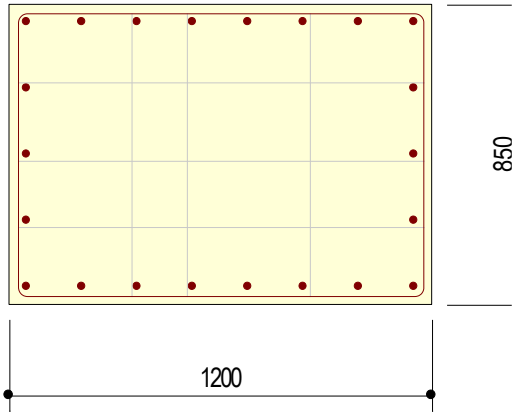
■ MEMBER NAME : C01

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) F_{ys} : 420MPa



3. Section

(1) Section Size : 1,200 x 850mm
(2) L_x : 4.000m
(3) L_y : 4.000m
(4) K_x : 1.000
(5) K_y : 1.000
(6) Splicing Limit : 50%
(7) Frame Type : Braced Frame

4. Load Combinations

General			Forces					Factors		
No	CHK	Name	P_u (kN)	M_{ux} (kN·m)	M_{uy} (kN·m)	V_{ux} (kN)	V_{uy} (kN)	C_{mx}	C_{my}	β_d
-	PM	LCB22	169	811	-130	59.19	235	0.600	0.600	0.600
-	Vx	LCB2	420	0.000	-228	150	0.000	0.600	0.600	0.600
-	Vy	LCB22	169	811	-130	59.19	235	0.600	0.600	0.600
1	Yes	LCB1	278	0.000	-147	99.03	0.000	0.600	0.600	0.600
2	Yes	LCB2	420	0.000	-228	150	0.000	0.600	0.600	0.600
3	Yes	LCB3	365	0.000	-227	122	0.000	0.600	0.600	0.600
4	Yes	LCB4	352	4.221	-190	126	-1.182	0.600	0.600	0.600
5	Yes	LCB5	338	0.000	-152	129	0.000	0.600	0.600	0.600
6	Yes	LCB6	352	-4.221	-190	126	1.182	0.600	0.600	0.600
7	Yes	LCB7	385	243	-71.83	141	70.43	0.600	0.600	0.600
8	Yes	LCB8	385	-243	-71.83	141	-70.43	0.600	0.600	0.600
9	Yes	LCB9	362	811	-154	130	235	0.600	0.600	0.600
10	Yes	LCB10	342	811	-225	121	235	0.600	0.600	0.600
11	Yes	LCB11	319	-243	-307	111	-70.43	0.600	0.600	0.600
12	Yes	LCB12	319	243	-307	111	70.43	0.600	0.600	0.600
13	Yes	LCB13	342	-811	-225	121	-235	0.600	0.600	0.600
14	Yes	LCB14	362	-811	-154	130	-235	0.600	0.600	0.600

15	Yes	LCB15	193	0.000	-133	60.37	0.000	0.600	0.600	0.600
16	Yes	LCB16	179	4.221	-94.76	63.66	-1.182	0.600	0.600	0.600
17	Yes	LCB17	165	0.000	-56.96	66.95	0.000	0.600	0.600	0.600
18	Yes	LCB18	179	-4.221	-94.76	63.66	1.182	0.600	0.600	0.600
19	Yes	LCB19	212	243	23.02	78.55	70.43	0.600	0.600	0.600
20	Yes	LCB20	212	-243	23.02	78.55	-70.43	0.600	0.600	0.600
21	Yes	LCB21	189	811	-59.42	68.13	235	0.600	0.600	0.600
22	Yes	LCB22	169	811	-130	59.19	235	0.600	0.600	0.600
23	Yes	LCB23	146	-243	-213	48.77	-70.43	0.600	0.600	0.600
24	Yes	LCB24	146	243	-213	48.77	70.43	0.600	0.600	0.600
25	Yes	LCB25	169	-811	-130	59.19	-235	0.600	0.600	0.600
26	Yes	LCB26	189	-811	-59.42	68.13	-235	0.600	0.600	0.600
27	Yes	LCB27	199	0.000	-105	70.73	0.000	0.600	0.600	0.600
28	Yes	LCB28	312	0.000	-169	112	0.000	0.600	0.600	0.600
29	Yes	LCB29	207	0.000	-128	68.76	0.000	0.600	0.600	0.600
30	Yes	LCB30	199	2.532	-105	70.73	-0.709	0.600	0.600	0.600
31	Yes	LCB31	191	0.000	-82.61	72.71	0.000	0.600	0.600	0.600
32	Yes	LCB32	199	-2.532	-105	70.73	0.709	0.600	0.600	0.600
33	Yes	LCB33	222	170	-22.84	81.16	49.30	0.600	0.600	0.600
34	Yes	LCB34	222	-170	-22.84	81.16	-49.30	0.600	0.600	0.600
35	Yes	LCB35	206	567	-80.55	73.86	164	0.600	0.600	0.600
36	Yes	LCB36	192	567	-130	67.61	164	0.600	0.600	0.600
37	Yes	LCB37	176	-170	-188	60.31	-49.30	0.600	0.600	0.600
38	Yes	LCB38	176	170	-188	60.31	49.30	0.600	0.600	0.600
39	Yes	LCB39	192	-567	-130	67.61	-164	0.600	0.600	0.600
40	Yes	LCB40	206	-567	-80.55	73.86	-164	0.600	0.600	0.600
41	Yes	LCB41	290	0.000	-170	99.93	0.000	0.600	0.600	0.600
42	Yes	LCB42	284	1.899	-153	101	-0.532	0.600	0.600	0.600
43	Yes	LCB43	278	0.000	-136	103	0.000	0.600	0.600	0.600
44	Yes	LCB44	284	-1.899	-153	101	0.532	0.600	0.600	0.600
45	Yes	LCB45	301	128	-90.90	109	36.97	0.600	0.600	0.600
46	Yes	LCB46	301	-128	-90.90	109	-36.97	0.600	0.600	0.600
47	Yes	LCB47	289	426	-134	104	123	0.600	0.600	0.600
48	Yes	LCB48	279	426	-171	99.07	123	0.600	0.600	0.600
49	Yes	LCB49	266	-128	-215	93.59	-36.97	0.600	0.600	0.600
50	Yes	LCB50	266	128	-215	93.59	36.97	0.600	0.600	0.600
51	Yes	LCB51	279	-426	-171	99.07	-123	0.600	0.600	0.600
52	Yes	LCB52	289	-426	-134	104	-123	0.600	0.600	0.600
53	Yes	LCB53	127	0.000	-85.85	40.47	0.000	0.600	0.600	0.600
54	Yes	LCB54	119	2.532	-63.17	42.44	-0.709	0.600	0.600	0.600
55	Yes	LCB55	111	0.000	-40.49	44.41	0.000	0.600	0.600	0.600
56	Yes	LCB56	119	-2.532	-63.17	42.44	0.709	0.600	0.600	0.600
57	Yes	LCB57	143	170	19.27	52.87	49.30	0.600	0.600	0.600
58	Yes	LCB58	143	-170	19.27	52.87	-49.30	0.600	0.600	0.600
59	Yes	LCB59	126	567	-38.44	45.57	164	0.600	0.600	0.600
60	Yes	LCB60	112	567	-87.90	39.31	164	0.600	0.600	0.600
61	Yes	LCB61	96.06	-170	-146	32.02	-49.30	0.600	0.600	0.600
62	Yes	LCB62	96.06	170	-146	32.02	49.30	0.600	0.600	0.600
63	Yes	LCB63	112	-567	-87.90	39.31	-164	0.600	0.600	0.600
64	Yes	LCB64	126	-567	-38.44	45.57	-164	0.600	0.600	0.600

5. Rebar

(1) Main Bar

- Layer-1 : 22 - 5 - #8 (C_c = 50.00mm, A_s = 11,213mm²)
- Layer-2 : -
- Layer-3 : -
- $A_{s.total}$: 11,213mm²

(2) Hoop Bar

- End : #4@100
- Middle : #4@100

(3) Tie Bar

- Apply Tie Bar to Shear Check : Yes
- Tie Bar : #3 (F_y = 420MPa)

6. Option

(1) Special provisions for seismic design is applied.
(2) Frame Type : DMO(Moderate Energy Dissipation)

7. Calculation Summary

(1) Check Design Parameter

Category	Value	Criteria	Ratio	Note
Rebar Ratio (Min.)	0.0110	0.0100	0.910	ρ_{min} / ρ
Rebar Ratio (Max.)	0.0110	0.0400	0.275	ρ / ρ_{max}

(2) Check Moment Capacity (Neutral axis)

Category	Value	Criteria	Ratio	Note
Moment Capacity (Dir. X) (kN·m)	811	1,737	0.467	M_{ux} / øM_{nx}
Moment Capacity (Dir. Y) (kN·m)	-130	282	0.461	M_{uy} / øM_{ny}
Axial Capacity (kN)	169	360	0.469	P_u / øP_n
Moment Capacity (kN·m)	821	1,759	0.467	M_u / øM_n

(3) Check shear capacity

Category	Value	Criteria	Ratio	Note
Maximum Shear Strength (Dir. X) (kN)	150	3,228	0.0466	V_{ux} / ø$V_{nx.max}$
Shear Strength (Dir. X) (kN)	150	2,373	0.0633	V_{ux} / øV_{nx}
Spacing Limits for Reinforcement (Dir. X) (mm)	100	150	0.667	s_x / $s_{x.max}$
Maximum Shear Strength (Dir. Y) (kN)	235	3,170	0.0741	V_{uy} / ø$V_{ny.max}$
Shear Strength (Dir. Y) (kN)	235	1,842	0.127	V_{uy} / øV_{ny}
Spacing Limits for Reinforcement (Dir. Y) (mm)	100	150	0.667	s_y / $s_{y.max}$

(4) Check Dimension by Special Provision for Seismic Design

Category	Value	Criteria	Ratio	Note
Section Dimension Limit (mm)	850	250	0.294	$Dim_{min.limit}$ / Dim_{min}
Section Dimension Ratio	-	-	-	-

(5) Check Rebar Limit by Special Provision for Seismic Design

Category	Value	Criteria	Ratio	Note
Amount of Transverse Rebar (Dir. X) (mm²)	471	315	0.669	$A_{shx.min}$ / A_{shx}
Amount of Transverse Rebar (Dir. Y) (mm²)	471	455	0.967	$A_{shy.min}$ / A_{shy}

8. Check slenderness ratio

(1) Calculate radii of gyration

- r_x = 0.3D = 255mm
- r_y = 0.3B = 360mm

(2) Calculate slenderness ratio

- $\frac{M_{1x}}{M_{2x}}$ = 0.000
- $\frac{M_{1y}}{M_{2y}}$ = 0.000
- $\frac{k_x l_{ux}}{r_x}$ = 15.69 < min(34 - 12 $\frac{M_{1x}}{M_{2x}}$, 40.0) = 34.00 → Not Slender
- $\frac{k_y l_{uy}}{r_y}$ = 11.11 < min(34 - 12 $\frac{M_{1y}}{M_{2y}}$, 40.0) = 34.00 → Not Slender

9. Check Magnified Moment

(1) Calculate moment magnification factor

- $\delta_{ns.x}$ = 1.000
- $\delta_{ns.y}$ = 1.000

10. Check Minimum Moment

(1) Calculate minimum eccentricity

- $e_{min.x}$ = 15 + 0.03D = 40.50mm
- $e_{min.y}$ = 15 + 0.03B = 51.00mm

(2) Calculate minimum moment

- $M_{min.x} = P_u\ e_{min.x}$ = 6.845kN·m
- $M_{min.y} = P_u\ e_{min.y}$ = 8.620kN·m

11. Check design moment

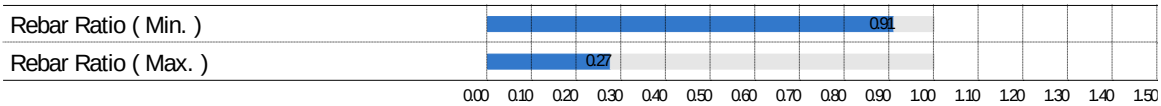
(1) Calculate design moment

- $M_{c.x} = M_{ux}$ = 811kN·m
- $M_{c.y} = M_{uy}$ = -130kN·m
- M_c = 821kN·m

12. Check Design Parameter

Calculation Summary (Check Design Parameter)

Category	Value	Criteria	Ratio	Note
Rebar Ratio (Min.)	0.0110	0.0100	0.910	ρ_{min} / ρ
Rebar Ratio (Max.)	0.0110	0.0400	0.275	ρ / ρ_{max}



(1) Calculate rebar ratio

- A_g = 1,020,000mm², A_{st} = 11,213mm²
- ρ_{min} = 0.0100, ρ_{max} = 0.0400, ρ = 0.0110
- $\rho_{min} < \rho < \rho_{max}$ → O.K

(2) Calculate eccentricity

- $e_x = M_{c.y} / P_u$ = 770mm
- $e_y = M_{c.x} / P_u$ = 4,796mm
- $e = M_c / P_u$ = 4,858mm
- Rotation angle of neutral axis = 3.134°

(3) Calculate concentric axial load capacity

- $P_0 = 0.85f'_c\ (A_g - A_{st}) + f_y A_{st}$ = 28,719kN
- $P_{0.max} = 0.75P_0$ = 21,539kN
- $P_t = f_y A_{st}$ = -4,709kN

13. Check Moment Capacity (Balanced axis)

(1) Calculate capacity of compression stress block

- β_1 = 0.850
- c = 507mm, $a = \beta_1 \cdot c$ = 431mm
- A_{com} = 478,357mm²
- c_{cx} = 16.48mm, c_{cy} = 225mm
- $C_c = 0.85 \cdot f'_c \cdot A_{com}$ = 11,385kN
- $M_{nx} = C_c \cdot c_{cy}$ = 2,564kN·m
- $M_{ny} = C_c \cdot c_{cx}$ = 188kN·m

(2) Calculate capacity of rebar

i	d_s (mm)	ε_s	f_s (MPa)	A_s (mm²)	F_s (kN)	d_y (mm)	M_{nx} (kN)	d_x (mm)	M_{ny} (kN)
1	862	-0.002100	-420	510	-214	-375	80.27	-550	118
2	674	-0.000992	-198	510	-101	-188	18.96	-550	55.61
3	487	0.000116	23.24	510	11.84	0.000	0.000	-550	-6.515
4	300	0.001224	245	510	125	188	23.40	-550	-68.64
5	113	0.002332	420	510	214	375	80.27	-550	-118
6	104	0.002383	420	510	214	375	80.27	-393	-84.10
7	95.61	0.002434	420	510	214	375	80.27	-236	-50.46
8	87.02	0.002485	420	510	214	375	80.27	-78.57	-16.82
9	78.43	0.002536	420	510	214	375	80.27	78.57	16.82
10	69.84	0.002587	420	510	214	375	80.27	236	50.46
11	61.25	0.002637	420	510	214	375	80.27	393	84.10
12	52.66	0.002688	420	510	214	375	80.27	550	118
13	240	0.001580	316	510	161	188	30.20	550	88.59
14	427	0.000472	94.43	510	48.13	0.000	0.000	550	26.47
15	614	-0.000636	-127	510	-64.83	-188	12.16	550	-35.66
16	802	-0.001744	-349	510	-178	-375	66.67	550	-97.78
17	810	-0.001795	-359	510	-183	-375	68.61	393	-71.88
18	819	-0.001846	-369	510	-188	-375	70.56	236	-44.35
19	827	-0.001897	-379	510	-193	-375	72.50	78.57	-15.19
20	836	-0.001947	-389	510	-199	-375	74.44	-78.57	15.60
21	844	-0.001998	-400	510	-204	-375	76.39	-236	48.01
22	853	-0.002049	-410	510	-209	-375	78.33	-393	82.06

- $\sum F_s$ = 325kN
- $\sum M_{nx}$ = 1,315kN·m
- $\sum M_{ny}$ = 94.07kN·m

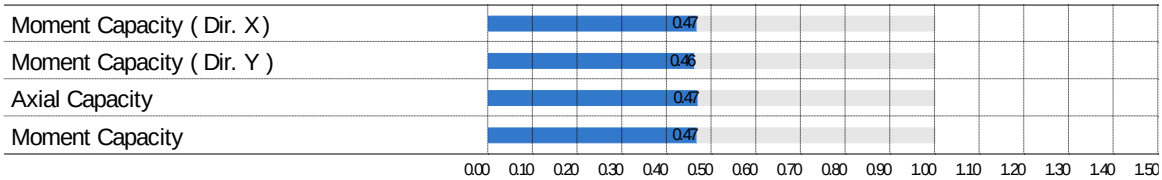
(3) Calculate nominal capacity for neutral axis

- $P_b = C_c + P_s$ = 11,710kN
- $M_{nx} = M_{nx.conc} + M_{nx.bar}$ = 3,879kN·m
- $M_{ny} = M_{ny.conc} + M_{ny.bar}$ = 282kN·m
- $M_n = \sqrt{(M_{nx})^2 + (M_{ny})^2}$ = 3,889kN·m

14. Check Moment Capacity (Neutral axis)

Calculation Summary (Check Moment Capacity (Neutral axis))

Category	Value	Criteria	Ratio	Note
Moment Capacity (Dir. X) (kN·m)	811	1,737	0.467	M_{ux} / øM_{nx}
Moment Capacity (Dir. Y) (kN·m)	-130	282	0.461	M_{uy} / øM_{ny}
Axial Capacity (kN)	169	360	0.469	P_u / øP_n
Moment Capacity (kN·m)	821	1,759	0.467	M_u / øM_n



(1) Calculate capacity of compression stress block

- c = 138mm, $a = \beta_1$ · c = 117mm
- A_{com} = 101,565mm²
- c_{cx} = 77.63mm, c_{cy} = 381mm
- C_c = 0.85 · f_{ck} · A_{com} = 2,417kN
- $M_{nx} = C_c$ · c_{cy} = 920kN·m
- $M_{ny} = C_c$ · c_{cx} = 188kN·m

(2) Calculate capacity of rebar

i	d_s (mm)	ε_s	f_s (MPa)	A_s (mm^2)	F_s (kN)	d_y (mm)	M_{nx} (kN)	d_x (mm)	M_{ny} (kN)
1	862	-0.015730	-420	510	-214	-375	80.27	-550	118
2	674	-0.011661	-420	510	-214	-188	40.14	-550	118
3	487	-0.007591	-420	510	-214	0.000	0.000	-550	118
4	300	-0.003521	-420	510	-214	188	-40.14	-550	118
5	113	0.000548	110	510	55.88	375	20.96	-550	-30.73
6	104	0.000735	147	510	74.92	375	28.09	-393	-29.43
7	95.61	0.000922	184	510	93.95	375	35.23	-236	-22.15
8	87.02	0.001108	222	510	113	375	42.37	-78.57	-8.877
9	78.43	0.001295	259	510	132	375	49.51	78.57	10.37
10	69.84	0.001482	296	510	151	375	56.65	236	35.61
11	61.25	0.001669	334	510	170	375	63.78	393	66.82
12	52.66	0.001855	371	510	189	375	70.92	550	104
13	240	-0.002214	-420	510	-214	188	-40.14	550	-118
14	427	-0.006284	-420	510	-214	0.000	0.000	550	-118
15	614	-0.010353	-420	510	-214	-188	40.14	550	-118
16	802	-0.014423	-420	510	-214	-375	80.27	550	-118
17	810	-0.014610	-420	510	-214	-375	80.27	393	-84.10
18	819	-0.014796	-420	510	-214	-375	80.27	236	-50.46
19	827	-0.014983	-420	510	-214	-375	80.27	78.57	-16.82
20	836	-0.015170	-420	510	-214	-375	80.27	-78.57	16.82
21	844	-0.015357	-420	510	-214	-375	80.27	-236	50.46
22	853	-0.015543	-420	510	-214	-375	80.27	-393	84.10

- $\sum F_s$ = -2,017kN
- $\sum M_{nx}$ = 1,010kN·m
- $\sum M_{ny}$ = 126kN·m

(3) Calculate nominal capacity for neutral axis

- $P_n = C_c + P_s$ = 400kN
- $M_{nx} = M_{nx.conc} + M_{nx.bar}$ = 1,930kN·m
- $M_{ny} = M_{ny.conc} + M_{ny.bar}$ = 313kN·m
- $M_n = \sqrt{(M_{nx})^2 + (M_{ny})^2}$ = 1,955kN·m

(4) Calculate strength reduction factor

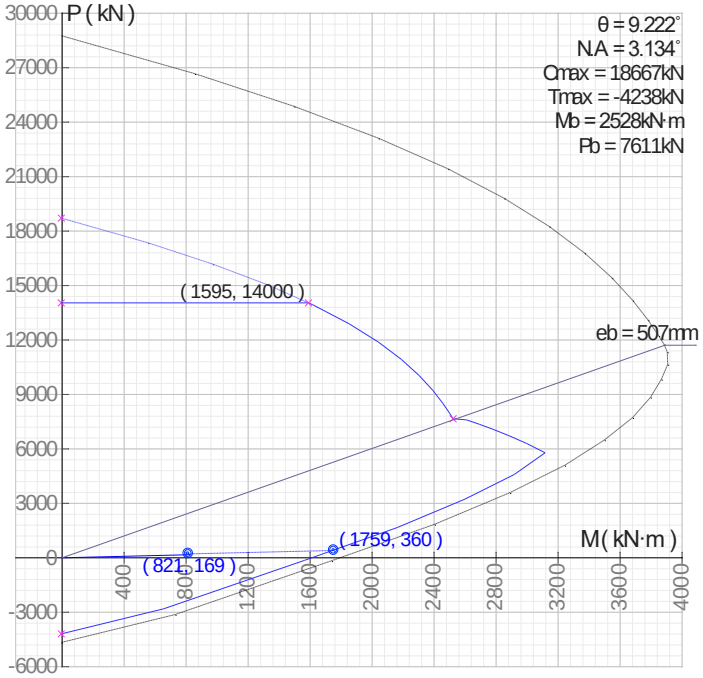
- $\varepsilon_{t.min}$ = 0.0021, $\varepsilon_{t.max}$ = 0.0050
- ε_t = 0.005493
- ø = 0.900

(5) Calculate axial load and moment capacities

- $øP_n$ = 360kN
- $øM_{nx}$ = 1,737kN·m
- $øM_{ny}$ = 282kN·m
- $øM_n$ = 1,759kN·m
- $M_{ux} / øM_{nx}$ = 0.467 < 1.000 → O.K
- $M_{uy} / øM_{ny}$ = 0.461 < 1.000 → O.K
- $P_u / øP_n$ = 0.469 < 1.000 → O.K
- $M_c / øM_n$ = 0.467 < 1.000 → O.K

15. Interaction Curve

(1) PM Interaction Curve



16. Calculate Shear Force by Special Provisions for Seismic Design (Direction Y).

(1) Calculate bending strength for design shear force.

- ø = 1.000
- $M_{nx.I.CW}$ = 0.000kN·m
- $M_{nx.J.CW}$ = 1,940kN·m
- $M_{nx.I.CCW}$ = 0.000kN·m
- $M_{nx.J.CCW}$ = 1,940kN·m

(2) Calculate design shear force by special provision for seismic design

- V_{ey1} = ($M_{nx.I.CW}$ + $M_{nx.J.CW}$) /L_{ny} = 485kN
- V_{ey2} = ($M_{nx.I.CCW}$ + $M_{nx.J.CCW}$) /L_{ny} = 485kN
- V_{ey} = max(V_{ey1} , V_{ey2}) = 485kN

17. Calculate Shear Force by Special Provisions for Seismic Design (Direction X).

(1) Calculate bending strength for design shear force.

- ø = 1.000
- $M_{ny.I.CW}$ = 0.000kN·m
- $M_{ny.J.CW}$ = 4,583kN·m
- $M_{ny.I.CCW}$ = 0.000kN·m
- $M_{ny.J.CCW}$ = 4,583kN·m

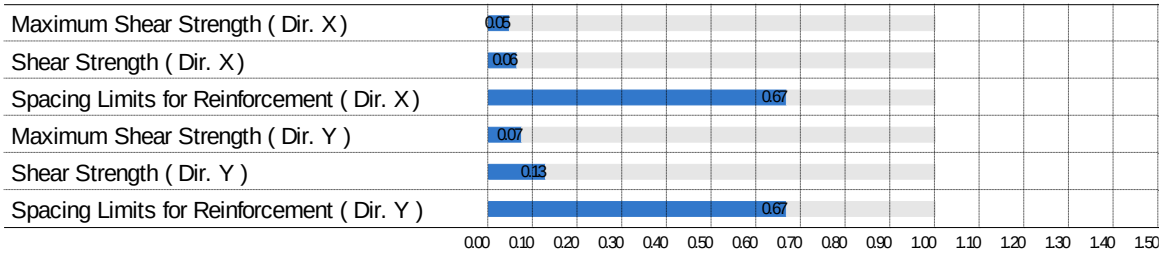
(2) Calculate design shear force by special provision for seismic design

- V_{ex1} = ($M_{ny.I.CW}$ + $M_{ny.J.CW}$) /L_{nx} = 1,146kN
- V_{ex2} = ($M_{ny.I.CCW}$ + $M_{ny.J.CCW}$) /L_{nx} = 1,146kN
- V_{ex} = max(V_{ex1} , V_{ex2}) = 1,146kN

18. Check shear capacity

Calculation Summary (Check shear capacity)

Category	Value	Criteria	Ratio	Note
Maximum Shear Strength (Dir. X) (kN)	150	3,228	0.0466	V_{ux} / $øV_{nx.max}$
Shear Strength (Dir. X) (kN)	150	2,373	0.0633	V_{ux} / $øV_{nx}$
Spacing Limits for Reinforcement (Dir. X) (mm)	100	150	0.667	s_x / $s_{x.max}$
Maximum Shear Strength (Dir. Y) (kN)	235	3,170	0.0741	V_{uy} / $øV_{ny.max}$
Shear Strength (Dir. Y) (kN)	235	1,842	0.127	V_{uy} / $øV_{ny}$
Spacing Limits for Reinforcement (Dir. Y) (mm)	100	150	0.667	s_y / $s_{y.max}$



(1) Calculate maximum space

- ø = 0.750
- s_{max} = min($8D_{MainBar}$, $16D_{Stirrup}$, B/3, D/3, 150) = 150mm

(2) Calculate Shear Strength (Direction X)

- s = 100mm < s_{max} = 150mm → O.K
- $øV_c = ø0.17\left(1+\frac{N_u}{14A_g}\right)\sqrt{f'_c}\ b_w\ d$ = 667kN
- $øV_s = ø\frac{A_v\ f_{yt}\ d}{s}$ = 1,706kN
- $øV_n = øV_c + øV_s$ = 2,373kN
- $øV_{nmax}$ = 3,228kN
- V_u / $øV_{nmax}$ = 0.0466 → O.K
- V_u / $øV_n$ = 0.0633 → O.K

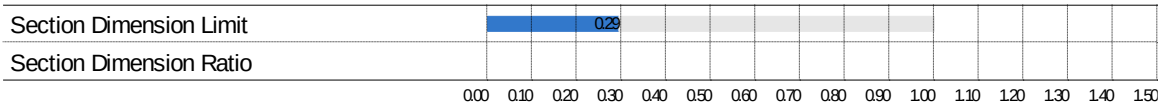
(3) Calculate Shear Strength (Direction Y)

- s = 100mm < s_{max} = 150mm → O.K
- $øV_c = ø0.17\left(1+\frac{N_u}{14A_g}\right)\sqrt{f'_c}\ b_w\ d$ = 655kN
- $øV_s = ø\frac{A_v\ f_{yt}\ d}{s}$ = 1,187kN
- $øV_n = øV_c + øV_s$ = 1,842kN
- $øV_{nmax}$ = 3,170kN
- V_u / $øV_{nmax}$ = 0.0741 → O.K
- V_u / $øV_n$ = 0.127 → O.K

19. Check Dimension by Special Provision for Seismic Design

Calculation Summary (Check Dimension by Special Provision for Seismic Design)

Category	Value	Criteria	Ratio	Note
Section Dimension Limit (mm)	850	250	0.294	$Dim_{min.limit}$ / Dim_{min}
Section Dimension Ratio	-	-	-	-



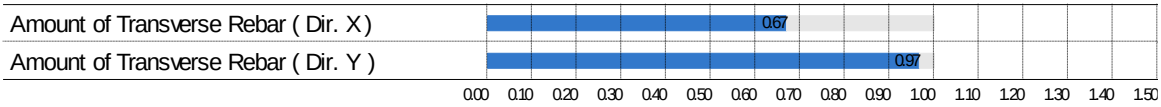
(1) Calculate section dimension limit

- $Dim_{min.limit}$ = 250mm
- Dim_{min} = 850mm
- D_{min} > $D_{min.limit}$ → O.K

20. Check Rebar Limit by Special Provision for Seismic Design

Calculation Summary (Check Rebar Limit by Special Provision for Seismic Design)

Category	Value	Criteria	Ratio	Note
Amount of Transverse Rebar (Dir. X) (mm²)	471	315	0.669	$A_{shx.min}$ / A_{shx}
Amount of Transverse Rebar (Dir. Y) (mm²)	471	455	0.967	$A_{shy.min}$ / A_{shy}



(1) Calculate amount of transverse rebar (Direction X)

- $A_{sh.min1} = 0.2 \frac{sb_c f'_c}{f_{yt}} \left(\frac{A_g}{A_{ch}} - 1 \right) = 112mm^2$
- $A_{sh.min2} = 0.06 \frac{sb_c f'_c}{f_{yt}} = 315mm^2$
- $A_{sh.min} = \max (A_{sh.min1} , A_{sh.min2}) = 315mm^2$
- $A_{shx} = 471mm^2 > A_{shx.min} = 315mm^2 \rightarrow$ O.K

(2) Calculate amount of transverse rebar (Direction Y)

- $A_{sh.min1} = 0.2 \frac{sb_c f'_c}{f_{yt}} \left(\frac{A_g}{A_{ch}} - 1 \right) = 162mm^2$
- $A_{sh.min2} = 0.06 \frac{sb_c f'_c}{f_{yt}} = 455mm^2$
- $A_{sh.min} = \max (A_{sh.min1} , A_{sh.min2}) = 455mm^2$
- $A_{shy} = 471mm^2 > A_{shy.min} = 455mm^2 \rightarrow$ O.K