LOUIS J. CORTINA, P.E.

City of Puyallup
Development & Permitting Services
ISSUED PERMIT
Building | Planning
Engineering | Public Works
Fire | Traffic

City of Puyallup
Building
REVIEWED FOR COMPLIANCE
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10/15/2025
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PRSG20251040

Calculations required to be provided by the Permittee on site for all Inspections

STRUCTURAL CALCULATIONS FOR:

McDonald's #43903

Puyallup, WA

CALCULATION PACKET

JOB INFORMATION

Comm. No.:	**250030-067-02**
Project:	**McDonald's #43903**
City:	**Puyallup**
State:	**WA**
Building Code:	**2021 WASBC**
Loads Based On:	**ASCE 7-16**
Designer:	**MRW**
Date:	**9/23/2025**
Doing Business As:	**LJC**

STRUCTURAL

LOUIS J. CORTINA
STATE OF WASHINGTON
39228
REGISTERED
PROFESSIONAL ENGINEER
9/23/25

LOUIS J. CORTINA, PE
LIC. NO. 39228

STRUCTURAL CALCULATIONS FOR:

McDonald's #43903

Puyallup, WA

MONUMENT

WIND DATA

Building Code	2021 IBC	Importance Factor, I	1.0	Damping Ratio, β	0.005
Wind Load Criteria	ASCE 7-16	Directionality Factor, K_d [2]	0.85	Natural Frequency, n_1	2.10 Hz
Wind Speed, V	110 mph	Topography Factor, K_{zt}	1.0	Gust Effect Factor, G	0.85
Exposure Category	C	Base Pressure, $\gamma(q_z/K_z)$	15.8 psf	ASD Wind Load Factor, γ [3]	0.6
Wind Pressure Override per Jurisdiction Requirement	0 psf				

DEFLECTION ANALYSIS

Deflection Limit		H/60
Deflection at 0.7*W		1.05 in
Deflection Ratio	✓	H/115

Notes: *(1) Loading values in chart below are based upon average K_z values for each segment. Actual values are calculated on hidden sheet using derived V-M equations. Chart is provided for information purposes only.*
(2) Wind directionality (K_d) factor is 0.95 for Single Pole (Round) segments instead of 0.85. The C_f value from Fig. 6-21 has been increased by 0.95/0.85 to account for this variation.
(3) Wind pressures listed below have already been multiplied by the ASD Wind Load Factor, γ.

GEOMETRY INPUT [1] ***Monument:*** Yes

No. of Poles: 1 No. of Footings: 1

Section	Location	Type	Height	Width	Horiz. Offset	Area	Top Elev.	Centroid	K_z	C_f	Wind Press.	Support Pole Loads			Footing Loads		
												Trib. Factor	Shear	Moment	Trib. Factor	Shear	Moment
			ft	ft	ft	sq ft	ft	ft			psf		kips	k-ft		kips	k-ft
1	Base	Single Pole w/ Cabinet	0.50	8.00		4.0	0.5	0.3	0.85	1.30	14.8	1.0	0.1	0.0	1.0	0.1	0.0
2		Single Pole w/ Cabinet	9.50	7.50		71.3	10.0	5.7	0.85	1.51	17.3	1.0	1.2	7.0	1.0	1.2	7.0
3		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
4		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
5		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
6		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
7		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
8		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
9		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
10	Top	None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
		Overall Height: 10.00 ft						***Summation based upon averages above:***					**1.3**	**7.1**		**1.3**	**7.1**
								Actual base reactions based upon V-M equations:					**1.3**	**7.1**		**1.3**	**7.1**

SUPPORT POLE DESIGN SUMMARY **MATERIAL =** STEEL

Base Elev	Section	Axis	Required Strength Values (ASD)				Allowable Strength Values (ASD)				Unity Ratios				Interaction Ratios		Status
			V_r	M_r	T_r	P_r	V_c	M_c	T_c	P_c	V_r/V_c	M_r/M_c	T_r/T_c	P_r/P_c	P-M	P-M-V-T	
ft			kips	kip-ft	kip-ft	kips	kips	kip-ft	kip-ft	kips							
0.00	HSS4X4X1/4	Strong	1.3	7.1	1.9	0.9	28.3	10.8	9.0	20.3	4.6%	66.1%	21.5%	4.3%	70.4%	77.2%	✓
2.08	HSS4X4X1/4	Strong	1.0	4.5	1.5	0.7	28.3	10.8	9.0	32.4	3.6%	41.8%	17.1%	2.1%	43.9%	0.0%	✓
0.00	None	Strong	1.3	7.1	1.9	0.9	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.3	7.1	1.9	0.9	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.3	7.1	1.9	0.9	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.3	7.1	1.9	0.9	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.3	7.1	1.9	0.9	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.3	7.1	1.9	0.9	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.3	7.1	1.9	0.9	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.3	7.1	1.9	0.9	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓

ELEMENT DESIGN LOCATIONS, LOADS AND DISPLACEMENTS

Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ	Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ
	ft		kips	kip-ft	kip-ft	kips	radians	in		ft		kips	kip-ft	kip-ft	kips	radians	in
1	0.00	Base Plate	1.3	7.1	1.9	0.9	0.0	0.0	3	0.00	Match Plate 2	1.3	7.1	1.9	0.9	0.000	0.00
2	2.08	Match Plate 1	1.0	4.5	1.5	0.7	0.0	0.1	4	0.00	Torsion Tube	1.3	7.1	1.9	0.9	0.000	0.00

PLATE DESIGN SUMMARY

Type	Plate Dimensions				Bolts								Weld		Status
	N	B	D	t	Number	d_b	N_{edge}	B_{edge}	Circle Diamete	Material	Embed in Caisson / Vertical Slab	Embed in	Size	Gussets	
	in	in	in	in		in	in	in	in		in	in	in		
✓ Rectangular Base Plate	15	15	--	0.75	4	0.75	1.5	1.5	--	F1554 Grade 36	30	N/A	0.188	Yes	OK
Circular Base Plate															
✓ Match Plate 1 (Lower)	14	14	--	0.5	4	0.5	1	1	--	A325	--	--	0.188	No	OK
✓ Match Plate 1 (Upper)	14	14	--	0.5	4	0.5	1	1	--	A325	--	--	0.188	No	OK
Match Plate 2 (Lower)															
Match Plate 2 (Upper)															

FOUNDATION DESIGN SUMMARY

Type	Diameter	Width	Thickness	Length	Depth	Volume	Reinforcing	Status	Allowable Soil Pressure
	ft	ft	ft	ft	ft	CY			
Caisson									
✓ Vertical Slab	--	8.00	2.00	--	4.00	2.37	#5 at 14 in o.c. E.W. E.F.	OK	200 psf/ft
Spread									

FOUNDATION DESIGN

Footing Loads

Axial, P_a	0.9 k
Moment, M_a	7.1 k-ft
Shear, V_a	1.3 k
Base Column to Footing Connection Type	Base Plate

Footing and Soils Data

Concrete Strength, f'_c	2500 psi
Materials Class	5
Sign or Flagpole	Yes
Allowable Vertical Bearing Pressure	1500 psf
Allowable Lateral Bearing Pressure	200 psf/ft

Vertical Slab Footing

Constrained Base	No
Width, b	8.00 ft
Thickness, t	2.00 ft
Selected Bar Size	#5
Top Depth to Ignore for Poor Soil Conditions	0.00 ft
Depth Calculation Status	OK
Effective Height, h (ft)	5.52 ft
S1	0.25
S3	0.75
A	1.45 ft
Assumed Depth (not including ignored top depth)	3.77 ft
Required Depth (not including ignored top depth)	✓ 3.77 ft
Concrete Strength, f'_c	2500 psi
Minimum Thickness for Structural Plain Concrete Use	0.66 ft
Required Reinforcing Type	T&S Only
Minimum Reinforcing Ratio Each Face	0.09%
Minimum Reinforcing, $A_{s\text{-}min}$	0.26 sq in/ft
Required Flexural Reinforcing, A_s	0.00 sq in/ft
Controlling Reinforcing, $A_{s\text{-}req'd}$	0.26 sq in/ft
#4 Bars @ 8 in O.C.	0.30 sq in/ft
#5 Bars @ 14 in O.C.	0.27 sq in/ft
#6 Bars @ 18 in O.C.	0.29 sq in/ft
#7 Bars @ 18 in O.C.	0.40 sq in/ft
#8 Bars @ 18 in O.C.	0.53 sq in/ft

Vertical Slab Footing Design Summary

Footing Width, b	8.00 ft
Footing Thickness, t	2.00 ft
Footing Depth, D	4.00 ft
Estimated Volume	2.4 yd3
Selected Bar Size	#5
Required Spacing	14 in o.c.

IBC Table 1806.2 - Allowable Foundation and Lateral Pressure

Class of Materials		Allowable Bearing Pressures	
		Vertical	Lateral
		psf	*psf/ft*
1	Crystalline bedrock	12000	1200
2	Sedimentary and foliated rock	4000	400
3	Sandy gravel and/or gravel (GW and GP)	3000	200
4	Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2000	150
5	Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1500	100
Geotech	Geotechnical study is applicable	--	--

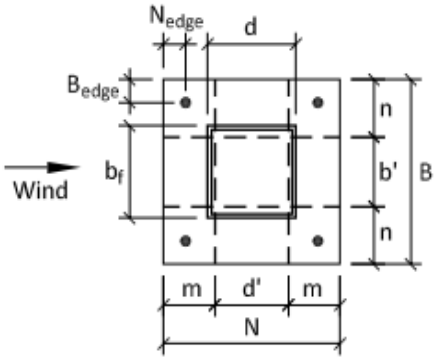
Note: If structure is a sign or flagpole, the lateral bearing pressure value from above has been doubled at left per IBC 1806.3.4 (only for Class of Materials 1-5)

Note: If "Thickness, t" exceeds "Minimum Thickness for Structural Plain Concrete Use" value, ACI 318 does not require any reinforcement in footing since an unreinforced section is sufficient to resist the flexural loads applied to the footing. However, office standard practice is to provide at minimum 0.18% in a vertical slab footing with one-half distributed to each face, normal to the wind direction, of the footing.

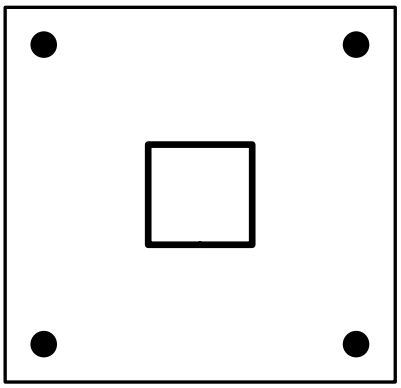
RECTANGULAR BASE PLATE DESIGN

Input Parameters

Column Size	HSS4X4X1/4	
Column Type	HSS_Rect	
Axis	Strong	
Depth or Diameter, d	4.0 in	
Width, b_f	4.0 in	
Plate Length, N	15.0 in	**OK**
Plate Width, B	15.0 in	
Plate Thickness, t	0.75 in	**OK**
Edge Distance, N_{edge}	1.50 in	**OK**
Edge Distance, B_{edge}	1.50 in	**OK**
Bolt Configuration	Flange	
# per Flange Side	2	**OK**
Diameter, d_b	0.75 in	**OK**
Bolt Material	F1554 Grade 36	
Embedment Depth in Caisson / Vert. Slab	30 in	**OK**
Embedment Depth in Spread Footing		**N/A**
Grout Bed	No	
Fillet Weld Size at Column Base	0.19 in	**Use Gussets, Fw = 21.86**
Gussets (If yes, reduce req'd plate thickness by 20%)	Yes	
Second Fillet Weld at Inside of Column	No	
Weld Group Section Modulus With Gussets		



Base Plate Dimensions Diagram



Bolt Configuration Layout

Column Loads

Axial, P_a	0.9 k
Moment, M_a	7.1 k-ft
Shear, V_a	1.3 k

Base Plate Dimensions

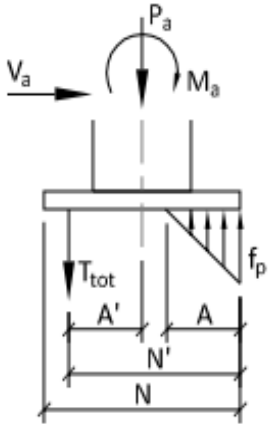
Plate Area, A_1	225.0 sq in
Effective Plate Length, m	5.6 in
Effective Plate Width, n	5.9 in
Effective Column Depth, d'	3.8 in
Effective Column Width, b'	3.2 in
C.G. of Bolt Group from Centerline, A'	6.0 in
C.G. of Bolt Group from Plate Edge, N'	13.5 in

Footing Information

Concrete Strength, f'_c	2500 psi
Caisson Footing Bearing Surface Area	999999.0 sf
Vertical Slab Footing Bearing Surface Area	16.0 sf
Spread Footing Bearing Surface Area	999999.0 sf
Foundation Area, A_2	16.0 sf

Base Plate Forces Per Triangular Pressure Distribution

Eccentricity, e	97.7 in
Kern Eccentricity, e_{kern}	2.5 in
Bearing Safety Factor, $\Omega_{bearing}$	2.5
Bearing Stress at Edge, f_p	1.700 ksi
Bearing Stress at Column, f_{p1}	0.000 ksi
Bearing Resultant, f'	172.1 k
Bearing Length, A	0.5 in
Total Tension on Bolt Group, T_{total}	5.9 k



Force Distribution Diagram

Required Base Plate Thickness

Base Plate Yield Stress, F_y	36.0 ksi
Bearing Moment, $M_{a\text{-}pl\text{-}bearing}$	2.5 k-in/in
Tension Moment, $M_{a\text{-}pl\text{-}tension}$	1.5 k-in/in
Controlling Moment, $M_{a\text{-}pl\text{-}max}$	2.5 k-in/in
Required Plate Thickness, $t_{pl\text{-}reqd}$	0.68 in

Column Base Weld to Base Plate

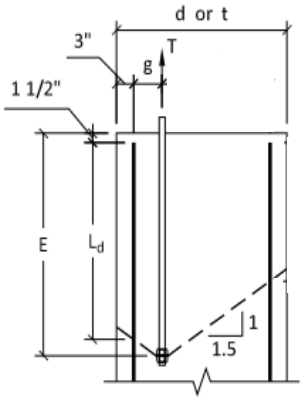
Fillet Weld Size	0.1875	
Column Type	HSS_Rect	
Depth or Diameter, d	4.0 in	
Width, b	4.0 in	
Allowable Weld Stress, F_w/Ω	14.8 ksi	
Section Modulus of Weld w/out Gussets	21.33 in2	
Weld Stress Without Gussets, f_w	21.9 ksi	**NG**
Custom Section Modulus With Gussets	0.00 in2	
Weld Stress With Gussets, $f_{w\text{-}gussets}$	0.0 ksi	**OK**

Anchor Bolt Design

# of Bolts in Tension	2	
# of Bolts in Shear	4	
Distance Between Plate and Footing	1.5 in	
Tension, T_a	3.0 k	
Shear, V_a	0.3 k	
Moment, M_a	0.5 k-in	
Area, A_b	0.44 sq in	
Section Modulus, S_b	0.04 in3	
Yield Stress, F_y	36.0 ksi	
Ultimate Stress, F_u	58.0 ksi	
Nominal Shear Stress, F_{nv}	23.2 ksi	
Nominal Tensile Stress, F_{nt}	43.5 ksi	
Nominal Effective Tensile Stress, F'_{nt}	43.5 ksi	
Shear / Tension Safety Factor, $\Omega_{v/t}$	2	
Allowable Shear Stress, F_v	11.6 ksi	
Allowable Tensile Stress, F_t	21.8 ksi	
Nominal Bending Sress, F_{nb}	57.6 ksi	
Bending Safety Factor, Ω_b	1.67	
Allowable Bending Stress, F_b	34.5 ksi	
Actual Shear Stress, f_v	0.7 ksi	
Actual Tensile Stress, f_t	6.7 ksi	
Actual Bending Stress, f_b	11.7 ksi	
Combined Stress Ratio	65%	**OK**

Anchor Bolt Embedment Into Caisson or Vertical Slab Footing

	Caisson		Vertical Slab
Caisson Diameter, d			--
Caisson Vertical Bar Size			--
Caisson Vertical Bar Quantity			--
Vertical Slab Thickness, t			2.0 ft
Vertical Slab Width, b			8.0 ft
Vertical Slab Vertical Bar Size			#5
Vertical Slab Vertical Bar Spacing			14 in o.c.
Footing Reinforcing in Tensile Face, $A_{s\text{-}prov}$			2.10 sq in
Clear Cover to Reinforcing			3.0 in
Reinforcing to Bolt Gage Tension Face, g			2.7 in
Reinforcing to Bolt Gage Compression Face, g'			15.0 in
Total Tension on Bolt Group, T_{total}			5.9 k
Reinforcing Req'd to Develop Tension, $A_{s\text{-}req'd}$			0.18 sq in
Excess Reinforcing Ratio, $A_{s\text{-}req'd}/A_{s\text{-}prov}$			8%
Excess Reinforcement Reduction (25% min)			25%
Development Length, L_d			30 in
Reduced Development Length, L'_d			12 in
Minimum Required Embedment Depth, E			16 in

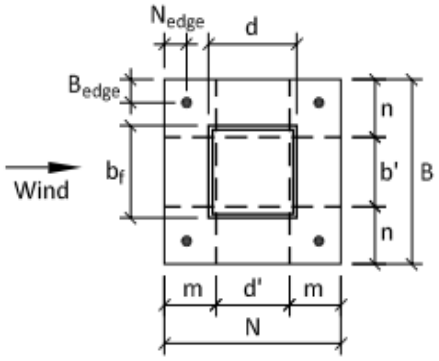


Straight Reinforcing Development Diagram

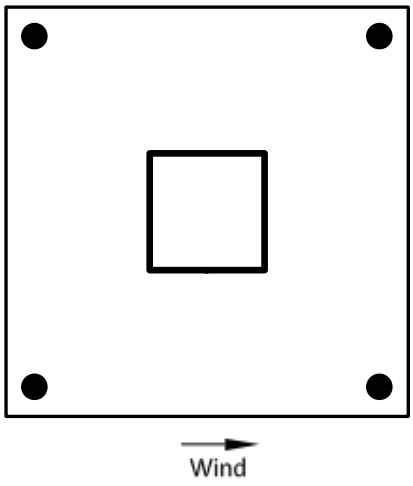
MATCH PLATE 1 DESIGN - LOWER COLUMN

Input Parameters

Elevation	2.1 ft	
Column Size	HSS4X4X1/4	
Column Type	HSS_Rect	
Axis	Strong	
Depth or Diameter, d	4.0 in	
Width, b_f	4.0 in	
Plate Length, N	14.00 in	
Plate Width, B	14.00 in	
Plate Thickness, t	0.50 in	OK
Edge Distance, N_{edge}	1.00 in	OK
Edge Distance, B_{edge}	1.00 in	OK
Bolt Configuration	Flange	
# per Flange Side	2	
Diameter, d_b	0.50 in	OK
Bolt Material	A325	
Fillet Weld Size at Column Base	0.19 in	OK
Gussets (If yes, reduce req'd plate thickness by 20%	No	
Weld Group Section Modulus With Gussets		



Match Plate Dimensions Diagram



Bolt Configuration Layout

Joint Loads

Axial, P_a	0.7 k
Moment, M_a	4.5 k-ft
Shear, V_a	1.0 k

Match Plate Dimensions

Effective Plate Length, m	5.1 in
Effective Plate Width, n	5.4 in
Effective Column Depth, d'	3.8 in
Effective Column Width, b'	3.2 in
Tensile Group from Centerline, A'	6.0 in
Tensile Group from Plate Edge, N'	13.0 in
Tensile Group to Center of Bearing, N'-0.5m	10.5 in

Required Match Plate Thickness

Compression on Bearing Face, C_{total}	5.6 k
Tension on Bolt Group, T_{total}	4.9 k
Steel Yield Stress, F_y	36.0 ksi
Bearing Moment, $M_{a\text{-}pl\text{-}bearing}$	1.0 k-in/in
Tension Moment, $M_{a\text{-}pl\text{-}tension}$	1.2 k-in/in
Controlling Moment, $M_{a\text{-}pl\text{-}max}$	1.2 k-in/in
Required Plate Thickness, $t_{pl\text{-}reqd}$ (Unreduced)	0.48 in

Bolt Design

# of Bolts in Tension	2	
# of Bolts in Shear	4	
Tension, T_a	2.4 k	
Shear, V_a	0.3 k	
Area, A_b	0.20 sq in	
Ultimate Stress, F_u	120.0 ksi	
Nominal Shear Stress, F_{nv}	48.0 ksi	
Nominal Tensile Stress, F_{nt}	90.0 ksi	
Nominal Effective Tensile Stress, F'_{nt}	90.0 ksi	
Shear / Tension Safety Factor, $\Omega_{v/t}$	2	
Allowable Shear Stress, F_v	24.0 ksi	
Allowable Tensile Stress, F_t	45.0 ksi	
Actual Shear Stress, f_v	1.3 ksi	OK
Actual Tensile Stress, f_t	12.4 ksi	OK

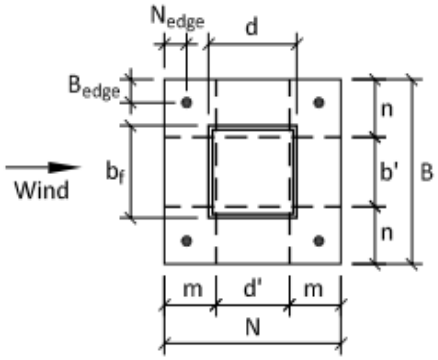
Column Base Weld to Match Plate

Allowable Weld Stress, F_w/Ω	14.8 ksi	
Section Modulus of Weld w/out Gussets	21.33 in2	
Weld Stress Without Gussets, f_w	13.9 ksi	OK
Custom Section Modulus With Gussets	0.00 in2	
Weld Stress With Gussets, $f_{w\text{-}gussets}$	0.0 ksi	OK

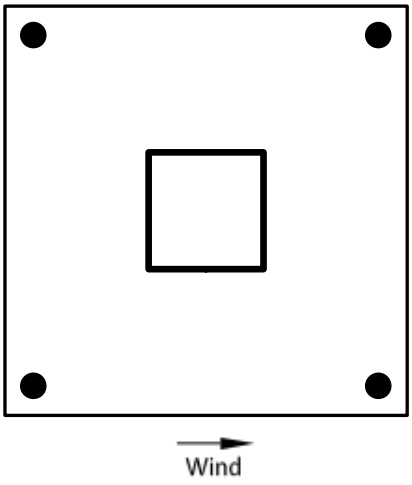
MATCH PLATE 1 DESIGN - UPPER COLUMN

Input Parameters

Elevation	2.1 ft	
Column Size	HSS4X4X1/4	
Column Type	HSS_Rect	
Axis	Strong	
Depth or Diameter, d	4.0 in	
Width, b_f	4.0 in	
Plate Length, N	14.00 in	
Plate Width, B	14.00 in	
Plate Thickness, t	0.50 in	OK
Edge Distance, N_{edge}	1.00 in	OK
Edge Distance, B_{edge}	1.00 in	OK
Bolt Configuration	Flange	
# per Flange Side	2	
Diameter, d_b	0.50 in	OK
Bolt Material	A325	
Fillet Weld Size at Column Base	0.19 in	OK
Gussets (If yes, reduce req'd plate thickness by 20%	No	
Weld Group Section Modulus With Gussets		



Match Plate Dimensions Diagram



Bolt Configuration Layout

Joint Loads

Axial, P_a	0.7 k
Moment, M_a	4.5 k-ft
Shear, V_a	1.0 k

Match Plate Dimensions

Effective Plate Length, m	5.1 in
Effective Plate Width, n	5.4 in
Effective Column Depth, d'	3.8 in
Effective Column Width, b'	3.2 in
Tensile Group from Centerline, A'	6.0 in
Tensile Group from Plate Edge, N'	13.0 in
Tensile Group to Center of Bearing, N'-0.5m	10.5 in

Required Match Plate Thickness

Compression on Bearing Face, C_{total}	5.6 k
Tension on Bolt Group, T_{total}	4.9 k
Steel Yield Stress, F_y	36.0 ksi
Bearing Moment, $M_{a\text{-}pl\text{-}bearing}$	1.0 k-in/in
Tension Moment, $M_{a\text{-}pl\text{-}tension}$	1.2 k-in/in
Controlling Moment, $M_{a\text{-}pl\text{-}max}$	1.2 k-in/in
Required Plate Thickness, $t_{pl\text{-}reqd}$ (Unreduced)	0.48 in

Bolt Design

# of Bolts in Tension	2	
# of Bolts in Shear	4	
Tension, T_a	2.4 k	
Shear, V_a	0.3 k	
Area, A_b	0.20 sq in	
Ultimate Stress, F_u	120.0 ksi	
Nominal Shear Stress, F_{nv}	48.0 ksi	
Nominal Tensile Stress, F_{nt}	90.0 ksi	
Nominal Effective Tensile Stress, F'_{nt}	90.0 ksi	
Shear / Tension Safety Factor, $\Omega_{v/t}$	2	
Allowable Shear Stress, F_v	24.0 ksi	
Allowable Tensile Stress, F_t	45.0 ksi	
Actual Shear Stress, f_v	1.3 ksi	OK
Actual Tensile Stress, f_t	12.4 ksi	OK

Column Base Weld to Match Plate

Allowable Weld Stress, F_w/Ω	14.8 ksi	
Section Modulus of Weld w/out Gussets	21.33 in2	
Weld Stress Without Gussets, f_w	13.9 ksi	OK
Custom Section Modulus With Gussets	0.00 in2	
Weld Stress With Gussets, $f_{w\text{-}gussets}$	0.0 ksi	OK

STRUCTURAL CALCULATIONS FOR:

McDonald's

NEXT-GEN OHC

CALCULATIONS CONTAINED HEREIN ARE SUITABLE FOR THE THE FOLLOWING CODE REQUIREMENTS:

2021 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

2018 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

WIND DATA

Building Code	2021 / 2018 IBC	Importance Factor, I	1.0	Damping Ratio, β	0.005
Wind Load Criteria	ASCE 7-16	Directionality Factor, K_d [2]	0.85	Natural Frequency, n_1	4.65 Hz
Wind Speed, V	130 mph	Topography Factor, K_{zt}	1.0	Gust Effect Factor, G	0.85
Exposure Category	C	Base Pressure, $\gamma(q_z/K_z)$	22.1 psf	ASD Wind Load Factor, γ [3]	0.6
Wind Pressure Override per Jurisdiction Requirement	0 psf				

DEFLECTION ANALYSIS

Deflection Limit		H/60
Deflection at 0.7*W		0.20 in
Deflection Ratio	✓	H/695

Notes: (1) Loading values in chart below are based upon average K_z values for each segment. Actual values are calculated on hidden sheet using derived V-M equations. Chart is provided for information purposes only.
(2) Wind directionality (K_d) factor is 0.95 for Single Pole (Round) segments instead of 0.85. The C_f value from Fig. 6-21 has been increased by 0.95/0.85 to account for this variation.
(3) Wind pressures listed below have already been multiplied by the ASD Wind Load Factor, γ.

GEOMETRY INPUT [1] ***Monument:*** No

No. of Poles: 2 No. of Footings: 1

Section	Location	Type	Height	Width	Horiz. Offset	Area	Top Elev.	Centroid	K_z	C_f	Wind Press.	Support Pole Loads			Footing Loads		
												Trib. Factor	Shear	Moment	Trib. Factor	Shear	Moment
			ft	ft	ft	sq ft	ft	ft			psf		kips	k-ft		kips	k-ft
1	Base	Single Pole (Round)	0.25	3.00		0.8	0.3	0.1	0.85	0.78	12.5	1.0	0.0	0.0	2.0	0.0	0.0
2		Multiple Poles w/ Cabinet	10.83	1.09		11.8	11.1	5.7	0.85	1.73	27.5	1.6	0.5	2.9	1.0	0.3	1.8
3		Multiple Poles w/ Cabinet	0.79	3.53		2.8	11.9	11.5	0.85	1.86	29.6	1.6	0.1	1.5	1.0	0.1	0.9
4		None				0.0	11.9	11.9	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
5		None				0.0	11.9	11.9	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
6		None				0.0	11.9	11.9	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
7		None				0.0	11.9	11.9	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
8		None				0.0	11.9	11.9	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
9		None				0.0	11.9	11.9	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
10	Top	None				0.0	11.9	11.9	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
		Overall Height:	11.88 ft														
		Column Spacing:	0.67 ft			***Actual base reactions based upon V-M equations:***							**0.3**	**3.3**		**0.5**	**6.9**

SUPPORT POLE DESIGN SUMMARY **MATERIAL =** **STEEL**

Base Elev	Section	Axis	Required Strength Values (ASD)				Allowable Strength Values (ASD)				Unity Ratios				Interaction Ratios		Status
			V_r	M_r	T_r	P_r	V_c	M_c	T_c	P_c	V_r/V_c	M_r/M_c	T_r/T_c	P_r/P_c	P-M	P-M-V-T	
ft			kips	kip-ft	kip-ft	kips	kips	kip-ft	kip-ft	kips							
																	✓
																	✓
																	✓
																	✓
																	✓
																	✓
																	✓
																	✓
																	✓
																	✓

ELEMENT DESIGN LOCATIONS, LOADS AND DISPLACEMENTS

Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ	Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ
	ft		kips	kip-ft	kip-ft	kips	radians	in		ft		kips	kip-ft	kip-ft	kips	radians	in
1	0.00	Base Plate	0.7	4.4	0.0	0.5	0.0	0.0	3	0.00	Match Plate 2	0.7	4.4	0.0	0.5	0.000	0.00
2	11.00	Match Plate 1	0.1	0.1	0.0	0.1	0.0	0.2	4	0.00	Torsion Tube	0.7	4.4	0.0	0.5	0.000	0.00

PLATE DESIGN SUMMARY

Type	Plate Dimensions				Bolts								Weld		Status
	N	B	D	t	Number	d_b	N_{edge}	B_{edge}	Circle Diamete	Material	Embed in Caisson / Vertical Slab	Embed in	Size	Gussets	
	in	in	in	in		in	in	in	in		in	in	in		
✓ Rectangular Base Plate	18	18	--	1	4	1	3.5	3.5	--	F1554 Grade 36	34	N/A	0.188	No	OK
☐ Circular Base Plate															
✓ Match Plate 1 (Lower)	11	11	--	0.5	4	0.5	1.5	3.5	--	A325	--	--	0.188	No	OK
☐ Match Plate 1 (Upper)															
☐ Match Plate 2 (Lower)															
☐ Match Plate 2 (Upper)															

FOUNDATION DESIGN SUMMARY

Type	Diameter	Width	Thickness	Length	Depth	Volume	Reinforcing	Status	Allowable Soil Pressure
	ft	ft	ft	ft	ft	CY			
✓ Caisson	3.00	--	--	--	8.00	2.09	(12) #6 Vert. w/ #4 Ties @ 9 in o.c. and (6) @ 4 in o.c. Top	OK	200 psf/ft
☐ Vertical Slab									
☐ Spread									

FOUNDATION DESIGN

Footing Loads

Axial, P_a	1.4 k
Moment, M_a	6.9 k-ft
Shear, V_a	0.4 k
Base Column to Footing Connection Type	Base Plate

Footing and Soils Data

Concrete Strength, f'$_c$	2500 psi
Materials Class	5
Sign or Flagpole	Yes
Allowable Vertical Bearing Pressure	1500 psf
Allowable Lateral Bearing Pressure	200 psf/ft

IBC Table 1806.2 - Allowable Foundation and Lateral Pressure

Class of Materials		Allowable Bearing Pressures	
		Vertical	Lateral
		psf	*psf/ft*
1	Crystalline bedrock	12000	1200
2	Sedimentary and foliated rock	4000	400
3	Sandy gravel and/or gravel (GW and GP)	3000	200
4	Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2000	150
5	Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1500	100
Geotech	Geotechnical study is applicable	--	--

Note: If structure is a sign or flagpole, the lateral bearing pressure value from above has been doubled at left per IBC 1806.3.4 (only for Class of Materials 1-5)

Caisson Footing

Constrained Base	No
Diameter, b	3.00 ft
Vertical Reinforcing Bar Size	#6
Top Depth to Ignore for Poor Soil Conditions	3.00 ft
Depth Calculation Status	OK
Effective Height, h	19.8
S1	0.32
S3	0.95
A	0.86 ft
Assumed Depth (not including ignored top depth)	4.76 ft
Required Depth (not including ignored top depth)	✓ 4.76 ft
Concrete Strength, f'$_c$	2500 psi
Minimum Diameter for Structural Plain Concrete Use	1.79 ft
Required Reinforcing Type	T&S Only
Minimum Reinforcing Ratio	0.50%
Minimum Reinforcing, $A_{s\text{-}min}$	5.09 sq in
Required Flexural Reinforcing Ratio	0.00%
Required Flexural Reinforcing, A_s	0.00 sq in
Controlling Reinforcing, $A_{s\text{-}req'd}$	5.09 sq in
(26) #4 Bars	5.20 sq in
(18) #5 Bars	5.58 sq in
(12) #6 Bars	5.28 sq in
(10) #7 Bars	6.00 sq in
(8) #8 Bars	6.32 sq in

Note: If pole is directly embedded into caisson footing, the steel pole is deemed to provide footing reinforcement for flexural loads applied to the footing. If anchor bolts are used and the "Diameter, b" exceeds "Minimum Diameter for Structural Plain Concrete Use" value, ACI 318 does not require reinforcement in footing since an unreinforced section is sufficient to resist the flexural loads applied to the footing. However, office standard practice is to provide at minimum 0.18% in a caisson footing due to the presence of anchor bolts, primarily due to the need to develop the anchor bolt tensile forces with the longitudinal reinforcing.

Caisson Footing Design Summary

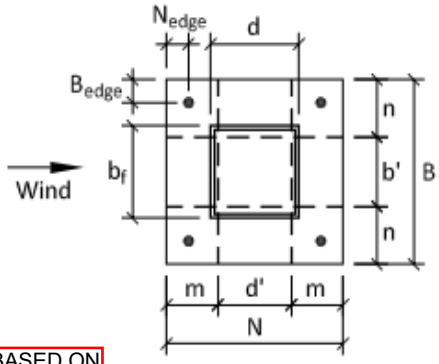
Footing Diameter, b	3.00 ft	
Footing Depth, D	8.00 ft	
Estimated Volume	2.1 yd3	**Stirrup Size & Spacing**
Selected Bar Size	#6	#4
Required Quantity	12	9.0 in

RECTANGULAR BASE PLATE DESIGN

HSS 10"x6"x3/16" IS USED AS A PLACEHOLDER FOR THE (2) HSS 6"x2"x3/16" W/ AN OUT-TO-OUT DIMENSION ON BASEPLATE

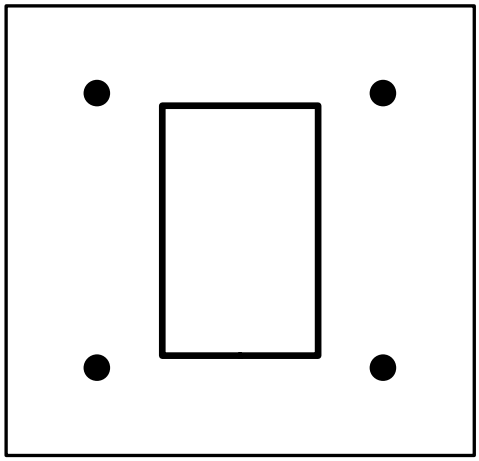
Input Parameters

Column Size	HSS10X6X3/16	
Column Type	HSS_Rect	
Axis	Weak	
Depth or Diameter, d	6.0 in	
Width, b_f	10.0 in	
Plate Length, N	18.0 in	OK
Plate Width, B	18.0 in	
Plate Thickness, t	1.00 in	OK
Edge Distance, N_{edge}	3.50 in	OK
Edge Distance, B_{edge}	3.50 in	OK
Bolt Configuration	Flange	
# per Flange Side	2	
Diameter, d_b	1.00 in	OK
Bolt Material	F1554 Grade 36	
Embedment Depth in Caisson / Vert. Slab	34 in	OK
Embedment Depth in Spread Footing		N/A
Grout Bed	No	
Fillet Weld Size at Column Base	0.19 in	OK
Gussets (If yes, reduce req'd plate thickness by 20%)	No	
Second Fillet Weld at Inside of Column	No	
Weld Group Section Modulus With Gussets		



Base Plate Dimensions Diagram

CALCULATIONS BASED ON NO GROUT BED



Bolt Configuration Layout

Custom Bolt Configuration Entry	Coordinates from Column Center		
Bolt Number	**X**		**Y**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Column Loads

Axial, P_a	1.4 k
Moment, M_a	6.9 k-ft
Shear, V_a	0.4 k

Base Plate Dimensions

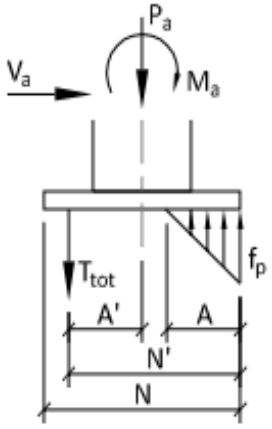
Plate Area, A_1	324.0 sq in
Effective Plate Length, m	6.2 in
Effective Plate Width, n	5.0 in
Effective Column Depth, d'	5.7 in
Effective Column Width, b'	8.0 in
C.G. of Bolt Group from Centerline, A'	5.5 in
C.G. of Bolt Group from Plate Edge, N'	14.5 in

Footing Information

Concrete Strength, f'_c	2500 psi
Caisson Footing Bearing Surface Area	7.1 sf
Vertical Slab Footing Bearing Surface Area	999999.0 sf
Spread Footing Bearing Surface Area	999999.0 sf
Foundation Area, A_2	7.1 sf

Base Plate Forces Per Triangular Pressure Distribution

Eccentricity, e	60.3 in
Kern Eccentricity, e_{kern}	3.0 in
Bearing Safety Factor, $\Omega_{bearing}$	2.5
Bearing Stress at Edge, f_p	1.507 ksi
Bearing Stress at Column, f_{p1}	0.000 ksi
Bearing Resultant, f'	196.6 k
Bearing Length, A	0.5 in
Total Tension on Bolt Group, T_{total}	4.9 k



Force Distribution Diagram

Required Base Plate Thickness

Base Plate Yield Stress, F_y	36.0 ksi
Bearing Moment, $M_{a\text{-}pl\text{-}bearing}$	2.1 k-in/in
Tension Moment, $M_{a\text{-}pl\text{-}tension}$	1.2 k-in/in
Controlling Moment, $M_{a\text{-}pl\text{-}max}$	2.1 k-in/in
Required Plate Thickness, $t_{pl\text{-}reqd}$	0.62 in

Column Base Weld to Base Plate

Fillet Weld Size	0.1875	
Column Type	HSS_Rect	
Depth or Diameter, d	6.0 in	
Width, b	10.0 in	
Allowable Weld Stress, F_w/Ω	14.8 ksi	
Section Modulus of Weld w/out Gussets	72.00 in2	
Weld Stress Without Gussets, f_w	6.4 ksi	**OK**
Custom Section Modulus With Gussets	0.00 in2	
Weld Stress With Gussets, $f_{w\text{-}gussets}$	0.0 ksi	**OK**

Anchor Bolt Design

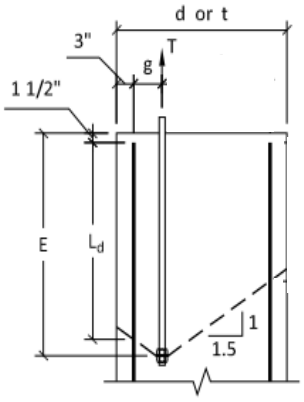
# of Bolts in Tension	2
# of Bolts in Shear	4
Distance Between Plate and Footing	1.5 in
Tension, T_a	2.5 k
Shear, V_a	0.1 k
Moment, M_a	0.1 k-in
Area, A_b	0.79 sq in
Section Modulus, S_b	0.10 in3
Yield Stress, F_y	36.0 ksi
Ultimate Stress, F_u	58.0 ksi
Nominal Shear Stress, F_{nv}	23.2 ksi
Nominal Tensile Stress, F_{nt}	43.5 ksi
Nominal Effective Tensile Stress, F'_{nt}	43.5 ksi
Shear / Tension Safety Factor, $\Omega_{v/t}$	2
Allowable Shear Stress, F_v	11.6 ksi
Allowable Tensile Stress, F_t	21.8 ksi
Nominal Bending Sress, F_{nb}	57.6 ksi
Bending Safety Factor, Ω_b	1.67
Allowable Bending Stress, F_b	34.5 ksi
Actual Shear Stress, f_v	0.1 ksi
Actual Tensile Stress, f_t	3.1 ksi
Actual Bending Stress, f_b	1.3 ksi
Combined Stress Ratio	18%

OK

ANCHOR BOLTS HAVE BENDING STRESS DUE TO LOADS IMPOSED W/OUT GROUT BED - ANCHOR BOLTS STILL CODE COMPLIANT

Anchor Bolt Embedment Into Caisson or Vertical Slab Footing

	Caisson		Vertical Slab
Caisson Diameter, d	3.0 ft		
Caisson Vertical Bar Size	#6		
Caisson Vertical Bar Quantity	12		
Vertical Slab Thickness, t	--		
Vertical Slab Width, b	--		
Vertical Slab Vertical Bar Size	--		
Vertical Slab Vertical Bar Spacing	--		
Footing Reinforcing in Tensile Face, $A_{s\text{-}prov}$	2.65 sq in		
Clear Cover to Reinforcing	3.0 in		
Reinforcing to Bolt Gage Tension Face, g	9.1 in		
Reinforcing to Bolt Gage Compression Face, g'	20.5 in		
Total Tension on Bolt Group, T_{total}	4.9 k		
Reinforcing Req'd to Develop Tension, $A_{s\text{-}req'd}$	0.15 sq in		
Excess Reinforcing Ratio, $A_{s\text{-}req'd}/A_{s\text{-}prov}$	6%		
Excess Reinforcement Reduction (25% min)	25%		
Development Length, L_d	36 in		
Reduced Development Length, L'_d	12 in		
Minimum Required Embedment Depth, E	20 in		



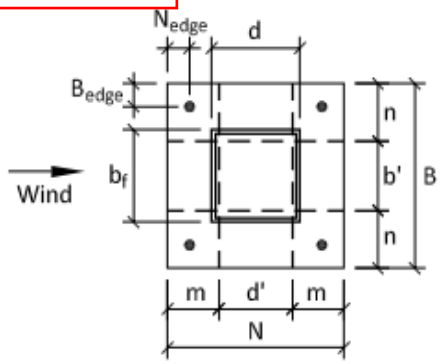
Straight Reinforcing Development Diagram

HSS 10"x6"x3/16" IS USED AS A PLACEHOLDER FOR THE (2) HSS 6"x2"x3/16" W/ AN OUT-TO-OUT DIMENSION ON MATCH PLATE

MATCH PLATE 1 DESIGN - LOWER COLUMN

Input Parameters

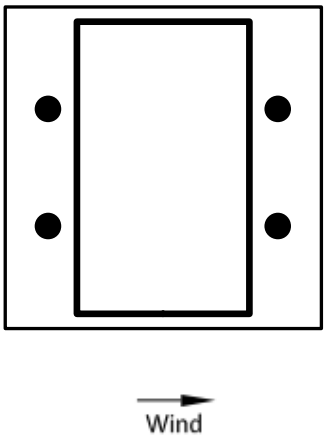
Elevation	11.0 ft	
Column Size	HSS10X6X3/16	
Column Type	HSS_Rect	
Axis	Weak	
Depth or Diameter, d	6.0 in	
Width, b_f	10.0 in	
Plate Length, N	11.00 in	
Plate Width, B	11.00 in	
Plate Thickness, t	0.50 in	OK
Edge Distance, N_{edge}	1.50 in	OK
Edge Distance, B_{edge}	3.50 in	OK
Bolt Configuration	Flange	
# per Flange Side	2	
Diameter, d_b	0.50 in	OK
Bolt Material	A325	
Fillet Weld Size at Column Base	0.19 in	OK
Gussets (If yes, reduce req'd plate thickness by 20%	No	
Weld Group Section Modulus With Gussets		



Match Plate Dimensions Diagram

Custom Bolt Configuration Entry

Bolt Number	Coordinates from Column Center X		Y
1			
2			
3			
4			
5			
6			
7			
8			



Bolt Configuration Layout

Joint Loads

Axial, P_a	1.8 k
Moment, M_a	4.8 k-ft
Shear, V_a	0.1 k

Match Plate Dimensions

Effective Plate Length, m	2.7 in
Effective Plate Width, n	1.5 in
Effective Column Depth, d'	5.7 in
Effective Column Width, b'	8.0 in
Tensile Group from Centerline, A'	4.0 in
Tensile Group from Plate Edge, N'	9.5 in
Tensile Group to Center of Bearing, N'-0.5m	8.2 in

Required Match Plate Thickness

Compression on Bearing Face, C_{total}	7.9 k
Tension on Bolt Group, T_{total}	6.1 k
Steel Yield Stress, F_y	36.0 ksi
Bearing Moment, $M_{a\text{-}pl\text{-}bearing}$	1.0 k-in/in
Tension Moment, $M_{a\text{-}pl\text{-}tension}$	1.5 k-in/in
Controlling Moment, $M_{a\text{-}pl\text{-}max}$	1.5 k-in/in
Required Plate Thickness, $t_{pl\text{-}reqd}$ (Unreduced)	0.50 in

Bolt Design

# of Bolts in Tension	2	
# of Bolts in Shear	4	
Tension, T_a	3.1 k	
Shear, V_a	0.0 k	
Area, A_b	0.20 sq in	
Ultimate Stress, F_u	120.0 ksi	
Nominal Shear Stress, F_{nv}	48.0 ksi	
Nominal Tensile Stress, F_{nt}	90.0 ksi	
Nominal Effective Tensile Stress, F'_{nt}	90.0 ksi	
Shear / Tension Safety Factor, $\Omega_{v/t}$	2	
Allowable Shear Stress, F_v	24.0 ksi	
Allowable Tensile Stress, F_t	45.0 ksi	
Actual Shear Stress, f_v	0.2 ksi	OK
Actual Tensile Stress, f_t	15.6 ksi	OK

Column Base Weld to Match Plate

Allowable Weld Stress, F_w/Ω	14.8 ksi	
Section Modulus of Weld w/out Gussets	72.00 in2	
Weld Stress Without Gussets, f_w	4.3 ksi	OK
Custom Section Modulus With Gussets	0.00 in2	
Weld Stress With Gussets, $f_{w\text{-}gussets}$	0.0 ksi	OK

STRUCTURAL CALCULATIONS FOR:

McDonald's

GATEWAY - DOUBLE

CALCULATIONS CONTAINED HEREIN ARE SUITABLE FOR THE THE FOLLOWING CODE REQUIREMENTS:

2021 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

2018 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

WIND DATA

Building Code	2021 / 2018 IBC	Importance Factor, I	1.0	Damping Ratio, β	0.005
Wind Load Criteria	ASCE 7-16	Directionality Factor, K_d [2]	0.85	Natural Frequency, n_1	4.75 Hz
Wind Speed, V	130 mph	Topography Factor, K_{zt}	1.0	Gust Effect Factor, G	0.85
Exposure Category	C	Base Pressure, $\gamma(q_z/K_z)$	22.1 psf	ASD Wind Load Factor, γ [3]	0.6
Wind Pressure Override per Jurisdiction Requirement	0 psf				

DEFLECTION ANALYSIS

Deflection Limit		H/60
Deflection at 0.7*W		0.30 in
Deflection Ratio	✓	H/439

Notes: (1) Loading values in chart below are based upon average K_z values for each segment. Actual values are calculated on hidden sheet using derived V-M equations. Chart is provided for information purposes only.
(2) Wind directionality (K_d) factor is 0.95 for Single Pole (Round) segments instead of 0.85. The C_f value from Fig. 6-21 has been increased by 0.95/0.85 to account for this variation.
(3) Wind pressures listed below have already been multiplied by the ASD Wind Load Factor, γ.

GEOMETRY INPUT [1] ***Monument:*** No

No. of Poles: 1 No. of Footings: 1

Section	Location	Type	Height	Width	Horiz. Offset	Area	Top Elev.	Centroid	K_z	C_f	Wind Press.	Support Pole Loads			Footing Loads		
												Trib.	Shear	Moment	Trib.	Shear	Moment
			ft	*ft*	*ft*	*sq ft*	*ft*	*ft*			*psf*	Factor	*kips*	*k-ft*	Factor	*kips*	*k-ft*
1	Base	Single Pole (Round)	0.25	3.00		0.8	0.3	0.1	0.85	0.78	12.5	1.0	0.0	0.0	1.0	0.0	0.0
2		Single Pole w/ Cabinet	9.48	1.00		9.5	9.7	5.0	0.85	1.73	27.5	1.0	0.3	1.3	1.0	0.3	1.3
3		Single Pole w/ Cabinet	1.20	8.44		10.1	10.9	10.3	0.85	1.87	29.7	1.0	0.3	3.1	1.0	0.3	3.1
4		Single Pole w/ Cabinet	0.14	1.00		0.1	11.1	11.0	0.85	1.90	30.2	1.0	0.0	0.0	1.0	0.0	0.0
5		None				0.0	11.1	11.1	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
6		None				0.0	11.1	11.1	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
7		None				0.0	11.1	11.1	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
8		None				0.0	11.1	11.1	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
9		None				0.0	11.1	11.1	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
10	Top	None				0.0	11.1	11.1	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
		Overall Height: 11.07 ft						***Summation based upon averages above:***					**0.6**	**4.5**		**0.6**	**4.5**
								Actual base reactions based upon V-M equations:					**0.6**	**4.5**		**0.6**	**4.5**

SUPPORT POLE DESIGN SUMMARY **MATERIAL =** STEEL

Base Elev	Section	Axis	Required Strength Values (ASD)				Allowable Strength Values (ASD)				Unity Ratios				Interaction Ratios		Status
			V_r	M_r	T_r	P_r	V_c	M_c	T_c	P_c	V_r/V_c	M_r/M_c	T_r/T_c	P_r/P_c	P-M	P-M-V-T	
ft			*kips*	*kip-ft*	*kip-ft*	*kips*	*kips*	*kip-ft*	*kip-ft*	*kips*							
0.00	HSS6X6X3/16	Strong	0.6	4.5	0.6	0.4	35.1	18.5	16.3	47.1	1.6%	24.3%	3.5%	0.8%	25.1%	0.0%	✓
0.00	None	Strong	0.6	4.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	4.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	4.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	4.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	4.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	4.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	4.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	4.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	4.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓

ELEMENT DESIGN LOCATIONS, LOADS AND DISPLACEMENTS

Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ	Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ
	ft		*kips*	*kip-ft*	*kip-ft*	*kips*	*radians*	*in*		*ft*		*kips*	*kip-ft*	*kip-ft*	*kips*	*radians*	*in*
1	0.00	Base Plate	0.6	4.5	0.6	0.4	0.0	0.0	3	0.00	Match Plate 2	0.6	4.5	0.6	0.4	0.000	0.00
2	0.00	Match Plate 1	0.6	4.5	0.6	0.4	0.0	0.0	4	0.00	Torsion Tube	0.6	4.5	0.6	0.4	0.000	0.00

PLATE DESIGN SUMMARY

Type	Plate Dimensions				Bolts								Weld		Status
	N	B	D	t	Number	d_b	N_{edge}	B_{edge}	Circle Diamete	Material	Embed in Caisson / Vertical Slab	Embed in	Size	Gussets	
	in	*in*	*in*	*in*		*in*	*in*	*in*	*in*		*in*	*in*	*in*		
✓ Rectangular Base Plate	14	14	--	0.75	4	0.75	2	2	--	F1554 Grade 36	33	N/A	0.188	No	OK
☐ Circular Base Plate															
☐ Match Plate 1 (Lower)															
☐ Match Plate 1 (Upper)															
☐ Match Plate 2 (Lower)															
☐ Match Plate 2 (Upper)															

FOUNDATION DESIGN SUMMARY

Type	Diameter	Width	Thickness	Length	Depth	Volume	Reinforcing	Status	Allowable Soil Pressure
	ft	*ft*	*ft*	*ft*	*ft*	*CY*			
✓ Caisson	3.00	--	--	--	5.50	1.44	(12) #6 Vert. w/ #4 Ties @ 9 in o.c. and (6) @ 3 in o.c. Top	OK	200 psf/ft
☐ Vertical Slab									
☐ Spread									

FOUNDATION DESIGN

Footing Loads

Axial, P_a	0.4 k
Moment, M_a	4.5 k-ft
Shear, V_a	0.6 k
Base Column to Footing Connection Type	Base Plate

Footing and Soils Data

Concrete Strength, f'$_c$	2500 psi
Materials Class	5
Sign or Flagpole	Yes
Allowable Vertical Bearing Pressure	1500 psf
Allowable Lateral Bearing Pressure	200 psf/ft

Caisson Footing

Constrained Base	No
Diameter, b	3.00 ft
Vertical Reinforcing Bar Size	#6
Top Depth to Ignore for Poor Soil Conditions	1.00 ft
Depth Calculation Status	OK
Effective Height, h	7.8
S1	0.30
S3	0.89
A	1.53 ft
Assumed Depth (not including ignored top depth)	4.44 ft
Required Depth (not including ignored top depth)	✓ 4.44 ft
Concrete Strength, f'$_c$	2500 psi
Minimum Diameter for Structural Plain Concrete Use	1.55 ft
Required Reinforcing Type	T&S Only
Minimum Reinforcing Ratio	0.50%
Minimum Reinforcing, $A_{s\text{-}min}$	5.09 sq in
Required Flexural Reinforcing Ratio	0.00%
Required Flexural Reinforcing, A_s	0.00 sq in
Controlling Reinforcing, $A_{s\text{-}req'd}$	5.09 sq in
(26) #4 Bars	5.20 sq in
(18) #5 Bars	5.58 sq in
(12) #6 Bars	5.28 sq in
(10) #7 Bars	6.00 sq in
(8) #8 Bars	6.32 sq in

Caisson Footing Design Summary

Footing Diameter, b	3.00 ft	
Footing Depth, D	5.50 ft	
Estimated Volume	1.4 yd3	**Stirrup Size & Spacing**
Selected Bar Size	#6	#4
Required Quantity	12	9.0 in

IBC Table 1806.2 - Allowable Foundation and Lateral Pressure

	Class of Materials	Allowable Bearing Pressures	
		Vertical	**Lateral**
		psf	*psf/ft*
1	Crystalline bedrock	12000	1200
2	Sedimentary and foliated rock	4000	400
3	Sandy gravel and/or gravel (GW and GP)	3000	200
4	Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2000	150
5	Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1500	100
Geotech	Geotechnical study is applicable	--	--

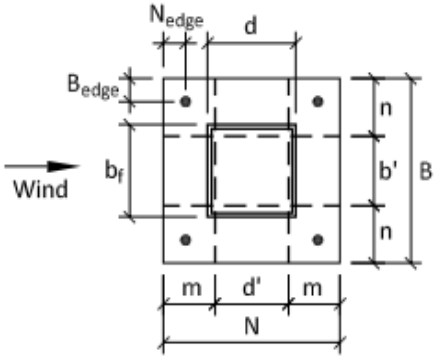
Note: If structure is a sign or flagpole, the lateral bearing pressure value from above has been doubled at left per IBC 1806.3.4 (only for Class of Materials 1-5)

Note: If pole is directly embedded into caisson footing, the steel pole is deemed to provide footing reinforcement for flexural loads applied to the footing. If anchor bolts are used and the "Diameter, b" exceeds "Minimum Diameter for Structural Plain Concrete Use" value, ACI 318 does not require reinforcement in footing since an unreinforced section is sufficient to resist the flexural loads applied to the footing. However, office standard practice is to provide at minimum 0.18% in a caisson footing due to the presence of anchor bolts, primarily due to the need to develop the anchor bolt tensile forces with the longitudinal reinforcing.

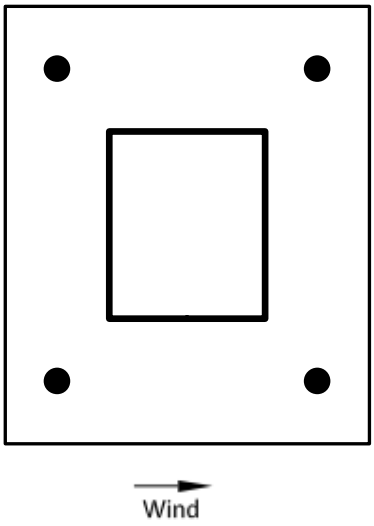
RECTANGULAR BASE PLATE DESIGN

Input Parameters

Column Size	HSS6X6X3/16	
Column Type	HSS_Rect	
Axis	Strong	
Depth or Diameter, d	6.0 in	
Width, b_f	6.0 in	
Plate Length, N	14.0 in	OK
Plate Width, B	14.0 in	
Plate Thickness, t	0.75 in	OK
Edge Distance, N_{edge}	2.00 in	OK
Edge Distance, B_{edge}	2.00 in	OK
Bolt Configuration	Flange	
# per Flange Side	2	
Diameter, d_b	0.75 in	OK
Bolt Material	F1554 Grade 36	
Embedment Depth in Caisson / Vert. Slab	33 in	OK
Embedment Depth in Spread Footing		N/A
Grout Bed	No	
Fillet Weld Size at Column Base	0.19 in	OK
Gussets (If yes, reduce req'd plate thickness by 20%)	No	
Second Fillet Weld at Inside of Column	No	
Weld Group Section Modulus With Gussets		



Base Plate Dimensions Diagram



Bolt Configuration Layout

Custom Bolt Configuration Entry	**Coordinates from Column Center**		
Bolt Number	**X**		**Y**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Column Loads

Axial, P_a	0.4 k
Moment, M_a	4.5 k-ft
Shear, V_a	0.6 k

Base Plate Dimensions

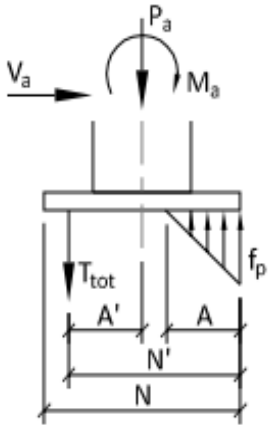
Plate Area, A_1	196.0 sq in
Effective Plate Length, m	4.2 in
Effective Plate Width, n	4.6 in
Effective Column Depth, d'	5.7 in
Effective Column Width, b'	4.8 in
C.G. of Bolt Group from Centerline, A'	5.0 in
C.G. of Bolt Group from Plate Edge, N'	12.0 in

Footing Information

Concrete Strength, f'_c	2500 psi
Caisson Footing Bearing Surface Area	7.1 sf
Vertical Slab Footing Bearing Surface Area	999999.0 sf
Spread Footing Bearing Surface Area	999999.0 sf
Foundation Area, A_2	7.1 sf

Base Plate Forces Per Triangular Pressure Distribution

Eccentricity, e	149.7 in
Kern Eccentricity, e_{kern}	2.3 in
Bearing Safety Factor, $\Omega_{bearing}$	2.5
Bearing Stress at Edge, f_p	1.700 ksi
Bearing Stress at Column, f_{p1}	0.000 ksi
Bearing Resultant, f'	142.8 k
Bearing Length, A	0.4 in
Total Tension on Bolt Group, T_{total}	4.3 k



Force Distribution Diagram

Required Base Plate Thickness

Base Plate Yield Stress, F_y	36.0 ksi
Bearing Moment, $M_{a\text{-}pl\text{-}bearing}$	1.3 k-in/in
Tension Moment, $M_{a\text{-}pl\text{-}tension}$	1.1 k-in/in
Controlling Moment, $M_{a\text{-}pl\text{-}max}$	1.3 k-in/in
Required Plate Thickness, $t_{pl\text{-}reqd}$	0.50 in

Column Base Weld to Base Plate

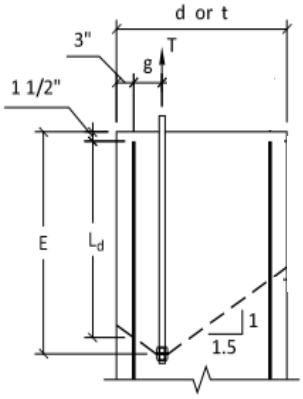
Fillet Weld Size	0.1875	
Column Type	HSS_Rect	
Depth or Diameter, d	6.0 in	
Width, b	6.0 in	
Allowable Weld Stress, F_w/Ω	14.8 ksi	
Section Modulus of Weld w/out Gussets	48.00 in2	
Weld Stress Without Gussets, f_w	6.4 ksi	**OK**
Custom Section Modulus With Gussets	0.00 in2	
Weld Stress With Gussets, $f_{w\text{-}gussets}$	0.0 ksi	**OK**

Anchor Bolt Design

# of Bolts in Tension	2
# of Bolts in Shear	4
Distance Between Plate and Footing	1.5 in
Tension, T_a	2.2 k
Shear, V_a	0.1 k
Moment, M_a	0.2 k-in
Area, A_b	0.44 sq in
Section Modulus, S_b	0.04 in3
Yield Stress, F_y	36.0 ksi
Ultimate Stress, F_u	58.0 ksi
Nominal Shear Stress, F_{nv}	23.2 ksi
Nominal Tensile Stress, F_{nt}	43.5 ksi
Nominal Effective Tensile Stress, F'_{nt}	43.5 ksi
Shear / Tension Safety Factor, $\Omega_{v/t}$	2
Allowable Shear Stress, F_v	11.6 ksi
Allowable Tensile Stress, F_t	21.8 ksi
Nominal Bending Sress, F_{nb}	57.6 ksi
Bending Safety Factor, Ω_b	1.67
Allowable Bending Stress, F_b	34.5 ksi
Actual Shear Stress, f_v	0.3 ksi
Actual Tensile Stress, f_t	4.9 ksi
Actual Bending Stress, f_b	5.2 ksi
Combined Stress Ratio	38% **OK**

Anchor Bolt Embedment Into Caisson

	Caisson
Caisson Diameter, d	3.0 ft
Caisson Vertical Bar Size	#6
Caisson Vertical Bar Quantity	12
Vertical Slab Thickness, t	--
Vertical Slab Width, b	--
Vertical Slab Vertical Bar Size	--
Vertical Slab Vertical Bar Spacing	--
Footing Reinforcing in Tensile Face, $A_{s\text{-}prov}$	2.65 sq in
Clear Cover to Reinforcing	3.0 in
Reinforcing to Bolt Gage Tension Face, g	9.6 in
Reinforcing to Bolt Gage Compression Face, g'	20.0 in
Total Tension on Bolt Group, T_{total}	4.3 k
Reinforcing Req'd to Develop Tension, $A_{s\text{-}req'd}$	0.13 sq in
Excess Reinforcing Ratio, $A_{s\text{-}req'd}/A_{s\text{-}prov}$	5%
Excess Reinforcement Reduction (25% min)	25%
Development Length, L_d	36 in
Reduced Development Length, L'_d	12 in
Minimum Required Embedment Depth, E	20 in



Straight Reinforcing Development Diagram

STRUCTURAL CALCULATIONS FOR:

McDonald's

DIGITAL MENU BOARD

CALCULATIONS CONTAINED HEREIN ARE SUITABLE FOR THE THE FOLLOWING CODE REQUIREMENTS:

2021 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

2018 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

WIND DATA

Building Code	2021 / 2018 IBC	Importance Factor, I	1.0	Damping Ratio, β	0.005
Wind Load Criteria	ASCE 7-16	Directionality Factor, K_d [2]	0.85	Natural Frequency, n_1	9.17 Hz
Wind Speed, V	130 mph	Topography Factor, K_{zt}	1.0	Gust Effect Factor, G	0.85
Exposure Category	C	Base Pressure, $\gamma(q_z/K_z)$	22.1 psf	ASD Wind Load Factor, γ [3]	0.6
Wind Pressure Override per Jurisdiction Requirement	0 psf				

DEFLECTION ANALYSIS

Deflection Limit		H/60
Deflection at 0.7*W		0.08 in
Deflection Ratio	✓	H/964

Notes: *(1) Loading values in chart below are based upon average K_z values for each segment. Actual values are calculated on hidden sheet using derived V-M equations. Chart is provided for information purposes only.*
(2) Wind directionality (K_d) factor is 0.95 for Single Pole (Round) segments instead of 0.85. The C_f value from Fig. 6-21 has been increased by 0.95/0.85 to account for this variation.
(3) Wind pressures listed below have already been multiplied by the ASD Wind Load Factor, γ.

GEOMETRY INPUT [1] ***Monument:*** No

No. of Poles: 1 No. of Footings: 1

Section	Location	Type	Height	Width	Horiz. Offset	Area	Top Elev.	Centroid	K_z	C_f	Wind Press.	Support Pole Loads			Footing Loads		
												Trib. Factor	Shear	Moment	Trib. Factor	Shear	Moment
			ft	ft	ft	sq ft	ft	ft			psf		kips	k-ft		kips	k-ft
1	Base	Single Pole (Round)	0.25	2.00		0.5	0.3	0.1	0.85	0.78	12.5	1.0	0.0	0.0	1.0	0.0	0.0
2		Single Pole (Not Round)	1.93	0.82		1.6	2.2	1.2	0.85	1.61	25.6	1.0	0.0	0.0	1.0	0.0	0.0
3		Single Pole w/ Cabinet	4.14	4.83		20.0	6.3	4.2	0.85	1.65	26.3	1.0	0.5	2.2	1.0	0.5	2.2
4		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
5		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
6		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
7		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
8		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
9		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
10	Top	None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
		Overall Height: 6.31 ft						***Summation based upon averages above:***					**0.6**	**2.3**		**0.6**	**2.3**
								Actual base reactions based upon V-M equations:					**0.6**	**2.3**		**0.6**	**2.3**

SUPPORT POLE DESIGN SUMMARY **MATERIAL =** STEEL

Base Elev	Section	Axis	Required Strength Values (ASD)				Allowable Strength Values (ASD)				Unity Ratios				Interaction Ratios		Status
			V_r	M_r	T_r	P_r	V_c	M_c	T_c	P_c	V_r/V_c	M_r/M_c	T_r/T_c	P_r/P_c	P-M	P-M-V-T	
ft			kips	kip-ft	kip-ft	kips	kips	kip-ft	kip-ft	kips							
0.00	9.8 x 3.9 x 0.20	Weak	0.6	2.3	0.5	0.3	16.5	9.7	13.1	63.1	3.5%	23.5%	4.0%	0.5%	23.9%	0.0%	✓
0.00	None	Strong	0.6	2.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	2.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	2.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	2.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	2.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	2.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	2.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.6	2.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓

ELEMENT DESIGN LOCATIONS, LOADS AND DISPLACEMENTS

Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ	Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ
	ft		kips	kip-ft	kip-ft	kips	radians	in		ft		kips	kip-ft	kip-ft	kips	radians	in
1	0.00	Base Plate	0.6	2.3	0.5	0.3	0.0	0.0	3	0.00	Match Plate 2	0.6	2.3	0.5	0.3	0.000	0.00
2	0.00	Match Plate 1	0.6	2.3	0.5	0.3	0.0	0.0	4	0.00	Torsion Tube	0.6	2.3	0.5	0.3	0.000	0.00

PLATE DESIGN SUMMARY

Type	Plate Dimensions				Bolts								Weld		Status
	N	B	D	t	Number	d_b	N_{edge}	B_{edge}	Circle Diamete	Material	Embed in Caisson / Vertical Slab	Embed in	Size	Gussets	
	in	in	in	in		in	in	in	in		in	in	in		
✓ Rectangular Base Plate					4	0.75			--	F1554 Grade 36	38	N/A			OK
☐ Circular Base Plate															
☐ Match Plate 1 (Lower)															
☐ Match Plate 1 (Upper)															
☐ Match Plate 2 (Lower)															
☐ Match Plate 2 (Upper)															

FOUNDATION DESIGN SUMMARY

Type	Diameter	Width	Thickness	Length	Depth	Volume	Reinforcing	Status	Allowable Soil Pressure
	ft	ft	ft	ft	ft	CY			
✓ Caisson	2.00	--	--	--	5.50	0.64	(6) #6 Vert. w/ #4 Ties @ 9 in o.c. and (6) @ 4 in o.c. Top	OK	200 psf/ft
☐ Vertical Slab									
☐ Spread									

FOUNDATION DESIGN

Footing Loads

Axial, P_a	0.3 k
Moment, M_a	2.3 k-ft
Shear, V_a	0.6 k
Base Column to Footing Connection Type	Base Plate

Footing and Soils Data

Concrete Strength, f'$_c$	2500 psi
Materials Class	5
Sign or Flagpole	Yes
Allowable Vertical Bearing Pressure	1500 psf
Allowable Lateral Bearing Pressure	200 psf/ft

IBC Table 1806.2 - Allowable Foundation and Lateral Pressure

	Class of Materials	Allowable Bearing Pressures	
		Vertical	Lateral
		psf	*psf/ft*
1	Crystalline bedrock	12000	1200
2	Sedimentary and foliated rock	4000	400
3	Sandy gravel and/or gravel (GW and GP)	3000	200
4	Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2000	150
5	Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1500	100
Geotech	Geotechnical study is applicable	--	--

Note: If structure is a sign or flagpole, the lateral bearing pressure value from above has been doubled at left per IBC 1806.3.4 (only for Class of Materials 1-5)

Caisson Footing

Constrained Base	No
Diameter, b	2.00 ft
Vertical Reinforcing Bar Size	#6
Top Depth to Ignore for Poor Soil Conditions	1.00 ft
Depth Calculation Status	OK
Effective Height, h	4.0
S1	0.30
S3	0.89
A	2.26 ft
Assumed Depth (not including ignored top depth)	4.46 ft
Required Depth (not including ignored top depth)	✓ 4.46 ft
Concrete Strength, f'$_c$	2500 psi
Minimum Diameter for Structural Plain Concrete Use	1.23 ft
Required Reinforcing Type	T&S Only
Minimum Reinforcing Ratio	0.50%
Minimum Reinforcing, $A_{s\text{-}min}$	2.26 sq in
Required Flexural Reinforcing Ratio	0.00%
Required Flexural Reinforcing, A_s	0.00 sq in
Controlling Reinforcing, $A_{s\text{-}req'd}$	2.26 sq in
(12) #4 Bars	2.40 sq in
(8) #5 Bars	2.48 sq in
(6) #6 Bars	2.64 sq in
(4) #7 Bars	2.40 sq in
(4) #8 Bars	3.16 sq in

Note: If pole is directly embedded into caisson footing, the steel pole is deemed to provide footing reinforcement for flexural loads applied to the footing. If anchor bolts are used and the "Diameter, b" exceeds "Minimum Diameter for Structural Plain Concrete Use" value, ACI 318 does not require reinforcement in footing since an unreinforced section is sufficient to resist the flexural loads applied to the footing. However, office standard practice is to provide at minimum 0.18% in a caisson footing due to the presence of anchor bolts, primarily due to the need to develop the anchor bolt tensile forces with the longitudinal reinforcing.

Caisson Footing Design Summary

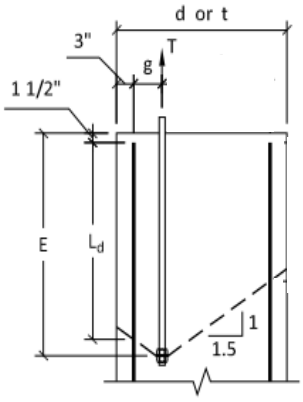
Footing Diameter, b	2.00 ft	
Footing Depth, D	5.50 ft	
Estimated Volume	0.6 yd3	**Stirrup Size & Spacing**
Selected Bar Size	#6	#4
Required Quantity	6	9.0 in

Anchor Bolt Design

# of Bolts in Tension	2	
# of Bolts in Shear	4	
Distance Between Plate and Footing	1.5 in	
Tension, T_a	1.3 k	
Shear, V_a	0.1 k	
Moment, M_a	0.2 k-in	
Area, A_b	0.44 sq in	
Section Modulus, S_b	0.04 in3	
Yield Stress, F_y	36.0 ksi	
Ultimate Stress, F_u	58.0 ksi	
Nominal Shear Stress, F_{nv}	23.2 ksi	
Nominal Tensile Stress, F_{nt}	43.5 ksi	
Nominal Effective Tensile Stress, F'_{nt}	43.5 ksi	
Shear / Tension Safety Factor, $\Omega_{v/t}$	2	
Allowable Shear Stress, F_v	11.6 ksi	
Allowable Tensile Stress, F_t	21.8 ksi	
Nominal Bending Sress, F_{nb}	57.6 ksi	
Bending Safety Factor, Ω_b	1.67	
Allowable Bending Stress, F_b	34.5 ksi	
Actual Shear Stress, f_v	0.3 ksi	
Actual Tensile Stress, f_t	2.9 ksi	
Actual Bending Stress, f_b	5.2 ksi	
Combined Stress Ratio	28%	**OK**

Anchor Bolt Embedment Into Caisson or Vertical Slab Footing

	Caisson		Vertical Slab
Caisson Diameter, d	2.0 ft		
Caisson Vertical Bar Size	#6		
Caisson Vertical Bar Quantity	6		
Vertical Slab Thickness, t	--		
Vertical Slab Width, b	--		
Vertical Slab Vertical Bar Size	--		
Vertical Slab Vertical Bar Spacing	--		
Footing Reinforcing in Tensile Face, $A_{s\text{-}prov}$	1.33 sq in		
Clear Cover to Reinforcing	3.0 in		
Reinforcing to Bolt Gage Tension Face, g	4.6 in		
Reinforcing to Bolt Gage Compression Face, g'	13.0 in		
Total Tension on Bolt Group, T_{total}	2.5 k		
Reinforcing Req'd to Develop Tension, $A_{s\text{-}req'd}$	0.07 sq in		
Excess Reinforcing Ratio, $A_{s\text{-}req'd}/A_{s\text{-}prov}$	6%		
Excess Reinforcement Reduction (25% min)	25%		
Development Length, L_d	36 in		
Reduced Development Length, L'_d	12 in		
Minimum Required Embedment Depth, E	17 in		



Straight Reinforcing Development Diagram

STRUCTURAL CALCULATIONS FOR:

McDonald's

DIGITAL PRESELL BOARD

CALCULATIONS CONTAINED HEREIN ARE SUITABLE FOR THE THE FOLLOWING CODE REQUIREMENTS:

2021 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

2018 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

WIND DATA

Building Code	2021 / 2018 IBC	Importance Factor, I	1.0	Damping Ratio, β	0.005
Wind Load Criteria	ASCE 7-16	Directionality Factor, K_d [2]	0.85	Natural Frequency, n_1	11.26 Hz
Wind Speed, V	130 mph	Topography Factor, K_{zt}	1.0	Gust Effect Factor, G	0.85
Exposure Category	C	Base Pressure, $\gamma(q_z/K_z)$	22.1 psf	ASD Wind Load Factor, γ [3]	0.6
Wind Pressure Override per Jurisdiction Requirement	0 psf				

DEFLECTION ANALYSIS

Deflection Limit		H/60
Deflection at 0.7*W		0.04 in
Deflection Ratio	✓	H/1868

Notes: *(1) Loading values in chart below are based upon average K_z values for each segment. Actual values are calculated on hidden sheet using derived V-M equations. Chart is provided for information purposes only.*
(2) Wind directionality (K_d) factor is 0.95 for Single Pole (Round) segments instead of 0.85. The C_f value from Fig. 6-21 has been increased by 0.95/0.85 to account for this variation.
(3) Wind pressures listed below have already been multiplied by the ASD Wind Load Factor, γ.

GEOMETRY INPUT [1] ***Monument:*** No

No. of Poles: 1 No. of Footings: 1

Section	Location	Type	Height	Width	Horiz. Offset	Area	Top Elev.	Centroid	K_z	C_f	Wind Press.	Support Pole Loads			Footing Loads		
												Trib. Factor	Shear	Moment	Trib. Factor	Shear	Moment
			ft	ft	ft	sq ft	ft	ft			psf		kips	k-ft		kips	k-ft
1	Base	Single Pole (Round)	0.25	2.00		0.5	0.3	0.1	0.85	0.78	12.5	1.0	0.0	0.0	1.0	0.0	0.0
2		Single Pole (Not Round)	1.93	0.82		1.6	2.2	1.2	0.85	1.61	25.6	1.0	0.0	0.0	1.0	0.0	0.0
3		Single Pole w/ Cabinet	4.14	2.42		10.0	6.3	4.2	0.85	1.69	26.9	1.0	0.3	1.1	1.0	0.3	1.1
4		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
5		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
6		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
7		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
8		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
9		None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
10	Top	None				0.0	6.3	6.3	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
		Overall Height: 6.31 ft						***Summation based upon averages above:***					**0.3**	**1.2**		**0.3**	**1.2**
								Actual base reactions based upon V-M equations:					**0.3**	**1.2**		**0.3**	**1.2**

SUPPORT POLE DESIGN SUMMARY **MATERIAL =** STEEL

Base Elev	Section	Axis	Required Strength Values (ASD)				Allowable Strength Values (ASD)				Unity Ratios				Interaction Ratios		Status
			V_r	M_r	T_r	P_r	V_c	M_c	T_c	P_c	V_r/V_c	M_r/M_c	T_r/T_c	P_r/P_c	P-M	P-M-V-T	
ft			kips	kip-ft	kip-ft	kips	kips	kip-ft	kip-ft	kips							
0.00	9.8 x 3.9 x 0.20	Weak	0.3	1.2	0.1	0.2	16.5	9.7	13.1	63.1	1.9%	12.3%	1.1%	0.3%	12.6%	0.0%	✓
0.00	None	Strong	0.3	1.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.3	1.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.3	1.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.3	1.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.3	1.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.3	1.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.3	1.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.3	1.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓

ELEMENT DESIGN LOCATIONS, LOADS AND DISPLACEMENTS

Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ	Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ
	ft		kips	kip-ft	kip-ft	kips	radians	in		ft		kips	kip-ft	kip-ft	kips	radians	in
1	0.00	Base Plate	0.3	1.2	0.1	0.2	0.0	0.0	3	0.00	Match Plate 2	0.3	1.2	0.1	0.2	0.000	0.00
2	0.00	Match Plate 1	0.3	1.2	0.1	0.2	0.0	0.0	4	0.00	Torsion Tube	0.3	1.2	0.1	0.2	0.000	0.00

PLATE DESIGN SUMMARY

Type	Plate Dimensions				Bolts								Weld		Status
	N	B	D	t	Number	d_b	N_{edge}	B_{edge}	Circle Diamete	Material	Embed in Caisson / Vertical Slab	Embed in	Size	Gussets	
	in	in	in	in		in	in	in	in		in	in	in		
✓ Rectangular Base Plate					4	0.75			--	F1554 Grade 36	38	N/A			OK
☐ Circular Base Plate															
☐ Match Plate 1 (Lower)															
☐ Match Plate 1 (Upper)															
☐ Match Plate 2 (Lower)															
☐ Match Plate 2 (Upper)															

FOUNDATION DESIGN SUMMARY

Type	Diameter	Width	Thickness	Length	Depth	Volume	Reinforcing	Status	Allowable Soil Pressure
	ft	ft	ft	ft	ft	CY			
✓ Caisson	2.00	--	--	--	4.25	0.49	(6) #6 Vert. w/ #4 Ties @ 9 in o.c. and (6) @ 4 in o.c. Top	OK	200 psf/ft
☐ Vertical Slab									
☐ Spread									

FOUNDATION DESIGN

Footing Loads

Axial, P_a	0.2 k
Moment, M_a	1.2 k-ft
Shear, V_a	0.3 k
Base Column to Footing Connection Type	Base Plate

Footing and Soils Data

Concrete Strength, f'$_c$	2500 psi
Materials Class	5
Sign or Flagpole	Yes
Allowable Vertical Bearing Pressure	1500 psf
Allowable Lateral Bearing Pressure	200 psf/ft

Caisson Footing

Constrained Base	No
Diameter, b	2.00 ft
Vertical Reinforcing Bar Size	#6
Top Depth to Ignore for Poor Soil Conditions	0.75 ft
Depth Calculation Status	OK
Effective Height, h	3.8
S1	0.23
S3	0.70
A	1.60 ft
Assumed Depth (not including ignored top depth)	3.48 ft
Required Depth (not including ignored top depth)	✓ 3.48 ft
Concrete Strength, f'$_c$	2500 psi
Minimum Diameter for Structural Plain Concrete Use	0.99 ft
Required Reinforcing Type	T&S Only
Minimum Reinforcing Ratio	0.50%
Minimum Reinforcing, $A_{s\text{-}min}$	2.26 sq in
Required Flexural Reinforcing Ratio	0.00%
Required Flexural Reinforcing, A_s	0.00 sq in
Controlling Reinforcing, $A_{s\text{-}req'd}$	2.26 sq in
(12) #4 Bars	2.40 sq in
(8) #5 Bars	2.48 sq in
(6) #6 Bars	2.64 sq in
(4) #7 Bars	2.40 sq in
(4) #8 Bars	3.16 sq in

Caisson Footing Design Summary

Footing Diameter, b	2.00 ft	
Footing Depth, D	4.25 ft	
Estimated Volume	0.5 yd3	**Stirrup Size & Spacing**
Selected Bar Size	#6	#4
Required Quantity	6	9.0 in

IBC Table 1806.2 - Allowable Foundation and Lateral Pressure

Class of Materials		Allowable Bearing Pressures	
		Vertical	Lateral
		psf	*psf/ft*
1	Crystalline bedrock	12000	1200
2	Sedimentary and foliated rock	4000	400
3	Sandy gravel and/or gravel (GW and GP)	3000	200
4	Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2000	150
5	Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1500	100
Geotech	Geotechnical study is applicable	--	--

Note: If structure is a sign or flagpole, the lateral bearing pressure value from above has been doubled at left per IBC 1806.3.4 (only for Class of Materials 1-5)

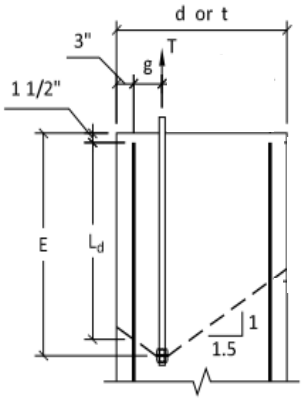
Note: If pole is directly embedded into caisson footing, the steel pole is deemed to provide footing reinforcement for flexural loads applied to the footing. If anchor bolts are used and the "Diameter, b" exceeds "Minimum Diameter for Structural Plain Concrete Use" value, ACI 318 does not require reinforcement in footing since an unreinforced section is sufficient to resist the flexural loads applied to the footing. However, office standard practice is to provide at minimum 0.18% in a caisson footing due to the presence of anchor bolts, primarily due to the need to develop the anchor bolt tensile forces with the longitudinal reinforcing.

Anchor Bolt Design

# of Bolts in Tension	2	
# of Bolts in Shear	4	
Distance Between Plate and Footing	1.5 in	
Tension, T_a	0.6 k	
Shear, V_a	0.1 k	
Moment, M_a	0.1 k-in	
Area, A_b	0.44 sq in	
Section Modulus, S_b	0.04 in3	
Yield Stress, F_y	36.0 ksi	
Ultimate Stress, F_u	58.0 ksi	
Nominal Shear Stress, F_{nv}	23.2 ksi	
Nominal Tensile Stress, F_{nt}	43.5 ksi	
Nominal Effective Tensile Stress, F'_{nt}	43.5 ksi	
Shear / Tension Safety Factor, $\Omega_{v/t}$	2	
Allowable Shear Stress, F_v	11.6 ksi	
Allowable Tensile Stress, F_t	21.8 ksi	
Nominal Bending Sress, F_{nb}	57.6 ksi	
Bending Safety Factor, Ω_b	1.67	
Allowable Bending Stress, F_b	34.5 ksi	
Actual Shear Stress, f_v	0.2 ksi	
Actual Tensile Stress, f_t	1.5 ksi	
Actual Bending Stress, f_b	2.9 ksi	
Combined Stress Ratio	15%	**OK**

Anchor Bolt Embedment Into Caisson or Vertical Slab Footing

	Caisson		Vertical Slab
Caisson Diameter, d	2.0 ft		
Caisson Vertical Bar Size	#6		
Caisson Vertical Bar Quantity	6		
Vertical Slab Thickness, t	--		
Vertical Slab Width, b	--		
Vertical Slab Vertical Bar Size	--		
Vertical Slab Vertical Bar Spacing	--		
Footing Reinforcing in Tensile Face, $A_{s\text{-}prov}$	1.33 sq in		
Clear Cover to Reinforcing	3.0 in		
Reinforcing to Bolt Gage Tension Face, g	4.6 in		
Reinforcing to Bolt Gage Compression Face, g'	13.0 in		
Total Tension on Bolt Group, T_{total}	1.3 k		
Reinforcing Req'd to Develop Tension, $A_{s\text{-}req'd}$	0.04 sq in		
Excess Reinforcing Ratio, $A_{s\text{-}req'd}/A_{s\text{-}prov}$	3%		
Excess Reinforcement Reduction (25% min)	25%		
Development Length, L_d	36 in		
Reduced Development Length, L'_d	12 in		
Minimum Required Embedment Depth, E	17 in		



Straight Reinforcing Development Diagram

STRUCTURAL CALCULATIONS FOR:

McDonald's

48" DIRECTIONAL

CALCULATIONS CONTAINED HEREIN ARE SUITABLE FOR THE THE FOLLOWING CODE REQUIREMENTS:

2021 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

2018 IBC / ASCE 7-16 - UP TO AND INCLUDING 130 MPH

WIND DATA

Building Code	2021 / 2018 IBC	Importance Factor, I	1.0	Damping Ratio, β	0.005
Wind Load Criteria	ASCE 7-16	Directionality Factor, K_d [2]	0.85	Natural Frequency, n_1	11.24 Hz
Wind Speed, V	130 mph	Topography Factor, K_{zt}	1.0	Gust Effect Factor, G	0.85
Exposure Category	C	Base Pressure, $\gamma(q_z/K_z)$	22.1 psf	ASD Wind Load Factor, γ [3]	0.6
Wind Pressure Override per Jurisdiction Requirement	0 psf				

DEFLECTION ANALYSIS

Deflection Limit		H/60
Deflection at 0.7*W		0.06 in
Deflection Ratio	✓	H/915

Notes: *(1) Loading values in chart below are based upon average K_z values for each segment. Actual values are calculated on hidden sheet using derived V-M equations. Chart is provided for information purposes only.*
(2) Wind directionality (K_d) factor is 0.95 for Single Pole (Round) segments instead of 0.85. The C_f value from Fig. 6-21 has been increased by 0.95/0.85 to account for this variation.
(3) Wind pressures listed below have already been multiplied by the ASD Wind Load Factor, γ.

GEOMETRY INPUT [1] ***Monument:*** No

No. of Poles: 2 No. of Footings: 1

Section	Location	Type	Height	Width	Horiz. Offset	Area	Top Elev.	Centroid	K_z	C_f	Wind Press.	Support Pole Loads			Footing Loads		
												Trib. Factor	Shear	Moment	Trib. Factor	Shear	Moment
			ft	ft	ft	sq ft	ft	ft			psf		kips	k-ft		kips	k-ft
1	Base	Single Pole (Round)	0.25	2.00		0.5	0.3	0.1	0.85	0.78	12.5	1.0	0.0	0.0	2.0	0.0	0.0
2		Single Pole (Not Round)	1.13	0.25		0.3	1.4	0.8	0.85	1.71	27.1	1.0	0.0	0.0	2.0	0.0	0.0
3		Multiple Poles w/ Cabinet	3.00	1.92		5.8	4.4	2.9	0.85	1.67	26.6	0.7	0.1	0.3	1.0	0.2	0.4
4		None				0.0	4.4	4.4	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
5		None				0.0	4.4	4.4	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
6		None				0.0	4.4	4.4	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
7		None				0.0	4.4	4.4	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
8		None				0.0	4.4	4.4	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
9		None				0.0	4.4	4.4	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
10	Top	None				0.0	4.4	4.4	0.85	1.46	23.2	0.0	0.0	0.0	0.0	0.0	0.0
		Overall Height:	4.38 ft				***Summation based upon averages above:***						**0.1**	**0.3**		**0.2**	**0.5**
		Column Spacing:	1.67 ft				***Actual base reactions based upon V-M equations:***						**0.1**	**0.3**		**0.2**	**0.5**

SUPPORT POLE DESIGN SUMMARY **MATERIAL =** ALUMINUM **ALLOY =** 6061-T6W (Welded properties used for base plate connection)

Base Elev	Section	Axis	Required Strength Values (ASD)				Allowable Strength Values (ASD)				Unity Ratios				Interaction Ratios		Status
			V_r	M_r	T_r	P_r	V_c	M_c	T_c	P_c	V_r/V_c	M_r/M_c	T_r/T_c	P_r/P_c	P-M	P-M-V-T	
ft			kips	kip-ft	kip-ft	kips	kips	kip-ft	kip-ft	kips							
0.25	RT 3 x 3 x 0.250	Strong	0.1	0.3	0.0	0.1	483.3	1.9	119.9	13.5	3.5%	16.3%	0.0%	0.4%	16.7%	0.0%	✓
0.00	None	Strong	0.1	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.1	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.1	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.1	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.1	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.1	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.1	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	0.1	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓

ELEMENT DESIGN LOCATIONS, LOADS AND DISPLACEMENTS

Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ	Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ
	ft		kips	kip-ft	kip-ft	kips	radians	in		ft		kips	kip-ft	kip-ft	kips	radians	in
1	0.00	Base Plate	0.1	0.3	0.0	0.1	0.0	0.0	3	0.00	Match Plate 2	0.1	0.3	0.0	0.1	0.000	0.00
2	0.00	Match Plate 1	0.1	0.3	0.0	0.1	0.0	0.0	4	0.00	Torsion Tube	0.1	0.3	0.0	0.1	0.000	0.00

PLATE DESIGN SUMMARY

Type	Plate Dimensions				Bolts								Weld		Status
	N	B	D	t	Number	d_b	N_{edge}	B_{edge}	Circle Diamete	Material	Embed in Caisson / Vertical Slab	Embed in	Size	Gussets	
	in	in	in	in		in	in	in	in		in	in	in		
✓ Rectangular Base Plate	7	7	--	0.5	4	0.5	1	1	--	F1554 Grade 36	20	N/A	0.188	No	OK
☐ Circular Base Plate															
☐ Match Plate 1 (Lower)															
☐ Match Plate 1 (Upper)															
☐ Match Plate 2 (Lower)															
☐ Match Plate 2 (Upper)															

FOUNDATION DESIGN SUMMARY

Type	Diameter	Width	Thickness	Length	Depth	Volume	Reinforcing	Status	Allowable Soil Pressure
	ft	ft	ft	ft	ft	CY			
✓ Caisson	2.00	--	--	--	3.50	0.41	(4) #6 Vert. w/ #4 Ties @ 9 in o.c. and (6) @ 4 in o.c. Top	OK	200 psf/ft
☐ Vertical Slab									
☐ Spread									

FOUNDATION DESIGN

Footing Loads

Axial, P_a	0.1 k
Moment, M_a	0.5 k-ft
Shear, V_a	0.2 k
Base Column to Footing Connection Type	Base Plate

Footing and Soils Data

Concrete Strength, f'$_c$	2500 psi
Materials Class	5
Sign or Flagpole	Yes
Allowable Vertical Bearing Pressure	1500 psf
Allowable Lateral Bearing Pressure	200 psf/ft

Caisson Footing

Constrained Base	No
Diameter, b	2.00 ft
Vertical Reinforcing Bar Size	#6
Top Depth to Ignore for Poor Soil Conditions	0.75 ft
Depth Calculation Status	OK
Effective Height, h	2.5
S1	0.17
S3	0.51
A	1.24 ft
Assumed Depth (not including ignored top depth)	2.56 ft
Required Depth (not including ignored top depth)	✓ 2.56 ft
Concrete Strength, f'$_c$	2500 psi
Minimum Diameter for Structural Plain Concrete Use	0.72 ft
Required Reinforcing Type	T&S Only
Minimum Reinforcing Ratio	0.18%
Minimum Reinforcing, $A_{s\text{-}min}$	0.81 sq in
Required Flexural Reinforcing Ratio	0.00%
Required Flexural Reinforcing, A_s	0.00 sq in
Controlling Reinforcing, $A_{s\text{-}req'd}$	0.81 sq in
(6) #4 Bars	1.20 sq in
(4) #5 Bars	1.24 sq in
(4) #6 Bars	1.76 sq in
(4) #7 Bars	2.40 sq in
(4) #8 Bars	3.16 sq in

Caisson Footing Design Summary

Footing Diameter, b	2.00 ft	
Footing Depth, D	3.50 ft	
Estimated Volume	0.4 yd3	**Stirrup Size & Spacing**
Selected Bar Size	#6	#4
Required Quantity	4	9.0 in

IBC Table 1806.2 - Allowable Foundation and Lateral Pressure

Class of Materials		Allowable Bearing Pressures	
		Vertical	Lateral
		psf	*psf/ft*
1	Crystalline bedrock	12000	1200
2	Sedimentary and foliated rock	4000	400
3	Sandy gravel and/or gravel (GW and GP)	3000	200
4	Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2000	150
5	Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1500	100
Geotech	Geotechnical study is applicable	--	--

Note: If structure is a sign or flagpole, the lateral bearing pressure value from above has been doubled at left per IBC 1806.3.4 (only for Class of Materials 1-5)

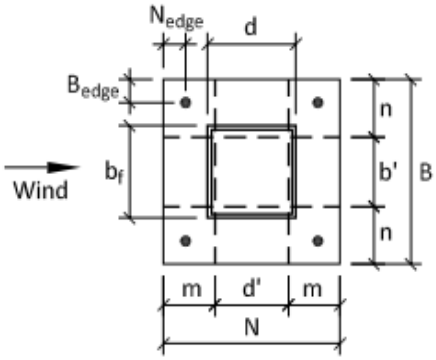
Note: If pole is directly embedded into caisson footing, the steel pole is deemed to provide footing reinforcement for flexural loads applied to the footing. If anchor bolts are used and the "Diameter, b" exceeds "Minimum Diameter for Structural Plain Concrete Use" value, ACI 318 does not require reinforcement in footing since an unreinforced section is sufficient to resist the flexural loads applied to the footing. However, office standard practice is to provide at minimum 0.18% in a caisson footing due to the presence of anchor bolts, primarily due to the need to develop the anchor bolt tensile forces with the longitudinal reinforcing.

RECTANGULAR BASE PLATE DESIGN

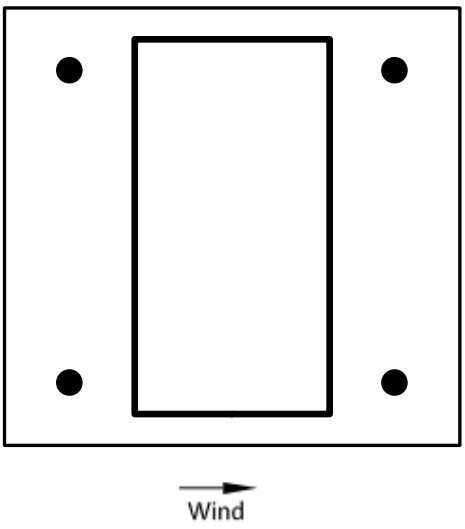
RT 3" x 6" x 1/8" IS USED AS A PLACEHOLDER FOR BASE PLATE CALCULATIONS

Input Parameters

Column Size	RT 3 x 6 x 1/8	
Column Type	AL_TUBE	
Axis	Weak	
Depth or Diameter, d	3.0 in	
Width, b_f	6.0 in	
Plate Length, N	7.0 in	OK
Plate Width, B	7.0 in	
Plate Thickness, t	0.50 in	OK
Edge Distance, N_{edge}	1.00 in	OK
Edge Distance, B_{edge}	1.00 in	OK
Bolt Configuration	Flange	
# per Flange Side	2	
Diameter, d_b	0.50 in	OK
Bolt Material	F1554 Grade 36	
Embedment Depth in Caisson / Vert. Slab	20 in	OK
Embedment Depth in Spread Footing		N/A
Grout Bed	No	
Fillet Weld Size at Column Base	0.19 in	OK
Gussets (If yes, reduce req'd plate thickness by 20%)	No	
Second Fillet Weld at Inside of Column	No	
Weld Group Section Modulus With Gussets		



Base Plate Dimensions Diagram



Bolt Configuration Layout

Custom Bolt Configuration Entry	Coordinates from Column Center		
Bolt Number	**X**		**Y**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Column Loads

Axial, P_a	0.1 k
Moment, M_a	0.5 k-ft
Shear, V_a	0.2 k

Base Plate Dimensions

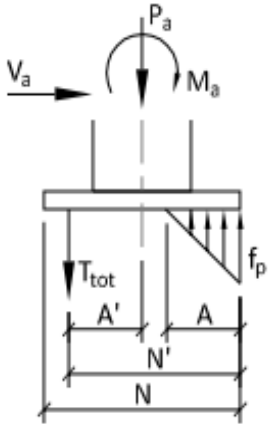
Plate Area, A_1	49.0 sq in
Effective Plate Length, m	2.1 in
Effective Plate Width, n	1.1 in
Effective Column Depth, d'	2.9 in
Effective Column Width, b'	4.8 in
C.G. of Bolt Group from Centerline, A'	2.5 in
C.G. of Bolt Group from Plate Edge, N'	6.0 in

Footing Information

Concrete Strength, f'_c	2500 psi
Caisson Footing Bearing Surface Area	3.1 sf
Vertical Slab Footing Bearing Surface Area	999999.0 sf
Spread Footing Bearing Surface Area	999999.0 sf
Foundation Area, A_2	3.1 sf

Base Plate Forces Per Triangular Pressure Distribution

Eccentricity, e	63.7 in
Kern Eccentricity, e_{kern}	1.2 in
Bearing Safety Factor, $\Omega_{bearing}$	2.5
Bearing Stress at Edge, f_p	1.700 ksi
Bearing Stress at Column, f_{p1}	0.000 ksi
Bearing Resultant, f'	35.7 k
Bearing Length, A	0.2 in
Total Tension on Bolt Group, T_{total}	0.9 k



Force Distribution Diagram

Required Base Plate Thickness

Base Plate Yield Stress, F_y	7.5 ksi
Bearing Moment, $M_{a\text{-}pl\text{-}bearing}$	0.3 k-in/in
Tension Moment, $M_{a\text{-}pl\text{-}tension}$	0.2 k-in/in
Controlling Moment, $M_{a\text{-}pl\text{-}max}$	0.3 k-in/in
Required Plate Thickness, $t_{pl\text{-}reqd}$	0.50 in

Column Base Weld to Base Plate

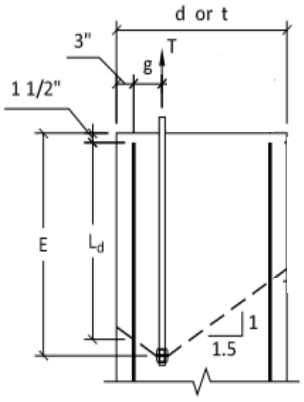
Fillet Weld Size	0.1875	
Column Type	AL_TUBE	
Depth or Diameter, d	3.0 in	
Width, b	6.0 in	
Allowable Weld Stress, F_w/Ω	5.0 ksi	
Section Modulus of Weld w/out Gussets	21.00 in2	
Weld Stress Without Gussets, f_w	1.6 ksi	**OK**
Custom Section Modulus With Gussets	0.00 in2	
Weld Stress With Gussets, $f_{w\text{-}gussets}$	0.0 ksi	**OK**

Anchor Bolt Design

# of Bolts in Tension	2	
# of Bolts in Shear	4	
Distance Between Plate and Footing	1.5 in	
Tension, T_a	0.4 k	
Shear, V_a	0.0 k	
Moment, M_a	0.1 k-in	
Area, A_b	0.20 sq in	
Section Modulus, S_b	0.01 in3	
Yield Stress, F_y	36.0 ksi	
Ultimate Stress, F_u	58.0 ksi	
Nominal Shear Stress, F_{nv}	23.2 ksi	
Nominal Tensile Stress, F_{nt}	43.5 ksi	
Nominal Effective Tensile Stress, F'_{nt}	43.5 ksi	
Shear / Tension Safety Factor, $\Omega_{v/t}$	2	
Allowable Shear Stress, F_v	11.6 ksi	
Allowable Tensile Stress, F_t	21.8 ksi	
Nominal Bending Sress, F_{nb}	57.6 ksi	
Bending Safety Factor, Ω_b	1.67	
Allowable Bending Stress, F_b	34.5 ksi	
Actual Shear Stress, f_v	0.2 ksi	
Actual Tensile Stress, f_t	2.2 ksi	
Actual Bending Stress, f_b	5.5 ksi	
Combined Stress Ratio	26%	**OK**

Anchor Bolt Embedment Into Caisson or Vertical Slab Footing

	Caisson		Vertical Slab
Caisson Diameter, d	2.0 ft		
Caisson Vertical Bar Size	#6		
Caisson Vertical Bar Quantity	4		
Vertical Slab Thickness, t	--		
Vertical Slab Width, b	--		
Vertical Slab Vertical Bar Size	--		
Vertical Slab Vertical Bar Spacing	--		
Footing Reinforcing in Tensile Face, $A_{s\text{-}prov}$	0.88 sq in		
Clear Cover to Reinforcing	3.0 in		
Reinforcing to Bolt Gage Tension Face, g	6.1 in		
Reinforcing to Bolt Gage Compression Face, g'	11.5 in		
Total Tension on Bolt Group, T_{total}	0.9 k		
Reinforcing Req'd to Develop Tension, $A_{s\text{-}req'd}$	0.03 sq in		
Excess Reinforcing Ratio, $A_{s\text{-}req'd}/A_{s\text{-}prov}$	3%		
Excess Reinforcement Reduction (25% min)	25%		
Development Length, L_d	36 in		
Reduced Development Length, L'_d	12 in		
Minimum Required Embedment Depth, E	18 in		



Straight Reinforcing Development Diagram

STRUCTURAL CALCULATIONS FOR:

McDonald's #43903

Puyallup, WA

MONUMENT

WIND DATA

Building Code	2021 WASBC	Importance Factor, I	1.0	Damping Ratio, β	0.005
Wind Load Criteria	ASCE 7-16	Directionality Factor, K_d [2]	0.85	Natural Frequency, n_1	2.16 Hz
Wind Speed, V	110 mph	Topography Factor, K_{zt}	1.0	Gust Effect Factor, G	0.85
Exposure Category	C	Base Pressure, $\gamma(q_z/K_z)$	15.8 psf	ASD Wind Load Factor, γ [3]	0.6
Wind Pressure Override per Jurisdiction Requirement	0 psf				

DEFLECTION ANALYSIS

Deflection Limit		H/60
Deflection at 0.7*W		0.98 in
Deflection Ratio	✓	H/122

Notes: (1) Loading values in chart below are based upon average K_z values for each segment. Actual values are calculated on hidden sheet using derived V-M equations. Chart is provided for information purposes only.
(2) Wind directionality (K_d) factor is 0.95 for Single Pole (Round) segments instead of 0.85. The C_f value from Fig. 6-21 has been increased by 0.95/0.85 to account for this variation.
(3) Wind pressures listed below have already been multiplied by the ASD Wind Load Factor, γ.

GEOMETRY INPUT [1] ***Monument:*** Yes

No. of Poles: 1 No. of Footings: 1

Section	Location	Type	Height	Width	Horiz. Offset	Area	Top Elev.	Centroid	K_z	C_f	Wind Press.	Support Pole Loads Trib. Factor	Shear	Moment	Footing Loads Trib. Factor	Shear	Moment
			ft	*ft*	*ft*	*sq ft*	*ft*	*ft*			*psf*		*kips*	*k-ft*		*kips*	*k-ft*
1	Base	Single Pole w/ Cabinet	0.50	7.50		3.8	0.5	0.3	0.85	1.30	14.8	1.0	0.1	0.0	1.0	0.1	0.0
2		Single Pole w/ Cabinet	9.50	7.00		66.5	10.0	5.7	0.85	1.52	17.3	1.0	1.2	6.6	1.0	1.2	6.6
3		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
4		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
5		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
6		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
7		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
8		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
9		None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
10	Top	None				0.0	10.0	10.0	0.85	1.46	16.6	0.0	0.0	0.0	0.0	0.0	0.0
		Overall Height: 10.00 ft						***Summation based upon averages above:***					**1.2**	**6.6**		**1.2**	**6.6**
								Actual base reactions based upon V-M equations:					**1.2**	**6.7**		**1.2**	**6.7**

SUPPORT POLE DESIGN SUMMARY **MATERIAL =** STEEL

Base Elev	Section	Axis	Required Strength Values (ASD) V_r	M_r	T_r	P_r	Allowable Strength Values (ASD) V_c	M_c	T_c	P_c	Unity Ratios V_r/V_c	M_r/M_c	T_r/T_c	P_r/P_c	Interaction Ratios P-M	P-M-V-T	Status
ft			*kips*	*kip-ft*	*kip-ft*	*kips*	*kips*	*kip-ft*	*kip-ft*	*kips*							
0.00	HSS4X4X1/4	Strong	1.2	6.7	1.7	0.8	28.3	10.8	9.0	20.3	4.3%	62.0%	18.8%	4.1%	66.0%	0.0%	✓
0.00	None	Strong	1.2	6.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.2	6.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.2	6.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.2	6.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.2	6.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.2	6.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.2	6.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓
0.00	None	Strong	1.2	6.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	✓

ELEMENT DESIGN LOCATIONS, LOADS AND DISPLACEMENTS

Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ	Element	Elev.	Type	V_r	M_r	T_r	P_r	0.7*θ	0.7*δ
	ft		*kips*	*kip-ft*	*kip-ft*	*kips*	*radians*	*in*		*ft*		*kips*	*kip-ft*	*kip-ft*	*kips*	*radians*	*in*
1	0.00	Base Plate	1.2	6.7	1.7	0.8	0.0	0.0	3	0.00	Match Plate 2	1.2	6.7	1.7	0.8	0.000	0.00
2	0.00	Match Plate 1	1.2	6.7	1.7	0.8	0.0	0.0	4	0.00	Torsion Tube	1.2	6.7	1.7	0.8	0.000	0.00

PLATE DESIGN SUMMARY

Type	Plate Dimensions N	B	D	t	Bolts Number	d_b	N_{edge}	B_{edge}	Circle Diamete	Material	Embed in Caisson / Vertical Slab	Embed in	Weld Size	Gussets	Status
	in	*in*	*in*	*in*		*in*	*in*	*in*	*in*		*in*	*in*	*in*		
✓ Rectangular Base Plate	15	15	--	0.75	4	0.75	1.5	1.5	--	F1554 Grade 36	30	N/A	0.188	Yes	OK
☐ Circular Base Plate															
☐ Match Plate 1 (Lower)															
☐ Match Plate 1 (Upper)															
☐ Match Plate 2 (Lower)															
☐ Match Plate 2 (Upper)															

FOUNDATION DESIGN SUMMARY

Type	Diameter	Width	Thickness	Length	Depth	Volume	Reinforcing	Status	Allowable Soil Pressure
	ft	*ft*	*ft*	*ft*	*ft*	*CY*			
☐ Caisson									
✓ Vertical Slab	--	7.50	3.00	--	3.75	3.13	#6 at 12 in o.c. E.W. E.F.	OK	200 psf/ft
☐ Spread									

FOUNDATION DESIGN

Footing Loads

Axial, P_a	0.8 k
Moment, M_a	6.7 k-ft
Shear, V_a	1.2 k
Base Column to Footing Connection Type	Base Plate

Footing and Soils Data

Concrete Strength, f'_c	2500 psi
Materials Class	5
Sign or Flagpole	Yes
Allowable Vertical Bearing Pressure	1500 psf
Allowable Lateral Bearing Pressure	200 psf/ft

Vertical Slab Footing

Constrained Base	No
Width, b	7.50 ft
Thickness, t	3.00 ft
Selected Bar Size	#6
Top Depth to Ignore for Poor Soil Conditions	0.00 ft
Depth Calculation Status	OK
Effective Height, h (ft)	5.52 ft
S1	0.25
S3	0.74
A	1.41 ft
Assumed Depth (not including ignored top depth)	3.71 ft
Required Depth (not including ignored top depth)	✓ 3.71 ft
Concrete Strength, f'_c	2500 psi
Minimum Thickness for Structural Plain Concrete Use	0.66 ft
Required Reinforcing Type	T&S Only
Minimum Reinforcing Ratio Each Face	0.09%
Minimum Reinforcing, $A_{s\text{-}min}$	0.39 sq in/ft
Required Flexural Reinforcing, A_s	0.00 sq in/ft
Controlling Reinforcing, $A_{s\text{-}req'd}$	0.39 sq in/ft
#4 Bars @ 6 in O.C.	0.40 sq in/ft
#5 Bars @ 8 in O.C.	0.47 sq in/ft
#6 Bars @ 12 in O.C.	0.44 sq in/ft
#7 Bars @ 18 in O.C.	0.40 sq in/ft
#8 Bars @ 18 in O.C.	0.53 sq in/ft

Vertical Slab Footing Design Summary

Footing Width, b	7.50 ft
Footing Thickness, t	3.00 ft
Footing Depth, D	3.75 ft
Estimated Volume	3.1 yd3
Selected Bar Size	#6
Required Spacing	12 in o.c.

IBC Table 1806.2 - Allowable Foundation and Lateral Pressure

Class of Materials		Allowable Bearing Pressures	
		Vertical	Lateral
		psf	*psf/ft*
1	Crystalline bedrock	12000	1200
2	Sedimentary and foliated rock	4000	400
3	Sandy gravel and/or gravel (GW and GP)	3000	200
4	Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2000	150
5	Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1500	100
Geotech	Geotechnical study is applicable	--	--

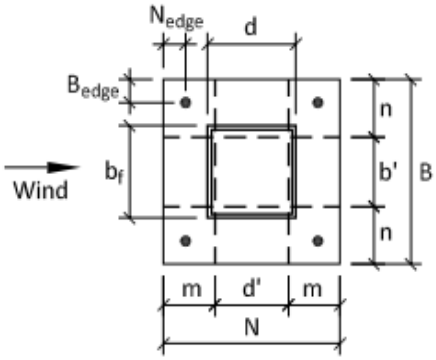
Note: If structure is a sign or flagpole, the lateral bearing pressure value from above has been doubled at left per IBC 1806.3.4 (only for Class of Materials 1-5)

Note: If "Thickness, t" exceeds "Minimum Thickness for Structural Plain Concrete Use" value, ACI 318 does not require any reinforcement in footing since an unreinforced section is sufficient to resist the flexural loads applied to the footing. However, office standard practice is to provide at minimum 0.18% in a vertical slab footing with one-half distributed to each face, normal to the wind direction, of the footing.

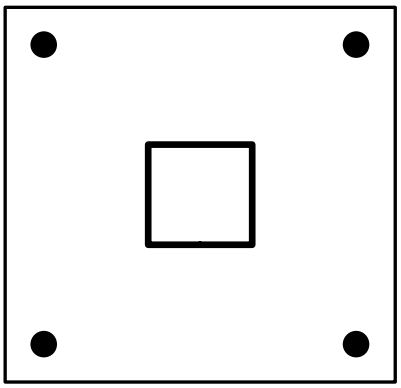
RECTANGULAR BASE PLATE DESIGN

Input Parameters

Column Size	HSS4X4X1/4	
Column Type	HSS_Rect	
Axis	Strong	
Depth or Diameter, d	4.0 in	
Width, b_f	4.0 in	
Plate Length, N	15.0 in	**OK**
Plate Width, B	15.0 in	
Plate Thickness, t	0.75 in	**OK**
Edge Distance, N_{edge}	1.50 in	**OK**
Edge Distance, B_{edge}	1.50 in	**OK**
Bolt Configuration	Flange	
# per Flange Side	2	**OK**
Diameter, d_b	0.75 in	**OK**
Bolt Material	F1554 Grade 36	
Embedment Depth in Caisson / Vert. Slab	30 in	**OK**
Embedment Depth in Spread Footing		**N/A**
Grout Bed	Yes	
Fillet Weld Size at Column Base	0.19 in	**Use Gussets, Fw = 20.26**
Gussets (If yes, reduce req'd plate thickness by 20%)	No	
Second Fillet Weld at Inside of Column	No	
Weld Group Section Modulus With Gussets		



Base Plate Dimensions Diagram



Bolt Configuration Layout

Column Loads

Axial, P_a	0.8 k
Moment, M_a	6.7 k-ft
Shear, V_a	1.2 k

Base Plate Dimensions

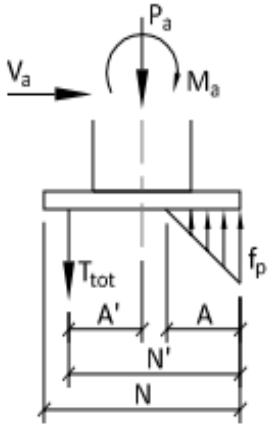
Plate Area, A_1	225.0 sq in
Effective Plate Length, m	5.6 in
Effective Plate Width, n	5.9 in
Effective Column Depth, d'	3.8 in
Effective Column Width, b'	3.2 in
C.G. of Bolt Group from Centerline, A'	6.0 in
C.G. of Bolt Group from Plate Edge, N'	13.5 in

Footing Information

Concrete Strength, f'_c	2500 psi
Caisson Footing Bearing Surface Area	999999.0 sf
Vertical Slab Footing Bearing Surface Area	22.5 sf
Spread Footing Bearing Surface Area	999999.0 sf
Foundation Area, A_2	22.5 sf

Base Plate Forces Per Triangular Pressure Distribution

Eccentricity, e	97.1 in
Kern Eccentricity, e_{kern}	2.5 in
Bearing Safety Factor, $\Omega_{bearing}$	2.5
Bearing Stress at Edge, f_p	1.700 ksi
Bearing Stress at Column, f_{p1}	0.000 ksi
Bearing Resultant, f'	172.1 k
Bearing Length, A	0.5 in
Total Tension on Bolt Group, T_{total}	5.6 k



Force Distribution Diagram

Required Base Plate Thickness

Base Plate Yield Stress, F_y	36.0 ksi
Bearing Moment, $M_{a\text{-}pl\text{-}bearing}$	2.3 k-in/in
Tension Moment, $M_{a\text{-}pl\text{-}tension}$	1.4 k-in/in
Controlling Moment, $M_{a\text{-}pl\text{-}max}$	2.3 k-in/in
Required Plate Thickness, $t_{pl\text{-}reqd}$	0.65 in

Column Base Weld to Base Plate

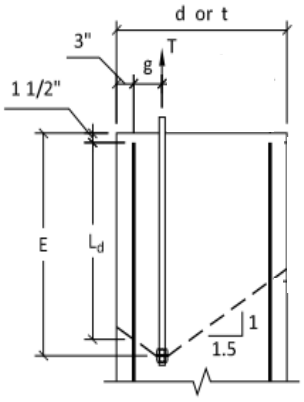
Fillet Weld Size	0.1875	
Column Type	HSS_Rect	
Depth or Diameter, d	4.0 in	
Width, b	4.0 in	
Allowable Weld Stress, F_w/Ω	14.8 ksi	
Section Modulus of Weld w/out Gussets	21.33 in2	
Weld Stress Without Gussets, f_w	20.3 ksi	**NG**
Custom Section Modulus With Gussets	0.00 in2	
Weld Stress With Gussets, $f_{w\text{-}gussets}$	0.0 ksi	**OK**

Anchor Bolt Design

# of Bolts in Tension	2	
# of Bolts in Shear	4	
Distance Between Plate and Footing	1.5 in	
Tension, T_a	2.8 k	
Shear, V_a	0.3 k	
Moment, M_a	0.5 k-in	
Area, A_b	0.44 sq in	
Section Modulus, S_b	0.04 in3	
Yield Stress, F_y	36.0 ksi	
Ultimate Stress, F_u	58.0 ksi	
Nominal Shear Stress, F_{nv}	23.2 ksi	
Nominal Tensile Stress, F_{nt}	43.5 ksi	
Nominal Effective Tensile Stress, F'_{nt}	43.5 ksi	
Shear / Tension Safety Factor, $\Omega_{v/t}$	2	
Allowable Shear Stress, F_v	11.6 ksi	
Allowable Tensile Stress, F_t	21.8 ksi	
Nominal Bending Sress, F_{nb}	57.6 ksi	
Bending Safety Factor, Ω_b	1.67	
Allowable Bending Stress, F_b	34.5 ksi	
Actual Shear Stress, f_v	0.7 ksi	
Actual Tensile Stress, f_t	6.3 ksi	
Actual Bending Stress, f_b	0.0 ksi	
Combined Stress Ratio	29%	**OK**

Anchor Bolt Embedment Into Caisson or Vertical Slab Footing

	Caisson		Vertical Slab
Caisson Diameter, d			--
Caisson Vertical Bar Size			--
Caisson Vertical Bar Quantity			--
Vertical Slab Thickness, t			3.0 ft
Vertical Slab Width, b			7.5 ft
Vertical Slab Vertical Bar Size			#6
Vertical Slab Vertical Bar Spacing			12 in o.c.
Footing Reinforcing in Tensile Face, $A_{s\text{-}prov}$			3.31 sq in
Clear Cover to Reinforcing			3.0 in
Reinforcing to Bolt Gage Tension Face, g			8.6 in
Reinforcing to Bolt Gage Compression Face, g'			21.0 in
Total Tension on Bolt Group, T_{total}			5.6 k
Reinforcing Req'd to Develop Tension, $A_{s\text{-}req'd}$			0.16 sq in
Excess Reinforcing Ratio, $A_{s\text{-}req'd}/A_{s\text{-}prov}$			5%
Excess Reinforcement Reduction (25% min)			25%
Development Length, L_d			36 in
Reduced Development Length, L'_d			12 in
Minimum Required Embedment Depth, E			20 in



Straight Reinforcing Development Diagram