



Reviewed for Code Compliance
Inspections Division
Approved with Conditions
Date: 07/29/15

(Revised) STRUCTURAL ANALYSIS REPORT

For

ME 5040 (LTE 4C)
AWE-MUNJOY HILL
211 Cumberland Avenue
Portland, ME 04101

**Antennas Mounted on Building Façade and on Ballast Frames;
Equipment Room in Basement**



Prepared for:



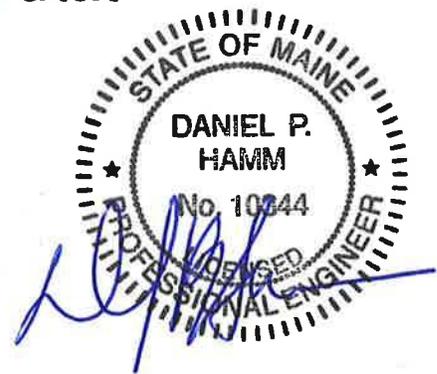
Dated: July 29, 2015 (Rev.2)

April 24, 2015 (Rev.1)
January 21, 2015

Prepared by:



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North Andover, MA 01845
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SCOPE OF WORK:

Hudson Design Group LLC (HDG) has been authorized by AT&T to conduct a structural evaluation of the structure that will support the existing AT&T equipment located in the areas depicted in the latest HDG's construction drawings.

This report represents this office's findings, conclusions and recommendations' pertaining to the support of AT&T's proposed equipment.

An on-site visual survey of the above areas was performed by ProVertic on December 5, 2014. Attendees included Nick Bestor and Mark Gormley (ProVertic Field Technicians).

CONCLUSION SUMMARY:

Building plans prepared by Leasure, Tuttle, Lee dated 03/23/1967 were obtained for our use. A limited visual survey of the structure was completed in or near the areas of the proposed work.

Based on our evaluation, we have determined that the existing structure **IS CAPABLE** of supporting the proposed equipment loading with the following modifications:

- Add ballast to the existing Alpha and Beta sector frames. See the chart below for ballast requirements.

MINIMUM BALLAST REQUIREMENTS		
SIDE	A (Back)	B (Front)
NUMBER OF BLOCKS	32	19
SIZE OF BLOCKS	4"x8"X16" Solid	
WEIGHT OF BLOCKS	38 lbs./ ea.	
TOTAL BALLAST WEIGHT	1938 lbs.	

- Relocate the Alpha sector antenna frame at least 4 feet away from the parapets to meet the roof design loads provided in the building plans.



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APPURTENACE/EQUIPMENT CONFIGURATION:

- (2) HPA-65R-BUU-H6 Antennas (72"x14.8"x9" - Wt. = 56 lbs. /ea.) (Beta & Gamma sector)**
- (1) SBNH-1D6565C Antenna (96.4"x11.9"x7.1" – Wt. = 61 lbs.) (Alpha sector)**
- (3) A2 Module (16.4"x15.2"x3.4" – Wt. = 22 lbs. /ea.) (One per sector)**
- (6) RRH (RRUS-11) (19.69"x16.97"x7.17" – Wt. = 50.7 lbs. /ea.) (Two per sector)**
- (3) Surge Arrestors (Wt. = 32.8 lbs. /ea.) (One per sector)**
- (1) Power Plant (Wt. = 1900 lbs.)**
- (1) Battery Rack (Wt. = 2500 lbs.)**
- (6) 7750 Antennas (57"x11"x5" Wt. = 35 lbs. /ea.) (Two per Sector)
- (2) AM-X-CD-16-65-00T-RET Antennas (72"x11.8"x5.9" Wt. = 48.5 lbs. /ea.) (Beta & Gamma sector)
- (1) AM-X-CD-14-65-00T-RET Antenna (48"x11.8"x5.9" Wt. = 36.5 lbs.) (Alpha sector)
- (3) 9E Surge Arrestors (Wt. = 43.5 lbs. /ea.) (One per sector)
- (6) RRH (RRUS-11) (19.69"x16.97"x7.17" – Wt. = 50.7 lbs. /ea.) (Two per sector)

Referenced documents are attached.



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DESIGN CRITERIA:

1. International Building Code (IBC) 2009, and ASCE 7-05 (Minimum Design Loads for Buildings and Other Structures).

Wind Analysis:

Reference Wind Speed:	100 mph	(FIG 6-1C; ASCE 7-05)
Category:	B	(Section 6.5.6.3; ASCE 7-05)

Roof:

Ground Snow, P_g :	60 psf	(FIG 7-1; ASCE 7-05)
Importance Factor, I :	1.0	(Category II)
Exposure Factor, C_e :	1.0	(Exp. B- Partially Exposed)
Thermal Factor, C_t :	1.0	(Typical Structure)
Flat Roof Snow Load:	42 psf	($P_i=0.7 \cdot C_e \cdot C_t \cdot I \cdot P_g$)

2. EIA/TIA -222- G Structural Standards for Steel Antenna Towers and Antenna Supporting Structures

City/Town:	Portland
County:	Cumberland
Wind Load:	100 mph
Nominal Ice Thickness:	1 inch

3. Approximate height above grade to the center of the Antennas:

161'-6" +/- (Alpha & Beta)
155'-0" +/- (Gamma)



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ANTENNA SUPPORT RECOMMENDATIONS:

- The new Alpha and Beta sector antennas are proposed to be mounted on new and existing pipe masts secured to the existing non-penetrating ballast frames located on the roof.
- The new Gamma sector antennas are proposed to be mounted on new and existing pipe masts secured to the existing building façade with epoxy anchors.

RRH SUPPORT RECOMMENDATIONS:

The new RRH's are proposed to be mounted on new non-penetrating ballast frames located on the roof. Install the new RRH frames at least 4 feet away from the parapets. See the chart below for ballast requirements.

MINIMUM BALLAST REQUIREMENTS	
NUMBER OF BLOCKS PER SIDE	2
TOTAL NUMBER OF BLOCKS	4
SIZE OF BLOCKS	4"x8"X16" Solid
WEIGHT OF BLOCKS	38 lbs./ ea.
TOTAL BALLAST WEIGHT	152 lbs.

EQUIPMENT SUPPORT RECOMMENDATIONS:

The new power plant and battery rack are proposed to be installed inside the AT&T equipment room located in the basement.



Limitations and assumptions:

1. Reference the latest HDG construction drawings for all the equipment locations details.
2. Mount all equipment per manufacturer's specifications.
3. All structural members and their connections are assumed to be in good condition and are free from defects with no deterioration to its member capacities.
4. All antennas, coax cables and waveguide cables are assumed to be properly installed and supported as per the manufacturer requirements.
5. HDG is not responsible for any modifications completed prior to and hereafter which HDG was not directly involved.
6. If field conditions differ from what is assumed in this report, then the engineer of record is to be notified as soon as possible.



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FIELD PHOTOS:



Photo 1: Sample photo illustrating the existing Alpha sector antennas.



Photo 2: Sample photo illustrating the existing Beta sector antennas.



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Photo 3: Sample photo illustrating the existing Gamma sector antennas.



Photo 4: Sample photo illustrating the existing Gamma sector RRH's.



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Alpha and Beta Sector Antenna Calculations



Date: 4-24-15

Project Name: AWE-MUNJOY HILL

Project Number: ME5040

Designed By: AA Checked By: MSC



2.6.5.2 Velocity Pressure Coeff:

$$K_z = 2.01 (z/z_g)^{2/\alpha}$$

z = 161.5 (ft)

z_g = 1200 (ft)

α = 7

K_z = 1.133

ALPHA SECTOR ANTENNAS

$$K_{zmin} \leq K_z \leq 2.01$$

Table 2-4

Exposure	Z _g	α	K _{zmin}	K _e
B	1200 ft	7	0.70	0.90
C	900 ft	9.5	0.85	1
D	700 ft	11.5	1.03	1.10

2.6.6.4 Topographic Factor:

Table 2-5

Topo. Category	K _t	f
2	0.43	1.25
3	0.53	2
4	0.72	1.5

$$K_{zt} = [1 + (K_e K_t / K_h)]^2$$

$$K_h = e^{(fz/H)}$$

K_{zt} = #DIV/0!

K_h = #DIV/0!

K_e = 0 (from Table 2-4)

K_t = 0 (from Table 2-5)

f = 0 (from Table 2-5)

z = 161.5

H = 0 (Ht. of the crest above surrounding terrain)

K_{zt} = 1.00

(If Category 1 then K_{zt} = 1.0)

Category = 1



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Date: 4-24-15

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2.6.7 Gust Effect Factors

2.6.7.1 Self Supporting Lattice Structures

Gh = 1.0 Latticed Structures > 600 ft

Gh = 0.85 Latticed Structures 450 ft or less

Gh = 0.85 + 0.15 [h/150 - 3.0] h= ht. of structure

h= 161.5 Gh= 0.5615

2.6.7.2 Guyed Masts Gh= 0.85

2.6.7.3 Pole Structures Gh= 1.1

2.6.7.4 Structures Supported on Other Structures

(Cantilevered tubular or latticed spines, pole, structures on buildings (ht. : width ratio > 5)

Gh= 1.35 Gh= 1.35



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2.6.8 Design Ice Thickness:

$$t_{iz} = 2.0 * t_i * I * K_{iz} * (K_{zt})^{0.35}$$

$$t_i = 1$$

$$I = 1$$

$$K_{iz} = 1.17$$

$$K_{zt} = 1$$

$$t_{iz} = 2.34$$

$$K_{iz} = [z/33]^{0.10} \leq 1.4$$

$$K_{iz} = 1.17$$

Calculating the weight of ice, the cross-sectional area of ice shall be determined by:

$$A_{iz} = \pi * t_{iz} * (D_c + t_{iz})$$

$$D_c = 72 \text{ (in) Largest Dim of Member}$$

$$A_{iz} = 547.51$$

2.6.9 Design Wind Load:

$$F = qz * Gh * (\text{EPA's})$$

$$q_z = 0.00256 * K_z * K_{zt} * K_d * V_{max}^2$$

$$K_z = 1.133$$

$$K_{zt} = 1$$

$$K_d = 0.95$$

$$V_{max} = 100$$

$$q_z = 27.56$$

Table 2-2

Structure Type	Wind Direction Probability Factor, Kd
Latticed structures with triangular, square or rectangular cross sections	0.85
Tubular pole structures, latticed structures with other cross sections, appurtenances.	0.95



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Determine Cf:

If lattice Structure See Manual

If Tubular Pole Structure, Use Corrected Value from Table 2.7 Below

C mph.ft	Round	18 Sided	16 Sided	12 Sided	8 Sided
< 32 (Subcritical)	1.2	1.2	1.2	1.2	1.2
32 to 64 (Transitional)	$38.4/C^{1.0}$	$25.8/C^{0.885}$	$12.6/C^{0.678}$	$2.99/C^{0.263}$	1.2
> 64 (Supercritical)	0.6	0.65	0.75	1	1.2

$$C = (I * K_{zt} * K_z)^{0.5} * V * D$$

Dp = Outside Diameter or Out to Out: 0.2 feet

C= 21.29

Cf= 1.2

<u>Appurtenances</u>	<u>Height</u>	<u>Width</u>	<u>Depth</u>	<u>Flat Area</u>	<u>Force Per Appurtenance</u>
(E) Antenna	96.4	11.9	7.1	7.97	355.69 (lbs)
(E) Antenna	57	11	5	4.35	194.41 (lbs)
(E) Antenna	57	11	5	4.35	194.41 (lbs)
(P) Antenna	48	11.8	5.9	3.93	175.62 (lbs)
Item No.5	0	0	0	0.00	0.00 (lbs)

TOTAL FORCE ($\sum F_A$) =	920.14 (lbs)
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2.6.5.2 Velocity Pressure Coeff:

$$K_z = 2.01 (z/z_g)^{2/\alpha}$$

z= 161.5 (ft)

z_g= 1200 (ft)

α= 7

BETA SECTOR ANTENNAS

K_z= 1.133

$$K_{zmin} \leq K_z \leq 2.01$$

Table 2-4

Exposure	Z _g	α	K _{zmin}	K _e
B	1200 ft	7	0.70	0.90
C	900 ft	9.5	0.85	1
D	700 ft	11.5	1.03	1.10

2.6.6.4 Topographic Factor:

Table 2-5

Topo. Category	K _t	f
2	0.43	1.25
3	0.53	2
4	0.72	1.5

$$K_{zt} = [1 + (K_e K_t / K_h)]^2$$

$$K_h = e^{(f \cdot z / H)}$$

K_{zt}= #DIV/0!

K_h= #DIV/0!

K_e= 0 (from Table 2-4)

K_t= 0 (from Table 2-5)

f= 0 (from Table 2-5)

z= 161.5

H= 0 (Ht. of the crest above surrounding terrain)

K_{zt}= 1.00

(If Category 1 then K_{zt} = 1.0)

Category= 1



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2.6.7 Gust Effect Factors

2.6.7.1 Self Supporting Lattice Structures

Gh = 1.0 Latticed Structures > 600 ft

Gh = 0.85 Latticed Structures 450 ft or less

Gh = 0.85 + 0.15 [h/150 - 3.0] h= ht. of structure

h= 161.5 Gh= 0.5615

2.6.7.2 Guyed Masts Gh= 0.85

2.6.7.3 Pole Structures Gh= 1.1

2.6.7.4 Structures Supported on Other Structures
(Cantilevered tubular or latticed spines, pole, structures on buildings (ht. : width ratio > 5)

Gh= 1.35 Gh= 1.35



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2.6.8 Design Ice Thickness:

$$t_{iz} = 2.0 * t_i * I * K_{iz} * (K_{zt})^{0.35}$$

$$t_i = 1$$

$$I = 1$$

$$K_{iz} = 1.17$$

$$K_{zt} = 1$$

$$t_{iz} = 2.34$$

$$K_{iz} = [z/33]^{0.10} \leq 1.4$$

$$K_{iz} = 1.17$$

Calculating the weight of ice, the cross-sectional area of ice shall be determined by:

$$A_{iz} = \pi * t_{iz} * (D_c + t_{iz})$$

$$D_c = 72 \text{ (in) Largest Dim of Member}$$

$$A_{iz} = 547.51$$

2.6.9 Design Wind Load:

$$F = qz * Gh * (EPA's)$$

$$q_z = 0.00256 * K_z * K_{zt} * K_d * V_{max}^2$$

$$K_z = 1.133$$

$$K_{zt} = 1$$

$$K_d = 0.95$$

$$V_{max} = 100$$

$$q_z = 27.56$$

Table 2-2

Structure Type	Wind Direction Probability Factor, Kd
Latticed structures with triangular, square or rectangular cross sections	0.85
Tubular pole structures, latticed structures with other cross sections, appurtenances.	0.95



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Determine Cf:

If lattice Structure See Manual

If Tubular Pole Structure, Use Corrected Value from Table 2.7 Below

C mph.ft	Round	18 Sided	16 Sided	12 Sided	8 Sided
< 32 (Subcritical)	1.2	1.2	1.2	1.2	1.2
32 to 64 (Transitional)	$38.4/C^{1.0}$	$25.8/C^{0.885}$	$12.6/C^{0.678}$	$2.99/C^{0.263}$	1.2
> 64 (Supercritical)	0.6	0.65	0.75	1	1.2

$C = (I * K_{zt} * K_z)^{0.5} * V * D$

Dp = Outside Diameter or Out to Out: 0.2 feet

C= 21.29

Cf= 1.2

Appurtenances	Height	Width	Depth	Flat Area	Force Per Appurtenance
(E) Antenna	57	11	5	4.35	194.41 (lbs)
(E) Antenna	57	11	5	4.35	194.41 (lbs)
(E) Antenna	72	11.8	5.9	5.90	263.43 (lbs)
(P) Antenna	72	14.8	9	7.40	330.41 (lbs)
Item No.5	0	0	0	0.00	0.00 (lbs)

TOTAL FORCE (ΣF_A) = 982.66 (lbs)



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2.6.5.2 Velocity Pressure Coeff:

$$K_z = 2.01 (z/z_g)^{2/\alpha}$$

z = 157 (ft)

z_g = 1200 (ft)

α = 7

ALPHA & BETA SECTOR RRH

K_z = 1.124

$$K_{zmin} \leq K_z \leq 2.01$$

Table 2-4

Exposure	Z _g	α	K _{zmin}	K _e
B	1200 ft	7	0.70	0.90
C	900 ft	9.5	0.85	1
D	700 ft	11.5	1.03	1.10

2.6.6.4 Topographic Factor:

Table 2-5

Topo. Category	K _t	f
2	0.43	1.25
3	0.53	2
4	0.72	1.5

$$K_{zt} = [1 + (K_e K_t / K_h)]^2$$

$$K_h = e^{(fz/H)}$$

K_{zt} = #DIV/0!

K_h = #DIV/0!

K_e = 0 (from Table 2-4)

K_t = 0 (from Table 2-5)

f = 0 (from Table 2-5)

z = 157

H = 0 (Ht. of the crest above surrounding terrain)

K_{zt} = 1.00

(If Category 1 then K_{zt} = 1.0)

Category = 1



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2.6.7 Gust Effect Factors

2.6.7.1 Self Supporting Lattice Structures

Gh = 1.0 Latticed Structures > 600 ft

Gh = 0.85 Latticed Structures 450 ft or less

Gh = 0.85 + 0.15 [h/150 - 3.0] h= ht. of structure

h= 157

Gh= 0.557

2.6.7.2 Guyed Masts

Gh= 0.85

2.6.7.3 Pole Structures

Gh= 1.1

2.6.7.4 Structures Supported on Other Structures

(Cantilevered tubular or latticed spines, pole, structures on buildings (ht. : width ratio > 5)

Gh= 1.35

Gh= 1.35



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2.6.8 Design Ice Thickness:

$$t_{iz} = 2.0 * t_i * I * K_{iz} * (K_{zt})^{0.35}$$

$t_i = 1$

$I = 1$

$K_{iz} = 1.17$

$K_{zt} = 1$

$t_{iz} = 2.34$

$$K_{iz} = [z/33]^{0.10} \leq 1.4$$

$K_{iz} = 1.17$

Calculating the weight of ice, the cross-sectional area of ice shall be determined by:

$$A_{iz} = \pi * t_{iz} * (D_c + t_{iz})$$

$D_c = 20.4$ (in) Largest Dim of Member

$A_{iz} = 166.98$

2.6.9 Design Wind Load:

$$F = q_z * G * h * (EPA's)$$

$$q_z = 0.00256 * K_z * K_{zt} * K_d * V_{max}^2$$

$K_z = 1.124$

$K_{zt} = 1$

$K_d = 0.95$

$V_{max} = 100$

$q_z = 27.34$

Table 2-2

Structure Type	Wind Direction Probability Factor, Kd
Latticed structures with triangular, square or rectangular cross sections	0.85
Tubular pole structures, latticed structures with other cross sections, appurtenances.	0.95



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Determine Cf:

If lattice Structure See Manual

If Tubular Pole Structure, Use Corrected Value from Table 2.7 Below

C mph.ft	Round	18 Sided	16 Sided	12 Sided	8 Sided
< 32 (Subcritical)	1.2	1.2	1.2	1.2	1.2
32 to 64 (Transitional)	$38.4/C^{1.0}$	$25.8/C^{0.885}$	$12.6/C^{0.678}$	$2.99/C^{0.263}$	1.2
> 64 (Supercritical)	0.6	0.65	0.75	1	1.2

$$C = (I * K_{zt} * K_z)^{0.5} * V * D$$

Dp = Outside Diameter or Out to Out: 0.2 feet

C= 21.21 Cf= 1.2

Appurtenances	Height	Width	Depth	Flat Area	Force Per Appurtenance
RRH-11	19.7	17	7.2	2.33	103.01 (lbs)
RRH-12	20.4	18.5	7.5	2.62	116.08 (lbs)
FIBER BOX	20	20	10	2.78	123.03 (lbs)
SURGE ARRESTOR	11.5	10.4	6.3	0.83	36.79 (lbs)
Item No.5	0	0	0	0.00	0.00 (lbs)

$$\text{TOTAL FORCE } (\Sigma F_A) = 378.90 \text{ (lbs)}$$



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Gamma Sector Antenna Calculations



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2.6.5.2 Velocity Pressure Coeff:

$$K_z = 2.01 (z/z_g)^{2/\alpha}$$

z= 155 (ft)

z_g= 1200 (ft)

α= 7

GAMMA SECTOR ANTENNAS

K_z= 1.120

$$K_{zmin} \leq K_z \leq 2.01$$

Table 2-4

Exposure	Z _g	α	K _{zmin}	K _e
B	1200 ft	7	0.70	0.90
C	900 ft	9.5	0.85	1
D	700 ft	11.5	1.03	1.10

2.6.6.4 Topographic Factor:

Table 2-5

Topo. Category	K _t	f
2	0.43	1.25
3	0.53	2
4	0.72	1.5

$$K_{zt} = [1 + (K_e K_t / K_h)]^2$$

$$K_h = e^{(f \cdot z / H)}$$

K_{zt}= #DIV/0!

K_h= #DIV/0!

K_e= 0 (from Table 2-4)

K_t= 0 (from Table 2-5)

f= 0 (from Table 2-5)

z= 155

H= 0 (Ht. of the crest above surrounding terrain)

K_{zt}= 1.00

(If Category 1 then K_{zt}=1.0)

Category= 1



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2.6.7 Gust Effect Factors

2.6.7.1 Self Supporting Lattice Structures

Gh = 1.0 Latticed Structures > 600 ft

Gh = 0.85 Latticed Structures 450 ft or less

Gh = 0.85 + 0.15 [h/150 - 3.0] h= ht. of structure

h= 155

Gh= 0.555

2.6.7.2 Guyed Masts

Gh= 0.85

2.6.7.3 Pole Structures

Gh= 1.1

2.6.7.4 Structures Supported on Other Structures

(Cantilevered tubular or latticed spines, pole, structures on buildings (ht. : width ratio > 5)

Gh= 1.35

Gh= 1.35



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2.6.8 Design Ice Thickness:

$$t_{iz} = 2.0 * t_i * I * K_{iz} * (K_{zt})^{0.35}$$

$t_{iz} = 2.33$

$t_i = 1$

$I = 1$

$K_{iz} = 1.17$

$K_{zt} = 1$

$$K_{iz} = [z/33]^{0.10} \leq 1.4$$

$K_{iz} = 1.17$

Calculating the weight of ice, the cross-sectional area of ice shall be determined by:

$$A_{iz} = \pi * t_{iz} * (D_c + t_{iz})$$

$D_c = 48$ (in) Largest Dim of Member

$A_{iz} = 369.17$

2.6.9 Design Wind Load:

$$F = q_z * Gh * (EPA's)$$

$$q_z = 0.00256 * K_z * K_{zt} * K_d * V_{max}^2$$

$q_z = 27.24$

$K_z = 1.120$

$K_{zt} = 1$

$K_d = 0.95$

$V_{max} = 100$

Table 2-2

Structure Type	Wind Direction Probability Factor, Kd
Latticed structures with triangular, square or rectangular cross sections	0.85
Tubular pole structures, latticed structures with other cross sections, appurtenances.	0.95



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Determine Cf:

If lattice Structure See Manual

If Tubular Pole Structure, Use Corrected Value from Table 2.7 Below

C mph.ft	Round	18 Sided	16 Sided	12 Sided	8 Sided
< 32 (Subcritical)	1.2	1.2	1.2	1.2	1.2
32 to 64 (Transitional)	$38.4/C^{1.0}$	$25.8/C^{0.885}$	$12.6/C^{0.678}$	$2.99/C^{0.263}$	1.2
> 64 (Supercritical)	0.6	0.65	0.75	1	1.2

$C = (I * K_{zt} * K_z)^{0.5} * V * D$

Dp = Outside Diameter or Out to Out: 0.2 feet

C= 21.17

Cf= 1.2

Appurtenances	Height	Width	Depth	Flat Area	Force Per Appurtenance
(E) Antenna	57	11	5	4.35	192.14 (lbs)
(E) Antenna	57	11	5	4.35	192.14 (lbs)
(E) Antenna	48	11.8	5.9	3.93	173.57 (lbs)
(P) Antenna	48	14.8	9	4.93	217.70 (lbs)
Item No.5	0	0	0	0.00	0.00 (lbs)

TOTAL FORCE (ΣF_A) = 775.56 (lbs)



ICE WEIGHT CALCULATIONS

Project: ME5040

Thickness of ice: 1

Weight of ice based on total radial SF area:

Antenna

Depth (in): 9

height (in): 48

Width (in): 14.9

Total weight of ice on object: 74 pounds ice

Weight of object: 34 pounds

Combined weight of ice and object: 108 pounds

Per foot weight of ice:

Pipe

pipe weight per foot: 3.65

pipe length (ft): 5

diameter (in): 2.375

Per foot weight of ice on object: 3 pounds ice /ft

Total weight of ice on object: 15 pounds

Total weight of pipe: 18.25 pounds

Combined weight of pipe and ice: 33 pounds

* Density of ice used = 56 PCF

Total Weight: 141 pounds



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Inspections Division
Approved with Conditions
Date: 07/29/15

Site Name: AWE-MUNJOY HILL
Site No. ME5040
Done by: AA Checked by: MSC
Date: 4/24/2015



CHECK CONNECTION CAPACITY

Reference: Hilti Volume 2: Anchor Fastening Technical Guide

Epoxy Type = HIT-HY20
Anchor Diameter = 3/8 in. (Assumed)
Min. Embedment Depth = 2 in. (Assumed)

Allowable Tensile Load =
 $F_{Tall} = 525 \text{ lbs.}$

Allowable Shear Load =
 $F_{Vall} = 790 \text{ lbs.}$

WIND FORCES

Reaction $F = 220 \text{ lbs.}$

GRAVITY LOADS

Ice and Equipment 141 lbs.

No. of Supports = 2
No. of Anchors / Support = 2

Tension Design Load / Anchor =
 $f_t = 55.00 \text{ lbs.} < 525 \text{ lbs. Therefore, OK !}$

Shear Design Load / Anchor =
 $f_v = 35.25 \text{ lbs.} < 790 \text{ lbs. Therefore, OK !}$

CHECK COMBINED TENSION AND SHEAR

$$\begin{matrix} f_t / F_T & + & f_v / F_V & \leq & 1.0 \\ 0.105 & + & 0.045 & = & 0.149 < 1.0 \end{matrix} \text{ Therefore, OK !}$$



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RRH Frame Calculations



Date: 4-24-15

Project Name: AWE-MUNJOY HILL

Project Number: ME5040

Designed By: AA Checked By: MSC



2.6.5.2 Velocity Pressure Coeff:

$$K_z = 2.01 (z/z_g)^{2/\alpha}$$

z= 157 (ft)

RRH FRAME

z_g= 1200 (ft)

α= 7

K_z= 1.124

$$K_{zmin} \leq K_z \leq 2.01$$

Table 2-4

Exposure	Z _g	α	K _{zmin}	K _e
B	1200 ft	7	0.70	0.90
C	900 ft	9.5	0.85	1
D	700 ft	11.5	1.03	1.10

2.6.6.4 Topographic Factor:

Table 2-5

Topo. Category	K _t	f
2	0.43	1.25
3	0.53	2
4	0.72	1.5

$$K_{zt} = [1 + (K_e K_t / K_h)]^2$$

$$K_h = e^{(f \cdot z / H)}$$

K_{zt}= #DIV/0!

K_h= #DIV/0!

K_e= 0 (from Table 2-4)

K_t= 0 (from Table 2-5)

f= 0 (from Table 2-5)

z= 157

H= 0 (Ht. of the crest above surrounding terrain)

K_{zt}= 1.00

(If Category 1 then K_{zt}=1.0)

Category= 1



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2.6.7 Gust Effect Factors

2.6.7.1 Self Supporting Lattice Structures

Gh = 1.0 Latticed Structures > 600 ft

Gh = 0.85 Latticed Structures 450 ft or less

Gh = 0.85 + 0.15 [h/150 - 3.0] h= ht. of structure

h= 157

Gh= 0.557

2.6.7.2 Guyed Masts

Gh= 0.85

2.6.7.3 Pole Structures

Gh= 1.1

2.6.7.4 Structures Supported on Other Structures

(Cantilevered tubular or latticed spines, pole, structures on buildings (ht. : width ratio > 5)

Gh= 1.35

Gh= 1.35



Date: 4-24-15

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2.6.8 Design Ice Thickness:

$$t_{iz} = 2.0 * t_i * I * K_{iz} * (K_{zt})^{0.35}$$

$$t_i = 1$$

$$I = 1$$

$$K_{iz} = 1.17$$

$$K_{zt} = 1$$

$$t_{iz} = 2.34$$

$$K_{iz} = [z/33]^{0.10} \leq 1.4$$

$$K_{iz} = 1.17$$

Calculating the weight of ice, the cross-sectional area of ice shall be determined by:

$$A_{iz} = \pi * t_{iz} * (D_c + t_{iz})$$

$$D_c = 20.4 \text{ (in) Largest Dim of Member}$$

$$A_{iz} = 166.98$$

2.6.9 Design Wind Load:

$$F = q_z * Gh * (\text{EPA's})$$

$$q_z = 0.00256 * K_z * K_{zt} * K_d * V_{max}^2$$

$$K_z = 1.124$$

$$K_{zt} = 1$$

$$K_d = 0.95$$

$$V_{max} = 100$$

$$q_z = 27.34$$

Table 2-2

Structure Type	Wind Direction Probability Factor, Kd
Latticed structures with triangular, square or rectangular cross sections	0.85
Tubular pole structures, latticed structures with other cross sections, appurtenances.	0.95



Date: 4-24-15
Project Name: AWE-MUNJOY HILL
Project Number: ME5040
Designed By: AA Checked By: MSC



Determine Cf:

If lattice Structure See Manual

If Tubular Pole Structure, Use Corrected Value from Table 2.7 Below

C mph.ft	Round	18 Sided	16 Sided	12 Sided	8 Sided
< 32 (Subcritical)	1.2	1.2	1.2	1.2	1.2
32 to 64 (Transitional)	$38.4/C^{1.0}$	$25.8/C^{0.885}$	$12.6/C^{0.678}$	$2.99/C^{0.263}$	1.2
> 64 (Supercritical)	0.6	0.65	0.75	1	1.2

$C = (I * K_{zt} * K_r)^{0.5} * V * D$

Dp = Outside Diameter or Out to Out: 0.2 feet

C= 21.21

Cf= 1.2

<u>Appurtenances</u>	<u>Height</u>	<u>Width</u>	<u>Depth</u>	<u>Flat Area</u>	<u>Force Per Appurtenance</u>
RRH-11	19.7	17	7.2	2.33	103.01 (lbs)

Site Name: AWE-MUNJOY HILL

Site No.: ME5040

Done by: AA

Date: 4/24/2015

Checked by: MSC



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Calculate Total Ballast Required for Ballast Mount

Assume (2) RRH's as projected area

Force (F) = 207 lbs.

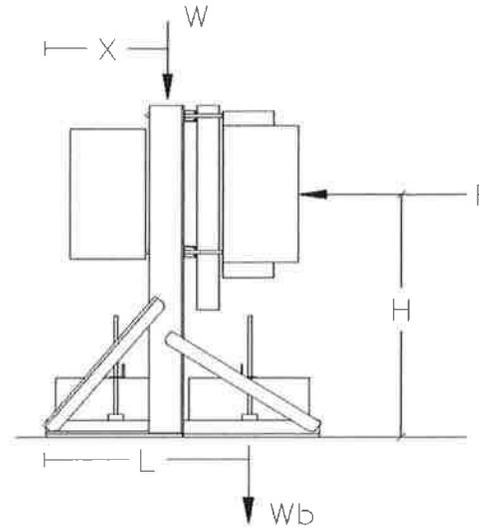
Height (H) = 3 ft

Weight (W) = 350 lbs.

Frame Width/2 (X) = 1.5 ft

Length (L) = 2.2 ft

Ballast (Wb) = TBD



Overtipping at Ballast

$\Sigma M = 0 = (F * H) - (W * X) - (Wb * L) \text{ --->}$

$Wb = [(F*H-W*X)/L]*SF =$ **44 lbs.**

Determine Number of Blocks Required

(assume 4"x8"x16" solid blocks @ 38 lbs. each)

Number of Blocks Required = **2 BLOCKS PER SIDE**

-Total Weight of Fully Loaded Frame = 502 lbs.

-Footprint Area Under Ballast Frame = 10.5 sqft.

-Distributed Load Under Ballast Frame = 48 psf



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Roof Calculations



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Date: 07/29/15

Date: 04-24-2015

Project Name: AWE-MUNJOY HILL

Project Number: ME5040

Designed By: AA Checked By: MSC

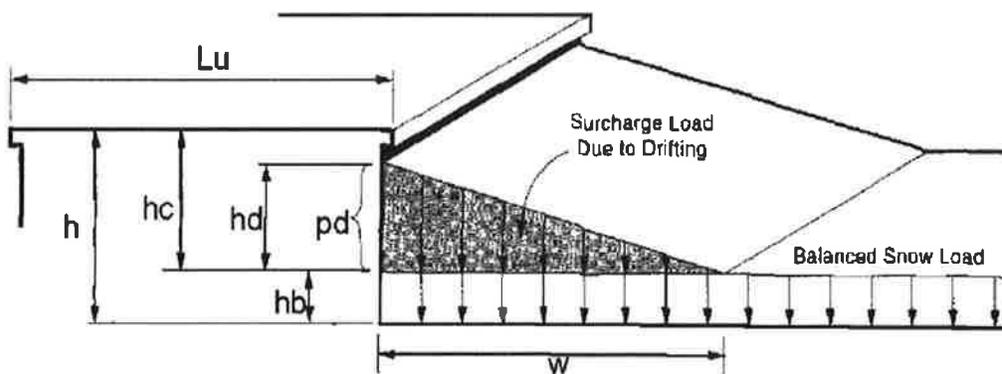


Calculate Drift Snow:

Ground Snow Load, P_g	60 psf
Calculated Flat Roof Snow:	42 psf
Minimum Roof/Parapet Length, L_u	25 ft.
Snow Density, Y	21.8 pcf
Height of Parapet, h	3.5 ft.
Balance Snow Height, h_b	1.93 ft.
Clear Ht. from top of balanced snow load to parapet, h_c	1.57 ft.
$h_c/h_b > 0.2$	0.82 Therefore, design for drift
Height of Snow Drift, h_d	1.5 Figure 7-9 (ASCE 7-05)
Width of snow drift, w	6 ft.

Surcharge load, p_d

32.7 psf





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Project Name: AWE-MUNJOY HILL

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Check Roof Capacity:

Reference: • Building Plans by Leasure, Tuttle, Lee dated 03/23/1967.

Roof Design LL: 100 psf

Calculated Flat Roof Snow: 42 psf

Calculated Drift Snow: 32.7 psf

Net Available Load: 25.3 psf

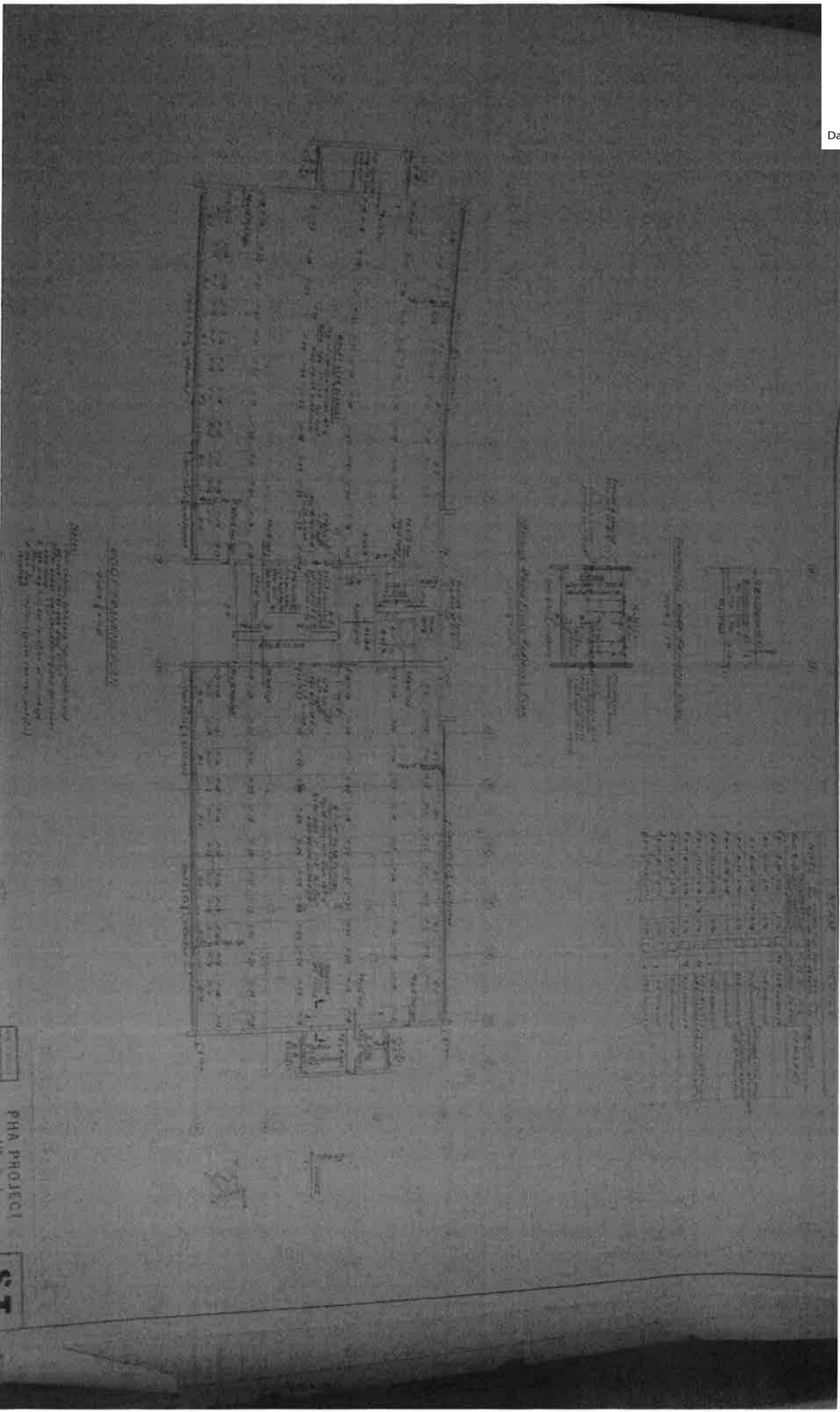
Antenna Ballast Frame Load: 48 psf > 25.3 PSF **N.G!**

HDG recommends relocating the existing Alpha sector ballasted frame at least 4 ft. away from the parapets to meet the roof design loads provided in the building plans.



GENERAL NOTES

1. FLOOR DESIGN LL = 50#/FT² + DRIPPING LL = 100#/FT²
FLOOR DESIGN UL = 50#/FT² + PARTITION DL = 20#/FT²
2. ALLOWABLE SOIL PRESSURE = 2000 PSF
3. CONCRETE TO BE 3000 PSI W/ GRADE TO REINFORCING.
4. MASONRY WALLS TO HAVE DUR-O-WALL REINFORCING @ EVERY 16" O.C.
5. STEEL TO BE A36 EXCEPT TUBE TO BE A500 GRADE
"B" - 46 KSI, DETAIL, FABRICATED, AND ERECT PER
AISC STANDARDS AND SPECIFICATIONS.
6. JOIST TO BE DETAIL FABRICATED AND ERECT PER
SOIL STANDARDS AND SPECIFICATIONS.
7. ROOF DECK TO BE 1/2" X 22 GA. TYPE B GALVANIZED,
FLOOR DECK TO BE 1/4" X 28 GA. UNIFORM OPS GALV.
8. ALL LINTELS & BEAMS TO BEAR 6" MIN ON TO WALLS,
FIB ONE BLOCK BELOW THE LINTELS & BEAMS W/ GROUT.
9. # INDICATES JOIST W/ BOLTED CONNECTIONS.
10. 19.0' INDICATES BOTTOM OF FOOTING ELEV.
(100.0') INDICATES TOP OF WALL ELEV.



PHA PROJECT

ST