JEI Structural Engineering
Glazing Systems
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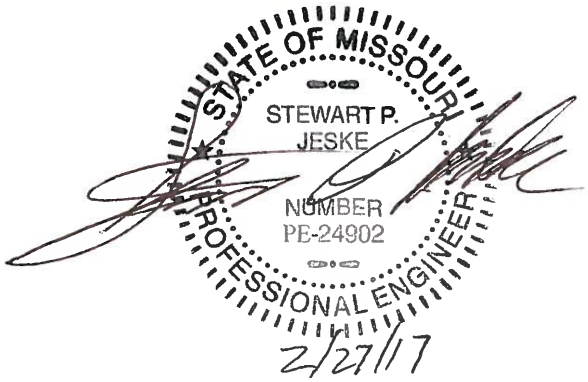
Webster University
St. Louis, Missouri

NGG

Aluminum Curtainwall Calculation Package
(Wind Analysis)

Addendum #1



Project No. JE16059

February 27, 2017

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

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Webster University
St. Louis, Missouri

Addendum #1

1. Addendum #1 Scope

   Addendum #1 modified the original Webster University project calculation package, JE16059, dated December 2, 2016 as follows:

   1. All low-profile corner mullions were changed to E9-3402 extrusion, as opposed to the E9-3401 heavy profile.

   2. Frame 213 horizontal mullion reinforcing was changed to a 2" x 2" A36 solid steel bar from the 2" x 2" x ¼" HSS tube.

   3. The anchor condition at the roof of frames 216-218 was resolved. Originally the last 3 mullions to the east end, were too short to be supported by the roof edge angle. The mullions will now hang from the parapet cap.

   4. T-Anchors at the sill of frames 217-218 were changed from 1-piece to 2-piece construction.

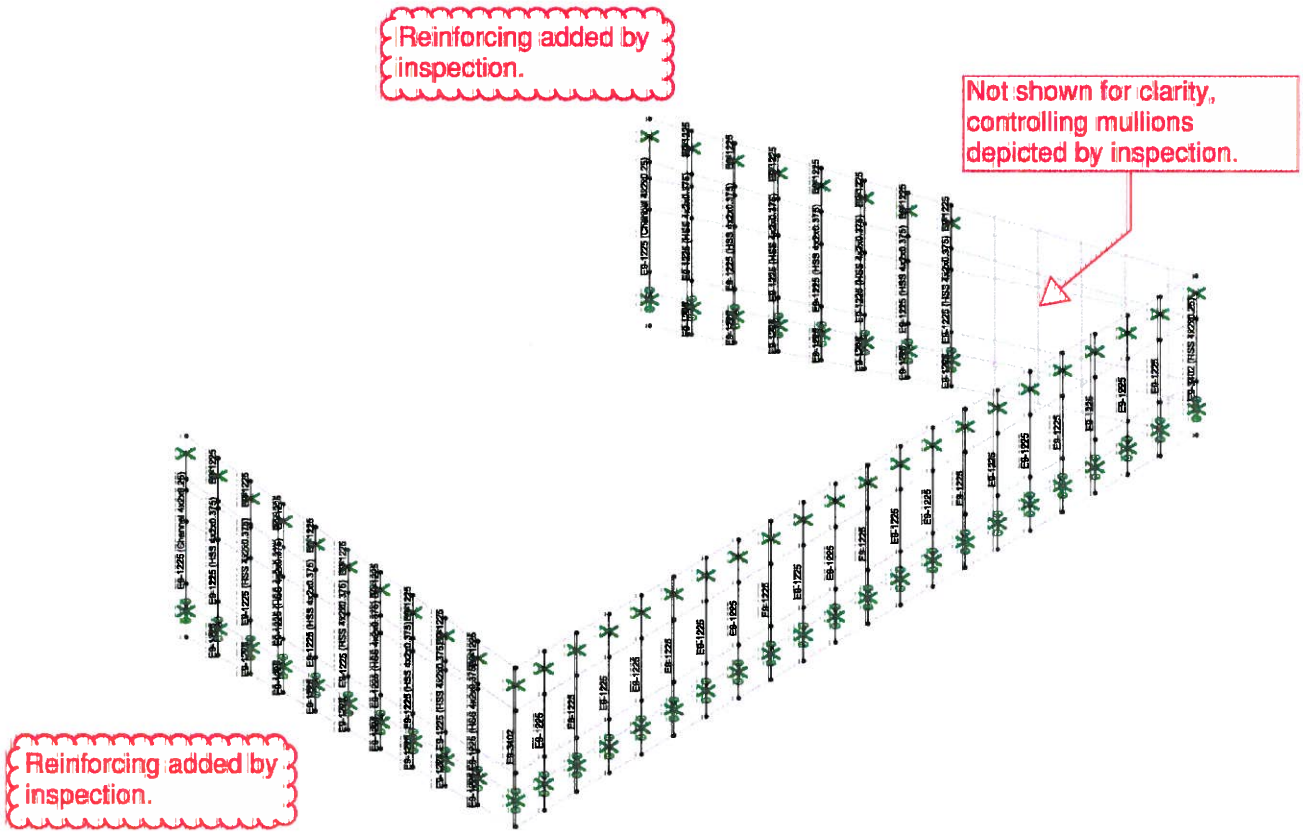
   5. The dead load anchors on the 90 and 64 degree corners, associated with EGS-1, were changed to be directly welded to the pour stop angle. The eccentricity created by accommodating for safety railings during construction was too great to utilize the standard assembly used throughout the project.

2. Revised Calculation Package Pages

   Added pages: 13, 38-43, 93a-v, 97-100, 118, 119, 127, 129a-b, 131a-i, 142, 149, 150, 151a

   Replaced pages: 13, 38-43, 97-100, 118, 119, 127, 142, 149, 150

Section sets



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

JEI Structural Engineering	Webster University	SK - 2
M. Gorny		Jan 19, 2017 at 7:48 AM
JE16059		EGS-1 Preliminary.r3d

Beam: *M710*

Shape:
Material: gen_Alum
Length: 180.75 in
I Joint: N794B
J Joint: N724A

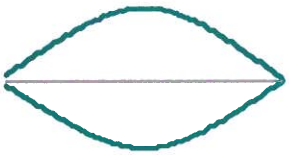
Code Check: No Calc
Report Based On 97 Sections

.093 at 90.375 in

Dy  in

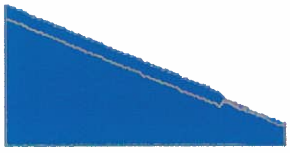
-.097 at 90.375 in

.271 at 90.375 in

Dz  in

-.249 at 90.375 in

725.465 at 0 in

A  lb

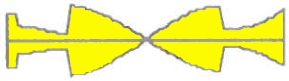
85.172 at 180.75 in

146.729 at 180.75 in

Vy  lb

-161.344 at 180.75 in

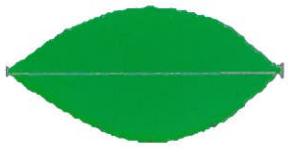
170.252 at 41.422 in

Vz  lb

-181.037 at 41.422 in

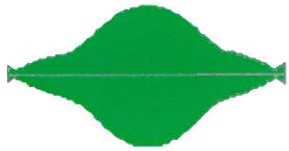
T ——— lb-ft

501.685 at 94.141 in

Mz  lb-ft

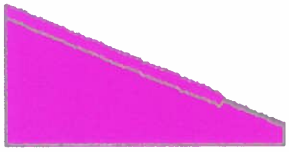
-544.25 at 94.141 in

525.596 at 90.375 in

My  lb-ft

-570.428 at 90.375 in

321.857 at 0 in

fa  psi

37.787 at 180.75 in

f(y) ——— psi

f(z) ——— psi

YKK E9-3402
64 deg corner

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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:	1/210
Detail:	1/405 **Member M710**

Date:	1/19/2017
Proj. No.:	JE16059
Designer:	M. Gorny

INPUT | CHECK | RISA

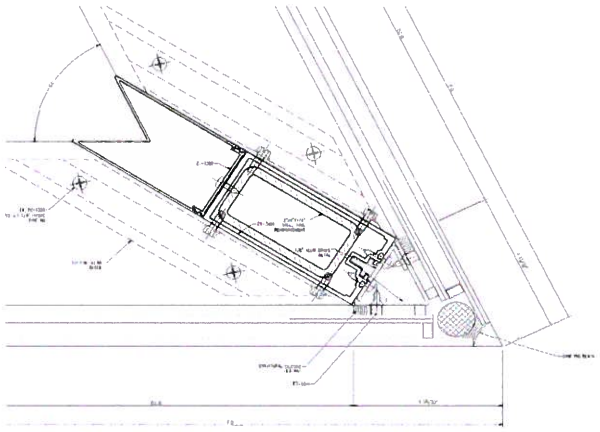
Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

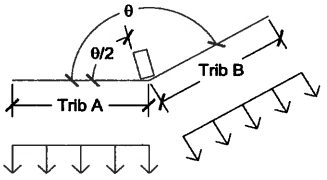
Tributary Width A (t_{WLA})	2.80 ft	Corner Angle (θ)	
Tributary Width B (t_{WLB})	1.62 ft	64.00 °	
Height (h)	15.44 ft		
Unbraced Length (L)	8.33 ft		

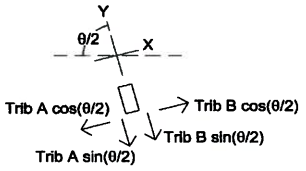
Design Loads

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 E9-3402	
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
Thermal Reduction Factors (TRF_i, TRF_s)			
I_x Reduc.	1.00	S_x Reduc.	1.00
Reinforcing		HSS 2x4x1/4	
$I_{x,\,steel}$ =	4.490 in^4	$I_{y,\,steel}$ =	1.480 in^4
$S_{x,\,steel}$ =	2.250 in^3	$S_{y,\,steel}$ =	1.480 in^3
$I_{x,\,combined}$ =	19.506 in^4	$I_{y,\,combined}$ =	6.021 in^4







X-Axis Bending Stress (ADM F.2 & F.3)			**Ω = 1.65**	
w = p * t		w_y =	N/A	lb/ft
Shear Load V = wl/2		V_y =	150.1	lb
Moment M = $wl^2/8$		M_x =	513.2	lb-ft
M_{alum} = M * I_{alum}*TRF_i/I_{comb}		$M_{x\text{-}alum}$ =	170.6	lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	178.0	
f_b = $M_{alum}/(S_{x,\,alum}$*$TRF_s)$		$f_{b\text{-}alum\text{-}x}$ =	0.93	ksi
$f_{b\text{-}alum\text{-}x}/F_{bx}$ =	0.063	Fbx/Ω = Fbx =	14.88	ksi
Y-Axis Bending Stress (ADM F.2 & F.3)			**Ω = 1.65**	
w = p * t		w_x =	N/A	lb/ft
Shear Load V = wl/2		V_x =	180.9	lb
Moment M = $wl^2/8$		M_y =	555.8	lb-ft
M_{alum} = M * I_{alum}/I_{comb}		$M_{y\text{-}alum}$ =	159.6	lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	112.0	
f_b = $M_{alum}/(S_{y,\,alum})$		$f_{b\text{-}alum\text{-}y}$ =	1.38	ksi
$f_{b\text{-}alum\text{-}y}/F_{by}$ =	0.091	Fby/Ω = Fby =	15.26	ksi
Combined Stress Ratio		$f_{bx}/F_{bx} + f_{by}/F_{by}$ =	**0.15**	
		OK		

Check Combined Bending & Compression (ADM H.1)		
$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b$ =	0.218
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)
0.332	0.668	0.287	0.713

Axial Load		
P = p_{wt} * t * h + wt * h	P =	578.3 lb

Check Allowable Compression - ADM E.3		
kL_b/r =	kL_b/r =	100.62
F_{a1} (Allowable Compression)	Fa1/Ω =	5.07 ksi
Check Allowable Compression - Flange element (ADM B.5.4.2)		
b/t =	b/t =	23.48
F_{a2} (Allowable Compression)	Fa2/Ω =	15.01 ksi
Check Allowable Compression - Web element (ADM B.5.5.1)		
b/t =	b/t =	54.86
F_{a3} (Allowable Compression)	Fa3/Ω =	19.70 ksi

f_a = P/A	f_a =	0.33 ksi
Lessor of F_{a1}, F_{a2} ,F_{a3}	Fa/Ω = Fa =	5.07 ksi
	f_a/F_a =	0.065
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:	1/210
Detail:	1/405

Date:	1/19/2017
Proj. No.:	JE16059
Designer:	M. Gorny

INPUT | CHECK | RISA

Strong Axis Deflection (M_x, w_y)	Typical Vertical	
$\Delta_y = (5w_yL4)/(384EI)$	Δ_y =	0.101 in
within DLO (Conservative)	Δ_y =	0.101 in
Weak-Axis Deflection (w_x)		
$\Delta_x = (5w_xL^4)/(384EI_\Delta)$	Δ_x =	0.283 in
within DLO (Conservative)	Δ_x =	0.283 in
Resultant Deflection		
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$	Δ_{total} =	0.300 in
Angle Relative to X-Axis	θ_Δ =	19.6 °
	Δ_{allow} =	1.022 in
Allowable deflection = L/175 or if span > 13'-6" then allowable def = L/240 + 1/4"	Deflection Factor DF =	#######
OK		

Deflection Along Glazing		
$\Delta_{y\text{-glazing}} = \Delta_y$*sin((180-θ)/2)	$\Delta_{y\text{-glazing}}$ =	0.086 in
$\Delta_{x\text{-glazing}} = \Delta_x$*cos((180-θ)/2)	$\Delta_{x\text{-glazing}}$ =	0.150 in
Tributary Area A		
$\Delta_{total\text{-}A} = \Delta_{x\text{-glazing}} + \Delta_{y\text{-glazing}}$	Δ_{total} =	0.236 in
Tributary Area B		
$\Delta_{total\text{-}B} = \Delta_{x\text{-glazing}} - \Delta_{y\text{-glazing}}$	Δ_{total} =	0.064 in

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

Steel Stress (X-axis)		
Moment to Steel = I_x, steel/ I comb =		342.6 lb-ft
$f_b = M/S_{x,\ steel}$	f_b =	0.9 ksi
M_n/Ω_b =	M_n/Ω_b =	8814 lb-ft
OK		

Steel Stress (Y-axis)		
Moment to Steel = Iy, steel/ I comb =		396.2 lb-ft
$f_b = M/S_{y,\ steel}$	f_b =	3.2 ksi
M_n/Ω_b =	M_n/Ω_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

	.175 at 138.125 in Dy — in -.129 at 135.469 in	.205 at 135.469 in Dz — in -.213 at 135.469 in
733.984 at 42.5 in A — lb -132.813 at 39.844 in	137.573 at 185.938 in Vy — lb -150.503 at 42.5 in	162.93 at 87.656 in Vz — lb -162.353 at 185.938 in
T — lb-ft	446.994 at 138.125 in Mz — lb-ft -325.676 at 135.469 in	265.646 at 138.125 in My — lb-ft -256.984 at 138.125 in
325.636 at 42.5 in fa — psi -58.923 at 39.844 in	f(y) — psi	f(z) — psi

YKK E9-3402
90 deg corner

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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:	1/19/2017
Proj. No.:	JE16059
Designer:	M. Gorny

INPUT | CHECK | RISA

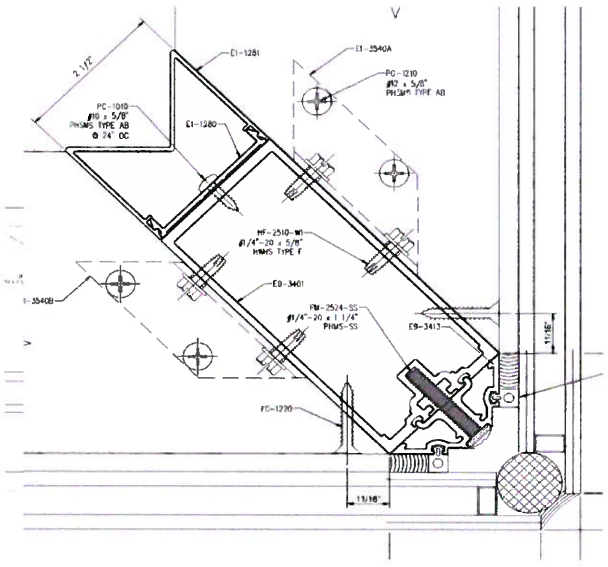
Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

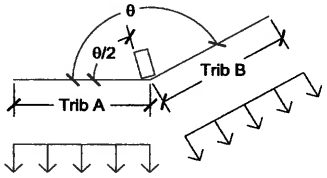
Tributary Width A (t_{WLA})	2.80 ft	Corner Angle (θ)	
Tributary Width B (t_{WLB})	1.62 ft	90.00 °	
Height (h)	15.44 ft		
Unbraced Length (L)	8.33 ft		

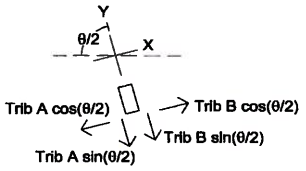
Design Loads

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 E9-3402	
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
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
$I_{x,\,combined}$ =	6.485 in^4	$I_{y,\,combined}$ =	1.729 in^4







X-Axis Bending Stress (ADM F.2 & F.3)			**Ω = 1.65**
w = p * t		w_y =	N/A lb/ft
Shear Load V = wl/2		V_y =	138.1 lb
Moment M = $wl^2/8$		M_x =	386.9 lb-ft
M_{alum} = M * I_{alum}*TRF_I/I_{comb}		$M_{x\text{-}alum}$ =	386.9 lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	178.0
f_b = $M_{alum}/(S_{x,\,alum}$*$TRF_S)$		$f_{b\text{-}alum\text{-}x}$ =	2.11 ksi
$f_{b\text{-}alum\text{-}x}/F_{bx}$ =	0.142	Fbx/Ω = Fbx =	14.88 ksi
Y-Axis Bending Stress (ADM F.2 & F.3)			**Ω = 1.65**
w = p * t		w_x =	N/A lb/ft
Shear Load V = wl/2		V_x =	162.8 lb
Moment M = $wl^2/8$		M_y =	251.9 lb-ft
M_{alum} = M * I_{alum}/I_{comb}		$M_{y\text{-}alum}$ =	251.9 lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	112.0
f_b = $M_{alum}/(S_{y,\,alum})$		$f_{b\text{-}alum\text{-}y}$ =	2.19 ksi
$f_{b\text{-}alum\text{-}y}/F_{by}$ =	0.143	Fby/Ω = Fby =	15.26 ksi
Combined Stress Ratio		$f_{bx}/F_{bx} + f_{by}/F_{by}$ =	**0.29**
		OK	

Check Combined Bending & Compression (ADM H.1)		
$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b$ =	0.350
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} * t * h + wt * h	P =	578.3 lb

Check Allowable Compression - ADM E.3		
kL_b/r =	kL_b/r =	100.62
F_{a1} (Allowable Compression)	Fa1/Ω =	5.07 ksi
Check Allowable Compression - Flange element (ADM B.5.4.2)		
b/t =	b/t =	23.48
F_{a2} (Allowable Compression)	Fa2/Ω =	15.01 ksi
Check Allowable Compression - Web element (ADM B.5.5.1)		
b/t =	b/t =	54.86
F_{a3} (Allowable Compression)	Fa3/Ω =	19.70 ksi

f_a = P/A	f_a =	0.33 ksi
Lessor of F_{a1}, F_{a2} ,F_{a3}	Fa/Ω = Fa =	5.07 ksi
	f_a/F_a =	0.065
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:	1/19/2017
Proj. No.:	JE16059
Designer:	M. Gorny

INPUT | CHECK | RISA

Strong Axis Deflection (M_x, w_y)	Typical Vertical	
$\Delta_y = (5w_yL4)/(384EI)$	Δ_y =	0.190 in
within DLO (Conservative)	Δ_y =	0.190 in
Weak-Axis Deflection (w_x)		
$\Delta_x = (5w_xL^4)/(384EI_\Delta)$	Δ_x =	0.236 in
within DLO (Conservative)	Δ_x =	0.236 in
Resultant Deflection		
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$	Δ_{total} =	0.303 in
Angle Relative to X-Axis	θ_Δ =	38.8 °
	Δ_{allow} =	1.022 in
Allowable deflection = L/175 or if span > 13'-6" then allowable def = L/240 + 1/4"	Deflection Factor DF =	#######
OK		

Deflection Along Glazing		
$\Delta_{y\text{-glazing}} = \Delta_y$*sin((180-θ)/2)	$\Delta_{y\text{-glazing}}$ =	0.134 in
$\Delta_{x\text{-glazing}} = \Delta_x$*cos((180-θ)/2)	$\Delta_{x\text{-glazing}}$ =	0.167 in
Tributary Area A		
$\Delta_{total\text{-}A} = \Delta_{x\text{-glazing}} + \Delta_{y\text{-glazing}}$	Δ_{total} =	0.301 in
Tributary Area B		
$\Delta_{total\text{-}B} = \Delta_{x\text{-glazing}} - \Delta_{y\text{-glazing}}$	Δ_{total} =	0.033 in

SSG Sealant Deflection	
1/4 in. joint	50% ± movement capacity
0.280 in. allowable deflection	SSG Sealant 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_n/Ω_b =	M_n/Ω_b =	0 lb-ft
N/A		

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

General Section Sets

	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

Basic Load Cases

	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		

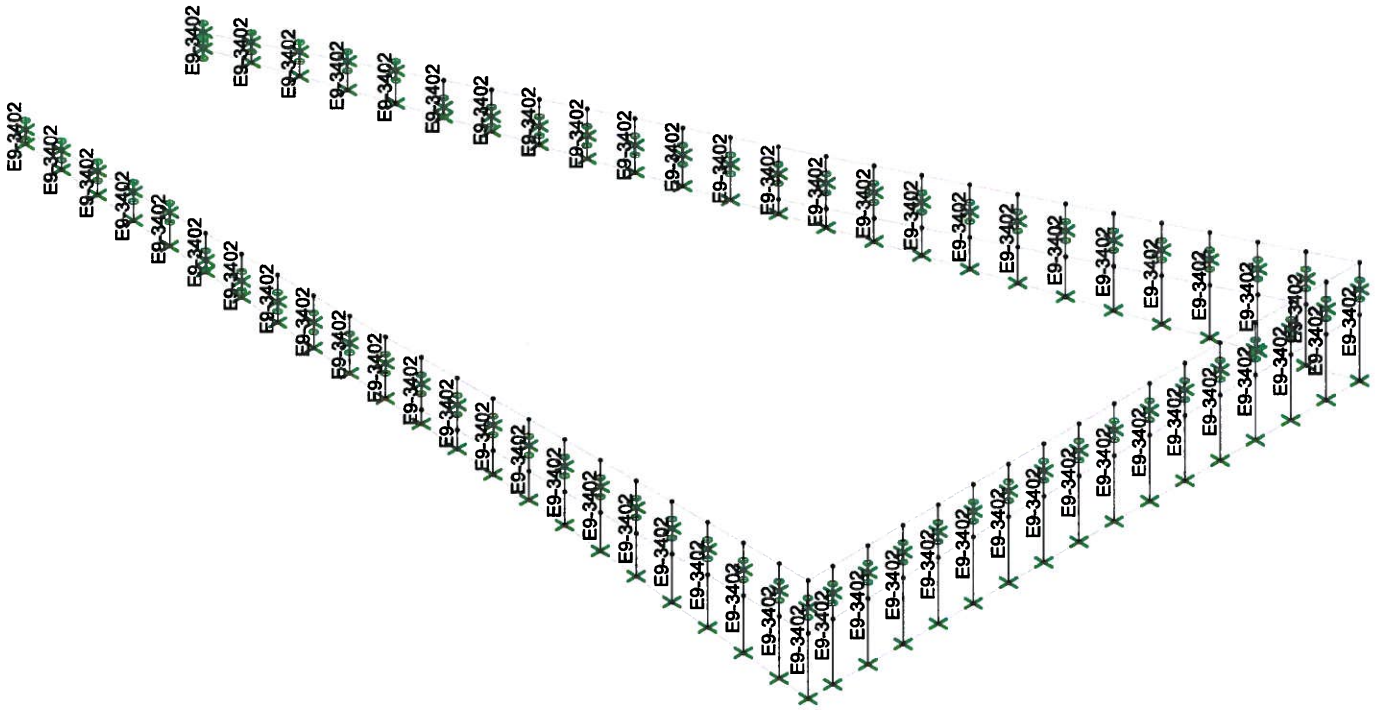
Load Combinations

	Description	S...	PD...	S...	B...	Fa...	B...	Fa...	B...	Fa...
1	Negative Wind Face A	Yes	Y		1	1	7	1		
2	Negative Wind Face B	Yes	Y		3	1	7	1		
3	Negative Wind Face C	Yes	Y		5	1	7	1		
4	Dead + 75% Negative Wind Face A + 75% Positive Wind Face B	Yes	Y		1	.75	4	.75	7	1
5	Dead + 75% Negative Wind Face B + 75% Positive Wind Face A	Yes	Y		3	.75	2	.75	7	1
6	Dead + 75% Negative Wind Face C + 75% Positive Wind Face B	Yes	Y		5	.75	4	.75	7	1
7	Dead + 75% Negative Wind Face B + 75% Positive Wind Face C	Yes	Y		3	.75	6	.75	7	1
8	Dead + Negative Wind Face A + Positive Wind Face C	Yes	Y		1	1	6	1	7	1
9	Dead + Negative Wind Face C + Positive Wind Face A	Yes	Y		5	1	2	1	7	1

Risa analysis covers the following frames:
EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

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

Section sets



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

JEI Structural Engineering	Webster University	SK - 11
M. Gorny		Jan 18, 2017 at 2:49 PM
JE16059		EGS-1 Preliminary.r3d

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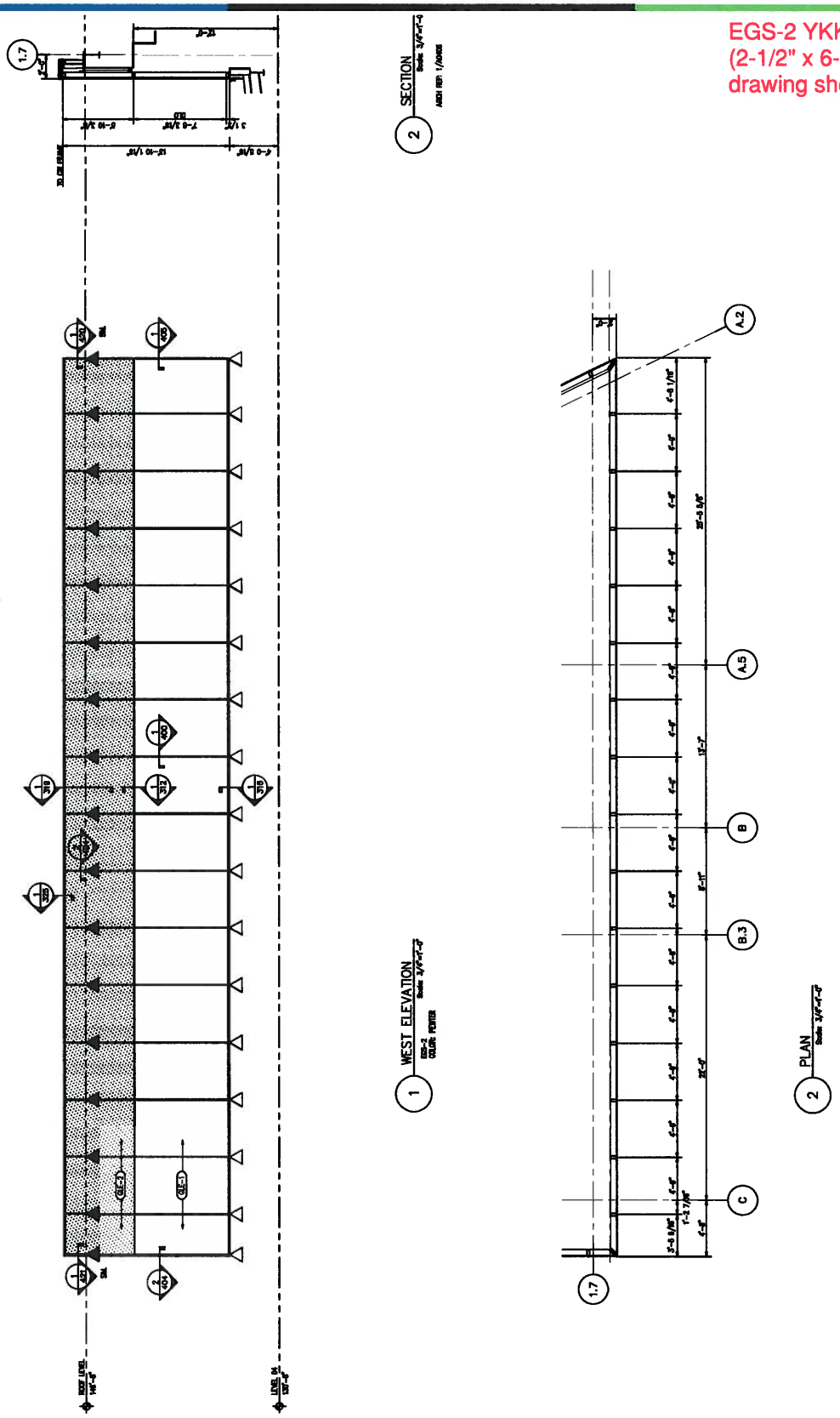
Project #JE16059
November 7, 2016

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



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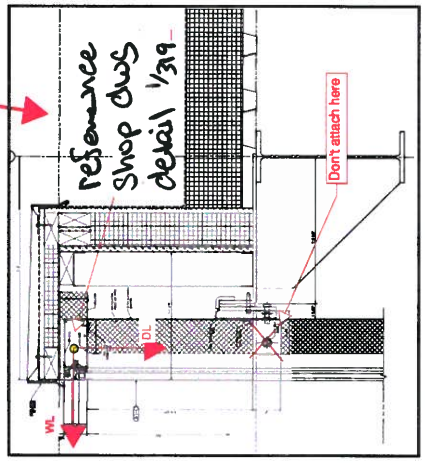
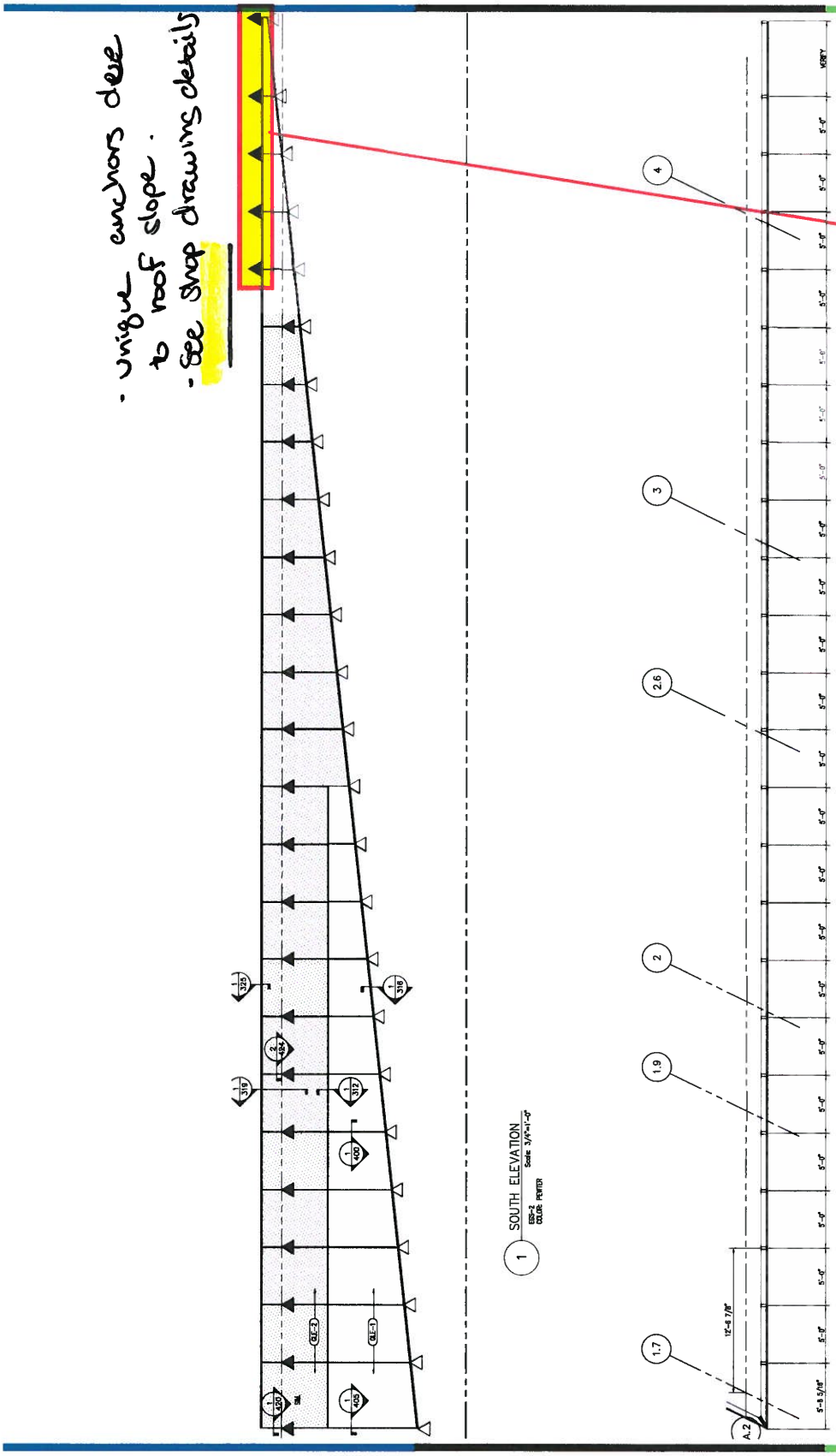
- Unique anchors dese to roof slope.
- See shop drawings details

EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 217





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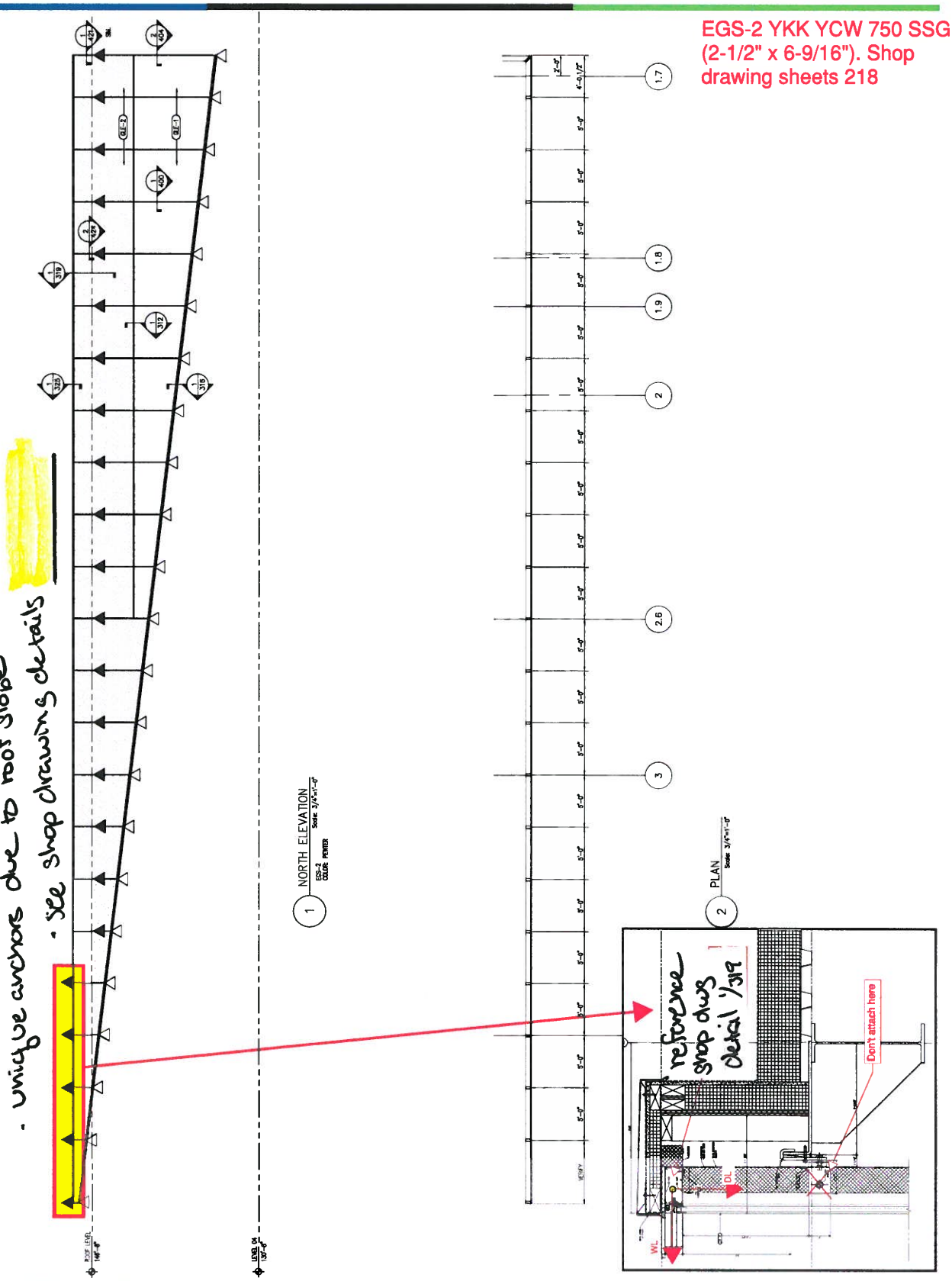
Project #JE16059
November 7, 2016

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



- Unique anchors due to roof slope
- See shop drawings details

reference shop dwg detail 1/319

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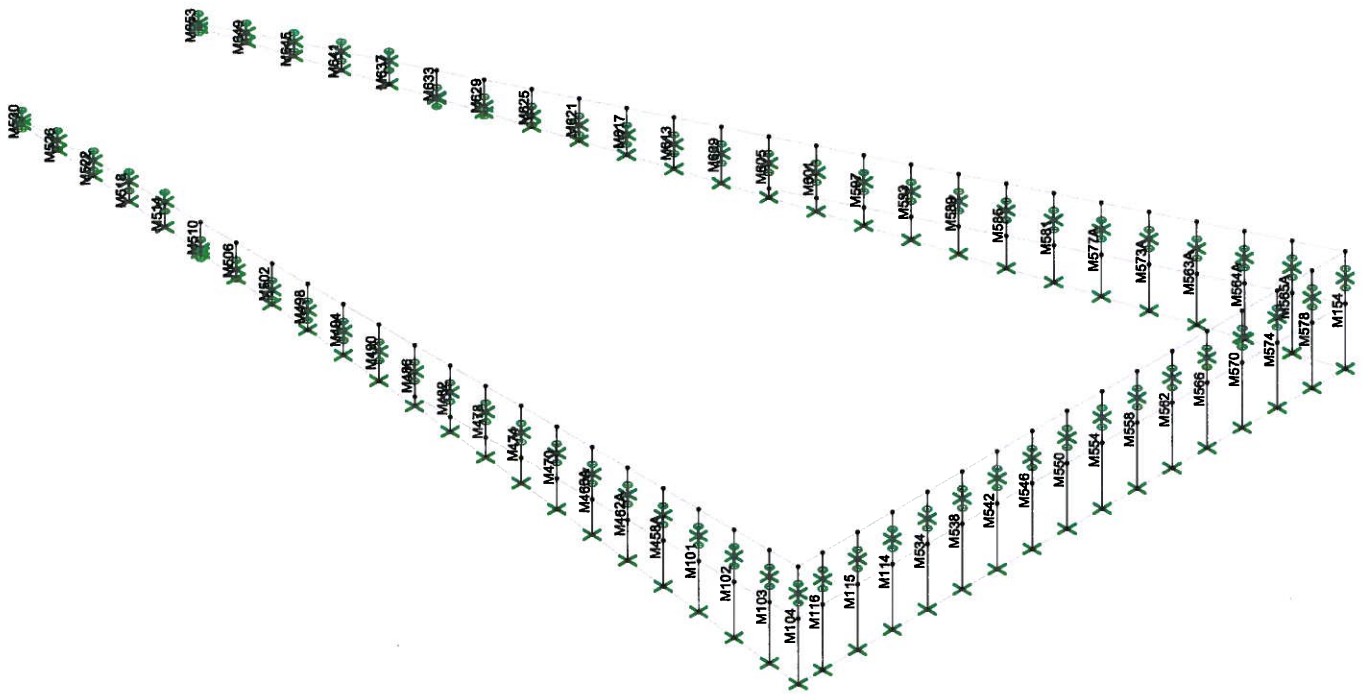
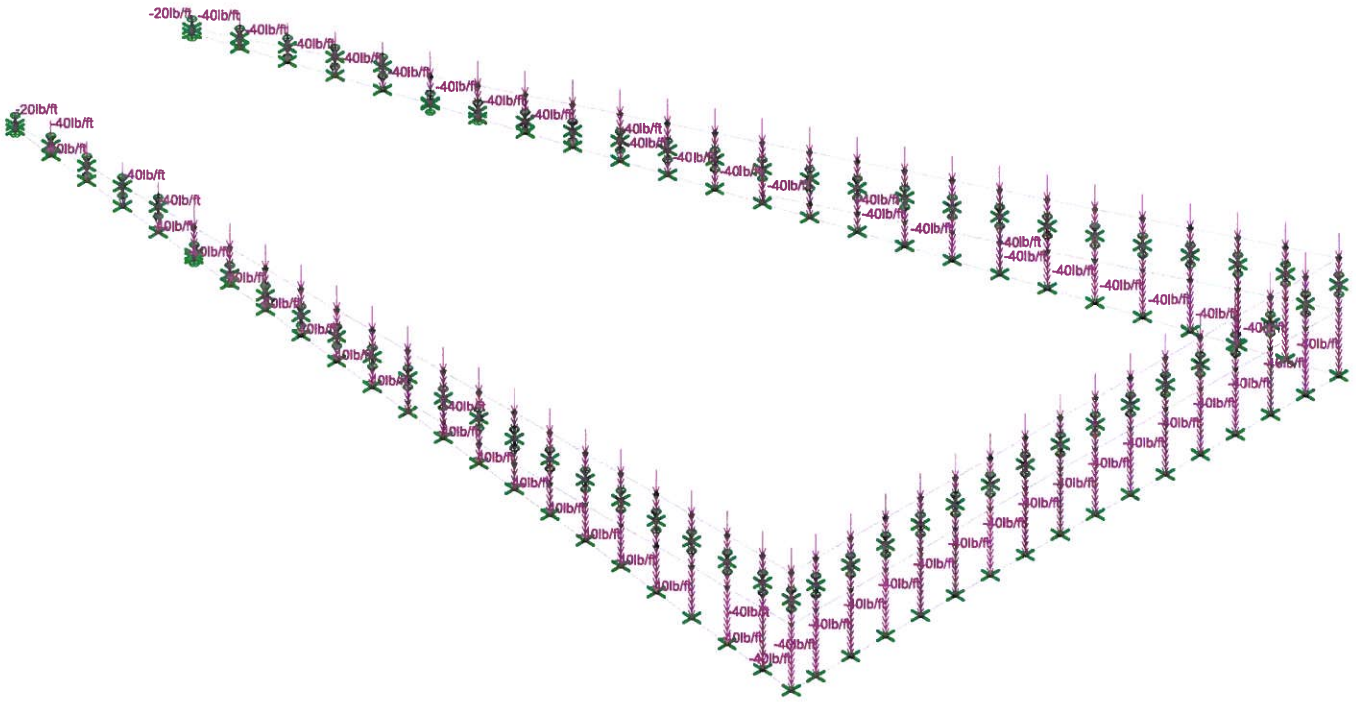
Member labels



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

JEI Structural Engineering	Webster University	SK - 51
M. Gorny		Nov 2, 2016 at 7:20 AM
JE16059		EGS-1 Preliminary.r3d

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

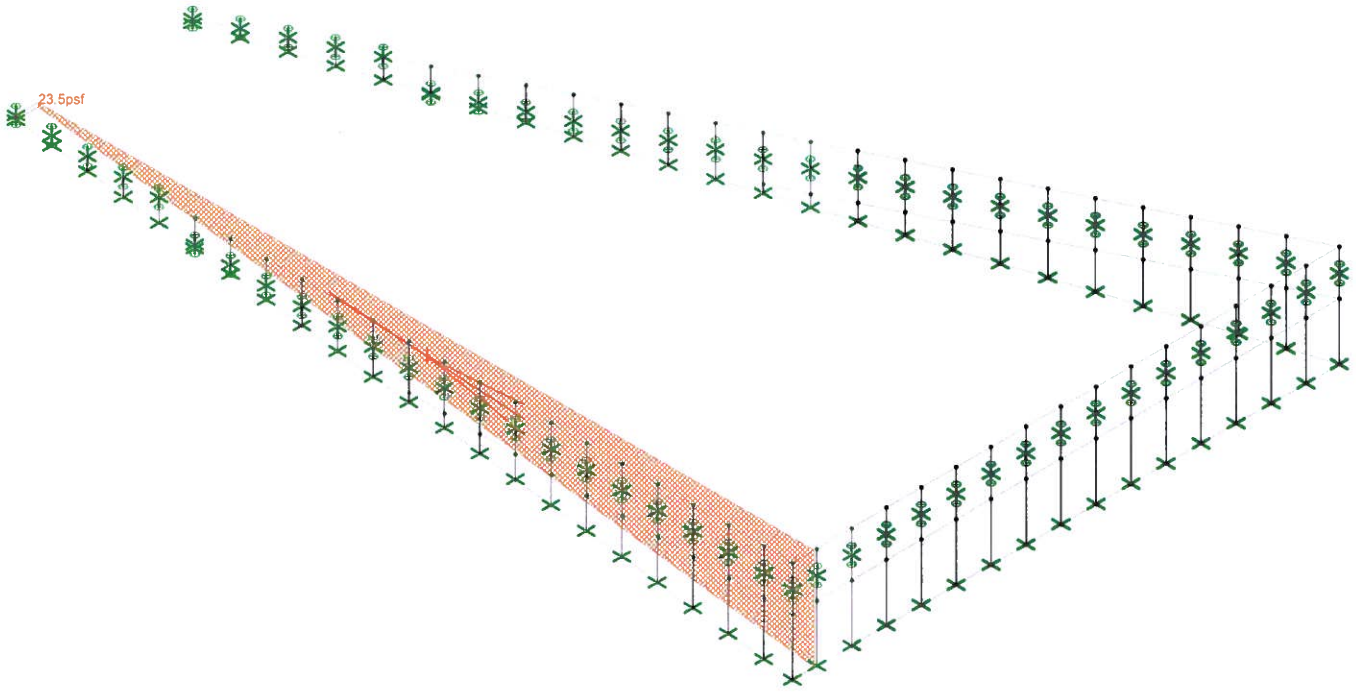


EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Loads: BLC 7, Dead

JEI Structural Engineering	Webster University	SK - 52
M. Gorny		Nov 2, 2016 at 7:20 AM
JE16059		EGS-1 Preliminary.r3d

Negative Wind - 23.5psf

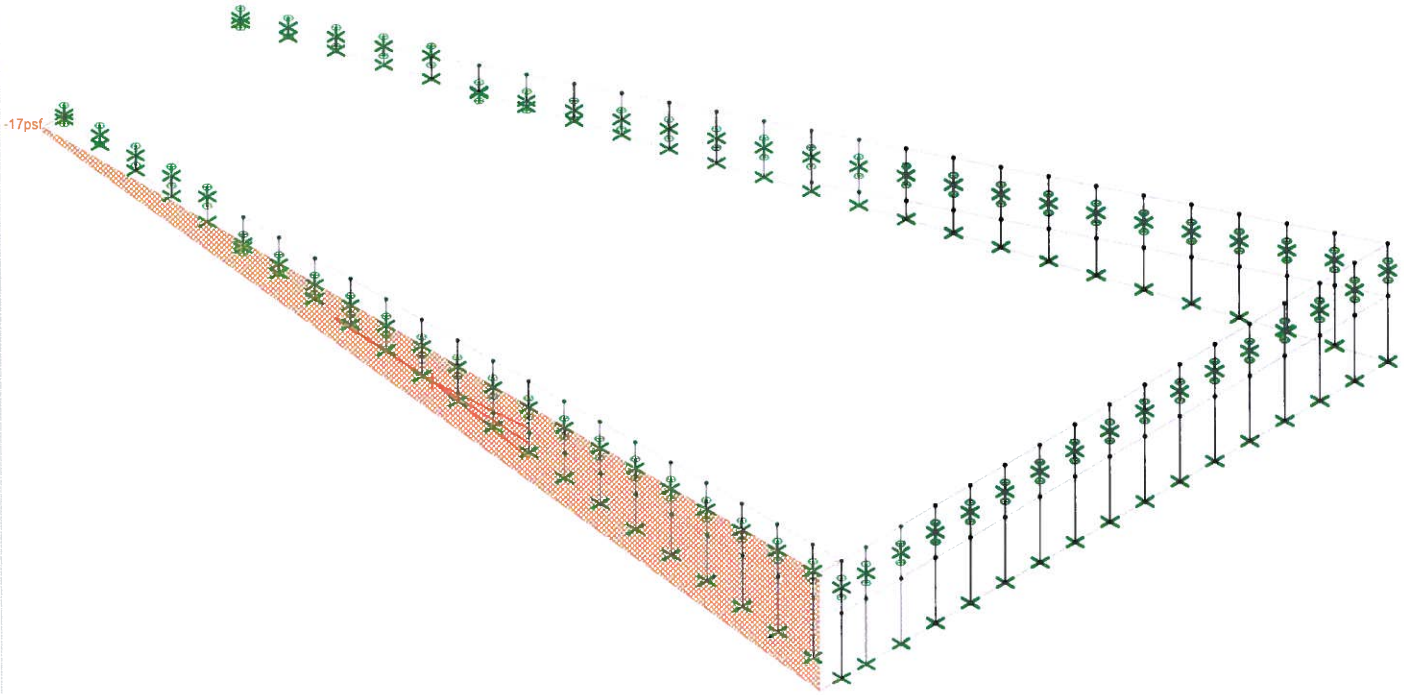


EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

Loads: BLC 1, Negative Wind (Face A)

JEI Structural Engineering	Webster University	SK - 53
M. Gorny		Nov 2, 2016 at 7:22 AM
JE16059		EGS-1 Preliminary.r3d

Positive Wind - 17psf

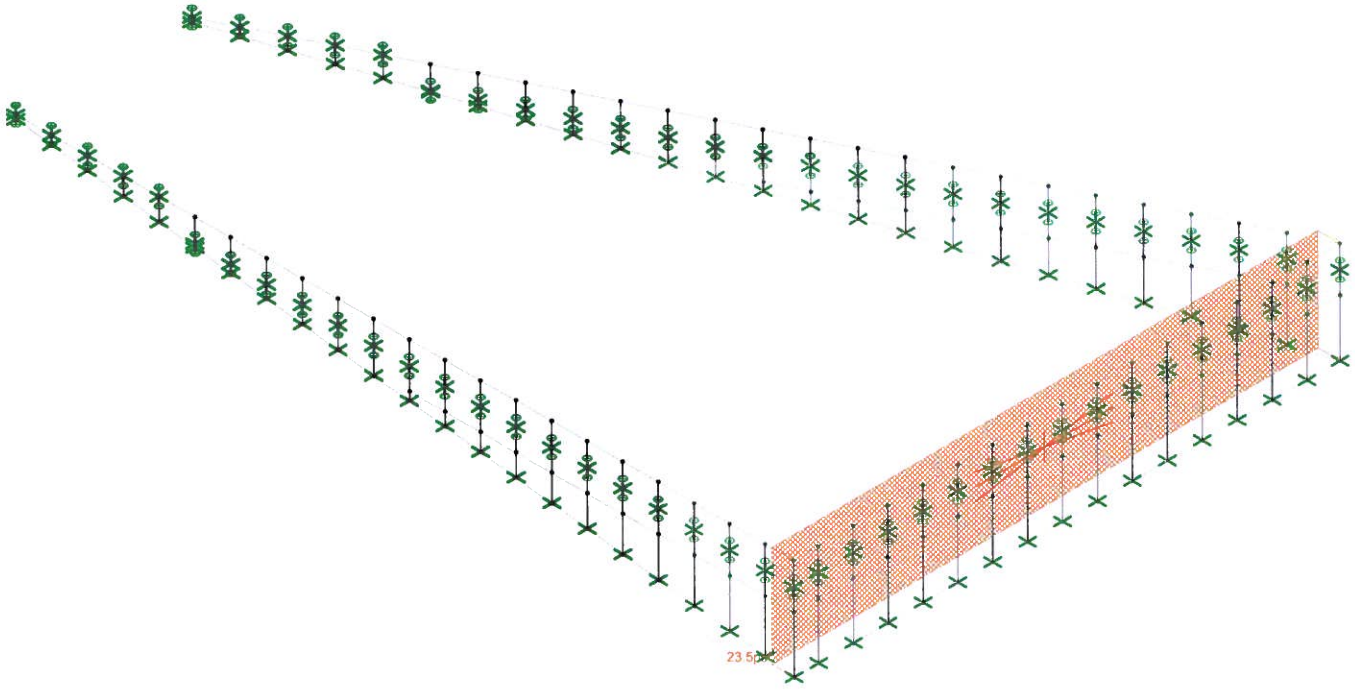


EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

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

Negative Wind - 23.5psf

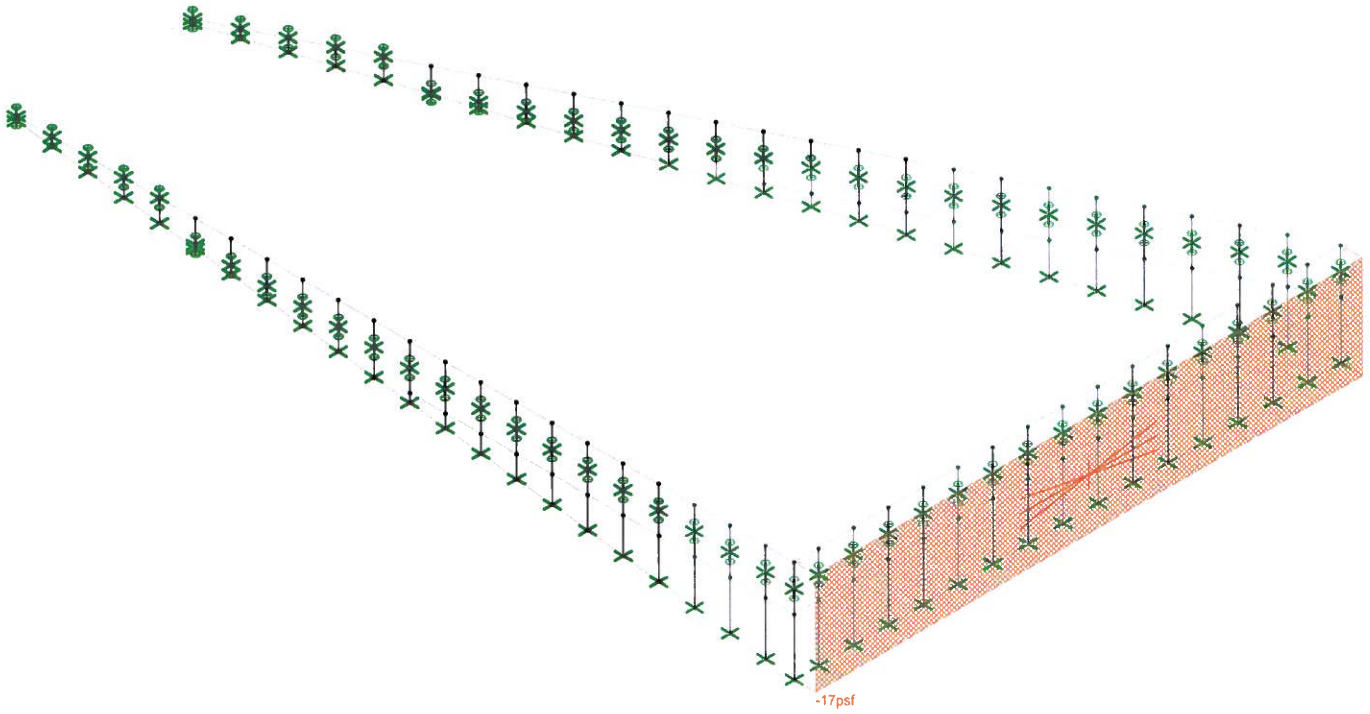


EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

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

Positive Wind - 17psf

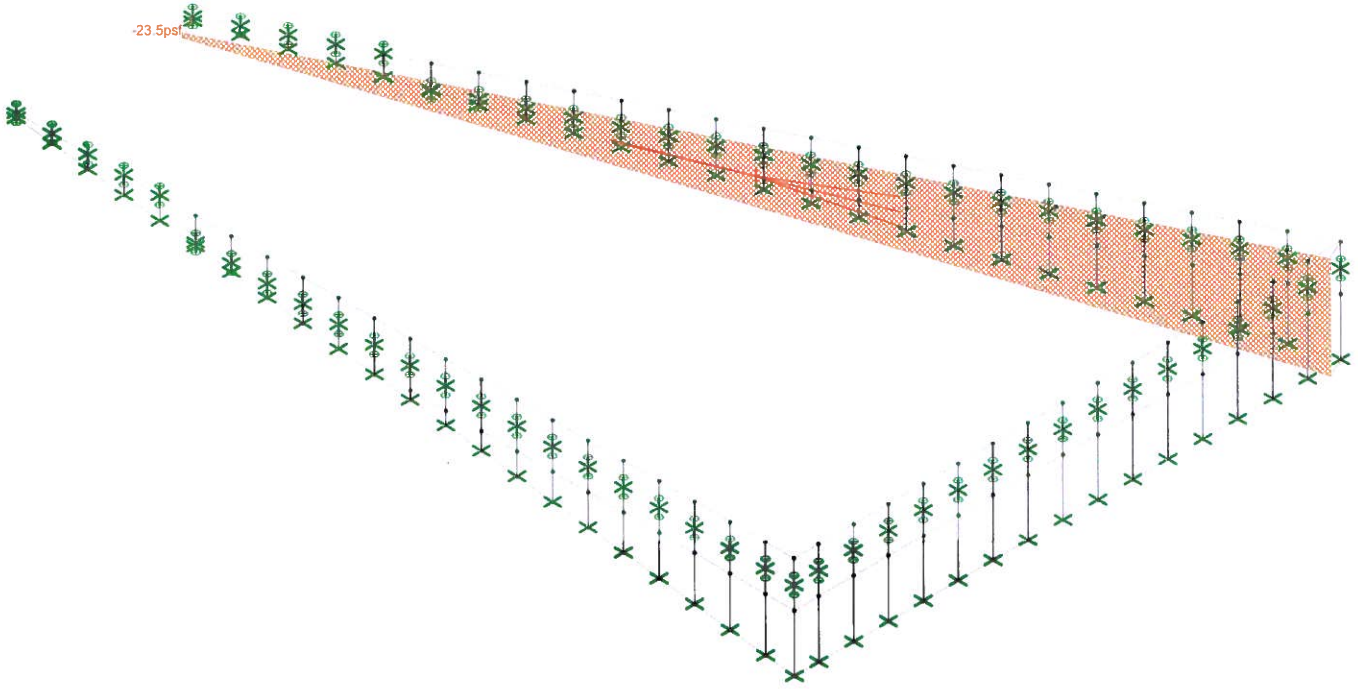


EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

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

Negative Wind - 23.5psf



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

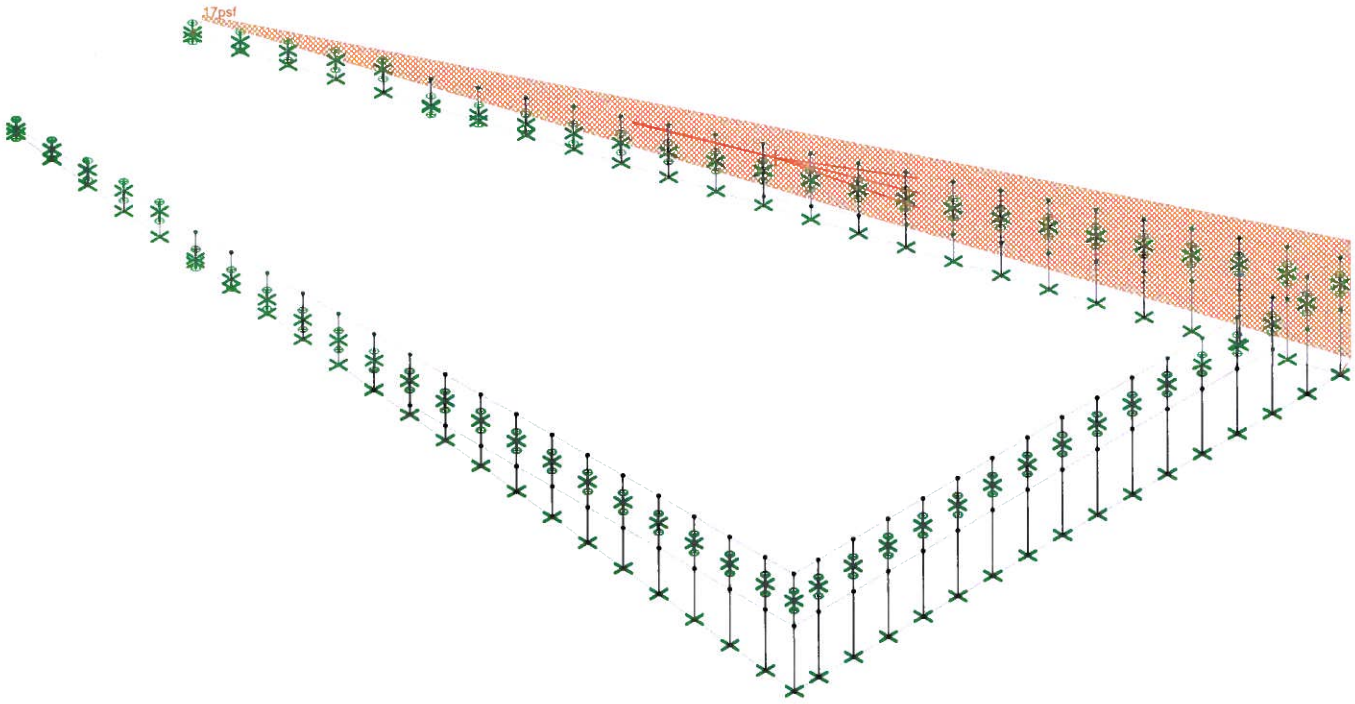
Loads: BLC 5, Negative Load (Face C)

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

93m

1

Positive Wind - 17psf



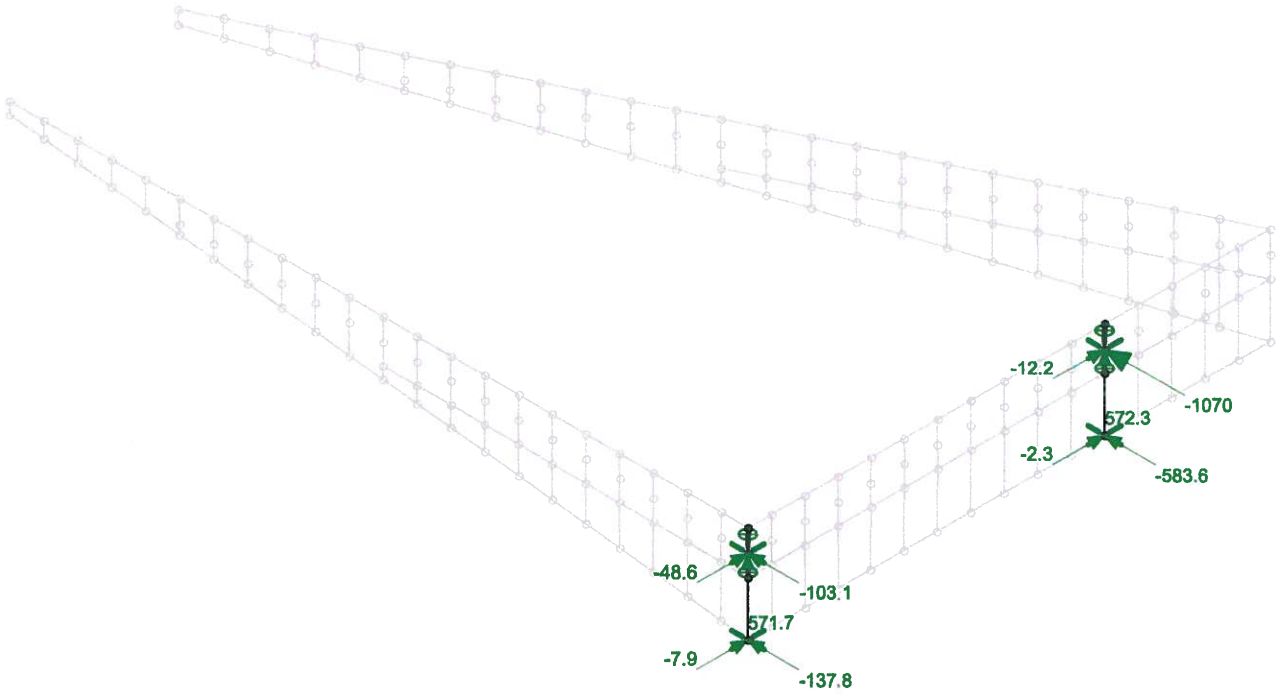
EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

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

93n

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

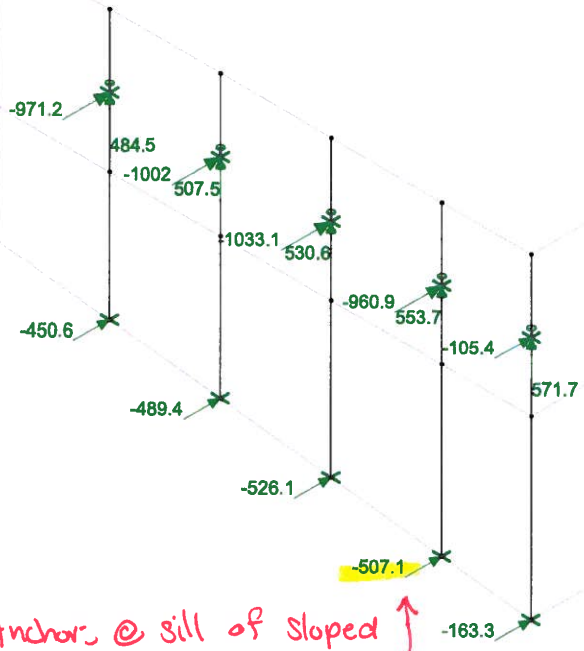


EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

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

JEI Structural Engineering	Webster University	SK - 2
M. Gorny		Jan 18, 2017 at 10:30 AM
JE16059		EGS-1 Preliminary.r3d

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



Anchors @ sill of sloped walls are made of 2-piece anchors. Loads are placed in F-Anchor summary sheet as $507.1^{lb}/2 = 253.6^{lb}$ per anchor

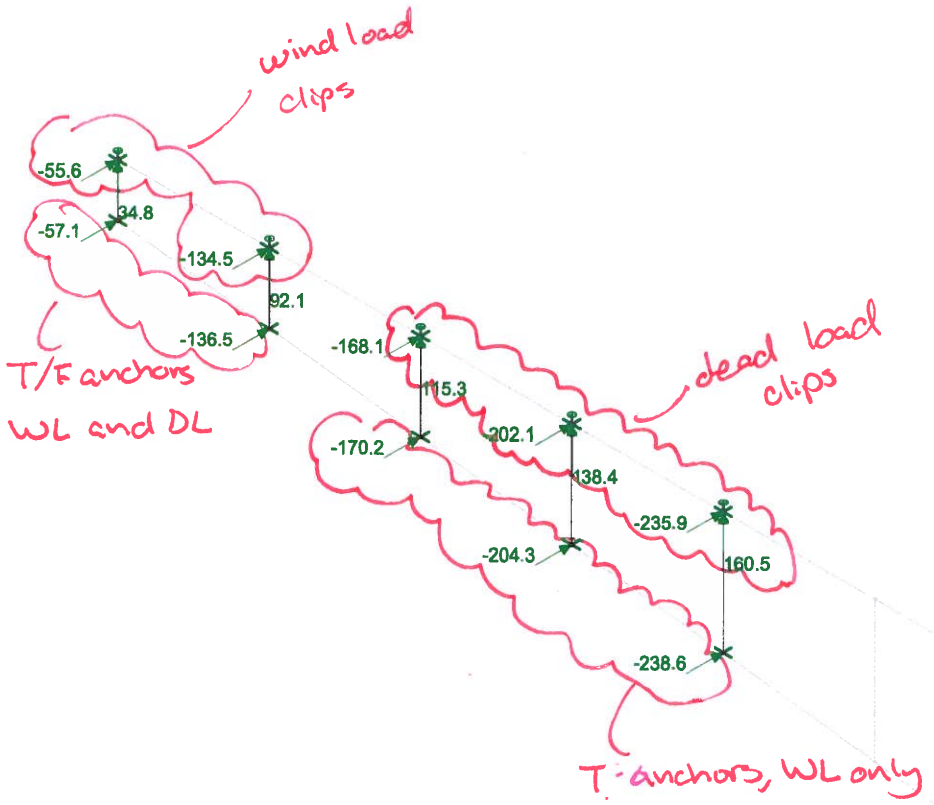
Applies to 218 as well as 217 above.

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 - 9
M. Gorny		Jan 18, 2017 at 11:11 AM
JE16059		EGS-1 Preliminary.r3d

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

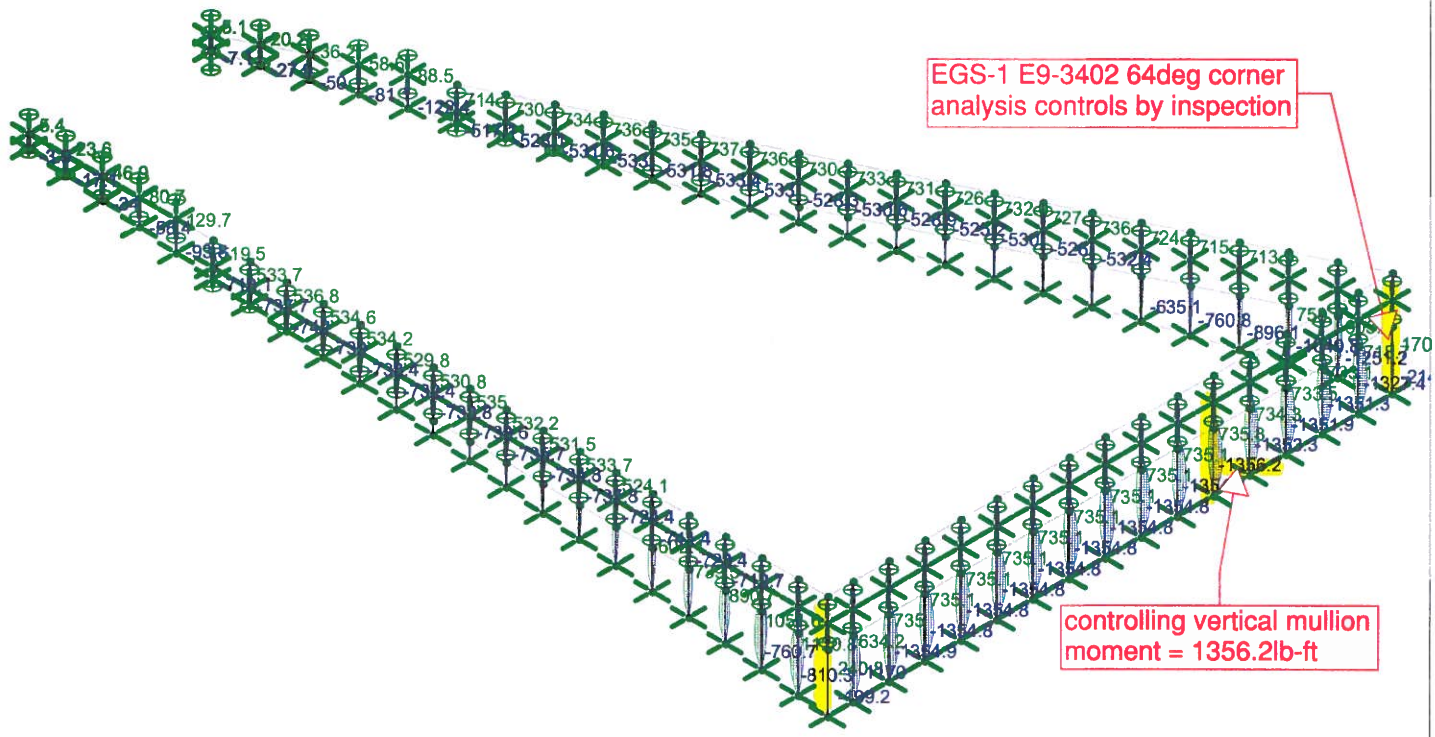


EGS-2 YKK YCW 750 SSG (2-1/2" x 6-9/16"). Shop drawing sheets 216-218

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

JEI Structural Engineering	Webster University	SK - 10
M. Gorny		Jan 18, 2017 at 11:17 AM
JE16059		EGS-1 Preliminary.r3d

Moment diagram



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

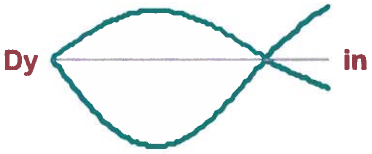
JEI Structural Engineering	Webster University	SK - 5
M. Gorny		Jan 18, 2017 at 10:49 AM
JE16059		EGS-1 Preliminary.r3d

Beam: *M562*

Shape:
Material: gen_Alum
Length: 171.688 in
I Joint: N691A
J Joint: N688

Code Check: No Calc
Report Based On 97 Sections

.247 at 171.688 in



-.411 at 64.383 in

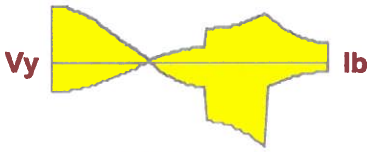
.054 at 73.325 in

-.059 at 71.536 in

125.189 at 134.131 in

-441.141 at 132.342 in

441.405 at 0 in

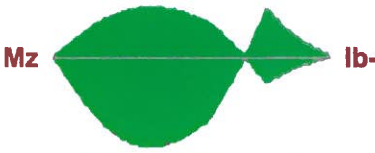


-688.349 at 132.342 in

29.887 at 96.574 in

-33.358 at 96.574 in

735.823 at 60.806 in

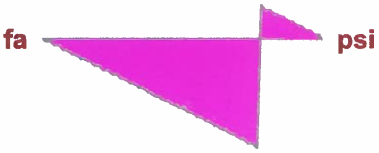


-1356.231 at 60.806 in

67.035 at 94.786 in

-61.57 at 94.786 in

71.496 at 134.131 in



-251.937 at 132.342 in

YKK E9-3402

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Kansas City, MO 64155

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Fax: 816-734-7013
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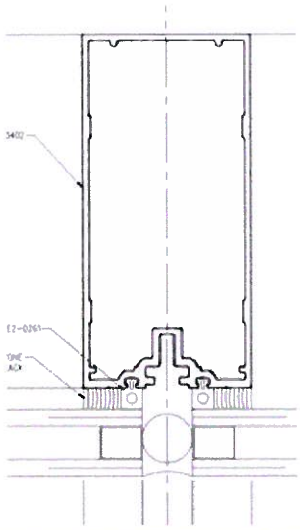
Client:	NGG
Project:	Webster University
Structure:	YKK YCW 750 SSG (2-1/2" x 6-9/16")
Part of:	Vertical Mullion Analysis
Elevation:	1/216
Detail:	1/400 **Member M562**

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)	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

Reinforcing: No Reinforcing

$I_{x,\,steel}$ =	0.000 in^4
$S_{x,\,steel}$ =	0.000 in^3
$I_{combined}$ =	6.485 in^4

Load Share	
Aluminum	Steel
1.000	0.000

Applied Bending Moment		
w = p * 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
$M_{alum} = M * I_{alum} * TRF_I / I_{comb}$	M_{alum} =	1356.2 lb-ft
$f_{b\text{-}alum} = M_{alum}/(S_{x,\,alum} * TRF_s)$	$f_{b\text{-}alum}$ =	7.41 ksi
Applied Axial Compression		
$P = p_{wt} * t * h + wt * h$	P =	441.1 lb
$f_{c\text{-}alum} = P/A$	$f_{c\text{-}alum}$ =	0.25 ksi

Allowable Loads	**Ω = 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	$f_{c\text{-}alum}/F_c$ =	0.043

Check Deflection	Typical Vertical	
N/A in. joint	$\Delta = (5wL4)/(384EI)$ =	0.411 in
N/A ± movement cap.	Δ_{allow} =	0.758 in
Allowable deflection = L/175 or if span > 13'-6" then allowable def = L/240 + 1/4"	Deflection Factor DF =	########

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

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

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

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

	.042 at 57.229 in Dy — in -.049 at 55.441 in	.206 at 48.287 in Dz — in -.212 at 48.287 in
125.189 at 134.131 in A — lb -440.691 at 132.342 in	83.09 at 0 in Vy — lb -96.831 at 94.786 in	203.943 at 94.786 in Vz — lb -206.44 at 94.786 in
T — lb-ft	170.07 at 48.287 in Mz — lb-ft -214.85 at 46.499 in	334.738 at 42.922 in My — lb-ft -327.553 at 42.922 in
71.496 at 134.131 in fa — psi -251.68 at 132.342 in	f(y) — psi	f(z) — psi

YKK E9-3402 64deg corner vertical

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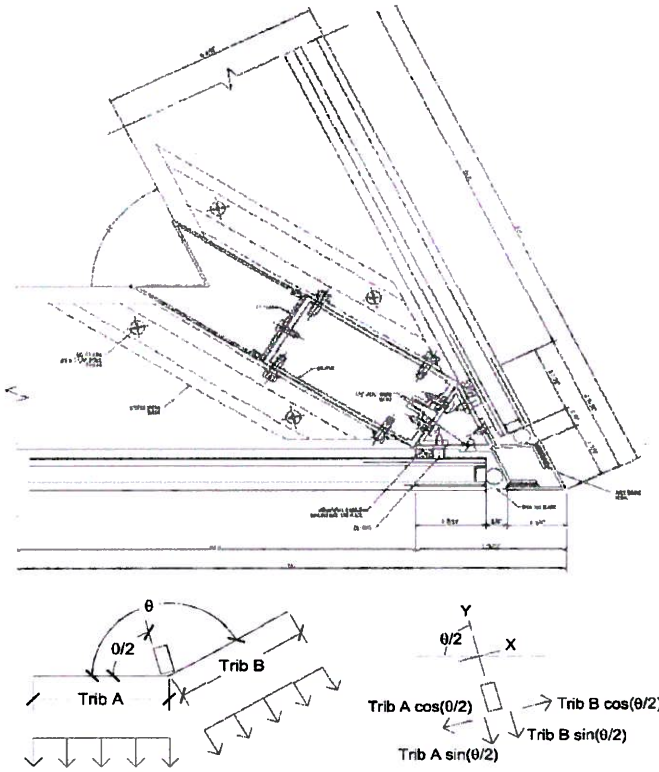
www.jeistructural.com

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

Date:	1/18/2017
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)		Ω = 1.65	
w = p * t		w_y =	N/A lb/ft
Shear Load V = wl/2		V_y =	96.8 lb
Moment M = $wl^2/8$		M_x =	214.9 lb-ft
M_{alum} = M * I_{alum}*TRF_I/I_{comb}		$M_{x\text{-}alum}$ =	214.9 lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	179.3
f_b = $M_{alum}/(S_{x,alum}$*TRF_S)		$f_{b\text{-}alum\text{-}x}$ =	0.82 ksi
$f_{b\text{-}alum\text{-}x}/F_{bx}$ =	0.055	Fbx/Ω = Fbx =	14.87 ksi
Y-Axis Bending Stress (ADM F.2 & F.3)		Ω = 1.65	
w = p * t		w_x =	N/A lb/ft
Shear Load V = wl/2		V_x =	206.4 lb
Moment M = $wl^2/8$		M_y =	334.7 lb-ft
M_{alum} = M * I_{alum}/I_{comb}		$M_{y\text{-}alum}$ =	334.7 lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	101.2
f_b = $M_{alum}/(S_{y,alum})$		$f_{b\text{-}alum\text{-}y}$ =	2.28 ksi
$f_{b\text{-}alum\text{-}y}/F_{by}$ =	0.148	Fby/Ω = Fby =	15.34 ksi
Combined Stress Ratio		$f_{bx}/F_{bx} + f_{by}/F_{by}$ =	0.20
		OK	

Check Combined Bending & Compression (ADM H.1)		
$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b$ =	0.291
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			
Aluminum (x)	Steel (x)	Aluminum (y)	Steel (y)
1.000	0.000	1.000	0.000

Axial Load		
P = p_{wt} * t * h + wt * h	P =	1184.0 lb

Check Allowable Compression - ADM E.3		
kL_b/r =	kL_b/r =	92.28
F_{a1} (Allowable Compression)	Fa1/Ω =	6.03 ksi
Check Allowable Compression - Flange element (ADM B.5.4.2)		
b/t =	b/t =	12.36
F_{a2} (Allowable Compression)	Fa2/Ω =	15.20 ksi
Check Allowable Compression - Web element (ADM B.5.5.1)		
b/t =	b/t =	37.72
F_{a3} (Allowable Compression)	Fa3/Ω =	19.70 ksi

f_a = P/A	f_a =	0.53 ksi
Lessor of F_{a1}, F_{a2} ,F_{a3}	Fa/Ω = Fa =	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:	1/18/2017
Proj. No.:	JE16059
Designer:	M. Gorny

INPUT | CHECK | RISA

Strong Axis Deflection (M_x, w_y)	Typical Vertical	
$\Delta_y = (5w_yL4)/(384EI)$	Δ_y =	0.049 in
within DLO (Conservative)	Δ_y =	0.049 in
Weak-Axis Deflection (w_x)		
$\Delta_x = (5w_xL^4)/(384EI_\Delta)$	Δ_x =	0.212 in
within DLO (Conservative)	Δ_x =	0.212 in
Resultant Deflection		
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$	Δ_{total} =	0.218 in
Angle Relative to X-Axis	θ_Δ =	13.0 °
	Δ_{allow} =	0.941 in
Allowable deflection = L/175 or if span > 13'-6" then allowable def = L/240 + 1/4"	Deflection Factor DF =	########
OK		

Deflection Along Glazing		
$\Delta_{y\text{-glazing}} = \Delta_y$*sin((180-θ)/2)	$\Delta_{y\text{-glazing}}$ =	0.042 in
$\Delta_{x\text{-glazing}} = \Delta_x$*cos((180-θ)/2)	$\Delta_{x\text{-glazing}}$ =	0.112 in
Tributary Area A		
$\Delta_{total\text{-}A} = \Delta_{x\text{-glazing}} + \Delta_{y\text{-glazing}}$	Δ_{total} =	0.154 in
Tributary Area B		
$\Delta_{total\text{-}B} = \Delta_{x\text{-glazing}} - \Delta_{y\text{-glazing}}$	Δ_{total} =	0.071 in

SSG Sealant Deflection	
1/4 in. joint	50% ± movement capacity
0.280 in. allowable deflection	SSG Sealant 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_n/Ω_b =	M_n/Ω_b =	0 lb-ft
N/A		

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_n/Ω_b =	M_n/Ω_b =	0 lb-ft
N/A		

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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:	1/203
Detail:	1/406

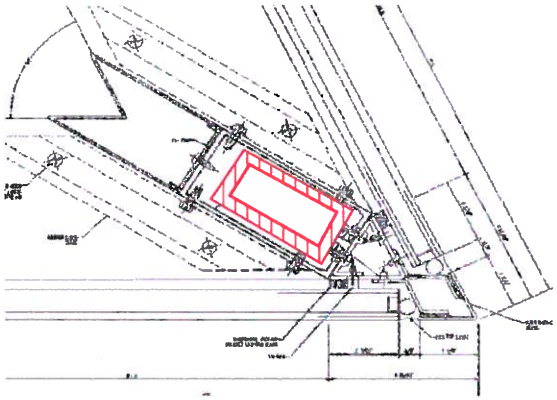
Date:	1/18/2017
Proj. No.:	JE16059
Designer:	M. Gorny
INPUT	CHECK / RISA

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

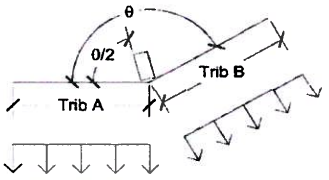
Tributary Width A (t_{WLA})	4.15 ft	Corner Angle (θ)	
Tributary Width B (t_{WLB})	2.38 ft	64.00 °	
Height (h)	11.24 ft		
Unbraced Length (L)	10.78 ft		

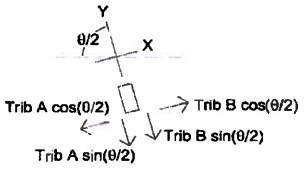
Design Loads

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



Manuf. / Part #:		YKK E9-3402	
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
Thermal Reduction Factors (TRF_t TRF_a)			
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
$I_{x,\,combined}$ =	22.725 in^4	$I_{y,\,combined}$ =	6.949 in^4





X-Axis Bending Stress (ADM F.2 & F.3)			Ω = 1.65
w = p * t		w_y =	52.7 lb/ft
Shear Load V = wl/2		V_y =	296.3 lb
Moment M = $wl^2/8$		M_x =	832.6 lb-ft
$M_{alum} = M * I_{alum} * TRF_t / I_{comb}$		$M_{x\text{-}alum}$ =	237.6 lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	230.3
$f_b = M_{alum}/(S_{x,\,alum} * TRF_a)$		$f_{b\text{-}alum\text{-}x}$ =	1.30 ksi
$f_{b\text{-}alum\text{-}x}/F_{bx}$ =	0.089	Fbx/Ω = Fbx =	14.62 ksi
Y-Axis Bending Stress (ADM F.2 & F.3)			Ω = 1.65
w = p * t		w_x =	84.4 lb/ft
Shear Load V = wl/2		V_x =	474.2 lb
Moment M = $wl^2/8$		M_y =	1332.5 lb-ft
$M_{alum} = M * I_{alum}/I_{comb}$		$M_{y\text{-}alum}$ =	331.5 lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	145.0
$f_b = M_{alum}/(S_{y,\,alum})$		$f_{b\text{-}alum\text{-}y}$ =	2.88 ksi
$f_{b\text{-}alum\text{-}y}/F_{by}$ =	0.191	Fby/Ω = Fby =	15.06 ksi
Combined Stress Ratio		$f_{bx}/F_{bx} + f_{by}/F_{by}$ =	**0.28**
		OK	

Check Combined Bending & Compression (ADM H.1)		
$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b$ =	0.395
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			
Aluminum (x)	Steel (x)	Aluminum (y)	Steel (y)
0.285	0.715	0.249	0.751

Axial Load		
$P = p_{wt} * t * h + wt * h$	P =	610.4 lb

Check Allowable Compression - ADM E.3		
kL_b/r =	kL_b/r =	130.18
F_{a1} (Allowable Compression)	Fa1/Ω =	3.03 ksi
Check Allowable Compression - Flange element (ADM B.5.4.2)		
b/t =	b/t =	23.48
F_{a2} (Allowable Compression)	Fa2/Ω =	15.01 ksi
Check Allowable Compression - Web element (ADM B.5.5.1)		
b/t =	b/t =	54.86
F_{a3} (Allowable Compression)	Fa3/Ω =	19.70 ksi

$f_a = P/A$	f_a =	0.35 ksi
Lessor of F_{a1}, F_{a2} ,F_{a3}	Fa/Ω = Fa =	3.03 ksi
	f_a/F_a =	0.115
OK		

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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:	1/203
Detail:	1/406

Date:	1/18/2017
Proj. No.:	JE16059
Designer:	M. Gorny

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Strong Axis Deflection (M_x, w_y)	Typical Vertical	
$\Delta_y = (5w_yL4)/(384EI)$	Δ_y =	0.082 in

Weak-Axis Deflection (w_x)		
$\Delta_x = (5w_xL^4)/(384EI_\Delta)$	Δ_x =	0.432 in

Resultant Deflection		
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$	Δ_{total} =	0.440 in
Angle Relative to X-Axis	θ_Δ =	10.8 °
	Δ_{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		

Deflection Along Glazing		
$\Delta_{y\text{-glazing}} = \Delta_y$*sin((180-θ)/2)	$\Delta_{y\text{-glazing}}$ =	0.070 in
$\Delta_{x\text{-glazing}} = \Delta_x$*cos((180-θ)/2)	$\Delta_{x\text{-glazing}}$ =	0.229 in
Tributary Area A		
$\Delta_{total\text{-}A} = \Delta_{x\text{-glazing}} + \Delta_{y\text{-glazing}}$	Δ_{total} =	0.299 in
Tributary Area B		
$\Delta_{total\text{-}B} = \Delta_{x\text{-glazing}} - \Delta_{y\text{-glazing}}$	Δ_{total} =	0.159 in

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

Steel Stress (X-axis)		
Moment to Steel = I_x steel/ I comb =		595.0 lb-ft
$f_b = M/S_{x,\ steel}$	f_b =	1.3 ksi
M_n/Ω_b =	M_n/Ω_b =	8814 lb-ft
OK		

Steel Stress (Y-axis)		
Moment to Steel = I_y steel/ I comb =		1000.9 lb-ft
$f_b = M/S_{y,\ steel}$	f_b =	6.7 ksi
M_n/Ω_b =	M_n/Ω_b =	5302 lb-ft
OK		

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Client:	NGG
Project:	Webster University
Structure:	YKK YCW 750 SSG (2-1/2" x 7-9/16")
Part of:	Vertical Mullion Analysis
Elevation:	1/203
Detail:	1/406

Date:	1/18/2017
Proj. No.:	JE16059
Designer:	M. Gorny

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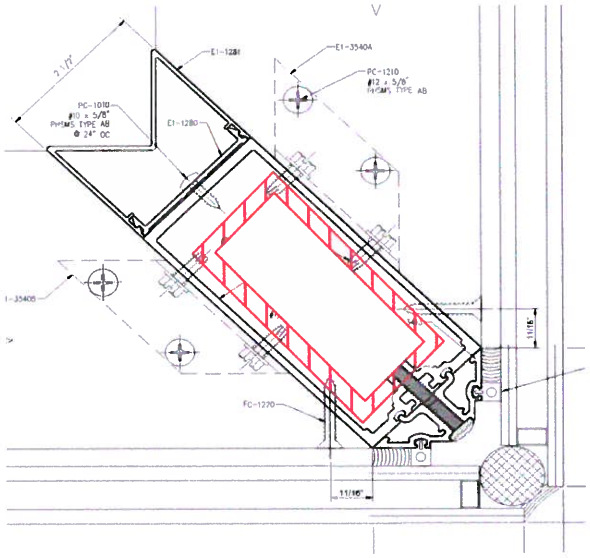
Load Design Code	
ASCE7-05 ASD	
Material Design Code	
Aluminum Design Manual 2010	
ADM 2010 Type	Alloy-Temper
Closed Shape	6063-T6

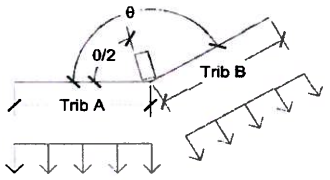


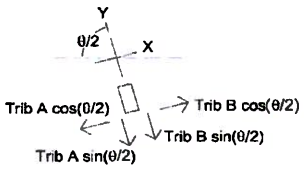
Tributary Width A (t_{WLA})	4.61 ft	Corner Angle (θ)	
Tributary Width B (t_{WLB})	2.42 ft	90.00 °	
Height (h)	11.24 ft		
Unbraced Length (L)	10.78 ft		

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 E9-3402		
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
Thermal Reduction Factors (TRF_t TRF_a)			
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
$I_{x,\ combined}$ =	22.725 in^4	$I_{y,\ combined}$ =	6.949 in^4





X-Axis Bending Stress (ADM F.2 & F.3)			**Ω = 1.65**
w = p * t		w_y =	78.3 lb/ft
Shear Load V = wl/2		V_y =	440.1 lb
Moment M = $wl^2/8$		M_x =	1236.6 lb-ft
$M_{alum} = M * I_{alum} * TRF_t / I_{comb}$		$M_{x\text{-}alum}$ =	352.9 lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	230.3
$f_b = M_{alum}/(S_{x,\ alum} * TRF_a)$		$f_{b\text{-}alum\text{-}x}$ =	1.93 ksi
$f_{b\text{-}alum\text{-}x}/F_{bx}$ =	0.132	Fbx/Ω = Fbx =	14.62 ksi
Y-Axis Bending Stress (ADM F.2 & F.3)			**Ω = 1.65**
w = p * t		w_x =	78.3 lb/ft
Shear Load V = wl/2		V_x =	440.1 lb
Moment M = $wl^2/8$		M_y =	1236.6 lb-ft
$M_{alum} = M * I_{alum}/I_{comb}$		$M_{y\text{-}alum}$ =	307.7 lb-ft
Ln = (2*Lb*Sx)/(IyJ)^1/2		L_n =	145.0
$f_b = M_{alum}/(S_{y,\ alum})$		$f_{b\text{-}alum\text{-}y}$ =	2.67 ksi
$f_{b\text{-}alum\text{-}y}/F_{by}$ =	0.177	Fby/Ω = Fby =	15.06 ksi
Combined Stress Ratio		$f_{bx}/F_{bx} + f_{by}/F_{by}$ =	**0.31**
		OK	

Check Combined Bending & Compression (ADM H.1)		
$f_a/F_a + f_b/F_b < 1.0$	$f_a/F_a + f_b/F_b$ =	0.433
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			
Aluminum (x)	Steel (x)	Aluminum (y)	Steel (y)
0.285	0.715	0.249	0.751

Axial Load		
$P = p_{wt} * t * h + wt * h$	P =	655.9 lb

Check Allowable Compression - ADM E.3		
kL_b/r =	kL_b/r =	130.18
F_{a1} (Allowable Compression)	Fa1/Ω =	3.03 ksi
Check Allowable Compression - Flange element (ADM B.5.4.2)		
b/t =	b/t =	23.48
F_{a2} (Allowable Compression)	Fa2/Ω =	15.01 ksi
Check Allowable Compression - Web element (ADM B.5.5.1)		
b/t =	b/t =	54.86
F_{a3} (Allowable Compression)	Fa3/Ω =	19.70 ksi

$f_a = P/A$	f_a =	0.37 ksi
Lessor of F_{a1}, F_{a2} ,F_{a3}	Fa/Ω = Fa =	3.03 ksi
	f_a/F_a =	0.124
OK		

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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:	1/203
Detail:	1/406

Date:	1/18/2017
Proj. No.:	JE16059
Designer:	M. Gorny

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Strong Axis Deflection (M_x, w_y)	Typical Vertical	
$\Delta_y = (5w_yL4)/(384EI)$	Δ_y =	0.123 in

Weak-Axis Deflection (w_x)		
$\Delta_x = (5w_xL^4)/(384EI_\Delta)$	Δ_x =	0.401 in

Resultant Deflection		
$\Delta_{total} = \sqrt{(\Delta_x^2 + \Delta_y^2)}$	Δ_{total} =	0.419 in
Angle Relative to X-Axis	θ_Δ =	17.0 °
	Δ_{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 =		883.7 lb-ft
$f_b = M/S_{x,\ steel}$	f_b =	1.9 ksi
M_n/Ω_b =	M_n/Ω_b =	8814 lb-ft
OK		

Deflection Along Glazing		
$\Delta_{y\text{-glazing}} = \Delta_y$*sin((180-θ)/2)	$\Delta_{y\text{-glazing}}$ =	0.087 in
$\Delta_{x\text{-glazing}} = \Delta_x$*cos((180-θ)/2)	$\Delta_{x\text{-glazing}}$ =	0.283 in
Tributary Area A		
$\Delta_{total\text{-}A} = \Delta_{x\text{-glazing}} + \Delta_{y\text{-glazing}}$	Δ_{total} =	0.370 in
Tributary Area B		
$\Delta_{total\text{-}B} = \Delta_{x\text{-glazing}} - \Delta_{y\text{-glazing}}$	Δ_{total} =	0.197 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 =		928.9 lb-ft
$f_b = M/S_{y,\ steel}$	f_b =	6.2 ksi
M_n/Ω_b =	M_n/Ω_b =	5302 lb-ft
OK		

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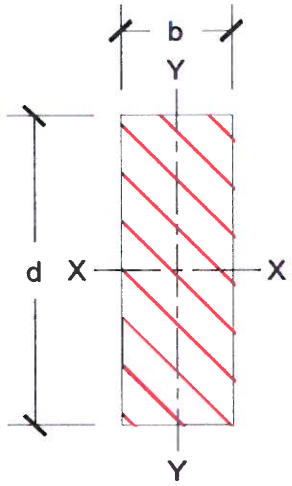
Client:	NGG	Date	1/18/2017
Project:	Webster University	Proj. No.	JE16059
Structure:	YKK YCW 750 SSG	Designer	M. Gorny
Part of:	Bar Allowable Flexural Strength	INPUT	CHECK

Shape: 2x2 A36 Solid Steel Bar



Unbraced Length (L_b) =	74 in		
Depth (d) =	2 in		
Width (b) =	2 in		
Moduls of Elasticity (E) =	29000 ksi	Material	
Yeild Strength (F_y) =	36 ksi	A36	

I_x =	1.3333 in^4	I_y =	1.3333 in^4
S_x =	1.3333 in^3	S_y =	1.3333 in^3
Z_x =	2.0000 in^3	Z_y =	2.0000 in^3

X-Axis Lateral Torsional Buckling Limits			
L_bd/t^2 =	37	$L_bd/t^2 <= 0.08E/F_y$	1 applies
$0.08E/F_y$ =	64.44	$0.08E/F_y < L_bd/t^2 <= 1.9E/F_y$	X
$1.9E/F_y$ =	1530.56	$L_bd/t^2 > 1.9E/F_y$	X

X-Axis Yielding (AISC F11.1)		**Y-Axis Yielding (AISC F11.1)**	
$M_n = M_p = F_yZ_x$ =	72.00 kip-in	$M_n = M_p = F_yZ_y$ =	72.00 kip-in
$M_n \le 1.6M_y = 1.6F_yS_x$ =	76.80 kip-in	$M_n \le 1.6M_y = 1.6F_yS_y$ =	76.80 kip-in
M_n =	72.00 kip-in	M_n =	72.00 kip-in

X-Axis Lateral-Torsional Buckling (AISC F11.2)		
AISC F11.2.a $0.08E/F_y < L_bd/t^2 <= 1.9E/F_y$		
$M_n = C_b[1.52 - 0.274(L_bd/t^2)F_y/E]M_y$ =	M_n =	N/A kip-in
M_p =	M_p =	N/A kip-in
M_n =	M_n =	N/A kip-in
AISC F11.2.b $L_bd/t^2 > 1.9E/F_y$		
$F_{cr} = 1.9EC_b/(L_bd/t^2)$ =	F_{cr} =	N/A ksi
$M_n = F_{cr}S_x$ =	M_n =	N/A kip-in
M_p =	M_p =	N/A kip-in
M_n =	M_n =	N/A kip-in

X-Axis Capacity	Ω_b = 1.67
M_n =	72.00 kip-in
M_n/Ω_b =	43.11 kip-in
M_n/Ω_b =	3593 lb-ft

Y-Axis Capacity	Ω_b = 1.67
M_n =	72.00 kip-in
M_n/Ω_b =	43.11 kip-in
M_n/Ω_b =	3593 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

Date:	1/18/2017
Proj. No.:	JE16059
Designer:	M. Gorny

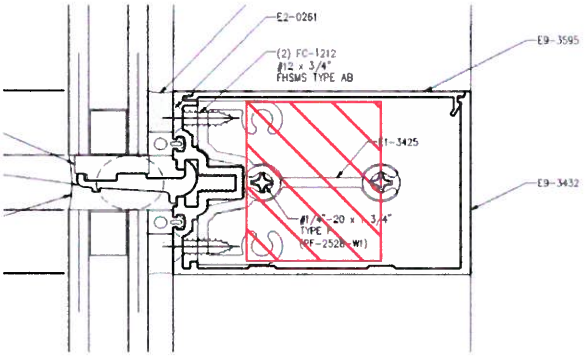
INPUT | CHECK | RISA

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	$r_{x,alum}$ =	1.504 in
$I_{x,alum}$ =	2.712 in^4	$r_{y,alum}$ =	0.786 in
$I_{y,alum}$ =	0.740 in^4	A =	1.198 in^2
$S_{x,alum}$ =	1.276 in^3	J =	0.006 in^4
$S_{y,alum}$ =	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 2x2 A36 Solid Steel Bar

$I_{x,steel}$ =	1.330 in^4	$I_{y,steel}$ =	1.330 in^4
$S_{x,steel}$ =	1.330 in^3	$S_{y,steel}$ =	1.330 in^3
$I_{x,combined}$ =	6.569 in^4	$I_{y,combined}$ =	4.597 in^4
A_{steel} =	4.00 in^2	wt_{steel} =	13.61 lb/ft
$A_{alum-total}$ =	12.527 in^2	wt_{total} =	15.392 lb/ft

X-Axis Applied Bending Moment (Wind Load)		Load Share = 41%
$w_{WL} = p * t_{WL}$	w =	184.6 lb/ft
Shear Load V = wl/2	V =	673.1 lb
Moment $M = wl^2/8$	M =	1227.0 lb-ft
$M_{alum} = M * I_{alum}*TRF_I/I_{comb}$	M_{alum} =	506.6 lb-ft
$f_b = M_{alum}/(S_{x,alum}*TRF_S)$	$f_{b\text{-}alum\text{-}x}$ =	4.76 ksi
Y-Axis Applied Bending Moment (Dead Load)		Load Share = 16%
Shear $V = P + wt_{total} * L/2$	V =	271.1 lb
Moment $M = wt_{total}*L^2/8 + P*L*s$	M =	494.2 lb-ft
$M_{alum} = M * I_{alum}/I_{comb}$	M_{alum} =	79.6 lb-ft
$f_b = M_{alum}/(S_{y,alum})$	$f_{b\text{-}alum\text{-}y}$ =	2.04 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	$\Delta_x = (5wL^4)/(384EI_\Delta)$ =	0.177 in
N/A ± 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
$\Delta = ((P_{sb}Ls)/(24EI))*(3L^2-4(Ls)^2)$	Δ =	0.110 in
$+ 5wt_{total}L^4/(384EI)$	$\Delta_{y\text{-}allow}$ =	0.1250 in

Steel Capacity (X-Axis)		Load Share = 59%
$M_{steel} = I_{x,steel}/I_{comb}$ =	M_{steel} =	720.5 lb-ft
Mb/Ω =	Mb/Ω =	3593 lb-ft
	Ms/(Mb/Ω) =	**0.201**
Steel Capacity (Y-Axis)		Load Share = 84%
$M_{steel} = I_{x,steel}/I_{comb}$ =	M_{steel} =	414.7 lb-ft
Φ*Mb =	Mb/Ω =	3593 lb-ft
	Ms/(Mb/Ω) =	**0.115**

X-Axis Allowable Loads		Ω = 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	$f_{b\text{-}alum\text{-}x}/F_{bx}$ =	0.679

Y-Axis Allowable Loads		Ω = 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	$f_{b\text{-}alum\text{-}y}/F_{by}$ =	0.290

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

Combined Interaction Ratio	
$f_{c\text{-}alum}/F_c + f_{b\text{-}alum\text{-}x}/F_{bx} + f_{b\text{-}alum\text{-}y}/F_{by}$ =	0.969

Stress OK. Use 1/4 point setting blocks.

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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: 1/18/2017
Proj. No.: JE16059

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

Anchor Type: Point

See pgs for anchor designs and loads

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	Check	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		
- - -	Wood	217	1/217	1/319	Refer to RISA-3D Model				~~235.9~~	Check	A)
Head (F)	CFS	202, 204	2/202, 1/204	1/302	C	11.24	2.39	24.0	321.7	Check	2)
- - -	Wood	217	1/217	1/319	Refer to RISA-3D Model				~~55.6~~	Check	B)
Sill (T)	CFS	216	1/216	1/316	Refer to RISA-3D Model				583.6	Check	3)
- - -	Concrete	202, 204	2/202, 1/204	1/300	C	11.24	5.00	24.0	674.4	Check	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				263.1	Check	5)
- - -	Concrete	202, 204	2/202, 1/204	1/300	C	11.24	2.39	24.0	321.7	Check	6)
Sill (U)	Concrete	202	1/202	1/401	C	11.24	3.01	24.0	406.0	Check	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 Drilflex into minimum 16ga, 50ksi CFS
2: Use (4) 1/4"(min) Elco Drilflex into minimum 16ga, 50ksi CFS
3: Use (4) 1/4"(min) Elco Drilflex 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 Drilflex into minimum 16ga, 50ksi CFS
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 = 2-5/8", minimum spacing = 2-5/8"

12\a 1

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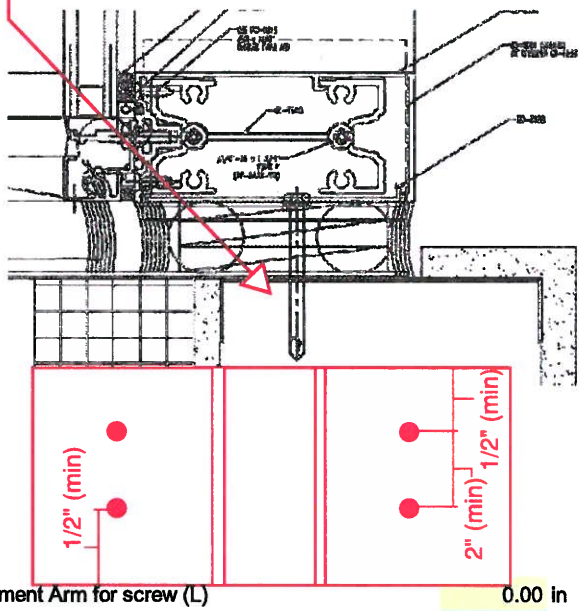
Use 1/4" Elco Drilflex into minimum 18ga, 50ksi steel

(4) per T anchor, see sketch below

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**

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)		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 (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 =	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.: Rn = de1*t1*Ftu1 <= 2*D*t1*Ftu1
Ω = 3 (Aluminum) Rn/Ω = 687.5 lb

Base Mat.: Rn = 1.2*de2*t2*Ftu2 <= 2.4*D*t2*Ftu2
Ω = 2 (Steel) Rn/Ω = 1103.7 lb

Tilting (ADM J.5.6.2) Ω = 3 ≤ t_1? YES
$R_n = 4.2(t_2^3 D)^{1/2} F_{tu2}$ Rn/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
$V_{rec} = (\alpha_M * M_{uM,5\%})/(1.7L)$ 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 Pns*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) Ω = 3
Rn = 1.01*D*Le*Fty2 Rn/Ω = N/A lb

Pull-Over (ADM J.5.5.2) Ω = 3
Rn = (1.0+1.7*t1/Dws)Dws*t1*Fty1 Rn/Ω = 798.8 lb

AISI Cold-Formed Steel Design IV-12 Ω = 3
LGM Pull-Out P_{not} = 0.782 k
Using 0.0566" LGM Pnot*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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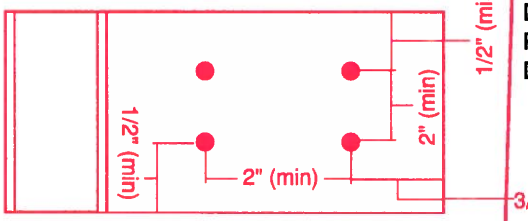
Use 1/4" Elco Drilflex into minimum 16ga, 50ksi steel

(4) per F anchor, see sketch below



Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Anchors to CFS
Elevation:	1/217
Detail:	1/316

Check 5

Date:	2/24/2017
Proj. No.:	JE16059
Designer:	M. Gorny

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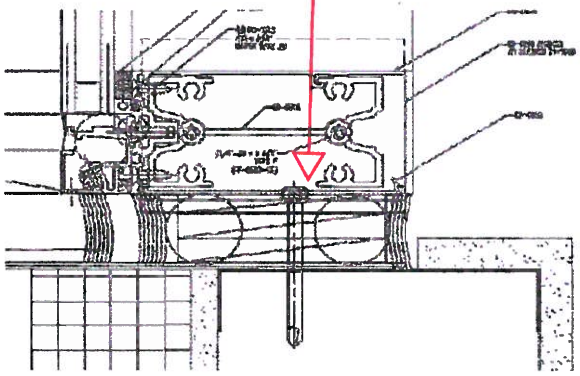


FASTENER PROPERTIES:

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 =	560.3	lb

DESIGN LOADING / ORIENTATION:

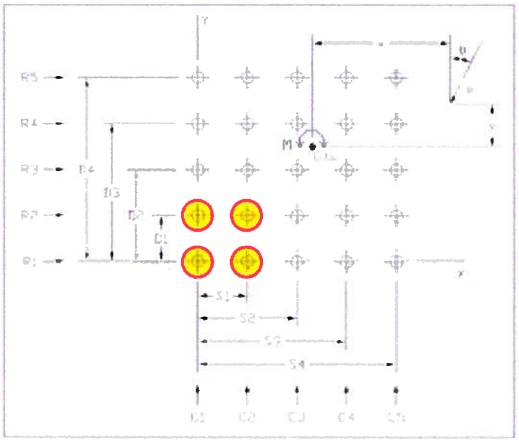
Design Load, P =	263.10	lb
Design Moment, $M_{c.g.}$ =	0.00	lb-in
Angle of Load, θ =	90.00	deg
Horz. Dist. from Centroid, x =	0.00	in
Vert. Dist. From Centroid, y =	4.31	in

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 4

Fasteners per Row		Fasteners per Column	
N_{R1} =	2	N_{C1} =	2
N_{R2} =	2	N_{C2} =	2
N_{R3} =		N_{C3} =	
N_{R4} =		N_{C4} =	
N_{R5} =		N_{C5} =	

Row Dimensions			Column Dimensions		
D_1 =	2.00	in	S_1 =	2.00	in
D_2 =		in	S_2 =		in
D_3 =		in	S_3 =		in
D_4 =		in	S_4 =		in



Centroid, x =	1.00	in
Centroid, y =	1.00	in

FASTENER CALCULATIONS:

Σx^2 =	4.00	in^2	fy =	2889.28	ksi ← Vert Stress Due to Eccentric Shear
Σy^2 =	4.00	in^2	fsy =	0.00	psi ← Vert Stress Due to Direct Shear
$\Sigma x^2 + \Sigma y^2$ =	8.00	in^2	fx =	2889.28	psi ← Horiz Stress Due to Eccentric Shear
M =	-1134.62	lb-in	fsx =	1339.96	psi ← Horiz Stress Due to Direct Shear
			f =	5121.96	psi ← Maximum Bolt Stress
			V =	251.42	lb ← Maximum Bolt Load
			V_a =	560.300	lb OK

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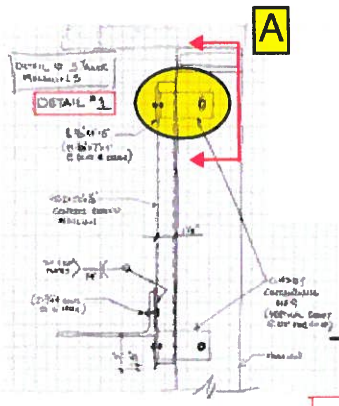
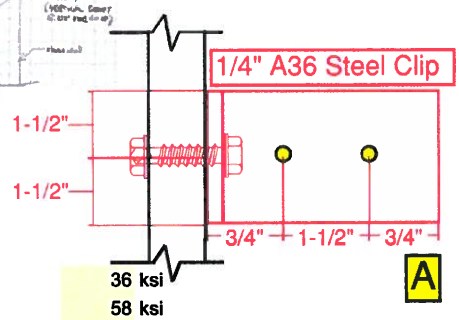


Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Dead Load Anchors to Structure
Elevation:	1/217
Detail:	1/319 Check A

Date:	2/20/2017
Proj. No.:	JE16059
Designer:	M. Gorny
INPUT	CHECK

Alloy-Temper	Anchor Type	Anchor Location
6063-T6	Dead Load	Typ Vertical (2 Anchors)



Wind Load (V_{WL})	240.00 lb → $V_{WL/A}$	120.00	lb per anchor
Dead Load (V_{DL})	160.00 lb → $V_{DL/A}$	80.00	lb per anchor

Z (in)	X (in)	t (in)	Y (in)
8.00	3.00	0.25	3.00

Thermal Expansion Clear Span =	N/A	ft	
Span of Spandrel Beam =	N/A	ft	
Max Spandrel Deflection =	0.000	in	(L/360 or RFI to EOR)
Bolt Diameter (D) =	0.500	in	
Number of Bolts (n) =	1 bolts @	1	bolt(s)/slot
Alum. Thickness (t_m) =	0.091	in	
Alum. F_{tu} =	30	ksi	
Alum. Edge Dist. (d_{emul}) =	1.00	in	

Steel F_y =	36	ksi	
Steel F_{tu} =	58	ksi	
Steel E =	29000	ksi	
Min Bolt End Distance (L_e) =	0.750	in	(AISC J3.4 & J3.5)
Min Bolt Edge Distance (L_c) =	0.750	in	(AISC J3.4)
Anchor L_b =	7.25	in	
Weak Axis Ecentricity (e) =	0.75		

Bolt Shear (Grade 5 Bolt)

$V_1 = V_{WL/A}$	V_1 =	120.00 lb	
$V_2 = V_{DL/A}$	V_2 =	80.00 lb	
$V_{TOTAL} = \sqrt{(V_1^2+V_2^2)}$	V_{TOTAL} =	144.22 lb	
AAMA TIR A9-91 Table 6	V_a =	3580.00 lb	
	V_{TOTAL}/V_a =	0.040	OK

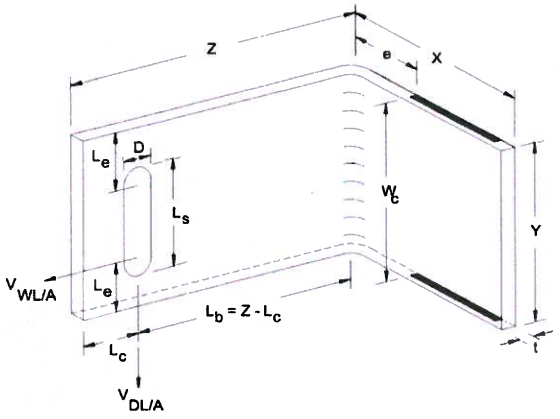
Aluminum Bearing @ Bolt Connection; Ω = 1.95

2010 Aluminum Design Manual Section J.5.6.1

$V_a = R_n/\Omega = d_{emul}t_m F_{tumul}/\Omega$	V_a =	1400.00 lb	
$\leq 2Dt_m Ftu_{mul}/\Omega$	V_{TOTAL}/V_a =	0.103	OK

Minimum Slot & Clip Height

$\Delta_{temp} = T_{change}(Coef)*h$	Δ_{temp} =	N/A in	
$L_s = (2\Delta_{temp})+(D*n)+(2*Spandrel\ Deflection)+(n-1)(1.25\ in)$			
Minimum Slot Length (L_s)	L_s =	0.00 in	
Minimum Slot Length to Use =	L_s =	0.00 in	
Minimum Anchor Y Dimension =	Y_{min} =	1.00 in	



Major Axis Steel Bending - Dead Load; Ω_b = 1.67

AISC Steel Manual 13th Ed, Chapter F

F11.2.a Lateral-Torsional Buckling Applies

L_bY/t^2	348.00			
0.08 E/F_y	64.44	Z_x =	0.563	in^3
1.90 E/F_y	1530.56	S_x =	0.375	in^3
$M_p = F_yZ_x$		M_p =	20250.00	lb-in
$M_y = F_yS_x$		M_y =	13500.00	lb-in
Mn=Cb[1.52-0.274(LbY/t^2)(Fy/E)]My<=Mp		M_n =	18922.03	lb-in
$M_{ax} = M_n/\Omega_b$		M_a =	11330.56	lb-in
$M_x = V_{DL/A} * L_b$		M_x =	580.00	lb-in
		M_x / M_{ax} =	0.05	OK

Weak Axis Bending; Ω_b = 1.67

AISC Steel Manual 13th Ed, Chapter F11.1

$W_c = Y$	W_c =	3.000	in
$Z = (W_c*t^2)/4$	Z =	0.0469	in^3
$S = (W_c*t^2)/6$	S =	0.0313	in^3
$M_n = M_p = F_y*Z/\Omega_b$ =	M_n =	1010.48	lb-in
$1.6*M_y/\Omega_b$ =	$1.6*M_y/\Omega_b$ =	1077.84	lb-in
$M_a = M_n/\Omega_b \leq 1.6*M_y/\Omega_b$ =	M_a =	1010.48	lb-in
$M = V_{WL/A} * e$ =	M =	90.00	lb-in
M_y/M_{ay} =	M_y/M_{ay} =	0.09	OK

Combined Bending

$M_x/M_{ax} + M_y/M_{ay} \leq 1.0$ =	0.14	OK

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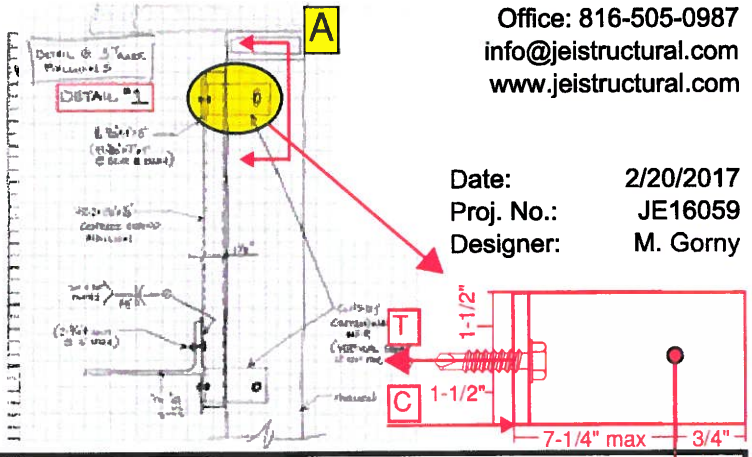


Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Dead Load Anchors to Structure
Elevation:	1/217
Detail:	1/319 check A

Date: 2/20/2017
Proj. No.: JE16059
Designer: M. Gorny

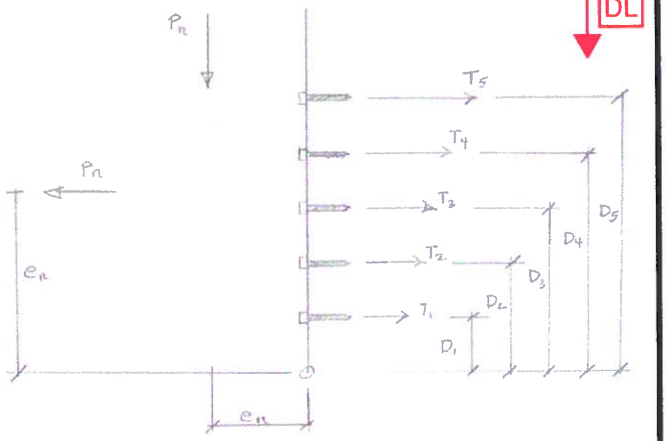
INPUT | CHECK

FASTENER PROPERTIES:

Fastener Type =	Grade 5 Bolt	
Fastener Size =	1/2-in	
Nominal Diameter, D =	0.500	in
Area, A =	0.196	in^2

DESIGN LOAD - ECCENTRIC ABOUT ROTATION POINT "O"

Design Load, P1 =	80.00	lb
Eccentric distance e1	7.25	in
Design Load P2 =	0.00	lb
Eccentric distance e2	0.00	in
Design Load P3 =	0.00	lb
Eccentric distance e3	0.00	in
Design Load P3 =	0.00	lb
Eccentric distance e3	0.00	in

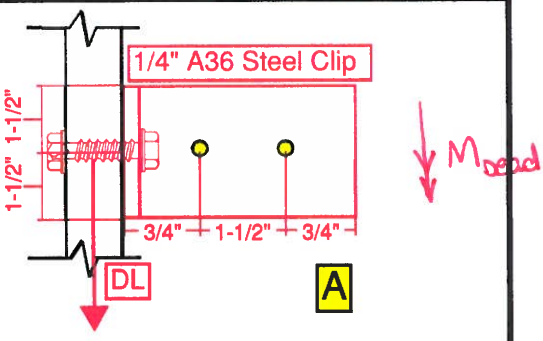


Design Moment about "o"	M =	580	lb-in

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 2

Fasteners per Row		Row Dimensions	
N_{R1} =	2	D_1 =	1.500
N_{R2} =		D_2 =	
N_{R3} =		D_3 =	
N_{R4} =		D_4 =	
N_{R5} =		D_5 =	



FASTENER CALCULATIONS:

Tension T1 =	193.33	lb	← Tension per anchor
Tension T2 =		lb	← Tension per anchor
Tension T3 =		lb	← Tension per anchor
Tension T4 =		lb	← Tension per anchor
Tension T5 =		lb	← Tension per anchor
T max =	**193.33**	lb	← Maximum Bolt/anchor Load

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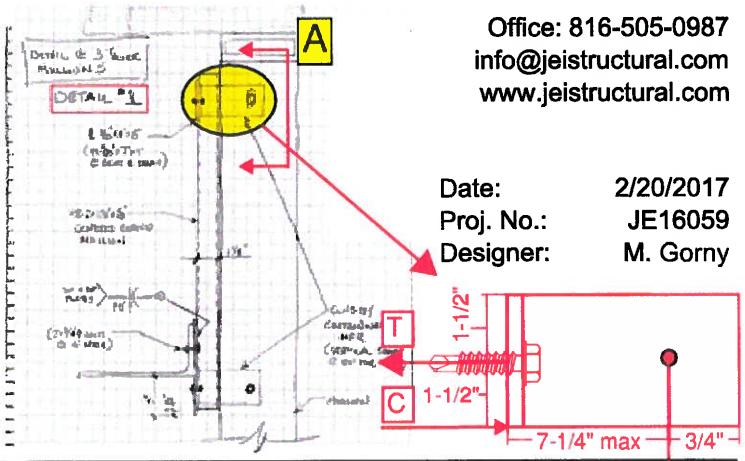


Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Dead Load Anchors to Structure
Elevation:	1/217
Detail:	1/319

Check A

Date:	2/20/2017
Proj. No.:	JE16059
Designer:	M. Gorny

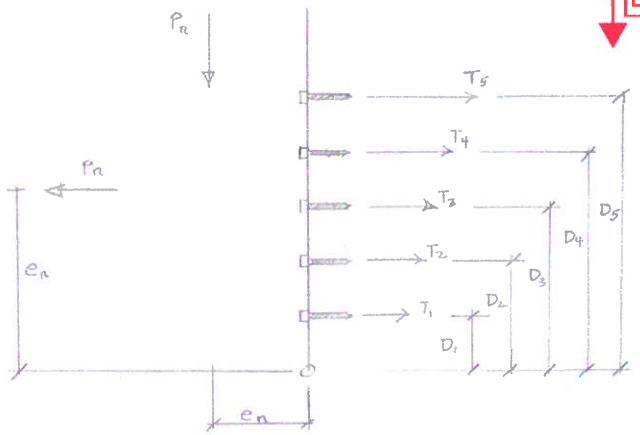
INPUT | CHECK

FASTENER PROPERTIES:

Fastener Type =	Hilti Kwik Flex	
Fastener Size =	1/4-20	
Nominal Diameter, D =	0.250	in
Area, A =	0.049	in^2

DESIGN LOAD - ECCENTRIC ABOUT ROTATION POINT "O"

Design Load, P1 =	120.00	lb
Eccentric distance e1	3.00	in
Design Load P2 =	0.00	lb
Eccentric distance e2	0.00	in
Design Load P3 =	0.00	lb
Eccentric distance e3	0.00	in
Design Load P3 =	0.00	lb
Eccentric distance e3	0.00	in

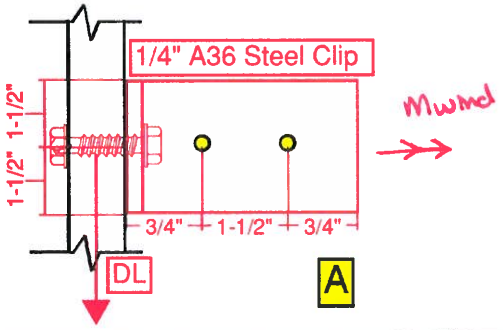


Design Moment about "o"	M =	360	lb-in

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 2

Fasteners per Row		Row Dimensions	
N_{R1} =	1	D_1 =	0.750
N_{R2} =	1	D_2 =	2.250
N_{R3} =		D_3 =	
N_{R4} =		D_4 =	
N_{R5} =		D_5 =	



FASTENER CALCULATIONS:

Tension T1 =	48.00	lb	← Tension per anchor
Tension T2 =	144.00	lb	← Tension per anchor
Tension T3 =		lb	← Tension per anchor
Tension T4 =		lb	← Tension per anchor
Tension T5 =		lb	← Tension per anchor
T max =	**144.00**	**lb**	← Maximum Bolt/anchor Load

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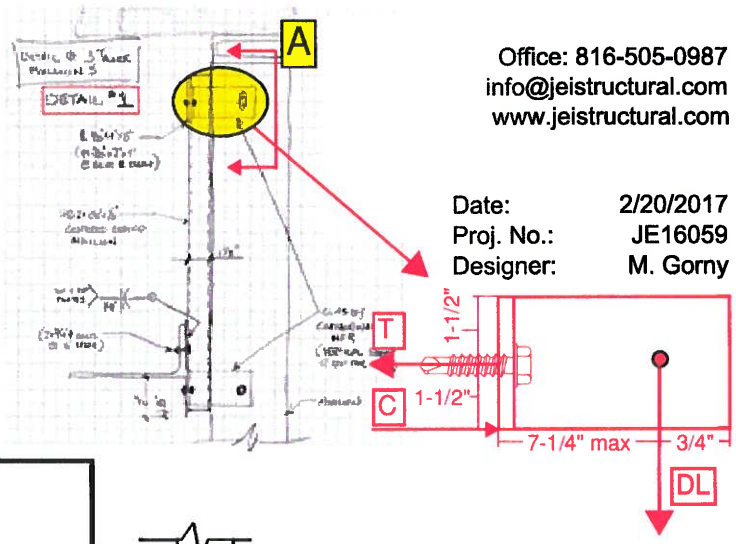


Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Dead Load Anchors to Structure
Elevation:	1/217
Detail:	1/319 check A

Date:	2/20/2017
Proj. No.:	JE16059
Designer:	M. Gorny

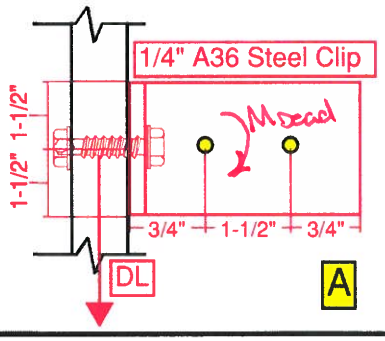
INPUT | CHECK

FASTENER PROPERTIES:

Fastener Type =	Hilti Kwik Flex	
Fastener Size =	1/4-20	
Nominal Diameter, D =	0.250	in
Area, A =	0.049	in^2

DESIGN LOADING / ORIENTATION:

Design Load, P =	80.00	lb
Design Moment, $M_{c.g.}$ =	0.00	lb-in
Angle of Load, θ =	0.00	deg
Horz. Dist. from Centroid, x =	1.50	in
Vert. Dist. From Centroid, y =	0.00	in

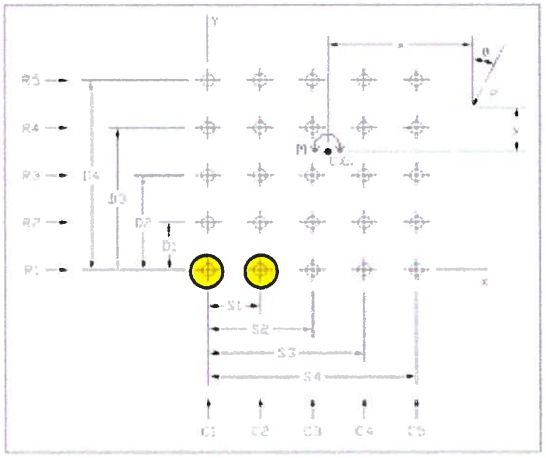


FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 2

Fasteners per Row		Fasteners per Column	
N_{R1} =	2	N_{C1} =	2
N_{R2} =		N_{C2} =	2
N_{R3} =		N_{C3} =	
N_{R4} =		N_{C4} =	
N_{R5} =		N_{C5} =	

Row Dimensions			Column Dimensions		
D_1 =		in	S_1 =	1.50	in
D_2 =		in	S_2 =		in
D_3 =		in	S_3 =		in
D_4 =		in	S_4 =		in



Centroid, x =	1.50	in
Centroid, y =	0.00	in

FASTENER CALCULATIONS:

$\sum x^2$ =	4.50	in^2	fy =	814.87	ksi	← Vert Stress Due to Eccentric Shear
$\sum y^2$ =	0.00	in^2	fsy =	814.87	psi	← Vert Stress Due to Direct Shear
$\sum x^2 + \sum y^2$ =	4.50	in^2	fx =	0.00	psi	← Horiz Stress Due to Eccentric Shear
M =	120.00	lb-in	fsx =	0.00	psi	← Horiz Stress Due to Direct Shear
			f =	1629.75	psi	← Maximum Bolt Stress
			V =	80.00	lb	← Maximum Bolt Load

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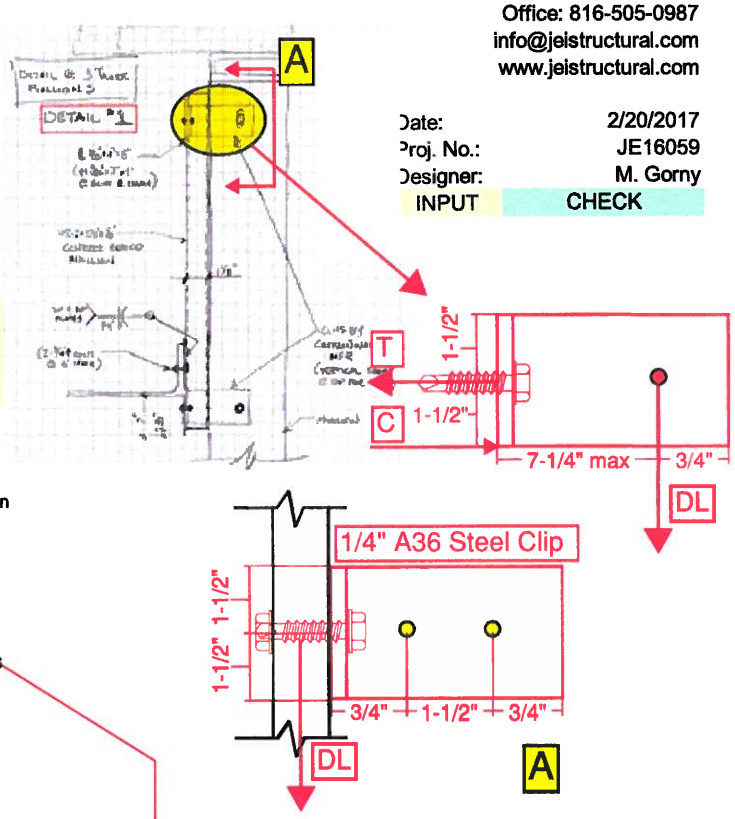
Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Dead Load Anchors to Structure
Elevation:	1/217
Detail:	1/319

Check A

Date:	2/20/2017
Proj. No.:	JE16059
Designer:	M. Gorny
INPUT	CHECK



Load Design Criteria:	ASCE7-05 ASD
Material Design Criteria:	Aluminum Design Manual 2010
Fastener Name:	Hilti KwikFlex
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)		80.00	lb
Design Tension Load (T)		337.33	lb
Number of Screws		2.00	screws
Screw Selection (D)	1/4"	0.2500	in
F_{ty1}, F_{tu1} (Top Material)	A36	36 , 58	ksi
F_{ty2}, F_{tu2} (Base Material)	A36	36 , 58	ksi
Thickness of top material (t_1)		0.2500	in
Thickness base material (t_2)		0.3750	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

144.0lb + 193.33lb
See previous eccentric fastener calculations

	0.00	in
	0.001534	in^3
	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 =	80.0	lb
Fastener Tension (T_{fas})	T / fastener =	337.3	lb

Fastened Material Shear Design

Bearing (ADM J3.7, J.5.6.1, AISC J4.10)

Top Mat.: Rn = 1.2*de1*t1*Ftu1 <= 2.4*D*t1*Ftu1
Ω = 2 (Steel) Rn/Ω = 4350.0 lb

Base Mat.: Rn = 1.2*de2*t2*Ftu2 <= 2.4*D*t2*Ftu2
Ω = 2 (Steel) Rn/Ω = 6525.0 lb

Tilting (ADM J.5.6.2) Ω = 3 ≤ t_1? NO
$R_n = 4.2(t_2^3 D)^{1/2} F_{tu2}$ Rn/Ω = 9323.4 lb

Shear load associated with bolt bending (ref Hilti)
$M_{uM,5\%} = 1.2Sf(1 - T/Ta)$ $M_{uM,5\%}$ = N/A lb-in
$V_{rec} = (\alpha_M * M_{uM,5\%})/(1.7L)$ V_{rec} = N/A lb

AISI Cold-Formed Steel Design (Tbl IV-8a) Ω = 3
LGM Shear of sheet P_{ns} = N/A k
Pns*1000/Ω = N/A lb

Allowable Shear / Fastener ($V_{allowable}$) = 4350.0 lb
$V_{fas} / V_{allowable}$ = 0.02 ≤ 1.0
OK.

Fastened Material Tension Design

Pull-Out (ADM J.5.5.1.1) Ω = 3
Rn = 0.58*Asn*Le*Ftu2 Rn/Ω = 2270.7 lb

Pull-Over (ADM J.5.5.2) Ω = 3
Rn = (1.0+1.7*t1/Dws)Dws*t1*Fty1 Rn/Ω = 2715.0 lb

AISI Cold-Formed Steel Design IV-12 Ω = 3
LGM Pull-Out P_{not} = N/A k
Pnot*1000/Ω = N/A lb

Allowable Tension / Fastener ($T_{allowable}$) = 2270.7 lb
$T_{fas} / T_{allowable}$ = 0.15 ≤ 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:	$V_{fas} / V_{TIR} + T_{fas} / T_{TIR}$ =	0.39	≤ 1.0
TIR A9-91:	$(V_{fas} / V_{TIR})^2 + (T_{fas} / T_{TIR})^2$ =	N/A	≤ 1.0

OK.

Use (2) 1/4" Hilti KwikFlex Screws.

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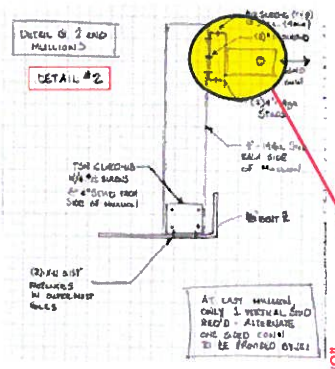
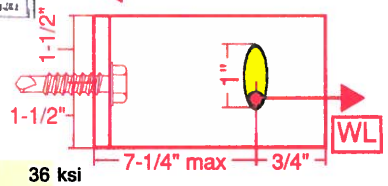
Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Wind Load Anchors to Structure
Elevation:	1/217
Detail:	1/319

Check b

Date:	2/20/2017
Proj. No.:	JE16059
Designer:	M. Gorny
INPUT	CHECK





Alloy-Temper	Anchor Type	Anchor Location
6063-T6	Wind Load	Typ Vertical (2 Anchors)

Wind Load (V_{WL})	140.00 lb → $V_{WL/A}$	70.00	lb per anchor
Dead Load (V_{DL})	0.00 lb → $V_{DL/A}$	0.00	lb per anchor

Z (in)	X (in)	t (in)	Y (in)
8.00	3.00	0.25	3.00

Thermal Expansion Clear Span =	2.50	ft	
Span of Spandrel Beam =	N/A	ft	
Max Spandrel Deflection =	0.000	in	(L/360 or RFI to EOR)
Bolt Diameter (D) =	0.500	in	
Number of Bolts (n) =	1 bolts @	1	bolt(s)/slot
Alum. Thickness (t_m) =	0.091	in	
Alum. F_{tu} =	30	ksi	
Alum. Edge Dist. (d_{emul}) =	1.00	in	

Steel F_y =	36	ksi	
Steel F_{tu} =	58	ksi	
Steel E =	29000	ksi	
Min Bolt End Distance (L_e) =	1.125	in	(AISC J3.4 & J3.5)
Min Bolt Edge Distance (L_c) =	0.750	in	(AISC J3.4)
Anchor L_b =	7.25	in	
Weak Axis Ecentricity (e) =	0.75		

Bolt Shear (Grade 5 Bolt)

$V_1 = V_{WL/A}$	V_1 =	70.00 lb	
$V_2 = V_{DL/A}$	V_2 =	0.00 lb	
$V_{TOTAL} = \sqrt{(V_1^2+V_2^2)}$	V_{TOTAL} =	70.00 lb	
AAMA TIR A9-91 Table 6	V_a =	3580.00 lb	
	V_{TOTAL}/V_a =	0.020	OK

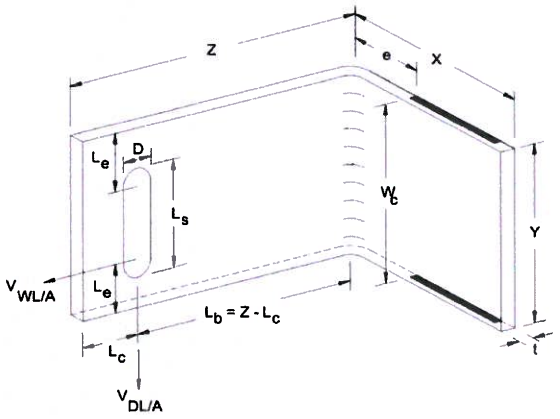
Aluminum Bearing @ Bolt Connection; Ω = 1.95

2010 Aluminum Design Manual Section J.5.6.1

$V_a = R_n/\Omega = d_{emul}t_m F_{tumul}/\Omega$	V_a =	1400.00 lb	
$\leq 2Dt_m Ftu_{mul}/\Omega$	V_{TOTAL}/V_a =	0.050	OK

Minimum Slot & Clip Height

$\Delta_{temp} = T_{change}(Coef)*h$	Δ_{temp} =	0.03 in	
$L_s = (2\Delta_{temp})+(D*n)+(2*Spandrel\ Deflection)+(n-1)(1.25\ in)$			
Minimum Slot Length (L_s)	L_s =	0.56 in	
Minimum Slot Length to Use =	L_s =	0.75 in	
Minimum Anchor Y Dimension =	Y_{min} =	2.50 in	



Major Axis Steel Bending - Dead Load; Ω_b = 1.67

AISC Steel Manual 13th Ed, Chapter F

F11.2.a Lateral-Torsional Buckling Applies

CHECK DOES NOT APPLY TO WIND LOAD ANCHORS

L_bY/t^2	348.00			
0.08 E/F_y	64.44	Z_x =	0.563	in^3
1.90 E/F_y	1530.56	S_x =	0.375	in^3
$M_p = F_yZ_x$		M_p =	N/A	lb-in
$M_y = F_yS_x$		M_y =	N/A	lb-in
Mn=Cb[1.52-0.274(LbY/t^2)(Fy/E)]My<=Mp		M_n =	N/A	lb-in
$M_{ax} = M_n/\Omega_b$		M_a =	N/A	lb-in
$M_x = V_{DL/A} * L_b$		M_x =	N/A	lb-in
		M_x / M_{ax} =	N/A	OK

Weak Axis Bending; Ω_b = 1.67

AISC Steel Manual 13th Ed, Chapter F11.1

$W_c = Y$	W_c =	3.000	in
$Z = (W_c*t^2)/4$	Z =	0.0469	in^3
$S = (W_c*t^2)/6$	S =	0.0313	in^3
$M_n = M_p = F_y*Z/\Omega_b$ =	M_n =	1010.48	lb-in
$1.6*M_y/\Omega_b$ =	$1.6*M_y/\Omega_b$ =	1077.84	lb-in
$M_a = M_n/\Omega_b \leq 1.6*M_y/\Omega_b$ =	M_a =	1010.48	lb-in
$M = V_{WL/A} * e$ =	M =	52.50	lb-in
M_y/M_{sy} =	M_y/M_{sy} =	0.05	OK

Combined Bending

$M_x/M_{ax} + M_y/M_{sy} \leq 1.0$ =	0.05	OK

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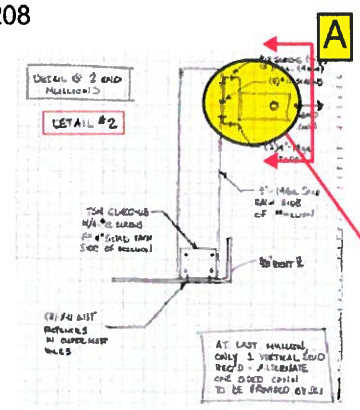
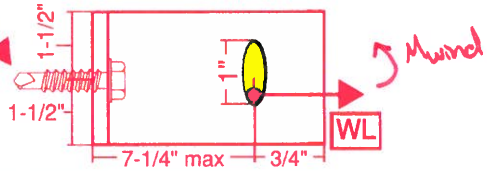




Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Wind Load Anchors to Structure
Elevation:	1/217
Detail:	1/319

check b

Date:	2/20/2017
Proj. No.:	JE16059
Designer:	M. Gorny

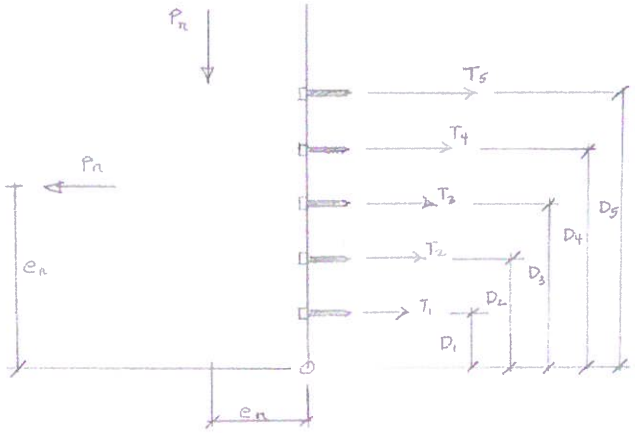
INPUT | CHECK

FASTENER PROPERTIES:

Fastener Type =	Grade 5 Bolt	
Fastener Size =	1/2-in	
Nominal Diameter, D =	0.500	in
Area, A =	0.196	in^2

DESIGN LOAD - ECCENTRIC ABOUT ROTATION POINT "O"

Design Load, P1 =	70.00	lb
Eccentric distance e1	0.50	in
Design Load P2 =	0.00	lb
Eccentric distance e2	0.00	in
Design Load P3 =	0.00	lb
Eccentric distance e3	0.00	in
Design Load P3 =	0.00	lb
Eccentric distance e3	0.00	in

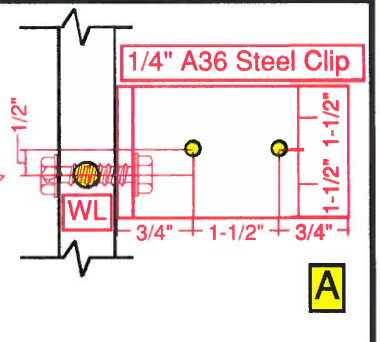


Design Moment about "o"	M =	35	lb-in

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 2

Fasteners per Row		Row Dimensions	
N_{R1} =	2	D_1 =	1.500
N_{R2} =		D_2 =	
N_{R3} =		D_3 =	
N_{R4} =		D_4 =	
N_{R5} =		D_5 =	



Assume bolt is in bottom of 1" slot, 1/2" eccentricity

FASTENER CALCULATIONS:

Tension T1 =	11.67	lb	← Tension per anchor
Tension T2 =		lb	← Tension per anchor
Tension T3 =		lb	← Tension per anchor
Tension T4 =		lb	← Tension per anchor
Tension T5 =		lb	← Tension per anchor
T max =	**11.67**	**lb**	← Maximum Bolt/anchor Load

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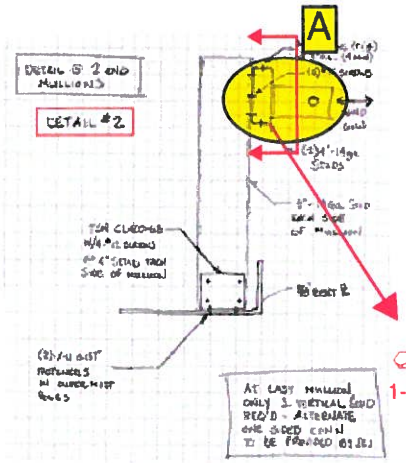
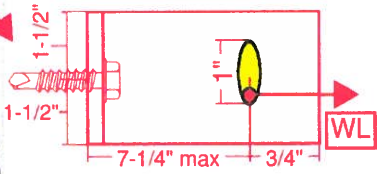




Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Wind Load Anchors to Structure
Elevation:	1/217
Detail:	1/319

Check 5

Date:	2/20/2017
Proj. No.:	JE16059
Designer:	M. Gorny

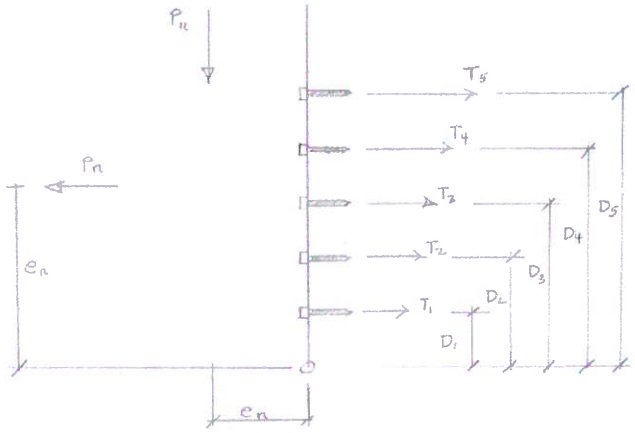
INPUT	CHECK

FASTENER PROPERTIES:

Fastener Type =	Hilti Kwik Flex	
Fastener Size =	1/4-20	
Nominal Diameter, D =	0.250	in
Area, A =	0.049	in^2

DESIGN LOAD - ECCENTRIC ABOUT ROTATION POINT "O"

Design Load, P1 =	70.00	lb
Eccentric distance e1	3.00	in
Design Load P2 =	0.00	lb
Eccentric distance e2	0.00	in
Design Load P3 =	0.00	lb
Eccentric distance e3	0.00	in
Design Load P3 =	0.00	lb
Eccentric distance e3	0.00	in

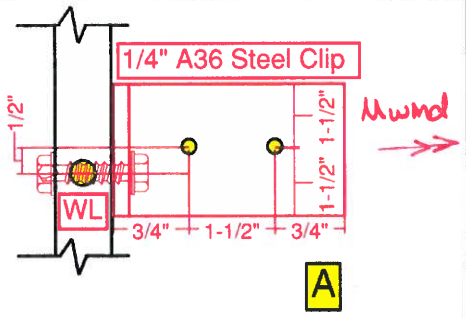


Design Moment about "o"	M =	210	lb-in

FASTENER PATTERN GEOMETRY:

Total No. of Fasteners: 2

Fasteners per Row		Row Dimensions	
N_{R1} =	1	D_1 =	0.750
N_{R2} =	1	D_2 =	2.250
N_{R3} =		D_3 =	
N_{R4} =		D_4 =	
N_{R5} =		D_5 =	



FASTENER CALCULATIONS:

Tension T1 =	28.00	lb	← Tension per anchor
Tension T2 =	84.00	lb	← Tension per anchor
Tension T3 =		lb	← Tension per anchor
Tension T4 =		lb	← Tension per anchor
Tension T5 =		lb	← Tension per anchor
T max =	**84.00**	lb	← Maximum Bolt/anchor Load

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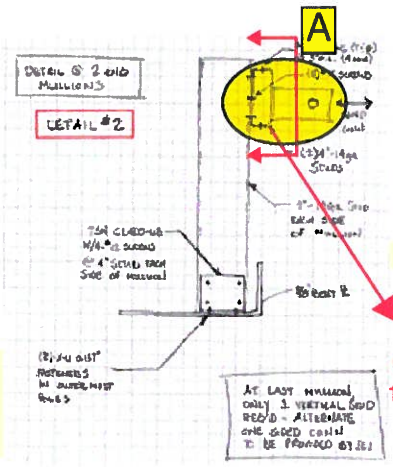
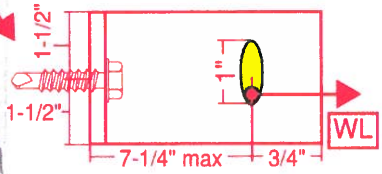


Client:	NGG
Project:	Webster University
Structure:	YKK 750 (2-1/2" x 6-9/16")
Part of:	Wind Load Anchors to Structure
Elevation:	1/217
Detail:	1/319

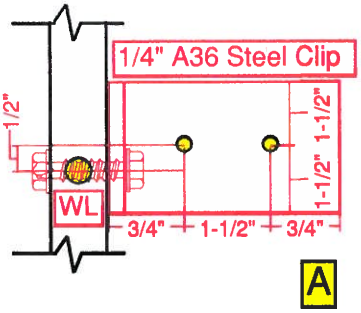
Checks

Date: 2/20/2017
Proj. No.: JE16059
Designer: M. Gorny
INPUT | CHECK



Load Design Criteria:	ASCE7-05 ASD
Material Design Criteria:	Aluminum Design Manual 2010
Fastener Name:	Hilti KwikFlex
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)		0.00	lb
Design Tension Load (T)		95.67	lb
Number of Screws		2.00	screws
Screw Selection (D)	1/4"	0.2500	in
F_{ty1}, F_{tu1} (Top Material)	A36	36 , 58	ksi
F_{ty2}, F_{tu2} (Base Material)	A653 Gr. 33	33 , 45	ksi
Thickness of top material (t_1)		0.2500	in
Thickness base material (t_2)		0.0451	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 =		377.0	lb
Manufacturer Allowable Tension =		131.0	lb

11.67lb + 84lb
See previous eccentric fastener calculations

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 =	0.0	lb
Fastener Tension (T_{fas})	T / fastener =	95.7	lb

Fastened Material Shear Design

Bearing (ADM J3.7, J.5.6.1, AISC J4.10)

Top Mat.: Rn = 1.2*de1*t1*Ftu1 <= 2.4*D*t1*Ftu1
Ω = 2 (Steel) Rn/Ω = 4350.0 lb

Base Mat.: Rn = 1.2*de2*t2*Ftu2 <= 2.4*D*t2*Ftu2
Ω = 2 (Steel) Rn/Ω = 608.9 lb

Tilting (ADM J.5.6.2) Ω = 3 ≤ t_1? YES
$R_n = 4.2(t_2^3 D)^{1/2} F_{tu2}$ Rn/Ω = 301.7 lb

Shear load associated with bolt bending (ref Hilti)
$M_{uM,5\%} = 1.2Sf(1 - T/Ta)$ $M_{uM,5\%}$ = N/A lb-in
$V_{rec} = (\alpha_M * M_{uM,5\%})/(1.7L)$ V_{rec} = N/A lb

AISI Cold-Formed Steel Design (Tbl IV-8a) Ω = 3
LGM Shear of sheet P_{ns} = 0.905 k
Using 0.0451" LGM Pns*1000/Ω = 301.7 lb

Allowable Shear / Fastener ($V_{allowable}$) = 301.7 lb
V_{fas} / $V_{allowable}$ = 0.00 ≤ 1.0
OK.

Fastened Material Tension Design

Pull-Out (ADM J.5.5.1.1) Ω = 3
Rn = 1.01*D*Le*Fty2 Rn/Ω = N/A lb

Pull-Over (ADM J.5.5.2) Ω = 3
Rn = (1.0+1.7*t1/Dws)Dws*t1*Fty1 Rn/Ω = 2715.0 lb

AISI Cold-Formed Steel Design IV-12 Ω = 3
LGM Pull-Out P_{not} = 0.431 k
Using 0.0451" LGM Pnot*1000/Ω = 143.7 lb

Allowable Tension / Fastener ($T_{allowable}$) = 131.0 lb
T_{fas} / $T_{allowable}$ = 0.73 ≤ 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:	$V_{fas}/V_{TIR} + T_{fas}/T_{TIR}$ =	0.08	≤ 1.0
TIR A9-91:	$(V_{fas}/V_{TIR})^2 + (T_{fas}/T_{TIR})^2$ =	N/A	≤ 1.0

OK.

Use (2) 1/4" Hilti KwikFlex Screws.

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Client: NGG
Project: Webster University
Structure: YKK 750 SSG
Part of: Intermediate Anchor Summary Sheet
Designer: M. Gorny

Date: 1/18/2017
Proj. No.: JE16059

Typical Wind Pressure (T) = 20.0 psf
Corner Zone Wind Pressure (C) = 23.5 psf
Interior Pressure (INT) = 5.0 psf
Typical Dead Load = 8.0 psf

Anchor Type: Point

INPUT | CHECK | RISA

Location	Substrate	Sheet	Elevation	Section	Wind Zone	Mullion Length (ft)	Trib. Width (ft)	Wind Pres. (psf)	Lateral Load (lb)	Gravity Load (lb)							
WL (only)	Vertical (J-hook)	205 (typ)	1/205 (typ)	1/306	C	Refer to RISA-3D		23.5	2195.3	N/A		a.1)	N/A	b.1)	c.1)	d.1)	
		207	1/207	1/306	C	Refer to RISA-3D		23.5	2219.9	N/A	Check	a.1)	N/A	b.1)	c.1)	d.1)	
		208	1/208	1/318	C	Refer to RISA-3D		23.5	1448.1	N/A		a.1)	N/A	b.1)	c.1)	d.1)	
	Vertical (Standard)	205	1/205	1/309	C	Refer to RISA-3D		23.5	2264.4	N/A		a.2)	N/A	N/A	N/A	N/A	
	Jamb (J-hook)	205 (typ)	1/205 (typ)	1/306	C	Refer to RISA-3D		23.5	788.1	N/A		a.1)	N/A	b.1)	c.1)	d.2)	
		208	1/208	1/318	C	Refer to RISA-3D		23.5	720.4	N/A		a.1)	N/A	b.1)	c.1)	d.2)	
	Jamb (Standard)	213	1/213	1/357	C	Refer to RISA-3D		23.5	1446.9	N/A	Check	a.2)	a'.1)	N/A	N/A	N/A	
		207	1/207	1/309	C	Refer to RISA-3D		23.5	895.5	N/A		a.2)	N/A	N/A	N/A	N/A	
	Corner (90deg) (J-hook)	208	1/208	1/318	C	Refer to RISA-3D		23.5	167.5	N/A	Check	a.3)	N/A	b.2)	c.1)	d.3	
	Corner (64deg) (J-hook)	208	1/208	1/318	C	Refer to RISA-3D		23.5	281.9	N/A	Check	a.3)	N/A	b.3)	c.1)	d.3	
DL/WL	Vertical (J-hook)	208	1/208	1/303	C	Refer to RISA-3D		23.5	1614.3	1292.8	Check	a.4.1)	N/A	b.4)	c.1)	d.1)	
		216	1/216	1/319	C	Refer to RISA-3D		23.5	1070.0	812.3		a.4.1)	N/A	b.4)	c.1)	d.1)	
	Jamb (J-hook)	208	1/208	1/303	C	Refer to RISA-3D		23.5	812.5	616.8	Check	a.4.2)	N/A	b.4)	c.1)	d.2)	
	Corner (90deg) (J-hook)	208	1/208	1/303	C	Refer to RISA-3D		23.5	286.7	975.7	Check	a.5)	a'.2	N/A	N/A	N/A	
	Corner (64deg) (J-hook)	208	1/208	1/303	C	Refer to RISA-3D		23.5	269.4	1009.6	Check	a.5)	a'.2	N/A	N/A	N/A	

In highlighted checks above, worst case dead and wind load were conservatively combined

Check a: Mullion to Intermediate Anchor Clip Connection and Intermediate Anchor Clip
Check a': Weld to Structure
Check b: Bolt to Pour Stop Clip
Check c: Pour Stop Clip
Check d: Self Drilling Fasteners to Structure
** Added 240lb to vertical dead weight to account for 2x4x3/8 HSS tube reinforcing
** Added 130lb to 64deg corner vertical dead weight to account for 2x4x1/4 HSS tube reinforcing
** Added 80lb to jamb vertical dead weight to account for 2x4x1/4 channel reinforcing

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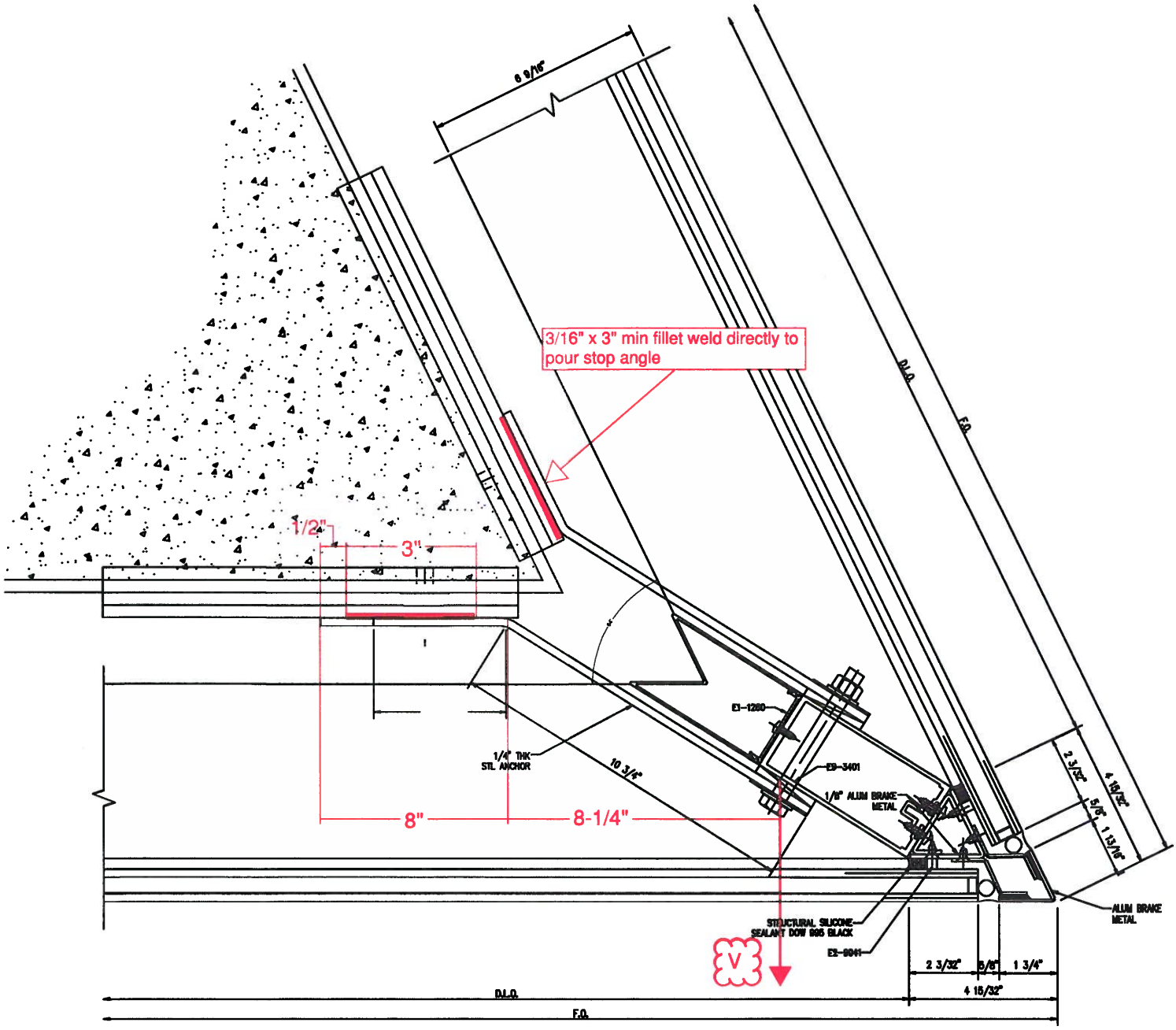
Project #JE16059
July 28, 2016

64deg corner condition



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ISD

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Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG
Part of: Intermediate Anchor Analysis
Elevation: 1/208
Detail: 1/303 **Check a.5**

Date: 1/18/2017
Proj. No.: JE16059
Designer: M. Gorny
INPUT | CHECK

Alloy-Temper	Anchor Type	Anchor Location
6063-T6	Dead Load	Typ Vertical (2 Anchors)

Wind Load (V_{WL}) 143.35 lb → $V_{WL/A}$ = 71.68 lb per anchor
Dead Load (V_{DL}) 1059.60 lb → $V_{DL/A}$ = 529.80 lb per anchor

Z (in)	X (in)	t (in)	Y (in)
10.75	16.25	0.38	5.00

Thermal Expansion Clear Span = N/A ft
Span of Spandrel Beam = N/A ft
Max Spandrel Deflection = 0.000 in (RFI to EOR)

Bolt Diameter (D) = 0.500 in
Number of Bolts (n) = 1 bolts @ 1 bolt(s)/slot

Alum. Thickness (t_m) = 0.090 in
Alum. F_{tu} = 30 ksi
Alum. Edge Dist. (d_{emul}) = 1.00 in

Steel F_y = 36 ksi
Steel F_{tu} = 58 ksi
Steel E = 29000 ksi

Bolt Edge Distance (L_c) = 0.875 in (AISC J3.4)
Anchor L_b = 9.625 in

Weak Axis Ecentricity (e) = 13.25 in

Bolt Shear (Grade 5 Bolt)

$V_1 = V_{WL/A}$	V_1 =	71.68 lb	
$V_2 = V_{DL/A}$	V_2 =	529.80 lb	
$V_{TOTAL} = \sqrt{(V_1^2+V_2^2)}$	V_{TOTAL} =	534.63 lb	
AAMA TIR A9-91 Table 6	V_a =	3580.00 lb	
	V_{TOTAL}/V_a =	0.149	OK

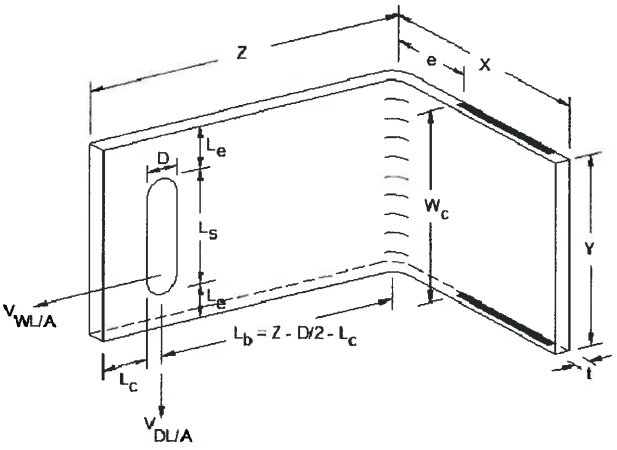
Aluminum Bearing @ Bolt Connection; Ω = 1.95

2010 Aluminum Design Manual Section J.5.6.1

$V_a = R_n/\Omega = d_{emul}t_mF_{tumul}/\Omega$	V_a =	1384.62 lb	
$\leq 2Dt_mFtu_{mul}/\Omega$	V_{TOTAL}/V_a =	0.386	OK

Slot Size

$\Delta_{temp} = T_{change}(Coef)*h$	Δ_{temp} =	N/A in	
$L_s = (2\Delta_{temp})+(D*n)+(2*Spandrel\ Deflection)+(n-1)(1.25\ in)$			
Minimum Slot Length (L_s)	L_s =	0.00 in	
Actual Slot Length to Use =	L_s =	0.00 in	



Major Axis Steel Bending - Dead Load; Ω_b = 1.67

AISC Steel Manual 13th Ed, Chapter F
F11.2.a Lateral-Torsional Buckling Applies

L_bY/t^2	342.22			
0.08 E/F_y	64.44	Z_x =	2.344	in^3
1.90 E/F_y	1530.56	S_x =	1.563	in^3
$M_p = F_yZ_x$		M_p =	84375.00	lb-in
$M_y = F_yS_x$		M_y =	56250.00	lb-in
Mn=Cb[1.52-0.274(LbY/t^2)(Fy/E)]My<=Mp		M_n =	78952.34	lb-in
$M_{ax} = M_n/\Omega_b$		M_a =	47276.85	lb-in
$M_x = V_{DL/A} * L_b$		M_x =	5099.33	lb-in
		M_x / M_{ax} =	0.11	OK

Weak Axis Bending; Ω_b = 1.67

AISC Steel Manual 13th Ed, Chapter F11.1

$W_c = Y$	W_c =	5.000	in
$Z = (W_c*t^2)/4$	Z =	0.1758	in^3
$S = (W_c*t^2)/6$	S =	0.1172	in^3
$M_n = M_p = F_y*Z/\Omega_b$ =	M_n =	3789.30	lb-in
$1.6*M_y/\Omega_b$ =	$1.6*M_y/\Omega_b$ =	4041.92	lb-in
$M_a = M_n/\Omega_b \leq 1.6*M_y/\Omega_b$ =	M_a =	3789.30	lb-in
$M = V_{WL/A} * e$ =	M =	949.69	lb-in
M_y/M_{ay} =	M_y/M_{ay} =	0.25	OK

Combined Bending

$M_x/M_{ax} + M_y/M_{ay} \leq 1.0$ =	0.36	OK

15a

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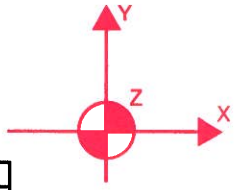
Client: NGG
Project: Webster University
Structure: YKK YCW 750 SSG
Part of: Intermediate Anchor Analysis
Elevation: 1/208
Detail: 1/303 **Check a'.2**

Date: 1/18/2017
Proj. No.: JE16059
Designer: M. Gorny
INPUT | CHECK | RISA

Design Wind Pressure 23.50 psf
Weld Filler Metal Yield (F_{yw}) 70 ksi



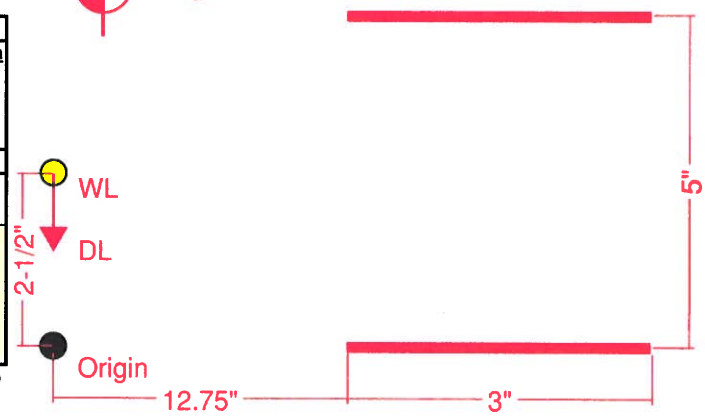
Design Loads

	Design Loads	Load Location Relative to Origin
X-axis	lb (V_x)	in (X_V)
Y-axis (DL)	529.8 lb (V_y)	2.500 in (Y_V)
Z-axis (WL)	71.7 lb (V_z)	10.75 in (Z_V)

Weld Group Layout

Weld Line	Parallel Axis (X or Y)	Length (in) (A_n)	Vert Dist from X-Axis (in) (y_n)	Horz Dist from Y-Axis (in) (x_n)
1	X	3	5	14.25
2	X	3	0	14.25
3				
4				
5				
6				

Note: Load location & magnitude must use proper pos/neg values based on the origin. x_n & y_n are measured from the same origin as the applied load



Design Moments

X-axis	5695.4 lb-in	Note: Design moments are taken about the weld centroidal axis.
Y-axis	1021.4 lb-in	
Z-axis	7549.7 lb-in	

Weld Group Centroid

$e_x = \Sigma A_n * y_n / \Sigma A_n$	e_x =	2.500 in
$e_y = \Sigma A_n * x_n / \Sigma A_n$	e_y =	14.250 in

Weld Group Moment of Inertia

Weld Line	I_{nx-x}	$A_{wn} * y_{bar}^2$	I_{ny-y}	$A_{wn} * x_{bar}^2$
1	0.0000	18.7500	2.2500	0.0000
2	0.0000	18.7500	2.2500	0.0000
3	N/A	N/A	N/A	N/A
4	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A

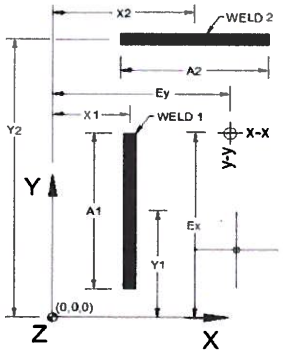
$I_{x-x} = \Sigma(I_{nx-x} + A_{wn} y_{bar}^2)$	I_{x-x} =	37.500 in^3
$I_{y-y} = \Sigma(I_{ny-y} + A_{wn} x_{bar}^2)$	I_{y-y} =	4.500 in^3
$J_z = I_{x-x} + I_{y-y}$	J_z =	42.000 in^3

$y_{bar} = abs(y_n - e_x)$, $x_{bar} = abs(x_n - e_y)$
I_{x-x} & I_{y-y} are about weld group centroidal axis

Weld Extreme Fiber Dimensions

Weld Line	e_{w-x} (in)	e_{w-y} (in)
1	1.500	2.500
2	1.500	2.500
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
6	N/A	N/A

Extreme Fiber is the weld point furthest from the centroidal axis of the weld group



NOTE: LOCATION OF X & Y AXIS IS ARBITRARY BUT MUST BE TAKEN AT THE SAME LOCATION FOR ALL WELDS IN THE GROUP AS SHOWN ABOVE.

X-Axis Weld Design

X-Axis Shear		
$f_{wx} V_x = V_x / \Sigma A_n$	$f_{wx} V_x$ =	0.00 lb/in
Z-Axis Moment		
$f_{wx} M_z = M_z * e_{w-y} / J_w$	$f_{wx} M_z$ =	449.38 lb/in
$f_{wx} = f_{wx} V_x + f_{wx} M_z$	f_{wx} =	449.38 lb/in

Y-Axis Forces

Y-Axis Shear		
$f_{wy} V_y = V_y / \Sigma A_n$	$f_{wy} V_y$ =	88.30 lb/in
Z-Axis Moment		
$f_{wx\,Mz} = M_z * e_{w-x} / J_w$	$f_{wy} M_z$ =	269.63 lb/in
$f_{wy} = f_{wy} V_y + f_{wy} M_z$	f_{wy} =	357.93 lb/in

Z-Axis Forces

Z-Axis Shear		
$f_{wz} V_z = V_z / \Sigma A_n$	$f_{wz} V_z$ =	11.95 lb/in
X-Axis Moment		
$f_{wz} M_x = M_x * e_{w-y} / I_{x-x}$	$f_{wz} M_x$ =	379.69 lb/in
Y-Axis Moment		
$f_{wz} M_y = M_y * e_{w-x} / I_{y-y}$	$f_{wz} M_y$ =	340.48 lb/in
$f_{wz} = f_{wy} V_z + f_{wy} M_x + F_{wy} M_z$	f_{wz} =	732.12 lb/in

Weld Design

$f_w = v(f_{wx}^2 + f_{wy}^2 + f_{wz}^2)$	f_w =	930.62 lb/in
$t_{req} = f_w / (0.707 * F_{yw} / 3.33)$	t_{req} =	0.0626 in
Use 3/16" (0.1875") fillet weld		

CANNONDESIGN

SUBMITTAL IDENTIFICATION SHEET

To be completed by Contractor/CM

WEBSTER UNIVERSITY ISB
PROJECT NAME

8274 BIG BEND BLVD
ADDRESS

NUMBER

WEBSTER UNIVERSITY
OWNER

CANNON DESIGN
ARCHITECT / ENGINEER

Joe Voypick
SUBMITTED BY

084423-025
CONTRACTOR / CM SUBMITTAL NO.

CANNON DESIGN SUBMITTAL NO.

DRAWING / DETAIL REFERENCE

084423
SPECIFICATION SECTION / PARAGRAPH

MANUFACTURER / SUPPLIER

ITEM / PRODUCT ID

REQUIRED DATE

PRIORITY

◯ CRITICAL

ITEM BEING SUBMITTED (check only one)

- ◉ Shop Drawings
- ◯ Samples (_____ copies)
- ◯ LEED Submittal
- ◯ Certification / Qualifications
- ◯ Record Documents
- ◯ Product Data
- ◯ Coordination Drawing
- ◯ Calculations
- ◯ Schedules
- ◯ O&M Manuals
- ◯ Other _____

ITEM BEING SUBMITTED FOR (check only one)

◉ Action ◯ Information Only ◯ Record

REMARKS OR DEVIATIONS

Sealed Curtainwall calculations. Files will not merge so shop drawings emailed to Melissa Pirtle and Kelvin Patel on 3/24.

CONTRACTOR / CM CERTIFICATION
(SUBMITTALS NOT CERTIFIED WILL BE RETURNED WITHOUT REVIEW)

PARIC

PARIC CORPORATION
SUBMITTAL STAMP

THIS SHOP DRAWING HAS BEEN REVIEWED BY PARIC CORPORATION

Subcontractor remains responsible for dimensions, quantities, coordination with other trades and compliance with contract documents.

By:
Devin D. Gates

Joe Voypick
REVIEWED BY

3/24/17
DATE

To be completed by Reviewer

08 4423-025
CANNON DESIGN SUBMITTAL NUMBER

3/24/17
RECEIVED DATE

- ◯ A. No Exceptions Taken
  No further review of submittal is required.
- ◯ B. Make Corrections Noted
  Incorporate corrections in work; resubmission is not required.
- ◯ C. Revise and Resubmit
  Revise as noted, and resubmit for review.
- ◯ D. Rejected
  Submittal is not in compliance with Contract Documents; provide new submittal.
- ◉ E. For Record / Information Only
  Submittal was reviewed for Record / Information purposes only.
- ◯ F. Not Required for Review
  Submittal is not required by Contract Documents and has not been reviewed.

Review is for conformance with the design concept of this project and for general compliance with contract documents. Contractor is responsible for quantities, dimensions and compliance with contract documents and for information that pertains to fabrication processes, construction techniques and coordination of this work with all trades which will be affected thereby. This review is null and void if submittal deviates from contract documents and does not indicate or note deviations.

A/E COMMENTS ◯ See attached sheet(s) for additional comments

KWA did not review calculations in this submittal and takes no responsibility for its accuracy or correctness. Curtain wall was a delegated design. Contractor and Curtain wall manufacturer take full responsibility for the information provided.

REVIEWED BY

04/26/17
DATE