ADVANCED
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Structural Design Calculations

Site No.: **MA1306 - Cedar Street WT**
Client: **SAI Communications**
Date: **February 14, 2019**

Synopsis:

The proposed AT&T equipment installation consists of:

- Three (3) Kathrein antennas (1 per sector)
- Six (6) Ericsson RRUS-4478 remote radio heads (RRHs)(2 per sector)
- Three (3) Ericsson RRUS-32 RRHs (1 per sector)

The existing AT&T antenna & RRH configuration will be reconfigured, in order to achieve the desired antenna separation and RRH location, as detailed on drawings by this office.

Material Properties:

Structural steel yield stress (shapes), $F_{ys} := 36 \cdot ksi$

Modulus of elasticity of steel, $E_s := 29 \cdot 10^6 \cdot psi$

Structural steel yield stress (pipe), $F_{yp} := 35 \cdot ksi$

Steel unit weight, $\gamma_s := 490 \cdot pcf$

Loads:

Environmental Loads:

Wind Load:

Exposure category,	B	(ASCE 7-10 Sec 26.7.3)
Risk Category,	Category IV	(ASCE 7-10 Table 1.5-1)
Basic Wind Velocity,	$V_w := 137\ mph$	(MSBC Table 1604.11)
Antenna Height,	$Height := 75ft$	
Exposure coefficient,	$K_z = 0.911$	(ASCE 7-10 Table 29.3-1)
Wind Directionality Factor,	$K_d := 0.9$	(ASCE 7-10 Table 26.6-1)
Velocity wind pressure,	$q_z := .00256 \cdot V_w{}^2 \cdot K_z \cdot K_d \cdot psf = 39.387 \cdot psf$	(ASCE 7-10 Sec. 27.3.2)
Gust response factor,	$G_r := 0.85$	(ASCE 7-10 Sec. 26.9.1)
Force coeff: Flat,	$C_f := 1.4$	(ASCE 7-10 Fig. 29.5-1)
Wind Load factor,	$LF := .6$	(ASCE 7-10 Sect 2.4)
Wind load pressure,	$WL_f := q_z \cdot G_r \cdot C_f = 46.871 \cdot psf$	(ASCE 7-10 C26.5-1)
Radial ice thickness,	$t_i := 0.75 \cdot in$	
Ice Importance Factor,	$I_i := 1.25$	
Thickness of Ice,	$t_{ice} := t_i \cdot I_i = 0.937 \cdot in$	
Density of ice,	$\gamma_{ice} := 56 \cdot pcf$	

AT&T Equipment Loads:

Position 1:

Kathrein 800-10121

Width, $w := 10.3 \cdot in$

Depth, $t := 5.9 \cdot in$

Length, $l := 55 \cdot in$

Weight, $W_1 := 131 \cdot lb$

Ice Weight, $I_1 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left(w + 2 \cdot t_{ice}\right) \cdot \left(t + 2 \cdot t_{ice}\right) - l \cdot w \cdot t\right] \cdot \gamma_{ice} = 30.009\,kg$

Side wind load, $SW_1 := WL_f \cdot l \cdot t = 47.909\,kg$

Front wind load, $FW_1 := WL_f \cdot l \cdot w = 83.639\,kg$

Surge Suppressor:

Dia., $\phi := 11 \cdot in$

Length, $l := 24 \cdot in$

Weight, $W_2 := 33 \cdot lb$

Ice Weight, $W_2 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left[\frac{\pi \cdot \left(\phi + 2 \cdot t_{ice}\right)^2}{4}\right] - l \cdot \frac{\pi \cdot \phi^2}{4}\right] \cdot \gamma_{ice} = 15.992\,kg$

Side wind load, $SW_2 := WL_f \cdot l \cdot \phi = 38.977\,kg$

Front wind load, $FW_2 := SW_2 = 38.977\,kg$

2" Mount pipe:

Length, $l := 11 \cdot ft$

Dia, $\phi := 2.375 \cdot in$

Weight, $W_4 := (3.65 \cdot plf) \cdot l = 18.212\,kg$

Ice Weight, $W_4 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left[\frac{\pi \cdot \left(\phi + 2 \cdot t_{ice}\right)^2}{4}\right] - l \cdot \frac{\pi \cdot \phi^2}{4}\right] \cdot \gamma_{ice} = 19.321\,kg$

Side wind load, $SW_4 := WL_f \cdot l \cdot \phi = 46.285\,kg$

Front wind load, $FW_4 := 0 \cdot lb$

Total dead load, $DL_1 := \sum W = 94.734\,kg$

Total ice load, $I_1 := \sum I = 30.009\,kg$

Total side wind load, $SW_1 := \sum SW = 133.172\,kg$

Total front wind load, $FW_1 := \sum FW = 122.616\,kg$

Position 2:

CCI OPA-65R-LCUU-H4

Width, $w := 14.4 \cdot in$

Depth, $t := 7.3 \cdot in$

Length, $l := 48 \cdot in$

Weight, $W_1 := 57 \cdot lb$

Ice Weight, $I_1 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left(w + 2 \cdot t_{ice}\right) \cdot \left(t + 2 \cdot t_{ice}\right) - l \cdot w \cdot t\right] \cdot \gamma_{ice} = 35.305\,kg$

Side wind load, $SW_1 := WL_f \cdot l \cdot t = 51.733\,kg$

Front wind load, $FW_1 := WL_f \cdot l \cdot w = 102.049\,kg$

RRUS-E2:

Width, $w := 18.5 \cdot in$

Depth, $t := 7.5 \cdot in$

Length, $l := 20.4 \cdot in$

Weight, $W_2 := 60 \cdot lb$

Ice Weight, $I_2 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left(w + 2 \cdot t_{ice}\right) \cdot \left(t + 2 \cdot t_{ice}\right) - l \cdot w \cdot t\right] \cdot \gamma_{ice} = 20.938\,kg$

Side wind load, $SW_2 := WL_f \cdot l \cdot t = 22.589\,kg$

Front wind load, $FW_2 := WL_f \cdot l \cdot w = 55.72\,kg$

RRUS-32:

Width, $w := 12.1 \cdot in$

Depth, $t := 6.7 \cdot in$

Length, $l := 26.7 \cdot in$

Weight, $W_3 := 60 \cdot lb$

Ice Weight, $I_3 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left(w + 2 \cdot t_{ice}\right) \cdot \left(t + 2 \cdot t_{ice}\right) - l \cdot w \cdot t\right] \cdot \gamma_{ice} = 18.518\,kg$

Side wind load, $SW_3 := WL_f \cdot l \cdot t = 26.411\,kg$

Front wind load, $FW_3 := WL_f \cdot l \cdot w = 47.698\,kg$

2" Mount pipe:

Length, $l := 11 \cdot ft$

Dia, $\phi := 2.375 \cdot in$

Weight, $W_4 := (3.65 \cdot plf) \cdot l = 18.212\,kg$

Ice Weight, $W_4 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left[\frac{\pi \cdot \left(\phi + 2 \cdot t_{ice}\right)^2}{4}\right] - l \cdot \frac{\pi \cdot \phi^2}{4}\right] \cdot \gamma_{ice} = 19.321\,kg$

Side wind load, $SW_4 := WL_f \cdot l \cdot \phi = 46.285\,kg$

Front wind load, $FW_4 := 0 \cdot lb$

Total dead load, $DL_2 := \sum W = 99.607\,kg$

Total ice load, $I_2 := \sum I = 74.761\,kg$

Total side wind load, $SW_2 := \sum SW = 147.019\,kg$

Total front wind load, $FW_2 := \sum FW = 205.467\,kg$

Position 3:

Kathrein 800-10964

Width, $w := 20 \cdot in$

Depth, $t := 6.9 \cdot in$

Length, $l := 59 \cdot in$

Weight, $W_1 := 84 \cdot lb$

Ice Weight, $I_1 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left(w + 2 \cdot t_{ice}\right) \cdot \left(t + 2 \cdot t_{ice}\right) - l \cdot w \cdot t\right] \cdot \gamma_{ice} = 52.083\,kg$

Side wind load, $SW_1 := WL_f \cdot l \cdot t = 60.105\,kg$

Front wind load, $FW_1 := WL_f \cdot l \cdot w = 174.216\,kg$

RRUS-32:

Width, $w := 12.1 \cdot in$

Depth, $t := 6.7 \cdot in$

Length, $l := 26.7 \cdot in$

Weight, $W_2 := 60 \cdot lb$

Ice Weight, $I_2 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left(w + 2 \cdot t_{ice}\right) \cdot \left(t + 2 \cdot t_{ice}\right) - l \cdot w \cdot t\right] \cdot \gamma_{ice} = 18.518\,kg$

Side wind load, $SW_2 := WL_f \cdot l \cdot t = 26.411\,kg$

Front wind load, $FW_2 := WL_f \cdot l \cdot w = 47.698\,kg$

RRUS-4478:

Width, $w := 13 \cdot in$

Depth, $t := 8 \cdot in$

Length, $l := 15 \cdot in$

Weight, $W_3 := 60 \cdot lb$

Ice Weight, $I_3 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left(w + 2 \cdot t_{ice}\right) \cdot \left(t + 2 \cdot t_{ice}\right) - l \cdot w \cdot t\right] \cdot \gamma_{ice} = 13.506\,kg$

Side wind load, $SW_3 := WL_f \cdot l \cdot t = 17.717\,kg$

Front wind load, $FW_3 := WL_f \cdot l \cdot w = 28.79\,kg$

2" Mount pipe:

Length, $l := 11 \cdot ft$

Dia, $\phi := 2.375 \cdot in$

Weight, $W_4 := (3.65 \cdot plf) \cdot l = 18.212\,kg$

Ice Weight, $W_4 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left[\frac{\pi \cdot \left(\phi + 2 \cdot t_{ice}\right)^2}{4}\right] - l \cdot \frac{\pi \cdot \phi^2}{4}\right] \cdot \gamma_{ice} = 19.321\,kg$

Side wind load, $SW_4 := WL_f \cdot l \cdot \phi = 46.285\,kg$

Front wind load, $FW_4 := 0 \cdot lb$

Total dead load, $DL_3 := \sum W = 111.854\,kg$

Total ice load, $I_3 := \sum I = 84.107\,kg$

Total side wind load, $SW_3 := \sum SW = 150.518\,kg$

Total front wind load, $FW_3 := \sum FW = 250.704\,kg$

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Position 4:

KMW AM-X-CD-14

Width, $w := 11.8 \cdot in$

Depth, $t := 5.9 \cdot in$

Length, $l := 48 \cdot in$

Weight, $W_1 := 37 \cdot lb$

Ice Weight, $I_1 := \left[(l + 2 \cdot t_{ice}) \cdot (w + 2 \cdot t_{ice}) \cdot (t + 2 \cdot t_{ice}) - l \cdot w \cdot t \right] \cdot \gamma_{ice} = 28.828 \, kg$

Side wind load, $SW_1 := WL_f \cdot l \cdot t = 41.812 \, kg$

Front wind load, $FW_1 := WL_f \cdot l \cdot w = 83.624 \, kg$

RRUS-11:

Width, $w := 17 \cdot in$

Depth, $t := 7.2 \cdot in$

Length, $l := 19.7 \cdot in$

Weight, $W_2 := 50 \cdot lb$

Ice Weight, $I_2 := \left[(l + 2 \cdot t_{ice}) \cdot (w + 2 \cdot t_{ice}) \cdot (t + 2 \cdot t_{ice}) - l \cdot w \cdot t \right] \cdot \gamma_{ice} = 18.879 \, kg$

Side wind load, $SW_2 := WL_f \cdot l \cdot t = 20.941 \, kg$

Front wind load, $FW_2 := WL_f \cdot l \cdot w = 49.445 \, kg$

RRUS-4478:

Width, $w := 13 \cdot in$

Depth, $t := 8 \cdot in$

Length, $l := 15 \cdot in$

Weight, $W_3 := 60 \cdot lb$

Ice Weight, $I_3 := \left[(l + 2 \cdot t_{ice}) \cdot (w + 2 \cdot t_{ice}) \cdot (t + 2 \cdot t_{ice}) - l \cdot w \cdot t \right] \cdot \gamma_{ice} = 13.506 \, kg$

Side wind load, $SW_3 := WL_f \cdot l \cdot t = 17.717 \, kg$

Front wind load, $FW_3 := WL_f \cdot l \cdot w = 28.79 \, kg$

2" Mount pipe:

Length, $l := 11 \cdot ft$

Dia, $\phi := 2.375 \cdot in$

Weight, $W_4 := (3.65 \cdot plf) \cdot l = 18.212\,kg$

Ice Weight, $W_4 := \left[\left(l + 2 \cdot t_{ice}\right) \cdot \left[\frac{\pi \cdot \left(\phi + 2 \cdot t_{ice}\right)^2}{4} \right] - l \cdot \frac{\pi \cdot \phi^2}{4} \right] \cdot \gamma_{ice} = 19.321\,kg$

Side wind load, $SW_4 := WL_f \cdot l \cdot \phi = 46.285\,kg$

Front wind load, $FW_4 := 0 \cdot lb$

Total dead load, $DL_4 := \sum W = 86\,kg$

Total ice load, $I_4 := \sum I = 61.213\,kg$

Total side wind load, $SW_4 := \sum SW = 126.756\,kg$

Total front wind load, $FW_4 := \sum FW = 161.859\,kg$

1/2 of all AT&T inventory in each sector will be supported by the center mount pipe (w/ Sprint equipment)

Total side wind load from all of AT&T equipment, $P_{side} := SW_1 + SW_2 + SW_3 + SW_4 = 557.465\,kg$

Side wind load from AT&T equipment on middle mount pipe, $P_{side\_att} := \frac{P_{side}}{2} = 278.733\,kg$

Total frontal wind load from all of AT&T equipment, $P_{front} := FW_1 + FW_2 + FW_3 + FW_4 = 740.646\,kg$

Frontal wind load from AT&T equipment on middle mount pipe, $P_{front\_att} := \frac{P_{front}}{2} = 370.323\,kg$

Conservative Sprint equipment dimensions:

Effective length, $l_{sprint} := 8 \cdot ft$

Effective width, $W_s := 18 \cdot in$

Effective depth, $d_s := 22 \cdot in$

Per Chappell Eng. drawings

Weight of Sprint antenna, $W_{sant} := 60lb$

Weight of RRH under antenna, $W_{sr1} := 53lb$

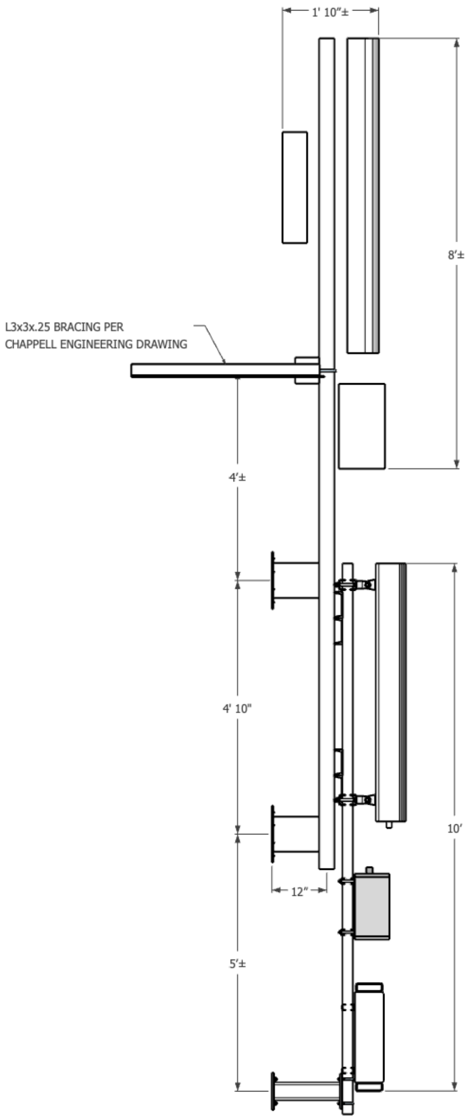
Weight of RRH behind antenna, $W_{sr2} := 70lb$

Per Chappell Eng. drawings

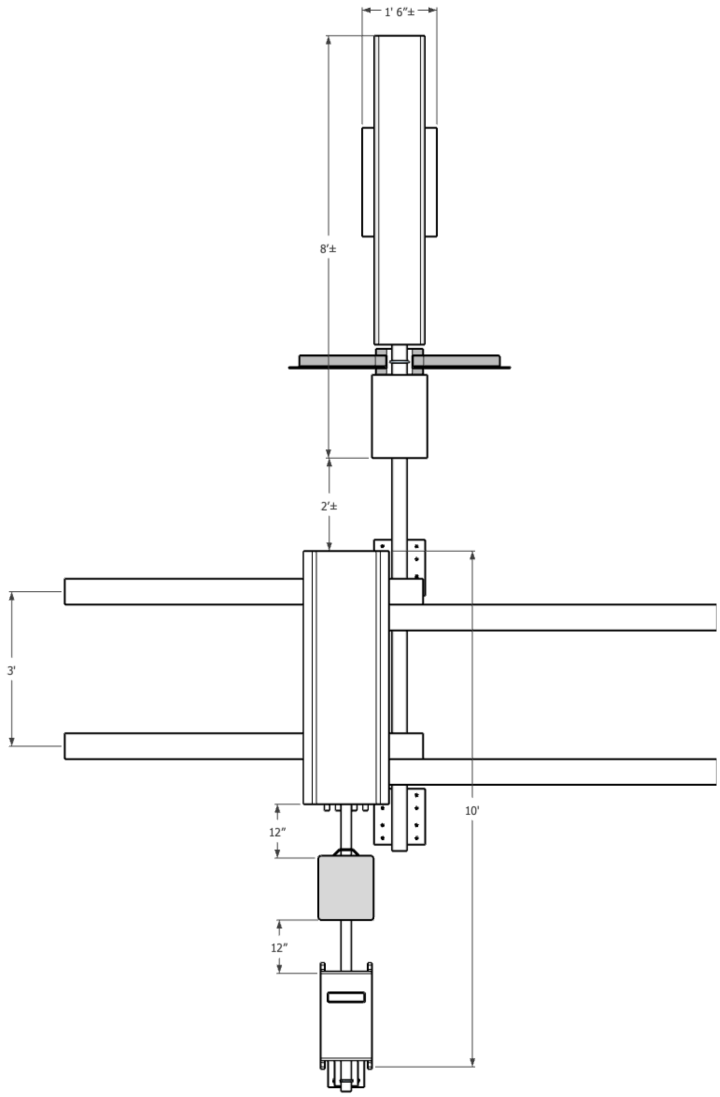
Weight of ice, $I_{sprint} = 123.878\,kg$

Analysis:

Worst-case loading occurs at support with Sprint equipment.



Side



Front

Distance of mount pipe from face of tank, $d_1 := 12 \cdot in$

Separation of existing brackets, $d_2 := 4.83 \cdot ft$

Separation of bottom bracket (AT&T), $d_1 := 4 \cdot ft$

Separation of top bracket (Sprint), $d_3 := 4 \cdot ft$

Total length of C6x8.2 steel channel, $L_{channel} := 4 \cdot (7 \cdot ft) = 8.534\,m$

Total weight of channel, $DL_5 := L_{channel} \cdot (8.2 \cdot plf) = 104.145\ kg$

Number of mounts, $n_{mount} := 4$ (including new Sprint mount per Chappell Eng.)

Side Wind Loading:

Total Side wind load from AT&T equipment, $P_{side\_att} = 278.733\ kg$

Total side wind load from Sprint equipment, $P_{side\_sprint} := WL_f \cdot l_{sprint} \cdot d_s = 311.817\ kg$

Effective length of AT&T equipment, $l_{att} := 10 \cdot ft$

Effective length of Sprint equipment, $l_{sprint} = 2.438\ m$

Linear load of AT&T equipment, $w_{att} := \frac{P_{side\_att}}{l_{att}} = 61.45 \cdot plf$

Input to Enercalc

Linear load of Sprint equipment, $w_{sprint} := \frac{P_{side\_sprint}}{l_{sprint}} = 85.93 \cdot plf$

Side wind load reactions at each mount location:

$P_{side\_1} := .10 \cdot kip$

$P_{side\_2} := .47 \cdot kip$ See Enercalc output

$P_{side\_3} := .38 \cdot kip$

$P_{side\_4} := 1.10 \cdot kip$

Front Wind Loading:

Total front wind load from AT&T equipment, $P_{front\_att} = 370.323\ kg$

Total front wind load from Sprint equipment, $P_{front\_sprint} := WL_f \cdot l_{sprint} \cdot W_s = 255.123\ kg$

Effective length of AT&T equipment, $l_{att} = 3.048\ m$

Effective length of Sprint equipment, $l_{sprint} = 2.438\ m$

Linear load of AT&T equipment, $w_{att} := \dfrac{P_{front\_att}}{l_{att}} = 81.642 \cdot plf$

Input to Enercalc

Linear load of Sprint equipment, $w_{sprint} := \dfrac{P_{front\_sprint}}{l_{sprint}} = 70.306 \cdot plf$

Front wind load reactions at each mount location:

$P_{front\_1} := .12 \cdot kip$

$P_{front\_2} := .70 \cdot kip$ See Enercalc output

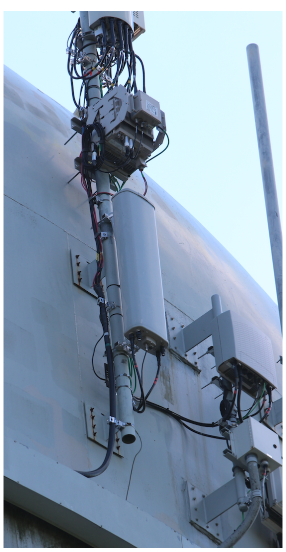
$P_{front\_3} := .90 \cdot kip$

$P_{front\_4} := 1.68 \cdot kip$

Determine maximum tensile force acting on studs:

Note: Due to the placement configuration of the supplemental mount designed by Chappell Engineering (for Sprint), that mount experiences shear forces only when under wind load. Therefore, the tensile capacity check will be limited to the existing mounts and the supplemental mount proposed by this office.

Existing mounts:



Side Loading:

Maximum side load reaction on existing wall mounts, $R_{ts} := \max\left(P_{side\_2}, P_{side\_3}\right) = 213.188\,kg$

Force couple from rection, $M := R_{ts} \cdot d_1 = 259.919\,kg \cdot m$

Number of Studs in Tension on Mount, $n_{stud} := 4$

Horizontal separation of studs, $s := 10 \cdot in$

Tensile Force on Stud, $T_{se} := \dfrac{\frac{M}{s}}{n_{stud}} = 255.826\,kg$

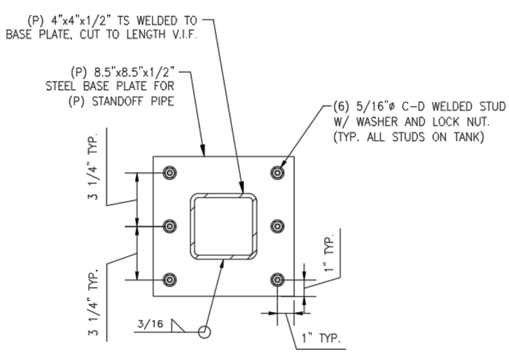
Front Loading:

Maximum front load reaction on existing wall mounts, $R_{tf} := \max\left(P_{front\_2}, P_{front\_3}\right) = 408.233\,kg$

Number of Studs in Tension on Mount, $n_{stud} := 8$

Tensile Force on Stud, $T_{fe} := \dfrac{R_{tf}}{n_{stud}} = 51.029\,kg$

Proposed Mounts:



DETAIL A-A

Side Loading:

Maximum side load reaction on proposed wall mounts, $R_{ts} := P_{side\_1} = 45.359\,kg$

Force couple from reaction, $M := R_{ts} \cdot d_1 = 55.302\,kg \cdot m$

Number of Studs in Tension on Mount, $n_{stud} := 3$

Horizontal separation of studs, $s := 6.5 \cdot in$

Tensile Force on Stud, $T_{sp} := \dfrac{\frac{M}{s}}{n_{stud}} = 111.654\,kg$

Front Loading:

Maximum front load reaction on proposed wall mounts, $R_{tf} := P_{front\_1} = 54.431\,kg$

Number of Studs in Tension on Mount, $n_{stud} := 6$

Tensile Force on Stud, $T_{fp} := \dfrac{R_{tf}}{n_{stud}} = 9.072\,kg$

Maximum tensile force on stud, $T_{stud} := max\left(T_{fp}, T_{sp}, T_{se}, T_{fe}\right) = 255.826\,kg$

Determine maximum shear force acting on studs:

Maximum front load reaction, due to wind, acting on top mount, $R_{vf} := P_{front\_4} = 762.035\,kg$

Number of studs in top mount, $n_{top} := 8$ per Chappell plans

Shear force on stud from wind, $V_{vf} := \dfrac{R_{vf}}{n_{top}} = 95.254\,kg$

Total weight of Sprint equipment, $W_{sprint} := W_{sant} + W_{sr1} + W_{sr2} = 83.007\,kg$

Total ice load from Sprint, $I_{sprint} = 123.878\,kg$

Weight from AT&T equipment applied to center mount pipe, $DL_{att} := \left(DL_1 + DL_2 + DL_3 + DL_4 + DL_5\right) \cdot .5 = 248.17\,kg$

Ice load from AT&T equipment applied to center mount pipe, $I_{att} := \left(I_1 + I_2 + I_3 + I_4\right) \cdot .5 = 125.045\,kg$

Total shear load acting at center mount pipe, $V := W_{sprint} + I_{sprint} + DL_{att} + I_{att} = 580.1\,kg$

Assume shear, due to gravity loading, is distributed equally between the lower three mounts

Number of mounts, $n_{mount} := 3$

Shear load per mount, $V_{mount} := \dfrac{V}{n_{mount}} = 193.367\,kg$

Number of studs in lower mount, $n_{lower} := 4$

Shear force on stud from gravity load, $V_g := \dfrac{V_{mount}}{n_{lower}} = 48.342\,kg$

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Maximum shear force on stud, $V_{stud} := \max(V_{vf}, V_g) = 95.254\,kg$

Check 5/16" C-D Studs

Tension:

Maximum tensile force on stud, $T_{stud} = 255.826\,kg$

Allowable tensile load on 5/16" C-D stud, $T_{allow} := \frac{2900 \cdot lb}{4} = 328.854\,kg$

$$StudWeldTensileCheck := \begin{cases} \text{"OK"} & \text{if } T_{allow} \geq T_{stud} \\ \text{"NG"} & \text{otherwise} \end{cases}$$

StudWeldTensileCheck = "OK"

Shear:

Maximum shear force on stud, $V_{stud} = 95.254\,kg$

Allowable shear load of 5/16" C-D stud, $V_{allow} := \frac{2200 \cdot lb}{4} = 249.476\,kg$

$$StudWeldShearCheck := \begin{cases} \text{"OK"} & \text{if } V_{allow} \geq V_{stud} \\ \text{"NG"} & \text{otherwise} \end{cases}$$

StudWeldShearCheck = "OK"

Conclusion:

Based on the results of the analysis, **the proposed AT&T LTE 6C installation, and existing water tank**, is structurally sound, as designed and depicted on plans by this office. The analysis was conducted in accordance with the Massachusetts State Building Code, 9th Edition, and ASCE 7-10.

Note: The C-D welded stud testing procedure, and removal of leveling nuts on the proposed mount plates, that have been recommended by Haley and Ward, and referenced on drawings by this office, is acknoweledged by this office and does not affect the results of this analysis.

References:

1. American Society of Civil Engineers (2010), Minimum Design Loads for Buildings and Other Structures (7-10), American Society of Civil Engineers, New York, NY
2. Massachusetts State Building Code, 9th Edition.

C-D Stud Load Strengths (Stud Welding Associates, Inc.)

STUD MATERIAL	STUD SIZE	MAXIMUM FASTENING TORQUE (INCH LBS.)*	ULTIMATE TENSILE LOAD (LBS.)	MAXIMUM SHEAR LOAD (LBS.)
Low-Carbon,	6-32	6	500	375
Copper-Flashed	8-32	12	765	575
Steel	10-24	14	960	720
	1/4-20	43	1750	1300
	5/16-18	72	2900	2200
	3/8-16	106	4300	3250
Stainless	6-32	10	790	590
Steel	8-32	20	1260	940
	10-24	23	1530	1150
	1/4-20	75	2880	2160
	5/16-18	126	3750	5350
	3/8-16	186	4850	7150
Aluminum	6-32	6.5	350	160
Alloy	8-32	13	560	229
6061	10-24	19	670	310
	1/4-20	40	1240	679
	5/16-18	70.5	2025	1210
	3/8-16	100	2985	1750

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Project Title: Cedar Street WT
Engineer: MRC
Project ID: MA1306
Project Descr: AT&T LTE 6C

Printed: 28 JAN 2019, 1:22PM

Steel Beam

File = W:\ENER~P21\MA1306 Cantilevered WT Pipe Mount.ec6 .

Lic. # : KW-06008463 **Licensee : ADVANCED ENGINEERING GROUP, PC**

Description : Existing Mount Pipe - Side Loading

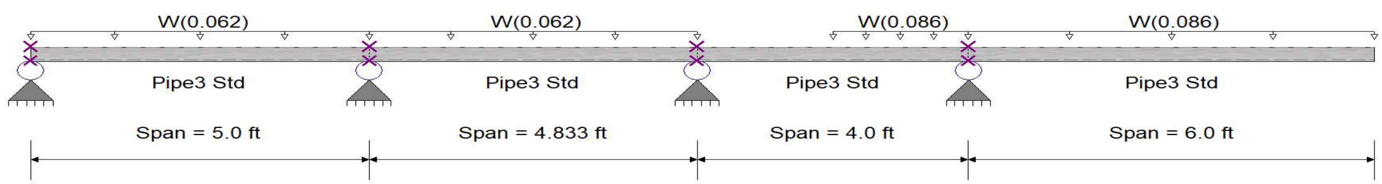
CODE REFERENCES

Calculations per AISC 360-10, IBC 2015, CBC 2016, ASCE 7-10
Load Combination Set : IBC 2015

Material Properties

Analysis Metho Allowable Strength Design
Beam Bracing Completely Unbraced
Bending Axis : Major Axis Bending

Fy : Steel Yield 35.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Load for Span Number 1
Uniform Load : W = 0.0620 k/ft, Tributary Width = 1.0 ft, (AT&T)

Load for Span Number 2
Uniform Load : W = 0.0620 k/ft, Tributary Width = 1.0 ft, (AT&T / Sprint)

Load for Span Number 3
Uniform Load : W = 0.0860 k/ft, Extent = 2.0 -->> 4.0 ft, Tributary Width = 1.0 ft, (Sprint Equipment)

Load for Span Number 4
Uniform Load : W = 0.0860 k/ft, Tributary Width = 1.0 ft, (Sprint Equipment)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.243** : 1	Maximum Shear Stress Ratio =	**0.027** : 1
Section used for this span	**Pipe3 Std**	Section used for this span	**Pipe3 Std**
Ma : Applied	0.929 k-ft	Va : Applied	0.3528 k
Mn / Omega : Allowable	3.825 k-ft	Vn/Omega : Allowable	13.078 k
Load Combination	+0.60W	Load Combination	+0.60W
Location of maximum on span	4.000 ft	Location of maximum on span	4.000 ft
Span # where maximum occurs	Span # 3	Span # where maximum occurs	Span # 3

Maximum Deflection

Max Downward Transient Deflection	0.509 in	Ratio =	283 >=120
Max Upward Transient Deflection	-0.025 in	Ratio =	1,923 >=120
Max Downward Total Deflection	0.305 in	Ratio =	472 >=120
Max Upward Total Deflection	-0.015 in	Ratio =	3206 >=120

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
Dsgn. L = 5.00 ft	1		0.000				6.39	3.82	1.00	1.00	-0.00	21.84	13.08
Dsgn. L = 4.83 ft	2		0.000				6.39	3.82	1.00	1.00	-0.00	21.84	13.08
Dsgn. L = 4.00 ft	3		0.000				6.39	3.82	1.00	1.00	-0.00	21.84	13.08
Dsgn. L = 6.00 ft	4		0.000				6.39	3.82	1.00	1.00	-0.00	21.84	13.08
+0.60W													
Dsgn. L = 5.00 ft	1	0.041	0.012	0.05	-0.15	0.15	6.39	3.82	2.49	1.00	0.16	21.84	13.08
Dsgn. L = 4.83 ft	2	0.047	0.019	0.18	-0.15	0.18	6.39	3.82	1.54	1.00	0.25	21.84	13.08
Dsgn. L = 4.00 ft	3	0.243	0.027	0.17	-0.93	0.93	6.39	3.82	2.05	1.00	0.35	21.84	13.08
Dsgn. L = 6.00 ft	4	0.243	0.024		-0.93	0.93	6.39	3.82	1.00	1.00	0.31	21.84	13.08
+0.450W													

ADVANCED ENGINEERING GROUP, P.C.
500 North Broadway
East Providence, RI 02914
(401) 354-2403

Project Title: Cedar Street WT
Engineer: MRC
Project ID: MA1306
Project Descr: AT&T LTE 6C

Printed: 28 JAN 2019, 1:22PM

Steel Beam

Description : Existing Mount Pipe - Side Loading

Load Combination Segment Length		Span #	Max Stress Ratios M	Max Stress Ratios V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
Dsgn. L =	5.00 ft	1	0.030	0.009	0.04	-0.12	0.12	6.39	3.82	2.49	1.00	0.12	21.84	13.08
Dsgn. L =	4.83 ft	2	0.035	0.014	0.13	-0.12	0.13	6.39	3.82	1.54	1.00	0.19	21.84	13.08
Dsgn. L =	4.00 ft	3	0.182	0.020	0.13	-0.70	0.70	6.39	3.82	2.05	1.00	0.26	21.84	13.08
Dsgn. L =	6.00 ft	4	0.182	0.018		-0.70	0.70	6.39	3.82	1.00	1.00	0.23	21.84	13.08

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
W Only	1	0.0026	1.833	W Only	-0.0005	4.500
W Only	2	0.0107	2.932		0.0000	4.500
	3	0.0000	2.932	W Only	-0.0250	2.480
W Only	4	0.5086	6.000		0.0000	2.480

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5
Overall MAXimum	0.103	0.470	-0.379	1.104	
Overall MINimum	0.047	0.211	-0.171	0.497	
+0.60W	0.062	0.282	-0.228	0.662	
+0.450W	0.047	0.211	-0.171	0.497	
W Only	0.103	0.470	-0.379	1.104	

ADVANCED ENGINEERING GROUP, P.C.
500 North Broadway
East Providence, RI 02914
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Project Title: Cedar Street WT
Engineer: MRC
Project ID: MA1306
Project Descr: AT&T LTE 6C

Printed: 29 JAN 2019, 5:44PM

Steel Beam

File = W:\ENER~P21\MA1306 Cantilevered WT Pipe Mount.ec6 .

Lic. # : KW-06008463 **Licensee : ADVANCED ENGINEERING GROUP, PC**

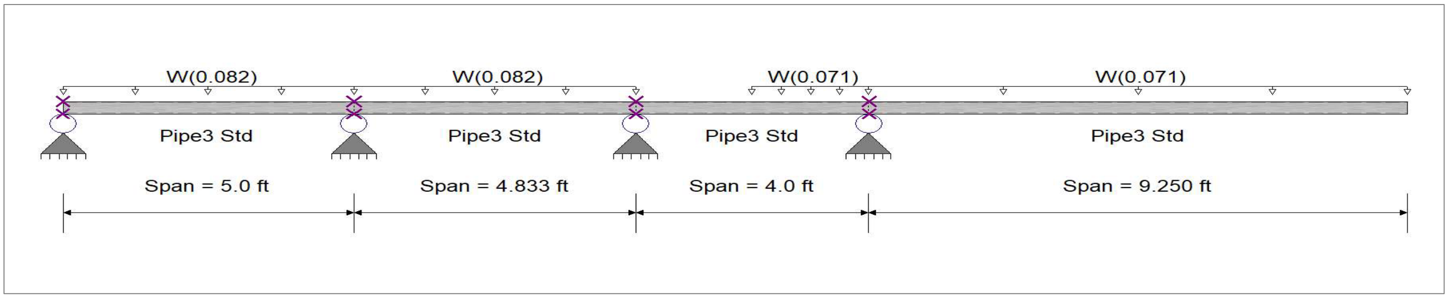
Description : Existing Mount Pipe -Front Loading

CODE REFERENCES

Calculations per AISC 360-10, IBC 2015, CBC 2016, ASCE 7-10
Load Combination Set : IBC 2015

Material Properties

Analysis Metho	Allowable Strength Design	Fy : Steel Yield	35.0 ksi
Beam Bracing	Completely Unbraced	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Load for Span Number 1
Uniform Load : W = 0.0820 k/ft, Tributary Width = 1.0 ft, (AT&T Equipement)

Load for Span Number 2
Uniform Load : W = 0.0820 k/ft, Tributary Width = 1.0 ft, (AT&T Equipment)

Load for Span Number 3
Uniform Load : W = 0.0710 k/ft, Extent = 2.0 -->> 4.0 ft, Tributary Width = 1.0 ft, (Sprint Equipment)

Load for Span Number 4
Uniform Load : W = 0.0710 k/ft, Tributary Width = 1.0 ft, (Sprint Equipment)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.476** : 1	Maximum Shear Stress Ratio =	**0.047** : 1
Section used for this span	**Pipe3 Std**	Section used for this span	**Pipe3 Std**
Ma : Applied	1.822 k-ft	Va : Applied	0.6154 k
Mn / Omega : Allowable	3.825 k-ft	Vn/Omega : Allowable	13.078 k
Load Combination	+0.60W	Load Combination	+0.60W
Location of maximum on span	4.000 ft	Location of maximum on span	4.000 ft
Span # where maximum occurs	Span # 3	Span # where maximum occurs	Span # 3

Maximum Deflection

Max Downward Transient Deflection	2.033 in	Ratio =	109 >=
Max Upward Transient Deflection	-0.051 in	Ratio =	942 >=
Max Downward Total Deflection	1.220 in	Ratio =	182 >=
Max Upward Total Deflection	-0.031 in	Ratio =	1570 >=

Maximum Forces & Stresses for Load Combinations

Load Combination			Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length		Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
Dsgn. L =	5.00 ft	1		0.000				6.39	3.82	1.00	1.00	-0.00	21.84	13.08
Dsgn. L =	4.83 ft	2		0.000				6.39	3.82	1.00	1.00	-0.00	21.84	13.08
Dsgn. L =	4.00 ft	3		0.000				6.39	3.82	1.00	1.00	-0.00	21.84	13.08
Dsgn. L =	9.25 ft	4		0.000				6.39	3.82	1.00	1.00	-0.00	21.84	13.08
+0.60W														
Dsgn. L =	5.00 ft	1	0.064	0.019	0.06	-0.24	0.24	6.39	3.82	2.75	1.00	0.25	21.84	13.08
Dsgn. L =	4.83 ft	2	0.100	0.041	0.38	-0.24	0.38	6.39	3.82	1.67	1.00	0.53	21.84	13.08
Dsgn. L =	4.00 ft	3	0.476	0.047	0.38	-1.82	1.82	6.39	3.82	2.00	1.00	0.62	21.84	13.08
Dsgn. L =	9.25 ft	4	0.476	0.030		-1.82	1.82	6.39	3.82	1.00	1.00	0.39	21.84	13.08
+0.450W														

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Project ID: MA1306
Project Descr: AT&T LTE 6C

Printed: 29 JAN 2019, 5:44PM

Steel Beam

Description : Existing Mount Pipe -Front Loading

Load Combination			Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length		Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
Dsgn. L =	5.00 ft	1	0.048	0.014	0.04	-0.18	0.18	6.39	3.82	2.75	1.00	0.19	21.84	13.08
Dsgn. L =	4.83 ft	2	0.075	0.030	0.29	-0.18	0.29	6.39	3.82	1.67	1.00	0.40	21.84	13.08
Dsgn. L =	4.00 ft	3	0.357	0.035	0.29	-1.37	1.37	6.39	3.82	2.00	1.00	0.46	21.84	13.08
Dsgn. L =	9.25 ft	4	0.357	0.023		-1.37	1.37	6.39	3.82	1.00	1.00	0.30	21.84	13.08

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
W Only	1	0.0017	1.467	W Only	-0.0019	4.167
W Only	2	0.0206	2.932		0.0000	4.167
	3	0.0000	2.932	W Only	-0.0509	2.453
W Only	4	2.0326	9.250		0.0000	2.453

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5
Overall MAXimum	0.124	0.700	-0.902	1.682	
Overall MINimum	0.056	0.315	-0.406	0.757	
+0.60W	0.074	0.420	-0.541	1.009	
+0.450W	0.056	0.315	-0.406	0.757	
W Only	0.124	0.700	-0.902	1.682	