Mr. Andrew Murray
American Resource & Energy (ARE)
(651) 330-1263 ext. 23
amurray@arewindtowers.com

Subject: **ARE 11m Monopole w/ Windtronics 2.2kW Wind Turbine - TEP# 110005.19**
Limited Structural Analysis and Generic Foundation Design

Dear Mr. Murray:

Tower Engineering Professionals, Inc. (TEP) utilized the following information to complete the structural design review and foundation design for the American Resource & Energy (ARE) 11m monopole with a top mounted Windtronics 2.2kW Wind Turbine:

1) Tower design drawing by ARE dated August 31, 2011, Quotation # W11015, Version F, Description: *11m 2.2kW Wind Pole*, provided by ARE
2) Correspondence from ARE indicating the turbine mechanical specifications from the turbine manufacturer/supplier.

A limited structural analysis of the proposed monopole was conducted based upon the provided information. This analysis was used to verify the overall tower section capacities and verify the tower base reactions to facilitate a foundation design. TEP did not conduct a verification of the connection capacities, with the exception of proposed anchor bolts and baseplate. TEP did not verify the operational and/or vibrational characteristics of the proposed tower and turbine configuration, specifically with regard to fatigue, harmonics, vortex shedding or destructive resonance induced by the spinning rotor.

The tower and foundation have been designed to meet a 140-mph 3-second gust wind speed (Exposure C, Structure Class II, Topographic Category I). Seismic loading was not addressed for this site. This design meets the requirements of the ANSI/TIA-222-G-2-2009, Structural Standard for Antenna Supporting Structures and Antennas, ASCE/SEI 7-05, Minimum Design Loads for Buildings and Other Structures and the 2006 Michigan Building Code (IBC 2006).

A geotechnical report was not provided to TEP. The foundation design is based on assumed Presumptive Soil Parameters per the ANSI/TIA-222-G Annex F - Table F-1. TEP utilized clay soil with an ultimate bearing capacity of 5,000-psf and a unit weight of 110-pcf for this foundation design. TEP assumed that groundwater is not present within the depth of the foundation. These are average soil properties for reference only. A site-specific foundation design shall be conducted for each installation of the proposed tower/turbine configuration.

Thank you for the opportunity to perform this service for you. If you have any questions please contact our office.

Regards,

Andrew T. Haldane, P.E.

STATE OF MICHIGAN
Andrew T. Haldane
ENGINEER
No. 55580
09/29/2011
LICENSED PROFESSIONAL ENGINEER

Attachments:
1) Calculations
2) Foundation Design Drawings

STRUCTURAL CALCULATIONS

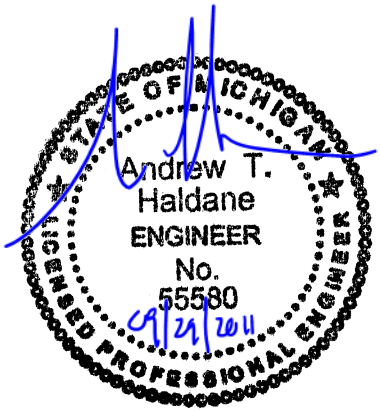
PROJECT DESCRIPTION:

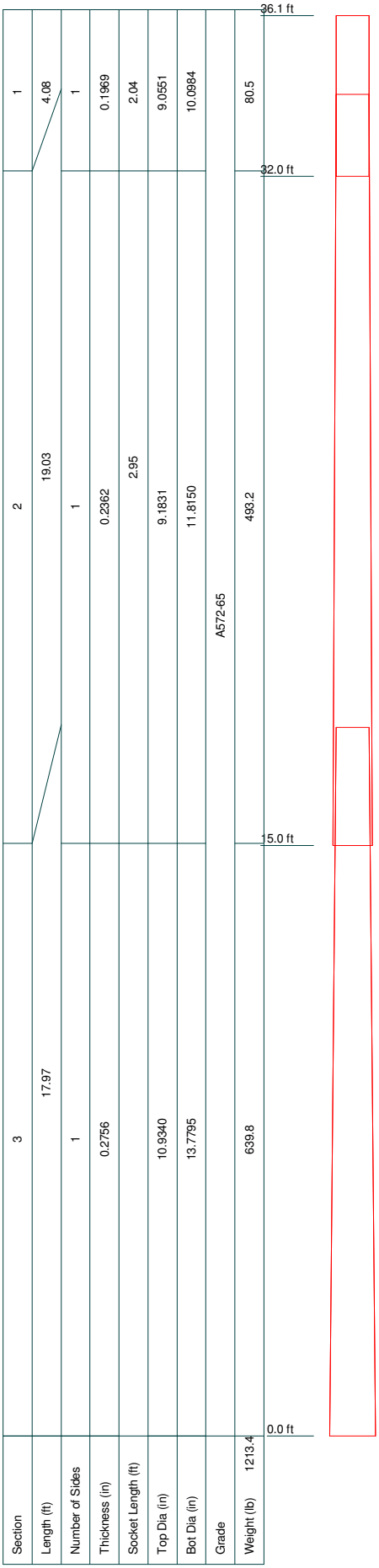
11m ARE Monopole w/ Windtronics 2.2kW Wind Turbine

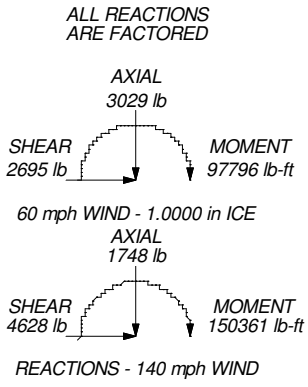
TEP# 110005.19

PROJECT REPRESENTATIVE:

Mr. Andrew Murray
American Resource & Energy (ARE)
(651) 330-1263 ext. 23
amurray@arewindtowers.com







DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Windtronics 2.2kW Wind Turbine	39.6982		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-65	65 ksi	80 ksi			

TOWER DESIGN NOTES

1. Tower designed for Exposure C to the TIA-222-G Standard.
2. Tower designed for a 140 mph basic wind in accordance with the TIA-222-G Standard.
3. Tower is also designed for a 60 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 60 mph wind.
5. Tower Structure Class II.
6. Topographic Category 1 with Crest Height of 0.00 ft
7. Tower geometry and turbine loading reference: Dwg by A.R.E. Quotation #: W11015, Dated: 08-31-2011, Version: F, Description: 11m 2.2kW Wind Pole
8. Additional turbine loading reference: Windtronics Spec Sheet (BTPS 6500 Wind Turbine - Blade Tip Power System)
9. TOWER RATING: 67.5%

Tower Engineering Professionals
3703 Junction Blvd.
Raleigh, NC 27603
Phone: (919) 661-6351
FAX: (919) 661-6350

Job: ***11M ARE Monopole - Windtronics 2.2kW***			
Project: ***TEP # 110005.19***			
Client: American Resource and Energy (ARE)	Drawn by: Lukas Burgher	App'd:	
Code: TIA-222-G	Date: 09/27/11	Scale: NTS	
Path: P:\0005_ARE\19_11m ARE-2.2kW\Windtronics\Structures\RISATower\11M ARE Monopole - Windtronics 2.2kW.eri		Dwg No. E-1	

Tower Input Data

There is a pole section.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

Basic wind speed of 140 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.00 ft.
Nominal ice thickness of 1.0000 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 60 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 60 mph.
Tower geometry and turbine loading reference: Dwg by A.R.E. Quotation #: W11015, Dated: 08-31-2011, Version: F, Description: 11m 2.2kW Wind Pole.
Additional turbine loading reference: Windtronics Spec Sheet (BTPS 6500 Wind Turbine - Blade Tip Power System).
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.
Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs	Distribute Leg Loads As Uniform	Treat Feedline Bundles As Cylinder
Consider Moments - Horizontals	Assume Legs Pinned	Use ASCE 10 X-Brace Ly Rules
Consider Moments - Diagonals	√ Assume Rigid Index Plate	Calculate Redundant Bracing Forces
Use Moment Magnification	√ Use Clear Spans For Wind Area	Ignore Redundant Members in FEA
√ Use Code Stress Ratios	Use Clear Spans For KL/r	SR Leg Bolts Resist Compression
√ Use Code Safety Factors - Guys	Retension Guys To Initial Tension	All Leg Panels Have Same Allowable
Escalate Ice	√ Bypass Mast Stability Checks	Offset Girt At Foundation
Always Use Max Kz	√ Use Azimuth Dish Coefficients	√ Consider Feedline Torque
Use Special Wind Profile	√ Project Wind Area of Appurt.	Include Angle Block Shear Check
Include Bolts In Member Capacity	Autocalc Torque Arm Areas	Poles
Leg Bolts Are At Top Of Section	SR Members Have Cut Ends	√ Include Shear-Torsion Interaction
Secondary Horizontal Braces Leg	Sort Capacity Reports By Component	Always Use Sub-Critical Flow
Use Diamond Inner Bracing (4 Sided)	Triangulate Diamond Inner Bracing	Use Top Mounted Sockets
Add IBC .6D+W Combination		

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	36.09-32.01	4.08	2.04	Round	9.0551	10.0984	0.1969		A572-65 (65 ksi)

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L2	32.01-15.02	19.03	2.95	Round	9.1831	11.8150	0.2362		A572-65 (65 ksi)
L3	15.02-0.00	17.97		Round	10.9340	13.7795	0.2756		A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	9.0551	5.4782	53.7743	3.1358	4.5276	11.8771	107.4020	2.7374	0.0000	0
	10.0984	6.1234	75.1002	3.5052	5.0492	14.8736	149.9957	3.0599	0.0000	0
L2	9.4651	6.6395	66.4844	3.1672	4.5915	14.4798	132.7877	3.3178	0.0000	0
	11.8150	8.5927	144.1097	4.0989	5.9075	24.3944	287.8268	4.2938	0.0000	0
L3	11.4016	9.2280	131.1390	3.7731	5.4670	23.9874	261.9207	4.6112	0.0000	0
	13.7795	11.6916	266.7088	4.7804	6.8898	38.7109	532.6909	5.8423	0.0000	0

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 36.09-32.01				1	1	1		
L2 32.01-15.02				1	1	1		
L3 15.02-0.00				1	1	1		

User Defined Loads

Description	Elevation ft	Offset From Centroid ft	Azimuth Angle °		Weight lb	F_x lb	F_z lb	Wind Force lb	C_AA_C ft^2
Windtronics 2.2kW Wind Turbine	39.70	0.00	0.0000	No Ice	243.00	0.00	0.00	1927.00	**35.27**
				Ice	304.00	0.00	0.00	2216.00	**220.84**
				Service	243.00	0.00	0.00	1927.00	**214.63**

222-G Verification Constants

Constant	Value
Wind Importance Factor Without Ice	1
Wind Importance Factor With Ice Factor	1
Ice Importance Factor	1
K_d	0.95
Z_g	900
α	9.5
K_{zmin}	0.85
K_e	1

Constant	Value
K_t	1
f	1

222-G Section Verification ArRr By Element

Section Elevation ft	Elem. Num.	Size	C	C w/Ice	Face	e	e w/Ice	A_r ft²	A_r w/Ice ft²	A_rR_r ft²	A_rR_r w/Ice ft²
L1 36.09-32.01	1	TP10.0984x9.0551x0.1969	112.206	68.235		1	1	3.255	4.618	3.255	4.618
							Sum:	3.255	4.618	3.255	4.618
L2 32.01-15.02	2	TP11.815x9.1831x0.2362	118.158	69.264		1	1	15.064	20.745	15.064	20.745
							Sum:	15.064	20.745	15.064	20.745
L3 15.02-0.00	3	TP13.7795x10.934x0.2756	132.911	72.813		1	1	15.760	20.594	15.760	20.594
							Sum:	15.760	20.594	15.760	20.594

222-G Section Verification Tables - No Ice

Section Elevation ft	z_{wind} ft	z_{ice} ft	K_z	K_h	K_{zt}	t_z in	q_z psf	Face	e	A_rR_r ft²
L1 36.09-32.01	34.01		1.009	1	1		48		1	3.255
L2 32.01-15.02	23.20		0.931	1	1		44		1	15.064
L3 15.02-0.00	7.27		0.85	1	1		41		1	15.760

222-G Section Verification Tables - Ice

Section Elevation ft	z_{wind} ft	z_{ice} ft	K_z	K_h	K_{zt}	t_z in	q_z psf	Face	e	A_rR_r ft²
L1 36.09-32.01	34.01	34.05	1.009	1	1	2.0061	9		1	4.618
L2 32.01-15.02	23.20	23.52	0.931	1	1	1.9308	8		1	20.745
L3 15.02-0.00	7.27	7.51	0.85	1	1	1.7193	7		1	20.594

222-G Section Verification Tables - Service

Section Elevation ft	z_{wind} ft	z_{ice} ft	K_z	K_h	K_{zt}	t_z in	q_z psf	Face	e	A_rR_r ft²
L1 36.09-32.01	34.01		1.009	1	1		8		1	3.255
L2 32.01-15.02	23.20		0.931	1	1		7		1	15.064
L3 15.02-0.00	7.27		0.85	1	1		7		1	15.760

Tower Pressures - No Ice

$G_H = 1.100$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 36.09-32.01	34.01	1.009	48	3.255	A	0.000	3.255	3.255	100.00	0.000	0.000
					B	0.000	3.255		100.00	0.000	0.000
					C	0.000	3.255		100.00	0.000	0.000
L2 32.01-15.02	23.20	0.931	44	15.064	A	0.000	15.064	15.064	100.00	0.000	0.000
					B	0.000	15.064		100.00	0.000	0.000
					C	0.000	15.064		100.00	0.000	0.000
L3 15.02-0.00	7.27	0.85	41	15.760	A	0.000	15.760	15.760	100.00	0.000	0.000
					B	0.000	15.760		100.00	0.000	0.000
					C	0.000	15.760		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.100$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 36.09-32.01	34.01	1.009	9	2.0061	4.618	A	0.000	4.618	4.618	100.00	0.000	0.000
						B	0.000	4.618		100.00	0.000	0.000
						C	0.000	4.618		100.00	0.000	0.000
L2 32.01-15.02	23.20	0.931	8	1.9308	20.745	A	0.000	20.745	20.745	100.00	0.000	0.000
						B	0.000	20.745		100.00	0.000	0.000
						C	0.000	20.745		100.00	0.000	0.000
L3 15.02-0.00	7.27	0.85	7	1.7193	20.594	A	0.000	20.594	20.594	100.00	0.000	0.000
						B	0.000	20.594		100.00	0.000	0.000
						C	0.000	20.594		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.100$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 36.09-32.01	34.01	1.009	8	3.255	A	0.000	3.255	3.255	100.00	0.000	0.000
					B	0.000	3.255		100.00	0.000	0.000
					C	0.000	3.255		100.00	0.000	0.000
L2 32.01-15.02	23.20	0.931	7	15.064	A	0.000	15.064	15.064	100.00	0.000	0.000
					B	0.000	15.064		100.00	0.000	0.000
					C	0.000	15.064		100.00	0.000	0.000
L3 15.02-0.00	7.27	0.85	7	15.760	A	0.000	15.760	15.760	100.00	0.000	0.000
					B	0.000	15.760		100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{Leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
					C	0.000	15.760		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	0.00	80.50	A	1	0.6	48	1	1	3.255	103.27	25.32	C
36.09-32.01			B	1	0.6		1	1	3.255			
			C	1	0.6		1	1	3.255			
L2	0.00	493.15	A	1	0.6	44	1	1	15.064	441.01	25.96	C
32.01-15.02			B	1	0.6		1	1	15.064			
			C	1	0.6		1	1	15.064			
L3 15.02-0.00	0.00	639.77	A	1	0.6	41	1	1	15.760	421.45	28.06	C
			B	1	0.6		1	1	15.760			
			C	1	0.6		1	1	15.760			
Sum Weight:	0.00	1213.42						OTM	16810.98 lb-ft	965.73		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	0.00	80.50	A	1	0.6	48	1	1	3.255	103.27	25.32	C
36.09-32.01			B	1	0.6		1	1	3.255			
			C	1	0.6		1	1	3.255			
L2	0.00	493.15	A	1	0.6	44	1	1	15.064	441.01	25.96	C
32.01-15.02			B	1	0.6		1	1	15.064			
			C	1	0.6		1	1	15.064			
L3 15.02-0.00	0.00	639.77	A	1	0.6	41	1	1	15.760	421.45	28.06	C
			B	1	0.6		1	1	15.760			
			C	1	0.6		1	1	15.760			
Sum Weight:	0.00	1213.42						OTM	16810.98 lb-ft	965.73		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	0.00	80.50	A	1	0.6	48	1	1	3.255	103.27	25.32	C
36.09-32.01			B	1	0.6		1	1	3.255			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
			C	1	0.6		1	1	3.255			
L2	0.00	493.15	A	1	0.6	44	1	1	15.064	441.01	25.96	C
32.01-15.02			B	1	0.6		1	1	15.064			
			C	1	0.6		1	1	15.064			
L3 15.02-0.00	0.00	639.77	A	1	0.6	41	1	1	15.760	421.45	28.06	C
			B	1	0.6		1	1	15.760			
			C	1	0.6		1	1	15.760			
Sum Weight:	0.00	1213.42						OTM	16810.98 lb-ft	965.73		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	0.00	196.26	A	1	1.2	9	1	1	4.618	53.83	13.20	C
36.09-32.01			B	1	1.2		1	1	4.618			
			C	1	1.2		1	1	4.618			
L2	0.00	996.96	A	1	1.2	8	1	1	20.745	223.09	13.13	C
32.01-15.02			B	1	1.2		1	1	20.745			
			C	1	1.2		1	1	20.745			
L3 15.02-0.00	0.00	1091.28	A	1	1.2	7	1	1	20.594	202.30	13.47	C
			B	1	1.2		1	1	20.594			
			C	1	1.2		1	1	20.594			
Sum Weight:	0.00	2284.50						OTM	8478.85 lb-ft	479.22		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	0.00	196.26	A	1	1.2	9	1	1	4.618	53.83	13.20	C
36.09-32.01			B	1	1.2		1	1	4.618			
			C	1	1.2		1	1	4.618			
L2	0.00	996.96	A	1	1.2	8	1	1	20.745	223.09	13.13	C
32.01-15.02			B	1	1.2		1	1	20.745			
			C	1	1.2		1	1	20.745			
L3 15.02-0.00	0.00	1091.28	A	1	1.2	7	1	1	20.594	202.30	13.47	C
			B	1	1.2		1	1	20.594			
			C	1	1.2		1	1	20.594			
Sum Weight:	0.00	2284.50						OTM	8478.85 lb-ft	479.22		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	0.00	196.26	A	1	1.2	9	1	1	4.618	53.83	13.20	C
36.09-32.01			B	1	1.2		1	1	4.618			
			C	1	1.2		1	1	4.618			
L2	0.00	996.96	A	1	1.2	8	1	1	20.745	223.09	13.13	C
32.01-15.02			B	1	1.2		1	1	20.745			
			C	1	1.2		1	1	20.745			
L3 15.02-0.00	0.00	1091.28	A	1	1.2	7	1	1	20.594	202.30	13.47	C
			B	1	1.2		1	1	20.594			
			C	1	1.2		1	1	20.594			
Sum Weight:	0.00	2284.50						OTM	8478.85 lb-ft	479.22		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	0.00	80.50	A	1	0.799	8	1	1	3.255	22.59	5.54	C
36.09-32.01			B	1	0.799		1	1	3.255			
			C	1	0.799		1	1	3.255			
L2	0.00	493.15	A	1	0.748	7	1	1	15.064	90.38	5.32	C
32.01-15.02			B	1	0.748		1	1	15.064			
			C	1	0.748		1	1	15.064			
L3 15.02-0.00	0.00	639.77	A	1	0.662	7	1	1	15.760	76.37	5.08	C
			B	1	0.662		1	1	15.760			
			C	1	0.662		1	1	15.760			
Sum Weight:	0.00	1213.42						OTM	3420.98 lb-ft	189.34		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	0.00	80.50	A	1	0.799	8	1	1	3.255	22.59	5.54	C
36.09-32.01			B	1	0.799		1	1	3.255			
			C	1	0.799		1	1	3.255			
L2	0.00	493.15	A	1	0.748	7	1	1	15.064	90.38	5.32	C
32.01-15.02			B	1	0.748		1	1	15.064			
			C	1	0.748		1	1	15.064			
L3 15.02-0.00	0.00	639.77	A	1	0.662	7	1	1	15.760	76.37	5.08	C
			B	1	0.662		1	1	15.760			
			C	1	0.662		1	1	15.760			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
Sum Weight:	0.00	1213.42						OTM	3420.98 lb-ft	189.34		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	0.00	80.50	A	1	0.799	8	1	1	3.255	22.59	5.54	C
36.09-32.01			B	1	0.799		1	1	3.255			
			C	1	0.799		1	1	3.255			
L2	0.00	493.15	A	1	0.748	7	1	1	15.064	90.38	5.32	C
32.01-15.02			B	1	0.748		1	1	15.064			
			C	1	0.748		1	1	15.064			
L3 15.02-0.00	0.00	639.77	A	1	0.662	7	1	1	15.760	76.37	5.08	C
			B	1	0.662		1	1	15.760			
			C	1	0.662		1	1	15.760			
Sum Weight:	0.00	1213.42						OTM	3420.98 lb-ft	189.34		

User Load Vectors - No Ice

Windtronics 2.2kW Wind Turbine - Elevation 39.6982

Wind Azimuth °	$Offset_x$ ft	$Offset_z$ ft	F lb	V_x lb	V_z lb	OTM_x lb-ft	OTM_z lb-ft	Torque lb-ft
0	0.00	0.00	1927.00	0.00	-1927.00	-76498.37	0.00	0.00
30	0.00	0.00	1927.00	963.50	-1668.83	-66249.53	-38249.18	0.00
60	0.00	0.00	1927.00	1668.83	-963.50	-38249.18	-66249.53	0.00
90	0.00	0.00	1927.00	1927.00	0.00	0.00	-76498.37	0.00
120	0.00	0.00	1927.00	1668.83	963.50	38249.18	-66249.53	0.00
150	0.00	0.00	1927.00	963.50	1668.83	66249.53	-38249.18	0.00
180	0.00	0.00	1927.00	0.00	1927.00	76498.37	0.00	0.00
210	0.00	0.00	1927.00	-963.50	1668.83	66249.53	38249.18	0.00
240	0.00	0.00	1927.00	-1668.83	963.50	38249.18	66249.53	0.00
270	0.00	0.00	1927.00	-1927.00	0.00	0.00	76498.37	0.00
300	0.00	0.00	1927.00	-1668.83	-963.50	-38249.18	66249.53	0.00
330	0.00	0.00	1927.00	-963.50	-1668.83	-66249.53	38249.18	0.00

User Load Totals - No Ice

Wind Azimuth °	V_x lb	V_z lb	OTM_x lb-ft	OTM_z lb-ft	Torque lb-ft

Wind Azimuth °	V_x lb	V_z lb	OTM_x lb-ft	OTM_z lb-ft	Torque lb-ft
0	0.00	-1927.00	-76498.37	0.00	0.00
30	963.50	-1668.83	-66249.53	-38249.18	0.00
60	1668.83	-963.50	-38249.18	-66249.53	0.00
90	1927.00	0.00	0.00	-76498.37	0.00
120	1668.83	963.50	38249.18	-66249.53	0.00
150	963.50	1668.83	66249.53	-38249.18	0.00
180	0.00	1927.00	76498.37	0.00	0.00
210	-963.50	1668.83	66249.53	38249.18	0.00
240	-1668.83	963.50	38249.18	66249.53	0.00
270	-1927.00	0.00	0.00	76498.37	0.00
300	-1668.83	-963.50	-38249.18	66249.53	0.00
330	-963.50	-1668.83	-66249.53	38249.18	0.00

User Load Vectors - With Ice

Windtronics 2.2kW Wind Turbine - Elevation 39.6982

Wind Azimuth °	$Offset_x$ ft	$Offset_z$ ft	F lb	V_x lb	V_z lb	OTM_x lb-ft	OTM_z lb-ft	Torque lb-ft
0	0.00	0.00	2216.00	0.00	-2216.00	-87971.14	0.00	0.00
30	0.00	0.00	2216.00	1108.00	-1919.11	-76185.24	-43985.57	0.00
60	0.00	0.00	2216.00	1919.11	-1108.00	-43985.57	-76185.24	0.00
90	0.00	0.00	2216.00	2216.00	0.00	0.00	-87971.14	0.00
120	0.00	0.00	2216.00	1919.11	1108.00	43985.57	-76185.24	0.00
150	0.00	0.00	2216.00	1108.00	1919.11	76185.24	-43985.57	0.00
180	0.00	0.00	2216.00	0.00	2216.00	87971.14	0.00	0.00
210	0.00	0.00	2216.00	-1108.00	1919.11	76185.24	43985.57	0.00
240	0.00	0.00	2216.00	-1919.11	1108.00	43985.57	76185.24	0.00
270	0.00	0.00	2216.00	-2216.00	0.00	0.00	87971.14	0.00
300	0.00	0.00	2216.00	-1919.11	-1108.00	-43985.57	76185.24	0.00
330	0.00	0.00	2216.00	-1108.00	-1919.11	-76185.24	43985.57	0.00

User Load Totals - With Ice

Wind Azimuth °	V_x lb	V_z lb	OTM_x lb-ft	OTM_z lb-ft	Torque lb-ft
0	0.00	-2216.00	-87971.14	0.00	0.00
30	1108.00	-1919.11	-76185.24	-43985.57	0.00
60	1919.11	-1108.00	-43985.57	-76185.24	0.00
90	2216.00	0.00	0.00	-87971.14	0.00
120	1919.11	1108.00	43985.57	-76185.24	0.00
150	1108.00	1919.11	76185.24	-43985.57	0.00
180	0.00	2216.00	87971.14	0.00	0.00
210	-1108.00	1919.11	76185.24	43985.57	0.00
240	-1919.11	1108.00	43985.57	76185.24	0.00
270	-2216.00	0.00	0.00	87971.14	0.00
300	-1919.11	-1108.00	-43985.57	76185.24	0.00
330	-1108.00	-1919.11	-76185.24	43985.57	0.00

User Load Vectors - Service

Windtronics 2.2kW Wind Turbine - Elevation 39.6982

Wind Azimuth °	$Offset_x$ ft	$Offset_z$ ft	F lb	V_x lb	V_z lb	OTM_x lb-ft	OTM_z lb-ft	Torque lb-ft
0	0.00	0.00	1927.00	0.00	-1927.00	-76498.37	0.00	0.00
30	0.00	0.00	1927.00	963.50	-1668.83	-66249.53	-38249.18	0.00
60	0.00	0.00	1927.00	1668.83	-963.50	-38249.18	-66249.53	0.00
90	0.00	0.00	1927.00	1927.00	0.00	0.00	-76498.37	0.00
120	0.00	0.00	1927.00	1668.83	963.50	38249.18	-66249.53	0.00
150	0.00	0.00	1927.00	963.50	1668.83	66249.53	-38249.18	0.00
180	0.00	0.00	1927.00	0.00	1927.00	76498.37	0.00	0.00
210	0.00	0.00	1927.00	-963.50	1668.83	66249.53	38249.18	0.00
240	0.00	0.00	1927.00	-1668.83	963.50	38249.18	66249.53	0.00
270	0.00	0.00	1927.00	-1927.00	0.00	0.00	76498.37	0.00
300	0.00	0.00	1927.00	-1668.83	-963.50	-38249.18	66249.53	0.00
330	0.00	0.00	1927.00	-963.50	-1668.83	-66249.53	38249.18	0.00

User Load Totals - Service

Wind Azimuth °	V_x lb	V_z lb	OTM_x lb-ft	OTM_z lb-ft	Torque lb-ft
0	0.00	-1927.00	-76498.37	0.00	0.00
30	963.50	-1668.83	-66249.53	-38249.18	0.00
60	1668.83	-963.50	-38249.18	-66249.53	0.00
90	1927.00	0.00	0.00	-76498.37	0.00
120	1668.83	963.50	38249.18	-66249.53	0.00
150	963.50	1668.83	66249.53	-38249.18	0.00
180	0.00	1927.00	76498.37	0.00	0.00
210	-963.50	1668.83	66249.53	38249.18	0.00
240	-1668.83	963.50	38249.18	66249.53	0.00
270	-1927.00	0.00	0.00	76498.37	0.00
300	-1668.83	-963.50	-38249.18	66249.53	0.00
330	-963.50	-1668.83	-66249.53	38249.18	0.00

Force Totals

Load Case	Vertical Forces lb	Sum of Forces X lb	Sum of Forces Z lb	Sum of Overturning Moments, M_x lb-ft	Sum of Overturning Moments, M_z lb-ft	Sum of Torques lb-ft
Leg Weight	1213.42					
Bracing Weight	0.00					
Total Member Self-Weight	1213.42			0.00	0.00	
Total Weight	1456.42			0.00	0.00	
Wind 0 deg - No Ice		0.00	-2892.73	-93309.35	0.00	0.00
Wind 30 deg - No Ice		1446.36	-2505.18	-80808.27	-46654.68	0.00
Wind 60 deg - No Ice		2505.18	-1446.36	-46654.68	-80808.27	0.00
Wind 90 deg - No Ice		2892.73	0.00	0.00	-93309.35	0.00
Wind 120 deg - No Ice		2505.18	1446.36	46654.68	-80808.27	0.00
Wind 150 deg - No Ice		1446.36	2505.18	80808.27	-46654.68	0.00
Wind 180 deg - No Ice		0.00	2892.73	93309.35	0.00	0.00

Load Case	Vertical Forces lb	Sum of Forces X lb	Sum of Forces Z lb	Sum of Overturning Moments, M_x lb-ft	Sum of Overturning Moments, M_z lb-ft	Sum of Torques lb-ft
Wind 210 deg - No Ice		-1446.36	2505.18	80808.27	46654.68	0.00
Wind 240 deg - No Ice		-2505.18	1446.36	46654.68	80808.27	0.00
Wind 270 deg - No Ice		-2892.73	0.00	0.00	93309.35	0.00
Wind 300 deg - No Ice		-2505.18	-1446.36	-46654.68	80808.27	0.00
Wind 330 deg - No Ice		-1446.36	-2505.18	-80808.27	46654.68	0.00
Member Ice	1071.08					
Total Weight Ice	2588.50			0.00	0.00	
Wind 0 deg - Ice		0.00	-2695.22	-96449.99	0.00	0.00
Wind 30 deg - Ice		1347.61	-2334.13	-83528.14	-48225.00	0.00
Wind 60 deg - Ice		2334.13	-1347.61	-48225.00	-83528.14	0.00
Wind 90 deg - Ice		2695.22	0.00	0.00	-96449.99	0.00
Wind 120 deg - Ice		2334.13	1347.61	48225.00	-83528.14	0.00
Wind 150 deg - Ice		1347.61	2334.13	83528.14	-48225.00	0.00
Wind 180 deg - Ice		0.00	2695.22	96449.99	0.00	0.00
Wind 210 deg - Ice		-1347.61	2334.13	83528.14	48225.00	0.00
Wind 240 deg - Ice		-2334.13	1347.61	48225.00	83528.14	0.00
Wind 270 deg - Ice		-2695.22	0.00	0.00	96449.99	0.00
Wind 300 deg - Ice		-2334.13	-1347.61	-48225.00	83528.14	0.00
Wind 330 deg - Ice		-1347.61	-2334.13	-83528.14	48225.00	0.00
Total Weight	1456.42			0.00	0.00	
Wind 0 deg - Service		0.00	-2116.34	-79919.34	0.00	0.00
Wind 30 deg - Service		1058.17	-1832.81	-69212.18	-39959.67	0.00
Wind 60 deg - Service		1832.81	-1058.17	-39959.67	-69212.18	0.00
Wind 90 deg - Service		2116.34	0.00	0.00	-79919.34	0.00
Wind 120 deg - Service		1832.81	1058.17	39959.67	-69212.18	0.00
Wind 150 deg - Service		1058.17	1832.81	69212.18	-39959.67	0.00
Wind 180 deg - Service		0.00	2116.34	79919.34	0.00	0.00
Wind 210 deg - Service		-1058.17	1832.81	69212.18	39959.67	0.00
Wind 240 deg - Service		-1832.81	1058.17	39959.67	69212.18	0.00
Wind 270 deg - Service		-2116.34	0.00	0.00	79919.34	0.00
Wind 300 deg - Service		-1832.81	-1058.17	-39959.67	69212.18	0.00
Wind 330 deg - Service		-1058.17	-1832.81	-69212.18	39959.67	0.00

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.6 Wind 0 deg - No Ice
3	0.9 Dead+1.6 Wind 0 deg - No Ice
4	1.2 Dead+1.6 Wind 30 deg - No Ice
5	0.9 Dead+1.6 Wind 30 deg - No Ice
6	1.2 Dead+1.6 Wind 60 deg - No Ice
7	0.9 Dead+1.6 Wind 60 deg - No Ice
8	1.2 Dead+1.6 Wind 90 deg - No Ice
9	0.9 Dead+1.6 Wind 90 deg - No Ice
10	1.2 Dead+1.6 Wind 120 deg - No Ice
11	0.9 Dead+1.6 Wind 120 deg - No Ice
12	1.2 Dead+1.6 Wind 150 deg - No Ice
13	0.9 Dead+1.6 Wind 150 deg - No Ice
14	1.2 Dead+1.6 Wind 180 deg - No Ice
15	0.9 Dead+1.6 Wind 180 deg - No Ice
16	1.2 Dead+1.6 Wind 210 deg - No Ice
17	0.9 Dead+1.6 Wind 210 deg - No Ice
18	1.2 Dead+1.6 Wind 240 deg - No Ice
19	0.9 Dead+1.6 Wind 240 deg - No Ice

Comb. No.	Description
20	1.2 Dead+1.6 Wind 270 deg - No Ice
21	0.9 Dead+1.6 Wind 270 deg - No Ice
22	1.2 Dead+1.6 Wind 300 deg - No Ice
23	0.9 Dead+1.6 Wind 300 deg - No Ice
24	1.2 Dead+1.6 Wind 330 deg - No Ice
25	0.9 Dead+1.6 Wind 330 deg - No Ice
26	1.2 Dead+1.0 Ice+1.0 Temp
27	1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp
28	1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp
29	1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp
30	1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp
31	1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp
32	1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp
33	1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp
34	1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp
35	1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp
36	1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp
37	1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp
38	1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp
39	Dead+Wind 0 deg - Service
40	Dead+Wind 30 deg - Service
41	Dead+Wind 60 deg - Service
42	Dead+Wind 90 deg - Service
43	Dead+Wind 120 deg - Service
44	Dead+Wind 150 deg - Service
45	Dead+Wind 180 deg - Service
46	Dead+Wind 210 deg - Service
47	Dead+Wind 240 deg - Service
48	Dead+Wind 270 deg - Service
49	Dead+Wind 300 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial lb	Major Axis Moment lb-ft	Minor Axis Moment lb-ft
L1	36.089 - 32.0109	Pole	Max Tension	7	25.22	-12383.89	7150.01
			Max. Compression	26	-457.44	0.00	0.00
			Max. Mx	8	-76.88	-17526.94	0.00
			Max. My	2	-76.88	0.00	17526.94
			Max. Vy	8	3180.66	-17526.94	0.00
			Max. Vx	2	-3180.66	0.00	17526.94
			Max. Torque	4			0.00
L2	32.0109 - 15.0211	Pole	Max Tension	3	3.16	0.00	8765.72
			Max. Compression	26	-1531.62	0.00	0.00
			Max. Mx	8	-691.88	-74062.29	0.00
			Max. My	2	-691.88	0.00	74062.29
			Max. Vy	8	3858.08	-74062.29	0.00
			Max. Vx	2	-3858.08	0.00	74062.29
			Max. Torque	4			-0.00
L3	15.0211 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-3029.03	0.00	0.00
			Max. Mx	8	-1741.15	-150355.78	0.00
			Max. My	2	-1741.15	0.00	150355.78
			Max. Vy	8	4630.60	-150355.78	0.00
			Max. Vx	2	-4630.60	0.00	150355.78

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial lb	Major Axis Moment lb-ft	Minor Axis Moment lb-ft
			Max. Torque	4			-0.01

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
Pole	Max. Vert	26	3029.03	0.00	0.00
	Max. H_x	21	1310.77	4628.20	0.00
	Max. H_z	3	1310.77	0.00	4628.20
	Max. M_x	2	150355.78	0.00	4628.14
	Max. M_z	8	150355.78	-4628.14	0.00
	Max. Torsion	12	0.01	-2314.17	-4008.25
	Min. Vert	3	1310.77	0.00	4628.20
	Min. H_x	9	1310.77	-4628.20	0.00
	Min. H_z	15	1310.77	0.00	-4628.20
	Min. M_x	14	-150355.78	0.00	-4628.14
	Min. M_z	20	-150355.78	4628.14	0.00
	Min. Torsion	4	-0.01	-2314.17	4008.25

Tower Mast Reaction Summary

Load Combination	Vertical lb	$Shear_x$ lb	$Shear_z$ lb	Overturning Moment, M_x lb-ft	Overturning Moment, M_z lb-ft	Torque lb-ft
Dead Only	1456.42	0.00	0.00	0.00	0.00	0.00
1.2 Dead+1.6 Wind 0 deg - No Ice	1747.69	0.00	-4628.14	-150355.78	0.00	0.00
0.9 Dead+1.6 Wind 0 deg - No Ice	1310.77	0.00	-4628.20	-150044.67	0.00	0.00
1.2 Dead+1.6 Wind 30 deg - No Ice	1747.70	2314.17	-4008.25	-130216.51	-75180.58	0.01
0.9 Dead+1.6 Wind 30 deg - No Ice	1310.77	2314.17	-4008.26	-129945.73	-75024.24	0.01
1.2 Dead+1.6 Wind 60 deg - No Ice	1747.70	4008.25	-2314.17	-75180.58	-130216.51	-0.01
0.9 Dead+1.6 Wind 60 deg - No Ice	1310.77	4008.26	-2314.17	-75024.24	-129945.73	-0.01
1.2 Dead+1.6 Wind 90 deg - No Ice	1747.69	4628.14	0.00	0.00	-150355.78	0.00
0.9 Dead+1.6 Wind 90 deg - No Ice	1310.77	4628.20	0.00	0.00	-150044.67	0.00
1.2 Dead+1.6 Wind 120 deg - No Ice	1747.70	4008.25	2314.17	75180.58	-130216.51	0.01
0.9 Dead+1.6 Wind 120 deg - No Ice	1310.77	4008.26	2314.17	75024.24	-129945.73	0.01
1.2 Dead+1.6 Wind 150 deg - No Ice	1747.70	2314.17	4008.25	130216.51	-75180.58	-0.01
0.9 Dead+1.6 Wind 150 deg - No Ice	1310.77	2314.17	4008.26	129945.73	-75024.24	-0.01
1.2 Dead+1.6 Wind 180 deg - No Ice	1747.69	0.00	4628.14	150355.78	0.00	0.00
0.9 Dead+1.6 Wind 180 deg -	1310.77	0.00	4628.20	150044.67	0.00	0.00

Load Combination	Vertical lb	$Shear_x$ lb	$Shear_z$ lb	Overturning Moment, M_x lb-ft	Overturning Moment, M_z lb-ft	Torque lb-ft
No Ice						
1.2 Dead+1.6 Wind 210 deg - No Ice	1747.70	-2314.17	4008.25	130216.51	75180.58	0.01
0.9 Dead+1.6 Wind 210 deg - No Ice	1310.77	-2314.17	4008.26	129945.73	75024.24	0.01
1.2 Dead+1.6 Wind 240 deg - No Ice	1747.70	-4008.25	2314.17	75180.58	130216.51	-0.01
0.9 Dead+1.6 Wind 240 deg - No Ice	1310.77	-4008.26	2314.17	75024.24	129945.73	-0.01
1.2 Dead+1.6 Wind 270 deg - No Ice	1747.69	-4628.14	0.00	0.00	150355.78	0.00
0.9 Dead+1.6 Wind 270 deg - No Ice	1310.77	-4628.20	0.00	0.00	150044.67	0.00
1.2 Dead+1.6 Wind 300 deg - No Ice	1747.70	-4008.25	-2314.17	-75180.58	130216.51	0.01
0.9 Dead+1.6 Wind 300 deg - No Ice	1310.77	-4008.26	-2314.17	-75024.24	129945.73	0.01
1.2 Dead+1.6 Wind 330 deg - No Ice	1747.70	-2314.17	-4008.25	-130216.51	75180.58	-0.01
0.9 Dead+1.6 Wind 330 deg - No Ice	1310.77	-2314.17	-4008.26	-129945.73	75024.24	-0.01
1.2 Dead+1.0 Ice+1.0 Temp	3029.03	0.00	0.00	0.00	0.00	0.00
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	3029.02	0.00	-2695.02	-97789.56	0.00	0.00
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp	3029.03	1347.59	-2334.10	-84694.05	-48898.15	0.00
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp	3029.03	2334.10	-1347.59	-48898.15	-84694.05	-0.00
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	3029.02	2695.02	0.00	0.00	-97789.56	0.00
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp	3029.03	2334.10	1347.59	48898.15	-84694.05	0.00
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp	3029.03	1347.59	2334.10	84694.05	-48898.15	-0.00
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	3029.02	0.00	2695.02	97789.56	0.00	0.00
1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp	3029.03	-1347.59	2334.10	84694.05	48898.15	0.00
1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp	3029.03	-2334.10	1347.59	48898.15	84694.05	-0.00
1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp	3029.02	-2695.02	0.00	0.00	97789.56	0.00
1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp	3029.03	-2334.10	-1347.59	-48898.15	84694.05	0.00
1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp	3029.03	-1347.59	-2334.10	-84694.05	48898.15	-0.00
Dead+Wind 0 deg - Service	1456.41	0.00	-2116.23	-80464.12	0.00	0.00
Dead+Wind 30 deg - Service	1456.41	1058.12	-1832.71	-69684.01	-40232.12	0.00
Dead+Wind 60 deg - Service	1456.41	1832.71	-1058.12	-40232.12	-69684.01	-0.00
Dead+Wind 90 deg - Service	1456.41	2116.23	0.00	0.00	-80464.12	0.00
Dead+Wind 120 deg - Service	1456.41	1832.71	1058.12	40232.12	-69684.01	0.00
Dead+Wind 150 deg - Service	1456.41	1058.12	1832.71	69684.01	-40232.12	-0.00
Dead+Wind 180 deg - Service	1456.41	0.00	2116.23	80464.12	0.00	0.00
Dead+Wind 210 deg - Service	1456.41	-1058.12	1832.71	69684.01	40232.12	0.00
Dead+Wind 240 deg - Service	1456.41	-1832.71	1058.12	40232.12	69684.01	-0.00
Dead+Wind 270 deg - Service	1456.41	-2116.23	0.00	0.00	80464.12	0.00
Dead+Wind 300 deg - Service	1456.41	-1832.71	-1058.12	-40232.12	69684.01	0.00
Dead+Wind 330 deg - Service	1456.41	-1058.12	-1832.71	-69684.01	40232.12	-0.00

Solution Summary

Load Comb.	Sum of Applied Forces PX lb	PY lb	PZ lb	Sum of Reactions PX lb	PY lb	PZ lb	% Error
1	0.00	-1456.42	0.00	0.00	1456.42	0.00	0.000%
2	0.00	-1747.70	-4628.36	0.00	1747.69	4628.14	0.005%
3	0.00	-1310.77	-4628.36	0.00	1310.77	4628.20	0.003%
4	2314.18	-1747.70	-4008.28	-2314.17	1747.70	4008.25	0.001%
5	2314.18	-1310.77	-4008.28	-2314.17	1310.77	4008.26	0.000%
6	4008.28	-1747.70	-2314.18	-4008.25	1747.70	2314.17	0.001%
7	4008.28	-1310.77	-2314.18	-4008.26	1310.77	2314.17	0.000%
8	4628.36	-1747.70	0.00	-4628.14	1747.69	0.00	0.005%
9	4628.36	-1310.77	0.00	-4628.20	1310.77	0.00	0.003%
10	4008.28	-1747.70	2314.18	-4008.25	1747.70	-2314.17	0.001%
11	4008.28	-1310.77	2314.18	-4008.26	1310.77	-2314.17	0.000%
12	2314.18	-1747.70	4008.28	-2314.17	1747.70	-4008.25	0.001%
13	2314.18	-1310.77	4008.28	-2314.17	1310.77	-4008.26	0.000%
14	0.00	-1747.70	4628.36	0.00	1747.69	-4628.14	0.005%
15	0.00	-1310.77	4628.36	0.00	1310.77	-4628.20	0.003%
16	-2314.18	-1747.70	4008.28	2314.17	1747.70	-4008.25	0.001%
17	-2314.18	-1310.77	4008.28	2314.17	1310.77	-4008.26	0.000%
18	-4008.28	-1747.70	2314.18	4008.25	1747.70	-2314.17	0.001%
19	-4008.28	-1310.77	2314.18	4008.26	1310.77	-2314.17	0.000%
20	-4628.36	-1747.70	0.00	4628.14	1747.69	0.00	0.005%
21	-4628.36	-1310.77	0.00	4628.20	1310.77	0.00	0.003%
22	-4008.28	-1747.70	-2314.18	4008.25	1747.70	2314.17	0.001%
23	-4008.28	-1310.77	-2314.18	4008.26	1310.77	2314.17	0.000%
24	-2314.18	-1747.70	-4008.28	2314.17	1747.70	4008.25	0.001%
25	-2314.18	-1310.77	-4008.28	2314.17	1310.77	4008.26	0.000%
26	0.00	-3029.03	0.00	0.00	3029.03	0.00	0.000%
27	0.00	-3029.03	-2695.22	0.00	3029.02	2695.02	0.005%
28	1347.61	-3029.03	-2334.13	-1347.59	3029.03	2334.10	0.001%
29	2334.13	-3029.03	-1347.61	-2334.10	3029.03	1347.59	0.001%
30	2695.22	-3029.03	0.00	-2695.02	3029.02	0.00	0.005%
31	2334.13	-3029.03	1347.61	-2334.10	3029.03	-1347.59	0.001%
32	1347.61	-3029.03	2334.13	-1347.59	3029.03	-2334.10	0.001%
33	0.00	-3029.03	2695.22	0.00	3029.02	-2695.02	0.005%
34	-1347.61	-3029.03	2334.13	1347.59	3029.03	-2334.10	0.001%
35	-2334.13	-3029.03	1347.61	2334.10	3029.03	-1347.59	0.001%
36	-2695.22	-3029.03	0.00	2695.02	3029.02	0.00	0.005%
37	-2334.13	-3029.03	-1347.61	2334.10	3029.03	1347.59	0.001%
38	-1347.61	-3029.03	-2334.13	1347.59	3029.03	2334.10	0.001%
39	0.00	-1456.42	-2116.34	0.00	1456.41	2116.23	0.004%
40	1058.17	-1456.42	-1832.81	-1058.12	1456.41	1832.71	0.004%
41	1832.81	-1456.42	-1058.17	-1832.71	1456.41	1058.12	0.004%
42	2116.34	-1456.42	0.00	-2116.23	1456.41	0.00	0.004%
43	1832.81	-1456.42	1058.17	-1832.71	1456.41	-1058.12	0.004%
44	1058.17	-1456.42	1832.81	-1058.12	1456.41	-1832.71	0.004%
45	0.00	-1456.42	2116.34	0.00	1456.41	-2116.23	0.004%
46	-1058.17	-1456.42	1832.81	1058.12	1456.41	-1832.71	0.004%
47	-1832.81	-1456.42	1058.17	1832.71	1456.41	-1058.12	0.004%
48	-2116.34	-1456.42	0.00	2116.23	1456.41	0.00	0.004%
49	-1832.81	-1456.42	-1058.17	1832.71	1456.41	1058.12	0.004%
50	-1058.17	-1456.42	-1832.81	1058.12	1456.41	1832.71	0.004%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	4	0.00000001	0.00024031
3	Yes	4	0.00000001	0.00017161
4	Yes	5	0.00000001	0.00070432
5	Yes	5	0.00000001	0.00049835
6	Yes	5	0.00000001	0.00070432
7	Yes	5	0.00000001	0.00049835
8	Yes	4	0.00000001	0.00024031
9	Yes	4	0.00000001	0.00017161
10	Yes	5	0.00000001	0.00070432
11	Yes	5	0.00000001	0.00049835
12	Yes	5	0.00000001	0.00070432
13	Yes	5	0.00000001	0.00049835
14	Yes	4	0.00000001	0.00024031
15	Yes	4	0.00000001	0.00017161
16	Yes	5	0.00000001	0.00070432
17	Yes	5	0.00000001	0.00049835
18	Yes	5	0.00000001	0.00070432
19	Yes	5	0.00000001	0.00049835
20	Yes	4	0.00000001	0.00024031
21	Yes	4	0.00000001	0.00017161
22	Yes	5	0.00000001	0.00070432
23	Yes	5	0.00000001	0.00049835
24	Yes	5	0.00000001	0.00070432
25	Yes	5	0.00000001	0.00049835
26	Yes	4	0.00000001	0.00000001
27	Yes	4	0.00000001	0.00122844
28	Yes	5	0.00000001	0.00071778
29	Yes	5	0.00000001	0.00071778
30	Yes	4	0.00000001	0.00122844
31	Yes	5	0.00000001	0.00071778
32	Yes	5	0.00000001	0.00071778
33	Yes	4	0.00000001	0.00122844
34	Yes	5	0.00000001	0.00071778
35	Yes	5	0.00000001	0.00071778
36	Yes	4	0.00000001	0.00122844
37	Yes	5	0.00000001	0.00071778
38	Yes	5	0.00000001	0.00071778
39	Yes	4	0.00000001	0.00021110
40	Yes	4	0.00000001	0.00127210
41	Yes	4	0.00000001	0.00127210
42	Yes	4	0.00000001	0.00021110
43	Yes	4	0.00000001	0.00127210
44	Yes	4	0.00000001	0.00127210
45	Yes	4	0.00000001	0.00021110
46	Yes	4	0.00000001	0.00127210
47	Yes	4	0.00000001	0.00127210
48	Yes	4	0.00000001	0.00021110
49	Yes	4	0.00000001	0.00127210
50	Yes	4	0.00000001	0.00127210

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	36.089 - 32.0109	11.501	42	2.7785	0.0000

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L2	34.05 - 15.0211	10.333	42	2.6905	0.0000
L3	17.9748 - 0	2.994	42	1.4998	0.0000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
39.70	Windtronics 2.2kW Wind Turbine	42	11.501	2.7785	0.0000	1058

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	36.089 - 32.0109	20.408	8	4.8264	0.0000
L2	34.05 - 15.0211	18.377	8	4.6854	0.0000
L3	17.9748 - 0	5.446	8	2.6983	0.0000

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
39.70	Windtronics 2.2kW Wind Turbine	8	20.408	4.8264	0.0000	662

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
L1	36.089 - 35.0695	TP10.0984x9.0551x0.1969	4.08	0.00	0.0	5.6395	-52.63	329908.00	0.000
	35.0695 - 34.05					5.8007	-76.87	339344.00	0.000
	34.05 - 32.0109					6.1234	-82.63	358216.00	0.000
L2	34.05 - 32.0109	TP11.815x9.1831x0.2362	19.03	0.00	0.0	6.8488	-97.29	400655.00	0.000
	32.0109 - 31.0083					6.9517	-210.45	406675.00	0.001

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
	31.0083 - 30.0058					7.0546	-242.02	412695.00	0.001
	30.0058 - 29.0032					7.1575	-274.55	418715.00	0.001
	29.0032 - 28.0006					7.2604	-308.03	424735.00	0.001
	28.0006 - 26.998					7.3633	-342.44	430755.00	0.001
	26.998 - 25.9954					7.4662	-377.77	436775.00	0.001
	25.9954 - 24.9929					7.5691	-414.00	442795.00	0.001
	24.9929 - 23.9903					7.6721	-451.11	448815.00	0.001
	23.9903 - 22.9877					7.7750	-489.11	454835.00	0.001
	22.9877 - 21.9851					7.8779	-527.97	460855.00	0.001
	21.9851 - 20.9826					7.9808	-567.68	466875.00	0.001
	20.9826 - 19.98					8.0837	-608.24	472895.00	0.001
	19.98 - 18.9774					8.1866	-649.63	478915.00	0.001
	18.9774 - 17.9748					8.2895	-691.86	484935.00	0.001
	17.9748 - 15.0211					8.5927	-430.37	502671.00	0.001
L3	17.9748 - 15.0211	TP13.7795x10.934x0.2756	17.97	0.00	0.0	9.6328	-484.26	563518.00	0.001
	15.0211 - 14.0197					9.7701	-966.89	571548.00	0.002
	14.0197 - 13.0183					9.9073	-1017.05	579577.00	0.002
	13.0183 - 12.0169					10.0446	-1068.03	587606.00	0.002
	12.0169 - 11.0155					10.1818	-1119.80	595636.00	0.002
	11.0155 - 10.0141					10.3191	-1172.37	603665.00	0.002
	10.0141 - 9.01265					10.4563	-1225.74	611694.00	0.002
	9.01265 - 8.01125					10.5936	-1279.89	619724.00	0.002
	8.01125 - 7.00984					10.7308	-1334.83	627753.00	0.002
	7.00984 - 6.00844					10.8681	-1390.55	635782.00	0.002
	6.00844 - 5.00703					11.0053	-1447.05	643812.00	0.002
	5.00703 - 4.00562					11.1426	-1504.33	651841.00	0.002
	4.00562 - 3.00422					11.2798	-1562.38	659870.00	0.002
	3.00422 - 2.00281					11.4171	-1621.20	667900.00	0.002
	2.00281 - 1.00141					11.5543	-1680.80	675929.00	0.002
	1.00141 - 0					11.6916	-1741.16	683958.00	0.003

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$

Pole Bending Design Data

Section No.	Elevation ft	Size	M_{ux} lb-ft	ϕM_{nx} lb-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} lb-ft	ϕM_{ny} lb-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
L1	36.089 - 35.0695	TP10.0984x9.0551x0.1969	14306.33	73380.83	0.195	0.00	73380.83	0.000
	35.0695 - 34.05		17527.33	77338.75	0.227	0.00	77338.75	0.000
	34.05 - 32.0109		12038.58	85562.50	0.141	0.00	85562.50	0.000
L2	34.05 - 32.0109	TP11.815x9.1831x0.2362	12068.33	92493.33	0.130	0.00	92493.33	0.000
	32.0109 - 31.0083		27408.42	95071.67	0.288	0.00	95071.67	0.000
	31.0083 - 30.0058		30749.50	97684.17	0.315	0.00	97684.17	0.000
	30.0058 - 29.0032		34130.33	100331.67	0.340	0.00	100331.67	0.000
	29.0032 - 28.0006		37551.42	103013.33	0.365	0.00	103013.33	0.000
	28.0006 - 26.998		41013.25	105730.83	0.388	0.00	105730.83	0.000
	26.998 - 25.9954		44516.25	108482.50	0.410	0.00	108482.50	0.000
	25.9954 - 24.9929		48060.67	111269.17	0.432	0.00	111269.17	0.000
	24.9929 - 23.9903		51646.92	114090.83	0.453	0.00	114090.83	0.000
	23.9903 - 22.9877		55275.50	116947.50	0.473	0.00	116947.50	0.000
	22.9877 - 21.9851		58946.67	119838.33	0.492	0.00	119838.33	0.000
	21.9851 - 20.9826		62660.75	122764.17	0.510	0.00	122764.17	0.000
	20.9826 - 19.98		66418.17	125725.00	0.528	0.00	125725.00	0.000
	19.98 - 18.9774		70219.25	128720.83	0.546	0.00	128720.83	0.000
	18.9774 - 17.9748		74064.33	131750.83	0.562	0.00	131750.83	0.000
	17.9748 - 15.0211		42322.08	140881.67	0.300	0.00	140881.67	0.000
L3	17.9748 - 15.0211	TP13.7795x10.934x0.2756	43341.83	156034.17	0.278	0.00	156034.17	0.000
	15.0211 - 14.0197		89686.67	160165.00	0.560	0.00	160165.00	0.000
	14.0197 - 13.0183		93750.00	164349.17	0.570	0.00	164349.17	0.000
	13.0183 - 12.0169		97853.33	168586.67	0.580	0.00	168586.67	0.000
	12.0169 - 11.0155		101997.50	172876.67	0.590	0.00	172876.67	0.000
	11.0155 - 10.0141		106182.50	177220.00	0.599	0.00	177220.00	0.000

Section No.	Elevation ft	Size	M_{ux} lb-ft	ϕM_{nx} lb-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} lb-ft	ϕM_{ny} lb-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
	10.0141 - 9.01265		110409.17	181615.83	0.608	0.00	181615.83	0.000
	9.01265 - 8.01125		114677.50	186065.83	0.616	0.00	186065.83	0.000
	8.01125 - 7.00984		118987.50	190568.33	0.624	0.00	190568.33	0.000
	7.00984 - 6.00844		123340.00	195124.17	0.632	0.00	195124.17	0.000
	6.00844 - 5.00703		127735.00	199732.50	0.640	0.00	199732.50	0.000
	5.00703 - 4.00562		132173.33	204394.17	0.647	0.00	204394.17	0.000
	4.00562 - 3.00422		136655.00	209109.17	0.654	0.00	209109.17	0.000
	3.00422 - 2.00281		141180.00	213877.50	0.660	0.00	213877.50	0.000
	2.00281 - 1.00141		145748.33	218698.33	0.666	0.00	218698.33	0.000
	1.00141 - 0		150360.83	223572.50	0.673	0.00	223572.50	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V_u lb	ϕV_n lb	Ratio $\frac{V_u}{\phi V_n}$	Actual T_u lb-ft	ϕT_n lb-ft	Ratio $\frac{T_u}{\phi T_n}$
L1	36.089 - 35.0695	TP10.0984x9.0551x0.1969	3138.84	164954.00	0.019	0.00	122630.83	0.000
	35.0695 - 34.05		3181.37	169672.00	0.019	0.00	129822.50	0.000
	34.05 - 32.0109		1655.33	178442.00	0.009	0.00	144281.67	0.000
L2	34.05 - 32.0109	TP11.815x9.1831x0.2362	1618.77	200328.00	0.008	0.00	150131.67	0.000
	32.0109 - 31.0083		3313.66	203338.00	0.016	0.00	154734.17	0.000
	31.0083 - 30.0058		3353.23	206348.00	0.016	0.00	159406.67	0.000
	30.0058 - 29.0032		3393.24	209358.00	0.016	0.00	164148.33	0.000
	29.0032 - 28.0006		3433.66	212368.00	0.016	0.00	168959.17	0.000
	28.0006 - 26.998		3474.49	215378.00	0.016	0.00	173840.00	0.000
	26.998 - 25.9954		3515.71	218388.00	0.016	0.00	178790.83	0.000
	25.9954 - 24.9929		3557.32	221398.00	0.016	0.00	183810.00	0.000
	24.9929 - 23.9903		3599.30	224408.00	0.016	0.00	188899.17	0.000
	23.9903 - 22.9877		3641.65	227418.00	0.016	0.00	194058.33	0.000
	22.9877 - 21.9851		3684.36	230428.00	0.016	0.00	199286.67	0.000
	21.9851 - 20.9826		3727.42	233438.00	0.016	0.00	204584.17	0.000
	20.9826 -		3770.82	236448.00	0.016	0.00	209951.67	0.000

Section No.	Elevation ft	Size	Actual V_u lb	ϕV_n lb	Ratio $\frac{V_u}{\phi V_n}$	Actual T_u lb-ft	ϕT_n lb-ft	Ratio $\frac{T_u}{\phi T_n}$
	19.98							
	19.98 - 18.9774		3814.56	239458.00	0.016	0.00	215388.33	0.000
	18.9774 - 17.9748		3858.62	242468.00	0.016	0.00	220895.00	0.000
	17.9748 - 15.0211		2009.05	251335.00	0.008	0.00	237521.67	0.000
L3	17.9748 - 15.0211	TP13.7795x10.934x0.2756	1990.27	281759.00	0.007	0.00	254770.83	0.000
	15.0211 - 14.0197		4038.83	285774.00	0.014	0.00	262171.67	0.000
	14.0197 - 13.0183		4079.08	289789.00	0.014	0.00	269679.17	0.000
	13.0183 - 12.0169		4119.65	293803.00	0.014	0.00	277291.67	0.000
	12.0169 - 11.0155		4160.55	297818.00	0.014	0.00	285010.83	0.000
	11.0155 - 10.0141		4201.76	301833.00	0.014	0.00	292835.83	0.000
	10.0141 - 9.01265		4243.30	305847.00	0.014	0.01	300767.50	0.000
	9.01265 - 8.01125		4285.14	309862.00	0.014	0.01	308804.17	0.000
	8.01125 - 7.00984		4327.30	313877.00	0.014	0.01	316947.50	0.000
	7.00984 - 6.00844		4369.76	317891.00	0.014	0.01	325196.67	0.000
	6.00844 - 5.00703		4412.53	321906.00	0.014	0.01	333551.67	0.000
	5.00703 - 4.00562		4455.59	325921.00	0.014	0.01	342012.50	0.000
	4.00562 - 3.00422		4498.96	329935.00	0.014	0.01	350579.17	0.000
	3.00422 - 2.00281		4542.61	333950.00	0.014	0.01	359252.50	0.000
	2.00281 - 1.00141		4586.56	337964.00	0.014	0.01	368031.67	0.000
	1.00141 - 0		4630.79	341979.00	0.014	0.01	376916.67	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Ratio $\frac{V_u}{\phi V_n}$	Ratio $\frac{T_u}{\phi T_n}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	36.089 - 35.0695	0.000	0.195	0.000	0.019	0.000	0.195 ✔	1.000	4.8.2 ✔
	35.0695 - 34.05	0.000	0.227	0.000	0.019	0.000	0.227 ✔	1.000	4.8.2 ✔
	34.05 - 32.0109	0.000	0.141	0.000	0.009	0.000	0.141 ✔	1.000	4.8.2 ✔
L2	34.05 - 32.0109	0.000	0.130	0.000	0.008	0.000	0.131 ✔	1.000	4.8.2 ✔
	32.0109 - 31.0083	0.001	0.288	0.000	0.016	0.000	0.289 ✔	1.000	4.8.2 ✔

Section No.	Elevation ft	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Ratio $\frac{V_u}{\phi V_n}$	Ratio $\frac{T_u}{\phi T_n}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
	31.0083 - 30.0058	0.001	0.315	0.000	0.016	0.000	0.316 ✔	1.000	4.8.2 ✔
	30.0058 - 29.0032	0.001	0.340	0.000	0.016	0.000	0.341 ✔	1.000	4.8.2 ✔
	29.0032 - 28.0006	0.001	0.365	0.000	0.016	0.000	0.366 ✔	1.000	4.8.2 ✔
	28.0006 - 26.998	0.001	0.388	0.000	0.016	0.000	0.389 ✔	1.000	4.8.2 ✔
	26.998 - 25.9954	0.001	0.410	0.000	0.016	0.000	0.411 ✔	1.000	4.8.2 ✔
	25.9954 - 24.9929	0.001	0.432	0.000	0.016	0.000	0.433 ✔	1.000	4.8.2 ✔
	24.9929 - 23.9903	0.001	0.453	0.000	0.016	0.000	0.454 ✔	1.000	4.8.2 ✔
	23.9903 - 22.9877	0.001	0.473	0.000	0.016	0.000	0.474 ✔	1.000	4.8.2 ✔
	22.9877 - 21.9851	0.001	0.492	0.000	0.016	0.000	0.493 ✔	1.000	4.8.2 ✔
	21.9851 - 20.9826	0.001	0.510	0.000	0.016	0.000	0.512 ✔	1.000	4.8.2 ✔
	20.9826 - 19.98	0.001	0.528	0.000	0.016	0.000	0.530 ✔	1.000	4.8.2 ✔
	19.98 - 18.9774	0.001	0.546	0.000	0.016	0.000	0.547 ✔	1.000	4.8.2 ✔
	18.9774 - 17.9748	0.001	0.562	0.000	0.016	0.000	0.564 ✔	1.000	4.8.2 ✔
	17.9748 - 15.0211	0.001	0.300	0.000	0.008	0.000	0.301 ✔	1.000	4.8.2 ✔
L3	17.9748 - 15.0211	0.001	0.278	0.000	0.007	0.000	0.279 ✔	1.000	4.8.2 ✔
	15.0211 - 14.0197	0.002	0.560	0.000	0.014	0.000	0.562 ✔	1.000	4.8.2 ✔
	14.0197 - 13.0183	0.002	0.570	0.000	0.014	0.000	0.572 ✔	1.000	4.8.2 ✔
	13.0183 - 12.0169	0.002	0.580	0.000	0.014	0.000	0.582 ✔	1.000	4.8.2 ✔
	12.0169 - 11.0155	0.002	0.590	0.000	0.014	0.000	0.592 ✔	1.000	4.8.2 ✔
	11.0155 - 10.0141	0.002	0.599	0.000	0.014	0.000	0.601 ✔	1.000	4.8.2 ✔
	10.0141 - 9.01265	0.002	0.608	0.000	0.014	0.000	0.610 ✔	1.000	4.8.2 ✔
	9.01265 - 8.01125	0.002	0.616	0.000	0.014	0.000	0.619 ✔	1.000	4.8.2 ✔
	8.01125 - 7.00984	0.002	0.624	0.000	0.014	0.000	0.627 ✔	1.000	4.8.2 ✔
	7.00984 - 6.00844	0.002	0.632	0.000	0.014	0.000	0.634 ✔	1.000	4.8.2 ✔
	6.00844 - 5.00703	0.002	0.640	0.000	0.014	0.000	0.642 ✔	1.000	4.8.2 ✔
	5.00703 -	0.002	0.647	0.000	0.014	0.000	0.649 ✔	1.000	4.8.2 ✔

Section No.	Elevation ft	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Ratio $\frac{V_u}{\phi V_n}$	Ratio $\frac{T_u}{\phi T_n}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
	4.00562						✔		
	4.00562 - 3.00422	0.002	0.654	0.000	0.014	0.000	0.656 ✔	1.000	4.8.2 ✔
	3.00422 - 2.00281	0.002	0.660	0.000	0.014	0.000	0.663 ✔	1.000	4.8.2 ✔
	2.00281 - 1.00141	0.002	0.666	0.000	0.014	0.000	0.669 ✔	1.000	4.8.2 ✔
	1.00141 - 0	0.003	0.673	0.000	0.014	0.000	0.675 ✔	1.000	4.8.2 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
L1	36.089 - 32.0109	Pole	TP10.0984x9.0551x0.1969	1	-76.87	339344.00	22.7	Pass
L2	32.0109 - 15.0211	Pole	TP11.815x9.1831x0.2362	2	-691.86	484935.00	56.4	Pass
L3	15.0211 - 0	Pole	TP13.7795x10.934x0.2756	3	-1741.16	683958.00	67.5	Pass
							Summary	
						Pole (L3)	67.5	Pass
						RATING =	**67.5**	**Pass**

Circular Base Plate and Anchor Bolts--ANSI/TIA-222-G

TEP #: 110005.19

Calculations By: LSB 9/23/2011

Checked By: REG 9/26/2011

11M ARE Monopole - Windtronics 2.2kW

Base Plate

Anchor Rod Input:

Qty:	12	
Diam:	1.2992126	in (M33)
Rod Material:	Other	F1554-55
Yield (Fy):	55	ksi
Strength (Fu):	75	ksi
Bolt Circle:	19.015748	in (483mm)

Factored Reactions

Mu:	150.361	ft-kips
Axial, Pu:	1.748	kips
Shear, Vu:	4.628	kips

Anchor Rod Results

Max Rod Tension:	32.5	Kips
Allowable Axial:	64.5	Kips
Anchor Rod Stress Ratio:	**50.5%**	**Pass**

Pole Data:

Diam:	13.779528	in (350mm)
Thick:	0.2755906	in (7mm)
Grade:	65	ksi (A572-65)
# of Sides:	0	"0" IF Round
Ultimate (Fu):	80	ksi

Base Plate Input:

Diam:	22.874016	in (581mm)
Thick:	1.5748031	in (40mm)
Grade:	50	ksi (A572-50)

Pole Results

Pole Punching Shear Check: **n/a**

Base Plate Results

	Flexural Check	
Base Plate Stress:	19.4	ksi
Allowable Plate Stress:	45.0	ksi
Base Plate Stress Ratio:	**43.0%**	**Pass**

Stiffener Input:

Fillet H. Weld:	0	in
Fillet V. Weld:	0	in
Width:	0	in
Height:	0	in
Thick:	0	in
Notch:	0	in
Grade:	0	ksi
Weld str.:	0	ksi

Stiffener Results

Horizontal Weld :	**n/a**
Vertical Weld:	**n/a**
Plate in Flexure and Shear:	**n/a**
Plate in Tension and Shear:	**n/a**
Plate Compression:	**n/a**

Circular Flange Plate and Bolts--ANSI/TIA-222-G

TEP #:		110005.19
Calculations By:	LSB	9/23/2011
Checked By:	REG	9/26/2011

11M ARE Monopole - Windtronics 2.2kW

Turbine Flange

Bolt Input:

Qty:	6	
Diam:	0.629921	in (M16, assumed)
Rod Material:	Other	(A325M/ISO Gr 8.8, assumed)
Strength (Fu):	120	ksi
Yield (Fy):	-	ksi
Bolt Circle:	12.20472	in (310mm)

Factored Reactions

Mu:	11.13	ft-kips
Axial, Pu:	0.2916	kips
Shear, Vu:	3.0832	kips
Elevation:	36.1	ft

Bolt Results

Bolt Tension Capacity:	21.9	Kips
Total Bolt Tension:	7.2	Kips
Flange Bolt Percent Capacity:	**33.2%**	**Pass**

Pole Data:

Diam:	9.05512	in (230mm)
Thick:	0.19685	in (5mm)
Grade:	65	ksi (A572-65)
# of Sides:	0	"0" IF Round
Ultimate (Fu):	80	ksi

Flange Plate Input:

Diam:	14.17323	in (360mm)
Thick:	0.5	in (assumed)
Grade:	65	ksi
Strength, Fu:	80	ksi

Flange Plate Results: Flexural Check

Compression Side Plate Stress:	37.0	ksi
Allowable Plate Stress:	58.5	ksi
Compression Plate Capacity:	**63.2%**	**Pass**

No Prying

Tension Stress Ratio:	**23.1%**	**Pass**

Stiffener Input:

Fillet H. Weld:	0	in
Fillet V. Weld:	0	in
Width:	0	in
Height:	0	in
Thick:	0	in
Notch:	0	in
Grade:	0	ksi
Weld str.:	0	ksi

Stiffener Results:

Horizontal Weld :	**n/a**
Vertical Weld:	**n/a**
Plate Flexure and Shear:	**n/a**
Plate Tension and Shear:	**n/a**
Plate Compression:	**n/a**

Monopole Mat Foundation Design--ANSI/TIA-222-G - ACI 318-05/08

TEP #:	110005.19	
Calculations By:	LSB	9/23/2011
Checked By:	REG	9/26/2011

11M ARE Monopole - Windtronics 2.2kW

INPUT:

Factored Base Reactions:

P_u =	1.748	kip
V_u =	4.628	kip
M_u =	150.361	kip-ft

Constants:

γ_s =	110.0	lb/ft^3
γ_w =	62.4	lb/ft^3
γ_c =	150.0	lb/ft^3
F'c =	2.5	ksi
F'y =	60.0	ksi

Options:

Code	Rev G	
Subtract Overburden?	no	
Groundwater Present?	no	
Shear Key?	no	
Geotechnical Report?	no	
FS =	2	*TIA-G Presumptive Clay*
ϕ_s =	0.75	
Q_a =	2.5	ksf (Allowable)
P_s =	100	psf/ft
Φ =	0	°

ϕQn = 3.75

Try:

Length (ft)	Width (ft)	Thickness (ft)	Projection (in)	Bearing Depth (ft)
9.00	9.00	4.50	3.00	4.2500

CHECK STABILITY:	**ϕsMn>Mu, O.K.**	**75.3 %**
CHECK BEARING CAPACITY:	**ϕsQn>Qu, O.K.**	**89.8 %**
CHECK LATERAL BEARING CAPACITY:	**ϕsFn>Fu, O.K.**	**25.2 %**
CHECK ONE-WAY SHEAR-MAT:	**ϕsVc>Vu, O.K.**	**3.8 %**
CHECK PAD FLEXURAL CAPACITY:	**ϕnMn>Mu, O.K.**	**6.9 %**

REINFORCING:

Mat Reinforcing

Bar Size =	8	Spacing O.K.					
Cover =	3.00	in					
Bar Quantity =	7	T & B =	28	Total	Length =	8.50	ft
Bar Spacing =	16.8333	in					

Shear Reinforcing OK

Vu<0.5ϕVc, NO SHEAR REINFORCEMENT REQUIRED

Cast-In Place Monopole Anchor Bolts--ACI 318-05/08 Appendix D

TEP #: 110005.19
Calculations By: LSB 9/23/2011
Checked By: REG 9/26/2011

11M ARE Monopole - Windtronics 2.2kW

Bolt Data (Cast-In Place)			Factored Reactions (1.6W+1.2D)					
Qty =	12		Mu =	150.361	ft-kips	Appendix D, Percent =	73.4%	
Bolt Diameter =	1.299	in (M33)	Axial, Pu =	1.748	kips	Rod Push-through, Percent =	43.4%	
Bolt Material =	F1554-55		Shear, Vu =	4.628	kips	Seismic Factor =	No	
Strength (Fu) =	75	ksi						
Yield (Fy) =	55	ksi	f`c =	2,500	psi			
Circle (in.) =	19.01574803	(483mm)	hef =	39.92126	in	h_bottom =	42.51968504	in
Washer ?			Tfnd. =	54	in			
Type =			B (horiz.) =	108	in	hef limited by geometry, See D.5.2.9		
Nom. O.D. =	3.937	in (100mm	L (vert.) =	108	in			

D.4.4 - Strength Reduction Factors Φ for anchors in concrete - Load Combinations of 9.2:

Tension Loads

	a) Ductile Steel	Anchor governed by strength of a ductile steel element (Fy)
Φ_{Steel} =	0.75	
$\Phi_{Tension}$ =	Condition B	No supplemental reinforcement
$\Phi_{Tension}$ =	0.70	

D.5.2.1

S_1 =	16.47	in	Horizontal Distance B/T Tension Bolt Group
S_2 =	4.7539	in	Vertical Distance B/T Tension Bolt Group
Vertical ED =	49.25	in	Vertical Edge Distance from Closest Edge Bolt in Group to edge of Foundation
Horizontal ED =	45.77	in	Horizontal Edge Distance from Closest Edge Bolt in Group to edge of Foundation
ANco =	13,808.10	in^2	Projected concrete breakout area
ANc =	11,664.00	in^2	Projected concrete breakout area
Ratio =	0.84		

D.5.2- Modification Factors

$\Psi_{ec,N}$ =	0.991	eccentric tension loading about one axis
$\Psi_{ed,N}$ =	0.93	ca,min<1.5hef
$\Psi_{c,N}$ =	1.00	cast-in anchors, cracked concrete
$\Psi_{cp,N}$ =	1.00	cast-in anchors

D.5.3- Modification Factors

$\Psi_{c,P}$ =	1.00		cracking at service load levels
Abrg =	10.85	in^2	net bearing area of the head of stud, anchor bolt, headed deformed bar, or washer

D.5.1 Steel strength of critical anchor in tension

Ncb =	80,625	lb =	80.6	kips			
$\Phi_{Tension}$ =	0.75	based on ACI 318 - Appendix D, D.5.1					
Φ x Ncb =	**60.5**	**kips**	Tu =	31.5	kips	Capacity =	52.1%

D.5.2 Concrete breakout strength of anchor group in tension

Ncb =	228,262	lb =	228.3	kips				
$\Phi_{Tension}$ =	0.70							
Φ x Ncb =	**159.8**	**kips**	Tu,g =	117.3	kips	Capacity =	73.4%	**CONTROLS**

D.5.3 Pullout Strength of critical anchor in tension

Npn =	216,960	lb =	217.0	kips			
$\Phi_{Tension}$ =	0.70						
Φ x Npn =	**151.9**	**kips**	Tu =	31.5	kips	Capacity =	20.7%

D.5.4 Concrete side-face blowout strength of anchor group in tension

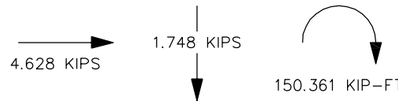
Nsbg =	n/a	lb =	0	kips			
$\Phi_{Tension}$ =	0.70						
Φ x Nsbg =	**0.0**	**kips**	Tu,g =	117.3	kips	Capacity =	N/A

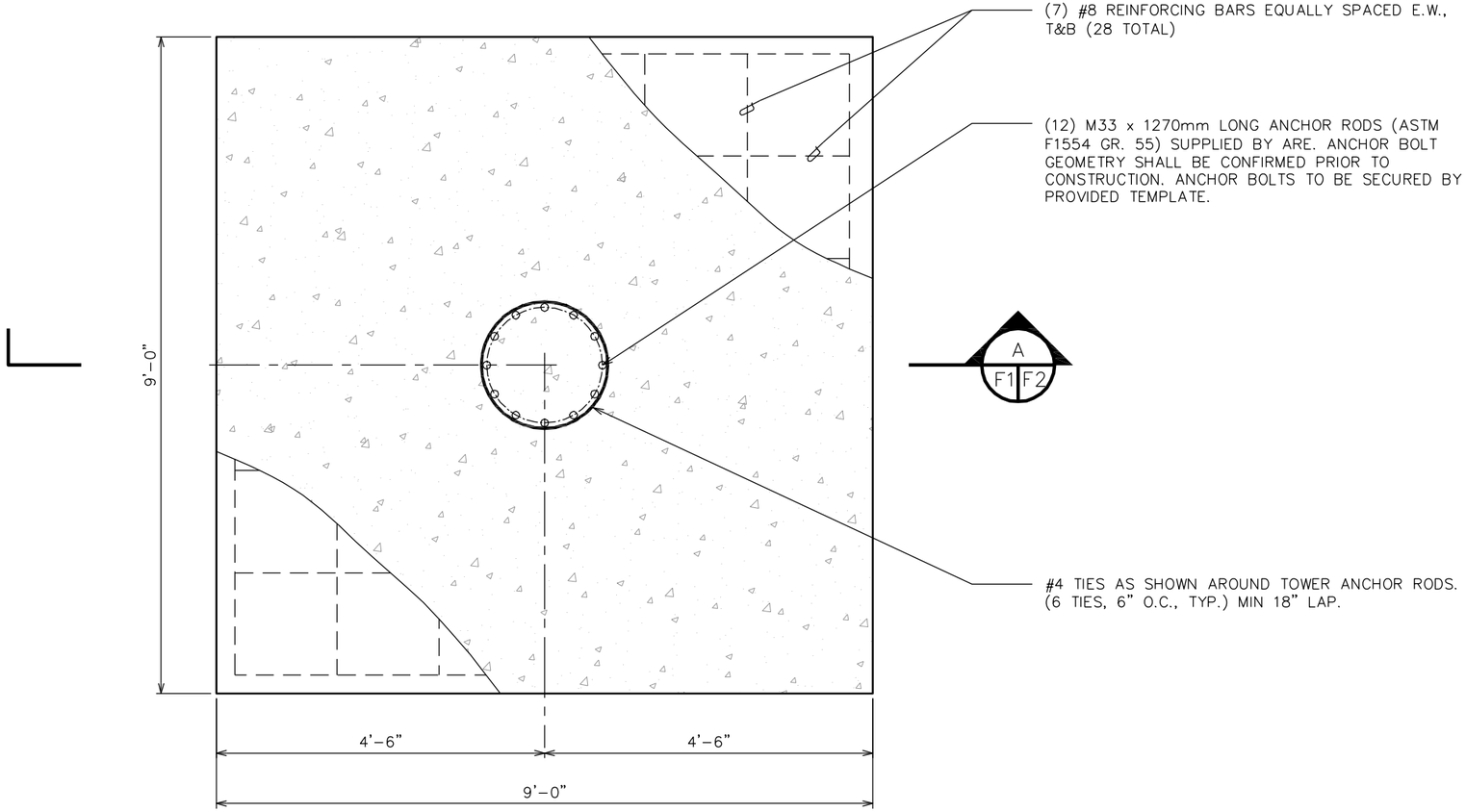
Percent Capacity =	**73.4%**	**TENSION**
Percent Capacity =	**5.2%**	**SHEAR**
Interaction =	**n/a**	

NOTES:

1. THE FOUNDATION HAS BEEN DESIGNED IN ACCORDANCE WITH THE ANSI/TIA-222-G STANDARD AND THE 2006 MICHIGAN BUILDING CODE (2006 IBC) FOR A 140-MPH 3-SECOND GUST BASIC WIND SPEED WITH NO ICE AND A 60-MPH 3-SEC GUST WIND SPEED IN CONJUNCTION WITH 1" ICE.
2. TOWER DESIGN INFORMATION FOR THE PROPOSED 11-M MONOPOLE WITH A TOP MOUNTED WINDTRONICS 2.2kW WIND TURBINE PROVIDED BY ARE. DRAWING REFERENCE DATED AUGUST 31, 2011, QUOTATION # W11015, VERSION F, DESCRIPTION; 11M 2.2KW WIND POLE.
3. TOWER IS DESIGNED TO SUPPORT A WINDTRONICS 2.2kW WIND TURBINE. TURBINE LOADING SPECIFICATIONS PROVIDED BY ARE.
4. THE FOUNDATION HAS BEEN DESIGNED TO RESIST THE FACTORED LOADS SHOWN ON THIS SHEET IN ACCORDANCE WITH THE ANSI/TIA-222-G STANDARD USING PRESUMPTIVE CLAY SOIL PARAMETERS.

MAXIMUM FACTORED TOWER REACTIONS





MAT FOUNDATION DETAILS

SCALE: ½" = 1'-0"

0 2 4
SCALE IN FEET

PLANS PREPARED FOR:

American Resource & Energy Co.
www.arewindtowers.com

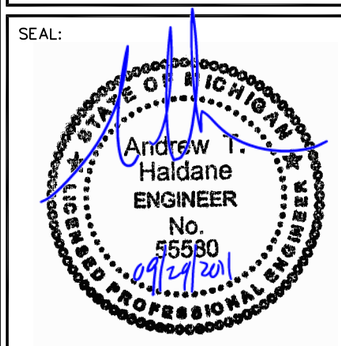
PROJECT INFORMATION:

11-M (36-FT) ARE MONOPOLE W/ 2.2kW WINDTRONICS WIND TURBINE GENERIC FOUNDATION DESIGN
(ANSI/TIA-222-G PRESUMPTIVE CLAY SOIL PARAMETERS)

PLANS PREPARED BY:

TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
RALEIGH, NC 27603-5263
OFFICE: (919) 661-6351
FAX: (919) 661-6350

SEAL:



September 29, 2011

REV	DATE	ISSUED FOR:
0	09-29-11	FOUNDATION DESIGN

DRAWN BY: LSB | CHECKED BY: REG

SHEET TITLE:

MAT FOUNDATION DETAILS

SHEET NUMBER: **F-1**

REVISION: **0**

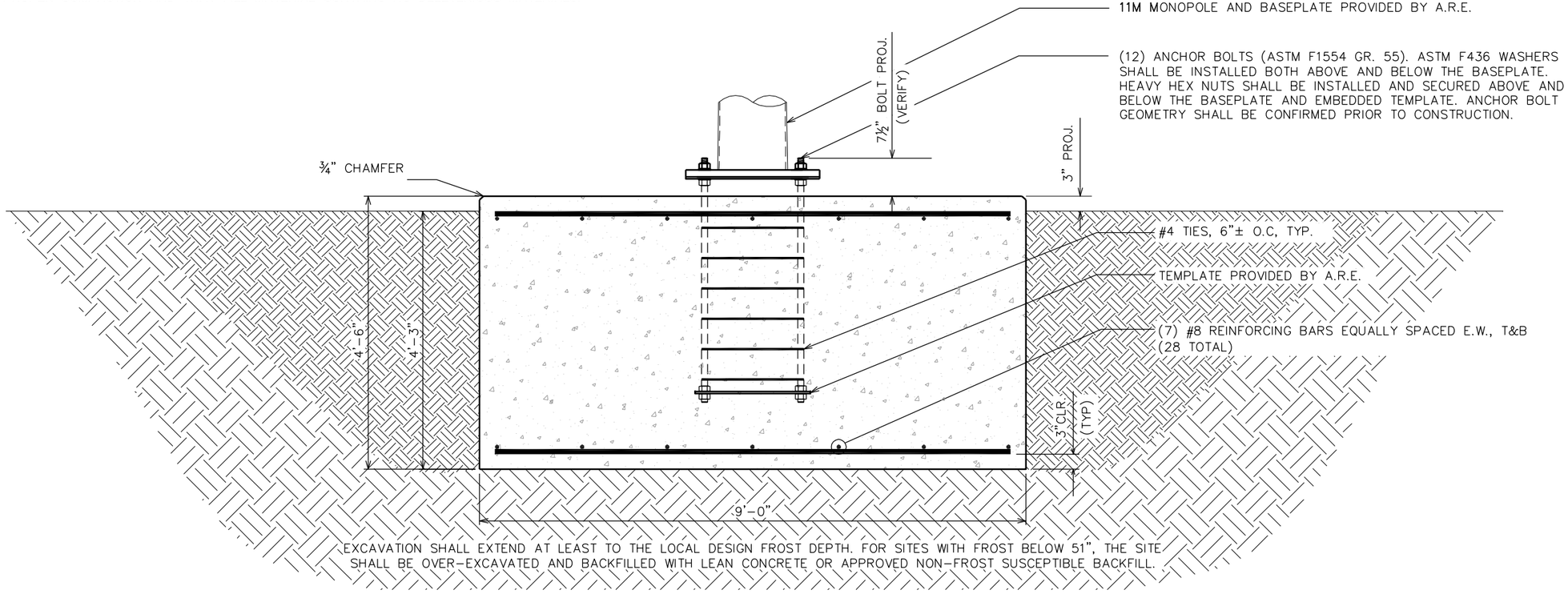
TEP#: 110005.19

FOUNDATION NOTES:

1. THE FOUNDATION HAS BEEN DESIGNED FOR THE REACTIONS SHOWN ON SHEET F-1.
2. THE FOUNDATION DESIGN IS BASED ON ASSUMED PRESUMPTIVE SOIL PARAMETERS PER THE ANSI/TIA-222-G ANNEX F – TABLE F-1. TEP UTILIZED CLAY SOIL WITH AN ULTIMATE BEARING CAPACITY OF 5,000-PSF AND A UNIT WEIGHT OF 110-PCF FOR THIS FOUNDATION DESIGN. THESE DESIGN PARAMETERS ARE FOR REFERENCE ONLY. A SITE-SPECIFIC FOUNDATION DESIGN SHALL BE CONDUCTED FOR EACH INSTALLATION OF THE PROPOSED TOWER/ TURBINE CONFIGURATION.
3. TEP ASSUMED THAT GROUNDWATER IS NOT PRESENT WITHIN THE DEPTH OF THE FOUNDATION.
4. THE EXCAVATION SHALL EXTEND THROUGH THE UPPER SOIL LAYERS DOWN TO AT LEAST 4'-3" BELOW GRADE. IN REGIONS WHERE THE LOCAL DESIGN FROST DEPTH IS GREATER THAN 51", THE SITE SHALL BE OVER-EXCAVATED TO THE DESIGN FROST DEPTH AND BACKFILLED WITH A LEAN CONCRETE MIX OR AN APPROVED NON-FROST SUSCEPTIBLE BACKFILL.
5. THE EXCAVATION SHALL BE FLAT AND STABLE PRIOR TO CONCRETE PLACEMENT.
6. THE CONTRACTOR SHALL SECURE ANCHOR BOLTS TO PREVENT SHIFTING DURING CONSTRUCTION.

FILL AND COMPACTION NOTES:

1. THE FOUNDATION EXCAVATION SHALL BE FREE OF ALL SURFACE ORGANIC MATERIALS.
2. PROPER FILL PLACEMENT AND PROPER RECOMPACTING OF THE SOILS IS REQUIRED.
3. IF THE PROPOSED TOWER LOCATION CONTAINS UNAPPROVED FILL MATERIALS, THE EXCAVATION SHALL EXTEND BEYOND TO THE VIRGIN SOIL LAYER AND BE BACKFILLED WITH APPROVED MATERIAL.
4. AFTER EXCAVATION AND PRIOR TO FILL OR CONCRETE PLACEMENT, THE SURFACE OF THE VIRGIN SOIL LAYER SHOULD BE MECHANICALLY COMPACTED TO DENSIFY THE SURFACE DISTURBED DURING THE EXCAVATION.
5. ALL BACKFILL SHALL BE PLACED IN MAXIMUM LOOSE LIFTS OF 8" AND COMPACTED TO A MINIMUM 95% OF ASTM D-1557 TO ACHIEVE A MINIMUM BACKFILL DENSITY OF 110-PCF.
6. TEP RECOMMENDS THAT A GEOTECHNICAL ENGINEER BE RETAINED TO VERIFY AND OBSERVE EXCAVATIONS, VERIFY THAT THE FILL MATERIALS AND COMPACTION ARE ACCEPTABLE, THE MOISTURE CONTENT IS APPROPRIATE FOR PROPER COMPACTION AND THAT FILL MATERIAL CONTAINS NO DELETERIOUS MATERIALS.



SECTION A (F1 | F2)

SCALE: ½" = 1'-0"

0 2 4

SCALE IN FEET

PLANS PREPARED FOR:

American Resource & Energy Co.

www.arewindtowers.com

PROJECT INFORMATION:

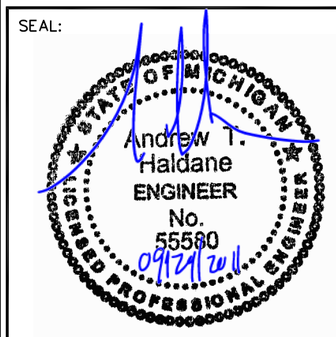
11-M (36-FT) ARE MONOPOLE W/ 2.2kW WINDTRONICS WIND TURBINE GENERIC FOUNDATION DESIGN

(ANSI/TIA-222-G PRESUMPTIVE CLAY SOIL PARAMETERS)

PLANS PREPARED BY:

TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
RALEIGH, NC 27603-5263
OFFICE: (919) 661-6351
FAX: (919) 661-6350

SEAL:



September 29, 2011

REV	DATE	ISSUED FOR:
0	09-29-11	FOUNDATION DESIGN

DRAWN BY: LSB | CHECKED BY: REG

SHEET TITLE:

MAT FOUNDATION DETAILS II

SHEET NUMBER: **F-2**

REVISION: **0**

TEP#: 110005.19

GENERAL NOTES:

1. ALL WORK PRESENTED ON THESE DRAWINGS MUST BE COMPLETED BY THE CONTRACTOR UNLESS NOTED OTHERWISE. THE CONTRACTOR MUST HAVE CONSIDERABLE EXPERIENCE IN PERFORMANCE OF WORK SIMILAR TO THAT DESCRIBED HEREIN. BY ACCEPTANCE OF THIS ASSIGNMENT, THE CONTRACTOR IS ATTESTING THAT HE DOES HAVE SUFFICIENT EXPERIENCE AND ABILITY, THAT HE IS KNOWLEDGEABLE OF THE WORK TO BE PERFORMED AND THAT HE IS PROPERLY LICENSED AND PROPERLY REGISTERED TO DO THIS WORK IN THE STATE WHERE THE PROJECT IS LOCATED.

2. WORK SHALL BE COMPLETED IN ACCORDANCE WITH THE APPLICABLE BUILDING CODE.

3. UNLESS SHOWN OR NOTED OTHERWISE ON THE CONTRACT DRAWINGS, OR IN THE SPECIFICATIONS, THE FOLLOWING NOTES SHALL APPLY TO THE MATERIALS LISTED HEREIN, AND TO THE PROCEDURES TO BE USED ON THIS PROJECT.

4. ALL HARDWARE ASSEMBLY MANUFACTURER'S INSTRUCTIONS SHALL BE FOLLOWED EXACTLY AND SHALL SUPERSEDE ANY CONFLICTING NOTES ENCLOSED HEREIN.

5. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE TO INSURE THE SAFETY OF THE STRUCTURE AND IT'S COMPONENT PARTS DURING ERECTION AND/OR FIELD MODIFICATIONS. THIS INCLUDES, BUT IS NOT LIMITED TO, THE ADDITION OF TEMPORARY BRACING, GUYS OR TIE DOWNS THAT MAY BE NECESSARY. SUCH MATERIAL SHALL BE REMOVED AND SHALL REMAIN THE PROPERTY OF THE CONTRACTOR AFTER THE COMPLETION OF THE PROJECT.

6. ALL DIMENSIONS, ELEVATIONS, AND EXISTING CONDITIONS SHOWN ON THE DRAWINGS SHALL BE FIELD VERIFIED BY THE CONTRACTOR PRIOR TO BEGINNING ANY MATERIALS ORDERING, FABRICATION OR CONSTRUCTION WORK ON THIS PROJECT. CONTRACTOR SHALL NOT SCALE CONTRACT DRAWINGS IN LIEU OF FIELD VERIFICATIONS. ANY DISCREPANCIES SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE OWNER AND THE OWNER'S ENGINEER. THE DISCREPANCIES MUST BE RESOLVED BEFORE THE CONTRACTOR IS TO PROCEED WITH THE WORK. THE CONTRACT DOCUMENTS DO NOT INDICATE THE METHOD OF CONSTRUCTION. THE CONTRACTOR SHALL SUPERVISE AND DIRECT THE WORK AND SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, AND PROCEDURES. OBSERVATION VISITS TO THE SITE BY THE OWNER AND/OR THE ENGINEER SHALL NOT INCLUDE INSPECTION OF THE PROTECTIVE MEASURES OR THE PROCEDURES.

7. ALL MATERIALS AND EQUIPMENT FURNISHED SHALL BE NEW AND OF GOOD QUALITY, FREE FROM FAULTS AND DEFECTS AND IN CONFORMANCE WITH THE CONTRACT DOCUMENTS. ANY AND ALL SUBSTITUTIONS MUST BE PROPERLY APPROVED AND AUTHORIZED IN WRITING BY THE OWNER AND ENGINEER PRIOR TO INSTALLATION. THE CONTRACTOR SHALL FURNISH SATISFACTORY EVIDENCE AS TO THE KIND AND QUALITY OF THE MATERIALS AND EQUIPMENT BEING SUBSTITUTED.

8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INITIATING, MAINTAINING, AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR INSURING THAT THIS PROJECT AND RELATED WORK COMPLIES WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL SAFETY CODES AND REGULATIONS GOVERNING THIS WORK.

9. ACCESS TO THE PROPOSED WORK SITE MAY BE RESTRICTED. THE CONTRACTOR SHALL COORDINATE INTENDED CONSTRUCTION ACTIVITY, INCLUDING WORK SCHEDULE AND MATERIALS ACCESS, WITH THE RESIDENT LEASING AGENT FOR APPROVAL.

10. CONTRACTOR SHALL SECURE ALL NECESSARY PERMITS FOR THIS PROJECT FROM ALL APPLICABLE GOVERNMENTAL AGENCIES.

11. ALL PERMITS THAT MUST BE OBTAINED ARE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR WILL BE RESPONSIBLE FOR ABIDING BY ALL CONDITIONS AND REQUIREMENTS OF THE PERMITS.

12. ALL WORK SHALL COMPLY TO LOCAL CODES AND THE ACI 318-08, "BUILDING REQUIREMENTS FOR STRUCTURAL CONCRETE".

13. 24 HOURS PRIOR TO THE BEGINNING OF ANY CONSTRUCTION, THE CONTRACTOR MUST NOTIFY THE APPLICABLE JURISDICTIONAL (STATE, COUNTY OR CITY) ENGINEER.

14. ALL MATERIALS AND WORKMANSHIP SHALL BE WARRANTED FOR ONE YEAR FROM ACCEPTANCE DATE.

15. ALL TOWER DIMENSIONS SHALL BE VERIFIED WITH THE PLANS (LATEST REVISION) PRIOR TO COMMENCING CONSTRUCTION. NOTIFY THE ENGINEER IMMEDIATELY IF ANY DISCREPANCIES ARE DISCOVERED. THE OWNER SHALL HAVE A SET OF APPROVED PLANS AVAILABLE AT THE SITE AT ALL TIMES WHILE WORK IS BEING PERFORMED. A DESIGNATED RESPONSIBLE EMPLOYEE SHALL BE AVAILABLE FOR CONTACT BY GOVERNING AGENCY INSPECTORS.

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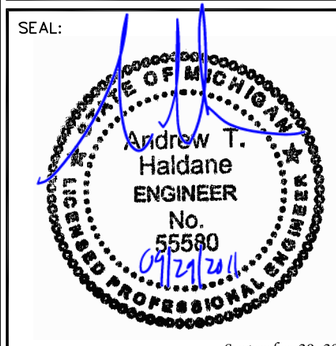


September 29, 2011

REV	DATE	ISSUED FOR:
0	09-29-11	FOUNDATION DESIGN

DRAWN BY: LSB | CHECKED BY: REG

SHEET TITLE:

PROJECT NOTES

SHEET NUMBER: **N-1**

REVISION: **0**

TEP#: 110005.19

FOUNDATION NOTES:

GENERAL NOTES:

1. FOUNDATION INSTALLATION SHALL BE SUPERVISED BY PERSONNEL KNOWLEDGEABLE AND EXPERIENCED WITH THE PROPOSED FOUNDATION TYPE. CONSTRUCTION SHALL BE IN ACCORDANCE WITH GENERALLY ACCEPTED PRACTICES AND IN A GOOD WORKMANLIKE MANNER.
2. CONTRACTOR SHALL VERIFY DIMENSIONS WITH ORIGINAL DRAWINGS.
3. FOR FOUNDATION AND ANCHOR TOLERANCES, SEE ORIGINAL DRAWINGS.
4. FOUNDATION DESIGN ASSUMES LEVEL GRADE AT THE SITE.
5. THE FOUNDATION DESIGN IS IN ACCORDANCE WITH GENERALLY ACCEPTED PROFESSIONAL ENGINEERING PRINCIPLES AND PRACTICES WITHIN THE LIMITS OF THE SUBSURFACE DATA PROVIDED.
6. FOUNDATION DESIGN MODIFICATIONS MAY BE REQUIRED IN THE EVENT THE DESIGN PARAMETERS ARE NOT APPLICABLE FOR THE SUBSURFACE CONDITIONS ENCOUNTERED DURING CONSTRUCTION.
7. THE FOUNDATION DESIGN ASSUMES FIELD INSPECTIONS WILL BE PERFORMED TO VERIFY THAT CONSTRUCTION MATERIALS, INSTALLATION METHODS, AND ASSUMED DESIGN PARAMETERS ARE ACCEPTABLE BASED ON THE CONDITIONS AT THE SITE.

EXCAVATION:

1. WORK SHALL BE IN ACCORDANCE WITH LOCAL CODES AND SAFETY REGULATIONS. PROCEDURES FOR THE PROTECTION OF EXCAVATIONS, EXISTING CONSTRUCTION, AND UTILITIES SHALL BE ESTABLISHED PRIOR TO BEGINNING WORK.
2. THE SIDES OF THE EXCAVATION SHALL BE ROUGH AND FREE OF LOOSE CUTTINGS.
3. LOOSE MATERIAL TO BE REMOVED FROM THE BOTTOM OF EXCAVATION PRIOR TO CONCRETE PLACEMENT.
4. DRILLING FLUID, IF USED, SHALL BE FULLY DISPLACED BY CONCRETE AND SHALL NOT BE DETRIMENTAL TO THE CONCRETE OR SURROUNDING SOIL. CONTAMINATED CONCRETE SHALL BE REMOVED AND REPLACED WITH FRESH CONCRETE.

REINFORCING STEEL:

1. THE REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM A-615, GRADE 60. IT SHALL BE DEFORMED AND SPLICES SHALL NOT BE ALLOWED UNLESS OTHERWISE NOTED.
2. WELDING IS PROHIBITED ON REINFORCING STEEL AND EMBEDMENTS.
3. REINFORCING CAGES SHALL BE BRACED TO RETAIN PROPER DIMENSIONS DURING HANDLING AND THROUGHOUT PLACEMENT OF CONCRETE. WHEN TEMPORARY CASING IS UTILIZED, BRACING SHALL BE ADEQUATE TO RESIST FORCES OCCURRING FROM FLOWING CONCRETE DURING CASING EXTRACTION.
4. SPACERS SHALL BE ATTACHED INTERMITTENTLY THROUGHOUT THE ENTIRE LENGTH OF TIEBACK REINFORCING TO INSURE CONCENTRIC PLACEMENT OF CAGES IN EXCAVATIONS.
5. MINIMUM CONCRETE COVER FOR REINFORCEMENT SHALL BE 3" UNLESS OTHERWISE NOTED. APPROVED SPACERS SHALL BE USED TO INSURE A 3" MINIMUM COVER ON REINFORCEMENT.

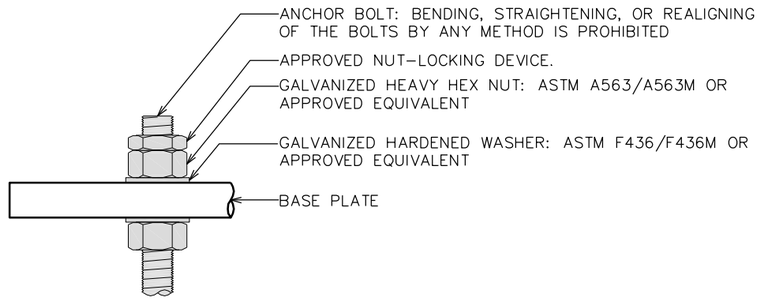
CONCRETE:

1. WORK SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF THE ACI-318, "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE."
2. THE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI IN 28-DAYS. HOWEVER, A MINIMUM COMPRESSIVE STRENGTH OF UP TO 4,500 PSI IN 28-DAYS SHALL BE USED IN LOCATIONS WITH MODERATE TO SEVERE FREEZING/THAWING OR SULFATE EXPOSURE, UNLESS OTHERWISE REQUIRED BY THE LOCAL JURISDICTION.
3. PROPORTIONS OF CONCRETE MATERIALS SHALL BE SUITABLE FOR THE INSTALLATION METHOD UTILIZED AND SHALL RESULT IN DURABLE CONCRETE FOR RESISTANCE TO LOCAL ANTICIPATED AGGRESSIVE ACTIONS. THE DURABILITY REQUIREMENTS OF ACI-318 SHALL BE SATISFIED BASED ON THE CONDITIONS EXPECTED AT THE SITE.
4. CONCRETE SHALL BE PLACED IN A MANNER THAT WILL PREVENT SEGREGATION OF CONCRETE MATERIALS, INFILTRATION OF WATER OR SOIL, AND OTHER OCCURRENCES THAT MAY DECREASE THE STRENGTH OR DURABILITY OF THE FOUNDATION.
5. FREE FALL CONCRETE MAY BE USED PROVIDED FALL IS VERTICAL DOWN WITHOUT HITTING THE SIDES OF THE EXCAVATION, FORMWORK, REINFORCING BARS, FORM TIES, CAGE BRACING, OR OTHER OBSTRUCTIONS. UNDER NO CIRCUMSTANCES SHALL CONCRETE FALL THROUGH WATER.
6. THE MAXIMUM SIZE OF THE AGGREGATE SHALL NOT EXCEED A SIZE SUITABLE FOR THE INSTALLATION METHOD UTILIZED OR 1/3-CLEAR DISTANCE BEHIND OR BETWEEN REINFORCING. THE MAXIMUM SIZE MAY BE INCREASED TO 2/3-CLEAR DISTANCE PROVIDED WORKABILITY AND METHODS OF CONSOLIDATION SUCH AS VIBRATING WILL PREVENT HONEYCOMBS AND VOIDS.

FINISHING:

1. THE TOP OF THE FOUNDATION SHALL BE SLOPED TO DRAIN WITH A FLOATED FINISH.
2. THE EXPOSED EDGES OF THE CONCRETE SHALL BE CHAMFERED ¾" x ¾".

BASE INSTALLATION DETAIL:



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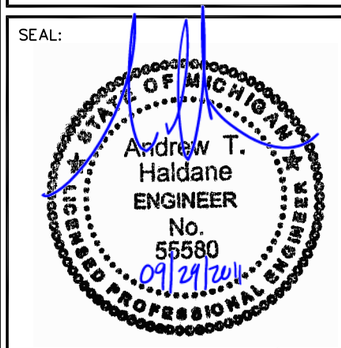

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DRAWN BY: LSB | CHECKED BY: REG

SHEET TITLE:

FOUNDATION NOTES

SHEET NUMBER: **N-2**

REVISION: **0**

TEP#: 110005.19