MEMBER NAME : Z-T1

1. General Information

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

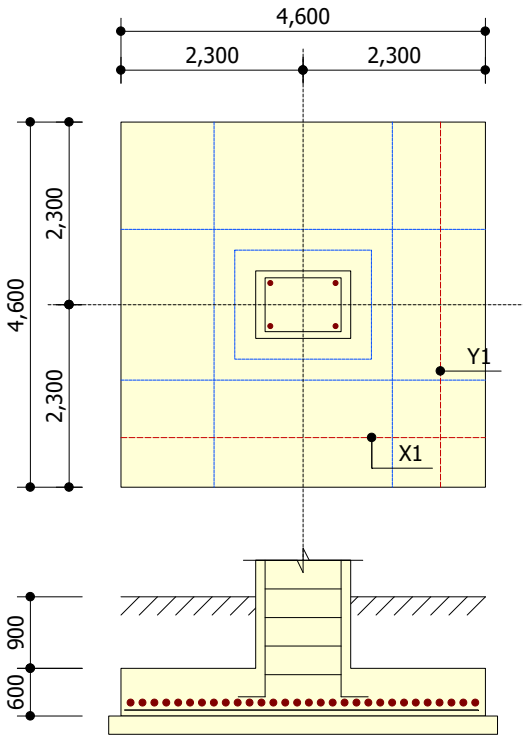
2. Material

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

3. Section

(1) Section Size
- Depth : 600mm
- Cover : 75.00mm

(2) Column Section
- Shape of Column : Rectangle
- Section : 1,200x850mm



4. Rebar

(1) Direction Y
- Layer 1 : #5@150 (A_s = 1,333mm²)

(2) Direction X
- Layer 1 : #5@150 (A_s = 1,333mm²)

5. Foundation

(1) Foundation Size
- L_x : 4.600m
- L_y : 4.600m
- f_e : 149kN/m²

6. Design Load

(1) Service Load (by Load Combinations)

No.	CHK	Name	P_s (kN)	M_{sx} (kN·m)	M_{sy} (kN·m)	Description
-	-	LCB13	192	-567	-130	
1	Yes	LCB38	199	0.000	-105	
2	Yes	LCB2	312	0.000	-169	
3	Yes	LCB3	207	0.000	-128	
4	Yes	LCB4	199	2.532	-105	
5	Yes	LCB5	191	0.000	-82.61	
6	Yes	LCB6	199	-2.532	-105	
7	Yes	LCB7	222	170	-22.84	
8	Yes	LCB8	222	-170	-22.84	
9	Yes	LCB9	206	567	-80.55	
10	Yes	LCB10	192	567	-130	
11	Yes	LCB11	176	-170	-188	
12	Yes	LCB12	176	170	-188	
13	Yes	LCB13	192	-567	-130	
14	Yes	LCB14	206	-567	-80.55	
15	Yes	LCB15	290	0.000	-170	
16	Yes	LCB16	284	1.899	-153	
17	Yes	LCB17	278	0.000	-136	
18	Yes	LCB18	284	-1.899	-153	
19	Yes	LCB19	301	128	-90.90	

20	Yes	LCB20	301	-128	-90.90	
21	Yes	LCB21	289	426	-134	
22	Yes	LCB22	279	426	-171	
23	Yes	LCB23	266	-128	-215	
24	Yes	LCB24	266	128	-215	
25	Yes	LCB25	279	-426	-171	
26	Yes	LCB26	289	-426	-134	
27	Yes	LCB27	127	0.000	-85.85	
28	Yes	LCB28	119	2.532	-63.17	
29	Yes	LCB29	111	0.000	-40.49	
30	Yes	LCB30	119	-2.532	-63.17	
31	Yes	LCB31	143	170	19.27	
32	Yes	LCB32	143	-170	19.27	
33	Yes	LCB33	126	567	-38.44	
34	Yes	LCB34	112	567	-87.90	
35	Yes	LCB35	96.06	-170	-146	
36	Yes	LCB36	96.06	170	-146	
37	Yes	LCB37	112	-567	-87.90	
38	Yes	LCB38	126	-567	-38.44	

(2) Factored Load (by Load Combinations)

No.	CHK	Name	P_u (kN)	M_{ux} (kN·m)	M_{uy} (kN·m)	Description
-	-	LCB14	362	-811	-154	
1	Yes	LCB1	278	0.000	-147	
2	Yes	LCB2	420	0.000	-228	
3	Yes	LCB3	365	0.000	-227	
4	Yes	LCB4	352	4.221	-190	
5	Yes	LCB5	338	0.000	-152	
6	Yes	LCB6	352	-4.221	-190	
7	Yes	LCB7	385	243	-71.83	
8	Yes	LCB8	385	-243	-71.83	
9	Yes	LCB9	362	811	-154	
10	Yes	LCB10	342	811	-225	
11	Yes	LCB11	319	-243	-307	
12	Yes	LCB12	319	243	-307	
13	Yes	LCB13	342	-811	-225	
14	Yes	LCB14	362	-811	-154	
15	Yes	LCB15	193	0.000	-133	
16	Yes	LCB16	179	4.221	-94.76	
17	Yes	LCB17	165	0.000	-56.96	
18	Yes	LCB18	179	-4.221	-94.76	
19	Yes	LCB19	212	243	23.02	
20	Yes	LCB20	212	-243	23.02	
21	Yes	LCB21	189	811	-59.42	
22	Yes	LCB22	169	811	-130	
23	Yes	LCB23	146	-243	-213	
24	Yes	LCB24	146	243	-213	
25	Yes	LCB25	169	-811	-130	

26	Yes	LCB26	189	-811	-59.42	

(3) Surcharge Load

- Surface Load : 0.000KPa
- Weight Density : 18.00kN/m³
- Soil Height : 0.900m

(4) Self weight is considered.

7. Calculation Summary

(1) Overturning Moment (Service Load)

Category	Value	Criteria	Ratio	Note
Direction X (kN·m)	-130	1,451	0.0896	M_{sy} / M_{rx}
Direction Y (kN·m)	-567	1,451	0.391	M_{sx} / M_{ry}

(2) Overturning Moment (Factored Load)

Category	Value	Criteria	Ratio	Note
Direction X (kN·m)	-154	1,742	0.0886	M_{uy} / M_{rx}
Direction Y (kN·m)	-811	1,742	0.465	M_{ux} / M_{ry}

(3) Bearing Capacity

Category	Value	Criteria	Ratio	Note
Compression (kN/m²)	82.05	149	0.550	

(4) One Way Shear

Category	Value	Criteria	Ratio	Note
Direction X (kN)	31.09	1,605	0.0194	ø = 0.750
Direction Y (kN)	233	1,555	0.150	ø = 0.750

(5) Two Way Shear

Category	Value	Criteria	Ratio	Note
Two Way Shear (kN)	1,018	4,177	0.244	ø = 0.750

(6) Moment Capacity

Category	Value	Criteria	Ratio	Note
Direction Y, M_{ux} (kN·m)	94.15	247	0.382	ø = 0.900
Direction X, M_{uy} (kN·m)	35.10	255	0.138	ø = 0.900

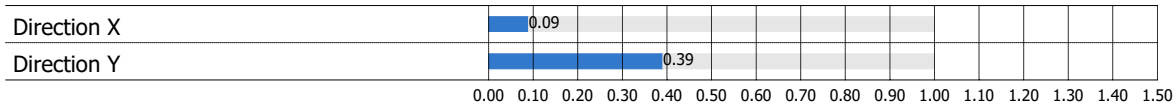
(7) Rebar Space

Category	Value	Criteria	Ratio	Note
Direction Y, M_{ux} (mm)	150	185	0.810	$A_{s.req}$ = 1,080mm²
Direction X, M_{uy} (mm)	150	185	0.810	

8. Check overturning moment (Service Load)

Calculation Summary (Overturning Moment (Service Load))

Category	Value	Criteria	Ratio	Note
Direction X (kN·m)	-130	1,451	0.0896	M_{sy} / M_{rx}
Direction Y (kN·m)	-567	1,451	0.391	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	288	1.000	2.300	2.300	663	663
Self Weight of Soil	343	1.000	2.300	2.300	788	788
Surcharge Load	0.000	1.000	2.300	2.300	-	-
Resistance Moment	-	-	-	-	1,451	1,451

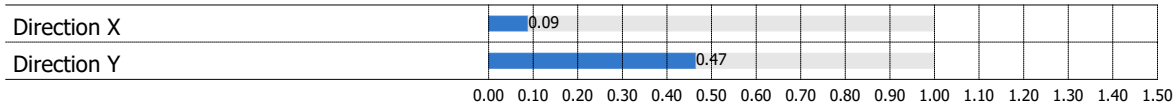
(2) Check overturning moment

Direction X (M_{sy})			Direction Y (M_{sx})		
M_a	M_R	M_a / M_R	M_a	M_R	M_a / M_R
-130kN·m	1,451kN·m	0.0896	-567kN·m	1,451kN·m	0.391

9. Check overturning moment (Factored Load)

Calculation Summary (Overturning Moment (Factored Load))

Category	Value	Criteria	Ratio	Note
Direction X (kN·m)	-154	1,742	0.0886	M_{uy} / M_{rx}
Direction Y (kN·m)	-811	1,742	0.465	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	288	1.200	2.300	2.300	796	796
Self Weight of Soil	343	1.200	2.300	2.300	946	946
Surcharge Load	0.000	1.600	2.300	2.300	-	-
Resistance Moment	-	-	-	-	1,742	1,742

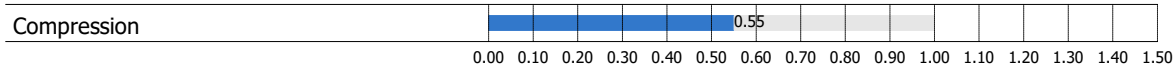
(2) Check overturning moment

Direction X (M_{uy})			Direction Y (M_{ux})		
M_a	M_R	M_a / M_R	M_a	M_R	M_a / M_R
-154kN·m	1,742kN·m	0.0886	-811kN·m	1,742kN·m	0.465

10. Check Soil Capacity

Calculation Summary (Bearing Capacity)

Category	Value	Criteria	Ratio	Note
Compression (kN/m²)	82.05	149	0.550	



(1) Calculate actual soil stress

- $q_{s,top\text{-}left}$ = 11.80kN/m² $q_{s,top\text{-}right}$ = 0.000kN/m²
- $q_{s,bot\text{-}left}$ = 82.05kN/m² $q_{s,bot\text{-}right}$ = 65.92kN/m²
- $q_{s,max}$ = 82.05kN/m²
- **$q_{s,max}$ / f_e = 0.550 → O.K**

(2) Calculate factored soil stress

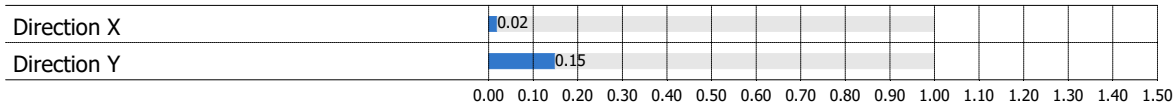
- $q_{u,top\text{-}left}$ = 18.85kN/m² $q_{u,top\text{-}right}$ = 0.000kN/m²
- $q_{u,bot\text{-}left}$ = 119kN/m² $q_{u,bot\text{-}right}$ = 99.90kN/m²
- $q_{u,max}$ = 119kN/m² $q_{u,min}$ = 0.000kN/m²

11. Check Shear

Calculation Summary (One Way Shear)

MEMBER NAME : F01-01

Category	Value	Criteria	Ratio	Note
Direction X (kN)	31.09	1,605	0.0194	ø = 0.750
Direction Y (kN)	233	1,555	0.150	ø = 0.750



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

- V_u = 31.09kN
- ø = 0.750
- øV_c = 1,605kN
- **V_u / øV_c = 0.0194 → O.K**

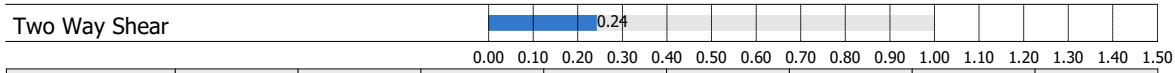
(2) Calculate one-way shear (Direction Y)

- V_u = 233kN
- ø = 0.750
- øV_c = 1,555kN
- **V_u / øV_c = 0.150 → O.K**

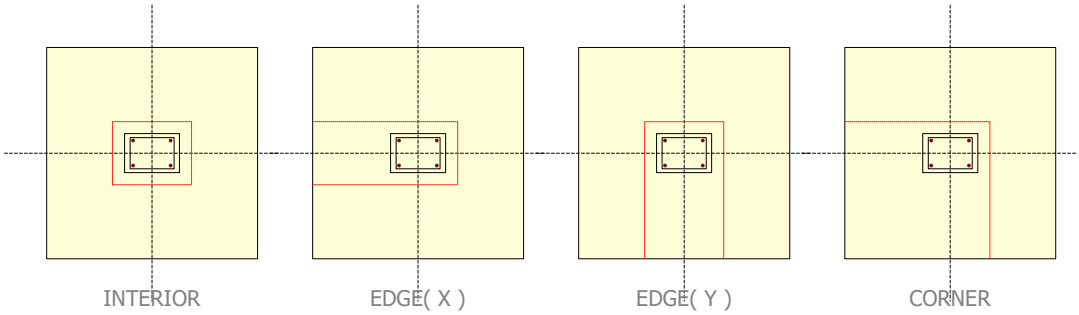
(3) Calculate two-way shear

Calculation Summary (Two Way Shear)

Category	Value	Criteria	Ratio	Note
Two Way Shear (kN)	1,018	4,177	0.244	ø = 0.750



-	b_0 (mm)	V_{c1} (kN)	V_{c2} (kN)	V_{c3} (kN)	V_c (kN)	V_u (kN)	øV_c (kN)	Ratio
Interior	6,168	6,933	7,498	5,569	5,569	1,018	4,177	0.244
Edge(X)	7,684	8,637	7,013	6,938	6,938	901	5,203	0.173
Edge(Y)	7,684	8,637	7,013	6,938	6,938	853	5,203	0.164
Corner	6,142	6,904	5,138	5,546	5,138	598	3,854	0.155

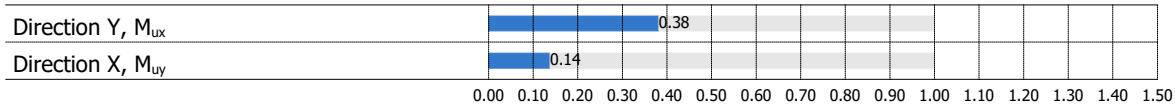


- ø = 0.750
- d = 517mm
- $V_{c1} = 0.17 \left(1 + \frac{2}{\beta} \right) \sqrt{f'_c}\ b_0\ d$
- $V_{c2} = 0.083 \left(\frac{a_s\ d}{b_0} + 2 \right) \sqrt{f'_c}\ b_0\ d$
- $V_{c3} = 0.33 \sqrt{f'_c}\ b_0\ d$
- $V_c = \min(V_{c1}, V_{c2}, V_{c3})$
- V_u = 1,018kN
- **V_u / øV_c = 0.244 → O.K**

12. Check Moment Capacity

Calculation Summary (Moment Capacity)

Category	Value	Criteria	Ratio	Note
Direction Y, M_{ux} (kN·m)	94.15	247	0.382	ø = 0.900
Direction X, M_{uy} (kN·m)	35.10	255	0.138	ø = 0.900



(1) Calculate moment capacity (Direction X)

- ø = 0.900
- M_{uy} = 35.10kN·m øM$_{ny}$ = 255kN·m
- **M_{uy} / øM$_{ny}$ = 0.138 → O.K**

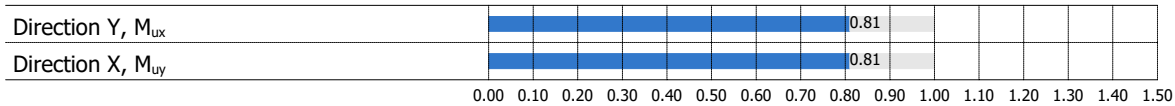
(2) Calculate moment capacity (Direction Y)

- ø = 0.900
- M_{ux} = 94.15kN·m øM$_{nx}$ = 247kN·m
- **M_{ux} / øM$_{nx}$ = 0.382 → O.K**

13. Check Rebar

Calculation Summary (Rebar Space)

Category	Value	Criteria	Ratio	Note
Direction Y, M_{ux} (mm)	150	185	0.810	$A_{s.req}$ = 1,080mm²
Direction X, M_{uy} (mm)	150	185	0.810	



(1) Calculate minimum rebar area required

- $A_{s,min}$ = 0.00180D = 1,080mm²

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

- A_s = 200mm² (#5@150)
- $s_{req.}$ = 185mm
- **s_x = 150mm < $s_{req.}$ = 185mm → O.K**

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

- A_s = 200mm² (#5@150)
- $s_{req.}$ = 185mm
- **s_y = 150mm < $s_{req.}$ = 185mm → O.K**