Entertainment Engineering Consultants, LLC

July 15, 2024

Global Truss
4295 Charter Street
Los Angeles, CA 90058
ATTN: Tony Gomez

Entertainment Engineering Consultants, LLC
6104 S. Helena St.
Spokane, WA 99223

DT-44P Truss Load Tables

EEC Project #: 24.149.02D

Dear Tony,

We have completed our analysis of the above referenced project according to the provisions and requirements of the 2021 International Building Code and 2022 California Building Code.

A review was performed on the attached modular aluminum box truss designated DT-44P. Spans of unbraced truss were reviewed as simply supported beams for spans up to 12m (39.4ft). For general use, truss tables have been provided on the attached S0.0 drawing.

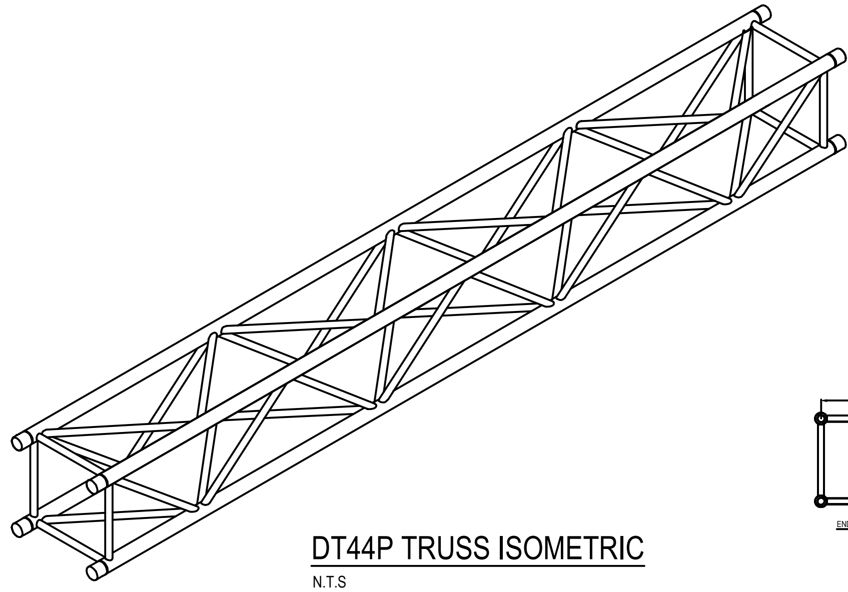
This review in no way shall be conceived as authorizing or approving a specific installation or usage of the aluminum box truss. All structures, lighting plots, or other uses of the aluminum truss shall be reviewed by a licensed professional engineer.

Sincerely,

2024-07-16

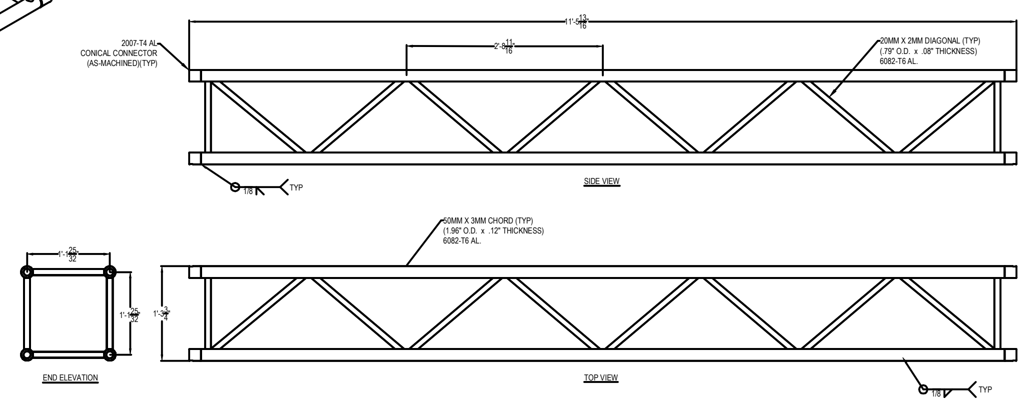
LICENSED PROFESSIONAL ENGINEER
ANDREW L SAVAGE
C 95116
EXP. 2025-09-30
CIVIL
STATE OF CALIFORNIA

Andrew L. Savage, P.E.
CA Registration No.: 95116



DT44P TRUSS ISOMETRIC

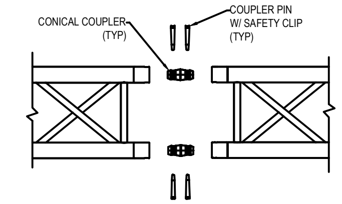
N.T.S



TYPICAL DT44P TRUSS

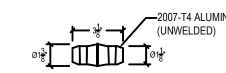
1/8" = 1'-0"

NOTES:
GENERAL CONSTRUCTION SHOWN ONLY. LENGTH OF INDIVIDUAL TRUSS UNITS USED IN CONSTRUCTION WILL VARY
SEE MANUFACTURERS WEBSITE FOR ADDITIONAL INFORMATION ON AVAILABLE LENGTHS.
TRUSS IS FABRICATED USING METRIC UNITS, DIMENSIONS ON THESE DRAWINGS ARE ROUNDED TO THE NEAREST 1/16". DO NOT USE THESE DRAWINGS FOR FABRICATION OR REPAIR. DRAWINGS ARE FOR GENERAL DESCRIPTION AND ALLOWABLE LOADING ONLY.



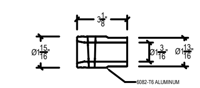
TRUSS TO TRUSS CONNECTION

1/2" = 1'-0"



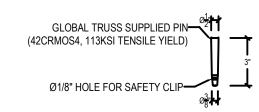
CONICAL COUPLER

1" = 1'-0"



CONICAL ADAPTER

1" = 1'-0"



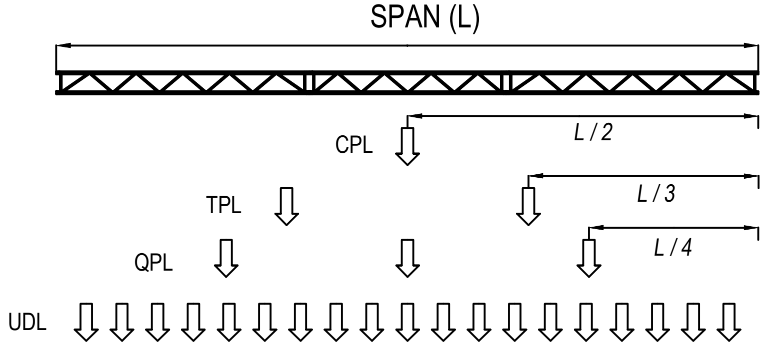
COUPLER PIN

1" = 1'-0"

GENERAL NOTES

REFERENCED CODES
1. 2021 INTERNATIONAL BUILDING CODE
2. 2022 CALIFORNIA BUILDING CODE
3. ANSI E1.2 2021 'ENTERTAINMENT TECHNOLOGY – DESIGN, MANUFACTURE AND USE OF ALUMINUM TRUSSES AND TOWERS'
4. ADM 2015 'SPECIFICATION FOR ALUMINUM STRUCTURES'
5. AISC 360-16 'SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS'

ALUMINUM TRUSS
1. FABRICATION AND ERECTION OF STRUCTURAL ALUMINUM SHALL CONFORM TO THE ALUMINUM DESIGN MANUAL - 2015
2. STRUCTURAL ALUMINUM SHALL BE ALLOY 6082-T6 (U.N.O.)
3. ALL WELD FILLER SHALL BE 5556 (U.N.O.)
4. ALL WELDING MUST CONFORM TO AWS D1.2
5. TAPERED PINS SUPPLIED BY GLOBAL TRUSS MUST BE USED IN INSTALLATION
6. WHERE THE CONTACT OF DISSIMILIAR METALS MAY CAUSE CORROSION, THE CONTACT SURFACE OF EITHER METAL MUST BE PROPERLY COATED TO PREVENT THE EFFECT.



ALLOWABLE LOADING

GLOBAL TRUSS DT44P LOAD SPAN TABLE
Limited based on Strength and L/180 Deflections

TRUSS SPAN		UNIFORMLY DISTRIBUTED LOAD (UDL)		CENTER POINT LOAD (CPL)		THIRD POINT LOADS (TPL)		QUARTER POINT LOADS (QPL)	
METERS	FEET	LOAD (PLF)	DEFLECTION (IN)	LOAD (LBS)	DEFLECTION (IN)	LOAD (LBS)	DEFLECTION (IN)	LOAD (LBS)	DEFLECTION (IN)
2	6.56	430	0.07	2600	0.1	1300	0.07	900	0.08
2.5	8.2	373	0.11	2475	0.15	1295	0.12	890	0.13
3	9.84	315	0.14	2350	0.21	1290	0.17	875	0.18
3.5	11.48	258	0.18	2225	0.26	1280	0.22	865	0.24
4	13.12	200	0.22	2100	0.31	1275	0.27	850	0.29
4.5	14.76	183	0.30	2010	0.39	1270	0.38	840	0.39
5	16.41	165	0.38	1925	0.48	1260	0.50	825	0.50
5.5	18.05	148	0.46	1840	0.56	1255	0.61	815	0.60
6	19.69	130	0.54	1750	0.64	1250	0.73	800	0.70
6.5	21.33	123	0.71	1665	0.75	1245	0.92	790	0.89
7	22.97	115	0.88	1575	0.87	1240	1.11	775	1.08
7.5	24.61	108	1.05	1490	0.98	1230	1.30	765	1.27
8	26.25	100	1.22	1400	1.09	1225	1.49	750	1.46
8.5	27.89	94	1.46	1340	1.24	1145	1.67	725	1.64
9	29.53	88	1.71	1275	1.39	1065	1.84	700	1.82
9.5	31.17	81	1.95	1215	1.54	980	2.01	675	2.01
10	32.81	75	2.19	1150	1.69	900	2.19	650	2.19
10.5	34.45	67	2.3	1115	1.90	835	2.3	600	2.3
11	36.09	59	2.41	1075	2.11	765	2.41	550	2.41
11.5	37.73	51	2.52	1040	2.31	700	2.52	500	2.52
12	39.37	43	2.63	1000	2.52	630	2.63	450	2.63

GLOBAL TRUSS DT44P LOAD SPAN TABLE
Limited based on Strength Only (No Deflection Limits)

TRUSS SPAN		UNIFORMLY DISTRIBUTED LOAD (UDL)		CENTER POINT LOAD (CPL)		THIRD POINT LOADS (TPL)		QUARTER POINT LOADS (QPL)	
METERS	FEET	LOAD (PLF)	DEFLECTION (IN)	LOAD (LBS)	DEFLECTION (IN)	LOAD (LBS)	DEFLECTION (IN)	LOAD (LBS)	DEFLECTION (IN)
2	6.56	430	0.07	2600	0.1	1300	0.07	900	0.08
2.5	8.2	373	0.11	2475	0.15	1295	0.12	890	0.13
3	9.84	315	0.14	2350	0.21	1290	0.17	875	0.18
3.5	11.48	258	0.18	2225	0.26	1280	0.22	865	0.24
4	13.12	200	0.22	2100	0.31	1275	0.27	850	0.29
4.5	14.76	183	0.30	2010	0.39	1270	0.38	840	0.39
5	16.41	165	0.38	1925	0.48	1260	0.50	825	0.50
5.5	18.05	148	0.46	1840	0.56	1255	0.61	815	0.60
6	19.69	130	0.54	1750	0.64	1250	0.73	800	0.70
6.5	21.33	123	0.71	1665	0.75	1245	0.92	790	0.89
7	22.97	115	0.88	1575	0.87	1240	1.11	775	1.08
7.5	24.61	108	1.05	1490	0.98	1230	1.30	765	1.27
8	26.25	100	1.22	1400	1.09	1225	1.49	750	1.46
8.5	27.89	95	1.49	1340	1.24	1155	1.68	735	1.66
9	29.53	90	1.76	1275	1.39	1080	1.87	715	1.87
9.5	31.17	85	2.03	1215	1.54	1010	2.06	700	2.07
10	32.81	80	2.29	1150	1.69	940	2.25	680	2.28
10.5	34.45	74	2.53	1115	1.90	895	2.46	650	2.50
11	36.09	68	2.78	1075	2.11	845	2.68	615	2.72
11.5	37.73	61	3.02	1040	2.32	800	2.89	585	2.95
12	39.37	55	3.26	1000	2.53	750	3.10	550	3.17

GLOBAL TRUSS DT44P LOAD SPAN TABLE
Limited based on Strength and Reduced per ANSI E1.21

TRUSS SPAN		UNIFORMLY DISTRIBUTED LOAD (UDL)		CENTER POINT LOAD (CPL)		THIRD POINT LOADS (TPL)		QUARTER POINT LOADS (QPL)	
METERS	FEET	LOAD (PLF)	DEFLECTION (IN)	LOAD (LBS)	DEFLECTION (IN)	LOAD (LBS)	DEFLECTION (IN)	LOAD (LBS)	DEFLECTION (IN)
2	6.56	366	0.06	2210	0.09	1105	0.06	765	0.07
2.5	8.2	317	0.09	2105	0.13	1100	0.10	755	0.11
3	9.84	268	0.12	2000	0.17	1095	0.14	745	0.16
3.5	11.48	219	0.15	1890	0.22	1090	0.19	735	0.20
4	13.12	170	0.18	1785	0.26	1085	0.23	725	0.25
4.5	14.76	155	0.25	1710	0.33	1080	0.33	710	0.33
5	16.41	140	0.32	1640	0.40	1075	0.42	700	0.42
5.5	18.05	125	0.39	1560	0.47	1070	0.52	690	0.51
6	19.69	111	0.45	1490	0.54	1065	0.62	680	0.60
6.5	21.33	104	0.60	1415	0.64	1065	0.78	670	0.76
7	22.97	98	0.75	1340	0.74	1055	0.94	660	0.92
7.5	24.61	91	0.89	1265	0.83	1050	1.10	650	1.08
8	26.25	85	1.04	1190	0.93	1045	1.27	640	1.24
8.5	27.89	81	1.27	1135	1.05	1040	1.43	625	1.41
9	29.53	77	1.49	1085	1.18	980	1.59	610	1.59
9.5	31.17	72	1.72	1030	1.31	920	1.75	595	1.76
10	32.81	68	1.95	980	1.44	800	1.91	580	1.93
10.5	34.45	63	2.15	945	1.61	760	2.09	550	2.12
11	36.09	57	2.36	915	1.79	720	2.27	525	2.32
11.5	37.73	52	2.57	880	1.97	680	2.45	495	2.51
12	39.37	47	2.77	850	2.15	640	2.64	470	2.70

NOTES:
1. ALL LOADS MUST BE ATTACHED TO TRUSS PANEL POINTS
2. BRIDLES ARE NOT PERMITTED UNLESS APPROVED IN WRITTING BY A LICENSED STRUCTURAL ENGINEER.
3. SELF WEIGHT OF THE TRUSS HAS BEEN INCLUDED IN THE ALLOWABLE LOADING TABLES. NO REDUCTION IS REQUIRED TO ACCOUNT FOR THE TRUSS ITSELF.
4. NO SHOCK OR DYNAMIC FORCES HAVE BEEN INCLUDED IN THE ALLOWABLE LOADING.
5. UNIFORMLY DISTRIBUTED LOADS APPLY ONLY TO LOADS EVENLY DISTRIBUTED ACROSS THE ENTIRE SPAN
6. LOADS SEEN IN THE TABLE ARE NOT ADDITIVE.
7. THE ALLOWABLE LOADING TABLES HAVE BEEN PROVIDED FOR GENERAL REFERENCE ONLY AND ALL RIGGING PLOTS SHOULD BE REVIEWED BY A LICENSED STRUCTURAL ENGINEER.

Entertainment Engineering Consultants, LLC

Entertainment Engineering Consultants, LLC
6104 S. Helena St.
Spokane, WA 99223

Project Name
DT44P Load Span Tables

Event/Venue Name and Address
General Use

Client Name and Address
Global Truss
4295 Charter St..
Los Angeles, CA 90058

ISSUE/REVISIONS

Sheet Name
GENERAL NOTES/ DETAILS

Project No.
24.149.02D

Sheet
S0.0

Date
07/09/2024

Entertainment Engineering Consultants, LLC

Aluminum Truss Calculations - Global Truss DT44P

Project Description

This project is a review of the DT44P aluminum truss for general use. Allowable load span tables will be produced to provide general guidance only. All structures, lighting plots, or other uses of the aluminum truss shall be reviewed by a licensed professional engineer.

Design Codes

- 2021 International Building Code
- ASCE 7-16 '*Minimum Design Loads and Associated Criteria for Buildings and Other Structures'*
- ANSI E1.2 - 2012 *'Entertainment Technology - Design, Manufacture and Use of Aluminum Trusses and Towers'*
- 2020 Aluminum Design Manual

Assumptions

- Load span tables assume a simply supported beam.
- Additional assumptions may be located in the body of the calculations.
- See General Notes on drawing page S1.0
- See Allowable Loading Notes on drawing page S1.0 for important information
- Base metal and weld fillers used based on prior engineering reports provided by Global Truss.

General Design Factors of Safety (U.N.O.)

	Steel	Aluminum
Yield	$\Omega_{s\_y} := 1.67$	$\Omega_{a\_y} := 1.65$
Rupture	$\Omega_{s\_r} := 2$	$\Omega_{a\_r} := 1.95$

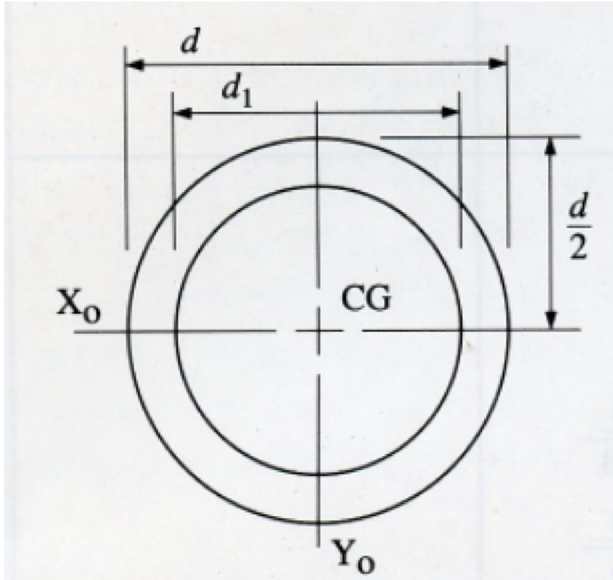
Mechanical Properties 6082-T6 - Base Metal

Modulus of Elasticity	$E_a := 10100 \cdot ksi$
Shear Modulus	$G_a := \frac{3}{8} \cdot E_a = (3.788 \cdot 10^3)\ ksi$
Tensile Yield	$F_{ty} := 38 \cdot ksi$
Tensile Ultimate	$F_{tu} := 45 \cdot ksi$
Shear Yield	$F_{sy} := .6 \cdot F_{ty} = 22.8\ ksi$
Welded Tensile Yield	$F_{tyw} := 16 \cdot ksi$
Welded Comp. Yield	$F_{cyw} := 16 \cdot ksi$
Welded Tensile Ultimate	$F_{tuw} := 28 \cdot ksi$
Welded Shear Yield	$F_{suw} := .6 \cdot F_{tyw} = 9.6\ ksi$

Mechanical Properties - Weld Filler 5556

Tensile Ultimate	$F_{tuw\_filler} := 42 \cdot ksi$

Cross Section Properties



Chords - 50mm x 3mm

Chord thickness $t_{ch} := 3 \cdot mm = 0.118\ in$

Outside and Inside Diameters $OD_{ch} := 50 \cdot mm = 1.969\ in$

$ID_{ch} := OD_{ch} - 2 \cdot t_{ch} = 1.732\ in$

Area $A_{ch} := \dfrac{\pi \cdot \left(OD_{ch}^{\ 2} - ID_{ch}^{\ 2}\right)}{4} = 0.687\ in^2$

Section Modulus $S_{ch} := \dfrac{\pi \cdot \left(OD_{ch}^{\ 4} - ID_{ch}^{\ 4}\right)}{32 \cdot OD_{ch}} = 0.3\ in^3$

Plastic Section Modulus $Z_{ch} := \dfrac{OD_{ch}^{\ 3}}{6} - \dfrac{ID_{ch}^{\ 3}}{6} = 0.405\ in^3$

Moment of Inertia $I_{ch} := \dfrac{\pi \cdot \left(OD_{ch}^{\ 4} - ID_{ch}^{\ 4}\right)}{64} = 0.295\ in^4$

Radius of Gyration $r_{ch} := \dfrac{\sqrt{OD_{ch}^{\ 2} + ID_{ch}^{\ 2}}}{4} = 0.656\ in$

Polar Moment of Interia $J_{ch} := \dfrac{\pi \cdot \left(OD_{ch}^{\ 4} - ID_{ch}^{\ 4}\right)}{32} = 0.59\ in^4$

Unbraced Length $L_{ch} := 546.6 \cdot mm$

Diagonals - 20mm x 2mm

Chord thickness $t_{diag} := 2 \cdot mm = 0.079\ in$

Outside and Inside Diameters $OD_{diag} := 20 \cdot mm = 0.787\ in$ $ID_{diag} := OD_{diag} - 2 \cdot t_{diag} = 0.63\ in$

Area
$$A_{diag} := \frac{\pi \cdot \left(OD_{diag}^{\ 2} - ID_{diag}^{\ 2}\right)}{4} = 0.175\ in^2$$

Section Modulus
$$S_{diag} := \frac{\pi \cdot \left(OD_{diag}^{\ 4} - ID_{diag}^{\ 4}\right)}{32 \cdot OD_{diag}} = 0.028\ in^3$$

Plastic Section Modulus
$$Z_{diag} := \frac{OD_{diag}^{\ 3}}{6} - \frac{ID_{diag}^{\ 3}}{6} = 0.04\ in^3$$

Moment of Inertia
$$I_{diag} := \frac{\pi \cdot \left(OD_{diag}^{\ 4} - ID_{diag}^{\ 4}\right)}{64} = 0.011\ in^4$$

Radius of Gyration
$$r_{diag} := \frac{\sqrt{OD_{diag}^{\ 2} + ID_{diag}^{\ 2}}}{4} = 0.252\ in$$

Polar Moment of Interia
$$J_{diag} := \frac{\pi \cdot \left(OD_{diag}^{\ 4} - ID_{diag}^{\ 4}\right)}{32} = 0.022\ in^4$$

Unbraced Length $L_{diag} := 348.7 \cdot mm$

Perpendicular members - 20mm x 2mm

Chord thickness $t_{perp} := 2 \cdot mm = 0.079\ in$

Outside and Inside Diameters $OD_{perp} := 50 \cdot mm = 1.969\ in$ $ID_{perp} := OD_{perp} - 2 \cdot t_{perp} = 1.811\ in$

Area
$$A_{perp} := \frac{\pi \cdot \left(OD_{perp}^{\ 2} - ID_{perp}^{\ 2}\right)}{4} = 0.467\ in^2$$

Section Modulus
$$S_{perp} := \frac{\pi \cdot \left(OD_{perp}^{\ 4} - ID_{perp}^{\ 4}\right)}{32 \cdot OD_{perp}} = 0.212\ in^3$$

Plastic Section Modulus
$$Z_{perp} := \frac{OD_{perp}^{\ 3}}{6} - \frac{ID_{perp}^{\ 3}}{6} = 0.281\ in^3$$

Moment of Inertia
$$I_{perp} := \frac{\pi \cdot \left(OD_{perp}^{\ 4} - ID_{perp}^{\ 4}\right)}{64} = 0.209\ in^4$$

Radius of Gyration
$$r_{perp} := \frac{\sqrt{OD_{perp}^{\ 2} + ID_{perp}^{\ 2}}}{4} = 0.669\ in$$

Polar Moment of Interia
$$J_{perp} := \frac{\pi \cdot \left(OD_{perp}^{\ 4} - ID_{perp}^{\ 4}\right)}{32} = 0.418\ in^4$$

Unbraced Length $L_{perp} := 240 \cdot mm$

Chord Allowable Stresses and Strengths

Review is based on 2020 ADM Design Aids Table 2-22 and Table 2-22W

Tension Capacity

Axial Tension on gross area (welded) D.2a — $F_{D.2a} := 9.7 \cdot ksi$

Allowable Tensile Yield Stress — $F_{ty\_ch} := F_{D.2a} = 9.7\ ksi$

Allowable Tensile Strength — $T_{ch} := A_{ch} \cdot F_{ty\_ch} = 6.66\ kip$

Compression Capacity

Axial Compression - Member Buckling E.2

Effective Length Factor — $k := .9$

Slenderness Ratio — $kL\_r_{ch} := \dfrac{k \cdot L_{ch}}{r_{ch}} = 29.544$

$$F_{E.2} := ksi \cdot \begin{cases} 9.7 & \text{if } kL\_r_{ch} \le 21.7 \\ \left(.00008 \cdot kL\_r_{ch}^{\ 2} - .074 \cdot kL\_r_{ch} + 11.3\right) & \text{also if } \left(21.7 < kL\_r_{ch}\right) < 129 \\ \dfrac{51352}{kL\_r_{ch}^{\ 2}} & \text{else} \end{cases}$$

$F_{E.2} = 9.184\ ksi$

Elements in Uniform Compression B.5.4.5

Slenderness Ratio — $S_{B545} := \sqrt{\dfrac{.5 \cdot OD_{ch} - .5 \cdot t_{ch}}{t_{ch}}} = 2.799$

$$k_{n\Psi} := \left(1 + \frac{S_{B545}}{35}\right)^2 = 1.166$$

$$F_{B545} := ksi \cdot \begin{cases} (9.7) & \text{if } S_{B545} \le 6.7 \\ (12.6 - .434 \cdot S_{B545}) & \text{also if } 6.7 \le S_{B545} < 19 \\ \dfrac{3776}{S_{B545}^{\ 2} \cdot (k_{n\Psi})} & \text{else} \end{cases} = 9.7\ ksi$$

Allowable Compressive Yield Stress $F_{cy\_ch} := min\left(F_{B545}, F_{E.2}\right) = 9.184\ ksi$

Allowable Compressive Strength $C_{ch} := F_{cy\_ch} \cdot A_{ch} = 6.305\ kip$

Flexural Capacity
Yielding and Rupture F.2

Allowable Flexural Strength

$$M_{F2} := \frac{min\left(1.5 \cdot S_{ch} \cdot F_{tyw}, 1.5 \cdot S_{ch} \cdot F_{cyw}, Z_{ch} \cdot F_{cyw}\right)}{\Omega_{a\_y}} = 3.927\ kip \cdot in$$

Corresponding flexural stress $\dfrac{M_{F2}}{Z_{ch}} = 9.697\ ksi$

Elements in Flexural Compression B.5.5.4

Slenderness Ratio

$$S_{B554} := S_{B545} = 2.799$$

$$F_{B554} := ksi \cdot \begin{cases} (18.9 - 1.021 \cdot S_{B554}) & \text{if } S_{B554} \le 10.7 \\ (12.6 - .434 \cdot S_{B554}) & \text{also if } 10.7 \le S_{B554} < 19 \\ \dfrac{3776}{S_{B545}^{\ 2} \cdot (k_{n\Psi})} & \text{else} \end{cases} = 16.042\ ksi$$

Allowable Flexural Yield Stress

$$F_{by\_ch} := F_{B554} = 16.042\ ksi$$

$$M_{B554} := F_{B554} \cdot Z_{ch} = 6.496\ kip \cdot in$$

Allowable Flexural Strength $M_{ch} := min\left(M_{F2}, M_{B554}\right) = 3.927\ kip \cdot in$

Shear Capacity

Elements in Shear - Pipes - G.4

Length of Tube from Zero to Maximum shear

$$L_v := \frac{L_{ch}}{2}$$

Slenderness Ratio

$$S_{G4} := 2.9 \cdot \left(\frac{.5 \cdot OD_{ch} - .5 \cdot t_{ch}}{t_{ch}}\right)^{\frac{5}{8}} \cdot \left(\frac{L_v}{\left(.5 \cdot OD_{ch} - .5 \cdot t_{ch}\right)}\right)^{\frac{1}{4}} = 19.387$$

$$F_{G4} := \mathbf{ksi} \cdot \begin{cases} 5.8 & \text{if } S_{G4} \le 77.8 \\ \left(7.8 - .056 \cdot S_{G4}\right) & \text{also if } 77.8 < S_{G4} \le 122 \\ \frac{50264}{S_{G4}^{\ 2}} & \text{else} \end{cases} = 5.8\ ksi$$

Allowable Shear Stress

$$F_{v\_ch} := F_{G4} = 5.8\ ksi$$

Allowable Shear Strength

$$V_{ch} := F_{v\_ch} \cdot \frac{A_{ch}}{2} = 1.991\ kip$$

Torsional Capacity

Torsion - Pipes - H.2.1

Slenderness Ratio

$$S_{H21} := 2.9 \cdot \left(\frac{.5 \cdot OD_{ch} - .5 \cdot t_{ch}}{t_{ch}}\right)^{\frac{5}{8}} \cdot \left(\frac{L_v}{\left(.5 \cdot OD_{ch} - .5 \cdot t_{ch}\right)}\right)^{\frac{1}{4}} = 19.387$$

$$F_{H21} := \mathbf{ksi} \cdot \begin{cases} 5.8 & \text{if } S_{G4} \le 46.6 \\ \left(7.8 - .043 \cdot S_{G4}\right) & \text{also if } 46.6 < S_{G4} \le 122 \\ \frac{38665}{S_{G4}^{\ 2}} & \text{else} \end{cases} = 5.8\ ksi$$

Allowable Torsional Stress

$$F_{tor} := F_{H21} = 5.8\ ksi$$

Allowable Torsional Strength

$$Tor_{ch} := \frac{F_{tor} \cdot J_{ch}}{0.5 \cdot OD_{ch}} = 3.477\ kip \cdot in$$

Diagonal Allowable Stresses and Strengths

Review is based on 2020 ADM Design Aids Table 2-22 and Table 2-22W

Tension Capacity

Axial Tension on gross area (welded) D.2a $F_{D.2a} := 9.7 \cdot ksi$

Allowable Tensile Yield Stress $F_{ty\_diag} := F_{D.2a} = 9.7\ ksi$

Allowable Tensile Strength $T_{diag} := A_{diag} \cdot F_{ty\_diag} = 1.7\ kip$

Compression Capacity

Axial Compression - Member Buckling E.2

Effective Length Factor $k := 1$

Slenderness Ratio $kL\_r_{diag} := \dfrac{k \cdot L_{diag}}{r_{diag}} = 54.458$

$$F_{E.2} := ksi \cdot \begin{cases} 9.7 & \text{if } kL\_r_{diag} \le 21.7 \\ (.00008 \cdot kL\_r_{diag}{}^2 - .074 \cdot kL\_r_{diag} + 11.3) & \text{also if } 21.7 < kL\_r_{diag} \le 129 \\ \dfrac{51352}{kL\_r_{diag}{}^2} & \text{else} \end{cases}$$

$F_{E.2} = 7.507\ ksi$

Elements in Uniform Compression B.5.4.5

Slenderness Ratio $S_{B545} := \sqrt{\dfrac{.5 \cdot OD_{diag} - .5 \cdot t_{diag}}{t_{diag}}} = 2.121$

$$k_{n\psi} := \left(1 + \frac{S_{B545}}{35}\right)^2 = 1.125$$

$$F_{B545} := ksi \cdot \begin{cases} (9.7) & \text{if } S_{B545} \le 6.7 \\ (12.6 - .434 \cdot S_{B545}) & \text{also if } 6.7 \le S_{B545} < 19 \\ \dfrac{3776}{S_{B545}{}^2 \cdot (k_{n\psi})} & \text{else} \end{cases} = 9.7\ ksi$$

Allowable Compressive Yield Stress $F_{cy\_diag} := min\left(F_{B545}, F_{E.2}\right) = 7.507\ ksi$

Allowable Compressive Strength $C_{diag} := F_{cy\_diag} \cdot A_{diag} = 1.316\ kip$

Flexural Capacity

Elements in Flexural Compression B.5.5.4

Slenderness Ratio

$$S_{B554} := S_{B545}$$

$$F_{B554} := ksi \cdot \left\| \begin{array}{l} \text{if } S_{B554} \le 10.7 \\ \quad \left\| \left(18.9 - 1.021 \cdot S_{B554}\right) \right. \\ \text{also if } 10.7 \le S_{B554} < 19 \\ \quad \left\| \left(12.6 - .434 \cdot S_{B554}\right) \right. \\ \text{else} \\ \quad \left\| \dfrac{3776}{S_{B545}^{\ 2} \cdot \left(k_{n\Psi}\right)} \right. \end{array} \right\| = 16.734\ ksi$$

Allowable Flexural Yield Stress

$$F_{by\_diag} := F_{B554} = 16.734\ ksi$$

Allowable Flexural Strength

$$M_{diag} := F_{by\_diag} \cdot Z_{diag} = 0.664\ kip \cdot in$$

Shear Capacity

Elements in Shear - Pipes - G.4

Length of Tube from Zero to Maximum shear

$$L_v := \frac{L_{diag}}{2}$$

Slenderness Ratio

$$S_{G4} := 2.9 \cdot \left(\frac{.5 \cdot OD_{diag} - .5 \cdot t_{diag}}{t_{diag}}\right)^{\frac{5}{8}} \cdot \left(\frac{L_v}{\left(.5 \cdot OD_{diag} - .5 \cdot t_{diag}\right)}\right)^{\frac{1}{4}} = 15.576$$

$$F_{G4} := ksi \cdot \left\| \begin{array}{l} \text{if } S_{G4} \le 77.8 \\ \quad \left\| 5.8 \right. \\ \text{also if } 77.8 < S_{G4} \le 122 \\ \quad \left\| \left(7.8 - .056 \cdot S_{G4}\right) \right. \\ \text{else} \\ \quad \left\| \dfrac{50264}{S_{G4}^{\ 2}} \right. \end{array} \right\| = 5.8\ ksi$$

Allowable Shear Stress

$$F_{v\_diag} := F_{G4} = 5.8\ ksi$$

Allowable Shear Strength

$$V_{diag} := F_{v\_diag} \cdot \frac{A_{diag}}{2} = 0.508\ kip$$

Torsional Capacity

Torsion - Pipes - H.2.1

Slenderness Ratio

$$S_{H21} := 2.9 \cdot \left(\frac{.5 \cdot OD_{diag} - .5 \cdot t_{diag}}{t_{diag}}\right)^{\frac{5}{8}} \cdot \left(\frac{L_v}{\left(.5 \cdot OD_{diag} - .5 \cdot t_{diag}\right)}\right)^{\frac{1}{4}} = 15.576$$

$$F_{H21} := \mathbf{ksi} \cdot \begin{Vmatrix} \text{if } S_{G4} \le 46.6 \\ \quad \Vert\ 5.8 \\ \text{also if } 46.6 < S_{G4} \le 122 \\ \quad \Vert\ \left(7.8 - .043 \cdot S_{G4}\right) \\ \text{else} \\ \quad \Vert\ \dfrac{38665}{{S_{G4}}^{2}} \end{Vmatrix} = 5.8\ ksi$$

Allowable Torsional Stress

$$F_{tor} := F_{H21} = 5.8\ ksi$$

Allowable Torsional Strength

$$Tor_{diag} := \frac{J_{diag} \cdot F_{H21}}{0.5 \cdot OD_{diag}} = 0.328\ kip \cdot in$$

Perpendicular Member Allowable Stresses and Strengths

Review is based on 2020 ADM Design Aids Table 2-22 and Table 2-22W

Tension Capacity

Axial Tension on gross area (welded) D.2a — $F_{D.2a} := 9.7 \cdot ksi$

Allowable Tensile Yield Stress — $F_{ty\_perp} := F_{D.2a} = 9.7\ ksi$

Allowable Tensile Strength — $T_{perp} := A_{perp} \cdot F_{ty\_perp} = 4.534\ kip$

Compression Capacity

Axial Compression - Member Buckling E.2

Effective Length Factor — $k := 1$

Slenderness Ratio — $kL\_r_{perp} := \dfrac{k \cdot L_{perp}}{r_{perp}} = 14.13$

$$F_{E.2} := ksi \cdot \begin{cases} 9.7 & \text{if } kL\_r_{perp} \le 21.7 \\ \left(.00008 \cdot kL\_r_{perp}^{\ 2} - .074 \cdot kL\_r_{perp} + 11.3\right) & \text{also if } 21.7 < kL\_r_{perp} \le 129 \\ \dfrac{51352}{kL\_r_{perp}^{\ 2}} & \text{else} \end{cases}$$

$F_{E.2} = 9.7\ ksi$

Elements in Uniform Compression B.5.4.5

Slenderness Ratio — $S_{B545} := \sqrt{\dfrac{.5 \cdot OD_{perp} - .5 \cdot t_{perp}}{t_{perp}}} = 3.464$

$$k_{n\psi} := \left(1 + \frac{S_{B545}}{35}\right)^2 = 1.208$$

$$F_{B545} := ksi \cdot \begin{cases} (9.7) & \text{if } S_{B545} \le 6.7 \\ \left(12.6 - .434 \cdot S_{B545}\right) & \text{also if } 6.7 \le S_{B545} < 19 \\ \dfrac{3776}{S_{B545}^{\ 2} \cdot \left(k_{n\psi}\right)} & \text{else} \end{cases} = 9.7\ ksi$$

Allowable Compressive Yield Stress — $F_{cy\_perp} := min\left(F_{B545}, F_{E.2}\right) = 9.7\ ksi$

Allowable Compressive Strength — $C_{perp} := F_{cy\_perp} \cdot A_{perp} = 4.534\ kip$

Flexural Capacity

Elements in Flexural Compression B.5.5.4

Slenderness Ratio

$$S_{B554} := S_{B545}$$

$$F_{B554} := ksi \cdot \begin{cases} (18.9 - 1.021 \cdot S_{B554}) & \text{if } S_{B554} \le 10.7 \\ (12.6 - .434 \cdot S_{B554}) & \text{also if } 10.7 \le S_{B554} < 19 \\ \dfrac{3776}{S_{B545}^{\ 2} \cdot (k_{n\Psi})} & \text{else} \end{cases} = 15.363\ ksi$$

Allowable Flexural Yield Stress

$$F_{by\_perp} := F_{B554} = 15.363\ ksi$$

Allowable Flexural Strength

$$M_{perp} := F_{by\_perp} \cdot Z_{perp} = 4.323\ kip \cdot in$$

Shear Capacity

Elements in Shear - Pipes - G.4

Length of Tube from Zero to Maximum shear

$$L_v := \frac{L_{perp}}{2}$$

Slenderness Ratio

$$S_{G4} := 2.9 \cdot \left(\frac{.5 \cdot OD_{perp} - .5 \cdot t_{perp}}{t_{perp}}\right)^{\frac{5}{8}} \cdot \left(\frac{L_v}{(.5 \cdot OD_{perp} - .5 \cdot t_{perp})}\right)^{\frac{1}{4}} = 20.494$$

$$F_{G4} := ksi \cdot \begin{cases} 5.8 & \text{if } S_{G4} \le 77.8 \\ (7.8 - .056 \cdot S_{G4}) & \text{also if } 77.8 < S_{G4} \le 122 \\ \dfrac{50264}{S_{G4}^{\ 2}} & \text{else} \end{cases} = 5.8\ ksi$$

Allowable Shear Stress

$$F_{v\_perp} := F_{G4} = 5.8\ ksi$$

Allowable Shear Strength

$$V_{perp} := F_{v\_perp} \cdot \frac{A_{perp}}{2} = 1.356\ kip$$

Torsional Capacity

Torsion - Pipes - H.2.1

Slenderness Ratio

$$S_{H21} := 2.9 \cdot \left(\frac{.5 \cdot OD_{perp} - .5 \cdot t_{perp}}{t_{perp}}\right)^{\frac{5}{8}} \cdot \left(\frac{L_v}{\left(.5 \cdot OD_{perp} - .5 \cdot t_{perp}\right)}\right)^{\frac{1}{4}} = 20.494$$

$$F_{H21} := ksi \cdot \begin{array}{|l} \text{if } S_{G4} \le 46.6 \\ \quad 5.8 \\ \text{also if } 77.8 < S_{G4} \le 122 \\ \quad \left(7.8 - .043 \cdot S_{G4}\right) \\ \text{else} \\ \quad \dfrac{38665}{{S_{G4}}^2} \end{array} = 5.8\ ksi$$

Allowable Torsional Stress

$$F_{tor} := F_{H21} = 5.8\ ksi$$

Allowable Torsional Strength

$$Tor_{perp} := \frac{J_{perp} \cdot F_{H21}}{0.5 \cdot OD_{perp}} = 2.464\ kip \cdot in$$

Weld Allowable Stresses and Strengths

Weld of Diagonal to Chord

Angle of diagonal from horizontal (Parallel with chord)

$$\theta_{diag} := 37 \cdot deg$$

Tensile Ultimate Stress of 5556 filler

$$F_{tuw\_filler} = 42\ ksi$$

Effective Throat of weld

$$S_{we} := .707 \cdot 2 \cdot mm = 0.056\ in$$

Perimeter of Ellipse weld

$$a := \frac{OD_{diag}}{2 \cdot \cos\left(\theta_{diag}\right)} = 12.521\ mm$$

$$b := \frac{OD_{diag}}{2} = 10\ mm$$

$$L_{we} := \pi \cdot \left(3 \cdot (a+b) - \sqrt{(3 \cdot a + b) \cdot (a + 3 \cdot b)}\right) = 2.794\ in$$

Nominal base metal strength J.2-1

$$P_{n\_J21} := .6 \cdot F_{tuw} \cdot t_{ch} \cdot L_{we} = 5.545\ kip$$

Nominal fillet weld strength J.2-2

$$P_{n\_J22} := .6 \cdot \left(.85 \cdot F_{tuw\_filler}\right) \cdot S_{we} \cdot L_{we} = 3.332\ kip$$

Allowable connection axial strength

$$P_{a\_diag\_weld} := \frac{min\left(P_{n\_J21}, P_{n\_J22}\right)}{\Omega_{a\_r}} = 1.709\ kip$$

Allowable strength per length of weld

$$R_{a\_diag\_weld} := \frac{P_{a\_diag\_weld}}{L_{we}} = 0.612\ \frac{kip}{in}$$

Weld of Chord to Conical Connector

Tensile Ultimate Stress of 5556 filler $F_{tuw\_filler} = 42\ ksi$

Effective Throat of weld $\boxed{S_{we}} := 3 \cdot mm = 0.118\ in$

Length of weld $\boxed{L_{we}} := \pi \cdot OD_{ch} = 6.184\ in$

Weld Modulus $S_{weld} := \pi \cdot \left(\frac{OD_{ch}}{2}\right)^2 = 3.043\ \frac{in^3}{in}$

Nominal base metal strength J.2-1 $\boxed{P_{n\_J21}} := .6 \cdot F_{tuw} \cdot t_{ch} \cdot L_{we} = 12.271\ kip$

Nominal fillet weld strength J.2-2 $\boxed{P_{n\_J22}} := .6 \cdot (.85 \cdot F_{tuw\_filler}) \cdot S_{we} \cdot L_{we} = 15.646\ kip$

Allowable connection axial strength $P_{a\_ch\_weld} := \frac{min\left(P_{n\_J21}, P_{n\_J22}\right)}{\Omega_{a\_r}} = 6.293\ kip$

Allowable strength per length of weld $R_{a\_ch\_weld} := \frac{P_{a\_ch\_weld}}{L_{we}} = 1.018\ \frac{kip}{in}$

Global Truss Properties

Weight of Truss (taken from Global Truss Website) $wt_{tr} := 6\ plf$

Depth between Chords $d_{ch} := 400 \cdot mm = 15.748\ in$

Moment of Interia $I_{tr\_calc} := 4 \cdot I_{ch} + 4 \cdot A_{ch} \cdot \left(\frac{d_{ch}}{2}\right)^2 = 171.456\ in^4$

$A_{tr} := 4 \cdot A_{ch} = 2.746\ in^2$

Ideal Truss Capacity

Maximum chord axial force $P_{a\_ch} := min\left(P_{a\_ch\_weld}, T_{ch}, C_{ch}\right) = 6.293\ kip$

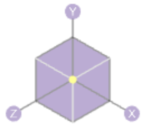
Truss bending capacity $M_{tr} := 2 \cdot P_{a\_ch} \cdot d_{ch} = 16.517\ kip \cdot ft$

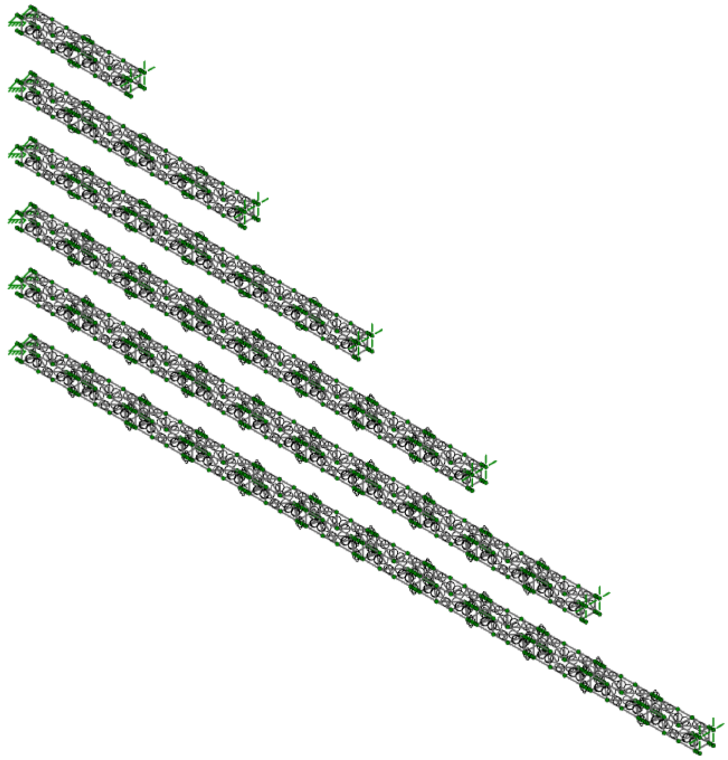
Maximum diagonal axial force $P_{a\_diag} := min\left(P_{a\_diag\_weld}, T_{diag}, C_{diag}\right) = 1.316\ kip$

Maximum truss shear capacity $V_{tr} := 2 \cdot P_{a\_diag} \cdot \sin\left(\theta_{diag}\right) = 1.584\ kip$

This information is used for comparison only. Load span tables include effects of local bending + axial at truss to truss connections.

Truss Review

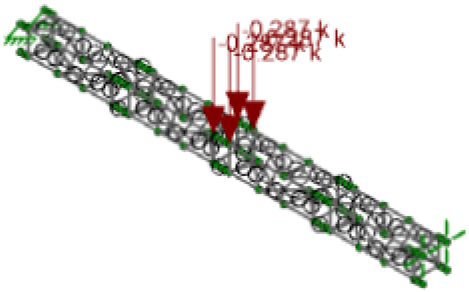




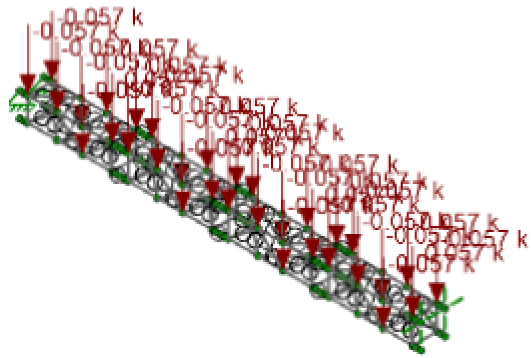
A RISA 3D static linear analysis model was created for the review of the aluminum box truss. Lengths of 2m, 4m, 6m, 8m, 10m and 12m were reviewed. All other tabulated values given on the load on S1.0 are interpolated from these lengths.

Example Loading

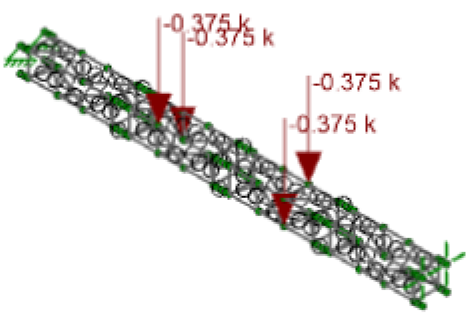
Center Point Load (CPL)



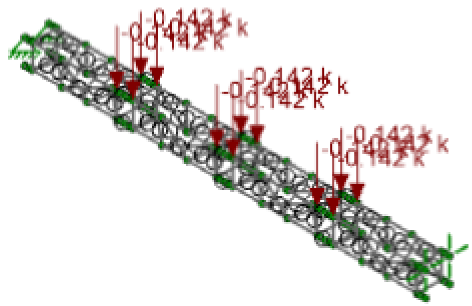
Uniformly Distributed Loads (UDL)



Third Point Loads (TPL)



Quarter Point Loads (QPL)



All loads are applied to truss panel points. If CPL, TPL or QPL loads occur at a truss connection, it is assumed that a minumum of 2 chords are supporting the vertical load. No resultant horizontal load from rigging, such as bridles or baskets, have been considered in this analysis and should be reviewed on a case by case basis.

Excel Checks

50mm x 3mm Tube

Section Properties	
Area (in^2)	0.687
S (in^3)	0.300
Z (in^3)	0.405
J (in^4)	0.590
Outside Dia. (in	1.970
Thickness (in)	0.118
Angstrom (in^2	2.694

Allowable Stresses (ksi)	
Axial Tension	9.7
Axial Compressio	9.2
Shear	5.8
Flexural	12.846
Torsional Shear	5.8

Allowable Forces		
Axial Tension	6.660	kip
Axial Compressio	6.305	kip
Shear	1.991	kip
Flexure	3.927	kip*in
Torque	3.477	kip*in

Input
Calculated
Check

Compression is positive

Based on 2015 ADM Chapter H

Load Case	Member Label	Section	Required Strength Imported from RISA 3D						Calculated Required Stress				Flexure and Axial Check	Torsion, Flexure, Shear and/or Axial
			Axial(Kip)	y Shear (Kip)	z Shear (Kip	Torque (k*in)	y-y Moment (k*in)	z-z Moment (k*in)	fa (ksi)	v SRSS (ks	fst (ksi)	fb SRSS (ksi	H.1-1	H.3-4
			5.027	0.667	0.029	0.018	0.253	1.335	7.317	1.945	0.038	5.900	0.973	0.948
			-5.027	-0.668	-0.022	-0.024	-0.243	-1.769						
1	M45	1	0	0	0	0	0	0	0	0	0	0	0	0
		2	-0.706	0.015	0	0.003	-0.007	0.117	1.0277	0.04367	0.0047	0.390697	0.13758227	0.141894685
		3	-0.706	0.015	0	0.003	-0.007	0.09	1.0277	0.04367	0.0047	0.300906	0.1307068	0.134904856
		4	-0.706	0.014	0	0.003	-0.007	0.062	1.0277	0.04076	0.0047	0.20798	0.12357667	0.127662859
		5	-0.706	0.014	0	0.003	-0.008	0.035	1.0277	0.04076	0.0047	0.119675	0.11695584	0.120788797
		6	-0.706	0.014	0	0.003	-0.008	0.008	1.0277	0.04076	0.0047	0.037712	0.11008036	0.114408357
		7	-0.706	0.014	0	0.003	-0.008	-0.018	1.0277	0.04076	0.0047	0.065659	0.11262684	0.116583874
		8	-0.699	0.014	0	0.002	-0.008	-0.043	1.0175	0.04076	0.0031	0.145793	0.11794197	0.121713087
		9	-0.699	0.014	0	0.002	-0.006	-0.069	1.0175	0.04076	0.0031	0.230868	0.1240535	0.128335777
		10	-0.699	0.014	0	0.002	-0.005	-0.094	1.0175	0.04076	0.0031	0.313776	0.13016504	0.134789798
		11	-0.699	0.013	0	0.002	-0.004	-0.119	1.0175	0.03785	0.0031	0.396891	0.13627657	0.141252513

Resultant Member forces from each load combination have been exported from RISA 3D into an Excel spreadsheet used to determine combined forces per 2020 ADM H.1-1 and H.3-4

$$\left|\frac{P_r}{P_c}+\frac{M_{rx}}{M_{cx}}+\frac{M_{ry}}{M_{cy}}\right| \le 1.0 \qquad \text{(H.1-1)}$$

For ASD:

$$f_c/(F_c/\Omega)+f_b/(F_b/\Omega)+[f_s/(F_s/\Omega)]^2 \le 1.0 \qquad \text{(H.3-4)}$$

50mm x 2mm Chord Weldament

Properties		
Length of Weld	6.184	in
Strength of Weld	1.018	Kip/in
Weld Modulus	3.043	in^3/in

Maximum Demand	0.996152431
Available Str.	1.018
% Utilization	0.978538733

Compression is positive

Load Case	Member Label	Section	Chord to Weldament Required Forces						Weld Demand (kip/in) due to:				
			Axial (Kip)	y Shear (Kip)	z Shear (Kip)	Torque (k*in)	y-y Moment (k*in)	z-z Moment (k*in)	Axial	y z Shear	Shear - Torsion	Moment	
		Max	4.948	0.667	0.029	0.017	0.252	0.503	0.8005	0.21612	0.00274903	0.58162	0.996152431
		Min	-4.95	-0.668	-0.018	-0.017	-0.239	-1.769					
2	M45	1	0	0	0	0	0	0	0	0	0	0	0
		2	-0.789	0.024	0	0.002	-0.009	0.126	0.1276	0.007762	0.00032342	0.04151	0.174051773
		3	-0.789	0.024	0	0.002	-0.007	0.081	0.1276	0.007762	0.00032342	0.02672	0.159519043
		4	-0.789	0.024	0	0.002	-0.005	0.037	0.1276	0.007762	0.00032342	0.01227	0.145326401
		5	-0.789	0.024	0	0.002	-0.003	-0.008	0.1276	0.007762	0.00032342	0.00281	0.136031887
		6	-0.789	0.024	0	0.002	-0.001	-0.052	0.1276	0.007762	0.00032342	0.01709	0.150063127

Resultant forces for member ends were also exported from RISA3D and imported into excel to check the welds of diagonals to chords and conical adapter to chords.