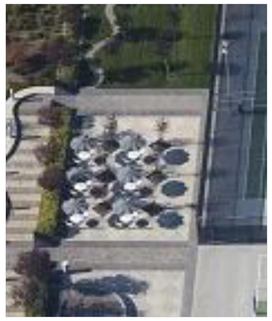
EXISTING IDEC CAMPUS



SCOPE OF WORK and IMPROVEMENTS PROPOSED

PROVIDE CLEAN ENERGY BY WIND GENERATION AT EXISTING IDEC SITE
PROVIDE ENERGY SAVINGS THROUGH INTEGRATION OF ASCETICALLY PLEASING, PEDESTRIAN SCALED WIND TURBINES AT EXISTING PLAZA LOCATION.
SMALL CLUSTER OF 6 TURBINES PROPOSED AT 100 FEET FROM STREETS.

TURBINE TYPICAL IMAGES

INDEX OF DRAWINGS

WT-1	COVER SHEET / INDEX
WT-2	SITE PLAN
WT-3	DATA SHT. ELECTRICAL
WT-4	FOUNDATION
WT-5	FOUNDATION DESIGN
WT-6	FOUNDATION DESIGN
WT-7	LATERAL ANALYSIS
WT-8	LATERAL ANALYSIS / TOWER ANALYSIS
WT-9	TOWER ANALYSIS

CONTRACTOR CONTACT

Grant Gluck
916.275.3559
grant@energystarsconstruction.com

EnergyStars CONSTRUCTION
Energy performance solutions for where you work, live and play.
3811 Dividend Drive, Suite D
Shingle Springs, CA 95682
License Number: 950064
www.energystarsconstruction.com

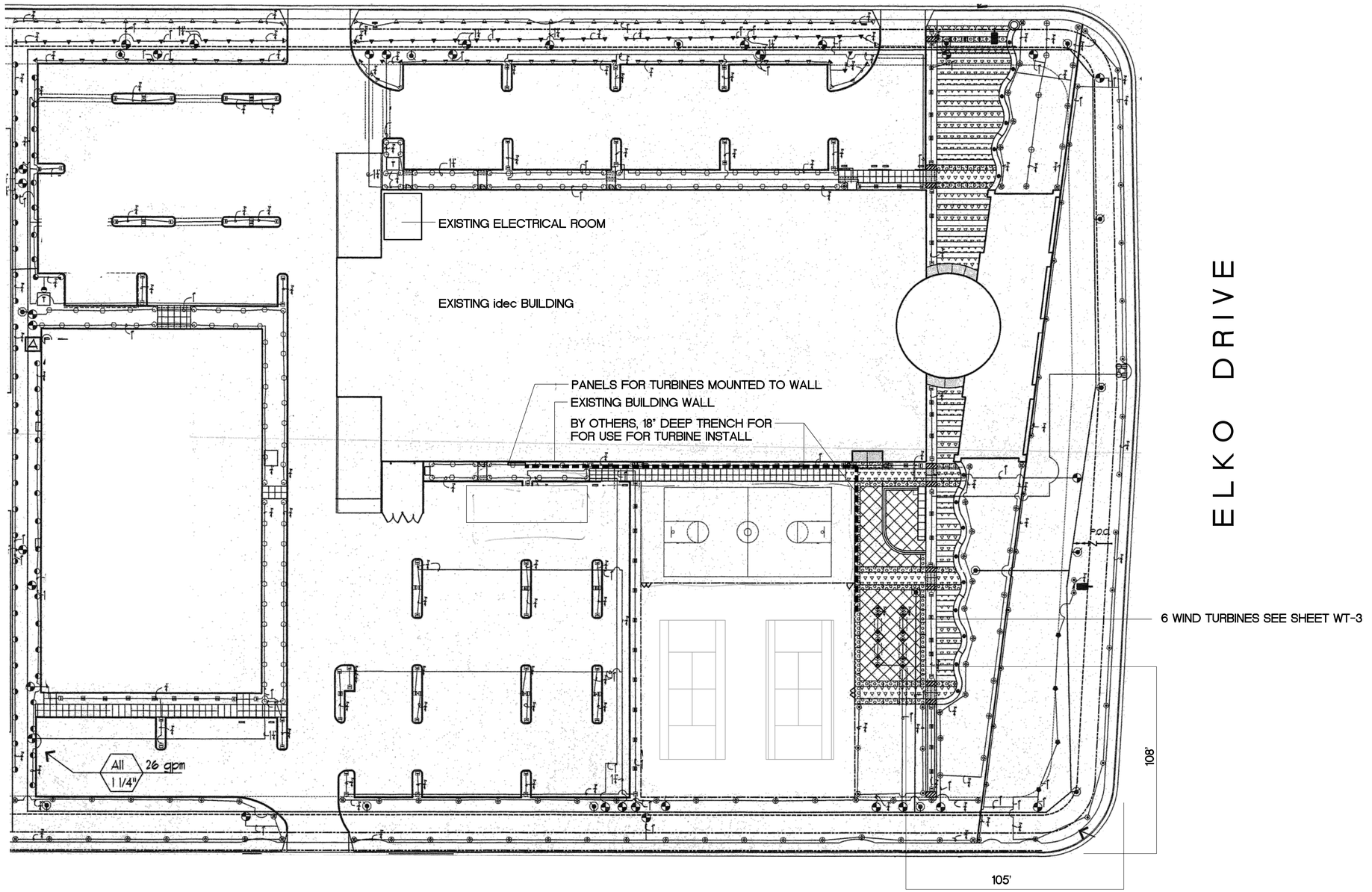
Grant Gluck
916.275.3559
grant@energystarsconstruction.com

idec
1175 Elko Dr.
Sunnyvale, CA

Date 8 . 21 . 15

COVER SHEET / INDEX

WT-1



EnergyStars CONSTRUCTION
Energy performance solutions for where you work, live and play.
3811 Dividend Drive, Suite D
Shingle Springs, CA 95682
License Number: 950064
www.energystarsconstruction.com

Grant Gluck
916.275.3559
grant@energystarsconstruction.com

idec
1175 Elko Dr.
Sunnyvale, CA

Date 7 . 14 . 15

NORTH

SITE PLAN

WT-2

Windspire ENERGY
www.WindspireEnergy.com

Technical Data Sheet - *Proprietary & Confidential*

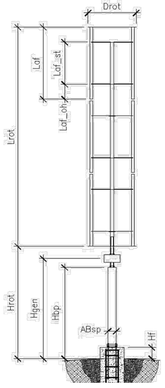
Windspire® Wind Turbine

2.0kw and *1.2kW - Standard (30 ft.)*

April 2010

Material Specifications:

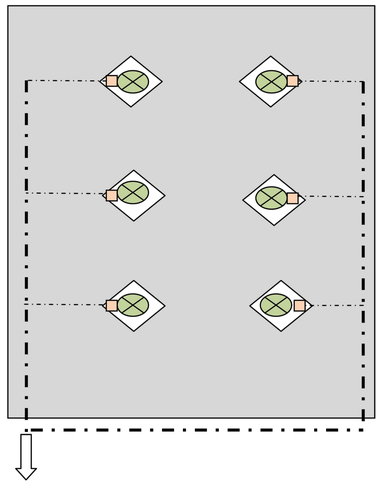
Mechanical Item	*Size*	*Grade*
Top Shaft:	3.5" OD x 0.120" Wall x 230" Lg.	Steel, ASTM A513 Type 5
Bottom Shaft:	3.5" OD x 0.500" Wall x 114" Lg.	Steel, ASTM A513 Type 5
Tower:	8.625" OD x 0.188" Wall x 84" Lg.	Steel, ASTM A500 Grade B
Base Plate:	10" sq. x 1" Thick	Steel, ASTM A36
Anchor Bolts:	(4) M20 x 1m Length (4.5" projection)	Steel, ISO 898.1 - Class 8.8
Airfoils:	5" Chord x 78" Length	Aluminum, 6063-T6
Airfoil Struts:	1.5" Width x 0.25" Thick	Aluminum, 6061-T6
Elastomer Dampers:	2" OD x 0.75" ID x 0.125" Thick	Fabreeka Washer - (5) at each anchor bolt (4 below, 1 above base plate)



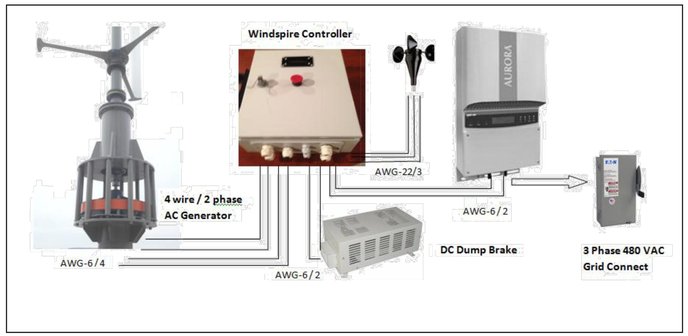
Cut-In Wind Speed =	8.5 mph (200 rpm)
Cut-Out Wind Speed =	31 mph (420 rpm)
Design Peak Gust =	**105 mph**
Peak Lateral Force (105mph) =	757 lbs.
Peak Overturing Moment (105mph) =	13,003 lbs*ft
Approx. Weight =	630 lbs
Rated Power (RP) =	1,200 Watts
Wind Speed @ RP =	24 mph
1st Resonance Mode =	60 rpm (+/-)
2nd Resonance Mode =	280 rpm (+/-)
D_{rot} =	48 in
L_{rot} =	240 in
L_{af} =	78 in
L_{af_st} =	46 in
L_{af_oh} =	16 in
H_{rot} =	120 in
H_{gen} =	108 in
H_{bp} =	96 in
H_f =	12 in (adjustable with engineering)
ABsp =	8 in

Note: Product variations, revised base connections or additional connections, and/or removal of Fabreeka dampening washers will effect the rotordynamics and will result in voiding of the warranty and damage to the unit. Prior to any revisions or modifications, consult with engineering department.

DATA SHEET



TURBINE LAYOUT



ELECTRICAL CONCEPT DIAGRAM

EnergyStars CONSTRUCTION
Energy performance solutions for where you work, live and play.
3811 Dividend Drive, Suite D
Shingle Springs, CA 95682
License Number: 950064
www.energystarsconstruction.com

Grant Gluck
916.275.3559
grant@energystarsconstruction.com

idec
1175 Elko Dr.
Sunnyvale, CA

Date 7 .14 . 15

DATA SHT.
ELECTRICAL

WT-3

FOUNDATION DETAIL

GENERAL:

PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY THE APPROPRIATE UTILITY LOCATING SERVICE TO VERIFY LOCATION OF UNDERGROUND UTILITIES. THE CONTRACTOR SHALL NOTIFY THE OWNER IMMEDIATELY IF ANY UNIDENTIFIED EXISTING UNDERGROUND UTILITIES ARE DISCOVERED.
ALL WORK SHALL CONFORM TO THE MINIMUM STANDARDS OF THE FOLLOWING CODES:

2006 INTERNATIONAL BUILDING CODE (IBC)

AND ANY OTHER REGULATING AGENCIES WHICH MAY HAVE AUTHORITY OVER ANY PORTION OF THE WORK.
CONTRACTOR TO PROVIDE PROPER SHORING/BRACING WHERE NEEDED DURING CONSTRUCTION ACTIVITIES.

FOUNDATIONS:

MAXIMUM ALLOWABLE FOUNDATION SOIL BEARING PRESSURE = 1500 PSF (72 KPa) FOUNDATIONS SOILS SHALL BE FREE OF ORGANIC SILTS, ORGANIC CLAYS, OR PEAT.
FOR FROST PROTECTION, THE BOTTOM OF ALL EXTERIOR FOOTINGS SHALL BE A MINIMUM OF 24" (0.610m) BELOW ADJACENT FINISHED GRADE OR GREATER DEPTH DEPENDING UPON THE LOCAL JURISDICTION.
ALL DISTURBED SOILS SURROUNDING FOOTINGS SHALL BE MOISTURE CONDITIONED AND COMPACTED IN 12" (0.305m) LIFTS, TO REACH 95 PERCENT OF THE MAXIMUM DENSITY AS DETERMINED BY ASTM D1557.
BRACE SONATUBE OR FORM WALLS AS REQUIRED DURING BACKFILLING OPERATIONS.

CONCRETE:

ALL CONCRETE WORK SHALL CONFORM TO THE LATEST EDITION OF ACI 318, EXCEPT AS MODIFIED BY THE FOLLOWING SUPPLEMENTAL REQUIREMENTS:

ALL FOUNDATION CONCRETE SHALL BE NORMAL WEIGHT CONCRETE.
CONCRETE MIX DESIGN SHALL BE ESTABLISHED IN ACCORDANCE WITH CHAPTER 5 OF ACI 318.
CEMENT II OR I/II PER ASTM C-150
MAXIMUM SLUMP
- 3 INCHES (0.076m) – PRIOR TO ADDITION OF WATER-REDUCING ADMIXTURE
- 8 INCHES (0.203m) – WITH ADDITION OF WATER-REDUCING ADMIXTURE

IF SULFATE CONCENTRATIONS IN SOILS ARE GREATER THAN 0.10% (OR ANTICIPATED TO BE GREATER THAN) TYPE V CEMENT SHALL BE USED.
ADMIXTURES
1. FLYASH PER ASTM C-618
2. AIR ENTRAINING PER ASTM C-260

MAXIMUM SIZE COARSE AGGREGATE: 1 INCH (0.025m) PER ASTM C-33
28-DAY COMPRESSIVE STRENGTHS (f'c):
1. FOUNDATIONS = 3000 PSI (20,700 KPa) – FOR WORKABILITY, NOT STRENGTH
2. CONCRETE DESIGN STRENGTH = 2500 PSI (17,200 KPa) – NO SPECIAL INSPECTION

REINFORCEMENT FOR CONCRETE:
1. ALL REINFORCING SHALL BE SUPPORTED IN FORMS SPACED WITH NECESSARY ACCESSORIES AND SHALL BE SECURELY WIRED TOGETHER IN ACCORDANCE WITH CRSI "MANUAL OF STANDARD PRACTICE" (1986)
2. DEFORMED BARS – ASTM A615, GRADE 60 KSI (420 MPa)

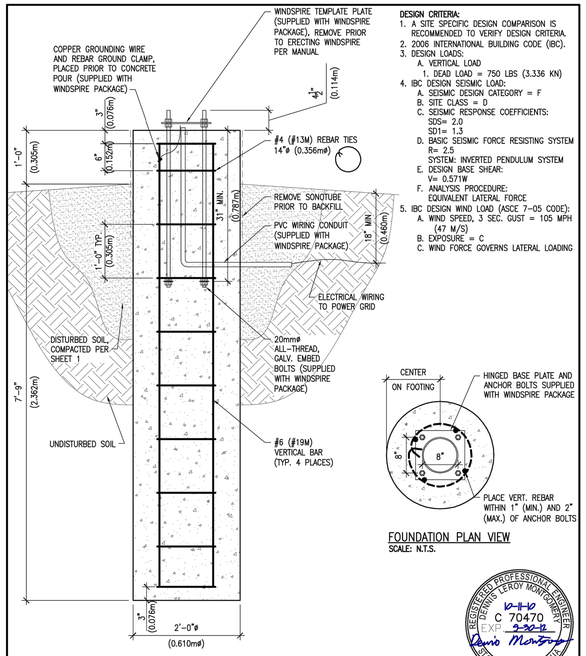
MINIMUM REINFORCEMENT LAP = 44 BAR DIAMETERS
MINIMUM CONCRETE COVER OVER REINFORCEMENT:
CONCRETE CAST AGAINST EARTH = 3 INCHES (0.076m)
CONCRETE EXPOSED TO EARTH OR WEATHER = 1½ INCHES (0.038m)
ALL CONCRETE SHALL BE MECHANICALLY VIBRATED INTO FOUNDATIONS AND FORMS

STRUCTURAL AND MISCELLANEOUS STEEL:

ALL STRUCTURAL STEEL WORK SHALL CONFORM TO THE AISC AND AWS SPECIFICATIONS.
ALL TOWER, BASE PLATE, AND WIND TURBINE DESIGNS BY WINDSPIRE ENERGY.
PROVIDE E70XX ELECTRODES FOR ALL WELDS, IN ACCORDANCE WITH AWS D1.4.
ISO 898.1, CLASS 8.8 GALV. OR EQUAL, BOLTS FOR ALL STEEL TO FOUNDATION CONNECTIONS.

REGISTERED PROFESSIONAL ENGINEER DENNIS LEROY MONTGOMERY C 70470 EXP. 9-30-12 CIVIL STATE OF CALIFORNIA 10-11-10

FOUNDATION NOTES		35' WINDSPIRE V.A.W.T. TYPICAL FOOTINGS (1500 PSF MIN. SOIL BEARING CAPACITY)	Windspire ENERGY 5450 LOUIE LANE RENO, NV 89511 (775) 852-0200 WWW.WINDSPIREENERGY.COM
DATE: OCT. 11, 2010	DENNIS MONTGOMERY, P.E.		
REV. B (#10006)	SHEET: 1 OF 4		



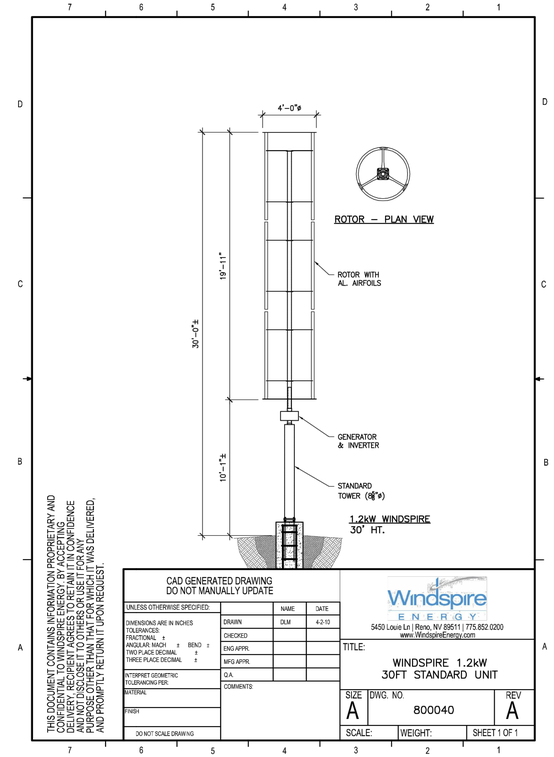
NON-CONSTRAINED FOUNDATION SECTION VIEW
SCALE: N.T.S.

DESIGN CRITERIA:
1. A SITE SPECIFIC DESIGN COMPARISON IS RECOMMENDED TO VERIFY DESIGN CRITERIA.
2. 2006 INTERNATIONAL BUILDING CODE (IBC).
3. DESIGN LOADS:
   - A. VERTICAL LOAD
     1. DEAD LOAD = 750 LBS (3.336 KN)
4. IBC DESIGN SEISMIC LOAD:
   - A. SEISMIC DESIGN CATEGORY = F
   - B. SITE CLASS = D
   - C. SEISMIC RESPONSE COEFFICIENTS: SDS= 2.0 SD1= 1.3
   - D. BASIC SEISMIC FORCE RESISTING SYSTEM R= 2.5 SYSTEM: INVERTED PENDULUM SYSTEM
   - E. DESIGN BASE SHEAR: V= 0.571W
   - F. ANALYSIS PROCEDURE: EQUIVALENT LATERAL FORCE
5. IBC DESIGN WIND LOAD (ASCE 7-05 CODE):
   - A. WIND SPEED, 3 SEC. GUST = 105 MPH (47 M/S)
   - B. EXPOSURE = C
   - C. WIND FORCE GOVERNS LATERAL LOADING

FOUNDATION PLAN VIEW
SCALE: N.T.S.

REGISTERED PROFESSIONAL ENGINEER DENNIS LEROY MONTGOMERY C 70470 EXP. 9-30-12 CIVIL STATE OF CALIFORNIA 10-11-10

FOUNDATION DETAIL – OPTION #1		35' WINDSPIRE V.A.W.T. TYPICAL FOOTINGS (1500 PSF MIN. SOIL BEARING CAPACITY)	Windspire ENERGY 5450 LOUIE LANE RENO, NV 89511 (775) 852-0200 WWW.WINDSPIREENERGY.COM
DATE: OCT. 11, 2010	DENNIS MONTGOMERY, P.E.		
REV. B (#10007)	SHEET: 2 OF 4		



THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY AND CONFIDENTIAL TO WINDSPIRE ENERGY. BY ACCEPTING DELIVERY, RECIPIENT AGREES TO RETAIN IT IN CONFIDENCE AND NOT DISCLOSE IT TO OTHERS OR USE IT FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT WAS DELIVERED, AND PROMPTLY RETURN IT UPON REQUEST.

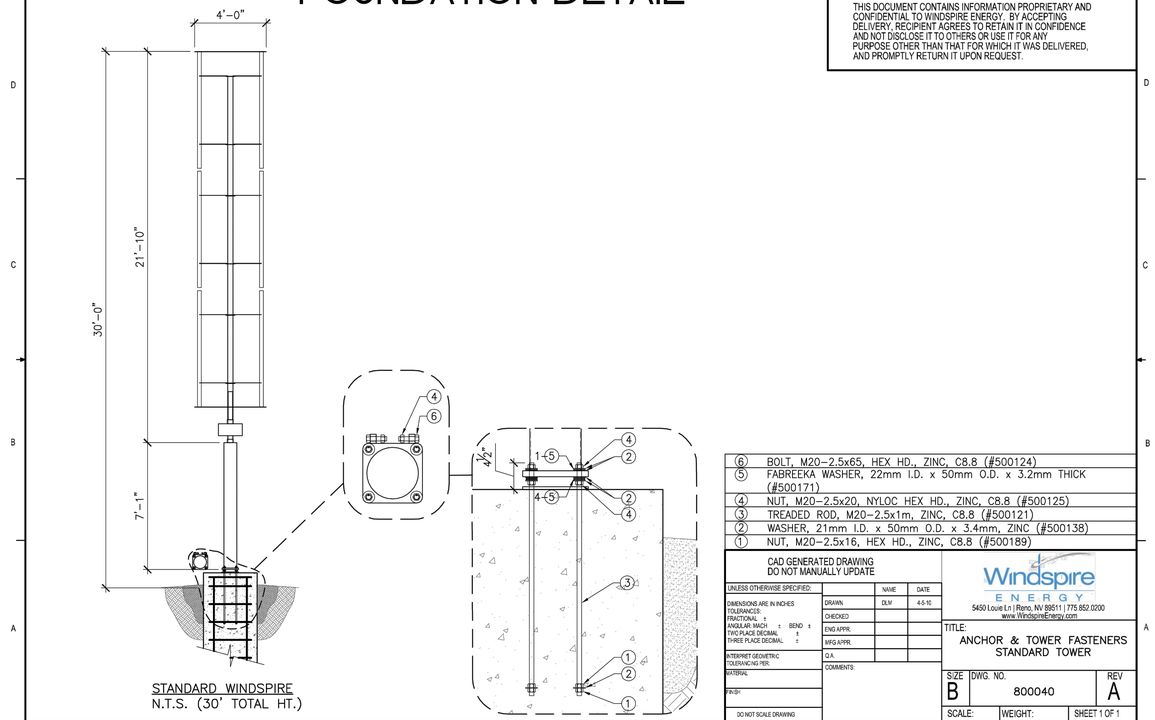
CAD GENERATED DRAWING
DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES	DRAWN	DLM	4-2-10
TOLERANCES: FRACTIONAL ±	CHECKED		
ANGULAR: MACH ± BEND ±	ENG APPR.		
TWO PLACE DECIMAL ±	MFG APPR.		
THREE PLACE DECIMAL ±	Q.A.		
INTERPRET GEOMETRIC TOLERANCING PER:	COMMENTS:		
MATERIAL			
FINISH			
DO NOT SCALE DRAWING			

Windspire ENERGY
5450 Louie Ln | Reno, NV 89511 | 775.852.0200
www.WindspireEnergy.com

TITLE: WINDSPIRE 1.2kW 30FT STANDARD UNIT

SIZE	DWG. NO.	REV
A	800040	A
SCALE:	WEIGHT:	SHEET 1 OF 1



6	BOLT, M20-2.5x65, HEX HD., ZINC, C8.8 (#500124)
5	FABREEKA WASHER, 22mm I.D. x 50mm O.D. x 3.2mm THICK (#500171)
4	NUT, M20-2.5x20, NYLOC HEX HD., ZINC, C8.8 (#500125)
3	TREADED ROD, M20-2.5x1m, ZINC, C8.8 (#500121)
2	WASHER, 21mm I.D. x 50mm O.D. x 3.4mm, ZINC (#500138)
1	NUT, M20-2.5x16, HEX HD., ZINC, C8.8 (#500189)

THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY AND CONFIDENTIAL TO WINDSPIRE ENERGY. BY ACCEPTING DELIVERY, RECIPIENT AGREES TO RETAIN IT IN CONFIDENCE AND NOT DISCLOSE IT TO OTHERS OR USE IT FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT WAS DELIVERED, AND PROMPTLY RETURN IT UPON REQUEST.

CAD GENERATED DRAWING
DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES	DRAWN	DLM	4-5-10
TOLERANCES: FRACTIONAL ±	CHECKED		
ANGULAR: MACH ± BEND ±	ENG APPR.		
TWO PLACE DECIMAL ±	MFG APPR.		
THREE PLACE DECIMAL ±	Q.A.		
INTERPRET GEOMETRIC TOLERANCING PER:	COMMENTS:		
MATERIAL			
FINISH			
DO NOT SCALE DRAWING			

Windspire ENERGY
5450 Louie Ln | Reno, NV 89511 | 775.852.0200
www.WindspireEnergy.com

TITLE: ANCHOR & TOWER FASTENERS STANDARD TOWER

SIZE	DWG. NO.	REV
B	800040	A
SCALE:	WEIGHT:	SHEET 1 OF 1

TOWER BOLTS

EnergyStars CONSTRUCTION
Energy performance solutions for where you work, live and play.
3811 Dividend Drive, Suite D
Shingle Springs, CA 95682
License Number: 950064
www.energystarsconstruction.com

Grant Gluck
916.275.3559
grant@energystarsconstruction.com

idec
1175 Elko Dr.
Sunnyvale, CA

Date 7 . 14 . 15

FOUNDATON

WT-4

EnergyStars CONSTRUCTION
Energy performance solutions for where you work, live and play.
3811 Dividend Drive, Suite D
Shingle Springs, CA 95682
License Number: 950064
www.energystarsconstruction.com

Grant Gluck
916.275.3559
grant@energystarsconstruction.com

idec
1175 Elko Dr.
Sunnyvale, CA

Date 7.7.15

Windspire ENERGY

Foundation Analysis

For

30 FOOT WINDSPIRE (1.2KW)

April 2, 2010

REGISTERED PROFESSIONAL ENGINEER
DENNIS LEROY MONTGOMERY
C 70470
EXP 1-30-10
CIVIL
STATE OF CALIFORNIA

Prepared by:

Windspire Energy
5450 Louie Lane
Reno, NV 89511
Phone: (775) 852-0200
Fax: (775) 201-0467
www.WindspireEnergy.com

Dennis Montgomery, P.E.
NCEES #31559

Windspire ENERGY

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	As Stated	**Designed**	DLM	**Date**	04/2010
Item	Foundation Design	**Checked**		**Date**	

Design Codes / Specifications:

2006 International Building Code
ASCE 7-05 - Minimum Design Loads for Buildings and Other Structures
Wind Speed: 105 mph (47 m/s)
Exposure Category: 'C'
Structure Category: II
Soils & Foundations (IBC Section 18)
Allowable Soil Bearing Pressure: 1,500 psf (assumed worst case soils)
Allowable Soil Lateral Pressure: 100 psf/ft (assumed worst case soils)
200 psf/ft (with increase per IBC 1804.3.1)

Pole Foundation Analysis Summary:
Static Load Case (105 mph):
Rotor Force @ 20' Ht = 665 lbf (2958 N)
Base Pole @ 5' Ht. = 92 lbf (409 N)

Pole Foundation Size:
Opt. #1 - Nonconstrained Pole Foundation: 2'-0" Diam. x 7'-0" Depth
Opt. #2 - Constrained* Pole Foundation: 2'-0" Diam. x 5'-6" Depth
Opt. #3 - Square Pad Foundation: 4'-9" Sq. x 1'-3" Depth with 2'-0" Diam. Pedestal

Windspire ENERGY

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006	**Designed**	DLM	**Date**	04/2010
Item	Non-Constrained Foundation Option #1	**Checked**		**Date**	

Pole Foundation Embedment:

Lateral Force (P):	688	lbs (Including base pole wind load transposed to 20' height)
Force Height (h):	20	ft
Footing Diameter (b):	2	ft
Assumed Ftg. Depth (d):	7.0	ft
Soil Lateral Pressure (Sb):	200	psf/ft (Increased per IBC 1804.3.1, allowing 0.5" displacement)
Max. Soil Lateral Pressure:	3000	psf (IBC 1804.3.1)

S_1 = 468.864 psf (1/3*d*Sb)

A = 1.7 (2.34*P/(S_1*b))

d = **7.0** ft (IBC Eq. 18-1, REQUIRED DEPTH) d=0.5*A*(1+(1+(4.36*h/A))^0.5)

Pole Foundation: 2'-0" Diam. x 7'-0" Depth

FOUNDATION DESIGN

FOUNDATION DESIGN

WT-5

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006	**Designed**	DLM	**Date**	04/2010
Item	Constrained Foundation Option #2	**Checked**		**Date**	

Constrained Pole Foundation Embedment:

Lateral Force (P):	688	lbs (Including base pole wind load transposed to 20' height)
Force Height (h):	20	ft
Footing Diameter (b):	2	ft
Assumed Ftg. Depth (d):	5.3	ft
Soil Lateral Pressure (Sb):	200	psf/ft (Increased per IBC 1804.3.1, allowing 0.5" displacement)
Max. Soil Lateral Pressure:	3000	psf (IBC 1804.3.1)

S_3 = 1052 psf (S_3=d*Sb)

d = **5.3** ft (IBC Eq. 18-2, REQUIRED DEPTH; d=(4.25*(P*h/(S_3*b)))^0.5)

Constrained* Pole Foundation: 2'-0" Diam. x 5'-6" Depth

*For constrained condition, concrete or pavement slab is required at all sides of pole foundation.

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006	**Designed**	DLM	**Date**	04/2010
Item	Pad Foundation Option #3	**Checked**		**Date**	

Square Pad Foundation:

Lateral Force (P_H):	688	lbs (Including base pole wind load transposed to 20' height)
Force Height (h):	20	ft
Overturning Moment (Mo):	13760	lbs*ft
Vertical Force (P_V):	630	lbs
Assumed Ftg. Width (b):	4.75	ft (square)
Assumed Ftg. Depth (d):	1.3	ft
Assumed Ped. Diam. (D_P):	2.0	ft
Assumed Ped. Height (H_P):	3.0	ft
Concrete Density (γ_C):	150	pcf
Soil Density (γ_s):	110	pcf
Soil Lateral Pressure (Sb):	200	psf/ft (Increased per IBC 1804.3.1, allowing 0.5" displacement)
Soil Brg. Pressure (S_{brg}):	1500	psf (IBC 1804.3.1)

Total Vertical Force (P_{VT}) = 10547 lbs
$P_{vt}=P_v+(b^2*d*\gamma_c)+((D_p^2)/4*\pi*H_p*\gamma_c)+((b^2-(D_p^2)/4*\pi)*(H_p-1)*\gamma_s)$

Resisting Moment (M_R) = 22544 lbs.*ft …M_R =0.9*P_{vt}*b/2
Overturning Mement (M_o) = 13760 lbs.*ft

O.T.M. Factor of Safety = 1.6

Sliding Resistence (V_r) = 2847.632 lbs …V_r =0.9*P_{VT}*0.3

Sliding Factor of Safety = 4.1

Bearing Eccentricity (e) = 1.3 ft …e =M_o/P_{VT}
Soil Bearing Pressure = 1383 psf …=P_{VT}/(b*(3*(b/2-e)/2))

Bearing Pressure => OK

Square Pad Foundation: 4'-9" Sq. x 1'-3" Depth with 2'-0" Diam. Pedestal

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006, ACI 318-08	**Designed**	DLM	**Date**	04/2010
Item	Anchor Bolt Design	**Checked**		**Date**	

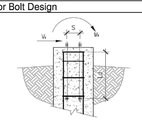
Design Codes / Specifications:
2006 International Building Code
ASCE 7-05 - Minimum Design Loads for Buildings and Other Structures
Wind Speed: 105 mph (47 m/s)
Exposure Category: 'C'
Structure Category: II
Anchor Bolt Specifications
ISO '898-1' Class 8.8
Min. Yield Stress: 95 ksi (660 Mpa)
Min. Ultimate Stress: 120 ksi (830 Mpa)

Anchor Bolt Analysis Summary:
Static Load Case (105 mph):
Rotor Force @ 19' Ht = 665 lbf (2958 N)
Base Pole @ 4' Ht. = 92 lbf (409 N)

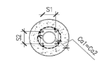
PROVIDE: (4) 20mm diam. 'ISO 898-1' Class 8.8 A.B. with 23 inches min. Embed

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006, ACI 318-08	**Designed**	DLM	**Date**	04/2010
Item	Anchor Bolt Design	**Checked**		**Date**	



FOUNDATION SECTION VIEW
SCALE: N.T.S.



FOUNDATION PLAN VIEW
SCALE: N.T.S.

Foundation Anchor Bolt Design

Resulting Forces (ASD)

Shear (V_{20}) =	**0.665**	k @ 19 ft
Shear (V_S) =	**0.092**	k @ 4 ft
Shear (V_T) =	**0.757**	k (4 bolts in shear)
Moment (M_T) =	**13.00**	k*ft
s_1=	**8**	in …*anchor bolt spacing*
Tension (T) =	**19.50**	k (2 bolts in tension)

Anchor Bolt Steel Capacity
ACI Sections D5.1 & D.6.1

4 of **0.787** Diam. ISO 898-1 Class 8.8 Anchor Bolts, F_t = 0.33F_u; F_v = 0.17F_u
A.B. allowable tension: 19.5 k/bolt (ASD Value; Table I-B)
A.B. allowable shear: 9.9 k/bolt (ASD Value; Table I-D)

T_{ALLOW}= 38.9 k **Tallow>T => OK**
V_{ALLOW}= 39.7 k **Vallow>V => OK**

Tension & Shear= **0.3 <1** **COMBINED STRESS OK**

Concrete Breakout Strength (Tension) Required Tension Development Length:
ACI Section D.5.2 (RD.5.2.9 & Figure RD.5.2.9 - Anchor Reinforcement for Tension)

l_d= 34 5/8 inches l_d= 44*d_b (ACI 12.2.2, #6 Bar or smaller)

T_{ALLOW}= 38.9 k
$T_{REQ'D}$= 19.5 k

l_d= l_d*(T_{ALLOW}/$T_{REQ'D}$); Minimum of 12" (ACI 12.2.5)
l_d= 17.4 inches
l_h= 5.0 inches (horizontal distance to reinforcing)

PROVIDE: 23 " MIN OF LAP DISTANCE

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006, ACI 318-08	**Designed**	DLM	**Date**	04/2010
Item	Anchor Bolt Design	**Checked**		**Date**	

Pullout Strength of Anchor in Tension
ACI Section D.5.3

$\Psi_{c,P}$=	1.0		…Conservatively taken at 1.0 (cracked concrete)
W_d	2.00	in	…washer diameter
A_{brg} =	2.7	in^2	…Bearing area Abrg = PI*(Wd^2-Da^2)/4
f'_C=	2500	psi	
N_p =	53103	lbs	…ACI Eq. D-15 Np=8*Abrg*fc
N_{pn} =	**39827**	**lbs**	…ACI Eq. D-14 Npn=$\phi\Psi_{c,P}$*Np (ϕ = 0.75)
T_{MAX}=	**15604**	**lbs**	…LRFD Factor Included (1.6) Tmax =1.6*T2*1000

Npn>Tmax => OK

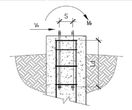
Side-face Blowout Strength of Anchor in Tension
ACI Section D.5.4

c_{a1}=	6	in	…*edge distance (perp. to shear force)*
c_{a2}=	6	in	…*edge distance (parrallel to shear force)*
λ =	1.0		…Lightweight concrete factor (1.0 if normal weight)
N_{sb} =	**39107**	**lbs**	…ACI Eq. D-17 N_{sb} = 160*c_{a1}*(A_{brg})^.5*λ*(f'c)^.5*(1+c_{a2}/c_{a1}))/4
N_{sbg} =	**35848**	**lbs**	…ACI Eq. D-18 N_{sbg} = ϕ(1+s/(6*c_{a1}))*N_{sb} (ϕ = 0.75)
T_{MAX}=	**31207**	**lbs**	…LRFD Factor Included (1.6) Tmax =1.6*T*1000

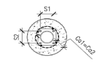
Nsbg>Tmax => OK

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.MariahPower.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006, ACI 318-08	**Designed**	DLM	**Date**	04/2010
Item	Anchor Bolt Design	**Checked**		**Date**	



FOUNDATION SECTION VIEW
SCALE: N.T.S.



FOUNDATION PLAN VIEW
SCALE: N.T.S.

Concrete Breakout Strength of Anchor in Shear
ACI Section D.6.2

V_{cbg}=(0.75)(A_{vc}/A_{vco})($\Psi_{ec,V}$)($\Psi_{ed,V}$)($\Psi_{c,V}$)(Ψh,v)V_b (ACI EQ. D-22)

f'_c=	2500	psi	
P_W=	24	in	…*Pole footing width perp. to shear force*
P_L=	24	in	…*Pole footing length parallel to shear force*
H_p=	36	in	…*Pole footing height*
h_e=	23	in	…Anchor embed depth to bottom washer and double nut
c_{a1}=	6	in	…*edge distance (perp. to shear force)*
s_1=	8	in	…*spacing distance between bolts (perp. to shear force)*
c_{a2}=	6	in	…*edge distance (parrellel. to shear force)*
s_2=	8	in	…*spacing distance between bolts (parallel to shear force)*
A_{vc}=	**216.0**	in^2	…*ACI Fig. RD.6.2.1(c): $A_{vc}=(Pw)(1.5c_{a1})$*
A_{vco}=	162.0	in^2	…*ACI Eq. D-23: $A_{vco}=4.5(c_{a1})^2$*
V_b=	8963	lbs	…*ACI Eq. D-24: $V_b=(7(l_e/d_a)^{0.2}(d_a)^{0.5})(f'_c)^{0.5}(c_{a1})^{1.5}$*
$\Psi_{ec,V}$=	1.0		…*ACI Eq. D-26: concentric loading=1.0*
$\Psi_{ed,V}$=	0.9		…*ACI Eq. D-28, $\Psi_{ed,V}=0.7+0.3*[c_{a2}/(1.5c_{a1})]$*
$\Psi_{c,V}$=	1.4		…*ACI D.6.2.7 Reinf. of #4 or greater stirrups*
$\Psi_{h,V}$=	1.0		…*ACI D.6.2.8 $H_a > 1.5*c_{a1}$*
V_{cbg}=	**11293**	lbs	…Including ϕ = 0.75
V_{MAX}=	**1064**	lbs	…Including Wind Factor (1.6)

Vcbg>Vmax => OK

Interaction of Tensile and Shear
ACI Section D.7

Full Tensile Strength Allowed - (20%Vcbg)>Vmax, ACI D.7.1

PROVIDE: (4) 20mm diam. 'ISO 898-1' Class 8.8 A.B. with 23 inches min. Embed

FOUNDATION DESIGN

EnergyStars CONSTRUCTION
Energy performance solutions for where you work, live and play.
3811 Dividend Drive, Suite D
Shingle Springs, CA 95682
License Number: 950064
www.energystarsconstruction.com
Grant Gluck
916.275.3559
grant@energystarsconstruction.com

idec
1175 Elko Dr.
Sunnyvale, CA

Date 7 . 14 . 15

FOUNDATION DESIGN

WT-6

Lateral Load Analysis

For

30 FOOT WINDSPIRE (1.2KW)

April 2, 2010

Prepared by:

Windspire Energy
5450 Louie Lane
Reno, NV 89511
Phone: (775) 852-0200
Fax: (775) 201-0467
www.WindspireEnergy.com

Dennis Montgomery, P.E.
NCEES #31559

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	As Stated	**Designed**	DLM	**Date**	04/2010
Item	Lateral Loading - Summary	**Checked**		**Date**	

Static Design Codes / Specifications[1]:
2006 International Building Code
ASCE 7-05 - Minimum Design Loads for Buildings and Other Structures
Wind Speed: 105 mph (47 m/s)
Exposure Category: 'C'
Structure Category: II
Seismic S_{DS}: 3.000
Seismic S_{D1}: 1.300

Dynamic Design Codes / Specifications[1]:
"MPG Report Analysis 2", Sept. 6, 2007. Dr. Ion Parashivoiu
CARDAAV Code Analysis Software
Wind Speed: 34 mph (15 m/s)
Wind Speed Ref. Ht: 30 feet (9.144m)

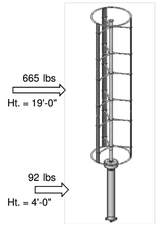
Load Analysis Summary (Wind Governs - Lateral Loading):
Static Load Case (105 mph):
Rotor Force @ 20' Ht = 665 lbf (2958 N)
Base Pole @ 5' Ht. = 92 lbf (409 N)

Dynamic Load Case (34 mph, 15 m/s) - Cyclic Loading @ Rotational Components
Rotor Force @ 20' Ht = 127 lbf (565 N)

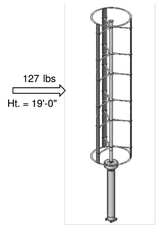
(1): Mechanical Brake is engaged at rotor revolutions greater than 400 rpm, approximately equal to 34 mph (15 m/s) wind speed as determined from CARDAAV Code Analysis. Therefore, wind speeds up to 34 mph (15 m/s) shall result in dynamic wind loads and wind speeds in excess of 34 mph (15 m/s) shall result in static wind loads.

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006; ASCE 7-05	**Designed**	DLM	**Date**	04/2010
Item	Wind Load Diagram	**Checked**		**Date**	



Static Loading
* 105 mph (3-sec. gust)
* Exposure 'C'
* Category II Structure



Dynamic (Cyclic) Loading
* Extrapolated Dynamic Wind Force, "MPG Report Analysis 2"
* 34 mph (15 m/s) Dynamic Wind Speed @ 400 rpm

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	As Stated	**Designed**	DLM	**Date**	04/2010
Item	Seismic Loads	**Checked**		**Date**	

Input	
Zip Code	ALL
Site Class	D

S_S =	3.000	(Worst Case Design)	
S_1 =	1.300	(Worst Case Design)	
F_a =	1.00	(Table 11.4-1 from ASCE 7)	
F_v =	1.50	(Table 11.4-2 from ASCE 7)	
S_{MS} =	3.000	$S_{MS} = F_a S_S$	
S_{M1} =	1.950	$S_{M1} = F_v S_1$	(Eqn's 11.4-1 & 11.4-2, ASCE 7)
S_{DS} =	2.000	$S_{DS} = \frac{2}{3} S_{MS}$	
S_{D1} =	1.300	$S_{D1} = \frac{2}{3} S_{M1}$	

Seismic Design Category (for seismic use group I, or II) => **F**

Input	
R =	2.5
I =	1.0

(Table 12.2-1, ASCE 7)

W =	630	lbf	
H =	30	ft	
T =	0.43	s	(Eq. 12.8-7, ASCE 7)
$C_{s\,max}$ =	1.22		(Eq. 12.8-3, ASCE 7)
$C_{s\,min}$ =	0.26		(Eq. 12.8-6, ASCE 7)
C_s =	**0.800**		(Eq. 12.8-2, ASCE 7)

$V = \frac{C_s}{1.4} W$ modified for ASD

V = 0.571 x W

V = 360 lbf

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006; ASCE 7-05	**Designed**	DLM	**Date**	04/2010
Item	Ice + Wind Load Calculation	**Checked**		**Date**	

Design: 50 MPH WIND, Static Design Wind Load Condition

K_z =	0.90	*velocity pressure coefficient (from ASCE 7-05 Table 6-3)*
		(Avg. rotor height = 20 *ft. - Exposure 'C')*
K_{zt} =	1.0	*topographic factor (see ASCE 7-05 Section 6.5.7.2)*
		K_1 = 0.0 K_2 = 1.0 K_3 = 1.0
		(topographic effect - verify w/ site specific conditions)
K_d =	0.85	*wind directionality factor (from ASCE 7-05 Table 6-4)*
		(Lattice Framework)
I =	1.0	*Importance factor (from ASCE 7-05 Table 6-1)*
		(Category II Structure)
V =	50 mph	*3-second gust*
		(Concurrent Wind Speed with Ice Loading)
q_z =	4.9 psf	*ASCE 7-05 Eq. 6-15* $q_z = 0.00256 K_z K_{zt} K_d V^2 I$
G =	0.85	*gust-effect factor (from ASCE 7-05 Section 6.5.8)*
F =	4.2 *Cf*Af (lbs.)	*ASCE 7-05 Eq. 6-28* $F = q_z G C_f A_f$

Ice + Wind Load:

Ice Load:

t =	1.0	in. (ASCE 7-05, Figure 10-2)
I_i =	1.0	
f_z =	0.95	(ASCE 7-05, Eq. 10-4)
t_d =	**1.9**	in. (ASCE 7-05, Eq. 10-5)

Windspire Profile:

Airfoils =	10	in (total chord width profile)
Airfoils + Ice =	13.8	in (chord width + ice)
Ht. =	6.5	ft
# of Foils =	3	
C_f =	1.7	…IEC 61400 Force Coefficients
V_i =	13985	in^3 (ASCE 7-05, Eq. 10-2)

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006; ASCE 7-05	**Designed**	DLM	**Date**	04/2010
Item	Ice + Wind Load Calculation	**Checked**		**Date**	

Windspire Profile (Cont.):

Rotor Center Pole =	3.5	in (diam.)
Center Pole + Ice =	7.3	in (diam. + ice)
Ht. =	20	ft
C_f =	1.3	…IEC 61400 Force Coefficients
V_i =	15771	in^3 (ASCE 7-05, Eq. 10-2)
Airfoil Struts =	0.25	in (thickness)
Airfoil Structs + Ice =	2.5	in (chord width + ice)
Length =	2.9	ft
# of Struts =	8.0	(including top and bottom safety rings)
C_f =	1.5	…IEC 61400 Force Coefficients
V_i =	4238	in^3 (ASCE 7-05, Eq. 10-2)
Base Pole =	8.625	in (diam.)
Base Pole + Ice =	12.4	in (diam. + ice)
Ht. =	10.0	ft
C_f =	0.7	…IEC 61400 Force Coefficients
V_i =	19354	in^3 (ASCE 7-05, Eq. 10-2)
ΣV_i =	31	ft^2
ΣW_i =	1729	lbs. (Vertical)

Rotor Force =	**257 lbs @ 20' Ht. (19' from steel base plate)**
Base Pole Force =	**30 lbs @ 5' Ht. (4' from steel base plate)**

EnergyStars CONSTRUCTION
Energy performance solutions for where you work, live and play.
3811 Dividend Drive, Suite D
Shingle Springs, CA 95682
License Number: 950064
www.energystarsconstruction.com

Grant Gluck
916.275.3559
grant@energystarsconstruction.com

idec
1175 Elko Dr.
Sunnyvale, CA

Date 7 . 14 . 15

LATERAL ANALYSIS

WT-7

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	Project No.		Sheet	
Code(s)	IBC 2006; ASCE 7-05	Designed	DLM	Date	04/2010
Item	Static Wind Load Calculation	Checked		Date	

Design: 105 MPH WIND, Static Design Wind Load Condition

K_z =	0.90	*velocity pressure coefficient (from ASCE 7-05 Table 6-3)*
		(Avg. rotor height = 20 *ft. - Exposure 'C')*
K_{zt} =	1.0	*topographic factor (see ASCE 7-05 Section 6.5.7.2)*
		K_1 = 0.0 K_2 = 1.0 K_3 = 1.0
		(topographic effect - verify w/ site specific conditions)
K_d =	0.85	*wind directionality factor (from ASCE 7-05 Table 6-4)*
		(Lattice Framework)
I =	1.0	*Importance factor (from ASCE 7-05 Table 6-1)*
		(Category II Structure)
V =	105 mph	*3-second gust*
		(Maximum Designed Wind Speed)
q_z =	21.6 psf	*ASE 7-05 Eq. 6-15* $q_z = 0.00256 K_z K_{zt} K_d V^2 I$
G =	0.85	*gust-effect factor (from ASCE 7-05 Section 6.5.8)*
F =	18.4 *Cf*Af (lbs.)	*ASCE 7-05 Eq. 6-28* $F = q_z G C_f A_f$

Static Wind Load:

Windspire Profile:

Airfoils = 10 in (total chord width profile)
Ht. = 6.5 ft
# of Foils = 3
C_f = 1.7 …IEC 61400 Force Coefficients

Rotor Center Pole = 3.5 in (diam.)
Ht. = 20 ft
C_f = 1.3 …IEC 61400 Force Coefficients

Airfoil Struts = 0.25 in (thickness)
Length = 2.9 ft
# of Struts = 8.0 (including top and bottom safety rings)
C_f = 1.5 …IEC 61400 Force Coefficients

Base Pole = 8.625 in (diam.)
Ht. = 10.0 ft
C_f = 0.7 …IEC 61400 Force Coefficients

Rotor Force = 665 lbs @ 20' Ht. (19' from steel base plate)
Base Pole Force = 92 lbs @ 5' Ht. (4' from steel base plate)

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	Project No.		Sheet	
Code(s)	IBC 2006; ASCE 7-05	Designed	DLM	Date	04/2010
Item	Dynamic Wind Load Calculation	Checked		Date	

Dynamic Wind Load: **(15 m/s & 400 rpm)**

Rotor Force:
-Dynamic (Cyclic) Force - Ref. "MPG Report Analysis 2", 09-06-2007, Dr. Parashivoiu)

Extrapolation of Dynamic Wind Forces:
35 m/s, 400 rpm = 332 lbs (1475 N)
45 m/s, 400 rpm = 470 lbs (2090 N)

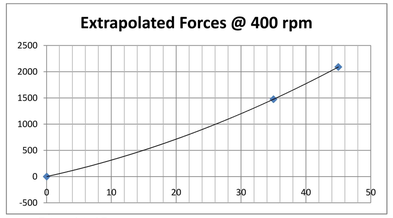
Extrapolated to 15 m/s = 112 lbs (500 N)

Rotor Center Pole = 3.5 in (diam.)
Ht. = 20 ft
C_f = 1.3 …IEC 61400 Force Coefficients
V = 34 mph (15 m/s)
Drag Force @ 15 m/s = 15 lbs

Dynamic Rotor Force = 127 lbs @ 20' Ht. (19' from steel base plate)

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	Project No.		Sheet	
Code(s)	CARDAAV Analysis Software	Designed	DLM	Date	04/2010
Item	Dynamic Wind Load Calculation	Checked		Date	



Extrapolated Forces:
Dynamic Wind Force @ 15 m/s = 500 N (112 lbf)

m/s	N
0	0
35	1475
45	2090

LATERAL ANALYSIS

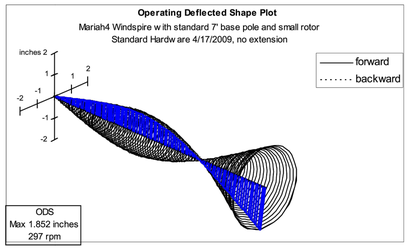
EnergyStars CONSTRUCTION
Energy performance solutions for where you work, live and play.
3811 Dividend Drive, Suite D
Shingle Springs, CA 95682
License Number: 950064
www.energystarsconstruction.com
Grant Gluck
916.275.3559
grant@energystarsconstruction.com

idec
1175 Elko Dr.
Sunnyvale, CA

Date 7 .14 . 15

LATERAL ANALYSIS / TOWER ANALYSIS

WT-8



4. Dynamic loads on the studs

$\theta_{base1} := .0011$ $\theta_{base2} := .0079$ radians (from XLRotor)

$M_{\theta 1} := \sqrt{(K_\theta \cdot \theta_{base1})^2 + (\omega_1 \cdot C_{\theta 1} \cdot \theta_{base1})^2}$ $M_{\theta 1} = 709.958$ in-lb

$M_{\theta 2} := \sqrt{(K_\theta \cdot \theta_{base2})^2 + (\omega_1 \cdot C_{\theta 2} \cdot \theta_{base2})^2}$ $M_{\theta 2} = 5.051 \times 10^3$ in-lb

$F_{d1} := \frac{M_{\theta 1}}{a}$ $F_{d2} := \frac{M_{\theta 2}}{a}$ Dynamic Force on 2 studs

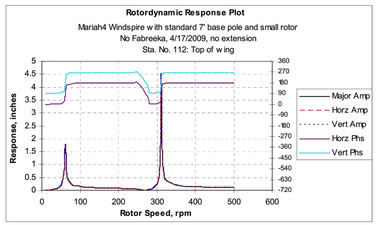
(continued next page)

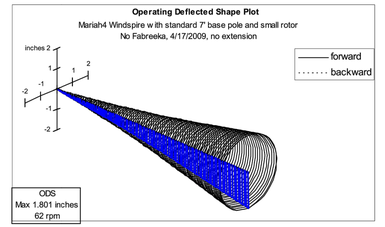
$F_{stud1} := \frac{F_{d1}}{2}$ $F_{stud2} := \frac{F_{d2}}{2}$

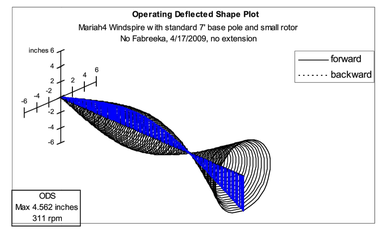
$F_{stud1} = 44.372$ $F_{stud2} = 315.661$ lb

$Crit_1 = 43$ $Crit_2 = 297$ cpm

B. STANDARD UNIT WITH NO FABREEKA WASHERS:
Whirl Amplitudes and Dynamic Loads at the Base Plate







B. STANDARD UNIT WITH NO FABREEKA WASHERS

1. Moment stiffness coefficient of the base with no Fabreeka washers (backed out from early Gabrys tests)

$K_{\theta steel} := 1500000$ in-lb/rad

TOWER ANALYSIS

Windspire ENERGY

Tower Analysis

For

30 FOOT WINDSPIRE (1.2KW)

April 2, 2010

Prepared by:

Windspire Energy
5450 Louie Lane
Reno, NV 89511
Phone: (775) 852-0200
Fax: (775) 201-0467
www.WindspireEnergy.com

Dennis Montgomery, P.E.
NCEES #31559

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	As Stated	**Designed**	DLM	**Date**	04/2010
Item	Tower Design	**Checked**		**Date**	

Design Codes / Specifications:

2006 International Building Code
AISC Steel Column Base Plate Design Guide 1
ASCE 7-05 - Minimum Design Loads for Buildings and Other Structures
Wind Speed: 105 mph (47 m/s)
Exposure Category: 'C'
Structure Category: II
Tower Steel & Weld Material (AISC-Allowable Stress Design)
Steel Tower: ASTM A500 B (fy = 42 ksi, fu = 58 ksi, min.)
Weld Filler Material: E70xx (fy = 70 ksi)
Steel Base Plate: ASTM A36

Pole Foundation Analysis Summary:

Static Load Case (105 mph):
Rotor Force @ 20' Ht = 665 lbf (2958 N)
Base Pole @ 5' Ht. = 92 lbf (409 N)

Tower Size, Base Weld, & Base Plate:
Provide: ASTM A500 Grade B, 8.625" x 0.188" Wall Tower w/ 0.188" Fillet Weld
1" x 10" x 10" ASTM A36 Steel Base Plate

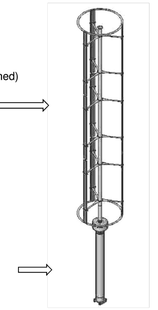
Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006	**Designed**	DLM	**Date**	04/2010
Item	Tower Design	**Checked**		**Date**	

Tower Stress:

Shear (V_{20}) =	**0.665**	k @ 19 ft
Shear (V_4) =	**0.092**	k @ 4 ft
Static Moment (M_T) =	**13.00**	k*ft
Dynamic Moment (M_D) =	**0.42**	k*ft …(Rotordynamic Analysis, Attached)
Tower O.D. =	**8.625**	in
Tower I.D. =	**8.249**	in
I_T =	**44.36**	in^4 … = π*(OD^4-ID^4)/64
σ_T =	**15.17**	ksi … = M_T*12*(OD/2)/I_T
σ_D =	**0.49**	ksi … = M_D*12*(OD/2)/I_T
Allowable σ_T =	**25.20**	ksi … = 0.6(fy)
Allowable σ_D =	**2.50**	ksi …(AWS D14.4, Table 5)

8.625x0.188 Wall Tower OK



Weld Stress:

S_W =	**61.00**	in^2 … = π*(OD/2+W_T/2)^2
$\sigma_{WT/in}$ =	**2.56**	k/in … = M_T*12/S_W
$\sigma_{WD/in}$ =	**0.08**	k/in … = M_D*12/S_W
Weld Thickness (W_T) =	**0.188**	in
Allowable $\sigma_{WT/in}$ =	**2.79**	k/in …= 0.707*0.3*W_T*70
Allowable $\sigma_{WD/in}$ =	**0.47**	k/in …= (2.5 ksi)*W_T

Base Weld OK

Windspire Energy
5450 Louie Lane
Reno, NV 89511
www.WindspireEnergy.com
Phone (775) 852-0200
Fax (775) 201-0467

Project	30 Ft. WINDSPIRE (1.2KW)	**Project No.**		**Sheet**	
Code(s)	IBC 2006	**Designed**	DLM	**Date**	04/2010
Item	Tower Design	**Checked**		**Date**	

Base Plate Design Per AISC - Design Guide 1:

P =	**0.60**	K
f'_c =	**2.50**	ksi
Base Plate Width (N=B) =	**10.00**	in (square)
F_p =	**1.75**	ksi … = 0.7*f'_c
M + PA' =	**158**	in*kip …(Assume A' = 4")
F_p*B*N'^2 =	**1264**	in*kip …(Assume N' = 8.5")
B =	**0.125**	… = (M+PA')/(F_p*B*N'^2)
A/N' =	**0.300**	… (Figure 16)
A =	**2.550**	in … = (A/N')*N'
α =	**0.9**	… (Figure 16)
T =	**20.1**	kips … = (M+P*A')/(α*N') - P
D_{cr} =	**0.90**	in … = (B-0.95*OD)/2
σ_1 =	**1.278**	ksi … = (F_p/A)*(OD/2-(N/2-A))
M_{PL} =	**0.65**	in*kip/in … = ((σ_1*D_{cr}^2)/2+((F_p-σ_1)*D_{cr}^2*0.67)/2
Min. Base Plate (t_p)=	**0.38**	in … = ((6*M_{PL})/(0.75*f_{yPL}))$^{0.5}$

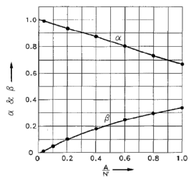


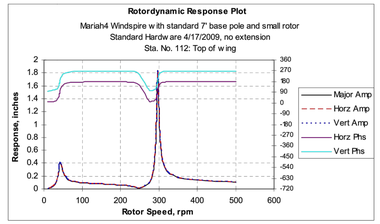
Fig. 16. Design Aidfor Axial Load Plus Moment

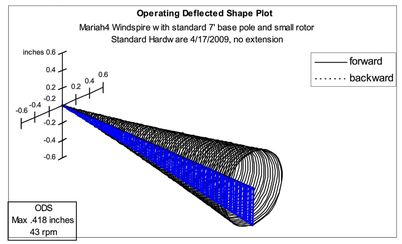
Provide: ASTM A500 Grade B, 8.625" x 0.188" Wall Tower w/ 0.188" Fillet Weld
1" x 10" x 10" ASTM A36 Steel Base Plate

Attachment I

A. STANDARD UNIT WITH FABREEKA WASHERS:

Whirl Amplitudes and Dynamic Loads at the Base Plate





TOWER ANALYSIS

EnergyStars CONSTRUCTION
Energy performance solutions for where you work, live and play.
3811 Dividend Drive, Suite D
Shingle Springs, CA 95682
License Number: 950064
www.energystarsconstruction.com

Grant Gluck
916.275.3559
grant@energystarsconstruction.com

idec
1175 Elko Dr.
Sunnyvale, CA

Date 7 . 14 . 15

/ TOWER ANALYSIS

WT-9