NB+C Engineering Services

Installation of New Antennas on Building Rooftop

Prepared for Verizon – PCS-Pittsburgh

SITE INFORMATION

Address	5080 Tuttle Crossing Blvd. Dublin, OH 43016 Lat: 40.077364°, Long: -83.127496°
Verizon Site Name	Tuttle Crossing
NB+C Project Number	27212
Date	July 19, 2016

TABLE OF CONTENTS

1.0 INTRODUCTION

The existing structure is a 52'-0" multi-story building located in Dublin, OH.

Verizon has proposed to replace existing antennas and distribution box with (6) Quintel QS4658-3 panel antennas and (3) Raycap RCMDC-3315-PF-48. Verizon has also proposed to add (3) 700 RRHs and (3) PCS RRHs. A structural analysis was performed to see if the new loads are safely supported by the existing structure and verify if the structure is in compliance with the applicable codes and standards. Information we have received and used for this analysis includes:

- RF Configuration provided by Verizon, dated June 21, 2016
- Preliminary Construction Drawings prepared by NB+C ES, dated July 14, 2016
- Previous Structural Analysis Report (Project #48713-0046 MOD) prepared by PJF, dated July 16, 2013
- Construction Drawings prepared by TERRA Consulting, dated July 30, 2013

2.0 APPURTENANCES LOADING

As per the information provided to us, the following tables show the proposed and existing antenna installation by Verizon.

Table 1 – Existing Antenna and Cable Information

Center Line Elevation (ft)	No. of Mounts	Antenna Model	Carrier	Feed Line (in)
63'-0" 67'-0"	Existing Screen Wall Post (5x5 HSS)	(3) JMA XDUO4-65-4 panel antennas[2] (50.5"x12.5"x7.1", 24.2lbs) (3) JMA X7CAP-465-40 panel antennas[2] (50.5"x12.5"x7.1", 28lbs) (3) Alcatel-Lucent B4 RRH2x40-2R[1] (24.4"x10.6"x6.7", 44lbs) (3) Distribution Box[2]	Verizon	(12) Andrew-LDF7 coax[1] (3) 7/8" Hybrid Cables[2]

1. Existing antennas to remain
2. Existing antennas to be removed

Table 2 – Proposed Antenna and Cable Information

Center Line Elevation (ft)	No. of Mounts	Antenna Model	Carrier	Feed Line (in)
63'-0" 67'-0"	Existing Screen Wall Mount;	(6) Quintel QS4658-3 Panel Antennas (52"x12"x9.6", 69.4lbs)	Verizon	(3) 1-5/8" Hybrid Cables

	Wall Mount Brackets with 2-3/8" O.D. Mounting Pipe	(3) Alcatel-Lucent B13 RRH4x30-4R (21.6"x12"x9", 57.2lbs) (3) Alcatel-Lucent B25 RRH4x30-4R (21.4"x12"x7.2", 51lbs) (3) Raycap RCMDC-3315-PF-48 Distribution Box (28.9"x15.7"x10.3", 32lbs)		

3.0 ASSUMPTIONS

This report is based on the theoretical capacity of the existing/proposed structural elements and is not an assessment of the overall suitability of the existing structure or its components for any particular use other than specified here in this report:

- This report makes no warranties, expressed and/or implied, and disclaims any liability arising from material, fabrication and erection of the existing Structure and any other existing or proposed components or appurtenances.
- All proposed and existing antennas, mounts, coaxial cables and appurtenances are assumed to be properly installed and configured according to manufacturer requirements.
- All existing structural elements are assumed to be in place and in good condition, and were previously designed and constructed in accordance with applicable codes and standards.
- Contractor to verify existing site condition including the existing structure prior to fabrication and construction. In the event the existing structure conditions are different than the assumptions made in this report, this has to be brought to the structural engineer's attention before proceeding any further with bidding, fabrication and/or erection.

4.0 APPLICABLE CODES AND STANDARDS

The existing structure was analyzed/designed per the provisions of following applicable codes and standards:

- *Ohio Building Code, Incorporating the 2009 International Building Code*
- *Minimum Design Loads for Buildings and Other Structures ASCE/SEI 7-05*
- *AISC Manual of Steel Construction, 13th Edition – ANSI/AISC 360-05*
- *ANSI/TIA-222-G – Structural Standards for Antenna Supporting Structures and Antennas*

5.0 ANALYSIS

Design Loads:

- Basic wind speed: 90 mph
- Occupancy Category: II
- Exposure: C

Load Combinations:

- D
- D+L

- D+S
- D+0.75L+.075S
- D+(W or 0.7E)
- D+0.75(W or 0.7E)+0.75L+0.75S
- 0.6D+W

6.0 CONCLUSIONS & RECOMMENDATIONS

As outlined above in this report, the proposed panel antennas will be supported on existing screen wall mount at an elevation of 63.0' and 67.0' AGL and the proposed RRHs and Distribution Boxes will be mounted on proposed 2-3/8" O.D. Mounting Pipes attached to screen wall post using 2x2x1/4 HSS Wall Mount Brackets. The HSS will be attached to the screen wall post using 1/4''x3''x10'' bent plates with (4) 1/4'' Dia x20 HWH TEK/4 TEK Screws each end. Refer to the construction drawings prepared by NB+C ES for the proposed location of the appurtenances details.

Based on the performed analysis of this structure for applied gravity and lateral loads, the existing structure was determined to have ***adequate*** structural capacity to support the proposed antennas. In addition the proposed Mounting Pipe and Wall Mount connections were determined to have adequate structural capacity to support proposed Verizon appurtenances.

The results in Appendix B of the report show that the additional forces imparted to the existing structure due to proposed appurtenance placement are within acceptable limits considering the overall configuration of the existing support structure.

The conclusions reached by NB+C ES in this report are only applicable for the previously mentioned existing structural members supporting the Verizon telecommunications equipment. Further, no structural qualification is made or implied by this report for existing structural members not supporting the Verizon equipment.

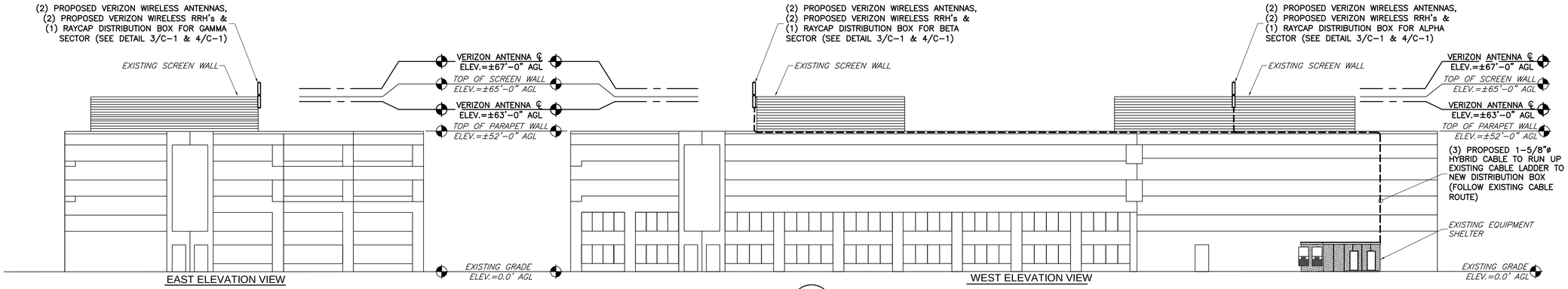
Prepared by: Rachel Huang, E.I.T.

Respectfully Submitted by:
NB+C ENGINEERING SERVICES, LLC

Krupakaran Kolandaivelu, P.E.
Engineering Manager - Structural
OH PE License # 76494

07/19/2016

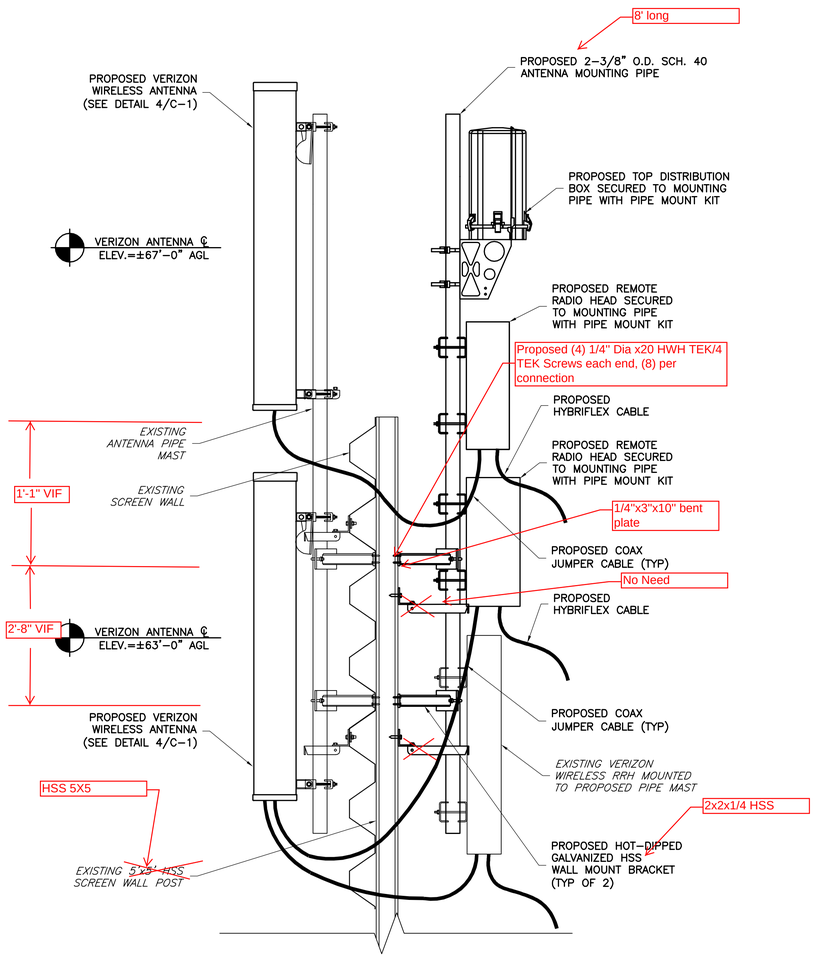
APPENDIX A:
PLAN AND ELEVATION



1 / C-1 ELEVATION
SCALE: 1" = 20'

GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 INCH = 20 FEET

STRUCTURAL NOTE:
CONTRACTOR TO VERIFY ALL PROPOSED AND EXISTING ANTENNAS AND CABLES WERE CONSIDERED AND PASSED A STRUCTURAL ANALYSIS PERFORMED BY A LICENSED ENGINEER PRIOR TO INSTALLATION.



2 / C-1 ANTENNA, RRH'S & DISTRIBUTION BOX MOUNTING DETAIL
NTS

PCS REMOTE RADIO HEAD B25 RRH 4x30-4R	
WEIGHT	51 LBS.
DIMENSIONS (HxWxD)	21.4"x12.0"x7.2"
RF OUTPUT POWER	2x60W OR 4x30W

700 MHz REMOTE RADIO HEAD B13 RRH 4X30-4R	
WEIGHT	57.2 LBS.
DIMENSIONS (HxWxD)	21.6"x12.0"x9.0"
RF OUTPUT POWER	2x60W OR 4x30W

SEQUENCE OF CONSTRUCTION:

1. REMOVE (6) EXISTING ANTENNAS AT ELEV 68'-0"±. EXISTING PIPE MOUNTS TO REMAIN.
2. INSTALL (6) NEW ANTENNAS AND MOUNTING HARDWARE AT ELEV. 67'-0"± AND ELEV. 63'-0"±.
3. INSTALL (6) RRH's TO PROPOSED EQUIPMENT PIPE MAST AT ELEV. 68'-0"±.
4. INSTALL (3) OVP DISTRIBUTION BOXES ON PROPOSED EQUIPMENT PIPE MAST AT EXISTING ANTENNA LOCATIONS.
5. RETURN ALL REMOVED ITEMS TO VERIZON.

NOTES:

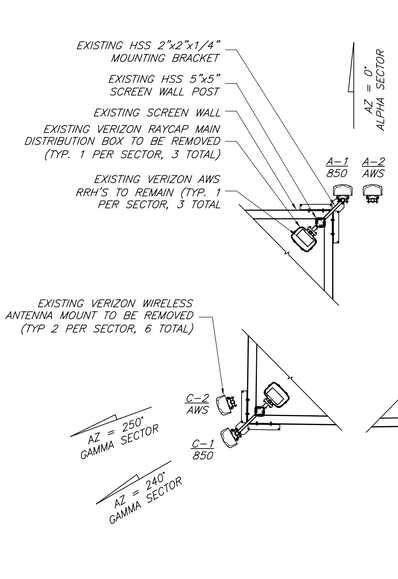
1. INSTALL (3) (1-5/8") HYBRID CABLES FROM EXISTING VERIZON EQUIPMENT SHELTER (EQUIPMENT LOCATION) TO OVP DISTRIBUTION BOX ON EXISTING BUILDING ELEVATION AND ROOF AT ELEV. 67'-0"±.
2. NO ELECTRICAL WORK IS REQUIRED FOR THIS INSTALLATION. NO NEW VOLTAGE REQUIRED.

ANTENNA REPLACEMENT NOTES:

1. CONTRACTOR TO INSPECT THE CONDITION OF EXISTING MOUNTING PIPE. CONFIRM THE FOLLOWING:

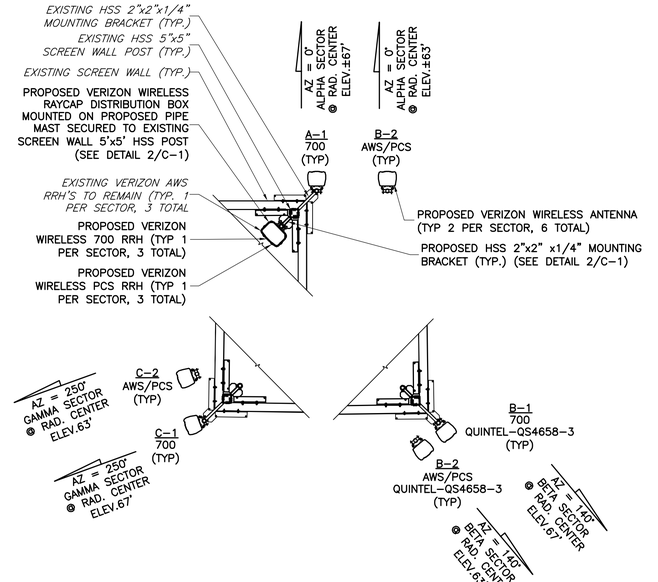
   A. CORROSION IF MOUNTS ARE FOUND TO BE CORRODED, CONTACT VERIZON REP. FOR DIRECTION.
   B. CHECK CONDITION OF ATTACHMENT BOLTS. IF FOUND LOOSE, TIGHTEN TO ORIGINAL SPECIFICATIONS (AISC; TURN OF THE NUT METHOD)
   C. IF BOLTS ARE MISSING, REPLACE TO SUITE.
   D. CONFIRM MOUNTING PIPE IS ADEQUATELY SIZED TO ACCOMMODATE PROPOSED ANTENNA INSTALL.

2. ALL WORK DEPICTED ON THIS DRAWING DESIGNED IN ACCORDANCE WITH OBC 2011 AND AMENDMENTS.



3 / C-1 EXISTING ANTENNA ORIENTATION PLAN
NTS

APPROX TRUE NORTH



4 / C-1 PROPOSED ANTENNA ORIENTATION PLAN
NTS

APPROX TRUE NORTH

ENGINEER

NB+C TOTALLY COMMITTED.
NB+C ENGINEERING SERVICES, LLC.
6095 MARSHALEE DRIVE, SUITE 300
ELKRIDGE, MD 21075
(410) 712-7092

APPLICANT

verizon
18 ABELE ROAD
BRIDGEVILLE, PA 15017

SITE INFORMATION

TUTTLE CROSSING
5080 TUTTLE CROSSING BLVD
DUBLIN, OH 43016
FRANKLIN COUNTY

DESIGN RECORD

REVISIONS

REV	DATE	DESCRIPTION	BY
A	07/14/16	PRELIMINARY CDs	AMM

PROFESSIONAL STAMP

ENGINEER

PHILIP BURTNER, P.E.
OH PROFESSIONAL ENGINEER LIC. #73386

SHEET TITLE

ELEVATION, ANTENNA LAYOUTS, NOTES & DETAILS

SHEET NUMBER

C-1

APPENDIX B:
CALCULATIONS

PURPOSE / ASSUMPTIONS

The purpose of these calculations is to structurally qualify the existing and propose mounts located at 5080 Tuttle Crossing Blvd., Dublin OH 43016 for supporting the proposed Verizon Wireless antennas.

All calculations are computed in compliance with the following:

- Ohio Building Code, Incorporating the 2009 International Building Code
- Minimum Design Loads for Buildings and Other Structures ASCE/SEI 7-05
- Specifications for Structural Steel Buildings ANSI/AISC 360-05 13th Edition
- Structural Standards for Antenna supporting structures and Antennas - ANSI/TIA-222-G

Wind Load Per ASCE/SEI 7-05:

		ASCE/SEI 7-05 Reference
Location:	Dublin, OH	
Building Classification:	II	Table 1-1, Pg. 3
Exposure:	C	Section 6.5.6.3, Pg. 25
Topographic Factor:	$(K_{zt} := 1.0)$	Section 6.5.7.2, Pg. 26
Wind Directional Factor:	$K_d := 0.9$	Table 6-4, Pg. 80
Basic Wind Speed (mph):	$V := 90$	Figure 6-1c, Pg. 36
Importance Factor:	$I := 1.0$	Table 6-1, Pg. 77
Gust Response Factor:	$G_{app} := 0.85$	Section 6.5.8.1, Pg. 26
Velocity Pressure Coefficient:	$K_z := 1.16$	Table 6-3, Pg. 79
Antenna Height AGL (ft):	$h := 67ft$	
Velocity Pressure (psf):	$q_z := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2 \cdot I psf$	Equation 6-15, Pg. 31
	$\boxed{(q_z) = 21.6 \cdot psf}$	

Check Existing Screen Wall Mounts

Proposed panel antennas will be mounted to existing screen wall mount. Existing screen wall mount consists of 8' long 2-1/2" STD. Mounting Pipe supported on (2) HSS 2x2x1/4 mounted directly to the post 2'-8" apart, and (2) Antenna Mount Brackets attached to the screen wall. The wind area (front) will not increase thus existing HSS and brackets are considered to have adequate capacity to support proposed Verizon antennas.

1. Calculate Loads on Antennas

Loads on Antenna:

(2) Proposed Quintel QS4658-3 panel antenna
52"x12"x9.6", wt.69.4lbs

Antenna Area: $A_{ant} := 52in \cdot 12in$ $(A_{ant}) = 4.33 \cdot ft^2$

Force Coefficient: $(C_{f1} := 1.35)$

Wind Load: $(F_{ant1} := q_z \cdot G_{app} \cdot (C_{f1} \cdot A_{ant}))$ $(F_{ant1}) = 107.65 \cdot lbf$

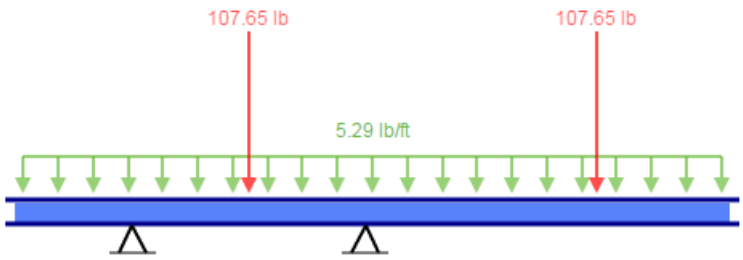
2. Check Mounting Pipe

Pipe mast:

Area: $Area := 2.875in$ $(Area) = 0.2 \cdot ft$

Force Coefficient: $(C_f := 1.2)$

Wind Load: $(F_{pipe1} := q_z \cdot G_{app} \cdot C_f \cdot Area)$ $(F_{pipe1}) = 5.29 \cdot plf$



$R_a := 54.5lbf$

$R_b := 312.1lbf$

$(M_{max} := 358ft \cdot lbf)$

Pipe Parameters

$S_{pipe} := 1.01in^3$

$(F_y := 35ksi)$

Allowable Stress

$\left(\sigma_{all} := \frac{F_y}{1.67} = 20.958 \cdot ksi\right)$

Actual Stress

$\left(\sigma_{act} := \frac{M_{max}}{S_{pipe}} = 4.253 \cdot ksi\right)$

2.5" Std pipe is adequate

3. Check HSS to Post Connection

Total Load:

(2) panel antenna+ (1) pipe mount $Wt_{total} := 2 \cdot 69.4lbf + 8ft \cdot 5.8 \frac{lbf}{ft} = 185.2 \cdot lbf$

Shear force in the mount per connection - $\left(V_{shear} := \frac{Wt_{total}}{2}\right) \quad \left(V_{shear}\right) = 92.6 \cdot lbf$

Screw Parameters

Type = 20 HWH TEK/4 Screws
Size = 1/4 in
Screw Number = 12

Screw Shear = 345 lbs/bolt
Screw Tension = 645 lbs/bolt
Screw Capacity = 4.1 kips (Shear) > Computed Shear = 0.93 kips
Screw Capacity = 7.7 kips (Tension) > Computed Tension = 0.31 kips

Existing 1/4" HWH TEK/4 Screws are adequate

Check Proposed Screen Wall Mounts

Proposed RRHs and distribution boxes will be mounted to proposed screen wall mount. Proposed screen wall mount consists of 8' long 2" STD. Mounting Pipe supported on (2) HSS 2x2x1/4, 2'-8" apart, mounted directly to the screen wall post. The HSS will be attached to the screen wall post using 1/4"x3"x10" bent plates with (4) 1/4" Dia x20 HWH TEK/4 TEK Screws each end.

1. Calculate Loads on Antennas

Loads on Antenna:

(1) Raycap RCMDC-3315-PF-48
28.9"x15.7"x10.3", wt.32.0lbs

Area: $A_{db} := 28.9in \cdot 15.7in \quad A_{db} = 3.15 \cdot ft^2$

Force Coefficient: $C_f := 1.3$

Wind Load: $F_{db} := q_z \cdot G_{app} \cdot \left(C_f \cdot A_{db}\right) \quad F_{db} = 75.37 \cdot lbf$

(1) PCS RRH Alcatel-Lucent B25 RRH4x30-4R
21.4"x12"x7.2", wt.51lbs

Area: $A_{rrh} := 21.4in \cdot 12in \quad A_{rrh} = 1.78 \cdot ft^2$

Force Coefficient: $C_f := 1.3$

Wind Load: $F_{pcs} := q_z \cdot G_{app} \cdot \left(C_f \cdot A_{rrh}\right) \quad F_{pcs} = 42.66 \cdot lbf$

(1) 700 RRH Alcatel-Lucent B13 RRH4x30-4R
21.6"x12"x9", wt.57.2lbs

Area: $A_{rrh} := 21.6in \cdot 12in$ $A_{rrh} = 1.8 \cdot ft^2$

Force Coefficient: $C_f := 1.3$

Wind Load: $F_{700} := q_z \cdot G_{app} \cdot (C_f \cdot A_{rrh})$ $F_{700} = 43.06 \cdot lbf$ (behind screen wall)

(1) AWS RRH Alcatel-Lucent B4 RRH2x40-2R
24.4"x10.6"x6.7", wt.44lbs

Area: $A_{rrh} := 24.4in \cdot 10.6in$ $A_{rrh} = 1.8 \cdot ft^2$

Force Coefficient: $C_f := 1.3$

Wind Load: $F_{aws} := q_z \cdot G_{app} \cdot (C_f \cdot A_{rrh})$ $F_{aws} = 42.97 \cdot lbf$ (behind screen wall)

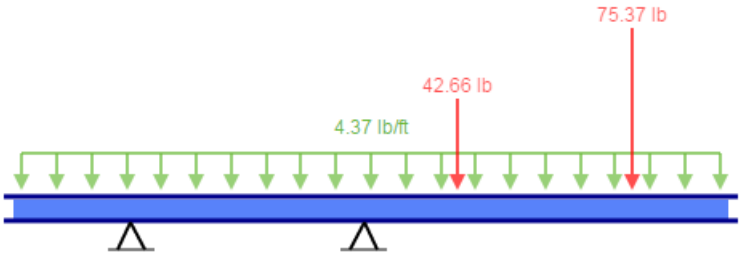
2. Check Mounting Pipe

Pipe mast:

Area: $Area := 2.375in$ $(Area) = 0.2 \cdot ft$

Force Coefficient: $(C_f := 1.2)$

Wind Load: $F_{pipe2} := q_z \cdot G_{app} \cdot C_f \cdot Area$ $F_{pipe2} = 4.37 \cdot plf$



$R_a := 105.3lbf$

$R_b := 258.2lbf$

$M_{max} := 314.6ft \cdot lbf$

Pipe Parameters

$S_{pipe} := 0.528in^3$

$(F_y := 35ksi)$

Allowable Stress

$\left(\sigma_{all} := \frac{F_y}{1.67} = 20.958 \cdot ksi\right)$

Actual Stress

$\left(\sigma_{act} := \frac{M_{max}}{S_{pipe}} = 7.15 \cdot ksi\right)$

2.0" Std pipe is adequate

3. Check HSS to Post Connection

Total Load:

(3) RRH+(1) Box+ (1) pipe mount $Wt_{total} := 32lbf + 51lbf + 57.2lbf + 44lbf + 8ft \cdot 5.8\frac{lbf}{ft} = 230.6 \cdot lbf$

Shear force in the mount per connection - $\left(V_{shear} := \frac{Wt_{total}}{2}\right) \quad \left(V_{shear}\right) = 115.3 \cdot lbf$

Screw Parameters

Type = 20 HWH TEK/4 Screws
Size = 1/4 in
Screw Number = 8

Screw Shear = 345 lbs/bolt
Screw Tension = 645 lbs/bolt
Screw Capacity = 2.8 kips (Shear) > Computed Shear = 0.115 kips
Screw Capacity = 5.2 kips (Tension) > Computed Tension = 0.258 kips

Proposed 1/4" HWH TEK/4 Screws are adequate

Search Results

Query Date: Mon Jul 18 2016
Latitude: 40.0774
Longitude: -83.1275

ASCE 7-10 Windspeeds
(3-sec peak gust in mph*):

Risk Category I: 105
Risk Category II: 115
Risk Category III-IV: 120
MRI 10-Year:** 76
MRI 25-Year:** 84
MRI 50-Year:** 90
MRI 100-Year:** 96

ASCE 7-05 Windspeed:
90 (3-sec peak gust in mph)
ASCE 7-93 Windspeed:
70 (fastest mile in mph)

*Miles per hour
**Mean Recurrence Interval

Users should consult with local building officials to determine if there are community-specific wind speed requirements that govern.

Print your results

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