IZPILDĪTĀJS:

SIA „REM PRO"

Reģ. Nr. 41503041904
Daugavpils, 18. novembra iela 37A
LV - 5401
Tālr. +371 29444421

PASŪTĪTĀJS:

BŪVPROJEKTA AUTORS:

SIA „REM PRO"

Reģ. Nr. 41503041904
Daugavpils, 18. novembra iela 37A
LV - 5401
Tālr. +371 29444421

BŪVOBJEKTA NOSAUKUMS:

BŪVPROJEKTA IZSTRĀDE, SASKAŅOŠANA BŪVVALDĒ UN AUTORUZRAUDZĪBA BŪVDARBU VEIKŠANAS LAIKĀ TRIBĪŅU IZBŪVEI UN MODUĻU ĒKU NOVIETOŠANAI PIE ESOŠĀ FUTBOLA LAUKUMA, STADIONA IELĀ 1, DAUGAVPILĪ.

BŪVOBJEKTA ADRESE:

-

STADIJA

BP (būvprojekts)

APRĒĶINA ATSKAITE

Apgaismojuma masta pamati

BŪVPROJEKTA DAĻAS VADĪTĀJS:

RĪGA, 2018

Satura rādītājs

1. Aprēķina izejas dati

Pamatojums:

LVS EN 1990 standartu saime “Eirokodekss. Konstrukciju projektešanas pamati”;
LVS EN 1991 standartu saime " Eirokodekss. Iedarbes uz konstrukcijam";
LBN 003-15 “Buvklimatologija”;
LBN 201-15 “Buvju ugunsdrošiba”;
LBN 203-15 "Betona buvkonstrukciju projektešana" (LVS EN 1992)
LBN 204-14 "Terauda buvkonstrukciju projektešana" (LVS EN 1993)
LBN 207-15 “Geotehniska projektešana” (LVS EN 1997)
LVS EN 206+A1:2017 “Betons. Tehniskie noteikumi, darbu izpildijums, ražošana un atbilstiba”;
LVS 156-1:2009 “Betons. Latvijas standarta nacionalais pielikums Eiropas standartam EN 206-1. 1. dala: Prasibasklasifikacijai un atbilstibas apliecinašanai”;
LVS EN 13670 “Betona konstrukciju izgatavošana”;
LVS EN 10080:2006 L "Terauds betona stiegrojumam. Metinams stiegrojuma terauds. Visparigi."
LVS 191-1:2012/AC:2015 "Terauds betona stiegrošanai. 1. dala: Metinami un nemetinami taisni stieni, rituli un attitaritula izstradajumi. Tehniskie noteikumi un atbilstibas novertešana."
LVS EN 10025-1:2006 L "Karsti velmetie izstradajumi no konstrukciju teraudiem. 1.dala: Visparigie tehniskie piegades
nosacijumi"

Aprēķināmie elementi:
Ēkas pamati.

Otrajā sadaļā „Iedarbju kopsavilkums” mezglu marķējumi un sastāvi pieņemti atbilstoši projekta AR sadaļai.
Aprēķinos pieņemto elementu šķērsgriezumu profili izvēlēti atbilstoši Preliminary drawings TF23P-30F, N.C.M. MAGNAGO

Informacija par eku/buvi:

Buvniecibas vieta: .... STADIONA IELĀ 1, DAUGAVPILĪ., LV
Ekas ekspluatacijas ilguma kategorija: .... S4 (LVS EN 1990:2003/NA:2015)
Ekas nozimiguma klase .... CC2 (LVS EN 1990:2002 un LVS EN 1991-1-7:2006)
Telpu izmantošanas raksturs .... C5 (LVS EN 1991-1-1:2003/NA:2010)
Buvniecibas darbu konstrukciju drošuma klase .... RC2 (LVS EN 1990:2002)
Buvniecibas darbu vadišanas limenis .... DSL2 (LVS EN 1990:2002)
Buvniecibas darbu uzraudzibas limenis .... IL2 (LVS EN 1990:2002).

2. Iedarbju kopsavilkums

Nesošās konstrukcijas un elementi ir aprēķināti sekojošām normatīvām slodzēm:
- Vēja slodze: - 21m/s (starp atz. 0.000-15.000) un 42.5m/s (starp atz.15.000-27.600m)

3. Vēja slodze

3.1. Vēja slodze. Ēkas daļa Nr.1

Vēja slodzes aprēķins

Ēkas daļas garums: **L =0.817 m**
Ēkas daļas platums: **B =0.817 m**
Augstākais jumta punkts: **H_1 =27.6 m**
Zemākais jumta punkts: **H_2 =23.0 m**

Vēja virziena koeficients: **C_{dir} =1**
Sezonālais koeficients: **C_{season} =1**
Varbūtības koeficients: **C_{prob} =1**

Fundamentālais vēja pamatātrums: **$v_{b,}$=42.5m/s**
Fundamentālais vēja pamatātrums: **$v_b=c_{dir}\cdot c_{season}\cdot c_{prob}\cdot v_{b,0}$ =1·1·1·42.5=42.5m/s**
Vēja blīvums: **ρ =1.25kg/m³**
Vēja spiediena rādītājs: **$q_b=\rho\cdot v_b^2/2$ =1.25/1000·42.5·42.5/2=1.129kN/m²**
Raupjuma parametri (atkarībā no novietnes raksturojuma): **z_o =0.01m**
Minimālais augstums aprēķināms (no novietnes raksturojuma): **z_{min} =1m**
Maksimālais augstums aprēķināms (rekomendējamais lielums 200): **z_{max} =200m**

Vietas koeficients:
$k_r=0.19\cdot(z_o/0.05)^{0.07}=0.19\cdot(0.01/0.05)^{0.07}=0.170$

Orogrāfiskais koeficients: **$c_o(z)$ =1**

Turbulences koeficients: **k_I =1**

Bāzes augstums: **z**

Turbulences intensitāte:
$I_v(z)=\{k_I/[c_o(z)\cdot\ln(z/z_o)]\ z_{min}\le z\le z_{max};\ k_I/[c_o(z)\cdot\ln(z_{min}/z_o)]\ z<z_{min})$

Koeficients, kurā ņemts vērā vietas tips:
$c_r(z)=\{kr\cdot\ln(z/z_o)\ z_{min}\le z\le z_{max};\ kr\cdot\ln(z_{min}/z_o)\ \ z<z_{min}\}$

Vēja vidējais ātrums: **$v_m(z)=c_r(z)\cdot c_o(z)\cdot v_b$**

Augstākais ātruma spiedes lielums: **$q_p(z)=0.5\cdot[1+7\cdot I_v(z)]\cdot\rho\cdot v_m^2(z)$**

Ekspozīcijas koeficients: $c_e(z)=q_p(z)/q_b$

Aerodinamiskais koeficients priekš rezultējošā spiediena: $c_{p,net}$ / Cf

Vēja spiediens, kas iedarbojas uz ēkas ārējo virsmu w_{ek}, kN/m²:

$$w_{ek}=c_e(z)\cdot c_{p,net}\cdot q_b$$

Vēja spiediens, kas darbojas uz ēkas ārējo virsmu w_{ed}, kN/m²
(aprēķina vērtība):

$$w_{ed}=w_{ek}\cdot \gamma_f$$

Vēja slodze, kas darbojas uz konstrukciju vai konstrukcijas elementu **F_w,** kN

$$F_w=c_s c_d\cdot c_f\cdot q_p(Z_0)\cdot A_{ref}$$

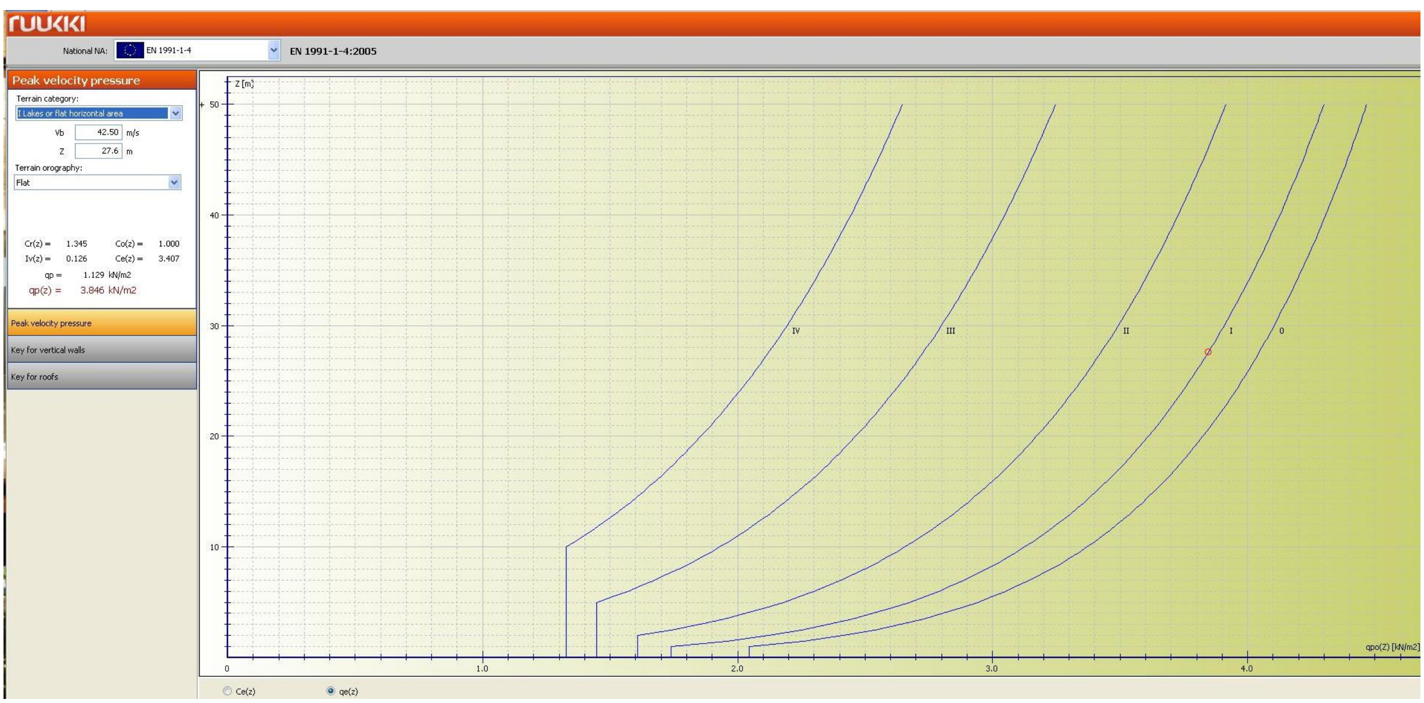
Konstruktīvais koeficients

$c_s c_{d=1}$

Aerodinamiskais koeficients $c_{f=1.9}$

Vēja spiediens pie maksimālā ātruma $q_p(Z_0)$

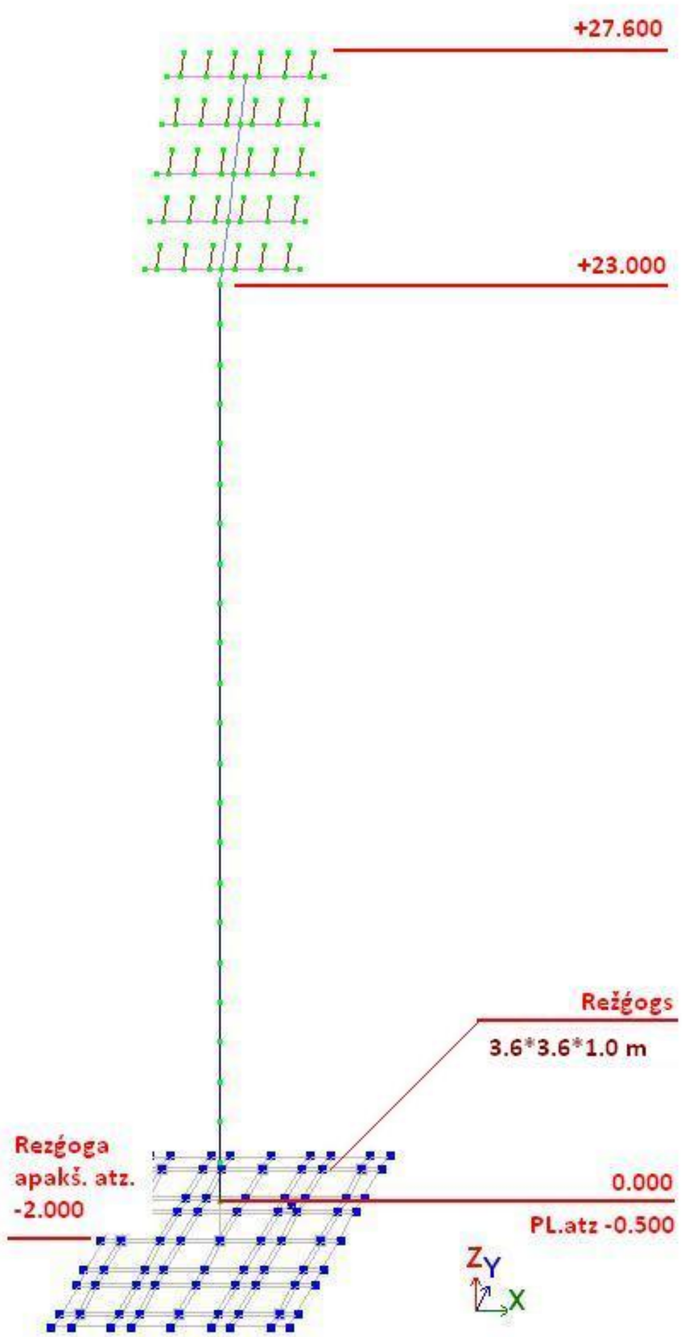
Konstrukcijas vai konstruktīva elementa bāzes laukums A_{ref}



TAB. 1

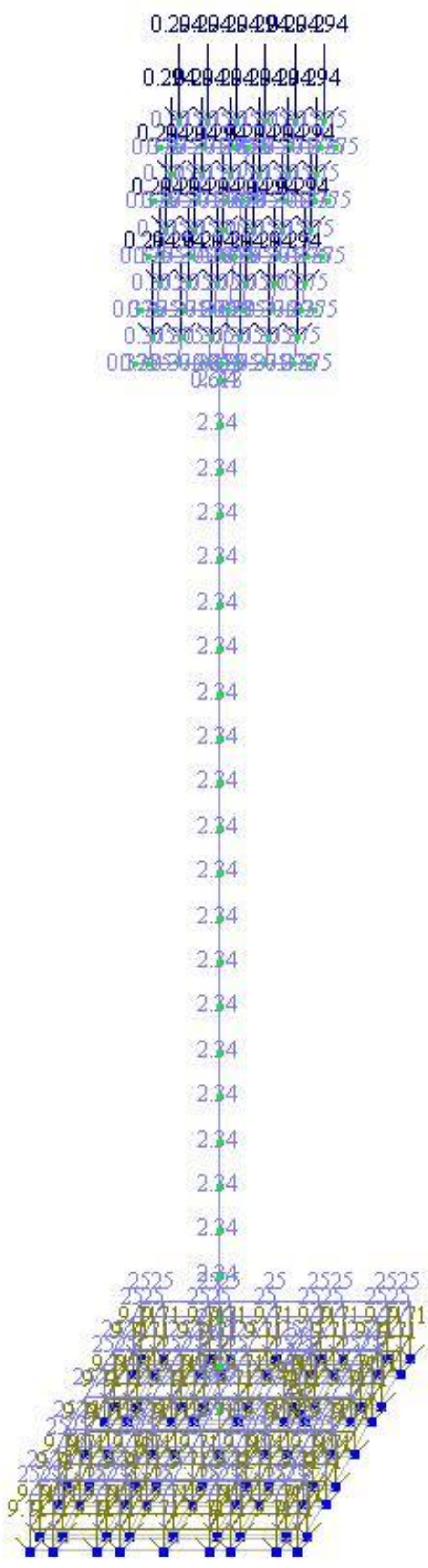
4. Slodzes un piepūles elementos

Aksonometriskās shēmas



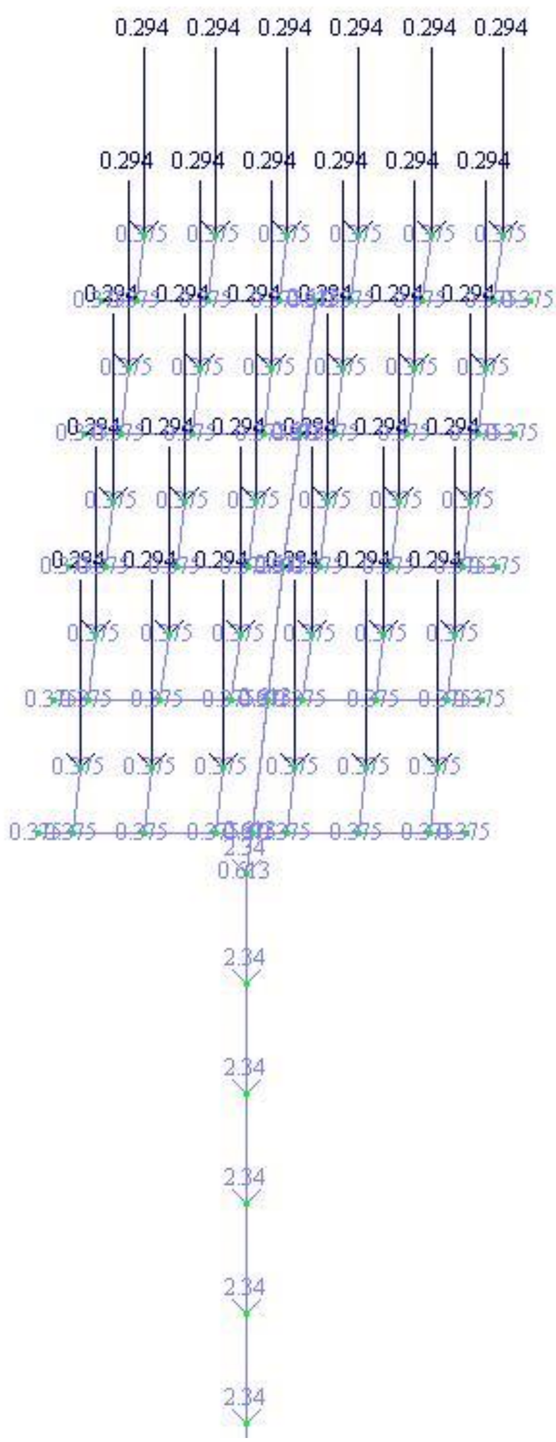
Att. 1.

4.1. Kombinācija Nr.1. Pašsvars - kN



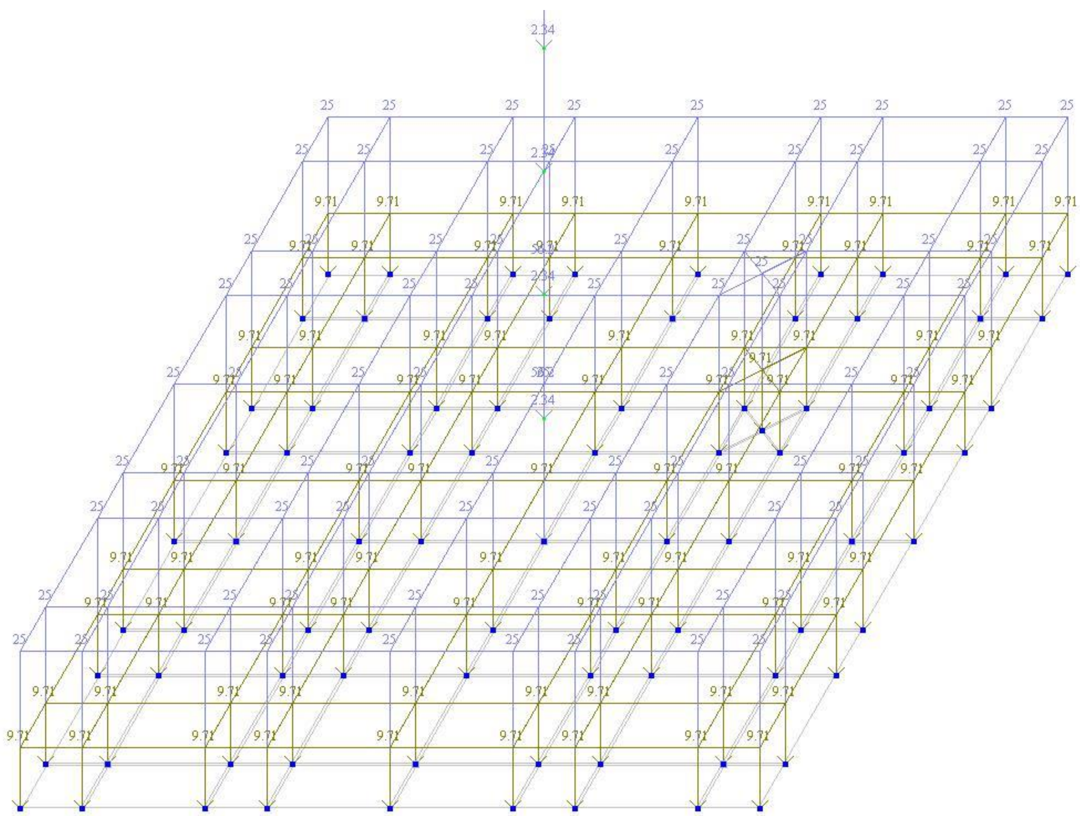
Att. 2.

4.1.1. Kombinācija Nr.1. Pašsvars (augšējā daļa) - kN



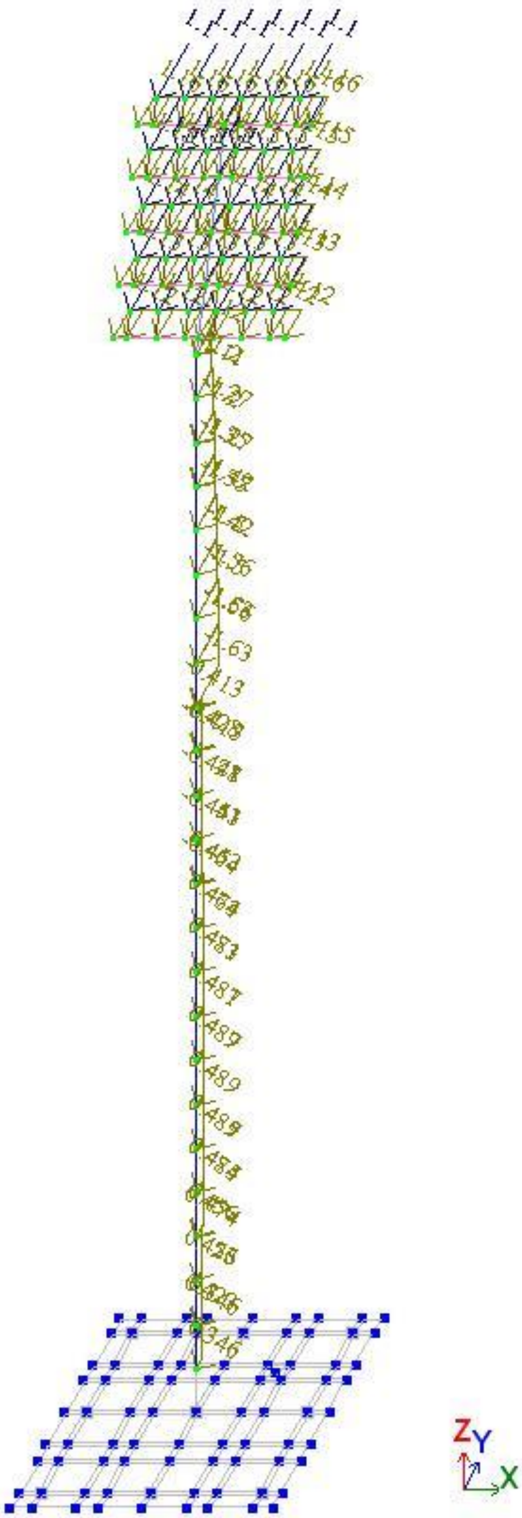
Att. 3.

4.1.2. Kombinācija Nr.1. Pašsvars (apakšējā daļa) - kN



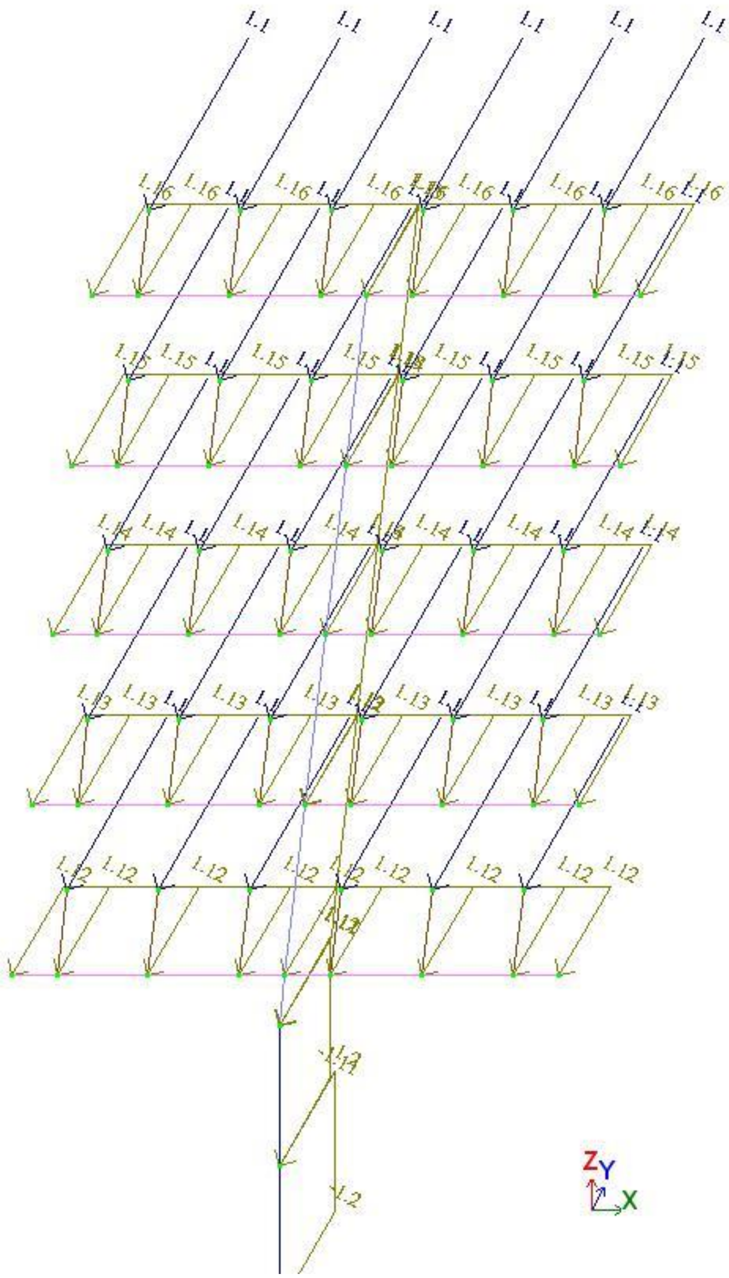
Att. 4.

4.2. Kombinācija Nr.2. Vēja slodze - kN



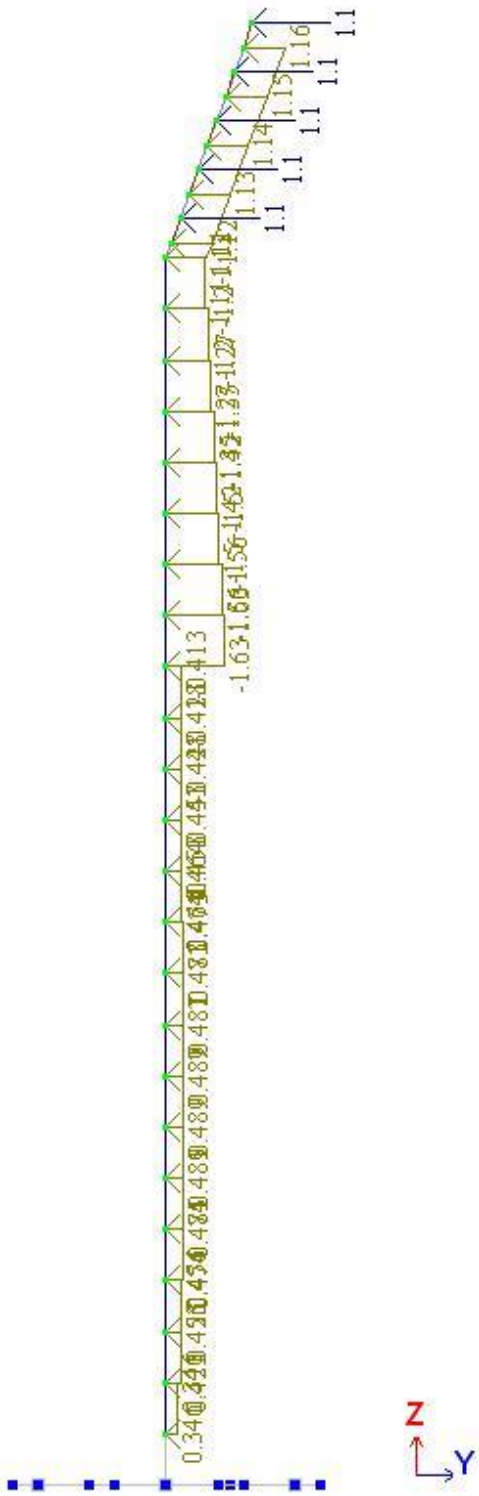
Att. 5.

4.2.1. Kombinācija Nr.2. Vēja slodze (augšējā daļa) - kN



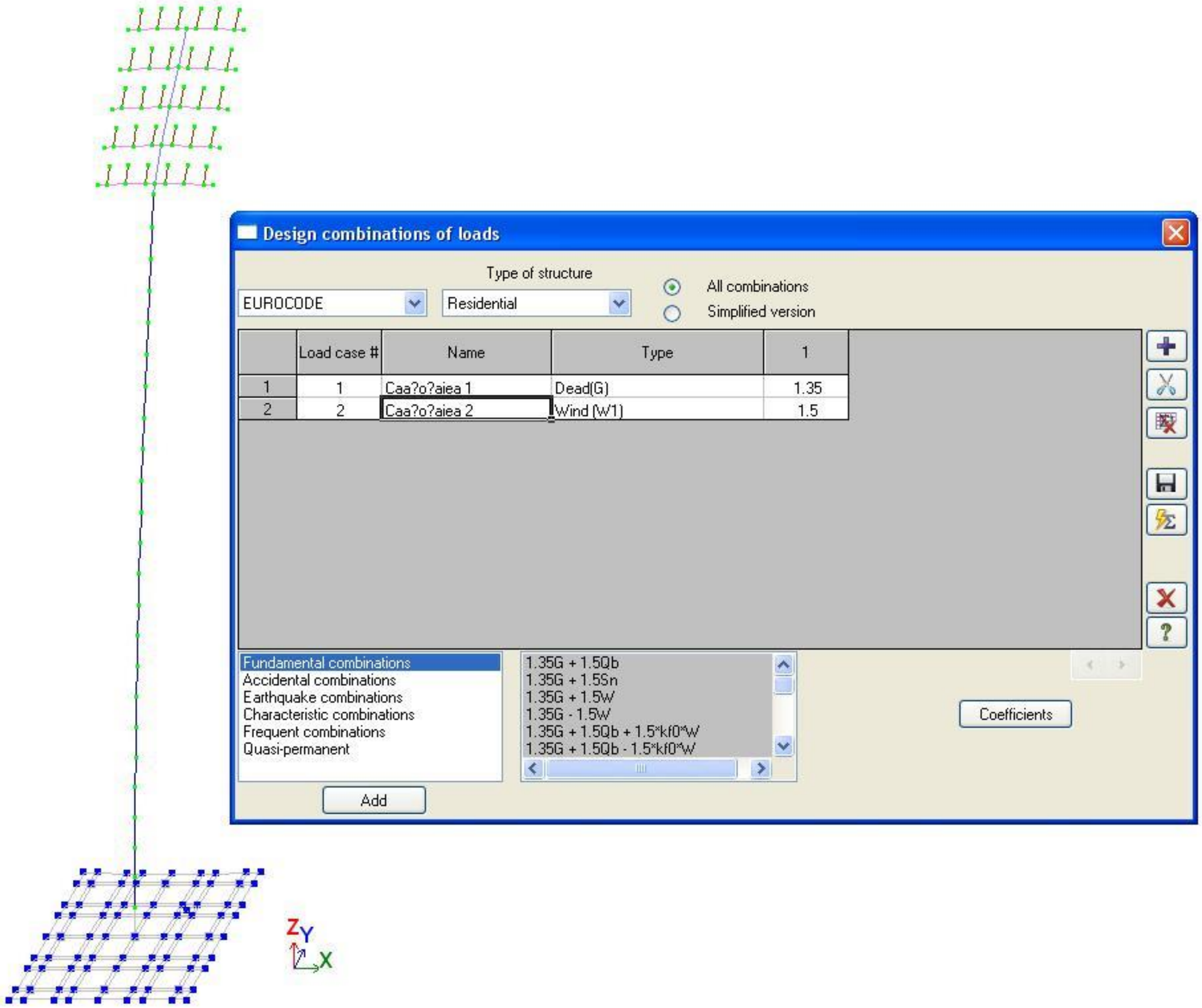
Att. 6.

4.2.2. Kombinācija Nr.2. Vēja slodze (sānu skats) - kN



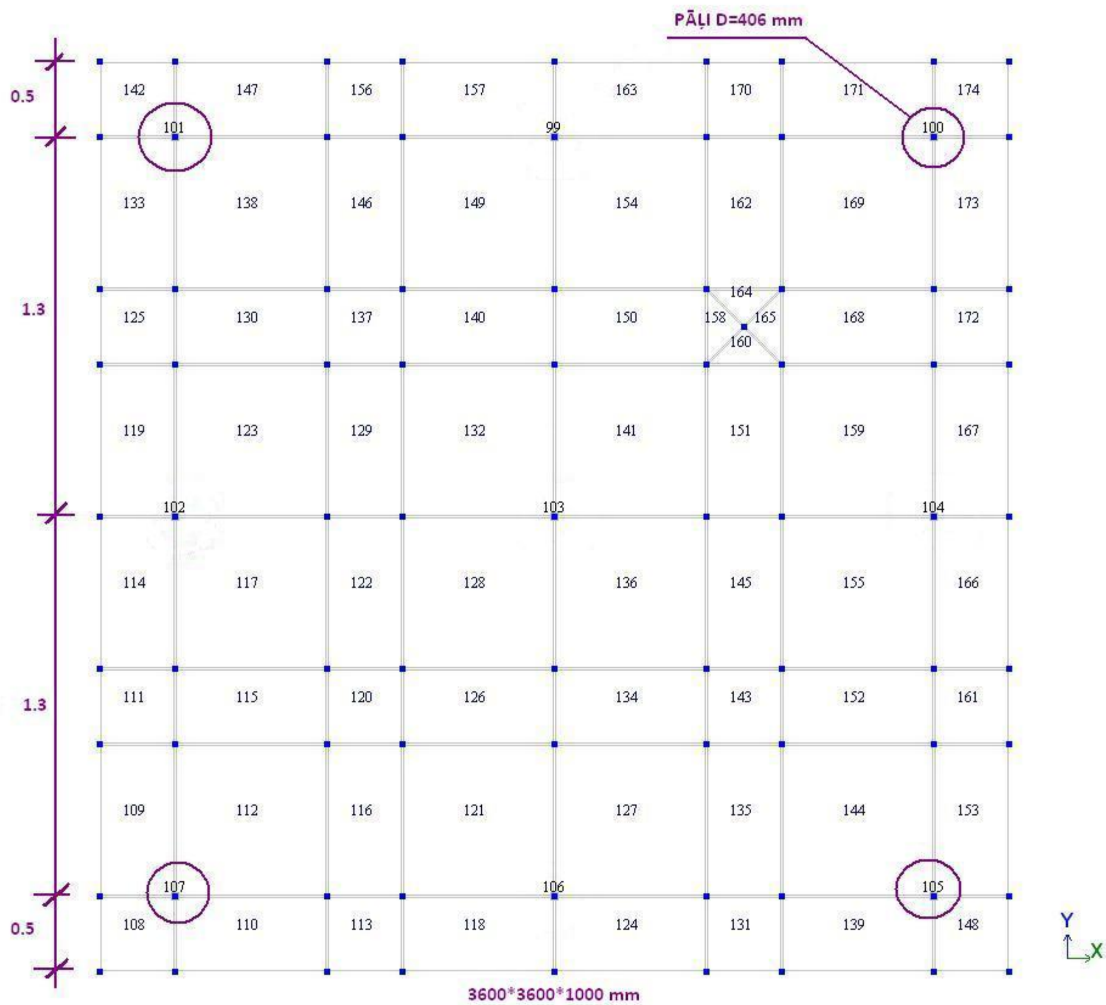
Att. 7.

5. Slodžu kombinācijas



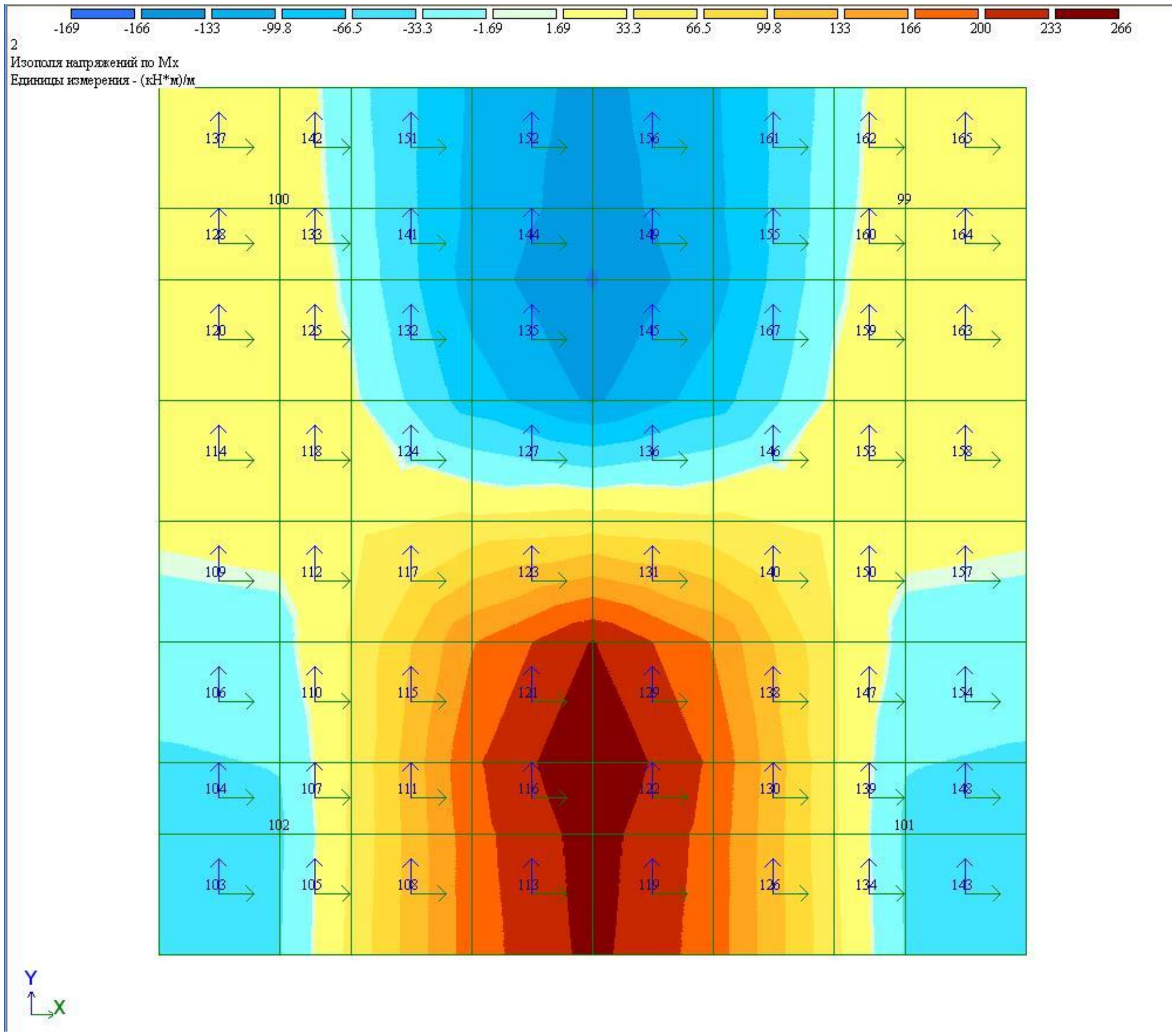
Att. 8.

6. Režģoga plāns



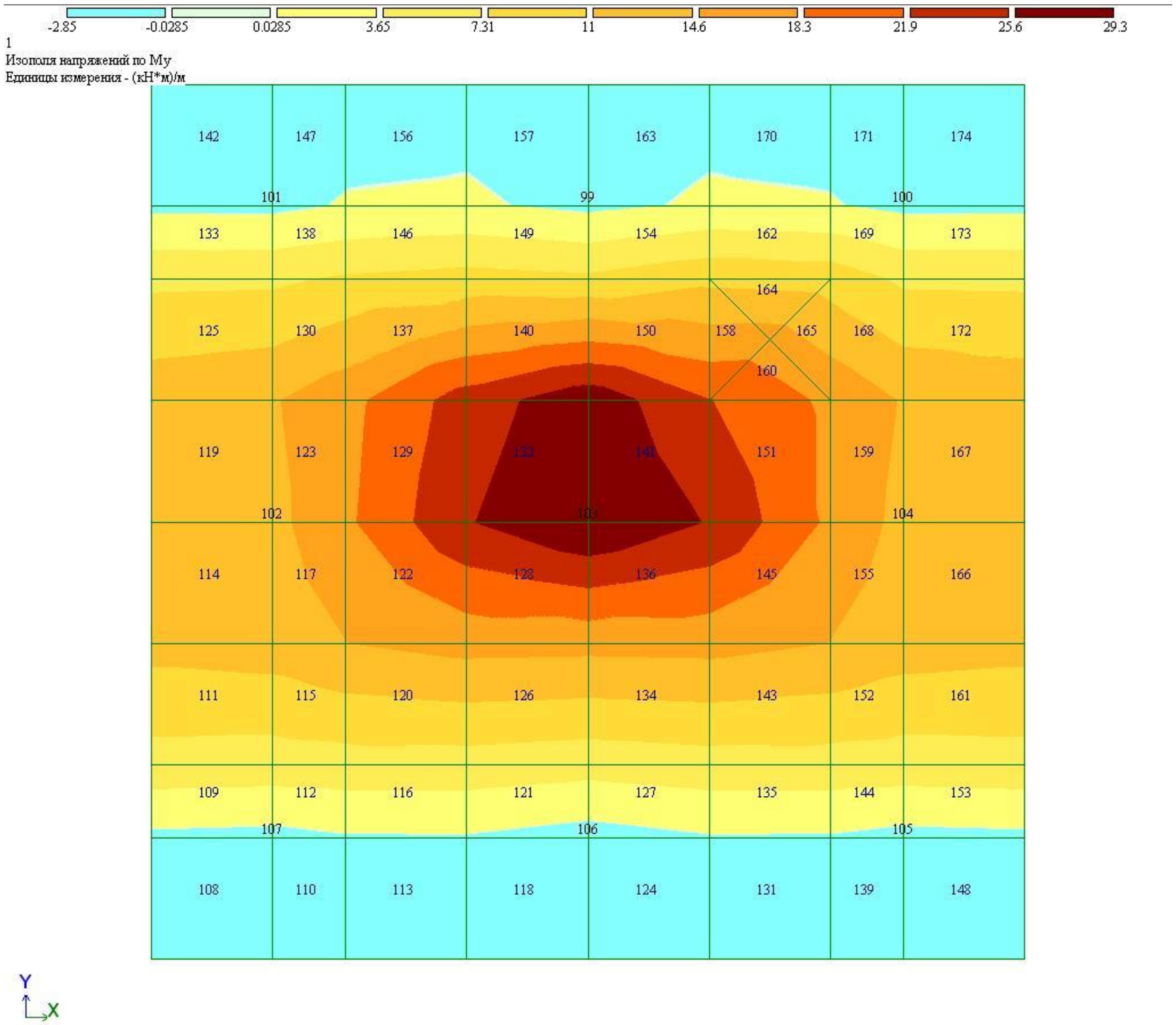
Att. 9.

6.1. Režģogi. Lieces moments Mx



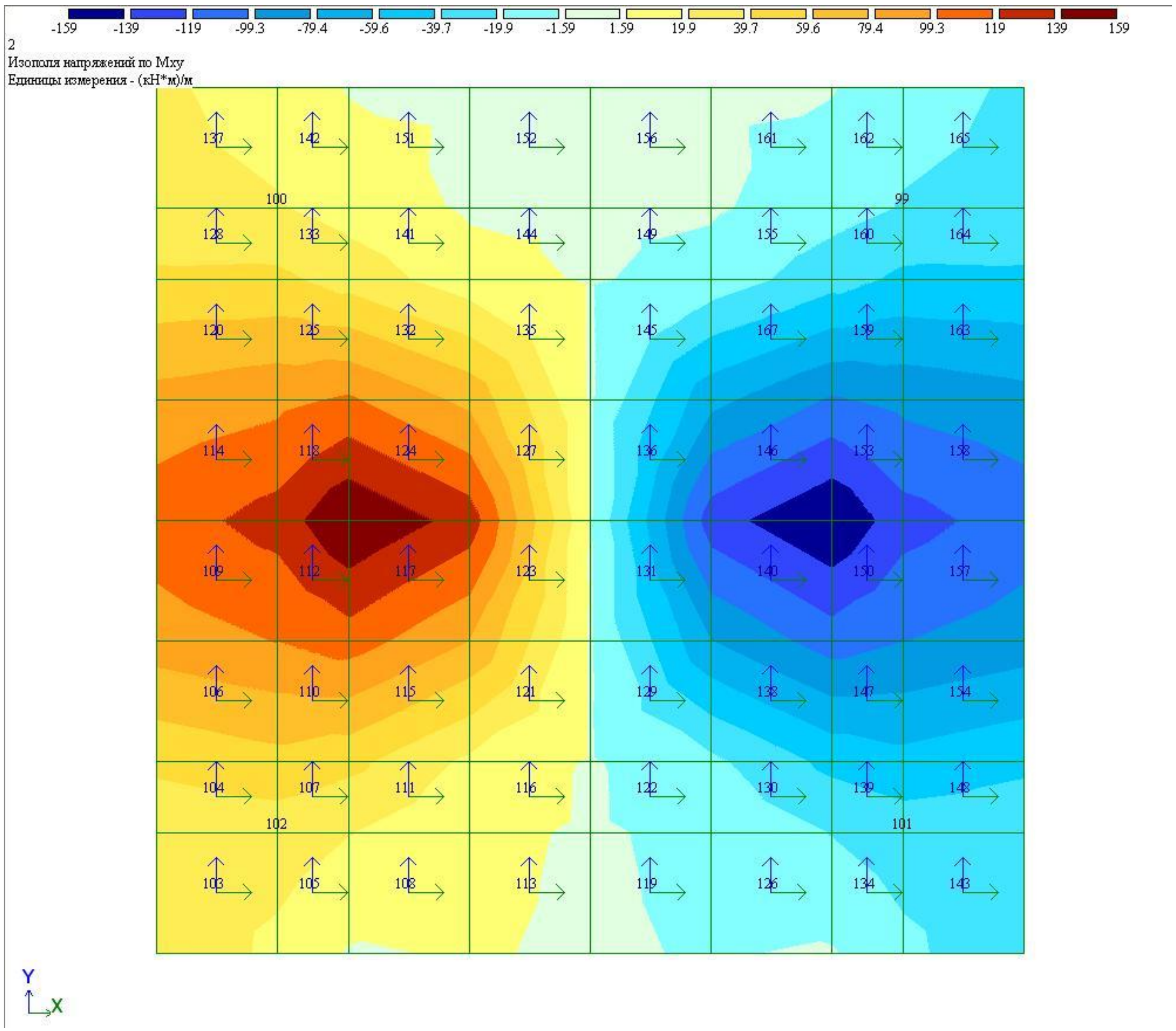
Att. 10

6.2. Režģogi. Lieces moments My



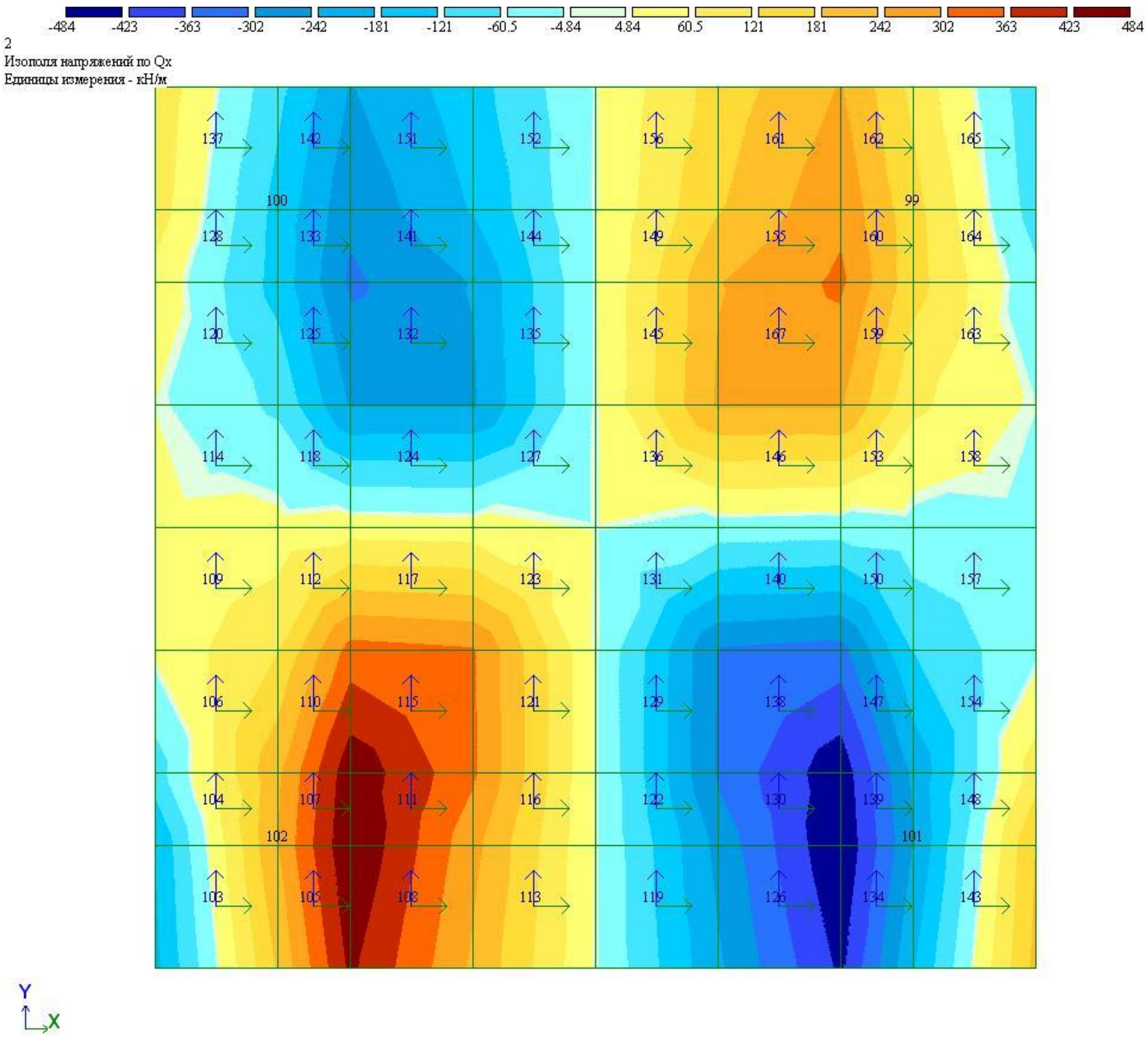
Att. 11.

6.3. Režģogi. Lieces moments Mxy



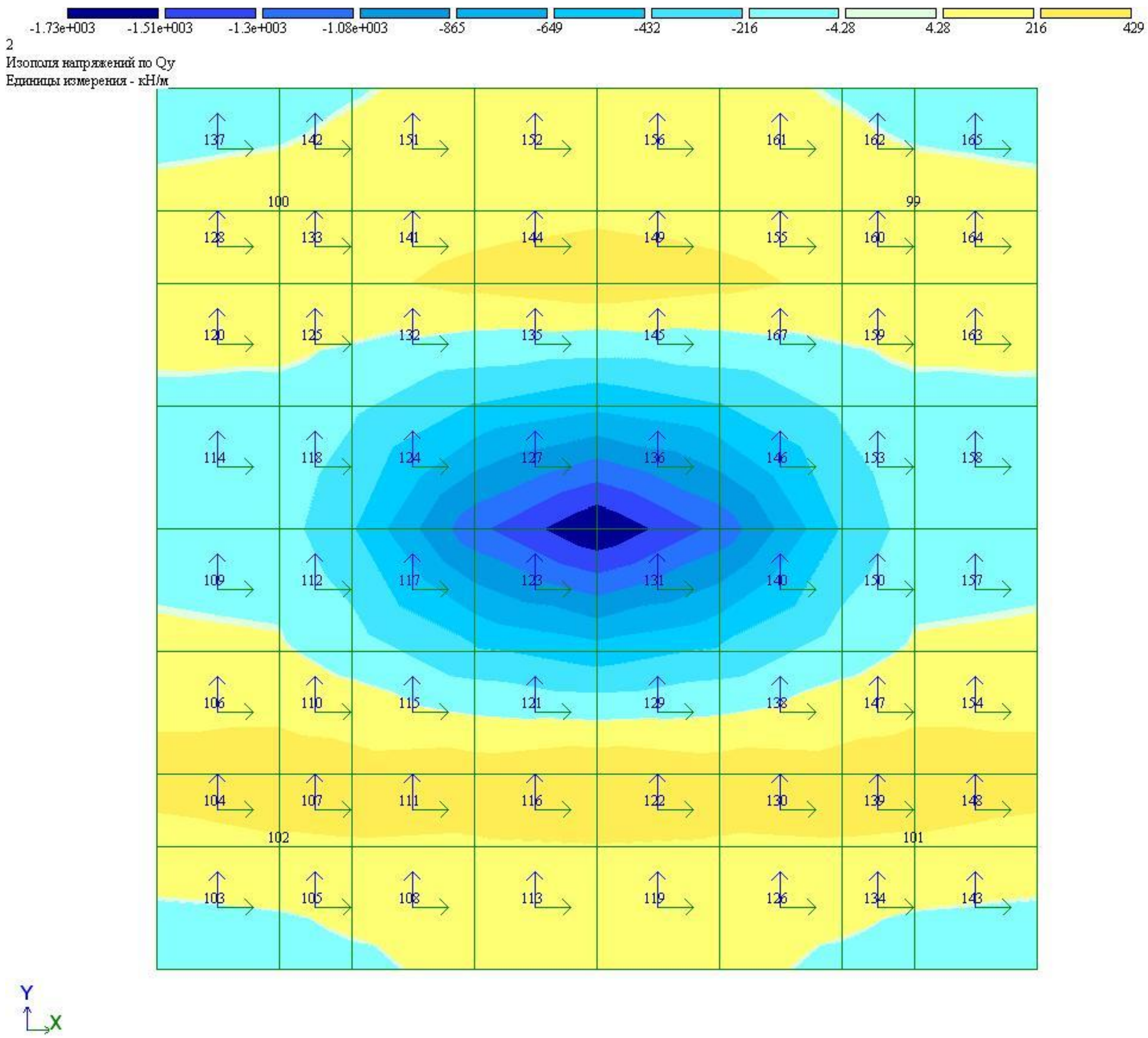
Att. 12

6.4. Režģogi. Šķērsspēks Qx



Att. 13.

6.5. Režģogi. Šķērsspēks Qy



Att. 14.

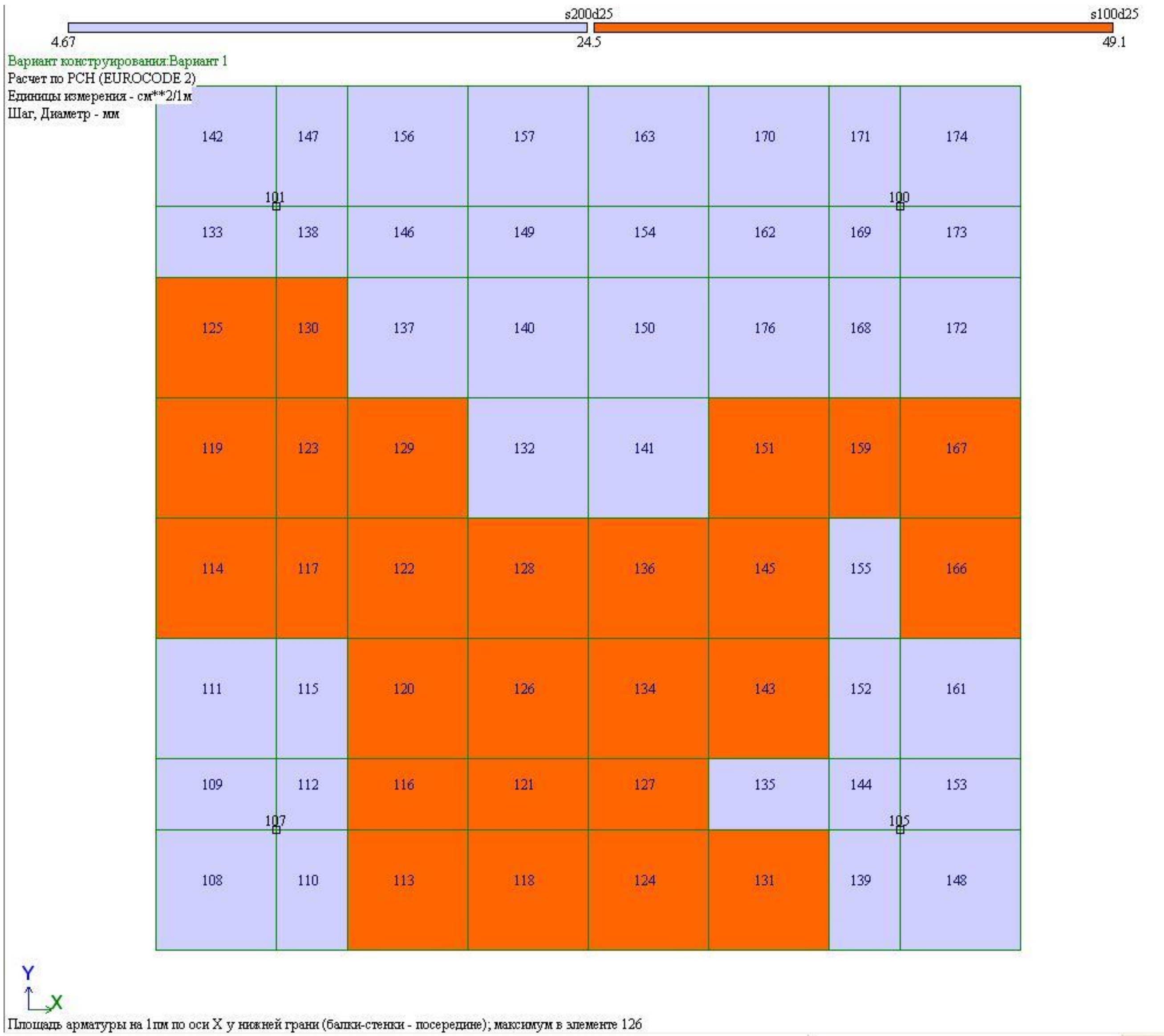
6.6. Režģogi. Augšējais stiegrojums X ass virzienā

Att. 15.

6.7. Režģogi. Augšējais stiegrojums Y ass virzienā

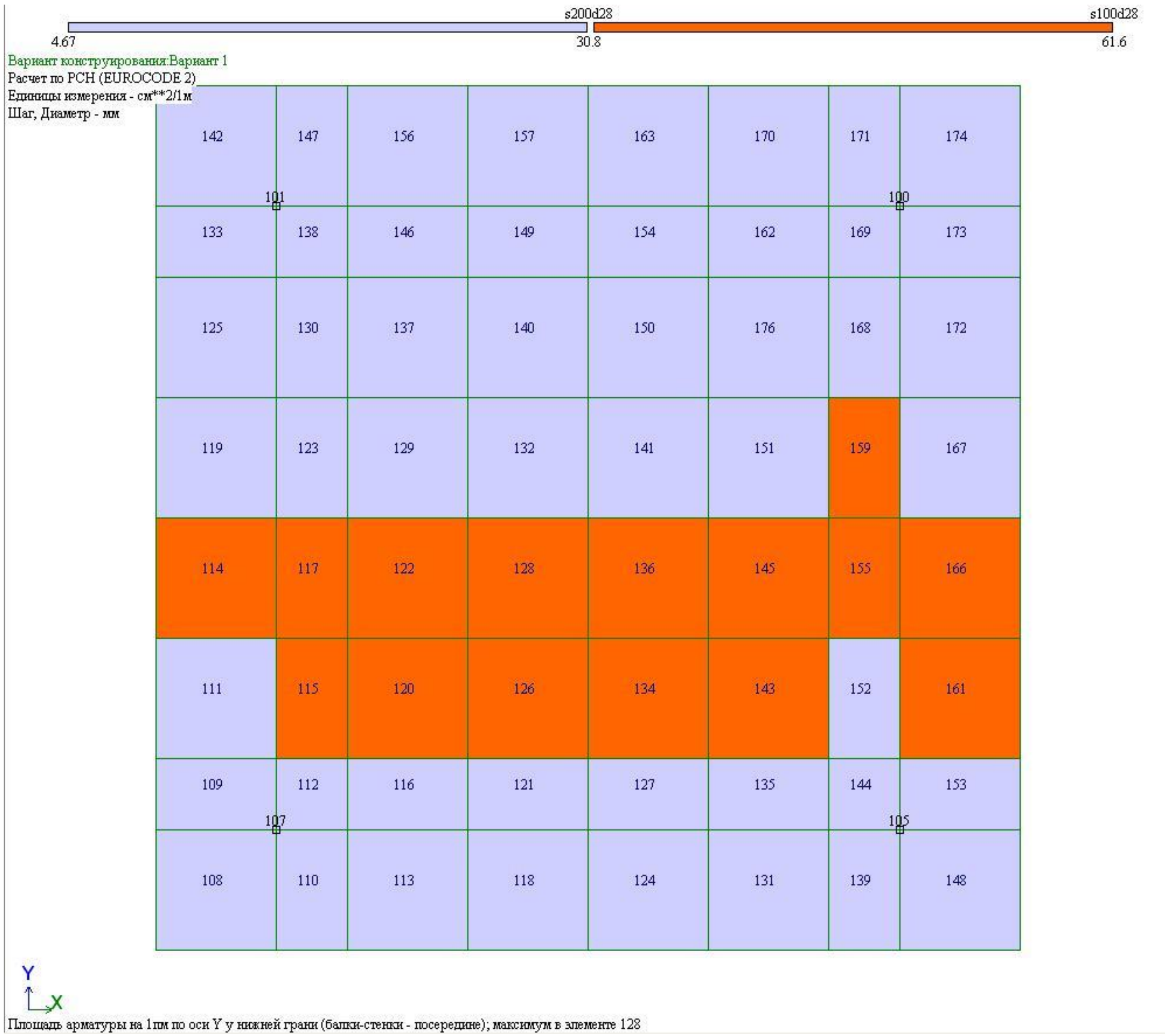
Att. 16

6.8. Režģogi. Apakšējais stiegrojums X ass virzienā



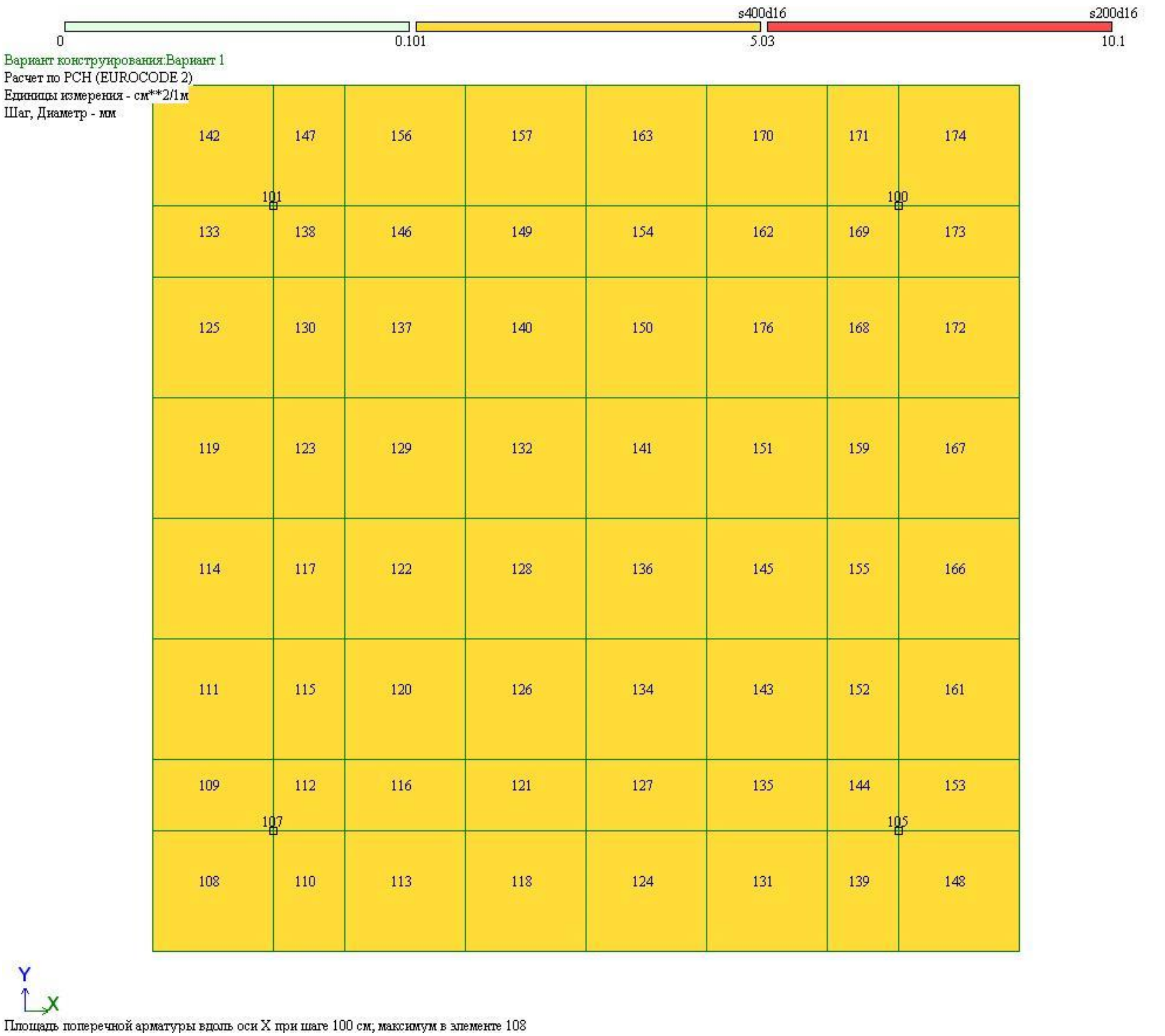
Att. 17

6.9. Režģogi. Apakšējais stiegrojums Y ass virzienā



Att. 18

6.10. Režģogi. Šķērsstiegrojums X ass virzienā



Att. 19.

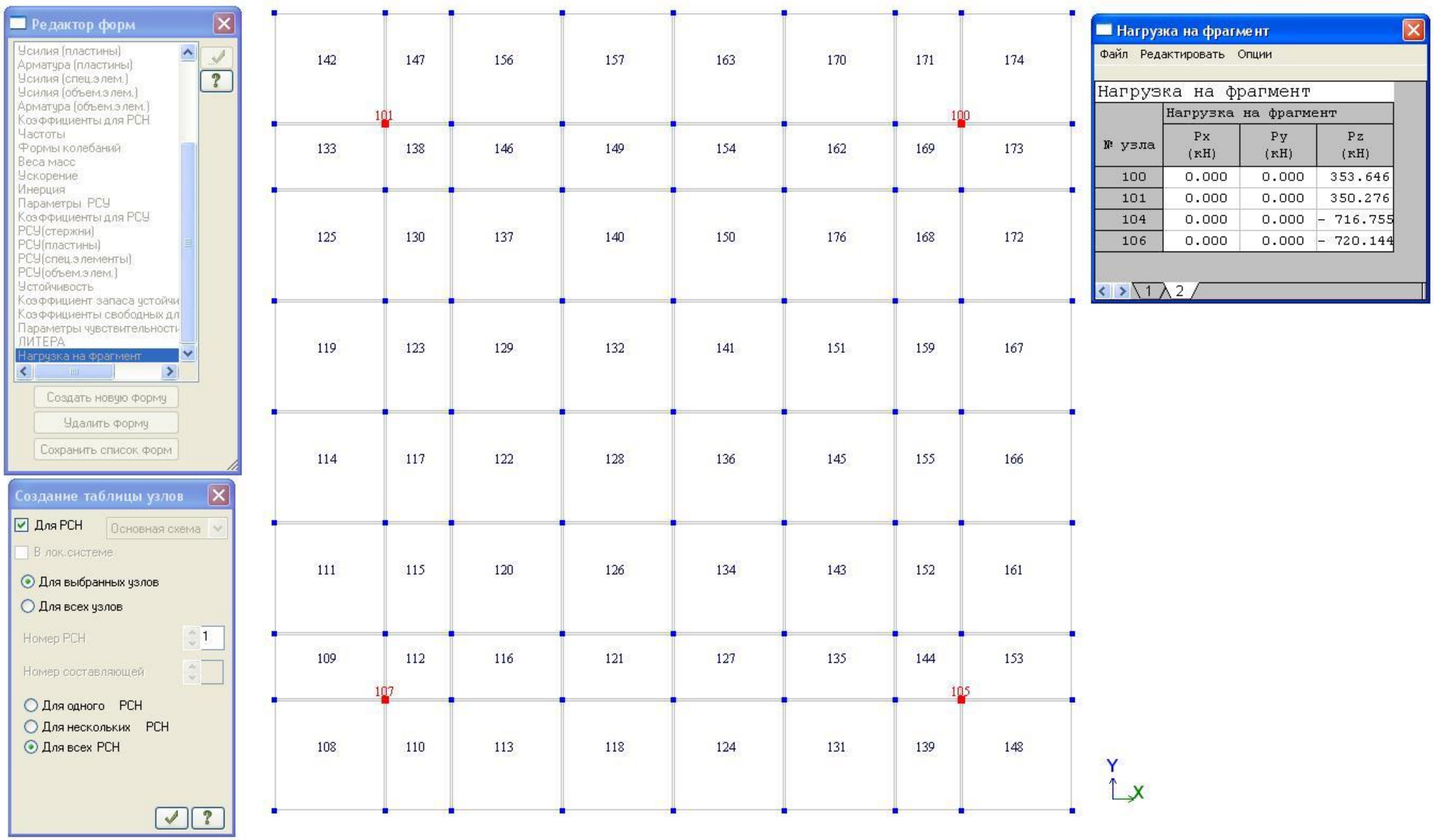
6.11. Režģogi. Šķērsstiegrojums Y ass virzienā

Att. 20.

7. Slodzes uz pāļiem

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}"+"\gamma_{P}P"+"\gamma_{Q,1}Q_{k,1}"+"\sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i}$$

PCH-1 – 1,35*G+1.5*W1



№ узла	Px (кН)	Py (кН)	Pz (кН)
100	0.000	0.000	353.646
101	0.000	0.000	350.276
104	0.000	0.000	- 716.755
106	0.000	0.000	- 720.144

Att. 21.

8. Pāļu nestspējas datu apkopojums, pāļu nestspējas analīze, pamatojoties uz ģeoloģiskajiem datiem (ģeo. urbumi) un pāļu ģeometriskajiem parametriem (garums un diametrs). Pāļa parametru izvēle "0" cikla projektam.

N.p.k.	Pāļu raksturojums - d,mm / L,m	5.CPT
		$R_{c;d}$, kN
1	400/10.0	604
2	400/12.5	1200
3	600/10.0	1159
4	600/12.5	2105

8.1. Aprēķina pāļa spiedes pretestība, kN. CPT.5. – 1.VARIANTS

Objekta nosaukums: Būvprojekta izstrāde, saskaņošana būvvaldē un autoruzraudzība būvdarbu veikšanas laikā tribīņu izbūvei un moduļu ēku novietošanai pie esošā futbola laukuma, Stadiona ielā 1, Daugavpilī.

Pāļa izvietojums:

$R_{c;d}=F_{c;d;max}=R_{c;k}/\gamma_t=$ **603.7** kN

1. VISPARĪGĀ DAĻA

1.1. Viena pāļa nestspējas aprēķins - pāļa tips: **FDP**

1.2. Pāļa garums, m **10**

1.3. Pāļa diametrs, m **0.4**

1.4. Ģeotehniski dati tiek pieņemti pēc: **SIA „BG Invest" 18/01-01lig/PR**

1.4.1. Ģeotehniskais punkts - **CPT 5**

1.5. Projektēšanas gaitā izmantotās normatīvu saraksts:

1.5.1. **EN 1997-1:2004.** Eurocode 7: Geotehnical design - Part 1: General rules. **- [2]**

1.5.2. **EN 1997-2:2004.** Eurocode 7: Geotehnical design - Part 2: Ground investigation and testing. **- [3]**

2. PĀĻU APRĒĶINS

2.1. Maksimālā pāļa spiedes pretestība, kN	$F_{max} = F_{max,base} + F_{max,shaft} =$	**929.73**
2.2. Pāļa apakšējā gala nestspēja, kN	$F_{max,base} = A_{base} \times p_{max,base}=$	**587.79**
2.3. Pāļa sānu virsmas nestspēja	$F_{max,shaft}= C_p \times \int_0^{\Delta L} p_{max,shaft,z} dz=$	**341.94**
2.3.1. Uz grunts balstītā pāļa apakšējā gala laukums, m^2	$A_{base}=\pi r^2=$	**0.126**
2.3.2. Pāļa kāta aploces garums, m	$C_p=2\pi r=$	**1.26**
2.3.3. Pretestība zem pāļa apakšējā gala, MPa	$p_{max,base}=$	4.68
2.3.4. Pāļa sānu virsmas berzes pretestība dziļumā z, MPa	$p_{max,shaft,z}=\alpha_s \times q_{c;z;a}=$	**sk.1.tab.**
2.3.4.1. Pāļa sānu virsmas koeficients, α_s	$\alpha_s=$	**0.009**
2.3.4.2. Pārveidotā q_c, **MPa** vērtība dziļumā **z, m -** $q_{c;z;a}$, **MPa**	$q_{c;z;a}=$	**sk.1.tab.**

2.3.4.3. Pretestība zem pāļa apakšējā gala, MPa

$$p_{max;base}=0.5\cdot\alpha_p\cdot\beta\cdot s\cdot\{(q_{c;I;mean}+q_{c;II;mean})/2 + q_{c;III;mean}\}= \quad \mathbf{4.68}$$

$$p_{max;base} \leq 15 \text{ MPa}$$

2.3.4.4. Pāļa klases koeficients	$\alpha_p=$	**0.9**
2.3.4.5. Pāļa gala formas koeficients	$\beta=$	**0.6**
2.3.4.6. Pāļa pēdas formas koeficients	$s=$	**1**

2.3.4.7.	Mpa	$q_{c;I;mean}=1/d_{crit}\cdot\int_0^{dcrit}q_{c;I}dz =$ $0.7\cdot D_{eq}<d_{crit}<4\cdot D_{eq}$	14.57
2.3.4.8.	Mpa	$q_{c;II;mean}=1/d_{crit}\cdot\int^0_{dcrit}q_{c;II}dz =$	11.60
2.3.4.9.	Mpa	$q_{c;III;mean}=1/d_{crit}\cdot\int^{-8Deq}_0 q_{c;III}dz =$	4.25

1. tabula. $F_{max,shaft}$ aprēķins

Dziļums, m	q_c, MPa	Pielīdzinātā $q_{c;z;a}$ vērtība, MPa	α_s	C_p, m	$P_{max,shaft,z}$, kPa	$F_{max,shaft}$ - i-tajā slānī, kN	Apzīm.
0	[1]	p.2.3.4.2.	p.2.3.4.1.	p.2.3.2.	p.2.3.4.	p.2.3.	
0.5	2.13	2.13	0.009	1.26	19.18	12.0	1'''
0.55	2.74	2.74	0.009	1.26	24.64	1.5	
0.6	5.54	5.54	0.009	1.26	49.89	3.1	
0.65	6.47	6.47	0.009	1.26	58.19	3.7	
0.7	6.69	6.69	0.009	1.26	60.23	3.8	
0.75	6.62	6.62	0.009	1.26	59.58	3.7	1''
0.8	6.38	6.38	0.009	1.26	57.42	3.6	
0.85	5.88	5.88	0.009	1.26	52.96	3.3	
0.9	5.38	5.38	0.009	1.26	48.46	3.0	
0.95	4.72	4.72	0.009	1.26	42.47	2.7	
1	4.16	4.16	0.009	1.26	37.46	2.4	
1.05	3.67	3.67	0.009	1.26	33.03	2.1	
1.1	0.80	0.80	0.009	1.26	7.22	0.5	1'''
1.15	3.16	3.16	0.009	1.26	28.45	1.8	
1.2	3.32	3.32	0.009	1.26	29.92	1.9	
1.25	4.65	4.65	0.009	1.26	41.88	2.6	
1.3	13.55	13.55	0.009	1.26	121.99	7.7	
1.35	15.61	15.00	0.009	1.26	135.00	8.5	
1.4	16.93	15.00	0.009	1.26	135.00	8.5	
1.45	18.69	15.00	0.009	1.26	135.00	8.5	1'
1.5	12.91	12.91	0.009	1.26	116.17	7.3	
1.55	10.36	10.36	0.009	1.26	93.28	5.9	
1.6	6.20	6.20	0.009	1.26	55.80	3.5	7''o
1.65	3.56	3.56	0.009	1.26	32.06	2.0	

1.7	5.24	5.24	0.009	1.26	47.15	3.0	
1.75	5.53	5.53	0.009	1.26	49.79	3.1	
1.8	5.53	5.53	0.009	1.26	49.79	3.1	
1.85	5.67	5.67	0.009	1.26	51.03	3.2	
1.9	5.81	5.81	0.009	1.26	52.28	3.3	
1.95	6.21	6.21	0.009	1.26	55.90	3.5	
2	4.91	4.91	0.009	1.26	44.17	2.8	
2.05	3.82	3.82	0.009	1.26	34.37	2.2	7'''o
2.1	3.30	3.30	0.009	1.26	29.73	1.9	
2.15	4.94	4.94	0.009	1.26	44.48	2.8	
2.2	2.86	2.86	0.009	1.26	25.70	1.6	
2.25	3.32	3.32	0.009	1.26	29.85	1.9	
2.3	4.55	4.55	0.009	1.26	40.94	2.6	
2.35	2.21	2.21	0.009	1.26	19.85	1.2	
2.4	2.44	2.44	0.009	1.26	21.99	1.4	
2.45	2.16	2.16	0.009	1.26	19.41	1.2	
2.5	1.88	1.88	0.009	1.26	16.94	1.1	15o
2.55	1.79	1.79	0.009	1.26	16.13	1.0	
2.6	1.97	1.97	0.009	1.26	17.72	1.1	
2.65	1.98	1.98	0.009	1.26	17.85	1.1	
2.7	1.70	1.70	0.009	1.26	15.33	1.0	
2.75	1.28	1.28	0.009	1.26	11.50	0.7	
2.8	0.97	0.97	0.009	1.26	8.77	0.6	
2.85	0.66	0.66	0.009	1.26	5.94	0.4	
2.9	0.53	0.53	0.009	1.26	4.77	0.3	
2.95	0.52	0.52	0.009	1.26	4.64	0.3	
3	0.49	0.49	0.009	1.26	4.45	0.3	
3.05	0.48	0.48	0.009	1.26	4.33	0.3	
3.1	0.24	0.24	0.009	1.26	2.15	0.1	
3.15	0.44	0.44	0.009	1.26	3.94	0.2	
3.2	0.42	0.42	0.009	1.26	3.77	0.2	
3.25	0.44	0.44	0.009	1.26	3.95	0.2	
3.3	0.42	0.42	0.009	1.26	3.80	0.2	
3.35	0.41	0.41	0.009	1.26	3.72	0.2	
3.4	0.39	0.39	0.009	1.26	3.47	0.2	
3.45	0.39	0.39	0.009	1.26	3.54	0.2	
3.5	0.38	0.38	0.009	1.26	3.40	0.2	
3.55	0.35	0.35	0.009	1.26	3.19	0.2	
3.6	0.36	0.36	0.009	1.26	3.22	0.2	
3.65	0.40	0.40	0.009	1.26	3.64	0.2	

3.7	0.45	0.45	0.009	1.26	4.01	0.3	
3.75	0.44	0.44	0.009	1.26	3.92	0.2	
3.8	0.40	0.40	0.009	1.26	3.62	0.2	
3.85	0.38	0.38	0.009	1.26	3.43	0.2	
3.9	0.38	0.38	0.009	1.26	3.38	0.2	
3.95	0.38	0.38	0.009	1.26	3.38	0.2	
4	0.37	0.37	0.009	1.26	3.31	0.2	
4.05	0.36	0.36	0.009	1.26	3.27	0.2	
4.1	0.36	0.36	0.009	1.26	3.27	0.2	
4.15	0.37	0.37	0.009	1.26	3.31	0.2	
4.2	0.31	0.31	0.009	1.26	2.83	0.2	
4.25	0.31	0.31	0.009	1.26	2.77	0.2	
4.3	0.31	0.31	0.009	1.26	2.76	0.2	
4.35	0.31	0.31	0.009	1.26	2.81	0.2	
4.4	0.37	0.37	0.009	1.26	3.37	0.2	
4.45	0.43	0.43	0.009	1.26	3.87	0.2	
4.5	0.47	0.47	0.009	1.26	4.19	0.3	
4.55	0.51	0.51	0.009	1.26	4.57	0.3	
4.6	0.50	0.50	0.009	1.26	4.47	0.3	
4.65	0.50	0.50	0.009	1.26	4.47	0.3	
4.7	0.46	0.46	0.009	1.26	4.11	0.3	
4.75	0.48	0.48	0.009	1.26	4.32	0.3	
4.8	0.50	0.50	0.009	1.26	4.50	0.3	
4.85	0.53	0.53	0.009	1.26	4.74	0.3	
4.9	0.52	0.52	0.009	1.26	4.64	0.3	
4.95	0.47	0.47	0.009	1.26	4.25	0.3	
5	0.44	0.44	0.009	1.26	3.96	0.2	
5.05	0.44	0.44	0.009	1.26	3.94	0.2	3
5.1	0.42	0.42	0.009	1.26	3.78	0.2	
5.15	0.49	0.49	0.009	1.26	4.40	0.3	
5.2	0.52	0.52	0.009	1.26	4.70	0.3	
5.25	0.55	0.55	0.009	1.26	4.97	0.3	
5.3	0.80	0.80	0.009	1.26	7.21	0.5	
5.35	1.71	1.71	0.009	1.26	15.40	1.0	
5.4	2.23	2.23	0.009	1.26	20.03	1.3	
5.45	1.98	1.98	0.009	1.26	17.79	1.1	
5.5	1.40	1.40	0.009	1.26	12.59	0.8	
5.55	1.04	1.04	0.009	1.26	9.37	0.6	
5.6	0.86	0.86	0.009	1.26	7.74	0.5	
5.65	1.06	1.06	0.009	1.26	9.51	0.6	

5.7	1.66	1.66	0.009	1.26	14.90	0.9	
5.75	2.44	2.44	0.009	1.26	21.93	1.4	7'''
5.8	3.26	3.26	0.009	1.26	29.31	1.8	
5.85	4.16	4.16	0.009	1.26	37.46	2.4	
5.9	4.80	4.80	0.009	1.26	43.20	2.7	
5.95	5.49	5.49	0.009	1.26	49.37	3.1	7''
6	5.83	5.83	0.009	1.26	52.45	3.3	
6.05	6.21	6.21	0.009	1.26	55.90	3.5	
6.1	6.05	6.05	0.009	1.26	54.44	3.4	
6.15	5.79	5.79	0.009	1.26	52.09	3.3	
6.2	5.64	5.64	0.009	1.26	50.73	3.2	$-8D_{eq}$
6.25	5.45	5.45	0.009	1.26	49.04	3.1	7''
6.3	5.15	5.15	0.009	1.26	46.39	2.9	
6.35	5.07	5.07	0.009	1.26	45.67	2.9	
6.4	4.98	4.98	0.009	1.26	44.80	2.8	
6.45	4.54	4.54	0.009	1.26	40.83	2.6	
6.5	3.87	3.87	0.009	1.26	34.81	2.2	
6.55	5.10	5.10	0.009	1.26	45.87	2.9	
6.6	5.82	5.82	0.009	1.26	52.41	3.3	
6.65	6.66	6.66	0.009	1.26	59.92	3.8	
6.7	7.33	7.33	0.009	1.26	66.00	4.1	
6.75	7.69	7.69	0.009	1.26	69.24	4.3	
6.8	7.20	7.20	0.009	1.26	64.79	4.1	
6.85	5.90	5.90	0.009	1.26	53.13	3.3	
6.9	5.29	5.29	0.009	1.26	47.65	3.0	
6.95	5.51	5.51	0.009	1.26	49.55	3.1	
7	6.51	6.51	0.009	1.26	58.63	3.7	
7.05	6.94	6.94	0.009	1.26	62.43	3.9	
7.1	6.43	6.43	0.009	1.26	57.86	3.6	
7.15	5.85	5.85	0.009	1.26	52.65	3.3	
7.2	5.32	5.32	0.009	1.26	47.90	3.0	
7.25	4.74	4.74	0.009	1.26	42.67	2.7	7'''o
7.3	3.83	3.83	0.009	1.26	34.51	2.2	
7.35	3.58	3.58	0.009	1.26	32.25	2.0	
7.4	3.44	3.44	0.009	1.26	30.99	1.9	
7.45	3.21	3.21	0.009	1.26	28.86	1.8	
7.5	2.60	2.60	0.009	1.26	23.42	1.5	
7.55	1.83	1.83	0.009	1.26	16.50	1.0	7''''o
7.6	2.42	2.42	0.009	1.26	21.75	1.4	
7.65	2.71	2.71	0.009	1.26	24.36	1.5	

7.7	2.47	2.47	0.009	1.26	22.26	1.4	
7.75	1.50	1.50	0.009	1.26	13.50	0.8	
7.8	1.58	1.58	0.009	1.26	14.24	0.9	
7.85	2.61	2.61	0.009	1.26	23.51	1.5	
7.9	1.91	1.91	0.009	1.26	17.19	1.1	
7.95	1.40	1.40	0.009	1.26	12.64	0.8	
8	1.42	1.42	0.009	1.26	12.78	0.8	
8.05	1.45	1.45	0.009	1.26	13.08	0.8	
8.1	0.87	0.87	0.009	1.26	7.79	0.5	
8.15	0.80	0.80	0.009	1.26	7.21	0.5	
8.2	0.79	0.79	0.009	1.26	7.10	0.4	
8.25	1.18	1.18	0.009	1.26	10.63	0.7	
8.3	1.15	1.15	0.009	1.26	10.34	0.6	
8.35	0.94	0.94	0.009	1.26	8.47	0.5	
8.4	1.09	1.09	0.009	1.26	9.85	0.6	
8.45	2.90	2.90	0.009	1.26	26.14	1.6	
8.5	4.14	4.14	0.009	1.26	37.27	2.3	7'''
8.55	4.57	4.57	0.009	1.26	41.15	2.6	
8.6	4.90	4.90	0.009	1.26	44.09	2.8	
8.65	5.64	5.64	0.009	1.26	50.80	3.2	
8.7	6.61	6.61	0.009	1.26	59.48	3.7	
8.75	6.58	6.58	0.009	1.26	59.24	3.7	
8.8	6.75	6.75	0.009	1.26	60.79	3.8	
8.85	6.78	6.78	0.009	1.26	61.01	3.8	7''
8.9	6.82	6.82	0.009	1.26	61.35	3.9	
8.95	6.13	6.13	0.009	1.26	55.16	3.5	
9	5.73	5.73	0.009	1.26	51.58	3.2	
9.05	5.08	5.08	0.009	1.26	45.74	2.9	
9.1	4.38	4.38	0.009	1.26	39.43	2.5	
9.15	3.48	3.48	0.009	1.26	31.35	2.0	7'''
9.2	2.84	2.84	0.009	1.26	25.58	1.6	
9.25	2.35	2.35	0.009	1.26	21.13	1.3	
9.3	2.00	2.00	0.009	1.26	17.99	1.1	7''''
9.35	1.95	1.95	0.009	1.26	17.52	1.1	
9.4	2.60	2.60	0.009	1.26	23.41	1.5	
9.45	9.30	9.30			$F_{max,shaft}$, kN =	341.9	0
9.5	11.08	11.08					$0.7D_{eq}$
9.55	12.24	12.24					
9.6	13.79	13.79					7'
9.65	15.17	15					

9.7	16.03	15					
9.75	16.46	15					
9.8	16.53	15					
9.85	16.98	15					
9.9	17.10	15					
9.95	16.20	15					
10	15.27	15					
10.05	16.07	15					
10.1	16.06	15					
10.15	14.98	14.98					
10.2	15.56	15					
10.25	15.86	15					
10.3	16.75	15					
10.35	17.27	15					
10.4	17.26	15					
10.45	16.93	15					
10.5	16.32	15					
10.55	15.86	15					
10.6	16.03	15					
10.65	16.30	15					
10.7	16.17	15					
10.75	15.41	15					
10.8	15.71	15					
10.85	16.00	15					
10.9	16.34	15					
10.95	16.97	15					
11	17.57	15					$4D_{eq}$

2.4. Pāļa spiedes pretestība ir vienāda, kN: $F_{max} = R_{c;cal} = F_{max,base} + F_{max,shaft}$ = **929.7**

2.5. $(R_{c;cal})_{mean}=(R_{c;cal})_{min}$= **929.7**

2.6. T.k. prēķins veikts pēc viena izpētes punkta, korelācijas koeficienti vienādi ar:

2.6.1. ξ_3= **1.4**

2.6.2. ξ_4= **1.4**

2.7. $R_{c;k}$= Min {$(R_{c;cal})_{mean}/\xi_3$;$(R_{c;cal})_{min}/\xi_4$}= **664.1**

2.8. Aprēķina pāļa spiedes pretestība, kN: $R_{c;d}=F_{c;d;max}=R_{c;k}/\gamma_t$= **603.7**

2.8.1. γt= **1.1**

8.2. Aprēķina pāļa spiedes pretestība, kN. CPT.5. – 2. VARIANTS

Objekta nosaukums: Būvprojekta izstrāde, saskaņošana būvvaldē un autoruzraudzība būvdarbu veikšanas laikā tribīņu izbūvei un moduļu ēku novietošanai pie esošā futbola laukuma, Stadiona ielā 1, Daugavpilī.

Pāļa izvietojums:

$R_{c;d}=F_{c;d;max}=R_{c;k}/\gamma_t=$ **1200.5** kN

1. VISPARĪGĀ DAĻA

1.1. Viena pāļa nestspējas aprēķins - pāļa tips:	**FDP**
1.2. Pāļa garums, m	**12.5**
1.3. Pāļa diametrs, m	**0.4**

1.4. Ģeotehniski dati tiek pieņemti pēc: **SIA „BG Invest" 18/01-01lig/PR**

1.4.1. Ģeotehniskais punkts - **CPT 5**

1.5. Projektēšanas gaitā izmantotās normatīvu saraksts:

1.5.1. **EN 1997-1:2004.** Eurocode 7: Geotechnical design - Part 1: General rules. - [2]

1.5.2. **EN 1997-2:2004.** Eurocode 7: Geotechnical design - Part 2: Ground investigation and testing. - [3]

2. PĀĻU APRĒĶINS

2.1. Maksimālā pāļa spiedes pretestība, kN	$F_{max} = F_{max,base} + F_{max,shaft} =$	**1848.72**
2.2. Pāļa apakšējā gala nestspēja, kN	$F_{max,base} = A_{base} \times p_{max,base}=$	**989.54**
2.3. Pāļa sānu virsmas nestspēja	$F_{max,shaft}= C_p \times \int_0^{\Delta L} p_{max,shaft,z} dz=$	**859.17**
2.3.1. Uz grunts balstītā pāļa apakšējā gala laukums, m^2	$A_{base}=\pi r^2=$	**0.126**
2.3.2. Pāļa kāta aploces garums, m	$C_p=2\pi r=$	**1.26**
2.3.3. Pretestība zem pāļa apakšējā gala, MPa	$p_{max,base}=$	7.88
2.3.4. Pāļa sānu virsmas berzes pretestība dziļumā z, MPa	$p_{max,shaft,z}=\alpha_s \times q_{c;z;a}=$	**sk.1.tab.**
2.3.4.1. Pāļa sānu virsmas koeficients, α_s	$\alpha_s=$	**0.009**
2.3.4.2. Pārveidotā q_c, MPa vērtība dziļumā z, m - $q_{c;z;a}$, MPa	$q_{c;z;a}=$	**sk.1.tab.**

2.3.4.3. Pretestība zem pāļa apakšējā gala, MPa

$$p_{max;base}=0.5 \cdot \alpha_p \cdot \beta \cdot s \cdot \{(q_{c;I;mean}+q_{c;II;mean})/2 + q_{c;III;mean}\}= \quad \mathbf{7.88}$$

$$p_{max;base} \leq 15 \text{ MPa}$$

2.3.4.4. Pāļa klases koeficients	$\alpha_p=$	**0.9**
2.3.4.5. Pāļa gala formas koeficients	$\beta=$	**0.6**
2.3.4.6. Pāļa pēdas formas koeficients	$s=$	**1**
2.3.4.7. **Mpa**	$q_{c;I;mean}=1/d_{crit} \cdot \int_0^{dcrit} q_{c;I} dz =$ $0.7 \cdot D_{eq}<d_{crit}<4 \cdot D_{eq}$	**15.00**
2.3.4.8. **Mpa**	$q_{c;II;mean}=1/d_{crit} \cdot \int^0_{dcrit} q_{c;II} dz =$	**15.00**

2.3.4.9. Mpa $q_{c;III;mean}=1/d_{crit}\cdot\int^{-8Deq}_{0}q_{c;III}dz$ = **14.18**

1. tabula. $F_{max,shaft}$ aprēķins

Dziļums, m	q_c, MPa	Pielīdzinātā $q_{c;z;a}$ vērtība, MPa	α_s	C_p, m	$P_{max,shaft,z}$, kPa	$F_{max,shaft}$ - i-tajā slānī, kN	Apzīm.
0	[1]	p.2.3.4.2.	p.2.3.4.1.	p.2.3.2.	p.2.3.4.	p.2.3.	
0.5	2.13	2.13	0.009	1.26	19.18	12.0	1'''
0.55	2.74	2.74	0.009	1.26	24.64	1.5	
0.6	5.54	5.54	0.009	1.26	49.89	3.1	1''
0.65	6.47	6.47	0.009	1.26	58.19	3.7	
0.7	6.69	6.69	0.009	1.26	60.23	3.8	
0.75	6.62	6.62	0.009	1.26	59.58	3.7	
0.8	6.38	6.38	0.009	1.26	57.42	3.6	
0.85	5.88	5.88	0.009	1.26	52.96	3.3	
0.9	5.38	5.38	0.009	1.26	48.46	3.0	
0.95	4.72	4.72	0.009	1.26	42.47	2.7	1'''
1	4.16	4.16	0.009	1.26	37.46	2.4	
1.05	3.67	3.67	0.009	1.26	33.03	2.1	
1.1	0.80	0.80	0.009	1.26	7.22	0.5	
1.15	3.16	3.16	0.009	1.26	28.45	1.8	
1.2	3.32	3.32	0.009	1.26	29.92	1.9	
1.25	4.65	4.65	0.009	1.26	41.88	2.6	
1.3	13.55	13.55	0.009	1.26	121.99	7.7	1'
1.35	15.61	15.00	0.009	1.26	135.00	8.5	
1.4	16.93	15.00	0.009	1.26	135.00	8.5	
1.45	18.69	15.00	0.009	1.26	135.00	8.5	
1.5	12.91	12.91	0.009	1.26	116.17	7.3	
1.55	10.36	10.36	0.009	1.26	93.28	5.9	
1.6	6.20	6.20	0.009	1.26	55.80	3.5	7''o
1.65	3.56	3.56	0.009	1.26	32.06	2.0	
1.7	5.24	5.24	0.009	1.26	47.15	3.0	
1.75	5.53	5.53	0.009	1.26	49.79	3.1	
1.8	5.53	5.53	0.009	1.26	49.79	3.1	
1.85	5.67	5.67	0.009	1.26	51.03	3.2	
1.9	5.81	5.81	0.009	1.26	52.28	3.3	

1.95	6.21	6.21	0.009	1.26	55.90	3.5	
2	4.91	4.91	0.009	1.26	44.17	2.8	
2.05	3.82	3.82	0.009	1.26	34.37	2.2	
2.1	3.30	3.30	0.009	1.26	29.73	1.9	
2.15	4.94	4.94	0.009	1.26	44.48	2.8	
2.2	2.86	2.86	0.009	1.26	25.70	1.6	
2.25	3.32	3.32	0.009	1.26	29.85	1.9	7'''o
2.3	4.55	4.55	0.009	1.26	40.94	2.6	
2.35	2.21	2.21	0.009	1.26	19.85	1.2	
2.4	2.44	2.44	0.009	1.26	21.99	1.4	
2.45	2.16	2.16	0.009	1.26	19.41	1.2	
2.5	1.88	1.88	0.009	1.26	16.94	1.1	
2.55	1.79	1.79	0.009	1.26	16.13	1.0	
2.6	1.97	1.97	0.009	1.26	17.72	1.1	
2.65	1.98	1.98	0.009	1.26	17.85	1.1	
2.7	1.70	1.70	0.009	1.26	15.33	1.0	
2.75	1.28	1.28	0.009	1.26	11.50	0.7	
2.8	0.97	0.97	0.009	1.26	8.77	0.6	
2.85	0.66	0.66	0.009	1.26	5.94	0.4	
2.9	0.53	0.53	0.009	1.26	4.77	0.3	
2.95	0.52	0.52	0.009	1.26	4.64	0.3	
3	0.49	0.49	0.009	1.26	4.45	0.3	
3.05	0.48	0.48	0.009	1.26	4.33	0.3	
3.1	0.24	0.24	0.009	1.26	2.15	0.1	
3.15	0.44	0.44	0.009	1.26	3.94	0.2	
3.2	0.42	0.42	0.009	1.26	3.77	0.2	
3.25	0.44	0.44	0.009	1.26	3.95	0.2	15o
3.3	0.42	0.42	0.009	1.26	3.80	0.2	
3.35	0.41	0.41	0.009	1.26	3.72	0.2	
3.4	0.39	0.39	0.009	1.26	3.47	0.2	
3.45	0.39	0.39	0.009	1.26	3.54	0.2	
3.5	0.38	0.38	0.009	1.26	3.40	0.2	
3.55	0.35	0.35	0.009	1.26	3.19	0.2	
3.6	0.36	0.36	0.009	1.26	3.22	0.2	
3.65	0.40	0.40	0.009	1.26	3.64	0.2	
3.7	0.45	0.45	0.009	1.26	4.01	0.3	
3.75	0.44	0.44	0.009	1.26	3.92	0.2	
3.8	0.40	0.40	0.009	1.26	3.62	0.2	
3.85	0.38	0.38	0.009	1.26	3.43	0.2	
3.9	0.38	0.38	0.009	1.26	3.38	0.2	
3.95	0.38	0.38	0.009	1.26	3.38	0.2	
4	0.37	0.37	0.009	1.26	3.31	0.2	
4.05	0.36	0.36	0.009	1.26	3.27	0.2	

4.1	0.36	0.36	0.009	1.26	3.27	0.2	
4.15	0.37	0.37	0.009	1.26	3.31	0.2	
4.2	0.31	0.31	0.009	1.26	2.83	0.2	
4.25	0.31	0.31	0.009	1.26	2.77	0.2	
4.3	0.31	0.31	0.009	1.26	2.76	0.2	
4.35	0.31	0.31	0.009	1.26	2.81	0.2	
4.4	0.37	0.37	0.009	1.26	3.37	0.2	
4.45	0.43	0.43	0.009	1.26	3.87	0.2	
4.5	0.47	0.47	0.009	1.26	4.19	0.3	
4.55	0.51	0.51	0.009	1.26	4.57	0.3	
4.6	0.50	0.50	0.009	1.26	4.47	0.3	
4.65	0.50	0.50	0.009	1.26	4.47	0.3	
4.7	0.46	0.46	0.009	1.26	4.11	0.3	
4.75	0.48	0.48	0.009	1.26	4.32	0.3	
4.8	0.50	0.50	0.009	1.26	4.50	0.3	
4.85	0.53	0.53	0.009	1.26	4.74	0.3	
4.9	0.52	0.52	0.009	1.26	4.64	0.3	
4.95	0.47	0.47	0.009	1.26	4.25	0.3	
5	0.44	0.44	0.009	1.26	3.96	0.2	
5.05	0.44	0.44	0.009	1.26	3.94	0.2	
5.1	0.42	0.42	0.009	1.26	3.78	0.2	3
5.15	0.49	0.49	0.009	1.26	4.40	0.3	
5.2	0.52	0.52	0.009	1.26	4.70	0.3	
5.25	0.55	0.55	0.009	1.26	4.97	0.3	
5.3	0.80	0.80	0.009	1.26	7.21	0.5	
5.35	1.71	1.71	0.009	1.26	15.40	1.0	
5.4	2.23	2.23	0.009	1.26	20.03	1.3	
5.45	1.98	1.98	0.009	1.26	17.79	1.1	
5.5	1.40	1.40	0.009	1.26	12.59	0.8	
5.55	1.04	1.04	0.009	1.26	9.37	0.6	
5.6	0.86	0.86	0.009	1.26	7.74	0.5	
5.65	1.06	1.06	0.009	1.26	9.51	0.6	
5.7	1.66	1.66	0.009	1.26	14.90	0.9	
5.75	2.44	2.44	0.009	1.26	21.93	1.4	
5.8	3.26	3.26	0.009	1.26	29.31	1.8	7'''
5.85	4.16	4.16	0.009	1.26	37.46	2.4	
5.9	4.80	4.80	0.009	1.26	43.20	2.7	
5.95	5.49	5.49	0.009	1.26	49.37	3.1	
6	5.83	5.83	0.009	1.26	52.45	3.3	
6.05	6.21	6.21	0.009	1.26	55.90	3.5	7''
6.1	6.05	6.05	0.009	1.26	54.44	3.4	
6.15	5.79	5.79	0.009	1.26	52.09	3.3	
6.2	5.64	5.64	0.009	1.26	50.73	3.2	

6.25	5.45	5.45	0.009	1.26	49.04	3.1	
6.3	5.15	5.15	0.009	1.26	46.39	2.9	
6.35	5.07	5.07	0.009	1.26	45.67	2.9	
6.4	4.98	4.98	0.009	1.26	44.80	2.8	
6.45	4.54	4.54	0.009	1.26	40.83	2.6	
6.5	3.87	3.87	0.009	1.26	34.81	2.2	
6.55	5.10	5.10	0.009	1.26	45.87	2.9	
6.6	5.82	5.82	0.009	1.26	52.41	3.3	
6.65	6.66	6.66	0.009	1.26	59.92	3.8	
6.7	7.33	7.33	0.009	1.26	66.00	4.1	
6.75	7.69	7.69	0.009	1.26	69.24	4.3	
6.8	7.20	7.20	0.009	1.26	64.79	4.1	
6.85	5.90	5.90	0.009	1.26	53.13	3.3	
6.9	5.29	5.29	0.009	1.26	47.65	3.0	
6.95	5.51	5.51	0.009	1.26	49.55	3.1	
7	6.51	6.51	0.009	1.26	58.63	3.7	
7.05	6.94	6.94	0.009	1.26	62.43	3.9	
7.1	6.43	6.43	0.009	1.26	57.86	3.6	
7.15	5.85	5.85	0.009	1.26	52.65	3.3	
7.2	5.32	5.32	0.009	1.26	47.90	3.0	
7.25	4.74	4.74	0.009	1.26	42.67	2.7	7'''o
7.3	3.83	3.83	0.009	1.26	34.51	2.2	
7.35	3.58	3.58	0.009	1.26	32.25	2.0	
7.4	3.44	3.44	0.009	1.26	30.99	1.9	
7.45	3.21	3.21	0.009	1.26	28.86	1.8	
7.5	2.60	2.60	0.009	1.26	23.42	1.5	
7.55	1.83	1.83	0.009	1.26	16.50	1.0	7''''o
7.6	2.42	2.42	0.009	1.26	21.75	1.4	
7.65	2.71	2.71	0.009	1.26	24.36	1.5	
7.7	2.47	2.47	0.009	1.26	22.26	1.4	
7.75	1.50	1.50	0.009	1.26	13.50	0.8	
7.8	1.58	1.58	0.009	1.26	14.24	0.9	
7.85	2.61	2.61	0.009	1.26	23.51	1.5	
7.9	1.91	1.91	0.009	1.26	17.19	1.1	
7.95	1.40	1.40	0.009	1.26	12.64	0.8	
8	1.42	1.42	0.009	1.26	12.78	0.8	
8.05	1.45	1.45	0.009	1.26	13.08	0.8	
8.1	0.87	0.87	0.009	1.26	7.79	0.5	
8.15	0.80	0.80	0.009	1.26	7.21	0.5	
8.2	0.79	0.79	0.009	1.26	7.10	0.4	
8.25	1.18	1.18	0.009	1.26	10.63	0.7	
8.3	1.15	1.15	0.009	1.26	10.34	0.6	
8.35	0.94	0.94	0.009	1.26	8.47	0.5	

8.4	1.09	1.09	0.009	1.26	9.85	0.6	
8.45	2.90	2.90	0.009	1.26	26.14	1.6	
8.5	4.14	4.14	0.009	1.26	37.27	2.3	7'''
8.55	4.57	4.57	0.009	1.26	41.15	2.6	
8.6	4.90	4.90	0.009	1.26	44.09	2.8	
8.65	5.64	5.64	0.009	1.26	50.80	3.2	
8.7	6.61	6.61	0.009	1.26	59.48	3.7	
8.75	6.58	6.58	0.009	1.26	59.24	3.7	
8.8	6.75	6.75	0.009	1.26	60.79	3.8	
8.85	6.78	6.78	0.009	1.26	61.01	3.8	7''
8.9	6.82	6.82	0.009	1.26	61.35	3.9	
8.95	6.13	6.13	0.009	1.26	55.16	3.5	
9	5.73	5.73	0.009	1.26	51.58	3.2	
9.05	5.08	5.08	0.009	1.26	45.74	2.9	
9.1	4.38	4.38	0.009	1.26	39.43	2.5	
9.15	3.48	3.48	0.009	1.26	31.35	2.0	7'''
9.2	2.84	2.84	0.009	1.26	25.58	1.6	
9.25	2.35	2.35	0.009	1.26	21.13	1.3	7''''
9.3	2.00	2.00	0.009	1.26	17.99	1.1	$-8D_{eq}$
9.35	1.95	1.95	0.009	1.26	17.52	1.1	7''''
9.4	2.60	2.60	0.009	1.26	23.41	1.5	
9.45	9.30	9.30	0.009	1.26	83.71	5.3	
9.5	11.08	11.08	0.009	1.26	99.72	6.3	
9.55	12.24	12.24	0.009	1.26	110.12	6.9	
9.6	13.79	13.79	0.009	1.26	124.07	7.8	
9.65	15.17	15	0.009	1.26	135	8.5	
9.7	16.03	15	0.009	1.26	135	8.5	
9.75	16.46	15	0.009	1.26	135	8.5	
9.8	16.53	15	0.009	1.26	135	8.5	
9.85	16.98	15	0.009	1.26	135	8.5	
9.9	17.10	15	0.009	1.26	135	8.5	
9.95	16.20	15	0.009	1.26	135	8.5	7'
10	15.27	15	0.009	1.26	135	8.5	
10.05	16.07	15	0.009	1.26	135	8.5	
10.1	16.06	15	0.009	1.26	135	8.5	
10.15	14.98	14.98	0.009	1.26	134.83	8.5	
10.2	15.56	15	0.009	1.26	135	8.5	
10.25	15.86	15	0.009	1.26	135	8.5	
10.3	16.75	15	0.009	1.26	135	8.5	
10.35	17.27	15	0.009	1.26	135	8.5	
10.4	17.26	15	0.009	1.26	135	8.5	
10.45	16.93	15	0.009	1.26	135	8.5	
10.5	16.32	15	0.009	1.26	135	8.5	

10.55	15.86	15	0.009	1.26	135	8.5	
10.6	16.03	15	0.009	1.26	135	8.5	
10.65	16.30	15	0.009	1.26	135	8.5	
10.7	16.17	15	0.009	1.26	135	8.5	
10.75	15.41	15	0.009	1.26	135	8.5	
10.8	15.71	15	0.009	1.26	135	8.5	
10.85	16.00	15	0.009	1.26	135	8.5	
10.9	16.34	15	0.009	1.26	135	8.5	
10.95	16.97	15	0.009	1.26	135	8.5	
11	17.57	15	0.009	1.26	135	8.5	
11.05	17.78	15	0.009	1.26	135	8.5	
11.1	17.82	15	0.009	1.26	135	8.5	
11.15	17.04	15	0.009	1.26	135	8.5	
11.2	18.66	15	0.009	1.26	135	8.5	
11.25	19.11	15	0.009	1.26	135	8.5	
11.3	20.54	15	0.009	1.26	135	8.5	
11.35	21.12	15	0.009	1.26	135	8.5	
11.4	21.09	15	0.009	1.26	135	8.5	
11.45	20.57	15	0.009	1.26	135	8.5	
11.5	19.68	15	0.009	1.26	135	8.5	
11.55	18.55	15	0.009	1.26	135	8.5	
11.6	16.97	15	0.009	1.26	135	8.5	
11.65	15.43	15	0.009	1.26	135	8.5	
11.7	14.54	14.54	0.009	1.26	130.88	8.2	
11.75	14.21	14.21	0.009	1.26	127.88	8.0	
11.8	15.56	15	0.009	1.26	135	8.5	
11.85	18.00	15	0.009	1.26	135	8.5	
11.9	18.37	15	0.009	1.26	135	8.5	
11.95	19.05	15	0.009	1.26	135	8.5	
12	19.32	15	0.009	1.26	135	8.5	
12.05	18.91	15	0.009	1.26	135	8.5	
12.1	18.97	15	0.009	1.26	135	8.5	
12.15	19.01	15	0.009	1.26	135	8.5	
12.2	19.12	15	0.009	1.26	135	8.5	
12.25	18.75	15	0.009	1.26	135	8.5	
12.3	17.96	15	0.009	1.26	135	8.5	
12.35	17.79	15	0.009	1.26	135	8.5	
12.4	17.84	15	0.009	1.26	135	8.5	
12.45	18.74	15	0.009	1.26	135	8.5	
12.5	19.64	15	0.009	1.26	135	8.5	
					$F_{max,shaft}$, kN =	859.2	0
12.55	21.03	15					$0.7D_{eq}$
12.6	21.34	15					7'a

12.65	20.76	15					
12.7	20.54	15					
12.75	20.45	15					
12.8	21.63	15					$4D_{eq}$

2.4. Pāļa spiedes pretestība ir vienāda, kN: $F_{max} = R_{c;cal} = F_{max,base} + F_{max,shaft} =$ 1848.7

2.5. $(R_{c;cal})_{mean}=(R_{c;cal})_{min}=$ 1848.7

2.6. T.k. prēķins veikts pēc viena izpētes punkta, korelācijas koeficienti vienādi ar:

2.6.1. $\xi_3=$ 1.4

2.6.2. $\xi_4=$ 1.4

2.7. $R_{c;k}= \text{Min} \{(R_{c;cal})_{mean}/ \xi_3;(R_{c;cal})_{min}/ \xi_4\}=$ 1320.5

2.8. Aprēķina pāļa spiedes pretestība, kN: $R_{c;d}=F_{c;d;max}=R_{c;k}/\gamma_t=$ 1200.5

2.8.1. $\gamma t=$ 1.1

8.3. Aprēķina pāļa spiedes pretestība, kN. CPT.5. – 3. VARIANTS

Objekta nosaukums: Būvprojekta izstrāde, saskaņošana būvvaldē un autoruzraudzība būvdarbu veikšanas laikā tribīņu izbūvei un moduļu ēku novietošanai pie esošā futbola laukuma, Stadiona ielā 1, Daugavpilī.

Pāļa izvietojums:

$R_{c;d}=F_{c;d;max}=R_{c;k}/\gamma_t=$ 1158.5 kN

1. VISPARĪGĀ DAĻA

1.1. Viena pāļa nestspējas aprēķins - pāļa tips: FDP

1.2. Pāļa garums, m 10

1.3. Pāļa diametrs, m 0.6

1.4. Ģeotehniski dati tiek pieņemti pēc: **SIA „BG Invest" 18/01-01lig/PR**

1.4.1. Ģeotehniskais punkts - **CPT 5**

1.5. Projektēšanas gaitā izmantotās normatīvu saraksts:

1.5.1. **EN 1997-1:2004.** Eurocode 7: Geotehnical design - Part 1: General rules. - [2]

1.5.2. **EN 1997-2:2004.** Eurocode 7: Geotehnical design - Part 2: Ground investigation and testing. - [3]

2. PĀĻU APRĒĶINS

2.1. Maksimālā pāļa spiedes pretestība, kN $F_{max} = F_{max,base} + F_{max,shaft} =$ 1784.13

2.2. Pāļa apakšējā gala nestspēja, kN $F_{max,base} = A_{base} \times p_{max,base}=$ 1271.22

2.3. Pāļa sānu virsmas nestspēja $F_{max,shaft}= C_p \times \int_0^{\Delta L} p_{max,shaft,z} dz=$ 512.91

2.3.1. Uz grunts balstītā pāļa apakšējā gala laukums, m^2 $A_{base}=\pi r^2=$ 0.283

2.3.2. Pāļa kāta aploces garums, m $C_p=2\pi r=$ 1.88

2.3.3. Pretestība zem pāļa apakšējā gala, MPa $p_{max,base}=$ 4.50

2.3.4. Pāļa sānu virsmas berzes pretestība dziļumā z, MPa $p_{max,shaft,z}=\alpha_s \times q_{c;z;a}=$ sk.1.tab.

2.3.4.1. Pāļa sānu virsmas koeficients, α_s $\alpha_s=$ 0.009

2.3.4.2. Pārveidotā **q_c, MPa** vērtība dziļumā **z, m - $q_{c;z;a}$, MPa** $q_{c;z;a}=$ sk.1.tab.

2.3.4.3. Pretestība zem pāļa apakšējā gala, MPa

$$p_{max;base}=0.5\cdot\alpha_p\cdot\beta\cdot s\cdot\{(q_{c;I;mean}+q_{c;II;mean})/2 + q_{c;III;mean}\}= \quad 4.50$$

$$p_{max;base} \leq 15 \text{ MPa}$$

2.3.4.4. Pāļa klases koeficients $\alpha_p=$ 0.9

2.3.4.5. Pāļa gala formas koeficients $\beta=$ 0.6

2.3.4.6. Pāļa pēdas formas koeficients $s=$ 1

2.3.4.7. **Mpa** $q_{c;I;mean}=1/d_{crit}\cdot\int_0^{dcrit} q_{c;I} dz =$ 14.69

$0.7\cdot D_{eq}<d_{crit}<4\cdot D_{eq}$

2.3.4.8. **Mpa** $q_{c;II;mean}=1/d_{crit}\cdot\int_{dcrit}^{0} q_{c;II} dz =$ 11.60

2.3.4.9. **Mpa** $q_{c;III;mean}=1/d_{crit}\cdot\int_{0}^{-8Deq} q_{c;III} dz =$ 3.51

1. tabula. $F_{max,shaft}$ aprēķins

Dziļums, m	q_c, MPa	Pielīdzinātā $q_{c;z;a}$ vērtība, MPa	α_s	C_p, m	$P_{max,shaft,z}$, kPa	$F_{max,shaft}$ - i-tajā slānī, kN	Apzīm.
0	[1]	p.2.3.4.2.	p.2.3.4.1.	p.2.3.2.	p.2.3.4.	p.2.3.	
0.5	2.13	2.13	0.009	1.88	19.18	18.1	1'''
0.55	2.74	2.74	0.009	1.88	24.64	2.3	
0.6	5.54	5.54	0.009	1.88	49.89	4.7	1''
0.65	6.47	6.47	0.009	1.88	58.19	5.5	
0.7	6.69	6.69	0.009	1.88	60.23	5.7	
0.75	6.62	6.62	0.009	1.88	59.58	5.6	
0.8	6.38	6.38	0.009	1.88	57.42	5.4	
0.85	5.88	5.88	0.009	1.88	52.96	5.0	
0.9	5.38	5.38	0.009	1.88	48.46	4.6	
0.95	4.72	4.72	0.009	1.88	42.47	4.0	1'''
1	4.16	4.16	0.009	1.88	37.46	3.5	
1.05	3.67	3.67	0.009	1.88	33.03	3.1	
1.1	0.80	0.80	0.009	1.88	7.22	0.7	

1.15	3.16	3.16	0.009	1.88	28.45	2.7	
1.2	3.32	3.32	0.009	1.88	29.92	2.8	
1.25	4.65	4.65	0.009	1.88	41.88	3.9	
1.3	13.55	13.55	0.009	1.88	121.99	11.5	1'
1.35	15.61	15.00	0.009	1.88	135.00	12.7	
1.4	16.93	15.00	0.009	1.88	135.00	12.7	
1.45	18.69	15.00	0.009	1.88	135.00	12.7	
1.5	12.91	12.91	0.009	1.88	116.17	10.9	
1.55	10.36	10.36	0.009	1.88	93.28	8.8	
1.6	6.20	6.20	0.009	1.88	55.80	5.3	7''o
1.65	3.56	3.56	0.009	1.88	32.06	3.0	
1.7	5.24	5.24	0.009	1.88	47.15	4.4	
1.75	5.53	5.53	0.009	1.88	49.79	4.7	
1.8	5.53	5.53	0.009	1.88	49.79	4.7	
1.85	5.67	5.67	0.009	1.88	51.03	4.8	
1.9	5.81	5.81	0.009	1.88	52.28	4.9	
1.95	6.21	6.21	0.009	1.88	55.90	5.3	
2	4.91	4.91	0.009	1.88	44.17	4.2	
2.05	3.82	3.82	0.009	1.88	34.37	3.2	7'''o
2.1	3.30	3.30	0.009	1.88	29.73	2.8	
2.15	4.94	4.94	0.009	1.88	44.48	4.2	
2.2	2.86	2.86	0.009	1.88	25.70	2.4	
2.25	3.32	3.32	0.009	1.88	29.85	2.8	
2.3	4.55	4.55	0.009	1.88	40.94	3.9	
2.35	2.21	2.21	0.009	1.88	19.85	1.9	
2.4	2.44	2.44	0.009	1.88	21.99	2.1	
2.45	2.16	2.16	0.009	1.88	19.41	1.8	
2.5	1.88	1.88	0.009	1.88	16.94	1.6	15o
2.55	1.79	1.79	0.009	1.88	16.13	1.5	
2.6	1.97	1.97	0.009	1.88	17.72	1.7	
2.65	1.98	1.98	0.009	1.88	17.85	1.7	
2.7	1.70	1.70	0.009	1.88	15.33	1.4	
2.75	1.28	1.28	0.009	1.88	11.50	1.1	
2.8	0.97	0.97	0.009	1.88	8.77	0.8	
2.85	0.66	0.66	0.009	1.88	5.94	0.6	
2.9	0.53	0.53	0.009	1.88	4.77	0.4	
2.95	0.52	0.52	0.009	1.88	4.64	0.4	
3	0.49	0.49	0.009	1.88	4.45	0.4	
3.05	0.48	0.48	0.009	1.88	4.33	0.4	
3.1	0.24	0.24	0.009	1.88	2.15	0.2	
3.15	0.44	0.44	0.009	1.88	3.94	0.4	
3.2	0.42	0.42	0.009	1.88	3.77	0.4	
3.25	0.44	0.44	0.009	1.88	3.95	0.4	

3.3	0.42	**0.42**	**0.009**	**1.88**	**3.80**	**0.4**	
3.35	0.41	**0.41**	**0.009**	**1.88**	**3.72**	**0.4**	
3.4	0.39	**0.39**	**0.009**	**1.88**	**3.47**	**0.3**	
3.45	0.39	**0.39**	**0.009**	**1.88**	**3.54**	**0.3**	
3.5	0.38	**0.38**	**0.009**	**1.88**	**3.40**	**0.3**	
3.55	0.35	**0.35**	**0.009**	**1.88**	**3.19**	**0.3**	
3.6	0.36	**0.36**	**0.009**	**1.88**	**3.22**	**0.3**	
3.65	0.40	**0.40**	**0.009**	**1.88**	**3.64**	**0.3**	
3.7	0.45	**0.45**	**0.009**	**1.88**	**4.01**	**0.4**	
3.75	0.44	**0.44**	**0.009**	**1.88**	**3.92**	**0.4**	
3.8	0.40	**0.40**	**0.009**	**1.88**	**3.62**	**0.3**	
3.85	0.38	**0.38**	**0.009**	**1.88**	**3.43**	**0.3**	
3.9	0.38	**0.38**	**0.009**	**1.88**	**3.38**	**0.3**	
3.95	0.38	**0.38**	**0.009**	**1.88**	**3.38**	**0.3**	
4	0.37	**0.37**	**0.009**	**1.88**	**3.31**	**0.3**	
4.05	0.36	**0.36**	**0.009**	**1.88**	**3.27**	**0.3**	
4.1	0.36	**0.36**	**0.009**	**1.88**	**3.27**	**0.3**	
4.15	0.37	**0.37**	**0.009**	**1.88**	**3.31**	**0.3**	
4.2	0.31	**0.31**	**0.009**	**1.88**	**2.83**	**0.3**	
4.25	0.31	**0.31**	**0.009**	**1.88**	**2.77**	**0.3**	
4.3	0.31	**0.31**	**0.009**	**1.88**	**2.76**	**0.3**	
4.35	0.31	**0.31**	**0.009**	**1.88**	**2.81**	**0.3**	
4.4	0.37	**0.37**	**0.009**	**1.88**	**3.37**	**0.3**	
4.45	0.43	**0.43**	**0.009**	**1.88**	**3.87**	**0.4**	
4.5	0.47	**0.47**	**0.009**	**1.88**	**4.19**	**0.4**	**3**
4.55	0.51	**0.51**	**0.009**	**1.88**	**4.57**	**0.4**	
4.6	0.50	**0.50**	**0.009**	**1.88**	**4.47**	**0.4**	**$-8D_{eq}$**
4.65	0.50	**0.50**	**0.009**	**1.88**	**4.47**	**0.4**	
4.7	0.46	**0.46**	**0.009**	**1.88**	**4.11**	**0.4**	
4.75	0.48	**0.48**	**0.009**	**1.88**	**4.32**	**0.4**	
4.8	0.50	**0.50**	**0.009**	**1.88**	**4.50**	**0.4**	
4.85	0.53	**0.53**	**0.009**	**1.88**	**4.74**	**0.4**	
4.9	0.52	**0.52**	**0.009**	**1.88**	**4.64**	**0.4**	
4.95	0.47	**0.47**	**0.009**	**1.88**	**4.25**	**0.4**	
5	0.44	**0.44**	**0.009**	**1.88**	**3.96**	**0.4**	
5.05	0.44	**0.44**	**0.009**	**1.88**	**3.94**	**0.4**	**3**
5.1	0.42	**0.42**	**0.009**	**1.88**	**3.78**	**0.4**	
5.15	0.49	**0.49**	**0.009**	**1.88**	**4.40**	**0.4**	
5.2	0.52	**0.52**	**0.009**	**1.88**	**4.70**	**0.4**	
5.25	0.55	**0.55**	**0.009**	**1.88**	**4.97**	**0.5**	
5.3	0.80	**0.80**	**0.009**	**1.88**	**7.21**	**0.7**	
5.35	1.71	**1.71**	**0.009**	**1.88**	**15.40**	**1.5**	
5.4	2.23	**2.23**	**0.009**	**1.88**	**20.03**	**1.9**	

5.45	1.98	1.98	0.009	1.88	17.79	1.7	
5.5	1.40	1.40	0.009	1.88	12.59	1.2	
5.55	1.04	1.04	0.009	1.88	9.37	0.9	
5.6	0.86	0.86	0.009	1.88	7.74	0.7	
5.65	1.06	1.06	0.009	1.88	9.51	0.9	
5.7	1.66	1.66	0.009	1.88	14.90	1.4	
5.75	2.44	2.44	0.009	1.88	21.93	2.1	
5.8	3.26	3.26	0.009	1.88	29.31	2.8	7'''
5.85	4.16	4.16	0.009	1.88	37.46	3.5	
5.9	4.80	4.80	0.009	1.88	43.20	4.1	
5.95	5.49	5.49	0.009	1.88	49.37	4.7	
6	5.83	5.83	0.009	1.88	52.45	4.9	
6.05	6.21	6.21	0.009	1.88	55.90	5.3	
6.1	6.05	6.05	0.009	1.88	54.44	5.1	
6.15	5.79	5.79	0.009	1.88	52.09	4.9	
6.2	5.64	5.64	0.009	1.88	50.73	4.8	
6.25	5.45	5.45	0.009	1.88	49.04	4.6	
6.3	5.15	5.15	0.009	1.88	46.39	4.4	
6.35	5.07	5.07	0.009	1.88	45.67	4.3	
6.4	4.98	4.98	0.009	1.88	44.80	4.2	
6.45	4.54	4.54	0.009	1.88	40.83	3.8	
6.5	3.87	3.87	0.009	1.88	34.81	3.3	
6.55	5.10	5.10	0.009	1.88	45.87	4.3	
6.6	5.82	5.82	0.009	1.88	52.41	4.9	7''
6.65	6.66	6.66	0.009	1.88	59.92	5.6	
6.7	7.33	7.33	0.009	1.88	66.00	6.2	
6.75	7.69	7.69	0.009	1.88	69.24	6.5	
6.8	7.20	7.20	0.009	1.88	64.79	6.1	
6.85	5.90	5.90	0.009	1.88	53.13	5.0	
6.9	5.29	5.29	0.009	1.88	47.65	4.5	
6.95	5.51	5.51	0.009	1.88	49.55	4.7	
7	6.51	6.51	0.009	1.88	58.63	5.5	
7.05	6.94	6.94	0.009	1.88	62.43	5.9	
7.1	6.43	6.43	0.009	1.88	57.86	5.5	
7.15	5.85	5.85	0.009	1.88	52.65	5.0	
7.2	5.32	5.32	0.009	1.88	47.90	4.5	
7.25	4.74	4.74	0.009	1.88	42.67	4.0	
7.3	3.83	3.83	0.009	1.88	34.51	3.3	
7.35	3.58	3.58	0.009	1.88	32.25	3.0	
7.4	3.44	3.44	0.009	1.88	30.99	2.9	7'''o
7.45	3.21	3.21	0.009	1.88	28.86	2.7	
7.5	2.60	2.60	0.009	1.88	23.42	2.2	
7.55	1.83	1.83	0.009	1.88	16.50	1.6	7''''o

7.6	2.42	2.42	0.009	1.88	21.75	2.0	
7.65	2.71	2.71	0.009	1.88	24.36	2.3	
7.7	2.47	2.47	0.009	1.88	22.26	2.1	
7.75	1.50	1.50	0.009	1.88	13.50	1.3	
7.8	1.58	1.58	0.009	1.88	14.24	1.3	
7.85	2.61	2.61	0.009	1.88	23.51	2.2	
7.9	1.91	1.91	0.009	1.88	17.19	1.6	
7.95	1.40	1.40	0.009	1.88	12.64	1.2	
8	1.42	1.42	0.009	1.88	12.78	1.2	
8.05	1.45	1.45	0.009	1.88	13.08	1.2	
8.1	0.87	0.87	0.009	1.88	7.79	0.7	
8.15	0.80	0.80	0.009	1.88	7.21	0.7	
8.2	0.79	0.79	0.009	1.88	7.10	0.7	
8.25	1.18	1.18	0.009	1.88	10.63	1.0	
8.3	1.15	1.15	0.009	1.88	10.34	1.0	
8.35	0.94	0.94	0.009	1.88	8.47	0.8	
8.4	1.09	1.09	0.009	1.88	9.85	0.9	
8.45	2.90	2.90	0.009	1.88	26.14	2.5	
8.5	4.14	4.14	0.009	1.88	37.27	3.5	7'''
8.55	4.57	4.57	0.009	1.88	41.15	3.9	
8.6	4.90	4.90	0.009	1.88	44.09	4.2	
8.65	5.64	5.64	0.009	1.88	50.80	4.8	
8.7	6.61	6.61	0.009	1.88	59.48	5.6	
8.75	6.58	6.58	0.009	1.88	59.24	5.6	
8.8	6.75	6.75	0.009	1.88	60.79	5.7	
8.85	6.78	6.78	0.009	1.88	61.01	5.7	7''
8.9	6.82	6.82	0.009	1.88	61.35	5.8	
8.95	6.13	6.13	0.009	1.88	55.16	5.2	
9	5.73	5.73	0.009	1.88	51.58	4.9	
9.05	5.08	5.08	0.009	1.88	45.74	4.3	
9.1	4.38	4.38	0.009	1.88	39.43	3.7	
9.15	3.48	3.48	0.009	1.88	31.35	3.0	7'''
9.2	2.84	2.84	0.009	1.88	25.58	2.4	
9.25	2.35	2.35	0.009	1.88	21.13	2.0	
9.3	2.00	2.00	0.009	1.88	17.99	1.7	7''''
9.35	1.95	1.95	0.009	1.88	17.52	1.7	
9.4	2.60	2.60	0.009	1.88	23.41	2.2	
9.45	9.30	9.30			$F_{max,shaft}$, kN =	512.9	0
9.5	11.08	11.08					$0.7D_{eq}$
9.55	12.24	12.24					
9.6	13.79	13.79					7'
9.65	15.17	15					
9.7	16.03	15					

9.75	16.46	**15**					
9.8	16.53	**15**					
9.85	16.98	**15**					
9.9	17.10	**15**					
9.95	16.20	**15**					
10	15.27	**15**					
10.05	16.07	**15**					
10.1	16.06	**15**					
10.15	14.98	**14.98**					
10.2	15.56	**15**					
10.25	15.86	**15**					
10.3	16.75	**15**					
10.35	17.27	**15**					
10.4	17.26	**15**					
10.45	16.93	**15**					
10.5	16.32	**15**					
10.55	15.86	**15**					
10.6	16.03	**15**					
10.65	16.30	**15**					
10.7	16.17	**15**					
10.75	15.41	**15**					
10.8	15.71	**15**					
10.85	16.00	**15**					
10.9	16.34	**15**					
10.95	16.97	**15**					
11	17.57	**15**					
11.05	17.78	**15**					
11.1	17.82	**15**					
11.15	17.04	**15**					
11.2	18.66	**15**					
11.25	19.11	**15**					
11.3	20.54	**15**					
11.35	21.12	**15**					
11.4	21.09	**15**					
11.45	20.57	**15**					
11.5	19.68	**15**					
11.55	18.55	**15**					
11.6	16.97	**15**					
11.65	15.43	**15**					
11.7	14.54	**14.54**					
11.75	14.21	**14.21**					
11.8	15.56	**15**					**$4D_{eq}$**

2.4. Pāļa spiedes pretestība ir vienāda, kN: $F_{max} = R_{c;cal} = F_{max,base} + F_{max,shaft} =$ **1784.1**

2.5. $(R_{c;cal})_{mean}=(R_{c;cal})_{min}=$ **1784.1**

2.6.	T.k. prēķins veikts pēc viena izpētes punkta, korelācijas koeficienti vienādi ar:		
2.6.1.		ξ_3=	1.4
2.6.2.		ξ_4=	1.4
2.7.		$R_{c;k}$= Min {$(R_{c;cal})_{mean}$/ ξ_3;$(R_{c;cal})_{min}$/ ξ_4}=	1274.4
2.8.	Aprēķina pāļa spiedes pretestība, kN:	$R_{c;d}=F_{c;d;max}=R_{c;k}/\gamma_t$=	1158.5
2.8.1.		γt=	1.1

8.4. Aprēķina pāļa spiedes pretestība, kN. CPT.5. – 4. VARIANTS

Objekta nosaukums: Būvprojekta izstrāde, saskaņošana būvvaldē un autoruzraudzība būvdarbu veikšanas laikā tribīņu izbūvei un moduļu ēku novietošanai pie esošā futbola laukuma, Stadiona ielā 1, Daugavpilī.

Pāļa izvietojums:

$R_{c;d}=F_{c;d;max}=R_{c;k}/\gamma_t$= **2105.4** kN

1. VISPARĪGĀ DAĻA

1.1. Viena pāļa nestspējas aprēķins - pāļa tips: **FDP**
1.2. Pāļa garums, m **12.5**
1.3. Pāļa diametrs, m **0.6**

1.4. Ģeotehniski dati tiek pieņemti pēc: **SIA „BG Invest" 18/01-01lig/PR**

1.4.1. Ģeotehniskais punkts - **CPT 5**
1.5. Projektēšanas gaitā izmantotās normatīvu saraksts:
1.5.1. **EN 1997-1:2004.** Eurocode 7: Geotehnical design - Part 1: General rules. - [2]
1.5.2. **EN 1997-2:2004.** Eurocode 7: Geotehnical design - Part 2: Ground investigation and testing. - [3]

2. PĀĻU APRĒĶINS

2.1. Maksimālā pāļa spiedes pretestība, kN	$F_{max} = F_{max,base} + F_{max,shaft}$ =	3242.37
2.2. Pāļa apakšējā gala nestspēja, kN	$F_{max,base} = A_{base} \times p_{max,base}$=	1953.61
2.3. Pāļa sānu virsmas nestspēja	$F_{max,shaft}= C_p \times \int_0^{\Delta L} p_{max,shaft,z} dz$=	1288.76
2.3.1. Uz grunts balstītā pāļa apakšējā gala laukums, m^2	$A_{base}=\pi r^2$=	0.283
2.3.2. Pāļa kāta aploces garums, m	$C_p=2\pi r$=	1.88
2.3.3. Pretestība zem pāļa apakšējā gala, MPa	$p_{max,base}$=	6.91
2.3.4. Pāļa sānu virsmas berzes pretestība dziļumā z, MPa	$p_{max,shaft,z}=\alpha_s \times q_{c;z;a}$=	sk.1.tab.
2.3.4.1. Pāļa sānu virsmas koeficients, α_s	α_s=	0.009
2.3.4.2. Pārveidotā q_c, MPa vērtība dziļumā z, m - $q_{c;z;a}$, MPa	$q_{c;z;a}$=	sk.1.tab.

2.3.4.3. Pretestība zem pāļa apakšējā gala, MPa

$p_{max;base}=0.5\cdot\alpha_p\cdot\beta\cdot s\cdot\{(q_{c;I;mean}+q_{c;II;mean})/2 + q_{c;III;mean}\}=$ 6.91

$p_{max;base} \leq 15$ MPa

2.3.4.4. Pāļa klases koeficients $\alpha_p=$ 0.9

2.3.4.5. Pāļa gala formas koeficients $\beta=$ 0.6

2.3.4.6. Pāļa pēdas formas koeficients $s=$ 1

2.3.4.7. Mpa $q_{c;I;mean}=1/d_{crit}\cdot\int_0^{dcrit} q_{c;I}dz =$ 15.00

$0.7\cdot D_{eq}<d_{crit}<4\cdot D_{eq}$

2.3.4.8. Mpa $q_{c;II;mean}=1/d_{crit}\cdot\int^0_{dcrit} q_{c;II}dz =$ 15.00

2.3.4.9. Mpa $q_{c;III;mean}=1/d_{crit}\cdot\int^{-8Deq}_0 q_{c;III}dz =$ 10.60

1. tabula. $F_{max,shaft}$ aprēķins

Dziļums, m	q_c, MPa	Pielīdzinātā $q_{c;z;a}$ vērtība, MPa	α_s	C_p, m	$P_{max,shaft,z}$, kPa	$F_{max,shaft}$ - i-tajā slānī, kN	Apzīm.
0	[1]	p.2.3.4.2.	p.2.3.4.1.	p.2.3.2.	p.2.3.4.	p.2.3.	
0.5	2.13	2.13	0.009	1.88	19.18	18.1	1'''
0.55	2.74	2.74	0.009	1.88	24.64	2.3	
0.6	5.54	5.54	0.009	1.88	49.89	4.7	1''
0.65	6.47	6.47	0.009	1.88	58.19	5.5	
0.7	6.69	6.69	0.009	1.88	60.23	5.7	
0.75	6.62	6.62	0.009	1.88	59.58	5.6	
0.8	6.38	6.38	0.009	1.88	57.42	5.4	
0.85	5.88	5.88	0.009	1.88	52.96	5.0	
0.9	5.38	5.38	0.009	1.88	48.46	4.6	
0.95	4.72	4.72	0.009	1.88	42.47	4.0	1'''
1	4.16	4.16	0.009	1.88	37.46	3.5	
1.05	3.67	3.67	0.009	1.88	33.03	3.1	
1.1	0.80	0.80	0.009	1.88	7.22	0.7	
1.15	3.16	3.16	0.009	1.88	28.45	2.7	
1.2	3.32	3.32	0.009	1.88	29.92	2.8	
1.25	4.65	4.65	0.009	1.88	41.88	3.9	
1.3	13.55	13.55	0.009	1.88	121.99	11.5	1'
1.35	15.61	15.00	0.009	1.88	135.00	12.7	
1.4	16.93	15.00	0.009	1.88	135.00	12.7	
1.45	18.69	15.00	0.009	1.88	135.00	12.7	
1.5	12.91	12.91	0.009	1.88	116.17	10.9	

1.55	10.36	10.36	0.009	1.88	93.28	8.8	
1.6	6.20	6.20	0.009	1.88	55.80	5.3	
1.65	3.56	3.56	0.009	1.88	32.06	3.0	
1.7	5.24	5.24	0.009	1.88	47.15	4.4	
1.75	5.53	5.53	0.009	1.88	49.79	4.7	
1.8	5.53	5.53	0.009	1.88	49.79	4.7	7''o
1.85	5.67	5.67	0.009	1.88	51.03	4.8	
1.9	5.81	5.81	0.009	1.88	52.28	4.9	
1.95	6.21	6.21	0.009	1.88	55.90	5.3	
2	4.91	4.91	0.009	1.88	44.17	4.2	
2.05	3.82	3.82	0.009	1.88	34.37	3.2	
2.1	3.30	3.30	0.009	1.88	29.73	2.8	
2.15	4.94	4.94	0.009	1.88	44.48	4.2	
2.2	2.86	2.86	0.009	1.88	25.70	2.4	
2.25	3.32	3.32	0.009	1.88	29.85	2.8	7'''o
2.3	4.55	4.55	0.009	1.88	40.94	3.9	
2.35	2.21	2.21	0.009	1.88	19.85	1.9	
2.4	2.44	2.44	0.009	1.88	21.99	2.1	
2.45	2.16	2.16	0.009	1.88	19.41	1.8	
2.5	1.88	1.88	0.009	1.88	16.94	1.6	
2.55	1.79	1.79	0.009	1.88	16.13	1.5	
2.6	1.97	1.97	0.009	1.88	17.72	1.7	
2.65	1.98	1.98	0.009	1.88	17.85	1.7	
2.7	1.70	1.70	0.009	1.88	15.33	1.4	
2.75	1.28	1.28	0.009	1.88	11.50	1.1	
2.8	0.97	0.97	0.009	1.88	8.77	0.8	
2.85	0.66	0.66	0.009	1.88	5.94	0.6	
2.9	0.53	0.53	0.009	1.88	4.77	0.4	
2.95	0.52	0.52	0.009	1.88	4.64	0.4	
3	0.49	0.49	0.009	1.88	4.45	0.4	
3.05	0.48	0.48	0.009	1.88	4.33	0.4	
3.1	0.24	0.24	0.009	1.88	2.15	0.2	15o
3.15	0.44	0.44	0.009	1.88	3.94	0.4	
3.2	0.42	0.42	0.009	1.88	3.77	0.4	
3.25	0.44	0.44	0.009	1.88	3.95	0.4	
3.3	0.42	0.42	0.009	1.88	3.80	0.4	
3.35	0.41	0.41	0.009	1.88	3.72	0.4	
3.4	0.39	0.39	0.009	1.88	3.47	0.3	
3.45	0.39	0.39	0.009	1.88	3.54	0.3	
3.5	0.38	0.38	0.009	1.88	3.40	0.3	
3.55	0.35	0.35	0.009	1.88	3.19	0.3	
3.6	0.36	0.36	0.009	1.88	3.22	0.3	
3.65	0.40	0.40	0.009	1.88	3.64	0.3	

3.7	0.45	0.45	0.009	1.88	4.01	0.4	
3.75	0.44	0.44	0.009	1.88	3.92	0.4	
3.8	0.40	0.40	0.009	1.88	3.62	0.3	
3.85	0.38	0.38	0.009	1.88	3.43	0.3	
3.9	0.38	0.38	0.009	1.88	3.38	0.3	
3.95	0.38	0.38	0.009	1.88	3.38	0.3	
4	0.37	0.37	0.009	1.88	3.31	0.3	
4.05	0.36	0.36	0.009	1.88	3.27	0.3	
4.1	0.36	0.36	0.009	1.88	3.27	0.3	
4.15	0.37	0.37	0.009	1.88	3.31	0.3	
4.2	0.31	0.31	0.009	1.88	2.83	0.3	
4.25	0.31	0.31	0.009	1.88	2.77	0.3	
4.3	0.31	0.31	0.009	1.88	2.76	0.3	
4.35	0.31	0.31	0.009	1.88	2.81	0.3	
4.4	0.37	0.37	0.009	1.88	3.37	0.3	
4.45	0.43	0.43	0.009	1.88	3.87	0.4	
4.5	0.47	0.47	0.009	1.88	4.19	0.4	
4.55	0.51	0.51	0.009	1.88	4.57	0.4	
4.6	0.50	0.50	0.009	1.88	4.47	0.4	
4.65	0.50	0.50	0.009	1.88	4.47	0.4	
4.7	0.46	0.46	0.009	1.88	4.11	0.4	
4.75	0.48	0.48	0.009	1.88	4.32	0.4	
4.8	0.50	0.50	0.009	1.88	4.50	0.4	
4.85	0.53	0.53	0.009	1.88	4.74	0.4	
4.9	0.52	0.52	0.009	1.88	4.64	0.4	
4.95	0.47	0.47	0.009	1.88	4.25	0.4	
5	0.44	0.44	0.009	1.88	3.96	0.4	
5.05	0.44	0.44	0.009	1.88	3.94	0.4	
5.1	0.42	0.42	0.009	1.88	3.78	0.4	3
5.15	0.49	0.49	0.009	1.88	4.40	0.4	
5.2	0.52	0.52	0.009	1.88	4.70	0.4	
5.25	0.55	0.55	0.009	1.88	4.97	0.5	
5.3	0.80	0.80	0.009	1.88	7.21	0.7	
5.35	1.71	1.71	0.009	1.88	15.40	1.5	
5.4	2.23	2.23	0.009	1.88	20.03	1.9	
5.45	1.98	1.98	0.009	1.88	17.79	1.7	
5.5	1.40	1.40	0.009	1.88	12.59	1.2	
5.55	1.04	1.04	0.009	1.88	9.37	0.9	
5.6	0.86	0.86	0.009	1.88	7.74	0.7	
5.65	1.06	1.06	0.009	1.88	9.51	0.9	
5.7	1.66	1.66	0.009	1.88	14.90	1.4	
5.75	2.44	2.44	0.009	1.88	21.93	2.1	7'''
5.8	3.26	3.26	0.009	1.88	29.31	2.8	

5.85	4.16	4.16	0.009	1.88	37.46	3.5	
5.9	4.80	4.80	0.009	1.88	43.20	4.1	
5.95	5.49	5.49	0.009	1.88	49.37	4.7	
6	5.83	5.83	0.009	1.88	52.45	4.9	
6.05	6.21	6.21	0.009	1.88	55.90	5.3	
6.1	6.05	6.05	0.009	1.88	54.44	5.1	
6.15	5.79	5.79	0.009	1.88	52.09	4.9	
6.2	5.64	5.64	0.009	1.88	50.73	4.8	
6.25	5.45	5.45	0.009	1.88	49.04	4.6	
6.3	5.15	5.15	0.009	1.88	46.39	4.4	
6.35	5.07	5.07	0.009	1.88	45.67	4.3	
6.4	4.98	4.98	0.009	1.88	44.80	4.2	
6.45	4.54	4.54	0.009	1.88	40.83	3.8	
6.5	3.87	3.87	0.009	1.88	34.81	3.3	
6.55	5.10	5.10	0.009	1.88	45.87	4.3	
6.6	5.82	5.82	0.009	1.88	52.41	4.9	7''
6.65	6.66	6.66	0.009	1.88	59.92	5.6	
6.7	7.33	7.33	0.009	1.88	66.00	6.2	
6.75	7.69	7.69	0.009	1.88	69.24	6.5	
6.8	7.20	7.20	0.009	1.88	64.79	6.1	
6.85	5.90	5.90	0.009	1.88	53.13	5.0	
6.9	5.29	5.29	0.009	1.88	47.65	4.5	
6.95	5.51	5.51	0.009	1.88	49.55	4.7	
7	6.51	6.51	0.009	1.88	58.63	5.5	
7.05	6.94	6.94	0.009	1.88	62.43	5.9	
7.1	6.43	6.43	0.009	1.88	57.86	5.5	
7.15	5.85	5.85	0.009	1.88	52.65	5.0	
7.2	5.32	5.32	0.009	1.88	47.90	4.5	
7.25	4.74	4.74	0.009	1.88	42.67	4.0	
7.3	3.83	3.83	0.009	1.88	34.51	3.3	
7.35	3.58	3.58	0.009	1.88	32.25	3.0	7'''o
7.4	3.44	3.44	0.009	1.88	30.99	2.9	
7.45	3.21	3.21	0.009	1.88	28.86	2.7	
7.5	2.60	2.60	0.009	1.88	23.42	2.2	
7.55	1.83	1.83	0.009	1.88	16.50	1.6	
7.6	2.42	2.42	0.009	1.88	21.75	2.0	7''''o
7.65	2.71	2.71	0.009	1.88	24.36	2.3	
7.7	2.47	2.47	0.009	1.88	22.26	2.1	$-8D_{eq}$
7.75	1.50	1.50	0.009	1.88	13.50	1.3	
7.8	1.58	1.58	0.009	1.88	14.24	1.3	
7.85	2.61	2.61	0.009	1.88	23.51	2.2	7''''o
7.9	1.91	1.91	0.009	1.88	17.19	1.6	
7.95	1.40	1.40	0.009	1.88	12.64	1.2	

8	1.42	1.42	0.009	1.88	12.78	1.2	
8.05	1.45	1.45	0.009	1.88	13.08	1.2	
8.1	0.87	0.87	0.009	1.88	7.79	0.7	
8.15	0.80	0.80	0.009	1.88	7.21	0.7	
8.2	0.79	0.79	0.009	1.88	7.10	0.7	
8.25	1.18	1.18	0.009	1.88	10.63	1.0	
8.3	1.15	1.15	0.009	1.88	10.34	1.0	
8.35	0.94	0.94	0.009	1.88	8.47	0.8	
8.4	1.09	1.09	0.009	1.88	9.85	0.9	
8.45	2.90	2.90	0.009	1.88	26.14	2.5	
8.5	4.14	4.14	0.009	1.88	37.27	3.5	7'''
8.55	4.57	4.57	0.009	1.88	41.15	3.9	
8.6	4.90	4.90	0.009	1.88	44.09	4.2	
8.65	5.64	5.64	0.009	1.88	50.80	4.8	
8.7	6.61	6.61	0.009	1.88	59.48	5.6	
8.75	6.58	6.58	0.009	1.88	59.24	5.6	
8.8	6.75	6.75	0.009	1.88	60.79	5.7	
8.85	6.78	6.78	0.009	1.88	61.01	5.7	7''
8.9	6.82	6.82	0.009	1.88	61.35	5.8	
8.95	6.13	6.13	0.009	1.88	55.16	5.2	
9	5.73	5.73	0.009	1.88	51.58	4.9	
9.05	5.08	5.08	0.009	1.88	45.74	4.3	
9.1	4.38	4.38	0.009	1.88	39.43	3.7	
9.15	3.48	3.48	0.009	1.88	31.35	3.0	7'''
9.2	2.84	2.84	0.009	1.88	25.58	2.4	
9.25	2.35	2.35	0.009	1.88	21.13	2.0	
9.3	2.00	2.00	0.009	1.88	17.99	1.7	
9.35	1.95	1.95	0.009	1.88	17.52	1.7	7''''
9.4	2.60	2.60	0.009	1.88	23.41	2.2	
9.45	9.30	9.30	0.009	1.88	83.71	7.9	
9.5	11.08	11.08	0.009	1.88	99.72	9.4	
9.55	12.24	12.24	0.009	1.88	110.12	10.4	
9.6	13.79	13.79	0.009	1.88	124.07	11.7	
9.65	15.17	15	0.009	1.88	135	12.7	
9.7	16.03	15	0.009	1.88	135	12.7	
9.75	16.46	15	0.009	1.88	135	12.7	
9.8	16.53	15	0.009	1.88	135	12.7	7'
9.85	16.98	15	0.009	1.88	135	12.7	
9.9	17.10	15	0.009	1.88	135	12.7	
9.95	16.20	15	0.009	1.88	135	12.7	
10	15.27	15	0.009	1.88	135	12.7	
10.05	16.07	15	0.009	1.88	135	12.7	
10.1	16.06	15	0.009	1.88	135	12.7	

10.15	14.98	14.98	0.009	1.88	134.83	12.7
10.2	15.56	15	0.009	1.88	135	12.7
10.25	15.86	15	0.009	1.88	135	12.7
10.3	16.75	15	0.009	1.88	135	12.7
10.35	17.27	15	0.009	1.88	135	12.7
10.4	17.26	15	0.009	1.88	135	12.7
10.45	16.93	15	0.009	1.88	135	12.7
10.5	16.32	15	0.009	1.88	135	12.7
10.55	15.86	15	0.009	1.88	135	12.7
10.6	16.03	15	0.009	1.88	135	12.7
10.65	16.30	15	0.009	1.88	135	12.7
10.7	16.17	15	0.009	1.88	135	12.7
10.75	15.41	15	0.009	1.88	135	12.7
10.8	15.71	15	0.009	1.88	135	12.7
10.85	16.00	15	0.009	1.88	135	12.7
10.9	16.34	15	0.009	1.88	135	12.7
10.95	16.97	15	0.009	1.88	135	12.7
11	17.57	15	0.009	1.88	135	12.7
11.05	17.78	15	0.009	1.88	135	12.7
11.1	17.82	15	0.009	1.88	135	12.7
11.15	17.04	15	0.009	1.88	135	12.7
11.2	18.66	15	0.009	1.88	135	12.7
11.25	19.11	15	0.009	1.88	135	12.7
11.3	20.54	15	0.009	1.88	135	12.7
11.35	21.12	15	0.009	1.88	135	12.7
11.4	21.09	15	0.009	1.88	135	12.7
11.45	20.57	15	0.009	1.88	135	12.7
11.5	19.68	15	0.009	1.88	135	12.7
11.55	18.55	15	0.009	1.88	135	12.7
11.6	16.97	15	0.009	1.88	135	12.7
11.65	15.43	15	0.009	1.88	135	12.7
11.7	14.54	14.54	0.009	1.88	130.88	12.3
11.75	14.21	14.21	0.009	1.88	127.88	12.0
11.8	15.56	15	0.009	1.88	135	12.7
11.85	18.00	15	0.009	1.88	135	12.7
11.9	18.37	15	0.009	1.88	135	12.7
11.95	19.05	15	0.009	1.88	135	12.7
12	19.32	15	0.009	1.88	135	12.7
12.05	18.91	15	0.009	1.88	135	12.7
12.1	18.97	15	0.009	1.88	135	12.7
12.15	19.01	15	0.009	1.88	135	12.7
12.2	19.12	15	0.009	1.88	135	12.7
12.25	18.75	15	0.009	1.88	135	12.7

12.3	17.96	15	0.009	1.88	135	12.7	
12.35	17.79	15	0.009	1.88	135	12.7	
12.4	17.84	15	0.009	1.88	135	12.7	
12.45	18.74	15	0.009	1.88	135	12.7	
12.5	19.64	15	0.009	1.88	135	12.7	
					$F_{max,shaft}$, kN =	1288.8	0
12.55	21.03	15					$0.7D_{eq}$
12.6	21.34	15					7'a
12.65	20.76	15					
12.7	20.54	15					
12.75	20.45	15					
12.8	21.63	15					$4D_{eq}$

2.4. Pāļa spiedes pretestība ir vienāda, kN: $F_{max} = R_{c;cal} = F_{max,base} + F_{max,shaft} =$ **3242.4**

2.5. $(R_{c;cal})_{mean}=(R_{c;cal})_{min}=$ **3242.4**

2.6. T.k. prēķins veikts pēc viena izpētes punkta, korelācijas koeficienti vienādi ar:

2.6.1. $\xi_3=$ **1.4**

2.6.2. $\xi_4=$ **1.4**

2.7. $R_{c;k}=$ Min $\{(R_{c;cal})_{mean}/\xi_3;(R_{c;cal})_{min}/\xi_4\}=$ **2316.0**

2.8. Aprēķina pāļa spiedes pretestība, kN: $R_{c;d}=F_{c;d;max}=R_{c;k}/\gamma_t=$ **2105.4**

2.8.1. $\gamma t=$ **1.1**

9. Pāļu materiālu nestspējas pārbaude. Pāļa nestspēja atkarībā no ekscentricitātes.

Bored piles Ø400 mm /530

The nominal diameter of the pile is 400 mm, it is made from concrete C20/25 (B25 by Russian standard) and reinforced with concentric located longitudinal bars 6Ø16 A-III (Russian steel) and with transverse reinforcement Ø8 A-I step 200 mm. Outer diameter of reinforcement cage is 280 mm.

The bearing capacity of the pile as a centrally compressed **reinforced concrete member** is:

$N_{Rd} = A_c \alpha f_{cd} + A_s f_{ycd}$, where

A_c – effective area of cross–section of the pile;

By Eurocode 1992-3 the diameter of the piles in the design calculations sould be taken as 0,95 times the nominal diameter, d_{nom}, however not greater than d_{nom} –20 mm and not less than d_{nom}–50 mm.

$A_c = 0{,}95 \times \pi \times 400^2/4 = 0{,}95 \times 125700 = 119400$ mm^2, according diameter

$$Ø = \sqrt{\frac{4A_c}{\pi}} = \sqrt{\frac{4 \cdot 119400}{\pi}} = 390 \text{ mm} > d_{nom} - 20 = 380 \text{ mm}.$$

Consequently, the effective area of cross–section of the pile is

$A_c = \pi \times 380^2/4 = 113400$ mm^2.

α – reduction factor taking into account of long term effects by Eurocode 1992-1-1: $\alpha = 0{,}85$;

f_{cd} – design compression strength of concrete: $f_{cd} = \dfrac{20}{1{,}5 \times 1{,}1} = 12{,}1$ N/mm^2;

(20 – characteristic compressive strength of concrete C20/30, 1,5 – partial safety factor for concrete strength by Eurocode 1992-1-1, 1,1 – additional partial safety factor for bored pile's concrete by Eurocode 1992-3);

A_s – the sum of the area of longitudinal bars: $A_s = 6 \times \pi \times (16/2)^2 = 1206$ mm$^2 > 0{,}005A_c = 567$ mm^2;

f_{ycd} –design compression yield strength of longitudinal reinforcement A-III: $f_{ycd} = 340$ N/mm^2.

Consequently, the bearing capacity of the pile as a centrally compressed concrete member is:

$N_{Rd} = 113400 \times 0{,}85 \times 12{,}1 + 1206 \times 340 = 1\,166\,000 + 410\,000 = 1\,576\,000$ N = **1 580 kN**.

The bearing capacity of the pile as a centrally compressed **plain concrete member** is:

$N_{Rd} = A_c \alpha f_{cd}$, where

f_{cd} – design compression strength of plain concrete: $f_{cd} = \dfrac{20}{1{,}5 \times 1{,}2 \times 1{,}1} = 10{,}1$ N/mm^2;

(20 – characteristic compressive strength of concrete C20/25, 1,5 – partial safety factor for concrete strength by Eurocode 1992-1-1, 1,2 – additional partial safety factor for plain concrete by Eurocode 1992-1-6, 1,1 – additional partial safety factor for bored pile's concrete by Eurocode 1992-3).

Consequently, the bearing capacity of the pile as a centrally compressed plain concrete member is:

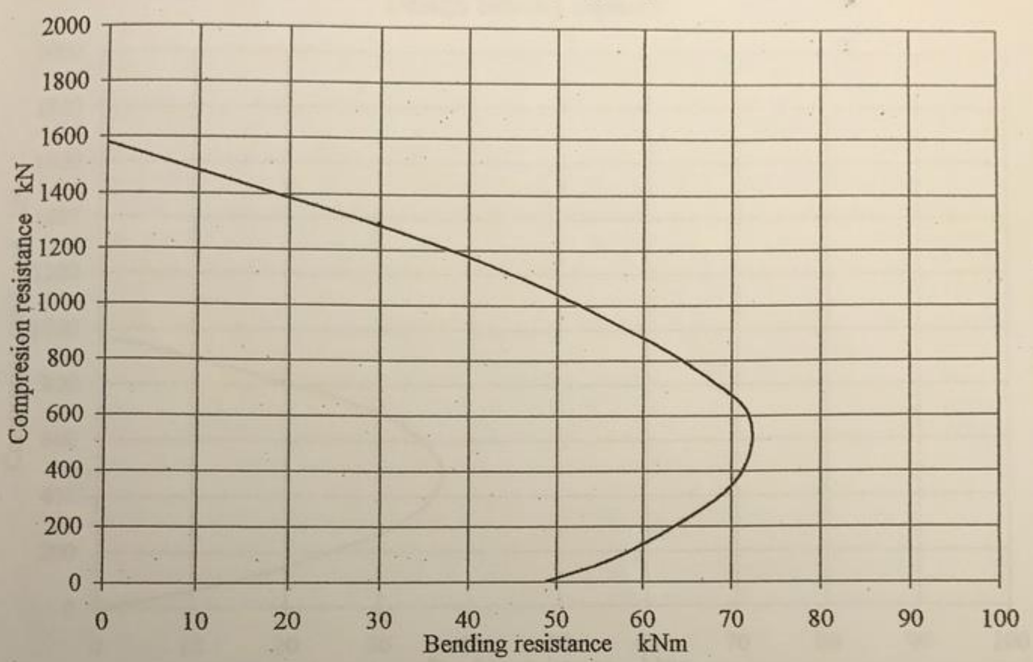
$N_{Rd} = 113400 \times 0{,}85 \times 10{,}1 = 974\ 000$ N = 970 **kN**.

In the following the curves of bearing capacities of reinforced and plain concrete piles subjected to eccentric compression calculated according to Eurocode are presented.

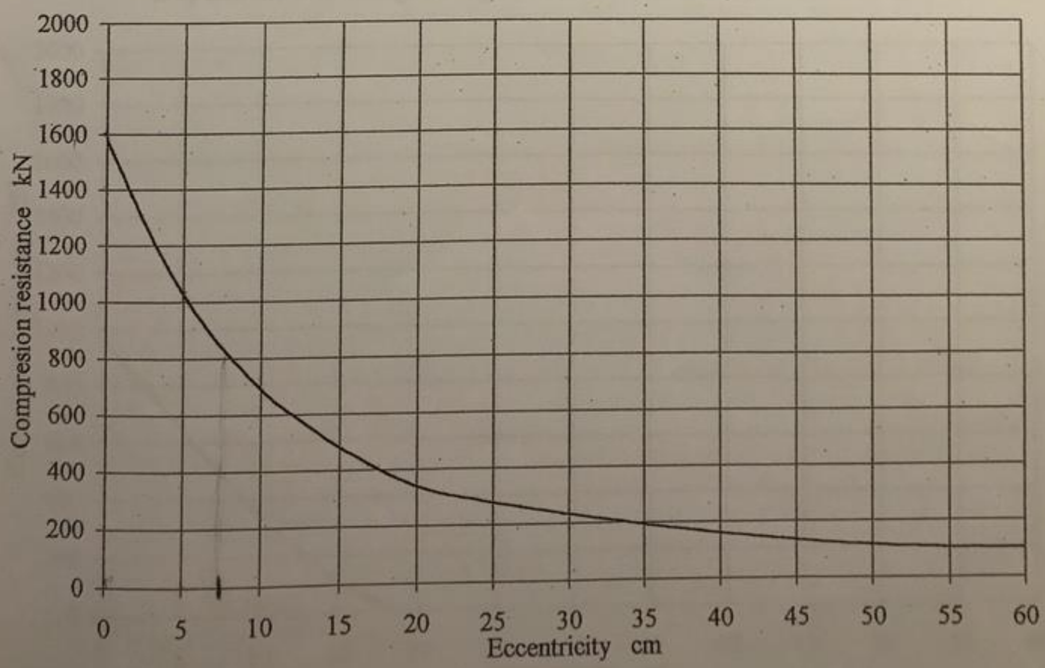
REINFORCED CONCRETE BORED PILE Ø400

C20/25; 6Ø16 A-III

Design bearing capacity



Dependence of design compression resistance from eccentricity



Bored piles Ø550 mm

The nominal diameter of the pile is 550 mm, it is made from concrete C20/25 (B25 by Russian standard) and reinforced with concentric located longitudinal bars 6Ø16 A-III (Russian steel) and with transverse reinforcement Ø8 A-I step 200 mm. Outer diameter of reinforcement cage is 430 mm.

The bearing capacity of the pile as a centrally compressed **reinforced concrete member** is:

$N_{Rd} = A_c \alpha f_{cd} + A_s f_{ycd}$, where

A_c – effective area of cross–section of the pile;

By Eurocode 1992-3 the diameter of the piles in the design calculations sould be taken as 0,95 times the nominal diameter, d_{nom}, however not greater than d_{nom} –20 mm and not less than d_{nom}–50 mm.

$A_c = 0{,}95 \times \pi \times 550^2/4 = 0{,}95 \times 237600 = 225700$ mm^2, according diameter

$$\text{Ø} = \sqrt{\frac{4A_c}{\pi}} = \sqrt{\frac{4 \cdot 225700}{\pi}} = 536 \text{ mm} > d_{nom} - 20 = 530 \text{ mm}.$$

Consequently, the effective area of cross–section of the pile is

$A_c = \pi \times 530^2/4 = 220600$ mm^2.

α – reduction factor taking into account of long term effects by Eurocode 1992-1-1: $\alpha = 0{,}85$;

f_{cd} – design compression strength of concrete: $f_{cd} = \dfrac{20}{1{,}5 \times 1{,}1} = 12{,}1$ N/mm^2;

(20 – characteristic compressive strength of concrete C20/25, 1,5 – partial safety factor for concrete strength by Eurocode 1992-1-1, 1,1 – additional partial safety factor for bored pile's concrete by Eurocode 1992-3);

A_s – the sum of the area of longitudinal bars: $A_s = 6 \times \pi \times (16/2)^2 = 1206$ mm$^2 > 0{,}005 A_c = 1103$ mm^2;

f_{ycd} –design compression yield strength of longitudinal reinforcement A-III: $f_{ycd} = 340$ N/mm^2.

Consequently, the bearing capacity of the pile as a centrally compressed concrete member is:

$N_{Rd} = 220600 \times 0{,}85 \times 12{,}1 + 1206 \times 340 = 2\,269\,000 + 410\,000 = 2\,679\,000$ N = **2 680 kN**.

The bearing capacity of the pile as a centrally compressed **plain concrete member** is:

$N_{Rd} = A_c \alpha f_{cd}$, where

f_{cd} – design compression strength of plain concrete: $f_{cd} = \dfrac{20}{1{,}5 \times 1{,}2 \times 1{,}1} = 10{,}1$ N/mm^2;

(20 – characteristic compressive strength of concrete C20/25, 1,5 – partial safety factor for concrete strength by Eurocode 1992-1-1, 1,2 – additional partial safety factor for plain concrete by Eurocode 1992-1-6, 1,1 – additional partial safety factor for bored pile's concrete by Eurocode 1992-3).

Consequently, the bearing capacity of the pile as a centrally compressed plain concrete member is:

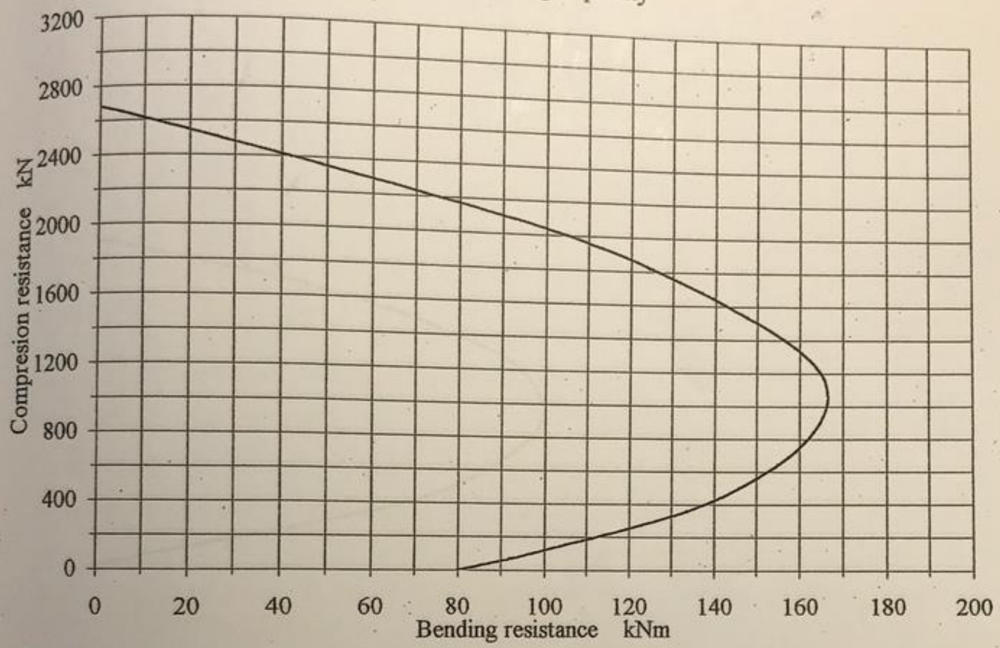
$N_{Rd} = 220600 \times 0{,}85 \times 10{,}1 = 1\,894\,000$ N = **1 890 kN**.

In the following the curves of bearing capacities of reinforced and plain concrete piles subjected to eccentric compression calculated according to Eurocode are presented.

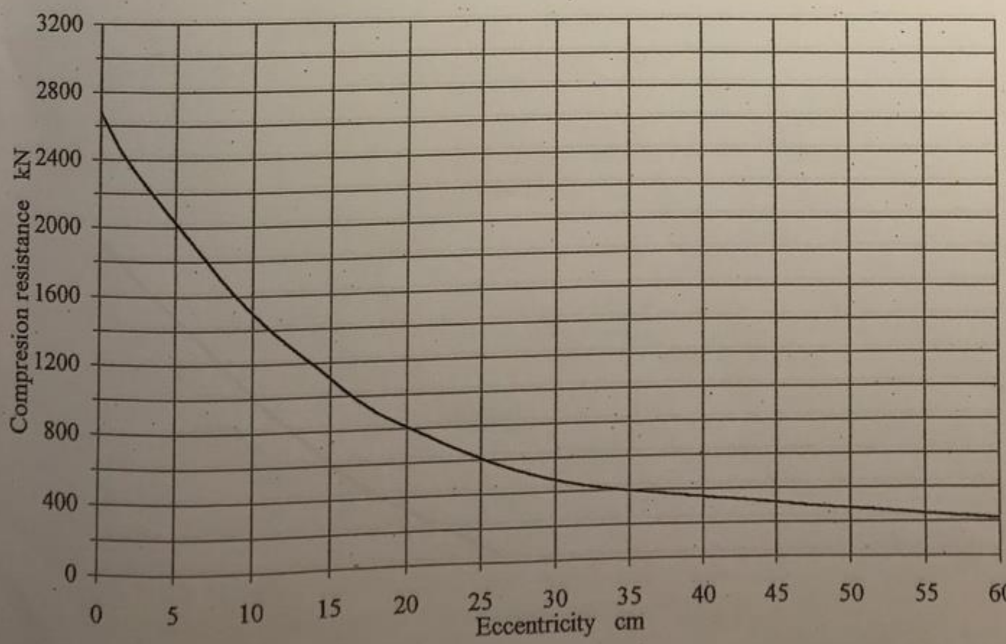
REINFORCED CONCRETE BORED PILE Ø550

C20/25; 6Ø16 A-III

Design bearing capacity



Dependence of design compression resistance from eccentricity



Bored piles Ø620 mm

The nominal diameter of the pile is 620 mm, it is made from concrete C20/25 (B25 by Russian standard) and reinforced with concentric located longitudinal bars 6Ø18 A-III (Russian steel) and with transverse reinforcement Ø8 A-I step 200 mm. Outer diameter of reinforcement cage is 420 mm.

The bearing capacity of the pile as a centrally compressed **reinforced concrete member** is:

$N_{Rd} = A_c \alpha f_{cd} + A_s f_{ycd}$, where

A_c – effective area of cross–section of the pile;

By Eurocode 1992-3 the diameter of the piles in the design calculations sould be taken as 0,95 times the nominal diameter, d_{nom}, however not greater than d_{nom} –20 mm and not less than d_{nom}–50 mm.

$A_c = 0{,}95 \times \pi \times 620^2/4 = 0{,}95 \times 319000 = 286800$ mm^2, according diameter

$$Ø = \sqrt{\frac{4A_c}{\pi}} = \sqrt{\frac{4 \cdot 286800}{\pi}} = 604 \text{ mm} > d_{nom} - 20 = 600 \text{ mm}.$$

Consequently, the effective area of cross–section of the pile is

$A_c = \pi \times 600^2/4 = 282700$ mm^2.

α – reduction factor taking into account of long term effects by Eurocode 1992-1-1: $\alpha = 0{,}85$;

f_{cd} – design compression strength of concrete: $f_{cd} = \frac{20}{1{,}5 \times 1{,}1} = 12{,}1$ N/mm^2;

(20 – characteristic compressive strength of concrete C20/25, 1,5 – partial safety factor for concrete strength by Eurocode 1992-1-1, 1,1 – additional partial safety factor for bored pile's concrete by Eurocode 1992-3);

A_s – the sum of the area of longitudinal bars: $A_s = 6 \times \pi \times 18^2/4 = 1524$ mm$^2 > 0{,}005 A_c = 1413$ mm^2;

f_{ycd} –design compression yield strength of longitudinal reinforcement A-III: $f_{ycd} = 340$ N/mm^2.

Consequently, the bearing capacity of the pile as a centrally compressed concrete member is:

$N_{Rd} = 282700 \times 0{,}85 \times 12{,}1 + 1524 \times 340 = 2\,908\,000 + 518\,000 = 3\,426\,000$ N = **3 430 kN**.

The bearing capacity of the pile as a centrally compressed **plain concrete member** is:

$N_{Rd} = A_c \alpha f_{cd}$, where

f_{cd} – design compression strength of plain concrete: $f_{cd} = \frac{20}{1{,}5 \times 1{,}2 \times 1{,}1} = 10{,}1$ N/mm^2;

(20 – characteristic compressive strength of concrete C20/25, 1,5 – partial safety factor for concrete strength by Eurocode 1992-1-1, 1,2 – additional partial safety factor for plain concrete by Eurocode 1992-1-6, 1,1 – additional partial safety factor for bored pile's concrete by Eurocode 1992-3).

Consequently, the bearing capacity of the pile as a centrally compressed plain concrete member is:

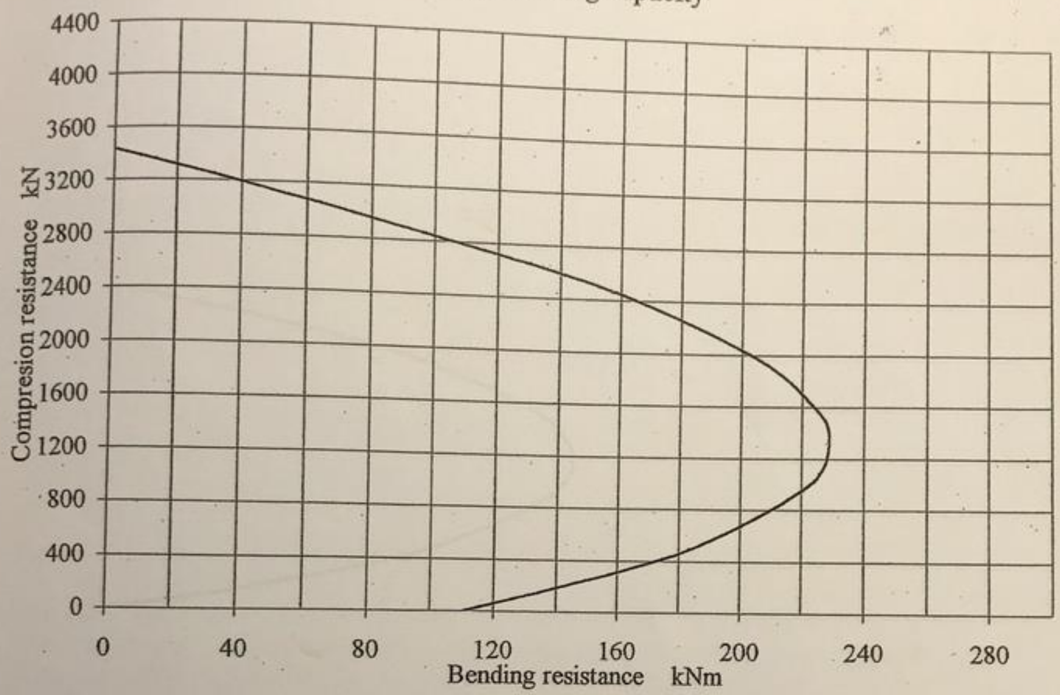
$N_{Rd} = 282700 \times 0{,}85 \times 10{,}1 = 2\,427\,000$ N = **2 430 kN**.

In the following the curves of bearing capacities of reinforced and plain concrete piles subjected to eccentric compression calculated according to Eurocode are presented.

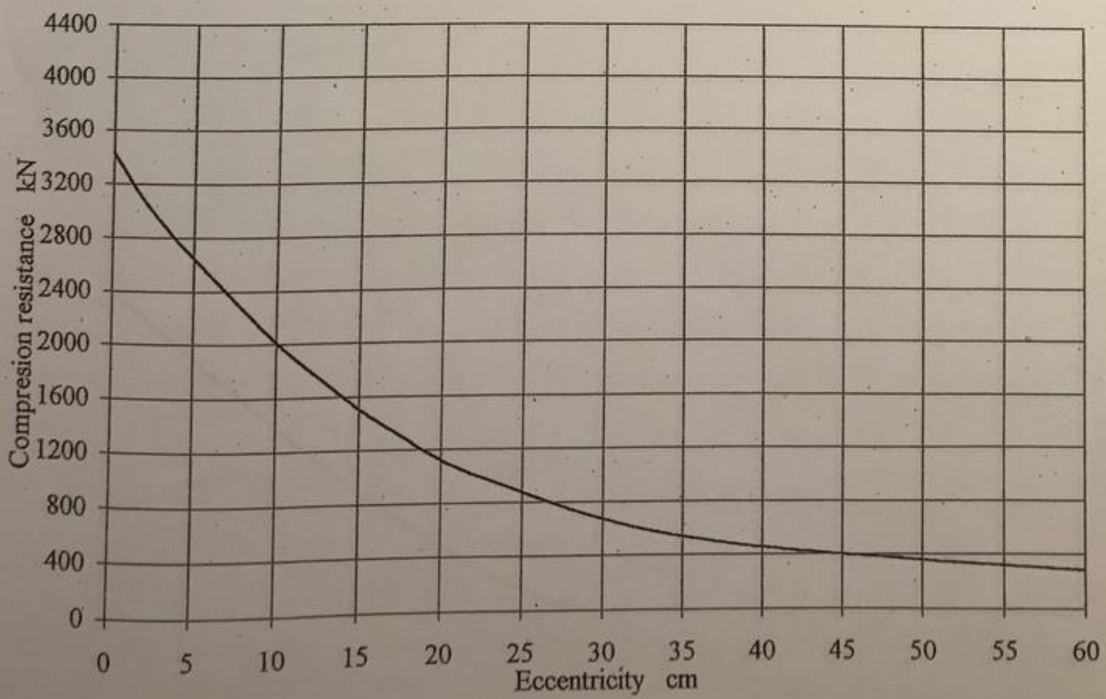
REINFORCED CONCRETE BORED PILE Ø620

C20/25; 6Ø18 A-III

Design bearing capacity



Dependence of design compression resistance from eccentricity



10. Režģoga kolonnas aprķins.

MATERIALS

fck	30	N/mm²	γ_s	1.15	Cover to link, C_{nom}	40	mm	Fire period
fyk	500	N/mm²	γ_c	1.5	dg	20	mm	
φ	2.2		φef	1.21	$\Delta_{c,dev}$	10	mm	
			Steel class	B				

SECTION

h	1800	mm
b	1800	mm
with	10	bars per 1 800 face
and	10	bars per 1 800 face

ie. 1 800 x 1 800 columns with 36 bars

Y  Y

RESTRAINTS

	Storey height (mm)	Top Condition	Btm Condition	Braced ?
on Y-AXIS	3000	P	F	Y
on Z-AXIS	3000	P	F	Y

	L (mm)	L_0 (mm)	h_0 (mm)
about Y-AXIS	2600	2600	900
about Z-AXIS	3000	3000	

CONNECTING BEAMS/SLABS

	b (mm)	h (mm)	L (m)	Remote end (F) or (P)
Top West	400	400	4	F
Top East				
Top North				
Top South				
Bottom West				
Bottom East				
Bottom North				
Bottom South				

Beam stiffnesses are 1% of uncracked stiffness

Column above? N Col below? Y

BAR ARRANGEMENTS

Bar Ø	Asc %	Link Ø	BAR CENTRES (mm) 1 800 Face	1 800 Face	Nuz (kN)	Checks
B 40	1.40	10	184	184	79729	ok
B 32	0.89	8	186	186	74354	ok
B 25	0.55	8	187	187	70632	ok
B 20	0.35	8	187	187	68532	ok
B 16	0.22	8	188	188	67189	ok
B 12		8	188	188		As or Ø < minimum

LOADCASES

	AXIAL N (kN)	TOP MOMENTS (kNm) m_{0y}	m_{0z}	BTM MOMENTS (kNm) m_{0y}	m_{0z}
1	106			-2658.0	
2					
3					
4					
5					
6					

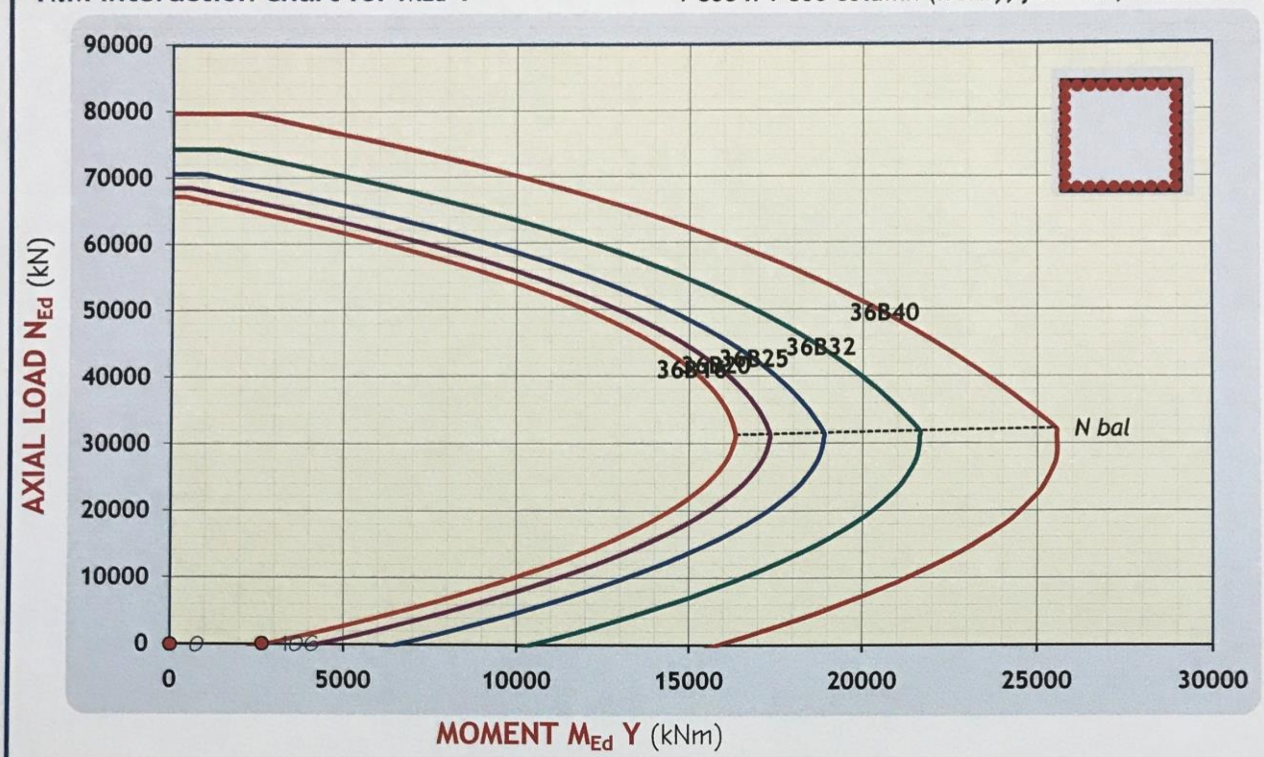
Moments m_0 at top and bottom of column (from analysis) are combined to find M_{0e}. The moment due to imperfections (e_1N) and the second order moment (M_2) are then added to obtain M_{Ed} In the table below.

DESIGN MOMENTS

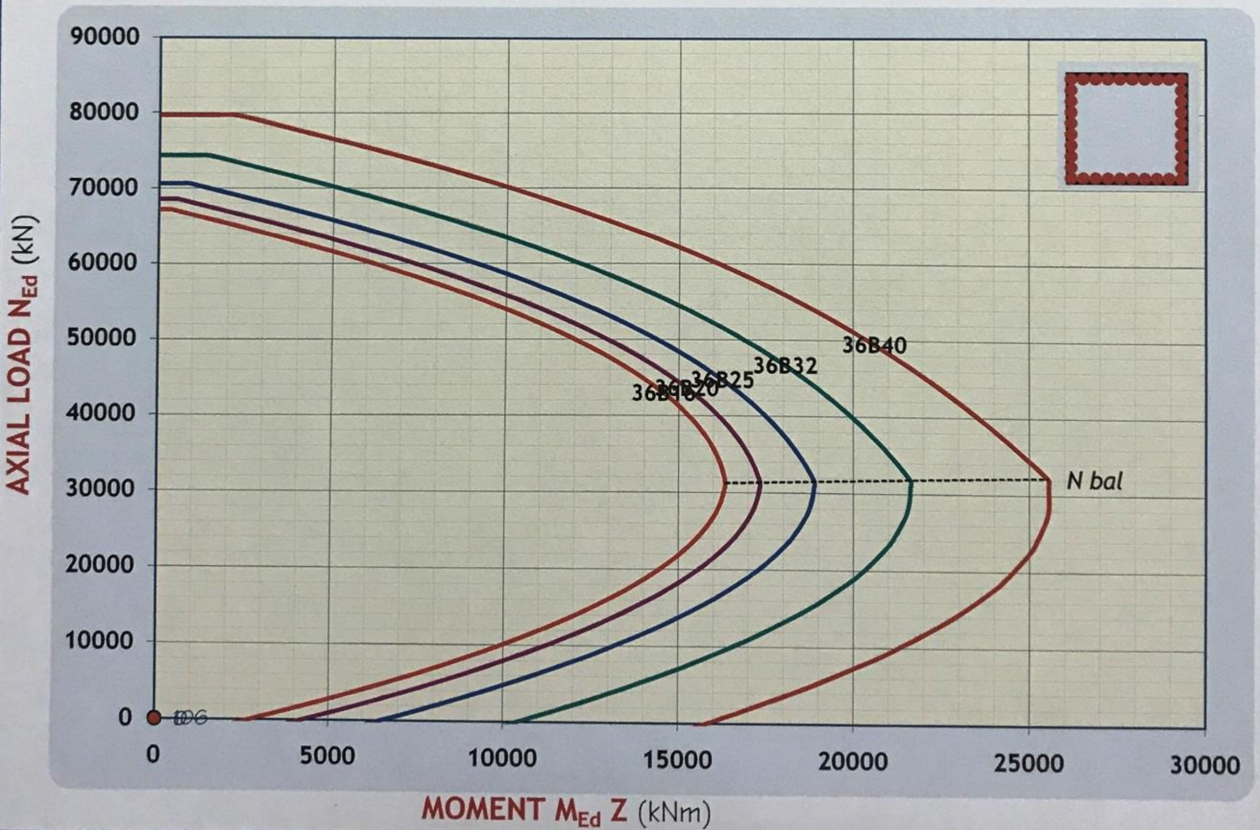
	Y AXIS M_{Ed} y	M_{Rd} y	Z AXIS M_{Ed} z	M_{Rd} z	Critical axis	Biaxial Check Equation (5.39)	REBAR	Fire
1	2658.0	2800.0	0.8	2800.0	Z	0.950	36 B16	ok
2								
3								
4								
5								
6								

SEE CHARTS ON NEXT SHEET

N:M interaction chart for MEd Y *1 800 x 1 800 column (h x b), fck = 30, 40 mm cover*



N:M interaction chart for MEd Z *1 800 x 1 800 column (h x b), fck = 30, 40 mm cover*



TYPICAL CALCULATION **for loadcase 1** **1800 x 1800 column with 36 B16 bars**

		About Y axis		About Z axis	
SLENDERNESS		Column is braced		Column is braced	
Clear height, L		3000	mm	2600	
Rotational stiffness, k_1	$Max[0.1, EI/l_{cols}/\sum(\kappa EI/l_{beams})]$	∞		∞	5.8.3.2(3)
Rotational stiffness, k_2	(κ=2 braced, or 4 unbraced)	∞		∞	
Effective length, l_0	Exp (5.15) braced or (5.16) unbraced	2600	mm	3000	5.8.3.2(3)
Radius of gyration, i	including reinforcement	523.3	mm	523.3	5.8.3.2(1)
Slenderness ratio, λ	l_0/i	5.0		5.7	
Reinforcement ratio, ω	$A_s \cdot f_{yd}/(A_c \cdot f_{cd})$	0.050		0.050	5.8.3.1
Relative normal force, n	$N_{Ed}/(A_c \cdot f_{cd})$	0.002		0.002	5.8.3.1
In expression 5.13N	A, B and C	0.805, 1.049, 0.10		0.805, 1.049, 0.10	5.8.3.1
Limiting slenderness, λ_{lim}	Exp (5.13N)	40.0		40.0	
Slenderness condition	$\lambda > \lambda_{lim}$?	Short		Short	
BUCKLING N_{Ed} =	106 kN				
At maximum MOR, n_{bal}	from charts	0.482		0.482	5.8.8.3(3)
Axial correction factor, K_r	$(n_u - n)/(n_u - n_{bal})$	1.000		1.000	Eqn (5.36)
Creep adjust factor, B	$0.35 + f_{ck}/200 - \lambda/150$	0.467		0.462	5.8.8.3(4)
Creep effect factor, K_φ	$1 + \beta \cdot \varphi_{ef} \leq 1$	1.565		1.559	Eqn (5.37)
Basic curvature, $1/r_0$	$f_{yd}/(0.45d.E_s)$	0.0028	/m	0.0028	5.8.8.3(1)
Curvature, $1/r$	$K_r \cdot K_\varphi \cdot 1/r_0$	0.00433	/m	0.00432	Eqn (5.34)
Curvature distribution, c	8 if M_0 constant, otherwise π^2	9.870		8.000	5.8.8.2(4)
Deflection, e_2	$(1/r) \cdot l_0^2/c$	2.969	mm	4.858	5.8.8.2(3)
Second order moment, M_2	$N_{Ed} \cdot e_2$ if short, otherwise 0	0.00	kNm	0.00	Eqn (5.33)
MOMENTS					
First order end M, M_{01}	lesser of end moments	0.00	kNm	0.00	
First order end M, M_{02}	greater of end moments	-2658.00	kNm	0.00	
Equiv mid-height M, M_{0e}	$0.6M_{02} + 0.4M_{01}$	1594.80	kNm	0.00	Eqn (5.32)
IMPERFECTIONS					
Inclination, θ_i	$Min[1, Max(⅔, 2/\sqrt{l})] \cdot \theta_0$	0.0050		0.0050	Eqn (5.1)
Imperfection M, M_{imp}	$= N_{Ed} e_i = \theta_i \cdot N_{Ed} \cdot l_0/2 =$	0.69	kNm	0.79	Eqn (5.2)
Minimum moment, M_{min}	$= N_{Ed} e_0 = Max(20, h/30) \cdot N_{Ed}$	6.36	kNm	0.00	6.1 (4)
FINAL DESIGN M					
Critical axis:	greater of M_{impY}/R_{dY} and M_{impZ}/R_{dY}	.		Z	5.8.9(2)
M_{Ed}	$Max[M_{min}, max(M_{01}, M_{02}+M_2/2, M_{0e}+M_2)+M_{imp}]$	2658.00	kNm	0.79	Eqn (5.33)
BIAXIAL CHECK					
Section MOR, M_{Rd}	from charts, with NEd = 106	2800.00	kNm	2800.00	
Relative force, N_{Ed}/N_{Rd}	$N_{Ed}/(A_c \cdot f_{cd} + A_s \cdot f_{yd}) =$	0.002			
Exponent, a	If{n<0.7, max[1, (10n + 11)/12], min[2, (5n + 1)/3]} =	1.000			5.8.9(4)
Check condition	$(M_{Edy}/M_{Rdy})^a + (M_{Edz}/M_{Rdz})^a =$	0.950	**≤ 1 - section ok**		Eqn (5.39)

11. Secinājumi:

1. Pieņemtie režģoga izmēri - 3600*3600*1000 mm, **Betons C30/37, XC2, XF3.**
    a. Augšējais stiegrojums – siets 28/28/100/100, **B500B**.
    b. Apakšējais stiegrojums– siets 28/28/100/100, ***B500B.***
    c. Šķersstiegrojums –d=16, **B500B**, s.200.
2. Pieņemtie pāļi: CSP (Cased Secant Piles) - CFA + casing, d=406mm, d=25, 8.gab., **B500B BETONS C30/37, XD2 XA1 XC3, L=12.5 m**.
    a. Par pāļa nesošo pamatslāņu pieņemts slānis Nr. 7'a. (sk. Ģeoloģiskā izpēte. **SIA „BG Invest" 18/01-01lig/PR**).

Sastādīja:

Būvinženieris