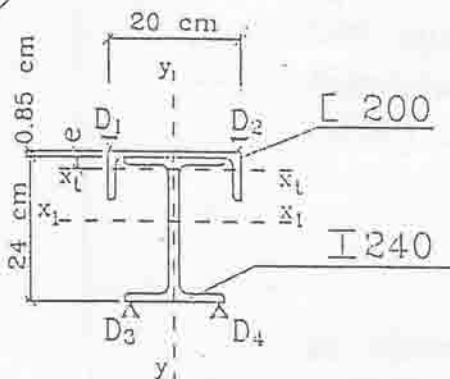




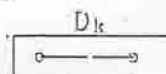
Ispitivanje konstrukcija - MAJ-2002. 25.05.2002 ... pismeni deo ispita

1. Na nosaču kranske staze, prema skici, merene su dilatacije deformetrom *Labiskon* ( $l = 250$  mm). Odrediti momenat i normalnu silu koji deluju na presek.

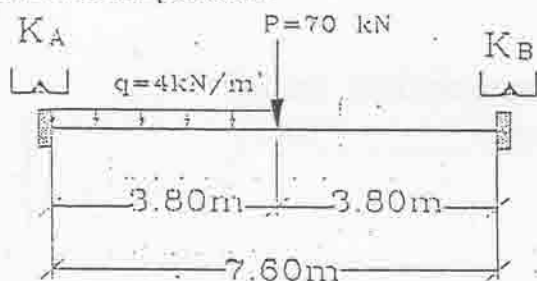


Stanje	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	D <sub>k</sub>
O	2728	2641	1566	3820	3701
P	2855	2764	1418	3670	3709
O	2726	2639	1564	3818	3699

I 240  $A = 46.1 \text{ cm}^2$   $I_{x-x} = 4250 \text{ cm}^4$   $k_i = k_l$   
 I 200  $A = 32.2 \text{ cm}^2$   $I_{x-x} = 148 \text{ cm}^4$   
 $e = 2.01 \text{ cm}$



2. Odrediti momente uklještenja i stepene uklještenja koristeći merene podatke.

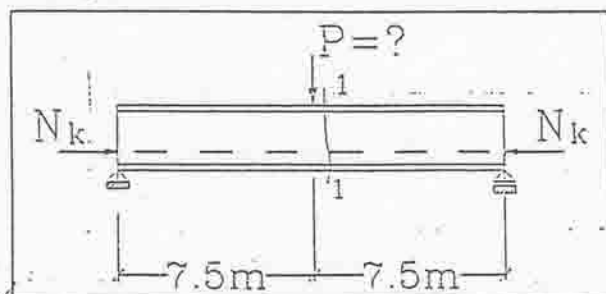


$E_c = 2.1 \times 10^4 \text{ kN/cm}^2$   
 $A = 86.7 \text{ cm}^2$   
 $I_{x-x} = 15700 \text{ cm}^4$

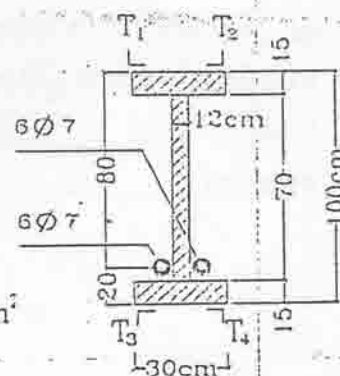
Stanje	KA	KB
O	0 + 227	0 + 072
P	0 + 054	0 + 1249

3. Na žici za prednaprezanje, grede na skici, izmerena je prosečna frekvencija  $f_r = 185 \text{ Hz}$ . Usled sopstvene težine nadene su dilatacije u preseku 1-1 (mereno mernim trakama).

- a) Naći ukupan dijagram naprezanja u preseku 1-1;  
 b) Naći veličinu sile P u tom preseku, ako je ukupni napon na gornjoj ivici  $\sigma_{bg} = 0.57 \text{ kN/cm}^2$  (pritiskak).

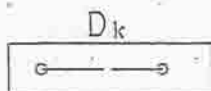
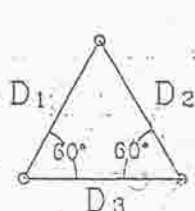


$l_i = 100 \text{ cm}$   
 $E_b = 0.35 \times 10^4 \text{ kN/cm}^2$   
 $k_i = k_l$



Stanje	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
O	12371	14825	08938	10141
g	12644	14736	09024	10231

4. Na armiranobetonskom elementu merene su deformacije instrumentom *Labiskon* ( $l = 250$  mm), prema skici. Računati i grafički odrediti deformacijsko i naponsko stanje i dati komentar sa stanovišta tačnosti i upotrebljivosti ovih postupaka. Podaci merenja dati su u tablici.



$E_b = 0.30 \times 10^4 \text{ kN/cm}^2$   
 $\nu_b = 0.18$

Stanje	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>K</sub>
O	5850	6190	5910	5560
P	5875	6215	5935	5570
O	5870	6210	5930	5580

1

ГЕОМЕТРИЈСКЕ КАРАКТЕРИСТИКЕ  
ПРЕСЕКА:

$$y_T = \frac{\sum A_i \cdot y_i}{\sum A_i}$$

$$\sum A_i = 46,1 + 32,2 = 78,3 \text{ cm}^2$$

$$y_{T1} = y_{T2} = 0$$

$$y_T = \frac{10,84 \cdot 32,2}{78,3} = 4,46 \text{ cm}$$

$$y_{T2} = y_{T1} = 12,8 - 2,01 = 10,84 \text{ cm}$$

(од табелица I.240.)

$$I = 4250 + 46,1 \cdot 4,46^2 + 148 + 32,2 \cdot (10,84 - 4,46)^2$$

$$J = 6625,68 \text{ cm}^4$$

$$y_g = 12 + 0,85 - 4,46 = 8,39 \text{ cm}$$

$$y_d = 16,15 \text{ cm}$$

$$W_g = \frac{J}{y_g} = 789,71 \text{ cm}^3$$

$$W_d = \frac{J}{y_d} = 402,53 \text{ cm}^3$$

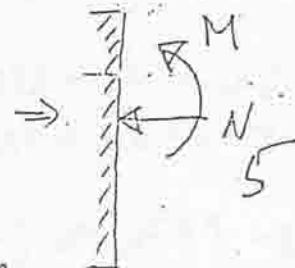
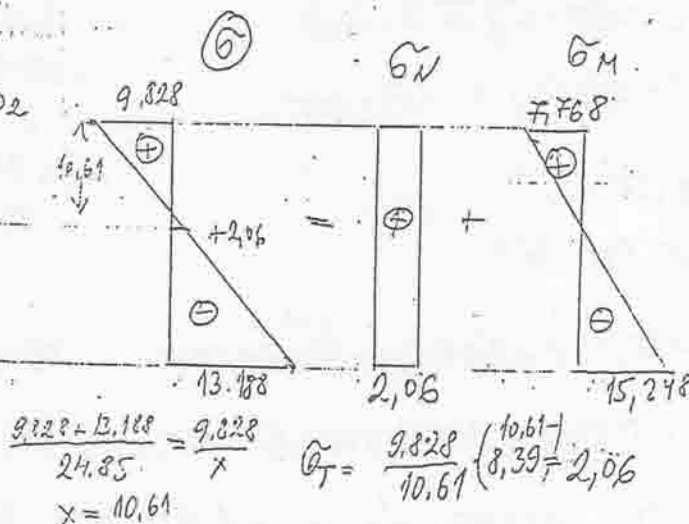
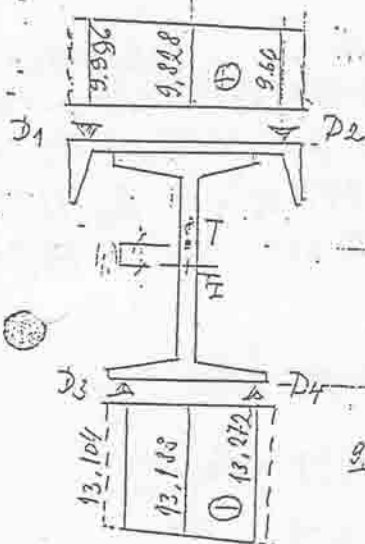
$$\beta_L = 4 \cdot 10^{-6} \frac{\text{mm}}{\text{mm}}$$

egm(Δ) + притисак - затезање

Ст.	D1	D2	D3	D4	Dx
(P-0) <sub>1</sub>	127	123	-148	-150	8
(P-0) <sub>2</sub>	129	125	-146	-148	10
Δs <sub>22</sub>	128	124	-147	-149	9
Δs <sub>22</sub> -Δx	119	115	-156	-158	—
E	476	460	-624	-632	—
σ	9,996	9,66	-13,104	-13,272	—

$\times 10^{-6}$   
[kN/cm<sup>2</sup>]

5

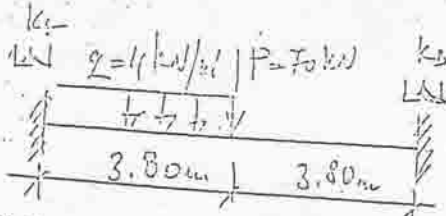


$$N = A \cdot \sigma_N = 78,3 \cdot 2,06 = 161,3 \text{ kN} \quad (\text{притисак})$$

$$M = \begin{cases} \sigma_g \cdot W_g = 7,768 \cdot 789,71 = 6134,5 \text{ kNm} \\ \sigma_d \cdot W_d = 15,248 \cdot 402,53 = 6137,8 \text{ kNm} \end{cases} = \frac{61,345 + 61,378}{2} = 61,36 \text{ kNm}$$

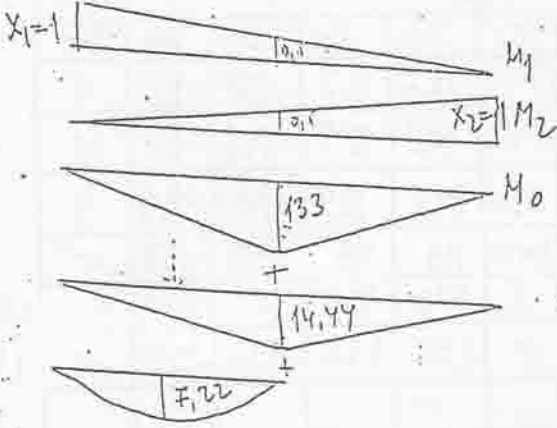
20

2



$$R_{A \text{ TOT}} = 79,74 \text{ kN/m}$$

$$R_{B \text{ TOT}} = 72,52 \text{ kN/m}$$



$$2X_1 + X_2 = 231,99$$

$$X_1 + 2X_2 = 224,77$$

$$J = 15700 \text{ cm}^4$$

$$EI = 2,1 \cdot 15700 \cdot 10^7 = 32970 \text{ kN cm}^2 = 32970 \text{ kN}$$

$$\frac{2EI}{l} = \frac{2 \cdot 32970}{7,6} = 8676,316 \text{ kN/m}$$

$$EI\delta_{11} = EI\delta_{22} = \frac{7,6}{3} \cdot 1^2 = \frac{2 \cdot 7,6}{6}$$

$$EI\delta_{12} = EI\delta_{21} = \frac{7,6}{6} \cdot \frac{7,6}{4}$$

$$EI\delta_{10} = -\frac{7,6}{6} \cdot (13,3 + 14,44) \cdot \frac{3}{2} \cdot 1 - \frac{3,8}{3} \cdot 7,22$$

$$= -\frac{7,6}{6} \cdot 231,99$$

$$EI\delta_{20} = -\frac{7,6}{6} (13,3 + 14,44) \cdot 1,5 - \frac{3,8}{3} \cdot 7,22$$

$$= -\frac{7,6}{6} \cdot 224,77$$

$$X_1 = 79,74 \text{ kN/m}$$

$$X_2 = 72,52 \text{ kN/m}$$

10

$$M_{A \text{ el}} = \frac{2EI}{l} \left( \frac{1}{3} \Delta_A - 2 \frac{1}{3} \Delta_B \right) + M_{A \text{ TOT}}$$

$$M_{B \text{ el}} = \frac{2EI}{l} \left( \frac{1}{3} \Delta_A + 2 \frac{1}{3} \Delta_B \right) + M_{B \text{ TOT}}$$

$$\frac{1}{3} \Delta_A = \hat{\Delta}_A = 395,504 \cdot 10^{-6}$$

$$\frac{1}{3} \Delta_B = \hat{\Delta}_B = 375,148 \cdot 10^{-6}$$

$$\Delta_A = 250 - 227 + 57 = 77$$

$$\Delta_A'' = 77 \cdot 1,06'' = 81,62'$$

$$\Delta_B = 724 - 250 - 210 = 264$$

$$= 73$$

$$\Delta_B'' = 73 \cdot 1,06'' = 77,38$$

$$M_{A \text{ el}} = 8676,316 \cdot (375,148 - 2 \cdot 395,504) \cdot 10^{-6} + 76,13 = 76,13 \text{ kN/m}$$

$$M_{B \text{ el}} = 8676,316 \cdot (395,504 - 2 \cdot 375,148) \cdot 10^{-6} + 72,52 = 69,44 \text{ kN/m}$$

$$\Delta_{A \text{ trac}} = \delta_{10} = \frac{7,6}{6} \cdot 231,99 \cdot \frac{1}{32970} = 8912,769 \cdot 10^{-6}$$

$$\Delta_{B \text{ trac}} = \delta_{20} = \frac{7,6}{6} \cdot 224,77 \cdot \frac{1}{32970} = 8635,385 \cdot 10^{-6}$$

$$\eta_A = \left( 1 - \frac{395,504}{8912,769} \right) \cdot 100\% = 95,55\%$$

$$\eta_B = \left( 1 - \frac{375,148}{8635,385} \right) \cdot 100\% = 95,66\%$$

30

3

$$A_x(\phi) = \frac{0,7 \cdot 25}{4} = 0,385 \text{ cm}^2 \quad A_k = 2,6 \cdot A_x = 4,62 \text{ cm}^2$$

$$A_g = 30 \cdot 100 - 2 \cdot 70 \cdot 9 = 1740 \text{ cm}^2$$

$$J_g = \frac{30 \cdot 100^3}{12} - 2 \cdot \frac{70 \cdot 9^3}{12} = 1385500 \text{ cm}^4 \quad W_g = \frac{J_g}{50} = 39710 \text{ cm}^3$$

$$\tilde{b}_x \cdot c \cdot l^2 \cdot \rho^2 = 3,2 \cdot 10^{-7} \cdot 100^2 \cdot 125^2 = 109,52 \text{ kN/cm}^2 \quad 5$$

$$N_k = A_k \cdot G_x = 505,98 \text{ kN} \quad c_k = 50 - 20 = 30 \text{ cm}$$

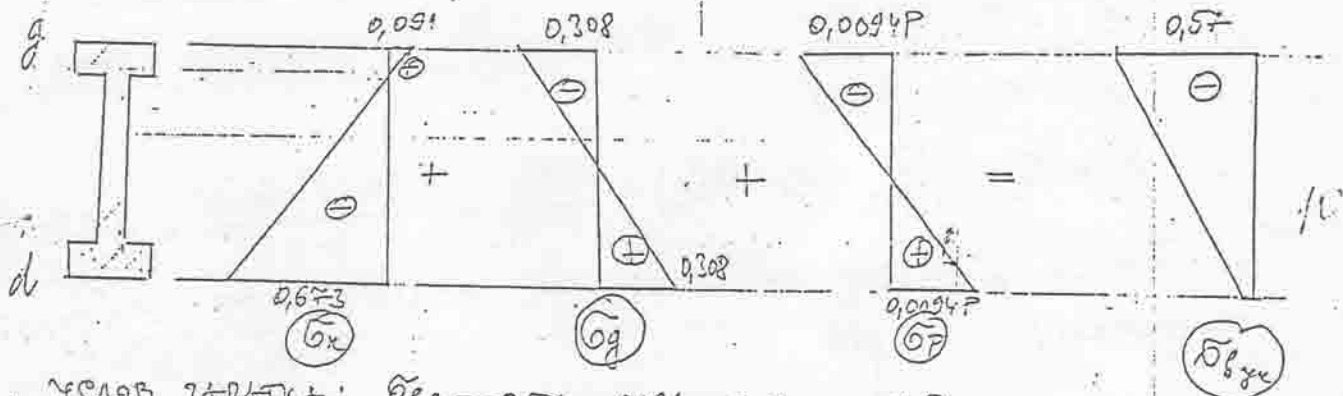
$$\tilde{G}_{gk} = - \frac{505,98}{1740} + \frac{505,98 \cdot 30}{39710} = -0,291 \left( \frac{1}{5} \right), 0,382 \quad \tilde{G}_{gk} = 0,091 \text{ kN/cm}^2$$

$$\tilde{G}_{gk} = -0,673 \text{ kN/cm}^2$$

$$\tilde{G}_{gg} = \frac{1}{2} [(2644 - 1231) + (1426 - 1425)] \cdot 1 \cdot 10^{-6} \cdot 0,35 \cdot 10^4 = -0,308 \text{ kN/cm}^2$$

$$\tilde{G}_{dg} = \frac{1}{2} [(9024 - 8938) + (10231 - 10141)] \cdot 1 \cdot 10^{-6} \cdot 0,35 \cdot 10^4 = 0,308 \text{ kN/cm}^2$$

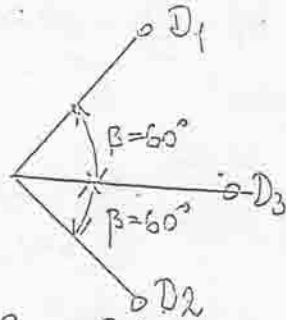
$$M_g = \frac{P l}{4} = 3,75 P = 37,5 P \text{ kNm} \quad \tilde{G}_{g(d)} = \frac{1}{4} 0,0094 P \text{ kN/cm}^2$$



услов затекта:  $\tilde{G}_{gg} = -0,57 = 0,091 + 0,308 - 0,0094 P$

$$P = 37,55 \text{ kN}$$

4



$$E_0 = E_{D3} = E_{+60} = E_{D1} = E_{-60} = E_{D2} = 60 \cdot 10^{-6}$$

$\sigma_{ABE}$	$D_1$	$D_2$	$D_3$	$D_K$
$\Delta_1$	25	25	25	10
$\Delta_2$	5	5	5	-10
$\Delta_{SR}$	15	15	15	0
$\Delta_{SR-DK}$	15	15	15	
$E \cdot 10^6$	60	60	60	

$$\rho = 4 \cdot 10^{-6} \frac{\text{N}}{\text{mm}^2} + \text{притужка}$$

5

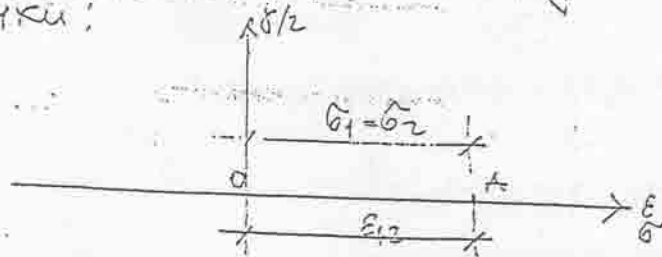
$$E_{1,2} = 60 \cdot 10^{-6} \frac{\text{N}}{\text{mm}^2}$$

$$\sigma_0 = 2095 \text{ MPa}$$

$$\frac{1}{6} 2 \sigma_0 = 0 \text{ (неопретер износ)}$$

$$\sigma_1 = \sigma_2 = \frac{E}{1-\nu} (E_1 + \nu E_2) = \frac{E E_1}{1-\nu} = \frac{0.30 \cdot 10^4 \cdot 60 \cdot 10^{-6}}{1-0.12} = 0.220 \frac{\text{N}}{\text{mm}^2}$$

Точка в чужој окolini је мерило притужки:



$$r_m = \frac{E}{1-\nu} r_a = \frac{0.3 \cdot 10^4 \cdot 20 \cdot 10^{-6}}{1-0.12}$$

$$r_m \hat{=} 1 \text{ cm} = 0.023 \frac{\text{N}}{\text{cm}^2}$$

$$OA = 3 \text{ cm} = 0.219 \frac{\text{N}}{\text{cm}^2}$$

У овом случају грешка је безначајна, ипак, зависи од размера, износ деформаци и проистиче из заокруживања

$$|\Delta| = 0.5\%$$

25