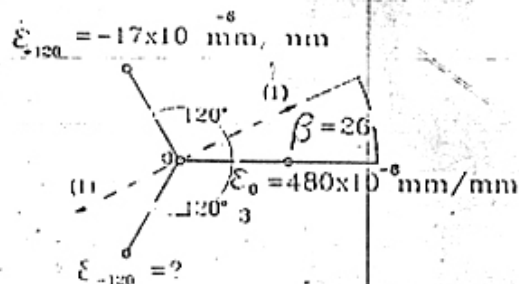




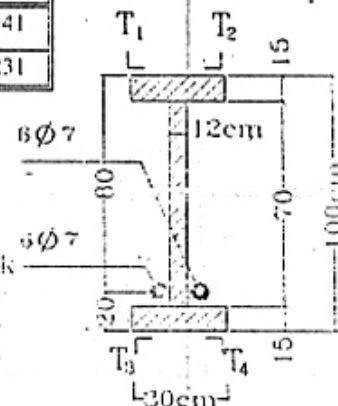
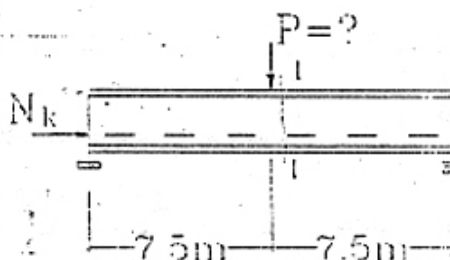
1. Na čeličnom elementu merene su lokalne deformacije putem rozete. Merenje u pravcu ε_{120} je bilo psprečeno, te je izvršeno modeliranje tog konstruktivnog elementa u strogoj geometrijskoj sličnosti za naponsko optičku analizu. Na modelu su u posmatranoj tački određeni red izohrome $n=14.5$ i ugao krsta glavnih napona $\beta \approx 26^\circ$ u pravcu suprotno od kazaljke na satu. Odrediti glavne dilatacije i napone.

MODEL: $E_m = 7000 \text{ kN/cm}^2$, $d_m = 0.5 \text{ cm}$, $c = 0.115 \text{ kN/cm}$ red).

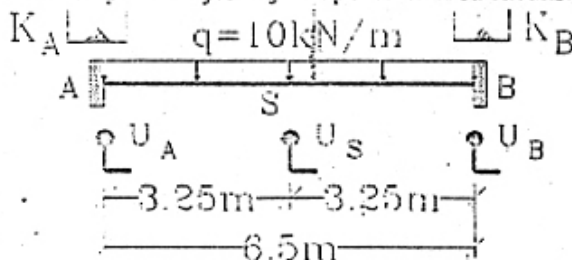


2. Na žici kabla za prethodno naprezanje, grede date na skici, izmerena je prosečna frekvencija $f_{sp} = 167 \text{ Hz}$. Usled sopstvene težine izmerene su dilatacije u preseku I-I (mereno mernim trakama). Naći: a) ukupan dijagram naprezanja u preseku I-I b) Veličinu sile P koja deluje u tom preseku uz uslov da je ukupan napon pritiska na gornjoj ivici $\sigma_{bz} = 0.57 \text{ kN/cm}^2$. ($E_b = 0.35 \times 10^4 \text{ kN/cm}^2$, $k_i = k_t$, $l_i = 100 \text{ cm}$ (dužina slobodnog oscilovanja)

Stanje	T1	T2	T3	T4
0	12731	14825	08938	10141
g	12644	14736	09024	10231



3. Prilikom ispitivanja čelične grede dobijeni su rezultati dati u tablici. Naći stvarne oslonačke momente M_A i M_B , kao i stepene uklještenja i uporediti ih sa računskim. ($p_u = 0.01 \text{ mm}$, $I_{x-x} = 4250 \text{ cm}^4$, $E = 2.1 \times 10^4 \text{ kN/cm}^2$).



Stanje	U _A	U _S	U _B	K ₁	K ₂
0	0158	0025	0223	0+023	0+055
q	0258	1099	0823	0+123	0+173

4. Na prikazanoj konstrukciji mosta dati detaljan raspored mernih mesta za merenje opštih i lokalnih deformacija, kao raspored i broj kompenzacionih mernih mesta.

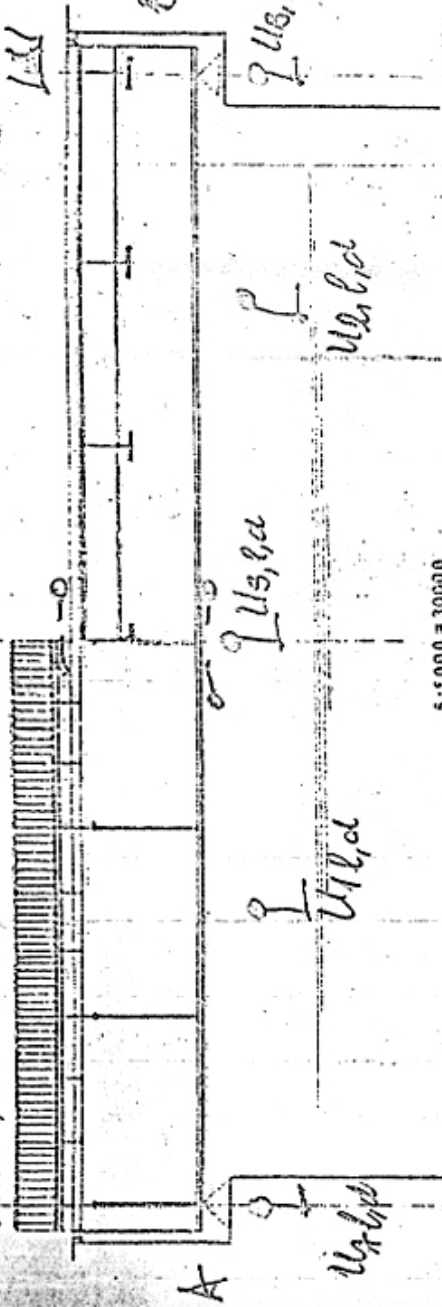
Napomena: Dispozicija mosta data je na poledini zadatka.

IZGLED

1A/10, 1, 1

PRODUŽNI PRESEK

10, 1, 1



POPREČNI PRESEK

asfalt 5 cm

izolacija

AB ploča

asfalt 2,5 cm

AB ploča

KOMPLEK. 1(5)

2.3000 ÷ 2.500 = 7000

5.5000 = 30000

KOLOVOZNI NOSAČI

KOLOVOZNA PLOČA

10, 1, 1

10, 1, 1

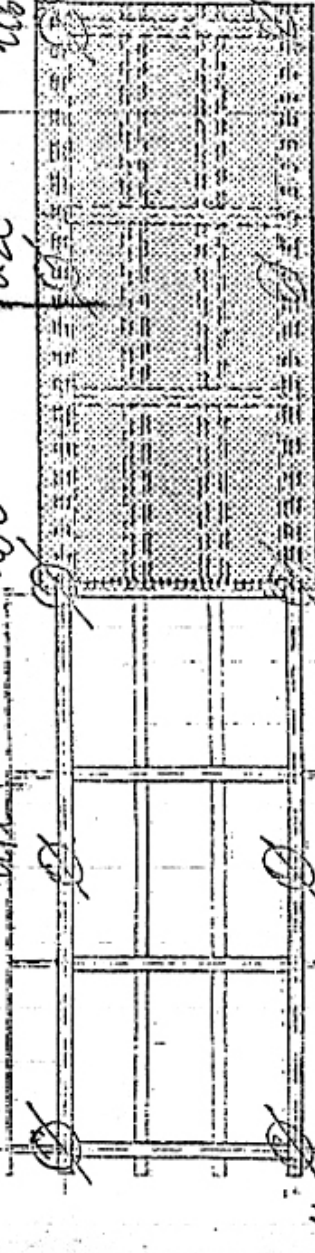
10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1



10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

— OŠTIRJE GEOP.

— NOZARNE

— KOLEN.

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

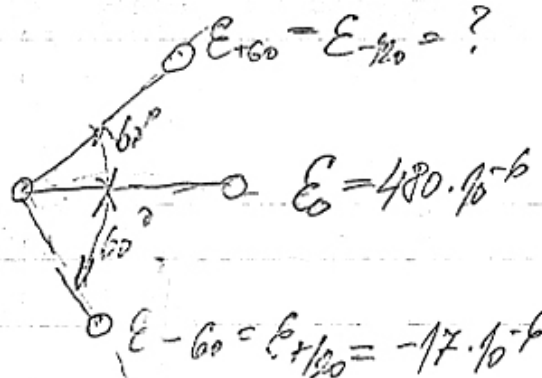
10, 1, 1

10, 1, 1

10, 1, 1

10, 1, 1

1/10



$$E_{1,2} = \frac{E_{-120} + E_0 + E_{+120}}{3} \pm \frac{1}{3} \sqrt{(2E_0 - E_{+120} - E_{-120})^2 - E_{-120}^2}$$

$$\varphi_{2,0}^* = \left| \frac{E_{+120} - E_{-120}}{2E_0 - E_{+120} - E_{-120}} \right| \sqrt{3}$$

$$\tilde{\sigma}_1 = \frac{\epsilon}{1-\nu^2} (E_1 + \nu E_2) ; \tilde{\sigma}_2 = \frac{\epsilon}{1-\nu^2} (E_2 + \nu E_1)$$

$$\tilde{\sigma}_1 - \tilde{\sigma}_2 = \frac{\epsilon}{1-\nu^2} [E_1(1-\nu) - E_2(1-\nu)] = \frac{\epsilon}{1+\nu} (E_1 - E_2)$$

$$16' (\tilde{\sigma}_1 - \tilde{\sigma}_2)_m = (\tilde{\sigma}_1 - \tilde{\sigma}_2)_p \rightarrow \text{конечн. см. и в см. сир. в}$$

$$m = \frac{\alpha}{c} (\tilde{\sigma}_1 - \tilde{\sigma}_2)_m \Rightarrow (\tilde{\sigma}_1 - \tilde{\sigma}_2)_m = \frac{m \cdot c}{\alpha} = \frac{14,5 \cdot 0,115}{0,5} = 3,335$$

$$\text{отг 1. } (E_1 - E_2)_p = \frac{1+\nu}{\epsilon} (\tilde{\sigma}_1 - \tilde{\sigma}_2)_m = \frac{1,3}{2,1 \cdot 10^4} \cdot 3,335 \cdot \frac{2,1}{7,0} = 619,35$$

$$\text{отг 2. } \alpha_{op} \approx 26^\circ$$

$$E_1 - E_2 = \frac{2}{3} \sqrt{(2E_0 - E_{+120} - E_{-120}) + 3(E_{+120} - E_{-120})^2} = 619,357 \cdot \frac{3}{2}$$

$$(977 - E_{-120})^2 + 3(-17 - E)^2 = 363106,9603$$

$$E_{-120}^2 - 463 E_{-120} + 23072,25993 = 0$$

$$(E_{-120})_{1,2} = \frac{463 \pm 349,399}{2} \Rightarrow E_{-120}^1 = 406,2 \text{ / } \mu\text{E}$$

$$E_{-120}^2 = 56,8005 \text{ / } \mu\text{E}$$

$$(\varphi_{2,0}^*)_1 = \left| \frac{-423,2}{570,8} \right| \sqrt{3} = 1,28497 \Rightarrow \alpha^* = 26,046$$

$$E_{-120} = 406,2 \cdot 10^{-6} \frac{\text{ннн}}{\text{ннн}}$$

$$E_1 = 599,492 \cdot 10^{-6} \frac{\text{ннн}}{\text{ннн}}$$

$$E_2 = -19,946 \cdot 10^{-6} \frac{\text{ннн}}{\text{ннн}}$$

$$\tilde{\sigma}_1 = 13,234 \text{ ннн/см}^2$$

$$\tilde{\sigma}_2 = 3,689 \text{ ннн/см}^2$$

2. a) таблица угловых деформаций:

	T1	T2	T3	T4
O	12.731	11.825	08.938	10.141
g	12.644	14.736	09.024	10.231
Δ	-87	-89	86	90
ε.δ	-87	-89	86	90
σ	-0,3045	-0,3115	0,301	0,315
σ _{ср}	-0,308		0,308	

+ значения

$$\varepsilon = \frac{L_i}{L_0} \cdot \rho \cdot \Delta \varepsilon$$

$$L_i = 1 \text{ м} \quad \rho = 1 \cdot 10^{-6} \frac{\text{см}}{\text{см}^2}$$

$$\sigma = E \cdot \varepsilon$$

$$E = 0,5 \cdot 10^4 \frac{\text{кг}}{\text{см}^2}$$

- работа угловых деформаций

$$\sigma_z = \varepsilon \cdot L_i^2 \cdot L_0^2 = 3,2 \cdot 10^{-7} \cdot 100^2 \cdot 167^2 = 89,2448 \text{ кг/см}^2$$

$$N_z = A_z \cdot \sigma_z = \frac{0,7^2 \pi}{4} \cdot 89,2448 = 34,345 \text{ кН}$$

$$N_k = 12 N_z = 12 \cdot 34,345 = 412,145 \text{ кН}$$

$$A_b = 2 \cdot 30 \cdot 15 + 70 \cdot 12 = 1740 \text{ см}^2$$

$$J_b = \frac{1}{12} (30 \cdot 100^3 - 2 \cdot 9 \cdot 70^3) = 1985500 \text{ см}^4$$

$$e_k = 30 - 20 - 30 \text{ см}$$

$$W_b = J_b / 50 = 39710 \text{ см}^3$$

$$\sigma_{bz} = - \frac{N_k}{A_b} \pm \frac{N_k \cdot e_k}{W_b} = - \frac{412,145}{1740} \pm \frac{412,145 \cdot 30}{39710} = -0,237 \pm 0,311$$

$$\sigma_{bz}^g = -0,237 + 0,311 = 0,074 \text{ кг/см}^2$$

$$\sigma_{bz}^{\sigma_k} = -0,237 - 0,311 = -0,548 \text{ кг/см}^2$$

- значения работы угловых деформаций

$$\sigma_z = -0,308 + 0,074 = -0,234 \text{ кг/см}^2$$

$$\sigma_{\sigma_k} = +0,308 - 0,548 = -0,24 \text{ кг/см}^2$$

$$5) M_p = \frac{Pl}{4} = P \cdot \frac{15}{4} = 3,75 P \quad [kNm]$$

$$\sigma_{\sigma, \sigma}^P = \mp \frac{375 P}{3970} = \mp 0,0094 P \quad [kN/cm^2]$$

условie заданное: $\sigma_{\sigma} = 0,57 kN/cm^2$ — сжимающее

$$\sigma_{\sigma} = -0,234 - 0,0094 P = -0,57$$

$$0,0094 P = 0,336$$

$$P = 35,74 \text{ kN}$$

$$\sigma_{\sigma} = -0,234 + 0,0094 \cdot 35,74 = +0,096 kN/cm^2$$

(25)

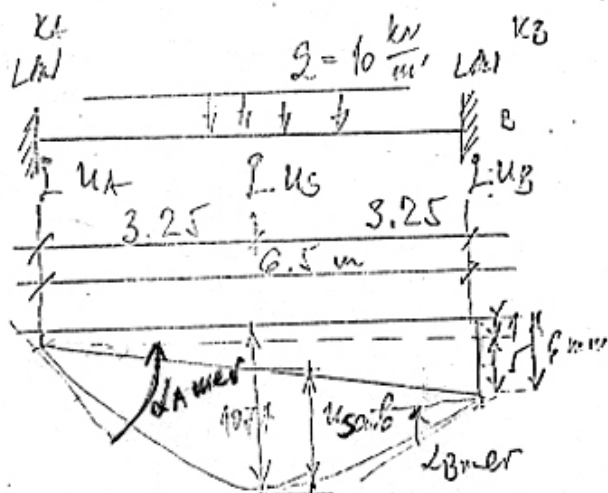
CT.	U _A	U _S	U _B	K _A	K _B
Δ	100	107.4	600	350	132
УТ.	1 мм	10,74	6,0	371"	139,92"

$$P_u = 0,01 \text{ мм}$$

$$P_k = 1,06''$$

$$\Delta_{A \text{ mer}} = f_{ds} = 17,977 \cdot 10^{-4} \text{ рад}$$

$$\Delta_{B \text{ mer}} = f_{ds} = 6,780 \cdot 10^{-4} \text{ рад}$$



$$U_{S \text{ ссб}} = 10,74 - \frac{6+1}{2} = 7,24 \text{ мм}$$

$$\psi_{AB} = \frac{5 \text{ мм}}{6,500} = 7,692 \cdot 10^{-4} \text{ рад}$$

(отрицательная величина указывает на то, что поворот происходит в другую сторону)

$$\Delta_{A \text{ ссб}} = \Delta_{A \text{ mer}} - \psi_{AB} = (17,977 - 7,692) \cdot 10^{-4} = 10,285 \cdot 10^{-4}$$

$$\Delta_{B \text{ ссб}} = \Delta_{B \text{ mer}} + \psi_{AB} = (6,780 + 7,692) \cdot 10^{-4} = 14,472 \cdot 10^{-4}$$

моменты (субарим):

$$M_A = \frac{2EI}{l} \left[(f_{ds} - 2f_{ds}) + 3\psi_{AB} \right] + \frac{2l^2}{12}$$

$$M_B = \frac{2EI}{l} \left[(f_{ds} - 2f_{ds}) + 3\psi_{AB} \right] + \frac{2l^2}{12}$$

$$\frac{2EI}{l} = 2 \cdot \frac{2,1 \cdot 10^4 \cdot 40,50}{650} = 2746,153 \cdot 10^2 \text{ Н/см} = 2746,153 \text{ кН/см}$$

$$M_{A \text{ ссб}} = 2746,153 \left[(14,472 - 2 \cdot 10,285) + 3 \cdot 7,692 \right] \cdot 10^{-4} + \frac{10 \cdot 6,5^2}{12}$$

$$= 4,662 + 35,208 = 39,870 \text{ кН/см}$$

$$M_{B \text{ ссб}} = 2746,153 \left[(10,285 - 2 \cdot 14,472) + 3 \cdot 7,692 \right] \cdot 10^{-4} + \frac{10 \cdot 6,5^2}{12}$$

$$= -11,461 + 35,208 = 23,747 \text{ кН/см}$$

СТЕПЕНЬ ЗАБЕЖИТЕЛЬНОСТИ;

$$\alpha_{A,B}^{rad} = \frac{\Delta l^2}{12 \left(2 \frac{EI}{E} \right)} = \frac{35,208}{2 \cdot 46.153} = 128,208 \cdot 10^{-4} \text{ rad}$$

$$\eta_A = \left(1 - \frac{\Delta l_{calc}}{\Delta l_{rad}} \right) \cdot 100\% = \left(1 - \frac{10,285}{128,208} \right) \cdot 100$$

$$\eta_A = 91,97\%$$

$$\eta_B = \left(1 - \frac{\Delta l_{calc}}{\Delta l_{pr}} \right) \cdot 100\% = \left(1 - \frac{14,472}{128,208} \right) \cdot 100$$

$$\eta_B = 88,71\%$$

- РАУЧНИ СКИ МОМЕНТИ;

ДИСТАНЦИЈЕ НА КОЈИ СТВРПИЛО ЈЕ;

