



Company's Name : PT INTI EVERSPRING INDONESIA
Plant Location : SERANG, BANTEN-INDONESIA
Project Name : FORMULATION & REPACKING PLANT
Document Title : ANALYSIS FOUNDATION HERBISIDA

CARBAMATION PROJECT (JOB No. :)	
ISSUE PURPOSE :	
RESULT CODE : A, C, R, F	(A)
NEXT STATUS : FA, FR, FI, FC, AB	()
SUBMISSION DATE :	(31 Juli 2017)
RESPONSIBLE DEPT./PERSON :	(Owner Project / Sudrajat)
Review Date:	()
A: Approved without Comment; C: Approved with Minor Comment R: Not Approved. Resubmit Incorporating Comment; F: Not Subject to Review/Approval	
Approval or review hereunder shall not be construed to relieve Supplier / Subcontractor of his responsibilities and liability under the Contract.	
DOC.NO	IEI-03-CS-137

Rev. No	Date	Note	Prepare	Checked by	Approved by	Approved by owner
A	31-07-2017	For Approval	GIDD	STP	HM	



CALCULATION FOUNDATION WAREHOUSE HERBISIDA

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I. BASIS OF CALCULATION

1.1 STANDARD

- SNI T 03 2847 2002 - Tata Cara Perencanaan Struktur Beton untuk Bangunan Gedung
- American Concrete Institute ACI 318 - 1998
- Principles of Foundation Engineering – BRAJA M. DAS

1.2 MATERIAL SPECIFICATION

- CONCRETE

Poer and Pedestal : K – 300 Kg/cm² (fc' = 25 Mpa)

Spun Pile : K – 600 Kg/cm² (fc' = 50 Mpa)

Steel Density : $\gamma_{\text{steel}} = 7850 \text{ kg /m}^3$

Concrete Density : $\gamma_{\text{concrete}} = 2400 \text{ kg /m}^3$

- REINFORCEMENT

Deform Bar : D \geq 13 mm, BJTD 40 (Fy = 400 Mpa)

Plain Bar : ϕ < 13 mm, BJTP 24 (Fy = 240 Mpa)

1.3 BEARING CAPACITY

Base on soil investigation reference specify on Bore Hole (BH-2)



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II. DESIGN OF PILE FOUNDATION

2.1 SINGLE PILE BEARING CAPACITY

the ultimate axial capacity of pile foundation can be obtained by a simply equation as the sum of the end bearing capacity plus the skin friction resistance:

$$Q_u = Q_s + Q_p = f A_s + q A_p$$

Q_s = skin friction resistance

Q_p = Total end bearing

f = unit load-transfer in skin friction (will normally vary with depth)

q = unit load-transfer in end-bearing (will normally vary with depth)

A_p = gross end area of pile

A_s = side surface area of pile

2.1.1 SKIN FRICTIONAL RESISTANCE (Q_s)

$$Q_s = p \times L \times f_s$$

p = perimeter of pile

L = length of pile

- Clay Layer

$$f_s = \alpha c_u$$

α = adhesion factor

c_u = undrained cohesion at corresponding depth

- Sand Layer

Based on field observation, Meyerhof (1976) the ultimate frictional resistance (Q_s) of pile in sand layer can be obtained from N-SPT:

For high displacement pile: $f_s = 2 \times N \text{ (kN/m}^2\text{)} < 100 \text{ kPa}$

For low displacement pile: $f_s = N \text{ (kN/m}^2\text{)}$

2.1.2 END BEARING CAPACITY (Q_p)

$$Q_p = q_p \times A_p$$

A_p = cross sectional area of pile tip

- Clay Layer

$$q_p = 9 \times c_u$$



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- Sand Layer

$$q_p = 200 \times N_{spt} < 9600 \text{ (kN/m}^2\text{)}$$

Bearing capacity maximum a pile foundation is calculated based on at result of Standard Penetration Test (SPT) by using method from Meyerhof (1976).

$$Q_p = 200 \times N_{sp} \times A + 2 \times N_{sp} \times A_s \times L$$

L = depth of penetration into the cohesionless soil layer

D = diameter of pile

N_{spt} = N_{spt} the pile tip

The axial bearing capacity of pile foundation is analysed base on bore hole BH2
(Please see soil test report)

2.2 UP LIFT CAPACITY

Based on Nicola and Randolph (1993) that in fine grained cohesive soil, where loading is assumed to occur under undrained condition, the shaft resistance is generally consider equal in compression and in uplift. Whereas in non-cohesive or free draining soils, They state that it has been customary to assume that the shaft resistance in uplift is approximately 70% of the shaft resistance in compression.

The axial bearing capacity of pile foundation is analysed base on bore hole BH2
(Please see soil test report)

2.3 GROUP PILE BEARING CAPACITY (IF REQUIRED)

Pile bearing capacity in one group in earning from single pile capacity is multiplied with a factor efficiency, factor friction pile efficiency in group of according to Joseph E, Bowles is calculated by using equation of continuity Converse Labarre :

$$C_e = 1 - \frac{\arctan\left(\frac{\phi}{S}\right)}{90^\circ} \cdot \left(2 - \frac{1}{m} - \frac{1}{n}\right)$$

Where is :



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ϕ = Pile diameter

S = Ace distance to ace between pile in group

m = number of row in groups

n = number of columns in groups

III. ALLOWABLE PILE BEARING CAPACITY

3.1 Rating working for one pile in group of pile is calculated based on axial force and moments working for pile. As for formula applied:

$$P_{maks} = \frac{\sum P}{n} + \frac{M_y \cdot X_{max}}{\sum X^2} + \frac{M_x \cdot Y_{max}}{\sum Y^2} \leq \bar{P}$$

dimana:

\bar{P} = allowable pile capacity in groups

P_{maks} = maximum force in one pile

$\sum P$ = Full scale of axial

n = the many pile in groups pile

M_x = Momen happened in direction X

M_y = Momen happened in direction Y

X_{maks} = Furthestmost abscissa to center of gravity group of pile

Y_{maks} = Furthestmost ordinate to center of gravity group of pile

$\sum X^2$ = Number of from abscissa squares every pile

$\sum Y^2$ = Number of from ordinate squares every pile



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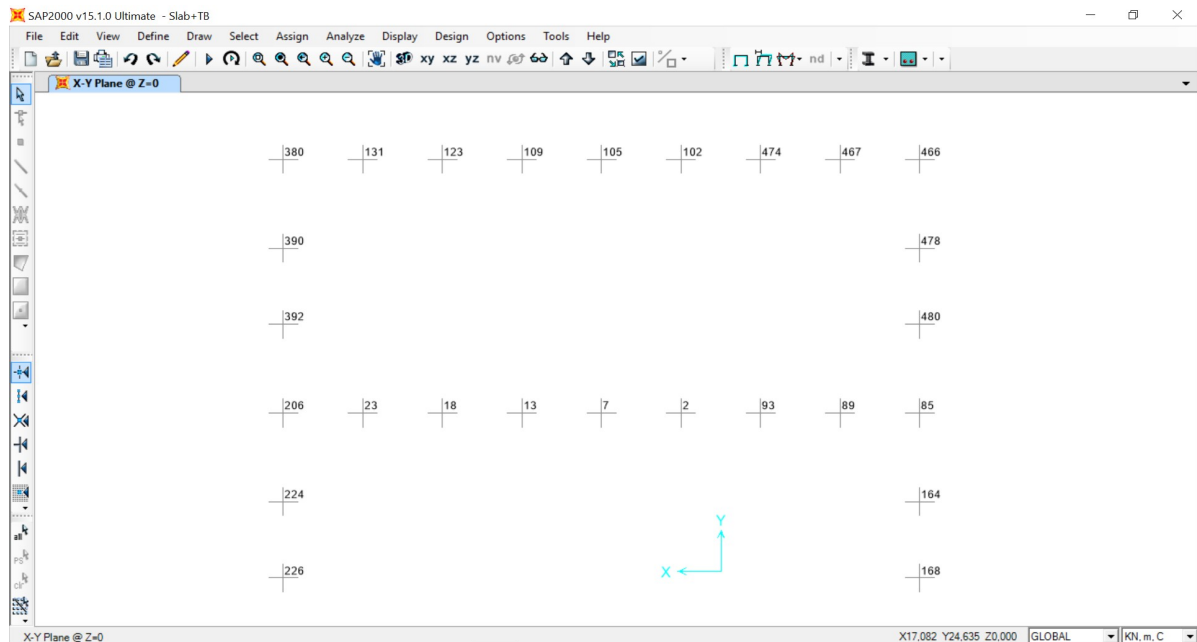
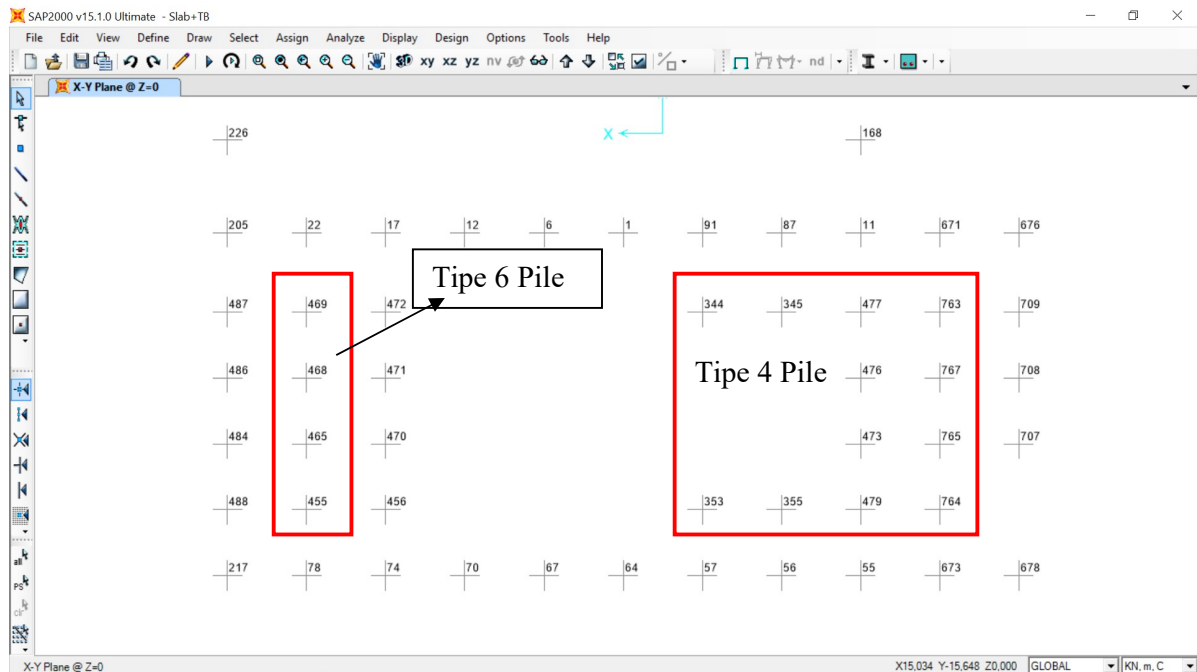
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3. CALCULATION SHEET



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TABLE: Joint Reactions Herbi

Joint	OutputCase	CaseType	StepType	F1	F2	F3	M1	M2	M3
Text	Text	Text	Text	KN	KN	KN	KN-m	KN-m	KN-m
1	COMB1	Combination		1,943	-8,228	130,229	-174,8499	3,642	-0,0009124
1	COMB2	Combination		1,943	-8,228	130,229	-174,8499	3,642	-0,0009124
1	COMB3	Combination		1,943	-8,228	130,229	-174,8499	3,642	-0,0009124
1	COMB4	Combination		1,901	-8,463	121,785	-163,2081	3,5807	-0,0013
1	COMB5	Combination		1,986	-7,994	138,673	-186,4918	3,7032	-0,0005436
1	COMB6	Combination	Max	2,173	-8,218	130,734	-174,8151	4,0958	-0,0008642
1	COMB6	Combination	Min	1,713	-8,239	129,724	-174,8848	3,1881	-0,0009605
1	COMB7	Combination	Max	2,012	-8,225	130,381	-174,8387	3,7787	-0,0008976
1	COMB7	Combination	Min	1,874	-8,232	130,077	-174,8611	3,5052	-0,0009272
2	COMB1	Combination		0,023	-1,944	67,617	13,4292	0,05	-0,0002429
2	COMB2	Combination		0,023	-1,944	67,617	13,4292	0,05	-0,0002429
2	COMB3	Combination		0,023	-1,944	67,617	13,4292	0,05	-0,0002429
2	COMB4	Combination		0,015	-3,39	61,159	23,6792	0,0336	-0,0003157
2	COMB5	Combination		0,031	-0,498	74,075	3,1792	0,0664	-0,0001701
2	COMB6	Combination	Max	0,153	-1,937	67,661	13,4548	0,316	-0,0002173
2	COMB6	Combination	Min	-0,108	-1,951	67,573	13,4035	-0,2161	-0,0002685
2	COMB7	Combination	Max	0,062	-1,942	67,63	13,437	0,1299	-0,0002352
2	COMB7	Combination	Min	-0,016	-1,946	67,604	13,4214	-0,0299	-0,0002506
6	COMB1	Combination		0,927	-8,78	123,785	-172,929	1,9556	0,0007591
6	COMB2	Combination		0,927	-8,78	123,785	-172,929	1,9556	0,0007591
6	COMB3	Combination		0,927	-8,78	123,785	-172,929	1,9556	0,0007591
6	COMB4	Combination		1,055	-9,136	114,938	-160,6192	2,1827	0,0006451
6	COMB5	Combination		0,798	-8,424	132,632	-185,2389	1,7285	0,000873
6	COMB6	Combination	Max	1,169	-8,779	124,282	-172,9238	2,4284	0,0008491
6	COMB6	Combination	Min	0,684	-8,781	123,288	-172,9343	1,4827	0,0006691
6	COMB7	Combination	Max	1	-8,78	123,935	-172,9272	2,0982	0,0007866
6	COMB7	Combination	Min	0,853	-8,781	123,635	-172,9308	1,8129	0,0007316
7	COMB1	Combination		0,043	-2,17	63,488	14,4763	0,0875	-0,00008763
7	COMB2	Combination		0,043	-2,17	63,488	14,4763	0,0875	-0,00008763
7	COMB3	Combination		0,043	-2,17	63,488	14,4763	0,0875	-0,00008763
7	COMB4	Combination		0,035	-3,612	57,341	24,7806	0,0705	-0,00004626
7	COMB5	Combination		0,051	-0,728	69,636	4,172	0,1046	-0,000129
7	COMB6	Combination	Max	0,173	-2,169	63,719	14,4816	0,353	-0,000063
7	COMB6	Combination	Min	-0,087	-2,172	63,258	14,4711	-0,1779	-0,0001123
7	COMB7	Combination	Max	0,082	-2,17	63,558	14,4781	0,1673	-0,00008022
7	COMB7	Combination	Min	0,003938	-2,171	63,419	14,4746	0,0078	-0,00009504
11	COMB1	Combination		-1,488	-14,936	241,95	2,0223	-1,4016	-0,0036
11	COMB2	Combination		-1,488	-14,936	241,95	2,0223	-1,4016	-0,0036
11	COMB3	Combination		-1,488	-14,936	241,95	2,0223	-1,4016	-0,0036
11	COMB4	Combination		-1,283	-23,201	235,58	19,0649	-1,0703	-0,0038
11	COMB5	Combination		-1,693	-6,672	248,32	-15,0203	-1,7329	-0,0035
11	COMB6	Combination	Max	-1,38	-14,88	241,981	2,1337	-1,2163	-0,0036
11	COMB6	Combination	Min	-1,596	-14,992	241,919	1,9109	-1,5869	-0,0036
11	COMB7	Combination	Max	-1,456	-14,919	241,959	2,0559	-1,3456	-0,0036
11	COMB7	Combination	Min	-1,521	-14,953	241,94	1,9887	-1,4576	-0,0036
12	COMB1	Combination		2,757	-6,879	133,467	-178,6421	5,2087	0,0014
12	COMB2	Combination		2,757	-6,879	133,467	-178,6421	5,2087	0,0014
12	COMB3	Combination		2,757	-6,879	133,467	-178,6421	5,2087	0,0014
12	COMB4	Combination		2,673	-7,012	125,19	-167,9061	5,0541	0,0023
12	COMB5	Combination		2,841	-6,746	141,745	-189,3782	5,3632	0,0005215
12	COMB6	Combination	Max	2,988	-6,866	134,359	-178,5981	5,6591	0,0015
12	COMB6	Combination	Min	2,527	-6,892	132,575	-178,6862	4,7582	0,0014
12	COMB7	Combination	Max	2,827	-6,875	133,736	-178,6288	5,3442	0,0014
12	COMB7	Combination	Min	2,688	-6,883	133,198	-178,6555	5,0731	0,0014
13	COMB1	Combination		0,454	-2,182	62,932	14,2469	0,5257	0,0002775
13	COMB2	Combination		0,454	-2,182	62,932	14,2469	0,5257	0,0002775

13	COMB3	Combination	0,454	-2,182	62,932	14,2469	0,5257	0,0002775
13	COMB4	Combination	0,414	-3,559	56,884	24,094	0,4756	0,0004325
13	COMB5	Combination	0,495	-0,804	68,98	4,3999	0,5759	0,0001225
13	COMB6	Combination Max	0,617	-2,179	63,642	14,2582	0,8295	0,0003061
13	COMB6	Combination Min	0,291	-2,184	62,222	14,2357	0,222	0,0002489
13	COMB7	Combination Max	0,503	-2,181	63,145	14,2504	0,617	0,0002861
13	COMB7	Combination Min	0,405	-2,182	62,719	14,2435	0,4345	0,0002689
17	COMB1	Combination	11,992	-2,928	240,575	-48,024	-18,0055	0,9645
17	COMB2	Combination	11,992	-2,928	240,575	-48,024	-18,0055	0,9645
17	COMB3	Combination	11,992	-2,928	240,575	-48,024	-18,0055	0,9645
17	COMB4	Combination	12,602	-14,382	241,082	-28,4603	-18,0318	1,0193
17	COMB5	Combination	11,383	8,525	240,068	-67,5878	-17,9792	0,9097
17	COMB6	Combination Max	12,257	-2,903	241,35	-48,0015	-17,58	0,9703
17	COMB6	Combination Min	11,728	-2,953	239,8	-48,0466	-18,431	0,9586
17	COMB7	Combination Max	12,072	-2,92	240,809	-48,0172	-17,8774	0,9662
17	COMB7	Combination Min	11,913	-2,936	240,342	-48,0309	-18,1336	0,9627
18	COMB1	Combination	-0,226	-2,164	63,883	13,1085	-0,1674	0,0003457
18	COMB2	Combination	-0,226	-2,164	63,883	13,1085	-0,1674	0,0003457
18	COMB3	Combination	-0,226	-2,164	63,883	13,1085	-0,1674	0,0003457
18	COMB4	Combination	-0,21	-3,479	58,002	22,2306	-0,1593	0,0005828
18	COMB5	Combination	-0,242	-0,849	69,765	3,9864	-0,1755	0,0001086
18	COMB6	Combination Max	-0,061	-2,155	64,557	13,1459	0,1384	0,0003726
18	COMB6	Combination Min	-0,391	-2,174	63,21	13,071	-0,4732	0,0003188
18	COMB7	Combination Max	-0,176	-2,161	64,086	13,12	-0,0756	0,0003538
18	COMB7	Combination Min	-0,276	-2,167	63,681	13,0969	-0,2592	0,0003376
22	COMB1	Combination	1,454	-16,719	417,555	-24,9505	28,5905	1,3845
22	COMB2	Combination	1,454	-16,719	417,555	-24,9505	28,5905	1,3845
22	COMB3	Combination	1,454	-16,719	417,555	-24,9505	28,5905	1,3845
22	COMB4	Combination	1,105	-28,133	420,352	-9,9139	28,5475	1,4011
22	COMB5	Combination	1,804	-5,305	414,758	-39,9871	28,6335	1,368
22	COMB6	Combination Max	1,766	-16,669	417,587	-24,8677	29,054	1,3894
22	COMB6	Combination Min	1,143	-16,769	417,523	-25,0334	28,127	1,3796
22	COMB7	Combination Max	1,548	-16,704	417,565	-24,9256	28,73	1,386
22	COMB7	Combination Min	1,361	-16,734	417,545	-24,9754	28,451	1,3831
23	COMB1	Combination	0,028	-2,25	47,334	14,1947	0,0759	0,0008078
23	COMB2	Combination	0,028	-2,25	47,334	14,1947	0,0759	0,0008078
23	COMB3	Combination	0,028	-2,25	47,334	14,1947	0,0759	0,0008078
23	COMB4	Combination	0,016	-3,782	40,904	25,7693	0,0528	0,001
23	COMB5	Combination	0,039	-0,717	53,763	2,6201	0,0989	0,0005947
23	COMB6	Combination Max	0,215	-2,221	47,533	14,3059	0,4579	0,000827
23	COMB6	Combination Min	-0,159	-2,278	47,134	14,0835	-0,3061	0,0007885
23	COMB7	Combination Max	0,084	-2,241	47,394	14,2283	0,1906	0,0008135
23	COMB7	Combination Min	-0,029	-2,258	47,274	14,1611	-0,0388	0,000802
55	COMB1	Combination	-4,955	6,472	135,648	1,0529	-5,0092	0,0194
55	COMB2	Combination	-4,955	6,472	135,648	1,0529	-5,0092	0,0194
55	COMB3	Combination	-4,955	6,472	135,648	1,0529	-5,0092	0,0194
55	COMB4	Combination	-5,189	-3,458	125,696	18,8641	-5,4338	0,0181
55	COMB5	Combination	-4,721	16,403	145,6	-16,7583	-4,5847	0,0207
55	COMB6	Combination Max	-4,853	6,521	135,683	1,1591	-4,8371	0,0194
55	COMB6	Combination Min	-5,056	6,424	135,612	0,9467	-5,1814	0,0194
55	COMB7	Combination Max	-4,924	6,487	135,659	1,0848	-4,9569	0,0194
55	COMB7	Combination Min	-4,986	6,458	135,637	1,0209	-5,0615	0,0194
56	COMB1	Combination	0,089	23,095	85,02	-56,9309	-0,1582	0,0044
56	COMB2	Combination	0,089	23,095	85,02	-56,9309	-0,1582	0,0044
56	COMB3	Combination	0,089	23,095	85,02	-56,9309	-0,1582	0,0044
56	COMB4	Combination	-0,164	3,599	69,63	-22,248	-0,6008	0,0033
56	COMB5	Combination	0,343	42,591	100,411	-91,6138	0,2844	0,0055
56	COMB6	Combination Max	0,197	23,113	85,051	-56,8918	0,0227	0,0044
56	COMB6	Combination Min	-0,018	23,076	84,99	-56,97	-0,339	0,0044

56	COMB7	Combination	Max	0,122	23,101	85,031	-56,918	-0,1032	0,0044
56	COMB7	Combination	Min	0,057	23,089	85,01	-56,9438	-0,2131	0,0044
57	COMB1	Combination		-0,549	29,239	88,388	-81,4986	-0,8259	0,0026
57	COMB2	Combination		-0,549	29,239	88,388	-81,4986	-0,8259	0,0026
57	COMB3	Combination		-0,549	29,239	88,388	-81,4986	-0,8259	0,0026
57	COMB4	Combination		-0,71	9,108	74,068	-39,9363	-1,177	0,0018
57	COMB5	Combination		-0,388	49,37	102,707	-123,0608	-0,4749	0,0035
57	COMB6	Combination	Max	-0,456	29,252	88,777	-81,4657	-0,6545	0,0027
57	COMB6	Combination	Min	-0,642	29,227	87,998	-81,5315	-0,9973	0,0026
57	COMB7	Combination	Max	-0,521	29,244	88,505	-81,4873	-0,7739	0,0026
57	COMB7	Combination	Min	-0,577	29,235	88,27	-81,5098	-0,878	0,0026
64	COMB1	Combination		-0,952	26,808	100,716	96,6364	-1,8237	0,0034
64	COMB2	Combination		-0,952	26,808	100,716	96,6364	-1,8237	0,0034
64	COMB3	Combination		-0,952	26,808	100,716	96,6364	-1,8237	0,0034
64	COMB4	Combination		-1,126	10,97	103,581	143,7677	-2,1642	0,0019
64	COMB5	Combination		-0,778	42,646	97,851	49,5052	-1,4832	0,0049
64	COMB6	Combination	Max	-0,835	26,823	101,042	96,6973	-1,5974	0,0035
64	COMB6	Combination	Min	-1,069	26,793	100,39	96,5756	-2,05	0,0034
64	COMB7	Combination	Max	-0,916	26,813	100,816	96,6555	-1,755	0,0034
64	COMB7	Combination	Min	-0,988	26,803	100,616	96,6174	-1,8925	0,0034
67	COMB1	Combination		-1,319	27,774	91,113	92,8572	-2,5593	-0,0015
67	COMB2	Combination		-1,319	27,774	91,113	92,8572	-2,5593	-0,0015
67	COMB3	Combination		-1,319	27,774	91,113	92,8572	-2,5593	-0,0015
67	COMB4	Combination		-1,344	11,609	95,61	141,5045	-2,612	-0,001
67	COMB5	Combination		-1,295	43,938	86,617	44,2099	-2,5065	-0,0019
67	COMB6	Combination	Max	-1,205	27,775	91,208	92,8603	-2,3377	-0,0013
67	COMB6	Combination	Min	-1,434	27,773	91,019	92,854	-2,7808	-0,0016
67	COMB7	Combination	Max	-1,285	27,774	91,142	92,8583	-2,4921	-0,0014
67	COMB7	Combination	Min	-1,354	27,773	91,085	92,8561	-2,6265	-0,0015
70	COMB1	Combination		-1,264	23,836	99,682	108,8183	-2,5492	-0,0088
70	COMB2	Combination		-1,264	23,836	99,682	108,8183	-2,5492	-0,0088
70	COMB3	Combination		-1,264	23,836	99,682	108,8183	-2,5492	-0,0088
70	COMB4	Combination		-1,366	8,82	100,595	152,2601	-2,6988	-0,0058
70	COMB5	Combination		-1,162	38,852	98,769	65,3765	-2,3996	-0,0118
70	COMB6	Combination	Max	-1,161	23,853	99,865	108,8863	-2,3475	-0,0087
70	COMB6	Combination	Min	-1,366	23,818	99,498	108,7504	-2,7509	-0,0088
70	COMB7	Combination	Max	-1,233	23,841	99,737	108,839	-2,488	-0,0088
70	COMB7	Combination	Min	-1,295	23,831	99,627	108,7977	-2,6104	-0,0088
74	COMB1	Combination		9,544	19,87	275,572	0,9841	-20,3133	-0,7271
74	COMB2	Combination		9,544	19,87	275,572	0,9841	-20,3133	-0,7271
74	COMB3	Combination		9,544	19,87	275,572	0,9841	-20,3133	-0,7271
74	COMB4	Combination		9,488	4,419	262,435	23,2114	-19,9892	-0,7328
74	COMB5	Combination		9,6	35,32	288,71	-21,2432	-20,6375	-0,7215
74	COMB6	Combination	Max	9,579	19,887	275,622	1,0109	-20,2508	-0,7256
74	COMB6	Combination	Min	9,509	19,852	275,523	0,9573	-20,3759	-0,7287
74	COMB7	Combination	Max	9,555	19,875	275,588	0,9922	-20,2944	-0,7267
74	COMB7	Combination	Min	9,533	19,864	275,557	0,976	-20,3323	-0,7276
78	COMB1	Combination		3,198	19,407	338,692	3,3959	28,17	-0,4119
78	COMB2	Combination		3,198	19,407	338,692	3,3959	28,17	-0,4119
78	COMB3	Combination		3,198	19,407	338,692	3,3959	28,17	-0,4119
78	COMB4	Combination		3,884	6,874	327,091	19,3349	28,5226	-0,4499
78	COMB5	Combination		2,512	31,94	350,293	-12,5432	27,8174	-0,3739
78	COMB6	Combination	Max	3,247	19,462	338,757	3,4781	28,2451	-0,4097
78	COMB6	Combination	Min	3,149	19,352	338,628	3,3136	28,0949	-0,4141
78	COMB7	Combination	Max	3,213	19,424	338,712	3,4206	28,1928	-0,4112
78	COMB7	Combination	Min	3,183	19,391	338,673	3,3712	28,1473	-0,4126
85	COMB1	Combination		0,065	-1,733	-7,082	7,8721	0,1227	-0,0002053
85	COMB2	Combination		0,065	-1,733	-7,082	7,8721	0,1227	-0,0002053
85	COMB3	Combination		0,065	-1,733	-7,082	7,8721	0,1227	-0,0002053

85	COMB4	Combination		0,054	-3,784	-14,811	18,0258	0,1013	-0,0003828
85	COMB5	Combination		0,076	0,318	0,648	-2,2817	0,1442	-0,0000277
85	COMB6	Combination	Max	0,193	-1,717	-6,858	7,9445	0,3856	-0,000175
85	COMB6	Combination	Min	-0,063	-1,749	-7,306	7,7996	-0,1401	-0,0002355
85	COMB7	Combination	Max	0,103	-1,728	-7,015	7,8939	0,2017	-0,0001961
85	COMB7	Combination	Min	0,026	-1,738	-7,149	7,8502	0,0438	-0,0002144
87	COMB1	Combination		-0,584	-20,032	305,815	27,2165	-0,5107	-0,0002414
87	COMB2	Combination		-0,584	-20,032	305,815	27,2165	-0,5107	-0,0002414
87	COMB3	Combination		-0,584	-20,032	305,815	27,2165	-0,5107	-0,0002414
87	COMB4	Combination		-0,365	-27,254	308,334	42,6911	-0,1653	-0,0003883
87	COMB5	Combination		-0,803	-12,81	303,296	11,7419	-0,8561	-0,00009444
87	COMB6	Combination	Max	-0,474	-19,977	305,862	27,3329	-0,3231	-0,0002343
87	COMB6	Combination	Min	-0,694	-20,088	305,767	27,1001	-0,6982	-0,0002484
87	COMB7	Combination	Max	-0,551	-20,015	305,83	27,2525	-0,454	-0,0002392
87	COMB7	Combination	Min	-0,617	-20,049	305,799	27,1805	-0,5674	-0,0002436
89	COMB1	Combination		0,015	-1,137	55,883	8,3631	0,0221	-0,0005084
89	COMB2	Combination		0,015	-1,137	55,883	8,3631	0,0221	-0,0005084
89	COMB3	Combination		0,015	-1,137	55,883	8,3631	0,0221	-0,0005084
89	COMB4	Combination		0,02	-2,294	49,949	16,9151	0,0298	-0,0007595
89	COMB5	Combination		0,009692	0,021	61,816	-0,1889	0,0144	-0,0002573
89	COMB6	Combination	Max	0,143	-1,12	56,093	8,4312	0,2847	-0,0004881
89	COMB6	Combination	Min	-0,114	-1,154	55,672	8,2949	-0,2405	-0,0005287
89	COMB7	Combination	Max	0,053	-1,132	55,946	8,3836	0,1009	-0,0005023
89	COMB7	Combination	Min	-0,024	-1,142	55,819	8,3425	-0,0567	-0,0005145
91	COMB1	Combination		-6,208	-13,568	222,196	21,6858	-5,9297	-0,0034
91	COMB2	Combination		-6,208	-13,568	222,196	21,6858	-5,9297	-0,0034
91	COMB3	Combination		-6,208	-13,568	222,196	21,6858	-5,9297	-0,0034
91	COMB4	Combination		-6,068	-20,856	224,301	39,196	-5,6587	-0,0037
91	COMB5	Combination		-6,347	-6,279	220,092	4,1756	-6,2007	-0,0031
91	COMB6	Combination	Max	-6,126	-13,557	222,364	21,7128	-5,77	-0,0034
91	COMB6	Combination	Min	-6,289	-13,578	222,029	21,6588	-6,0895	-0,0034
91	COMB7	Combination	Max	-6,183	-13,564	222,248	21,695	-5,8814	-0,0034
91	COMB7	Combination	Min	-6,232	-13,572	222,145	21,6765	-5,978	-0,0034
93	COMB1	Combination		0,111	-1,552	57,334	11,1501	0,202	-0,0003341
93	COMB2	Combination		0,111	-1,552	57,334	11,1501	0,202	-0,0003341
93	COMB3	Combination		0,111	-1,552	57,334	11,1501	0,202	-0,0003341
93	COMB4	Combination		0,095	-2,973	51,731	20,9467	0,1713	-0,0004587
93	COMB5	Combination		0,128	-0,131	62,938	1,3535	0,2328	-0,0002096
93	COMB6	Combination	Max	0,24	-1,543	57,533	11,188	0,4657	-0,0003081
93	COMB6	Combination	Min	-0,017	-1,561	57,136	11,1123	-0,0616	-0,0003601
93	COMB7	Combination	Max	0,15	-1,549	57,394	11,1616	0,2812	-0,0003263
93	COMB7	Combination	Min	0,073	-1,555	57,275	11,1387	0,1229	-0,000342
102	COMB1	Combination		0,247	-18,18	30,017	71,5987	0,5014	-0,0008374
102	COMB2	Combination		0,247	-18,18	30,017	71,5987	0,5014	-0,0008374
102	COMB3	Combination		0,247	-18,18	30,017	71,5987	0,5014	-0,0008374
102	COMB4	Combination		0,217	-22,876	22,477	84,5747	0,4388	-0,0008889
102	COMB5	Combination		0,278	-13,483	37,556	58,6226	0,5641	-0,0007859
102	COMB6	Combination	Max	0,394	-18,177	30,072	71,6068	0,7997	-0,0008077
102	COMB6	Combination	Min	0,101	-18,183	29,961	71,5905	0,2031	-0,0008671
102	COMB7	Combination	Max	0,291	-18,179	30,033	71,6012	0,591	-0,0008285
102	COMB7	Combination	Min	0,203	-18,181	30	71,5961	0,4119	-0,0008464
105	COMB1	Combination		0,156	-18,494	30,573	73,0448	0,3205	0,00004596
105	COMB2	Combination		0,156	-18,494	30,573	73,0448	0,3205	0,00004596
105	COMB3	Combination		0,156	-18,494	30,573	73,0448	0,3205	0,00004596
105	COMB4	Combination		0,12	-23,189	22,845	86,0488	0,2482	0,0000895
105	COMB5	Combination		0,191	-13,799	38,301	60,0407	0,3928	0,000002417
105	COMB6	Combination	Max	0,302	-18,493	30,64	73,0475	0,6189	0,00008051
105	COMB6	Combination	Min	0,009249	-18,494	30,506	73,0421	0,0221	0,0000114
105	COMB7	Combination	Max	0,199	-18,494	30,593	73,0456	0,4101	0,00005636

105	COMB7	Combination	Min	0,112	-18,494	30,553	73,0439	0,2309	0,00003555
109	COMB1	Combination		0,16	-18,044	36,963	71,165	0,3063	0,0015
109	COMB2	Combination		0,16	-18,044	36,963	71,165	0,3063	0,0015
109	COMB3	Combination		0,16	-18,044	36,963	71,165	0,3063	0,0015
109	COMB4	Combination		0,137	-22,685	30,878	83,8093	0,2547	0,0015
109	COMB5	Combination		0,183	-13,403	43,048	58,5207	0,3579	0,0014
109	COMB6	Combination	Max	0,304	-18,043	37,192	71,1708	0,6016	0,0015
109	COMB6	Combination	Min	0,016	-18,045	36,733	71,1592	0,011	0,0014
109	COMB7	Combination	Max	0,203	-18,044	37,031	71,1668	0,395	0,0015
109	COMB7	Combination	Min	0,117	-18,045	36,894	71,1632	0,2176	0,0015
123	COMB1	Combination		-0,074	-16,66	32,213	65,1691	-0,1406	0,002
123	COMB2	Combination		-0,074	-16,66	32,213	65,1691	-0,1406	0,002
123	COMB3	Combination		-0,074	-16,66	32,213	65,1691	-0,1406	0,002
123	COMB4	Combination		-0,129	-21,201	25,477	77,1258	-0,2502	0,0023
123	COMB5	Combination		-0,02	-12,119	38,949	53,2124	-0,0309	0,0017
123	COMB6	Combination	Max	0,07	-16,657	32,46	65,1764	0,1537	0,002
123	COMB6	Combination	Min	-0,218	-16,663	31,966	65,1617	-0,4349	0,002
123	COMB7	Combination	Max	-0,031	-16,659	32,287	65,1713	-0,0522	0,002
123	COMB7	Combination	Min	-0,118	-16,661	32,139	65,1668	-0,2289	0,002
131	COMB1	Combination		-0,062	-11,769	23,364	46,4477	-0,1291	0,0034
131	COMB2	Combination		-0,062	-11,769	23,364	46,4477	-0,1291	0,0034
131	COMB3	Combination		-0,062	-11,769	23,364	46,4477	-0,1291	0,0034
131	COMB4	Combination		-0,104	-13,956	16,583	54,2232	-0,2168	0,0035
131	COMB5	Combination		-0,019	-9,581	30,144	38,6722	-0,0413	0,0034
131	COMB6	Combination	Max	0,084	-11,752	23,442	46,5008	0,1687	0,0034
131	COMB6	Combination	Min	-0,208	-11,786	23,285	46,3947	-0,4268	0,0034
131	COMB7	Combination	Max	-0,018	-11,764	23,387	46,4637	-0,0397	0,0034
131	COMB7	Combination	Min	-0,106	-11,774	23,34	46,4317	-0,2185	0,0034
164	COMB1	Combination		-0,109	-0,171	24,18	0,7115	-1,1286	-0,000612
164	COMB2	Combination		-0,109	-0,171	24,18	0,7115	-1,1286	-0,000612
164	COMB3	Combination		-0,109	-0,171	24,18	0,7115	-1,1286	-0,000612
164	COMB4	Combination		-0,117	-2,715	19,092	5,4139	-1,2057	-0,0006962
164	COMB5	Combination		-0,101	2,374	29,267	-3,9909	-1,0515	-0,0005278
164	COMB6	Combination	Max	-0,085	-0,17	24,194	0,7163	-0,8965	-0,0005178
164	COMB6	Combination	Min	-0,133	-0,172	24,165	0,7067	-1,3607	-0,0007062
164	COMB7	Combination	Max	-0,102	-0,17	24,184	0,713	-1,0589	-0,0005836
164	COMB7	Combination	Min	-0,116	-0,171	24,175	0,7101	-1,1983	-0,0006403
168	COMB1	Combination		-0,101	-0,023	29,456	0,1855	-1,0486	0,0007364
168	COMB2	Combination		-0,101	-0,023	29,456	0,1855	-1,0486	0,0007364
168	COMB3	Combination		-0,101	-0,023	29,456	0,1855	-1,0486	0,0007364
168	COMB4	Combination		-0,109	-2,516	42,163	4,7056	-1,1272	0,0008607
168	COMB5	Combination		-0,093	2,47	16,75	-4,3346	-0,9701	0,0006122
168	COMB6	Combination	Max	-0,083	-0,022	29,484	0,1907	-0,8724	0,0007555
168	COMB6	Combination	Min	-0,119	-0,024	29,429	0,1803	-1,2248	0,0007173
168	COMB7	Combination	Max	-0,095	-0,023	29,464	0,1871	-0,9956	0,0007423
168	COMB7	Combination	Min	-0,106	-0,023	29,448	0,1839	-1,1016	0,0007306
205	COMB1	Combination		-8,681	-14,886	181,439	8,3048	-2,4464	-0,0029
205	COMB2	Combination		-8,681	-14,886	181,439	8,3048	-2,4464	-0,0029
205	COMB3	Combination		-8,681	-14,886	181,439	8,3048	-2,4464	-0,0029
205	COMB4	Combination		-8,699	-21,301	174,081	23,1799	-2,4868	-0,003
205	COMB5	Combination		-8,664	-8,47	188,797	-6,5703	-2,4059	-0,0027
205	COMB6	Combination	Max	-8,435	-14,818	181,607	8,4577	-2,034	-0,0028
205	COMB6	Combination	Min	-8,927	-14,953	181,272	8,1519	-2,8588	-0,0029
205	COMB7	Combination	Max	-8,607	-14,865	181,49	8,3508	-2,3223	-0,0028
205	COMB7	Combination	Min	-8,755	-14,906	181,389	8,2588	-2,5705	-0,0029
206	COMB1	Combination		0,014	-1,653	-4,794	7,5272	0,0333	0,00031
206	COMB2	Combination		0,014	-1,653	-4,794	7,5272	0,0333	0,00031
206	COMB3	Combination		0,014	-1,653	-4,794	7,5272	0,0333	0,00031
206	COMB4	Combination		0,013	-3,542	-11,453	16,9609	0,0292	0,0004807

206	COMB5	Combination		0,015	0,237	1,864	-1,9064	0,0373	0,0001394
206	COMB6	Combination	Max	0,142	-1,634	-4,612	7,6123	0,2951	0,0003377
206	COMB6	Combination	Min	-0,114	-1,671	-4,977	7,4422	-0,2285	0,0002823
206	COMB7	Combination	Max	0,052	-1,647	-4,74	7,5528	0,1119	0,0003185
206	COMB7	Combination	Min	-0,024	-1,658	-4,849	7,5017	-0,0453	0,0003016
217	COMB1	Combination		-7,902	8,586	108,072	-4,6601	-4,1857	0,0028
217	COMB2	Combination		-7,902	8,586	108,072	-4,6601	-4,1857	0,0028
217	COMB3	Combination		-7,902	8,586	108,072	-4,6601	-4,1857	0,0028
217	COMB4	Combination		-7,752	-0,022	101,343	11,7328	-3,8995	0,0029
217	COMB5	Combination		-8,052	17,194	114,801	-21,0529	-4,4719	0,0027
217	COMB6	Combination	Max	-7,87	8,653	108,232	-4,5086	-4,123	0,0028
217	COMB6	Combination	Min	-7,933	8,519	107,912	-4,8115	-4,2484	0,0028
217	COMB7	Combination	Max	-7,892	8,606	108,12	-4,6145	-4,1667	0,0028
217	COMB7	Combination	Min	-7,911	8,566	108,024	-4,7056	-4,2047	0,0028
224	COMB1	Combination		0,196	-0,151	21,742	0,6406	1,9848	0,0009546
224	COMB2	Combination		0,196	-0,151	21,742	0,6406	1,9848	0,0009546
224	COMB3	Combination		0,196	-0,151	21,742	0,6406	1,9848	0,0009546
224	COMB4	Combination		0,21	-2,682	16,23	5,2867	2,1215	0,0011
224	COMB5	Combination		0,183	2,381	27,255	-4,0055	1,8481	0,0008137
224	COMB6	Combination	Max	0,221	-0,149	21,761	0,6461	2,2185	0,001
224	COMB6	Combination	Min	0,172	-0,152	21,723	0,6351	1,751	0,0008669
224	COMB7	Combination	Max	0,204	-0,15	21,748	0,6422	2,0552	0,0009813
224	COMB7	Combination	Min	0,189	-0,151	21,737	0,6389	1,9144	0,0009279
226	COMB1	Combination		0,21	-0,038	26,346	0,2396	2,1203	-0,0007158
226	COMB2	Combination		0,21	-0,038	26,346	0,2396	2,1203	-0,0007158
226	COMB3	Combination		0,21	-0,038	26,346	0,2396	2,1203	-0,0007158
226	COMB4	Combination		0,225	-2,526	38,383	4,7308	2,2633	-0,0008615
226	COMB5	Combination		0,196	2,449	14,309	-4,2517	1,9772	-0,0005702
226	COMB6	Combination	Max	0,229	-0,037	26,368	0,2456	2,2978	-0,0007019
226	COMB6	Combination	Min	0,192	-0,04	26,325	0,2335	1,9427	-0,0007297
226	COMB7	Combination	Max	0,216	-0,038	26,353	0,2414	2,1738	-0,0007113
226	COMB7	Combination	Min	0,205	-0,039	26,34	0,2378	2,0667	-0,0007204
344	COMB1	Combination		-5,496	-5,634	105,573	-35,2775	-6,705	-0,0001576
344	COMB2	Combination		-5,496	-5,634	105,573	-35,2775	-6,705	-0,0001576
344	COMB3	Combination		-5,496	-5,634	105,573	-35,2775	-6,705	-0,0001576
344	COMB4	Combination		-5,499	-8,057	95,587	-31,3016	-6,6877	-0,000167
344	COMB5	Combination		-5,494	-3,211	115,56	-39,2535	-6,7222	-0,0001482
344	COMB6	Combination	Max	-5,464	-5,63	105,59	-35,2706	-6,6346	-0,0001571
344	COMB6	Combination	Min	-5,529	-5,637	105,556	-35,2845	-6,7754	-0,000158
344	COMB7	Combination	Max	-5,487	-5,633	105,578	-35,2751	-6,6837	-0,0001575
344	COMB7	Combination	Min	-5,506	-5,635	105,568	-35,2799	-6,7263	-0,0001577
345	COMB1	Combination		0,912	-0,014	235,949	-40,9297	-0,6427	-0,00007005
345	COMB2	Combination		0,912	-0,014	235,949	-40,9297	-0,6427	-0,00007005
345	COMB3	Combination		0,912	-0,014	235,949	-40,9297	-0,6427	-0,00007005
345	COMB4	Combination		0,954	-2,577	225,331	-37,2113	-0,5885	-0,00006647
345	COMB5	Combination		0,87	2,548	246,567	-44,6481	-0,697	-0,00007363
345	COMB6	Combination	Max	0,953	0,005295	236,014	-40,8969	-0,5644	-0,0000698
345	COMB6	Combination	Min	0,871	-0,034	235,884	-40,9625	-0,7211	-0,00007031
345	COMB7	Combination	Max	0,925	-0,008201	235,969	-40,9196	-0,619	-0,00006997
345	COMB7	Combination	Min	0,9	-0,02	235,929	-40,9399	-0,6665	-0,00007014
353	COMB1	Combination		-1,276	16,907	21,82	18,5545	-3,2632	0,0001571
353	COMB2	Combination		-1,276	16,907	21,82	18,5545	-3,2632	0,0001571
353	COMB3	Combination		-1,276	16,907	21,82	18,5545	-3,2632	0,0001571
353	COMB4	Combination		-1,152	12,036	34,73	28,2835	-2,9274	0,0001272
353	COMB5	Combination		-1,399	21,778	8,91	8,8254	-3,599	0,0001871
353	COMB6	Combination	Max	-1,26	16,911	21,839	18,5623	-3,2229	0,0001579
353	COMB6	Combination	Min	-1,291	16,904	21,8	18,5467	-3,3035	0,0001564
353	COMB7	Combination	Max	-1,271	16,909	21,826	18,5572	-3,2509	0,0001574
353	COMB7	Combination	Min	-1,28	16,906	21,813	18,5518	-3,2755	0,0001569

355	COMB1	Combination	-1,264	15,917	16,267	24,3081	-3,2395	0,0001709
355	COMB2	Combination	-1,264	15,917	16,267	24,3081	-3,2395	0,0001709
355	COMB3	Combination	-1,264	15,917	16,267	24,3081	-3,2395	0,0001709
355	COMB4	Combination	-1,101	10,831	33,252	32,808	-2,8653	0,0001297
355	COMB5	Combination	-1,427	21,004	-0,718	15,8082	-3,6137	0,0002122
355	COMB6	Combination Max	-1,245	15,924	16,292	24,3173	-3,196	0,0001712
355	COMB6	Combination Min	-1,282	15,911	16,242	24,299	-3,283	0,0001706
355	COMB7	Combination Max	-1,258	15,92	16,275	24,3112	-3,2262	0,000171
355	COMB7	Combination Min	-1,269	15,915	16,259	24,305	-3,2528	0,0001708
380	COMB1	Combination	-0,114	-2,128	11,497	9,3385	-0,2276	0,0058
380	COMB2	Combination	-0,114	-2,128	11,497	9,3385	-0,2276	0,0058
380	COMB3	Combination	-0,114	-2,128	11,497	9,3385	-0,2276	0,0058
380	COMB4	Combination	-0,152	-5,86	9,053	21,2787	-0,3064	0,0056
380	COMB5	Combination	-0,077	1,604	13,94	-2,6017	-0,1488	0,0059
380	COMB6	Combination Max	0,029	-2,112	11,668	9,4112	0,0665	0,0058
380	COMB6	Combination Min	-0,258	-2,144	11,326	9,2658	-0,5217	0,0057
380	COMB7	Combination Max	-0,071	-2,123	11,548	9,3603	-0,1393	0,0058
380	COMB7	Combination Min	-0,157	-2,133	11,445	9,3166	-0,3159	0,0057
390	COMB1	Combination	0,249	-0,14	17,587	0,6398	2,4925	0,0005903
390	COMB2	Combination	0,249	-0,14	17,587	0,6398	2,4925	0,0005903
390	COMB3	Combination	0,249	-0,14	17,587	0,6398	2,4925	0,0005903
390	COMB4	Combination	0,22	-2,666	9,709	5,2771	2,2093	0,0004598
390	COMB5	Combination	0,278	2,386	25,465	-3,9976	2,7757	0,0007209
390	COMB6	Combination Max	0,286	-0,14	17,673	0,6428	2,8469	0,0006756
390	COMB6	Combination Min	0,212	-0,141	17,501	0,6367	2,1381	0,0005051
390	COMB7	Combination Max	0,26	-0,14	17,613	0,6407	2,5989	0,000616
390	COMB7	Combination Min	0,238	-0,14	17,561	0,6388	2,3861	0,0005647
392	COMB1	Combination	0,275	-0,082	19,268	0,4314	2,7525	-0,0006566
392	COMB2	Combination	0,275	-0,082	19,268	0,4314	2,7525	-0,0006566
392	COMB3	Combination	0,275	-0,082	19,268	0,4314	2,7525	-0,0006566
392	COMB4	Combination	0,25	-2,578	26,657	4,9676	2,5	-0,0004929
392	COMB5	Combination	0,301	2,414	11,879	-4,1049	3,005	-0,0008203
392	COMB6	Combination Max	0,311	-0,08	19,334	0,4385	3,098	-0,0005836
392	COMB6	Combination Min	0,24	-0,084	19,203	0,4243	2,407	-0,0007296
392	COMB7	Combination Max	0,286	-0,082	19,288	0,4335	2,8562	-0,0006347
392	COMB7	Combination Min	0,265	-0,083	19,249	0,4293	2,6487	-0,0006786
455	COMB1	Combination	-4,013	0,955	719,124	-2,1378	43,8034	-0,0001814
455	COMB2	Combination	-4,013	0,955	719,124	-2,1378	43,8034	-0,0001814
455	COMB3	Combination	-4,013	0,955	719,124	-2,1378	43,8034	-0,0001814
455	COMB4	Combination	-3,686	-1,352	725,386	0,6733	43,9041	-0,0001729
455	COMB5	Combination	-4,34	3,262	712,862	-4,9489	43,7028	-0,0001898
455	COMB6	Combination Max	-3,997	0,967	719,149	-2,1207	43,8361	-0,0001812
455	COMB6	Combination Min	-4,029	0,944	719,099	-2,1549	43,7708	-0,0001816
455	COMB7	Combination Max	-4,008	0,958	719,131	-2,1326	43,8133	-0,0001813
455	COMB7	Combination Min	-4,018	0,952	719,116	-2,1429	43,7935	-0,0001814
456	COMB1	Combination	19,62	3,924	386,455	-4,3405	-39,2084	-0,00006747
456	COMB2	Combination	19,62	3,924	386,455	-4,3405	-39,2084	-0,00006747
456	COMB3	Combination	19,62	3,924	386,455	-4,3405	-39,2084	-0,00006747
456	COMB4	Combination	19,497	1,405	392,421	-0,5294	-39,1094	-0,00005379
456	COMB5	Combination	19,744	6,444	380,489	-8,1515	-39,3074	-0,00008115
456	COMB6	Combination Max	19,633	3,929	386,483	-4,3361	-39,1771	-0,00006715
456	COMB6	Combination Min	19,608	3,92	386,427	-4,3449	-39,2397	-0,0000678
456	COMB7	Combination Max	19,624	3,926	386,463	-4,3392	-39,1989	-0,00006737
456	COMB7	Combination Min	19,617	3,923	386,446	-4,3418	-39,2179	-0,00006757
465	COMB1	Combination	-2,775	2,985	756,824	-0,9105	41,041	0,0001427
465	COMB2	Combination	-2,775	2,985	756,824	-0,9105	41,041	0,0001427
465	COMB3	Combination	-2,775	2,985	756,824	-0,9105	41,041	0,0001427
465	COMB4	Combination	-2,774	-1,015	756,428	1,4256	41,0302	0,0001615
465	COMB5	Combination	-2,776	6,984	757,219	-3,2466	41,0518	0,000124

465	COMB6	Combination	Max	-2,769	3,003	756,826	-0,8966	41,0454	0,000143
465	COMB6	Combination	Min	-2,781	2,966	756,822	-0,9244	41,0366	0,0001424
465	COMB7	Combination	Max	-2,773	2,99	756,824	-0,9063	41,0424	0,0001428
465	COMB7	Combination	Min	-2,777	2,979	756,823	-0,9147	41,0397	0,0001426
466	COMB1	Combination		0,43	-2,258	11,626	10,028	0,8887	-0,0056
466	COMB2	Combination		0,43	-2,258	11,626	10,028	0,8887	-0,0056
466	COMB3	Combination		0,43	-2,258	11,626	10,028	0,8887	-0,0056
466	COMB4	Combination		0,398	-6,132	8,954	22,6636	0,8257	-0,0056
466	COMB5	Combination		0,461	1,616	14,299	-2,6076	0,9518	-0,0057
466	COMB6	Combination	Max	0,573	-2,244	11,894	10,0898	1,1833	-0,0056
466	COMB6	Combination	Min	0,286	-2,272	11,359	9,9662	0,5941	-0,0057
466	COMB7	Combination	Max	0,473	-2,254	11,707	10,0467	0,9772	-0,0056
466	COMB7	Combination	Min	0,386	-2,262	11,546	10,0093	0,8003	-0,0056
467	COMB1	Combination		0,467	-12,666	25,884	49,0816	0,9398	-0,0045
467	COMB2	Combination		0,467	-12,666	25,884	49,0816	0,9398	-0,0045
467	COMB3	Combination		0,467	-12,666	25,884	49,0816	0,9398	-0,0045
467	COMB4	Combination		0,447	-17,33	19,24	61,4427	0,8987	-0,0046
467	COMB5	Combination		0,487	-8,002	32,528	36,7205	0,9809	-0,0045
467	COMB6	Combination	Max	0,611	-12,66	26,162	49,0938	1,2344	-0,0045
467	COMB6	Combination	Min	0,323	-12,672	25,607	49,0694	0,6453	-0,0046
467	COMB7	Combination	Max	0,51	-12,664	25,968	49,0853	1,0283	-0,0045
467	COMB7	Combination	Min	0,424	-12,668	25,801	49,0778	0,8514	-0,0045
468	COMB1	Combination		-1,578	3,277	763,999	-1,4808	43,279	-0,0003645
468	COMB2	Combination		-1,578	3,277	763,999	-1,4808	43,279	-0,0003645
468	COMB3	Combination		-1,578	3,277	763,999	-1,4808	43,279	-0,0003645
468	COMB4	Combination		-1,769	-1,282	761,437	0,9868	43,2452	-0,000351
468	COMB5	Combination		-1,387	7,836	766,56	-3,9484	43,3127	-0,000378
468	COMB6	Combination	Max	-1,564	3,303	764,013	-1,4656	43,2891	-0,0003641
468	COMB6	Combination	Min	-1,592	3,252	763,984	-1,496	43,2689	-0,0003649
468	COMB7	Combination	Max	-1,574	3,285	764,003	-1,4762	43,282	-0,0003644
468	COMB7	Combination	Min	-1,582	3,27	763,994	-1,4854	43,2759	-0,0003646
469	COMB1	Combination		-9,841	9,265	787,367	-1,8047	31,3657	0,0002358
469	COMB2	Combination		-9,841	9,265	787,367	-1,8047	31,3657	0,0002358
469	COMB3	Combination		-9,841	9,265	787,367	-1,8047	31,3657	0,0002358
469	COMB4	Combination		-10,199	4,606	785,217	10,3052	31,3279	0,0002097
469	COMB5	Combination		-9,483	13,925	789,518	-13,9146	31,4036	0,0002619
469	COMB6	Combination	Max	-9,811	9,289	787,381	-1,7347	31,3884	0,0002361
469	COMB6	Combination	Min	-9,872	9,242	787,354	-1,8747	31,343	0,0002355
469	COMB7	Combination	Max	-9,832	9,273	787,372	-1,7837	31,3726	0,0002359
469	COMB7	Combination	Min	-9,85	9,258	787,363	-1,8257	31,3589	0,0002357
470	COMB1	Combination		22,72	5,483	425,806	-3,0164	-35,9551	-0,0002332
470	COMB2	Combination		22,72	5,483	425,806	-3,0164	-35,9551	-0,0002332
470	COMB3	Combination		22,72	5,483	425,806	-3,0164	-35,9551	-0,0002332
470	COMB4	Combination		22,657	1,111	425,049	0,3527	-35,9634	-0,0002219
470	COMB5	Combination		22,784	9,854	426,563	-6,3856	-35,9468	-0,0002444
470	COMB6	Combination	Max	22,727	5,492	425,809	-3,0126	-35,9509	-0,0002233
470	COMB6	Combination	Min	22,714	5,473	425,803	-3,0202	-35,9593	-0,0002333
470	COMB7	Combination	Max	22,722	5,485	425,807	-3,0153	-35,9539	-0,0002331
470	COMB7	Combination	Min	22,718	5,48	425,805	-3,0176	-35,9564	-0,0002332
471	COMB1	Combination		24,493	5,08	418,786	-4,2377	-36,945	0,00016
471	COMB2	Combination		24,493	5,08	418,786	-4,2377	-36,945	0,00016
471	COMB3	Combination		24,493	5,08	418,786	-4,2377	-36,945	0,00016
471	COMB4	Combination		24,22	0,503	419,29	-0,8972	-37,003	0,0001684
471	COMB5	Combination		24,767	9,657	418,282	-7,5782	-36,887	0,0001517
471	COMB6	Combination	Max	24,505	5,087	418,793	-4,2343	-36,9356	0,000161
471	COMB6	Combination	Min	24,482	5,073	418,779	-4,2411	-36,9544	0,0001591
471	COMB7	Combination	Max	24,497	5,082	418,788	-4,2367	-36,9422	0,0001603
471	COMB7	Combination	Min	24,49	5,078	418,784	-4,2387	-36,9478	0,0001597
472	COMB1	Combination		23,15	6,337	424,887	2,152	-41,8708	0,00008023

472	COMB2	Combination	23,15	6,337	424,887	2,152	-41,8708	0,00008023
472	COMB3	Combination	23,15	6,337	424,887	2,152	-41,8708	0,00008023
472	COMB4	Combination	23,264	3,835	422,868	5,9732	-42,0072	0,0000537
472	COMB5	Combination	23,036	8,84	426,906	-1,6692	-41,7343	0,0001068
472	COMB6	Combination Max	23,189	6,343	424,925	2,1562	-41,7739	0,00008039
472	COMB6	Combination Min	23,112	6,331	424,849	2,1478	-41,9677	0,00008007
472	COMB7	Combination Max	23,162	6,339	424,898	2,1533	-41,8416	0,00008028
472	COMB7	Combination Min	23,139	6,335	424,876	2,1508	-41,8999	0,00008018
473	COMB1	Combination	-12,89	-1,024	224,957	0,1757	-11,9228	-0,0061
473	COMB2	Combination	-12,89	-1,024	224,957	0,1757	-11,9228	-0,0061
473	COMB3	Combination	-12,89	-1,024	224,957	0,1757	-11,9228	-0,0061
473	COMB4	Combination	-13,03	-6,671	224,389	6,0774	-12,2138	-0,0058
473	COMB5	Combination	-12,751	4,624	225,525	-5,7259	-11,6318	-0,0064
473	COMB6	Combination Max	-12,886	-0,986	224,96	0,2143	-11,9132	-0,0061
473	COMB6	Combination Min	-12,894	-1,061	224,954	0,1372	-11,9324	-0,0062
473	COMB7	Combination Max	-12,889	-1,012	224,958	0,1874	-11,9198	-0,0061
473	COMB7	Combination Min	-12,892	-1,035	224,956	0,1641	-11,9258	-0,0061
474	COMB1	Combination	0,235	-16,844	36,58	65,777	0,5032	-0,0029
474	COMB2	Combination	0,235	-16,844	36,58	65,777	0,5032	-0,0029
474	COMB3	Combination	0,235	-16,844	36,58	65,777	0,5032	-0,0029
474	COMB4	Combination	0,194	-21,514	30,417	78,4395	0,4237	-0,0029
474	COMB5	Combination	0,276	-12,175	42,743	53,1145	0,5827	-0,0028
474	COMB6	Combination Max	0,38	-16,844	36,801	65,7844	0,7985	-0,0028
474	COMB6	Combination Min	0,091	-16,845	36,359	65,7696	0,2079	-0,0029
474	COMB7	Combination Max	0,279	-16,844	36,646	65,7793	0,5919	-0,0029
474	COMB7	Combination Min	0,192	-16,844	36,514	65,7747	0,4145	-0,0029
476	COMB1	Combination	-12,177	-0,445	209,459	0,8266	-11,4922	0,000227
476	COMB2	Combination	-12,177	-0,445	209,459	0,8266	-11,4922	0,000227
476	COMB3	Combination	-12,177	-0,445	209,459	0,8266	-11,4922	0,000227
476	COMB4	Combination	-12,205	-3,841	210,171	4,7053	-11,5639	0,0002226
476	COMB5	Combination	-12,149	2,95	208,747	-3,052	-11,4204	0,0002315
476	COMB6	Combination Max	-12,173	-0,423	209,466	0,852	-11,4829	0,000228
476	COMB6	Combination Min	-12,181	-0,468	209,452	0,8013	-11,5014	0,0002261
476	COMB7	Combination Max	-12,176	-0,439	209,461	0,8343	-11,4893	0,0002273
476	COMB7	Combination Min	-12,178	-0,452	209,457	0,819	-11,495	0,0002267
477	COMB1	Combination	-7,008	4,371	366,543	-1,6599	-7,8335	-0,0002985
477	COMB2	Combination	-7,008	4,371	366,543	-1,6599	-7,8335	-0,0002985
477	COMB3	Combination	-7,008	4,371	366,543	-1,6599	-7,8335	-0,0002985
477	COMB4	Combination	-6,978	0,739	362,009	2,528	-7,7935	-0,0003023
477	COMB5	Combination	-7,038	8,004	371,078	-5,8479	-7,8734	-0,0002948
477	COMB6	Combination Max	-6,967	4,394	366,578	-1,6334	-7,7558	-0,0002982
477	COMB6	Combination Min	-7,049	4,348	366,509	-1,6865	-7,9112	-0,0002989
477	COMB7	Combination Max	-6,996	4,378	366,554	-1,652	-7,8099	-0,0002984
477	COMB7	Combination Min	-7,02	4,365	366,533	-1,6679	-7,857	-0,0002986
478	COMB1	Combination	-0,276	-0,167	19,547	0,7449	-2,7761	-0,002
478	COMB2	Combination	-0,276	-0,167	19,547	0,7449	-2,7761	-0,002
478	COMB3	Combination	-0,276	-0,167	19,547	0,7449	-2,7761	-0,002
478	COMB4	Combination	-0,258	-2,705	11,763	5,4381	-2,6004	-0,0018
478	COMB5	Combination	-0,294	2,371	27,33	-3,9483	-2,9518	-0,0021
478	COMB6	Combination Max	-0,24	-0,167	19,63	0,7471	-2,428	-0,0019
478	COMB6	Combination Min	-0,312	-0,167	19,464	0,7427	-3,1242	-0,0021
478	COMB7	Combination Max	-0,265	-0,167	19,572	0,7456	-2,6715	-0,0019
478	COMB7	Combination Min	-0,287	-0,167	19,522	0,7442	-2,8807	-0,002
479	COMB1	Combination	-13,467	-1,733	231,226	1,1947	-14,3346	0,00001263
479	COMB2	Combination	-13,467	-1,733	231,226	1,1947	-14,3346	0,00001263
479	COMB3	Combination	-13,467	-1,733	231,226	1,1947	-14,3346	0,00001263
479	COMB4	Combination	-13,247	-4,446	236,464	5,4617	-13,909	0,000000354
479	COMB5	Combination	-13,687	0,98	225,988	-3,0722	-14,7602	0,00002491
479	COMB6	Combination Max	-13,444	-1,714	231,254	1,224	-14,2867	0,00001302

479	COMB6	Combination	Min	-13,491	-1,752	231,199	1,1655	-14,3825	0,00001225
479	COMB7	Combination	Max	-13,46	-1,727	231,234	1,2035	-14,32	0,00001275
479	COMB7	Combination	Min	-13,474	-1,739	231,218	1,1859	-14,3493	0,00001251
480	COMB1	Combination		-0,315	-0,072	21,522	0,4084	-3,1564	0,0018
480	COMB2	Combination		-0,315	-0,072	21,522	0,4084	-3,1564	0,0018
480	COMB3	Combination		-0,315	-0,072	21,522	0,4084	-3,1564	0,0018
480	COMB4	Combination		-0,297	-2,577	29,231	4,9858	-2,9815	0,0017
480	COMB5	Combination		-0,333	2,432	13,813	-4,169	-3,3313	0,0019
480	COMB6	Combination	Max	-0,28	-0,071	21,588	0,4149	-2,8168	0,0019
480	COMB6	Combination	Min	-0,35	-0,074	21,456	0,402	-3,496	0,0017
480	COMB7	Combination	Max	-0,304	-0,072	21,542	0,4104	-3,0544	0,0018
480	COMB7	Combination	Min	-0,325	-0,073	21,502	0,4065	-3,2584	0,0018
484	COMB1	Combination		-20,301	-1,846	261,009	1,3769	-9,8223	-0,0052
484	COMB2	Combination		-20,301	-1,846	261,009	1,3769	-9,8223	-0,0052
484	COMB3	Combination		-20,301	-1,846	261,009	1,3769	-9,8223	-0,0052
484	COMB4	Combination		-20,314	-6,306	260,295	7,6147	-9,839	-0,0015
484	COMB5	Combination		-20,288	2,614	261,723	-4,861	-9,8057	-0,0089
484	COMB6	Combination	Max	-20,297	-1,801	261,017	1,4392	-9,8168	-0,0052
484	COMB6	Combination	Min	-20,305	-1,891	261,001	1,3145	-9,8278	-0,0053
484	COMB7	Combination	Max	-20,3	-1,832	261,012	1,3956	-9,8206	-0,0052
484	COMB7	Combination	Min	-20,302	-1,86	261,007	1,3581	-9,824	-0,0052
486	COMB1	Combination		-19,026	-1,612	261,996	1,4929	-10,4319	0,0000995
486	COMB2	Combination		-19,026	-1,612	261,996	1,4929	-10,4319	0,0000995
486	COMB3	Combination		-19,026	-1,612	261,996	1,4929	-10,4319	0,0000995
486	COMB4	Combination		-19,026	-4,829	262,467	6,9758	-10,4347	0,00005641
486	COMB5	Combination		-19,025	1,604	261,524	-3,9899	-10,4291	0,0001426
486	COMB6	Combination	Max	-19,019	-1,579	261,998	1,5483	-10,4204	0,0001007
486	COMB6	Combination	Min	-19,033	-1,645	261,993	1,4376	-10,4433	0,00009825
486	COMB7	Combination	Max	-19,024	-1,602	261,996	1,5096	-10,4284	0,00009987
486	COMB7	Combination	Min	-19,028	-1,622	261,995	1,4763	-10,4353	0,00009912
487	COMB1	Combination		-19,14	0,317	272,863	0,6345	-12,3746	-0,0003887
487	COMB2	Combination		-19,14	0,317	272,863	0,6345	-12,3746	-0,0003887
487	COMB3	Combination		-19,14	0,317	272,863	0,6345	-12,3746	-0,0003887
487	COMB4	Combination		-19,219	-2,856	270,382	6,0598	-12,4871	-0,0003809
487	COMB5	Combination		-19,061	3,49	275,345	-4,7907	-12,2622	-0,0003965
487	COMB6	Combination	Max	-19,083	0,35	272,922	0,6899	-12,2672	-0,0003866
487	COMB6	Combination	Min	-19,198	0,284	272,804	0,5792	-12,4821	-0,0003908
487	COMB7	Combination	Max	-19,123	0,327	272,881	0,6512	-12,3423	-0,0003881
487	COMB7	Combination	Min	-19,158	0,307	272,846	0,6179	-12,407	-0,0003893
488	COMB1	Combination		-20,093	-2,515	267,508	2,4431	-11,857	-0,0001169
488	COMB2	Combination		-20,093	-2,515	267,508	2,4431	-11,857	-0,0001169
488	COMB3	Combination		-20,093	-2,515	267,508	2,4431	-11,857	-0,0001169
488	COMB4	Combination		-20,025	-5,484	272,422	8,1248	-11,7752	-0,0001882
488	COMB5	Combination		-20,161	0,454	262,594	-3,2386	-11,9388	-0,00004564
488	COMB6	Combination	Max	-20,074	-2,484	267,533	2,5002	-11,8224	-0,0001159
488	COMB6	Combination	Min	-20,112	-2,546	267,483	2,3861	-11,8915	-0,000118
488	COMB7	Combination	Max	-20,087	-2,506	267,516	2,4603	-11,8465	-0,0001166
488	COMB7	Combination	Min	-20,099	-2,524	267,5	2,426	-11,8674	-0,0001172
671	COMB1	Combination		1,068	-10,768	177,158	-2,1486	1,1418	0,0033
671	COMB2	Combination		1,068	-10,768	177,158	-2,1486	1,1418	0,0033
671	COMB3	Combination		1,068	-10,768	177,158	-2,1486	1,1418	0,0033
671	COMB4	Combination		1,234	-15,884	173,805	9,4492	1,4355	0,0026
671	COMB5	Combination		0,902	-5,652	180,512	-13,7464	0,8481	0,004
671	COMB6	Combination	Max	1,167	-10,733	177,199	-2,0694	1,3181	0,0033
671	COMB6	Combination	Min	0,97	-10,802	177,118	-2,2278	0,9655	0,0033
671	COMB7	Combination	Max	1,098	-10,758	177,171	-2,1248	1,1951	0,0033
671	COMB7	Combination	Min	1,039	-10,778	177,146	-2,1724	1,0885	0,0033
673	COMB1	Combination		7,703	7,813	176,624	0,5673	7,2841	-0,0128
673	COMB2	Combination		7,703	7,813	176,624	0,5673	7,2841	-0,0128

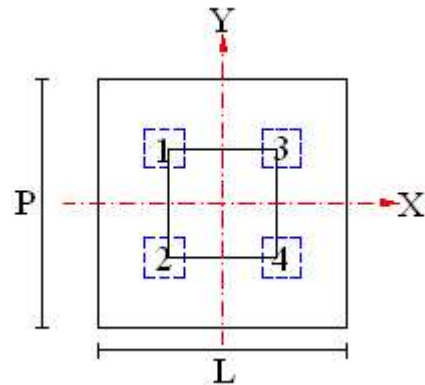
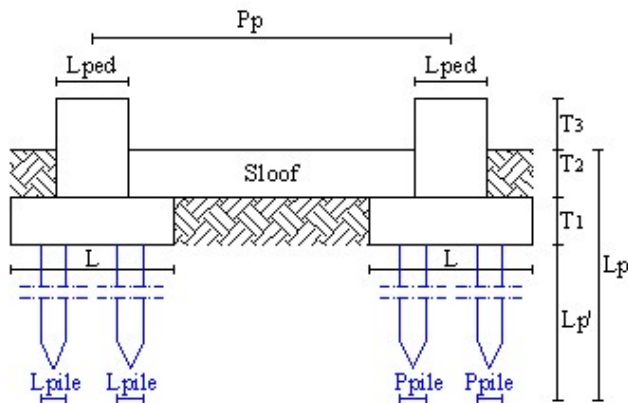
673	COMB3	Combination	7,703	7,813	176,624	0,5673	7,2841	-0,0128
673	COMB4	Combination	7,522	1,055	171,716	12,6965	6,9103	-0,0138
673	COMB5	Combination	7,885	14,57	181,532	-11,5619	7,6579	-0,0118
673	COMB6	Combination Max	7,788	7,845	176,724	0,6405	7,4389	-0,0128
673	COMB6	Combination Min	7,619	7,78	176,524	0,4941	7,1292	-0,0128
673	COMB7	Combination Max	7,729	7,823	176,655	0,5894	7,3311	-0,0128
673	COMB7	Combination Min	7,678	7,803	176,593	0,5453	7,237	-0,0128
676	COMB1	Combination	2,877	-10,188	89,898	15,5608	-1,3832	0,0012
676	COMB2	Combination	2,877	-10,188	89,898	15,5608	-1,3832	0,0012
676	COMB3	Combination	2,877	-10,188	89,898	15,5608	-1,3832	0,0012
676	COMB4	Combination	3,009	-11,942	84,894	19,1345	-1,1225	0,0006349
676	COMB5	Combination	2,745	-8,434	94,902	11,987	-1,644	0,0018
676	COMB6	Combination Max	2,937	-10,161	90,038	15,6231	-1,2435	0,0012
676	COMB6	Combination Min	2,816	-10,214	89,758	15,4984	-1,523	0,0012
676	COMB7	Combination Max	2,895	-10,179	89,941	15,5806	-1,341	0,0012
676	COMB7	Combination Min	2,858	-10,196	89,854	15,541	-1,4255	0,0012
678	COMB1	Combination	0,03	11,454	33,963	-32,3837	-4,3214	-0,0048
678	COMB2	Combination	0,03	11,454	33,963	-32,3837	-4,3214	-0,0048
678	COMB3	Combination	0,03	11,454	33,963	-32,3837	-4,3214	-0,0048
678	COMB4	Combination	-0,005349	3,623	36,648	-7,3588	-4,4735	-0,0029
678	COMB5	Combination	0,066	19,284	31,278	-57,4086	-4,1693	-0,0067
678	COMB6	Combination Max	0,042	11,506	34,014	-32,1498	-4,2712	-0,0047
678	COMB6	Combination Min	0,018	11,401	33,912	-32,6176	-4,3716	-0,0049
678	COMB7	Combination Max	0,034	11,47	33,979	-32,3109	-4,3061	-0,0048
678	COMB7	Combination Min	0,027	11,437	33,947	-32,4565	-4,3368	-0,0048
707	COMB1	Combination	2,843	-2,355	49,593	-3,8736	3,2789	0,000192
707	COMB2	Combination	2,843	-2,355	49,593	-3,8736	3,2789	0,000192
707	COMB3	Combination	2,843	-2,355	49,593	-3,8736	3,2789	0,000192
707	COMB4	Combination	2,746	-2,849	47,46	-2,8095	3,0165	-0,0001933
707	COMB5	Combination	2,94	-1,861	51,726	-4,9376	3,5412	0,0005772
707	COMB6	Combination Max	2,846	-2,341	49,615	-3,8506	3,287	0,0001959
707	COMB6	Combination Min	2,84	-2,368	49,571	-3,8965	3,2707	0,0001881
707	COMB7	Combination Max	2,844	-2,35	49,6	-3,8663	3,2814	0,0001932
707	COMB7	Combination Min	2,842	-2,359	49,586	-3,8808	3,2763	0,0001907
708	COMB1	Combination	5,346	-4,193	102,308	6,8013	5,3407	-0,00003067
708	COMB2	Combination	5,346	-4,193	102,308	6,8013	5,3407	-0,00003067
708	COMB3	Combination	5,346	-4,193	102,308	6,8013	5,3407	-0,00003067
708	COMB4	Combination	5,312	-4,848	103,121	8,0412	5,2653	-0,00006293
708	COMB5	Combination	5,381	-3,539	101,495	5,5614	5,4161	0,000001588
708	COMB6	Combination Max	5,35	-4,179	102,315	6,8254	5,3495	-0,00003049
708	COMB6	Combination Min	5,343	-4,208	102,301	6,7773	5,3319	-0,00003085
708	COMB7	Combination Max	5,348	-4,189	102,31	6,809	5,3434	-0,00003061
708	COMB7	Combination Min	5,345	-4,198	102,306	6,7937	5,338	-0,00003073
709	COMB1	Combination	6,12	-3,24	111,077	7,0738	4,8249	0,0001899
709	COMB2	Combination	6,12	-3,24	111,077	7,0738	4,8249	0,0001899
709	COMB3	Combination	6,12	-3,24	111,077	7,0738	4,8249	0,0001899
709	COMB4	Combination	6,127	-3,714	109,156	8,0835	4,8379	0,000142
709	COMB5	Combination	6,113	-2,766	112,998	6,0642	4,8119	0,0002377
709	COMB6	Combination Max	6,149	-3,226	111,103	7,0974	4,8926	0,0001926
709	COMB6	Combination Min	6,09	-3,254	111,052	7,0503	4,7571	0,0001872
709	COMB7	Combination Max	6,129	-3,235	111,085	7,0813	4,8454	0,0001907
709	COMB7	Combination Min	6,111	-3,244	111,069	7,0664	4,8043	0,000189
763	COMB1	Combination	5,73	3,14	363,165	-0,4287	4,2377	0,000135
763	COMB2	Combination	5,73	3,14	363,165	-0,4287	4,2377	0,000135
763	COMB3	Combination	5,73	3,14	363,165	-0,4287	4,2377	0,000135
763	COMB4	Combination	5,712	0,74	361,676	2,4268	4,2304	0,0001227
763	COMB5	Combination	5,747	5,539	364,654	-3,2842	4,2449	0,0001472
763	COMB6	Combination Max	5,768	3,157	363,175	-0,4086	4,3132	0,0001352
763	COMB6	Combination Min	5,691	3,123	363,155	-0,4487	4,1621	0,0001347

763	COMB7	Combination	Max	5,741	3,145	363,168	-0,4226	4,2605	0,000135
763	COMB7	Combination	Min	5,718	3,135	363,162	-0,4347	4,2148	0,0001349
764	COMB1	Combination		11,737	0,392	207,531	-0,5173	9,101	0,000005819
764	COMB2	Combination		11,737	0,392	207,531	-0,5173	9,101	0,000005819
764	COMB3	Combination		11,737	0,392	207,531	-0,5173	9,101	0,000005819
764	COMB4	Combination		11,911	-1,101	208,874	2,1691	9,4888	-0,000002691
764	COMB5	Combination		11,562	1,886	206,187	-3,2038	8,7131	0,00001433
764	COMB6	Combination	Max	11,758	0,403	207,544	-0,4989	9,1469	0,000006198
764	COMB6	Combination	Min	11,715	0,382	207,517	-0,5358	9,055	0,000005441
764	COMB7	Combination	Max	11,743	0,396	207,535	-0,5118	9,115	0,000005934
764	COMB7	Combination	Min	11,73	0,389	207,527	-0,5229	9,0869	0,000005705
765	COMB1	Combination		10,299	3,704	289,965	-3,2203	10,0072	0,009
765	COMB2	Combination		10,299	3,704	289,965	-3,2203	10,0072	0,009
765	COMB3	Combination		10,299	3,704	289,965	-3,2203	10,0072	0,009
765	COMB4	Combination		10,17	-0,2	289,885	1,0187	9,7209	0,0091
765	COMB5	Combination		10,428	7,609	290,044	-7,4593	10,2934	0,0089
765	COMB6	Combination	Max	10,303	3,731	289,967	-3,1915	10,0171	0,0091
765	COMB6	Combination	Min	10,294	3,677	289,962	-3,2491	9,9972	0,009
765	COMB7	Combination	Max	10,3	3,713	289,965	-3,2117	10,0103	0,009
765	COMB7	Combination	Min	10,297	3,696	289,964	-3,229	10,004	0,009
767	COMB1	Combination		5,591	0,785	344,804	-0,4648	5,2764	-0,0001283
767	COMB2	Combination		5,591	0,785	344,804	-0,4648	5,2764	-0,0001283
767	COMB3	Combination		5,591	0,785	344,804	-0,4648	5,2764	-0,0001283
767	COMB4	Combination		5,552	-1,58	345,1	2,3041	5,1979	-0,0001356
767	COMB5	Combination		5,629	3,149	344,508	-3,2337	5,355	-0,000121
767	COMB6	Combination	Max	5,595	0,801	344,805	-0,4458	5,2865	-0,0001274
767	COMB6	Combination	Min	5,586	0,768	344,803	-0,4838	5,2663	-0,0001292
767	COMB7	Combination	Max	5,592	0,79	344,804	-0,4591	5,2795	-0,000128
767	COMB7	Combination	Min	5,589	0,78	344,804	-0,4705	5,2733	-0,0001286
				Max	24,767	49,37	789,518	152,2601	43,9041
				Min	-20,314	-28,133	-14,811	-189,3782	-42,0072
									1,4011
									-0,7328

4. CALCULATION SHEET

4.1 FOUNDATION OF HERBI TIPE 1 (MAX. 600 kN)

4.1.1 Geometry



4.1.2 Assumption dimensional foundation

$L := 2.2\text{m}$	wide of pile cap
$P := 2.2\text{m}$	length of pile cap
$T_1 := 0.35\text{m}$	thickness of pile cap
$T_2 := 0.8\text{m}$	height of soil
$T_3 := 0.2\text{m}$	height of pedestal
$L_{ped} := 0.45\text{m}$	wide of pedestal
$P_{ped} := 0.7\text{m}$	length of pedestal
$n_{pile} := 4$	number of pile (for 1 pile cap)
$P_p := 6\text{m}$	length pedestal to pedestal
$B_{sloof} := 0.3\text{m}$	width sloof
$T_{sloof} := 0.4\text{m}$	height of sloof
$L_p := 4\text{m}$	
$h := T_1 + T_2$	$h = 1.15\text{m}$
$T_{total} := T_1 + T_2 + T_3$	
$T_{total} = 1.35\text{m}$	
$T_{sog} := 0.2\text{m}$	Thickness of slab on grid

Effective pile length :

$$L_{p'} := L_p - T_1$$

$$L_{p'} = 3.65\text{m}$$

Based on material specification can be assumed :

Concrete : K-300

$$f_c' := 0.83 \cdot 30 \cdot \text{Mpa}$$

$$f_c' = 24.9 \text{ Mpa}$$

$$f_y := 400 \cdot \text{Mpa} \quad \text{for diameter} \geq 13$$

$$f_y := 240 \cdot \text{Mpa} \quad \text{for diameter} \leq 10$$

$$\gamma_{\text{concrete}} := 24 \frac{\text{kN}}{\text{m}^3} \quad \gamma_{\text{soil}} := 19.6 \frac{\text{kN}}{\text{m}^3} \quad \text{SF1} := 2$$

$$\beta := 0.85 \quad f_c' := 24.5 \text{ Mpa} \quad \text{SF2} := 2.5$$

Pile Data :

$$\text{Used : Triangle Pile } 20\text{cm} \times 20\text{cm} \quad w_{\text{pile}} := \left(91 \frac{\text{kg}}{\text{m}} \right) \quad A_{\text{pile}} := 400 \cdot \text{cm}^2$$

4.1.3 Ultimate Pile Capacity

A. Axial Load Triangle Pile 20cm x 20cm

$$P_n := 350 \text{ kN}$$

(Please see attachment)

B. Pull out Capacity

$$M_{n_u} := 60 \text{ kN} \cdot \text{m} \quad (\text{Ulimit})$$

4.1.4 Actual Pile Capacity

Q allowable base on BH 2 , for caculation length of pile $L_p = 4 \text{ m}$

Based on soil investigation report,

Compression capacity :

$$Q_{\text{all}} := 218 \cdot \text{kN} \quad (\text{Please see attachment})$$

4.1.5 Pile Design

A. Dead Load

A.1 Foundation's self weight (concrete)

$$V_{\text{slab}} := P \cdot L \cdot T_1 \cdot \gamma_{\text{concrete}}$$

$$V_{\text{slab}} = 40.656 \text{ kN}$$

$$V_{\text{ped}} := [P_{\text{ped}} \cdot L_{\text{ped}} \cdot (T_2 + T_3) \cdot \gamma_{\text{concrete}}]$$

$$V_{\text{ped}} = 7.56 \text{ kN}$$

$$V_{\text{cap}} := V_{\text{slab}} + V_{\text{ped}}$$

$$V_{\text{cap}} = 48.216 \text{ kN}$$

A.2 Soil load

$$\gamma_{\text{soil}} = 19.6 \frac{\text{kN}}{\text{m}^3}$$

Vertical load :

$$V_{\text{soil}} := [(P \cdot L - P_{\text{ped}} \cdot L_{\text{ped}}) \cdot T_2] \cdot \gamma_{\text{soil}}$$

$$V_{\text{soil}} = 70.952 \text{ kN}$$

A.3 Slab on grid

$$V_{\text{slabog}} := \left[(P \cdot L - P_{\text{ped}} \cdot L_{\text{ped}}) \cdot T_{\text{sog}} \right] \cdot \gamma_{\text{concrete}}$$

$$V_{\text{slabog}} = 21.72 \text{ kN}$$

A.4 Pile Weight

$$V_{\text{pile}} := L_p \cdot w_{\text{pile}}$$

$$V_{\text{pile}} = 3.321 \text{ kN}$$

$$V_{\text{DL}} := (V_{\text{cap}} + V_{\text{soil}} + V_{\text{pile}} + V_{\text{slabog}})$$

$$V_{\text{DL}} = 144.21 \text{ kN}$$

B. Support Loads

Output Reaction of Structure from SAP 2000 (Not Factored) joint 88:

Vertical load : $V_{65} := 490 \cdot \text{kN}$

Horizontal load : $F_{65_{x1}} := 16.502 \text{ kN}$

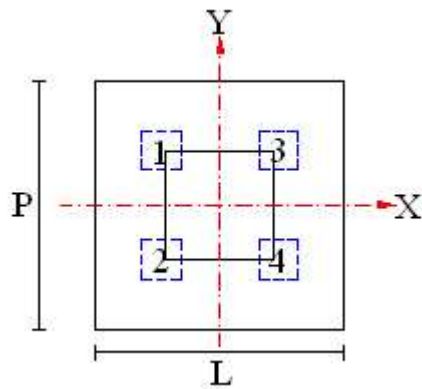
$$F_{65_{y1}} := 11.66 \cdot \text{kN}$$

Moment : $M_{65_{x1}} := 49.55 \text{ kN} \cdot \text{m}$

$$M_{65_{y1}} := 17.7 \text{ kN} \cdot \text{m}$$

C. Stability of Foundation

1.) Axial Load Capacity



Pile coordinate from centre of cap : $n_{\text{pile}} = 4$

$$x_1 := -0.7 \cdot \text{m} \quad y_1 := 0.7 \cdot \text{m}$$

$$x_2 := -0.7 \cdot \text{m} \quad y_2 := -0.7 \cdot \text{m}$$

$$x_3 := 0.7 \cdot \text{m} \quad y_3 := 0.7 \cdot \text{m}$$

$$x_4 := 0.7 \cdot \text{m} \quad y_4 := -0.7 \cdot \text{m}$$

$$V_t := V_{\text{DL}} + V_{65}$$

$$V_t = 634.21 \text{ kN}$$

$$Q_{\text{all}} = 218 \text{ kN}$$

Moment :

$$M_{ux} := |F_{65_{y1}}| \cdot T_{\text{total}}$$

$$M_{ux} = 15.741 \text{ kN} \cdot \text{m}$$

$$M_{uy} := |F_{65_{x1}}| \cdot T_{\text{total}}$$

$$M_{uy} = 22.278 \text{ kN} \cdot \text{m}$$

Pile Reaction :

$$x_{\max} := \max(|x_1|, |x_2|, |x_3|, |x_4|)$$

$$x_{\max} = 0.7 \text{ m}$$

$$y_{\max} := \max(|y_1|, |y_2|, |y_3|, |y_4|)$$

$$y_{\max} = 0.7 \text{ m}$$

$$\Sigma x^2 := x_1^2 + x_2^2 + x_3^2 + x_4^2$$

$$\Sigma x^2 = 1.96 \text{ m}^2$$

$$\Sigma y^2 := y_1^2 + y_2^2 + y_3^2 + y_4^2$$

$$\Sigma y^2 = 1.96 \text{ m}^2$$

$$P_{\text{pilemax}} := \left(\frac{V_t}{n_{\text{pile}}} \right) + \left| \frac{M_{uy} \cdot x_{\max}}{\Sigma x^2} \right| + \left| \frac{M_{ux} \cdot y_{\max}}{\Sigma y^2} \right|$$

$$P_{\text{pilemax}} = 172.13 \text{ kN}$$

$$\text{AxialFoundation} := \begin{cases} \text{"Ok"} & \text{if } Q_{\text{all}} > P_{\text{pilemax}} \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

$$\text{AxialFoundation} = \text{"Ok"}$$

$$P_{\text{pilemin}} := \left(\frac{V_t}{n_{\text{pile}}} \right) - \left| \frac{M_{uy} \cdot x_{\max}}{\Sigma x^2} \right| - \left| \frac{M_{ux} \cdot y_{\max}}{\Sigma y^2} \right|$$

$$P_{\text{pilemin}} = 144.974 \text{ kN}$$

$$\text{AxialFoundation} := \begin{cases} \text{"Ok"} & \text{if } P_{\text{pilemin}} > 0 \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

$$\text{AxialFoundation} = \text{"Ok"}$$

2.) Horizontal Load Capacity

Horizontal Load 1 Pile < 5%- 7% x Qall

$$\phi := 25 \text{ deg}$$

$$F_x := |F_{65x1}|$$

$$F_x = 16.502 \text{ kN}$$

$$F_y := |F_{65y1}|$$

$$F_y = 11.66 \text{ kN}$$

$$F_{\max} := \max(F_x, F_y)$$

$$F_{\max} = 16.502 \text{ kN}$$

$$H_{\text{hor}} := \frac{F_{\max}}{n_{\text{pile}}}$$

$$H_{\text{hor}} = 4.125 \text{ kN}$$

$$h := Q_{\text{all}} \cdot 0.05 + (V_{\text{cap}} + V_{\text{soil}} + V_{\text{pile}}) \cdot \tan\left(\frac{2}{3}\right) \cdot \phi$$

$$h = 52.954 \text{ kN}$$

$$\text{HorizontalFoundation} := \begin{cases} \text{"Ok"} & \text{if } h > H_{\text{hor}} \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

HorizontalFoundation = "Ok"

4.1.6 Efficiency of Pile Group

$n' := 2$ Number of piles in rows

$m' := 2$ Number of piles in columns

$\theta := 15.64\text{deg}$

Based the Converse - Labarre equation is :

$$E_g := 1 - \theta \cdot \frac{(n' - 1) \cdot m' + (m' - 1) \cdot n'}{90 \cdot m' \cdot n'}$$

$$E_g = 0.997$$

Group Capacity :

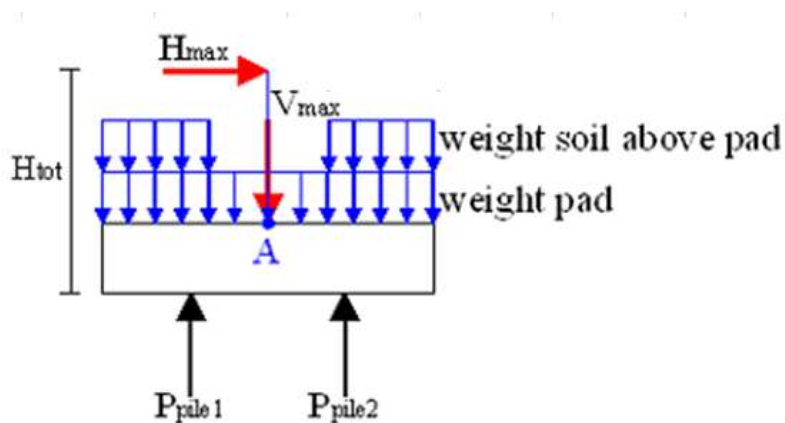
$$Q_g := n_{\text{pile}} \cdot P_n \cdot E_g$$

$$Q_g = 1.396 \times 10^3 \text{ kN}$$

4.1.7 Pile Cap Design

A. Pile Cap Reinforcement

Reinforcement for X and Y direction :



$$H_{\text{tot}} := T_1 + T_2 + T_3$$

$$H_{\text{tot}} = 1.35 \text{ m}$$

Output Reaction of Structure from SAP 2000 (Factored) :

Vertical load : $V_{65} := 152.83 \cdot \text{kN}$

Horizontal load : $F_{65_x} := 0.73 \text{ kN}$

$$F_{65_y} := 12.78 \cdot \text{kN}$$

Moment : $M_{65_x} := 347.82 \text{ kN} \cdot \text{m}$

$$M_{65_y} := 0 \text{ kN} \cdot \text{m}$$

Loading :

$$V_{\text{max}} := V_{65}$$

$$H_{\text{max}} := \max(F_{65_x}, F_{65_y})$$

$$V_{\max} = 152.83 \text{ kN}$$

$$H_{\max} = 12.78 \text{ kN}$$

$$V_{\text{soil}} = 7.095 \times 10^4 \text{ m} \cdot \text{kg} \cdot \text{s}^{-2}$$

$$q_{\text{soil}} := \frac{V_{\text{soil}}}{p}$$

$$q_{\text{pad}} := \frac{V_{\text{slab}}}{p}$$

$$q_{\text{soil}} = 32.251 \frac{\text{kN}}{\text{m}}$$

$$q_{\text{pad}} = 18.48 \frac{\text{kN}}{\text{m}}$$

Pile Reaction :

$$V_t := V_{\text{DL}} + V_{\max}$$

$$V_t = 297.039 \text{ kN}$$

$$P_{\text{pile1}} := \left(\frac{V_t}{n_{\text{pile}}} \right) + \left| \frac{M_{uy} \cdot x_1}{\Sigma x^2} \right| + \left| \frac{M_{ux} \cdot y_1}{\Sigma y^2} \right|$$

$$P_{\text{pile1}} = 87.838 \text{ kN}$$

$$P_{\text{pile2}} := \left(\frac{V_t}{n_{\text{pile}}} \right) + \left| \frac{M_{uy} \cdot x_2}{\Sigma x^2} \right| + \left| \frac{M_{ux} \cdot y_2}{\Sigma y^2} \right|$$

$$P_{\text{pile2}} = 87.838 \text{ kN}$$

Moment :

$$M_{\text{Aclockwise}} := \left[2 \cdot P_{\text{pile1}} \cdot \left(\frac{1.4 \cdot \text{m}}{2} \right) \right] + H_{\max} \cdot H_{\text{tot}} + M_{65x}$$

$$M_{\text{Aclockwise}} = 488.046 \text{ kN} \cdot \text{m}$$

$$M_{\text{Aunclockwise}} := \left[(q_{\text{pad}} \cdot 1.8 \cdot \text{m}) \cdot \left(\frac{1.8 \cdot \text{m}}{2} \right) \right] + \left[(q_{\text{soil}} \cdot 0.88 \cdot \text{m}) \cdot \left(\frac{1.4 \cdot \text{m}}{2} + \frac{0.88 \text{m}}{2} \right) \right]$$

$$M_{\text{Aunclockwise}} = 62.292 \text{ kN} \cdot \text{m}$$

$$M_A := M_{\text{Aclockwise}} - M_{\text{Aunclockwise}}$$

$$M_A = 425.754 \text{ kN} \cdot \text{m}$$

$$M_u := M_A$$

$$M_u = 425.754 \text{ kN} \cdot \text{m}$$

Foundation actual height (for assumption use D12mm)

$$d := T_1 - 40 \text{ mm} - 6 \text{ mm}$$

$$d = 0.304 \text{ m}$$

$$L = 2.2 \text{ m}$$

$$M_n := \frac{|M_u|}{0.85}$$

$$M_n = 500.888 \text{ kN} \cdot \text{m}$$

$$R_n := \frac{M_n}{0.8 \cdot L \cdot d^2}$$

$$R_n = 3.08 \times 10^3 \frac{\text{kN}}{\text{m}^2}$$

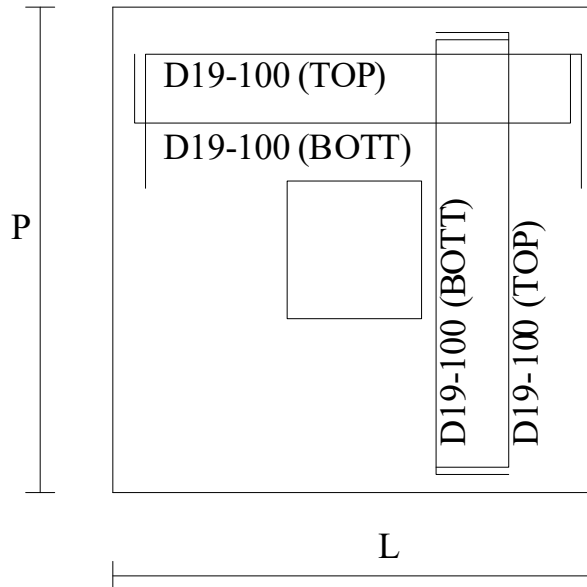
$$\rho := \frac{0.85 \cdot f_c'}{f_y} \cdot \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c'}} \right)$$

$$\rho = 8.372 \times 10^{-3} \quad \rho_{\min} := 0.0018$$

$$\rho_{\text{used}} := \begin{cases} \rho & \text{if } (\rho > \rho_{\min} \wedge \rho < 0.025) \\ \rho_{\min} & \text{if } \rho < \rho_{\min} \end{cases}$$

$$A_{s_{\text{used}}} := \rho_{\text{used}} \cdot 1m \cdot d$$

$$A_{s_{\text{used}}} = 25.45 \text{ cm}^2 \quad \text{Used As D19-100 (As=28.7cm}^2\text{)}$$



4.1.8 Pedestal Design

$$V_{xu} := |F_{65y}| \quad V_{xu} = 12.78 \text{ kN}$$

$$V_u := 1.4 |V_{xu}| \quad V_u = 17.892 \text{ kN}$$

$$F_{zu} := 1.4 \cdot V_{65} \quad F_{zu} = 213.962 \text{ kN}$$

Assumed : $\rho_g := 0.01$ Ratio of reinforcement

$\phi := 0.65$ Strength reduction factor

$$A_g := P_{\text{ped}} \cdot L_{\text{ped}}$$

$$A_g = 315000 \text{ mm}^2$$

Load supported by concrete area :

$$P'_u := 0.8 \cdot \phi \cdot [0.85 \cdot f_c' \cdot (A_g - A_g \cdot \rho_g) + (f_y \cdot A_g \cdot \rho_g)] \quad \text{SK SNI T - 15 - 1991 03 (3.3-2)}$$

$$P'_u = 4032.22 \text{ kN}$$

Load supported by Reinforcement :

$$P''_u := F_{zu} - P'_u$$

$$P''_u = -3818.26 \text{ kN}$$

Concrete can accounts axial load, was not required again reinforcement but in execution in applies use minimum reinforcement.

So use reinforcement : $A_{s_{\text{ped}}} := \rho_g \cdot (P_{\text{ped}} \cdot L_{\text{ped}})$

$$A_{s_{ped}} = 31.5 \text{ cm}^2$$

$$\text{dia} := 22 \cdot \text{mm}$$

$$A_{s_{22}} := \frac{1}{4} \cdot \pi \cdot \text{dia}^2$$

$$A_{s_{22}} = 3.801 \text{ cm}^2$$

$$n := \frac{A_{s_{ped}}}{A_{s_{22}}}$$

$$n = 8.287$$

Used As 8D22 (As=30.40cm2)

Shear Reinforcement :

Shear Capacity of concrete :

$$V_{xu} = 12.78 \text{ kN}$$

$$\phi := 0.75$$

$$f_{sy} := 240 \frac{\text{N}}{\text{mm}^2}$$

$$d := L_{ped} - 50 \cdot \text{mm} - 10 \cdot \text{mm} - \frac{13 \cdot \text{mm}}{2}$$

$$d = 383.5 \text{ mm}$$

$$b := L_{ped}$$

$$b = 0.45 \text{ m}$$

$$v_c := \frac{1}{6} \cdot \sqrt{f_{c'} \cdot \text{Mpa}} \cdot b \cdot d$$

$$v_c = 142.367 \text{ kN}$$

$$v_n := \frac{V_{xu}}{\phi}$$

$$v_n = 17.04 \text{ kN}$$

$$v_s := v_n - v_c$$

$$v_s = -125.327 \text{ kN}$$

$$v_n < v_c \quad \text{Used minimum shear reinforcement D10-150}$$

4.1.9 Checking for Punching Shear

$$V_u := P_{pilemax}$$

$$V_u = 172.13 \text{ kN}$$

$$d := T_1 - 0.06 \text{ m} - 0.008 \text{ m}$$

$$d = 0.282 \text{ m}$$

$$B_1 := 2[(P_{ped} + d) + (L_{ped} + d)]$$

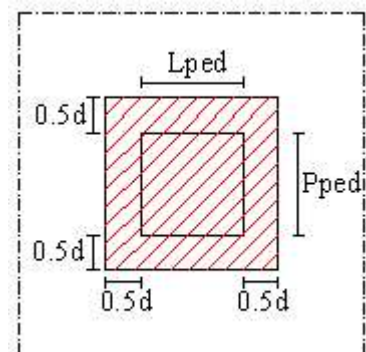
$$B_1 = 3.428 \text{ m}$$

$$\beta_c := 1 \quad \alpha_s := 40 \quad \phi := 0.75$$

$$V_{c1} := \frac{1}{6} \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \sqrt{f_{c'} \cdot \text{Mpa}} \cdot B_1 \cdot d$$

$$V_{c1} = 2.392 \times 10^3 \text{ kN}$$

Dimensional of Pile : 200mm x 200mm



$$V_{c2} := \left(\frac{\alpha_s \cdot d}{12 \cdot B_1} + \frac{1}{6} \right) \cdot \sqrt{f_c' \cdot \text{Mpa}} \cdot B_1 \cdot d$$

$$V_{c2} = 2.11 \times 10^3 \text{ kN}$$

$$V_{c3} := \frac{1}{3} \cdot \sqrt{f_c' \cdot \text{Mpa}} \cdot B_1 \cdot d$$

$$V_{c3} = 1.595 \times 10^3 \text{ kN}$$

$$V_c := \min(V_{c1}, V_{c2}, V_{c3})$$

$$V_c = 1.595 \times 10^3 \text{ kN}$$

$$\phi V_n := \phi \cdot V_c$$

$$\phi V_n = 1.196 \times 10^3 \text{ kN}$$

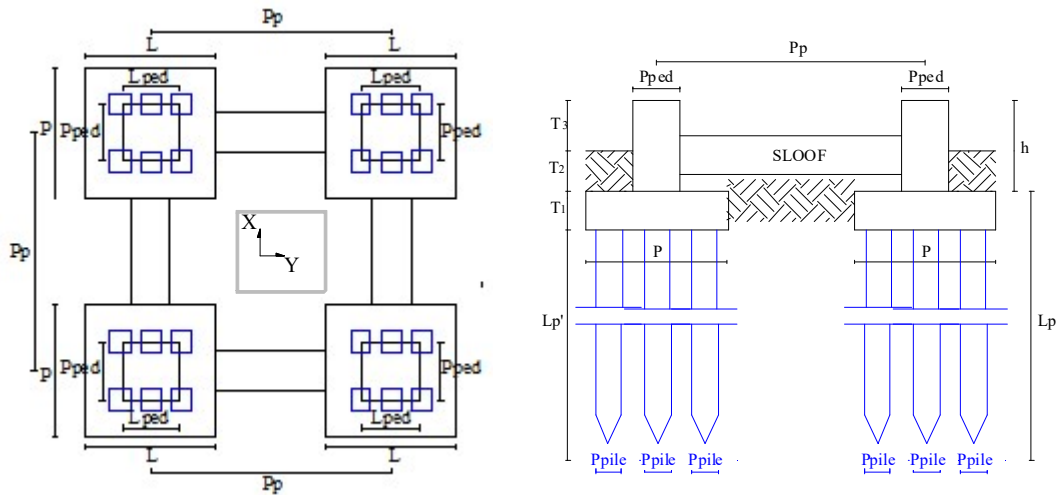
$$\text{PunchingShear} := \begin{cases} \text{"Ok"} & \text{if } \phi V_n > V_u \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

$$\text{PunchingShear} = \text{"Ok"}$$

4. CALCULATION SHEET

4.1 FOUNDATION HERBI TYPE 2

4.1.1 Geometry



4.1.2 Assumption dimensional foundation

- $L := 2.75\text{m}$ wide of pile cap
 $P := 2.2\text{m}$ length of pile cap
 $T_1 := 0.4\text{m}$ thickness of pile cap
 $T_2 := 0.8\text{m}$ height of soil
 $T_3 := 0.1\text{m}$ height of pedestal
 $L_{ped} := 0.5\text{m}$ wide of pedestal
 $P_{ped} := 0.5\text{m}$ length of pedestal
 $n_{pile} := 6$ number of pile (for 1 pile cap)
 $L_p := 6\text{m}$
 $h := T_1 + T_2$ $h = 1.2\text{m}$
 $T_{total} := T_1 + T_2 + T_3$
 $T_{total} = 1.3\text{m}$
 Effective pile length :
 $L_{p'} := L_p - (T_1 + T_2)$
 $L_{p'} = 4.8\text{m}$
 Based on material specification can be assumed :
 Concrete : K-300
 $f_c' := 0.83 \cdot 30 \cdot \text{Mpa}$
 $f_c' = 24.9\text{Mpa}$
 $f_y := 400 \cdot \text{Mpa}$ for diameter ≥ 13

$$f_{ys} := 240 \cdot \text{Mpa} \quad \text{for diameter} \leq 10$$

$$\gamma_{\text{concrete}} := 24 \frac{\text{kN}}{\text{m}^3} \quad \gamma_{\text{soil}} := 19.6 \cdot \frac{\text{kN}}{\text{m}^3} \quad \text{SF1} := 2$$

$$\beta := 0.85 \quad \underline{\underline{f_c'}} := 24.5 \text{Mpa} \quad \text{SF2} := 2.5$$

Pile Data :

$$\text{Used : Square Pile } 20\text{cm} \times 20\text{cm} \quad w_{\text{pile}} := \left(91 \frac{\text{kg}}{\text{m}} \right) \quad A_{\text{pile}} := 400 \cdot \text{cm}^2$$

4.1.3 Ultimate Pile Capacity

A. Axial Load Square Pile 20cm x 20cm

$$P_n := 350 \text{kN}$$

B. Momen Capacity

$$M_{n_u} := 60 \text{kN} \cdot \text{m} \quad (\text{Ultimate})$$

4.1.4 Actual Pile Capacity

Q allowable base on BH 2 , for caculation length of pile $L_p = 6 \text{ m}$

(to determine Q.ult & Q.pull ult., please see attachment)

Compression capacity :

$$Q_{\text{all}} := 218 \cdot \text{kN}$$

Pull capacity :

$$Q_{\text{pull}} := 44 \cdot \text{kN}$$

4.1.5 Pile Design

A. Dead Load

A.1 Foundation's self weight (concrete)

$$V_{\text{slab}} := P \cdot L \cdot T_1 \cdot \gamma_{\text{concrete}}$$

$$V_{\text{slab}} = 58.08 \text{ kN}$$

$$V_{\text{ped}} := [P_{\text{ped}} \cdot L_{\text{ped}} \cdot (T_2 + T_3) \cdot \gamma_{\text{concrete}}]$$

$$V_{\text{ped}} = 5.4 \text{ kN}$$

$$V_{\text{cap}} := V_{\text{slab}} + V_{\text{ped}}$$

$$V_{\text{cap}} = 63.48 \text{ kN}$$

A.2 Soil load

$$\gamma_{\text{soil}} = 19.6 \frac{\text{kN}}{\text{m}^3}$$

Vertical load :

$$V_{\text{soil}} := [(P \cdot L - P_{\text{ped}} \cdot L_{\text{ped}}) \cdot T_2] \cdot \gamma_{\text{soil}}$$

$$V_{\text{soil}} = 90.944 \text{ kN}$$

A.3 Pile Weight

$$V_{\text{pile}} := L_p \cdot w_{\text{pile}}$$

$$V_{\text{pile}} = 4.368 \text{ kN}$$

$$V_{\text{DL}} := (V_{\text{cap}} + V_{\text{soil}} + V_{\text{pile}})$$

$$V_{\text{DL}} = 158.792 \text{ kN}$$

B. Support Loads

Output Reaction of Structure from SAP 2000 (Not Factored) :

Vertical load : $V_{57} := 765.3 \cdot \text{kN}$

Horizontal load : $F_{57_{x1}} := 3 \text{ kN}$

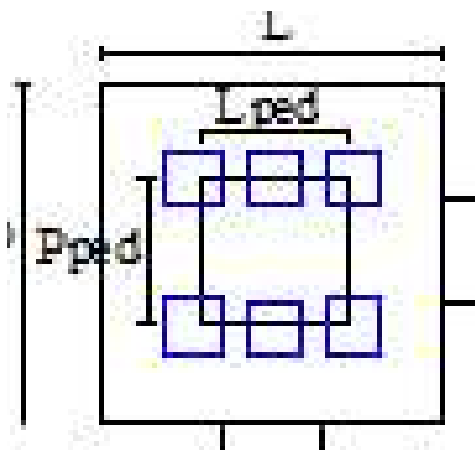
$$F_{57_{y1}} := 23 \cdot \text{kN}$$

Moment : $M_{57_{x1}} := -33 \text{ kN} \cdot \text{m}$

$$M_{57_{y1}} := 0 \text{ kN} \cdot \text{m}$$

C. Stability of Foundation

1.) Axial Load Capacity



Pile coordinate from centre of cap : $n_{\text{pile}} = 6$

$$V_t := V_{\text{DL}} + V_{57}$$

$$V_t = 924.092 \text{ kN}$$

$$Q_{\text{all}} = 218 \text{ kN}$$

$$Q_{\text{pull}} = 44 \text{ kN}$$

Moment :

$$M_{ux} := |F_{57_{y1}}| \cdot T_{\text{total}}$$

$$M_{ux} = 29.9 \text{ kN} \cdot \text{m}$$

$$M_{uy} := |F_{57_{x1}}| \cdot T_{\text{total}}$$

$$x_1 := -1 \cdot \text{m} \quad y_1 := 1 \cdot \text{m}$$

$$x_2 := -1 \cdot \text{m} \quad y_2 := -1 \cdot \text{m}$$

$$x_3 := 0 \cdot \text{m} \quad y_3 := 1 \cdot \text{m}$$

$$x_4 := 0 \cdot \text{m} \quad y_4 := -1 \cdot \text{m}$$

$$x_5 := 1 \cdot \text{m} \quad y_5 := 1 \cdot \text{m}$$

$$x_6 := 1 \cdot \text{m} \quad y_6 := -1 \cdot \text{m}$$

$$M_{uy} = 3.9 \text{ kN} \cdot \text{m}$$

Pile Reaction :

$$x_{\max} := \max(|x_1|, |x_2|, |x_3|, |x_4|, |x_5|, |x_6|)$$

$$x_{\max} = 1 \text{ m}$$

$$y_{\max} := \max(|y_1|, |y_2|, |y_3|, |y_4|, |y_5|, |y_6|)$$

$$y_{\max} = 1 \text{ m}$$

$$\Sigma x^2 := x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 + x_6^2$$

$$\Sigma x^2 = 4 \text{ m}^2$$

$$\Sigma y^2 := y_1^2 + y_2^2 + y_3^2 + y_4^2 + y_5^2 + y_6^2$$

$$\Sigma y^2 = 6 \text{ m}^2$$

$$P_{\text{pilemax}} := \left(\frac{V_t}{n_{\text{pile}}} \right) + \left| \frac{M_{uy} \cdot x_{\max}}{\Sigma x^2} \right| + \left| \frac{M_{ux} \cdot y_{\max}}{\Sigma y^2} \right|$$

$$P_{\text{pilemax}} = 159.974 \text{ kN}$$

$$\text{AxialFoundation} := \begin{cases} \text{"Ok"} & \text{if } Q_{\text{all}} > P_{\text{pilemax}} \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

$$\text{AxialFoundation} = \text{"Ok"}$$

$$P_{\text{pilemin}} := \left(\frac{V_t}{n_{\text{pile}}} \right) - \left| \frac{M_{uy} \cdot x_{\max}}{\Sigma x^2} \right| - \left| \frac{M_{ux} \cdot y_{\max}}{\Sigma y^2} \right|$$

$$P_{\text{pilemin}} = 148.057 \text{ kN}$$

$$\text{AxialFoundation} := \begin{cases} \text{"Ok"} & \text{if } P_{\text{pilemin}} > 0 \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

$$\text{AxialFoundation} = \text{"Ok"}$$

2.) Horizontal Load Capacity

Horizontal Load 1 Pile < 5% s/d 7% x Qall

$$\phi := 25 \text{ deg}$$

$$F_x := |F_{57x1}|$$

$$F_x = 3 \text{ kN}$$

$$F_y := |F_{57y1}|$$

$$F_y = 23 \text{ kN}$$

$$F_{\max} := \max(F_x, F_y)$$

$$F_{\max} = 23 \text{ kN}$$

$$H_{\text{hor}} := \frac{(F_{\max})}{n_{\text{pile}}}$$

$$H_{\text{hor}} = 3.833 \text{ kN}$$

$$h := Q_{all} \cdot 0.05 + (V_{cap} + V_{soil} + V_{pile}) \cdot \tan\left(\frac{2}{3}\right) \cdot \phi$$

$$h = 65.417 \text{ kN}$$

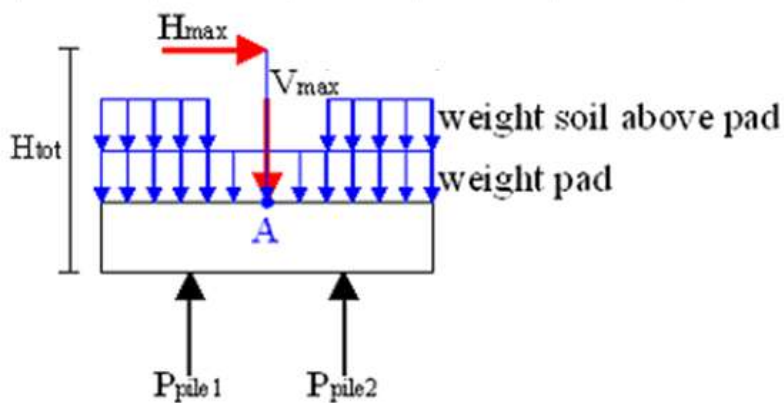
$$\text{HorizontalFoundation} := \begin{cases} \text{"Ok"} & \text{if } h > H_{hor} \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

$$\text{HorizontalFoundation} = \text{"Ok"}$$

4.1.6 Pile Cap Design

A. Pile Cap Reinforcement

Reinforcement for X and Y direction :



$$H_{tot} := T_1 + T_2 + T_3$$

$$H_{tot} = 1.3 \text{ m}$$

Output Reaction of Structure from SAP 2000 (Factored) :

Vertical load : $V_{57} := 779.825 \text{ kN}$

Horizontal load : $F57_x := 3 \text{ kN}$

$$F57_y := 23 \cdot \text{kN}$$

Moment : $M57_x := -33 \text{ kN} \cdot \text{m}$

$$M57_y := 0 \text{ kN} \cdot \text{m}$$

Loading :

$$V_{max} := V_{57}$$

$$H_{max} := \max(F57_x, F57_y)$$

$$V_{max} = 779.825 \text{ kN}$$

$$H_{max} = 23 \text{ kN}$$

$$V_{soil} = 90.944 \text{ kN}$$

$$q_{soil} := \frac{V_{soil}}{p}$$

$$q_{pad} := \frac{V_{slab}}{p}$$

$$q_{soil} = 41.338 \frac{\text{kN}}{\text{m}}$$

$$q_{pad} = 26.4 \frac{\text{kN}}{\text{m}}$$

Pile Reaction :

$$V_t := 1.2V_{DL} + V_{max}$$

$$V_t = 970.375 \text{ kN}$$

$$P_{\text{pile1}} := \left(\frac{V_t}{n_{\text{pile}}} \right) + \left| \frac{M_{uy} \cdot x_1}{\Sigma x^2} \right| + \left| \frac{M_{ux} \cdot y_1}{\Sigma y^2} \right|$$

$$P_{\text{pile1}} = 167.688 \text{ kN}$$

$$P_{\text{pile2}} := \left(\frac{V_t}{n_{\text{pile}}} \right) + \left| \frac{M_{uy} \cdot x_2}{\Sigma x^2} \right| + \left| \frac{M_{ux} \cdot y_2}{\Sigma y^2} \right|$$

$$P_{\text{pile2}} = 167.688 \text{ kN}$$

Moment :

$$M_{\text{Aclockwise}} := \left[4 \cdot P_{\text{pile1}} \cdot \left(\frac{2.25 \cdot \text{m}}{2} \right) \right] + H_{\text{max}} \cdot H_{\text{tot}}$$

$$M_{\text{Aclockwise}} = 784.494 \text{ kN} \cdot \text{m}$$

$$M_{\text{Aunclockwise}} := \left[(q_{\text{pad}} \cdot 2.25 \cdot \text{m}) \cdot \left(\frac{2.25 \cdot \text{m}}{2} \right) \right] + \left[(q_{\text{soil}} \cdot 1.7 \cdot \text{m}) \cdot \left(\frac{2.25 \cdot \text{m}}{2} + \frac{1.7 \text{m}}{2} \right) \right]$$

$$M_{\text{Aunclockwise}} = 205.618 \text{ kN} \cdot \text{m}$$

$$M_A := M_{\text{Aclockwise}} - M_{\text{Aunclockwise}}$$

$$M_A = 578.876 \text{ kN} \cdot \text{m}$$

$$M_u := M_A$$

$$M_u = 578.876 \text{ kN} \cdot \text{m}$$

Foundation actual height (for assumption use D12mm)

$$d := T_1 - 40 \text{ mm} - 6 \text{ mm}$$

$$d = 0.354 \text{ m}$$

$$L = 2.75 \text{ m}$$

$$M_n := \frac{|M_u|}{0.85}$$

$$M_n = 681.031 \text{ kN} \cdot \text{m}$$

$$R_n := \frac{M_n}{0.8 \cdot L \cdot d^2}$$

$$R_n = 2.47 \times 10^3 \frac{\text{kN}}{\text{m}^2}$$

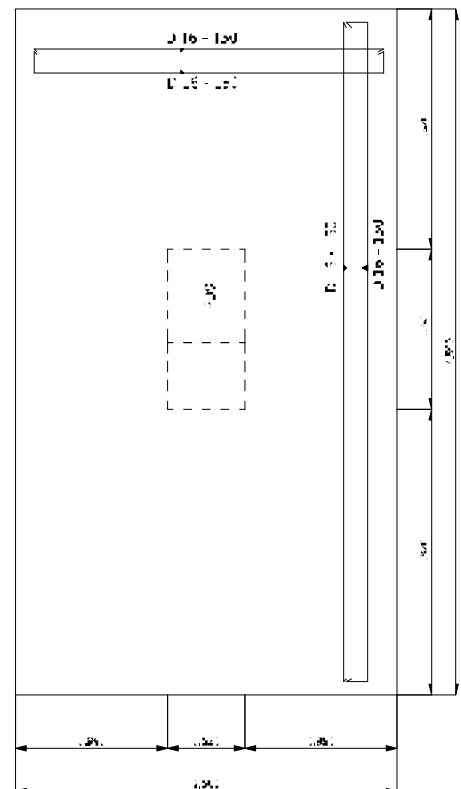
$$\rho := \frac{0.85 \cdot f_c'}{f_y} \cdot \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c'}} \right)$$

$$\rho = 6.593 \times 10^{-3} \quad \rho_{\text{min}} := 0.0018$$

$$\rho_{\text{used}} := \begin{cases} \rho & \text{if } (\rho > \rho_{\text{min}} \wedge \rho < 0.025) \\ \rho_{\text{min}} & \text{if } \rho < \rho_{\text{min}} \end{cases}$$

$$A_{s\text{used}} := \rho_{\text{used}} \cdot 1 \text{ m} \cdot d$$

$$A_{s\text{used}} = 23.339 \text{ cm}^2 \quad \text{Used As D19-100 (As=28.7cm}^2\text{)}$$



4.1.7 Pedestal Design

$$V_{xu} := |F_{57y}| \quad V_{xu} = 23 \text{ kN}$$

$$V_u := 1.4 |V_{xu}| \quad V_u = 32.2 \text{ kN}$$

$$F_{Z_u} := 1.4 \cdot V_{57} \quad F_{Z_u} = 1.092 \times 10^3 \text{ kN}$$

Assumed : $\rho_g := 0.01$ Ratio of reinforcement

$\phi := 0.65$ Strength reduction factor

$$A_g := P_{\text{ped}} \cdot L_{\text{ped}}$$

$$A_g = 250000 \text{ mm}^2$$

Load supported by concrete area :

$$P'_u := 0.8 \cdot \phi \cdot [0.85 \cdot f'_c \cdot (A_g - A_g \cdot \rho_g) + (f_y \cdot A_g \cdot \rho_g)] \quad \text{SK SNI T - 15 - 1991 03 (3.3-2)}$$

$$P'_u = 3200.18 \text{ kN}$$

Load supported by Reinforcement :

$$P''_u := F_{Z_u} - P'_u$$

$$P''_u = -2108.42 \text{ kN}$$

Concrete can accounts axial load, was not required again reinforcement but in execution in applies use minimum reinforcement.

So use reinforcement : $A_{s_{\text{ped}}} := \rho_g \cdot (P_{\text{ped}} \cdot L_{\text{ped}})$

$$A_{s_{\text{ped}}} = 25 \text{ cm}^2$$

$$\text{dia} := 19 \cdot \text{mm}$$

$$A_{s_{19}} := \frac{1}{4} \cdot \pi \cdot \text{dia}^2$$

$$A_{s_{19}} = 2.835 \text{ cm}^2$$

$$n := \frac{A_{s_{\text{ped}}}}{A_{s_{19}}}$$

$$n = 8.817$$

Used As 10 D19 (As=26.4cm2)

Shear Reinforcement :

Shear Capacity of concrete :

$$V_{xu} = 23 \text{ kN}$$

$$\phi := 0.75$$

$$f_{sy} := 240 \frac{\text{N}}{\text{mm}^2}$$

$$d := L_{\text{ped}} - 50 \cdot \text{mm} - 10 \cdot \text{mm} - \frac{19 \cdot \text{mm}}{2}$$

$$d = 430.5 \text{ mm}$$

$$b := L_{\text{ped}}$$

$$b = 0.5 \text{ m}$$

$$v_c := \frac{1}{6} \cdot \sqrt{f_c'} \cdot \text{Mpa} \cdot b \cdot d$$

$$v_c = 177.572 \text{ kN}$$

$$v_n := \frac{V_{xu}}{\phi}$$

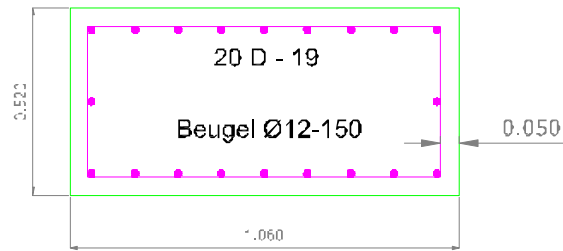
$$v_n = 30.667 \text{ kN}$$

$$v_s := v_n - v_c$$

$$v_s = -146.906 \text{ kN}$$

$$v_n < v_c$$

Used minimum shear reinforcement D12-150



4.1.8 Checking for Punching Shear

$$V_u := P_{\text{pilemax}}$$

$$V_u = 159.974 \text{ kN}$$

$$d := T_1 - 0.06 \text{ m} - 0.008 \text{ m}$$

$$d = 0.332 \text{ m}$$

$$B_1 := 2[(P_{\text{ped}} + d) + (L_{\text{ped}} + d)]$$

$$B_1 = 3.328 \text{ m}$$

$$\beta_c := 1 \quad \alpha_s := 40 \quad \phi := 0.75$$

$$V_{c1} := \frac{1}{6} \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \sqrt{f_c'} \cdot \text{Mpa} \cdot B_1 \cdot d$$

$$V_{c1} = 2.734 \times 10^3 \text{ kN}$$

$$V_{c2} := \left(\frac{\alpha_s \cdot d}{12 \cdot B_1} + \frac{1}{6} \right) \cdot \sqrt{f_c'} \cdot \text{Mpa} \cdot B_1 \cdot d$$

$$V_{c2} = 2.73 \times 10^3 \text{ kN}$$

$$V_{c3} := \frac{1}{3} \cdot \sqrt{f_c'} \cdot \text{Mpa} \cdot B_1 \cdot d$$

$$V_{c3} = 1.823 \times 10^3 \text{ kN}$$

$$V_c := \min(V_{c1}, V_{c2}, V_{c3})$$

$$V_c = 1.823 \times 10^3 \text{ kN}$$

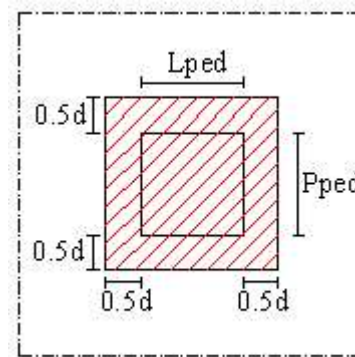
$$\phi V_n := \phi \cdot V_c$$

$$\phi V_n = 1.367 \times 10^3 \text{ kN}$$

$$\text{PunchingShear} := \begin{cases} \text{"Ok"} & \text{if } \phi V_n > V_u \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

PunchingShear = "Ok"

Dimensional of Pile : 200mm x 200mm

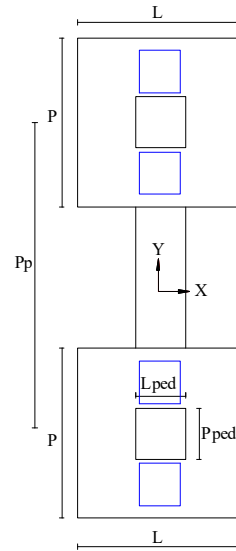
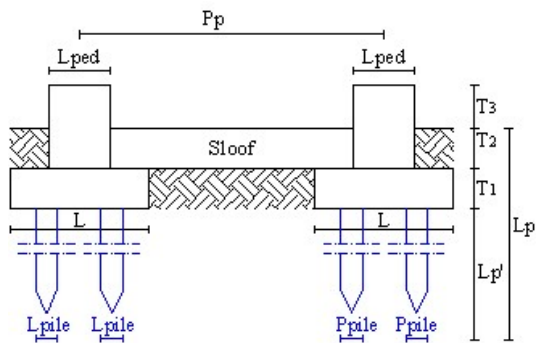


$\text{Mpa} := 10^6 \cdot \text{Pa}$	$\text{kgpm} := 1 \cdot \frac{\text{kg}}{\text{m}}$	$\text{ton} := 1000 \cdot \text{kg}$
$\text{kg} := 10 \cdot \text{N}$	$\text{kgm} := 1 \cdot \text{kg} \cdot \text{m}$	$\text{tonm} := 1 \cdot \text{ton} \cdot \text{m}$
$\text{kN} := 1000 \cdot \text{newton}$	$\text{kgpcm}^2 := 1 \cdot \frac{\text{kg}}{\text{cm}^2}$	$\text{tonm} := 1000 \cdot \text{kg} \cdot \text{m}$
$\text{kN} = 100 \text{ kg}$		

4. CALCULATION SHEET

4.1 FOUNDATION TYPE 3 (Max. 300 kN)

4.1.1 Geometry



4.1.2 Assumption dimensional foundation

$L := 0.8\text{m}$	wide of pile cap
$P := 2.2\text{m}$	length of pile cap
$T_1 := 0.35\text{m}$	thickness of pile cap
$T_2 := 0.6\text{m}$	height of soil
$T_3 := 0.1\text{m}$	height of pedestal
$L_{ped} := 0.25\text{m}$	wide of pedestal
$P_{ped} := 0.45\text{m}$	length of pedestal
$n_{pile} := 2$	number of pile (for 1 pile cap)
$P_p := 6\text{m}$	length pedestal to pedestal
$B_{sloof} := 0.3\text{m}$	width sloof
$T_{sloof} := 0.4\text{m}$	height of sloof
$L_p := 4\text{m}$	
$h := T_1 + T_2$	$h = 0.95\text{m}$
$T_{total} := T_1 + T_2 + T_3$	
$T_{total} = 1.05\text{m}$	
$T_{sog} := 0.2\text{m}$	Thickness of slab on grid

Effective pile length :

$$L_{p'} := L_p - T_1$$

$$L_{p'} = 3.65\text{m}$$

Based on material specification can be assumed :

Concrete : K-300

$$f_c' := 0.83 \cdot 30 \cdot \text{Mpa}$$

$$f_c' = 24.9 \text{ Mpa}$$

$$f_y := 400 \cdot \text{Mpa} \quad \text{for diameter} \geq 13$$

$$f_y := 240 \cdot \text{Mpa} \quad \text{for diameter} \leq 10$$

$$\gamma_{\text{concrete}} := 24 \frac{\text{kN}}{\text{m}^3} \quad \gamma_{\text{soil}} := 19.6 \cdot \frac{\text{kN}}{\text{m}^3} \quad \text{SF1} := 2$$

$$\beta := 0.85 \quad f_c' := 24.5 \text{ Mpa} \quad \text{SF2} := 2.5$$

Pile Data :

$$\text{Used : Square Pile } 20\text{cm} \times 20\text{cm} \quad w_{\text{pile}} := \left(91 \frac{\text{kg}}{\text{m}} \right) \quad A_{\text{pile}} := 400 \cdot \text{cm}^2$$

4.1.3 Ultimate Pile Capacity

A. Axial Load Square Pile 20cm x 20cm

$$P_n := 350 \text{ kN}$$

B. Momen Capacity

$$M_{n_u} := 60 \text{ kN} \cdot \text{m} \quad (\text{Ultimate})$$

4.1.4 Actual Pile Capacity

Q allowable base on BH 2 , for caculation length of pile $L_p = 4 \text{ m}$

Based on soil investigation report,

Compression capacity :

$$Q_{\text{all}} := 218 \cdot \text{kN} \quad Q_{\text{all}} = 218 \text{ kN}$$

Pull capacity :

$$Q_{\text{pull}} := 44 \cdot \text{kN} \quad Q_{\text{pull}} = 44 \text{ kN}$$

4.1.5 Pile Design

A. Dead Load

A.1 Foundation's self weight (concrete)

$$V_{\text{slab}} := P \cdot L \cdot T_1 \cdot \gamma_{\text{concrete}}$$

$$V_{\text{slab}} = 14.784 \text{ kN}$$

$$V_{\text{ped}} := [P_{\text{ped}} \cdot L_{\text{ped}} \cdot (T_2 + T_3) \cdot \gamma_{\text{concrete}}]$$

$$V_{\text{ped}} = 1.89 \text{ kN}$$

$$V_{\text{cap}} := V_{\text{slab}} + V_{\text{ped}}$$

$$V_{\text{cap}} = 16.674 \text{ kN}$$

A.2 Soil load

$$\gamma_{\text{soil}} = 19.6 \frac{\text{kN}}{\text{m}^3}$$

Vertical load :

$$V_{\text{soil}} := \left[(P \cdot L - P_{\text{ped}} \cdot L_{\text{ped}}) \cdot T_2 \right] \cdot \gamma_{\text{soil}}$$

$$V_{\text{soil}} = 19.375 \text{ kN}$$

A.3 Slab on grid

$$V_{\text{slabog}} := \left[(P \cdot L - P_{\text{ped}} \cdot L_{\text{ped}}) \cdot T_{\text{sog}} \right] \cdot \gamma_{\text{concrete}}$$

$$V_{\text{slabog}} = 7.908 \text{ kN}$$

A.4 Pile Weight

$$V_{\text{pile}} := L_p \cdot w_{\text{pile}}$$

$$V_{\text{pile}} = 3.321 \text{ kN}$$

$$V_{\text{DL}} := (V_{\text{cap}} + V_{\text{soil}} + V_{\text{slabog}} + V_{\text{pile}})$$

$$V_{\text{DL}} = 47.278 \text{ kN}$$

B. Support Loads

Output Reaction of Structure from SAP 2000 (Not Factored) :

Vertical load : $V_{89} := 77 \cdot \text{kN}$

Horizontal load : $F_{89_{x1}} := 0.06 \text{ kN}$

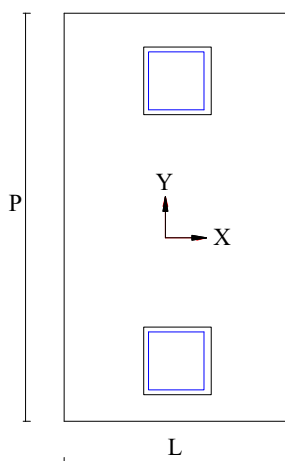
$$F_{89_{y1}} := 41.88 \cdot \text{kN}$$

Moment : $M_{89_{x1}} := -125.62 \text{ kN} \cdot \text{m}$

$$M_{89_{y1}} := 0 \text{ kN} \cdot \text{m}$$

C. Stability of Foundation

1.) Axial Load Capacity



Pile coordinate from centre of cap : $n_{\text{pile}} = 2$

$$x_1 := 0 \cdot \text{m} \quad y_1 := 0.7 \cdot \text{m}$$

$$x_2 := 0 \cdot \text{m} \quad y_2 := -0.7 \cdot \text{m}$$

$$V_t := V_{\text{DL}} + V_{89}$$

$$V_t = 124.278 \text{ kN}$$

$$Q_{all} = 218 \text{ kN}$$

$$Q_{pull} = 44 \text{ kN}$$

Moment :

$$M_{ux} := |F_{89_{y1}}| \cdot T_{total}$$

$$M_{ux} = 43.974 \text{ kN} \cdot \text{m}$$

$$M_{uy} := |F_{89_{x1}}| \cdot T_{total}$$

$$M_{uy} = 0.063 \text{ kN} \cdot \text{m}$$

Pile Reaction :

$$x_{max} := \max(|x_1|, |x_2|)$$

$$x_{max} = 0$$

$$y_{max} := \max(|y_1|, |y_2|)$$

$$y_{max} = 0.7 \text{ m}$$

$$\Sigma x^2 := x_1^2 + x_2^2$$

$$\Sigma x^2 = 0$$

$$\Sigma y^2 := y_1^2 + y_2^2$$

$$\Sigma y^2 = 0.98 \text{ m}^2$$

$$P_{pilemax} := \left(\frac{V_t}{n_{pile}} \right) + \left| \frac{M_{uy} \cdot x_{max}}{\Sigma x^2} \right| + \left| \frac{M_{ux} \cdot y_{max}}{\Sigma y^2} \right|$$

$$P_{pilemax} = 93.549 \text{ kN}$$

$$\text{AxialFoundation} := \begin{cases} \text{"Ok"} & \text{if } Q_{all} > P_{pilemax} \\ \text{"Not OK"} & \text{otherwise} \end{cases}$$

$$\text{AxialFoundation} = \text{"Ok"}$$

$$P_{pilemin} := \left(\frac{V_t}{n_{pile}} \right) - \left| \frac{M_{uy} \cdot x_{max}}{\Sigma x^2} \right| - \left| \frac{M_{ux} \cdot y_{max}}{\Sigma y^2} \right|$$

$$P_{pilemin} = 30.729 \text{ kN}$$

$$\text{AxialFoundation} := \begin{cases} \text{"Ok"} & \text{if } P_{pilemin} > 0 \\ \text{"Not OK"} & \text{otherwise} \end{cases}$$

$$\text{AxialFoundation} = \text{"Ok"}$$

2.) Horizontal Load Capacity

$$\text{Horizontal Load 1 Pile} < 5\% \text{ s/d } 7\% \times Q_{all}$$

$$\phi := 25 \text{ deg}$$

$$F_x := |F_{89_{x1}}|$$

$$F_x = 0.06 \text{ kN}$$

$$F_y := |F_{89_{y1}}|$$

$$F_y = 41.88 \text{ kN}$$

$$F_{\max} := \max(F_x, F_y)$$

$$F_{\max} = 41.88 \text{ kN}$$

$$H_{\text{hor}} := \frac{(F_{\max})}{n_{\text{pile}}}$$

$$H_{\text{hor}} = 20.94 \text{ kN}$$

$$h := Q_{\text{all}} \cdot 0.05 + (V_{\text{cap}} + V_{\text{soil}} + V_{\text{pile}}) \cdot \tan\left(\frac{2}{3}\right) \cdot \phi$$

$$h = 24.417 \text{ kN}$$

$$\text{HorizontalFoundation} := \begin{cases} \text{"Ok"} & \text{if } h > H_{\text{hor}} \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

$$\text{HorizontalFoundation} = \text{"Ok"}$$

4.1.6 Efficiency of Pile Group

$$n' := 2 \quad \text{Number of piles in rows}$$

$$m' := 1 \quad \text{Number of piles in columns}$$

$$\theta := 15.64 \text{ deg}$$

Based the Converse - Labarre equation is :

$$E_g := 1 - \theta \cdot \frac{(n' - 1) \cdot m' + (m' - 1) \cdot n'}{90 \cdot m' \cdot n'}$$

$$E_g = 0.998$$

Group Capacity :

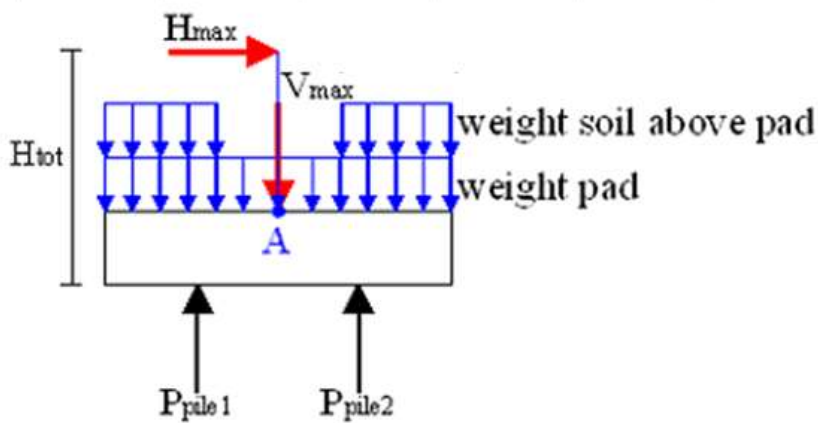
$$Q_g := n_{\text{pile}} \cdot P_n \cdot E_g$$

$$Q_g = 698.938 \text{ kN}$$

4.1.7 Pile Cap Design

A. Pile Cap Reinforcement

Reinforcement for X and Y direction :



$$H_{tot} := T_1 + T_2 + T_3$$

$$H_{tot} = 1.05 \text{ m}$$

Output Reaction of Structure from SAP 2000 (Factored) :

Vertical load : $V_{89} := 77.824 \cdot \text{kN}$

Horizontal load : $F_{89_x} := 0 \text{ kN}$

$$F_{89_y} := 43.07 \cdot \text{kN}$$

Moment : $M_{89_x} := -187.625 \text{ kN} \cdot \text{m}$

$$M_{89_y} := 0 \text{ kN} \cdot \text{m}$$

Loading :

$$V_{max} := V_{89}$$

$$H_{max} := \max(F_{89_x}, F_{89_y})$$

$$V_{max} = 77.824 \text{ kN}$$

$$H_{max} = 43.07 \text{ kN}$$

$$V_{soil} = 19.375 \text{ kN}$$

$$q_{soil} := \frac{V_{soil}}{p}$$

$$q_{pad} := \frac{V_{slab}}{p}$$

$$q_{soil} = 8.807 \frac{\text{kN}}{\text{m}}$$

$$q_{pad} = 6.72 \frac{\text{kN}}{\text{m}}$$

Pile Reaction :

$$V_t := 1.2V_{DL} + V_{max}$$

$$V_t = 134.558 \text{ kN}$$

$$P_{pile1} := \left(\frac{V_t}{n_{pile}} \right) + \left| \frac{M_{uy} \cdot x_1}{\sum x^2} \right| + \left| \frac{M_{ux} \cdot y_1}{\sum y^2} \right|$$

$$P_{pile1} = 98.689 \text{ kN}$$

$$P_{pile2} := \left(\frac{V_t}{n_{pile}} \right) + \left| \frac{M_{uy} \cdot x_2}{\sum x^2} \right| + \left| \frac{M_{ux} \cdot y_2}{\sum y^2} \right|$$

$$P_{pile2} = 98.689 \text{ kN}$$

Moment :

$$M_{Aclockwise} := \left[2 \cdot P_{pile1} \cdot \left(\frac{1.4 \cdot \text{m}}{2} \right) \right] + H_{max} \cdot H_{tot}$$

$$M_{Aclockwise} = 183.388 \text{ kN} \cdot \text{m}$$

$$M_{Aunlockwise} := \left[(q_{pad} \cdot 1.1 \cdot \text{m}) \cdot \left(\frac{1.1 \cdot \text{m}}{2} \right) \right] + \left[(q_{soil} \cdot 0.88 \cdot \text{m}) \cdot \left(\frac{1.4 \cdot \text{m}}{2} + \frac{0.88 \text{m}}{2} \right) \right]$$

$$M_{Aunlockwise} = 12.9 \text{ kN} \cdot \text{m}$$

$$M_A := M_{\text{Aclockwise}} - M_{\text{Aunclockwise}}$$

$$M_A = 170.487 \text{ kN}\cdot\text{m}$$

$$M_u := M_A$$

$$M_u = 170.487 \text{ kN}\cdot\text{m}$$

Foundation actual height (for assumption use D19mm)

$$d := T_1 - 40\text{mm} - 9.5\text{mm}$$

$$d = 0.3 \text{ m}$$

$$L = 0.8 \text{ m}$$

$$M_n := \frac{|M_u|}{0.85}$$

$$M_n = 200.574 \text{ kN}\cdot\text{m}$$

$$R_n := \frac{M_n}{0.8 \cdot L \cdot d^2}$$

$$R_n = 3.471 \times 10^3 \frac{\text{kN}}{\text{m}^2}$$

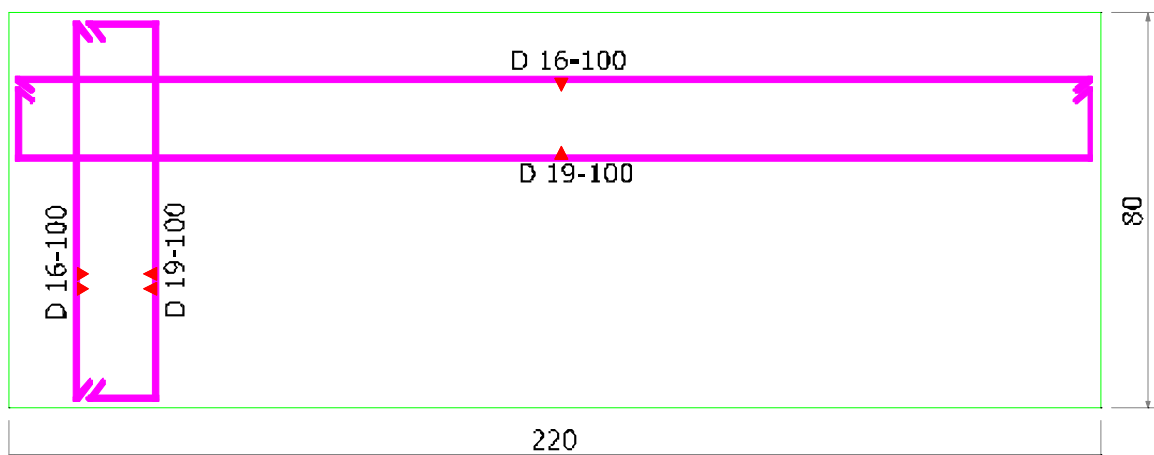
$$\rho := \frac{0.85 \cdot f_c'}{f_y} \cdot \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c'}} \right)$$

$$\rho = 9.553 \times 10^{-3} \quad \rho_{\min} := 0.0018$$

$$\rho_{\text{used}} := \begin{cases} \rho & \text{if } (\rho > \rho_{\min} \wedge \rho < 0.025) \\ \rho_{\min} & \text{if } \rho < \rho_{\min} \end{cases}$$

$$A_{s_{\text{used}}} := \rho_{\text{used}} \cdot 1\text{m} \cdot d$$

$$A_{s_{\text{used}}} = 28.707 \text{ cm}^2 \quad \text{Used As D19-100}$$



4.1.8 Pedestal Design

$$V_{xu} := |F_{89y}| \quad V_{xu} = 43.07 \text{ kN}$$

$$V_u := 1.4 |V_{xu}| \quad V_u = 60.298 \text{ kN}$$

$$F_{Z_u} := 1.4 \cdot V_{89} \quad F_{Z_u} = 108.954 \text{ kN}$$

$$\text{Assumed : } \rho_g := 0.01 \quad \text{Ratio of reinforcement}$$

$$\phi := 0.65 \quad \text{Strength reduction factor}$$

$$A_d := P_{\text{ped}} \cdot L_{\text{ped}}$$

$$A_g = 112500 \text{ mm}^2$$

Load supported by concrete area :

$$P'_u := 0.8 \cdot \phi \cdot [0.85 \cdot f_c' \cdot (A_g - A_g \cdot \rho_g) + (f_y \cdot A_g \cdot \rho_g)] \quad \text{SK SNI T - 15 - 1991 03 (3.3-2)}$$

$$P'_u = 1440.08 \text{ kN}$$

Load supported by Reinforcement :

$$P''_u := F_{Z_u} - P'_u$$

$$P''_u = -1331.13 \text{ kN}$$

Concrete can accounts axial load, was not required again reinforcement but in execution in applies use minimum reinforcement.

$$\text{So use reinforcement : } A_{s_{\text{ped}}} := \rho_g \cdot (P_{\text{ped}} \cdot L_{\text{ped}})$$

$$A_{s_{\text{ped}}} = 11.25 \text{ cm}^2$$

$$\text{dia} := 16 \cdot \text{mm}$$

$$A_{s_{16}} := \frac{1}{4} \cdot \pi \cdot \text{dia}^2$$

$$A_{s_{16}} = 2.011 \text{ cm}^2$$

$$n := \frac{A_{s_{\text{ped}}}}{A_{s_{16}}}$$

$$n = 5.595 \quad \text{Used As 6D16 (As=12.06 cm}^2\text{)}$$

Shear Reinforcement :

Shear Capacity of concrete :

$$V_{xu} = 43.07 \text{ kN}$$

$$\phi := 0.75$$

$$f_{sy} := 240 \frac{\text{N}}{\text{mm}^2}$$

$$d := L_{\text{ped}} - 50 \cdot \text{mm} - 10 \cdot \text{mm} - \frac{13 \cdot \text{mm}}{2}$$

$$d = 183.5 \text{ mm}$$

$$b := L_{\text{ped}}$$

$$b = 0.25 \text{ m}$$

$$v_c := \frac{1}{6} \cdot \sqrt{f_c' \cdot \text{Mpa}} \cdot b \cdot d$$

$$v_c = 37.845 \text{ kN}$$

$$v_n := \frac{V_{xu}}{\phi}$$

$$v_n = 57.427 \text{ kN}$$

$$v_s := v_n - v_c$$

$$v_s = 19.582 \text{ kN}$$

$$v_n < v_c \quad \text{Used minimum shear reinforcement D10-150}$$

4.1.9 Checking for Punching Shear

$$V_u := P_{\text{pilemax}}$$

$$V_u = 93.549 \text{ kN}$$

$$d := T_1 - 0.06 \text{ m} - 0.008 \text{ m}$$

$$d = 0.282 \text{ m}$$

$$B_1 := 2[(P_{\text{ped}} + d) + (L_{\text{ped}} + d)]$$

$$B_1 = 2.528 \text{ m}$$

$$\beta_c := 1 \quad \alpha_s := 40 \quad \phi_s := 0.75$$

$$V_{c1} := \frac{1}{6} \cdot \left(1 + \frac{2}{\beta_c} \right) \cdot \sqrt{f_c'} \cdot \text{Mpa} \cdot B_1 \cdot d$$

$$V_{c1} = 1.764 \times 10^3 \text{ kN}$$

$$V_{c2} := \left(\frac{\alpha_s \cdot d}{12 \cdot B_1} + \frac{1}{6} \right) \cdot \sqrt{f_c'} \cdot \text{Mpa} \cdot B_1 \cdot d$$

$$V_{c2} = 1.9 \times 10^3 \text{ kN}$$

$$V_{c3} := \frac{1}{3} \cdot \sqrt{f_c'} \cdot \text{Mpa} \cdot B_1 \cdot d$$

$$V_{c3} = 1.176 \times 10^3 \text{ kN}$$

$$V_c := \min(V_{c1}, V_{c2}, V_{c3})$$

$$V_c = 1.176 \times 10^3 \text{ kN}$$

$$\phi V_n := \phi \cdot V_c$$

$$\phi V_n = 882.164 \text{ kN}$$

$$\text{PunchingShear} := \begin{cases} \text{"Ok"} & \text{if } \phi V_n > V_u \\ \text{"Not Ok"} & \text{otherwise} \end{cases}$$

$$\text{PunchingShear} = \text{"Ok"}$$

Dimensional of Pile : 200mm x 200mm

