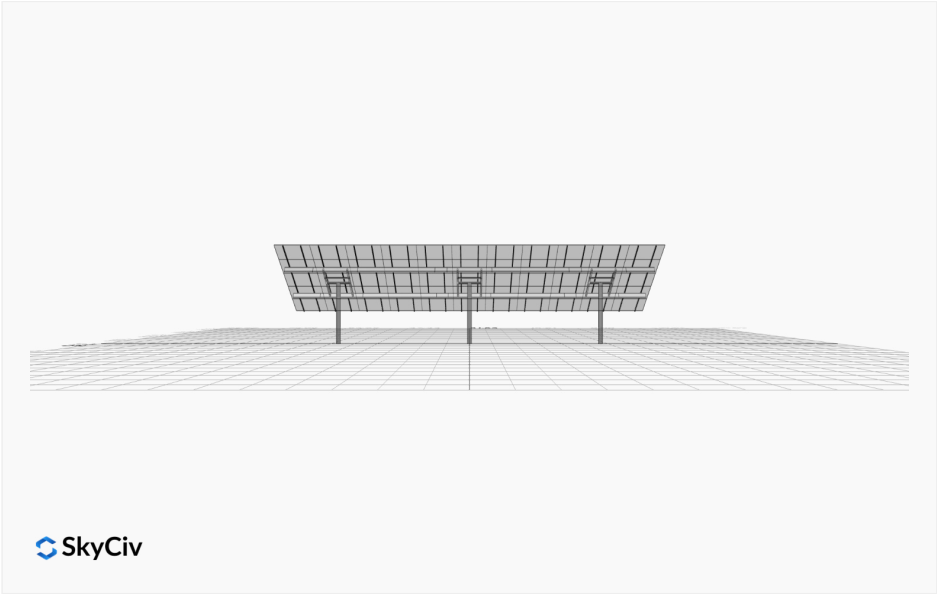
Project Details

Project Name: MTSOLAR_AL55AC9C07GC - V1Jb
Location: 774 County Hwy 7GQ, Cody, WY 82414, USA
Unique ID: 3P-22.5-8TOP-XD-57-L-5Hx11W-E6G3
Dealer: _____

Date: Wed Oct 15 2025
Number of Modules: 55
Number of Poles: 3
Date Sold: _____



Array Dimensions N/S	18.96 ft
Array Dimensions E/W	63.25 ft
Winter Tilt Angle (Degrees)	35
Front Edge Clearance	5

MT Solar Bill of Materials (3P-22.5-8TOP-XD-57-L-5Hx11W-E6G3)

Part	Short Description	BOM Qty
MTS-PC-8	8IN Pole Cap Assembly	3
MTS-HF-XD	H-Frame Assembly-XD	3
MTS-XD-Wing-57	57IN XD Wing	4
MTS-XD-Splice-90	90IN XD Splice	8
MTS-CLAMP-ANGLE-4PK	Angle Clamp	11

Rail Bill of Materials

Part	Qty
Rails (228in Long)	22x
Rail Attachment	88x
Module Mid Clamp	88x
Module End Clamp	44x
Ground Lug	11x

Site Details:

Site Address: 774 County Hwy 7GQ, Cody, WY 82414, USA

Array Specifications

Duty Classification:	XD
Module Width:	45.00 in
Module Length:	68.00 in
Number of Rows:	5
Number of Columns:	11
Total Number of Modules:	55
Winter Tilt Angle:	35
Front Edge Clearance:	5
Total Array Height at Tilt:	15.87 ft
Total Frame Length:	62.00 ft
Module Info/Notes:	JA 440w
Array Dimensions N/S:	18.96 ft
Array Dimensions E/W:	63.25 ft
Rail Length:	227.50 in
Rail Spacing:	2.88 ft

Support Specifications

Pole Size:	8in Pipe Sch 40
Pole Length above Grade:	10.44 ft
Number of Poles:	3
Pole Spacing:	22.5 ft

Foundation Specifications

Foundation Type:	round
Foundation Dimensions:	36 in dia.
Foundation Depth (below grade):	9.5 ft
Foundation Volume:	67.15 ft^3

Site Info

Risk Category:	I
Exposure:	C
Soil Classification:	sand
Site Location:	774 County Hwy 7GQ, Cody, WY 82414, USA
Wind Speed:	100 mph

Snow Load:	40 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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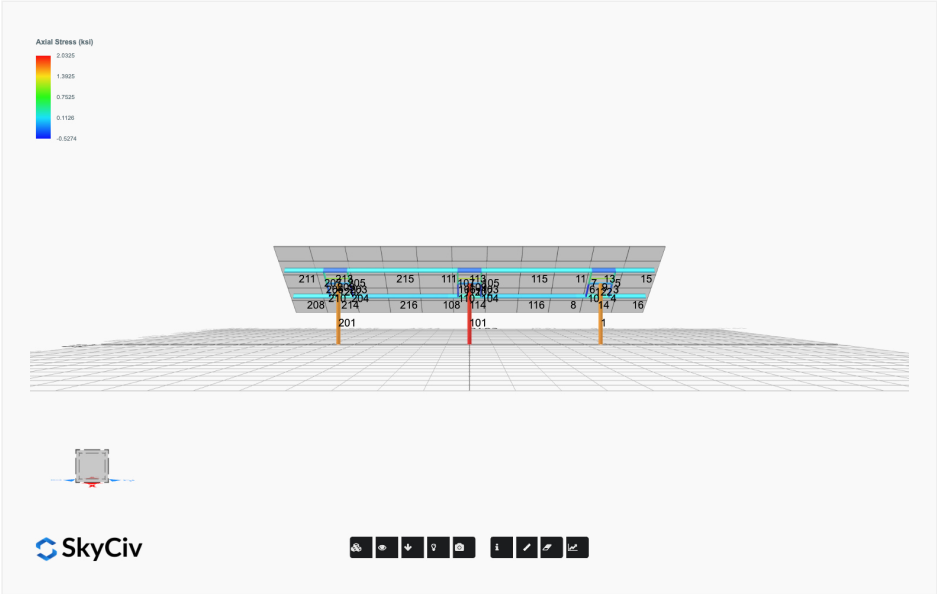
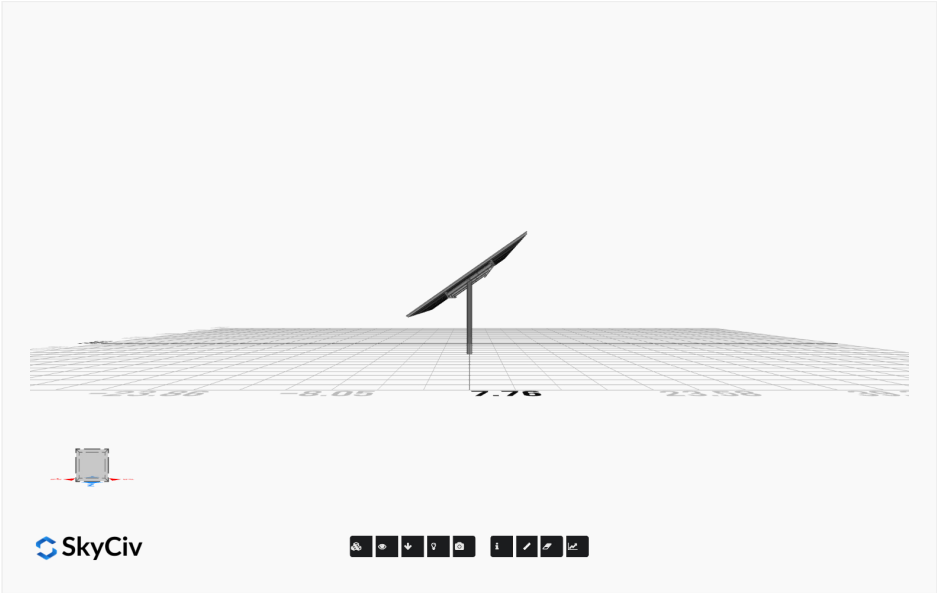
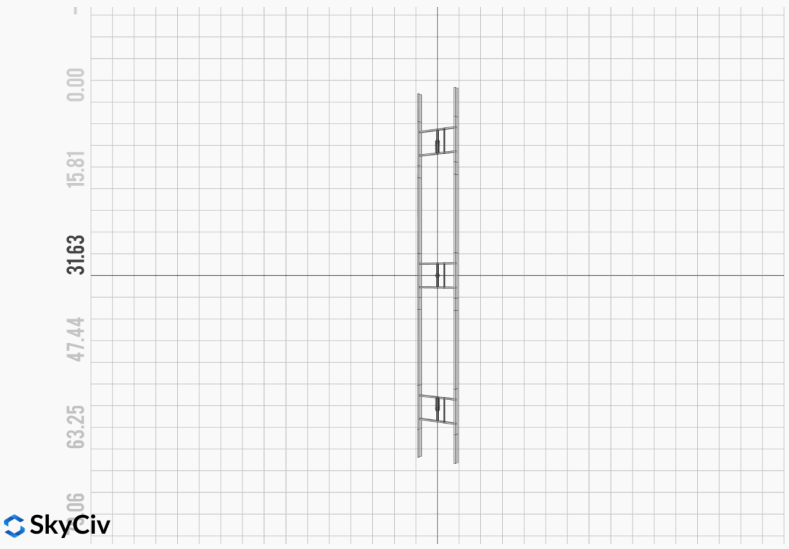
Design Notes:

- 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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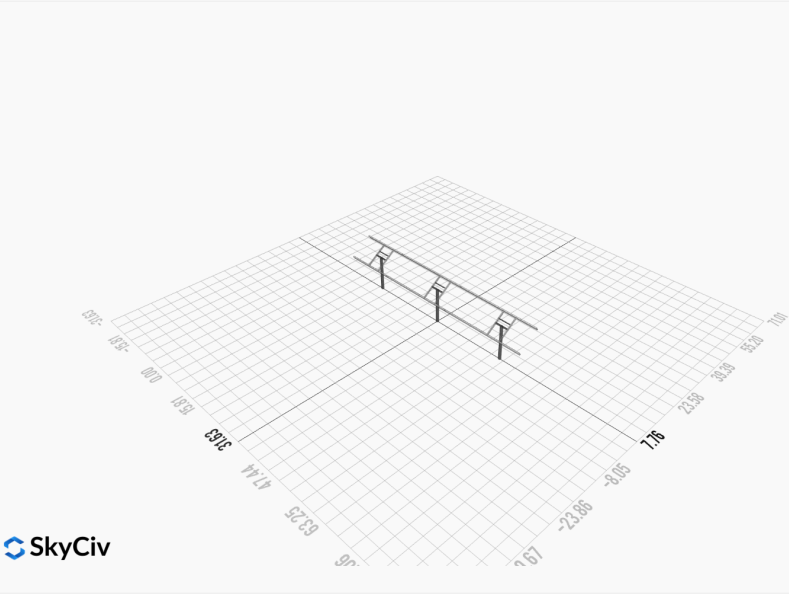
SkyCiv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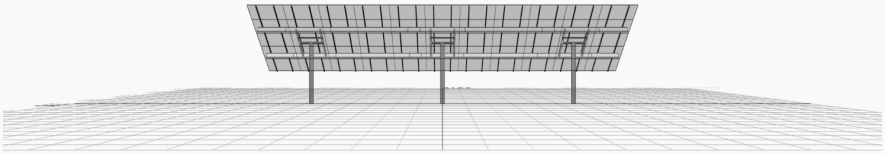
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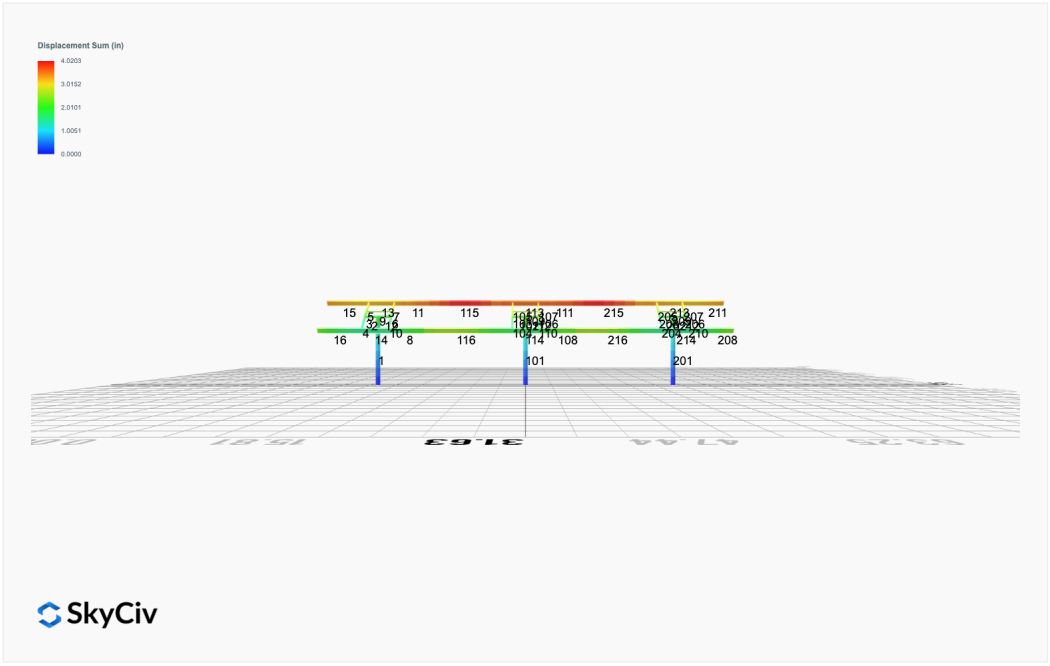
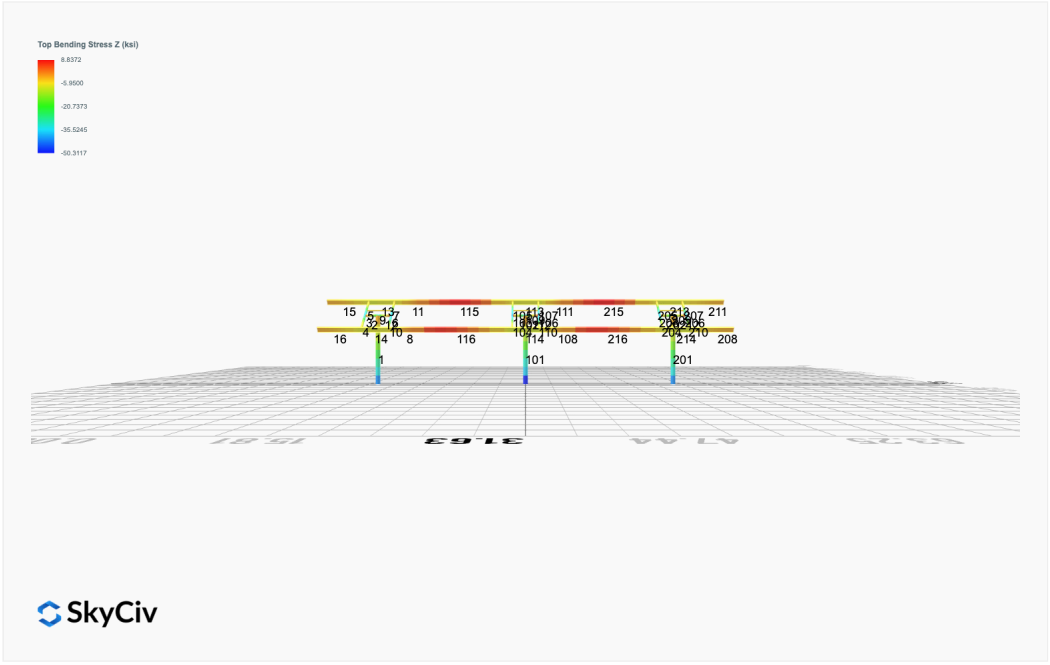
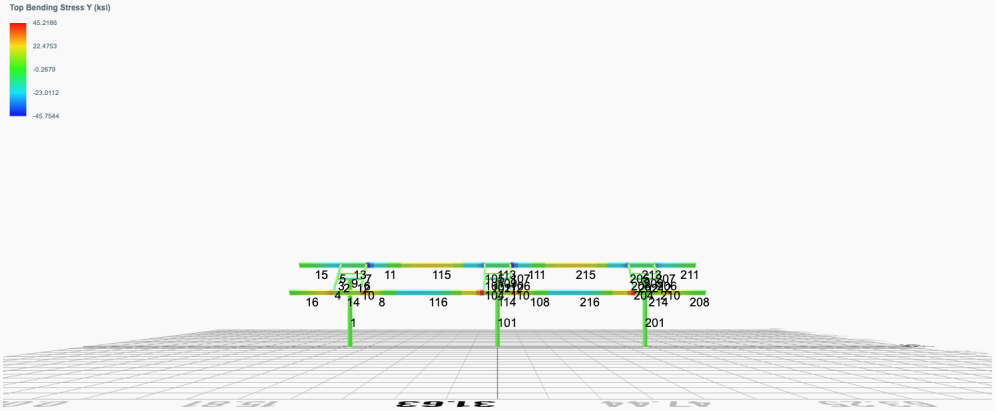
FEM Results (Envelope Worst Case)







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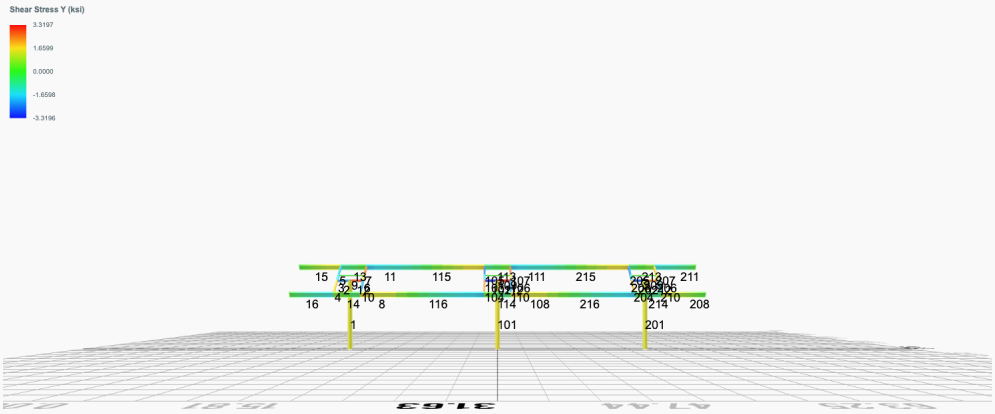

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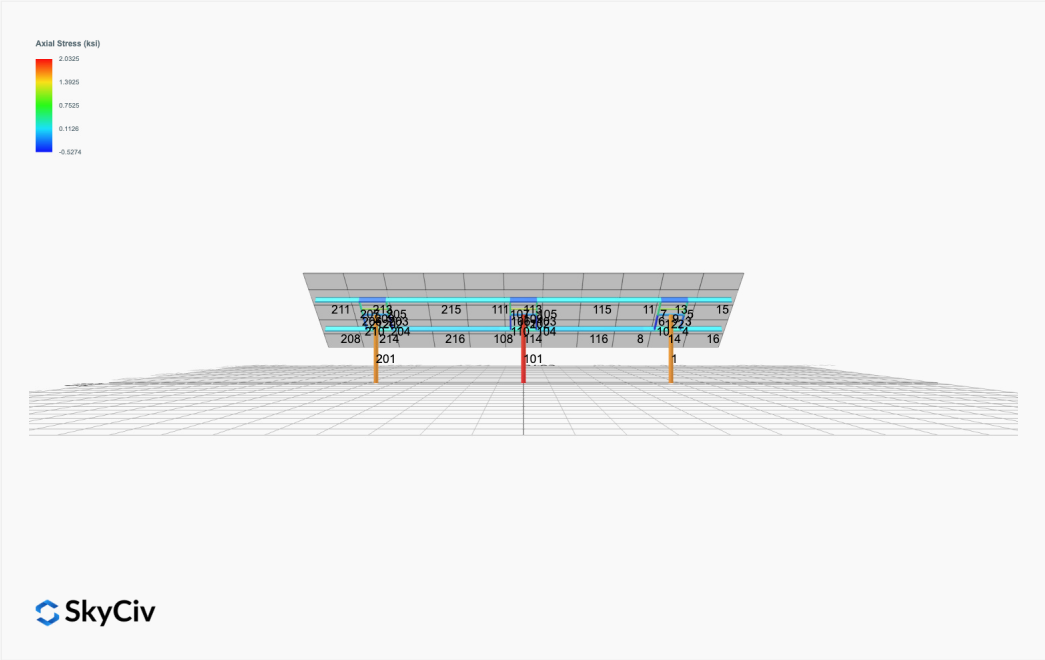
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0.1126
-0.5274
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215
111
115
15
208
214
216
108
116
8
16
201
101
1

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	0.0167	3.8216	0.0578	0.1787	-0.0123	-0.1109
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0273	5.6161	0.0946	0.2932	-0.0206	-0.2012
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0143	3.2756	0.0495	0.1530	-0.0106	-0.0963
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	0.0556	10.7652	0.1947	0.6062	-0.0430	-0.3927
ULS: 5. 1.2D + E + L + 0.2S	0.0195	4.2118	0.0675	0.2089	-0.0146	-0.1396
ULS: 7. 0.9D + 1.0E	0.0108	2.4567	0.0371	0.1146	-0.0079	-0.0736
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-5.5806	13.5844	0.3205	0.9475	-0.6214	61.3869
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-5.5806	13.5844	0.3205	0.9475	-0.6214	61.3869
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.7539	-1.1023	-0.0893	-0.2382	0.4693	-49.6883
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	3.9905	-0.0046	-0.0843	-0.2231	0.4607	-57.9356
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-5.5926	11.2431	0.2743	0.8041	-0.6088	61.0727
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-5.5926	11.2431	0.2743	0.8041	-0.6088	61.0727
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.7402	-3.4420	-0.1336	-0.3759	0.4775	-49.2649
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	3.9766	-2.3443	-0.1287	-0.3612	0.4691	-57.4176
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.7487	14.7497	0.3079	0.9339	-0.3437	30.5329
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-2.7487	14.7497	0.3079	0.9339	-0.3437	30.5329
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.4202	7.4048	0.1012	0.3356	0.2058	-25.7192
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	2.0387	7.9534	0.1039	0.3438	0.2012	-29.9747
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.7884	7.2586	0.1609	0.4755	-0.3073	30.1631
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-2.7884	7.2586	0.1609	0.4755	-0.3073	30.1631
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.3777	-0.0836	-0.0427	-0.1134	0.2351	-24.8932
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	1.9960	0.4652	-0.0402	-0.1060	0.2308	-28.9933
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-5.5959	10.4239	0.2616	0.7646	-0.6054	60.9524
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-5.5959	10.4239	0.2616	0.7646	-0.6054	60.9524
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	4.7364	-4.2607	-0.1458	-0.4135	0.4796	-49.1335
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	3.9728	-3.1629	-0.1409	-0.3991	0.4712	-57.2534

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	0.0120	2.7297	0.0412	0.1274	-0.0088	-0.0812
ULS: 2. D + L	0.0120	2.7297	0.0412	0.1274	-0.0088	-0.0812
ULS: 3. D + (S or Lr or R)	0.0379	7.4106	0.1316	0.4085	-0.0289	-0.2844
ULS: 3. D + (S or Lr or R)	0.0120	2.7297	0.0412	0.1274	-0.0088	-0.0812
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0314	6.2403	0.1089	0.3377	-0.0238	-0.2377
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0120	2.7297	0.0412	0.1274	-0.0088	-0.0812
ULS: 5b. D + 0.7E	0.0120	2.7297	0.0412	0.1274	-0.0088	-0.0812
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	0.0314	6.2403	0.1089	0.3377	-0.0238	-0.2377
ULS: 8. 0.6D + 0.7E	0.0072	1.6378	0.0247	0.0763	-0.0053	-0.0499
ULS: 5a. D + 0.6W_Wind downforce Case A only	-3.3514	7.5094	0.1751	0.5147	-0.3651	36.2512
ULS: 5a. D + 0.6W_Wind downforce Case B only	-3.3514	7.5094	0.1751	0.5147	-0.3651	36.2512
ULS: 5a. D + 0.6W_Wind uplift Case A only	2.8478	-1.3013	-0.0691	-0.1915	0.2853	-29.7419
ULS: 5a. D + 0.6W_Wind uplift Case B only	2.3897	-0.6426	-0.0662	-0.1827	0.2803	-34.6431
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-2.4916	9.8255	0.2097	0.6295	-0.2921	27.2004
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-2.4916	9.8255	0.2097	0.6295	-0.2921	27.2004
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.1590	3.2165	0.0254	0.0963	0.1985	-22.7609
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.8154	3.7104	0.0277	0.1032	0.1945	-26.5076

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-2.5104	6.3143	0.1413	0.4171	-0.2754	27.0816
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-2.5104	6.3143	0.1413	0.4171	-0.2754	27.0816
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.1390	-0.2936	-0.0417	-0.1123	0.2122	-22.3845
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.7954	0.2003	-0.0395	-0.1057	0.2084	-26.0668
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-3.3560	6.4173	0.1583	0.4628	-0.3610	36.1709
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-3.3560	6.4173	0.1583	0.4628	-0.3610	36.1709
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	2.8429	-2.3930	-0.0855	-0.2420	0.2884	-29.6227
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	2.3847	-1.7343	-0.0825	-0.2333	0.2834	-34.4976

Worst Case Reactions (LRFD)

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

Result	Value (kip, kip-ft)
Axial	14.7497
Shear X	-5.5959
Shear Z	0.3205
Moment X	0.9475
Moment Y (Twist)	0.6214
Moment Z	61.3869

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	9.8255
Shear X	-3.3560
Shear Z	0.2097
Moment X	0.6295
Moment Y (Twist)	0.3651
Moment Z	36.2512

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	-0.0335	4.3256	0.0000	0.0000	0.0001	0.3666
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0546	6.4383	0.0000	0.0000	0.0002	0.5837
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	-0.0287	3.7077	0.0000	0.0000	0.0001	0.3124
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	-0.1112	12.4452	0.0000	-0.0000	0.0006	1.2374
ULS: 5. 1.2D + E + L + 0.2S	-0.0391	4.8000	0.0000	0.0000	0.0001	0.4190
ULS: 7. 0.9D + 1.0E	-0.0215	2.7808	0.0000	0.0000	0.0000	0.2323
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-6.4768	15.6915	0.0000	-0.0002	0.0004	70.4745
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-6.4768	15.6915	0.0000	-0.0002	0.0004	70.4745
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	5.3743	-1.3789	0.0000	0.0002	-0.0000	-55.4743
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	4.4208	-0.0319	0.0000	0.0003	0.0001	-63.9732
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-6.4528	12.9627	-0.0000	-0.0001	0.0002	69.6932
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-6.4528	12.9627	-0.0000	-0.0001	0.0002	69.6932
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	5.4017	-4.1109	0.0000	0.0001	-0.0000	-55.3586
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	4.4485	-2.7641	-0.0000	0.0002	0.0001	-63.7477
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-3.3216	17.0712	0.0000	-0.0003	0.0008	36.3490
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-3.3216	17.0712	0.0000	-0.0003	0.0008	36.3490
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.6006	8.5391	0.0000	0.0002	0.0004	-27.4971
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	2.1235	9.2130	0.0000	0.0003	0.0005	-31.8961
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-3.2422	8.3366	0.0000	-0.0000	0.0001	34.6130
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-3.2422	8.3366	0.0000	-0.0000	0.0001	34.6130
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.6856	-0.2007	0.0000	0.0001	0.0000	-27.7778
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	2.2089	0.4728	0.0000	0.0001	0.0001	-31.9962
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-6.4463	12.0363	-0.0000	-0.0001	0.0001	69.4428
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-6.4463	12.0363	-0.0000	-0.0001	0.0001	69.4428
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	5.4093	-5.0382	0.0000	0.0001	-0.0000	-55.3097
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	4.4562	-3.6915	-0.0000	0.0002	0.0001	-63.6613

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	-0.0239	3.0898	0.0000	0.0000	0.0000	0.2589
ULS: 2. D + L	-0.0239	3.0898	0.0000	0.0000	0.0000	0.2589
ULS: 3. D + (S or Lr or R)	-0.0757	8.5509	0.0000	0.0000	0.0003	0.8111
ULS: 3. D + (S or Lr or R)	-0.0239	3.0898	0.0000	0.0000	0.0000	0.2589
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0628	7.1857	0.0000	0.0000	0.0002	0.6670
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	-0.0239	3.0898	0.0000	0.0000	0.0000	0.2589
ULS: 5b. D + 0.7E	-0.0239	3.0898	0.0000	0.0000	0.0000	0.2589
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	-0.0628	7.1857	0.0000	0.0000	0.0002	0.6670
ULS: 8. 0.6D + 0.7E	-0.0144	1.8539	0.0000	0.0000	0.0000	0.1535
ULS: 5a. D + 0.6W_Wind downforce Case A only	-3.8800	8.6443	-0.0000	-0.0001	0.0001	41.4454
ULS: 5a. D + 0.6W_Wind downforce Case B only	-3.8800	8.6443	-0.0000	-0.0001	0.0001	41.4454
ULS: 5a. D + 0.6W_Wind uplift Case A only	3.2336	-1.6007	0.0000	0.0001	-0.0000	-33.3352
ULS: 5a. D + 0.6W_Wind uplift Case B only	2.6617	-0.7926	-0.0000	0.0001	0.0001	-38.3765
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-2.9540	11.3508	0.0000	-0.0001	0.0003	31.7882
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-2.9540	11.3508	0.0000	-0.0001	0.0003	31.7882
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.3791	3.6690	0.0000	0.0001	0.0001	-24.8651
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.9499	4.2753	0.0000	0.0002	0.0001	-28.7272
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-2.9164	7.2561	-0.0000	-0.0000	0.0001	31.0451
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-2.9164	7.2561	-0.0000	-0.0000	0.0001	31.0451
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.4190	-0.4278	0.0000	0.0001	0.0000	-25.0059
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.9900	0.1783	0.0000	0.0001	0.0000	-28.7932
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-3.8709	7.4089	-0.0000	-0.0000	0.0000	41.2073
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-3.8709	7.4089	-0.0000	-0.0000	0.0000	41.2073
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	3.2435	-2.8369	0.0000	0.0000	-0.0000	-33.3360
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	2.6717	-2.0289	-0.0000	0.0001	0.0000	-38.3474

Worst Case Reactions (LRFD)

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

Result	Value (kip, kip-ft)
Axial	17.0712
Shear X	-6.4768
Shear Z	0.0000
Moment X	0.0003
Moment Y (Twist)	0.0008
Moment Z	70.4745

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	11.3508
Shear X	-3.8800
Shear Z	0.0000
Moment X	0.0002
Moment Y (Twist)	0.0003
Moment Z	41.4454

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	0.0167	3.8216	-0.0578	-0.1787	0.0125	-0.1108
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0273	5.6161	-0.0946	-0.2933	0.0209	-0.2011
ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R)	0.0143	3.2756	-0.0495	-0.1530	0.0106	-0.0962
ULS: 3. 1.2D + 1.6(S or Lr or R) + L	0.0555	10.7652	-0.1948	-0.6071	0.0440	-0.3920
ULS: 5. 1.2D + E + L + 0.2S	0.0195	4.2118	-0.0675	-0.2090	0.0147	-0.1395
ULS: 7. 0.9D + 1.0E	0.0108	2.4567	-0.0371	-0.1146	0.0080	-0.0735
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-5.5807	13.5843	-0.3205	-0.9480	0.6221	61.3882

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	-5.5807	13.5843	-0.3205	-0.9480	0.6221	61.3882
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.7539	-1.1023	0.0893	0.2384	-0.4694	-49.6890
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	3.9905	-0.0046	0.0843	0.2236	-0.4606	-57.9367
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only	-5.5926	11.2430	-0.2743	-0.8043	0.6091	61.0737
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only	-5.5926	11.2430	-0.2743	-0.8043	0.6091	61.0737
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only	4.7402	-3.4420	0.1336	0.3760	-0.4776	-49.2656
ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only	3.9766	-2.3442	0.1287	0.3617	-0.4690	-57.4187
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.7488	14.7496	-0.3079	-0.9351	0.3452	30.5343
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-2.7488	14.7496	-0.3079	-0.9351	0.3452	30.5343
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.4202	7.4048	-0.1012	-0.3361	-0.2051	-25.7191
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	2.0387	7.9534	-0.1039	-0.3441	-0.2004	-29.9749
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only	-2.7884	7.2586	-0.1609	-0.4756	0.3075	30.1636
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only	-2.7884	7.2586	-0.1609	-0.4756	0.3075	30.1636
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only	2.3777	-0.0836	0.0427	0.1135	-0.2351	-24.8935
ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only	1.9960	0.4652	0.0402	0.1062	-0.2307	-28.9939
ULS: 6. 0.9D + 1.0W_Wind downforce Case A only	-5.5959	10.4239	-0.2616	-0.7648	0.6056	60.9532
ULS: 6. 0.9D + 1.0W_Wind downforce Case B only	-5.5959	10.4239	-0.2616	-0.7648	0.6056	60.9532
ULS: 6. 0.9D + 1.0W_Wind uplift Case A only	4.7364	-4.2607	0.1457	0.4136	-0.4797	-49.1340
ULS: 6. 0.9D + 1.0W_Wind uplift Case B only	3.9728	-3.1629	0.1409	0.3994	-0.4711	-57.2543

ASD Load Combination Results

Name	Fx	Fy	Fz	Mx	My	Mz
ULS: 1. D	0.0120	2.7297	-0.0412	-0.1274	0.0089	-0.0812
ULS: 2. D + L	0.0120	2.7297	-0.0412	-0.1274	0.0089	-0.0812
ULS: 3. D + (S or Lr or R)	0.0378	7.4106	-0.1316	-0.4089	0.0294	-0.2840
ULS: 3. D + (S or Lr or R)	0.0120	2.7297	-0.0412	-0.1274	0.0089	-0.0812
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0314	6.2403	-0.1089	-0.3379	0.0242	-0.2375
ULS: 4. D + 0.75L + 0.75(S or Lr or R)	0.0120	2.7297	-0.0412	-0.1274	0.0089	-0.0812
ULS: 5b. D + 0.7E	0.0120	2.7297	-0.0412	-0.1274	0.0089	-0.0812
ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S	0.0314	6.2403	-0.1089	-0.3379	0.0242	-0.2375
ULS: 8. 0.6D + 0.7E	0.0072	1.6378	-0.0247	-0.0763	0.0053	-0.0499
ULS: 5a. D + 0.6W_Wind downforce Case A only	-3.3514	7.5094	-0.1751	-0.5148	0.3653	36.2517
ULS: 5a. D + 0.6W_Wind downforce Case B only	-3.3514	7.5094	-0.1751	-0.5148	0.3653	36.2517
ULS: 5a. D + 0.6W_Wind uplift Case A only	2.8478	-1.3013	0.0691	0.1916	-0.2854	-29.7422
ULS: 5a. D + 0.6W_Wind uplift Case B only	2.3897	-0.6426	0.0662	0.1829	-0.2802	-34.6437
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-2.4916	9.8255	-0.2097	-0.6300	0.2926	27.2011
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-2.4916	9.8255	-0.2097	-0.6300	0.2926	27.2011
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.1589	3.2165	-0.0254	-0.0963	-0.1983	-22.7611
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.8154	3.7104	-0.0277	-0.1031	-0.1943	-26.5080
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only	-2.5104	6.3142	-0.1413	-0.4172	0.2755	27.0820
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only	-2.5104	6.3142	-0.1413	-0.4172	0.2755	27.0820
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only	2.1390	-0.2936	0.0417	0.1124	-0.2122	-22.3847
ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only	1.7954	0.2003	0.0395	0.1059	-0.2084	-26.0672
ULS: 7. 0.6D + 0.6W_Wind downforce Case A only	-3.3560	6.4173	-0.1583	-0.4629	0.3611	36.1712
ULS: 7. 0.6D + 0.6W_Wind downforce Case B only	-3.3560	6.4173	-0.1583	-0.4629	0.3611	36.1712
ULS: 7. 0.6D + 0.6W_Wind uplift Case A only	2.8429	-2.3930	0.0855	0.2421	-0.2884	-29.6229
ULS: 7. 0.6D + 0.6W_Wind uplift Case B only	2.3847	-1.7343	0.0825	0.2335	-0.2833	-34.4979

Worst Case Reactions (LRFD)

Worst Case Reactions (ASD)

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

Result	Value (kip, kip-ft)
Axial	14.7496
Shear X	-5.5959
Shear Z	-0.3205
Moment X	-0.9480
Moment Y (Twist)	0.6221
Moment Z	61.3882

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

Result	Value (kip, kip-ft)
Axial	9.8255
Shear X	-3.3560
Shear Z	-0.2097
Moment X	-0.6300
Moment Y (Twist)	0.3653
Moment Z	36.2517

Project Details

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

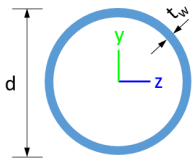
User Name: sales@mtsolar.us
Unit System: imperial

Design Input Information

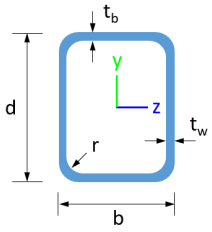
Design Factors			
Φ_t	Φ_c	Φ_b	Φ_v
0.9	0.9	0.9	0.9

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

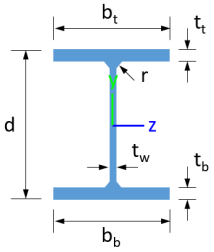
Section Dimensions



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					
9	8in Pipe Sch 40	8.63	0.32					



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
9	8in Pipe Sch 40	8.40	144.98	72.49	72.49	0.00	22.21	22.21
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	9	6.78	6.78	10.44	-	300	200	250
2	6	1.30	1.30	2.00	-	300	200	250
3	17	0.92	0.92	1.42	1.19,1.18,1.19,1.18,1.18,1.19,1.18,1.18,1.17,1.17,1.18,1.18,1.17,1.17,1.18,1.18,1.18,1.19,1.18,1.18,1.16,1.17,1.18,1.18,1.17,1.17,1.19,1.19,1.18,1.19,1.18,1.19,1.19,1.18,1.19,1.18,1.18,1.17,1.17,1.18,1.18,1.20,1.11,1.18,1.18,1.17,1.17,1.18,1.18,1.17,1.17	300	200	250
4	17	2.44	2.44	3.75	1.69,1.68,1.69,1.67,1.68,1.69,1.67,1.67,1.66,1.69,1.67,1.67,1.66,1.51,1.67,1.67,1.68,1.67,1.67,1.67,1.64,1.71,1.67,1.67,1.66,1.63,1.69,1.69,1.67,1.69,1.67,1.69,1.69,1.67,1.69,1.67,1.67,1.66,1.76,1.67,1.67,1.70,1.68,1.67,1.67,1.65,1.71,1.67,1.67,1.66,1.61	300	200	250
5	17	1.52	1.52	2.33	1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.67,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.69,1.60,1.67,1.67,1.65,1.66,1.67,1.67,1.66,1.66	300	200	250
6	17	0.92	0.92	1.42	1.19,1.18,1.19,1.18,1.19,1.19,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.19,1.19,1.18,1.19,1.18,1.19,1.19,1.18,1.19,1.18,1.18,1.18,1.18,1.18,1.18,1.19,1.15,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18	300	200	250
7	17	1.52	1.52	2.33	1.68,1.67,1.68,1.67,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.69,1.63,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66	300	200	250
8	20	1.33	1.33	2.05	2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.08,2.28,2.09,2.09,2.08,1.22,2.09,2.09,2.10,2.10,2.09,2.09,2.08,2.31,2.09,2.09,2.08,1.47,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.09,2.08,1.52,2.09,2.09,2.12,2.11,2.09,2.09,2.08,2.27,2.09,2.09,2.08,1.40	300	200	250
9	3	2.60	2.60	4.00	-	300	200	250
10	17	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.67,1.66,1.70,1.67,1.67,1.66,1.60,1.67,1.67,1.68,1.67,1.67,1.67,1.65,1.71,1.67,1.67,1.66,1.64,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.84,1.67,1.67,1.70,1.68,1.67,1.67,1.65,1.72,1.67,1.67,1.66,1.63	300	200	250
11	20	1.33	1.33	2.05	2.10,2.10,2.10,2.10,2.10,2.10,2.11,2.11,2.12,2.13,2.11,2.11,2.11,2.12,2.10,2.10,2.09,2.01,2.11,2.11,2.12,2.13,2.11,2.11,2.11,2.12,2.10,2.10,2.10,2.10,2.10,2.10,2.10,2.10,2.10,2.11,2.11,2.11,2.13,2.10,2.10,2.03,2.09,2.11,2.11,2.12,2.13,2.11,2.11,2.11,2.12	300	200	250
12	6	1.30	1.30	2.00	-	300	200	250
13	20	4.88	4.00	7.50	1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.09,1.08,1.08,1.08,1.09,1.08,1.08,1.09,1.08,1.08,1.08,1.08,1.09,1.08,1.08,1.08,1.09,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.09,1.08,1.08,1.10,1.94,1.08,1.08,1.08,1.09,1.08,1.08,1.08,1.09	300	200	250
14	20	4.88	4.00	7.50	1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.38,1.08,1.08,1.08,1.14,1.08,1.08,1.09,1.09,1.08,1.08,1.08,1.29,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,3.01,1.08,1.08,1.09,1.10,1.08,1.08,1.08,1.40,1.08,1.08,1.08,1.09	300	200	250
15	20	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	20	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	9	6.78	6.78	10.44	-	300	200	250
102	6	1.30	1.30	2.00	-	300	200	250
103	17	0.92	0.92	1.42	1.19,1.18,1.19,1.18,1.18,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.17,1.18,1.18,1.18,1.18,1.19,1.19,1.18,1.19,1.18,1.19,1.19,1.18,1.19,1.18,1.18,1.17,1.17,1.18,1.18,1.19,1.11,1.18,1.18,1.17,1.17,1.18,1.18,1.18,1.18	300	200	250
104	17	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.67,1.66,1.69,1.67,1.67,1.66,1.60,1.67,1.67,1.68,1.67,1.67,1.67,1.65,1.71,1.67,1.67,1.66,1.64,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.82,1.67,1.67,1.70,1.68,1.67,1.67,1.65,1.71,1.67,1.67,1.66,1.63	300	200	250
105	17	1.	1.	2.	1.68,1.67,1.68,1.67,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.66,1.67,1.67,1.	3	2	2

105	17	52	52	33	66,1.67,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.68,1.59,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66	00	00	50
106	17	0.92	0.92	1.42	1.19,1.18,1.19,1.18,1.18,1.19,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.17,1.18,1.18,1.18,1.18,1.19,1.19,1.18,1.19,1.18,1.19,1.19,1.18,1.19,1.18,1.18,1.17,1.17,1.18,1.18,1.19,1.11,1.18,1.18,1.17,1.17,1.18,1.18,1.18,1.18	300	200	250
107	17	1.52	1.52	2.33	1.68,1.67,1.68,1.67,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.67,1.67,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.68,1.59,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66	300	200	250
108	20	1.33	1.33	2.05	2.28,2.28,2.28,2.28,2.28,2.28,2.30,2.30,2.32,2.10,2.30,2.30,2.31,1.50,2.29,2.29,2.26,2.30,2.29,2.29,2.32,2.11,2.30,2.30,2.30,1.78,2.28,2.28,2.28,2.28,2.28,2.28,2.28,2.28,2.28,2.30,2.30,2.31,1.25,2.29,2.29,2.22,2.32,2.30,2.30,2.32,2.09,2.30,2.30,2.31,1.70	300	200	250
109	3	2.60	2.60	4.00	-	300	200	250
110	17	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.67,1.66,1.69,1.67,1.67,1.66,1.60,1.67,1.67,1.68,1.67,1.67,1.67,1.65,1.71,1.67,1.67,1.66,1.64,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.82,1.67,1.67,1.70,1.68,1.67,1.67,1.65,1.71,1.67,1.67,1.66,1.63	300	200	250
111	20	1.33	1.33	2.05	2.32,2.32,2.32,2.33,2.32,2.32,2.11,2.11,1.75,1.78,2.10,2.10,2.08,2.01,2.15,2.15,2.15,1.66,2.12,2.12,1.71,1.76,2.10,2.10,2.08,2.07,2.32,2.32,2.32,2.32,2.32,2.32,2.32,2.32,2.32,2.11,2.11,1.95,1.91,2.14,2.14,1.47,1.02,2.11,2.11,1.77,1.80,2.10,2.10,2.08,2.04	300	200	250
112	6	1.30	1.30	2.00	-	300	200	250
113	20	4.88	4.00	7.50	1.03,1.03,1.03,1.03,1.03,1.03,1.03,1.03,1.04,1.04,1.03,1.03,1.03,1.04,1.03,1.03,1.02,1.02,1.03,1.03,1.04,1.04,1.03,1.03,1.03,1.04,1.03,1.03,1.03,1.03,1.03,1.03,1.03,1.03,1.03,1.03,1.03,1.04,1.03,1.03,1.02,1.01,1.03,1.03,1.04,1.04,1.03,1.03,1.03,1.04	300	200	250
114	20	4.88	4.00	7.50	1.02,1.03,1.02,1.03,1.03,1.02,1.03,1.03,1.03,1.43,1.03,1.03,1.03,1.01,1.03,1.03,1.02,1.03,1.03,1.03,1.03,1.30,1.03,1.03,1.03,1.01,1.02,1.02,1.03,1.02,1.03,1.02,1.02,1.03,1.02,1.03,1.03,1.03,1.03,1.03,1.03,1.02,1.03,1.03,1.03,1.03,1.47,1.03,1.03,1.03,1.01	300	200	250
115	20	8.42	8.42	12.95	1.16,1.16,1.16,1.16,1.16,1.16,1.14,1.14,1.12,1.12,1.14,1.14,1.13,1.12,1.15,1.15,1.20,1.26,1.14,1.14,1.12,1.12,1.14,1.14,1.13,1.13,1.16,1.16,1.16,1.16,1.16,1.16,1.16,1.16,1.16,1.14,1.14,1.12,1.12,1.15,1.15,1.55,1.16,1.14,1.14,1.12,1.12,1.14,1.14,1.13,1.13	300	200	250
116	20	8.42	8.42	12.95	1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.14,1.17,1.17,1.17,1.36,1.17,1.17,1.18,1.17,1.17,1.17,1.17,1.14,1.17,1.17,1.17,1.24,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.17,1.13,1.17,1.17,1.19,1.17,1.17,1.17,1.17,1.13,1.17,1.17,1.17,1.25	300	200	250
201	9	6.78	6.78	10.44	-	300	200	250
202	6	1.30	1.30	2.00	-	300	200	250
203	17	0.92	0.92	1.42	1.19,1.18,1.19,1.18,1.19,1.19,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18,1.19,1.19,1.18,1.19,1.18,1.19,1.19,1.18,1.19,1.18,1.18,1.18,1.18,1.18,1.18,1.19,1.15,1.18,1.18,1.17,1.18,1.18,1.18,1.18,1.18	300	200	250
204	17	2.44	2.44	3.75	1.68,1.68,1.68,1.67,1.68,1.68,1.67,1.67,1.66,1.70,1.67,1.67,1.66,1.60,1.67,1.67,1.68,1.67,1.67,1.67,1.65,1.71,1.67,1.67,1.66,1.64,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.84,1.67,1.67,1.70,1.68,1.67,1.67,1.65,1.72,1.67,1.67,1.66,1.63	300	200	250
205	17	1.52	1.52	2.33	1.68,1.67,1.68,1.67,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.67,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.69,1.63,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66	300	200	250
206	17	0.92	0.92	1.42	1.19,1.18,1.19,1.18,1.18,1.19,1.18,1.18,1.17,1.17,1.18,1.18,1.17,1.17,1.18,1.18,1.18,1.19,1.18,1.18,1.16,1.17,1.18,1.18,1.17,1.17,1.19,1.19,1.18,1.19,1.18,1.19,1.19,1.18,1.19,1.18,1.18,1.17,1.17,1.18,1.18,1.20,1.11,1.18,1.18,1.17,1.17,1.18,1.18,1.17,1.17	300	200	250
207	17	1.52	1.52	2.33	1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.66,1.66,1.67,1.67,1.67,1.68,1.67,1.67,1.65,1.66,1.67,1.67,1.66,1.66,1.68,1.68,1.67,1.68,1.67,1.68,1.68,1.67,1.68,1.67,1.67,1.66,1.66,1.67,1.67,1.69,1.60,1.67,1.67,1.65,1.66,1.67,1.67,1.66,1.66	300	200	250
208	20	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	3	2.60	2.60	4.00	-	300	200	250
210	17	2.44	2.44	3.75	1.69,1.68,1.69,1.67,1.68,1.69,1.67,1.67,1.66,1.69,1.67,1.67,1.66,1.50,1.67,1.67,1.68,1.67,1.67,1.67,1.64,1.71,1.67,1.67,1.66,1.63,1.69,1.69,1.67,1.69,1.67,1.69,1.69,1.67,1.69,1.67,1.67,1.66,1.76,1.67,1.67,1.70,1.68,1.67,1.67,1.65,1.71,1.67,1.67,1.66,1.61	300	200	250
211	20	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	6	1.30	1.30	2.00	-	300	200	250
213	20	4.88	4.00	7.50	1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.09,1.08,1.08,1.08,1.09,1.08,1.08,1.09,1.08,1.08,1.08,1.07,1.09,1.08,1.08,1.08,1.09,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.09,1.08,1.08,1.10,1.94,1.08,1.08,1.08,1.09,1.08,1.08,1.08,1.09	300	200	250
214	20	4.	4.	7.	1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.38,1.08,1.08,1.08,1.14,1.08,1.08,1.09,1.09,1.08,1.08,1.08,1.29,1.08,1.08,1.	3	2	2

214	20	8.88	0.00	50	08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,1.08,3.04,1.08,1.08,1.09,1.10,1.08,1.08,1.08,1.40,1.08,1.08,1.09	300	200	250
215	20	8.42	8.42	12.95	1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.14,1.14,1.15,1.15,1.14,1.14,1.14,1.15,1.14,1.14,1.14,1.15,1.14,1.14,1.15,1.15,1.14,1.14,1.14,1.15,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.14,1.14,1.15,1.15,1.14,1.14,1.17,1.37,1.14,1.14,1.15,1.15,1.14,1.14,1.15	300	200	250
216	20	8.42	8.42	12.95	1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.17,1.13,1.13,1.13,1.14,1.13,1.13,1.14,1.14,1.13,1.13,1.13,1.17,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.13,1.35,1.13,1.13,1.14,1.14,1.13,1.13,1.13,1.18,1.13,1.13,1.13,1.13	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	377.97	357.33	83.29	83.29	113.39	113.39
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	145.15	20.17	14.14	54.12	28.95
5	151.65	149.10	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
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	32.86	6.46	56.26	44.91
14	159.30	97.43	32.92	6.46	56.26	44.91
15	159.30	34.37	46.90	6.46	56.26	44.91
16	159.30	34.37	46.90	6.46	56.26	44.91
101	377.97	357.33	83.29	83.29	113.39	113.39
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	30.97	6.46	56.26	44.91
114	159.30	97.43	30.87	6.46	56.26	44.91
115	159.30	48.27	14.82	6.46	56.26	44.91
116	159.30	48.27	15.00	6.46	56.26	44.91
201	377.97	357.33	83.29	83.29	113.39	113.39
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	34.37	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

210	151.65	145.15	20.17	14.14	54.12	28.95
211	159.30	34.37	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	32.85	6.46	56.26	44.91
214	159.30	97.43	32.89	6.46	56.26	44.91
215	159.30	48.27	15.06	6.46	56.26	44.91
216	159.30	48.27	14.97	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	0.041	0.737	0.029	0.049	0.003	0.767	#13	0.139	Not Required	Pass
2	0.005	0.386	0.195	0.088	0.036	0.562	#13	0.036	Not Required	Pass
3	0.009	0.616	0.050	0.061	0.008	0.629	#13	0.046	Not Required	Pass
4	0.008	0.599	0.182	0.060	0.039	0.698	#21	0.082	Not Required	Pass
5	0.008	0.382	0.178	0.061	0.047	0.411	#21	0.076	Not Required	Pass
6	0.011	0.705	0.075	0.071	0.009	0.749	#13	0.046	Not Required	Pass
7	0.012	0.437	0.242	0.070	0.063	0.477	#21	0.076	Not Required	Pass
8	0.002	0.062	0.298	0.045	0.025	0.318	#24	0.102	Not Required	Pass
9	0.024	0.063	0.074	0.002	0.003	0.132	#21	0.206	Not Required	Pass
10	0.012	0.670	0.230	0.067	0.049	0.774	#21	0.082	Not Required	Pass
11	0.003	0.061	0.306	0.047	0.025	0.332	#21	0.102	Not Required	Pass
12	0.005	0.470	0.218	0.104	0.039	0.672	#13	0.036	Not Required	Pass
13	0.009	0.254	0.643	0.058	0.030	0.829	#21	0.306	Not Required	Pass
14	0.012	0.246	0.633	0.055	0.030	0.804	#21	0.204	Not Required	Pass
15	0.000	0.085	0.258	0.030	0.016	0.339	#21	Not Required	Not Required	Pass
16	0.000	0.084	0.258	0.029	0.016	0.338	#21	Not Required	Not Required	Pass
101	0.048	0.846	0.000	0.057	0.000	0.868	#13	0.139	Not Required	Pass
102	0.006	0.498	0.240	0.111	0.043	0.715	#13	0.036	Not Required	Pass
103	0.011	0.753	0.057	0.075	0.002	0.784	#13	0.046	Not Required	Pass
104	0.011	0.751	0.234	0.075	0.049	0.869	#21	0.082	Not Required	Pass
105	0.011	0.468	0.244	0.074	0.064	0.515	#21	0.076	Not Required	Pass
106	0.011	0.753	0.057	0.075	0.002	0.784	#13	0.046	Not Required	Pass
107	0.011	0.468	0.244	0.074	0.064	0.515	#21	0.076	Not Required	Pass
108	0.002	0.063	0.305	0.048	0.025	0.367	#21	0.102	Not Required	Pass
109	0.028	0.061	0.056	0.001	0.000	0.123	#21	0.206	Not Required	Pass
110	0.011	0.751	0.234	0.075	0.049	0.869	#21	0.082	Not Required	Pass
111	0.003	0.059	0.312	0.047	0.025	0.361	#21	0.102	Not Required	Pass
112	0.006	0.498	0.240	0.111	0.043	0.715	#13	0.036	Not Required	Pass
113	0.009	0.253	0.650	0.058	0.031	0.882	#21	0.306	Not Required	Pass
114	0.013	0.290	0.642	0.059	0.031	0.897	#21	0.306	Not Required	Pass
115	0.010	0.529	0.345	0.047	0.025	0.838	#21	0.644	Not Required	Pass
116	0.003	0.484	0.343	0.048	0.025	0.804	#21	0.644	Not Required	Pass
201	0.041	0.737	0.029	0.049	0.003	0.767	#13	0.139	Not Required	Pass
202	0.005	0.470	0.218	0.104	0.039	0.672	#13	0.036	Not Required	Pass
203	0.011	0.705	0.075	0.071	0.009	0.749	#13	0.046	Not Required	Pass
204	0.012	0.670	0.230	0.067	0.049	0.774	#21	0.082	Not Required	Pass
205	0.012	0.437	0.242	0.070	0.063	0.477	#21	0.076	Not Required	Pass
206	0.009	0.616	0.050	0.061	0.008	0.629	#13	0.046	Not Required	Pass
207	0.008	0.382	0.178	0.061	0.047	0.411	#21	0.076	Not Required	Pass
208	0.000	0.084	0.258	0.029	0.016	0.338	#21	Not Required	Not Required	Pass

209	0.024	0.063	0.074	0.002	0.003	0.132	#21	0.206	Not Required	Pass
210	0.008	0.599	0.182	0.060	0.039	0.698	#21	0.082	Not Required	Pass
211	0.000	0.085	0.258	0.030	0.016	0.339	#21	Not Required	Not Required	Pass
212	0.005	0.386	0.195	0.088	0.036	0.562	#13	0.036	Not Required	Pass
213	0.009	0.254	0.643	0.058	0.030	0.829	#21	0.204	Not Required	Pass
214	0.012	0.246	0.633	0.055	0.031	0.804	#21	0.306	Not Required	Pass
215	0.010	0.530	0.345	0.047	0.025	0.840	#21	0.644	Not Required	Pass
216	0.003	0.495	0.341	0.045	0.025	0.810	#21	0.644	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

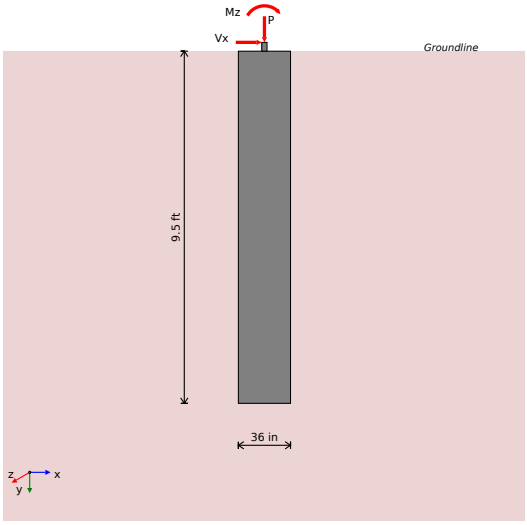
Input	Description	Value
f'_{ck}	Concrete compressive strength	2.5 ksi
f_{yk}	Yield strength of steel	60 ksi
d_b	Rebar diameter	#5 (0.625) in
cover	Concrete cover	3 in

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	9.825 kip	14.75 kip
Vx	-3.356 kip	-5.596 kip
Vz	-0.21 kip	-0.321 kip
Mx	-0.63 kip-ft	-0.948 kip-ft
Mz	36.25 kip-ft	61.39 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

$$H_o = \frac{V_x}{D} = \frac{-3.356}{36} = -1.119\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_z + (V_x \times H)}{D} = \frac{36.25 + (-3.356 \times 0)}{36} = 12.08\ \frac{kip - ft}{ft}$$

$$M_o = \frac{}{D} = \frac{}{36} = 12.05 \frac{}{ft}$$

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:

$$L_{e,x} = 8.525\ ft$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{D} = \frac{-0.21}{36} = -0.07\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_x + (V_z \times H)}{D} = \frac{-0.63 + (-0.21 \times 0)}{36} = -0.21\ \frac{kip - ft}{ft}$$

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:

$$L_{e,z} = -2.258\ ft$$

Minimum embedded depth

Depth of pile required

$$L_{e,req} = MAX[L_{e,x}, L_{e,z}] = MAX[8.525, -2.258] = 8.525\ ft$$

Actual embedded length

$$L_e = L - h_2 - h_e = 9.5 - 0 - 0 = 9.5\ ft$$

Utilisation

$$Ratio = \frac{L_{e,req}}{L_e} = \frac{8.525}{9.5} = 0.897$$

UTILITY: 0.90

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:

$$q = \frac{P}{A} = \frac{9.825}{7.069} = 1390\ psf$$

Utilisation

$$Ratio = \frac{q}{q_a} = \frac{1390}{2000} = 0.695$$

UTILITY: 0.70

Lateral Soil Pressure (ASD)

Allowable lateral pressure $R =$ 150 psf/ft

Length to least lateral dimension ratio:

$$\frac{L}{D} = \frac{9.5}{3} = 3.167$$

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

Considering x-direction:

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 12.08 \times 9.5) + (3 \times 1.119 \times 9.5^2)}{(6 \times 12.08) + (4 \times 1.119 \times 9.5)} = 6.626\ ft$$

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

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

$$p = \frac{1.178 \times [(4 \times 12.08) + (3 \times -1.119 \times 9.5)]^2}{9.5^2 \times [(3 \times 12.08) + (2 \times -1.119 \times 9.5)]} = 0.236\ \frac{kip}{ft^2}$$

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

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{6.626}{2} = 0.497\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of a/2

$$Ratio = \frac{p}{p_a} = \frac{0.236}{0.497} = 0.474$$

UTILITY: 0.47

Earth pressure against the pile at distance L_e:

$$s = \frac{9.425 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{9.425 \times [(2 \times 12.08) + (-1.119 \times 9.5)]}{9.5^2} = 1.414\ \frac{kip}{ft^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 9.5 = 1.425\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of L_e

$$Ratio = \frac{s}{p_s} = \frac{1.414}{1.425} = 0.992$$

UTILITY: 0.99

Considering z-direction:

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 0.21 \times 9.5) + (3 \times 0.07 \times 9.5^2)}{(6 \times 0.21) + (4 \times 0.07 \times 9.5)} = 6.87\ ft$$

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

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

$$p = \frac{1.178 \times [(4 \times -0.21) + (3 \times -0.07 \times 9.5)]^2}{9.5^2 \times [(3 \times -0.21) + (2 \times -0.07 \times 9.5)]} = -0.053\ \frac{kip}{ft^2}$$

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

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{6.87}{2} = 0.515\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of a/2

$$Ratio = \frac{p}{p_a} = \frac{-0.053}{0.515} = -0.104$$

UTILITY: 0.10

Earth pressure against the pile at distance L_e:

$$s = \frac{9.425 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{9.425 \times [(2 \times -0.21) + (-0.07 \times 9.5)]}{9.5^2} = -0.113\ \frac{kip}{ft^2}$$

Allowable lateral soil pressure at a depth of L_e:

$$p_s = R \times L_e = 0.15 \times 9.5 = 1.425\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of L_e

$$Ratio = \frac{s}{p_s} = \frac{-0.113}{1.425} = -0.079$$

UTILITY: 0.08

REFERENCES	CALCULATIONS	RESULTS

Shear force and bending moment (LRFD)

Considering x-direction:

Lateral force per section length

$$H_o = \frac{V_x}{D} = \frac{-5.596}{36} = -1.865\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_z + (V_x \times H)}{D} = \frac{61.39 + (-5.596 \times 0)}{36} = 20.46\ \frac{kip - ft}{ft}$$

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 20.46 \times 9.5) + (3 \times 1.865 \times 9.5^2)}{(6 \times 20.46) + (4 \times 1.865 \times 9.5)} = 6.623\ ft$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{20.46}{-1.865} = 10.97\ ft$$

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

$$V_{max,x} = (-1.865 \times 36) \times [1 - [3 \times \left(\frac{4 \times 10.97}{9.5} + 3\right) \times \left(\frac{6.623}{9.5}\right)^2] + [4 \times \left(\frac{3 \times 10.97}{9.5} + 2\right) \times \left(\frac{6.623}{9.5}\right)^3]]$$

$$V_{max,x} = 15.13\ kip$$

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

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

$$M_{max,x} = (-1.865 \times 36 \times 9.5) \times [\left(\frac{10.97}{9.5} + \frac{6.623}{2 \times 9.5}\right) - [\left(\frac{4 \times 10.97}{9.5} + 3\right) \times \left(\frac{6.623}{2 \times 9.5}\right)^3] + [\left(\frac{3 \times 10.97}{9.5} + 2\right) \times \left(\frac{6.623}{2 \times 9.5}\right)^4]]$$

$$M_{max,x} = 67.05\ kip - ft$$

Considering z-direction:

Lateral force per section length

$$H_o = \frac{V_z}{D} = \frac{-0.321}{36} = -0.107\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_x + (V_z \times H)}{D} = \frac{-0.948 + (-0.321 \times 0)}{36} = -0.316\ \frac{kip - ft}{ft}$$

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 0.316 \times 9.5) + (3 \times 0.107 \times 9.5^2)}{(6 \times 0.316) + (4 \times 0.107 \times 9.5)} = 6.873\ ft$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{-0.316}{-0.107} = 2.957\ ft$$

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

$$V_{max,z} = (-0.107 \times 36) \times [1 - [3 \times \left(\frac{4 \times 2.957}{9.5} + 3\right) \times \left(\frac{6.873}{9.5}\right)^2] + [4 \times \left(\frac{3 \times 2.957}{9.5} + 2\right) \times \left(\frac{6.873}{9.5}\right)^3]]$$

$$V_{max,z} = (-0.107 \times 36) \times [1 - [3 \times \left(\frac{}{9.5} + 3\right) \times \left(\frac{}{9.5}\right)^{}] + [4 \times \left(\frac{}{9.5} + 2\right) \times \left(\frac{}{9.5}\right)^{}]]$$

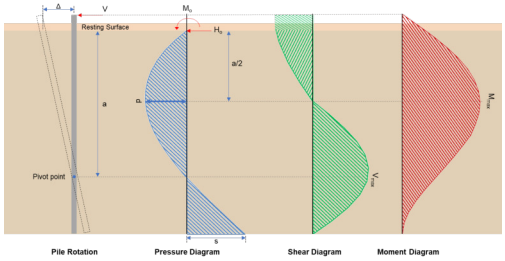
$$V_{max,z} = 0.392\ kip$$

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

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

$$M_{max,z} = (-0.107 \times 36 \times 9.5) \times [\left(\frac{2.957}{9.5} + \frac{6.873}{2 \times 9.5}\right) - [\left(\frac{4 \times 2.957}{9.5} + 3\right) \times \left(\frac{6.873}{2 \times 9.5}\right)^{3}] + [\left(\frac{3 \times 2.957}{9.5} + 2\right) \times \left(\frac{6.873}{2 \times 9.5}\right)^{4}]]$$

$$M_{max,z} = 1.591\ kip - ft$$



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:

$$A_{st,req} = \frac{P - (0.85 \times f'_{ck} \times A_g)}{f_{yk} - (0.85 \times f'_{ck})} = \frac{14.75 - (0.85 \times 2.5 \times 1018)}{60 - (0.85 \times 2.5)} = -37.12\ in^2$$

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

$$Ratio = \frac{P}{\phi P_N} = \frac{14.75}{1254} = 0.012$$

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	$V_{max,x} =$	15.13 kip
Maximum shear in the z-direction	$V_{max,z} =$	0.392 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:

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

$$V_{c,a} = \left(2 \times 1 \times \sqrt{2.5} + MIN[\frac{14.75}{6 \times 1018}, (0.05 \times 2.5)]\right) \times (36 \times 28.8) = 106.2\ kip$$

Governing shear strength of concrete:

$$V_c = MIN[V_{c,max}, V_{c,a}] = MIN[259.2, 106.2] = 106.2\ kip$$

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:

$$\phi V_n = \phi \times (V_c + V_s) = 0.75 \times (106.2 + 38.17) = 108.3\ kip$$

$$V_{max} = MAX[15.13, 0.392] = 15.13\ kip$$

Utilisation

$$Ratio = \frac{V_{max}}{\phi V_n} = \frac{15.13}{108.3} = 0.14$$

UTILITY: 0.14

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	$P =$	14.75 kip
Maximum moment in the x-direction	$M_{max,x} =$	67.05 kip-ft
Maximum moment in the z-direction	$M_{max,z} =$	1.591 kip-ft

Maximum moment in the z-direction $M_{max,z} =$ 1.591 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:

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

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

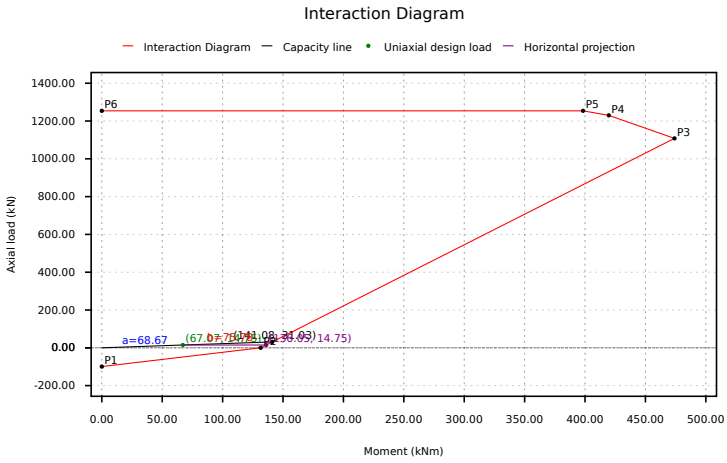
$$f_2 = E_s \times \varepsilon_2 \ (\varepsilon_2 < \varepsilon_{sy}),\ f_2 = \phi_s \times f_y \ (\varepsilon_2 \geq \varepsilon_{sy})$$

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

$$M_f = \sqrt{M_{max,x}^2 + M_{max,z}^2} = \sqrt{67.05^2 + 1.591^2} = 67.07\ kip - ft$$



Segment	Signed Distance
P1 - P2	50.61
P2 - P3	65.9
P3 - P4	817.4
P4 - P5	1071
P5 - P6	1239
Status	PASS: Point lies inside the curve

Utilisation

$$Ratio = \frac{a}{a+b} = \frac{68.67}{68.67 + 75.78} = 0.475$$

UTILITY: 0.48

Biaxial Bending Check

Maximum moment in the x-direction	$M_{max,x} =$ 67.05 kip-ft
Maximum moment in the z-direction	$M_{max,z} =$ 1.591 kip-ft
Nominal uniaxial moment strength about the x-axis	$M_{nox} =$ 136.1 kip-ft
Nominal uniaxial moment strength about the z-axis	$M_{noz} =$ 136.1 kip-ft
Interaction exponent	$\alpha =$ 1

Bresler (1960)

According to Bresler (method B):

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

$$\left(\frac{67.05}{136.1}\right)^{1} + \left(\frac{1.591}{136.1}\right)^{1} = 0.505$$

UTILITY: 0.50

REFERENCES	CALCULATIONS	RESULTS

Results Summary

Result Name	Results
PILE DETAILS	
Length of the pile	9.50 ft
Dimension	36Ø in
Main bar reinforcement	#5-6pcs at 1.5 in min.
Shear reinforcement	#3 at 10 in max.
UTILISATIONS	
Required depth	0.90
End-bearing capacity	0.70
p_a	0.47
p_s	0.99
Axial compression strength	0.01
Shear strength	0.14
Uniaxial bending strength	0.48
Biaxial bending strength	0.50