



ARHITEKTURA

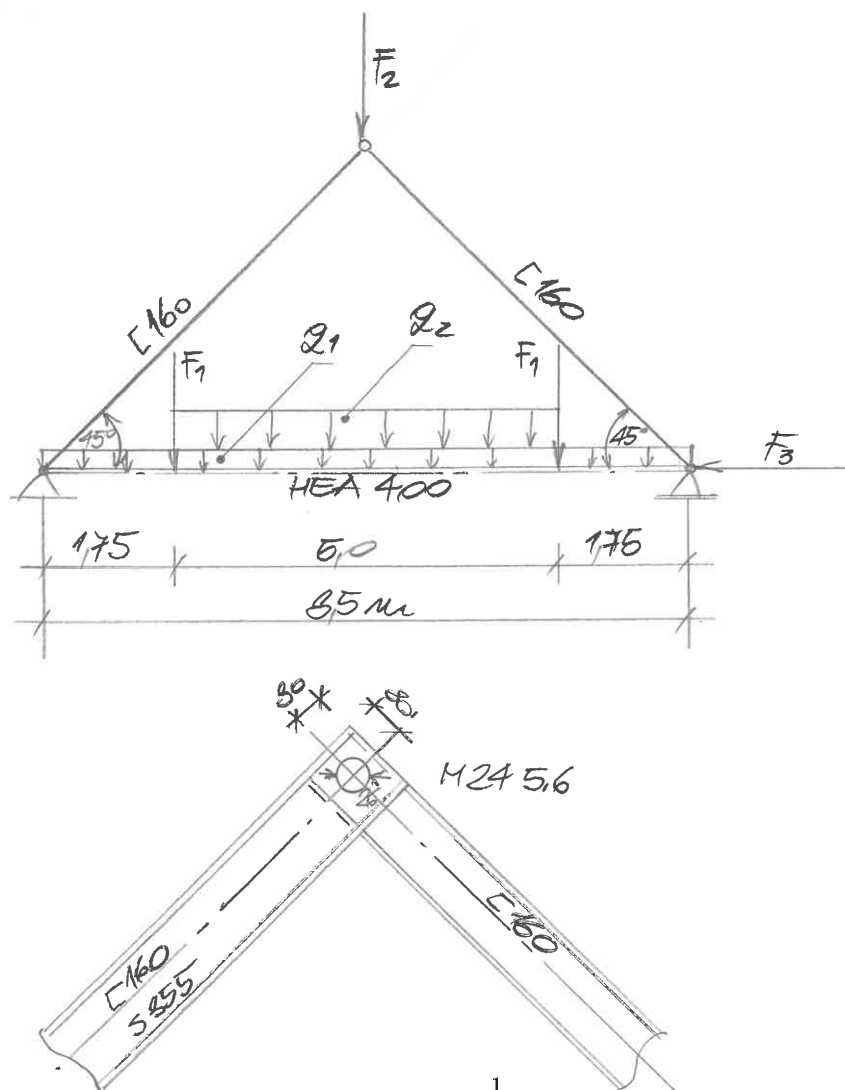
PISNI IZPIT IZ PREDMETA JEKLENE KONSTRUKCIJE

Kandidat:

Naloga

Strešna konstrukcija razpona $L=8,5$ m iz valjanega prereza HEA 400 in materiala S 355 je obremenjena s točkovnima silama $F_1=7,5$ kN (stalna obtežba), zvezno obtežbo $q_1=5$ kN/m (stalna obtežba), zvezno obtežbo $q_2=10$ kN/m (koristna obtežba), z navpično silo $F_2=30$ kN (sneg) in z vodoravno silo $F_3=100$ kN (veter). Lastno težo konstrukcije zanemari. V kombinaciji obtežb upoštevaj koristno obtežbo kot dominantni spremenljivi vpliv.

- Po mejnem stanju nosilnosti z elastično odpornostjo dimenzioniraj nosilec, ki je bočno podprt samo na obeh svojih podporah. Nariši diagrame notranjih statičnih količin. 60%
- ~~Po mejnem stanju uporabnosti preveri vertikalno deformacijo za stalno obtežbo v sredini nosilca.~~
- Preveri nosilnost jeklenega špirovca iz [160 in slemenski vijak M 24 kakovosti 5.6. 40%



RAZUMSKA DRTEŽBA:

$$\bar{F}_{1ed} = 1,35 \cdot 7,5 = 10,125 \text{ kN}$$

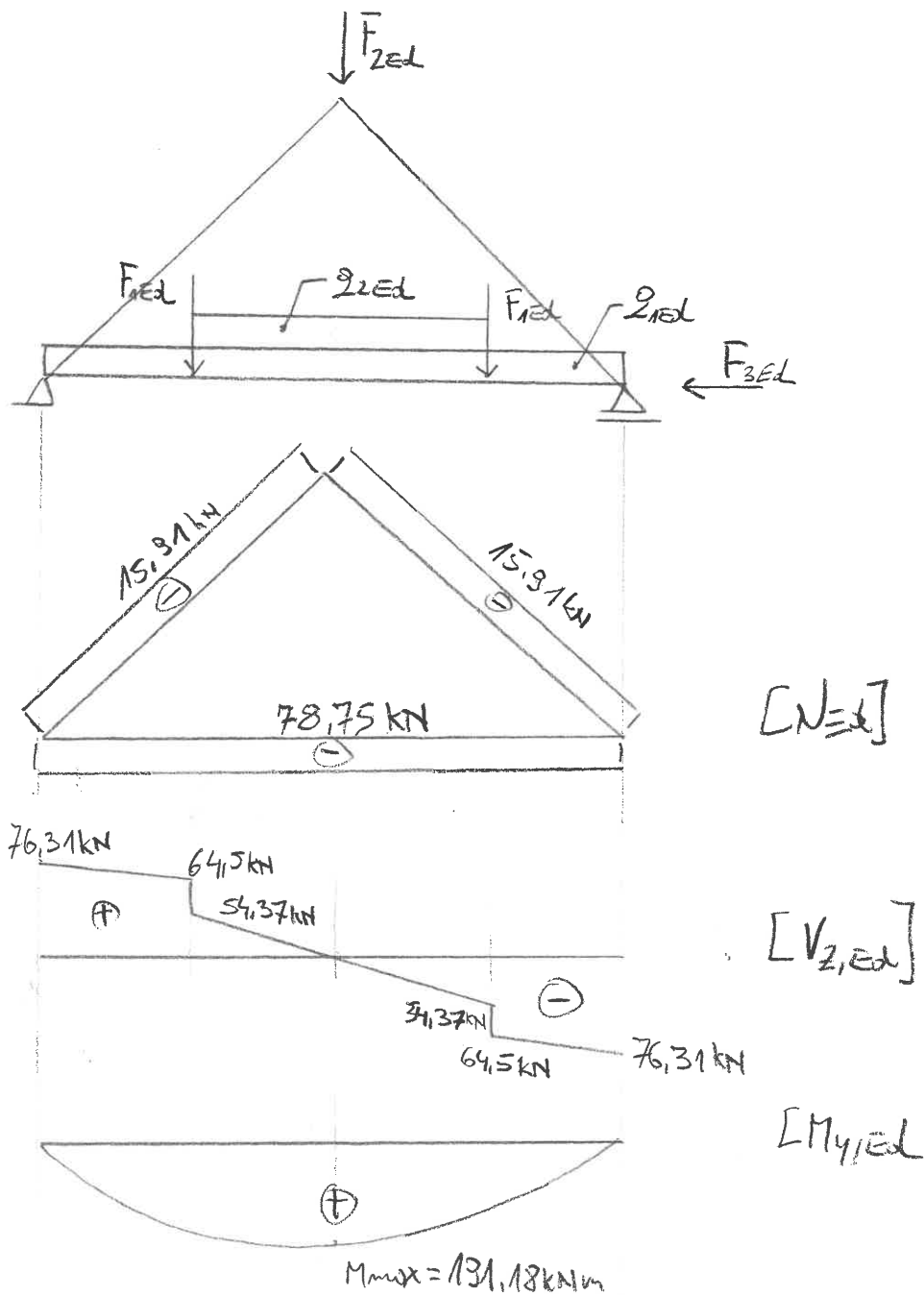
$$\bar{q}_{1ed} = 1,35 \cdot 5 = 6,75 \text{ kN/m}$$

$$\bar{q}_{2ed} = 1,5 \cdot 10 = 15 \text{ kN/m}$$

$$F_{2ed} = 1,5 \cdot 0,5 \cdot 30 \text{ kN} = 22,5 \text{ kN}$$

$$\bar{F}_{3ed} = 1,5 \cdot 0,6 \cdot 100 = 90 \text{ kN}$$

$$H_{ed} = 1,5 \cdot 0,6 \cdot 2,5 = 2,25 \text{ kN}$$



- ODORNOST PREREZA HEA 400

$$\frac{78,75}{158 \cdot 35,5} + \frac{19118}{2310 \cdot 35,5} \leq 1,0$$

$$0,014 + 0,233 = 0,247 \leq 1,0 \quad \checkmark$$

- STRIŽNA ODORNOST PREREZA

$$V_{2,ed} \leq \frac{h_w \cdot t_w \cdot f_y}{\sqrt{3} \cdot \gamma_{m0}} = \frac{35,2 \cdot 1,1 \cdot 35,5}{\sqrt{3} \cdot 1,0} = 793,6 \text{ kN}$$

$$76,31 \text{ kN} \leq 793,6 \text{ kN} \quad \checkmark$$

- ODORNOST ELEMENTA : UKLON + ZVRNITEV

• IZRAČUN χ_y :

$$\lambda_y = \frac{850}{16,8} = 50,59$$

$$\bar{\lambda}_y = \frac{50,59}{93,8 \cdot 0,81} = 0,66$$

UKLONSKA
KRIVULJA $\frac{h}{b} \geq 1,2$
 $t_f \leq 40 \text{ mm}$

a) $\chi_y = 0,872$

• IZRAČUN χ_z :

$$\lambda_z = \frac{850}{7,34} = 115,8$$

$$\bar{\lambda}_z = \frac{115,8}{93,8 \cdot 0,81} = 1,52$$

UKLONSKA
KRIVULJA

b)

$$\chi_z = 0,335$$

izračun χ_{LT} :

$$\begin{array}{lll} C_1 = 1,13 & I_w = 2942000 \text{ cm}^6 & G = 8077 \text{ kN/cm}^2 \\ C_2 = 0,46 & I_z = 8560 \text{ cm}^4 & E = 21000 \text{ kN/cm}^2 \\ z_G = 19,5 \text{ cm} & I_t = 189 \text{ cm}^4 & L = 850 \text{ cm} \end{array}$$

$$M_{CR} = C_1 \cdot \frac{\pi^2 \cdot E \cdot I_z}{L^2} \cdot \left[\sqrt{\frac{I_w}{I_z} + \frac{L^2 \cdot G \cdot I_t}{\pi^2 \cdot E \cdot I_z} + (C_2 \cdot z_G)^2} - (C_2 \cdot z_G) \right]$$

$$M_{CR} = 64845 \text{ kNcm}$$

$$\bar{\lambda}_{LT} = \sqrt{\frac{2310 \cdot 35,5}{64845}} = 1,12$$

UKLONSKA
KRIVULJA $\frac{h}{b} \leq 2$ b)

$$\phi_{LT} = 0,5 \left[1 + 0,34(1,12 - 0,4) + 0,75 \cdot 1,12^2 \right] = 1,09$$

$$\chi_{LT} = \frac{1}{1,09 + \sqrt{1,09^2 - 0,75 \cdot 1,12^2}} = 0,63$$

$$\frac{78,75}{0,872 \cdot 159 \cdot \frac{35,5}{1,0}} + \frac{19118}{0,63 - \frac{2310 \cdot 35,5}{1,0}} \leq 1,0$$

$$0,016 + 0,37 = 0,386 \leq 1,0 \quad \checkmark$$

$$\frac{78,75}{0,335 \cdot 159 \cdot \frac{35,5}{1,0}} + \frac{19118}{0,63 - \frac{2310 \cdot 35,5}{1,0}} \leq 1,0$$

$$0,041 + 0,37 = 0,411 \leq 1,0 \quad \checkmark$$

REFORMACIJA NOSILCA:

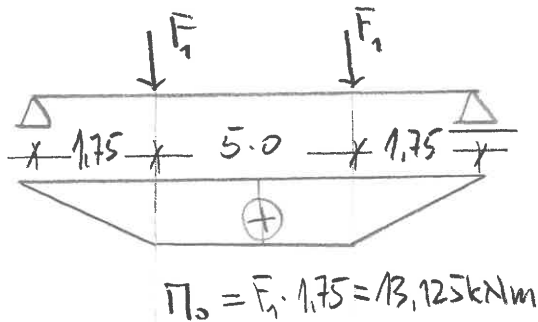
$$F_1 = 7,5 \text{ kN}$$

$$q_1 = 5 \text{ kN/m}$$

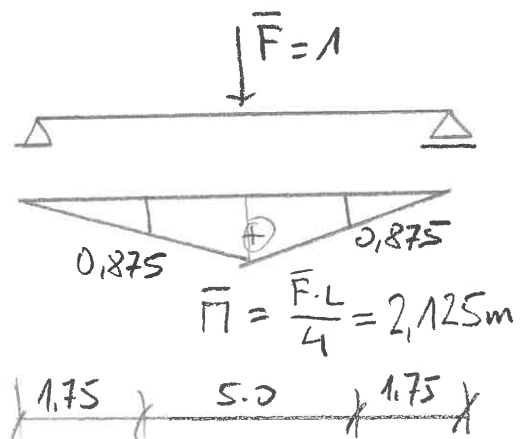
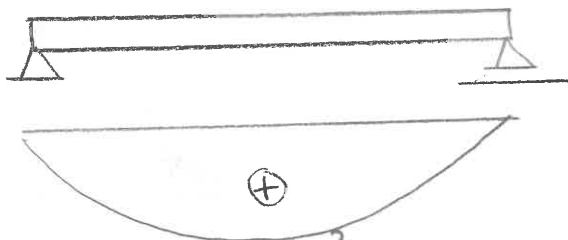
$$E = 21000 \text{ kN/cm}^2$$

$$I_y = 45070 \text{ cm}^4$$

$$L = 850 \text{ cm}$$



+



$$\delta = \int \frac{M_0 \cdot \bar{M}}{E \cdot I} \cdot dx =$$

$13,125 \quad 0,875 \quad 13,125 \quad 0,875 \quad 2,125$

$13,125 \quad 0,875 \quad 8,5 \quad 8,5$

$$E \cdot I \cdot \delta = \int M_0 \cdot \bar{M} = \frac{1}{3} \cdot 13,125 \cdot 0,875 \cdot 1,75 \text{ m} \times 2 + \frac{1}{2} \cdot 13,125 \cdot (0,875 + 2,125) \cdot 2,5 \text{ m} \times 2 +$$

$$+ \frac{5 \cdot q_1 \cdot L^4}{384} = 451,684 \text{ kNm}^3$$

$$\delta = \frac{451,684 \text{ kNm}^3}{210 \cdot 10^6 \cdot 4,507 \cdot 10^{-4}} = 0,00477 \text{ m} \quad \boxed{0,48 \text{ cm} \leq \frac{L}{250}} \checkmark$$

- KONTROLA NOSILNOSTI ŠPIROVCA [160 S355]

- UKLON OKOLI Z-Z OSI

$$\lambda_z = \frac{601 \text{ cm}}{1,89} = 317,99$$

$$\bar{\lambda}_z = \frac{317,99}{93,9 \cdot 0,81} = 4,18$$

UKLONSKA KRIVULJA $\hookrightarrow$ $\chi_{\lambda_z} = 0,051$

$$15,91 \text{ kN} \leq 0,051 \cdot \frac{24 \text{ cm}^2 \cdot 355 \frac{\text{kN}}{\text{cm}^2}}{1,0} = 43,64 \text{ kN} \checkmark$$

- STRIŽNA NOSILNOST VIJAKA M24; 5.6

$$F_{v,rd} = \frac{0,6 \cdot 50 \cdot 3,53}{1,25} = 84,72 \text{ kN}$$

$$15,91 \text{ kN} \leq 84,72 \text{ kN} \checkmark$$

- BOČNA NOSILNOST VIJAKA M24 5.6

$$F_{b,rd} = \frac{2,5 \cdot 0,98 \cdot 51 \cdot 2,4 \cdot 0,75}{1,25} = 179,93 \text{ kN} \geq 15,91 \text{ kN} \checkmark$$

$$d = \min \left\{ \frac{80}{3 \cdot 26} = 1,025 ; \frac{50}{51} = 0,98 ; 1 \right\}$$

$$t = d = 7,5 \text{ mm}$$

- PODPERKNA NOSILNOST NETO PRESEZA [160, $d_o = 26 \text{ mm}$]

$$A_{\text{NET}} = 24 \text{ cm}^2 - d_o \cdot t_f = 22,05 \text{ cm}^2$$

$$15,91 \text{ kN} \leq \frac{0,9 \cdot 22,05 \cdot 51}{1,25} = 809,67 \text{ kN} \checkmark$$

