Sabre Industries™
INNOVATION DELIVERED

Structural Design Report

25'-1" Smart Stack (30' Overall Height AGL)
Site: CRAN_RWOR_TGARD_001D, OR
Site Number: 16448-001D

Prepared for: J5 INFRASTRUCTURE PARTNERS
by: Sabre Industries ™

Job Number: 20-6599-EPG-R1

July 1, 2020

7/1/20

Designed Appurtenance Loading

Elev	Description	Tx-Line
29	(1) ACOM-2F15D-12P-R2	(1) 1/2"
26.58	(1) Canister (14.6" x 36")	
26	(1) Airscale Micro RRH B46 2T1W (LAA)	(1) 1/2"
25.08	Top Flange	
25.08	Top Flange	
23.08	Custom Mount	
22.2	(1) 16' Arm and Light	(1) 1/2"
14	Custom Mount	
14	(2) 78210778V01	(2) 1/2"
13	Custom Mount	
13	Custom Mount	
13	(1) Airscale RRH B66 4T/4R 20W (AHIB)	(1) 1/2"
13	(1) Airscale RRH B25 4T/4R 20W (AHFB)	(1) 1/2"
9.5	Custom Mount	
9.5	Custom Mount	
9.5	Custom Mount	
9.5	(1) Airscale RRH B66 4T/4R 20W (AHIB)	(1) 1/2"
9.5	(1) Airscale RRH B25 4T/4R 20W (AHFB)	(1) 1/2"
9.5	(2) 78210778V01	(2) 1/2"
6	Custom Mount	
6	(1) RSCAC-1333-PS-240-A	(1) 1/2"

Design Criteria - ANSI/TIA-222-H

Wind Speed (No Ice)	91 mph
Wind Speed (Ice)	0 mph
Design Ice Thickness	0.00 in
Risk Category	I
Exposure Category	C
Topographic Factor Procedure	Method 1 (Simplified)
Topographic Category	1
Ground Elevation	192 ft

Load Case Reactions

Description	Axial (kips)	Shear (kips)	Moment (ft-k)	Deflection (ft)	Sway (deg)
3s Gusted Wind	2.39	0.56	10.38	0.03	0.08
3s Gusted Wind 0.9 Dead	1.8	0.56	10.38	0.03	0.08
Service Loads	1.99	0.24	4.39	0.01	0.04

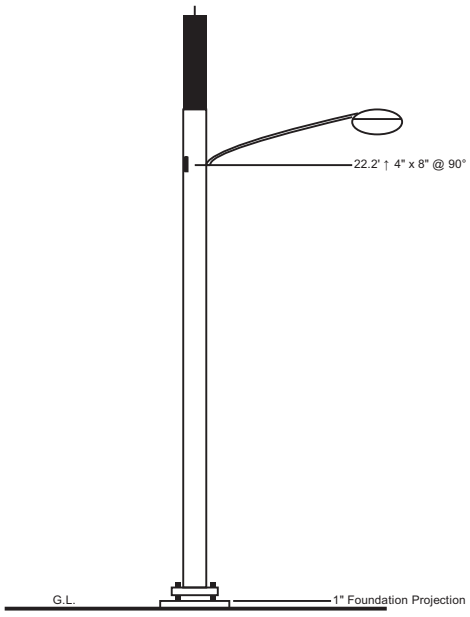
Base Plate Dimensions

Shape	Width	Thickness	Bolt Circle	Bolt Qty	Bolt Diameter
Square	17.25"	1"	17.25"	4	1"

Anchor Bolt Dimensions

Length	Diameter	Hole Diameter	Weight	Type	Finish	Projection
51"	1"	1.25"	56.8	F1554-105	Galv	7"

Length (ft)	25'-0"
Number Of Sides	Round
Thickness (in)	0.3750"
Lap Splice (ft)	
Top Diameter (in)	14"
Bottom Diameter (in)	14"
Taper (in/ft)	0
Grade	A53 Grade B-35
Weight (lbs)	1462
Overall Steel Height (ft)	25



Notes

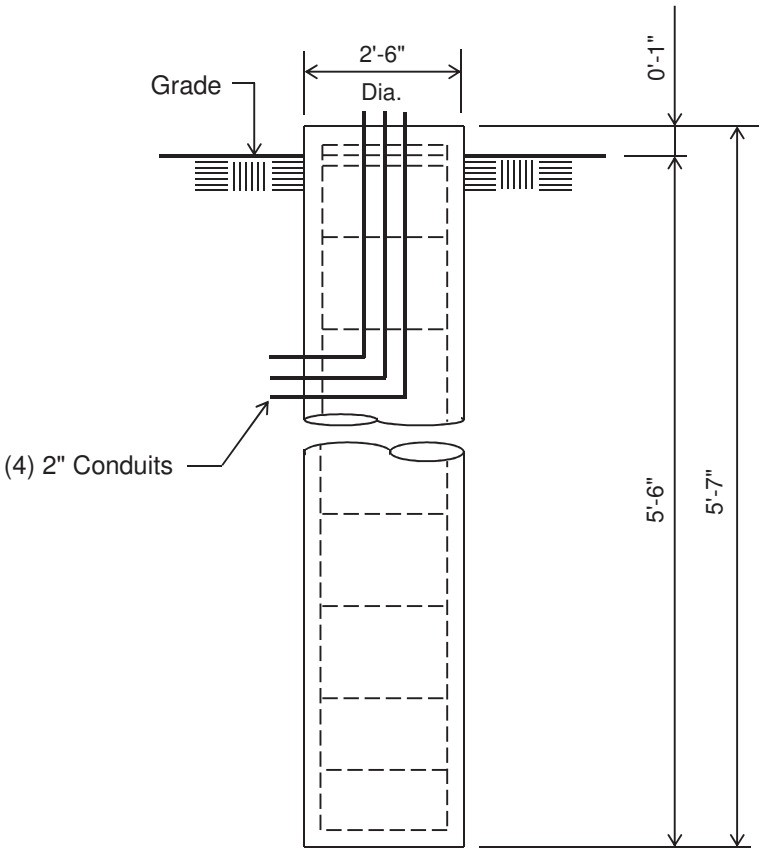
1) Antenna Feed Lines Run Inside Pole
2) All dimensions are above ground level, unless otherwise specified.
3) Weights shown are estimates. Final weights may vary.
4) This tower design and, if applicable, the foundation design(s) shown on the following page(s) also meet or exceed the requirements of the 2019 Oregon Structural Specialty Code.
5) Tower Rating: 12%

Sabre Industries
INNOVATION DELIVERED
Sabre Industries
7101 Southbridge Drive
P.O. Box 658
Sioux City, IA 51102-0658
Phone: (712) 258-6690
Fax: (712) 279-0814

Job:	**20-6599-EPG-R1**
Customer:	J5 INFRASTRUCTURE PARTNERS
Site Name:	CRAN_RWOR_TGARD_001D, OR 16448-001D
Description:	25'-1" Smart Stack - Pipe Pole
Date:	7/1/2020 By: KJT

No.: 20-6599-EPG-R1
Date: 07/01/20
By: KJT

Customer: J5 INFRASTRUCTURE PARTNERS
Site: CRAN_RWOR_TGARD_001D, OR 16448-001D
25.08' Smart Stack



ELEVATION VIEW
(1.02 Cu. Yds.)
(1 REQUIRED; NOT TO SCALE)

Notes:

1) Concrete shall have a minimum 28-day compressive strength of 4,500 psi, in accordance with ACI 318-14.
2) Rebar to conform to ASTM specification A615 Grade 60.
3) All rebar to have a minimum of 3" concrete cover.
4) All exposed concrete corners to be chamfered 3/4".
5) The foundation design is based on presumptive clay soil as defined in ANSI/TIA-222-H-2017.
6) The bottom anchor bolt template shall be positioned as closely as possible to the bottom of the anchor bolts.

Rebar Schedule for Pier	
Pier	(8) #6 vertical rebar w/ #3 ties, (3) within top 5" of pier, then 12" C/C

7101 Southbridge Drive - P.O. Box 658 - Sioux City, IA 51102-0658 - Phone 712.258.6690 - Fax 712.279.0814

25.08' Pipe Pole / CRAN_RWOR_TGARD_001D, OR

* All pole diameters shown on the following pages are across corners.
See profile drawing for widths across flats.

POLE GEOMETRY

ELEV ft	SECTION NAME	No. SIDE	OUTSIDE DIAM in	THICK -NESS in	RESISTANCES ϕ*Pn kip	ϕ*Mn ft-kip	SPLICE TYPE	...OVERLAP... LENGTH ft	RATIO	w/t
25.0										
			14.00	0.375	505.6	182.8				
	A	0								37.3
			14.00	0.375	505.6	182.8				
0.0										

POLE ASSEMBLY

SECTION NAME	BASE ELEV ft	.....BOLTS AT BASE OF SECTION..... NUMBER	TYPE	DIAM in	STRENGTH ksi	THREADS IN SHEAR PLANE	CALC BASE ELEV ft
A	0.000	0	A325	0.00	92.0	0	0.000

POLE SECTIONS

SECTION NAME	No.of SIDES	LENGTH ft	OUTSIDE.DIAMETER BOT * in	TOP * in	BEND RAD in	MAT-ERIAL ID	FLANGE.ID BOT	TOP	FLANGE.WELD ..GROUP.ID.. BOT	TOP
A	0	25.00	14.00	14.00	0.625	1	0	0	0	0

* - Diameter of circumscribed circle

MATERIAL TYPES

TYPE OF SHAPE	TYPE NO	NO OF ELEM.	ORIENT & deg	HEIGHT in	WIDTH in	.THICKNESS. WEB in	FLANGE in	IRREGULARITY .PROJECTION. % OF AREA	ORIENT deg
PL	1	1	0.0	14.00	0.38	0.375	0.375	0.00	0.0

& - With respect to vertical

MATERIAL PROPERTIES

MATERIAL TYPE NO.	ELASTIC MODULUS ksi	UNIT WEIGHT pcf	.. STRENGTH .. Fu ksi	Fy ksi	THERMAL COEFFICIENT /deg
1	29000.0	490.0	60.0	35.0	0.00001170

* Only 2 condition(s) shown in full

LOADING CONDITION A

91 mph wind with no ice. Wind Azimuth: 0ϕ

LOADS ON POLE

LOAD TYPE	ELEV ft	APPLY..LOAD..AT RADIUS ft	AZI	LOAD AZI	.....FORCES..... HORIZ kip	DOWN kip	.....MOMENTS..... VERTICAL ft-kip	TORSNAL ft-kip
C	28.917	0.00	0.0	0.0	0.0268	0.1200	0.0000	0.0000
C	26.497	0.00	0.0	0.0	0.0384	0.1200	0.0000	0.0000

C	25.917	0.00	0.0	0.0	0.0000	0.0286	0.0000	0.0000
C	24.997	0.00	0.0	0.0	0.0002	0.0000	0.0000	0.0000
C	24.997	0.00	0.0	0.0	0.0000	0.0120	0.0000	0.0000
C	24.997	0.00	0.0	0.0	0.0002	0.0000	0.0000	0.0000
C	22.997	0.00	0.0	0.0	0.0000	0.0110	0.0000	0.0000
C	22.117	0.00	0.0	0.0	0.0000	0.0106	0.0000	0.0000
C	22.117	0.00	0.0	0.0	0.2434	0.2700	0.0000	0.0000
C	13.917	0.00	0.0	0.0	0.0000	0.0134	0.0000	0.0000
C	13.917	0.00	0.0	0.0	0.0000	0.0323	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0062	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0156	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0062	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0156	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0090	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0323	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0045	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0156	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0045	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0156	0.0000	0.0000
C	5.917	0.00	0.0	0.0	0.0000	0.0028	0.0000	0.0000
C	5.917	0.00	0.0	0.0	0.0000	0.0096	0.0000	0.0000
D	25.000	0.00	180.0	0.0	0.0104	0.0655	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0096	0.0655	0.0000	0.0000

LOADING CONDITION M

91 mph wind with no ice. Wind Azimuth: 0◆

LOADS ON POLE

LOAD TYPE	ELEV ft	APPLY..LOAD..AT RADIUS ft	AZI	LOAD AZI	.....FORCES..... HORIZ kip	DOWN kip	.....MOMENTS..... VERTICAL ft-kip	TORSNAL ft-kip
C	28.917	0.00	0.0	0.0	0.0268	0.0900	0.0000	0.0000
C	26.497	0.00	0.0	0.0	0.0384	0.0900	0.0000	0.0000
C	25.917	0.00	0.0	0.0	0.0000	0.0214	0.0000	0.0000
C	24.997	0.00	0.0	0.0	0.0002	0.0000	0.0000	0.0000
C	24.997	0.00	0.0	0.0	0.0000	0.0090	0.0000	0.0000
C	24.997	0.00	0.0	0.0	0.0002	0.0000	0.0000	0.0000
C	22.997	0.00	0.0	0.0	0.0000	0.0083	0.0000	0.0000
C	22.117	0.00	0.0	0.0	0.0000	0.0080	0.0000	0.0000
C	22.117	0.00	0.0	0.0	0.2434	0.2025	0.0000	0.0000
C	13.917	0.00	0.0	0.0	0.0000	0.0100	0.0000	0.0000
C	13.917	0.00	0.0	0.0	0.0000	0.0242	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0047	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0117	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0047	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0117	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0068	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0242	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0034	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0117	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0034	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0117	0.0000	0.0000
C	5.917	0.00	0.0	0.0	0.0000	0.0021	0.0000	0.0000
C	5.917	0.00	0.0	0.0	0.0000	0.0072	0.0000	0.0000
D	25.000	0.00	180.0	0.0	0.0104	0.0492	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0096	0.0492	0.0000	0.0000

25.08' Pipe Pole / CRAN_RWOR_TGARD_001D, OR

MAXIMUM POLE DEFORMATIONS CALCULATED(w.r.t. wind direction)

MAST ELEV ft	.....DEFLECTIONS (ft)..... HORIZONTAL ..... ALONG	ACROSS	DOWN	.....ROTATIONS (deg)..... TILT ..... ALONG	ACROSS	TWIST
25.0	0.03D	0.00U	0.00D	0.08A	0.00U	0.00B
18.7	0.02D	0.00U	0.00D	0.08A	0.00U	0.00B
12.5	0.01D	0.00U	0.00D	0.07D	0.00U	0.00U
6.2	0.00D	0.00U	0.00D	0.04D	0.00U	0.00U

0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

MAXIMUM POLE FORCES CALCULATED(w.r.t. to wind direction)

MAST ELEV ft	TOTAL AXIAL kip	SHEAR.w.r.t.WIND.DIR ALONG kip	ACROSS kip	MOMENT.w.r.t.WIND.DIR ALONG ft-kip	ACROSS ft-kip	TORSION ft-kip
25.0						
	0.28 A	0.07 M	0.00 X	-0.16 R	0.00 K	0.00 N
	0.98 A	0.37 M	0.00 X	-1.60 A	0.00 X	0.00 X
18.7						
	0.98 D	0.37 P	0.00 B	-1.60 A	0.00 I	0.00 X
	1.48 D	0.44 P	0.00 B	-4.14 A	0.00 B	0.00 B
12.5						
	1.48 D	0.44 P	0.00 U	-4.14 A	0.00 B	0.00 B
	1.97 D	0.50 P	0.00 U	-7.07 A	0.00 U	0.00 U
6.2						
	1.97 D	0.50 W	0.00 B	-7.07 A	0.00 U	0.00 U
	2.39 D	0.56 W	0.00 B	-10.38 D	0.00 B	0.00 U
base reaction	2.39 D	-0.56 W	0.00 B	10.38 D	0.00 B	0.00 U

COMPLIANCE WITH 4.8.2 & 4.5.4

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
25.00							
	0.00A	0.00R	0.00M	0.00A	YES	37.33A	400.0
	0.00A	0.01A	0.00M	0.01A	YES	37.33A	400.0
18.75							
	0.00D	0.01A	0.00P	0.01A	YES	37.33A	400.0
	0.00D	0.02A	0.00P	0.03A	YES	37.33A	400.0
12.50							
	0.00D	0.02A	0.00P	0.03A	YES	37.33A	400.0
	0.00D	0.04A	0.00P	0.04A	YES	37.33A	400.0
6.25							
	0.00D	0.04A	0.00W	0.04A	YES	37.33A	400.0
	0.00D	0.06D	0.00W	0.06D	YES	37.33A	400.0
0.00							

MAXIMUM LOADS ONTO FOUNDATION(w.r.t. wind direction)

DOWN kip	SHEAR.w.r.t.WIND.DIR ALONG kip	ACROSS kip	MOMENT.w.r.t.WIND.DIR ALONG ft-kip	ACROSS ft-kip	TORSION ft-kip
2.39 D	0.56 W	0.00 B	-10.38 D	0.00 B	0.00 U

(USA 222-H) - Monopole Spatial Analysis (c)2017 Guymast Inc.

Tel:(416)736-7453 Fax:(416)736-4372 Web:www.guymast.com

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25.08' Pipe Pole / CRAN_RWOR_TGARD_001D, OR

********** Service Load Condition **********

* Only 1 condition(s) shown in full

LOADING CONDITION A

60 mph wind with no ice. Wind Azimuth: 0◆

LOADS ON POLE
==========

LOAD TYPE	ELEV ft	APPLY..LOAD..AT RADIUS ft	AZI	LOAD AZI	.....FORCES..... HORIZ kip	DOWN kip	.....MOMENTS..... VERTICAL ft-kip	TORSNAL ft-kip
C	28.917	0.00	0.0	0.0	0.0107	0.1000	0.0000	0.0000
C	26.497	0.00	0.0	0.0	0.0156	0.1000	0.0000	0.0000
C	25.917	0.00	0.0	0.0	0.0000	0.0238	0.0000	0.0000
C	24.997	0.00	0.0	0.0	0.0001	0.0000	0.0000	0.0000
C	24.997	0.00	0.0	0.0	0.0000	0.0100	0.0000	0.0000
C	24.997	0.00	0.0	0.0	0.0001	0.0000	0.0000	0.0000
C	22.997	0.00	0.0	0.0	0.0000	0.0092	0.0000	0.0000
C	22.117	0.00	0.0	0.0	0.0000	0.0088	0.0000	0.0000
C	22.117	0.00	0.0	0.0	0.0947	0.2250	0.0000	0.0000
C	13.917	0.00	0.0	0.0	0.0000	0.0111	0.0000	0.0000
C	13.917	0.00	0.0	0.0	0.0000	0.0269	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0052	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0130	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0052	0.0000	0.0000
C	12.917	0.00	0.0	0.0	0.0000	0.0130	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0075	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0269	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0038	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0130	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0038	0.0000	0.0000
C	9.417	0.00	0.0	0.0	0.0000	0.0130	0.0000	0.0000
C	5.917	0.00	0.0	0.0	0.0000	0.0024	0.0000	0.0000
C	5.917	0.00	0.0	0.0	0.0000	0.0080	0.0000	0.0000
D	25.000	0.00	180.0	0.0	0.0050	0.0546	0.0000	0.0000
D	0.000	0.00	180.0	0.0	0.0049	0.0546	0.0000	0.0000

MAXIMUM POLE DEFORMATIONS CALCULATED(w.r.t. wind direction)
==========

MAST ELEV ft	.....DEFLECTIONS (ft)..... HORIZONTAL ..... ALONG	ACROSS	DOWN	.....ROTATIONS (deg)..... TILT ..... ALONG	ACROSS	TWIST
25.0	0.01A	0.00F	0.00A	0.04A	0.00F	0.00F
18.7	0.01A	0.00F	0.00A	0.03A	0.00F	0.00F
12.5	0.00A	0.00F	0.00A	0.03A	0.00F	0.00F
6.2	0.00A	0.00F	0.00A	0.02A	0.00F	0.00F
0.0	0.00A	0.00A	0.00A	0.00A	0.00A	0.00A

MAXIMUM POLE FORCES CALCULATED(w.r.t. to wind direction)
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MAST ELEV ft	TOTAL AXIAL kip	SHEAR.w.r.t.WIND.DIR ALONG kip	ACROSS kip	MOMENT.w.r.t.WIND.DIR ALONG ft-kip	ACROSS ft-kip	TORSION ft-kip
25.0	0.23 D	0.03 A	0.00 B	-0.07 C	0.00 B	0.00 B
	0.82 D	0.15 A	0.00 B	-0.65 A	0.00 K	0.00 K
18.7	0.82 I	0.15 A	0.00 F	-0.65 A	0.00 K	0.00 E
	1.23 I	0.18 A	0.00 F	-1.70 A	0.00 F	0.00 F
12.5	1.23 E	0.18 A	0.00 F	-1.70 A	0.00 F	0.00 F
	1.64 E	0.21 A	0.00 F	-2.95 A	0.00 F	0.00 F
6.2	1.64 D	0.21 A	0.00 I	-2.95 A	0.00 F	0.00 F
	1.99 D	0.24 A	0.00 I	-4.39 A	0.00 F	0.00 F
base reaction	1.99 D	-0.24 A	0.00 I	4.39 A	0.00 F	0.00 F

COMPLIANCE WITH 4.8.2 & 4.5.4
==========

ELEV ft	AXIAL	BENDING	SHEAR + TORSIONAL	TOTAL	SATISFIED	D/t(w/t)	MAX ALLOWED
25.00	0.00D	0.00C	0.00A	0.00C	YES	37.33A	400.0

```
          0.00D     0.00A     0.00A     0.01A     YES       37.33A      400.0
18.75 ..................................................................
          0.00I     0.00A     0.00A     0.01A     YES       37.33A      400.0

          0.00I     0.01A     0.00A     0.01A     YES       37.33A      400.0
12.50 ..................................................................
          0.00E     0.01A     0.00A     0.01A     YES       37.33A      400.0

          0.00E     0.02A     0.00A     0.02A     YES       37.33A      400.0
 6.25 ..................................................................
          0.00D     0.02A     0.00A     0.02A     YES       37.33A      400.0

          0.00C     0.02A     0.00A     0.03A     YES       37.33A      400.0
 0.00 ..................................................................
```

MAXIMUM LOADS ONTO FOUNDATION(w.r.t. wind direction)

DOWN	SHEAR.w.r.t.WIND.DIR ALONG	ACROSS	MOMENT.w.r.t.WIND.DIR ALONG	ACROSS	TORSION
kip	kip	kip	ft-kip	ft-kip	ft-kip
1.99	0.24	0.00	-4.39	0.00	0.00
D	A	I	A	F	F

SO#: 20-6599-EPG-R1
Site Name: CRAN_RWOR_TGARD_001D, OI
Date: 7/1/2020

Square Base Plate and Anchor Rods per ANSI/TIA 222-H

Pole Data

Diameter:	14.000	in (flat to flat)
Thickness:	0.375	in
Yield (Fy):	35	ksi
# of Sides:	0	"0" IF Round
Strength (Fu):	60	ksi

Reactions

Moment, Mu:	10.38	ft-kips
Axial, Pu:	2.39	kips
Shear, Vu:	0.56	kips

Anchor Rod Data

Quantity:	4	(multiple of 4)	
Diameter:	1	in	
Rod Material:	F1554		
Strength (Fu):	125	ksi	
Yield (Fy):	105	ksi	
BC Diam. (in):	17.25	BC Override:	17.25

Plate Data

Width (in):	17.25	Width Override:	17.25
Thickness:	1	in	
Yield (Fy)	50	ksi	
Eff. Width:	10.08	in	

Center Hole:	14.125	in. diameter

Anchor Rod Results

(per 4.9.9)

Maximum Put:	6.77	Kips
Φt*Rnt:	56.81	Kips
Vu:	0.14	Kips
Φv*Rnv:	36.82	Kips
Tension Interaction Ratio:	0.01	
Maximum Puc:	7.82	Kips
Φc*Rnc:	63.63	Kips
Vu:	0.14	Kips
Φc*Rnvc:	19.09	Kips
Compression Interaction Ratio:	0.12	
Maximum Interaction Ratio:	**12.3%**	**Pass**

Base Plate Results

Base Plate (Mu/Z):	5.0	ksi	
Allowable Φ*Fy:	45	ksi	(per AISC)
Base Plate Interaction Ratio:	**11.2%**	**Pass**	

```
================================================================================

                     LPile for Windows, Version 2019-11.004

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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================================================================================

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Sabre Towers and Poles

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--------------------------------------------------------------------------------
                              Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\Program Files (x86)\Ensoft\Lpile2019\files\

Name of input data file:
20-6599-EPG-R1.lp11d

Name of output report file:
20-6599-EPG-R1.lp11o

Name of plot output file:
20-6599-EPG-R1.lp11p

Name of runtime message file:
20-6599-EPG-R1.lp11r


--------------------------------------------------------------------------------
                            Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  July 1, 2020               Time:  13:55:04


--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

Site         : CRAN_RWOR_TGARD_001D, OR


Tower        : 25.08' Pipe Pole


Prepared for : J5 INFRASTRUCTURE PARTNERS


Job Number   : 20-6599-EPG-R1


Engineer     : KJT




--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          999
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
```

- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 5.583 ft
Depth of ground surface below top of pile = 0.0833 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	30.0000
2	5.583	30.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 5.583333 ft
Shaft Diameter = 30.000000 in
Shear capacity of section = 0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer = 0.083333 ft
Distance from top of pile to bottom of layer = 1.083333 ft
Effective unit weight at top of layer = 110.000000 pcf
Effective unit weight at bottom of layer = 110.000000 pcf
Undrained cohesion at top of layer = 14.400000 psf
Undrained cohesion at bottom of layer = 14.400000 psf
Epsilon-50 at top of layer = 0.100000
Epsilon-50 at bottom of layer = 0.100000

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer = 1.083333 ft
Distance from top of pile to bottom of layer = 20.083333 ft
Effective unit weight at top of layer = 110.000000 pcf
Effective unit weight at bottom of layer = 110.000000 pcf
Undrained cohesion at top of layer = 1000.000000 psf
Undrained cohesion at bottom of layer = 1000.000000 psf
Epsilon-50 at top of layer = 0.010000
Epsilon-50 at bottom of layer = 0.010000

(Depth of the lowest soil layer extends 14.500 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	E50 or krm
1	Soft Clay	0.08333 1.0833	110.0000 110.0000	14.4000 14.4000	0.10000 0.10000
2	Stiff Clay w/o Free Water	1.0833 20.0833	110.0000 110.0000	1000.0000 1000.0000	0.01000 0.01000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V = 746.666667 lbs	M = 166080. in-lbs	3187.	No	Yes
2	1	V = 240.000000 lbs	M = 52680. in-lbs	1990.	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	5.583333 ft
Shaft Diameter	=	30.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	3.375000 in
Number of Reinforcing Bars	=	8 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	706.858347 sq. in.
Total Area of Reinforcing Steel	=	3.534292 sq. in.
Area Ratio of Steel Reinforcement	=	0.50 percent
Edge-to-Edge Bar Spacing	=	7.860377 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	10.48
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	2902.272 kips
Tensile Load for Cracking of Concrete	=	-321.491 kips
Nominal Axial Tensile Capacity	=	-212.058 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	0.750000	0.441786	11.250000	0.00000
2	0.750000	0.441786	7.954951	7.954951
3	0.750000	0.441786	0.00000	11.250000
4	0.750000	0.441786	-7.954951	7.954951
5	0.750000	0.441786	-11.250000	0.00000
6	0.750000	0.441786	-7.954951	-7.954951
7	0.750000	0.441786	0.00000	-11.250000
8	0.750000	0.441786	7.954951	-7.954951

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 7.860 inches
between bars 1 and 2.

Ratio of bar spacing to maximum aggregate size = 10.48

Concrete Properties:

Compressive Strength of Concrete	=	4500. psi
Modulus of Elasticity of Concrete	=	3823676. psi
Modulus of Rupture of Concrete	=	-503.115295 psi
Compression Strain at Peak Stress	=	0.002001
Tensile Strain at Fracture of Concrete	=	-0.0001152
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	1.990
2	3.187

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	1.990	2719.984	0.00300000
2	3.187	2733.115	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	2720.	1.293500	1768.	18438821.
2	0.65	2733.	2.071333	1777.	18552122.
1	0.75	2720.	1.393000	2040.	17695376.
2	0.75	2733.	2.230667	2050.	17799790.
1	0.90	2720.	1.492500	2448.	11864048.
2	0.90	2733.	2.390000	2460.	11933328.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.08333	0.00	N.A.	No	0.00	254.6963
2	1.0833	0.03390	No	No	254.6963	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.

Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	746.6667	M, in-lb	166080.	3187.	0.5050	-0.01165	-6300.	177141.
2	V, lb	240.0000	M, in-lb	52680.	1990.	0.00524	-1.27E-04	-1895.	56090.

Maximum pile-head deflection = 0.5050246810 inches
Maximum pile-head rotation = -0.0116486947 radians = -0.667421 deg.

The analysis ended normally.

1807.3.2.1 (2009 IBC, 2012 IBC, & 2015 IBC)

Moment (ft·k)	10.38	
Shear (k)	0.56	
Caisson diameter (ft)	2.5	
Caisson height above ground (ft)	0.083333	
Caisson height below ground (ft)	5.5	
Lateral soil pressure (lb/ft^2)	**245.45**	
Ground to application of force, h (ft)	18.62	
Applied lateral force, P (lb)	560	
Lateral soil bearing pressure, S_1 (lb/ft)	450.00	
Diameter, b (ft)	2.5	
A	1.16	$= (2.34P)/(S_1 b)$
Minimum depth of embedment, d (ft)	5.48	$= 0.5A[\ 1 + (\ 1 + (\ 4.36h\ /\ A\ )\ )^{1/2}\ ]$