(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:

EMPIRE telecom

at&t

Dated: July 29, 2015 (Rev.2)
April 24, 2015 (Rev.1)
January 21, 2015

Prepared by:

Hudson Design Group LLC

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Hudson Design Group LLC

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, Ce:	1.0	(Exp. B- Partially Exposed)
Thermal Factor, Ct:	1.0	(Typical Structure)
Flat Roof Snow Load:	**42 psf**	**(P_f=0.7*Ce*Ct*I*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.

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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.

FIELD PHOTOS:

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

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

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

Hudson Design Group LLC

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

Kzmin ≤ Kz ≤ 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

$K_{zt} = [1+(K_e\ K_t/K_h)]^2$ $K_h = e^{(f*z/H)}$

K_{zt}= #DIV/0!

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

Category=	1

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	

Date: 4-24-15
Project Name: AWE-MUNJOY HILL
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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
(Cantilivered 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:

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

Dc= 72 (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**

Date: 4-24-15
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Designed By: AA **Checked By**: MSC

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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	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 (ΣF_A) = **920.14** (lbs)

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2.6.5.2 Velocity Pressure Coeff:

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

BETA SECTOR ANTENNAS

z=	161.5	(ft)
z_g=	1200	(ft)
α=	7	
K_z=	**1.133**	

$Kzmin \leq Kz \leq 2.01$

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

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

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

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**

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
(Cantilivered 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:

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

Dc= 72 (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)

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

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2.6.5.2 Velocity Pressure Coeff:

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

ALPHA & BETA SECTOR RRH

z=	157	(ft)
z_g=	1200	(ft)
α=	7	

K_z= 1.124

Kzmin ≤ Kz ≤ 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

$K_{zt} = [1+(K_e K_t/K_h)]^2$ $K_h = e^{(f*z/H)}$

K_{zt}= #DIV/0!

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

Category=	1

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	

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

Gh=	1.35	**Gh=**	**1.35**

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

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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:

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

Dc= 20.4 (in) Largest Dim of Member

A_{iz} = 166.98

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=	1.124
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

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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

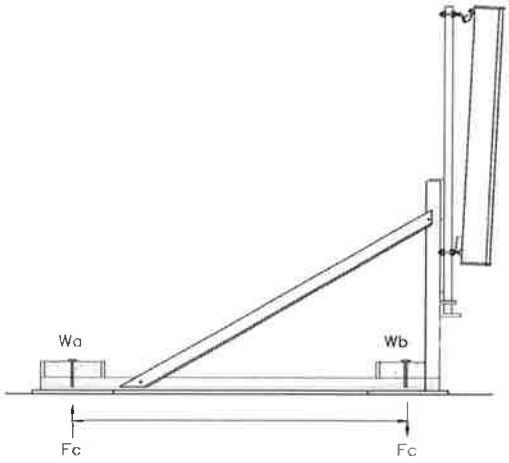
C= **21.21** **Cf=** 1.2

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)

TOTAL FORCE (ΣF_A) = **378.90** (lbs)

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

Calculate Total Ballast Required for Ballast Mount



WIND FORCES

F antennas =	at 7.5 ft.	389	lbs.
	at 7. ft.	594	lbs.
F RRH/SURGE/FIBER BOX		380	lbs.
Antenna Height =		7.5	ft
		7	ft
RRH/Surge/Fiber Box=		3	ft

Length = 7.25 ft
SF = 1.2

Overturning at Ballast

Moment = 9858.6 lbs.-ft

Hold Down Force = 1359.81 lbs. Per Side

Wa Ballast

Equipment

Frame =	150	lbs.

Total Ballast Required Wa= **1209.81** lbs.

Blocks Required Wa = **32** Assumed 38lbs Block (4"x8"x16" Solid)

Wb Ballast

Equipment

Frame	300	lbs.
-4 Antennas	175	lbs.
RRH's	139	lbs.
Surge Arrestor	43.5	lbs.
Total =	657.5	lbs.

Total Ballast Required Wb = **702.31** lbs.

Blocks Required Wb= **19** Assumed 38lbs Block (4"x8"x16" Solid)

Footprint Area under Ballast Frame= 58.34 sq. ft.

Distributed Load under Ballast Frame= 47.83 psf

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Gamma Sector
Antenna Calculations

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2.6.5.2 Velocity Pressure Coeff:

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

K_z= 1.120

z= 155 (ft)
z_g= 1200 (ft)
α= 7

GAMMA SECTOR ANTENNAS

Kzmin ≤ Kz ≤ 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

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

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

K_{zt}= #DIV/0!

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

Category= 1

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

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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
(Cantilivered 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}= 2.33

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

K_{iz}= 1.17

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

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

Dc= 48 (in) Largest Dim of Member

A_{iz} = 369.17

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=	1.120
K_{zt}=	1
K_d=	0.95
V_{max}=	100

q_z= 27.24

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

Hudson Design Group LLC

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

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

Hudson Design Group LLC

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 lbs.

Allowable Shear Load =

F_{Vall}= 790 lbs.

WIND FORCES

Reaction F = 220 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 lbs. < 525 lbs. **Therefore, OK !**

Shear Design Load / Anchor=

f_v= 35.25 lbs. < 790 lbs. **Therefore, OK !**

CHECK COMBINED TENSION AND SHEAR

f_t / F_T	+	f_v / F_V	≤	1.0			
0.105	+	0.045	=	0.149	<	1.0	**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

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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)	
K_z= 1.124	α=	7	

$Kzmin \leq Kz \leq 2.01$

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

$K_{zt} = [1+(K_e K_t/K_h)]^2$ $\quad K_h = e^{(f*z/H)}$

K_{zt}= #DIV/0!

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

Category=	1

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	

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

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

Gh=	1.35	Gh=	1.35

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

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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:

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

Dc= 20.4 (in) Largest Dim of Member

A_{iz} = 166.98

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=	1.124
K_{zt}=	1
K_d=	0.95
V_{max}=	100

q_z= 27.34

Table 2-2

Structure Type	Wind Direction Probability Factor, Kd
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Date: 4-24-15
Project Name: AWE-MUNJOY HILL
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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

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

Dp = Outside Diameter or Out to Out: 0.2 feet

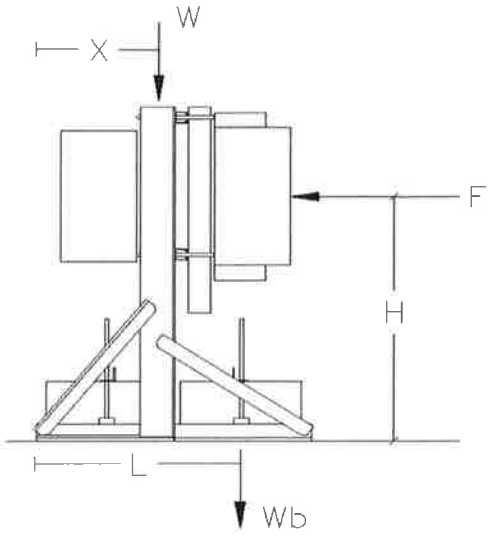
C= **21.21** **Cf=** 1.2

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

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

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	

Overturning at Ballast

$\Sigma M = 0 = (F * H) - (W * X) - (Wb * L)$ ---> $Wb = [(F*H-W*X)/L]*SF =$ **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

Date: 04-24-2015
Project Name: AWE-MUNJOY HILL
Project Number: ME5040
Designed By: AA Checked By: MSC

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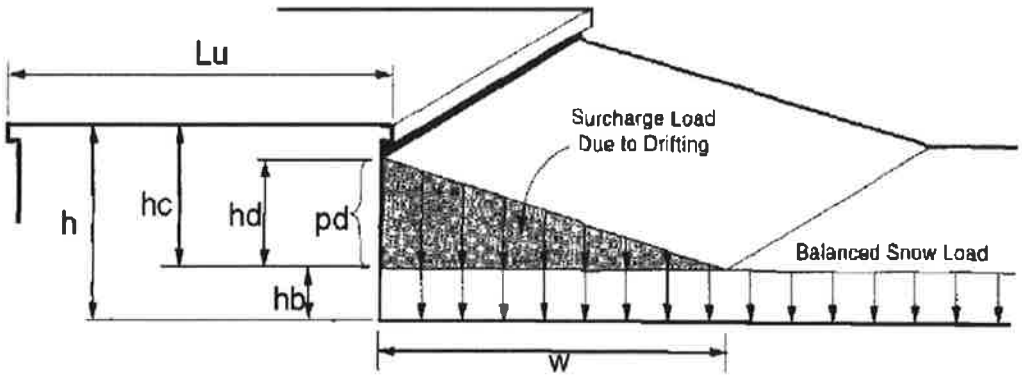
Calculate Drift Snow:

Ground Snow Load, Pg	60	psf
Calculated Flat Roof Snow:	42	psf
Minumum Roof/Parapet Length, Lu	25	ft.
Snow Densty, Y	21.8	pcf
Height of Parapet, h	3.5	ft.
Balance Snow Height, hb	1.93	ft.
Clear Ht. from top of balanced snow load to parapet, hc	1.57	ft.
hc/hb > 0.2	0.82	**Therefore, design for drift**
Height of Snow Drift, hd	1.5	**Figure 7-9 (ASCE 7-05)**
Width of snow drift, w	6	ft.

Surchage load, pd **32.7 psf**



Date: 04-24-2015
Project Name: AWE-MUNJOY HILL
Project Number: ME5040
Designed By: AA Checked By: MSC

Hudson Design Group LLC

Check Roof Capacity:

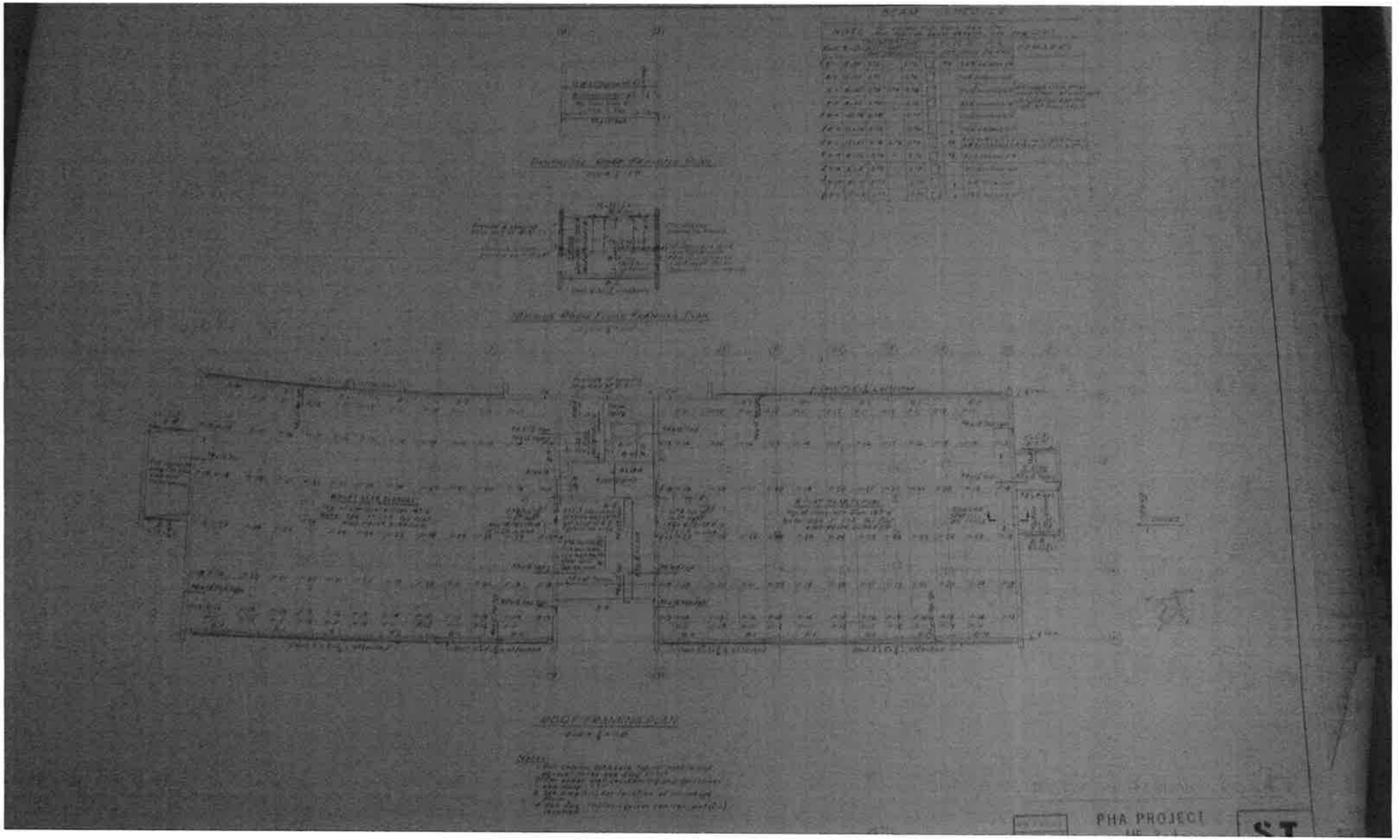
Reference: • Building Plans by Leasure, Tuttle, Lee dated 03/23/1967.

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. ROOF DESIGN LL = 50#/FT² + DRIFTING LL = 100 #/FT²
   FLOOR DESIGN LL = 50#/FT² + PARTION DL = 20 #/FT²
2. ALLOWABLE SOIL PRESSURE = 2000 PSF
3. CONCRETE TO BE 3000 PSI W/ GRADE 60 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. DET/DL. FABRICATED, AND ERECT PER AISC STANDARDS AND SPECIFICATIONS.
6. JOIST TO BE DETAIL FABRICATED AND ERECTED PER SJI STANDARDS AND SPECIFICATIONS.
7. ROOF DECK TO BE 1½" x 22 GA. TYPE B GALVANIZED.
   FLOOR DECK TO BE 9/16 x 20GA. UNIFORM 'UFS' GALV.
8. ALL LINTELS & BEAMS TO BEAR 6" MIN ON TO WALLS.
   FILL ONE BLOCK BELOW THE LINTELS & BEAMS W/ GROUT.
9. * INDICATES JOIST W/ BOLTED CONNECTIONS.
10. 99.0' INDICATES BOTTOM OF FOOTING ELEV.
    (100.0') INDICATES TOP OF WALL ELEV.


PHA PROJECT