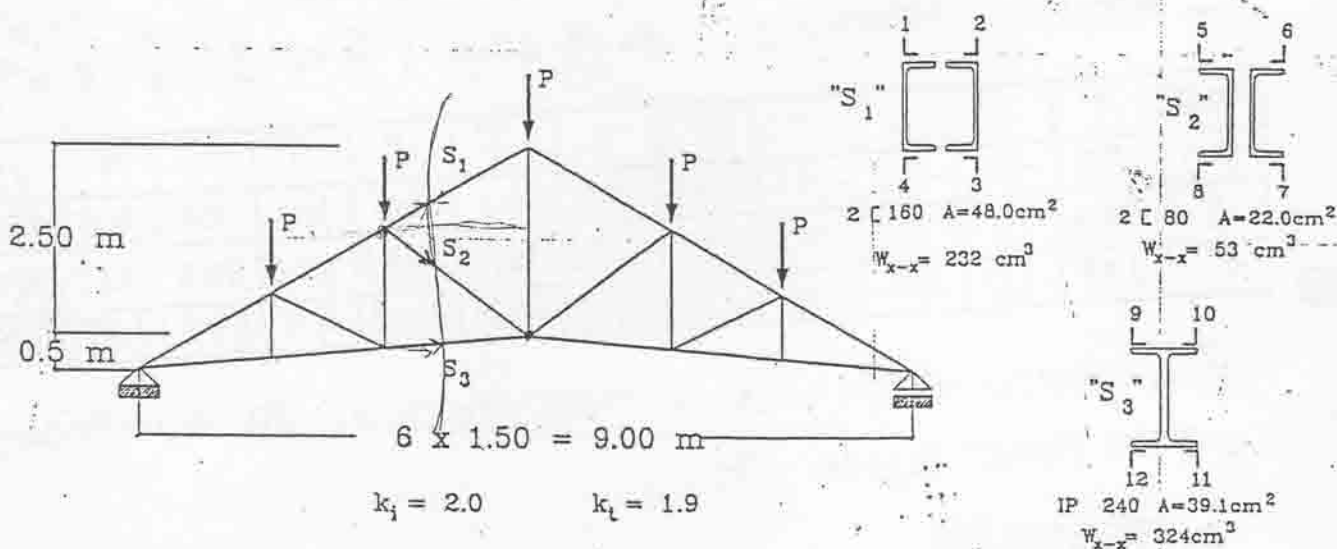




Ispitivanje konstrukcija - JANUARSKO-FEBRUARSKI - 2003. - 06.02.2003 ... pismeni deo

IMA USMENI

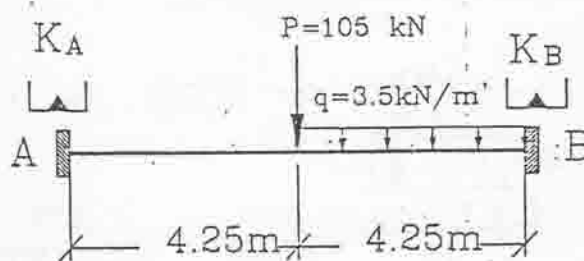
1. Na osnovu podataka merenja odrediti primarne i sekundarne presečne sile u štapovima čelične rešetke, a zatim odrediti probno opterećenje.



stanje	1	2	3	4	5	6	7	8	9	10	11	12
0	08320	09145	12383	17135	14225	16173	10320	08145	05921	06377	09125	10234
P	08185	09010	12258	17010	14117	16064	10220	08042	06101	06557	09290	10404

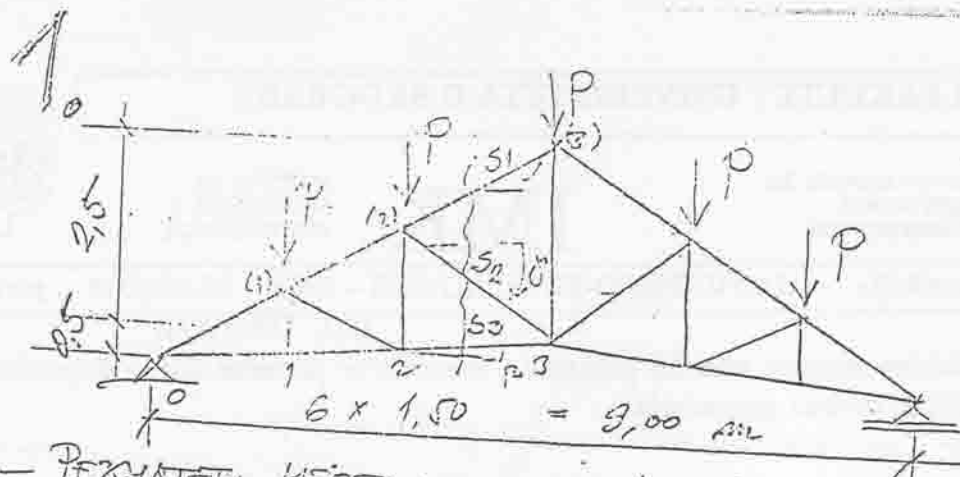
2. Naći momente elastičnog uklještenja i stepene uklještenja preko izmerenih podataka koji su dati tablično.

stanje	K_A	K_B
0	0 + 123	0 + 080
opt.	0 + 127	0 + 085



$$I_{400} \dots J = 29210 \text{ cm}^4$$

3. U tački napregnutog modela (debljine $d = 0.6 \text{ cm}$) naponsko-optičkom metodom dobijen je red izohrome $n = 0.79$, promena debljine u $\Delta d = 0.1 \times 10^{-3} \text{ mm}$ i parametar izokline $+30^\circ$ u odnosu na horizontalnu ravan. Naći analitički i grafički naponsko i deformacijsko stanje koje će karakterisati bližu oblast tačke, ($c = 0.12 \text{ kN/cm red}$). Na osnovu tih rezultata predvideti dilatacije po mogućim pravcima za merenje rozetom ($\beta = 45^\circ$).

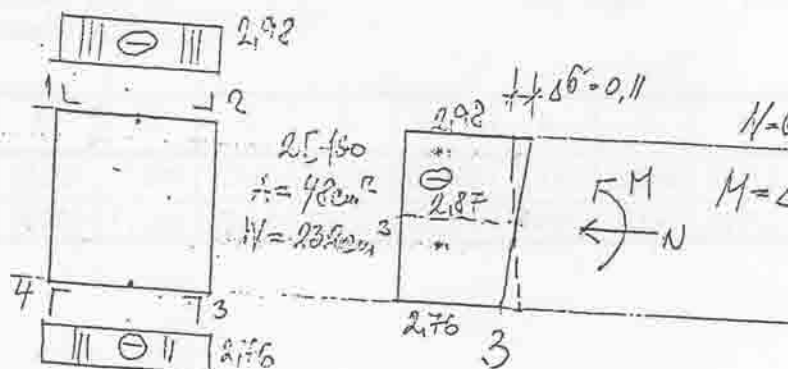


— РЕЗУЛЬТАТЫ ИСПЫТАНИЙ:

$$\epsilon = \frac{w}{k_t} \cdot \Delta \sigma \cdot \rho ; \sigma = E \cdot \epsilon ; E = 2.1 \cdot 10^4 \text{ kN/cm}^2 ; \rho = 1 \cdot 10^{-6} \frac{\text{mm}}{\text{mm}}$$

СТАВКА	1	2	3	4	5	6	7	8	9	10	11	12
P-0	-135	-135	-125	-125	-108	-109	-100	-103	180	180	165	170
E	-112.1	-112.1	-131.6	-131.6	-113.7	-114.7	-105.3	-102.4	189.5	189.5	173.7	178.9
σ	-2.98	-2.98	-2.76	-2.76	-2.39	-2.44	-2.21	-2.22	3.98	3.98	3.65	3.76

— ПУНКТОВЫЙ НАПРЕЖАКА И ПРЕСЫЧЕ СЛАН ПО ШТАТОВУМА:
ШТАТ ПОРРЕТ ПОЖАКА S1:

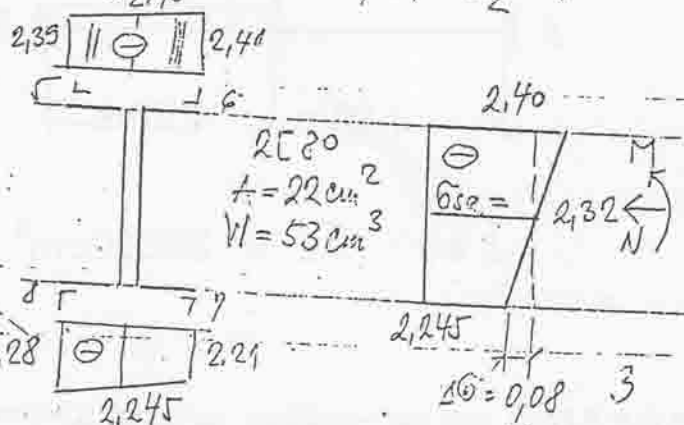


$$N = G_{10} \cdot A = -2.87 \cdot 48 = -137.76 \text{ kN} \dots 3$$

$$M = \Delta \sigma \cdot W = 0.11 \cdot 232 = 25.52 \text{ kNm} =$$

$$= 0.255 \text{ kNm/m} \dots 2$$

ПУНКТОВЫЙ ШТАТ S2:



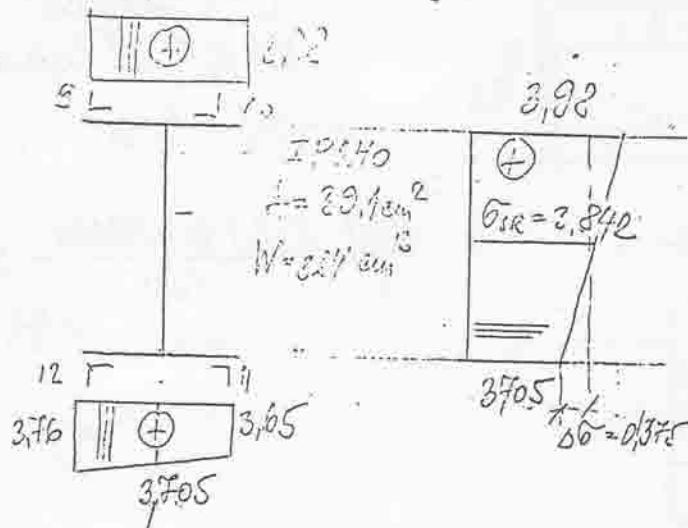
$$N = 2.32 \cdot 22.0 = 51.04 \text{ kN} \dots 3$$

$$M = 0.08 \cdot 53.0 = 4.24 \text{ kNm} =$$

$$= 0.042 \text{ kNm/m} \dots 2$$

— (8)

- ШТАГ ДОДЕЛ ПОЈАЧА S_3 :



$$N = 3.842 \cdot 39.1 = 150.22 \text{ kN}$$

$$M = -0.1375 \cdot 39.1 = -4.55 \text{ kNm}$$

$$= 0.445 \text{ kNm}$$

- Определимо $k_{\text{кр}}$:

$$h_2 = 2 - \frac{2}{3} \cdot 0.5 = \frac{5}{3} \text{ m} \quad h_3 = 2.50 \text{ m}$$

$$\sec \delta_2 = 1.414 \quad \sec \delta_3 = 1.202 \quad \sec \delta_1 = 1.006$$

$$\frac{M_{(2)}}{h_2} = \frac{3}{5} \cdot (2.5P \cdot 3.0 - P \cdot 1.50) = 3.6P$$

$$\frac{M_3}{h_3} = \frac{1}{2.5} (2.5P \cdot 4.5 - P \cdot 3.0 - P \cdot 1.50) = 2.7P$$

$$S_1 = -2.7P \cdot 1.202 = -3.245P = -137.76$$

$$P_{(1)} = 42.45 \text{ kN}$$

(1)

$$S_2 = (2.7P - 3.6P) \cdot 1.414 = -1.273P = -51.04$$

$$P_{(2)} = 40.11 \text{ kN}$$

(1)

$$S_3 = 3.6P \cdot 1.006 = 3.622P = 150.22$$

$$P_{(3)} = 41.48 \text{ kN}$$

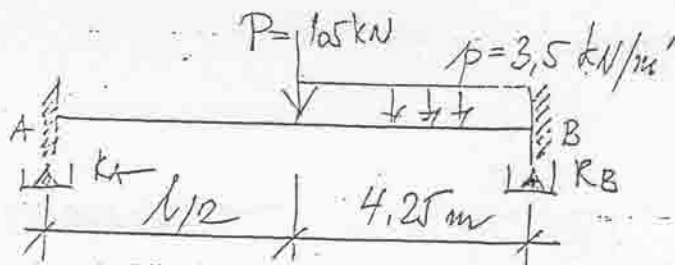
(1)

$$P_{\text{sr}} = \frac{\sum P_{(i)}}{3} = \frac{42.45 + 40.11 + 41.48}{3} = 41.35 \text{ kN}$$

(3)

(35)

2.



$$I_{400} \\ J = 29210 \text{ cm}^4 \\ E = 2.1 \cdot 10^4 \text{ kN/cm}^2 \\ p_n = 1.06''$$

- РЕЗУЛЬТАТЫ МЕРЕБЪ :

	KA	KB
0	0+123	0+080
P	0+127	0+085
P-0	254	245
α''	269.24	259.7
$\bar{\alpha}$	0,001305	0,001259

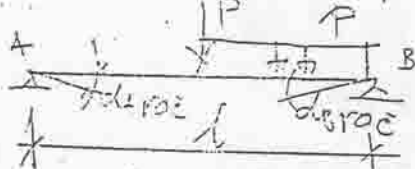
$$\frac{2EJ}{l} = \frac{2 \cdot 2.1 \cdot 10^4 \cdot 29210}{850} = 144.3 \cdot 10^4 \text{ kN} \\ = 144.3 \cdot 10^4 \text{ kN} \quad (5)$$

- МОМЕНТЫ ЭЛАСТИЧНОГО УКЛОНЕНИЯ :

$$M_A = \frac{2EJ}{l} (\alpha \lg \alpha_A - \frac{1}{2} \lg \alpha_B) - \frac{Pl}{8} - \frac{5}{192} pl^2 = \\ = 144.3 \cdot 10^4 (2 \cdot 0,001305 - 0,001259) - \frac{105 \cdot 8.5}{8} - \frac{5}{192} \cdot 3.5 \cdot 8.5^2 = \\ = 19.50 - 118.147 = -98.65 \text{ kNm}$$

$$M_B = \frac{2EJ}{l} (\frac{1}{2} \lg \alpha_A + 2 \frac{1}{2} \lg \alpha_B) - \frac{Pl}{8} - \frac{11}{192} pl^2 = \\ = 144.3 \cdot 10^4 (-0,001259 + 2 \cdot 0,001259) - \frac{1}{8} \cdot 105 \cdot 8.5 - \frac{11}{192} \cdot 3.5 \cdot 8.5^2 = \\ = 17.51 - 126.05 = -108.54 \text{ kNm} \quad \dots (10)$$

- СТЕПЕНЬ УКЛОНЕНИЯ :



$$\alpha_{Aroc} = \frac{1}{EJ} \left(\frac{Pl^2}{16} + \frac{7}{384} pl^3 \right) = 0,00837$$

$$\alpha_{Broc} = \frac{1}{EJ} \left(\frac{Pl^2}{16} + \frac{3}{128} pl^3 \right) = 0,00855 \quad (5)$$

$$\eta = \left(1 - \frac{\alpha_{mer}}{\alpha_{rocc}} \right) \cdot 100 \%$$

$$\eta_A = \left(1 - \frac{0,001305}{0,00837} \right) \cdot 100 = 84.41 \%$$

$$\eta_B = \left(1 - \frac{0,001259}{0,00855} \right) \cdot 100 = 85.27 \% \quad (5)$$

(25)

3.

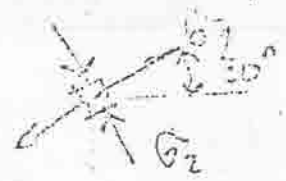
$$d = 0,6 \text{ м}$$

$$n = 1,5$$

$$E = 2 \cdot 10^{11} \text{ Па}$$

$$\Delta d = 0,002 \text{ м}$$

$$\beta = 30^\circ \rightarrow \text{середине}$$



$$n = \frac{d}{c} (\sigma_1 - \sigma_2) \Rightarrow (1) \quad \sigma_1 - \sigma_2 = \frac{n \cdot c}{d} = \frac{0,78 \cdot 0,02}{0,6} = 0,0026$$

$$\epsilon_3 = \frac{\Delta d}{d} = \frac{1}{E} [\sigma_1 - \nu (\sigma_1 + \sigma_2)] \Rightarrow (2) \quad \sigma_1 + \sigma_2 = -\frac{E \Delta d}{\nu d} = -\frac{2 \cdot 10^{11} \cdot 0,002}{0,22 \cdot 0,6} = -0,015$$

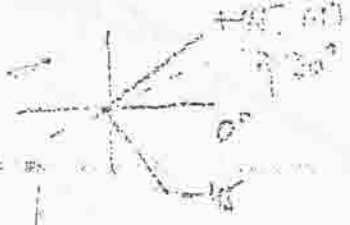
$$(1) + (2) \Rightarrow 2\sigma_1 = 0,0026 \Rightarrow \sigma_1 = 0,0013 \text{ Па/см}^2$$

$$(1) \Rightarrow \sigma_2 = -0,0026 \text{ Па/см}^2 \quad (5)$$

АНАЛИЗ НАПРЯЖЕНИЙ:

$$\epsilon_1 = \frac{1}{E} (\sigma_1 - \nu \sigma_2) = \frac{1}{2 \cdot 10^{11}} (0,0013 - 0,22 \cdot -0,0026) = 3,4 \cdot 10^{-6} \frac{\text{мм}}{\text{мм}}$$

$$\epsilon_2 = \frac{1}{E} (\sigma_2 - \nu \sigma_1) = \frac{1}{2 \cdot 10^{11}} (-0,0026 - 0,22 \cdot 0,0013) = -3,6 \cdot 10^{-6} \frac{\text{мм}}{\text{мм}} \quad (5)$$



$$\epsilon_{\text{max}} = \frac{\epsilon_1 - \epsilon_2}{2} + \frac{1}{2} \sqrt{(\epsilon_1 - \epsilon_2)^2 + (\epsilon_1 + \epsilon_2)^2}$$

$$\epsilon_{\text{max}} = \left| \frac{\epsilon_1 - \epsilon_2}{2} \right| = \frac{15}{100}$$

$$a) \quad 45^\circ < \alpha < 90^\circ \Rightarrow \alpha_0 = 90^\circ - \alpha = 90^\circ - 30^\circ = 60^\circ$$

$$b) \quad 0^\circ < \alpha < 45^\circ \Rightarrow \alpha_0 = 30^\circ$$

$$\epsilon_1 + \epsilon_2 = \epsilon_{45} + \epsilon_{-45} = -31,3 \text{ мк} \quad (3)$$

$$\epsilon_1 - \epsilon_2 = \sqrt{11^2 + 5^2} = 120,5 \text{ мк}$$

$$11^2 + 5^2 = 490 \quad 700,25 \quad (4)$$

$$\frac{1}{2} \epsilon_{2\alpha_0} = \frac{1}{2} \epsilon_{2 \cdot 60} = -1,732 < 0 \text{ не принимаем} \quad (5a)$$

$$\frac{1}{2} \epsilon_{2\alpha_0} = \frac{1}{2} \epsilon_{2 \cdot 30} = 1,732 = \frac{5}{11} \quad (5b)$$

$$(5b), (4) \Rightarrow 11 = 350,258 \text{ мк} \quad (4a)$$

$$5 = -606,646 \text{ мк} \quad (5a)$$

$$11 = 2\epsilon_0 - (\epsilon_{45} + \epsilon_{-45}) = 2\epsilon_0 + 31,3 = 350,258$$

$$\epsilon_0 = 159,479 \cdot 10^{-6} \frac{\text{мм}}{\text{мм}}$$

$$\sigma_{45} + \sigma_{-45} = -31.3$$

$$-\epsilon_{45} + \epsilon_{-45} = -606.646 \Rightarrow (+) \epsilon_{-45} = -637.946$$

$$\epsilon_{-45} = -318.9 \approx 3 \cdot 10^{-6} \frac{\text{cm}}{\text{mm}}$$

$$\epsilon_{+45} = -31.3 + 318.9 \approx 287.646 \cdot 10^{-6} \frac{\text{cm}}{\text{mm}}$$

— ТРАФІКУ ПОСТУПАК :

$$\sigma_1 = 0.072 \text{ kN/cm}^2 \Rightarrow \frac{1}{2}(\sigma_1 + \sigma_2) = -2.007 \text{ kN/cm}^2$$

$$\sigma_2 = -0.086 \text{ kN/cm}^2 \Rightarrow \frac{1}{2}(\sigma_1 - \sigma_2) = 0.079 \text{ kN/cm}^2$$

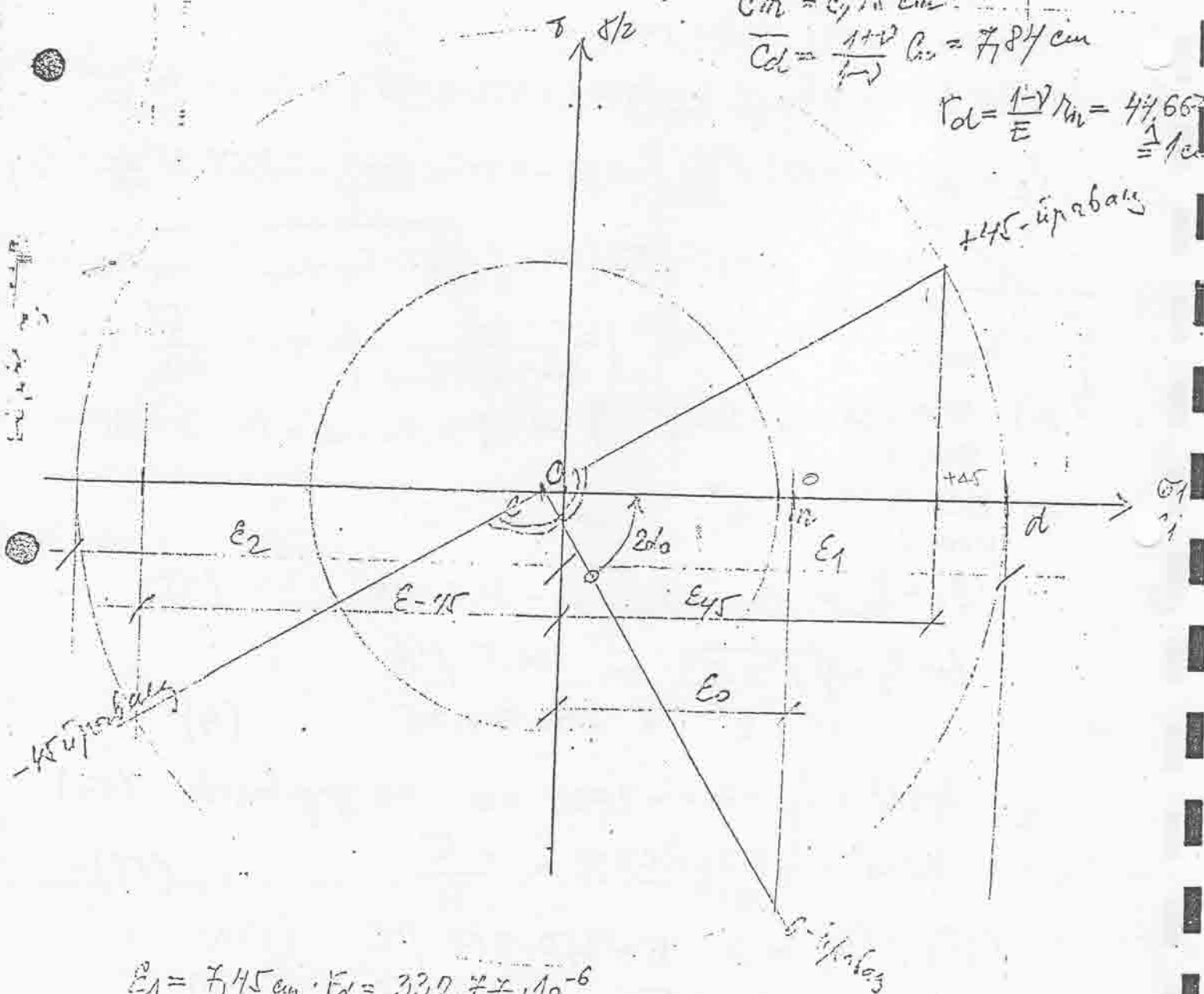
$$\tau_m = 1 \text{ cm} \approx 0.02 \text{ kN/cm}^2$$

$$\bar{CO} = -0.35 \text{ cm}$$

$$\bar{Cm} = 0.95 \text{ cm}$$

$$\bar{Cd} = \frac{1+\nu}{1-\nu} C_m = 7.84 \text{ cm}$$

$$r_{cd} = \frac{1-\nu}{E} r_m = 47.667 \frac{1}{\text{cm}}$$



$$\epsilon_1 = 7.45 \text{ cm} \cdot r_{cd} = 332.77 \cdot 10^{-6}$$

$$\epsilon_2 = -8.05 \text{ cm} \cdot r_{cd} = -353.6 \cdot 10^{-6}$$

$$\epsilon_0 = 3.6 \text{ cm} \cdot r_{cd} = 160.2 \cdot 10^{-6}$$

$$\epsilon_{45} = 6.3 \text{ cm} \cdot r_{cd} = 281.11 \cdot 10^{-6}$$

(1.5-)

(1.1)