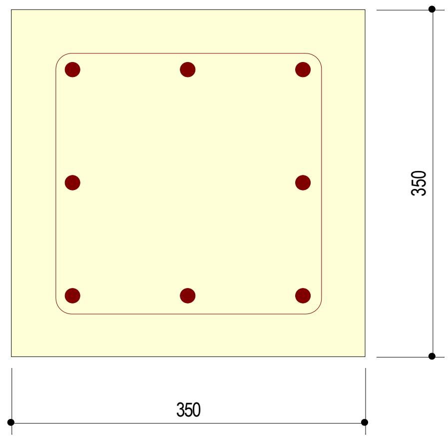
■ PEDESTAL COLUMNA 6” x 6mm

1. General Information

(1) Design Code : ACI318M-14
(2) Unit System : N, mm

2. Material

(1) F'_c : 28.00MPa
(2) F_y : 413MPa
(3) F_{ys} : 413MPa



3. Section

(1) Section Size : 350 x 350mm
(2) L_x : 1.000m
(3) L_y : 1.000m
(4) K_x : 1.000
(5) K_y : 1.000
(6) Splicing Limit : 50%
(7) Frame Type : Braced Frame

4. Forces

(1) P_u : 32.82kN
(2) M_{ux} : 2.500kN·m
(3) M_{uy} : 5.500kN·m
(4) V_{ux} : 3.200kN
(5) V_{uy} : 3.150kN
(6) P_{ux} : 32.82kN
(7) P_{uy} : 32.82kN

5. Factors

(1) C_{mx} : 0.600
(2) C_{my} : 0.600
(3) β_{dns} : 0.600

6. Rebar

(1) Main Bar

- Layer-1 : 8 - 3 - #5 (C_c = 61.00mm, A_s = 1,600mm²)
- $A_{s.total}$: 1,600mm²

(2) Hoop Bar

- End : #3@100
- Middle : #3@100

(3) Tie Bar

- Apply Tie Bar to Shear Check : Yes
- Tie Bar : #3 (F_y = 414MPa)

7. Check Slenderness Ratio

(1) Calculate radii of gyration

- $r_x = 0.3D = 105mm$
- $r_y = 0.3B = 105mm$

(2) Calculate slenderness ratio

- $\frac{M_{1x}}{M_{2x}} = 0.000$
- $\frac{M_{1y}}{M_{2y}} = 0.000$
- $\frac{k_x\ l_{ux}}{r_x} = 9.524 < \min(34 + 12\frac{M_{1x}}{M_{2x}}, 40.0) = 34.00 \rightarrow$ Not Slender
- $\frac{k_y\ l_{uy}}{r_y} = 9.524 < \min(34 + 12\frac{M_{1y}}{M_{2y}}, 40.0) = 34.00 \rightarrow$ Not Slender

8. Check Magnified Moment

(1) Calculate moment magnification factor

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

9. Check Minimum Moment

(1) Calculate minimum eccentricity

- $e_{min.x} = 15 + 0.03D = 25.50mm$
- $e_{min.y} = 15 + 0.03B = 25.50mm$

(2) Calculate minimum moment

- $M_{min.x} = P_u\ e_{min.x} = 0.837kN{\cdot}m$
- $M_{min.y} = P_u\ e_{min.y} = 0.837kN{\cdot}m$

10. Check Design Moment

(1) Calculate design moment

- $M_{c.x} = M_{ux} = 2.500kN{\cdot}m$
- $M_{c.y} = M_{uy} = 5.500kN{\cdot}m$
- $M_c = 6.042kN{\cdot}m$

11. Check Design Parameter

(1) Calculate rebar ratio

- A_g = **¡Error!** = 1,600mm²
- ρ_{min} = 0.0100, ρ_{max} = 0.0800, ρ = 0.0131
- $\rho_{min} < \rho < \rho_{max}$ → O.K

(2) Calculate eccentricity

- $e_x = M_{c.y} / P_u$ = 168mm
- $e_y = M_{c.x} / P_u$ = 76.17mm
- $e = M_c / P_u$ = 184mm
- Rotation angle of neutral axis = 63.51°

(3) Calculate concentric axial load capacity

- $P_0 = 0.85f'_c (A_g - A_{st}) + f_y A_{st}$ = 3,538kN
- $P_{0.max} = 0.80P_0$ = 2,831kN
- $P_t = f_y A_{st}$ = -661kN

12. Check Moment Capacity (Balanced axis)

(1) Calculate capacity of compression stress block

- β_1 = 0.850
- c = 230mm, $a = \beta_1 \cdot c$ = 195mm
- A_{com} = 45,778mm²
- c_{cx} = 99.91mm, c_{cy} = 38.90mm
- $C_c = 0.85 \cdot f'_c \cdot A_{com}$ = 1,090kN
- $M_{nx} = C_c \cdot c_{cy}$ = 42.38kN·m
- $M_{ny} = C_c \cdot c_{cx}$ = 109kN·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	388	-0.002065	-413	200	-82.60	-114	9.416	-114	9.416
2	337	-0.001400	-280	200	-56.02	0.000	0.000	-114	6.386
3	286	-0.000736	-147	200	-29.43	114	-3.355	-114	3.355
4	184	0.000598	120	200	23.90	114	2.725	0.000	0.000
5	81.81	0.001931	386	200	77.24	114	8.805	114	8.805
6	133	0.001266	253	200	50.65	0.000	0.000	114	5.774
7	184	0.000602	120	200	24.07	-114	-2.744	114	2.744
8	286	-0.000732	-146	200	-29.26	-114	3.336	0.000	0.000

- $\sum F_s$ = -21.45kN
- $\sum M_{nx}$ = 18.18kN·m
- $\sum M_{ny}$ = 36.48kN·m

(3) Calculate nominal capacity for neutral axis

- $P_b = C_c + P_s$ = 1,068kN
- $M_{nx} = M_{nx.conc} + M_{nx.bar}$ = 60.57kN·m
- $M_{ny} = M_{ny.conc} + M_{ny.bar}$ = 145kN·m
- $M_n = \sqrt{(M_{nx})^2 + (M_{ny})^2}$ = 157kN·m

13. Check Moment Capacity (Neutral axis)

(1) Calculate capacity of compression stress block

- $c = 207mm$, $a = \beta_1 \cdot c = 176mm$
- $A_{com} = 38{,}413mm^2$
- $c_{cx} = 109mm$, $c_{cy} = 46.36mm$
- $C_c = 0.85 \cdot f_{ck} \cdot A_{com} = 914kN$
- $M_{nx} = C_c \cdot c_{cy} = 42.38kN{\cdot}m$
- $M_{ny} = C_c \cdot c_{cx} = 99.26kN{\cdot}m$

(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	388	-0.002606	-413	200	-82.60	-114	9.416	-114	9.416
2	337	-0.001871	-374	200	-74.82	0.000	0.000	-114	8.530
3	286	-0.001135	-227	200	-45.40	114	-5.175	-114	5.175
4	184	0.000341	68.18	200	13.64	114	1.554	0.000	0.000
5	81.81	0.001817	363	200	72.67	114	8.284	114	8.284
6	133	0.001081	216	200	43.24	0.000	0.000	114	4.930
7	184	0.000346	69.11	200	13.82	-114	-1.576	114	1.576
8	286	-0.001130	-226	200	-45.21	-114	5.154	0.000	0.000

- $\sum F_s = -105kN$
- $\sum M_{nx} = 17.66kN{\cdot}m$
- $\sum M_{ny} = 37.91kN{\cdot}m$

(3) Calculate nominal capacity for neutral axis

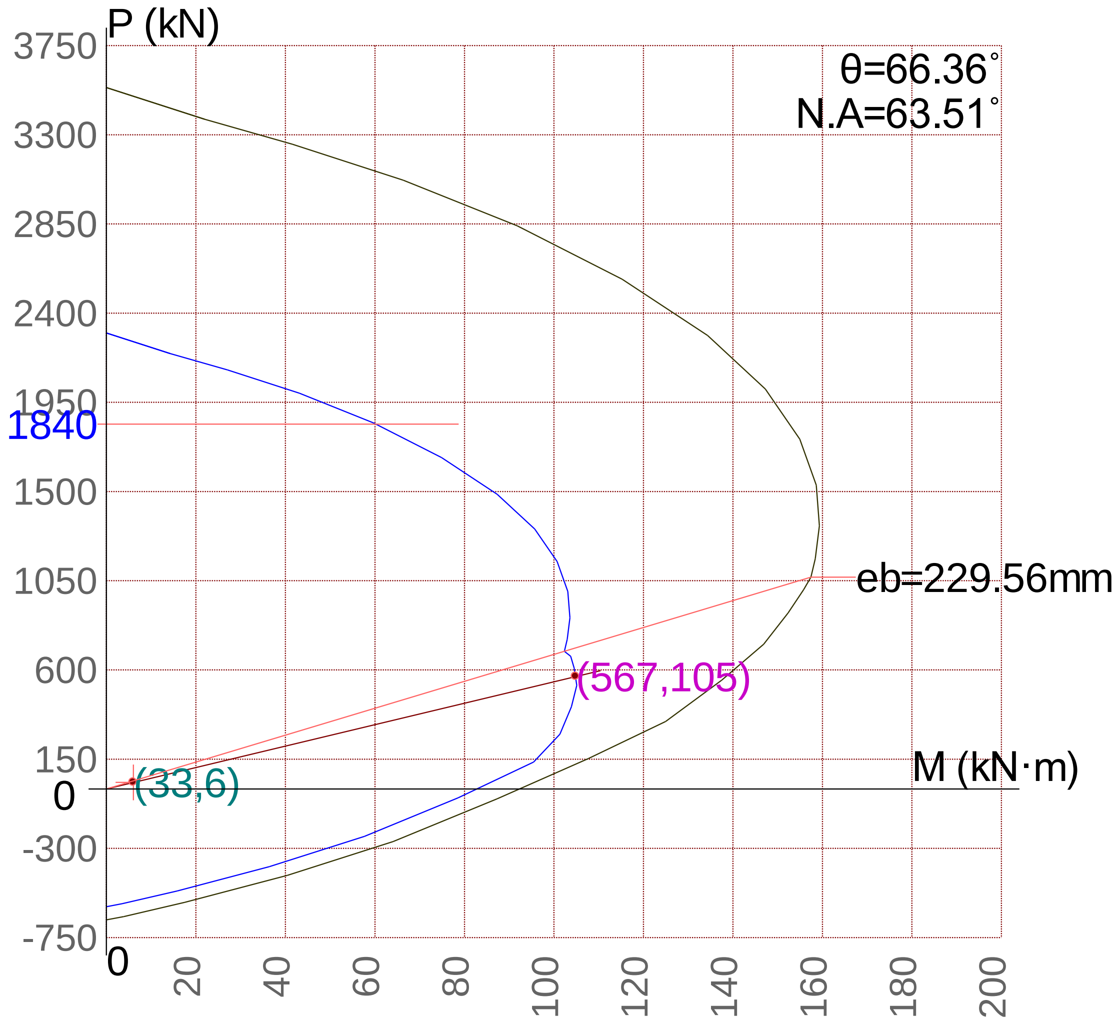
- $P_n = C_c + P_s = 810kN$
- $M_{nx} = M_{nx.conc} + M_{nx.bar} = 60.04kN{\cdot}m$
- $M_{ny} = M_{ny.conc} + M_{ny.bar} = 137kN{\cdot}m$
- $M_n = \sqrt{(M_{nx})^2 + (M_{ny})^2} = 150kN{\cdot}m$

(4) Calculate strength reduction factor

- $\varepsilon_{t.min} = 0.0021$, $\varepsilon_{t.max} = 0.0050$
- $\varepsilon_t = 0.002606$
- $\phi = 0.701$

(5) Calculate axial load and moment capacities

- $\phi P_n = 567kN$
- $\phi M_{nx} = 42.06kN{\cdot}m$
- $\phi M_{ny} = 96.09kN{\cdot}m$
- $\phi M_n = 105kN{\cdot}m$
- $M_{ux} / \phi M_{nx} = 0.0594 < 1.000 \rightarrow$ O.K
- $M_{uy} / \phi M_{ny} = 0.0572 < 1.000 \rightarrow$ O.K
- $P_u / \phi P_n = 0.0579 < 1.000 \rightarrow$ O.K
- $M_c / \phi M_n = 0.0576 < 1.000 \rightarrow$ O.K



P (kN)
3750
3300
2850
2400
1950
1840
1500
1050
600
150
0
-300
-750
θ=66.36°
N.A=63.51°
eb=229.56mm
(567,105)
(33,6)
M (kN·m)
0
20
40
60
80
100
120
140
160
180
200

14. Check Shear Capacity

(1) Calculate maximum space

- $\phi = 0.750$
- S_{max} = min($16D_{MainBar}$, $48D_{Stirrup}$, B, D) = 254mm

(2) Calculate Shear Strength (Direction X)

- $s = 100mm < s_{max} = 254mm$ → O.K
- $\phi V_c = \phi 0.17 \left(1+ \frac{N_u}{14A_g} \right) \sqrt{f'_c}\ b_w\ d = 69.55kN$
- $\phi V_s = \phi \frac{A_v\ f_{yt}\ d}{s} = 127kN$
- $\phi V_n = \phi V_c + \phi V_s = 197kN$
- $V_u / \phi V_n = 0.0163$ → O.K

(3) Calculate Shear Strength (Direction Y)

- $s = 100mm < s_{max} = 254mm$ → O.K
- $\phi V_c = \phi 0.17 \left(1+ \frac{N_u}{14A_g} \right) \sqrt{f'_c}\ b_w\ d = 69.55kN$
- $\phi V_s = \phi \frac{A_v\ f_{yt}\ d}{s} = 127kN$
- $\phi V_n = \phi V_c + \phi V_s = 197kN$
- $V_u / \phi V_n = 0.0160$ → O.K
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