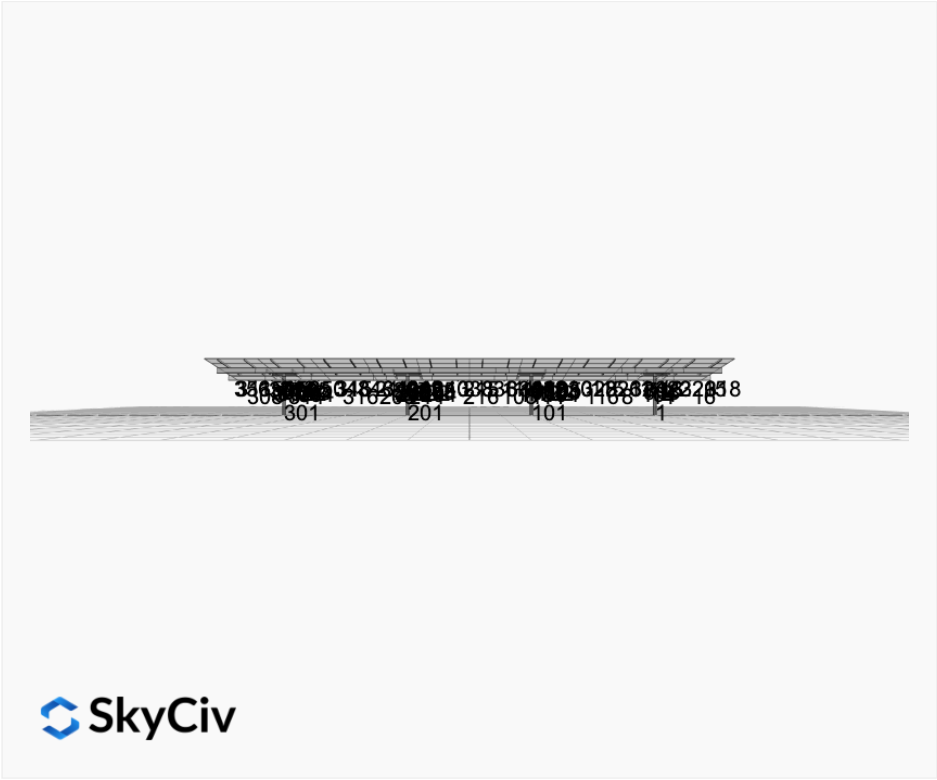
Project Details

Project Name: Wallace Residence - V1Jb
Location: 8555 Ward Line Rd, Lake Charles, LA 70607, USA
Unique ID: 4P-19.75-6TOP-XD-72-L-5Hx10W-7H4E
Dealer: _____

Date: Fri Oct 10 2025
Number of Modules: 50
Number of Poles: 4
Date Sold: _____



Array Dimensions N/S	21.58 ft
Array Dimensions E/W	79.05 ft
Winter Tilt Angle (Degrees)	8
Front Edge Clearance	5

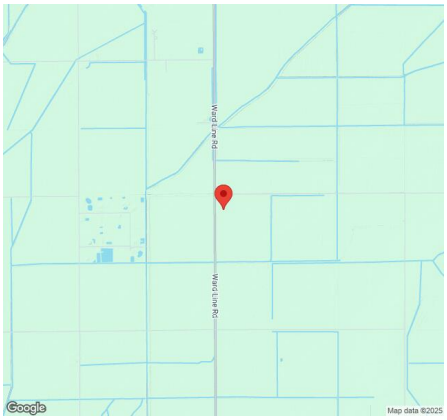
MT Solar Bill of Materials (4P-19.75-6TOP-XD-72-L-5Hx10W-7H4E)

Part	Short Description	BOM Qty
MTS-PC-6	6IN Pole Cap Assembly	4
MTS-HF-XD	H-Frame Assembly-XD	4
MTS-XD-Wing-72	72IN XD Wing	4
MTS-XD-Splice-90	90IN XD Splice	6
MTS-XD-Splice-57	57IN XD Splice	6
MTS-CLAMP-ANGLE-4PK	Angle Clamp	10

Rail Bill of Materials

Part	Qty
Rails (259in Long)	20x
Rail Attachment	80x
Module Mid Clamp	80x
Module End Clamp	40x
Ground Lug	10x

Site Details:



Site Address: 8555 Ward Line Rd, Lake Charles, LA 70607, USA

Array Specifications

Duty Classification:	XD
Module Width:	51.30 in
Module Length:	93.86 in
Number of Rows:	5
Number of Columns:	10
Total Number of Modules:	50
Winter Tilt Angle:	8
Front Edge Clearance:	5
Total Array Height at Tilt:	8.00 ft
Total Frame Length:	78.75 ft
Module Info/Notes:	
Array Dimensions N/S:	21.58 ft
Array Dimensions E/W:	79.05 ft
Rail Length:	259.00 in
Rail Spacing:	3.95 ft

Support Specifications

Pole Size:	6in Pipe Sch 40
Pole Length above Grade:	6.50 ft
Number of Poles:	4
Pole Spacing:	19.75 ft

Foundation Specifications

Foundation Type:	round
Foundation Dimensions:	36 in dia.
Foundation Depth (below grade):	8.8 ft
Foundation Volume:	61.85 ft^3

Site Info

Risk Category:	I
Exposure:	C
Soil Classification:	sand
Site Location:	8555 Ward Line Rd, Lake Charles, LA 70607, USA
Wind Speed:	124 mph

Snow Load:	0 psf

Design Disclaimer

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

AutoDesigner Input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Design Notes:

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


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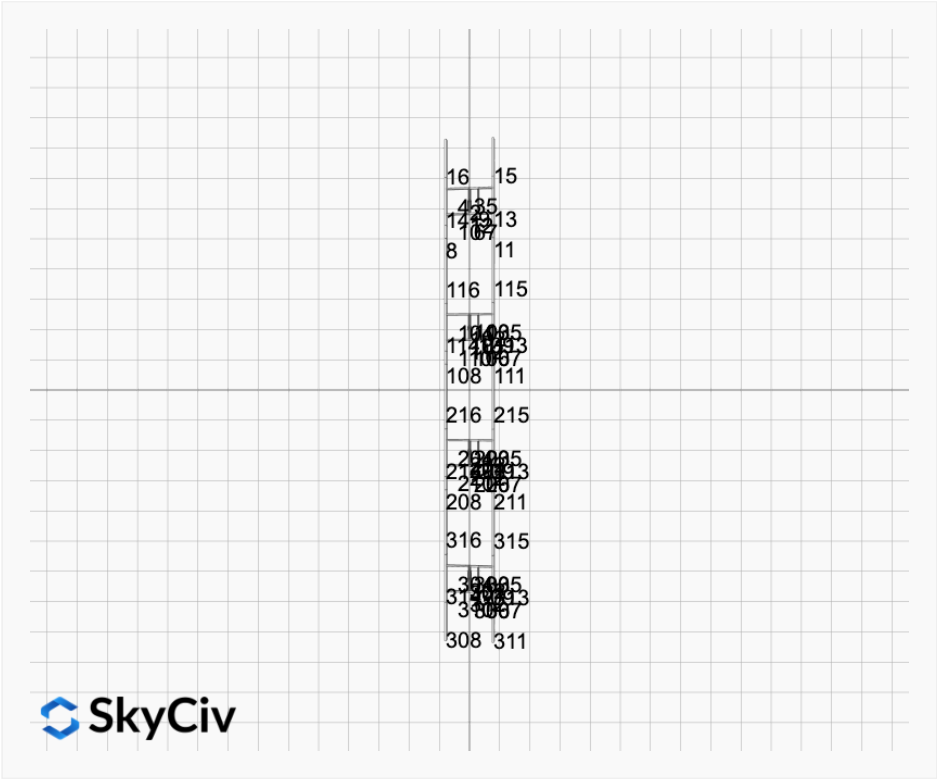
SkyCiv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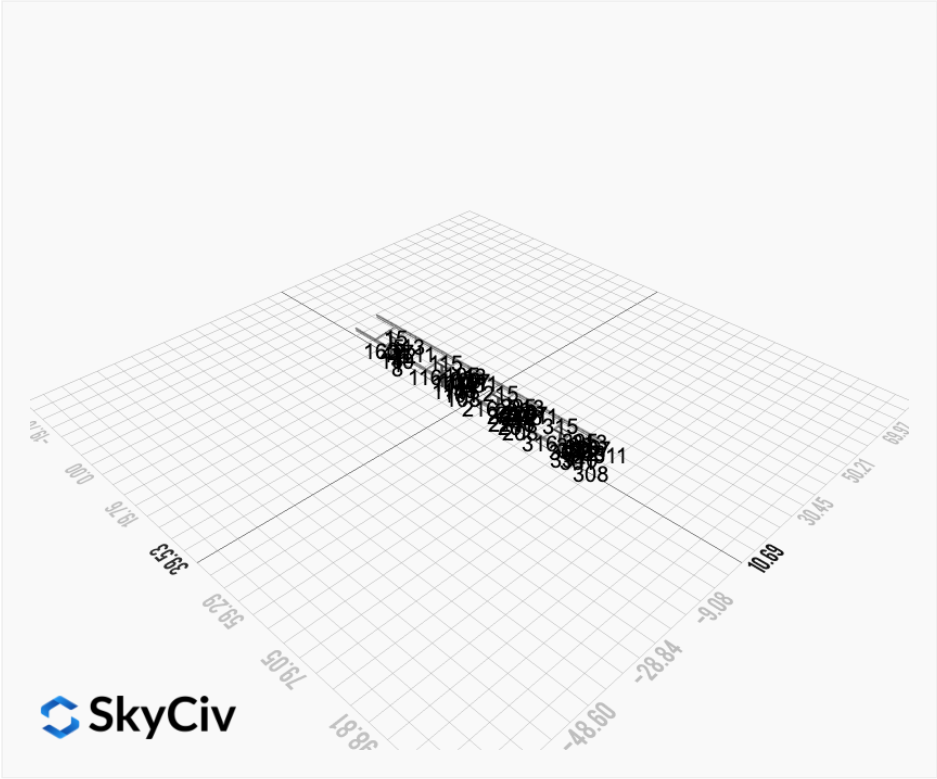
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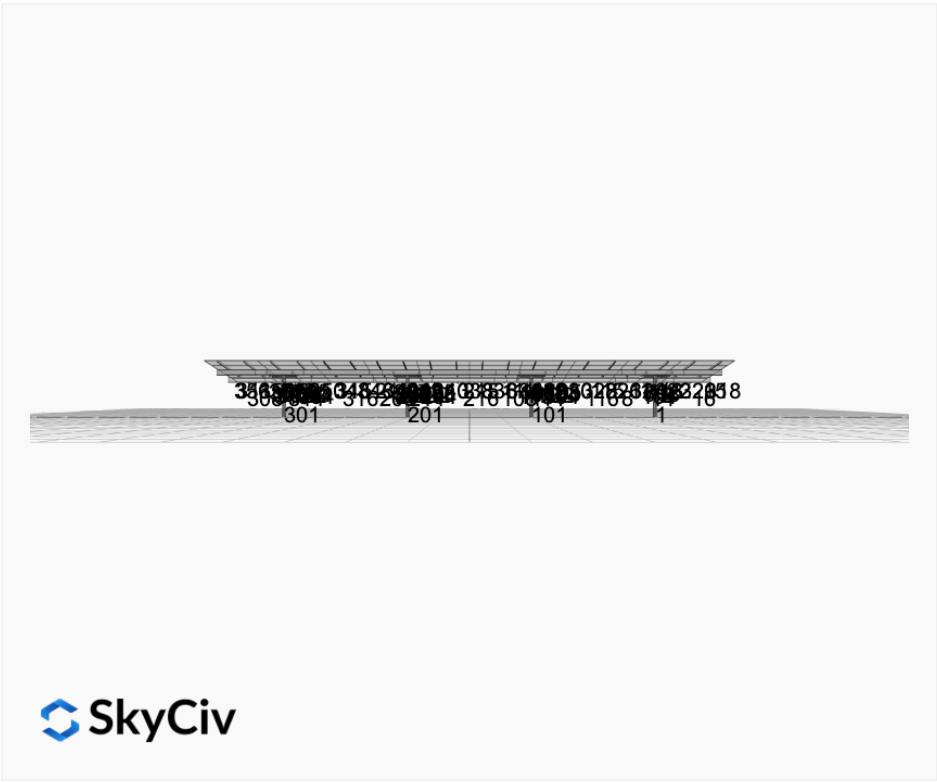
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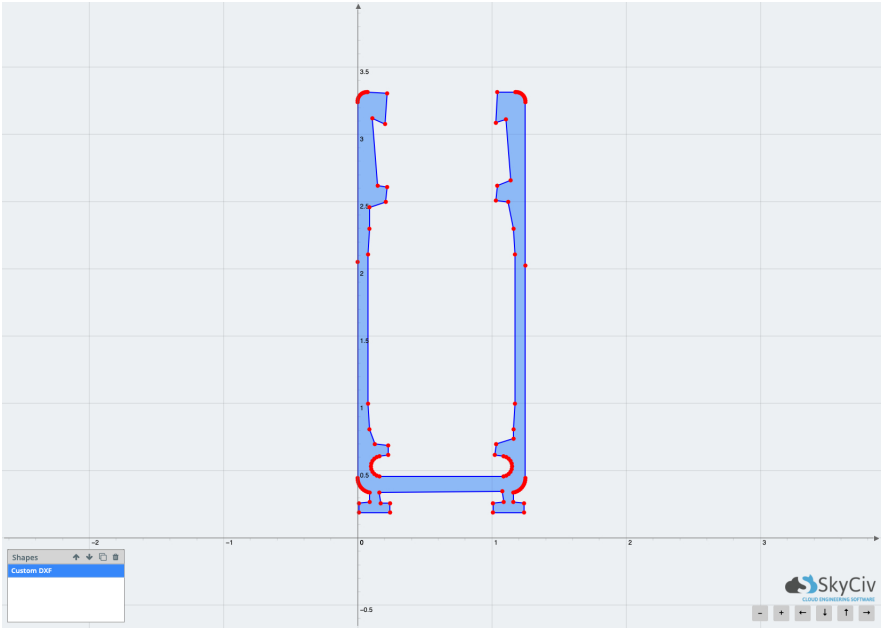
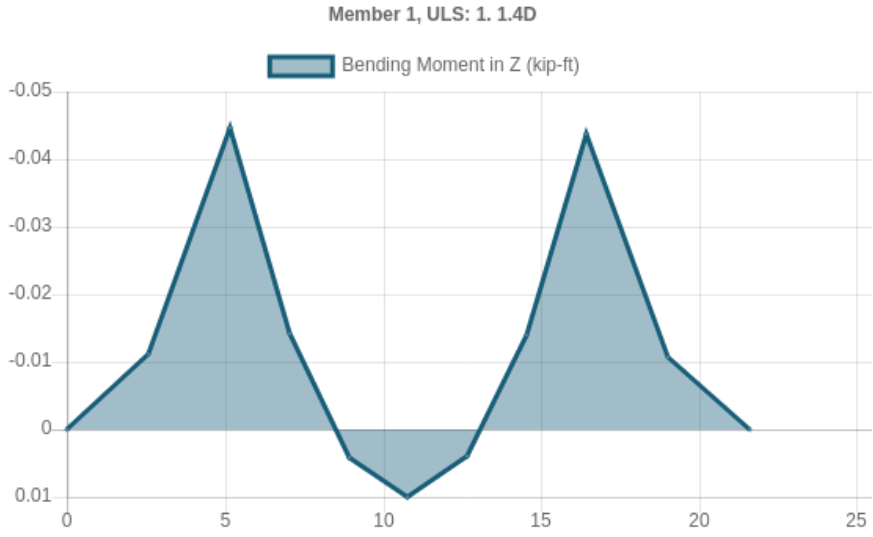
Rail Design Check

Rail Length: 21.58 ft
Additional Restraints Required: 4ft Spread Clamps
Tributary Width: 3.95 ft
Material: Aluminium
Density: 169.00 lb/ft^3
Elastic Modulus: 10000.00 ksi
Fy: 34.50 ksi
Fu: 37.00 ksi

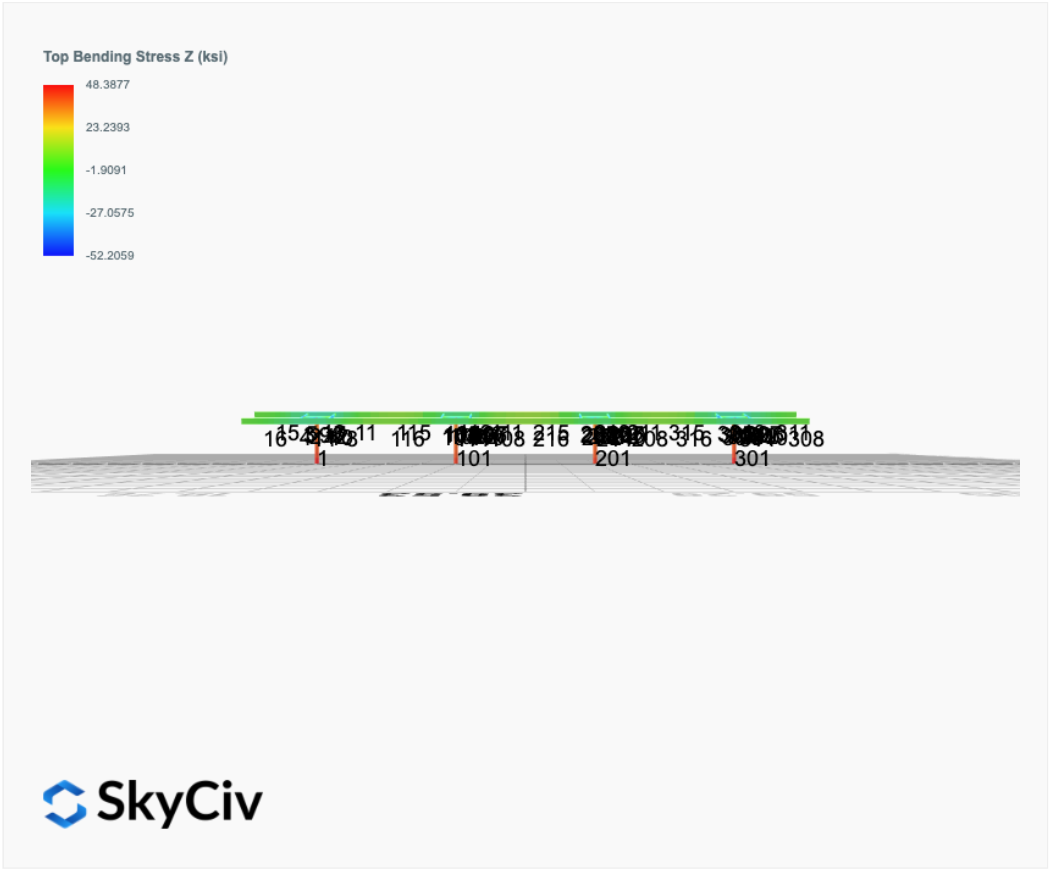
Rail Distributed Loading:
Note, gravity loading is resolved into member local X and Y axes.
Wind uplift Case A (Y): 0.0973 kip/ft
Wind uplift Case A (Y): 0.0591 kip/ft
Wind uplift Case B (Y): 0.1367 kip/ft
Wind uplift Case B (Y): 0.1367 kip/ft
Wind downforce Case A (Y): -0.1437 kip/ft
Wind downforce Case A (Y): -0.0884 kip/ft
Wind downforce Case B (Y): -0.1437 kip/ft
Wind downforce Case B (Y): -0.0884 kip/ft
Dead (Panel load) (X): 0.0170 kip/ft
Dead (Panel load) (Y): -0.0024 kip/ft

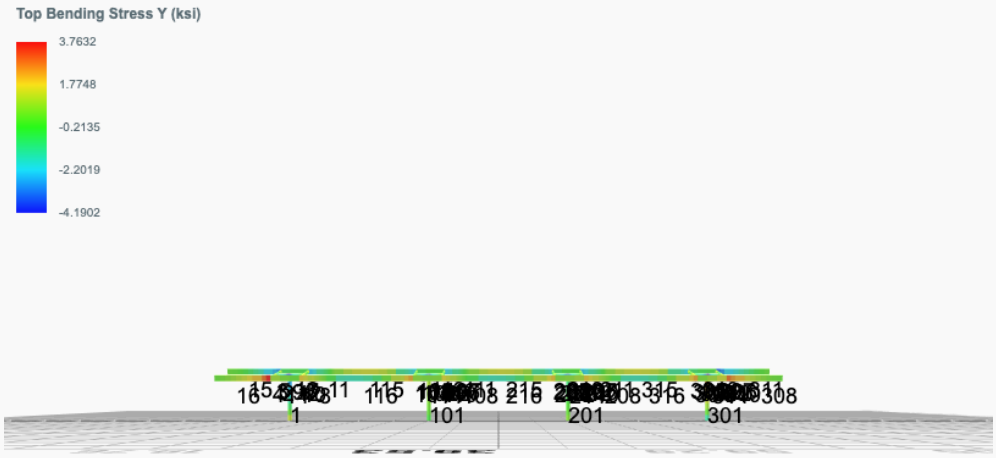


Result Check	Max Limit	Max Value	Utility	Status
Custom Stress Limit	34.50	42.25	1.225	FAIL
Material Yield	34.50	42.25	1.225	FAIL
Material Strength	37.00	42.25	1.142	FAIL



FEM Results (Envelope Worst Case)

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-0.2135
-2.2019
-4.1902
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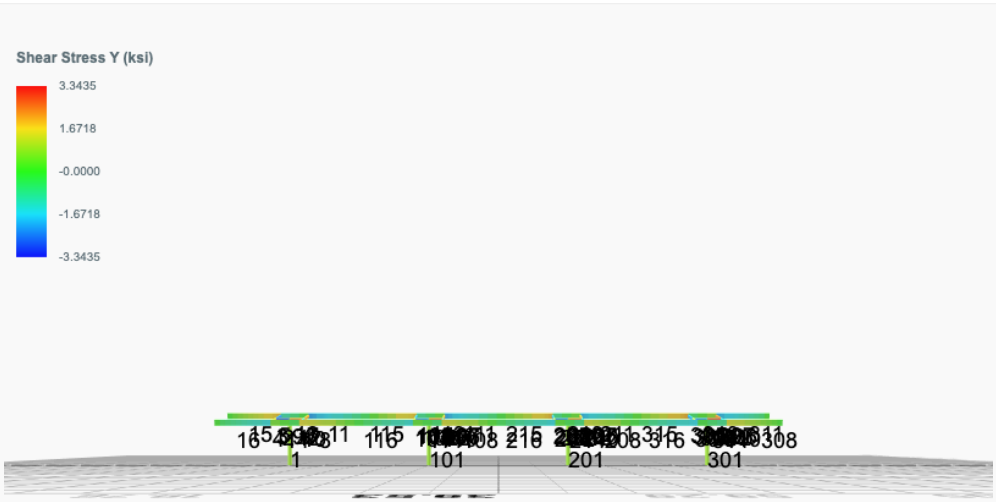
101
201
301


Shear Stress Y (ksi)
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1.6718
-0.0000
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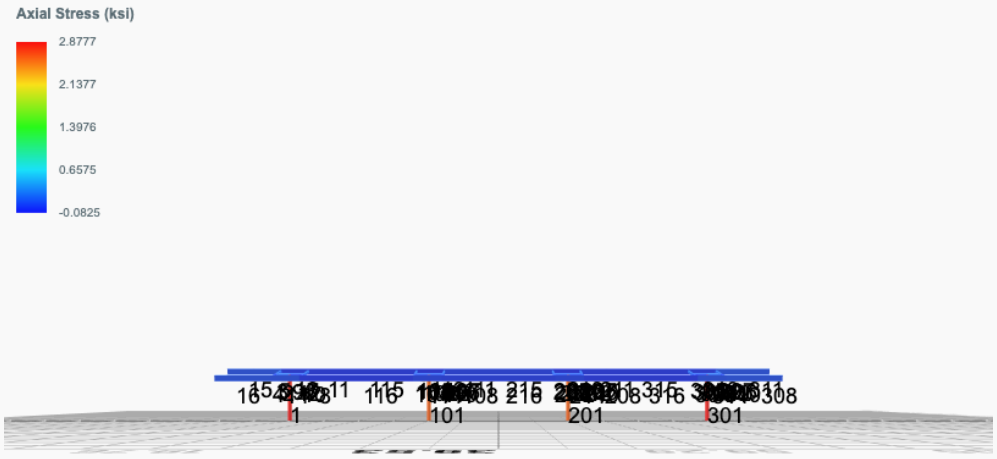
-3.3435
1
101
201
301


Axial Stress (ksi)
2.8777
2.1377
1.3976
0.6575
-0.0825
1
101
201
301

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	-0.0139	3.8987	-0.1084	-0.1761	0.0279	0.1286
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0119	3.3417	-0.0929	-0.1509	0.0239	0.1097
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0119	3.3417	-0.0929	-0.1509	0.0239	0.1097
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	-0.0119	3.3417	-0.0929	-0.1509	0.0239	0.1097
ULS: 5. 1.2D + E + L + 0.2S	-0.0119	3.3417	-0.0929	-0.1509	0.0239	0.1097
ULS: 7. 0.9D + 1.0E	-0.0089	2.5063	-0.0696	-0.1131	0.0179	0.0816
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-1.7927	16.0617	-0.5150	-0.8346	0.1657	24.2249
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-1.7927	16.0617	-0.5150	-0.8346	0.1657	24.2249
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	1.1939	-5.2331	0.1840	0.2966	-0.0669	0.0763
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	1.0308	-4.1481	0.1598	0.2570	-0.0645	-34.2575
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-1.7927	16.0617	-0.5150	-0.8346	0.1657	24.2249
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-1.7927	16.0617	-0.5150	-0.8346	0.1657	24.2249
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	1.1939	-5.2331	0.1840	0.2966	-0.0669	0.0763
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	1.0308	-4.1481	0.1598	0.2570	-0.0645	-34.2575
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-0.9024	9.7017	-0.3033	-0.4914	0.0946	11.9254
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.9024	9.7017	-0.3033	-0.4914	0.0946	11.9254
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	0.5910	-0.9457	0.0458	0.0734	-0.0215	0.1133
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.5093	-0.4032	0.0337	0.0536	-0.0204	-17.2957
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-0.9024	9.7017	-0.3033	-0.4914	0.0946	11.9254
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.9024	9.7017	-0.3033	-0.4914	0.0946	11.9254
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	0.5910	-0.9457	0.0458	0.0734	-0.0215	0.1133
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.5093	-0.4032	0.0337	0.0536	-0.0204	-17.2957
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-1.7898	15.2263	-0.4915	-0.7963	0.1597	24.1283
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-1.7898	15.2263	-0.4915	-0.7963	0.1597	24.1283
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	1.1969	-6.0686	0.2070	0.3340	-0.0728	0.0427
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	1.0338	-4.9835	0.1829	0.2946	-0.0705	-34.1857

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	-0.0099	2.7848	-0.0774	-0.1257	0.0199	0.0909
ULS: 2. D + L	-0.0099	2.7848	-0.0774	-0.1257	0.0199	0.0909
ULS: 3. D + (S or Lr or R)	-0.0099	2.7848	-0.0774	-0.1257	0.0199	0.0909
ULS: 3. D + (S or Lr or R)	-0.0099	2.7848	-0.0774	-0.1257	0.0199	0.0909
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0099	2.7848	-0.0774	-0.1257	0.0199	0.0909
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0099	2.7848	-0.0774	-0.1257	0.0199	0.0909
ULS: 5b. D + 0.7E	-0.0099	2.7848	-0.0774	-0.1257	0.0199	0.0909
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	-0.0099	2.7848	-0.0774	-0.1257	0.0199	0.0909
ULS: 8. 0.6D + 0.7E	-0.0059	1.6709	-0.0464	-0.0754	0.0120	0.0540
ULS: 5a. D + 0.6W_Wind downforce Case A only	-1.0786	10.4167	-0.3299	-0.5344	0.1048	14.3003
ULS: 5a. D + 0.6W_Wind downforce Case B only	-1.0786	10.4167	-0.3299	-0.5344	0.1048	14.3003
ULS: 5a. D + 0.6W_Wind uplift Case A only	0.7136	-2.3602	0.0889	0.1432	-0.0346	0.0880
ULS: 5a. D + 0.6W_Wind uplift Case B only	0.6156	-1.7091	0.0744	0.1195	-0.0332	-20.7011
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-0.8114	8.5087	-0.2666	-0.4319	0.0835	10.6841
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.8114	8.5087	-0.2666	-0.4319	0.0835	10.6841
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	0.5327	-1.0739	0.0474	0.0761	-0.0210	0.0943
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.4592	-0.5856	0.0365	0.0583	-0.0200	-15.5634

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	-0.8114	8.5087	-0.2666	-0.4319	0.0835	10.6841
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.8114	8.5087	-0.2666	-0.4319	0.0835	10.6841
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	0.5327	-1.0739	0.0474	0.0761	-0.0210	0.0943
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.4592	-0.5856	0.0365	0.0583	-0.0200	-15.5634
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-1.0746	9.3028	-0.2987	-0.4837	0.0968	14.2105
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-1.0746	9.3028	-0.2987	-0.4837	0.0968	14.2105
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	0.7175	-3.4741	0.1197	0.1932	-0.0425	0.0466
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	0.6196	-2.8230	0.1053	0.1696	-0.0412	-20.6570

Worst Case Reactions (LRFD)

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

Result	Value (kip, kip-ft)
Axial	16.0617
Shear X	-1.7927
Shear Z	-0.5150
Moment X	-0.8346
Moment Y (Twist)	0.1657
Moment Z	34.2575

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	10.4167
Shear X	-1.0786
Shear Z	-0.3299
Moment X	-0.5344
Moment Y (Twist)	0.1048
Moment Z	20.7011

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	0.0139	3.7105	0.0275	0.0463	-0.0090	-0.0316
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0119	3.1804	0.0236	0.0397	-0.0077	-0.0275
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0119	3.1804	0.0236	0.0397	-0.0077	-0.0275
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	0.0119	3.1804	0.0236	0.0397	-0.0077	-0.0275
ULS: 5. 1.2D + E + L + 0.2S	0.0119	3.1804	0.0236	0.0397	-0.0077	-0.0275
ULS: 7. 0.9D + 1.0E	0.0089	2.3853	0.0177	0.0298	-0.0058	-0.0211
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-1.6806	15.1742	0.1290	0.2175	-0.0376	23.0602
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-1.6806	15.1742	0.1290	0.2175	-0.0376	23.0602
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	1.1470	-4.9011	-0.0488	-0.0814	0.0157	0.0566
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	1.0152	-3.8872	-0.0363	-0.0614	0.0063	-33.1569
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-1.6806	15.1742	0.1290	0.2175	-0.0376	23.0602
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-1.6806	15.1742	0.1290	0.2175	-0.0376	23.0602
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	1.1470	-4.9011	-0.0488	-0.0814	0.0157	0.0566
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	1.0152	-3.8872	-0.0363	-0.0614	0.0063	-33.1569
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-0.8342	9.1773	0.0762	0.1284	-0.0227	11.2922
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.8342	9.1773	0.0762	0.1284	-0.0227	11.2922
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	0.5794	-0.8603	-0.0127	-0.0210	0.0040	0.0340
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.5136	-0.3534	-0.0063	-0.0108	-0.0008	-16.7991
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-0.8342	9.1773	0.0762	0.1284	-0.0227	11.2922
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.8342	9.1773	0.0762	0.1284	-0.0227	11.2922
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	0.5794	-0.8603	-0.0127	-0.0210	0.0040	0.0340
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.5136	-0.3534	-0.0063	-0.0108	-0.0008	-16.7991
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-1.6835	14.3791	0.1231	0.2075	-0.0357	23.0034
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-1.6835	14.3791	0.1231	0.2075	-0.0357	23.0034
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	1.1440	-5.6962	-0.0546	-0.0912	0.0176	0.0572
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	1.0121	-4.6823	-0.0421	-0.0713	0.0082	-33.0572

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	0.0099	2.6503	0.0196	0.0331	-0.0064	-0.0233
ULS: 2. D + L	0.0099	2.6503	0.0196	0.0331	-0.0064	-0.0233
ULS: 3. D + (S or Lr or R)	0.0099	2.6503	0.0196	0.0331	-0.0064	-0.0233
ULS: 3. D + (S or Lr or R)	0.0099	2.6503	0.0196	0.0331	-0.0064	-0.0233
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0099	2.6503	0.0196	0.0331	-0.0064	-0.0233
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0099	2.6503	0.0196	0.0331	-0.0064	-0.0233
ULS: 5b. D + 0.7E	0.0099	2.6503	0.0196	0.0331	-0.0064	-0.0233
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	0.0099	2.6503	0.0196	0.0331	-0.0064	-0.0233
ULS: 8. 0.6D + 0.7E	0.0059	1.5902	0.0118	0.0198	-0.0038	-0.0144
ULS: 5a. D + 0.6W_Wind downforce Case A only	-1.0054	9.8466	0.0828	0.1395	-0.0245	13.5888
ULS: 5a. D + 0.6W_Wind downforce Case B only	-1.0054	9.8466	0.0828	0.1395	-0.0245	13.5888
ULS: 5a. D + 0.6W_Wind uplift Case A only	0.6910	-2.1986	-0.0238	-0.0397	0.0076	0.0434
ULS: 5a. D + 0.6W_Wind uplift Case B only	0.6120	-1.5902	-0.0162	-0.0275	0.0019	-20.0611
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-0.7515	8.0476	0.0670	0.1129	-0.0200	10.1266
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.7515	8.0476	0.0670	0.1129	-0.0200	10.1266
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	0.5207	-0.9863	-0.0130	-0.0215	0.0041	0.0320
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.4615	-0.5301	-0.0072	-0.0124	-0.0002	-15.1079
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-0.7515	8.0476	0.0670	0.1129	-0.0200	10.1266
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.7515	8.0476	0.0670	0.1129	-0.0200	10.1266
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	0.5207	-0.9863	-0.0130	-0.0215	0.0041	0.0320
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.4615	-0.5301	-0.0072	-0.0124	-0.0002	-15.1079
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-1.0093	8.7865	0.0749	0.1262	-0.0219	13.5489
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-1.0093	8.7865	0.0749	0.1262	-0.0219	13.5489
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	0.6870	-3.2587	-0.0316	-0.0528	0.0102	0.0476
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	0.6080	-2.6504	-0.0241	-0.0407	0.0045	-19.9765

Worst Case Reactions (LRFD)

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

Result	Value (kip, kip-ft)
Axial	15.1742
Shear X	-1.6835
Shear Z	0.1290
Moment X	0.2175
Moment Y (Twist)	0.0376
Moment Z	33.1569

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	9.8466
Shear X	-1.0093
Shear Z	0.0828
Moment X	0.1395
Moment Y (Twist)	0.0245
Moment Z	20.0611

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	0.0139	3.7105	-0.0275	-0.0463	0.0090	-0.0316
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0119	3.1804	-0.0236	-0.0397	0.0077	-0.0275
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0119	3.1804	-0.0236	-0.0397	0.0077	-0.0275
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	0.0119	3.1804	-0.0236	-0.0397	0.0077	-0.0275
ULS: 5. 1.2D + E + L + 0.2S	0.0119	3.1804	-0.0236	-0.0397	0.0077	-0.0275
ULS: 7. 0.9D + 1.0E	0.0089	2.3853	-0.0177	-0.0298	0.0058	-0.0211
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-1.6806	15.1742	-0.1290	-0.2175	0.0376	23.0601

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	-1.6806	15.1742	-0.1290	-0.2175	0.0376	23.0601
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	1.1470	-4.9011	0.0488	0.0813	-0.0157	0.0565
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	1.0152	-3.8872	0.0362	0.0615	-0.0063	-33.1568
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-1.6806	15.1742	-0.1290	-0.2175	0.0376	23.0601
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-1.6806	15.1742	-0.1290	-0.2175	0.0376	23.0601
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	1.1470	-4.9011	0.0488	0.0813	-0.0157	0.0565
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	1.0152	-3.8872	0.0362	0.0615	-0.0063	-33.1568
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-0.8342	9.1773	-0.0762	-0.1284	0.0227	11.2922
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.8342	9.1773	-0.0762	-0.1284	0.0227	11.2922
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	0.5794	-0.8603	0.0127	0.0210	-0.0040	0.0339
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.5136	-0.3534	0.0063	0.0109	0.0008	-16.7991
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-0.8342	9.1773	-0.0762	-0.1284	0.0227	11.2922
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.8342	9.1773	-0.0762	-0.1284	0.0227	11.2922
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	0.5794	-0.8603	0.0127	0.0210	-0.0040	0.0339
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.5136	-0.3534	0.0063	0.0109	0.0008	-16.7991
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-1.6835	14.3791	-0.1231	-0.2074	0.0357	23.0034
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-1.6835	14.3791	-0.1231	-0.2074	0.0357	23.0034
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	1.1440	-5.6962	0.0546	0.0912	-0.0176	0.0572
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	1.0121	-4.6823	0.0421	0.0714	-0.0082	-33.0571

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	0.0099	2.6503	-0.0196	-0.0331	0.0064	-0.0233
ULS: 2. D + L	0.0099	2.6503	-0.0196	-0.0331	0.0064	-0.0233
ULS: 3. D + (S or Lr or R)	0.0099	2.6503	-0.0196	-0.0331	0.0064	-0.0233
ULS: 3. D + (S or Lr or R)	0.0099	2.6503	-0.0196	-0.0331	0.0064	-0.0233
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0099	2.6503	-0.0196	-0.0331	0.0064	-0.0233
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0099	2.6503	-0.0196	-0.0331	0.0064	-0.0233
ULS: 5b. D + 0.7E	0.0099	2.6503	-0.0196	-0.0331	0.0064	-0.0233
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	0.0099	2.6503	-0.0196	-0.0331	0.0064	-0.0233
ULS: 8. 0.6D + 0.7E	0.0059	1.5902	-0.0118	-0.0198	0.0038	-0.0144
ULS: 5a. D + 0.6W_Wind downforce Case A only	-1.0054	9.8466	-0.0828	-0.1395	0.0244	13.5888
ULS: 5a. D + 0.6W_Wind downforce Case B only	-1.0054	9.8466	-0.0828	-0.1395	0.0244	13.5888
ULS: 5a. D + 0.6W_Wind uplift Case A only	0.6910	-2.1986	0.0238	0.0397	-0.0076	0.0434
ULS: 5a. D + 0.6W_Wind uplift Case B only	0.6120	-1.5902	0.0162	0.0276	-0.0019	-20.0610
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-0.7516	8.0476	-0.0670	-0.1129	0.0199	10.1265
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.7516	8.0476	-0.0670	-0.1129	0.0199	10.1265
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	0.5207	-0.9863	0.0130	0.0215	-0.0041	0.0320
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.4615	-0.5301	0.0072	0.0124	0.0002	-15.1078
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-0.7516	8.0476	-0.0670	-0.1129	0.0199	10.1265
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.7516	8.0476	-0.0670	-0.1129	0.0199	10.1265
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	0.5207	-0.9863	0.0130	0.0215	-0.0041	0.0320
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.4615	-0.5301	0.0072	0.0124	0.0002	-15.1078
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-1.0093	8.7865	-0.0749	-0.1262	0.0219	13.5489
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-1.0093	8.7865	-0.0749	-0.1262	0.0219	13.5489
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	0.6870	-3.2587	0.0316	0.0528	-0.0102	0.0476
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	0.6080	-2.6504	0.0241	0.0408	-0.0045	-19.9765

Worst Case Reactions (LRFD)

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	15.1742
Shear X	-1.6835
Shear Z	-0.1290
Moment X	-0.2175
Moment Y (Twist)	0.0376
Moment Z	33.1568

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

Result	Value (kip, kip-ft)
Axial	9.8466
Shear X	-1.0093
Shear Z	-0.0828
Moment X	-0.1395
Moment Y (Twist)	0.0244
Moment Z	20.0610

Reaction Forces for Foundation 4 (Node ID#301), (kip, kip-ft)

LRFD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. 1.4D	-0.0139	3.8987	0.1084	0.1761	-0.0279	0.1286
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0119	3.3417	0.0929	0.1509	-0.0239	0.1097
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0119	3.3417	0.0929	0.1509	-0.0239	0.1097
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	-0.0119	3.3417	0.0929	0.1509	-0.0239	0.1097
ULS: 5. 1.2D + E + L + 0.2S	-0.0119	3.3417	0.0929	0.1509	-0.0239	0.1097
ULS: 7. 0.9D + 1.0E	-0.0089	2.5063	0.0696	0.1131	-0.0179	0.0816
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-1.7927	16.0617	0.5150	0.8346	-0.1657	24.2247
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-1.7927	16.0617	0.5150	0.8346	-0.1657	24.2247
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	1.1939	-5.2331	-0.1840	-0.2967	0.0669	0.0762
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	1.0308	-4.1481	-0.1597	-0.2569	0.0646	-34.2571
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-1.7927	16.0617	0.5150	0.8346	-0.1657	24.2247
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-1.7927	16.0617	0.5150	0.8346	-0.1657	24.2247
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	1.1939	-5.2331	-0.1840	-0.2967	0.0669	0.0762
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	1.0308	-4.1481	-0.1597	-0.2569	0.0646	-34.2571
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-0.9024	9.7017	0.3033	0.4914	-0.0947	11.9253
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.9024	9.7017	0.3033	0.4914	-0.0947	11.9253
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	0.5910	-0.9457	-0.0458	-0.0735	0.0215	0.1132
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.5093	-0.4031	-0.0337	-0.0536	0.0204	-17.2955
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-0.9024	9.7017	0.3033	0.4914	-0.0947	11.9253
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-0.9024	9.7017	0.3033	0.4914	-0.0947	11.9253
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	0.5910	-0.9457	-0.0458	-0.0735	0.0215	0.1132
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	0.5093	-0.4031	-0.0337	-0.0536	0.0204	-17.2955
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-1.7898	15.2263	0.4915	0.7963	-0.1597	24.1282
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-1.7898	15.2263	0.4915	0.7963	-0.1597	24.1282
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	1.1969	-6.0686	-0.2070	-0.3341	0.0729	0.0427
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	1.0338	-4.9835	-0.1829	-0.2945	0.0705	-34.1854

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	-0.0099	2.7848	0.0774	0.1257	-0.0199	0.0909
ULS: 2. D + L	-0.0099	2.7848	0.0774	0.1257	-0.0199	0.0909
ULS: 3. D + (S or Lr or R)	-0.0099	2.7848	0.0774	0.1257	-0.0199	0.0909
ULS: 3. D + (S or Lr or R)	-0.0099	2.7848	0.0774	0.1257	-0.0199	0.0909
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0099	2.7848	0.0774	0.1257	-0.0199	0.0909
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0099	2.7848	0.0774	0.1257	-0.0199	0.0909
ULS: 5b. D + 0.7E	-0.0099	2.7848	0.0774	0.1257	-0.0199	0.0909
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	-0.0099	2.7848	0.0774	0.1257	-0.0199	0.0909

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 8. 0.6D + 0.7E	-0.0059	1.6709	0.0464	0.0754	-0.0120	0.0540
ULS: 5a. D + 0.6W_Wind downforce Case A only	-1.0786	10.4167	0.3299	0.5345	-0.1048	14.3002
ULS: 5a. D + 0.6W_Wind downforce Case B only	-1.0786	10.4167	0.3299	0.5345	-0.1048	14.3002
ULS: 5a. D + 0.6W_Wind uplift Case A only	0.7136	-2.3602	-0.0889	-0.1432	0.0346	0.0880
ULS: 5a. D + 0.6W_Wind uplift Case B only	0.6156	-1.7091	-0.0744	-0.1194	0.0332	-20.7009
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-0.8114	8.5087	0.2666	0.4319	-0.0836	10.6840
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.8114	8.5087	0.2666	0.4319	-0.0836	10.6840
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	0.5327	-1.0739	-0.0474	-0.0761	0.0210	0.0943
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.4592	-0.5856	-0.0365	-0.0583	0.0200	-15.5632
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-0.8114	8.5087	0.2666	0.4319	-0.0836	10.6840
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-0.8114	8.5087	0.2666	0.4319	-0.0836	10.6840
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	0.5327	-1.0739	-0.0474	-0.0761	0.0210	0.0943
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	0.4592	-0.5856	-0.0365	-0.0583	0.0200	-15.5632
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-1.0746	9.3028	0.2987	0.4837	-0.0968	14.2105
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-1.0746	9.3028	0.2987	0.4837	-0.0968	14.2105
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	0.7175	-3.4741	-0.1197	-0.1932	0.0425	0.0466
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	0.6196	-2.8230	-0.1053	-0.1696	0.0412	-20.6569

Worst Case Reactions (LRFD)

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

Result	Value (kip, kip-ft)
Axial	16.0617
Shear X	-1.7927
Shear Z	0.5150
Moment X	0.8346
Moment Y (Twist)	0.1657
Moment Z	34.2571

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	10.4167
Shear X	-1.0786
Shear Z	0.3299
Moment X	0.5345
Moment Y (Twist)	0.1048
Moment Z	20.7009

Project Details

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

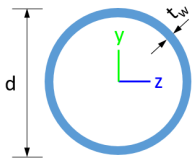
User Name: sales@mtsolar.us
Unit System: imperial

Design Input Information

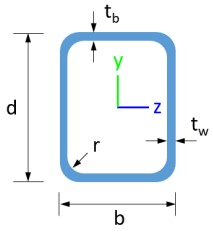
Design Factors			
Φ_t	Φ_c	Φ_b	Φ_v
0.9	0.9	0.9	0.9

Design Materials			
ID	E (ksi)	F_y (ksi)	F_u (ksi)
1	29000	50	65

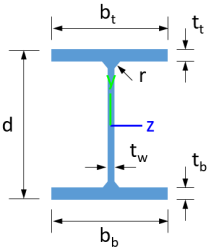
Section Dimensions



ID	Name	d (in)	t_w (in)					
3	2in Pipe Sch 120	2.38	0.25					
6	4in Pipe Sch 120	4.50	0.44					
7	6in Pipe Sch 40	6.63	0.28					



ID	Name	d (in)	b (in)	t_w (in)	t_b (in)	r (in)		
17	HSS5x3x1/4	5.00	3.00	0.23	0.23	0.23		



ID	Name	d (in)	t_w (in)	b_t (in)	b_b (in)	t_t (in)	t_b (in)	r (in)
20	W10x12	9.87	0.19	3.96	3.96	0.21	0.21	0.30

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)

3	2in Pipe Sch 120	1.67	1.91	0.96	0.96	0.00	1.13	1.13
6	4in Pipe Sch 120	5.58	23.29	11.64	11.64	0.00	7.24	7.24
7	6in Pipe Sch 40	5.58	56.28	28.14	28.14	0.00	11.28	11.28
17	HSS5x3x1/4	3.37	11.00	4.81	10.70	0.93	3.77	5.38
20	W10x12	3.54	0.05	2.18	53.80	50.90	1.74	12.60

Member Properties

Member ID	Section ID	$K_z L$ (ft)	$K_y L$ (ft)	L_b (ft)	C_b	LST	LSC	LD
1	7	4.23	4.23	6.50	-	300	200	250
2	6	1.30	1.30	2.00	-	300	200	250
3	17	0.92	0.92	1.42	1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.12,1.17,1.18,1.18,1.12,1.17,1.18,1.18,1.18,1.18,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.14,1.18,1.18,1.18,1.14,1.18,1.18,1.18,1.18,1.18	300	200	250
4	17	2.44	3.75	3.75	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68	300	200	250
5	17	1.52	2.33	2.33	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.60,1.66,1.67,1.67,1.60,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.63,1.66,1.67,1.67,1.63,1.66,1.67,1.67,1.66,1.66	300	200	250
6	17	0.92	0.92	1.42	1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.17,1.18,1.18,1.17,1.17,1.18,1.18,1.09,1.17,1.18,1.18,1.09,1.17,1.18,1.18,1.17,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.16,1.17,1.18,1.18,1.13,1.17,1.18,1.18,1.13,1.17,1.18,1.18,1.17,1.17	300	200	250
7	17	1.52	1.52	2.33	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.58,1.66,1.67,1.67,1.58,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.62,1.66,1.67,1.67,1.62,1.66,1.67,1.67,1.66,1.66	300	200	250
8	20	1.33	1.33	2.05	1.74,1.74,1.74,1.74,1.74,1.74,1.72,1.72,1.75,1.89,1.72,1.72,1.75,1.89,1.73,1.73,1.75,1.81,1.73,1.73,1.75,1.81,1.72,1.72,1.74,1.97,1.74,1.74,1.74,1.74,1.74,1.74,1.74,1.74,1.74,1.72,1.72,1.75,1.84,1.73,1.73,1.75,1.81,1.73,1.73,1.75,1.81,1.72,1.72,1.75,1.94	300	200	250
9	3	2.60	2.60	4.00	-	300	200	250
10	17	2.44	2.44	3.75	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68	300	200	250
11	20	1.33	1.33	2.05	1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.72,1.77,1.75,1.75,1.72,1.77,1.75,1.75,1.63,1.78,1.75,1.75,1.63,1.78,1.75,1.75,1.72,1.77,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.70,1.78,1.75,1.75,1.67,1.78,1.75,1.75,1.67,1.78,1.75,1.75,1.72,1.77	300	200	250
12	6	1.30	1.30	2.00	-	300	200	250
13	20	4.88	4.00	7.50	1.08,1.08,1.08,1.08,1.08,1.08,1.07,1.07,1.08,1.11,1.07,1.07,1.08,1.11,1.07,1.07,1.09,1.13,1.07,1.07,1.09,1.13,1.07,1.07,1.08,1.10,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.07,1.07,1.08,1.12,1.07,1.07,1.08,1.13,1.07,1.07,1.08,1.13,1.07,1.07,1.08,1.11	300	200	250
14	20	4.88	4.00	7.50	1.07,1.07,1.07,1.07,1.07,1.07,1.08,1.08,1.07,1.38,1.08,1.08,1.07,1.38,1.08,1.08,1.08,1.18,1.08,1.08,1.08,1.18,1.08,1.08,1.07,1.56,1.07,1.07,1.07,1.07,1.07,1.07,1.07,1.07,1.07,1.08,1.08,1.07,1.26,1.08,1.08,1.08,1.19,1.08,1.08,1.08,1.19,1.08,1.08,1.07,1.49	300	200	250
15	20	12.60	12.60	6.00	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	20	12.60	12.60	6.00	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	7	4.23	4.23	6.50	-	300	200	250
102	6	1.30	1.30	2.00	-	300	200	250
103	17	0.92	0.92	1.42	1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.09,1.17,1.18,1.18,1.09,1.17,1.18,1.18,1.17,1.18,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.16,1.17,1.18,1.18,1.13,1.17,1.18,1.18,1.13,1.17,1.18,1.18,1.17,1.18	300	200	250
104	17	2.44	2.44	3.75	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68	300	200	250

105	17	1.52	1.52	2.33	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.58,1.66,1.67,1.67,1.58,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.61,1.66,1.67,1.67,1.61,1.66,1.67,1.67,1.67,1.66,1.66	300	200	250
106	17	0.92	0.92	1.42	1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.10,1.17,1.18,1.18,1.10,1.17,1.18,1.18,1.17,1.18,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.16,1.18,1.18,1.18,1.14,1.17,1.18,1.18,1.14,1.17,1.18,1.18,1.18,1.17,1.18	300	200	250
107	17	1.52	1.52	2.33	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.59,1.66,1.67,1.67,1.59,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.62,1.66,1.67,1.67,1.62,1.66,1.67,1.67,1.66,1.66	300	200	250
108	20	1.33	1.33	2.05	1.87,1.87,1.87,1.87,1.87,1.87,1.80,1.80,2.00,2.29,1.80,1.80,2.00,2.29,1.81,1.81,2.06,2.10,1.81,1.81,2.06,2.10,1.79,1.79,1.99,2.11,1.87,1.87,1.87,1.87,1.87,1.87,1.87,1.87,1.81,1.81,2.03,2.38,1.81,1.81,2.06,2.10,1.81,1.81,2.06,2.10,1.80,1.80,2.00,2.24	300	200	250
109	3	2.60	2.60	4.00	-	300	200	250
110	17	2.44	2.44	3.75	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68	300	200	250
111	20	1.33	1.33	2.05	1.94,1.94,1.94,1.94,1.94,1.94,2.02,2.02,1.76,2.07,2.02,2.02,1.76,2.07,2.01,2.01,1.47,2.08,2.01,2.01,1.47,2.08,2.02,2.02,1.79,2.07,1.94,1.94,1.94,1.94,1.94,1.94,1.94,1.94,1.94,2.01,2.01,1.70,2.07,2.01,2.01,1.56,2.08,2.01,2.01,1.56,2.08,2.02,2.02,1.78,2.07	300	200	250
112	6	1.30	1.30	2.00	-	300	200	250
113	20	4.88	4.00	7.50	1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.05,1.06,1.06,1.06,1.05,1.06,1.06,1.06,1.05,1.07,1.06,1.06,1.05,1.07,1.06,1.06,1.05,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.05,1.06,1.06,1.06,1.05,1.07,1.06,1.06,1.05,1.07,1.06,1.06,1.06,1.05,1.06	300	200	250
114	20	4.88	4.00	7.50	1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.33,1.06,1.06,1.06,1.33,1.06,1.06,1.06,1.13,1.06,1.06,1.06,1.13,1.06,1.06,1.06,1.48,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.22,1.06,1.06,1.06,1.14,1.06,1.06,1.06,1.14,1.06,1.06,1.06,1.42	300	200	250
115	20	6.63	6.63	10.20	1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.16,1.17,1.17,1.17,1.16,1.17,1.17,1.17,1.15,1.18,1.17,1.17,1.15,1.18,1.17,1.17,1.16,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.16,1.18,1.17,1.17,1.15,1.18,1.17,1.17,1.15,1.18,1.17,1.17	300	200	250
116	20	6.63	6.63	10.20	1.17,1.17,1.17,1.17,1.17,1.17,1.16,1.16,1.17,1.23,1.16,1.16,1.17,1.23,1.16,1.16,1.17,1.18,1.16,1.16,1.17,1.18,1.16,1.16,1.17,1.32,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.16,1.16,1.17,1.20,1.16,1.16,1.17,1.18,1.16,1.16,1.17,1.18,1.16,1.16,1.26	300	200	250
201	7	4.23	4.23	6.50	-	300	200	250
202	6	1.30	1.30	2.00	-	300	200	250
203	17	0.92	0.92	1.42	1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.10,1.17,1.18,1.18,1.10,1.17,1.18,1.18,1.17,1.18,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.16,1.18,1.18,1.18,1.14,1.17,1.18,1.18,1.14,1.17,1.18,1.18,1.18,1.17,1.18	300	200	250
204	17	2.44	2.44	3.75	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68	300	200	250
205	17	1.52	1.52	2.33	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.59,1.66,1.67,1.67,1.59,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.62,1.66,1.67,1.67,1.62,1.66,1.67,1.67,1.66,1.66	300	200	250
206	17	0.92	0.92	1.42	1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.09,1.17,1.18,1.18,1.09,1.17,1.18,1.18,1.17,1.18,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.16,1.17,1.18,1.18,1.13,1.17,1.18,1.18,1.13,1.17,1.18,1.18,1.18,1.17,1.18	300	200	250
207	17	1.52	1.52	2.33	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.58,1.66,1.67,1.67,1.58,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.61,1.66,1.67,1.67,1.61,1.66,1.67,1.67,1.66,1.66	300	200	250
208	20	1.33	1.33	2.05	2.07,2.07,2.07,2.07,2.07,2.07,2.06,2.06,2.09,2.16,2.06,2.06,2.09,2.16,2.06,2.06,2.12,2.33,2.06,2.06,2.12,2.33,2.06,2.06,2.09,1.89,2.07,2.07,2.07,2.07,2.07,2.07,2.07,2.07,2.07,2.06,2.06,2.09,2.27,2.06,2.06,2.10,2.32,2.06,2.06,2.10,2.32,2.06,2.06,2.09,1.98	300	200	250
209	3	2.60	2.60	4.00	-	300	200	250
210	17	2.44	2.44	3.75	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68	300	200	250
211	20	1.33	1.33	2.05	2.08,2.08,2.08,2.08,2.08,2.08,2.09,2.09,2.06,2.36,2.09,2.09,2.06,2.36,2.09,2.09,1.60,2.38,2.09,2.09,1.60,2.38,2.09,2.09,2.06,2.33,2.08,2.08,2.08,2.08,2.08,2.08,2.08,2.08,2.09,2.09,2.05,2.40,2.09,2.09,1.80,2.39,2.09,2.09,1.80,2.39,2.09,2.09,2.09,2.06,2.34	300	200	250
212	6	1.30	1.30	2.00	-	300	200	250
213	20	4.88	4.00	7.50	1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.05,1.06,1.06,1.06,1.05,1.06,1.06,1.06,1.05,1.07,1.06,1.06,1.05,1.07,1.06,1.06,1.05,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.05,1.06,1.06,1.06,1.05,1.07,1.06,1.06,1.05,1.07,1.06,1.06,1.06,1.05,1.06	300	200	250

214	20	4.88	4.00	7.50	1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.33,1.06,1.06,1.06,1.33,1.06,1.06,1.06,1.13,1.06,1.06,1.06,1.13,1.06,1.06,1.06,1.48,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.06,1.22,1.06,1.06,1.06,1.14,1.06,1.06,1.06,1.14,1.06,1.06,1.06,1.42	300	200	250
215	20	6.63	6.63	10.20	1.14,1.14,1.14,1.14,1.14,1.14,1.14,1.14,1.13,1.15,1.14,1.14,1.13,1.15,1.14,1.14,1.11,1.15,1.14,1.14,1.11,1.15,1.14,1.14,1.13,1.15,1.14,1.14,1.14,1.14,1.14,1.14,1.14,1.14,1.14,1.14,1.14,1.14,1.13,1.15,1.14,1.14,1.12,1.15,1.14,1.14,1.12,1.15,1.14,1.14,1.13,1.15	300	200	250
216	20	6.63	6.63	10.20	1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.14,1.20,1.13,1.13,1.14,1.20,1.13,1.13,1.14,1.16,1.13,1.13,1.14,1.16,1.13,1.13,1.14,1.24,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.14,1.18,1.13,1.13,1.14,1.16,1.13,1.13,1.14,1.16,1.13,1.13,1.14,1.22	300	200	250
301	7	4.23	4.23	6.50	-	300	200	250
302	6	1.30	1.30	2.00	-	300	200	250
303	17	0.92	0.92	1.42	1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.17,1.18,1.18,1.17,1.17,1.18,1.18,1.09,1.17,1.18,1.18,1.09,1.17,1.18,1.18,1.17,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.16,1.17,1.18,1.18,1.13,1.17,1.18,1.18,1.13,1.17,1.18,1.18,1.17,1.17	300	200	250
304	17	2.44	2.44	3.75	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68	300	200	250
305	17	1.52	1.52	2.33	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.58,1.66,1.67,1.67,1.58,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.62,1.66,1.67,1.67,1.62,1.66,1.67,1.67,1.66,1.66	300	200	250
306	17	0.92	0.92	1.42	1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.12,1.17,1.18,1.18,1.12,1.17,1.18,1.18,1.18,1.18,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.14,1.18,1.18,1.18,1.14,1.18,1.18,1.18,1.18	300	200	250
307	17	1.52	1.52	2.33	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.60,1.66,1.67,1.67,1.60,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.63,1.66,1.67,1.67,1.63,1.66,1.67,1.67,1.66,1.66	300	200	250
308	20	12.60	12.60	6.00	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
309	3	2.60	2.60	4.00	-	300	200	250
310	17	2.44	3.75	3.75	1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.67,1.66,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.65,1.68,1.67,1.67,1.66,1.68	300	200	250
311	20	12.60	12.60	6.00	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
312	6	1.30	1.30	2.00	-	300	200	250
313	20	4.88	4.00	7.50	1.08,1.08,1.08,1.08,1.08,1.08,1.07,1.07,1.08,1.11,1.07,1.07,1.08,1.11,1.07,1.07,1.09,1.13,1.07,1.07,1.09,1.13,1.07,1.07,1.08,1.10,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.07,1.07,1.08,1.12,1.07,1.07,1.08,1.13,1.07,1.07,1.08,1.13,1.07,1.07,1.08,1.11	300	200	250
314	20	4.88	4.00	7.50	1.07,1.07,1.07,1.07,1.07,1.07,1.08,1.08,1.07,1.38,1.08,1.08,1.07,1.38,1.08,1.08,1.08,1.18,1.08,1.08,1.08,1.18,1.08,1.08,1.07,1.56,1.07,1.07,1.07,1.07,1.07,1.07,1.07,1.07,1.07,1.08,1.08,1.07,1.26,1.08,1.08,1.08,1.19,1.08,1.08,1.08,1.19,1.08,1.08,1.07,1.49	300	200	250
315	20	6.63	6.63	10.20	1.39,1.39,1.39,1.39,1.39,1.39,1.39,1.39,1.43,1.37,1.39,1.39,1.43,1.37,1.39,1.39,1.54,1.37,1.39,1.39,1.54,1.37,1.39,1.39,1.42,1.38,1.39,1.39,1.39,1.39,1.39,1.39,1.39,1.39,1.39,1.39,1.39,1.44,1.37,1.39,1.39,1.49,1.37,1.39,1.39,1.49,1.37,1.39,1.39,1.42,1.37	300	200	250
316	20	6.63	6.63	10.20	1.40,1.40,1.40,1.40,1.40,1.40,1.42,1.42,1.40,1.29,1.42,1.42,1.40,1.29,1.42,1.42,1.40,1.34,1.42,1.42,1.40,1.34,1.42,1.42,1.40,1.26,1.40,1.40,1.40,1.40,1.40,1.40,1.40,1.40,1.40,1.42,1.42,1.40,1.32,1.42,1.42,1.40,1.34,1.42,1.42,1.40,1.34,1.42,1.42,1.40,1.26	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	251.16	241.97	42.30	42.30	75.35	75.35
2	251.01	248.88	27.16	27.16	75.30	75.30
3	151.65	150.70	20.17	14.14	54.12	28.95
4	151.65	136.71	20.17	14.14	54.12	28.95
5	151.65	145.68	20.17	14.14	54.12	28.95
6	151.65	150.70	20.17	14.14	54.12	28.95
7	151.65	149.10	20.17	14.14	54.12	28.95

7	151.65	149.10	20.17	14.14	54.12	28.95
8	159.30	140.46	46.90	6.46	56.26	44.91
9	75.10	66.32	4.25	4.25	22.53	22.53
10	151.65	145.15	20.17	14.14	54.12	28.95
11	159.30	140.46	46.90	6.46	56.26	44.91
12	251.01	248.88	27.16	27.16	75.30	75.30
13	159.30	97.43	32.83	6.46	56.26	44.91
14	159.30	97.43	32.78	6.46	56.26	44.91
15	159.30	21.54	46.90	6.46	56.26	44.91
16	159.30	21.54	46.90	6.46	56.26	44.91
101	251.16	241.97	42.30	42.30	75.35	75.35
102	251.01	248.88	27.16	27.16	75.30	75.30
103	151.65	150.70	20.17	14.14	54.12	28.95
104	151.65	145.15	20.17	14.14	54.12	28.95
105	151.65	149.10	20.17	14.14	54.12	28.95
106	151.65	150.70	20.17	14.14	54.12	28.95
107	151.65	149.10	20.17	14.14	54.12	28.95
108	159.30	140.46	46.90	6.46	56.26	44.91
109	75.10	66.32	4.25	4.25	22.53	22.53
110	151.65	145.15	20.17	14.14	54.12	28.95
111	159.30	140.46	46.90	6.46	56.26	44.91
112	251.01	248.88	27.16	27.16	75.30	75.30
113	159.30	97.43	31.98	6.46	56.26	44.91
114	159.30	97.43	32.25	6.46	56.26	44.91
115	159.30	75.13	22.10	6.46	56.26	44.91
116	159.30	75.13	22.41	6.46	56.26	44.91
201	251.16	241.97	42.30	42.30	75.35	75.35
202	251.01	248.88	27.16	27.16	75.30	75.30
203	151.65	150.70	20.17	14.14	54.12	28.95
204	151.65	145.15	20.17	14.14	54.12	28.95
205	151.65	149.10	20.17	14.14	54.12	28.95
206	151.65	150.70	20.17	14.14	54.12	28.95
207	151.65	149.10	20.17	14.14	54.12	28.95
208	159.30	140.46	46.90	6.46	56.26	44.91
209	75.10	66.32	4.25	4.25	22.53	22.53
210	151.65	145.15	20.17	14.14	54.12	28.95
211	159.30	140.46	46.90	6.46	56.26	44.91
212	251.01	248.88	27.16	27.16	75.30	75.30
213	159.30	97.43	31.98	6.46	56.26	44.91
214	159.30	97.43	32.25	6.46	56.26	44.91
215	159.30	75.13	21.32	6.46	56.26	44.91
216	159.30	75.13	21.78	6.46	56.26	44.91
301	251.16	241.97	42.30	42.30	75.35	75.35
302	251.01	248.88	27.16	27.16	75.30	75.30
303	151.65	150.70	20.17	14.14	54.12	28.95
304	151.65	145.15	20.17	14.14	54.12	28.95
305	151.65	149.10	20.17	14.14	54.12	28.95
306	151.65	150.70	20.17	14.14	54.12	28.95
307	151.65	149.10	20.17	14.14	54.12	28.95
308	159.30	21.54	46.90	6.46	56.26	44.91
309	75.10	66.32	4.25	4.25	22.53	22.53
310	151.65	136.71	20.17	14.14	54.12	28.95

311	159.30	21.54	46.90	6.46	56.26	44.91
312	251.01	248.88	27.16	27.16	75.30	75.30
313	159.30	97.43	32.83	6.46	56.26	44.91
314	159.30	97.43	32.78	6.46	56.26	44.91
315	159.30	75.13	26.32	6.46	56.26	44.91
316	159.30	75.13	24.24	6.46	56.26	44.91

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	0.066	0.810	0.059	0.024	0.007	0.825	#32	0.113	Not Required	Pass
2	0.001	0.565	0.067	0.112	0.013	0.632	#13	0.054	Not Required	Pass
3	0.001	0.923	0.021	0.093	0.004	0.944	#13	0.046	Not Required	Pass
4	0.001	0.630	0.021	0.063	0.005	0.645	#13	0.126	Not Required	Pass
5	0.001	0.573	0.026	0.092	0.008	0.585	#13	0.117	Not Required	Pass
6	0.001	0.828	0.014	0.082	0.004	0.843	#13	0.046	Not Required	Pass
7	0.001	0.514	0.016	0.082	0.005	0.520	#13	0.076	Not Required	Pass
8	0.002	0.081	0.018	0.038	0.002	0.100	#13	0.102	Not Required	Pass
9	0.002	0.104	0.029	0.002	0.002	0.133	#13	0.206	Not Required	Pass
10	0.001	0.557	0.032	0.056	0.008	0.590	#13	0.122	Not Required	Pass
11	0.002	0.115	0.014	0.055	0.002	0.128	#13	0.102	Not Required	Pass
12	0.001	0.473	0.060	0.099	0.011	0.534	#13	0.054	Not Required	Pass
13	0.002	0.430	0.053	0.070	0.002	0.469	#13	0.306	Not Required	Pass
14	0.002	0.309	0.053	0.048	0.003	0.350	#13	0.204	Not Required	Pass
15	0.000	0.178	0.032	0.049	0.002	0.205	#13	Not Required	Not Required	Pass
16	0.000	0.120	0.032	0.033	0.002	0.147	#13	Not Required	Not Required	Pass
101	0.063	0.784	0.015	0.022	0.002	0.793	#16	0.113	Not Required	Pass
102	0.000	0.470	0.057	0.098	0.011	0.528	#13	0.036	Not Required	Pass
103	0.001	0.819	0.006	0.082	0.001	0.820	#13	0.046	Not Required	Pass
104	0.001	0.545	0.013	0.055	0.003	0.558	#13	0.082	Not Required	Pass
105	0.001	0.508	0.014	0.081	0.004	0.509	#13	0.076	Not Required	Pass
106	0.001	0.840	0.009	0.084	0.002	0.850	#13	0.046	Not Required	Pass
107	0.001	0.521	0.014	0.083	0.004	0.526	#13	0.076	Not Required	Pass
108	0.001	0.057	0.014	0.034	0.002	0.063	#13	0.102	Not Required	Pass
109	0.001	0.076	0.015	0.001	0.000	0.092	#13	0.206	Not Required	Pass
110	0.001	0.567	0.012	0.057	0.003	0.569	#13	0.082	Not Required	Pass
111	0.001	0.075	0.014	0.050	0.002	0.079	#13	0.102	Not Required	Pass
112	0.000	0.493	0.059	0.101	0.011	0.552	#13	0.054	Not Required	Pass
113	0.002	0.247	0.036	0.065	0.002	0.258	#13	0.306	Not Required	Pass
114	0.002	0.169	0.036	0.044	0.002	0.177	#13	0.306	Not Required	Pass
115	0.002	0.221	0.020	0.045	0.002	0.239	#13	0.507	Not Required	Pass
116	0.002	0.154	0.019	0.030	0.002	0.171	#13	0.507	Not Required	Pass
201	0.063	0.784	0.015	0.022	0.002	0.793	#16	0.113	Not Required	Pass
202	0.000	0.493	0.059	0.101	0.011	0.552	#13	0.054	Not Required	Pass
203	0.001	0.840	0.009	0.084	0.002	0.850	#13	0.046	Not Required	Pass
204	0.001	0.567	0.012	0.057	0.003	0.569	#13	0.082	Not Required	Pass
205	0.001	0.521	0.014	0.084	0.004	0.526	#13	0.076	Not Required	Pass
206	0.001	0.819	0.006	0.082	0.001	0.820	#13	0.046	Not Required	Pass
207	0.001	0.508	0.014	0.081	0.004	0.509	#13	0.076	Not Required	Pass
208	0.002	0.037	0.016	0.030	0.002	0.044	#13	0.102	Not Required	Pass
209	0.001	0.076	0.015	0.001	0.000	0.092	#13	0.206	Not Required	Pass

210	0.001	0.545	0.013	0.055	0.003	0.558	#13	0.082	Not Required	Pass
211	0.002	0.047	0.016	0.045	0.002	0.055	#13	0.102	Not Required	Pass
212	0.000	0.470	0.057	0.098	0.011	0.528	#13	0.036	Not Required	Pass
213	0.002	0.247	0.036	0.065	0.002	0.258	#13	0.306	Not Required	Pass
214	0.002	0.169	0.036	0.044	0.002	0.177	#13	0.306	Not Required	Pass
215	0.001	0.334	0.019	0.050	0.002	0.350	#13	0.507	Not Required	Pass
216	0.002	0.241	0.020	0.034	0.002	0.259	#13	0.507	Not Required	Pass
301	0.066	0.810	0.059	0.024	0.007	0.825	#32	0.113	Not Required	Pass
302	0.001	0.473	0.060	0.099	0.011	0.534	#13	0.054	Not Required	Pass
303	0.001	0.828	0.014	0.082	0.004	0.843	#13	0.046	Not Required	Pass
304	0.001	0.557	0.032	0.056	0.008	0.590	#13	0.122	Not Required	Pass
305	0.001	0.514	0.016	0.082	0.005	0.520	#13	0.076	Not Required	Pass
306	0.001	0.923	0.021	0.093	0.004	0.944	#13	0.046	Not Required	Pass
307	0.001	0.573	0.026	0.092	0.008	0.585	#13	0.076	Not Required	Pass
308	0.000	0.120	0.032	0.033	0.002	0.147	#13	Not Required	Not Required	Pass
309	0.002	0.104	0.029	0.002	0.002	0.133	#13	0.206	Not Required	Pass
310	0.001	0.630	0.021	0.063	0.005	0.645	#13	0.126	Not Required	Pass
311	0.000	0.178	0.032	0.049	0.002	0.205	#13	Not Required	Not Required	Pass
312	0.001	0.565	0.067	0.112	0.013	0.632	#13	0.054	Not Required	Pass
313	0.002	0.430	0.053	0.070	0.002	0.469	#13	0.204	Not Required	Pass
314	0.002	0.309	0.053	0.048	0.003	0.350	#13	0.306	Not Required	Pass
315	0.002	0.202	0.020	0.055	0.002	0.215	#13	0.507	Not Required	Pass
316	0.002	0.139	0.019	0.038	0.002	0.158	#13	0.507	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	Round
D	Section diameter	36 in

Material Properties

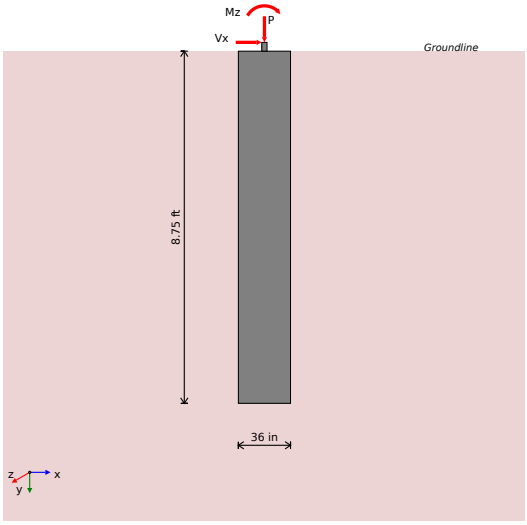
Input	Description	Value
f'_{ck}	Concrete compressive strength	2.5 ksi
f_{yk}	Yield strength of steel	60 ksi
d_b	Rebar diameter	#5 (0.625) in
cover	Concrete cover	3 in

Soil Parameters (IBC 1806)

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

Loading

Load	ASD	LRFD
P	10.42 kip	16.06 kip
Vx	-1.079 kip	-1.793 kip
Vz	0.33 kip	0.515 kip
Mx	0.534 kip-ft	0.835 kip-ft
Mz	20.7 kip-ft	34.26 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

$$H_o = \frac{V_x}{D} = \frac{-1.079}{36} = -0.36\ \frac{kip}{ft}$$

Moment per section length

$$M = \frac{M_z + (V_x \times H)}{} = \frac{20.7 + (-1.079 \times 0)}{} = 6.9\ \frac{kip - ft}{}$$

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

Required depth of embedment in earth:

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

Solving the cubic equation:

$$L_{e,x} = 8.358\ ft$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{D} = \frac{0.33}{36} = 0.11\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_x + (V_z \times H)}{D} = \frac{0.534 + (0.33 \times 0)}{36} = 0.178\ \frac{kip - ft}{ft}$$

Required depth of embedment in earth:

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

Solving the cubic equation:

$$L_{e,z} = 3.996\ ft$$

Minimum embedded depth

Depth of pile required

$$L_{e,req} = MAX[L_{e,x}, L_{e,z}] = MAX[8.358, 3.996] = 8.358\ ft$$

Actual embedded length

$$L_e = L - h_2 - h_e = 8.75 - 0 - 0 = 8.75\ ft$$

Utilisation

$$Ratio = \frac{L_{e,req}}{L_e} = \frac{8.358}{8.75} = 0.955$$

UTILITY: 0.96

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:

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

End-bearing pressure:

$$q = \frac{P}{A} = \frac{10.42}{7.069} = 1474\ psf$$

Utilisation

$$Ratio = \frac{q}{q_a} = \frac{1474}{2000} = 0.737$$

UTILITY: 0.74

Lateral Soil Pressure (ASD)

Allowable lateral pressure	$R =$	150 psf/ft

Length to least lateral dimension ratio:

$$\frac{L}{D} = \frac{8.75}{3} = 2.917$$

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

Considering x-direction:

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 6.9 \times 8.75) + (3 \times 0.36 \times 8.75^2)}{(6 \times 6.9) + (4 \times 0.36 \times 8.75)} = 6.003\ ft$$

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

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

$$p = \frac{1.178 \times [(4 \times 6.9) + (3 \times -0.36 \times 8.75)]^2}{8.75^2 \times [(3 \times 6.9) + (2 \times -0.36 \times 8.75)]} = 0.352\ \frac{kip}{ft^2}$$

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

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{6.003}{2} = 0.45\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of a/2

$$Ratio = \frac{p}{p_a} = \frac{0.352}{0.45} = 0.782$$

UTILITY: 0.78

Earth pressure against the pile at distance L_e:

$$s = \frac{9.425 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{9.425 \times [(2 \times 6.9) + (-0.36 \times 8.75)]}{8.75^2} = 1.312\ \frac{kip}{ft^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 8.75 = 1.313\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of L_e

$$Ratio = \frac{s}{p_s} = \frac{1.312}{1.313} = 0.999$$

UTILITY: 1.00

Considering z-direction:

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 0.178 \times 8.75) + (3 \times 0.11 \times 8.75^2)}{(6 \times 0.178) + (4 \times 0.11 \times 8.75)} = 6.404\ ft$$

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

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

$$p = \frac{1.178 \times [(4 \times 0.178) + (3 \times 0.11 \times 8.75)]^2}{8.75^2 \times [(3 \times 0.178) + (2 \times 0.11 \times 8.75)]} = 0.081\ \frac{kip}{ft^2}$$

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

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{6.404}{2} = 0.48\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of a/2

$$Ratio = \frac{p}{p_a} = \frac{0.081}{0.48} = 0.169$$

UTILITY: 0.17

Earth pressure against the pile at distance L_e:

$$s = \frac{9.425 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{9.425 \times [(2 \times 0.178) + (0.11 \times 8.75)]}{8.75^2} = 0.162\ \frac{kip}{ft^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 8.75 = 1.313\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of L_e

$$Ratio = \frac{s}{p_s} = \frac{0.162}{1.313} = 0.124$$

UTILITY: 0.12

REFERENCES	CALCULATIONS	RESULTS

Shear force and bending moment (LRFD)

Considering x-direction:

Lateral force per section length

$$H_o = \frac{V_x}{D} = \frac{-1.793}{36} = -0.598\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_z + (V_x \times H)}{D} = \frac{34.26 + (-1.793 \times 0)}{36} = 11.42\ \frac{kip - ft}{ft}$$

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 11.42 \times 8.75) + (3 \times 0.598 \times 8.75^2)}{(6 \times 11.42) + (4 \times 0.598 \times 8.75)} = 6.004\ ft$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{11.42}{-0.598} = 19.11\ ft$$

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

$$V_{max,x} = (-0.598 \times 36) \times [1 - [3 \times \left(\frac{4 \times 19.11}{8.75} + 3\right) \times \left(\frac{6.004}{8.75}\right)^2] + [4 \times \left(\frac{3 \times 19.11}{8.75} + 2\right) \times \left(\frac{6.004}{8.75}\right)^3]]$$

$$V_{max,x} = 8.112\ kip$$

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

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

$$M_{max,x} = (-0.598 \times 36 \times 8.75) \times [\left(\frac{19.11}{8.75} + \frac{6.004}{2 \times 8.75}\right) - [\left(\frac{4 \times 19.11}{8.75} + 3\right) \times \left(\frac{6.004}{2 \times 8.75}\right)^3] + [\left(\frac{3 \times 19.11}{8.75} + 2\right) \times \left(\frac{6.004}{2 \times 8.75}\right)^4]]$$

$$M_{max,x} = 34.06\ kip - ft$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{D} = \frac{0.515}{36} = 0.172\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_x + (V_z \times H)}{D} = \frac{0.835 + (0.515 \times 0)}{36} = 0.278\ \frac{kip - ft}{ft}$$

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 0.278 \times 8.75) + (3 \times 0.172 \times 8.75^2)}{(6 \times 0.278) + (4 \times 0.172 \times 8.75)} = 6.404\ ft$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{0.278}{0.172} = 1.621\ ft$$

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

$$V_{max,z} = (0.172 \times 36) \times [1 - [3 \times \left(\frac{4 \times 1.621}{8.75} + 3\right) \times \left(\frac{6.404}{8.75}\right)^2] + [4 \times \left(\frac{3 \times 1.621}{8.75} + 2\right) \times \left(\frac{6.404}{8.75}\right)^3]]$$

$$V_{max,z} = (0.172 \times 36) \times [1 - [3 \times \left(\frac{}{8.75} + 3\right) \times \left(\frac{}{8.75}\right)^3] + [4 \times \left(\frac{}{8.75} + 2\right) \times \left(\frac{}{8.75}\right)^4]]$$

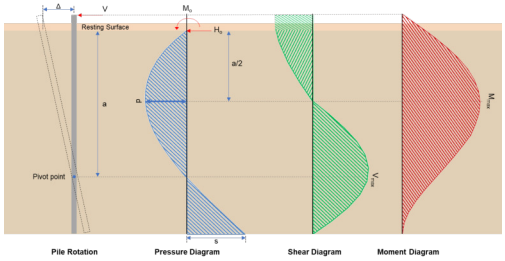
$$V_{max,z} = 0.517\ kip$$

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

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

$$M_{max,z} = (0.172 \times 36 \times 8.75) \times [\left(\frac{1.621}{8.75} + \frac{6.404}{2 \times 8.75}\right) - [\left(\frac{4 \times 1.621}{8.75} + 3\right) \times \left(\frac{6.404}{2 \times 8.75}\right)^3] + [\left(\frac{3 \times 1.621}{8.75} + 2\right) \times \left(\frac{6.404}{2 \times 8.75}\right)^4]]$$

$$M_{max,z} = 1.864\ kip - ft$$



Minimum Reinforcement Check (LRFD)

Gross area of concrete:

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

Main Reinforcement

22.4.2.2 Required reinforcement:

$$A_{st,req} = \frac{P - (0.85 \times f'_{ck} \times A_g)}{f_{yk} - (0.85 \times f'_{ck})} = \frac{16.06 - (0.85 \times 2.5 \times 1018)}{60 - (0.85 \times 2.5)} = -37.1\ in^2$$

10.6.1.1 Maximum reinforcement:

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

7.6.1.1 Minimum reinforcement:

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

Governing minimum reinforcement area:

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

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

Minimum number of reinforcements:

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

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

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: $n = 6$pcs at 1.5 in minimum spacing

Total reinforcement area:

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

Shear Reinforcement

25.7.2.2 For main reinforcement $\leq$ 1.41 in: Use #3(0.375 in)

Maximum spacing of shear Reinforcements:

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

Detailing Summary	
Main reinforcement	#5 (0.625 in) - 6pcs 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:

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

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

Utilisation

$$Ratio = \frac{P}{\phi P_N} = \frac{16.06}{1254} = 0.013$$

UTILITY: 0.01

Shear Strength LRFD)

Effective shear width	$b_w =$	36 in
Effective shear depth	$d =$	28.8 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	$V_{max,x} =$	8.112 kip
Maximum shear in the z-direction	$V_{max,z} =$	0.517 kip

22.5.5.1.1 Max shear strength of concrete:

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

Table 22.5.5.1 Shear strength of concrete:

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

$$V_{c,a} = \left(2 \times 1 \times \sqrt{2.5} + MIN[\frac{16.06}{6 \times 1018}, (0.05 \times 2.5)]\right) \times (36 \times 28.8) = 106.4\ kip$$

Governing shear strength of concrete:

$$V_c = MIN[V_{c,max}, V_{c,a}] = MIN[259.2, 106.4] = 106.4\ kip$$

22.5.1.2 Shear strength of steel (a):

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

22.5.8.5.3 Shear strength of steel (b):

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

Governing shear strength of steel:

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

22.5.1.1 Allowable shear strength:

$$\phi V_n = \phi \times (V_c + V_s) = 0.75 \times (106.4 + 38.17) = 108.4\ kip$$

$$V_{max} = MAX[8.112, 0.517] = 8.112\ kip$$

Utilisation

$$Ratio = \frac{V_{max}}{\phi V_n} = \frac{8.112}{108.4} = 0.075$$

UTILITY: 0.07

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	$b =$	36 in
Distance to the compression rebar	$d_s =$	3.688 in
Distance to the tension rebar	$d =$	28.8 in
Total bar area	$A_s =$	1.841 in^2
Maximum applied axial load	$P =$	16.06 kip
Maximum moment in the x-direction	$M_{max,x} =$	34.06 kip-ft
Maximum moment in the z-direction	$M_{max,z} =$	1.864 kip-ft

Maximum moment in the z-direction $M_{max,z}$ = 1.864 kip-ft

Compressive force due to concrete:

$$\beta_1 = 0.85$$

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

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

$$\theta = \text{Central angle of the compressive area in radians}$$

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:

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

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

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

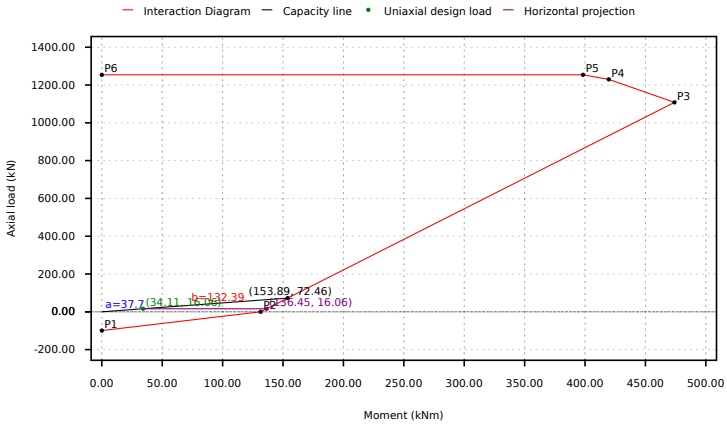
Interaction Diagram Summary

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

Uniaxial Bending Check

$$M_f = \sqrt{M_{max,x}^2 + M_{max,z}^2} = \sqrt{34.06^2 + 1.864^2} = 34.11\ kip - ft$$

Interaction Diagram



Segment	Signed Distance
P1 - P2	71.53
P2 - P3	97.78
P3 - P4	847
P4 - P5	1095
P5 - P6	1238
Status	PASS: Point lies inside the curve

Utilisation

$$Ratio = \frac{a}{a+b} = \frac{37.7}{37.7 + 132.4} = 0.222$$

UTILITY: 0.22

Biaxial Bending Check

Maximum moment in the x-direction	$M_{max,x} =$ 34.06 kip-ft
Maximum moment in the z-direction	$M_{max,z} =$ 1.864 kip-ft
Nominal uniaxial moment strength about the x-axis	$M_{nox} =$ 136.4 kip-ft
Nominal uniaxial moment strength about the z-axis	$M_{noz} =$ 136.4 kip-ft
Interaction exponent	$\alpha =$ 1

Bresler (1960)

According to Bresler (method B):

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

$$\left(\frac{34.06}{136.4}\right)^{1} + \left(\frac{1.864}{136.4}\right)^{1} = 0.263$$

UTILITY: 0.26

REFERENCES	CALCULATIONS	RESULTS

Results Summary

Result Name	Results
PILE DETAILS	
Length of the pile	8.75 ft
Dimension	36Ø in
Main bar reinforcement	#5-6pcs at 1.5 in min.
Shear reinforcement	#3 at 10 in max.
UTILISATIONS	
Required depth	0.96
End-bearing capacity	0.74
p_a	0.78
p_s	1.00
Axial compression strength	0.01
Shear strength	0.07
Uniaxial bending strength	0.22
Biaxial bending strength	0.26