

Project Name: stapf

Date: Thu Nov 06 2025

Location: 1200 Estrella Dr, Santa Barbara, CA 93110,

Number of Modules: 30

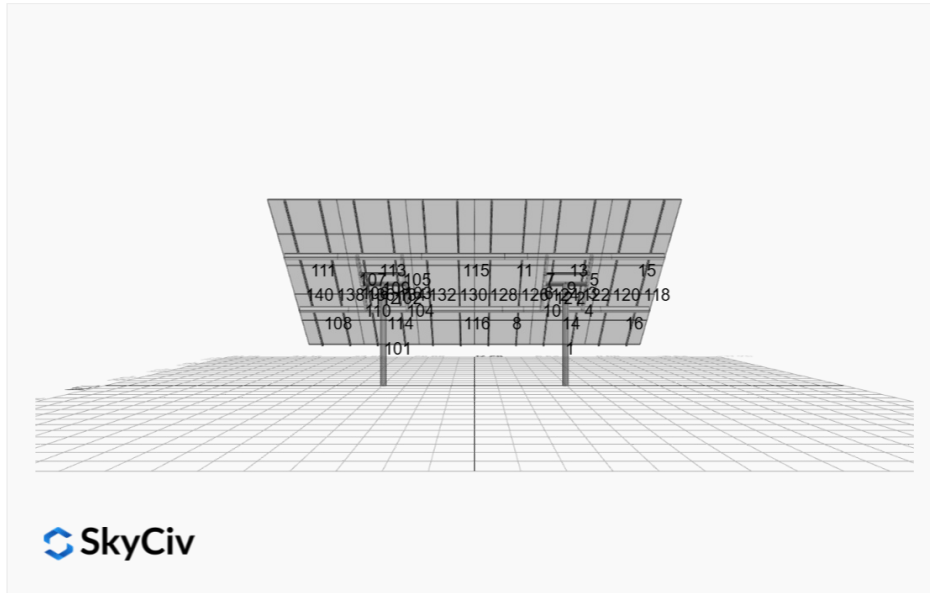
USA

Number of Poles: 2

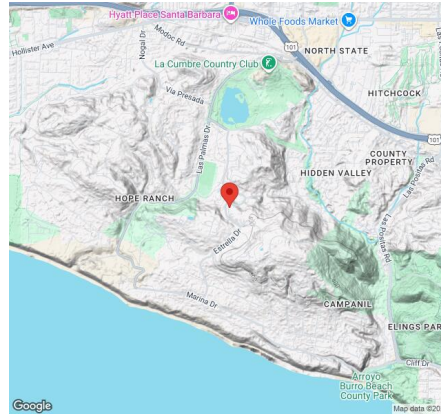
Unique ID: 2P-17-6TOP-SD-57-L-5Hx6W-KL8H

Date Sold:

Dealer: _____



Site Details:



Site Address: 1200 Estrella Dr, Santa Barbara, CA 93110, USA

Array Specifications

Duty Classification:	SD
Module Width:	48.00 in
Module Length:	68.00 in
Number of Rows:	5
Number of Columns:	6
Total Number of Modules:	30
Winter Tilt Angle:	40
Front Edge Clearance:	3
Total Array Height at Tilt:	15.99 ft
Total Frame Length:	34.00 ft
Module Info/Notes:	REC 460
Array Dimensions N/S:	20.21 ft
Array Dimensions E/W:	34.50 ft
Rail Length:	242.50 in
Rail Spacing:	2.88 ft

Support Specifications

Pole Size:	6in Pipe Sch 80
Pole Length above Grade:	9.49 ft
Number of Poles:	2
Pole Spacing:	17 ft

Foundation Specifications

Foundation Type:	round
Foundation Dimensions:	36 in dia.
Foundation Depth (below grade):	8.5 ft
Foundation Volume:	60.08 ft ³

Site Info

Risk Category:	I
Exposure:	B
Soil Classification:	sand
Site Location:	1200 Estrella Dr, Santa Barbara, CA 93110, USA
Wind Speed:	88 mph

Snow Load:

0 psf

Design Disclaimer

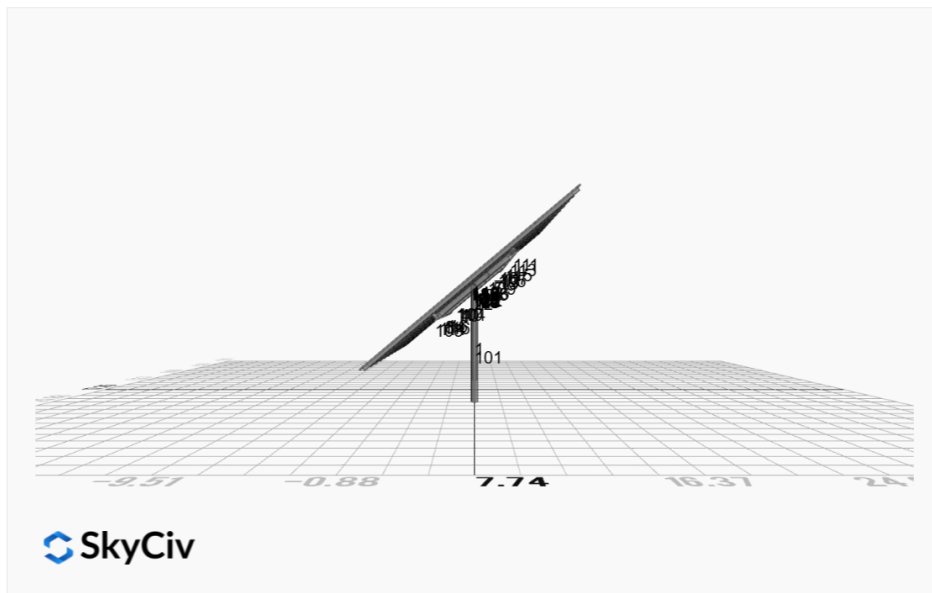
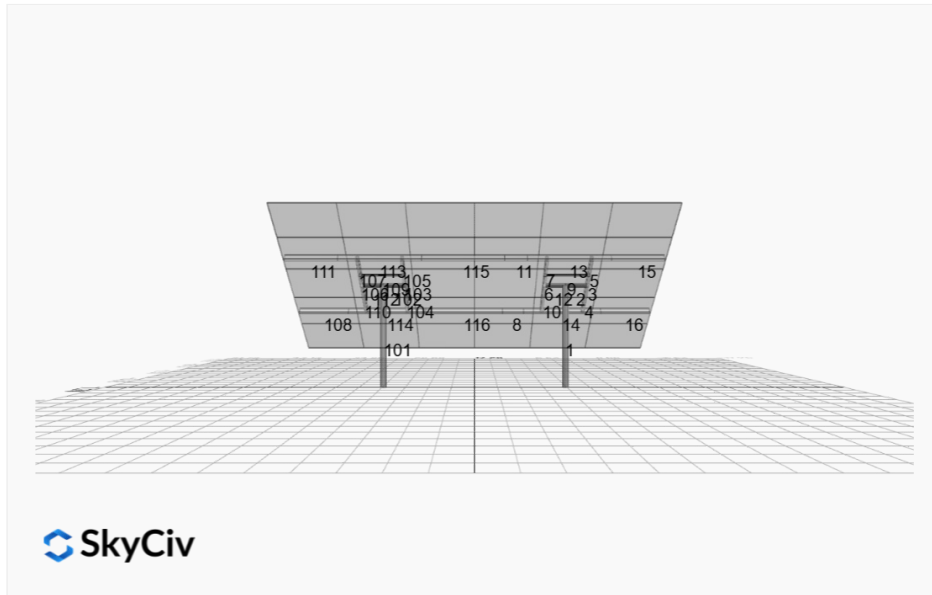
This software should be used for preliminary designs and should not be used as a final design unless reviewed, verified and designed by a qualified structural engineer.

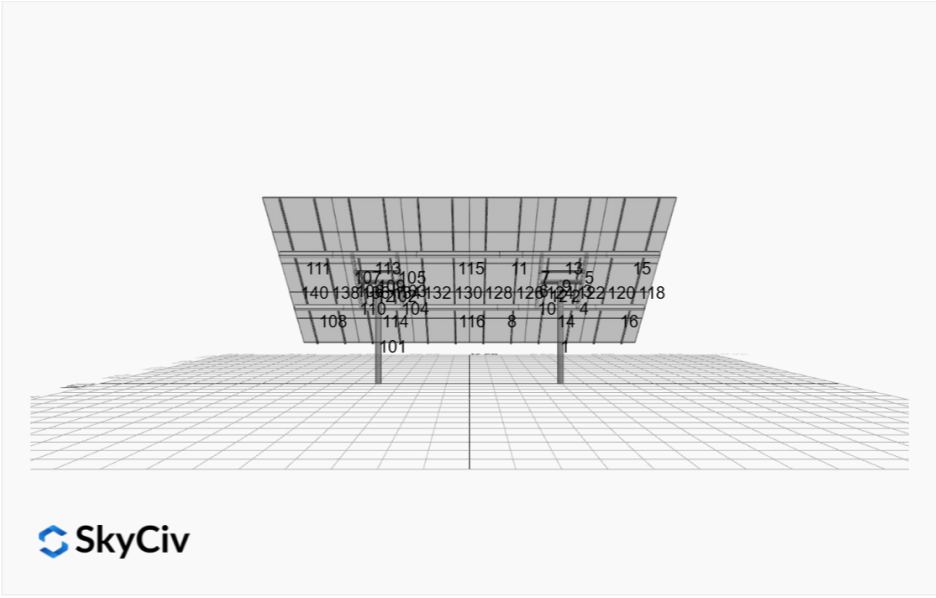
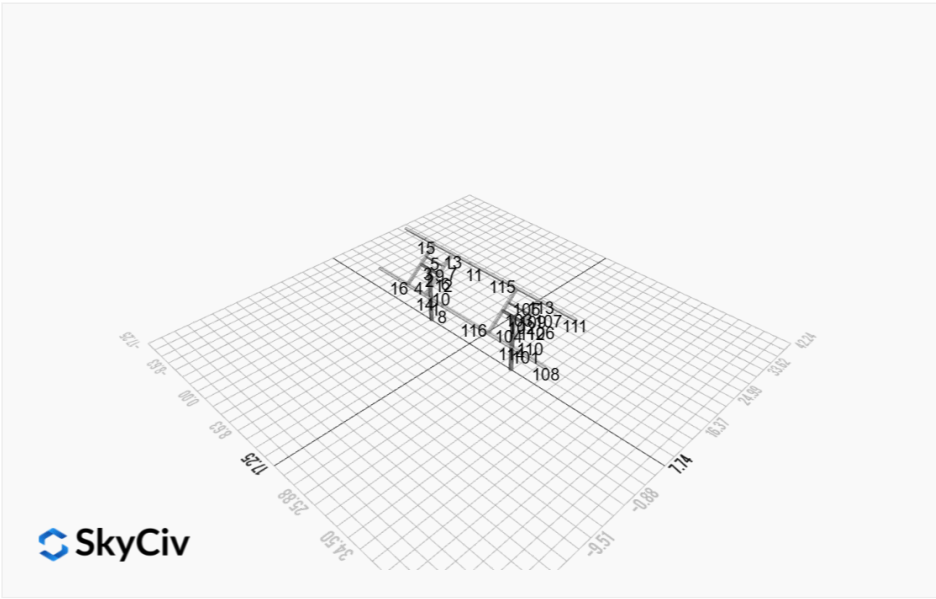
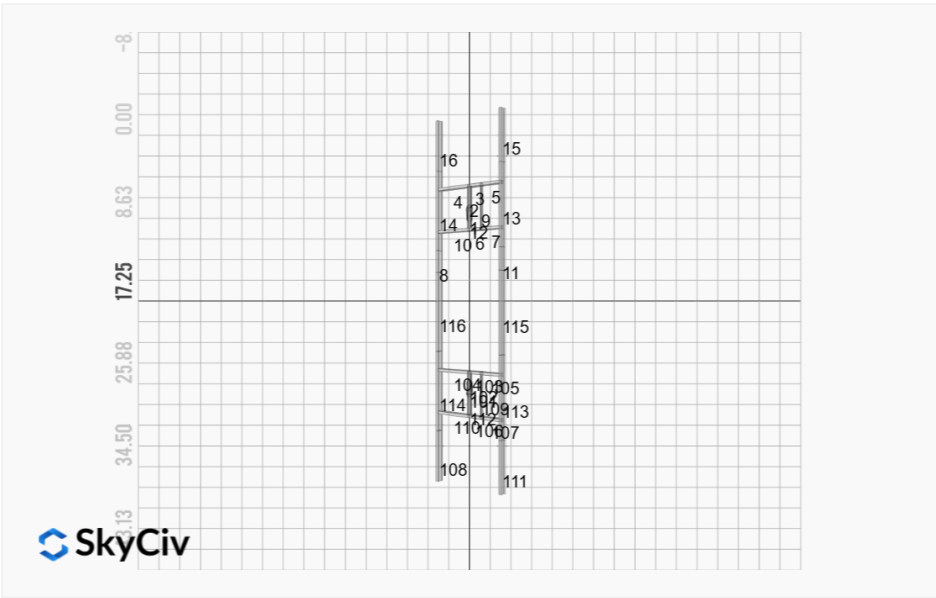
AutoDesigner Input

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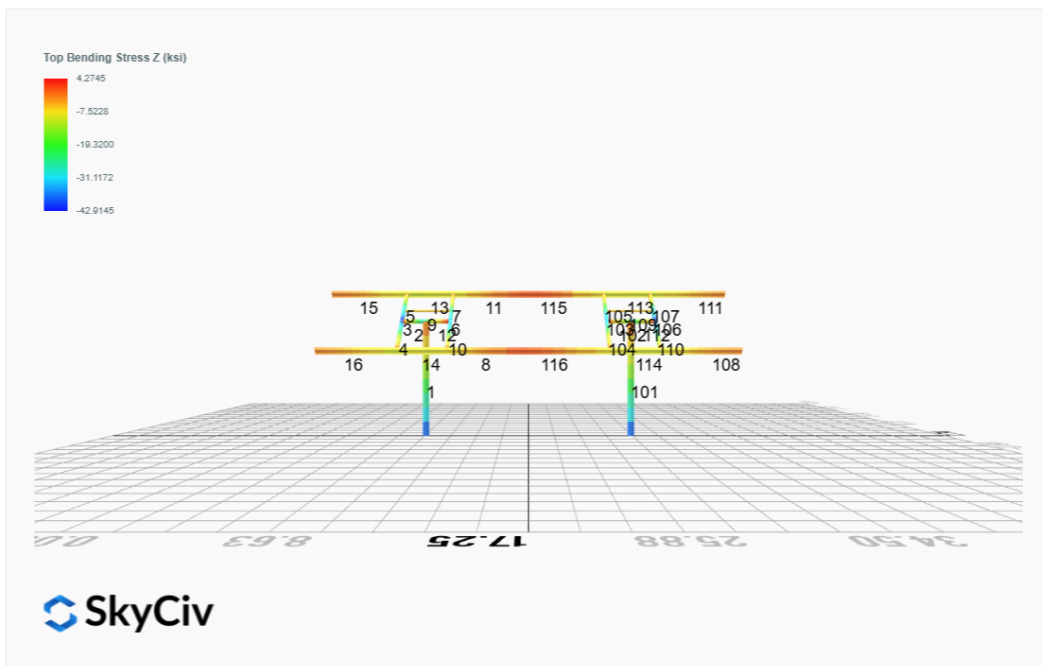
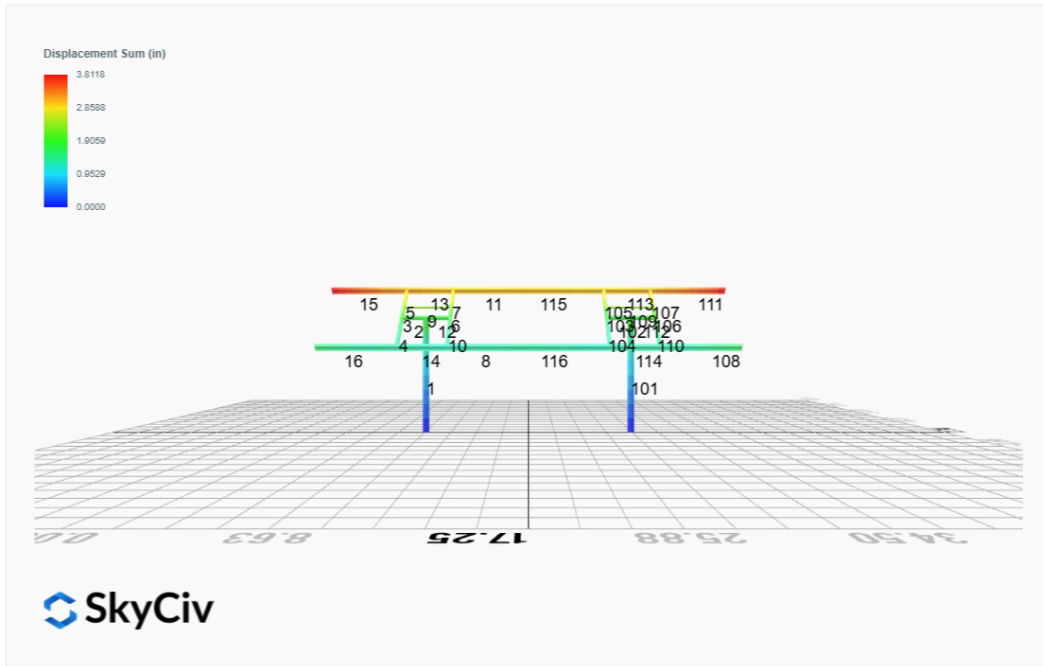
Design Notes:

- Deflection checks are set to L/1 due to manufacturer structural design intent
- Foundation Soil Parameters used in this Autodesign are all estimates, proper geotechnical reports are required to confirm soil profiles
- Wind speeds, snow loads and other site specific results are based on ASCE 7-16
- Steel frame design checks are based on AISC 360-16 LRFD
- Design / analysis of fixings and connections are not carried out by this module.
- Impacts of eccentrically applied, partial or pattern loading are not considered by this module.
- Foundation Design and Sizing is approximate only

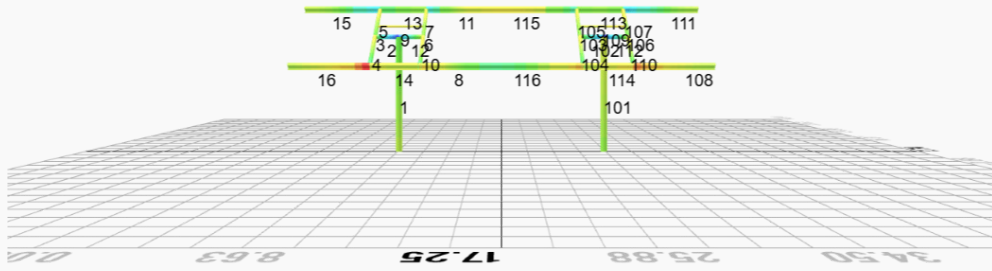




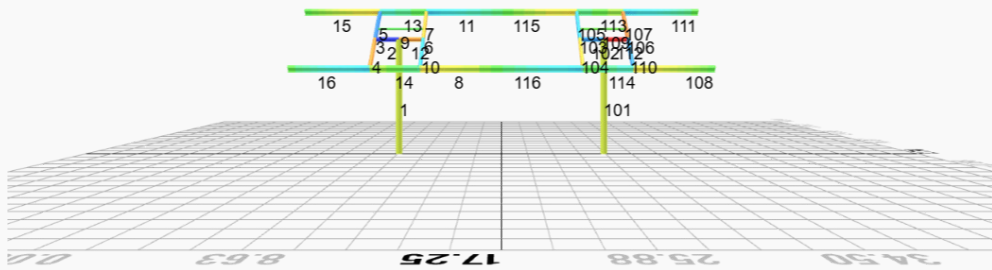
FEM Results (Envelope Worst Case)

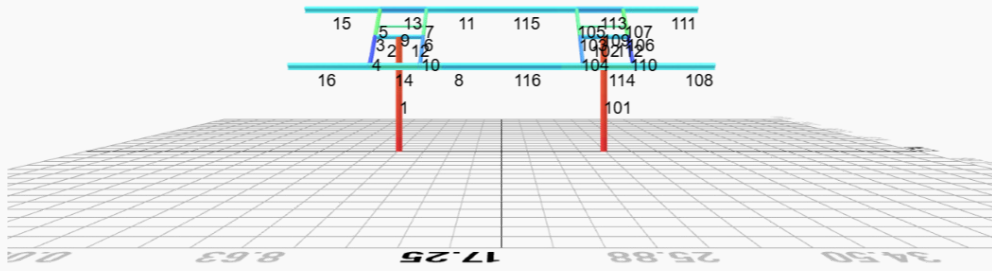
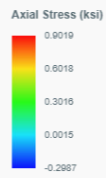


Top Bending Stress Y (ksi)



Shear Stress Y (ksi)





Reaction Forces for Foundation 1 (Node ID#1), (kip, kip-ft)

LRFD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. 1.4D	0.0000	3.2258	-0.0923	-0.2467	0.1787	0.0360
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0000	2.7650	-0.0791	-0.2114	0.1531	0.0291
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0000	2.7650	-0.0791	-0.2114	0.1531	0.0291
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	0.0000	2.7650	-0.0791	-0.2114	0.1531	0.0291
ULS: 5. 1.2D + E + L + 0.2S	0.0000	2.7650	-0.0791	-0.2114	0.1531	0.0291
ULS: 7. 0.9D + 1.0E	0.0000	2.0737	-0.0593	-0.1585	0.1148	0.0199
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.0409	7.5808	-0.3362	-0.8828	0.8522	40.4682
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-4.0409	7.5808	-0.3362	-0.8828	0.8522	40.4682
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	3.2206	-1.0732	0.1252	0.3207	-0.4040	-30.1049
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	2.7345	-0.4938	0.0950	0.2423	-0.3215	-35.1031
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.0409	7.5808	-0.3362	-0.8828	0.8522	40.4682
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-4.0409	7.5808	-0.3362	-0.8828	0.8522	40.4682
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	3.2206	-1.0732	0.1252	0.3207	-0.4040	-30.1049
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	2.7345	-0.4938	0.0950	0.2423	-0.3215	-35.1031
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.0205	5.1729	-0.2075	-0.5466	0.5027	20.0618
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-2.0205	5.1729	-0.2075	-0.5466	0.5027	20.0618
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	1.6103	0.8459	0.0231	0.0550	-0.1254	-15.1442
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	1.3672	1.1356	0.0080	0.0156	-0.0841	-17.6569
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.0205	5.1729	-0.2075	-0.5466	0.5027	20.0618
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-2.0205	5.1729	-0.2075	-0.5466	0.5027	20.0618
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	1.6103	0.8459	0.0231	0.0550	-0.1254	-15.1442
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	1.3672	1.1356	0.0080	0.0156	-0.0841	-17.6569
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-4.0409	6.8895	-0.3163	-0.8296	0.8141	40.3416
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-4.0409	6.8895	-0.3163	-0.8296	0.8141	40.3416
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	3.2206	-1.7644	0.1449	0.3734	-0.4424	-30.0313
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	2.7345	-1.1851	0.1149	0.2953	-0.3602	-35.0056

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	0.0000	2.3042	-0.0659	-0.1761	0.1276	0.0228
ULS: 2. D + L	0.0000	2.3042	-0.0659	-0.1761	0.1276	0.0228
ULS: 3. D + (S or Lr or R)	0.0000	2.3042	-0.0659	-0.1761	0.1276	0.0228
ULS: 3. D + (S or Lr or R)	0.0000	2.3042	-0.0659	-0.1761	0.1276	0.0228
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0000	2.3042	-0.0659	-0.1761	0.1276	0.0228
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0000	2.3042	-0.0659	-0.1761	0.1276	0.0228
ULS: 5b. D + 0.7E	0.0000	2.3042	-0.0659	-0.1761	0.1276	0.0228
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	0.0000	2.3042	-0.0659	-0.1761	0.1276	0.0228
ULS: 8. 0.6D + 0.7E	0.0000	1.3825	-0.0395	-0.1056	0.0766	0.0120
ULS: 5a. D + 0.6W_Wind downforce Case A only	-2.4246	5.1936	-0.2200	-0.5784	0.5472	24.0603
ULS: 5a. D + 0.6W_Wind downforce Case B only	-2.4246	5.1936	-0.2200	-0.5784	0.5472	24.0603
ULS: 5a. D + 0.6W_Wind uplift Case A only	1.9324	0.0013	0.0567	0.1434	-0.2067	-18.1259
ULS: 5a. D + 0.6W_Wind uplift Case B only	1.6407	0.3489	0.0386	0.0962	-0.1573	-21.1282
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-1.8184	4.4713	-0.1815	-0.4777	0.4423	18.0012
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-1.8184	4.4713	-0.1815	-0.4777	0.4423	18.0012
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.4493	0.5770	0.0261	0.0636	-0.1231	-13.6175
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.2305	0.8377	0.0125	0.0282	-0.0860	-15.8729

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-1.8184	4.4713	-0.1815	-0.4777	0.4423	18.0012
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-1.8184	4.4713	-0.1815	-0.4777	0.4423	18.0012
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.4493	0.5770	0.0261	0.0636	-0.1231	-13.6175
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.2305	0.8377	0.0125	0.0282	-0.0860	-15.8729
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-2.4246	4.2720	-0.1936	-0.5076	0.4962	23.9577
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-2.4246	4.2720	-0.1936	-0.5076	0.4962	23.9577
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	1.9324	-0.9204	0.0830	0.2137	-0.2578	-18.0700
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	1.6407	-0.5728	0.0650	0.1668	-0.2086	-21.0531

Worst Case Reactions (LRFD)

Note: Downforce / downwind wind load cases are assumed to govern.

Result	Value (kip, kip-ft)
Axial	7.5808
Shear X	-4.0409
Shear Z	-0.3362
Moment X	-0.8828
Moment Y (Twist)	0.8522
Moment Z	40.4682

Worst Case Reactions (ASD)

Note: Downforce / downwind wind load cases are assumed to govern.

Result	Value (kip, kip-ft)
Axial	5.1936
Shear X	-2.4246
Shear Z	-0.2200
Moment X	-0.5784
Moment Y (Twist)	0.5472
Moment Z	24.0603

Reaction Forces for Foundation 2 (Node ID#101), (kip, kip-ft)

LRFD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. 1.4D	-0.0000	3.2258	0.0923	0.2468	-0.1786	0.0360
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0000	2.7650	0.0791	0.2115	-0.1531	0.0291
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0000	2.7650	0.0791	0.2115	-0.1531	0.0291
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	-0.0000	2.7650	0.0791	0.2115	-0.1531	0.0291
ULS: 5. 1.2D + E + L + 0.2S	-0.0000	2.7650	0.0791	0.2115	-0.1531	0.0291
ULS: 7. 0.9D + 1.0E	-0.0000	2.0737	0.0593	0.1585	-0.1148	0.0199
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.0409	7.5808	0.3362	0.8829	-0.8523	40.4688
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-4.0409	7.5808	0.3362	0.8829	-0.8523	40.4688
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	3.2206	-1.0732	-0.1252	-0.3207	0.4042	-30.1052
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	2.7344	-0.4938	-0.0950	-0.2421	0.3219	-35.1039
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.0409	7.5808	0.3362	0.8829	-0.8523	40.4688
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-4.0409	7.5808	0.3362	0.8829	-0.8523	40.4688
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	3.2206	-1.0732	-0.1252	-0.3207	0.4042	-30.1052
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	2.7344	-0.4938	-0.0950	-0.2421	0.3219	-35.1039
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.0205	5.1729	0.2075	0.5467	-0.5028	20.0621
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-2.0205	5.1729	0.2075	0.5467	-0.5028	20.0621
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	1.6103	0.8459	-0.0231	-0.0549	0.1255	-15.1444
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	1.3672	1.1356	-0.0080	-0.0155	0.0843	-17.6573
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.0205	5.1729	0.2075	0.5467	-0.5028	20.0621
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-2.0205	5.1729	0.2075	0.5467	-0.5028	20.0621
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	1.6103	0.8459	-0.0231	-0.0549	0.1255	-15.1444
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	1.3672	1.1356	-0.0080	-0.0155	0.0843	-17.6573
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-4.0409	6.8895	0.3163	0.8296	-0.8142	40.3421
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-4.0409	6.8895	0.3163	0.8296	-0.8142	40.3421
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	3.2206	-1.7644	-0.1449	-0.3734	0.4425	-30.0316
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	2.7344	-1.1851	-0.1149	-0.2951	0.3605	-35.0062

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	-0.0000	2.3042	0.0659	0.1761	-0.1276	0.0229
ULS: 2. D + L	-0.0000	2.3042	0.0659	0.1761	-0.1276	0.0229
ULS: 3. D + (S or Lr or R)	-0.0000	2.3042	0.0659	0.1761	-0.1276	0.0229
ULS: 3. D + (S or Lr or R)	-0.0000	2.3042	0.0659	0.1761	-0.1276	0.0229
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0000	2.3042	0.0659	0.1761	-0.1276	0.0229
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0000	2.3042	0.0659	0.1761	-0.1276	0.0229
ULS: 5b. D + 0.7E	-0.0000	2.3042	0.0659	0.1761	-0.1276	0.0229
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	-0.0000	2.3042	0.0659	0.1761	-0.1276	0.0229
ULS: 8. 0.6D + 0.7E	-0.0000	1.3825	0.0395	0.1056	-0.0766	0.0120
ULS: 5a. D + 0.6W_Wind downforce Case A only	-2.4246	5.1936	0.2200	0.5784	-0.5472	24.0606
ULS: 5a. D + 0.6W_Wind downforce Case B only	-2.4246	5.1936	0.2200	0.5784	-0.5472	24.0606
ULS: 5a. D + 0.6W_Wind uplift Case A only	1.9324	0.0013	-0.0567	-0.1433	0.2068	-18.1261
ULS: 5a. D + 0.6W_Wind uplift Case B only	1.6407	0.3489	-0.0386	-0.0961	0.1574	-21.1286
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-1.8184	4.4713	0.1815	0.4777	-0.4423	18.0014
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-1.8184	4.4713	0.1815	0.4777	-0.4423	18.0014
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.4493	0.5770	-0.0261	-0.0636	0.1232	-13.6177
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.2305	0.8377	-0.0125	-0.0281	0.0861	-15.8732
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-1.8184	4.4713	0.1815	0.4777	-0.4423	18.0014
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-1.8184	4.4713	0.1815	0.4777	-0.4423	18.0014
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.4493	0.5770	-0.0261	-0.0636	0.1232	-13.6177
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.2305	0.8377	-0.0125	-0.0281	0.0861	-15.8732
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-2.4246	4.2720	0.1936	0.5076	-0.4963	23.9579
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-2.4246	4.2720	0.1936	0.5076	-0.4963	23.9579
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	1.9324	-0.9204	-0.0830	-0.2137	0.2579	-18.0701
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	1.6407	-0.5728	-0.0650	-0.1668	0.2087	-21.0534

Worst Case Reactions (LRFD)

Note: Downforce / downwind wind load cases are assumed to govern.

Result	Value (kip, kip-ft)
Axial	7.5808
Shear X	-4.0409
Shear Z	0.3362
Moment X	0.8829
Moment Y (Twist)	0.8523
Moment Z	40.4688

Worst Case Reactions (ASD)

Note: Downforce / downwind wind load cases are assumed to govern.

Result	Value (kip, kip-ft)
Axial	5.1936
Shear X	-2.4246
Shear Z	0.2200
Moment X	0.5784
Moment Y (Twist)	0.5472
Moment Z	24.0606

Project Details

Design Code: AISC 360-16 LRFD
 Provision: LRFD
 Country: United States
 User Name: sales@mtsolar.us
 Project Name: stapf
 Unit System: imperial

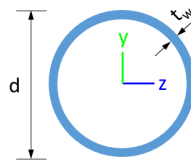


Design Input Information

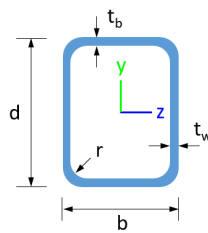
Design Factors			
Φ_t	Φ_c	Φ_b	Φ_v
0.9	0.9	0.9	0.9

Design Materials			
ID	E (ksi)	F_y (ksi)	F_u (ksi)
1	29000	50	65
2	29000	46	62
4	29000	50	62

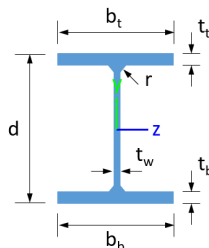
Section Dimensions



ID	Name	d (in)	t_w (in)					
1	2in Pipe Sch 40	2.38	0.15					
4	4in Pipe Sch 40	4.50	0.24					
8	6in Pipe Sch 80	6.63	0.43					



ID	Name	d (in)	b (in)	t_w (in)	t_b (in)	r (in)		
15	HSS5x3x1/8	5.00	3.00	0.12	0.12	0.12		



ID	Name	d (in)	t_w (in)	b_t (in)	b_b (in)	t_t (in)	t_b (in)	r (in)
18	W6x9	5.90	0.17	3.94	3.94	0.21	0.21	0.25

105	79.65	74.30	10.99	6.26	29.14	16.61
106	79.65	74.89	10.99	6.26	29.14	16.61
107	79.65	74.30	10.99	6.26	29.14	16.61
108	120.60	34.69	23.36	6.45	30.09	45.74
109	44.49	40.02	2.63	2.63	13.35	13.35
110	79.65	72.84	10.99	6.26	29.14	16.61
111	120.60	34.69	23.36	6.45	30.09	45.74
112	131.41	130.46	14.87	14.87	39.42	39.42
113	120.60	84.03	19.40	6.45	30.09	45.74
114	120.60	84.03	19.38	6.45	30.09	45.74
115	120.60	84.26	23.36	6.45	30.09	45.74
116	120.60	84.26	21.71	6.45	30.09	45.74

Design Ratio

Member ID	P	M _z	M _y	V _y	V _z	(P,M _z ,M _y)	Worst LC	KL/r	δ	Status
1	0.024	0.707	0.040	0.039	0.003	0.734	#13	0.169	Not Required	Pass
2	0.002	0.503	0.302	0.103	0.055	0.805	#13	0.052	Not Required	Pass
3	0.006	0.785	0.060	0.080	0.010	0.848	#13	0.044	Not Required	Pass
4	0.007	0.740	0.111	0.075	0.020	0.766	#13	0.078	Not Required	Pass
5	0.006	0.486	0.117	0.078	0.023	0.515	#13	0.073	Not Required	Pass
6	0.006	0.641	0.036	0.063	0.004	0.660	#13	0.044	Not Required	Pass
7	0.005	0.399	0.079	0.064	0.016	0.411	#13	0.073	Not Required	Pass
8	0.002	0.063	0.033	0.036	0.005	0.086	#13	0.088	Not Required	Pass
9	0.005	0.086	0.085	0.003	0.002	0.173	#13	0.198	Not Required	Pass
10	0.005	0.599	0.102	0.060	0.020	0.694	#13	0.078	Not Required	Pass
11	0.001	0.066	0.033	0.038	0.005	0.086	#13	0.059	Not Required	Pass
12	0.002	0.348	0.245	0.081	0.047	0.594	#13	0.034	Not Required	Pass
13	0.003	0.263	0.163	0.052	0.007	0.403	#13	0.177	Not Required	Pass
14	0.004	0.255	0.163	0.049	0.007	0.388	#13	0.177	Not Required	Pass
15	0.000	0.117	0.087	0.038	0.005	0.192	#13	Not Required	Not Required	Pass
16	0.000	0.111	0.087	0.036	0.005	0.185	#13	Not Required	Not Required	Pass
101	0.024	0.707	0.040	0.039	0.003	0.734	#13	0.169	Not Required	Pass
102	0.002	0.348	0.245	0.081	0.047	0.594	#13	0.034	Not Required	Pass
103	0.006	0.641	0.036	0.063	0.004	0.660	#13	0.044	Not Required	Pass
104	0.005	0.599	0.102	0.060	0.020	0.694	#13	0.078	Not Required	Pass
105	0.005	0.399	0.079	0.064	0.016	0.411	#13	0.073	Not Required	Pass
106	0.006	0.785	0.060	0.080	0.010	0.848	#13	0.044	Not Required	Pass
107	0.006	0.486	0.117	0.078	0.023	0.515	#13	0.073	Not Required	Pass
108	0.000	0.111	0.087	0.036	0.005	0.185	#13	Not Required	Not Required	Pass
109	0.005	0.086	0.085	0.003	0.002	0.173	#13	0.198	Not Required	Pass
110	0.007	0.740	0.111	0.075	0.020	0.766	#13	0.078	Not Required	Pass
111	0.000	0.117	0.087	0.038	0.005	0.192	#13	Not Required	Not Required	Pass
112	0.002	0.503	0.302	0.103	0.055	0.805	#13	0.052	Not Required	Pass
113	0.003	0.263	0.163	0.052	0.007	0.403	#13	0.177	Not Required	Pass
114	0.004	0.254	0.163	0.049	0.007	0.388	#13	0.265	Not Required	Pass
115	0.001	0.066	0.061	0.038	0.005	0.107	#13	0.214	Not Required	Pass
116	0.002	0.063	0.062	0.036	0.005	0.100	#13	0.321	Not Required	Pass

Definitions

Φ_t	Safety factor for tensile
Φ_c	Safety factor for compression
Φ_b	Safety factor for flexure
Φ_v	Safety factor for shear
E	Modulus of elasticity
F_y	Specified minimum yield stress
F_u	Specified minimum tensile strength
A	Cross-sectional area
J	Torsional constant
I_{yp}	Moment of inertia about the Y axes
I_{zp}	Moment of inertia about the Z axes
I_w	Warping constant
S_{yp}	Plastic section modulus about the Y axis
S_{zp}	Plastic section modulus about the Z axis
KL	Effective length
C_b	Buckling modification factor (from all load combinations)
L_b	Length between braced points
LST	Limited slenderness for tension
LSC	Limited slenderness for compression
LD	Limited deflection
P_n	Nominal axial strength (tension/compression)
M_n	Nominal flexural strength (about Z/Y axis)
V_n	Nominal shear strength (along Z/Y axis)
P	Design ratio in case of axial force
M_z	Design ratio in case of bending about Z axis
M_y	Design ratio in case of bending about Y axis
V_y	Design ratio in case of shear along Y axis
V_z	Design ratio in case of shear along Z axis
(P, M_z , M_y)	Design ratio in case of axial force and bending action
KL/r	Design ratio in case of section slenderness
δ	Design ratio in case of member deflection
OK	Capacity is provided
NG	Capacity is not provided

IBC 2018 Pile Design



Input	Description
Region	American Standard
Concrete design code	American Concrete Institute (ACI 318:2019)

Cross-section

Input	Description	Value
Shape	Cross-sectional shape	Round
D	Section diameter	36 in

Material Properties

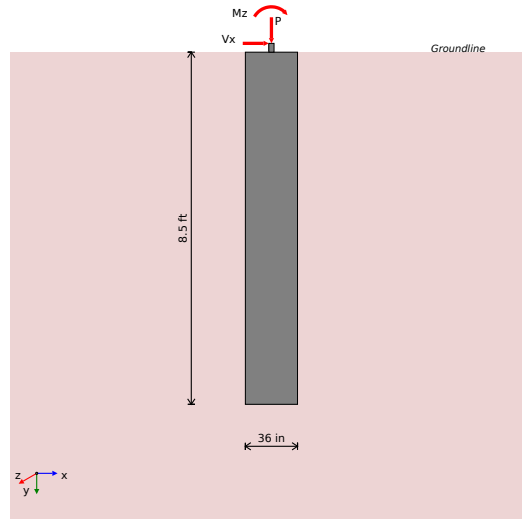
Input	Description	Value
f'_{ck}	Concrete compressive strength	2.5 ksi
f_{yk}	Yield strength of steel	60 ksi
d_b	Rebar diameter	#5 (0.625) in
cover	Concrete cover	3 in

Soil Parameters (IBC 1806)

Input	Description	Value
Soil type	Sand, silty sand, clayey sand, silty gravel & clayey gravel	
q_a	Allowable bearing pressure	2000 psf
R	Allowable lateral pressure	150 psf/ft

Loading

Load	ASD	LRFD
P	5.194 kip	7.581 kip
V _x	-2.425 kip	-4.041 kip
V _z	0.22 kip	0.336 kip
M _x	0.578 kip-ft	0.883 kip-ft
M _z	24.06 kip-ft	40.47 kip-ft



Required depth to resist lateral loads (ASD)

Allowable lateral pressure

$$R = 150 \text{ psf/ft}$$

Point of application of lateral load:

$$H = h_1 + h_2 + h_e = 0 + 0 + 0 = 0 \text{ ft}$$

Considering x-direction:

Lateral force per section length

$$H_o = \frac{V_x}{D} = \frac{-2.425}{36} = -0.808 \frac{\text{kip}}{\text{ft}}$$

Moment per section length

$$M = \frac{M_z + (V_x \times H)}{8} = \frac{24.06 + (-2.425 \times 0)}{8} = 8.02 \text{ kip-ft}$$

$$M_o = \frac{D}{36} = 0.028 \text{ ft}$$

Required depth of embedment in earth:

$$L_z^3 - \left(14.14 \times \frac{H_o \times L_z}{R}\right) - \left(18.85 \times \frac{M_o}{R}\right) = 0$$

Solving the cubic equation:

$$L_{e,z} = 7.559 \text{ ft}$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{D} = \frac{0.22}{36} = 0.073 \frac{\text{kip}}{\text{ft}}$$

Moment per section length

$$M_o = \frac{M_x + (V_z \times H)}{D} = \frac{0.578 + (0.22 \times 0)}{36} = 0.193 \frac{\text{kip-ft}}{\text{ft}}$$

Required depth of embedment in earth:

$$L_z^3 - \left(14.14 \times \frac{H_o \times L_z}{R}\right) - \left(18.85 \times \frac{M_o}{R}\right) = 0$$

Solving the cubic equation:

$$L_{e,z} = 3.675 \text{ ft}$$

Minimum embedded depth

Depth of pile required

$$L_{e,req} = \text{MAX}[L_{e,x}, L_{e,z}] = \text{MAX}[7.559, 3.675] = 7.559 \text{ ft}$$

Actual embedded length

$$L_e = L - h_2 - h_c = 8.5 - 0 - 0 = 8.5 \text{ ft}$$

Utilisation

$$\text{Ratio} = \frac{L_{e,req}}{L_e} = \frac{7.559}{8.5} = 0.889$$

UTILITY: 0.89

REFERENCES

CALCULATIONS

RESULTS

End-bearing Capacity (ASD)

Allowable bearing pressure
Unit weight of concrete

$q_a = 2000 \text{ psf}$
 $w_c = 0.15 \text{ kip/ft}^3$

Cross-sectional area:

$$A = \frac{\pi \times D^2}{4} = \frac{\pi \times 36^2}{4} = 7.069 \text{ ft}^2$$

End-bearing pressure:

$$q = \frac{P}{A} = \frac{5.194}{7.069} = 734.7 \text{ psf}$$

Utilisation

$$\text{Ratio} = \frac{q}{q_a} = \frac{734.7}{2000} = 0.367$$

UTILITY: 0.37

Lateral Soil Pressure (ASD)

Allowable lateral pressure

$R = 150 \text{ psf/ft}$

Length to least lateral dimension ratio:

$$\frac{L}{D} = \frac{8.5}{3} = 2.833$$

L/D ratio ≤ 10 . This pile is classified as a short pile.

Considering x-direction:

Distance from resting surface to pivot point:

$$a = \frac{(4 \times M_o \times L_e) + (3 \times H_o \times L_e^2)}{(6 \times M_o) + (4 \times H_o \times L_e)}$$

$$a = \frac{(4 \times 8.02 \times 8.5) + (3 \times 0.808 \times 8.5^2)}{(6 \times 8.02) + (4 \times 0.808 \times 8.5)} = 5.924 \text{ ft}$$

Earth pressure against the pile at a distance a/2 from the resting surface:

$$p = \frac{1.178 \times [(4 \times M_o) + (3 \times H_o \times L_e)]^2}{L_e^2 \times [(3 \times M_o) + (2 \times H_o \times L_e)]}$$

$$p = \frac{1.178 \times [(4 \times 8.02) + (3 \times -0.808 \times 8.5)]^2}{8.5^2 \times [(3 \times 8.02) + (2 \times -0.808 \times 8.5)]} = 0.208 \frac{\text{kip}}{\text{ft}^2}$$

Allowable lateral soil pressure at a depth of a/2:

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{5.924}{2} = 0.444 \frac{\text{kip}}{\text{ft}^2}$$

Utilisation - pressure at a depth of a/2

$$\text{Ratio} = \frac{p}{p_a} = \frac{0.208}{0.444} = 0.468$$

UTILITY: 0.47

Earth pressure against the pile at distance L_e:

$$s = \frac{9.425 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{9.425 \times [(2 \times 8.02) + (-0.808 \times 8.5)]}{8.5^2} = 1.196 \frac{\text{kip}}{\text{ft}^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 8.5 = 1.275 \frac{\text{kip}}{\text{ft}^2}$$

Utilisation - pressure at a depth of L_e

$$\text{Ratio} = \frac{s}{p_s} = \frac{1.196}{1.275} = 0.938$$

UTILITY: 0.94

Considering z-direction:

Distance from resting surface to pivot point:

$$a = \frac{(4 \times M_o \times L_e) + (3 \times H_o \times L_e^2)}{(6 \times M_o) + (4 \times H_o \times L_e)}$$

$$a = \frac{(4 \times 0.193 \times 8.5) + (3 \times 0.073 \times 8.5^2)}{(6 \times 0.193) + (4 \times 0.073 \times 8.5)} = 6.151 \text{ ft}$$

Earth pressure against the pile at a distance a/2 from the resting surface:

$$p = \frac{1.178 \times [(4 \times M_o) + (3 \times H_o \times L_e)]^2}{L_e^2 \times [(3 \times M_o) + (2 \times H_o \times L_e)]}$$

$$p = \frac{1.178 \times [(4 \times 0.193) + (3 \times 0.073 \times 8.5)]^2}{8.5^2 \times [(3 \times 0.193) + (2 \times 0.073 \times 8.5)]} = 0.062 \frac{\text{kip}}{\text{ft}^2}$$

Allowable lateral soil pressure at a depth of a/2:

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{6.151}{2} = 0.461 \frac{\text{kip}}{\text{ft}^2}$$

Utilisation - pressure at a depth of a/2

$$\text{Ratio} = \frac{p}{p_a} = \frac{0.062}{0.461} = 0.135$$

UTILITY: 0.14

Earth pressure against the pile at distance L_e:

$$s = \frac{9.425 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{9.425 \times [(2 \times 0.193) + (0.073 \times 8.5)]}{8.5^2} = 0.132 \frac{\text{kip}}{\text{ft}^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 8.5 = 1.275 \frac{\text{kip}}{\text{ft}^2}$$

Utilisation - pressure at a depth of L_e

$$\text{Ratio} = \frac{s}{p_s} = \frac{0.132}{1.275} = 0.103$$

UTILITY: 0.10

REFERENCES

CALCULATIONS

RESULTS

Shear force and bending moment (LRFD)

Considering x-direction:

Lateral force per section length

$$H_o = \frac{V_x}{D} = \frac{-4.041}{36} = -1.347 \frac{\text{kip}}{\text{ft}}$$

Moment per section length

$$M_o = \frac{M_z + (V_x \times H)}{D} = \frac{40.47 + (-4.041 \times 0)}{36} = 13.49 \frac{\text{kip-ft}}{\text{ft}}$$

Distance from resting surface to pivot point:

$$a = \frac{(4 \times M_o \times L_e) + (3 \times H_o \times L_e^2)}{(6 \times M_o) + (4 \times H_o \times L_e)}$$

$$a = \frac{(4 \times 13.49 \times 8.5) + (3 \times 1.347 \times 8.5^2)}{(6 \times 13.49) + (4 \times 1.347 \times 8.5)} = 5.923 \text{ ft}$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{13.49}{-1.347} = 10.01 \text{ ft}$$

$$V_{max,x} = (H_o \times D) \times \left[1 - \left[3 \times \left(\frac{4 \times E}{L_e} + 3 \right) \times \left(\frac{a}{L_e} \right)^2 \right] + \left[4 \times \left(\frac{3 \times E}{L_e} + 2 \right) \times \left(\frac{a}{L_e} \right)^3 \right] \right]$$

$$V_{max,x} = (-1.347 \times 36) \times \left[1 - \left[3 \times \left(\frac{4 \times 10.01}{8.5} + 3 \right) \times \left(\frac{5.923}{8.5} \right)^2 \right] + \left[4 \times \left(\frac{3 \times 10.01}{8.5} + 2 \right) \times \left(\frac{5.923}{8.5} \right)^3 \right] \right]$$

$$V_{max,x} = 11.09 \text{ kip}$$

Max bending moment located at a depth of a/2:

$$M_{max,x} = (H_o \times D \times L_e) \times \left[\left(\frac{E}{L_e} + \frac{a}{2 \times L_e} \right) - \left[\left(\frac{4 \times E}{L_e} + 3 \right) \times \left(\frac{a}{2 \times L_e} \right)^3 \right] + \left[\left(\frac{3 \times E}{L_e} + 2 \right) \times \left(\frac{a}{2 \times L_e} \right)^4 \right] \right]$$

$$M_{max,x} = (-1.347 \times 36 \times 8.5) \times \left[\left(\frac{10.01}{8.5} + \frac{5.923}{2 \times 8.5} \right) - \left[\left(\frac{4 \times 10.01}{8.5} + 3 \right) \times \left(\frac{5.923}{2 \times 8.5} \right)^3 \right] + \left[\left(\frac{3 \times 10.01}{8.5} + 2 \right) \times \left(\frac{5.923}{2 \times 8.5} \right)^4 \right] \right]$$

$$M_{max,x} = 44.03 \text{ kip-ft}$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{D} = \frac{0.336}{36} = 0.112 \frac{\text{kip}}{\text{ft}}$$

Moment per section length

$$M_o = \frac{M_x + (V_z \times H)}{D} = \frac{0.883 + (0.336 \times 0)}{36} = 0.294 \frac{\text{kip-ft}}{\text{ft}}$$

Distance from resting surface to pivot point:

$$a = \frac{(4 \times M_o \times L_e) + (3 \times H_o \times L_e^2)}{(6 \times M_o) + (4 \times H_o \times L_e)}$$

$$a = \frac{(4 \times 0.294 \times 8.5) + (3 \times 0.112 \times 8.5^2)}{(6 \times 0.294) + (4 \times 0.112 \times 8.5)} = 6.151 \text{ ft}$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{0.294}{0.112} = 2.626 \text{ ft}$$

$$V_{max,z} = (H_o \times D) \times \left[1 - \left[3 \times \left(\frac{4 \times E}{L_e} + 3 \right) \times \left(\frac{a}{L_e} \right)^2 \right] + \left[4 \times \left(\frac{3 \times E}{L_e} + 2 \right) \times \left(\frac{a}{L_e} \right)^3 \right] \right]$$

$$V_{max,z} = (0.112 \times 36) \times \left[1 - \left[3 \times \left(\frac{4 \times 2.626}{8.5} + 3 \right) \times \left(\frac{6.151}{8.5} \right)^2 \right] + \left[4 \times \left(\frac{3 \times 2.626}{8.5} + 2 \right) \times \left(\frac{6.151}{8.5} \right)^3 \right] \right]$$

$$V_{max,z} = (0.112 \times 36) \times [1 - \{3 \times (\frac{1}{8.5} + 3) \times (\frac{1}{8.5})\} + \{4 \times (\frac{1}{8.5} + 2) \times (\frac{1}{8.5})\}]$$

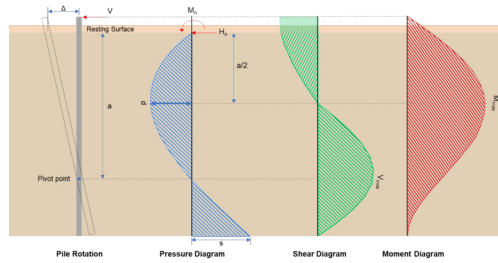
$$V_{max,z} = 0.409 \text{ kip}$$

Max bending moment located at a depth of a/2:

$$M_{max,z} = (H_o \times D \times L_e) \times \left[\left(\frac{E}{L_e} + \frac{a}{2 \times L_e} \right) - \left[\left(\frac{4 \times E}{L_e} + 3 \right) \times \left(\frac{a}{2 \times L_e} \right)^3 \right] + \left[\left(\frac{3 \times E}{L_e} + 2 \right) \times \left(\frac{a}{2 \times L_e} \right)^4 \right] \right]$$

$$M_{max,z} = (0.112 \times 36 \times 8.5) \times \left[\left(\frac{2.626}{8.5} + \frac{6.151}{2 \times 8.5} \right) - \left[\left(\frac{4 \times 2.626}{8.5} + 3 \right) \times \left(\frac{6.151}{2 \times 8.5} \right)^3 \right] + \left[\left(\frac{3 \times 2.626}{8.5} + 2 \right) \times \left(\frac{6.151}{2 \times 8.5} \right)^4 \right] \right]$$

$$M_{max,z} = 1.487 \text{ kip-ft}$$



Minimum Reinforcement Check (LRFD)

Gross area of concrete:

$$A_g = \frac{\pi \times D^2}{4} = \frac{\pi \times 36^2}{4} = 1018 \text{ in}^2$$

Main Reinforcement

22.4.2.2 Required reinforcement:

$$A_{st,req} = \frac{P - (0.85 \times f'_{ck} \times A_g)}{f_{yk} - (0.85 \times f'_{ck})} = \frac{7.581 - (0.85 \times 2.5 \times 1018)}{60 - (0.85 \times 2.5)} = -37.24 \text{ in}^2$$

10.6.1.1 Maximum reinforcement:

$$A_{st,max} = 0.08 \times A_g = 0.08 \times 1018 = 81.43 \text{ in}^2$$

7.6.1.1 Minimum reinforcement:

$$A_{st,min} = 0.0018 \times A_g = 0.0018 \times 1018 = 1.832 \text{ in}^2$$

Governing minimum reinforcement area:

$$(0.0018 \times A_g) \leq A_{st,req} \leq (0.08 \times A_g)$$

$$A_{min} = 1.832 \text{ in}^2$$

Minimum number of reinforcements:

$$A_{bar} = 0.307 \text{ in}^2$$

$$n_{min} = \frac{A_{min}}{A_{bar}} = \frac{1.832}{0.307} = 6$$

25.2.3 Minimum spacing:

$$s_{rebar} = \text{MAX}[1.5, 1.5 \times d_b] = \text{MAX}[1.5, (1.5 \times 0.625)] = 1.5 \text{ in}$$

Use: n = 6pcs at 1.5 in minimum spacing

Total reinforcement area:

$$A_{st} = 6 \times 0.307 = 1.841 \text{ in}^2$$

Shear Reinforcement

25.7.2.2 For main reinforcement ≤ 1.41 in: Use #3(0.375 in)

Maximum spacing of shear Reinforcements:

$$s = \text{MIN}[16 \times d_b, 48 \times d_{b,ties}, D] = \text{MIN}[(16 \times 0.625), (48 \times 0.375), 36] = 10 \text{ in}$$

Detailing Summary

Main reinforcement

#5 (0.625 in) - 6pcs at 1.5 in min. spacing

Reinforcement	#3 (0.375 in) at 10 in max. spacing
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Axial Compression Strength (LRFD)

22.4.2.2 Allowable axial compressive strength:

$$\phi P_N = \phi \times 0.85 \times [(0.85 \times f'_{ck} \times [A_g - A_{st}] + (f_{yk} \times A_{st})]$$

$$\phi P_N = 0.65 \times 0.85 \times [(0.85 \times 2.5 \times [1018 - 1.841]) + (60 \times 1.841)] = 1254 \text{ kip}$$

Utilisation

$$Ratio = \frac{P}{\phi P_N} = \frac{7.581}{1254} = 0.006$$

UTILITY: 0.01

Shear Strength LRFD

Effective shear width	$b_w = 36 \text{ in}$
Effective shear depth	$d = 28.8 \text{ in}$
Shear reinforcement area	$A_v = 0.221 \text{ in}^2$
Shear reinforcement spacing	$s = 10 \text{ in}$
Concrete type factor (Normal concrete)	$\lambda = 1$
Strength reduction factor for shear	$\phi = 0.75$
Maximum shear in the x-direction	$V_{max,x} = 11.09 \text{ kip}$
Maximum shear in the z-direction	$V_{max,z} = 0.409 \text{ kip}$

22.5.5.1.1 Max shear strength of concrete:

$$V_{c,max} = 5 \times \lambda \times \sqrt{f'_{ck}} \times b_w \times d = 5 \times 1 \times \sqrt{2.5} \times 36 \times 28.8 = 259.2 \text{ kip}$$

Table 22.5.5.1 Shear strength of concrete:

$$V_{c,a} = \left(2 \times \lambda \times \sqrt{f'_{ck}} + MIN\left[\frac{P}{6 \times A_g}, (0.05 \times f'_{ck})\right] \right) \times (b_w \times d)$$

$$V_{c,a} = \left(2 \times 1 \times \sqrt{2.5} + MIN\left[\frac{7.581}{6 \times 1018}, (0.05 \times 2.5)\right] \right) \times (36 \times 28.8) = 105 \text{ kip}$$

Governing shear strength of concrete:

$$V_c = MIN[V_{c,max}, V_{c,a}] = MIN[259.2, 105] = 105 \text{ kip}$$

22.5.1.2 Shear strength of steel (a):

$$V_{s,a} = 8 \times \sqrt{f'_{ck}} \times b_w \times d = 8 \times \sqrt{2.5} \times 36 \times 28.8 = 414.7 \text{ kip}$$

22.5.8.5.3 Shear strength of steel (b):

$$V_{s,b} = \frac{A_v \times f_{yk} \times d}{s} = \frac{0.221 \times 60 \times 28.8}{10} = 38.17 \text{ kip}$$

Governing shear strength of steel:

$$V_s = MIN[V_{s,a}, V_{s,b}] = MIN[414.7, 38.17] = 38.17 \text{ kip}$$

22.5.1.1 Allowable shear strength:

$$\phi V_n = \phi \times (V_c + V_s) = 0.75 \times (105 + 38.17) = 107.4 \text{ kip}$$

$$V_{max} = MAX[11.09, 0.409] = 11.09 \text{ kip}$$

Utilisation

$$Ratio = \frac{V_{max}}{\phi V_n} = \frac{11.09}{107.4} = 0.103$$

UTILITY: 0.10

Flexural Strength (LRFD)

Concrete type factor (Normal concrete)	$\lambda = 1$
Strength reduction factor for flexure	$\phi = 0.65$
Modulus of steel reinforcement	$E_s = 200e3 \text{ ksi}$
Maximum concrete strain	$\epsilon_c = 0.0030$
Yield strain of steel f_y/E_s	$\epsilon_y = 0.0003$
Section width	$b = 36 \text{ in}$
Distance to the compression rebar	$d_c = 3.688 \text{ in}$
Distance to the tension rebar	$d = 28.8 \text{ in}$
Total bar area	$A_s = 1.841 \text{ in}^2$
Maximum applied axial load	$P = 7.581 \text{ kip}$
Maximum moment in the x-direction	$M_{max,x} = 44.03 \text{ kip-ft}$
Maximum moment in the z-direction	$M = 1.697 \text{ kip-ft}$

Compressive force due to concrete:

$$\beta_1 = 0.85$$

$$C_{rc} = \beta_1 \times f'_c \times A_c$$

$$A_c = \frac{h^2}{8} \times (\theta - \sin\theta)$$

θ = Central angle of the compressive area in radians

Compressive force due to bars in compression:

$$C_{rb} = f_1 \times A_{sc}$$

$$\epsilon_1 = (c - d_s) \times \frac{\epsilon_c}{c}$$

$$f_1 = E_s \times \epsilon_1 \quad (\epsilon_1 < \epsilon_{sy}), \quad f_1 = f_y \quad (\epsilon_1 \geq \epsilon_{sy})$$

Tensile force due to bars in tension:

$$T_{rb} = f_2 \times A_{st}$$

$$\epsilon_2 = (d - c) \times \frac{\epsilon_{cu}}{c}$$

$$f_2 = E_s \times \epsilon_2 \quad (\epsilon_2 < \epsilon_{sy}), \quad f_2 = \phi_s \times f_y \quad (\epsilon_2 \geq \epsilon_{sy})$$

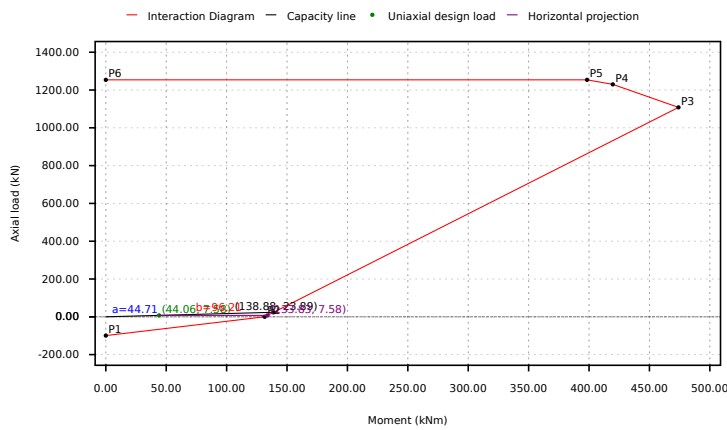
Interaction Diagram Summary

Point	Case	M_r	P_r
P1	Pure Tension	0	-99.4
P2	Pure Bending	131.5	0
P3	Balanced Failure	474.1	1108
P4	Decompression	419.7	1230
P5	Compression Limit	398.3	1254
P6	Pure Compression	0	1254

Uniaxial Bending Check

$$M_f = \sqrt{M_{max,x}^2 + M_{max,z}^2} = \sqrt{44.03^2 + 1.487^2} = 44.06 \text{ kip-ft}$$

Interaction Diagram



Segment	Signed Distance
P1 - P2	58.77
P2 - P3	85.77
P3 - P4	841.4
P4 - P5	1093
P5 - P6	1246
Status	PASS: Point lies inside the curve

Utilisation

$$Ratio = \frac{a}{a+b} = \frac{44.71}{44.71 + 96.21} = 0.317$$

UTILITY: 0.32

Biaxial Bending Check

Maximum moment in the x-direction
 Maximum moment in the z-direction
 Nominal uniaxial moment strength about the x-axis
 Nominal uniaxial moment strength about the z-axis
 Interaction exponent

$$M_{max,x} = 44.03 \text{ kip-ft}$$

$$M_{max,z} = 1.487 \text{ kip-ft}$$

$$M_{nox} = 133.8 \text{ kip-ft}$$

$$M_{noz} = 133.8 \text{ kip-ft}$$

$$\alpha = 1$$

Bresler (1960)

According to Bresler (method B):

$$\left(\frac{M_{max,x}}{M_{nox}}\right)^\alpha + \left(\frac{M_{max,z}}{M_{noz}}\right)^\alpha = 1.0$$

$$\left(\frac{44.03}{133.8}\right)^1 + \left(\frac{1.487}{133.8}\right)^1 = 0.34$$

UTILITY: 0.34

REFERENCES

CALCULATIONS

RESULTS

Results Summary

Result Name	Results
PILE DETAILS	
Length of the pile	8.50 ft
Dimension	36Ø in
Main bar reinforcement	#5-6pcs at 1.5 in min.
Shear reinforcement	#3 at 10 in max.
UTILISATIONS	
Required depth	0.89
End-bearing capacity	0.37
P _a	0.47
P _s	0.94
Axial compression strength	0.01
Shear strength	0.10
Uniaxial bending strength	0.32
Biaxial bending strength	0.34