

MEMBER NAME : Z-T1

1. General Information

- (1) Design Code : NSR-10
(2) Code Unit : N, mm

2. Material

- (1) F'_c : 28.00MPa
(2) F_y : 420MPa

3. Section

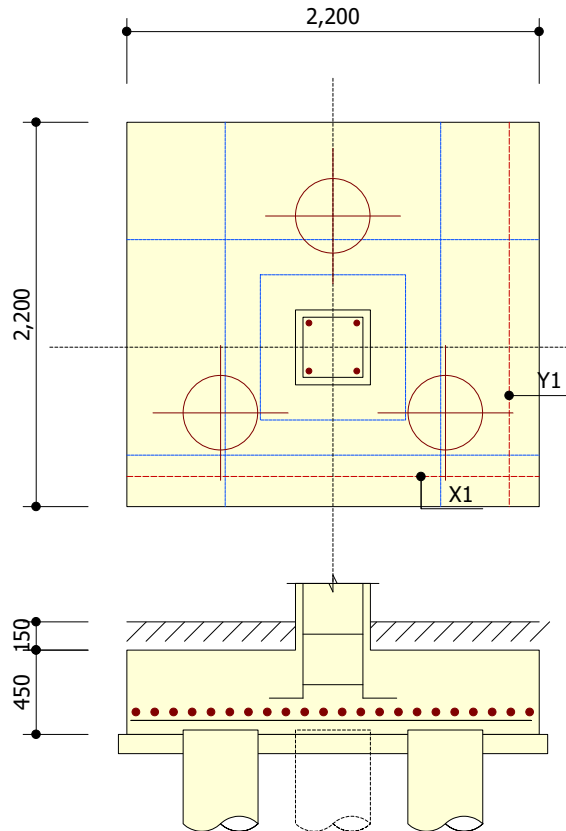
- (1) Section Size
 • Depth : 450mm
 • Cover : 75.00mm
 (2) Column Section
 • Shape of Column : Rectangle
 • Section : 400x400mm

4. Rebar

- (1) Direction Y
 • Layer 1 : #4@100 ($A_s = 1,290\text{mm}^2$)
 (2) Direction X
 • Layer 1 : #4@100 ($A_s = 1,290\text{mm}^2$)

5. Foundation

- (1) Foundation Size
 • L_x : 2.200m
 • L_y : 2.200m
 • No. of pile : 3- $\phi 400$
 • Space of pile : 1,200mm
 • $q_{a,comp.}$: 132kN/EA
 • $q_{a,tens.}$: 0.000kN/EA



6. Design Load

- (1) Service Load
 • P_s : 176kN
 • M_{sx} : 30.99kN·m
 • M_{sy} : 50.31kN·m
 (2) Factored Load (by Load Combinations)

No.	CHK	Name	P_u (kN)	M_{ux} (kN·m)	M_{uy} (kN·m)	Description
-	-	23	198	-46.58	-76.49	
1	Yes	1	233	-32.17	-33.44	
2	Yes	2	245	-42.27	-34.72	
3	Yes	3	214	-32.17	-30.50	
4	Yes	4	215	-31.97	-25.50	
5	Yes	5	213	-32.46	-35.50	
6	Yes	6	216	-40.01	-31.48	
7	Yes	7	213	-24.32	-29.62	
8	Yes	8	216	-37.85	-27.46	
9	Yes	9	212	-26.48	-33.54	
10	Yes	10	246	-42.17	-32.17	
11	Yes	11	245	-42.36	-37.17	
12	Yes	12	246	-46.19	-35.21	
13	Yes	13	244	-38.34	-34.23	

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14	Yes	14	246	-45.11	-33.15	
15	Yes	15	244	-39.42	-36.19	
16	Yes	16	151	-20.50	-16.48	
17	Yes	17	149	-20.99	-26.48	
18	Yes	18	152	-28.54	-22.36	
19	Yes	19	148	-12.85	-20.50	
20	Yes	20	219	-42.36	12.65	
21	Yes	21	192	-16.48	-71.39	
22	Yes	22	213	-12.26	17.65	
23	Yes	23	198	-46.58	-76.49	
24	Yes	24	219	-79.04	-24.52	
25	Yes	25	193	20.20	-34.32	
26	Yes	26	212	-80.32	-51.19	
27	Yes	27	199	21.48	-7.551	
28	Yes	28	163	-33.64	20.50	
29	Yes	29	137	-7.747	-63.45	
30	Yes	30	157	-3.530	25.60	
31	Yes	31	143	-37.85	-68.55	
32	Yes	32	163	-70.31	-16.57	
33	Yes	33	137	28.93	-26.38	
34	Yes	34	157	-71.59	-43.35	
35	Yes	35	143	30.20	0.392	

(3) Surcharge Load

- Surface Load : 0.000KPa
- Weight Density : 18.00kN/m³
- Soil Height : 0.150m

(4) Self weight is considered.

7. Calculation Summary

(1) Overturning Moment (Service Load)

Category	Value	Criteria	Ratio	Note
Direction X (kN·m)	50.31	64.08	0.785	M _{sy} / M _{rx}
Direction Y (kN·m)	30.99	59.71	0.519	M _{sx} / M _{ry}

(2) Overturning Moment (Factored Load)

Category	Value	Criteria	Ratio	Note
Direction X (kN·m)	-76.49	76.89	0.995	M _{uy} / M _{rx}
Direction Y (kN·m)	-46.58	71.65	0.650	M _{ux} / M _{ry}

(3) Pile Bearing (Compression)

Category	Value	Criteria	Ratio	Note
Compression (kN)	104	132	0.787	
Tension (kN)	0.000	0.000	0.000	
Pile Punching (kN)	170	774	0.220	

(4) One Way Shear

Category	Value	Criteria	Ratio	Note
Direction X (kN)	102	510	0.200	ø = 0.750
Direction Y (kN)	36.72	528	0.0695	ø = 0.750

(5) Two Way Shear

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Category	Value	Criteria	Ratio	Note
Two Way Shear (kN)	246	1,484	0.166	$\phi = 0.750$

(6) Moment Capacity

Category	Value	Criteria	Ratio	Note
Direction Y, M_{ux} (kN·m)	14.55	168	0.0866	$\phi = 0.900$
Direction X, M_{uy} (kN·m)	33.25	174	0.191	$\phi = 0.900$

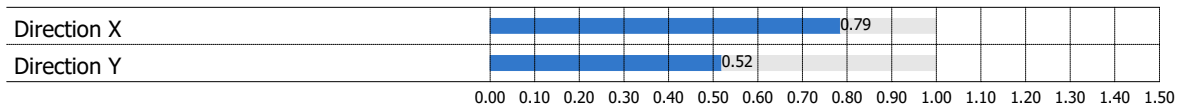
(7) Rebar Space

Category	Value	Criteria	Ratio	Note
Direction Y, M_{ux} (mm)	100	159	0.628	$A_{s,req} = 810\text{mm}^2$
Direction X, M_{uy} (mm)	100	159	0.628	

8. Check overturning moment (Service Load)

Calculation Summary (Overturning Moment (Service Load))

Category	Value	Criteria	Ratio	Note
Direction X (kN·m)	50.31	64.08	0.785	M_{sy} / M_{rx}
Direction Y (kN·m)	30.99	59.71	0.519	M_{sx} / M_{ry}



(1) Calculate resistance Moment

Items	Weight (kN)	Factor	L_x (m)	L_y (m)	R_x (kN·m)	R_y (kN·m)
Self Weight of Concrete	46.07	1.000	1.100	1.025	50.68	47.23
Self Weight of Soil	12.18	1.000	1.100	1.025	13.39	12.48
Surcharge Load	0.000	1.000	1.100	1.025	-	-
Resistance Moment	-	-	-	-	64.08	59.71

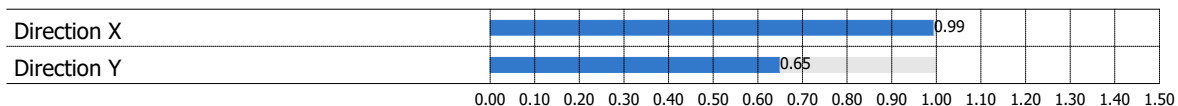
(2) Check overturning moment

Direction X (M_{sy})			Direction Y (M_{sx})		
M_a	M_R	M_a / M_R	M_a	M_R	M_a / M_R
50.31kN·m	64.08kN·m	0.785	30.99kN·m	59.71kN·m	0.519

9. Check overturning moment (Factored Load)

Calculation Summary (Overturning Moment (Factored Load))

Category	Value	Criteria	Ratio	Note
Direction X (kN·m)	-76.49	76.89	0.995	M_{uy} / M_{rx}
Direction Y (kN·m)	-46.58	71.65	0.650	M_{ux} / M_{ry}



(1) Calculate resistance Moment

Items	Weight (kN)	Factor	L_x (m)	L_y (m)	R_x (kN·m)	R_y (kN·m)
Self Weight of Concrete	46.07	1.200	1.100	1.025	60.82	56.67
Self Weight of Soil	12.18	1.200	1.100	1.025	16.07	14.98
Surcharge Load	0.000	1.800	1.100	1.025	-	-
Resistance Moment	-	-	-	-	76.89	71.65

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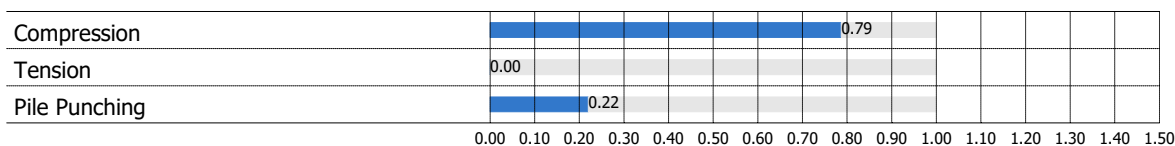
(2) Check overturning moment

Direction X (M_{uy})			Direction Y (M_{ux})		
M_a	M_R	M_a / M_R	M_a	M_R	M_a / M_R
-76.49kN·m	76.89kN·m	0.995	-46.58kN·m	71.65kN·m	0.650

10. Check Pile Capacity

Calculation Summary (Pile Bearing (Compression))

Category	Value	Criteria	Ratio	Note
Compression (kN)	104	132	0.787	
Tension (kN)	0.000	0.000	0.000	
Pile Punching (kN)	170	774	0.220	



Index	X (mm)	Y (mm)	V _u (kN)	∅V _{c,INT} (kN)	∅V _{c,EDG} (kN)	∅V _{c,COR} (kN)	∅V _c (kN)	V _u / ∅V _c
01	0.000	700	40.13	1,166	1,066	1,064	1,064	0.0377
02	-600	-350	170	1,166	1,066	774	774	0.220
03	600	-350	42.93	1,166	1,066	774	774	0.0554

- V_u , V_c : Pile Punching

(1) Calculate actual pile stress (kN)

- $q_{s,max} = 104 \text{ kN/Ea}$
- $q_{s,max} / q_a = 0.787 \rightarrow \text{O.K.}$
- $q_{s,min} = 0.000 \text{ kN/Ea}$
- $q_{s,min} / q_a = 0.000 \rightarrow \text{O.K.}$

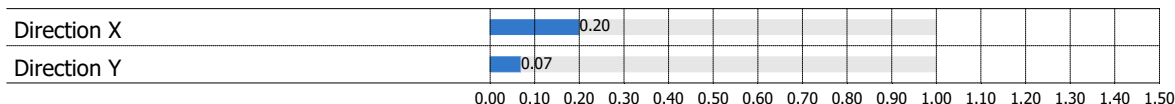
(2) Calculate factored pile stress (kN)

- $q_{u,max} = 170 \text{ kN/EA}$
- $q_{u,min} = 40.13 \text{ kN/EA}$

11. Check Shear

Calculation Summary (One Way Shear)

Category	Value	Criteria	Ratio	Note
Direction X (kN)	102	510	0.200	$\phi = 0.750$
Direction Y (kN)	36.72	528	0.0695	$\phi = 0.750$



(1) Calculate one-way shear (Direction X)

- $V_u = 102\text{kN}$
- $\phi = 0.750$
- $\phi V_c = 510\text{kN}$
- $V_u / \phi V_c = 0.200 \rightarrow \text{O.K.}$

(2) Calculate one-way shear (Direction Y)

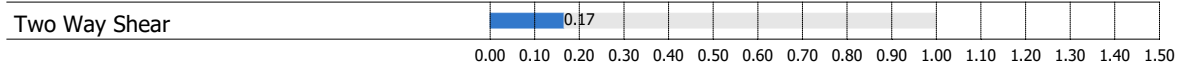
- $V_u = 36.72 \text{ kN}$
- $\phi = 0.750$
- $\phi V_c = 528 \text{ kN}$
- $V_u / \phi V_c = 0.0695 \rightarrow \text{O.K.}$

(3) Calculate two-way shear

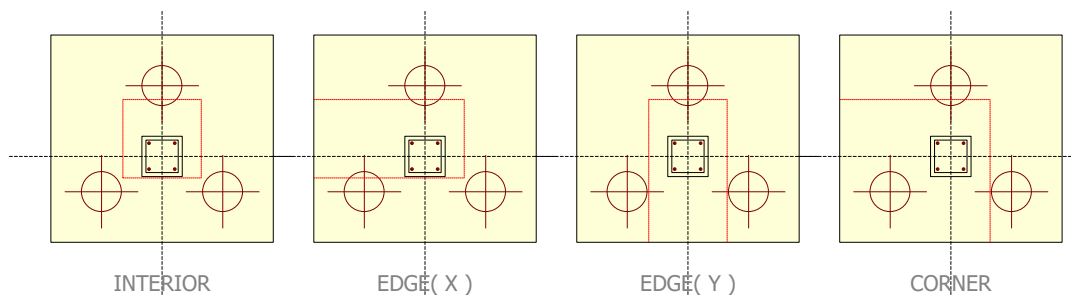
Calculation Summary (Two Way Shear)

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Category	Value	Criteria	Ratio	Note
Two Way Shear (kN)	246	1,484	0.166	$\phi = 0.750$



-	b_0 (mm)	V_{c1} (kN)	V_{c2} (kN)	V_{c3} (kN)	V_c (kN)	V_u (kN)	ϕV_c (kN)	Ratio
Interior	3,075	3,059	3,383	1,979	1,979	246	1,484	0.166
Edge(X)	3,737	3,718	3,001	2,406	2,406	220	1,804	0.122
Edge(Y)	3,587	3,569	2,952	2,309	2,309	246	1,732	0.142
Corner	2,894	2,879	2,131	1,863	1,863	203	1,397	0.146

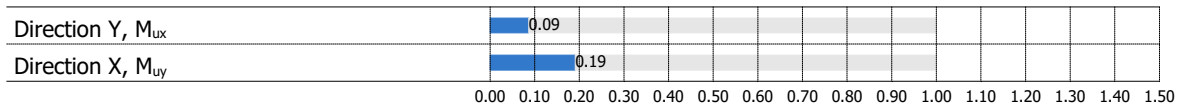


- $\phi = 0.750$
- $d = 369\text{mm}$
- $V_{c1} = 0.17 \left(1 + \frac{2}{\beta} \right) \sqrt{f'_c} b_0 d$
- $V_{c2} = 0.083 \left(\frac{a_s d}{b_0} + 2 \right) \sqrt{f'_c} b_0 d$
- $V_{c3} = 0.33 \sqrt{f'_c} b_0 d$
- $V_c = \min(V_{c1}, V_{c2}, V_{c3})$
- $V_u = 246\text{kN}$
- $V_u / \phi V_c = 0.166 \rightarrow \text{O.K}$

12. Check Moment Capacity

Calculation Summary (Moment Capacity)

Category	Value	Criteria	Ratio	Note
Direction Y, M_{ux} (kN·m)	14.55	168	0.0866	$\phi = 0.900$
Direction X, M_{uy} (kN·m)	33.25	174	0.191	$\phi = 0.900$



(1) Calculate moment capacity (Direction X)

- $\phi = 0.900$
- $M_{uy} = 33.25\text{kN}\cdot\text{m}$ $\phi M_{ny} = 174\text{kN}\cdot\text{m}$
- $M_{uy} / \phi M_{ny} = 0.191 \rightarrow \text{O.K}$

(2) Calculate moment capacity (Direction Y)

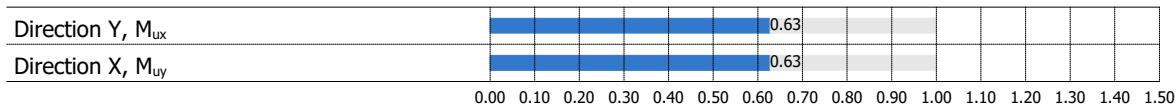
- $\phi = 0.900$
- $M_{ux} = 14.55\text{kN}\cdot\text{m}$ $\phi M_{nx} = 168\text{kN}\cdot\text{m}$
- $M_{ux} / \phi M_{nx} = 0.0866 \rightarrow \text{O.K}$

13. Check Rebar

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Calculation Summary (Rebar Space)

Category	Value	Criteria	Ratio	Note
Direction Y, M_{ux} (mm)	100	159	0.628	$A_{s,req} = 810\text{mm}^2$
Direction X, M_{uy} (mm)	100	159	0.628	



(1) Calculate minimum rebar area required

- $A_{s,min} = 0.00180D = 810\text{mm}^2$

(2) Calculate minimum rebar space required (Direction Y)

- $A_s = 129\text{mm}^2$ (#4@100)
- $s_{req.} = 159\text{mm}$
- $s_x = 100\text{mm} < s_{req.} = 159\text{mm} \rightarrow \text{O.K}$

(3) Calculate minimum rebar space required (Direction X)

- $A_s = 129\text{mm}^2$ (#4@100)
- $s_{req.} = 159\text{mm}$
- $s_y = 100\text{mm} < s_{req.} = 159\text{mm} \rightarrow \text{O.K}$