

Masivna konstrukcija:

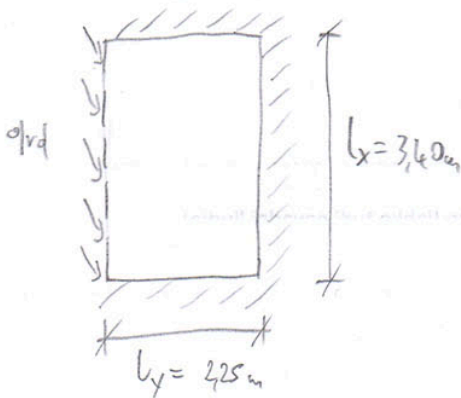
2. ledenij - Primer ledenija 20W/m<sup>2</sup>

Klancek.si

1

a) POZ 3:

Racunski model plošče:



Obtežba plošče:

$$q_{rd} = (1,35 \cdot 9,1 + 1,50 \cdot 3) \cdot \frac{10,031 \cdot 3,0}{2} = 23,92 \text{ kN/m}^2$$

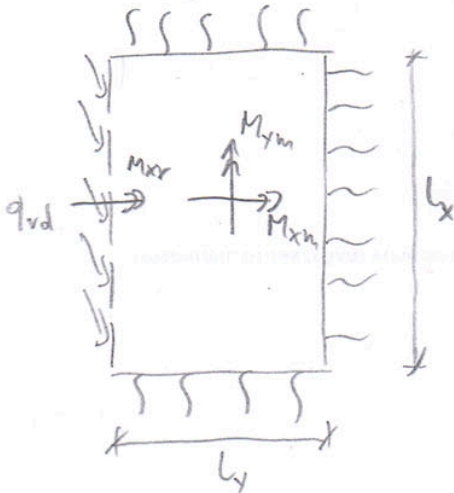
$$q_d = 1,35 \cdot 6,35 + 1,50 \cdot 3 = 13,9 \text{ kN/m}^2$$

$$k_d = 13,9 \cdot 3,4 \cdot 2,25 = 106,3 \text{ kN}$$

$$S_d = 23,92 \cdot 3,4 = 81,3 \text{ kN}$$

$$\xi = l_y / l_x = 2,25 / 3,40 = 0,66 \approx 0,65$$

Predpostavimo 50% upotost vseh robov za izračun momentov v ploči:

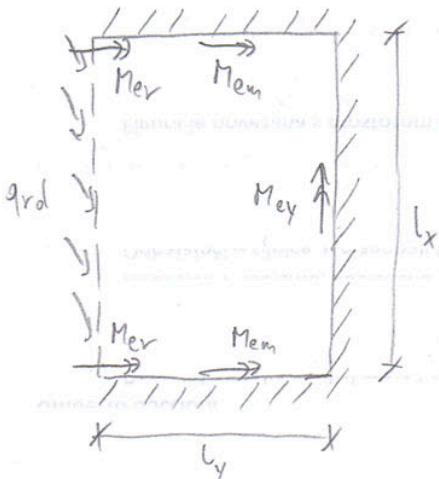


$$M_{xm,d} = \frac{1}{2} \left[ \left( \frac{k_d}{m_{xm}} + \frac{S_d}{m_{xm}} \right) + \left( \frac{k_d}{m_{xr}} + \frac{S_d}{m_{xr}} \right) \right] =$$
$$= \frac{1}{2} \left[ \left( \frac{106,3}{37,1} + \frac{81,3}{27,7} \right) + \left( \frac{106,3}{14,7} + \frac{81,3}{9,3} \right) \right] = 11,21 \text{ kNm/m}$$

$$M_{ym,d} = \frac{1}{2} \left[ \left( \frac{k_d}{m_{ym}} + \frac{S_d}{m_{ym}} \right) + \left( \frac{k_d}{m_{yr}} + \frac{S_d}{m_{yr}} \right) \right] =$$
$$= \frac{1}{2} \left[ \left( \frac{106,3}{81,7} + \frac{81,3}{-20} \right) + \left( \frac{106,3}{28,7} + \frac{81,3}{-36,7} \right) \right] = -0,64 \text{ kNm/m}$$

$$M_{xr,d} = \frac{1}{2} \left[ \left( \frac{k_d}{m_{xr}} + \frac{S_d}{m_{xr}} \right) + \left( \frac{k_d}{m_{xy}} + \frac{S_d}{m_{xy}} \right) \right] =$$
$$= \frac{1}{2} \left[ \left( \frac{106,3}{13,9} + \frac{81,3}{7,7} \right) + \left( \frac{106,3}{9,1} + \frac{81,3}{4,4} \right) \right] = 23,94 \text{ kNm/m}$$

Za izračun momentov nad podporami privzamemo 100% vpetost:



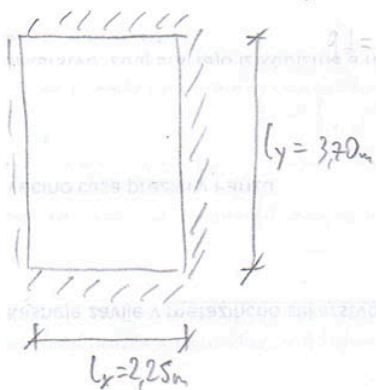
$$M_{ex,d} = \frac{k_d}{m_{ex}} + \frac{s_d}{m_{ex}} = \frac{106,3}{-14,5} + \frac{81,3}{-14,5} = -12,94 \text{ kNm/m}$$

$$M_{ey,d} = \frac{k_d}{m_{ey}} + \frac{s_d}{m_{ey}} = \frac{106,3}{-11,3} + \frac{81,3}{-16,2} = -13,95 \text{ kNm/m}$$

$$M_{er,d} = \frac{k_d}{m_{er}} + \frac{s_d}{m_{er}} = \frac{106,3}{-7,8} + \frac{81,3}{-2,2} = -50,58 \text{ kNm/m}$$

POZ 4:

računski model plošče:



$$q_d = 13,9 \text{ kN/m}^2$$

$$k_d = 3,70 \cdot 2,25 \cdot 13,9 = 115,7 \text{ kN}$$

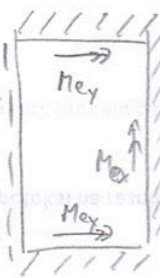
$$\xi = 3,70 / 2,25 = 1,64 \approx 1,6$$

Za momente v pdju privzamemo 50% vpetje:

Za momente nad podporami privzamemo 100% vpetje.

$$M_{x,d} = \frac{1}{2} \left( \frac{k_d}{m_{x1}} + \frac{k_d}{m_{x2}} \right) = \frac{1}{2} \left( \frac{115,7}{3,7} + \frac{115,7}{2,25} \right) = 4,38 \text{ kNm/m}$$

$$M_{y,d} = \frac{1}{2} \left( \frac{k_d}{m_{y1}} + \frac{k_d}{m_{y2}} \right) = \frac{1}{2} \left( \frac{115,7}{2,25} + \frac{115,7}{3,7} \right) = 1,60 \text{ kNm/m}$$



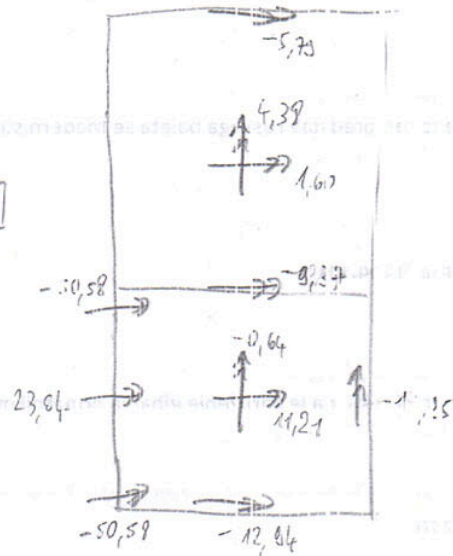
$$M_{ey,d} = - \frac{k_d}{m_{ey}} = - \frac{115,7}{20,0} = -5,79 \text{ kNm/m}$$

$$M_{ex,d} = - \frac{k_d}{m_{ex}} = - \frac{115,7}{16,1} = -7,19 \text{ kNm/m}$$

Izračuna po 3 - po 4:  $M_e = \frac{M_{ey}^{po24} + M_{ex,d}^{po23}}{2} = \frac{-7,19 + (-12,94)}{2} = -10,07 \text{ kNm/m}$

teris obremenitev POZ 3 in POZ 4:

$v [kNm/m]$



3

b

Dimenzioniranje armature POZ 3:

$h = 18 \text{ cm}$ ,  $a = 4 \text{ cm}$   $\rightarrow d = 14 \text{ cm}$

Armatura v polju:

$M_{x,d} = -0,64 \text{ kNm/m} \rightarrow k_d = \frac{-0,64 \cdot 100}{1,67 \cdot 100 \cdot 14^2} = 0,022 \rightarrow k_s = 1,033$

$M_{y,d} = 11,21 \text{ kNm/m} \rightarrow k_d = \frac{11,21 \cdot 100}{1,67 \cdot 100 \cdot 14^2} = 0,036 \rightarrow k_s = 1,033$

Beton C25/30  $\rightarrow f_{ctd} = 2,5 \frac{N}{mm^2} \rightarrow f_{ctd} = 1,67 \frac{N}{mm^2}$

Armatura S500  $\rightarrow f_{ctm} = 0,16 \frac{N}{mm^2}$

$\sigma_{sx} = \frac{-0,64 \cdot 100}{k_s \cdot k_d \cdot 14} = -1,11 \frac{N}{mm^2}$   $\epsilon_s = 10 \text{‰}$

$\sigma_{sy} = \frac{11,21 \cdot 100}{k_s \cdot k_d \cdot 14} = 1,11 \frac{N}{mm^2}$

Armatura na prostem robu:

$M_{x,d} = 23,04 \text{ kNm/m} \rightarrow k_d = \frac{23,04 \cdot 100}{1,67 \cdot 100 \cdot 14^2} = 0,073 \rightarrow k_s = 1,059 \rightarrow a_{sx} = 1,059 \cdot \frac{23,04 \cdot 100}{43,48 \cdot 14} = 4,10 \frac{cm^2}{m}$

$M_{y,d} = -50,59 \text{ kNm/m} \rightarrow k_d = \frac{50,59 \cdot 100}{1,67 \cdot 100 \cdot 14^2} = 0,161 \rightarrow k_s = 1,103 \rightarrow a_{sy} = 1,103 \cdot \frac{50,59 \cdot 100}{43,48 \cdot 14} = 8,17 \frac{cm^2}{m}$

Armatura nad podporami:

$M_{x,d} = -13,35 \text{ kNm/m} \rightarrow k_d = \frac{13,35 \cdot 100}{1,67 \cdot 100 \cdot 14^2} = 0,044 \rightarrow k_s = 1,041 \rightarrow a_{sx} = 1,041 \cdot \frac{13,35 \cdot 100}{43,48 \cdot 14} = 2,39 \frac{cm^2}{m}$

$M_{y,d} = -12,84 \text{ kNm/m} \rightarrow k_d = \frac{12,84 \cdot 100}{1,67 \cdot 100 \cdot 14^2} = 0,041 \rightarrow k_s = 1,041 \rightarrow a_{sy} = 1,041 \cdot \frac{12,84 \cdot 100}{43,48 \cdot 14} = 2,21 \frac{cm^2}{m}$

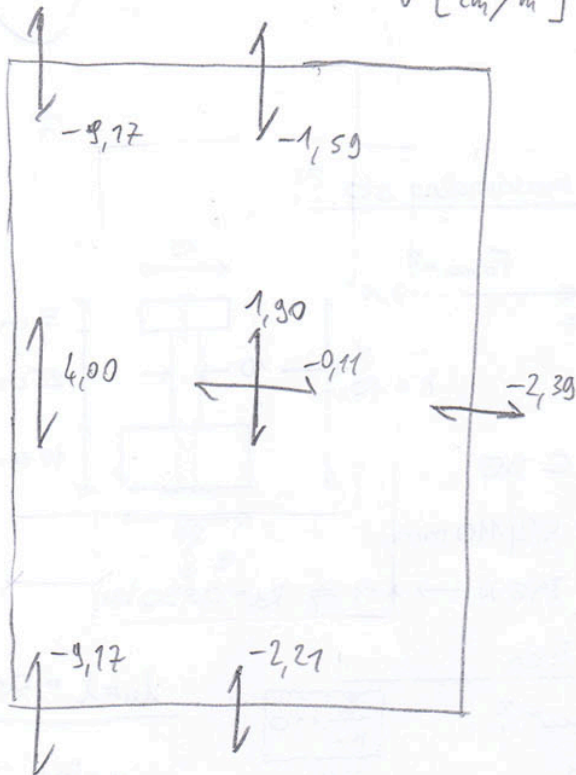
$M_{y,d}^{3-4} = -1,15 \text{ kNm/m} \rightarrow k_d = \frac{1,15 \cdot 100}{1,67 \cdot 100 \cdot 14^2} = 0,003 \rightarrow k_s = 1,033 \rightarrow a_{sy}^{3-4} = 1,033 \cdot \frac{1,15 \cdot 100}{43,48 \cdot 14} = 0,15 \frac{cm^2}{m}$

Minimalna potrebna armatura:

$a_{s,min} = 0,26 \cdot \frac{0,26}{50} \cdot 100 \text{ m}^2 = 1,89 \frac{cm^2}{m}$

Skica potrebne armature na POZ 3:

$v$  [ $\text{cm}^2/\text{m}$ ]



⊖ - armatura na zgornjem robu

⊕ - armatura na spodnjem robu

Kjer je  $a_s < a_{s,\min}$ , tam damo  $a_{s,\min}$  (na skici so pa označene le potrebne armature  $a_s$ ).