



JEI Structural Engineering

Glazing Systems

Fast, Friendly, Affordable

**Webster University
St. Louis, Missouri**

NGG

**Aluminum Curtainwall Calculation Package
(Wind Analysis)**

****EXCLUDES INTERIOR FRAMES: 1/201, 3/204, 4/204**

Project No. JE16059

November 8, 2016



Webster University St. Louis, Missouri

Design Criteria

1. Scope of Work:

The calculations provided herein are limited to a review of proposed shop drawings and structural analysis for the main curtain wall systems on the Webster University building. The calculations pertain and are limited to the structural design of the following:

- a. Vertical and horizontal framing members
- b. Anchorage of the framing members to the main structure

2. Exclusions:

The following items are explicitly excluded from this calculation package unless otherwise noted and are the responsibility of the system manufacturers, material suppliers, installers or others to review, confirm and approve as required by the project contract documents and specifications.

- a. Structural design of
 - i. Interior frames; 1/201, 3/204, 4/204
 - ii. Monolithic glazing and insulated glazing units (IGU)
 - iii. IGU spacers, sealants and associated components
 - iv. System gaskets, glazing spacers, thermal isolators and setting blocks
- b. Dimensional accuracy of shop drawings provided to JEI Structural Engineering.
 - i. It is the responsibility of the installing contractor to confirm field dimensions of rough openings (RO) or to obtain confirmation of guaranteed rough opening sizes prior to assembly and installation.
- c. Means and methods to include but not limited to manufacture, assembly and installation of the glazing system(s) used on the project.
- d. Material quantities required for a complete installation of the glazing system based on the provided shop drawings.
- e. Design of air infiltration and water penetration prevention or thermal performance.
- f. Review and submittal of testing reports to include but not limited to:
 - i. Air infiltration, water penetration and thermal performance testing
 - ii. Large & Small Missile Impact Testing
 - iii. Blast Testing
 - iv. AAMA 501.4 & 501.6 Seismic Testing

It is the responsibility of the project Architect and/or Engineer of Record to review system testing reports and data to confirm system acceptability.



Designs contained within this calculation package assume appropriate material separation between dissimilar materials to prevent galvanic reaction (corrosion). Installer shall follow manufacturer's recommendations & code requirements for material separation.

3. Reference Standards:

Project Specifications;
International Building Code, 2009 Edition;
ASCE 7-05 – Minimum Design Loads for Buildings and Other Structures;
Aluminum Design Manual, 2010 Edition;
AISC Steel Construction Manual, 13th Edition;
AAMA TIR-A9-1991 – Metal Curtain Wall Fasteners;
Elcho Fastener Product Information;
Dow Corning Americas Technical Manual, June 2007

4. Reference Drawings:

The calculations herein are based upon the following drawings prepared by NGG:

Sheets: 001, 200-220, 300-360, 400-455
Dated: 8/10/2016

5. Design Loads:

Wind, Snow & Seismic Loads are as noted in the Structural General Notes, Sheet S0001

a. Dead Load:

Glass:	156 pcf	1" IGU and Aluminum Framing:	8.0 psf
Aluminum:	173 pcf	Steel:	490 pcf

b. Wind Load (ASCE 7-05):

Basic Wind Speed, $V = 90$ mph (3-Second Gust)
Wind Importance Factor, $I_w = 1.15$
Exposure Category B
Enclosed Building Condition
Topographic Factor, $K_t = 1.0$

Components and Cladding Design Pressure (Service, ASD)

Zone 4_{asd}: +20 / -20.0 psf
Zone 5_{asd}: +20 / -23.5 psf



Note: Zone 5 is located within 20' of a building corner.

6. Deflection of Framing Members:

a. Wind Load (ASCE 7-05/10)

Normal to Glazing Plane:

- i. $L/175$ of clear span (spans $\leq 13'-6"$)
- ii. $L/240 + \frac{1}{4}"$ of clear span (spans $> 13'-6"$)
- iii. $\frac{3}{4}"$ edge deflection of individual glazing lite, whichever is less

Parallel to Glazing Plane:

- i. Limited to amount not exceeding that which reduces glazing bite to less than 75% of design dimension and which reduces edge clearance between framing members and glazing or other fixed components to less than $\frac{1}{8}"$.

7. Material Basis of Design:

Project materials shall conform to the listed standards and minimum strengths unless otherwise noted or approved in writing by JEI Structural Engineering. Note all F_y and F_u values are minimums.

a. Aluminum

Bent Plate	5052-H32	$F_y = 21$ ksi, $F_u = 31$ ksi
Sheet, Bar, Flat Plate	6061-T6, T651	$F_y = 35$ ksi, $F_u = 42$ ksi
Misc Structural Extrusions & Pipe	6061-T6511	$F_y = 35$ ksi, $F_u = 38$ ksi
Architectural Extrusions (Framing)	6063-T5	$F_y = 16$ ksi, $F_u = 22$ ksi
	6063-T6	$F_y = 25$ ksi, $F_u = 30$ ksi

Brake metal covers, closures and flashing are non-structural and alloy selection is by the installer.

b. Steel

Sheet, Bent/Flat Plate & Bar	ASTM A1011 / A36	$F_y = 36$ ksi, $F_u = 58$ ksi
Angle & Channel	ASTM A36	$F_y = 36$ ksi, $F_u = 58$ ksi
HSS Tube (Rect.)	ASTM A500 Grade B	$F_y = 46$ ksi, $F_u = 58$ ksi
Light Gage Framing	ASTM A1003 / A653	$F_y = 33$ ksi, $F_u = 45$ ksi

c. Fasteners

300 Series Stainless Steel,	ASTM A193 / A194	$F_y = 30$ ksi, $F_u = 70$ ksi
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Condition "A" (Annealed)

 300 Series Stainless Steel ASTM F593 / F594 $F_y = 65 \text{ ksi}$, $F_u = 110 \text{ ksi}$

Condition "CW" (Cold Worked)

 Zinc Plated Grade 5 Steel SAE J429 / J995 $F_u = 120 \text{ ksi}$

300 Series Stainless fasteners assume condition A unless otherwise specified. ASTM F593 annealed bolts may be substituted for A193 at installer option.

All bolts shall be installed snug tight unless otherwise specified. Provide standard washers and nylock nuts or other means which prevent loosening. All bolts shall protrude from the base material or fastening nut a minimum of 2 threads.

All shims at anchor locations shall be full depth of system T/F anchor, subsill or other bearing surface minus 1/4" allowance front and rear (1/2" total) for sealant joints.

Reference vendor product data for product specific installation procedures, torque requirements, etc.

 d. Sealants

DOW 790 Silicone Sealant (High Movement) +100/-50% Movement Capacity

DOW 795 Silicone Sealant (Typical) +50/-50% Movement Capacity

Sealant joint width to thickness ratio shall be 2:1 for joints less than 1" wide and not less than 1/4" by 1/4". Joints 1" wide or greater shall be held to 3/8" to 1/2" thickness.

 8. Concrete:

The analysis of anchors into normal weight concrete is based upon a 28-day concrete strength of $f'_c = 4000 \text{ psi}$ unless otherwise noted.

 9. Reference ICC-ES Evaluation Reports:
Elco/Hilti

 ESR-3332 Elco Dril-Flex Self-Drilling Structural Fasteners
 Hilti Kwik-Flex Self-Drilling Structural Fasteners
 (Reissued October 1, 2013)

 10. Conflicts between Calculations and Drawings:

Where conflicts between the calculations and reference drawings occur, the calculations shall have precedence.



11. Construction:

JEI Structural Engineering is not responsible for any deviations from the calculations and reference drawings. Should the as-built conditions differ from those specified within the calculations or reference drawings, the client must inform JEI Structural Engineering so that the actual conditions may be reviewed for compliance with project specifications and design. It is assumed that all anchors will be installed in a dry environment and that the glazing system will be sealed properly to avoid any water infiltration.



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NGG. LTD
Project #JE16059
April 22, 2016

Wind Design Criteria (per Structural General Notes Sheets S0001):

DESIGN CODES:

THE INTERNATIONAL BUILDING CODE/2009.
MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES.
ASCE 7-05

WIND LOAD:

BASIC WIND SPEED 90 MPH.
RISK CATEGORY III
WIND EXPOSURE B
DIRECTIONALITY FACTOR, $K_d = 0.85$
INTERNAL PRESSURE COEFFICIENT = $(+/-) 0.18$
WIND LOAD IMPORTANCE FACTOR: $I_w = 1.15$
COMPONENTS & CLADDING LOAD:
LOADS SHALL BE DETERMINED ACCORDING TO THE ASCE 7-05 REQUIREMENTS
BASED ON TRIB AREA, LOCATION OF BUILDING, AND ANY ADDITIONAL
PARAMETERS NOTED IN THE DESIGN CODE.

Building Dimensions:

Length: 524'
Width: 262'
Height: 47' Reference Architectural Elevations A0301




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Project #JE16059

April 22, 2016

MecaWind Pro v2.2.7.0 per ASCE 7-05

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Date : 4/22/2016	Project No. : JE16059
Company Name : JEI Structural Engineering	Designed By : M. Gorny
Address : 11108 N. Oak Tfwy, Suite 208	Description : Webster University
City : Kansas City	Customer Name : NGG. Inc.
State : MO	Proj Location : Webster Groves, MO
File Location: C:\Users\User1\AppData\Roaming\MecaWind\Default.wnd	

Input Parameters: Detailed Wind Load Design (Method 2) per ASCE 7-05

Basic Wind Speed(V) = 90.00 mph	Structure Type = BUILDING
Structural Category = III	Exposure Category = B
Natural Frequency = N/A	Flexible Structure = No
Importance Factor = 1.15	Kd Directional Factor = 0.85
Alpha = 7.00	Zg = 1200.00 ft
At = 0.14	Bt = 0.84
Am = 0.25	Bm = 0.45
Cc = 0.30	l = 320.00 ft
Epsilon = 0.33	Zmin = 30.00 ft
Pitch of Roof = 0 : 12	Slope of Roof(Theta) = .00 Deg
h: Mean Roof Ht = 47.00 ft	Type of Roof = FLAT
RHt: Ridge Ht = 47.00 ft	Eht: Eave Height = 47.00 ft
OH: Roof Overhang at Eave = .00 ft	Overhead Type = No Overhang
Bldg Length Along Ridge = 524.00 ft	Bldg Width Across Ridge = 262.00 ft

Gust Factor Calculations

Gust Factor Category I Rigid Structures - Simplified Method

Gust1: For Rigid Structures (Nat. Freq.>1 Hz) use 0.85 = 0.85

Gust Factor Category II Rigid Structures - Complete Analysis

Zm: 0.6*Ht = 30.00 ft

lzm: $Cc \cdot (33/Zm)^{0.167}$ = 0.30

Lzm: $1 \cdot (Zm/33)^{Epsilon}$ = 309.99 ft

Q: $(1 / (1 + 0.63 \cdot ((B+Ht)/Lzm)^{0.63}))^{0.5}$ = 0.78

Gust2: $0.925 \cdot ((1 + 1.7 \cdot lzm \cdot 3.4 \cdot Q) / (1 + 1.7 \cdot 3.4 \cdot lzm))$ = 0.80

Gust Factor Summary

Not a Flexible Structure use the Lessor of Gust1 or Gust2 = 0.80

Figure 6-5 Internal Pressure Coefficients for Buildings, GCpi

GCpi : Internal Pressure Coefficient = +/-0.18

Wind Pressure on Components and Cladding

All pressures shown are based upon ASD Design, with a Load Factor of 1

Width of Pressure Coefficient Zone "a" = 18.80 ft ← Use 20' corner wind zone

Description	Width ft	Span ft	Area Zone ft ²	Max GCp	Min GCp	Max P psf	Min P psf
Glass 10	2.00	5.00	10.0 4	0.90	-0.99	17.44	-18.89
Glass 20	4.00	5.00	20.0 4	0.85	-0.94	16.66	-18.12
Glass 30	3.00	10.00	33.3 4	0.82	-0.91	16.09	-17.55
Glass 40	4.00	10.00	40.0 4	0.80	-0.89	15.89	-17.34
Glass 50	5.00	10.00	50.0 4	0.79	-0.88	15.64	-17.10
Glass 60	6.00	10.00	60.0 4	0.78	-0.87	15.44	-16.89
Glass 70	7.00	10.00	70.0 4	0.77	-0.86	15.27	-16.72
Glass 80	8.00	10.00	80.0 4	0.76	-0.85	15.12	-16.57
Glass 90	9.00	10.00	90.0 4	0.75	-0.84	14.99	-16.44
Glass 100	10.00	10.00	100.0 4	0.74	-0.83	14.87	-16.32
Glass 10	2.00	5.00	10.0 5	0.90	-1.26	17.44	-23.25
Glass 20	4.00	5.00	20.0 5	0.85	-1.16	16.66	-21.70
Glass 30	3.00	10.00	33.3 5	0.82	-1.09	16.09	-20.56
Glass 40	4.00	10.00	40.0 5	0.80	-1.07	15.89	-20.16
Glass 50	5.00	10.00	50.0 5	0.79	-1.04	15.64	-19.66
Glass 60	6.00	10.00	60.0 5	0.78	-1.01	15.44	-19.25
Glass 70	7.00	10.00	70.0 5	0.77	-0.99	15.27	-18.91
Glass 80	8.00	10.00	80.0 5	0.76	-0.97	15.12	-18.61
Glass 90	9.00	10.00	90.0 5	0.75	-0.96	14.99	-18.35
Glass 100	10.00	10.00	100.0 5	0.74	-0.94	14.87	-18.12

Khcc:Comp. & Clad. Table 6-3 Case 1

= 0.80

Qhcc: $.00256 \cdot V^2 \cdot I \cdot Khcc \cdot Kht \cdot Kd$

= 16.14 psf

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Date 11/8/2016
Proj. # JE16059
Designer M. Gorny

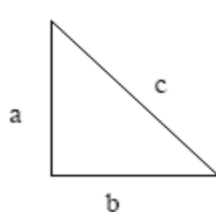
INPUT	CHECK
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Allowable Expansion:	50%	Allowable Compression:	50%
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Values in **red** apply to the sealant listed above.

Allowable Shear Movement (Inches)								
Joint Width (in)	25%		35%		50%		100%	
	b	c	b	c	b	c	b	c
1/4	0.19	0.31	0.23	0.34	0.28	0.38	0.43	0.50
3/8	0.28	0.47	0.34	0.51	0.42	0.56	0.65	0.75
1/2	0.38	0.63	0.45	0.68	0.56	0.75	0.87	1.00
5/8	0.47	0.78	0.57	0.84	0.70	0.94	1.08	1.25
3/4	0.56	0.94	0.68	1.01	0.84	1.13	1.30	1.50
7/8	0.66	1.09	0.79	1.18	0.98	1.31	1.52	1.75
1	0.75	1.25	0.91	1.35	1.12	1.50	1.73	2.00

Allowable Expansion & Compression (Inches)				
Joint Width (in)	25%	35%	50%	100%
1/4	0.063	0.088	0.125	0.250
3/8	0.094	0.131	0.188	0.375
1/2	0.125	0.175	0.250	0.500
5/8	0.156	0.219	0.313	0.625
3/4	0.188	0.263	0.375	0.750
7/8	0.219	0.306	0.438	0.875
1	0.250	0.350	0.500	1.000
1 1/8	0.281	0.394	0.563	1.125
1 1/4	0.313	0.438	0.625	1.250
1 3/8	0.344	0.481	0.688	1.375
1 1/2	0.375	0.525	0.750	1.500



$$a^2 + b^2 = c^2$$

where a = original glueline
b = joint movement
c = new glueline after joint movement



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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG
Part of: Sealant Joint Allowable Movement

Date: 11/8/2016
Proj. #: JE16059
Designer: M. Gorny

INPUT CHECK

Sealant: DOW 795

Allowable Expansion: 100% Allowable Compression: 50%

a = joint width b = maximum joint deflection c = maximum sealant expansion

Allowable Shear Movement (Inches)								
Joint Width (in)	25%		35%		50%		100%	
	b	c	b	c	b	c	b	c
1/4	0.19	0.31	0.23	0.34	0.28	0.38	0.43	0.50
3/8	0.28	0.47	0.34	0.51	0.42	0.56	0.65	0.75
1/2	0.38	0.63	0.45	0.68	0.56	0.75	0.87	1.00
5/8	0.47	0.78	0.57	0.84	0.70	0.94	1.08	1.25
3/4	0.56	0.94	0.68	1.01	0.84	1.13	1.30	1.50
7/8	0.66	1.09	0.79	1.18	0.98	1.31	1.52	1.75
1	0.75	1.25	0.91	1.35	1.12	1.50	1.73	2.00

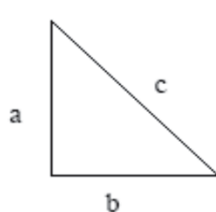
Values in **red** apply to the sealant listed above.

Allowable Expansion & Compression (Inches)				
Joint Width (in)	25%	35%	50%	100%
1/4	0.063	0.088	0.125	0.250
3/8	0.094	0.131	0.188	0.375
1/2	0.125	0.175	0.250	0.500
5/8	0.156	0.219	0.313	0.625
3/4	0.188	0.263	0.375	0.750
7/8	0.219	0.306	0.438	0.875
1	0.250	0.350	0.500	1.000
1 1/8	0.281	0.394	0.563	1.125
1 1/4	0.313	0.438	0.625	1.250
1 3/8	0.344	0.481	0.688	1.375
1 1/2	0.375	0.525	0.750	1.500

Note: 100% movement does not apply in compression.

Joint Movement in Shear

When joints move in shear, greater joint movement can be accommodated since actual movement on the sealant is less. The joint width required (a) for joint movement (b), as calculated below, or the allowable movement (b) for a particular joint width dimension (a), can be calculated using the Pythagorean theorem. The new joint width after movement (c) is limited by the movement capability of the sealant in shear in a weatherseal joint configuration. The calculation is as follows:



$$a^2 + b^2 = c^2$$

where a = original glue line
b = joint movement
c = new glue line after joint movement



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Client: NGG
Project: Webster University
Structure: YKK 750 Curtain Wall
Part of: Structural Silicone Design

Date: 11/8/2016
Proj. #: JE16059
Designer: M. Gorny

INPUT CHECK

Typical Wind Pressure (T)

20.0 psf

Silicone Design Strength Wind Load =

20.0 psi*

Corner Wind Pressure (C)

23.5 psf

Silicone Design Strength Dead Load =

1.0 psi*

Dead Load of Glass

8.0 psf

Glass Thermal Exp. Coefficient =

0.0000051 in/in°F

Glue Line Thickness =

0.25 in

Aluminum Thermal Exp. Coefficient =

0.0000128 in/in°F

* Ref DOW Corning Technical Manual, DOW 995 assumed

Temperature at Construction =

45 deg

Maximum Temp of Aluminum =

125 deg

Elevation Panel Areas & Bite Design					Wind Load		Dead Load		SSG Bite	
Elevation	Wind Zone	DL supported by Silicone?	Width (in)	Height (in)	perimeter (in)	Wind Load (lb/in)	WL Bite Req (in)	Dead Load (lb/in)	DL Bite Req (in)	SSG Bite Required (in)
1/200	C	No	58.9375	140.5	398.88	4.81	0.24	1.2	1.15	0.240
1/201	C	No	53.75	140.5	388.50	4.39	0.22	1.1	1.08	0.219
1/202	C	No	57.5	129.375	373.75	4.69	0.23	1.1	1.11	0.235
1/203	C	No	55.375	129.375	369.50	4.52	0.23	1.1	1.08	0.226
1/204	C	No	57.5	129.375	373.75	4.69	0.23	1.1	1.11	0.235
2/204	C	No	74	45.5	239.00	3.71	0.19	0.8	0.78	0.186
1/205	C	No	60.5	106.75	334.50	4.94	0.25	1.1	1.07	0.247
1/208	C	No	70.0625	97.5	335.13	5.72	0.29	1.1	1.13	0.286
1/213	C	No	90	108.875	397.75	7.34	0.37	1.4	1.37	0.367
1/215	C	No	60.5	69.5	260.00	4.94	0.25	0.9	0.90	0.247
1/218	C	No	65.8125	92.1875	316.00	5.37	0.27	1.1	1.07	0.269
1/219	C	No	47.5	32	159.00	2.61	0.13	0.5	0.53	0.131
1/220	C	No	54.75	14	137.50	1.14	0.06	0.3	0.31	0.057
4/220	C	No	60.625	141.5	404.25	4.95	0.25	1.2	1.18	0.247
4/220	C	No	74	45.5	239.00	3.71	0.19	0.8	0.78	0.186
Maximum Structural Bite Req'd =										0.367

Calculate Thermal Expansion of Member vs. Glass

Max Alum. Length = 141.50 in

Alum Δ temp = 0.14 in

Glass Δ temp = 0.06 in

Difference Δ temp = 0.09 in

glue line after expansion = 0.26 in

% Expansion = 5.90 % < 15% ?

OK

Use minimum
Thickness ratio 3/8 " SSG bite
1.5:1 OK



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Client: NGG
Project: Webster University
Structure: YKK 750 Curtain Wall
Part of: Sizing of Joints @ Head
Designer: M. Gorny

Date: 11/8/2016
Proj. No.: JE16059

Thermal Expansion coef =	0.00128
Temp. at Construction =	45 deg
Max. Temp. of Alum. =	120 deg

<u>1/216, 1/217, 1/218</u>	Total Height of Frame	13.83 ft		
	Deflection from Head (per SOR) =	0.44 in		
	Δ temp =	0.16 in		
	Controlling Joint Size Factor	DEFL. FROM HEAD		
	Total Vertical Δ =	0.44 in		
	Required Joint Size	0.88 in ←	>>>Use 7/8" Joint	
<u>1/205-212</u>	Total Height of Frame	48.83 ft		
	Deflection from Head (per SOR) =	0.60 in		
	Δ temp =	0.56 in		
	Controlling Joint Size Factor	DEFL. FROM HEAD		
	Total Vertical Δ =	0.60 in		
	Required Joint Size	1.200 in ←	>>>Use 1-1/8" Joint	
			Joint ok for expansion when 3rd floor moves downr	
			beneath cantilevered portion by inpsction.	
<u>1/202-204</u>	Total Height of Frame	11.24 ft		
	Deflection from Head (per SOR) =	0.70 in		
	Δ temp =	0.13 in		
	Controlling Joint Size Factor	BOTH CAN OCCUR AT SAME TIME, ADDITIVE		
	Total Vertical Δ =	0.83 in		
	Required Joint Size	1.66 in ←	>>>Use 1-5/8" Joint	
<u>1/213</u>	Total Height of Frame	36.57 ft		
	Deflection from Head (per SOR) =	0.00 in		
	Δ temp =	0.42 in		
	Controlling Joint Size Factor	Δ TEMP		
	Total Vertical Δ =	0.42 in		
	Required Joint Size	0.84 in ←	>>>Use 7/8" Joint	
<u>1/200, 1/201</u>	Total Height of Frame	12.17 ft		
	Deflection from Head (per SOR) =	0.46 in		
	Δ temp =	0.14 in		
	Controlling Joint Size Factor	BOTH CAN OCCUR AT SAME TIME, ADDITIVE		
	Total Vertical Δ =	0.60 in		
	Required Joint Size	1.20 in ←	>>>Use 1-1/8" Joint	
<u>1/214, 1/215,</u> <u>1/220, 3/220, 5/220</u>	Total Height of Frame	12.00 ft		
	Deflection from Head (per SOR) =	0.00 in		
	Δ temp =	0.14 in		
	Controlling Joint Size Factor	Δ TEMP		
	Total Vertical Δ =	0.14 in		
	Required Joint Size	0.28 in ←	>>>1/2" Joint OK	

	Label	Shape	Type	Material	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	E9-1225		Beam	gen_Alum	2.079	1.818	9.838	4.11
2	E9-1225 (HSS 4x2x0.375)		Beam	gen_Alum	2.083	1.814	26.078	4.107
3	E9-1225 (Channel 4x2x0.25)		Beam	gen_Alum	2.083	1.814	21.748	4.107
4	E9-8981		Beam	gen_Alum	2.477	2.954	11.81	6.349
5	E9-3402		Beam	gen_Alum	1.751	1.729	6.485	3.525
6	E9-3401		Beam	gen_Alum	2.254	2.213	8.555	4.596
7	E9-3401 (HSS 4x2x0.25)		Beam	gen_Alum	2.254	6.505	21.576	4.596
8	E9-3423		Beam	gen_Alum	1.482	1.333	2.835	2.156

BLC Description		Category	X Gra...	Y Gra...	Z Gra...	Joint	Point	Distributed	Area(M...	Surface(Plate/W...
1	Negative Wind (Face A)	None							6	
2	Positive Wind (Face A)	None							5	
3	Negative Wind (Face B)	None							2	
4	Positive Wind (Face B)	None							2	
5	Negative Load (Face C)	None							2	
6	Positive Load (Face C)	None							2	
7	Dead	None						166		
8	BLC 1 Transient Area Loads	None						14089		
9	BLC 3 Transient Area Loads	None						8836		
10	BLC 5 Transient Area Loads	None						13518		
11	BLC 4 Transient Area Loads	None						8836		
12	BLC 2 Transient Area Loads	None						13547		
13	BLC 6 Transient Area Loads	None						13518		

[illegible]

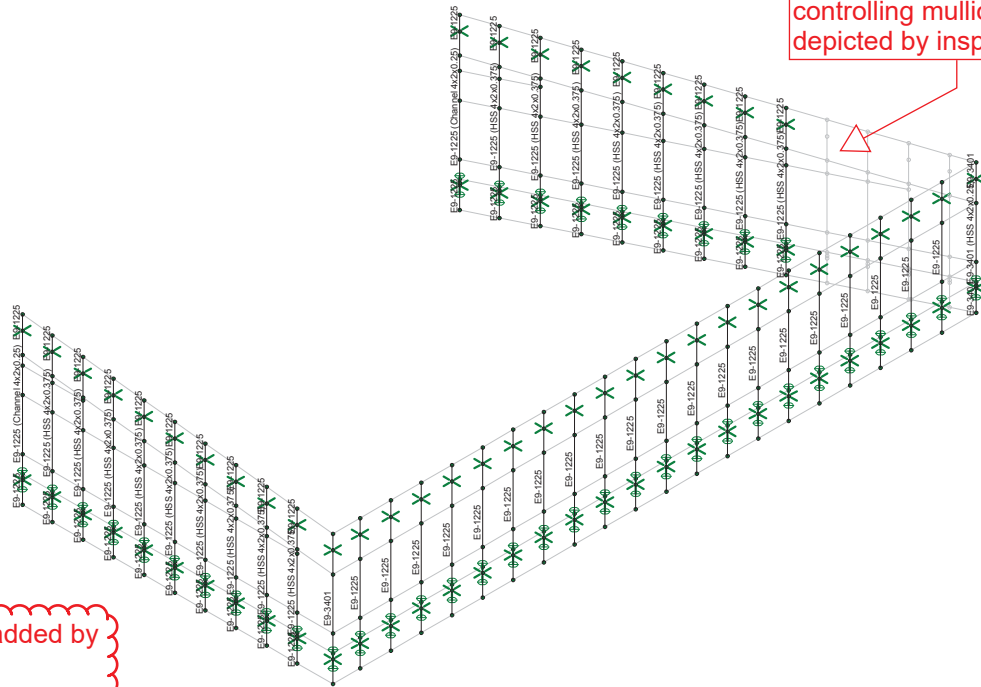
Analysis covers all vertical mullion associated with the above elevations, while extracting anchor loads to be used in later analysis.



Section sets

Reinforcing added by inspection.

Not shown for clarity, controlling mullions depicted by inspection.



Reinforcing added by inspection.

EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

JEI Structural Engineering

M. Gorny

JE16059

Webster University

SK - 4

Nov 1, 2016 at 2:57 PM

EGS-1 Preliminary.r3d



JEI Structural Engineering

Glazing Systems

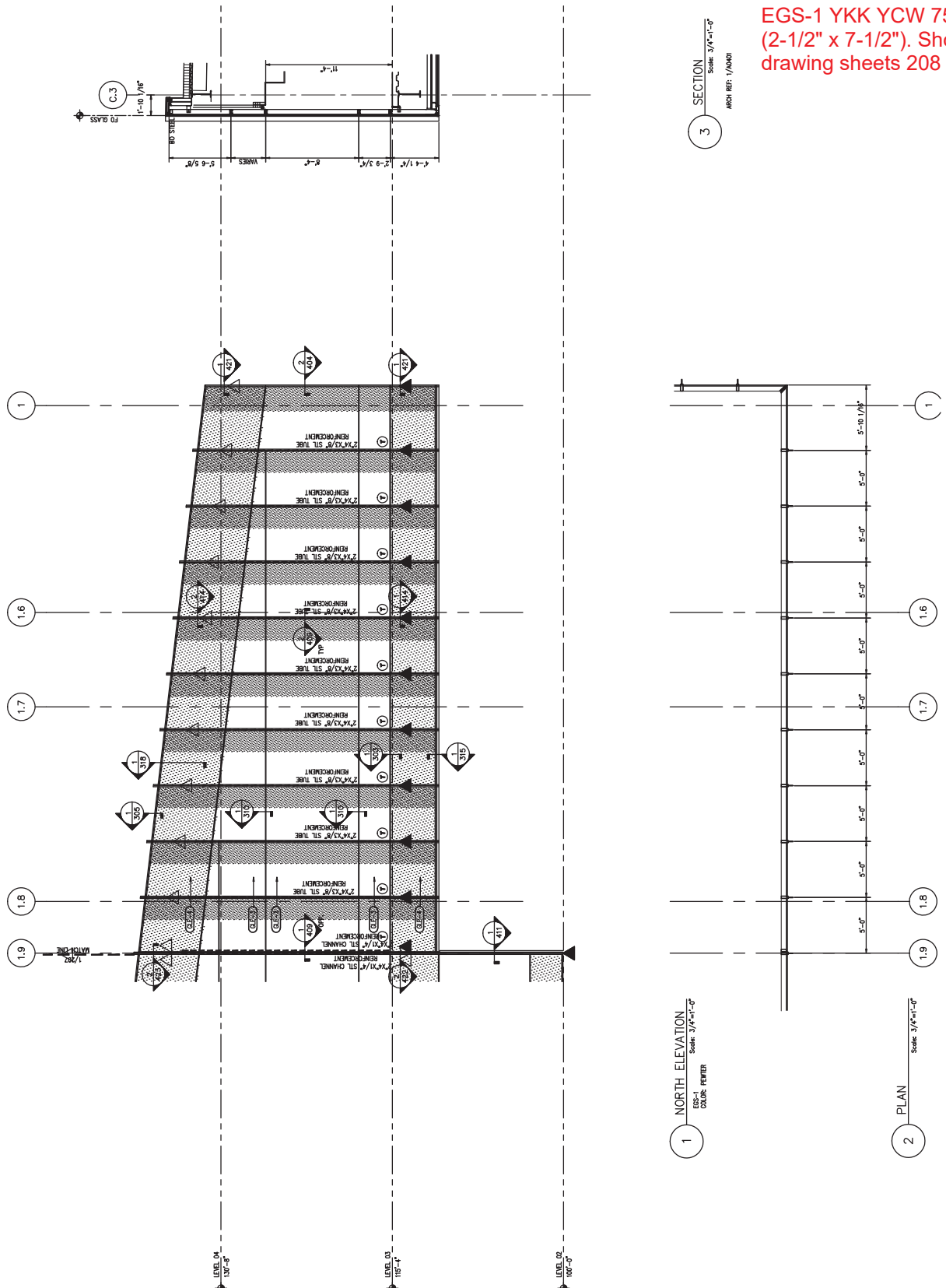
Fast, Friendly, Affordable

Webster University

NGG

Project #JE16059

November 7, 2016





JEI Structural Engineering

Glazing Systems

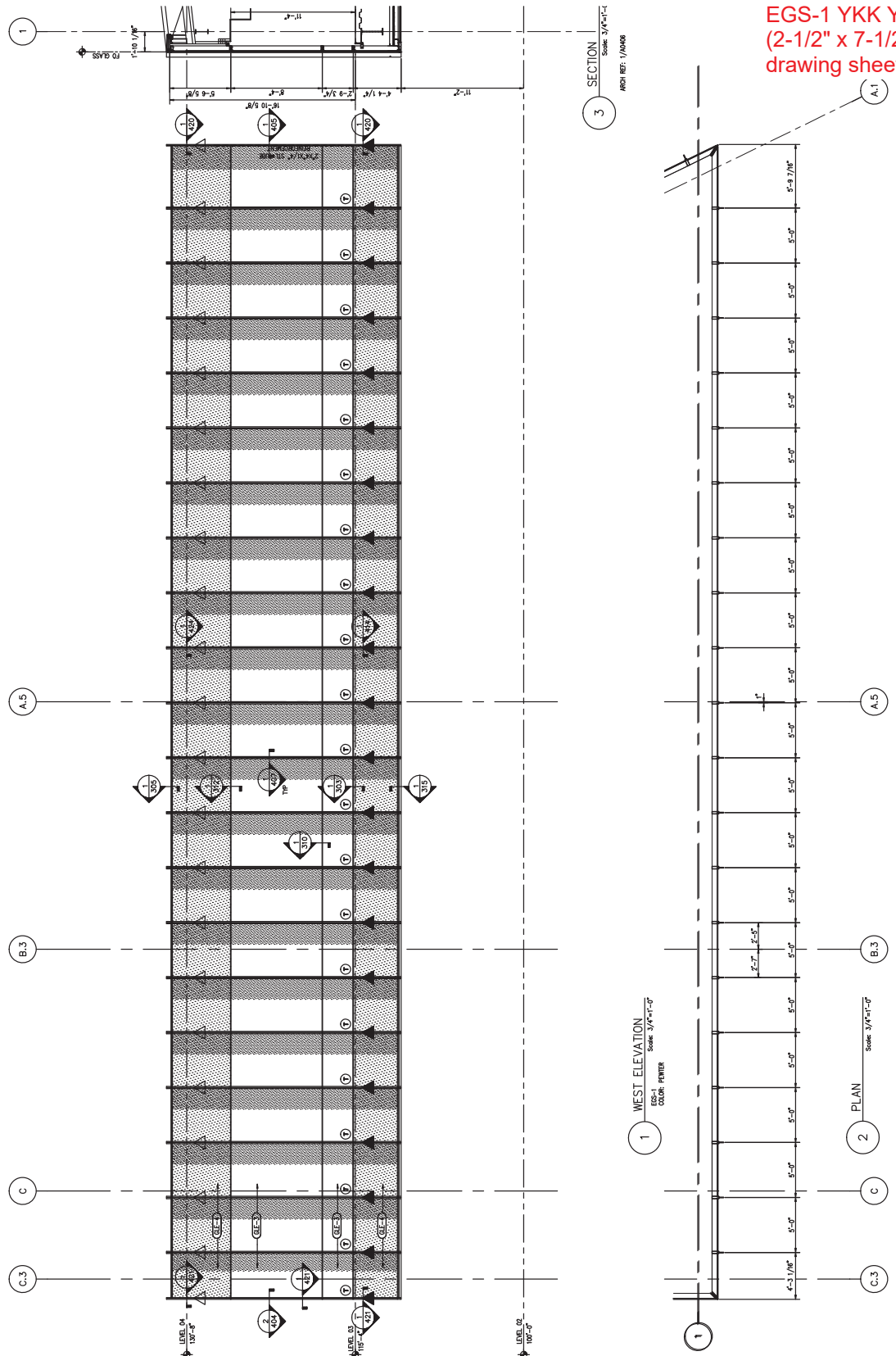
Fast, Friendly, Affordable

Webster University

NGG

Project #JE16059

November 7, 2016





JEI Structural Engineering

Glazing Systems

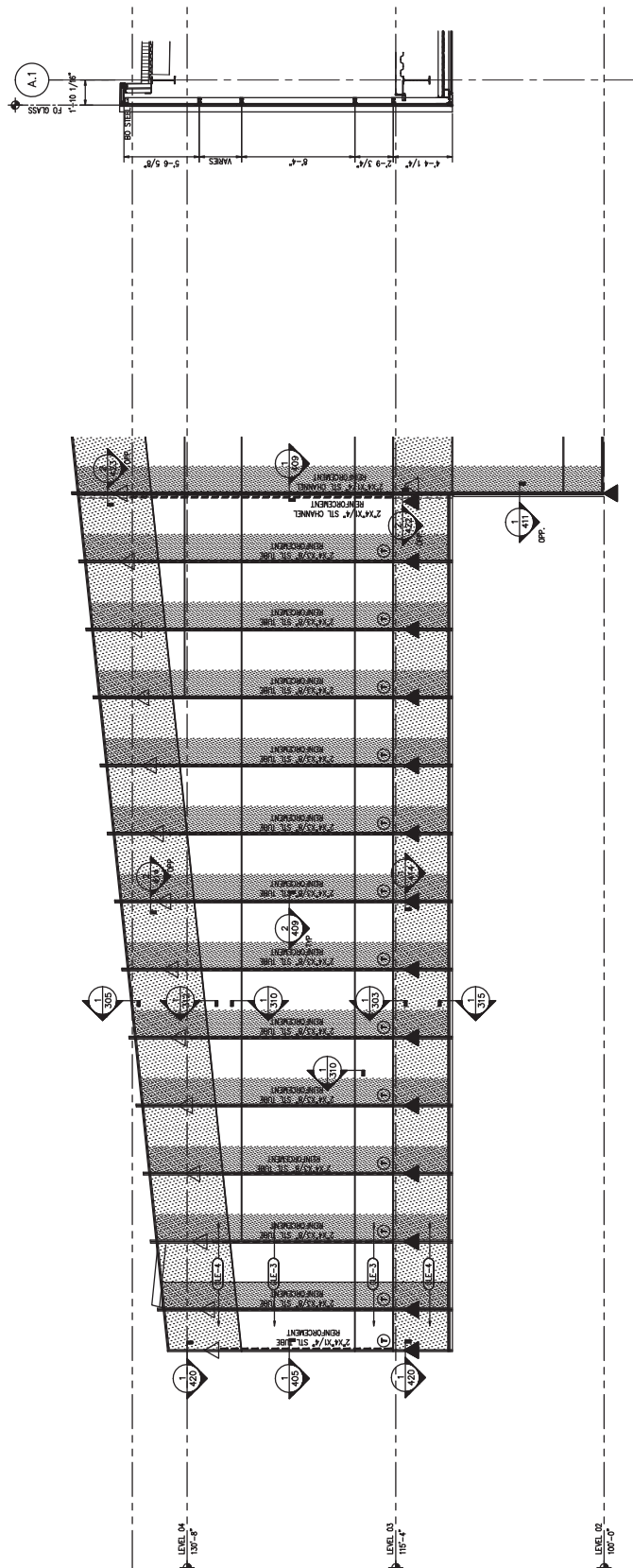
Fast, Friendly, Affordable

Webster University

NGG

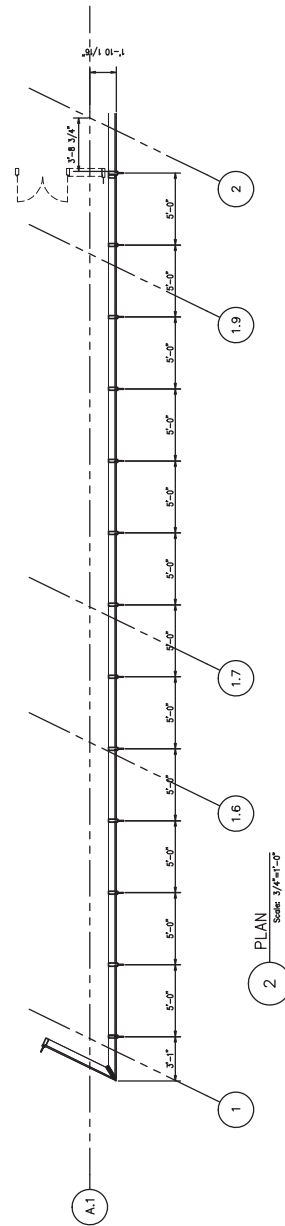
Project #JE16059

November 7, 2016



EGS-1 YKK YCW 750 SSG
(2-1/2" x 7-1/2"). Shop
drawing sheets 210

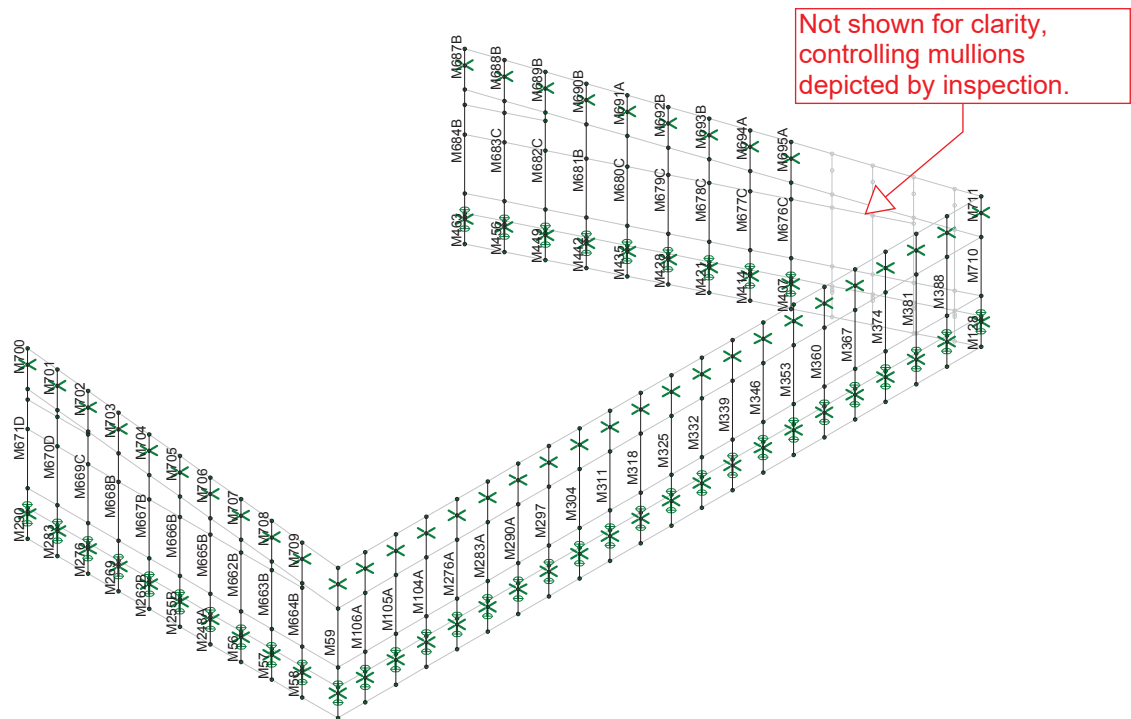
1 SOUTH ELEVATION
Scale: 3/4"=1'-0"
EGS-1
COLOR: PETER



2 PLAN
Scale: 3/4"=1'-0"



Member labels



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

JEI Structural Engineering

M. Gorny

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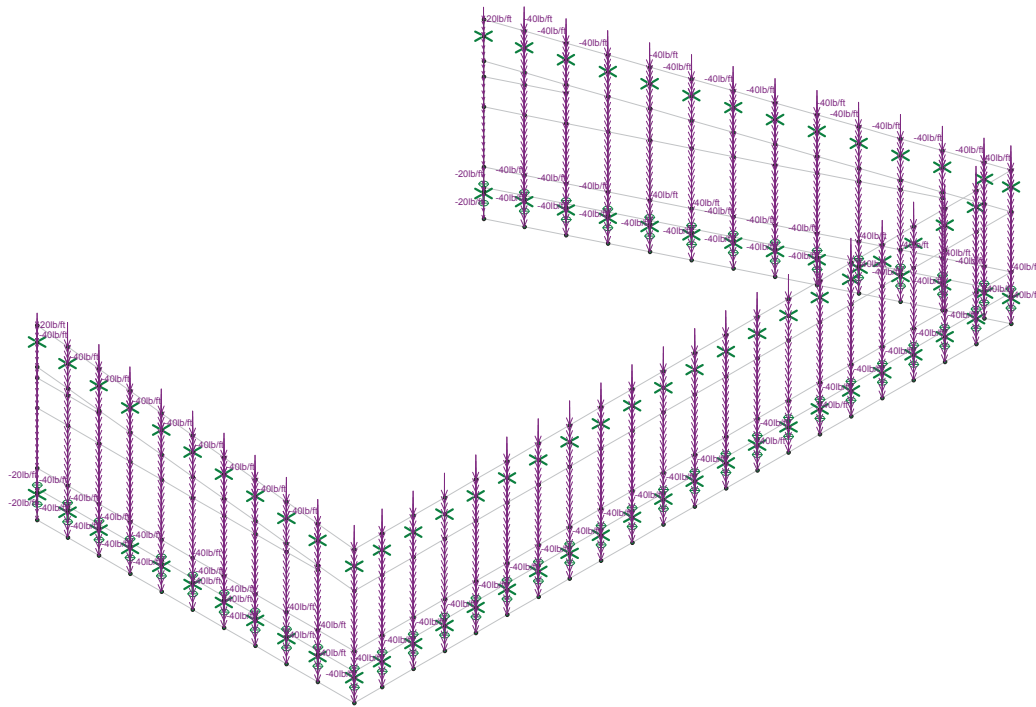
SK - 5

Nov 1, 2016 at 2:57 PM

EGS-1 Preliminary.r3d



Dead load
8psf (5') = 40lb/ft (20lb/ft at jambs)



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Loads: BLC 7, Dead

JEI Structural Engineering

M. Gorny

JE16059

Webster University

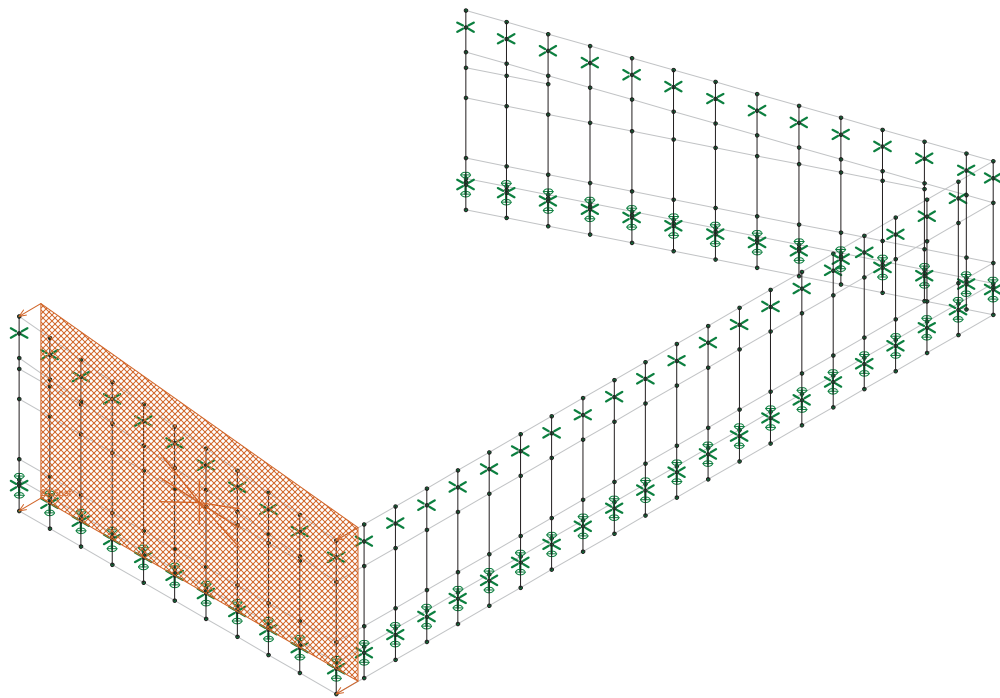
SK - 7

Nov 1, 2016 at 3:09 PM

EGS-1 Preliminary.r3d



Negative Wind - 23.5psf



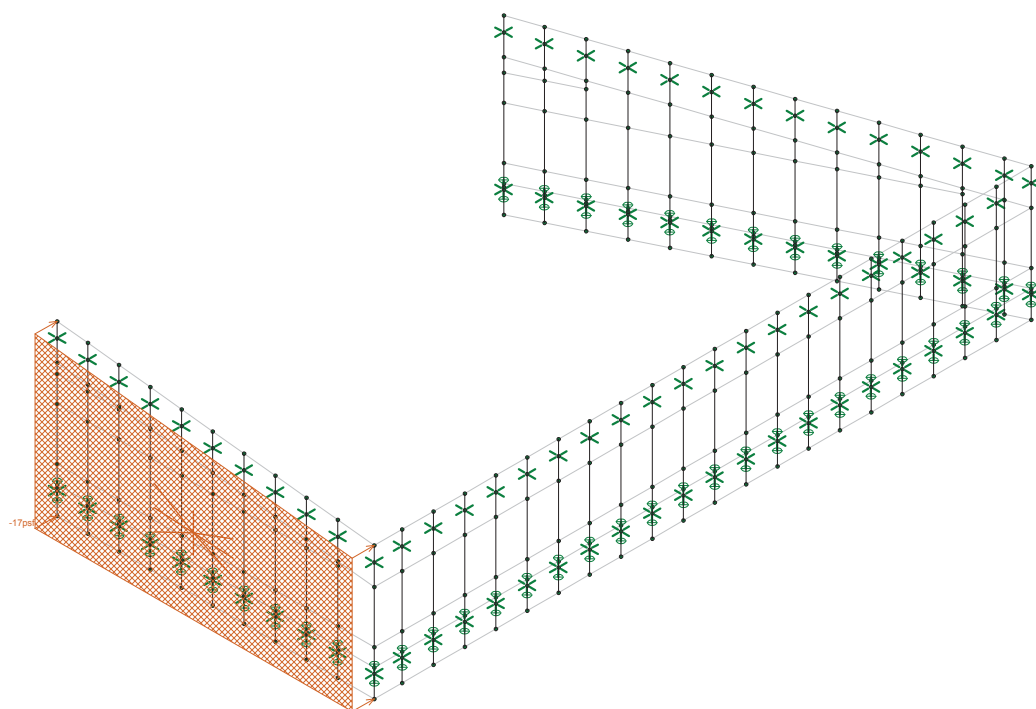
EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Loads: BLC 1, Negative Wind (Face A)

JEI Structural Engineering	Webster University	SK - 8
M. Gorny		Nov 1, 2016 at 3:10 PM
JE16059		EGS-1 Preliminary.r3d



Positive Wind - 17psf



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Loads: BLC 2, Positive Wind (Face A)

JEI Structural Engineering

M. Gorny

JE16059

Webster University

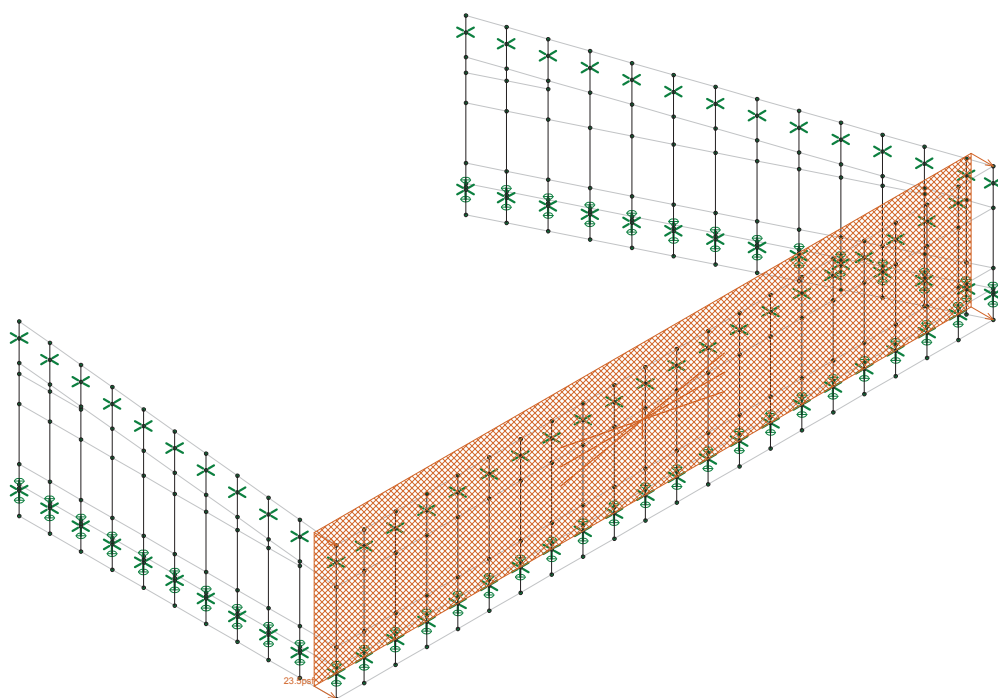
SK - 9

Nov 1, 2016 at 3:10 PM

EGS-1 Preliminary.r3d



Negative Wind - 23.5psf



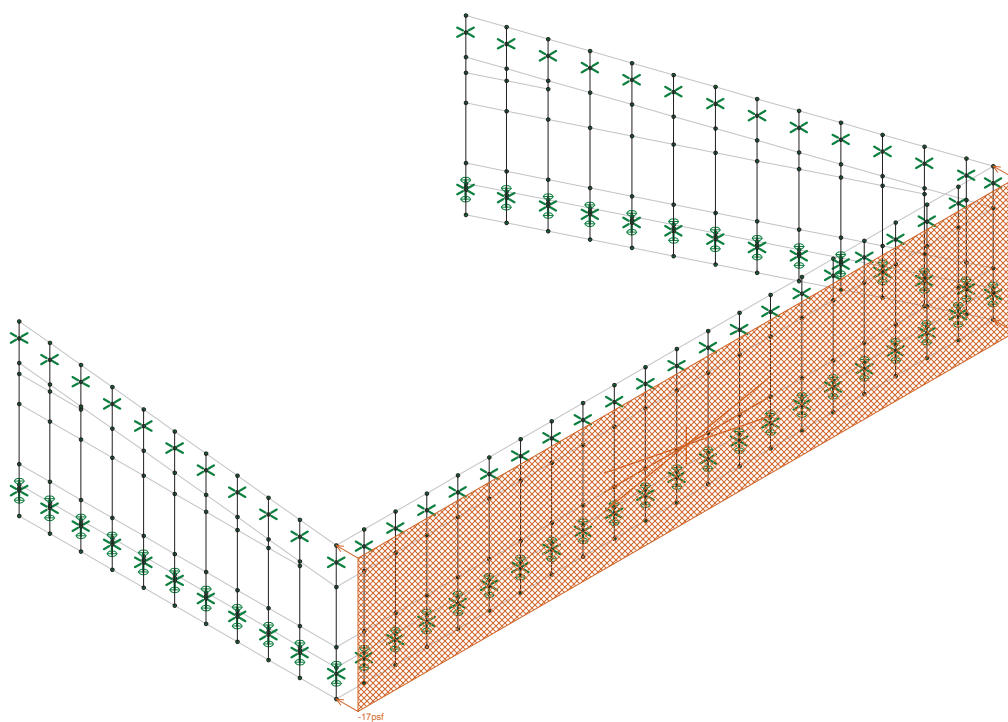
EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Loads: BLC 3, Negative Wind (Face B)

JEI Structural Engineering	Webster University	SK - 10
M. Gorny		Nov 1, 2016 at 3:10 PM
JE16059		EGS-1 Preliminary.r3d



Positive Wind - 17psf



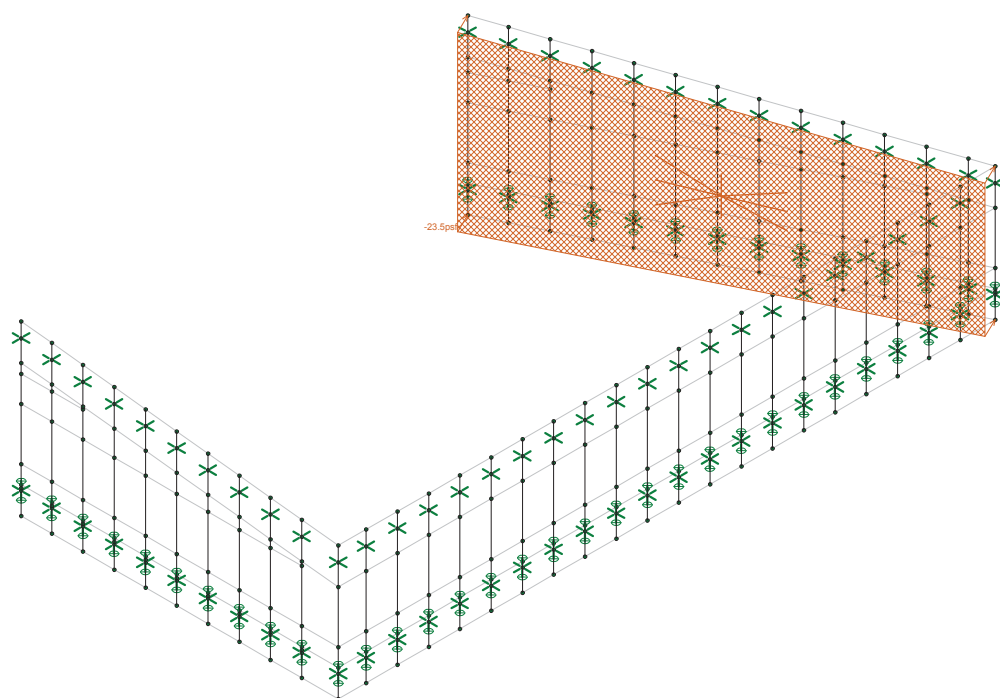
EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Loads: BLC 4, Positive Wind (Face B)

JEI Structural Engineering	Webster University	SK - 11
M. Gorny		Nov 1, 2016 at 3:10 PM
JE16059		EGS-1 Preliminary.r3d



Negative Wind - 23.5psf



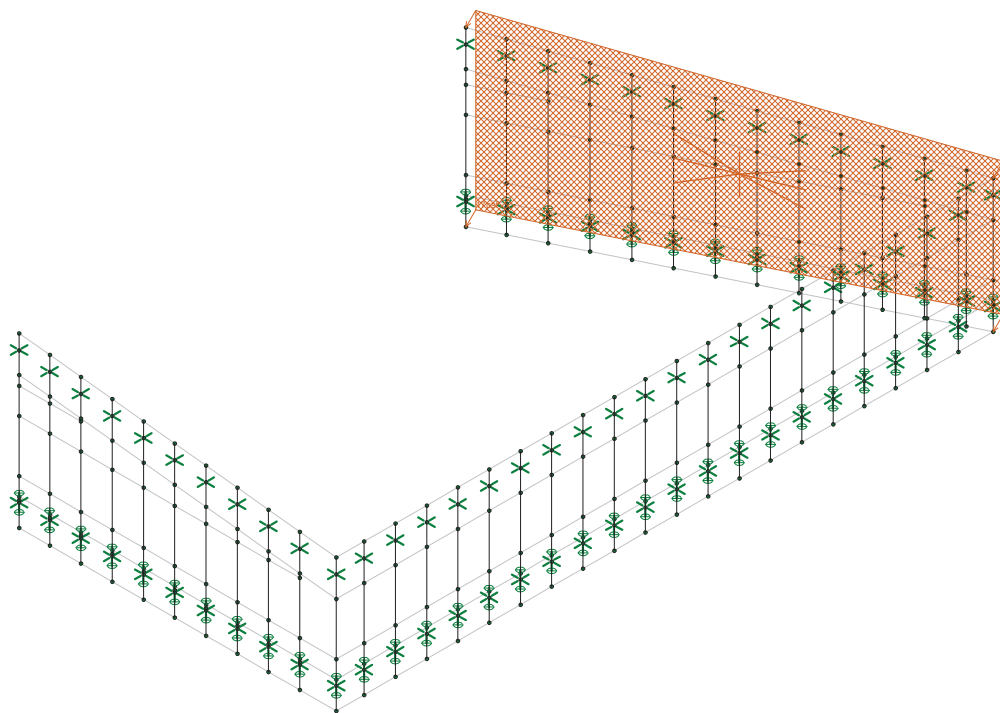
EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Loads: BLC 5, Negative Load (Face C)

JEI Structural Engineering	Webster University	SK - 12
M. Gorny		Nov 1, 2016 at 3:10 PM
JE16059		EGS-1 Preliminary.r3d



Positive Wind - 17psf



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Loads: BLC 6, Positive Load (Face C)

JEI Structural Engineering

M. Gorny

JE16059

Webster University

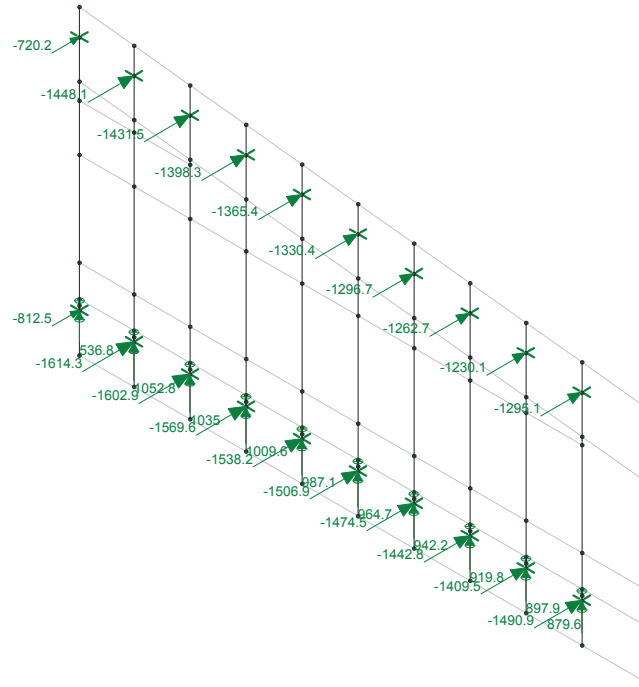
SK - 13

Nov 1, 2016 at 3:11 PM

EGS-1 Preliminary.r3d



Anchor Loads (1 of 2)
showing controlling vertical mullion anchor loads by inspection.



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Results for LC 1, Negative Wind Face A
Z-direction Reaction Units are lb and lb-ft

JEI Structural Engineering

M. Gorny

JE16059

Webster University

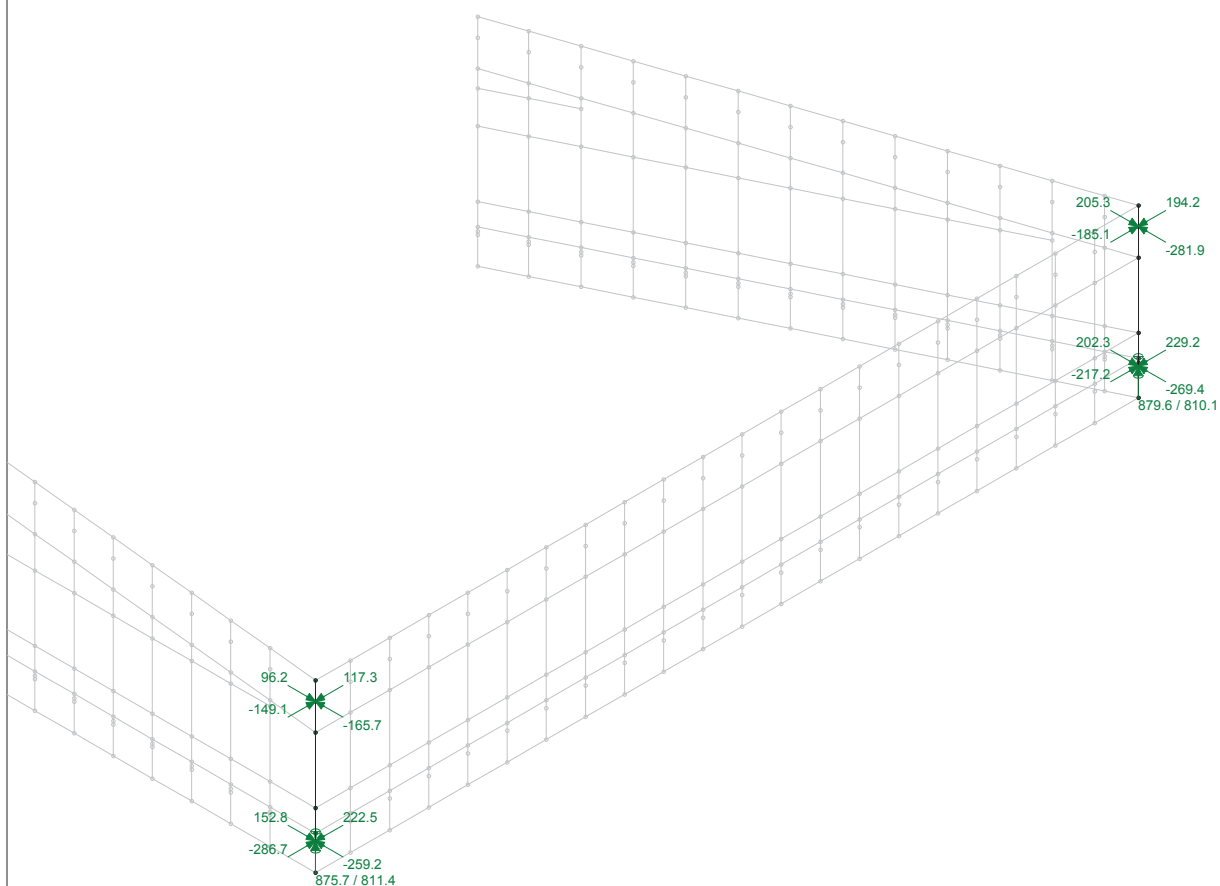
SK - 21

Nov 1, 2016 at 3:24 PM

EGS-1 Preliminary.r3d



Anchor Loads (2 of 2)
showing controlling corner vertical mullion anchor loads by inspection.



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Z-direction Reaction Units are lb and lb-ft (Enveloped)

JEI Structural Engineering

M. Gorny

JE16059

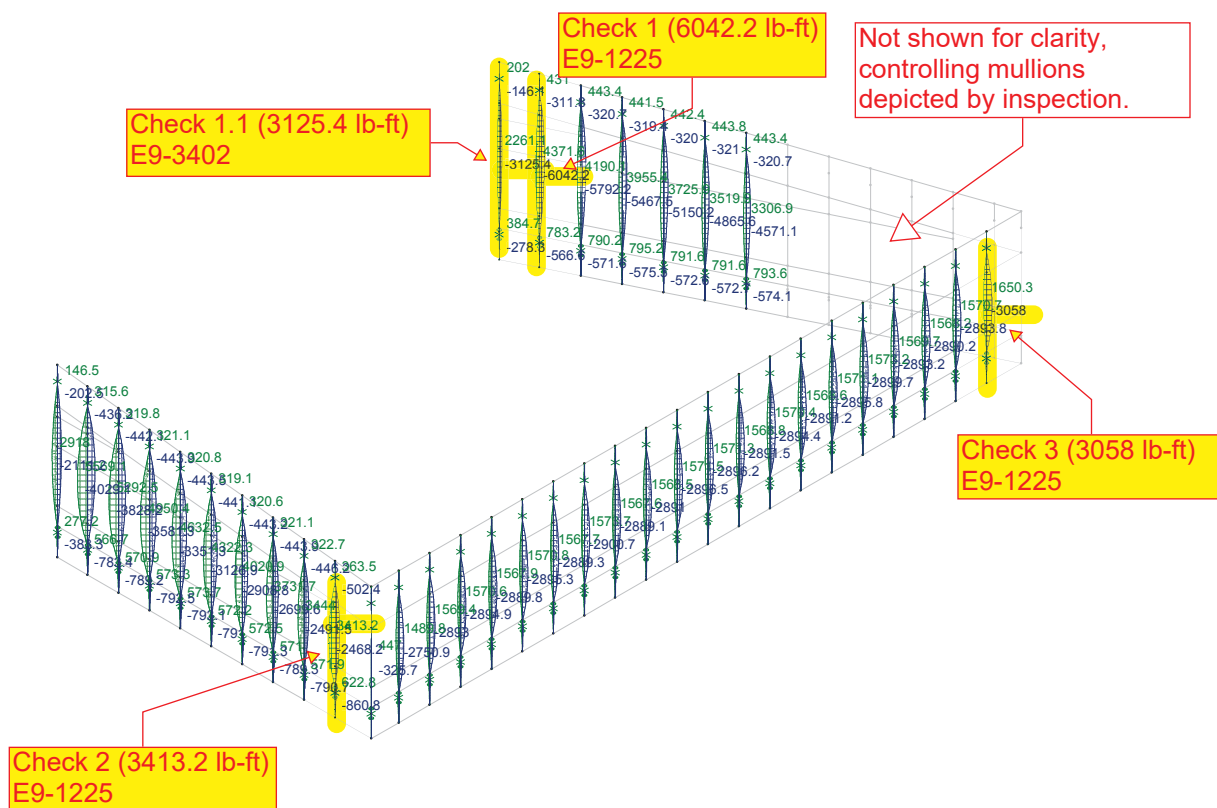
Webster University

SK - 20

Nov 1, 2016 at 3:23 PM

EGS-1 Preliminary.r3d

Moment diagram



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 208-210

Member z Bending Moments (lb-ft) (Enveloped)

JEI Structural Engineering	Webster University	SK - 1
M. Gorny		Nov 7, 2016 at 9:36 AM
JE16059		EGS-1 Preliminary.r3d

Beam: **M683C**

Shape:

Material: **gen_Alum**

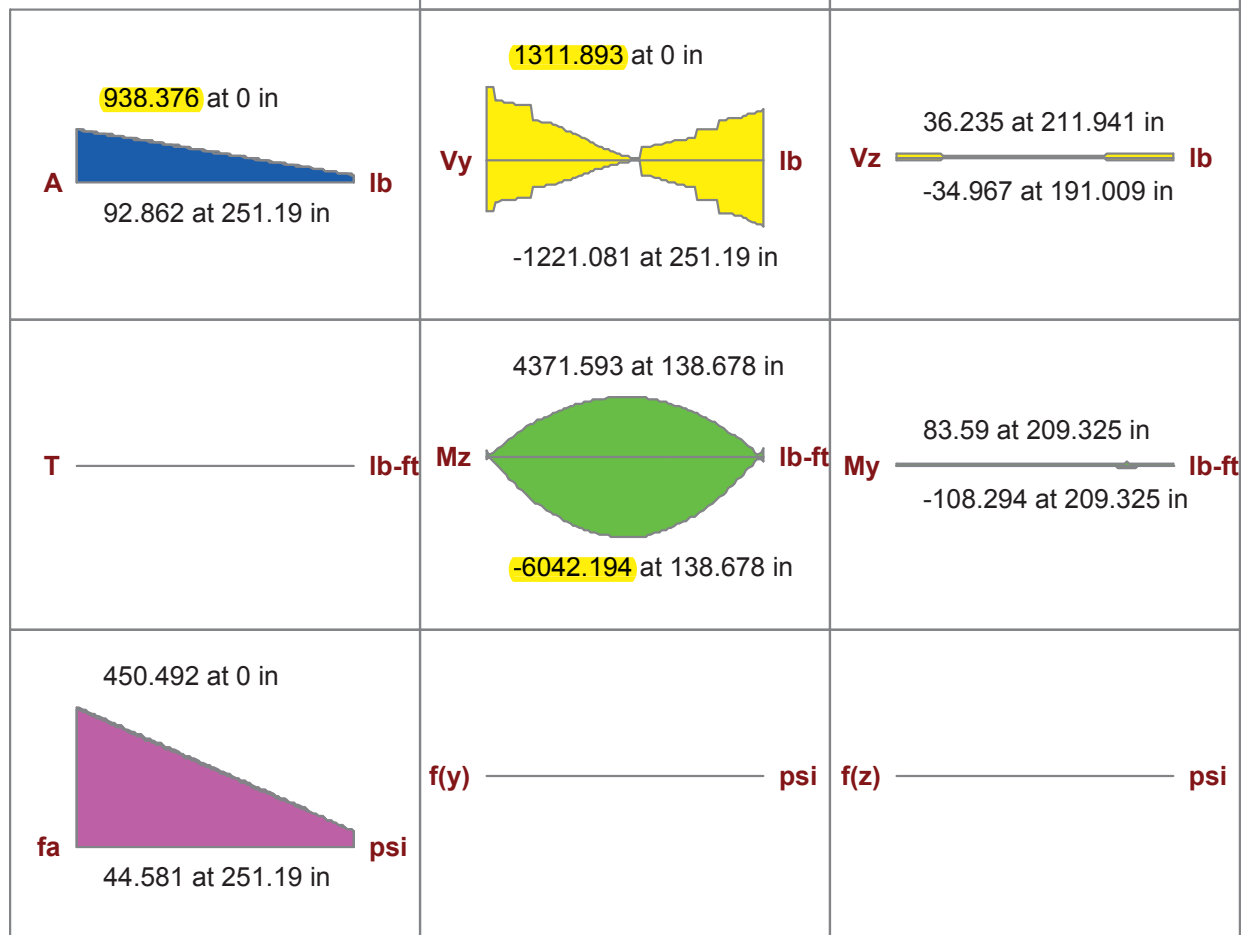
Length: **251.19 in**

I Joint: **N792D**

J Joint: **N791B**

Code Check: **No Calc**

Report Based On 97 Sections



Check 1

YKK E9-1225 with 4x2x3/8 HSS tube

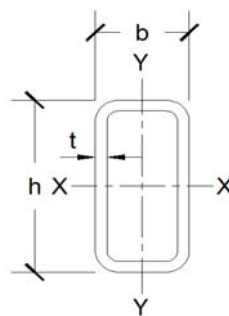
Using reduced pressure based on 70sf area to reduce deflection.

Dy = 1.757" (19psf / 23.5psf) = 1.42"

JEI Structural Engineering
11108 N Oak Trfy, Suite 208
Kansas City, MO 64155

Voice: 816-734-8345
Fax: 816-734-7013

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG
Part of: HSS allowable flexural strength



Date: 11/1/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT CHECK

Shape: HSS 4 x 2 x 3/8

Check 1

h = 4 in
b = 2 in
t = 0.349 in

b/t = 2.73
h/t = 8.46

E = 29000 ksi
Material = A500 Gr B
F_y = 46 ksi

I_x = 5.600 in⁴
S_x = 2.800 in³
Z_x = 3.840 in³

I_y = 1.800 in⁴
S_y = 1.800 in³
Z_y = 2.310 in³

A = 3.390 in²
wt = 12.170 lb/ft

X-Axis Flange/Web Slenderness Limits	Y-Axis Flange/Web Slenderness Limits
Flange (b/t) $\lambda_p = 1.12(E/F_y)^{1/2} = 28.12$ Compact $\lambda_r = 1.40(E/F_y)^{1/2} = 35.15$ X	Flange (h/t) $\lambda_p = 1.12(E/F_y)^{1/2} = 28.12$ Compact $\lambda_r = 1.40(E/F_y)^{1/2} = 35.15$ X
Web (h/t) $\lambda_p = 2.42(E/F_y)^{1/2} = 60.76$ Compact $\lambda_r = 5.70(E/F_y)^{1/2} = 143.12$ X	Web (b/t) $\lambda_p = 2.42(E/F_y)^{1/2} = 60.76$ Compact $\lambda_r = 5.70(E/F_y)^{1/2} = 143.12$ X

X-Axis Yielding (AISC F7.1)	Y-Axis Yielding (AISC F7.1)
$M_n = M_p = F_y Z_x = 176.64$ kip-in	$M_n = M_p = F_y Z_y = 106.26$ kip-in

X-Axis Flange Local Buckling (AISC F7.2)	Y-Axis Flange Local Buckling (AISC F7.2)
a) Compact sections: does not apply	a) Compact sections: does not apply
b) Noncompact flanges: $M_n = M_p - (M_p - F_y S_x)(3.57 * b/t * (F_y/E)^{1/2} - 4.0) =$ $M_n =$ N/A kip-in	b) Noncompact flanges: $M_n = M_p - (M_p - F_y S_y)(3.57 * h/t * (F_y/E)^{1/2} - 4.0) =$ $M_n =$ N/A kip-in
c) Slender flanges: $b_e = 1.92t(E/F_y)^{1/2}[1 - 0.38/(b/t) * (E/F_y)^{1/2}] =$ $b_e = -41.98$ in $S_{eff,x} = -47.92$ in ³ $M_n = F_y S_{eff} = -2204.39$ kip-in $M_n =$ N/A kip-in	c) Slender flanges: $b_e = 1.92t(E/F_y)^{1/2}[1 - 0.38/(h/t) * (E/F_y)^{1/2}] =$ $b_e = -2.15$ in $S_{eff,y} = -0.91$ in ³ $M_n = F_y S_{eff} = -41.84$ kip-in $M_n =$ N/A kip-in

X-Axis Web Local Buckling (AISC F7.3)	Y-Axis Web Local Buckling (AISC F7.3)
a) Compact sections: does not apply	a) Compact sections: does not apply
b) Noncompact webs: $M_n = M_p - (M_p - F_y S_x)(0.305 * h/t * (F_y/E)^{1/2} - 0.738) =$ $M_n =$ N/A kip-in	b) Noncompact webs: $M_n = M_p - (M_p - F_y S_y)(0.305 * b/t * (F_y/E)^{1/2} - 0.738) =$ $M_n =$ N/A kip-in

X-Axis Capacity	$\Omega_b = 1.67$
$M_n =$	176.64 kip-in
$M_n/\Omega_b =$	105.77 kip-in
$M_n/\Omega_b =$	8814 lb-ft

Y-Axis Capacity	$\Omega_b = 1.67$
$M_n =$	106.26 kip-in
$M_n/\Omega_b =$	63.63 kip-in
$M_n/\Omega_b =$	5302 lb-ft

JEI Structural Engineering
11108 N. Oak Tfwy, Suite 208
Kansas City, MO 64155

Voice: 816-734-8345
Fax: 816-734-7013
www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/210
Detail: 2/409

Date: 11/1/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Member M683C **Check 1**

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t)	5.00 ft	$F_y =$	25.0 ksi
Height (h)	21.31 ft	$F_u =$	30.0 ksi
Unbraced Length (L)	8.33 ft		

Design Loads

Design Pressure (p)	19.0 psf (Using reduced area load based on 70sf)
Panel Weight (p_{wt})	8.0 psf (deflection only)

Manuf. / Part #:		YKK E9-1225	
E =	10100 ksi	$r_{x, \text{alum}} =$	2.176 in
$I_{x, \text{alum}} =$	9.838 in ⁴	$r_{y, \text{alum}} =$	0.935 in
$I_{y, \text{alum}} =$	1.818 in ⁴	A =	2.079 in ²
$S_{x, \text{alum}} =$	3.213 in ³	J =	4.110 in ⁴
$S_{y, \text{alum}} =$	1.454 in ³	wt =	2.498 lb/ft
$b/t_{web} =$	52.71	$b/t_{flange} =$	22.33
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
--------------	------	--------------	------

Applied Bending Moment

$w = p \cdot t$	$w =$	N/A lb/ft
Shear Load $V = wL/2$	$V =$	1311.9 lb
Moment $M = wL^2/8$	$M =$	6042.2 lb-ft
$M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$	$M_{alum} =$	2279.4 lb-ft
$f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum} =$	8.51 ksi

Applied Axial Compression

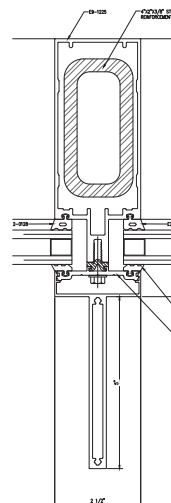
$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$	938.4 lb
$f_{c-alum} = P/A$	$f_{c-alum} =$	0.45 ksi

Check Deflection

Typical Vertical	
N/A in. joint $\Delta = (5wL^4)/(384EI) =$	1.421 in
N/A $\pm$ movement cap. $\Delta_{allow} =$	1.315 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = #####

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$	$M_{steel} =$	3762.8 lb-ft
$Mb/\Omega =$	$Mb/\Omega =$	8814 lb-ft
$Ms/(Mb/\Omega) =$		0.427



Reinforcing

HSS 2x4x3/8	
$I_{x, steel} =$	5.600 in ⁴
$S_{x, steel} =$	2.800 in ³
$I_{combined} =$	26.078 in ⁴

Load Share

Aluminum	Steel
0.377	0.623

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.15 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.92 ksi
E.3 - Axial Compression	4.49 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.60 ksi

Compression Interaction

Allowable Compression	$F_c =$	4.49 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.101

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.92 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.612

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	0.712
---------------------------	-----------------------	-------

Mullion OK, $\leq 1/8"$ over allowable deflection.

Beam: **M664B**

Shape:

Material: **gen_Alum**

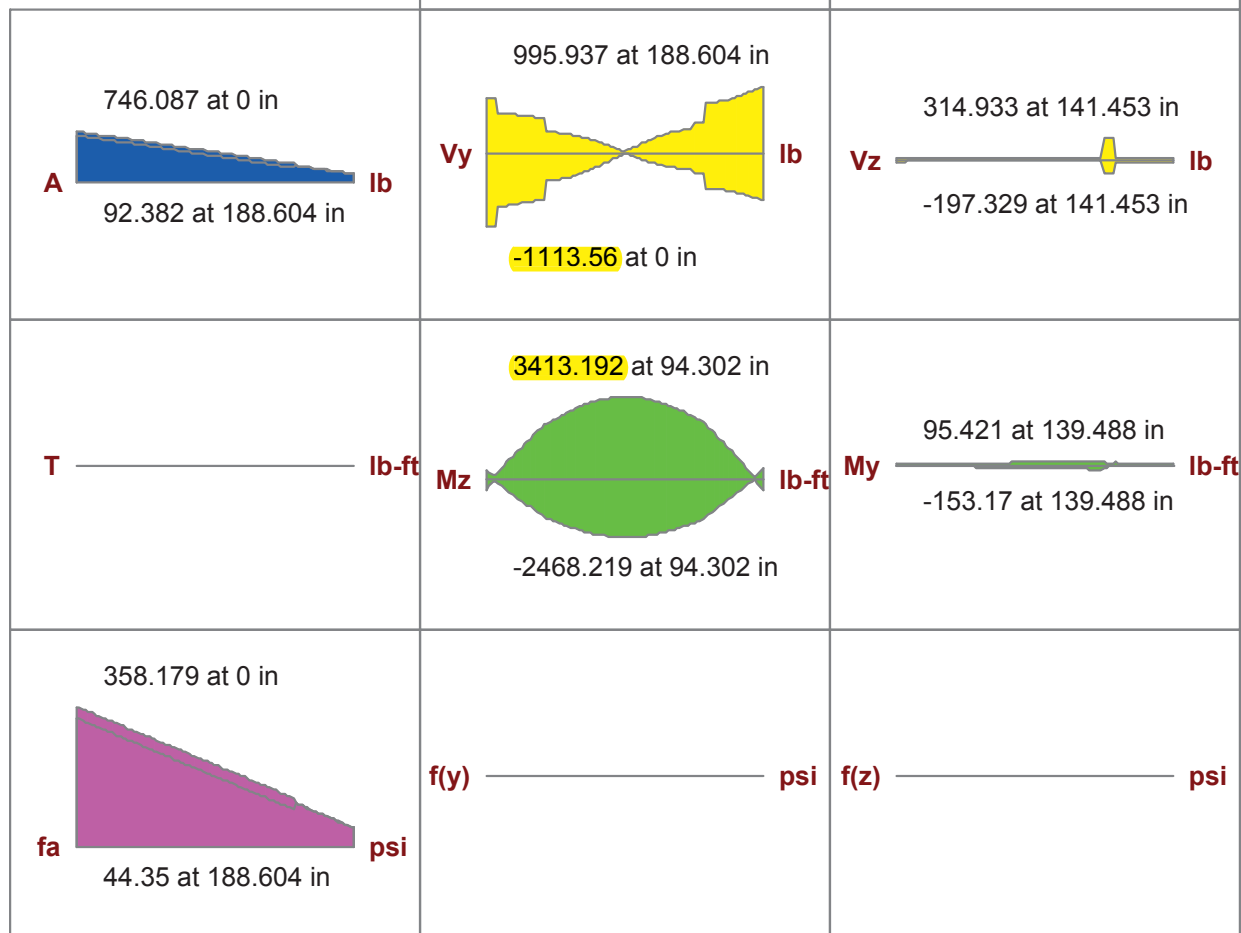
Length: **188.604 in**

I Joint: **N773**

J Joint: **N720A**

Code Check: **No Calc**

Report Based On 97 Sections



Check 2

YKK E9-1225 with 4x2x3/8 HSS tube

JEI Structural Engineering
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Kansas City, MO 64155

Voice: 816-734-8345
Fax: 816-734-7013
www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/208
Detail: 2/409

Member M683C

Check 2

Date: 11/1/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t)	5.42 ft	$F_y =$	25.0 ksi
Height (h)	16.09 ft	$F_u =$	30.0 ksi
Unbraced Length (L)	8.33 ft		

Design Loads

Design Pressure (p)	23.5 psf
Panel Weight (p_{wt})	8.0 psf

Manuf. / Part #:		YKK E9-1225	
E =	10100 ksi	$r_{x, \text{alum}} =$	2.176 in
$I_{x, \text{alum}} =$	9.838 in ⁴	$r_{y, \text{alum}} =$	0.935 in
$I_{y, \text{alum}} =$	1.818 in ⁴	A =	2.079 in ²
$S_{x, \text{alum}} =$	3.213 in ³	J =	4.110 in ⁴
$S_{y, \text{alum}} =$	1.454 in ³	wt =	2.498 lb/ft
$b/t_{web} =$	52.71	$b/t_{flange} =$	22.33
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
--------------	------	--------------	------

Applied Bending Moment

$w = p \cdot t$	$w =$	N/A lb/ft
Shear Load $V = wl/2$	$V =$	1113.6 lb
Moment $M = wl^2/8$	$M =$	3413.2 lb-ft
$M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$	$M_{alum} =$	1287.6 lb-ft
$f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum} =$	4.81 ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$	746.1 lb
$f_{c-alum} = P/A$	$f_{c-alum} =$	0.36 ksi

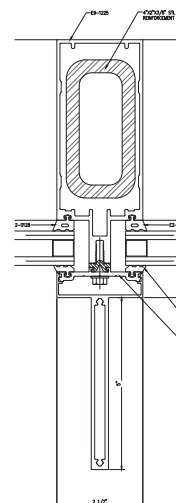
Check Deflection

Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) =$	0.562 in
N/A $\pm$ movement cap. $\Delta_{allow} =$	1.055 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = #####

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$	$M_{steel} =$	2125.6 lb-ft
$Mb/\Omega =$	$Mb/\Omega =$	8814 lb-ft
$Ms/(Mb/\Omega) =$	$Ms/(Mb/\Omega) =$	0.241



Reinforcing

HSS 2x4x3/8

$I_{x, steel} =$	5.600 in ⁴	Load Share	
$S_{x, steel} =$	2.800 in ³	Aluminum	Steel
$I_{combined} =$	26.078 in ⁴	0.377	0.623

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.15 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.92 ksi
E.3 - Axial Compression	4.49 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.60 ksi

Compression Interaction

Allowable Compression	$F_c =$	4.49 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.080

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.92 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.346

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	0.425
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Mullion OK

Beam: **M388**

Shape:

Material: **gen_Alum**

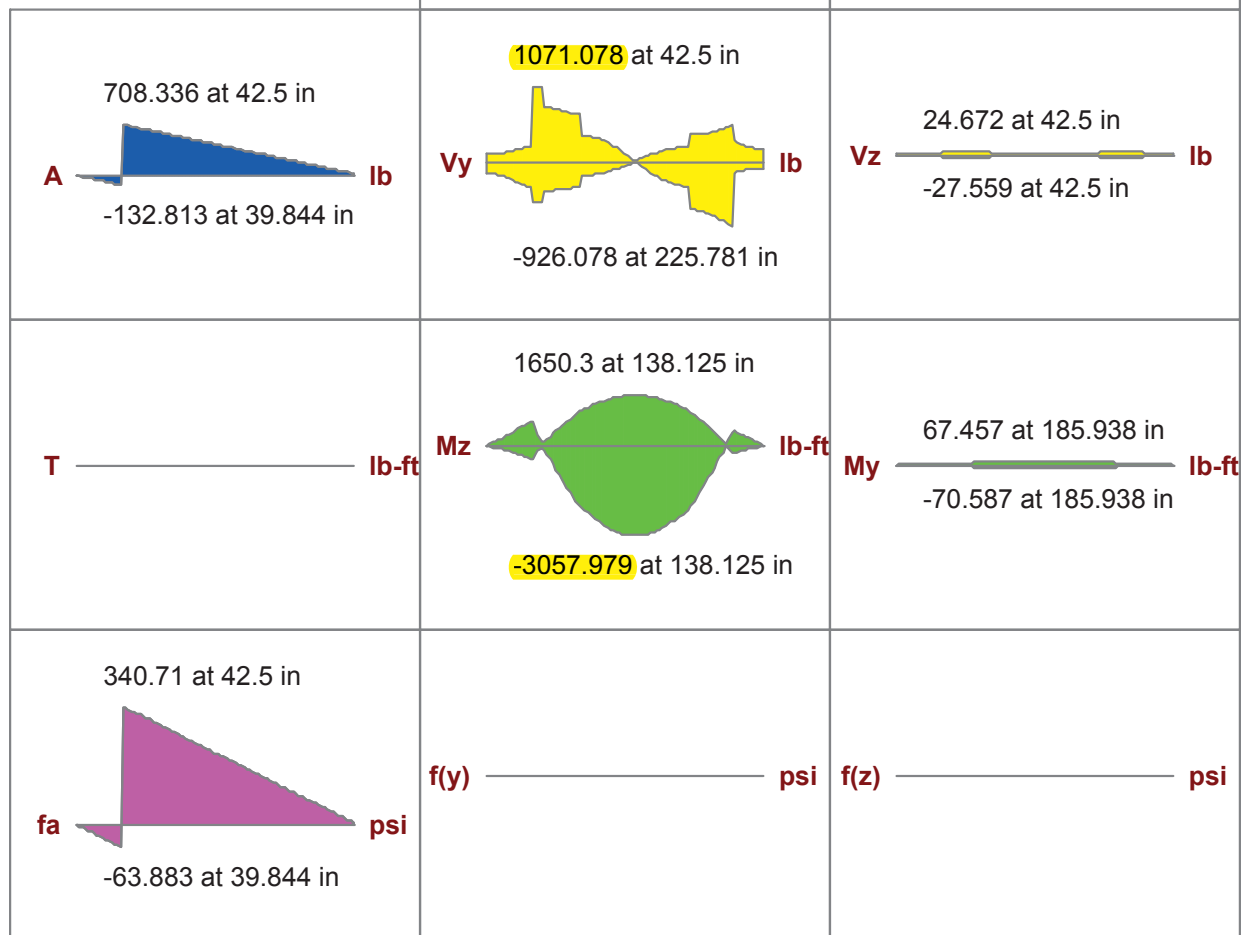
Length: **255 in**

I Joint: **N571**

J Joint: **N583**

Code Check: **No Calc**

Report Based On 97 Sections



Check 3

YKK E9-1225

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Voice: 816-734-8345
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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/209
Detail: 1/407 **Check 3**

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t)	5.00 ft	$F_y =$	25.0 ksi
Height (h)	15.44 ft	$F_u =$	30.0 ksi
Unbraced Length (L)	8.33 ft		

Design Loads

Design Pressure (p)	19.0 psf (Using reduced area load based on 70sf)
Panel Weight (p_{wt})	8.0 psf (deflection only)

Manuf. / Part #:		YKK E9-1225	
E =	10100 ksi	$r_{x, alum} =$	2.176 in
$I_{x, alum} =$	9.838 in ⁴	$r_{y, alum} =$	0.935 in
$I_{y, alum} =$	1.818 in ⁴	A =	2.079 in ²
$S_{x, alum} =$	3.213 in ³	J =	4.110 in ⁴
$S_{y, alum} =$	1.454 in ³	wt =	2.498 lb/ft
$b/t_{web} =$	52.71	$b/t_{flange} =$	22.33
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
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Applied Bending Moment

$w = p \cdot t$	$w =$	N/A lb/ft
Shear Load $V = wL/2$	$V =$	1071.1 lb
Moment $M = wL^2/8$	$M =$	3058.0 lb-ft
$M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$	$M_{alum} =$	3058.0 lb-ft
$f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum} =$	11.42 ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$	708.3 lb
$f_{c-alum} = P/A$	$f_{c-alum} =$	0.34 ksi

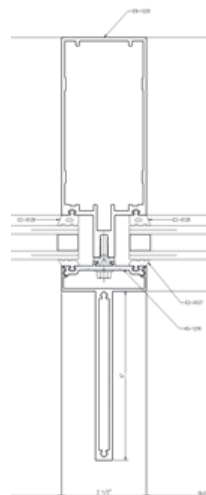
Check Deflection

Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) =$	0.987 in
N/A $\pm$ movement cap. $\Delta_{allow} =$	1.022 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = #####

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$	$M_{steel} =$	0.0 lb-ft
$Mb/\Omega =$	$Mb/\Omega =$	0 lb-ft
$Ms/(Mb/\Omega) =$		N/A

**Reinforcing**

No Reinforcing

$I_{x, steel} =$	0.000 in ⁴	Load Share	
$S_{x, steel} =$	0.000 in ³	Aluminum	Steel
$I_{combined} =$	9.838 in ⁴	1.000	0.000

Allowable Loads $\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.15 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.92 ksi
E.3 - Axial Compression	4.49 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.60 ksi

Compression Interaction

Allowable Compression	$F_c =$	4.49 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.076

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.92 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.821

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	0.896
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Mullion OK

Beam: **M684B**

Shape:

Material: **gen_Alum**

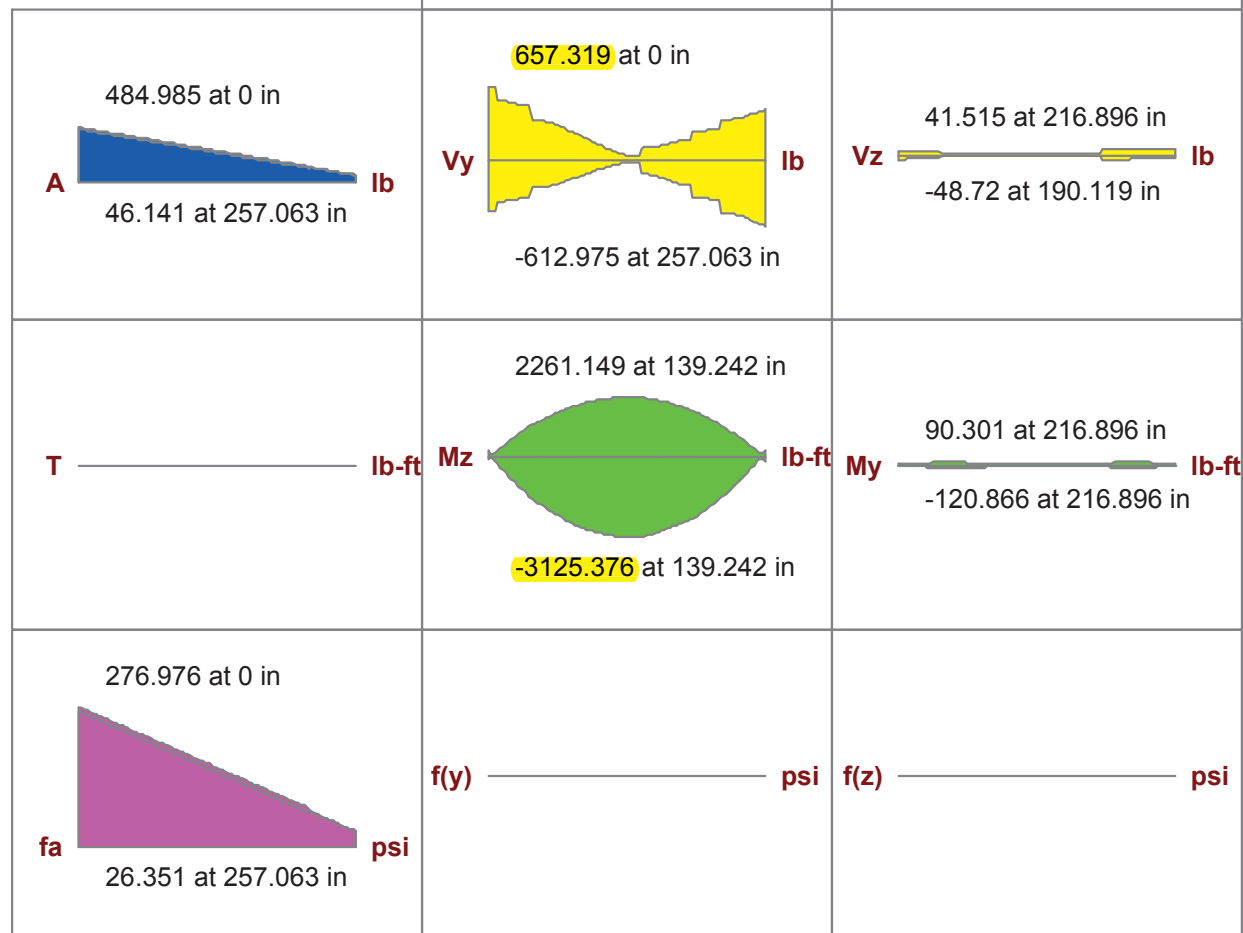
Length: **257.063 in**

I Joint: **N793C**

J Joint: **N792C**

Code Check: **No Calc**

Report Based On 97 Sections



Check 1.1

YKK E9-3402 with 4x2x1/4 bent steel channel

Using reduced pressure based on 70sf area to reduce deflection.

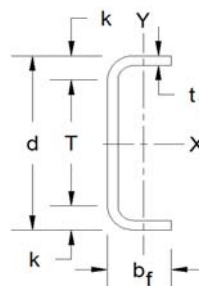
$Dy = 1.343''$ ($17\text{psf} / 23.5\text{psf}$) = 0.972"

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Voice: 816-734-8345
Fax: 816-734-7013

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG
Part of: Channel allowable flexural strength

Date: 11/1/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT CHECK



Check 1.1

AISC Shape: 4" x 2" x 1/4" E = 29000 ksi Material = A36
Cust Dims: N/A F_y = 36 ksi L_b = 100 in

d = 4.000 in	t _f = 0.250 in	T = h = 2.500 in
b _f = 2.000 in	t _w = 0.250 in	J = 0.039 in ⁴
I _x = 4.107 in ⁴	I _y = 0.671 in ⁴	C _w = 1.494 in ⁶
S _x = 2.054 in ³	S _y = 0.485 in ³	h _o = 3.750 in
Z _x = 2.483 in ³	Z _y = 0.876 in ³	A = 1.795 in ²
r _x = 1.513 in	r _y = 0.611 in	wt = 6.108 lb/ft

<u>Flange Slenderness</u>		<u>Web Slenderness</u>
$r_{ts}^2 = (I_y C_w)^{1/2} / S_x = 0.49$	$\lambda_{pf} = 0.38(E/F_y)^{1/2} = 10.79$	$\lambda_{pw} = 3.76(E/F_y)^{1/2} = 106.72$
$c = h_o/2 * (I_y/C_w)^{1/2} = 1.26$	$\lambda_{rf} = 1.0(E/F_y)^{1/2} = 28.38$	$\lambda_{rw} = 5.70(E/F_y)^{1/2} = 161.78$

Flange Slenderness $\lambda = b_f/t_f = 8.00$ Flange Slenderness = Compact	Web Slenderness $\lambda = h/t_w = 10.00$ Web Slenderness = Compact
$L_b =$ $L_p = 1.76r_y(E/F_y)^{1/2} =$ $L_r = 1.95r_{ts} * E/(0.7F_y) * (Jc/(S_x h_o))^{1/2} (1 + (1 + 6.76(0.7F_y/E * S_x h_o/(Jc))^2)^{1/2})^{1/2} =$	$L_b = 100$ in $L_p = 30.52$ in $L_r = 179.42$ in

X-Axis Yielding (AISC F2.1) $L_b \leq L_p$ $M_n = M_p = F_y Z_x = 89.39$ kip-in	Y-Axis Yielding (AISC F6.1) $M_n = M_p = F_y Z_y = 31.54$ kip-in $1.6F_y S_y = 27.94$ kip-in $M_n = M_p \leq 1.6F_y S_y = 27.94$ kip-in
--	---

X-Axis Lateral-Torsional Buckling (AISC F2.2) AISC F2.2.b $L_p < L_b \leq L_r$ $M_n = C_b [M_p - (M_p - 0.7F_y S_x)((L_b - L_p)/(L_r - L_p))] =$ $M_n = 71.83$ kip-in $M_p = F_y Z_x = 89.39$ kip-in $M_n \leq M_p = 71.83$ kip-in	Y-Axis Flange Local Buckling (AISC F6.2) AISC F6.2.b $\lambda_{pf} < \lambda \leq \lambda_{rf}$ $M_n = [M_p - (M_p - 0.7F_y S_y)((\lambda - \lambda_{pf})/(\lambda_{rf} - \lambda_{pf}))] =$ $M_n = 34.59$ kip-in $M_p = F_y Z_y = 31.54$ kip-in $M_n \leq M_p = N/A$ kip-in
AISC F2.2.c $L_b > L_r$ $F_{cr} = C_b \pi^2 E / (L_b/r_{ts})^2 (1 + 0.078 Jc / (S_x h_o) * (L_b/r_{ts})^2)^{1/2} =$ $F_{cr} = 46.65$ ksi $M_n = F_{cr} S_x = 95.82$ kip-in $M_p = F_y Z_x = 89.39$ kip-in $M_n \leq M_p = N/A$ kip-in	AISC F6.2b $\lambda > \lambda_{rf}$ $F_{cr} = 0.69 E / (b_f/2t_f)^2 =$ $F_{cr} = 1250.63$ ksi $M_n = F_{cr} S_y = 606.55$ kip-in $M_n = N/A$ kip-in

X-Axis Capacity	$\Omega_b = 1.67$
$M_n =$	71.83 kip-in
$M_n/\Omega_b =$	43.01 kip-in
$M_n/\Omega_b =$	3584 lb-ft

Y-Axis Capacity	$\Omega_b = 1.67$
$M_n =$	27.94 kip-in
$M_n/\Omega_b =$	16.73 kip-in
$M_n/\Omega_b =$	1394 lb-ft

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www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/210
Detail: 1/409

Date: 11/1/2016
Proj. No.: JE16059
Designer: M. Gorny

Member 684B

Check 1.1

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t)	2.44 ft	$F_y =$	25.0 ksi
Height (h)	21.12 ft	$F_u =$	30.0 ksi
Unbraced Length (L)	8.33 ft		

Design Loads

Design Pressure (p)	17.0 psf (Using reduced non corner winds, 50sf)
Panel Weight (p_{wt})	8.0 psf (deflection only)

Manuf. / Part #:		YKK E9-3402	
E =	10100 ksi	$r_{x, \text{alum}} =$	1.925 in
$I_{x, \text{alum}} =$	6.485 in ⁴	$r_{y, \text{alum}} =$	0.994 in
$I_{y, \text{alum}} =$	1.729 in ⁴	A =	1.751 in ²
$S_{x, \text{alum}} =$	2.197 in ³	J =	3.525 in ⁴
$S_{y, \text{alum}} =$	1.383 in ³	wt =	2.104 lb/ft
$b/t_{web} =$	54.86	$b/t_{flange} =$	23.48
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
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Applied Bending Moment

$w = p \cdot t$	$w =$	N/A lb/ft
Shear Load $V = wl/2$	$V =$	657.3 lb
Moment $M = w^2/8$	$M =$	3125.4 lb-ft
$M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$	$M_{alum} =$	1101.8 lb-ft
$f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum} =$	6.02 ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$	485.0 lb
$f_{c-alum} = P/A$	$f_{c-alum} =$	0.28 ksi

Check Deflection

Jamb Vertical	
1/2 in. joint $\Delta = (5wL^4)/(384EI) =$	0.972 in
100% $\pm$ movement cap. $\Delta_{allow} =$	0.866 in
See sealant joint calculation for allowable joint movement.	
Deflection Factor	DF = #####

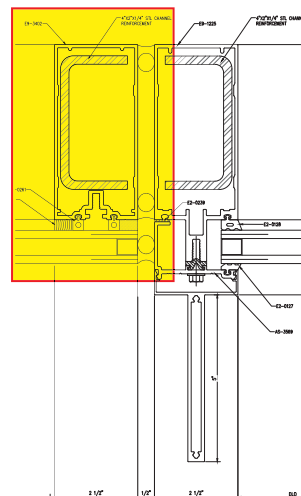
Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$	$M_{steel} =$	2023.6 lb-ft
$Mb/\Omega =$	$Mb/\Omega =$	3584 lb-ft
$Ms/(Mb/\Omega) =$		0.565

INPUT

CHECK

RISA



Reinforcing

Channel 2x4x1/4

$I_{x, steel} =$	4.107 in ⁴	Load Share	
$S_{x, steel} =$	2.054 in ³	Aluminum	Steel
$I_{combined} =$	18.395 in ⁴	0.353	0.647

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.04 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.38 ksi
E.3 - Axial Compression	5.07 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.88 ksi

Compression Interaction

Allowable Compression	$F_c =$	5.07 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.055

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.38 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.450

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	0.505
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Mullion OK, $\leq 1/8"$ over allowable deflection.

Joint needs to consider multi-directional movement. See page ____ for other half of double vertical analysis, and full joint analysis.

Beam: **M710**

Shape:

Material: **gen_Alum**

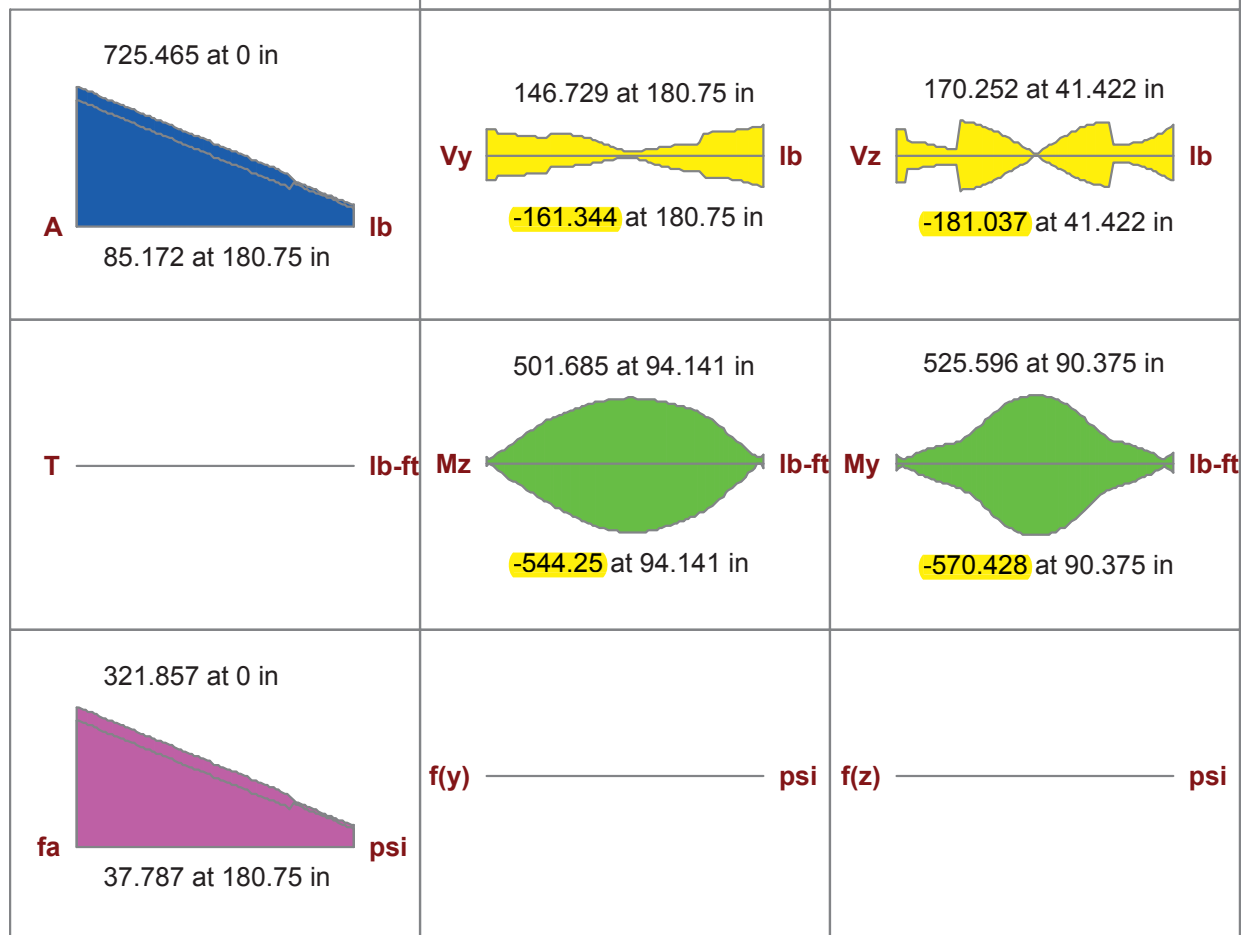
Length: **180.75 in**

I Joint: **N794B**

J Joint: **N724A**

Code Check: **No Calc**

Report Based On 97 Sections



YKK E9-3401
64 deg corner

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Office: 816-505-0987
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www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/210
Detail: 1/405 **Member M710**

Date: 11/1/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width A (t_{wLA})	2.80 ft	Corner Angle (θ)
Tributary Width B (t_{wLB})	1.62 ft	64.00 °
Height (h)	15.44 ft	
Unbraced Length (L)	8.33 ft	

Design Loads

Design Pressure A (p_A)	17.63 psf
Design Pressure B (p_B)	12.75 psf
Panel Weight (p_{wt})	8 psf

Manuf. / Part #:

YKK E9-3401

E =	10100 ksi	$r_{x, alum} =$	1.948 in
$I_{x, alum} =$	8.555 in ⁴	$r_{y, alum} =$	0.991 in
$I_{y, alum} =$	2.213 in ⁴	A =	2.254 in ²
$S_{x, alum} =$	3.127 in ³	J =	4.596 in ⁴
$S_{y, alum} =$	1.765 in ³	wt =	2.708 lb/ft

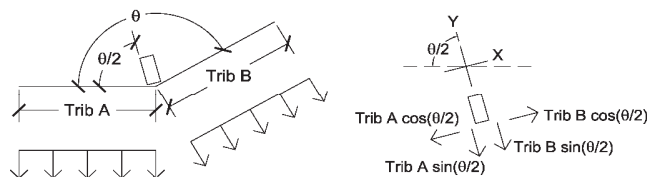
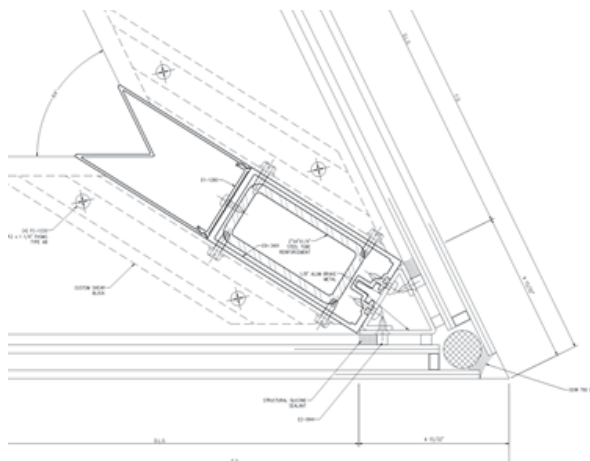
Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
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Reinforcing

HSS 2x4x3/8

$I_{x, steel} =$	5.600 in ⁴	$I_{y, steel} =$	1.800 in ⁴
$S_{x, steel} =$	2.800 in ³	$S_{y, steel} =$	1.800 in ³
$I_{x, combined} =$	24.795 in ⁴	$I_{y, combined} =$	7.433 in ⁴

**X-Axis Bending Stress (ADM F.2 & F.3) $\Omega = 1.65$**

$w = p \cdot t$	$w_y =$	N/A lb/ft
Shear Load $V = wl/2$	$V_y =$	161.3 lb
Moment $M = wl^2/8$	$M_x =$	544.3 lb-ft
$M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$	$M_{x-alum} =$	187.8 lb-ft
$L_n = (2 \cdot L_b \cdot S_x) / (I_y J)^{1/2}$	$L_n =$	196.1
$f_b = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum-x} =$	0.72 ksi
$f_{b-alum-x} / F_{bx} =$	$F_{bx} / \Omega = F_{bx} =$	14.79 ksi

Y-Axis Bending Stress (ADM F.2 & F.3) $\Omega = 1.65$

$w = p \cdot t$	$w_x =$	N/A lb/ft
Shear Load $V = wl/2$	$V_x =$	181.0 lb
Moment $M = wl^2/8$	$M_y =$	570.4 lb-ft
$M_{alum} = M \cdot I_{alum} / I_{comb}$	$M_{y-alum} =$	169.8 lb-ft
$L_n = (2 \cdot L_b \cdot S_x) / (I_y J)^{1/2}$	$L_n =$	110.7
$f_b = M_{alum} / (S_{y, alum})$	$f_{b-alum-y} =$	1.15 ksi
$f_{b-alum-y} / F_{by} =$	$F_{by} / \Omega = F_{by} =$	15.27 ksi

Combined Stress Ratio $f_{bx} / F_{bx} + f_{by} / F_{by} =$

0.12

OK

Check Combined Bending & Compression (ADM H.1)

$f_a / F_a + f_b / F_b < 1.0$	$f_a / F_a + f_b / F_b =$	0.176
-------------------------------	---------------------------	-------

OK

Mullion Resultant Forces

Strong Axis Bending, $M_x, w_y =$	37.09 lb/ft
Weak Axis Bending, $M_y, w_x =$	24.33 lb/ft

Load Share

Aluminum (x)	Steel (x)	Aluminum (y)	Steel (y)
0.345	0.655	0.298	0.702

Axial Load

$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$	587.6 lb
---	-------	----------

Check Allowable Compression - ADM E.3

$kL_p / r =$	$kL_p / r =$	100.92
F_{a1} (Allowable Compression)	$F_{a1} / \Omega =$	5.04 ksi

Check Allowable Compression - Flange element (ADM B.5.4.2)

$b/t =$	$b/t =$	12.36
F_{a2} (Allowable Compression)	$F_{a2} / \Omega =$	15.20 ksi

Check Allowable Compression - Web element (ADM B.5.5.1)

$b/t =$	$b/t =$	37.72
F_{a3} (Allowable Compression)	$F_{a3} / \Omega =$	19.70 ksi

$f_a = P/A$	$f_a =$	0.26 ksi
Lessor of F_{a1}, F_{a2}, F_{a3}	$F_a / \Omega = F_a =$	5.04 ksi
	$f_a / F_a =$	0.052

OK

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 www.jeistructural.com

Client: NGG
 Project: Webster University
 Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
 Part of: Vertical Mullion Analysis
 Elevation: 1/210
 Detail: 1/405

Date: 11/1/2016
 Proj. No.: JE16059
 Designer: M. Gorny

INPUT CHECK RISA

Strong Axis Deflection (M_x, w_y)		Typical Vertical	
$\Delta_y = (5w_y L^4)/(384EI)$		$\Delta_y =$	0.097 in
within DLO (Conservative)		$\Delta_y =$	0.097 in
Weak-Axis Deflection (w_x)			
$\Delta_x = (5w_x L^4)/(384EI_\Delta)$		$\Delta_x =$	0.271 in
within DLO (Conservative)		$\Delta_x =$	0.271 in
Resultant Deflection			
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$		$\Delta_{total} =$	0.288 in
Angle Relative to X-Axis		$\theta_\Delta =$	19.7 °
		$\Delta_{allow} =$	1.022 in
Allowable deflection = L/175 or if span > 13'-6"		Deflection Factor	DF = #####
then allowable def = L/240 + 1/4"			
OK			

Steel Stress (X-axis)			
Moment to Steel = I_x steel/ I comb =			356.5 lb-ft
$f_b = M/S_{x, steel}$		$f_b =$	0.8 ksi
$M_r/\Omega_b =$		$M_r/\Omega_b =$	8814 lb-ft
OK			

Deflection Along Glazing			
$\Delta_{y-glazing} = \Delta_y \sin((180-\theta)/2)$		$\Delta_{y-glazing} =$	0.082 in
$\Delta_{x-glazing} = \Delta_x \cos((180-\theta)/2)$		$\Delta_{x-glazing} =$	0.144 in
Tributary Area A			
$\Delta_{total-A} = \Delta_{x-glazing} + \Delta_{y-glazing}$		$\Delta_{total} =$	0.226 in
Tributary Area B			
$\Delta_{total-B} = \Delta_{x-glazing} - \Delta_{y-glazing}$		$\Delta_{total} =$	0.061 in

SSG Sealant Deflection			
1/4 in. joint		50% ± movement capacity	
0.280 in. allowable deflection		SSG Sealant OK	

Steel Stress (Y-axis)			
Moment to Steel = I_y steel/ I comb =			400.6 lb-ft
$f_b = M/S_{y, steel}$		$f_b =$	2.7 ksi
$M_r/\Omega_b =$		$M_r/\Omega_b =$	5302 lb-ft
OK			

Beam: **M59**

Shape:

Material: **gen_Alum**

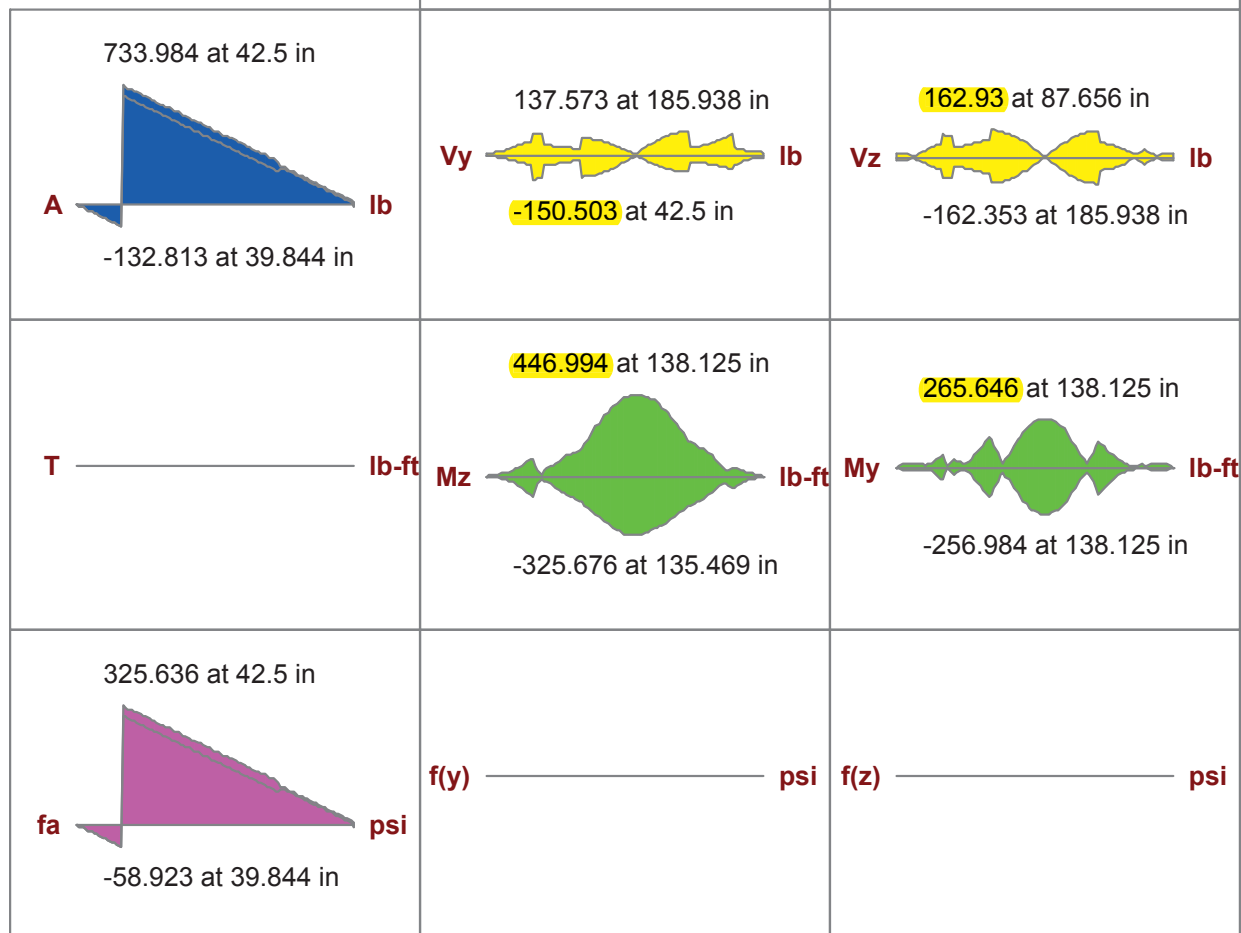
Length: **255 in**

I Joint: **N83**

J Joint: **N128**

Code Check: **No Calc**

Report Based On 97 Sections



YKK E9-3401
90 deg corner

JEI Structural Engineering
7280 NW 87th Terrace, Suite C-208
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Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/208
Detail: 2/404 **Member M59**

Date: 11/1/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width A (t_{wLA})	2.80 ft	Corner Angle (θ)
Tributary Width B (t_{wLB})	1.62 ft	90.00 °
Height (h)	15.44 ft	
Unbraced Length (L)	8.33 ft	

Design Loads

Design Pressure A (p_A)	17.63 psf
Design Pressure B (p_B)	12.75 psf
Panel Weight (p_{wt})	8 psf

Manuf. / Part #:

YKK E9-3401

E =	10100 ksi	$r_{x, \text{alum}}$ =	1.948 in
$I_{x, \text{alum}}$ =	8.555 in ⁴	$r_{y, \text{alum}}$ =	0.991 in
$I_{y, \text{alum}}$ =	2.213 in ⁴	A =	2.254 in ²
$S_{x, \text{alum}}$ =	3.127 in ³	J =	4.596 in ⁴
$S_{y, \text{alum}}$ =	1.765 in ³	wt =	2.708 lb/ft

Thermal Reduction Factors (TRF_x , TRF_y)

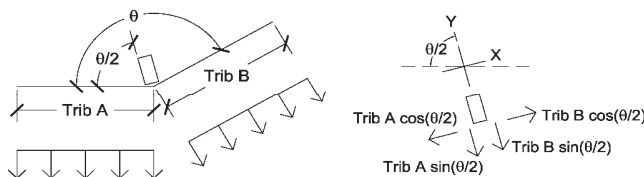
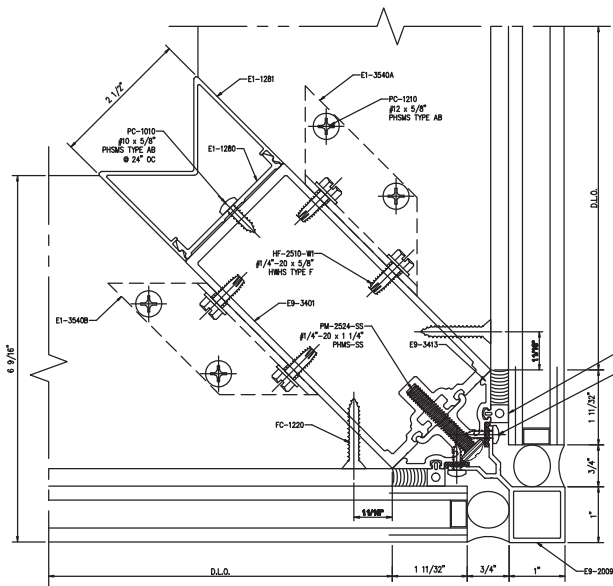
I_x Reduc.	1.00	S_x Reduc.	1.00
Reinforcing No Reinforcing			
$I_{x, \text{steel}}$ =	0.000 in ⁴	$I_{y, \text{steel}}$ =	0.000 in ⁴
$S_{x, \text{steel}}$ =	0.000 in ³	$S_{y, \text{steel}}$ =	0.000 in ³
$I_{x, \text{combined}}$ =	8.555 in ⁴	$I_{y, \text{combined}}$ =	2.213 in ⁴

X-Axis Bending Stress (ADM F.2 & F.3)		$\Omega = 1.65$
$w = p \cdot t$	$w_y =$	N/A lb/ft
Shear Load $V = wl/2$	$V_y =$	150.5 lb
Moment $M = wl^2/8$	$M_x =$	447.0 lb-ft
$M_{\text{alum}} = M \cdot I_{\text{alum}} / I_{\text{comb}}$	$M_{x-\text{alum}} =$	447.0 lb-ft
$L_n = (2 \cdot L_b \cdot S_x) / (I_y J)^{1/2}$	$L_n =$	196.1
$f_b = M_{\text{alum}} / (S_{x, \text{alum}} \cdot TRF_x)$	$f_{b-\text{alum-x}} =$	1.72 ksi
$f_{b-\text{alum-x}} / F_{bx} =$	$F_{bx} / \Omega = F_{bx} =$	14.79 ksi
Y-Axis Bending Stress (ADM F.2 & F.3)		$\Omega = 1.65$
$w = p \cdot t$	$w_x =$	N/A lb/ft
Shear Load $V = wl/2$	$V_x =$	162.9 lb
Moment $M = wl^2/8$	$M_y =$	265.6 lb-ft
$M_{\text{alum}} = M \cdot I_{\text{alum}} / I_{\text{comb}}$	$M_{y-\text{alum}} =$	265.6 lb-ft
$L_n = (2 \cdot L_b \cdot S_x) / (I_y J)^{1/2}$	$L_n =$	110.7
$f_b = M_{\text{alum}} / (S_{y, \text{alum}})$	$f_{b-\text{alum-y}} =$	1.81 ksi
$f_{b-\text{alum-y}} / F_{by} =$	$F_{by} / \Omega = F_{by} =$	15.27 ksi
Combined Stress Ratio		$f_{bx} / F_{bx} + f_{by} / F_{by} =$
		0.23
		OK

Check Combined Bending & Compression (ADM H.1)

$f_a / F_a + f_b / F_b < 1.0$	$f_a / F_a + f_b / F_b =$	0.286
-------------------------------	---------------------------	-------

OK



Mullion Resultant Forces			
Strong Axis Bending, M_x , w_y =		49.50 lb/ft	
Weak Axis Bending, M_y , w_x =		20.28 lb/ft	
Load Share			
Aluminum (x)	Steel (x)	Aluminum (y)	Steel (y)
1.000	0.000	1.000	0.000

Axial Load

$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$	587.6 lb
---	-------	----------

Check Allowable Compression - ADM E.3

$kL_b / r =$	$kL_b / r =$	100.92
F_{a1} (Allowable Compression)	$F_{a1} / \Omega =$	5.04 ksi

Check Allowable Compression - Flange element (ADM B.5.4.2)

$b/t =$	$b/t =$	12.36
F_{a2} (Allowable Compression)	$F_{a2} / \Omega =$	15.20 ksi

Check Allowable Compression - Web element (ADM B.5.5.1)

$b/t =$	$b/t =$	37.72
F_{a3} (Allowable Compression)	$F_{a3} / \Omega =$	19.70 ksi

$f_a = P/A$	$f_a =$	0.26 ksi
Lessor of F_{a1} , F_{a2} , F_{a3}	$F_a / \Omega = F_a =$	5.04 ksi
	$f_a / F_a =$	0.052

OK

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Client: NGG
 Project: Webster University
 Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
 Part of: Vertical Mullion Analysis
 Elevation: 1/208
 Detail: 2/404

Date: 11/1/2016
 Proj. No.: JE16059
 Designer: M. Gorny

INPUT

CHECK

RISA

Strong Axis Deflection (M_x, w_y)		Typical Vertical	
$\Delta_y = (5w_y L^4)/(384EI)$	$\Delta_y =$	0.175 in	
within DLO (Conservative)	$\Delta_y =$	0.175 in	
Weak-Axis Deflection (w_x)			
$\Delta_x = (5w_x L^4)/(384EI_{\Delta})$	$\Delta_x =$	0.213 in	
within DLO (Conservative)	$\Delta_x =$	0.213 in	
Resultant Deflection			
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$	$\Delta_{total} =$	0.276 in	
Angle Relative to X-Axis	$\theta_{\Delta} =$	39.4 °	
	$\Delta_{allow} =$	1.022 in	
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor	DF =	#####
OK			

Steel Stress (X-axis)			
Moment to Steel = I_x steel/ I comb =		0.0 lb-ft	
$f_b = M/S_{x, steel}$	$f_b =$	N/A ksi	
$M_r/\Omega_b =$	$M_r/\Omega_b =$	0 lb-ft	
N/A			

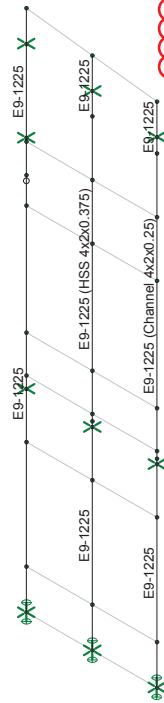
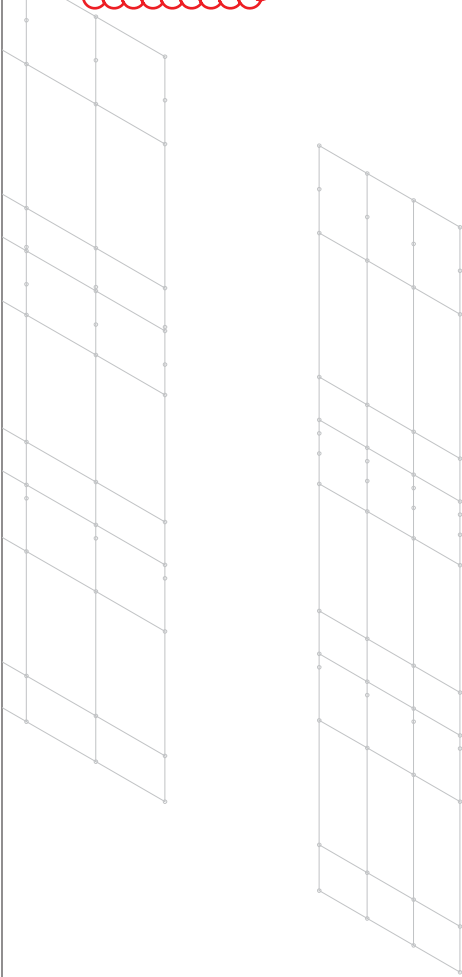
Deflection Along Glazing			
$\Delta_{y-glazing} = \Delta_y \sin((180-\theta)/2)$	$\Delta_{y-glazing} =$	0.124 in	
$\Delta_{x-glazing} = \Delta_x \cos((180-\theta)/2)$	$\Delta_{x-glazing} =$	0.151 in	
Tributary Area A			
$\Delta_{total-A} = \Delta_{x-glazing} + \Delta_{y-glazing}$	$\Delta_{total} =$	0.274 in	
Tributary Area B			
$\Delta_{total-B} = \Delta_{x-glazing} - \Delta_{y-glazing}$	$\Delta_{total} =$	0.027 in	

SSG Sealant Deflection			
1/4 in. joint	50% ± movement capacity		
0.280 in. allowable deflection	SSG Sealant OK		

Steel Stress (Y-axis)			
Moment to Steel = I_y steel/ I comb =		0.0 lb-ft	
$f_b = M/S_{y, steel}$	$f_b =$	N/A ksi	
$M_r/\Omega_b =$	$M_r/\Omega_b =$	0 lb-ft	
N/A			



Section sets



Reinforcing added by inspection.

EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 207, 211

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JE16059

Webster University

SK - 23

Nov 2, 2016 at 6:41 AM

EGS-1 Preliminary.r3d



JEI Structural Engineering

Glazing Systems

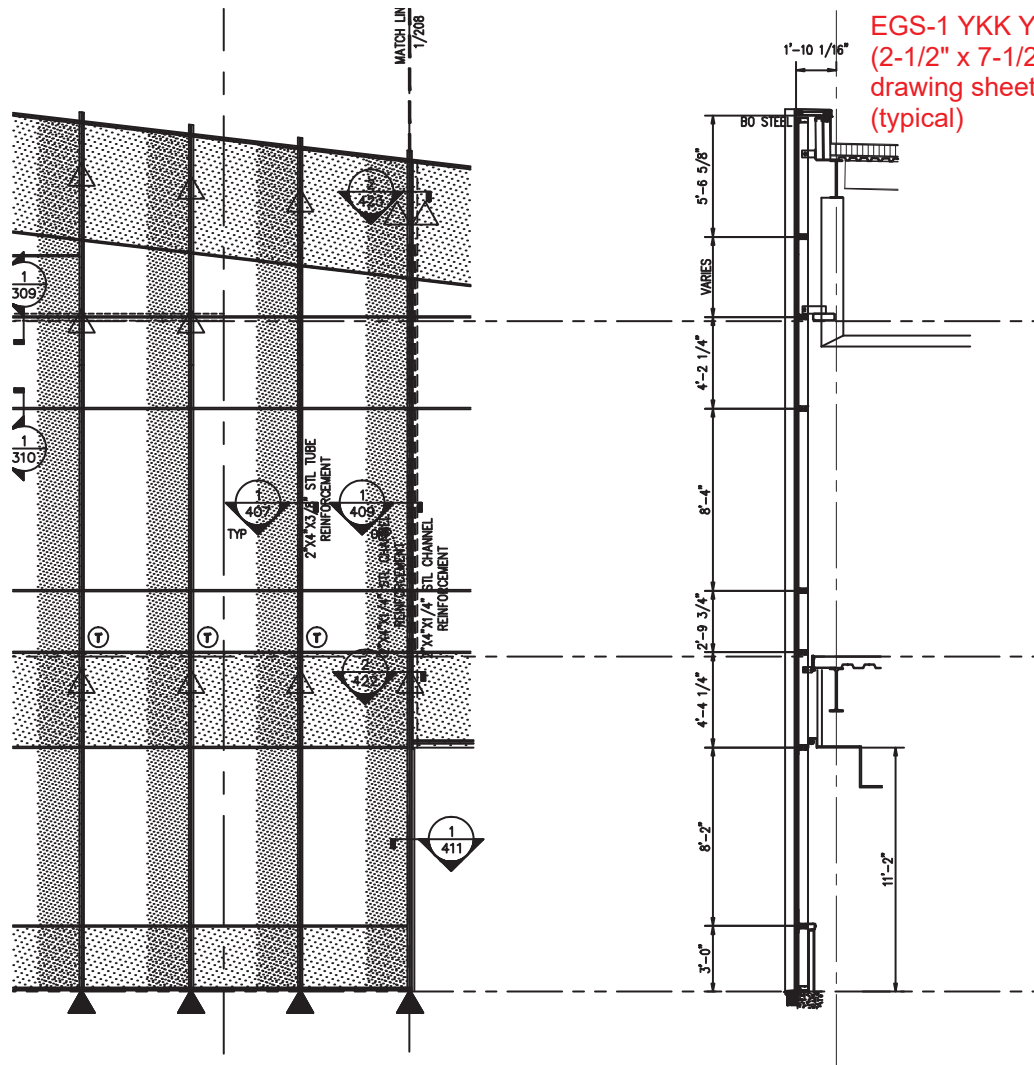
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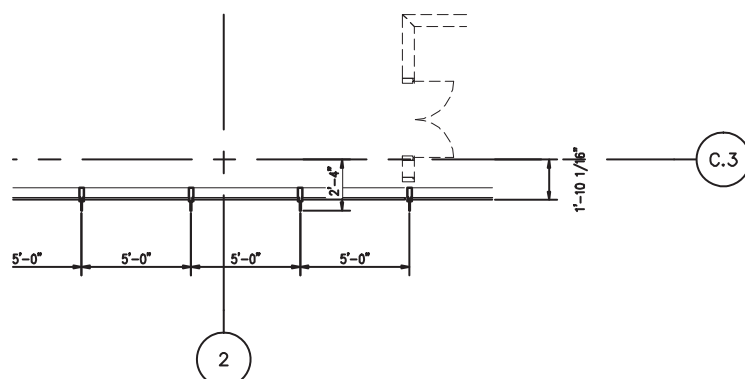
NGG

Project #JE16059

November 7, 2016

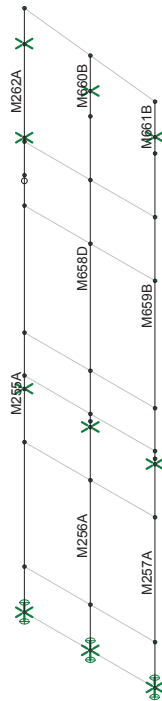
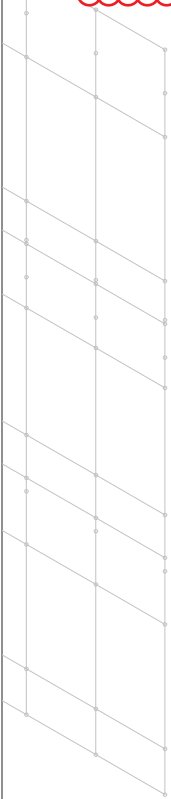


3 SECTION
Scale: 3/4"=1'-0"
ARCH REF: 2/A0401





Member labels



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 207, 211

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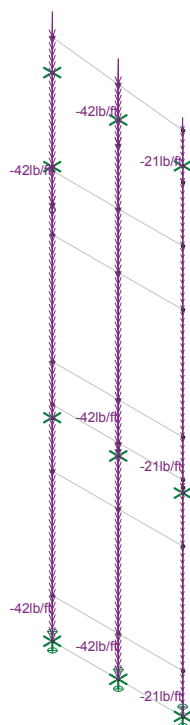
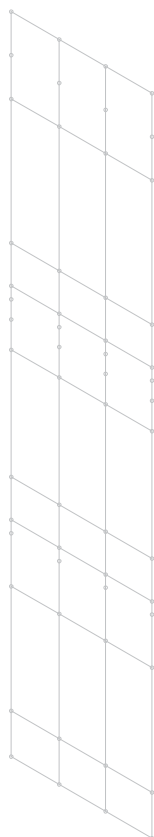
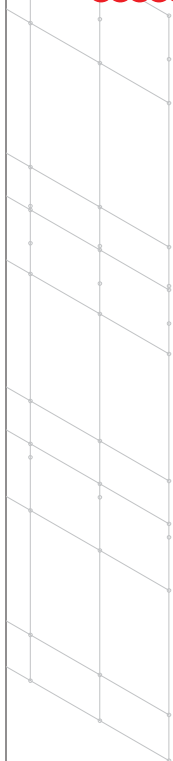
SK - 25

Nov 2, 2016 at 6:42 AM

EGS-1 Preliminary.r3d



Dead load
8psf (5' 3") = 42lb/ft (21lb/ft at jambs)



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 207, 211

Loads: BLC 7, Dead

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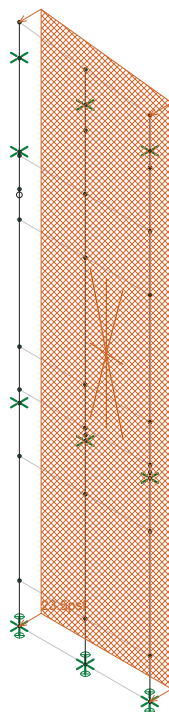
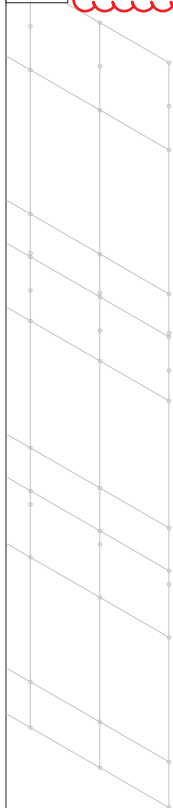
SK - 24

Nov 2, 2016 at 6:42 AM

EGS-1 Preliminary.r3d



Negative Wind - 23.5psf



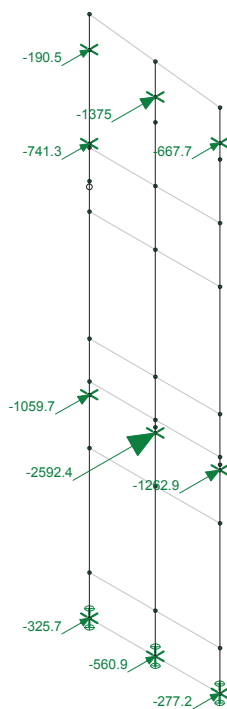
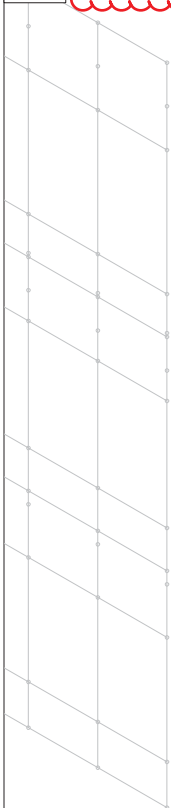
EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 207, 211

Loads: BLC 1, Negative Wind (Face A)

JEI Structural Engineering	Webster University	SK - 26
M. Gorny		Nov 2, 2016 at 6:42 AM
JE16059		EGS-1 Preliminary.r3d



Anchor Loads



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 207, 211

Results for LC 1, Negative Wind Face A
Z-direction Reaction Units are lb and lb-ft

JEI Structural Engineering

M. Gorny

JE16059

Webster University

SK - 27

Nov 2, 2016 at 6:44 AM

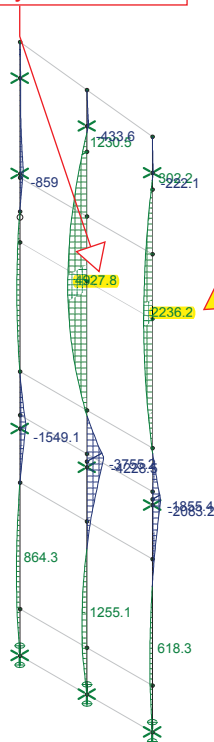
EGS-1 Preliminary.r3d



Moment diagram

E9-1225 Vertical mullion
OK by comparison to
previous analysis, Check 1

Check 4 (2236.2lb-ft)
E9-1225



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 207, 211

Results for LC 1, Negative Wind Face A
Member z Bending Moments (lb-ft)

JEI Structural Engineering	Webster University	SK - 31
M. Gorny		Nov 2, 2016 at 6:48 AM
JE16059		EGS-1 Preliminary.r3d

Beam: **M658D**

Shape:

Material: **gen_Alum**

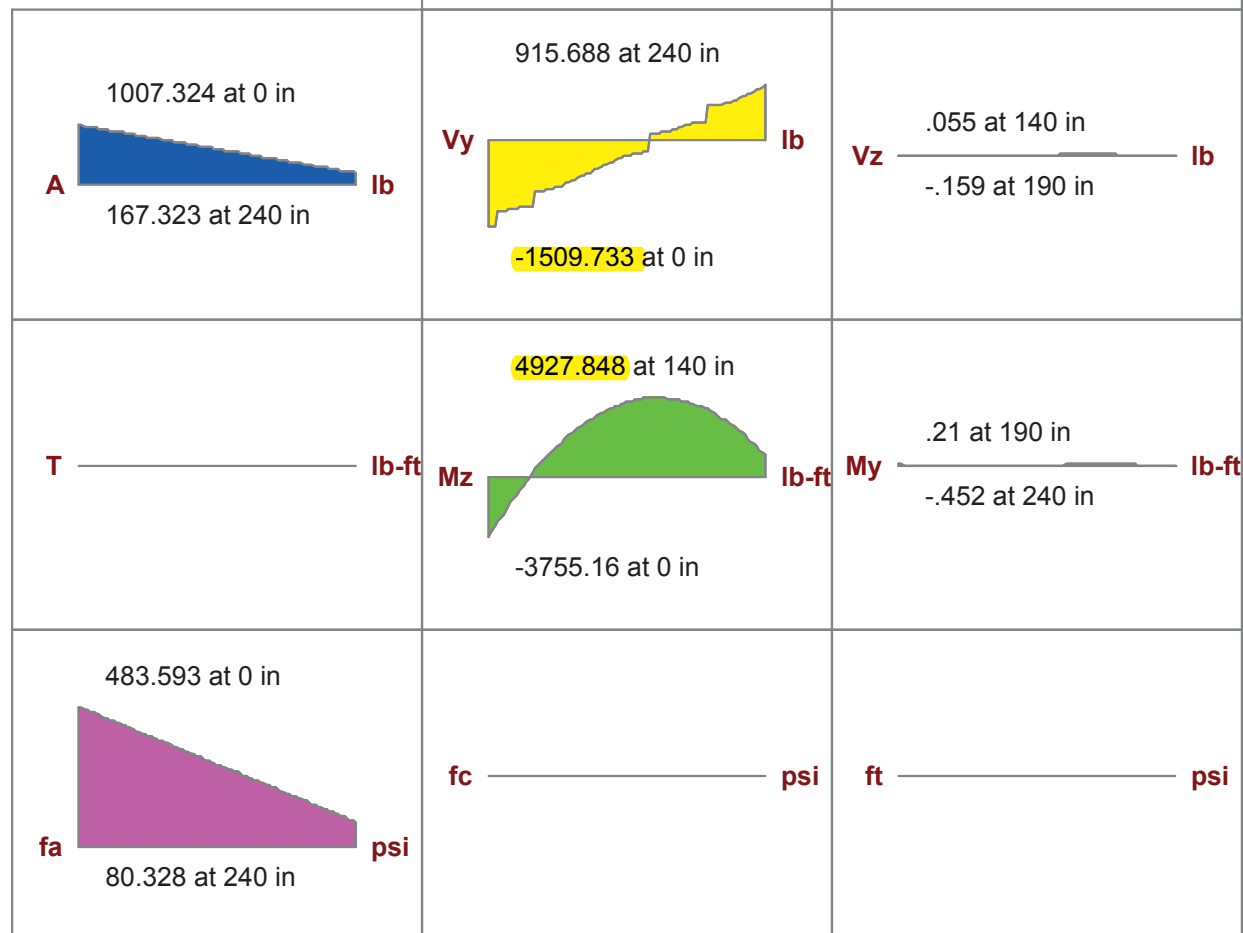
Length: **240 in**

I Joint: **N767**

J Joint: **N769A**

Code Check: **No Calc**

Report Based On 97 Sections



E9-1225 Vertical mullion

OK by comparison to previous analysis, Check 1

Beam: **M659B**

Shape:

Material: **gen_Alum**

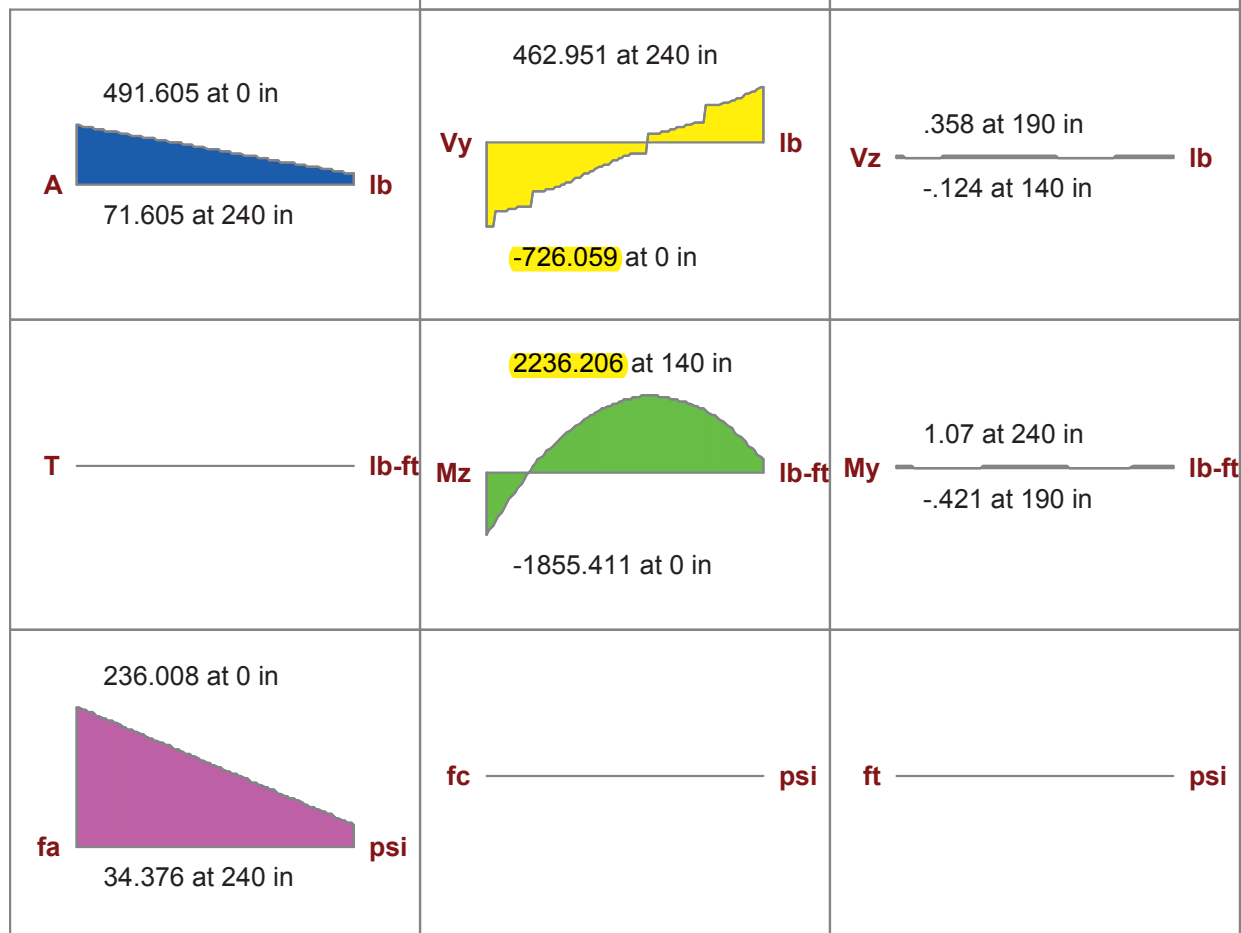
Length: **240 in**

I Joint: **N768A**

J Joint: **N770**

Code Check: **No Calc**

Report Based On 97 Sections



Check 4

YKK E9-1225 with 4x2x1/4 Steel Channel



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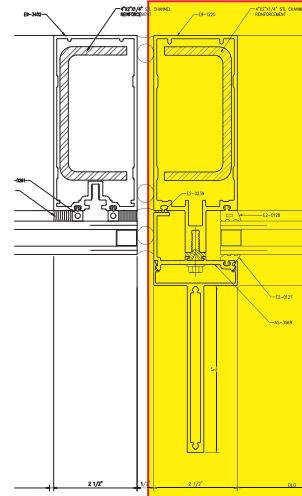
Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/207
Detail: 1/409

Member 659B

Check 4

Date: 11/7/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA



Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t)	2.44 ft	$F_y =$	25.0 ksi
Height (h)	21.45 ft	$F_u =$	30.0 ksi
Unbraced Length (L)	8.33 ft		

Design Loads

Design Pressure (p)	23.5 psf
Panel Weight (p_{wt})	8.0 psf

Manuf. / Part #:		YKK E9-1225	
E =	10100 ksi	$r_{x, \text{alum}} =$	2.176 in
$I_{x, \text{alum}} =$	9.838 in ⁴	$r_{y, \text{alum}} =$	0.935 in
$I_{y, \text{alum}} =$	1.818 in ⁴	A =	2.079 in ²
$S_{x, \text{alum}} =$	3.213 in ³	J =	4.110 in ⁴
$S_{y, \text{alum}} =$	1.454 in ³	wt =	2.498 lb/ft
$b/t_{web} =$	52.71	$b/t_{flange} =$	22.33
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
--------------	------	--------------	------

Applied Bending Moment

$w = p \cdot t$	$w =$	N/A lb/ft
Shear Load $V = wL/2$	$V =$	726.1 lb
Moment $M = wL^2/8$	$M =$	2236.2 lb-ft
$M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$	$M_{alum} =$	1011.6 lb-ft
$f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum} =$	3.78 ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$	491.6 lb
$f_{c-alum} = P/A$	$f_{c-alum} =$	0.24 ksi

Check Deflection

Jamb Vertical	
1/2 in. joint $\Delta = (5wL^4)/(384EI) =$	0.688 in
100% $\pm$ movement cap. $\Delta_{allow} =$	0.866 in
See sealant joint calculation for allowable joint movement.	
Deflection Factor	DF = #####

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$	$M_{steel} =$	1224.6 lb-ft
$Mb/\Omega =$	$Mb/\Omega =$	3584 lb-ft
$Ms/(Mb/\Omega) =$		0.342

Reinforcing

Channel 2x4x1/4	
$I_{x, steel} =$	4.107 in ⁴
$S_{x, steel} =$	2.054 in ³
$I_{combined} =$	21.748 in ⁴
Load Share	
	Aluminum Steel
	0.452 0.548

Allowable Loads

$\Omega = 1.65$	
B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.15 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.92 ksi
E.3 - Axial Compression	4.49 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.60 ksi

Compression Interaction

Allowable Compression	$F_c =$	4.49 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.053

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.92 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.271

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	0.324
---------------------------	-----------------------	-------

Mullion OK

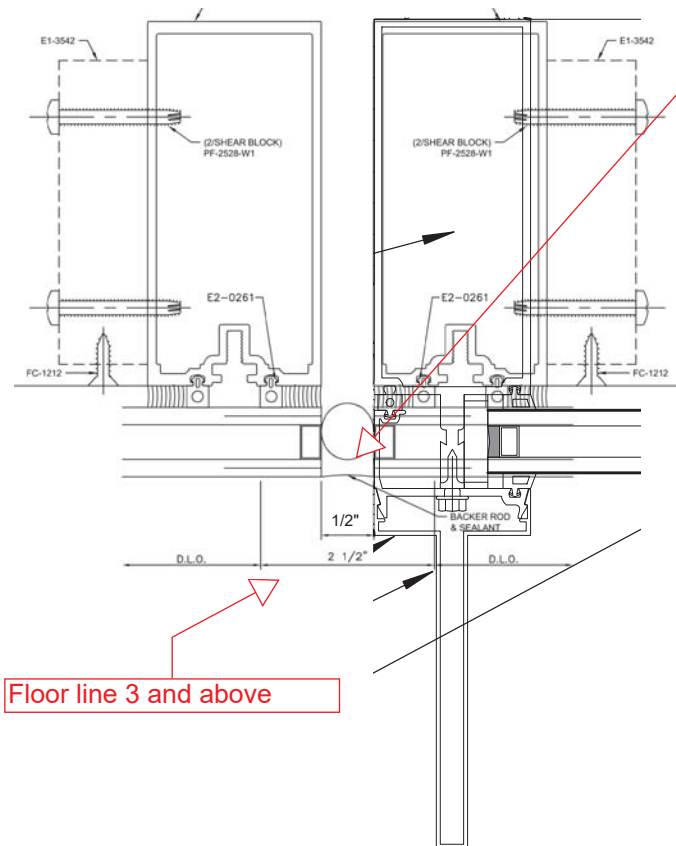
See following pages for full joint analysis



New double mullion created at location highlighted in attached if EGS-1 is supported at floor line 2

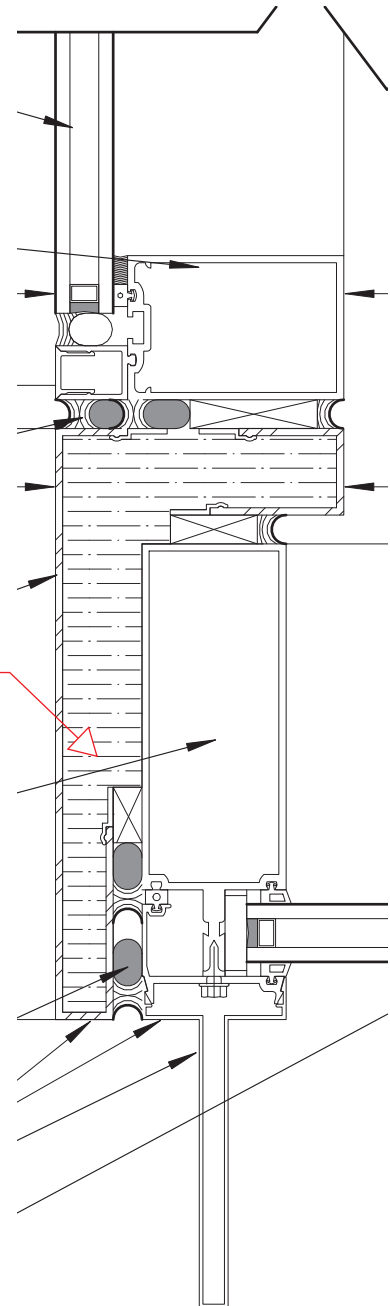
Mullions will grow at the same rate of expansion. Differential thermal movement is only between floor lines 2 - 3.

See thermal expansion calculation below, and full joint consideration of following page.



Floor line 3 and above

Floor line 2 to 3



Maximum Thermal Expansion Floor Line 2-3

INPUT	CHECK
Max Heights (h)	11.17 ft
E =	10100 ksi
Aluminum Expansion Coef =	0.00128
Temp at Construction =	40 deg
Max Temp of Alum =	120 deg
Thermal Expansion Calculation	
$\Delta \text{ temp} = T \text{ change}(\text{Coef}) * h$	0.14 in



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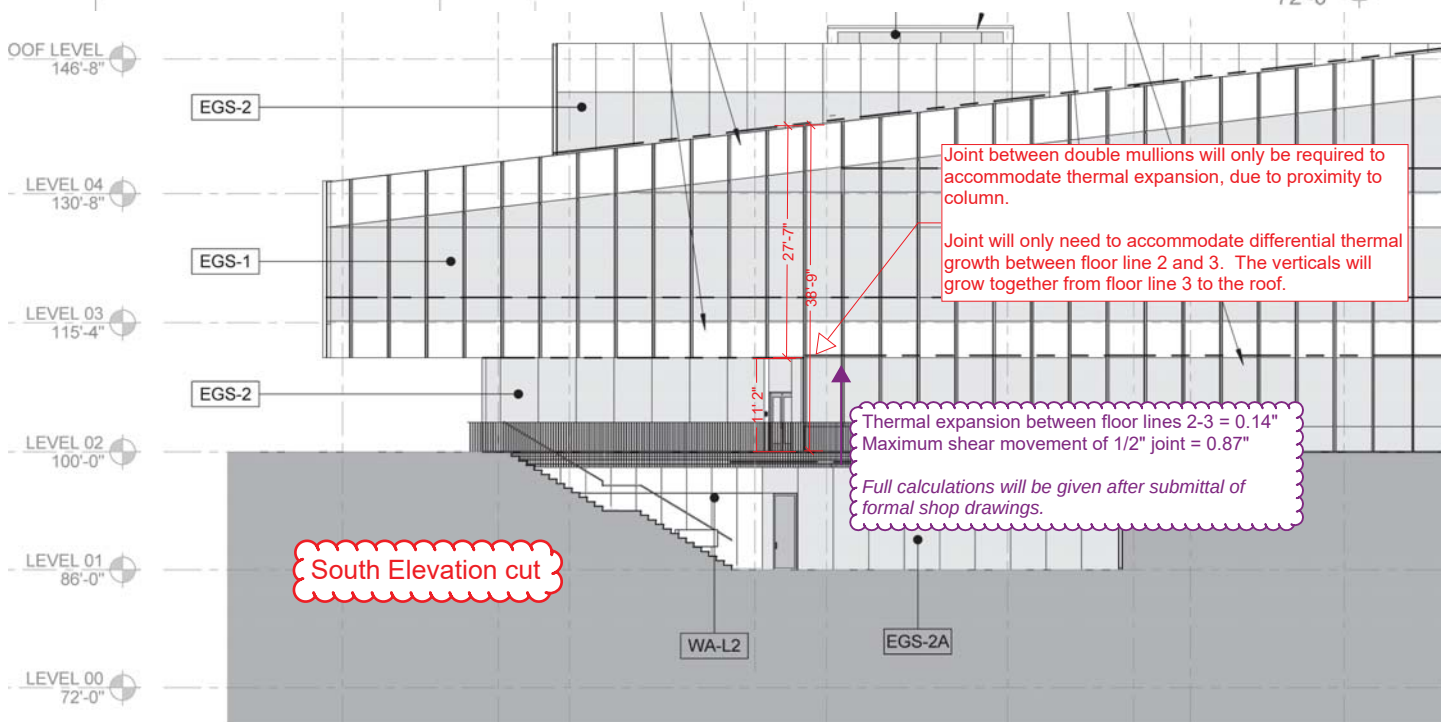
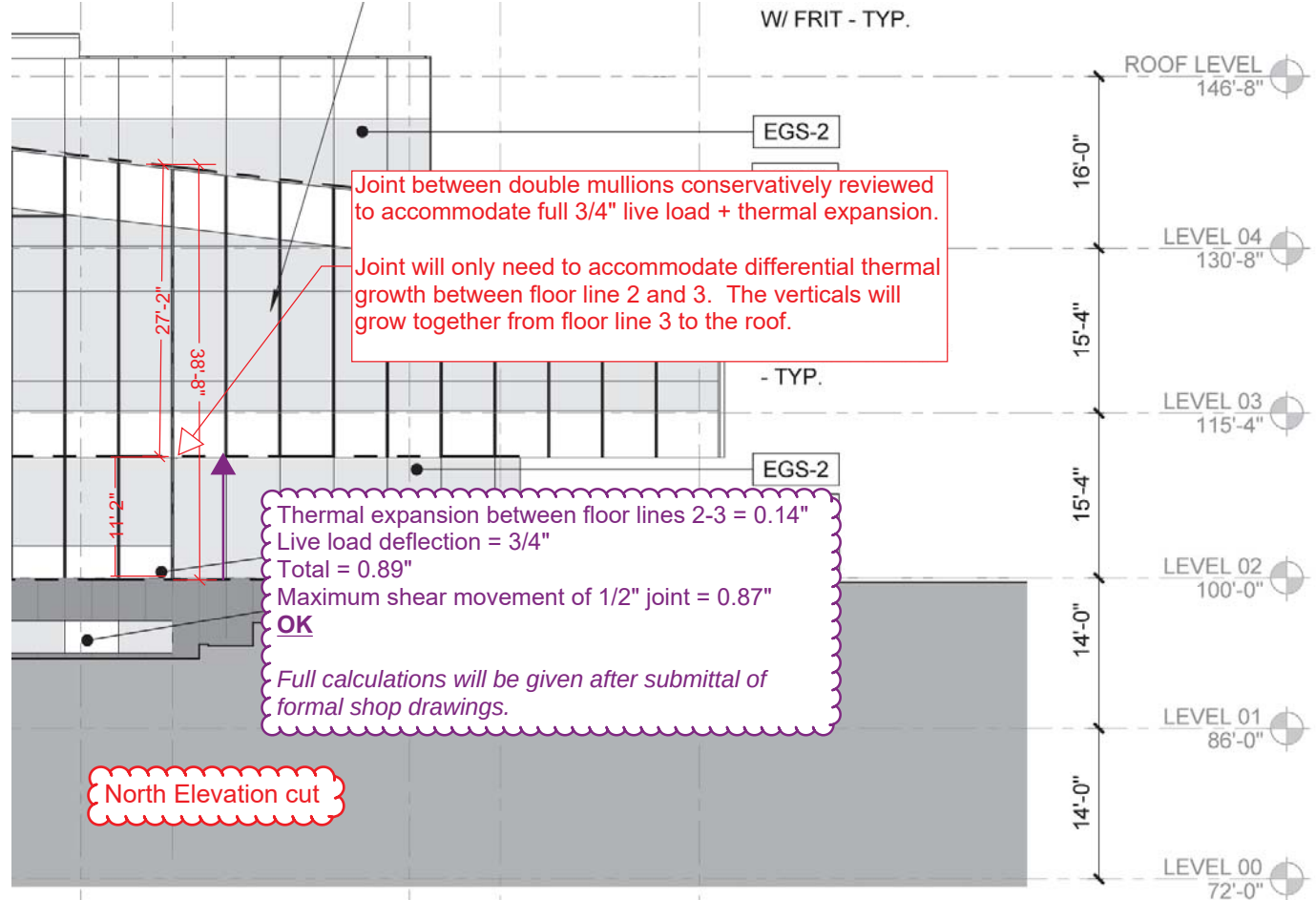
Webster University

Dan Ward

Project #JE16059

June 24, 2016

W/ FRIT - TYP.





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Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Perimeter Sealant Joint Under Combined
In-Plane / Out-of-Plane Movement

Date: 11/7/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT **CHECK**

Sealant: *Dow Corning 790 Silicone Building Sealant*

Allowable Extension:

100%

Allowable Compression:

50%

Joint Dimensions

Nominal Joint Width:	$a = 0.750$ in
In-Plane Movement:	$a' = 0.178$ in
Out-of-Plane Movement:	$b' = 0.655$ in
Maximum thermal expansion	$c' = 0.890$ in

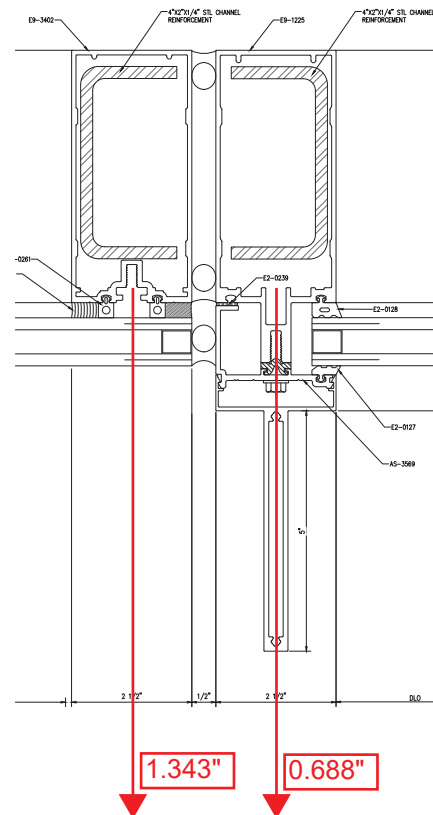
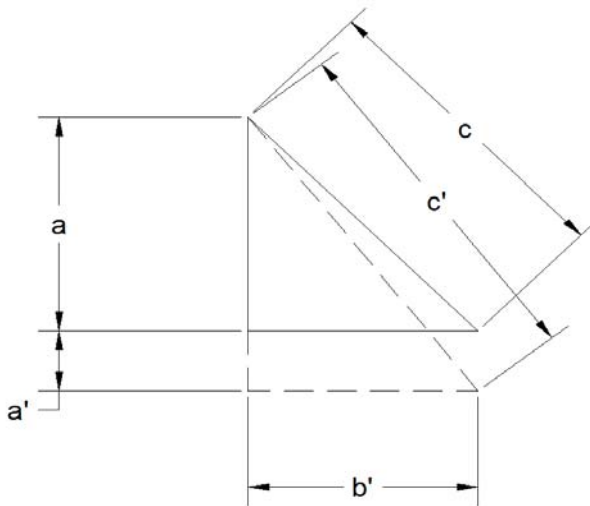
$$1.343" - 0.688" = 0.655"$$

full deflection of E9-3402
from previous analysis
(Check 1.1), no
reduction in pressure

Joint Movements Checks

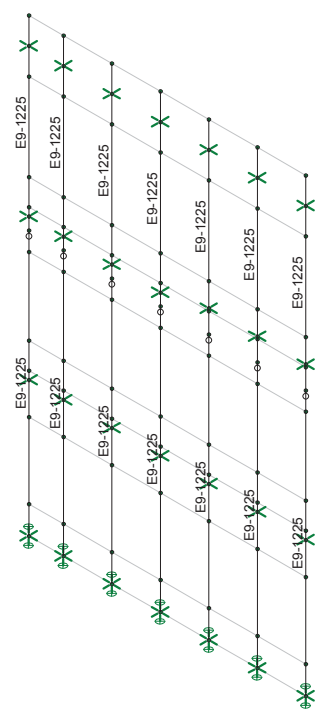
Allowable Expanded Length	$c'_{\text{allow}} = 1.500$ in
Allowable Compressed Length	$a_{\text{allow}} = 0.375$ in
Joint Compressed Length	$a - a' = 0.572$
Joint Expanded Length	$c' = 1.443$ in

OK
OK





Section sets



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 205, 207, 211

JEI Structural Engineering	Webster University	SK - 29
M. Gorny		Nov 2, 2016 at 6:46 AM
JE16059		EGS-1 Preliminary.r3d



JEI Structural Engineering

Glazing Systems

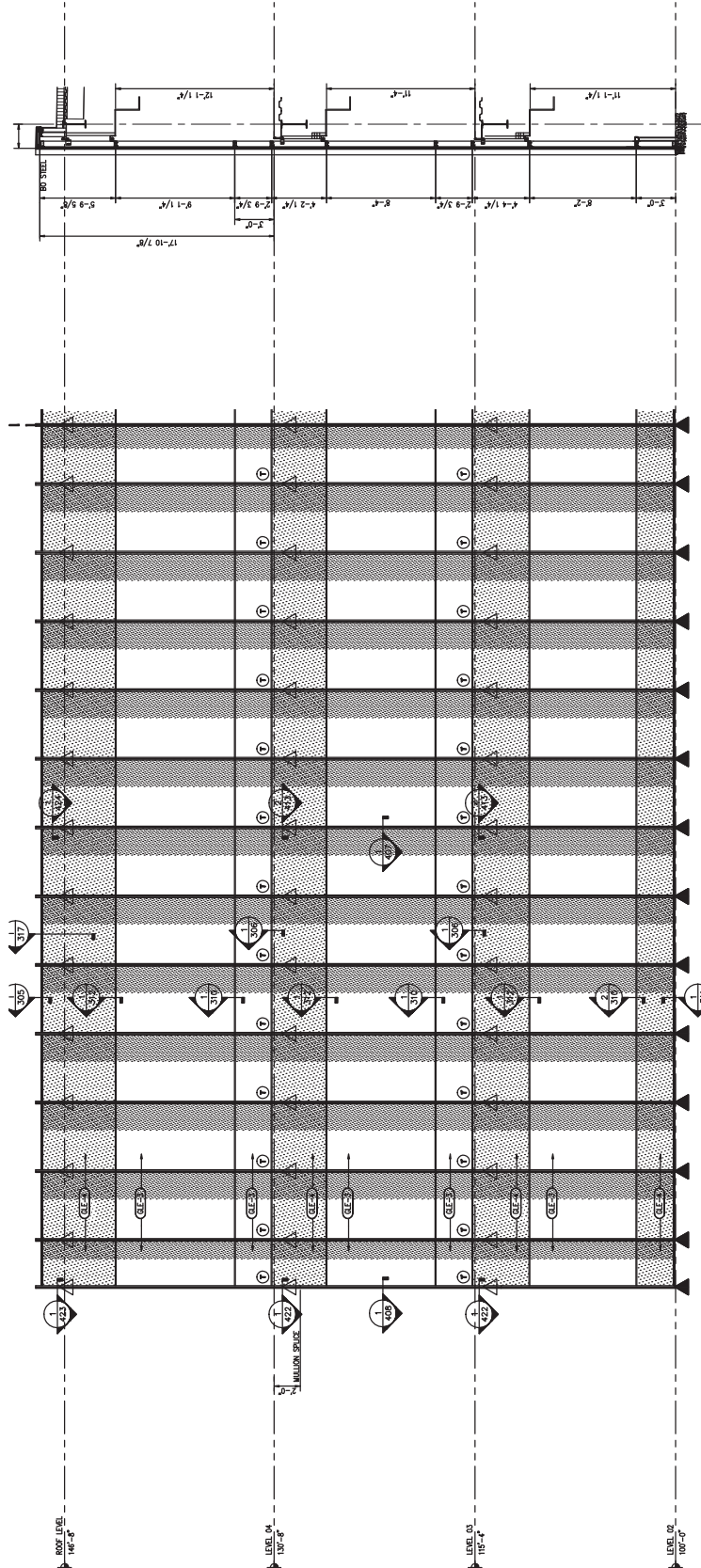
Fast, Friendly, Affordable

Webster University

NGG

Project #JE16059

November 7, 2016

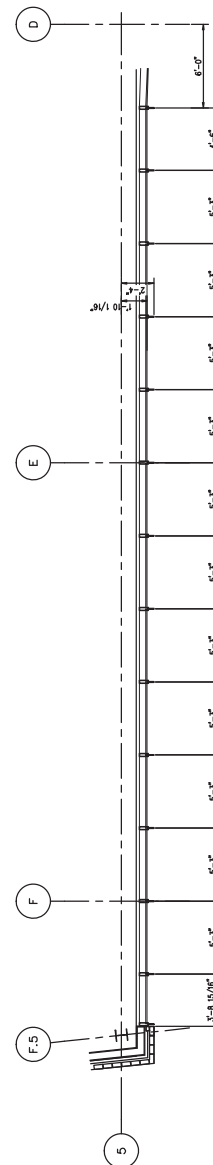


SECTION
Scale: 3/4"=1'-0"
ARCH REF: 1/04002

EGS-1 YKK YCW 750 SSG
(2-1/2" x 7-1/2"). Shop
drawing sheets 205, 207, 211

Sheet 205 used here to show
typical dimensions

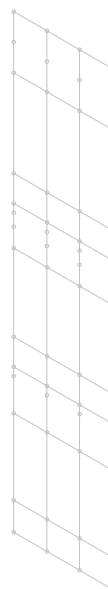
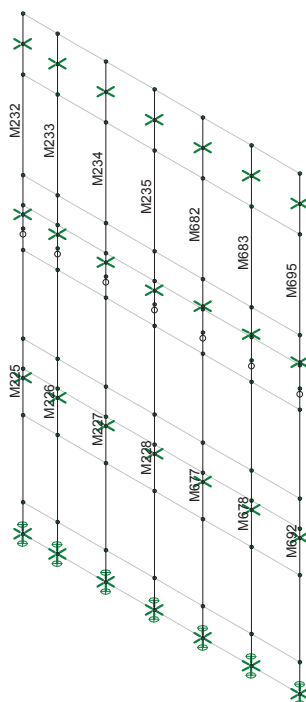
1 WEST ELEVATION
EGS-1
COLOR: PETER
Scale: 3/4"=1'-0"



2 PLAN
Scale: 3/4"=1'-0"



Member labels



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 205, 207, 211

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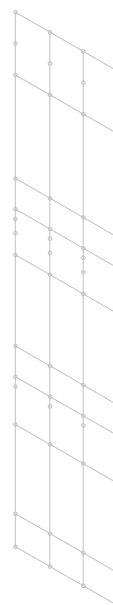
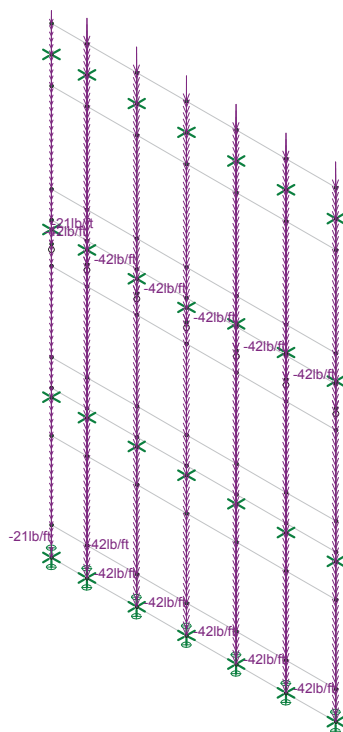
SK - 30

Nov 2, 2016 at 6:47 AM

EGS-1 Preliminary.r3d



Dead load
 $8\text{psf} (5' 3) = 42\text{lb/ft} (21\text{lb/ft at jambs})$



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 205, 207, 211

Loads: BLC 7, Dead

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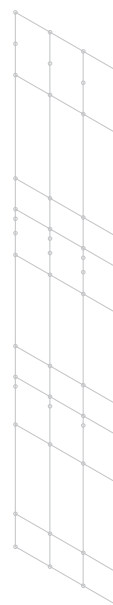
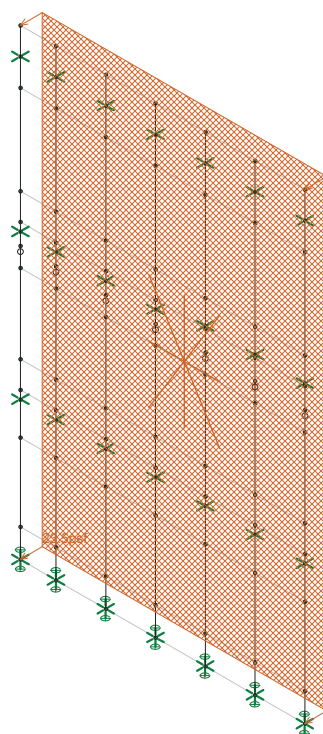
SK - 32

Nov 2, 2016 at 6:49 AM

EGS-1 Preliminary.r3d



Negative Wind - 23.5psf



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 205, 207, 211

Loads: BLC 1, Negative Wind (Face A)

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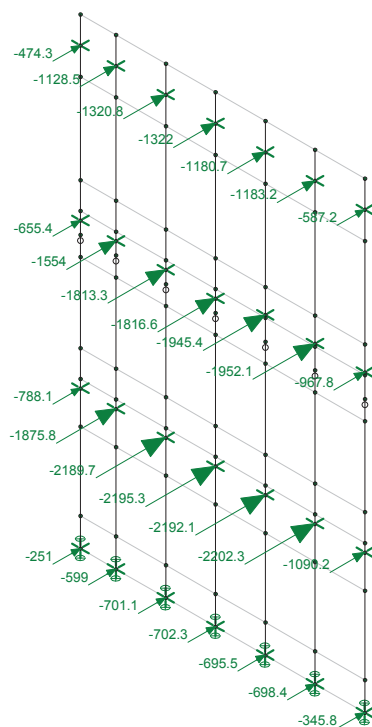
SK - 33

Nov 2, 2016 at 6:50 AM

EGS-1 Preliminary.r3d



Anchor Loads



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 205, 207, 211

Results for LC 1, Negative Wind Face A
Z-direction Reaction Units are lb and lb-ft

JEI Structural Engineering

M. Gorny

JE16059

Webster University

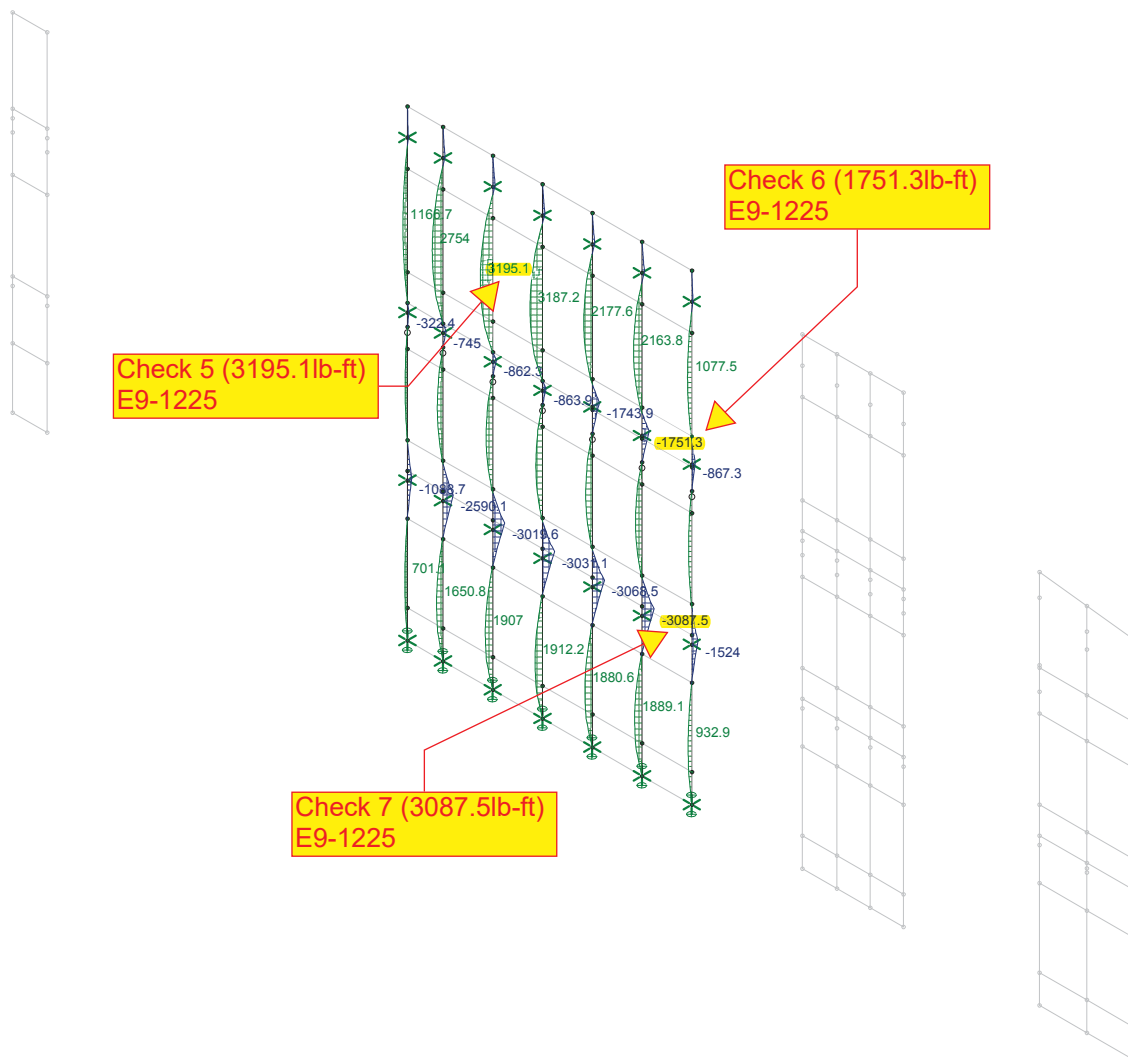
SK - 34

Nov 2, 2016 at 6:50 AM

EGS-1 Preliminary.r3d



Moment diagram



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 205, 207, 211

Results for LC 1, Negative Wind Face A
Member z Bending Moments (lb-ft)

JEI Structural Engineering

M. Gorny

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SK - 35

Nov 2, 2016 at 6:51 AM

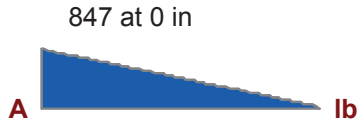
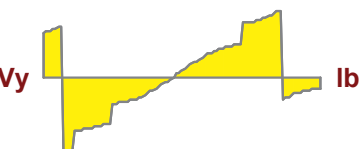
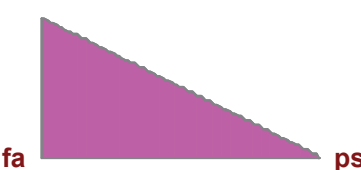
EGS-1 Preliminary.r3d

Beam: **M234**

Shape:

Material: **gen_Alum**Length: **242 in**I Joint: **N303**J Joint: **N250**Code Check: **No Calc**

Report Based On 97 Sections

 847 at 0 in A lb	 964.564 at 206.708 in Vy lb -1080.383 at 17.646 in	Dz in Vz lb
T lb-ft	 3195.089 at 113.438 in Mz lb-ft -862.287 at 15.125 in	My lb-ft
 407.407 at 0 in fa psi	fc psi	ft psi

Check 5

YKK E9-1225

Using reduced pressure based on 70sf area to reduce deflection.

 $Dy = 1.358'' (17\text{psf} / 23.5\text{psf}) = 1.098''$

JEI Structural Engineering
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Kansas City, MO 64155

Voice: 816-734-8345
Fax: 816-734-7013
www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/205
Detail: 1/407

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA

Member M234 **Check 5**

Load Design Code

ASCE7-05 ASD

Material Design Code

Aluminum Design Manual 2010

ADM 2010 Type

Alloy-Temper

Closed Shape

6063-T6

Tributary Width (t) 5.25 ft $F_y = 25.0$ ksi
Height (h) 16.00 ft $F_u = 30.0$ ksi
Unbraced Length (L) 8.33 ft

Design Loads

Design Pressure (p) 19.0 psf (Using reduced area load based on 70sf)
Panel Weight (p_{wt}) 8.0 psf (deflection only)

Manuf. / Part #:

YKK E9-1225

E = 10100 ksi $r_{x, alum} = 2.176$ in
 $I_{x, alum} = 9.838$ in⁴ $r_{y, alum} = 0.935$ in
 $I_{y, alum} = 1.818$ in⁴ A = 2.079 in²
 $S_{x, alum} = 3.213$ in³ J = 4.110 in⁴
 $S_{y, alum} = 1.454$ in³ wt = 2.498 lb/ft
 $b/t_{web} = 52.71$ $b/t_{flange} = 22.33$
Fixity_{web} = 2 end(s) Fixity_{flange} = 2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$ w = N/A lb/ft
Shear Load $V = wL/2$ V = 1080.4 lb
Moment $M = wL^2/8$ M = 3195.1 lb-ft
 $M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$ $M_{alum} = 3195.1$ lb-ft
 $f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$ $f_{b-alum} = 11.93$ ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$ P = 847.0 lb
 $f_{c-alum} = P/A$ $f_{c-alum} = 0.41$ ksi

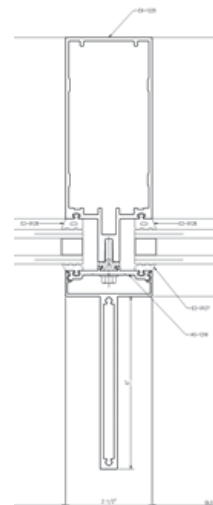
Check Deflection

Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) = 1.098$ in
N/A $\pm$ movement cap. $\Delta_{allow} = 1.050$ in
Allowable deflection = L/175 or if span > 13'-6"
then allowable def = L/240 + 1/4" Deflection Factor
DF = #####

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$ $M_{steel} = 0.0$ lb-ft
 $Mb/\Omega =$ $Mb/\Omega = 0$ lb-ft
 $Ms/(Mb/\Omega) =$ N/A

**Reinforcing**

No Reinforcing

		Load Share	
		Aluminum	Steel
$I_{x, steel} =$	0.000 in ⁴	1.000	0.000
$S_{x, steel} =$	0.000 in ³		
$I_{combined} =$	9.838 in ⁴		

Allowable Loads $\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.15 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.92 ksi
E.3 - Axial Compression	4.49 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.60 ksi

Compression Interaction

Allowable Compression	$F_c =$	4.49 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.091

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.92 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.857

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	0.948
---------------------------	-----------------------	-------

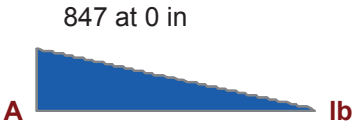
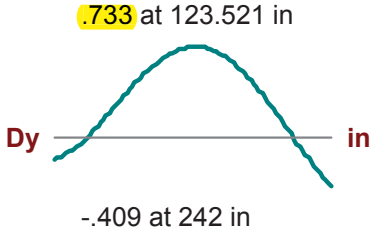
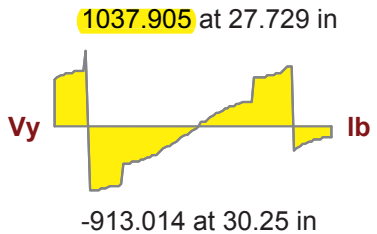
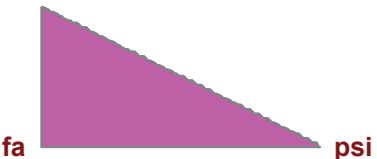
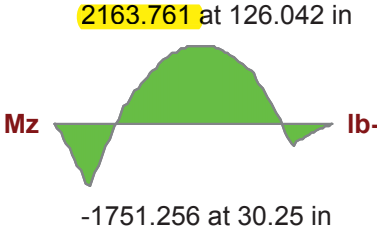
Mullion OK, $\leq 1/8"$ over allowable deflection.

Beam: **M683**

Shape:

Material: **gen_Alum**Length: **242 in**I Joint: **N802**J Joint: **N766**Code Check: **No Calc**

Report Based On 97 Sections

 847 at 0 in A _____ lb	 Dy _____ in Dz _____ in	
T _____ lb-ft	 Vy _____ lb Vz _____ lb	
 407.407 at 0 in fa _____ psi	 Mz _____ lb-ft My _____ lb-ft	
	fc _____ psi	ft _____ psi

Check 6

YKK E9-1225

JEI Structural Engineering
11108 N. Oak Tfwy, Suite 208
Kansas City, MO 64155

Voice: 816-734-8345
Fax: 816-734-7013
www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/205
Detail: 1/407

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

Member M683 **Check 6**

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t) 5.25 ft $F_y = 25.0$ ksi
Height (h) 14.88 ft $F_u = 30.0$ ksi
Unbraced Length (L) 8.33 ft

Design Loads

Design Pressure (p) 19.0 psf
Panel Weight (p_{wt}) 8.0 psf

Manuf. / Part #: YKK E9-1225

E =	10100 ksi	$r_{x, alum} =$	2.176 in
$I_{x, alum} =$	9.838 in ⁴	$r_{y, alum} =$	0.935 in
$I_{y, alum} =$	1.818 in ⁴	A =	2.079 in ²
$S_{x, alum} =$	3.213 in ³	J =	4.110 in ⁴
$S_{y, alum} =$	1.454 in ³	wt =	2.498 lb/ft
$b/t_{web} =$	52.71	$b/t_{flange} =$	22.33
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$ $w =$ N/A lb/ft
Shear Load $V = wL/2$ $V =$ 1037.9 lb
Moment $M = wL^2/8$ $M =$ 2163.8 lb-ft
 $M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$ $M_{alum} =$ 2163.8 lb-ft
 $f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$ $f_{b-alum} =$ 8.08 ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$ $P =$ 847.0 lb
 $f_{c-alum} = P/A$ $f_{c-alum} =$ 0.41 ksi

Check Deflection

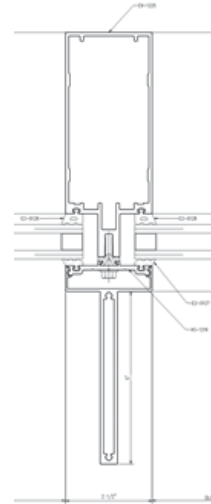
Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) =$ 0.733 in
N/A $\pm$ movement cap. $\Delta_{allow} =$ 0.994 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$
Deflection Factor DF = #####

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$ $M_{steel} =$ 0.0 lb-ft
 $Mb/\Omega =$ $Mb/\Omega =$ 0 lb-ft
 $Ms/(Mb/\Omega) =$ N/A

INPUT CHECK RISA



Reinforcing

	No Reinforcing	Load Share	
$I_{x, steel} =$	0.000 in ⁴	Aluminum	Steel
$S_{x, steel} =$	0.000 in ³	1.000	0.000
$I_{combined} =$	9.838 in ⁴		

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.15 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.92 ksi
E.3 - Axial Compression	4.49 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.60 ksi

Compression Interaction

Allowable Compression	$F_c =$	4.49 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.091

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.92 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.581

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$ $f_a/F_a + f_b/F_b =$ 0.671

Mullion OK

Beam: **M678**

Shape:

Material: **gen_Alum**

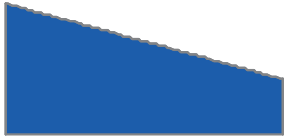
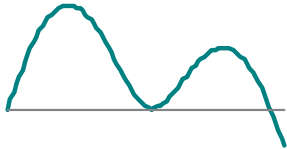
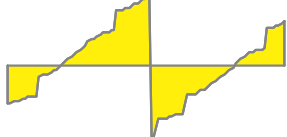
Length: **344 in**

I Joint: **N765**

J Joint: **N802**

Code Check: **No Calc**

Report Based On 97 Sections

2051 at 0 in  A 847 at 344 in lb	.546 at 75.25 in  Dy in -.187 at 344 in	Dz _____ in
T _____ lb-ft	1052.602 at 175.583 in  Vy lb -1148.899 at 179.167 in	Vz _____ lb
fa _____ psi 986.532 at 0 in  407.407 at 344 in	1889.102 at 68.083 in  Mz lb-ft -3087.497 at 175.583 in	My _____ lb-ft fc _____ psi ft _____ psi

Check 7

YKK E9-1225

JEI Structural Engineering
11108 N. Oak Tfwy, Suite 208
Kansas City, MO 64155

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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/205
Detail: 1/407

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA

Member M678

Check 7

Load Design Code

ASCE7-05 ASD

Material Design Code

Aluminum Design Manual 2010

ADM 2010 Type

Alloy-Temper

Closed Shape

6063-T6

Tributary Width (t) 5.25 ft $F_y = 25.0$ ksi
Height (h) 16.46 ft $F_u = 30.0$ ksi
Unbraced Length (L) 8.33 ft

Design Loads

Design Pressure (p) 19.0 psf (Using reduced area load based on 70sf)
Panel Weight (p_{wt}) 8.0 psf (moment only)

Manuf. / Part #:

YKK E9-1225

E = 10100 ksi $r_{x, alum} = 2.176$ in
 $I_{x, alum} = 9.838$ in⁴ $r_{y, alum} = 0.935$ in
 $I_{y, alum} = 1.818$ in⁴ A = 2.079 in²
 $S_{x, alum} = 3.213$ in³ J = 4.110 in⁴
 $S_{y, alum} = 1.454$ in³ wt = 2.498 lb/ft
 $b/t_{web} = 52.71$ $b/t_{flange} = 22.33$
Fixity_{web} = 2 end(s) Fixity_{flange} = 2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$ w = N/A lb/ft
Shear Load $V = wL/2$ V = 1152.6 lb
Moment $M = wL^2/8$ M = 3087.5 lb-ft
 $M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$ $M_{alum} = 3087.5$ lb-ft
 $f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$ $f_{b-alum} = 11.53$ ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$ P = 2051.0 lb
 $f_{c-alum} = P/A$ $f_{c-alum} = 0.99$ ksi

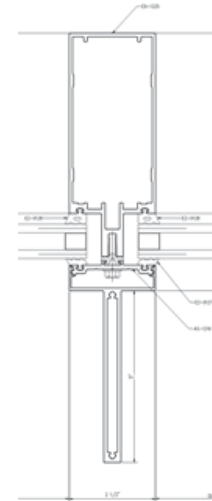
Check Deflection

Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) = 0.546$ in
N/A $\pm$ movement cap. $\Delta_{allow} = 1.073$ in
Allowable deflection = L/175 or if span > 13'-6"
then allowable def = L/240 + 1/4" Deflection Factor
DF = #####

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$ $M_{steel} = 0.0$ lb-ft
 $Mb/\Omega =$ $Mb/\Omega = 0$ lb-ft
 $Ms/(Mb/\Omega) =$ N/A

**Reinforcing**

No Reinforcing

		Load Share	
		Aluminum	Steel
$I_{x, steel} =$	0.000 in ⁴	1.000	0.000
$S_{x, steel} =$	0.000 in ³		
$I_{combined} =$	9.838 in ⁴		

Allowable Loads $\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.15 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.92 ksi
E.3 - Axial Compression	4.49 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.60 ksi

Compression Interaction

Allowable Compression	$F_c =$	4.49 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.220

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.92 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.828

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	1.048
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Approximately 4% over allowable, OK

Beam: **M232**

Shape:

Material: **gen_Alum**

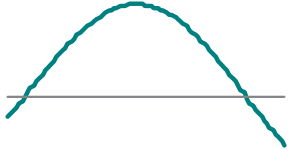
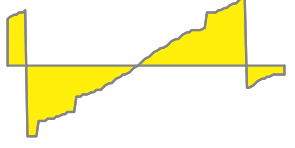
Length: **242 in**

I Joint: **N301**

J Joint: **N246A**

Code Check: **No Calc**

Report Based On 97 Sections

423.5 at 0 in  A lb	.493 at 113.438 in  Dy in -.261 at 242 in	Dz in
T lb-ft	345.586 at 206.708 in  Vy lb -375.345 at 17.646 in	Vz lb
203.704 at 0 in  fa psi	1166.741 at 113.438 in  Mz lb-ft -322.41 at 15.125 in	My lb-ft
	fc psi	ft psi

YKK E9-1225 jamb mullion

OK in terms of stress and deflection by comparison to Check 5

See following sheets for sealant joint analysis



JEI Structural Engineering

Glazing Systems

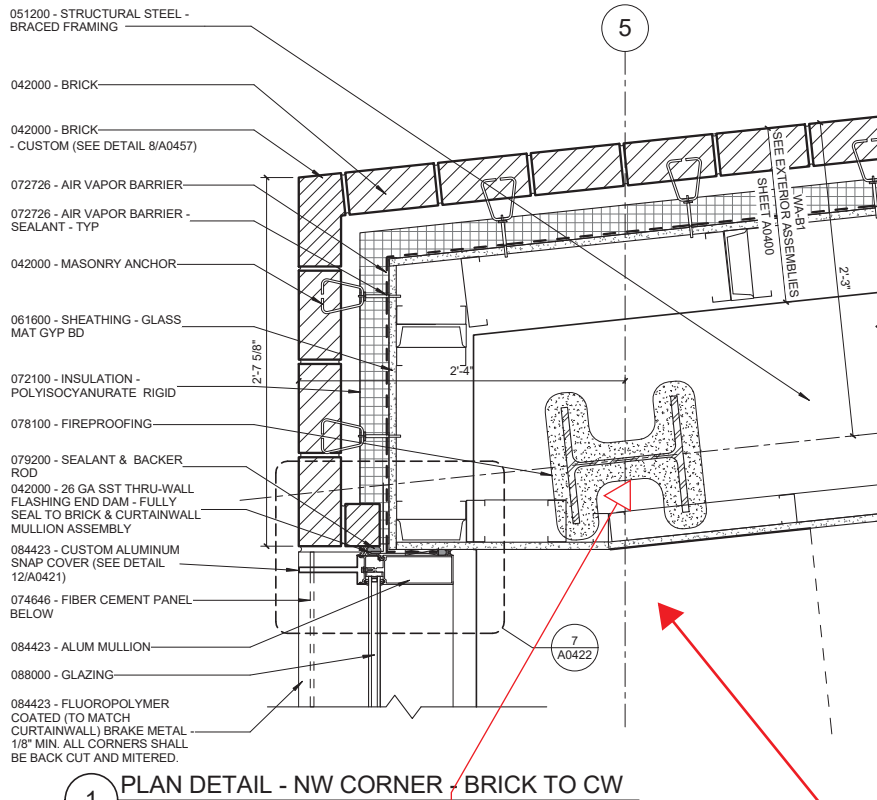
Fast, Friendly, Affordable

Webster University

Dan Ward

Project #JE16059

June 23, 2016



1/A0421

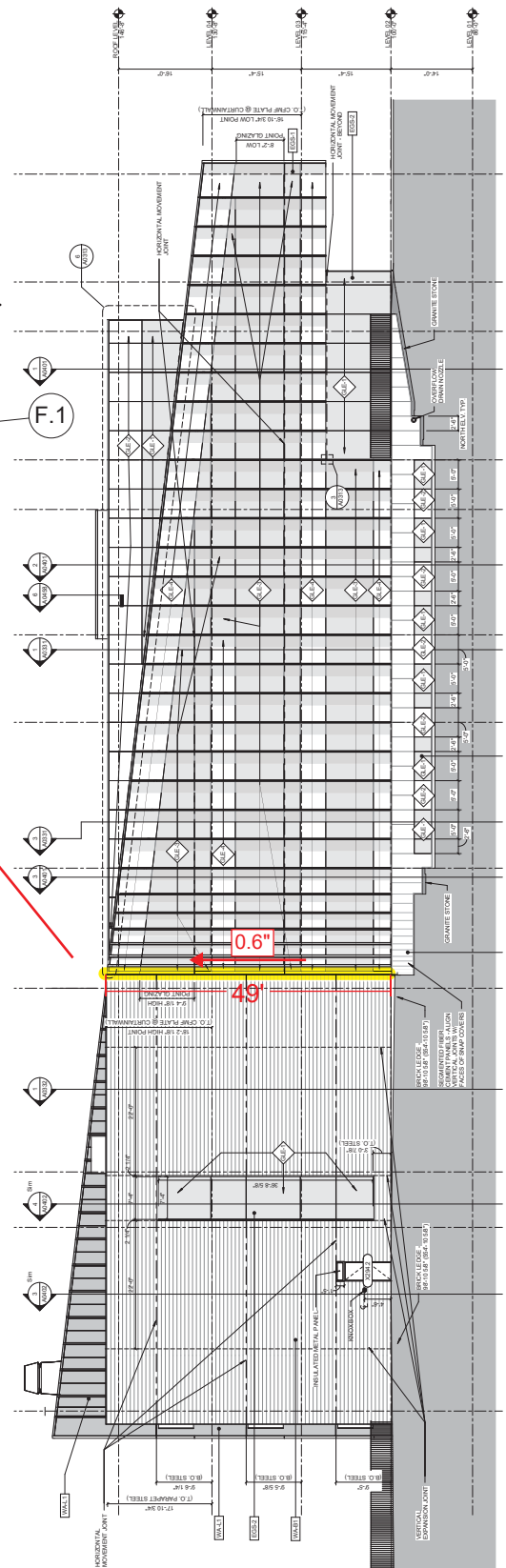
Due to proximity to column. This joint will not be required to accommodate live load deflection.

Maximum Thermal Expansion at roof

INPUT	CHECK
Max Heights (h)	49.00 ft
E =	10100 ksi
Aluminum Expansion Coef =	0.00128
Temp at Construction =	40 deg
Max Temp of Alum =	120 deg
Thermal Expansion Calculation	
$\Delta \text{temp} = T \text{ change}(\text{Coef}) \cdot h$	0.60 in

Use 1/2" Tremco Spectrum 1 silicone joint

See following page for maximum joint movement in shear.





JEI Structural Engineering
7280 NW 87th Terrace, Suite C-208
Kansas City, MO 64153

Office: 816-505-0987
info@jeistructural.com
www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Perimeter Sealant Joint Under Combined
In-Plane / Out-of-Plane Movement

Date: 11/7/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT CHECK

Sealant: *Dow Corning 790 Silicone Building Sealant*

Allowable Extension:

100%

Allowable Compression:

50%

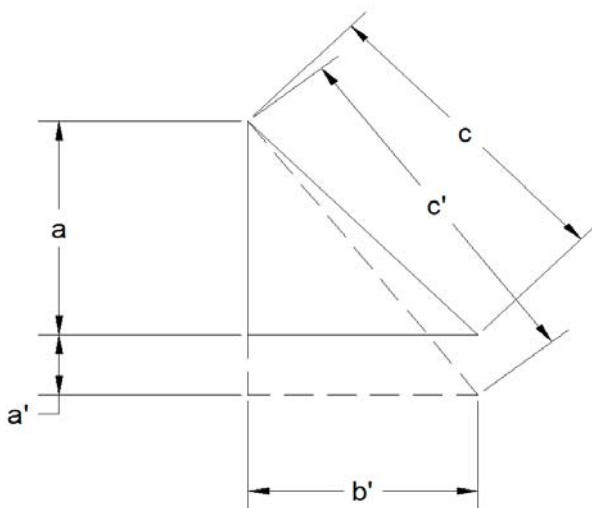
Joint Dimensions

Nominal Joint Width:	$a = 0.500$ in
In-Plane Movement:	$a' = 0.000$ in
Out-of-Plane Movement:	$b' = 0.493$ in
Maximum thermal expansion	$c' = 0.600$ in

Joint Movements Checks

Allowable Expanded Length	$c'_{\text{allow}} = 1.000$ in
Allowable Compressed Length	$a_{\text{allow}} = 0.250$ in
Joint Compressed Length	$a - a' = 0.500$
Joint Expanded Length	$c' = 0.924$ in

OK
OK





JEI Structural Engineering

Glazing Systems

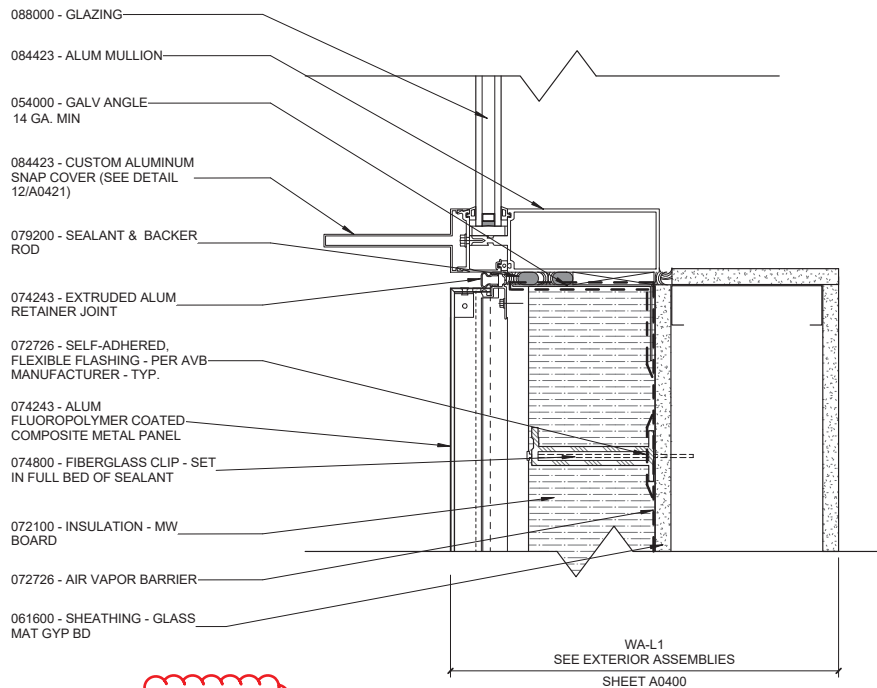
Fast, Friendly, Affordable

Webster University

Dan Ward

Project #JE16059

June 23, 2016



3 PLAN DETAIL - CURTAINWALL JAMB @ METAL COMPOSITE PANEL

3" = 1'-0"

Maximum Thermal Expansion at roof

INPUT	CHECK
Max Heights (h)	49.00 ft
E =	10100 ksi
Aluminum Expansion Coef =	0.00128
Temp at Construction =	40 deg
Max Temp of Alum =	120 deg
Thermal Expansion Calculation	
$\Delta \text{ temp} = T \text{ change}(\text{Coef}) \cdot h$	
	0.60 in

Use 5/8" Tremco Spectrum 1 silicone joint

1) Maximum thermal expansion and live load movement at each floor line can occur simultaneously, since metal panel system is dead loaded at each level.
*Conservatively use maximum thermal expansion at roof with maximum live load movement provided for Level 4.

$$0.6" + 0.378" \text{ (down, at level 4 per SOR)} = 0.978"$$

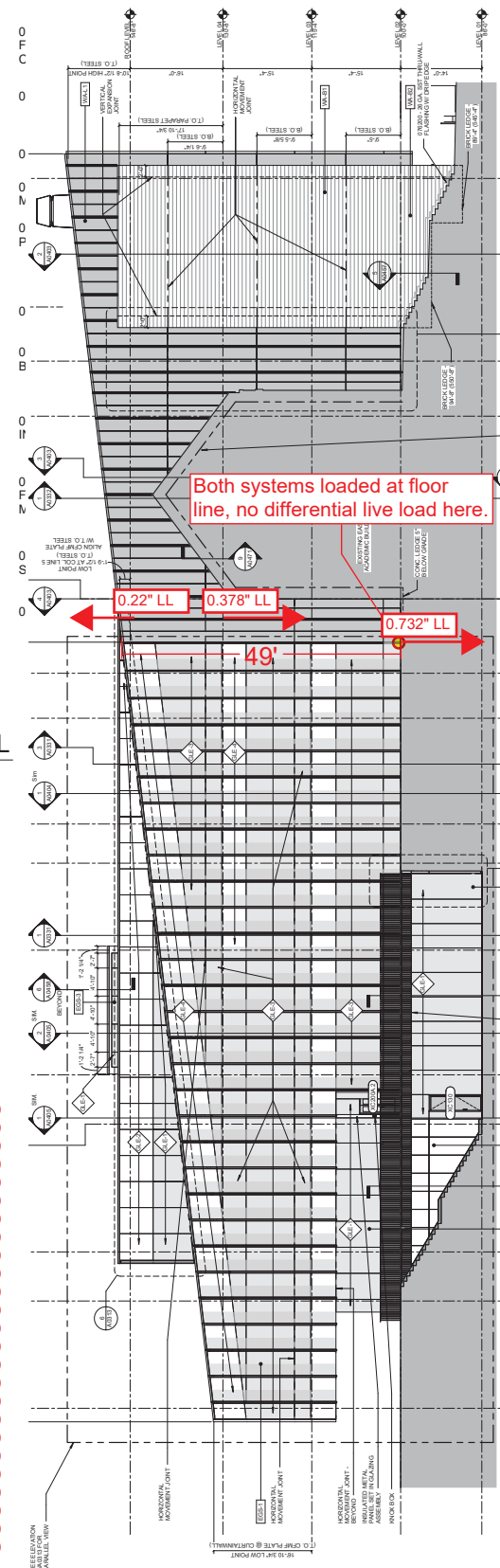
2) Live Load at level 2 will drop EGS-1 down, while live load movement up at each level (per SOR of metal panel system) will lift the metal panel system. This could occur simultaneously.

*Worst case occurs at roof.

$$0.732" \text{ (down, at level 2 per SOR)} + 0.22" \text{ (up, at roof per SOR)} = 0.952"$$

Condition 1 controls. Maximum shear movement = 0.978"

See following page for maximum joint movement in shear.





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7280 NW 87th Terrace, Suite C-208
Kansas City, MO 64153

Office: 816-505-0987
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www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Perimeter Sealant Joint Under Combined
In-Plane / Out-of-Plane Movement

Date: 11/7/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT CHECK

Sealant: *Dow Corning 790 Silicone Building Sealant*

Allowable Extension:

100%

Allowable Compression:

50%

Joint Dimensions

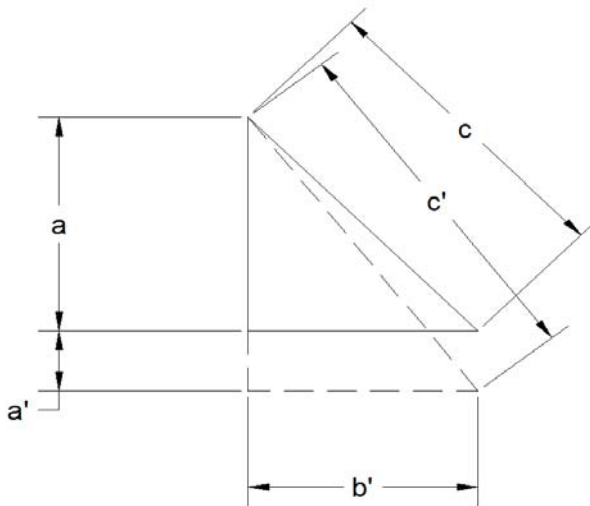
Nominal Joint Width:	$a = 0.625$ in
In-Plane Movement:	$a' = 0.000$ in
Out-of-Plane Movement:	$b' = 0.493$ in
Maximum thermal expansion	$c' = 0.978$ in

Joint Movements Checks

Allowable Expanded Length	$c'_{\text{allow}} = 1.250$ in
Allowable Compressed Length	$a_{\text{allow}} = 0.313$ in
Joint Compressed Length	$a - a' = 0.625$
Joint Expanded Length	$c' = 1.261$ in

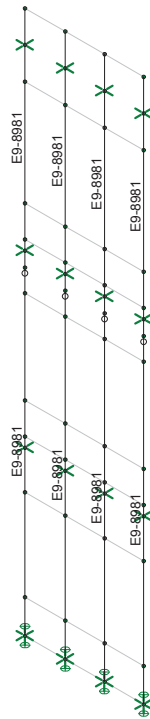
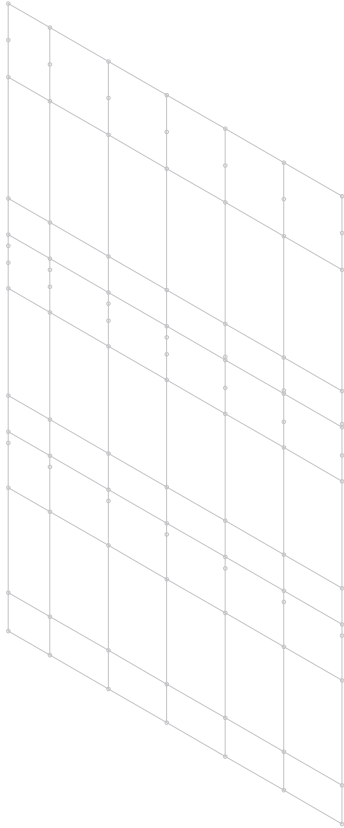
OK

OK





Section sets



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 206, 212

JEI Structural Engineering

M. Gorny

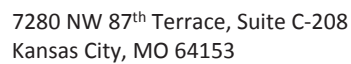
JE16059

Webster University

SK - 36

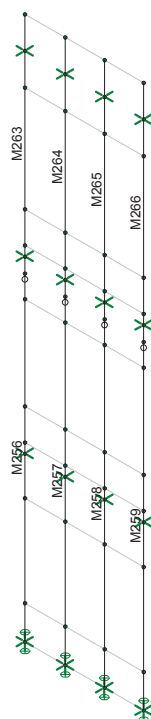
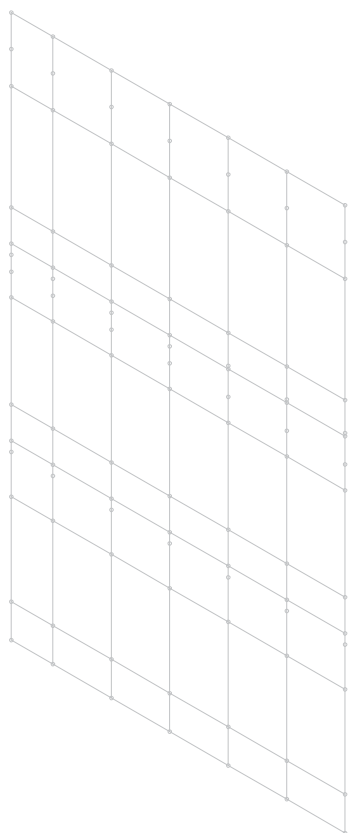
Nov 2, 2016 at 7:06 AM

EGS-1 Preliminary.r3d





Member labels



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 206, 212

JEI Structural Engineering

M. Gorny

JE16059

Webster University

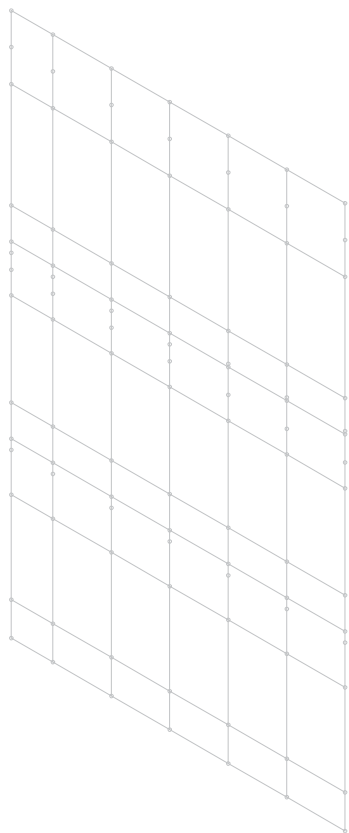
SK - 37

Nov 2, 2016 at 7:07 AM

EGS-1 Preliminary.r3d



Dead load
 $8\text{psf (5' 3")} = 42\text{lb/ft (21lb/ft at jambs)}$



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 206, 212

Loads: BLC 7, Dead

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M. Gorny

JE16059

Webster University

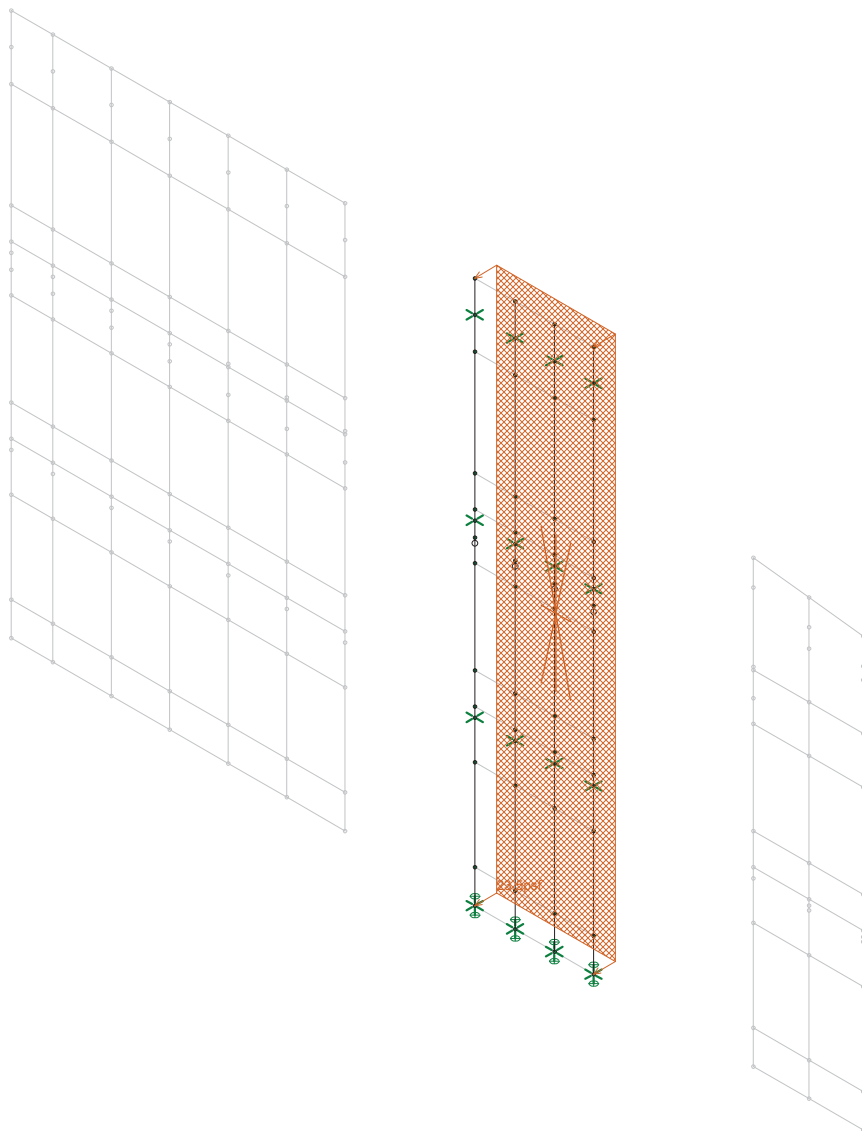
SK - 38

Nov 2, 2016 at 7:07 AM

EGS-1 Preliminary.r3d



Negative Wind - 23.5psf



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 206, 212

Loads: BLC 1, Negative Wind (Face A)

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Webster University

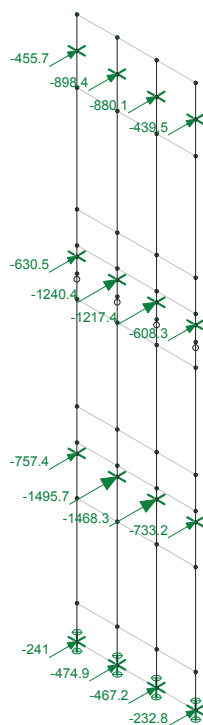
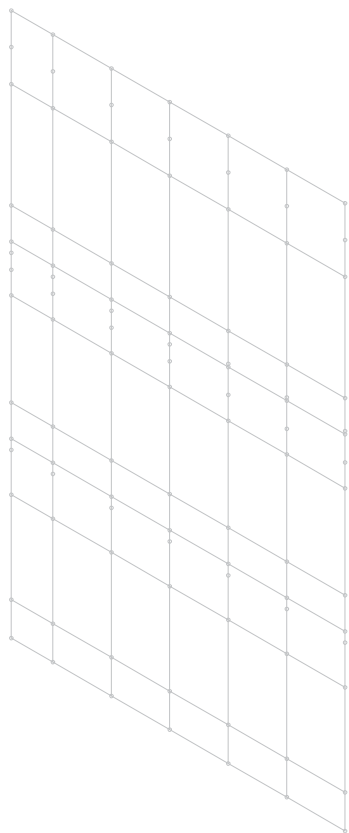
SK - 39

Nov 2, 2016 at 7:07 AM

EGS-1 Preliminary.r3d



Anchor Loads



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 206, 212

Results for LC 1, Negative Wind Face A
Z-direction Reaction Units are lb and lb-ft

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JE16059

Webster University

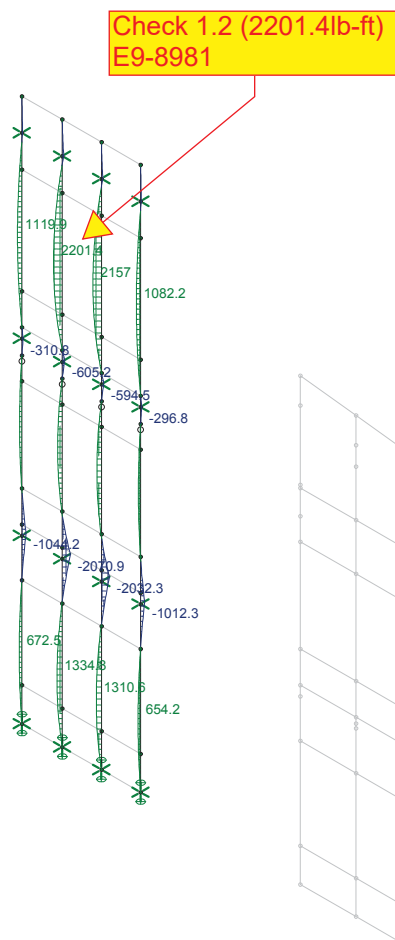
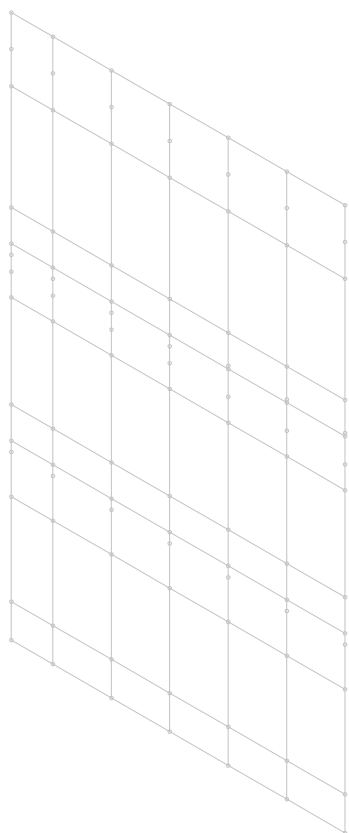
SK - 40

Nov 2, 2016 at 7:08 AM

EGS-1 Preliminary.r3d



Moment diagram



EGS-1 YKK YCW 750 SSG (2-1/2" x 7-1/2"). Shop drawing sheets 206, 212

Results for LC 1, Negative Wind Face A
Member z Bending Moments (lb-ft)

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M. Gorny

JE16059

Webster University

SK - 41

Nov 2, 2016 at 7:09 AM

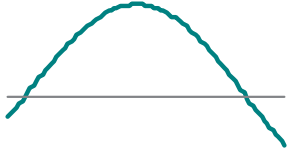
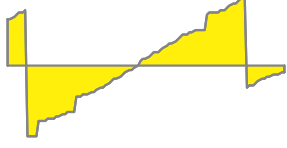
EGS-1 Preliminary.r3d

Beam: **M264**

Shape:

Material: **gen_Alum**Length: **242 in**I Joint: **N346**J Joint: **N296**Code Check: **No Calc**

Report Based On 97 Sections

847 at 0 in  A lb	.779 at 113.438 in  Dy in -.413 at 242 in	Dz in
847 at 0 in  A lb	656.293 at 206.708 in  Vy lb -713.751 at 17.646 in	Vz lb
T lb-ft	2201.415 at 113.438 in  Mz lb-ft -605.169 at 15.125 in	My lb-ft
341.946 at 0 in  fa psi	fc psi	ft psi

Check 1.2

YKK E9-8981

JEI Structural Engineering
11108 N. Oak Tfwy, Suite 208
Kansas City, MO 64155

Voice: 816-734-8345
Fax: 816-734-7013
www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/206
Detail: 2/407

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

Member M264

Check 1.2

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t) 3.57 ft $F_y = 25.0$ ksi
Height (h) 16.00 ft $F_u = 30.0$ ksi
Unbraced Length (L) 8.33 ft

Design Loads

Design Pressure (p) 23.5 psf
Panel Weight (p_{wt}) 8.0 psf

Manuf. / Part #: YKK E9-8981

E =	10100 ksi	$r_{x, alum} =$	2.184 in
$I_{x, alum} =$	11.810 in ⁴	$r_{y, alum} =$	1.092 in
$I_{y, alum} =$	2.954 in ⁴	A =	2.477 in ²
$S_{x, alum} =$	3.589 in ³	J =	6.349 in ⁴
$S_{y, alum} =$	1.911 in ³	wt =	2.976 lb/ft
b/t _{web} =	38.25	b/t _{flange} =	22.25
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$ $w =$ N/A lb/ft
Shear Load $V = wL/2$ $V =$ 713.8 lb
Moment $M = wL^2/8$ $M =$ 2201.4 lb-ft
 $M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$ $M_{alum} =$ 2201.4 lb-ft
 $f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$ $f_{b-alum} =$ 7.36 ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$ $P =$ 2051.0 lb
 $f_{c-alum} = P/A$ $f_{c-alum} =$ 0.83 ksi

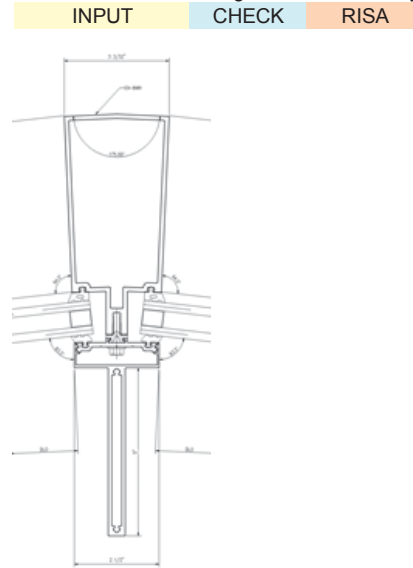
Check Deflection

Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) =$ 0.779 in
N/A $\pm$ movement cap. $\Delta_{allow} =$ 1.050 in
Allowable deflection = L/175 or if span > 13'-6" then allowable def = L/240 + 1/4" Deflection Factor DF = #####

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$ $M_{steel} =$ 0.0 lb-ft
 $Mb/\Omega =$ $Mb/\Omega =$ 0 lb-ft
 $Ms/(Mb/\Omega) =$ N/A



Reinforcing

No Reinforcing

$I_{x, steel} =$	0.000 in ⁴	Load Share	
$S_{x, steel} =$	0.000 in ³	Aluminum	Steel
$I_{combined} =$	11.810 in ⁴	1.000	0.000

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.15 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	17.77 ksi
E.3 - Axial Compression	6.12 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.94 ksi

Compression Interaction

Allowable Compression	$F_c =$	6.12 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.135

Flexure Interaction

Controls: F.3.1 - Closed Shape Flexure		
Allowable Flexural Compression	$F_b =$	14.94 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.493

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$ $f_a/F_a + f_b/F_b =$ 0.628

Mullion OK



JEI Structural Engineering
7280 NW 87th Terrace, Suite C-208
Kansas City, MO 64153

Office: 816-505-0987
info@jeistructural.com
www.jeistructural.com

Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Summary
Designer: M. Gorny

Manufacture: YKK
Part #: E9-1225
Alloy/Temper: 6063-T6

Date: 11/2/2016
Proj.: JE16059

Typical Wind Pressure (T) = 20.0 psf
Corner Zone Wind Pressure (C) = 24.0 psf
Interior Pressure (INT) = 5.0 psf

INPUT CHECK RISA

Sheet	Elevation	Section	Part No	Wind Zone	Unbraced Length (L_u)	Trib Height (h) ft	Trib Width (t) ft	Trib Area ($h \times t$) = (A)	Wind Pres (p)	linear load (w) (plf)	Deflection Factor ($w \times h^4$ (div by 10E7)	Stress Factor ($((w \times h^2)/1000$
214	1/214	1/407	E9-1225	T	6.07	6.49	5.25	34.1	20.0	105.0	6.0	4.4
1)												Check

Mullion Design Summary

1: OK



JEI Structural Engineering
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Kansas City, MO 64155

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Fax: 816-734-7013
www.jeistructural.com

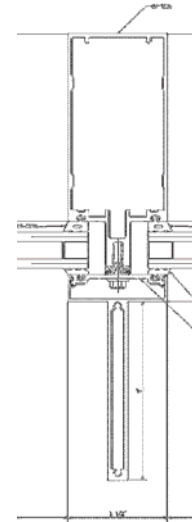
Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/241
Detail: 1/407

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA



Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t)	5.25 ft	$F_y =$	25.0 ksi
Height (h)	6.49 ft	$F_u =$	30.0 ksi
Unbraced Length (L)	6.07 ft		

Design Loads

Design Pressure (p)	20.0 psf
Panel Weight (p_{wt})	8.0 psf

Manuf. / Part #:		YKK E9-1225	
E =	10100 ksi	$r_{x, \text{alum}} =$	2.176 in
$I_{x, \text{alum}} =$	9.838 in ⁴	$r_{y, \text{alum}} =$	0.935 in
$I_{y, \text{alum}} =$	1.818 in ⁴	A =	2.079 in ²
$S_{x, \text{alum}} =$	3.213 in ³	J =	4.110 in ⁴
$S_{y, \text{alum}} =$	1.454 in ³	wt =	2.498 lb/ft
$b/t_{web} =$	52.71	$b/t_{flange} =$	22.33
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
--------------	------	--------------	------

Applied Bending Moment

$w = p \cdot t$	$w =$	105.0 lb/ft
Shear Load $V = wL/2$	$V =$	340.7 lb
Moment $M = wL^2/8$	$M =$	552.8 lb-ft
$M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$	$M_{alum} =$	552.8 lb-ft
$f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum} =$	2.06 ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$	288.8 lb
$f_{c-alum} = P/A$	$f_{c-alum} =$	0.14 ksi

Check Deflection

Typical Vertical	
N/A in. joint $\Delta = (5wL^4)/(384EI) =$	0.042 in
N/A $\pm$ movement cap. $\Delta_{allow} =$	0.445 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 6.0

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$	$M_{steel} =$	0.0 lb-ft
$Mb/\Omega =$	$Mb/\Omega =$	0 lb-ft
$Ms/(Mb/\Omega) =$		N/A

Reinforcing

No Reinforcing	
$I_{x, steel} =$	0.000 in ⁴
$S_{x, steel} =$	0.000 in ³
$I_{combined} =$	9.838 in ⁴
Load Share	
Aluminum	Steel
1.000	0.000

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.15 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.92 ksi
E.3 - Axial Compression	8.43 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.91 ksi

Compression Interaction

Allowable Compression	$F_c =$	8.43 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.016

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.92 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.148

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	0.165
---------------------------	-----------------------	-------

Mullion OK



JEI Structural Engineering
7280 NW 87th Terrace, Suite C-208
Kansas City, MO 64153

Office: 816-505-0987
info@jeistructural.com
www.jeistructural.com

Client: NGG

Project: Webster University

Structure: YKK 750 SSG (2-1/2" x 7-1/2")

Part of: Jamb Mullion Summary

Designer: M. Gorny

Manufacture: YKK

Part #: E9-1225

Alloy/Temper: 6063-T6

Jamb $I_x = 9.838 \text{ in}^4$

Typical Wind Pressure (T) = 20.0 psf

Corner Zone Wind Pressure (C) = 24.0 psf

Interior Pressure (INT) = 5.0 psf

Date
Proj.

11/2/2016
JE-16059

Sealant Joint Size & Expansion

1/2" Joint (50% Expandable)

Allowable Movement = 0.560 in

INPUT CHECK RISA

Sheet	Elevation	Section	Part No	Wind Zone	Unbraced Length (L _b)	Trib Height (h) ft	Trib Width (t) ft	Trib Area (h)*(t) = (A)	Wind Pres (p)	linear load (w) (plf)	Unreinforced Deflection (in)	Stress Factor ((w)*(h) ²)*L/1000	Deflection > 0.56 in. ?
214	1/214	1/419	E9-1225	T	6.07	6.49	2.63	17.0	20.0	52.5	0.02	2.2	OK
1) Check													

Mullion Design Summary

1: OK by comparison to Vertical Mullion Check 1



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Kansas City, MO 64153

Office: 816-505-0987
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www.jeistructural.com

Client: NGG

Project: Webster University

Structure: YKK 750 SSG (2-1/2" x 7-1/2")

Part of: Horizontal Mullion Summary

Designer: M. Gorny

Manufacture: YKK

Part #: E9-3403

Alloy/Temper: 6063-T6

Typical Wind Pressure (T) = 20.0 psf

Corner Zone Wind Pressure (C) = 24.0 psf

Interior Pressure (INT) = 5.0 psf

INPUT CHECK

Sheet	Elevation	Section	Part No	Wind Zone	Unbraced Length (Lb)	Total Length (L)	Trib Width (tw)	DL Trib (t)	Trib Area (h)*(t) = (A)	Wind Pres (p)	linear load (w) (plf)	Def. Factor (w) * (h)^4 (div. By 10E7)	Stress Factor ((w)*(h)^2)/L	DL Factor (t)*(L)^4
205	1/205	1/310	E9-3403	C	5.25	5.25	7.40	5.49	38.9	24.0	177.6	5.33	4.15	4170.4
205	1/205	1/310	E9-3403	C	5.25	5.25	5.96	8.90	31.3	24.0	143.0	4.29	3.34	6758.1
208	1/208	1/308	E9-3403	C	5.84	5.84	5.57	8.13	32.5	24.0	133.8	5.52	3.82	9441.5
216	1/216	1/312	E9-3403	C	5.00	5.00	6.79	5.54	33.9	24.0	162.9	4.22	3.47	3463.5

Mullion Design Summary

1: Use 1/8 point blocking

2: OK

3) OK



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Kansas City, MO 64153

Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 7-1/2")
Part of: Horizontal Mullion Analysis
Elevation: 1/208
Detail: 1/310

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Check 1

Load Design Code	Material Design Code
ASCE7-05 ASD	ADM 2010
ADM 2010 Type	Alloy-Temper
Open Shape	6063-T6

Wind Tributary Width (t_{WL})	5.57 ft	$F_y =$	25.0 ksi
Dead Load Trib. Height (t_{DL})	8.13 ft	$F_u =$	30.0 ksi
Length (L)	5.84 ft		
Unbraced Length (L_b)	5.84 ft		

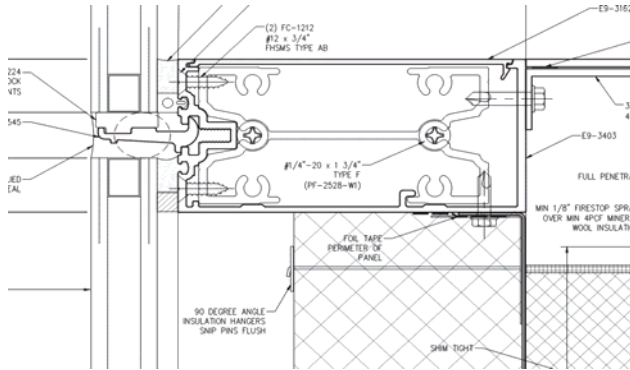
Design Loads

Design Pressure (p)	24.0 psf
Infill Weight (p_{wt})	6.5 psf

Manuf. / Part #:		YKK E9-3403	
E =	10100 ksi	$r_{x, \text{alum}} =$	2.090 in
$I_{x, \text{alum}} =$	6.100 in ⁴	$r_{y, \text{alum}} =$	0.801 in
$I_{y, \text{alum}} =$	0.893 in ⁴	A =	1.392 in ²
$S_{x, \text{alum}} =$	2.092 in ³	J =	0.007 in ⁴
$S_{y, \text{alum}} =$	0.536 in ³	wt =	1.672 lb/ft
$b/t_{web} =$	54.50	$b/t_{flange} =$	17.67
Fixity _{web} =	2 end(s)	Fixity _{flange} =	1 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
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Setting Block Locations (s) =	1/8	points
Setting Block Load (P) =	154.2	lb/setting block

Reinforcing	No Reinforcing		
$I_{x, \text{ steel }} =$	0.000 in ⁴	$I_{y, \text{ steel }} =$	0.000 in ⁴
$S_{x, \text{ steel }} =$	0.000 in ³	$S_{y, \text{ steel }} =$	0.000 in ³
$I_{x, \text{ combined }} =$	6.100 in ⁴	$I_{y, \text{ combined }} =$	0.893 in ⁴
$A_{\text{ steel }} =$	0.00 in ²	$wt_{\text{ steel }} =$	0.00 lb/ft
$A_{\text{ alum-total }} =$	1.392 in ²	$wt_{\text{ total }} =$	1.672 lb/ft

X-Axis Applied Bending Moment (Wind Load)	Load Share = 100%
$w_{WL} = p \cdot t_{WL}$	$w =$ 133.8 lb/ft
Shear Load $V = wL/2$	$V =$ 390.5 lb
Moment $M = wL^2/8$	$M =$ 569.9 lb-ft
$M_{\text{alum}} = M \cdot I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} =$ 569.9 lb-ft
$f_b = M_{\text{alum}} / (S_{x, \text{alum}} \cdot \text{TRF}_s)$	$f_{b-\text{alum-x}} =$ 3.27 ksi
Y-Axis Applied Bending Moment (Dead Load)	Load Share = 100%
Shear $V = P + w_{\text{total}} \cdot L/2$	$V =$ 159.1 lb
Moment $M = w_{\text{total}} \cdot L^2/8 + P \cdot L \cdot s$	$M =$ 119.6 lb-ft
$M_{\text{alum}} = M \cdot I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} =$ 119.6 lb-ft
$f_b = M_{\text{alum}} / (S_{y, \text{alum}})$	$f_{b-\text{alum-y}} =$ 2.68 ksi
Applied Axial Compression	
$P =$	0.0 lb
$f_{c-\text{alum}} = P/A$	$f_{c-\text{alum}} =$ 0.00 ksi

X-axis Deflection (Wind Load)	Typical Horizontal
N/A in. joint $\Delta_x = (5wL^4)/(384EI_x)$	0.057 in
N/A $\pm$ movement cap. $\Delta_{x-\text{allow}} =$	0.400 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 32.2
Y-axis Deflection (Dead Load)	Typical Horizontal
$\Delta = ((P_{\text{sb}}L^3)/(24EI)) + (3L^2 \cdot 4(Ls)^2) + 5w_{\text{total}}L^4/(384EI)$	$\Delta =$ 0.095 in
	$\Delta_{y-\text{allow}} =$ 0.1250 in

Steel Capacity (X-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{x, \text{steel}}/I_{\text{comb}} =$	$M_{\text{steel}} =$ 0.0 lb-ft
$Mb/\Omega =$	$Mb/\Omega =$ 0 lb-ft
$Ms/(Mb/\Omega) =$	N/A
Steel Capacity (Y-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{y, \text{steel}}/I_{\text{comb}} =$	$M_{\text{steel}} =$ 0.0 lb-ft
$\Phi \cdot Mb =$	$Mb/\Omega =$ 0 lb-ft
$Ms/(Mb/\Omega) =$	N/A

X-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	8.76 ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	N/A ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.46 ksi
F.2.1 - Open Shape Flexure	10.36 ksi
F.3.1 - Closed Shape Flexure	N/A ksi
X-Axis Bending Interaction	
Allowable X-Axis Bending $F_{bx} =$	8.76 ksi
X-Axis Interaction $f_{b-\text{alum-x}}/F_{bx} =$	0.373

Y-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	8.88 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	13.64 ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	N/A ksi
F.2.1	F.2.1 10.36 ksi
F.3.1	F.3.1 N/A ksi
Y-Axis Bending Interaction	
Allowable Y-Axis Bending $F_{by} =$	8.88 ksi
Y-Axis Interaction $f_{b-\text{alum-y}}/F_{by} =$	0.301

Axial Allowable Load	
Allowable Axial Compression	6.71 ksi
Compression Interaction $f_{c-\text{alum}}/F_c =$	0.000

Combined Interaction Ratio	
$f_{c-\text{alum}}/F_c + f_{b-\text{alum-x}}/F_{bx} + f_{b-\text{alum-y}}/F_{by} =$	0.674
Stress OK. Use 1/8 point setting blocks.	



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 7-1/2")
Part of: Horizontal Mullion Analysis
Elevation: 1/205
Detail: 1/310

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Check 2

Load Design Code	Material Design Code
ASCE7-05 ASD	ADM 2010
ADM 2010 Type	Alloy-Temper
Open Shape	6063-T6

Wind Tributary Width (t_{WL})	5.96 ft	$F_y =$	25.0 ksi
Dead Load Trib. Height (t_{DL})	8.90 ft	$F_u =$	30.0 ksi
Length (L)	5.25 ft		
Unbraced Length (L_b)	5.25 ft		

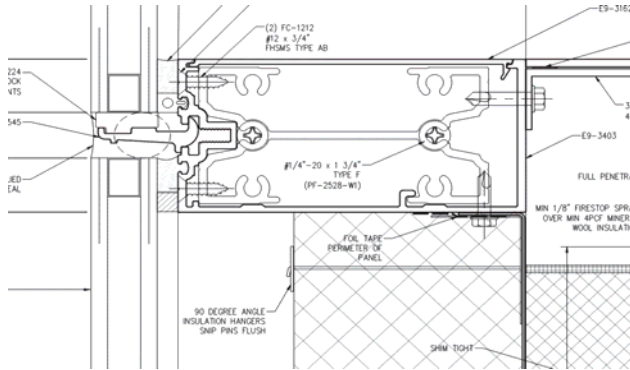
Design Loads

Design Pressure (p)	24.0 psf
Infill Weight (p_{wt})	6.5 psf

Manuf. / Part #:		YKK E9-3403	
E =	10100 ksi	$r_{x, \text{alum}} =$	2.090 in
$I_{x, \text{alum}} =$	6.100 in ⁴	$r_{y, \text{alum}} =$	0.801 in
$I_{y, \text{alum}} =$	0.893 in ⁴	A =	1.392 in ²
$S_{x, \text{alum}} =$	2.092 in ³	J =	0.007 in ⁴
$S_{y, \text{alum}} =$	0.536 in ³	wt =	1.672 lb/ft
$b/t_{web} =$	54.50	$b/t_{flange} =$	17.67
Fixity _{web} =	2 end(s)	Fixity _{flange} =	1 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
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Setting Block Locations (s) =	1/4	points
Setting Block Load (P) =	151.8	lb/setting block

Reinforcing	No Reinforcing		
$I_{x, \text{ steel }} =$	0.000 in ⁴	$I_{y, \text{ steel }} =$	0.000 in ⁴
$S_{x, \text{ steel }} =$	0.000 in ³	$S_{y, \text{ steel }} =$	0.000 in ³
$I_{x, \text{ combined }} =$	6.100 in ⁴	$I_{y, \text{ combined }} =$	0.893 in ⁴
$A_{\text{ steel }} =$	0.00 in ²	$wt_{\text{ steel }} =$	0.00 lb/ft
$A_{\text{ alum-total }} =$	1.392 in ²	$wt_{\text{ total }} =$	1.672 lb/ft

X-Axis Applied Bending Moment (Wind Load)	Load Share = 100%
$w_{WL} = p * t_{WL}$	$w = 143.0$ lb/ft
Shear Load $V = wL/2$	$V = 375.4$ lb
Moment $M = wL^2/8$	$M = 492.7$ lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} = 492.7$ lb-ft
$f_b = M_{\text{alum}} / (S_{x, \text{alum}} * TRF_s)$	$f_{b-\text{alum-x}} = 2.83$ ksi
Y-Axis Applied Bending Moment (Dead Load)	Load Share = 100%
Shear $V = P + wt_{\text{total}} * L/2$	$V = 156.2$ lb
Moment $M = wt_{\text{total}} * L^2/8 + P * L * s$	$M = 205.0$ lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} = 205.0$ lb-ft
$f_b = M_{\text{alum}} / (S_{y, \text{alum}})$	$f_{b-\text{alum-y}} = 4.59$ ksi
Applied Axial Compression	
$P =$	0.0 lb
$f_{c-\text{alum}} = P/A$	$f_{c-\text{alum}} = 0.00$ ksi

X-axis Deflection (Wind Load)	Typical Horizontal
N/A in. joint $\Delta_x = (5wL^4)/(384EI_x)$	0.040 in
N/A $\pm$ movement cap. $\Delta_{x-\text{allow}} =$	0.360 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 22.5
Y-axis Deflection (Dead Load)	Typical Horizontal
$\Delta = ((P_{sb}Ls)/(24EI)) + (3L^2-4(Ls)^2) + 5wt_{\text{total}}L^4/(384EI)$	$\Delta = 0.124$ in
	$\Delta_{y-\text{allow}} = 0.1250$ in

Steel Capacity (X-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{x, \text{steel}}/I_{\text{comb}} =$	$M_{\text{steel}} = 0.0$ lb-ft
$Mb/\Omega =$	$Mb/\Omega = 0$ lb-ft
$Ms/(Mb/\Omega) =$	N/A
Steel Capacity (Y-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{y, \text{steel}}/I_{\text{comb}} =$	$M_{\text{steel}} = 0.0$ lb-ft
$\Phi * Mb =$	$Mb/\Omega = 0$ lb-ft
$Ms/(Mb/\Omega) =$	N/A

X-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	8.76 ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	N/A ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.46 ksi
F.2.1 - Open Shape Flexure	11.01 ksi
F.3.1 - Closed Shape Flexure	N/A ksi
X-Axis Bending Interaction	
Allowable X-Axis Bending $F_{bx} =$	8.76 ksi
X-Axis Interaction $f_{b-\text{alum-x}}/F_{bx} =$	0.322

Y-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	8.88 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	13.64 ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	N/A ksi
F.2.1	F.2.1 11.01 ksi
F.3.1	F.3.1 N/A ksi
Y-Axis Bending Interaction	
Allowable Y-Axis Bending $F_{by} =$	8.88 ksi
Y-Axis Interaction $f_{b-\text{alum-y}}/F_{by} =$	0.516

Axial Allowable Load	
Allowable Axial Compression	8.30 ksi
Compression Interaction $f_{c-\text{alum}}/F_c =$	0.000

Combined Interaction Ratio	
$f_{c-\text{alum}}/F_c + f_{b-\text{alum-x}}/F_{bx} + f_{b-\text{alum-y}}/F_{by} =$	0.839
Stress OK. Use 1/4 point setting blocks.	



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Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 7-1/2")
Part of: Horizontal Mullion Analysis
Elevation: 1/205
Detail: 1/310

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

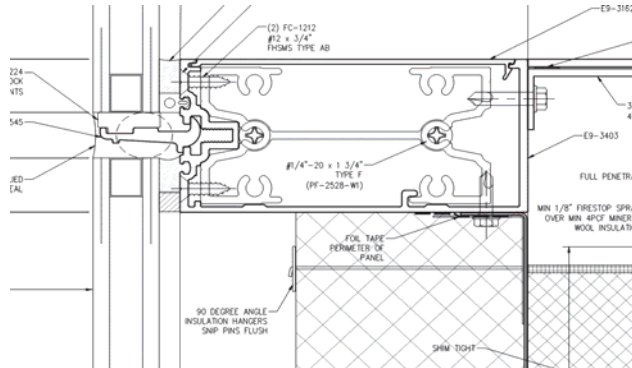
Check 3

Load Design Code	Material Design Code
ASCE7-05 ASD	ADM 2010
ADM 2010 Type	Alloy-Temper
Open Shape	6063-T6

Wind Tributary Width (t_{WL})	7.40 ft	$F_y =$	25.0 ksi
Dead Load Trib. Height (t_{DL})	5.49 ft	$F_u =$	30.0 ksi
Length (L)	5.25 ft		
Unbraced Length (L_b)	5.25 ft		

Design Loads

Design Pressure (p)	24.0 psf
Infill Weight (p_{wt})	6.5 psf



Manuf. / Part #:		YKK E9-3403	
E =	10100 ksi	$r_{x, \text{alum}} =$	2.090 in
$I_{x, \text{alum}} =$	6.100 in ⁴	$r_{y, \text{alum}} =$	0.801 in
$I_{y, \text{alum}} =$	0.893 in ⁴	A =	1.392 in ²
$S_{x, \text{alum}} =$	2.092 in ³	J =	0.007 in ⁴
$S_{y, \text{alum}} =$	0.536 in ³	wt =	1.672 lb/ft
$b/t_{web} =$	54.50	$b/t_{flange} =$	17.67
Fixity _{web} =	2 end(s)	Fixity _{flange} =	1 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
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Setting Block Locations (s) =	1/4	points
Setting Block Load (P) =	93.7	lb/setting block

Reinforcing

$I_{x, \text{steel}} =$	0.000 in ⁴	$I_{y, \text{steel}} =$	0.000 in ⁴
$S_{x, \text{steel}} =$	0.000 in ³	$S_{y, \text{steel}} =$	0.000 in ³
$I_{x, \text{combined}} =$	6.100 in ⁴	$I_{y, \text{combined}} =$	0.893 in ⁴
$A_{\text{steel}} =$	0.00 in ²	$wt_{\text{steel}} =$	0.00 lb/ft
$A_{\text{alum-total}} =$	1.392 in ²	$wt_{\text{total}} =$	1.672 lb/ft

X-Axis Applied Bending Moment (Wind Load)	Load Share = 100%
$w_{WL} = p * t_{WL}$	$w =$ 177.6 lb/ft
Shear Load $V = wL/2$	$V =$ 466.3 lb
Moment $M = wL^2/8$	$M =$ 612.0 lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} =$ 612.0 lb-ft
$f_b = M_{\text{alum}} / (S_{x, \text{alum}} * TRF_s)$	$f_{b-\text{alum-x}} =$ 3.51 ksi
Y-Axis Applied Bending Moment (Dead Load)	Load Share = 100%
Shear $V = P + wt_{\text{total}} * L/2$	$V =$ 98.1 lb
Moment $M = wt_{\text{total}} * L^2/8 + P * L * s$	$M =$ 128.7 lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} =$ 128.7 lb-ft
$f_b = M_{\text{alum}} / (S_{y, \text{alum}})$	$f_{b-\text{alum-y}} =$ 2.88 ksi
Applied Axial Compression	
$P =$	0.0 lb
$f_{c-\text{alum}} = P/A$	$f_{c-\text{alum}} =$ 0.00 ksi

X-axis Deflection (Wind Load)	Typical Horizontal
N/A in. joint $\Delta_x = (5wL^4)/(384EI_x)$	0.049 in
N/A $\pm$ movement cap. $\Delta_{x-\text{allow}} =$	0.360 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 28.0
Y-axis Deflection (Dead Load)	Typical Horizontal
$\Delta = ((P_{sb}Ls)/(24EI)) * (3L^2 - 4(Ls)^2) + 5wt_{\text{total}}L^4/(384EI)$	$\Delta =$ 0.078 in
	$\Delta_{y-\text{allow}} =$ 0.1250 in

Steel Capacity (X-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{x, \text{steel}} / I_{\text{comb}} =$	$M_{\text{steel}} =$ 0.0 lb-ft
$Mb/\Omega =$	0 lb-ft
$Ms/(Mb/\Omega) =$	N/A
Steel Capacity (Y-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{y, \text{steel}} / I_{\text{comb}} =$	$M_{\text{steel}} =$ 0.0 lb-ft
$\Phi * Mb =$	0 lb-ft
$Ms/(Mb/\Omega) =$	N/A

X-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	8.76 ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	N/A ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.46 ksi
F.2.1 - Open Shape Flexure	11.01 ksi
F.3.1 - Closed Shape Flexure	N/A ksi
X-Axis Bending Interaction	
Allowable X-Axis Bending $F_{bx} =$	8.76 ksi
X-Axis Interaction $f_{b-\text{alum-x}}/F_{bx} =$	0.400

Y-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	8.88 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	13.64 ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	N/A ksi
F.2.1	F.2.1 11.01 ksi
F.3.1	F.3.1 N/A ksi
Y-Axis Bending Interaction	
Allowable Y-Axis Bending $F_{by} =$	8.88 ksi
Y-Axis Interaction $f_{b-\text{alum-y}}/F_{by} =$	0.324

Axial Allowable Load	
Allowable Axial Compression	8.30 ksi
Compression Interaction $f_{c-\text{alum}}/F_c =$	0.000

Combined Interaction Ratio	
$f_{c-\text{alum}}/F_c + f_{b-\text{alum-x}}/F_{bx} + f_{b-\text{alum-y}}/F_{by} =$	0.725
Stress OK. Use 1/4 point setting blocks.	



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 7-1/2")
Part of: Horizontal Mullion Analysis
Elevation: 2/204
Detail: 1/308

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Check 1 (door header controls by inspection)

Load Design Code	Material Design Code
ASCE7-05 ASD	ADM 2010
ADM 2010 Type	Alloy-Temper
Open Shape	6063-T6

Wind Tributary Width (t_{WL})	5.62 ft	$F_y =$	25.0 ksi
Dead Load Trib. Height (t_{DL})	3.79 ft	$F_u =$	30.0 ksi
Length (L)	6.17 ft		
Unbraced Length (L_b)	6.17 ft		

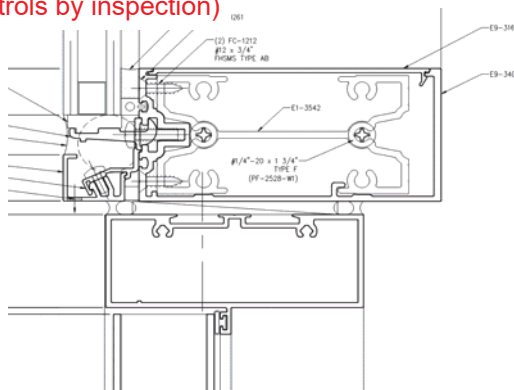
Design Loads

Design Pressure (p)	24.0 psf
Infill Weight (p_{wt})	6.5 psf

Manuf. / Part #:		YKK E9-3403	
E =	10100 ksi	$r_{x, \text{alum}} =$	2.090 in
$I_{x, \text{alum}} =$	6.100 in ⁴	$r_{y, \text{alum}} =$	0.801 in
$I_{y, \text{alum}} =$	0.893 in ⁴	A =	1.392 in ²
$S_{x, \text{alum}} =$	2.092 in ³	J =	0.007 in ⁴
$S_{y, \text{alum}} =$	0.536 in ³	wt =	1.672 lb/ft
b/ $t_{web} =$	54.50	b/ $t_{flange} =$	17.67
Fixity _{web} =	2 end(s)	Fixity _{flange} =	1 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
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Setting Block Locations (s) =	1/8	points
Setting Block Load (P) =	76.0	lb/setting block

Reinforcing	No Reinforcing		
$I_{x, \text{ steel }} =$	0.000 in ⁴	$I_{y, \text{ steel }} =$	0.000 in ⁴
$S_{x, \text{ steel }} =$	0.000 in ³	$S_{y, \text{ steel }} =$	0.000 in ³
$I_{x, \text{ combined }} =$	6.100 in ⁴	$I_{y, \text{ combined }} =$	0.893 in ⁴
$A_{\text{ steel }} =$	0.00 in ²	$wt_{\text{ steel }} =$	0.00 lb/ft
$A_{\text{ alum-total }} =$	1.392 in ²	$wt_{\text{ total }} =$	1.672 lb/ft

X-Axis Applied Bending Moment (Wind Load)	Load Share = 100%
$w_{WL} = p * t_{WL}$	w = 134.9 lb/ft
Shear Load $V = wL/2$	V = 415.9 lb
Moment $M = wL^2/8$	M = 641.1 lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} = 641.1$ lb-ft
$f_b = M_{\text{alum}} / (S_{x, \text{alum}} * TRF_s)$	$f_{b-\text{alum-x}} = 3.68$ ksi
Y-Axis Applied Bending Moment (Dead Load)	Load Share = 100%
Shear $V = P + wt_{\text{total}} * L/2$	V = 81.1 lb
Moment $M = wt_{\text{total}} * L^2/8 + P * L * s$	M = 66.5 lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} = 66.5$ lb-ft
$f_b = M_{\text{alum}} / (S_{y, \text{alum}})$	$f_{b-\text{alum-y}} = 1.49$ ksi
Applied Axial Compression	
	P = 0.0 lb
$f_{c-\text{alum}} = P/A$	$f_{c-\text{alum}} = 0.00$ ksi

X-axis Deflection (Wind Load)	Typical Horizontal
N/A in. joint $\Delta_x = (5wL^4)/(384EI_x)$	0.071 in
N/A $\pm$ movement cap. $\Delta_{x-\text{allow}} =$	0.423 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 40.4
Y-axis Deflection (Dead Load)	Door Header
$\Delta = ((P_{sb}Ls)/(24EI)) * (3L^2 - 4(Ls)^2) + 5wt_{\text{total}}L^4/(384EI)$	$\Delta = 0.058$ in
	$\Delta_{y-\text{allow}} = 0.0625$ in

Steel Capacity (X-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{x, \text{steel}} / I_{\text{comb}} =$	$M_{\text{steel}} = 0.0$ lb-ft
$Mb/\Omega =$	$Mb/\Omega = 0$ lb-ft
$Ms/(Mb/\Omega) =$	N/A
Steel Capacity (Y-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{y, \text{steel}} / I_{\text{comb}} =$	$M_{\text{steel}} = 0.0$ lb-ft
$\Phi * Mb =$	$Mb/\Omega = 0$ lb-ft
$Ms/(Mb/\Omega) =$	N/A

X-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	8.76 ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	N/A ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.46 ksi
F.2.1 - Open Shape Flexure	10.00 ksi
F.3.1 - Closed Shape Flexure	N/A ksi
X-Axis Bending Interaction	
Allowable X-Axis Bending $F_{bx} =$	8.76 ksi
X-Axis Interaction $f_{b-\text{alum-x}}/F_{bx} =$	0.420

Y-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	8.88 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	13.64 ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	N/A ksi
F.2.1	F.2.1 10.00 ksi
F.3.1	F.3.1 N/A ksi
Y-Axis Bending Interaction	
Allowable Y-Axis Bending $F_{by} =$	8.88 ksi
Y-Axis Interaction $f_{b-\text{alum-y}}/F_{by} =$	0.168

Axial Allowable Load	
Allowable Axial Compression	6.02 ksi
Compression Interaction $f_{c-\text{alum}}/F_c =$	0.000

Combined Interaction Ratio	
$f_{c-\text{alum}}/F_c + f_{b-\text{alum-x}}/F_{bx} + f_{b-\text{alum-y}}/F_{by} =$	0.587
Stress OK. Use 1/8 point setting blocks.	



JEI Structural Engineering
7280 NW 87th Terrace, Suite C-208
Kansas City, MO 64153

Office: 816-505-0987
info@jeistructural.com
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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 7-1/2")
Part of: Horizontal Mullion Analysis
Elevation: 1/202
Detail: 1/308

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Check 2 (door header controls by inspection)

Load Design Code	Material Design Code
ASCE7-05 ASD	ADM 2010
ADM 2010 Type	Alloy-Temper
Open Shape	6063-T6

Wind Tributary Width (t_{WL})	5.62 ft	$F_y =$	25.0 ksi
Dead Load Trib. Height (t_{DL})	3.79 ft	$F_u =$	30.0 ksi
Length (L)	3.33 ft		
Unbraced Length (L_b)	3.33 ft		

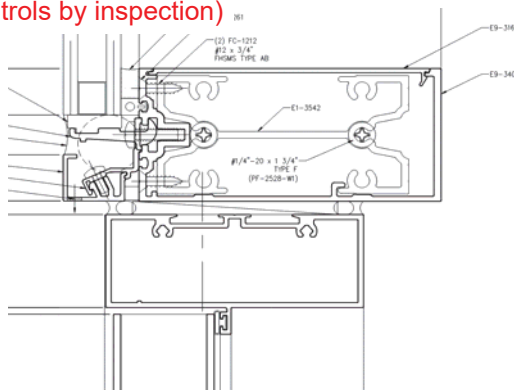
Design Loads

Design Pressure (p)	24.0 psf
Infill Weight (p_{wt})	6.5 psf

Manuf. / Part #:		YKK E9-3403	
E =	10100 ksi	$r_{x, \text{alum}} =$	2.090 in
$I_{x, \text{alum}} =$	6.100 in ⁴	$r_{y, \text{alum}} =$	0.801 in
$I_{y, \text{alum}} =$	0.893 in ⁴	A =	1.392 in ²
$S_{x, \text{alum}} =$	2.092 in ³	J =	0.007 in ⁴
$S_{y, \text{alum}} =$	0.536 in ³	wt =	1.672 lb/ft
b/t _{web} =	54.50	b/t _{flange} =	17.67
Fixity _{web} =	2 end(s)	Fixity _{flange} =	1 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
--------------	------	--------------	------



Setting Block Locations (s) =	1/4	points
Setting Block Load (P) =	41.1	lb/setting block

Reinforcing	No Reinforcing		
$I_{x, steel} =$	0.000 in ⁴	$I_{y, steel} =$	0.000 in ⁴
$S_{x, steel} =$	0.000 in ³	$S_{y, steel} =$	0.000 in ³
$I_{x, combined} =$	6.100 in ⁴	$I_{y, combined} =$	0.893 in ⁴
$A_{steel} =$	0.00 in ²	$wt_{steel} =$	0.00 lb/ft
$A_{alum-total} =$	1.392 in ²	$wt_{total} =$	1.672 lb/ft

X-Axis Applied Bending Moment (Wind Load)	Load Share = 100%
$w_{WL} = p * t_{WL}$	w = 134.9 lb/ft
Shear Load $V = wL/2$	V = 224.8 lb
Moment $M = wL^2/8$	M = 187.3 lb-ft
$M_{alum} = M * I_{alum} / I_{comb}$	$M_{alum} = 187.3$ lb-ft
$f_b = M_{alum} / (S_{x, alum} * TRF_s)$	$f_{b-alum-x} = 1.07$ ksi
Y-Axis Applied Bending Moment (Dead Load)	Load Share = 100%
Shear $V = P + wt_{total} * L/2$	V = 43.9 lb
Moment $M = wt_{total} * L^2/8 + P * L * s$	M = 36.6 lb-ft
$M_{alum} = M * I_{alum} / I_{comb}$	$M_{alum} = 36.6$ lb-ft
$f_b = M_{alum} / (S_{y, alum})$	$f_{b-alum-y} = 0.82$ ksi
Applied Axial Compression	
	P = 0.0 lb
$f_{c-alum} = P/A$	$f_{c-alum} = 0.00$ ksi

X-axis Deflection (Wind Load)	Typical Horizontal
N/A in. joint $\Delta_x = (5wL^4)/(384EI_x)$	0.006 in
N/A $\pm$ movement cap. $\Delta_{x-allow} =$	0.229 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 3.5
Y-axis Deflection (Dead Load)	Door Header
$\Delta = ((P_{sb}Ls)/(24EI)) * (3L^2 - 4(Ls)^2) + 5wt_{total}L^4/(384EI)$	$\Delta = 0.009$ in
	$\Delta_{y-allow} = 0.0625$ in

Steel Capacity (X-Axis)	Load Share = 0%
$M_{steel} = I_{x, steel} / I_{comb} =$	$M_{steel} = 0.0$ lb-ft
$Mb/\Omega =$	$Mb/\Omega = 0$ lb-ft
$Ms/(Mb/\Omega) =$	N/A
Steel Capacity (Y-Axis)	Load Share = 0%
$M_{steel} = I_{y, steel} / I_{comb} =$	$M_{steel} = 0.0$ lb-ft
$\Phi * Mb =$	$Mb/\Omega = 0$ lb-ft
$Ms/(Mb/\Omega) =$	N/A

X-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	8.76 ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	N/A ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.46 ksi
F.2.1 - Open Shape Flexure	13.10 ksi
F.3.1 - Closed Shape Flexure	N/A ksi
X-Axis Bending Interaction	
Allowable X-Axis Bending $F_{bx} =$	8.76 ksi
X-Axis Interaction $f_{b-alum-x}/F_{bx} =$	0.123

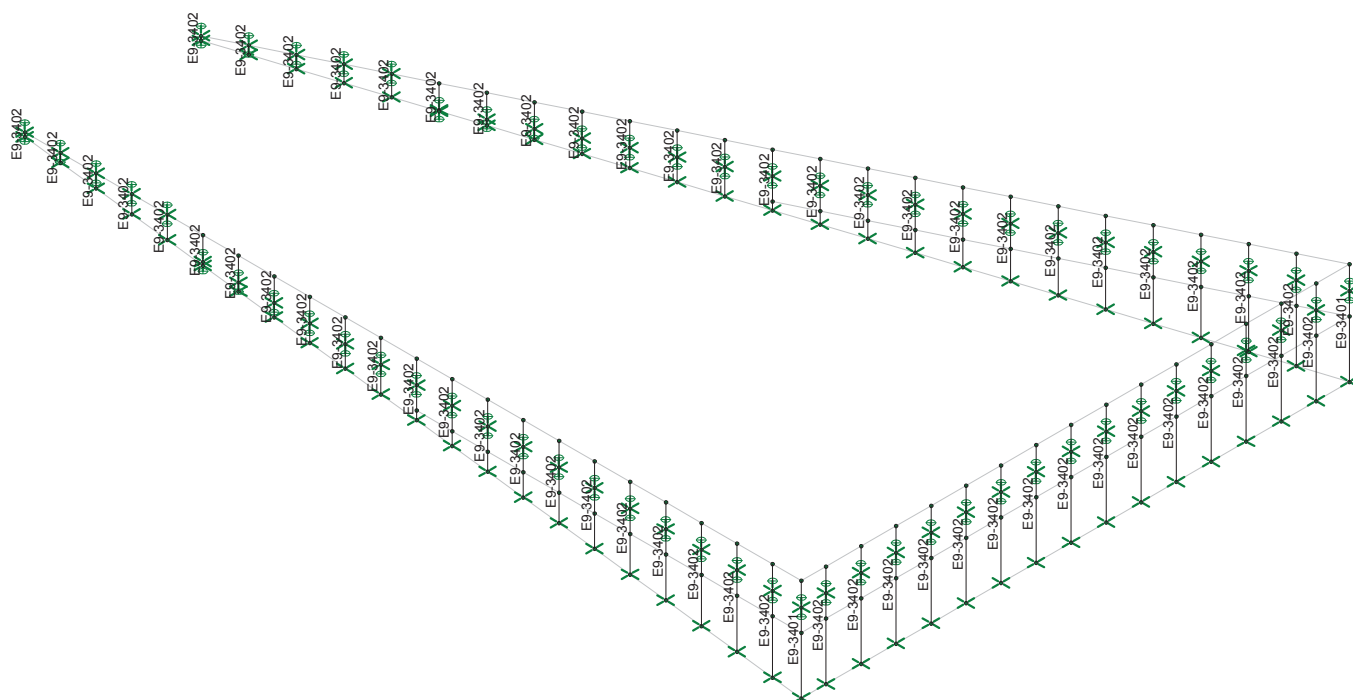
Y-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	8.88 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	13.64 ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	N/A ksi
F.2.1	F.2.1 13.10 ksi
F.3.1	F.3.1 N/A ksi
Y-Axis Bending Interaction	
Allowable Y-Axis Bending $F_{by} =$	8.88 ksi
Y-Axis Interaction $f_{b-alum-y}/F_{by} =$	0.092

Axial Allowable Load	
Allowable Axial Compression	10.52 ksi
Compression Interaction $f_{c-alum}/F_c =$	0.000

Combined Interaction Ratio	
$f_{c-alum}/F_c + f_{b-alum-x}/F_{bx} + f_{b-alum-y}/F_{by} =$	0.215
Stress OK. Use 1/4 point setting blocks.	



Section sets



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

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M. Gorny

JE16059

Webster University

SK - 50

Nov 2, 2016 at 7:19 AM

EGS-1 Preliminary.r3d



JEI Structural Engineering

Glazing Systems

Fast, Friendly, Affordable

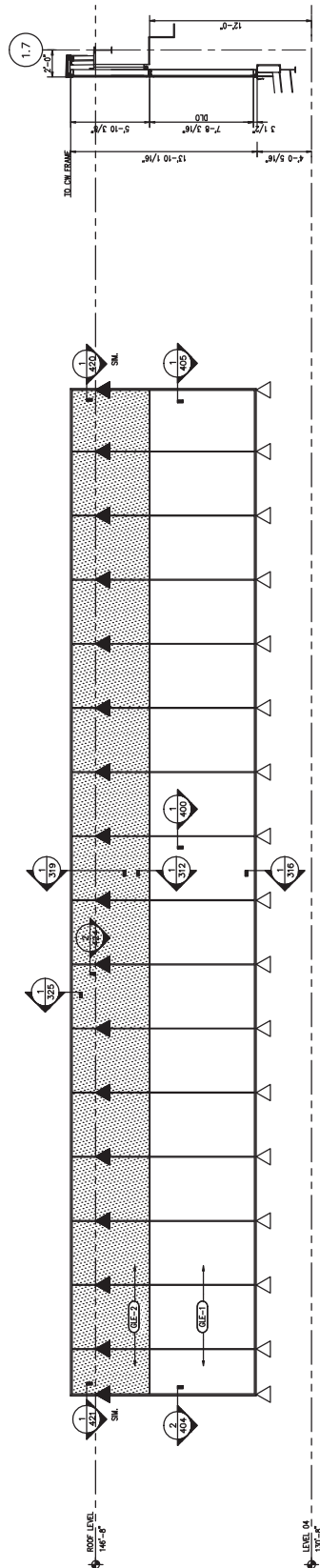
Webster University

NGG

Project #JE16059

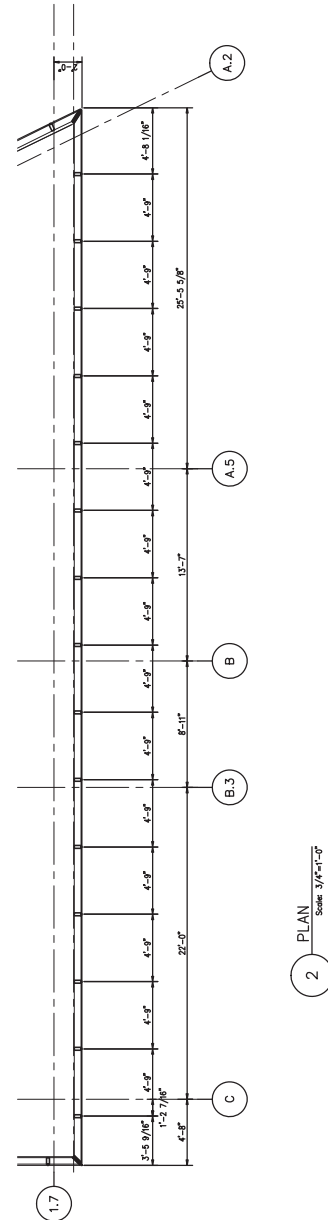
November 7, 2016

EGS-2 YKK YCW 750 SSG
(2-1/2" x 6-9/16"). Shop
drawing sheets 216



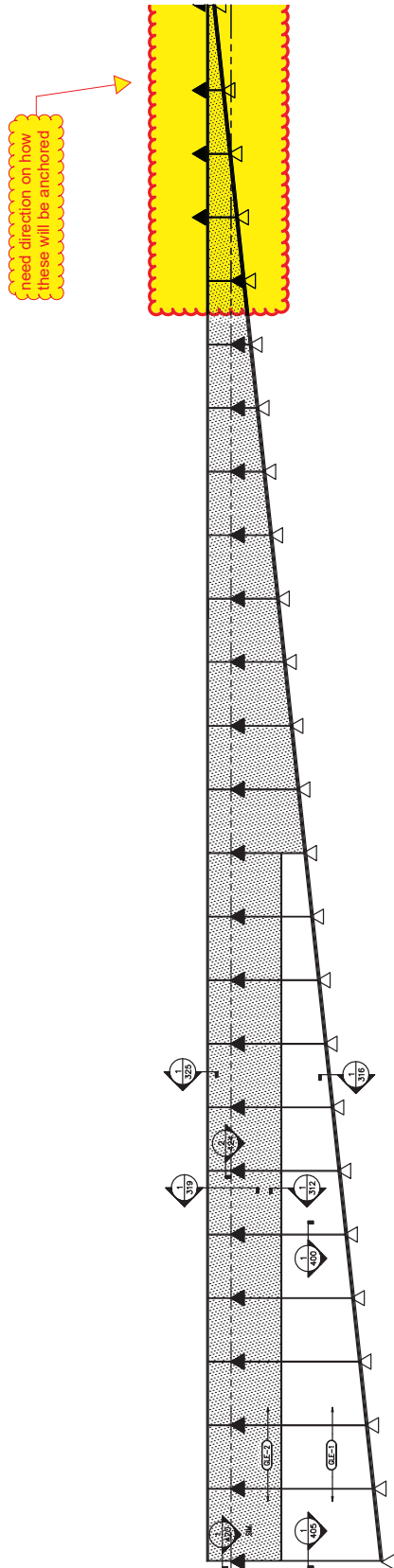
SECTION 2
Scale: 3/4"=1'-0"
ARCH REF: 1/AD06

1 WEST ELEVATION
Scale: 3/4"=1'-0"
ARCH REF: 1/AD06

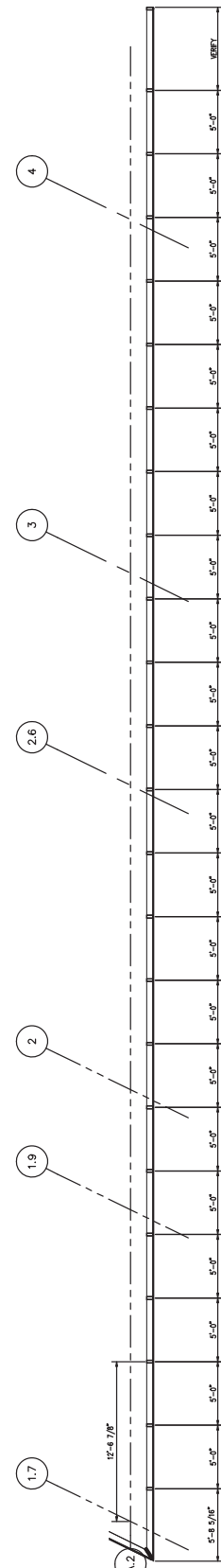


2 PLAN
Scale: 3/4"=1'-0"

2 PLAN
Scale: $3/4" = 1' - 0"$



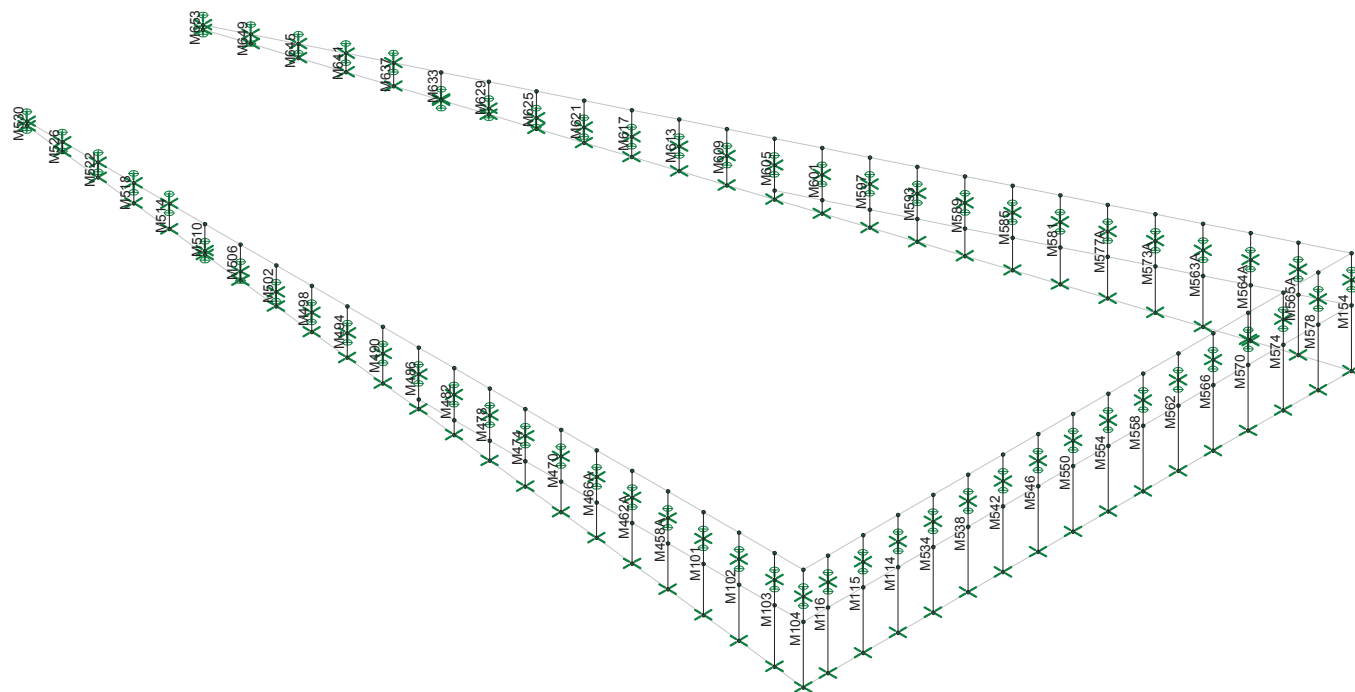
1 SOUTH ELEVATION
EGS-2
COLOR: PAPER
Scale: 3/4"=1'-0"



EGS-2 YKK YCW 750 SSG
(2-1/2" x 6-9/16"). Shop
drawing sheets 218



Member labels



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

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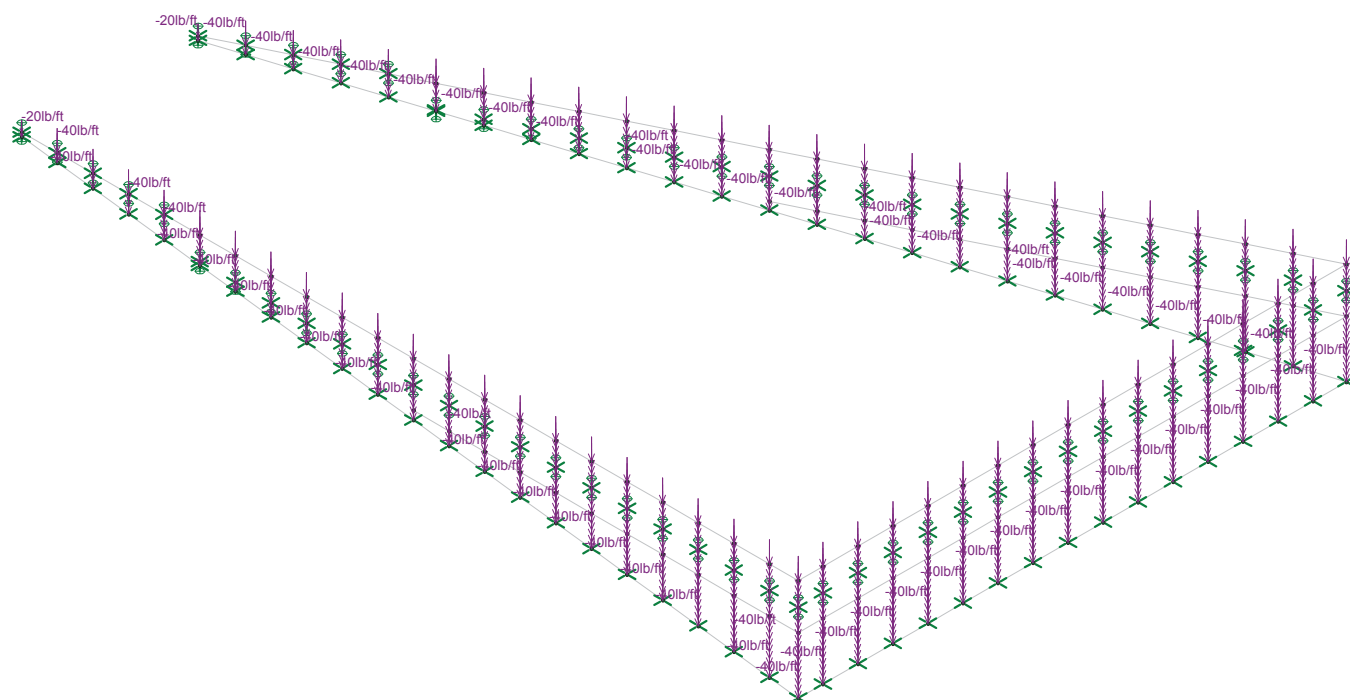
SK - 51

Nov 2, 2016 at 7:20 AM

EGS-1 Preliminary.r3d



Dead load
8psf (5') = 40lb/ft (20lb/ft at jambs)



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Loads: BLC 7, Dead

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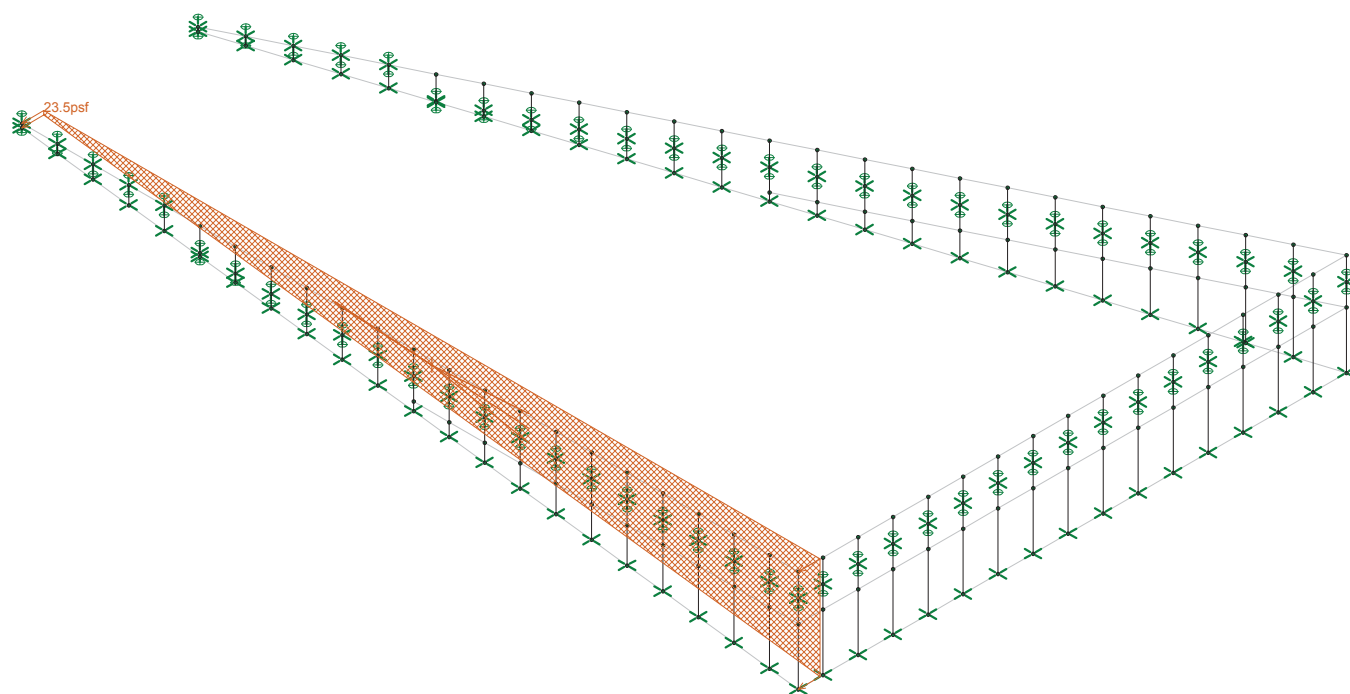
SK - 52

Nov 2, 2016 at 7:20 AM

EGS-1 Preliminary.r3d



Negative Wind - 23.5psf



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Loads: BLC 1, Negative Wind (Face A)

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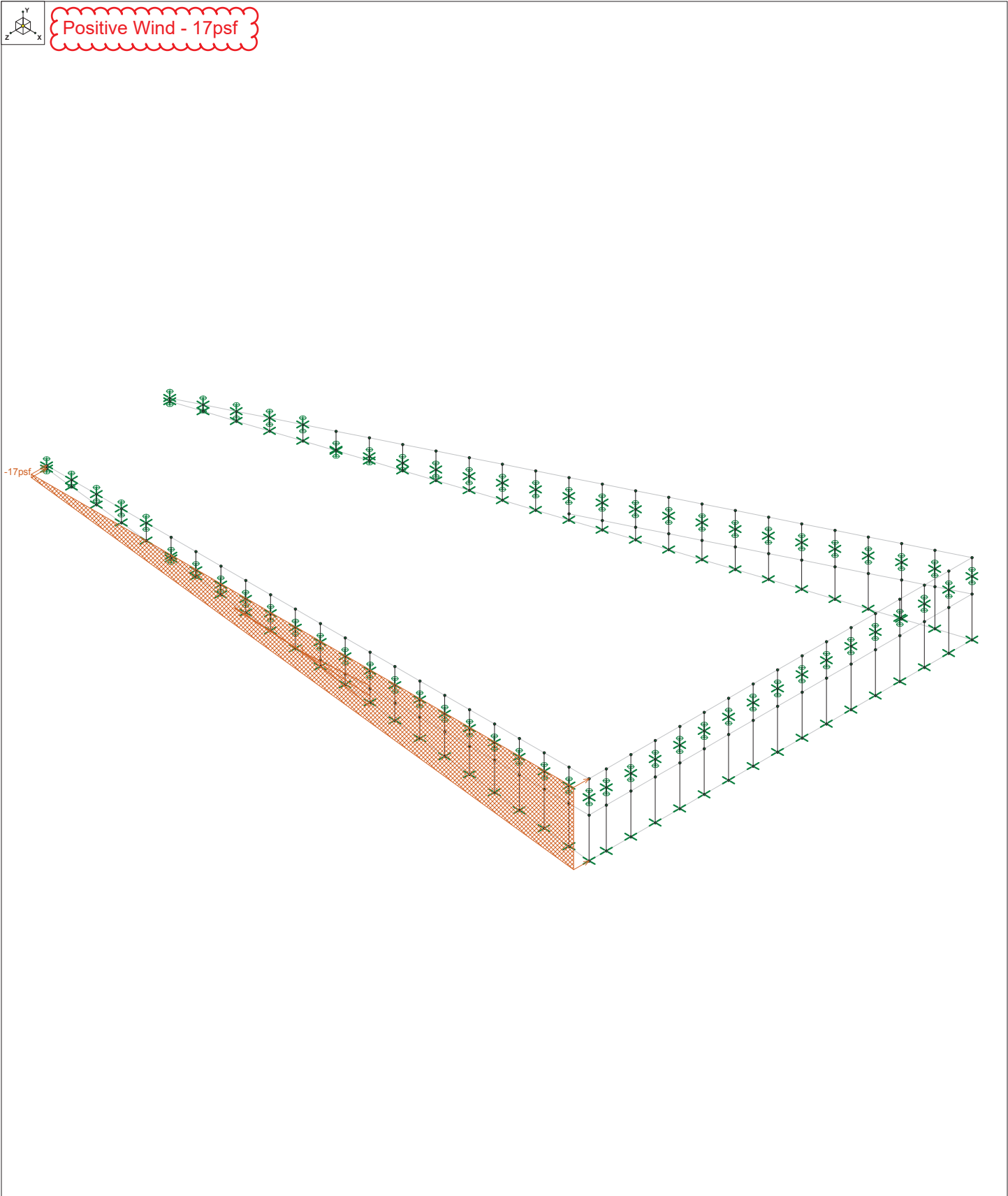
JE16059

Webster University

SK - 53

Nov 2, 2016 at 7:22 AM

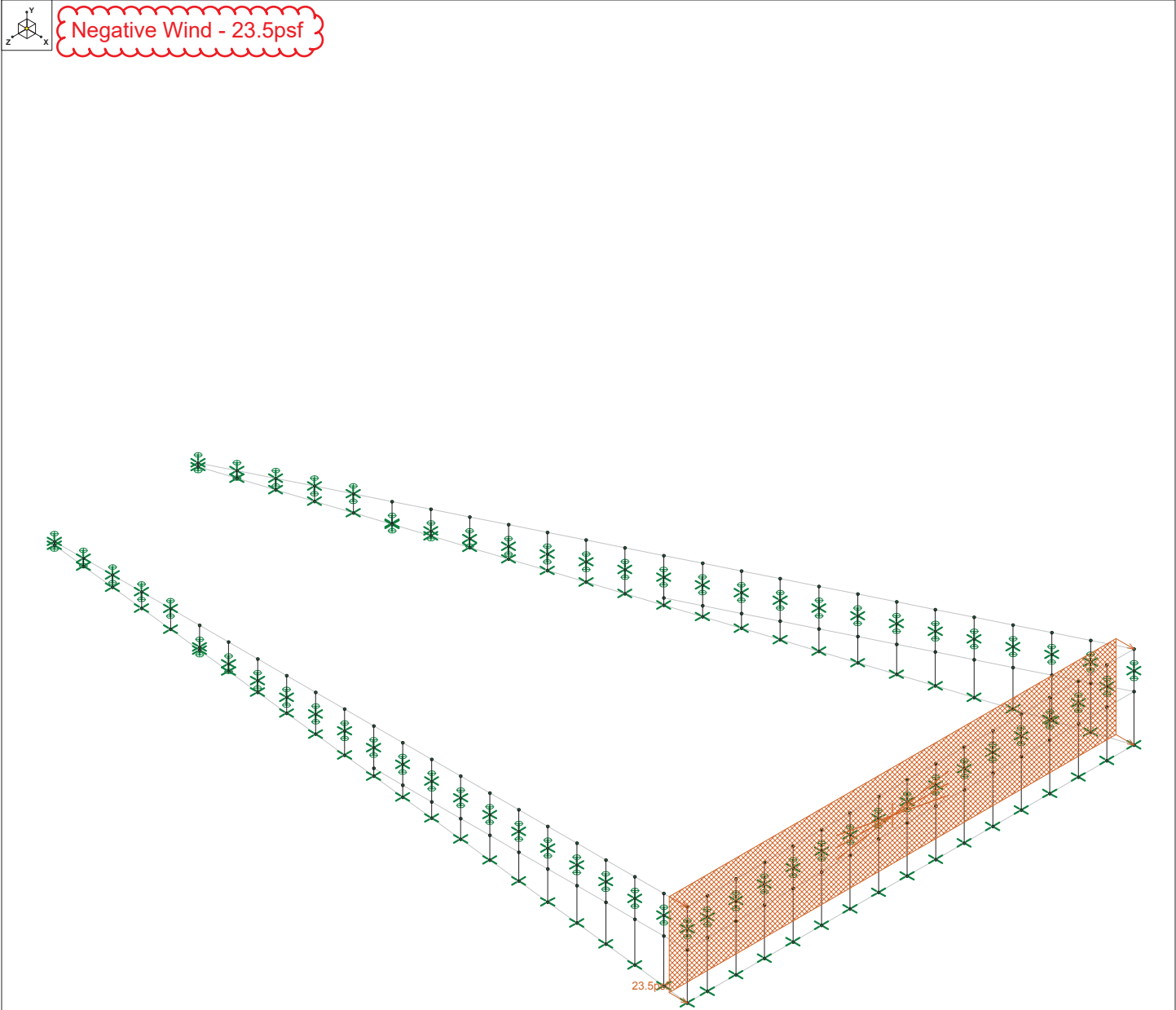
EGS-1 Preliminary.r3d



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Loads: BLC 2, Positive Wind (Face A)

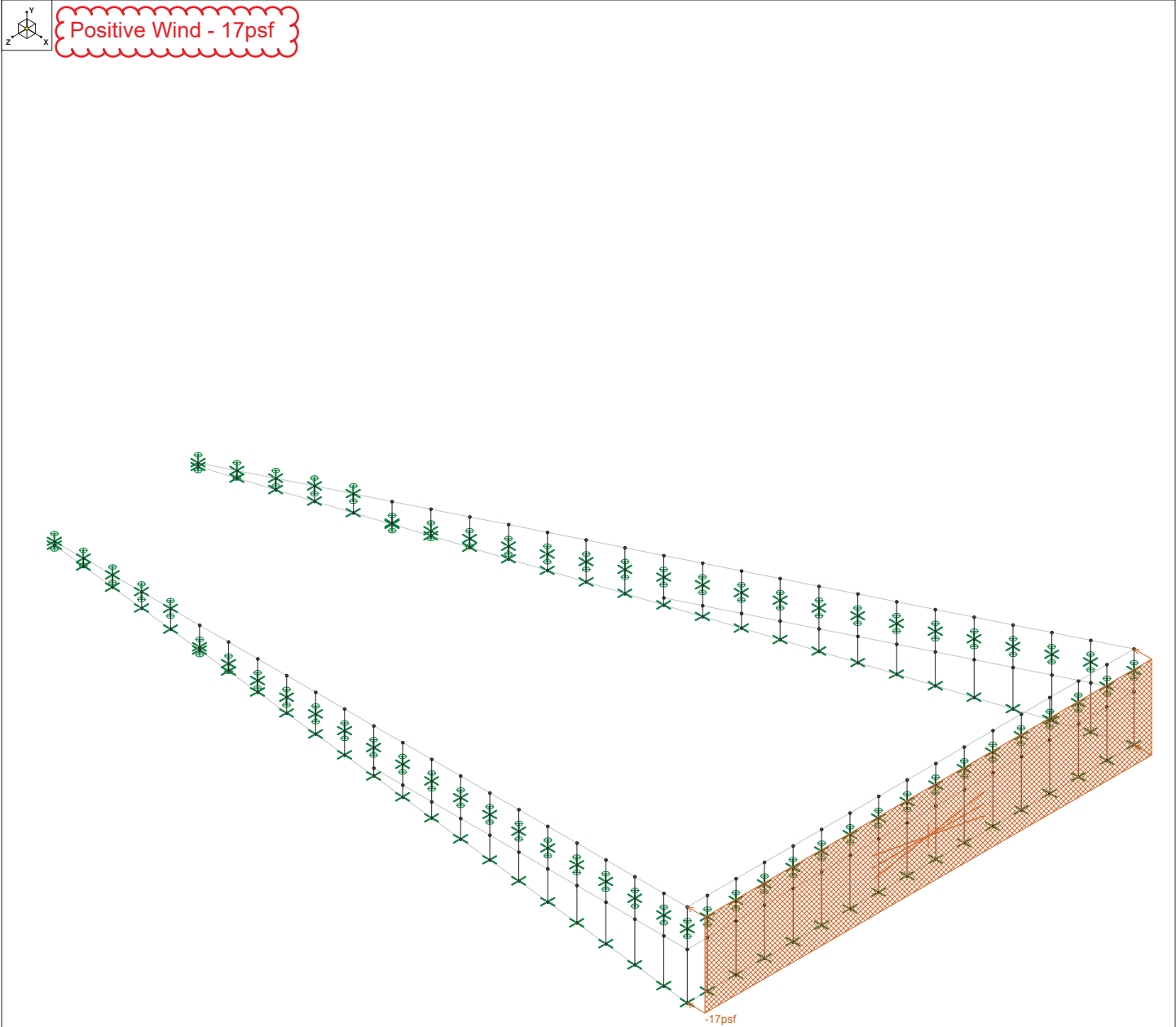
JEI Structural Engineering	Webster University	SK - 54
M. Gorny		Nov 2, 2016 at 7:22 AM
JE16059		EGS-1 Preliminary.r3d



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Loads: BLC 3, Negative Wind (Face B)

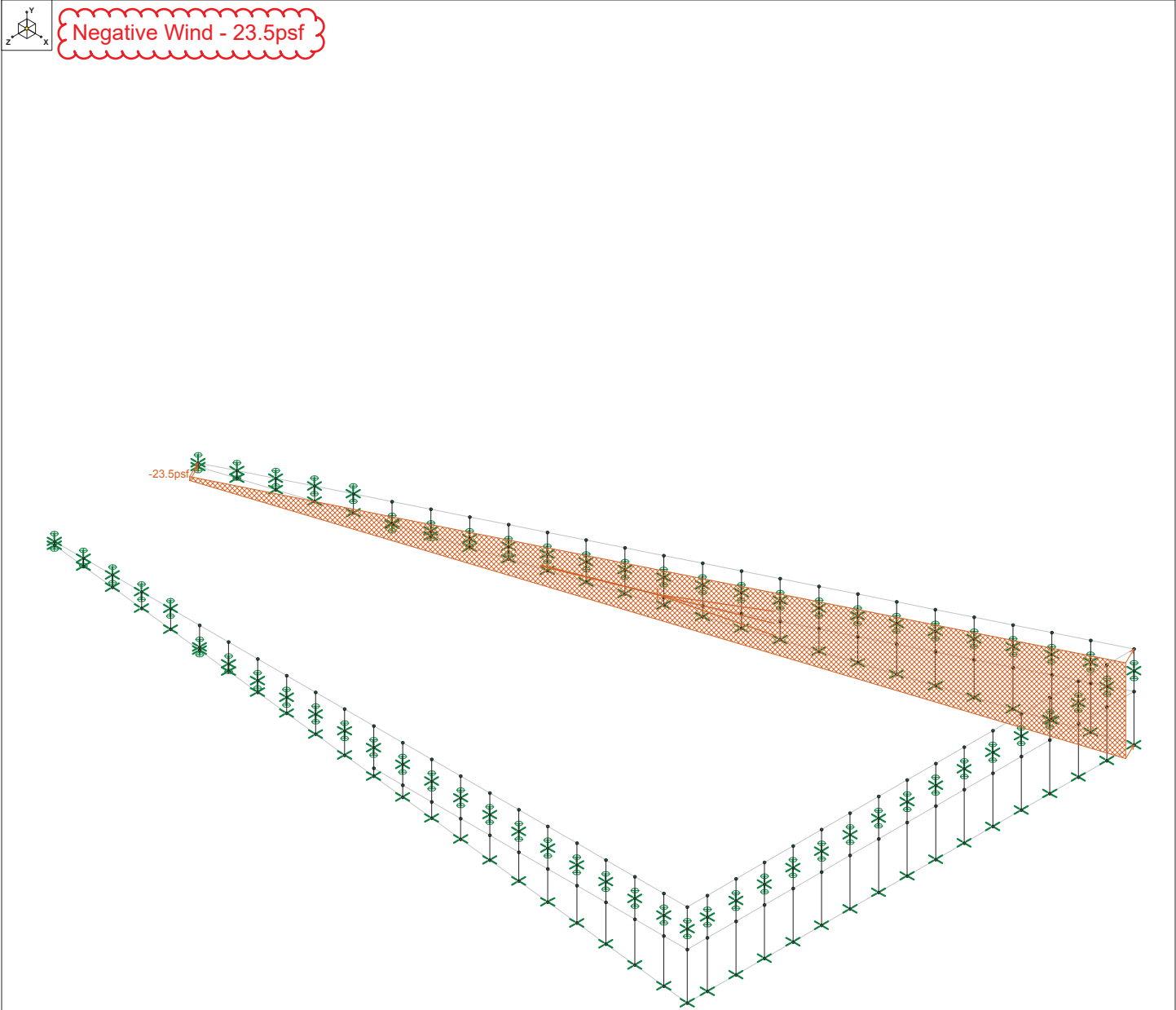
JEI Structural Engineering	Webster University	SK - 55
M. Gorny		Nov 2, 2016 at 7:22 AM
JE16059		EGS-1 Preliminary.r3d



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Loads: BLC 4, Positive Wind (Face B)

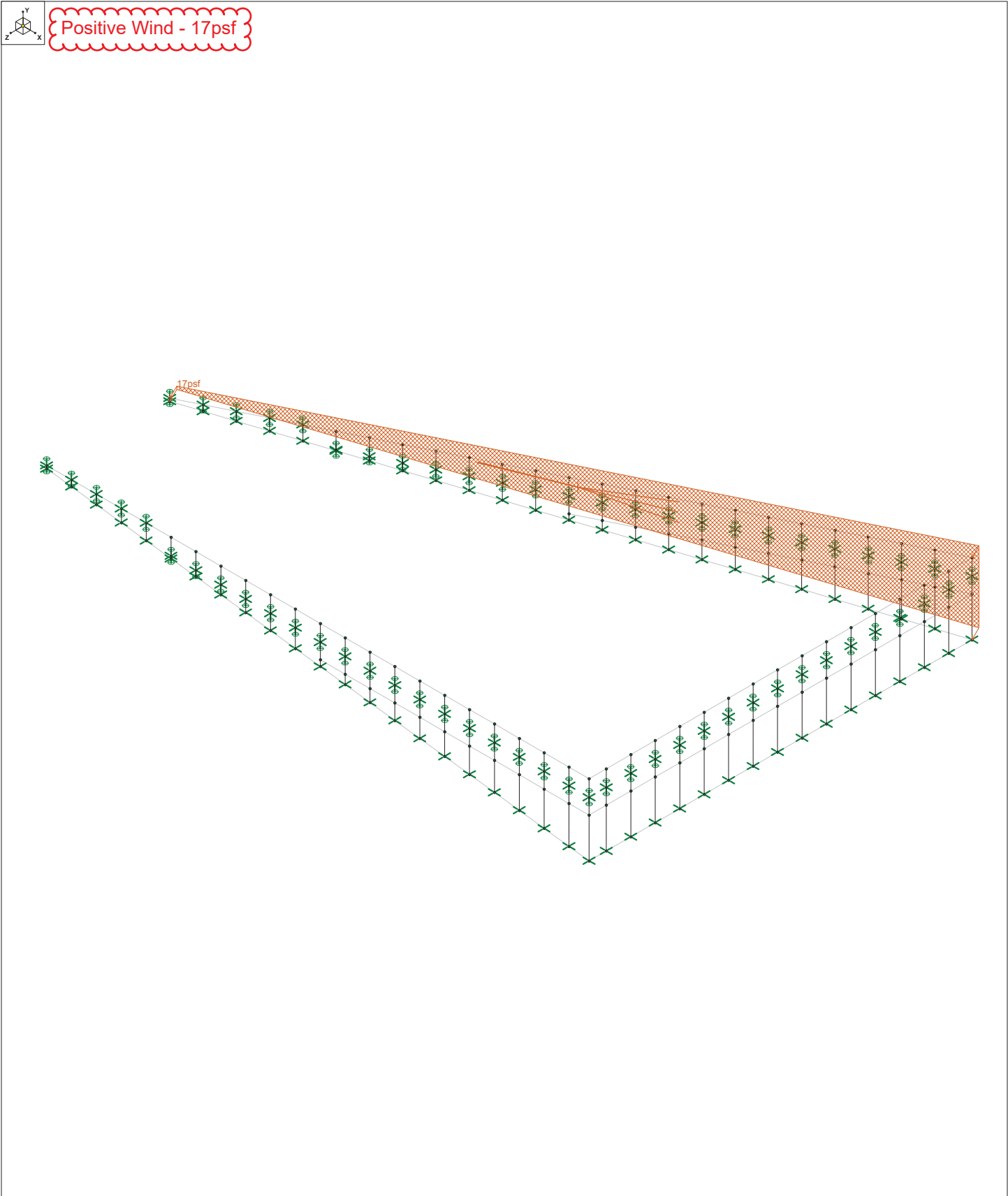
JEI Structural Engineering	Webster University	SK - 56
M. Gorny		Nov 2, 2016 at 7:22 AM
JE16059		EGS-1 Preliminary.r3d



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Loads: BLC 5, Negative Load (Face C)

JEI Structural Engineering	Webster University	SK - 57
M. Gorny		Nov 2, 2016 at 7:23 AM
JE16059		EGS-1 Preliminary.r3d



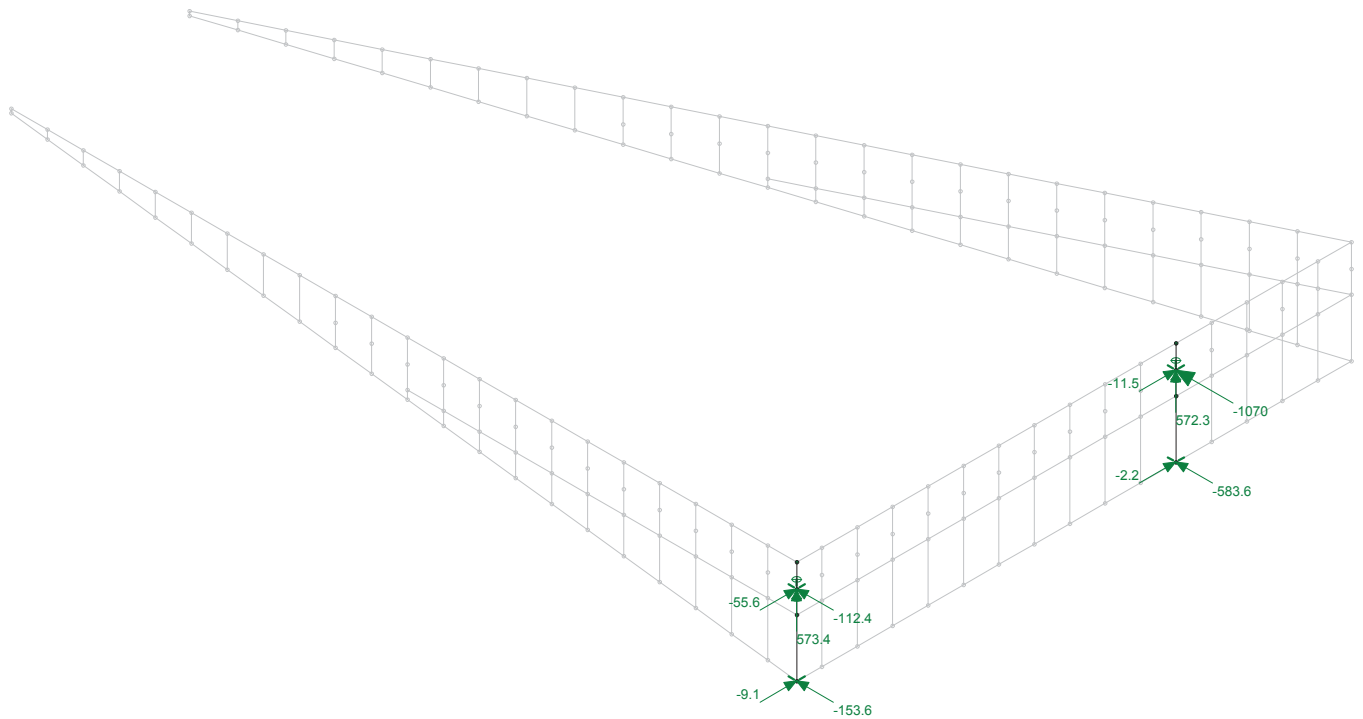
EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Loads: BLC 6, Positive Load (Face C)

JEI Structural Engineering	Webster University	SK - 58
M. Gorny		Nov 2, 2016 at 7:23 AM
JE16059		EGS-1 Preliminary.r3d



Anchor Loads (1 of 3)
showing controlling vertical mullion anchor loads by inspection.



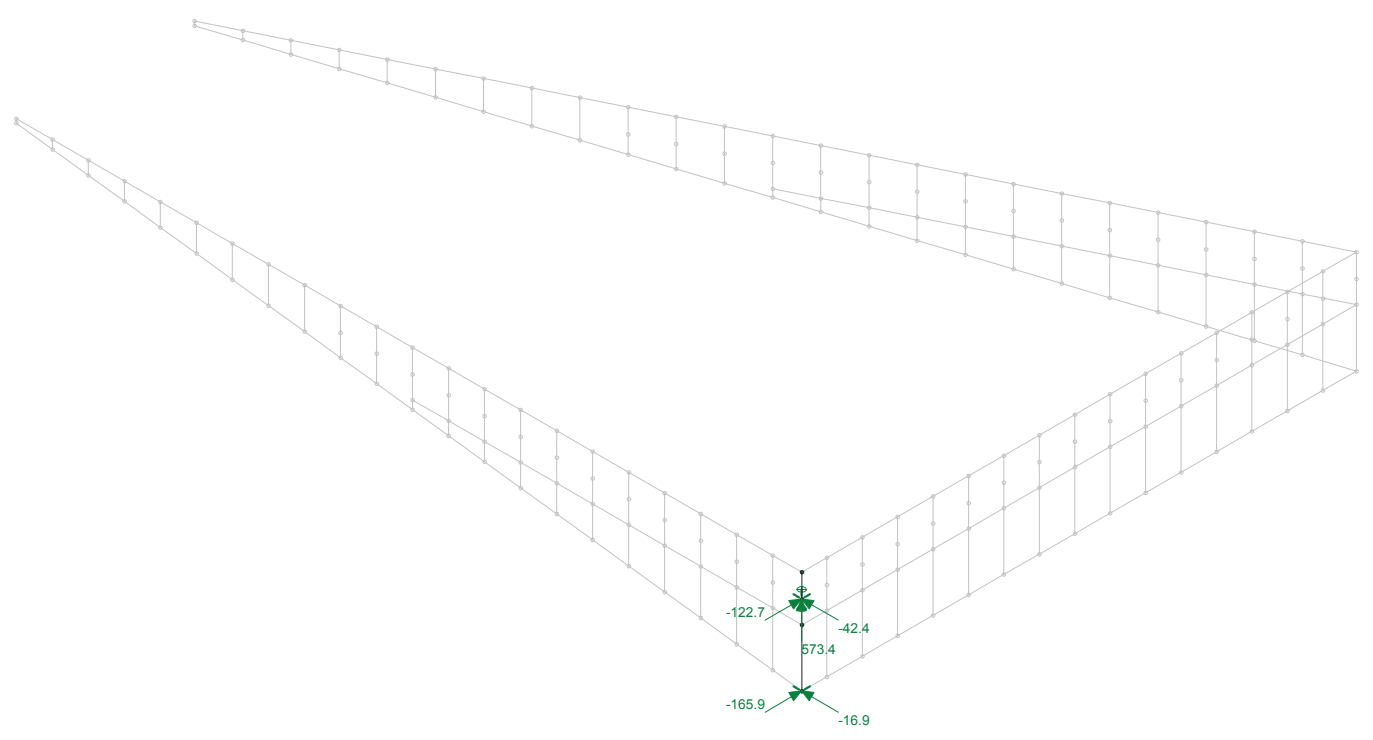
EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Results for LC 2, Negative Wind Face B
Z-direction Reaction Units are lb and lb-ft

JEI Structural Engineering	Webster University	SK - 68
M. Gorny		Nov 2, 2016 at 8:03 AM
JE16059		EGS-1 Preliminary.r3d



Anchor Loads (2 of 3)
showing controlling vertical mullion anchor loads by inspection.



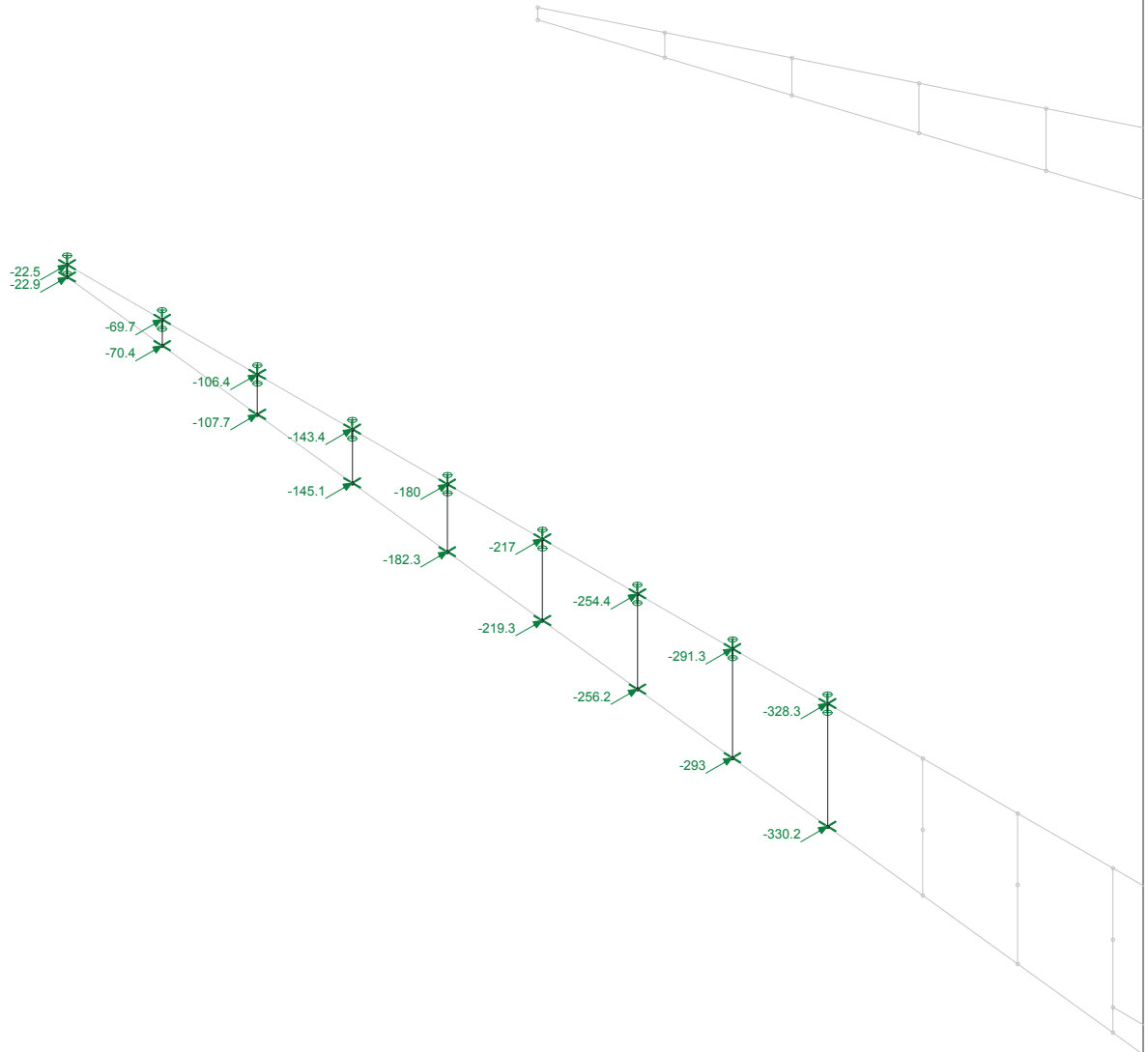
EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Results for LC 1, Negative Wind Face A
Z-direction Reaction Units are lb and lb-ft

JEI Structural Engineering	Webster University	SK - 69
M. Gorny		Nov 2, 2016 at 8:04 AM
JE16059		EGS-1 Preliminary.r3d



Anchor Loads (3 of 3)
showing controlling vertical mullion anchor loads by inspection.



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Results for LC 1, Negative Wind Face A
Z-direction Reaction Units are lb and lb-ft

JEI Structural Engineering

M. Gorny

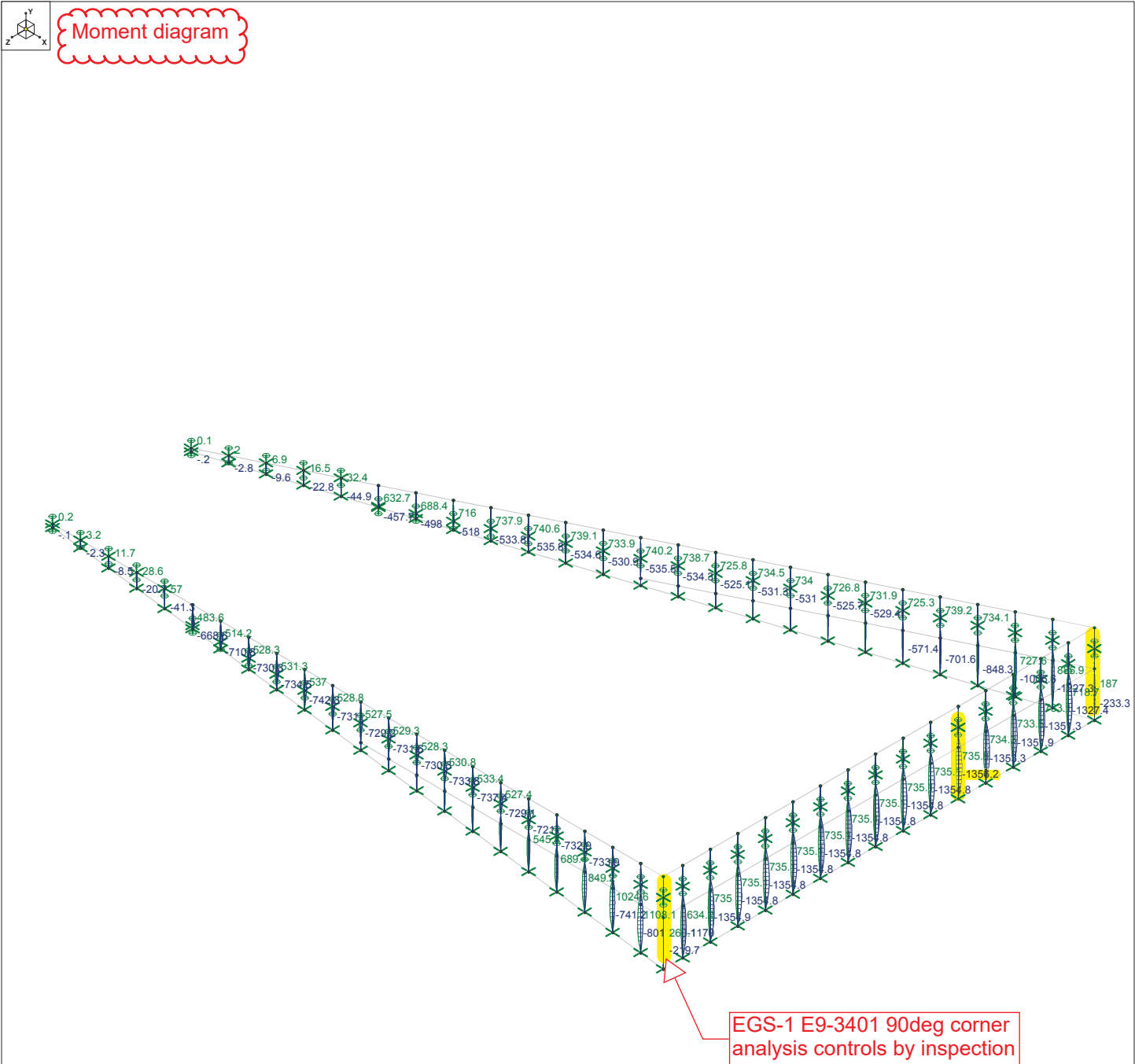
JE16059

Webster University

SK - 1

Nov 3, 2016 at 4:24 AM

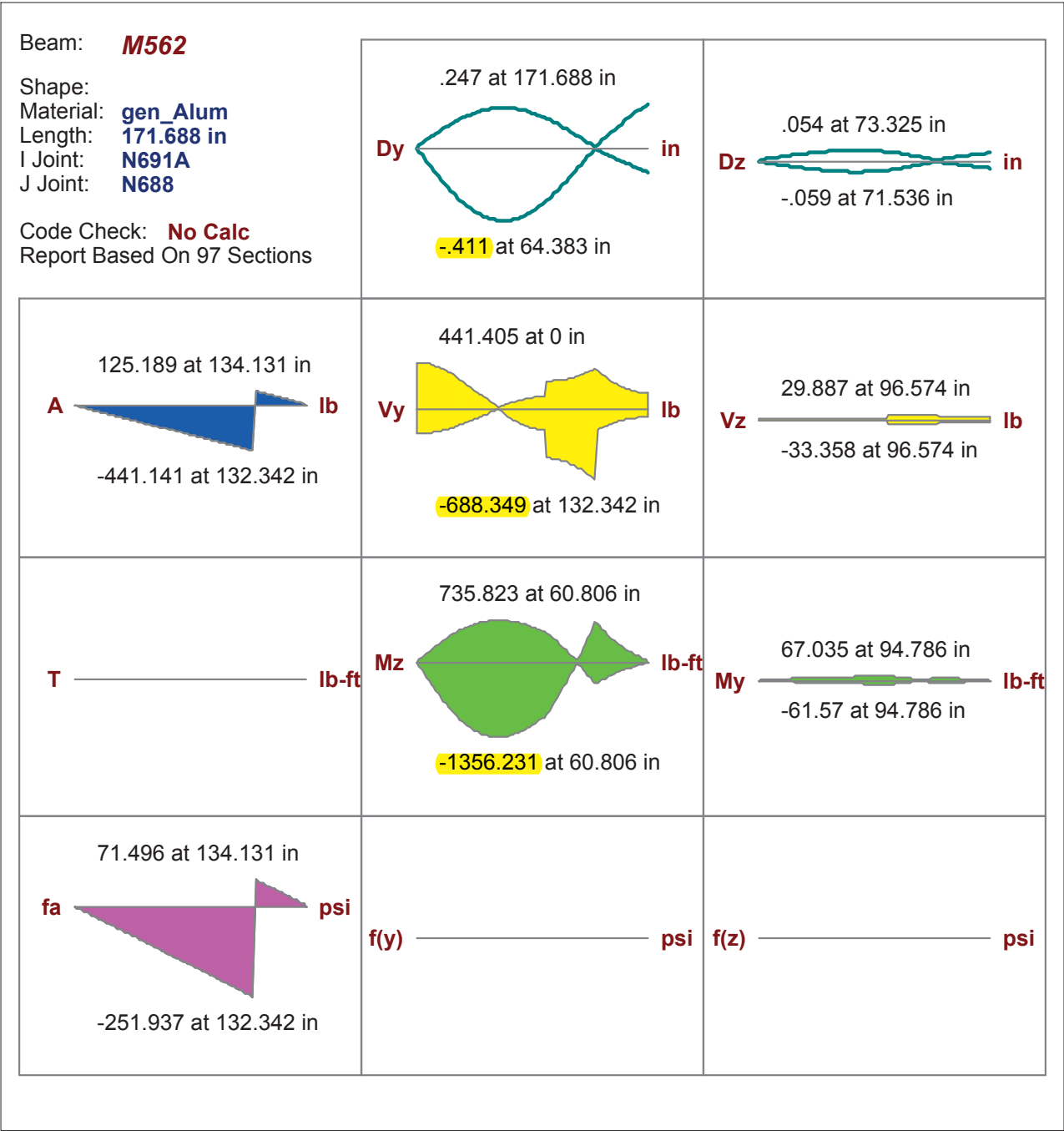
EGS-1 Preliminary.r3d



EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Member z Bending Moments (lb-ft) (Enveloped)

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M. Gorny		Nov 2, 2016 at 7:23 AM
JE16059		EGS-1 Preliminary.r3d



YKK E9-3402

JEI Structural Engineering
11108 N. Oak Tfwy, Suite 208
Kansas City, MO 64155

Voice: 816-734-8345
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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 6-9/16")
Part of: Vertical Mullion Analysis
Elevation: 1/216
Detail: 1/400

Member M562

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t) 4.92 ft $F_y = 25.0$ ksi
Height (h) 11.06 ft $F_u = 30.0$ ksi
Unbraced Length (L) 7.72 ft

Design Loads

Design Pressure (p) 23.5 psf
Panel Weight (p_{wt}) 8.0 psf

Manuf. / Part #: YKK E9-3402

E =	10100 ksi	$r_{x, alum} =$	1.925 in
$I_{x, alum} =$	6.485 in ⁴	$r_{y, alum} =$	0.994 in
$I_{y, alum} =$	1.729 in ⁴	A =	1.751 in ²
$S_{x, alum} =$	2.197 in ³	J =	3.525 in ⁴
$S_{y, alum} =$	1.383 in ³	wt =	2.104 lb/ft
b/t _{web} =	54.86	b/t _{flange} =	23.48
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$	$w =$	N/A lb/ft
Shear Load $V = wL/2$	$V =$	688.3 lb
Moment $M = wL^2/8$	$M =$	1356.2 lb-ft
$M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$	$M_{alum} =$	1356.2 lb-ft
$f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum} =$	7.41 ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$	441.1 lb
$f_{c-alum} = P/A$	$f_{c-alum} =$	0.25 ksi

Check Deflection

Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) =$	0.411 in
N/A $\pm$ movement cap. $\Delta_{allow} =$	0.758 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = #####

Steel Capacity

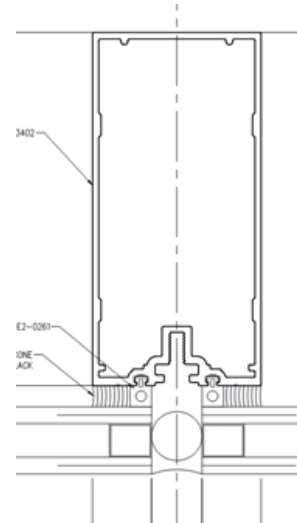
$M_{steel} = I_{x, steel} / I_{comb} =$	$M_{steel} =$	0.0 lb-ft
$Mb/\Omega =$	$Mb/\Omega =$	0 lb-ft
$Ms/(Mb/\Omega) =$		N/A

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA



Reinforcing

No Reinforcing

$I_{x, steel} =$	0.000 in ⁴	Load Share	
$S_{x, steel} =$	0.000 in ³	Aluminum	Steel
$I_{combined} =$	6.485 in ⁴	1.000	0.000

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.04 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.38 ksi
E.3 - Axial Compression	5.90 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.95 ksi

Compression Interaction

Allowable Compression	$F_c =$	5.90 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.043

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.38 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.554

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	0.597
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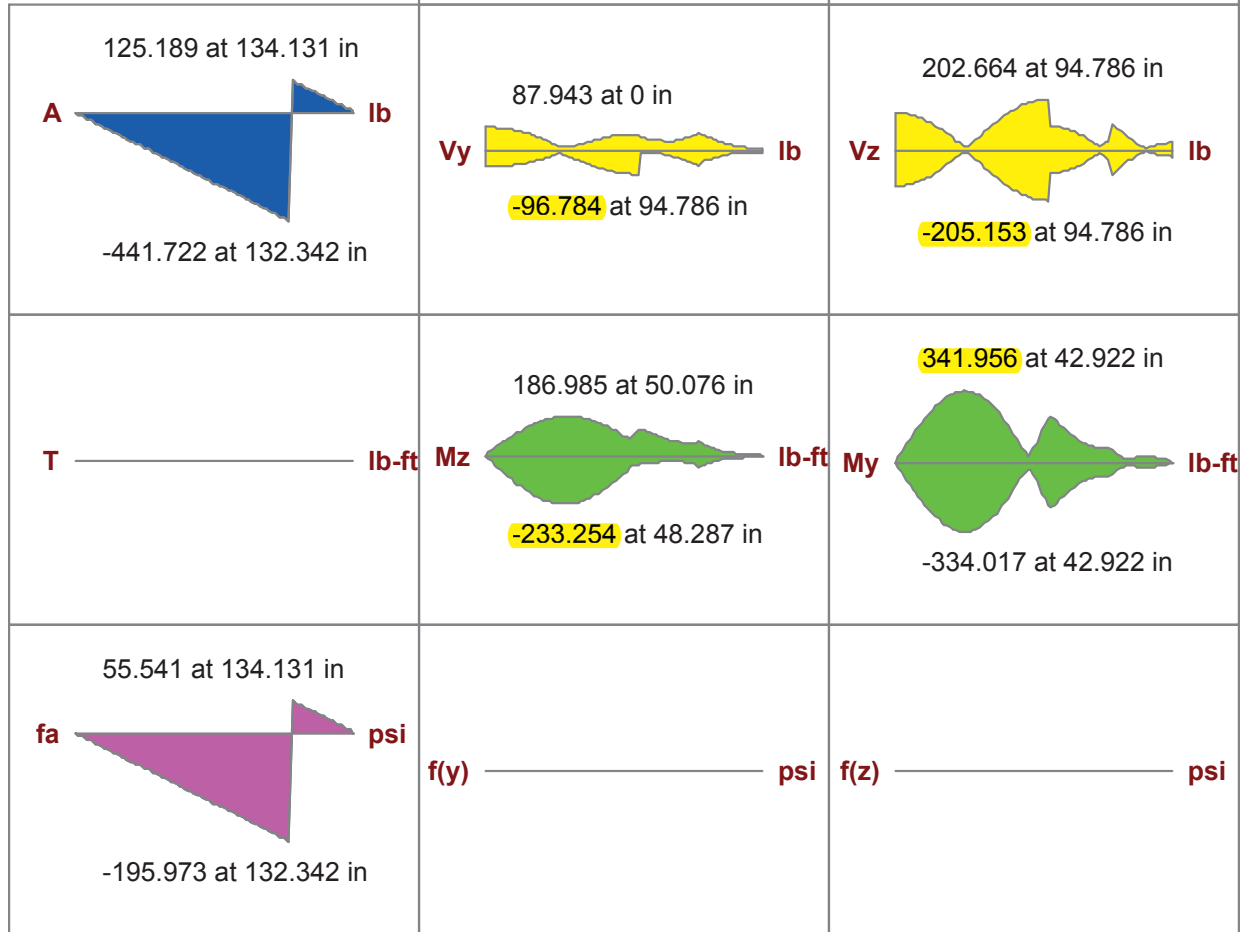
Mullion OK

Beam: **M154**

Shape:

Material: **gen_Alum**Length: **171.688 in**I Joint: **N204**J Joint: **N196**Code Check: **No Calc**

Report Based On 97 Sections



YKK E9-3401 64deg corner vertical



JEI Structural Engineering
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Kansas City, MO 64153

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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/218
Detail: 1/405

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width A (t_{wLA})	5.69 ft	Corner Angle (θ)
Tributary Width B (t_{wLB})	4.67 ft	64.00 °
Height (h)	13.83 ft	
Unbraced Length (L)	7.62 ft	

Design Loads

Design Pressure A (p_A)	17.63 psf
Design Pressure B (p_B)	12.75 psf
Panel Weight (p_{wt})	8 psf

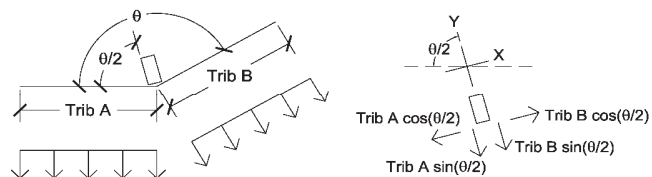
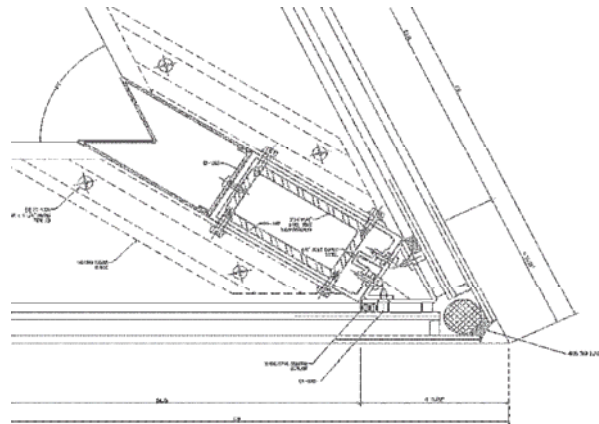
Manuf. / Part #:

YKK E9-3401

E =	10100 ksi	$r_{x, alum}$ =	1.948 in
$I_{x, alum}$ =	8.555 in ⁴	$r_{y, alum}$ =	0.991 in
$I_{y, alum}$ =	2.213 in ⁴	A =	2.254 in ²
$S_{x, alum}$ =	3.127 in ³	J =	4.596 in ⁴
$S_{y, alum}$ =	1.765 in ³	wt =	2.708 lb/ft

Thermal Reduction Factors (TRF_i , TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
Reinforcing No Reinforcing			
$I_{x, steel}$ =	0.000 in ⁴	$I_{y, steel}$ =	0.000 in ⁴
$S_{x, steel}$ =	0.000 in ³	$S_{y, steel}$ =	0.000 in ³
$I_{x, combined}$ =	8.555 in ⁴	$I_{y, combined}$ =	2.213 in ⁴



X-Axis Bending Stress (ADM F.2 & F.3)		$\Omega = 1.65$
$w = p \cdot t$	$w_y =$	N/A lb/ft
Shear Load $V = wl/2$	$V_y =$	96.8 lb
Moment $M = wl^2/8$	$M_x =$	233.3 lb-ft
$M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$	$M_{x-alum} =$	233.3 lb-ft
$L_n = (2 \cdot L_b \cdot S_x) / (I_y J)^{1/2}$	$L_n =$	179.3
$f_b = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum-x} =$	0.90 ksi
$f_{b-alum-x} / F_{bx} =$	$F_{bx} / \Omega = F_{bx} =$	14.87 ksi
Y-Axis Bending Stress (ADM F.2 & F.3)		$\Omega = 1.65$
$w = p \cdot t$	$w_x =$	N/A lb/ft
Shear Load $V = wl/2$	$V_x =$	205.2 lb
Moment $M = wl^2/8$	$M_y =$	342.0 lb-ft
$M_{alum} = M \cdot I_{alum} / I_{comb}$	$M_{y-alum} =$	342.0 lb-ft
$L_n = (2 \cdot L_b \cdot S_x) / (I_y J)^{1/2}$	$L_n =$	101.2
$f_b = M_{alum} / (S_{y, alum})$	$f_{b-alum-y} =$	2.32 ksi
$f_{b-alum-y} / F_{by} =$	$F_{by} / \Omega = F_{by} =$	15.34 ksi
Combined Stress Ratio		$f_{bx} / F_{bx} + f_{by} / F_{by} = 0.21$
		OK

Check Combined Bending & Compression (ADM H.1)	
$f_a / F_a + f_b / F_b < 1.0$	$f_a / F_a + f_b / F_b = 0.299$
OK	

Mullion Resultant Forces			
Strong Axis Bending, M_x , w_y =		84.73 lb/ft	
Weak Axis Bending, M_y , w_x =		34.57 lb/ft	
Load Share			
<u>Aluminum (x)</u>	<u>Steel (x)</u>	<u>Aluminum (y)</u>	<u>Steel (y)</u>
1.000	0.000	1.000	0.000

Axial Load	
$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P = 1184.0$ lb

Check Allowable Compression - ADM E.3	
$kL_b / r =$	$kL_b / r = 92.28$
F_{a1} (Allowable Compression)	$F_{a1} / \Omega = 6.03$ ksi
Check Allowable Compression - Flange element (ADM B.5.4.2)	
$b/t =$	$b/t = 12.36$
F_{a2} (Allowable Compression)	$F_{a2} / \Omega = 15.20$ ksi
Check Allowable Compression - Web element (ADM B.5.5.1)	
$b/t =$	$b/t = 37.72$
F_{a3} (Allowable Compression)	$F_{a3} / \Omega = 19.70$ ksi

$f_a = P/A$	$f_a = 0.53$ ksi
Lessor of F_{a1} , F_{a2} , F_{a3}	$F_a / \Omega = F_a = 6.03$ ksi
	$f_a / F_a = 0.087$
OK	



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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/218
Detail: 1/405

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA

Strong Axis Deflection (M_x, w_y)		Typical Vertical	
$\Delta_y = (5w_y L^4)/(384EI)$		$\Delta_y =$	0.043 in
within DLO (Conservative)		$\Delta_y =$	0.043 in
Weak-Axis Deflection (w_x)			
$\Delta_x = (5w_x L^4)/(384EI_{\Delta})$		$\Delta_x =$	0.174 in
within DLO (Conservative)		$\Delta_x =$	0.174 in
Resultant Deflection			
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$		$\Delta_{total} =$	0.179 in
Angle Relative to X-Axis		$\theta_{\Delta} =$	13.9 °
		$\Delta_{allow} =$	0.941 in
Allowable deflection = L/175 or if span > 13'-6" then allowable def = L/240 + 1/4"		Deflection Factor	DF = #####
OK			

Steel Stress (X-axis)			
Moment to Steel = I_x steel/ I comb =			0.0 lb-ft
$f_b = M/S_{x, steel}$		$f_b =$	N/A ksi
$M_r/\Omega_b =$		$M_r/\Omega_b =$	0 lb-ft
N/A			

Deflection Along Glazing			
$\Delta_{y-glazing} = \Delta_y \sin((180-\theta)/2)$		$\Delta_{y-glazing} =$	0.036 in
$\Delta_{x-glazing} = \Delta_x \cos((180-\theta)/2)$		$\Delta_{x-glazing} =$	0.092 in
Tributary Area A			
$\Delta_{total-A} = \Delta_{x-glazing} + \Delta_{y-glazing}$		$\Delta_{total} =$	0.129 in
Tributary Area B			
$\Delta_{total-B} = \Delta_{x-glazing} - \Delta_{y-glazing}$		$\Delta_{total} =$	0.056 in

SSG Sealant Deflection			
1/4 in. joint		50% ± movement capacity	
0.280 in. allowable deflection		SSG Sealant OK	

Steel Stress (Y-axis)			
Moment to Steel = I_y steel/ I comb =			0.0 lb-ft
$f_b = M/S_{y, steel}$		$f_b =$	N/A ksi
$M_r/\Omega_b =$		$M_r/\Omega_b =$	0 lb-ft
N/A			



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 6-9/16")
Part of: Vertical Mullion Summary
Designer: M. Gorny

Manufacture: YKK
Part #: E9-3402
Alloy/Temper: 6063-T6

Date: 11/2/2016
Proj.: JE16059

Typical Wind Pressure (T) = 20.0 psf
Corner Zone Wind Pressure (C) = 24.0 psf
Interior Pressure (INT) = 5.0 psf

INPUT CHECK RISA

Sheet	Elevation	Section	Part No	Wind Zone	Unbraced Length (L _u)	Trib Height (h) ft	Trib Width (t) ft	Trib Area (h)*(t) = (A)	Wind Pres (p)	linear load (w) (plf)	Deflection Factor (w) * (h)^4 (div by 10E7)	Stress Factor ((w)*(h)^2)/1000
202	1/202	1/401	E9-3402	C	10.78	11.24	3.01	33.8	24.0	72.3	21.3	9.1
202, 204	2/202, 1/204	1/400	E9-3402	C	10.78	11.24	5.00	56.2	24.0	120.0	35.3	15.2
203	1/203	1/400	E9-3402	C	10.78	11.24	4.56	51.2	24.0	109.4	32.2	13.8
204	2/204	1/401	E9-3402	C	10.78	11.24	4.30	48.3	24.0	103.2	30.4	13.0

Mullion Design Summary

1: OK



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Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 6-9/16")
Part of: Vertical Mullion Analysis
Elevation: 1/202, 1/204
Detail: 1/400

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t) 5.00 ft $F_y = 25.0$ ksi
Height (h) 11.24 ft $F_u = 30.0$ ksi
Unbraced Length (L) 10.78 ft

Design Loads

Design Pressure (p) 24.0 psf
Panel Weight (p_{wt}) 8.0 psf

Manuf. / Part #: YKK E9-3402

E =	10100 ksi	$r_{x, \text{alum}} =$	1.925 in
$I_{x, \text{alum}} =$	6.485 in ⁴	$r_{y, \text{alum}} =$	0.994 in
$I_{y, \text{alum}} =$	1.729 in ⁴	A =	1.751 in ²
$S_{x, \text{alum}} =$	2.197 in ³	J =	3.525 in ⁴
$S_{y, \text{alum}} =$	1.383 in ³	wt =	2.104 lb/ft
b/t _{web} =	54.86	b/t _{flange} =	23.48
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$ $w = 120.0$ lb/ft
Shear Load $V = wL/2$ $V = 674.4$ lb
Moment $M = wL^2/8$ $M = 1894.9$ lb-ft
 $M_{\text{alum}} = M \cdot I_{\text{alum}} / I_{\text{comb}}$ $M_{\text{alum}} = 1894.9$ lb-ft
 $f_{b-\text{alum}} = M_{\text{alum}} / (S_{x, \text{alum}} \cdot \text{TRF}_s)$ $f_{b-\text{alum}} = 10.35$ ksi

Applied Axial Compression

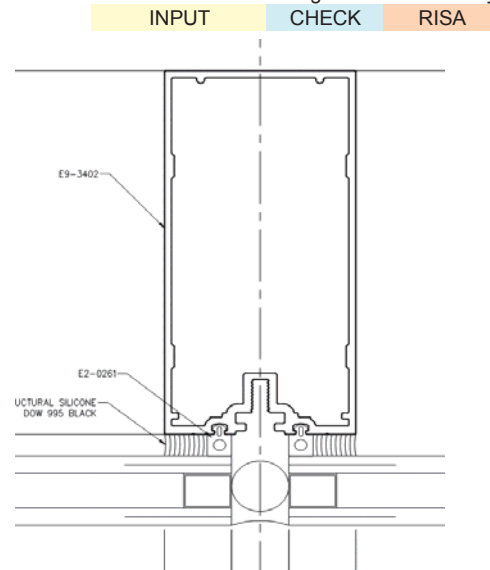
$P = p_{wt} \cdot t \cdot h + wt \cdot h$ $P = 473.2$ lb
 $f_{c-\text{alum}} = P/A$ $f_{c-\text{alum}} = 0.27$ ksi

Check Deflection

Typical Vertical	
N/A in. joint $\Delta = (5wL^4)/(384EI) =$	0.658 in
N/A $\pm$ movement cap. $\Delta_{\text{allow}} =$	0.771 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 35.3

Steel Capacity

$M_{\text{steel}} = I_{x, \text{steel}} / I_{\text{comb}} =$ $M_{\text{steel}} = 0.0$ lb-ft
 $Mb/\Omega =$ $Mb/\Omega = 0$ lb-ft
 $Ms/(Mb/\Omega) =$ N/A



Reinforcing	No Reinforcing	Load Share	
$I_{x, \text{steel}} =$	0.000 in ⁴	Aluminum	Steel
$S_{x, \text{steel}} =$	0.000 in ³	1.000	0.000
$I_{\text{combined}} =$	6.485 in ⁴		

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.04 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	13.38 ksi
E.3 - Axial Compression	3.03 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.62 ksi

Compression Interaction

Allowable Compression	$F_c =$	3.03 ksi
Compression Stress Interaction	$f_{c-\text{alum}}/F_c =$	0.089

Flexure Interaction

Controls: B.5.5.1 - Flat Elem. 2 End Support Flexure		
Allowable Flexural Compression	$F_b =$	13.38 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.774

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$ $f_a/F_a + f_b/F_b = 0.863$

Mullion OK



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 6-9/16")
Part of: Jamb Mullion Summary
Designer: M. Gorny

Manufacture: Kawneer
Part #: E9-3402
Alloy/Temp: 6063-T6
Jamb $I_x = 6.485 \text{ in}^4$
Typical Wind Pressure (T) = 20.0 psf
Corner Zone Wind Pressure (C) = 24.0 psf
Interior Pressure (INT) = 5.0 psf

Sealant Joint Size & Expansion
1/2" Joint (50% Expandable) 0.560 in
Allowable Movement =

Date 11/2/2016
Proj: JE16059

INPUT CHECK RISA

Sheet	Elevation	Section	Part No	Wind Zone	Unbraced Length (L _b)	Trib Height (h) ft	Trib Width (t) ft	Trib Area (h)*(t) = (A)	Wind Pres (p)	linear load (w) (plf)	Unreinforced Deflection (in)	Stress Factor ((w)*(h) ²)*L/1000	Deflection > 0.56 in.?
202, 204	2/202, 1/204	1/403	E9-3402	T	10.78	11.24	2.39	26.8	20.0	47.7	0.26	6.0	OK
Check 1)													

Mullion Design Summary

1: OK by comparison to Vertical Mullion Check 1



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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/203
Detail: 1/406

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width A (t_{wLA})	4.15 ft	Corner Angle (θ)
Tributary Width B (t_{wLB})	2.38 ft	64.00 °
Height (h)	11.24 ft	
Unbraced Length (L)	10.78 ft	

Design Loads

Design Pressure A (p_A)	24 psf
Design Pressure B (p_B)	0 psf
Panel Weight (p_{wt})	8 psf

Manuf. / Part #:

YKK E9-3401

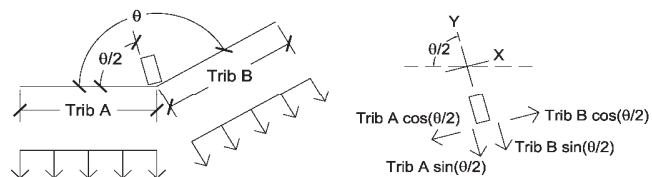
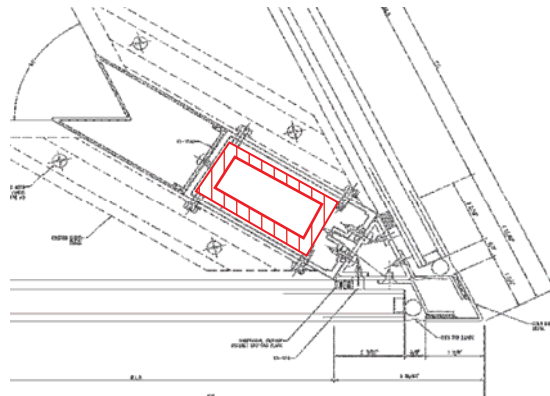
E =	10100 ksi	$r_{x, alum}$ =	1.948 in
$I_{x, alum}$ =	8.555 in ⁴	$r_{y, alum}$ =	0.991 in
$I_{y, alum}$ =	2.213 in ⁴	A =	2.254 in ²
$S_{x, alum}$ =	3.127 in ³	J =	4.596 in ⁴
$S_{y, alum}$ =	1.765 in ³	wt =	2.708 lb/ft

Thermal Reduction Factors (TRF_i , TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
Reinforcing HSS 2x4x3/8			
$I_{x, steel}$ =	5.600 in ⁴	$I_{y, steel}$ =	1.800 in ⁴
$S_{x, steel}$ =	2.800 in ³	$S_{y, steel}$ =	1.800 in ³
$I_{x, combined}$ =	24.795 in ⁴	$I_{y, combined}$ =	7.433 in ⁴

X-Axis Bending Stress (ADM F.2 & F.3)		$\Omega = 1.65$
$w = p \cdot t$	$w_y =$	52.7 lb/ft
Shear Load $V = w/2$	$V_y =$	296.3 lb
Moment $M = w/2 \cdot L$	$M_x =$	832.6 lb-ft
$M_{alum} = M \cdot I_{alum} / I_{comb}$	$M_{x-alum} =$	287.3 lb-ft
$L_n = (2 \cdot L_b \cdot S_x) / (I_y J)^{1/2}$	$L_n =$	253.7
$f_b = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum-x} =$	1.10 ksi
$f_{b-alum-x} / F_{bx} =$	$F_{bx} / \Omega = F_{bx} =$	14.52 ksi
Y-Axis Bending Stress (ADM F.2 & F.3)		$\Omega = 1.65$
$w = p \cdot t$	$w_x =$	84.4 lb/ft
Shear Load $V = w/2$	$V_x =$	474.2 lb
Moment $M = w/2 \cdot L$	$M_y =$	1332.5 lb-ft
$M_{alum} = M \cdot I_{alum} / I_{comb}$	$M_{y-alum} =$	396.7 lb-ft
$L_n = (2 \cdot L_b \cdot S_y) / (I_x J)^{1/2}$	$L_n =$	143.2
$f_b = M_{alum} / (S_{y, alum})$	$f_{b-alum-y} =$	2.70 ksi
$f_{b-alum-y} / F_{by} =$	$F_{by} / \Omega = F_{by} =$	15.07 ksi
Combined Stress Ratio		$f_{bx} / F_{bx} + f_{by} / F_{by} =$
		0.25
		OK

Check Combined Bending & Compression (ADM H.1)		
$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b =$	0.346
OK		



Mullion Resultant Forces			
Strong Axis Bending, M_x , w_y =		52.73 lb/ft	
Weak Axis Bending, M_y , w_x =		84.38 lb/ft	
Load Share			
<u>Aluminum (x)</u>	<u>Steel (x)</u>	<u>Aluminum (y)</u>	<u>Steel (y)</u>
0.345	0.655	0.298	0.702

Axial Load	
$P = p_{wt} \cdot t \cdot h + wt \cdot h$	$P =$ 617.2 lb

Check Allowable Compression - ADM E.3		
$kL_y/r =$	$kL_y/r =$	130.56
F_{a1} (Allowable Compression)	$F_{a1}/\Omega =$	3.01 ksi
Check Allowable Compression - Flange element (ADM B.5.4.2)		
$b/t =$	$b/t =$	12.36
F_{a2} (Allowable Compression)	$F_{a2}/\Omega =$	15.20 ksi
Check Allowable Compression - Web element (ADM B.5.5.1)		
$b/t =$	$b/t =$	37.72
F_{a3} (Allowable Compression)	$F_{a3}/\Omega =$	19.70 ksi

$f_a = P/A$	$f_a =$	0.27 ksi
Lessor of F_{a1}, F_{a2}, F_{a3}	$F_a/\Omega = F_a =$	3.01 ksi
	$f_a/F_a =$	0.091
OK		



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Part of: Vertical Mullion Analysis
Elevation: 1/203
Detail: 1/406

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA

Strong Axis Deflection (M_x, w_y)	Typical Vertical
$\Delta_y = (5w_y L^4)/(384EI)$	$\Delta_y = 0.076$ in

Weak-Axis Deflection (w_x)	
$\Delta_x = (5w_x L^4)/(384EI_\Delta)$	$\Delta_x = 0.404$ in

Resultant Deflection	
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$	$\Delta_{total} = 0.411$ in
Angle Relative to X-Axis	$\theta_\Delta = 10.6^\circ$
	$\Delta_{allow} = 0.771$ in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 15.5
OK	

Steel Stress (X-axis)	
Moment to Steel = $I_{x, steel} / I_{comb}$	545.3 lb-ft
$f_b = M/S_{x, steel}$	$f_b = 1.2$ ksi
$M_r/\Omega_b =$	$M_r/\Omega_b = 8814$ lb-ft
OK	

Deflection Along Glazing	
$\Delta_{y-glazing} = \Delta_y \sin((180-\theta)/2)$	$\Delta_{y-glazing} = 0.064$ in
$\Delta_{x-glazing} = \Delta_x \cos((180-\theta)/2)$	$\Delta_{x-glazing} = 0.214$ in
Tributary Area A	
$\Delta_{total-A} = \Delta_{x-glazing} + \Delta_{y-glazing}$	$\Delta_{total} = 0.278$ in
Tributary Area B	
$\Delta_{total-B} = \Delta_{x-glazing} - \Delta_{y-glazing}$	$\Delta_{total} = 0.150$ in

SSG Sealant Deflection	
1/4 in. joint	50% $\pm$ movement capacity
0.280 in. allowable deflection	SSG Sealant OK

Steel Stress (Y-axis)	
Moment to Steel = $I_{y, steel} / I_{comb}$	935.8 lb-ft
$f_b = M/S_{y, steel}$	$f_b = 6.2$ ksi
$M_r/\Omega_b =$	$M_r/\Omega_b = 5302$ lb-ft
OK	



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Elevation: 1/203
Detail: 1/406

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

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Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width A (t_{wLA}) 4.61 ft Corner Angle (θ)
Tributary Width B (t_{wLB}) 2.42 ft 90.00 °
Height (h) 11.24 ft
Unbraced Length (L) 10.78 ft

Design Loads

Design Pressure A (p_A) 24 psf
Design Pressure B (p_B) 0 psf
Panel Weight (p_{wt}) 8 psf

Manuf. / Part #:

YKK E9-3401

E = 10100 ksi $r_{x, \text{alum}} = 1.948$ in
 $I_{x, \text{alum}} = 8.555$ in⁴ $r_{y, \text{alum}} = 0.991$ in
 $I_{y, \text{alum}} = 2.213$ in⁴ A = 2.254 in²
 $S_{x, \text{alum}} = 3.127$ in³ J = 4.596 in⁴
 $S_{y, \text{alum}} = 1.765$ in³ wt = 2.708 lb/ft

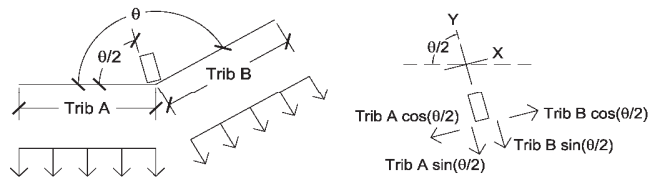
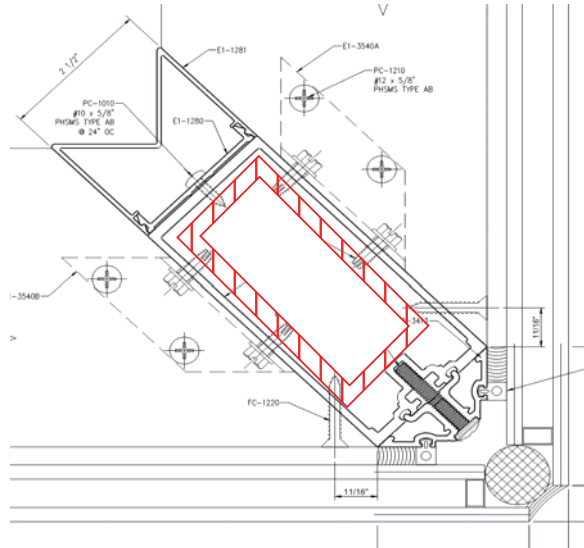
Thermal Reduction Factors (TRF_i , TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Reinforcing

HSS 2x4x3/8

$I_{x, \text{steel}} = 5.600$ in⁴ $I_{y, \text{steel}} = 1.800$ in⁴
 $S_{x, \text{steel}} = 2.800$ in³ $S_{y, \text{steel}} = 1.800$ in³
 $I_{x, \text{combined}} = 24.795$ in⁴ $I_{y, \text{combined}} = 7.433$ in⁴



X-Axis Bending Stress (ADM F.2 & F.3)		$\Omega = 1.65$
$w = p \cdot t$	$w_y = 78.3$ lb/ft	
Shear Load $V = w/2$	$V_y = 440.1$ lb	
Moment $M = w/2 \cdot L$	$M_x = 1236.6$ lb-ft	
$M_{alum} = M \cdot I_{alum} / I_{comb}$	$M_{x-alum} = 426.7$ lb-ft	
$L_n = (2 \cdot L_b \cdot S_x) / (I_y J)^{1/2}$	$L_n = 253.7$	
$f_b = M_{alum} / (S_{x, alum} \cdot TRF_s)$	$f_{b-alum-x} = 1.64$ ksi	
$f_{b-alum-x} / F_{bx} = 0.113$	$F_{bx} / \Omega = F_{bx} = 14.52$ ksi	
Y-Axis Bending Stress (ADM F.2 & F.3)		$\Omega = 1.65$
$w = p \cdot t$	$w_x = 78.3$ lb/ft	
Shear Load $V = w/2$	$V_x = 440.1$ lb	
Moment $M = w/2 \cdot L$	$M_y = 1236.6$ lb-ft	
$M_{alum} = M \cdot I_{alum} / I_{comb}$	$M_{y-alum} = 368.2$ lb-ft	
$L_n = (2 \cdot L_b \cdot S_y) / (I_x J)^{1/2}$	$L_n = 143.2$	
$f_b = M_{alum} / (S_{y, alum})$	$f_{b-alum-y} = 2.50$ ksi	
$f_{b-alum-y} / F_{by} = 0.166$	$F_{by} / \Omega = F_{by} = 15.07$ ksi	
Combined Stress Ratio		0.28
		OK

Check Combined Bending & Compression (ADM H.1)	
$f_a / F_a + f_b / F_b < 1.0$	$f_a / F_a + f_b / F_b = 0.376$
OK	

Mullion Resultant Forces			
Strong Axis Bending, M_x , w_y =		78.31 lb/ft	
Weak Axis Bending, M_y , w_x =		78.31 lb/ft	
Load Share			
<u>Aluminum (x)</u>	<u>Steel (x)</u>	<u>Aluminum (y)</u>	<u>Steel (y)</u>
0.345	0.655	0.298	0.702

Axial Load	
$P = p_{wt} \cdot t \cdot h + w_t \cdot h$	$P = 662.7$ lb

Check Allowable Compression - ADM E.3	
$kL/r =$	$kL/r = 130.56$
F_{a1} (Allowable Compression)	$F_{a1} / \Omega = 3.01$ ksi
Check Allowable Compression - Flange element (ADM B.5.4.2)	
$b/t =$	$b/t = 12.36$
F_{a2} (Allowable Compression)	$F_{a2} / \Omega = 15.20$ ksi
Check Allowable Compression - Web element (ADM B.5.5.1)	
$b/t =$	$b/t = 37.72$
F_{a3} (Allowable Compression)	$F_{a3} / \Omega = 19.70$ ksi

$f_a = P/A$	$f_a = 0.29$ ksi
Lessor of F_{a1}, F_{a2}, F_{a3}	$F_a / \Omega = F_a = 3.01$ ksi
	$f_a / F_a = 0.098$
OK	



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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 7-1/2")
Part of: Vertical Mullion Analysis
Elevation: 1/203
Detail: 1/406

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Strong Axis Deflection (M_x, w_y)	Typical Vertical
$\Delta_y = (5w_y L^4)/(384EI)$	$\Delta_y = 0.112$ in

Weak-Axis Deflection (w_x)	
$\Delta_x = (5w_x L^4)/(384EI_\Delta)$	$\Delta_x = 0.375$ in

Resultant Deflection	
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$	$\Delta_{total} = 0.391$ in
Angle Relative to X-Axis	$\theta_\Delta = 16.7^\circ$
	$\Delta_{allow} = 0.771$ in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 23.1
OK	

Steel Stress (X-axis)	
Moment to Steel = I_x steel/ I comb =	810.0 lb-ft
$f_b = M/S_{x, steel}$	$f_b = 1.7$ ksi
$M_r/\Omega_b =$	$M_r/\Omega_b = 8814$ lb-ft
OK	

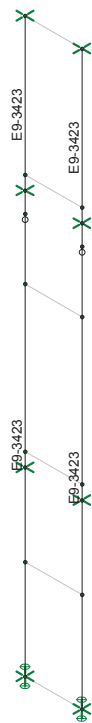
Deflection Along Glazing	
$\Delta_{y-glazing} = \Delta_y \sin((180-\theta)/2)$	$\Delta_{y-glazing} = 0.079$ in
$\Delta_{x-glazing} = \Delta_x \cos((180-\theta)/2)$	$\Delta_{x-glazing} = 0.265$ in
Tributary Area A	
$\Delta_{total-A} = \Delta_{x-glazing} + \Delta_{y-glazing}$	$\Delta_{total} = 0.344$ in
Tributary Area B	
$\Delta_{total-B} = \Delta_{x-glazing} - \Delta_{y-glazing}$	$\Delta_{total} = 0.185$ in

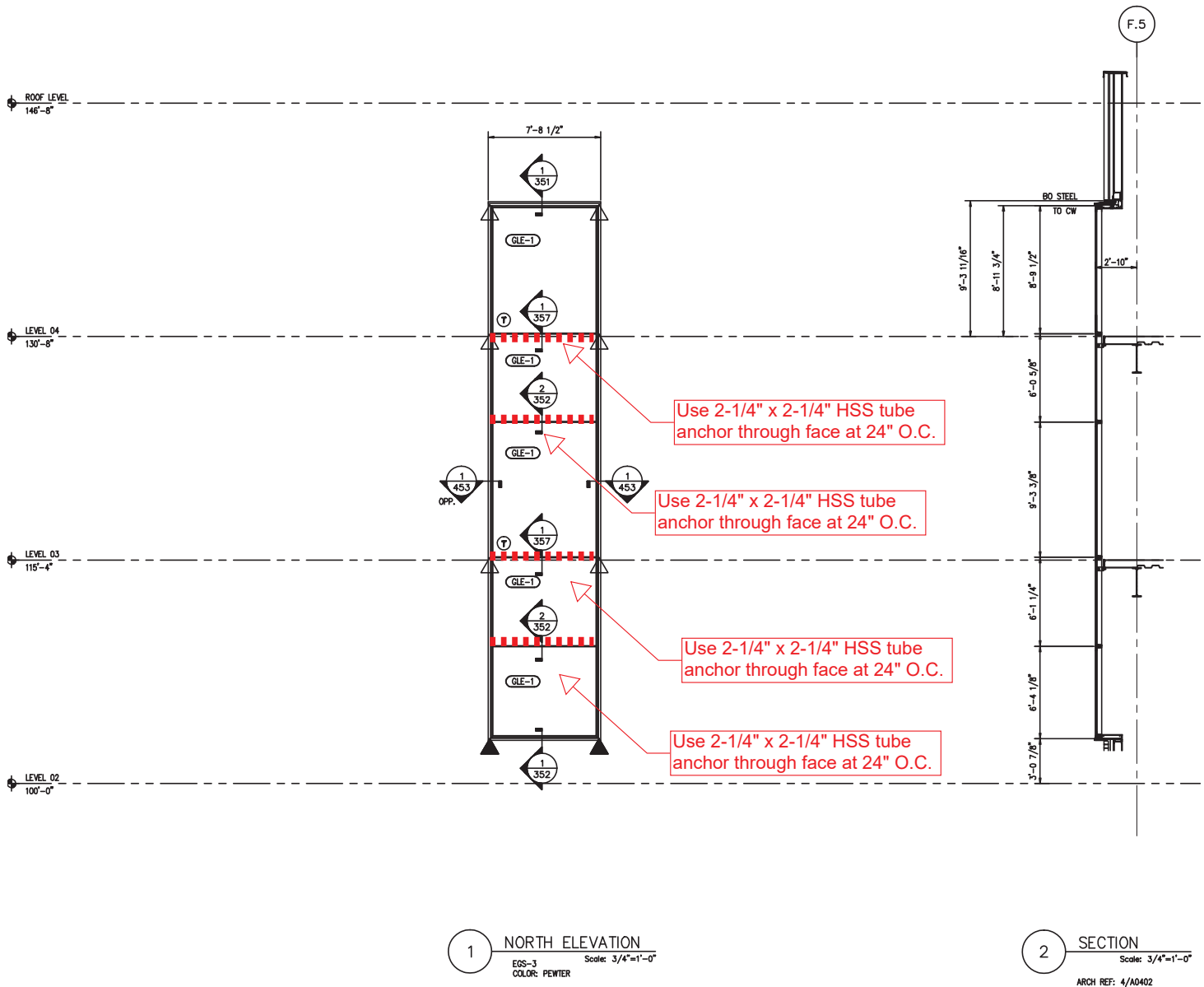
SSG Sealant Deflection	
1/4 in. joint	50% $\pm$ movement capacity
0.280 in. allowable deflection	SSG Sealant OK

Steel Stress (Y-axis)	
Moment to Steel = I_y steel/ I comb =	868.5 lb-ft
$f_b = M/S_{y, steel}$	$f_b = 5.8$ ksi
$M_r/\Omega_b =$	$M_r/\Omega_b = 5302$ lb-ft
OK	



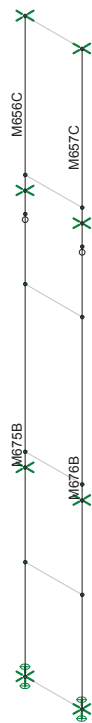
Section sets





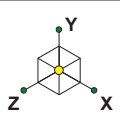


Member labels

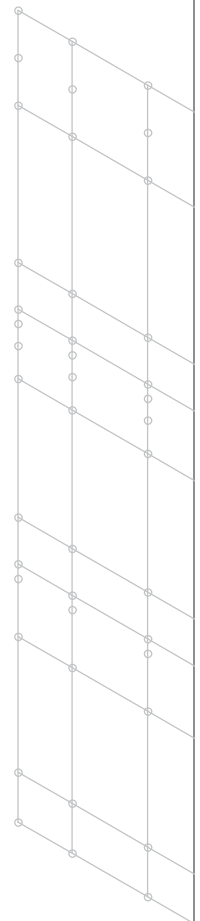
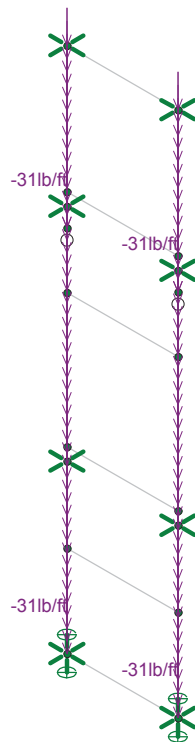


EGS-3 YKK YCW 750 SSG (2-1/2" x 5-1/16"). Shop drawing sheets 213

JEI Structural Engineering	Webster University	SK - 44
M. Gorny		Nov 2, 2016 at 7:14 AM
JE16059		EGS-1 Preliminary.r3d



Dead load
 $8\text{psf } (7' 8\text{-}1/2'') / 2 = 31\text{lb/ft}$



EGS-3 YKK YCW 750 SSG (2-1/2" x 5-1/16"). Shop drawing sheets 213

Loads: BLC 7, Dead

JEI Structural Engineering

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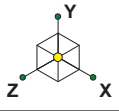
JE16059

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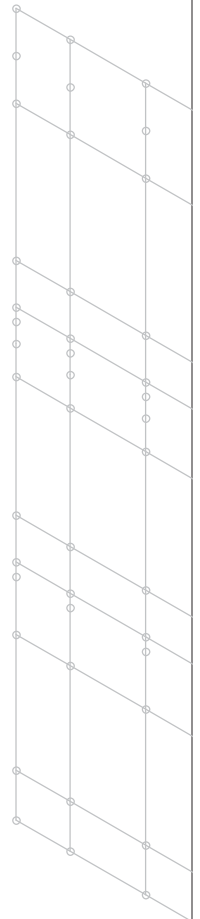
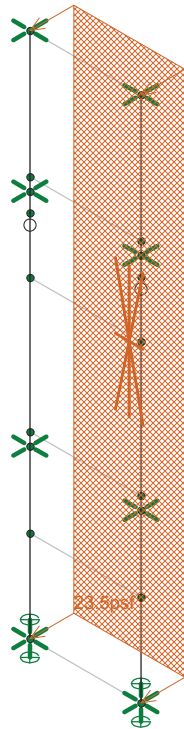
SK - 4

Nov 7, 2016 at 2:31 PM

EGS-1 Preliminary.r3d



Negative Wind - 23.5psf



EGS-3 YKK YCW 750 SSG (2-1/2" x 5-1/16"). Shop drawing sheets 213

Loads: BLC 1, Negative Wind (Face A)

JEI Structural Engineering

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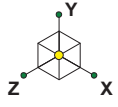
JE16059

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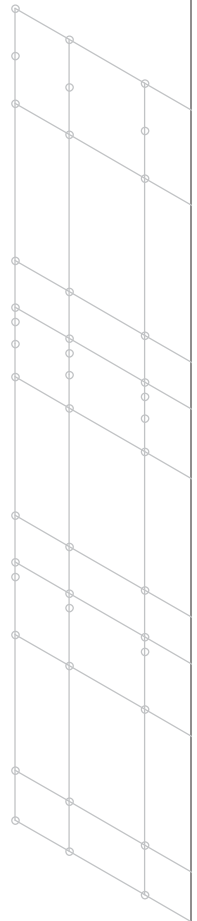
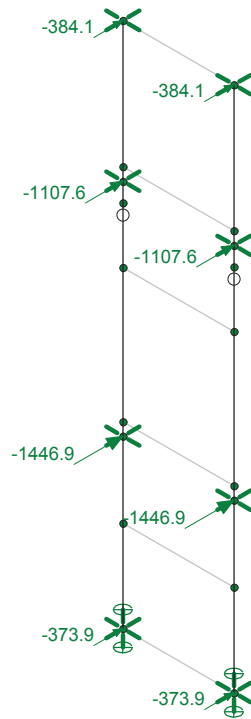
SK - 5

Nov 7, 2016 at 2:32 PM

EGS-1 Preliminary.r3d

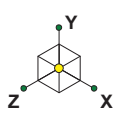


Anchor Loads

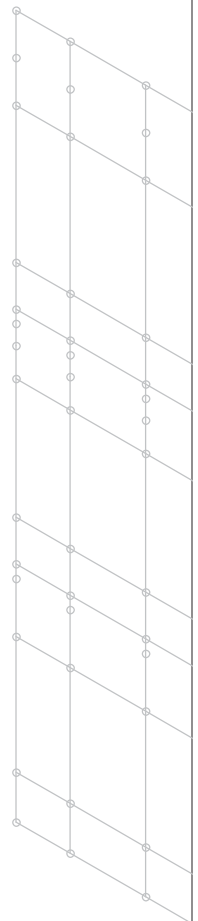
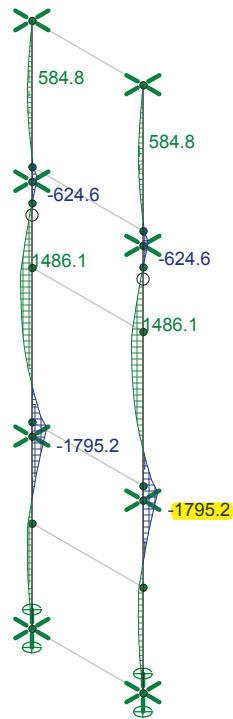


EGS-3 YKK YCW 750 SSG (2-1/2" x 5-1/16"). Shop drawing sheets 213
Results for LC 1, Negative Wind Face A
Z-direction Reaction Units are lb and lb-ft

JEI Structural Engineering	Webster University	SK - 6
M. Gorny		Nov 7, 2016 at 2:33 PM
JE16059		EGS-1 Preliminary.r3d



Moment diagram



EGS-3 YKK YCW 750 SSG (2-1/2" x 5-1/16"). Shop drawing sheets 213
Results for LC 1, Negative Wind Face A
Member z Bending Moments (lb-ft)

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JE16059

Webster University

SK - 7

Nov 7, 2016 at 2:34 PM

EGS-1 Preliminary.r3d

Beam: **M676B**

Shape:

Material: **gen_Alum**Length: **307.375 in**I Joint: **N751**J Joint: **N766A**Code Check: **No Calc**

Report Based On 97 Sections

1133.76 at 0 in A  lb 339.708 at 307.375 in	578.811 at 137.678 in Vy  lb -874.638 at 140.88 in	Vz lb
T lb-ft	1486.074 at 259.348 in Mz  lb-ft -1795.209 at 137.678 in	My lb-ft
765.021 at 0 in fa  psi 229.223 at 307.375 in	fc psi	ft psi

YKK E9-3423

Using reduced pressure based on non-corner wind condition to reduce stress and deflection.

 $M_z = 1795.209 \text{ lb-ft} \left(\frac{19 \text{ psf}}{23.5 \text{ psf}} \right) = 1451.4 \text{ lb-ft}$ $D_y = 1.334 \text{ in} \left(\frac{19 \text{ psf}}{23.5 \text{ psf}} \right) = 1.079 \text{ in}$



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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG (2-1/2" x 5-1/16")
Part of: Vertical Mullion Analysis
Elevation: 1/213
Detail: 1/453 **Member M676B**

Date: 11/7/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t) 3.85 ft $F_y = 25.0$ ksi
Height (h) 15.33 ft $F_u = 30.0$ ksi
Unbraced Length (L) 8.33 ft

Design Loads

Design Pressure (p) 19.0 psf (reduced deflection, using non-corner winds)
Panel Weight (p_{wt}) 8.0 psf

Manuf. / Part #: YKK E9-3423

$E = 10100$ ksi $r_{x, \text{alum}} = 1.383$ in
 $I_{x, \text{alum}} = 2.835$ in⁴ $r_{y, \text{alum}} = 0.949$ in
 $I_{y, \text{alum}} = 1.333$ in⁴ $A = 1.482$ in²
 $S_{x, \text{alum}} = 1.331$ in³ $J = 2.156$ in⁴
 $S_{y, \text{alum}} = 1.066$ in³ $wt = 1.780$ lb/ft
 $b/t_{web} = 38.37$ $b/t_{flange} = 23.48$
Fixity_{web} = 2 end(s) Fixity_{flange} = 2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$ $w = \text{N/A}$ lb/ft
Shear Load $V = wL/2$ $V = \text{N/A}$ lb
Moment $M = wL^2/8$ $M = 1451.4$ lb-ft
 $M_{alum} = M \cdot I_{alum} / I_{comb}$ $M_{alum} = 1451.4$ lb-ft
 $f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$ $f_{b-alum} = 13.09$ ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$ $P = 1133.8$ lb
 $f_{c-alum} = P/A$ $f_{c-alum} = 0.77$ ksi

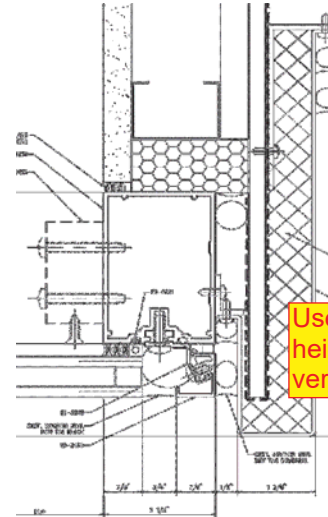
Check Deflection

Jamb Vertical

5/8 in. joint $\Delta = (5wL^4)/(384EI) = 1.079$ in
100% $\pm$ movement cap. $\Delta_{allow} = 1.017$ in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$
Deflection Factor DF = #####

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$ $M_{steel} = 0.0$ lb-ft
 $Mb/\Omega =$ $Mb/\Omega = 0$ lb-ft
 $Ms/(Mb/\Omega) = \text{N/A}$



Use 5/8" silicone joint, full height of hight of this jamb vertical

Reinforcing

No Reinforcing

		Load Share	
		Aluminum	Steel
$I_{x, steel} =$	0.000 in ⁴	1.000	0.000
$S_{x, steel} =$	0.000 in ³		
$I_{combined} =$	2.835 in ⁴		

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.04 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	17.74 ksi
E.3 - Axial Compression	4.62 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.99 ksi

Compression Interaction

Allowable Compression	$F_c =$	4.62 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.166

Flexure Interaction

Controls: F.3.1 - Closed Shape Flexure		
Allowable Flexural Compression	$F_b =$	14.99 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.873

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$ $f_a/F_a + f_b/F_b = 1.038$

Mullion OK, $\leq 4\%$ over allowable stress.



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www.jeistructural.com

Client: NGG

Project: Webster University

Structure: YKK 750 SSG (2-1/2" x 5-1/16")

Part of: Vertical Mullion Summary

Designer: M. Gorny

Manufacture: YKK

Part #: E9-3423

Alloy/Temper: 6063-T6

Typical Wind Pressure (T) = 20.0 psf

Corner Zone Wind Pressure (C) = 24.0 psf

Interior Pressure (INT) = 5.0 psf

Date

Proj.

11/2/2016

JE16059

INPUT CHECK RISA

Sheet	Elevation	Section	Part No	Wind Zone	Unbraced Length (L_u)	Trib Height (h) ft	Trib Width (t) ft	Trib Area (h)*(t) = (A)	Wind Pres (p)	linear load (w) (plf)	Deflection Factor (w) * (h)^4 (div by 10E7)	Stress Factor ((w)*(h)^2)/1000
200	1/200	1/418	E9-3423	T	11.71	12.17	5.53	67.3	20.0	110.6	41.3	16.4
200	1/200	1/417	E9-3423	T	11.71	12.17	3.92	47.7	20.0	78.3	29.3	11.6
201	1/201	1/451	E9-3423	T	11.71	12.17	4.69	57.0	20.0	93.8	35.0	13.9
201	1/201	1/454	E9-3423	T	11.71	12.17	2.38	29.0	20.0	47.6	17.8	7.0
215	1/215	1/451	E9-3423	C	5.79	6.21	5.25	32.6	24.0	126.0	6.3	4.9
219	1/219	2/452	E9-3423	C	3.08	3.50	5.00	17.5	24.0	120.0	1.1	1.5
220	1/220	2/452	E9-3423	T	1.58	2.00	4.56	9.1	20.0	91.3	0.2	0.4
220, 220	3/220, 5/220	2/416	E9-3423	T	11.58	12.00	5.82	69.8	20.0	116.4	41.7	16.8

Mullion Design Summary

1: Use 4" x 2" x 1/4" A36 Steel Channel Reinforcing

2: OK



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 5-1/16")
Part of: Vertical Mullion Analysis
Elevation: 3/220, 5/220
Detail: 2/416

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA

Check 1

Load Design Code

ASCE7-05 ASD

Material Design Code

Aluminum Design Manual 2010

ADM 2010 Type

Alloy-Temper

Closed Shape

6063-T6

Tributary Width (t) 5.82 ft $F_y = 25.0$ ksi
Height (h) 12.00 ft $F_u = 30.0$ ksi
Unbraced Length (L) 11.58 ft

Design Loads

Design Pressure (p) 20.0 psf
Panel Weight (p_{wt}) 8.0 psf

Manuf. / Part #:

YKK E9-3423

E = 10100 ksi $r_{x, \text{alum}} = 1.383$ in
 $I_{x, \text{alum}} = 2.835$ in⁴ $r_{y, \text{alum}} = 0.949$ in
 $I_{y, \text{alum}} = 1.333$ in⁴ A = 1.482 in²
 $S_{x, \text{alum}} = 1.331$ in³ J = 2.156 in⁴
 $S_{y, \text{alum}} = 1.066$ in³ wt = 1.780 lb/ft
 $b/t_{\text{web}} = 38.37$ $b/t_{\text{flange}} = 23.48$
Fixity_{web} = 2 end(s) Fixity_{flange} = 2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$ w = 116.4 lb/ft
Shear Load $V = wL/2$ V = 698.1 lb
Moment $M = wL^2/8$ M = 2094.4 lb-ft
 $M_{\text{alum}} = M \cdot I_{\text{alum}} / I_{\text{comb}}$ $M_{\text{alum}} = 2094.4$ lb-ft
 $f_{b-\text{alum}} = M_{\text{alum}} / (S_{x, \text{alum}} \cdot \text{TRF}_s)$ $f_{b-\text{alum}} = 18.88$ ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$ P = 579.9 lb
 $f_{c-\text{alum}} = P/A$ $f_{c-\text{alum}} = 0.39$ ksi

Check Deflection

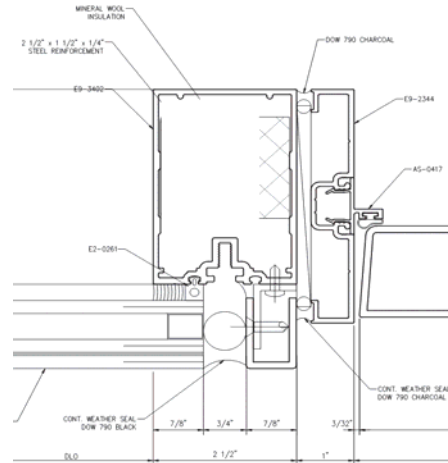
Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) = 1.896$ inN/A $\pm$ movement cap. $\Delta_{\text{allow}} = 0.823$ in

Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$
Deflection Factor DF = 41.7

Steel Capacity

$M_{\text{steel}} = I_{x, \text{steel}} / I_{\text{comb}} =$ $M_{\text{steel}} = 0.0$ lb-ft
 $Mb/\Omega =$ $Mb/\Omega = 0$ lb-ft
 $Ms/(Mb/\Omega) =$ N/A

**Reinforcing**

No Reinforcing

		Load Share	
		Aluminum	Steel
$I_{x, \text{steel}} =$	0.000 in ⁴	1.000	0.000
$S_{x, \text{steel}} =$	0.000 in ³		
$I_{\text{combined}} =$	2.835 in ⁴		

Allowable Loads $\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.04 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	17.74 ksi
E.3 - Axial Compression	2.39 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.68 ksi

Compression Interaction

Allowable Compression	$F_c =$	2.39 ksi
Compression Stress Interaction	$f_{c-\text{alum}}/F_c =$	0.164

Flexure Interaction

Controls: F.3.1 - Closed Shape Flexure		
Allowable Flexural Compression	$F_b =$	14.68 ksi
Flexure Interaction	$f_{b\text{-alum}}/F_b =$	1.286

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$ $f_a/F_a + f_b/F_b = 1.450$

Mullion deflection exceeds limits! Reinforcing or heavier mullion required.

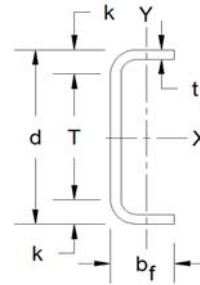
REINFORCE!!!!!!



JEI Structural Engineering
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Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG
Part of: Channel allowable flexural strength



Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT CHECK

Check 1

AISC Shape: 2-1/2" x 1-1/2" x 1/4"
Cust Dims: N/A
E = 29000 ksi
F_y = 36 ksi
Material = A36
L_b = 140 in

d = 2.500 in
b_f = 1.500 in
t_f = 0.250 in
t_w = 0.250 in
T = h = 1.000 in
J = 0.023 in⁴
C_w = 0.183 in⁶
h_o = 2.250 in
A = 1.170 in²
wt = 3.981 lb/ft
I_x = 1.004 in⁴
S_x = 0.803 in³
Z_x = 0.997 in³
r_x = 0.926 in
I_y = 0.243 in⁴
S_y = 0.251 in³
Z_y = 0.449 in³
r_y = 0.456 in

Flange Slenderness
 $r_{ts}^2 = (I_y C_w)^{1/2} / S_x = 0.26$
 $c = h_o / 2 * (I_y / C_w)^{1/2} = 1.30$
 $\lambda_{pf} = 0.38(E/F_y)^{1/2} = 10.79$
 $\lambda_{rf} = 1.0(E/F_y)^{1/2} = 28.38$
Web Slenderness
 $\lambda_{pw} = 3.76(E/F_y)^{1/2} = 106.72$
 $\lambda_{rw} = 5.70(E/F_y)^{1/2} = 161.78$

Flange Slenderness $\lambda = b_f / t_f = 6.00$ Flange Slenderness = Compact	Web Slenderness $\lambda = h / t_w = 4.00$ Web Slenderness = Compact
L _b = L _p = 1.76r _y (E/F _y) ^{1/2} = L _r = 1.95r _{ts} * E/(0.7F _y) * (Jc/(S _x h _o)) ^{1/2} (1 + (1 + 6.76(0.7F _y /E * S _x h _o /(Jc)) ²) ^{1/2} =	L _b = 140 in L _p = 22.78 in L _r = 211.29 in

X-Axis Yielding (AISC F2.1) L _b ≤ L _p M _n = M _p = F _y Z _x = 35.89 kip-in	Y-Axis Yielding (AISC F6.1) M _n = M _p = F _y Z _y = 16.18 kip-in 1.6F _y S _y = 14.46 kip-in M _n = M _p ≤ 1.6F _y S _y = 14.46 kip-in
---	--

X-Axis Lateral-Torsional Buckling (AISC F2.2) AISC F2.2.b L _p < L _b ≤ L _r M _n = C _b [M _p - (M _p - 0.7F _y S _x)(L _b - L _p)/(L _r - L _p)] = M _n = 26.16 kip-in M _p = F _y Z _x = 35.89 kip-in M _n ≤ M _p = 26.16 kip-in	Y-Axis Flange Local Buckling (AISC F6.2) AISC F6.2.b λ _{pf} < λ ≤ λ _{rf} M _n = [M _p - (M _p - 0.7F _y S _y)(λ - λ _{pf})/(λ _r - λ _{pf})] = M _n = 18.86 kip-in M _p = F _y Z _y = 16.18 kip-in M _n ≤ M _p = N/A kip-in
AISC F2.2.c L _b > L _r F _{cr} = C _b π ² E/(L _b /r _{ts}) ² (1 + 0.078Jc/(S _x h _o)*(L _b /r _{ts}) ²) ^{1/2} = F _{cr} = 38.12 ksi M _n = F _{cr} S _x = 30.61 kip-in M _p = F _y Z _x = 35.89 kip-in M _n ≤ M _p = N/A kip-in	AISC F6.2.b λ > λ _{rf} F _{cr} = 0.69E/(b _f /2t _f) ² = F _{cr} = 2223.33 ksi M _n = F _{cr} S _y = 558.06 kip-in M _n = N/A kip-in

X-Axis Capacity	Ω_b = 1.67
M _n =	26.16 kip-in
M _n /Ω _b =	15.66 kip-in
M _n /Ω _b =	1305 lb-ft

Y-Axis Capacity	Ω_b = 1.67
M _n =	14.46 kip-in
M _n /Ω _b =	8.66 kip-in
M _n /Ω _b =	721 lb-ft



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 5-1/16")
Part of: Vertical Mullion Analysis
Elevation: 3/220, 5/220
Detail: 2/416

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT

CHECK

RISA

Check 1

Load Design Code

ASCE7-05 ASD

Material Design Code

Aluminum Design Manual 2010

ADM 2010 Type

Alloy-Temper

Closed Shape

6063-T6

Tributary Width (t) 5.82 ft $F_y = 25.0$ ksi
Height (h) 12.00 ft $F_u = 30.0$ ksi
Unbraced Length (L) 11.58 ft

Design Loads

Design Pressure (p) 20.0 psf
Panel Weight (p_{wt}) 8.0 psf

Manuf. / Part #:

YKK E9-3423

$E = 10100$ ksi $r_{x, \text{alum}} = 1.383$ in
 $I_{x, \text{alum}} = 2.835$ in⁴ $r_{y, \text{alum}} = 0.949$ in
 $I_{y, \text{alum}} = 1.333$ in⁴ $A = 1.482$ in²
 $S_{x, \text{alum}} = 1.331$ in³ $J = 2.156$ in⁴
 $S_{y, \text{alum}} = 1.066$ in³ $wt = 1.780$ lb/ft
 $b/t_{web} = 38.37$ $b/t_{flange} = 23.48$
Fixity_{web} = 2 end(s) Fixity_{flange} = 2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$ $w = 116.4$ lb/ft
Shear Load $V = wL/2$ $V = 698.1$ lb
Moment $M = wL^2/8$ $M = 2094.4$ lb-ft
 $M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$ $M_{alum} = 1035.3$ lb-ft
 $f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$ $f_{b-alum} = 9.33$ ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$ $P = 579.9$ lb
 $f_{c-alum} = P/A$ $f_{c-alum} = 0.39$ ksi

Check Deflection

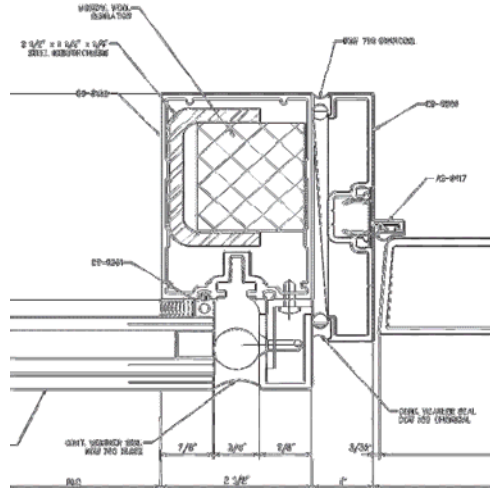
Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) = 0.937$ in
N/A $\pm$ movement cap. $\Delta_{allow} = 0.823$ in

Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$
Deflection Factor DF = 41.7

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$ $M_{steel} = 1059.1$ lb-ft
 $Mb/\Omega =$ $Mb/\Omega = 1305$ lb-ft
 $Ms/(Mb/\Omega) = 0.812$

**Reinforcing**

2x4x1/4 A36 Steel Channel

		Load Share	
		Aluminum	Steel
$I_{x, steel} =$	1.000 in ⁴		
$S_{x, steel} =$	0.803 in ³		
$I_{combined} =$	5.735 in ⁴	0.494	0.506

Allowable Loads $\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.04 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	17.74 ksi
E.3 - Axial Compression	2.39 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.68 ksi

Compression Interaction

Allowable Compression $F_c = 2.39$ ksi
Compression Stress Interaction $f_{c-alum}/F_c = 0.164$

Flexure Interaction

Controls: F.3.1 - Closed Shape Flexure
Allowable Flexural Compression $F_b = 14.68$ ksi
Flexure Interaction $f_{b-alum}/F_b = 0.636$

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$ $f_a/F_a + f_b/F_b = 0.800$

Mullion OK, $\leq 1/8"$ over allowable deflection.



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 5-1/16")
Part of: Vertical Mullion Analysis
Elevation: 1/201
Detail: 1/454 **Check 2**

Date: 11/2/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK RISA

Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Tributary Width (t) 2.38 ft $F_y = 25.0$ ksi
Height (h) 12.17 ft $F_u = 30.0$ ksi
Unbraced Length (L) 11.71 ft

Design Loads

Design Pressure (p) 20.0 psf
Panel Weight (p_{wt}) 8.0 psf

Manuf. / Part #: YKK E9-3423

E = 10100 ksi $r_{x, \text{alum}} = 1.383$ in
 $I_{x, \text{alum}} = 2.835$ in⁴ $r_{y, \text{alum}} = 0.949$ in
 $I_{y, \text{alum}} = 1.333$ in⁴ A = 1.482 in²
 $S_{x, \text{alum}} = 1.331$ in³ J = 2.156 in⁴
 $S_{y, \text{alum}} = 1.066$ in³ wt = 1.780 lb/ft
 $b/t_{web} = 38.37$ $b/t_{flange} = 23.48$
Fixity_{web} = 2 end(s) Fixity_{flange} = 2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc. 1.00 S_x Reduc. 1.00

Applied Bending Moment

$w = p \cdot t$ w = 47.6 lb/ft
Shear Load V = wL/2 V = 289.6 lb
Moment M = wL²/8 M = 880.8 lb-ft
 $M_{alum} = M \cdot I_{alum} \cdot TRF_i / I_{comb}$ $M_{alum} = 880.8$ lb-ft
 $f_{b-alum} = M_{alum} / (S_{x, alum} \cdot TRF_s)$ $f_{b-alum} = 7.94$ ksi

Applied Axial Compression

$P = p_{wt} \cdot t \cdot h + wt \cdot h$ P = 253.3 lb
 $f_{c-alum} = P/A$ $f_{c-alum} = 0.17$ ksi

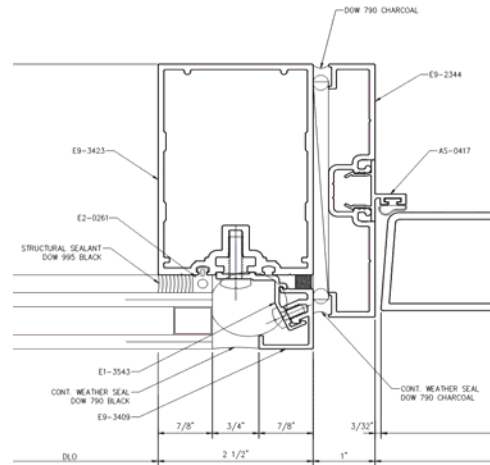
Check Deflection

Typical Vertical

N/A in. joint $\Delta = (5wL^4)/(384EI) = 0.820$ in
N/A $\pm$ movement cap. $\Delta_{allow} = 0.834$ in
Allowable deflection = L/175 or if span > 13'-6"
then allowable def = L/240 + 1/4" Deflection Factor
DF = 17.8

Steel Capacity

$M_{steel} = I_{x, steel} / I_{comb} =$ $M_{steel} = 0.0$ lb-ft
 $Mb/\Omega =$ $Mb/\Omega = 0$ lb-ft
 $Ms/(Mb/\Omega) =$ N/A



Reinforcing

No Reinforcing

		Load Share	
		Aluminum	Steel
$I_{x, steel} =$	0.000 in ⁴	1.000	0.000
$S_{x, steel} =$	0.000 in ³		
$I_{combined} =$	2.835 in ⁴		

Allowable Loads

$\Omega = 1.65$

B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.04 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	17.74 ksi
E.3 - Axial Compression	2.34 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	14.67 ksi

Compression Interaction

Allowable Compression	$F_c =$	2.34 ksi
Compression Stress Interaction	$f_{c-alum}/F_c =$	0.073

Flexure Interaction

Controls: F.3.1 - Closed Shape Flexure		
Allowable Flexural Compression	$F_b =$	14.67 ksi
Flexure Interaction	$f_{b-alum}/F_b =$	0.541

Check Combined Bending & Compression (ADM H.1)

$f_a/F_a + f_b/F_b < 1.0$ $f_a/F_a + f_b/F_b = 0.614$

Mullion OK



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2'-1/2" x 5'-1/16")
Part of: Jamb Mullion Summary
Designer: M. Gorny

Manufacture: Kawneer
Part #: E9-3423
Alloy/Temper: 6063-T6
Jamb $I_x = 2.835 \text{ in}^4$
Typical Wind Pressure (T) = 20.0 psf
Corner Zone Wind Pressure (C) = 24.0 psf
Interior Pressure (INT) = 5.0 psf

Date: 11/2/2016
Proj: JE16059

Sealant Joint Size & Expansion
1/2" Joint (50% Expandable)
Allowable Movement = 0.560 in

INPUT CHECK RISA

Sheet	Elevation	Section	Part No	Wind Zone	Unbraced Length (L_u)	Trib Height (h) ft	Trib Width (t) ft	Trib Area (h)*(t) = (A)	Wind Pres (p)	linear load (w) (plf)	Unreinforced Deflection (in)	Stress Factor $((w)*(h)^2)*L/1000$	Deflection > 0.56 in. ?
200	1/200	2/417	E9-3423	T	11.71	12.17	2.34	28.5	20.0	46.9	0.82	6.9	Reinforce
201	1/201	2/400	E9-3423	T	11.71	12.17	0.69	8.4	20.0	13.9	0.24	2.1	OK
215	1/215	2/451	E9-3423	C	5.79	6.21	2.63	16.3	24.0	63.0	0.07	2.4	OK
219	1/219	1/452	E9-3423	C	3.08	3.50	2.50	8.8	24.0	60.0	0.01	0.7	OK
220	1/220	1/452	E9-3423	T	1.58	2.00	2.28	4.6	20.0	45.6	0.00	0.2	OK
220	3/220, 5/220	1/452	E9-3423	T	11.58	12.00	2.63	31.6	20.0	52.6	0.87	7.6	Reinforce

Mullion Design Summary

1: OK by comparison to Vertical Mullion Check 2. Use DOW 790 (or similar 100% expandable sealant)
2: OK by comparison to Vertical Mullion Check 2.



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 7-1/2")
Part of: Horizontal Mullion Analysis
Elevation: 1/200
Detail: 1/324

Check 1

Load Design Code	Material Design Code
ASCE7-05 ASD	ADM 2010
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

Wind Tributary Width (t_{WL})	6.08 ft	$F_y =$	25.0 ksi
Dead Load Trib. Height (t_{DL})	2.72 ft	$F_u =$	30.0 ksi
Length (L)	6.17 ft		
Unbraced Length (L_b)	6.17 ft		

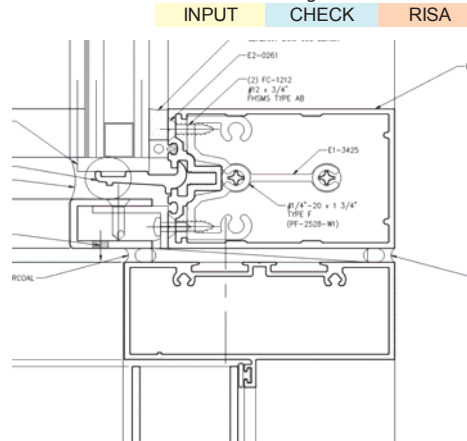
Design Loads

Design Pressure (p)	24.0 psf
Infill Weight (p_{wt})	6.5 psf

Manuf. / Part #:		YKK E9-3423	
E =	10100 ksi	$r_{x, \text{alum}} =$	1.383 in
$I_{x, \text{alum}} =$	2.835 in ⁴	$r_{y, \text{alum}} =$	0.949 in
$I_{y, \text{alum}} =$	1.333 in ⁴	A =	1.482 in ²
$S_{x, \text{alum}} =$	1.331 in ³	J =	2.156 in ⁴
$S_{y, \text{alum}} =$	1.066 in ³	wt =	1.780 lb/ft
$b/t_{web} =$	38.37	$b/t_{flange} =$	23.48
Fixity _{web} =	2 end(s)	Fixity _{flange} =	2 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
--------------	------	--------------	------



Setting Block Locations (s) =	1/4	points
Setting Block Load (P) =	54.5	lb/setting block

Reinforcing	No Reinforcing		
$I_{x, \text{ steel }} =$	0.000 in ⁴	$I_{y, \text{ steel }} =$	0.000 in ⁴
$S_{x, \text{ steel }} =$	0.000 in ³	$S_{y, \text{ steel }} =$	0.000 in ³
$I_{x, \text{ combined }} =$	2.835 in ⁴	$I_{y, \text{ combined }} =$	1.333 in ⁴
$A_{\text{ steel }} =$	0.00 in ²	$wt_{\text{ steel }} =$	0.00 lb/ft
$A_{\text{ alum-total }} =$	1.482 in ²	$wt_{\text{ total }} =$	1.780 lb/ft

X-Axis Applied Bending Moment (Wind Load)	Load Share = 100%
$w_{WL} = p * t_{WL}$	$w =$ 146.0 lb/ft
Shear Load $V = wL/2$	$V =$ 450.2 lb
Moment $M = wL^2/8$	$M =$ 694.0 lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} =$ 694.0 lb-ft
$f_b = M_{\text{alum}} / (S_{x, \text{alum}} * TRF_s)$	$f_{b-\text{alum-x}} =$ 6.26 ksi
Y-Axis Applied Bending Moment (Dead Load)	Load Share = 100%
Shear $V = P + wt_{\text{total}} * L/2$	$V =$ 60.0 lb
Moment $M = wt_{\text{total}} * L^2/8 + P * L * s$	$M =$ 92.5 lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} =$ 92.5 lb-ft
$f_b = M_{\text{alum}} / (S_{y, \text{alum}})$	$f_{b-\text{alum-y}} =$ 1.04 ksi
Applied Axial Compression	
$P =$	0.0 lb
$f_{c-\text{alum}} = P/A$	$f_{c-\text{alum}} =$ 0.00 ksi

X-axis Deflection (Wind Load)	Typical Horizontal
N/A in. joint $\Delta_x = (5wL^4)/(384EI_x)$	0.166 in
N/A $\pm$ movement cap. $\Delta_{x-\text{allow}} =$	0.423 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 43.8
Y-axis Deflection (Dead Load)	Door Header
$\Delta = ((P_{sb}Ls)/(24EI)) * (3L^2 - 4(Ls)^2) + 5wt_{\text{total}}L^4/(384EI)$	$\Delta =$ 0.051 in
	$\Delta_{y-\text{allow}} =$ 0.0625 in

Steel Capacity (X-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{x, \text{steel}} / I_{\text{comb}} =$	$M_{\text{steel}} =$ 0.0 lb-ft
$Mb/\Omega =$	0 lb-ft
$Ms/(Mb/\Omega) =$	N/A
Steel Capacity (Y-Axis)	Load Share = 0%
$M_{\text{steel}} = I_{y, \text{steel}} / I_{\text{comb}} =$	$M_{\text{steel}} =$ 0.0 lb-ft
$\Phi * Mb =$	0 lb-ft
$Ms/(Mb/\Omega) =$	N/A

X-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	15.04 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	17.74 ksi
F.2.1 - Open Shape Flexure	N/A ksi
F.3.1 - Closed Shape Flexure	15.24 ksi
X-Axis Bending Interaction	
Allowable X-Axis Bending $F_{bx} =$	15.04 ksi
X-Axis Interaction $f_{b-\text{alum-x}}/F_{bx} =$	0.416

Y-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	12.51 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	19.70 ksi
F.2.1	N/A ksi
F.3.1	15.40 ksi
Y-Axis Bending Interaction	
Allowable Y-Axis Bending $F_{by} =$	12.51 ksi
Y-Axis Interaction $f_{b-\text{alum-y}}/F_{by} =$	0.083

Axial Allowable Load	
Allowable Axial Compression	8.43 ksi
Compression Interaction $f_{c-\text{alum}}/F_c =$	0.000

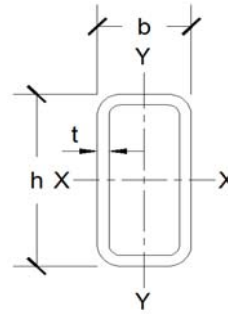
Combined Interaction Ratio	
$f_{c-\text{alum}}/F_c + f_{b-\text{alum-x}}/F_{bx} + f_{b-\text{alum-y}}/F_{by} =$	0.499
Stress OK. Use 1/4 point setting blocks.	



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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG
Part of: HSS allowable flexural strength



Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT CHECK

Shape: HSS 2-1/4 x 2-1/4 x 1/4

$h = 2.25$ in
 $b = 2.25$ in
 $t = 0.233$ in

$b/t = 6.66$
 $h/t = 6.66$

$E = 29000$ ksi
Material = A500 Gr B
 $F_y = 46$ ksi

$I_x = 1.130$ in⁴
 $S_x = 1.010$ in³
 $Z_x = 1.280$ in³

$I_y = 1.130$ in⁴
 $S_y = 1.010$ in³
 $Z_y = 1.280$ in³

$A = 1.740$ in²
 $wt = 6.260$ lb/ft

X-Axis Flange/Web Slenderness Limits	Y-Axis Flange/Web Slenderness Limits
Flange (b/t) $\lambda_p = 1.12(E/F_y)^{1/2} = 28.12$ Compact $\lambda_r = 1.40(E/F_y)^{1/2} = 35.15$ X	Flange (h/t) $\lambda_p = 1.12(E/F_y)^{1/2} = 28.12$ Compact $\lambda_r = 1.40(E/F_y)^{1/2} = 35.15$ X
Web (h/t) $\lambda_p = 2.42(E/F_y)^{1/2} = 60.76$ Compact $\lambda_r = 5.70(E/F_y)^{1/2} = 143.12$ X	Web (b/t) $\lambda_p = 2.42(E/F_y)^{1/2} = 60.76$ Compact $\lambda_r = 5.70(E/F_y)^{1/2} = 143.12$ X

X-Axis Yielding (AISC F7.1)	Y-Axis Yielding (AISC F7.1)
$M_n = M_p = F_y Z_x = 58.88$ kip-in	$M_n = M_p = F_y Z_y = 58.88$ kip-in

X-Axis Flange Local Buckling (AISC F7.2)	Y-Axis Flange Local Buckling (AISC F7.2)
a) Compact sections: does not apply	a) Compact sections: does not apply
b) Noncompact flanges: $M_n = M_p - (M_p - F_y S_x)(3.57 * b/t * (F_y/E)^{1/2} - 4.0) =$ $M_n =$ N/A kip-in	b) Noncompact flanges: $M_n = M_p - (M_p - F_y S_y)(3.57 * h/t * (F_y/E)^{1/2} - 4.0) =$ $M_n =$ N/A kip-in
c) Slender flanges: $b_e = 1.92t(E/F_y)^{1/2}[1 - 0.38/(b/t) * (E/F_y)^{1/2}] =$ $b_e = -4.86$ in $S_{eff,x} = -1.86$ in ³ $M_n = F_y S_{eff} = -85.58$ kip-in $M_n =$ N/A kip-in	c) Slender flanges: $b_e = 1.92t(E/F_y)^{1/2}[1 - 0.38/(h/t) * (E/F_y)^{1/2}] =$ $b_e = -4.86$ in $S_{eff,y} = -1.86$ in ³ $M_n = F_y S_{eff} = -85.58$ kip-in $M_n =$ N/A kip-in

X-Axis Web Local Buckling (AISC F7.3)	Y-Axis Web Local Buckling (AISC F7.3)
a) Compact sections: does not apply	a) Compact sections: does not apply
b) Noncompact webs: $M_n = M_p - (M_p - F_y S_x)(0.305 * h/t * (F_y/E)^{1/2} - 0.738) =$ $M_n =$ N/A kip-in	b) Noncompact webs: $M_n = M_p - (M_p - F_y S_y)(0.305 * b/t * (F_y/E)^{1/2} - 0.738) =$ $M_n =$ N/A kip-in

X-Axis Capacity	$\Omega_b = 1.67$
$M_n =$	58.88 kip-in
$M_n/\Omega_b =$	35.26 kip-in
$M_n/\Omega_b =$	2938 lb-ft

Y-Axis Capacity	$\Omega_b = 1.67$
$M_n =$	58.88 kip-in
$M_n/\Omega_b =$	35.26 kip-in
$M_n/\Omega_b =$	2938 lb-ft



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Client: NGG
Project: Webster University
Structure: YKK 750 SSG (2-1/2" x 7-1/2")
Part of: Horizontal Mullion Analysis
Elevation: 1/200
Detail: 1/357

Check 1

Load Design Code	Material Design Code
ASCE7-05 ASD	ADM 2010
ADM 2010 Type	Alloy-Temper
Open Shape	6063-T6

Wind Tributary Width (t_{WL})	7.69 ft	$F_y =$	25.0 ksi
Dead Load Trib. Height (t_{DL})	9.07 ft	$F_u =$	30.0 ksi
Length (L)	7.29 ft		
Unbraced Length (L_b)	7.29 ft		

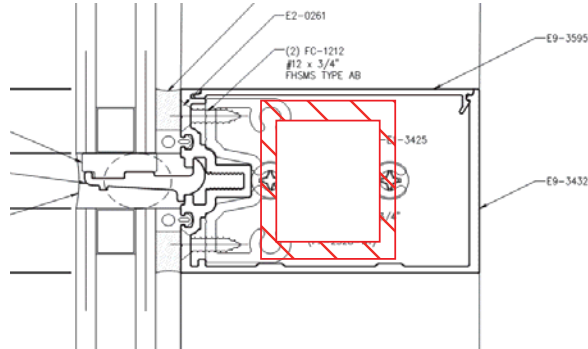
Design Loads

Design Pressure (p)	24.0 psf
Infill Weight (p_{wt})	6.5 psf

Manuf. / Part #:		YKK E9-3432	
E =	10100 ksi	$r_{x, \text{alum}} =$	1.504 in
$I_{x, \text{alum}} =$	2.712 in ⁴	$r_{y, \text{alum}} =$	0.786 in
$I_{y, \text{alum}} =$	0.740 in ⁴	A =	1.198 in ²
$S_{x, \text{alum}} =$	1.276 in ³	J =	0.006 in ⁴
$S_{y, \text{alum}} =$	0.469 in ³	wt =	1.780 lb/ft
$b/t_{web} =$	38.05	$b/t_{flange} =$	17.67
Fixity _{web} =	2 end(s)	Fixity _{flange} =	1 end(s)

Thermal Reduction Factors (TRF_i, TRF_s)

I_x Reduc.	1.00	S_x Reduc.	1.00
--------------	------	--------------	------



Setting Block Locations (s) =	1/4 points
Setting Block Load (P) =	215.0 lb/setting block

Reinforcing	2-1/2" x 2-1/2" x 1/4" HSS tube		
$I_{x, \text{ steel }} =$	1.130 in ⁴	$I_{y, \text{ steel }} =$	1.130 in ⁴
$S_{x, \text{ steel }} =$	1.010 in ³	$S_{y, \text{ steel }} =$	1.010 in ³
$I_{x, \text{ combined }} =$	5.989 in ⁴	$I_{y, \text{ combined }} =$	4.017 in ⁴
$A_{\text{ steel }} =$	0.00 in ²	$wt_{\text{ steel }} =$	0.00 lb/ft
$A_{\text{ alum-total }} =$	1.198 in ²	$wt_{\text{ total }} =$	1.780 lb/ft

X-Axis Applied Bending Moment (Wind Load)	Load Share = 45%
$w_{WL} = p * t_{WL}$	$w =$ 184.6 lb/ft
Shear Load $V = wL/2$	$V =$ 673.1 lb
Moment $M = wL^2/8$	$M =$ 1227.0 lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} =$ 555.6 lb-ft
$f_b = M_{\text{alum}} / (S_{x, \text{alum}} * TRF_s)$	$f_{b-\text{alum-x}} =$ 5.23 ksi
Y-Axis Applied Bending Moment (Dead Load)	Load Share = 18%
Shear $V = P + wt_{\text{total}} * L/2$	$V =$ 221.5 lb
Moment $M = wt_{\text{total}} * L^2/8 + P * L * s$	$M =$ 403.8 lb-ft
$M_{\text{alum}} = M * I_{\text{alum}} / I_{\text{comb}}$	$M_{\text{alum}} =$ 74.4 lb-ft
$f_b = M_{\text{alum}} / (S_{y, \text{alum}})$	$f_{b-\text{alum-y}} =$ 1.90 ksi
Applied Axial Compression	
$P =$	0.0 lb
$f_{c-\text{alum}} = P/A$	$f_{c-\text{alum}} =$ 0.00 ksi

X-axis Deflection (Wind Load)	Typical Horizontal
N/A in. joint $\Delta_x = (5wL^4)/(384EI_x)$	0.194 in
N/A $\pm$ movement cap. $\Delta_{x-\text{allow}} =$	0.500 in
Allowable deflection = $L/175$ or if span > 13'-6" then allowable def = $L/240 + 1/4"$	Deflection Factor DF = 108.2
Y-axis Deflection (Dead Load)	Typical Horizontal
$\Delta = ((P_{sb}L^3)/(24EI)) + (3L^2 - 4(Ls)^2) + 5wt_{\text{total}}L^4/(384EI)$	$\Delta =$ 0.104 in
	$\Delta_{y-\text{allow}} =$ 0.1250 in

Steel Capacity (X-Axis)	Load Share = 55%
$M_{\text{steel}} = I_{x, \text{steel}} / I_{\text{comb}} =$	$M_{\text{steel}} =$ 671.4 lb-ft
$Mb/\Omega =$	$Mb/\Omega =$ 2938 lb-ft
$Ms/(Mb/\Omega) =$	0.229
Steel Capacity (Y-Axis)	Load Share = 82%
$M_{\text{steel}} = I_{y, \text{steel}} / I_{\text{comb}} =$	$M_{\text{steel}} =$ 329.4 lb-ft
$\Phi * Mb =$	$Mb/\Omega =$ 2938 lb-ft
$Ms/(Mb/\Omega) =$	0.112

X-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	8.76 ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	N/A ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	N/A ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	17.83 ksi
F.2.1 - Open Shape Flexure	7.02 ksi
F.3.1 - Closed Shape Flexure	N/A ksi
X-Axis Bending Interaction	
Allowable X-Axis Bending $F_{bx} =$	7.02 ksi
X-Axis Interaction $f_{b-\text{alum-x}}/F_{bx} =$	0.745

Y-Axis Allowable Loads	$\Omega = 1.65$
B.5.4.1 - Flat Elem. 1 End Support Comp.	N/A ksi
B.5.4.2 - Flat Elem. 2 End Support Comp.	12.57 ksi
B.5.5.2 - Flat Elem. 1 End Support Flexure	13.64 ksi
B.5.5.1 - Flat Elem. 2 End Support Flexure	N/A ksi
F.2.1	F.2.1 7.02 ksi
F.3.1	F.3.1 N/A ksi
Y-Axis Bending Interaction	
Allowable Y-Axis Bending $F_{by} =$	7.02 ksi
Y-Axis Interaction $f_{b-\text{alum-y}}/F_{by} =$	0.271

Axial Allowable Load	
Allowable Axial Compression	4.14 ksi
Compression Interaction $f_{c-\text{alum}}/F_c =$	0.000

Combined Interaction Ratio	
$f_{c-\text{alum}}/F_c + f_{b-\text{alum-x}}/F_{bx} + f_{b-\text{alum-y}}/F_{by} =$	1.016
Stress OK, $\leq 4\%$ over allowable stress. Use 1/4 point setting blocks.	



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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x7-1/2")
Part of: Anchor Summary Sheet
Designer: M. Gorny

Date: 11/3/2016
Proj. No.: JE16059

Typical Wind Pressure (T) = 20.0 psf
Corner Zone Wind Pressure (C) = 24.0 psf
Interior Pressure (INT) = 5.0 psf

INPUT CHECK RISA

Anchor Type
Point

Location	Substrate	Sheet	Elevation	Section	Wind Zone	Mullion Length (ft)	Trib. Width (ft)	Wind Pres. (psf)	Anchor Load (lb)	
Head (T)	Steel	214	1/214	1/313	C	6.49	5.25	24.0	408.8	Check 1)
Head (F)	Steel	214	1/214	1/313	C	6.49	2.63	24.0	204.4	Check 2)
Sill (T)	CFS	214	1/214	1/314	C	6.49	5.25	24.0	408.8	Check 3)
- - -	Concrete	205	1/205	1/311		Refer to RISA-3D Model			702.3	Check 4)
Sill (F)	CFS	214	1/214	1/314	C	6.49	2.63	24.0	204.4	Check 5)
- - -	Concrete	205	1/205	1/311		Refer to RISA-3D Model			277.2	Check 6)

Anchor Design Summary:

- 1: Use (2) 1/4"(min) Elco Driflex into minimum 1/8" thick steel
- 2: Use (2) 1/4"(min) Elco Driflex into minimum 1/8" thick steel
- 3: Use (4) 1/4"(min) Elco Driflex into minimum 16ga, 50ksi CFS
- 4: Use (2) 3/8" Elco Conflex into 4,000psi concrete, minimum edge distance = 2-1/2", minimum embedment = 2-5/8", minimum spacing = 2-5/8"
- 5: Use (4) 1/4"(min) Elco Driflex into minimum 16ga, 50ksi CFS
- 6: Use (1) 3/8" Elco Conflex into 4,000psi concrete, minimum edge distance = 2-1/2", minimum embedment = 2-5/8", minimum spacing = 2-5/8"



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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 7-1/2")
Part of: Anchors to Steel
Elevation: 1/214
Detail: 1/313

Check 1

Use 1/4" Elco Drillflex into minimum 1/8" thick steel

(2) per T anchor

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK

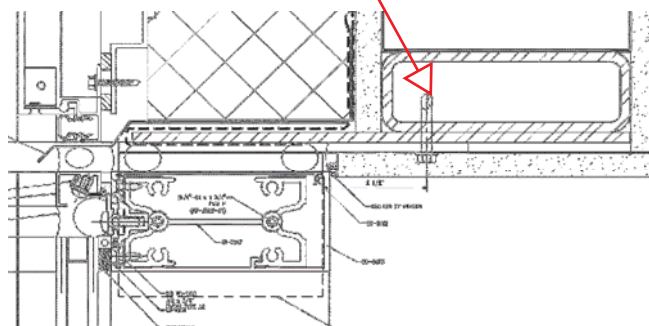
Load Design Criteria: ASCE7-05 ASD
Material Design Criteria: Aluminum Design Manual 2010
Fastener Name: Elco Drillflex
Fastener Material: SAE Grade 5 (SAE J429)
Fastener Type: Screw

Top Hole: ☒ Standard Hole ☐ Long Slotted Hole
Base Hole: ☒ Standard Hole ☐ Long Slotted Hole
☐ Eccentric Shear Design
☐ Eccentric Tension Design

☐ Generic Fastener (TIR A9-91) ☐ Countersunk Screw

Design Pressure: 24.00 psf
Design Shear Load (V): 408.80 lb
Design Tension Load (T): 0.00 lb
Number of Screws: 2.00 screws
Screw Selection (D): 1/4" 0.2500 in
F_{ty1}, F_{tu1} (Top Material): 6063-T5 16, 22 ksi
F_{ty2}, F_{tu2} (Base Material): A36 36, 58 ksi
Thickness of top material (t₁): 0.1875 in
Thickness base material (t₂): 0.1250 in
Distance to edge of top material (d_{e1}): 0.5000 in
Distance to edge of bottom material (d_{e2}): 0.5000 in

Manufacturer Allowable Shear = 0.0 lb
Manufacturer Allowable Tension = 0.0 lb



Moment Arm for screw (L): 0.00 in
Screw Section Modulus (S): 0.001534 in³
Screw Ultimate Tensile: 120 ksi
Bending Moment mod (αM): 1
(bolt fixity α_M=1 free to rotate and =2 rotation restrained)

Factored Fastener Loads (per fastener)			
Fastener Shear (V _{fas})	V / fastener =	204.4	lb
Fastener Tension (T _{fas})	T / fastener =	0.0	lb

Fastened Material Shear Design			
Bearing (ADM J3.7, J.5.6.1, AISC J4.10)			
Top Mat.: R _n = d _{e1} *t ₁ *F _{tu1} ≤ 2*D*t ₁ *F _{tu1}			
Ω = 3 (Aluminum)	R _n /Ω =	687.5	lb
Base Mat.: R _n = 1.2*d _{e2} *t ₂ *F _{tu2} ≤ 2.4*D*t ₂ *F _{tu2}			
Ω = 2 (Steel)	R _n /Ω =	2175.0	lb
Tilting (ADM J.5.6.2)	Ω = 3 ≤ t ₁ ?	YES	
R _n = 4.2*(t ₂ ³ D) ^{1/2} *F _{tu2}	R _n /Ω =	1794.3	lb

Shear load associated with bolt bending (ref Hilti)
M_{UM,5%} = 1.2Sf(1 - T/Ta) M_{UM,5%} = N/A lb-in
V_{rec} = (α_M * M_{UM,5%})/(1.7L) V_{rec} = N/A lb

AISI Cold-Formed Steel Design (Tbl IV-8a) Ω = 3
LGM Shear of sheet P_{ns} = N/A k
P_{ns}*1000/Ω = N/A lb

Allowable Shear / Fastener (V_{allowable}) = 687.5 lb
V_{fas} / V_{allowable} = 0.30 ≤ 1.0

OK.

Fastened Material Tension Design			
Pull-Out (ADM J.5.5.1.1)			
R _n = 1.2*D*Le*F _{ty2}	R _n /Ω =	450.0	lb
Pull-Over (ADM J.5.5.2)			
R _n = (1.0+1.7*t ₁ /Dws)Dws*t ₁ *F _{ty1}	R _n /Ω =	798.8	lb
AISI Cold-Formed Steel Design IV-12			
LGM Pull-Out	P _{not} =	N/A	k
	P _{not} *1000/Ω =	N/A	lb
Allowable Tension / Fastener (T _{allowable}) = 450.0 lb			
T _{fas} / T _{allowable} = 0.00 ≤ 1.0			
OK.			

Fastener Interaction Check			
Ω = 3			
Screw Shear (V _{TIR})	(AAMA TIR A9 Table 20.3)	646.0	lb
Screw Tension (T _{TIR})	(AAMA TIR A9 Table 20.3)	1273.0	lb
Typical:	V _{fas} / V _{TIR} + T _{fas} / T _{TIR} =	0.32	≤ 1.0
TIR A9-91:	(V _{fas} / V _{TIR}) ² + (T _{fas} / T _{TIR}) ² =	N/A	≤ 1.0
OK.			

Use (2) 1/4" Elco Drillflex Screws.



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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 7-1/2")
Part of: Anchors to Steel
Elevation: 1/214
Detail: 1/313

Use 1/4" Elco Drilflex into minimum 1/8" thick steel

(2) per F anchor, see sketch below

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

Check 2

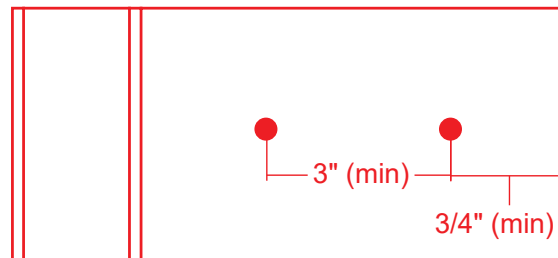
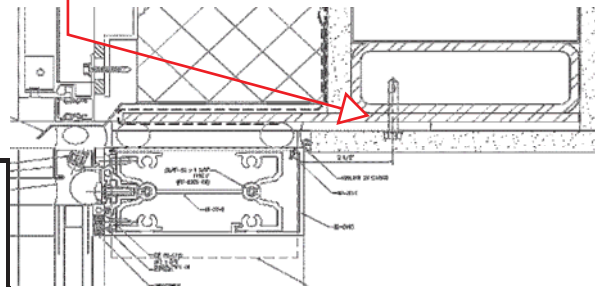
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FASTENER PROPERTIES:

Fastener Type =	Elco Dril Flex
Fastener Size =	1/4-14
Nominal Diameter, D =	0.250 in
Area, A =	0.049 in ²
Allowable Shear per Spec, V _a =	687.5 lb

DESIGN LOADING / ORIENTATION:

Design Load, P =	204.40 lb
Design Moment, M _{c.g.} =	0.00 lb-in
Angle of Load, θ =	90.00 deg
Horz. Dist. from Centroid, x =	0.00 in
Vert. Dist. From Centroid, y =	3.81 in



FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 2

Fasteners per Row

N _{R1} =	1
N _{R2} =	1
N _{R3} =	
N _{R4} =	
N _{R5} =	

Fasteners per Column

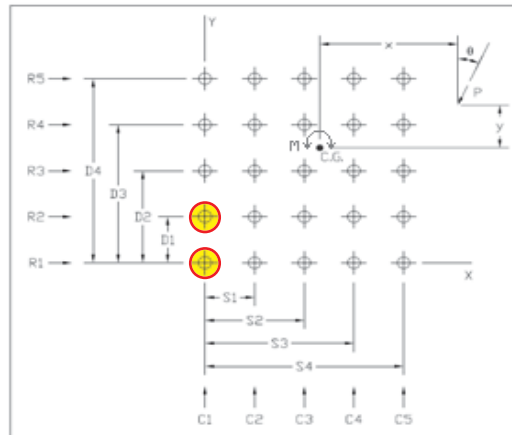
N _{C1} =	2
N _{C2} =	
N _{C3} =	
N _{C4} =	
N _{C5} =	

Row Dimensions

D ₁ =	3.00 in
D ₂ =	
D ₃ =	
D ₄ =	

Column Dimensions

S ₁ =		in
S ₂ =		in
S ₃ =		in
S ₄ =		in



Centroid, x =	0.00 in
Centroid, y =	1.50 in

FASTENER CALCULATIONS:

Σx ² =	0.00 in ²
Σy ² =	4.50 in ²
Σx ² + Σy ² =	4.50 in ²
M =	-779.28 lb-in

f _y =	0.00 ksi	← Vert Stress Due to Eccentric Shear
f _{sy} =	0.00 psi	← Vert Stress Due to Direct Shear
f _x =	5291.75 psi	← Horiz Stress Due to Eccentric Shear
f _{sx} =	2082.00 psi	← Horiz Stress Due to Direct Shear

f =	7373.75 psi	← Maximum Bolt Stress
V =	361.96 lb	← Maximum Bolt Load
V _a =	687.500 lb	OK



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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 7-1/2")
Part of: Anchors to CFS
Elevation: 1/214
Detail: 1/314

Use 1/4" Elco Drilflex into minimum
16ga, 50ksi steel

(4) per T anchor, see sketch below

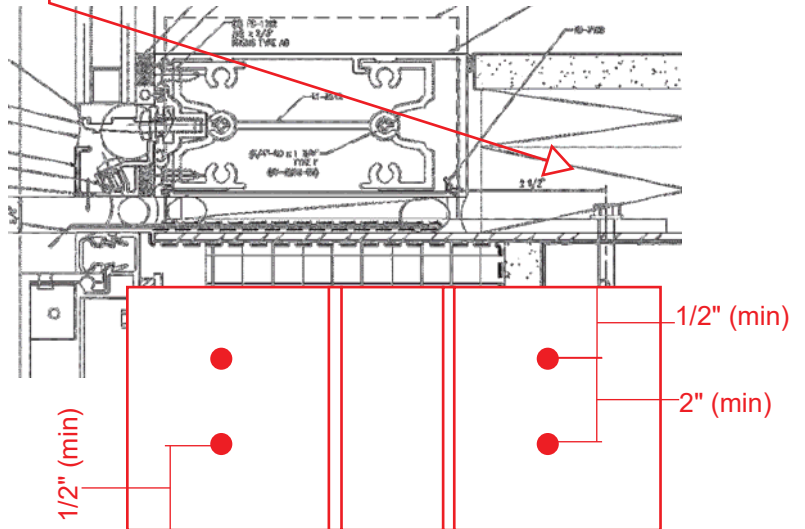
Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT CHECK

Load Design Criteria: ASCE7-05 ASD
Material Design Criteria: Aluminum Design Manual 2010
Fastener Name: Elco Drilflex
Fastener Material: SAE Grade 5 (SAE J429)
Fastener Type: Screw

Top Hole: ☒ Standard Hole ☐ Long Slotted Hole
Base Hole: ☒ Standard Hole ☐ Long Slotted Hole
☐ Eccentric Shear Design
☐ Eccentric Tension Design
☐ Generic Fastener (TIR A9-91) ☐ Countersunk Screw

Design Pressure		24.00	psf
Design Shear Load (V)		408.80	lb
Design Tension Load (T)		0.00	lb
Number of Screws		4.00	screws
Screw Selection (D)	1/4"	0.2500	in
F _{ty1} , F _{tu1} (Top Material)	6063-T5	16, 22	ksi
F _{ty2} , F _{tu2} (Base Material)	A653 Gr. 50	50, 65	ksi
Thickness of top material (t ₁)		0.1875	in
Thickness base material (t ₂)		0.0566	in
Distance to edge of top material (d _{e1})		0.5000	in
Distance to edge of bottom material (d _{e2})		0.5000	in

Manufacturer Allowable Shear = 560.3 lb
Manufacturer Allowable Tension = 176.7 lb



Moment Arm for screw (L) 0.00 in
Screw Section Modulus (S) 0.001534 in³
Screw Ultimate Tensile 120 ksi
Bending Moment mod (αM) 1
(bolt fixity α_M=1 free to rotate and =2 rotation restrained)

Factored Fastener Loads (per fastener)			
Fastener Shear (V _{fas})	V / fastener =	102.2	lb
Fastener Tension (T _{fas})	T / fastener =	0.0	lb

Fastened Material Shear Design			
Bearing (ADM J3.7, J.5.6.1, AISC J4.10)			
Top Mat.: R _n = d _{e1} *t ₁ *F _{tu1} ≤ 2*D*t ₁ *F _{tu1}			
Ω = 3 (Aluminum)	R _n /Ω =	687.5	lb
Base Mat.: R _n = 1.2*D*t ₂ *F _{tu2} ≤ 2.4*D*t ₂ *F _{tu2}			
Ω = 2 (Steel)	R _n /Ω =	1103.7	lb
Tilting (ADM J.5.6.2)	Ω = 3 ≤ t ₁ ?	YES	
R _n = 4.2*(t ₂ ³ D) ^{1/2} *F _{tu2}	R _n /Ω =	612.7	lb

Shear load associated with bolt bending (ref Hilti)
M_{UM,5%} = 1.2Sf(1 - T/Ta) M_{UM,5%} = N/A lb-in
V_{rec} = (α_M * M_{UM,5%})/(1.7L) V_{rec} = N/A lb

AISI Cold-Formed Steel Design (Tbl IV-8a) Ω = 3
LGM Shear of sheet P_{ns} = 1.840 k
Using 0.0566" LGM P_{ns}*1000/Ω = 613.3 lb

Allowable Shear / Fastener (V_{allowable}) = 560.3 lb
V_{fas} / V_{allowable} = 0.18 ≤ 1.0
OK.

Fastened Material Tension Design			
Pull-Out (ADM J.5.5.1.1)			
R _n = 1.01*D*Le*F _{ty2}	R _n /Ω =	N/A	lb
Pull-Over (ADM J.5.5.2)			
R _n = (1.0+1.7*t ₁ /Dws)Dws*t ₁ *F _{ty1}	R _n /Ω =	798.8	lb
AISI Cold-Formed Steel Design IV-12			
LGM Pull-Out	P _{not} =	0.782	k
Using 0.0566" LGM	P _{not} *1000/Ω =	260.7	lb
Allowable Tension / Fastener (T _{allowable}) =		176.7	lb
T _{fas} / T _{allowable} =		0.00	≤ 1.0
OK.			

Fastener Interaction Check			
Ω = 3			
Screw Shear (V _{TIR})	(AAMA TIR A9 Table 20.3)	646.0	lb
Screw Tension (T _{TIR})	(AAMA TIR A9 Table 20.3)	1273.0	lb
Typical:	V _{fas} / V _{TIR} + T _{fas} / T _{TIR} =	0.16	≤ 1.0
TIR A9-91:	(V _{fas} / V _{TIR}) ² + (T _{fas} / T _{TIR}) ² =	N/A	≤ 1.0
OK.			

Use (4) 1/4" Elco Drilflex Screws.



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Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x7- 1/2")
Part of: Anchors to Concrete
Elevation: 1/205
Detail: 1/311 **Check 4**

Use 3/8" Elco Conflex into 4000psi concrete
minimum embedment = 2-1/2"
minimum spacing = 2-5/8"
minimum concrete edge distance = 2-5/8"
(2) per T anchors

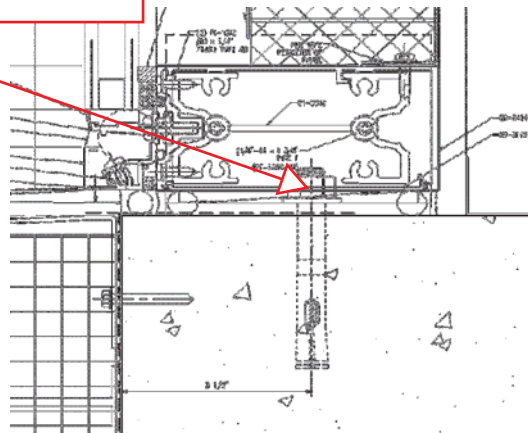
Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK

Design Criteria: ADM 2010 / AAMA TIR A9-91
Design Basis: N/A

Fastener Type: Elco Conflex

Design Wind Pressure 24.00 psf
Design Shear Load (V) 702.30 lb
Design Tension Load (T) 0.00 lb
Number of Screws 1 screws
Screw Selection (D) 3/8-in 0.3750 in
F_{tu1} of top material 22 ksi
Thickness of top material (t₁) 0.188 in
Distance to edge of part (d_e) 0.750 in
Embedment 2.5 in
Concrete Strength 4000 psi
Published Load Values:
Elco Conflex Allowable Shear 820 lb
Elco Conflex Allowable Tension 905 lb
Moment arm for screw (L) 0.00 in
Screw Section Modulus (S) 0.00518 in³
Screw Ultimate Tensile Strength 163 ksi
Bending Moment mod (αM) 1 (bolt fixity at standoff α_M=1 free to rotate and =2 rotation restrained)



Calculated Reduction Factors			
Edge			
	Spacing	Distance	
Shear	1.00	1.00	
Tension	1.00	1.00	
Number of reductions (due to group geometry)			
	Spacing	Edge Distance	Final Allowable Capacity (lb)
Shear	1.0	1.0	820
Tension	1.0	1.0	905

Capacity = Allowable Load * Shear Factor ^ (num. reduc.)

* Tension Factor ^ (num. reduc.)

Screw Attachment Design		Ω = 3
Bearing (ADM J.5.6.1)		
$R_n/\Omega = d_e t_1 F_{tu1}/\Omega \leq 2 D t_1 F_{tu1}/\Omega$	$R_n/\Omega =$	1031.3 lb
Shear load associated with bolt bending (2011 Hilti Anchor Guide)		
$M_{uM,5\%} = 1.2 S_f (1 - T/T_a)$	$M_{uM,5\%} =$	1012.7 lb-in
$V_{rec} = (\alpha_M * M_{uM,5\%})/(1.7L)$	$V_{rec} =$	N/A lb
Screw Shear (AAMA TIR A9)		1937.0 lb
Allowable Fastener Shear V _a =		819.7 lb
Pull-Over (ADM J.5.5.2)		
$R_n/\Omega = C_{pov} t_1 F_{tu1} (D_{ws} - D_h)/\Omega$	$R_n/\Omega =$	343.8 lb
Screw Tension (AAMA TIR A9)		3720.0 lb
Allowable Fastener Tension T _a =		343.8 lb
V/screw =		702.30 lb
T/screw =		0.00 lb
Interaction Formula < 1.0		0.86 < 1.0
Use (1) 3/8-in Elco Conflex		

	Spacing	Edge Dist.
Installed Dist.	2.63	2.63
Shear Factors		
Critical. Dist.	2.63	2.63
Minimum Dist.	2.63	2.63
Load Factor @ Minimum	1.00	1.00
Tension Factors		
Critical. Dist.	2.63	2.63
Minimum Dist.	2.63	2.63
Load Factor @ Minimum	1.00	1.00

OK



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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 7-1/2")
Part of: Anchors to CFS
Elevation: 1/214
Detail: 1/314

Use 1/4" Elco Drillflex into minimum
16ga, 50ksi steel

(4) per F anchor, see sketch below

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

Check 5

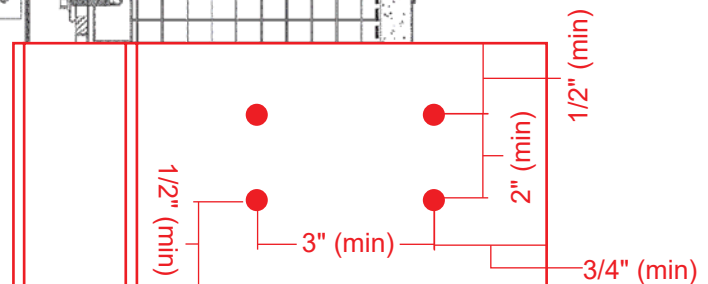
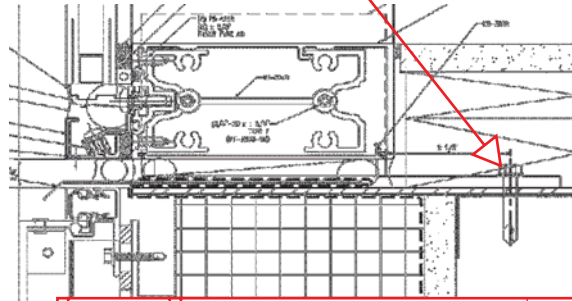
INPUT CHECK

FASTENER PROPERTIES:

Fastener Type =	Elco Drill Flex
Fastener Size =	1/4-14
Nominal Diameter, D =	0.250 in
Area, A =	0.049 in ²
Allowable Shear per Spec, V _a =	560.3 lb

DESIGN LOADING / ORIENTATION:

Design Load, P =	204.40 lb
Design Moment, M _{c.g.} =	0.00 lb-in
Angle of Load, θ =	90.00 deg
Horz. Dist. from Centroid, x =	0.00 in
Vert. Dist. From Centroid, y =	3.81 in



FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 4

Fasteners per Row

N _{R1} =	2
N _{R2} =	2
N _{R3} =	
N _{R4} =	
N _{R5} =	

Fasteners per Column

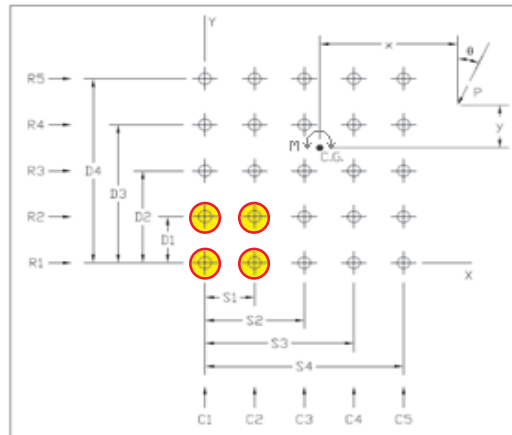
N _{C1} =	2
N _{C2} =	2
N _{C3} =	
N _{C4} =	
N _{C5} =	

Row Dimensions

D ₁ =	3.00 in
D ₂ =	
D ₃ =	
D ₄ =	

Column Dimensions

S ₁ =	2.00 in
S ₂ =	
S ₃ =	
S ₄ =	



Centroid, x =	1.00 in
Centroid, y =	1.50 in

FASTENER CALCULATIONS:

$\sum x^2 =$	4.00 in ²
$\sum y^2 =$	9.00 in ²
$\sum x^2 + \sum y^2 =$	13.00 in ²
M =	-779.28 lb-in

f _y =	1221.17 ksi
f _{sy} =	0.00 psi
f _x =	1831.76 psi
f _{sx} =	1041.00 psi

← Vert Stress Due to Eccentric Shear
← Vert Stress Due to Direct Shear
← Horiz Stress Due to Eccentric Shear
← Horiz Stress Due to Direct Shear

f =	3121.54 psi
V =	153.23 lb
V _a =	560.300 lb

← Maximum Bolt Stress
← Maximum Bolt Load

OK



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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 7-1/2")
Part of: Anchors to Concrete
Elevation: 1/205
Detail: 1/311

Use 3/8" Elco Conflex into 4000psi concrete
minimum embedment = 2-1/2"
minimum spacing = 2-5/8"
minimum concrete edge distance = 2-5/8"

(2) per F anchors, see sketch below for
F-anchor layout

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

Check 6

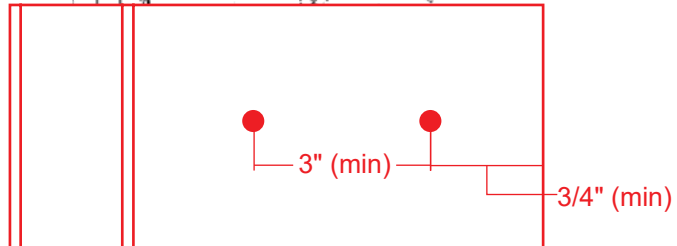
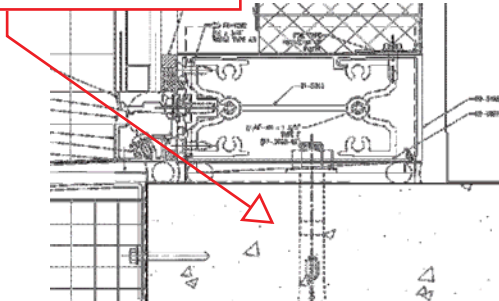
INPUT CHECK

FASTENER PROPERTIES:

Fastener Type =	Elco Conflex
Fastener Size =	3/8-in
Nominal Diameter, D =	0.375 in
Area, A =	0.110 in ²
Allowable Shear per Spec, V _a =	820.0 lb

DESIGN LOADING / ORIENTATION:

Design Load, P =	277.20 lb
Design Moment, M _{c.g.} =	0.00 lb-in
Angle of Load, θ =	90.00 deg
Horz. Dist. from Centroid, x =	0.00 in
Vert. Dist. From Centroid, y =	3.81 in



FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 2

Fasteners per Row

N _{R1} =	1
N _{R2} =	1
N _{R3} =	
N _{R4} =	
N _{R5} =	

Fasteners per Column

N _{C1} =	2
N _{C2} =	
N _{C3} =	
N _{C4} =	
N _{C5} =	

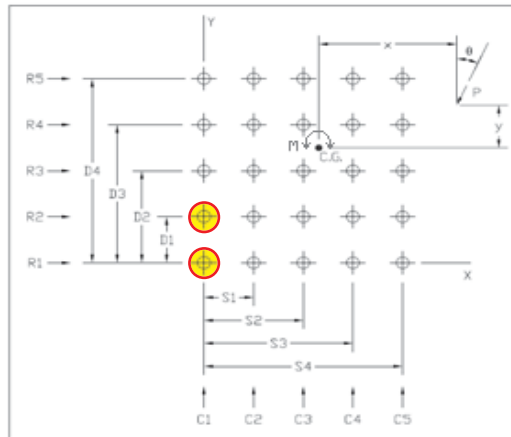
Row Dimensions

D ₁ =	3.00 in
D ₂ =	
D ₃ =	
D ₄ =	

Column Dimensions

S ₁ =		in
S ₂ =		in
S ₃ =		in
S ₄ =		in

Centroid, x =	0.00 in
Centroid, y =	1.50 in



FASTENER CALCULATIONS:

$\sum x^2 =$	0.00 in ²
$\sum y^2 =$	4.50 in ²
$\sum x^2 + \sum y^2 =$	4.50 in ²
M =	-1056.83 lb-in

f _y =	0.00 ksi	← Vert Stress Due to Eccentric Shear
f _{sy} =	0.00 psi	← Vert Stress Due to Direct Shear
f _x =	3189.55 psi	← Horiz Stress Due to Eccentric Shear
f _{sx} =	1254.90 psi	← Horiz Stress Due to Direct Shear

f =	4444.45 psi	← Maximum Bolt Stress
V =	490.88 lb	← Maximum Bolt Load
V _a =	820.000 lb	OK



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Client: NGG

Project: Webster University

Structure: YKK 750 (2-1/2" x 6-9/16")

Part of: Anchor Summary Sheet

Designer: M. Gorny

Date: 11/3/2016

Proj. No.: JE16059

Typical Wind Pressure (T) = 20.0 psf
Corner Zone Wind Pressure (C) = 24.0 psf
Interior Pressure (INT) = 5.0 psf

Anchor Type
Point

INPUT CHECK RISA

Location	Substrate	Sheet	Elevation	Section	Wind Zone	Mullion Length (ft)	Trib. Width (ft)	Wind Pres. (psf)	Anchor Load (lb)	
Head (T)	CFS	202	1/202	1/302	C	11.24	3.01	24.0	406.0	
---	---	202, 204	2/202, 1/204	1/302	C	11.24	5.00	24.0	674.4	1)
---	---	203	1/203	1/302	C	11.24	4.56	24.0	614.7	
---	---	204	2/204	1/302	C	11.24	4.30	24.0	579.9	
Head (F)	CFS	202, 204	2/202, 1/204	1/302	C	11.24	2.39	24.0	321.7	2)
Sill (T)	CFS	216	1/216	1/316		Refer to RISA-3D Model			583.6	3)
---	Concrete	202, 204	2/202, 1/204	1/300	C	11.24	5.00	24.0	674.4	4)
---	---	203	1/203	1/300	C	11.24	4.56	24.0	614.7	
Sill (F)	CFS	217	1/217	1/316		Refer to RISA-3D Model			22.9	5)
---	Concrete	202, 204	2/202, 1/204	1/300	C	11.24	2.39	24.0	321.7	6)
Sill (U)	Concrete	202	1/202	1/401	C	11.24	3.01	24.0	406.0	7)
---	---	204	2/204	1/401	C	12.17	2.38	20.0	289.6	

Anchor Design Summary:

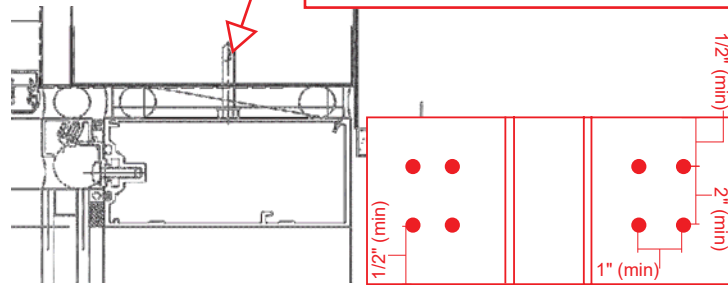
- 1: Use (8) 1/4"(min) Elco Driflex into minimum 16ga, 50ksi CFS
- 2: Use (4) 1/4"(min) Elco Driflex into minimum 16ga, 50ksi CFS
- 3: Use (4) 1/4"(min) Elco Driflex into minimum 16ga, 50ksi CFS
- 4: Use (2) 3/8" Elco Conflex into 4,000psi concrete, minimum embedment = 2-1/2", minimum edge distance = 2-5/8", minimum spacing = 2-5/8"
(by comparison to 7-1/2" anchor analysis, Check 4)
- 5: Use (4) 1/4"(min) Elco Driflex into minimum 16ga, 50ksi CFS **(by comparison to 7-1/2" anchor analysis, Check 5)**
- 6: Use (2) 3/8" Elco Conflex into 4,000psi concrete, minimum embedment = 2-1/2", minimum edge distance = 2-5/8", minimum spacing = 2-5/8"
- 7: Use (1) 3/8" Elco Conflex into 4,000psi concrete, minimum embedment = 2-1/2", minimum edge distance = 1-7/8", minimum spacing = 1-7/8"



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7280 NW 87th Terrace, Suite C-208
Kansas City, MO 64153

Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 6-9/16")
Part of: Anchors to CFS
Elevation: 2/202, 1/204
Detail: 1/302 **Check 1**

INPUT CHECK



Office: 816-505-0987
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Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

FASTENER PROPERTIES:

Fastener Type = Elco Drillflex
Fastener Size = 1/4-in
Nominal Diameter, D = 0.25 in
Area, A = 0.05 in²
Allowable Shear per Spec, V_a = 560.30 lb
Allowable Tension per Spec, T_s = 176.70 lb

DESIGN LOADING / ORIENTATION:

Design Load, P = 674.40 lb
Design Moment, M_{c.g.} = 0.00 lb-in
Angle of Load, θ = 90.00 deg
Horz. Dist. from Centroid, x = 0.00 in
Vert. Dist. From Centroid, y = 3.13 in
Load Eccentricity from Bolt Plane, z = 1.63 in
Fastener Edge Distance, E = 0.50 in
Axis of Rotation for Tension Analysis = Y Axis

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners:

8

Fasteners per Row

N_{R1} = 2
N_{R2} = 2
N_{R3} = 2
N_{R4} = 2
N_{R5} = 0

Fasteners per Column

N_{C1} = 4
N_{C2} = 4
N_{C3} = 0
N_{C4} = 0
N_{C5} = 0

Row Dimensions

D₁ = 1.000 in
D₂ = 5.250 in
D₃ = 6.250 in
D₄ = 0.000 in

Column Dimensions

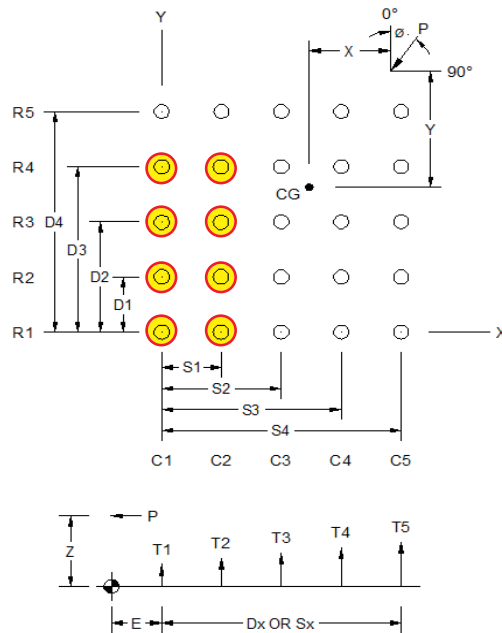
S₁ = 2.000 in
S₂ = 0.000 in
S₃ = 0.000 in
S₄ = 0.000 in

Bolt Group Centroid (CG)

Centroid, x = 1.000 in
Centroid, y = 3.125 in

Design Load Components

Design Load, P_x = 674.40 lb
Design Load, P_y = 0.00 lb



FASTENER CALCULATIONS:

$$\begin{aligned}\sum x^2 &= 8.00 \text{ in}^2 \\ \sum y^2 &= 57.13 \text{ in}^2 \\ \sum x^2 + \sum y^2 &= 65.13 \text{ in}^2 \\ M &= -2107.50 \text{ lb-in}\end{aligned}$$

$$\begin{aligned}f_y &= 659.25 \text{ ksi} \\ f_{sy} &= 0.00 \text{ psi} \\ f_x &= 2060.16 \text{ psi} \\ f_{sx} &= 1717.35 \text{ psi}\end{aligned}$$

← Vert Stress Due to Eccentric Shear
← Vert Stress Due to Direct Shear
← Horiz Stress Due to Eccentric Shear
← Horiz Stress Due to Direct Shear

Bolt Tension by Column

T₁ = 21.08 lb/bolt
T₂ = 105.38 lb/bolt
T₃ = 0 lb/bolt
T₄ = 0 lb/bolt
T₅ = 0 lb/bolt

$$\begin{aligned}f &= 3834.60 \text{ psi} \\ V &= 188.23 \text{ lb} \\ V_a &= 560.30 \text{ lb} \\ T &= 105.38 \text{ lb} \\ T_a &= 176.70 \text{ lb}\end{aligned}$$

← Maximum Bolt Shear Stress
← Maximum Bolt Shear
OK
← Maximum Bolt Tension
OK

Interaction Values

Standard Bolts

$$\frac{V/V_a + T/T_a}{0.932} < 1.0 \quad \text{OK}$$

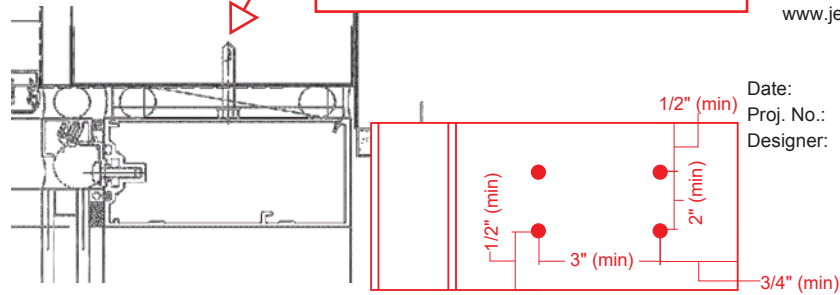
TIR Fasteners

$$\frac{(V/V_a)^2 + (T/T_a)^2}{0.468} < 1.0 \quad \text{OK}$$



JEI Structural Engineering
7280 NW 87th Terrace, Suite C-208
Kansas City, MO 64153

Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 6-9/16")
Part of: Anchors to CFS
Elevation: 2/202, 1/204
Detail: 1/302 **Check 2**



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Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK

FASTENER PROPERTIES:

Fastener Type = Elco Driflex
Fastener Size = 1/4-in
Nominal Diameter, D = 0.25 in
Area, A = 0.05 in²
Allowable Shear per Spec, V_a = 560.30 lb
Allowable Tension per Spec, T_s = 176.70 lb

DESIGN LOADING / ORIENTATION:

Design Load, P = 321.70 lb
Design Moment, M_{c.g.} = 0.00 lb-in
Angle of Load, θ = 90.00 deg
Horz. Dist. from Centroid, x = 0.00 in
Vert. Dist. From Centroid, y = 3.81 in
Load Eccentricity from Bolt Plane, z = 1.63 in
Fastener Edge Distance, E = 0.50 in
Axis of Rotation for Tension Analysis = Y Axis

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners:

4

Fasteners per Row

N_{R1} = 2
N_{R2} = 2
N_{R3} = 0
N_{R4} = 0
N_{R5} = 0

Fasteners per Column

N_{C1} = 2
N_{C2} = 2
N_{C3} = 0
N_{C4} = 0
N_{C5} = 0

Row Dimensions

D₁ = 3.000 in
D₂ = 0.000 in
D₃ = 0.000 in
D₄ = 0.000 in

Column Dimensions

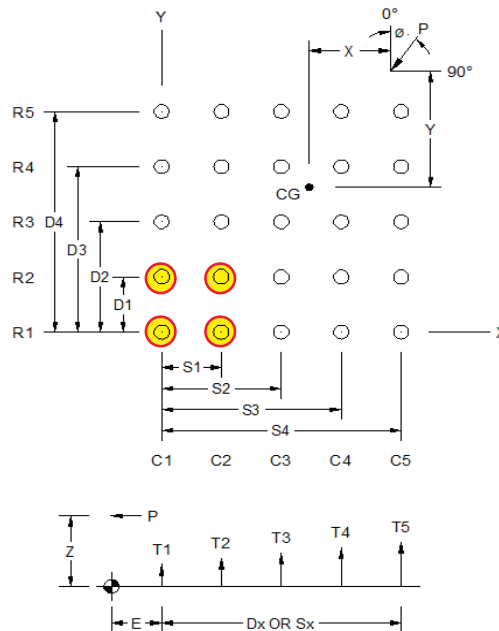
S₁ = 2.000 in
S₂ = 0.000 in
S₃ = 0.000 in
S₄ = 0.000 in

Bolt Group Centroid (CG)

Centroid, x = 1.000 in
Centroid, y = 1.500 in

Design Load Components

Design Load, P_x = 321.70 lb
Design Load, P_y = 0.00 lb



FASTENER CALCULATIONS:

$$\begin{aligned}\sum x^2 &= 4.00 \text{ in}^2 \\ \sum y^2 &= 9.00 \text{ in}^2 \\ \sum x^2 + \sum y^2 &= 13.00 \text{ in}^2 \\ M &= -1226.48 \text{ lb-in}\end{aligned}$$

$$\begin{aligned}f_y &= 1921.97 \text{ ksi} \\ f_{sy} &= 0.00 \text{ psi} \\ f_x &= 2882.96 \text{ psi} \\ f_{sx} &= 1638.40 \text{ psi}\end{aligned}$$

← Vert Stress Due to Eccentric Shear
← Vert Stress Due to Direct Shear
← Horiz Stress Due to Eccentric Shear
← Horiz Stress Due to Direct Shear

Bolt Tension by Column

T₁ = 20.11 lb/bolt
T₂ = 100.53 lb/bolt
T₃ = 0 lb/bolt
T₄ = 0 lb/bolt
T₅ = 0 lb/bolt

$$\begin{aligned}f &= 4912.92 \text{ psi} \\ V &= 241.16 \text{ lb} \\ V_a &= 560.30 \text{ lb} \\ T &= 100.53 \text{ lb} \\ T_a &= 176.70 \text{ lb}\end{aligned}$$

← Maximum Bolt Shear Stress
← Maximum Bolt Shear
OK
← Maximum Bolt Tension
OK

Interaction Values

Standard Bolts

$$\frac{V/V_a + T/T_a}{0.999} < 1.0 \quad \text{OK}$$

TIR Fasteners

$$\frac{(V/V_a)^2 + (T/T_a)^2}{0.509} < 1.0 \quad \text{OK}$$



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Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 6-9/16")
Part of: Anchors to CFS
Elevation: 1/216
Detail: 1/316

Check 3

Load Design Criteria: ASCE7-05 ASD
Material Design Criteria: Aluminum Design Manual 2010
Fastener Name: Elco Drilflex
Fastener Material: SAE Grade 5 (SAE J429)
Fastener Type: Screw

Top Hole: ☒ Standard Hole ☐ Long Slotted Hole
Base Hole: ☒ Standard Hole ☐ Long Slotted Hole
☐ Eccentric Shear Design
☐ Eccentric Tension Design
☐ Generic Fastener (TIR A9-91) ☐ Countersunk Screw

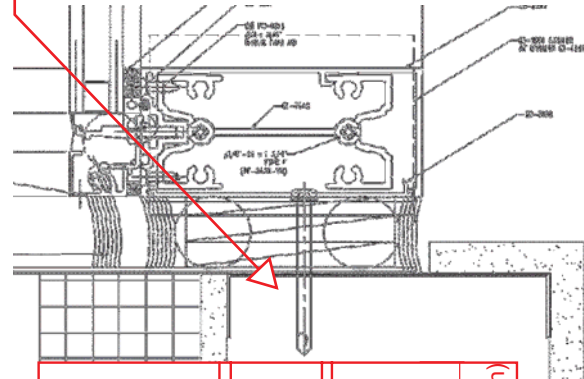
Design Pressure: 24.00 psf
Design Shear Load (V): 583.60 lb
Design Tension Load (T): 0.00 lb
Number of Screws: 4.00 screws
Screw Selection (D): 1/4" 0.2500 in
F_{ty1}, F_{tu1} (Top Material): 6063-T5 16, 22 ksi
F_{ty2}, F_{tu2} (Base Material): A653 Gr. 50 50, 65 ksi
Thickness of top material (t₁): 0.1875 in
Thickness base material (t₂): 0.0566 in
Distance to edge of top material (d_{e1}): 0.5000 in
Distance to edge of bottom material (d_{e2}): 0.5000 in

Manufacturer Allowable Shear = 560.3 lb
Manufacturer Allowable Tension = 176.7 lb

Use 1/4" Elco Drilflex into minimum
18ga, 50ksi steel

(4) per T anchor, see sketch below

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT CHECK



Moment Arm for screw (L): 0.00 in
Screw Section Modulus (S): 0.001534 in³
Screw Ultimate Tensile: 120 ksi
Bending Moment mod (αM): 1
(bolt fixity α_M=1 free to rotate and =2 rotation restrained)

Factored Fastener Loads (per fastener)			
Fastener Shear (V _{fas})	V / fastener =	145.9 lb	
Fastener Tension (T _{fas})	T / fastener =	0.0 lb	

Fastened Material Shear Design			
Bearing (ADM J3.7, J.5.6.1, AISC J4.10)			
Top Mat.: R _n = d _{e1} *t ₁ *F _{tu1} ≤ 2*D*t ₁ *F _{tu1}			
Ω = 3 (Aluminum)	R _n /Ω =	687.5 lb	
Base Mat.: R _n = 1.2*d _{e2} *t ₂ *F _{tu2} ≤ 2.4*D*t ₂ *F _{tu2}			
Ω = 2 (Steel)	R _n /Ω =	1103.7 lb	
Tilting (ADM J.5.6.2)	Ω = 3 ≤ t ₁ ?	YES	
R _n = 4.2*(t ₂ ³ D) ^{1/2} *F _{tu2}	R _n /Ω =	612.7 lb	

Shear load associated with bolt bending (ref Hilti)
M_{UM,5%} = 1.2Sf(1 - T/Ta) M_{UM,5%} = N/A lb-in
V_{rec} = (α_M * M_{UM,5%})/(1.7L) V_{rec} = N/A lb

AISI Cold-Formed Steel Design (Tbl IV-8a) Ω = 3
LGM Shear of sheet P_{ns} = 1.840 k
Using 0.0566" LGM P_{ns}*1000/Ω = 613.3 lb

Allowable Shear / Fastener (V_{allowable}) = 560.3 lb
V_{fas} / V_{allowable} = 0.26 ≤ 1.0
OK.

Fastened Material Tension Design			
Pull-Out (ADM J.5.5.1.1)			
R _n = 1.01*D*Le*F _{ty2}	R _n /Ω =	N/A lb	Ω = 3
Pull-Over (ADM J.5.5.2)			
R _n = (1.0+1.7*t ₁ /Dws)Dws*t ₁ *F _{ty1}	R _n /Ω =	798.8 lb	Ω = 3
AISI Cold-Formed Steel Design IV-12			
LGM Pull-Out	P _{not} =	0.782 k	
Using 0.0566" LGM	P _{not} *1000/Ω =	260.7 lb	
Allowable Tension / Fastener (T _{allowable}) =		176.7 lb	
T _{fas} / T _{allowable} =		0.00 ≤ 1.0	
OK.			

Fastener Interaction Check			
Ω = 3			
Screw Shear (V _{TIR})	(AAMA TIR A9 Table 20.3)	646.0 lb	
Screw Tension (T _{TIR})	(AAMA TIR A9 Table 20.3)	1273.0 lb	
Typical:	V _{fas} / V _{TIR} + T _{fas} / T _{TIR} =	0.23 ≤ 1.0	
TIR A9-91:	(V _{fas} / V _{TIR}) ² + (T _{fas} / T _{TIR}) ² =	N/A ≤ 1.0	
OK.			

Use (4) 1/4" Elco Drilflex Screws.



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Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 6-9/16")
Part of: Anchors to Concrete
Elevation: 2/202, 1/204
Detail: 1/300

Use 3/8" Elco Conflex into 4000psi concrete
minimum embedment = 2-1/2"
minimum spacing = 2-5/8"
minimum concrete edge distance = 2-5/8"

(2) per F anchors, see sketch below for F-anchor layout

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

Check 6

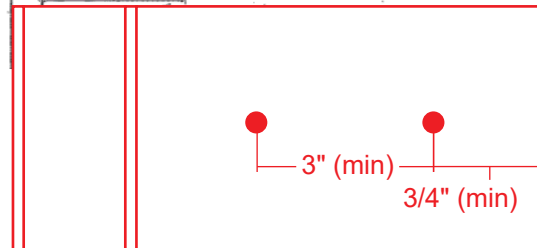
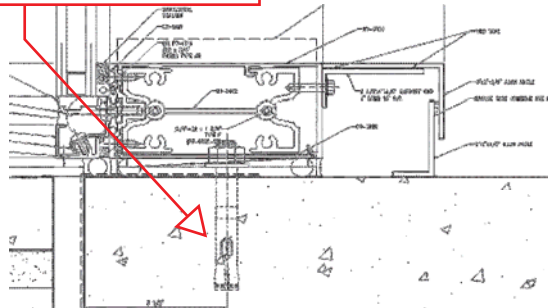
INPUT CHECK

FASTENER PROPERTIES:

Fastener Type =	Elco Conflex
Fastener Size =	3/8-in
Nominal Diameter, D =	0.375 in
Area, A =	0.110 in ²
Allowable Shear per Spec, V _a =	820.0 lb

DESIGN LOADING / ORIENTATION:

Design Load, P =	321.70 lb
Design Moment, M _{c.g.} =	0.00 lb-in
Angle of Load, θ =	90.00 deg
Horz. Dist. from Centroid, x =	0.00 in
Vert. Dist. From Centroid, y =	3.81 in



FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 2

Fasteners per Row

N _{R1} =	1
N _{R2} =	1
N _{R3} =	
N _{R4} =	
N _{R5} =	

Fasteners per Column

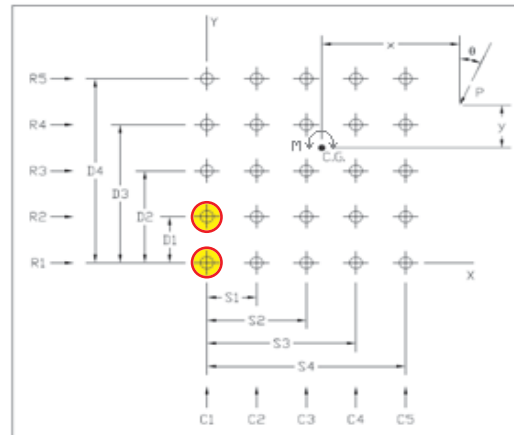
N _{C1} =	2
N _{C2} =	
N _{C3} =	
N _{C4} =	
N _{C5} =	

Row Dimensions

D ₁ =	3.00 in
D ₂ =	
D ₃ =	
D ₄ =	

Column Dimensions

S ₁ =		in
S ₂ =		in
S ₃ =		in
S ₄ =		in



Centroid, x =	0.00 in
Centroid, y =	1.50 in

FASTENER CALCULATIONS:

Σx ² =	0.00 in ²
Σy ² =	4.50 in ²
Σx ² + Σy ² =	4.50 in ²
M =	-1226.48 lb-in

f _y =	0.00 ksi	← Vert Stress Due to Eccentric Shear
f _{sy} =	0.00 psi	← Vert Stress Due to Direct Shear
f _x =	3701.58 psi	← Horiz Stress Due to Eccentric Shear
f _{sx} =	1456.36 psi	← Horiz Stress Due to Direct Shear

f =	5157.94 psi	← Maximum Bolt Stress
V =	569.68 lb	← Maximum Bolt Load
V _a =	820.000 lb	OK



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7280 NW 87th Terrace, Suite C-208
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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 6-9/16")
Part of: Anchors to Concrete
Elevation: 1/202
Detail: 1/401 **Check 7**

Use 3/8" Elco Conflex into 4000psi concrete
minimum embedment = 2-1/2"
minimum spacing = 2-5/8"
minimum concrete edge distance = 2-5/8"

(1) per U anchors
miter off leg of F-anchor

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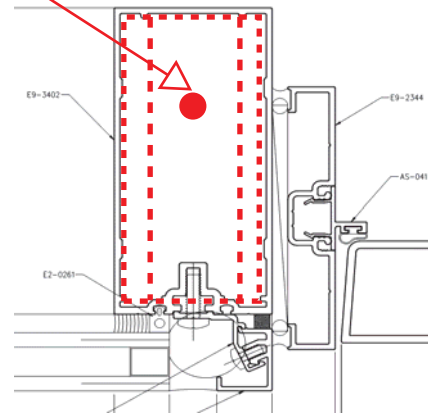
Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK

Design Criteria: ADM 2010 / AAMA TIR A9-91
Design Basis: N/A

Fastener Type: Elco Conflex

Design Wind Pressure	24.00	psf
Design Shear Load (V)	406.00	lb
Design Tension Load (T)	0.00	lb
Number of Screws	1	screws
Screw Selection (D)	3/8-in	0.3750 in
F _{tu1} of top material	22	ksi
Thickness of top material (t ₁)	0.188	in
Distance to edge of part (d _e)	0.750	in
Embedment	2.5	in
Concrete Strength	4000	psi
<u>Published Load Values:</u>		
Elco Conflex Allowable Shear	820	lb
Elco Conflex Allowable Tension	905	lb
Moment arm for screw (L)	0.00	in
Screw Section Modulus (S)	0.00518	in ³
Screw Ultimate Tensile Strength	163	ksi
Bending Moment mod (αM)	1	(bolt fixity at standoff α _M =1 free to rotate and =2 rotation restrained)



Calculated Reduction Factors

Edge			
Spacing		Distance	
Shear	1.00	1.00	
Tension	1.00	1.00	
Number of reductions (due to group geometry)			
Spacing		Edge Distance	Final Allowable Capacity (lb)
Shear	1.0	1.0	820
Tension	1.0	1.0	905

Capacity = Allowable Load * Shear Factor ^ (num. reduc.)

* Tension Factor ^ (num. reduc.)

Screw Attachment Design		Ω = 3
Bearing (ADM J.5.6.1)		
$R_n/\Omega = d_e t_1 F_{tu1}/\Omega \leq 2 D t_1 F_{tu1}/\Omega$	$R_n/\Omega =$	1031.3 lb
Shear load associated with bolt bending (2011 Hilti Anchor Guide)		
$M_{uM,5\%} = 1.2 S_f (1 - T/T_a)$	$M_{uM,5\%} =$	1012.7 lb-in
$V_{rec} = (\alpha_M * M_{uM,5\%})/(1.7L)$	$V_{rec} =$	N/A lb
Screw Shear (AAMA TIR A9)		1937.0 lb
Allowable Fastener Shear V _a =		819.7 lb
Pull-Over (ADM J.5.5.2)		
$R_n/\Omega = C_{pov} t_1 F_{tu1} (D_{ws} - D_h)/\Omega$	$R_n/\Omega =$	343.8 lb
Screw Tension (AAMA TIR A9)		3720.0 lb
Allowable Fastener Tension T _a =		343.8 lb
V/screw =		406.00 lb
T/screw =		0.00 lb
Interaction Formula < 1.0		0.50 < 1.0
Use (1) 3/8-in Elco Conflex		

	Spacing	Edge Dist.
Installed Dist.	2.63	2.63
Shear Factors		
Critical. Dist.	2.63	2.63
Minimum Dist.	2.63	2.63
Load Factor @ Minimum	1.00	1.00
Tension Factors		
Critical. Dist.	2.63	2.63
Minimum Dist.	2.63	2.63
Load Factor @ Minimum	1.00	1.00

OK



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Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 5-1/16)
Part of: T/U Anchor Summary Sheet
Designer: M. Gorny

Date: 11/3/2016
Proj. No.: JE16059

Typical Wind Pressure (T) = 20.0 psf
Corner Zone Wind Pressure (C) = 24.0 psf
Interior Pressure (INT) = 5.0 psf

INPUT CHECK RISA

Anchor Type
Point

Location	Substrate	Sheet	Elevation	Section	Wind Zone	Mullion Length (ft)	Trib. Width (ft)	Wind Pres. (psf)	Anchor Load (lb)	
Head (T)	Steel Slotted	215	1/215	1/351	C	6.21	5.25	24.0	391.1	Check 1-1)
---	Steel (Angle)	200	1/200	1/323	T	12.17	5.53	20.0	673.0	Check 1-2)
---	---	201	1/201	1/301	T	12.17	4.69	20.0	570.3	
---	Steel	220	1/220	1/320	T	2.00	4.56	20.0	91.3	Check 1)
---	CFS	220	3/220, 5/220	N/A	T	12.00	5.82	20.0	698.1	Check 2)
---	Concrete	219	1/219	1/354, 1/356	C	3.50	5.00	24.0	210.0	Check 3)
Sill (T)	Steel	215	1/215	1/352	C	6.21	5.25	24.0	391.1	Check 1)
---	---	219	1/219	1/353, 1/355	C	3.50	5.00	24.0	210.0	
---	CFS	220	1/220	1/316	T	2.00	4.56	20.0	91.3	Check 2)
---	Concrete	200	1/200	1/322	T	12.17	3.92	20.0	476.5	
---	---	201	1/201	1/360	T	12.17	4.69	20.0	570.3	Check 3)
Sill (U)	Concrete	200	1/200	1/418	T	12.17	5.53	20.0	673.0	
---	---	201	1/201	1/545	T	12.17	2.38	20.0	289.6	
---	---	220, 220	3/220, 5/220	2/416	T	12.00	5.82	20.0	698.1	Check 4)

Anchor Design Summary:

- 1: Use (4) 1/4"(min) Elco Driflex into minimum 1/8" thick steel
- 2: Use (4) 1/4"(min) Elco Driflex into minimum 16ga, 50ksi CFS
- 3: Use (2) 3/8" Elco Conflex into 4,000psi concrete, minimum embedment = 2-1/2", minimum edge distance = 2-5/8", minimum spacing = 2-5/8" **(by comparison to 7-1/2" anchor analysis, Check 4)**
- 4: Use (1) 3/8" Elco Conflex into 4,000psi concrete, minimum embedment = 2-1/2", minimum edge distance = 1-7/8", minimum spacing = 1-7/8"



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Use 1/4" Elco Drillflex into minimum
1/8" thick steel

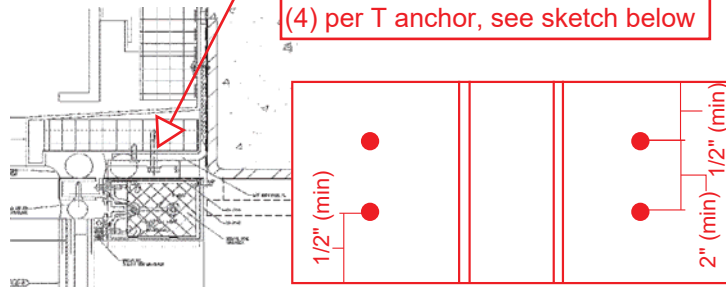
(4) per T anchor, see sketch below

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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 5-1/16")
Part of: Anchors to Steel
Elevation: 1/200
Detail: 1/323 **Check 1-2**

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK



FASTENER PROPERTIES:

Fastener Type = Elco Drillflex
Fastener Size = 1/4-in
Nominal Diameter, D = 0.25 in
Area, A = 0.05 in²
Allowable Shear per Spec, V_a = 687.50 lb
Allowable Tension per Spec, T_s = 450.00 lb

DESIGN LOADING / ORIENTATION:

Design Load, P = 673.00 lb
Design Moment, M_{c.g.} = 0.00 lb-in
Angle of Load, θ = 90.00 deg
Horz. Dist. from Centroid, x = 0.00 in
Vert. Dist. From Centroid, y = 3.13 in
Load Eccentricity from Bolt Plane, z = 1.13 in
Fastener Edge Distance, E = 0.50 in
Axis of Rotation for Tension Analysis = Y Axis

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners:

4

Fasteners per Row

N_{R1} = 2
N_{R2} = 2
N_{R3} = 0
N_{R4} = 0
N_{R5} = 0

Fasteners per Column

N_{C1} = 2
N_{C2} = 2
N_{C3} = 0
N_{C4} = 0
N_{C5} = 0

Row Dimensions

D₁ = 6.250 in
D₂ = 0.000 in
D₃ = 0.000 in
D₄ = 0.000 in

Column Dimensions

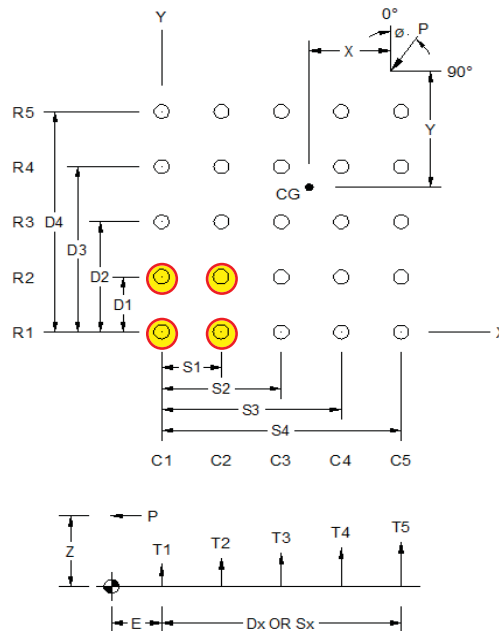
S₁ = 2.000 in
S₂ = 0.000 in
S₃ = 0.000 in
S₄ = 0.000 in

Bolt Group Centroid (CG)

Centroid, x = 1.000 in
Centroid, y = 3.125 in

Design Load Components

Design Load, P_x = 673.00 lb
Design Load, P_y = 0.00 lb



FASTENER CALCULATIONS:

$$\begin{aligned}\sum x^2 &= 4.00 \text{ in}^2 \\ \sum y^2 &= 39.06 \text{ in}^2 \\ \sum x^2 + \sum y^2 &= 43.06 \text{ in}^2 \\ M &= -2103.13 \text{ lb-in}\end{aligned}$$

$$\begin{aligned}f_y &= 994.94 \text{ ksi} \\ f_{sy} &= 0.00 \text{ psi} \\ f_x &= 3109.18 \text{ psi} \\ f_{sx} &= 3427.56 \text{ psi}\end{aligned}$$

← Vert Stress Due to Eccentric Shear
← Vert Stress Due to Direct Shear
← Horiz Stress Due to Eccentric Shear
← Horiz Stress Due to Direct Shear

Bolt Tension by Column

T₁ = 29.12 lb/bolt
T₂ = 145.60 lb/bolt
T₃ = 0 lb/bolt
T₄ = 0 lb/bolt
T₅ = 0 lb/bolt

$$\begin{aligned}f &= 6612.03 \text{ psi} \\ V &= 324.57 \text{ lb} \\ V_a &= 687.50 \text{ lb} \\ T &= 145.60 \text{ lb} \\ T_a &= 450.00 \text{ lb}\end{aligned}$$

← Maximum Bolt Shear Stress
← Maximum Bolt Shear
OK
← Maximum Bolt Tension
OK

Interaction Values

Standard Bolts

$$\frac{V/V_a + T/T_a}{0.796} < 1.0 \quad \text{OK}$$

TIR Fasteners

$$\frac{(V/V_a)^2 + (T/T_a)^2}{0.328} < 1.0 \quad \text{OK}$$



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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 5-1/16")
Part of: Anchors to CFS
Elevation: 3/220, 5/220
Detail: **N/A (verify) Check 2**

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny
INPUT CHECK

Load Design Criteria: ASCE7-05 ASD
Material Design Criteria: Aluminum Design Manual 2010
Fastener Name: Elco Drilflex
Fastener Material: SAE Grade 5 (SAE J429)
Fastener Type: Screw

Top Hole		Base Hole		☐ Eccentric Shear Design ☐ Eccentric Tension Design
☒ Standard Hole	☒ Standard Hole	☐ Standard Hole	☐ Standard Hole	
☐ Long Slotted Hole	☐ Long Slotted Hole	☐ Long Slotted Hole	☐ Long Slotted Hole	

☐ Generic Fastener (TIR A9-91) ☐ Countersunk Screw

Design Pressure	24.00	psf
Design Shear Load (V)	698.10	lb
Design Tension Load (T)	0.00	lb
Number of Screws	4.00	screws
Screw Selection (D)	1/4"	0.2500 in
F _{ty1} , F _{tu1} (Top Material)	6063-T5	16 , 22 ksi
F _{ty2} , F _{tu2} (Base Material)	A653 Gr. 50	50 , 65 ksi
Thickness of top material (t ₁)	0.1875	in
Thickness base material (t ₂)	0.0566	in
Distance to edge of top material (d _{e1})	0.5000	in
Distance to edge of bottom material (d _{e2})	0.5000	in
Manufacturer Allowable Shear =	560.3	lb
Manufacturer Allowable Tension =	176.7	lb

Moment Arm for screw (L)	0.00	in
Screw Section Modulus (S)	0.001534	in ³
Screw Ultimate Tensile	120	ksi
Bending Moment mod (αM)	1	

(bolt fixity α_M=1 free to rotate and =2 rotation restrained)

Factored Fastener Loads (per fastener)			
Fastener Shear (V _{fas})	V / fastener =	174.5	lb
Fastener Tension (T _{fas})	T / fastener =	0.0	lb

Fastened Material Shear Design			
Bearing (ADM J3.7, J.5.6.1, AISC J4.10)			
Top Mat.: R _n = d _{e1} *t ₁ *F _{tu1} ≤ 2*D*t ₁ *F _{tu1}	Ω = 3	(Aluminum)	R _n /Ω = 687.5 lb
Base Mat.: R _n = 1.2*d _{e2} *t ₂ *F _{tu2} ≤ 2.4*D*t ₂ *F _{tu2}	Ω = 2	(Steel)	R _n /Ω = 1103.7 lb
Tilting (ADM J.5.6.2)	Ω = 3	≤ t ₁ ?	YES
R _n = 4.2*(t ₂ ³ D) ^{1/2} *F _{tu2}	R _n /Ω =	612.7	lb
Shear load associated with bolt bending (ref Hilti)			
M _{UM,5%} = 1.2Sf(1 - T/Ta)	M _{UM,5%} =	N/A	lb-in
V _{rec} = (α _M * M _{UM,5%})/(1.7L)	V _{rec} =	N/A	lb
AISI Cold-Formed Steel Design (Tbl IV-8a)			
LGM Shear of sheet	P _{ns} =	1.840	k
Using 0.0566" LGM	P _{ns} *1000/Ω =	613.3	lb
Allowable Shear / Fastener (V _{allowable}) =	560.3	lb	
V _{fas} / V _{allowable} =	0.31	≤ 1.0	
OK.			

Fastened Material Tension Design			
Pull-Out (ADM J.5.5.1.1)			
R _n = 1.01*D*Le*F _{ty2}	R _n /Ω =	N/A	lb
Pull-Over (ADM J.5.5.2)			
R _n = (1.0+1.7*t ₁ /Dws)Dws*t ₁ *F _{ty1}	R _n /Ω =	798.8	lb
AISI Cold-Formed Steel Design IV-12			
LGM Pull-Out	P _{not} =	0.782	k
Using 0.0566" LGM	P _{not} *1000/Ω =	260.7	lb
Allowable Tension / Fastener (T _{allowable}) =	176.7	lb	
T _{fas} / T _{allowable} =	0.00	≤ 1.0	
OK.			

Fastener Interaction Check			
Ω = 3			
Screw Shear (V _{TIR})	(AAMA TIR A9 Table 20.3)	646.0	lb
Screw Tension (T _{TIR})	(AAMA TIR A9 Table 20.3)	1273.0	lb
Typical:	V _{fas} / V _{TIR} + T _{fas} / T _{TIR} =	0.27	≤ 1.0
TIR A9-91:	(V _{fas} / V _{TIR}) ² + (T _{fas} / T _{TIR}) ² =	N/A	≤ 1.0
OK.			

Use (4) 1/4" Elco Drilflex Screws.



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Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 5-1/16")
Part of: Anchors to Concrete
Elevation: 3/220, 5/220
Detail: 2/416 **Check 4**

Use 3/8" Elco Conflex into 4000psi concrete
minimum embedment = 2-1/2"
minimum spacing = 2-5/8"
minimum concrete edge distance = 2-5/8"
(1) per U anchors
miter off leg of F-anchor

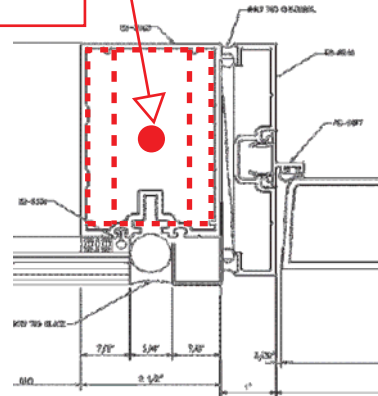
Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK

Design Criteria: ADM 2010 / AAMA TIR A9-91
Design Basis: N/A

Fastener Type: Elco Conflex

Design Wind Pressure 24.00 psf
Design Shear Load (V) 698.10 lb
Design Tension Load (T) 0.00 lb
Number of Screws 1 screws
Screw Selection (D) 3/8-in 0.3750 in
F_{tu1} of top material 22 ksi
Thickness of top material (t₁) 0.188 in
Distance to edge of part (d_e) 0.750 in
Embedment 2.5 in
Concrete Strength 4000 psi
Published Load Values:
Elco Conflex Allowable Shear 820 lb
Elco Conflex Allowable Tension 905 lb
Moment arm for screw (L) 0.00 in
Screw Section Modulus (S) 0.00518 in³
Screw Ultimate Tensile Strength 163 ksi
Bending Moment mod (αM) 1 (bolt fixity at standoff α_M=1 free to rotate and =2 rotation restrained)



Calculated Reduction Factors

		Edge		
		Spacing	Distance	
Shear		1.00	1.00	
Tension		1.00	1.00	
Number of reductions (due to group geometry)				
		Edge	Final Allowable	
		Spacing	Distance	Capacity (lb)
Shear		1.0	1.0	820
Tension		1.0	1.0	905

Capacity = Allowable Load * Shear Factor ^ (num. reduc.)

* Tension Factor ^ (num. reduc.)

Screw Attachment Design		Ω = 3
Bearing (ADM J.5.6.1)	$R_n/\Omega = d_e t_1 F_{tu1}/\Omega \leq 2 D t_1 F_{tu1}/\Omega$	$R_n/\Omega = 1031.3 \text{ lb}$
Shear load associated with bolt bending (2011 Hilti Anchor Guide)		
$M_{uM,5\%} = 1.2 S_f (1 - T/T_a)$	$M_{uM,5\%} =$	1012.7 lb-in
$V_{rec} = (\alpha_M * M_{uM,5\%})/(1.7L)$	$V_{rec} =$	N/A lb
Screw Shear (AAMA TIR A9)		1937.0 lb
Allowable Fastener Shear V _a =		819.7 lb
Pull-Over (ADM J.5.5.2)		
$R_n/\Omega = C_{pov} t_1 F_{tu1} (D_{ws} - D_h)/\Omega$	$R_n/\Omega =$	343.8 lb
Screw Tension (AAMA TIR A9)		3720.0 lb
Allowable Fastener Tension T _a =		343.8 lb
V/screw =		698.10 lb
T/screw =		0.00 lb
Interaction Formula < 1.0		0.85 < 1.0
Use (1) 3/8-in Elco Conflex		

	Spacing	Edge Dist.
Installed Dist.	2.63	2.63
Shear Factors		
Critical. Dist.	2.63	2.63
Minimum Dist.	2.63	2.63
Load Factor @ Minimum	1.00	1.00
Tension Factors		
Critical. Dist.	2.63	2.63
Minimum Dist.	2.63	2.63
Load Factor @ Minimum	1.00	1.00

OK

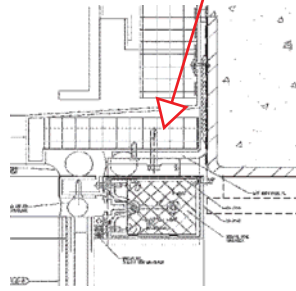


JEI Structural Engineering
7280 NW 87th Terrace, Suite C-208
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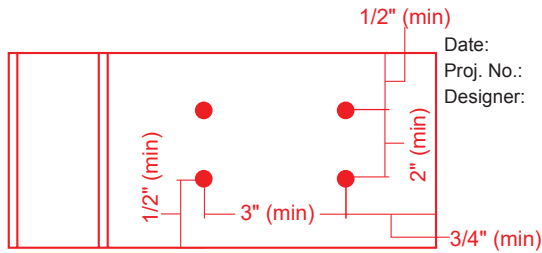
Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 5-1/16")
Part of: Anchors to Steel
Elevation: 1/200
Detail: 1/323 **Check 5**

INPUT CHECK



Use 1/4" Elco Drillflex into minimum 1/8" thick steel

(4) per F anchor, see sketch below



Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

FASTENER PROPERTIES:

Fastener Type = Elco Drillflex
Fastener Size = 1/4-in
Nominal Diameter, D = 0.25 in
Area, A = 0.05 in²
Allowable Shear per Spec, V_a = 687.50 lb
Allowable Tension per Spec, T_s = 450.00 lb

DESIGN LOADING / ORIENTATION:

Design Load, P = 307.00 lb
Design Moment, M_{c.g.} = 0.00 lb-in
Angle of Load, θ = 90.00 deg
Horz. Dist. from Centroid, x = 0.00 in
Vert. Dist. From Centroid, y = 3.81 in
Load Eccentricity from Bolt Plane, z = 1.13 in
Fastener Edge Distance, E = 0.50 in
Axis of Rotation for Tension Analysis = Y Axis

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners:

4

Fasteners per Row

N_{R1} = 2
N_{R2} = 2
N_{R3} = 0
N_{R4} = 0
N_{R5} = 0

Fasteners per Column

N_{C1} = 2
N_{C2} = 2
N_{C3} = 0
N_{C4} = 0
N_{C5} = 0

Row Dimensions

D₁ = 3.000 in
D₂ = 0.000 in
D₃ = 0.000 in
D₄ = 0.000 in

Column Dimensions

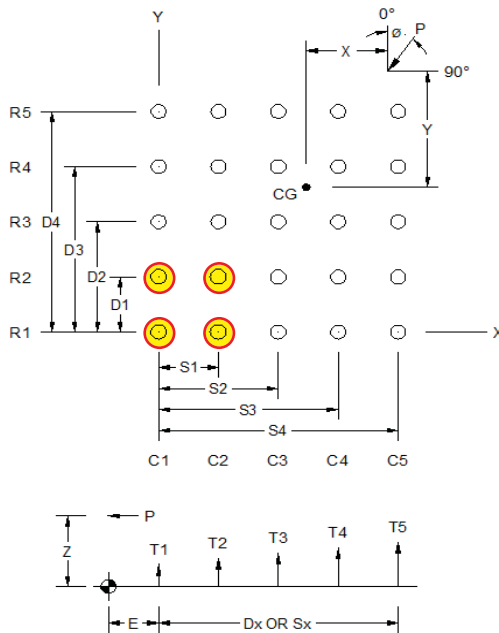
S₁ = 2.000 in
S₂ = 0.000 in
S₃ = 0.000 in
S₄ = 0.000 in

Bolt Group Centroid (CG)

Centroid, x = 1.000 in
Centroid, y = 1.500 in

Design Load Components

Design Load, P_x = 307.00 lb
Design Load, P_y = 0.00 lb



FASTENER CALCULATIONS:

$\sum x^2 = 4.00 \text{ in}^2$
 $\sum y^2 = 9.00 \text{ in}^2$
 $\sum x^2 + \sum y^2 = 13.00 \text{ in}^2$
M = -1170.44 lb-in
f_y = 1834.15 ksi
f_{sy} = 0.00 psi
f_x = 2751.23 psi
f_{sx} = 1563.54 psi

← Vert Stress Due to Eccentric Shear
← Vert Stress Due to Direct Shear
← Horiz Stress Due to Eccentric Shear
← Horiz Stress Due to Direct Shear

Bolt Tension by Column

T₁ = 13.28 lb/bolt
T₂ = 66.42 lb/bolt
T₃ = 0 lb/bolt
T₄ = 0 lb/bolt
T₅ = 0 lb/bolt

f = 4688.42 psi

V = 230.14 lb
V_a = 687.50 lb

T = 66.42 lb
T_a = 450.00 lb

← Maximum Bolt Shear Stress
← Maximum Bolt Shear
OK
← Maximum Bolt Tension
OK

Interaction Values

Standard Bolts

$V/V_a + T/T_a$
0.482 < 1.0 **OK**

TIR Fasteners

$(V/V_a)^2 + (T/T_a)^2$
0.134 < 1.0 **OK**



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Office: 816-505-0987
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Client: NGG
Project: Webster University
Structure: YKK 750 (2-1/2" x 5-1/16")
Part of: Anchors to CFS
Elevation: 3/220, 5/220
Detail: **N/A (verify)** **Check 6**

Date: 11/3/2016
Proj. No.: JE16059
Designer: M. Gorny

INPUT CHECK

FASTENER PROPERTIES:

Fastener Type = Elco Driflex
Fastener Size = 1/4-14
Nominal Diameter, D = 0.250 in
Area, A = 0.049 in²
Allowable Shear per Spec, V_a = 560.3 lb

DESIGN LOADING / ORIENTATION:

Design Load, P = 315.60 lb
Design Moment, M_{c.g.} = 0.00 lb-in
Angle of Load, θ = 90.00 deg
Horz. Dist. from Centroid, x = 0.00 in
Vert. Dist. From Centroid, y = 3.81 in

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 4

Fasteners per Row

N_{R1} = 2
N_{R2} = 2
N_{R3} =
N_{R4} =
N_{R5} =

Fasteners per Column

N_{C1} = 2
N_{C2} = 2
N_{C3} =
N_{C4} =
N_{C5} =

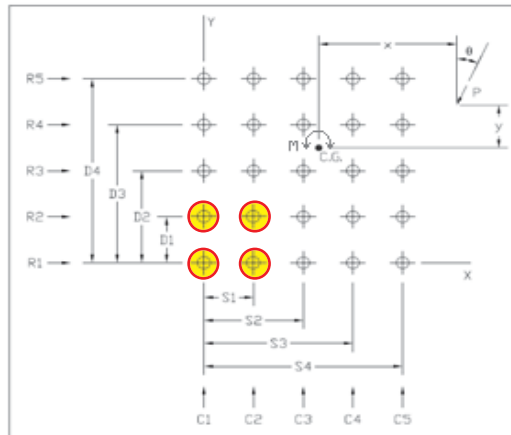
Row Dimensions

D₁ = 3.00 in
D₂ = in
D₃ = in
D₄ = in

Column Dimensions

S₁ = 2.00 in
S₂ = in
S₃ = in
S₄ = in

Centroid, x = 1.00 in
Centroid, y = 1.50 in



FASTENER CALCULATIONS:

$\Sigma x^2 = 4.00 \text{ in}^2$
 $\Sigma y^2 = 9.00 \text{ in}^2$
 $\Sigma x^2 + \Sigma y^2 = 13.00 \text{ in}^2$
M = -1203.23 lb-in

f_y = 1885.53 ksi ← Vert Stress Due to Eccentric Shear
f_{sy} = 0.00 psi ← Vert Stress Due to Direct Shear
f_x = 2828.30 psi ← Horiz Stress Due to Eccentric Shear
f_{sx} = 1607.34 psi ← Horiz Stress Due to Direct Shear

f = 4819.76 psi ← Maximum Bolt Stress
V = 236.59 lb ← Maximum Bolt Load
V_a = 560.300 lb **OK**

JEI STRUCTURAL ENGINEERING

Stewart Jeske

E9-1225

Dimensions

Depth	6.5 in
Width	2.5 in
Perimeter	20.62 in

Geometric

Area	2.079 in ²
I _x	9.838 in ⁴
I _y	1.818 in ⁴
I _{xy}	0.0012 in ⁴
r _x	2.176 in
r _y	0.9351 in
S _{x+}	2.861 in ³
S _{x-}	3.213 in ³
S _{y+}	1.454 in ³
S _{y-}	1.454 in ³
X _c	22.55 in
Y _c	3.64 in

Principal

I ₁	9.838 in ⁴
I ₂	1.818 in ⁴
α	-0.0087 deg
r ₁	2.176 in
r ₂	0.9351 in
S ₁₊	2.861 in ³
S ₁₋	3.213 in ³
S ₂₊	1.454 in ³
S ₂₋	1.453 in ³

Polar

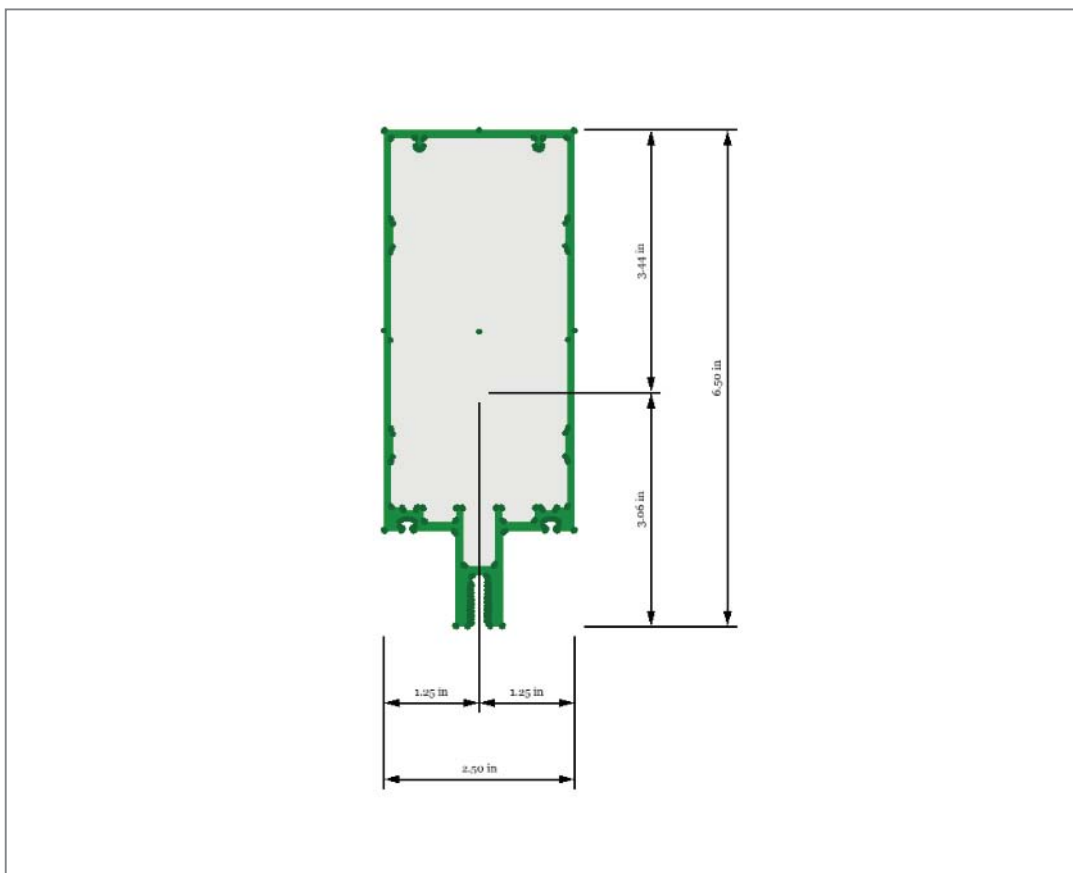
I _p	11.66 in ⁴
r _p	2.368 in

Minimum Results

Warping	-1.474 in ²
Function	

Maximum Results

Warping	1.468 in ²
Function	

Plastic

Z _x	3.985 in ³
Z _y	1.724 in ³
PNA X	22.54 in
PNA Y	3.021 in

FEA Mesh

Nodes	3644
Elements	3087
Largest Element	0.0831 in ²

Torsion

r _o	2.476 in
H	0.9145
X _{sc}	22.54 in
Y _{sc}	4.364 in
C _w	0.9432 in ⁶
J	4.11 in ⁴
B _t	-0.5806 in

Part Materials

All	ASTM A36
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Dimensions

Depth	6.566 in
Width	3.09 in
Perimeter	21.12 in

Geometric

Area	2.477 in ²
Ix	11.81 in ⁴
Iy	2.954 in ⁴
Ixy	0.0044 in ⁴
rx	2.184 in
ry	1.092 in
Sx+	3.607 in ³
Sx-	3.589 in ³
Sy+	1.912 in ³
Sy-	1.911 in ³
Xc	27.95 in
Yc	11.08 in

Principal

I1	11.81 in ⁴
I2	2.954 in ⁴
α	-0.0282 deg
r1	2.184 in
r2	1.092 in
S1+	3.607 in ³
S1-	3.589 in ³
S2+	1.914 in ³
S2-	1.909 in ³

Polar

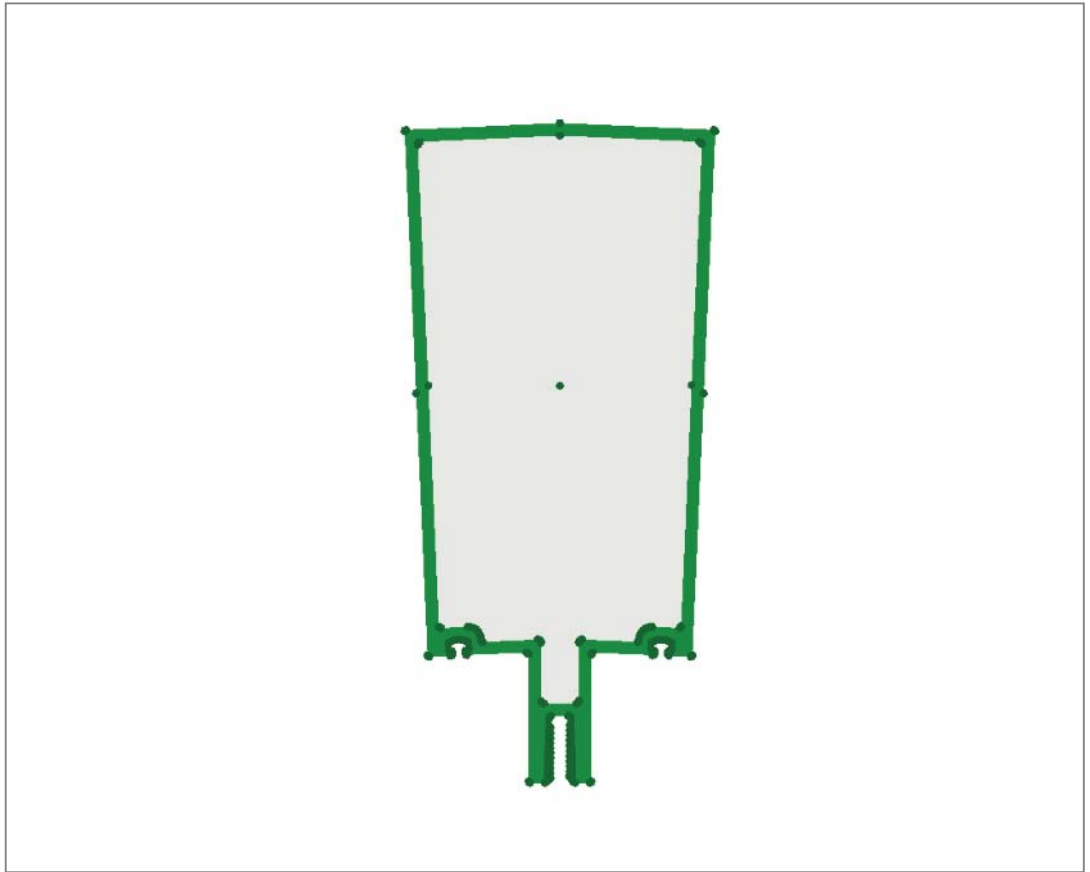
Ip	14.77 in ⁴
rp	2.441 in

Minimum Results

Warping	-1.093 in ²
Function	

Maximum Results

Warping	1.087 in ²
Function	

Plastic

Zx	4.836 in ³
Zy	2.404 in ³
PNA X	27.95 in
PNA Y	10.78 in

FEA Mesh

Nodes	2590
Elements	2199
Largest Element	0.0991 in ²

Torsion

ro	2.592 in
H	0.8875
Xsc	27.95 in
Ysc	11.95 in
Cw	0.6482 in ⁶
J	6.349 in ⁴
B1	-1.143 in

Part Materials

All	ASTM A36
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JEI STRUCTURAL ENGINEERING

Stewart Jeske

E9-3401

Dimensions

Depth	5.25 in
Width	2.5 in
Perimeter	18.41 in

Geometric

Area	2.254 in ²
Ix	8.555 in ⁴
Iy	2.213 in ⁴
Ixy	-0.0005 in ⁴
rx	1.948 in
ry	0.9909 in
Sx+	3.127 in ³
Sx-	3.403 in ³
Sy+	1.775 in ³
Sy-	1.765 in ³
Xc	104.1 in
Yc	43.27 in

Principal

I1	8.555 in ⁴
I2	2.213 in ⁴
α	0.0045 deg
r1	1.948 in
r2	0.9909 in
S1+	3.127 in ³
S1-	3.403 in ³
S2+	1.775 in ³
S2-	1.766 in ³

Polar

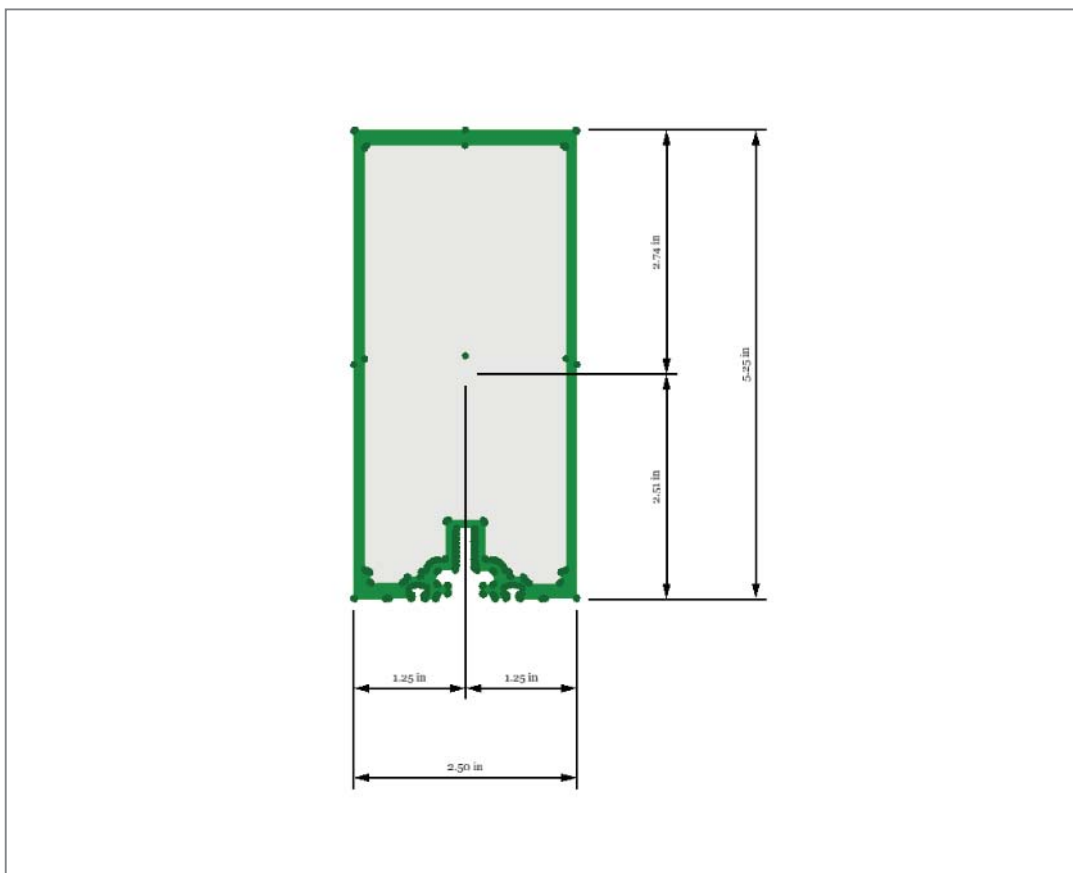
Ip	10.77 in ⁴
rp	2.186 in

Minimum Results

Warping	-1.212 in ²
Function	

Maximum Results

Warping	1.21 in ²
Function	

Plastic

Zx	3.984 in ³
Zy	2.054 in ³
PNA X	104.1 in
PNA Y	43.1 in

FEA Mesh

Nodes	2582
Elements	2172
Largest Element	0.0902 in ²

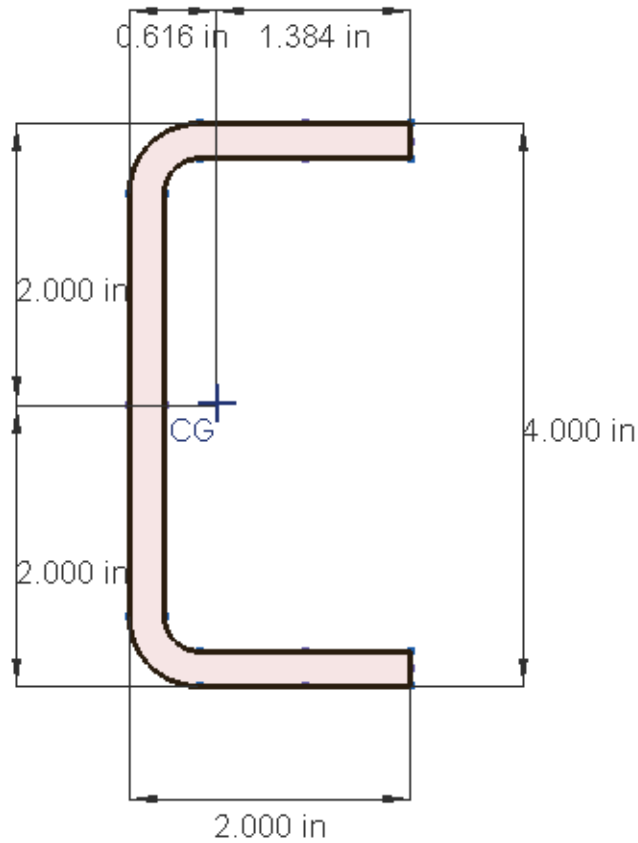
Torsion

ro	2.343 in
H	0.8703
Xsc	104.1 in
Ysc	44.12 in
Cw	0.6573 in ⁶
J	4.596 in ⁴
B1	-1.403 in

Part Materials

All	ASTM A36
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Overall Dimensions

Width	2.000 in
Height	4.000 in
Perimeter	14.855 in

Geometric Properties

Iy	0.671 in ⁴
Ix	4.107 in ⁴
J	0.039 in ⁴
ry	0.611 in
rx	1.513 in
A	1.795 in ²
Sy Right	0.485 in ³
Sy Left	1.088 in ³
Sx Bottom	2.054 in ³
Sx Top	2.054 in ³
Centroid Y	-0.370 in
Centroid X	-0.651 in

Material Properties

E	29000.000 Ksi
---	---------------

Plastic Properties

Zy	0.876 in ³
Zx	2.483 in ³
PNA-Y	-0.370 in
PNA-X	-1.019 in

Polar Properties

Ip	4.778 in ⁴
rp	1.632 in

Principal Properties

I2	0.671 in ⁴
I1	4.107 in ⁴
Ixy	-0.000 in ⁴
Theta	0.000 deg

Shear Properties

SC Y	-0.370 in
SC X	-1.866 in

Torsion Properties

H	0.854
ro	1.765 in
Cw	1.494 in ⁶

Advanced Properties

Elements	366.000
Mesh Curve %	2.000
Mesh Size #	0.070
Nodes	491.000

Bent Channel

Width	2.000 in
Height	4.000 in
Iy	0.671 in ⁴

Ix	4.107 in ⁴
A	1.795 in ²
Sy Right	0.485 in ³
Sy Left	1.088 in ³
Sx Bottom	2.054 in ³
Sx Top	2.054 in ³

JEI STRUCTURAL ENGINEERING

Stewart Jeske

E9-3402

Dimensions

Depth	5.25 in
Width	2.5 in
Perimeter	18.56 in

Geometric

Area	1.751 in ²
I _x	6.485 in ⁴
I _y	1.729 in ⁴
I _{xy}	0.0015 in ⁴
r _x	1.925 in
r _y	0.9938 in
S _{x+}	2.197 in ³
S _{x-}	2.821 in ³
S _{y+}	1.383 in ³
S _{y-}	1.383 in ³
X _c	19.76 in
Y _c	43.23 in

Principal

I ₁	6.485 in ⁴
I ₂	1.729 in ⁴
α	-0.0181 deg
r ₁	1.925 in
r ₂	0.9938 in
S ₁₊	2.197 in ³
S ₁₋	2.821 in ³
S ₂₊	1.383 in ³
S ₂₋	1.382 in ³

Polar

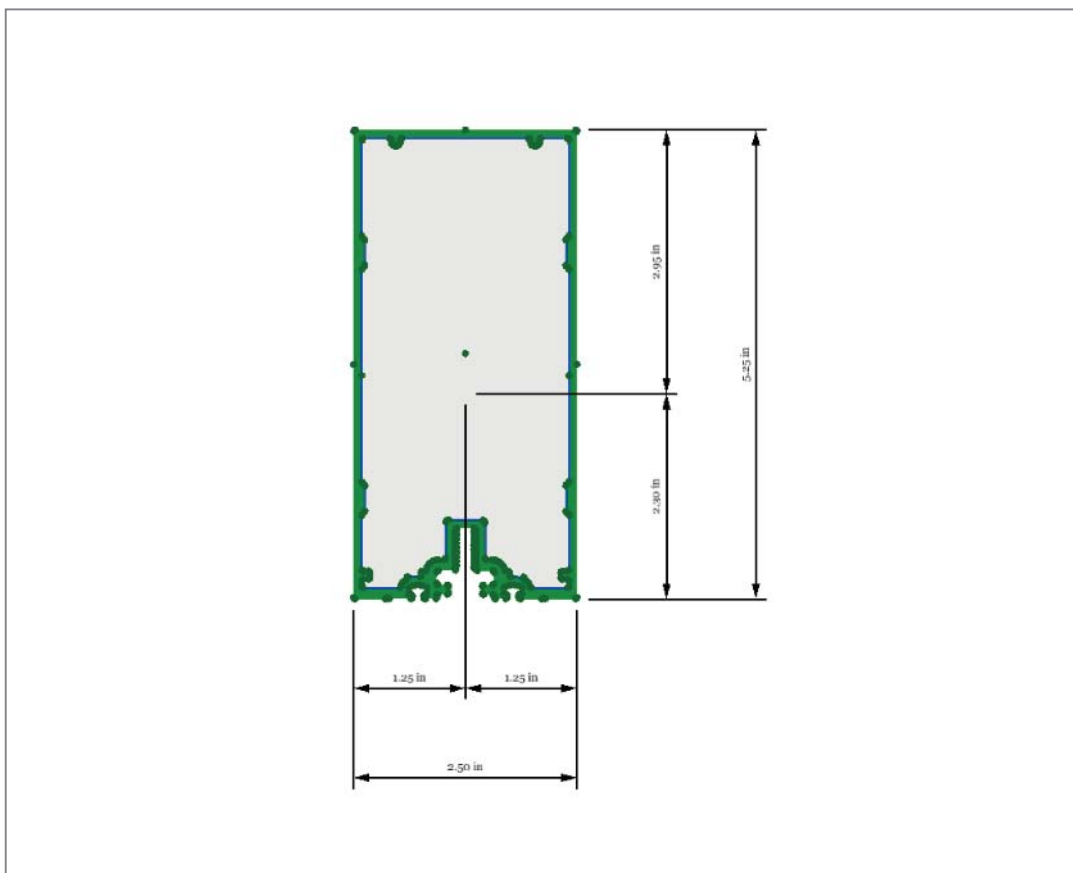
I _p	8.214 in ⁴
r _p	2.166 in

Minimum Results

Warping	-1.054 in ²
Function	

Maximum Results

Warping	1.049 in ²
Function	

Plastic

Z _x	3.024 in ³
Z _y	1.591 in ³
PNA X	19.76 in
PNA Y	42.82 in

FEA Mesh

Nodes	3612
Elements	3030
Largest Element	0.07 in ²

Torsion

r _o	2.275 in
H	0.9066
X _{sc}	19.76 in
Y _{sc}	43.92 in
C _w	0.4367 in ⁶
J	3.525 in ⁴
B _t	-0.7399 in

Part Materials

All	ASTM A36
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JEI STRUCTURAL ENGINEERING

Stewart Jeske

E9-3403

Dimensions

Depth	5.25 in
Width	2.5 in
Perimeter	26.16 in

Geometric

Area	1.392 in ²
Ix	6.1 in ⁴
Iy	0.8929 in ⁴
Ixy	-0.1839 in ⁴
rx	2.093 in
ry	0.8009 in
Sx+	2.614 in ³
Sx-	2.092 in ³
Sy+	1.07 in ³
Sy-	0.5361 in ³
Xc	143.5 in
Yc	29.21 in

Principal

I1	6.107 in ⁴
I2	0.8864 in ⁴
α	2.02 deg
r1	2.094 in
r2	0.798 in
S1+	2.554 in ³
S1-	2.075 in ³
S2+	0.968 in ³
S2-	0.5017 in ³

Polar

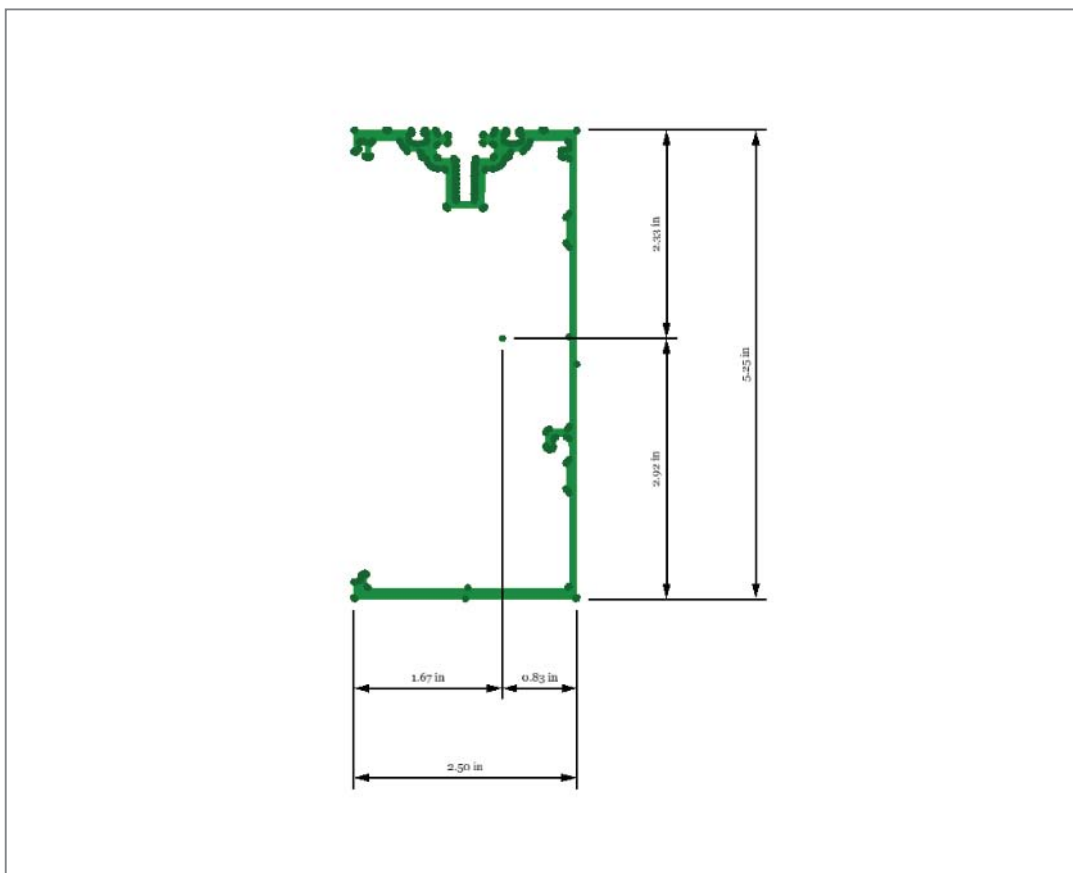
Ip	6.993 in ⁴
rp	2.241 in

Minimum Results

Warping	-3.27 in ²
Function	

Maximum Results

Warping	4.158 in ²
Function	

Plastic

Zx	2.671 in ³
Zy	0.9766 in ³
PNA X	143.7 in
PNA Y	29.89 in

FEA Mesh

Nodes	3073
Elements	2586
Largest Element	0.0557 in ²

Torsion

ro	2.903 in
H	0.5963
Xsc	145.3 in
Ysc	28.9 in
Cw	3.672 in ⁶
J	0.0066 in ⁴
B1	0.1407 in

Part Materials

Import 1	ASTM A36
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JEI STRUCTURAL ENGINEERING

Stewart Jeske

E9-3423

Dimensions

Depth	3.75 in
Width	2.5 in
Perimeter	15.46 in

Geometric

Area	1.482 in ²
I _x	2.835 in ⁴
I _y	1.333 in ⁴
I _{xy}	0.0015 in ⁴
r _x	1.383 in
r _y	0.9486 in
S _{x+}	1.331 in ³
S _{x-}	1.749 in ³
S _{y+}	1.066 in ³
S _{y-}	1.067 in ³
X _c	12.1 in
Y _c	27.78 in

Principal

I ₁	2.835 in ⁴
I ₂	1.333 in ⁴
α	-0.0564 deg
r ₁	1.383 in
r ₂	0.9486 in
S ₁₊	1.331 in ³
S ₁₋	1.748 in ³
S ₂₊	1.065 in ³
S ₂₋	1.065 in ³

Polar

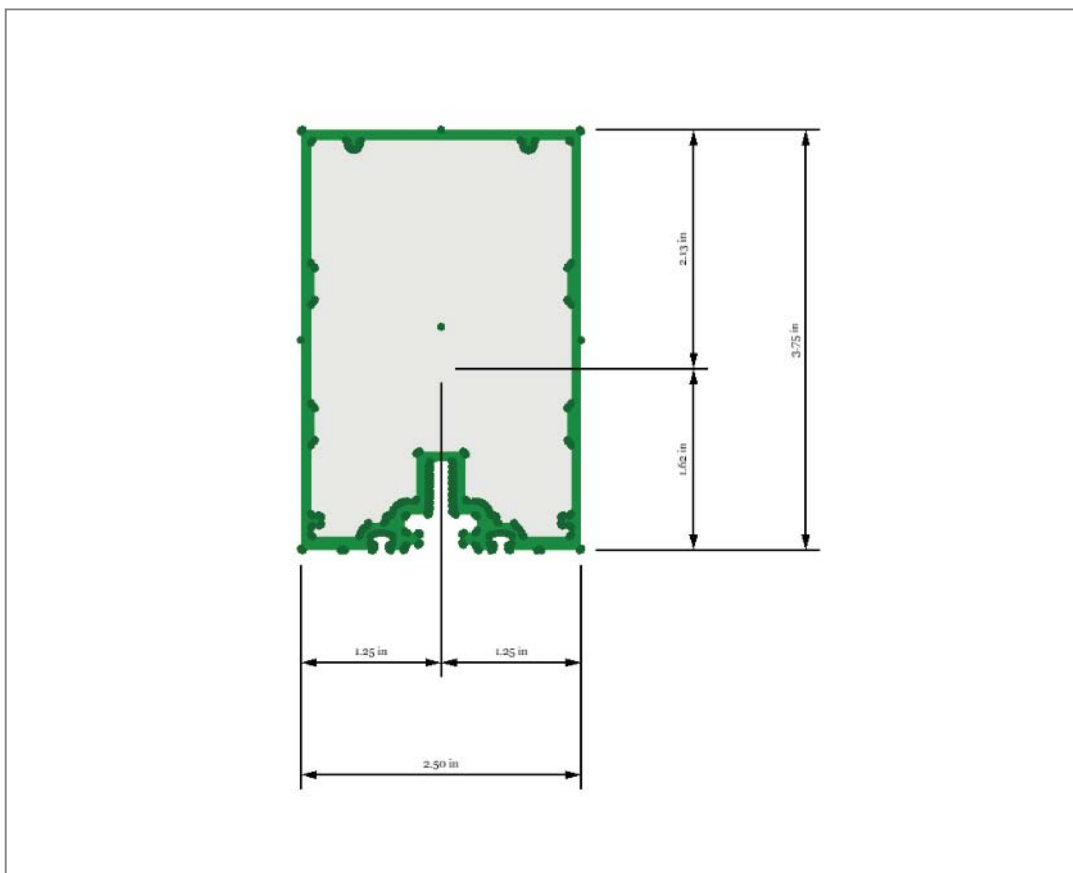
I _p	4.168 in ⁴
r _p	1.677 in

Minimum Results

Warping	-0.9264 in ²
Function	

Maximum Results

Warping	0.9254 in ²
Function	

Plastic

Z _x	1.817 in ³
Z _y	1.263 in ³
PNA X	12.1 in
PNA Y	27.34 in

FEA Mesh

Nodes	3406
Elements	2865
Largest Element	0.0593 in ²

Torsion

r _o	1.789 in
H	0.8787
X _{sc}	12.1 in
Y _{sc}	28.41 in
C _w	0.0869 in ⁶
J	2.156 in ⁴
B _t	-0.6486 in

Part Materials

All	ASTM A36
-----	----------



ConFlex® Large Diameter Masonry Screws

Conflex fasteners are a new generation of masonry screws from Elco Construction Products. The design combines our 25 years of experience in manufacturing the highest quality masonry screws with our unique Flex Technology® heat treat process used in our Drill-Flex® drill screws. The result is a large diameter masonry screw that is virtually immune to brittle failures, allowing use in exterior applications.

High Performance

The major feature of the ConFlex design is the Flex Technology heat treatment, which provides dual hardness zones on the screw shank:

- The lead threads are extremely hard for more efficient and effective thread tapping
- The lower hardness of the rest of the fastener renders it virtually immune to brittle failures

Brittle failures occur when high hardness fasteners, under high loads (including that from installation torque), are used in applications where moisture is present. The chance of failure is greatly enhanced when aluminum is in contact with such a fastener. This type of metallurgical reaction is usually referred to as Hydrogen-Assisted Stress Corrosion Cracking (HASCC).

Other Features and Benefits

- Installs using standard ANSI masonry drill bits
 - 3/8" masonry drill bit for 3/8" ConFlex fastener
 - 7/16" masonry drill bit for 1/2" ConFlex fastener
- Silver Stalgard® finish provides exceptional corrosion resistance (1,000 hours without red rust in salt spray testing per ASTM B117)
- Double-lead threads allow rapid fastener advancement into the pilot hole – twice as fast as a standard single-lead thread
- Locking serrations under the head provide back-out resistance
- Provides high pull-out and shear values
- Low installation torque
- Head markings allow easy inspection

Specifications

Sizes: 3/8" and 1/2" diameters

Actual thread O.D. is greater than nominal screw anchor diameter designation (see thread diameter information on following page)

Material: Alloy steel

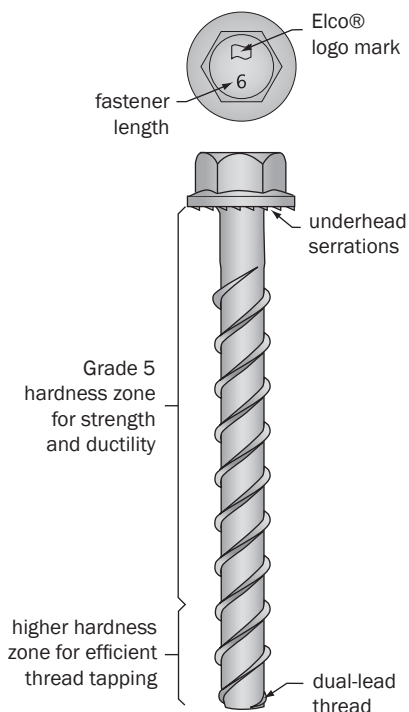
Mechanical Properties

Tensile Yield: 92,000 KSI min. (Grade 5)

Tensile Ultimate: 120,000 KSI min. (Grade 5)

Finish: Silver Stalgard corrosion-resistant coating

Corrosion Resistance: 1,000 hours in salt spray testing without red rust (per ASTM B117)



Applications

- Curtain wall and glazing
- Blast- and impact-resistant window systems
- Accordion and pull-down hurricane shutter tracks
- Racking and shelving
- Maintenance and repairs
- Window and door frames
- Fencing
- Mudsills and ledgers
- Material handling
- Pool enclosures

ConFlex® Large Diameter Masonry Anchors

ConFlex® Large Diameter Masonry Screws

ConFlex® Selection Guide

3/8" Diameter				1/2" Diameter			
Length	Thread Length	Part No.	Quantity Per Box	Length	Thread Length	Part No.	Quantity Per Box
2-1/2"	2-1/4"	EMR215	50	2-1/2"	2-1/4"	EMR320	50
3"	2-1/4"	EMR235	50	3"	2-1/4"	EMR340	50
4"	3-1/2"	EMR255	50	4"	3-1/2"	EMR360	50
5"	3-1/2"	EMR265	25	5"	3-1/2"	EMR370	25
7-1/2"	3-1/2"	EMR295	25	6"	3-1/2"	EMR380	25

Recommended min. embedment: 2"

Recommended min. embedment: 2"

Installation:

- Standard 3/8" ANSI masonry drill bit (.398" +.000"/-.010")
- Recommended functional masonry drill bit length: minimum 1" more than fastener length

Installation:

- Standard 7/16" ANSI masonry drill bit (.468" +.000"/-.010")
- Recommended functional masonry drill bit length: minimum 1" more than fastener length

Dimensional Properties

3/8" Diameter	1/2" Diameter
Drive system: 9/16" hex	Drive system: 3/4" hex
Washer diameter: 11/16"	Washer diameter: 1.0"
Thread O.D.: .430"	Thread O.D.: .525"
Thread root: .345"	Thread root: .405"
Unthreaded shank dia.: .360"	Unthreaded shank dia.: .426"
Head mark: Elco® logo mark and length in inches	Head mark: Elco® logo mark and length in inches

† Note: Indicated pull-out and shear values listed are ultimate values and were obtained in tests conducted by HETI/ Miami, FL, an independent test lab. These figures are offered only as a guide and are not guaranteed in any way by Elco Construction Products. A safety factor of 4:1 or 25% of ultimate values are generally accepted as a safe working load.

Testing was done per ASTM E 488 - 96. Additional technical data is available upon request.



For more information, please contact:



Elco Construction Products

1301 Kerr Drive • Decorah, IA 52101

1.800.435.7213 • Fax: 563.387.3540

www.elcoconstruction.com



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ConFlex Performance Data†

Ultimate Value (Lbs) in Concrete

1,819 PSI				
Dia .	Edge Distance	Embedment	Pull-out	Shear
3/8"	1-7/8" (5d)	1-1/2"	1,364	X
		2"	2,995	X
		2-1/2"	3,226	1,534
		3-1/2"	5,379	2,170
	2-5/8"	1-1/2"	X	X
		2"	X	X
		2-1/2"	3,620	2,459
		3-1/2"	6,070	3,902
	3-3/4" (10d)	1-1/2"	1,232	4,766
		2"	3,296	5,658
		2-1/2"	3,936	6,419
		3-1/2"	6,493	7,047
1/2"	2	1-3/4"	X	X
		2"	X	X
		3"	X	X
		4"	X	X
	2-1/2" (5d)	1-3/4"	2,266	X
		2"	2,706	X
		3"	4,666	4,549
		4"	7,058	6,960
	3-1/2"	1-3/4"	X	X
		2"	X	X
		3"	5,483	5,739
		4"	8,656	8,028
	4	1-3/4"	X	X
		2"	X	X
		3"	X	X
		4"	X	X
	5" (10d)	1-3/4"	2,090	6,081
		2"	2,875	7,167
		3"	6,042	9,148
		4"	8,732	9,631

4,510 PSI				
Dia.	Edge Distance	Embedment	Pull-out	Shear
3/8"	1-7/8" (5d)	1-1/2	2,497	X
		2	3,169	X
		2-1/2	5,063	2,111
		3-1/2	9,288	2,732
	2-5/8"	1-1/2		
		2		
		2-1/2	5,111	2,667
		3-1/2	8,438	4,046
	3-1/2"	1-1/2	2,055	X
		2	X	5,810
		2-1/2	4,778	X
		3-1/2	X	X
	3-3/4" (10d)	1-1/2	2,055	3,414
		2	X	5,810
		2-1/2	5,111	7,309
		3-1/2	9,508	8,339
1/2"	2"	1-3/4	3,515	X
		2	4,388	X
		3	6,719	2,229
		4	11,076	3,860
	3" (6d)	1-3/4	X	X
		2	X	X
		3	X	X
		4	X	X
	3-1/2"	1-3/4	X	X
		2	X	X
		3	7,646	X
		4	10,234	X
	4"	1-3/4	2,887	6,787
		2	4,310	6,678
		3	8,169	8,489
		4	11,111	10,942
	5" (10d)	1-3/4	X	X
		2	X	X
		3	X	X
		4	X	X

Dril-Flex® Structural Self-Drilling Fasteners

Offers virtual immunity to hydrogen-assisted stress corrosion cracking for maximum performance in the field

Dril-Flex fasteners are specially designed and processed to help prevent hydrogen-induced brittle failures. Each fastener undergoes the unique Flex Technology® dual-hardening process to ensure the optimal combination of ductility and hardness required for maximum performance in the field.

Testing of this product, in accordance with ASTM standards, has proven that Dril-Flex fasteners provide the same resistance to hydrogen-assisted cracking (HAC) as a Grade 5 fastener.

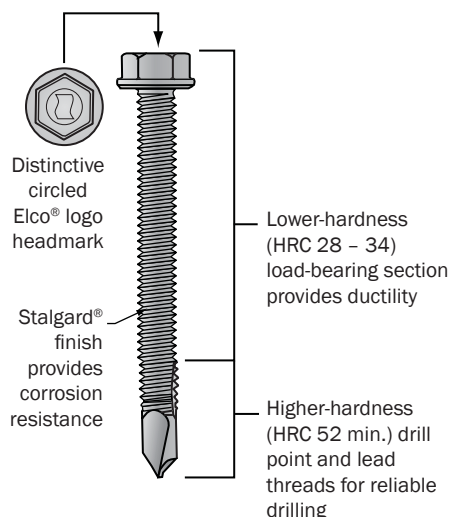
Unique Hardening and Finishing Processes Provide High Performance

Hydrogen-Assisted Stress Corrosion Cracking (HASCC) refers to a time-delayed failure that is aggravated or accelerated by hydrogen generated in the application. This is most often encountered and associated with dissimilar metal applications through the galvanic corrosion process. Most self-drilling fasteners, including 410 fasteners, are case or similarly hardened, which provides the necessary hardness for drilling and tapping, but leaves the screws vulnerable to HASCC due to their high surface or core hardness.

Dril-Flex fasteners offer the unique Flex Technology dual-hardening process. The self-drilling point and lead tapping threads are selectively hardened to a minimum of HRC 52. The load-bearing portion of the screw is held at or below the critical HRC 34 level. This reduced hardness level also meets SAE J429 Grade 5 and ASTM A449 strength and ductility standards.

Dril-Flex fasteners are then coated with silver Stalgard finish to provide superior corrosion resistance and enhanced galvanic compatibility. Fasteners coated with Stalgard finish typically show no red rust or other base metal corrosion on significant surfaces even after 1000 hours of 5% neutral salt spray exposure (ASTM B117).

The combination of this unique dual-hardening process and Stalgard finish results in a strong, reliable fastener that can be used where other self-drillers would fail. Dril-Flex self-drilling fasteners are the ideal fastening solution for demanding construction applications.



Features

- Self-drilling point
- Higher hardness (HRC 52 min.) point and lead threads
- Lower-hardness (HRC 28 - 34) load-bearing threads
- Silver Stalgard multi-layered corrosion resistant finish

Benefits

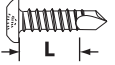
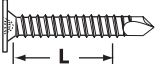
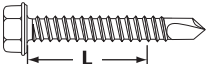
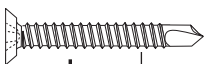
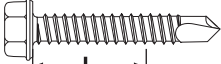
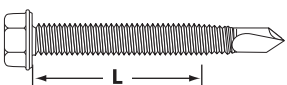
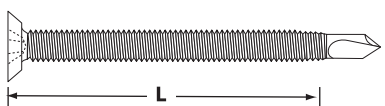
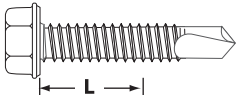
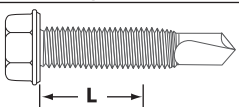
- Virtually immune to delayed HASCC brittle failures found with other hardened fasteners
- Provides the same high resistance to hydrogen-assisted failure as a Grade 5 fastener
- Precision self-drilling point ensures consistent, reliable drilling and tapping
- Eliminates separate drilling and tapping operations
- Corrosion resistance superior to zinc- or cadmium-based finishes
- Provides enhanced galvanic compatibility in dissimilar metal applications
- Approvals: ICC ES ER-4780 Legacy Report; COLA (City of Los Angeles) Research Report #25095

Product Information

Dril-Flex® Structural Self-Drilling Fasteners



Selection Guide

	Catalog No.	Description	Point	L Load-Bearing Area	Finish	Carton Qty.	Carton Weight
#10-16 With 5/16" Hex Washer Head							
	EAF430	10-16 x 3/4"	#3	.500"	Stalgard	6,000	48
	EAF460	10-16 x 1-1/2"	#3	1.00"	Stalgard	2,500	30
	EAF470	10-16 x 2"	#3	1.50"	Stalgard	2,000	28
	EAF480	10-16 x 2-1/2"	#3	1.83"	Stalgard	1,500	25
#10-16 With #2 Phillips Pan Head							
	EDX445	10-16 x 3/4"	#2	.500"	Stalgard	6,000	36
#10-24 With #2 Phillips Wafer Head							
	EBL530	10-24 x 1-1/4"	#3	.750"	Stalgard	5,000	44
#12-14 With 5/16" Hex Washer Head							
	EAF621*	12-14 x 7/8"	#3	.470"	Stalgard	5,000	54
	EAF641	12-14 x 1"	#3	.500"	Stalgard	4,000	44
	EAF681	12-14 x 1-1/2"	#3	1.00"	Stalgard	2,500	38
	EAF755	12-24 x 1-3/4"	#5	.800"	Stalgard	2,500	48
	EAF690	12-14 x 2"	#3	1.50"	Stalgard	2,000	37
	EAF715	12-14 x 3"	#3	2.50"	Stalgard	1,000	27
#12-14 With #3 Phillips Undercut Flat Head							
	EBL215	12-14 x 1"	#3	.500"	Stalgard	4,000	36
	EBL223	12-14 x 1-1/2"	#3	1.00"	Stalgard	2,500	26
1/4-14 With 3/8" Hex Washer Head							
	EAF816	1/4-14 x 1"	#3	.450"	Stalgard	3,000	54
	EAF841	1/4-14 x 1-1/2"	#3	.950"	Stalgard	2,000	45
	EAF846	1/4-14 x 2"	#3	1.45"	Stalgard	1,500	41
1/4-20 With 3/8" Hex Washer Head							
	EAF876	1/4-20 x 1-1/2"	#4	.830"	Stalgard	2,000	48
	EAF886	1/4-20 x 2"	#4	1.33"	Stalgard	1,500	45
	EAF865	1/4-20 x 1-1/8"	#4	.500"	Stalgard	2,500	51
	EAF888	1/4-20 x 1-3/4"	#5	.800"	Stalgard	1,000	27
	EAF890	1/4-20 x 2-1/2"	#4	1.830"	Stalgard	1,000	45
	EAF900	1/4-20 x 3-3/8"	#4	2.70"	Stalgard	500	22
	EAF910	1/4-20 x 4"	#4	3.50"	Stalgard	500	23
1/4-20 With #3 Phillips Undercut Flat Head							
	EBL330	1/4-20 x 3"	#4	2.50"	Stalgard	500	20
	EBL340	1/4-20 x 4"	#4	3.50"	Stalgard	500	23
5/16-18 With 3/8" Hex Washer Head							
	EAF940	5/16-18 x 1-1/2"	#3	.850"	Stalgard	1,000	37
5/16-24 With 3/8" Hex Washer Head							
	EAF960	5/16-24 x 1-1/2"	#4	.850"	Stalgard	1,000	40
	EAF970	5/16-24 x 2"	#4	1.35"	Stalgard	1,000	49

* EAF621 is for aluminum applications ONLY.

Fasteners shown are in-stock. Other head styles, threads, lengths and drilling capabilities can be produced to meet specific application needs.

IMPORTANT: to ensure proper performance, only the load-bearing area should be engaged in the material being fastened.

COMPARISON TO STAINLESS STEEL FASTENERS

300 series stainless steel fasteners will not rust, and, because of their low hardness, they also provide high resistance to hydrogen embrittlement failures. However, because plain-finished stainless steel is galvanically incompatible with certain building materials – including steel and aluminum – it can cause other problems (see chart) when combined with these materials. Stainless steel fasteners trigger a sacrificial action in the aluminum or steel panel, which can lead to degradation of the panel and loosening of the fastener.

The dual-hardening process allows Dril-Flex® fasteners to provide high strength and resistance to hydrogen embrittlement failures. Their unique Stalgard® finish provides corrosion resistance several times greater than other commonly-used finishes. Fasteners coated with Stalgard finish typically show no red rust or other base metal corrosion on significant surfaces even after 1000 hours of 5% neutral salt spray exposure (ASTM B117).

If the environment is corrosive enough to significantly affect the Stalgard finish, the potential for significant degradation of the aluminum/stainless steel assembly would also exist.

Galvanic Series

Anodic End	
Metal/Alloy	EMF (v)
Magnesium.....	-1.60
Zinc.....	-1.10
Alum (5000, 6000, 7000).....	-.75
Iron, Low Alloy Steels.....	-.70
Alum (2000).....	-.60
Lead.....	-.55
18% Chromium Steel.....	-.35
Naval Brass.....	-.30
Brass, Bronze.....	-.25
Austenitic Stainless (300 Series)....	-.20
Nickel.....	-.15
Silver.....	0
Gold.....	+15
Cathodic End	

In the presence of moisture, materials higher on the list will be sacrificial to materials lower on the list. The greater the EMF differential, the greater the sacrificial action of the anode to the cathode in a galvanic cell.

EMBRITTLMENT TESTING

Embrittlement testing of Dril-Flex fasteners was performed in accordance to ASTM F1624-06, "Standard Test Method for Measurement of Hydrogen Embrittlement in Steel by the Incremental Loading Method". Fastener lots were tested to determine their Threshold Stress Limits for both Internal Hydrogen Embrittlement and Environmental Hydrogen Embrittlement. Threshold Stress Limit is the stress level below which no time-dependent cracking will occur. Above this level, subcritical cracking that leads to time-delayed fracture or embrittlement may occur if the fastener is exposed to a hydrogen environment.

Embrittlement Test Results

- Dril-Flex fasteners have a hardness range of HRC 28 – 34, which is roughly equivalent to a SAE Grade 5 fastener (HRC 25 – 34).
- Dril-Flex fasteners showed resistance to the effect of hydrogen-assisted cracking when loaded to 75% of their tensile strength. This is within accepted industry guidelines for in-service loading conditions.
- Dril-Flex fasteners showed no degradation or failures in tensile strength below their Ultimate Tensile Strength.

SHEAR AND PULL-OUT VALUES

Pull-out Tests – Steel

Pull-out values shown are in lbs.

Screw Size	Point Type	Drill Cap.	Steel							
			18	16	14	12	1/8	3/16	1/4	5/16
10-16	3	.150	396	501	634	1595	1693			
12-14	3	.187	396	527	710	1678	2061	2898		
1/4-14	3	.187	398	530	686	1950	2264	3919		
1/4-20	4	.312		516	649	1912	2296	2928	3561	4488
5/16-24	4	.312				2148	2573	4226	5424	6622

Shear Tests – Steel

Shear values shown are in lbs.

Screw Size	Point Type	Drill Cap.	Steel							
			18-18 gage	18-14 gage	16-16 gage	14-14 gage	1/8"-3/16"	3/16"-1/4"	1/4"-12 gage	
10-16	3	.150	1362	1733	1462					
12-14	3	.187	1315	2118	1655	1816				
1/4-14	3	.187	1395	2313	1681	2417	2600			
1/4-20	4	.312	1350	2086	1582	2450	2814	2810	2706	
5/16-24	4	.312					5486	5283	4761	

Pull-out Tests – Aluminum

Pull-out values shown are in lbs.

Screw Size	Point Type	Drill Cap.	Aluminum 6063-T5		
			1/8"	1/4"	3/8"
10-16	3	.150			
12-14	3	.187	939	2286	
1/4-14	3	.187	1003	2424	
1/4-20	4	.312	897	2075	3683
5/16-24	4	.312	1043	2566	

Shear Tests – Aluminum

Shear values shown are in lbs.

Screw Size	Point Type	Drill Cap.	Aluminum 6063-T5	
			1/8" - 1/8"	1/8" - 1/4"
10-16	3	.150	1466	
12-14	3	.187	1797	2483
1/4-14	3	.187	1996	2883
1/4-20	4	.312	2006	2926
5/16-24	4	.312	1849	2926

NOTE: All test setups and dimensions were as limited and outlined in AISI Test Method for Mechanically Fastened Cold-Formed Steel Connections (CF92-1) document. Performance values listed are ultimate values obtained under laboratory conditions. Appropriate safety factors should be applied for design purposes.

SPECIFICATIONS

Applications:

Metal (including aluminum) to steel structurals like those found in curtainwall and solar panel systems

Short Form Specification:

Dual-hardened fastener with self-drilling point and self-tapping thread that meets SAE J429 Grade 5 and ASTM A449 strength and ductility requirements, which provides a maximum load-bearing area of _____.

Approvals/Listings:

- ICC ES ER-4780 Legacy Report
- COLA (City of Los Angeles) Research Report #25095

Diameters:

#10, #12, 1/4", 5/16"

Head Styles:

Hex washer, undercut flat, pan and wafer; custom heads styles available

Thread Form:

Self-tapping

Point Type:

Self-drilling

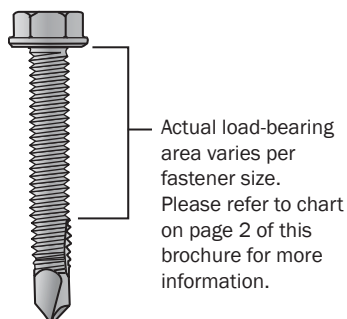
Material:

Special alloy steel

Finish:

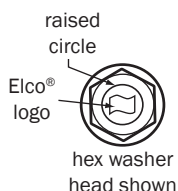
Silver-colored

Stalgard® corrosion-resistant finish withstands a minimum of 1000 hours salt spray per ASTM B117 standards



Inspection

In-place inspection can be made by identifying the special Dril-Flex headmarking. This is a combination of two markings: an Elco® logo surrounded by a raised circle.



Installation Tools:

Standard 4.5 min. amp screw gun that has a torque-limiting and/or depth-sensitive nose piece

DESIGNING WITH DRIL-FLEX® FASTENERS

Download CAD files from our web site at www.elcoconstruction.com or contact Elco Construction Products for a free disk containing CAD drawings and specifications.

QUALITY CONTROL

Dril-Flex fasteners are produced under lot control conditions. Each production run is sampled and checked for two key conditions. First, that the lower hardness zone extends down the shank to the length specified, and second, that the hardness in that zone is per the specifications. Documentation is retained for a period of five years. Lot numbers are marked on every box of product.



QUALITY FLEX TECHNOLOGY® PRODUCTS

- Bi-Flex™ bi-metal self-drilling fasteners with Stalgard GB coating for metal applications, including aluminum, in demanding environments
- Aggre-gator® bi-metal anchors with Stalgard GB coating for concrete applications, including exposed/wet areas
- ConFlex® large diameter masonry fasteners with Stalgard coating in 3/8" and 1/2" diameters
- AllFlex™ stainless steel thread-forming and thread-cutting screws with Stalgard GB coating
- Alumi-Flex™ 302 stainless steel drill screws with Stalgard GB coating

Visit www.elcoconstruction.com for more information on these and other quality fastening systems from Elco Construction Products.



Elco Construction Products

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800.435.7213 • Fax: 563.387.3540

www.elcoconstruction.com





77 Westport Plaza
Suite 250
St. Louis, MO 63146

TRANSMITTAL

No. 15051-0313

Paric Corporation

PROJECT: 15051-Webster University Interdisciplinary Science Building

DATE: 11/09/2016

TO: Cannon Design
1100 Clark Ave
St Louis MO 63102

RE: Preliminary Curtainwall Calculations

ATTN: Kelvin Patel

JOB: 15051

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
☐ Shop Drawings	☒ Approval	☐ Approved as Submitted
☐ Letter	☐ Your Use	☐ Approved as Noted
☐ Prints	☐ As Requested	☐ Returned After Loan
☐ Change Order	☐ Review and Comment	☐ Resubmit
☐ Plans		☐ Submit
☐ Samples	SENT VIA:	☐ Returned
☐ Specifications	☐ Attached	☐ Returned for Corrections
☒ Other: Calculations	☐ Separate Cover Via:	☐ Due Date:

Item	Package	Code	Rev.	Copies	Date	Description	Status
Submittal		084423-022	1		11/09/2016	Preliminary Curtainwall Calculations	Submitted

NOTES:

CC:

Signed: _____
Devin Gates