Design Criteria: 2012 IBC - ASCE 7-10

Wind Criteria: 120 mph (Occupancy Category II)
Exposure B
Mean Roof Height < 30 ft

Material Ref. Standards:
2010 Aluminum Design Manual
2008 Cold-Formed Steel Design Manual
AISC 2010 Specifications for Structural Steel Buildings
ACI 318-11
ACI 530-11/TMS 402-11/ASCE 5-11
2012 NDS

Window Manufacturer: Cascade Aluminum

Storefront System: TOV-450 Offset-Glaze

Frame Member Dimensions: 2" x 4.5"

Strength Criteria: $F_b = F_{ty}/n_y$ = 25,000/1.65 = 15,152 psi for 6063 T6 Aluminum

Deflection Criteria:
TIR-A11-04
IBC 2403.3
Specifications (Where Applicable)

Seismic Drift Criteria: ASCE 7-10 13.5.9 and Specifications, Where Applicable

STRUCTURAL
REGISTERED PROFESSIONAL
ENGINEER
83287PE
OREGON
JAN. 11, 2005
BRAD C. CONNELLY
EXPIRES: 12/31/2017

Project Name: 2205 NW QUIMBY IMPROVEMENTS	Project No. (if applicable)	CONNELLY STRUCTURAL Consulting Structural Engineering
Project Location: PORTLAND, OR	Date: 10/11/2016	1111 Ryan Court West Linn, OR 97068
Client Name: LINDQUIST GLASS	Page: 1 of 12	t: 503-887-0536 f: 503-744-0074 e: brad@connellystructural.com

OUT-OF-PLANE WIND LOAD DEFLECTION OF FRAMING MEMBERS

The out-of-plane deflection of curtainwall and storefront framing members is often limited to some established percentage of the overall span (denoted as $L_{[overall]}$) of the mullions. Some specs don't establish a limit as a function of mullion length, but rather by the largest uninterrupted length of glass supported by the mullion. In either case, these criteria are typically found in the project specifications.

Section 2403.3 of the International Building Code states, *"To be considered firmly supported, the framing members for each individual pane of glass shall be designed so the deflection of the edge of the glass perpendicular to the glass pane shall not exceed $L_{[edge]}/175$ of the glass edge length or ¾" (19.1 mm), whichever is less, when subjected to the larger of the positive or negative load where loads are combined as specified in Section 1605."* This does not say that the overall deflection of the mullion is limited to any maximum value. Instead, the Code mandates that the mullions must meet the deformational needs of the glass it supports. It is common for storefront and curtain wall frames to be made up of two or more lites of glass over the height of the window mullions, separated (and supported vertically) by horizontal muntins connected to the sides of the vertical mullions. In this scenario, the overall deflection of the mullions could be greater than $L_{[overall]}/175$, but still not exceed $L_{[edge]}/175$, or ¾", for the edges of the lites. There are sometimes window frames with just one panel of glass over the height of the mullion span. In this case, the overall mullion deflection limit would be $L_{[edge]}/175 \leq$ ¾".

To determine a limit set by Code for overall mullion deflection, the designer must refer to 1604.3. This section mandates that deflection limits of aluminum are to be based on the Aluminum Design Manual, Part 1 (Specifications). Under Specifications Section L.3: Deflections, in the *Serviceability* Chapter L, it states that, "Deflections caused by service load combinations shall not impair serviceability." This general statement then is subject to the definition of *serviceability*. L.1 defines *serviceability* as, *"...the preservation of a structure's function under service load combinations."*

Meeting the needs of the supported glass means that the out-of-plane deflection of the vertical mullion is limited in order to keep the curvature of any continuous edge of glass panel within limits that coincide with predictable glass behavior. Predictability, in this sense, is expressed as a probability that no more than 8 lights of glass out of 1000 total lites will break. The limits set forth in 2403.3 are based on ASTM E1300, which assumes this probability can be met, as long as edge deflections don't exceed $L_{[edge]}/175$ or ¾".

Most storefront manufacturers publish wind load tables that can be used by building designers in choosing system depth, span, and spacing to meet a variety of conditions, without having to do rigorous analysis. *TIR-11 Maximum Allowable Deflection of Framing Systems for Building Cladding Components at Design Wind Loads* is a technical publication available for purchase from American Architectural Manufacturer's Association (AAMA), in which the recommended overall deflection of window mullions be within the following limits:

Spans ≤ 13'-6" $\Delta_{[OVERALL]} \leq L_{[overall]}/175$ *or ¾"*
Spans > 13'-6" $\Delta_{[OVERALL]} > L_{[overall]}/240$ *+ ¼"*

Most if not all of the tables provided by manufacturers for their various extrusions are based on these deflection limits. In reviewing TIR-11, a specific reason for using these limits for overall mullion deflection could not be found. It references standards such as ASTM E1300, as well as excerpts from past building codes, which all could arguably be traced back to ASTM E1300. It does, however, clearly note the factors that influence what we consider to be acceptable deflection, such as weatherability, occupant comfort, and adjacent construction.

It should be noted that many architectural specifications do not specify TIR-11. Many have requirements consistent with IBC 2403.3, often with added verbiage such as, "... with full recovery of glazing materials..." This allows the designer to decide a reasonable overall mullion deflection for a given condition, while still meeting the Code-mandated deflections needed to ensure that the panels are *"...considered firmly supported..."*. Regardless what an acceptable overall deflection ends up being, structural stability and strength should always be considered.

The following diagram illustrates the graphical analysis performed to ensure that each lite of glass will be firmly supported in the event that the overall mullion deflection should exceed L/175.

CONNELLY STRUCTURAL
Consulting Structural Engineering
1111 Ryan Court
West Linn, OR 97068
t: 503-887-0536
f: 503-744-0074
e: brad@connellystructural.com

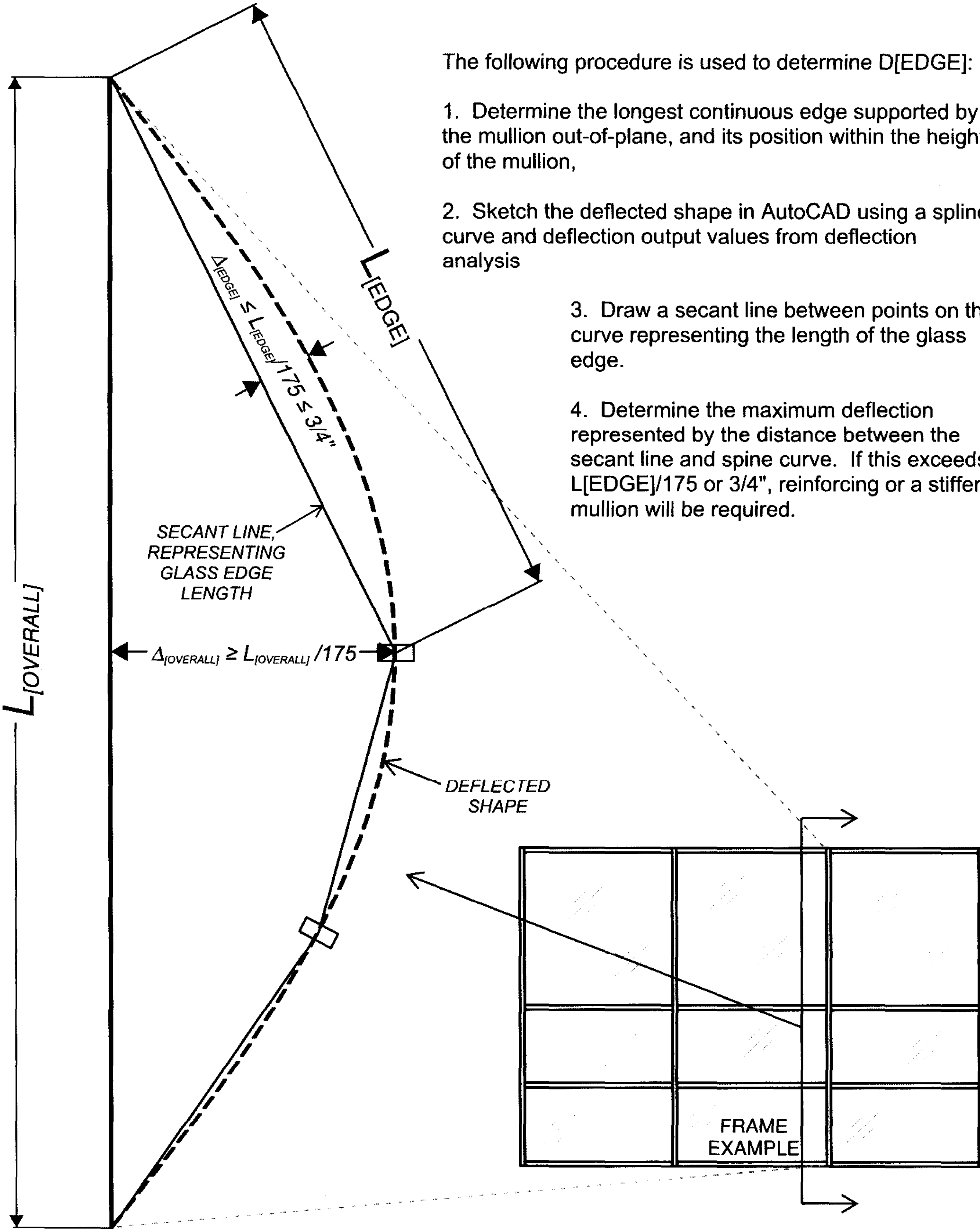
The following procedure is used to determine D[EDGE]:

1. Determine the longest continuous edge supported by the mullion out-of-plane, and its position within the height of the mullion,

2. Sketch the deflected shape in AutoCAD using a spline curve and deflection output values from deflection analysis

3. Draw a secant line between points on the curve representing the length of the glass edge.

4. Determine the maximum deflection represented by the distance between the secant line and spine curve. If this exceeds L[EDGE]/175 or 3/4", reinforcing or a stiffer mullion will be required.



Project Name:	Project No. (if applicable)	CONNELLY STRUCTURAL
2205 NW QUIMBY IMPROVEMENTS		Consulting Structural Engineering
Project Location: PORTLAND, OR	Date: 10/11/2016	1111 Ryan Court West Linn, OR 97068
Client Name: LINDQUIST GLASS	Page: 3 of 12	t: 503-887-0536 f: 503-744-0074 e: brad@connellystructural.com

SIMPLE-SPAN UNIFORMLY-LOADED MULLION ANALYSIS FOR WIND LOADING

Project: 2215 NW Quimby
Client: Lindquist Glass

Wind pressure per 2012 IBC Alternate All-Heights Method

ULTIMATE Basic Wind Speed	120 mph	Risk Cat. (doesn't affect results)	II	Pressure, $q_z = 0.00256V^2 =$	36.9 psf	(LRFD)
Enter Exposure	B	Enter K_{zt} per ASCE Fig. 6-4	1	$K_z = 0.700$		(ASCE 7-10 Table 27.3-1)
Height Above Ground (not < 15ft)	30.0ft					

Type	Part No.	Ix (in^4)	Sx (in^3)
A	Cascade TOV-452 / OHF-450 FILLER	2.26	0.91
B	Cascade TDJ-450 / OHF-450 Filler	2.96	1.18
C	Cascade TWJ-450 W/ FILLER	2.29	0.84
D	None	0.00	0.00
E	None	0.00	0.00
F	None	0.00	0.00

	Window Frame	Span Length (in)	Left Lite (in)	Mullion Width (in)	Right Lite (in)	Trib. Width (in)	Mullion Effective Area (ft^2)	Pressure Zone	Negative Pressure Pnet (psf)	Positive Pressure Pnet (psf)	Negative Wind Load (#/in)	Mullion Type	Δ_{max} (in)	Deflection Limit (in)	Deflection OK?	Req'd Steel Moment of Inertial (in^4)	f_b (psi)	Reinf. Required for Stress?	Comments, Additional Calculation, Etc.
	SF1 DP	144	40 1/2	2	36	40.25	48.00	4	16.6	15.2	4.63	B	0.88	0.82	CHK 2403.3	0.065	10213	NO	F.B. 1" X 2"
	SF1 J	144	0	2	40 1/2	22.25	48.00	4	16.6	15.2	2.56	C	0.63	0.82	OK	No Reinf.	7916	NO	
	SF2 J	144	0	2	20	12.00	48.00	5	20.1	15.2	1.68	C	0.41	0.82	OK	No Reinf.	5190	NO	
	SF3 DP	144	40 1/2	2	36	40.25	48.00	5	20.1	15.2	5.63	B	1.06	0.82	CHK 2403.3	0.299	12415	NO	F.B. 1" X 2"
	SF3 J	144	0	2	40 1/2	22.25	48.00	5	20.1	15.2	3.11	C	0.76	0.82	OK	No Reinf.	9623	NO	
	SF4 J	144	0	2	75 3/4	39.88	48.00	5	20.1	15.2	5.58	C	1.36	0.82	CHK 2403.3	0.518	17245	YES!	MID-SPAN ANCH.OR F.B. 1" X 2"
	SF5 J	144	0	2	36 7/8	20.44	48.00	5	20.1	15.2	2.86	C	0.70	0.82	OK	No Reinf.	8839	NO	
	SF5 M	144	36 7/8	2	36 7/8	38.88	48.00	5	20.1	15.2	5.44	A	1.35	0.82	CHK 2403.3	0.496	15551	YES!	F.B. 1" X 2"
	SF6 J	144	0	2	39	21.50	48.00	4	16.6	15.2	2.47	C	0.60	0.82	OK	No Reinf.	7650	NO	
	SF6 M	144	39	2	39	41.00	48.00	4	16.6	15.2	4.72	A	1.17	0.82	CHK 2403.3	0.327	13493	NO	LARGEST LITE OK
	SF7 J/DP	144	0	2	36	20.00	48.00	5	20.1	15.2	2.80	B	0.53	0.82	OK	No Reinf.	6169	NO	

NOTES:

1. Wind pressures are calculated using the 2012 IBC Alternate All-Heights Method, and converted to ASD-Level wind loads (i.e., $W_{ASD} = 0.6W_{LRFD}$)
2. Wind pressure for vertical member analysis is reduced using the effective wind area, as defined in ASCE 7 Chapter 26, for each condition.
3. Wind pressure for use in determining reactions was reduce based on the actual tributary area at reaction point.
4. "Pressure Zone" is either Zone "4", Zone "5", or "INT" for interior 5 psf

SIMPLE-SPAN UNIFORMLY-LOADED MULLION REACTIONS

Project: 2215 NW Quimby
Client: Lindquis: Glass

Wind pressure per 2012 IBC Alternate All-Heights Method

ULTIMATE Basic Wind Speed	120 mph	Risk Cat. (doesn't affect results)	II	Pressure, $q_z = 0.00256V^2 =$ 36.9 psf	(LRFD)
Enter Exposure	B	Enter K_{zt} per ASCE Fig. 6-4	1.00	$K_z = 0.700$	(ASCE 7-10 Table 27.3-1)
Height Above Ground (not < 15ft)	30.0ft				

	Window Frame	Span Length (in)	Left Lite (in)	Mullion Width (in)	Right Lite (in)	Trib. Width (in)	Pressure Zone	Connection Tributary Area (ft^2)	Negative Connection Pressure Pnet (psf)	Positive Connection Pressure Pnet (psf)	Negative Reaction (lbs)	Positive Reaction (lbs)	Head Detail 1	Head Detail 2	Sill Detail 1	Sill Detail 2	Comment
	SF1 DP	144	40 1/2	2	36	40.25	4	20.1	16.8	15.4	338	310	4/6		5/7	8/7	
	SF1 J	144	0	2	40 1/2	22.3	4	11.1	16.9	15.5	188	172	4/6		5/7		
	SF2 J	144	0	2	20	12.0	5	6.0	20.7	15.5	124	93	4/6		5/7		
	SF3 DP	144	40 1/2	2	36	40.3	5	20.1	20.6	15.4	414	310	4/6		5/7	8/7	
	SF3 J	144	0	2	40 1/2	22.3	5	11.1	20.7	16.5	231	172	4/6		5/7		
	SF4 J	144	0	2	75 3/4	39.9	5	19.9	20.6	15.4	410	307	7/7		5/7		
	SF5 J	144	0	2	36 7/8	20.4	5	10.2	20.7	15.5	212	158	7/7		5/7		
	SF5 M	144	36 7/8	2	36 7/8	38.9	5	19.4	20.6	15.4	400	299	7/7		5/7		
	SF6 J	144	0	2	39	21.5	4	10.8	16.9	15.5	181	166	7/7		5/7		
	SF6 M	144	39	2	39	41.0	4	20.5	16.8	15.4	344	316	7/7		5/7		
	SF7 J/DP	144	0	2	36	20.0	5	10.0	20.7	15.5	207	155	7/7		8/7	13/9	

Project Name:	Project No. (if applicable)
2205 NW QUIMBY IMPROVEMENTS	
Project Location:	Date:
PORTLAND, OR	10/11/2016
Client Name:	Page:
LINDQUIST GLASS	

CONNELLY STRUCTURAL
Consulting Structural Engineering
20575 South Indigo Ave
Oregon City, OR 97045-9620
t: 503-887-0536
f: 503-631-8706
e: brad@connellystructural.com

2215 NW QUIMBY

Cbeam 2005

10/10/2016 17:41 File: SF4 2-WAY.cbm

SF4 2-WAY LOADING

By: BC

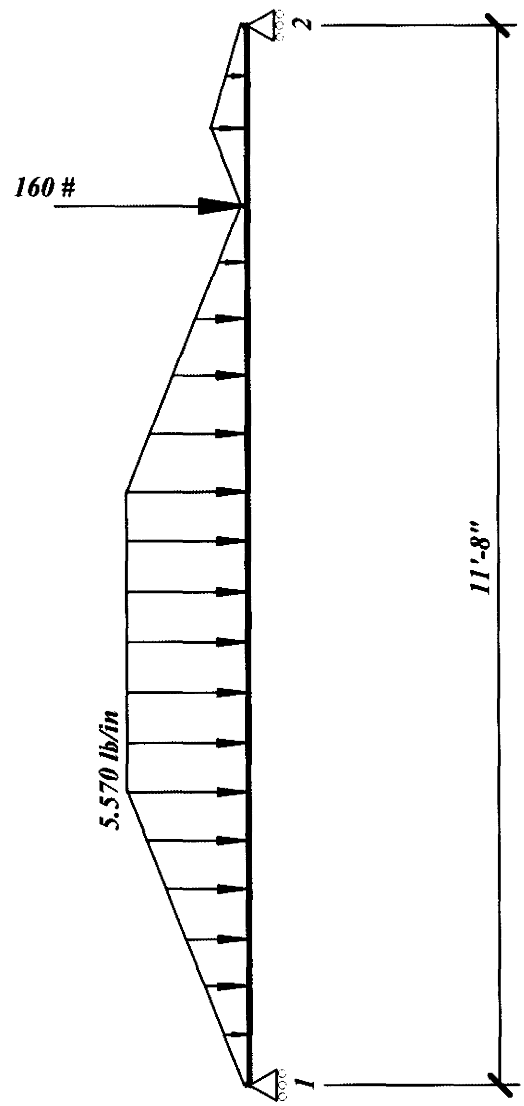
Beam Results			
Max. Span Deflection	=	-1.1029"	(Span 1, @ 70.00")
Max. Positive Moment	=	12429"#	(Span 1, @ 70.00")

Member Information				
Span	Length(in)	I(in^4)	S(in^3)	E(psi)
1	140.000	2.290	0.840	1.0e+007

Distributed Load Information				
Span	W1(#/in)	W2(#/in)	X1(in)	X2(in)
1	0.280	5.570	0.000	38.767
	5.570	5.570	38.767	78.507
	5.570	0.280	78.507	116.302
	0.280	1.720	116.302	126.389
	1.720	0.280	126.389	140.000

Point Load Information		
Span	P(#)	X(in)
1	160.000	116.302

Support Reactions	
Joint	Pounds
1	289
2	340



Maximum distributed load value shown only, see distributed load table for detailed information.

Span No. 1

	0.00L	0.10L	0.20L	0.30L	0.40L	0.50L	0.60L	0.70L	0.80L	0.90L	1.00L
Location	0.00	14.00	28.00	42.00	56.00	70.00	84.00	98.00	112.00	126.00	140.00
Shear	288.90	271.60	227.57	157.50	79.52	1.54	-74.33	-127.83	-153.90	-325.83	-340.10
Moment	-0.0	3954.7	7480.1	10202.5	11861.6	12429.0	11908.5	10461.3	8457.2	4685.5	0.0
Defl.	0.0000	-0.3402	-0.6469	-0.8902	-1.0469	-1.1029	-1.0532	-0.9023	-0.6623	-0.3510	0.0000
Stress	-0.0	4708.0	8904.9	12145.8	14120.9	14796.4	14176.7	12453.9	10068.1	5578.0	0.0

LOWER HORIZ. RXN = $(130 in^2)(20.1/144)$
$= 158^{\#} \rightarrow$ USE $160^{\#}$

MAX DEFLECTION OF UPPER LIGHT = 0.8" > 0.75" NG
MID-SPAN ANCHORAGE OR REINF. REQ'D

$$\Delta_{max} = \frac{5(4.72)(116.63)^4}{384(10e6)(2.26)} = 0.50"$$
$$= L/232 \text{ OK}$$

SF5 MULLION $I_{reqd} = 0.65 in^4 = \frac{b(2)^3}{12}$

$$b = \frac{0.65(12)}{8} = 0.98"$$

USE F.B. 1"x2".

CHECK SF6 MULLION DEFLECTION FOR UPPER PANEL:

$$\Delta_{max} = \frac{5(4.72)(116.63)^4}{384(1026)(2.26)} = 0.50"$$

$$= L/232 \text{ OK}$$

SF5 MULLION $I_{STEEL} = 0.5 in^4 = \frac{b(2)^3}{12}$

$$b = \frac{0.5(12)}{8} = 0.75"$$

USE F.B. 3/4" x 2", TYP.

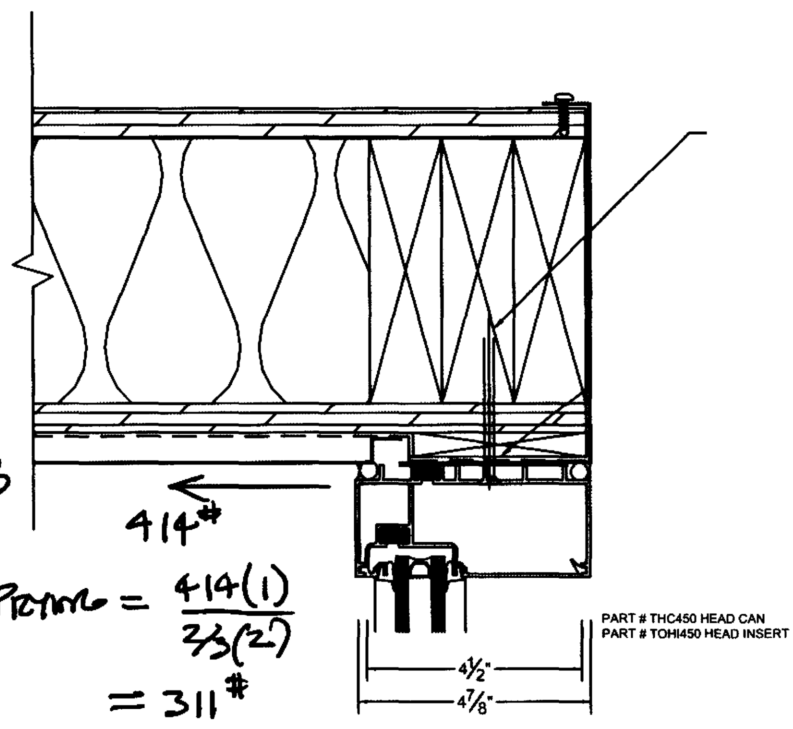
HEAD DETAIL 4/6

SDS 1/4 W/ 1.5" THREAD ENGAGEMENT

$V_{ALLOW} = 1.6(420) = 672^{\#}$

$T_{ALLOW} = 1.6(255) = 408^{\#}$

USE (2) SDS 1/4 @ EA. MULLION & JAMB



$$P_{TENSION} = \frac{414(1)}{2/3(2)} = 311^{\#}$$

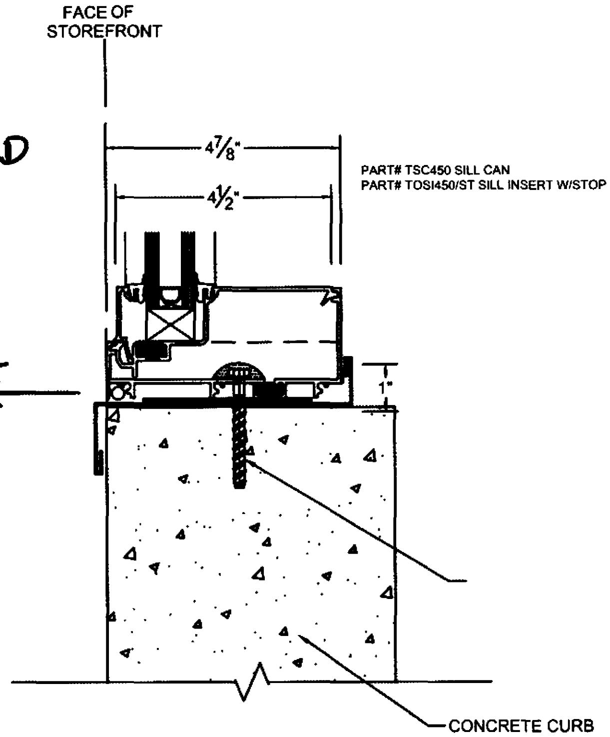
Project Name:	Project No. (if applicable)
2205 NW QUIMBY IMPROVEMENTS	
Project Location: PORTLAND, OR	Date: 10/11/2016
Client Name: LINDQUIST GLASS	Page: 7 of 12

CONNELLY STRUCTURAL
Consulting Structural Engineering
20575 South Indigo Ave
Oregon City, OR 97045-9620
t: 503-887-0536
f: 503-631-8706
e: brad@connellystructural.com

SILL DETAIL 5/7

$V_u = 1.6(414) = 662^{\#}$

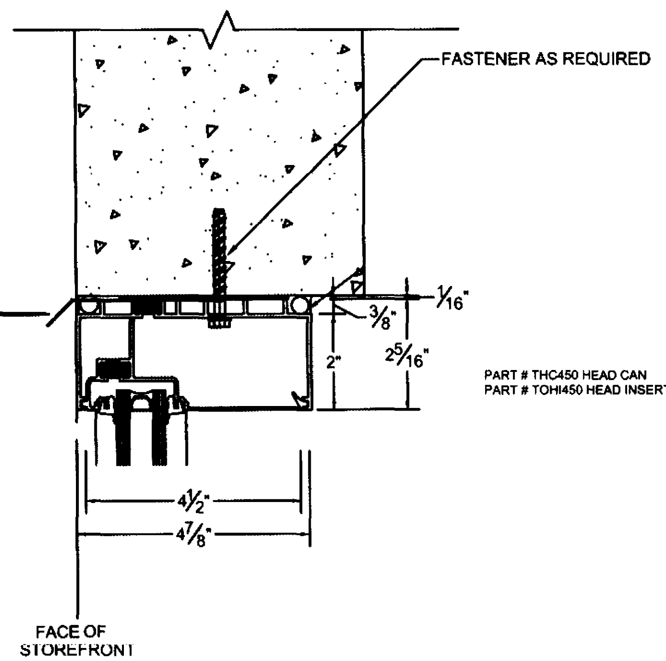
USE 1/4" ϕ SIMPSON TITEN HD
3" MIN. END DIST
2.5" MIN. EDGE DIST
2.5" NOMINAL EMBED
(h_{nom})



HEAD DETAIL 7/7

$V_u = 1.6(414) = 662^{\#}$

USE 1/4" ϕ SIMPSON TITEN HD
3" MIN. END DIST
2.5" MIN. EDGE DIST
2.5" NOMINAL EMBED
(h_{nom})



Project Name:	Project No. (if applicable)	CONNELLY STRUCTURAL Consulting Structural Engineering
2205 NW QUIMBY IMPROVEMENTS		
Project Location: PORTLAND, OR	Date: 10/11/2016	20575 South Indigo Ave Oregon City, OR 97045-9620
Client Name: LINDQUIST GLASS	Page: 8 of 12	t: 503-887-0536 f: 503-631-8706 e: brad@connellystructural.com

SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 2.4.6025.2

Company:		Date:	10/11/2016
Engineer:		Page:	1/4
Project:			
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

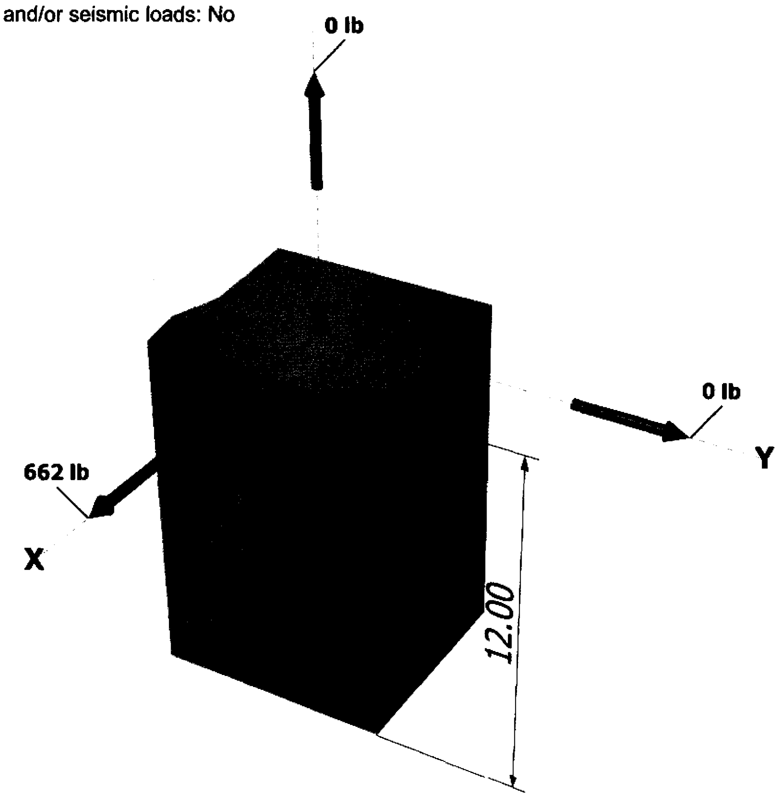
General
Design method:ACI 318-11
Units: Imperial units

Anchor Information:
Anchor type: Concrete screw
Material: Carbon Steel
Diameter (inch): 0.250
Nominal Embedment depth (inch): 2.250
Effective Embedment depth, h_{ef} (inch): 1.730
Code report: ICC-ES ESR-2713
Anchor category: 1
Anchor ductility: No
h_{min} (inch): 3.43
c_{ac} (inch): 5.14
C_{min} (inch): 1.50
S_{min} (inch): 1.50

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Uncracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.4
Reinforcement condition: B tension, B shear
Supplemental reinforcement: No
Reinforcement provided at corners: No
Do not evaluate concrete breakout in tension: No
Do not evaluate concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Load and Geometry
Load factor source: ACI 318 Section 9.2
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

<Figure 1>



Company:		Date:	10/11/2016
Engineer:		Page:	2/4
Project:			
Address:			
Phone:			
E-mail:			

<Figure 2>

Recommended Anchor
Anchor Name: Titen HD® - 1/4"Ø Titen HD, hnom:2.25" (57mm)
Code Report: ICC-ES ESR-2713

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	662.0	0.0	662.0
Sum	0.0	662.0	0.0	662.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

8. Steel Strength of Anchor in Shear (Sec. D.6.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
2020	1.0	0.60	1212

9. Concrete Breakout Strength of Anchor in Shear (Sec. D.6.2)

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. D-33 & Eq. D-34)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
1.73	0.25	1.00	2500	2.50	1019

$\phi V_{cbx} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. D.4.1 & Eq. D-30)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbx} (lb)
25.31	28.13	0.940	1.400	1.000	1019	0.70	844

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. D-33 & Eq. D-34)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
1.73	0.25	1.00	2500	3.00	1339

$\phi V_{cbx} = \phi\,(2)(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. D.4.1 & Eq. D-30)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbx} (lb)
27.00	40.50	1.000	1.400	1.000	1339	0.70	1749

10. Concrete Pryout Strength of Anchor in Shear (Sec. D.6.3)

$\phi V_{cp} = \phi k_{cp}N_{cb} = \phi k_{cp}(A_{Nc}/A_{Nco})\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Eq. D-40)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cp} (lb)
1.0	26.44	26.94	0.989	1.000	0.505	2731	0.70	937

11. Results

Interaction of Tensile and Shear Forces (Sec. D.7)

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	662	1212	0.55	Pass
T Concrete breakout x+	**662**	**844**	**0.78**	**Pass (Governs)**
|| Concrete breakout y+	**662**	**1749**	**0.38**	**Pass (Governs)**
Pryout	662	937	0.71	Pass

1/4"Ø Titen HD, hnom:2.25" (57mm) meets the selected design criteria.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections D.8.1 and D.8.2 for torqued cast-in-place anchor is waived per designer option.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.