STRUCTURAL ANALYSIS REPORT

For

ME 5023 (LTE-3C)

BRADLEY'S CORNER
1050 Westbrook Street
Portland, ME 04102

Antennas Mounted on Non-Penetrating Ballast Frames on Roof;
Equipment Area at Ground Level

Prepared for:

SAI at&t

Dated: April 8, 2015

STATE OF MAINE
DANIEL P. HAMM
No. 10844
LICENSED PROFESSIONAL ENGINEER

Prepared by:

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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.

CONCLUSION SUMMARY:

Building plans were not available and could not be 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:

- Reconfigure ballast blocks as to meet the requirements shown below:

MINIMUM BALLAST REQUIREMENTS (ALPHA/BETA)		
SIDE	A (Back)	B (Front)
BALLAST REQUIRED	848 lbs.	273 lbs.
TOTAL BALLAST WEIGHT	1121 lbs.	

MINIMUM BALLAST REQUIREMENTS (GAMMA)		
SIDE	A (Back)	B (Front)
BALLAST REQUIRED	781 lbs.	227 lbs.
TOTAL BALLAST WEIGHT	1008 lbs.	

APPURTENACE/EQUIPMENT CONFIGURATION:

(3) HPA-65R-BUU-H8 Antennas (92.4"x14.8"x7.4" Wt. = 73 lbs. /each) (One per sector)

(3) RRH (RRUS-12) (20.4"x18.5"x7.5" – Wt. = 58 lbs. /each) (One per sector)

(3) A2 Module (16.4"x15.2"x3.4" – Wt. = 22 lbs. /each) (One per sector)

(3) Surge Arrestors (24"x9.7"ø - Wt. = 32.8 lbs. /each) (One per sector)

(6) Powerwave 7770 Antennas (55"x11"x5" Wt. = 35 lbs. /each) (Two per sector)

(2) P65-17-XLH-RR Antennas (96"x12"x6" Wt. = 70 lbs./each) (Alpha & Beta sector)

(1) AM-X-CD-16-65-00T-RET Antenna (72"x11.8"x5.9" Wt. = 49 lbs.) (Gamma sector)

(6) RRH (RRUS-11) (19.69"x16.97"x7.17" – Wt. = 50.7 lbs. /each) (Two per sector)

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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:

   74'-0"+/-

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ANTENNA/RRH/SURGE SUPPRESSOR SUPPORT RECOMMENDATIONS:

The new antennas, RRH's and surge suppressors are proposed to be secured to the existing non-penetrating ballast frames located on the roof of the existing building.

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 under the assumption that the ballast frames are located over structurally adequate roof supports (i.e. beams, columns, or bearing walls). HDG was not able to verify the roof structure and its components at the time of our visit.
6. HDG is not responsible for any modifications completed prior to and hereafter which HDG was not directly involved.
7. 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 antennas.

Photo 2: Sample photo illustrating the existing antennas.

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Calculations

Date: 04/08/2015
Project Number: NH5023
Project Name: Bradley's Corner
Designed By: GH **Checked By:** MSC

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2.6.5.2 Velocity Pressure Coeff:

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

z=	74	(ft)
z_g=	1200	(ft)
α=	7	

K_z= 0.907

$Kzmin \le Kz \le 2.01$

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!

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=	74	
H=	0	(Ht. 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=	74	Gh=	0.474

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}=	1.08
K_{zt}=	1

t_{iz}= 2.17

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

K_{iz}= 1.08

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= 96 (in) Largest Dim of Member

A_{iz} = 668.69

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=	0.907
K_{zt}=	1
K_d=	0.95
V_{max}=	100

q_z= 22.05

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: 0.25 feet

C= 23.81 **Cf=** 1.2

Appurtenances	Height	Width	Depth	Flat Area	Force Per Appurtenance
HPA-65R Antenna	92.4	14.8	7.4	9.50	**339.3** lbs
7770 Antenna	55	11	5	4.20	**150.1** lbs
P65-17-XLH Antenna	96	12	6	8.00	**285.8** lbs
AM-X-CD Antenna	72	11.8	5.9	5.90	**210.8** lbs
RRUS-12	20.4	18.5	7.5	2.62	**93.6** lbs
RRUS-11	19.7	17	7.2	2.33	**83.1** lbs
Squid	24	9.7	9.7	1.62	**57.8** lbs

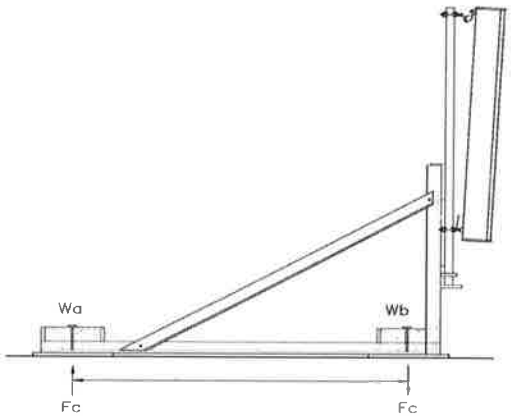
Date: 4/8/2015
Site Number: ME5023
Site Name: Bradley's Corner
Done by: GH **Checked by:** MSC

Calculate Total Ballast Required for Ballast Mount (ALPHA & BETA)

WIND FORCES

F antenna = 926 lbs.

F rrh = 318 lbs.



Antenna Height = 5 ft

RRH & Surge Height = 3 ft

Length = 7 ft

Overturning at Ballast

Moment = 6980 lbs.-ft

S.F. 1.25

Hold Down Force = 997.14 lbs. Per Side

Wa Ballast

Equipment

Frame = 150 lbs.

Total Ballast Required Wa= **847.14 lbs.**

Wb Ballast

Equipment

Frame	300 lbs.
Antennas	213 lbs.
RRH's	212 lbs.
Total =	725 lbs.

Total Ballast Required Wb = **272.14 lbs.**

Total weight of Fully Loaded Ballast Frame = 1996 lbs

Footprint Area under Ballast Frame = 62.5 ft^2

Area Load under Ballast Frame = 32 psf

Date: 4/8/2015
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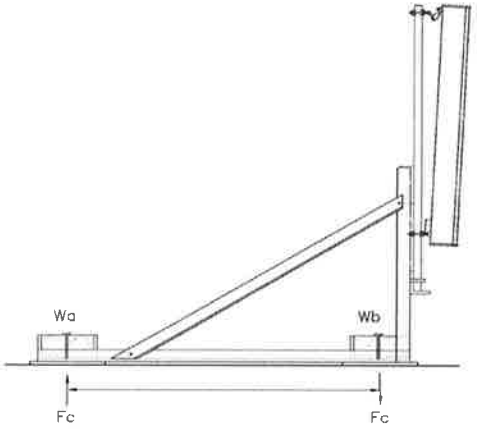
Calculate Total Ballast Required for Ballast Mount (GAMMA)

WIND FORCES

F antenna = 851 lbs.

F rrh = 318 lbs.



Antenna Height = 5 ft

RRH & Surge Height = 3 ft

Length = 7 ft

Overturning at Ballast

Moment = 6511.25 lbs.-ft

S.F. 1.25

Hold Down Force = 930.18 lbs. Per Side

Wa Ballast

Equipment

Frame = 150 lbs.

Total Ballast Required Wa= **780.18 lbs.**

Wb Ballast

Equipment

Frame	300 lbs.
Antennas	192 lbs.
RRH's	212 lbs.
Total =	704 lbs.

Total Ballast Required Wb = **226.18 lbs.**

Total weight of Fully Loaded Ballast Frame = 1862 lbs
Footprint Area under Ballast Frame = 62.5 ft^2
Area Load under Ballast Frame = 30 psf