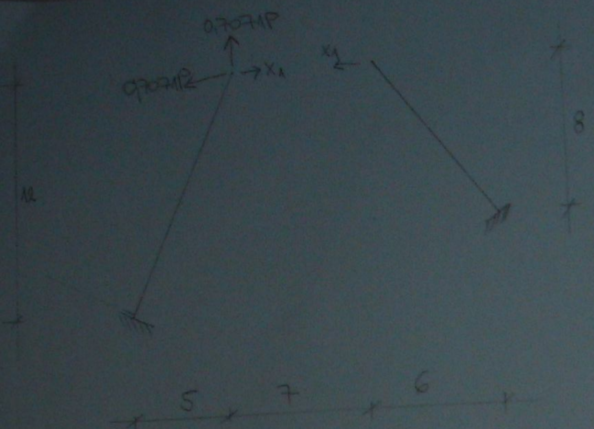
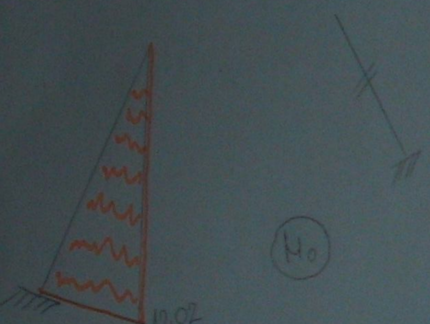
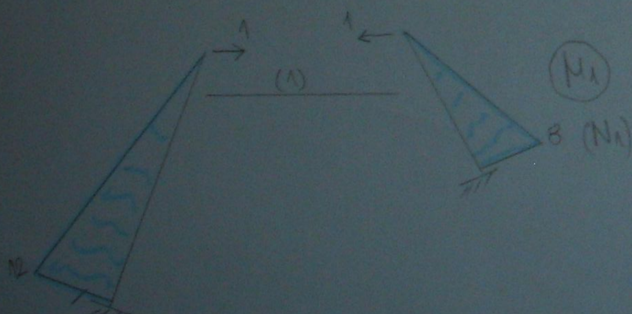


27.06.2010





(1)

$$\delta_{10} = \frac{1}{EI_c}\int\left(M_0 M_1 \frac{I_c}{I} + N_0 N_1 \frac{I_c}{F}\right)ds$$

$I = \frac{15}{12} 40^3 = 80\,000\ cm^4$ $F = 4^2\pi = 50{,}265\ cm^2$ ($E I_c$ ...)

$\frac{I}{F} = 0{,}1591\ m^2$

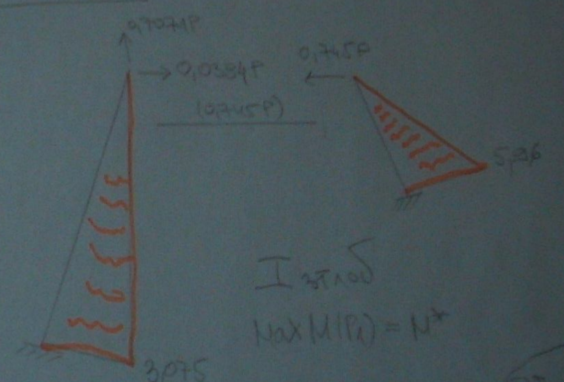
$W^* = 15 \cdot 20^2 = 6000\ cm^4$ $M^* = 240\ kNm$ $N^* = 201{,}06\ kN$

$$\delta_{10} = \frac{1}{EI_c}\left(-\frac{13}{3}\, 12{,}02 \cdot 12\right) = -\frac{625{,}04}{EI_c}$$

$$\delta_{11} = \frac{1}{EI_c}\int\left(\frac{I_c}{I} M_1^2 + \frac{I_c}{F} N_1^2\right)ds = \frac{1}{EI_c}\left(\frac{13}{3} 12^2 + \frac{10}{3} 8^2 + 0{,}1591 \cdot 7 \cdot 1^2\right)$$

$$\delta_{11} = \frac{838{,}447}{EI_c}$$

$$\boxed{X_1 = 0{,}745P}$$



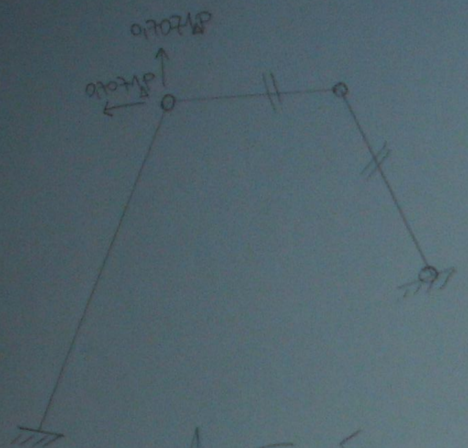
I στύλος

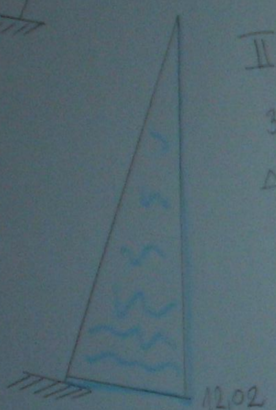
$max\, M(P_1) = M^*$

1) $5{,}96 \cdot P_1^* = 240\ kNm$ $\quad P_1^* = 40{,}268$

2) $0{,}745 \cdot P_1^* = 201{,}06$ $\quad P_1^* = 269{,}88$

(2)





II згиб

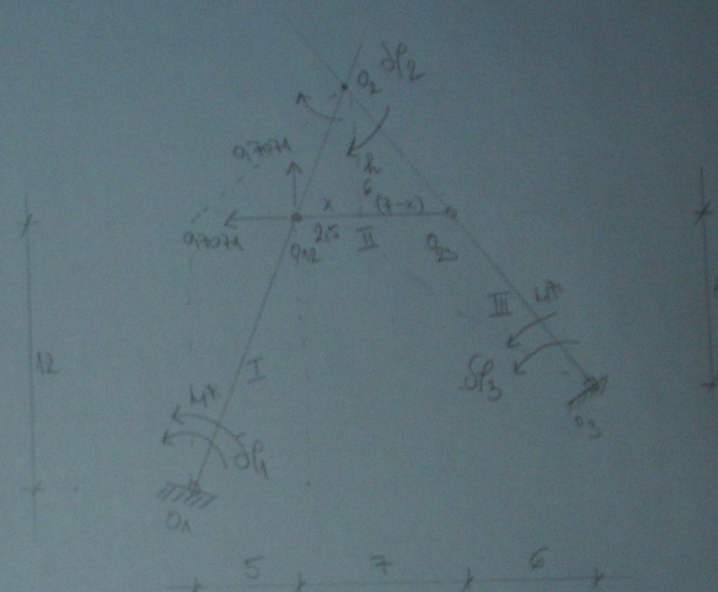
$3{,}075 \cdot 40{,}268 + 12{,}02\,\Delta P = 240$

$\Delta P = 9{,}665$

$P^{*} = 9{,}665 + 40{,}268 = 49{,}93\,kN$

(3.)

Провера кинематички



$5 : 12 = x : h$

$5h = 12x$

$h = \frac{12x}{5}$

$6 \cdot 8 = (7-x) : h$

$6h = 8(7-x)$

$6h = 56 - 8x$

$6\frac{12x}{5} = 56 - 8x$

$14{,}4x = 56 - 8x$

$x \cdot 22{,}4 = 56$

$x = 2{,}5$

$2{,}5\,\delta\varphi_1 = 2{,}5\,\delta\varphi_2$; $4{,}5\,\delta\varphi_2 = 6\,\delta\varphi_3$

$\boxed{2\delta\varphi_1 = \delta\varphi_2}$

$\delta\varphi_3 = 0{,}75 \cdot \delta\varphi_2$

$\delta\varphi_3 = 0{,}75 \cdot 2\delta\varphi_1$

$\boxed{\delta\varphi_3 = 1{,}5\,\delta\varphi_1}$

$0{,}7071P \cdot 12\delta\varphi_1 + 0{,}7071P \cdot 5\delta\varphi_1$

$= M^{*}\delta\varphi_1 + 1{,}5M^{*}\delta\varphi_1$

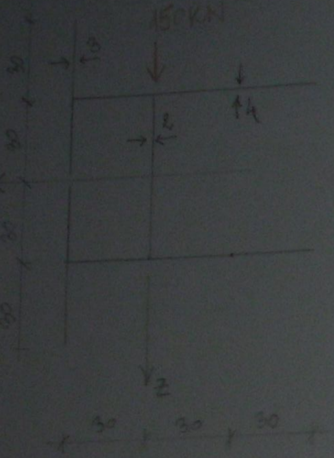
$12{,}0207P\,\delta\varphi_1 = 600\,\delta\varphi_1$

$P = 49{,}91$

Jeee!

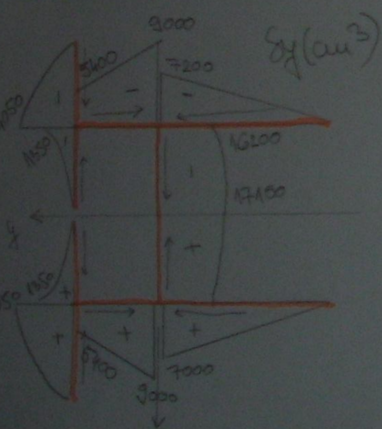
(4.)

9.30



$I_y = 2\left[\frac{60}{3} 60^2 \cdot 3 + 90 \cdot 30^2 \cdot 4 + \frac{30^3}{3} \cdot 2\right]$

$I_y = 1116000\ cm^4$

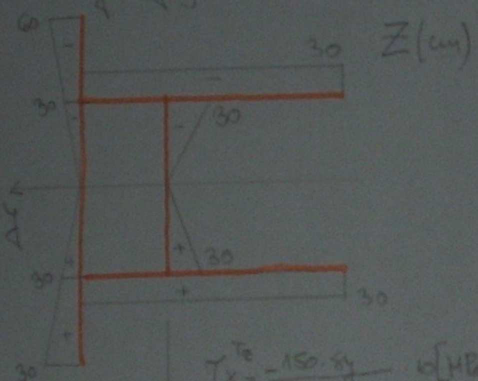


Услед $T_z \to \tau_x^{T_z} = -\frac{T_z \cdot S_y}{I_y t_i}$

$T_z \to M_t^{T_z} \to \tau_x^{M_t} = \frac{M_t}{I_t} t_i$

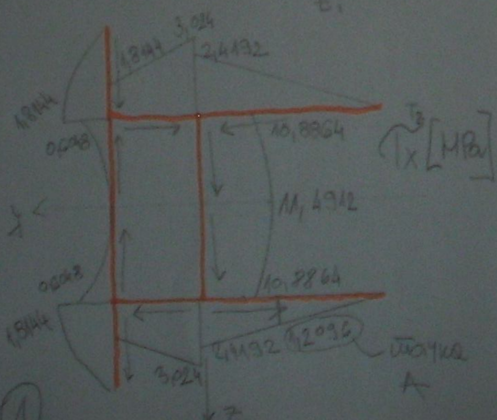
$y_S = y_P + \frac{I_{z\omega_P}^{(A)}}{I_y}$

$I_y, S_y \} Z (cm)$



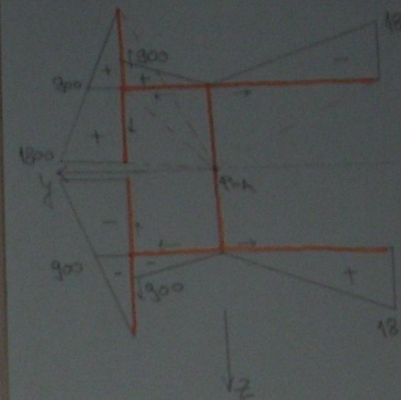
$\tau_x^{T_z} = \frac{-150 \cdot S_y}{1116000\ cm^4 t_i} \cdot 10 [MPa]$

$\tau_x = -\frac{0.001344\ S_y}{t_i}$



(1)

$S_\omega = 0 \quad \omega_0 = 0$



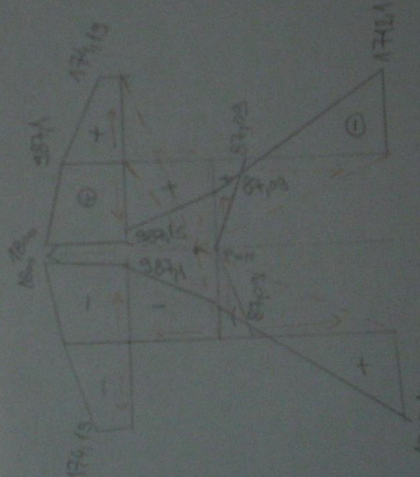
$\omega_P^{(A)} [cm^2]$

$I_{z\omega_P}^{(A)} = -2\left[\frac{60}{6} 1800 \cdot 60 \cdot 3 + \frac{30}{2} 900 \cdot 30 \cdot 4\right] + 2 \frac{60}{2} 1800 \cdot 30 \cdot 4$

$I_{z\omega_P}^{(A)} = 3240000\ cm^5$

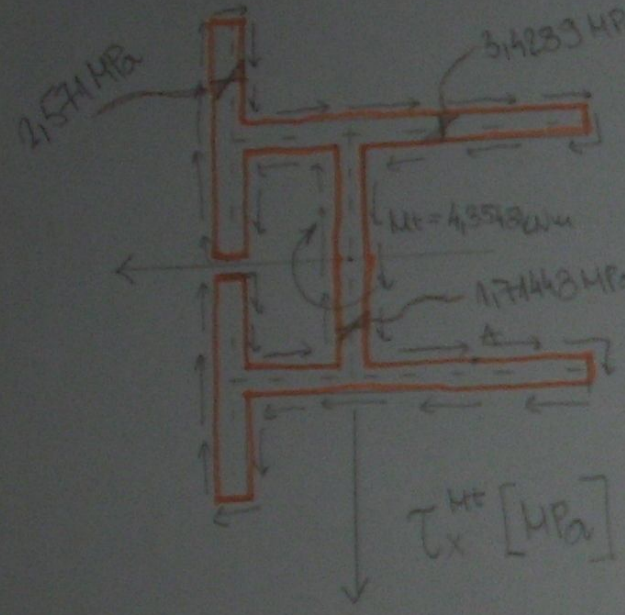
$y_S = 0 + \frac{3240000}{1116000} = 2{,}903\ cm$

$M_t = 43{,}548$



Ово сам радео бадава! Не треба ми.
А да их нађем колико нису нормални, кад оно не треба! ☺

(2)



$$\tau_x^{Mt} = \frac{Mt}{It} \cdot t_i$$

$$It = \frac{1}{3}\left[180 \cdot 4^3 + 120 \cdot 3^3 + 60 \cdot 2^3\right]$$

$$It = \frac{1540}{3} = 5080 \text{ cm}^4$$

$$\tau_x^{Mt} = \frac{4,3548 \cdot 10^3}{5080 \text{ cm}^4} \cdot t_i \text{ [MPa]}$$

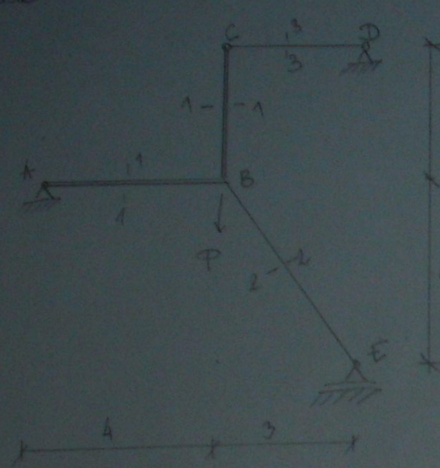
$$\tau_x = 0,85724 \cdot t_i \text{ [MPa]}$$

$$\tau_{xy(A)} = -4,6385$$

Тензор напружень у точці A

$$A\begin{bmatrix} 0 & -4,6385 & 0 \\ -4,6385 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

Ало братан



1-1

$I_1 = 213333{,}33\ cm^4$

$W_1^* = 16000\ cm^3$

$M_1^* = 160\ kNm$

40

40

2-2

2

60

20

$I_2 = 106666{,}67\ cm^4$

$W_2^* = 8000\ cm^3$

$M_2^* = 80\ kNm$

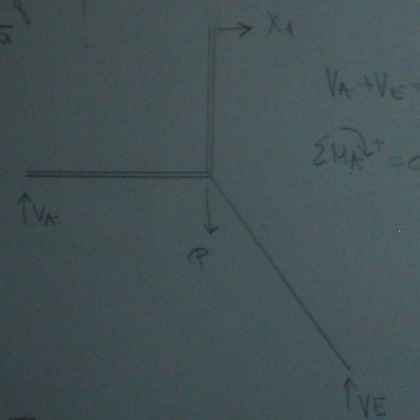
$k = 5 + 0 + 2 + 4 - 2 \cdot 5 = 1$

[3] ⌶5

$F_3 = 25\ cm^2$

$N^* = 25\ kN$

Укидам штап



$V_A + V_E = P$

$\Sigma M_A = 0; \quad 4P = (3+4) V_E$

$V_E = \frac{4P}{7} = 0{,}571P$

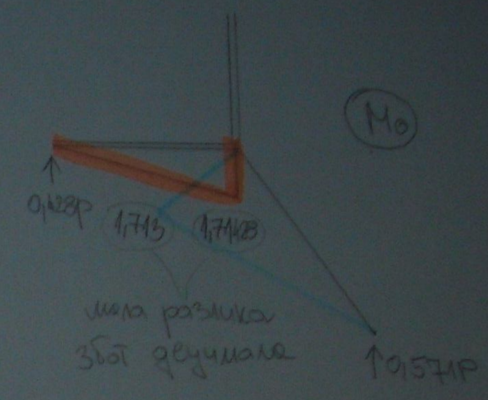
$V_A = 0{,}428P$

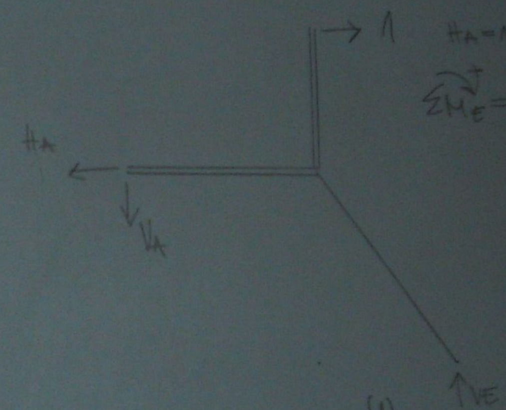
$I_c = I_1$

$\frac{I_c}{I_2} = 2$

$\frac{I_c}{F} = 0{,}8533\ m^2$

(1)





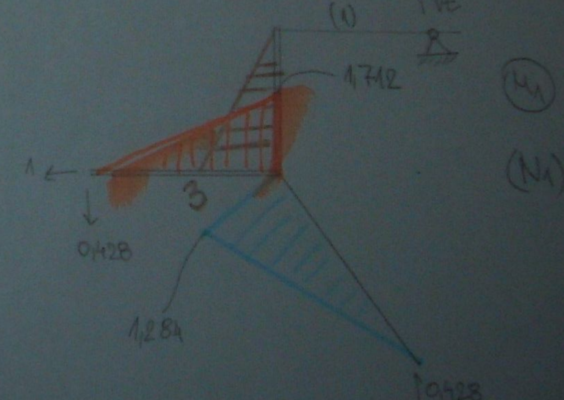
$H_A = 1$

$\Sigma M_E = 0 \quad 7 - 4 = 7V_A$

$3 = 7V_A$

$V_A = 0{,}428$

$V_E = 0{,}428$

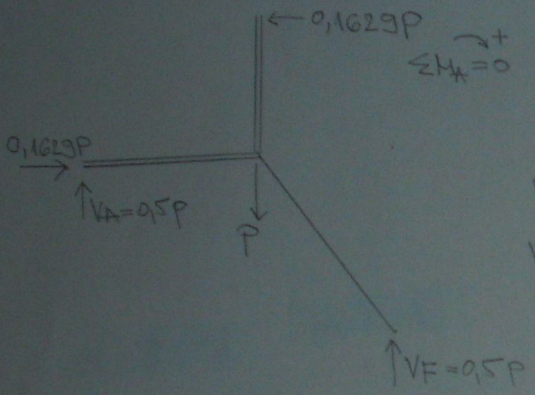


(2)

$$\delta_{10} = -\frac{4}{3}\,1{,}712\cdot 1{,}7148 + 2\cdot\frac{5}{3}\,1{,}713\cdot 1{,}284 = \frac{3{,}417}{EI_C}$$

$$\delta_{11} = \frac{4}{3}\,1{,}712^2 + 2\cdot\frac{5}{3}\,1{,}284^2 + \frac{3}{3}\,3^2 + 0{,}8533\cdot 3\cdot 1^2$$

$$\delta_{11} = \frac{20{,}96}{EI_C} \qquad X_1 = -0{,}1629P$$

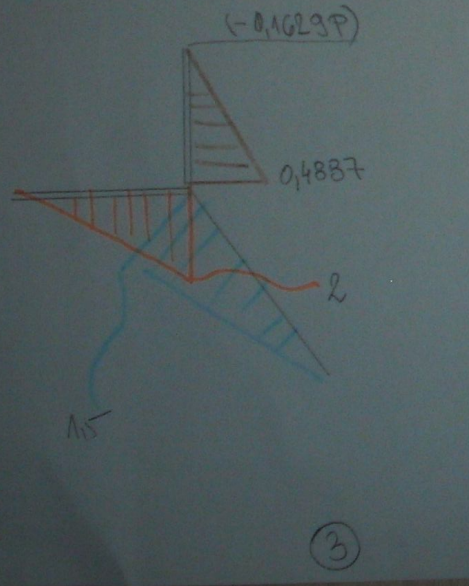


$\Sigma M_A \overset{+}{=} 0 \quad 4P - 0{,}1629P\cdot 3 = 7V_F$

$3{,}5113P = 7V_F$

$V_F \cong 0{,}5P$

$V_A \cong 0{,}5P$



③

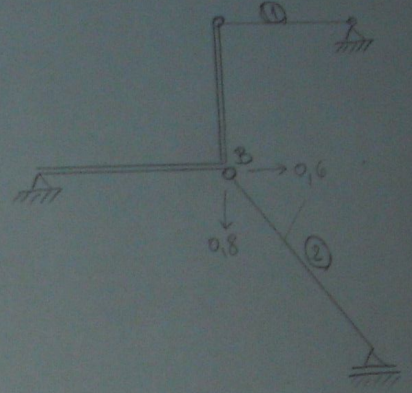
I stato

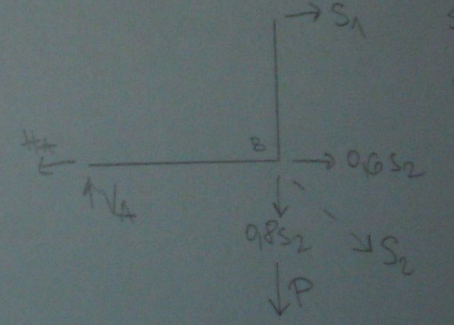
1) $2P = 160\,kNm \Rightarrow P_1^* = 80\,kN$

2) $1{,}5P = 80\,kNm \Rightarrow P_1^* = 53{,}333\,kN$

3) $0{,}1629P = 25\,kN \Rightarrow P_1^* = 153{,}468\,kN$

$\Rightarrow P_1^* = 53{,}333\,kN$





$S_1 + 0{,}6S_2 = H_A$

$V_A - 0{,}8S_2 + P$

$\Sigma M_B \overset{+}{=} 0 \quad 3S_1 + 4V_A = 0$

$\boxed{S_2 = 0}$

$V_A = P \qquad H_A = S_1$

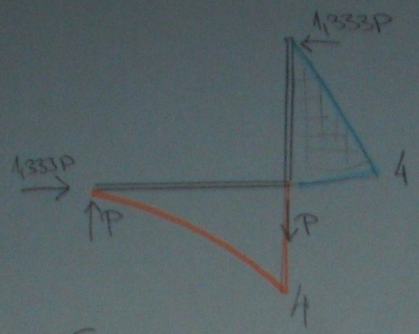
$\Sigma M_A \overset{+}{=} 0 \quad 4P + 3S_1 = 0$

$4P = -3S_1$

$\boxed{S_1 = -1{,}3333P}$

$\boxed{H_A = -1{,}333P}$

④



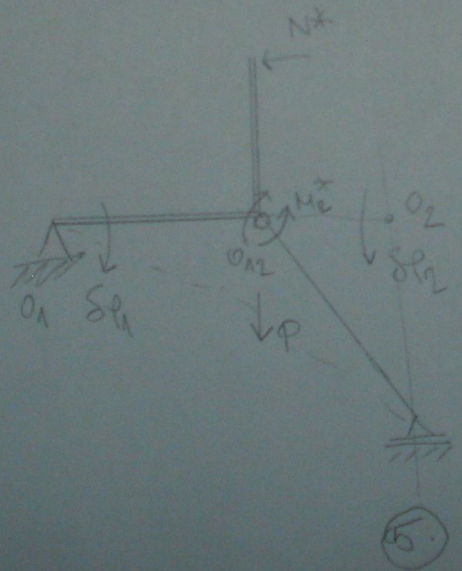
II этап

1) $0{,}4889 \cdot 53{,}333 + 4\Delta P = 160 \qquad \Delta P = 33{,}484$

2) $0{,}1629 \cdot 53{,}333 + 1{,}33P = 25 \qquad \Delta P = 12{,}237 \Rightarrow$ удлинение

$$P^* = 65{,}57 = 12{,}237 + 53{,}333$$

Проверка



$4\delta_{11} - 3\delta_{12} \qquad \frac{4}{3}\delta_{11} = \delta_{12}$

$4P\delta_{11} = M_2^* \delta_{12} + M_2^* \delta_{22} + N^* \cdot \delta_{11}$

$4P\delta_{11} = \frac{7}{3}\delta_{11} M_2^* + 75\delta_{11}$

$4P = 186{,}667 + 75$

$P = 65{,}4167$ KN

5.