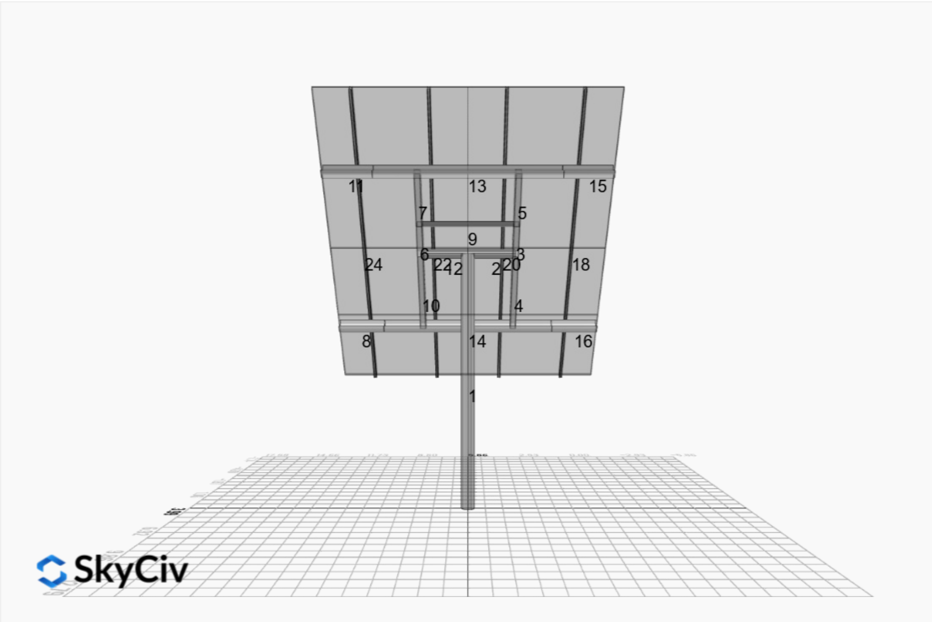
# Project Details

**Project Name:** Cossey MTSOLAR_577HFBAIC227B
**Date:** Mon Oct 13 2025
**Location:** Priest River, ID 83856, USA
**Number of Modules:** 8
**Unique ID:** 1P-0-6TOP-SD-24-L-4Hx2W-717D
**Number of Poles:** 1
**Dealer:** ______________________________
**Date Sold:** ______________________________




| | |
|---|---|
| **Array Dimensions N/S** | 13.92 ft |
| **Array Dimensions E/W** | 11.73 ft |
| **Winter Tilt Angle (Degrees)** | 55 |
| **Front Edge Clearance** | 5 |

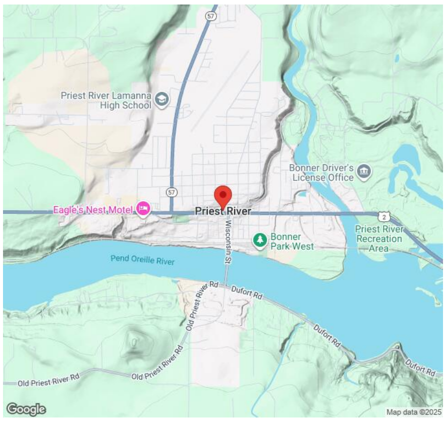
### MT Solar Bill of Materials (1P-0-6TOP-SD-24-L-4Hx2W-717D)

| Part | Short Description | BOM Qty |
|---|---|---|
| MTS-PC-6 | 6IN Pole Cap Assembly | 1 |
| MTS-HF-SD | H-Frame Assembly-SD | 1 |
| MTS-SD-Wing-24 | 24IN SD Wing | 4 |
| MTS-CLAMP-HOOK-4PK | Hook Clamp | 2 |

### Rail Bill of Materials

| Part | Qty |
|---|---|
| Rails (167in Long) | 4x |
| Rail Attachment | 8x |
| Module Mid Clamp | 12x |
| Module End Clamp | 8x |
| Ground Lug | 2x |

## Site Details:




**Site Address:** Priest River, ID 83856, USA

### Array Specifications

| | |
|---|---|
| **Duty Classification:** | SD |
| **Module Width:** | 41.26 in |
| **Module Length:** | 69.37 in |
| **Number of Rows:** | 4 |
| **Number of Columns:** | 2 |
| **Total Number of Modules:** | 8 |
| **Winter Tilt Angle:** | 55 |
| **Front Edge Clearance:** | 5 |
| **Total Array Height at Tilt:** | 16.40 ft |
| **Total Frame Length:** | 11.50 ft |
| **Module Info/Notes:** | F6M 365 E7G-BB |
| **Array Dimensions N/S:** | 13.92 ft |
| **Array Dimensions E/W:** | 11.73 ft |
| **Rail Length:** | 167.04 in |
| **Rail Spacing:** | 2.93 ft |

### Support Specifications

| | |
|---|---|
| **Pole Size:** | 6in Pipe Sch 40 |
| **Pole Length above Grade:** | 10.70 ft |
| **Number of Poles:** | 1 |
| **Pole Spacing:** | 0 |

### Foundation Specifications

| | |
|---|---|
| **Foundation Type:** | rectangular |
| **Foundation Dimensions:** | 48x48 in |
| **Foundation Depth (below grade):** | 5.5 ft |
| **Foundation Volume:** | 88.00 $ft^3$ |

### Site Info

| | |
|---|---|
| **Risk Category:** | I |
| **Exposure:** | C |
| **Soil Classification:** | sand |
| **Site Location:** | Priest River, ID 83856, USA |
| **Wind Speed:** | 97 mph |

| | |
|---|---|
| **Snow Load:** | 16.75 psf |

### Design Disclaimer

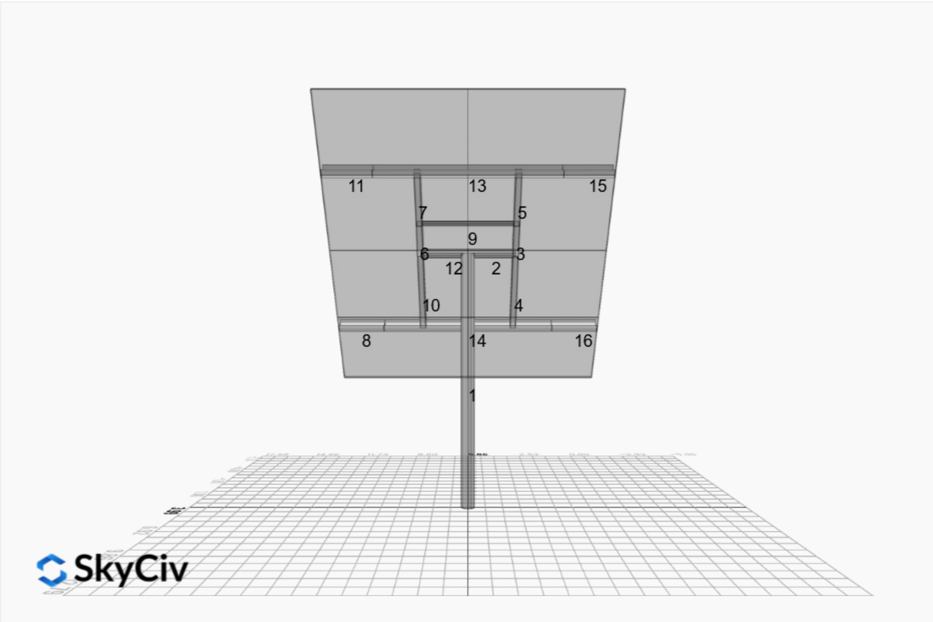
This software should be used for preliminary designs and should not be used as a final design unless reviewed, verified and designed by a qualified structural engineer.

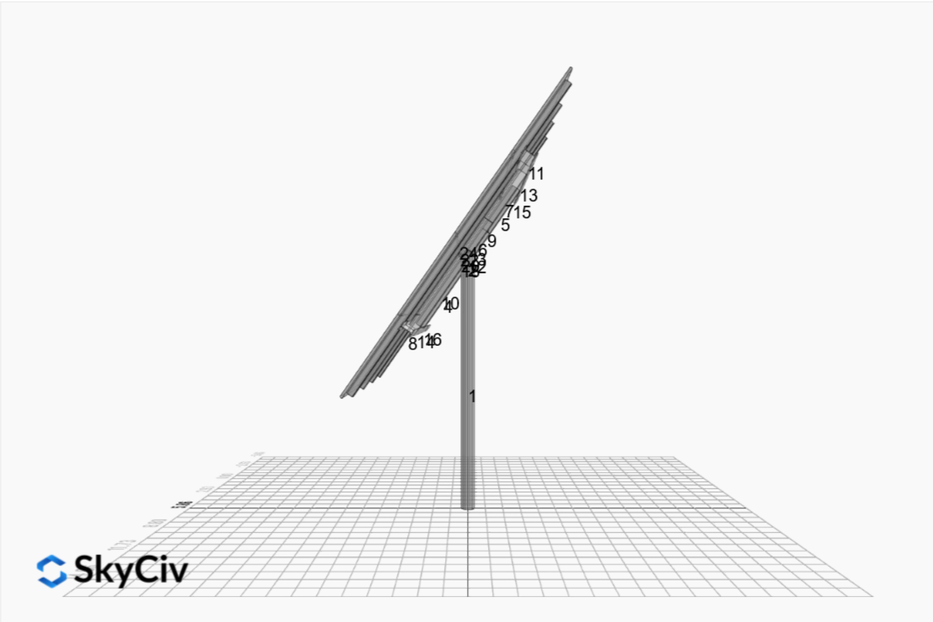
**AutoDesigner Input**

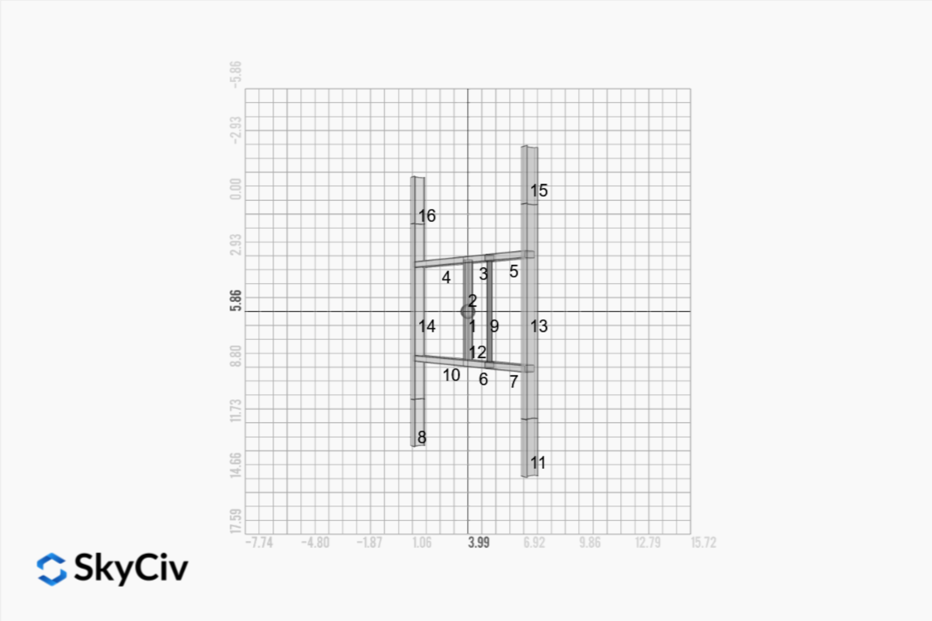
{"wind_speed_override":null,"snow_load_override":null,"direct_snow_load":false,"add_angle_brace":false,"product_type":"Beam","designer_name":"Doug Whitney","designer_email":"doug.beyondthegrid@gmail.com","designer_phone":"2082907957","project_id":"Cossey MTSOLAR_577HFBAIC227B","site_address":"Priest River, ID 83856, USA","module_info":"F6M 365 E7G-BB","module_width":41.26,"module_length":69.37,"number_rows":"4","number_columns":2,"pole_mount_section":"4_40","core_pipe_width":65,"core_pipe_section":"2_40","adjuster_section":"2_40","core_beam_height":65,"core_beam_section":"HSS3x2x1/8","main_pipe_section":"2_12GA","pole_spacing":"15","tilt_angle":55,"ground_clearance":5,"risk_category":"I","exposure_category":"C","frame_duty_override":"auto","pole_override":"auto","soil_type":"sand","customer_foundation_override":"48_Square","foundation_type":"Square","foundation_size":48,"check_rails":false}

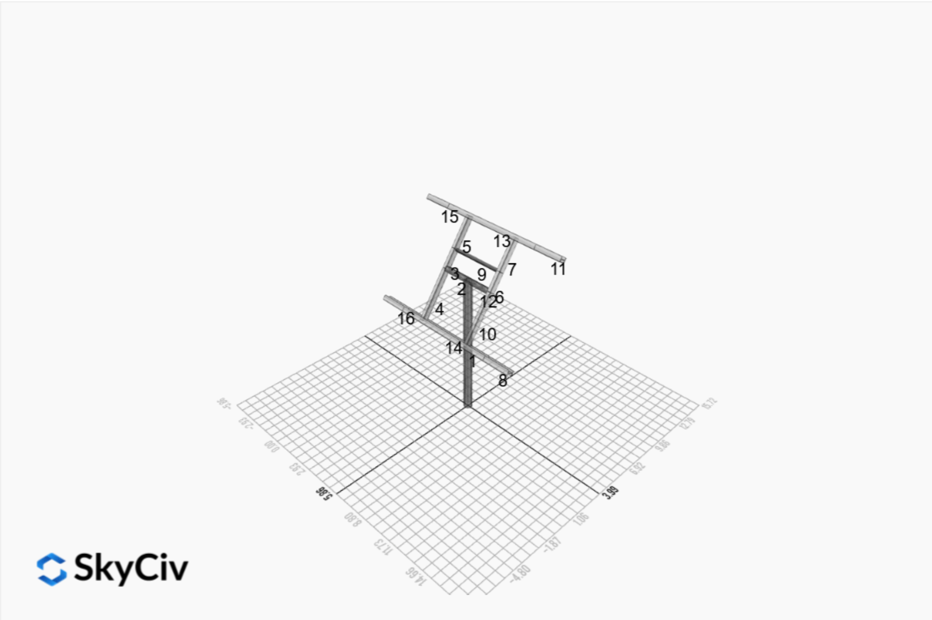
**Design Notes:**

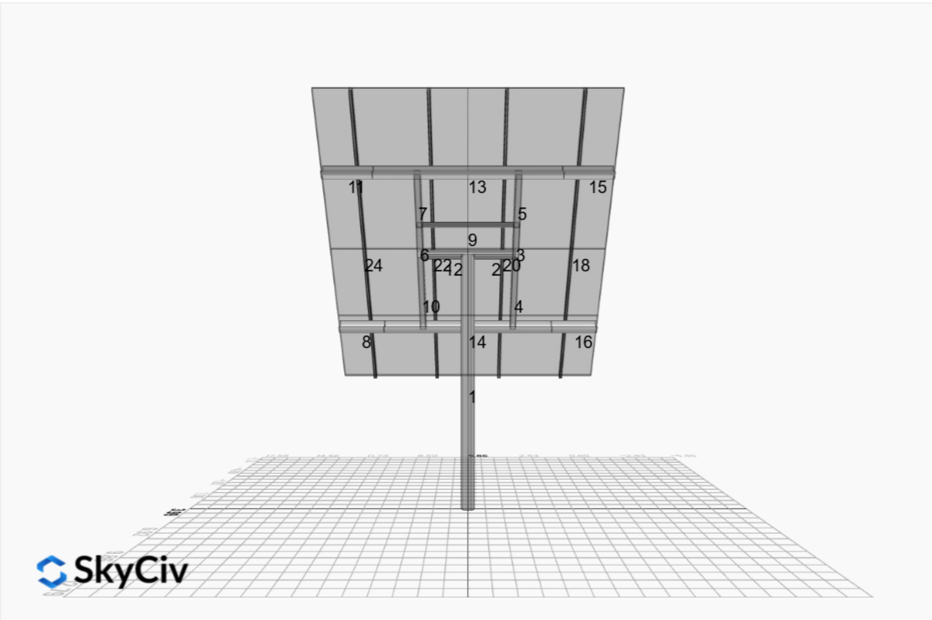
- Deflection checks are set to L/1 due to manufacturer structural design intent
- Foundation Soil Parameters used in this Autodesign are all estimates, proper geotechnical reports are required to confirm soil profiles
- Wind speeds, snow loads and other site specific results are based on ASCE 7-16
-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



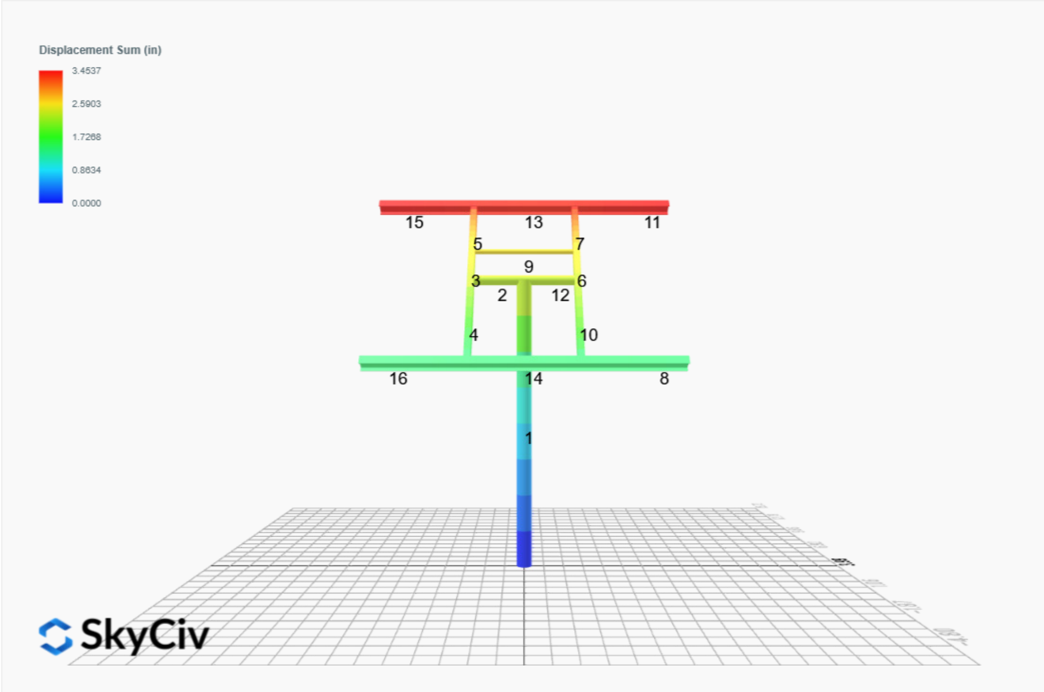



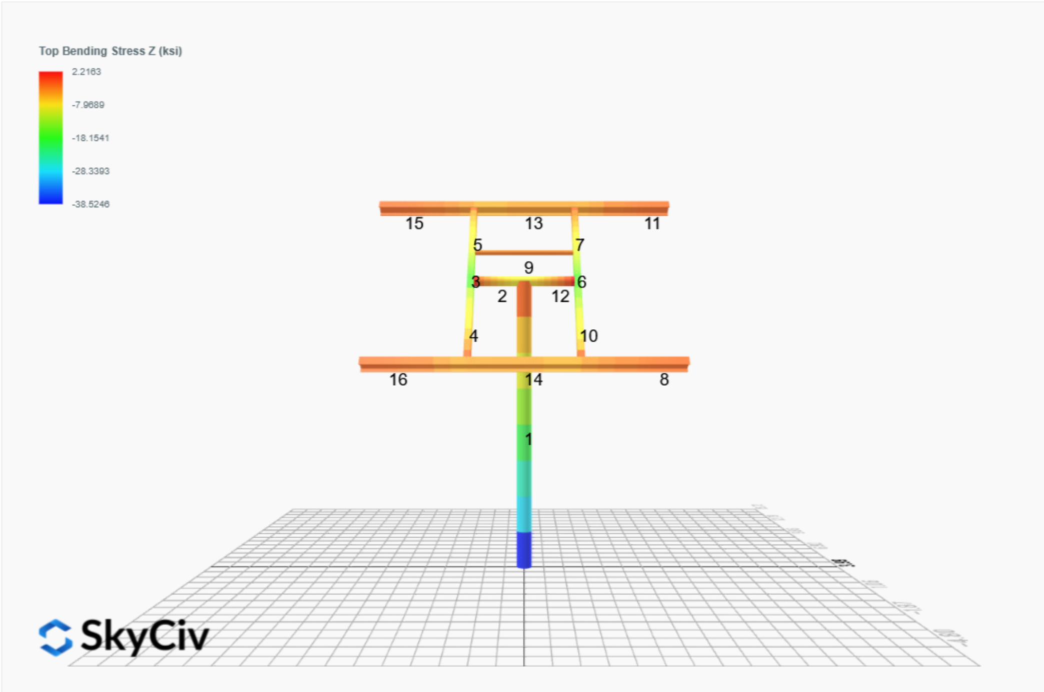

-5.86
-2.93
0.00
2.93
5.86
8.80
11.73
14.66
17.59
-7.74
-4.80
-1.87
1.06
3.99
6.92
9.86
12.79
15.72
15
16
4
3
5
2
14
1
9
13
12
10
6
7
8
11
SkyCiv

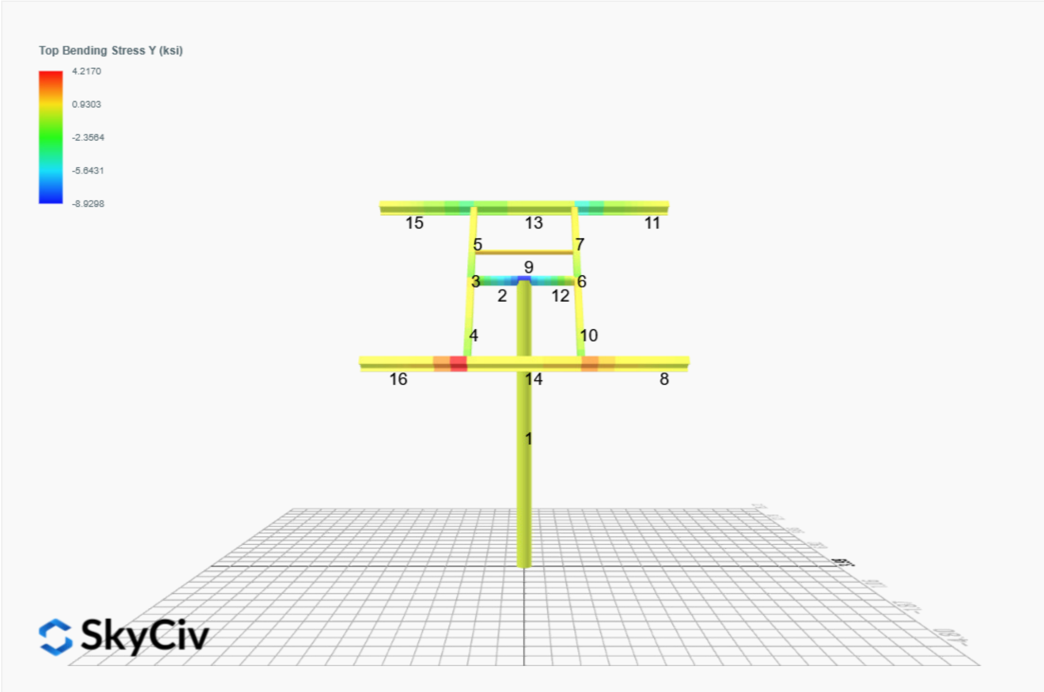

15
5
13
11
3
9
7
2
12
6
16
4
10
14
1
8
SkyCiv

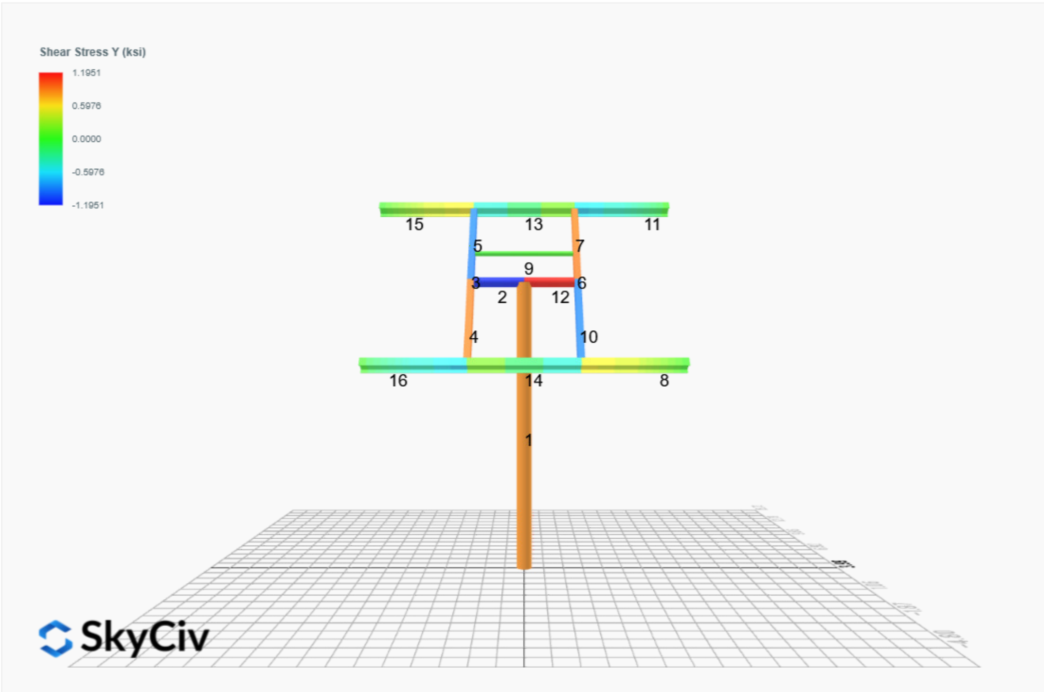

11
13
15
7
5
9
6
3
24
22
12
2
20
18
10
4
8
14
16
1
SkyCiv

## FEM Results (Envelope Worst Case)




Top Bending Stress Y (ksi)
4.2170
0.9303
-2.3564
-5.6431
-8.9298
15
13
11
5
7
9
3
6
2
12
4
10
16
14
8
1
SkyCiv


Shear Stress Y (ksi)
1.1951
0.5976
0.0000
-0.5976
-1.1951
15
13
11
5
7
9
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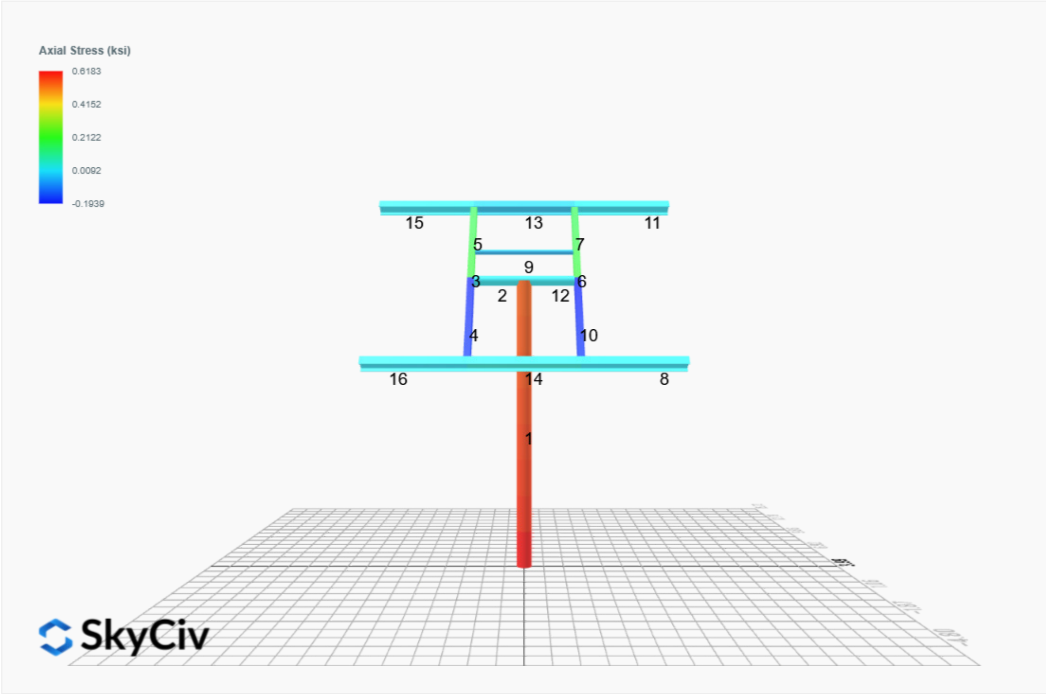
6
2
12
4
10
16
14
8
1
SkyCiv


Axial Stress (ksi)
0.6183
0.4152
0.2122
0.0092
-0.1939
15
13
11
5
7
9
3
6
2
12
4
10
16
14
8
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 | 0.0000 | 1.8468 | 0.0000 | 0.0000 | -0.0000 | 0.0204 |
| ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R) | 0.0000 | 1.7098 | 0.0000 | 0.0000 | -0.0000 | 0.0176 |
| ULS: 2. 1.2D + 1.6L + 0.5(S or Lr or R) | 0.0000 | 1.5830 | 0.0000 | 0.0000 | -0.0000 | 0.0170 |
| ULS: 3. 1.2D + 1.6(S or Lr or R) + L | 0.0000 | 1.9889 | 0.0000 | 0.0000 | -0.0000 | 0.0191 |
| ULS: 5. 1.2D + E + L + 0.2S | 0.0000 | 1.6337 | 0.0000 | 0.0000 | -0.0000 | 0.0172 |
| ULS: 7. 0.9D + 1.0E | 0.0000 | 1.1872 | 0.0000 | 0.0000 | -0.0000 | 0.0122 |
| ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only | -2.4864 | 3.4508 | 0.0000 | 0.0000 | 0.0000 | 27.2746 |
| ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only | 0.0000 | 1.7098 | 0.0000 | 0.0000 | -0.0000 | 0.0176 |
| ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only | 2.4864 | -0.0312 | 0.0000 | -0.0000 | -0.0000 | -26.5972 |
| ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only | 0.0000 | 1.7098 | 0.0000 | 0.0000 | -0.0000 | 0.0176 |
| ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case A only | -2.4864 | 3.3239 | 0.0000 | 0.0000 | 0.0000 | 27.2488 |
| ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind downforce Case B only | 0.0000 | 1.5830 | 0.0000 | 0.0000 | -0.0000 | 0.0170 |
| ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case A only | 2.4864 | -0.1580 | 0.0000 | -0.0000 | -0.0000 | -26.5739 |
| ULS: 4. 1.2D + W + L + 0.5(S or Lr or R)_Wind uplift Case B only | 0.0000 | 1.5830 | 0.0000 | 0.0000 | -0.0000 | 0.0170 |
| ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only | -1.2432 | 2.8593 | 0.0000 | 0.0000 | 0.0000 | 13.5931 |
| ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only | 0.0000 | 1.9889 | 0.0000 | 0.0000 | -0.0000 | 0.0191 |
| ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only | 1.2432 | 1.1184 | 0.0000 | -0.0000 | -0.0000 | -13.3936 |
| ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only | 0.0000 | 1.9889 | 0.0000 | 0.0000 | -0.0000 | 0.0191 |
| ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case A only | -1.2432 | 2.4535 | 0.0000 | 0.0000 | 0.0000 | 13.5511 |
| ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind downforce Case B only | 0.0000 | 1.5830 | 0.0000 | 0.0000 | -0.0000 | 0.0170 |
| ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case A only | 1.2432 | 0.7125 | 0.0000 | -0.0000 | -0.0000 | -13.3568 |
| ULS: 3. 1.2D + 1.6(S or Lr or R) + 0.5W_Wind uplift Case B only | 0.0000 | 1.5830 | 0.0000 | 0.0000 | -0.0000 | 0.0170 |
| ULS: 6. 0.9D + 1.0W_Wind downforce Case A only | -2.4864 | 2.9282 | 0.0000 | 0.0000 | 0.0000 | 27.1662 |
| ULS: 6. 0.9D + 1.0W_Wind downforce Case B only | 0.0000 | 1.1872 | 0.0000 | 0.0000 | -0.0000 | 0.0122 |
| ULS: 6. 0.9D + 1.0W_Wind uplift Case A only | 2.4864 | -0.5537 | 0.0000 | -0.0000 | -0.0000 | -26.5051 |
| ULS: 6. 0.9D + 1.0W_Wind uplift Case B only | 0.0000 | 1.1872 | 0.0000 | 0.0000 | -0.0000 | 0.0122 |

### ASD Load Combination Results

| Name | Fx | Fy | Fz | Mx | My | Mz |
|---|---|---|---|---|---|---|
| ULS: 1. D | 0.0000 | 1.3191 | 0.0000 | 0.0000 | -0.0000 | 0.0138 |
| ULS: 2. D + L | 0.0000 | 1.3191 | 0.0000 | 0.0000 | -0.0000 | 0.0138 |
| ULS: 3. D + (S or Lr or R) | 0.0000 | 1.5728 | 0.0000 | 0.0000 | -0.0000 | 0.0148 |
| ULS: 3. D + (S or Lr or R) | 0.0000 | 1.3191 | 0.0000 | 0.0000 | -0.0000 | 0.0138 |
| ULS: 4. D + 0.75L + 0.75(S or Lr or R) | 0.0000 | 1.5094 | 0.0000 | 0.0000 | -0.0000 | 0.0145 |
| ULS: 4. D + 0.75L + 0.75(S or Lr or R) | 0.0000 | 1.3191 | 0.0000 | 0.0000 | -0.0000 | 0.0138 |
| ULS: 5b. D + 0.7E | 0.0000 | 1.3191 | 0.0000 | 0.0000 | -0.0000 | 0.0138 |
| ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S | 0.0000 | 1.5094 | 0.0000 | 0.0000 | -0.0000 | 0.0145 |
| ULS: 8. 0.6D + 0.7E | 0.0000 | 0.7915 | 0.0000 | 0.0000 | 0.0000 | 0.0078 |
| ULS: 5a. D + 0.6W_Wind downforce Case A only | -1.4918 | 2.3637 | 0.0000 | 0.0000 | 0.0000 | 16.2434 |
| ULS: 5a. D + 0.6W_Wind downforce Case B only | 0.0000 | 1.3191 | 0.0000 | 0.0000 | -0.0000 | 0.0138 |
| ULS: 5a. D + 0.6W_Wind uplift Case A only | 1.4918 | 0.2746 | 0.0000 | -0.0000 | -0.0000 | -15.9861 |
| ULS: 5a. D + 0.6W_Wind uplift Case B only | 0.0000 | 1.3191 | 0.0000 | 0.0000 | -0.0000 | 0.0138 |
| ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only | -1.1189 | 2.2928 | 0.0000 | 0.0000 | 0.0000 | 12.1816 |
| ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only | 0.0000 | 1.5094 | 0.0000 | 0.0000 | -0.0000 | 0.0145 |
| ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only | 1.1189 | 0.7260 | 0.0000 | -0.0000 | -0.0000 | -12.0229 |
| ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only | 0.0000 | 1.5094 | 0.0000 | 0.0000 | -0.0000 | 0.0145 |

| Name | Fx | Fy | Fz | Mx | My | Mz |
|---|---|---|---|---|---|---|
| ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case A only | -1.1189 | 2.1026 | 0.0000 | 0.0000 | 0.0000 | 12.1641 |
| ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind downforce Case B only | 0.0000 | 1.3191 | 0.0000 | 0.0000 | -0.0000 | 0.0138 |
| ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case A only | 1.1189 | 0.5357 | 0.0000 | -0.0000 | -0.0000 | -12.0074 |
| ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R)_Wind uplift Case B only | 0.0000 | 1.3191 | 0.0000 | 0.0000 | -0.0000 | 0.0138 |
| ULS: 7. 0.6D + 0.6W_Wind downforce Case A only | -1.4918 | 1.8361 | 0.0000 | 0.0000 | 0.0000 | 16.1762 |
| ULS: 7. 0.6D + 0.6W_Wind downforce Case B only | 0.0000 | 0.7915 | 0.0000 | 0.0000 | 0.0000 | 0.0078 |
| ULS: 7. 0.6D + 0.6W_Wind uplift Case A only | 1.4918 | -0.2531 | 0.0000 | -0.0000 | -0.0000 | -15.9330 |
| ULS: 7. 0.6D + 0.6W_Wind uplift Case B only | 0.0000 | 0.7915 | 0.0000 | 0.0000 | 0.0000 | 0.0078 |

### Worst Case Reactions (LRFD)

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

| Result | Value (kip, kip-ft) |
|---|---|
| Axial | 3.4508 |
| Shear X | -2.4864 |
| Shear Z | 0.0000 |
| Moment X | 0.0000 |
| Moment Y (Twist) | 0.0000 |
| Moment Z | 27.2746 |

### Worst Case Reactions (ASD)

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

| Result | Value (kip, kip-ft) |
|---|---|
| Axial | 2.3637 |
| Shear X | -1.4918 |
| Shear Z | 0.0000 |
| Moment X | 0.0000 |
| Moment Y (Twist) | 0.0000 |
| Moment Z | 16.2434 |

## Project Details

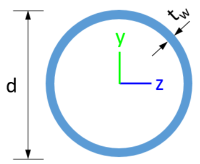
| | |
|---|---|
| Design Code: | AISC 360-16 LRFD |
| Provision: | LRFD |
| Country: | United States |
| User Name: | sales@mtsolar.us |
| Unit System: | imperial |

## Design Input Information

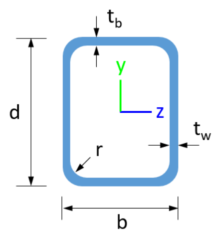
| Design Factors | | | |
|---|---|---|---|
| $\Phi_t$ | $\Phi_c$ | $\Phi_b$ | $\Phi_v$ |
| 0.9 | 0.9 | 0.9 | 0.9 |

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

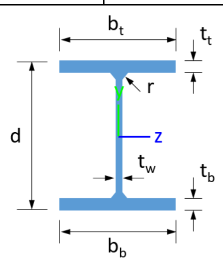
**Section Dimensions**




| ID | Name | d (in) | $t_w$ (in) | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 2in Pipe Sch 40 | 2.38 | 0.15 | | | | | |
| 4 | 4in Pipe Sch 40 | 4.50 | 0.24 | | | | | |
| 7 | 6in Pipe Sch 40 | 6.63 | 0.28 | | | | | |




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




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

| Section Properties | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ID | Name | A ($in^2$) | J ($in^4$) | $I_{yp}$ ($in^4$) | $I_{zp}$ ($in^4$) | $I_w$ ($in^6$) | $S_{yp}$ ($in^3$) | $S_{zp}$ ($in^3$) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 2in Pipe Sch 40 | 1.07 | 1.33 | 0.67 | 0.67 | 0.00 | 0.76 | 0.76 |
| 4 | 4in Pipe Sch 40 | 3.17 | 14.47 | 7.23 | 7.23 | 0.00 | 4.31 | 4.31 |
| 7 | 6in Pipe Sch 40 | 5.58 | 56.28 | 28.14 | 28.14 | 0.00 | 11.28 | 11.28 |
| 15 | HSS5x3x1/8 | 1.77 | 6.02 | 2.75 | 6.03 | 0.51 | 2.07 | 2.93 |
| 18 | W6x9 | 2.68 | 0.04 | 2.20 | 16.40 | 17.70 | 1.72 | 6.23 |

| **Member Properties** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Member ID | Section ID | $K_z$ L (ft) | $K_y$ L (ft) | $L_b$ (ft) | $C_b$ | LST | LSC | LD |
| 1 | 7 | 6.96 | 6.96 | 10.70 | - | 300 | 200 | 250 |
| 2 | 4 | 1.30 | 1.30 | 2.00 | - | 300 | 200 | 250 |
| 3 | 15 | 0.92 | 0.92 | 1.42 | 1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.18,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.18,1.19 | 300 | 200 | 250 |
| 4 | 15 | 2.44 | 2.44 | 3.75 | 1.69,1.69,1.69,1.68,1.69,1.69,1.67,1.69,1.66,1.69,1.67,1.69,1.66,1.69,1.67,1.68,1.64,1.68,1.67,1.69,1.65,1.69,1.67,1.69,1.66,1.69,1.69,1.69,1.68,1.69,1.68,1.69,1.69,1.68,1.69,1.67,1.69,1.66,1.69,1.67,1.68,1.65,1.68,1.67,1.69,1.65,1.69,1.67,1.69,1.66,1.69 | 300 | 200 | 250 |
| 5 | 15 | 1.52 | 1.52 | 2.33 | 1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.65,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68 | 300 | 200 | 250 |
| 6 | 15 | 0.92 | 0.92 | 1.42 | 1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.18,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.17,1.19,1.18,1.19,1.18,1.19 | 300 | 200 | 250 |
| 7 | 15 | 1.52 | 1.52 | 2.33 | 1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.65,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68,1.67,1.68,1.66,1.68 | 300 | 200 | 250 |
| 8 | 18 | 4.20 | 4.20 | 2.00 | 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 |
| 9 | 1 | 2.60 | 2.60 | 4.00 | - | 300 | 200 | 250 |
| 10 | 15 | 2.44 | 2.44 | 3.75 | 1.69,1.69,1.69,1.68,1.69,1.69,1.67,1.69,1.66,1.69,1.67,1.69,1.66,1.69,1.67,1.68,1.64,1.68,1.67,1.69,1.65,1.69,1.67,1.69,1.66,1.69,1.69,1.69,1.68,1.69,1.68,1.69,1.69,1.68,1.69,1.67,1.69,1.66,1.69,1.67,1.68,1.65,1.68,1.67,1.69,1.65,1.69,1.67,1.69,1.66,1.69 | 300 | 200 | 250 |
| 11 | 18 | 4.20 | 4.20 | 2.00 | 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 |
| 12 | 4 | 1.30 | 1.30 | 2.00 | - | 300 | 200 | 250 |
| 13 | 18 | 4.88 | 4.00 | 7.50 | 1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09 | 300 | 200 | 250 |
| 14 | 18 | 4.88 | 4.00 | 7.50 | 1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09,1.09 | 300 | 200 | 250 |
| 15 | 18 | 4.20 | 4.20 | 2.00 | 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 |
| 16 | 18 | 4.20 | 4.20 | 2.00 | 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 |

## 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 | 227.03 | 42.30 | 42.30 | 75.35 | 75.35 |
| 2 | 142.83 | 141.72 | 16.17 | 16.17 | 42.85 | 42.85 |
| 3 | 79.65 | 74.89 | 10.99 | 6.26 | 29.14 | 16.61 |
| 4 | 79.65 | 72.84 | 10.99 | 6.26 | 29.14 | 16.61 |
| 5 | 79.65 | 74.20 | 10.99 | 6.26 | 29.14 | 16.61 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | 79.65 | 74.30 | 10.99 | 6.26 | 29.14 | 16.61 |
| 6 | 79.65 | 74.89 | 10.99 | 6.26 | 29.14 | 16.61 |
| 7 | 79.65 | 74.30 | 10.99 | 6.26 | 29.14 | 16.61 |
| 8 | 120.60 | 96.18 | 23.36 | 6.45 | 30.09 | 45.74 |
| 9 | 48.35 | 43.11 | 2.85 | 2.85 | 14.51 | 14.51 |
| 10 | 79.65 | 72.84 | 10.99 | 6.26 | 29.14 | 16.61 |
| 11 | 120.60 | 96.18 | 23.36 | 6.45 | 30.09 | 45.74 |
| 12 | 142.83 | 141.72 | 16.17 | 16.17 | 42.85 | 42.85 |
| 13 | 120.60 | 84.03 | 19.16 | 6.45 | 30.09 | 45.74 |
| 14 | 120.60 | 84.03 | 19.11 | 6.45 | 30.09 | 45.74 |
| 15 | 120.60 | 96.18 | 23.36 | 6.45 | 30.09 | 45.74 |
| 16 | 120.60 | 96.18 | 23.36 | 6.45 | 30.09 | 45.74 |

## Design Ratio

| Member ID | P | $M_z$ | $M_y$ | $V_y$ | $V_z$ | $(P,M_z,M_y)$ | Worst LC | KL/r | δ | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.015 | 0.645 | 0.000 | 0.033 | 0.000 | 0.652 | #13 | 0.186 | Not Required | Pass |
| 2 | 0.000 | 0.160 | 0.148 | 0.037 | 0.029 | 0.308 | #13 | 0.052 | Not Required | Pass |
| 3 | 0.005 | 0.328 | 0.045 | 0.033 | 0.011 | 0.368 | #13 | 0.044 | Not Required | Pass |
| 4 | 0.004 | 0.327 | 0.040 | 0.033 | 0.008 | 0.360 | #13 | 0.078 | Not Required | Pass |
| 5 | 0.005 | 0.203 | 0.039 | 0.033 | 0.007 | 0.208 | #13 | 0.073 | Not Required | Pass |
| 6 | 0.005 | 0.328 | 0.045 | 0.033 | 0.011 | 0.368 | #13 | 0.044 | Not Required | Pass |
| 7 | 0.005 | 0.203 | 0.039 | 0.033 | 0.007 | 0.208 | #13 | 0.073 | Not Required | Pass |
| 8 | 0.000 | 0.014 | 0.017 | 0.011 | 0.002 | 0.028 | #13 | Not Required | Not Required | Pass |
| 9 | 0.001 | 0.018 | 0.028 | 0.001 | 0.000 | 0.047 | #13 | 0.132 | Not Required | Pass |
| 10 | 0.004 | 0.327 | 0.040 | 0.033 | 0.008 | 0.360 | #13 | 0.078 | Not Required | Pass |
| 11 | 0.000 | 0.014 | 0.017 | 0.011 | 0.002 | 0.028 | #13 | Not Required | Not Required | Pass |
| 12 | 0.000 | 0.160 | 0.148 | 0.037 | 0.029 | 0.308 | #13 | 0.052 | Not Required | Pass |
| 13 | 0.001 | 0.068 | 0.061 | 0.020 | 0.005 | 0.110 | #13 | 0.177 | Not Required | Pass |
| 14 | 0.002 | 0.070 | 0.061 | 0.020 | 0.005 | 0.110 | #13 | 0.177 | Not Required | Pass |
| 15 | 0.000 | 0.014 | 0.017 | 0.011 | 0.002 | 0.028 | #13 | Not Required | Not Required | Pass |
| 16 | 0.000 | 0.014 | 0.017 | 0.011 | 0.002 | 0.028 | #13 | Not Required | Not Required | Pass |

## Definitions

| | |
|---|---|
| $\Phi_t$ | Safety factor for tensile |
| $\Phi_c$ | Safety factor for compression |
| $\Phi_b$ | Safety factor for flexure |
| $\Phi_v$ | Safety factor for shear |
| E | Modulus of elasticity |
| $F_y$ | Specified minimum yield stress |
| $F_u$ | Specified minimum tensile strength |
| A | Cross-sectional area |
| J | Torsional constant |
| $I_{yp}$ | Moment of inertia about the Y axes |
| $I_{zp}$ | Moment of inertia about the Z axes |
| $I_w$ | Warping constant |
| $S_{yp}$ | Plastic section modulus about the Y axis |
| $S_{zp}$ | Plastic section modulus about the Z axis |
| KL | Effective length |
| $C_b$ | Buckling modification factor (from all load combinations) |
| $L_b$ | Length between braced points |
| LST | Limited slenderness for tension |
| LSC | Limited slenderness for compression |
| LD | Limited deflection |
| $P_n$ | Nominal axial strength (tension/comression) |
| $M_n$ | Nominal flexural strength (about Z/Y axis) |

| | |
|---|---|
| $V_n$ | Nominal shear strength (along Z/Y axis) |
| P | Design ratio in case of axial force |
| $M_z$ | Design ratio in case of bending about Z axis |
| $M_y$ | Design ratio in case of bending about Y axis |
| $V_y$ | Design ratio in case of shear along Y axis |
| $V_z$ | Design ratio in case of shear along Z axis |
| $(P,M_z,M_y)$ | Design ratio in case of axial force and bending action |
| KL/r | Design ratio in case of section slenderness |
| δ | Design ratio in case of member deflection |
| OK | Capacity is provided |
| NG | Capacity is not provided |

# IBC 2018 Pile Design

Powered by SkyCiv

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

## Cross-section

| Input | Description | Value |
|---|---|---|
| Shape | Cross-sectional shape | Square |
| b | Section width | 48 in |
| D | Section deph | 48 in |

## Material Properties

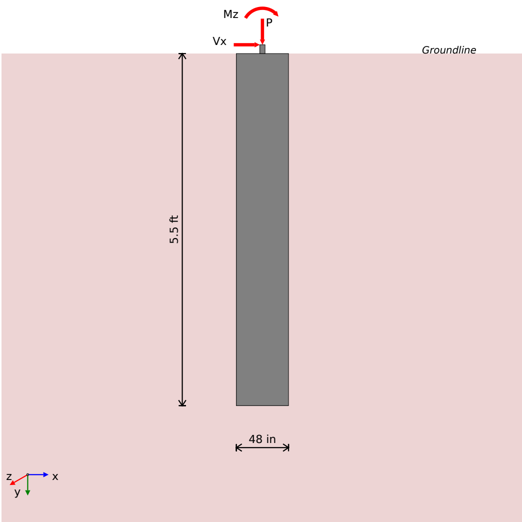
| Input | Description | Value |
|---|---|---|
| $f'_{ck}$ | Concrete compressive strength | 2.5 ksi |
| $f_{yk}$ | Yield strength of steel | 60 ksi |
| $d_b$ | Rebar diameter | #5 (0.625) in |
| cover | Concrete cover | 3 in |

## Soil Parameters (IBC 1806)

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

## Loading

| Load | ASD | LRFD |
|---|---|---|
| P | 2.364 kip | 3.451 kip |
| Vx | -1.492 kip | -2.486 kip |
| Vz | 0 kip | 0 kip |
| Mx | 0 kip-ft | 0 kip-ft |
| Mz | 16.24 kip-ft | 27.27 kip-ft |




REFERENCES CALCULATIONS RESULTS

## Required depth to resist lateral loads (ASD)

Allowable lateral pressure $R =$ 150 psf/ft

Point of application of lateral load:

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

**Considering x-direction:**

Lateral force per section length

$$H_o = \frac{V_x}{1.57 \times D} = \frac{-1.492}{1.57 \times 48} = -0.238\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_z + (V_x \times H)}{1.57 \times D} = \frac{16.24 + (-1.492 \times 0)}{1.57 \times 48} = 2.587\ \frac{kip - ft}{ft}$$

Required depth of embedment in earth:

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

Solving the cubic equation:

$$L_{e,x} = 5.117\ ft$$

**Considering z-direction:**

Since there are no loads applied in this direction, the required effective length: $L_{e,z}$ = 0 ft.

**Minimum embedded depth**

Depth of pile required

$$L_{e,req} = MAX[L_{e,x}, L_{e,z}] = MAX[5.117, 0] = 5.117\ ft$$

Actual embedded length

$$L_e = L - h_2 - h_e = 5.5 - 0 - 0 = 5.5\ ft$$

Utilisation

$$Ratio = \frac{L_{e,req}}{L_e} = \frac{5.117}{5.5} = 0.93$$

UTILITY: 0.93

| REFERENCES | CALCULATIONS | RESULTS |
|---|---|---|

## End-bearing Capacity (ASD)

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

Cross-sectional area:

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

End-bearing pressure:

$$q = \frac{P}{A} = \frac{2.364}{16} = 147.7\ psf$$

Utilisation

$$Ratio = \frac{q}{q_a} = \frac{147.7}{2000} = 0.074$$

UTILITY: 0.07

## Lateral Soil Pressure (ASD)

| | | |
|---|---|---|
| Allowable lateral pressure | $R =$ | 150 psf/ft |

Length to least lateral dimension ratio:

$$\frac{L}{MIN[b, D]} = \frac{5.5}{MIN[4, 4]} = 1.375$$

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

**Considering x-direction:**

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 2.587 \times 5.5) + (3 \times 0.238 \times 5.5^2)}{(6 \times 2.587) + (4 \times 0.238 \times 5.5)} = 3.782\ ft$$

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

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

$$p = \frac{0.75 \times [(4 \times 2.587) + (3 \times -0.238 \times 5.5)]^2}{5.5^2 \times [(3 \times 2.587) + (2 \times -0.238 \times 5.5)]} = 0.199\ \frac{kip}{ft^2}$$

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

$$p_a = R \times \frac{a}{2} = 0.15 \times \frac{3.782}{2} = 0.284\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of a/2

$$Ratio = \frac{p}{p_a} = \frac{0.199}{0.284} = 0.701$$

**UTILITY: 0.70**

Earth pressure against the pile at distance $L_e$:

$$s = \frac{6 \times [(2 \times M_o) + (H_o \times L_e)]}{L_e^2} = \frac{6 \times [(2 \times 2.587) + (-0.238 \times 5.5)]}{5.5^2} = 0.767\ \frac{kip}{ft^2}$$

Allowable lateral soil pressure at a depth of $L_e$:

$$p_s = R \times L_e = 0.15 \times 5.5 = 0.825\ \frac{kip}{ft^2}$$

Utilisation - pressure at a depth of $L_e$

$$Ratio = \frac{s}{p_s} = \frac{0.767}{0.825} = 0.93$$

**UTILITY: 0.93**

**Considering z-direction:**

Since no loads are applied in this direction, lateral soil pressure check is not required.

| REFERENCES | CALCULATIONS | RESULTS |
|---|---|---|

## Shear force and bending moment (LRFD)

**Considering x-direction:**

Lateral force per section length

$$H_o = \frac{V_x}{1.57 \times D} = \frac{-2.486}{1.57 \times 48} = -0.396\ \frac{kip}{ft}$$

Moment per section length

$$M_o = \frac{M_z + (V_x \times H)}{1.57 \times D} = \frac{27.27 + (-2.486 \times 0)}{1.57 \times 48} = 4.343\ \frac{kip-ft}{ft}$$

Distance from resting surface to pivot point:

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

$$a = \frac{(4 \times 4.343 \times 5.5) + \left(3 \times 0.396 \times 5.5^2\right)}{(6 \times 4.343) + (4 \times 0.396 \times 5.5)} = 3.781\ ft$$

Max shear force located at depth a:

$$E = \frac{M_o}{H_o} = \frac{4.343}{-0.396} = 10.97\ ft$$

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

$$V_{max,x} = (-0.396 \times 48) \times [1 - [3 \times \left(\frac{4 \times 10.97}{5.5} + 3\right) \times \left(\frac{3.781}{5.5}\right)^2] + [4 \times \left(\frac{3 \times 10.97}{5.5} + 2\right) \times \left(\frac{3.781}{5.5}\right)^3]]$$

$$V_{max,x} = 6.635\ kip$$

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

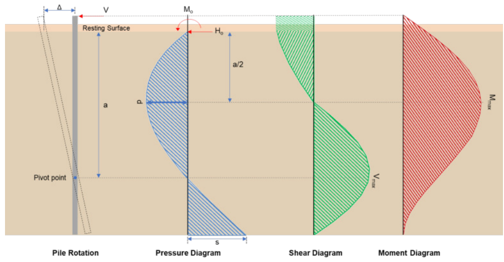
$$M_{max,x} = (H_o \times D \times L_e) \times [\left(\frac{E}{L_e} + \frac{a}{2 \times L_e}\right) - [\left(\frac{4 \times E}{L_e} + 3\right) \times \left(\frac{a}{2 \times L_e}\right)^3] + [\left(\frac{3 \times E}{L_e} + 2\right) \times \left(\frac{a}{2 \times L_e}\right)^4]]$$

$$M_{max,x} = (-0.396 \times 48 \times 5.5) \times [\left(\frac{10.97}{5.5} + \frac{3.781}{2 \times 5.5}\right) - [\left(\frac{4 \times 10.97}{5.5} + 3\right) \times \left(\frac{3.781}{2 \times 5.5}\right)^3] + [\left(\frac{3 \times 10.97}{5.5} + 2\right) \times \left(\frac{3.781}{2 \times 5.5}\right)^4]]$$

$$M_{max,x} = 17.45\ kip-ft$$

**Considering z-direction:**

There are no loads applied in this direction.




## Minimum Reinforcement Check (LRFD)

Gross area of concrete:

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

**Main Reinforcement**

22.4.2.2 Required reinforcement:

$$A_{st,req} = \frac{P - (0.85 \times f'_{ck} \times A_g)}{f_{yk} - (0.85 \times f'_{ck})} = \frac{3.451 - (0.85 \times 2.5 \times 2304)}{60 - (0.85 \times 2.5)} = -84.54\, in^2$$

10.6.1.1 Maximum reinforcement:

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

7.6.1.1 Minimum reinforcement:

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

Governing minimum reinforcement area:

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

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

Minimum number of reinforcements:

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

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

25.2.3 Minimum spacing:

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

$$\text{Use: } n = 16 \text{pcs at } 1.5 \text{ in minimum spacing}$$

Total reinforcement area:

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

**Shear Reinforcement**

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

Maximum spacing of shear Reinforcements:

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

| Detailing Summary | |
|---|---|
| Main reinforcement | #5 (0.625 in) - 16pcs at 1.5 in min. spacing |
| Shear reinforcement | #3 (0.375 in) at 10 in max. spacing |

## Axial Compression Strength (LRFD)

22.4.2.2 Allowable axial compressive strength:

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

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

Utilisation

$$Ratio = \frac{P}{\phi P_N} = \frac{3.451}{2694} = 0.001$$

$\phi P_N$ 2694

UTILITY: 0.00

## Shear Strength LRFD)

| | | |
|---|---|---|
| Effective shear width | $b_w =$ | 48 in |
| Effective shear depth | $d =$ | 44.31 in |
| Shear reinforcement area | $A_v =$ | 0.221 in$^2$ |
| Shear reinforcement spacing | $s =$ | 10 in |
| Concrete type factor (Normal concrete) | $\lambda =$ | 1 |
| Strength reduction factor for shear | $\phi =$ | 0.75 |
| Maximum shear in the x-direction | $V_{max,x} =$ | 6.635 kip |
| Maximum shear in the z-direction | $V_{max,z} =$ | 0 kip |

*22.5.5.1.1* Max shear strength of concrete:

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

*Table 22.5.5.1* Shear strength of concrete:

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

$$V_{c,a} = \left(2 \times 1 \times \sqrt{2.5} + MIN[\frac{3.451}{6 \times 2304}, (0.05 \times 2.5)]\right) \times (48 \times 44.31) = 213.2\,kip$$

Governing shear strength of concrete:

$$V_c = MIN[V_{c,max}, V_{c,a}] = MIN[531.8, 213.2] = 213.2\,kip$$

*22.5.1.2* Shear strength of steel (a):

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

*22.5.8.5.3* Shear strength of steel (b):

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

Governing shear strength of steel:

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

*22.5.1.1* Allowable shear strength:

$$\phi V_n = \phi \times (V_c + V_s) = 0.75 \times (213.2 + 58.73) = 204\,kip$$

$$V_{max} = MAX[6.635, 0] = 6.635\,kip$$

Utilisation

$$Ratio = \frac{V_{max}}{\phi V_n} = \frac{6.635}{204} = 0.033$$

UTILITY: 0.03

## Flexural Strength (LRFD)

| | | |
|---|---|---|
| Concrete type factor (Normal concrete) | $\lambda =$ | 1 |
| Strength reduction factor for flexure | $\phi =$ | 0.65 |
| Modulus of steel reinforcement | $E_s =$ | 200e3 ksi |
| Maximum concrete strain | $\varepsilon_c =$ | 0.0030 |
| Yield strain of steel $f_y/E_s$ | $\varepsilon_y =$ | 0.0003 |
| Section width | $b =$ | 48 in |
| Distance to the compression rebar | $d_s =$ | 3.688 in |
| Distance to the tension rebar | $d =$ | 44.31 in |
| Total bar area | $A_s =$ | 4.909 in$^2$ |
| Maximum applied axial load | $P =$ | 3.451 kip |
| Maximum moment in the x-direction | $M_{max,x} =$ | 17.45 kip-ft |
| Maximum moment in the z-direction | $M_{max,z} =$ | 0 kip-ft |

Compressive force due to concrete:

$$\beta_1 = 0.85$$

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

Compressive force due to bars in compression:

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

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

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

Tensile force due to bars in tension:

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

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

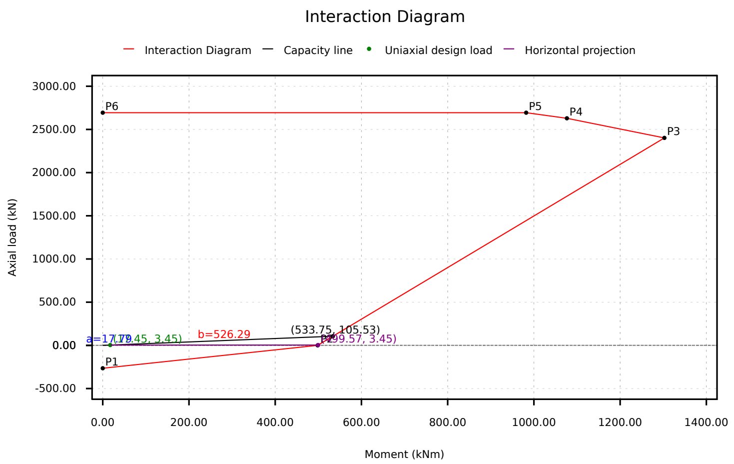
$$f_2 = E_s \times \varepsilon_2 \ (\varepsilon_2 < \varepsilon_{sy}),\ f_2 = \phi_s \times f_y \ (\varepsilon_2 \geq \varepsilon_{sy})$$

## Interaction Diagram Summary

| Point | Case | $M_r$ | $P_r$ |
|---|---|---|---|
| P1 | Pure Tension | 0 | -265.1 |
| P2 | Pure Bending | 498.4 | 0 |
| P3 | Balanced Failure | 1303 | 2402 |
| P4 | Decompression | 1077 | 2629 |
| P5 | Compression Limit | 982 | 2694 |
| P6 | Pure Compression | 0 | 2694 |

## Uniaxial Bending Check

$$M_f = MAX[17.45, 0] = 17.45\ kip - ft$$




| Segment | Signed Distance |
|---|---|
| P1 - P2 | 228.9 |
| P2 - P3 | 457.2 |
| P3 - P4 | 2603 |
| P4 - P5 | 2764 |
| P5 - P6 | 2690 |
| Status | PASS: Point lies inside the curv e |

Utilisation

$$Ratio = \frac{a}{a+b} = \frac{17.79}{17.79 + 526.3} = 0.033$$

**UTILITY: 0.03**

| REFERENCES | CALCULATIONS | RESULTS |
|---|---|---|

## Results Summary

| Result Name | Results |
|---|---|
| PILE DETAILS | |
| Length of the pile | 5.50 ft |
| Dimensions | 48 x 48 in |
| Main bar reinforcement | #5-16pcs at 1.5 in min. |
| Shear reinforcement | #3 at 10 in max. |
| UTILISATIONS | |
| Required depth | 0.93 |
| End-bearing capacity | 0.07 |
| $P_a$ | 0.70 |
| $P_s$ | 0.93 |
| Axial compression strength | 0.00 |
| Shear strength | 0.03 |
| Uniaxial bending strength | 0.03 |