RICE ENGINEERING
105 School Creek Trail | Luxemburg, WI 54217
(P) 920.617.1042 | (F) 920.617.1100

Klarity System
Interior Divider Calculations

Project Location:
Los Angeles, California
REI Project # R19-07-001

Prepared for:
CRLaurence - Los Angeles, CA
10/3/2019

Design Criteria:

1. Compliance with **IBC 2012, IBC 2015, IBC 2018, ASCE-7/10 and ASCE-7/16**
2. IBC section 1607 requires a minimum uniform design pressure of 5 PSF lateral load on interior walls. In addition to the 5 PSF uniform lateral load, the Klarity System has been designed for the following:
   A) 200 lb over 1 ft^2 of infill glass applied at 42" above finished floor at the center of the panel width
   B) 50 lb/ft uniform load applied to the glass at 42" above finished floor across the full panel width
   C) Minimum anchorage live load of 250 lb applied to posts at 42" above finished floor
   D) 10 PSF maximum uniform pressure
3. The seismic anchorage design information provided in this calculation package is for reference only and is not applicable for risk Category III or IV buildings and/or all buildings that fall within Seismic Design Categories D, E or F; a licensed design professional should be consulted for Klarity system installations in these locations.
4. Stainless steel members designed per "SEI/ASCE-8/02" or conservatively designed per "AISC Steel Construction Manual: ASD"
5. Member sizes, grade, alloy and strengths shall be as recommended in the calculation package
6. Stainless steel fasteners to be minimum **Condition "CW", 300 Series, Fu=100 ksi**
7. Carbon steel fasteners to be minimum **SAE Grade 5, Fu= 120 ksi (Interior Only)**
8. All other fasteners shall be the size and strength as is recommended in the calculation package
9. **Concrete slabs to be F'c=3,000 psi, normal weight with minimum thickness of 4-3/4". Calculations assume cracked concrete.**
10. **Anchorage for Seismic Category D, E & F regions should be designed by a licensed professional.**
11. **Lightweight concrete slabs and/or corrugated metal deck slabs should not be used to anchor the Klarity system posts.**
12. Concrete anchors shall be as recommended in the calculation package. Installer is responsible for maintaining the fastener spacing, edge distance, end distance, embedment depth and minimum substrate thickness that is recommended in the calculation package
13. Concrete anchors shall be installed per manufacturer's recommended installation procedures, including recommended ambient temperatures for chemical/adhesive anchors
14. **Structural steel, concrete slabs, concrete curbs, masonry units and all other host structure substrates designed by others**
15. All glass is to be 3/8" thick fully tempered or 1/2" thick fully tempered. Exposed edges polished; maximum/minimum glass lite to be 5'-0" Wide x 8'-0" Tall.
16. Swinging glass door to be 1/2" thick fully tempered glass. Exposed edges polished; maximum/minimum glass lite to be 36" Wide x 83" Tall
17. Sliding glass door to be 3/8" thick fully tempered glass. Exposed edges polished; maximum/minimum glass lite to be 40" Wide x 84" Tall
18. Per IBC, glass has been designed using a safety factor of 4 in determining the allowable flexural stress (24,000/4= 6,000 psi)
19. Per IBC, glass panels need to be manufactured from an approved safety glazing material conforming to CPSC 16 CFR 1201 (II). The glass manufacturer is responsible to provide acceptable safety glass conforming to the IBC & CPSC provisions.
20. Shim dis-similar metals. Maximum recommended shim height for the Klarity system is 1/4". Use full bearing structural shims whenever shims are used.
21. Design of material separation to prevent reaction between dissimilar materials **not designed by Rice Engineering Inc.**
22. Due to the large amount of data involved for the engineering of this divider system, only information pertinent to the worst-case design scenarios have been included in this calculation package. Please contact CR Laurence if additional information is needed.
23. The Klarity divider system is not to be used for fall protection

Disclaimer:

This Certification is limited to the structural design of structural components of this glass divider system.
It does NOT include responsibility for:

- Structural design of hardware, clevises, and turnbuckles.
- Design of material separation to prevent reaction between dissimilar materials.
- Design of air and water infiltration prevention.
- The manufacture, assembly, or installation of the system.
- Quantities of materials or dimensional accuracy of drawings

Engineers Design Approval Stamp:

SIGNED / SEALED VERSION OF THIS REPORT IS AVAILABLE UPON REQUEST. PLEASE PROVIDE SITE SPECIFIC TECHNICAL DOCUMENTS SHOWING PROJECT ADDRESS, DESIGN INTENT, SPECIAL CODE REQUIREMENTS AND HOST STRUCTURE ANCHORAGE SUBSTRATE.

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Design Criteria:

Page:	Description:	Date:	Revision:
E1:E1A	Typical Layout	7/18/19	
E2:E2C	Typical Swinging Door Layout	7/18/19	
E3:E3C	Typical Sliding Door Layout	7/18/19	
1:1A	Post Analysis	7/18/19	
2:2D	Typ Glass Analysis	7/18/19	
3:3A	Anchorage Analysis - Steel	7/18/19	
4:4D	Concrete Anchor (60" Span, 5 PSF)	7/18/19	
5:5D	Concrete Anchor (54" Span, 10 PSF)	7/18/19	
6	Glass Clamp Analysis	7/18/19	
7:7B	Sill Member Analysis & Anchorage	7/18/19	
8:8A	Base Plate Analysis	7/18/19	
9:9A	Swinging Door Analysis	7/18/19	
10:10B	Sliding Door Analysis	7/18/19	
Z1:Z1A	AAMA Fastener Data	7/18/19	
Z2:Z2A	GANA Design Data	7/18/19	
Z3	Weld Filler Reference	7/18/19	
Z4	ITW Buildex Tapcon+ Design Data	7/18/19	

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***NOTE:** STRUCTURAL STEEL, CONCRETE, CMU, MASONRY, WOOD/STEEL STUD WALLS, WOOD BLOCKING AND ALL OTHER HOST STRUCTURE ANCHORAGE SUBSTRATES ARE ASSUMED DESIGNED BY OTHERS*

Klarity System - Typical Layout	Detail Ref.	Sheet No: E1

CR LAURENCE - KLARITY - INTERIOR DIVIDER SYSTEM

Design	Max Post	Anchorage to Steel[1]		Anchorage to Concrete[4]	
Pressure	Spacing	Bolt Size[2]	Drill / Tap[3]	Anchor Type	Embedment
5 PSF	5'-0"	1/2" Dia.	5/16" Thk Min.	HILTI M8 HSL-3	2-3/8"
10 PSF[5]	4'-6"	1/2" Dia.	5/16" Thk Min.	HILTI M10 HSL-3	2-3/4"

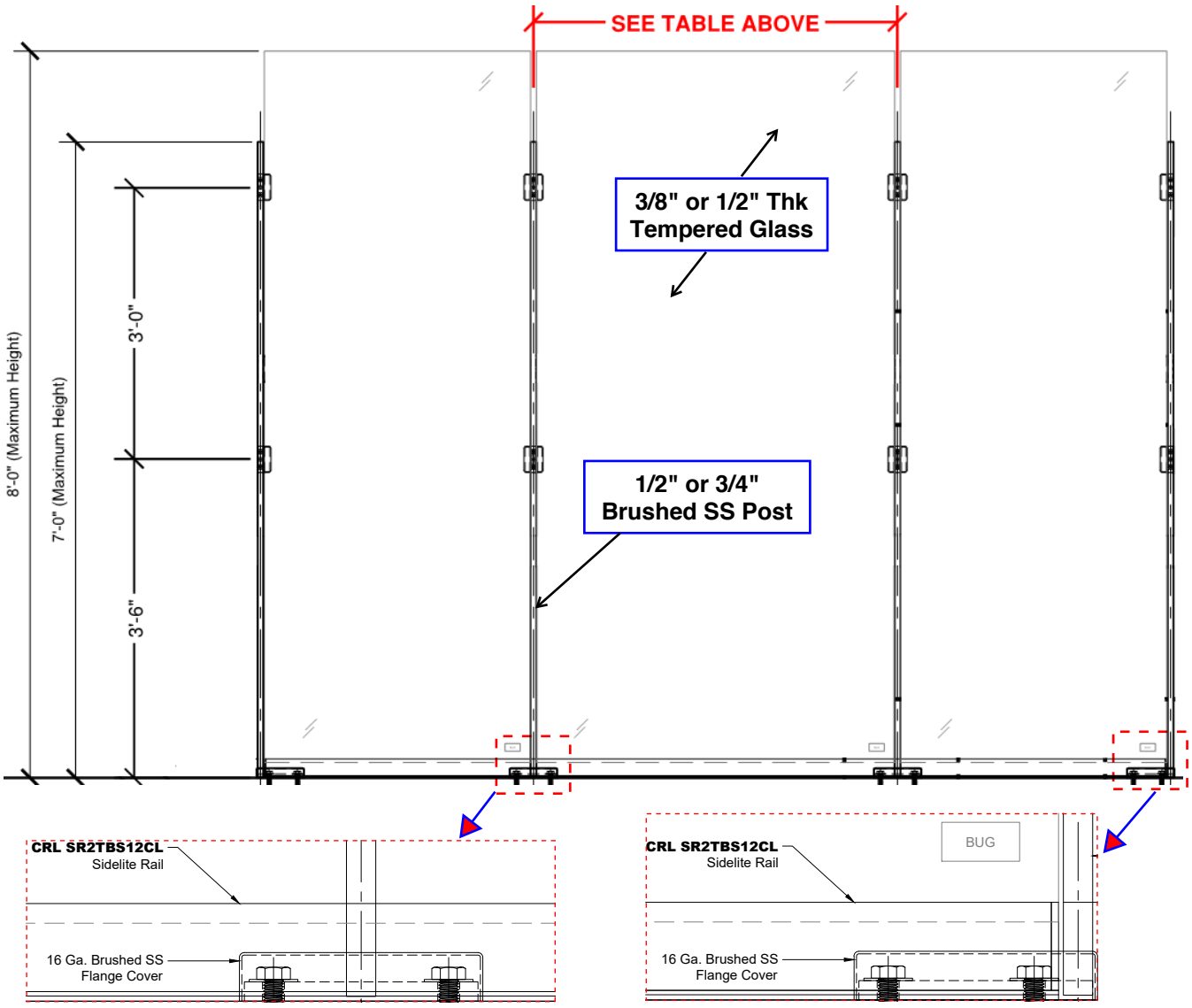
[1] *HOST STRUCTURE STEEL TO BE ASTM A36 CARBON STEEL, Fu= 58 KSI MINIMUM*

[2] *THRU BOLT FOR NON-TAPPING SITUATION*

[3] *5/16" THK, A36 STEEL REQUIRED TO ACHIEVE 4 THREADS ENGAGED*

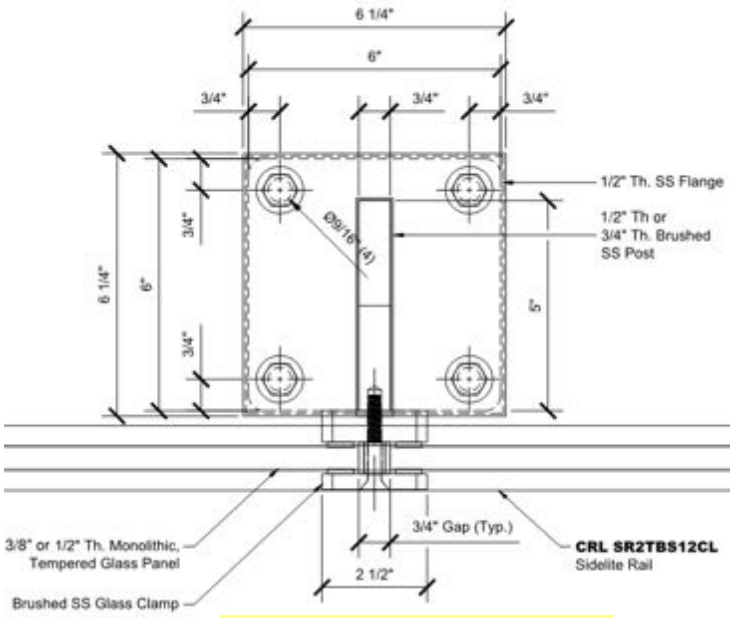
[4] *3,000 PSI MIN, NORMAL WEIGHT, 4-3/4" THK MINIMUM MONOLITHIC SLAB*

[5] *MAXIMUM DESIGN LOAD FOR INTERIOR KLARITY SYSTEM*



RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No: R19-07-001 Engineer: KEP Date: 7/18/19 Chk By:	Sheet No: E1 Rev: Date:

Klarity System - Typical Layout	Detail Ref.	Sheet No: E1 A



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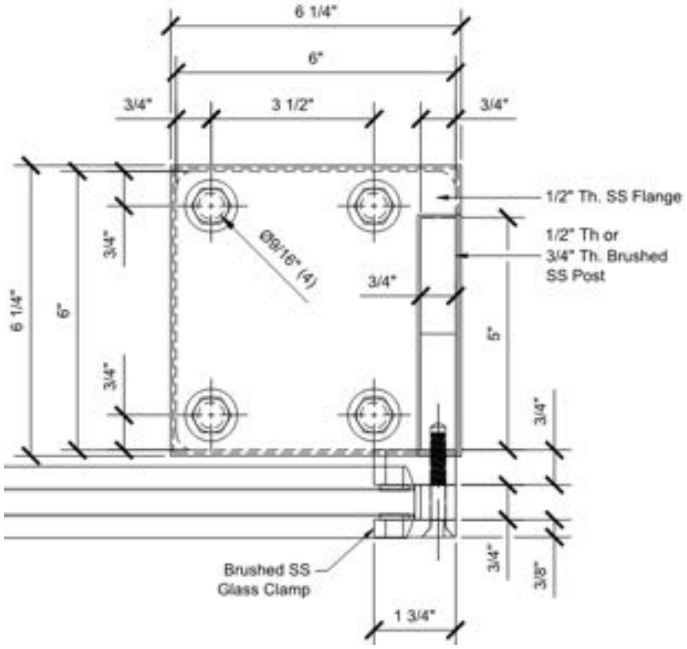

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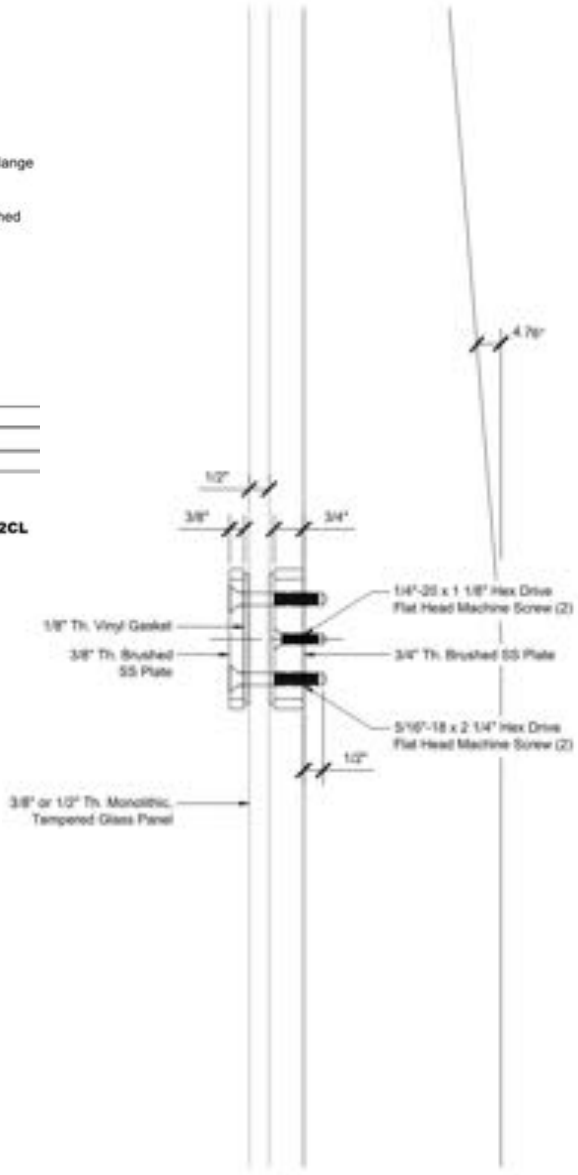
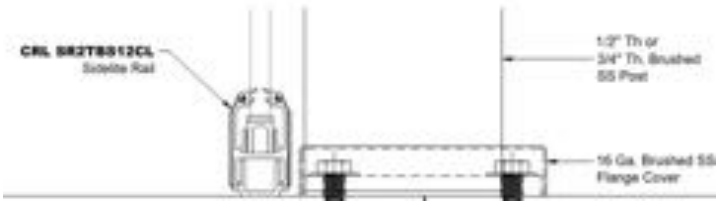


05 Section Detail at Glass Clamp



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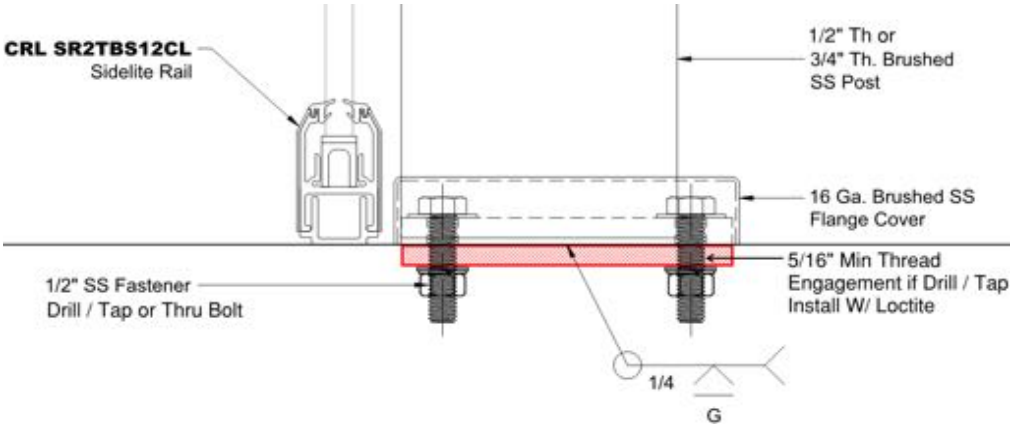
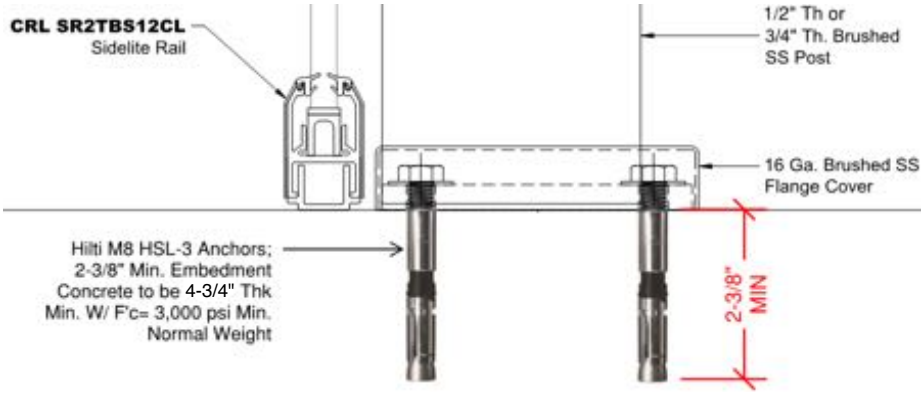
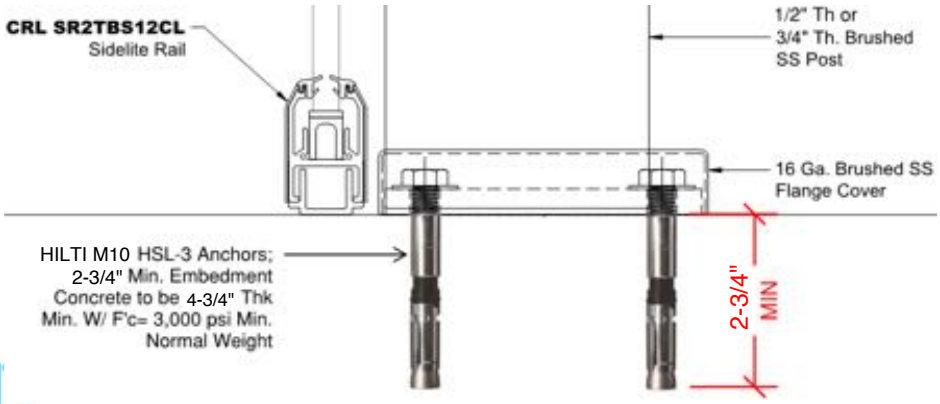
Klarity System - Typical Layout	Detail Ref.	Sheet No: E1 B



TYPICAL ANCHORAGE AT STEEL



CONCRETE ANCHORAGE - 5 PSF / 5'-0" MAX POST SPACING



CONCRETE ANCHORAGE - 10 PSF / 4'-6" MAX POST SPACING

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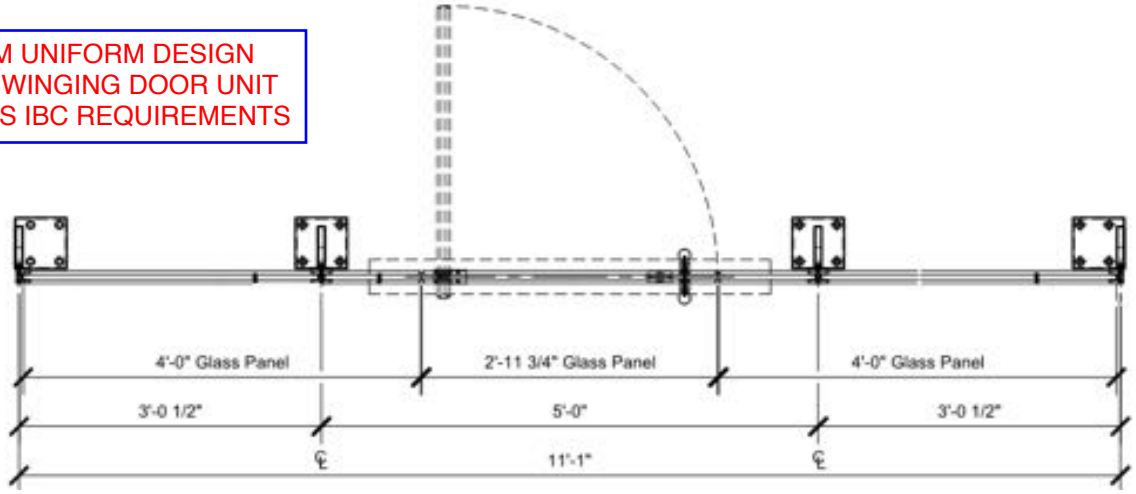
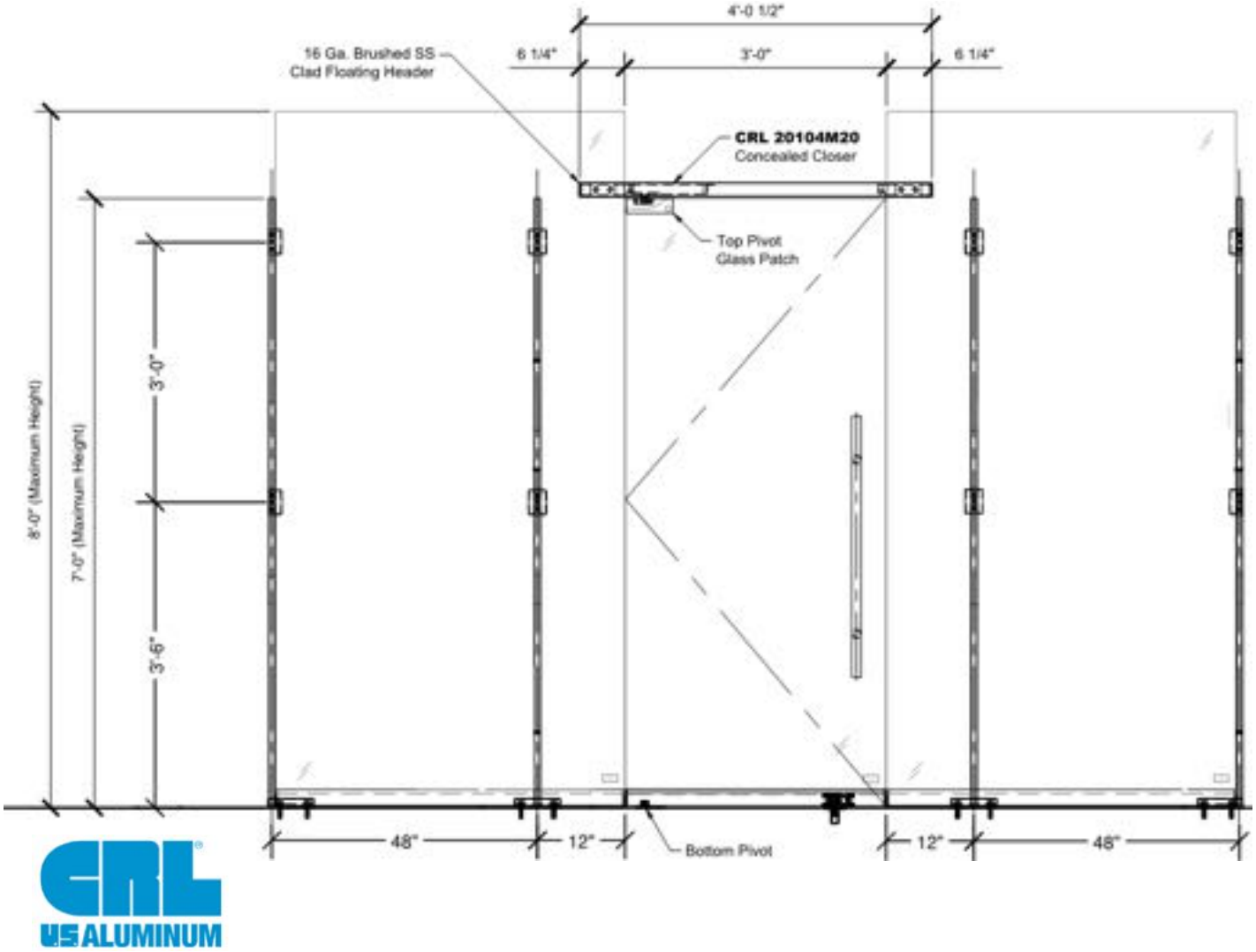
Klarity System - Swinging Door Layout	Detail Ref.	Sheet No: E2

5 PSF MAXIMUM UNIFORM DESIGN LOAD FOR THE SWINGING DOOR UNIT AS DRAWN; MEETS IBC REQUIREMENTS





CRL US ALUMINUM

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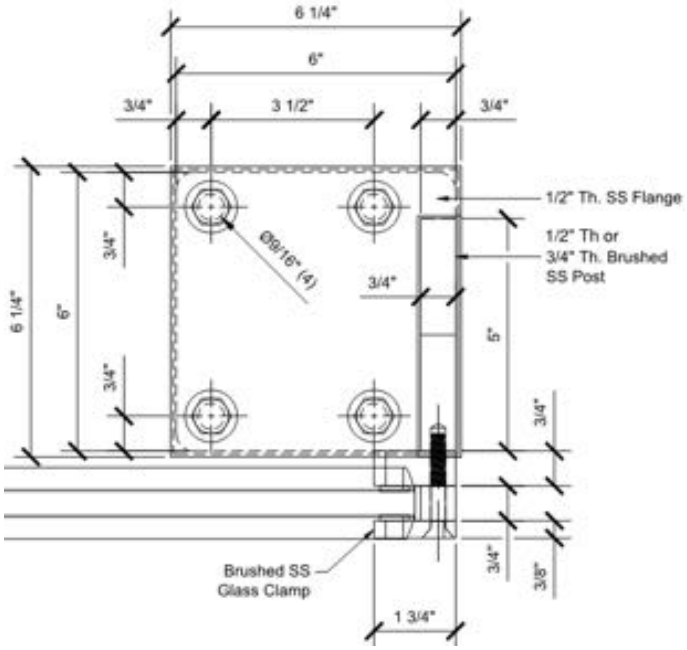
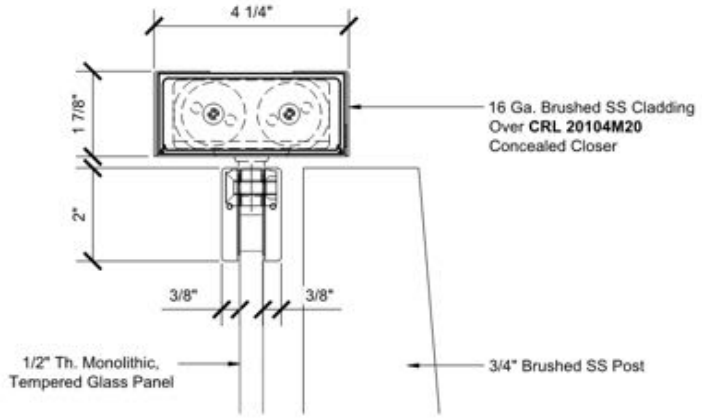
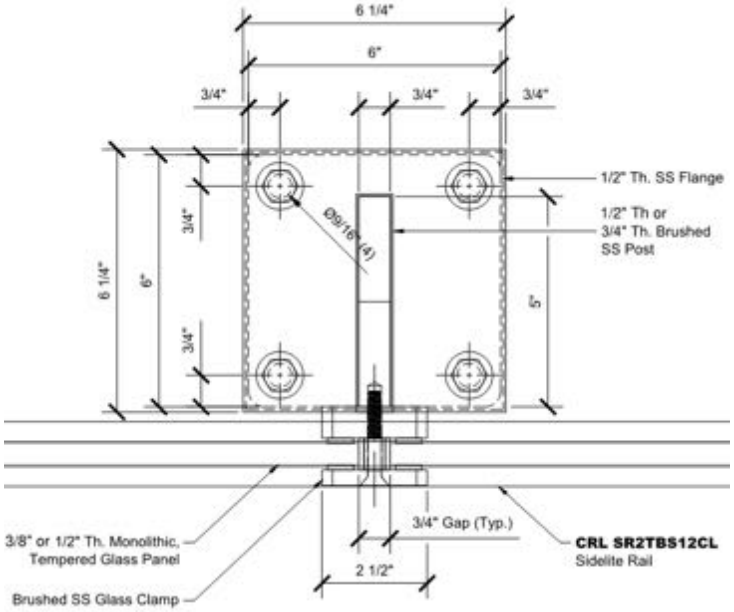
			Engineer: KEP	Sheet No: E2	
			Date: 7/18/19	Rev:	
			Chk By:	Date:	

Klarity System - Swinging Door Layout	Detail Ref.	Sheet No: E2 A



END POST BASE PLATE





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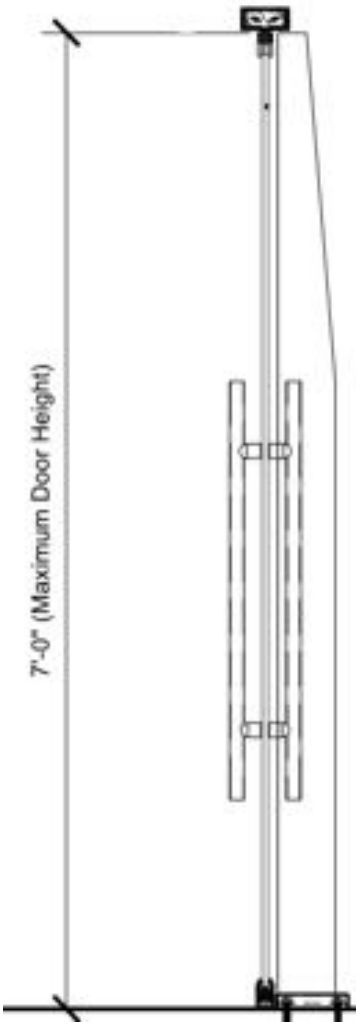

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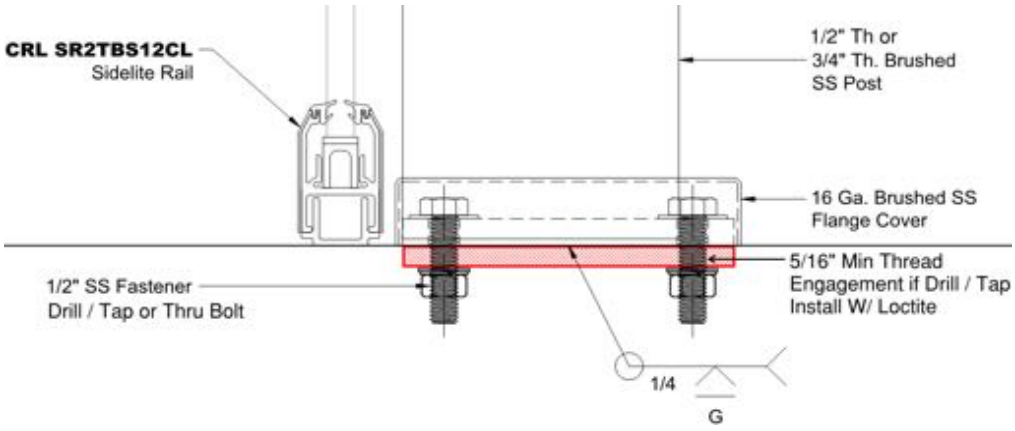
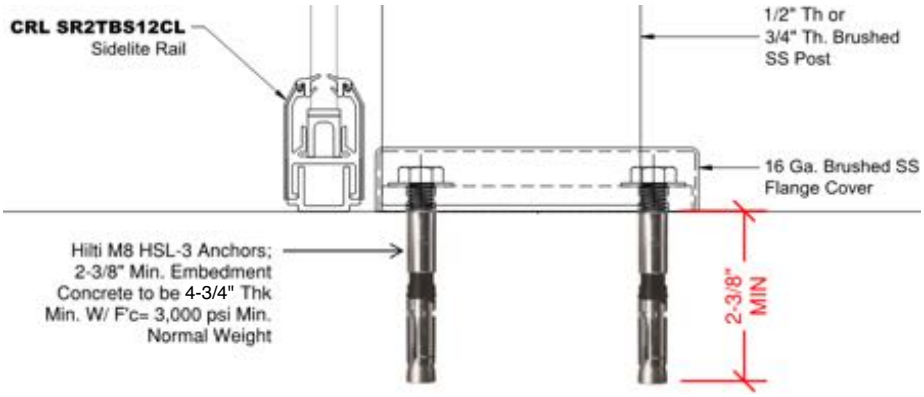


TYPICAL ANCHORAGE AT STEEL



CONCRETE ANCHORAGE - 5 PSF / POST SPACING AS SHOWN ON SHT E2

CRL US ALUMINUM

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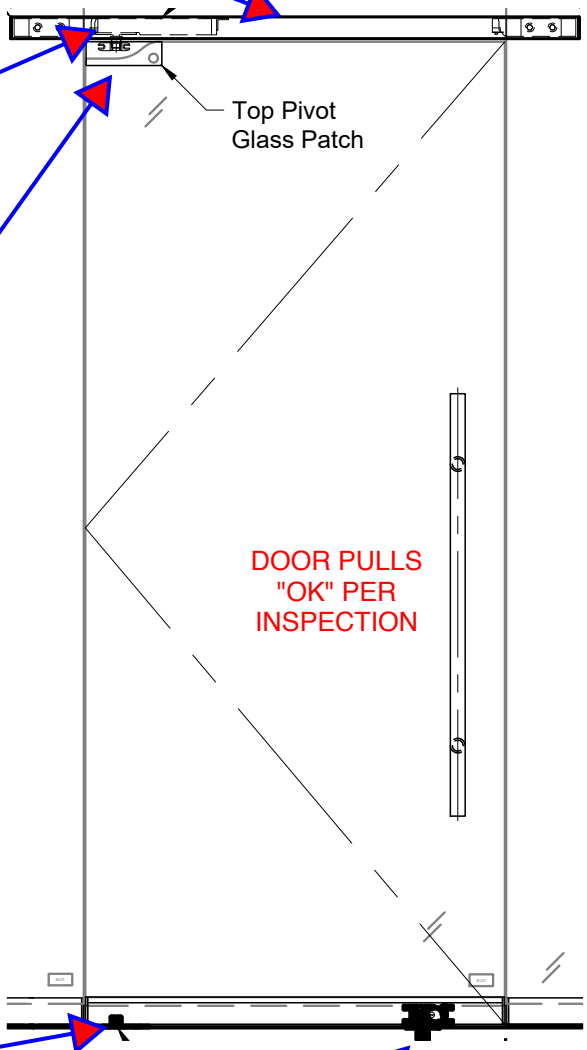
Klarity System - Swinging Door Layout	Detail Ref.	Sheet No: E2 C

USE NHF4BS HEADER

USE 20104M20 CLOSER

USE PH20ABS PIVOT

USE 8010 BP PIVOT



USE 777LP

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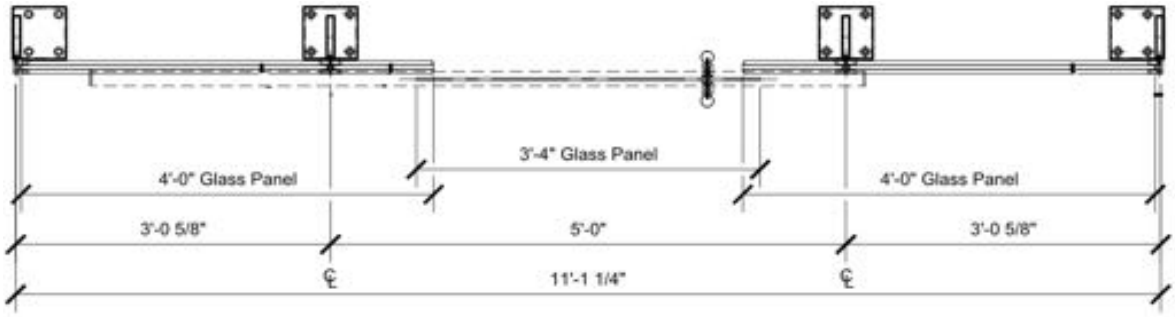
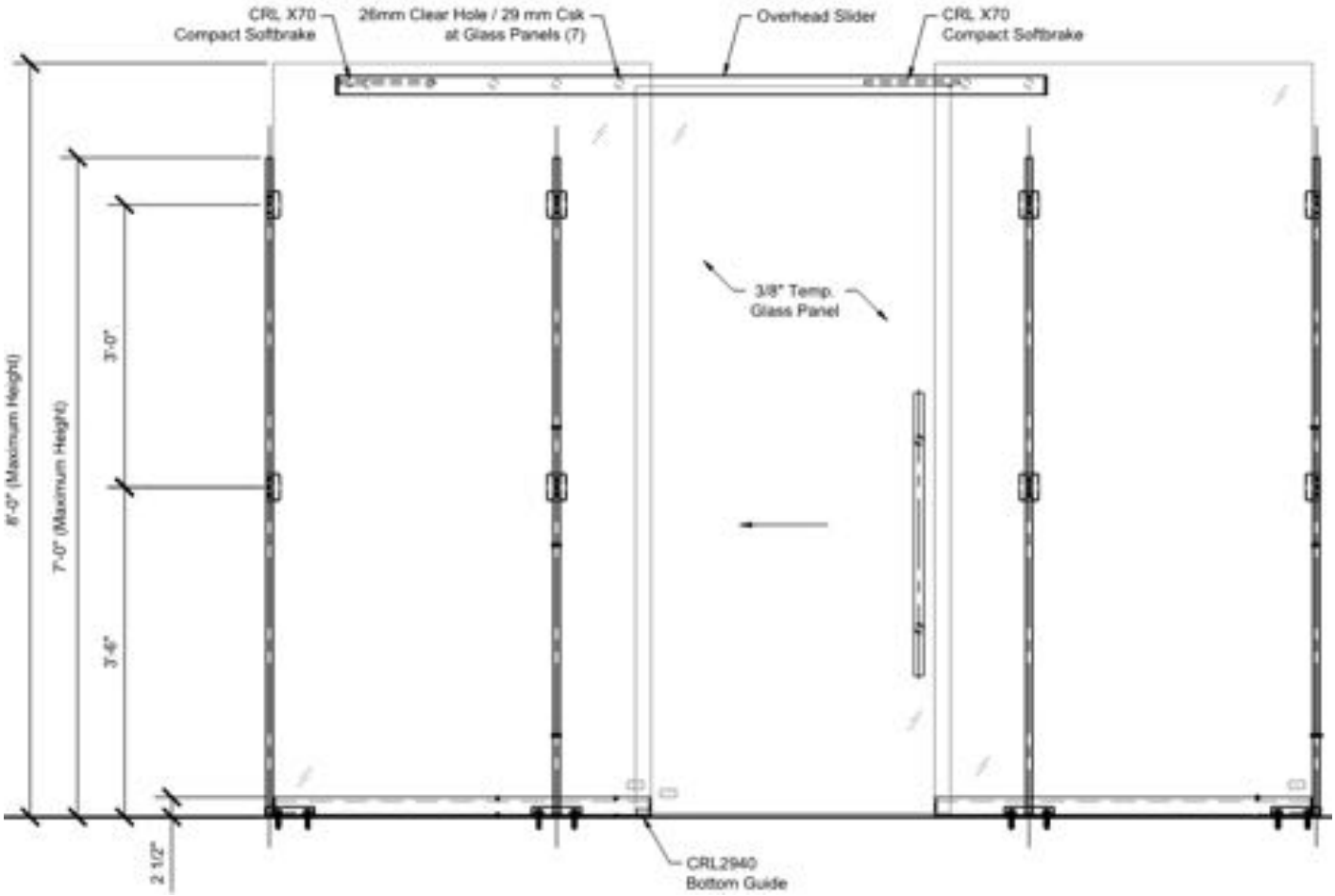
Klarity System - Sliding Door Layout	Detail Ref.	Sheet No: E3





5 PSF MAXIMUM UNIFORM DESIGN LOAD FOR THE SWINGING DOOR UNIT AS DRAWN; MEETS IBC REQUIREMENTS

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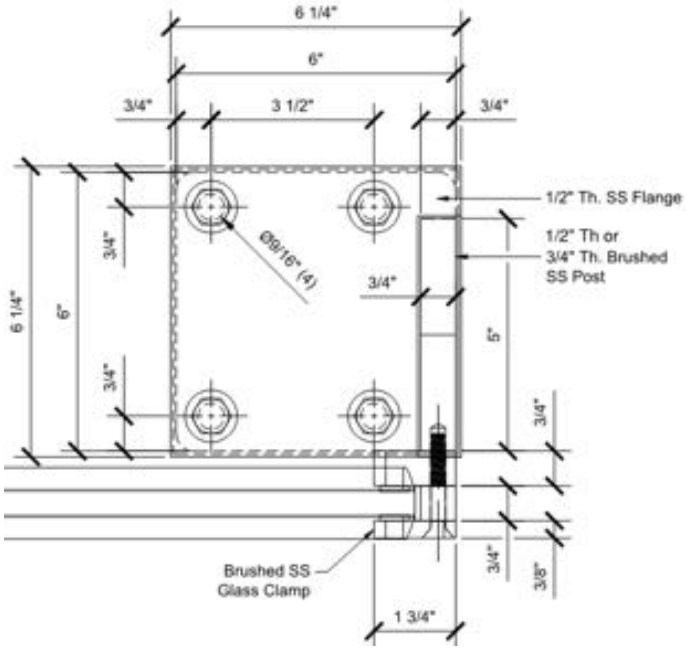
Klarity System - Sliding Door Layout	Detail Ref.	Sheet No: E3 A



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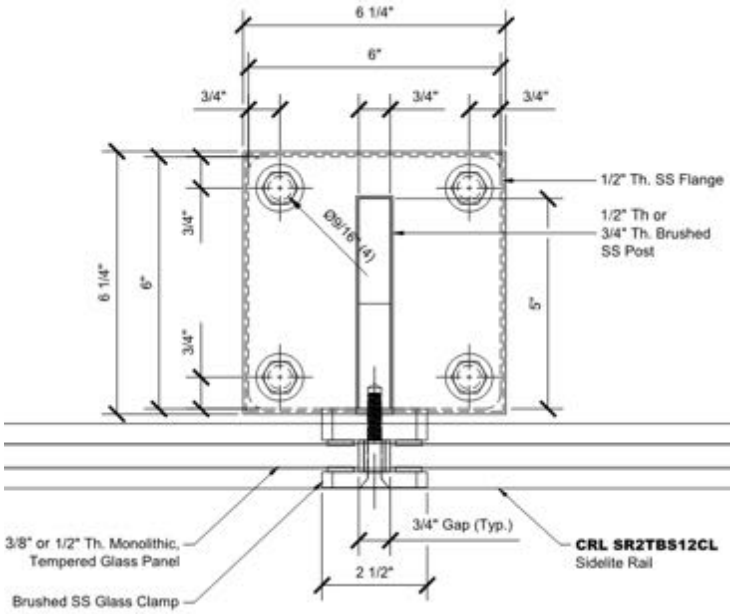
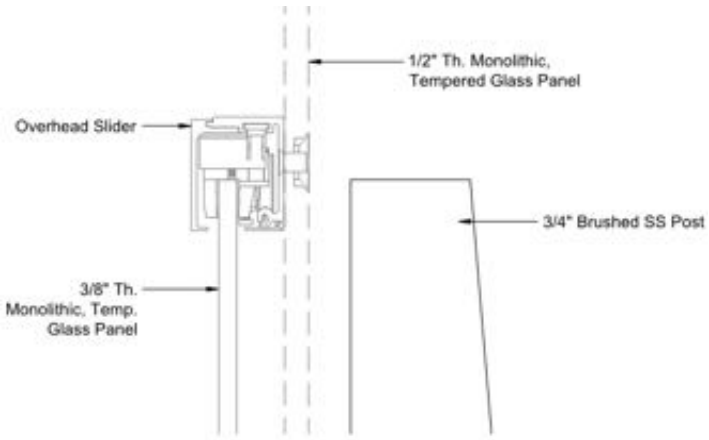
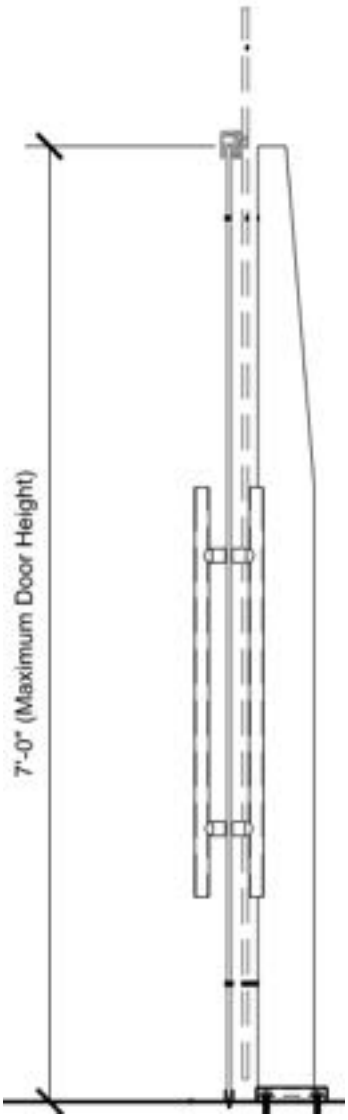
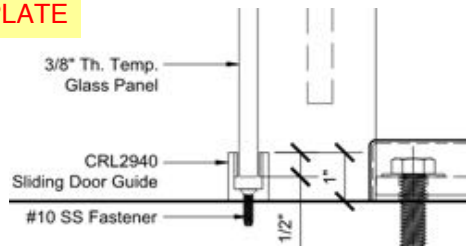


INTERMEDIATE BASE PLATE







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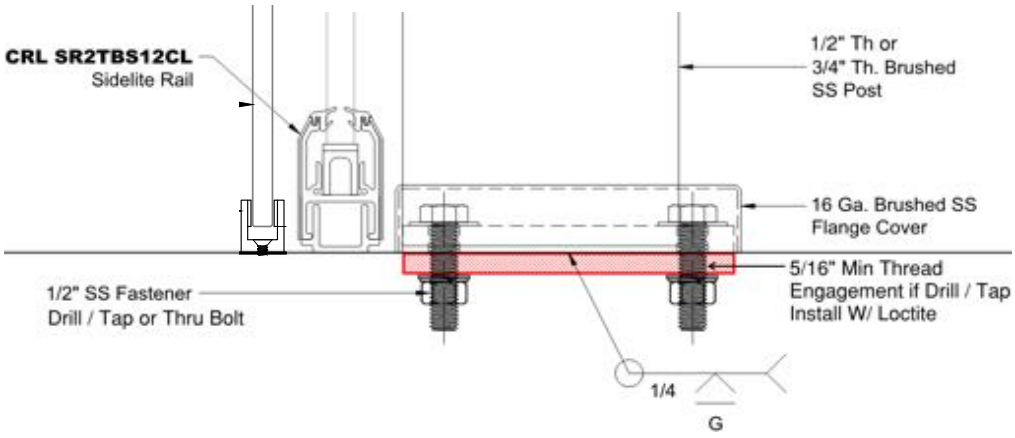
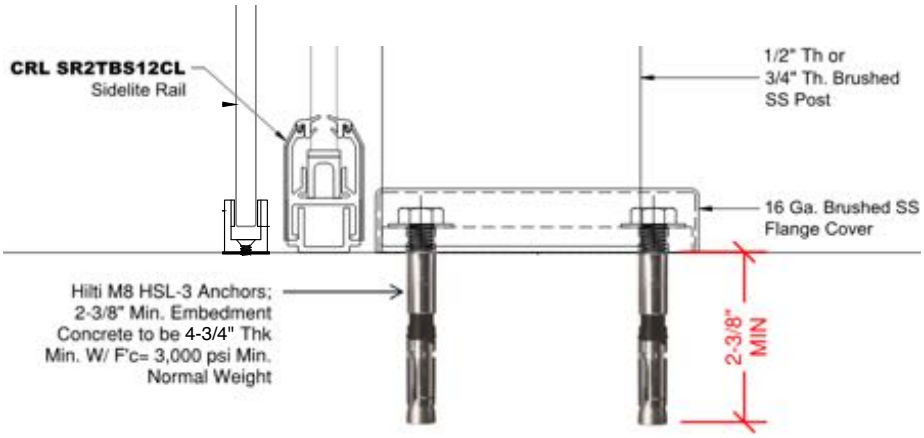
Klarity System - Sliding Door Layout	Detail Ref.	Sheet No: E3 B



TYPICAL ANCHORAGE AT STEEL



CONCRETE ANCHORAGE - 5 PSF / POST SPACING AS SHOWN ON SHT E2

CRL US ALUMINUM

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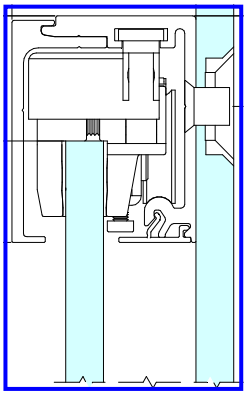
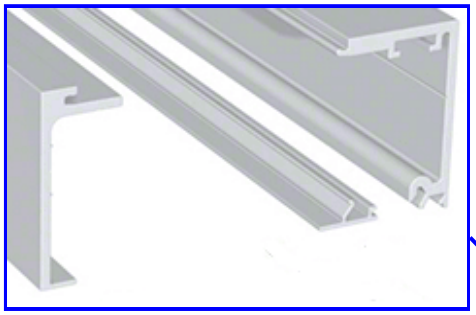
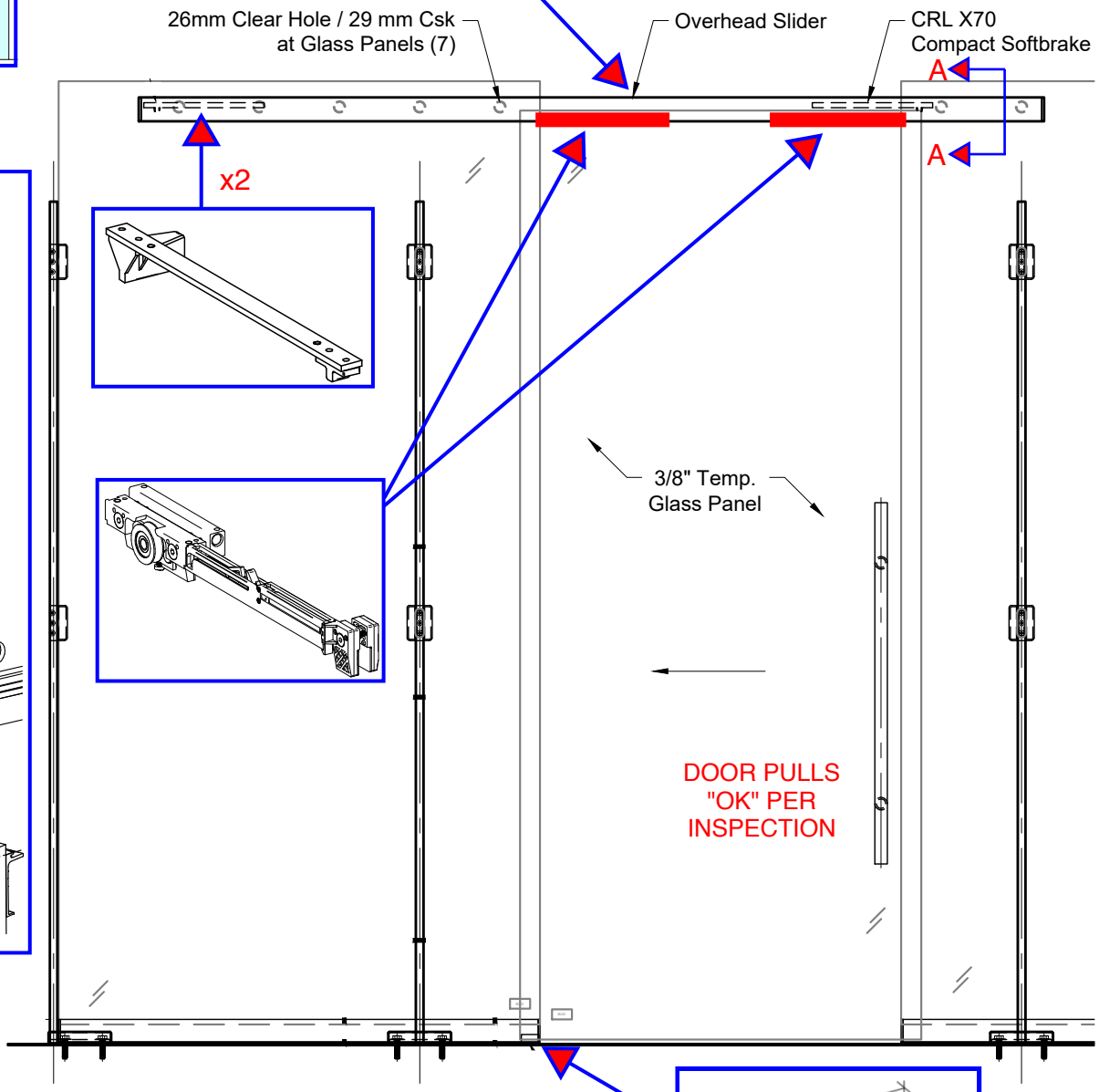
Klarity System - Sliding Door Layout	Detail Ref.	Sheet No: E3 C

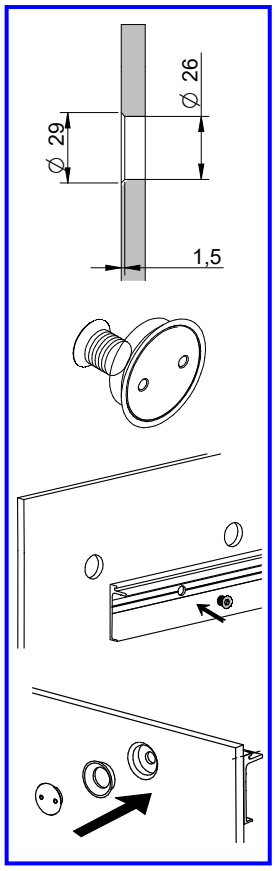


VIEW A-A

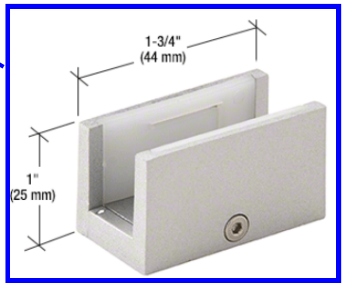


USE CRL COMPACT-X70 SLIDING DOOR KIT





FASTENING DETAIL



NOTE: COMPACT-X70 IS RATED FOR A MAX WORKING CAPACITY OF 150 LB DEAD LOAD; 3/8" THK GLASS DOOR AS SHOWN WEIGHS ~115 LB; ALL HARDWARE SHOWN "OK" PER INSPECTION

CRL US ALUMINUM

RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No: R19-07-001 Engineer: KEP Date: 7/18/19 Chk By:	Sheet No: E3 C Rev: Date:

Klarity System - Post Analysis	Detail Ref.	Sheet No: 1

Post Properties:

$H_p := 96in$

$L_b := 0.5 \cdot H_p = 48 \cdot in$

$d_p := 5in$

$t_p := 0.5in$

$Z_x := 3.125in^3$

$S_x := 2.083in^3$

$C_b := 1.0$

Material Information:

$F_y := 30ksi$

$E_{ss} := 29000ksi$

$\Omega_c := 1.67$

Ix	(in^4)	+7.81
Iy	(in^4)	+0.18
Ixy	(in^4)	+0.
Io	(in^4)	+7.99
rx	(in)	+1.44
ry	(in)	+0.22
ro	(in)	+1.46
Y top	(in)	+2.5
Y bot	(in)	+2.5
Sx top	(in^3)	+3.12
Sx bot	(in^3)	+3.12
X right	(in)	+0.38
X left	(in)	+0.38
Sy right	(in^3)	+0.47
Sy left	(in^3)	+0.47
Zpx	(in^3)	+4.69
Zpy	(in^3)	+0.7

Check Post Capacity: AISC Steel Construction Manual

$\frac{L_b \cdot d_p}{t_p^2} = 960$ $\quad \frac{0.08 \cdot E_{ss}}{F_y} = 77.33$ $\quad \frac{1.9 \cdot E_{ss}}{F_y} = 1836.67$

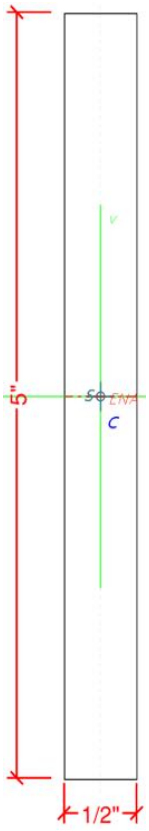
$M_p := F_y \cdot Z_x = 93750 \cdot in \cdot lbf$ $\quad M_y := F_y \cdot S_x = 62490 \cdot in \cdot lbf$

$$M_n := \begin{cases} \left(\min\left(M_p, 1.6 \cdot M_y\right)\right) & \text{if } \frac{L_b \cdot d_p}{t_p^2} \le \frac{0.08 \cdot E_{ss}}{F_y} \\ \min\left[C_b \cdot \left(1.52 - 0.274 \cdot \frac{L_b \cdot d_p}{t_p^2} \cdot \frac{F_y}{E_{ss}}\right) \cdot M_y, M_p\right] & \text{if } \left(\frac{0.08 \cdot E_{ss}}{F_y}\right) < \frac{L_b \cdot d_p}{t_p^2} \le \left(\frac{1.9 \cdot E_{ss}}{F_y}\right) \\ \left[\min\left[\frac{1.9 E_{ss}}{\left(\frac{L_b \cdot d_p}{t_p^2}\right)} \cdot S_x, M_p\right]\right] & \text{otherwise} \end{cases}$$

$M_n = 77981 \cdot in \cdot lbf$

$M_{all1} := \frac{M_n}{\Omega_c} = 46695 \cdot in \cdot lbf$

POST DOES NOT LIMIT DESIGN



Ix	(in^4)	+5.208
Iy	(in^4)	+0.052
Ixy	(in^4)	+0.
Io	(in^4)	+5.26
rx	(in)	+1.443
ry	(in)	+0.144
ro	(in)	+1.451
Y top	(in)	+2.5
Y bot	(in)	+2.5
Sx top	(in^3)	+2.083
Sx bot	(in^3)	+2.083
X right	(in)	+0.25
X left	(in)	+0.25
Sy right	(in^3)	+0.208
Sy left	(in^3)	+0.208
Zpx	(in^3)	+3.125
Zpy	(in^3)	+0.312

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Project Description:

Klarity System R&D Calcs

Job No:		R19-07-001	
Engineer:	KEP	Sheet No:	1
Date:	7/18/19	Rev:	
Chk By:		Date:	

Klarity System - Post Analysis	Detail Ref.	Sheet No: 1 A

Check Weld Capacities: (Single Vee Corner Welds)

$F_u := 80000\,psi$ ***308 Filler*** $\Omega := 2.7$

Typical Interior Posts

$b_w := 0.5\,in$ $d_w := 5\,in$ $t_w := 0.1875\,in$

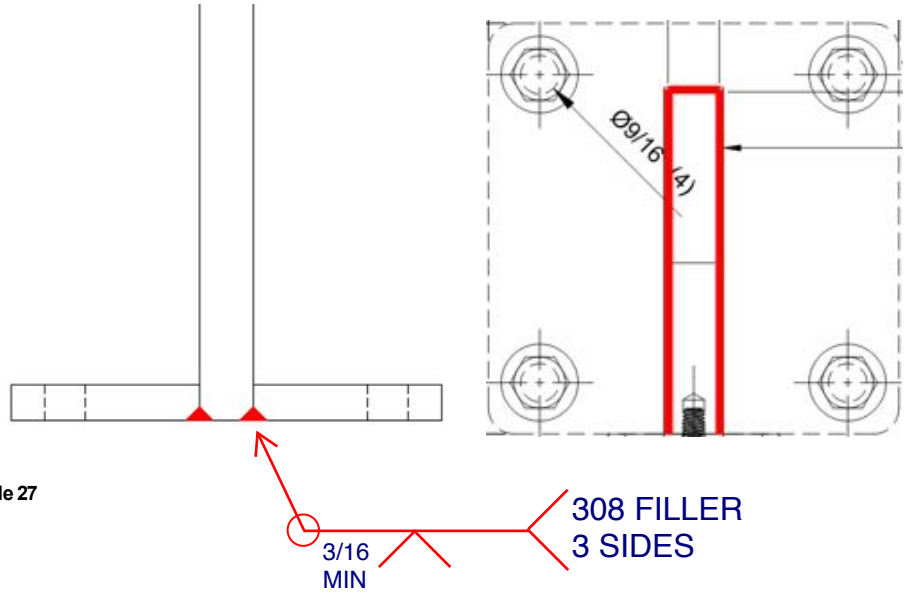
$$S_{w1} := \left(\frac{2 \cdot b_w \cdot d_w + d_w^2}{3}\right) \cdot t_w = 1.88 \cdot in^3$$

$$S_{w2} := \left[\frac{d_w^2 \cdot (2 \cdot b_w + d_w)}{3 \cdot (b_w + d_w)}\right] \cdot t_w = 1.7 \cdot in^3$$

$$F_w := \frac{0.6 \cdot F_u}{2.7} = 17778\,psi$$ ⇐= AISC Deisgn Guide 27

$M_{WInt} := \min(S_{w1}, S_{w2}) \cdot F_w = 30303 \cdot in \cdot lbf$

$M_{all2} := M_{WInt} = 30303 \cdot in \cdot lbf$ ***WELD LIMITS DESIGN @ INTERIOR POSTS***



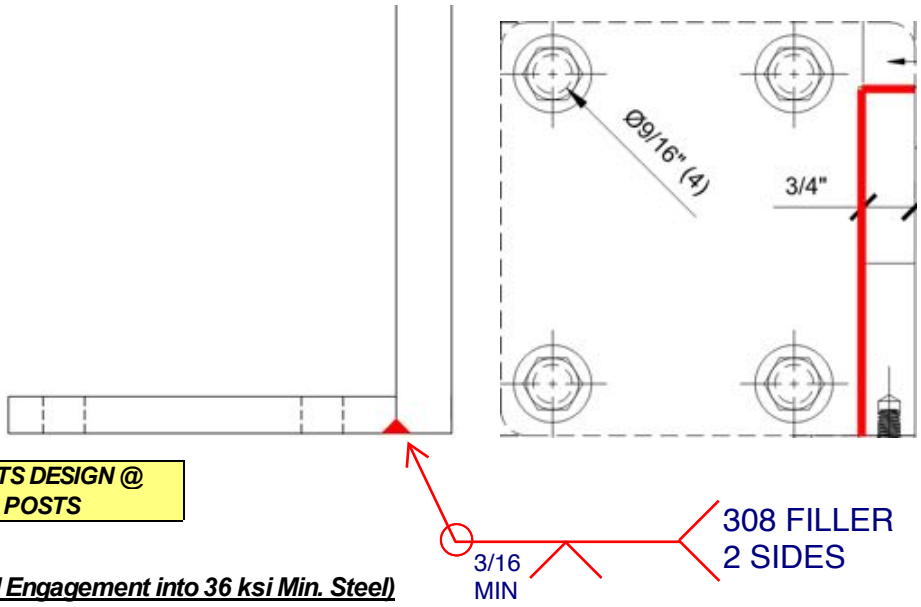
Typical End Posts

$$S_{w3} := \left(\frac{4 \cdot b_w \cdot d_w + d_w^2}{6}\right) \cdot t_w = 1.09 \cdot in^3$$

$$S_{w4} := \left[\frac{d_w^2 \cdot (4 \cdot b_w + d_w)}{6 \cdot (2 \cdot b_w + d_w)}\right] \cdot t_w = 0.91 \cdot in^3$$

$M_{WEnd} := \min(S_{w3}, S_{w4}) \cdot F_w = 16204 \cdot in \cdot lbf$

$M_{all3} := M_{WEnd} = 16204 \cdot in \cdot lbf$ ***WELD LIMITS DESIGN @ END POSTS***



Check Bolt Capacities: (Min. 1/4" Thread Engagement into 36 ksi Min. Steel)

$D_{PL} := 6\,in$ *Depth of Plate* $D_{ED} := 0.75\,in$ *Dist From Edge of Plate* $d := 0.5\,in$ *Bolt Dia.* $n := 13\,in^{-1}$ $t := 0.3125\,in$ *Thickness*

$$T_{Bmax} := (t - 0.25\,in) \cdot \left(3 \cdot n \cdot 0.086\,in^2 \cdot \frac{58\,ksi}{3 \cdot \sqrt{3}}\right) + (0.375\,in - t) \cdot \left(1.7 \cdot d \cdot \frac{58\,ksi}{3}\right) = 3367\,lbf$$

$M_{all4} := 2 \cdot T_{Bmax} \cdot (D_{PL} - D_{ED}) = 35353 \cdot in \cdot lbf$ *INT Post*

$M_{all5} := T_{Bmax} \cdot (D_{PL} - D_{ED}) = 17676 \cdot in \cdot lbf$ *END Post*

DRILL / TAP BOLT DOES NOT LIMIT DESIGN

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Project Description: **Klarity System R&D Calcs**

Job No:		R19-07-001	
Engineer:	KEP	Sheet No:	1 A
Date:	7/18/19	Rev:	
Chk By:		Date:	

Klarity System - Glass Analysis	Detail Ref.	Sheet No: 2

Inputs:

$L := 60\,in = 1524\,mm$ Length of Glass

$t := 0.375\,in = 9.52\,mm$ Overall thickness of Glass

Use 3/8" or 1/2" Thick Fully Tempered Glass Panels

Maximum Panel Size : 60" x 96"

Results from SJ Mepla:

$\Delta := 7.92\,mm = 0.31\,in$ Maximum Deflection

$Stress := 16.82\,\frac{N}{mm^2}$ Maximum Stress

Reference Sheets 2A-2D for SJ Mepla Glass Report

Glass Type:	*Probability of Breakage:*	*Load Type:*
☑ Fully Tempered	☑ < 1/1000	☑ Uniform/Point Load
☐ Heat Strengthened	☐ 1/1000	☐ 50 PLF
☐ Annealed	☐ 8/1000	

Calculations: *All Calculations Below This Line Are Automatic*

Check Deflection:

$\Delta_{meet} := \frac{L}{\Delta} = 192$ GLASS MEETS L / 192 DEFLECTION CRITERIA

SILICONE_AT_JOINTS = "NOT REQUIRED"

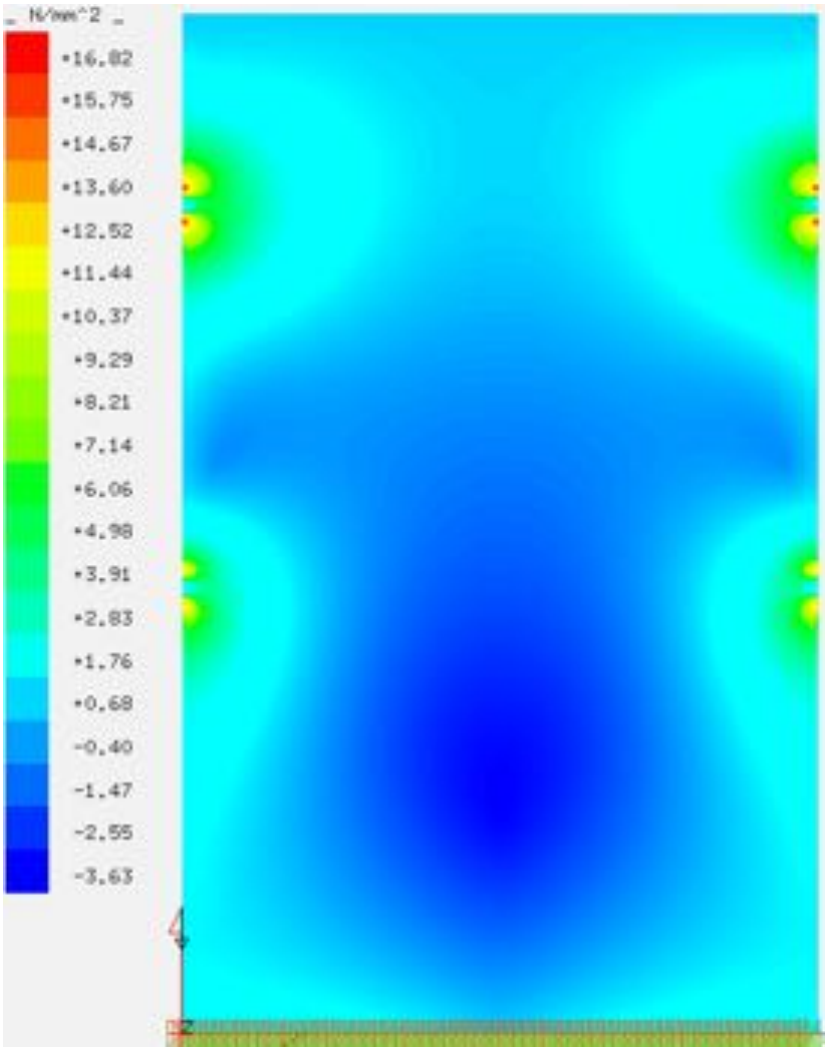
DEFLECTION = "OK"

Check Stress: (Per GANA Glazing Manual 2010)

$f_b := Stress = 16.82 \cdot \frac{N}{mm^2}$ $f_b = 2440$ psi

$F_b = 41.37 \cdot \frac{N}{mm^2}$ $F_b = 6000$ psi

$STRESS := \begin{cases} \text{"OK"} & \text{if } f_b \le F_b \\ \text{"FAIL"} & \text{otherwise} \end{cases}$ STRESS = "OK"



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			Engineer: KEP	Sheet No: 2
			Date: 7/18/19	Rev:
Template: REI-MC-5403			Chk By:	Date:

SJ MEPLA Calculation protocol:

Geometry:

Edge	Borderpoint mm	Borderpoint mm	Arccenter mm	Arccenter mm	Direction of rotation +/-
1	0.00	0.00			
2	1524.00	0.00			
3	1524.00	2438.40			
4	0.00	2438.40			

Supports:

Edge supports:

Edge	Type of supports
1	w,u,v : fixed - φ,θ : free (simply supported and fixed in plane direction)

Point fixings:

Position of point fixings:

Reference	Position x mm	Position y mm	Position z mm	Spring rigidities C_x N/mm	C_y N/mm	C_z N/mm	C_φ Nmm/rad	C_θ Nmm/rad
1	1524.00	1981.20	-10.00	0.000e+00	0.000e+00	1.000e+04	0.000e+00	0.000e+00
1	1524.00	1067.00	-10.00	0.000e+00	0.000e+00	1.000e+04	0.000e+00	0.000e+00
1	0.00	1981.20	-10.00	0.000e+00	0.000e+00	1.000e+04	0.000e+00	0.000e+00
1	0.00	1067.00	-10.00	0.000e+00	0.000e+00	1.000e+04	0.000e+00	0.000e+00

Kind of point fixing:

Reference	Type	Width Disk mm	Depth Disk mm	E-modul Shim N/mm²	E-modul Edge N/mm²	Thickn. Shim mm	thickn. Edge mm
1	4	88.90	22.40	500.00	500.00	3.00	3.00

The point fixings of typ 3, 4 or 7 are torsion proof fixed around the z-axis.

Point fixing reference:

Reference	Manufactor/Name
1	ClampFixing angular

Contact settings:

Without contact approaches between bush resp. edgeprotection and glass

Without contact approaches between shim and glass

Layers:

Layer order:

Package	Layer	Description
1	1	Glass, heat toughened

Mechanical properties:

Package	Layer	E-mod. N/mm²	ν	Thickness mm	Density kg/m³	αt 1/K	ΔT K
1	1	71705.00	0.23	10.00	2550.00	1.0000e-05	0.00

Loads:

Face loads:
- constant distributed:

Package	pressure N/mm²
1	-4.79000e-04

Dead weight:
Inclination of pane: 90.00° degree
Direction vector of gravity acceleration [g = 9.81 m/s²]:

ex	ey	ez
0.00000	-1.00000	0.00000

Calculation approaches:
small deflections, linear
static calculation

Characteristics of the finite element mesh:
Element size : 25.0 mm
Number of elements : 6728
Number of nodes : 25645 (per package)
Number of unknown : 127862

Calculation results:

Minimum and maximum displacements w:

Package	- Position- x mm	y mm	Displacement w mm	
1	762.00	2438.40	-7.92	(min)
	0.00	1885.36	0.09	(max)

Maximum principal stress:

Package	Layer	x mm	y mm	σ N/mm²	σ (max) N/mm²
1	1 (top)	2.53	1942.67	16.82	16.82
	(bottom)	759.21	2099.03	8.30	

Spring forces and deformations at base point of point fixing:

u mm	v mm	w mm	φ rad	θ rad	Fx N	Fy N	Fz N
(x: 1524.00 y: 1981.20)							
0.20	-5582492.02	-0.04	-1.348e-02	2.425e-03	0.00	-0.00	-365.62
(x: 1524.00 y: 1067.00)							
0.15	-4867209.26	-0.03	-1.011e-02	-1.291e-03	0.00	-0.00	-338.09
(x: 0.00 y: 1981.20)							
-0.20	798313670.43	-0.04	1.348e-02	2.425e-03	-0.00	0.00	-365.62
(x: 0.00 y: 1067.00)							
-0.15	693152434.37	-0.03	1.011e-02	-1.291e-03	-0.00	0.00	-338.09

LOADS: 5 PSF; 60" SPAN

$F_{T\_CL} := 183.2N = 41.18lbf$

$F_{B\_CL} := 169.4N = 38.08lbf$

LOADS: 10 PSF; 54" SPAN

$F_{T\_CL} := 324N = 72.84lbf$

$F_{B\_CL} := 313.5N = 70.48lbf$

LOADS: 10 PSF; 48" SPAN

$F_{T\_CL} := 284N = 63.85lbf$

$F_{B\_CL} := 286N = 64.3lbf$

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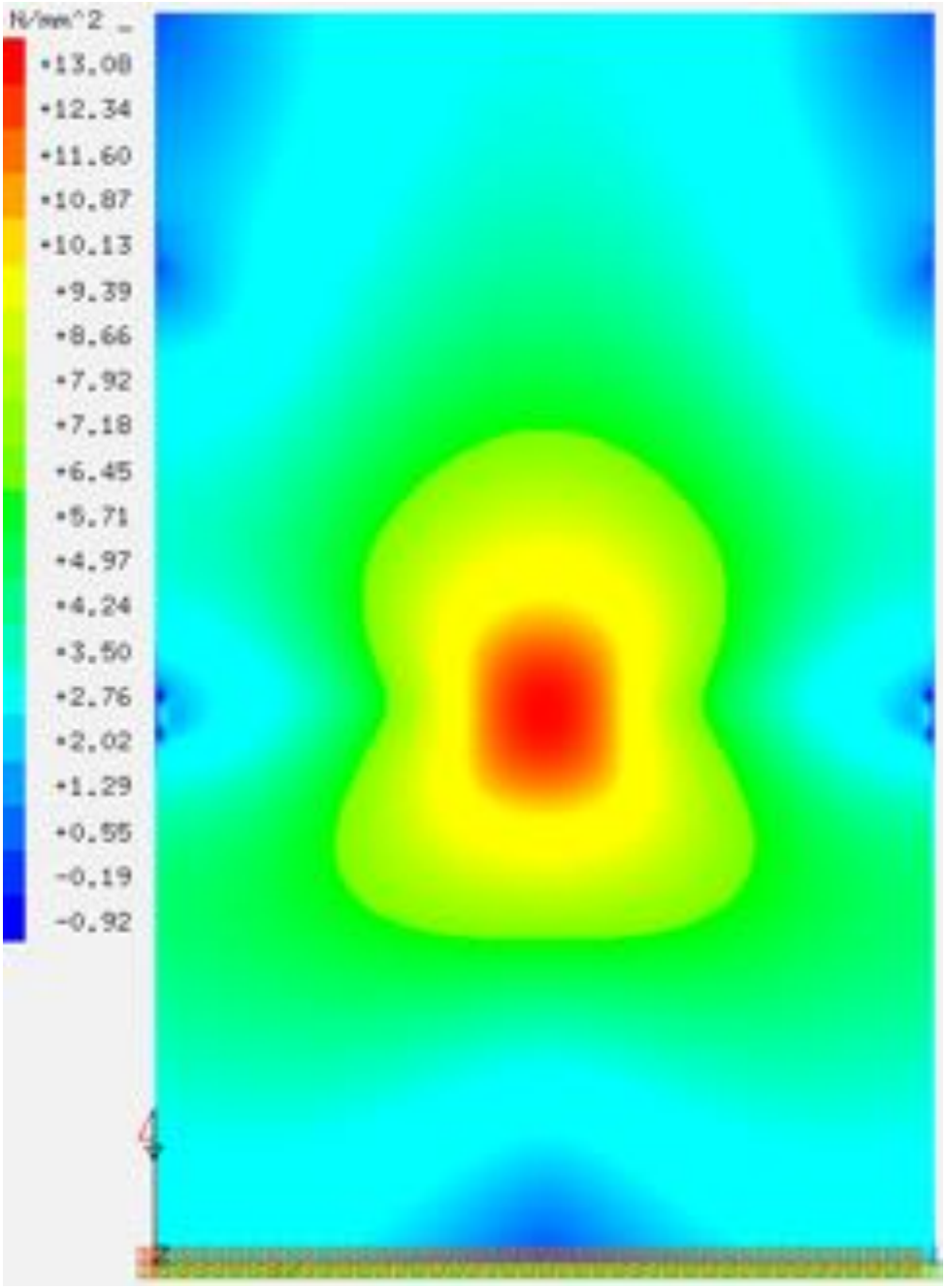
200 LB LOAD AT CENTER OF GLASS

Klarity System - Glass Analysis	Detail Ref.	Sheet No: 2 C



Package	x mm	y mm	w mm	
1	762.04	1106.08	-5.45	(min)
	1524.00	2438.40	0.71	(max)

Maximum principal stress:

Package	Layer		x mm	y mm	σ N/mm²	σ (max) N/mm²
1	1	(top)	3.90	1028.48	12.12	13.08
		(bottom)	764.91	1078.11	13.08	

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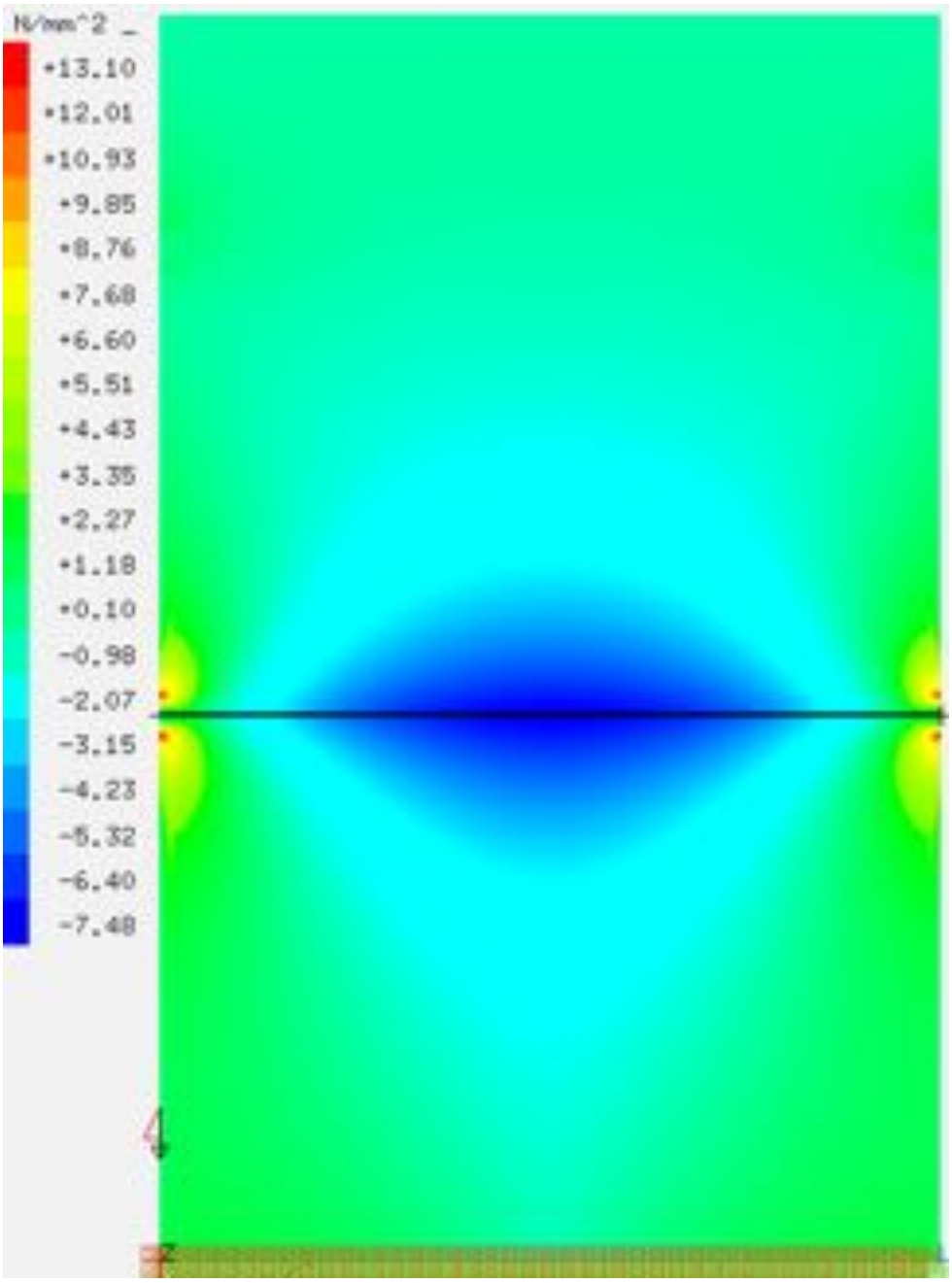
Project Description: **Klarity System R&D Calcs**

Job No:	R19-07-001		
Engineer:	KEP	Sheet No:	2 C
Date:	7/18/19	Rev:	
Chk By:		Date:	



Package	x mm	y mm	w mm	
1	762.05	1093.51	-4.34	(min)
	1524.00	2438.40	0.65	(max)

Maximum principal stress:

Package	Layer		x mm	y mm	σ N/mm²	σ (max) N/mm²
1	1	(top)	1520.10	1028.48	13.10	13.10
		(bottom)	739.50	1058.63	7.63	

Klarity System - Anchorage to Steel	Detail Ref.	Sheet No: 3

5'-0" Max Post Spacing @ 5 PSF:

$PS := 60in$ *Post Spacing*

$H_g := 96in$ *Height of Glass*

$d_1 := 78in$ *Height of Upper Clamp*

$d_2 := 42in$ *Height of Lower Clamp*

DESIGN LOADS:

$LL_1 := 5psf$ *Uniform Load per Code*

$LL_2 := 250lbf$ *Optional Live Load*

$P_1 := (2)\cdot 41.2lbf = 82.4\,lbf$ ***<== From Sht 2B; (x2) for Intermediate Post***

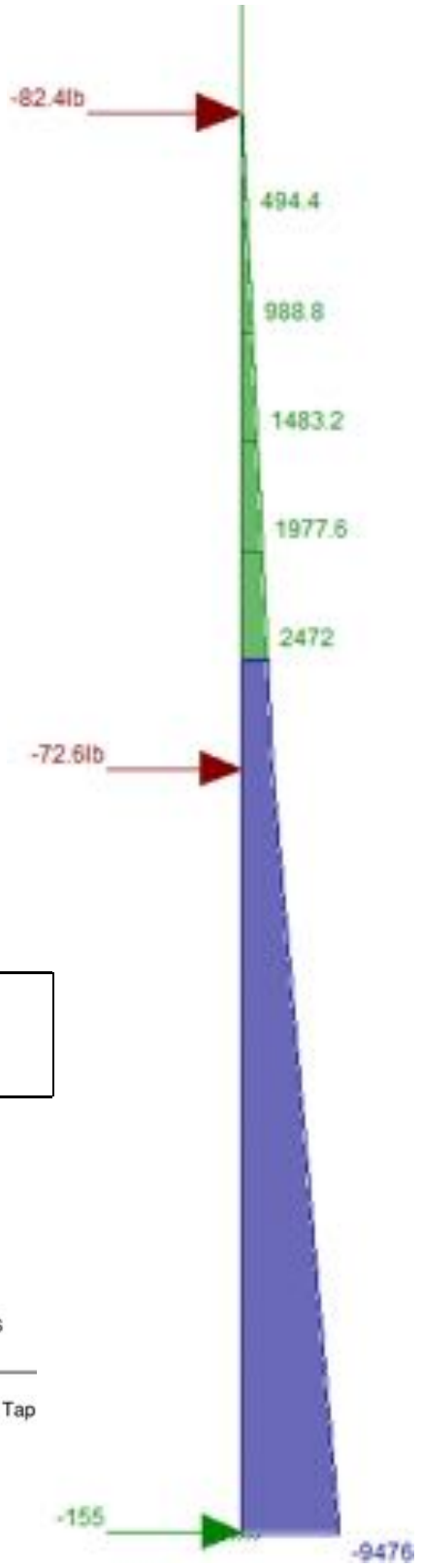
$P_2 := (2)\cdot 38.1lbf = 76.2\,lbf$ ***<== From Sht 2B; (x2) for Intermediate Post***

$M_1 := P_1\cdot d_1 + P_2\cdot d_2 = 9628\cdot in\cdot lbf$ $M_2 := 9476in\cdot lbf$ ***<== RISA Model***

$M_3 := LL_2\cdot d_2 = 10500\cdot in\cdot lbf$

$M_{max} := \max(M_1, M_2, M_3) = 10500\cdot in\cdot lbf$

$V_{max} := \max(LL_2, LL_1\cdot PS\cdot H_g) = 250\,lbf$



Chk Thru Bolts or Drill/Tap Bolts (5/16" Min. Thread Engagement):

$BP := 6in$ *Base PL Depth* $ED := 0.75in$ *Distance to Edge of Plate*

$d := 0.5in$ *Bolt Dia.* $n := 13in^{-1}$ $t := 0.3125in$ *Thickness*

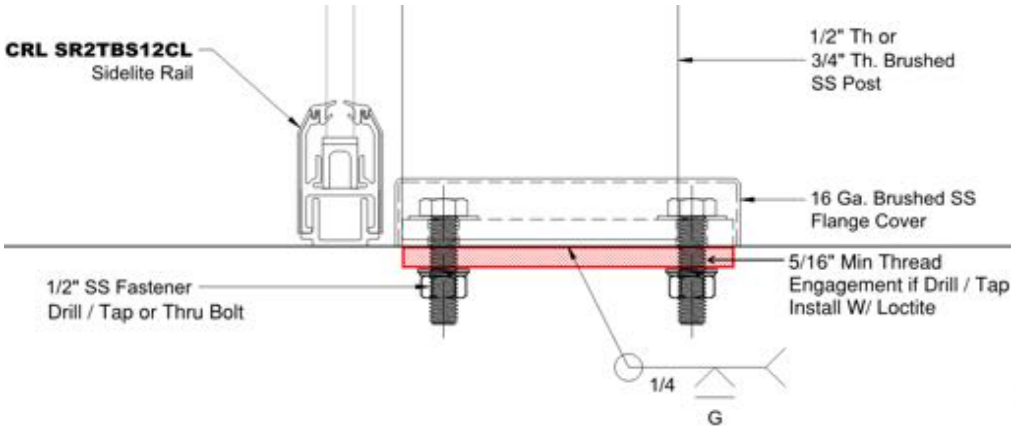
$V_b := \frac{V_{max}}{4} = 62.5\,lbf$ $V_{all} := 2984lbf$

$T_b := \frac{M_{max}}{(BP - ED)\cdot 0.85\cdot 2} = 1176\,lbf$

$T_{all} := (t - 0.25in)\cdot\left(3\cdot n\cdot 0.086in^2\cdot\frac{58ksi}{3\cdot\sqrt{3}}\right) + (0.375in - t)\cdot\left(1.7\cdot d\cdot\frac{58ksi}{3}\right) = 3367\,lbf$

$I_b := \left(\frac{V_b}{V_{all}}\right)^2 + \left(\frac{T_b}{T_{all}}\right)^2 = 0.12$

Use (4) - 1/2" Dia. S.S. Thru Bolts or Drill / Tap
300 Series S.S., Cond. CW, Fu= 100 ksi Min
or SAE Grade 5, Fu= 120 ksi Min
Min. 5/16" thread engagement to A36 steel or Better



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4'-6" Max Post Spacing @ 10 PSF:

$PS := 54in$ *Post Spacing*

$H_g := 96in$ *Height of Glass*

$d_1 := 78in$ *Height of Upper Clamp*

$d_2 := 42in$ *Height of Lower Clamp*

DESIGN LOADS:

$LL_1 := 10psf$ *Uniform Load per Code*

$LL_2 := 250lbf$ *Optional Live Load*

$P_1 := (2)\cdot 72.9lbf = 145.8\,lbf$ ***<== From Sht 2B; (x2) for Intermediate Post***

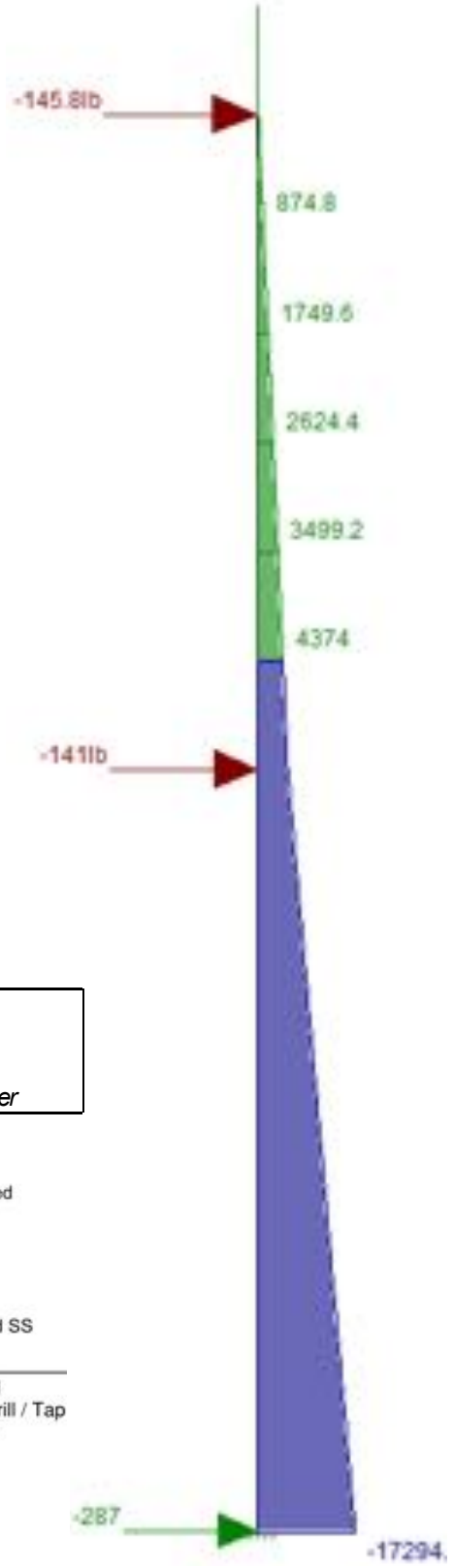
$P_2 := (2)\cdot 70.5lbf = 141\,lbf$ ***<== From Sht 2B; (x2) for Intermediate Post***

$M_1 := P_1\cdot d_1 + P_2\cdot d_2 = 17294\cdot in\cdot lbf$

$M_2 := LL_2\cdot d_2 = 10500\cdot in\cdot lbf$

$M_{max} := \max(M_1, M_2) = 17294\cdot in\cdot lbf$

$V_{max} := \max(LL_2, LL_1\cdot PS\cdot H_g) = 360\,lbf$



Chk Thru Bolts or Drill/Tap Bolts (5/16" Min. Thread Engagement):

$BP := 6in$ *Base PL Depth* $\quad ED := 0.75in$ *Distance to Edge of Plate*

$d := 0.5in$ *Bolt Dia.* $\quad n := 13in^{-1}$ $\quad t := 0.3125in$ *Thickness*

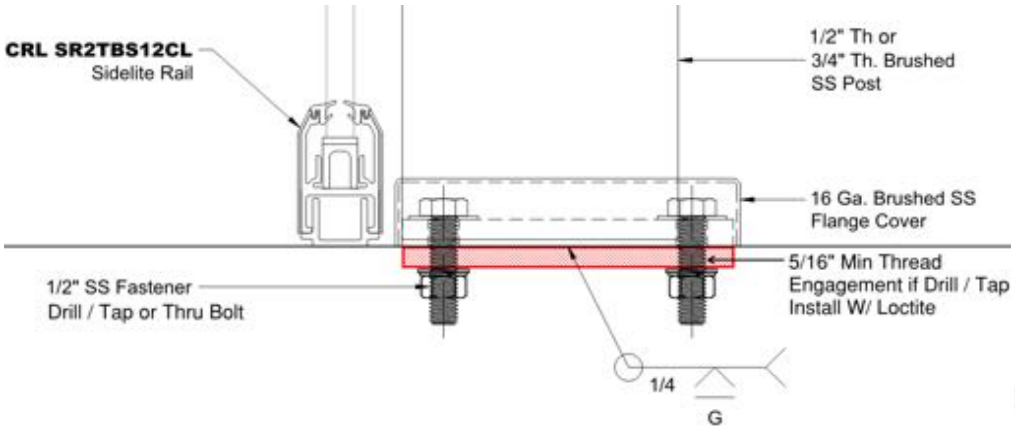
$V_b := \frac{V_{max}}{4} = 90\,lbf$ $\quad V_{all} := 2984lbf$

$T_b := \frac{M_{max}}{(BP - ED)\cdot 0.85\cdot 2} = 1938\,lbf$

$T_{all} := (t - 0.25in)\cdot\left(3\cdot n\cdot 0.086in^2\cdot\frac{58ksi}{3\cdot\sqrt{3}}\right) + (0.375in - t)\cdot\left(1.7\cdot d\cdot\frac{58ksi}{3}\right) = 3367\,lbf$

$I_b := \left(\frac{V_b}{V_{all}}\right)^2 + \left(\frac{T_b}{T_{all}}\right)^2 = 0.33$

Use (4) - 1/2" Dia. S.S. Thru Bolts or Drill / Tap
300 Series S.S., Cond. CW, Fu= 100 ksi Min
or SAE Grade 5, Fu= 120 ksi Min
Min. 5/16" thread engagement to A36 steel or Better



Klarity System - Concrete Anchors (60" Span / 5 PSF)	Detail Ref.	Sheet No: 4

Worst Case Loads for 5'-0" Max Post Spacing:

$PS := 60in$ *Post Spacing*

$H_g := 96in$ *Height of Glass*

$d_1 := 78in$ *Height of Upper Clamp*

$d_2 := 42in$ *Height of Lower Clamp*

DESIGN LOADS:

$LL_1 := 5psf$ *Uniform Load per Code*

$LL_2 := 250lbf$ *Optional Live Load*

$P_1 := (2)\cdot 41.2lbf = 82.4\,lbf$ ***<== From Sht 2B; (x2) for Intermediate Post***

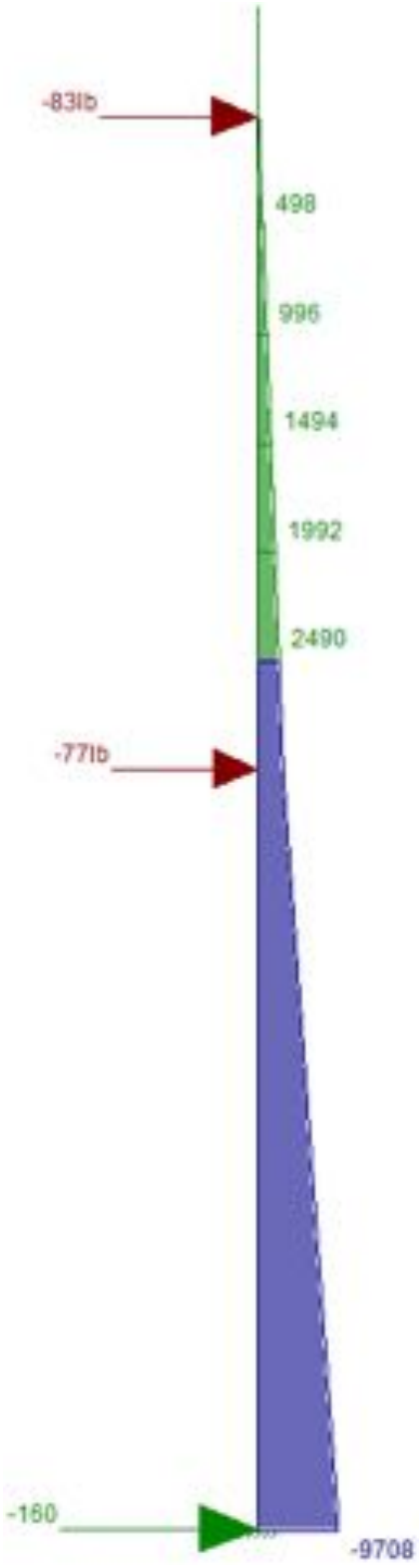
$P_2 := (2)\cdot 38.1lbf = 76.2\,lbf$ ***<== From Sht 2B; (x2) for Intermediate Post***

$M_1 := P_1\cdot d_1 + P_2\cdot d_2 = 9628\cdot in\cdot lbf$ $M_2 := 9708in\cdot lbf$ ***<== RISA Model***

$M_3 := LL_2\cdot d_2 = 10500\cdot in\cdot lbf$

$M_{max} := \max(M_1, M_2, M_3) = 10500\cdot in\cdot lbf$

$V_{max} := \max(LL_2, LL_1\cdot PS\cdot H_g) = 250\,lbf$



Chk Concrete Anchors (f'c= 3,000 psi Min / Normal Weight):

Worst Case Live Load

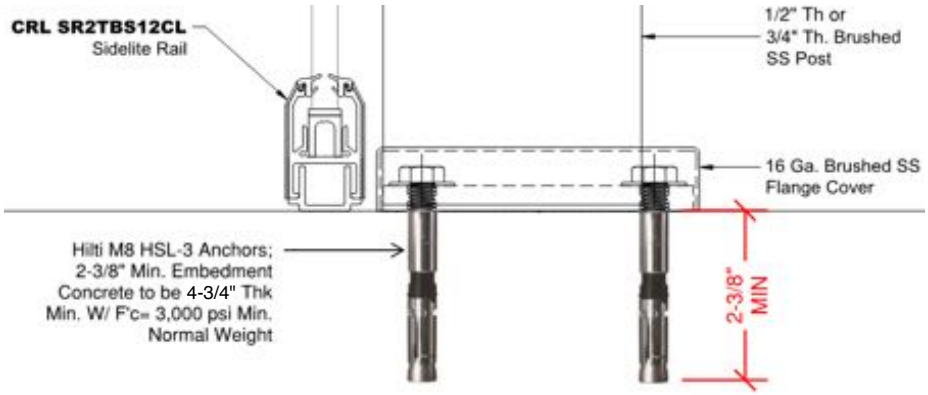
$V_{bLL} := V_{max}\cdot 1.6 = 400\,lbf$ $M_{bLL} := M_{max}\cdot 1.6 = 16800\cdot in\cdot lbf$

*****SEE SHT 4A THRU 4D FOR PROFIS DATA*****

Use (4) Hilti M8 HSL-3 Concrete Anchors
Grade 8.8 Carbon Steel (Interior Applications)

Embedment: 2-3/8" Min.
Edge Distance: +36", Non-Fall Hazard Area
Min. Slab Thickness: 4-3/4"
Concrete Strength: f'c= 3,000 psi, Normal Wt., Cracked

*****Install per Manufacturer's instructions*****



RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No:	R19-07-001	
			Engineer: KEP	Sheet No: 4	
			Date: 7/18/19	Rev:	
			Chk By:	Date:	

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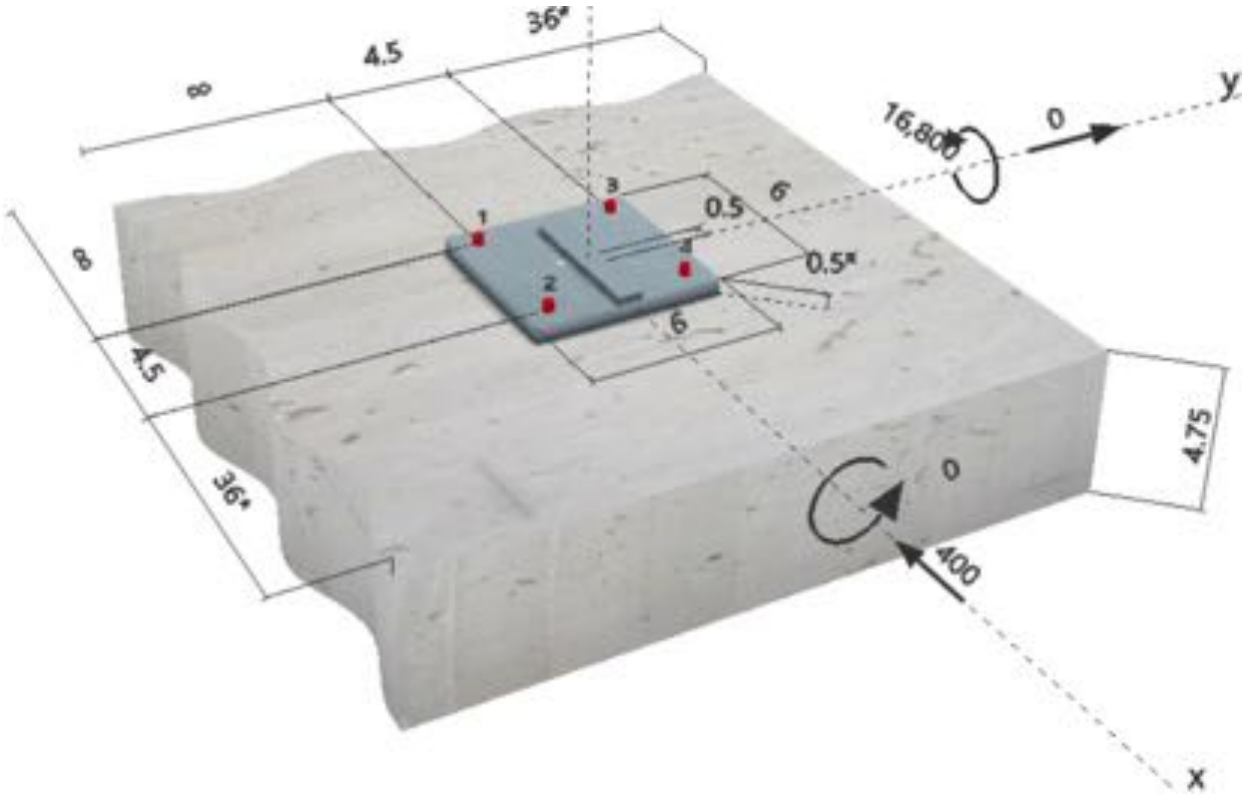
Profis Anchor 2.8.3

Company:	Rice Engineering	Page:	1
Specifier:	KEP	Project:	Klarity Anchors
Address:		Sub-Project I Pos. No.:	Intermediate Anchors
Phone I Fax:	|	Date:	9/11/2019
E-Mail:			

Specifier's comments: 5 PSF - 60" Span

1 Input data

Anchor type and diameter:	**HSL-3 M8**
Effective embedment depth:	$h_{ef,act}$ = 2.362 in., h_{nom} = 2.362 in.
Material:	8.8
Evaluation Service Report:	ESR-1545
Issued I Valid:	4/1/2019 | 3/1/2020
Proof:	Design method ACI 318-11 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 6.000 in. x 6.000 in. x 0.500 in.; (Recommended plate thickness: not calculated
Profile:	Rectangular plates and bars (AISC); (L x W x T) = 5.000 in. x 0.750 in.
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 4.750 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar



Company:	Rice Engineering	Page:	2
Specifier:	KEP	Project:	Klarity Anchors
Address:		Sub-Project I Pos. No.:	Intermediate Anchors
Phone I Fax:	|	Date:	9/11/2019
E-Mail:			

2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	Proof	Load	Capacity	β_N / β_V [%]	Status
Tension	Concrete Breakout Strength	3,424	3,594	96 / -	OK
Shear	Pryout Strength	400	6,330	- / 7	OK

Loading	β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
Combined tension and shear loads	0.953	0.063	1.0	85	OK

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

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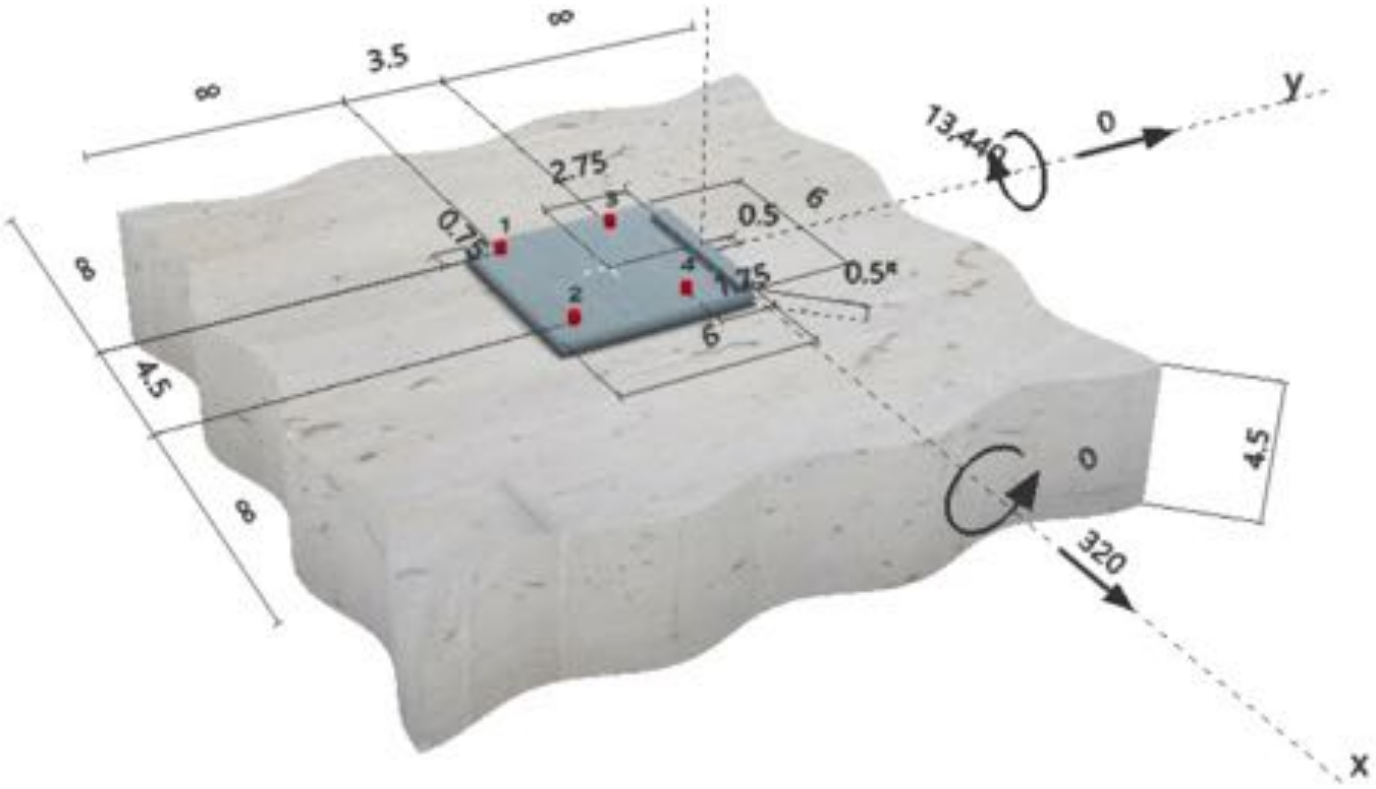
Profis Anchor 2.8.3

Company:	Rice Engineering	Page:	1
Specifier:	KEP	Project:	Klarity Anchors
Address:		Sub-Project I Pos. No.:	End Post Anchors
Phone I Fax:	|	Date:	7/23/2019
E-Mail:			

Specifier's comments: 5 PSF - 60" Span

1 Input data

Anchor type and diameter:	**HSL-3 M8**
Effective embedment depth:	$h_{ef,act}$ = 2.362 in., h_{nom} = 2.362 in.
Material:	8.8
Evaluation Service Report:	ESR-1545
Issued I Valid:	4/1/2019 | 3/1/2020
Proof:	Design method ACI 318-11 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 6.000 in. x 6.000 in. x 0.500 in.; (Recommended plate thickness: not calculated
Profile:	Rectangular plates and bars (AISC); (L x W x T) = 5.000 in. x 0.500 in.
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 4.500 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar



RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No:	R19-07-001	
			Engineer: KEP	Sheet No:	4 C
			Date: 7/18/19	Rev:	
			Chk By:	Date:	

Company:	Rice Engineering	Page:	2
Specifier:	KEP	Project:	Klarity Anchors
Address:		Sub-Project I Pos. No.:	End Post Anchors
Phone I Fax:	|	Date:	7/23/2019
E-Mail:			

2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	**β_N / β_V [%]**	**Status**
Tension	Concrete Breakout Strength	2,744	3,232	85 / -	OK
Shear	Steel Strength	154	4,705	- / 4	OK

Loading	**β_N**	**β_V**	**ζ**	**Utilization $\beta_{N,V}$ [%]**	**Status**
Combined tension and shear loads	0.849	0.106	5/3	79	OK

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

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Klarity System - Concrete Anchors (54" Span, 10 PSF)	Detail Ref.	Sheet No: 5

Worst Case Loads for 4'-6" Max Post Spacing:

$PS := 48in$ *Post Spacing*

$H_g := 96in$ *Height of Glass*

$d_1 := 78in$ *Height of Upper Clamp*

$d_2 := 42in$ *Height of Lower Clamp*

DESIGN LOADS:

$LL := 10psf$ *Max Uniform Pressure*

$P_1 := (2)\cdot 72.84lbf = 145.68\,lbf$ ***<== From SJ Mepla; (x2) for Intermediate Post***

$P_2 := (2)\cdot 70.48lbf = 140.96\,lbf$ ***<== From SJ Mepla; (x2) for Intermediate Post***

$M_1 := P_1\cdot d_1 + P_2\cdot d_2 = 17283\cdot in\cdot lbf$ $M_{max} := M_1 = 17283\cdot in\cdot lbf$

$V_{max} := (P_1 + P_2) = 287lbf$

Chk Concrete Anchors (f'c=3,000 psi Min / Normal Weight):

10 PSF Factored Load

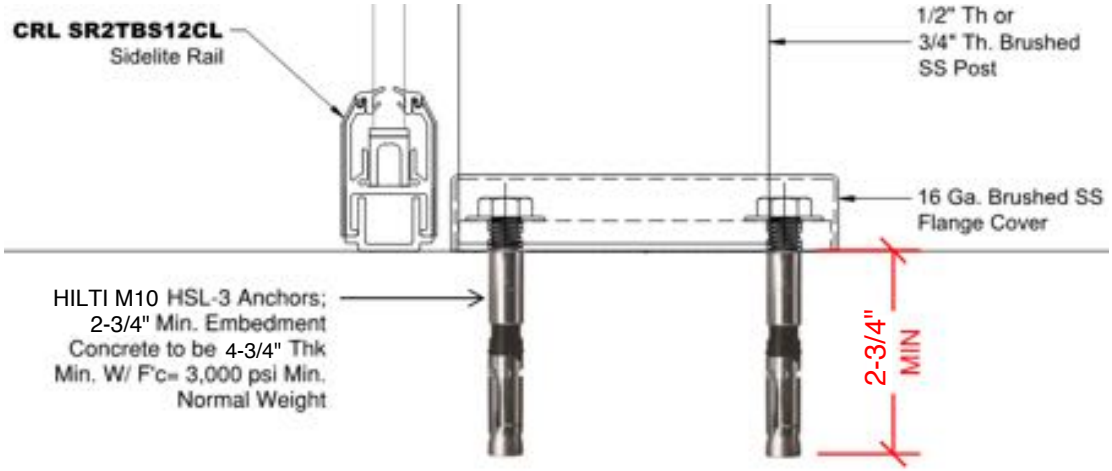
$V_{bE} := V_{max}\cdot 1.6 = 459lbf$ $M_{bE} := M_{max}\cdot 1.6 = 27653\cdot in\cdot lbf$

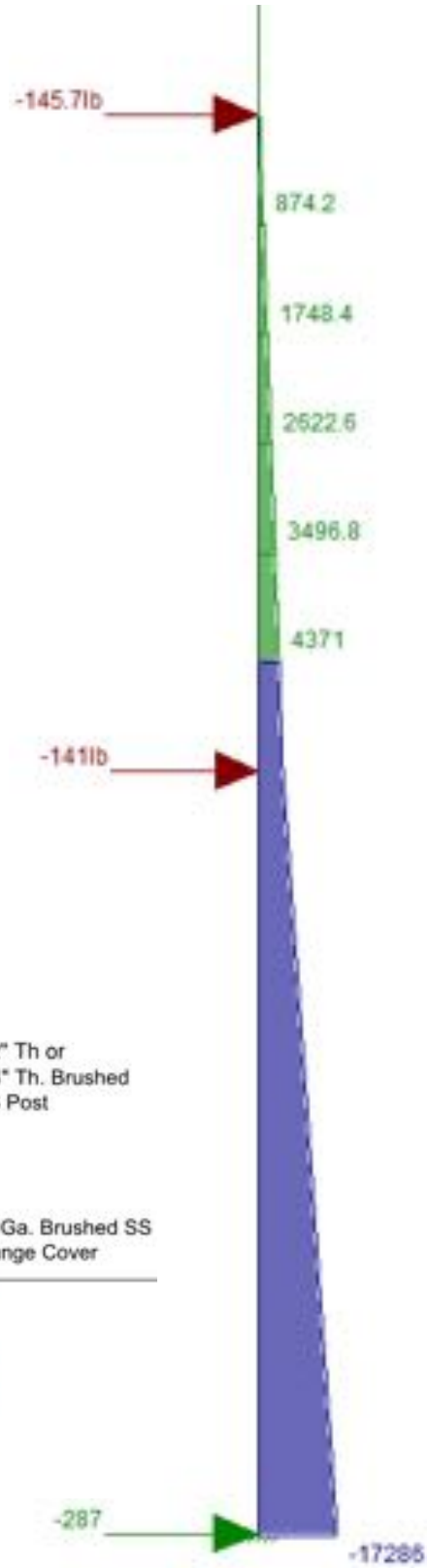
*****SEE SHT 5A THRU 5D FOR PROFIS DATA*****

Use (4) Hilti M10 HSL-3 Concrete Anchors
Grade 8.8 Carbon Steel (Interior Applications)

Embedment: 2-3/4" Min.
Edge Distance: +36", Non-Fall Hazard Area
Min. Slab Thickness: 4-3/4"
Concrete Strength: f'c= 3,000 psi, Normal Wt., Cracked

*****Install per Manufacturer's instructions*****





RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No: R19-07-001 Engineer: KEP Date: 7/18/19 Chk By:	Sheet No: 5 Rev: Date:

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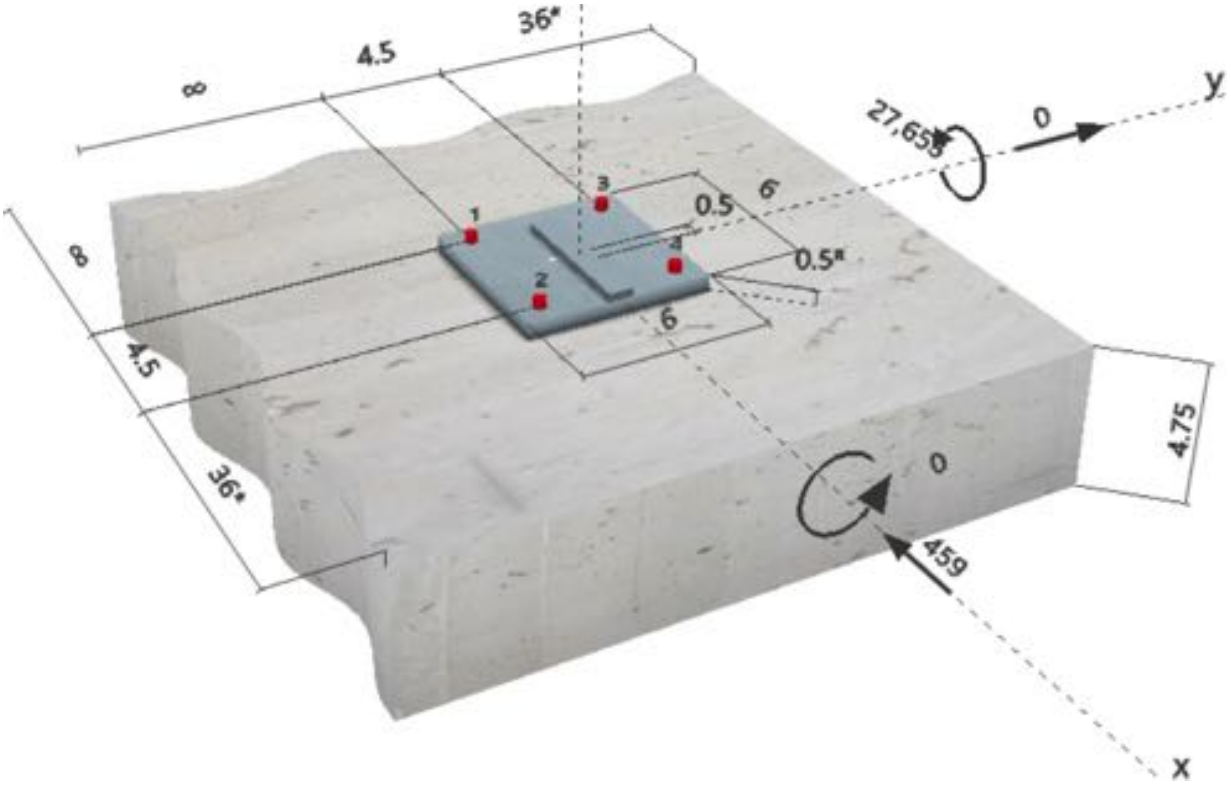
Profis Anchor 2.8.3

Company:	Rice Engineering	Page:	1
Specifier:	KEP	Project:	Klarity Anchors
Address:		Sub-Project I Pos. No.:	Intermediate Anchors
Phone I Fax:	|	Date:	9/11/2019
E-Mail:			

Specifier's comments: 10 PSF - 54" Span

1 Input data

Anchor type and diameter:	**HSL-3 M10**
Effective embedment depth:	$h_{ef,act}$ = 2.756 in., h_{nom} = 2.756 in.
Material:	8.8
Evaluation Service Report:	ESR-1545
Issued I Valid:	4/1/2019 | 3/1/2020
Proof:	Design method ACI 318-11 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 6.000 in. x 6.000 in. x 0.500 in.; (Recommended plate thickness: not calculated
Profile:	Rectangular plates and bars (AISC); (L x W x T) = 5.000 in. x 0.750 in.
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 4.750 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar



2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	**β_N / β_V [%]**	**Status**
Tension	Concrete Breakout Strength	5,726	6,034	95 / -	OK
Shear	Pryout Strength	459	20,058	- / 3	OK

Loading	**β_N**	**β_V**	**ζ**	**Utilization $\beta_{N,V}$ [%]**	**Status**
Combined tension and shear loads	0.949	0.023	1.0	81	OK

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

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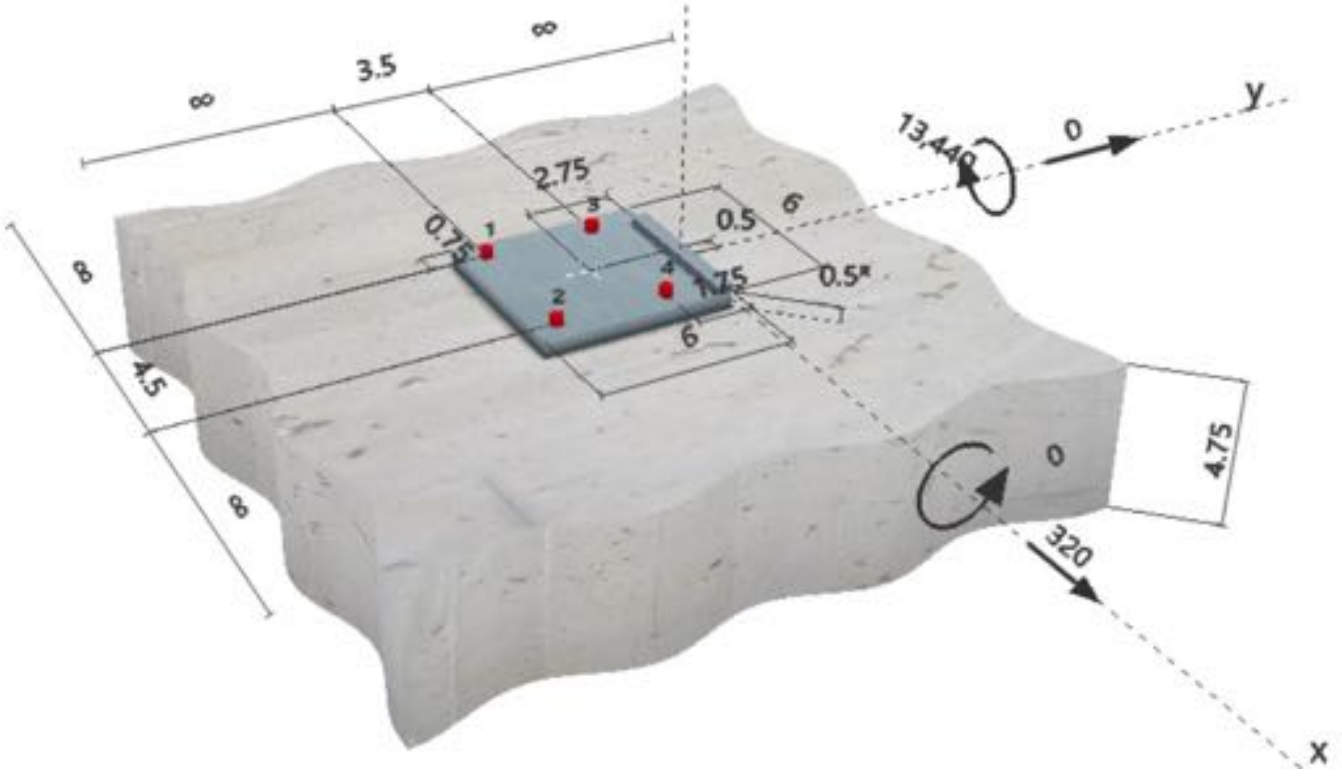
Profis Anchor 2.8.3

Company:	Rice Engineering	Page:	1
Specifier:	KEP	Project:	Klarity Anchors
Address:		Sub-Project I Pos. No.:	End Post Anchors
Phone I Fax:	|	Date:	9/11/2019
E-Mail:			

Specifier's comments: 10 PSF - 54" Span

1 Input data

Anchor type and diameter:	**HSL-3 M10**
Effective embedment depth:	$h_{ef,act}$ = 2.756 in., h_{nom} = 2.756 in.
Material:	8.8
Evaluation Service Report:	ESR-1545
Issued I Valid:	4/1/2019 | 3/1/2020
Proof:	Design method ACI 318-11 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 6.000 in. x 6.000 in. x 0.500 in.; (Recommended plate thickness: not calculated
Profile:	Rectangular plates and bars (AISC); (L x W x T) = 5.000 in. x 0.500 in.
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 4.750 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar



RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No:	R19-07-001	
			Engineer: KEP	Sheet No:	5 C
			Date: 7/18/19	Rev:	
			Chk By:	Date:	

2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	**β_N / β_V [%]**	**Status**
Tension	Concrete Breakout Strength	2,788	5,469	51 / -	OK
Shear	Steel Strength	154	6,649	- / 3	OK

Loading	**β_N**	**β_V**	**ζ**	**Utilization $\beta_{N,V}$ [%]**	**Status**
Combined tension and shear loads	0.510	0.033	5/3	33	OK

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

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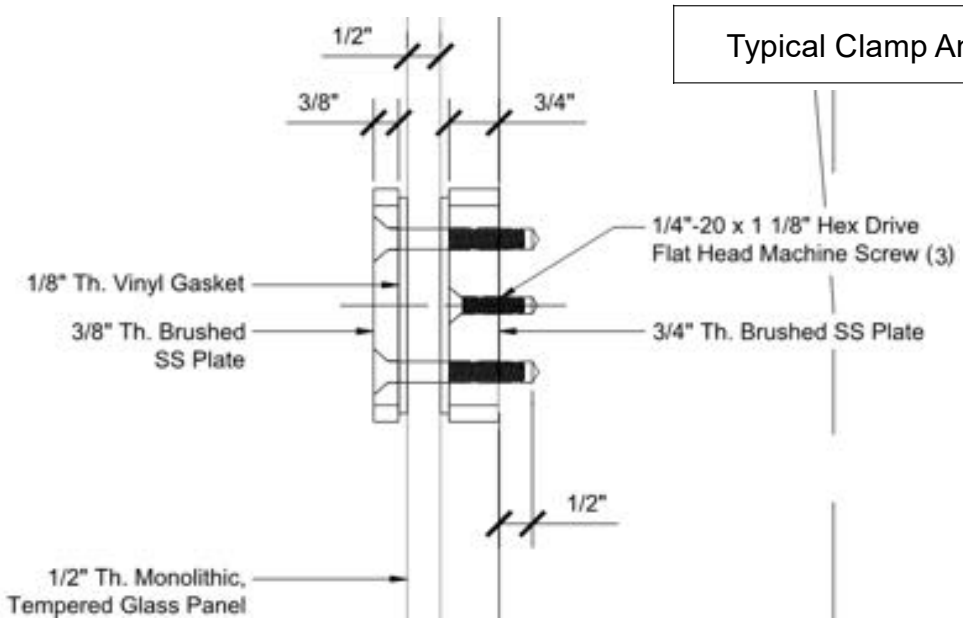
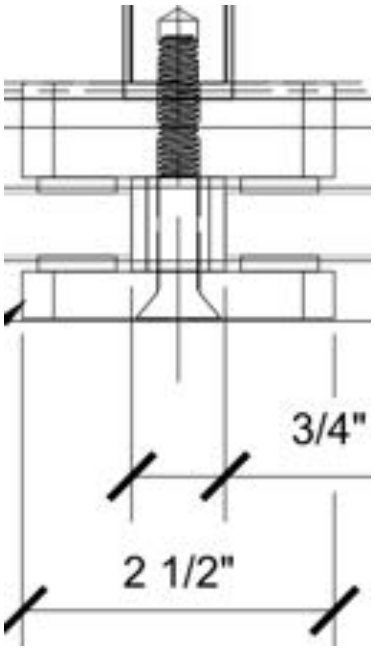
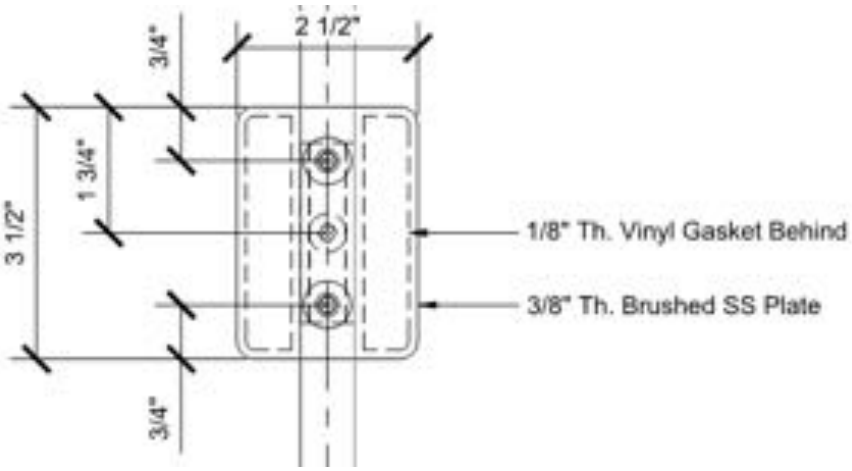
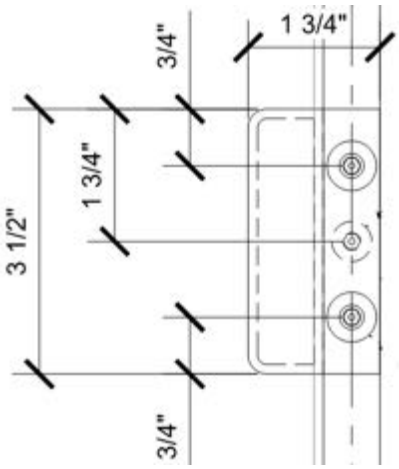
Typical Clamp Analysis	Detail Ref.	Sheet No: 6









Chk Clamp Bending:

Since the lower clamps are at 42" A.F.F., Max load on the clamp is the 50 LB/FT Uniform Live Load

$LL := 50plf$ $SP := 5ft$ $P := LL \cdot SP = 250lbf$

$t := 0.375in$ $L_{eff} := 3.5in$ $L_1 := 2in$ $L_2 := 1.375in$

$M_{pl1} := \frac{P \cdot L_1}{4} = 125 \cdot in \cdot lbf$ $F_y := 30000psi$

$M_{pl2} := 0.5 \cdot P \cdot L_2 = 172in \cdot lbf$ $M_{pl} := \max(M_{pl1}, M_{pl2})$

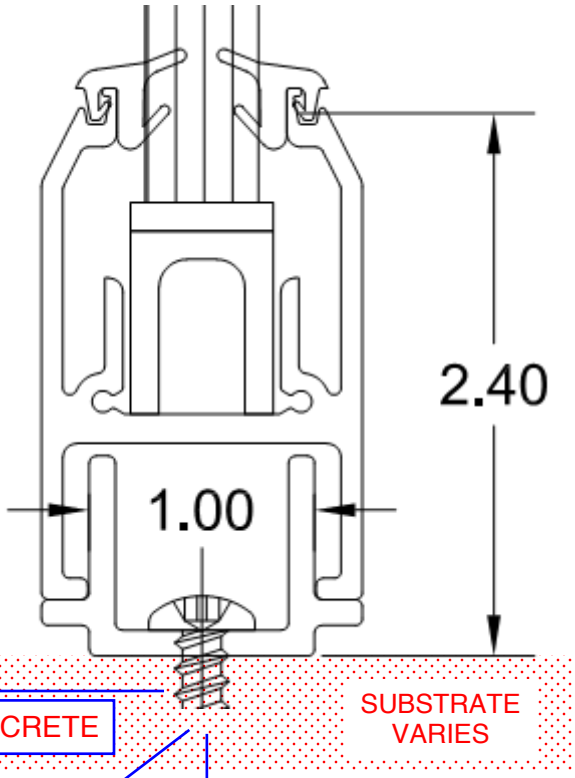
$L_{req} := \frac{6 \cdot M_{pl}}{0.75 \cdot F_y \cdot t^2} = 0.33 \cdot in$ $I_c := \frac{L_{req}}{L_{eff}} = 0.09$

Use 3-1/2" Long SS Clamps As Drawn
300 Series Stainless, Fy= 30 ksi Min.
Use Gaskets To Protect Glass Edges

$T_1 := \frac{0.5 \cdot P \cdot L_2}{0.5 \cdot (0.5in) \cdot 2} = 344lbf$ $T_2 := 0.5 \cdot P = 125lbf$

$T_{all} := 1061lbf$ $I_{sc} := \frac{\max(T_1, T_2)}{T_{all}} = 0.32$

Use 1/4"-20 SS Fasteners, As Drawn
300 Series Stainless, Fy= 65 ksi Min.
See Sht Z1 for Fastener Capacities
5/16" Minimum Thread Penetration Req'd



Use 1/4" Dia. ITW Buildex Tapcon+ at 24" O.C.
Carbon Steel W/ Climaseal Coating

Embedment: 1-3/4" Min.
Edge Distance: 3"
End Distance: 3"
Min. Slab Thickness: 4-3/4"
Concrete Strength: f'c= 3,000 psi, Normal Wt., Cracked

*****Install per Manufacturer's instructions*****

THE CONCRETE HAS BEEN ASSUMED CRACKED WITH A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI & 4-3/4" THK MIN.

Use #14-10 Wood Screws Spaced at 24" O.C.

Thread Penetration: 1-1/4" Min.
Edge Distance: 3/4"
End Distance: 1-1/2"
Spacing: as shown
Assume S.G. = 0.42 Spruce-Pine-Fir

*****Install per NDS Guidelines*****

THE WOOD BLOCKING HAS BEEN ASSUMED TO HAVE A MINIMUM SPECIFIC GRAVITY OF OF 0.42 AND MUST BE STRUCTURALLY ATTACHED TO THE SYSTEM - BY OTHERS

Use 1/4" Dia. Fastener into Steel at 24" O.C.
300 Series S.S., Cond. CW, Fu= 100 ksi Min
or SAE Grade 5, Fu= 120 ksi Min
Min. 1/4" thread engagement to A36 steel or Better

THE STEEL HAS BEEN ASSUMED TO BE 1/4" THICK AND HAVE A MINIMUM YIELD STRENGTH OF 36 KSI

ASD DESIGN REACTIONS - PER INCH
(SEE SHEET 7A)

Ry = 82 LB PER SETTING BLOCK LOCATION

Rz = 34 LB

ENGINEER OF RECORD TO VERIFY THE STRUCTURAL INTEGRITY OF THE SUBSTRATE BASED ON THE IMPOSED LOADS FROM THE SYSTEM

SEPARATION BETWEEN DISSIMILAR MATERIALS IS NOT THE RESPONSIBILITY OF RICE ENGINEERING INC.

Sill Channel Analysis	Detail Ref.	Sheet No: 7 A

Inputs:

Reactions:

$WL := 5psf$ $PL := 50plf$

$H := 60in$ $a := 42in$

$Trib := 1in$

$W := 60in$

$t_{glass} := 0.5in$

$\delta := 158pcf$

Shoe:

$ecc := 2.4in$

$t := 0.094in$

$L_{set} := 4in$

Anchor Bolts:

$spacing := 24$

$L_{resist} := 0.5in$

$L_{bend} := 0.25in$

$F_y := 70000psi$

$Crush := 0.85$

$d_b := 0.25in$

Edge Duration:

- ☐ 10 Min (Wind)
- ☐ 60 Min (Live)
- ☐ 1 Month (Snow)
- ☑ Long Term (Dead)

Beam Type:

- ☑ Pinned-Pinned
- ☐ Pinned-Fixed
- ☐ Fixed-Fixed

Glass Type:

- ☐ Annealed
- ☐ Heat Strengthened
- ☑ Fully Tempered

Calculations:

All Calculations Below This Line Are Automatic

$w := WL \cdot Trib = 0.03 \cdot pli$ $DL := \frac{H \cdot W \cdot t_{glass} \cdot \delta}{2} = 82lbf$ Per Setting Block Location $b := H - a = 18in$

$$R_Z := \max\left(\frac{w \cdot H}{2}, PL \cdot Trib \cdot \frac{b}{H}\right) \cdot Beam1 + \max\left[\frac{5 \cdot w \cdot H}{8}, PL \cdot Trib \cdot \frac{b}{2 \cdot H^3} \cdot \left(3 \cdot H^2 - b^2\right)\right] \cdot Beam2 + \max\left[\frac{w \cdot H}{2}, PL \cdot Trib \cdot \frac{b^2}{H^3} \cdot (b + 3a)\right] \cdot Beam3 = 1.25lbf$$

$$M_r := 0 \cdot Beam1 + \max\left[\frac{w \cdot H^2}{8}, PL \cdot Trib \cdot \frac{a \cdot b}{H^2} \cdot (b + H)\right] \cdot Beam2 + \max\left(\frac{w \cdot H^2}{12}, PL \cdot Trib \cdot \frac{b^2 \cdot a}{H^2}\right) \cdot Beam3 = 0in \cdot lbf$$

Check Glass:

$A_{edge} := t_{glass} \cdot L_{set} = 0.01ft^2$

$f_{edge} := \frac{DL}{A_{edge}} = 41psi$

$F_{edge} = 3286psi$ *Per ASTM E1300 Assuming Seamed or Polished Edges*

$GLASS := \begin{cases} \text{"OK"} & \text{if } f_{edge} \le F_{edge} \\ \text{"FAIL"} & \text{otherwise} \end{cases}$ GLASS = "OK"

Use 4" Long Deadload Setting Blocks @ 1/4 Points Typical

Check Shoe:

$M_{weak} := R_Z \cdot ecc + M_r = 3 \cdot in \cdot lbf$

$S_{by} := \frac{t^2 \cdot Trib}{6} = 0.0015 \cdot in^3$

$f_{by} := \frac{M_{weak}}{S_{by}} = 2037psi$

$F_{by} := 12500psi$ *6063-T5*

$SHOE := \begin{cases} \text{"OK"} & \text{if } f_{by} \le F_{by} \\ \text{"FAIL"} & \text{otherwise} \end{cases}$ SHOE = "OK"

Use CRL SR2TBS AL Shoe, As Drawn
(6063-T5 Minimum)

Check Wood Anchors:

$V_b := R_Z \cdot spacing \cdot 1.14 = 34lbf$

$T_b := \frac{\left[R_Z \cdot \left(d_b + L_{bend}\right) + M_r\right] \cdot spacing}{Crush \cdot L_{resist}} \cdot 1.14 = 40lbf$

$V_{all} := 217lbf$ ***"OK" Per Sht 7B***

$T_{all} := 211lbf$

Check Concrete Anchors:

Per ITW Buildex Design Data Sht Z4

$V_{all} := \frac{1670lbf}{5} = 334lbf$

$T_{all} := \frac{2200lbf}{5} = 440lbf$

$I := \left(\frac{V_b}{V_{all}}\right) + \left(\frac{T_b}{T_{all}}\right) = 0.19$

$M_{bend} := 0.5 \cdot V_b \cdot L_{bend} = 4.28 \cdot in \cdot lbf$

$S_{bend} := \frac{d_b^3 \cdot \pi}{32} = 0.0015 \cdot in^3$

$f_{bend} := \frac{M_{bend}}{S_{bend}} = 2787psi$

$F_{bend} := 0.75F_y = 52500psi$

$SCREWS := \begin{cases} \text{"OK"} & \text{if } f_{bend} < F_{bend} \\ \text{"FAIL"} & \text{otherwise} \end{cases}$ SCREWS = "OK"

NOTE: *1/4" FASTENER THRU BOLT OR DRILL/TAP IS "OK" PER INSPECTION; SEE CALLOUT ON SHT 7*

RICE ENGINEERING Template: REI-MC-5433	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No:	R19-07-001	
			Engineer: KEP	Sheet No: 7 A	
			Date: 7/18/19	Rev:	
			Chk By:	Date:	

Dowel Type Fastener Capacity (NDS 2012)

Wood Screw Capacity	Detail Ref.	Sheet No: 7B

$V_{pos} := 34 \cdot lbf$ $V_{neg} := 34 \cdot lbf$

$T_{pos} := 40 \cdot lbf$ $T_{neg} := 40 \cdot lbf$

#14 Woodscrew Rolled Threads

$l_m := p$ thickness of main member, in.

$l_s := 0.14$ thickness of side member, in

6063-T5 Hole

$F_{yb} = 80000$ bending yield strength, psi.

$D = 0.242$ unthreaded shank diameter of screw, in.

$D_r = 0.2$ root diameter of screw

39000

$F_{es} = 23000$ bearing strength, psi

$G = 0.42$ Material = "Spruce Pine-Fir"

Spruce Pine-Fir $G = 0.42$

$p := 1.25$ penetration, in

$t_{shim} := 0.25$ maximum thickness of shim, in

$C_D := 1.6$ load duration factor, 10.3.2

$C_M := 1.0$ wet service factor, 10.3.3

$C_t := 1.0$ temperature factor, 10.3.4

$C_g := 1.0$ group action factor, 10.3.6

$C_\Delta := 1.0$ geometry factor, 11.5.1

$C_{eg} := 1.0$ end grain factor, 11.5.2

$C_{di} := 1.0$ diaphragm factor, 11.5.3

$\theta := 90$ angle of Shear load to grain, degree

Calculations

$K_\theta := 1 + 0.25 \cdot \frac{\theta}{90} = 1.25$ $R_e := \frac{F_{em}}{F_{es}} = 0.15$ $R_t := \frac{l_m}{l_s} = 8.93$

$$K_D := \begin{cases} 2.2 & \text{if } D_r \le 0.17 \\ \text{otherwise} & \\ \quad \begin{cases} 10 \cdot D_r + 0.5 & \text{if } 0.17 < D_r \le 0.25 \\ 0 & \text{otherwise} \end{cases} & \end{cases} = 2.46$$

$$k_1 := \frac{\sqrt{R_e + 2 \cdot R_e^2 \cdot \left(1 + R_t + R_t^2\right) + R_t^2 \cdot R_e^3} - R_e \cdot \left(1 + R_t\right)}{1 + R_e} = 0.53$$

$$R_{d1} := \begin{cases} K_D & \text{if } D_r \le 0.25 \\ 4.0 \cdot K_\theta & \text{if } 0.25 < D_r \le 1 \\ \text{otherwise} & \end{cases} = 2.46$$

$$k_2 := -1 + \sqrt{2 \cdot \left(1 + R_e\right) + \frac{2 \cdot F_{yb} \cdot \left(1 + 2 \cdot R_e\right) \cdot D_r^2}{3 \cdot F_{em} \cdot l_m^2}} = 0.67$$

$$R_{d2} := \begin{cases} K_D & \text{if } D_r \le 0.25 \\ 3.6 \cdot K_\theta & \text{if } 0.25 < D_r \le 1 \\ \text{otherwise} & \end{cases} = 2.46$$

$$k_3 := -1 + \sqrt{\frac{2 \cdot \left(1 + R_e\right)}{R_e} + \frac{2 \cdot F_{yb} \cdot \left(2 + R_e\right) \cdot D_r^2}{3 \cdot F_{em} \cdot l_s^2}}$$

$$R_{d3} := \begin{cases} K_D & \text{if } D_r \le 0.25 \\ 3.2 \cdot K_\theta & \text{if } 0.25 < D_r \le 1 \\ \text{otherwise} & \end{cases} = 2.46$$

$Z_{Im} := \frac{D_r \cdot l_m \cdot F_{em}}{R_{d1}} = 335.06$ $Z_{Is} := \frac{D_r \cdot l_s \cdot F_{es}}{R_{d1}} = 256.55$ $Z_{II} := \frac{k_1 \cdot D_r \cdot l_s \cdot F_{es}}{R_{d2}} = 135.38$ $Z_{IIIm} := \frac{k_2 \cdot D_r \cdot l_m \cdot F_{em}}{\left(1 + 2R_e\right) \cdot R_{d3}} = 174.26$

$Z_{IIIs} := \frac{k_3 \cdot D_r \cdot l_s \cdot F_{em}}{\left(2 + R_e\right) \cdot R_{d3}} = 141.19$ $Z_{IV} := \frac{D_r^2}{R_{d3}} \cdot \sqrt{\frac{2 \cdot F_{em} \cdot F_{yb}}{3 \cdot \left(1 + R_e\right)}} = 195.38$

$Z_1 := \min\left(Z_{Im}, Z_{Is}, Z_{II}, Z_{IIIm}, Z_{IIIs}, Z_{IV}\right) = 135.38$

$W_1 = 121.66$

$R_{pos} := \sqrt{T_{pos}^2 + V_{pos}^2} = 52.5\,lbf$ $R_{neg} := \sqrt{T_{neg}^2 + V_{neg}^2} = 52.5\,lbf$

$\alpha_{pos} := \operatorname{atan}\left(T_{pos} \cdot V_{pos}^{-1}\right) = 49.64 \cdot deg$ $\alpha_{neg} := \operatorname{atan}\left(T_{neg} \cdot V_{neg}^{-1}\right) = 49.64 \cdot deg$

Results

$Z' := Z_1 \cdot C_D \cdot C_M \cdot C_t \cdot C_g \cdot C_\Delta \cdot C_{eg} \cdot C_{di} \cdot lbf = 217\,lbf$ **Allowable Shear**

$W' := W_1 \cdot C_D \cdot C_M \cdot C_t \cdot C_{eg} \cdot p_{ten} \cdot lbf = 211\,lbf$ **Allowable Tension**

Fastener = "Woodscrew"
Predrill = "Predrill Not Required"
Material = "Spruce Pine-Fir"

$Z_{\alpha pos} := \frac{W' \cdot Z'}{W' \cdot \left(\cos\left(\alpha_{pos}\right)\right)^2 + Z' \cdot \left(\sin\left(\alpha_{pos}\right)\right)^2} = 213.14\,lbf$ $Int_{pos} := \frac{R_{pos}}{Z_{\alpha pos}} = 0.25$

$Z_{\alpha neg} := \frac{W' \cdot Z'}{W' \cdot \left(\cos\left(\alpha_{neg}\right)\right)^2 + Z' \cdot \left(\sin\left(\alpha_{neg}\right)\right)^2} = 213.14\,lbf$ $Int_{neg} := \frac{R_{neg}}{Z_{\alpha neg}} = 0.25$

RICE ENGINEERING
Template: REI-MC-7602

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Luxemburg, WI 54217
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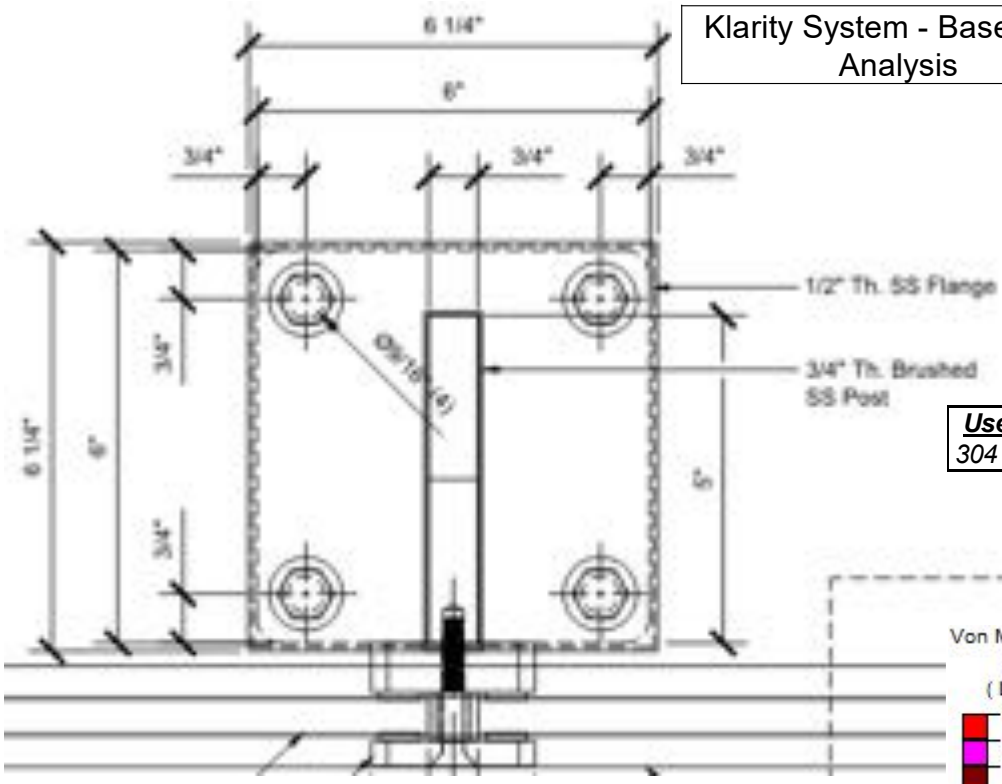
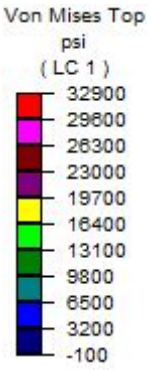
Project Description: **Klarity System R&D Calcs**

Job No:	R19-07-001		
Engineer:	KEP	Sheet No:	7B
Date:	7/18/19	Rev:	
Chk By:		Date:	

Klarity System - Base Plate Analysis	Detail Ref.	Sheet No: 8



Use 1/2" Thk SS Plate, As Shown
304 or 316 SS, Fy= 45 ksi Min Req'd

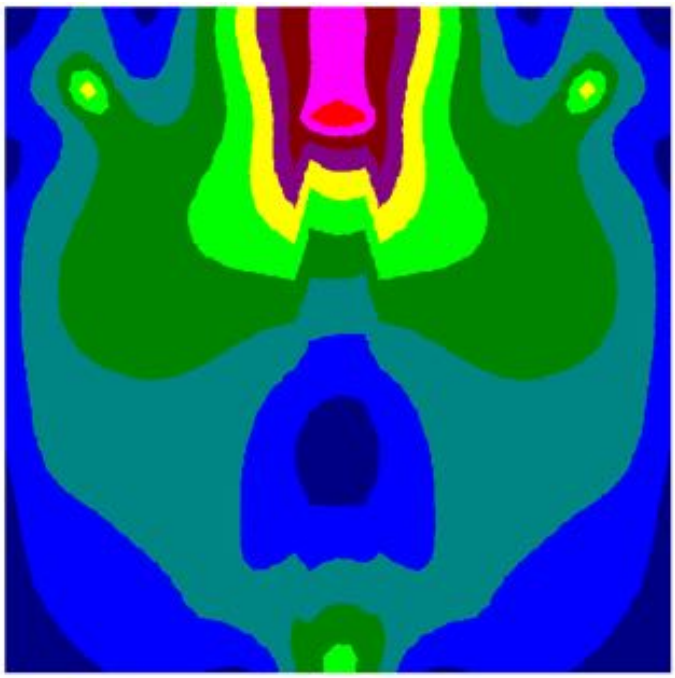


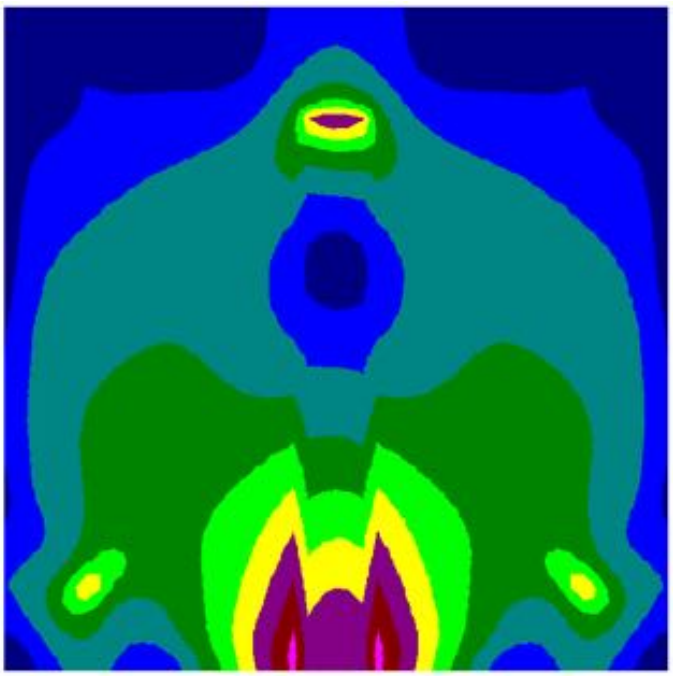
Stress Chk:

$F_y := 45ksi$

$F_{by} := 0.75 \cdot F_y = 33750\,psi$

Von Mises Stress Less Than Allowable Stress "OK"; Conservative





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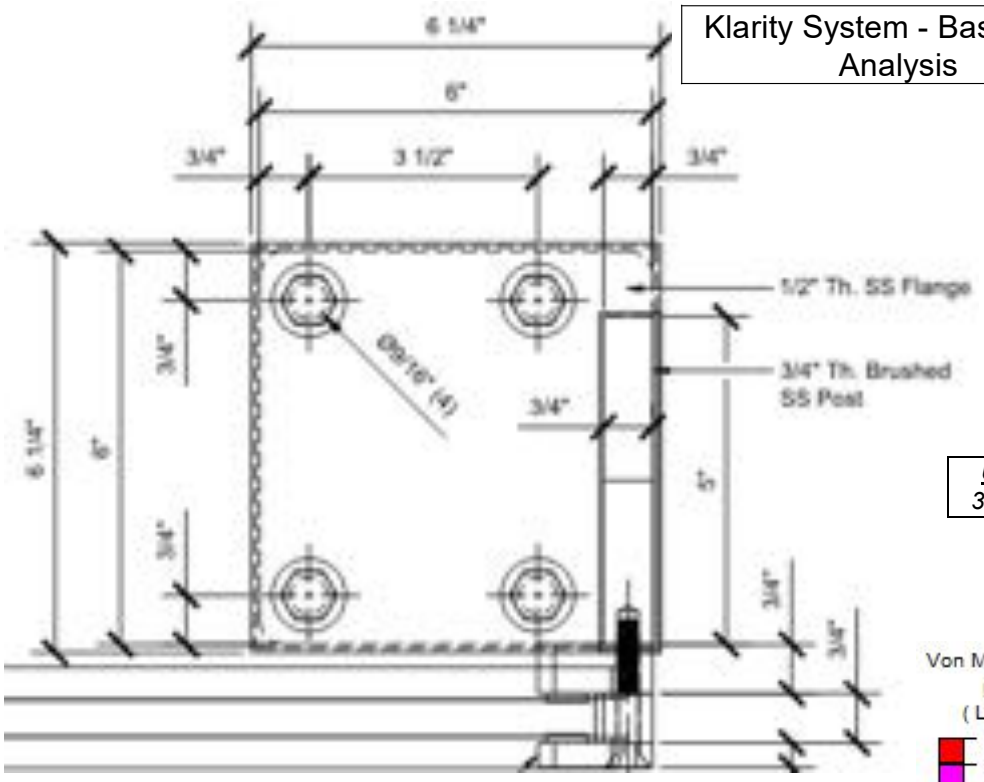
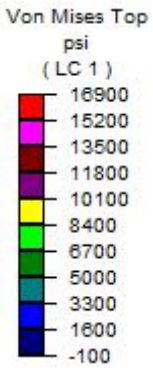
			Engineer: KEP	Sheet No: 8
			Date: 7/18/19	Rev:
			Chk By:	Date:

Klarity System - Base Plate Analysis	Detail Ref.	Sheet No: 8 A



Use 1/2" Thk SS Plate, As Shown
304 or 316 SS, Fy= 40 ksi Min Req'd

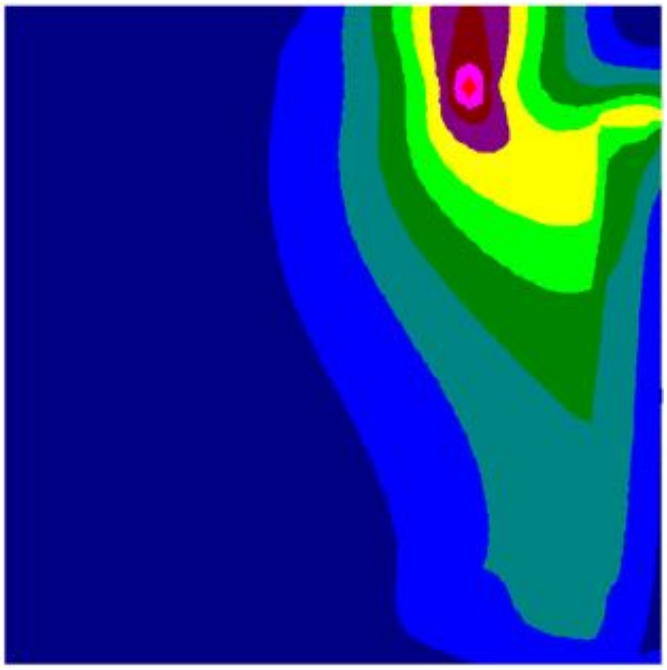


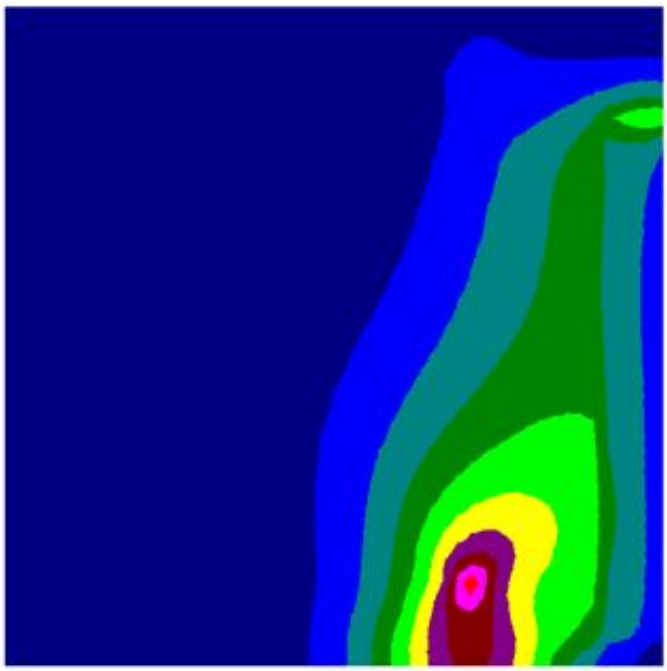
Stress Chk:

$F_y := 40ksi$

$F_{by} := 0.75 \cdot F_y = 30000\ psi$

Von Mises Stress Less Than Allowable Stress "OK"; Conservative





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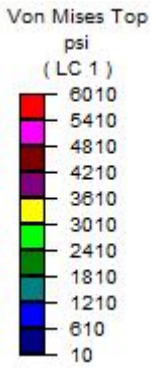
			Engineer: KEP	Sheet No: 8 A
			Date: 7/18/19	Rev:
			Chk By:	Date:



Worst Case Principal & Von Mises Stress at 5 PSF

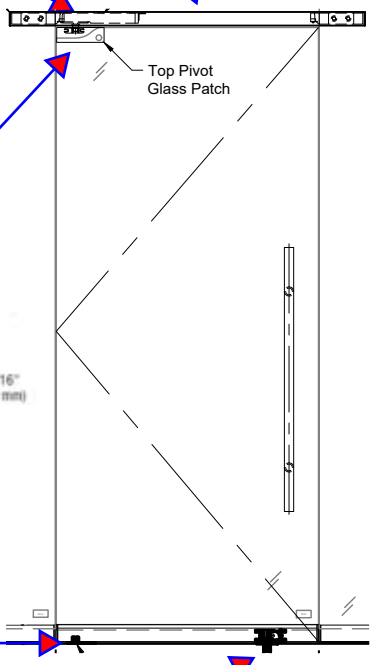
Sigma...	Sigma...	Tau M...	Angle[r...	Von ...
74.878	-668.999	371.939	1.95	709.408
668.999	-74.878	371.939	.379	709.408

Use 3/8" or 1/2" Thick Fully Tempered Glass Panels

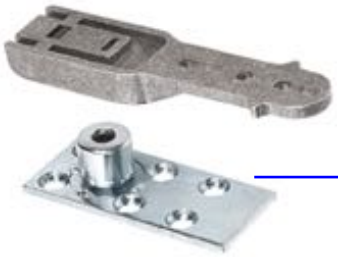
Maximum Panel Size : 36" x 84"

USE FLOATING HEADER AS DRAWN

USE 20104M20 CLOSER



USE PH20ABS PIVOT



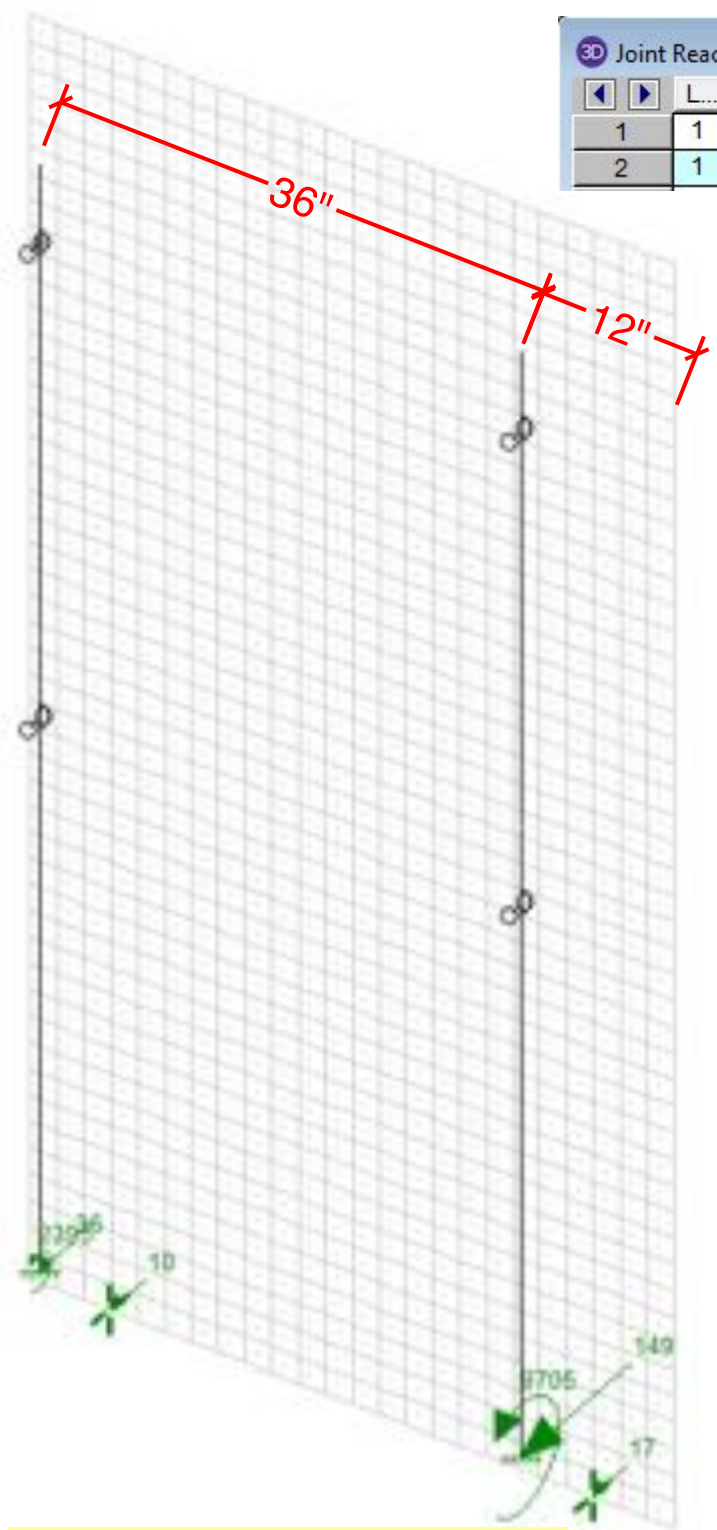
USE 8010 BP PIVOT

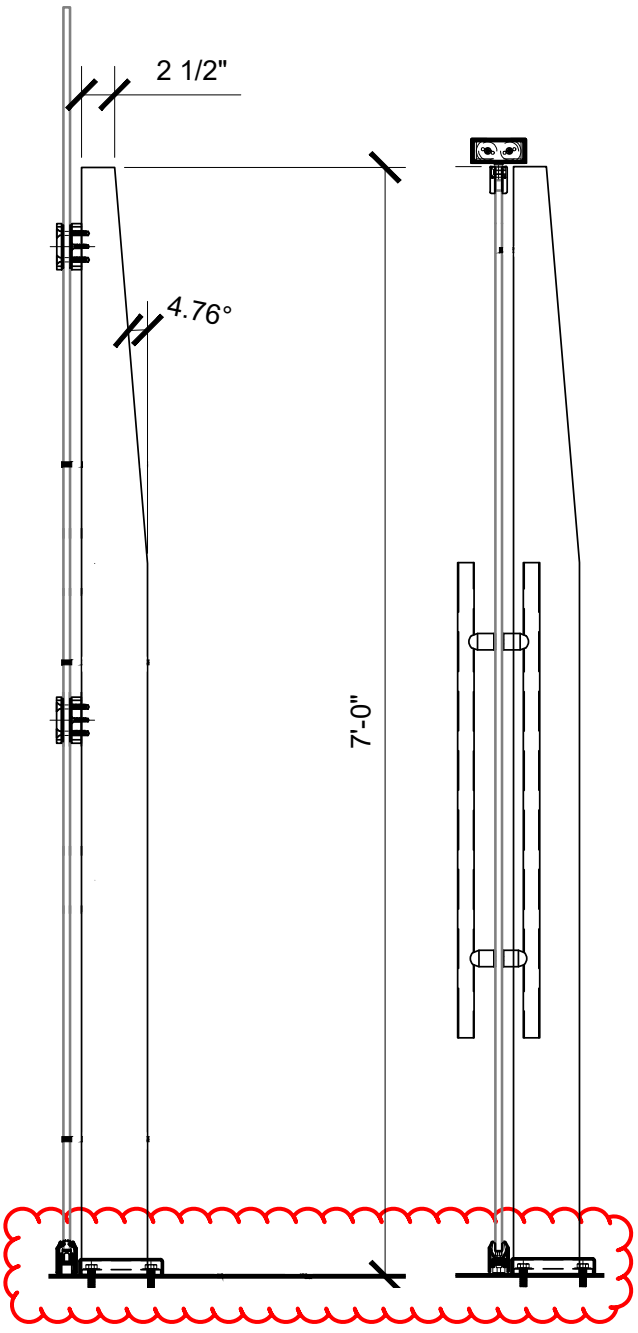
USE 777LP

Klarity System - Swinging Door Analysis	Detail Ref.	Sheet No: 9 A

Joint Reactions (By Combination)

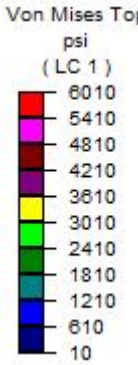
	L...	Joint Label	X [lb]	Y [lb]	Z [lb]	MX [lb-i...
1	1	N4801	0	0	36.333	2394.88
2	1	N17	0	0	149.313	9705.12





ANCHORAGE IS "OK" PER INSPECTION BASED ON CALCULATIONS FOR TYP POSTS AT 5 PSF; SEE SHT E2B FOR DETAILS

RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No: R19-07-001 Engineer: KEP Date: 7/18/19 Chk By:	Sheet No: 9 A Rev: Date:



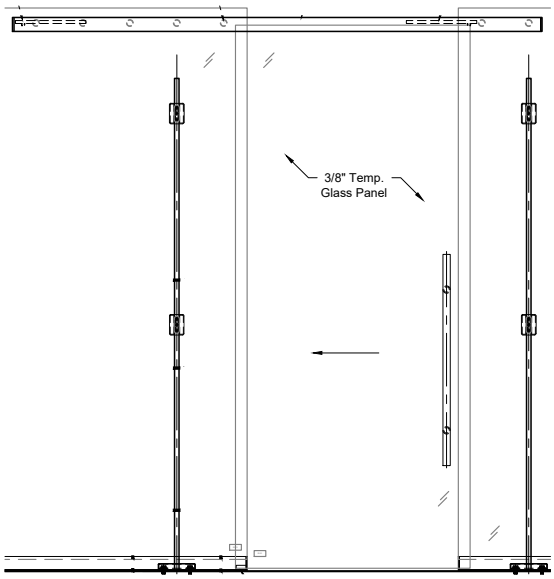
Worst Case Principal & Von Mises Stress at 5 PSF

Sigma...	Sigma...	Tau M...	Angle[r...	Von ...
250.617	-1464.273	857.445	1.164	1604.33
1469.594	-249.631	859.613	-.406	1609

Use 3/8" Thick Fully Tempered Glass Panels

Maximum Panel Size : 40" x 84"

USE CRL COMPACT-X70 SLIDING DOOR KIT



LOAD AT TOP RAIL:

$WL := 5psf \quad W := 40in \quad H := 84in$

$R_{ZBR} := 58lbf \quad R_{ZTOT} := WL \cdot W \cdot H = 117lbf$

$R_{ZTR} := R_{ZTOT} - R_{ZBR} = 58.67\,lbf$

$W_{TR} := \frac{R_{ZTR}}{W} = 1.47\,pli$ ⟸ ***FOR USE IN RISA MODEL***

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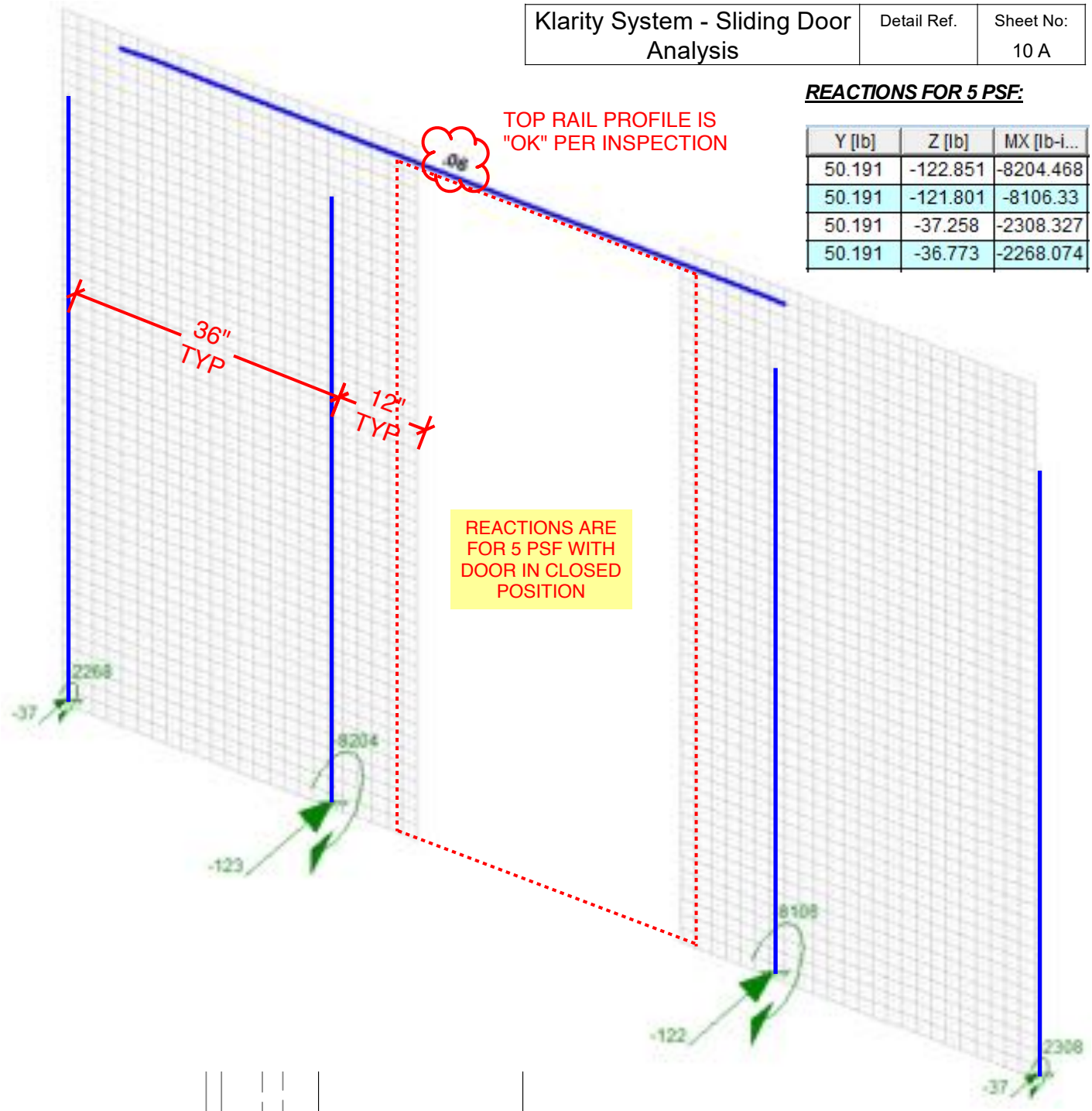
Project Description:	Job No:	R19-07-001	
Klarity System R&D Calcs	Engineer:	KEP	Sheet No: 10
	Date:	7/18/19	Rev:
	Chk By:		Date:

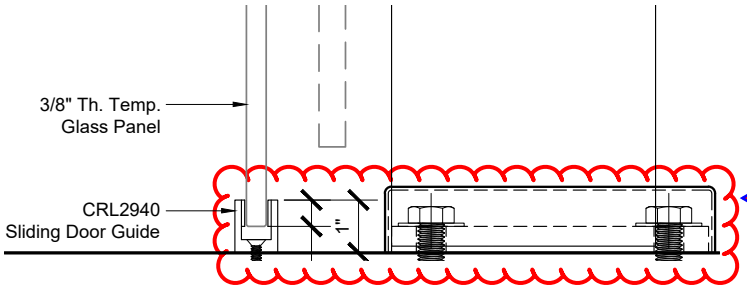
Template:

Klarity System - Sliding Door Analysis	Detail Ref.	Sheet No: 10 A

REACTIONS FOR 5 PSF:

Y [lb]	Z [lb]	MX [lb-i...
50.191	-122.851	-8204.468
50.191	-121.801	-8106.33
50.191	-37.258	-2308.327
50.191	-36.773	-2268.074





ANCHORAGE IS "OK" PER INSPECTION BASED ON CALCULATIONS FOR TYP POSTS AT 5 PSF; SEE SHT E2B FOR DETAILS

RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No:	R19-07-001	
			Engineer: KEP	Sheet No: 10 A	
			Date: 7/18/19	Rev:	
			Chk By:	Date:	

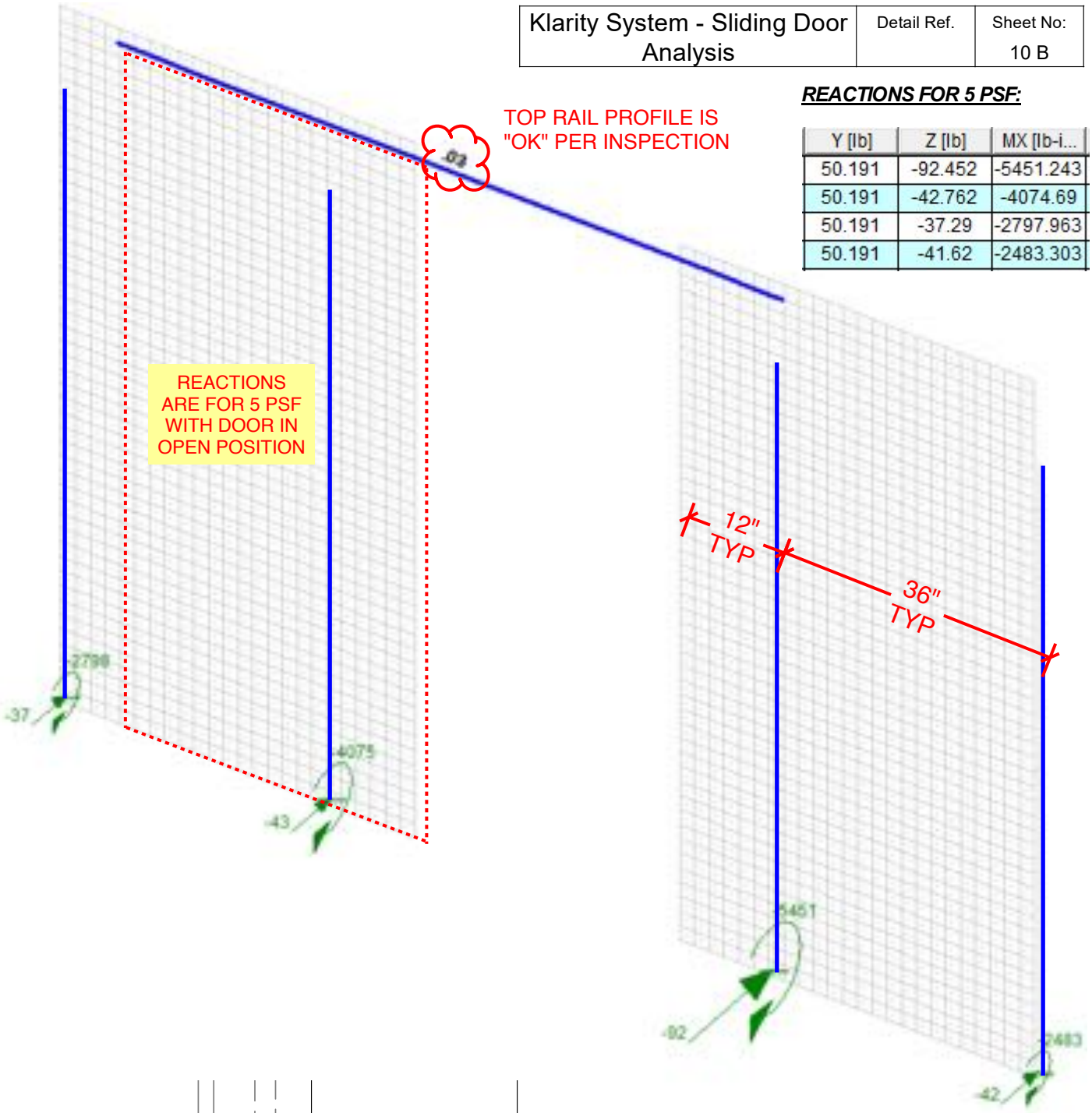
Klarity System - Sliding Door Analysis	Detail Ref.	Sheet No: 10 B

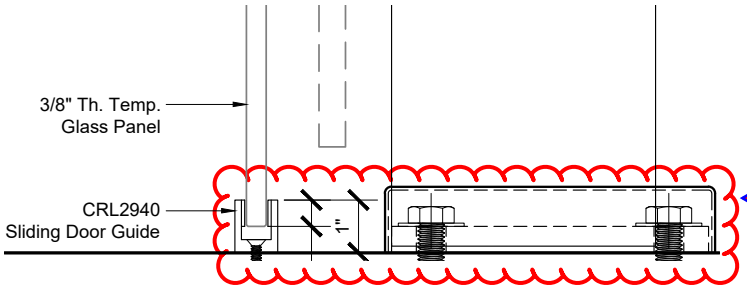
TOP RAIL PROFILE IS "OK" PER INSPECTION

REACTIONS FOR 5 PSF:

Y [lb]	Z [lb]	MX [lb-i...
50.191	-92.452	-5451.243
50.191	-42.762	-4074.69
50.191	-37.29	-2797.963
50.191	-41.62	-2483.303

REACTIONS ARE FOR 5 PSF WITH DOOR IN OPEN POSITION





ANCHORAGE IS "OK" PER INSPECTION BASED ON CALCULATIONS FOR TYP POSTS AT 5 PSF; SEE SHT E2B FOR DETAILS

RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920) 617-1042 Fax: (920) 617-1100 www.rice-inc.com	Project Description: **Klarity System R&D Calcs**	Job No: R19-07-001 Engineer: KEP Date: 7/18/19 Chk By:	Sheet No: 10 B Rev: Date:

TABLE 20.9: Fastener Capacity

STAINLESS STEEL - Alloy Groups 1, 2 and 3, Condition CW (UNC Treads)

Nominal Fastener Diameter & Threads per Inch	D Nominal Thread Diameter (in)	A(S) Tensile Stress Area (in2)	A(R) Thread Root Area (in2)	Allow able Tension (lbs)	Allow able Shear		Allow able Bearing (lbs)			Minimum Material Thickness (lbs) to Equal Tensile Capacity of Fastener (in)			Maximum Tensile Load (lbs) for Available 3/8" Plate Thickness		
					Single (lbs)	Double (lbs)	1/8" Steel A36	1/8" Aluminum 6063-T5	1/8" Aluminum 6063-T6	A36	6063-T5	6063-T6	3/8" Steel A36	3/8" Aluminum 6063-T5	3/8" Aluminum 6063-T6
#6-32	0.1380	0.0091	0.0078	303	150	300	900	253	345	0.1335	0.2538	0.1943	303	303	303
#8-32	0.1640	0.0140	0.0124	467	239	477	1,070	301	410	0.1733	0.3356	0.2466	467	467	467
#10-24	0.1900	0.0175	0.0151	584	292	583	1,240	348	475	0.1872	0.3410	0.2501	584	584	584
#12-24	0.2160	0.0242	0.0214	805	411	822	1,409	396	540	0.2269	> 3/8"	0.3016	805	734	805
1/4-20	0.2500	0.0318	0.0280	1,061	538	1,076	1,631	458	625	0.2634	> 3/8"	0.3373	1,061	865	1,061
5/16-18	0.3125	0.0524	0.0469	2,097	1,083	2,166	2,039	573	781	0.2867	> 3/8"	> 3/8"	2,097	1,303	1,776
3/8-16	0.3750	0.0775	0.0699	3,100	1,614	3,228	2,447	688	938	0.3181	> 3/8"	> 3/8"	3,100	1,572	2,144
7/16-14	0.4375	0.1063	0.0961	4,252	2,220	4,440	2,855	802	1,094	0.3442	> 3/8"	> 3/8"	4,252	1,873	2,554
1/2-13	0.5000	0.1419	0.1292	5,676	2,984	5,968	3,263	917	1,250	> 3/8"	> 3/8"	> 3/8"	5,642	2,140	2,918
9/16-12	0.5625	0.1819	0.1664	7,278	3,842	7,685	3,670	1,031	1,406	> 3/8"	> 3/8"	> 3/8"	6,444	2,444	3,333
5/8-11	0.6250	0.2260	0.2071	9,040	4,782	9,564	4,078	1,146	1,563	> 3/8"	> 3/8"	> 3/8"	7,148	2,711	3,697
3/4-10	0.7500	0.3345	0.3091	11,372	6,022	12,045	4,894	1,375	1,875	> 3/8"	> 3/8"	> 3/8"	8,612	3,266	4,454
7/8-9	0.8750	0.4617	0.4285	15,583	8,351	16,701	5,709	1,604	2,188	> 3/8"	> 3/8"	> 3/8"	10,158	3,853	5,254
1-8	1.0000	0.6057	0.5630	20,448	10,970	21,940	6,525	1,833	2,500	> 3/8"	> 3/8"	> 3/8"	11,696	4,437	6,050

STAINLESS STEEL - Alloy Groups 1, 2 and 3, Condition CW (Spaced Threads)

Nominal Fastener Diameter & Threads per Inch	D Nominal Thread Diameter (in)	K Basic Minor Diameter (in)	A(R) Thread Root Area (in2)	Allow able Tension (lbs)	Allow able Shear		Allow able Bearing (lbs)			Minimum Material Thickness (lbs) to Equal Tensile Capacity of Fastener (in)			Maximum Tensile Load (lbs) for Available 3/8" Plate Thickness		
					Single (lbs)	Double (lbs)	1/8" Steel A36	1/8" Aluminum 6063-T5	1/8" Aluminum 6063-T6	A36	6063-T5	6063-T6	3/8" Steel A36	3/8" Aluminum 6063-T5	3/8" Aluminum 6063-T6
#6-20	0.1380	0.0990	0.0077	257	148	296	900	253	345	0.1191	0.1695	0.1378	257	257	257
#8-18	0.1640	0.1160	0.0106	352	203	407	1,070	301	410	0.1437	0.1930	0.1567	352	352	352
#10-16	0.1900	0.1350	0.0143	477	275	551	1,240	348	475	0.1528	0.2225	0.1805	477	477	477
#12-14	0.2160	0.1570	0.0194	645	373	745	1,409	396	540	0.1620	0.2610	0.2115	645	645	645
1/4-16	0.2500	0.1850	0.0269	896	517	1,035	1,631	458	625	0.2181	0.2994	0.2379	896	896	896
5/16-12	0.3125	0.2360	0.0437	1,750	1,010	2,020	2,039	573	781	0.2839	> 3/8"	0.2990	1,750	1,681	1,750
3/8-12	0.3750	0.2990	0.0702	2,809	1,622	3,243	2,447	688	938	> 3/8"	> 3/8"	> 3/8"	2,773	2,017	2,751

Group 1,2,3-Cond. CW	≤ 5/8" Dia.	≥ 3/4" Dia.	For Diameters < 3/4"	Effective Area (UNC Threads)	Effective Area (Spaced Threads)
F_u (Min. Ultimate Tensile Strength)	100,000 psi	85,000 psi	$F_T = F_u/SF$	$A(R) = \pi\ (D\text{-}1.2269/N)^2 / 4$	$A(R) = \pi K^2/4$
F_T (Allow. Tensile Stress, D≤1/4")	33,333 psi	N/A psi	Allow able Tension = $F_T[A(S)]$	$A(S) = \pi\ (D\text{-}0.9743/N)^2 / 4$	$A(S) = \pi K^2/4$
F_T (Allow. Tensile Stress, D> 1/4")	40,000 psi	33,750 psi	$F_V = Fu / (\ SF \times \text{sq rt}\ (3))$		
F_V (Allowable Shear Strass; D≤1/4")	19,245 psi	N/A psi	Allowable Single Shear $= F_V[A(R)]$		
F_V (Allowable Shear Strass; D>1/4")	23,094 psi	19,486 psi			

NOTE 11:

1. Values are taken from AISC, ASTM, IFI, SAE and AA documents. K values for spaced threads are taken as the minimum values in IFI Fastener Handbook, 6th Ed. 2. Safety Factor used for fasteners with diameters 1/4" or less is 3.0, Safety Factor used for fasteners with diameters 5/16" or greater is 2.5.

3. Fasteners with diameters of 3/4" and greater are fabricated from different material than fasteners less than 3/4" in diameter.

4. For diameters of 3/4" and greater, F_y=45,00 psi. For these, tensile and shear yields govern the allowable tension and shear values (i.e., 0.75 F_y<F_u/SF

TABLE 20.3: Fastener Capacity

SAE Grade 5 Steel for Diameters up thru 9/16" (UNC Threads)
ASTM A 449 Steel for Diameters 5/8" and Over (UNC Threads)

Nominal Fastener Diameter & Threads per Inch	D Nominal Thread Diameter (in)	A(S) Tensile Stress Area (in2)	A(R) Thread Root Area (in2)	Allow able Tension (lbs)	Allow able Shear		Allow able Bearing (lbs)			Minimum Material Thickness (lbs) to Equal Tensile Capacity of Fastener (in)			Maximum Tensile Load (lbs) for Available 3/8" Plate Thickness		
					Single (lbs)	Double (lbs)	1/8" Steel A36	1/8" Aluminum 6063-T5	1/8" Aluminum 6063-T6	A36	6063-T5	6063-T6	3/8" Steel A36	3/8" Aluminum 6063-T5	3/8" Aluminum 6063-T6
#6-32	0.1380	0.0091	0.0078	363	180	360	900	253	345	0.1602	0.3046	0.2268	363	363	363
#8-32	0.1640	0.0140	0.0124	560	286	573	1,070	301	410	0.2079	> 3/8"	0.2953	560	522	560
#10-24	0.1900	0.0175	0.0151	701	350	700	1,240	348	475	0.2246	> 3/8"	0.3001	701	643	701
#12-24	0.2160	0.0242	0.0214	967	493	986	1,409	396	540	0.2594	> 3/8"	0.3619	967	734	967
1/4-20	0.2500	0.0318	0.0280	1,273	646	1,291	1,631	458	625	0.2745	> 3/8"	> 3/8"	1,273	865	1,179
5/16-18	0.3125	0.0524	0.0469	2,517	1,299	2,599	2,039	573	781	0.3144	> 3/8"	> 3/8"	2,517	1,303	1,776
3/8-16	0.3750	0.0775	0.0699	3,719	1,937	3,874	2,447	688	938	0.3518	> 3/8"	> 3/8"	3,719	1,572	2,144
7/16-14	0.4375	0.1063	0.0961	5,103	2,664	5,328	2,855	802	1,094	> 3/8"	> 3/8"	> 3/8"	4,937	1,873	2,554
1/2-13	0.5000	0.1419	0.1292	6,811	3,581	7,162	3,263	917	1,250	> 3/8"	> 3/8"	> 3/8"	5,642	2,140	2,918
9/16-12	0.5625	0.1819	0.1664	8,733	4,611	9,222	3,670	1,031	1,406	> 3/8"	> 3/8"	> 3/8"	6,444	2,444	3,333
5/8-11	0.6250	0.2260	0.2071	10,848	5,738	11,477	4,078	1,146	1,563	> 3/8"	> 3/8"	> 3/8"	7,148	2,711	3,697
3/4-10	0.7500	0.3345	0.3081	16,054	8,565	17,130	4,894	1,375	1,875	> 3/8"	> 3/8"	> 3/8"	8,612	3,266	4,454
7/8-9	0.8750	0.4617	0.4285	22,163	11,876	23,753	5,709	1,604	2,188	> 3/8"	> 3/8"	> 3/8"	10,158	3,853	5,254
1-8	1.0000	0.6057	0.5630	29,076	15,601	31,203	6,525	1,833	2,500	> 3/8"	> 3/8"	> 3/8"	11,696	4,437	6,050

	SAE Grade 5 (≤ 9/16")	ASTM A449 (≥ 5/8")	For All Diameters	Effective Area (UNC Threads)	Effective Area (Spaced Threads)
F_U (Min. Ultimate Tensile Strength)	120,000 psi	120,000 psi	$F_T = F_U/SF$	$A(R) = \pi\ (D\text{-}1.2269/N)^2 / 4$	$A(R) = \pi K^2/4$
F_T (Allow. Tensile Stress, D≤1/4")	40,000 psi	N/A	Allow able Tension = $F_T[A(S)]$	$A(S) = \pi\ (D\text{-}0.9743/N)^2 / 4$	$A(S) = \pi K^2/4$
F_T (Allow. Tensile Stress, D> 1/4")	48,000 psi	48,000 psi	$F_V = Fu / (\ SF \times \text{sq rt}\ (3))$		
F_V (Allowable Shear Strass; D≤1/4")	23,094 psi	N/A	Allowable Single Shear $= F_V[A(R)]$		
F_V (Allowable Shear Strass; D>1/4")	27,713 psi	27,713 psi			

6063-T6

Nominal Thread Diameter & Thread Per Inch	D Nominal Thread Diameter (Inch)	TSA(I) Internal Thread Stripping Area Sq. In./Thread	Aluminum Thickness (Inches)									
			0.060	0.072	0.080	0.094	0.125	0.156	0.188	0.250	0.312	0.375
			Allowable Pullout (Pounds)									
#8-32	0.1640	0.010270	83	100	132	155	206	273	341	474	592	712
#10-24	0.1900	0.016864	96	116	153	180	239	324	413	584	729	876
#12-24	0.2160	0.019273	110	132	174	204	271	370	471	668	833	1001
1/4-20	0.2500	0.027234	127	152	201	236	314	431	552	786	981	1179
5/16-18	0.3125	0.037983	--	--	--	354	471	648	831	1184	1478	1776
3/8-16	0.3750	0.051581	--	--	--	--	565	780	1001	1429	1784	2144
7/16-14	0.4375	0.070205	--	--	--	--	--	918	1185	1702	2125	2554
1/2-13	0.5000	0.086405	--	--	--	--	--	1049	1354	1946	2428	2918

6063-T6		
F_U (Tensile Ultimate Strength)	30000	psi
F_Y (Tensile Yield Strength)	25000	psi

Shading indicates transition region.

NOTE 26:

1. *Each table lists allowable pull-out (internal threads) values. SF = 3.0 for D ≤ 0.25"; SF = 2.5 for D ≥ 0.3125". Fastener allowable strength (basic tension and external threads) needs to be checked separately.*
2. *For pilot hole sizes refer to tables 21.1 to 21.7*
3. *Fastener pullout not shown for aluminum thickness less than approximately 2 threads, unless tested at a lesser thickness.*
4. *Multiple fastener connections and embrittlement need to be checked separately.*

6061-T6

Nominal Thread Diameter & Thread Per Inch	D Nominal Thread Diameter (Inch)	TSA(I) Internal Thread Stripping Area Sq. In./Threa	Aluminum Thickness (Inches)									
			0.060	0.072	0.080	0.094	0.125	0.156	0.188	0.250	0.312	0.375
			Allowable Pullout (Pounds)									
#8-32	0.1640	0.010270	117	140	185	217	288	366	446	601	750	901
#10-24	0.1900	0.016864	135	162	214	251	334	435	539	740	923	1110
#12-24	0.2160	0.019273	154	184	243	286	380	495	615	846	1055	1268
1/4-20	0.2500	0.027234	178	213	281	331	440	578	720	996	1243	1494
5/16-18	0.3125	0.037983	--	--	--	496	660	868	1083	1500	1872	2250
3/8-16	0.3750	0.051581	--	--	--	--	792	1044	1305	1811	2260	2716
7/16-14	0.4375	0.070205	--	--	--	--	--	1229	1545	2156	2691	3235
1/2-13	0.5000	0.086405	--	--	--	--	--	1405	1766	2464	3076	3697

6061-T6		
F_U (Tensile Ultimate Strength)	38000	psi
F_Y (Tensile Yield Strength)	35000	psi

Shading indicates transition region.

Glass Informational Bulletin **GANA FGMD 05-1212 (2018)**

Physical and Mechanical Properties of Typical Soda Lime Float Glass

Glass is a brittle material. It will act elastically until it fractures at ultimate load. That ultimate load will vary, depending upon the type and duration of the loads applied and the distribution, orientation and severity of the inhomogeneties and micro-flaws that exist in the surface of the glass. Because of this nature, glass cannot be engineered in the same way as other building envelope materials that have a predictable, specific strength. In those cases, factors can be (and are) assigned to help assure that breakage does not occur at the selected design load.

Because the ultimate strength of glass does vary, its strength can best be described statistically. Architects and engineers who wish to specify a design factor for glass in buildings must choose the anticipated wind load, its duration and the probability of glass breakage (defined as x per 1000 lites of glass at the initial occurrence of the design load). The International Building Code (IBC) currently used in the United States references ASTM E1300, which commonly uses a conservative factor of 8 per 1000 for vertical glazing.

Glass manufacturers can provide the appropriate data for determining the expected performance of their products. However, it remains the responsibility of the design professional to review these performance criteria and determine if they are suitable for the intended application. The following is a summary of the average physical and mechanical properties of soda lime float glass produced in North America.

- Modulus of Elasticity (E) is the mathematical description of an object or substance's tendency to be deformed elastically (i.e., non-permanently) when a force is applied to it. The elastic modulus of an object is defined as the slope of its stress-strain curve in the elastic deformation region.

  Modulus of Elasticity for glass is – 10.4×10^6 psi (71.7 GPa)

- Modulus of Rigidity (Shear) (*G*) is defined as the ratio of shear stress to the shear strain.

  – 4.3×10^6 psi (29.6 GPa)

- Poisson's Ratio (v) is the ratio, when a sample object is stretched, of the contraction (perpendicular to the applied load), to the extension (in the direction of the applied load).

  ~ 0.22

- Coefficient of Linear Thermal Expansion (α) defines the change in the length of an object with a change in temperature. Specifically, it measures the fractional change in volume per degree change in temperature at a constant pressure.

  ~ 4.6 x 10^{-6} strain per °F (8.3 x 10^{-6} strain per °C)

- Density (ρ) of a material is defined as its mass per unit volume

  ~ 157 lb/ft^3 (2500 kg/m^3)

- Modulus of Rupture (MOR) (Flexure)[a] is defined as a material's ability to resist deformation under load.

Glass Type	(mean)	(design: 8 in 1000)[b]
Annealed Glass	6,000 psi (41 MPa)	2,800 psi (19 MPa)
Heath Strengthened Glass	12,000 psi (83 MPa)	5,600 psi (39 MPa)
Fully Tempered Glass	24,000 psi (166 MPa)	11,200 psi (77 MPa)

note a - These are approximate values for short load durations (under 1 minute) for undamaged glass in four-sided support.
note b - Probability of breakage - note that these values are for the surface of the glass (not the edge) and do not take into consideration area effects.

- Hardness characterizes the scratch resistance of various minerals through the ability of a harder material to scratch a softer material

  Knoop's Scale ~ 470 - 605kg/mm^2

- Specific heat capacity (C) a measurable physical quantity that characterizes the amount of heat that is required to change an object's temperature by a given amount.

  ~ 0.20 - 0.21 Btu/lb x °F (0.84 - 0.88 J/ kg x K)

- Thermal conductivity (*k*) is the rate at which heat flows through a material between points at different temperatures, measured in watts per meter per degree.

  ~ 0.52 - 0.57 Btu/hr x ft x °F (0.9 - 1.0W K^{-1} m^{-1})

GANA

GANA FGMD 05-1212 (2018)

STAINLESS STEEL WELDING ELECTRODES

AC-DC (-16) titania coated electrodes are the most popular because their "dual-current" usage allows for the stocking of one type for all needs. This electrode coating provides a smooth stable arc, with low spatter and complete penetration. The spray type metal trans fer produces a smooth flat bead with very easy slag removal. Titania coated electrodes have exceptional starting characteristics and may be used in all positions.

MSDS SHEETS AVAILABLE

STAINLESS WELDING ELECTRODES

WELDING STAINLESS STL INFO.

SS FILLER METAL SELECTOR GUIDE

ELECTRODE CHART

Part No	Price per Pack	Size (dia)	Packaging	Usages	Typical Chemical Composition	Mechanical Properties of All Weld Metal (as welded)
E308-16		**AWS A5.4**				
308-16-332-1	$9.95	3/32	1 lb Pack	308 electrodes are used to weld unstabilized 18-8 stainless steels such as Types 301, 302, 304, 305, and 308. 308 electrodes provide corrosion resistance and physical properties equal to or greater than the steels for which they are recommended. Typical applications include dairy, distillery and restaurant equipment, and chemical tanks.	Carbon .05 Manganese 1.7 Silicon .52 Chromium 19.70 Nickel 9.30 Sulfur .021 Phosphorus .023 Nitrogen .04 Iron Balance	Tensile Strength 87,500 PSI .. 600 MPA Yield Strength 58,000 PSI .. 400 MPA Elongation ... 38%
308-16-332-8	$58.00	3/32	8 lb Pack			
308-16-332-10	$72.50	3/32	10 lb Pack			
308-16-18-1	$9.95	1/8	1 lb Pack			
308-16-18-10	$65.00	1/8	10 lb Pack			
308-16-532-1	$9.95	5/32	1 lb Pack			
308-16-532-10	$65.00	5/32	10 lb Pack			
E308L-16		**AWS A5.4**				
308L16-332-1	$11.95	3/32	1 lb Pack	308L is an extra low carbon electrode used to weld Types 304L and 347. The weld deposit contains a maximum of .04% carbon, which minimizes the formation of chromium carbides, and consequent susceptibility to intergranular corrosion. The weld deposit, with controlled ferrite, gives excellent notch toughness at -320°F (-196°C).	Carbon .03 Manganese 1.65 Silicon .43 Chromium 19.70 Nickel 9.30 Sulfur .02 Phosphorus .021 Nitrogen .05 Iron Balance	Tensile Strength 84,500 PSI . 580 MPA Yield Strength 55,000 PSI . 380 MPA Elongation ... 40%
308L16-332-8	$65.00	3/32	8 lb Pack			
308L16-332-10	$81.25	3/32	10 lb Pack			
308L16-18-1	$11.95	1/8	1 lb Pack			
308L16-18-10	$68.00	1/8	10 lb Pack			
308L16-532-1	$11.95	5/32	1 lb Pack			
308L16-532-10	$68.00	5/32	10 lb Pack			
E309-16		**AWS A5.4**				
309-16-116-1	$14.95	1/16	1 lb Pack	309 electrodes are used for the welding of similar alloys in wrought and cast form, as well as for dissimilar metals such as stainless steels to carbon or low alloy steels. They also can be used for a barrier layer before cladding. Welding of Types 405 and 430 can be accomplished without preheat, while Types 410, 442, and 446 may call for preheating of a minimum of 300°F (150°C).	Carbon .08 Manganese 1.70 Silicon .52 Chromium 23.5 Nickel 12.3 Sulfur .021 Phosphorus .024 Nitrogen .05 Iron Balance	Tensile Strength 87,500 PSI . 600 MPA Yield Strength 59,500 PSI . 400 MPA Elongation ... 35%
309-16-332-1	$10.95	3/32	1 lb Pack			
309-16-332-8	$68.00	3/32	8 lb Pack			
309-16-332-10	$85.00	3/32	10 lb Pack			
309-16-18-1	$10.95	1/8	1 lb Pack			
309-16-18-10	$69.50	1/8	10 lb Pack			
309-16-532-1	$10.95	5/32	1 lb Pack			
309-16-532-10	$69.50	5/32	10 lb Pack			
E309L-16		**AWS A5.4**				
309L16-332-1	$12.95	3/32	1 lb Pack	309L gives a weld deposit similar to 309, with reduced carbon levels (.04% maximum) that offer increased resistance to intergranular corrosion. Type 309L is ideal for joining stainless steels to themselves or to carbon or low alloy steels. 309L is preferred to 309 for cladding over carbon or low alloy steels, as well as dissimilar joints which undergo heat treatment.	Carbon .035 Manganese 1.58 Silicon .53 Chromium 23.45 Nickel 12.6 Sulfur .021 Phosphorus .024 Iron Balance	Tensile Strength 88,500 PSI .. 555 MPA Yield Strength 59,000 PSI .. 410 MPA Elongation ... 36%
309L16-332-8	$69.00	3/32	8 lb Pack			
309L16-332-10	$86.25	3/32	10 lb Pack			
309L16-18-1	$11.95	1/8	1 lb Pack			
309L16-18-10	$80.00	1/8	10 lb Pack			
309L16-532-1	$11.95	5/32	1 lb Pack			
309L16-532-10	$80.00	5/32	10 lb Pack			
E310-16		**AWS A5.4**				
310-16-332-1	$14.95	3/32	1 lb Pack	310 electrodes are used to weld stainless steels of similar composition in wrought and cast form. The weld deposit is fully austenitic, and as such calls for minimum heat input during welding.	Carbon .11 Manganese 1.90 Silicon .52 Chromium 26.2 Nickel 20.95 Sulfur .012 Phosphorus .016 Iron Balance	Tensile Strength 90,500 PSI . 525 MPA Yield Strength 61,500 PSI . 425 MPA Elongation ... 34%
310-16-332-8	$78.00	3/32	8 lb Pack			
310-16-332-10	$97.50	3/32	10 lb Pack			
310-16-18-1	$12.95	1/8	1 lb Pack			
310-16-18-10	$90.00	1/8	10 lb Pack			
310-16-532-1	$12.95	5/32	1 lb Pack			
310-16-532-10	$90.00	5/32	10 lb Pack			
E312-16		**AWS A5.4**				
312-16-332-1	$14.95	3/32	1 lb Pack	312 electrodes are used for welding wrought and cast alloys of similar composition as well as for welding of dissimilar metals. The weld deposits exhibit high tensile strength and after good resistance to abrasion.	Carbon .12 Manganese 1.80 Silicon .56 Chromium 29.3 Nickel 9.4 Sulfur .021 Phosphorus .022 Iron Balance	Tensile Strength 109,500 PSI .750 MPA Yield Strength 78,000 PSI ... 540 MPA Elongation ... 23%
312-16-332-8	$78.00	3/32	8 lb Pack			
312-16-332-10	$97.50	3/32	10 lb Pack			
312-16-18-1	$12.95	1/8	1 lb Pack			
312-16-18-10	$95.00	1/8	10 lb Pack			
312-16-532-1	$12.95	5/32	1 lb Pack			
312-16-532-10	$95.00	5/32	10 lb Pack			

RED HEAD
CONCRETE ANCHORING SPECIALISTS

DESCRIPTION/SUGGESTED SPECIFICATIONS

Tapcon Anchors —

SPECIFIED FOR ANCHORAGE INTO CONCRETE, BRICK OR BLOCK

The "original masonry" anchor that cuts its own threads into concrete, brick, or block. Maximum performance is achieved because the Tapcon Anchor, the Condrive Installation Tool, and the carbide-tipped Tapcon Drill Bits are designed to work as a system. It is essential to use the Condrive tool and the correct drill bit to assure consistent anchor performance.

PERFORMANCE TABLE

Tapcon® Anchors

Ultimate Tension and Shear Values (lbs/kN) in Solid Concrete

ANCHOR DIA.		MIN. DEPTH OF EMBEDMENT		f'c = 2000 PSI (13.8 MPa)				f'c = 3000 PSI (20.7 MPa)				f'c = 4000 PSI (27.6 MPa)			
				TENSION		SHEAR		TENSION		SHEAR		TENSION		SHEAR	
in.	(mm)	in.	(mm)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)
3/16	(4.8)	1	(25.4)	600	(2.7)	720	(3.2)	625	(2.8)	720	(3.2)	650	(2.9)	720	(3.2)
		1-1/4	(31.8)	845	(3.7)	720	(3.2)	858	(3.8)	720	(3.2)	870	(3.9)	720	(3.2)
		1-1/2	(38.1)	1,090	(4.8)	860	(3.8)	1,090	(4.8)	860	(3.8)	1,090	(4.8)	860	(3.8)
		1-3/4	(44.5)	1,450	(6.5)	870	(3.9)	1,455	(6.5)	870	(3.9)	1,460	(6.5)	990	(4.4)
1/4	(6.4)	1	(25.4)	750	(3.3)	900	(4.0)	775	(3.4)	900	(4.0)	800	(3.6)	1,360	(6.1)
		1-1/4	(31.8)	1,050	(4.7)	900	(4.0)	1,160	(5.2)	900	(4.0)	1,270	(5.6)	1,360	(6.1)
		1-1/2	(38.1)	1,380	(6.1)	1,200	(5.3)	1,600	(7.2)	1,200	(5.3)	1,820	(8.1)	1,380	(6.1)
		1-3/4	(44.5)	2,020	(9.0)	1,670	(7.4)	2,200	(9.8)	1,670	(7.4)	2,380	(10.6)	1,670	(7.4)

Safe working loads for single installation under static loading should not exceed 25% of the ultimate load capacity