(Revised)
STRUCTURAL ANALYSIS REPORT

For

ME 5038 (LTE 2C)
MORRILLS CORNER
880 Forrest Avenue
Portland, ME 04101

Equipment Shelter on the Roof and Antennas Supported on Ballast Frames

Prepared for:

500 ENTERPRISE DRIVE, SUITE 3A
ROCKY HILL, CT 06067
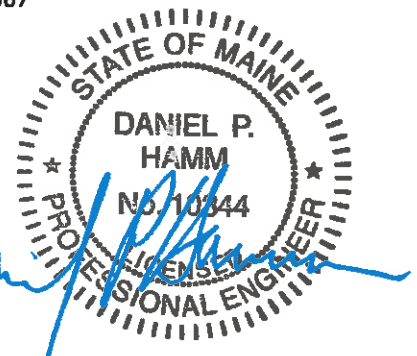
Dated: December 20, 2013 (Rev. 1)
November 6, 2013

Prepared by:

Hudson
Design Group LLC

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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 supporting the proposed 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 LTE Equipment.

This office conducted an on-site visual survey of the existing structure on October 31, 2013. Attendees included Pierre Gagnon (HDG-Sr. Field Technician).

CONCLUSION SUMMARY:

Limited building plans prepared by Krumbhaar & Holt Associates Architects were available 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.

APPURTENANCE/EQUIPMENT CONFIGURATION:

(3) Powerwave 7770 Antennas (55"x11"x5" – Wt. = 35 lbs. /each) (One per sector)

(9) HPA-65R-BUU-H6 Antennas (72"x14.8"x9" – Wt. 51 lbs. /each) (Three per Sector)

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

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

(6) RRH's (RRUS-12) (20.4"x18.5"x7.5" – Wt. = 58 lbs. /each) (Two per sector)

(3) RRH's (RRUS-E2) (20.4"x18.5"x7.5" – Wt. = 58 lbs. /each) (One per sector)

(3) RRH's (RRUS-32) (29.9"x13.3"x9.5" – Wt. = 77 lbs. /each) (One per sector)

(3) Surge Suppressors (Wt. = 20 lbs. /each) (One per sector)

(3) DTMABP7819VG12A TMA's (10.63"x11.02"x3.78" – Wt. = 19.18 lbs.) (One per sector)

(1) Rx-AIT Cabinet (Wt. = 600 lbs.)

(1) DC Power Plant (Wt. = 1900 lbs.)

Referenced documents are attached.

DESIGN CRITERIA:

1. International Building Code 2009, ASCE 7-10 Minimum Design Loads for Buildings and Other Structures.

    Wind Analysis:

Reference Wind Speed:	100 MPH	(FIG 26.5-1C; ASCE 7-10)
Category:	C	(26.7.3; ASCE 7 -10)
Gust Effect Factor (G):	0.85	(26.9.1; ASCE 7-10)
Force Coefficient (Cf):	Varies	(FIG 29.5-1 thru 29.5-3; ASCE 7-10)
$F = q_z * G * C_f * A_f$:		(Equation 29.5-1; ASCE 7-10)

    Snow Loading:

Ground Snow Load (Pg):	60 psf	(FIG 7-1; ASCE 7-10)
Flat Roof Snow Load (Pf):	37.8 psf	

    $P_f = 0.7 * C_e * C_t * I * P_g$ (Equation 7.3-1; ASCE 7-10)

    Ce=0.9; Ct=1.0; I=1.0

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

County:	Cumberland
Wind Load:	100 mph

3. Approximate height above grade to antennas: 107'-0"

EXISTING ROOF CONSTRUCTION:

The roof appears to consist of a roofing membrane on rigid insulation over precast-prestressed concrete planks, supported by reinforced concrete bearing walls.

EQUIPMENT SUPPORT RECOMMENDATIONS:

HDG recommends that the proposed RxAIT cabinet and Power Plant cabinet be mounted inside the existing AT&T equipment shelter on the roof located over existing reinforced concrete bearing walls.

RRH's / SURGE ARRESTOR SUPPORT RECOMMENDATIONS:

The new Surge Arrestors are proposed to be located on the existing RRH ballast frame with the (2) existing RRUS-11 that will remain. The new RRH's are proposed to be mounted on new unistrut components secured to the existing ballast frames.

ANTENNA SUPPORT RECOMMENDATIONS:

The new LTE antennas are proposed to be supported by the existing steel pipes, secured to the existing ballasted roof top frames.

HDG could not verify the locations of the ballast mounts over adequate support locations during our site visit. HDG is under the assumption that the ballast mounts have been located over beams or columns to adequately support the loading.

Notes:

1. Reference the latest HDG construction drawings for all the equipment locations.

2. All detail requirements will be designed and furnished in the construction drawings.

3. Mount all equipment per manufacturer's specifications.

4. HDG could not verify the support attachments to the roof structure at the time of our site visit. HDG is under the assumption that the equipment shelter was constructed properly and adequately attached to the building structure over bearing walls.

5. 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.

EXISTING EQUIPMENT:

Photo 1: Sample photo illustrating the existing equipment shelter.

Photo 2: Sample photo illustrating the **existing** equipment.

Photo 3: Sample photo illustrating the existing equipment.

EXISTING ANTENNAS:

Photo 4: Sample photo illustrating the existing antennas.

Photo 5: Sample photo illustrating the existing antennas.

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Calculations

2.6.5.2 Velocity Pressure Coeff:

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

z=	107 (ft)
z_g=	900 (ft)
α=	9.5

$$K_z = 1.284$$

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

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

$$K_{zt} = \text{\#DIV/0!}$$

(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=	107
H=	0 (Ht. of the crest above surrounding terrain)
K_{zt}=	1.00

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=   107   Gh=   0.507

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

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}=	1.12
K_{zt}=	1

t_{iz}=   2.25

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

K_{iz}=   1.12

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} =   694.38

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=	1.284
K_{zt}=	1
K_d=	0.95
V_{max}=	100

q_z=   31.22

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

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=   22.66   **Cf=**   1.2

Appurtenances		Height	Width	Depth	Flat Area	Force Per Appurtenance
Item No.1	**Antenna**	72	14.8	9	7.40	**374.28** (lbs)
Item No.2	Antenna	55	11	5	4.20	**212.50** (lbs)
Item No.3	**RRU-12**	20.4	18.5	7.5	2.62	**132.56** (lbs)
Item No.4	**RRU-32**	29.9	13.3	9.5	2.76	**139.68** (lbs)
Item No.5	Arrestors	23.5	9.7	9.7	1.58	**80.07** (lbs)

TOTAL FORCE ($\sum F_A$) =   **939.08** (lbs)

DATE: 12/11/13
Project Name: Morrills Corner
Project No.: ME 5038
Design By: EC   Chk'd By: MSC   Page 1 of ____

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- ### Check Ballast Mount for Overturning:
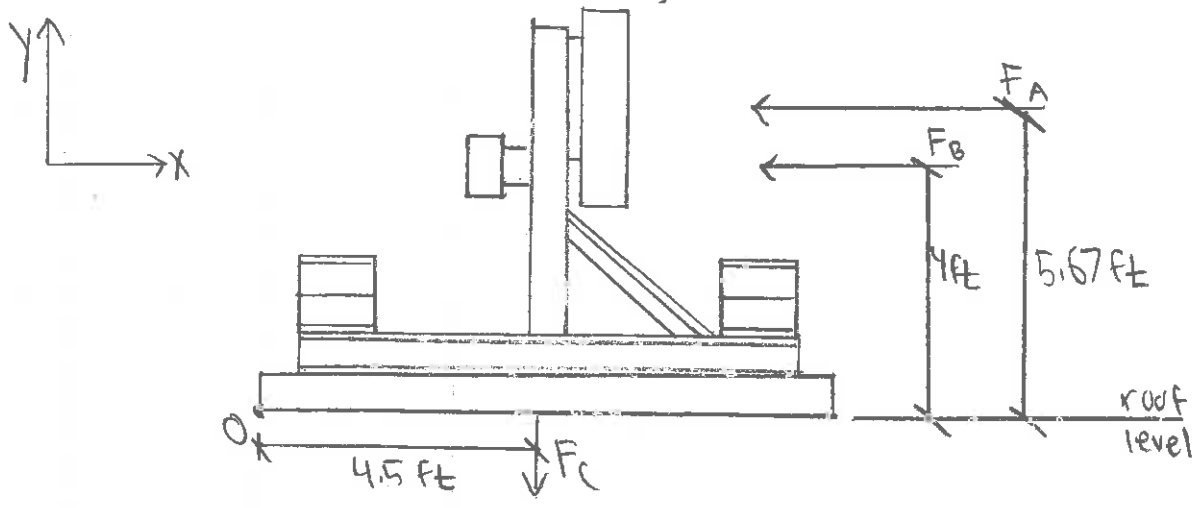
- ### Determine Weights:

- F_A: — (1) Powerwave 7770 Antenna = (1)(212.5#) =   212.5 #
      — (3) proposed Antennas = (3)(374.28#) =   1122.84#
                                                F_a = 1335 lbs

- F_B: — (3) RRUS-12/E2 = (3)(132.56#) =   397.68#
      — (1) RRUS-32 = (1)(139.68#) =   139.68#
                                           F_B = 537.4#

- F_C: — RRH's & A2 = (3)(58#) + (1)(77#) + 2(22#) =   295 #
      — Antennas = (3)(51#) + (1)(35#) =   188 #
      — Antenna mounting pipes = (3)(8")(3.66 plf) =   87.84#
      — Unistruts = (4)(6 ft)(1.89 plf) =   45.36#
      — Wooden post = (3)(7.35 plf)(9 ft) =   198.45#
      — beam made up of (4) 3" x 3" x 3/8" angles,
         = (3 beams)(4/beam)(7.2 plf)(8 ft) =   691.2#
      — (4) plates/beam = 4(3)(12")(19")($\frac{3}{16}$")($\frac{1}{12}$)^3(490 $\frac{lbs}{ft^3}$) =   145.5#
      — (4) conc. blocks per beam = (3)(4)(38 lbs/block) =   456 #
      — (3) 3" Std pips = (3)(7.58 plf)(7.5 ft) =   170.55#
      — (4) kick-back 2½" x 2½" x 3/16" angles
         = (4)(3.07 plf)(3.5 ft) =   42.98#
      — (4) brace angles (2½" x 2½" x 3/16 angles)
         = (4)(3.07 plf)(6.5 ft) =   79.82#
                                           F_C = 2400.7#

- ### Calculate Overturning Moment: $\circlearrowright \Sigma M_D = 0$

$$2400.7\#(4.5 \, ft) > 133.5\#(5.67 \, ft) + 537.4\#(4 \, ft) = 10.8 \, k\text{-}ft > 9.7 \, k\text{-}ft \therefore OK \checkmark$$

157132

		Site Information		

Scope Date	12/2/2013		
UTRAN ID	MEL05038		
Site Number	ME5038	**Defined SOW Summary**	
Polygon	LTE 2C (P3)-AIR	ANT QTY:	12
Stucture Type	Rooftop	Surge Type:	SQUID
AT&T CL	107	Surge QTY:	3
		A2 QTY:	6
Equipment Location	Indoor	RRH QTY:	18
ProjectCode	2056598912	TMA QTY:	3
FA Code	10086384	Fiber Trunk QTY:	1
		DC Trunk QTY:	6
		Power:	Vortex
		Node Type:	Indoor RBS6601
		RAN Area:	1
		RRH Location:	TOP

		Existing Configuration		
		Alpha	Beta	Gamma
		UMTS/GSM Existing Configuration		
COAX (UMTS/GSM)	Coax MFG	Andrew	Andrew	Andrew
	Coax QTY	4	4	4
	Coax Diameter	7/8	7/8	7/8
Antenna (UMTS/GSM)	Antenna Count	2	2	2
	Antenna Type	7770	7770	7770
	AZ	30	150	270
TMA (UMTS/GSM)	TMA Type	LGP21404	LGP21404	LGP21404
	TMA Count	2	2	2
Diplexer (BTS)	Diplexer Type	LGP13519/LGP21901	LGP13519/LGP21901	LGP13519/LGP21901
	Diplexer Count	2 / (2)	2 / (2)	2 / (2)
RETS	QTY	6		
Current UMTS RRH Location 1900	Top/Bottom	Bottom		
Current UMTS RRH Location 850	Top/Bottom	Bottom		
		LTE Existing Configuration		
Antenna (LTE)	Antenna Count	1	1	1
	Antenna Type	AM-X-CD-16-65-00T	AM-X-CD-16-65-00T	AM-X-CD-16-65-00T
	AZ	40	160	280
Existing Fiber Pairs	12 or 18	Pinnacle		
TMA (LTE)	TMA Type			
	TMA Count			
Diplexer (BTS)	Diplexer Type			
	Diplexer Count			
		CCI Existing Configuration		
Auxiliary Equipment	Booster	n/a		
	RxAIT	n/a		
	LLC	n/a		

		Final Configuration		
		Alpha	Beta	Gamma
Integrated Antenna Schedule (ANT)	ANT 1 Type	7770	7770	7770
	ANT 1 AZ	30	150	270
	ANT 2 Type	HPA-65R-BUU-H6 - (6' HEX)	HPA-65R-BUU-H6 - (6' HEX)	HPA-65R-BUU-H6 - (6' HEX)
	ANT 2 AZ	40	160	280
	ANT 3 Type	HPA-65R-BUU-H6 - (6' HEX)	HPA-65R-BUU-H6 - (6' HEX)	HPA-65R-BUU-H6 - (6' HEX)
	ANT 3 AZ	40	160	280
	ANT 4 Type	HPA-65R-BUU-H6 - (6' HEX)	HPA-65R-BUU-H6 - (6' HEX)	HPA-65R-BUU-H6 - (6' HEX)
	ANT 4 AZ	40	160	280
	RAD	107	107	107
RRH (TOP)	RRH Model 1 QTY	2	2	2
	RRH Model 1 Type	RRUS-11	RRUS-11	RRUS-11
	RRH Model 2 QTY	2	2	2
	RRH Model 2 Type	RRUS-12	RRUS-12	RRUS-12
	RRH Model 3 QTY	1	1	1
	RRH Model 3 Type	RRUS-E2	RRUS-E2	RRUS-E2
	RRH Model 4 QTY	1	1	1
	RRH Model 4 Type	RRUS-32	RRUS-32	RRUS-32
	UMTS RRH 1900 QTY	0	0	0
	UMTS RRH 1900 Type	RRUS-11	RRUS-11	RRUS-11
	UMTS RRH 850 QTY	0	0	0
	UMTS RRH 850 Type	RRUS-11	RRUS-11	RRUS-11
A2 Module (TOP)	QTY	2	2	2
TMA (ANT)	TMA Count	1	1	1
	TMA Type	DTMABP7819VG12A-BP	DTMABP7819VG12A-BP	DTMABP7819VG12A-BP
Surge Protection Device (ANT)	Surge Type	SQUID		
	Surge QTY	1	1	1
Fiber & DC	Fiber Trunk QTY	1		
	New 18 Pair Req'd?	Need to Verify Pairs		
	DC Trunk QTY	6		
Triplexer (BTS)	Tri/Quadplexer Count	n/a	n/a	n/a
	Tri/Quadplexer Type	n/a	n/a	n/a
Diplexer (BTS)	Diplexer Count	2	2	2
	Diplexer Type	LGP13519/LGP21901	LGP13519/LGP21901	LGP13519/LGP21901
CCI Gear (BTS)	RxAIT	850		
	Booster	n/a		
	LLC	850 (A+B)		

		End Of Form		