



Design 1

March 25, 2021

Attention: Sam Diedrich
9973 Valley View Road
Eden Prairie, MN 55344

Re: Structural Analysis
MIN Airport L-Sub 6
CPC059-STRL1 Structural - Building/Rooftop Attachment
7900 International Drive
Bloomington, MN 55425
Project Number: 211095

Dear Mr. Diedrich:

At your request, I have analyzed the structural capacity of the existing antenna support framing and the existing roof screen to support the proposed equipment changes on the antenna support frame. The proposed equipment to be supported on the existing antenna support frame is shown in Table 1 of this report.

In summary, the existing antenna support frame and roof screen have been analyzed and have been found to have **SUFFICIENT CAPACITY** to support the proposed equipment. The design stress ratios with regards to maximum design capacity are shown in Table 2.

Per TIA-222-H, all bolted connections, including u-bolts, shall be provided with nut-locking device or mechanism such as, but not limited to, lock nuts, lock washers, or palnuts, to prevent loosening.

This structural analysis has been performed in accordance with the local code requirements listed in this report and the disclaimers noted within.

If you have any questions, please don't hesitate to contact me at (612) 844-1234.

Sincerely,
Herzog Engineering, LLC

A handwritten signature in black ink, reading 'John Thomas Kowalchuk'.

JT Kowalchuk, P.E.
Structural Engineer

A handwritten signature in black ink, reading 'Thomas L. Mach'.

Thomas L. Mach, P.E.
Structural Engineer

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Print Name: Thomas L. Mach

Signature

A handwritten signature in black ink, reading 'Thomas L. Mach'.

Date 03/25/2021 LICENSE # 100000

A. SCOPE OF WORK SUMMARY

The intent of this structural analysis is to complete a feasibility structural analysis per the TIA-222-H standard, Section 16.9 for the supporting structure with the proposed equipment loading.

B. BASIS OF DESIGN

Reference codes, standards, and construction documents:

- 1.) 2020 Minnesota State Building Code (IBC 2018)
- 2.) ANSI/TIA-222-H, dated 2017, Structural Standard for Antenna Supporting Structures, Antennas and Small Wind Turbine Support Structures.
- 3.) AISC 360-16, Specification for Structural Steel Buildings
- 4.) Design 1 / MIN Airport L-Sub 6 / Project No. 20202204430 / Rev. A drawings, dated 03/25/21.
- 5.) Design 1 / MIN Airport OPTM / Project No. 20192005319 / Rev. C drawings, dated 10/18/19.
- 6.) Design 1 / MINC Airport LTE ADD 850 / Project No. 20161458968 Rev A dwgs., dated 09/20/16.
- 7.) Design 1 / MINC Airport PCS-LTE / Project No. 20141138775 Rev. A dwgs, dated 01/22/15.
- 8.) Design 1 / MIN Airport / Project No. 01066304554 Rev 4 dwgs, dated 10/26/04.
- 9.) Herzog Engineering / MIN Airport OPTM / Project No. 191237 / Structural Review letter dated 10/21/19.
- 10.) Herzog Engineering / MIN Airport LTE ADD 850 / Project No. 161147 / Structural Review letter dated 01/25/17.

C. APPURTENANCES AND EQUIPMENT

Table 1 - Proposed Antenna / Equipment							
Equip. Owner	Centerline Elevation AGL (ft.)	Type	Pos.	QTY (per Sector)	Manuf.	Model	Status
X, Y, and Z Sectors							
Verizon	139.0	Antenna	1	1	CSS	X7C-CAP-86-865V	Exist. to Remain
	137.8	Dist. Box	1.1 ²	1	Raycap	RVZDC-6627-PF-48	
	139.0	Antenna	2	1	Ericsson	AIR 6449	
	139.0	Antenna	3	1	Commscope	NHH-45C-R2B	Exist. to Remain
	133.0	Radio		1	Ericsson	4449	
	142.3	Antenna	4	1	Commscope	KRE 101 2251	
	133.0	Radio		1	Ericsson	RRUS32	
	137.8	Dist. Box	4.1 ³	1	Raycap	RVZDC-6627-PF-48	
	139.0	Antenna	5	1	Commscope	NHH-45C-R2B	
	133.0	Radio		1	Ericsson	RRUS32	
4 th Sector							
Verizon	139.0	Antenna	1	1	Commscope	NHH-45C-R2B	Exist. to Remain
	132.3	Radio		1	Ericsson	RRUS 32	
	129.0	Radio		1	Ericsson	4449	
	142.3	Antenna	2	1	Ericsson	KRE 101 2251	
	131.3	Radio		1	Ericsson	RRUS 32	
	139.0	Antenna	3	1	Commscope	NHH-45C-R2B	
	137.3	Dist. Box		1	Raycap	RVZDC-6627-PF-48	

Table 1 Notes:

- 1.) The roof level of the existing building is 127.0' AGL.
- 2.) The Distribution Box at Position 1.1 only occurs at Sector X and is mounted on the interior side of the screen.
- 3.) The Distribution Box at Position 4.1 only occurs at Sectors Y and Z.

D. RESULTS SUMMARY

Table 2 - Mount Frame Member Design Check				
Mount Member	Member Type	Max. Design Utilization	Pass / Fail	Remarks
Typical XYZ Sectors				
Frame	Horizontal	40%	Pass	HSS3x3x3/16
	Vertical	42%	Pass	HSS3x3x3/16
	Mounting Pipe	47%	Pass	2 1/2" Ø Sch. 40 Pipe
4th Sector ³				
Frame	Mounting Pipe	63%	Pass	2 1/2" Ø Sch. 40 Pipe

Table 2 Notes:

1. Maximum design utilization ratio is 100%, although design utilization ratios may be allowed up to 105% per the discretion of the professional engineer in charge of the mount design review.
2. See Appendix 1 for supporting structural calculations.
3. Although the 4th Sector has no new proposed loading, the configuration of the radios on the controlling mount is different from that previously proposed, therefore the updated controlling mount is reported in Appendix 1.

E. REPORT DISCLAIMERS AND ASSUMPTIONS

- 1.) This report and analysis was performed under the assumption that all information provided to Herzog Engineering, LLC is current and correct. This includes but is not limited to site data, mapping reports, existing and proposed appurtenances, tower and foundation details, and geotechnical data. If this information is not current and correct, this report should be considered obsolete and further analysis will be required.
- 2.) This analysis assumes that the structural components and mounts, including all steel sections and attachment hardware are in good working order and in their original state, free from rust or other forms of corrosion.
- 3.) Capacity of the structural members is based on the member sizes and configuration supplied. The material grade is as per the data supplied or as assumed and stated.
- 4.) All connections (bolted and welded) are assumed to develop the member capacity unless stated otherwise in this report.
- 5.) Ring clamps and other clamp connections are excluded from this report and analysis unless noted otherwise in the report.
- 6.) This structural analysis and report by Herzog Engineering, LLC reviews only the main structural components of the mount. Unless noted otherwise, sub-elements such as bolts, welds, plate connections, etc. have been excluded from this analysis and report.

F. APPENDIX 1 – STRUCTURAL CALCULATIONS

- 1.) Load Determination
- 2.) RISA-3D Frame Analysis (Controlling XYZ Sector Mount)
- 3.) RISA-3D Frame Analysis (Controlling 4th Sector Mount)



Project: MIN Airport L-Sub 6
 Project No. 211095
 Date: 3/24/21
 By: JTK

Wind Load

Bloomington, MN

Wind Load Design Criteria**TIA-222-H / Standard Reference**

$z =$	139	feet	(Height above ground)
$V =$	109	MPH	(Basic wind speed without ice, ASCE 7-16 Hazard Tool)
Exposure Category =	C		(A.2.6.5, and 2.6.5.1.2)
Risk Category =	II		(A.2.2 and Table 2-1)
$K_d =$	0.95		(Table 2-2, also $K_d=0.95$ for all mounts per 16.6)
$Z_g =$	900		(Table 2-4)
$\alpha =$	9.50		(Table 2-4)
$K_{zmin} =$	0.85		(Table 2-4)
$K_c =$	1.00		(Table 2-4)
$2.01(z/Z_g)^{2/\alpha} =$	1.36		(2.6.5.2)
$K_z =$	1.36		(2.6.5.2)
$K_{zt} =$	1.00		(2.6.6.2 Topographic Factor)
$G_h =$	1.00		(2.6.11.2 and 2.6.11, for appurtenance mounting systems $G_h=1.0$ per 16.6)

Does the building meet the requirements of 1 or 2 under section 2.6.7? (Y or N) **Y**

$z_p =$	3.00		(Parapet height)
$z_r =$	16.00		(Height above roof)
$X_p =$	45.00		(Horiz. distance from windward face to center of structure)
$W_s =$	315.00		(Width of the windward face of the building)
$H_s =$	128.00		(Height of the windward face of the building)
$H_1 =$	12.00		
$H_2 =$	131.00		
Is $H_1 \leq z_r \leq H_2$?	YES		
W_s/H_s	1.00		
$K_s =$	1.30		(2.6.7 and Fig. 2-2)
$K_a =$	0.90		(2.6.11.2-for Mounting systems, $K_a=0.90$ per 16.6)
$K_e =$	1.00		(2.6.8)
$q_z =$	50.95	psf	(2.6.11.6 Velocity Pressure)
$C_{a(Flat)} =$	2.00		(Table 2-9)
$C_{a(Round)} =$	1.20		(Table 2-9)

Wind Loads**Any Flat Surface** 91.72 psf**Angles**

Leg (in.)	A_A	EPA_A	$F_{A(wind)} (lb/ft)$
LSxS 5	0.42	0.75	38.21

Pipe Rounds

OD (in.)	A_A	EPA_A	$F_{A(wind)} (lb/ft)$
Pipe 2 1/2 Std.	2.88	0.24	13.21

HSS

	Height (in.)	Thickness (in.)	OSC Radius (in.)	r_s	$C_{a(HSS)}$	A_A	EPA_A	$F_{A(wind)}$ (lb/ft)
HSS3x3x3/16	3.00	0.188	0.422	0.141	1.25	0.25	0.28	14.33



Project: MIN Airport L-Sub 6

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Wind Load (Continued)**Wind Loads****Cold Formed Steel Channels**

	Leg (in.)	A _A	EPA _A	F _{A(wind)} (lb/ft)
P1000 Unistrut	1.63	0.14	0.24	12.42

Equipment

	Width (in.)	Length (in.)	Height (in.)	A _A (sq. ft.)	C _A	EPA _A (sq. ft.)	F _{A(wind)} (lbs.)	Weight (lbs.)
NORMAL								
KRE 101 2251 Antenna	7.9	4.7	17.7	1.0	1.2	1.0	53.3	33.0
X7CQAP-86-865-V Antenna	14.6	7.3	96.0	9.7	1.4	12.1	616.5	71.8
NHH-45C-R2B Antenna	18.0	7.0	95.9	12.0	1.3	14.3	728.8	87.1
Air 6449 Antenna	15.9	10.6	30.6	3.4	1.2	3.6	185.9	96.8
RRUS32 Radio	12.1	7.0	27.2	2.3	1.2	2.5	125.8	52.9
4449 Radio	13.2	9.4	18.0	1.7	1.2	1.8	90.8	70.0
6627 Distribution Box	16.5	12.6	29.5	3.4	1.2	3.7	186.0	32.0
Splice Box	14.0	4.0	14.0	1.4	1.2	1.5	74.9	5.0

TRANSVERSE

KRE 101 2251 Antenna	4.7	7.9	17.7	0.6	1.3	0.7	33.3	
X7CQAP-86-865-V Antenna	7.3	14.6	96.0	4.9	1.6	7.0	358.2	
NHH-45C-R2B Antenna	7.0	18.0	95.9	4.7	1.6	6.8	347.0	
Air 6449 Antenna	10.6	15.9	30.6	2.3	1.2	2.5	125.7	
RRUS32 Radio	7.0	12.1	27.2	1.3	1.3	1.5	76.5	
4449 Radio	9.4	13.2	18.0	1.2	1.2	1.3	64.7	
6627 Distribution Box	12.6	16.5	29.5	2.6	1.2	2.8	142.0	
Splice Box	4.0	14.0	14.0	0.4	1.2	0.4	22.2	



Project: MIN Airport L-Sub 6

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Ice Load**Ice Load Design Criteria****TIA-222-H / Standard Reference**

$z =$	139	feet	(Height above ground)
$t_i =$	1.50	inches	(Design ice thickness for site location - Fig. B-9, ASCE 7-16 Hazard Tool)
Risk Category =	II		
$I_{ice} =$	1.00		(Table 2-3)
$K_{iz} =$	1.15		(2.6.10 Height Escalation Factor)
$K_{zt} =$	1.00		(2.6.6.2 Topographic Factor)
$t_{iz} =$	1.73	inches	(Design ice thickness for site location, 2.6.10)
$\gamma_{ice} =$	56.00	lb/ft³	(2.6.10 Unit weight of ice)

Ice Loads**Angles**

		D_c	A_{iz}	w_{ice} (lb/ft)
L5x5	5	7.07	47.90	18.63

Pipe Rounds

		D_c	A_{iz}	w_{ice} (lb/ft)
Pipe 2 1/2 Std.	2.88	2.88	25.09	9.76

HSS

	Height (in.)	Width (in.)	D_c	A_{iz}	w_{ice} (lb/ft)
HSS3x3	3.0	3.0	4.24	32.51	12.64

Cold Formed Steel Channels

	Web (in.)	Flange (in.)	D_c	A_{iz}	w_{ice} (lb/ft)
P1000 Unistrut	1.63	1.625	2.30	21.93	8.53

Equipment

	Width (in.)	Length (in.)	Height (in.)	D_c (in.)	A_{iz} (sq. in.)	w_{ice} (lb/ft)	W_{ice} (lbs.)
KRE 101 2251 Antenna	7.88	4.7	17.7	9.2	59.3	23.1	34.0
X7CQAP-86-865-V Antenna	14.6	7.3	96	16.3	98.2	38.2	305.6
NHH-45C-R2B Antenna	18	7	95.9	19.3	114.5	44.5	355.9
Air 6449 Antenna	15.9	10.6	30.6	19.1	113.4	44.1	112.5
RRUS32 Radio	12.1	7	27.2	14.0	85.5	33.2	75.4
4449 Radio	13.2	9.4	18	16.2	97.6	38.0	56.9
6627 Distribution Box	16.5	12.6	29.5	20.8	122.4	47.6	117.0
Splice Box	14	4	14	14.6	88.6	34.5	40.2

Wind Load on Ice**Wind Load on Ice Design Criteria****TIA-222-H / Standard Reference**

$z =$	139	feet	(Height above ground)
$V_i =$	50	MPH	(Basic wind speed with ice, Fig. B-9)
$t_{iz} =$	1.73	inches	(Design ice thickness for site location, 2.6.10)
$K_d =$	0.95		(Table 2-2, also $K_d=0.95$ for all mounts per 16.6)
$K_z =$	1.36		(2.6.5.2)
$K_{zt} =$	1.00		(2.6.6.2 Topographic Factor)
$G_h =$	1.00		(2.6.11.2 and 2.6.11, for appurtenance mounting systems $G_h=1.0$ per 16.6)
$K_s =$	1.30		(2.6.7 and Fig. 2-2)
$K_a =$	0.90		(2.6.11.2-for Mounting systems, $K_a=0.90$ per 16.6)
$K_e =$	1.00		(2.6.8)
$q_{zice} =$	8.25	psf	(2.6.9.6 Velocity Pressure with ice)
$C_{a(Flat)} =$	2.00		(Table 2-9)
$C_{a(Round)} =$	1.20		(Table 2-9)

Wind Loads on Ice**Angles**

	Leg (in.)	A_A	EPA_A	$F_{A(windonice)} (lb/ft)$
L5x5	5	0.71	0.76	6.28

Pipe Rounds

	OD (in.)	A_{Aice}	EPA_{Aice}	$F_{A(windonice)} (lb/ft)$
Pipe 2 1/2 Std.	2.88	0.53	0.57	4.71

HSS

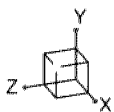
	Height (in.)	A_A	EPA_A	$F_{A(windonice)} (lb/ft)$
HSS3x3	3.00	0.54	0.58	4.80

Cold Formed Steel Channels

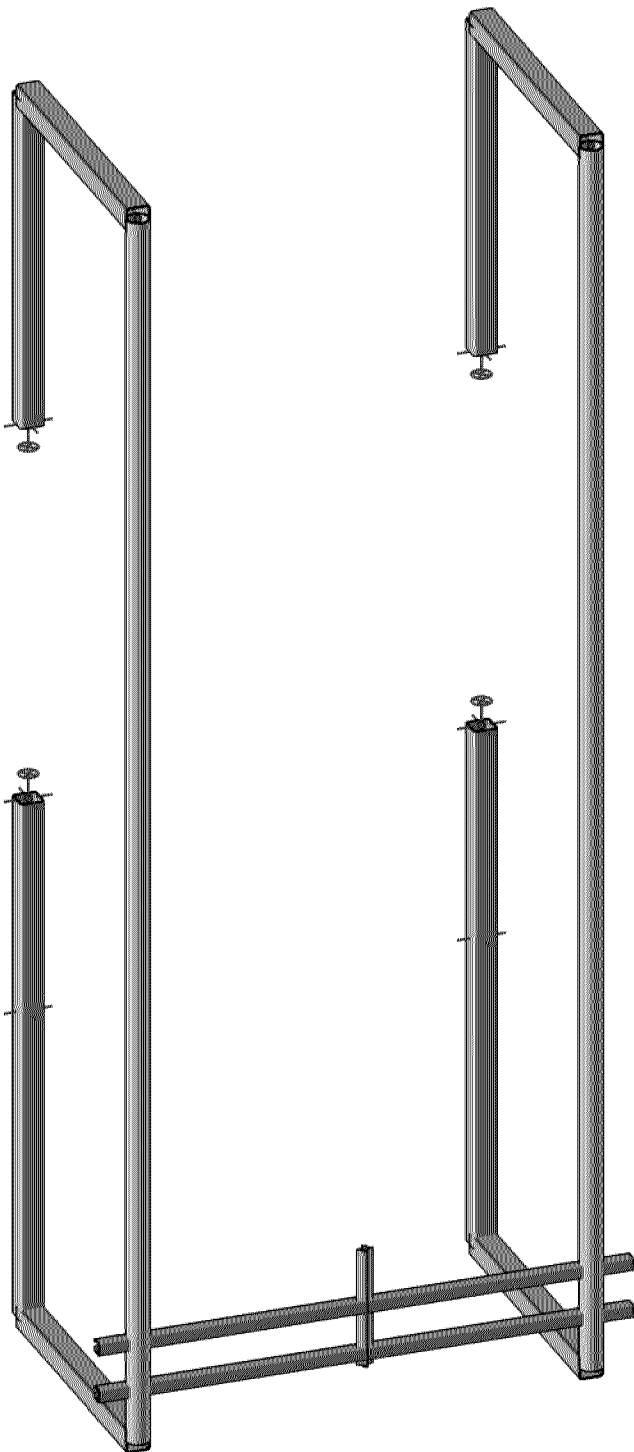
	Leg (in.)	A_A	EPA_A	$F_{A(windonice)} (lb/ft)$
P1000 Unistrut	1.63	0.42	0.46	3.78

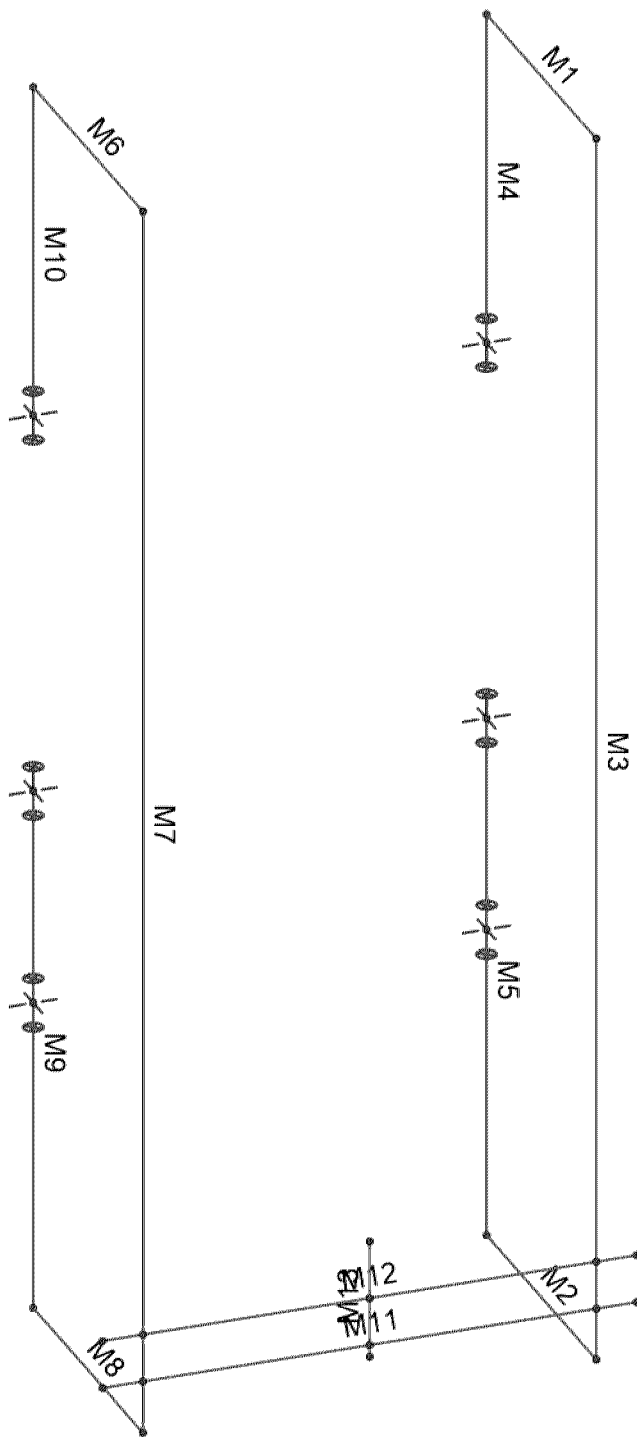
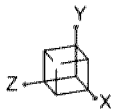
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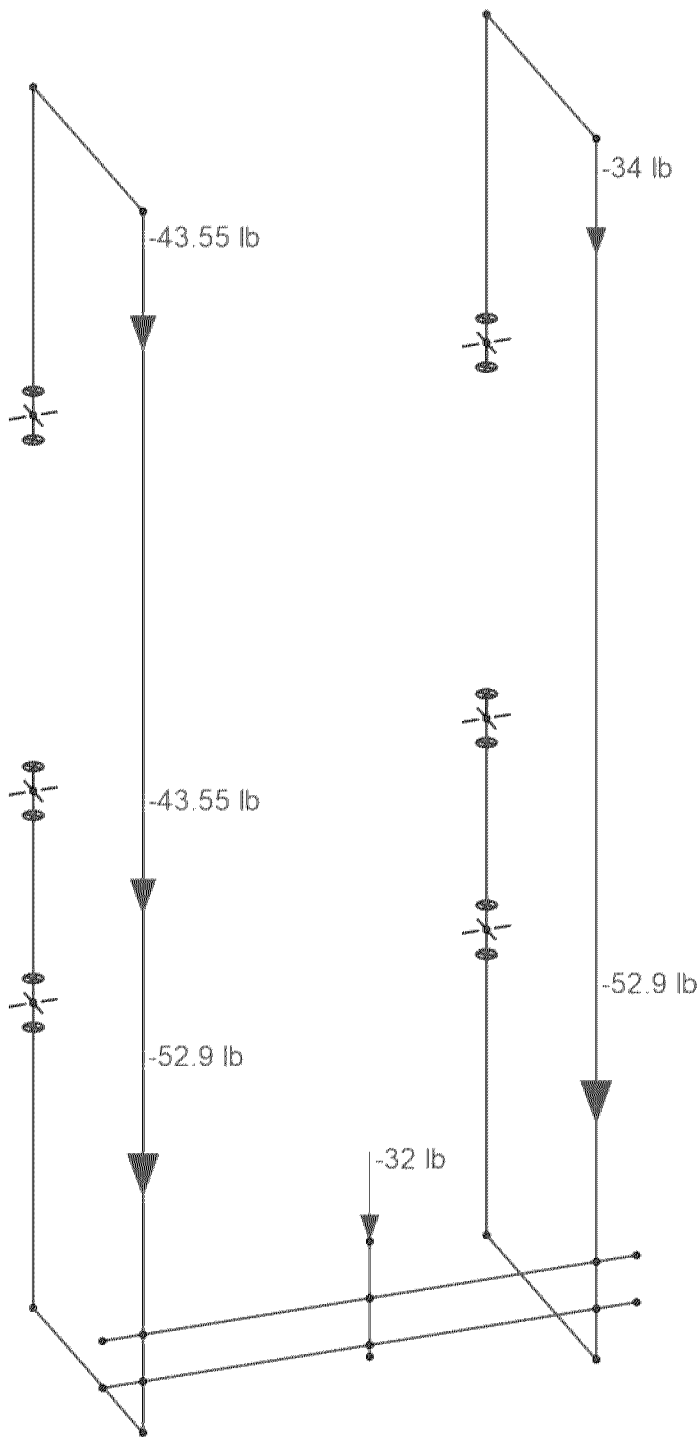
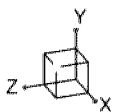
	Width (in.)	Length (in.)	Height (in.)	$A_{iz} (sq. in.)$	Eff. Dia w/ Ice (in.)	$EPA_{Aice} (sq. ft.)$	$F_{A(windonice)} (lbs.)$
KRE 101 2251 Antenna	7.88	4.7	17.7	59.3	12.6	1.7	13.8
X7CQAP-86-865-V Antenna	14.6	7.3	96	98.2	19.8	14.2	117.5
NHH-45C-R2B Antenna	18	7	95.9	114.5	22.8	16.4	135.1
Air 6449 Antenna	15.9	10.6	30.6	113.4	22.6	5.2	42.7
RRUS32 Radio	12.1	7	27.2	85.5	17.4	3.6	29.3
4449 Radio	13.2	9.4	18	97.6	19.7	2.7	21.9
6627 Distribution Box	16.5	12.6	29.5	122.4	24.2	5.4	44.2
Splice Box	14	4	14	88.6	18.0	1.9	15.6



XYZ Sectors Controlling Mount







Loads: BLC 2, DL Equipment

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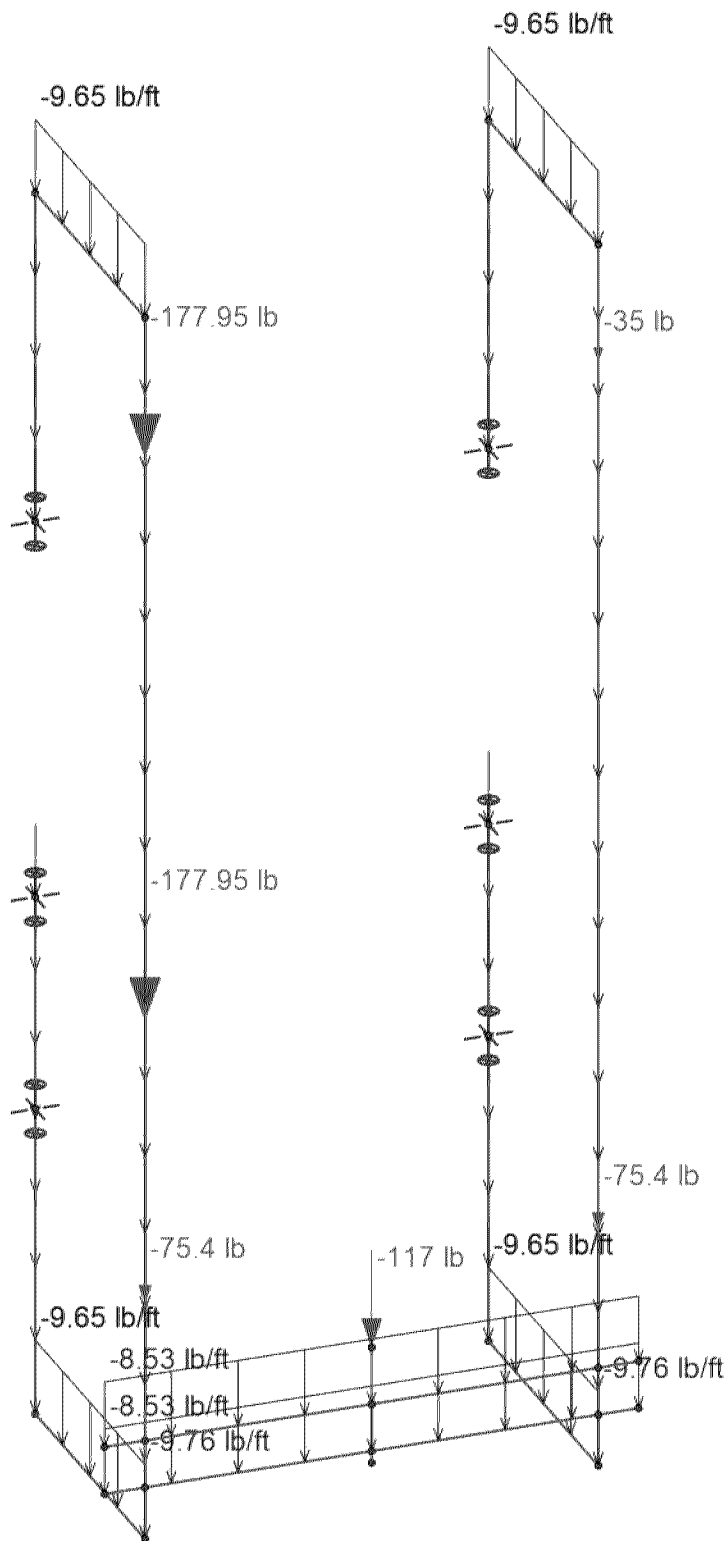
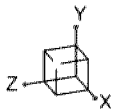
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MIN Airport L-Sub 6 (controlling location)

Equipment DL 3

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Loads: BLC 3, Ice Load

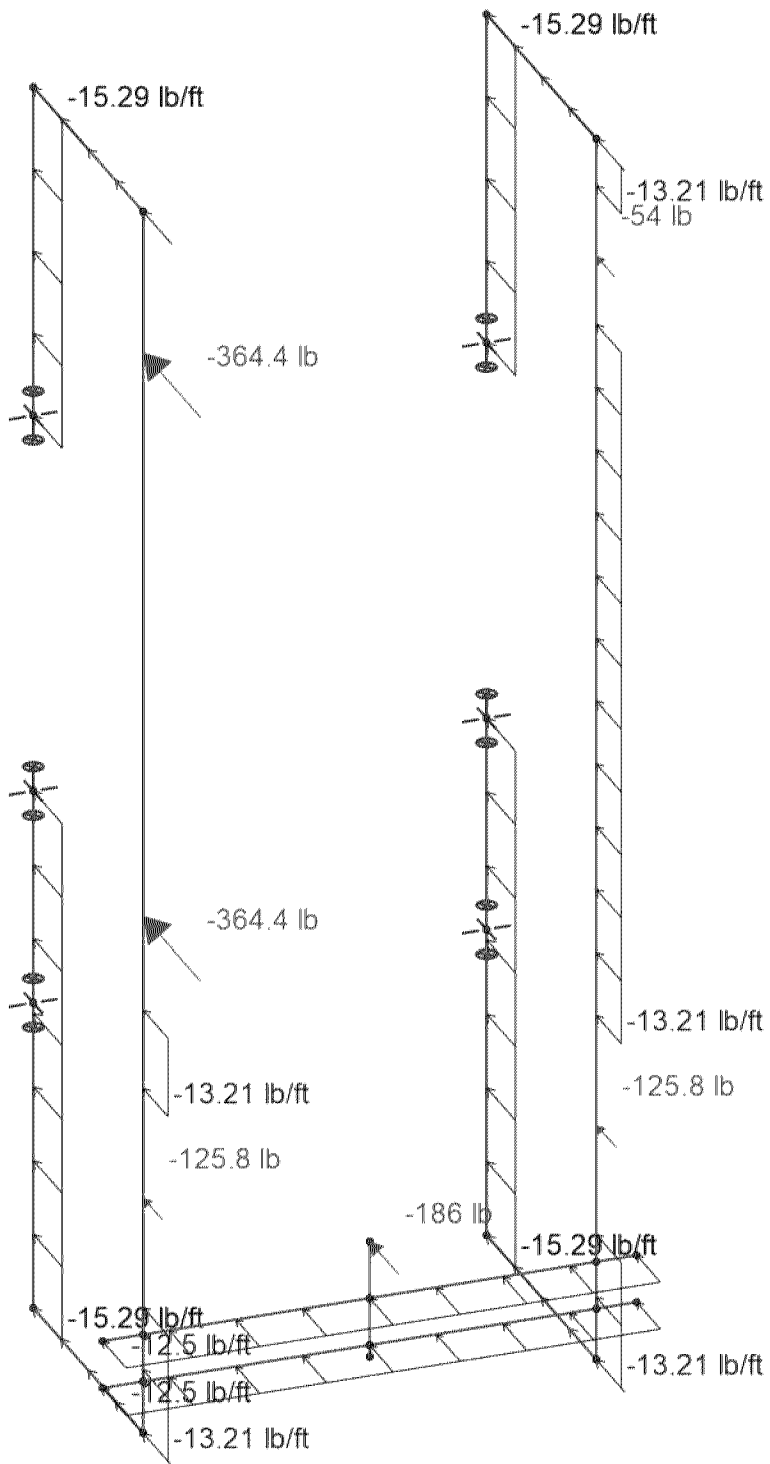
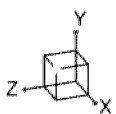
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Ice Load 4

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Loads: BLC 4, WLx

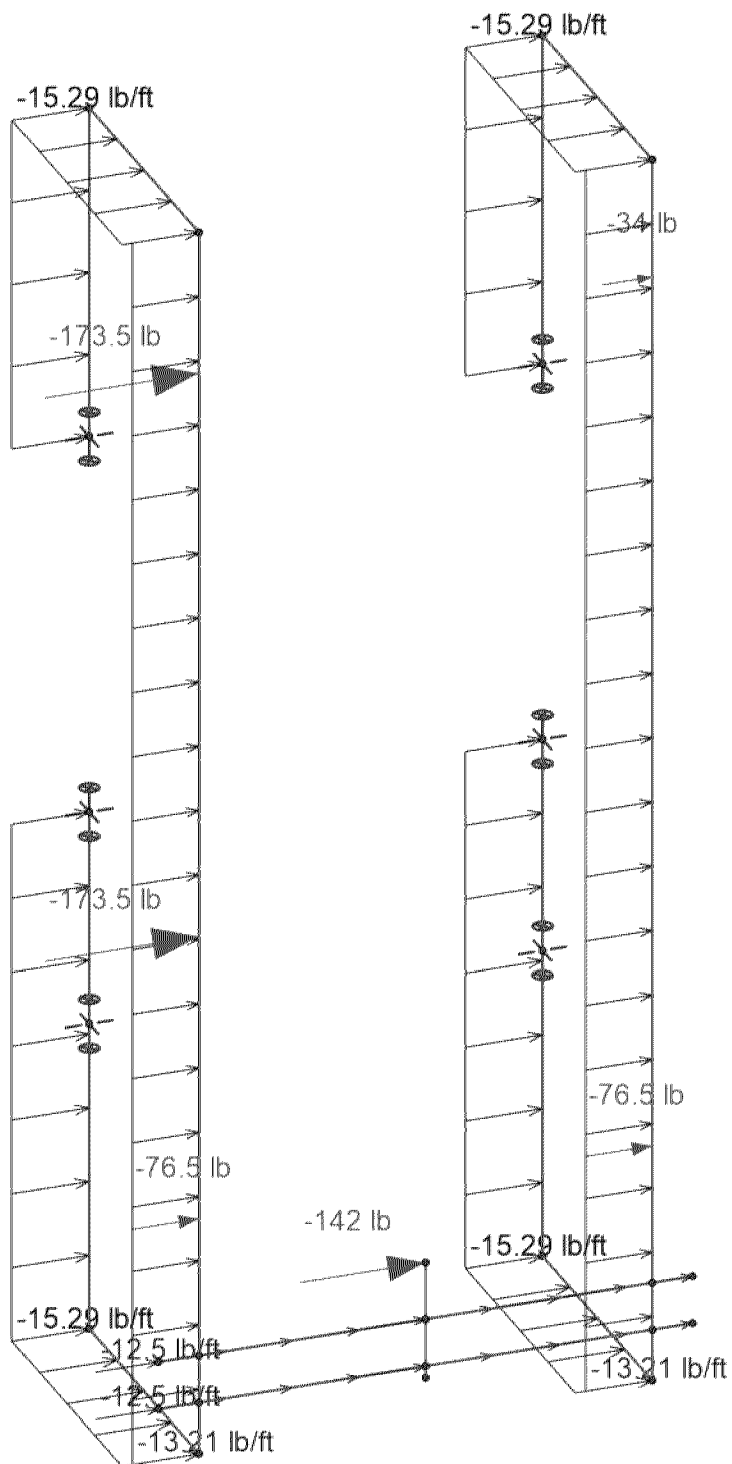
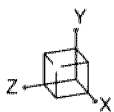
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MIN Airport L-Sub 6 (controlling location)

Wind Load (+x) 5

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Loads: BLC 5, WLz

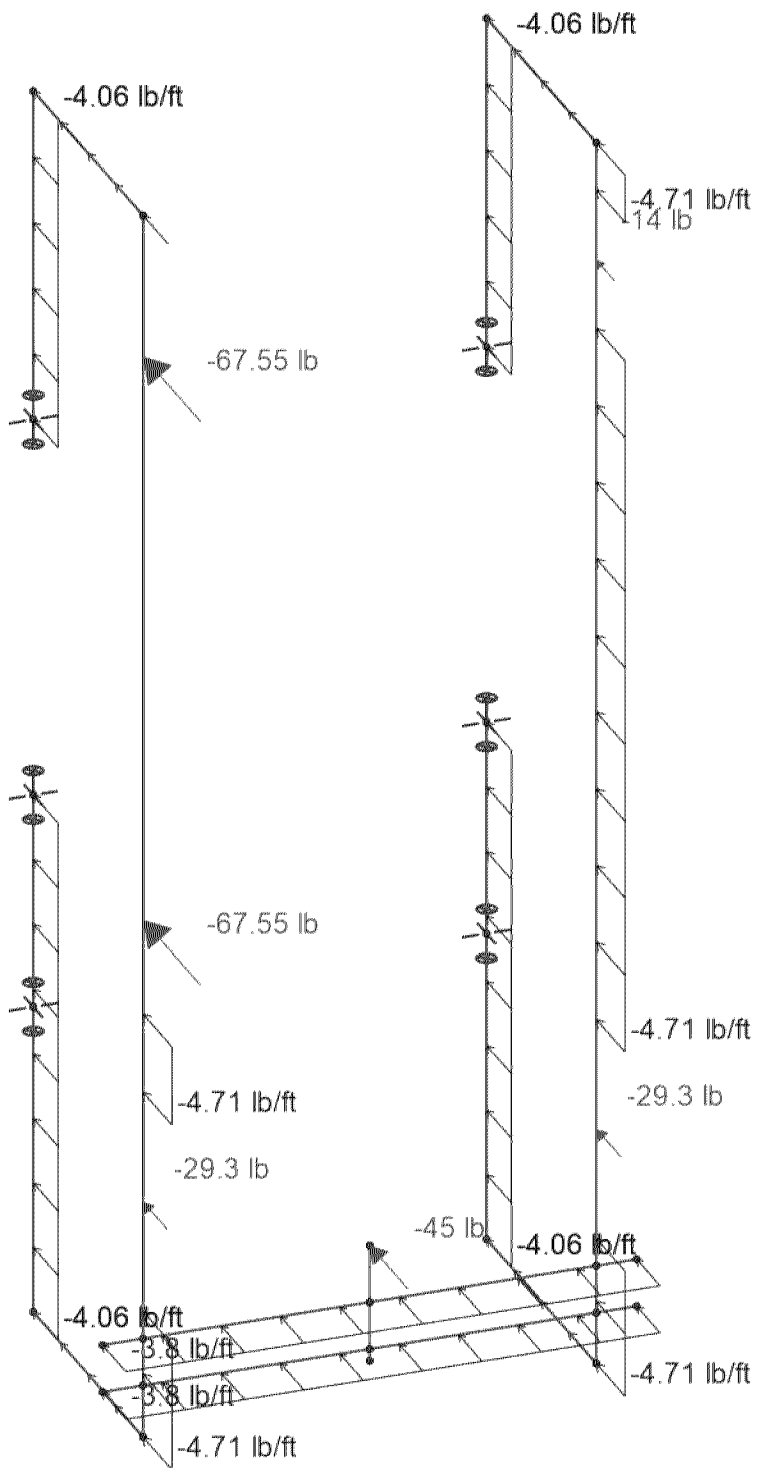
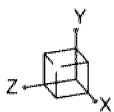
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Wind Load (+z) 6

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Loads: BLC 6, WLx on Ice

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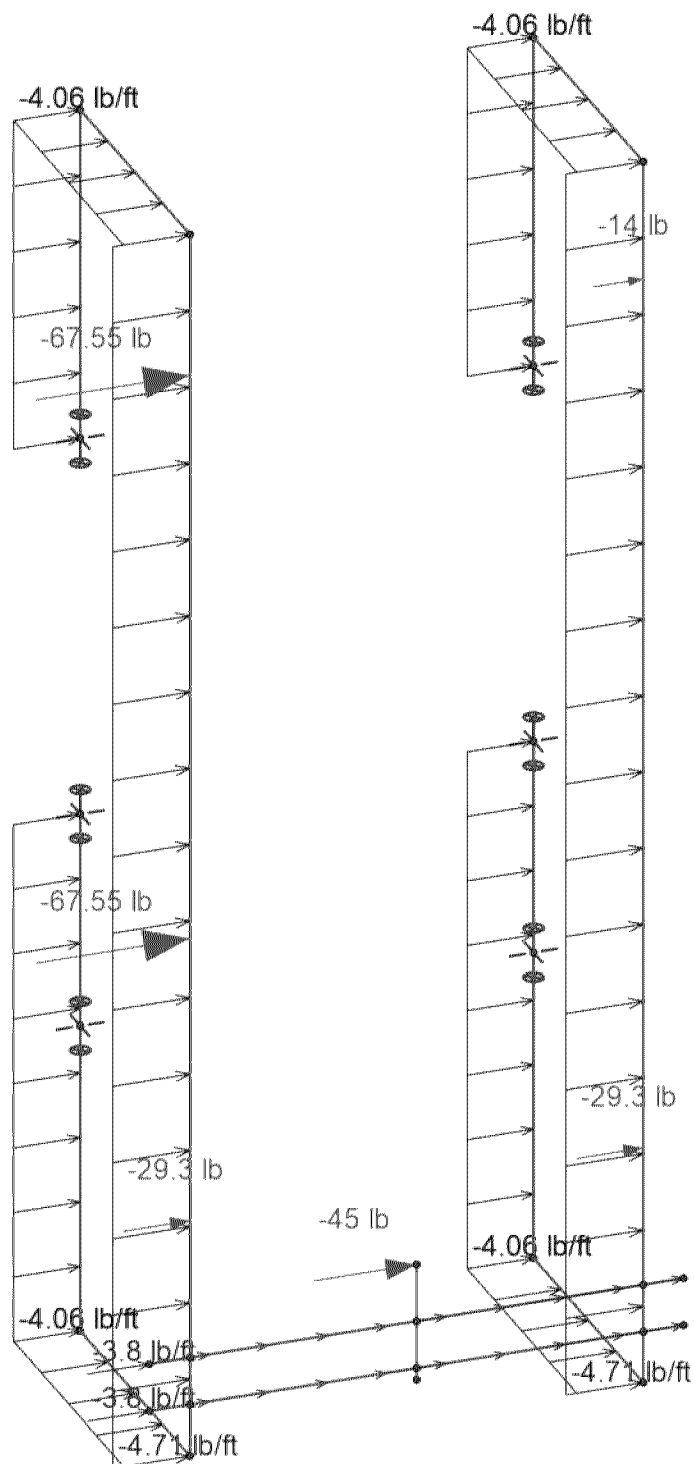
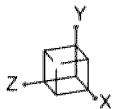
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MIN Airport L-Sub 6 (controlling location)

Wind Load on Ice (+x) 7

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Loads: BLC 7, WLz on Ice

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MIN Airport L-Sub 6 (controlling location)

Wind Load on Ice (+z) 8

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211095 MIN Airport L-Sub 6 - Cont...

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e ⁵ F ⁻¹]	Density [k/ft ³]	Yield [ksi]	Ry	Fu [ksi]	Rt
1	A992	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
2	A36 Gr.36	29000	11154	0.3	0.65	0.49	36	1.5	58	1.2
3	A572 Gr.50	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
4	A500 Gr.B RND	29000	11154	0.3	0.65	0.527	42	1.4	58	1.3
5	A500 Gr.B Rect	29000	11154	0.3	0.65	0.527	46	1.4	58	1.3
6	A53 Gr.B	29000	11154	0.3	0.65	0.49	35	1.6	60	1.2
7	A1085	29000	11154	0.3	0.65	0.49	50	1.4	65	1.3

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in ²]	Iyy [in ⁴]	Izz [in ⁴]	J [in ⁴]
1	mounting pipe	PIPE 2.5	Column	Pipe	A53 Gr.B	Typical	1.61	1.45	1.45	2.89
2	HSS frame vert	HSS3X3X3	Column	SquareTube	A500 Gr.B Rect	Typical	1.89	2.46	2.46	4.03
3	HSS frame horiz	HSS3X3X3	Beam	SquareTube	A500 Gr.B Rect	Typical	1.89	2.46	2.46	4.03

Member Primary Data

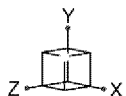
	Label	I Node	J Node	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N4	N2		HSS frame horiz	Beam	SquareTube	A500 Gr.B Rect	Typical
2	M2	N3	N1		HSS frame horiz	Beam	SquareTube	A500 Gr.B Rect	Typical
3	M3	N1	N2		mounting pipe	Column	Pipe	A53 Gr.B	Typical
4	M4	N4	N5		HSS frame vert	Column	SquareTube	A500 Gr.B Rect	Typical
5	M5	N3	N6		HSS frame vert	Column	SquareTube	A500 Gr.B Rect	Typical
6	M6	N11	N9		HSS frame horiz	Beam	SquareTube	A500 Gr.B Rect	Typical
7	M7	N8	N9		mounting pipe	Column	Pipe	A53 Gr.B	Typical
8	M8	N10	N8		HSS frame horiz	Beam	SquareTube	A500 Gr.B Rect	Typical
9	M9	N10	N13		HSS frame vert	Column	SquareTube	A500 Gr.B Rect	Typical
10	M10	N11	N12		HSS frame vert	Column	SquareTube	A500 Gr.B Rect	Typical
11	M11	N17	N18	180	Unistrut	Beam	CS	A653 SS Gr33	Typical
12	M12	N21	N22	180	Unistrut	Beam	CS	A653 SS Gr33	Typical
13	M13	N25	N26		RIGID	None	None	RIGID	Typical

Load Combinations

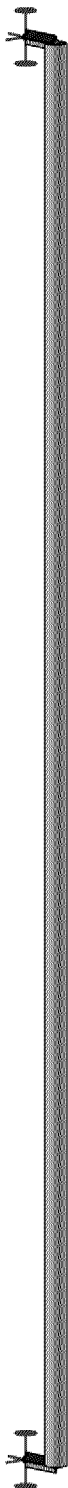
	Description	Solve	P	Delta	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	1.4DL+1.4DLequip	Yes	Y	1	1.4	2	1.4							
2	1.2DL+1.2DLequip+1.0WL (0 deg)	Yes	Y	1	1.2	2	1.2	4	1					
3	1.2DL+1.2DLequip+1.0WL (30 deg)	Yes	Y	1	1.2	2	1.2	4	0.87	5	0.5			
4	1.2DL+1.2DLequip+1.0WL (60 deg)	Yes	Y	1	1.2	2	1.2	4	0.5	5	0.87			
5	1.2DL+1.2DLequip+1.0WL (90 deg)	Yes	Y	1	1.2	2	1.2	5	1					
6	1.2DL+1.2DLequip+1.0WL (120 deg)	Yes	Y	1	1.2	2	1.2	4	-0.5	5	0.87			
7	1.2DL+1.2DLequip+1.0WL (150 deg)	Yes	Y	1	1.2	2	1.2	4	-0.87	5	0.5			
8	1.2DL+1.2DLequip+1.0WL (180 deg)	Yes	Y	1	1.2	2	1.2	4	-1					
9	1.2DL+1.2DLequip+1.0WL (210 deg)	Yes	Y	1	1.2	2	1.2	4	-0.87	5	-0.5			
10	1.2DL+1.2DLequip+1.0WL (240 deg)	Yes	Y	1	1.2	2	1.2	4	-0.5	5	-0.87			
11	1.2DL+1.2DLequip+1.0WL (270 deg)	Yes	Y	1	1.2	2	1.2	5	-1					
12	1.2DL+1.2DLequip+1.0WL (300 deg)	Yes	Y	1	1.2	2	1.2	4	0.5	5	-0.87			
13	1.2DL+1.2DLequip+1.0WL (330 deg)	Yes	Y	1	1.2	2	1.2	4	0.87	5	-0.5			
14	1.2DL+1.2DLequip+1.0Ic+1.0WLice (0 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	1			
15	1.2DL+1.2DLequip+1.0Ic+1.0WLice (30 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	0.87	7	0.5	
16	1.2DL+1.2DLequip+1.0Ic+1.0WLice (60 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	0.5	7	0.87	
17	1.2DL+1.2DLequip+1.0Ic+1.0WLice (90 deg)	Yes	Y	1	1.2	2	1.2	3	1	7	1			
18	1.2DL+1.2DLequip+1.0Ic+1.0WLice (120 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	-0.5	7	0.87	
19	1.2DL+1.2DLequip+1.0Ic+1.0WLice (150 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	-0.87	7	0.5	
20	1.2DL+1.2DLequip+1.0Ic+1.0WLice (180 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	-1			
21	1.2DL+1.2DLequip+1.0Ic+1.0WLice (210 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	-0.87	7	-0.5	
22	1.2DL+1.2DLequip+1.0Ic+1.0WLice (240 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	-0.5	7	-0.87	
23	1.2DL+1.2DLequip+1.0Ic+1.0WLice (270 deg)	Yes	Y	1	1.2	2	1.2	3	1	7	-1			
24	1.2DL+1.2DLequip+1.0Ic+1.0WLice (300 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	0.5	7	-0.87	
25	1.2DL+1.2DLequip+1.0Ic+1.0WLice (330 deg)	Yes	Y	1	1.2	2	1.2	3	1	6	0.87	7	-0.5	

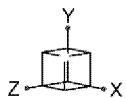
Envelope AISC 15TH (360-16): LRFD Member Steel Code Checks

Member	Shape	Code Check	Loc[in]	LC	Shear	Check	Loc[in]	Dir	LC	phi*Pnc [lb]	phi*Pnt [lb]	phi*Mn y-y [k-ft]	phi*Mn z-z [k-ft]	Cb	Eqn
1	M1	HSS3X3X3	0.175	0	7	0.172	0	z	11	73176.811	78246	6.796	6.796	1.102	H1-1b
2	M2	HSS3X3X3	0.234	0	7	0.108	0	z	11	73176.811	78246	6.796	6.796	1.85	H1-1b
3	M3	PIPE 2.5	0.273	156	5	0.16	6.5		4	13460.421	50715	3.596	3.596	2.648	H1-1b
4	M4	HSS3X3X3	0.201	0	6	0.119	42	z	11	71428.123	78246	6.796	6.796	1.631	H1-1b
5	M5	HSS3X3X3	0.303	38.5	17	0.135	38.5	z	5	62472.935	78246	6.796	6.796	1.185	H1-1b
6	M6	HSS3X3X3	0.405	0	10	0.299	0	z	11	73176.811	78246	6.796	6.796	1.127	H3-6
7	M7	PIPE 2.5	0.468	156	10	0.125	6.5		6	13460.421	50715	3.596	3.596	2.146	H1-1b
8	M8	HSS3X3X3	0.315	0	7	0.109	0	y	11	73176.811	78246	6.796	6.796	1.436	H1-1b
9	M9	HSS3X3X3	0.314	38.5	24	0.136	38.5	z	11	62472.935	78246	6.796	6.796	1.193	H1-1b
10	M10	HSS3X3X3	0.425	0	9	0.209	42	z	11	71428.123	78246	6.796	6.796	1.648	H1-1b



4th Sector Controlling Mount





M3



Herzog Engineering, LLC

JTK

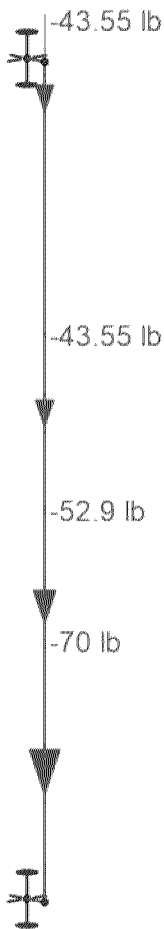
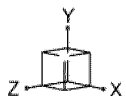
211095

MIN Airport L-Sub 6 4th Sector Controlling Mount

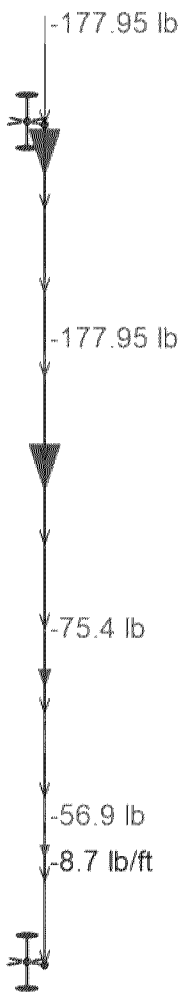
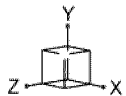
Member Labels 2

Mar 25, 2021

211095 MIN Airport L-Sub 6 - 4th s...



Loads: BLC 2, DL Equipment		
Herzog Engineering, LLC	MIN Airport L-Sub 6 4th Sector Controlling Mount	Dead Load 3
JTK		Mar 25, 2021
211095		211095 MIN Airport L-Sub 6 - 4th s...



Loads: BLC 3, Ice Load

Herzog Engineering, LLC

JTK

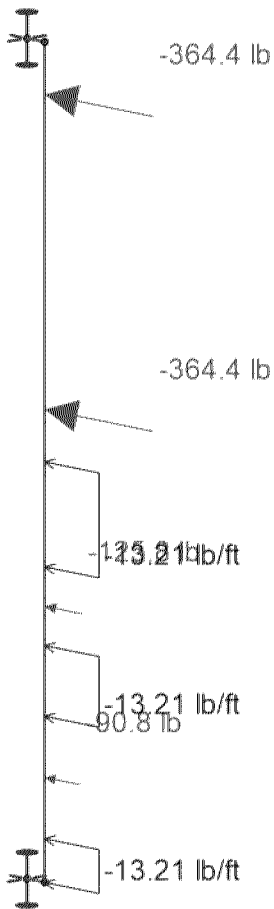
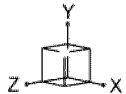
211095

MIN Airport L-Sub 6 4th Sector Controlling Mount

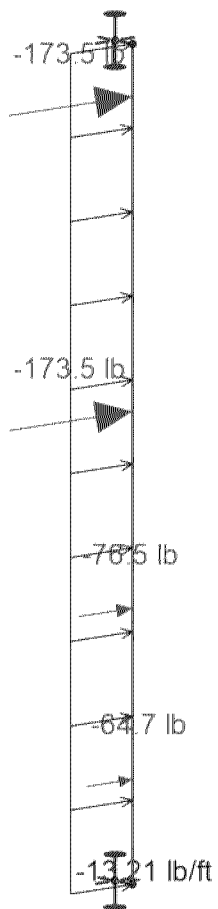
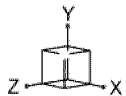
Ice Load 4

Mar 25, 2021

211095 MIN Airport L-Sub 6 - 4th s...



Loads: BLC 4, WLx		
Herzog Engineering, LLC	MIN Airport L-Sub 6 4th Sector Controlling Mount	WInd Load (+x) 5
JTK		Mar 25, 2021
211095		211095 MIN Airport L-Sub 6 - 4th s...



Loads: BLC 5, WLz

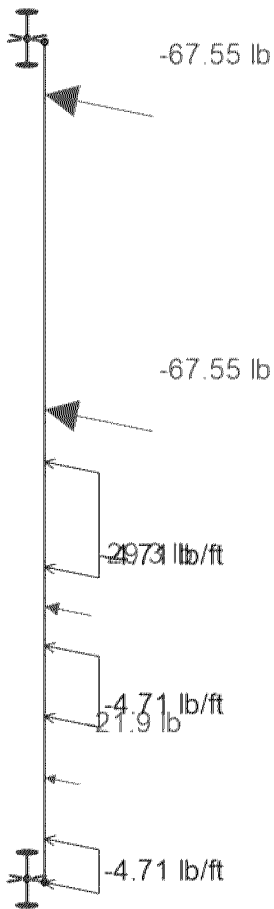
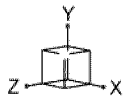
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MIN Airport L-Sub 6 4th Sector Controlling Mount

WInd Load (+z) 6

Mar 25, 2021

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Loads: BLC 6, WLx on Ice

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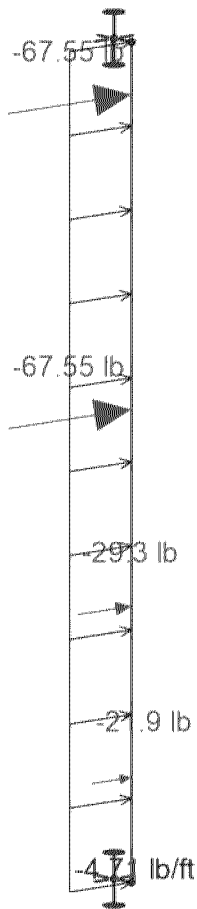
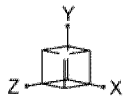
211095

MIN Airport L-Sub 6 4th Sector Controlling Mount

Wind Load on Ice (+x) 7

Mar 25, 2021

211095 MIN Airport L-Sub 6 - 4th s...



Loads: BLC 7, WLz on Ice

Herzog Engineering, LLC

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MIN Airport L-Sub 6 4th Sector Controlling Mount

Wind Load on Ice (+z) 8

Mar 25, 2021

211095 MIN Airport L-Sub 6 - 4th s...

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e ⁵ F ⁻¹]	Density [k/ft ³]	Yield [ksi]	Ry	Fu [ksi]	Rt
1	A992	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
2	A36 Gr.36	29000	11154	0.3	0.65	0.49	36	1.5	58	1.2
3	A572 Gr.50	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
4	A500 Gr.B RND	29000	11154	0.3	0.65	0.527	42	1.4	58	1.3
5	A500 Gr.B Rect	29000	11154	0.3	0.65	0.527	46	1.4	58	1.3
6	A53 Gr.B	29000	11154	0.3	0.65	0.49	35	1.6	60	1.2
7	A1085	29000	11154	0.3	0.65	0.49	50	1.4	65	1.3

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in ²]	I _{yy} [in ⁴]	I _{zz} [in ⁴]	J [in ⁴]
1	mounting pipe	PIPE 2.5	Column	Pipe	A53 Gr.B	Typical	1.61	1.45	1.45	2.89
2	HSS frame vert	HSS2X2X4	Column	SquareTube	A500 Gr.B Rect	Typical	1.51	0.747	0.747	1.31
3	HSS frame horiz	HSS2X2X4	Beam	SquareTube	A500 Gr.B Rect	Typical	1.51	0.747	0.747	1.31

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N4	N2	RIGID	None	None	RIGID	Typical
2	M2	N3	N1	RIGID	None	None	RIGID	Typical
3	M3	N1	N2	mounting pipe	Column	Pipe	A53 Gr.B	Typical

Envelope AISC 15TH (360-16): LRFD Member Steel Code Checks

Member	Shape	Code Check	Loc[in]	LC	Shear Check	Loc[in]	LC	phi*P _{nc} [lb]	phi*P _{nt} [lb]	phi*M _n y-y [k-ft]	phi*M _n z-z [k-ft]	C _b	Eqn
1	M3 PIPE 2.5	0.627	0	2	0.041	192	8	8885.981	50715	3.596	3.596	2.367	H1-1a