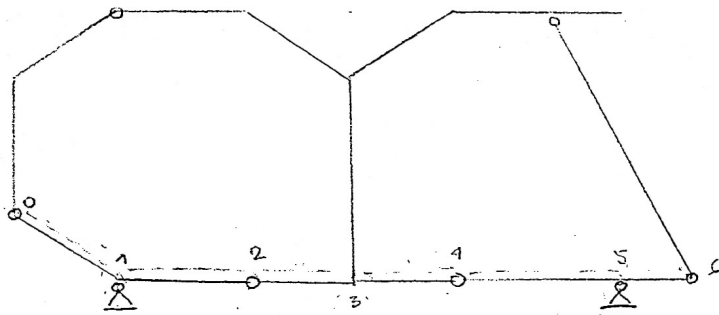
$$\frac{I}{F_0} \approx 0$$

$$\frac{I}{F_0} = 0,1 \text{ m}^2$$



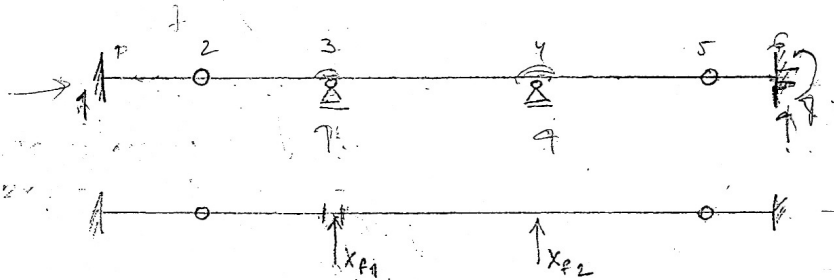
$\bar{M}$
 $\bar{N}$

ПОД СЛУ ПОПЛА
ДЕКОР
РЕДКИ. ПЕР. СЛАС
 $S=0$ $\Rightarrow$
 $\Sigma M_n = 0 \Rightarrow S=0$

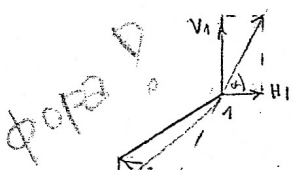
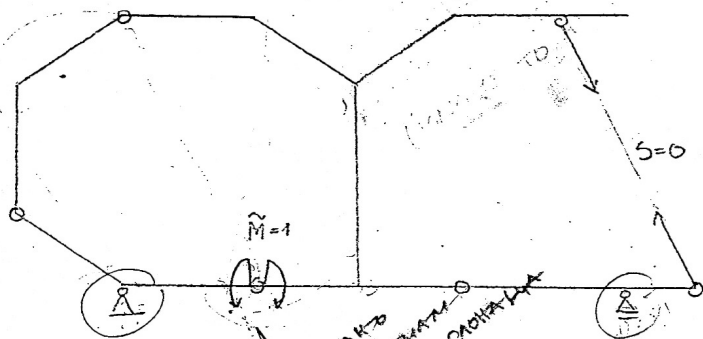


$$\begin{array}{llllll} V_0 \neq 0 & V_1 = 0 & V_2 \neq 0 & V_4 \neq 0 & V_5 = 0 & V_6 \neq 0 \\ \varphi_0 \neq 0 & \varphi_1 = \varphi_1^d & \varphi_2 \neq \varphi_2^d & \varphi_4 \neq \varphi_4^d & \varphi_5 = \varphi_5^d & \varphi_6 \neq 0 \end{array}$$

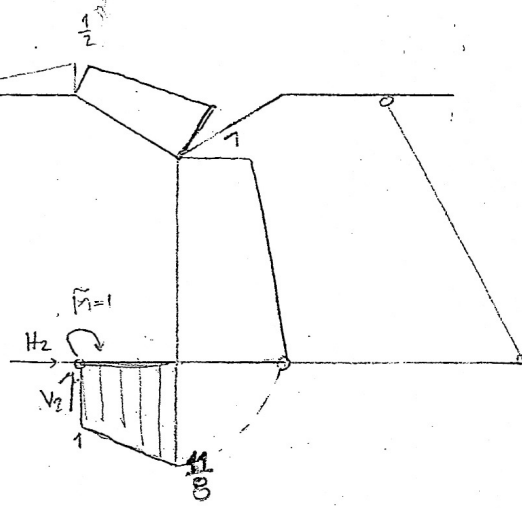
$$\left. \begin{array}{l} K=6 \\ L_3=5 \\ L_0=5 \\ L_u=2 \\ L_k=2 \end{array} \right\}$$



ДЕР НАПРЯЖЕ УЗНА ВЕРТНХ. СНАЕ (АКШЕ, ПЕМА РЕЧЕ. ОДОИТА)

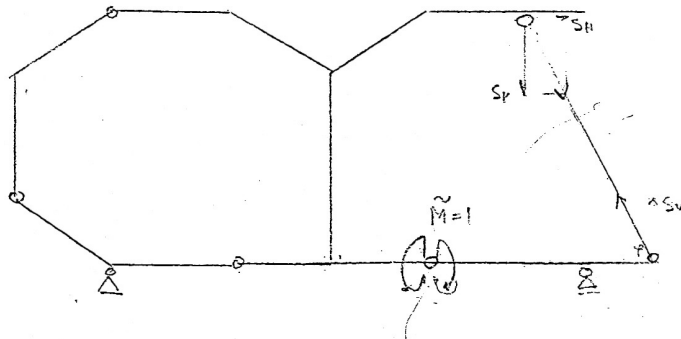


$$\begin{aligned} \tan \alpha &= \frac{6}{3} = 2 = \frac{V_1}{H_1} \Rightarrow V_1 = 2H_1 \\ \sum M_2 = 0 &\Rightarrow 1 - H_1 \cdot 8 - V_1 \cdot 4 = 0 \\ 1 - (8 + 4 \cdot 2)H_1 &= 0 \end{aligned}$$



$$\begin{aligned} H_1 &= \frac{1}{16} & H_2 &= \frac{1}{16} \\ V_1 &= \frac{1}{8} & V_2 &= \frac{1}{8} \end{aligned}$$

$$\begin{pmatrix} \tilde{M}^{(1)} \\ \tilde{N}^{(1)} \end{pmatrix}$$



$$l_0 \varphi = 2 \cdot 2 = \frac{S_V}{S_H}$$

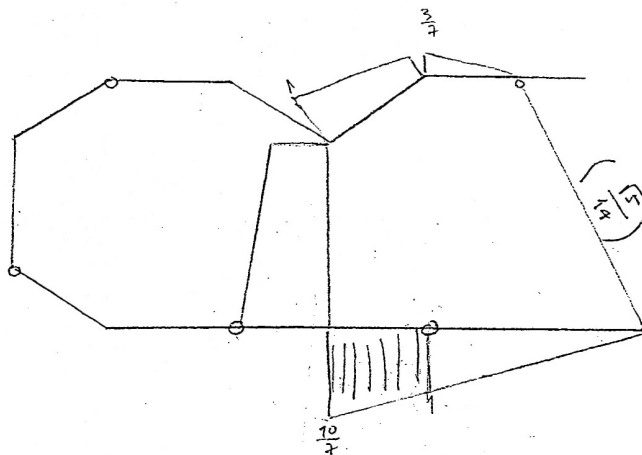
$$\omega_3 \varphi = \frac{1}{17}$$

$$\sum M_n^d = 0 \quad 1 - S_V \cdot 2 = 0$$

$$S_V = \frac{1}{2}$$

$$S_H = \frac{1}{14}$$

$$S = \frac{\sqrt{5}}{14}$$



$$\begin{pmatrix} \tilde{M}^{(2)} \\ \tilde{N}^{(2)} \end{pmatrix}$$

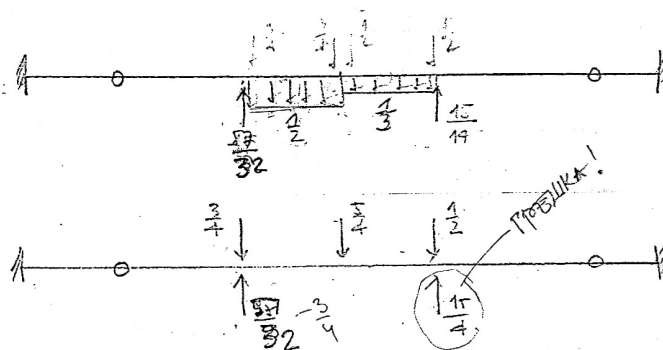
$$\begin{aligned} \chi_{f1}^* &= \int \left(\frac{I_0}{I} \tilde{M} \tilde{M}^{(2)} + \frac{I_0}{F_0} \tilde{N} \tilde{N}^{(2)} \right) ds \\ &= \frac{1}{2} \cdot \frac{3}{2} \cdot 1 \cdot \left(1 + \frac{11}{8} \right) = 1.875 - \frac{1\pi}{8} = \frac{17}{32} \end{aligned}$$

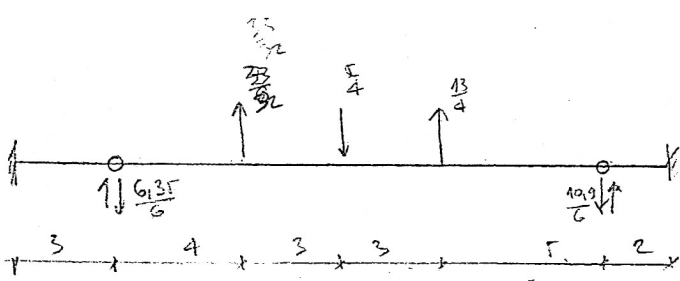
$$\begin{aligned} \chi_{f2}^* &= \int \left(\frac{I_0}{I} \tilde{M} \tilde{M}^{(2)} + \frac{I_0}{F_0} \tilde{N} \tilde{N}^{(2)} \right) ds \\ &= \frac{1}{2} \cdot \frac{3}{2} \cdot 1 \cdot \left(\frac{10}{7} + 1 \right) = \frac{85}{7} \quad 8 \frac{1}{2} = \frac{17}{4} \end{aligned}$$

$$P_f = \frac{M}{EI \omega_3 l}$$

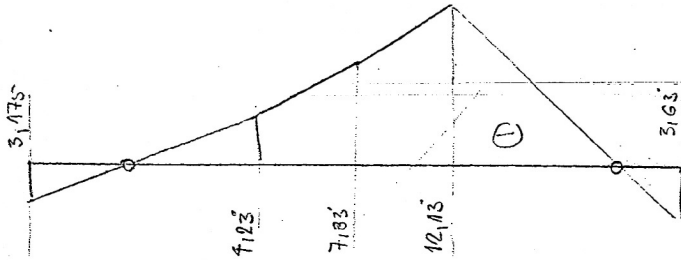
$$m_f = \frac{N}{EF} l_0 2 + k \cdot \frac{I}{GJ}$$

$$P_f^* = \frac{I_0}{I} \cdot \bar{M}$$



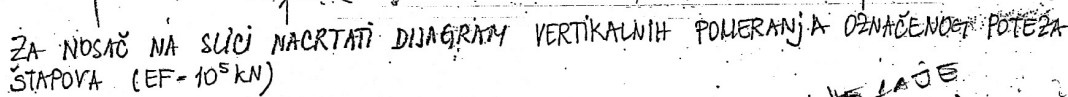


$$\frac{1}{2} \times 11 = \frac{10.9}{6}$$

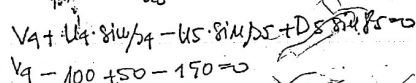


$$(\varphi_m^d - \varphi_m^e) \times EI_c$$

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ЗАШТО ЈЕ $M(0) = 0$ (ЗАП СМ. 800 НЕМ. МОМ.)



$$R_2 = 400 \cdot \sqrt{5}$$

$$2g/m = \frac{2}{4} = \frac{1}{2} = \frac{V_2}{H_2} \rightarrow \boxed{H_2 = 2V_2}$$

$$\sum M_g^L = 0: 300 \cdot 8 + H_2 \cdot 3 + V_2 \cdot 12 = 0$$

$$300 \cdot 8 + 3 \cdot 2 \cdot V_2 - 12 V_2 = 0$$

$$\tan \phi = \frac{1}{4} = \frac{V_c}{H_c} \Rightarrow H_c = 4V_c$$

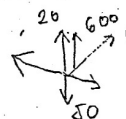
$$\sum M_b = 0: 300 \cdot 20 + 800 \cdot 5 - 400 \cdot 24 - H_c \cdot 5 = 0$$

$$H_2 = 800 \text{ kN}$$

$$V_5 + U_5 \sin \alpha_5 + D_5 \sin \alpha_5 - U_6 \sin \alpha_6 = 0$$

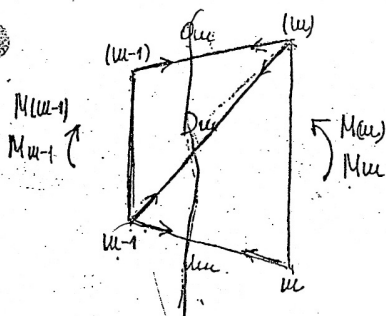
$$\sum H = 0 \Rightarrow$$

$$V_b = 120 \text{ kN}$$



мучин 7702

u	$M(u)$	M_u	l_u	$\frac{M(u)}{l_u}$	$\frac{M_u}{l_u}$	$\frac{1}{\cos \beta_u}$	$\cos \beta_u$	$\frac{1}{\cos \beta_u}$	$\cos \beta_u$	$\sin \beta_u$
0	0	0	0	0	0	1	1	1	1	0
1	-2400	1200	3	-800	0	$\frac{1}{2}$	$\frac{2}{\sqrt{5}}$	$\frac{3}{4}$	0,8	0,6
2	-2000	0	2,5	-800	0	$\frac{1}{8}$	$\frac{8}{\sqrt{65}}$	$\frac{5}{8}$	$\frac{8}{\sqrt{89}}$	$\frac{5}{\sqrt{89}}$
3	-1600	0	2	-800	0	$\frac{1}{8}$	$\frac{8}{\sqrt{65}}$	$\frac{1}{2}$	$\frac{2}{\sqrt{5}}$	$\frac{1}{\sqrt{5}}$
4	-1200	+1200	3	-400	400	$\frac{1}{4}$	$\frac{4}{\sqrt{17}}$	$\frac{1}{2}$	$\frac{2}{\sqrt{5}}$	$\frac{1}{\sqrt{5}}$
5	-800	2400	4	-200	600	$\frac{1}{4}$	$\frac{4}{\sqrt{17}}$	$\frac{3}{4}$	0,8	0,6
6	0	0	5	0	0	$\frac{1}{4}$	$\frac{4}{\sqrt{17}}$	1	$\frac{1}{12}$	$\frac{1}{12}$



$$\sum M_{u-1} = 0: M_{u-1} + D_u \cdot \cos \beta_u \cdot l_u = 0$$

$$D_u = - \frac{1}{\cos \beta_u} \cdot \frac{M_{u-1}}{l_u}$$

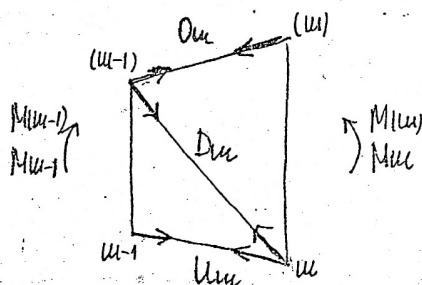
$$\sum M_u = 0: M_u - U_u \cdot \cos \beta_u \cdot l_u = 0$$

$$U_u = \frac{1}{\cos \beta_u} \cdot \frac{M_u}{l_u}$$

$$\sum M_u = 0: M_u + D_u \cdot \cos \beta_u \cdot l_u + D_u \cdot \cos \beta_u \cdot l_u = 0$$

$$M_u - \frac{M_{u-1}}{l_{u-1}} \cdot l_u + D_u \cdot \cos \beta_u \cdot l_u = 0$$

$$D_u = \frac{1}{\cos \beta_u} \left(\frac{M_{u-1}}{l_{u-1}} - \frac{M_u}{l_u} \right)$$



$$\sum M_u = 0: M_u + D_u \cdot \cos \beta_u \cdot l_u = 0$$

$$D_u = - \frac{1}{\cos \beta_u} \cdot \frac{M_u}{l_u}$$

$$\sum M_{u-1} = 0: M_{u-1} - U_u \cdot \cos \beta_u \cdot l_{u-1} = 0$$

$$U_u = \frac{1}{\cos \beta_u} \cdot \frac{M_{u-1}}{l_{u-1}}$$

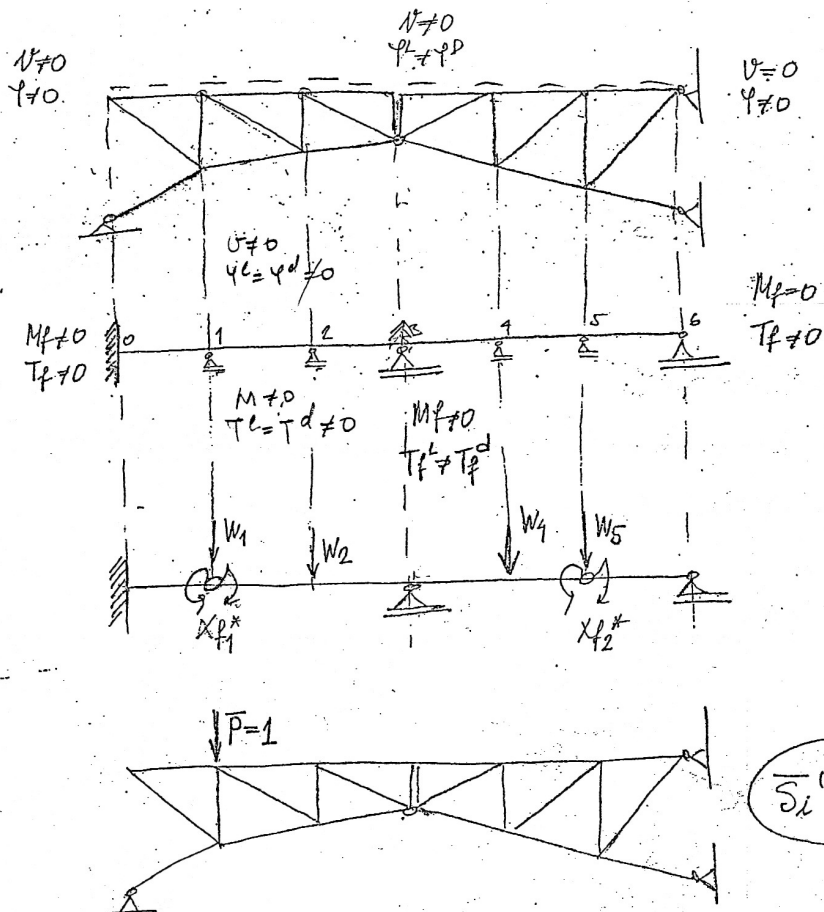
$$U_1 = \frac{1}{\cos \beta_1} \cdot \frac{M_{u0}}{l_{u0}}$$

$$= \frac{\sqrt{5} \cdot 2000}{2 \cdot 8}$$

$$\sum M_{u-1} = 0: M_{u-1} + D_u \cdot \cos \beta_u \cdot l_{u-1} + D_u \cdot \cos \beta_u \cdot l_{u-1} = 0$$

$$M_{u-1} - \frac{M_u}{l_u} \cdot l_{u-1} + D_u \cdot \cos \beta_u \cdot l_{u-1} = 0$$

$$D_u = \frac{1}{\cos \beta_u} \left(\frac{M_u}{l_u} - \frac{M_{u-1}}{l_{u-1}} \right)$$



$$\bar{S}_i^{(n)} = \frac{1}{300} S_i$$

$$X_{p1}^* = \sum S_i \bar{S}_i^{(1)} \cdot l_i$$

$$= \sum S_i \cdot \frac{1}{300} \cdot S_i \cdot l_i$$

$$= \frac{1}{300} \sum S_i^2 \cdot l_i$$

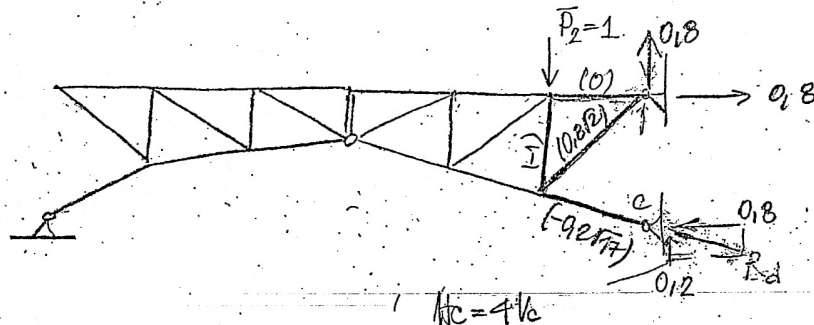
$$= \frac{1}{300} \left[4(400^2 + 600^2) + \sqrt{20} \cdot 400^2 \cdot 5 + \frac{\sqrt{65}}{2} (100^2 + 100^2) \cdot 65 \right.$$

$$\left. + \sqrt{17} (100^2 + 50^2 + 20^2) \cdot 17 + 3(300^2 + 200^2) + 4 \cdot 150^2 + \right.$$

$$\left. + \sqrt{20} \cdot 200^2 \cdot 5 + 5 \cdot 250^2 + \sqrt{32} \cdot 120^2 \cdot 2 \right]$$

$$= 145507.139732$$

$$\lambda_{f2}^* = ?$$

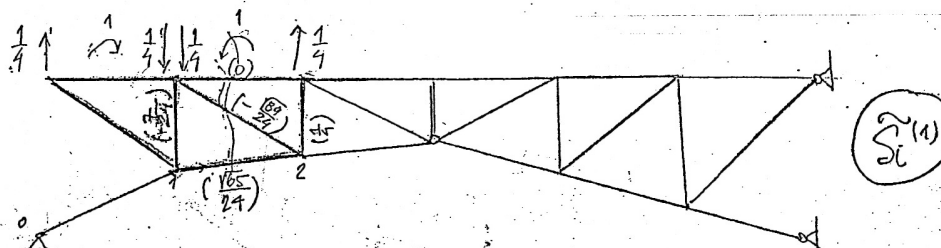


$$X_{f_2}^* = \sum \bar{s}_i \cdot \bar{s}_i^{(2)} \cdot d_i$$

$$= 4 \cdot 150 \cdot (-1) + 4 \sqrt{2} \cdot 0,8 \cdot (-20) \cdot 2 + 177 \cdot (-0,2) \cdot (-20) \cdot 17$$

$$= -1405,7448$$

$$[W_1^*]$$



$$u_2 \cdot \frac{8}{165} \cdot 3 = 1$$

$$D_2 \cdot \frac{8}{189} \cdot 3 = -1$$

$$\bar{z} V(1)$$

$$u_2 = \frac{\sqrt{65}}{29}$$

$$D_2 = -\frac{\sqrt{89}}{29}$$

↓ $\frac{1}{2}$

$$v_1 + \frac{1}{2} + \left(-\frac{\sqrt{89}}{24}\right) \cdot \frac{5}{\sqrt{89}} = 0$$

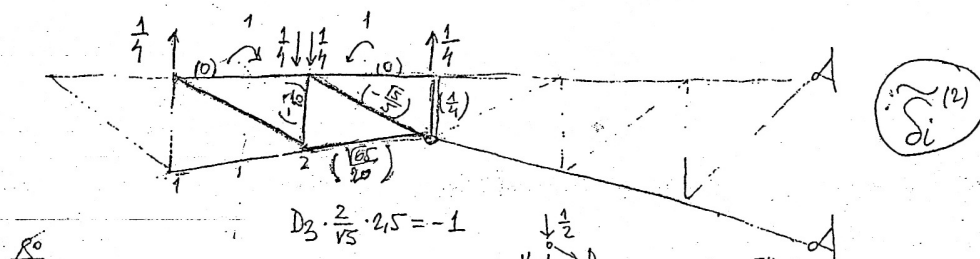
$$v_1 = -\frac{7}{24}$$

$$W_1^* = \sum \delta_i \cdot \tilde{\zeta}_i^{(1)} \cdot l_i$$

$$= 3 \cdot \left(-\frac{7}{24}\right) \cdot (-300) + \frac{\sqrt{65}}{2} \cdot \frac{\sqrt{65}}{24} \cdot (-100\sqrt{65})$$

$$= -829,2641$$

$$[W_2^*]$$



$$D_3 \cdot \frac{2}{\sqrt{5}} \cdot 2,5 = -1$$

$\downarrow \frac{1}{2}$
 $V_2 \downarrow \quad \rightarrow D_3$

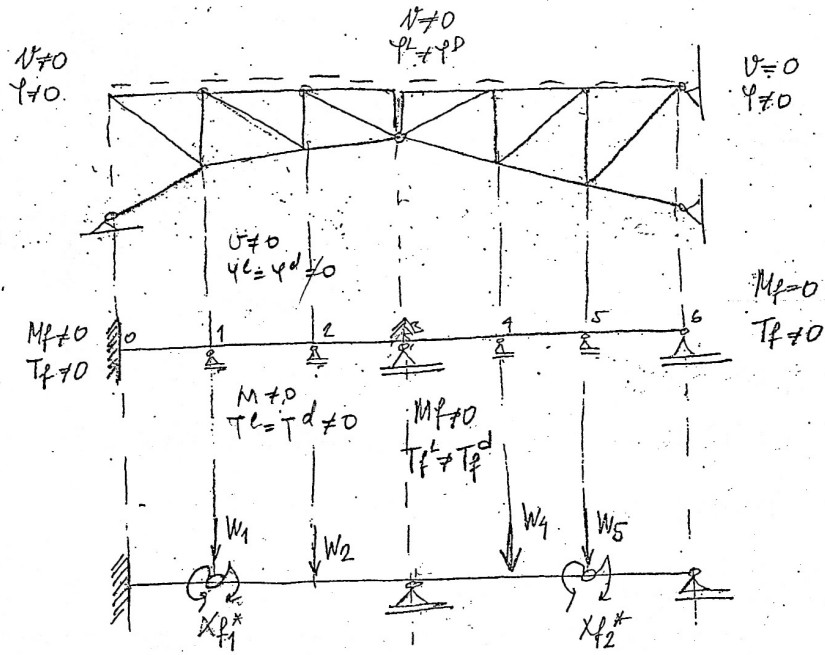
$$V_2 + \frac{1}{2} \left(-\frac{\sqrt{2}}{5} \right) \frac{1}{\sqrt{2}} = 0$$

$$V_2 = -\frac{3}{10}$$

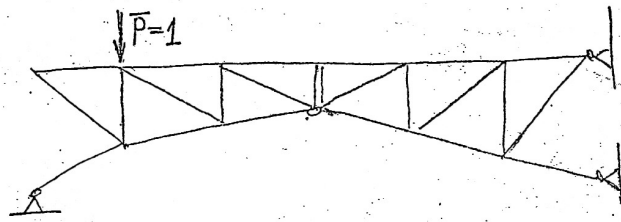
$$W_2^* = \sum \delta_i \tilde{\delta}_i^{(2)} \ell_i$$

$$= \frac{\sqrt{65}}{21} \cdot \frac{\sqrt{65}}{20} \cdot (-100 \cdot \sqrt{65})$$

$$= -1310,169$$



$n=2$

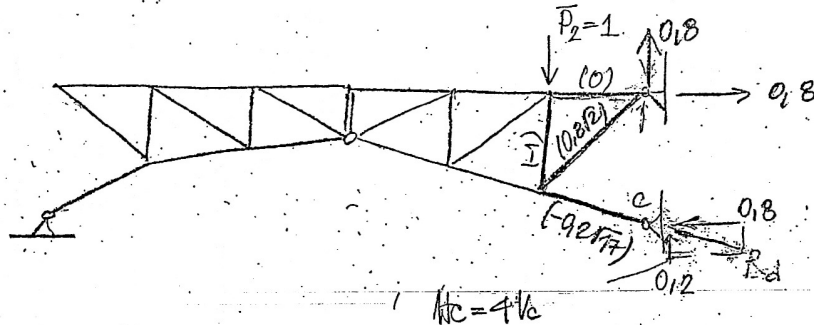


$$\bar{S}_i^{(1)} = \frac{1}{300} S_i$$

$$\begin{aligned} X_{f1}^* &= \sum S_i \bar{S}_i^{(1)} \cdot l_i \\ &= \sum S_i \cdot \frac{1}{300} \cdot S_i \cdot l_i \\ &= \frac{1}{300} \sum S_i^2 \cdot l_i \\ &= \frac{1}{300} \left[4(400^2 + 600^2) + \sqrt{20} \cdot 400^2 \cdot 5 + \frac{\sqrt{65}}{2} (100^2 + 700^2) \cdot 65 \right. \\ &\quad \left. + 17(100^2 + 50^2 + 20^2) \cdot 17 + 3(300^2 + 200^2) + 4 \cdot 150^2 + \right. \\ &\quad \left. + \sqrt{20} \cdot 200^2 \cdot 5 + 5 \cdot 250^2 + \sqrt{32} \cdot 120^2 \cdot 2 \right] \\ &= 145507.3932 \end{aligned}$$

$$\lambda_{f2}^* = ?$$

$$\tilde{S}_i^{(2)}$$

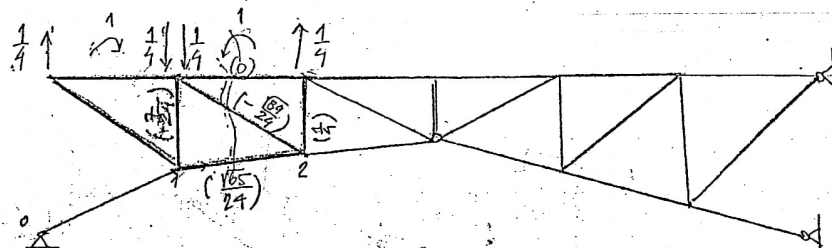


$$\lambda_{f2}^* = \sum S_i \tilde{S}_i^{(2)} \cdot l_i$$

$$= 4 \cdot 150 \cdot (-1) + 4 \sqrt{2} \cdot 0.8 \cdot (-120) \cdot 2 + 177 \cdot (-0.2) \cdot (-20) \cdot 17$$

$$= -1405.7448$$

$$W_1^*$$



$$\tilde{S}_i^{(1)}$$

$$u_2 \cdot \frac{8}{\sqrt{65}} \cdot 3 = 1$$

$$D_2 \cdot \frac{8}{\sqrt{65}} \cdot 3 = -1$$

$$\sum V_i = 0$$

$$V_1 + \frac{1}{2} = 0$$

$$V_1 = -\frac{1}{2}$$

$$V_1 + \frac{1}{2} + (-\frac{1}{24}) \cdot \frac{5}{\sqrt{65}} = 0$$

$$V_1 = -\frac{7}{24}$$

$$u_2 = \frac{\sqrt{65}}{24}$$

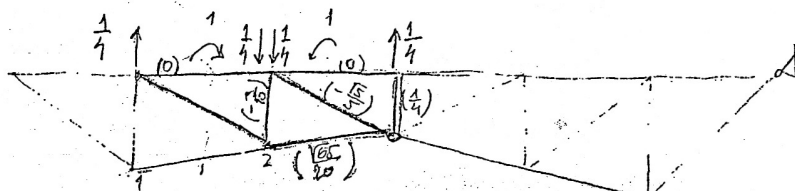
$$D_2 = -\frac{\sqrt{89}}{24}$$

$$W_1^* = \sum S_i \tilde{S}_i^{(1)} \cdot l_i$$

$$= 3 \cdot (-\frac{7}{24}) \cdot (-300) + \frac{\sqrt{65}}{2} \cdot \frac{\sqrt{65}}{24} \cdot (-100 \sqrt{65})$$

$$= -829.2641$$

$$W_2^*$$



$$\tilde{S}_i^{(2)}$$

$$D_3 \cdot \frac{2}{\sqrt{5}} \cdot 2.5 = -1$$

$$V_2 + \frac{1}{2} = 0$$

$$V_2 + \frac{1}{2} + (-\frac{1}{5}) \cdot \frac{1}{\sqrt{5}} = 0$$

$$V_2 = -\frac{3}{10}$$

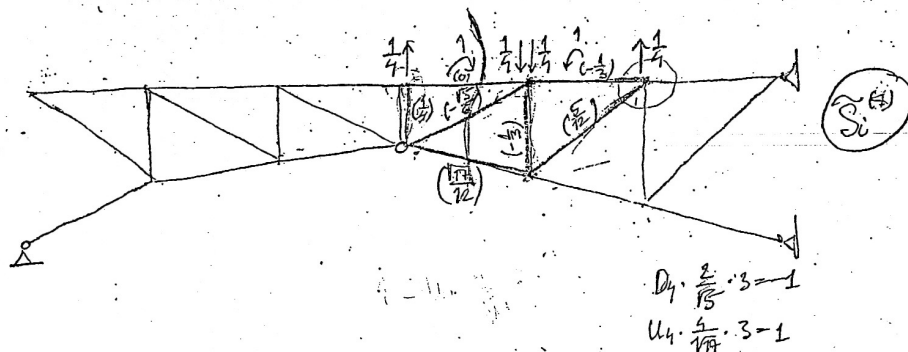
$$W_2^* = \sum S_i \tilde{S}_i^{(2)} \cdot l_i$$

$$= \frac{\sqrt{65}}{2} \cdot \frac{\sqrt{65}}{20} \cdot (-100 \sqrt{65})$$

$$= -1310.169$$

$$W_3^*$$

$$D_5 \cdot \frac{3}{5} = \frac{1}{4}$$



$$D_4 \cdot \frac{2}{15} \cdot 3 = 1$$

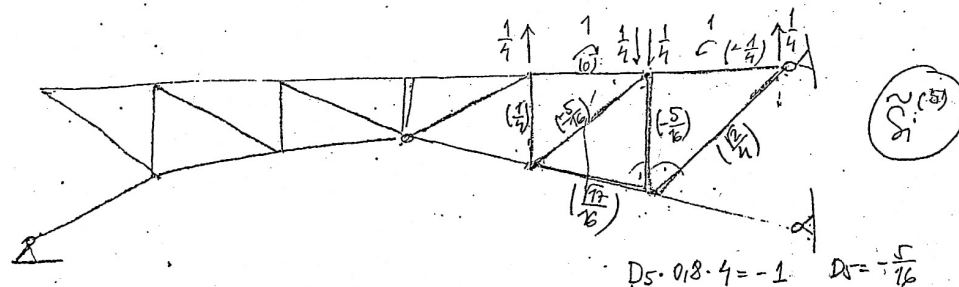
$$U_4 \cdot \frac{4}{14} \cdot 3 = 1$$

$$W_3^* = \sum S_i \hat{S}_i^{(4)} l_i$$

$$= 4 \cdot \left(\frac{1}{33} \cdot 400 \cdot \frac{17}{12} \right) + 3 \cdot \frac{1}{3} \cdot 200 + 120 \cdot \frac{15}{6} \cdot 200 - 15 \cdot \frac{5}{12} \cdot 250$$

$$= -26,2506$$

$$W_5^*$$

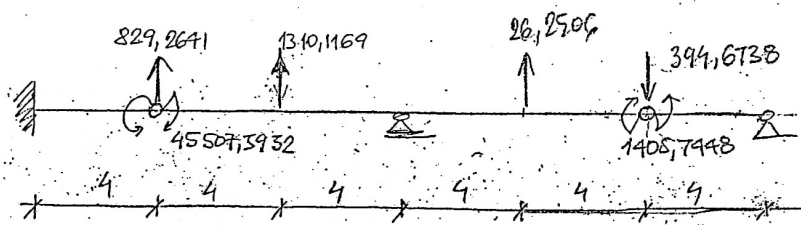


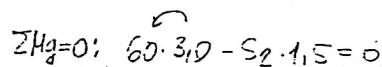
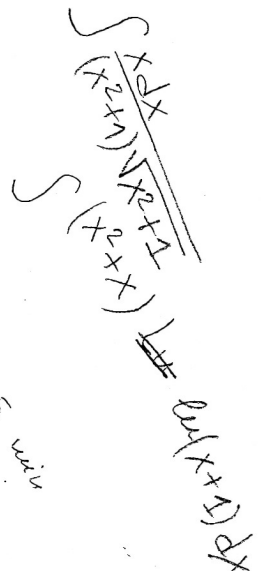
$$D_5 \cdot 0.8 \cdot 4 = -1 \quad D_5 = -\frac{5}{16}$$

$$W_5^* = \sum S_i \hat{S}_i^{(5)} l_i$$

$$= \frac{4 \cdot 600}{4} - 17 \cdot \frac{17 \cdot 50}{16} + 3 \cdot \frac{1}{4} \cdot 200 - 4 \cdot \frac{5}{16} \cdot 150 + 5 \cdot \frac{5}{16} \cdot 250 - 4 \cdot \frac{2}{4} \cdot 120$$

$$= 394,6738$$





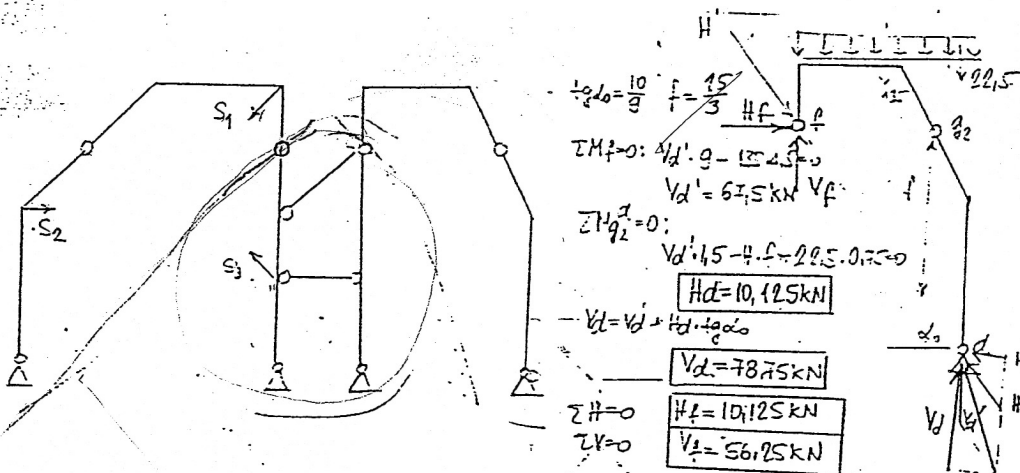
$$S_2 = 120 \text{ kN}$$

$$\underline{\Sigma M_1 = 0: S_2 \cdot 3 - 60 \cdot 4.5 - S_3 \cdot \frac{1}{\sqrt{2}} \cdot 3 = 0}$$

$$S_3 = 30\sqrt{2} \text{ kN}$$

$$\sum \ddot{v}_i = 0: -s_2 + s_3 \frac{1}{\sqrt{2}} + s_4 \cdot \frac{1}{\sqrt{2}} = 0$$

$$S_1 = 90\sqrt{2} \text{ kN}$$



$\frac{1}{\sigma} \Delta = \frac{\partial}{\partial}$

$$TM_f^2 = 0: 4\frac{1}{2}$$

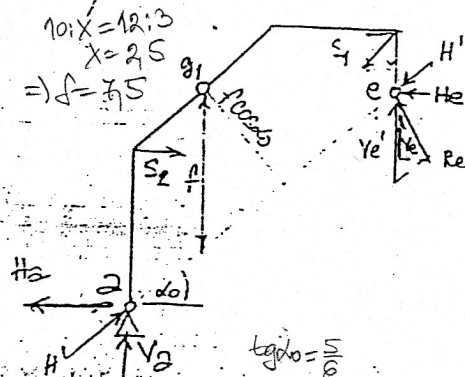
$$\sum_{i=1}^n a_i^2 = 0:$$

Y

$$v_1 = v_2 + 1$$

$$\sum \ddot{H} = 0$$

21-5



$$\frac{1}{8}d\phi = \frac{10}{12} = \frac{5}{6}$$

$$\frac{P}{I} = 10 - 3 \cdot \frac{1}{3} d_0 = 7.5 \text{ m}$$

$$\sum M_B = 0: Y_e \cdot 12 + S_1 (13 \cdot \cos \alpha - 12 \cdot \cos \alpha) - S_2 \cdot 7 = 0$$

$$Y_e' = 62,5 \text{ kN}$$

$$\sum M_1 = 0: Y_e \cdot g \cdot \frac{H}{4} \cdot \frac{1}{2} \cos \alpha_0 + Y_1 (3 \cos \alpha_0 - g \cdot \sin \alpha_0) = 0$$

$$H_e = 3 \text{ kN}$$

$$V_e = V_e' - \text{Hetzgdo} \Rightarrow V_e = 60 \text{ km/h}$$

$$\sum V = 0: V_a + V_e - S_1 \cdot \cos \alpha = 0 \quad \boxed{V_a = 30 \text{ kN}}$$

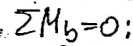
$$\sum H = 0: -H_E + S_2 - S_1 \cos \alpha - H_D = 0 \quad H_E = 27 \text{ kN}$$

$$S_{\text{uud}} = \frac{10}{\sqrt{10^2 + 12^2}} = 0.640$$

$$\cos \theta_{AB} = \frac{3}{3\sqrt{2}} = \frac{1}{\sqrt{2}}$$

$$\frac{1}{\frac{1}{\cos \beta}} = \frac{3}{4} \Rightarrow \cos \beta = 0.8$$

$$\sin \beta = 0.6$$



$$V_c = 38,4375 \text{ kN}$$

$$2H=0: 3-10,125-H_6+H_2=0$$

$$H_c = H_b + 7125 \dots (1)$$

$$60.4 + 3 \cdot 6 - 77.8125 \cdot 4 \div 116.4 = 0$$

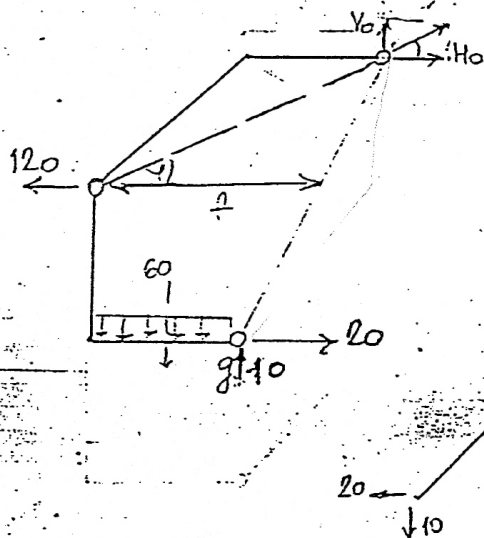
$$H_0 = 13,3125 \text{ kN}$$

$$2H=0 \rightarrow H_e = 20,4375 \text{ kN}$$

$$\sum V^D = 0: V_3 - 60 + 54 \cdot 0,6 = 0$$

$$\underline{S_1 = -29,6875 \text{ kN}}$$

$$\sum H = 0: S_4 \cdot 0,8 + 3 + S_5 \cdot 1 = 0 \rightarrow S_5 = -34,0625 \text{ kN}$$

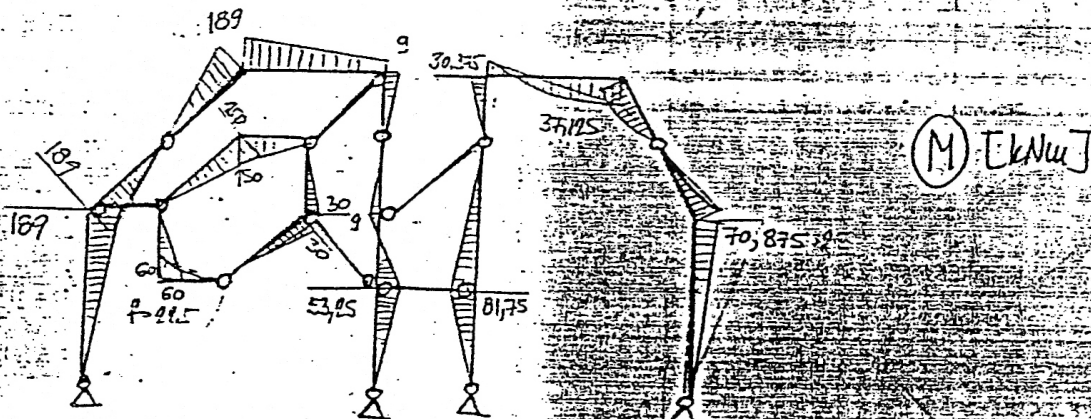


$$\tan \varphi = \frac{3}{6} = \frac{1}{2} = \frac{V_0}{H_0} \Rightarrow H_0 = 2V_0$$

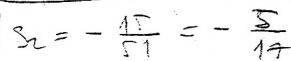
$$\Sigma M_g = 0: 120 \cdot 3 + 60 \cdot 1,5 - 110 \cdot 6 + 10 \cdot 3 = 0$$

$$-450 = 12V_0 + 3V_2 = 0$$

$$V_0 = 50 \text{ kN} \quad H_0 = 100 \text{ kN}$$



✓



$$I_c = I$$

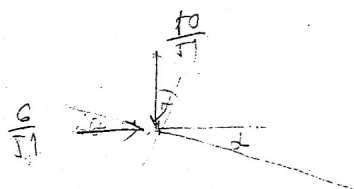
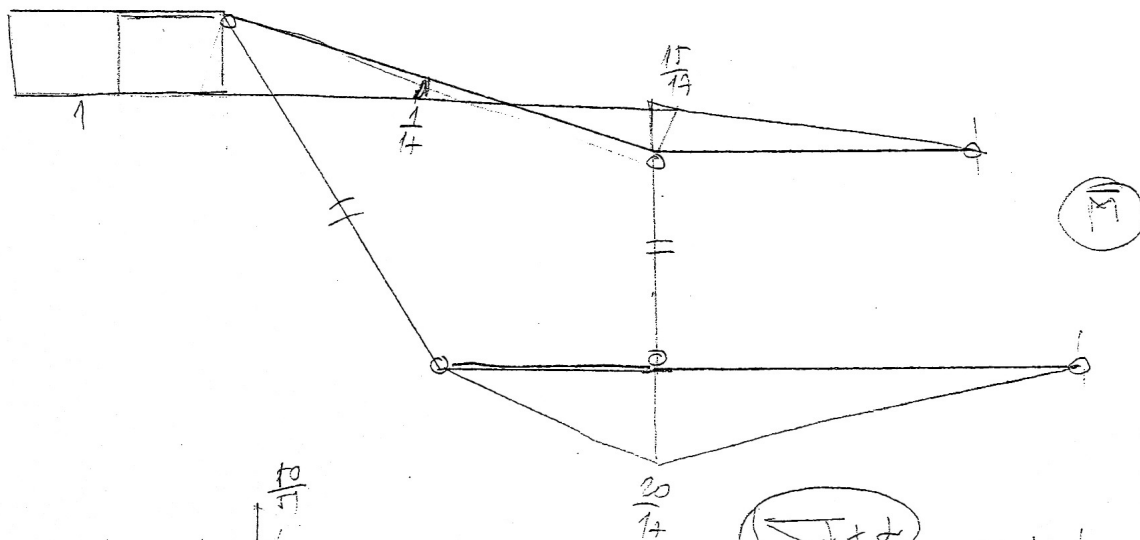
$$I = \frac{1}{12} \cdot 0,4 \cdot 1^3 = \frac{4}{10 \cdot 10^3} = \frac{1}{30} \text{ m}^4$$

$$F = 0,4 \cdot 1 = 0,4 \text{ m}^2$$

$$F_0 = 0,4^2 = 0,16 \text{ m}^2$$

$$\frac{I_c}{F_c} = \frac{\frac{1}{30}}{0,4} = \frac{1}{12} \text{ m}^2$$

$$\frac{I_c}{F_0} = \frac{1}{30 \cdot 0,16} = \frac{1}{4,8} \text{ m}^2$$

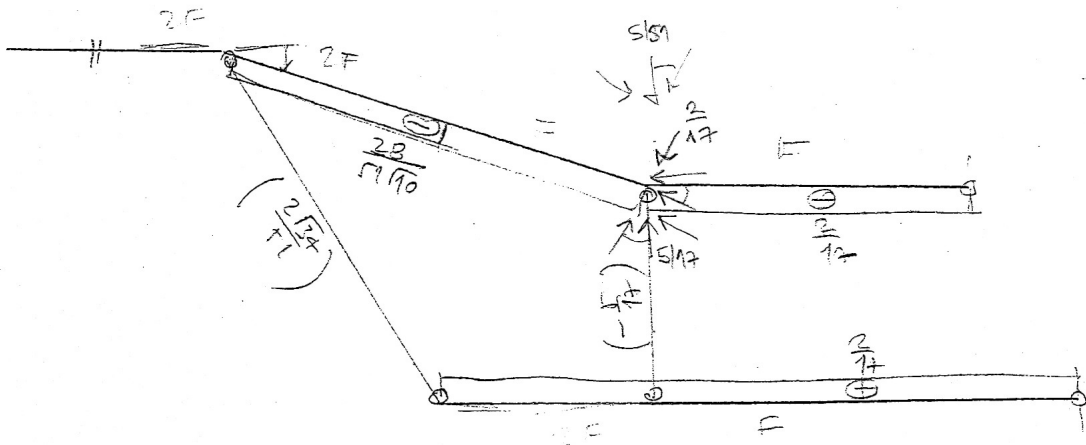


$\tan \alpha = \frac{4}{12} = \frac{1}{3}$

$\sin \alpha = \frac{1}{\sqrt{10}}$
 $\cos \alpha = \frac{3}{\sqrt{10}}$

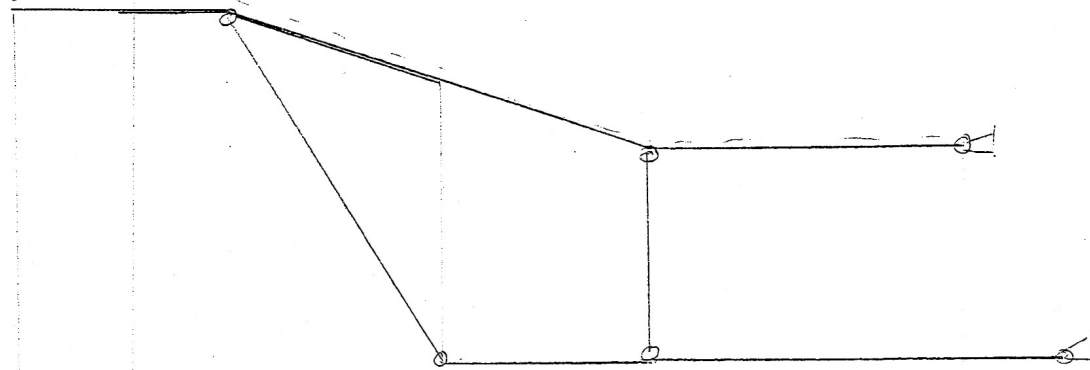
$\frac{5}{\sqrt{14}} \cdot 12$

$N_L = -\frac{6}{51} \cdot \frac{3}{\sqrt{10}} - \frac{10}{51} \cdot \frac{1}{\sqrt{10}} = -\frac{28}{51\sqrt{10}}$



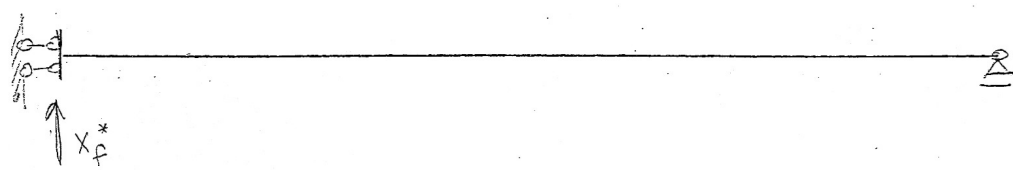
$2.3.3.3 \oplus$

$\cos \alpha = \frac{3}{\sqrt{10}}$
 $\sin \alpha = \frac{1}{\sqrt{10}}$
 $\tan \alpha = \frac{1}{3}$



$$h=1$$

$$\begin{aligned} k &= 2 \\ z_0 &= 3 \\ z_u &= 1 \\ z_s &= 1 \\ z_c &= 0 \\ \hline 5 - 4 &= 1 \end{aligned}$$



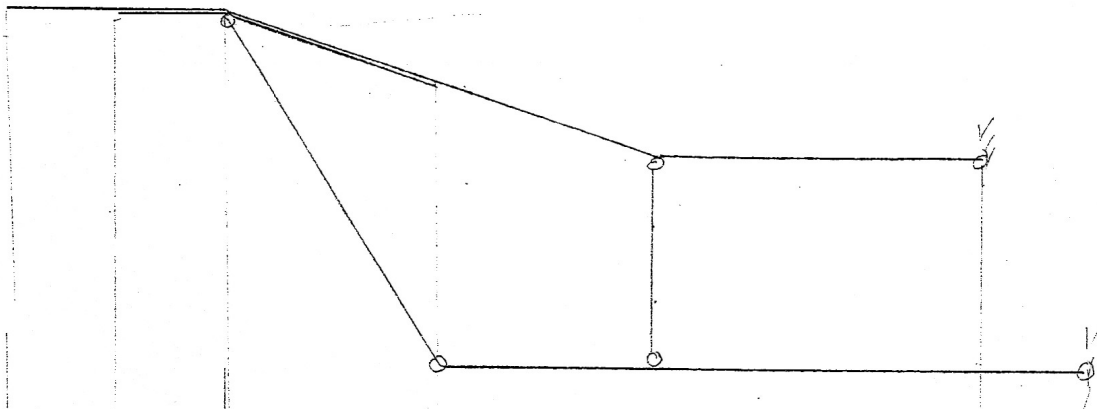
$$U_f^* = \int \left(\frac{I_c}{I} M^2 + \frac{I_c}{F} N^2 \right) ds \quad ?$$

$$\begin{aligned} &= 3 \cdot 1^2 + \frac{1}{2} \cdot 3 \cdot 1^2 + \frac{1}{2} \cdot \frac{40}{3} \cdot \left(1^2 + 1 \cdot \frac{1}{17} + \frac{1}{17^2} \right) + \frac{40}{3} \cdot \left(\frac{1}{17^2} - \frac{1 \cdot 17}{17^2} + \frac{17^2}{17^2} \right) \\ &+ \frac{9}{3} \cdot \left(\frac{17}{17} \right)^2 + \frac{1}{2} \cdot \frac{6}{3} \cdot \left(\frac{20}{17} \right)^2 + \frac{12}{3} \cdot \left(\frac{20}{17} \right)^2 \\ &+ \frac{1}{12} \cdot \left[\frac{1}{2} \cdot 170 \cdot \left(\frac{28}{17 \cdot 170} \right)^2 + 170 \cdot \left(\frac{28}{17 \cdot 170} \right)^2 + 9 \cdot \left(\frac{2}{17} \right)^2 + \frac{1}{2} \cdot 6 \cdot \left(\frac{2}{17} \right)^2 + 12 \cdot \left(\frac{2}{17} \right)^2 \right] \\ &+ \frac{1}{4.8} \left[\sqrt{136} \cdot \left(\frac{2\sqrt{136}}{51} \right)^2 + 8 \cdot \left(\frac{5}{17} \right)^2 \right] \end{aligned}$$

$$= 16,701673$$

$$P_F^+ = \frac{I_c}{I} \cdot \frac{M}{\cos \alpha}$$

$$m_F^+ = \frac{I_c}{F} \cdot N \tan \alpha + \frac{k E I_c}{G F} \cdot T = \frac{I_c}{F_c} \cdot \frac{F_c}{F}$$



$$\alpha = 0$$

$$P_F^+ = M$$

$$m_F^+ = 0$$

$$\alpha = 0$$

$$P_F^+ = \frac{1}{2} M$$

$$m_F^+ = 0$$

$$\tan \alpha = \frac{1}{3}$$

$$\cos \alpha = \frac{3}{\sqrt{10}}$$

$$P_F^+ = \frac{1}{2} \cdot \frac{\sqrt{10}}{3} \cdot M$$

$$m_F^+ = \frac{1}{12} \cdot \frac{1}{3} \cdot N$$

$$P_F^+ = \frac{\sqrt{10}}{3} \cdot M$$

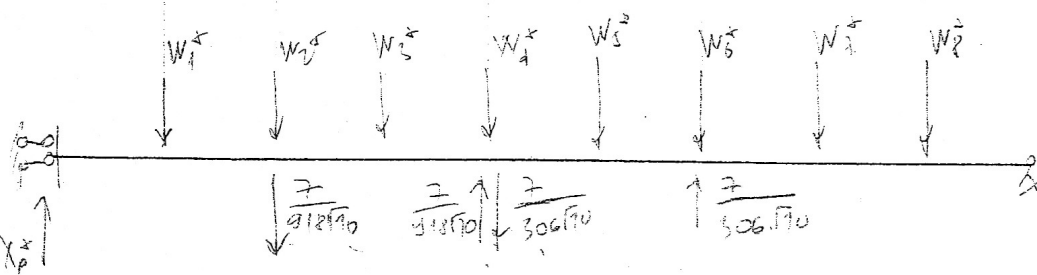
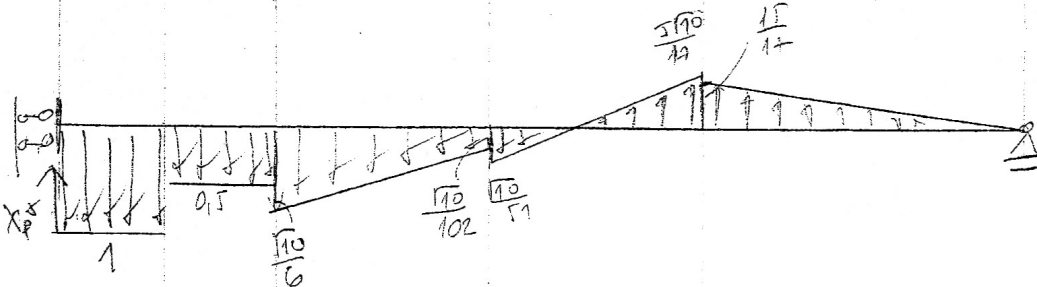
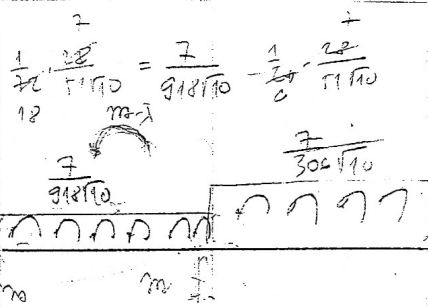
$$m_F^+ = \frac{1}{12} \cdot \frac{1}{3} \cdot N$$

$$\alpha = 0$$

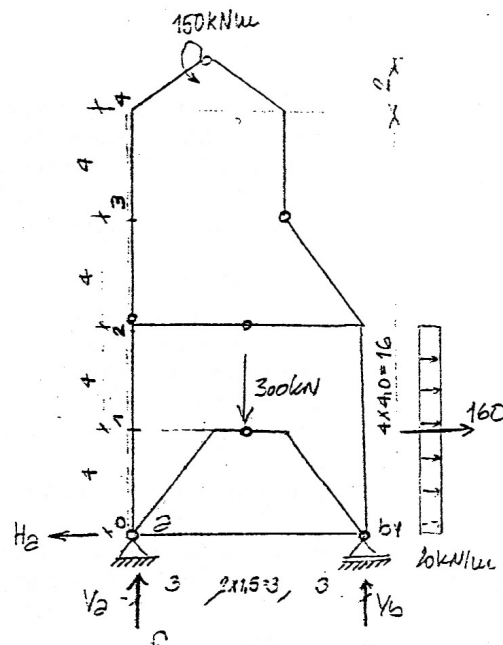
$$P_F^+ = M$$

$$m_F^+ = 0$$

$$m_F^+ \oplus$$



29.06.2002.



ZA NOSAČ NA GLAVI, UVEDI ZADATOG
OPTEREĆENJA, SKLADNOSTI DIZAJNIRAN
HORIZONTALNOG POMERANJA
POTEZA STAPOVA 0-1-2-3-4
ZA ORDINATAMA NA SVAKA 4M.

GEOMETRIJSKE KARAKTERISTIKE
STAPOVA:

0-1: $b/h = 0,5/1,2m = 0,042$

1-2: $b/h = 0,5/1,0m$

2-3: $b/h = 0,5/0,8m$

3-4: $b/h = 0,5/0,6m$

ZATEGA $b/h = 0,5/0,5m$

MATERIJAL: $E = 3 \cdot 10^7 \text{ kN/m}^2$

ZANEMARITI UTICAJ N I T NA
NA DEFORMACIJU PUNOG NOSAČA.

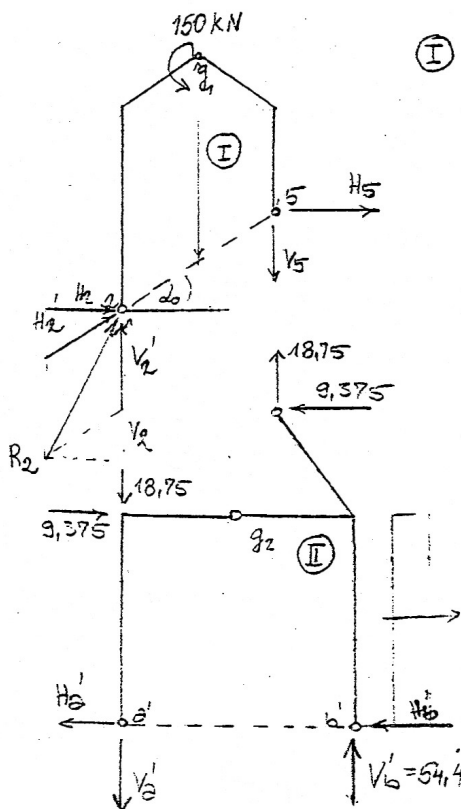
$$\sum M_a = 0: 150 \cdot 6 - 160 \cdot 4 + V_b \cdot 6 - 300 \cdot 4,5 = 0$$

$$V_b = 204,4 \text{ kN}$$

$$\sum V = 0: -300 + V_a + V_b = 0$$

$$V_a = 95,5 \text{ kN}$$

$$\sum H = 0: H_a = 160 \text{ kN}$$



$$\textcircled{I} \quad \tan \alpha_0 = \frac{4}{6} = \frac{2}{3} \quad f = 6 + 3 \cdot \tan \alpha_0 = 8m$$

$$\sum M_5 = 0: 150 - V_2' \cdot 6 = 0 \quad V_2' = 25 \text{ kN}$$

$$\sum M_{g_1} = 0: 150 - V_2' \cdot 3 + H_2' \cdot f \cos \alpha_0 = 0$$

$$150 - 3 \cdot 25 + H_2' \cdot \frac{8}{3} = 0$$

$$H_2 = -9,375 \text{ kN}$$

$$V_2 = V_2' + H_2 \cdot \tan \alpha_0 = 25 - 9,375 \cdot \frac{2}{3} \Rightarrow V_2 = 18,75 \text{ kN}$$

$$\sum V = 0: V_5 = 18,75 \text{ kN}$$

$$\sum H = 0: H_5 = 9,375 \text{ kN}$$

$$\textcircled{II} \quad \sum M_b' = 0:$$

$$160 - V_3' \cdot 9 + 9,375 \cdot 8 - 18,75 \cdot 9 + 18,75 \cdot 3 - 9,375 \cdot 12 + 160 = 0$$

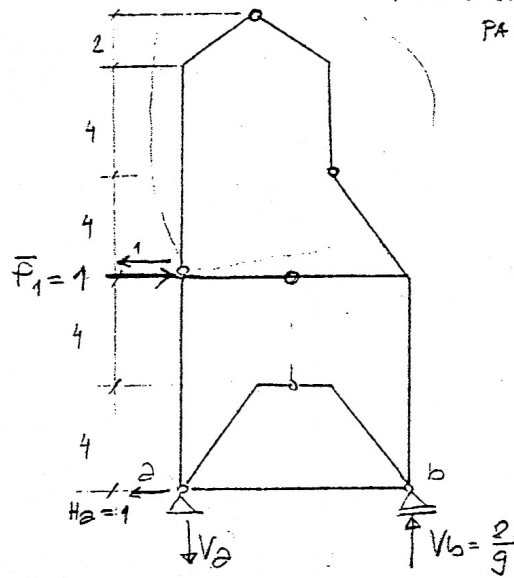
$$V_3' = 54,4$$

$$\sum M_{g_2} = 0: -V_3' \cdot 4,5 - 18,75 \cdot 4,5 + H_3' \cdot 8 = 0$$

$$H_3 = 41,171875$$

$$\sum H = 0: H_b' = 118,828125$$

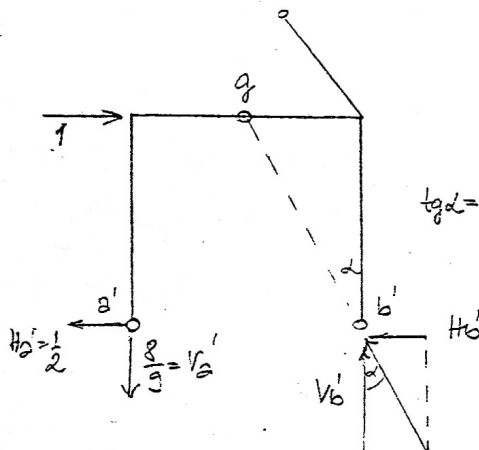
NEOPTEREČENO,
PA NE PRENOSIMO REAKCIJE



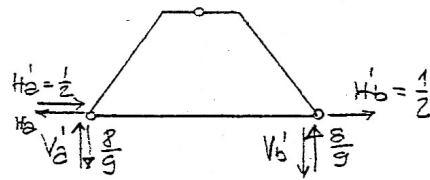
$$\sum M_b = 0$$

$$V_2 \cdot 9 - 1 \cdot 8 = 0$$

$$V_2 = \frac{8}{9}$$



$$\tan \alpha = \frac{4.5}{8} = \frac{9}{16}$$



$$\tan \alpha = \frac{9}{16} = \frac{H_b'}{V_b'}$$

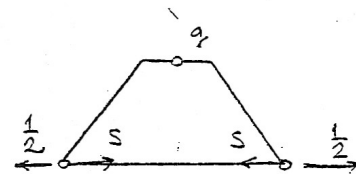
$$H_b' = \frac{9}{16} V_b'$$

$$\sum M_a = 0: 1 \cdot 8 - V_b' \cdot 9 = 0$$

$$V_b' = \frac{8}{9} \Rightarrow H_b' = \frac{1}{2}$$

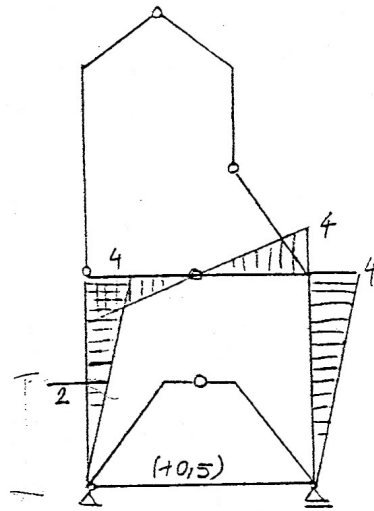
$$\sum H = 0: H_2' = \frac{1}{2}$$

$$\sum V = 0: V_2' = \frac{8}{9}$$



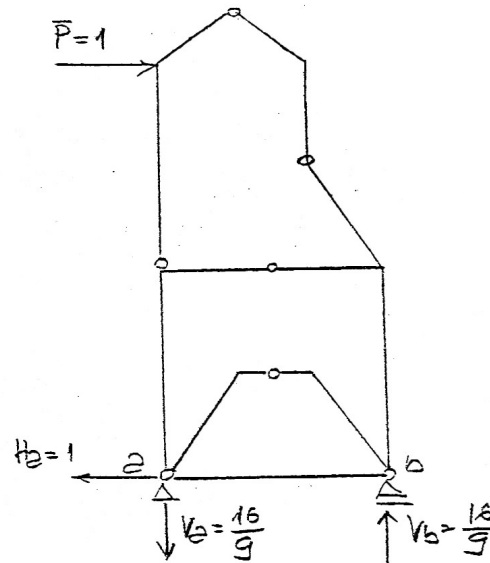
$$\sum M_g^L = 0: \frac{1}{2} \cdot 4 - 5 \cdot 4 = 0$$

$$S = \frac{1}{2}$$



(M)

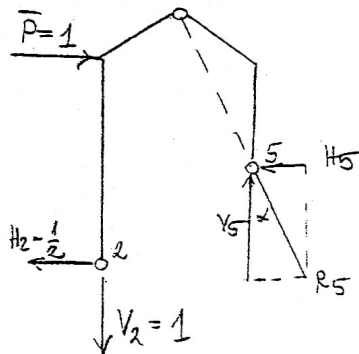
$$\begin{aligned}
 X_{f1}^* &= \frac{1}{2} \cdot 4 \cdot 164,6875 \cdot \frac{2}{3} \cdot 2 + 1,728 \cdot \frac{4}{6} (164,6875 (2 \cdot \frac{2}{2} + 4) + 329,375 (2 + 2 \cdot 4)) \\
 &+ 13,824 (\frac{1}{2} \cdot 4,8 \cdot 329,375 \cdot \frac{2}{3} \cdot 4 - 2 + \frac{1}{2} \cdot 8 \cdot 310,625 \cdot \frac{2}{3} \cdot 4 + \frac{2}{3} \cdot 160 \cdot 8 \cdot \frac{1}{2} \cdot 4) \\
 &+ 0,8 \cdot 9 \cdot 287,578125 \cdot 0,5 = \underline{\underline{130822,4479}}
 \end{aligned}$$



$$\sum M_2 = 0; V_b \cdot 9 - 1 \cdot 16 = 0$$

$$V_b = \frac{16}{9}$$

$$V_2 = \frac{16}{9}$$

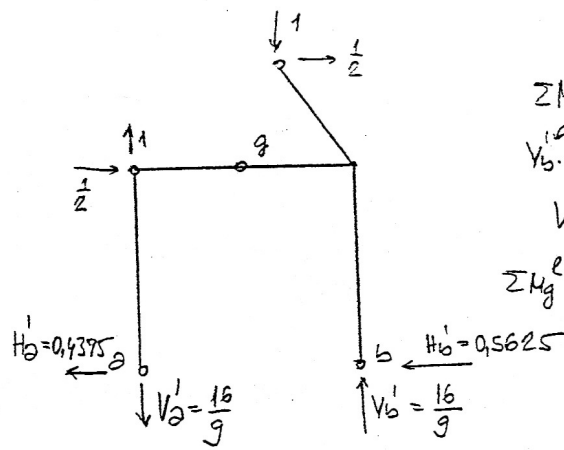


$$\tan \alpha = \frac{3}{6} = \frac{1}{2} = \frac{H_5}{V_5} \Rightarrow V_5 = 2H_5$$

$$\sum M_2 = 0; H_5 \cdot 4 + V_5 \cdot 6 - 1 \cdot 8 = 0$$

$$4H_5 + 12H_5 = 8$$

$$H_5 = \frac{1}{2}, V_5 = 1$$



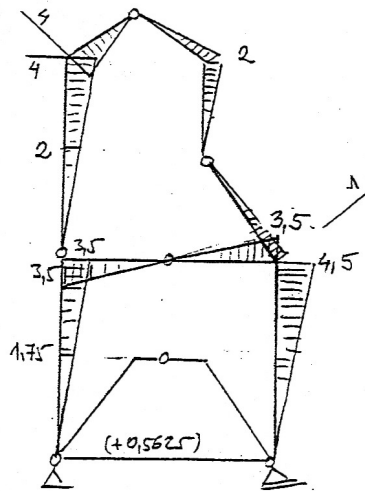
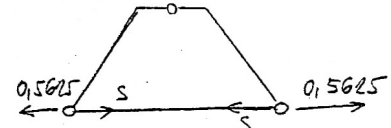
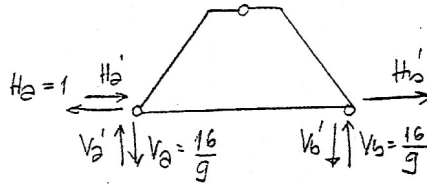
$$\sum M_2 = 0:$$

$$V_6 \cdot 9 - 1 \cdot 6 - \frac{1}{2} \cdot 12 - \frac{1}{2} \cdot 8 = 0$$

$$V_6 = \frac{16}{9}$$

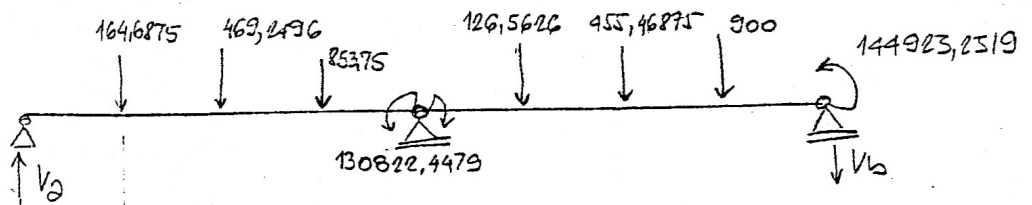
$$\sum M_9 = 0: 1 \cdot 4.5 + H_2 \cdot 8 - \frac{16}{9} \cdot 4.5 = 0$$

$$H_2 = 0.4375$$



(M₂)

$$\begin{aligned} X_{f2}^* &= \frac{1}{2} \cdot 4 \cdot 1.75 \cdot \frac{2}{3} \cdot 164.6275 + 1.728 \cdot \frac{4}{6} (164.6275 (2 \cdot 1.75 + 3.5) + 329.375 (1.75 + 2 \cdot 3.5)) \\ &+ 3.375 \cdot \frac{1}{2} \cdot 4 \cdot 2 \cdot \frac{2}{3} \cdot 37.5 + 8 \cdot \frac{4}{6} \cdot (37.5 (2 \cdot 2 + 4) + 75 (2 + 2 \cdot 4)) \\ &+ 13.824 \left(\frac{16}{6} \cdot 4 (2 \cdot 75 + 150) - \frac{1}{2} \cdot 173 \cdot 2 \cdot \frac{2}{3} \cdot 37.5 - \frac{1}{2} \cdot 4 \cdot 2 \cdot \frac{2}{3} \cdot 37.5 - \right. \\ &\quad \left. - \frac{1}{2} \cdot 5 \cdot 1 \cdot \frac{2}{3} \cdot 18.75 + 2 \cdot \frac{1}{2} \cdot 4.5 \cdot 3.5 \cdot \frac{2}{3} \cdot 329.375 + \frac{1}{2} \cdot 8 \cdot 4.5 \cdot \frac{2}{3} \cdot 30.62 \right. \\ &\quad \left. + \frac{2}{3} \cdot 160 \cdot 2 \cdot \frac{1}{2} \cdot 4.5 \right) + 0.8 \cdot 9 \cdot 0.5625 \cdot 287.578125 = 144923.2319 \end{aligned}$$

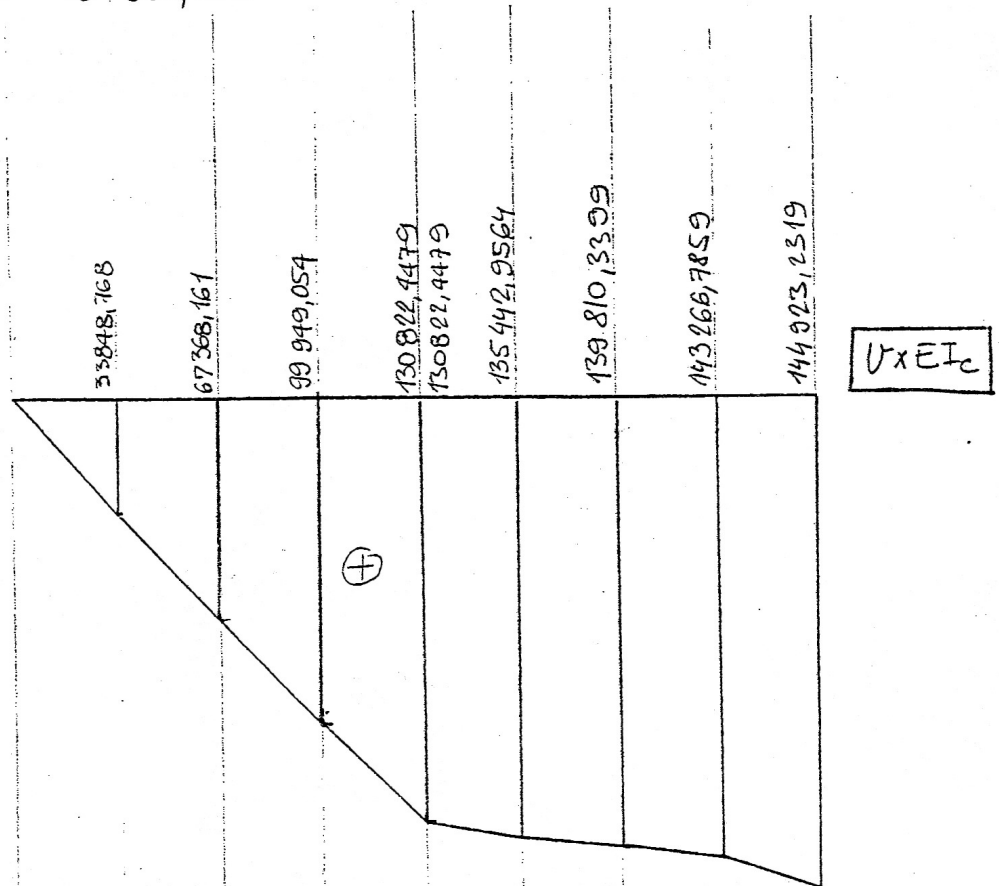


$$\sum M_g^l = 0: V_a \cdot 8 - 164,6875 \cdot 6 - 469,2496 \cdot 4 - 853,75 \cdot 2 - 130822,4479 = 0$$

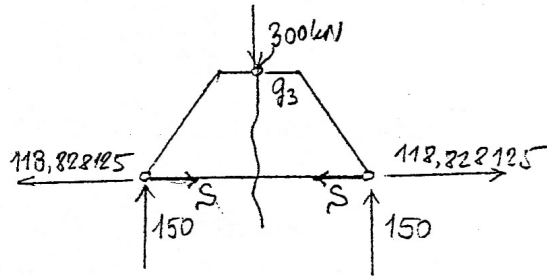
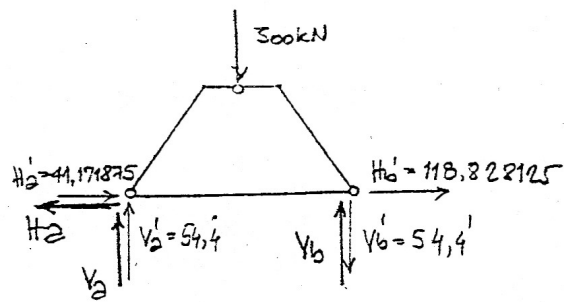
$$V_a = 16924,5839$$

$$\sum M_g^d = 0: V_b \cdot 8 + 130822,4479 + 126,5626 \cdot 2 + 455,46875 \cdot 4 + 900 \cdot 6 - 144923,2319 = 0$$

$$V_b = 828,223$$

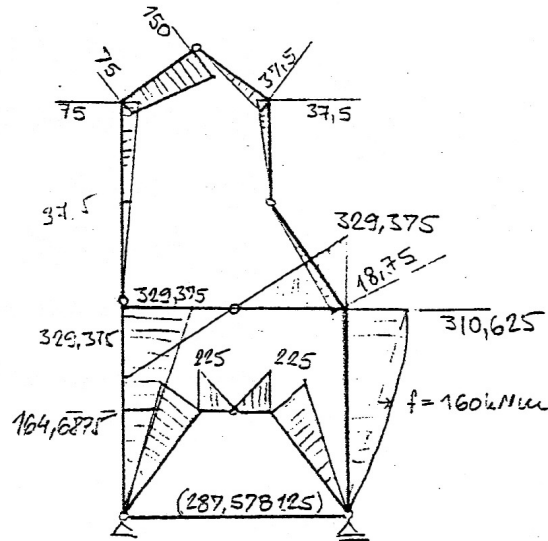


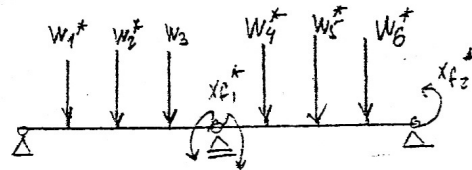
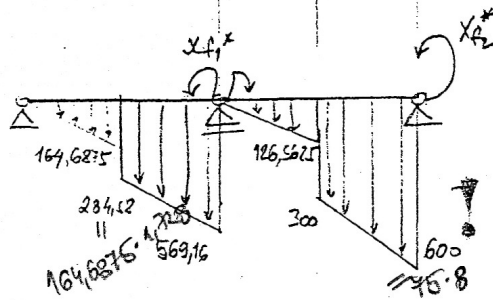
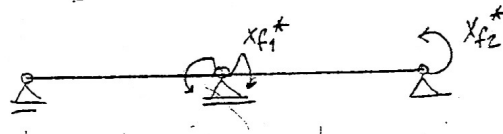
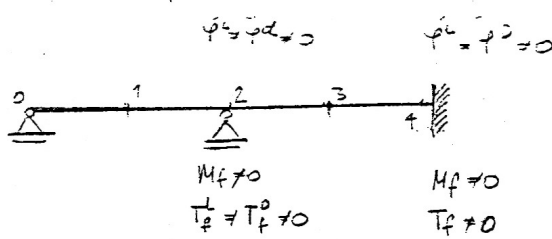
$V \times EI_c$



$$\sum M_{g_3} = 0: 150 \cdot 4,5 + 118,822125 \cdot 4 - S \cdot 4 = 0$$

$$S = 287,578125$$





$$I_c = I_{0-1} = \frac{1}{12} \cdot 8 \cdot 1,2^3 = 0,072 \text{ m}$$

$$\frac{I_c}{I_c} = 1$$

$$\frac{I_c}{I_{1-2}} = \frac{\frac{1}{12} \cdot 6 \cdot 1,2^3}{\frac{1}{12} \cdot 6 \cdot 0,8^3} = 1,728$$

$$\frac{I_c}{I_{2-3}} = \frac{\frac{1}{12} \cdot 6 \cdot 1,2^3}{\frac{1}{12} \cdot 6 \cdot 0,6^3} = 3,375$$

$$\frac{I_c}{I_{3-4}} = \frac{\frac{1}{12} \cdot 6 \cdot 1,2^3}{\frac{1}{12} \cdot 6 \cdot 0,6^3} = 8$$

$$\text{OSTALO: } \frac{I_c}{I} = \frac{\frac{1}{12} \cdot 6 \cdot 1,2^3}{\frac{1}{12} \cdot 6 \cdot 0,5^3} = 13,824$$

$$\text{ZATEGA: } \frac{I_c}{F} = \frac{\frac{1}{12} \cdot 0,5 \cdot 1,2^3}{0,3^2} = 0,8$$

$$W_1^* = \frac{2}{6} (0 + 4 \cdot 82,34375 + 126,5625) = 164,6875$$

$$W_2^* = \frac{2}{6} (82,34375 + 2 \cdot 164,6875 + 2 \cdot 284,52 + 4 \cdot 126,5625) = 469,2496$$

$$W_3^* = \frac{2}{6} (284,52 + 2(284,52 + 569,16) + 569,16) = 853,75$$

$$W_4^* = \frac{2}{6} (0 + 4 \cdot \frac{126,5625}{2} + 126,5625) = 126,5625$$

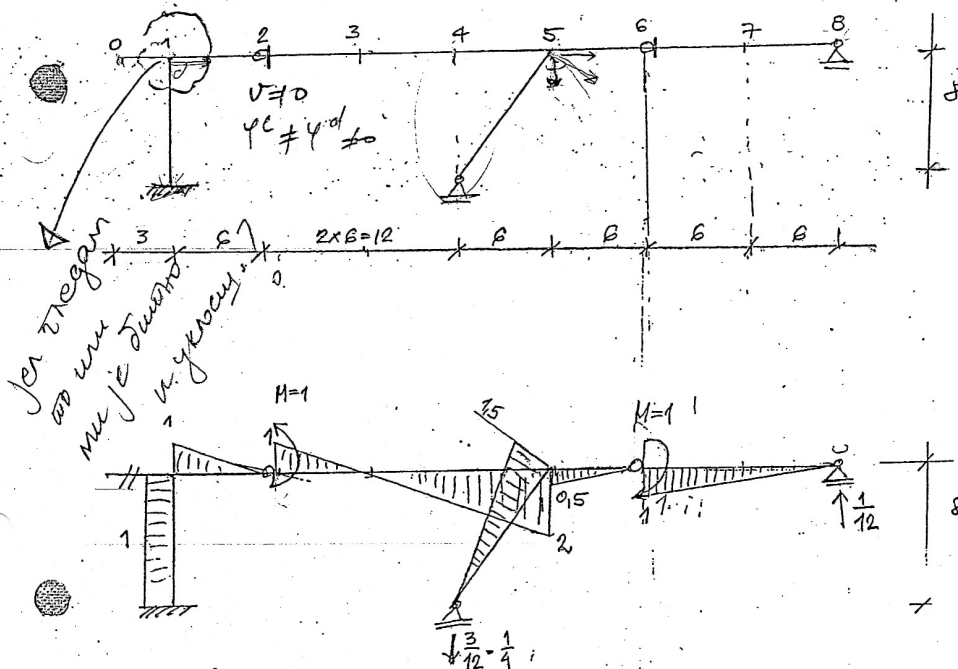
$$W_5^* = \frac{2}{6} (63,28125 + 2 \cdot 126,5625 + 2 \cdot 300 + 450) = 455,46875$$

$$W_6^* = \frac{2}{6} (300 + 4 \cdot 450 + 600) = 900$$

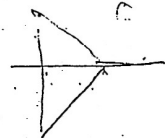
6.

Јер била је смер стрелица?
шта се дешава

* KONSTRUISATI UTICAJNU LINIJU ZA PROMENU UGLA IZMEĐU OZNAČENIH PRESEKA SA
ORDINATAMA U TAČKAMA 0, ..., 8 $EI = \text{const}$ $\frac{I}{F} = 0$

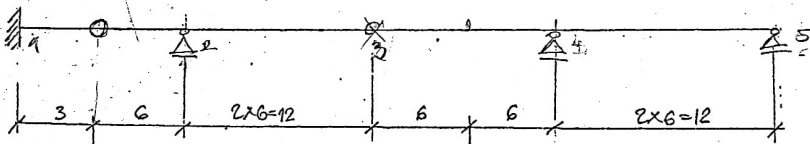


по мени некако
пом. $\frac{I}{F}$



$$\frac{1}{12} \cdot 36 - x \cdot 12 = 0$$

ФИКТИВНО НОСАЧЕ I ФИКТИВНО ОПТЕРЕЖЕЊЕ



$k=5$

$$z_0 = 5$$

$$z_1 = 1$$

$$z_2 = 4$$

$$z_k = 2$$

$$n=2$$

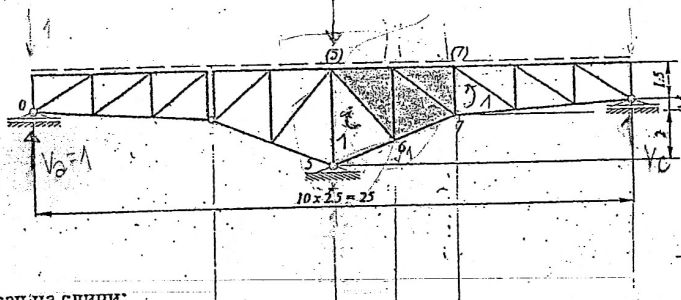
$$\Delta l \left(\frac{I}{F} \neq 0 \right)$$

→ ОД ОБРАТА

(НЕ ЗАВИСИ ОД $\frac{I}{F}$)
=) УКОГ ПОСТОЈИ

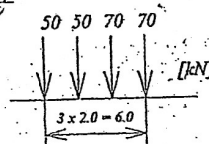
28.

10.



$$0.6 : 7.5 = x : 2.5$$

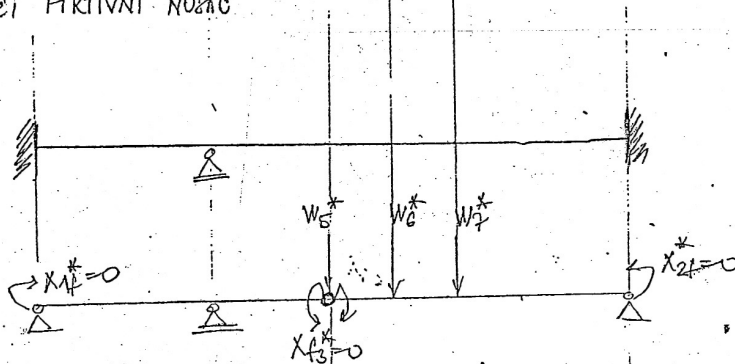
$$x = 0.16$$



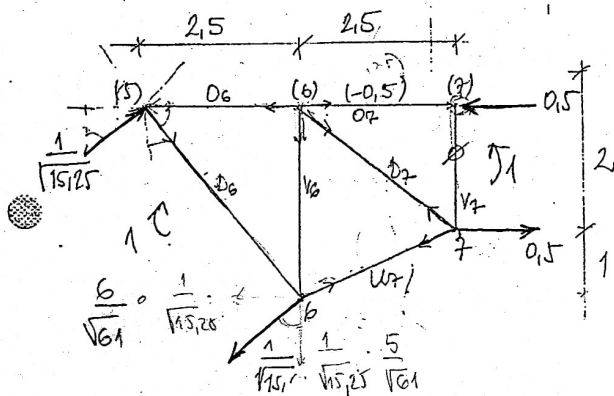
За носач на слици:

- Конструисати и нацртати утицају линију за разлику обртања штапова D_6 и V_7 ($EF = \text{const.}$).
- Сринути екстремне вредности сила у штаповима V_5 и D_7 услед везаног система концентрисаних сила, који се креће у задатом поретку.

ODGOVORJUEI FIKTIVNI NOSAČ



$$u=3$$



$$\sum M(6) = 0: 1 - u_7 \cdot \cos \alpha_7 \cdot 3 = 0$$

$$\tan \alpha_7 = \frac{1}{2.5}$$

$$\cos \alpha_7 = \frac{2.5}{\sqrt{7.25}}$$

$$u_7 = \frac{1}{\cos \alpha_7 \cdot 3}$$

$$u_7 = \frac{\sqrt{7.25}}{7.5}$$

$$\sum M_6 = 0: 1 + 0.7 \cdot 3 + D_7 \cdot \cos \beta_7 \cdot 3 = 0$$

$$\tan \beta_7 = \frac{2}{2.5}$$

$$\cos \beta_7 = \frac{2.5}{\sqrt{10.25}}$$

$$1 - 0.5 \cdot 3 + \frac{2.5}{\sqrt{10.25}} \cdot 3 \cdot D_7 = 0$$

$$\frac{7.5}{\sqrt{10.25}} \cdot D_7 = -0.5$$

$$D_7 = -\frac{\sqrt{10.25}}{15}$$

$$\sum H_6 = 0: 0.6 - 0.5 \cdot D_7 \cdot \cos \beta_7 = 0$$

$$0.6 = -0.5 + \frac{\sqrt{10.25}}{15} \cdot \frac{2.5}{\sqrt{10.25}} \cdot 3 \cdot D_7$$

$$0.6 = -\frac{1}{3}$$

$$\sum V_6 = 0 \Rightarrow V_6 = -D_7 \cdot \sin \beta_7$$

$$V_6 = -\frac{\sqrt{10.25}}{15} \cdot \frac{2}{\sqrt{10.25}} \cdot 3 \cdot D_7$$

$$V_6 = -\frac{2}{15}$$

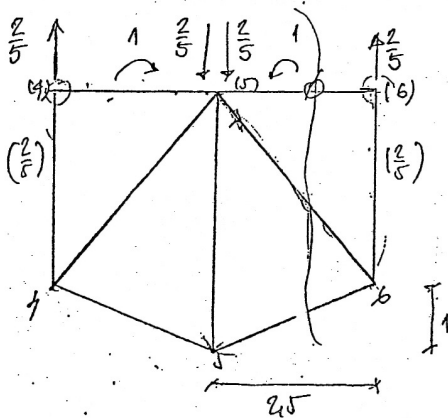
$$\tan \theta = \frac{3}{2.5} \Rightarrow \cos \theta = \frac{2.5}{\sqrt{15.25}}$$

$$\sum V_y = 0: D_6 \cdot \sin \theta = \frac{1}{\sqrt{15.25}} \cdot \cos \theta = 1 / \sin \theta$$

$$D_6 = \frac{1}{\sqrt{15.25}} \cdot \cot \theta = \frac{1}{\sqrt{15.25}} \cdot \frac{2.5}{3}$$

$$D_6 = \frac{2.5}{3\sqrt{15.25}}$$

064. / 27 07 505

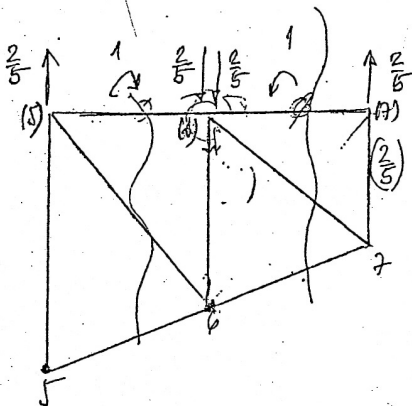


$$\sum M_5 = 0: 1 + D_6 \cdot \cos \theta \cdot 4 = 0$$

$$-1 \cdot \cos \theta D_6 = -1$$

$$D_6 = -\frac{1}{4 \cdot \frac{2.5}{\sqrt{15.25}}}$$

$$D_6 = -\frac{\sqrt{15.25}}{10}$$



$$\sum M_6 = 0: 1 + D_7 \cdot \cos \theta_7 \cdot 3 = 0$$

$$D_7 = -\frac{1}{3 \cos \theta_7} = 7$$

$$D_7 = -\frac{\sqrt{10.25}}{7.5}$$

$$\sum H_x = 0: D_7 \cdot \cos \theta_7 - O_6 = 0$$

$$O_6 = D_7 \cdot \cos \theta_7 = -\frac{\sqrt{10.25}}{7.5} \cdot \frac{2.5}{\sqrt{10.5}}$$

$$O_6 = -\frac{1}{3}$$

$$\sum V_y = 0: \frac{4}{5} + D_7 \cdot \sin \theta_7 + V_6 = 0$$

$$V_6 = -\frac{4}{5} - D_7 \cdot \frac{2}{\sqrt{10.25}}$$

$$= -\frac{4}{5} + \frac{\sqrt{10.25}}{7.5} \cdot \frac{2}{\sqrt{10.25}}$$

$$\sum M_5 = 0: 0 + O_6 \cdot 4 + D_6 \cdot \cos \theta_6 \cdot 4 = 0 / 4$$

$$D_6 = -\frac{O_6}{\cos \theta_6} = +\frac{1}{3 \cdot 2.5} \sqrt{15.25}$$

$$D_6 = +\frac{\sqrt{15.25}}{7.5}$$

$$V_6 = -\frac{8}{15}$$

11.

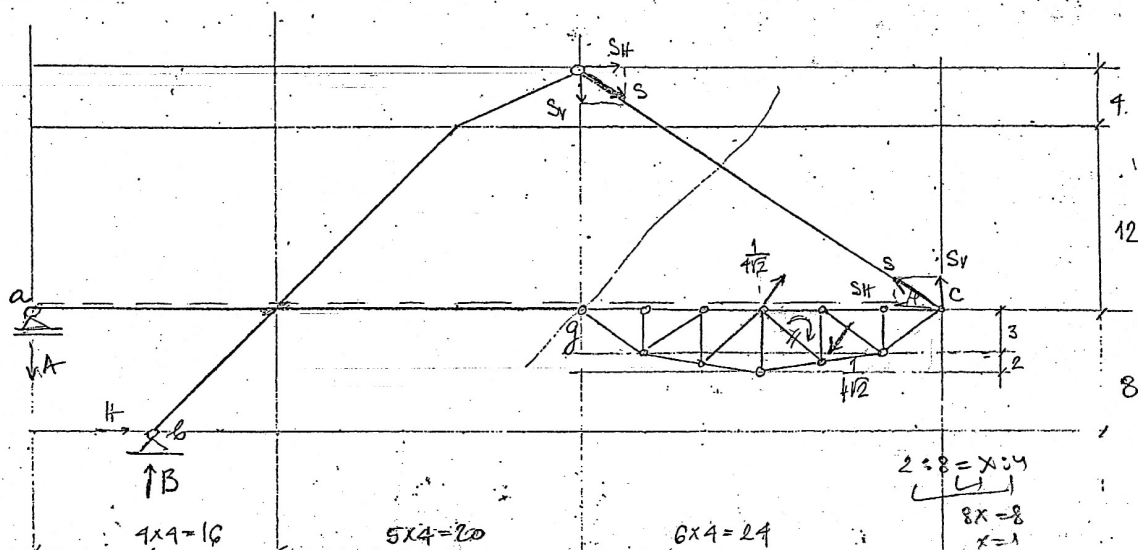
SRABUNATI I NACRTATI UTICAJNU LINIJU ZA OBRATANJE OZNAČENOG ŠTKPA RESETKASTE
PLOŠE g-c SA ORDINATAMA NA SVAKA 4m.

PUNI NOSAČ: $b/h = 0,4/1,0$

$E = 5 \cdot 10^7 \text{ kN/m}^2$

PROSTI ŠTAKOVI: $F_0 = 30 \text{ kN/m}^2$

$E_0 = 21 \cdot 10^7 \text{ kN/m}^2$



$$\sum M_g = 0: \quad 1 - S_v \cdot 24 = 0 \quad \boxed{S_v = \frac{1}{24}}$$

$$\tan \gamma = \frac{16}{24} = \frac{2}{3} = \frac{S_v}{S_H}$$

$$\Rightarrow S_H = \frac{3}{2} \cdot S_v = \frac{3}{2} \cdot \frac{1}{24} \quad \boxed{S_H = \frac{1}{16}}$$

$$\cos \gamma = \frac{3}{\sqrt{13}} \quad \boxed{S = \frac{\sqrt{13}}{72}}$$

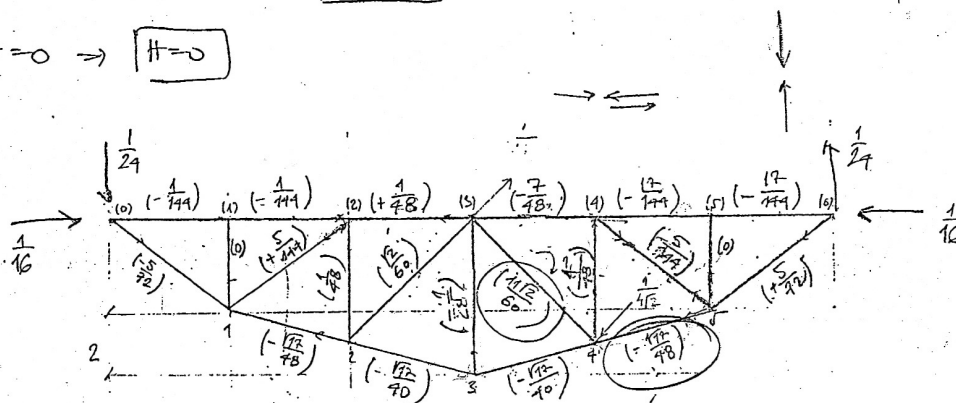
$$\sum M_b = 0: \quad 1 - A \cdot 8 = 0$$

$$\boxed{A = \frac{1}{8}}$$

$$\sum V = 0: \quad -A + B = 0$$

$$\boxed{B = \frac{1}{8}}$$

$$\sum H = 0 \Rightarrow \boxed{H = 0}$$



$$\sum M(1) = 0: \frac{1}{24} \cdot 4 + D_2 \cdot \cos \alpha_2 \cdot h_1 - U_2 \cdot \cos \alpha_2 \cdot h_1 = 0$$

$$h_1 = 3$$

$$\tan \alpha_2 = \frac{3}{4}, \quad \cos \alpha_2 = \frac{4}{5}$$

$$\frac{1}{24} \cdot 4 - D_2 \cdot \frac{4}{5} \cdot 3 - \left(1 - \frac{\sqrt{12}}{48}\right) \cdot \frac{4}{\sqrt{12}} \cdot 3 = 0$$

$$D_2 = \frac{5}{144}$$

$$\sum M(3) = 0: -1 + \frac{1}{24} \cdot 12 - U_3 \cdot \cos \alpha_3 \cdot h_3 = 0$$

$$\tan \alpha_3 = \frac{1}{5}, \quad \cos \alpha_3 = \frac{5}{\sqrt{26}}$$

$$-0.5 - U_3 \cdot \frac{4}{\sqrt{12}} \cdot 5 = 0$$

$$U_3 = -\frac{\sqrt{12}}{40}$$

$$\sum M(2) = 0: -\frac{1}{24} \cdot 8 + \frac{\sqrt{12}}{40} \cdot \frac{4}{\sqrt{12}} \cdot 4 - D_3 \cdot \cos \alpha_3 \cdot 4 = 0$$

$$\tan \alpha_3 = 1$$

$$D_3 = \frac{12}{60}$$

$$\sum M(4) = 0: 1 - \frac{1}{24} \cdot 16 - U_5 \cdot \cos \alpha_5 \cdot h_5 = 0$$

$$\sum M(5) = 0: \frac{1}{24} \cdot 4 - D_5 \cdot \cos \alpha_5 \cdot h_5 - U_5 \cdot \cos \alpha_5 \cdot h_5 = 0$$

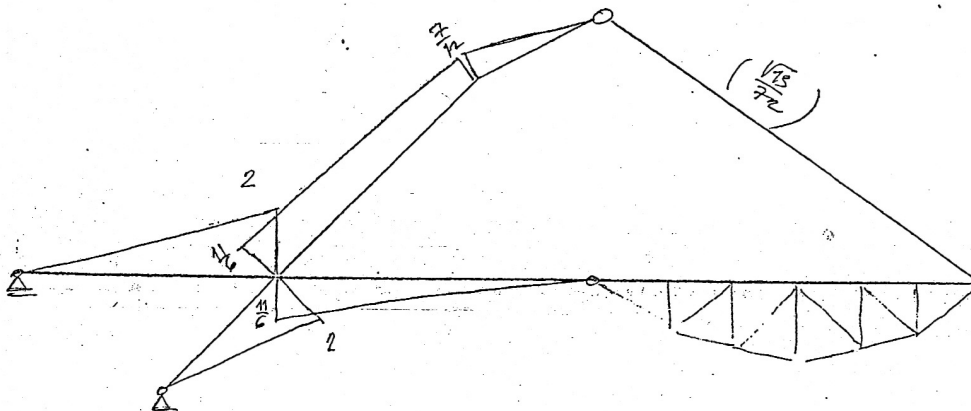
$$h_5 = 3$$

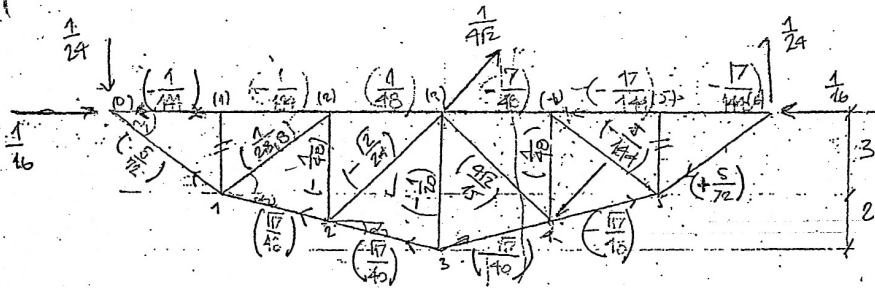
$$\frac{1}{6} - D_5 \cdot \frac{4}{5} \cdot 3 + \frac{\sqrt{12}}{48} \cdot \frac{4}{\sqrt{12}} \cdot 3 = 0$$

$$D_5 = \frac{25}{144}$$

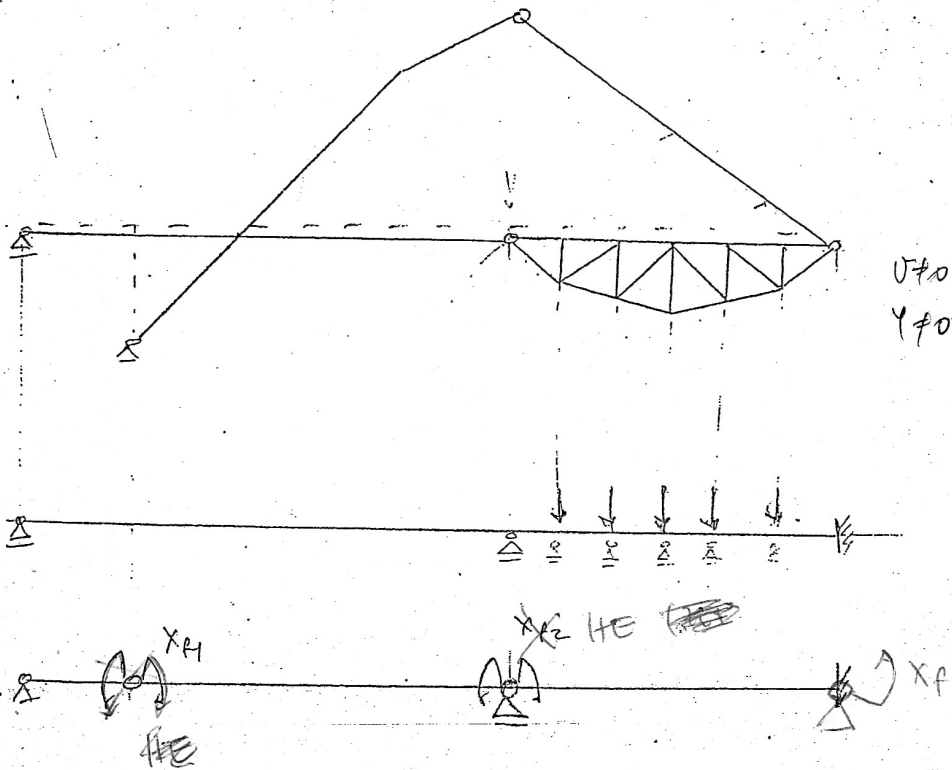
$$\sum M(4) = 0: \frac{1}{24} \cdot 8 + \frac{\sqrt{12}}{40} \cdot \frac{4}{\sqrt{12}} \cdot 4 - D_4 \cdot \frac{1}{12} \cdot 4 = 0$$

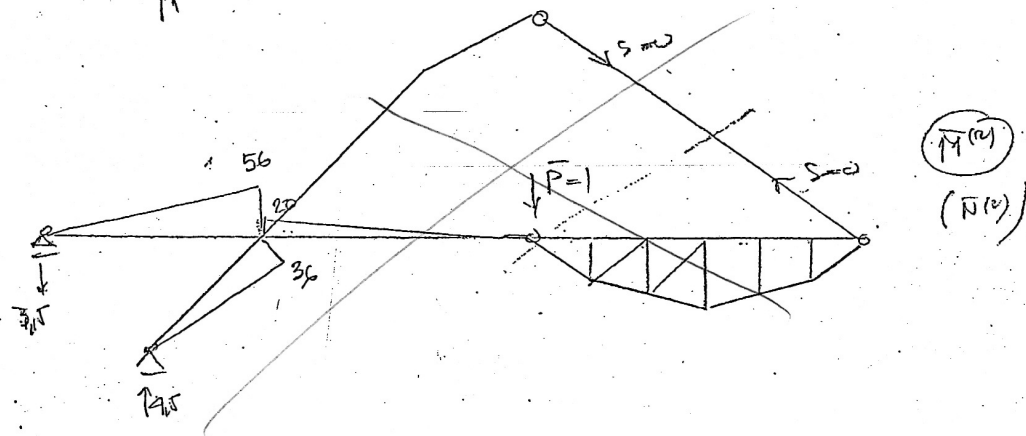
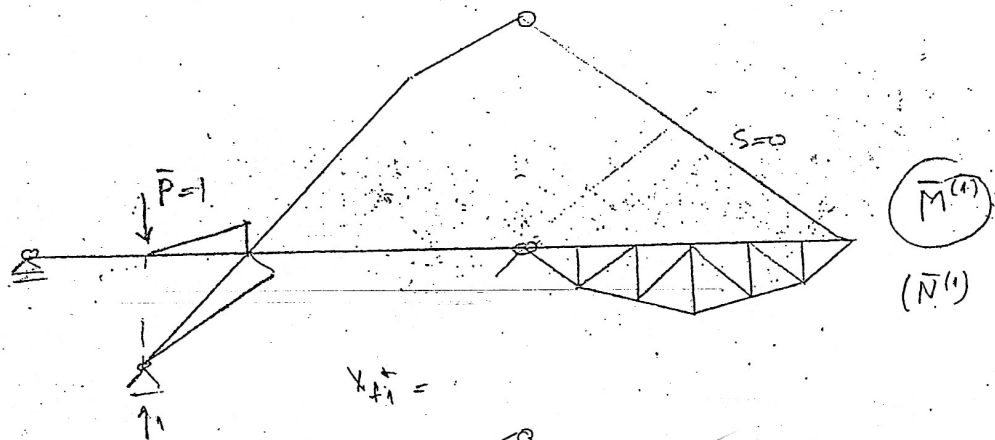
$$D_4 = \frac{11\sqrt{2}}{60}$$





$$\begin{aligned}
 \tan \alpha_1 &= \frac{3}{4} \rightarrow \cos \alpha_1 = 0.8 & h_1 &= 3 & \tan \alpha_2 &= \frac{3}{4} & \cos \alpha_2 &= 0.8 \\
 \tan \alpha_2 &= \frac{2}{8} = \frac{1}{4} \rightarrow \cos \alpha_2 = \frac{4}{\sqrt{17}} & h_2 &= 4 & \tan \alpha_3 &= 1 & \cos \alpha_3 &= \frac{1}{\sqrt{2}} \\
 \tan \alpha_3 &= \tan \alpha_2 = \frac{1}{4} & \cos \alpha_3 &= \frac{4}{\sqrt{17}} & h_3 &= 5 & \tan \alpha_4 &= 1 & \cos \alpha_4 &= \frac{1}{\sqrt{2}} \\
 \tan \alpha_4 &= \frac{1}{1} & \cos \alpha_4 &= \frac{1}{\sqrt{2}} & h_4 &= 4 & \tan \alpha_5 &= \frac{3}{4} & \cos \alpha_5 &= 0.8 \\
 \tan \alpha_5 &= \frac{1}{4} & \cos \alpha_5 &= \frac{4}{\sqrt{17}} & h_5 &= 3 & \tan \alpha_6 &= \frac{3}{4} & \cos \alpha_6 &= 0.8 \\
 \tan \alpha_6 &= \frac{3}{4} & \cos \alpha_6 &= 0.8 & h_6 &= 3 & \tan \alpha_7 &= \frac{3}{4} & \cos \alpha_7 &= 0.8
 \end{aligned}$$



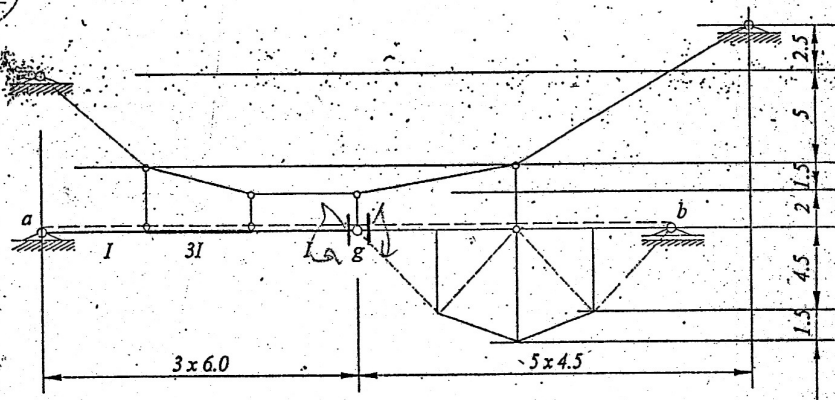


ОБАВЕЗНО
ПРИКАЖИ
 $M_{max} = M_{min} = 4 \gamma_{w}$

Писмени испит из Статике конструкција I

• Одржан: 31. јануара 2004.

Задатак II



Срачунати и нацртати утицајну линију за промену угла између пресека бесконачно блиско лево и десно од зглоба g са ординатама на свака $3m$ на делу $a-g$, а на свака $4.5m$ на делу $g-b$.

Греда:

Штапови ланца и вешалки:

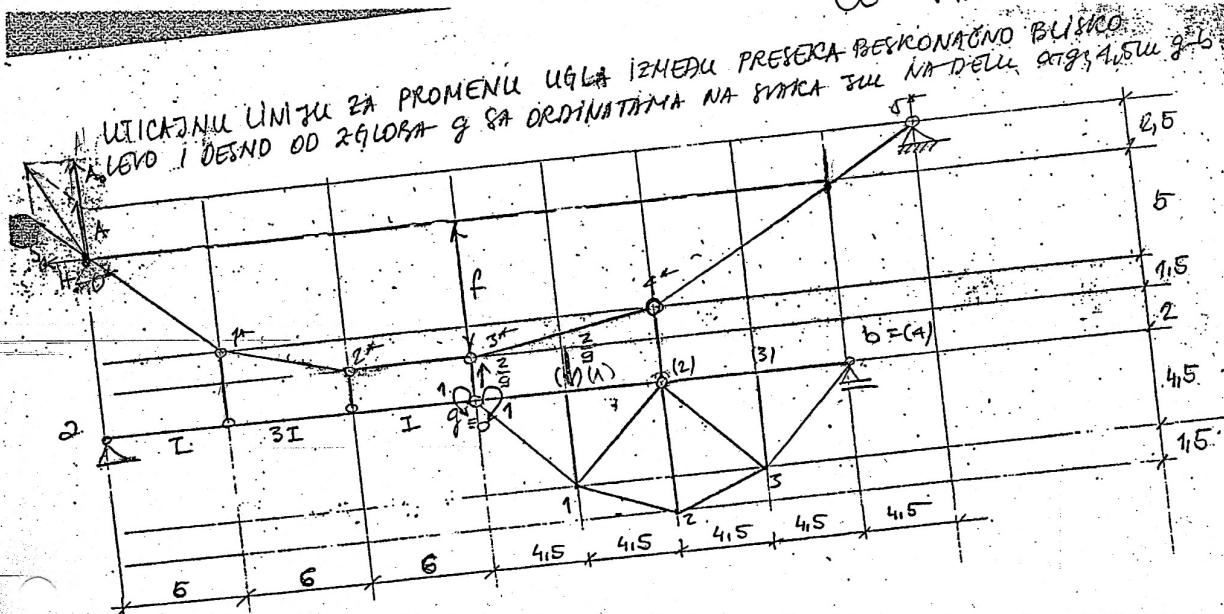
Штапови решетке:

$$E = 3 \cdot 10^7 \text{ kN/m}^2 \quad I = 10^{-3} \text{ m}^4 \quad I/F \sim 0 \quad I/G \sim 0$$

$$E = 3 \cdot 10^8 \text{ kN/m}^2 \quad F = 10^{-2} \text{ m}^2$$

$$E = 3 \cdot 10^8 \text{ kN/m}^2 \quad F = 0.5 \cdot 10^{-2} \text{ m}^2$$

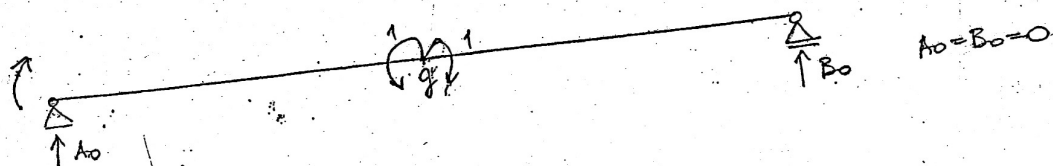
(ПИТАЊ ЗА А А₀ А') И ОДНОСТЕ САОПРА МН
 СЕ НИИ ОДЗОНМА ?



$$\text{tg } \alpha_0 = 0 \Rightarrow f = 6,5u = \frac{13}{2}$$

$$A_0 = A + A'$$

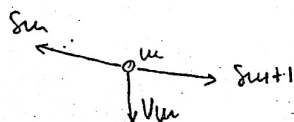
$$A = A_0 - A'$$



$$M_q = M_{q,0} - Hf = 0 \Rightarrow H = \frac{M_{q,0}}{f}$$

$$M_{q,0} = 1$$

$$H = -\frac{2}{13}$$



$$\sum H = 0: S_u \cos \alpha_u = S_{u+1} \cos \alpha_{u+1} = H$$

$$S_u = \frac{H}{\cos \alpha_u}$$

$$\sum V = 0: S_u \sin \alpha_u - S_{u+1} \sin \alpha_{u+1} - V_u = 0$$

$$V_u = H (\text{tg } \alpha_u - \text{tg } \alpha_{u+1})$$

$$\text{tg } \alpha_1 = \frac{5}{6}$$

$$\text{tg } \alpha_2 = \frac{1,5}{6} = \frac{1}{4}$$

$$\text{tg } \alpha_3 = 0$$

$$\text{tg } \alpha_4 = -\frac{1,5}{9} = -\frac{1}{6}$$

$$\text{tg } \alpha_5 = -\frac{7,5}{13,5} = -\frac{5}{9}$$

$$\cos \alpha_1 = \frac{6}{\sqrt{61}}$$

$$\cos \alpha_2 = \frac{4}{\sqrt{17}}$$

$$\cos \alpha_3 = 1$$

$$\cos \alpha_4 = \frac{6}{\sqrt{37}}$$

$$\cos \alpha_5 = \frac{9}{\sqrt{106}}$$

$$S_1 = -\frac{1}{39} \sqrt{61}$$

$$S_2 = -\frac{1}{26} \sqrt{17}$$

$$S_3 = -\frac{2}{13}$$

$$S_4 = -\frac{1}{39} \sqrt{37}$$

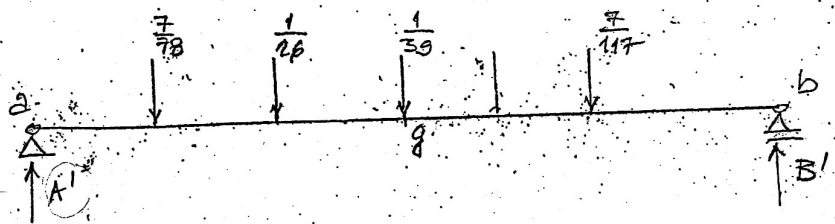
$$S_5 = -\frac{2}{117} \sqrt{106}$$

$$V_{q1} = -\frac{7}{78}$$

$$V_2 = -\frac{1}{26}$$

$$V_3 = -\frac{1}{39}$$

$$V_4 = -\frac{7}{117}$$



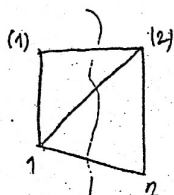
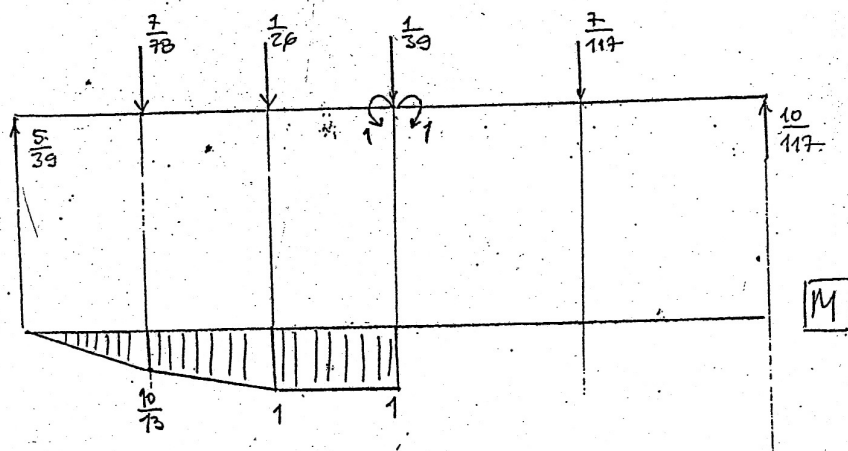
$$\sum M_a = 0: B' = \frac{10}{117}$$

$$\sum V = 0: A' = \frac{5}{39}$$

$$A = A_0 + A' = \frac{5}{39} \quad \checkmark$$

$$B = B_0 + B' = \frac{10}{117}$$

(11700000?)



$$\sum M_1 = 0:$$

$$M_1 + O_2 \cdot h_1 = 0$$

$$O_2 = -\frac{M_1}{h_1}$$

$$\sum M(2) = 0:$$

$$M(2) - U_2 \cdot h_2 \cdot \cos \alpha_2 = 0$$

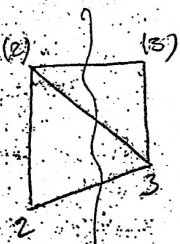
$$U_2 = \frac{1}{\cos \alpha_2} \cdot \frac{M(2)}{h_2}$$

$$\sum M_2 = 0:$$

$$M_2 + D_2 \cdot \cos \varphi_2 \cdot h_2 + O_2 \cdot h_2 = 0$$

$$D_2 = \frac{1}{\cos \varphi_2} \left(-\frac{M_2}{h_2} - O_2 \right)$$

$$D_2 = \frac{1}{\cos \varphi_2} \left(-\frac{M_2}{h_2} + \frac{M_1}{h_1} \right)$$



$$\sum M_3 = 0: M_3 + O_3 \cdot h_3 = 0$$

$$O_3 = -\frac{M_3}{h_3}$$

$$\sum M_{(2)} = 0: M_{(2)} - U_3 \cdot \cos \alpha_3 \cdot h_2 = 0$$

$$U_3 = \frac{1}{\cos \alpha_3} \cdot \frac{M_{(2)}}{h_2}$$

$$\sum M_2 = 0: M_2 + D_3 \cdot \cos \beta_3 \cdot h_2 + O_3 \cdot h_2 = 0$$

$$D_3 = \frac{1}{\cos \beta_3} \left(-\frac{M_2}{h_2} - O_3 \right)$$

$$D_3 = \frac{1}{\cos \beta_3} \left(-\frac{M_2}{h_2} + \frac{M_3}{h_3} \right)$$

Моменты от опор.

$$M_{ui} = M_{ui0} - H \cdot y_{ui}$$

$$M_{ui} = -H \cdot y_{ui}$$

(ЗНАЧЕНО ОТ ПЛАН) W

$$h_1 = h_3 = \frac{9}{2}$$

$$h_2 = 6$$

$$M_0 = 1$$

$$\tan \alpha_1 = 1$$

$$\cos \alpha_1 = \frac{1}{\sqrt{2}}$$

$$O_1 = -\frac{23}{117}$$

per $\sum H_{(1)} = 0$

$$M_1 = \frac{23}{26}$$

$$\tan \alpha_2 = \frac{1}{3}$$

$$\cos \alpha_2 = \frac{3}{\sqrt{10}}$$

$$O_2 = -\frac{23}{117}$$

$$M_2 = \frac{10}{13}$$

$$\tan \alpha_3 = -\frac{1}{3}$$

$$\cos \alpha_3 = \frac{3}{\sqrt{10}}$$

$$O_3 = -\frac{10}{117}$$

per $\sum H_{(5)} = 0$

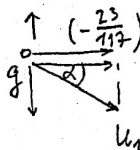
$$M_3 = \frac{5}{13}$$

$$\tan \alpha_4 = -1$$

$$\cos \alpha_4 = \frac{1}{\sqrt{2}}$$

$$O_4 = -\frac{10}{117}$$

$$M_4 = 0$$



$$\sum H = 0$$

$$-\frac{23}{117} + U_1 \cdot \cos \alpha_1 = 0$$

$$U_1 = \frac{23}{117} \sqrt{2}$$

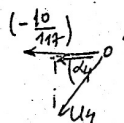
$$U_1 = \frac{23}{117} \cdot \frac{1}{\cos \alpha_1}$$

$$U_2 = \frac{5}{117} \sqrt{10}$$

$$\sum H = 0$$

$$-\frac{10}{117} + U_4 \cdot \cos \alpha_4 = 0$$

$$U_3 = \frac{5}{117} \sqrt{10}$$



$$U_4 = \frac{10}{117} \cdot \frac{1}{\cos \alpha_4}$$

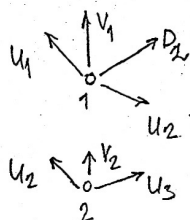
$$U_4 = \frac{10}{117} \sqrt{2}$$

$$\tan \beta_2 = 1 \Rightarrow \cos \beta_2 = \frac{1}{\sqrt{2}}$$

$$D_2 = \frac{8}{117} \sqrt{2}$$

$$\tan \beta_3 = 1 \Rightarrow \cos \beta_3 = \frac{1}{\sqrt{2}}$$

$$D_3 = -\frac{5}{117} \sqrt{2}$$

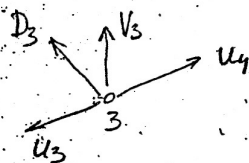


$$\sum V_1 = 0: V_1 = -\frac{23}{117} \sqrt{2} \cdot \frac{1}{\sqrt{2}} - \frac{8}{117} \sqrt{2} \cdot \frac{1}{\sqrt{2}} + \frac{5}{117} \sqrt{10} \cdot \frac{1}{\sqrt{10}}$$

$$V_1 = -\frac{2}{9}$$

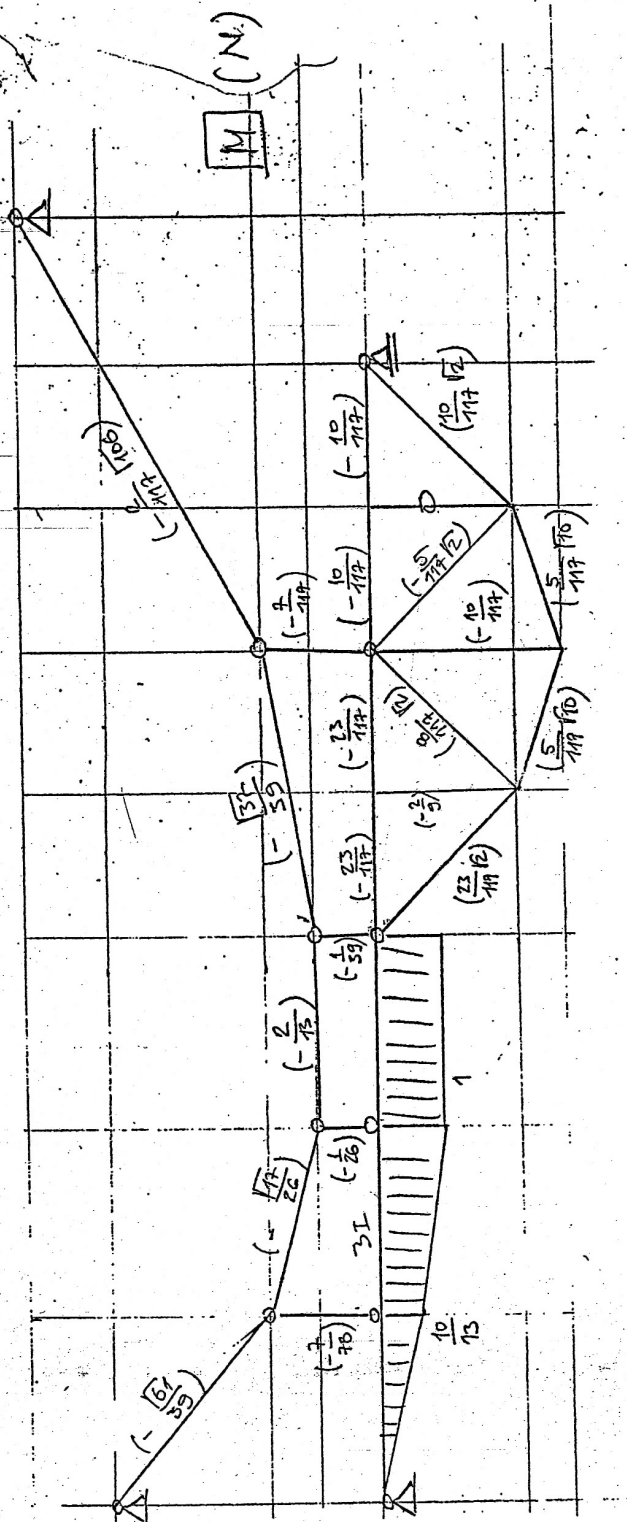
$$\sum V_2 = 0: V_2 = -\frac{5}{117} \sqrt{10} \cdot \frac{1}{\sqrt{10}} - \frac{5}{117} \sqrt{10} \cdot \frac{1}{\sqrt{10}}$$

$$V_2 = -\frac{10}{117}$$

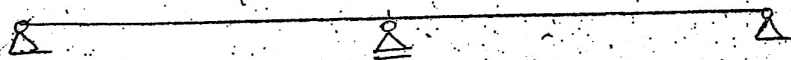


$$V_3 = + \frac{5}{117} \sqrt{2} \cdot \frac{1}{\sqrt{2}} - \frac{10}{117} \sqrt{2} \cdot \frac{1}{\sqrt{2}} + \frac{5}{117} \sqrt{10} \cdot \frac{1}{\sqrt{10}}$$

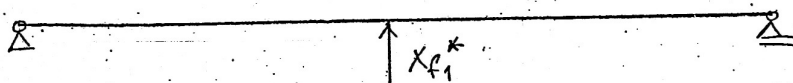
$$V_3 = 0$$



odgovarajući fiktni nosač:



$n=1$



$$X_{f1}^* = \int \left(\frac{I_c}{I} M^2 + \frac{I_c E_c}{E F} N^2 \right) ds$$

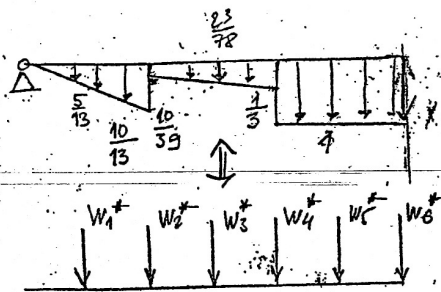
GREDA: $E = 3 \cdot 10^7 \text{ kN/m}^2$ $I = 10^{-3} \text{ m}^4$ $\Rightarrow E I_c = 3 \cdot 10^4 \text{ kNm}^2$

LANČANICA: $E = 3 \cdot 10^8 \text{ kN/m}^2$ $F = 10^{-2} \text{ m}^2$ $\Rightarrow \frac{I_c E_c}{E F} = \frac{8 \cdot 10^4}{3 \cdot 10^8 \cdot 10^{-2}} = 0,01$

REŠETKA: $E = 3 \cdot 10^8 \text{ kN/m}^2$ $F = 0,5 \cdot 10^{-2} \text{ m}^2$ $\Rightarrow \frac{I_c E_c}{E F} = \frac{3 \cdot 10^4}{3 \cdot 10^8 \cdot 0,5 \cdot 10^{-2}} = 0,02$

$$\begin{aligned} X_{f1}^* = & \frac{1}{2} \cdot 6 \cdot \left(\frac{10}{13} \right)^2 \cdot \frac{2}{3} + \frac{6}{6} + \frac{1}{3} \left(\frac{10}{13} \left(2 \cdot \frac{10}{13} + 1 \right) + 1 \left(\frac{10}{13} + 2 \cdot 1 \right) \right) + 6 \cdot 1^2 \\ & + 0,01 \left[\sqrt{61} \cdot \left(\frac{\sqrt{61}}{59} \right)^2 + \sqrt{38,25} \left(\frac{\sqrt{14}}{26} \right)^2 + 6 \cdot \left(\frac{2}{13} \right)^2 + \sqrt{83,25} \left(\frac{\sqrt{37}}{59} \right)^2 + \sqrt{238,5} \left(\frac{2}{117} \sqrt{106} \right)^2 \right. \\ & \left. + 3,5 \cdot \left(\frac{7}{78} \right)^2 + 2 \cdot \left(\frac{1}{26} \right)^2 + 2 \cdot \left(\frac{1}{39} \right)^2 + 3,5 \cdot \left(\frac{7}{117} \right)^2 \right] \quad 8,75739645 \\ & + 0,02 \left[2 \cdot 4,5 \cdot \left(\frac{23}{117} \right)^2 + 2 \cdot 4,5 \cdot \left(\frac{10}{117} \right)^2 + 4,5 \cdot \left(\frac{2}{9} \right)^2 + 6 \cdot \left(\frac{10}{117} \right)^2 + \right. \\ & \left. + \sqrt{40,5} \cdot \left(\frac{8\sqrt{2}}{117} \right)^2 + \sqrt{49,5} \left(\frac{5\sqrt{2}}{117} \right)^2 + \sqrt{40,5} \left(\frac{23\sqrt{2}}{117} \right)^2 + \sqrt{49,5} \left(\frac{10\sqrt{2}}{117} \right)^2 \right. \\ & \left. + 2 \cdot \sqrt{22,5} \left(\frac{5\sqrt{10}}{117} \right)^2 \right] \quad 0,030408877 \end{aligned}$$

$$X_{f1}^* = 8,801365946$$



$$W_i^* = \sum \frac{E_c E_c}{F E} S_i \bar{S}_i l_i$$

$$W_1^* = \frac{3}{6} \left(0 + 4 \cdot \frac{5}{13} + \frac{10}{13} \right) = \frac{15}{13}$$

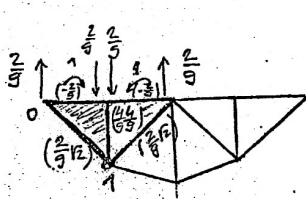
$$W_2^* = \frac{3}{6} \left(\frac{5}{13} + 2 \cdot \frac{10}{13} + 2 \cdot \frac{10}{39} + \frac{23}{72} \right) = \frac{71}{52}$$

$$W_3^* = \frac{3}{6} \left(\frac{10}{39} + 4 + \frac{23}{72} + \frac{1}{3} \right) = \frac{23}{24}$$

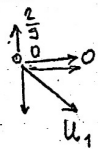
$$W_4^* = \frac{3}{6} \left(\frac{23}{72} + 2 \cdot \frac{1}{3} + 2 \cdot 1 + 1 \right) = \frac{103}{52}$$

$$W_5^* = \frac{3}{6} (1 + 4 \cdot 1 + 1) = 3$$

$$W_6^* = \frac{3}{6} (1 + 2 \cdot 1 + 0) = \frac{3}{2}$$



$\bar{S}_1^{(7)}$



$$\sum H = 0$$

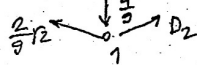
$$U_1 \sin \alpha_1 = \frac{2}{9}$$

$$U_1 = \frac{2}{9} \sqrt{2}$$

$$\sum H = 0$$

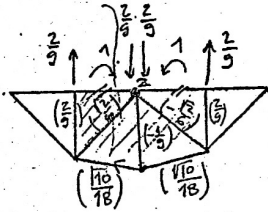
$$U_1 \cos \alpha_1 + O_1 = 0$$

$$O_1 = -\frac{2}{9} = O_2$$



$$\sum H = 0 \quad D_2 \cos \alpha_2 = U_2 \cos \alpha$$

$$D_2 = \frac{2}{9} \sqrt{2}$$

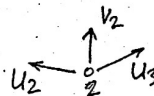


$$\sum M_{(2)} = 0$$

$$1 - U_2 \cos \alpha_2 \cdot h_2 = 0$$

$$1 - U_2 \cdot \frac{3}{10} \cdot 6 = 0$$

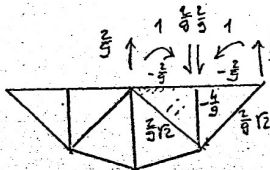
$$1 - \frac{18}{10} \cdot U_3 = 0 \Rightarrow U_2 = \frac{10}{18}$$



$$V_2 = -2 \cdot \frac{10}{18} \cdot \sin \alpha = -\frac{10}{9} \cdot \frac{1}{10} \quad V_2 = -\frac{1}{9}$$

$$\sum M_2 = 0 : 1 + D_2 \cos \alpha_2 \cdot h_2 = 0$$

$$1 + D_2 \cdot \frac{1}{12} \cdot 6 = 0 \Rightarrow D_2 = -\frac{\sqrt{2}}{6} = D_3$$

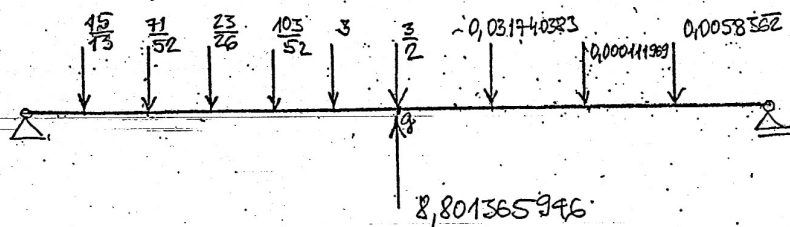


$$W_7^* = 0.02 \left[2 \cdot \left(-\frac{23}{117} \right) \cdot \left(-\frac{2}{9} \right) \cdot 4.5 + 4.5 \cdot \left(-\frac{2}{9} \right) \cdot \left(-\frac{1}{3} \right) + \sqrt{40.5} \cdot \frac{2}{9} \sqrt{2} \left(\frac{23}{117} + \frac{8}{117} \right) \sqrt{2} \right]$$

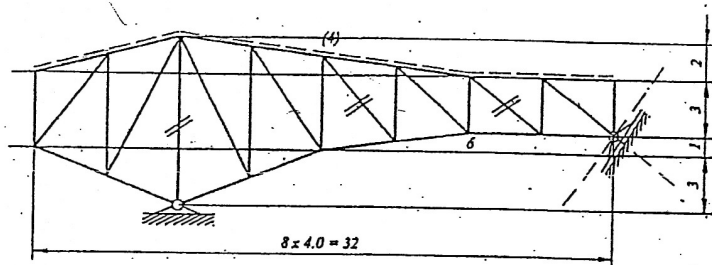
$$= 0.031740383$$

$$W_8^* = 0.02 \left[4.5 \cdot \frac{2}{9} \cdot \left(-\frac{2}{9} \right) + \sqrt{40.5} \cdot \left(-\frac{\sqrt{2}}{6} \right) \cdot \left(\frac{8\sqrt{2}}{117} - \frac{5\sqrt{2}}{117} \right) + 6 \cdot \left(-\frac{1}{9} \right) \cdot \left(-\frac{10}{117} \right) + 2 \cdot \sqrt{22.5} \cdot \frac{5\sqrt{10}}{117} \cdot \frac{10}{18} \right] = 0.000111969$$

$$W_9^* = 0.02 \left[2 \cdot \left(-\frac{2}{9} \right) \cdot 4.5 \cdot \left(-\frac{10}{117} \right) + \sqrt{40.5} \cdot \frac{2}{9} \sqrt{2} \cdot \sqrt{2} \left(\frac{10}{117} - \frac{5}{117} \right) \right] = 0.0058362$$

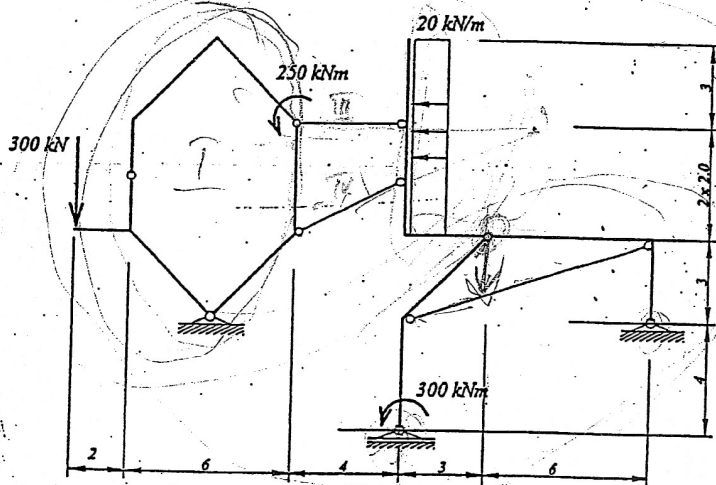


Задатак I



- 1) Статичком методом конструисати утицајне линије за силе у означеним штаповима.
- 2) Конструисати утицајну линију за размицање тачака (4) и 6.
($EF \neq \text{const.}$).

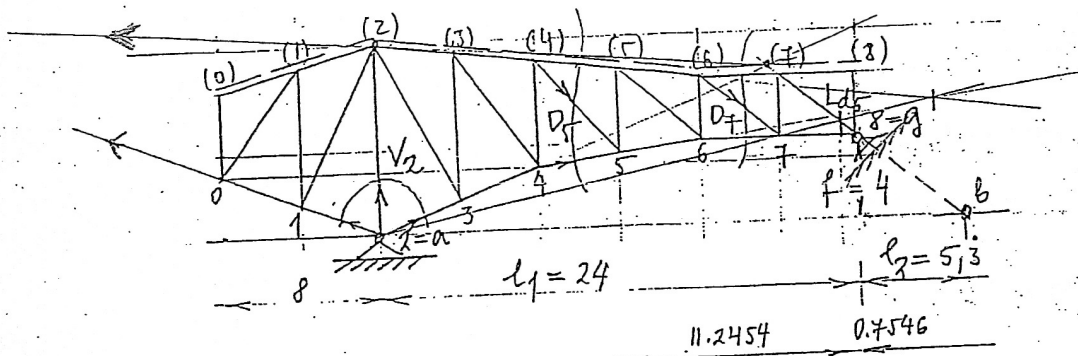
Задатак II



Услед задаог оптерећења нацрта дијаграме M, T и N у носачу.

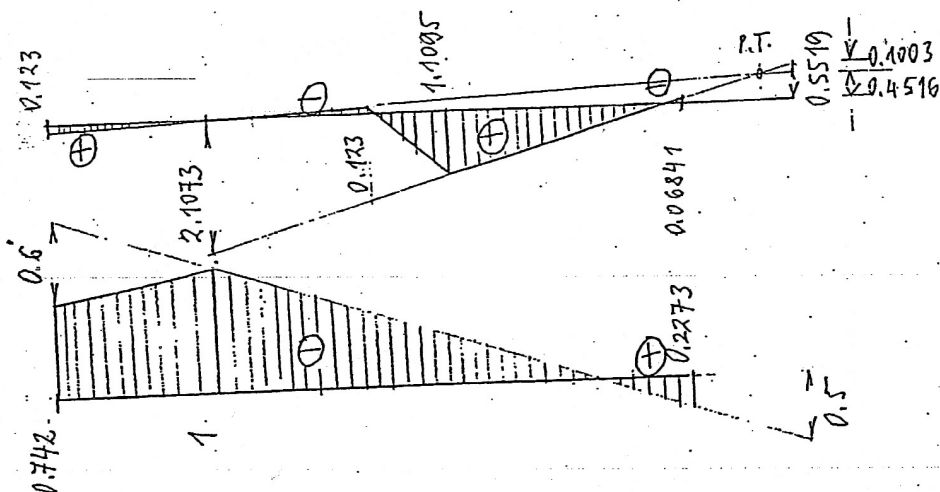
1.344 TAK

1)



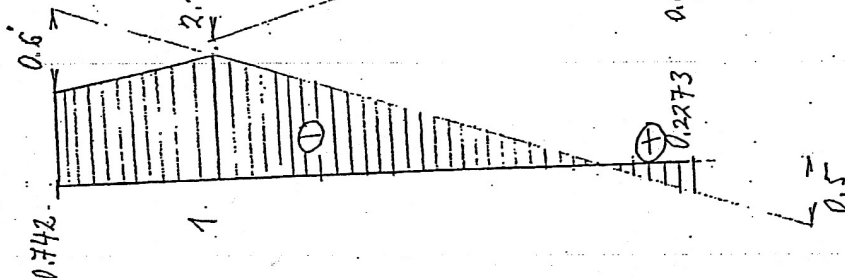
10

D_5



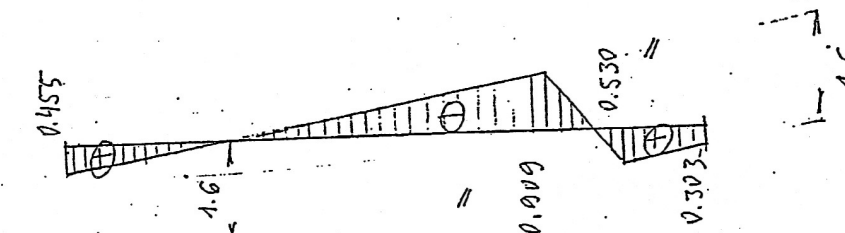
10

V_2



10

D_7



Угнута лінійа D_5 :

2

$$D_5 = \left(\frac{M_5}{h_5} - \frac{M_{(4)}}{h_4} - 1 \right) \text{рег}_5$$

$$M_5 = M_{50} - 4 \cdot y_5$$

$$M_{(4)} = M_{40} - 4 \cdot y_{(4)}$$

$$D_5 = D_{50} + 4 \cdot D_{54}$$

$$\begin{aligned} D_{50} &= 4 \cdot D_{54} ; \quad D_{54} = \left(\frac{x_5}{h_5} - \frac{x_{(4)}}{h_4} \right) \text{рег}_5 \\ &= \left(\frac{12}{4} - \frac{8}{5} \right) 1.5052 \\ &= 2.1073 \end{aligned}$$

a

$$\begin{aligned} 4 \cdot D_{54} &= \frac{h_2}{f} \left(-\frac{y_5}{h_5} + \frac{y_{(4)}}{h_4} - 1 \right) \text{рег}_5 \\ &= \frac{50}{4} \left(-\frac{3.5}{4} + \frac{8}{5} - 1 \right) 1.5052 \\ &= -0.5519 \end{aligned}$$

b

$$\begin{aligned} D_{58} &= \left(\frac{x_5'}{h_5} - \frac{x_{(4)'}}{h_4} \right) \text{рег}_5 \\ &= \left(\frac{17.3}{4} - \frac{21.3}{5} \right) 1.5052 \\ &= 0.10035 \end{aligned}$$

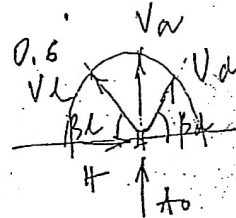
УТНЧАТХА ЛУНУТХА V_a :

$$V_a = -A_0 - \frac{M a l_0}{l_{na}} (\operatorname{tg} \beta_L + \operatorname{tg} \beta_d) + \frac{1}{2} (\operatorname{tg} \beta_d - \operatorname{tg} \beta_0)$$

-1 ... a

$$\frac{l_2}{f} (\operatorname{tg} \beta_d - \operatorname{tg} \beta_0) = \frac{5/3}{4} \left(\frac{3}{8} - 0 \right) = 0.5 \quad \dots \quad b$$

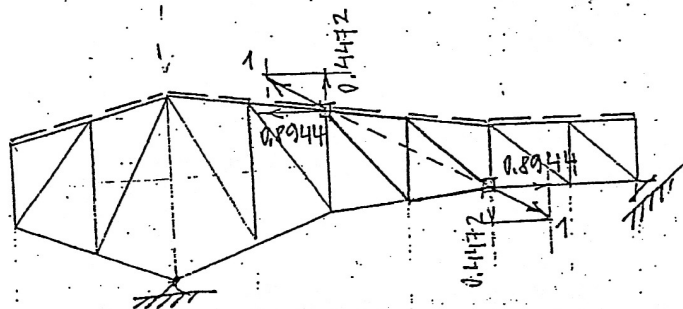
$$-\frac{2}{l_{na}} (\operatorname{tg} \beta_L + \operatorname{tg} \beta_d) = -\frac{8}{9} \left(\frac{3}{8} + \frac{3}{8} \right) = -0.6$$



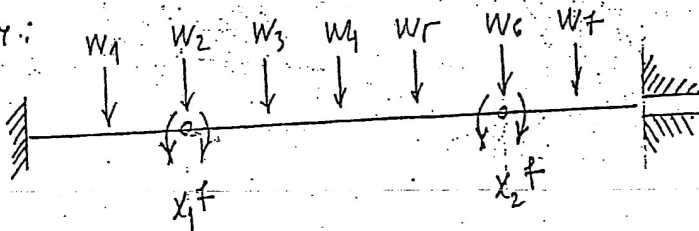
УТНЧАТХА ЛУНУТХА D_f :

$$D_f = \frac{T_f}{m \delta_f} = \frac{T_{f0}}{m \delta_f} \rightarrow \begin{matrix} 1.6 & \dots & a \\ -1.6 & \dots & b \end{matrix}$$

2) УТНЧАТХА ЛУНУТХА ЗТ РАТНУЧАТХЕ ТАЛУТ (4) И 6:



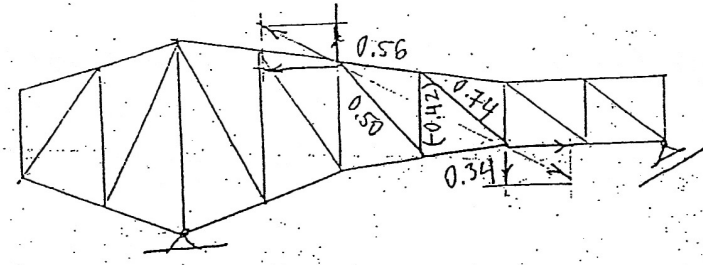
ФУНКЦИОНАЛНОСТ:



$$EF W_m = \sum S \cdot S_m \cdot l, \quad m=1, 7$$

$$EF X_1^f = \sum S \cdot S_1 \cdot l, \quad m=1, 2$$

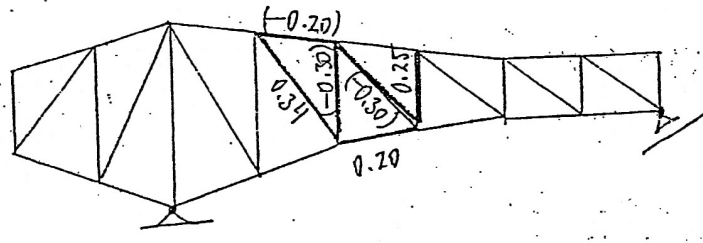
S



0.25 0.5 0.25

↑ ↓ ↑

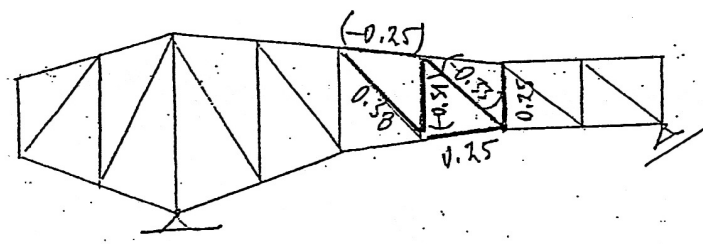
S₄



0.25 0.5 0.25

↑ ↓ ↑

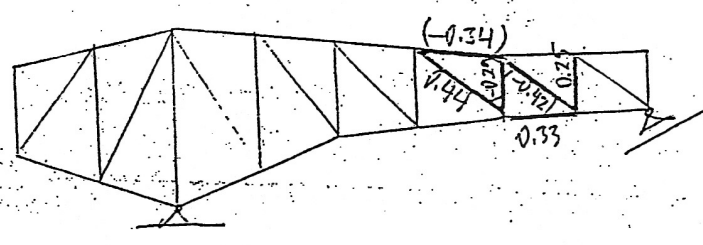
S₅



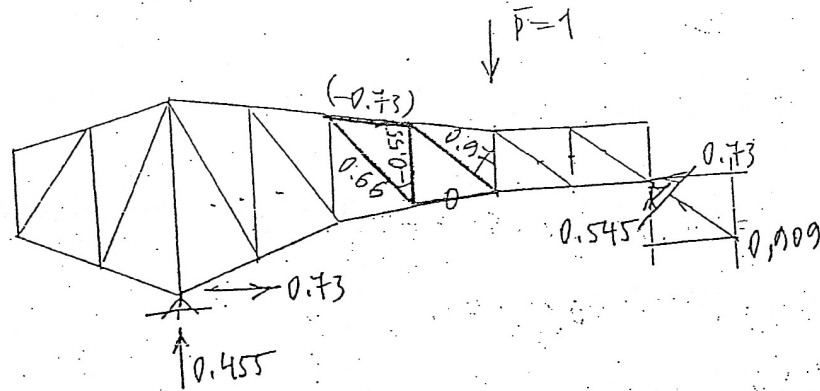
0.25 0.5 0.25

↑ ↓ ↑

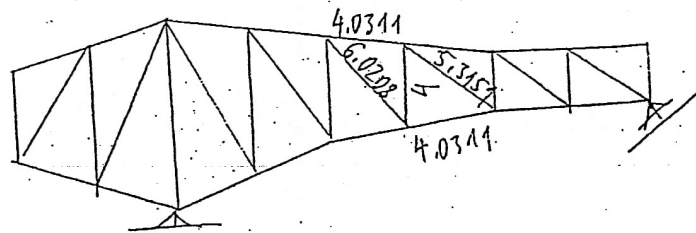
S₆



5.2



2



$$EFW_1 = EFW_2 = EFW_3 = EFW_7 = 0$$

$$EFW_4 = \sum S \cdot S_4 \cdot L$$

$$= (-0.42) \times 0.25 \times 4 + 0.5 \times (-0.3) \times 6.0208$$

$$= -1.323$$

$$EFW_5 = \sum S \cdot S_5 \cdot L$$

$$= 0.50 \times 0.33 \times 6.0208 + 0.74 \times (-0.33) \times 5.3151 + 0.56 \times (-0.25) \times 4.0311$$

$$+ 0.34 \times 0.25 \times 4.0311 + (-0.42) \times (-0.31) \times 4$$

$$= 0.145$$

$$EFW_6 = \sum S \cdot S_6 \cdot L$$

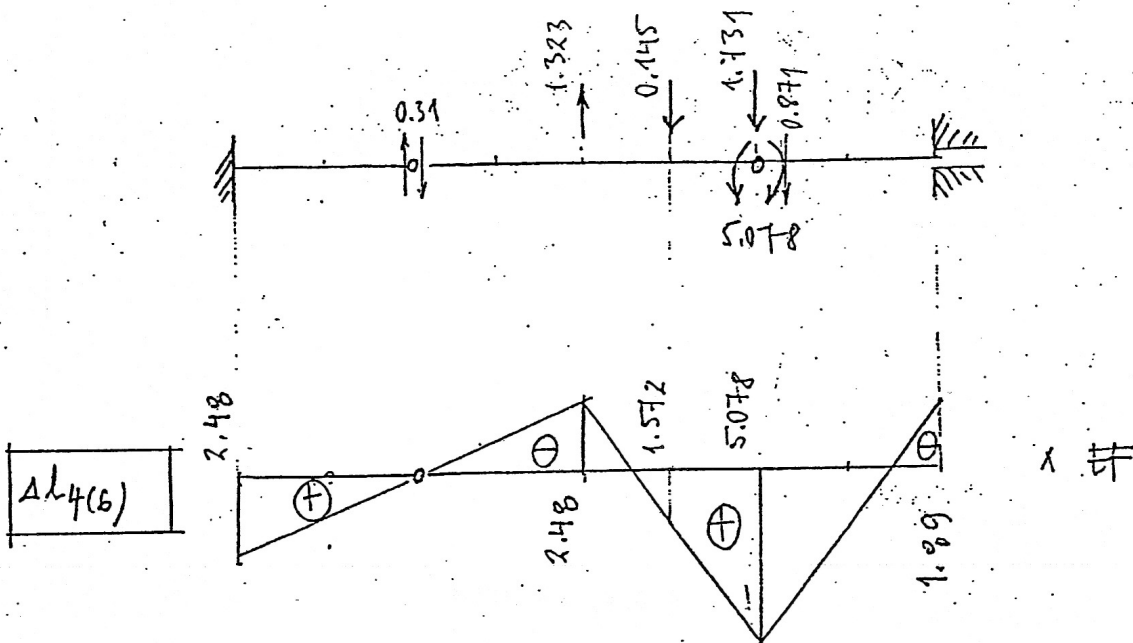
$$= 0.74 \times 0.44 \times 5.3151$$

$$= 1.731$$

$$EF_{x_1}^f \equiv 0$$

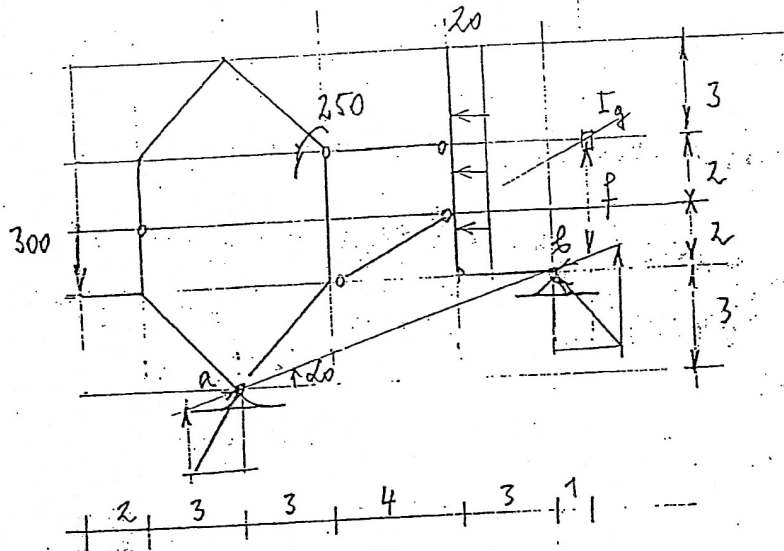
$$EF_{x_2}^f = \sum_s s \cdot \bar{s}_2 \cdot l$$

$$= 0.5 \times 0.66 \times 6.0208 + 0.74 \times 0.97 \times 5.3151 + 0.56 \times (-0.73) \times 4.0311 \\ + 0.42 \times 0.55 \times 4 \\ = 5.078$$



2.3444-TAK

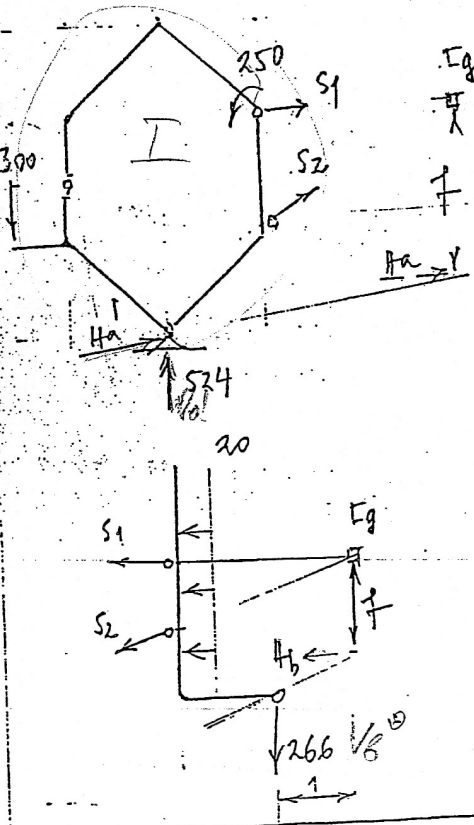
7



$$t_{g'do} = \frac{3}{10}, \quad f = 3.7$$

$$V_a = \frac{M_b}{L} = \frac{300 \times 15 + 250 + 20 \times 7 \times 3}{10} = 524$$

$$V_b = \frac{M_a}{L} = \frac{-300 \times 5 - 250 - 20 \times 7 \times 6}{10} = -266$$



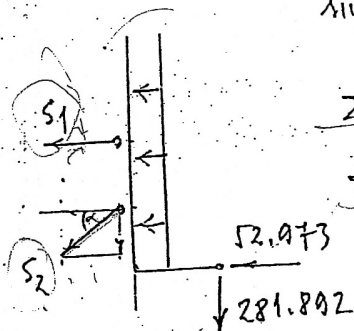
$$h_a = \frac{M_{I_g}}{f} = \frac{-300 \times 16 - 250 + 524 \times 11}{3.7} = 192.973$$

$$h_b = \frac{M_{I_{g'}}}{f} = \frac{-20 \times 7 \times 0.5 + 266 \times 1}{3.7} = 52.973$$

$$V_d = V_d' + A_d t g \alpha_0 = 524 + 192.973 \frac{3}{10} = 581.892$$

$$V_b = V_b' - A_b t g \alpha_0 = -266 - 52.973 \frac{3}{10} = -281.892$$

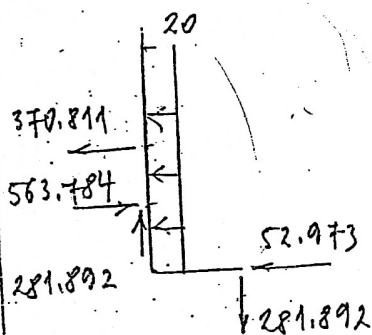
$$\sin \alpha_0 = 0.4472 \quad \cos \alpha_0 = 0.8944$$



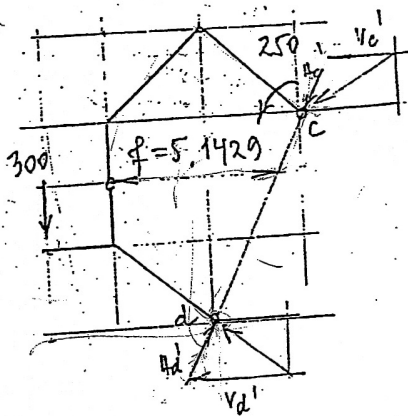
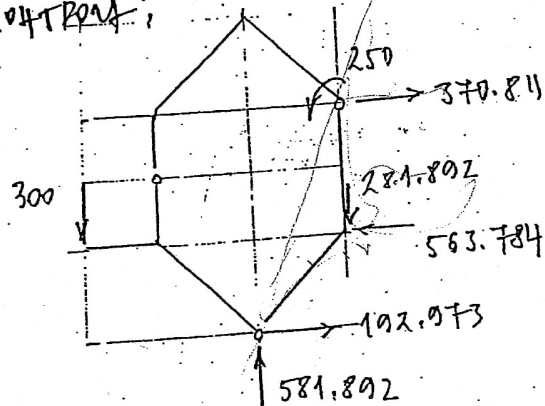
$$\sum X = 0: S_1 + 0.8944 S_2 = -192.973$$

$$\sum Y = 0: 0.4472 S_2 = -281.892$$

$$S_1 = 370.811 \quad S_2 = -630.349$$



КРАТКА;



$$V_d' = \frac{M_c}{L} = \frac{300 \times 2 + 250}{7} = 378.571$$

$$V_c' = \frac{M_d}{L} = \frac{-300 \times 5 - 250}{7} = -250$$

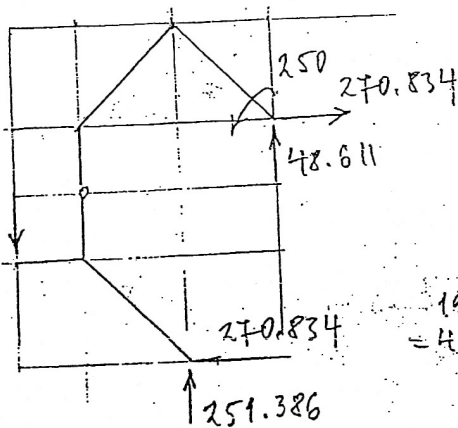
$$A_d = \frac{\sum M}{f} = \frac{378.571 \times 5 - 300 \times 2}{5.1429} = 251.386$$

$$A_c = \frac{M_d}{f} = \frac{250 + (-250 \times 2)}{5.1429} = -48.611$$

$$V_d = V_d' - A_d t g \alpha_0 = 378.571 - 251.386 \times \frac{3}{7} = 270.834$$

$$V_c = V_c' + A_c t g \alpha_0 = -250 - 48.611 \times \frac{3}{7} = -270.834$$

300



48.611

$$370.811 - 270.834 = 99.977$$

9

99.977

281.892

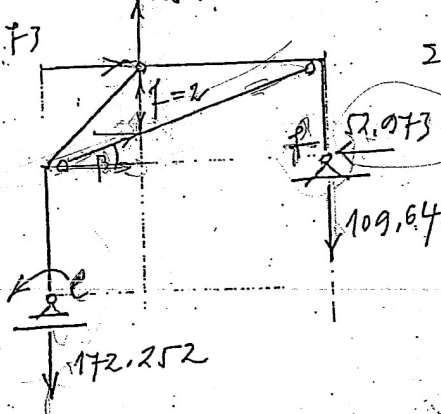
563.784

$$192.973 + 270.834 = 463.807$$

$$581.892 - 251.386 = 330.506$$

52.973

281.892



$$\sum X = 0: H_f = 52.973$$

$$V_c = \frac{M_f}{L} = \frac{-300 + 281.892 \times 6 + 52.973 \times 3}{9}$$

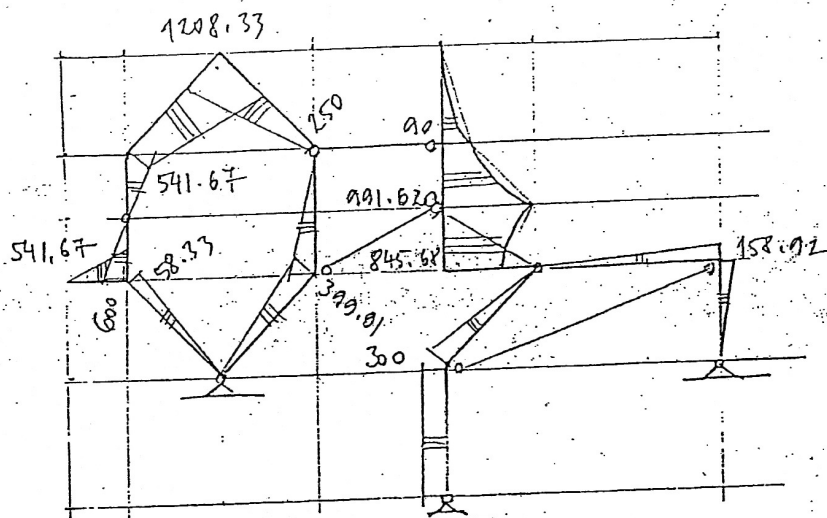
$$V_c = 172.252$$

$$\sum T = 0: V_f = -172.252 + 281.892 = 109.64$$

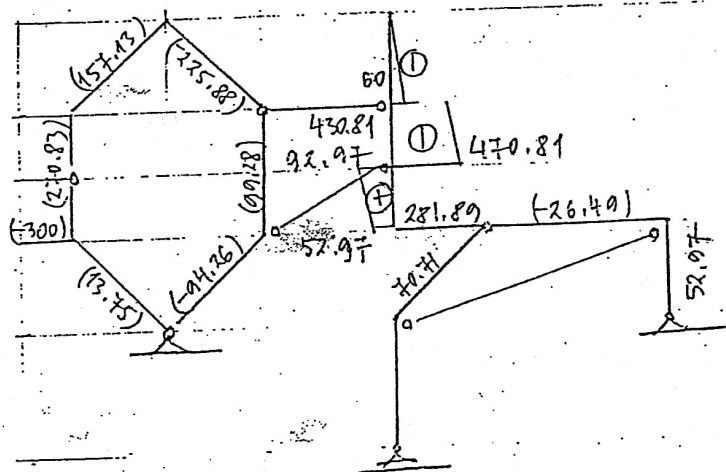
$$M_c = \frac{f \cdot \cos \beta}{2 \times 0.947} = \frac{-172.252 \times 3 - 300}{2 \times 0.947} = -430.468$$

WAVE BETE
20

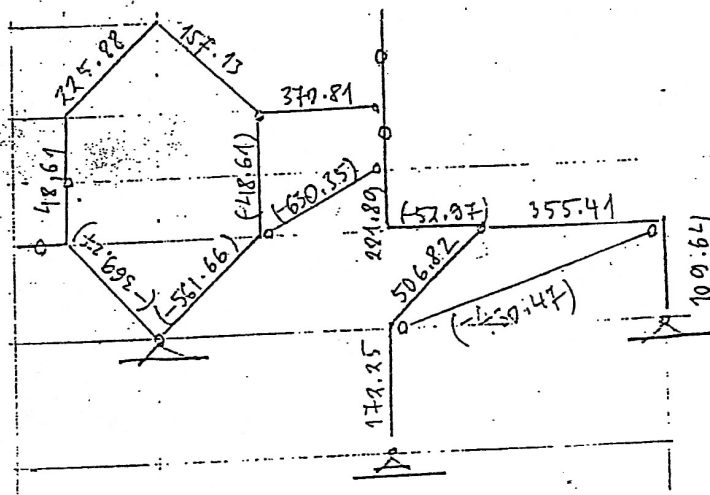
(M)
[KNm]



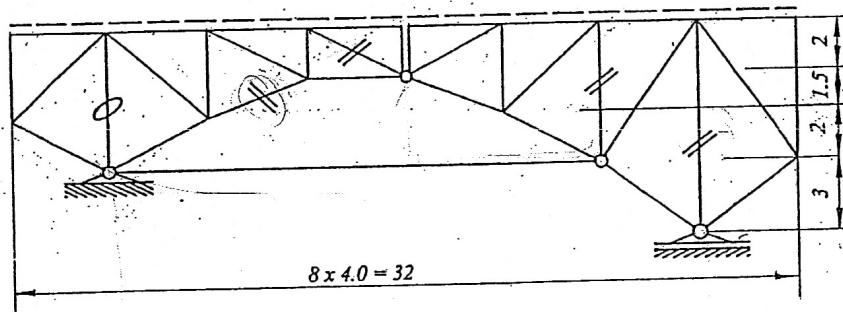
(T)
[KN]



(N)
[KN]



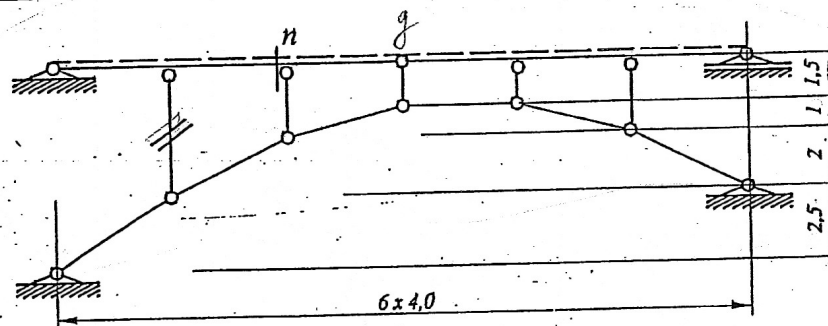
Задатак I



Конструисати и нацртати утицајне линије за означене штапове решеткастог носача на слици:

1. Статичком методом. ($//$)
2. Кинематичком методом. (O)

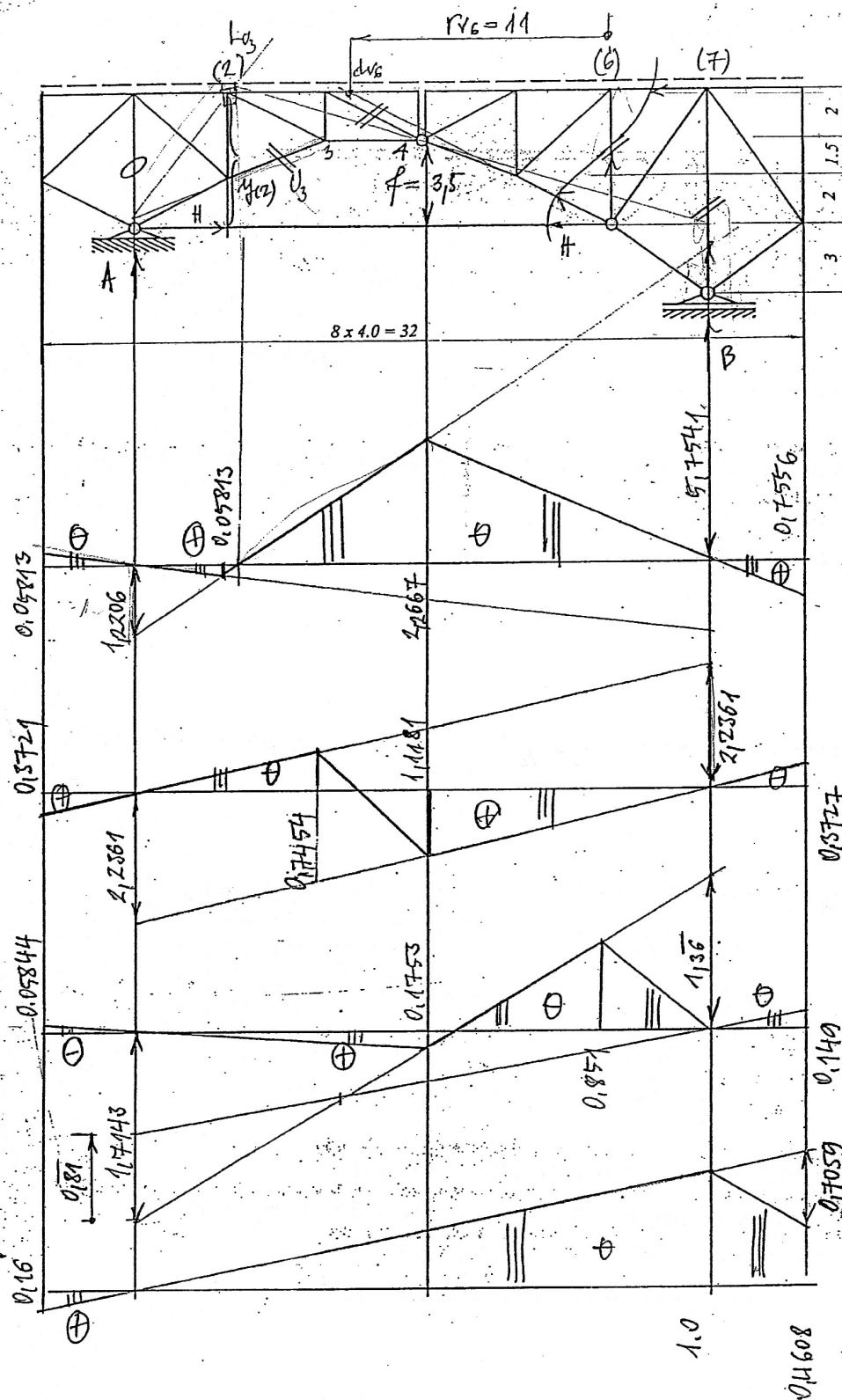
Задатак II



1. Конструисати утицајну линију за обртање пресека n лево ϕ'_n .
2. Срачунати екстремну вредност силе у означеној вертикали услед једнако подељеног покретног оптерећења $p = 10 \text{ kN/m}$ непрекидне дужине.

(пун носач: $EI = \text{const}$, $I/F \approx 0$, $I/G \approx 0$, прости штапови: $I/F = 0.1 \text{ m}^2$)

1.844477K



$$M_2 = M_{\text{max}} - H \cdot 0.2$$

$$\frac{M_2}{L_2} \text{ - used}$$

(3)

(4)

(6)

(7)

$$V_3 = \frac{M_{(2)}}{h_2} \sec \beta_3 = \frac{M_{(2)0}}{h_2} \sec \beta_3 - \# \frac{y_{(2)}}{h_2} \sec \beta_3$$

$$\# \frac{y_{(2)}}{h_2} \sec \beta_3 = \frac{4}{3,5} \cdot 1,0680 = -1,2206 \quad \dots , a'$$

$$\# \left\langle \begin{array}{l} -\frac{h_2}{f} \frac{y_{(2)}}{h_2} \sec \beta_3 = -\frac{4,2}{3,5} \frac{5,5}{3,5} 1,0680 = -5,7541 \quad \dots , b' \end{array} \right.$$

$$(II) \left\langle \begin{array}{l} 0 \\ b \frac{x_{(2)}}{h_2} \sec \beta_3 = \frac{20}{3,5} 1,0680 = 6,1029 \end{array} \right.$$

$$D_4 = \frac{T_4}{\sin \delta_4} = \frac{T_{40} + \# t_3 \overset{=0}{\alpha_0}}{\sin \delta_4} = \frac{T_{40}}{\sin \delta_4}$$

$$I) \left\langle \begin{array}{l} 0 \\ -\frac{1}{\sin \delta_4} = -\frac{1}{0,4472} = -2,2361 \end{array} \right. \quad II) \left\langle \begin{array}{l} \frac{1}{\sin \delta_4} = 2,2361 \\ 0 \end{array} \right. \quad \dots , b'$$

$$V_6 = -\frac{M_{V6}}{r_{V6}} = -\frac{M_{V60}}{r_{V6}} + \# \frac{y_{V6}}{r_{V6}}$$

$$\# \frac{y_{V6}}{r_{V6}} = -\frac{15}{11} = -1,36 \dots , b'$$

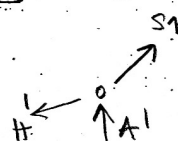
$$\# \frac{t_1 y_{V6}}{f r_{V6}} = \frac{12}{3,5} \frac{5,5}{11} = 1,7143 \dots , a'$$

$$\# \frac{r_{a6}}{r_{V6}} = -\frac{9}{11} = -0,81 \dots , a'$$

$$V_6 = -5 - \frac{M_{(7)0}}{h_7} (t_3 \beta_1 + t_3 \rho_d)$$

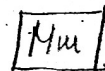
$$I) \left\langle \begin{array}{l} -1 \dots , b' \\ 0 \dots , a' \end{array} \right.$$

$$-\frac{2}{h_7} (t_3 \beta_1 + t_3 \rho_d) = -\frac{4}{8,5} \left(\frac{3}{4} + \frac{3}{4} \right) = -0,7059$$

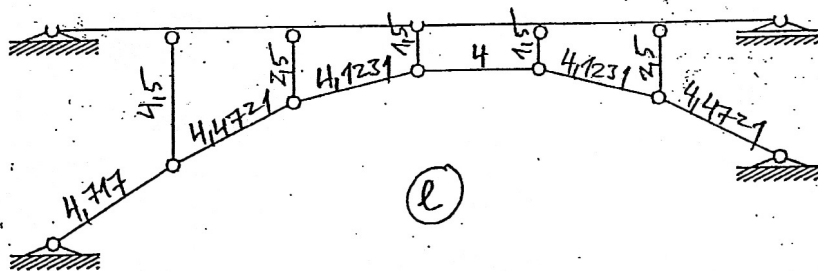
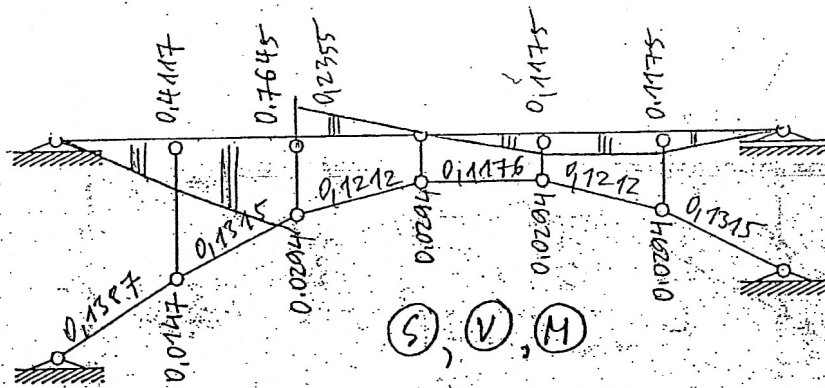
$$A^1 = H(\operatorname{tg} \alpha_0 - \operatorname{tg} \alpha_1)$$


$$\begin{aligned} A' &= H' \sin d_0 + H \sin d_1 \\ A' &= H \tan d_0 - H \tan d_1 \end{aligned}$$

A diagram showing a horizontal line representing a surface. A vertical line intersects it. A line with an arrow pointing downwards is labeled 'B1'. A line with an arrow pointing upwards is labeled 'H100'. A line with an arrow pointing to the right is labeled 'H100'. A line with an arrow pointing to the left is labeled 'H100'.

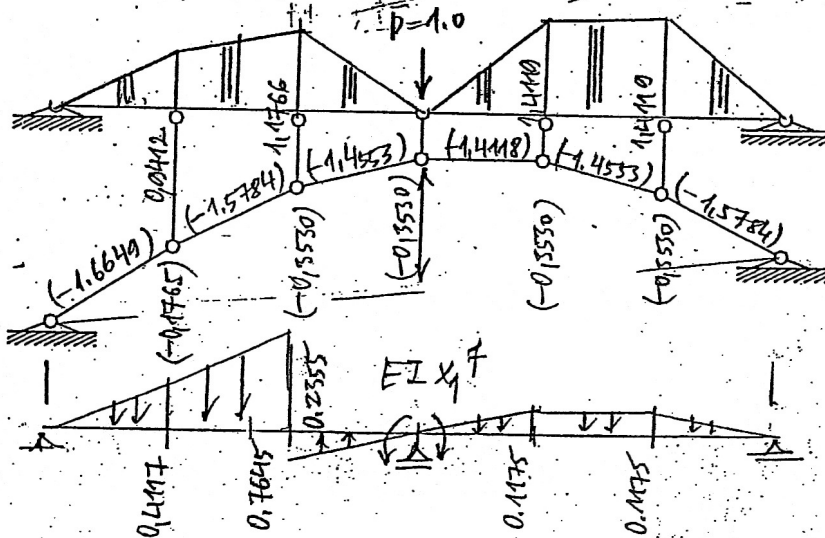


1.



функция чороз

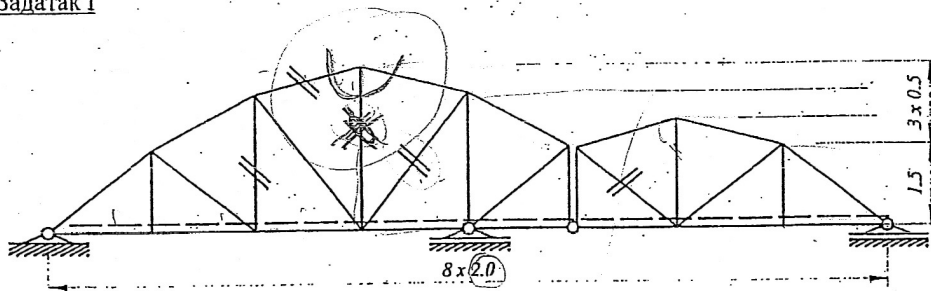
$$EI \phi'' = M_1, \quad EI x_1'' = \int M \cdot \bar{M}' ds + \frac{F}{F} \int N \bar{N} ds$$



$$H = \frac{M_{g0}}{F} - \frac{6}{4.25} = 1.4118 \quad (\text{нормированно})$$

$$M_u = \hat{M}_{u0} - \hat{H} \cdot y_m$$

Задатак I

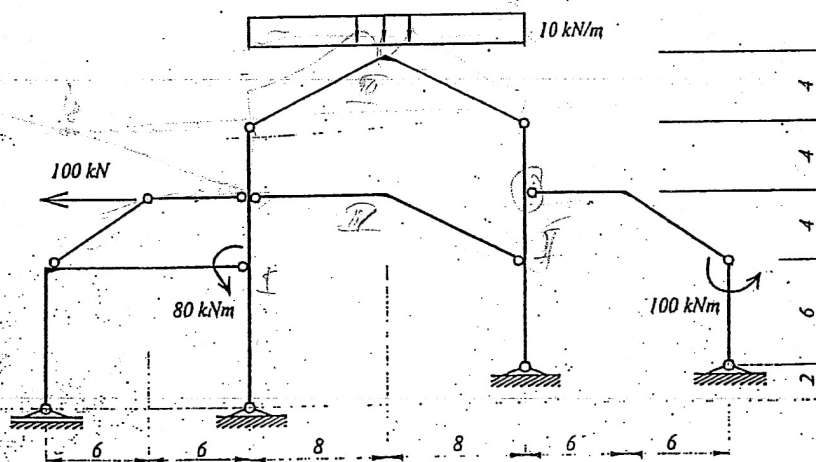


Конструисати и нацртати утицајне линије за означене штапове решеткастог носача на слици:

1. Статичком методом (//)
2. Кинематичком методом (O)

Handwritten note: D - f_{10} \rightarrow 100 - 100

Задатак II



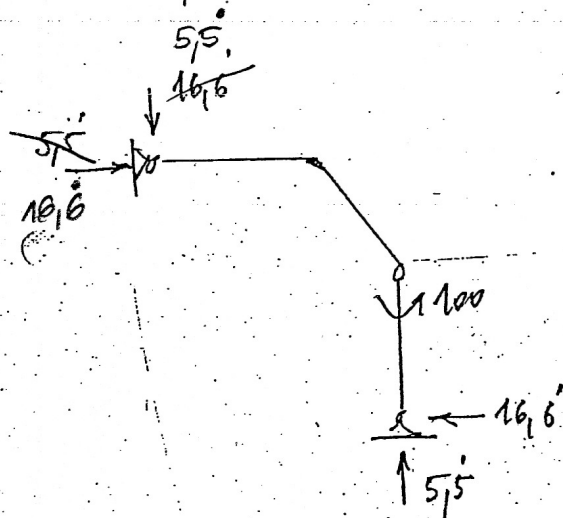
За носач на слици нацртати дијаграме сила у пресецима.

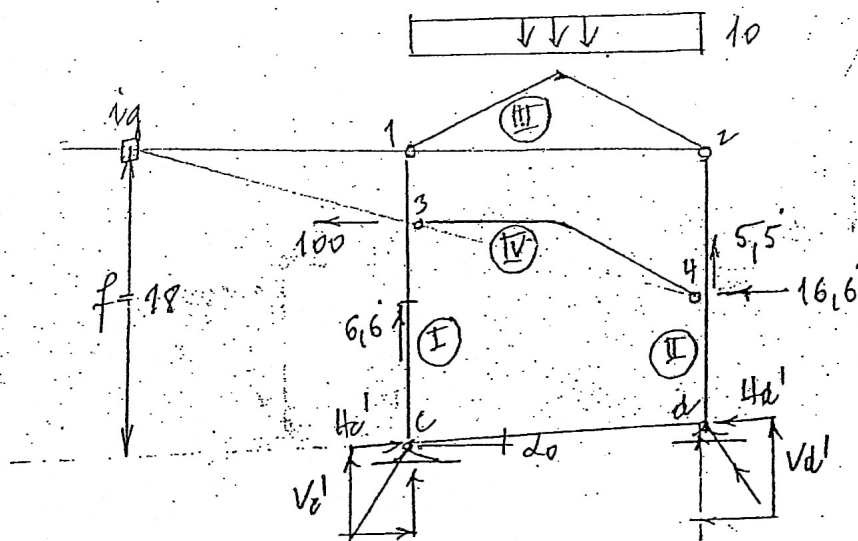
$$\begin{aligned} V_a &= V_a' + 4a \tan \phi_b \\ &= 10 + 5,5 \frac{12}{10} \\ &= 16,6 \end{aligned}$$

$$\begin{aligned} V_b &= V_b' - 46 \lg 20 \\ &= -10 - 5,5' \frac{12}{10} \\ &= -16,6' \end{aligned}$$

$$\begin{aligned} V_b &= V_b' - 46 \lg 20 \\ &= -10 - 5,5' \frac{12}{10} \\ &= -16,6' \end{aligned}$$

$$\begin{aligned} V_b &= V_b' - 46 \lg 20 \\ &= -10 - 5,5' \frac{12}{10} \\ &= -16,6' \end{aligned}$$

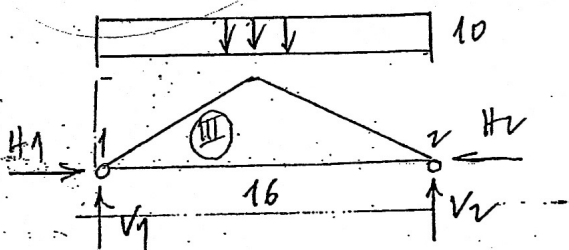




$$V_c' = \frac{M_d}{L} = \frac{(16.6 + 100) \times 10 + 10 \times 16 \times 8 - 6.6 \times 16}{16} = 146.2500$$

$$V_d' = \frac{M_c}{L} = \frac{-(100 + 16.6) \times 12 - 5.5 \times 16 + 10 \times 16 \times 8}{16} = -13.05$$

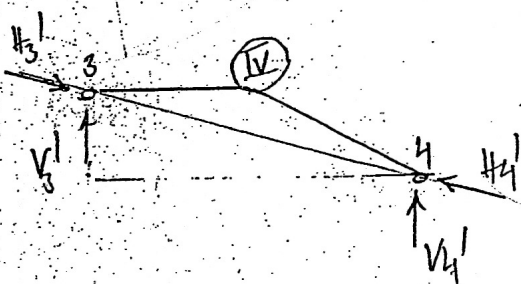
теперь (III) :



$$V_1 = V_2 = \frac{10 \times 16}{2} = 80$$

$$H_1 = H_2$$

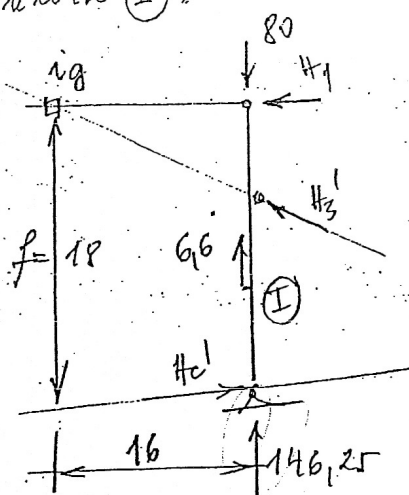
теперь (IV) :



$$V_3 = V_4 = 0$$

$$H_3 = H_4$$

πλοα (I):



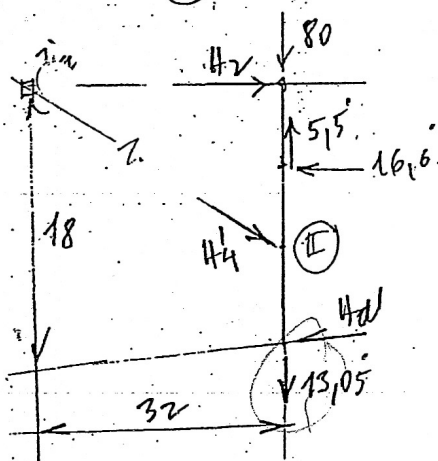
$$H_c = \frac{M_{i0}}{f} = \frac{(80 - 6,6 - 146,25) \times 16 + 100 \times 4}{18} = -42,5926$$

$$V_c = V_c' + H_c \tan \alpha_0$$

$$= 146,25 + (-42,5926) \frac{2}{16}$$

$$V_c = 140,9259$$

πλοα (II):



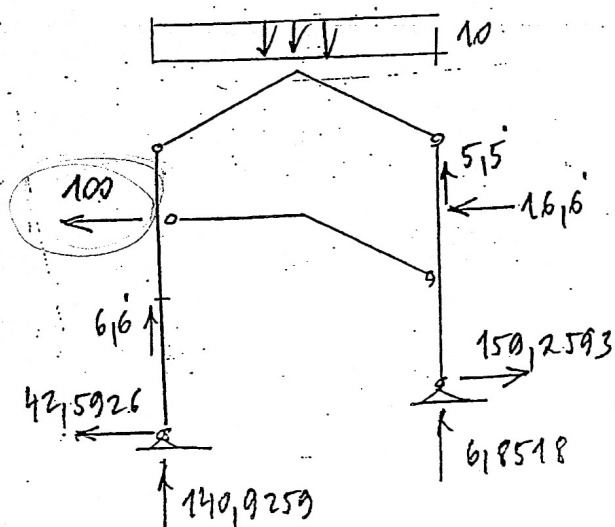
$$H_d = \frac{M_{i0}}{f} = \frac{(-80 - 13,05 + 5,5) \times 32 - 16,6 \times 4}{18} = -150,2593$$

$$V_d = V_d' - H_d \tan \alpha_0$$

$$= -93,05 - (-150,2593) \frac{2}{16}$$

$$V_d = 6,8518$$

ΚΟΗΤΡΟΛΗ:

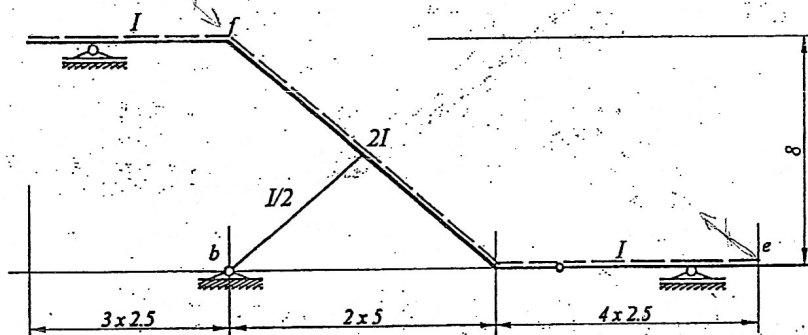


$$\sum H = 0 : 100 + 16,6 + 42,5926 = 159,2593$$

$$0 = 0$$

$$\sum V = 0 : 140,9259 + 6,6 + 5,5 + 6,8518 = 159,2593$$

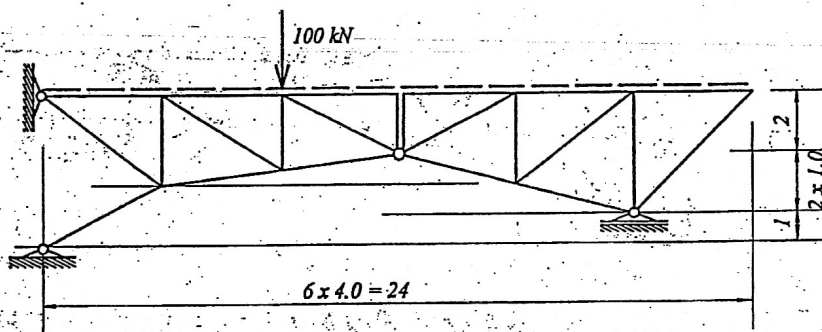
Задатак I



За носач на слици конструисати утицајну линију за промену растојања између тачака f и e ($EI = \text{const.}$, $I/F \approx 0$, $I/G \approx 0$).

M N T $\frac{I}{F} \approx 0$

Задатак II



За носач на слици нацртати дијаграм вертикалних померања означеног потеза штапова ($EF = 10^5 \text{ kN}$).

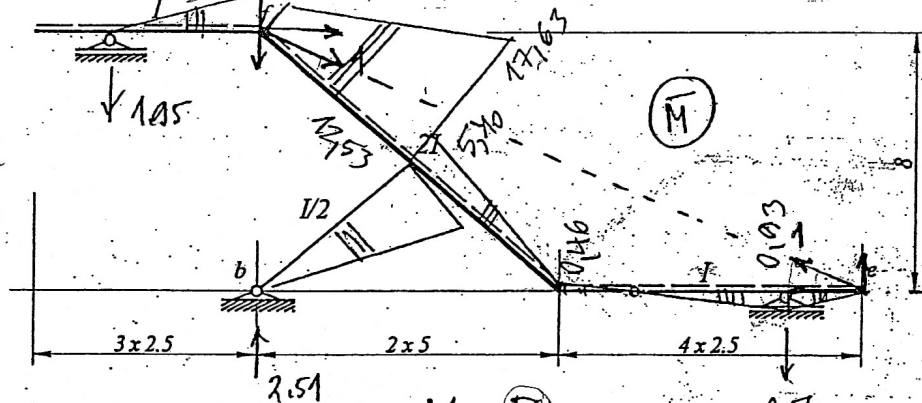
$\frac{I}{F} \approx 0$

1.344477K

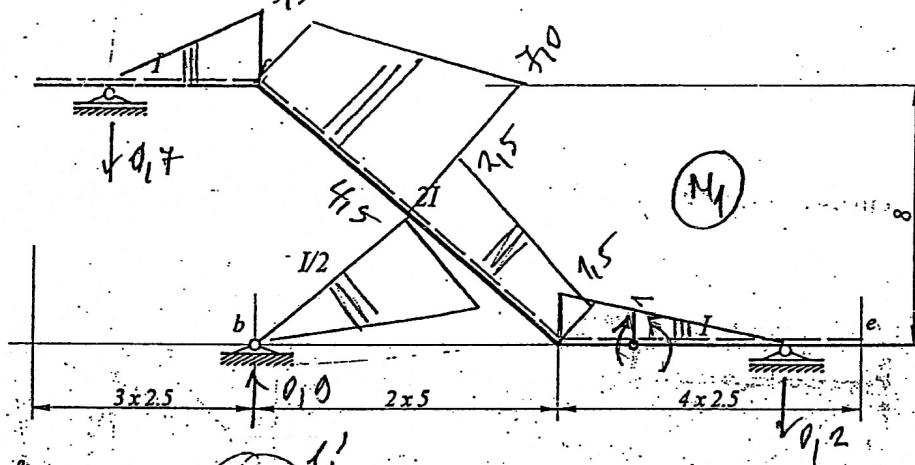
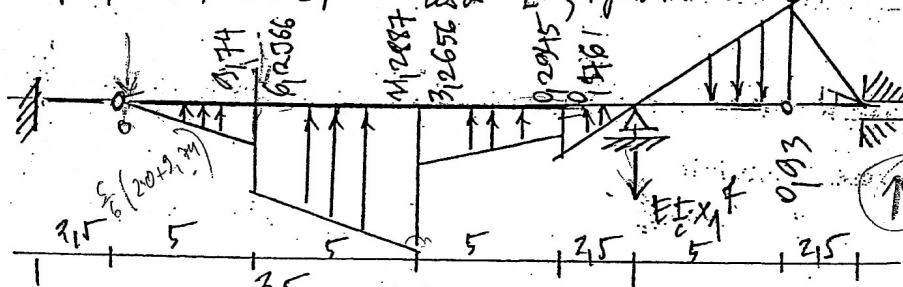
$$\left(\frac{1}{2} \times 10 \times 10 + \frac{1}{2} \times 10 \times 10 \right) \times 10 \times 10$$

$$F = 10 \times 10 = 100$$

$$70 + 20 = 90 + 2$$



$$- \text{функция по } x; EI_c \rho f = \frac{M}{\alpha x^2} \frac{I_c}{I}, \text{ где } EI - I$$



$$EI_c \chi_f = \int \bar{M} N_y \left(\frac{I_c}{I} \right) dy$$

$$= \frac{5}{3} \cdot 9.74 \times 0.5 + \frac{3.12016}{6} [9.74 (2 \times 0.5 + 7) + 17.63 (3.5 + 2 \times 7)] +$$

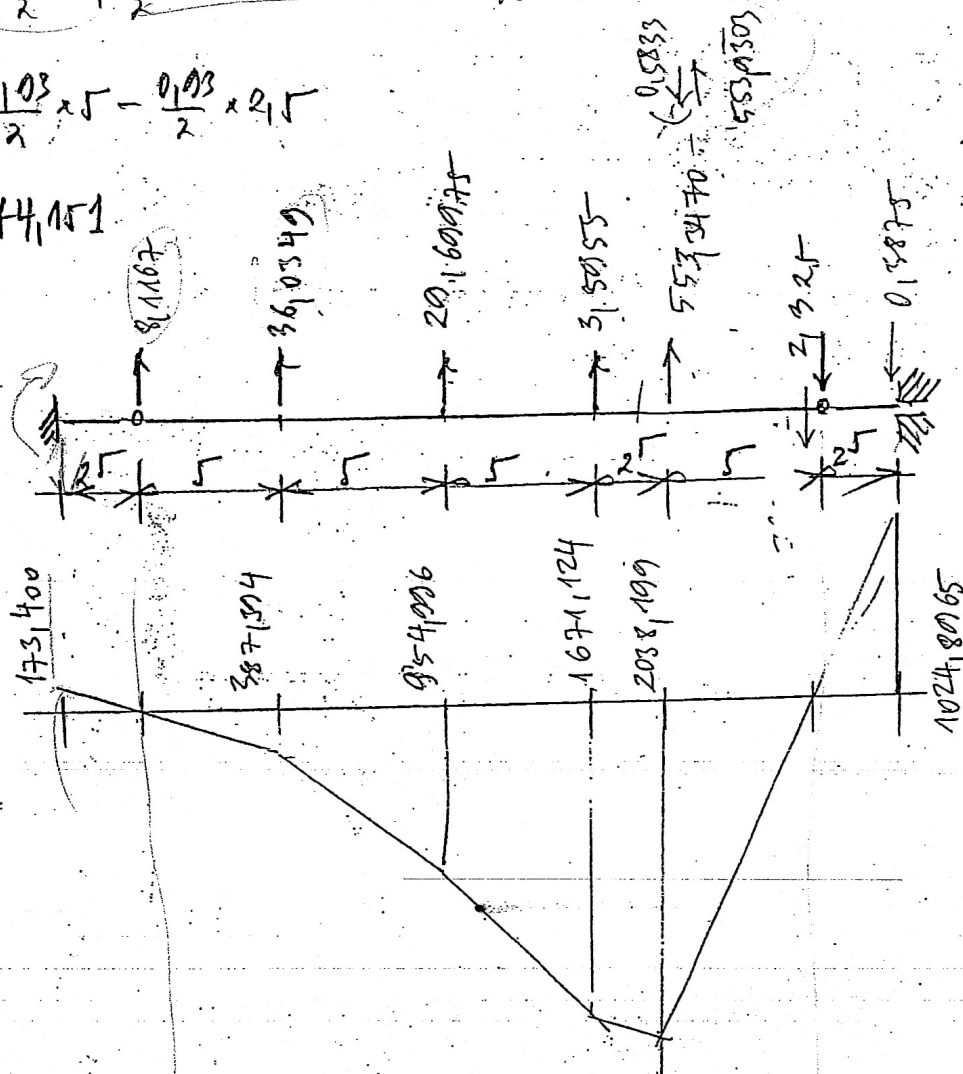
$$+ \frac{3.12016}{6} [5.1 (2 \times 2.5 + 1.5) + 0.46 (2 \times 1.5 + 2.5)] +$$

$$+ \frac{2.15}{6} \cdot 0.46 \times (2 \times 1.5 + 1) - \frac{5}{6} \cdot 0.93 \cdot 1 + \frac{12.8062}{3} \cdot 4.5 \times 12.53$$

$$= 553.19303$$

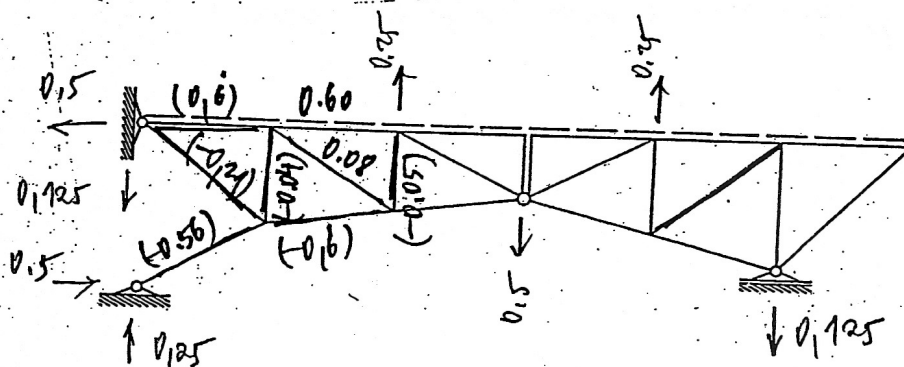
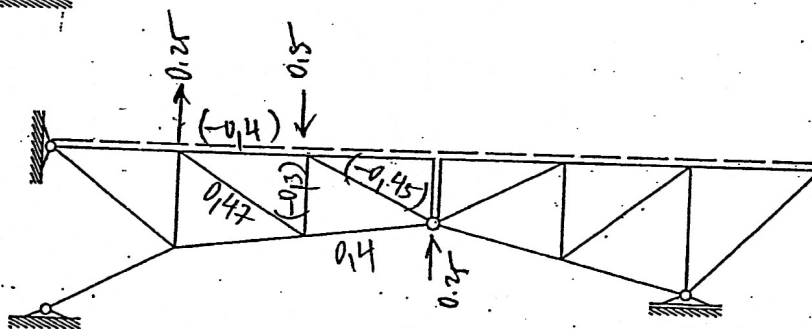
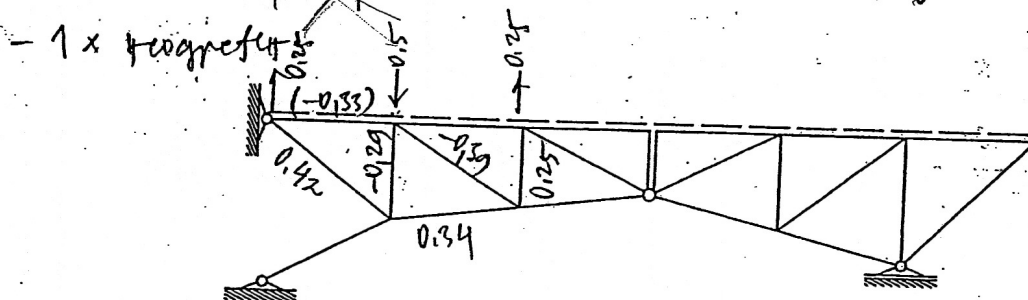
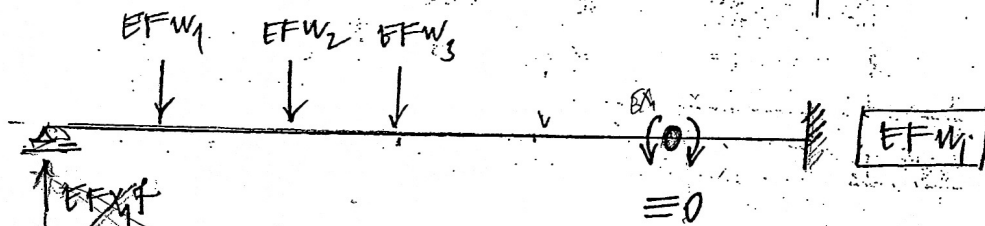
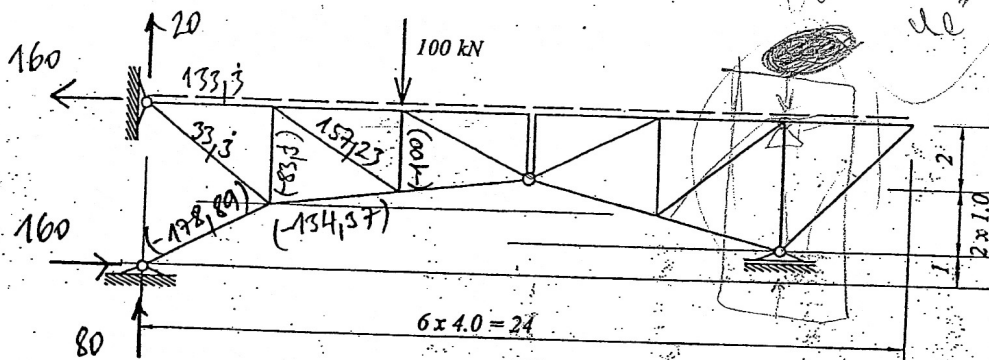
$$- \frac{0.03}{2} \times 5 - \frac{0.03}{2} \times 2.5$$

$$= 74.151$$



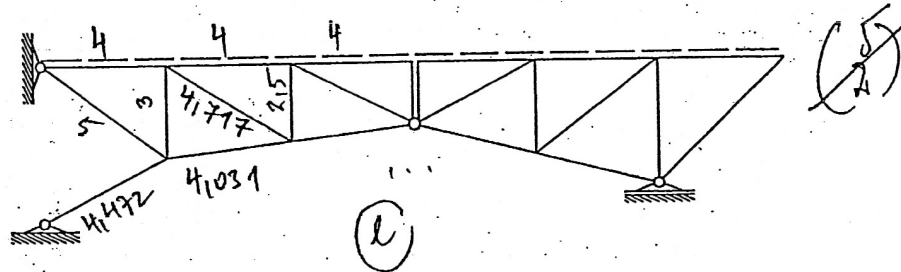
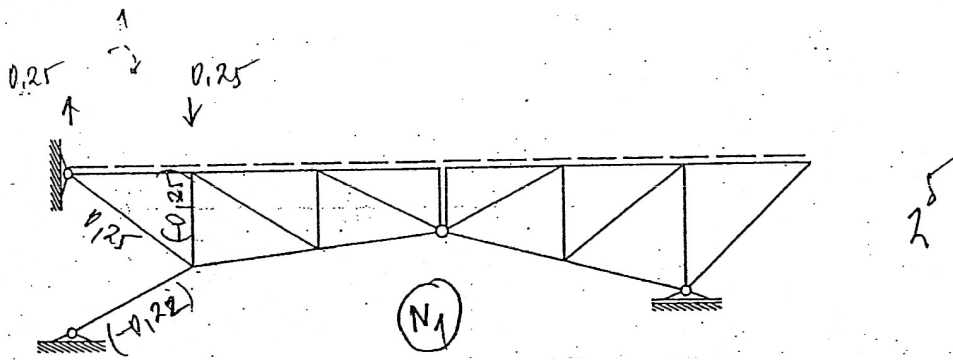
Дата приема 1987, присвоє познач за кваліфі и спеціаль на роботі

2.347474K



$$EFW_1 = \int_s N \cdot \bar{N}_1 \cdot ds$$

$$EFx_1^f = \int_s N \cdot N_1 \cdot ds$$



$$EI w_1 = \int N \cdot \bar{N}_1 ds$$

$$= 133 \times (-0.53) \times 4 + 33 \times 0.42 \times 5 + 157.23 \times (-0.39) \times 4.717 + (-83.3) \times (-0.29) \times 3 + (-100) \times 0.25 \times 2.5 + (-134.37) \times 0.34 \times 4.031$$

$$= -585.9139$$

$$EI w_2 = \int N \bar{N}_2 ds$$

$$= 157.23 \times 0.47 \times 4.717 + (-100) \times (-0.3) \times 2.5$$

$$= 423.5773$$

$$EI w_3 = \int N \bar{N}_3 ds$$

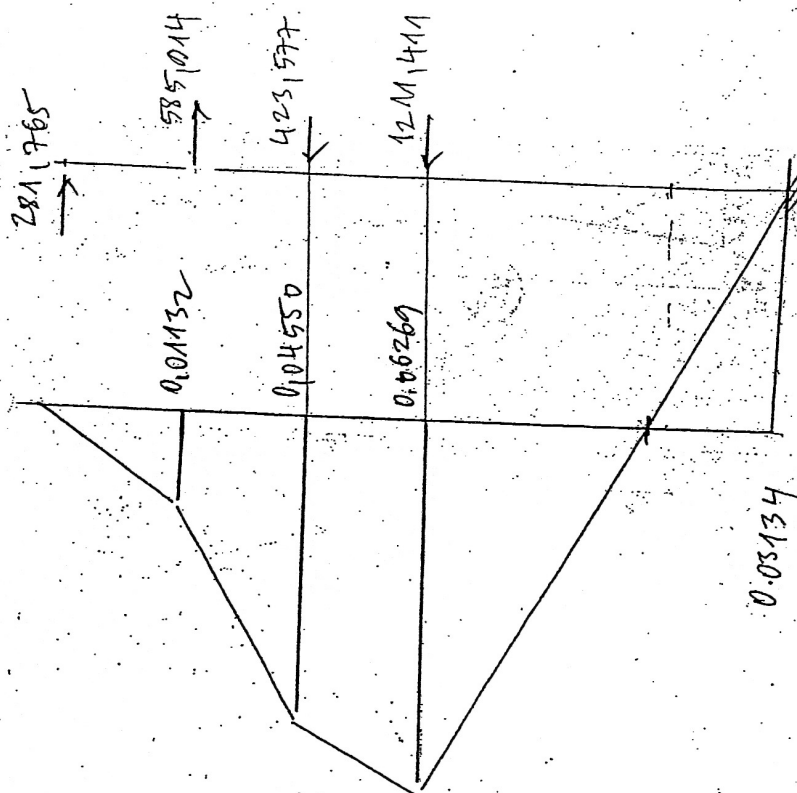
$$= 133.3 \times 0.18 \times 4 + (-134.37) \times (-0.18) \times 4.031 + 33.3 \times (-0.21) \times 5 + 157.23 \times 0.08 \times 4.717 + (-83.3) \times (-0.04) \times 3 + (-178.89) \times (-0.16) \times 4.472 + (-100) \times (-0.05) \times 2.5$$

$$= 1211.4110$$

$$EI x_1 = \int N \bar{N}_1 ds$$

$$= 33.3 \times 0.25 \times 5 + (-83.3) \times (-0.25) \times 3 + (-178.89) \times (-0.22) \times 4.472$$

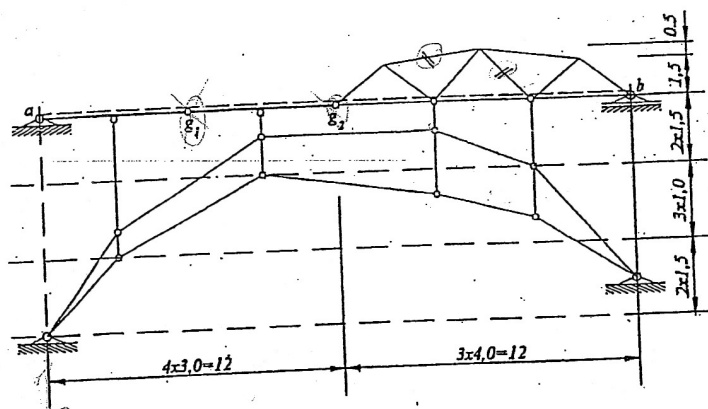
$$= 281.765$$



$\phi 75$
(mm)

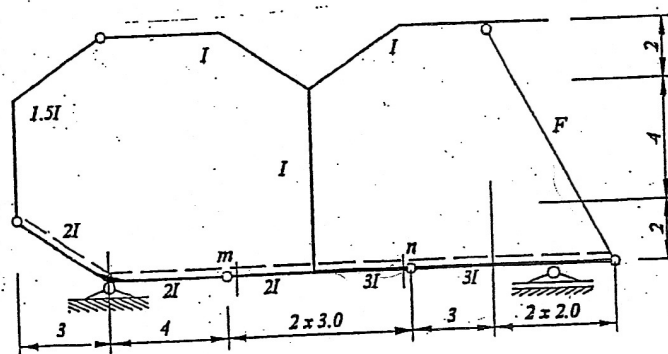
$\phi +$

Задатак I



Конструисати утицајне линије за силе у означеним штаповима решеткасте плоче, носача на слици.

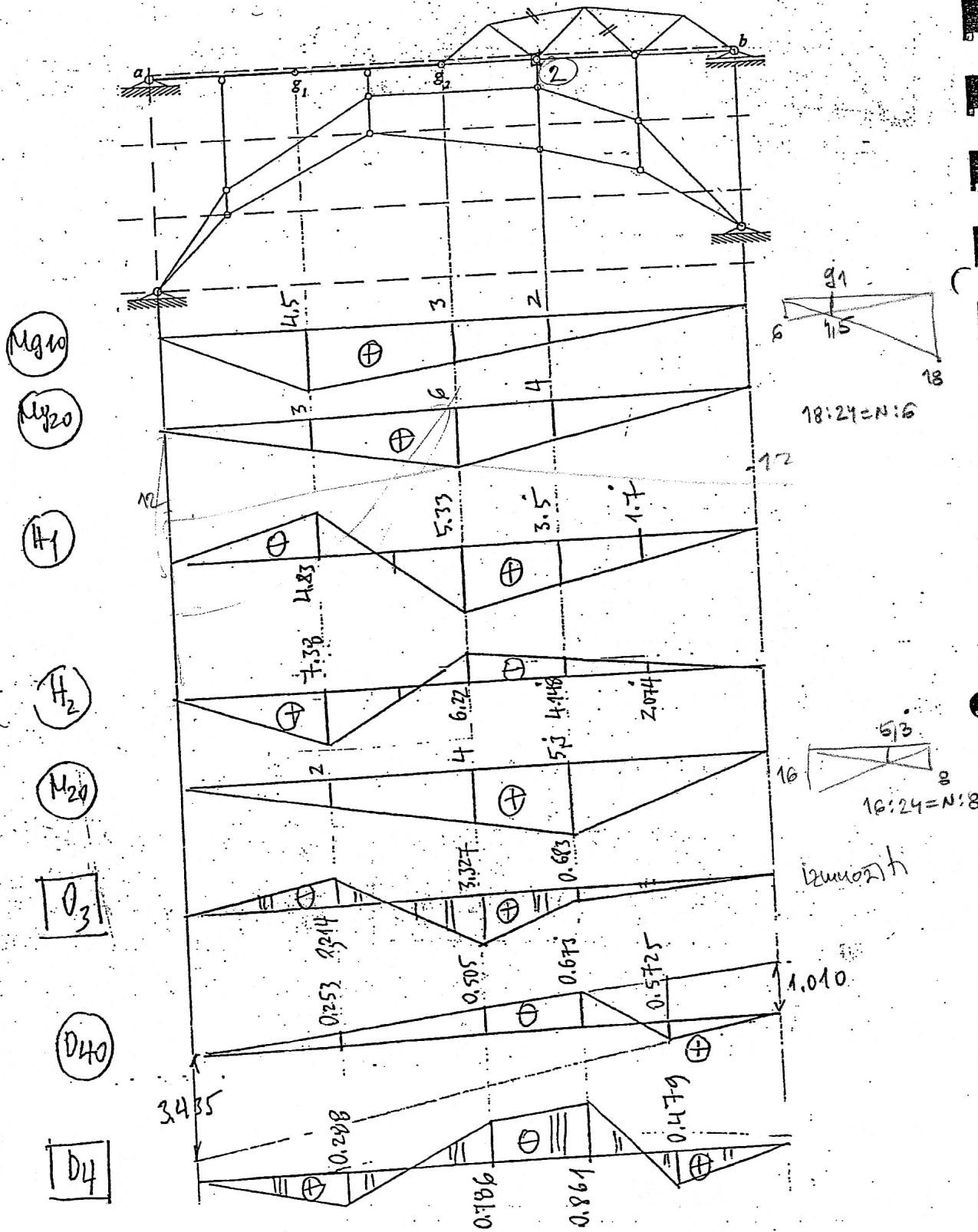
Задатак II



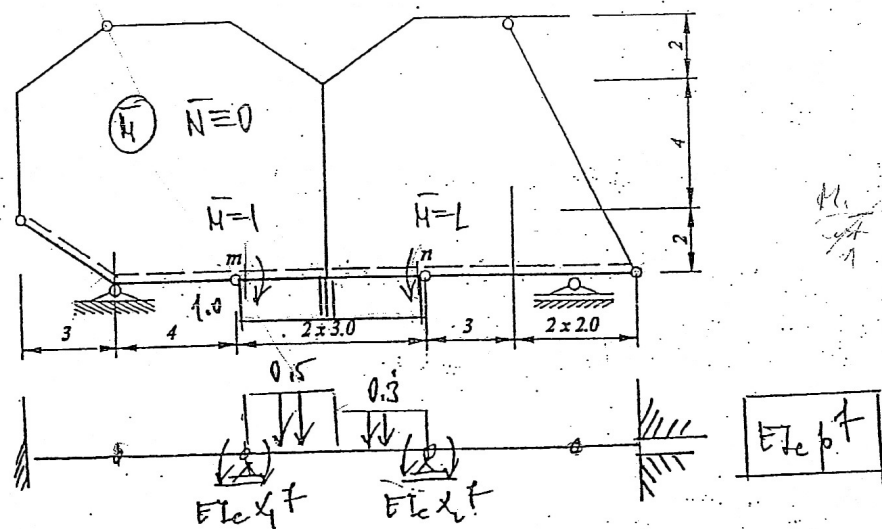
Срачунати и нацртати утицајну линију за разлику обртања пресека $\varphi_m^d - \varphi_n^l$. (Пун носач: $EI=10^5 \text{ kNm}^2$, $I/F \approx 0$, $I/G \approx 0$, прост штап: $I/F=0.1 \text{ m}^2$).

$$D_3 = -\frac{M_{20}}{1.75} + \frac{6.5}{1.75} H_1 + \frac{4}{1.75} H_2 \quad (= -0.5759 M_{20} - 1.291 M_{g10} + 1.583 M_{g20})$$

$$D_4 = D_{40} + \frac{1.375}{9.899} H_1 + \frac{1.625}{9.899} H_2 \quad (= 0.101 M_{d40} + 0.2273 M_{g10} - 0.1604 M_{g20})$$



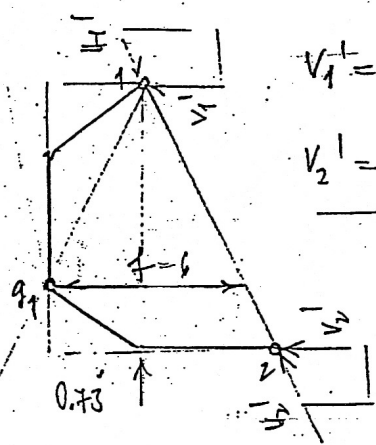
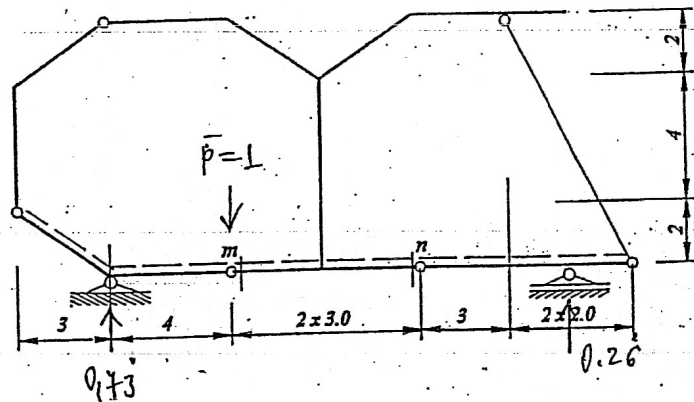
2.348.47AK :



$$\frac{H_1}{L} = \frac{P}{L}$$

учет $E_L = I$

$$E_L \rho \theta = H \frac{L}{E} \frac{1}{\cos \alpha} \quad , \quad E_L \chi_i = \sum H H_i \frac{E_L L}{E} + \frac{I}{E} \sum \bar{M} N_i \frac{E_L L}{F} = 0$$



$$V_1' = \frac{H_2}{L} = \frac{0.73 \times 4}{8} = 0.36$$

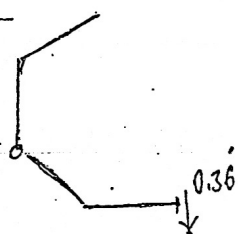
$$V_2' = \frac{H_1}{L} = 0$$

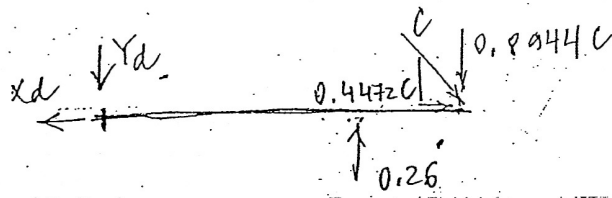
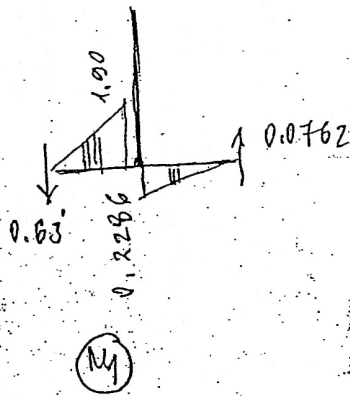
$$H_1 = \frac{H_2 \cdot 6}{L} = \frac{0.36 \times 6}{6} = 0.36$$

$$H_2 = \frac{H_1 \cdot 3}{L} = \frac{0.36 \times 3}{6} = -0.36$$

$$V_2 = V_2' - H_2 \cdot L_0 = \dots$$

$$V_1 = V_1' + H_1 \cdot L_0 = \dots$$





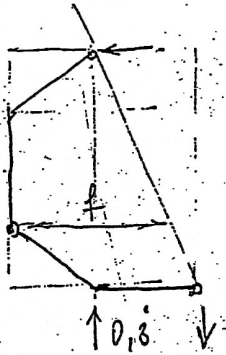
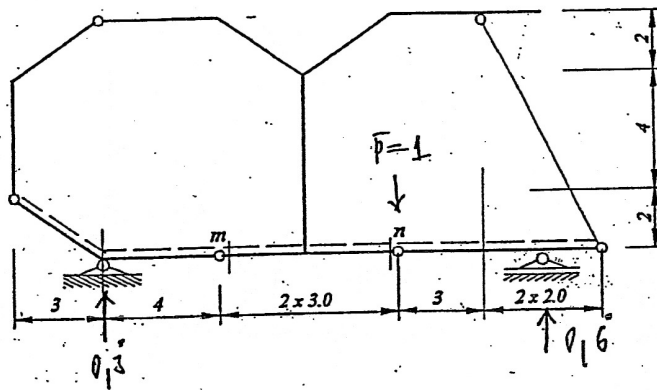
$$0.8944 \times l \times 7 - 0.26 \times 5 = 0 \rightarrow l = 0.213$$

$$Y_d = 0.26 - 0.8944 \times 0.213$$

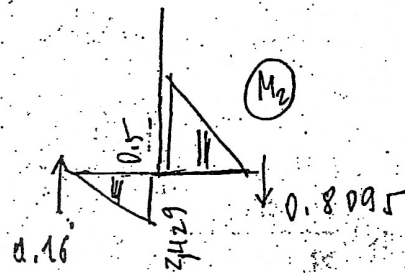
$$Y_d = 0.0762$$

$$EI_c \chi_1^f = \sum M_1 \cdot \bar{H} \cdot \frac{EI_c \cdot l}{EI}$$

$$= \frac{1}{2} \times 1 \times 1.90 \times \frac{1}{2} \times 3 + \frac{1}{2} \times 1 \times 0.2286 \times \frac{1}{3} \times 3 = -1.31$$

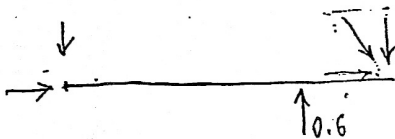


$$H_2 = \frac{-0.3 \times 3}{6} = -0.16$$



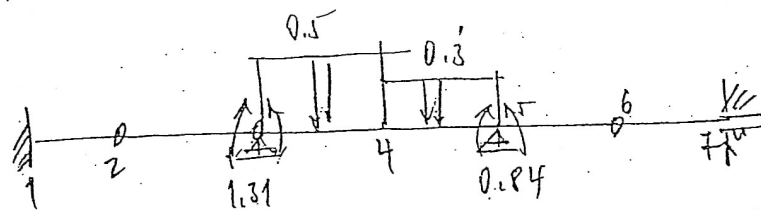
$$0.8944 \times l \times 7 - 0.16 \times 5 = 0 \rightarrow l = 0.5324$$

$$Y_d = 0.16 - 0.8944 \times 0.5324 = 0.1905$$

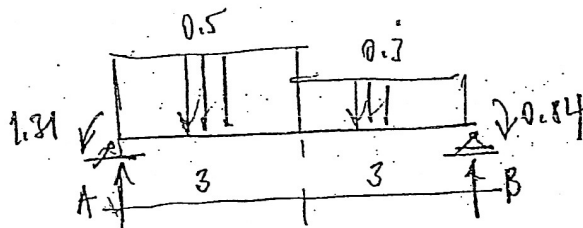


$$EI_c \chi_2^f = \sum M_2 \cdot \bar{H} \cdot \frac{EI_c \cdot l}{EI}$$

$$= \frac{1}{2} \times 1 \times 0.5 \times \frac{1}{2} \times 3 - \frac{1}{2} \times 1 \times 2.49 \times \frac{1}{3} \times 3 = -0.84$$



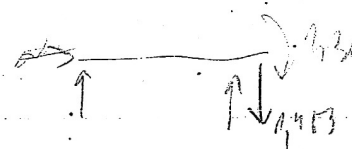
ΣEO 3-4-5:



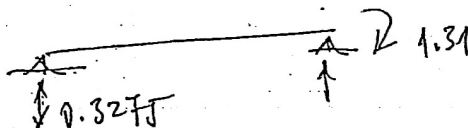
$$A = \frac{\sum M_b}{L} = \frac{1.31 - 0.84 + 0.3 \times 3^2/2 + 0.5 \times 3 \times 4^2}{6} = 1.453$$

$$M_4 = 0.80$$

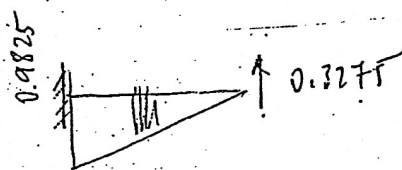
$$B = 0.5 \times 3 + 0.3 \times 3 - 1.453 = 1.046$$



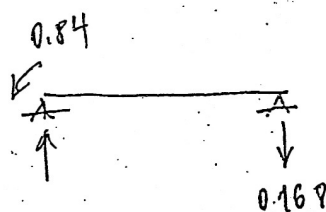
ΣEO 2-3:



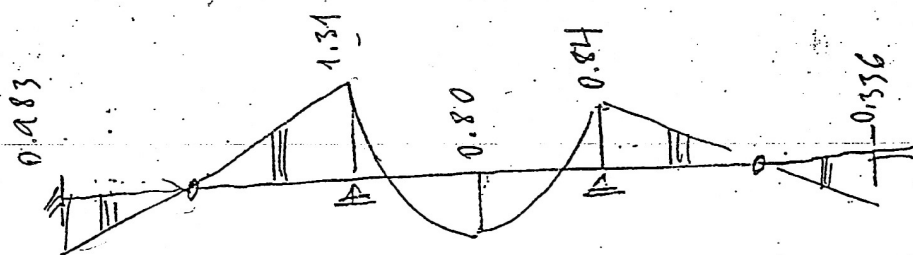
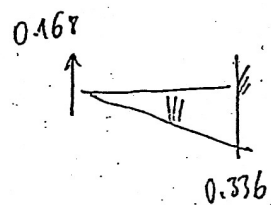
ΣEO 1-2:



ΣEO 5-6:



ΣEO 6-7:



$$E I_c (\psi_m^d - \psi_n^c)$$