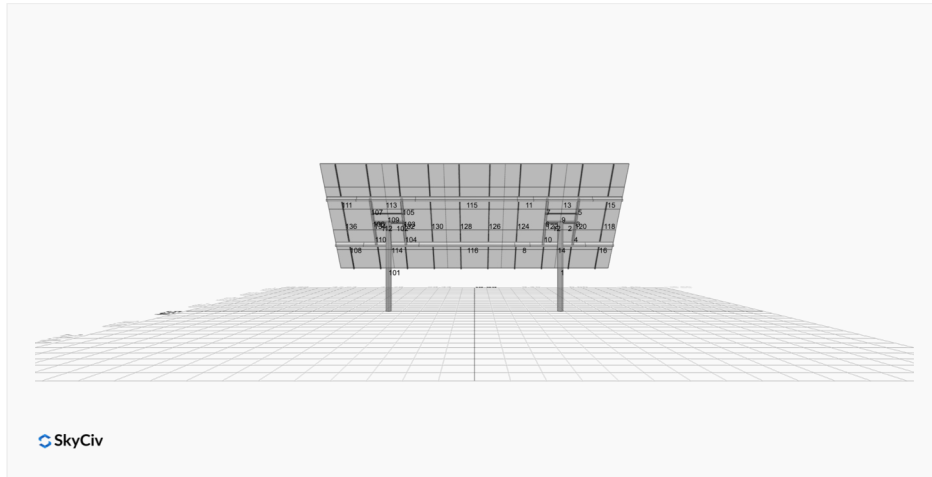


Project Name: MTSOLAR_EI960L3FH491
Location: 23817 Brookplace Ct, Farmington Hills, MI 48336, USA
Unique ID: 2P-22.5-8TOP-HD-45-L-5Hx5W-CD58
Dealer: _____

Date: Sun Nov 09 2025
Number of Modules: 25
Number of Poles: 2
Date Sold: _____



Array Dimensions N/S	17.25 ft
Array Dimensions E/W	37.79 ft
Winter Tilt Angle (Degrees)	50
Front Edge Clearance	5

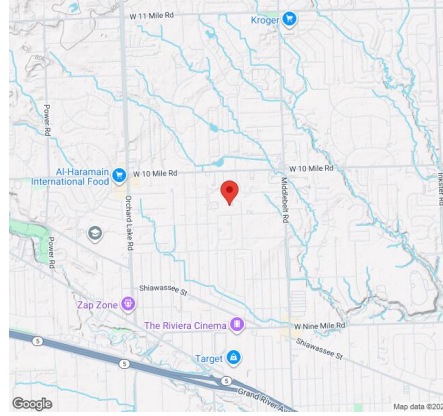
MT Solar Bill of Materials (2P-22.5-8TOP-HD-45-L-5Hx5W-CD58)

Part	Short Description	BOM Qty
MTS-PC-8	8IN Pole Cap Assembly	2
MTS-HF-HD	H-Frame Assembly-HD	2
MTS-HD-Wing-45	45IN HD Wing	4
MTS-HD-Splice-90	90IN HD Splice	4
MTS-CLAMP-ANGLE-4PK	Angle Clamp	5

Rail Bill of Materials

Part	Qty
Rails (207in Long)	10x
Rail Attachment	40x
Module Mid Clamp	40x
Module End Clamp	20x
Ground Lug	5x

Site Details:



Site Address: 23817 Brookplace Ct, Farmington Hills, MI 48336, USA

Array Specifications

Duty Classification:	HD
Module Width:	40.89 in
Module Length:	89.69 in
Number of Rows:	5
Number of Columns:	5
Total Number of Modules:	25
Winter Tilt Angle:	50
Front Edge Clearance:	5
Total Array Height at Tilt:	18.21 ft
Total Frame Length:	37.50 ft
Module Info/Notes:	
Array Dimensions N/S:	17.25 ft
Array Dimensions E/W:	37.79 ft
Rail Length:	206.95 in
Rail Spacing:	3.78 ft

Support Specifications

Pole Size:	8in Pipe Sch 40
Pole Length above Grade:	11.61 ft
Number of Poles:	2
Pole Spacing:	22.5 ft

Foundation Specifications

Foundation Type:	rectangular
Foundation Dimensions:	48x48 in
Foundation Depth (below grade):	7.3 ft
Foundation Volume:	116.00 ft ³

Site Info

Risk Category:	I
Exposure:	C
Soil Classification:	sand
Site Location:	23817 Brookplace Ct, Farmington Hills, MI 48336, USA
Wind Speed:	101 mph

Snow Load:	25 psf
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Design Disclaimer

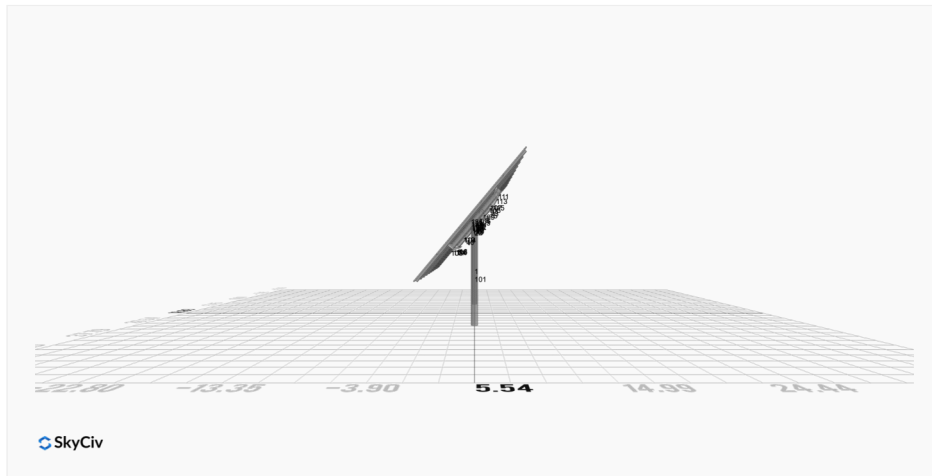
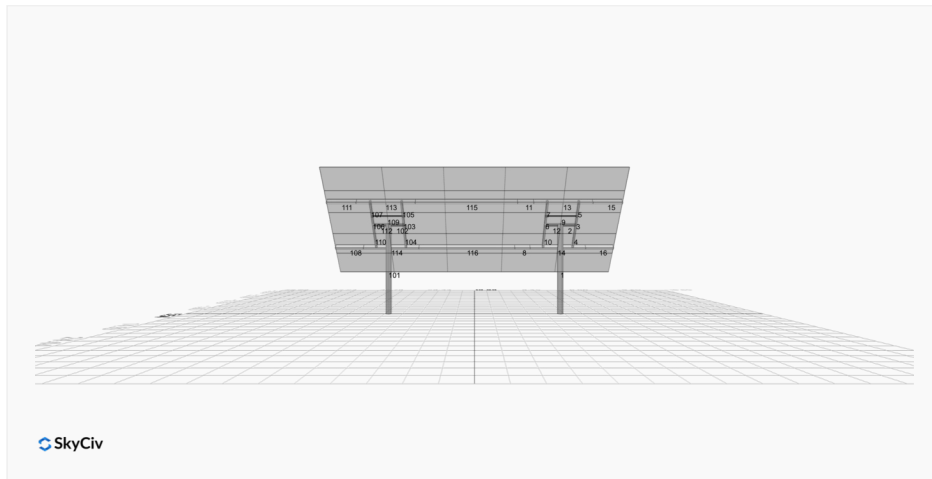
This software should be used for preliminary designs and should not be used as a final design unless reviewed, verified and designed by a qualified structural engineer.

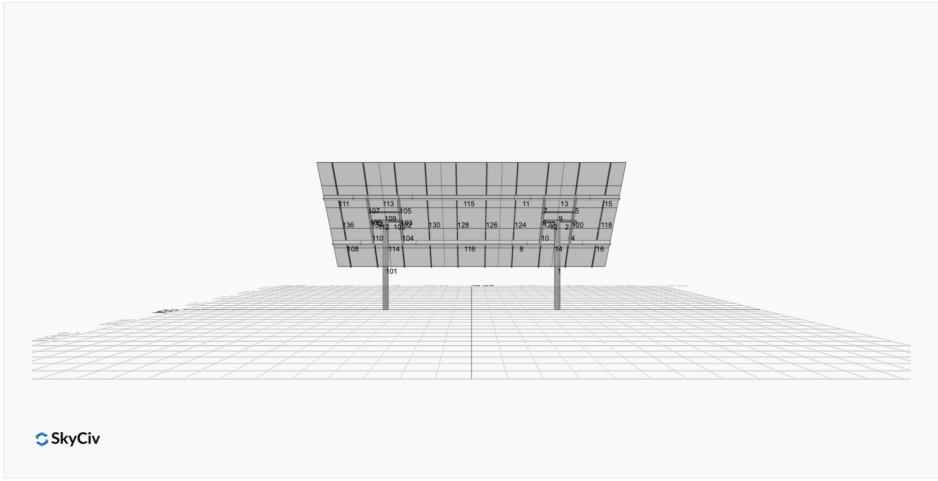
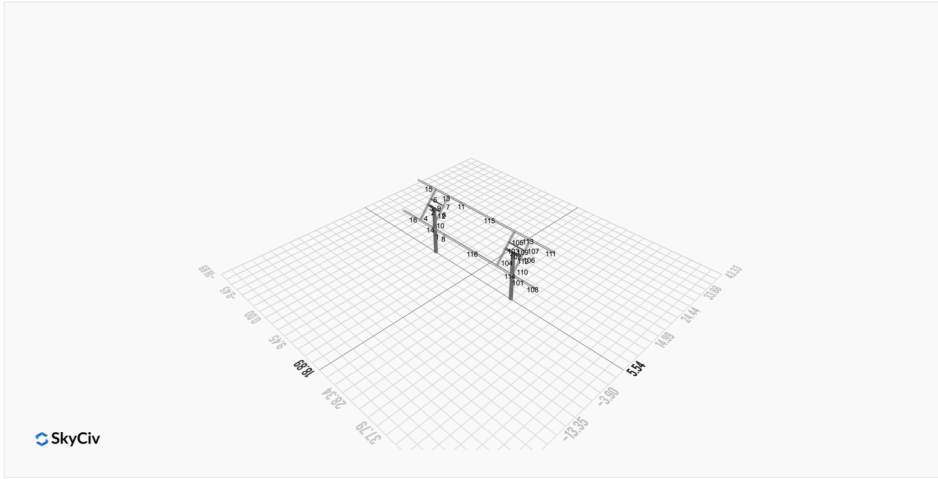
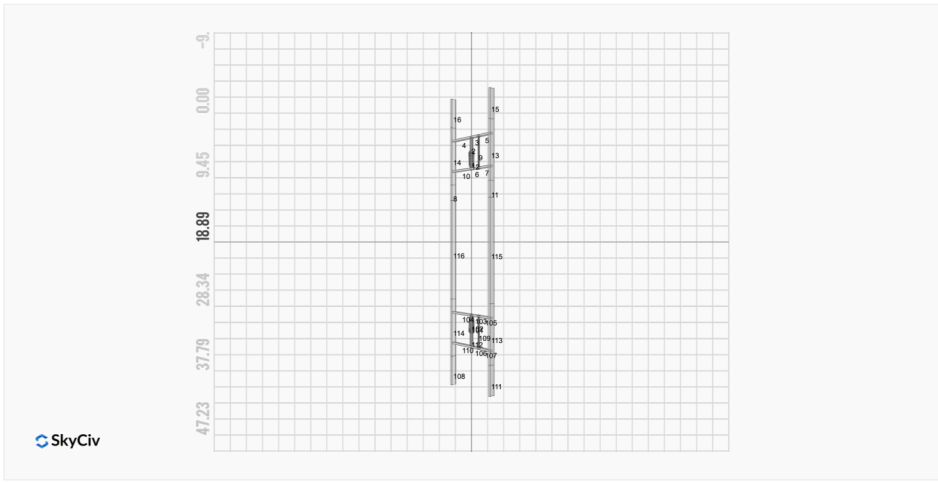
AutoDesigner Input

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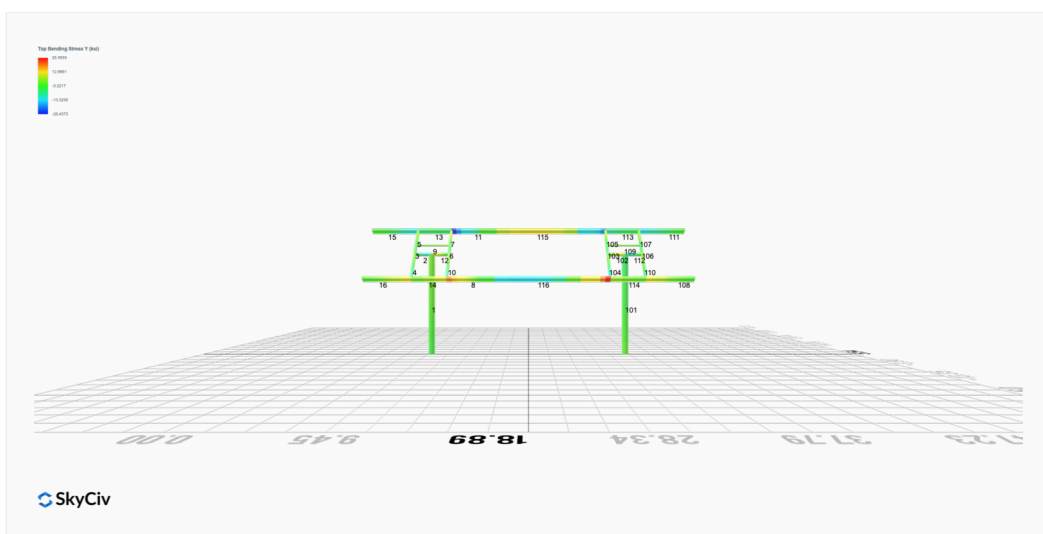
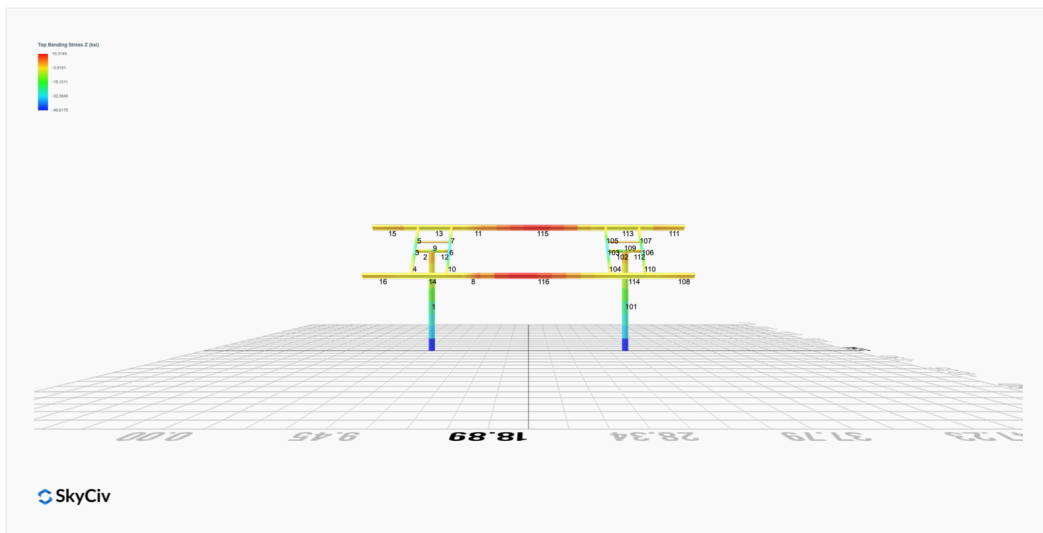
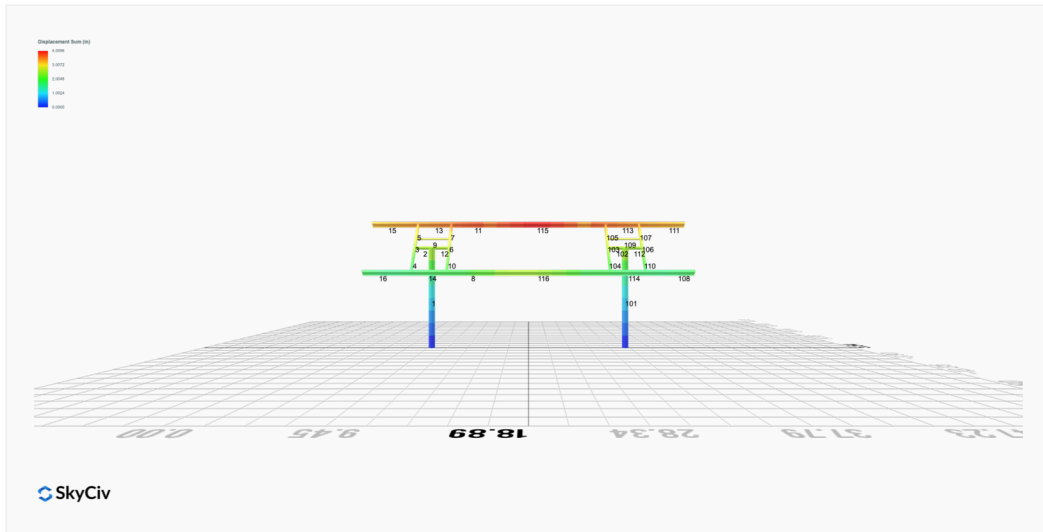
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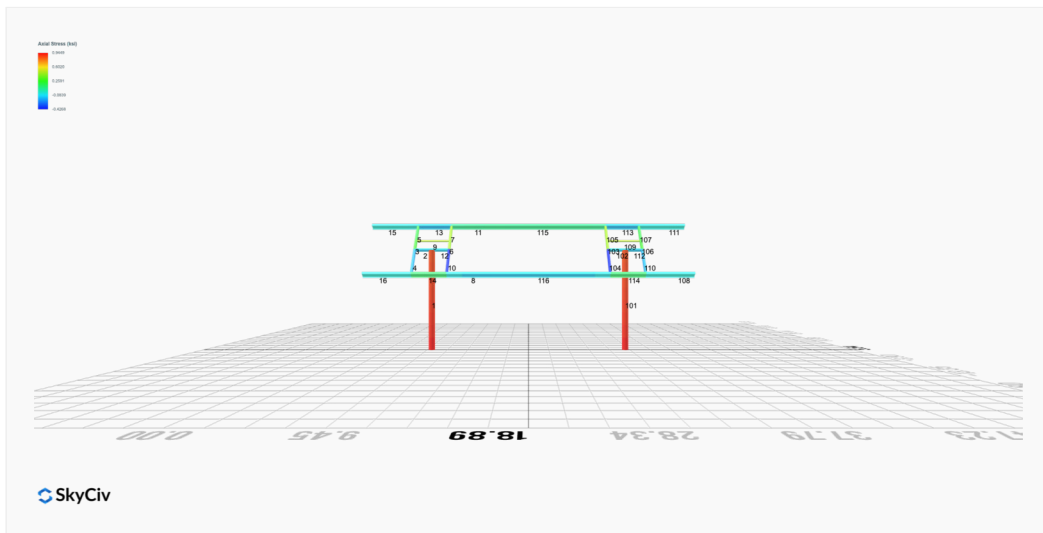
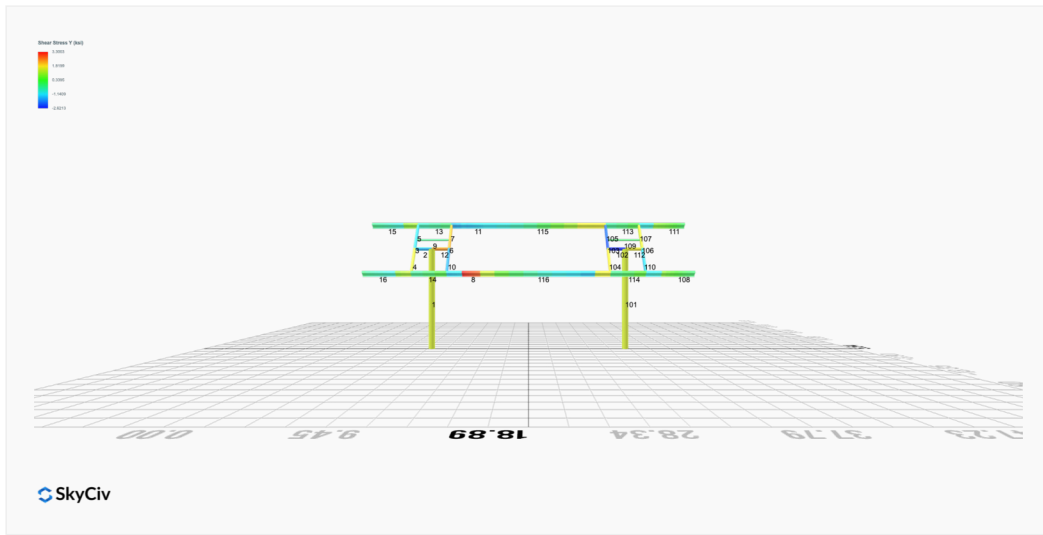
- Deflection checks are set to L/1 due to manufacturer structural design intent
- Foundation Soil Parameters used in this Autodesign are all estimates, proper geotechnical reports are required to confirm soil profiles
- Wind speeds, snow loads and other site specific results are based on ASCE 7-16
- 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)





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	-0.0002	3.3245	0.1021	0.3468	-0.1641	0.0252
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0002	3.4254	0.1105	0.3745	-0.1792	0.0214
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0001	2.8495	0.0874	0.2983	-0.1388	0.0215
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	-0.0006	4.6924	0.1625	0.5408	-0.2778	0.0221
ULS: 5. 1.2D + E + L + 0.2S	-0.0001	3.0799	0.0966	0.3289	-0.1546	0.0214
ULS: 7. 0.9D + 1.0E	-0.0000	2.1371	0.0655	0.2250	-0.1023	0.0161
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-5.4919	8.0326	0.3996	1.2589	-1.6304	65.3015
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-0.0002	3.4254	0.1105	0.3745	-0.1792	0.0214
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	5.4910	-1.1828	-0.1853	-0.6273	1.2385	-63.4141
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	-0.0002	3.4254	0.1105	0.3745	-0.1792	0.0214
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-5.4914	7.4567	0.3739	1.1796	-1.5712	65.1833
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-0.0001	2.8495	0.0874	0.2983	-0.1388	0.0215
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	5.4908	-1.7584	-0.2060	-0.7016	1.2604	-63.3026
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	-0.0001	2.8495	0.0874	0.2983	-0.1388	0.0215
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.7469	6.9964	0.3120	1.0043	-1.0282	32.5619
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.0006	4.6924	0.1625	0.5408	-0.2778	0.0221
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.7455	2.3882	0.0113	0.0486	0.4638	-32.0525
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	-0.0006	4.6924	0.1625	0.5408	-0.2778	0.0221
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.7457	5.1532	0.2317	0.7550	-0.8520	32.3724
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.0001	2.8495	0.0874	0.2983	-0.1388	0.0215
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.7454	0.5457	-0.0587	-0.1877	0.5665	-31.8695
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	-0.0001	2.8495	0.0874	0.2983	-0.1388	0.0215
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-5.4910	6.7442	0.3501	1.1046	-1.5206	65.0424
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-0.0000	2.1371	0.0655	0.2250	-0.1023	0.0161
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	5.4907	-2.4707	-0.2261	-0.7745	1.2826	-63.1804
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	-0.0000	2.1371	0.0655	0.2250	-0.1023	0.0161

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	-0.0001	2.3746	0.0728	0.2495	-0.1143	0.0179
ULS: 2. D + L	-0.0001	2.3746	0.0728	0.2495	-0.1143	0.0179
ULS: 3. D + (S or Lr or R)	-0.0002	3.5263	0.1190	0.4022	-0.1946	0.0175
ULS: 3. D + (S or Lr or R)	-0.0001	2.3746	0.0728	0.2495	-0.1143	0.0179
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0002	3.2384	0.1074	0.3643	-0.1736	0.0176
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0001	2.3746	0.0728	0.2495	-0.1143	0.0179
ULS: 5b. D + 0.7E	-0.0001	2.3746	0.0728	0.2495	-0.1143	0.0179
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	-0.0002	3.2384	0.1074	0.3643	-0.1736	0.0176
ULS: 8. 0.6D + 0.7E	-0.0000	1.4247	0.0437	0.1510	-0.0673	0.0107
ULS: 5a. D + 0.6W_Wind downforce Case A only	-3.2947	5.1389	0.2450	0.7931	-0.9649	38.8405
ULS: 5a. D + 0.6W_Wind downforce Case B only	-0.0001	2.3746	0.0728	0.2495	-0.1143	0.0179
ULS: 5a. D + 0.6W_Wind uplift Case A only	3.2945	-0.3899	-0.1019	-0.3367	0.7246	-38.1444
ULS: 5a. D + 0.6W_Wind uplift Case B only	-0.0001	2.3746	0.0728	0.2495	-0.1143	0.0179
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-2.4714	5.3117	0.2384	0.7777	-0.8228	29.1507
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.0002	3.2384	0.1074	0.3643	-0.1736	0.0176
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.4709	1.1648	-0.0250	-0.0728	0.4688	-28.7422
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	-0.0002	3.2384	0.1074	0.3643	-0.1736	0.0176

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	-2.4710	4.4479	0.2022	0.6614	-0.7514	29.0728
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.0001	2.3746	0.0728	0.2495	-0.1143	0.0179
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.4708	0.3012	-0.0581	-0.1863	0.5163	-28.6656
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	-0.0001	2.3746	0.0728	0.2495	-0.1143	0.0179
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-3.2945	4.1890	0.2147	0.6940	-0.9087	38.7268
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-0.0000	1.4247	0.0437	0.1510	-0.0673	0.0107
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	3.2944	-1.3397	-0.1299	-0.4355	0.7620	-38.0488
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	-0.0000	1.4247	0.0437	0.1510	-0.0673	0.0107

Worst Case Reactions (LRFD)

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

Result	Value (kip, kip-ft)
Axial	8.0326
Shear X	-5.4919
Shear Z	0.3996
Moment X	1.2589
Moment Y (Twist)	1.6304
Moment Z	65.3015

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	5.3117
Shear X	-3.2947
Shear Z	0.2450
Moment X	0.7931
Moment Y (Twist)	0.9649
Moment Z	38.8405

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	0.0002	3.3242	-0.1021	-0.3497	0.1605	0.0257
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0002	3.4251	-0.1105	-0.3782	0.1746	0.0217
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0001	2.8494	-0.0874	-0.3002	0.1364	0.0222
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	0.0006	4.6915	-0.1625	-0.5514	0.2642	0.0187
ULS: 5. 1.2D + E + L + 0.2S	0.0001	3.0796	-0.0966	-0.3314	0.1515	0.0220
ULS: 7. 0.9D + 1.0E	0.0000	2.1370	-0.0655	-0.2259	0.1013	0.0168
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-5.4892	8.0321	-0.3996	-1.2654	1.6003	65.2963
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	0.0002	3.4251	-0.1105	-0.3782	0.1746	0.0217
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	5.4901	-1.1812	0.1853	0.6440	-1.2293	-63.4183
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	0.0002	3.4251	-0.1105	-0.3782	0.1746	0.0217
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-5.4897	7.4565	-0.3739	-1.1819	1.5524	65.1828
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	0.0001	2.8494	-0.0874	-0.3002	0.1364	0.0222
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	5.4903	-1.7573	0.2060	0.7138	-1.2550	-63.3084
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	0.0001	2.8494	-0.0874	-0.3002	0.1364	0.0222
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.7436	6.9947	-0.3120	-1.0241	0.9904	32.5491
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	0.0006	4.6915	-0.1625	-0.5514	0.2642	0.0187
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.7450	2.3886	-0.0113	-0.0431	-0.4579	-32.0505
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.0006	4.6915	-0.1625	-0.5514	0.2642	0.0187
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.7448	5.1529	-0.2317	-0.7588	0.8423	32.3734
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	0.0001	2.8494	-0.0874	-0.3002	0.1364	0.0222
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.7451	0.5461	0.0587	0.1917	-0.5633	-31.8708
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.0001	2.8494	-0.0874	-0.3002	0.1364	0.0222
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-5.4901	6.7442	-0.3501	-1.1045	1.5098	65.0443
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	0.0000	2.1370	-0.0655	-0.2259	0.1013	0.0168
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	5.4904	-2.4699	0.2261	0.7828	-1.2801	-63.1865
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	0.0000	2.1370	-0.0655	-0.2259	0.1013	0.0168

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	0.0001	2.3745	-0.0728	-0.2507	0.1129	0.0186
ULS: 2. D + L	0.0001	2.3745	-0.0728	-0.2507	0.1129	0.0186
ULS: 3. D + (S or Lr or R)	0.0002	3.5259	-0.1190	-0.4068	0.1890	0.0175
ULS: 3. D + (S or Lr or R)	0.0001	2.3745	-0.0728	-0.2507	0.1129	0.0186
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0002	3.2381	-0.1074	-0.3677	0.1694	0.0179
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0001	2.3745	-0.0728	-0.2507	0.1129	0.0186
ULS: 5b. D + 0.7E	0.0001	2.3745	-0.0728	-0.2507	0.1129	0.0186
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	0.0002	3.2381	-0.1074	-0.3677	0.1694	0.0179
ULS: 8. 0.6D + 0.7E	0.0000	1.4247	-0.0437	-0.1513	0.0670	0.0112
ULS: 5a. D + 0.6W_Wind downforce Case A only	-3.2940	5.1387	-0.2450	-0.7952	0.9571	38.8423
ULS: 5a. D + 0.6W_Wind downforce Case B only	0.0001	2.3745	-0.0728	-0.2507	0.1129	0.0186
ULS: 5a. D + 0.6W_Wind uplift Case A only	3.2942	-0.3895	0.1019	0.3411	-0.7218	-38.1469
ULS: 5a. D + 0.6W_Wind uplift Case B only	0.0001	2.3745	-0.0728	-0.2507	0.1129	0.0186
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-2.4701	5.3111	-0.2384	-0.7846	0.8085	29.1497
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	0.0002	3.2381	-0.1074	-0.3677	0.1694	0.0179
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.4706	1.1652	0.0250	0.0766	-0.4652	-28.7425
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.0002	3.2381	-0.1074	-0.3677	0.1694	0.0179
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-2.4705	4.4477	-0.2022	-0.6638	0.7453	29.0744
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	0.0001	2.3745	-0.0728	-0.2507	0.1129	0.0186
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.4707	0.3015	0.0581	0.1890	-0.5142	-28.6670
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.0001	2.3745	-0.0728	-0.2507	0.1129	0.0186
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-3.2942	4.1890	-0.2147	-0.6943	0.9057	38.7288
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	0.0000	1.4247	-0.0437	-0.1513	0.0670	0.0112
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	3.2943	-1.3395	0.1299	0.4378	-0.7610	-38.0514
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	0.0000	1.4247	-0.0437	-0.1513	0.0670	0.0112

Worst Case Reactions (LRFD)

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

Result	Value (kip, kip-ft)
Axial	8.0321
Shear X	-5.4904
Shear Z	-0.3996
Moment X	-1.2654
Moment Y (Twist)	1.6003
Moment Z	65.2963

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	5.3111
Shear X	-3.2943
Shear Z	-0.2450
Moment X	-0.7952
Moment Y (Twist)	0.9571
Moment Z	38.8423

Project Details

Design Code: AISC 360-16 LRFD
 Provision: LRFD
 Country: United States
 User Name: sales@mtsolar.us
 Project Name: MTSOLAR_EI960L3FH491
 Unit System: imperial

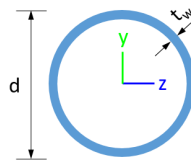


Design Input Information

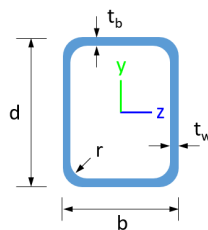
Design Factors			
Φ_t	Φ_c	Φ_b	Φ_v
0.9	0.9	0.9	0.9

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

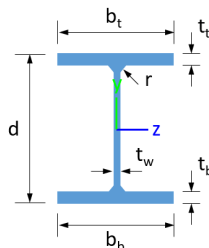
Section Dimensions



ID	Name	d (in)	t_w (in)				
2	2in Pipe Sch 80	2.38	0.22				
5	4in Pipe Sch 80	4.50	0.34				
9	8in Pipe Sch 40	8.63	0.32				



ID	Name	d (in)	b (in)	t_w (in)	t_b (in)	r (in)	
16	HSS5x3x3/16	5.00	3.00	0.17	0.17	0.17	



ID	Name	d (in)	t_w (in)	b_t (in)	b_b (in)	t_t (in)	t_b (in)	r (in)
19	W8x10	7.89	0.17	3.94	3.94	0.20	0.20	0.30

105	116.10	114.23	15.79	11.10	42.08	23.28
106	116.10	115.41	15.79	11.10	42.08	23.28
107	116.10	114.23	15.79	11.10	42.08	23.28
108	133.20	52.83	32.87	6.12	40.24	43.62
109	61.16	54.71	3.51	3.51	18.35	18.35
110	116.10	111.33	15.79	11.10	42.08	23.28
111	133.20	52.83	32.87	6.12	40.24	43.62
112	182.47	181.10	20.19	20.19	54.74	54.74
113	133.20	85.85	24.65	6.12	40.24	43.62
114	133.20	85.85	24.50	6.12	40.24	43.62
115	133.20	46.28	11.93	6.12	40.24	43.62
116	133.20	46.28	11.91	6.12	40.24	43.62

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	0.852	0.045	0.054	0.004	0.882	#13	0.154	Not Required	Pass
2	0.004	0.227	0.219	0.056	0.044	0.447	#13	0.035	Not Required	Pass
3	0.006	0.464	0.032	0.046	0.005	0.469	#13	0.045	Not Required	Pass
4	0.005	0.464	0.101	0.047	0.023	0.534	#13	0.080	Not Required	Pass
5	0.005	0.288	0.089	0.047	0.023	0.292	#13	0.074	Not Required	Pass
6	0.009	0.611	0.097	0.062	0.043	0.711	#13	0.045	Not Required	Pass
7	0.009	0.378	0.170	0.061	0.045	0.439	#13	0.074	Not Required	Pass
8	0.003	0.159	0.173	0.097	0.014	0.238	#21	0.095	Not Required	Pass
9	0.012	0.054	0.081	0.004	0.003	0.132	#13	0.204	Not Required	Pass
10	0.009	0.613	0.159	0.061	0.034	0.663	#13	0.080	Not Required	Pass
11	0.003	0.088	0.177	0.045	0.014	0.244	#23	0.095	Not Required	Pass
12	0.003	0.422	0.275	0.093	0.061	0.695	#13	0.035	Not Required	Pass
13	0.005	0.165	0.381	0.042	0.019	0.425	#23	0.286	Not Required	Pass
14	0.006	0.169	0.373	0.040	0.018	0.464	#21	0.286	Not Required	Pass
15	0.000	0.036	0.095	0.016	0.007	0.114	#23	0.562	Not Required	Pass
16	0.000	0.035	0.095	0.016	0.007	0.118	#21	0.562	Not Required	Pass
101	0.024	0.852	0.045	0.054	0.004	0.882	#13	0.154	Not Required	Pass
102	0.003	0.421	0.275	0.093	0.061	0.694	#13	0.035	Not Required	Pass
103	0.009	0.611	0.097	0.062	0.043	0.711	#13	0.045	Not Required	Pass
104	0.009	0.611	0.159	0.061	0.034	0.662	#13	0.080	Not Required	Pass
105	0.009	0.378	0.170	0.061	0.045	0.439	#13	0.074	Not Required	Pass
106	0.006	0.465	0.031	0.046	0.005	0.470	#13	0.045	Not Required	Pass
107	0.005	0.289	0.089	0.047	0.023	0.293	#13	0.074	Not Required	Pass
108	0.000	0.035	0.095	0.016	0.007	0.118	#21	0.562	Not Required	Pass
109	0.012	0.054	0.081	0.003	0.003	0.131	#13	0.204	Not Required	Pass
110	0.005	0.464	0.101	0.047	0.023	0.534	#13	0.080	Not Required	Pass
111	0.000	0.036	0.095	0.016	0.007	0.114	#23	0.562	Not Required	Pass
112	0.004	0.227	0.219	0.056	0.044	0.448	#13	0.035	Not Required	Pass
113	0.005	0.165	0.382	0.048	0.019	0.427	#23	0.286	Not Required	Pass
114	0.006	0.169	0.376	0.036	0.018	0.445	#21	0.286	Not Required	Pass
115	0.009	0.544	0.203	0.044	0.014	0.676	#13	0.601	Not Required	Pass
116	0.004	0.558	0.207	0.044	0.014	0.700	#13	0.601	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	Square
b	Section width	48 in
D	Section depth	48 in

Material Properties

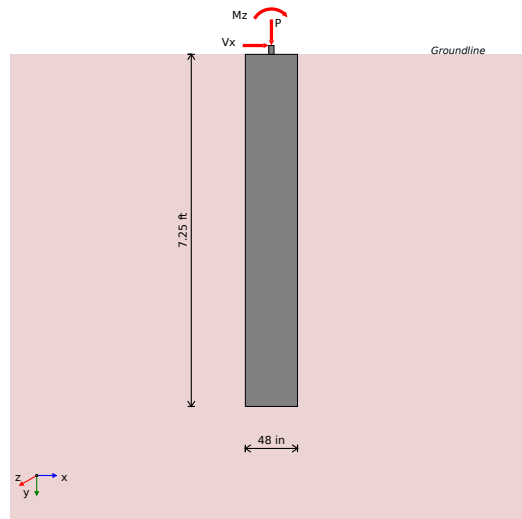
Input	Description	Value
f'_{ck}	Concrete compressive strength	2.5 ksi
f_{yk}	Yield strength of steel	60 ksi
d_b	Rebar diameter	#5 (0.625) in
cover	Concrete cover	3 in

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	5.311 kip	8.032 kip
V _x	-3.294 kip	-5.49 kip
V _z	-0.245 kip	-0.4 kip
M _x	-0.795 kip-ft	-1.265 kip-ft
M _z	38.84 kip-ft	65.3 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

$$H_o = \frac{V_x}{1.57 \times D} = \frac{-3.294}{1.57 \times 48} = -0.525 \frac{\text{kip}}{\text{ft}}$$

Moment per section length

$$M_o = \frac{M_z + (V_z \times H)}{1.57 \times D} = \frac{38.84 + (-3.294 \times 0)}{1.57 \times 48} = 6.185 \frac{\text{kip-ft}}{\text{ft}}$$

Required depth of embedment in earth:

$$L_e^3 - \left(9 \times \frac{H_o \times L_z}{R}\right) - \left(12 \times \frac{M_o}{R}\right) = 0$$

Solving the cubic equation:

$$L_{e,z} = 6.597 \text{ ft}$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{1.57 \times b} = \frac{-0.245}{1.57 \times 48} = -0.039 \frac{\text{kip}}{\text{ft}}$$

Moment per section length

$$M_o = \frac{M_z + (V_z \times H)}{1.57 \times b} = \frac{-0.795 + (-0.245 \times 0)}{1.57 \times 48} = -0.127 \frac{\text{kip-ft}}{\text{ft}}$$

Required depth of embedment in earth:

$$L_e^3 - \left(9 \times \frac{H_o \times L_z}{R}\right) - \left(12 \times \frac{M_o}{R}\right) = 0$$

Solving the cubic equation:

$$L_{e,z} = -1.807 \text{ ft}$$

Minimum embedded depth

Depth of pile required

$$L_{e,req} = \text{MAX}[L_{e,z}, L_{e,z}] = \text{MAX}[6.597, -1.807] = 6.597 \text{ ft}$$

Actual embedded length

$$L_e = L - h_2 - h_e = 7.25 - 0 - 0 = 7.25 \text{ ft}$$

Utilisation

$$\text{Ratio} = \frac{L_{e,req}}{L_e} = \frac{6.597}{7.25} = 0.91$$

UTILITY: 0.91

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:

$$A = b \times D = 48 \times 48 = 16 \text{ ft}^2$$

End-bearing pressure:

$$q = \frac{P}{A} = \frac{5.311}{16} = 331.9 \text{ psf}$$

Utilisation

$$\text{Ratio} = \frac{q}{q_a} = \frac{331.9}{2000} = 0.166$$

UTILITY: 0.17

Lateral Soil Pressure (ASD)

Allowable lateral pressure

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

Length to least lateral dimension ratio:

$$\frac{L}{\text{MIN}[b, D]} = \frac{7.25}{\text{MIN}[4, 4]} = 1.813$$

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

Considering x-direction:

Distance from resting surface to pivot point:

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

$$(6 \times M_o) + (4 \times H_o \times L_e)$$

$$a = \frac{(4 \times 6.185 \times 7.25) + (3 \times 0.525 \times 7.25^2)}{(6 \times 6.185) + (4 \times 0.525 \times 7.25)} = 5.009 \text{ ft}$$

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

$$p = \frac{0.75 \times [(4 \times M_o) + (3 \times H_o \times L_e)]^2}{L_e^2 \times [(3 \times M_o) + (2 \times H_o \times L_e)]}$$

$$p = \frac{0.75 \times [(4 \times 6.185) + (3 \times -0.525 \times 7.25)]^2}{7.25^2 \times [(3 \times 6.185) + (2 \times -0.525 \times 7.25)]} = 0.232 \frac{\text{kip}}{\text{ft}^2}$$

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

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{5.009}{2} = 0.376 \frac{\text{kip}}{\text{ft}^2}$$

Utilisation - pressure at a depth of a/2

$$\text{Ratio} = \frac{p}{p_a} = \frac{0.232}{0.376} = 0.616$$

UTILITY: 0.62

Earth pressure against the pile at distance L_e:

$$s = \frac{6 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{6 \times [(2 \times 6.185) + (-0.525 \times 7.25)]}{7.25^2} = 0.978 \frac{\text{kip}}{\text{ft}^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 7.25 = 1.087 \frac{\text{kip}}{\text{ft}^2}$$

Utilisation - pressure at a depth of L_e

$$\text{Ratio} = \frac{s}{p_s} = \frac{0.978}{1.087} = 0.899$$

UTILITY: 0.90

Considering z-direction:

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 0.127 \times 7.25) + (3 \times 0.039 \times 7.25^2)}{(6 \times 0.127) + (4 \times 0.039 \times 7.25)} = 5.195 \text{ ft}$$

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

$$p = \frac{0.75 \times [(4 \times M_o) + (3 \times H_o \times L_e)]^2}{L_e^2 \times [(3 \times M_o) + (2 \times H_o \times L_e)]}$$

$$p = \frac{0.75 \times [(4 \times -0.127) + (3 \times -0.039 \times 7.25)]^2}{7.25^2 \times [(3 \times -0.127) + (2 \times -0.039 \times 7.25)]} = -0.028 \frac{\text{kip}}{\text{ft}^2}$$

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

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{5.195}{2} = 0.39 \frac{\text{kip}}{\text{ft}^2}$$

Utilisation - pressure at a depth of a/2

$$\text{Ratio} = \frac{p}{p_a} = \frac{-0.028}{0.39} = -0.071$$

UTILITY: 0.07

Earth pressure against the pile at distance L_e:

$$s = \frac{6 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{6 \times [(2 \times -0.127) + (-0.039 \times 7.25)]}{7.25^2} = -0.061 \frac{\text{kip}}{\text{ft}^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 7.25 = 1.087 \frac{\text{kip}}{\text{ft}^2}$$

Utilisation - pressure at a depth of L_e

$$\text{Ratio} = \frac{s}{p_s} = \frac{-0.061}{1.087} = -0.056$$

UTILITY: 0.06

REFERENCES

CALCULATIONS

RESULTS

Shear force and bending moment (LRFD)

Considering x-direction:

Lateral force per section length

$$H_o = \frac{V_x}{1.57 \times D} = \frac{-5.49}{1.57 \times 48} = -0.874 \frac{\text{kip}}{\text{ft}}$$

Moment per section length

$$M_o = \frac{M_x + (V_x \times H)}{1.57 \times D} = \frac{65.3 + (-5.49 \times 0)}{1.57 \times 48} = 10.4 \frac{\text{kip-ft}}{\text{ft}}$$

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 10.4 \times 7.25) + (3 \times 0.874 \times 7.25^2)}{(6 \times 10.4) + (4 \times 0.874 \times 7.25)} = 5.008 \text{ ft}$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{10.4}{-0.874} = 11.89 \text{ ft}$$

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

$$V_{max,x} = (-0.874 \times 48) \times [1 - [3 \times \left(\frac{4 \times 11.89}{7.25} + 3\right) \times \left(\frac{5.008}{7.25}\right)^2] + [4 \times \left(\frac{3 \times 11.89}{7.25} + 2\right) \times \left(\frac{5.008}{7.25}\right)^3]$$

$$V_{max,x} = 12.46 \text{ kip}$$

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

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

$$M_{max,x} = (-0.874 \times 48 \times 7.25) \times \left[\left(\frac{11.89}{7.25} + \frac{5.008}{2 \times 7.25}\right) - \left[\left(\frac{4 \times 11.89}{7.25} + 3\right) \times \left(\frac{5.008}{2 \times 7.25}\right)^3 \right] + \left[\left(\frac{3 \times 11.89}{7.25} + 2\right) \times \left(\frac{5.008}{2 \times 7.25}\right)^4 \right] \right]$$

$$M_{max,x} = 42.86 \text{ kip-ft}$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{1.57 \times b} = \frac{-0.4}{1.57 \times 48} = -0.064 \frac{\text{kip}}{\text{ft}}$$

Moment per section length

$$M_o = \frac{M_z + (V_z \times H)}{1.57 \times b} = \frac{-1.265 + (-0.4 \times 0)}{1.57 \times 48} = -0.201 \frac{\text{kip-ft}}{\text{ft}}$$

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 0.201 \times 7.25) + (3 \times 0.064 \times 7.25^2)}{(6 \times 0.201) + (4 \times 0.064 \times 7.25)} = 5.198 \text{ ft}$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{-0.201}{-0.064} = 3.167 \text{ ft}$$

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

$$V_{max,z} = (-0.064 \times 48) \times [1 - [3 \times (\frac{4 \times 5.198}{7.25} + 3) \times (\frac{5.198}{7.25})] + [4 \times (\frac{3 \times 5.198}{7.25} + 2) \times (\frac{5.198}{7.25})]]$$

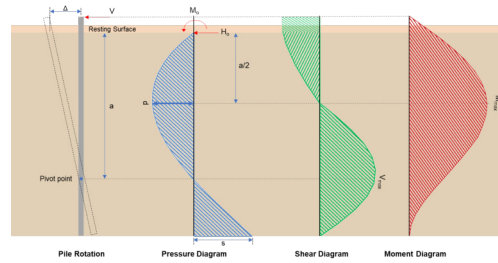
$$V_{max,z} = 0.367 \text{ kip}$$

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

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

$$M_{max,z} = (-0.064 \times 48 \times 7.25) \times [(\frac{3.167}{7.25} + \frac{5.198}{2 \times 7.25}) - [(\frac{4 \times 3.167}{7.25} + 3) \times (\frac{5.198}{2 \times 7.25})^3] + [(\frac{3 \times 3.167}{7.25} + 2) \times (\frac{5.198}{2 \times 7.25})^4]]$$

$$M_{max,z} = 1.165 \text{ kip-ft}$$



Minimum Reinforcement Check (LRFD)

Gross area of concrete:

$$A_g = b \times D = 48 \times 48 = 2304 \text{ in}^2$$

Main Reinforcement

22.4.2.2 Required reinforcement:

$$A_{st,req} = \frac{P - (0.85 \times f'_{ck} \times A_g)}{f_{yk} - (0.85 \times f'_{ck})} = \frac{8.032 - (0.85 \times 2.5 \times 2304)}{60 - (0.85 \times 2.5)} = -84.46 \text{ in}^2$$

10.6.1.1 Maximum reinforcement:

$$A_{st,max} = 0.08 \times A_g = 0.08 \times 2304 = 184.3 \text{ in}^2$$

7.6.1.1 Minimum reinforcement:

$$A_{st,min} = 0.0018 \times A_g = 0.0018 \times 2304 = 4.147 \text{ in}^2$$

Governing minimum reinforcement area:

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

$$A_{min} = 4.147 \text{ in}^2$$

Minimum number of reinforcements:

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

$$n_{min} = \frac{A_{min}}{A_{bar}} = \frac{4.147}{0.307} = 14$$

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: $n = 16$ pcs at 1.5 in minimum spacing

Total reinforcement area:

$$A_{st} = 16 \times 0.307 = 4.909 \text{ in}^2$$

Shear Reinforcement

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

Maximum spacing of shear Reinforcements:

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

Detailing Summary

Main reinforcement

#5 (0.625 in) - 16pcs at 1.5 in min. spacing

Axial Compression Strength (LRFD)

22.4.2.2 Allowable axial compressive strength:

$$\phi P_N = \phi \times 0.8 \times [(0.85 \times f'_{ck} \times [A_g - A_{st}]) + (f_{yk} \times A_{st})]$$

$$\phi P_N = 0.65 \times 0.8 \times [(0.85 \times 2.5 \times [2304 - 4.909]) + (60 \times 4.909)] = 2694 \text{ kip}$$

Utilisation

$$\text{Ratio} = \frac{P}{\phi P_N} = \frac{8.032}{2694} = 0.003$$

UTILITY: 0.00

Shear Strength LRFD)

Effective shear width	$b_w = 48 \text{ in}$
Effective shear depth	$d = 44.31 \text{ in}$
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	$V_{max,x} = 12.46 \text{ kip}$
Maximum shear in the z-direction	$V_{max,z} = 0.367 \text{ kip}$

22.5.5.1.1 Max shear strength of concrete:

$$V_{c,max} = 5 \times \lambda \times \sqrt{f'_{ck}} \times b_w \times d = 5 \times 1 \times \sqrt{2.5} \times 48 \times 44.31 = 531.8 \text{ kip}$$

Table 22.5.5.1 Shear strength of concrete:

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

$$V_{c,a} = \left(2 \times 1 \times \sqrt{2.5} + \text{MIN} \left[\frac{8.032}{6 \times 2304}, (0.05 \times 2.5) \right] \right) \times (48 \times 44.31) = 213.9 \text{ kip}$$

Governing shear strength of concrete:

$$V_c = \text{MIN}[V_{c,max}, V_{c,a}] = \text{MIN}[531.8, 213.9] = 213.9 \text{ kip}$$

22.5.1.2 Shear strength of steel (a):

$$V_{s,a} = 8 \times \sqrt{f'_{ck}} \times b_w \times d = 8 \times \sqrt{2.5} \times 48 \times 44.31 = 850.8 \text{ kip}$$

22.5.8.5.3 Shear strength of steel (b):

$$V_{s,b} = \frac{A_v \times f_{yk} \times d}{s} = \frac{0.221 \times 60 \times 44.31}{10} = 58.73 \text{ kip}$$

Governing shear strength of steel:

$$V_s = \text{MIN}[V_{s,a}, V_{s,b}] = \text{MIN}[850.8, 58.73] = 58.73 \text{ kip}$$

22.5.1.1 Allowable shear strength:

$$\phi V_n = \phi \times (V_c + V_s) = 0.75 \times (213.9 + 58.73) = 204.5 \text{ kip}$$

$$V_{max} = \text{MAX}[12.46, 0.367] = 12.46 \text{ kip}$$

Utilisation

$$\text{Ratio} = \frac{V_{max}}{\phi V_n} = \frac{12.46}{204.5} = 0.061$$

UTILITY: 0.06

Flexural Strength (LRFD)

Concrete type factor (Normal concrete)	$\lambda = 1$
Strength reduction factor for flexure	$\phi = 0.65$
Modulus of steel reinforcement	$E_s = 200 \text{e}3 \text{ ksi}$
Maximum concrete strain	$\epsilon_c = 0.0030$
Yield strain of steel f_y/E_s	$\epsilon_y = 0.0003$
Section width	$b = 48 \text{ in}$
Distance to the compression rebar	$d_c = 3.688 \text{ in}$
Distance to the tension rebar	$d = 44.31 \text{ in}$
Total bar area	$A_s = 4.909 \text{ in}^2$
Maximum applied axial load	$P = 8.032 \text{ kip}$
Maximum moment in the x-direction	$M_{max,x} = 42.86 \text{ kip-ft}$
Maximum moment in the z-direction	$M_{max,z} = 1.165 \text{ kip-ft}$

Compressive force due to concrete:

$$\beta_1 = 0.85$$

$$C_{rc} = 0.85 \times \beta_1 \times f'_c \times b \times c$$

Compressive force due to bars in compression:

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

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

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

Tensile force due to bars in tension:

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

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

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

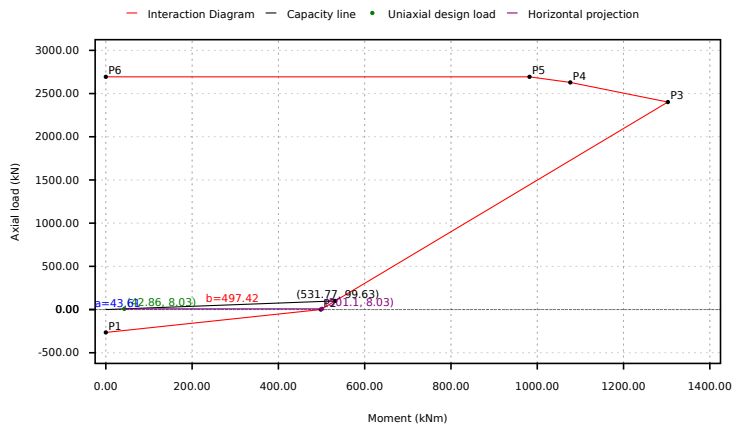
Interaction Diagram Summary

Point	Case	M _r	P _r
P1	Pure Tension	0	-265.1
P2	Pure Bending	498.4	0
P3	Balanced Failure	1303	2402
P4	Decompression	1077	2629
P5	Compression Limit	982	2694
P6	Pure Compression	0	2694

Uniaxial Bending Check

$$M_f = \text{MAX}[42.86, 1.165] = 42.86 \text{ kip-ft}$$

Interaction Diagram



Segment	Signed Distance
P1 - P2	221
P2 - P3	434.5
P3 - P4	2582
P4 - P5	2746
P5 - P6	2686
Status	PASS: Point lies inside the curve

Utilisation

$$\text{Ratio} = \frac{a}{a + b} = \frac{43.61}{43.61 + 497.4} = 0.081$$

UTILITY: 0.08

Biaxial Bending Check

Maximum moment in the x-direction

$$M_{max,x} = 42.86 \text{ kip-ft}$$

Maximum moment in the z-direction

$$M_{max,z} = 1.165 \text{ kip-ft}$$

Nominal uniaxial moment strength about the x-axis

$$M_{nox} = 501.1 \text{ kip-ft}$$

Nominal uniaxial moment strength about the z-axis

$$M_{noz} = 501.1 \text{ kip-ft}$$

Interaction exponent

$$\alpha = 1$$

Bresler (1960)

According to Bresler (method B):

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

$$\left(\frac{42.86}{501.1}\right)^1 + \left(\frac{1.165}{501.1}\right)^1 = 0.088$$

UTILITY: 0.09

REFERENCES

CALCULATIONS

RESULTS

Results Summary

Result Name	Results
PILE DETAILS	
Length of the pile	7.25 ft
Dimensions	48 x 48 in
Main bar reinforcement	#5-16pcs at 1.5 in min.
Shear reinforcement	#3 at 10 in max.
UTILISATIONS	
Required depth	0.91
End-bearing capacity	0.17
P _a	0.62
P _s	0.90
Axial compression strength	0.00
Shear strength	0.06
Uniaxial bending strength	0.08
Biaxial bending strength	0.09