$B' = b_x - |e_x| \cdot 2 = 0.9 - |(-0.158)| \cdot 2 = 0.584$ m

Lungimea eficienta a fundatiei:

$L' = b_y - |e_y| \cdot 2 = 1.1 - |(-0.039)| \cdot 2 = 1.022$ m

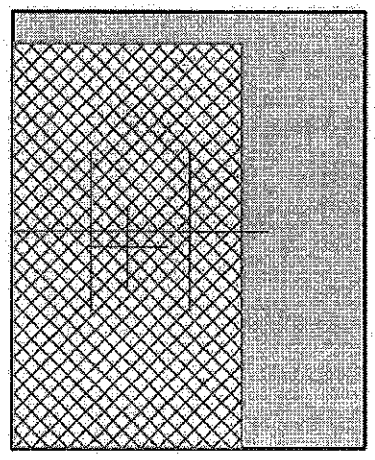
Aria eficienta a fundatiei:

$A' = B' \cdot L' = 0.584 \cdot 1.022 = 0.59685$ m²

$$q_{E,d} = \frac{V_d}{A'} = \frac{117.59}{0.59685} = 197.02 \text{ kN/m}^2$$

$H_B = -1.0462$ kN

$H_L = -3.6999$ kN



Valoare de dimensionare a impingerii efective a pamantului la baza fundatiei:

$q' = \gamma_\gamma \cdot q'_k = 1 \cdot 49.236 = 49.236$ kN/m²

3.4. Conditii drenate

Factori nedimensionati pentru calcul EN-1997-1 Anexa D D.4

Factorii capacitatii terenului la rupere:

$$N_q = e^{\pi \cdot \text{tg}\varphi'} \cdot \text{tg}^2\left(45° + \frac{\varphi'}{2}\right) = e^{3.1416 \cdot \text{tg}26.56°} \cdot \text{tg}^2\left(45° + \frac{26.56°}{2}\right) = 12.588$$

$$N_\gamma = 2 \cdot (N_q - 1) \cdot \text{tg}\,\varphi' = 2 \cdot (12.588 - 1) \cdot \text{tg}\,26.56° = 11.585$$

$$N_c = \frac{(N_q - 1)}{\text{tg}\,\varphi'} = \frac{(12.588 - 1)}{\text{tg}\,26.56°} = 23.18$$

Factori de forma a bazei fundatiei:

$$s_\gamma = 1 - 0.3 \cdot \frac{B'}{L'} = 1 - 0.3 \cdot \frac{0.584}{1.022} = 0.82857$$

$$s_q = 1 + \frac{B'}{L'} \cdot \sin \varphi' = 1 + \frac{0.584}{1.022} \cdot \sin 26.56° = 1.2555$$

$$s_c = \frac{s_q \cdot N_q - 1}{N_q - 1} = \frac{1.2555 \cdot 12.588 - 1}{12.588 - 1} = 1.2776$$

Factori pentru inclinarea bazei:

$\alpha = 0°$

$b_\gamma = 1$

$b_q = b_\gamma = 1$

$b_c = 1$

Factori pentru inclinarea incarcarii:

$$m_B = \frac{2 + \frac{B'}{L'}}{1 + \frac{B'}{L'}} = \frac{2 + \frac{0.584}{1.022}}{1 + \frac{0.584}{1.022}} = 1.6364$$

$$m_L = \frac{2 + \frac{L'}{B'}}{1 + \frac{L'}{B'}} = \frac{2 + \frac{1.022}{0.584}}{1 + \frac{1.022}{0.584}} = 1.3636$$

$$m = m_B \cdot \left(\frac{H_B}{H}\right)^2 + m_L \cdot \left(\frac{H_L}{H}\right)^2 = 1.6364 \cdot \left(\frac{(-1.0462)}{3.845}\right)^2 + 1.3636 \cdot \left(\frac{(-3.6999)}{3.845}\right)^2 = 1.3838$$

$$i_\gamma = \left[1 - \frac{H}{V_d + A' \cdot c' \cdot \operatorname{cotg} \varphi'}\right]^{(m+1)} = \left[1 - \frac{3.845}{117.59 + 0.59685 \cdot 0 \cdot \operatorname{cotg} 26.56°}\right]^{(1.3838+1)} = 0.92381$$

$$i_q = \left[1 - \frac{H}{V_d + A' \cdot c' \cdot \operatorname{cotg} \varphi'}\right]^{m} = \left[1 - \frac{3.845}{117.59 + 0.59685 \cdot 0 \cdot \operatorname{cotg} 26.56°}\right]^{1.3838} = 0.95504$$

$$i_c = i_q - \frac{1 - i_q}{N_c \cdot \operatorname{tg} \varphi'} = 0.95504 - \frac{1 - 0.95504}{23.18 \cdot \operatorname{tg} 26.56°} = 0.95116$$

Coeficienti		Coeziune c	Greutate proprie γ	Impingerea pamantului q
Factorii capacitatii terenului la rupere	N	23.18	11.585	12.588
Factori de forma a bazei fundatiei	s	1.2776	0.82857	1.2555
Factori pentru inclinarea bazei	b	1	1	1
Factori pentru inclinarea incarcarii	i	0.95116	0.92381	0.95504

Rezistenta la rupere:

$$R_{d,V} = \frac{c' \cdot N_c \cdot s_c \cdot b_c \cdot i_c + q' \cdot N_q \cdot s_q \cdot b_q \cdot i_q + 0.5 \cdot \gamma' \cdot B' \cdot N_\gamma \cdot b_\gamma \cdot s_\gamma \cdot i_\gamma}{\gamma_{R,v}} \cdot A' =$$

$$= \frac{0 \cdot 23.18 \cdot 1.2776 \cdot 1 \cdot 0.95116 + 49.236 \cdot 12.588 \cdot 1.2555 \cdot 1 \cdot 0.95504 + 0.5 \cdot 20.601 \cdot 0.584 \cdot 11.585 \cdot 1 \cdot 0.82857 \cdot 0.92381}{1} \cdot 0.59685$$

$= 475.38$ kN

Eficenta terenului la rupere:

$$\Lambda_{R,v} = \frac{V_d}{R_{d,V}} = \frac{117.59}{475.38} = 0.247 < \Lambda_{R,v,lim} = 1.000 \quad \text{se verifica}$$

4. Verificarea excentricitatii

Factorul limitei de excentricitate: $\gamma_{ecc,lim} = 0.33$

F_x F_y [kN]	F_z [kN]	M_x M_y [kNm]	V_d [kN]	e_x e_y [m]	γ_{ecc}	✔ x	Ipoteza
−2.2364 −3.7905	−74.457	1.207 −1.9693	121.99	−0.178 −0.035	0.19778	✔	[1.35*1*GP+1.35*1*Finisaje] {1.5*U2}
−2.2191 −3.8067	−74.507	1.227 −1.9564	122.04	−0.177 −0.035	0.19667	✔	[1.35*1*GP+1.35*1*Finisaje] {1.5*U4}
−1.3115 −4.6472	−88.935	1.9227 −1.1453	136.47	−0.174 −0.041	0.19333	✔	[1.35*1*GP+1.35*1*Finisaje] {1.5*U3}
−1.2961 −4.6139	−88.93	1.8771 −1.133	136.47	−0.174 −0.041	0.19333	✔	[1.35*1*GP+1.35*1*Finisaje] {1.5*U}
−0.61137 −2.2169	−47.494	0.16712 −0.53485	95.031	−0.128 −0.02	0.14222	✔	[1.15*GP+1.15*Finisaje]
0.32898 −3.0403	−61.967	0.83718 0.30144	109.5	−0.13 −0.03	0.14444	✔	[1.15*GP+1.15*Finisaje] {1.5*U1}
−1.8479 −2.9574	−57.509	1.0214 −1.6276	105.05	−0.16 −0.032	0.17778	✔	[GP+Finisaje] {1.3*U2}
−1.8329 −2.9714	−57.552	1.0387 −1.6164	105.09	−0.16 −0.033	0.17778	✔	[GP+Finisaje] {1.3*U4}
−1.0462 −3.6999	−70.056	1.6417 −0.9135	117.59	−0.158 −0.039	0.17556	✔	[GP+Finisaje] {1.3*U3}
−1.0329 −3.671	−70.052	1.6021 −0.90285	117.59	−0.158 −0.039	0.17556	✔	[GP+Finisaje] {1.3*U}
−0.53163 −1.9277	−41.299	0.14532 −0.46508	88.837	−0.118 −0.019	0.13111	✔	[GP+Finisaje]
0.28334 −2.6413	−53.842	0.72604 0.2597	101.38	−0.121 −0.028	0.13444	✔	[GP+Finisaje] {1.3*U1}

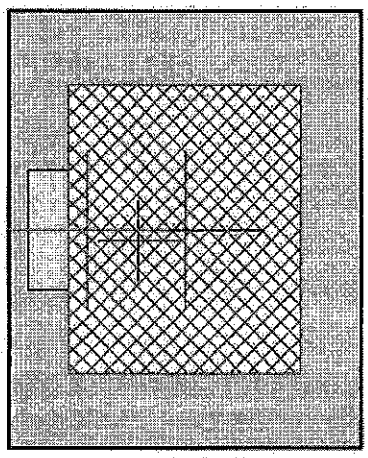
Unde:

$V_d = -F_z + (G_{f,k} + G_{b,k} + G_{bf,k}) \cdot \gamma_{G,unfav}$

$\gamma_{ecc} = \max\left(\left|\frac{e_x}{b_x}\right| , \left|\frac{e_y}{b_y}\right|\right)$ Valorile axcentricitatilor iau in considerare momentele suplimentare de la baza fundatiei din incarcarile orizontale

$\gamma_{G,unfav}$: Coeficient partial pentru greutatea proprie a fundatiei

$\gamma_{ecc,max} = 0.19778 \leq \gamma_{ecc,lim} = 0.33$ se verifica!



5. Verificarea stabilitatii

$\gamma_{G,dst} = 1.1$

$\gamma_{G,stb} = 0.9$

Valoarea de proiectare a greutatii fundatiei: $G_{f,d} = G_{f,k} \cdot \gamma_{G,stb} = 17.325 \cdot 0.9 = 15.592$ kN (↓)

Greutatea de proiectare a betonului de egalizare: $G_{b,d} = G_{b,k} \cdot \gamma_{G,stb} = 2.1366 \cdot 0.9 = 1.923$ kN (↓)

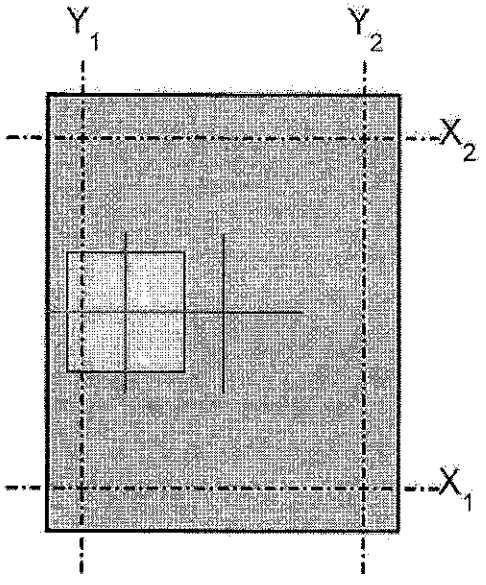
Valoarea caracteristica a greutatii umpluturii: $G_{bf,d} = G_{bf,k} \cdot \gamma_{G,stb} = 28.076 \cdot 0.9 = 25.269$ kN (↓)

Raportul distantei dintre axul rasturnarii si muchia fundatiei fata de dimensiunile fundatiei: $\gamma_{\omega} = 0.1$

Distanta dintre axul rasturnarii si centrul fundatiei

$$e_{EQUx} = \frac{b_x \cdot (1-\gamma_\omega)}{2} = \frac{0.9 \cdot (1-0.1)}{2} = 0.405 \text{ m}$$

$$e_{EQUy} = \frac{b_y \cdot (1-\gamma_\omega)}{2} = \frac{1.1 \cdot (1-0.1)}{2} = 0.495 \text{ m}$$



5.1. Verificarea rotirii in jurul axului x_1

Ipoteza: **[0.9*GP+0.9*Finisaje] {1.5*U3}** (EQU)

Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

$F_x = -1.1785$ kN

$F_y = -4.1653$ kN

$F_z = -78.61$ kN

$M_x = 1.8864$ kNm

$M_y = -1.029$ kNm

$V = -F_z = -(-78.61) = 78.61$ kN (↓)

Moment stabilizator

$$M_{x1,stb} = F_y \cdot h + (-V) \cdot e_{EQUy} + (-G_{f,d}) \cdot e_{EQUy} + (-G_{b,d}) \cdot e_{EQUy} + (-G_{bf,d}) \cdot e_{EQUy} =$$

$$= (-4.1653) \cdot 0.7 + (-78.61) \cdot 0.495 + (-15.592) \cdot 0.495 + (-1.923) \cdot 0.495 + (-25.269) \cdot 0.495 = -63.006 \text{ kNm}$$

Moment destabilizator

$$M_{x1,dst} = M_x = 1.8864 = 1.8864 \text{ kNm}$$

Factorul eficientei la stabilitate

$$\Lambda_{EQU,x1} = \left|\frac{M_{x1,dst}}{M_{x1,stb}}\right| = \left|\frac{1.8864}{(-63.006)}\right| = 0.02994 \leq \Lambda_{EQU,lim} = 1.000 \quad \text{se verifica!}$$

5.2. Verificarea rotirii in jurul axului x_2

Ipoteza: **[0.9*GP+0.9*Finisaje] {1.5*U3}** (EQU)

Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

$F_x = -1.1785$ kN

$F_y = -4.1653$ kN

$F_z = -78.61$ kN

$M_x = 1.8864$ kNm

$M_y = -1.029$ kNm

$V = -F_z = -(-78.61) = 78.61$ kN (↓)

Moment stabilizator

$M_{x2,stb} = M_x + (-V)\cdot(-e_{EQUy}) + (-G_{f,d})\cdot(-e_{EQUy}) + (-G_{b,d})\cdot -e_{EQUy} + (-G_{bf,d})\cdot(-e_{EQUy}) =$

$= 1.8864 + (-78.61)\cdot(-0.495) + (-15.592)\cdot(-0.495) + (-1.923)\cdot -0.495 + (-25.269)\cdot(-0.495) = 61.976$ kNm

Moment destabilizator

$M_{x2,dst} = F_y \cdot h = (-4.1653)\cdot 0.7 = -2.9157$ kNm

Factorul eficientei la stabilitate

$$\Lambda_{EQU,x2} = \left|\frac{M_{x2,dst}}{M_{x2,stb}}\right| = \left|\frac{(-2.9157)}{61.976}\right| = 0.047046 \leq \Lambda_{EQU,lim} = 1.000 \quad \text{se verifica!}$$

5.3. Verificarea rotirii in jurul axului y_1

Ipoteza: **[0.9*GP+0.9*Finisaje] {1.5*U2}** (EQU)

Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

$F_x = -2.1035$ kN

$F_y = -3.3086$ kN

$F_z = -64.133$ kN

$M_x = 1.1707$ kNm

$M_y = -1.853$ kNm

$V = -F_z = -(-64.133) = 64.133$ kN (↓)

Moment stabilizator

$M_{y1,stb} = V\cdot(e_{EQUx} - e_{0x}) + G_{f,d}\cdot e_{EQUx} + G_{b,d}\cdot e_{EQUx} + G_{bf,d}\cdot(e_{EQUx} - e_{bfx}) =$

$= 64.133\cdot(0.405 - (-0.25)) + 15.592\cdot 0.405 + 1.923\cdot 0.405 + 25.269\cdot(0.405 - 0.025) = 58.703$ kNm

Moment destabilizator

$M_{y1,dst} = M_y + F_x \cdot h = (-1.853) + (-2.1035) \cdot 0.7 = -3.3255$ kNm

Factorul eficientei la stabilitate

$$\Lambda_{EQU,y1} = \left|\frac{M_{y1,dst}}{M_{y1,stb}}\right| = \left|\frac{(-3.3255)}{58.703}\right| = 0.056649 \leq \Lambda_{EQU,lim} = 1.000 \quad \text{se verifica!}$$

5.4. Verificarea rotirii in jurul axului y_2

Ipoteza: **[1.1*GP+1.1*Finisaje] {1.5*UI}** (EQU)

Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

$F_x = 0.35556$ kN

$F_y = -2.9439$ kN

$F_z = -59.902$ kN

$M_x = 0.82992$ kNm

$M_y = 0.32469$ kNm

$V = -F_z = -(-59.902) = 59.902$ kN (↓)

Moment stabilizator

$M_{y2,stb} = V \cdot (-e_{EQUx} - e_{0x}) + G_{f,d} \cdot (-e_{EQUx}) + G_{b,d} \cdot -e_{EQUx} + G_{bf,d} \cdot (-e_{EQUx} - e_{bfx}) =$

$= 59.902 \cdot (-0.405 - (-0.25)) + 15.592 \cdot (-0.405) + 1.923 \cdot -0.405 + 25.269 \cdot (-0.405 - 0.025) = -27.244$ kNm

Moment destabilizator

$M_{y2,dst} = M_y + F_x \cdot h = 0.32469 + 0.35556 \cdot 0.7 = 0.57358$ kNm

Factorul eficientei la stabilitate

$$\Lambda_{EQU,y2} = \left|\frac{M_{y2,dst}}{M_{y2,stb}}\right| = \left|\frac{0.57358}{(-27.244)}\right| = 0.021053 \leq \Lambda_{EQU,lim} = 1.000 \quad \text{se verifica!}$$

Factorul eficientei la stabilitate

$\Lambda_{EQU,max} = 0.057 \leq \Lambda_{EQU,lim} = 1.000$ se verifica!

6. Calculul lunecarii

6.1. Alunecarea fundatiei pe teren

Metoda de proiectare: 1 Combinatia 1: {A1 "+" M1 "+" R1}

Metoda de proiectare: 1 Combinatia 2: {A2 "+" M2 "+" R1} (De dimensionare)

Metoda de proiectare: 2: {A1 "+" M1 "+" R2}

Metoda de proiectare: 3: {A2 "+" M2 "+" R3} EN-1997-1 Anexa A

	Coeficienti de siguranta		
A2	Actiuni permanente, defavorabile	$\gamma_{G,unfav}$	1
	Actiuni permanente, favorabile	$\gamma_{G,fav}$	1
	Actiuni variabile, defavorabile	$\gamma_{Q,unfav}$	1.3
	Actiuni variabile, favorabile	$\gamma_{Q,fav}$	0
M2	Unghiul eficient de frecare	γ_{φ}	1.25
	Coeziune eficienta	γ_{c}	1.25
	Rezistenta la forfecare nedrenata	γ_{cu}	1.4
	Rezistenta la compresiune unidirectionala	γ_{qu}	1.4
	Greutate volumica	γ_{γ}	1
R1	Rezistenta la rupere	$\gamma_{R,v}$	1
	Rezistenta la lunecare	$\gamma_{R,h}$	1
	Impingerile pamantului	$\gamma_{R,e}$	1

6.1.1. Valoarea de dimensionare a parametrilor solului de sub fundatie

Densitatea stratului: $\rho_s = 2100$ kg/m³

Greutate volumica:

$$\gamma' = \rho_s \cdot g \cdot \gamma_\gamma \cdot 10^{-3} = 2100 \cdot 9.810 \cdot 1 \cdot 10^{-3} = 20.601 \text{ kN/m}^3$$

Unghiul frecarii $\varphi'_k = 32.00°$

Unghiul eficient de frecare:

$$\varphi' = \text{Arc tg}\frac{\tan \varphi'_k}{\gamma_\varphi} = \text{Arc tg}\frac{\tan 32.00°}{1.25} = 26.56°$$

Coeziune: $c'_k = 0$ kN/m²

Coeziune eficienta: $c' = \frac{c'_k}{\gamma_c} = \frac{0}{1.25} = 0$ kN/m²

Unghiul de frecare critic a rezistentei la frecare: $\varphi_{cv} = 32.00°$

6.1.2. Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

Ipoteza: **[GP+Finisaje] {1.3*U4}** (A2(a,b))

Reazemul nodal 3

$F_x = -1.8329$ kN

$F_y = -2.9714$ kN

$F_z = -57.552$ kN

$M_x = 1.0387$ kNm

$M_y = -1.6164$ kNm

$V = -F_z = -(-57.552) = 57.552$ kN

Excentricitatea incarcarii verticale (V) fata de centrul fundatiei

$e_{0x} = -0.25$ m

$e_{0y} = 0$ m

6.1.3. Vloarea de dimensionare a incarcarilor la baza fundatiei

$H_{dx} = F_x = -1.8329$ kN

$H_{dy} = F_y = -2.9714$ kN

$V_d = V + (G_{f,k} + G_{b,k} + G_{bf,k}) \cdot \gamma_{G,unfav} = 57.552 + (17.325 + 2.1366 + 28.076) \cdot 1 = 105.09$ kN

Excentricitatea incarcarii verticale (V_d) fata de centrul fundatiei

$$e_x = \frac{V \cdot e_{0x} + M_y + F_x \cdot (h_b + h) + (G_{f,k} \cdot e_{fx} + G_{bf,k} \cdot e_{bfx}) \cdot \gamma_{G,unfav}}{V_d} =$$

$$= \frac{57.552 \cdot (-0.25) + (-1.6164) + (-1.8329) \cdot (0.1 + 0.7) + (17.325 \cdot 0 + 28.076 \cdot 0.025) \cdot 1}{105.09} = -0.16 \text{ m}$$

$$e_y = \frac{V \cdot e_{0y} - M_x + F_y \cdot (h_b + h) + (G_{f,k} \cdot e_{fy} + G_{bf,k} \cdot e_{bfy}) \cdot \gamma_{G,unfav}}{V_d} =$$

$$= \frac{57.552 \cdot 0 - 1.0387 + (-2.9714) \cdot (0.1 + 0.7) + (17.325 \cdot 0 + 28.076 \cdot 0) \cdot 1}{105.09} = -0.033 \text{ m}$$

Latimea eficienta a fundatiei:

$B' = b_x - |e_x| \cdot 2 = 0.9 - |(-0.16)| \cdot 2 = 0.58$ m

Lungimea eficienta a fundatiei:

$L' = b_y - |e_y| \cdot 2 = 1.1 - |(-0.033)| \cdot 2 = 1.034$ m

Aria eficienta a fundatiei:

$A' = B' \cdot L' = 0.58 \cdot 1.034 = 0.59972$ m²

6.1.4. Rezistenta la lunecare drenata

$\delta_k = \varphi_{cv} = 32.00°$

Valoarea de dimensionare a unghiului de frecare dintre structura si teren:

$$\delta_d = \text{Arc tg}\left(\frac{\text{tg}\,\delta_k}{\gamma_\varphi}\right) = \text{Arc tg}\left(\frac{\text{tg}\,32.00°}{1.25}\right) = 25.60°$$

Rezistenta la lunecare: EN-1997-1 6.5.3 (8)P (6.3a)

$R_{d,Hs} = V_d \cdot \text{tg}\,\delta_d = 105.09 \cdot \text{tg}\,25.60° = 50.351$ kN

Eficienta la lunecare: $\Lambda_{R,h,s} = \left|\frac{H_d}{R_{d,Hs}}\right| = \left|\frac{3.845_d}{50.351}\right| = 0.069 \leq \Lambda_{R,h,s,lim} = 1.000$ se verifica!

6.2. Lunecarea fundatiei pe betonul de egalizare

Metoda de proiectare: 1 Combinatia 1: {A1 "+" M1 "+" R1} (De dimensionare)
Metoda de proiectare: 1 Combinatia 2: {A2 "+" M2 "+" R1}
Metoda de proiectare: 2: {A1 "+" M1 "+" R2}
Metoda de proiectare: 3: {A1 "+" M2 "+" R3} EN-1997-1 Anexa A

	Coeficienti de siguranta		
A1	Actiuni permanente, defavorabile	$\gamma_{G,unfav}$	1.35
	Actiuni permanente, favorabile	$\gamma_{G,fav}$	1
	Actiuni variabile, defavorabile	$\gamma_{Q,unfav}$	1.5
	Actiuni variabile, favorabile	$\gamma_{Q,fav}$	0
M1	Unghiul eficient de frecare	γ_{φ}	1
	Coeziune eficienta	γ_{c}	1
	Rezistenta la forfecare nedrenata	γ_{cu}	1
	Rezistenta la compresiune unidirectionala	γ_{qu}	1
	Greutate volumica	γ_{γ}	1
R1	Rezistenta la rupere	$\gamma_{R,v}$	1
	Rezistenta la lunecare	$\gamma_{R,h}$	1
	Impingerile pamantului	$\gamma_{R,e}$	1

6.2.1. Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

Ipoteza: **[1.35*1*GP+1.35*1*Finisaje] {1.5*U4}** (A1(a,b))

Reazemul nodal 3

$F_x = -2.2191$ kN

$F_y = -3.8067$ kN

$F_z = -74.507$ kN

$M_x = 1.227$ kNm

$M_y = -1.9564$ kNm

$V = -F_z = -(-74.507) = 74.507$ kN

Excentricitatea incarcarii verticale (V) fata de centrul fundatiei

$e_{0x} = -0.25$ m

$e_{0y} = 0$ m

6.2.2. Valoarea de dimensionare a incarcarilor de pe betonul de egalizare

$H_{dx} = F_x = -2.2191$ kN

$H_{dy} = F_y = -3.8067$ kN

$V_d = V + (G_{fk} + G_{bfk}) \cdot \gamma_{G,fav} = 74.507 + (17.325 + 28.076) \cdot 1 = 119.91$ kN

Excentricitatea incarcarii verticale (V_d) fata de centrul fundatiei

$$e_x = \frac{V \cdot e_{0x} + M_y + F_x \cdot h + (G_{fk} \cdot e_{fx} + G_{bfk} \cdot e_{bfx}) \cdot \gamma_{G,fav}}{V_d} =$$

$$= \frac{74.507 \cdot (-0.25) + (-1.9564) + (-2.2191) \cdot 0.7 + (17.325 \cdot 0 + 28.076 \cdot 0.025) \cdot 1}{119.91} = -0.179 \text{ m}$$

$$e_y = \frac{V \cdot e_{0y} - M_x + F_y \cdot h + (G_{fk} \cdot e_{fy} + G_{bfk} \cdot e_{bfy}) \cdot \gamma_{G,fav}}{V_d} =$$

$$= \frac{74.507 \cdot 0 - 1.227 + (-3.8067) \cdot 0.7 + (17.325 \cdot 0 + 28.076 \cdot 0) \cdot 1}{119.91} = -0.032 \text{ m}$$

Latimea eficienta a fundatiei:

$B' = b_x - |e_x| \cdot 2 = 0.9 - |(-0.179)| \cdot 2 = 0.542$ m

Lungimea eficienta a fundatiei:

$L' = b_y - |e_y| \cdot 2 = 1.1 - |(-0.032)| \cdot 2 = 1.036$ m

Aria eficienta a fundatiei:

$A' = B' \cdot L' = 0.542 \cdot 1.036 = 0.56151$ m²

Coeficient de frecare dintre fundatie si beton de egalizare: $\mu_{cc} = 0.7$

Coeficient partial pentru frecare intre elemente: $\gamma_\mu = 1$

Rezistenta la lunecare:

$$R_{d,Hb} = V_d \cdot \frac{\mu_{cc}}{\gamma_\mu} = 119.91 \cdot \frac{0.7}{1} = 83.936 \text{ kN}$$

Eficienta la lunecare: $\Lambda_{R,h,b} = \left| \frac{H_d}{R_{d,Hb}} \right| = \left| \frac{3.845_d}{83.936} \right| = 0.052 \leq \Lambda_{R,h,b,lim} = 1.000$ se verifica!

7. Verificarea structurala a fundatiei

7.1. Dimensionarea armaturii

$d_x = h - u_{B,x} = 0.7 - 0.036 = 0.664$ m

$d_y = h - u_{B,y} = 0.7 - 0.048 = 0.652$ m

Armare longitudinala

	X	Y
Superior	Ø 12 mm ($A_{\varnothing}$ = 113 mm²)	Ø 12 mm ($A_{\varnothing}$ = 113 mm²)
Inferior	Ø 12 mm ($A_{\varnothing}$ = 113 mm²)	Ø 12 mm ($A_{\varnothing}$ = 113 mm²)

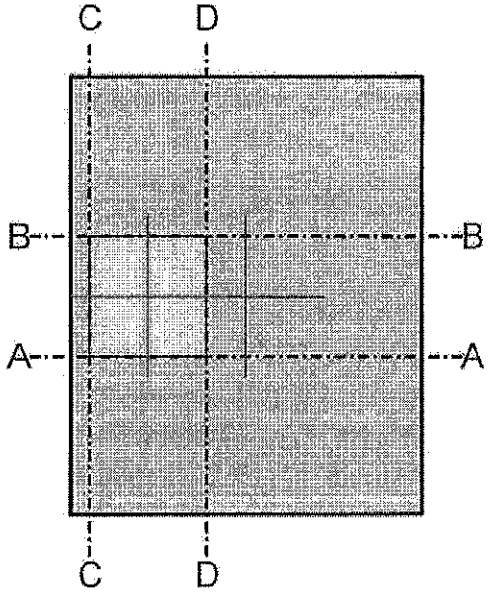
7.2. Dimensionarea armaturii la moment incovoietor

Factor ce defineste inaltimea efectiva a zonei comprimate:

$\lambda = 0.8$ EN-1992-1-1 3.1.7 (3.19)

Factor ce defineste rezistenta efectiva:

$\eta = 1$ EN-1992-1-1 3.1.7 (3.21)



Momente in sectiunile verificate:

	Sectiunea verificata	m_d [kNm/m]	Ipoteza
1.	A-A	**21.344**	[1.35*1*GP+1.35*1*Finisaje] {1.5*U3}
2.	B-B	14.325	[1.35*1*GP+1.35*1*Finisaje] {1.5*U}
3.	C-C	0.33351	[1.35*1*GP+1.35*1*Finisaje] {1.5*U3}
4.	D-D	**10.388**	[1.15*GP+1.15*Finisaje] {1.5*U1}

$f_{ck} = 16\ \text{N/mm}^2$ $\quad \gamma_c = 1.500$ $\quad f_{cd} = \alpha_{cc} \cdot \frac{f_{ck}}{\gamma_s} = 1 \cdot \frac{16}{1.150} = 10.667\ \text{N/mm}^2$

$f_{yk} = 500.25\ \text{N/mm}^2$ $\quad \gamma_s = 1.150$ $\quad f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500.25}{1.150} = 435\ \text{N/mm}^2$

$$\xi_0 = \frac{\varepsilon_{cu1}}{\varepsilon_{cu1} - \frac{f_{yd}}{E_s}} \cdot \lambda = \frac{(-3.500)}{(-3.500) - \frac{435000}{2 \cdot 10^8}} \cdot 0.8 = 0.49339$$

7.2.1. Dimensionarea armaturii longitudinale pentru momentul incovoietor M_y

7.2.1.1. Verificare la muchia elementului sustinut - Sectiunea C-C si D-D

Armatura intinsa pe directia x

$m_d = Max(m_{dC-C}\ ;\ m_{dD-D}) = Max(0.33351\ ;\ 10.388) = 10.388\ \text{kNm/m}$

$m_d = 10.388\ \text{kNm/m}$

$d = h - u_{Bx} = 0.7 - 0.036 = 0.664\ \text{m}$

$d_2 = u_{Tx} = 0.036\ \text{m}$

$x_{c0} = d \cdot \xi_0 = 0.664 \cdot 0.49339 = 0.32761\ \text{m}$

$$x_c = d - \sqrt{d^2 - \frac{2 \cdot m_d}{\eta \cdot f_{cd}}} = 0.664 - \sqrt{0.664^2 - \frac{2 \cdot 10.388}{1 \cdot 10667}} = 0.0014682\ \text{m} \le \quad x_{c0} = 0.32761\ \text{m}$$

Aria armaturii intinse:

$$a_{s1,c} = \frac{x_c \cdot b_w \cdot \eta \cdot f_{cd}}{f_{yd}} = \frac{0.0014682 \cdot 1 \cdot 1 \cdot 10667}{435000} = 3.60028 \cdot 10^{-5}\ \text{m}^2/\text{m} = 36\ \text{mm}^2/\text{m}$$

Procent minim de armare

$$\rho_{l,min} = 0.26 \cdot \frac{f_{ctm}}{f_{yk}} \ge 0.0013 = 0.26 \cdot \frac{1.9049}{500.25} \ge 0.0013 = 0.0013 \qquad \text{EN-1992-1-1 9.2.1.1 (1)}$$

Armatura intinsa minima longitudinala:

$a_{s,min} = \rho_{l,min} \cdot d = 0.0013 \cdot 0.664 = 0.0008632\ \text{m}^2/\text{m} = 863\ \text{mm}^2/\text{m}$

$a_{s1} = Max(a_{s1,c}\ ;\ a_{s,min}) = Max(36\ ;\ 863) = 863\ \text{mm}^2/\text{m} = 0.0008632\ \text{m}^2/\text{m}$

$$A_{\varnothing} = \frac{\varnothing_{Bx}^{\ 2}}{4} \cdot \pi = \frac{12^2}{4} \cdot 3.1416 = 113\ \text{mm}^2 = 0.0001131\ \text{m}^2$$

$s_{max,slabs} = \text{Min}(2 \cdot h = 2 \cdot 0.7 = 1.4\ ;\ 0.25) = 0.25\ \text{m} \qquad \text{EN-1992-1-1 9.3.1.1 (3)}$

$$s = \text{Min}\left(\frac{A_{\varnothing}}{a_{s1}} = \frac{0.0001131}{0.0008632} = 0.13102\ ;\ s_{max,slabs} = 0.25\right) = 0.13102\ \text{m} = 131\ \text{mm}$$

Armare longitudinala:

$$a_{s,prov} = \frac{A_{\varnothing}}{s} = \frac{0.0001131}{0.13102} = 0.0008632\ \text{m}^2/\text{m} = 863\ \text{mm}^2/\text{m} \quad (\varnothing\ 12\ \text{mm}/\ 131\ \text{mm})$$

7.2.2. Dimensionarea armaturii longitudinale pentru momentul incovoietor M_x

7.2.2.1. Verificare la muchia elementului sustinut - Sectiunea A-A si B-B

Armatura intinsa pe directia y

$$m_d = Max(m_{dA-A}\ ;\ m_{dB-B}) = Max(21.344\ ;\ 14.325) = 21.344\ \text{kNm/m}$$

$$m_d = 21.344\ \text{kNm/m}$$

$$d = h - u_{By} = 0.7 - 0.048 = 0.652\ \text{m}$$

$$d_2 = u_{Ty} = 0.048\ \text{m}$$

$$x_{c0} = d \cdot \xi_0 = 0.652 \cdot 0.49339 = 0.32169\ \text{m}$$

$$x_c = d - \sqrt{d^2 - \frac{2 \cdot m_d}{\eta \cdot f_{cd}}} = 0.652 - \sqrt{0.652^2 - \frac{2 \cdot 21.344}{1 \cdot 10667}} = 0.0030763\ \text{m} \le \quad x_{c0} = 0.32169\ \text{m}$$

Aria armaturii intinse:

$$a_{s1,c} = \frac{x_c \cdot b_w \cdot \eta \cdot f_{cd}}{f_{yd}} = \frac{0.0030763 \cdot 1 \cdot 1 \cdot 10667}{435000} = 75\ \text{mm}^2/\text{m}$$

Procent minim de armare

$$\rho_{l,min} = 0.26 \cdot \frac{f_{ctm}}{f_{yk}} \ge 0.0013 = 0.26 \cdot \frac{1.9049}{500.25} \ge 0.0013 = 0.0013 \qquad \text{EN-1992-1-1 9.2.1.1 (1)}$$

Armatura intinsa minima longitudinala:

$$a_{s,min} = \rho_{l,min} \cdot d = 0.0013 \cdot 0.652 = 848\ \text{mm}^2/\text{m}$$

$$a_{s1} = Max(a_{s1,c}\ ;\ a_{s,min}) = Max(75\ ;\ 848) = 0.0008476\ \text{m}^2/\text{m}$$

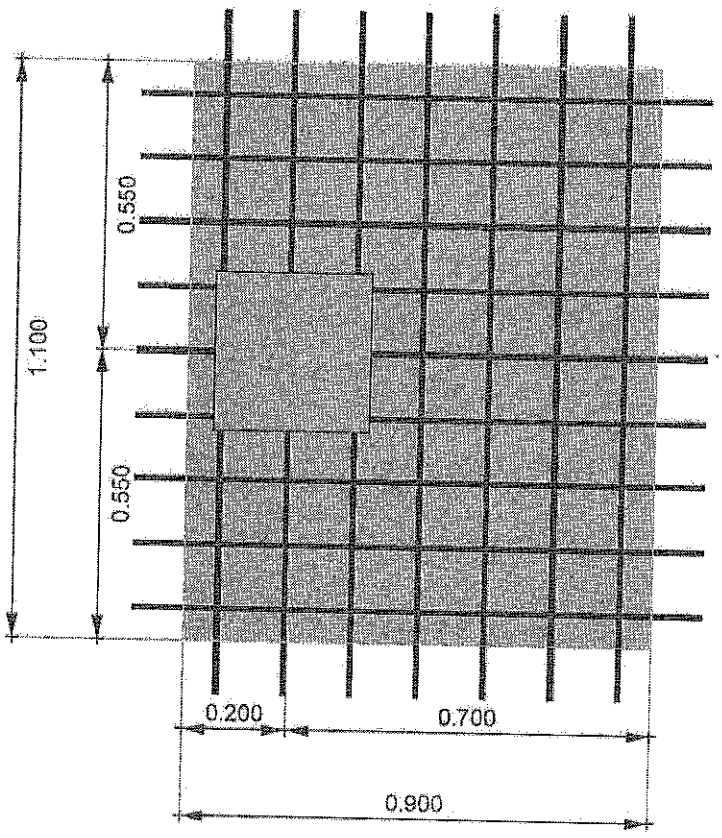
$$A_{\varnothing} = \frac{\varnothing_{By}^2}{4} \cdot \pi = \frac{12^2}{4} \cdot 3.1416 = 113\ \text{mm}^2 = 0.0001131\ \text{m}^2$$

$$s_{max,slabs} = \text{Min}(2 \cdot h = 2 \cdot 0.7 = 1.4\ ;\ 0.25) = 0.25\ \text{m} \qquad \text{EN-1992-1-1 9.3.1.1 (3)}$$

$$s = \text{Min}\left(\frac{A_{\varnothing}}{a_{s1}} = \frac{0.0001131}{0.0008476} = 0.13343\ ;\ s_{max,slabs} = 0.25\right) = 0.13343\ \text{m} = 133\ \text{mm}$$

Armare longitudinala:

$$a_{s,prov} = \frac{A_{\varnothing}}{s} = \frac{0.0001131}{0.13343} = 848\ \text{mm}^2/\text{m} \quad (\varnothing\ 12\ \text{mm}/\ 133\ \text{mm})$$



7.3. Strapungere - Armatura pentru strapungere

Grosimea placii

$h = 0.7$ m

Grosimea utila:

$$d = \frac{d_x + d_y}{2} = \frac{0.664 + 0.652}{2} = 0.658 \text{ m}$$

Distanta de la perimetrul convex al stalpului la prima armatura pentru strapungere $a_1 = 0.3$ m

Distanta radiala dintre elementele de armare $s_r = 0.4$ m

Procente de armaturi cu profil periodic intinse pe directia x si y:

$$\rho_{lx} = \frac{A_{s,ax}}{d_x} = \frac{0.0008632}{0.664} = 0.0013$$

$$\rho_{ly} = \frac{A_{s,ay}}{d_y} = \frac{0.0008476}{0.652} = 0.0013$$

$$\rho_l = \sqrt{\rho_{lx} \cdot \rho_{ly}} \leq 0.02 = \sqrt{0.0013 \cdot 0.0013} \leq 0.02 = 0.0013$$

$$k = 1 + \sqrt{\frac{200}{d}} \le 2 = 1 + \sqrt{\frac{200}{658}} \le 2 = 1.5513$$

Unde unitatea de masura a d este mm

$$v = 0.6 \cdot \left[1 - \frac{f_{ck}}{250}\right] = 0.6 \cdot \left[1 - \frac{16}{250}\right] = 0.5616$$

$$v_{min} = 0.035 \cdot k^{\frac{3}{2}} \cdot \sqrt{f_{ck}} = 0.035 \cdot 1.5513^{\frac{3}{2}} \cdot \sqrt{16} = 0.27051$$

Unde unitatea de masura a f_{ck} este N/mm^2

$\alpha_{cc} = 1$ EN-1992-1-1 2.4.8 (2)

Situatia proiectarii:Persistent si temporar

$\gamma_c = 1.5$

$\gamma_s = 1.15$

$$f_{cd} = \alpha_{cc} \cdot \frac{f_{ck}}{\gamma_c} = 1 \cdot \frac{16}{1.5} = 10.667 \text{ N/mm}^2 = 10667 \text{ kN/m}^2$$

Valoarea de proiectare a rezistentei maxime la strapungere pe perimetrul stalpului:

$$v_{Rd,max} = 0.4 \cdot v \cdot f_{cd} = 0.4 \cdot 0.5616 \cdot 10667 = 2396.2 \text{ kN/m}^2$$

$$C_{Rd,c} = \frac{0.18}{\gamma_c} = \frac{0.18}{1.5} = 0.12$$

Valoarea de proiectare a rezistentei la strapungere a planseului fara armatura pentru strapungere:

$$v_{Rd,c} = C_{Rd,c} \cdot k \cdot (100 \cdot \rho_l \cdot f_{ck})^{\frac{1}{3}} = 0.12 \cdot 1.5513 \cdot (100 \cdot 0.0013 \cdot 16)^{\frac{1}{3}} = 237.63 \text{ kN/m}^2$$

Unde unitatea de masura a f_{ck} este N/mm^2

Combinatie de dimensionare

7.3.1. Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

Ipoteza: **[1.35*1*GP+1.35*1*Finisaje] {1.5*U3}** (A1(a,b))

Reazemul nodal 3

$F_x = -1.3115$ kN

$F_y = -4.6472$ kN

$F_z = -88.935$ kN

$M_x = 1.9227$ kNm

$M_y = -1.1453$ kNm

$V = -F_z = -(-88.935) = 88.935$ kN

Excentricitatea incarcarii verticale (V) fata de centrul fundatiei

$e_{0x} = -0.25$ m

$e_{0y} = 0$ m

7.3.2. Vloarea de dimensionare a incarcarilor la baza fundatiei

$H_{dx} = F_x = -1.3115$ kN

$H_{dy} = F_y = -4.6472$ kN

$V_d = V + (G_{f,k} + G_{b,k} + G_{bf,k}) \cdot \gamma_{G,fav} = 88.935 + (17.325 + 2.1366 + 28.076) \cdot 1 = 136.47$ kN

Excentricitatea incarcarii verticale (V_d) fata de centrul fundatiei

$$e_x = \frac{V \cdot e_{0x} + M_y + F_x \cdot (h_b + h) + (G_{f,k} \cdot e_{fx} + G_{bf,k} \cdot e_{bfx}) \cdot \gamma_{G,fav}}{V_d} =$$

$$= \frac{88.935 \cdot (-0.25) + (-1.1453) + (-1.3115) \cdot (0.1 + 0.7) + (17.325 \cdot 0 + 28.076 \cdot 0.025) \cdot 1}{136.47} = -0.174 \text{ m}$$

$$e_y = \frac{V \cdot e_{0y} - M_x + F_y \cdot (h_b + h) + (G_{f,k} \cdot e_{fy} + G_{bf,k} \cdot e_{bfy}) \cdot \gamma_{G,fav}}{V_d} =$$

$$= \frac{88.935 \cdot 0 - 1.9227 + (-4.6472) \cdot (0.1 + 0.7) + (17.325 \cdot 0 + 28.076 \cdot 0) \cdot 1}{136.47} = -0.041 \text{ m}$$

Latimea eficienta a fundatiei:

$B' = b_x - |e_x| \cdot 2 = 0.9 - |(-0.174)| \cdot 2 = 0.552$ m

Lungimea eficienta a fundatiei:

$L' = b_y - |e_y| \cdot 2 = 1.1 - |(-0.041)| \cdot 2 = 1.018$ m

Aria eficienta a fundatiei:

$A' = B' \cdot L' = 0.552 \cdot 1.018 = 0.56194$ m²

$$q_{Ed} = \frac{V_d}{A'} = \frac{136.47}{0.56194} = 242.86 \text{ kN/m}^2$$

$H_B = -1.3115$ kN

$H_L = -4.6472$ kN

$V_{Ed} = -F_z = -(-88.935) = 88.935$ kN (↓)

Verificarea rezistentei maxime la strapungere pe perimetrul stalpului

Lungimea perimetrului suprafetei de incarcare

$u_0 = 1.3$ m

$$\beta = \left[1 + \sqrt{\left(k_x \cdot \frac{M_{Edx} \cdot u_0}{V_{Ed} \cdot W_x}\right)^2 + \left(k_y \cdot \frac{M_{Edy} \cdot u_0}{V_{Ed} \cdot W_y}\right)^2}\right] = \left[1 + \sqrt{\left(0.6 \cdot \frac{1.9227 \cdot 1.3}{88.935 \cdot 0.1275}\right)^2 + \left(0.6 \cdot \frac{(-1.1453) \cdot 1.3}{88.935 \cdot 0.1075}\right)^2}\right] = 1.1619$$

$$v_{Ed,0} = \frac{\beta \cdot V_{Ed}}{u_0 \cdot d} = \frac{1.1619 \cdot 88.935}{1.3 \cdot 0.658} = 120.8 \text{ kN/m}^2$$

$$\frac{v_{Ed,0}}{v_{Rd,max}} = \frac{120.8}{2396.2} = 0.050416 < 1 \text{ se verifica}$$

7.3.3. Verificarea rezistentei de strapungere a fundatiilor la perimetrele de control 2d

	a $[m]$	A_{cont} $[m^2]$	A_{sr} $[m^2]$	ΔV_{Ed} $[kN]$	$V_{Ed,red}$ $[kN]$	u_i $[m]$	$\frac{2 \cdot d}{a}$	v_{Ed} $[kN/m^2]$	v_{Rd} $[kN/m^2]$	$\frac{v_{Ed}}{v_{Rd}}$
1.	0.0658	0.17759	0.17759	39.639	49.295 (↓)	1.6383	20	56.063	4752.6	0.011796
2.	0.1316	0.26377	0.26377	58.874	30.06 (↓)	1.9765	10	30.123	2376.3	0.012676
3.	0.1974	0.36353	0.36353	81.141	7.7934 (↓)	2.3148	6.6667	10.186	1584.2	0.00643
4.	0.2632	0.47688	0.44445	99.204	−10.269 (↑)	2.653	5	−9.7215	1188.2	-0.008182

Unde:

a: Distanta dintre perimetrul stalpului si acest perimetru

A_{cont}: Aria interiorului perimetrului de control considerat

A_{sr}: partea comuna a zonei delimitata de perimetrului de control si a zonei efectiva de baza

$A_{sr} = A' \cap A_{cont}$

$\Delta V_{Ed} = A_{sr} \cdot (q_{Ed} - \gamma_{RC} \cdot h \cdot \gamma_G)$

$V_{Ed,red} = V_{Ed} - \Delta V_{Ed}$

$$v_{Ed} = \frac{V_{Ed,red}}{u \cdot d} \cdot \left[1 + \sqrt{\left(k_x \cdot \frac{M_{Edx} \cdot u}{V_{Ed,red} \cdot W_x}\right)^2 + \left(k_y \cdot \frac{M_{Edy} \cdot u}{V_{Ed,red} \cdot W_y}\right)^2}\right]$$

$$v_{Rd} = C_{Rd,c} \cdot k \cdot (100 \cdot \rho_l \cdot f_{ck})^{\frac{1}{3}} \cdot \frac{2 \cdot d}{a} \geq v_{min} \cdot \frac{2 \cdot d}{a} \rightarrow v_{Rd} = v_{Rd,c} \cdot \frac{2 \cdot d}{a}$$

Eficienta maxima este pe perimetrul de control 2.

$$\frac{v_{Ed}}{v_{Rd}} = \frac{30.123}{2376.3} = 0.012676 < 1$$ Nu este necesar armatura pentru strapungere.

Pe toate perimetrele ce control verificate $v_{Ed} \leq v_{Rd}$ Nu este necesar armatura pentru strapungere. se verifica

8. Calculul tasarii

8.1. Metoda tensiune-deformatie

(De dimensionare) EN-1997-1 Anexa A

EN-1997-1 Anexa F

	Coeficienti de siguranta		
A0	Actiuni permanente, defavorabile	$\gamma_{G,unfav}$	1
	Actiuni permanente, favorabile	$\gamma_{G,fav}$	1
	Actiuni variabile, defavorabile	$\gamma_{Q,unfav}$	1
	Actiuni variabile, favorabile	$\gamma_{Q,fav}$	0
M1	Unghiul eficient de frecare	γ_{φ}	1
	Coeziune eficienta	γ_{c}	1
	Rezistenta la forfecare nedrenata	γ_{cu}	1
	Rezistenta la compresiune unidirectionala	γ_{qu}	1
	Greutate volumica	γ_{γ}	1
R1	Rezistenta la rupere	$\gamma_{R,v}$	1
	Rezistenta la lunecare	$\gamma_{R,h}$	1
	Impingerile pamantului	$\gamma_{R,e}$	1

EN-1997-12.4.8 (2) Valorile factorilor partiali ai eficientei ar trebui luate 1.0

8.2. Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

Ipoteza: **[GP+Finisaje] {U3}** (SLS Caracteristic)

Reazemul nodal 3

$F_x = -0.92747$ kN

$F_y = -3.2909$ kN

$F_z = -63.42$ kN

$M_x = 1.2964$ kNm

$M_y = -0.81002$ kNm

$V = -F_z = -(-63.42) = 63.42$ kN

Excentricitatea incarcarii verticale (V) fata de centrul fundatiei

$e_{0x} = -0.25$ m

$e_{0y} = 0$ m

8.3. Vloarea de dimensionare a incarcarilor la baza fundatiei

$H_{dx} = F_x = -0.92747$ kN

$H_{dy} = F_y = -3.2909$ kN

$V_d = V + (G_{f,k} + G_{b,k} + G_{bf,k}) \cdot \gamma_{G,unfav} = 63.42 + (17.325 + 2.1366 + 28.076) \cdot 1 = 110.96$ kN

Excentricitatea incarcarii verticale (V_d) fata de centrul fundatiei

$$e_x = \frac{V \cdot e_{0x} + M_y + F_x \cdot (h_b + h) + (G_{f,k} \cdot e_{fx} + G_{bf,k} \cdot e_{bfx}) \cdot \gamma_{G,unfav}}{V_d} =$$

$$= \frac{63.42 \cdot (-0.25) + (-0.81002) + (-0.92747) \cdot (0.1 + 0.7) + (17.325 \cdot 0 + 28.076 \cdot 0.025) \cdot 1}{110.96} = -0.151 \text{ m}$$

$$e_y = \frac{V \cdot e_{0y} - M_x + F_y \cdot (h_b + h) + (G_{f,k} \cdot e_{fy} + G_{bf,k} \cdot e_{bfy}) \cdot \gamma_{G,unfav}}{V_d} =$$

$$= \frac{63.42 \cdot 0 - 1.2964 + (-3.2909) \cdot (0.1 + 0.7) + (17.325 \cdot 0 + 28.076 \cdot 0) \cdot 1}{110.96} = -0.035 \text{ m}$$

Latimea eficienta a fundatiei:

$B' = b_x - |e_x| \cdot 2 = 0.9 - |(-0.151)| \cdot 2 = 0.598$ m

Lungimea eficienta a fundatiei:

$L' = b_y - |e_y| \cdot 2 = 1.1 - |(-0.035)| \cdot 2 = 1.03$ m

Aria eficienta a fundatiei:

$A' = B' \cdot L' = 0.598 \cdot 1.03 = 0.61594$ m²

$$q_{E,d} = \frac{V_d}{A'} = \frac{110.96}{0.61594} = 180.14 \text{ kN/m}^2$$

$H_B = -0.92747$ kN

$H_L = -3.2909$ kN

Efortul normal sub coltul suprafetei de incarcare la adancimea z este:

$$\sigma_z = \frac{p}{2 \cdot \pi} \cdot \left[\text{Arc tg} \left(\frac{b}{z} \cdot \frac{a \cdot (a^2 + b^2) - 2 \cdot a \cdot z \cdot (r - z)}{z \cdot (a^2 + b^2) \cdot (r - z) - z \cdot (r - z)^2} \right) \right] + \left[\frac{b \cdot z}{b^2 + z^2} \cdot \frac{a \cdot (r^2 + z^2)}{(a^2 + z^2) \cdot r} \right]$$

Dupa Steinbrenner

Unde:

p este incarcarea distribuita uniform in suprafata incarcarii

a si b sunt lungimile si latimile suprafetei dreptunghiulare de incarcare

$r = \sqrt{a^2 + b^2 + z^2}$

Tensiunea sub punctul caracteristic:

$\sigma_{z,a} = \sigma_{z,I} + \sigma_{z,II} + \sigma_{z,III} + \sigma_{z,IV}$

	a	b
$\sigma_{z,I}$	$(0.5 - 0.37) \cdot L' = 0.1339$	$(0.5 - 0.37) \cdot B' = 0.07774$
$\sigma_{z,II}$	$(0.5 + 0.37) \cdot L' = 0.8961$	$(0.5 - 0.37) \cdot B' = 0.07774$
$\sigma_{z,III}$	$(0.5 + 0.37) \cdot L' = 0.8961$	$(0.5 + 0.37) \cdot B' = 0.52026$
$\sigma_{z,IV}$	$(0.5 + 0.37) \cdot B' = 0.52026$	$(0.5 - 0.37) \cdot L' = 0.1339$

Distanta punctului caracteristic de la axul central al suprafetei incarcate este $0.37B'$ si $0.37L'$.

Efortul suprasolicitarii efective la baza fundatiei:

$$q' = \gamma_y \cdot \sum \gamma_i \cdot h_i = 1 \cdot \sum \gamma_i \cdot h_i = 49.236 \text{ kN/m}^2$$

Efortul vertical efectiv din incarcarea fundatiei la baza fundatiei:

$$q_{E,d} = \frac{V_d}{A'} = \frac{110.96}{0.61594} = 180.14 \text{ kN/m}^2$$

$$p = q_{E,d} - q' = 180.14 - 49.236 = 130.91 \text{ kN/m}^2$$

Efortul vertical efectiv din incarcarea fundatiei la adancimea limita:

$$\sigma_{D_{lim}} = 15.154 \text{ kN/m}^2$$

Efortul suprasolicitarii efective la adancimea limita:

$$q_{D_{lim}} = 75.77 \text{ kN/m}^2$$

Adancimea limita:

$$D_{lim} = -3.678 \text{ m}$$

Aceasta adancime poate fi luata ca si adancimea la care efortul efectiv vertical din incarcarea fundatiei este la 20% din efortul suprasolicitarii efective. EN-1997-1 6.6.2 (6)

Tasare:

$$s = \Sigma s_i = 1.882 \text{ mm} < s_{lim} = 50.000 \text{ mm se verifica}$$

Strat de sol de referinta: CNT - (Nisip indesat, umed)

Modulul de compresiune al stratului de pamant de referinta $E_{s,ref} = 30000 \text{ kN/m}^2$

Densitatea stratului de referinta $\rho_{s,ref} = 2100 \text{ kg/m}^3$

i	z_0 [m]	h_i [m]	$h_{i,eq}$ [m]	σ_z [kN/m²]	q' [kN/m²]	σ_z/q' [%]	s_i [mm]	Σs_i [mm]
0.	0	0	0	0	0	-	0	0
1.	−0.1	0.1	0.048836	0	2.0601	0	0	0
2.	−0.2	0.1	0.048836	0	4.1202	0	0	0
3.	−0.3	0.1	0.048836	0	6.1803	0	0	0
4.	−0.4	0.1	0.048836	0	8.2404	0	0	0
5.	−0.5	0.1	0.048836	0	10.301	0	0	0
6.	−0.6	0.1	0.048836	0	12.361	0	0	0
7.	−0.7	0.1	0.048836	0	14.421	0	0	0
8.	−0.8	0.1	0.048836	0	16.481	0	0	0
9.	−0.9	0.1	0.048836	0	18.541	0	0	0
10.	−1	0.1	0.048836	0	20.601	0	0	0
11.	−1.1	0.1	0.048836	0	22.661	0	0	0
12.	−1.2	0.1	0.1	0	24.721	0	0	0

13.	−1.3	0.1	0.1	0	26.781	0	0	0
14.	−1.4	0.1	0.1	0	28.841	0	0	0
15.	−1.5	0.1	0.1	0	30.902	0	0	0
16.	−1.59	0.09	0.09	0	32.756	0	0	0
17.	−1.6	0.01	0.01	0	32.962	0	0	0
18.	−1.7	0.1	0.1	0	35.022	0	0	0
19.	−1.8	0.1	0.1	0	37.082	0	0	0
20.	−1.9	0.1	0.1	0	39.142	0	0	0
21.	−2	0.1	0.1	0	41.202	0	0	0
22.	−2.1	0.1	0.1	0	43.262	0	0	0
23.	−2.2	0.1	0.1	0	45.322	0	0	0
24.	−2.29	0.09	0.09	0	47.176	0	0	0
25.	−2.3	0.01	0.01	0	47.382	0	0	0
26.	−2.39	0.09	0.09	130.91	49.236	3	0	0
27.	−2.4	0.01	0.01	130.82	49.442	3	0.044	0.044
28.	−2.5	0.1	0.1	98.577	51.503	2	0.382	0.426
29.	−2.6	0.1	0.1	70.286	53.563	1	0.281	0.707
30.	−2.7	0.1	0.1	55.767	55.623	1	0.210	0.917
31.	−2.8	0.1	0.1	46.698	57.683	1	0.171	1.088
32.	−2.9	0.1	0.1	40.044	59.743	1	0.145	1.233
33.	−3	0.1	0.1	34.736	61.803	1	0.125	1.357
34.	−3.1	0.1	0.1	30.337	63.863	0	0.108	1.466
35.	−3.2	0.1	0.1	26.628	65.923	0	0.095	1.561
36.	−3.3	0.1	0.1	23.475	67.983	0	0.084	1.644
37.	−3.4	0.1	0.1	20.783	70.043	0	0.074	1.718
38.	−3.5	0.1	0.1	18.475	72.103	0	0.065	1.784
39.	−3.6	0.1	0.1	16.49	74.164	0	0.058	1.842
40.	−3.678	0.077986	0.077986	15.154	75.77	0	0.041	1.882
41.	−3.7	0.022014	0.022014	14.777	76.224	0	0.011	1.894
42.	−3.8	0.1	0.1	13.294	78.284	0	0.047	1.941
43.	−3.9	0.1	0.1	12.006	80.344	0	0.042	1.983
44.	−4	0.1	0.1	10.882	82.404	0	0.038	2.021
45.	−4.1	0.1	0.1	9.8981	84.464	0	0.035	2.056

z_0 : Adancime

h_i : Grosimea stratului

$h_{i,eq}$: Grosimea echivalenta

$$h_{i,eq} = h_i \cdot \left(\frac{E_{s,i}}{E_{s,ref}} \cdot \frac{\rho_{s,ref}}{\rho_{s,i}} \right)^{\frac{1}{2,5}}$$

Unde:

$\rho_{s,i}$: Densitatea stratului

$E_{s,i}$: Modulul de compresiune al stratului de pamant

$E_{s,ref}$: Modulul de compresiune al stratului de pamant de referinta

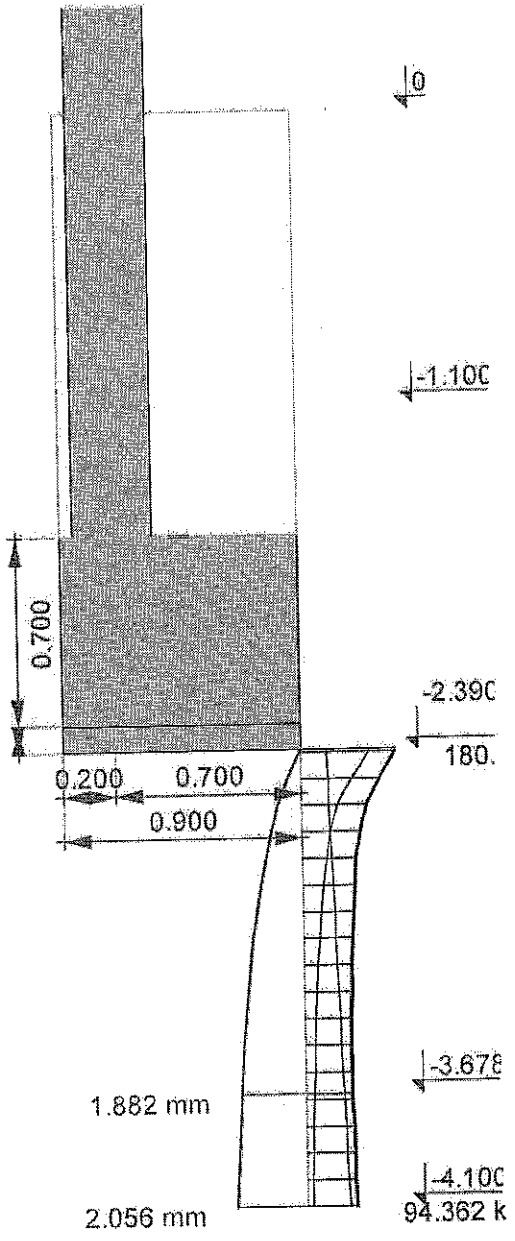
$\rho_{s,ref}$: Densitatea stratului de referinta

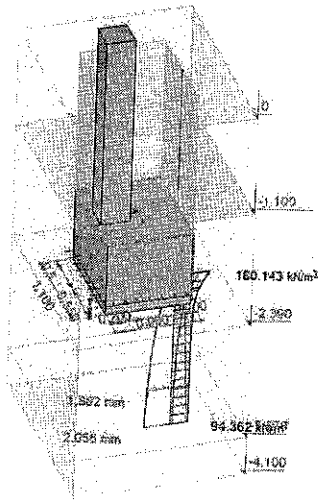
σ_z : Efortul vertical efectiv din incarcarea fundatiei

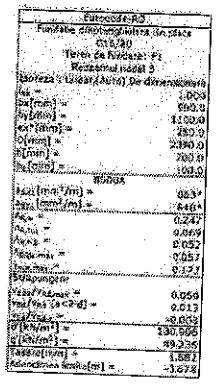
q' : Efortul suprasolicitarii efective

s_i : Tasarea stratului de pamant

Σs_i : Tasarea totala la adancimea data


0
-1.100
0.700
-2.390
180.
0.200
0.700
0.900
-3.678
1.882 mm
-4.100
2.056 mm
94.362 k





Fundatie, Reazemul nodal 3, Liniar,(Auto) De dimensionare

Dimensionare fundatie izolata

Normativ: Eurocod [RO]

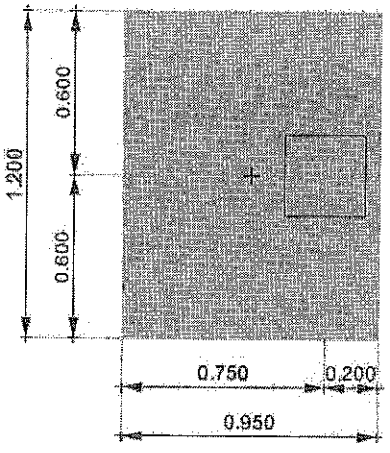
1. Parametri solului

Nume	Descriere	Nivelul superior z_i $[m]$	Grosime h_i $[m]$	Densitate ρ_s $[kg/m^3]$	Unghiul frecarii φ $[°]$	Coeziune c $[kN/m^2]$	Modulul de compresiune al stratului de pamant E_s $[kN/m^2]$
FNT	Nisip fainos, indesat, umed	0	1.1	2100	30.00	–	5000
CNT	Nisip indesat, umed	-1.1	3	2100	32.00	–	30000

2. Fundatie

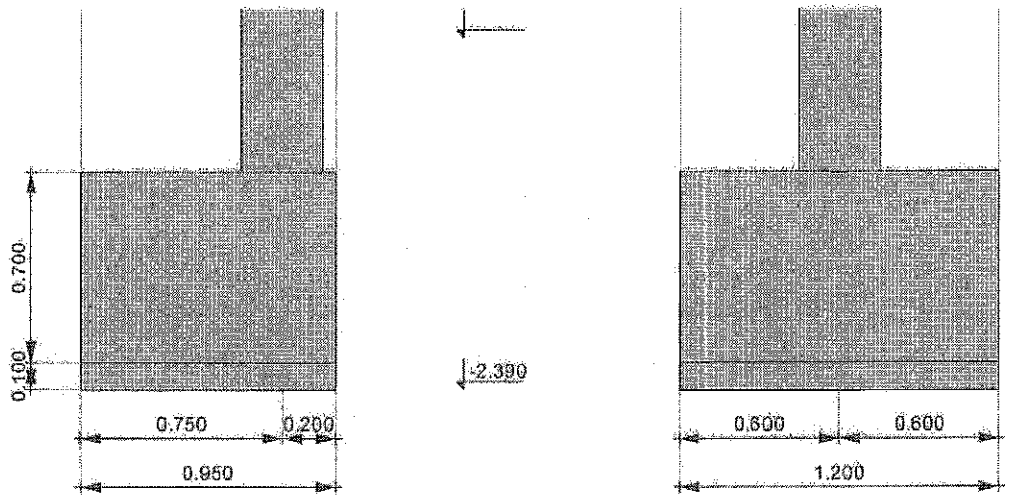
2.1. Parametrii de proiectare a fundatiei

Geometrie:



Materiale

Beton: C16/20
f_{ck} = 16 N/mm²
Densitate: ρ_C = 2200 kg/m³
Beton armat:
Densitate: ρ_{RC} = 2548 kg/m³
Otel beton
Armare longitudinala: B500C
f_{yk} = 500.25 N/mm²
Armatura pentru strapungere:B500C
f_{ywk} = 500.25 N/mm²



Adancimea de inglobare: $D = 2.39$ m

Valoarea caracteristica a greutatii volumice a materialelor:

Beton: $\gamma_{C,k} = \rho_C \cdot g \cdot 10^{-3} = 2200 \cdot 9.810 \cdot 10^{-3} = 21.582$ kN/m³

Beton armat: $\gamma_{RC,k} = \rho_{RC} \cdot g \cdot 10^{-3} = 2548 \cdot 9.810 \cdot 10^{-3} = 25$ kN/m³

2.2. Fundatie

Latimea fundatiei izolate: $B = 0.95$ m

Lungimea fundatiei izolate: $L = 1.2$ m

Grosimea placii $h = 0.7$ m

Inclinarea bazei: $\alpha = 0°$

Volumul fundatiei: $V_f = 0.798$ m³

Valoarea caracteristica a greutatii fundatiei: $G_{f,k} = V_f \cdot \gamma_{RC,k} = 0.798 \cdot 25 = 19.95$ kN (↓)

2.3. Beton de egalizare

Grosimea betonului de egalizare: $h_b = 0.1$ m

Greutatea caracteristica a betonului de egalizare: $G_{b,k} = B \cdot L \cdot h_b \cdot \gamma_{C,k} = 0.95 \cdot 1.2 \cdot 0.1 \cdot 21.582 = 2.4603$ kN (↓)

2.4. Umplutura

Material: Pietris indesat, uscat (AST)

Densitatea umpluturii: $\rho_{bf} = 2000$ kg/m³

Greutatea volumica a umpluturii: $\gamma_{bf,k} = \rho_{bf} \cdot g \cdot 10^{-3} = 2000 \cdot 9.810 \cdot 10^{-3} = 19.62$ kN/m³

Volumul umpluturii: $V_{bf} = 1.6695$ m³

Valoarea caracteristica a greutatii umpluturii: $G_{bf,k} = V_{bf} \cdot \gamma_{bf,k} = 1.6695 \cdot 19.62 = 32.756$ kN (↓)

Excentricitatea greutatii fata de centrul fundatiei

$e_{bfx} = -0.024$ m

$e_{bfy} = 0$ m

3. Calculul rezistentei la terenului la rupere

Metoda de proiectare: 1 Combinatia 1: {A1 "+" M1 "+" R1}

Metoda de proiectare: 1 Combinatia 2: {A2 "+" M2 "+" R1} (De dimensionare)

Metoda de proiectare: 2: {A1 "+" M1 "+" R2}

Metoda de proiectare: 3: {A2 "+" M2 "+" R3} EN-1997-1 Anexa A

	Coeficienti de siguranta		
A2	Actiuni permanente, defavorabile	$\gamma_{G,unfav}$	1
	Actiuni permanente, favorabile	$\gamma_{G,fav}$	1
	Actiuni variabile, defavorabile	$\gamma_{Q,unfav}$	1.3
	Actiuni variabile, favorabile	$\gamma_{Q,fav}$	0
M2	Unghiul eficient de frecare	γ_{φ}	1.25
	Coeziune eficienta	γ_{c}	1.25
	Rezistenta la forfecare nedrenata	γ_{cu}	1.4
	Rezistenta la compresiune unidirectionala	γ_{qu}	1.4
	Greutate volumica	γ_{γ}	1
R1	Rezistenta la rupere	$\gamma_{R,v}$	1
	Rezistenta la lunecare	$\gamma_{R,h}$	1
	Impingerile pamantului	$\gamma_{R,e}$	1

3.1. Valoarea de dimensionare a parametrilor solului de sub fundatie

Densitatea stratului: $\rho_s = 2100$ kg/m³

Greutate volumica:

$$\gamma' = \rho_s \cdot g \cdot \gamma_{\gamma} \cdot 10^{-3} = 2100 \cdot 9.810 \cdot 1 \cdot 10^{-3} = 20.601 \text{ kN/m}^3$$

Unghiul frecarii $\varphi'_k = 32.00°$

Unghiul eficient de frecare:

$$\varphi' = \text{Arc tg} \frac{\tan \varphi'_k}{\gamma_{\varphi}} = \text{Arc tg} \frac{\tan 32.00°}{1.25} = 26.56°$$

Coeziune: $c'_k = 0$ kN/m²

Coeziune eficienta: $c' = \frac{c'_k}{\gamma_c} = \frac{0}{1.25} = 0$ kN/m²

Unghiul de frecare critic a rezistentei la frecare: $\varphi_{cv} = 32.00°$

Valoarea caracteristica a presiunii de suprasolicitare la baza fundatiei:

$$q'_k = g \cdot \sum \rho_{s,i} \cdot h_{s,i}$$

$$q'_k = g \cdot (\rho_{s,1} \cdot h_{s,1} + \rho_{s,2} \cdot h_{s,2}) \cdot 10^{-3} = 9.810 \cdot (2100 \cdot 0.7_{s,1} + 2100 \cdot 1.29) \cdot 10^{-3} = 49.236 \text{ kN/m}^2$$

3.2. Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

Ipoteza: **[GP+Finisaje] {1.3*U4}** (A2(a,b))

Reazemul nodal 5

$F_x = 2.4677$ kN

$F_y = 4.1963$ kN

$F_z = -77.605$ kN

$M_x = -2.2781$ kNm

$M_y = 2.1198$ kNm

$V = -F_z = -(-77.605) = 77.605$ kN

Excentricitatea incarcarii verticale (V) fata de centrul fundatiei

$e_{0x} = 0.275$ m

$e_{0y} = 0$ m

3.3. Vloarea de dimensionare a incarcarilor la baza fundatiei

$H_{dx} = F_x = 2.4677$ kN

$H_{dy} = F_y = 4.1963$ kN

$V_d = V + (G_{f,k} + G_{b,k} + G_{bf,k}) \cdot \gamma_{G,unfav} = 77.605 + (19.95 + 2.4603 + 32.756) \cdot 1 = 132.77$ kN

Excentricitatea incarcarii verticale (V_d) fata de centrul fundatiei

$$e_x = \frac{V \cdot e_{0x} + M_y + F_x \cdot (h_b + h) + (G_{f,k} \cdot e_{fx} + G_{bf,k} \cdot e_{bfx}) \cdot \gamma_{G,unfav}}{V_d} =$$

$$= \frac{77.605 \cdot 0.275 + 2.1198 + 2.4677 \cdot (0.1 + 0.7) + (19.95 \cdot 0 + 32.756 \cdot (-0.024)) \cdot 1}{132.77} = 0.186 \text{ m}$$

$$e_y = \frac{V \cdot e_{0y} - M_x + F_y \cdot (h_b + h) + (G_{f,k} \cdot e_{fy} + G_{bf,k} \cdot e_{bfy}) \cdot \gamma_{G,unfav}}{V_d} =$$

$$= \frac{77.605 \cdot 0 - (-2.2781) + 4.1963 \cdot (0.1 + 0.7) + (19.95 \cdot 0 + 32.756 \cdot 0) \cdot 1}{132.77} = 0.042 \text{ m}$$

Latimea eficienta a fundatiei:

$B' = b_x - |e_x| \cdot 2 = 0.95 - |0.186| \cdot 2 = 0.578$ m

Lungimea eficienta a fundatiei:

$L' = b_y - |e_y| \cdot 2 = 1.2 - |0.042| \cdot 2 = 1.116$ m

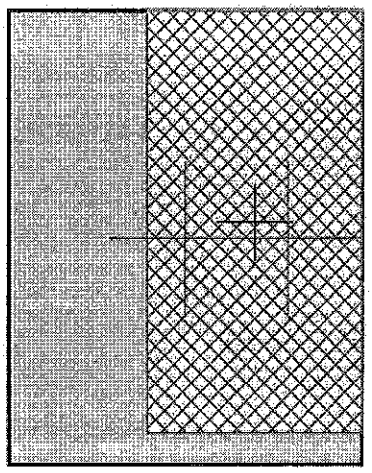
Aria eficienta a fundatiei:

$A' = B' \cdot L' = 0.578 \cdot 1.116 = 0.64505$ m²

$$q_{Ed} = \frac{V_d}{A'} = \frac{132.77}{0.64505} = 205.83 \text{ kN/m}^2$$

$H_B = 2.4677$ kN

$H_L = 4.1963$ kN



Valoare de dimensionare a impingerii efective a pamantului la baza fundatiei:

$q' = \gamma_\gamma \cdot q'_k = 1 \cdot 49.236 = 49.236$ kN/m²

3.4. Conditii drenate

Factori nedimensionati pentru calcul EN-1997-1 Anexa D D.4

Factorii capacitatii terenului la rupere:

$$N_q = e^{\pi \cdot \text{tg}\varphi'} \cdot \text{tg}^2\left(45^\circ + \frac{\varphi'}{2}\right) = e^{3.1416 \cdot \text{tg}\,26.56^\circ} \cdot \text{tg}^2\left(45^\circ + \frac{26.56^\circ}{2}\right) = 12.588$$

$$N_\gamma = 2 \cdot (N_q - 1) \cdot \text{tg}\,\varphi' = 2 \cdot (12.588 - 1) \cdot \text{tg}\,26.56^\circ = 11.585$$

$$N_c = \frac{(N_q - 1)}{\text{tg}\,\varphi'} = \frac{(12.588 - 1)}{\text{tg}\,26.56^\circ} = 23.18$$

Factori de forma a bazei fundatiei:

$$s_\gamma = 1 - 0.3 \cdot \frac{B'}{L'} = 1 - 0.3 \cdot \frac{0.578}{1.116} = 0.84462$$

$$s_q = 1 + \frac{B'}{L'} \cdot \sin\varphi' = 1 + \frac{0.578}{1.116} \cdot \sin 26.56° = 1.2316$$

$$s_c = \frac{s_q \cdot N_q - 1}{N_q - 1} = \frac{1.2316 \cdot 12.588 - 1}{12.588 - 1} = 1.2516$$

Factori pentru inclinarea bazei:

$\alpha = 0°$

$b_\gamma = 1$

$b_q = b_\gamma = 1$

$b_c = 1$

Factori pentru inclinarea incarcarii:

$$m_B = \frac{2 + \frac{B'}{L'}}{1 + \frac{B'}{L'}} = \frac{2 + \frac{0.578}{1.116}}{1 + \frac{0.578}{1.116}} = 1.6588$$

$$m_L = \frac{2 + \frac{L'}{B'}}{1 + \frac{L'}{B'}} = \frac{2 + \frac{1.116}{0.578}}{1 + \frac{1.116}{0.578}} = 1.3412$$

$$m = m_B \cdot \left(\frac{H_B}{H}\right)^2 + m_L \cdot \left(\frac{H_L}{H}\right)^2 = 1.6588 \cdot \left(\frac{2.4677}{4.8681}\right)^2 + 1.3412 \cdot \left(\frac{4.1963}{4.8681}\right)^2 = 1.4228$$

$$i_\gamma = \left[1 - \frac{H}{V_d + A' \cdot c' \cdot \operatorname{cotg}\varphi'}\right]^{(m+1)} = \left[1 - \frac{4.8681}{132.77 + 0.64505 \cdot 0 \cdot \operatorname{cotg} 26.56°}\right]^{(1.4228+1)} = 0.91347$$

$$i_q = \left[1 - \frac{H}{V_d + A' \cdot c' \cdot \operatorname{cotg}\varphi'}\right]^{m} = \left[1 - \frac{4.8681}{132.77 + 0.64505 \cdot 0 \cdot \operatorname{cotg} 26.56°}\right]^{1.4228} = 0.94824$$

$$i_c = i_q - \frac{1 - i_q}{N_c \cdot \operatorname{tg}\varphi'} = 0.94824 - \frac{1 - 0.94824}{23.18 \cdot \operatorname{tg} 26.56°} = 0.94377$$

Coeficienti		Coeziune c	Greutate proprie γ	Impingerea pamantului q
Factorii capacitatii terenului la rupere	N	23.18	11.585	12.588
Factori de forma a bazei fundatiei	s	1.2516	0.84462	1.2316
Factori pentru inclinarea bazei	b	1	1	1
Factori pentru inclinarea incarcarii	i	0.94377	0.91347	0.94824

Rezistenta la rupere:

$$R_{d,V} = \frac{c' \cdot N_c \cdot s_c \cdot b_c \cdot i_c + q' \cdot N_q \cdot s_q \cdot b_q \cdot i_q + 0.5 \cdot \gamma' \cdot B' \cdot N_\gamma \cdot b_\gamma \cdot s_\gamma \cdot i_\gamma}{\gamma_{R,v}} \cdot A' =$$

$$= \frac{0 \cdot 23.18 \cdot 1.2516 \cdot 1 \cdot 0.94377 + 49.236 \cdot 12.588 \cdot 1.2316 \cdot 1 \cdot 0.94824 + 0.5 \cdot 20.601 \cdot 0.578 \cdot 11.585 \cdot 1 \cdot 0.84462 \cdot 0.91347}{1} \cdot 0.64505$$

$= 501.2$ kN

Eficenta terenului la rupere:

$$\Lambda_{R,v} = \frac{V_d}{R_{d,V}} = \frac{132.77}{501.2} = 0.265 < \Lambda_{R,v,lim} = 1.000 \text{ se verifica}$$

4. Verificarea excentricitatii

Factorul limitei de excentricitate: $\gamma_{ecc,lim} = 0.33$

F_x F_y [kN]	F_z [kN]	M_x M_y [kNm]	V_d [kN]	e_x e_y [m]	γ_{ecc}	✔ ✘	Ipoteza
0.70439 3.6012	−65.034	−1.5448 0.60191	120.2	0.152 0.037	0.16	✔	[1.15*GP+1.15*Finisaje] {1.5*U1}
1.5434 2.4338	−55.067	−0.48841 1.3332	110.23	0.154 0.022	0.16211	✔	[1.15*GP+1.15*Finisaje]
3.1106 5.257	−98.938	−2.7118 2.6733	154.1	0.205 0.045	0.21579	✔	[1.35*1*GP+1.35*1*Finisaje] {1.5*U4}
3.0501 5.3146	−98.19	−2.7792 2.6347	153.36	0.204 0.046	0.21474	✔	[1.35*1*GP+1.35*1*Finisaje] {1.5*U}
3.889 4.1471	−88.224	−1.7228 3.366	143.39	0.209 0.035	0.22	✔	[1.35*1*GP+1.35*1*Finisaje] {1.5*U2}
3.8234 4.1735	−87.422	−1.7398 3.3247	142.59	0.208 0.036	0.21895	✔	[1.35*1*GP+1.35*1*Finisaje] {1.5*U3}
0.61495 3.1281	−56.522	−1.3402 0.52552	111.69	0.141 0.034	0.14842	✔	[GP+Finisaje] {1.3*U1}
1.3421 2.1163	−47.885	−0.42471 1.1593	103.05	0.142 0.021	0.14947	✔	[GP+Finisaje]
2.4677 4.1963	−77.605	−2.2781 2.1198	132.77	0.186 0.042	0.19579	✔	[GP+Finisaje] {1.3*U4}
2.4152 4.2462	−76.958	−2.3364 2.0863	132.12	0.185 0.043	0.19474	✔	[GP+Finisaje] {1.3*U}
3.1423 3.2344	−68.321	−1.4209 2.7201	123.49	0.188 0.032	0.19789	✔	[GP+Finisaje] {1.3*U2}
3.0855 3.2572	−67.626	−1.4356 2.6844	122.79	0.187 0.033	0.19684	✔	[GP+Finisaje] {1.3*U3}

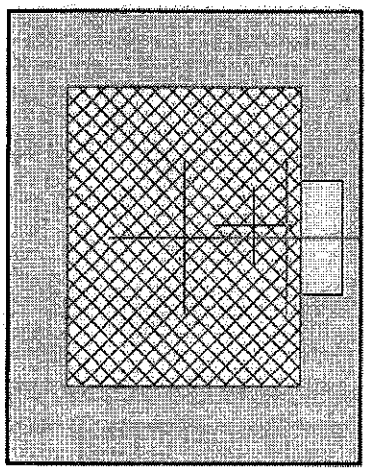
Unde:

$V_d = -F_z + (G_{f,k} + G_{b,k} + G_{bf,k}) \cdot \gamma_{G,unfav}$

$\gamma_{ecc} = \max\left(\left|\frac{e_x}{b_x}\right|, \left|\frac{e_y}{b_y}\right|\right)$ Valorile axcentricitatilor iau in considerare momentele suplimentare de la baza fundatiei din incarcarile orizontale

$\gamma_{G,unfav}$: Coeficient partial pentru greutatea proprie a fundatiei

$\gamma_{ecc,max} = 0.22 \leq \gamma_{ecc,lim} = 0.33$ se verifica!



5. Verificarea stabilitatii

$\gamma_{G,dst} = 1.1$

$\gamma_{G,stb} = 0.9$

Valoarea de proiectare a greutatii fundatiei: $G_{f,d} = G_{f,k} \cdot \gamma_{G,stb} = 19.95 \cdot 0.9 = 17.955$ kN (↓)

Greutatea de proiectare a betonului de egalizare: $G_{b,d} = G_{b,k} \cdot \gamma_{G,stb} = 2.4603 \cdot 0.9 = 2.2143$ kN (↓)

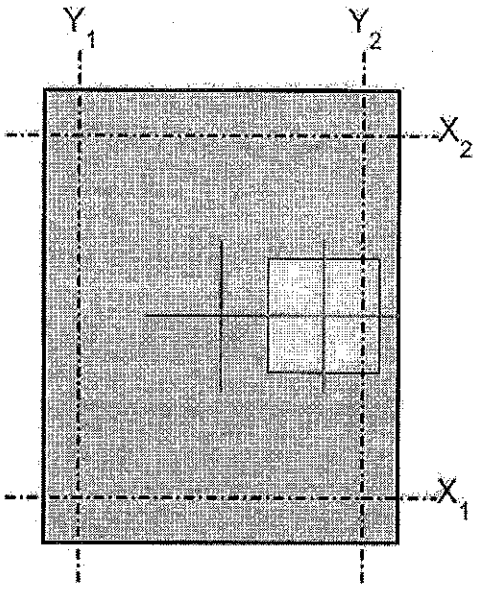
Valoarea caracteristica a greutatii umpluturii: $G_{bf,d} = G_{bf,k} \cdot \gamma_{G,stb} = 32.756 \cdot 0.9 = 29.48$ kN (↓)

Raportul distantei dintre axul rasturnarii si muchia fundatiei fata de dimensiunile fundatiei: $\gamma_{ab} = 0.1$

Distanta dintre axul rasturnarii si centrul fundatiei

$$e_{EQUx} = \frac{b_x \cdot (1 - \gamma_{ib})}{2} = \frac{0.95 \cdot (1 - 0.1)}{2} = 0.428 \text{ m}$$

$$e_{EQUy} = \frac{b_y \cdot (1 - \gamma_{ib})}{2} = \frac{1.2 \cdot (1 - 0.1)}{2} = 0.54 \text{ m}$$



5.1. Verificarea rotirii in jurul axului x_1

Ipoteza: **[0.9*GP+0.9*Finisaje] {1.5*U}** (EQU)

Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

$F_x = 2.7146$ kN

$F_y = 4.7855$ kN

$F_z = -86.219$ kN

$M_x = -2.673$ kNm

$M_y = 2.3448$ kNm

$V = -F_z = -(-86.219) = 86.219$ kN (↓)

Moment stabilizator

$$M_{x1,stb} = M_x + (-V) \cdot e_{EQUy} + (-G_{f,d}) \cdot e_{EQUy} + (-G_{b,d}) \cdot e_{EQUy} + (-G_{bf,d}) \cdot e_{EQUy} =$$

$$= (-2.673) + (-86.219) \cdot 0.54 + (-17.955) \cdot 0.54 + (-2.2143) \cdot 0.54 + (-29.48) \cdot 0.54 = -76.042 \text{ kNm}$$

Moment destabilizator

$$M_{x1,dst} = F_y \cdot h = 4.7855 \cdot 0.7 = 3.3498 \text{ kNm}$$

Factorul eficientei la stabilitate

$$\Lambda_{EQU,x1} = \left|\frac{M_{x1,dst}}{M_{x1,stb}}\right| = \left|\frac{3.3498}{(-76.042)}\right| = 0.044053 \leq \Lambda_{EQU,lim} = 1.000 \quad \text{se verifica!}$$

5.2. Verificarea rotirii in jurul axului x_2

Ipoteza: **[0.9*GP+0.9*Finisaje]** **{1.5*U}** (EQU)
Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

$F_x = 2.7146$ kN

$F_y = 4.7855$ kN

$F_z = -86.219$ kN

$M_x = -2.673$ kNm

$M_y = 2.3448$ kNm

$V = -F_z = -(-86.219) = 86.219$ kN (↓)

Moment stabilizator

$$M_{x2,stb} = F_y \cdot h + (-V) \cdot (-e_{EQUy}) + (-G_{f,d}) \cdot (-e_{EQUy}) + (-G_{b,d}) \cdot -e_{EQUy} + (-G_{bf,d}) \cdot (-e_{EQUy}) =$$
$$= 4.7855 \cdot 0.7 + (-86.219) \cdot (-0.54) + (-17.955) \cdot (-0.54) + (-2.2143) \cdot -0.54 + (-29.48) \cdot (-0.54) = 76.719$$
kNm

Moment destabilizator

$M_{x2,dst} = M_x = (-2.673) = -2.673$ kNm

Factorul eficientei la stabilitate

$$\Lambda_{EQU,x2} = \left|\frac{M_{x2,dst}}{M_{x2,stb}}\right| = \left|\frac{(-2.673)}{76.719}\right| = 0.034841 \leq \Lambda_{EQU,lim} = 1.000 \quad \text{se verifica!}$$

5.3. Verificarea rotirii in jurul axului y_1

Ipoteza: **[1.1*GP+1.1*Finisaje]** **{1.5*U1}** (EQU)
Valorile de proiectare a incarcarilor pe talpa superioara a fundatiei - Reactiunile reazemelor nodale

$F_x = 0.63729$ kN

$F_y = 3.4954$ kN

$F_z = -62.639$ kN

$M_x = -1.5236$ kNm

$M_y = 0.54394$ kNm

$V = -F_z = -(-62.639) = 62.639$ kN (↓)

Moment stabilizator

$$M_{y1,stb} = M_y + F_x \cdot h + V \cdot (e_{EQUx} - e_{0x}) + G_{f,d} \cdot e_{EQUx} + G_{b,d} \cdot e_{EQUx} + G_{bf,d} \cdot (e_{EQUx} - e_{bfx}) =$$
$$= 0.54394 + 0.63729 \cdot 0.7 + 62.639 \cdot (0.428 - 0.275) + 17.955 \cdot 0.428 + 2.2143 \cdot 0.428 + 29.48 \cdot (0.428 - (-0.024)) =$$