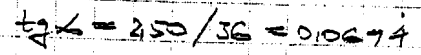


- ПАРЭБЛИНАТУ ПРОМЕНУ АПРОКСИМУРАТИ ЛИНЕАРНО!

~~*** $\lambda = 5.0 \text{ m}$ ***~~

25 IX 2004



$$r = 9 - 10 \lg 6 = 7,75 \text{ м}$$

$$t_{gk} = -0,0694$$

$$\sec \alpha_1 = 1.1577$$

$$\sec \alpha_2 = 1.11803$$

$$\sec \alpha_3 = \sec \alpha_4 = 1.00$$

SEC 45 = 111803

$$\sec \alpha_c = 1.9142$$

THE UNITED STATES GOVERNMENT
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

$$Z_0 = 172,50$$

$$A_0 = 207,50$$

= 191,613

Клас. Проакције
интервју

A hand-drawn diagram of a rectangular structure, possibly a building or a container, with dimensions and labels. The structure is a rectangle with a smaller rectangle inside it. The outer rectangle has a width of 4 units and a height of 5 units. The inner rectangle has a width of 2 units and a height of 3 units. The area between the two rectangles is shaded. The labels 'A' and 'B' are placed near the rectangles. The text 'X-82, 42' is written below the diagram.

~~A~~-82,42

$$B = -5.81$$

$\frac{1}{2} \text{ Sun} = \frac{1}{2} \text{ Sun} + 1$
 $\frac{1}{2} \text{ Sun} = \frac{1}{2} \text{ Sun} + 1$
 $\frac{1}{2} \text{ Sun} = \frac{1}{2} \text{ Sun} + 1$

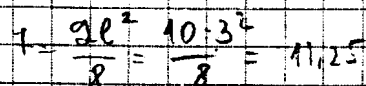
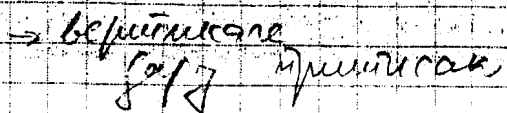
Yr: #1961-1962

② $H = 5 \text{ m sec}^{-1}$

4. Характеристики
Характеристики (свойства)
Материал: металл
Материал: металл

1940-1941

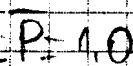
1



дуратам можеш ли
избави се когато си отиш срещу
филмът

- факты и часы

Пожалуйста, не забудьте подписать документ.



$$\Sigma \dot{\varphi} = \dot{\phi}'' \quad 0.50 + A_0 - 1.10 = \dot{\phi}'' \quad \Rightarrow \quad A_0 = 0.50 \quad \beta' = 1.1081 \quad \beta = -0.581$$

$\Sigma M_j^L = 0.50 \cdot 12 = 6$ # F75 \rightarrow # = 11615

реакция у опор (метод)
мол $\bar{P} = 1.00$ на 1 м ширины

$$Y_1 = 1.1613 (0.583 - 0.50) = 0.0967$$

$$Y_2 = 1.1813 (0.50 - \phi) = 0.5806$$

$$13 = \overline{111613} (\phi - \phi) = \phi$$

$$V_1 = \frac{11813}{\phi + 0.50} = 0.5808$$

$$Y_5 = 11.813(-0.5 + 1.0) = 0.5806$$

$$S_1 = 114613 \cdot 114577 = 1344$$

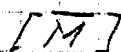
$$S_2 = 111813 \cdot 111803 = 11298$$

$$S_J = 111613 \cdot 1100 = 1,1613$$

$$S_f = 111613 \cdot 1,00 = 111613$$

$$55 - 74613 \cdot 144803 = 11298$$

$$56 = 1442 \cdot 11613 = 16423$$



гуаираи повечност;
сва ринт кога,
отворети; јд. Сино
 $P = 1$

$$EI_{X1}^+ = \overline{MHds} + 0.10 \overline{NNds}$$

$$\overline{MHds} = 5 \cdot 15,892 \cdot 0.0967 + 2 \cdot 25,302 \cdot 0.5306 + 2 \cdot 25,302 \cdot 0.5306 + 5 \cdot 25,302 \cdot 0.5306 +$$

$$+ \sqrt{13,25} \cdot 221,830 \cdot 1.344 + \sqrt{45} \cdot 214,223 \cdot 1.298 + 6 \cdot 191,613 \cdot 1.613 \cdot 2 +$$

$$+ \sqrt{45} \cdot 214,223 \cdot 1.298 + \sqrt{72} \cdot 270,980 \cdot 1.6423$$

$$\overline{NNds} = 7,539983 + 111,24993 + 111,24993 + 278,12482 + 2070,9433 + 1865,2929 +$$

$$+ 3708,2612 + 1265,2929 + 3776,2026$$

$$\overline{NNds} = 13794,814 \quad \text{of moments of inertia} \quad \text{horizontal} \quad \text{vertical}$$

$$\overline{MHds} = \frac{3}{3} \cdot 247,257 \cdot 0.774 - \frac{3}{6} \left[247,257 \cdot (2 \cdot 0.774 + 1.548) + 494,514 \cdot (2 \cdot 1.548 + 0.774) \right] -$$

$$\frac{3}{12} \left[494,514 \cdot (2 \cdot 1.548 + 2.0319) + 128,865 \cdot (2 \cdot 2.0319 + 1.548) \right] +$$

$$\frac{3}{12} \left[128,865 \cdot (2 \cdot (-2.0319) + 2.5158) + 116,784 \cdot (2 \cdot 2.5158 - 2.0319) \right] +$$

$$\frac{3}{9} \left[116,784 \cdot (2 \cdot 2.5158 + 1.2579) + 132,785 \cdot (2 \cdot 1.2579 + 2.5158) \right] +$$

$$+ \frac{3}{9} \cdot 1.2579 \cdot (2 \cdot 132,525 + 150) + \frac{3}{9} \cdot 62,418 \cdot 1.748 + \frac{3}{18} \left[1.748 \cdot (2 \cdot 62,418 + 214,836) \right] +$$

$$+ 3,4884 \cdot (2 \cdot 214,836 + 62,418) + \frac{3}{18} \left[3,4884 \cdot (2 \cdot 214,836 + 169,836) + \right.$$

$$+ 3,4872 \cdot (2 \cdot 169,836 + 214,836) \left. \right] + \frac{3}{18} \left[3,4872 \cdot (2 \cdot 169,836 + 214,836) + \right.$$

$$+ 3,426 \cdot (2 \cdot 214,836 + 169,836) \left. \right] + \frac{3}{6} \left[3,426 \cdot (2 \cdot 214,836 + 62,418) + \right.$$

$$+ 1,743 \cdot (2 \cdot 62,418 + 214,836) \left. \right] + \frac{3}{3} \cdot 1,743 \cdot 62,418 - \frac{3}{9} \cdot 11,25 \cdot 1,748 -$$

$$- \frac{3}{9} \cdot 11,25 \cdot (1,748 + 3,4884) - \frac{3}{9} \cdot 11,25 \cdot (3,4884 + 3,4872) -$$

$$- \frac{3}{9} \cdot 11,25 \cdot (3,4872 + 3,426) - \frac{3}{3} \cdot 11,25 \cdot (3,426 + 1,743) - \frac{3}{3} \cdot 11,25 \cdot 1,743$$

$$\overline{MHds} = -191,378 - 191,655 - 956,885 - 633,954 - 264,768 - 73,091 +$$

$$+ 87,579 + 244,838 + 222,707 + 174,081 + 36,369 + 98,958 +$$

$$+ 286,101 + 348,554 + 322,281 + 322,281 + 348,314 + 246,095 +$$

$$+ 296,024 + 108,795 - 6,555 - 19,6385 - 26,156 - 26,150 - 58,826 -$$

$$- 19,609$$

$$\overline{MHds} = 674,03 \quad \text{of moments of inertia} \quad \text{horizontal} \quad \text{vertical}$$

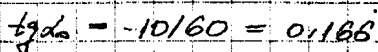
$$EI_{X1}^+ = 674,03 + 0.01 \cdot 13794,814 = 812,03$$

$$EI_{X1}^+ = 812,03$$

* СРЕДН. ОТС. НА КРАЙ. СЛОЕ

\Rightarrow УСРЕДН. МОМЕНТЫ ИЛИ
УСРЕДН. ВЕРТИКАЛЬН. ПОМЕРА

2



$$\sec x_1 = 1.68$$

$$\lg \alpha_2 = 4/12 = 0,33$$

$$\sec \kappa_2 = 1.0541$$

$$t_9 \alpha_3 = 2/12 = 0.166$$

$$\sec \alpha = 1.0138$$

$$t_2 \alpha_1 = \emptyset$$

$$\sec \alpha = 1.0$$

$$\frac{1}{2} \alpha_5 = -2.12 = -0.166$$

$$\sec \alpha = 1.10138$$

$$tg \alpha_G = -2/6 = -0,33$$

$$\sec \alpha B = 110544$$

$$\Sigma M_A = 0 \quad 150 - 350 + 20 \cdot 24 \cdot 54 = 30 \cdot 60 \quad \rightarrow \quad 30 = 428,68$$

$$\Sigma V = 0 \quad A_0 + 428,66 - 20 \cdot 24 = 0 \quad \rightarrow \quad A_0 = 51,35$$

$$\Sigma M_j^L = 0 \quad 51,35 \cdot 36 + 150 - H \cdot 8,0 = 0 \quad \Rightarrow \quad H = 249,75$$

$$A = H(t_2 \alpha_1 - t_2 \alpha_2) = 249,75 (1,133 - 0,165) = 291,375$$

$$B' = H(tg \alpha_1 - tg \alpha_2) = 249,75(0,1866 + 0,33) = 124,875$$

$$\rightarrow A = A_0 - A' = 57,33 - 291,375 = -240,042$$

$$A = -240,042$$

$$B = B_0 - B' = 428,66' - 124,875 = 303,792$$

$B = 303, 792$

$$V_1 = H(1,3j - 0,3j) = 249,75$$

$$S_1 = \# \cdot 1166 = 416,25$$

$$V_2 = 4(0,33 - 0,16) = 41,625$$

$$S_2 = 4.112541 = 263,26$$

$$V_3 = H(0,16 - 0) = 41,625$$

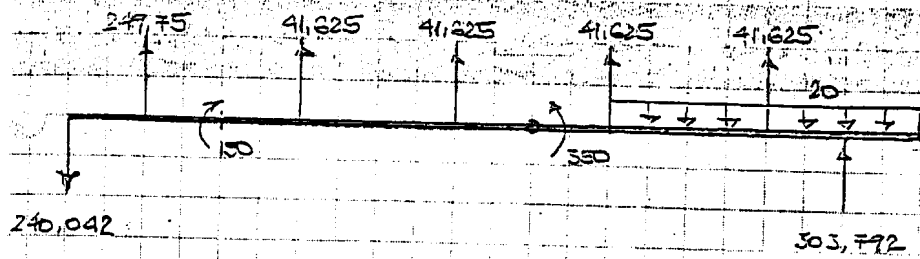
$$J_2 = 110138 = 253,19$$

$$V_4 = 4(\phi + 0.15) = 41.625$$

$$54 = 4 \cdot 1100 = 249,75$$

$$V_5 = H(-0.16 + 0.33) = 41.625$$

$$S_5 = H \cdot 110138 = 253,19$$

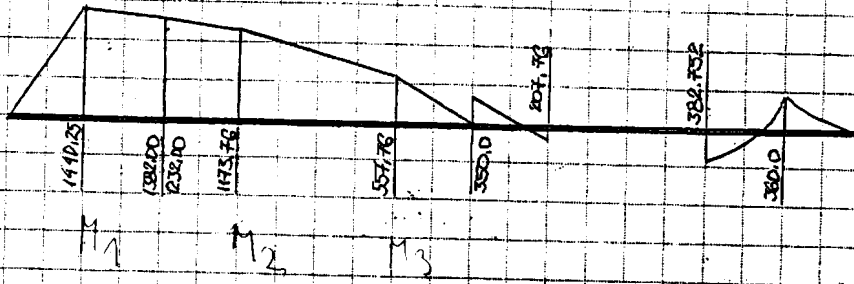


пробата са $H = \frac{1,50}{7}$

$$L' = L_0 - H \cdot \frac{1}{2}$$

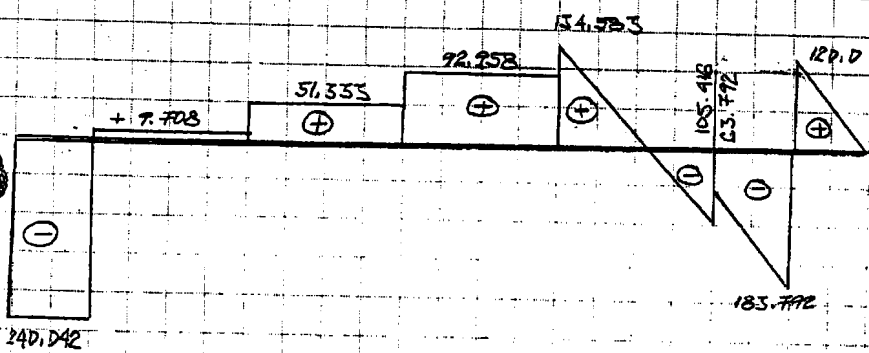
$$H_1 =$$

$$H_2 =$$



[M]

гужагали
нормальных сил
сильно разнота
(5 мВ)



[T]

$$A = A_0 - A' = A_0 - H(\tan \alpha_1 - \tan \alpha_2) = A_0 - H(1,53 - 0,166) = A_0 - 1,166 \cdot H$$

$$A_0 = 10$$

$$A_0 = 6$$

$$\frac{e_2}{f} \cdot 0,166 \cdot H = \frac{-24}{8} \cdot 1,166 = -3,50$$

$$M_c = X_c = 12,0$$

$$Y_c = 48 \cdot 0,166 = 8,0$$

$$M_c = M_{c0} - H \cdot Y_c$$

$$M_c = M_{c0} - 3 \cdot H$$

$$M_{c0} = X_c = 12,0$$

$$M_{c0} = X_c = 49,0$$

$$\frac{e_2}{f} \cdot M_{cH} = \frac{24}{8} \cdot (1 - 3) = -24,0$$

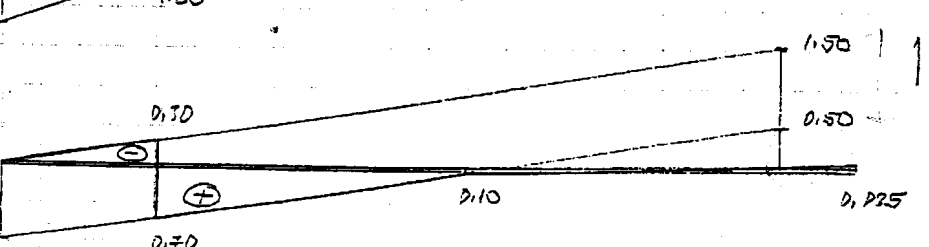
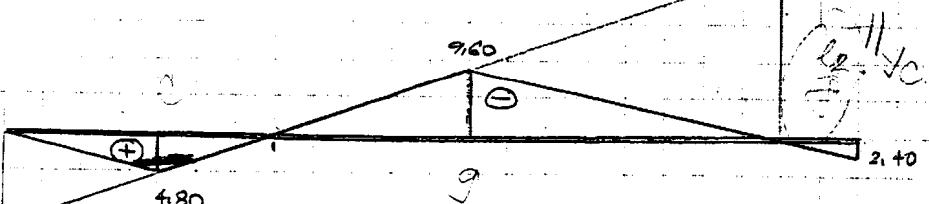
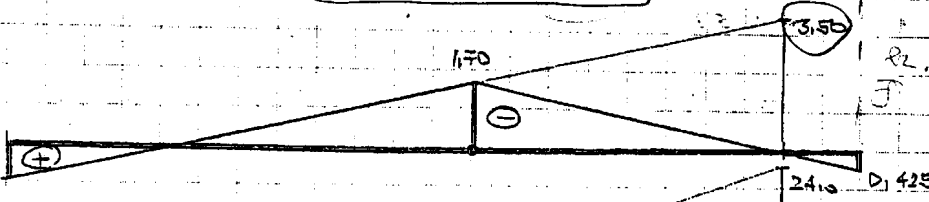
$$\Sigma F = 0$$

$$T_c = T_{c0} + H \tan \alpha_1 - H \tan \alpha_2$$

$$T_c = T_{c0} + H(\tan \alpha_1 - \tan \alpha_2) = T_{c0} + H(0,166 - 0,333)$$

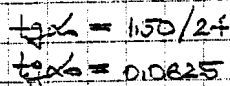
$$T_c = T_{c0} - 0,166 \cdot H$$

$$\frac{e_2}{f} \cdot T_{cH} = \frac{24}{8} \cdot (1 - 0,166) = -0,50$$



19 VI 2004

Q4 RELATION ext M HA LEAK $g_1 - g_2$ KIEG $p = 10.0 \text{ KN/m}^2$



$$\frac{1}{3}22 = 8 - 0,0625 \cdot 12 + 1,50 = 6,75$$

$$\rightarrow B_r = 166,25$$

$$A_0 = 193.75$$

$$H_1 = 165,455 - 1,303 H_2$$

$$\Delta H_2 = 250.73$$

$$H_1 = -161.25$$

-ЛАНТИЗ 2"

$$\lg x_1 = 413 = 11.55$$

$$t_{2x2} = 3,5/6 = 0,583$$

$$79 \times 3 = \phi$$

$$t_2 \times 4 = 115/4 = -0,375$$

$$t_2 \alpha_5 = 4,514 = -11125$$

Year	Number of Cases (approx.)
1990	100,000
1991	100,000
1992	80,000
1993	70,000
1994	60,000
1995	55,000
1996	50,000
1997	45,000
1998	40,000
1999	35,000
2000	30,000

[illegible]

$$\frac{1}{2} \times 6 = 0.0625$$

$$\Rightarrow A' = 167,464 \quad B' = 186,882$$

$$B = B_0 - B' = 166,25 - 186,882 = -20,632$$

$$V = A_1 \left(\frac{1}{2} x_1 - \frac{1}{2} x_2 \right) = A_1 (1 - 0.50) = -37.625$$

$$V_1 = V_1' + K_2 \left(\frac{1}{2} g x_1 - \frac{1}{2} g x_2 \right) = -80,625 + 250 \cdot 3 (1,133 - 0,133) = 107,422$$

$$M_2' = H_1 \left(\frac{1}{2} g x_2 - \frac{1}{2} g x_1 \right) = -161,25 (0,50 + 0,114286) = -103,66$$

$$V_2 = V_2' + H_2 \left(\frac{1}{g} \dot{x}_2 - \frac{1}{g} \dot{x}_3 \right) = -103.26 + 250.73 (0.521 - 0) = 42.60$$

$$V_3' = \mu_1 \left(\frac{1}{3} \times 3 - \frac{1}{3} \times 4 \right) = -16,25 (-0,14236 + 0,125) = -17,280$$

$$V_3 = V_3' + H_2 (t_2 \alpha_3 - t_2 \alpha_4) = -17,280 + 250,73(0 + 0,375) = 78,744$$

$$V_4' = 41 \left(\frac{1}{2} \times 4 - \frac{1}{2} \times 5 \right) = -16,25 (-0,25 + 0,625) = -60,470$$

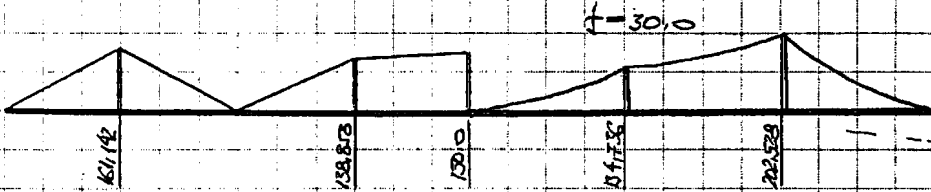
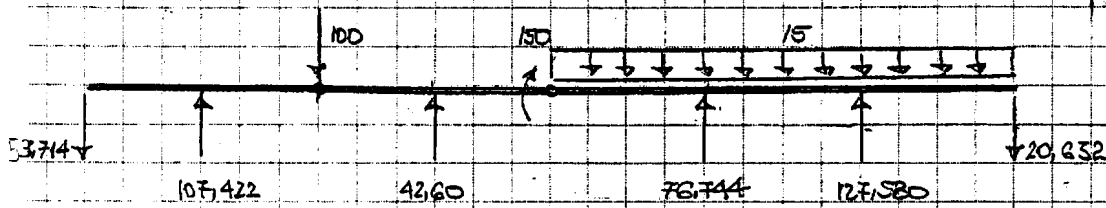
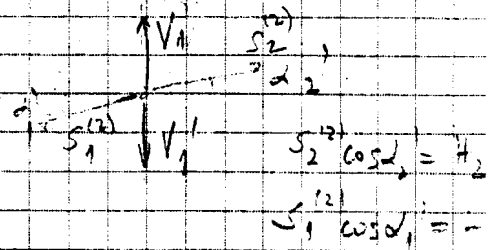
$$V_4 = V_4'' + \frac{1}{2} \left(\frac{1}{3} \times 4 - \frac{1}{3} \times 5 \right) = -69,470 + 250,73 \cdot (-0,375 + 1,125) = 127,530$$

$$Y_1 = 107,422$$

V3 = 76,744 + befristete

$$V_2 = 42,60$$

$$\sqrt{4} = 127,580$$



**** ПЛЕДАНУ КАКО БРТИ $H_1 + H_2$ ****

$$\underline{M_{21}}: M_{g,01} - H_1 f_{11} - H_2 f_{12} = 0 \rightarrow M_{g,01} - 4.125 H_1 + 5.375 H_2 \quad (1)$$

$$M_{g,02} - H_1 \cdot f_{21} - H_2 \cdot f_{22} = \phi \quad \Rightarrow \quad M_{g,02} = 1.821 H_1 + 6.75 H_2 \quad (12)$$

$$4.125 H_1 = M_{9.01} - 5.375 H_2 \rightarrow H_1 = 0.2424 M_{9.01} - 1.303 H_2$$

$$Mg_{1.02} = 4.821 (0.2424 Mg_{.01} - 11503 H_2) + 6.75 H_2$$

$$M_{g,02} = 1.1236 M_{g,01} - 6.282 H_2 + 6.75 H_2$$

$$Mg_{.02} = 1.1686 Mg_{.01} + 0.468 H_2$$

$$-7 \quad H_2 = 2,138 \text{ Mg}_{,02} - 2,497 \text{ Mg}_{,01}$$

$$H_1 = 0,2424 \text{ Mg}_{,01} - 1,303 (2,138 \text{ Mg}_{,02} - 2,497 \text{ Mg}_{,01})$$

$$H_1 = 0,2424 \text{ Mg}_{0,01} - 2,786 \text{ Mg}_{0,02} + 3,254 \text{ Mg}_{0,01}$$

$$H_1 = 3,498 \text{ Mg.01} - 2,786 \text{ Mg.02}$$

Мзр₁ - погребен със
злато 1 ~~сребро~~ сребро.

опитерейства и серотинка
реакција на крвонос протот

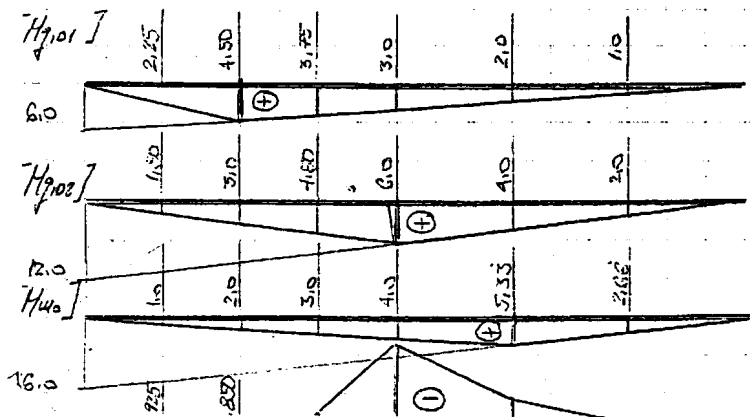
$$H_1 = 3,496 \text{ Mg}_{1.01} - 2786 \text{ Mg}_{1.02}$$

$$\mu_2 = -2.497 \quad \mu_{9,01} + 2.158 \quad \mu_{9,02}$$

$$M_{\text{net}} = M_{\text{net0}} - f_{w1} \cdot H_1 - f_{w2} \cdot H_2 = M_{\text{net0}} - 4H_1 - 0.5H_2$$

$$f_{\text{net}} = 5 - 0.10625 \cdot 18 = 4.0$$

$$y_{m2} = y_{m1} + 2.50 = 6.50$$



$$M_{\text{Mn}} = M_{\text{MnO}} - 4 (3.476 \text{ Mg}_{0.01} - 2.786 \text{ Mg}_{0.02}) -$$

$$-6.50 (-2.497 \text{ Mg}_{1.01} + 2.138 \text{ Mg}_{1.02})$$

$$M_{\text{H}} = M_{\text{H}0} + 2.2465 M_{\text{g},01} - 1.684 M_{\text{g},02}$$

Mc

$$M_c = M_{c0} - H_1 y_{c1} - H_2 y_{c2}$$

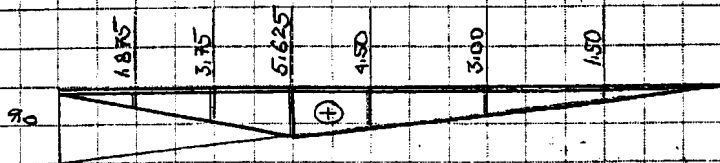
$$y_{c1} = 6 - 9 \cdot 0.0625 = 5.4375$$

$$y_{c2} = 35 - 9 \cdot 0.0625 = 6.9375$$

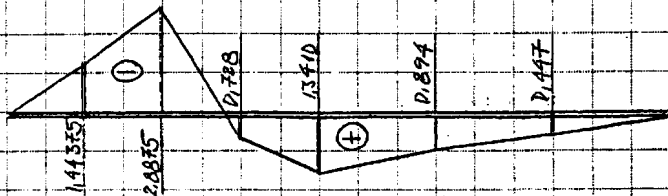
$$\Rightarrow M_c = M_{c0} - 5.4375 H_1 - 6.9375 H_2$$

$$M_c = M_{c0} - 5.4375 (3.496 M_{g,01} - 2.786 M_{g,02}) - 6.9375 (-2.497 M_{g,01} + 2.138 M_{g,02})$$

$$M_c = M_{c0} - 1.688 M_{g,01} + 0.3165 M_{g,02}$$



[Mc0]



[Mc]

T_w^d

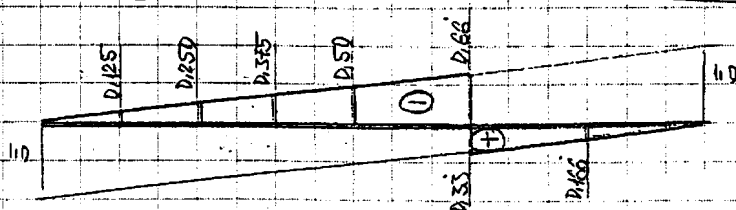
$$T_{w0}^d = T_{w0} + H_2 \cdot \frac{1}{2} \cdot 4 + H_1 \cdot \frac{1}{2} \cdot 4 + (H_1 + H_2) \cdot \frac{1}{2} \cdot 6$$

$$T_{w0}^d = T_{w0} - 0.375 H_2 - 0.125 H_1 + 0.0625 H_1 + 0.0625 H_2$$

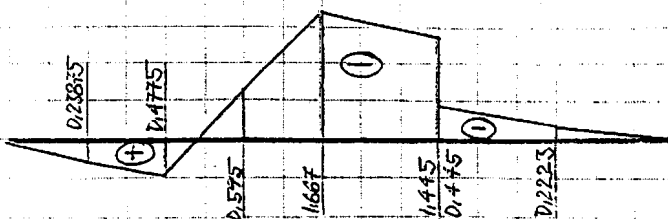
$$T_{w0}^d = T_{w0} - 0.11875 H_1 - 0.4375 H_2$$

$$T_{w0}^d = T_{w0} - 0.11875 (3.496 M_{g,01} - 2.786 M_{g,02}) - 0.4375 (-2.497 M_{g,01} + 2.138 M_{g,02})$$

$$T_{w0}^d = T_{w0} + 0.1437 M_{g,01} - 0.413 M_{g,02}$$



[Tw0]



[Twd]

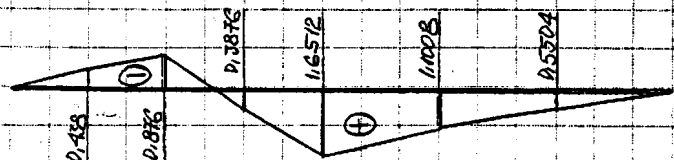
V₄

$$V_4 = H_1 (-\frac{1}{2} \times 4 + \frac{1}{2} \times 5) + H_2 (\frac{1}{2} \times 4 - \frac{1}{2} \times 5)$$

$$V_4 = H_1 (-0.25 + 0.625) + H_2 (-0.375 + 1.125) = 0.375 H_1 + 0.75 H_2$$

$$V_4 = 0.375 (3.496 M_{g,01} - 2.786 M_{g,02}) + 0.75 (-2.497 M_{g,01} + 2.118 M_{g,02})$$

$$V_4 = -0.5672 M_{g,01} + 0.5588 M_{g,02}$$



ext M_{g1-g2}

ПРОСТА ПРЯМА

* ПИТА-1 *

$$M_{max} = 2 \cdot 10 \cdot 6 \cdot 12 \cdot 0.5 = 720.0$$



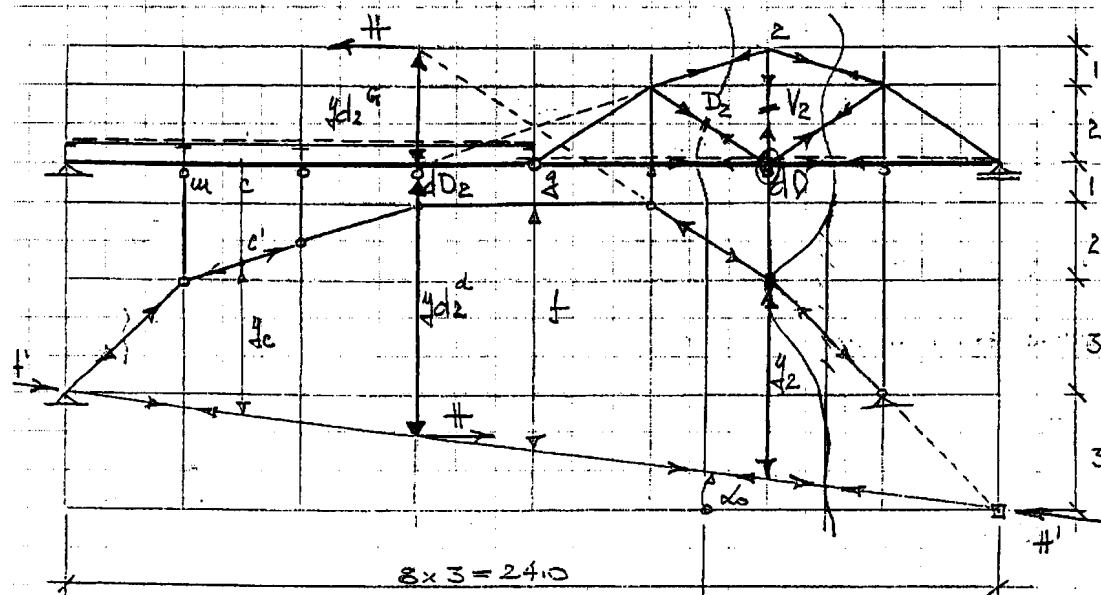
* НАПРАВЛЕНИЕ ДВИЖЕНИЯ ЗА ОЗНАЧЕНИЕ НАПРАВЛЕНИЯ

СРАВНЯВАТ ext M_c

СРАВНЯВАТ ext ВРЕДНОСТИ T_{u1}^L - T_{u1}^d

p = 15.0 kN/m

20. VII. 2007



$$\frac{1}{2} \times 4 = 3124 = 0.125$$

$$7 = 8 - 12 \cdot 0.125 = 6.50$$

$$40_2^d = 9 - 15 \cdot 0.125 = 7.125$$

$$40_2^L = 3.0$$

$$7_c = 15.46 - 19.5 \cdot 0.125$$

$$7_c = 4.0625$$

$$4_2 = 6 - 6 \cdot 0.125 = 5.25$$

[D₂]

[V₂]

[M_c]

9

$$\underline{D_2}: \quad \frac{1}{2} \cdot \frac{1}{2} = 2.3 = 0.66 \quad \sin \beta_2 = 0.5547 \quad \cos \beta_2 = 0.832$$

$$10 \cdot 3.3 + D_{2,A} \cdot \sin \beta_2 \cdot 2.3 + D_{2,H} \cdot \cos \beta_2 \cdot 2.0 = 0$$

$$9.0 + 3.3282 \cdot D_{2,A} + 1.664 \cdot D_{2,H} = 0 \Rightarrow D_{2,A} = -1.803$$

$$10 \cdot 5.3 + D_{2,B} \cdot \sin \beta_2 \cdot 3.3 = 0$$

$$15.0 + 4.9923 D_{2,B} = 0 \Rightarrow D_{2,B} = -3.00$$

$$3 \cdot H_1 + 7.125 \cdot H_2 - D_{2,H} \cdot \sin \beta_2 \cdot 2.3 - D_{2,H} \cdot \cos \beta_2 \cdot 2 = 0$$

$$10.125 H_1 - 3.3282 D_{2,H} - 1.664 D_{2,H} = 0 \Rightarrow D_{2,H} = 2.0282$$

$$\frac{11}{12} \cdot D_{2,H} = 6.50 \cdot 2.0282 = 3.744$$

$$\underline{M_C}: \quad X_C = 4.50 \quad Y_C = 4.0625 \quad \frac{12.0}{6.50} \cdot Y_C = -7.50$$

$$\underline{V_2}: \quad \sum F = 0: \quad V_2 + D_3 \cdot \sin \beta_3 + D_2 \cdot \sin \beta_2 = 0$$

$$\beta_2 = \beta_3 \Rightarrow D_2 = D_3$$

$$\tan \beta = 1/3; \quad \sin \beta = 0.3162$$

$$\cos \beta = 0.9487$$

$$V_2 + 2 \cdot D_2 \cdot \sin \beta = 0$$

$$V_2 + 0.6324 \cdot D_2 = 0 \Rightarrow V_2 = -0.6324 \cdot D_2$$

$$\underline{D_1}: \quad \text{ЛЕЧУ ПЕРЕДК} \quad \uparrow + M_{20}$$

$$M_{20} + D_2 \cdot \cos \beta \cdot 3.0 - H_2 = 0$$

$$M_{20} + 2.8461 \cdot D_2 - 5.25 H_2 = 0$$

$$D_2 = 1.845 H_2 - 0.3514 M_{20}$$

* СЕЧЕНИ КРОЗ ЧЕП 2 \Rightarrow
КАНО ЛОЖЕ H 1/3

$$\Rightarrow V_2 = -0.6324 \cdot (-0.3514 M_{20} + 1.845 H_2)$$

$$V_2 = 0.222 M_{20} - 1.1667 H_2$$

$$V_{2,A} = 0.222 \cdot 6.3 = 4.0$$

$$V_{2,B} = 0.222 \cdot 2.3 = 1.33$$

$$V_{2,H} = -1.1667$$

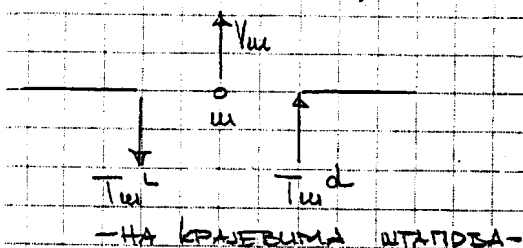
$$\frac{11}{12} \cdot V_{2,H} = \frac{-12}{6.50} \cdot 1.1667 = -2.154$$

ext Mc/V

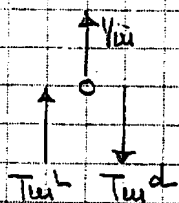
$$M_{c, \max} = 15.0 \cdot (1150 \cdot 3.0 \cdot 0.5 + 1150 \cdot 3.0 + 1150 \cdot 3.0 \cdot 0.5) = 135.0 \text{ kNm}$$

$$M_{c, \min} = 15.0 \cdot (1150 \cdot 3.0 \cdot 0.50 + 1150 \cdot 12.0 \cdot 0.50) = 162.75 \text{ kNm}$$

$T_{wL} - T_{wR}$



- ЧЕОП М -



$$\sum F = 0: T_{wL} - T_{wR} + V_{wL} = 0$$

$$T_{wL} - T_{wR} = -V_{wL}$$

$$V_{wL} + H \tan \alpha_1 - H \tan \alpha_2 + H \tan \alpha_3 - H \tan \alpha_4 = 0$$

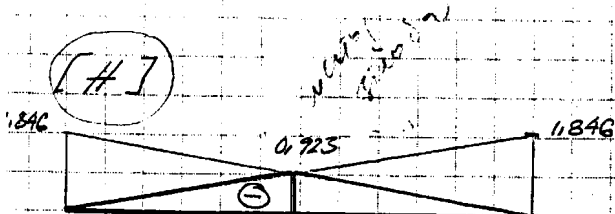
$$V_{wL} + H(3/3) - H(4/3) = 0$$

$$V_{wL} + \frac{2}{3}H = 0 \Rightarrow V_{wL} = -\frac{2}{3}H$$

$$\Rightarrow T_{wL} - T_{wR} = \left(\frac{2}{3}H\right)$$

$$-\frac{H}{3} = \frac{-12}{6.50} = -1.846 \quad -\frac{H}{3} = \frac{-12}{6.50} = -1.846$$

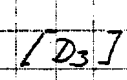
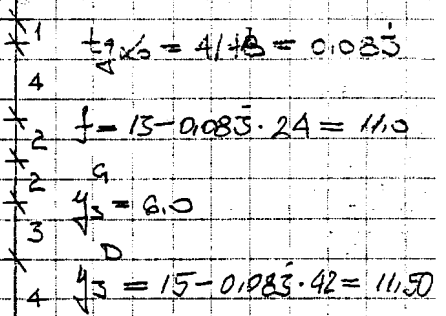
БУДУТ КРАЕВЫЕ СЕЧЕНИЯ



$$T_{wL} - T_{wR} = \frac{2}{3} \cdot 15.0 \cdot 2 \cdot 0.923 \cdot 12.0 \cdot 0.50 = 110.76 \text{ kN}$$

ext $T_{wL} - T_{wR} = 110.76 \text{ kN}$

5



$(A = A)$

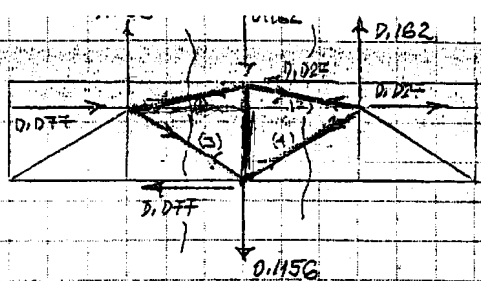
→ $D_{3A} = -2,524$

$\rightarrow D_{1.8} = -0.3605 \rightarrow 1935$

$$\Rightarrow D_{J,H} = 110516$$

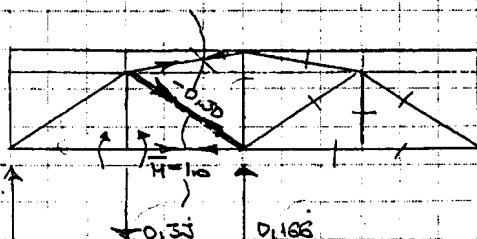
$$\frac{L_2}{f \cdot D_{J,H}} = \frac{240}{110 \cdot 110516} = 2,294$$

сума полевана
која се припада некиме другиме издацима издацима
са једне стране издацима



$$\begin{aligned} 0,027 \cdot 410 + 0,162 \cdot 2410 - D4 \cdot \sin 4^\circ \cdot 2410 - D4 \cdot \cos 4^\circ \cdot 410 &= 0 & \sin 4^\circ = 0,0698; \cos 4^\circ = 0,9927 \\ 3,996 - 16,6408 D4 &= 0 & \Rightarrow D4 = 0,240 \end{aligned}$$

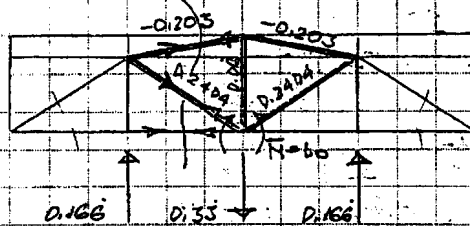
$$W_1 \equiv W_3$$



$$7,162 \cdot 13 - 0,33 \cdot 24 - D \cdot \sin 9^\circ \cdot 24 - D \cdot \cos 9^\circ \cdot 4 = 0$$

$$-5,0 - 16,6408 D = 0 \rightarrow D = -0,300$$

$$EFW_3 = -0,321$$



$$D \cdot \sin^{\circ} 6 + D \cdot \cos^{\circ} 4 + 0.166 \cdot 6.0 = 0$$

$$1.0 + 4.932 \cdot D = 0 \quad \rightarrow D = -0.203$$

$$D \cdot \sin^2 \cdot 24 + D \cdot \cos^2 \cdot 4 - 0,126 \cdot 24 = 0$$

$$12,6408 \cdot D - 4,0 = 0 \quad \rightarrow D = 0,2404$$

$$2 \cdot 0,203 \cdot 0,1644 - V = 0 \rightarrow V =$$

$$V_{FW_2} = -0.06 \cdot 0.099 \cdot 5 + 0.203^2 \cdot \sqrt{5} + 0.175 \cdot 0.203 \cdot \sqrt{5}$$

$$+ 0,1482 \cdot 0,2404 \cdot \sqrt{52} + 0,2404^2 \cdot \sqrt{52}$$

$$EFW_2 = -0.1033 + 0.3507 + 0.2161 + 0.2557 + 0.1137$$

$$EFW_2 = 1.1071$$

13

-> REFERENCE X_1^T

$$\sum M_A = 0 \quad 6 \cdot 4 \cdot 1.0 - B_0 \cdot 4.0 = 0 \quad \Rightarrow B_0 = 0.50$$

$$\sum F_H = 0 \quad A_0 + B_0 - 1.0 = 0 \quad \Rightarrow A_0 = 0.50$$

$$\sum M_G = 0 \quad 0.50 \cdot 2.0 - H \cdot 1.0 = 0 \quad \Rightarrow H = 1.0910$$

$$\tan \alpha_1 = 4/3 = 1.33 \quad \tan \alpha_3 = -2/6 = -0.33$$

$$\tan \alpha_2 = 3/6 = 0.50 \quad \tan \alpha_6 = -3/6 = -0.50$$

$$\tan \alpha_3 = 2/6 = 0.33 \quad \tan \alpha_7 = -4/6 = -0.66$$

$$\tan \alpha_4 = 0$$

$$A' = H(\tan \alpha_1 - \tan \alpha_6) = 1.0910(1.33 - 0.083) = 1.364$$

$$B' = H(\tan \alpha_0 - \tan \alpha_7) = 1.0910(0.083 + 0.66) = 0.8182$$

$$A = A_0 - A' = 0.50 - 1.364 = -0.864 \quad B = B_0 - B' = 0.50 - 0.8182 = -0.3182$$

$$V_1 = H(1.33 - 0.50) = 0.909$$

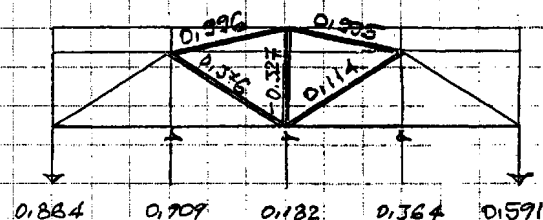
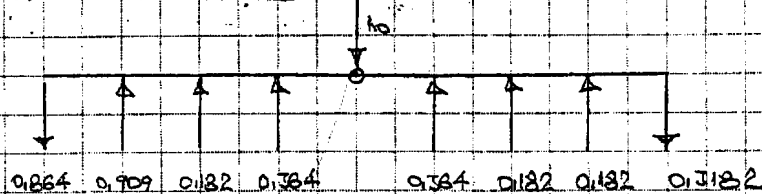
$$V_2 = H(0.50 - 0.33) = 0.182$$

$$V_3 = H(0.33 - 0) = 0.364$$

$$V_4 = H(0 + 0.33) = 0.364$$

$$V_5 = H(-0.33 + 0.5) = 0.182$$

$$V_6 = H(-0.50 + 0.66) = 0.182$$



[N]

$$D_3 \sin \theta_3 \cdot 2.0 + D_3 \cos \theta_3 \cdot 4.0 - 0.909 \cdot 2.0 + 0.864 \cdot 12.0 = 0$$

$$16.6408 \cdot D_3 - 6.264 = 0 \quad \Rightarrow D_3 = 0.376$$

$$D_1 \sin \theta_1 \cdot 6.0 + D_1 \cos \theta_1 \cdot 4.0 + 0.909 \cdot 6.0 - 0.864 \cdot 12.0 = 0$$

$$4.932 \cdot D_1 - 4.914 = 0 \quad \Rightarrow D_1 = 0.996$$

$$D_2 \sin \theta_2 \cdot 6.0 + D_2 \cos \theta_2 \cdot 4.0 + 0.364 \cdot 6.0 - 0.591 \cdot 12.0 = 0$$

$$4.932 \cdot D_2 - 4.908 = 0 \quad \Rightarrow D_2 = 0.995$$

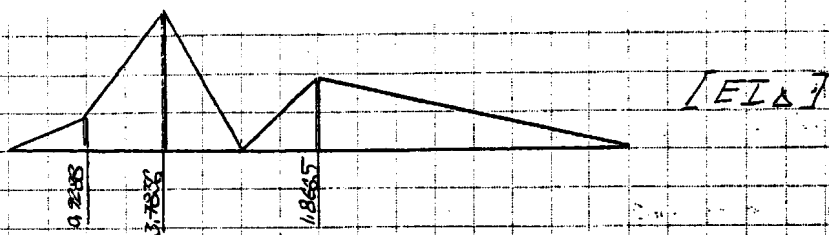
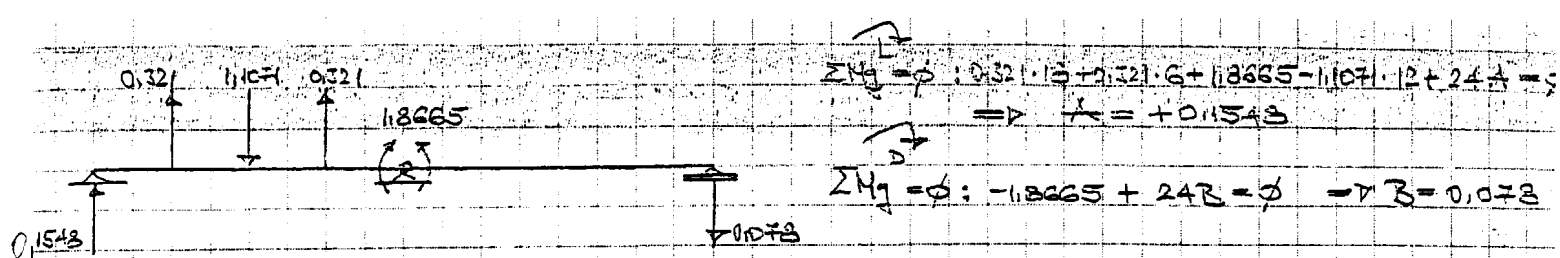
$$D_4 \sin \theta_4 \cdot 2.0 + D_4 \cos \theta_4 \cdot 4.0 + 0.591 \cdot 12.0 - 0.364 \cdot 2.0 = 0$$

$$16.6408 \cdot D_4 - 1.902 = 0 \quad \Rightarrow D_4 = 0.114$$

$$0.996 \sin \theta_1 + 0.995 \sin \theta_2 - V = 0 \quad \Rightarrow V = 0.327$$

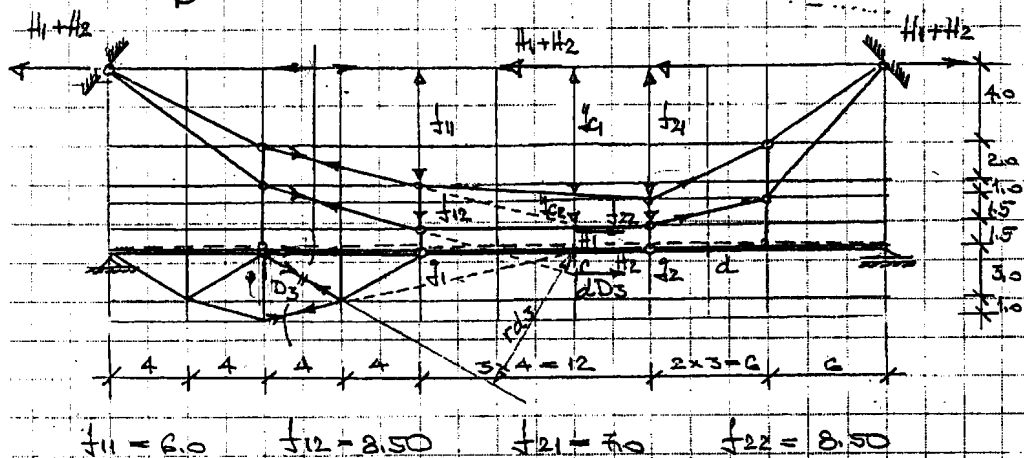
$$EJ X_1^T = \sqrt{N_1 N_2} ds = -0.203 \cdot 0.996 \cdot \sqrt{37} - 0.1175 \cdot 0.995 \cdot \sqrt{37} - 0.099 \cdot 0.327 \cdot 5 +$$

$$+ 0.1428 \cdot 0.376 \cdot \sqrt{52} + 0.1240 \cdot 0.114 \cdot \sqrt{52}$$



* ДА РЕШИМ УПРАЖНЕНИЕ АНАЛИЗ ЗА D_3 , M_C , T_d .

6



$$\tan \alpha_0 = 0$$

$$\tan \alpha_3 = 3/4 \rightarrow \sin \alpha_3 = 0.60$$

$$r_{d3} = 10 \cdot 0.60 = 6.00$$

$$\sum M_{g,01} = 0: M_{g,01} - H_1 \cdot 6.0 - H_2 \cdot 2.50 = 0 \Rightarrow H_1 = 0.166 M_{g,01} - 1.4166 H_2$$

$$\sum M_{g,02} = 0: M_{g,02} - H_1 \cdot 7.0 - H_2 \cdot 8.50 = 0$$

$$\Rightarrow M_{g,02} - 7.0(0.166 M_{g,01} - 1.4166 H_2) - 8.50 H_2 = 0$$

$$M_{g,02} - 1.166 M_{g,01} + 9.9166 H_2 - 8.50 H_2 = 0$$

$$1.4166 H_2 - 1.166 M_{g,01} + M_{g,02} = 0 \Rightarrow H_2 = 0.8235 M_{g,01} - 0.7058 M_{g,02}$$

$$H_1 = 0.166 M_{g,01} - 1.4166 (0.8235 M_{g,01} - 0.7058 M_{g,02})$$

$$H_1 = 0.166 M_{g,01} - 1.1666 M_{g,01} + M_{g,02}$$

\Rightarrow

$$H_1 = M_{g,02} - M_{g,01}$$

$$H_2 = 0.8235 M_{g,01} - 0.7058 M_{g,02}$$

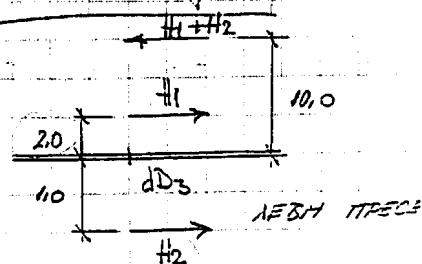
D_3 : $\sum M_{dD_3} = 0$

$$M_{dD_3} - 10(H_1 + H_2) + 20H_1 - H_2 - D_3 \cdot r_{d3} = 0$$

$$M_{dD_3} - 10H_1 - 10H_2 + 20H_1 - H_2 - D_3 \cdot r_{d3} = 0$$

$$D_3 = \frac{1}{r_{d3}} (M_{dD_3} - 8H_1 - 11H_2)$$

$$D_3 = \frac{1}{6.00} (M_{dD_3} - 8H_1 - 11H_2)$$



$$D_5 = 9.60 \left[M_{c0} - 8(M_{g,02} - M_{g,01}) - 11(0.8235 M_{g,01} - 0.7058 M_{g,02}) \right]$$

$$D_3 = 9.60 \left[M_{c0} - 8M_{g,02} + 8M_{g,01} - 7.0535 M_{g,01} + 7.7638 M_{g,02} \right]$$

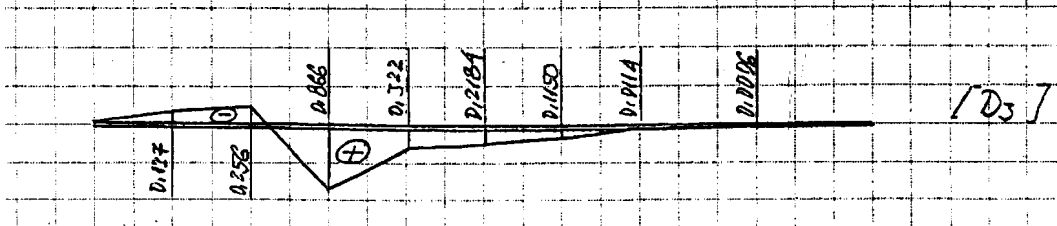
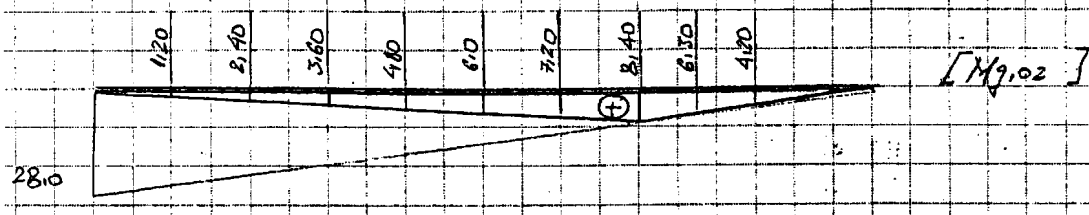
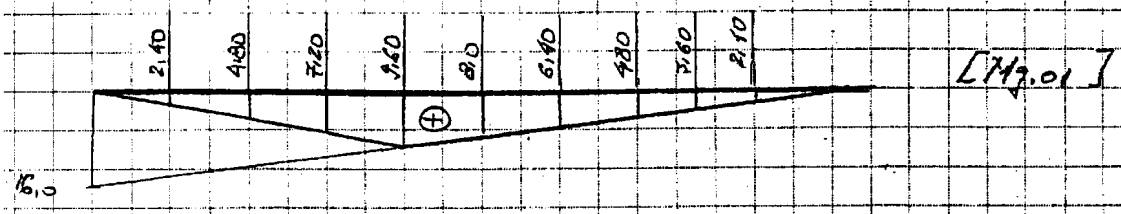
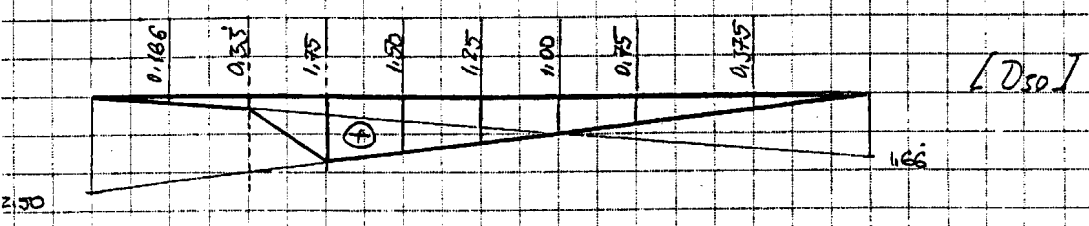
$$D_3 = \frac{M_{c0}}{9.60} - 0.1102 M_{g,01} - 0.025 M_{g,02}$$

$$D_3 = D_{3,0} - 0.1102 M_{g,01} - 0.025 M_{g,02}$$

4. $\frac{1}{4} \text{ of } D_{3,0} \text{ is found with } M_{g,01}$

$$110.240 - D_{3,0,1} \cdot \sin \frac{\pi}{3} \cdot 16.0 = 0 \rightarrow D_{3,0,1} = 2.50$$

$$110.60 - D_{3,0,2} \cdot \sin \frac{\pi}{3} \cdot 12.0 - D_{3,0,3} \cdot \cos \frac{\pi}{3} \cdot 5.0 = 0 \rightarrow D_{3,0,3} = 1.66$$



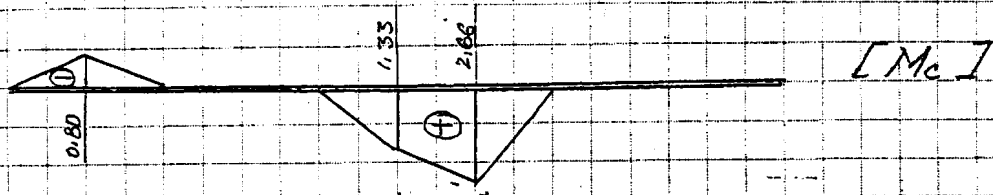
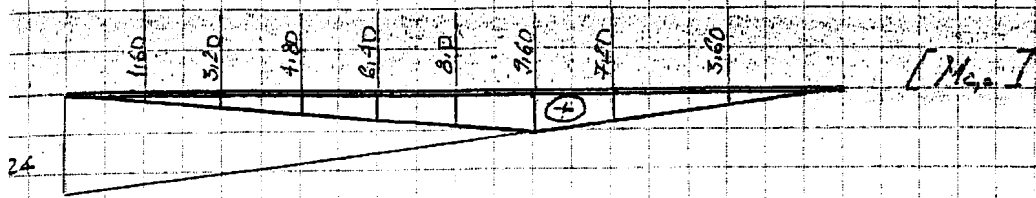
M_c : $y_{c1} = 0.66 + 6.0 = 6.66$ $y_{c2} = 8.50$

$$M_c = M_{c0} - H_1 \cdot y_{c1} - H_2 \cdot y_{c2} = M_{c0} - 6.66 \cdot H_1 - 8.50 \cdot H_2$$

$$M_c = M_{c0} - 6.66 (M_{g,02} - M_{g,01}) - 8.50 (0.8235 M_{g,01} - 0.7058 M_{g,02})$$

$$M_c = M_{c0} - 6.66 M_{g,02} + 6.66 M_{g,01} - 7.0 M_{g,01} + 6.0 M_{g,02}$$

$$M_c = M_{c0} - 0.33 M_{g,01} - 0.66 M_{g,02}$$



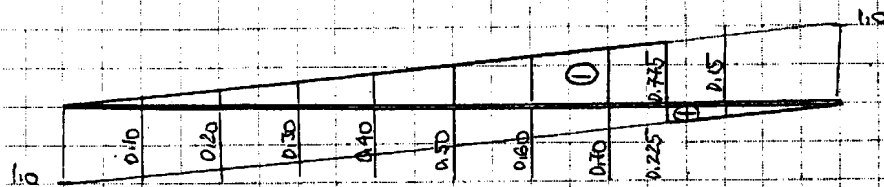
T_d : $T_d = T_{d0} + H_1 \cdot t_3 \times 4^{(1)} + H_2 \cdot t_3 \times 4^{(2)}$ $t_3 \times 4^{(1)} = 3/6 = 0.50$ $t_3 \times 4^{(2)} = 1.5/6 = 0.25$

$$T_d = T_{d0} + 0.50 \cdot H_1 + 0.25 \cdot H_2$$

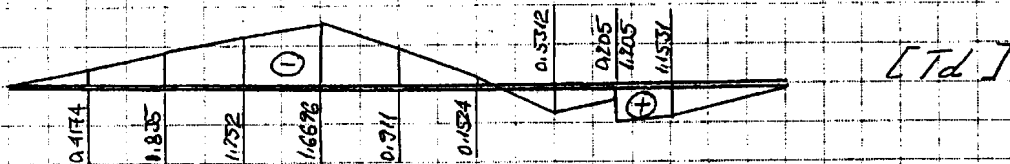
$$T_d = T_{d0} + 0.50 (H_{g,02} - H_{g,01}) + 0.25 (0.2835 H_{g,01} - 0.1705 H_{g,02})$$

$$T_d = T_{d0} + 0.50 H_{g,02} - 0.50 H_{g,01} + 0.206 H_{g,01} - 0.1765 H_{g,02}$$

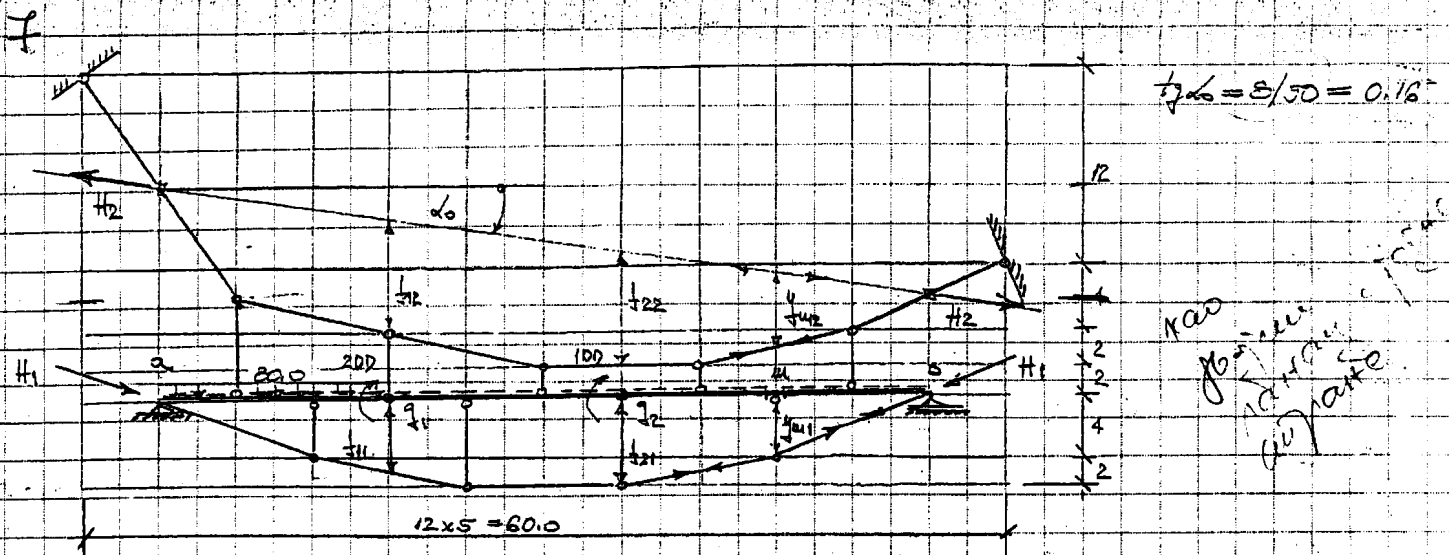
$$T_d = T_{d0} - 0.294 H_{g,01} + 0.3235 H_{g,02}$$



of other values
can be calculated



* СРАВНИЛИ ext M_{u1} & ext (T_{u1} - T_{u2}) ЧИЗ $p = 15.0 \text{ kN/m}$
 НАИДЕЛИ БЛИЗКАЯ ОМЕТКА ЧИЗ, ЗАТО ОШЕБЕЖА.



$$f_2 = 8/50 = 0.16$$

кад
 поперечный
 сечение

$$f_{11} = 5.0 \quad f_{12} = 10 - 0.16 \cdot 15 = 7.60 \quad f_{21} = 6.0 \quad f_{22} = 12 - 0.16 \cdot 30 = 7.20 \quad (\text{сечение 3 поперек 19.1})$$

$$\begin{aligned} \sum M_{g1} &= 0 \\ \sum M_{g2} &= 0 \end{aligned} \quad \begin{aligned} M_{g1} - H_1 \cdot f_{11} - H_2 \cdot f_{12} &= 0 \\ M_{g2} - H_1 \cdot f_{21} - H_2 \cdot f_{22} &= 0 \end{aligned}$$

$$\Rightarrow M_{g1} - 5H_1 - 7.60H_2 = 0 \quad H_1 = 0.20M_{g1} - 1.52H_2$$

$$M_{g2} - 6H_1 - 7.20H_2 = 0$$

$$M_{g2} - 6(0.20M_{g1} - 1.52H_2) - 7.20H_2 = 0$$

$$M_{g2} - 1.20M_{g1} + 9.12H_2 - 7.20H_2 = 0 \quad H_2 = 0.625M_{g1} - 0.5208M_{g2}$$

$$H_1 = 0.20M_{g1} - 1.52(0.625M_{g1} - 0.5208M_{g2})$$

$$H_1 = 0.20M_{g1} - 0.95M_{g1} + 0.792M_{g2}$$

$$H_1 = -0.75M_{g1} + 0.792M_{g2} \quad H_2 = 0.625M_{g1} - 0.521M_{g2}$$

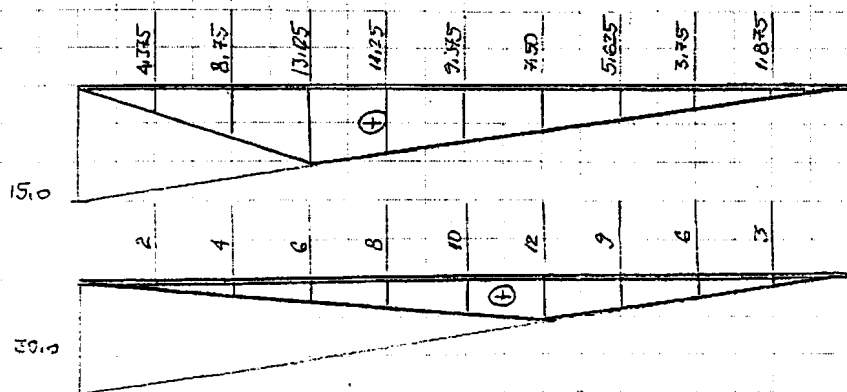
$$M_{u1} \quad y_{u1} = 4.0 \quad y_{u2} = 11 - 0.16 \cdot 40 = 4.60$$

$$M_u = M_{u0} - H_1 \cdot y_{u1} - H_2 \cdot y_{u2} = M_{u0} - 4H_1 - 4.60H_2$$

$$M_u = M_{u0} - 4(-0.75M_{g1} + 0.792M_{g2}) - 4.60(0.625M_{g1} - 0.521M_{g2})$$

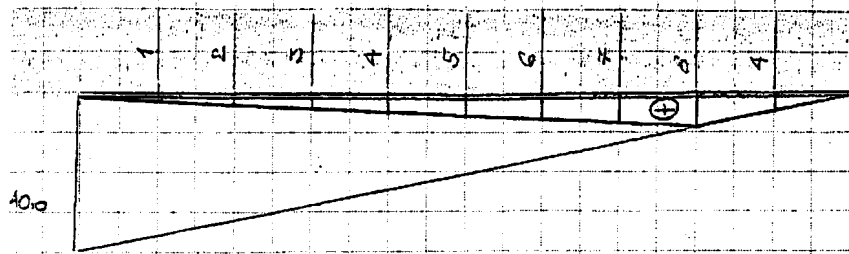
$$M_u = M_{u0} + 3M_{g1} - 3.17M_{g2} - 2.875M_{g1} + 2.40M_{g2}$$

$$M_u = M_{u0} + 0.125M_{g1} - 0.77M_{g2}$$

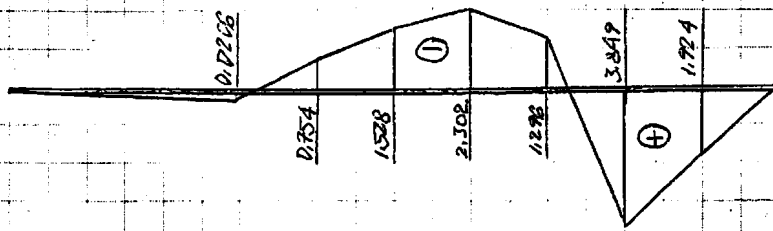


[M_{g1}]

[M_{g2}]



[M_{wo}]



[M_w]

$$\sqrt{M_{w, \max}} = 0.0206 \cdot 15 \cdot 0.50 \cdot 15 + 0.0206 \cdot 0.133 \cdot 0.50 \cdot 15 + 3.849 \cdot 3.741 \cdot 0.50 \cdot 15 + 0.5(3.849 + 1.924) \cdot 15 \cdot 5.0 + 1.924 \cdot 0.50 \cdot 5.0 \cdot 15 = 2.3175 + 0.0205 + 107.99 + 216.487 + 72.15$$

$$M_{w, \max} = 398.97 \text{ kNm}$$

$$\sqrt{M_{w, \min}} = 0.754 \cdot 4.867 \cdot 0.5 \cdot 15 + 0.5 \cdot 15 \cdot 5 \cdot (0.754 + 1.528) + 0.5 \cdot 15 \cdot 5 \cdot (1.528 + 2.302) + 0.5 \cdot 15 \cdot 5 \cdot (2.302 + 3.096) + 0.5 \cdot 15 \cdot 1.259 \cdot 1.296 = 27.52 + 85.575 + 71.825 + 134.925 + 12.237$$

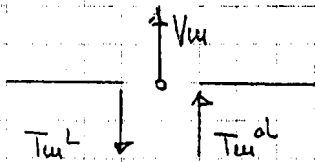
$$\sqrt{M_{w, \min}} = 332.07 \text{ kNm}$$

$$M_{w, \max} = p \cdot F^+$$

$$M_{w, \min} = p \cdot F^-$$

gives
positive
moment

$$\overline{T_{w, \min}^L - T_{w, \min}^d}$$



$$\sum F = 0: T_{w, \min}^L - T_{w, \min}^d + V_w = 0$$

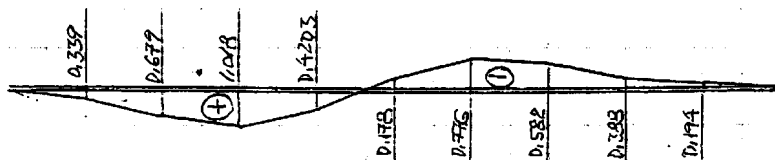
$$\overline{T_{w, \min}^L - T_{w, \min}^d} = -V_w$$

$$\Rightarrow (H_1 \cdot \tan \alpha_5 - H_2 \cdot \tan \alpha_5 + H_2 \cdot \tan \alpha_5 - H_2 \cdot \tan \alpha_5 - V_w - H_1 \cdot \tan \alpha_4 + H_1 \cdot \tan \alpha_5 = 0) ?$$

$$V_w = H_1 \cdot \tan \alpha_5 - H_1 \cdot \tan \alpha_4 = \frac{4}{10} \cdot H_1 - \frac{2}{10} \cdot H_1 = 0.4 \cdot H_1 - 0.2 \cdot H_1 = 0.20 \cdot H_1$$

$$V_w = 0.20 \cdot (-0.75 M_{g, 01} + 0.792 M_{g, 02}) = -0.15 M_{g, 01} + 0.1584 M_{g, 02}$$

$$\overline{T_{w, \min}^L - T_{w, \min}^d} = +0.15 M_{g, 01} - 0.1584 M_{g, 02}$$



[T_w^L - T_w^d]

$$F^+ = 11.97 \quad F^- = 11.469 \quad \checkmark$$

$$\max(T_{w, \min}^L - T_{w, \min}^d) = 11.97 \cdot 15 = 179.55 \text{ kN} \quad \checkmark$$

$$\Sigma M_1 = 0: 200 \cdot 150 \cdot 750 + 200 + 100 - B_0 \cdot 500 = 0 \Rightarrow B_0 = 186,0$$

$$\Sigma F^y = 0: 200 \cdot 150 - 186,0 - 10 = 0 \Rightarrow A_0 = 1014,0$$

$$\Sigma M_{j1} = 0: 1014,0 \cdot 500 + 200 \cdot 0 - 20 \cdot 0 \cdot 150 \cdot 750 - H_1 \cdot f_{11} - H_2 \cdot f_{12} = 0$$

$$6410 - 5H_1 - 7,5H_2 = 0 \Rightarrow H_1 = 1282 - 1,5H_2$$

$$\Sigma M_{j2} = 0: 1014 \cdot 50 + 200 + 100 - 20 \cdot 15 \cdot 22,5 - H_1 \cdot f_{21} - H_2 \cdot f_{22} = 0$$

$$3720 - 6H_1 - 7,20H_2 = 0$$

$$3720 - 6(1282 - 1,5H_2) - 7,20H_2 = 0$$

$$3720 - 7692 + 9,12H_2 - 7,20H_2 = 0 \Rightarrow H_2 = 2068,75$$

$$H_1 = -1862,50$$

Matrizen 1:

$$t_{jx1} = 4/10 = 0,40$$

$$t_{jx2} = 2/10 = 0,20$$

$$t_{jx3} = 0$$

$$t_{jx4} = -2/10 = -0,20$$

$$t_{jx5} = -4/10 = -0,40$$

Matrizen 2:

$$t_{jx1} = 2/5 = 0,40$$

$$t_{jx2} = 2/10 = 0,20$$

$$t_{jx3} = 2/10 = 0,20$$

$$t_{jx4} = 0$$

$$t_{jx5} = -2/10 = -0,20$$

$$t_{jx6} = -2/5 = -0,40$$

$$\text{Matrizen 1: } \begin{cases} A' = H_1(t_{jx1} - t_{jx6}) = -1862,50(0,40 - 0,16) = -447,0 \\ B' = H_1(t_{jx6} - t_{jx5}) = -1862,50(0,16 + 0,40) = -1043,0 \end{cases}$$

$$\text{Matrizen 2: } \begin{cases} A' = H_2(t_{jx1} - t_{jx6}) = 2068,75(0,40 - 0,16) = 2979,0 \\ B' = H_2(t_{jx6} - t_{jx5}) = 2068,75(0,16 + 0,40) = 1158,50 \end{cases}$$

$$\Rightarrow A = A_0 - A' = 1014 - (-447 + 2979) = -1518$$

$$B = B_0 - B' = 186 - (-1043 + 1158,50) = 70,50$$

Matrizen 1:

$$V_1 = H_1(t_{jx1} - t_{jx6}) = -1862,50(0,40 - 0,16) = -372,50$$

$$V_2 = H_1(t_{jx2} - t_{jx3}) = -1862,50(0,20 - 0) = -372,50$$

$$V_3 = H_1(t_{jx3} - t_{jx4}) = -1862,50(0 + 0,20) = -372,50$$

$$V_4 = H_1(t_{jx4} - t_{jx5}) = -1862,50(-0,20 + 0,40) = -372,50$$

Matrizen 2:

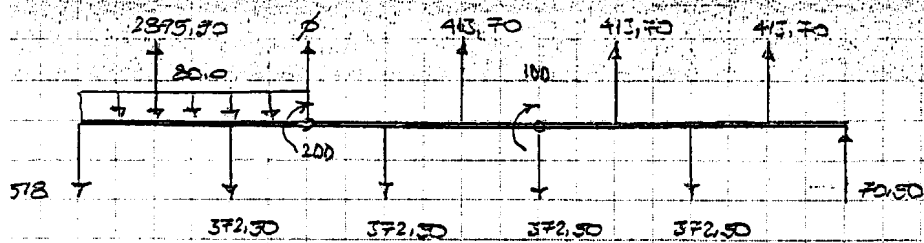
$$V_1 = H_2(t_{jx1} - t_{jx2}) = 2068,75(0,40 - 0,20) = 2895,00$$

$$V_2 = H_2(t_{jx2} - t_{jx3}) = 2068,75(0,20 - 0,20) = 0$$

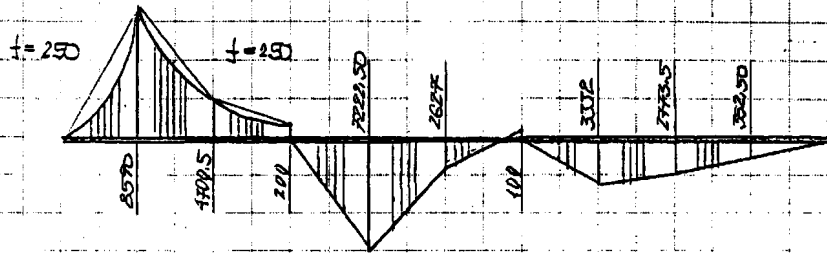
$$V_3 = H_2(t_{jx3} - t_{jx4}) = 2068,75(0,20 - 0) = 413,75$$

$$V_4 = H_2(t_{jx4} - t_{jx5}) = 2068,75(0 + 0,20) = 413,75$$

$$V_5 = H_2(t_{jx5} - t_{jx6}) = 2068,75(-0,20 + 0,40) = 413,75$$

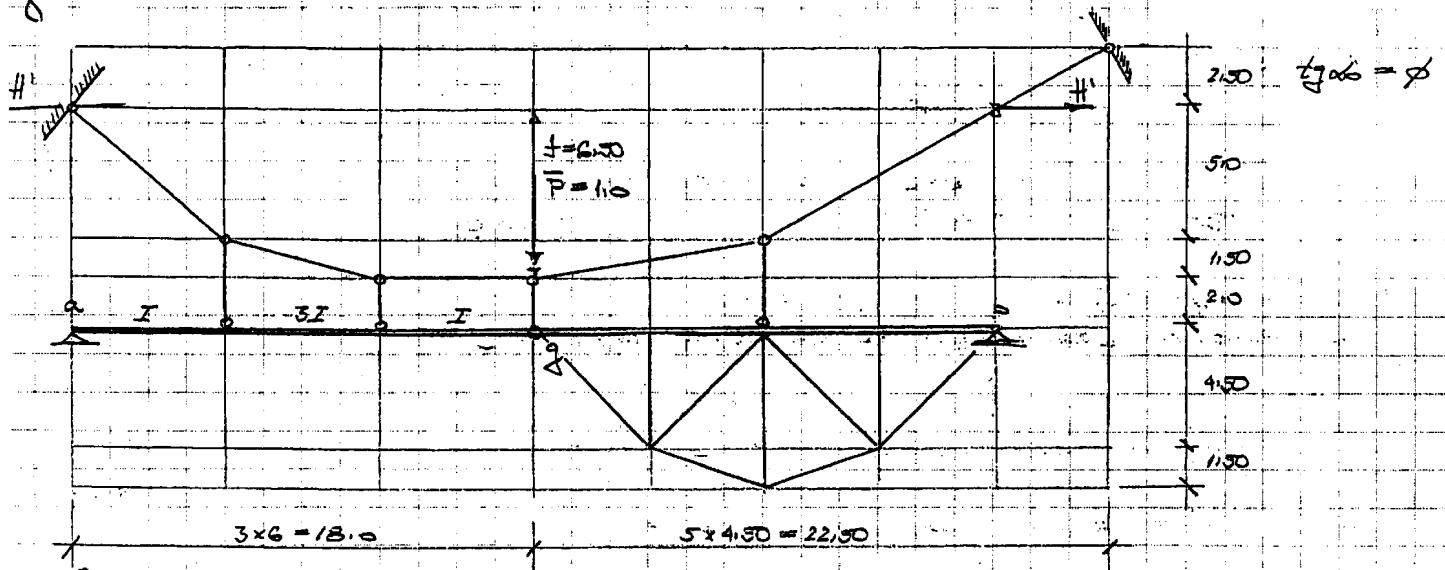


-КОНТРОЛЬ: $\sum F = 0$; $-518 - 372.50 \cdot 4 + 70.50 - 80 \cdot 15 + 2895.90 + 3 \cdot 413.70 = 0$ $0 = 0$



* ДАРЕДНУ ИТУКАЛИХ АУНУХУ ЗА БЕПТИКАНО ПОЧЕРАЊЕ ИТЛОСА 7.
 $I_c = 10^{-3} \text{ м}^4$; $F_c = 0.5 \cdot 10^{-2} \text{ м}^2$

8



$\sum M_A = 0$; $18.0 \cdot 1.10 - 36.0 \cdot A_0 = 0 \rightarrow A_0 = 0.50$; $B_0 = 0.50$

$\sum H_y = 0$; $0.50 \cdot 18.0 - H \cdot 6.50 = 0 \rightarrow H = 1.385$

$A' = H(t_j \alpha_1 - t_j \alpha_6) = 1.385(516 - 0) = 1.1542$

$B' = H(t_j \alpha_6 - t_j \alpha_5) = 1.385(0 + 519) = 0.769$

$A = A_0 - A' = 0.50 - 1.1542 = -0.6542$

$B = B_0 - B' = 0.50 - 0.769 = -0.269$

$$\tan \alpha_1 = 5/6 = 0.833$$

$$\tan \alpha_2 = 15/6 = 0.25$$

$$\tan \alpha_3 = 0$$

$$\tan \alpha_4 = -15/9 = -0.166$$

$$\tan \alpha_5 = -5/9 = -0.55$$

$$\sec \alpha_1 = 1.13017$$

$$\sec \alpha_2 = 1.0308$$

$$\sec \alpha_3 = 1.0$$

$$\sec \alpha_4 = 1.0138$$

$$\sec \alpha_5 = 1.1439$$

$$V_1 = H(0.833 - 0.25) = 0.808$$

$$V_2 = H(0.25 - 0) = 0.346$$

$$V_3 = H(0 + 0.166) = 0.2508$$

$$V_4 = H(-0.166 + 0.55) = 0.539$$

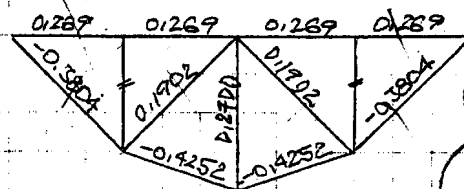
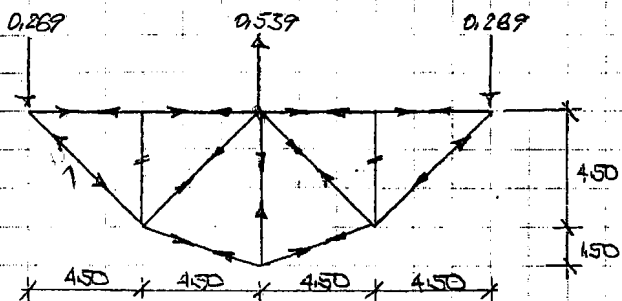
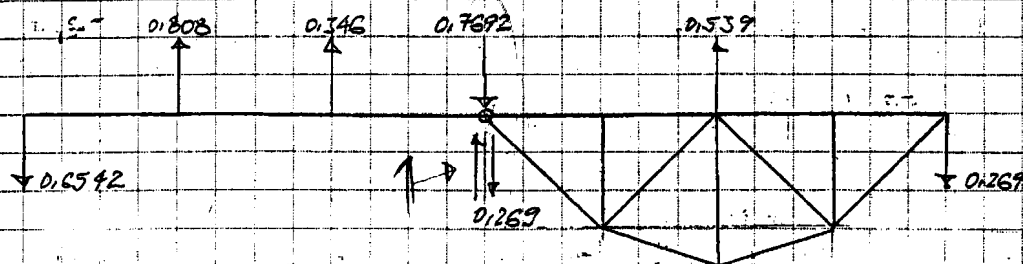
$$S_1 = H \cdot 1.13017 = 1.803$$

$$S_2 = H \cdot 1.0308 = 1.428$$

$$S_3 = H \cdot 1.0 = 1.385$$

$$S_4 = H \cdot 1.0138 = 1.404$$

$$S_5 = H \cdot 1.1439 = 1.584$$



$$D_1 \sin \alpha_1 = 0.269 \Rightarrow D_1 = -0.3804$$

$$D_4 = -0.3804$$

$$D_1 \cos \alpha_1 = D_1 \Rightarrow D_1 = 0.269$$

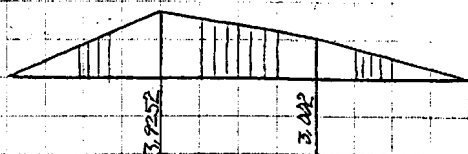
$$D_4 = 0.269$$

$$0.269 \cdot 9.0 - D_2 \cdot 0.1707 \cdot 13.50 - D_2 \cdot 0.1707 \cdot 4.50 = 0 \Rightarrow D_2 = 0.1902 \quad D_3 = 0.1902$$

$$0.269 \cdot 4.50 - D_2 \cdot 4.50 = 0 \Rightarrow D_2 = 0.269 \quad D_3 = 0.269$$

$$0.269 \cdot 9.0 + U_1 \cdot 4.50 \cdot 0.31623 + U_1 \cdot 4.50 \cdot 0.9429 = 0 \Rightarrow U_1 = -0.4252 \quad U_2 = -0.4252$$

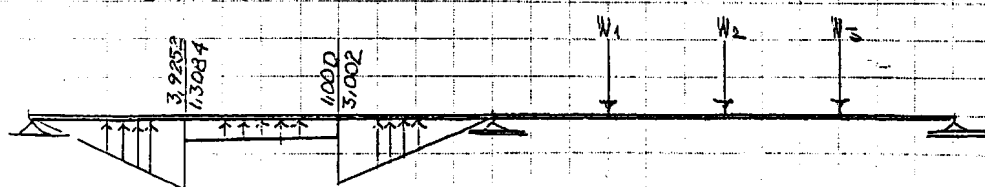
$$V + 2 \cdot 0.1707 \cdot 0.1902 - 0.539 = 0 \Rightarrow V = 0.2700$$



[M]

3a н/с
гед

ФНКТНЗМН НОСАЧ



x₁

(2)

2

$$EI \chi_1' = \int M^2 ds + \frac{I_0}{F_0} \int H^2 ds \quad \frac{I_0}{F_0} = \frac{10}{0.5 \cdot 10^{-2}} = 0.20$$

$$EI \chi_1' = \frac{6}{3} \cdot 3.9252^2 + \frac{6}{3} \cdot \frac{1}{3} (3.9252^2 + 3.9252 \cdot 3.002 + 3.002^2) + \frac{6}{3} \cdot 3.002^2 +$$

$$+ 0.20 \cdot [3.50 \cdot 0.803^2 + 2.0 \cdot 0.346^2 + 2.0 \cdot 0.2308 + 3.50 \cdot 0.539^2 + 4 \cdot 4.50 \cdot 0.269^2 +$$

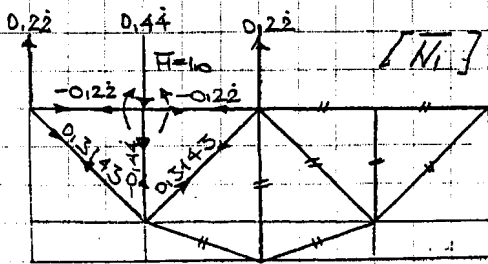
$$+ 2 \cdot \sqrt{40.5} \cdot 0.3804^2 + 2 \cdot \sqrt{22.5} \cdot 0.4252^2 + 2 \cdot \sqrt{40.5} \cdot 0.1902^2 + 6 \cdot 0.270^2 +$$

$$+ \sqrt{61} \cdot 1.803^2 + \sqrt{38.25} \cdot 1.428^2 + 6 \cdot 1.385^2 + \sqrt{146.25} \cdot 1.1404^2 + 13 \cdot 1.534^2]$$

$$EI \chi_1' = 30.214 + 24.135 + 12.024 + 0.20 \cdot [2.225 + 0.2394 + 0.2618 + 0.1682 +$$

$$+ 1.3025 + 1.8418 + 1.7152 + 0.4604 + 0.4374 + 25.390 + 12.612 + 11.509 + 56.456]$$

$$EI \chi_1' = 72.937 + 0.20 \cdot 115.727 = 96.082$$



$$D_1 = -0.22 / 0.707 = -0.3143$$

$$0.3143 \cdot 0.707 + D_1 = 0 \Rightarrow D_1 = -0.22 \quad D_2 = -0.22$$

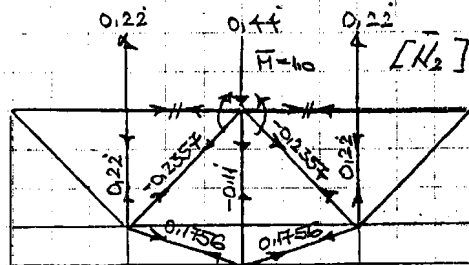
$$V_1 + 0.44 = 0 \Rightarrow V_1 = -0.44$$

$$-0.22 + 0.707 \cdot D_2 = 0 \Rightarrow D_2 = 0.3143$$

$$EFW_1 = EFW_3 = \int H H_1 ds = -0.22 \cdot 0.269 \cdot 4.50 \cdot 2.0 - 0.3804 \cdot 0.3143 \cdot \sqrt{40.5} +$$

$$+ 0.1902 \cdot 0.3143 \cdot \sqrt{40.50}$$

$$EFW_1 = EFW_2 = -0.538 - 0.78104 + 0.22044 = -0.9186$$



$$0.22 \cdot 13.50 + 0.707 \cdot D_1 \cdot 13.50 + 0.707 \cdot D_1 \cdot 4.50 = 0 \Rightarrow D_1 = 0.2357$$

$$2 \cdot 0.707 \cdot (-0.2357) + 0.44 + V = 0 \Rightarrow V = -0.11$$

$$0.22 \cdot 4.50 - U_1 \cdot 0.3623 \cdot 4.50 - U_1 \cdot 0.9489 \cdot 4.50 = 0$$

$$\Rightarrow U_1 = 0.17565$$

$$EFW_2 = \int H H_2 ds = -0.2357 \cdot 0.1902 \cdot \sqrt{40.5} \cdot 2 - 0.11 \cdot 0.270 \cdot 6.0 - 2 \cdot 0.1756 \cdot 0.4252 \cdot \sqrt{22.5}$$

$$EFW_2 = -0.570 - 0.177 - 0.70833 = -1.4533$$

$$P_0 = 0.75(2.0 + 3.9252) = 2.9439$$

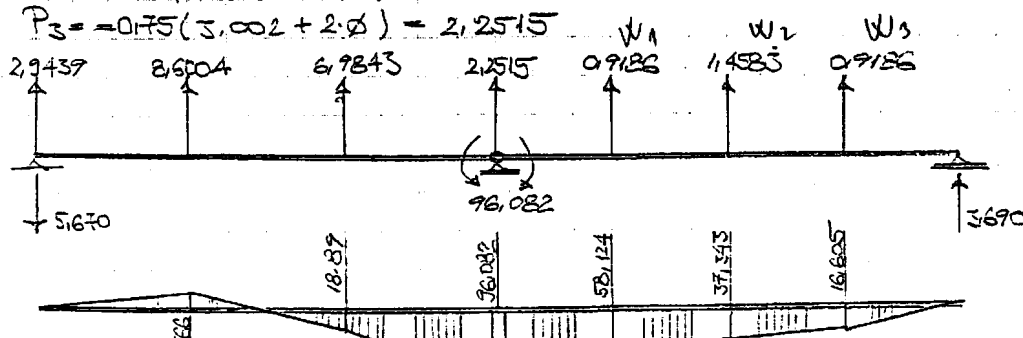
$$P_1' = 0.75(0 + 2 \cdot 3.9252) = 5.8873$$

$$P_1'' = 0.75(2 \cdot 1.3084 + 1.0) = 2.7126$$

$$P_2' = 0.75(1.3084 + 2 \cdot 1.0) = 2.4813$$

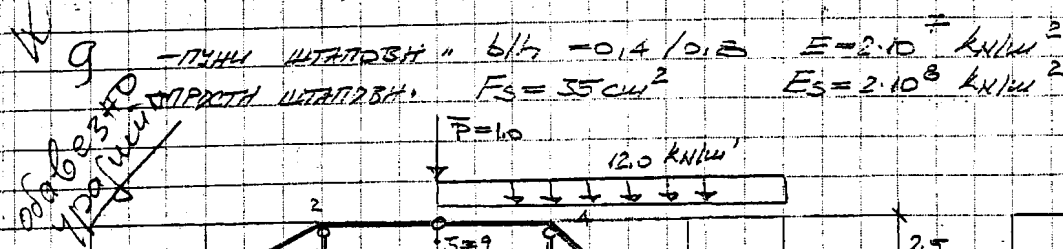
$$P_2'' = 0.75(2 \cdot 3.002 + 0) = 4.503$$

$$P_3 = 0.75(3.002 + 2 \cdot 0) = 2.2515$$



[EIN₂]

* НАПРЯЖА В КРАЙНЕМ СЕКЦИОНЕ ПОСРЕДИНА НА СЕЧ. А-Б-В.
ЗАДАЧА: УСТАЛЫ Т & Н ЗА ПУТЕ УСТАЛОСТЬ.



ПУТЕ УСТАЛОСТЬ			
УСТАЛ	$\sin \alpha$	$\cos \alpha$	
0-1	1.0	0.707	0.707
1-2	0.50	0.4472	0.8944
2-4	ϕ	ϕ	1.0
4-5	-0.833	0.6401	0.7682
5-B	-2.50	0.9235	0.3714

ПРЯМА УСТАЛОСТЬ			
0-1	0.50	0.4472	0.8944
1-2	0.25	0.2425	0.9701
2-4	ϕ	ϕ	1.0
4-5	-0.12083	0.120375	0.9789

$$\sum M_B = \phi, \quad V_A \cdot 30 - 12.0 \cdot 15.0 \cdot 7.50 = \phi \Rightarrow V_A = 45.0$$

$$\sum H = \phi, \quad H_B = \phi$$

$$\sum H = \phi, \quad V_A + V_B - 12.0 \cdot 15.0 = \phi \Rightarrow V_B = 135.0$$

$$\sum M_A = \phi, \quad 45.0 \cdot 15.0 - H \cdot 5.75 = \phi \Rightarrow H = 180.0$$

$$V_1 = 180 (0.50 - 0.25) = 45.0$$

$$V_2 = 180 (0.25 - \phi) = 45.0$$

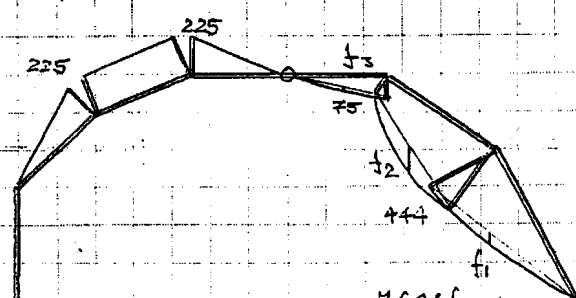
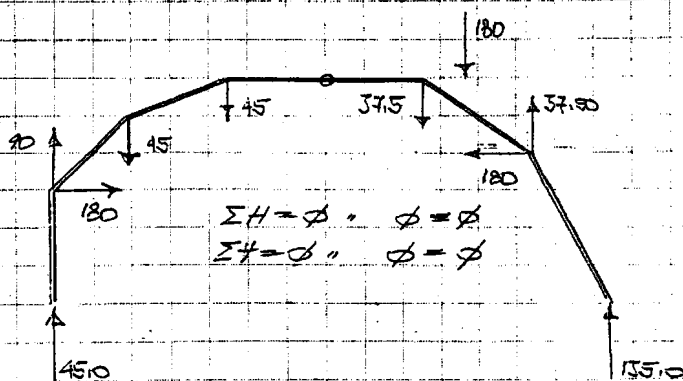
$$V_3 = 180 (\phi + 0.12083) = 37.50$$

$$S_{\alpha} = 180 / 0.8944 = 201.252$$

$$S_{12} = 180 / 0.9701 = 185.55$$

$$S_{24} = 180 / 1.0 = 180.0$$

$$S_{45} = 180 / 0.9789 = 183.88$$



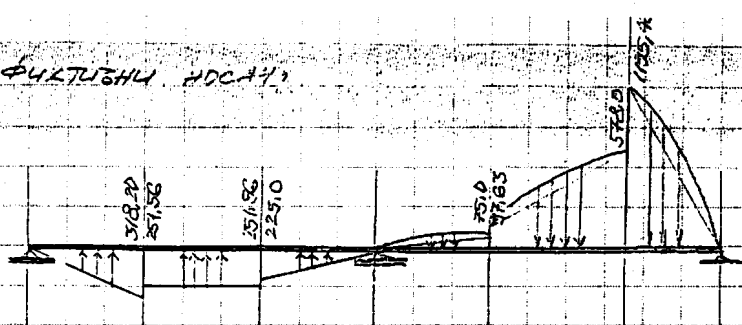
[M] $\gamma_{\text{ср.}} = \frac{1}{n} \sum \gamma_i$

$$f_1 = \frac{12.0 \cdot 4.0^2}{8} \cdot \frac{1}{0.3714} = 64.620$$

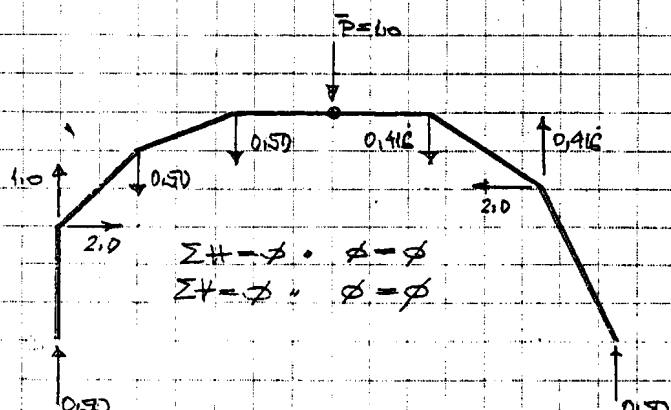
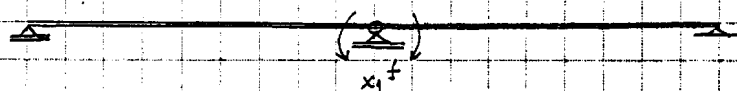
$$f_2 = \frac{12.0 \cdot 6.0^2}{8} \cdot \frac{1}{0.7682} = 70.294$$

$$f_3 = \frac{12.0 \cdot 5.0^2}{8} = 37.50$$

- ФУНКЦИЯ ПЛОСКОСТИ



ошибка
А. не введем
и не введем
а не введем
а не введем



$$\sum M_A = 0: V_A \cdot 5.0 - 10.0 \cdot 5.0 = 0 \rightarrow V_A = V_B = 0.50$$

$$\sum M_B = 0: 0.50 \cdot 5.0 - 10.0 \cdot 5.0 = 0 \rightarrow H = 2.0$$

$$V_1 = 2(0.50 - 0.25) = 0.50$$

$$V_2 = 2(0.25 - 0) = 0.50$$

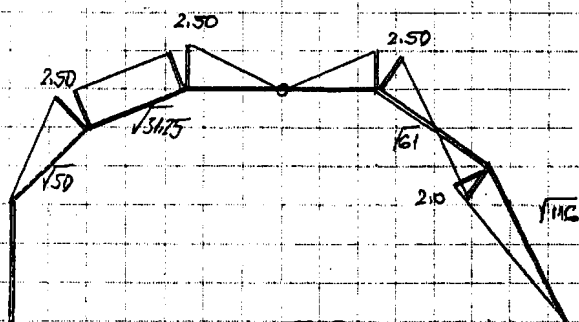
$$V_3 = 2(0 + 0.125) = 0.25$$

$$S_{01} = 2/0.8744 = 2.2361$$

$$S_{12} = 2/0.9701 = 2.0616$$

$$S_{24} = 2/1.0 = 2.0$$

$$S_{45} = 2/0.9789 = 2.0431$$



$$x_1 = \int \frac{M}{EI} ds + \int \frac{N}{E_s F_s} \cdot \frac{1}{EI}$$

$$I = \frac{1}{12} \cdot 0.1 \cdot 0.18^3 = 0.01708 \text{ m}^4$$

$$F_s = 35 \text{ cm}^2 = 3.5 \cdot 10^{-5} \text{ m}^2$$

$$EI x_1 = \int M \bar{M} ds + \left(\frac{EI}{E_s F_s} \right) \int N \bar{N} ds$$

$$\frac{EI}{E_s F_s} = \frac{2 \cdot 10^7 \cdot 0.01708}{2 \cdot 10^8 \cdot 3.5 \cdot 10^{-5}} = 0.4876$$

$$\Rightarrow EI x_1 = \int M \bar{M} ds + 0.4876 \int N \bar{N} ds$$

$$\int M \bar{M} ds = \frac{1}{3} \cdot 2.50 \cdot 225 + \sqrt{31.25} \cdot 2.50 \cdot 225 + 5 \cdot 2.50 \cdot 225 - (5 \cdot 75 \cdot 2.50 + 3 \cdot 37.50 \cdot 2.50) +$$

$$+ \left[\frac{\sqrt{61}}{6} [250(-2.75 - 444) + (-2(-2.444) - 75)] + \left[\frac{6}{3} (-70.294) \cdot (250 - 20) \right] + \right.$$

$$\left. + \frac{\sqrt{116}}{3} \cdot 444 \cdot 2.0 + \frac{1}{3} \cdot 2.0 \cdot 64.820 \right]$$

$$\int M \bar{M} ds = 1325.825 + 3144.47 + 2212.50 - 1093.75 - 1933.058 + 2214.206 - 70.294 +$$

$$+ 3188.013 + 172.32 = 9760.257$$

$$\int N \bar{N} ds = \sqrt{31.25} \cdot 201.232 \cdot 2.2361 + \sqrt{28.5625} \cdot 125.55 \cdot 2.0616 + 10 \cdot 130.0 \cdot 2.0 + \sqrt{37.5625} \cdot 125.23 \cdot$$

$$\cdot 2.0431 + 2.50 \cdot 45.0 \cdot 0.50 + 3.75 \cdot 45.0 \cdot 0.50 + 3.75 \cdot 37.50 \cdot 0.416$$

$$N \bar{N} ds = 10588,732$$

$$EI x_1^f = 9760,257 + 0,4876 \cdot 10588,732 = 14923,42$$

$$P_0 = 265,208$$

$$P_4 = 689,325$$

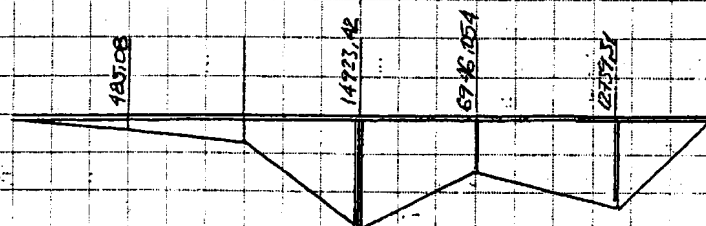
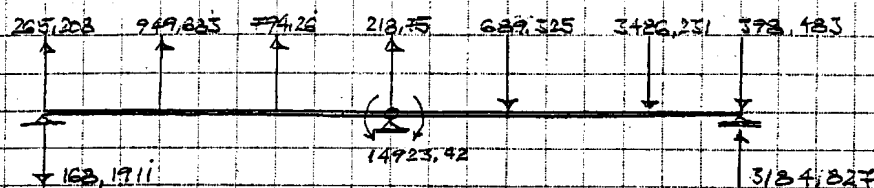
$$P_1 = 949,823$$

$$P_5 = 3426,231$$

$$P_2 = 774,266$$

$$P_6 = 378,483$$

$$P_3 = 218,75$$



[EIO]

* НАПРЯЖЕНИЯ ИЛИ МЫШКИ ЗА $\rho_u^L - \rho_u^d$
ОПРЕДЕЛЕНА СЯ НА 2,0 М.

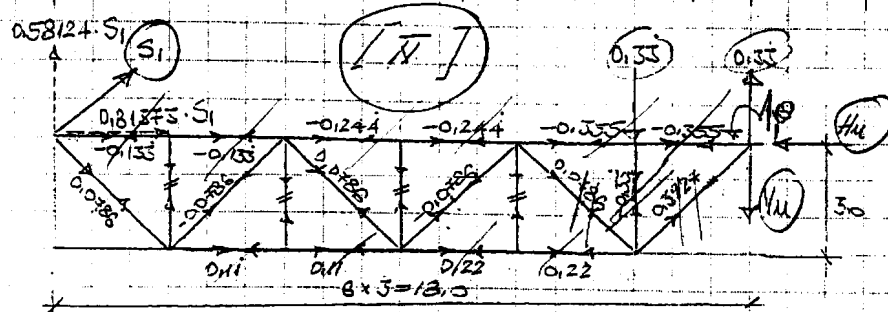
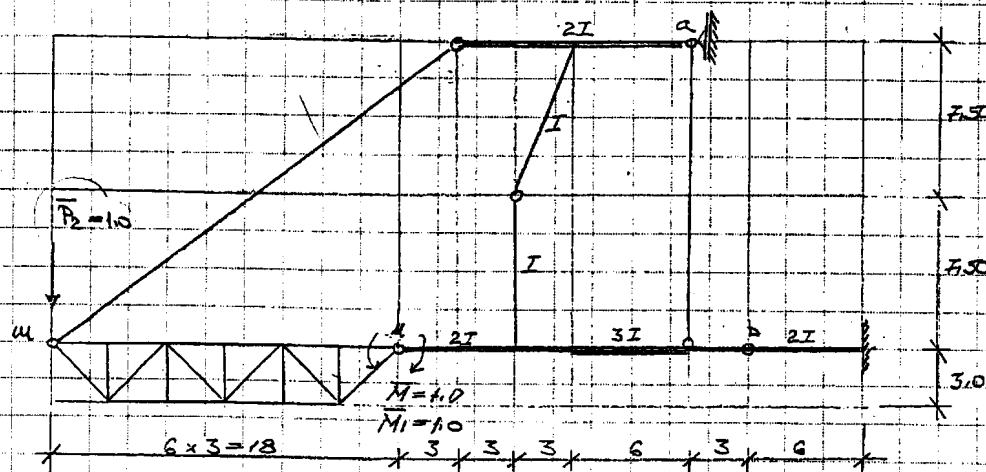
объемные
напряжения

состояние

10

- ПУЖИ ИЛИ МЫШКИ. $EI = \text{const}$; $I/F = \phi$

- ПРОСЧ. ШТАПОВ. $I/F = 0,10 \text{ м}^2$



$$\tan \alpha = 15/21 = 0,71428$$

$$\sin \alpha = 0,58124$$

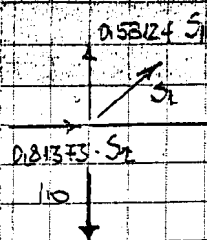
$$\cos \alpha = 0,81373$$

* курс и направление
рабочих моментов

$$\sum H_u = 0 \Rightarrow 0,58124 \cdot S_1 \cdot 18 - 0,33 \cdot 3,0 = 0 \Rightarrow S_1 = 0,0956$$

$$\sum X = 0 \Rightarrow 0,81373 \cdot 0,0956 = H_u \Rightarrow H_u = 0,0778$$

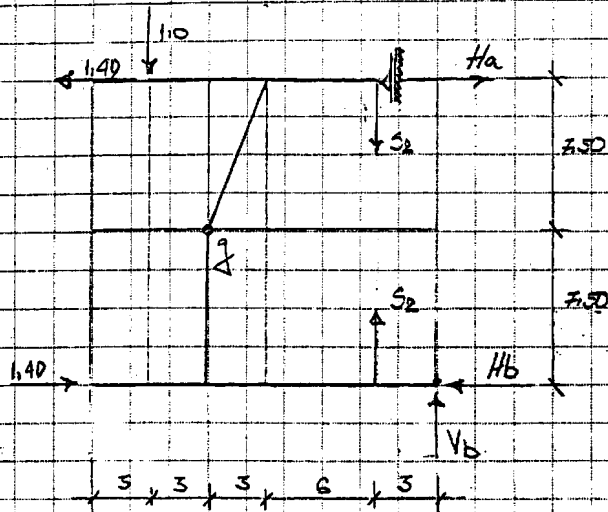
$$\sum Y = 0 \Rightarrow 0,58124 \cdot 0,0956 - V_u = 0 \Rightarrow V_u = 0,0556$$



$$\sum M_u = 0: 0.58124 \cdot S_1 \cdot 13 - 13 = 0 \Rightarrow S_1 = 1.7204$$

$$\sum Y = 0: 0.58124 \cdot 1.7204 - 1.0 + V_u = 0 \Rightarrow V_u = 0$$

$$\sum H = 0: H_u = 0.81373 \cdot 1.7204 \Rightarrow H_u = 1.40$$

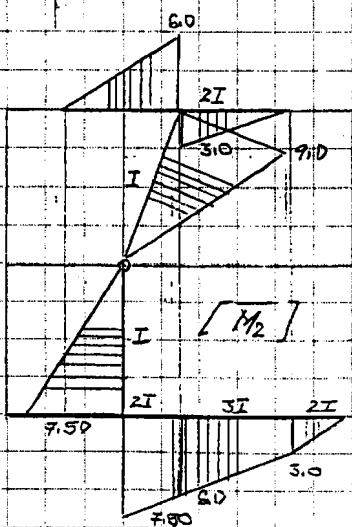
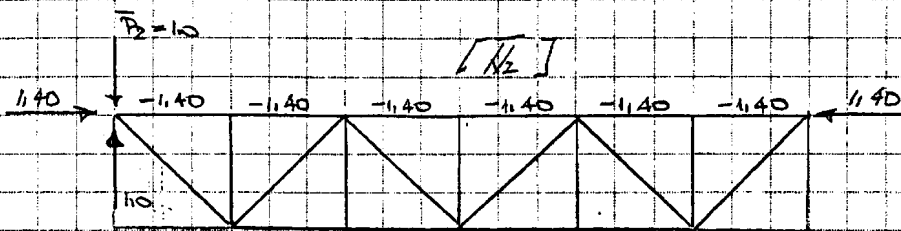


$$\sum H = 0: H_a = H_b = 2.40$$

$$\sum Y = 0: V_b = 1.0$$

$$\sum M_b = 0: -1.40 \cdot 15.0 - 1.0 \cdot 15.0 + H_a \cdot 15.0 = 0 \Rightarrow H_a = 2.40$$

$$\sum M_{S_2} = 0: 2.40 \cdot 7.50 - 1.0 \cdot 5.0 - 1.40 \cdot 7.50 + S_2 \cdot 9.0 = 0 \Rightarrow S_2 = -0.50$$



$$EI X_2 = \int M M_2 ds + 0.10 \int H H_2 ds$$

$$EI X_2 = \frac{6}{3} \cdot \frac{1}{2} \cdot 8 \cdot 9.3336 + \frac{6}{3} \cdot \frac{1}{2} \cdot 3 \cdot 0.50 + \frac{65.25}{3} \cdot 9.0 \cdot 9.3336$$

$$+ \frac{7.50}{3} \cdot 7.50 \cdot 0.5813 + \frac{3}{6} \cdot \frac{1}{2} \cdot [7.50(2 \cdot 0.75 + 0.50) + 6.0(2 \cdot 0.75 + 0.75)] + \frac{6}{6} \cdot \frac{1}{3} \cdot 0.50(2 \cdot 6 + 3) + 0.10 \cdot (\sqrt{66} \cdot 1.7204 \cdot 0.1$$

$$- 15 \cdot 0.50 \cdot 0.0833 + 2 \cdot 3 \cdot 0.133 \cdot 1.40 + 2 \cdot 3 \cdot 0.244 \cdot 1.40 + 2 \cdot 3 \cdot 0.355 \cdot 1.40)$$

$$EI X_2 = 2.0018 + 1.50 + 20.201 + 10.9375 + 3.75 + 2.625 + 2.5$$

$$+ 0.10(4.244 - 0.625 + 1.12 + 2.053 + 2.932)$$

$$EI X_2 = 43.5151 + 0.9775 = 44.492$$

$$EI X_2 = 44.492$$

$$D_1 \cdot 0,407 = 0,58124 \cdot 0,0956 \Rightarrow D_1 = 0,0756$$

$$0.81373 \cdot 0.0956 + D_1 + 0.0926 \cdot 0.504 = p \quad \Rightarrow D_1 = -0.133$$

$$0.0786 \cdot 0.1407 + D_2 \cdot 0.1407 = 0 \Rightarrow D_2 = -0.0786$$

$$0,0726 \cdot 0,707 + 0,0726 \cdot 0,707 = U_1 \quad \Rightarrow U_1 = 0,101$$

$$0,0488 \cdot 0,757 - 0,757 \cdot 0,0488 = 0 \Rightarrow D_3 = 0,0488$$

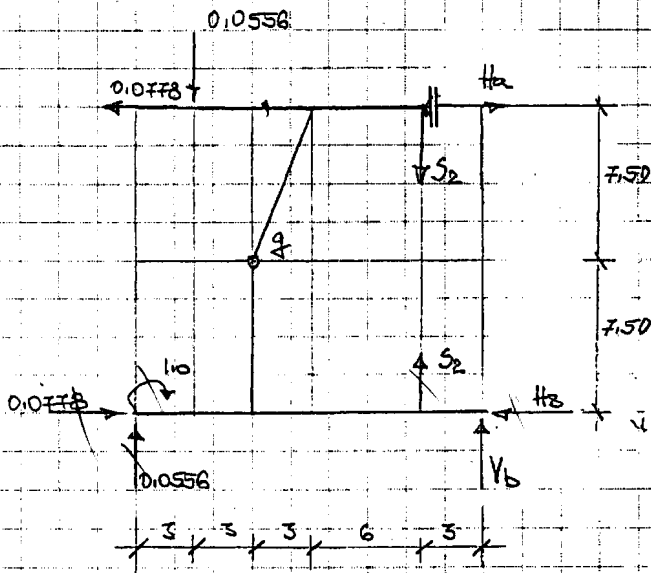
$$0,0786 \cdot 0,407 \cdot 2,0 + 0,132 + 0_3 = 0 \quad \rightarrow \quad 0_3 = -0,244$$

$$0,0786 \cdot 0,707 + D_4 \cdot 0,707 = 0 \Rightarrow D_4 = -0,0786$$

$$0,0736 \cdot 0,707 \cdot 2,0 + 0,111 = \phi \quad \Rightarrow \quad u_3 = 0,222$$

$$0,707 \cdot D_6 = 0,2776 \Rightarrow D_6 = 0,3923$$

$$0,707 \cdot 0,3927 + 0,6 + 0,0778 = \phi \quad \Rightarrow \quad 0,6 = -0,355$$



$$\Sigma H = \emptyset \quad H_a = H_b$$

$$\Sigma V = \phi, \quad V_b = \phi$$

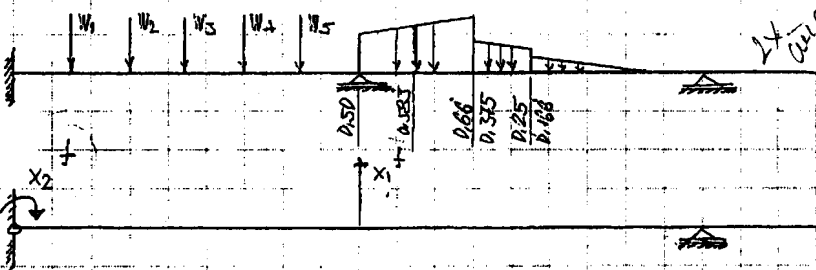
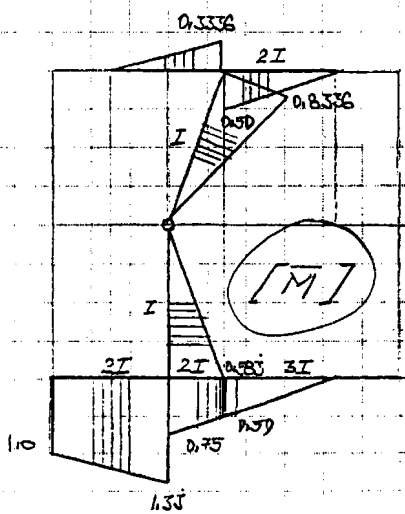
$$7.50 \quad \Sigma M_g^0 = 0 \quad 1.0 + 0.0556 \cdot 2.0 - 0.0772 \cdot 7.50 - 5.2 \cdot 9.0 + 4.8 \cdot 7.50 = 0$$

$$0.7501 - 952 + 7.546 = \phi$$

$$\Sigma M_A - \phi = -0.0556 \cdot 12 + 11.0 - 0.0778 \cdot 15 + 0.0556 \cdot 15 + 7.50 + 46.150 = \phi \quad \rightarrow H_b = \phi$$

$$\Rightarrow H_A = H_B = V_B = \emptyset$$

$$= \nabla 0.7501 - 9.52 - \phi \rightarrow \nabla S_2 = 0.0855$$



$$x_1 = \int \frac{\overline{M}^2}{EI} ds + \int \frac{\overline{N}^2}{EF} ds \quad / \cdot EI$$

$$U_{EI(x)} = \int M^2 ds + \frac{I}{F} \int N^2 ds$$

$$\underline{EI \chi_1} = \frac{6}{3} \cdot \frac{1}{2} \cdot 0,3336^2 + \frac{6}{3} \cdot \frac{1}{2} \cdot 0,50^2 + \frac{\sqrt{65,25}}{3} \cdot 0,8336^2 + \frac{7,50}{3} \cdot 0,583^2 + \frac{6}{3} \cdot \frac{1}{2} \cdot (1 + 1,53 + 1,53^2) + \frac{3}{3} \cdot \frac{1}{2} \cdot (0,75^2 + 0,75 \cdot 0,50 + 0,50^2) + \frac{6}{3} \cdot \frac{1}{3} \cdot 0,50^2 + 0,10 \cdot [2 \cdot 3 \cdot 0,113^2 + 2 \cdot 3 \cdot 0,244^2 + 2 \cdot 3 \cdot 0,355^2 + 2 \cdot 3 \cdot 0,11^2 + 2 \cdot 3 \cdot 0,22^2 + 3 \cdot 0,35^2 + \sqrt{13} \cdot 0,392^2 + 5 \cdot \sqrt{13} \cdot 0,0786^2]$$

$$EI x_1^f = 0,11129 + 0,250 + 1187104 + 0,8507 + 4,11 + 0,59375 + 0,166 + 0,10 (0,106 + 0,35852 + 0,75615 + 0,107407 + 0,2963 + 0,133 + 0,8543 + 0,13105 + 15 \cdot 0,0833^2 + \sqrt{226} \cdot 0,0956^2)$$

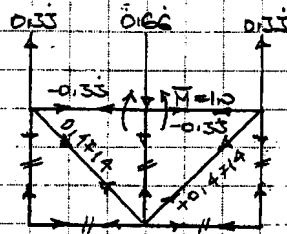
$$EIX_1^f = 7,9550 + 0,305 = 8,260$$

$$EI x_1^f = 8,260$$

$$\begin{aligned} EFW_1 &= 3 \cdot 0,13 \cdot 0,33 \cdot 2 + \sqrt{18} \cdot 0,47 \cdot 0,0786 - \\ &= \sqrt{18} \cdot 0,47 \cdot 0,0786 \\ EFW_1 &= 0,266 \end{aligned}$$

$$0,3j + 0,707 \cdot D = 0 \quad \Rightarrow D = -0,414$$

$$0,414 - 0,707 = u \quad \Rightarrow u = 0,3j$$



$$\begin{aligned} EF_{W4} &= 2.033 \cdot 0.22 = 0.44726 \\ EF_{W5} &= \sqrt{18} \cdot 0.471 \cdot 0.0726 + \\ &+ \sqrt{18} \cdot 0.3927 \cdot 0.471 + 2.033 \cdot 0.355 \\ EF_{W5} &= 0.1571 + 0.7847 + 0.7236 \\ EF_{W5} &= 1.6654 \end{aligned}$$

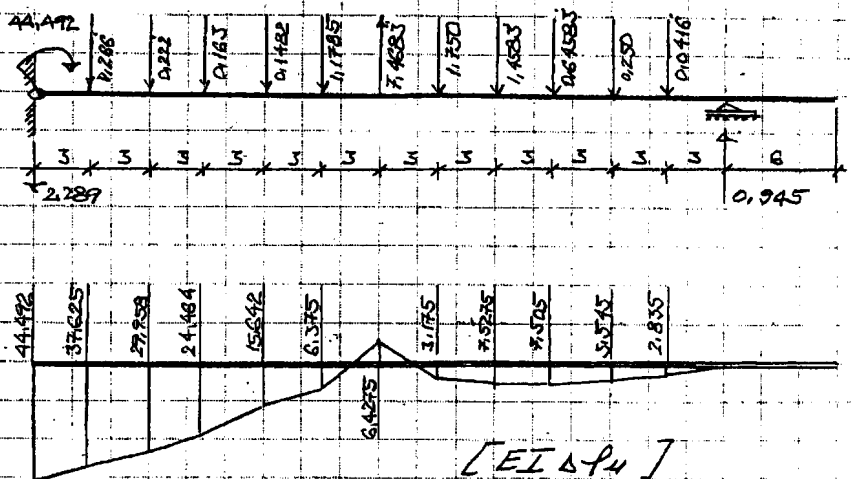
$$EFW_2 = 2.3 \cdot 0.33 \cdot 0.41 = 0.222$$

$$EFW_2 = 0.222$$

$$EFW_3 = 2 \cdot 0,33 \cdot 0,244 = 0,163$$

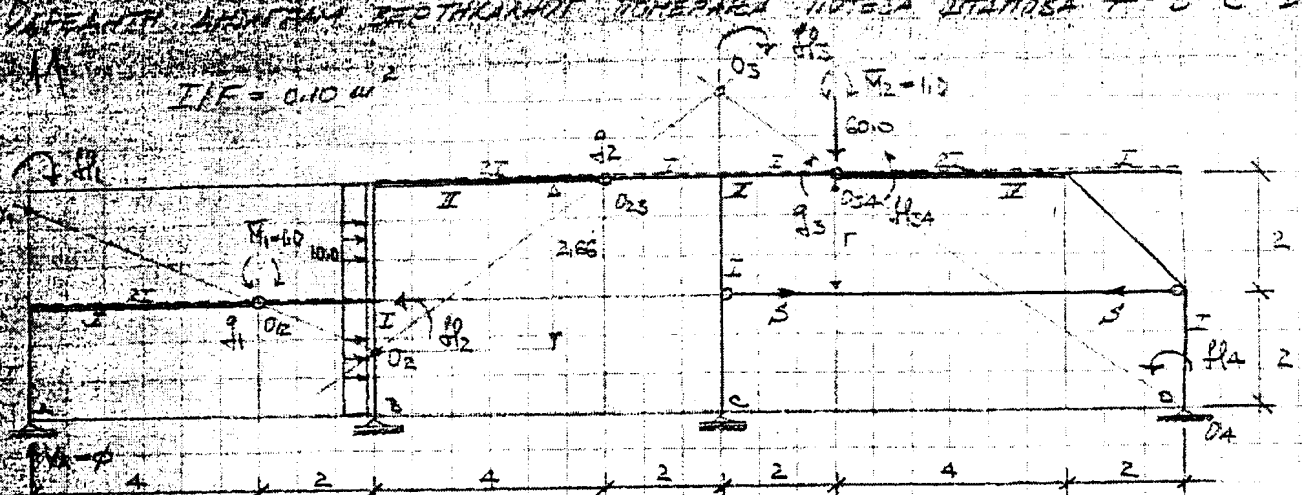
$$EFW_3 = 0,163$$

$$\begin{aligned} P_0 &= 0.50(2 \cdot 0.50 + 0.58\bar{3}) = 0.791\bar{6} \\ P_1 &= 0.50(0.50 + 4 \cdot 0.58\bar{3} + 0.6\bar{6}) = 1.75 \\ P_2 &= 0.50(2 \cdot 0.6\bar{6} + 0.58\bar{3}) = 0.958\bar{3} \\ P_2^* &= 0.50(0.375 \cdot 2 + 0.25) = 0.50 \\ P_3 &= 0.50(2 \cdot 0.25 + 0.375) = 0.4375 \\ P_3^* &= 0.50(2 \cdot 0.1\bar{6}\bar{6} + 0.08\bar{3}) = 0.208\bar{3} \\ P_4 &= 0.50(0.1\bar{6}\bar{6} + 4 \cdot 0.08\bar{3}) = 0.250 \\ P_5 &= 0.50(0.08\bar{3}) = 0.041\bar{6} \end{aligned}$$

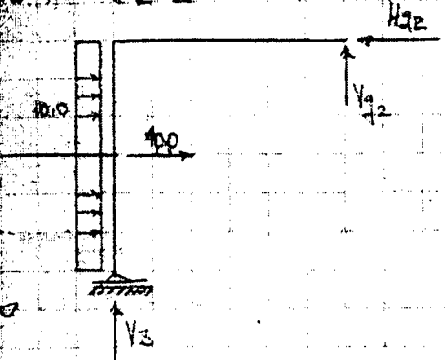


УДЕРЖИВАЮЩИЕ СИЛЫ И МОМЕНТЫ
 ВНЕШНИЙ НАГРУЗКА ВЕРХНИЙ ПОЯС СТАНДА А-В-С-Д.

$I/F = 0.10 \text{ м}^2$

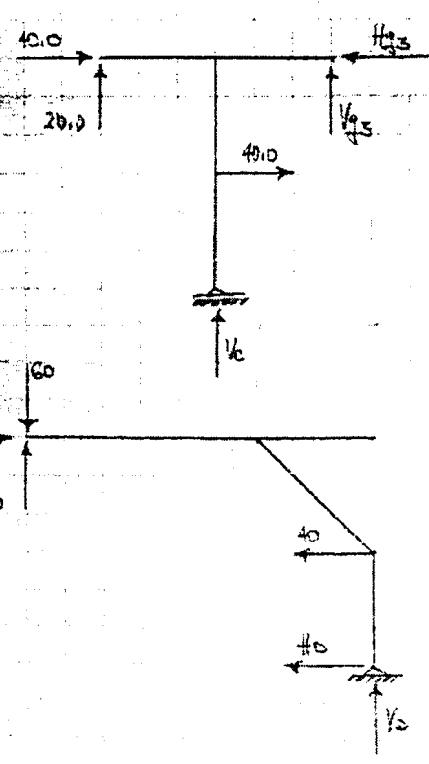


$q_{1,2} = 1/2 \cdot 110 = 55$
 $q_{3,4} = 1/2 \cdot 80 = 40$
 $q_{5,6} = 1/2 \cdot 80 = 40$
 $q_{7,8} = 1/2 \cdot 80 = 40$
 $q_{9,10} = 1/2 \cdot 80 = 40$
 $S = 60.0 \cdot 2.0 \cdot 0.375 + 100.0 \cdot 4.0 \cdot 0.66 \cdot 0.1875$
 $S = 40.0 \text{ кН}$
 (мгновенная нагрузка)



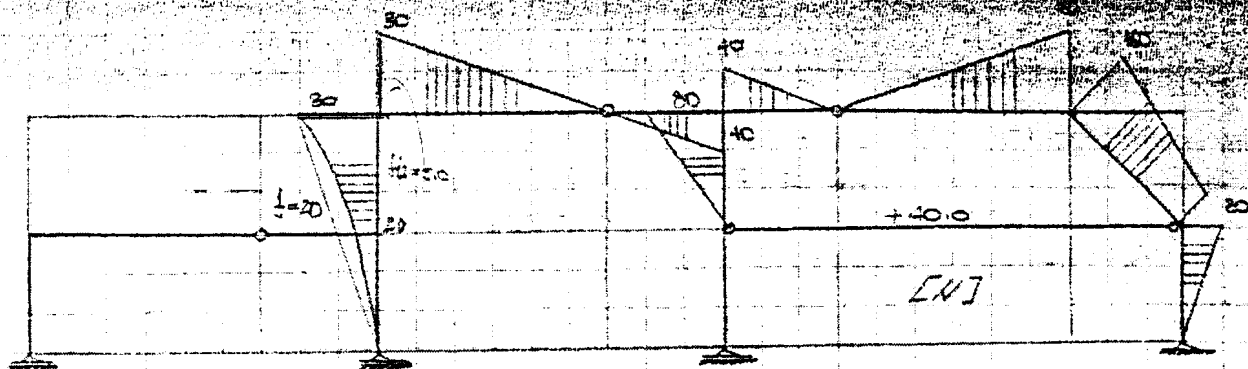
$\sum M_{32} = 0 \cdot V_3 \cdot 4.0 = 40.0 \cdot 2.0 \rightarrow V_3 = 20.0$
 $\sum H = 0 \cdot H_{32} = 40.0$
 $\sum V = 0 \cdot V_{32} = -20.0$

нагрузка на ступень



$\sum M_{33} = 0 \cdot -40 \cdot 2.0 + 20 \cdot 4.0 + V_c \cdot 2.0 = 0 \rightarrow V_c = 0$
 $\sum H = 0 \cdot H_{33} = 20.0$
 $\sum V = 0 \cdot V_{33} = -20.0$

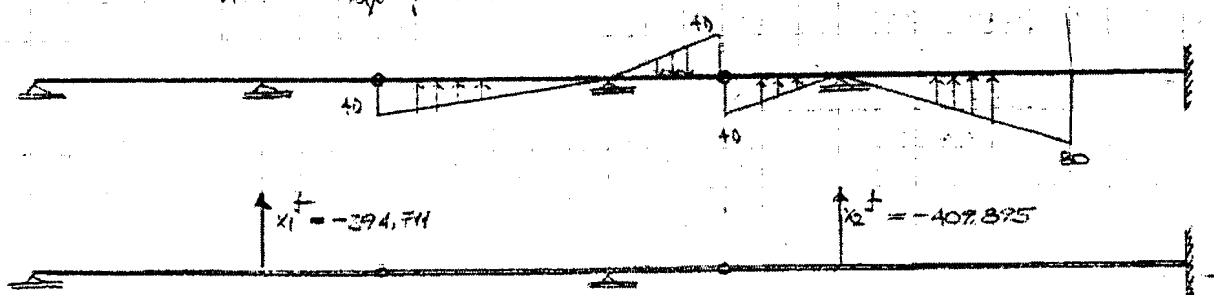
$\sum H = 0 \cdot H_0 = 40.0$
 $\sum V = 0 \cdot V_0 = 40.0$



[M]

- ФУКЦИОНАЛНИ ПОСАЧУ

(функциони
показ се поставља у табели
у којој се налази функција)



$$x_1^+ = -394,711$$

$$x_2^+ = -407,875$$

$$\begin{aligned} \sum H &= 0, H_1 = 0 \\ \sum V &= 0, V_1 = -V_2 \\ \sum M_2 &= 0, -10 \cdot 20 + V_1 \cdot 20 = 0 \\ \Rightarrow V_1 &= -0,25 \\ V_2 &= 0,25 \end{aligned}$$

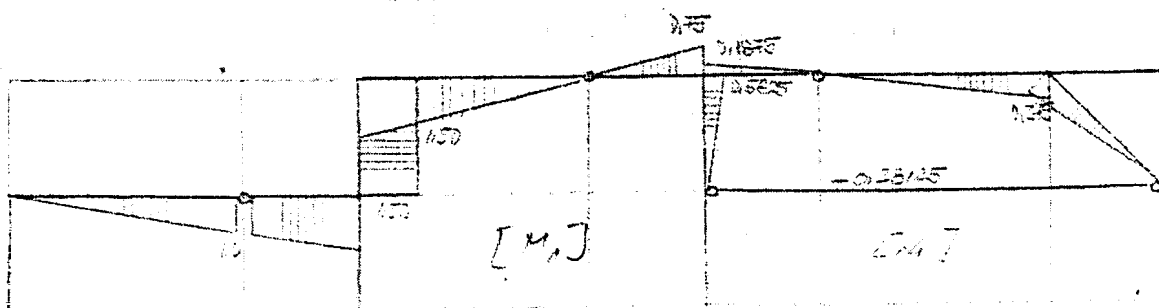
$$\begin{aligned} \sum H &= 0, H_2 = 0 \\ \sum V &= 0, 0,25 + V_2 + V_3 = 0 \\ \sum M_2 &= 0, 10 \cdot 20 + 0,25 \cdot 20 - V_3 \cdot 4 = 0 \\ \Rightarrow V_2 &= -0,375 \\ V_3 &= -0,625 \end{aligned}$$

$$\begin{aligned} S' &= -H_1 \cdot 10 - H_2 \cdot 10 \\ S' &= -0,28125 \end{aligned}$$

$$\begin{aligned} \sum H &= 0, H_3 = 0 \\ \sum V &= 0, V_3 + V_4 = 0,375 \\ \sum M_3 &= 0, 0,28125 \cdot 2 - 0,375 \cdot 4 + 2V_4 = 0 \\ \Rightarrow V_4 &= 0,4375 \\ V_3 &= -0,09375 \end{aligned}$$

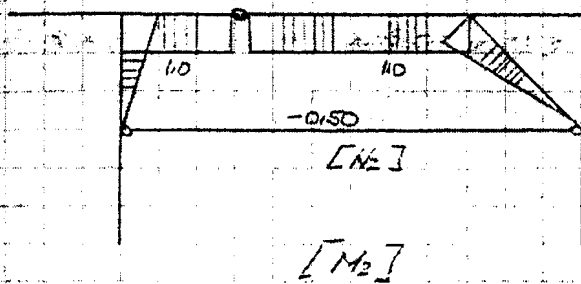
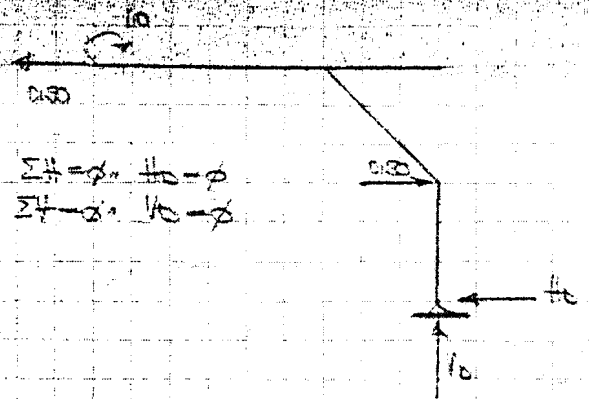
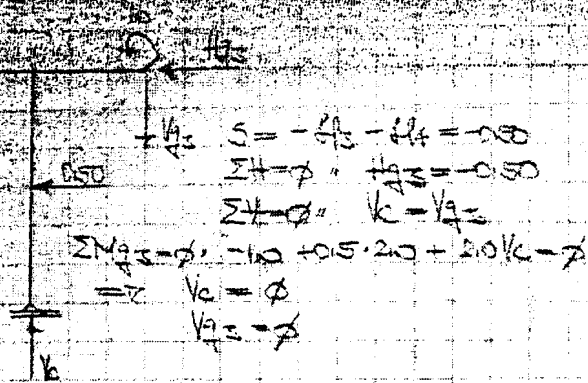
$$\begin{aligned} \sum H &= 0, H_3 = 0,28125 \\ \sum V &= 0, V_3 + V_4 = 0,375 \\ \sum M_3 &= 0, 0,28125 \cdot 2 - 0,375 \cdot 4 + 2V_4 = 0 \\ \Rightarrow V_4 &= 0,4375 \\ V_3 &= -0,09375 \end{aligned}$$

$$\begin{aligned} \sum H &= 0, H_4 = 0 \\ \sum V &= 0, V_4 = 0,09375 \end{aligned}$$



[M]

[M]



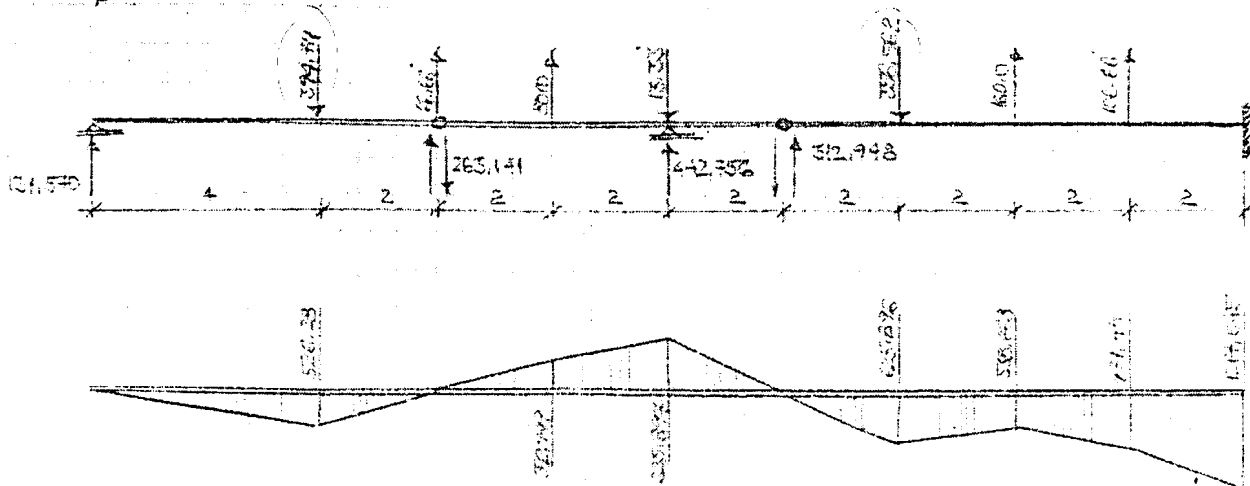
$$EI \chi_1^+ = \int \overline{M} \overline{M}_1 ds + 0.10 \int \overline{N} \overline{N}_1 ds = - \left[\frac{2}{3} \cdot 1.30 (20 + 80) - \frac{2.2}{3} \cdot 1.50 \cdot 50 \right] - \frac{4}{3} \cdot \frac{1}{2} \cdot 80 \cdot 1.30 - \frac{2}{3} \cdot 40 \cdot 0.75 - \frac{2}{3} \cdot 40 \cdot 0.1875 - \frac{2}{3} \cdot 80 \cdot 0.5625 - \frac{4}{3} \cdot \frac{1}{2} \cdot 160 \cdot 0.75 - \frac{\sqrt{2}}{6} \cdot 0.75 \cdot (2 \cdot 60 + 80) - 0.10 \cdot 80 \cdot 400 \cdot 0.23125$$

$$EI \chi_1^+ = -150 + 10 - 80 - 20 - 5 - 30 - 40 - 9.711 - 9.0 = -394.711$$

$$EI \chi_2^+ = \int \overline{M} \overline{M}_2 ds + 0.10 \int \overline{N} \overline{N}_2 ds = - \frac{2}{3} \cdot 10 \cdot 80 - \frac{2}{3} \cdot 10 \cdot 40 - \frac{4}{3} \cdot \frac{1}{2} \cdot 10 \cdot 160 - \frac{\sqrt{2}}{6} \cdot 10 \cdot (2 \cdot 160 + 80) - 0.10 \cdot 80 \cdot 400 \cdot 0.50$$

$$EI \chi_2^+ = -53.33 - 400 - 1600 - 188.562 - 16.0 = -409.895$$

$$\begin{aligned} P_1 &= 66.66 & P_5 &= 53.33 \\ P_2 &= 80.0 & P_6 &= 160.0 \\ P_3 &= -13.33 & P_7 &= 106.66 \\ P_4 &= 0 \end{aligned}$$

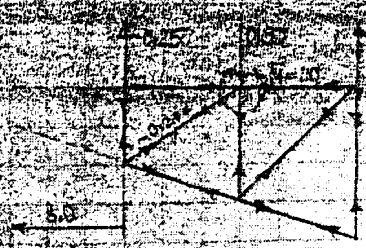


[EIN]

102

$$D \sin^2 30^\circ + D \cos^2 30^\circ = 3 + 7.5 \cdot 20 = 0 \Rightarrow D = -0.277$$

$$EFV_2 = -0.277 \cdot 0.266 \cdot 50 = -0.3703$$



$$\sum M_A = 0: 10 \cdot 30 - 20 \cdot 10 - 30 \cdot 10 + H_B = 0 \Rightarrow H_B = 9.33 \text{ kN} - 2.66$$

$$\sum M_B = 0: 10 \cdot 40 - 240 \cdot 10 + 20 \cdot 10 + H_B = 0 \Rightarrow V_2 = 0.375 \quad H_B = 0.253$$

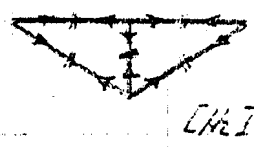


$$\begin{aligned} 0.375 \cdot 200 - 0.375 \cdot 90 - 0.6 \cdot D \cdot 120 &= 0 \Rightarrow D = 0 \\ 0.375 \cdot 120 - 0.1833 \cdot 60 + 0.30 &= 0 \Rightarrow D = 0.166 \\ D \cdot 0.6 + 0.375 &= 0 \Rightarrow D = -0.625 \end{aligned}$$

$$EFx_1 = -2 \cdot 4 \cdot 0.166 / 0.375 - 5 \cdot 0.625 \cdot 0.266 = -1.277$$

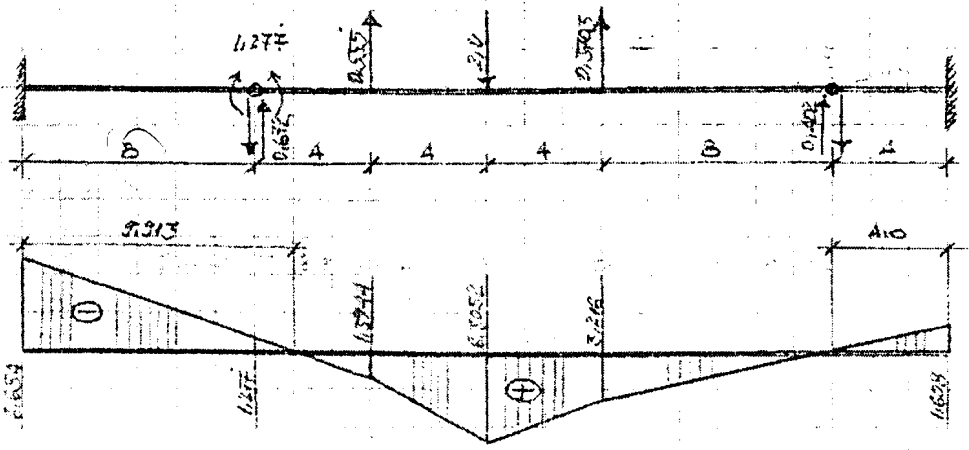
$$\sum M_A = 0: 10 \cdot 280 - V_B \cdot 280 + 30 \cdot 10 + H_B = 0 \Rightarrow H_B = 9.33 \text{ kN} - 9.33$$

$$\sum M_B = 0: 10 \cdot 240 - V_B \cdot 240 + 30 \cdot 10 + H_B = 0 \Rightarrow V_B = 10 \quad H_B = 0$$

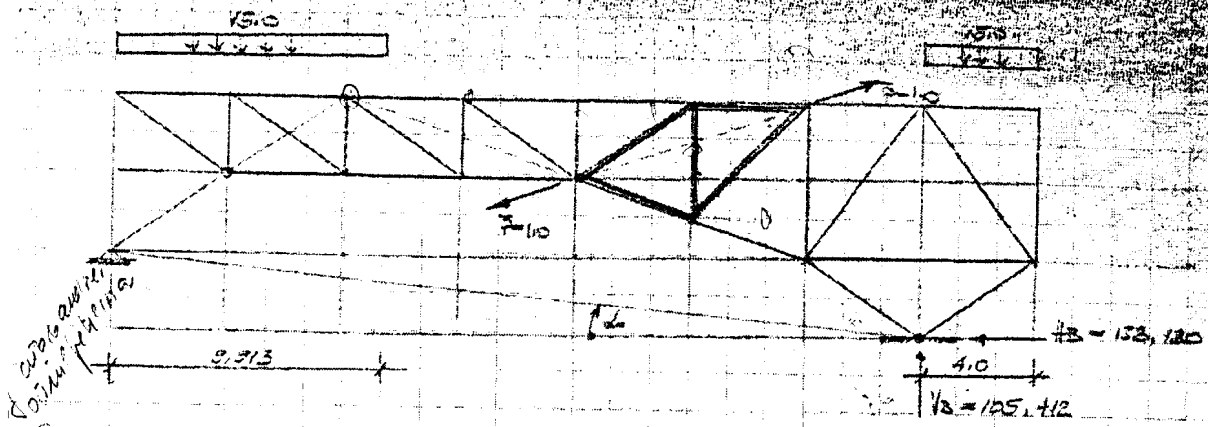


$$\begin{aligned} 10 \cdot 200 - D \cdot 0.60 \cdot 120 - 10 \cdot 200 &= 0 \Rightarrow D = 0 \\ D \cdot 30 - 10 \cdot 120 + 10 \cdot 120 &= 0 \Rightarrow D = 0 \end{aligned}$$

$$EFx_2 = 0$$



[EF1]



$$\sum M_A = 0: 15.0 \cdot 9.713 \cdot 4.9565 + 15.0 \cdot 4.0 \cdot 30.0 - V_B \cdot 28.0 + H_B \cdot 4.0 = 0$$

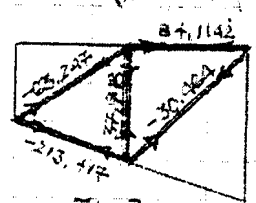
$$737.00 + 1800 - 28V_B + 4H_B = 0 \Rightarrow H_B = 9.33V_B - 245.66$$

$$\sum M_B = 0: 15.0 \cdot 5.713 \cdot 2.9565 + 15.0 \cdot 26.0 - V_B \cdot 24.0 + H_B \cdot 4.0 = 0$$

$$262.227 + 390 - 24V_B + 4H_B = 0$$

$$652.227 - 24V_B + 4(9.33H_B - 245.66) = 0$$

$$652.227 - 24V_B + 36H_B - 982.64 = 0 \Rightarrow H_B = 138.180, V_B = 105.412$$

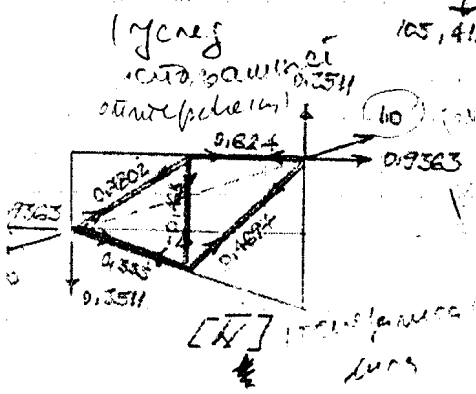


$$105.412 \cdot 8.0 - 138.180 \cdot 4.50 + 0 \cdot 4.180 - 15.0 \cdot 4.0 \cdot 10.0 = 0 \Rightarrow D = 24.1142$$

$$105.412 \cdot 20.0 - 138.180 \cdot 7.0 - 15.0 \cdot 4.0 \cdot 22.0 - D \cdot 20.0 \cdot 0.7474 = 0 \Rightarrow D = -30.464$$

$$105.412 \cdot 6.0 - 138.180 \cdot 7.0 - 15.0 \cdot 4.0 \cdot 10.0 - U \cdot 4.50 \cdot 0.9363 = 0 \Rightarrow U = -237.417$$

$$105.412 \cdot 20.0 - 138.180 \cdot 7.0 - 15.0 \cdot 4.0 \cdot 22.0 - D \cdot 12.0 \cdot 0.160 = 0 \Rightarrow D = -63.247$$



$$0.3511 \cdot 16.0 - D \cdot 16.0 \cdot 0.7474 = 0 \Rightarrow D = 0.4697$$

$$0.4697 \cdot 0.16844 - 0.9363 + 0 = 0 \Rightarrow 0 = 0.1624$$

$$0.3511 \cdot 16.0 - D \cdot 12.0 \cdot 0.160 = 0 \Rightarrow D = 0.7802$$

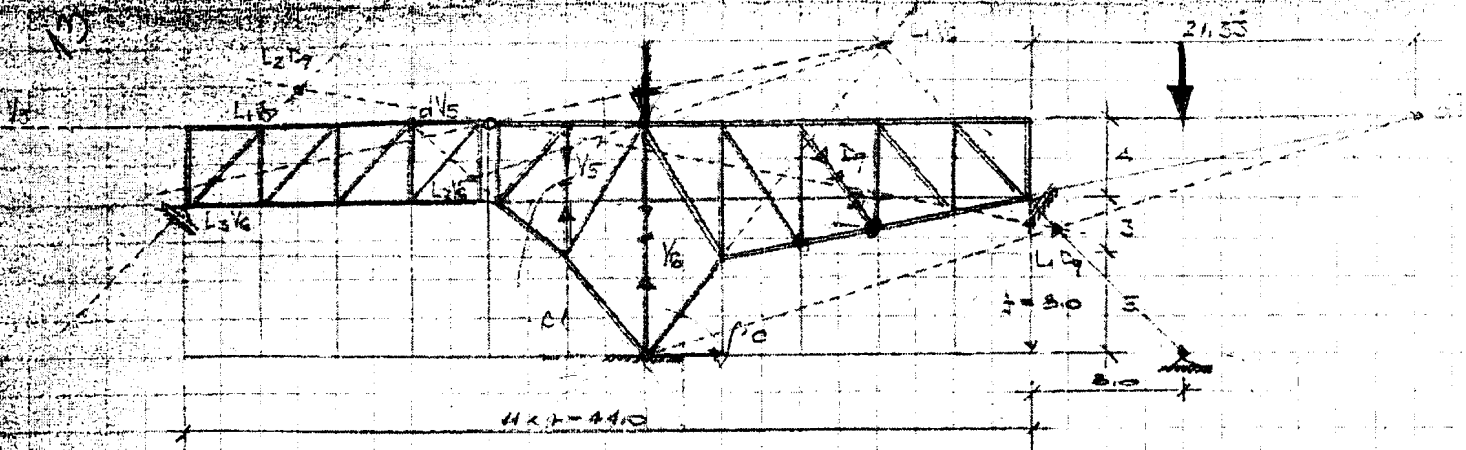
$$0.3511 \cdot 4.0 - U \cdot 4.50 \cdot 0.9363 = 0 \Rightarrow U = 0.1333$$

$$EF \downarrow = \sum N \cdot d_s = 24.1142 \cdot 0.1624 \cdot 4.0 - 30.464 \cdot 0.4697 \cdot 2.0207 - 57.948 \cdot 0.46815 \cdot 4.50 - 213.417 \cdot 0.1333 \cdot 4.1272 - 63.247 \cdot 0.7802 \cdot 5.0$$

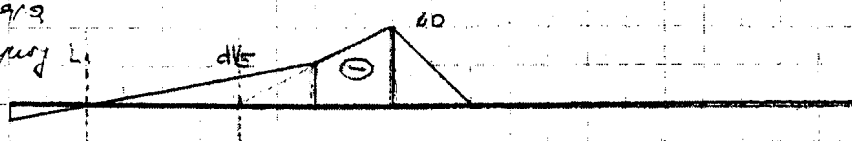
$$EF \downarrow = 209.749 - 66.150 - 79.941 - 503.708 - 248.733$$

$$EF \downarrow = -502.781 \quad (\text{с опорными тал})$$

РАСЧЕТЫ СТЕЛЖА И АРКА В СЪЕДИНЕНИИ

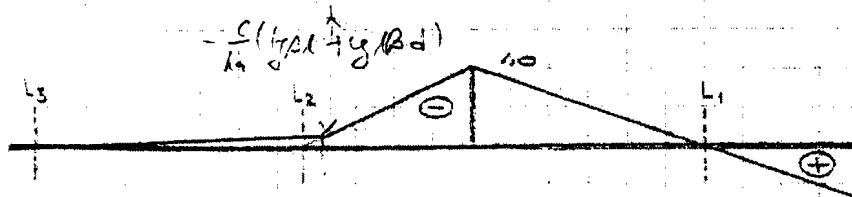


V₅ - РАСЧЕТ
ПРОФИТА ВЪЗГ. 9
НА СРЕДНУЮ L₁



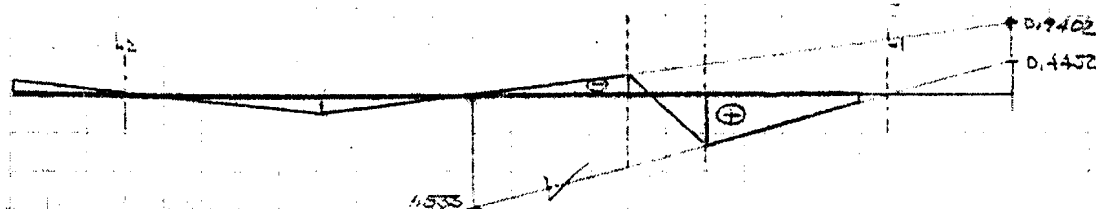
[V₅]

V₆ - РАСЧЕТ ВЕРТИКАЛ



[V₆]

D₉



$$\tan \alpha = 5.50 / 4.10 \rightarrow \cos \alpha = 0.58817 \quad \sin \alpha = 0.8087$$

$$10 \cdot 41.55 - D_{9,A} \cdot 0.8087 \cdot 33.13 = 0 \rightarrow D_{9,A} = 1.533$$

$$10 \cdot 13.33 + D_{9,B} \cdot 0.8087 \cdot 29.53 + D_{9,E} \cdot 0.58817 \cdot 5.50 = 0 \rightarrow D_{9,B} = -0.495$$

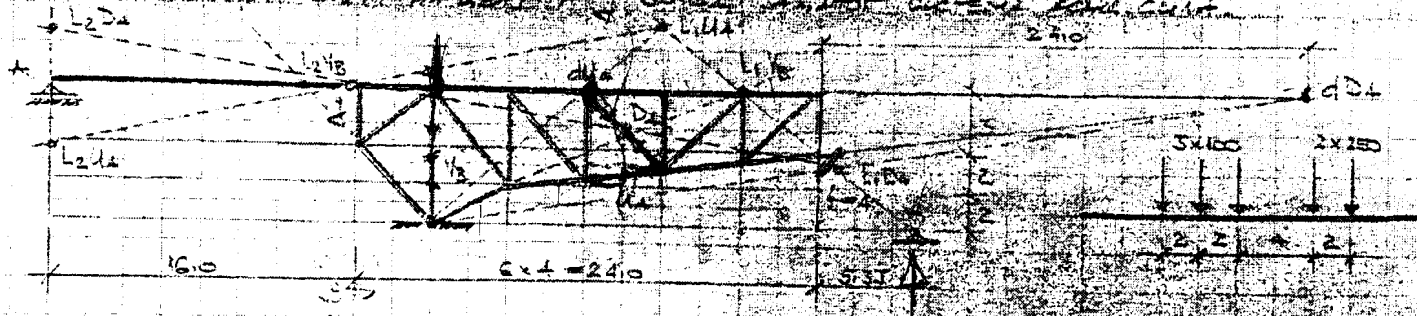
$$10 \cdot 12.5 + D_{9,H} \cdot 0.8087 \cdot 33.13 = 0 \rightarrow D_{9,H} = -0.4452$$

$$\frac{1}{2} \cdot D_{9,H} = \frac{-0.4452}{2} = -0.2226$$

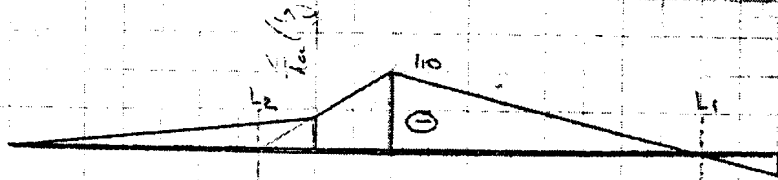
* ДИФЕРЕНЦИАЛЬНЫЕ УРАВНЕНИЯ ДЛЯ ПОПЕРЕЧНЫХ НАПРАВЛЕНИЙ

ДИФЕРЕНЦИАЛЬНЫЕ УРАВНЕНИЯ ДЛЯ ПОПЕРЕЧНЫХ НАПРАВЛЕНИЙ

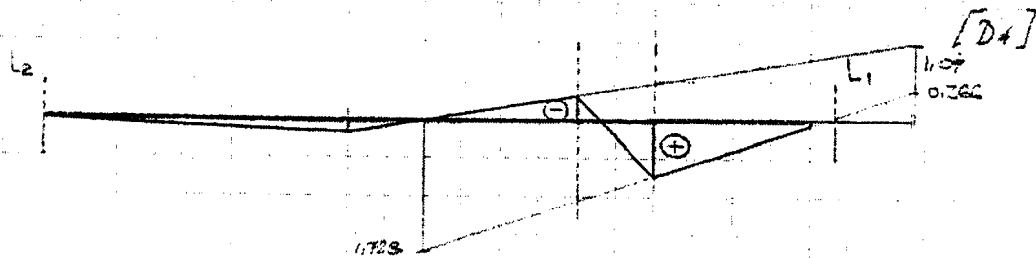
14



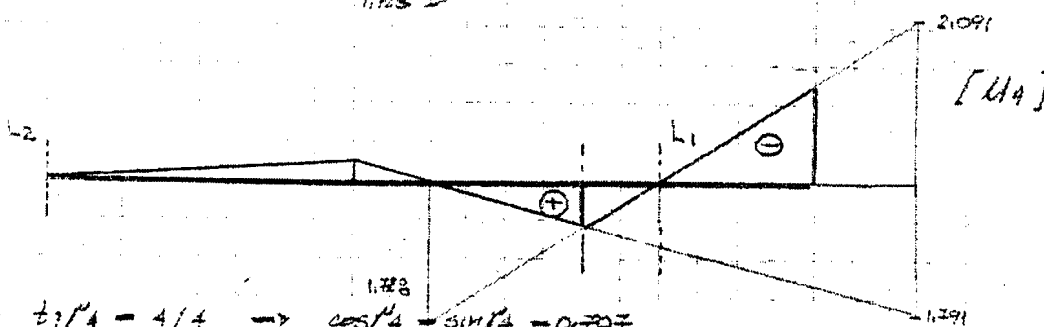
V3 - ОСНОВНЫЕ ВОЗМУЩЕНИЯ



D4



U4



$$D_4: \tan \alpha = 4/4 \rightarrow \cos \alpha = \sin \alpha = 0.707$$

$$10 \cdot 4.410 - D_{4,1} \cdot 0.707 \cdot 36.0 = 0 \rightarrow D_{4,1} = 1.728$$

$$10 \cdot 12.66 + D_{4,2} \cdot 0.707 \cdot 4.0 + D_{4,3} \cdot 0.707 \cdot 32.0 = 0 \rightarrow D_{4,2} = -0.752$$

$$10 \cdot 7.0 + D_{4,4} \cdot 0.707 \cdot 36.0 = 0 \rightarrow D_{4,4} = -0.225$$

$$\frac{2}{3} D_{4,1} = \frac{-5.11}{4.0} \cdot 0.225 = -0.366$$

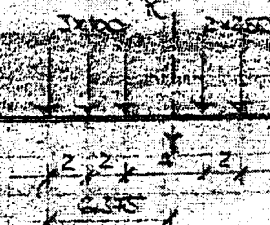
$$U_4: \tan \alpha = 2.150/4.0 \rightarrow \cos \alpha = 0.9923 \quad \sin \alpha = 0.1240$$

$$10 \cdot 2.10 - U_{4,1} \cdot 0.9923 \cdot 4.150 = 0 \rightarrow U_{4,1} = 1.7915$$

$$10 \cdot 17.13 - U_{4,2} \cdot 0.9923 \cdot 4.0 - U_{4,3} \cdot 0.1240 \cdot 4.0 = 0 \rightarrow U_{4,3} = 3.882$$

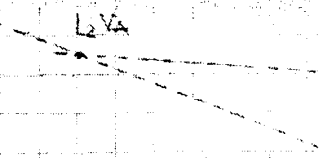
$$10 \cdot 7.0 + U_{4,4} \cdot 0.9923 \cdot 4.150 = 0 \rightarrow U_{4,4} = -1.5676$$

$$\frac{2}{3} U_{4,1} = \frac{-5.11}{4.0} \cdot 1.5676 = -2.0701$$



$$R = 3 \cdot 100 + 2 \cdot 250 = 800$$

$$Q_1 = 1/800 (100 \cdot 2 + 100 \cdot 4 + 250 \cdot 2 + 250 \cdot 10) = 6.375 \text{ m}$$



- ПЕРВАЯ ЧАСТЬ $P_1 = 100 \text{ kN}$

$$Q_1 = 6.375$$

$$R = 800$$

$$M_1^L = 0$$

$$\Rightarrow \max M_1 = \frac{800}{16} \left(\frac{16 - 6.375}{2} \right)^2 - 0 = 1153.50 \text{ kNm}$$

$$X_{1,1} = 0$$

$$X_{1,2} = 16 - 6.375 = 9.625 \text{ m}$$

- ВТОРАЯ ЧАСТЬ $P_2 = 250 \text{ kN}$

$$Q_2 = 4.375$$

$$R = 800$$

$$M_2^L = 100 \cdot 2 = 200$$

$$\Rightarrow \max M_2 = \frac{800}{16} \left(\frac{16 - 4.375}{2} \right)^2 - 200 = 1489.260 \text{ kNm}$$

$$X_2 = 5.8125 \pm \sqrt{33.785 - 4.0} \Rightarrow X_{2,1} = 0.355 \quad X_{2,2} = 11.25$$

- ТРЕТЬЯ ЧАСТЬ $P_3 = 100 \text{ kN}$

$$Q_3 = 2.375$$

$$R = 800$$

$$M_3^L = 400 + 200 = 600$$

$$\Rightarrow \max M_3 = \frac{800}{16} \left(\frac{16 - 2.375}{2} \right)^2 - 600 = 1720.51 \text{ kNm}$$

$$X_3 = 6.8125 \pm \sqrt{46.410 - 12.0} \Rightarrow X_{3,1} = 0.950 \quad X_{3,2} = 12.6$$

- ЧЕТВЕРТАЯ ЧАСТЬ $P_4 = 250 \text{ kN}$

$$Q_4 = -1.625$$

$$R = 800$$

$$M_4^L = 100(8+2+4) = 1800$$

$$\Rightarrow \max M_4 = \frac{800}{16} \left(\frac{16 + 1.625}{2} \right)^2 - 1800 = 1465.53 \text{ kNm}$$

$$X_4 = 8.8125 \pm \sqrt{77.66 - 36} \Rightarrow X_{4,1} = 2.36 \quad X_{4,2} = 12.27$$

- ПЯТАЯ ЧАСТЬ $P_5 = 250 \text{ kN}$

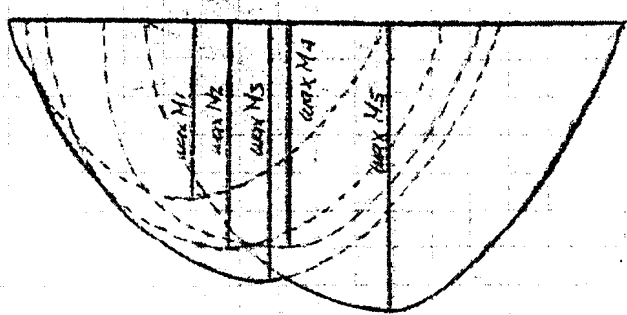
$$Q_5 = -3.625$$

$$R = 800$$

$$M_5^L = 100(10+2+6) + 250 \cdot 2 = 2900$$

$$\max M_5 = \frac{800}{16} \left(\frac{16 + 3.625}{2} \right)^2 - 2900 = 1914.26 \text{ kNm}$$

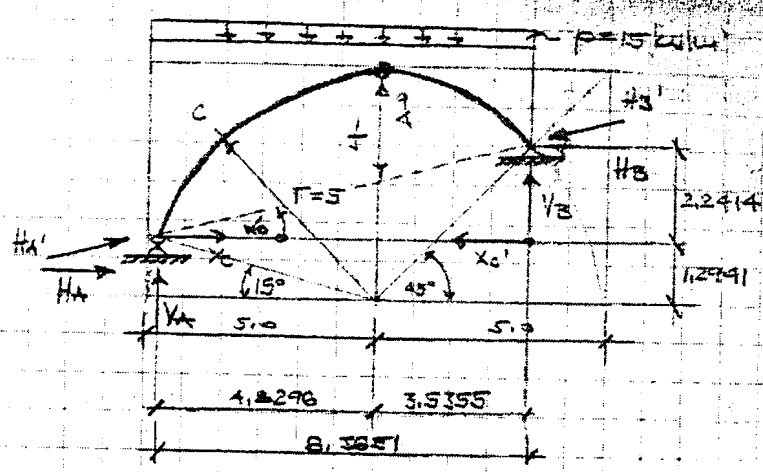
$$X_5 = 9.8125 \pm \sqrt{96.285 - 58} \Rightarrow X_{5,1} = 3.625 \quad X_{5,2} = 16.00$$



[ext M]

* DURELTH LAMPAN EXT N KUEZ $P = 15 \text{ kN/m}$

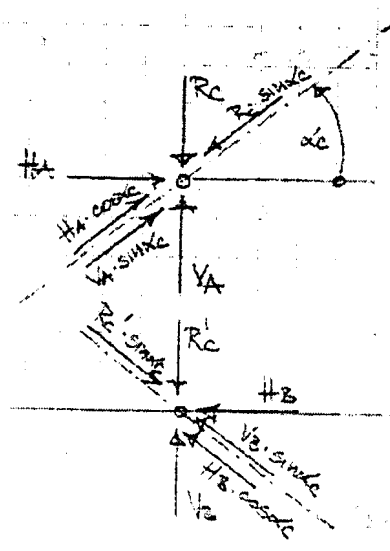
31.9.2004
31.1



$$\begin{aligned} \frac{1}{2} &= 5 - 1.2941 - 4.296 \cdot 2.2414 \\ \frac{1}{2} &= 2.4113 \text{ m} \\ R^I &= 4.296 \cdot 15 = 64.44 \text{ kN} \\ R^II &= 3.5355 \cdot 15 = 53.0325 \text{ kN} \\ R^III &= 125.476 \text{ kN} \end{aligned}$$

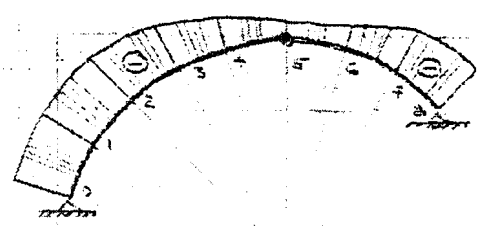
LEO I (a-g)

$$\begin{aligned} \sum M_B &= 0 \quad -125.476 \cdot 4.113255 + V_A \cdot 8.3251 - H_A \cdot 2.2414 = 0 \\ \sum M_A &= 0 \quad -64.44 \cdot 2.4113 + V_A \cdot 4.296 - H_A \cdot 5.7059 = 0 \\ \Rightarrow \quad -524.81 + 8.3251 V_A - 2.2414 H_A &= 0 \quad \Rightarrow \quad H_A = 3.7321 V_A - 234.444 \\ -174.937 + 4.296 V_A - 5.7059 (3.7321 V_A - 234.444) &= 0 \\ -174.937 + 4.296 V_A - 13.8103 V_A + 867.7142 &= 0 \\ 9.0012 V_A &= 692.776 \\ \Rightarrow \quad V_A &= 76.965 \quad H_A = 53.10 \\ V_B &= 48.511 \quad H_B = 53.10 \end{aligned}$$

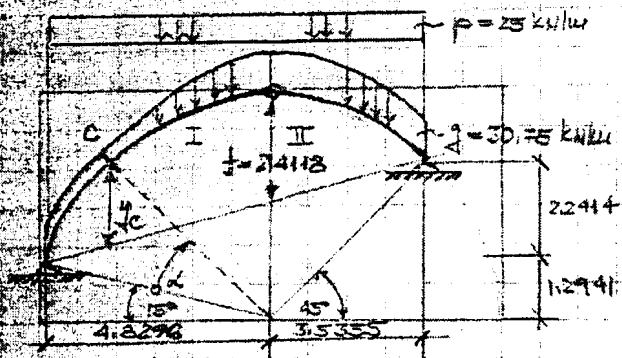


$$\begin{aligned} R_C &= x_C \cdot P = x_C \cdot 15.0 \\ \Rightarrow \quad N_C^I &= x_C \cdot 15 \cdot \sin x_C - 76.965 \cdot \sin x_C - 53.10 \cdot \cos x_C \\ R_C &= x_C' \cdot P = x_C' \cdot 15.0 \\ \Rightarrow \quad N_C^{II} &= x_C' \cdot 15 \cdot \sin x_C - 48.511 \cdot \sin x_C - 53.10 \cdot \cos x_C \end{aligned}$$

TAY.	$x_C (x_C')$	$\sin x_C$	$\cos x_C$	N_C
0	0	0.15882	0.98529	71.177
1	0.4995	0.150	0.866025	80.722
2	1.2941	0.70711	0.70711	78.244
3	2.3296	0.866025	0.50	62.941
4	3.5355	0.96529	0.25832	36.345
5	4.296	1.0	0	23.933
6	3.5355	1.0	0	23.923
7	2.3296	0.96529	0.25832	28.1165
8	1.2941	0.70711	0.70711	53.110



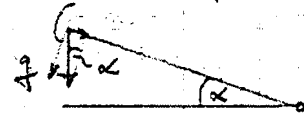
ЗАДАЧА: ЭКСТРЕМУМ ЭПЕДИОТУ РАЙОНА I. ДОДЕМ ВАРЬИ ТРАКТОРА
ПОСЛЕДНЕ ТЕХНИКЕ И ПОРЯДОК ОТВЕРЖЕНИЯ $p = 25 \text{ кН/м}$.



$$F = 1123.41^2$$

$$q = F \cdot p = 1123.25 = 30.75 \text{ кН/м}$$

$$q_t = -q \cdot \cos \alpha$$



$$H_p = q r \alpha \cos \alpha$$

$$H_p = 153.75 \cdot x \cdot \cos \alpha$$

$$N_1 = A_1 \sin \alpha + B_1 \cos \alpha + H_p$$

$$M_1 = A_1 r \sin \alpha + B_1 r \cos \alpha + H_p r + r^2 \int q_t d\alpha + C_1$$

$$\rightarrow N_1 = A_1 \sin \alpha + B_1 \cos \alpha + 153.75 \cdot x \cdot \cos \alpha$$

$$M_1 = 5A_1 \sin \alpha + 5B_1 \cos \alpha + 768.75 \cdot x \cdot \cos \alpha + 25 \int -30.75 \cdot \cos \alpha d\alpha + C_1$$

$$M_1 = 5A_1 \sin \alpha + 5B_1 \cos \alpha + 768.75 \cdot x \cdot \cos \alpha - 768.75 \int \cos \alpha d\alpha + C_1$$

$$\rightarrow \text{LEO II} \quad \rightarrow \alpha$$

$$N_2 = A_2 \sin \alpha + B_2 \cos \alpha + H_p$$

$$M_2 = A_2 r \sin \alpha + B_2 r \cos \alpha + H_p r + r^2 \int q_t d\alpha + C_2$$



$$q_t = q \cos \alpha$$

$$\rightarrow N_2 = A_2 \sin \alpha + B_2 \cos \alpha + 153.75 \cdot x \cdot \cos \alpha$$

$$M_2 = 5A_2 \sin \alpha + 5B_2 \cos \alpha + 768.75 \cdot x \cdot \cos \alpha + 768 \int \cos \alpha d\alpha + C_2$$

- ГРАНИЧНЫЕ УСЛОВИЯ.

$$\alpha = 0 \rightarrow M(0) = 0$$

$$M_1 = 5B_1 + C_1 = 0 \quad (1)$$

$$\alpha = \frac{5\pi}{12} \rightarrow M\left(\frac{5\pi}{12}\right) = 0$$

$$M_1 = 4.830 A_1 + 1.294 B_1 + 768.75 \cdot \frac{5\pi}{12} \cdot 0.2583 - 768.75 \cdot 0.2583 \cdot \frac{5\pi}{12} + C_1 = 0$$

$$4.830 A_1 + 1.294 B_1 + C_1 = 0 \quad (2)$$

$$\alpha = \frac{5\pi}{12} + \frac{\pi}{4} = \frac{2\pi}{3}$$

$$M_2 = 4.33 A_2 - 2.50 B_2 + 768.75 \cdot \frac{2\pi}{3} \cdot (-0.50) + 768.75 \cdot (-0.50) \cdot \frac{2\pi}{3} + C_2 = 0$$

$$4.33 A_2 - 2.50 B_2 - 805.1033 - 805.1033 + C_2 = 0$$

$$T_1 = A_1 \cos x - B_1 \sin x + Np' + \frac{1}{2} t \cdot r$$

$$T_2 = A_2 \cos x - B_2 \sin x + Np' + \frac{1}{2} t \cdot r$$

$$I: Np = 153,75 \cdot x \cdot \cos x$$

$$Np' = 153,75 (\cos x + x \cdot (-\sin x)) = 153,75 (\cos x - x \sin x)$$

$$II: Np = 153,75 \cdot x \cdot \cos x$$

$$Np' = 153,75 (\cos x - x \sin x)$$

$$\Rightarrow T_1 = A_1 \cos x - B_1 \sin x + 153,75 (\cos x - x \sin x) - 153,75 \cdot \cos x$$

$$T_1 = A_1 \cos x - B_1 \sin x + 153,75 \cos x - 153,75 x \sin x - 153,75 \cos x$$

$$T_1 = A_1 \cos x - B_1 \sin x - 153,75 x \sin x$$

$$T_2 = A_2 \cos x - B_2 \sin x + 153 (\cos x - x \sin x) + 153,75 \cos x$$

$$T_2 = A_2 \cos x - B_2 \sin x + 307,5 \cos x - 153,75 x \sin x$$

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

$$M_2(x) = 0$$

$$4,830 \cdot A_2 + 1129,4 B_2 + 520,856 + C_2 = 0 \quad (4)$$

-TYPE A1344 "CNOB1"

$$x = \frac{5\pi}{12} \quad H_1(x) = H_2(x)$$

$$0,966 A_1 + 0,2588 B_1 + 153,75 \cdot \frac{5\pi}{12} \cdot 0,2588 = 0,966 A_2 + 0,2588 B_2 + 153,75 \cdot \frac{5\pi}{12} \cdot 0,2588$$

$$0,966 A_1 + 0,2588 B_1 + 52,086 = 0,966 A_2 + 0,2588 B_2 + 52,086$$

$$0,966 A_1 - 0,966 A_2 + 0,2588 B_1 - 0,2588 B_2 = 0 \quad (5)$$

$$x = \frac{5\pi}{12} \quad T_1(x) = T_2(x)$$

$$0,2588 A_1 - 0,966 B_1 - 153,75 \cdot \frac{5\pi}{12} \cdot 0,966 = 0,2588 A_2 - 0,966 B_2 + 75,59 - 153,75 \cdot \frac{5\pi}{12} \cdot 0,966$$

$$0,2588 A_1 - 0,966 B_1 - 194,415 = 0,2588 A_2 - 0,966 B_2 + 75,59 - 194,415$$

$$0,2588 A_1 - 0,2588 A_2 - 0,966 B_1 + 0,966 B_2 - 75,59 = 0 \quad (6)$$

A_1	A_2	B_1	B_2	C_1	C_2	R
0	0	5	0	1	0	0
4,83	0	1129,4	0	1	0	0
0	4,83	0	-2,50	0	1	1610,07
0	4,83	0	1129,4	0	1	-320,856
0,966	-0,966	0,2588	-0,2588	0	0	0
0,2588	-0,2588	-0,966	0,966	0	0	75,59

$$A_1 = -440,452$$

$$B_1 = -574,043$$

$$N_{g,c} = -220,222 - 497,136 + 153,75 \cdot \frac{\pi}{6} \cdot 0,866$$

$$N_{g,c} = -647,646 \text{ kN}$$

-5DHE. 3AKHO.

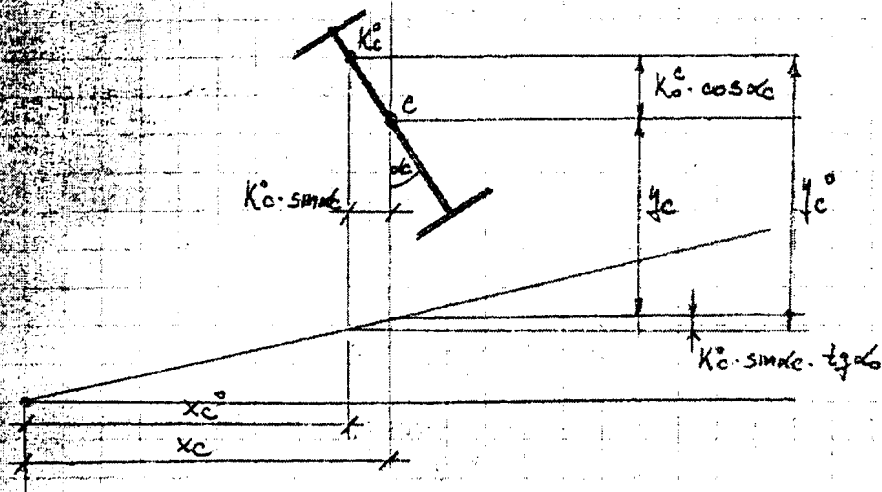
$$W_u = \frac{J_x}{y_u}$$

$$k^0 = \frac{W_u}{F}$$

$$W_u = 0,47337 \text{ m}^3$$

$$\alpha = 45^\circ$$

$$k^0 = 0,38993 \text{ m}$$



$$x_c^0 = x - k_c^0 \cdot \sin \alpha$$

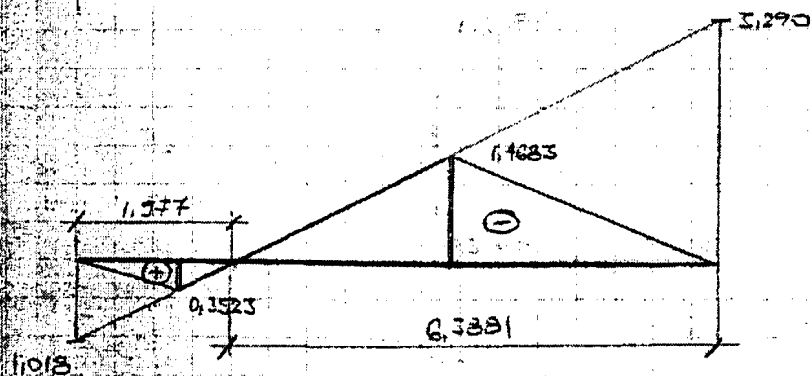
$$x_c^0 = 1,2941 - 0,38993 \cdot 0,707$$

$$x_c^0 = 1,018 \text{ m}$$

$$y_c^0 = 2,2414 - 1,2941 \cdot 0,2679 + 0,38993 \cdot 0,707 + 0,38993 \cdot 0,707 \cdot 0,2679$$

$$y_c^0 = 2,2443 \text{ m}$$

$$\frac{l}{f} y_c^0 = \frac{3,5355}{2,4118} \cdot 2,2443 = 3,290$$



$$\max H_{c,p}^0 = 25 (0,3323 \cdot 1,2941 \cdot 0,5 + 0,3323 \cdot 0,6829 \cdot 0,5) = 8,706 \text{ kNm}$$

$$\min M_{c,p}^0 = 25 (1,4683 \cdot 2,8526 \cdot 0,5 + 1,4683 \cdot 3,5355 \cdot 0,5) = 117,295 \text{ kNm}$$

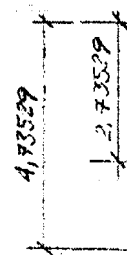
$$M_{g,c}^0 = 647,646 \cdot 0,38993 = 252,540 \text{ kNm}$$

$$\max M_c^0 = 252,540 + 8,706 = 261,246 \text{ kNm}$$

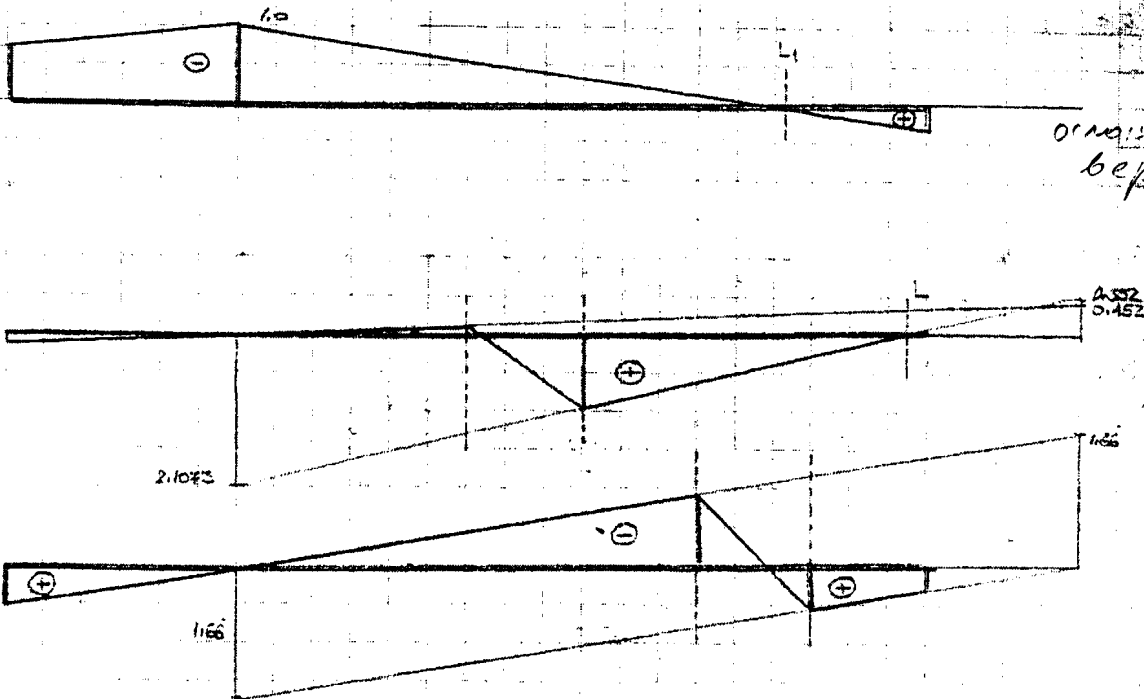
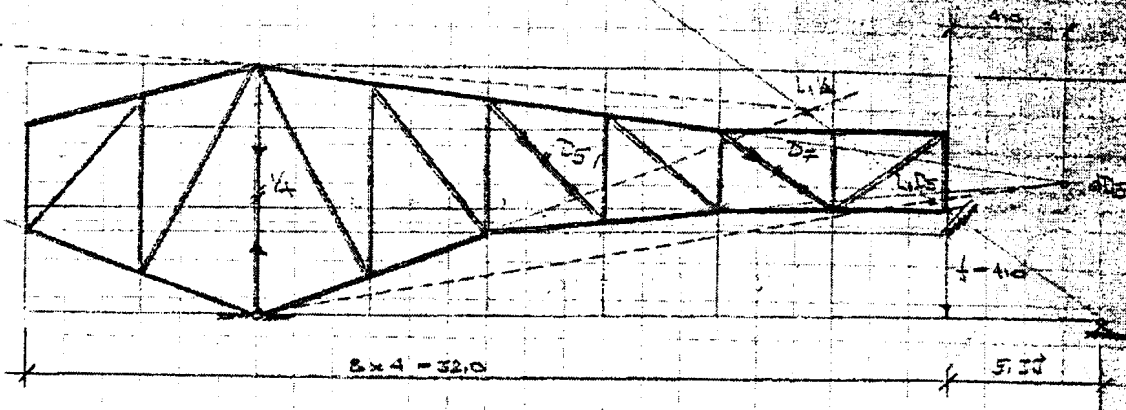
$$\min M_c^0 = 252,540 - 117,295 = 135,295 \text{ kNm}$$

$$\max \bar{\sigma}_c^u = \frac{\max M_c^0}{W^u} = \frac{261,246}{0,47337} = 545,55 \text{ kN/m}^2$$

$$\min \bar{\sigma}_c^u = \frac{\min M_c^0}{W^u} = \frac{135,295}{0,47337} = 282,53 \text{ kN/m}^2$$



* DAPPELUNG STÄHLERNE TRAGWERK IN QUADRALE TRAGWERK



[A]
Ordnung
bestimmen

$$D5: \sin \alpha = 4.00 / 4.10 \Rightarrow \cos \alpha = 0.9644 \quad \sin \alpha = 0.7474$$

$$10 \cdot 28.0 - D5A \cdot 0.7474 \cdot 20.0 + D5A \cdot 0.9644 \cdot 2.50 = 0 \Rightarrow D5A = 2.1073$$

$$10 \cdot 13.5 - D5B \cdot 0.9644 \cdot 2.0 - D5B \cdot 0.7474 \cdot 16.0 = 0 \Rightarrow D5B = 0.100$$

$$10 \cdot 5.80 + D5H \cdot 0.7474 \cdot 20 - D5H \cdot 0.9644 \cdot 2.50 = 0 \Rightarrow D5H = -9.4140$$

$$\frac{1}{4} \cdot D5H = \frac{-9.4140}{4} = -2.3535$$

$$D7: \sin \alpha = 3.14 \Rightarrow \cos \alpha = 0.80 \quad \sin \alpha = 0.60$$

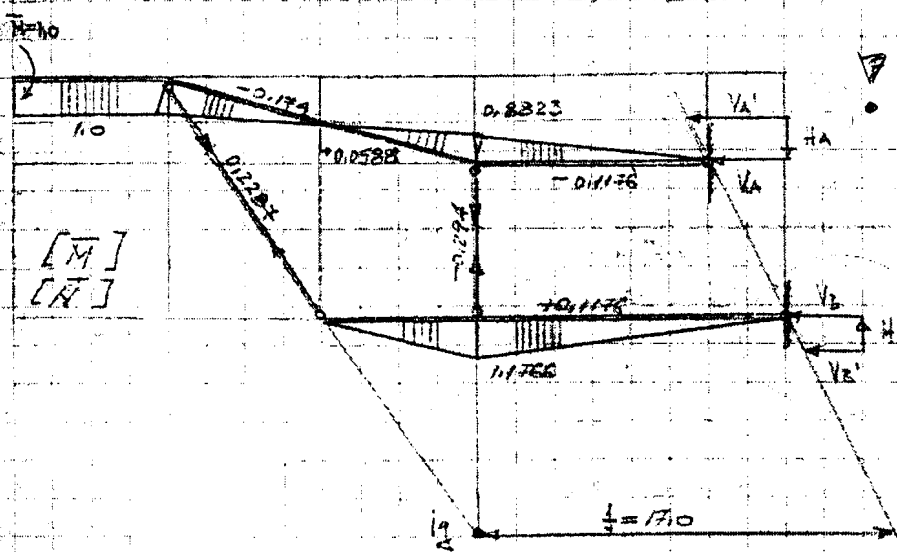
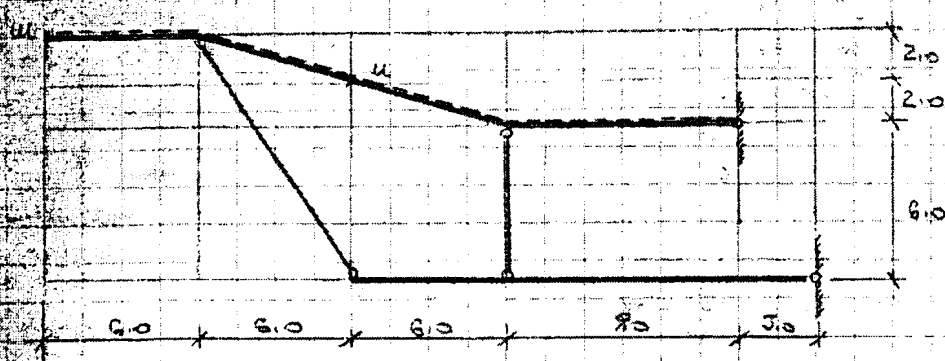
$$\Sigma F = 0 \quad T_{70} - 0.60 D7 = 0 \Rightarrow D7 = \frac{T_{70}}{0.60} \Rightarrow D7A = 1.66$$

$$D7B = -1.66$$

ВЕРХНЯЯ ПОПЕРЕЧНАЯ АНАЛИЗ ЗА СЕПТАЖЕ ПЕРЕКЛАДКА
 ПОСРЕДНЯЯ ПОПЕРЕЧНАЯ АНАЛИЗ ЗА П. 2. Т. 2 ПЕРЕКЛАДКА

небольшое
 минимизация
 за минимизацию
 прогиба
 сдвига

ПОСРЕДНЯЯ ПОПЕРЕЧНАЯ: $b/h = 0.40/1.0$
 ПЕРВАЯ ПОПЕРЕЧНАЯ: $b/h = 0.40/0.40 \Rightarrow$ разрыв в 4
 нормальная линия



$$t_{\text{сдв}} = 3/6 = 0.50$$

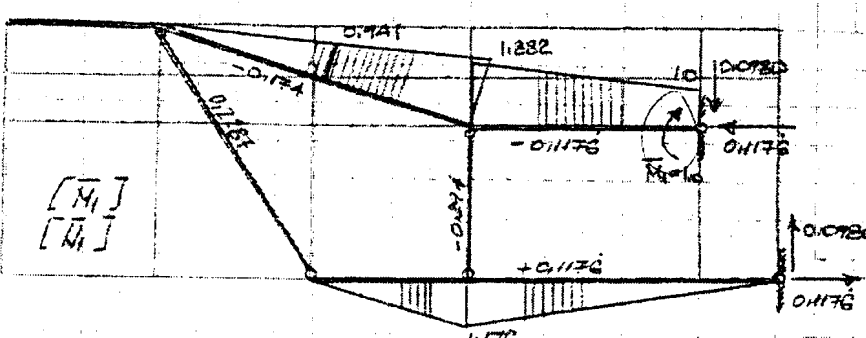
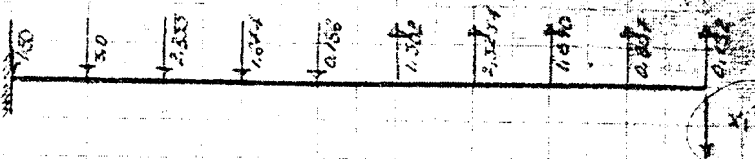
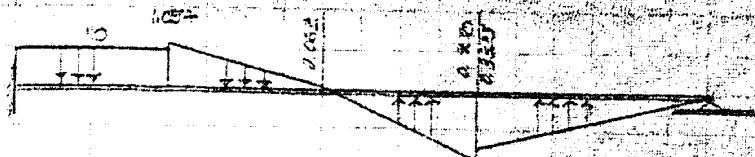
мы сд минимизировать
 вдобав, надо в
 коэф. сдвига
 минимизировать

$$\begin{aligned} \sum M_A = 0: 10 + V_B' \cdot 6.0 &= 0 \Rightarrow V_B' = -0.166 \\ \sum M_B = 0: 10 - V_A' \cdot 6.0 &= 0 \Rightarrow V_A' = 0.166 \\ \sum M_H = 0: 10 - V_A' \cdot 16.0 + H_A \cdot 17.0 &= 0 \Rightarrow H_A = 0.0980 \\ \sum M_B = 0: -V_B' \cdot 10.0 - H_B \cdot 17.0 &= 0 \Rightarrow H_B = 0.0980 \end{aligned}$$

$$\Rightarrow V_A = V_A' - H_A \cdot t_{\text{сдв}} = 0.166 - 0.0980 \cdot 0.50 = 0.1176 \quad H_A = 0.0980$$

$$V_B = V_B' + H_B \cdot t_{\text{сдв}} = -0.166 + 0.0980 \cdot 0.50 = -0.1176 \quad H_B = 0.0980$$

$$\begin{aligned} I: S_1 \cdot \cos \alpha_1 &= V_A \Rightarrow S_1 = 0.2287 \\ +0.2287 \cdot \sin \alpha_1 + S_2 + 0.0980 &= 0 \Rightarrow S_2 = -0.294 \end{aligned}$$



$$I = 0.005 \text{ m}^4$$

$$F = 0.40 \text{ m}^2$$

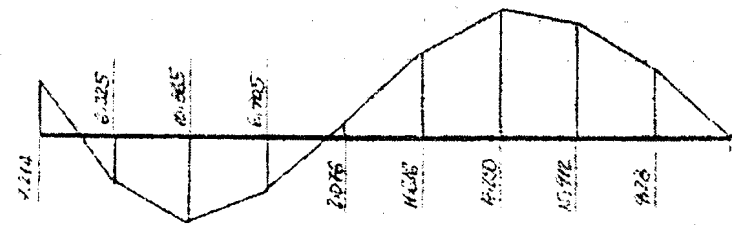
$$F_0 = 0.16 \text{ m}^2$$

$$EI x_1^+ = \int M_1 M_1 ds + 0.083 \int M_1 M_1 ds + 0.2083 \int M_1 M_1 ds$$

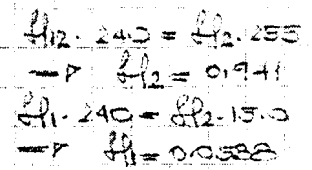
$$EI x_1^+ = - \frac{6.3245}{6} \cdot 0.941 \cdot (1.10 + 2 \cdot 0.0538) + \frac{6.3245}{6} \cdot [-0.0538(2 \cdot 0.941 + 1.132) + 0.8823(2 \cdot 1.132 + 1.10) + \frac{4}{3} \cdot 1.1176^2 + \frac{13}{3} \cdot 1.1176^2 + 0.083(12.647 \cdot 0.1174^2 + 9 \cdot 0.1176^2 + 12 \cdot 0.1176^2) + 0.2083(6 \cdot 0.0294^2 + 11.662 \cdot 0.2287^2)]$$

$$EI x_1^+ = -1.1035 - 0.2333 + 4.3757 + 6.305 + 2.77 + 5.5382 + 0.0319 + 0.0104 + 0.2077 + 0.1030 + 0.1221$$

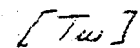
$$EI x_1^+ = 13.1322$$



$$[EI \phi_w]$$

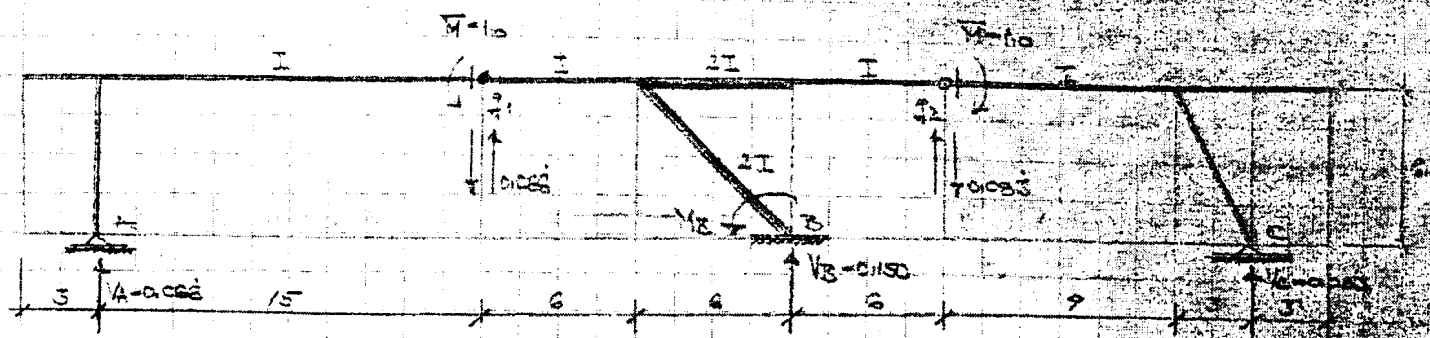


$$H_1 - H_2 - 1/r = 0.1928$$

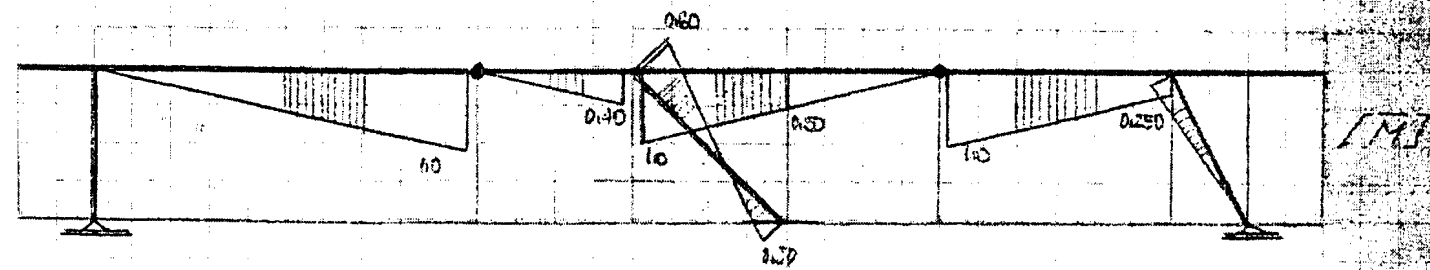


* Hauptstadt Stuhlentz August 24 1871
Hauptstadt Luitpold ex 17 1871, 10-15 Jahre

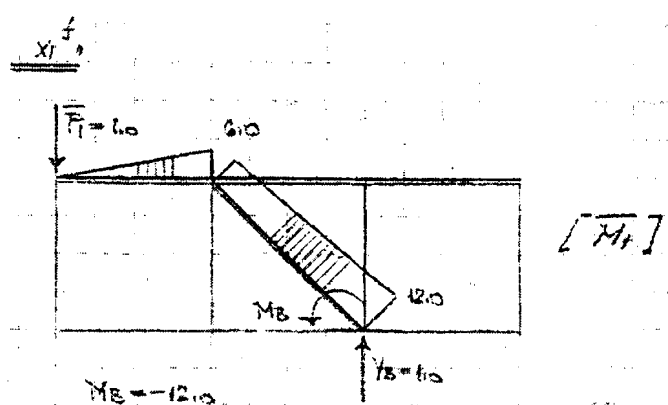
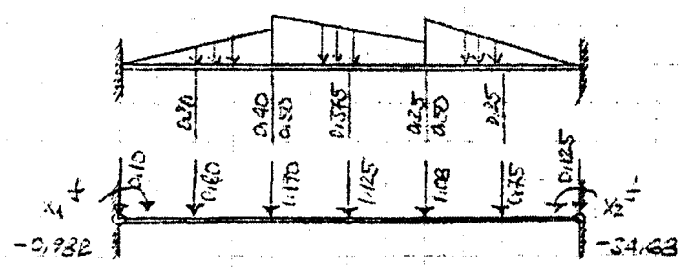
9



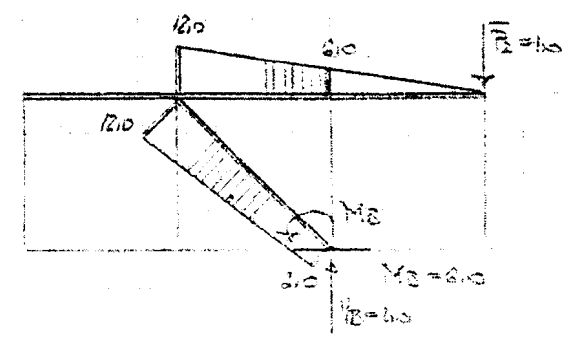
$$\begin{aligned} \sum M_A = 0 &: -110 + V_A \cdot 15.0 = 0 \quad \rightarrow V_A = 0.066 \\ \sum M_B = 0 &: 110 - V_C \cdot 12.0 = 0 \quad \rightarrow V_C = 0.0233 \\ \sum F_y = 0 &: 0.066 + 0.0233 - V_B = 0 \quad \rightarrow V_B = 0.150 \\ \sum M_B = 0 &: 0.066 \cdot 12.0 - 0.0233 \cdot 6.0 - M_B = 0 \quad \rightarrow M_B = 0.30 \end{aligned}$$



- ФУКТИЗМУ НОСНУ

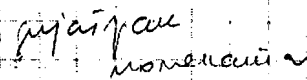
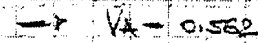


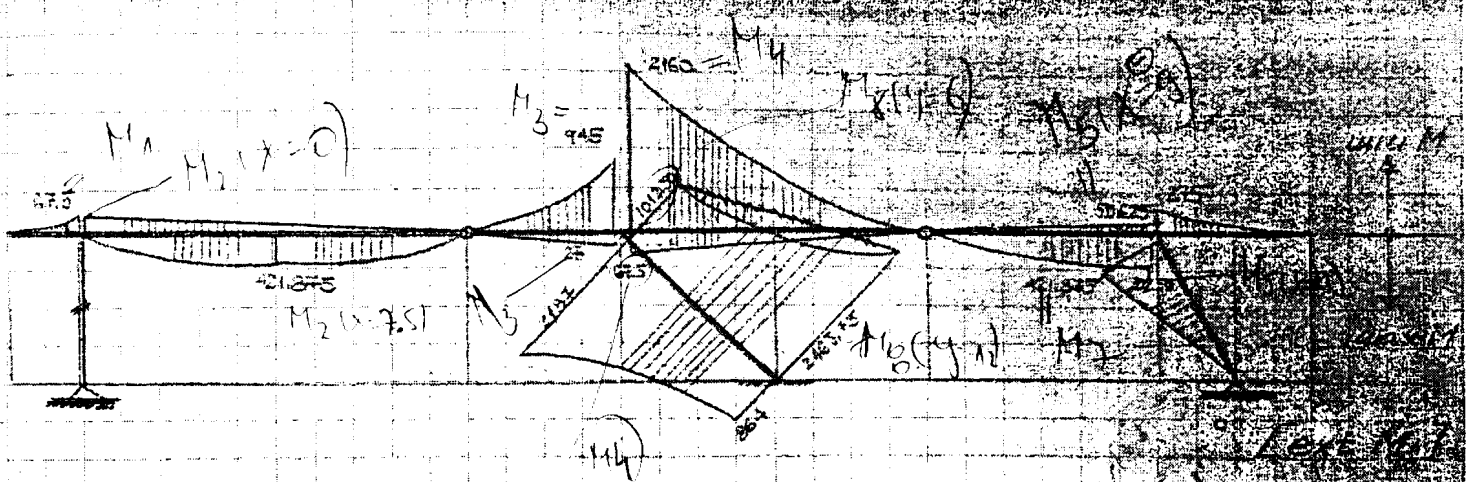
$$\begin{aligned}
 M_B &= -12.0 \\
 EI x_1 &= \frac{-6}{3} \cdot 6.0 \cdot 0.40 + \frac{\sqrt{2}}{6} \cdot \frac{1}{2} \cdot \left[6(2.06 - 0.30) + \right. \\
 &\quad \left. + 12(-0.60 + 0.60) \right] = -4.8 + 3.818 = -0.981 \\
 EI x_2 &= \frac{-6}{6} \cdot \frac{1}{2} \cdot \left[12(2 + 0.5) + 6(2 \cdot 0.5 + 1) \right] - \\
 &\quad - \frac{6}{3} \cdot 6 \cdot 0.5 + \frac{\sqrt{2}}{6} \cdot \frac{1}{2} \left[12(-1.12 + 0.3) + \right. \\
 &\quad \left. - 6(0.6 - 0.6) \right] = -15 - 6 - 8 = -29 \text{ JS} \\
 EI x_3 &= -34.28
 \end{aligned}$$



$$P_A = 0.50(0.5 + 4 \cdot 0.35 + 0.25) = 1.125$$

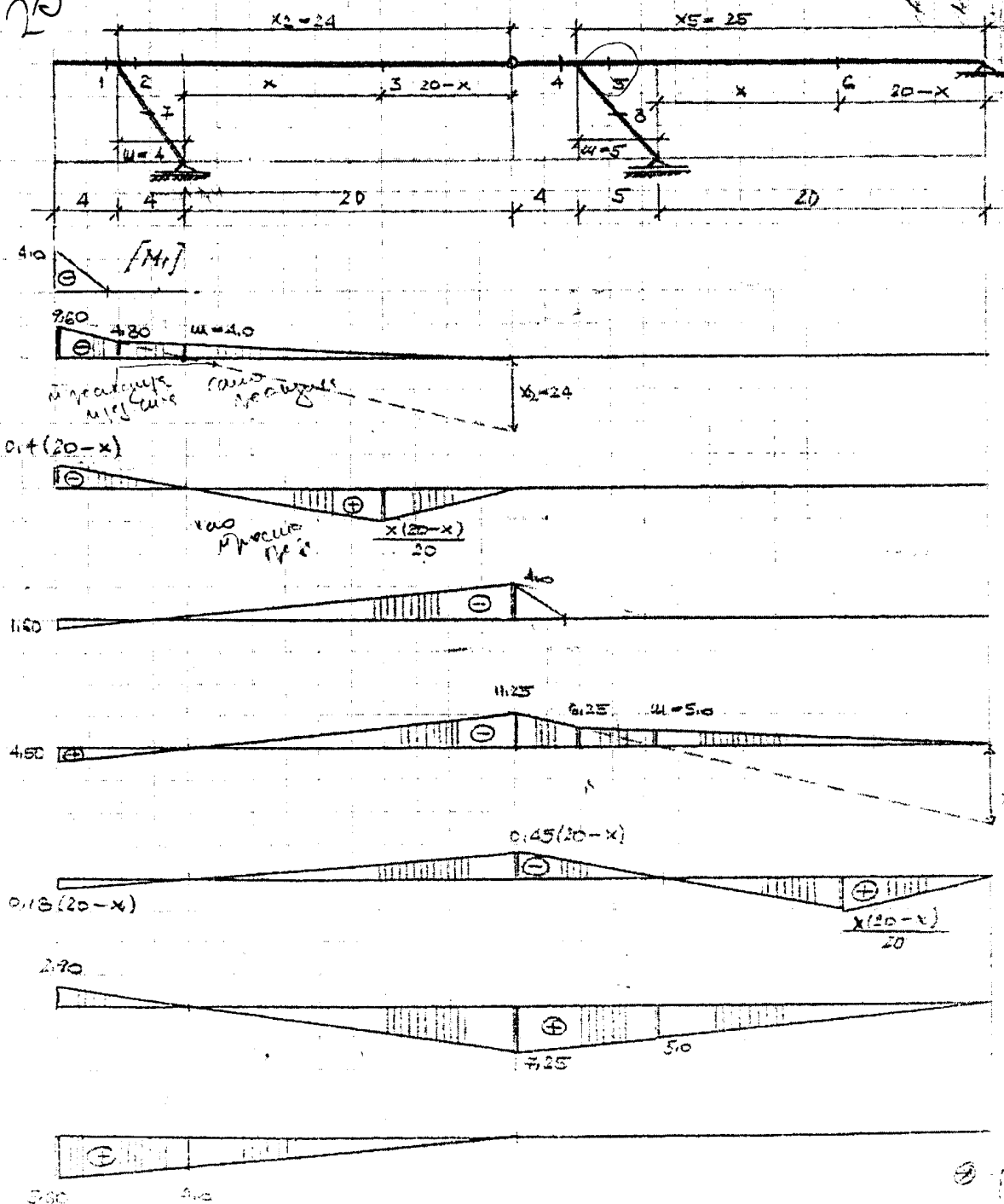
$$E = 0.5(p + 0.25) = 0.125$$





* НАЧРТАТИ ДИАГРАМ ЗА М И Q, $P=10 \text{ kN/m}$.

20



[M2] - СПЕД

[M3]

[M4]

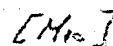
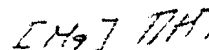
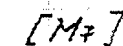
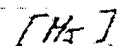
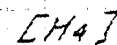
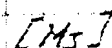
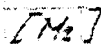
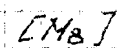
[M5] - СПЕД

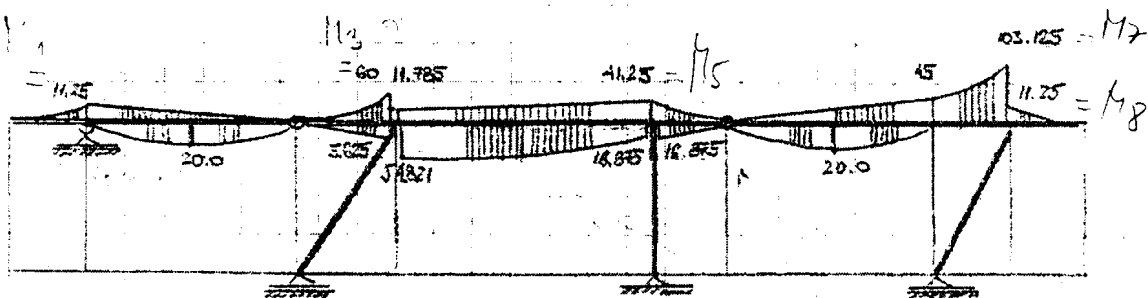
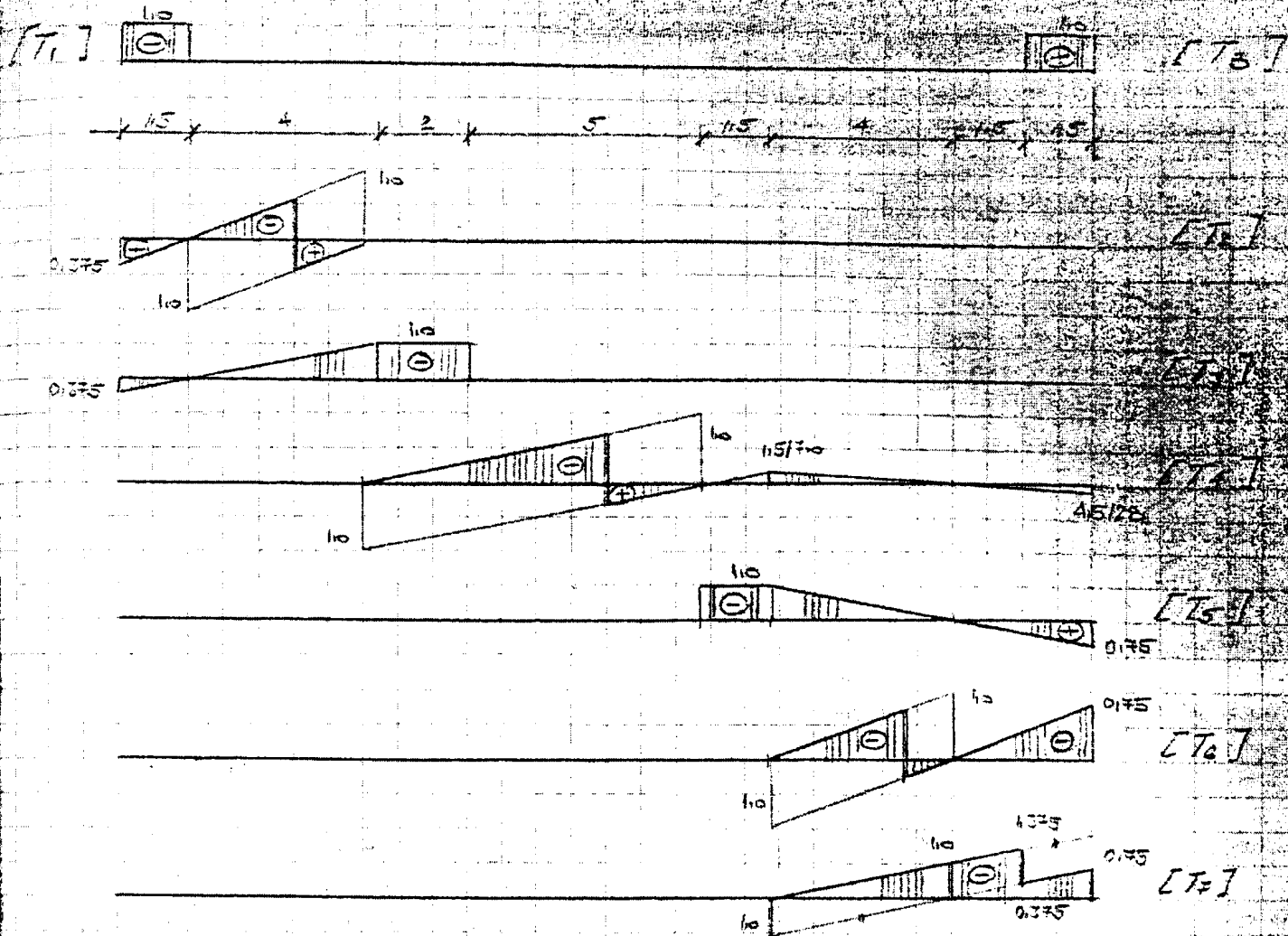
[M6]

[M7] - СПЕД

[M8] - СПЕД

3 October 2004

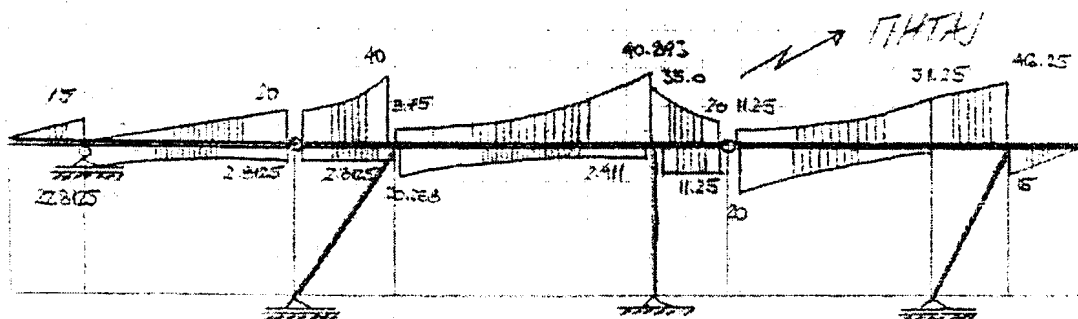




min M

max M

[ext M]

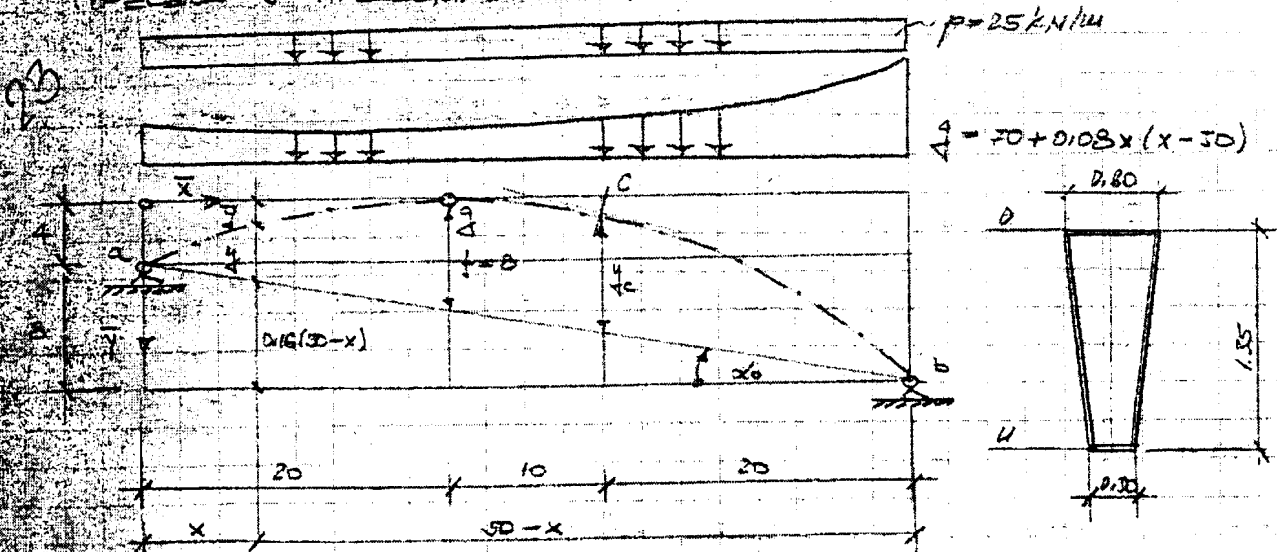


min T

max T

[ext T]

23. ДАТО СТАНО ОДРЕЂЕНОЕ ОДРЕДНОМ РЕКТОРИЈУ ОСУ АБС.
 ОДБ. СТАНО СТАНО И ЈЕДНАКОПОДЕБЕНОГ ОДРЕЂЕНОГ $P = 25 \text{ kN/m}$
 СМЕРУ ЕКСТРЕМНЕ ВРЕДНОСТИ НАПОНИ У ГОРЊЕМ ЗИДУ ПОПРЕЧНОГ
 ПРЕСЕКА У ПРЕСЕЦИМА А И С.



$$q = 12 - \bar{y} - 0.116(50 - x) ; \quad q = \frac{M_0}{H} \quad q' = -\bar{y}'$$

$$H \bar{y}'' = -M'' = q = 70 + 0.08x(x - 30)$$

$$H \bar{y}'' = 70 + 0.08x^2 - 2.40x$$

$$H \bar{y}' = 70x + 0.08 \frac{x^3}{3} - 2.40 \frac{x^2}{2} + C_1 = 70x + 0.0266x^3 - 1.20x^2 + C_1$$

$$H \bar{y} = 70 \frac{x^2}{2} + 0.0266 \frac{x^4}{4} - 1.20 \frac{x^3}{3} + C_1 x + C_2 = 35x^2 - 0.40x^3 + 0.0066x^4 + C_1 x + C_2$$

— ГРАНИЧНИ УСЛОВИ.

$$x = 0: \quad \bar{y} = 4.0 ; \quad 4H = C_2 \rightarrow C_2 - 4H = 0$$

$$x = 20, \quad \bar{y} = 0 ; \quad 0 = 14000 - 3200 + 1066.66 + 20C_1 + C_2 \rightarrow 20C_1 + C_2 = -118$$

$$x = 50, \quad \bar{y} = 12 ; \quad 12H = 87300 - 50000 + 41666.6625 + 50C_1 + C_2$$

$$\rightarrow 50C_1 + C_2 - 12H = -79166.66$$

$$C_2 = 4H$$

$$20C_1 + 4H = -11866.66 \rightarrow C_1 = \frac{-11866.66}{20} = -593.33 ; \quad \frac{4}{20}H = -(593.33 + 0.120H)$$

$$-50 \cdot (593.33 + 0.120H) + 4H - 12H = -79166.66$$

$$-29666.66 - 10H + 4H - 12H + 79166.66 = 0 \rightarrow 49300 - 18H = 0 \rightarrow H = 2738.89$$

$$C_1 = -593.33 - 0.120 \cdot 2738.89 = -1143.33$$

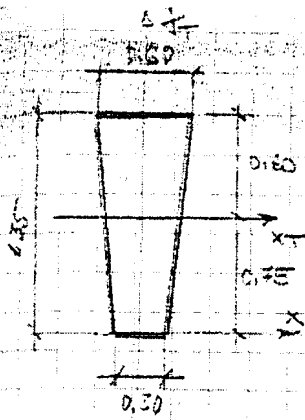
$$C_2 = 4 \cdot 2738.89 = 10955.56 \rightarrow C_1 = -1143.33$$

$$C_2 = 10955.56$$

$$H = 2738.89$$

$$\Rightarrow \bar{y} = \frac{1}{2738.89} (35x^2 - 0.40x^3 + 0.0066x^4 - 1143.33x + 10955.56)$$

$$\rightarrow \bar{y} = \frac{1}{2738.89} (35x^2 - 0.40x^3 + 0.0066x^4 - 1143.33x + 10955.56)$$



$$F = 0.30 \cdot 0.30 + 2 \cdot 0.15 \cdot 0.15 = 0.6075 \text{ m}^2$$

$$I_x = \frac{0.30 \cdot 0.30^3}{12} + 2 \cdot \frac{0.15 \cdot 0.15^3}{12} = 0.0455625 + 0.020625 = 0.0661875 \text{ m}^4$$

$$I_x = 0.0661875 \text{ m}^4$$

$$I_x = \frac{1}{12} \cdot 0.30 \cdot 0.30^3 + 0.30 \cdot 0.30 \cdot 0.15^2 + 2 \cdot \left[\frac{1}{12} \cdot 0.15 \cdot 0.15^3 + 0.15 \cdot 0.15 \cdot 0.15^2 \right] = 0.0455625 + 0.020625 + 0.020625 + 0.020625 = 0.0875 \text{ m}^4$$

$$I_x = 0.0875 \text{ m}^4$$

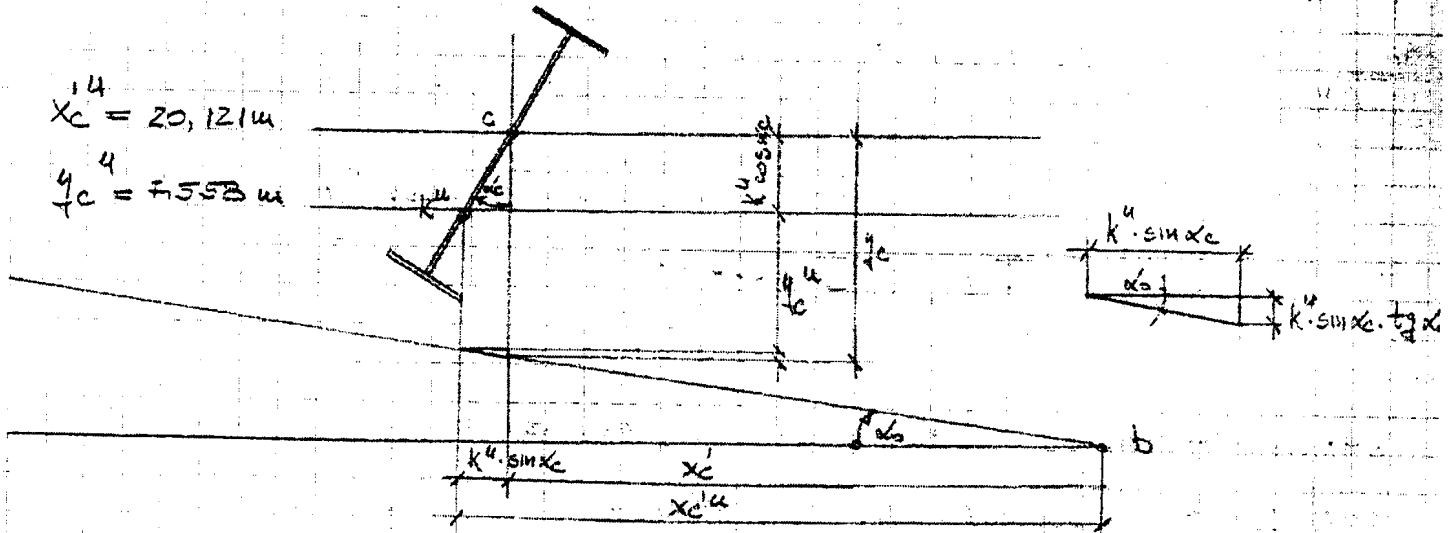
Take C: $x_c = 30$ $y_c = 1.0132$ $y_c = 12 - 1.0132 - 0.16(50 - 30) = 7.5518$

$$W_0 = \frac{I_x}{y_c} = \frac{0.0875}{7.5518} = 0.01158 \text{ m}^3$$

$$k_u = \frac{W_0}{F} = \frac{0.01158}{0.6075} = 0.01904 \text{ m}$$

$$\tan \alpha_c = \frac{1}{y_c} = \frac{1}{7.5518} = 0.1324 \Rightarrow \cos \alpha_c = 0.98607 \quad \sin \alpha_c = 0.15904$$

$$\tan \alpha_c = 0.159139 \Rightarrow \cos \alpha_c = 0.98607 \quad \sin \alpha_c = 0.15904$$



$$x_c = 20.121 \text{ m}$$

$$y_c = 7.558 \text{ m}$$

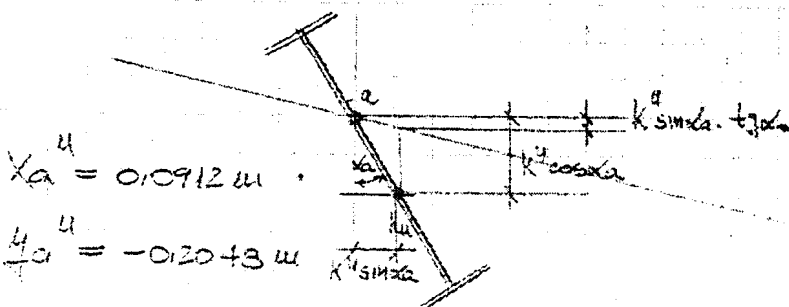
$$y_c^u = y_c - k^u \cdot \cos \alpha_c - k^u \sin \alpha_c \cdot \tan \alpha_c = 7.558 - 0.01904 \cdot 0.98607 - 0.01904 \cdot 0.15904 \cdot 0.16$$

$$y_c^u = 7.5580 \text{ m}$$

$$x_c^u = x_c + k^u \cdot \sin \alpha_c = 20 + 0.01904 \cdot 0.15904 = 20.1210 \text{ m}$$

Take a: $x_a = 0$ $y_a = 4.0$ $y_a = 12 - 4 - 0.16 \cdot 50 = 0$

$$\tan \alpha_a = \frac{1}{y_a} = \frac{1}{4.0} = 0.25 \Rightarrow \cos \alpha_a = 0.92337 \quad \sin \alpha_a = 0.22900$$



$$x_a^u = 0.0912 \text{ m}$$

$$y_a^u = -0.2043 \text{ m}$$

$$x_a^u = k^u \sin \alpha_a = 0.01904 \cdot 0.22900 = 0.00435 \text{ m}$$

$$y_a^u = - (k^u \cos \alpha_a - k^u \sin \alpha_a \cdot \tan \alpha_a)$$

$$y_a^u = -0.2043 \text{ m}$$

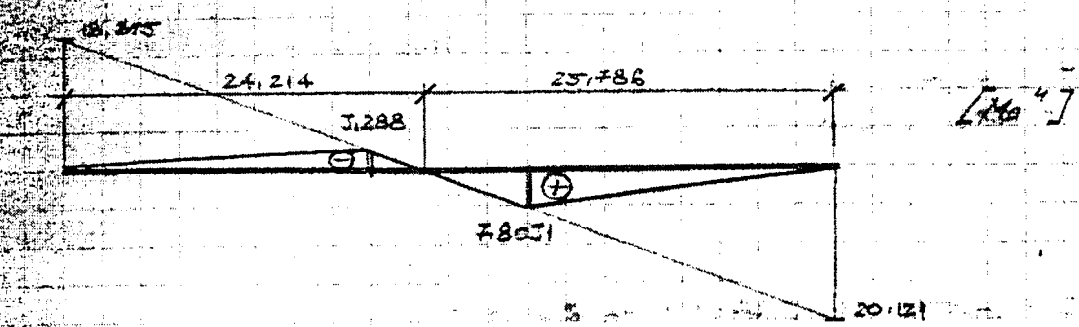
$$F_c = \frac{250}{0.0007} = -395,074 \text{ kN}$$

$$F_g = \frac{250}{0.0007} = -2978,222 \text{ kN}$$

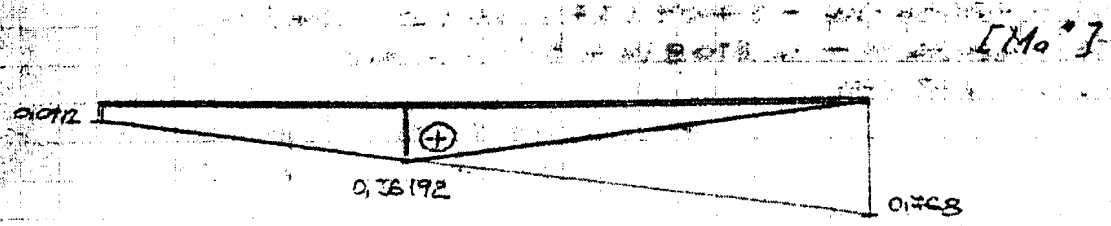
$$M_{gc} = k \cdot F_c = 0.2576 \cdot 395,074 = 759,150 \text{ kNm}$$

$$M_{ga} = k \cdot F_g = 0.2328 \cdot 2978,222 = 707,625 \text{ kNm}$$

$$M_c = X_c = 20,121 \text{ m} \quad f_c = 7,578 \text{ m} \quad f \cdot f_c = \frac{-l}{8} \cdot \frac{-20}{8} \cdot 7,578 = -18,895$$



$$M_a = X_a = 0,0912 \quad f_a = -0,2048 \quad f \cdot f_a = \frac{-l}{8} \cdot \frac{30}{8} \cdot 0,2048 = 0,762$$



$$\max M_{cp} = 78031 \cdot 20 \cdot 0,5 \cdot 25 + 78031 \cdot 4,214 \cdot 0,5 \cdot 25 = 2361,803 \text{ kNm}$$

$$\min M_{cp} = 3,288 \cdot 20 \cdot 0,5 \cdot 25 + 3,288 \cdot 4,214 \cdot 0,5 \cdot 25 = 995,195 \text{ kNm}$$

$$\max M_{ap} = 0,5(0,0912 + 0,76192) \cdot 20 \cdot 25 + 0,76192 \cdot 30 \cdot 0,5 \cdot 25 = 249 \text{ kNm}$$

$$\Rightarrow \max M_c = M_{gc} + \max M_{cp} = 759,150 + 2361,803 = 3120,953 \text{ kNm}$$

$$\min M_c = M_{gc} + \min M_{cp} = 759,150 - 995,195 = -236,045 \text{ kNm}$$

$$\max M_a = M_{ga} + \max M_{ap} = 707,625 + 249 = 956,625 \text{ kNm}$$

$$\min M_a = M_{ga} + \min M_{ap} = 707,625 \text{ kNm}$$

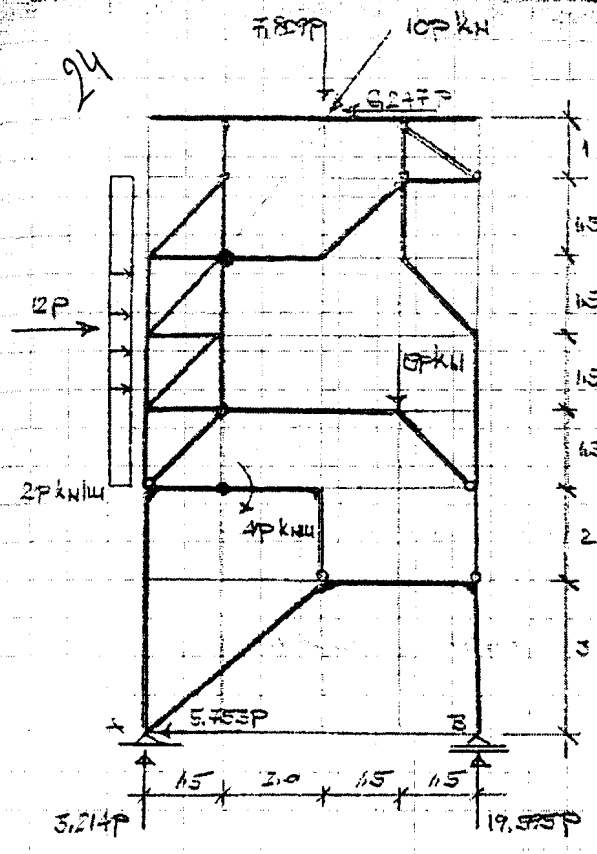
$$\max \bar{\sigma}_c = \frac{-\max M_c}{W^0} = \frac{-3120,953}{0,14433} = -21,62 \text{ GPa}$$

$$\min \bar{\sigma}_c = \frac{-\min M_c}{W^0} = \frac{-236,045}{0,14433} = 1,635 \text{ GPa}$$

$$\max \bar{\sigma}_a = \frac{-\max M_a}{W^0} = \frac{-956,625}{0,14433} = -6,628 \text{ GPa}$$

$$\min \bar{\sigma}_a = \frac{-\min M_a}{W^0} = \frac{-707,625}{0,14433} = -4,903 \text{ GPa}$$

9. ДЛЖЕЛНАТА БРЕЖИДНОСТ ПАРАМЕТРОА Р ТАКА ДА ПРОМЕНА ПОВЕЉА - КОМЕНА ПРАМЕНА
 а-и 3 б-и УЗЛОЖИ 2,855' $EI = 10^4 \text{ kNm}^2$



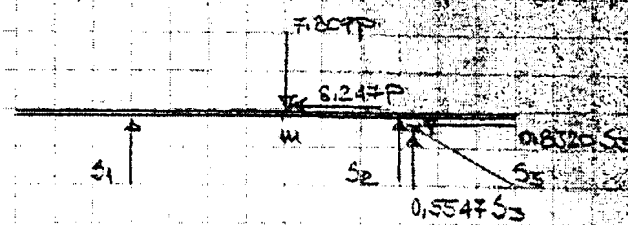
$$\sum M_A = 0 \Rightarrow 12P \cdot 3 + 4P + 10P \cdot 5 + 5.207P \cdot 3.5 - 6.247P \cdot 12 = 0$$

$$\Rightarrow V_2 = 12.555P$$

$$\sum Y = 0 \Rightarrow 19.555P + V_A - 10P - 5P = 0$$

$$\Rightarrow V_A = 3.214P$$

$$\sum H = 0 \Rightarrow H_A = 12P - 6.247P = 5.753P$$



$$\sum H = 0 \Rightarrow -6.247P - 0.832S_3 = 0 \Rightarrow S_3 = -7.508P$$

$$\sum Y = 0 \Rightarrow S_1 + S_2 + 0.5547(-7.508P) - 10P = 0$$

$$S_1 + S_2 - 11.974P = 0$$

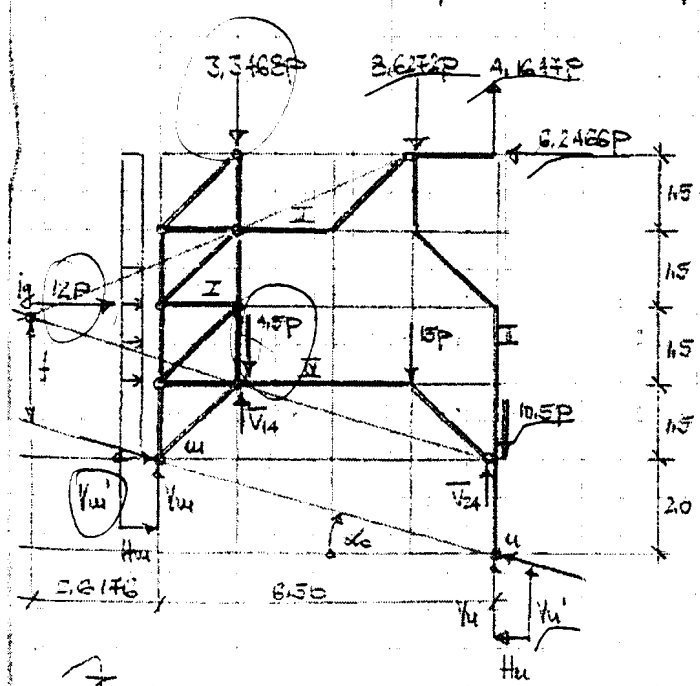
$$\sum M_u = 0 \Rightarrow S_1 \cdot 2.0 - S_2 \cdot 1.5 + 4.1648P \cdot 1.50 = 0$$

$$2S_1 - 1.5S_2 + 6.2472P = 0$$

$$\Rightarrow S_1 = 0.75S_2 - 3.1236P$$

$$0.75S_2 - 3.1236P + S_2 - 11.974P = 0 \Rightarrow S_2 = 8.6272P$$

$$S_1 = 3.3488P$$



- ПРАМЕНУ 15P НА ДВЕ ОУЛЕ НА ДВАЈЗЛУМИ ПРАМ. ГИОС
 (1) $10P : 5 = 2P$ $P_1 = 2P \cdot 1.50 = 4.50P$
 $P_2 = 2P \cdot 2.5 = 10.5P$

$$f = 2.73529 - 2.6176 \cdot \frac{6.50}{1.50} = 1.9279 \text{ m}$$

$$tg \alpha = 2.0 / 6.50 = 0.3077$$

- ПРАМОТЕНА МОДЕ IV

$$V_{14} = 4.50P \quad V_{24} = 10.5P$$

$$\sum M_u = 0 \Rightarrow 12P \cdot 3 + 3.3488P \cdot 1.5 + 8.6272P \cdot 5 - 4.1647P \cdot 6.5 - 6.2466P \cdot 2.0 + 15P \cdot 5.0 = V_u' \cdot 6.50$$

$$\Rightarrow V_u' = 14.5547P$$

$$\sum M_u = 0 \Rightarrow 12P \cdot 5 - 3.3488P \cdot 5 - 8.6272P \cdot 1.5 - 6.2466P \cdot 8 - 15P \cdot 1.50 = -V_u' \cdot 6.50$$

$$\Rightarrow V_u' = 6.4843P$$

$$\sum M_{14}^I = 0 \Rightarrow 12P \cdot (3 - 4.73529) + 3.3488P \cdot (2.6176 + 1.50) + 4.50P \cdot (2.6176 + 1.50) - V_u' \cdot 2.6176 - H_u \cdot f$$

$$3.20552P + 12.7258P + 18.5272P - 16.8733P = 1.9279 \cdot H_u \Rightarrow H_u = 9.610 \cdot P$$

$$\sum M_{14}^{II} = 0 \Rightarrow 8.6272P \cdot (2.6176 + 5) - 4.1647P \cdot (1.50 + 2.6176) - 6.2466P \cdot (3 - 4.73529) + 10.5P \cdot (2.5 + 2.6176) - V_u' \cdot (6.50 + 2.6176) = -H_u \cdot f$$

$$65.7135P - 33.972P - 20.3933P + 35.7343P - 132.7039P = -H_u \cdot f$$

$$\Rightarrow H_u = 15.316 \cdot P$$

$$V_B = V_B' + H_B \cdot \tan \alpha = 5.19543 \text{ P} + 8.50 \cdot \frac{2.0}{3.50} = 9.610 \text{ P} \rightarrow V_B = 9.610 \text{ P}$$

$$V_A = V_A' + H_A \cdot \tan \alpha = 14.5547 \text{ P} + 5.348 \cdot \frac{2.0}{3.50} \text{ P} \rightarrow V_A = 19.2765 \text{ P}$$

$$\tan \alpha = 3/3.50 = 0.85714$$

$$\sum M_A = 0: 4 \text{ P} - 9.610 \text{ P} \cdot 5 = V_B' \cdot 3.50 \rightarrow V_B' = -12.526 \text{ P}$$

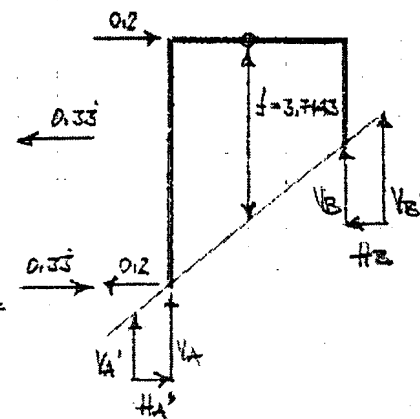
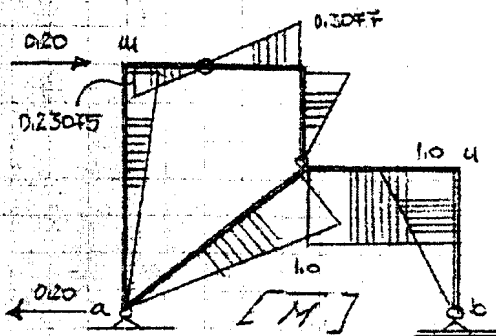
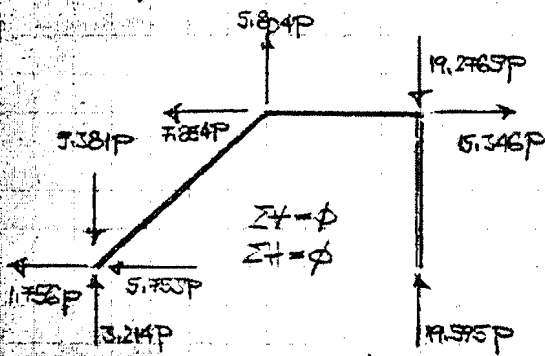
$$\sum M_B = 0: 4 \text{ P} - 3.5274 \text{ P} \cdot 3.50 - 9.610 \text{ P} \cdot 2.0 = -V_A' \cdot 3.50 \rightarrow V_A' = 7.8759 \text{ P}$$

$$\sum M_G = 0: -3.5274 \text{ P} \cdot 1.50 + 7.8759 \text{ P} \cdot 1.50 = H_A \cdot f \rightarrow H_A = 1.756 \text{ P}$$

$$\sum M_H = 0: 4 \text{ P} + 12.526 \text{ P} \cdot 2.0 = -H_B \cdot f \rightarrow H_B = -7.854 \text{ P}$$

$$\rightarrow V_A = V_A' + H_A \cdot \tan \alpha = 7.8759 + 1.756 \cdot \frac{3}{3.50} = 9.381 \text{ P} \quad H_A = 1.756 \text{ P}$$

$$V_B = V_B' - H_B \cdot \tan \alpha = -12.526 \text{ P} + 7.854 \cdot \frac{3}{3.50} = -5.804 \text{ P} \quad H_B = -7.854 \text{ P}$$



$$\sum M_A = 0: 0.20 \cdot 5 - V_B' \cdot 3.50 = 0 \rightarrow V_B' = 0.2857$$

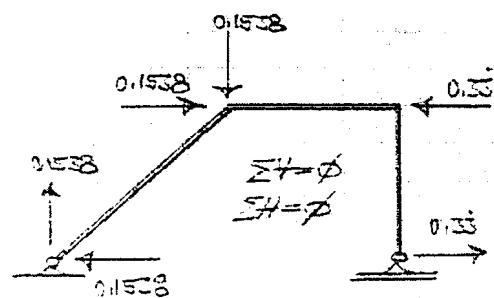
$$\sum M_B = 0: 0.2 \cdot 2 + 0.2 \cdot 3 = -V_A' \cdot 3.50 \rightarrow V_A' = -0.2857$$

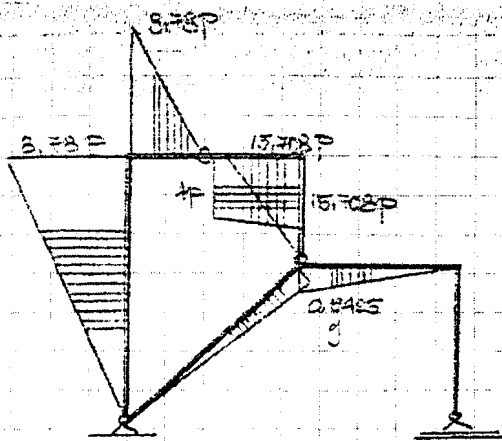
$$\sum M_G = 0: 0.2 \cdot 5 - 0.2857 \cdot 1.5 = H_A \cdot f \rightarrow H_A = 0.15385$$

$$H_B = 0.15385$$

$$V_A = -0.2857 + 0.15385 \cdot \frac{3}{3.50} = -0.1$$

$$V_B = 0.2857 - 0.15385 \cdot \frac{3}{3.50} = 0.1$$





[M]

$$EI\delta = \int M ds$$

$$EI\delta = \frac{-5}{3} \cdot 8.78P \cdot 0.23075 - \frac{1.5}{3} \cdot 8.78P \cdot 0.23075 - \frac{2}{6} \cdot 0.3077 \cdot (4P + 2 \cdot 15.708P) - \frac{2}{3} \cdot 0.3077 \cdot 15.708P + \frac{4.6098}{3} \cdot 10 \cdot 0.9425 + \frac{2}{3} \cdot 10 \cdot 0.9425$$

$$EI\delta = -3.35591P - 1.0129925P - 3.63260P - 3.2222P + 11.443245P + 11.41375P$$

$$EI\delta = -8.381607P \quad EI\delta = 2.854' = 8.3019 \text{ rad}$$

$$\rightarrow -8.381607P = 8.3019$$

$$\rightarrow P = 0.9905$$

$$\underline{P \approx 1.0}$$