CLARK REDER ENGINEERING

3/6/2014

Zasco Productions, LLC
340 McKinstry Ave. – Suite 400
Chicopee, MA 01013
Attn: Michael J. Burns

RE: Zasco Goal Post CRE Proj. No.: 14.601.16

Dear Michael,

Per your request, we have reviewed the truss structure for the Zasco Goal Post. Attached are the plans and details for the system.

Our analysis has determined that the goal post truss system, composed of Applied Electronics 16” x 16” box truss, will be stable in winds up to 30 mph with screen attached and in winds up to 60 mph with the screen removed.

Table of Contents for Analysis Package

We trust this information is suitable for your needs at this time. If you have any questions, please do not hesitate to contact our office.

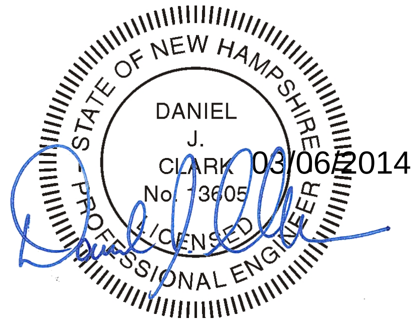
Regards,

Clark-Reder Engineering, Inc.

STATE OF CONNECTICUT
DANIEL JOSEPH CLARK
No. 27576
LICENSED
PROFESSIONAL ENGINEER
03/06/2014

STATE OF MAINE
DANIEL J. CLARK
No. 12873
LICENSED
PROFESSIONAL ENGINEER
03/06/2014

Clark-Reder Engineering, Inc • 4828 Business Center Way, Cincinnati, OH, 45246 • Phone (513) 851-1223 • Fax (513) 297-0934 •www.clarkreder.com



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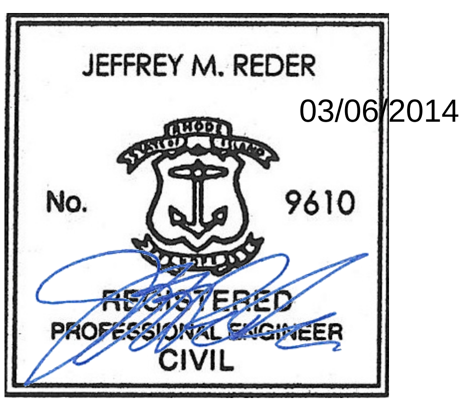
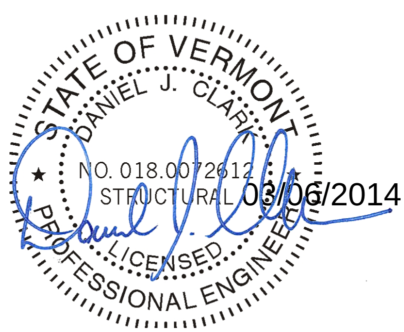




03/06/2014

Scott Horn, E.I.T.

GENERAL STRUCTURAL NOTES

EVENT DATE & LOCATION

1. EVENT LOCATION: VARIOUS

CODES AND REFERENCE

1. 2009 INTERNATIONAL BUILDING CODE
2. ASCE 7-05 MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES
3. ASCE 37-02 DESIGN LOADS ON STRUCTURES UNDER CONSTRUCTION
4. ANSI E1.21-2006 ENTERTAINMENT TECHNOLOGY, "TEMPORARY GROUND-SUPPORTED OVERHEAD STRUCTURES USED TO COVER THE STAGE AREAS AND SUPPORT EQUIPMENT IN THE PRODUCTION OF OUTDOOR ENTERTAINMENT EVENTS"
5. ANSI E1.2-2012 ENTERTAINMENT TECHNOLOGY, "MANUFACTURE AND USE OF ALUMINUM TRUSSES AND TOWERS"
6. ALUMINUM DESIGN MANUAL, 2010 EDITION

DESIGN LOADS

1. DEAD LOAD: SELFWEIGHT OF STRUCTURE
2. RIGGING LOADS: SEE ATTACHED SHOW SPECIFIC RIGGING PLOT
3. WIND LOAD:
   A. DESIGN WIND SPEED: 60 MPH* (BARE STRUCTURE – NO VIDEO WALL)
   B. DESIGN WIND SPEED: 30 MPH (WITH VIDEO WALL – SEE HIGH WIND ACTION PLAN)
   C. EXPOSURE: C
   D. IMPORTANCE FACTOR: 1.0
4. SEISMIC LOADS DO NOT CONTROL THE DESIGN OF THIS STRUCTURE.

*90 MPH WIND SPEED REQUIREMENT REDUCED IN ACCORDANCE WITH ASCE 37-02 DUE TO THE TEMPORARY NATURE OF STRUCTURE.

CONSTRUCTION AND SAFETY

1. ENGINEER SHALL NOT BE RESPONSIBLE FOR MEANS, METHODS, OR SEQUENCE OF CONSTRUCTION UNLESS SPECIFICALLY STATED ON THE DRAWINGS.
2. ENGINEER HAS DESIGNED THE STRUCTURES FOR THEIR FINAL AS-BUILT CONDITION. ENGINEER IS NOT RESPONSIBLE FOR TEMPORARY STABILITY OF STRUCTURES DURING ERECTION UNLESS SPECIFICALLY STATED ON THE DRAWINGS.
3. STRUCTURE HAS BEEN DESIGNED AS A TEMPORARY STRUCTURE THAT SHALL BE IN PLACE FOR LESS THAN 6 WEEKS.

FOUNDATIONS

1. THE STRUCTURE IS ASSUMED TO BE FOUNDED ON LEVEL GROUND (CONCRETE, ASPHALT, GRASS, ETC) WITH A MINIMUM NET ALLOWABLE BEARING CAPACITY OF 1500 PSF.

RIGGING

1. ALL POINTS SHALL BE DEAD HUNG POINTS.

2. ALL RIGGING SHALL BE HUNG FROM PANEL POINTS (LOCATIONS ON THE TRUSS CHORDS BRACED BOTH VERTICALLY AND HORIZONTALLY) UNLESS SPECIFICALLY APPROVED BY THE ENGINEER OF RECORD.
3. BRIDLES SHALL NOT BE USED UNLESS SPECIFICALLY ALLOWED BY THE ENGINEER OF RECORD.

ALUMINUM

1. ALUMINUM SHALL CONFORM TO THE FOLLOWING UNLESS NOTED OTHERWISE ON THE DRAWINGS:
   A. MEMBER ALLOY: 6061-T6
   B. CHANNELS, PLATES AND SHEETS: 6061-T6
   C. WELD FILLER ALLOW: 4043
2. ALL DETAILING, FABRICATION AND ERECTION SHALL CONFORM TO THE ALUMINUM ASSOCIATION ALUMINUM DESIGN MANUAL, CURRENT EDITION.
3. WELDING SHALL BE IN ACCORDANCE WITH THE AMERICAN WELDING SOCIETY LATEST EDITION.
4. FIELD CONNECTIONS SHALL BE BOLTED UNLESS SPECIFIED OTHERWISE ON THE DRAWINGS.
5. ALUMINUM TRUSS TO ALUMINUM TRUSS CONNECTION BOLTS: 5/8" DIAMETER GRADE 8 BOLTS

WIRE ROPE AND RIGGING ACCESSORIES

1. WIRE ROPE 3/8" OR LESS IN DIAMETER: 7X19 GAC, MEETING FEDERAL SPEC. RR-W-410E
2. WIRE ROPE 7/16" OR GREATER IN DIAMETER: 6X19 IWRC, MEETING FEDERAL SPEC. RR-W-410D, TYPE 1 CLASS 2
3. SHACKLES: GALVANIZED, SCREW PIN ANCHOR TYPE, ASTM A153
4. TURNBUCKLES: GALVANIZED, ASTM F-1145
5. FORGED WIRE ROPE CLIPS: GALVANIZED, MEETING FEDERAL SPEC. FF-C-450 TYPE I CLASS I
6. WIRE ROPE THIMBLES: GALVANIZED, MEETING FEDERAL SPEC. FF-T-276B TYPE II
7. RATCHET STRAPS
8. CHAIN PULLERS
9. POLYESTER OR STEEL CORE ROUND SLING

INSPECTIONS

1. ALL TRUSS UNITS, SCAFFOLD AND/OR OTHER RIGGING EQUIPMENT SHALL BE VISUALLY INSPECTED PRIOR TO ERECTION. DAMAGED OR CORRODED EQUIPMENT SHALL NOT BE USED. FIELD MODIFICATIONS SHALL BE APPROVED BY THE ENGINEER OF RECORD PRIOR TO INSTALLATION.

OPERATIONS MANAGEMENT PLAN

IMPLEMENTATION OF PLAN

1. PRIOR TO EACH INSTALLATION, THE CLIENT SHALL DESIGNATE A RESPONSIBLE PERSON IN CHARGE OF IMPLEMENTING ALL PHASES OF THE OPERATIONS MANAGEMENT PLAN.
2. A MEETING SHALL BE HELD AT THE VENUE WITH THE PROMOTER, OWNER OR STAGE MANAGER TO DISCUSS THE HIGH WIND ACTION PLAN AND OTHER OPERATIONAL ITEMS.
3. THE METHOD OF INITIATING EVENT CANCELLATION MUST BE OUTLINED EXPLICITLY PRIOR TO THE EVENT ALLOWING FOR IMMEDIATE ACTION IF NECESSARY.
4. A COPY OF THIS PLAN SHOULD BE PROVIDED TO LOCAL POLICE OR FIRE DEPARTMENTS IN ORDER TO HELP USHER PATRONS IN THE EVENT OF AN EVACUATION.

DAILY OPERATIONS PLAN

1. CHECK WEATHER EACH MORNING AND PERIODICALLY THROUGHOUT THE DAY.
2. CHECK TOWER BASES DAILY TO ENSURE ALL REMAIN LEVEL AND PLUMB
3. CHECK GUY WIRES AND BALLAST ASSEMBLIES DAILY TO VERIFY LINES ARE TENSIONED AND BALLAST HAS NOT MOVED.
4. PROVIDE A DAILY LOG OF THE ABOVE CHECKS FOR EACH INSTALLATION.

HIGH WIND ACTION PLAN

1. THE HIGH WIND ACTION PLAN SHALL BE IN EFFECT FOR THE ENTIRETY OF THE EVENT. AN EVENT SHALL BE DEFINED AS STARTING AT THE INITIAL COMMENCEMENT OF THE STRUCTURE INSTALLATION AND ENDING ONCE THE STRUCTURE IS COMPLETELY DISMANTLED.
2. A COMPETENT RESPONSIBLE PERSON FROM THE VENUE OR RIGGING COMPANY SHALL BE PRESENT FOR THE DURATION OF THE EVENT TO IMPLEMENT THE HIGH WIND ACTION PLAN (SEE ABOVE).
3. A REGULAR LIAISON WITH LOCAL AIRPORTS AND/OR WEATHER INFORMATION CENTERS SHALL BE MAINTAINED TO ASCERTAIN IF ANY SIGNIFICANT WEATHER EVENTS ARE EXPECTED IN THE IMMEDIATE VICINITY OF THE STRUCTURE
4. AN ANEMOMETER SHALL BE PLACED ON THE STRUCTURE TO MONITOR WIND SPEEDS. THE ANEMOMETER SHALL BE PLACED AT THE TOP OF A TOWER OR AN ADJACENT STRUCTURE AT A HEIGHT EQUIVALENT TO THE HEIGHT OF THE TOWER. THE ANEMOMETER SHALL BE LOCATED WITHIN 50 YARDS OF THE STRUCTURE.
5. NOTED WINDS SPEEDS ARE 3 SECOND GUSTS IN ACCORDANCE WITH ASCE 7.
6. **WHEN WIND SPEEDS ARE EXPECTED TO EXCEED 20 MPH**: A TEAM OF QUALIFIED PERSONNEL SHALL BE PUT ON ALERT. ALL NECESSARY PERSONNEL SHALL BE IN PLACE AND PUT ON STANDBY.
7. **WHEN WIND SPEEDS ARE EXPECTED TO REACH 30 MPH**: VIDEO WALL SHALL BE LOWERED TO A HEIGHT OF 30'. LOWERING OF EQUIPMENT SHALL BE DONE FROM THE GROUND BY MEANS OF REMOTELY ACTIVATED EQUIPMENT SUCH AS MOTORS OR MECHANICAL RELEASES.
8. **WHEN WIND SPEEDS ARE EXPECTED TO REACH 35 MPH**: VIDEO WALL SHALL BE LOWERED TO A HEIGHT OF 25'. LOWERING OF EQUIPMENT SHALL BE DONE FROM THE GROUND BY MEANS OF REMOTELY ACTIVATED EQUIPMENT SUCH AS MOTORS OR MECHANICAL RELEASES.
9. **WHEN WIND SPEEDS ARE EXPECTED TO REACH 40 MPH**: VIDEO WALL SHALL BE LOWERED TO A HEIGHT OF 20'. LOWERING OF EQUIPMENT SHALL BE DONE FROM THE GROUND BY MEANS OF REMOTELY ACTIVATED EQUIPMENT SUCH AS MOTORS OR MECHANICAL RELEASES.
10. **WHEN WIND SPEEDS ARE EXPECTED TO REACH 45 MPH**: VIDEO WALL SHALL BE LOWERED TO A HEIGHT OF 12'. LOWERING OF EQUIPMENT SHALL BE DONE FROM THE GROUND BY MEANS OF REMOTELY ACTIVATED EQUIPMENT SUCH AS MOTORS OR MECHANICAL RELEASES.

11. **AT WINDS SPEEDS IN EXCESS OF 45 MPH:** ALL SHOW OPERATIONS SHALL CEASE AND THE IMMEDIATE AREA SHALL BE EVACUATED.
12. **AT WINDS SPEEDS IN EXCESS OF 50 MPH:** ALL PERSONNEL SHOULD MAINTAIN SAFE DISTANCE FROM THE SYSTEM. LOWER SYSTEM IF TIME PERMITS AND WIND SPEEDS ARE BELOW 15 MPH.
13. THE HIGH WIND ACTION PLAN SHALL BE POSTED AT A CONSPICUOUS AREA ON SITE. IT MUST BE AVAILABLE AT ALL TIMES TO VENUE OPERATORS AND CREW.

SEISMIC LOADS

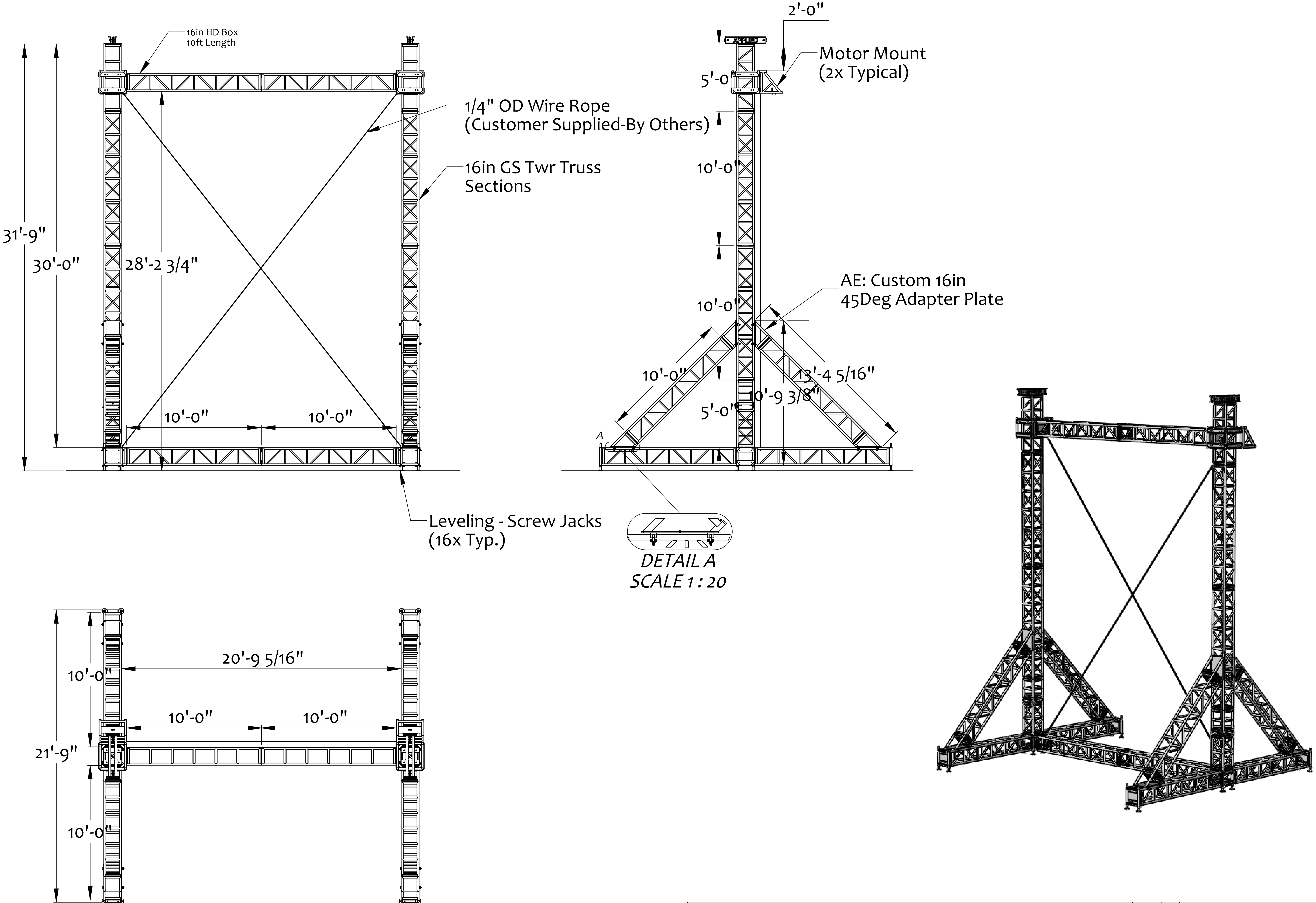
1. IN THE EVENT OF AN EARTHQUAKE, THE EVENT SHALL BE SUSPENDED UNTIL SUCH TIME THAT THE STRUCTURE HAS BEEN INSPECTED BY A COMPETENT PERSON ON SITE.

HOISTING

1. GUY WIRES SHALL BE INSTALLED IMMEDIATELY AFTER SYSTEM HAS BEEN HOISTED TO TRIM HEIGHT.

VIDEO WALL RIGGING			
MAXIMUM WIND SPEED	30 MPH	35 MPH	40 MPH
TOP OF VIDEO WALL HEIGHT	30 FT	25 FT	20 FT

NOTES:
1. WHEN WIND SPEEDS EXCEED THE MAXIMUM VALUE INDICATED IN THE TABLE ABOVE, THEN THE VIDEO WALL SHALL BE REMOVED FROM THE SYSTEM, LOWERED TO THE GROUND, AND SECURED.



Applied Electronics
722 Blue Crab Road
Newport News, VA 23606
757.591.9371 / fax 757.591.9514
www.appliednn.com

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PRODUCTION APPROVAL
APPROVED BY: APPROVAL DATE:
X:

TOLERANCES:
(DIMENSIONS ARE IN INCHES)
FRACTIONAL ±1/8th
ANGULAR: MACH & BEND ±1 Deg
TWO PLACE DECIMAL ±.13
THREE PLACE DECIMAL ±.125

MATERIAL
6061-T6 Alum.

FINISH
Black P. C. Paint

	NAME	DATE
DRAWN	AJT	14Feb14
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

DO NOT SCALE DRAWING

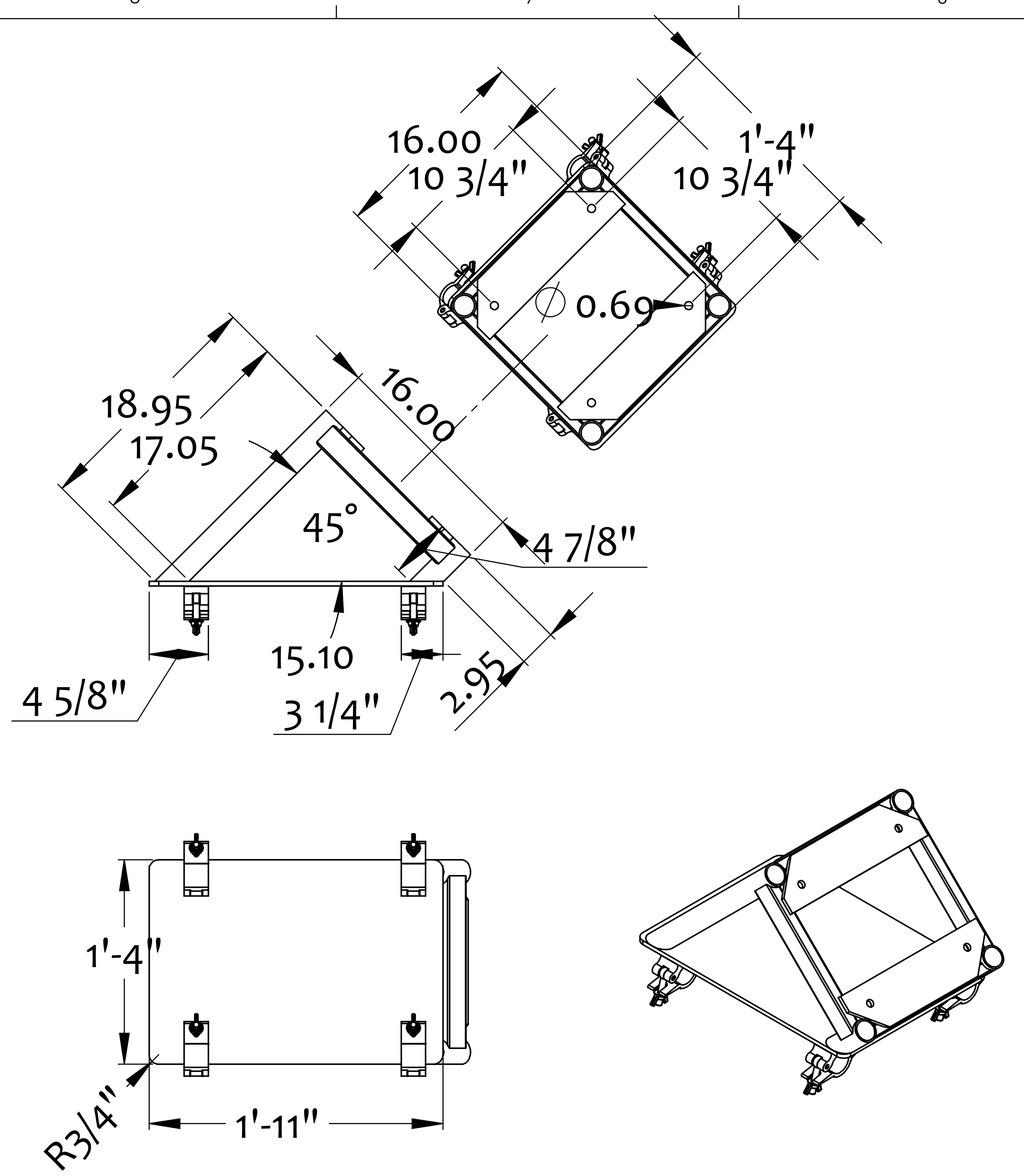
TITLE INFO:
Client: Zasco Screen Goalpost
16x16 GS Truss Tower System

SHOP PARTS SHEET

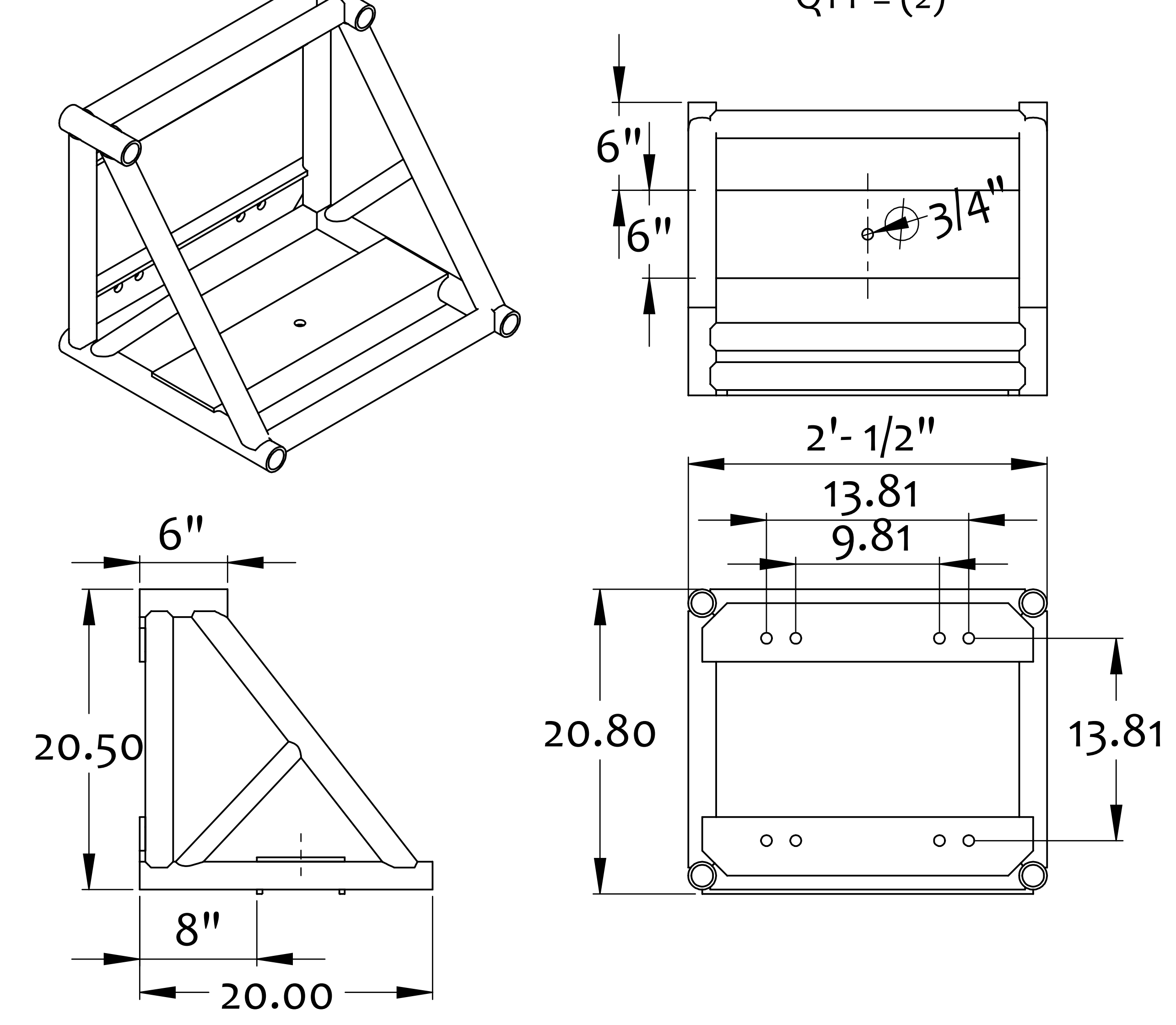
SIZE	DWG. NO.	REV.
C	7244 GS Grid Zasco	001

SCALE 1:60 WEIGHT: TBD SHEET 1 OF 5

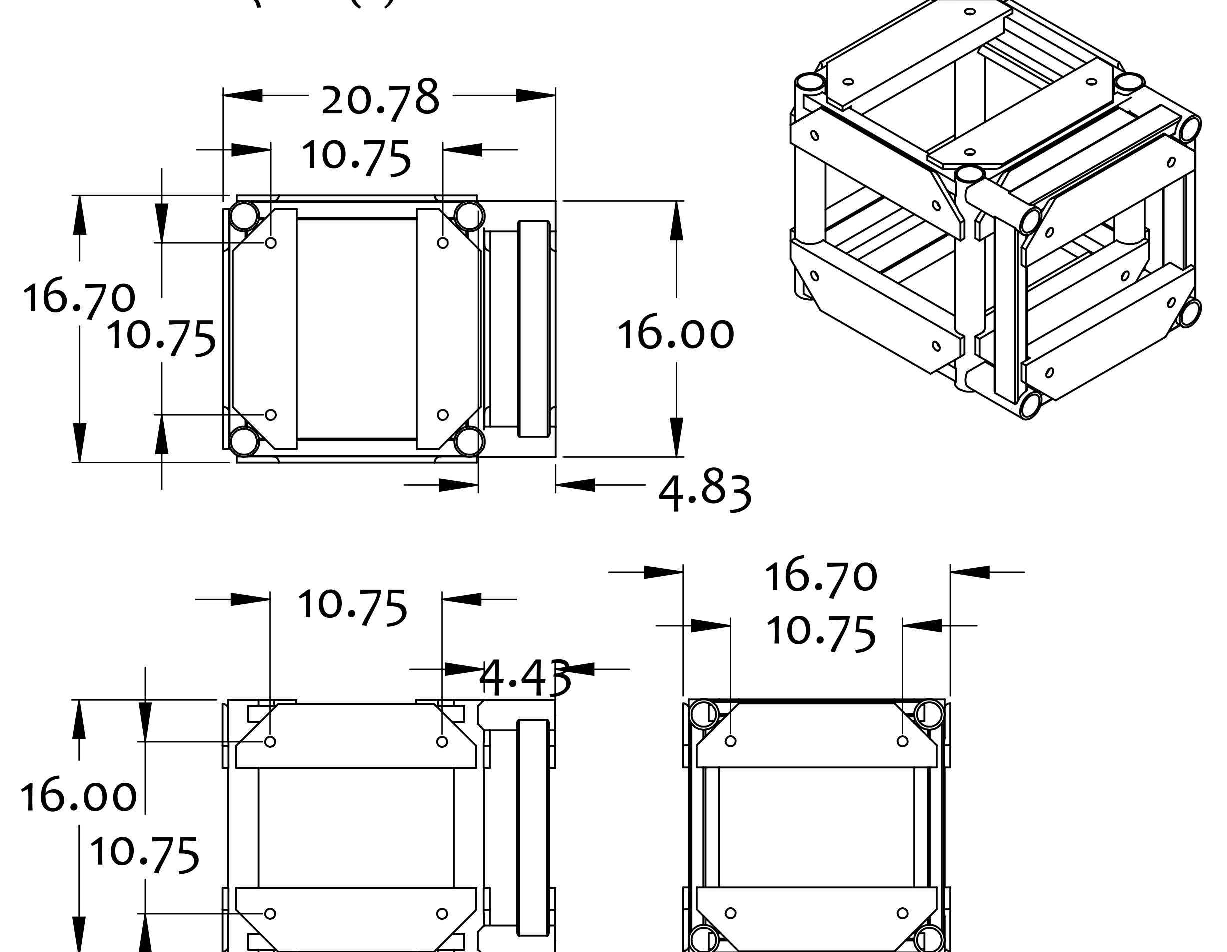
BRACE CONNECTOR
QTY = (4)

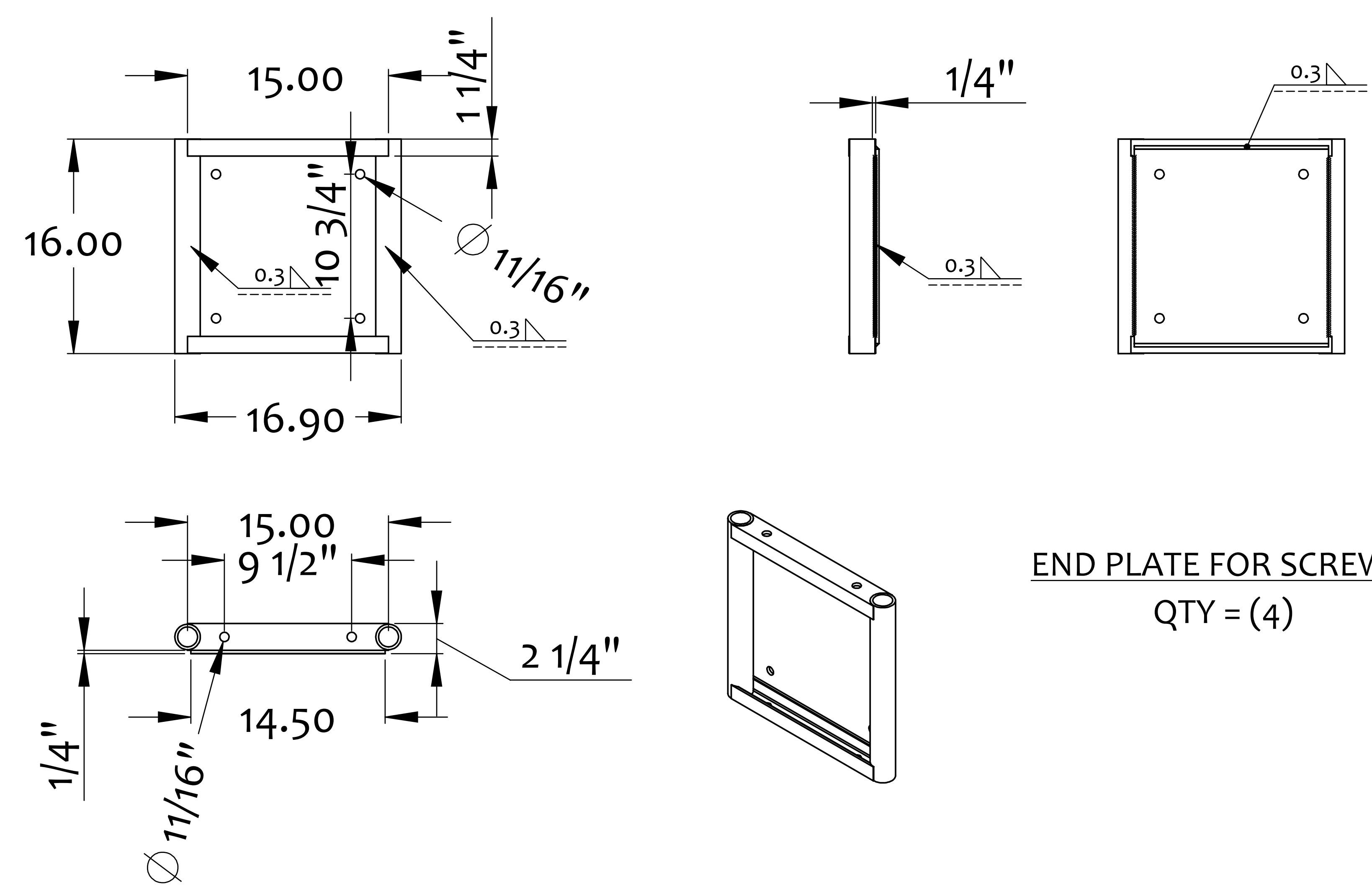


MOTOR MOUNT
QTY = (2)



CUSTOM CORNER BLOCK
QTY = (2)





END PLATE FOR SCREW JACK
QTY = (4)

NOTE:
1) ALL WELDS MADE FROM 4043 WELDING ROD
2) ALL ALUMINUM MATERIAL: 6061-T6 UNLESS MARKED OTHERWISE

Electronics Applied
722 Blue Crab Road
Newport News, VA 23606
757.591.9371 / fax 757.591.9514
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TOLERANCES:
(DIMENSIONS ARE IN INCHES)
FRACTIONAL ±1/8th
ANGULAR: MACH & BEND ±1 Deg
TWO PLACE DECIMAL ±.13
THREE PLACE DECIMAL ±.125

MATERIAL
6061-T6 (SS)

FINISH
Polished Alum. unless otherwise noted

	NAME	DATE
DRAWN	AJT	17Feb14
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

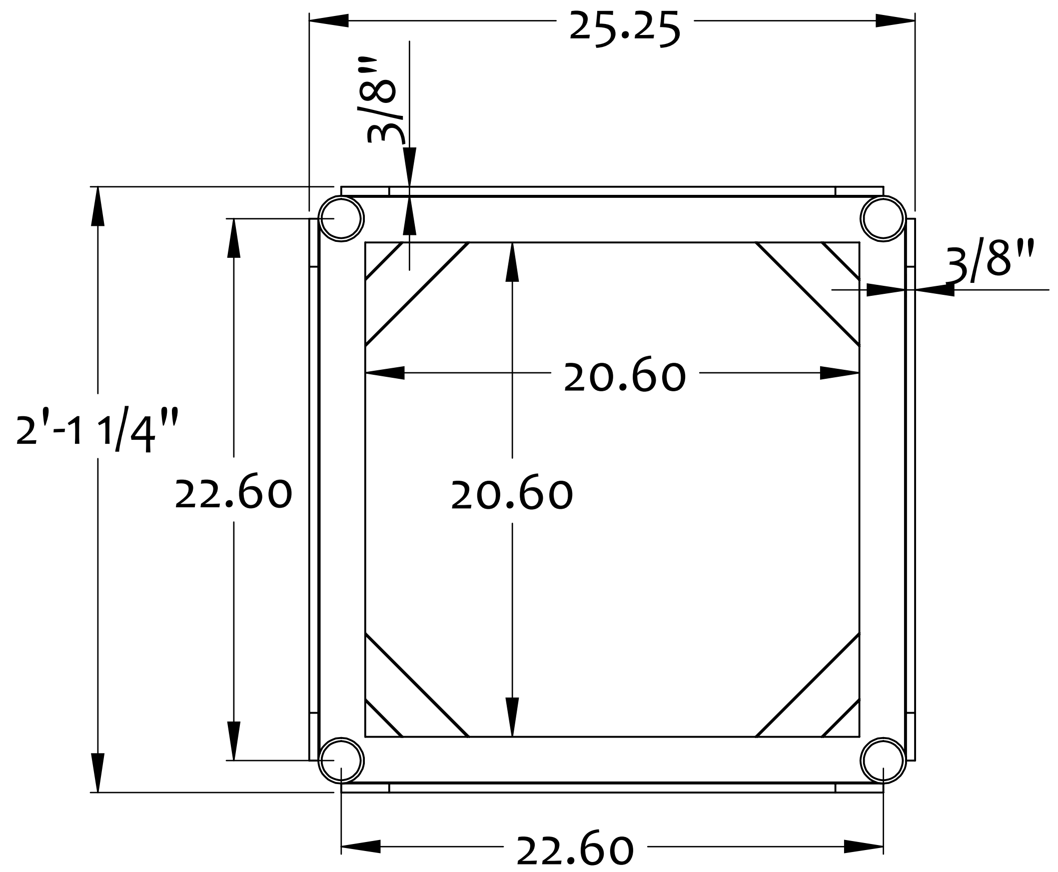
COMMENTS:
DO NOT SCALE DRAWING

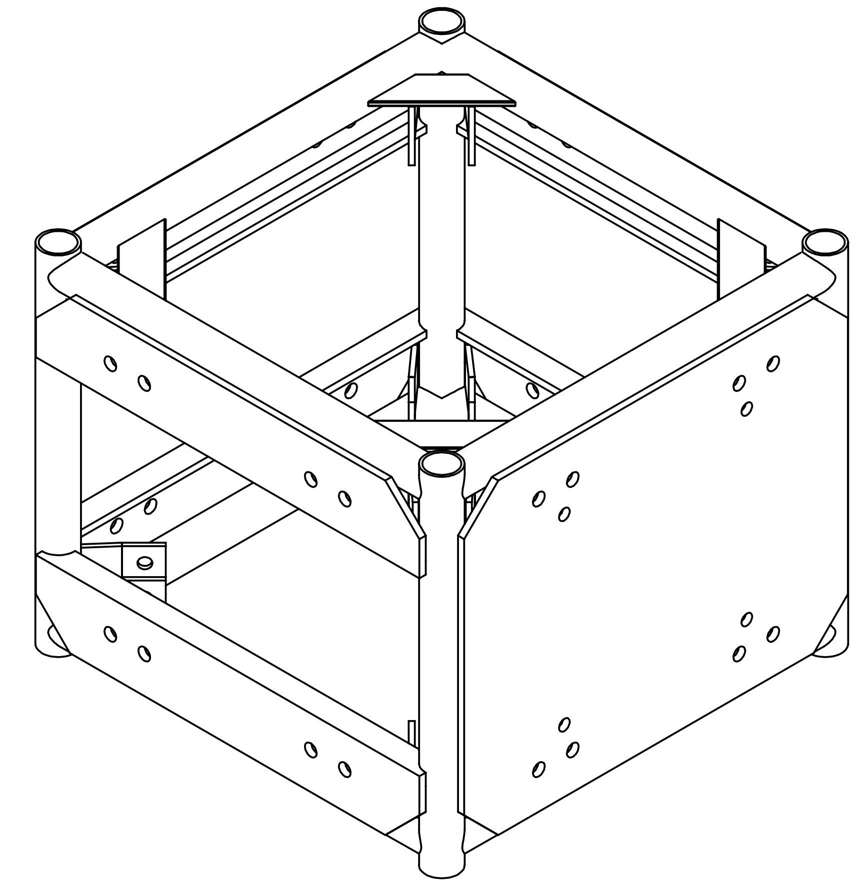
TITLE INFO:
Client: Zasco Screen Goalpost
16x16 GS Truss Tower System
Custom Parts

SHOP PARTS SHEET

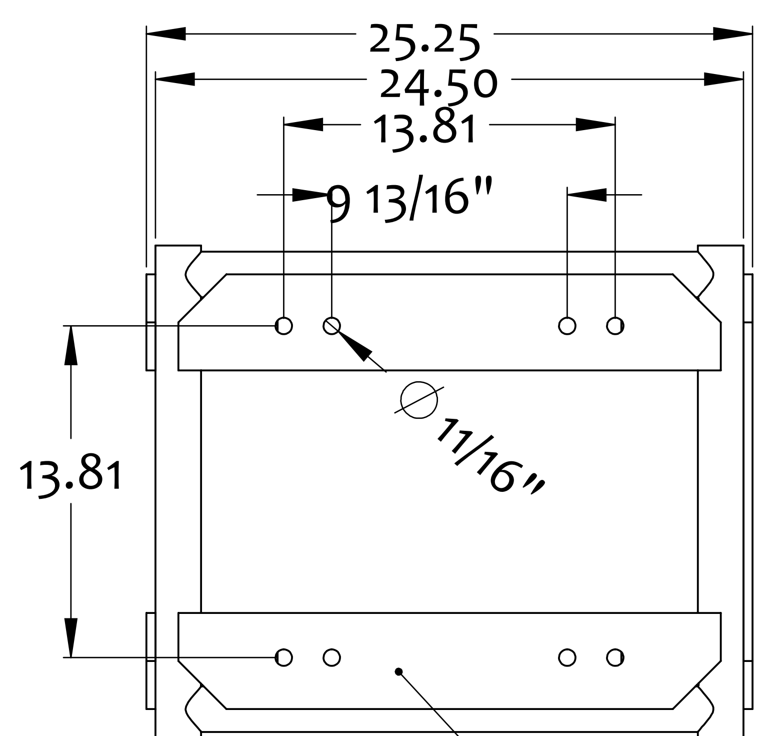
SIZE	DWG. NO.	REV.
C	7244 GS Grid Zasco	001

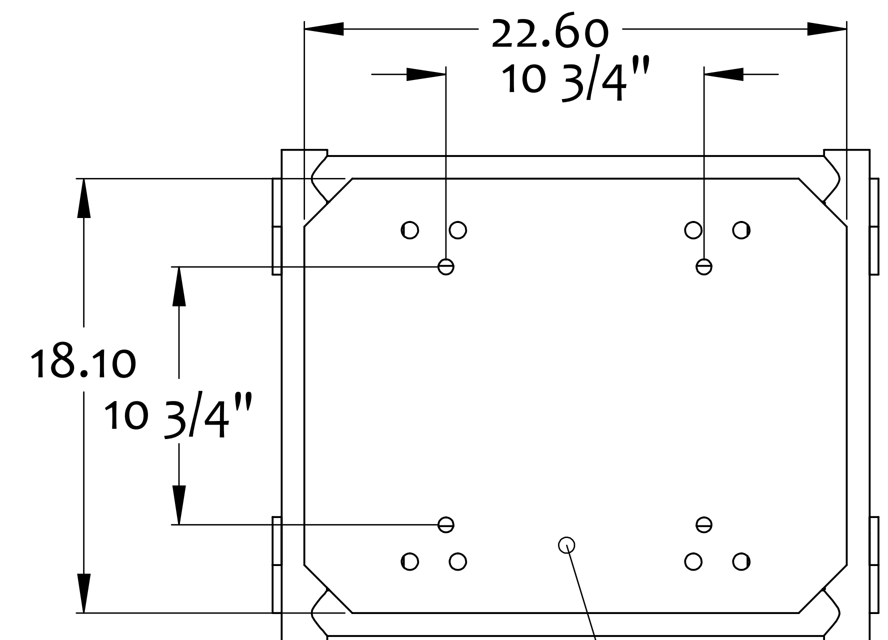
SCALE 1:12 WEIGHT: TBD SHEET 2 OF 5





CUSTOM SLEEVE BLOCK
QTY = (2) pcs





Applied Electronics
722 Blue Crab Road
Newport News, VA 23606
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(DIMENSIONS ARE IN INCHES)
FRACTIONAL ±1/8th
ANGULAR: MACH & BEND ±1 Deg
TWO PLACE DECIMAL ±.13
THREE PLACE DECIMAL ±.125

MATERIAL: 6061-T6 (SS)

FINISH: Polished Alum. unless otherwise noted

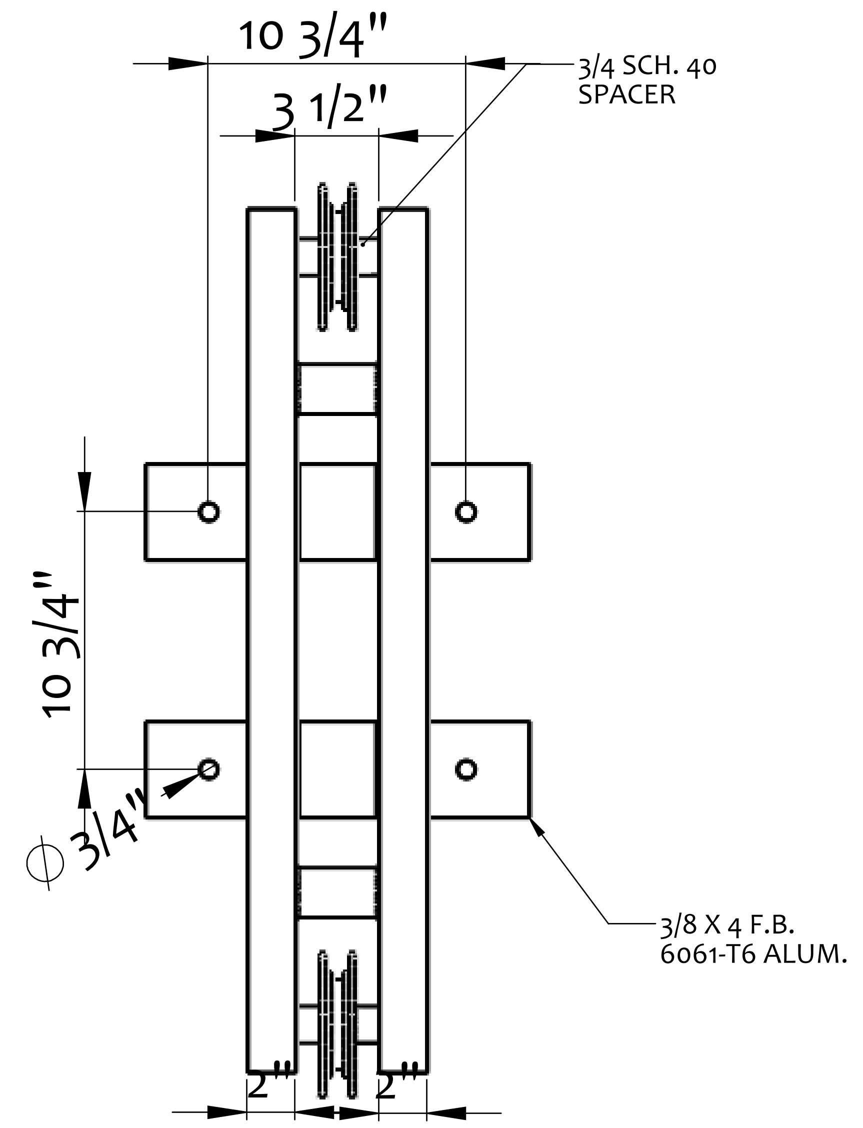
	NAME	DATE
DRAWN	AJT	17Feb14
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

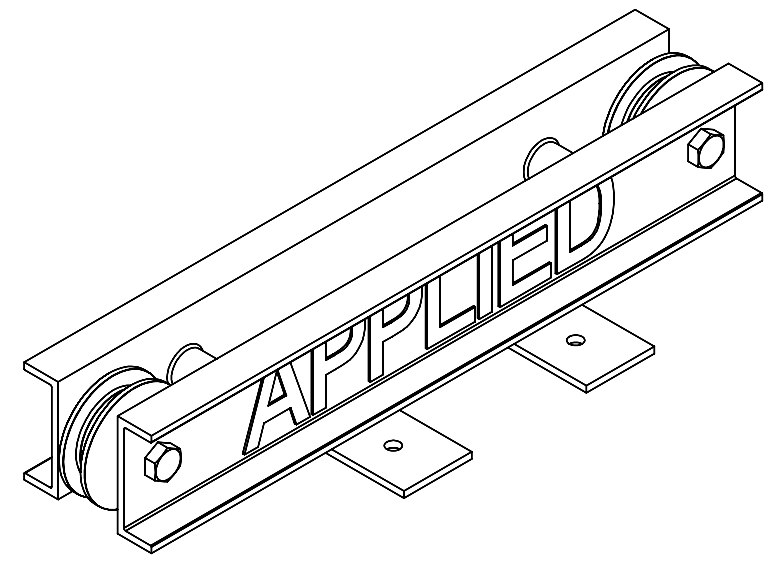
COMMENTS:
DO NOT SCALE DRAWING

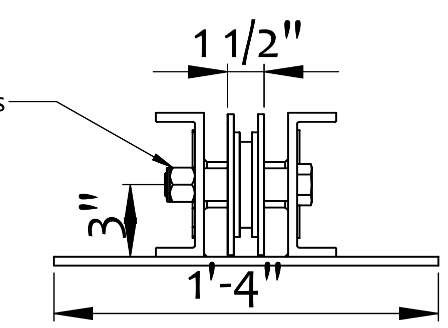
TITLE INFO:
Client: Zasco Screen Goalpost
16x16 GS Truss Tower System
Custom Parts

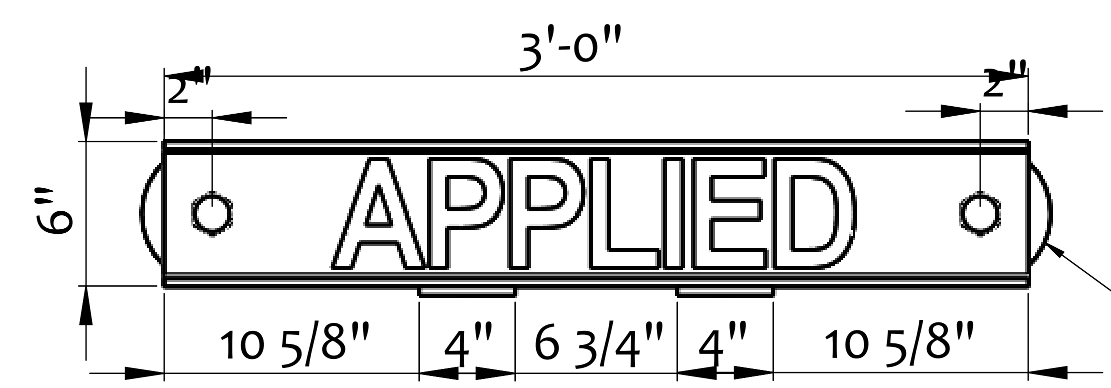
SHOP PARTS SHEET

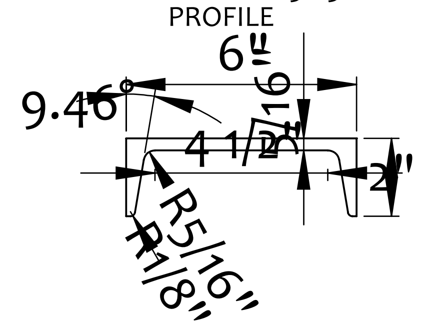
SIZE: C | DWG. NO.: 7244 GS Grid Zasco | REV.: 001
SCALE 1:8 | WEIGHT: TBD | SHEET 3 OF 5











Electronics **Applied**

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757.591.9371 / fax 757.591.9514
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(DIMENSIONS ARE IN INCHES)
FRACTIONAL ±1/8th
ANGULAR: MACH & BEND ±1 Deg
TWO PLACE DECIMAL ±.13
THREE PLACE DECIMAL ±.125

MATERIAL
As Noted In Part Files

FINISH
Polished Alum.

	NAME	DATE
DRAWN	AJT	05Mar14
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

DO NOT SCALE DRAWING

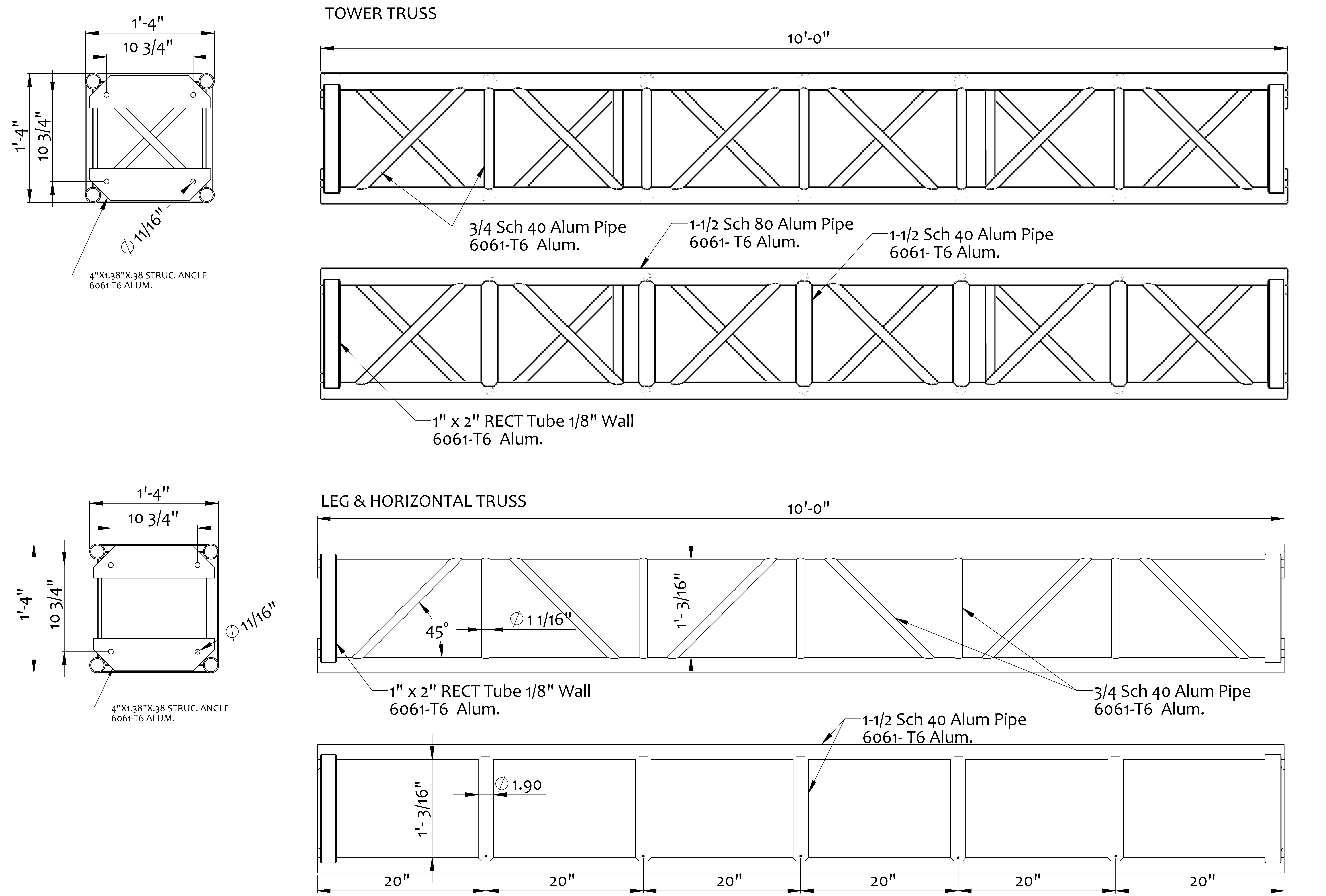
TITLE INFO:

16" GS Head Block

SHOP PARTS SHEET

SIZE	DWG. NO.	REV.
C	7244 GS Grid Zasco	001

SCALE 1:8 WEIGHT: TBD SHEET 4 OF 5



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			DRAWN	AJT	25Mar09	
			CHECKED			
			ENG APPR.			
			MFG APPR.			
			Q.A.			
		MATERIAL 6061-T6 (SS)	COMMENTS:			**SHOP PARTS SHEET**
	PRODUCTION APPROVAL APPROVED BY: X: ______ APPROVAL DATE: ______	FINISH Polished Alum. Unless Otherwise Noted	**DO NOT SCALE DRAWING**			SIZE C · DWG. NO. 7244 GS Grid Zasco · REV. 001 SCALE 1:8 · WEIGHT: TBD · SHEET 5 OF 5

Zasco - Truss Assembly

Location: Various

Codes and Referenced Standards

- 2009 International Building Code
- Aluminum Design Manual, 2010 ed.
- American Institute of Steel Construction, Steel Construction Manual 14th Edition
- American Society of Civil Engineers 7-05 (ASCE 7-05) *"Minimum Design Loads for Buildings and Other Structures"*
- American Society of Civil Engineers 37-02 (ASC 37-02) *"Design Loads on Structures During Construction"*
- ANSI E 1.21-2006 *"Temporary Ground-Supported Overhead Structures Used To Cover Stage Areas and Support Equipment in the Production of Outdoor Entertainment Events"*
- ANSI E 1.2-2012 *"Manufacture and Use of Aluminum Trusses and Towers"*

Project Description

A truss 'goal post' assemby is made up of 16" x 16" Box Truss, by Applied Electronics. The towers stand 31'-9". The top most truss sits at a height of 28'-2-3/4". The assembly measures 20'-0" across in the center. Both sides of the assembly are braced with truss. The leg truss at the bottom of each tower measure 10'-0" each side.

A video screen, weighing 1800 pounds and measuring 20' wide and 12' tall, is hung every 4' on the top 16" x 16" truss.

Analysis Assumptions/Design Criteria

- All aluminum is 6061-T6.
- Allowable wind speeds at the given height were determined for the truss assembly with no ballast.
- RISA 3D was used in conjunction for design and analysis.

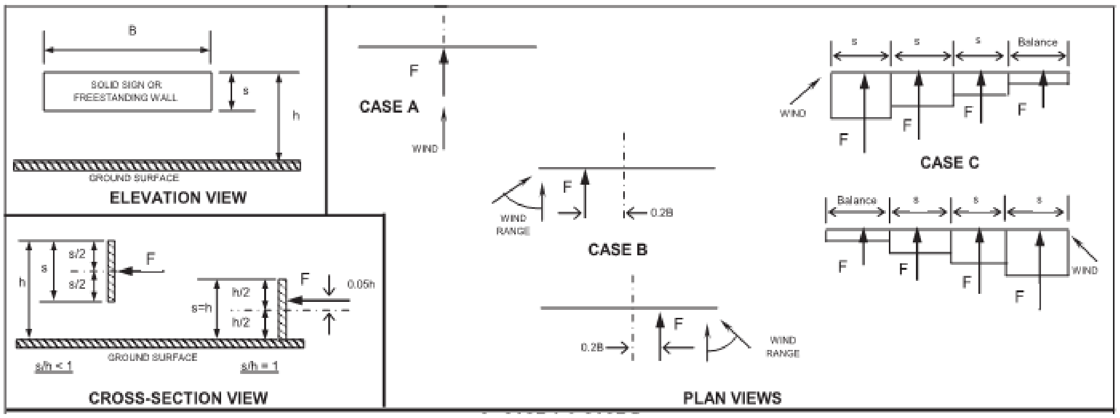
Clark-Reder Engineering, Inc
4828 Business Center Way
Cincinnati, OH 45246

CLARK REDER ENGINEERING

Phone (513) 851-1223
Fax (513) 297-0934
www.clarkreder.com

Wind Loads on Solid Freestanding Walls & Solid Signs (ASCE 7-05)

This Mathcad sheet calculates the wind pressures on a sign or scrim in accordance with figure 6-20 of ASCE 7-05.



Wind Velocity Pressure

The velocity pressure below is calculated for two separate cases. The first case calculates a velocity pressure for a basic wind speed of 90 mph reduced in accordance with ASCE37-02. The second case calculates a velocity pressure for a lower wind speed which is applicable while the High Wind Action Plan (HWAP) is in place. The occupancy category is II.

Exposure Category C

Basic wind speed: $V_w := 90$ mph

HWAP wind speed: $V_{hwap} := 40$ mph *Used as a starting point for wind loads on video screen*

Importance factor: $I_w := 1.0$

Mean roof height: $h_{mean} := 36ft$

Gust effect factor: $G_w := 0.85$

Velocity pressure exposure coefficient: $K_z := 1.01$

Topographic factor: $K_{zt} := 1.0$

Wind directionality factor: $K_d := 0.85$

Reduction coefficient: $red := 0.75$ *per ASCE 37-02 reduction for structures installed for 6 weeks to 1 year.*

ASCE 37-02 Reduction Factor

6.2.1 Design Velocity

The design wind speed shall be taken as the following factor multiplied by the basic wind speed in ASCE 7-95:

Construction Period	Factor
less than 6 weeks	0.75
6 weeks to 1 year	0.8
1 to 2 years	0.85
2 to 5 years	0.9

Wind velocity pressure: $q_z := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot I_w \cdot (red \cdot V_w)^2 \cdot psf$ $\quad q_z = 10.014 \cdot psf$

HWAP Wind velocity pressure: $q_{z\_hwap} := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot I_w \cdot V_{hwap}^{\ 2} \cdot psf$ $\quad q_{z\_hwap} = 3.516 \cdot psf$

Figure 6-20 - Solid Freestanding Walls & Solid Signs (ASCE 7-05)

Sign Dimensions - Video Screen measurements

Sign Width: $B_{sign1} := 20 \cdot ft$

Top of sign height: $h_{sign} := 30 \cdot ft$

Vertical dimension of sign: $s_{sign1} := 12 \cdot ft$

Aspect ratio, B/s: $B\_over\_s := \dfrac{B_{sign1}}{s_{sign1}} = 1.667$

Clearance ratio, s/h: $s\_over\_h := \dfrac{s_{sign1}}{h_{sign}} = 0.4$

C_f, CASE A & CASE B

Clearance Ratio, s/h	Aspect Ratio, B/s											
	≤ 0.05	0.1	0.2	0.5	1	2	4	5	10	20	30	≥ 45
1	1.80	1.70	1.65	1.55	1.45	1.40	1.35	1.35	1.30	1.30	1.30	1.30
0.9	1.85	1.75	1.70	1.60	1.55	1.50	1.45	1.45	1.40	1.40	1.40	1.40
0.7	1.90	1.85	1.75	1.70	1.65	1.60	1.60	1.55	1.55	1.55	1.55	1.55
0.5	1.95	1.85	1.80	1.75	1.75	1.70	1.70	1.70	1.70	1.70	1.70	1.75
0.3	1.95	1.90	1.85	1.80	1.80	1.80	1.80	1.80	1.80	1.85	1.85	1.85
0.2	1.95	1.90	1.85	1.80	1.80	1.80	1.80	1.80	1.85	1.90	1.90	1.95
≤ 0.16	1.95	1.90	1.85	1.85	1.80	1.80	1.85	1.85	1.85	1.90	1.90	1.95

C_f, CASE C

Region (horizontal distance from windward edge)	Aspect Ratio, B/s									Region (horizontal distance from windward edge)	Aspect Ratio, B/s	
	2	3	4	5	6	7	8	9	10		13	≥ 45
0 to s	2.25	2.60	2.90	3.10*	3.30*	3.40*	3.55*	3.65*	3.75*	0 to s	4.00*	4.30*
s to 2s	1.50	1.70	1.90	2.00	2.15	2.25	2.30	2.35	2.45	s to 2s	2.60	2.55
2s to 3s		1.15	1.30	1.45	1.55	1.65	1.70	1.75	1.85	2s to 3s	2.00	1.95
3s to 10s			1.10	1.05	1.05	1.05	1.05	1.00	0.95	3s to 4s	1.50	1.85
										4s to 5s	1.35	1.85
										5s to 10s	0.90	1.10
										>10s	0.55	0.55

*Values shall be multiplied by the following reduction factor when a return corner is present:

L_r/s	Reduction Factor
0.3	0.90
1.0	0.75
≥ 2	0.60

PLAN VIEW OF WALL OR SIGN WITH A RETURN CORNER

L_r

WIND

B

Case A & B

Force coefficient: $C_{f\_AB} := 1.76$

Case A & B sign wind pressures

$p_{sign\_AB1} := q_z \cdot C_{f\_AB} \cdot G_w$ $\qquad p_{sign\_AB1} = 14.98 \cdot psf$

$p_{sign\_AB\_hwap1} := q_{z\_hwap} \cdot C_{f\_AB} \cdot G_w$ $\qquad p_{sign\_AB\_hwap1} = 5.261 \cdot psf$

Case A & B total sign wind load:

$P_{sign\_AB} := p_{sign\_AB1} \cdot B_{sign1} \cdot s_{sign1}$ $\qquad P_{sign\_AB} = 3.595 \cdot kip$

$P_{sign\_AB\_hwap} := p_{sign\_AB\_hwap1} \cdot B_{sign1} \cdot s_{sign1}$ $\qquad P_{sign\_AB\_hwap} = 1.263 \cdot kip$

Figure 6-23 - Open Structures - Truss Towers (ASCE 7-05)

Use trussed tower to determine the wind loads on the truss towers.

Ratio of solid area to gross area: $\varepsilon_{truss} := 0.3$ typical for aluminum truss

Factor for round members: $c_{round} := \text{if}\left(0.51 \cdot \varepsilon_{truss}^{\ 2} + 0.57 > 1, 1, 0.51 \cdot \varepsilon_{truss}^{\ 2} + 0.57\right) = 0.616$

Force coefficient: $Cf_{tower} := \left(4.0 \cdot \varepsilon_{truss}^{\ 2} - 5.9 \cdot \varepsilon_{truss} + 4.0\right) \cdot c_{round} = 1.595$

Wind on truss

$w_{cl\_truss} := q_z \cdot Cf_{tower} \cdot G_w \cdot 16 \cdot in \cdot \varepsilon_{truss}$ $w_{cl\_truss} = 5.431 \cdot plf$

$w_{cl\_truss\_hwap} := q_{z\_hwap} \cdot Cf_{tower} \cdot G_w \cdot 16 \cdot in \cdot \varepsilon_{truss}$ $w_{cl\_truss\_hwap} = 1.907 \cdot plf$

Clark-Reder Engineering, Inc
4828 Business Center Way
Cincinnati, OH 45246

Phone (513) 851-1223
Fax (513) 297-0934
www.clarkreder.com

16" x 16" Box Truss

Truss Chords - 1 1/2"ϕ Schedule 40 pipe

$D_c := 1.9 \cdot in$ $A_c := 0.799 \cdot in^2$ $I_c := 0.310 \cdot in^4$ $J_c := 0.620 \cdot in^4$ $wt_c := 0.940 \cdot plf$

$t_c := 0.145 \cdot in$ $S_c := 0.326 \cdot in^3$ $r_c := 0.623 \cdot in$ $R\_t_c := 6.1$

Diagonals - 3/4"ϕ Schedule 40 pipe

$D_{diag} := 1.05 \cdot in$ $A_{diag} := 0.312 \cdot in^2$ $I_{diag} := 0.035 \cdot in^4$ $J_{diag} := 0.007 \cdot in^4$ $wt_{diag} := 0.366 \cdot plf$

$t_{diag} := 0.113 \cdot in$ $S_{diag} := 0.067 \cdot in^3$ $r_{diag} := 0.336 \cdot in$ $R\_t_{diag} := 4.03$

16" x 16" Box Truss Tower

Tower Chords - 1-1/2"ϕ Schedule 80 pipe

$D_{tc} := 1.9 \cdot in$ $A_{tc} := 1.07 \cdot in^2$ $I_{tc} := 0.391 \cdot in^4$ $J_{tc} := 0.7824 \cdot in^4$ $wt_{tc} := 1.26 \cdot plf$

$t_{tc} := 0.200 \cdot in$ $S_{tc} := 0.412 \cdot in^3$ $r_{tc} := 0.605 \cdot in$ $R\_t_{tc} := 4.3$

Diagonals same as truss above.

Global Truss Properties

Truss center of chord to center of chord depth: $d_{tr} := 16 \cdot in - D_c = 14.1 \cdot in$

Truss center of chord to center of chord width: $b_{tr} := 16 \cdot in - D_c = 14.1 \cdot in$

Area of truss: $A_{tr} := 4 \cdot A_c$ $A_{tr} = 3.196 \cdot in^2$

Moment of inertia of truss: $I_{tr} := 4 \cdot \left[I_c + A_c \cdot \left(\frac{d_{tr}}{2} \right)^2 \right]$ $I_{tr} = 160.089 \cdot in^4$

Radius of gyration of truss: $r_{tr} := \sqrt{\frac{I_{tr}}{A_{tr}}}$ $r_{tr} = 7.077 \cdot in$

Modulus of Elasticity of truss: $E_{tr} := 10100 \cdot ksi$

Truss Diagonals

The vertical diagonals are 6061-T6 aluminum.

Length of diagonals: $L_{diag} := 17.25 \cdot in$

Axial tension - D.2a/b

Allowable stress (weld affected): $F_{t\_D2a\_haz\_cl} := 9.1 \cdot ksi$ axial tension on gross

Allowable stress (weld affected): $F_{t\_D2b\_net\_haz\_cl} := 12.3 \cdot ksi$ axial tension on net

Compression in diagonal - E.3

Slenderness: $S_{E.3\_diag} := \frac{1.0 \cdot L_{diag}}{r_{diag}}$ $S_{E.3\_diag} = 51.339$

Allowable stress (unwelded):

$$F_{c\_E3\_diag} := \begin{cases} (20.3 - 0.127 \cdot S_{E.3\_diag}) \cdot ksi & \text{if } S_{E.3\_diag} < 66 \\ \left(\frac{51352}{S_{E.3\_diag}^{\ 2}}\right) \cdot ksi & \text{if } S_{E.3\_diag} \geq 66 \end{cases}$$

$F_{c\_E3\_diag} = 13.78 \cdot ksi$

Compression in diagonal - B5.4.5 - WELD AFFECTED

Slenderness: $S_{B545\_diag} := R\_t_{diag}$ $S_{B545\_diag} = 4.03$

Allowable stress:

$$F_{c\_B545\_diag\_haz} := \begin{cases} (9.1 \cdot ksi) & \text{if } S_{B545\_diag} \leq 46.4 \\ \left(11.8 - 0.396 \cdot \sqrt{S_{B545\_diag}}\right) \cdot ksi & \text{if } 46.4 < S_{B545\_diag} < 390 \\ \left[\frac{3776}{S_{B545\_diag} \cdot \left(1 + \frac{\sqrt{S_{B545\_diag}}}{35}\right)^2}\right] \cdot ksi & \text{if } 390 \leq S_{B545\_diag} \end{cases}$$

$F_{c\_B545\_diag\_haz} = 9.1 \cdot ksi$

Diagonal tension capacity: $T_{diag} := A_{diag} \cdot F_{t\_D2a\_haz\_cl}$ $T_{diag} = 2.839 \cdot kip$

Diagonal compression capacity: $C_{diag} := A_{diag} \cdot \min(F_{c\_E3\_diag}, F_{c\_B545\_diag\_haz})$ $C_{diag} = 2.839 \cdot kip$

Weld of Diagonal to Chord

Per J.2.2.2 stress on a fillet weld shall be considered to be shear for any direction of applied load.

Filler shear ultimate (4043): $F_{suf} := 11.5ksi$

Base metal shear ultimate welded: $F_{suw} := 15ksi$

Base metal tensile ultimate welded (6061-T6): $F_{tuw} := 24ksi$

Safety factor $n_u := 1.95$

Angle of diagonal to horizontal: $\theta_d := 45 \cdot deg$

Length of weld $L_{weld\_d} := \pi \sqrt{2 \cdot \left[\left(\frac{D_{diag}}{\sin(\theta_d)} \cdot 0.5\right)^2 + \left(D_{diag} \cdot 0.5\right)^2\right]}$ ellipse

Size of weld $S_{weld} := \frac{3}{16} \cdot in$ $\quad L_{weld\_d} = 4.04 \cdot in$

Effective throat of fillet weld $E_{weld} := S_{weld} \frac{\sqrt{2}}{2}$ $\quad E_{weld} = 0.1326 \cdot in$

Weld shear stress $F_{sw} := \min(F_{suf} \cdot E_{weld}, F_{suw} \cdot S_{weld}, F_{tuw} \cdot S_{weld})$

$F_{sw} = 1.525 \cdot \frac{kip}{in}$

Allowable shear force in fillet weld $V_w := \frac{F_{sw} \cdot L_{weld\_d}}{n_u}$ $\quad V_w = 3.159 \cdot kip$

Diag capacity: $P_{diag} := \min(T_{diag}, C_{diag}, V_w)$ $\quad P_{diag} = 2.839 \cdot kip$

Truss Chords

The bottom chords are 6061-T6 aluminum.

Unbraced length of chords: $L_c := 20 \cdot in$

Axial Capacity

Axial tension - D.2a/b

Allowable stress (weld affected): $F_{t\_D2\_c\_haz\_cl} := 9.1 \cdot ksi$

Compression in chord - E.3

Slenderness: $S_{E3\_c} := \dfrac{0.9 \cdot L_c}{r_c}$ $\quad S_{E3\_c} = 28.892$

Allowable stress (weld affected):

$$F_{c\_E3\_c\_haz\_cl} := \begin{cases} (20.3 - 0.127 \cdot S_{E3\_c}) \cdot ksi & \text{if } (0 < S_{E3\_c}) \wedge (66 > S_{E3\_c}) \\ \left(\dfrac{51352}{S_{E3\_c}^{\ 2}}\right) \cdot ksi & \text{if } 66 < S_{E3\_c} \end{cases}$$

$F_{c\_E3\_c\_haz\_cl} = 16.6 \cdot ksi$

Compression in chord - B.5.4.5

Slenderness: $S_{B545\_c} := R\_t_c$ $\quad S_{B545\_c} = 6.1$

Allowable stress (weld affected):

$$F_{c\_B545\_c\_haz\_cl} := \begin{cases} (9.1 \cdot ksi) & \text{if } S_{B545\_c} \le 46.4 \\ \left(11.8 - 0.396 \cdot \sqrt{S_{B545\_c}}\right) \cdot ksi & \text{if } (46.4 < S_{B545\_c}) \wedge (390 \ge S_{B545\_c}) \\ \left[\dfrac{3776}{S_{B545\_c} \cdot \left(1 + \dfrac{\sqrt{S_{B545\_c}}}{35}\right)^2}\right] \cdot ksi & \text{if } 390 < S_{B545\_c} \end{cases}$$

$F_{c\_B545\_c\_haz\_cl} = 9.1 \cdot ksi$

Chord tension capacity: $T_c := A_c \cdot F_{t\_D2\_c\_haz\_cl}$ $\quad T_c = 7.271 \cdot kip$

Chord compression capacity: $C_c := A_c \cdot \min(F_{c\_E3\_c\_haz\_cl}, F_{c\_B545\_c\_haz\_cl})$ $\quad C_c = 7.271 \cdot kip$

Chord axial capacity: $P_{chord} := \min(T_c, C_c)$ $\quad P_{chord} = 7.271 \cdot kip$

Clark-Reder Engineering, Inc
4828 Business Center Way
Cincinnati, OH 45246

CLARK REDER ENGINEERING

Phone (513) 851-1223
Fax (513) 297-0934
www.clarkreder.com

Tower Truss Chords

The bottom chords are 6061-T6 aluminum.

Unbraced length of chords: $L_{tc} := 20 \cdot in$

Axial Capacity

Axial tension - D.2a/b

Allowable stress (weld affected): $F_{t\_D2\_tc\_haz\_cl} := 9.1 \cdot ksi$

Compression in chord - E.3

Slenderness: $S_{E3\_tc} := \dfrac{0.9 \cdot L_{tc}}{r_{tc}}$ $\quad S_{E3\_c} = 28.892$

Allowable stress (weld affected):

$$F_{c\_E3\_tc\_haz\_cl} := \begin{cases} (20.3 - 0.127 \cdot S_{E3\_tc}) \cdot ksi & \text{if } (0 < S_{E3\_tc}) \wedge (66 > S_{E3\_tc}) \\ \left(\dfrac{51352}{S_{E3\_tc}^{\ 2}}\right) \cdot ksi & \text{if } 66 < S_{E3\_tc} \end{cases}$$

$F_{c\_E3\_tc\_haz\_cl} = 16.5 \cdot ksi$

Compression in chord - B.5.4.5

Slenderness: $S_{B545\_tc} := R\_t_{tc}$ $\quad S_{B545\_c} = 6.1$

Allowable stress (weld affected):

$$F_{c\_B545\_tc\_haz\_cl} := \begin{cases} (9.1 \cdot ksi) & \text{if } S_{B545\_tc} \le 46.4 \\ \left(11.8 - 0.396 \cdot \sqrt{S_{B545\_tc}}\right) \cdot ksi & \text{if } (46.4 < S_{B545\_tc}) \wedge (390 \ge S_{B545\_tc}) \\ \left[\dfrac{3776}{S_{B545\_tc} \cdot \left(1 + \dfrac{\sqrt{S_{B545\_tc}}}{35}\right)^2}\right] \cdot ksi & \text{if } 390 < S_{B545\_tc} \end{cases}$$

$F_{c\_B545\_tc\_haz\_cl} = 9.1 \cdot ksi$

Chord tension capacity: $T_{tc} := A_{tc} \cdot F_{t\_D2\_tc\_haz\_cl}$ $\quad T_{tc} = 9.737 \cdot kip$

Chord compression capacity: $C_{tc} := A_{tc} \cdot \min(F_{c\_E3\_tc\_haz\_cl}, F_{c\_B545\_tc\_haz\_cl})$ $\quad C_{tc} = 9.737 \cdot kip$

Chord axial capacity: $P_{tchord} := \min(T_{tc}, C_{tc})$ $\quad P_{tchord} = 9.737 \cdot kip$

Weld of End Vertical to Chord

Per J.2.2.2 stress on a fillet weld shall be considered to be shear for any direction of applied load.

Filler shear ultimate (4043): $F_{suf} := 11.5ksi$

Base metal shear ultimate welded: $F_{suw} := 15ksi$

Base metal tensile ultimate welded: $F_{tuw} := 24ksi$

Safety factor $n_u := 1.95$

Length of weld $L_{weld} := (1 \cdot in + 2 \cdot in) \cdot 2$ $L_{weld} = 6 \cdot in$

Size of weld $S_{weld} := \frac{3}{16} in$

Effective throat of fillet weld $E_{weld} := S_{weld} \frac{\sqrt{2}}{2}$ $E_{weld} = 0.1326 \cdot in$

Weld shear stress $F_{sw} := \min(F_{suf} \cdot E_{weld}, F_{suw} \cdot S_{weld}, F_{tuw} \cdot S_{weld})$

$F_{sw} = 1.525 \cdot \frac{kip}{in}$

Allowable shear force in fillet weld $V_{w\_end} := \frac{F_{sw} \cdot L_{weld}}{n_u}$ $V_{w\_end} = 4.691 \cdot kip$

Capacity of 5/8" Bolts

The truss to truss connection is made using 5/8" grade 8 bolts at the top and bottom of each truss.

Yield strength: $Fy_{bolt} := 130 \cdot ksi$

Tensile strength: $Fu_{bolt} := 150 \cdot ksi$

Bolt diameter: $d_b := 0.625 \cdot in$

Bolt area: $A_b := \frac{{d_b}^2 \cdot \pi}{4}$

Bolt tensile strength: $Ta_{bolt} := \frac{0.75 \cdot Fu_{bolt} \cdot A_b}{2.0}$ $Ta_{bolt} = 17.257 \cdot kip$

Bolt shear strength: $Va_{bolt} := \frac{0.4 \cdot Fu_{bolt} \cdot A_b}{2.0}$ $Va_{bolt} = 9.204 \cdot kip$

Truss & Tower Allowable Capacities

The allowable moment and shear capacity of the truss will be determined from the capacities determined above.

Truss Capacities

Minimum axial force in chord: $P_{chord\_min} := \min(P_{chord})$

$P_{chord\_min} = 7.271 \cdot kip$

Allowable truss moment capacity: $M_{truss} := 2 \cdot d_{tr} \cdot P_{chord\_min}$ $M_{truss} = 17.087 \cdot kip \cdot ft$

Minimum axial force in diagonal: $P_{diag\_min} := \min(T_{diag}, C_{diag}, V_w)$ $P_{diag\_min} = 2.839 \cdot kip$

Allowable truss shear capacity: $V_{truss} := 2 \cdot \sin(\theta_d) \cdot P_{diag\_min}$ $V_{truss} = 4.015 \cdot kip$

Allowable truss axial capacity: $P_{truss} := 4 \cdot P_{chord}$ $P_{truss} = 29.084 \cdot kip$

Tower Truss Capacities

Allowable tower truss moment capacity: $M_{tower} := 2 \cdot d_{tr} \cdot P_{tchord}$ $M_{tower} = 22.882 \cdot kip \cdot ft$

Allowable tower truss shear capacity: $V_{tower} := V_{truss}$ $V_{tower} = 4.015 \cdot kip$

Allowable tower truss axial capacity: $P_{tower} := 4 \cdot P_{tchord}$ $P_{tower} = 38.948 \cdot kip$

Results from RISA - Truss

The maximum results for each are given below:

	Truss	Tower
Maximum shear	$V_c := 1 \cdot kip$	$V_{tc} := 1.2 \cdot kip$
Maximum axial	$P_c := 1.6 \cdot kip$	$P_{tc} := 1.1 \cdot kip$
Maximum moment	$M_c := 3 \cdot kip \cdot ft$	$M_{tc} := 11 \cdot kip \cdot ft$

Truss Interaction; actual vs. allowable

$$INT_{V\_c} := \frac{V_c}{V_{truss}} = 0.249 \qquad INT_{P\_c} := \frac{P_c}{P_{truss}} = 0.055 \qquad INT_{M\_c} := \frac{M_c}{M_{truss}} = 0.176$$

Truss Tower Interaction; actual vs. allowable

$$INT_{V\_tc} := \frac{V_{tc}}{V_{tower}} = 0.299 \qquad INT_{P\_tc} := \frac{P_{tc}}{P_{tower}} = 0.028 \qquad INT_{M\_tc} := \frac{M_{tc}}{M_{tower}} = 0.481$$

Head Block Beam

The head block beams at the top of each truss tower is composed of (2) C 6 x 3.63.

Unbraced length $L_{C6} := 29 \cdot in$

Properties

$d_{C6} := 6 \cdot in$ $b_{C6} := 2.034 \cdot in$ $tf_{C6} := 0.343 \cdot in$ $tw_{C6} := 0.314 \cdot in$

$A_{C6} := 3.09 \cdot in^2$ $Ix_{C6} := 15.2 \cdot in^4$ $Sx_{C6} := 5.06 \cdot in^3$ $rx_{C6} := 2.22 \cdot in$

$x_{C6} := 0.50 \cdot in$ $Iy_{C6} := 0.87 \cdot in^4$ $Sy_{C6} := 0.56 \cdot in^3$ $ry_{C6} := 0.50 \cdot in$

Flexural Capacity

F.8.1 - Tension

F.8.1.1 - Elements in Uniform Tension

$F_{t\_F.8.1} := 19.5 \cdot ksi$

Allowable moment in the web

$$M_{all\_F.8.1\_w} := \frac{F_{t\_F.8.1} \cdot Ix_{C6}}{\frac{d_{C6}}{2}} \qquad M_{all\_F.8.1\_w} = 8.233 \cdot ft \cdot kip$$

F.8.1.2 - Element in Flexure

$F_{fl\_F.8.1} := 27.6 \cdot ksi$

Allowable moment in the flange

$$M_{all\_F.8.1\_fl} := \frac{F_{fl\_F.8.1} \cdot Ix_{C6}}{d_{C6} - \frac{d_{C6}}{2} - tf_{C6}} \qquad M_{all\_F.8.1\_fl} = 13.158 \cdot ft \cdot kip$$

F.8.2 - Compression

B.5.5.2 - Elements in Flexure

Slenderness: $S_{B552\_c} := \frac{d_{C6} - tf_{C6}}{tf_{C6}}$ $S_{B552\_c} = 16.493$

Allowable stress:

$$F_{c\_B552} := \begin{cases} (27.6 \cdot ksi) & \text{if } S_{B552\_c} \le 9.2 \\ (40.5 - 1.412 \cdot S_{B552\_c}) \cdot ksi & \text{if } (9.2 < S_{B552\_c}) \wedge (19 \ge S_{B552\_c}) \\ \left(\frac{4932}{S_{B552\_c}{}^2}\right) \cdot ksi & \text{if } 19 < S_{B552\_c} \end{cases}$$

$F_{c\_B552} = 17.2 \cdot ksi$

Allowable moment $M_{all\_B552} := \frac{F_{c\_B552} \cdot Ix_{C6}}{\frac{d_{C6}}{2}}$ $M_{all\_B552} = 7.267 \cdot ft \cdot kip$

Allowable moment for flexure $M_{ALL} := \min(M_{all\_F.8.1\_w}, M_{all\_F.8.1\_fl}, M_{all\_B552})$

$M_{ALL} = 7.267 \cdot ft \cdot kip$ this is the allowable moment for one channel

$M_{all\_beam} := 2 \cdot M_{ALL} = 14.535 \cdot ft \cdot kip$ this is the moment for both channels

Existing moment for flexure $P_{C6} := 4 \cdot kip$

$M_{C6} := \frac{2 \cdot P_{C6} \cdot L_{C6}}{4}$ $M_{C6} = 4.833 \cdot ft \cdot kip$

Interaction, actual vs allowable $INT_{C6} := \frac{M_{C6}}{M_{all\_beam}}$

$INT_{C6} = 0.333$

Clark-Reder Engineering, Inc
4828 Business Center Way
Cincinnati, OH 45246

CLARK REDER ENGINEERING

Phone (513) 851-1223
Fax (513) 297-0934
www.clarkreder.com

Overturning Check & Wind Speed @ Height Requirements

Eccentricity is the total leg truss length $ecc := 10 \cdot ft$

Resisting moment is the selfweight of the structure and the selfweight of the video screen (1800#)

$$M_{resist} := (31.75 \cdot ft \cdot 2 \cdot 7 \cdot plf + 1800 \cdot lbf + 21.333 \cdot ft \cdot 7 \cdot plf + 21.333 \cdot ft \cdot 7 \cdot plf + 2 \cdot 7 \cdot plf \cdot 13.25 \cdot ft + 2 \cdot 21.333 \cdot ft \cdot 7 \cdot plf + 14 \cdot lbf \cdot 2) \cdot ecc$$

$M_{resist} = 30.553 \cdot ft \cdot kip$ Resisting moment with screen attached

$$M_{resist\_NS} := (31.75 \cdot ft \cdot 2 \cdot 7 \cdot plf + 21.333 \cdot ft \cdot 7 \cdot plf + 21.333 \cdot ft \cdot 7 \cdot plf + 2 \cdot 7 \cdot plf \cdot 13.25 \cdot ft + 2 \cdot 21.333 \cdot ft \cdot 7 \cdot plf + 14 \cdot lbf \cdot 2) \cdot ecc$$

$M_{resist\_NS} = 12.553 \cdot ft \cdot kip$ Resisting moment with screen removed

$$M_{OT\_qz} := \left[w_{cl\_truss} \cdot \left(h_{sign} + 2ft\right) \cdot \frac{h_{sign} + 2ft}{2} \cdot 2 + w_{cl\_truss} \cdot \left(h_{sign} + 2ft\right) \cdot 23.3 \cdot ft \right]$$

$M_{OT\_qz} = 9.611 \cdot ft \cdot kip$ Overturning moment with screen removed

With the screen removed from the system, the wind speed will have to be reduced to meet the OT requiurements.

Apply a reduction to the wind: $redu := \frac{60^2}{67.5^2} = 0.79$

$$M_{OT\_qz\_red} := redu \cdot M_{OT\_qz}$$

$M_{OT\_qz\_red} = 7.594 \cdot kip \cdot ft$

$FS_{qz} := \frac{M_{resist\_NS}}{M_{OT\_qz\_red}} = 1.653$ **Must be 1.5 or greater.**

The bare structure is good in wind speeds of 60 mph.

With the screen at a height of 30' ft...

$h_{sign} := 30 \cdot ft$

$P_{sign\_AB\_hwap} = 1262.534\,lbf$ $\quad w_{cl\_truss\_hwap} = 1.907 \cdot plf$ $\quad$ Values @ 40 mph are used from above

$s_{sign1} = 12\,ft$ $\quad B_{sign1} = 20\,ft$ $\quad A_{sign} = 240\,ft^2$

$$M_{OT\_hwap} := \left[w_{cl\_truss\_hwap} \cdot 2 \cdot 31.25 \cdot ft \cdot \frac{31.25 \cdot ft}{2} + w_{cl\_truss\_hwap} \cdot 21.333 \cdot ft \cdot h_{sign} + P_{sign\_AB\_hwap} \cdot \left(h_{sign} - 2 \cdot ft - \frac{12 \cdot ft}{2} \right) \right]$$

$M_{OT\_hwap} = 30.859 \cdot kip \cdot ft$

The wind speed will have to be reduced to meet the OT requiurements.

Apply a reduction to the wind: $reduc := \frac{30^2}{40^2} = 0.563$

$M_{OT\_hwap\_red} := reduc \cdot M_{OT\_hwap}$

$M_{OT\_hwap\_red} = 17.358 \cdot kip \cdot ft$

$FS_{hwap} := \frac{M_{resist}}{M_{OT\_hwap\_red}} = 1.76$ $\quad$ **Must be 1.5 or greater.**

The screen can be hung in wind speeds of 30 mph.

Clark-Reder Engineering, Inc
4828 Business Center Way
Cincinnati, OH 45246

Phone (513) 851-1223
Fax (513) 297-0934
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With the screen at a height of 25' ft...

$h_{sign} := 25 \cdot ft$

$$M_{OT\_hwap} := \left[w_{cl\_truss\_hwap} \cdot 2 \cdot 31.25 \cdot ft \cdot \frac{31.25 \cdot ft}{2} + w_{cl\_truss\_hwap} \cdot 21.333 \cdot ft \cdot h_{sign} + P_{sign\_AB\_hwap} \cdot \left(h_{sign} - 2 \cdot ft - \frac{12 \cdot ft}{2} \right) \right]$$

$$M_{OT\_hwap} = 24.343 \cdot kip \cdot ft$$

The wind speed will have to be reduced to meet the OT requiurements.

Apply a reduction to the wind: $reduc := \frac{35^2}{40^2} = 0.766$

$$M_{OT\_hwap\_red} := reduc \cdot M_{OT\_hwap}$$

$$M_{OT\_hwap\_red} = 18.637 \cdot kip \cdot ft$$

$FS_{hwap} := \frac{M_{resist}}{M_{OT\_hwap\_red}} = 1.639$ **Must be 1.5 or greater.**

The screen can be hung in wind speeds of 35 mph.

With the screen at a height of 20' ft...

$h_{sign} := 20 \cdot ft$

$$M_{OT\_hwap} := \left[w_{cl\_truss\_hwap} \cdot 2 \cdot 31.25 \cdot ft \cdot \frac{31.25 \cdot ft}{2} + w_{cl\_truss\_hwap} \cdot 21.333 \cdot ft \cdot h_{sign} + P_{sign\_AB\_hwap} \cdot \left(h_{sign} - 2 \cdot ft - \frac{12 \cdot ft}{2} \right) \right]$$

$M_{OT\_hwap} = 17.827 \cdot kip \cdot ft$

The wind speed will have to be reduced to meet the OT requiurements.

Apply a reduction to the wind: $reduc := \frac{40^2}{40^2} = 1$

$M_{OT\_hwap\_red} := reduc \cdot M_{OT\_hwap}$

$M_{OT\_hwap\_red} = 17.827 \cdot kip \cdot ft$

$FS_{hwap} := \frac{M_{resist}}{M_{OT\_hwap\_red}} = 1.714$ **Must be 1.5 or greater.**

The screen can be hung in wind speeds of 40 mph.

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With the screen at a height of 12' ft...

$h_{sign} := 12 \cdot ft$

$$M_{OT\_hwap} := \left[w_{cl\_truss\_hwap} \cdot 2 \cdot 31.25 \cdot ft \cdot \frac{31.25 \cdot ft}{2} + w_{cl\_truss\_hwap} \cdot 21.333 \cdot ft \cdot h_{sign} + P_{sign\_AB\_hwap} \cdot \left(h_{sign} - 2 \cdot ft - \frac{12 \cdot ft}{2} \right) \right]$$

$M_{OT\_hwap} = 7.401 \cdot kip \cdot ft$

The wind speed will have to be reduced to meet the OT requiurements.

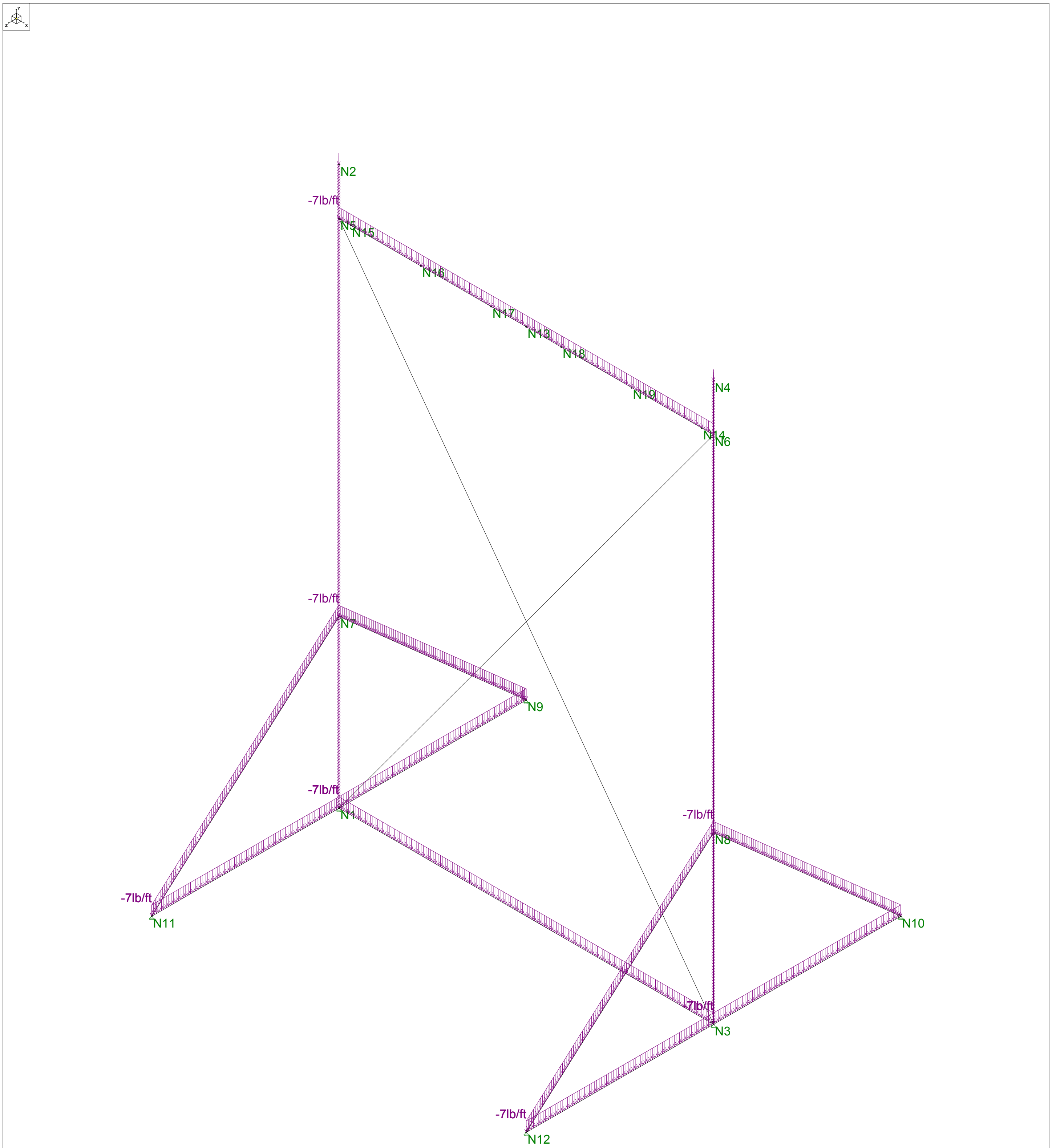
Apply a reduction to the wind: $reduc := \frac{45^2}{40^2} = 1.266$

$M_{OT\_hwap\_red} := reduc \cdot M_{OT\_hwap}$

$M_{OT\_hwap\_red} = 9.367 \cdot kip \cdot ft$

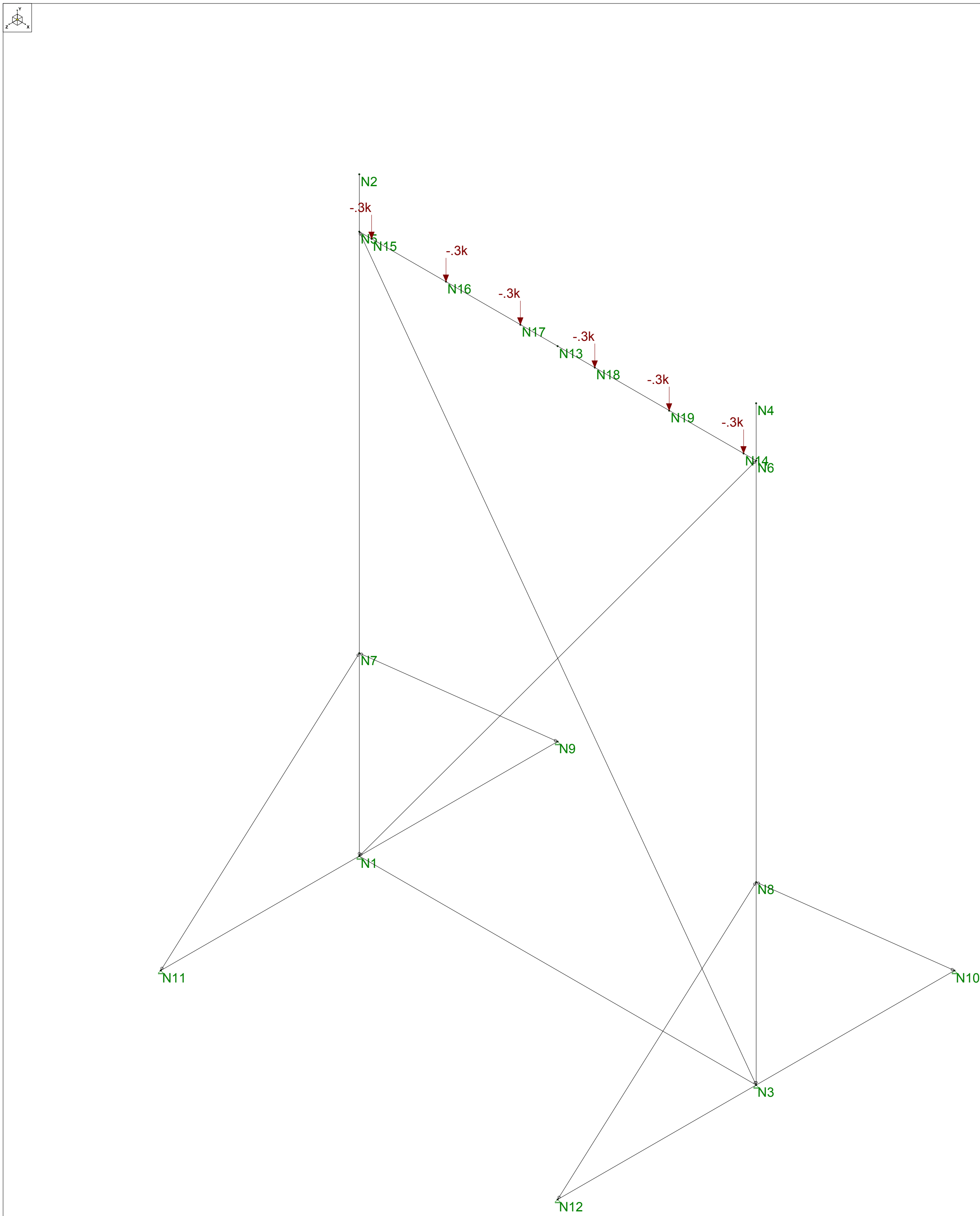
$$FS_{hwap} := \frac{M_{resist}}{M_{OT\_hwap\_red}} = 3.262$$

The screen can be hung in wind speeds of 45 mph.



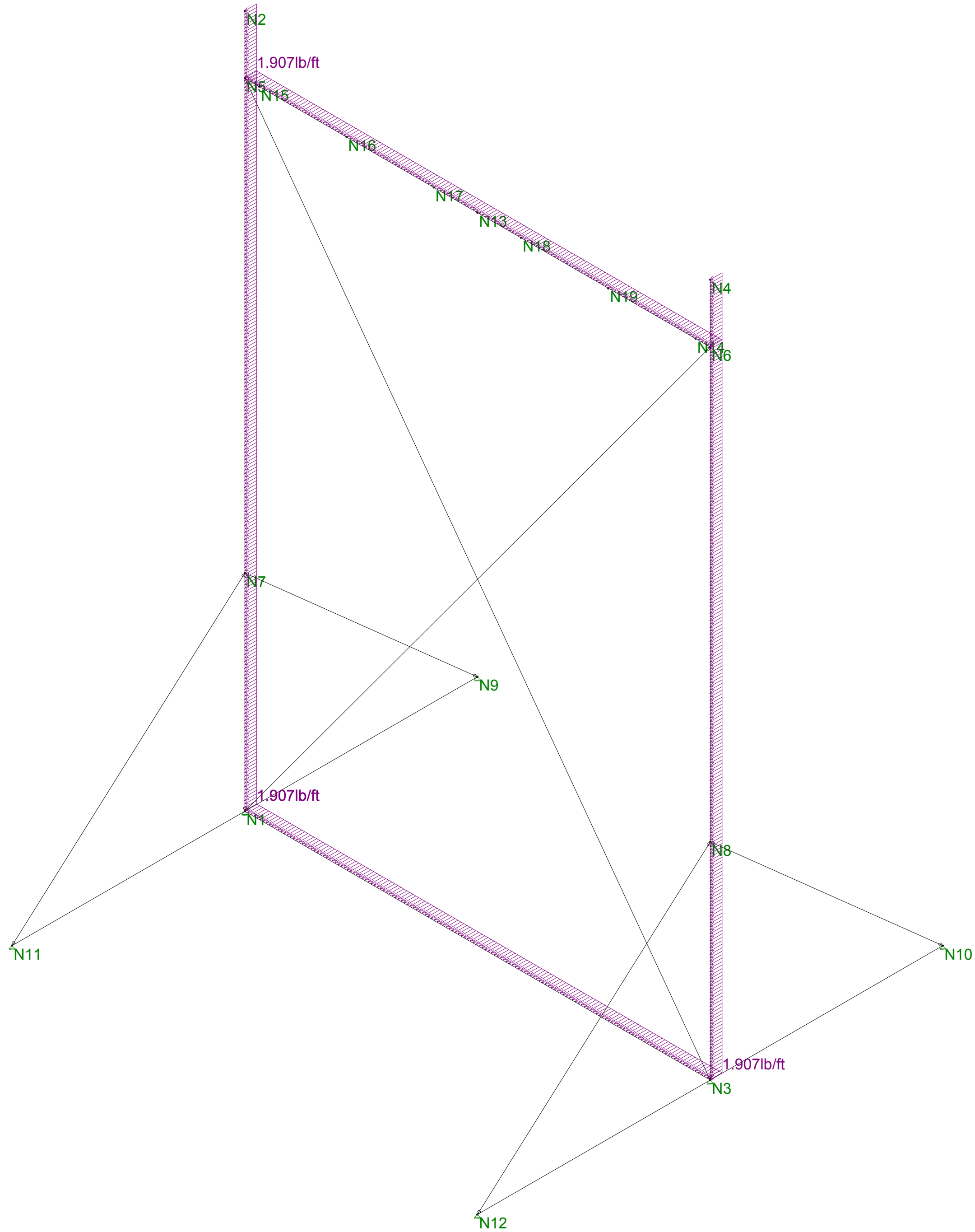
Loads: BLC 1, Selfweight
Envelope Only Solution

Clark-Reder Engineering I...		SK - 1
SSH	Zasco	Mar 5, 2014 at 11:43 AM
14.601.16	Selfweight	Zasco_revise.r3d



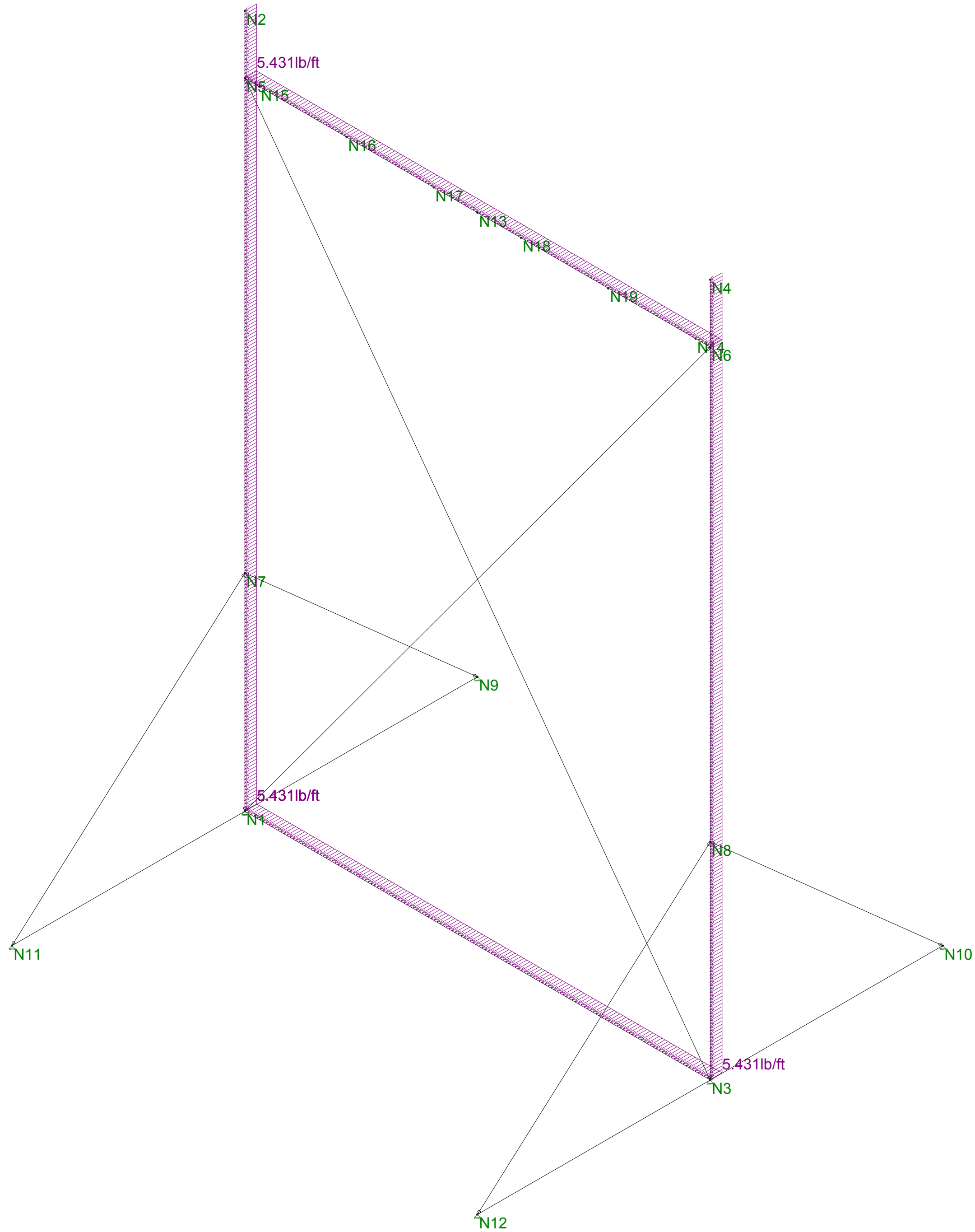
Loads: BLC 2, Video Screen
Envelope Only Solution

Clark-Reder Engineering I...		SK - 2
SSH	Zasco	Mar 5, 2014 at 11:43 AM
14.601.16	Video Screen	Zasco_revise.r3d



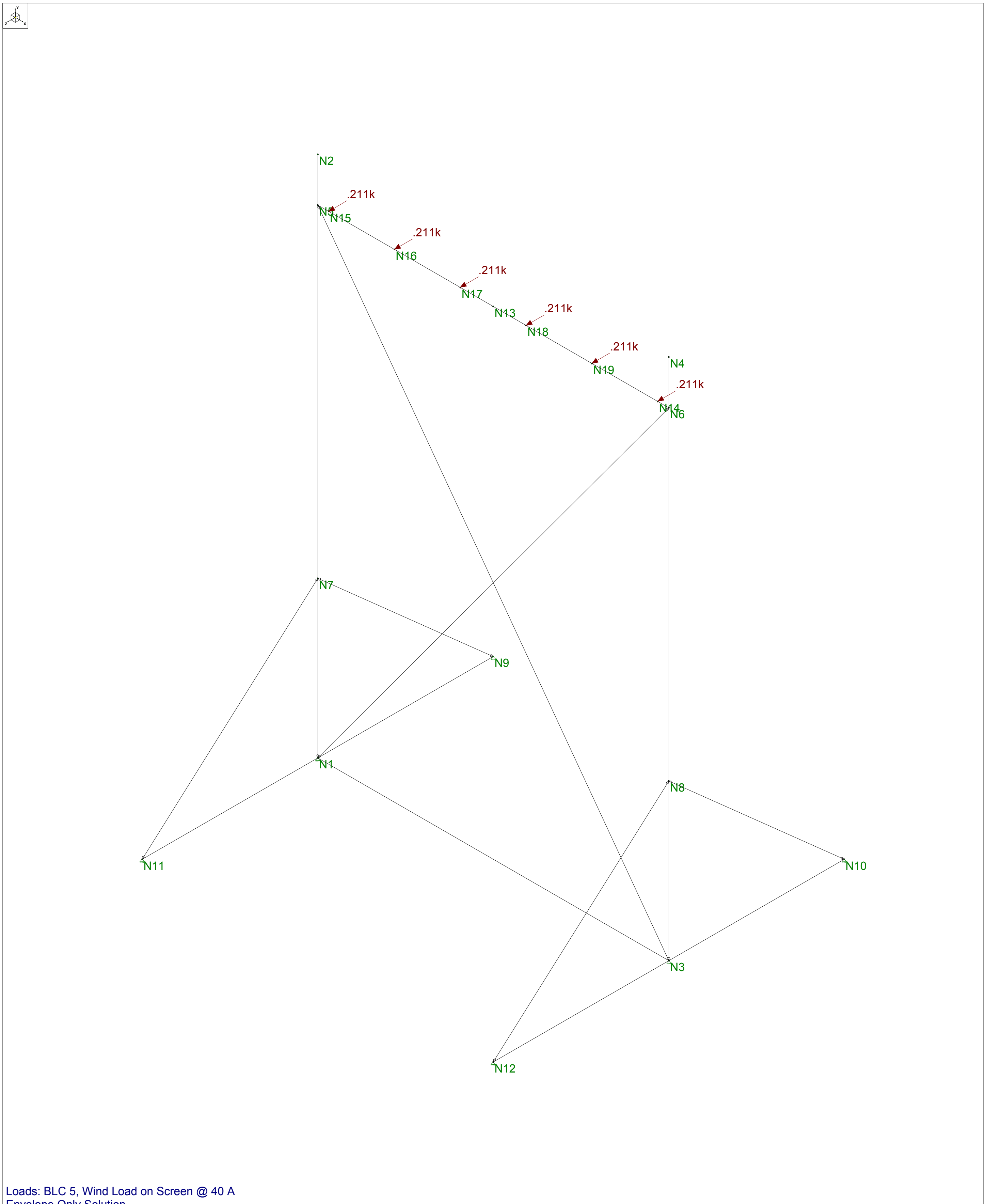
Loads: BLC 3, Wind Load Z-direction @ 40mph
Envelope Only Solution

Clark-Reder Engineering I...		SK - 3
SSH	Zasco	Mar 5, 2014 at 11:44 AM
14.601.16	Wind Load on Truss HWAP	Zasco_revise.r3d



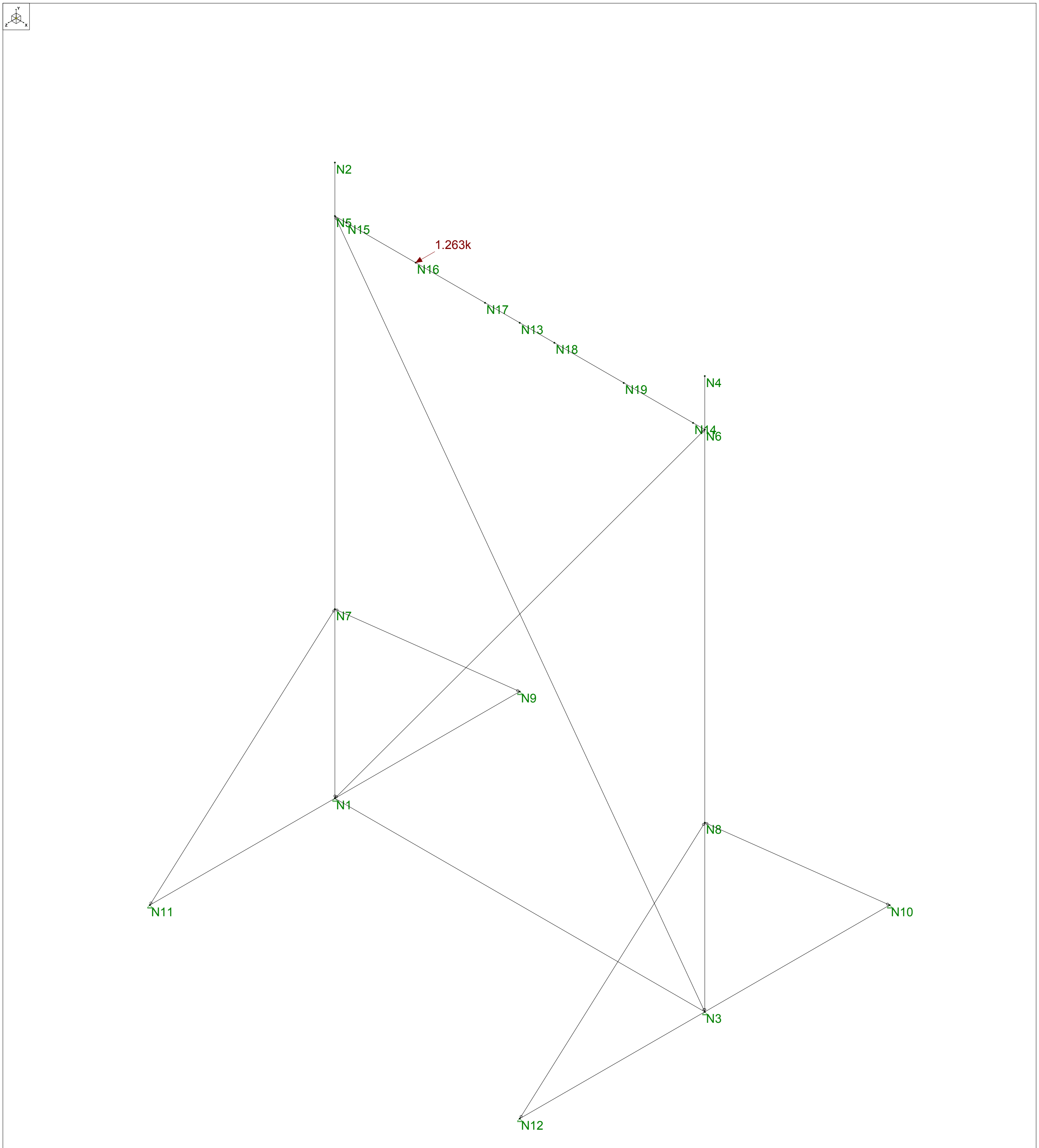
Loads: BLC 4, Wind Load Z-direction @ 67.5mph
Envelope Only Solution

Clark-Reder Engineering I...		SK - 4
SSH	Zasco	Mar 5, 2014 at 11:44 AM
14.601.16	Wind Load on Truss	Zasco_revise.r3d



Loads: BLC 5, Wind Load on Screen @ 40 A
Envelope Only Solution

Clark-Reder Engineering I...		SK - 5
SSH	Zasco	Mar 5, 2014 at 11:45 AM
14.601.16	Wind Load on Video Screen HWAP Case A	Zasco_revise.r3d



Loads: BLC 6, Wind Load on Screen @ 40 B
Envelope Only Solution

Clark-Reder Engineering I...		SK - 6
SSH	Zasco	Mar 5, 2014 at 11:45 AM
14.601.16	Wind Load on Video Screen HWAP Case B	Zasco_revise.r3d

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distribut...	Area(Me...	Surface(...
1	Selfweight	None						12		
2	Video Screen	None				6				
3	Wind Load Z-direction @ 40mph	None						4		
4	Wind Load Z-direction @ 67.5mph	None						4		
5	Wind Load on Screen @ 40 A	None				6				
6	Wind Load on Screen @ 40 B	None				1				

Load Combinations

	Description	Solve	PDelta	SRSS	BLC	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...
1	DL+WL @ 40 Case ...				1	1	2	1.5	3	1.5	5	1.5								
2	DL+WL @ 40 Case ...				1	1	2	1.5	3	-1.5	5	-1.5								
3	DL+WL @ 40 Case ...				1	1	2	1.5	3	1.5	6	1.5								
4	DL+WL @ 40 Case ...				1	1	2	1.5	3	-1.5	6	-1.5								
5	DL+WL @ 67.5 + (*1...				1	1			4	1.5										
6	DL+WL @ 67.5 - (*1....				1	1			4	-1.5										
7	DL+WL @ 40 Case ...	Yes			1	1	2	1	3	.563	5	.563								
8	DL+WL @ 40 Case ...	Yes			1	1	2	1	3	-.563	5	-.563								
9	DL+WL @ 40 Case ...	Yes			1	1	2	1	3	.563	6	.563								
10	DL+WL @ 40 Case ...	Yes			1	1	2	1	3	-.563	6	-.563								
11	DL+WL @ 67.5 +	Yes			1	1			4	1										
12	DL+WL @ 67.5 -	Yes			1	1			4	-1										

Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	7	N1	.056	.999	.776	0	0	0
2	7	N3	-.056	.999	.776	0	0	0
3	7	N9	-.002	-.216	-.332	0	0	0
4	7	N10	.002	-.216	-.332	0	0	0
5	7	N11	.002	.838	-.857	0	0	0
6	7	N12	-.002	.838	-.858	0	0	0
7	7	Totals:	0	3.241	-.827			
8	7	COG (ft):	X: 10.667	Y: 20.252	Z: 0			
9	8	N1	.056	.999	-.776	0	0	0
10	8	N3	-.056	.999	-.776	0	0	0
11	8	N9	.002	.838	.857	0	0	0
12	8	N10	-.002	.838	.858	0	0	0
13	8	N11	-.002	-.216	.332	0	0	0
14	8	N12	.002	-.216	.332	0	0	0
15	8	Totals:	0	3.241	.827			
16	8	COG (ft):	X: 10.667	Y: 20.252	Z: 0			
17	9	N1	.056	.999	1.187	0	0	0
18	9	N3	-.056	.999	.362	0	0	0
19	9	N9	-.001	-.486	-.637	0	0	0
20	9	N10	.002	.056	-.025	0	0	0
21	9	N11	.002	1.108	-1.162	0	0	0
22	9	N12	-.002	.565	-.55	0	0	0
23	9	Totals:	0	3.241	-.825			
24	9	COG (ft):	X: 10.667	Y: 20.252	Z: 0			
25	10	N1	.056	.999	-1.187	0	0	0
26	10	N3	-.056	.999	-.362	0	0	0
27	10	N9	.002	1.108	1.162	0	0	0
28	10	N10	-.002	.565	.55	0	0	0
29	10	N11	-.001	-.486	.637	0	0	0

Joint Reactions (Continued)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
30	10	N12	.002	.056	.025	0	0	0
31	10	Totals:	0	3.241	.825			
32	10	COG (ft):	X: 10.667	Y: 20.252	Z: 0			
33	11	N1	.005	.43	.18	0	0	0
34	11	N3	-.005	.43	.18	0	0	0
35	11	N9	-.008	-.062	-.158	0	0	0
36	11	N10	.008	-.062	-.158	0	0	0
37	11	N11	.008	.352	-.31	0	0	0
38	11	N12	-.008	.352	-.31	0	0	0
39	11	Totals:	0	1.441	-.577			
40	11	COG (ft):	X: 10.667	Y: 9.22	Z: 0			
41	12	N1	.005	.43	-.18	0	0	0
42	12	N3	-.005	.43	-.18	0	0	0
43	12	N9	.008	.352	.31	0	0	0
44	12	N10	-.008	.352	.31	0	0	0
45	12	N11	-.008	-.062	.158	0	0	0
46	12	N12	.008	-.062	.158	0	0	0
47	12	Totals:	0	1.441	.577			
48	12	COG (ft):	X: 10.667	Y: 9.22	Z: 0			