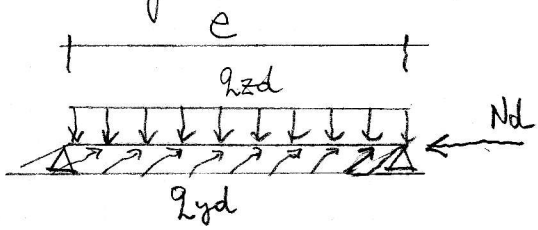
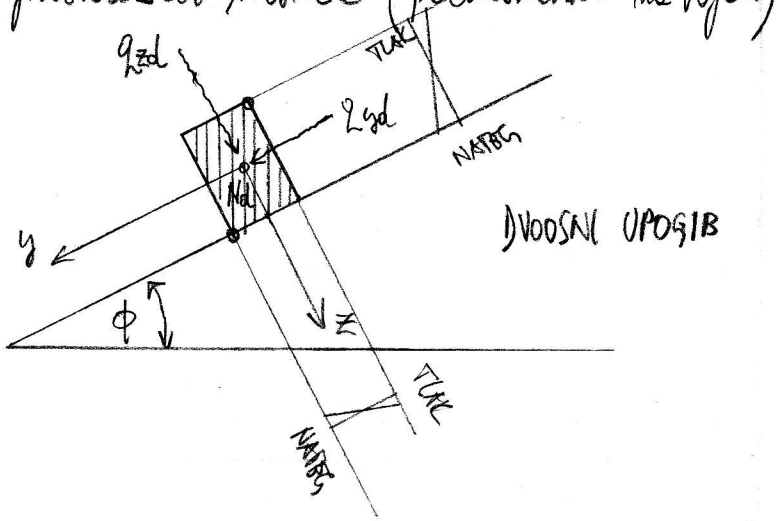
6.2 DIMENZIONIRANJE LEGE

→ lego obravnavamo kot prostoležeč nosilec (poenostavitev na vajah)





$e = 2{,}5\,m$

$\phi = 13{,}71°$

Nd = osna sila, ki je posledica izbočnih sil tlačenega pasu police (lega preprečuje izbočitev)

vaje 5.1 (nadomestna zv. obtežba)

$$N_d = \frac{2 \cdot q_d \cdot a'}{n} = \frac{2 \cdot 1{,}28\,kN/m \cdot 2{,}88\,m}{3} = 2{,}46\,kN$$

↳ vaje 5.1 $\left(\frac{\text{št. polic}}{\text{št. zorovn. kontr.}} = \frac{6}{2} = 3\right)$

→ vnaprej izberemo dimenzije lege $b/h = 14/18\,cm$

lastna teža $g_e = b \cdot h \cdot \rho_{MEAN} \cdot g = 0{,}14 \cdot 0{,}18 \cdot 460 \cdot 9{,}81 = 0{,}114\,\frac{kN}{m}$

↳ težnostni pospešek

• OBTEŽBA: (špirovci, kritina (0. vaje); lega)

$$q_{yd}^{"M"} = \gamma_g \cdot (g_1 \cdot a' + g_e) \cdot \sin\phi + \gamma_q \cdot (q_s \cdot a) \cdot \sin\phi =$$

$$= 1{,}35 \cdot \left(0{,}45\,\frac{kN}{m^2} \cdot 2{,}88\,m + 0{,}114\,\frac{kN}{m}\right) \cdot \sin 13{,}71° + 1{,}50\left(1{,}52\,\frac{kN}{m} \cdot 2{,}8\,m\right) \cdot \sin 13{,}71° = 1{,}96\,\frac{kN}{m}$$

$$q_{zd}^{M} = \gamma_g \cdot (\text{---}''\text{---}) \cdot \cos\phi + \gamma_q (\text{---}''\text{---}) \cdot \cos\phi = 8{,}05\,\frac{kN}{m}$$

$q_{yd}^{"S"} = \ldots$

$q_{zd}^{"S"} = \ldots$

→ kritenj obtežbe ... → merodajen obtež. primer "M"

• OBREMENITEV;

$$M_{y,d}^{"M"} = \frac{q_{z,d} \cdot e^2}{8} = \frac{8{,}05 \cdot 2{,}5^2}{8} = 6{,}29\ kNm$$

$$M_{z,d}^{"M"} = \frac{q_{y,d} \cdot e^2}{8} = \frac{1{,}96 \cdot 2{,}5^2}{8} = 1{,}53\ kNm$$

$$V_{y,d}^{"M"} = \frac{q_{y,d} \cdot e}{2} = \frac{1{,}96 \cdot 2{,}5}{2} = 2{,}45\ kN$$

$$V_{z,d}^{"M"} = \frac{q_{z,d} \cdot e}{2} = \frac{8{,}05 \cdot 2{,}5}{2} = 10{,}06\ kN$$

→ ker imamo dimenzije že izbrane, naredimo kontrolo:

• KONTROLA NORMALNIH NAPETOSTI;

– OKOLI OSI z:

$$\frac{\sigma_{c,0,d}}{k_{c,z} \cdot f_{c,0,d}} + k_M \frac{\sigma_{m,y,d}}{f_{m,d}} + \frac{\sigma_{z,m,d}}{f_{m,d}} \leq 1{,}0$$

↳ koeficient oblike pri upogibu
k_M (masivni prerez) = 0,70

– OKOLI OSI y:

$$\frac{\sigma_{c,0,d}}{k_{c,y} \cdot f_{c,0,d}} + k_M \frac{\sigma_{m,z,d}}{f_{m,d}} + \frac{\sigma_{m,y,d}}{f_{m,d}} \leq 1{,}0$$

→ obe zgornji pogoja morata biti izpolnjena
$k_{c,z}$ in $k_{c,y}$ ... vzdolžna koeficienta (4. vaja)

$$\sigma_{m,y,d} = \frac{M_{y,d}}{W_y} = \frac{M_{y,d}}{\frac{b \cdot h^2}{6}} = \frac{6{,}29 \cdot 100}{\frac{14 \cdot 18^2}{6}} = 0{,}832\ \frac{kN}{cm^2}$$

$$\sigma_{m,z,d} = \frac{M_{z,d}}{W_z} = \frac{M_{z,d}}{\frac{h \cdot b^2}{6}} = \frac{1{,}53 \cdot 100}{\frac{18 \cdot 14^2}{6}} = 0{,}260\ \frac{kN}{cm^2}$$

$$\sigma_{c,0,d} = \frac{N_d}{b \cdot h} = \frac{2{,}46}{14 \cdot 18} = 0{,}0098\ \frac{kN}{cm^2}$$

→ Izračun vitkosti:

k_{cy}: $i_y = \sqrt{\frac{J_y}{A}} = \sqrt{\frac{6804}{252}} = 5{,}196\,cm$

$J_y = \frac{b h^3}{12} = \frac{14 \cdot 18^3}{12} = 6804\,cm^4$; $A = b \cdot h = 14 \cdot 18 = 252\,cm$

$\lambda_y = \frac{l_{uy}}{i_y} = \frac{250\,cm}{5{,}196\,cm} = 48{,}11$

$l_y = e = 2{,}5\,m$

$\lambda_{REL,y} = \frac{\lambda_y}{\pi} \sqrt{\frac{f_{c,0,k}}{E_{0,05}}} = \frac{48{,}11}{\pi} \sqrt{\frac{2{,}3}{800}} = 0{,}82$

odčítam (4. VAJA) $\Rightarrow k_{cy}(\lambda_{REL,y}) = 0{,}813$

k_{cz}: $i_z = \sqrt{\frac{J_z}{A}} = \sqrt{\frac{4116}{252}} = 4{,}04\,cm$

$J_z = \frac{h \cdot b^3}{12} = \frac{18 \cdot 14^3}{12} = 4116{,}0\,cm^4$

$\lambda_z = \frac{l_{u,z}}{i_z} = \frac{250}{4{,}04} = 61{,}88$

$\lambda_{REL,z} = \frac{\lambda_z}{\pi} \sqrt{\frac{f_{c,0,k}}{E_{0,05}}} = \frac{61{,}88}{\pi} \sqrt{\frac{2{,}3}{800}} = 1{,}06$

odčítam $\Rightarrow k_{c,z}(\lambda_{REL,z}) = 0{,}645$

Sferične vrednosti računskih trdnosti:

$f_{c,0,d} = 1{,}415\,\frac{kN}{cm^2}$; $f_{m,d} = 1{,}846\,\frac{kN}{cm^2}$; $k_M = 0{,}7$

- kontrola normalnih napetosti okoli osi z:

$\frac{0{,}0098}{0{,}645 \cdot 1{,}415} + 0{,}7 \cdot \frac{0{,}832}{1{,}846} + \frac{0{,}260}{1{,}846} = 0{,}467 \leq 1{,}0$ ✓

- —"— okoli osi y:

$0{,}558 \leq 1{,}0$ ✓

- KONTROLA STRIŽNIH NAPETOSTI: $A_s = 2/3\,A = 168\,cm^2$

smer osi y: $\tau_{y,d} = \frac{V_{y,d}}{A_s} = \frac{2{,}45}{168} = 0{,}015\,kN/cm^2$

smer osi z: $\tau_{z,d} = \frac{V_{z,d}}{A_s} = \frac{10{,}06}{168} = 0{,}060\,kN/cm^2$

$\tau_{d,max} = \sqrt{\tau_{y,d}^2 + \tau_{z,d}^2} \leq f_{v,d} \Rightarrow \sqrt{0{,}015^2 + 0{,}060^2} = 0{,}062\,\frac{kN}{cm^2} \leq 0{,}185\,\frac{kN}{cm^2}$ ✓

• KONTROLA POVESA:

(t. špirovcev, kritine → $g_1 \cdot a'$; teža lege → g_e)

$$g_{1,y} = (g_1 \cdot a' + g_e) \cdot \sin\phi = (0{,}45 \cdot 2{,}88 + 0{,}114) \cdot \sin 13{,}71° = 0{,}33\ \frac{kN}{m}$$

$$g_{1,z} = (g_1 \cdot a' + g_e) \cdot \cos\phi = (0{,}45 \cdot 2{,}88 + 0{,}114) \cdot \cos 13{,}71° = 1{,}37\ \frac{kN}{m}$$

$$q_{s,y} = q_s \cdot a \cdot \sin\phi = 1{,}52 \cdot 2{,}8 \cdot \sin 13{,}71° = 1{,}01\ \frac{kN}{m}$$

$$q_{s,z} = q_s \cdot a \cdot \cos\phi = 1{,}52 \cdot 2{,}8 \cdot \cos 13{,}71° = 4{,}13\ \frac{kN}{m}$$

$$q_{v,y} = \emptyset$$

$$q_{v,z} = q_v \cdot a' = 0{,}24 \cdot 2{,}88 = 0{,}69\ \frac{kN}{m}$$

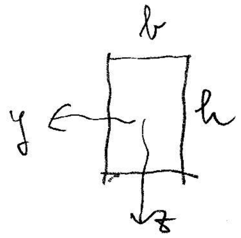
— Poves v začetnem času w_{inst}:

$$w_{inst,y} = w_{inst}(g_{1,y}) + w_{inst}(q_{s,y}) + w_{inst}(\psi_0 \cdot q_{v,y})$$

$$w_{inst,z} = \text{— '' —}$$

$$w_{inst} = \sqrt{w_{inst,y}^2 + w_{inst,z}^2} \leq w_{inst,lim} = \frac{\ell}{300}$$

$$w_{inst}(g_{1,y}) = \frac{5 \cdot g_{1,y} \cdot \ell^4}{384 \cdot E_{0,mean} \cdot \underline{\underline{I_z}}}$$



$$I_z = \frac{h \cdot b^3}{12} \qquad I_y = \frac{b\,h^3}{12}$$

$$w_{inst}(g_{1,z}) = \frac{5 \cdot g_{1,z} \cdot \ell^4}{384 \cdot E_{0,mean} \cdot \underline{\underline{I_y}}}$$

— Poves v končnem času $w_{net,fin}$:

$$w_{net,fin,y} = w_{inst,g_1}(1 + k_{def}) + w_{inst,q_s}(1 + \psi_2 \cdot k_{def}) + w_{inst,q_v}(\psi_0 + \psi_2 \cdot k_{def}) =$$

$$w_{net,fin,z} =$$

$$w_{net,fin} = \sqrt{w_{net,fin,y}^2 + w_{net,fin,z}^2} \leq w_{net,fin,lim} = \frac{\ell}{250}$$