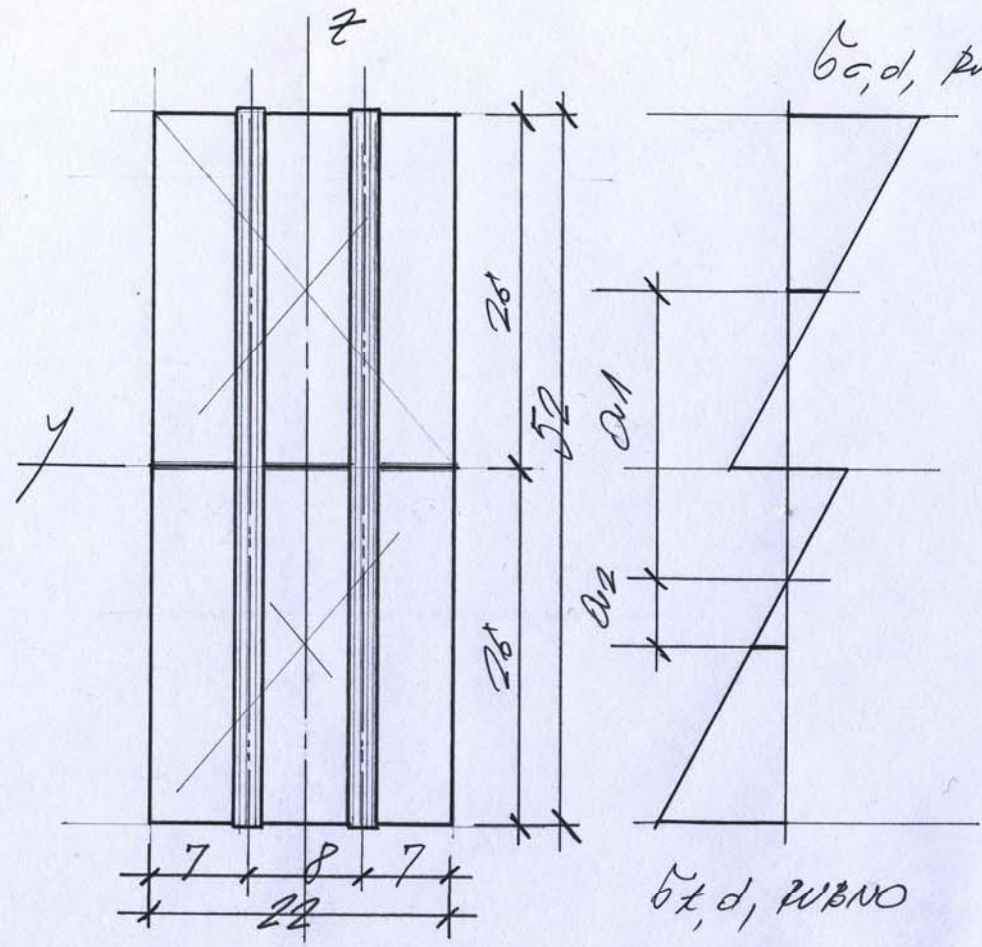


# SPŘEGNUTÉ KONSTRUKCE

SAVSTAVIŽENA DRVENA GREŠA



$b_1/h_1$  } 22/26 cm  
 $b_2/h_2$  }

ČELIČNÍ TRNOVI  
 S<sub>SK</sub> φ 20 (ČELIK S275)

PUNO DRVO ČETINARA  
 KLASA ČVRSTOSTE C24  
 KLASA UPORABLIVOSTI 2

RAZMAK TRNOVA  $a_1 = 100 \text{ mm}$

PROSTORNO OSLONJENA GREDA;  $l = 6,50 \text{ m}$

2.

STROVANJA - KARAKTERISTIČNE VZIJEMNOSTI:

STALNO;  $G_k = 4,0 \text{ kN/m'}$

PROMENLJIVO;  $Q_k = 8,0 \text{ kN/m'}$  (SPREMNJEKRAJNO)

KOEFICIJENT  $\gamma_c$

KOEFICIJENT MODIFIKACIJE

SPREMNJEKRAJNO / 2. KL. UPORABLJIVOSTI  $k_{mod} = 0,8$

(1) TAB. F.1

$$\gamma_M = 1,3$$

(4) TAB. 1

KOEFICIJENT DEFORMACIJE

$$k_{def} = 0,8$$

(1) TAB. F.2

MATERIJAL C24 - KARAKTERISTIČNE VRIJEDNOSTI

$$f_{m,k} = 24,0 \text{ N/mm}^2$$

(1) TAB. F.5 <sup>3.</sup>

$$f_{t,k} = 14,0 \text{ N/mm}^2$$

ČVRSTOĆE

$$f_{c,k} = 21,0 \text{ N/mm}^2$$

$$f_{v,k} = 2,7 \text{ N/mm}^2$$

$$E_{0,mean} = 11000 \text{ N/mm}^2$$

$$E_{0,05} = \frac{2}{3} 11000 = 7333 \text{ N/mm}^2$$

MODUL

$$\rho_k = 350 \text{ kg/m}^3$$

GUSTOĆA

# PROVAČUNSKÉ VRIŽEKNOSTI

4.

$$f_{01} = k_{\text{mod}} \cdot \frac{f_k}{\gamma_M}$$

(1)(3)

ČVRSTOŠŤ:

$$f_{m,k} = 14,8 \text{ N/mm}^2$$

$$f_{t,k} = 8,82 \text{ N/mm}^2$$

$$f_{c,k} = 12,9 \text{ N/mm}^2$$

$$f_{v,k} = 1,65 \text{ N/mm}^2$$

## MODUL ELIZANJA

5.

$$k_{PER} = \frac{\rho k^{1,5} \cdot d}{20} = \frac{350^{1,5} \cdot 20}{20}$$

(1) TAB. G. 1

(VRIJEDI ZA TENOVE, NIJE...)

$$k_1 = \frac{k_{U, mean}}{\rho^2 M}$$

(1)(4)

$$k_{U, mean} = \frac{2}{3} k_{PER} = \frac{2}{3} \frac{350^{1,5} \cdot 20}{20} = 5675 \text{ N/mm} \quad (1)(5)$$

$$k_1 = \frac{5675}{13} = 4365 \text{ N/mm}$$

RAZMACI TRNOVA

PARALELNO SA VLAKANCIIMA ( $\alpha = 0^\circ$ ):

$$a_{1, \text{sa}} = (3 + 2 \cdot \cos \alpha) \cdot d = (3 + 2 \cdot \cos 0^\circ) \cdot 20 = 100 \text{ mm}$$

OKOLITO MEKUSOBNO I OD NEOPTEREĆENOG RUBA!

$$3d = 3 \cdot 20 = 60 \text{ mm}$$

PRORAČUNSKA VRIJEDNOST OPTEREĆENJA:  
(SAMO JEDNO PROMJENLJIVO OPTEREĆENJE)

$$E_d = 1,35 \cdot G_k + 1,5 Q_k = 1,35 \cdot 4,0 + 1,5 \cdot 8,0$$

$$E_d = 17,40 \text{ kN/m'}$$

$$E_{d, \text{max}} = G_k + Q_k = (1,0) \cdot 4,0 + (1,0) \cdot 8,0 = 12,00 \text{ kN/m'}$$

6.

(1) TAB. 8

PROJEKCIJSKE PRIZEMNOSTI REZNIH OBLA:

7.

$$V_d = \frac{E_d \cdot l}{2} = \frac{17,4 \cdot 6,5}{2} = 56,6 \text{ kN}$$

$$M_d = \frac{E_d \cdot l^2}{8} = \frac{17,4 \cdot 6,5^2}{8} = 91,9 \text{ kNm}$$

POTREBNI MOM. INERCIJE ZA EL. DEFORMACIJU:

$$w_{\text{INST.}} = \frac{5}{384} \frac{E_{d, \text{INST.}} \cdot l^4}{E_{\text{MEAN}} \cdot J_{\text{EF}}} \leq \frac{l}{300}$$

$$J_{\text{EF, POTR}} = \frac{5 \cdot 300 \cdot E_{d, \text{INST.}} \cdot l^3}{384 \cdot E_{\text{MEAN}}} = \frac{5 \cdot 300 \cdot 12,0 \cdot 6500^3}{384 \cdot 11000}$$

$$J_{\text{EF, POTR}} = 1,170 \cdot 10^8 \text{ mm}^4$$

PREMA (1)(25) ZA  $E_1 = E_2 = E$

$$J_{y, \text{EF}} = \sum_{i=1}^2 (J_i + I_i \cdot A_i \cdot a_i^2)$$

\* (1)(25)

$$j_1 = \frac{1}{1 + \frac{\sum_{i=1}^n E_i \cdot A_i \cdot l_i}{k_1 \cdot l^2}}$$

(1)(29)  $j_1$

$s_1$  - RAZMAK TRNOGA SREBENO NA ZEDAN PES

$$s_1 = \frac{100}{2} = 50 \text{ mm}$$

$$j_1 = \frac{1}{1 + \frac{\pi^2 \cdot 11000 \cdot 220 \cdot 280 \cdot 50}{4365 \cdot 1500^2}} = 0,373$$

$$a_2 = \frac{1}{2} \frac{j_1 \cdot E_1 \cdot A_1 (h_1 + h_2) - j_3 \cdot E_3 \cdot A_3 (h_2 + h_3)}{\sum_{i=1}^3 j_i \cdot E_i \cdot A_i} \quad (1)(30)$$

$$A_1 = A_2 = 220 \cdot 280 = 57200 \text{ mm}^2$$

$$A_3 = \phi$$

$$j_2 = 1$$

(1)(28)



$$a_2 = \frac{1}{2} \frac{\cancel{\beta_1} \cdot \cancel{E_1} \cdot A_1 (h_1 + h_2)}{\cancel{\beta_1} \cdot \cancel{E_1} \cdot A_1 + \cancel{\beta_2} \cdot \cancel{E_2} \cdot A_2} \quad \begin{array}{l} E_1 = E_2 \\ \beta_2 = 1 \end{array} \quad 9.$$

$$a_2 = \frac{1}{2} \frac{0,373 \cdot 57200 (260 + 260)}{0,373 \cdot 57200 + 1 \cdot 57200} = 70,6 \text{ mm}$$

$$a_1 = \frac{h_1 + h_2}{2} - a_2 = \frac{260 + 260}{2} - 70,6 = 189,4 \text{ mm}$$

$$J_{y,ef} = J_{y_1} + J_{y_2} + \beta_1 \cdot A_1 \cdot a_1^2 + \beta_2 \cdot A_2 \cdot a_2^2 \quad * (1) (25)$$

$$J_{y,ef} = \left( 2 \cdot \frac{220 \cdot 260^3}{12} \right) + \left( 0,373 \cdot 220 \cdot 260 \cdot 189,4^2 + 220 \cdot 260 \cdot 70,6^2 \right)$$

$$J_{y,ef} = 1,695 \cdot 10^6 \text{ mm}^4 > J_{y,ef, \text{potr}} = 1,170 \cdot 10^6 \text{ mm}^4$$

MOMENT INERCIJE NETTO PRESJEKA

10.

$$J_{y,ef,NETTO} = \frac{b_{NETTO}}{b} \cdot J_{y,ef}$$

$$J_{y,ef,NETTO} = \frac{220 - 2 \cdot 20}{220} \cdot J_{y,ef} = 0,818 J_{y,ef}$$

(TRNOVI  $2 \times 20$  mm, ŠIRINA  $b = 220$  mm)

ĐOKAZ 1

1. RUBNO NAPREZANJE - VLAČNA ZONA

$$\frac{\sigma_{f,t,max,d}}{f_{m,d}} \leq 1$$

(1)(98)

$$\frac{M_d}{J_{y,ef,NETTO}} \left( \gamma_1 \cdot a_1 + h_1 / 2 \right) =$$

$$f_{m,d}$$

$$= \frac{91,9 \cdot 10^5}{1,675 \cdot 10^8 \cdot 0,818} \cdot \frac{(0,373 \cdot 189,4 + 250/2)}{14,8} = 0,9 < 1 \quad \checkmark$$

2. TEŽIŠNO NAPREŽANJE - KLAČNA ZONA

$$\frac{\sigma_{f,t,d}}{f_{t,d}} \leq 1$$

(1)(100)

$$\frac{\frac{M_d}{J_{y,ef,NETTO}} \cdot \sigma_i \cdot a_1}{f_{t,0,d}} = \frac{\frac{91,9 \cdot 10^6}{1.695 \cdot 10^6 \cdot 0,818} \cdot 0,373 \cdot 1894}{8,62} =$$

$$= 0,54 < 1 \quad \checkmark$$

3. RUBNO NAPREŽANJE - TLAČNA ZONA

$$\frac{\sigma_{f,c,max,d}}{f_{m,d}} \leq 1$$

(1)(97)

- SOKAZ NIJE POTREBAN ( $A_1 = A_2$  - SIMETRIJA)

#### 4. TEŽIŠNO NAPREŽANJE - TLAČNA ZONA

B.

$$\frac{\sigma_{f,c,d}}{k_c \cdot f_{c,d}} \leq 1$$

- DOKAZ NIJE POTREBAN :

- NOSAČ JE BOČNO POKRAN  $k_c = 1$
- $f_{c,d} > f_{t,d}$

OPTEREČENJE TRNOVA :

14.

$$F_d = \frac{V_d \cdot \rho_1 \cdot A_{1, \text{NETTO}} \cdot \alpha_1 \cdot \rho_1}{J_{y, e_1, \text{NETTO}}}$$

(45)

(1)(34)

(ZA  $\epsilon_1 = \epsilon_2 = \epsilon$ )

$$F_d = \frac{56.600 \cdot 0,373 \cdot 220 \cdot 280 \cdot 0,818 \cdot 1894 \cdot 50}{1695 \cdot 10^6 \cdot 0,818}$$

$$F_d = 6.747 \text{ N} / 1 \text{ TRN}$$

PROVJERA UPORABLJIVOSTI ZA :

$$W_{Q, \text{INST.}} \leq l/300$$

$$W_{FIN} - W_{G, \text{INST.}} \leq l/200$$

} ZA KARAKT.  
KOMBINACIJU

(1)(40)

(1)(41)

$$N_{FIN} - N_0 \leq l/200$$

ЗА НАЗОВИСТАЛНУ  
КОМБИНАЦИЈУ

(1)(42)

15.

ИЗВЕШЉИЈЕ / ОЉУГАТ 2010

