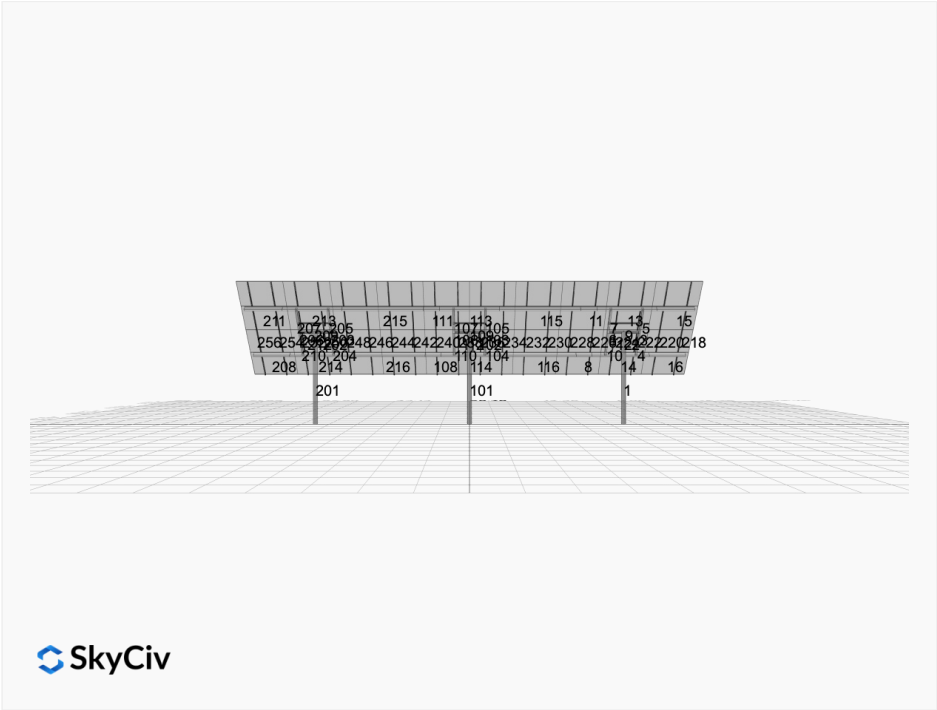
Project Details

Project Name: MTSOLAR_EK3EJC1530L8
Location: 3912 E Avery Ln, Coeur d'Alene, ID 83814, USA
Unique ID: 3P-19.75-6TOP-SD-57-L-4Hx10W-GHAA
Dealer: _____

Date: Sun Nov 09 2025
Number of Modules: 40
Number of Poles: 3
Date Sold: _____



Array Dimensions N/S	15.17 ft
Array Dimensions E/W	57.50 ft
Winter Tilt Angle (Degrees)	50
Front Edge Clearance	6

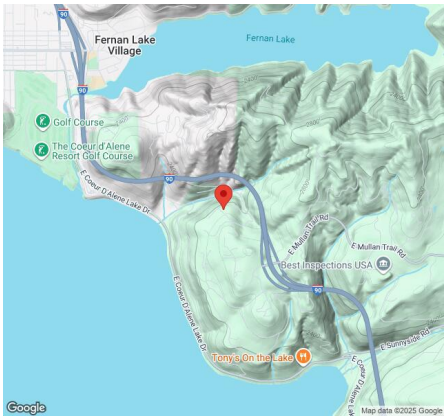
MT Solar Bill of Materials (3P-19.75-6TOP-SD-57-L-4Hx10W-GHAA)

Part	Short Description	BOM Qty
MTS-PC-6	6IN Pole Cap Assembly	3
MTS-HF-SD	H-Frame Assembly-SD	3
MTS-SD-Wing-57	57IN SD Wing	4
MTS-SD-Splice-90	90IN SD Splice	4
MTS-SD-Splice-57	57IN SD Splice	4
MTS-CLAMP-HOOK-4PK	Hook Clamp	10

Rail Bill of Materials

Part	Qty
Rails (182in Long)	20x
Rail Attachment	40x
Module Mid Clamp	60x
Module End Clamp	40x
Ground Lug	10x

Site Details:



Site Address: 3912 E Avery Ln, Coeur d'Alene, ID 83814, USA

Array Specifications

Duty Classification:	SD
Module Width:	45.00 in
Module Length:	68.00 in
Number of Rows:	4
Number of Columns:	10
Total Number of Modules:	40
Winter Tilt Angle:	50
Front Edge Clearance:	6
Total Array Height at Tilt:	17.62 ft
Total Frame Length:	56.50 ft
Module Info/Notes:	
Array Dimensions N/S:	15.17 ft
Array Dimensions E/W:	57.50 ft
Rail Length:	182.00 in
Rail Spacing:	2.88 ft

Support Specifications

Pole Size:	6in Pipe Sch 80
Pole Length above Grade:	11.81 ft
Number of Poles:	3
Pole Spacing:	19.75 ft

Foundation Specifications

Foundation Type:	rectangular
Foundation Dimensions:	48x48 in
Foundation Depth (below grade):	6.8 ft
Foundation Volume:	108.00 ft^3

Site Info

Risk Category:	I
Exposure:	C
Soil Classification:	sand
Site Location:	3912 E Avery Ln, Coeur d'Alene, ID 83814, USA
Wind Speed:	97 mph

Snow Load:	38.83 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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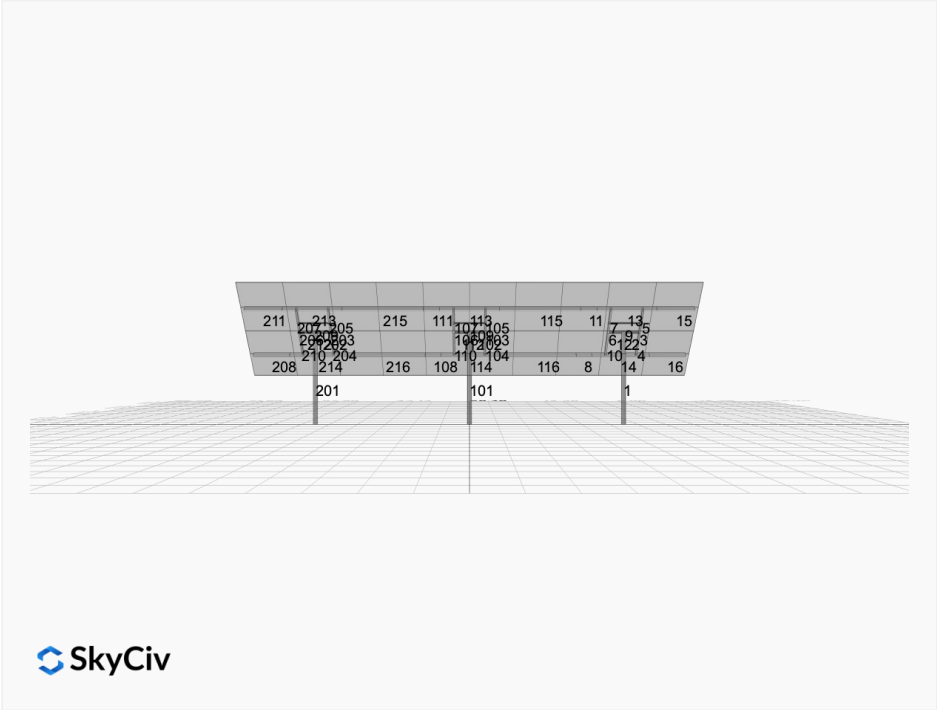
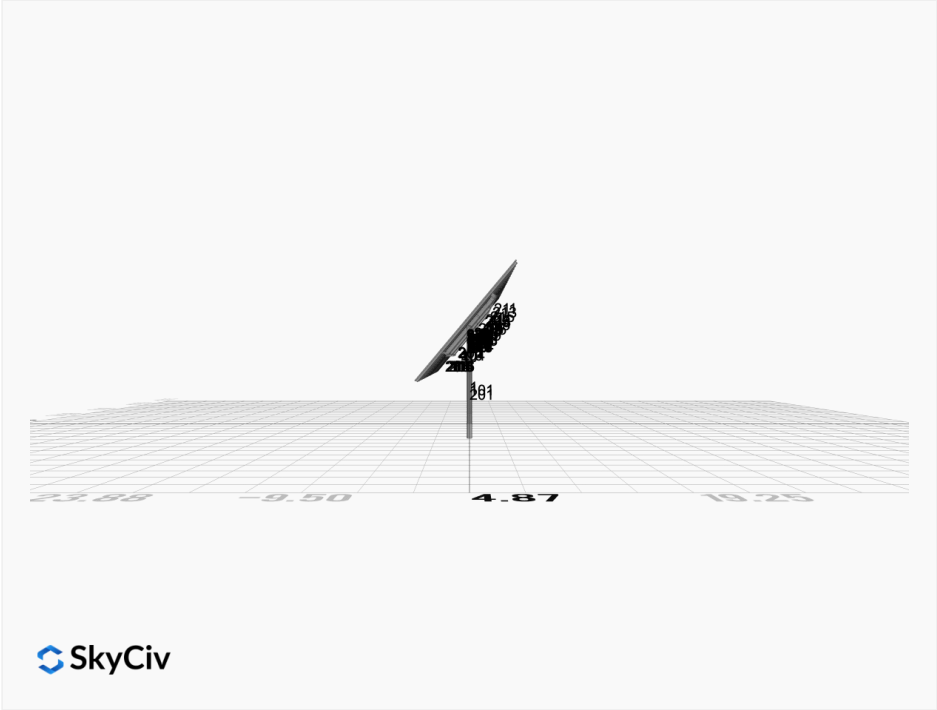
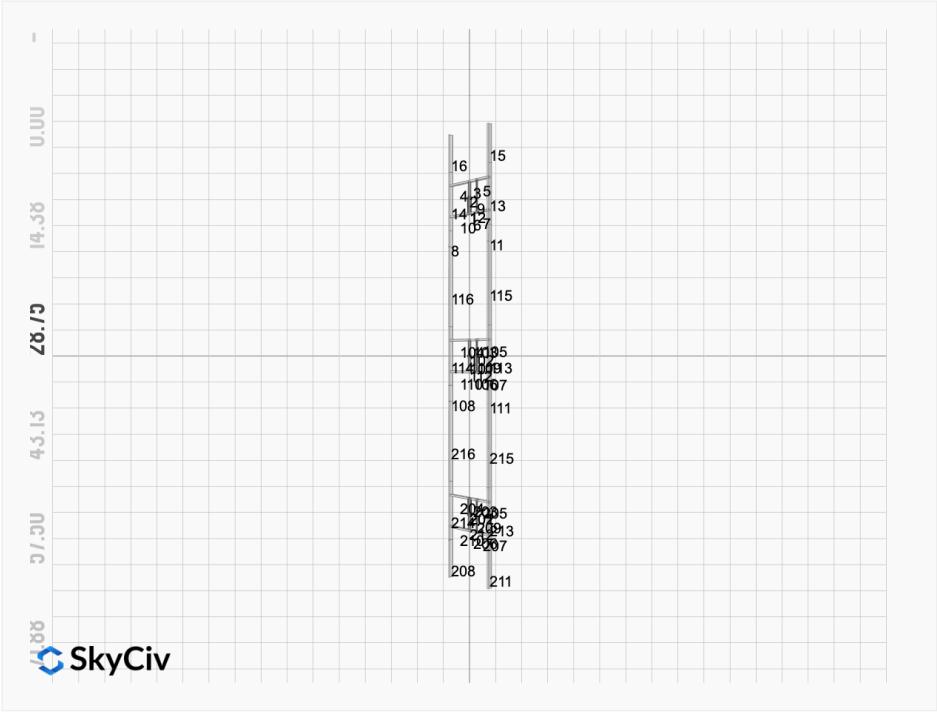
Design Notes:

- 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



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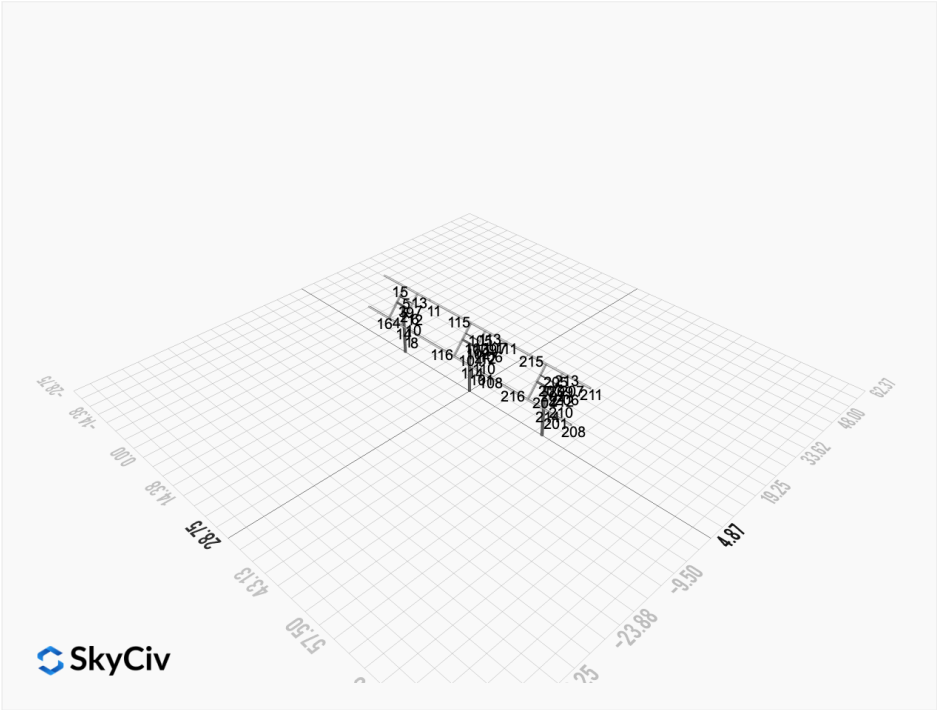
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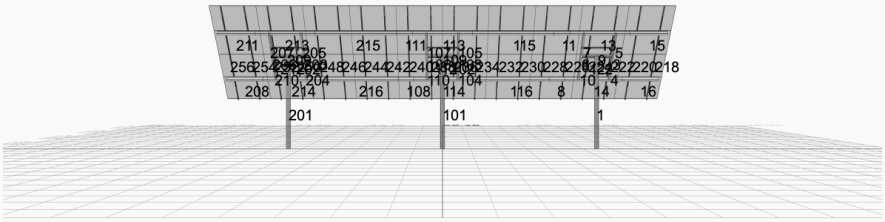
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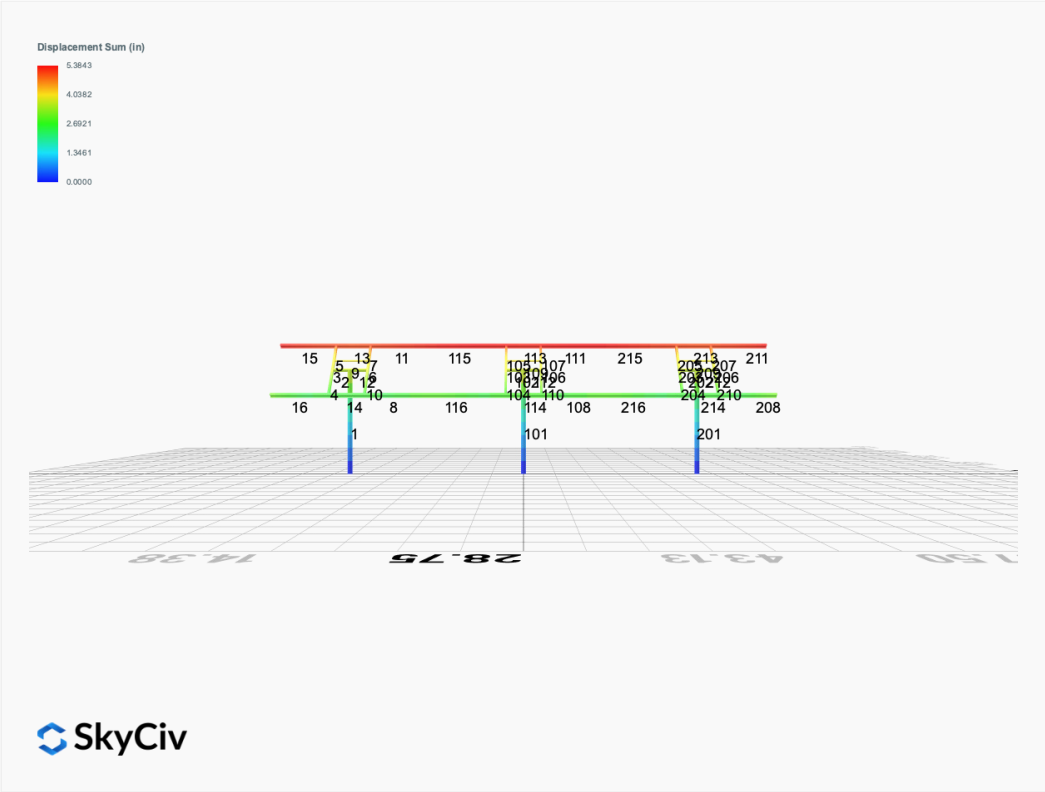
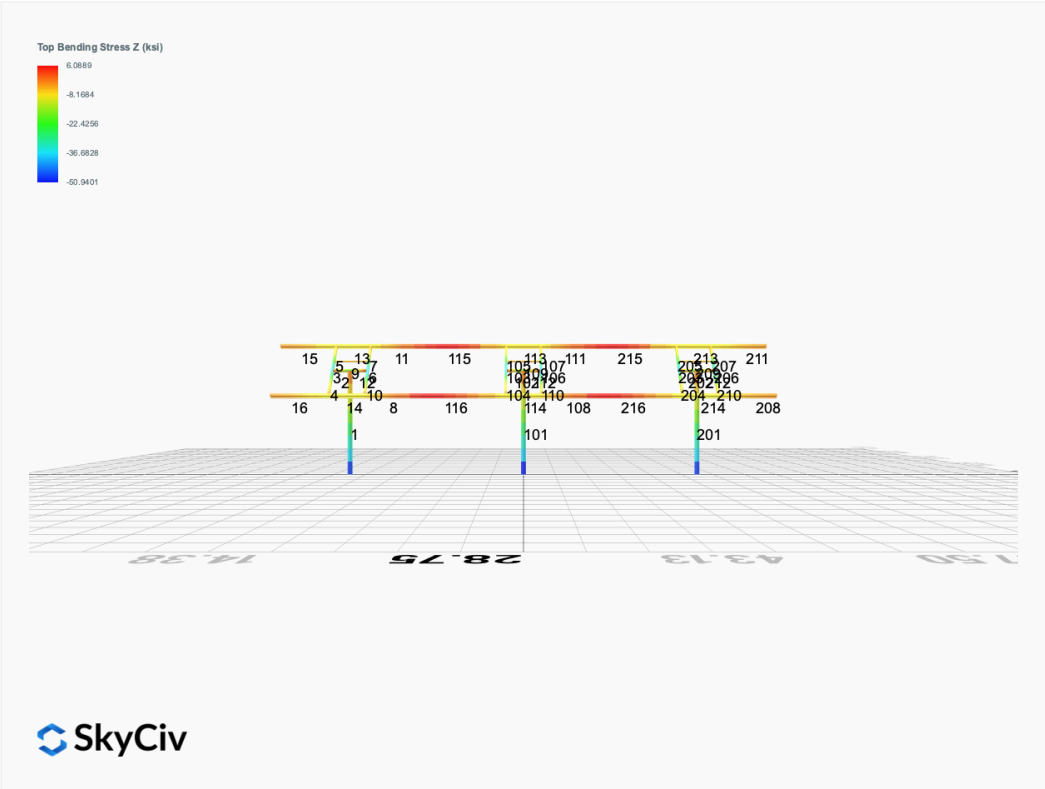
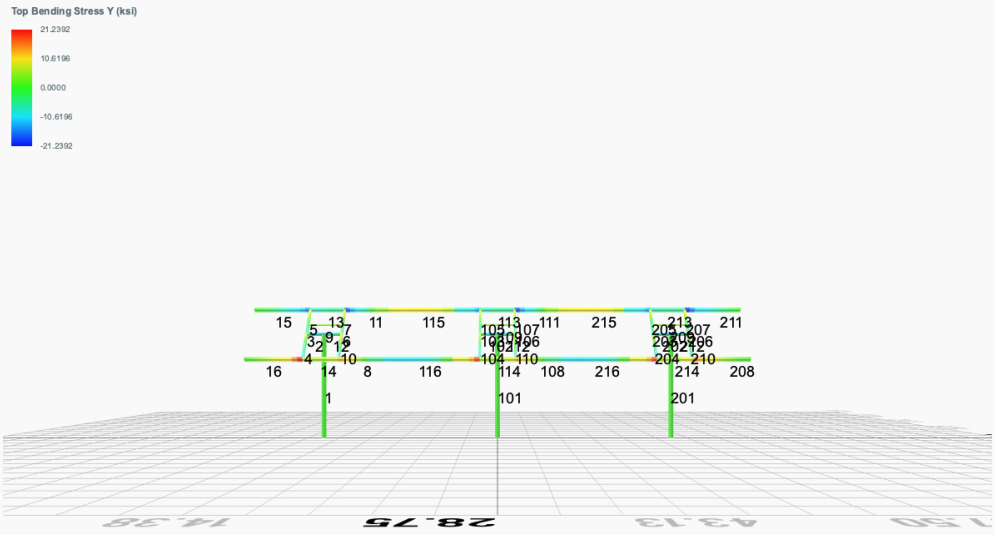
SkyCiv

FEM Results (Envelope Worst Case)







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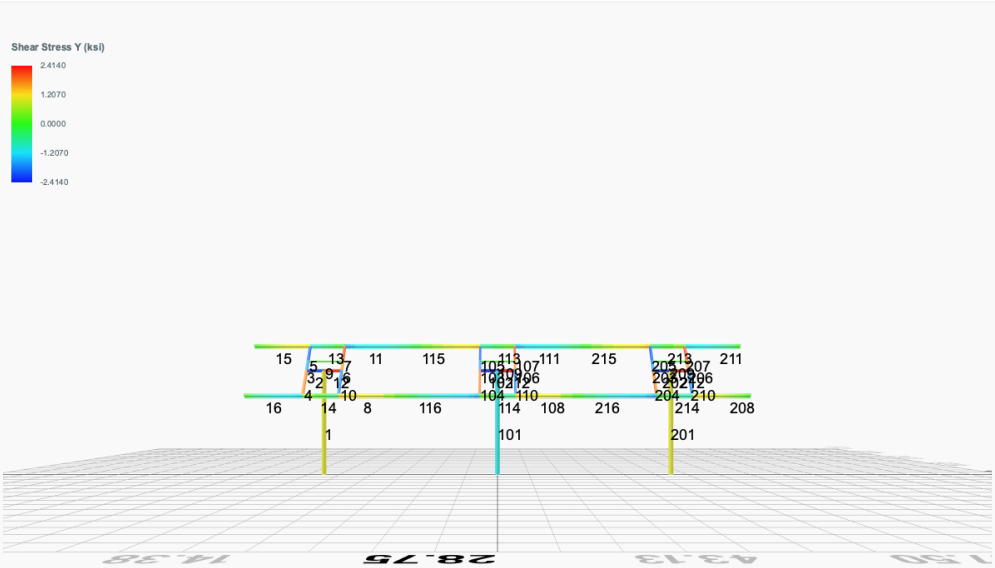

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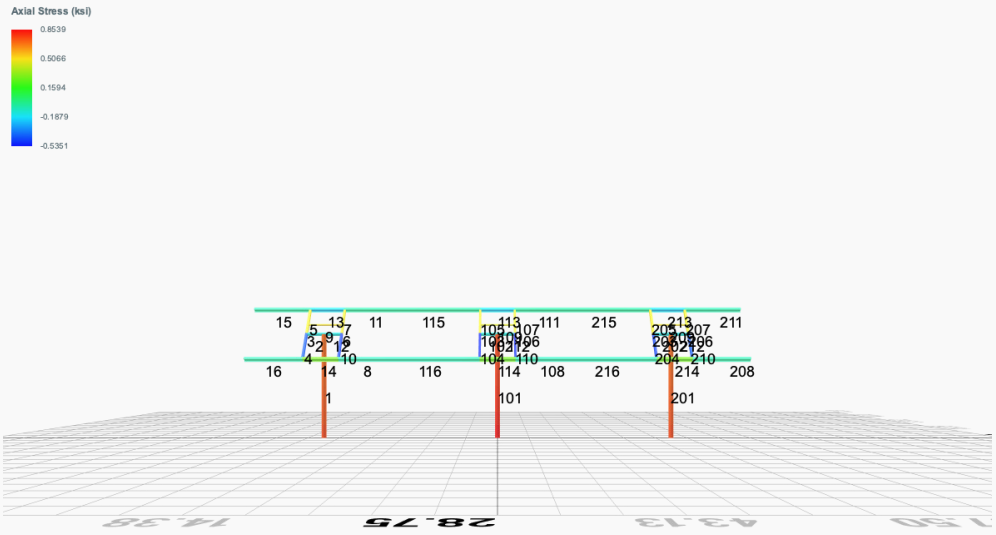
Axial Stress (ksi)
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0.5066
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-0.1879
-0.5351
15
13
11
115
113
111
215
213
211
16
14
8
116
114
108
216
214
208
1
101
201

SkyCiv

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	-0.0054	3.0164	-0.0019	-0.0045	0.0492	0.0863
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0064	3.3657	-0.0023	-0.0052	0.0584	0.0986
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0046	2.5855	-0.0017	-0.0038	0.0421	0.0725
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	-0.0102	5.0822	-0.0037	-0.0082	0.0943	0.1649
ULS: 5. 1.2D + E + L + 0.2S	-0.0053	2.8976	-0.0019	-0.0044	0.0487	0.0826
ULS: 7. 0.9D + 1.0E	-0.0034	1.9391	-0.0012	-0.0029	0.0316	0.0527
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.1057	6.7898	0.0015	0.0073	0.0285	50.5878
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-0.0064	3.3657	-0.0023	-0.0052	0.0584	0.0986
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.0909	-0.0577	-0.0046	-0.0127	0.0817	-48.3752
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	-0.0064	3.3657	-0.0023	-0.0052	0.0584	0.0986
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.1036	6.0095	0.0019	0.0081	0.0131	50.3077
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-0.0046	2.5855	-0.0017	-0.0038	0.0421	0.0725
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.0924	-0.8378	-0.0039	-0.0108	0.0646	-48.1704
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	-0.0046	2.5855	-0.0017	-0.0038	0.0421	0.0725
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.0600	6.7943	-0.0018	-0.0019	0.0792	25.4263
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.0102	5.0822	-0.0037	-0.0082	0.0943	0.1649
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.0390	3.3703	-0.0052	-0.0132	0.1077	-24.5798
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	-0.0102	5.0822	-0.0037	-0.0082	0.0943	0.1649
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.0538	4.2974	-0.0001	0.0015	0.0285	24.9319
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.0046	2.5855	-0.0017	-0.0038	0.0421	0.0725
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.0442	0.8738	-0.0029	-0.0079	0.0541	-24.2891
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	-0.0046	2.5855	-0.0017	-0.0038	0.0421	0.0725
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-4.1022	5.3630	0.0022	0.0086	0.0032	50.0825
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-0.0034	1.9391	-0.0012	-0.0029	0.0316	0.0527
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	4.0934	-1.4841	-0.0033	-0.0095	0.0534	-48.0034
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	-0.0034	1.9391	-0.0012	-0.0029	0.0316	0.0527

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	-0.0038	2.1546	-0.0014	-0.0032	0.0351	0.0592
ULS: 2. D + L	-0.0038	2.1546	-0.0014	-0.0032	0.0351	0.0592
ULS: 3. D + (S or Lr or R)	-0.0074	3.7150	-0.0026	-0.0059	0.0677	0.1117
ULS: 3. D + (S or Lr or R)	-0.0038	2.1546	-0.0014	-0.0032	0.0351	0.0592
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0065	3.3249	-0.0023	-0.0052	0.0596	0.0976
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0038	2.1546	-0.0014	-0.0032	0.0351	0.0592
ULS: 5b. D + 0.7E	-0.0038	2.1546	-0.0014	-0.0032	0.0351	0.0592
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	-0.0065	3.3249	-0.0023	-0.0052	0.0596	0.0976
ULS: 8. 0.6D + 0.7E	-0.0023	1.2927	-0.0008	-0.0019	0.0211	0.0341
ULS: 5a. D + 0.6W_Wind downforce Case A only	-2.4629	4.2088	0.0005	0.0032	0.0188	29.8711
ULS: 5a. D + 0.6W_Wind downforce Case B only	-0.0038	2.1546	-0.0014	-0.0032	0.0351	0.0592
ULS: 5a. D + 0.6W_Wind uplift Case A only	2.4545	0.1006	-0.0028	-0.0078	0.0491	-29.0402
ULS: 5a. D + 0.6W_Wind uplift Case B only	-0.0038	2.1546	-0.0014	-0.0032	0.0351	0.0592
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-1.8509	4.8657	-0.0008	-0.0002	0.0469	22.5544
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.0065	3.3249	-0.0023	-0.0052	0.0596	0.0976
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.8375	1.7843	-0.0035	-0.0092	0.0708	-21.9514
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	-0.0065	3.3249	-0.0023	-0.0052	0.0596	0.0976

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	-1.8481	3.6952	0.0000	0.0014	0.0231	22.3496
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.0038	2.1546	-0.0014	-0.0032	0.0351	0.0592
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.8400	0.6140	-0.0025	-0.0068	0.0458	-21.8305
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	-0.0038	2.1546	-0.0014	-0.0032	0.0351	0.0592
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-2.4612	3.3470	0.0010	0.0041	0.0052	29.6861
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-0.0023	1.2927	-0.0008	-0.0019	0.0211	0.0341
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	2.4559	-0.7612	-0.0022	-0.0062	0.0346	-28.9143
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	-0.0023	1.2927	-0.0008	-0.0019	0.0211	0.0341

Worst Case Reactions (LRFD)

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

Result	Value (kip, kip-ft)
Axial	6.7943
Shear X	-4.1057
Shear Z	-0.0052
Moment X	-0.0132
Moment Y (Twist)	0.1077
Moment Z	50.5878

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	4.8657
Shear X	-2.4629
Shear Z	-0.0035
Moment X	-0.0092
Moment Y (Twist)	0.0708
Moment Z	29.8711

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	0.0107	3.1744	-0.0000	0.0000	0.0000	-0.0824
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0127	3.5540	-0.0000	0.0000	0.0000	-0.1018
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0092	2.7209	-0.0000	0.0000	0.0000	-0.0720
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	0.0205	5.3868	-0.0000	0.0000	0.0000	-0.1592
ULS: 5. 1.2D + E + L + 0.2S	0.0106	3.0542	-0.0000	0.0000	0.0000	-0.0842
ULS: 7. 0.9D + 1.0E	0.0069	2.0407	-0.0000	0.0000	0.0000	-0.0555
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.2163	7.1338	0.0000	-0.0000	-0.0001	51.8893
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	0.0127	3.5540	-0.0000	0.0000	0.0000	-0.1018
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.2457	-0.0273	-0.0000	0.0001	0.0001	-50.0106
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	0.0127	3.5540	-0.0000	0.0000	0.0000	-0.1018
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.2205	6.3010	0.0000	-0.0000	-0.0001	51.6550
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	0.0092	2.7209	-0.0000	0.0000	0.0000	-0.0720
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.2428	-0.8605	-0.0000	0.0000	0.0001	-49.7407
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	0.0092	2.7209	-0.0000	0.0000	0.0000	-0.0720
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.0938	7.1766	-0.0000	0.0000	-0.0000	25.8557
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	0.0205	5.3868	-0.0000	0.0000	0.0000	-0.1592
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.1359	3.5965	-0.0000	0.0001	0.0001	-25.6401
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.0205	5.3868	-0.0000	0.0000	0.0000	-0.1592
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.1061	4.5111	0.0000	-0.0000	-0.0000	25.5248
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	0.0092	2.7209	-0.0000	0.0000	0.0000	-0.0720
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.1255	0.9304	-0.0000	0.0000	0.0001	-25.1544
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.0092	2.7209	-0.0000	0.0000	0.0000	-0.0720
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-4.2232	5.6209	0.0000	-0.0000	-0.0001	51.4589
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	0.0069	2.0407	-0.0000	0.0000	0.0000	-0.0555
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	4.2409	-1.5409	-0.0000	0.0000	0.0001	-49.5309
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	0.0069	2.0407	-0.0000	0.0000	0.0000	-0.0555

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	0.0077	2.2674	-0.0000	0.0000	0.0000	-0.0611
ULS: 2. D + L	0.0077	2.2674	-0.0000	0.0000	0.0000	-0.0611
ULS: 3. D + (S or Lr or R)	0.0147	3.9336	-0.0000	0.0000	0.0000	-0.1206
ULS: 3. D + (S or Lr or R)	0.0077	2.2674	-0.0000	0.0000	0.0000	-0.0611
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0130	3.5170	-0.0000	0.0000	0.0000	-0.1066
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0077	2.2674	-0.0000	0.0000	0.0000	-0.0611
ULS: 5b. D + 0.7E	0.0077	2.2674	-0.0000	0.0000	0.0000	-0.0611
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	0.0130	3.5170	-0.0000	0.0000	0.0000	-0.1066
ULS: 8. 0.6D + 0.7E	0.0046	1.3605	-0.0000	0.0000	0.0000	-0.0380
ULS: 5a. D + 0.6W_Wind downforce Case A only	-2.5308	4.4157	0.0000	-0.0000	-0.0000	30.6349
ULS: 5a. D + 0.6W_Wind downforce Case B only	0.0077	2.2674	-0.0000	0.0000	0.0000	-0.0611
ULS: 5a. D + 0.6W_Wind uplift Case A only	2.5475	0.1187	-0.0000	0.0000	0.0001	-30.0210
ULS: 5a. D + 0.6W_Wind uplift Case B only	0.0077	2.2674	-0.0000	0.0000	0.0000	-0.0611
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-1.8906	5.1281	-0.0000	0.0000	-0.0000	23.0176
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	0.0130	3.5170	-0.0000	0.0000	0.0000	-0.1066
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.9173	1.9057	-0.0000	0.0000	0.0001	-22.8095
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.0130	3.5170	-0.0000	0.0000	0.0000	-0.1066
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-1.8963	3.8787	0.0000	-0.0000	-0.0000	22.8901
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	0.0077	2.2674	-0.0000	0.0000	0.0000	-0.0611
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.9124	0.6559	-0.0000	0.0000	0.0000	-22.5983
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.0077	2.2674	-0.0000	0.0000	0.0000	-0.0611
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-2.5342	3.5088	0.0000	-0.0000	-0.0000	30.4925
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	0.0046	1.3605	-0.0000	0.0000	0.0000	-0.0380
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	2.5448	-0.7884	-0.0000	0.0000	0.0000	-29.8416
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	0.0046	1.3605	-0.0000	0.0000	0.0000	-0.0380

Worst Case Reactions (LRFD)

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

Result	Value (kip, kip-ft)
Axial	7.1766
Shear X	-4.2457
Shear Z	-0.0000
Moment X	0.0001
Moment Y (Twist)	0.0001
Moment Z	51.8893

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	5.1281
Shear X	-2.5475
Shear Z	-0.0000
Moment X	0.0000
Moment Y (Twist)	0.0001
Moment Z	30.6349

Reaction Forces for Foundation 3 (Node ID#201), (kip, kip-ft)

LRFD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. 1.4D	-0.0054	3.0164	0.0019	0.0045	-0.0491	0.0863
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0064	3.3657	0.0023	0.0053	-0.0584	0.0986
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0046	2.5855	0.0017	0.0039	-0.0421	0.0725
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	-0.0103	5.0822	0.0037	0.0083	-0.0943	0.1650
ULS: 5. 1.2D + E + L + 0.2S	-0.0053	2.8976	0.0019	0.0044	-0.0486	0.0827
ULS: 7. 0.9D + 1.0E	-0.0034	1.9391	0.0012	0.0029	-0.0316	0.0527
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.1056	6.7898	-0.0015	-0.0074	-0.0286	50.5887

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-0.0064	3.3657	0.0023	0.0053	-0.0584	0.0986
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.0909	-0.0576	0.0046	0.0129	-0.0814	-48.3759
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	-0.0064	3.3657	0.0023	0.0053	-0.0584	0.0986
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-4.1036	6.0095	-0.0019	-0.0081	-0.0133	50.3086
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-0.0046	2.5855	0.0017	0.0039	-0.0421	0.0725
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.0924	-0.8378	0.0039	0.0109	-0.0644	-48.1712
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	-0.0046	2.5855	0.0017	0.0039	-0.0421	0.0725
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.0600	6.7943	0.0018	0.0019	-0.0793	25.4268
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.0103	5.0822	0.0037	0.0083	-0.0943	0.1650
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.0390	3.3704	0.0052	0.0133	-0.1075	-24.5801
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	-0.0103	5.0822	0.0037	0.0083	-0.0943	0.1650
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.0538	4.2974	0.0001	-0.0015	-0.0285	24.9323
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.0046	2.5855	0.0017	0.0039	-0.0421	0.0725
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.0441	0.8738	0.0029	0.0080	-0.0540	-24.2894
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	-0.0046	2.5855	0.0017	0.0039	-0.0421	0.0725
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-4.1022	5.3630	-0.0022	-0.0087	-0.0033	50.0831
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-0.0034	1.9391	0.0012	0.0029	-0.0316	0.0527
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	4.0934	-1.4841	0.0033	0.0095	-0.0533	-48.0039
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	-0.0034	1.9391	0.0012	0.0029	-0.0316	0.0527

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	-0.0038	2.1546	0.0014	0.0032	-0.0351	0.0592
ULS: 2. D + L	-0.0038	2.1546	0.0014	0.0032	-0.0351	0.0592
ULS: 3. D + (S or Lr or R)	-0.0074	3.7150	0.0026	0.0060	-0.0677	0.1117
ULS: 3. D + (S or Lr or R)	-0.0038	2.1546	0.0014	0.0032	-0.0351	0.0592
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0065	3.3249	0.0023	0.0053	-0.0595	0.0977
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0038	2.1546	0.0014	0.0032	-0.0351	0.0592
ULS: 5b. D + 0.7E	-0.0038	2.1546	0.0014	0.0032	-0.0351	0.0592
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	-0.0065	3.3249	0.0023	0.0053	-0.0595	0.0977
ULS: 8. 0.6D + 0.7E	-0.0023	1.2927	0.0008	0.0019	-0.0210	0.0341
ULS: 5a. D + 0.6W_Wind downforce Case A only	-2.4629	4.2088	-0.0005	-0.0032	-0.0188	29.8715
ULS: 5a. D + 0.6W_Wind downforce Case B only	-0.0038	2.1546	0.0014	0.0032	-0.0351	0.0592
ULS: 5a. D + 0.6W_Wind uplift Case A only	2.4545	0.1006	0.0028	0.0079	-0.0490	-29.0406
ULS: 5a. D + 0.6W_Wind uplift Case B only	-0.0038	2.1546	0.0014	0.0032	-0.0351	0.0592
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-1.8509	4.8657	0.0008	0.0002	-0.0470	22.5547
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.0065	3.3249	0.0023	0.0053	-0.0595	0.0977
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.8375	1.7843	0.0035	0.0093	-0.0707	-21.9517
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	-0.0065	3.3249	0.0023	0.0053	-0.0595	0.0977
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-1.8481	3.6952	-0.0000	-0.0014	-0.0231	22.3499
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.0038	2.1546	0.0014	0.0032	-0.0351	0.0592
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	1.8400	0.6140	0.0025	0.0069	-0.0457	-21.8308
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	-0.0038	2.1546	0.0014	0.0032	-0.0351	0.0592
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-2.4612	3.3470	-0.0010	-0.0041	-0.0053	29.6863
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-0.0023	1.2927	0.0008	0.0019	-0.0210	0.0341
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	2.4559	-0.7612	0.0022	0.0062	-0.0345	-28.9145
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	-0.0023	1.2927	0.0008	0.0019	-0.0210	0.0341

Worst Case Reactions (LRFD)

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	6.7943
Shear X	-4.1056
Shear Z	0.0052
Moment X	0.0133
Moment Y (Twist)	0.1075
Moment Z	50.5887

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

Result	Value (kip, kip-ft)
Axial	4.8657
Shear X	-2.4629
Shear Z	0.0035
Moment X	0.0093
Moment Y (Twist)	0.0707
Moment Z	29.8715

Project Details

Design Code: AISC 360-16 LRFD
Provision: LRFD
Country: United States

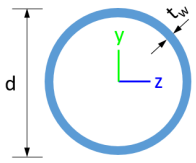
User Name: sales@mtsolar.us
Project Name: MTSOLAR_EK3EJC1530L8
Unit System: imperial

Design Input Information

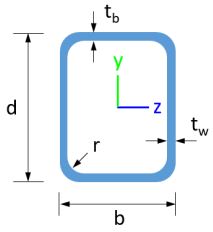
Design Factors			
Φ_t	Φ_c	Φ_b	Φ_v
0.9	0.9	0.9	0.9

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

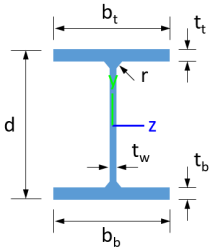
Section Dimensions



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

Section Properties								
ID	Name	A (in^2)	J (in^4)	I_{yp} (in^4)	I_{zp} (in^4)	I_w (in^6)	S_{yp} (in^3)	S_{zp} (in^3)
1	2in Pipe Sch 40	1.07	1.33	0.67	0.67	0.00	0.76	0.76
4	4in Pipe Sch 40	3.17	14.47	7.23	7.23	0.00	4.31	4.31
8	6in Pipe Sch 80	8.40	80.98	40.49	40.49	0.00	16.60	16.60
15	HSS5x3x1/8	1.77	6.02	2.75	6.03	0.51	2.07	2.93
18	W6x9	2.68	0.04	2.20	16.40	17.70	1.72	6.23

Member Properties								
Member ID	Section ID	K_zL (ft)	K_yL (ft)	L_b (ft)	C_b	LST	LSC	LD
1	8	7.68	7.68	11.81	-	300	200	250
2	4	1.30	1.30	2.00	-	300	200	250
3	15	0.92	0.92	1.42	1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.22,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.16,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18	300	200	250
4	15	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.74,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.64,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68	300	200	250
5	15	1.52	1.52	2.33	1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.71,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.65,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67	300	200	250
6	15	0.92	0.92	1.42	1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.22,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18	300	200	250
7	15	1.52	1.52	2.33	1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.75,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.65,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67	300	200	250
8	18	1.33	1.33	2.05	2.12,2.12,2.12,2.12,2.12,2.12,2.12,2.12,2.11,2.12,2.12,2.12,2.11,2.12,2.12,2.12,2.38,2.12,2.12,2.12,2.11,2.12,2.12,2.12,2.11,2.12,2.12,2.12,2.12,2.12,2.12,2.12,2.12,2.12,2.12,2.12,2.12,2.11,2.12,2.12,2.12,2.11,2.12,2.12,2.12,2.11,2.12,2.12,2.12,2.11,2.12	300	200	250
9	1	2.60	2.60	4.00	-	300	200	250
10	15	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.76,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.64,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68	300	200	250
11	18	1.33	1.33	2.05	2.11,2.11,2.11,2.11,2.11,2.11,2.15,2.11,2.25,2.11,2.16,2.11,2.22,2.11,2.12,2.11,1.47,2.11,2.13,2.11,2.32,2.11,2.16,2.11,2.21,2.11,2.11,2.11,2.11,2.11,2.11,2.11,2.11,2.11,2.11,2.14,2.11,2.25,2.11,2.12,2.11,2.33,2.11,2.14,2.11,2.30,2.11,2.16,2.11,2.21,2.11	300	200	250
12	4	1.30	1.30	2.00	-	300	200	250
13	18	4.88	4.00	7.50	1.10,1.10,1.10,1.10,1.10,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.10,1.10,1.28,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.07,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10	300	200	250
14	18	4.88	4.00	7.50	1.10,1.10,1.10,1.10,1.10,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.14,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.08,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10	300	200	250
15	18	9.97	9.97	4.75	2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33	300	200	250
16	18	9.97	9.97	4.75	2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33	300	200	250
101	8	7.68	7.68	11.81	-	300	200	250
102	4	1.30	1.30	2.00	-	300	200	250
103	15	0.92	0.92	1.42	1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.21,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.16,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18	300	200	250

104	15	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.74,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.64,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68	300	200	250
105	15	1.52	1.52	2.33	1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.70,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.65,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67	300	200	250
106	15	0.92	0.92	1.42	1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.21,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.16,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18	300	200	250
107	15	1.52	1.52	2.33	1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.70,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.65,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67	300	200	250
108	18	1.33	1.33	2.05	2.07,2.07,2.07,2.07,2.07,2.07,2.06,2.07,2.04,2.07,2.06,2.07,2.05,2.07,2.06,2.07,1.85,2.07,2.06,2.07,1.97,2.07,2.06,2.07,2.06,2.07,2.07,2.07,2.07,2.07,2.07,2.07,2.07,2.07,2.07,2.06,2.07,2.04,2.07,2.06,2.07,1.70,2.07,2.06,2.07,1.99,2.07,2.06,2.07,2.05,2.07	300	200	250
109	1	2.60	2.60	4.00	-	300	200	250
110	15	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.74,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.64,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68	300	200	250
111	18	1.33	1.33	2.05	2.09,2.09,2.09,2.09,2.09,2.09,1.99,2.09,1.71,2.09,1.97,2.09,1.77,2.09,2.06,2.09,1.31,2.09,2.04,2.09,1.60,2.09,1.95,2.09,1.81,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.00,2.09,1.71,2.09,2.06,2.09,1.30,2.09,2.04,2.09,1.63,2.09,1.96,2.09,1.80,2.09	300	200	250
112	4	1.30	1.30	2.00	-	300	200	250
113	18	4.88	4.00	7.50	1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.05,1.04,1.04,1.04,1.05,1.04,1.04,1.04,1.02,1.04,1.04,1.04,1.05,1.04,1.04,1.04,1.05,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.05,1.04,1.04,1.04,1.09,1.04,1.04,1.04,1.05,1.04,1.04,1.04,1.05,1.04	300	200	250
114	18	4.88	4.00	7.50	1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.03,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.05,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04,1.04	300	200	250
115	18	6.63	6.63	10.20	1.16,1.16,1.16,1.16,1.16,1.16,1.13,1.16,1.12,1.16,1.13,1.16,1.12,1.16,1.14,1.16,2.60,1.16,1.14,1.16,1.11,1.16,1.13,1.16,1.12,1.16,1.16,1.16,1.16,1.16,1.16,1.16,1.16,1.16,1.16,1.13,1.16,1.12,1.16,1.14,1.16,1.10,1.16,1.14,1.16,1.11,1.16,1.13,1.16,1.12,1.16	300	200	250
116	18	6.63	6.63	10.20	1.15,1.15,1.15,1.15,1.15,1.15,1.14,1.15,1.14,1.15,1.14,1.15,1.14,1.15,1.14,1.15,1.29,1.15,1.14,1.15,1.13,1.15,1.14,1.15,1.14,1.15,1.15,1.15,1.15,1.15,1.15,1.15,1.15,1.15,1.15,1.14,1.15,1.14,1.15,1.14,1.15,1.12,1.15,1.14,1.15,1.13,1.15,1.14,1.15,1.14,1.15	300	200	250
201	8	7.68	7.68	11.81	-	300	200	250
202	4	1.30	1.30	2.00	-	300	200	250
203	15	0.92	0.92	1.42	1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.22,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18	300	200	250
204	15	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.76,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.64,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68	300	200	250
205	15	1.52	1.52	2.33	1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.75,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.65,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67	300	200	250
206	15	0.92	0.92	1.42	1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.22,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.16,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18	300	200	250
207	15	1.52	1.52	2.33	1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.71,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.65,1.67,1.67,1.67,1.66,1.67,1.67,1.67,1.66,1.67	300	200	250
208	18	9.97	9.97	4.75	2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33	300	200	250
209	1	2.60	2.60	4.00	-	300	200	250
210	15	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.74,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.68,1.66,1.68,1.67,1.67,1.64,1.67,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68	300	200	250
211	18	9.97	9.97	4.75	2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33,2.33	300	200	250
212	4	1.30	1.30	2.00	-	300	200	250

213	18	4.88	4.00	7.50	1.10,1.10,1.10,1.10,1.10,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.10,1.10,1.28,1.10,1.09,1.10,1.08,1.10,1.09,1.10,1.09,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.07,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10	300	200	250
214	18	4.88	4.00	7.50	1.10,1.10,1.10,1.10,1.10,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.14,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.08,1.10,1.09,1.10,1.09,1.10,1.09,1.10,1.09,1.10	300	200	250
215	18	6.63	6.63	10.20	1.17,1.17,1.17,1.17,1.17,1.17,1.18,1.17,1.18,1.17,1.18,1.17,1.18,1.17,1.18,1.17,1.17,1.17,1.72,1.17,1.17,1.17,1.18,1.17,1.18,1.17,1.18,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.18,1.17,1.18,1.17,1.17,1.17,1.17,1.21,1.17,1.17,1.17,1.18,1.17,1.18,1.17,1.18,1.17	300	200	250
216	18	6.63	6.63	10.20	1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17	300	200	250

Member Design Capacity

Member ID	$\Phi_t P_n$ (kip)	$\Phi_c P_n$ (kip)	$\Phi_b M_{zn}$ (k-ft)	$\Phi_b M_{yn}$ (k-ft)	$\Phi_v V_{yn}$ (kip)	$\Phi_v V_{zn}$ (kip)
1	347.96	309.09	57.25	57.25	104.39	104.39
2	131.41	130.46	14.87	14.87	39.42	39.42
3	79.65	74.89	10.99	6.26	29.14	16.61
4	79.65	72.84	10.99	6.26	29.14	16.61
5	79.65	74.30	10.99	6.26	29.14	16.61
6	79.65	74.89	10.99	6.26	29.14	16.61
7	79.65	74.30	10.99	6.26	29.14	16.61
8	120.60	115.40	23.36	6.45	30.09	45.74
9	44.49	40.02	2.63	2.63	13.35	13.35
10	79.65	72.84	10.99	6.26	29.14	16.61
11	120.60	115.40	23.36	6.45	30.09	45.74
12	131.41	130.46	14.87	14.87	39.42	39.42
13	120.60	84.03	18.83	6.45	30.09	45.74
14	120.60	84.03	18.98	6.45	30.09	45.74
15	120.60	34.69	23.36	6.45	30.09	45.74
16	120.60	34.69	23.36	6.45	30.09	45.74
101	347.96	309.09	57.25	57.25	104.39	104.39
102	131.41	130.46	14.87	14.87	39.42	39.42
103	79.65	74.89	10.99	6.26	29.14	16.61
104	79.65	72.84	10.99	6.26	29.14	16.61
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	115.40	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	115.40	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	17.89	6.45	30.09	45.74
114	120.60	84.03	18.08	6.45	30.09	45.74
115	120.60	68.63	14.97	6.45	30.09	45.74
116	120.60	68.63	15.25	6.45	30.09	45.74
201	347.96	309.09	57.25	57.25	104.39	104.39
202	131.41	130.46	14.87	14.87	39.42	39.42
203	79.65	74.89	10.99	6.26	29.14	16.61
204	79.65	72.84	10.99	6.26	29.14	16.61
205	79.65	74.30	10.99	6.26	29.14	16.61
206	79.65	74.89	10.99	6.26	29.14	16.61
207	79.65	74.30	10.99	6.26	29.14	16.61

208	120.60	34.69	23.36	6.45	30.09	45.74
209	44.49	40.02	2.63	2.63	13.35	13.35
210	79.65	72.84	10.99	6.26	29.14	16.61
211	120.60	34.69	23.36	6.45	30.09	45.74
212	131.41	130.46	14.87	14.87	39.42	39.42
213	120.60	84.03	18.81	6.45	30.09	45.74
214	120.60	84.03	19.00	6.45	30.09	45.74
215	120.60	68.63	15.96	6.45	30.09	45.74
216	120.60	68.63	15.99	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	0.022	0.884	0.001	0.039	0.000	0.895	#13	0.210	Not Required	Pass
2	0.003	0.356	0.283	0.081	0.052	0.640	#13	0.034	Not Required	Pass
3	0.012	0.620	0.077	0.062	0.008	0.674	#13	0.044	Not Required	Pass
4	0.011	0.617	0.212	0.062	0.035	0.707	#13	0.078	Not Required	Pass
5	0.011	0.384	0.222	0.061	0.044	0.417	#13	0.073	Not Required	Pass
6	0.012	0.624	0.085	0.062	0.010	0.680	#13	0.044	Not Required	Pass
7	0.012	0.387	0.227	0.062	0.046	0.424	#13	0.073	Not Required	Pass
8	0.000	0.046	0.109	0.040	0.013	0.137	#21	0.088	Not Required	Pass
9	0.015	0.048	0.065	0.001	0.000	0.116	#13	0.198	Not Required	Pass
10	0.011	0.615	0.218	0.062	0.037	0.708	#13	0.078	Not Required	Pass
11	0.000	0.045	0.111	0.041	0.013	0.140	#21	0.088	Not Required	Pass
12	0.003	0.357	0.281	0.082	0.053	0.639	#13	0.034	Not Required	Pass
13	0.006	0.220	0.307	0.052	0.016	0.471	#21	0.265	Not Required	Pass
14	0.007	0.222	0.307	0.051	0.016	0.471	#21	0.177	Not Required	Pass
15	0.000	0.093	0.164	0.030	0.010	0.236	#21	Not Required	Not Required	Pass
16	0.000	0.093	0.164	0.030	0.010	0.236	#21	Not Required	Not Required	Pass
101	0.023	0.906	0.000	0.041	0.000	0.918	#13	0.210	Not Required	Pass
102	0.003	0.370	0.286	0.086	0.054	0.657	#13	0.034	Not Required	Pass
103	0.013	0.645	0.093	0.064	0.014	0.708	#13	0.044	Not Required	Pass
104	0.012	0.646	0.207	0.065	0.035	0.742	#13	0.078	Not Required	Pass
105	0.013	0.400	0.216	0.064	0.043	0.435	#13	0.073	Not Required	Pass
106	0.013	0.645	0.093	0.064	0.014	0.708	#13	0.044	Not Required	Pass
107	0.013	0.401	0.216	0.064	0.043	0.435	#13	0.073	Not Required	Pass
108	0.000	0.056	0.108	0.038	0.013	0.130	#21	0.088	Not Required	Pass
109	0.012	0.043	0.061	0.001	0.000	0.108	#13	0.198	Not Required	Pass
110	0.012	0.646	0.207	0.065	0.035	0.742	#13	0.078	Not Required	Pass
111	0.000	0.060	0.109	0.038	0.013	0.130	#21	0.088	Not Required	Pass
112	0.003	0.370	0.286	0.086	0.054	0.657	#13	0.034	Not Required	Pass
113	0.006	0.165	0.288	0.049	0.016	0.413	#21	0.265	Not Required	Pass
114	0.007	0.177	0.286	0.049	0.016	0.413	#21	0.265	Not Required	Pass
115	0.000	0.181	0.165	0.038	0.013	0.303	#21	0.439	Not Required	Pass
116	0.000	0.178	0.166	0.038	0.013	0.304	#21	0.439	Not Required	Pass
201	0.022	0.884	0.001	0.039	0.000	0.895	#13	0.210	Not Required	Pass
202	0.003	0.357	0.281	0.082	0.053	0.639	#13	0.034	Not Required	Pass
203	0.012	0.624	0.085	0.062	0.010	0.680	#13	0.044	Not Required	Pass
204	0.011	0.615	0.218	0.062	0.037	0.708	#13	0.078	Not Required	Pass
205	0.012	0.387	0.227	0.062	0.046	0.424	#13	0.073	Not Required	Pass
206	0.012	0.620	0.077	0.062	0.008	0.674	#13	0.044	Not Required	Pass

206	0.012	0.020	0.077	0.002	0.008	0.074	#13	0.044	Not Required	Pass
207	0.011	0.385	0.222	0.061	0.044	0.417	#13	0.073	Not Required	Pass
208	0.000	0.093	0.164	0.030	0.010	0.236	#21	Not Required	Not Required	Pass
209	0.015	0.048	0.065	0.001	0.000	0.116	#13	0.198	Not Required	Pass
210	0.011	0.617	0.212	0.062	0.035	0.707	#13	0.078	Not Required	Pass
211	0.000	0.093	0.164	0.030	0.010	0.236	#21	Not Required	Not Required	Pass
212	0.003	0.356	0.283	0.081	0.052	0.640	#13	0.034	Not Required	Pass
213	0.006	0.220	0.307	0.052	0.016	0.471	#21	0.177	Not Required	Pass
214	0.007	0.222	0.307	0.051	0.016	0.471	#21	0.265	Not Required	Pass
215	0.000	0.176	0.165	0.041	0.013	0.300	#21	0.439	Not Required	Pass
216	0.000	0.174	0.166	0.040	0.013	0.302	#21	0.439	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/comression)
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

Powered by SkyCiv

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 deph	48 in

Material Properties

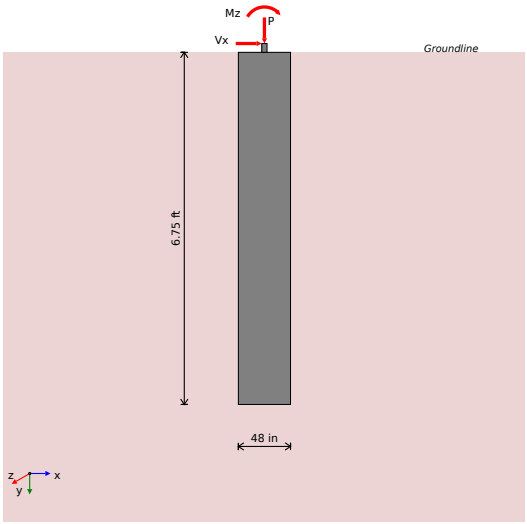
Input	Description	Value
f'_{ck}	Concrete compressive strength	2.5 ksi
f_{yk}	Yield strength of steel	60 ksi
d_b	Rebar diameter	#5 (0.625) in
cover	Concrete cover	3 in

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	4.866 kip	6.794 kip
Vx	-2.463 kip	-4.106 kip
Vz	0.004 kip	0.005 kip
Mx	0.009 kip-ft	0.013 kip-ft
Mz	29.87 kip-ft	50.59 kip-ft



REFERENCES CALCULATIONS RESULTS

Required depth to resist lateral loads (ASD)

Allowable lateral pressure $R =$ 150 psf/ft

Point of application of lateral load:

$$H = h_1 + h_2 + h_e = 0 + 0 + 0 = 0\ ft$$

Considering x-direction:

Lateral force per section length

$$H_o = \frac{V_x}{1.57 \times D} = \frac{-2.463}{1.57 \times 48} = -0.392\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_z + (V_x \times H)}{1.57 \times D} = \frac{29.87 + (-2.463 \times 0)}{1.57 \times 48} = 4.757 \ \frac{kip - ft}{ft}$$

Required depth of embedment in earth:

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

Solving the cubic equation:

$$L_{e,x} = 6.173 \ ft$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{1.57 \times b} = \frac{0.004}{1.57 \times 48} = 0.001 \ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_x + (V_z \times H)}{1.57 \times b} = \frac{0.009 + (0.004 \times 0)}{1.57 \times 48} = 0.001 \ \frac{kip - ft}{ft}$$

Required depth of embedment in earth:

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

Solving the cubic equation:

$$L_{e,z} = 0.514 \ ft$$

Minimum embedded depth

Depth of pile required

$$L_{e,req} = MAX[L_{e,x}, L_{e,z}] = MAX[6.173, 0.514] = 6.173 \ ft$$

Actual embedded length

$$L_e = L - h_2 - h_e = 6.75 - 0 - 0 = 6.75 \ ft$$

Utilisation

$$Ratio = \frac{L_{e,req}}{L_e} = \frac{6.173}{6.75} = 0.915$$

UTILITY: 0.91

REFERENCES	CALCULATIONS	RESULTS

End-bearing Capacity (ASD)

Allowable bearing pressure	$q_a =$	2000 psf
Unit weight of concrete	$w_c =$	0.15 kip/ft^3

Cross-sectional area:

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

End-bearing pressure:

$$q = \frac{P}{A} = \frac{4.866}{16} = 304.1 \ psf$$

Utilisation

$$Ratio = \frac{q}{q_a} = \frac{304.1}{2000} = 0.152$$

UTILITY: 0.15

Lateral Soil Pressure (ASD)

Allowable lateral pressure	$R =$	150 psf/ft

Length to least lateral dimension ratio:

$$\frac{L}{MIN[b, D]} = \frac{6.75}{MIN[4, 4]} = 1.688$$

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

Considering x-direction:

Distance from resting surface to pivot point:

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

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

$$a = \frac{(4 \times 4.757 \times 6.75) + (3 \times 0.392 \times 6.75^2)}{(6 \times 4.757) + (4 \times 0.392 \times 6.75)} = 4.652\ ft$$

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

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

$$p = \frac{0.75 \times [(4 \times 4.757) + (3 \times -0.392 \times 6.75)]^2}{6.75^2 \times [(3 \times 4.757) + (2 \times -0.392 \times 6.75)]} = 0.225\ \frac{kip}{ft^2}$$

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

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{4.652}{2} = 0.349\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of a/2

$$Ratio = \frac{p}{p_a} = \frac{0.225}{0.349} = 0.646$$

UTILITY: 0.65

Earth pressure against the pile at distance L_e:

$$s = \frac{6 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{6 \times [(2 \times 4.757) + (-0.392 \times 6.75)]}{6.75^2} = 0.904\ \frac{kip}{ft^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 6.75 = 1.012\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of L_e

$$Ratio = \frac{s}{p_s} = \frac{0.904}{1.012} = 0.893$$

UTILITY: 0.89

Considering z-direction:

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 0.001 \times 6.75) + (3 \times 0.001 \times 6.75^2)}{(6 \times 0.001) + (4 \times 0.001 \times 6.75)} = 4.855\ ft$$

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

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

$$p = \frac{0.75 \times [(4 \times 0.001) + (3 \times 0.001 \times 6.75)]^2}{6.75^2 \times [(3 \times 0.001) + (2 \times 0.001 \times 6.75)]} = 0\ \frac{kip}{ft^2}$$

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

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{4.855}{2} = 0.364\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of a/2

$$Ratio = \frac{p}{p_a} = \frac{0}{0.364} = 0.001$$

UTILITY: 0.00

Earth pressure against the pile at distance L_e:

$$s = \frac{6 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{6 \times [(2 \times 0.001) + (0.001 \times 6.75)]}{6.75^2} = 0.001\ \frac{kip}{ft^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 6.75 = 1.012\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of L_e

$$Ratio = \frac{s}{p_s} = \frac{0.001}{1.012} = 0.001$$

UTILITY: 0.00

REFERENCES	CALCULATIONS	RESULTS

Shear force and bending moment (LRFD)

Considering x-direction:

Lateral force per section length

$$H_o = \frac{V_x}{1.57 \times D} = \frac{-4.106}{1.57 \times 48} = -0.654 \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_z + (V_x \times H)}{1.57 \times D} = \frac{50.59 + (-4.106 \times 0)}{1.57 \times 48} = 8.056 \frac{kip - ft}{ft}$$

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 8.056 \times 6.75) + (3 \times 0.654 \times 6.75^2)}{(6 \times 8.056) + (4 \times 0.654 \times 6.75)} = 4.65\ ft$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{8.056}{-0.654} = 12.32\ ft$$

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

$$V_{max,x} = (-0.654 \times 48) \times [1 - [3 \times \left(\frac{4 \times 12.32}{6.75} + 3\right) \times \left(\frac{4.65}{6.75}\right)^2] + [4 \times \left(\frac{3 \times 12.32}{6.75} + 2\right) \times \left(\frac{4.65}{6.75}\right)^3]]$$

$$V_{max,x} = 10.17\ kip$$

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

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

$$M_{max,x} = (-0.654 \times 48 \times 6.75) \times [\left(\frac{12.32}{6.75} + \frac{4.65}{2 \times 6.75}\right) - [\left(\frac{4 \times 12.32}{6.75} + 3\right) \times \left(\frac{4.65}{2 \times 6.75}\right)^3] + [\left(\frac{3 \times 12.32}{6.75} + 2\right) \times \left(\frac{4.65}{2 \times 6.75}\right)^4]]$$

$$M_{max,x} = 32.73\ kip - ft$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{1.57 \times b} = \frac{0.005}{1.57 \times 48} = 0.001 \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_x + (V_z \times H)}{1.57 \times b} = \frac{0.013 + (0.005 \times 0)}{1.57 \times 48} = 0.002 \frac{kip - ft}{ft}$$

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 0.002 \times 6.75) + (3 \times 0.001 \times 6.75^2)}{(6 \times 0.002) + (4 \times 0.001 \times 6.75)} = 4.858\ ft$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{0.002}{0.001} = 2.572\ ft$$

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

$$V_{max,z} = (0.001 \times 48) \times [1 - [3 \times \left(\frac{4 \times 2.572}{6.75} + 3\right) \times \left(\frac{4.858}{6.75}\right)] + [4 \times \left(\frac{3 \times 2.572}{6.75} + 2\right) \times \left(\frac{4.858}{6.75}\right)^{3}]]$$

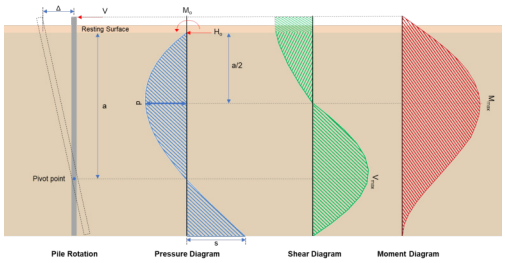
$$V_{max,z} = 0.004\ kip$$

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

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

$$M_{max,z} = (0.001 \times 48 \times 6.75) \times [\left(\frac{2.572}{6.75} + \frac{4.858}{2 \times 6.75}\right) - [\left(\frac{4 \times 2.572}{6.75} + 3\right) \times \left(\frac{4.858}{2 \times 6.75}\right)^{3}] + [\left(\frac{3 \times 2.572}{6.75} + 2\right) \times \left(\frac{4.858}{2 \times 6.75}\right)^{4}]]$$

$$M_{max,z} = 0.013\ kip - ft$$



Minimum Reinforcement Check (LRFD)

Gross area of concrete:

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

Main Reinforcement

22.4.2.2 Required reinforcement:

$$A_{st,req} = \frac{P - (0.85 \times f'_{ck} \times A_g)}{f_{yk} - (0.85 \times f'_{ck})} = \frac{6.794 - (0.85 \times 2.5 \times 2304)}{60 - (0.85 \times 2.5)} = -84.48\ in^2$$

10.6.1.1 Maximum reinforcement:

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

7.6.1.1 Minimum reinforcement:

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

Governing minimum reinforcement area:

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

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

Minimum number of reinforcements:

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

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

25.2.3 Minimum spacing:

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

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

Total reinforcement area:

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

Shear Reinforcement

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

Maximum spacing of shear Reinforcements:

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

Detailing Summary	
Main reinforcement	#5 (0.625 in) - 16pcs at 1.5 in min. spacing

Shear reinforcement	#3 (0.375 in) at 10 in max. spacing

Axial Compression Strength (LRFD)

22.4.2.2 Allowable axial compressive strength:

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

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

Utilisation

$$Ratio = \frac{P}{\phi P_N} = \frac{6.794}{2694} = 0.003$$

UTILITY: 0.00

Shear Strength LRFD)

Effective shear width	$b_w =$	48 in
Effective shear depth	$d =$	44.31 in
Shear reinforcement area	$A_v =$	0.221 in^2
Shear reinforcement spacing	$s =$	10 in
Concrete type factor (Normal concrete)	$\lambda =$	1
Strength reduction factor for shear	$\phi =$	0.75
Maximum shear in the x-direction	$V_{max,x} =$	10.17 kip
Maximum shear in the z-direction	$V_{max,z} =$	0.004 kip

22.5.5.1.1 Max shear strength of concrete:

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

Table 22.5.5.1 Shear strength of concrete:

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

$$V_{c,a} = \left(2 \times 1 \times \sqrt{2.5} + MIN[\frac{6.794}{6 \times 2304}, (0.05 \times 2.5)]\right) \times (48 \times 44.31) = 213.7\ kip$$

Governing shear strength of concrete:

$$V_c = MIN[V_{c,max}, V_{c,a}] = MIN[531.8, 213.7] = 213.7\ kip$$

22.5.1.2 Shear strength of steel (a):

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

22.5.8.5.3 Shear strength of steel (b):

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

Governing shear strength of steel:

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

22.5.1.1 Allowable shear strength:

$$\phi V_n = \phi \times (V_c + V_s) = 0.75 \times (213.7 + 58.73) = 204.4\ kip$$

$$V_{max} = MAX[10.17, 0.004] = 10.17\ kip$$

Utilisation

$$Ratio = \frac{V_{max}}{\phi V_n} = \frac{10.17}{204.4} = 0.05$$

UTILITY: 0.05

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 ksi
Maximum concrete strain	$\varepsilon_c =$	0.0030
Yield strain of steel f_y/E_s	$\varepsilon_y =$	0.0003
Section width	$b =$	48 in
Distance to the compression rebar	$d_s =$	3.688 in
Distance to the tension rebar	$d =$	44.31 in
Total bar area	$A_s =$	4.909 in^2
Maximum applied axial load	$P =$	6.794 kip
Maximum moment in the x-direction	$M_{max,x} =$	32.73 kip-ft
Maximum moment in the z-direction	$M_{max,z} =$	0.013 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:

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

$$\varepsilon_1 = (c - d_s) \times \frac{\varepsilon_c}{c}$$

$$f_1 = E_s \times \varepsilon_1 \ (\varepsilon_1 < \varepsilon_{sy}),\ f_1 = f_y \ (\varepsilon_1 \geq \varepsilon_{sy})$$

Tensile force due to bars in tension:

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

$$\varepsilon_2 = (d - c) \times \frac{\varepsilon_{cu}}{c}$$

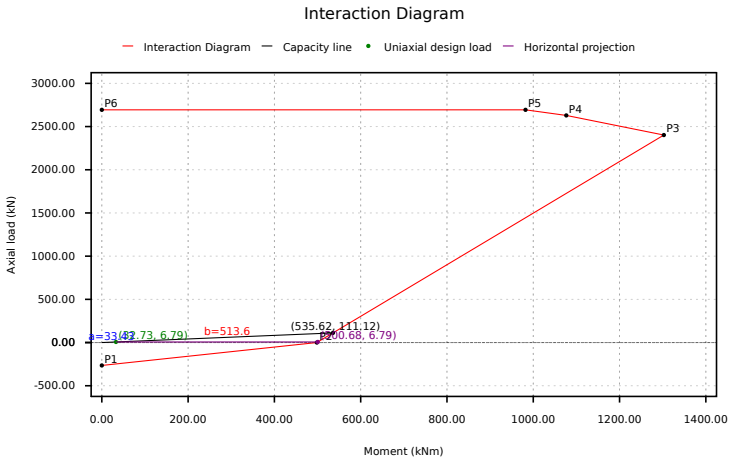
$$f_2 = E_s \times \varepsilon_2 \ (\varepsilon_2 < \varepsilon_{sy}),\ f_2 = \phi_s \times f_y \ (\varepsilon_2 \geq \varepsilon_{sy})$$

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

$$M_f = MAX[32.73, 0.013] = 32.73\ kip - ft$$



Segment	Signed Distance
P1 - P2	224.7
P2 - P3	443.7
P3 - P4	2590
P4 - P5	2753
P5 - P6	2687
Status	PASS: Point lies inside the curve

Utilisation

$$Ratio = \frac{a}{a+b} = \frac{33.43}{33.43 + 513.6} = 0.061$$

UTILITY: 0.06

Biaxial Bending Check

Maximum moment in the x-direction	$M_{max,x} =$ 32.73 kip-ft
Maximum moment in the z-direction	$M_{max,z} =$ 0.013 kip-ft
Nominal uniaxial moment strength about the x-axis	$M_{nox} =$ 500.7 kip-ft
Nominal uniaxial moment strength about the z-axis	$M_{noz} =$ 500.7 kip-ft
Interaction exponent	$\alpha =$ 1

Bresler (1960)	According to Bresler (method B): $$\left(\frac{M_{max,x}}{M_{nox}}\right)^{\alpha}+\left(\frac{M_{max,z}}{M_{noz}}\right)^{\alpha}=1.0$$ $$\left(\frac{32.73}{500.7}\right)^{1}+\left(\frac{0.013}{500.7}\right)^{1}=0.065$$	**UTILITY: 0.07**

REFERENCES	CALCULATIONS	RESULTS

Results Summary

Result Name	Results
PILE DETAILS	
Length of the pile	6.75 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	0.15
p_a	0.65
p_s	0.89
Axial compression strength	0.00
Shear strength	0.05
Uniaxial bending strength	0.06
Biaxial bending strength	0.07