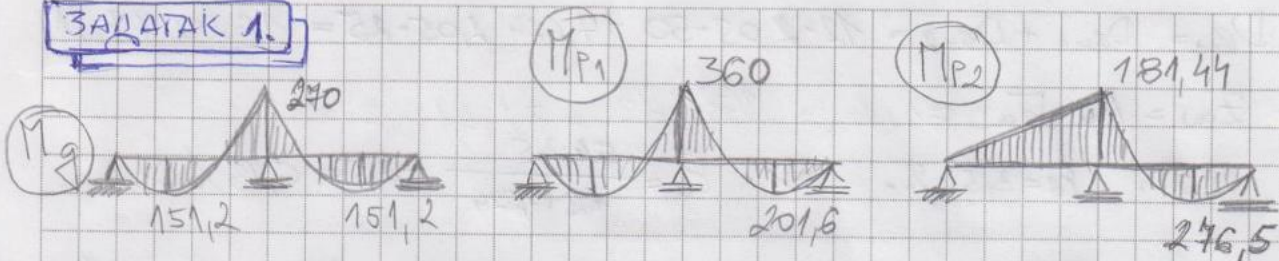


27.09.2015.

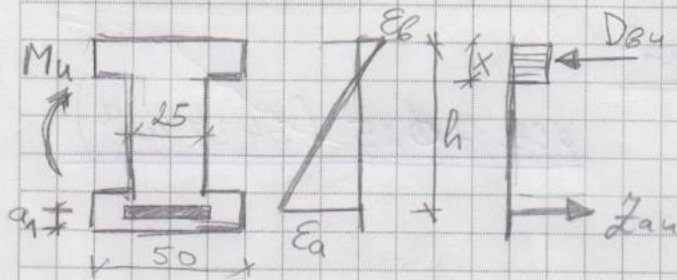
„ТЕОРИЈА БЕТОНСКИХ КОНСТРУКЦИЈА“ СТ.1

ЗАДАТАК 1.



1. ПРЕСЕК У ПОДУ

$$M_u = 1,6 \cdot 151,2 + 1,8 \cdot 276,5 = 739,62 \text{ kNm}$$



ПРЕТН. $a_1 = 6 \text{ cm} \Rightarrow h = 60 - 6 = 54 \text{ cm}$

ПРЕТН. НЕУТРАЛНА ЛИНИЈА У ПОДУ

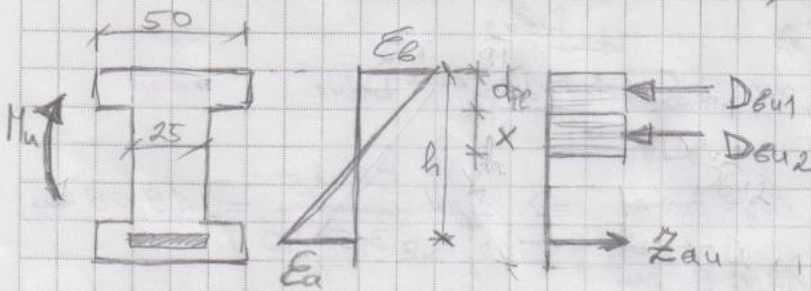
$$D_{bu} = x \cdot f_b \cdot B = x \cdot 2,05 \cdot 50$$

$$\sum M = 0 \Rightarrow D_{bu} \cdot \left(h - \frac{x}{2}\right) = M_u$$

$$x \cdot 2,05 \cdot 50 \cdot \left(54 - \frac{x}{2}\right) = 73962 \text{ kNcm}$$

$$51,25 x^2 - 5535 x + 73962 = 0$$

$$x = 15,62 \text{ cm} > 12 \text{ cm} \Rightarrow \text{ПРЕТН. КУДЕ ТАЈНА}$$



$$D_{bu} = D_{bu1} + D_{bu2}$$

$$\sum M = 0 \Rightarrow d_{fc} \cdot f_b \cdot B \cdot \left(h - \frac{d_{fc}}{2}\right) + x \cdot f_b \cdot b \cdot \left(h - d_{fc} - \frac{x}{2}\right) = 73962 \text{ kNcm}$$

$$12 \cdot 2,05 \cdot 50 \cdot (54 - 6) + x \cdot 2,05 \cdot 25 \cdot \left(54 - 12 - \frac{x}{2}\right) = 73962$$

$$25,625 x^2 - 2152,5 x + 14922 = 0$$

$$x = 7,624 \text{ cm}$$

$$\sum N = 0 \Rightarrow D_{bu} = Z_{au}$$

$$D_{bu} = D_{bu1} + D_{bu2} = 12 \cdot 2,05 \cdot 50 + 7,624 \cdot 2,05 \cdot 25 = \underline{1620,73 \text{ KN}}$$

$$Z_{au} = A_a \cdot \bar{\sigma}_a$$

ПРЕТП. $\epsilon_b = 3,5\%$ $\Rightarrow \epsilon_a = \frac{54 \cdot 3,5}{12 + 7,624} - 3,5 = 6,13\%$

$$\epsilon_v = \frac{500}{200} = 2,5\% < \epsilon_a = 6,13\% \Rightarrow \bar{\sigma}_a = \bar{\sigma}_v = 50 \text{ KN/cm}^2$$

$$A_a = \frac{1620,73}{50} = \underline{32,41 \text{ cm}^2}$$

УСВ. 7 ϕ 25 (34,37 cm²)

2. ПРЕСЕК НАД ОСЛОКЦЕМ

$$M_u = 1,6 \cdot 270 + 1,8 \cdot 360 = 1080 \text{ KNm}$$

ПОШТО ЈЕ $M_u^{OSL} > M_u^{POUJE}$ ПРЕТП. НЕУТРАЛНА ЛИНИЈА У РЕБРУ!

$$\sum M = 0 \Rightarrow 12 \cdot 2,05 \cdot 50 \cdot (54 - 6) + x \cdot 2,05 \cdot 25 \cdot (54 - 12 - \frac{x}{2}) = 108000$$

$$25,625 x^2 - 2152,5 \cdot x + 48960 = 0$$

ЈЕДНАЧКА НИЈЕ РЕШИВА ПА ЈЕ ПОТРЕБНО ДВОЈНО АРМИРАЊЕ



УСВ. $\epsilon_b = 3,5\%$; $\epsilon_{a1} = 3,0\%$ $\Rightarrow s = \frac{54 \cdot 3,5}{3,5 + 3,0} = 29,08 \text{ cm}$

$$x = 29,08 - 12 \text{ cm} = \underline{17,08 \text{ cm}}$$

ПРЕТП. $a_2 = 6 \text{ cm}$ $\Rightarrow \epsilon_{a2} = \frac{(29,08 - 6) \cdot 3,5}{29,08} = \underline{2,78\%} > \epsilon_v = 2,5\%$

$$\sum M = 0 \Rightarrow$$

$$12 \cdot 2,05 \cdot 50 \cdot (54 - 6) + 17,08 \cdot 2,05 \cdot 25 \cdot (54 - 12 - \frac{17,08}{2}) + 50 \cdot A_{a2} \cdot (54 - 6) = 108000$$

$$59040 + 29289,21 + 2400 A_{a2} = 108000 \text{ KNm}$$

$$A_{a2} = 8,20 \text{ cm}^2$$

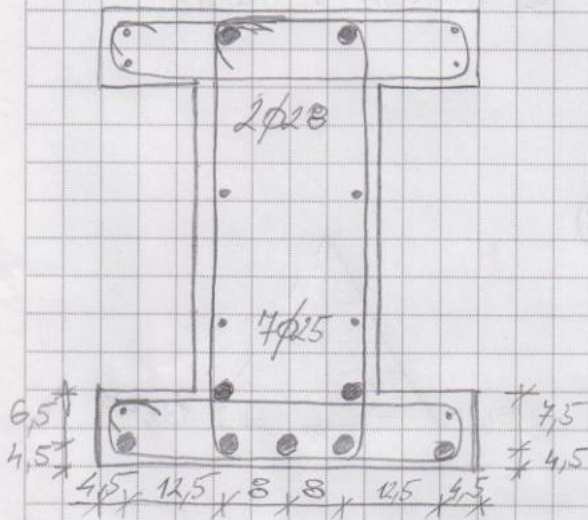
УСВ. 2 ϕ 25 (9,82 cm²)

$$\sum N = 0 \Rightarrow 12 \cdot 2,05 \cdot 50 + 17,08 \cdot 2,05 \cdot 25 + 50 \cdot 8,2 = \bar{\sigma} \cdot A_{a1}$$

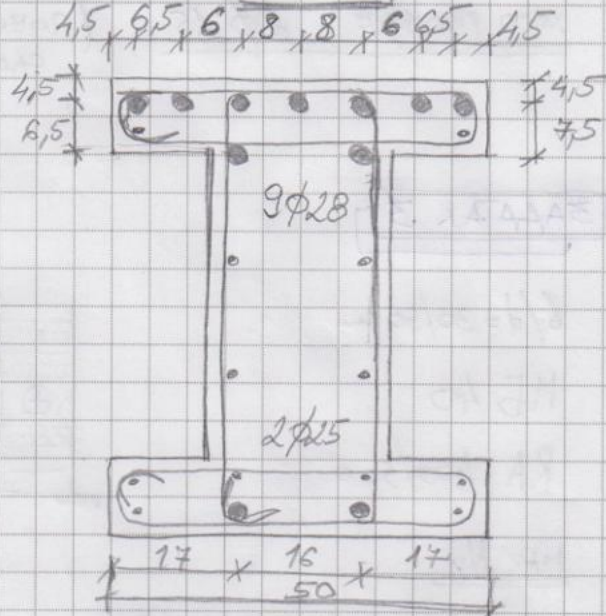
$$A_{a1} = 50,31 \text{ cm}^2$$

УСВ. 9 $\phi 28$ (55,44 cm^2)

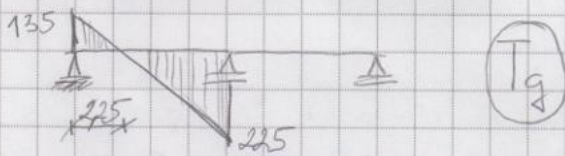
ПОБЕ



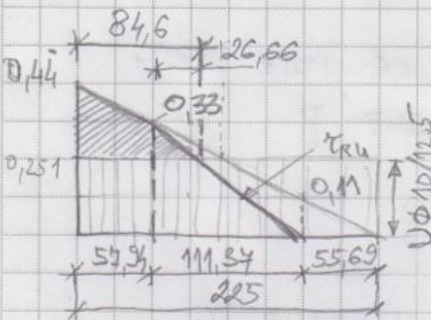
ОСНОВА



3. ОСНОВАНИЕ на Т ЧУВА



$$T_u = 1,6 \cdot 135 + 1,8 \cdot 180 = 540 \text{ kN} \Rightarrow \tau_u = \frac{540}{0,9 \cdot 54 \cdot 25} = 0,44 \text{ kN/cm}^2 > 3\tau_r = 0,33 < 5\tau_r = 0,55$$



ПРЕД. $\phi 10$; $e_u = 12,5 \text{ cm}$; $\angle = 90^\circ$; $\theta = 45^\circ$; $m = 2$

$$\tau_{u,m} = \frac{2 \cdot 0,785}{25 \cdot 12,5} \cdot 50 = 0,251 \text{ kN/cm}^2$$

$$H_{v,u,k} = \left[\frac{26,66}{2} (0,33 - 0,251) + \frac{57,94}{2} (0,44 + 0,33 - 2 \cdot 0,251) \right] \cdot 25$$

$$H_{v,u,k} = 223,64 \text{ kN}$$

$$\alpha_k = 45^\circ \Rightarrow A_{ak} = \frac{223,64}{50 \cdot (0,707 + 0,707 \cdot 1)} = 3,16 \text{ cm}^2 \quad \text{УСВ. 2 } \phi 25 \text{ (9,82 cm}^2\text{)}$$

$$T_{u,m}^{\text{RED}} = T_{e,u} + T_{u,m} = 0,251 \cdot 25 \cdot 0,9 \cdot 54 = 304,97 \text{ kN}$$

$$\Delta A_a = \frac{304,97}{2 \cdot 50} (1 - 0) = 3,05 \text{ cm}^2 \quad \text{УСВ. 2 } \phi 25 \text{ (9,82 cm}^2\text{)}$$

$$e_{u, y_{MIN}} = \frac{d \cdot 0,785}{25 \cdot 0,2 \cdot 10^{-2}} = 31,4 \text{ cm}$$

УОБ. ($m=2$) $\cup \phi 10/12,5$ $\lambda = 225 \text{ cm}$

КОСО ГВОЊИДЕ $2 \phi 25$

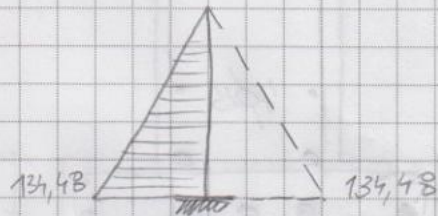
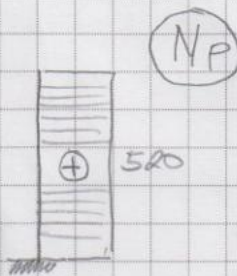
(ПРОВЈАДИ СЕ У ТЕЖИШТУ ШРАДУРАНЕ ПОР)
САСТОЈИ СЕ ОД ТРАПЕЗА И ТРОУГА

ЗАДАТАК 3

$$b/d = 30/50 \text{ cm}$$

МБ 40

РА 400/500



MAX N_u

$$N_u = 1,8 \cdot 520 = 936 \text{ kN}$$

$$M_u = 1,8 \cdot 134,48 = 242,06 \text{ kNm}$$

$$1) e_1 = \frac{\sum M}{\sum N} = \frac{242,06}{936} = 0,2586 \text{ m}$$

$$i_b = \frac{50}{\sqrt{12}} = 14,43 \text{ cm}$$

$$l_i = 2 \cdot 410 = 820 \text{ cm}$$

$$\lambda = \frac{820}{14,43} = 56,83 > 25$$

$$\frac{e_1}{d} = \frac{25,86}{50} = 0,517 < 3,5$$

УЗБУЊАКЕ СЕ ПОРА УЗЕТИ

У ОБЗУР !

$$2) e_0 = \frac{820}{300} = 2,73 \text{ cm} > e_{0, MIN} = 2,0 \text{ cm}$$

$$3) N_g = 0 \Rightarrow \text{ТЕТЕКЕ СЕ НЕ УЗУМА У ОБЗУР !}$$

$$4) \frac{e_1}{d} = \frac{25,86}{50} = 0,517 > 0,3 \Rightarrow e_d = 50 \cdot \frac{56,83 - 25}{100} = 9,95 \text{ cm}$$

$$5) e_2 = 25,86 + 2,73 + 9,95 = 38,54 \text{ cm}$$

$$N_u = 1,8 \cdot 520 = 936 \text{ kN}$$

$$M_u = 936 \cdot 0,3854 = 360,69 \text{ kNm}$$

$$\mu_u = \frac{360,69 \cdot 10^2}{50^2 \cdot 30 \cdot 2,55} = 0,189$$

$$\nu_u = \frac{936}{50 \cdot 30 \cdot 2,55} = 0,245$$

ПРЕТН. $a_1/d = 0,10$ ПБАБ-2, (2.4.10)

$$\bar{\mu} = 0,12 \quad \epsilon_a > 3\text{‰}$$

MIN N

$$N_u = 0$$

$$M_u = 1,8 \cdot 134,48 = 242,06 \text{ kNm}$$

$$\mu_u = \frac{242,06 \cdot 10^2}{50^2 \cdot 30 \cdot 2,55} = 0,127$$

$$\nu_u = 0$$

ПРЕТН. $a_1/d = 0,1$ ПБАБ-2 (2.4.10)

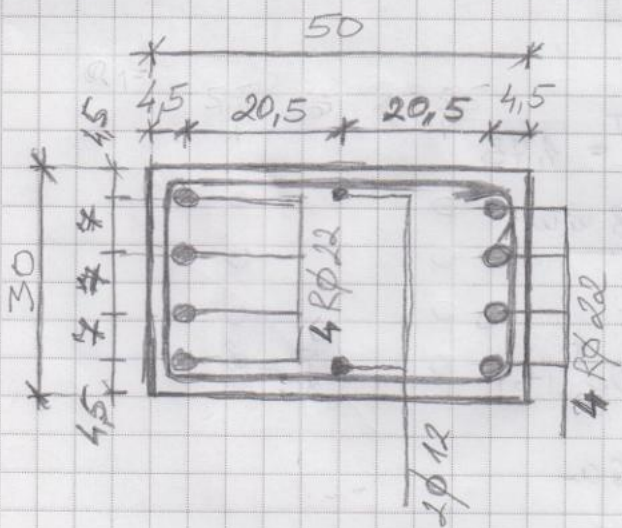
$$\bar{\mu} = 0,155 \quad \epsilon_a > 3\text{‰}$$

$$A_{a1} = A_{a2} = 0,155 \cdot 50 \cdot 30 \cdot \frac{2,55}{40} = 14,82 \text{ cm}^2$$

$$\mu_{\text{MIN}} = \frac{56,83}{50} = 0,4 = 0,764\% > 0,6\% \Rightarrow \mu_{\text{MIN}} = 0,737\%$$

$$A_{a, \text{MIN}} = 0,737 \cdot \frac{50 \cdot 30}{100} = 11,06 \text{ cm}^2$$

УСВ. $\pm 4\phi 22$ ($\pm 15,2 = 30,4 \text{ cm}^2$)



$$a_1 = 4,5 \text{ cm}$$

$$\frac{a_1}{d} = \frac{4,5}{50} = 0,09 \approx \text{ПРЕТН. } \underline{0,1}$$

ЗАДАТАК 3.

$$v_{II}^G(t_0) = 5,47 \text{ мм} ; v_{II}^{G+P}(t_0) = 10,46 \text{ мм} ; v_{II}^P(t_0) = ?$$

ПРИНЦИП СТЕРПОЗИЦИЈЕ: $v_G + v_P \neq v_{GP}$

$$A_{a1} = 8 \cdot 3,8 = 30,4 \text{ cm}^2 / a_1 = 6,5 \text{ cm} / h = 53,5 / \mu_1 = \frac{30,4}{30 \cdot 53,5} = 1,894\%$$

$$A_{a2} = 7,6 \text{ cm}^2 / a_2 = 4 \text{ cm} / \mu_2 = \frac{7,6}{30 \cdot 53,5} = 0,474\% / \alpha_2 = \frac{4}{53,5} = 0,0748$$

$$RA 400/500 \Rightarrow \sigma_V = 40 \text{ kN/cm}^2 ; E_0 = 210 \text{ GPa}$$

$$MB 40 \Rightarrow f_0 = 2,55 \text{ kN/cm}^2 ; E_0 = 34 \text{ GPa} ; f_{0z} = 2,9 \text{ MPa}$$

$$n = \frac{210}{34} = 6,176$$

$$S = 0,373$$

$$J_0 = \frac{30 \cdot 60^3}{12} = 540\,000 \text{ cm}^4$$

$$v_{G,P} = \frac{5}{384} \cdot \frac{20 \cdot 6^4}{34 \cdot 10^6 \cdot 540\,000 \cdot 10^{-8}} \cdot 10^3 = 1,84 \text{ мм}$$

СТАЊЕ I (БЕЗ ПРЕЛИНА)

$$\frac{a_1}{d} = \frac{6,5}{60} = 0,108 \approx 0,1$$

$$\frac{A_{a2}}{A_{a1}} = \frac{7,6}{30,4} = 0,25$$

$$\frac{n \cdot A_{a1}}{b \cdot h} = \frac{6,176 \cdot 30,4}{30 \cdot 53,5} = 0,117 \Rightarrow \text{ПБАБ-2 (3.4.2.) } k_a^I = \underline{0,805}$$

$$v_{II}^I(t_0) = 0,805 \cdot 1,84 = \underline{1,48 \text{ мм}}$$

СТАЊЕ II (СА ПРЕЛИНАМА)

$$\text{ПБАБ-2 (3.4.6)} \Rightarrow k_a^II = 1,73$$

$$v_{II}^II(t_0) = 1,73 \cdot 1,84 = \underline{3,18 \text{ мм}}$$

ПОУЕТКИ ШТАБ

$$v_{II}(t_0) = (1 - \xi) v_{II}^I(t_0) + \xi \cdot v_{II}^II(t_0) ; \xi = ?$$

$$y_{a2} = \frac{30,4 \cdot 53,5 + 7,6 \cdot 4}{30,4 + 7,6} = 43,6 \text{ cm}$$

$$A_{ai} = 30 \cdot 60 + 6,176 \cdot (30,4 + 7,6) = 2034,71 \text{ cm}^2$$

$$y_{i2}^I = 30 + \frac{(43,6 - 30) \cdot 6,176 \cdot (30,4 + 7,6)}{2034,71} = 31,57 \text{ cm}$$

$$J_a = 7,6 \cdot (43,6 - 4)^2 + 30,4 \cdot (43,6 - 53,5)^2 = 14\,897,52 \text{ cm}^4$$

$$\bar{J}_i^I = 540000 + 6,176 \cdot 14897,52 + 1800(43,6 - 30)(31,57 - 30) = 670417,8 \text{ cm}^4$$

$$W_{in}^I = \frac{670417,8}{60 - 31,57} = 23580,33 \text{ cm}^3$$

$$f_{exs} = 2,9 \cdot \left(0,6 + \frac{0,4}{\sqrt[4]{0,6}}\right) = 3,06 \text{ MPa} > 2,9 \text{ MPa} = f_{ex} = f_{exm}$$

$$M_T = 0,306 \cdot 23580,33 \cdot 10^{-2} = 72,11 \text{ KNm} < M_p = \frac{20 \cdot 6^2}{8} = 90 \text{ KNm}$$

$$\left. \begin{array}{l} \beta_1 = 1,0 \text{ (RA 400/500)} \\ \beta_2 = 1,0 \text{ (t=0)} \end{array} \right\} \Rightarrow \int_p^{t=0} = 1 - 1,0 \cdot 1,0 \cdot \frac{72,11}{90} = 0,1988$$

$$v_M^P(t_0) = (1 - 0,1988) \cdot 1,48 + 0,1988 \cdot 3,18 = \underline{\underline{1,82 \text{ mm}}}$$

$$v_M^G(t_0) + v_M^P(t_0) = 5,47 + 1,82 = 7,29 \text{ mm} \neq 10,46 \text{ mm} = v_M^{G+P}(t_0)$$