Steel Studio USA Guardrails

Stainless Steel Railing Design Calculations

Based on IBC 2006

Prepared for

Steel Studio USA Inc.

Mill Valley, California

Design Criteria: Date: 4/4/08

1. Railing live loads per International Building Code 2006:

   Guardrails

   50 plf uniform load in any direction on top rail
   200 pound concentrated load in any direction on top rail
   50 lb concentrated load over 1 ft^2 of infill area
   Concentrated load and uniform loads need not be assumed to act concurrently

   Railing deflections per ASTM E985

   Members designed per AISC, "Manual of Steel Construction: Allowable Stress Design", 9th Edition.

2. Stainless Steel Member sizes shall be as recommended in the calculation booklet
3. Stainless Steel alloys shall be as recommended in the calculation booklet
4. Stainless steel fasteners to be minimum **Grade A2-70, Fu= 101 ksi**
5. Concrete strength is assumed to be 4,**000 psi, normal weight**
6. Concrete slabs and other anchoring substrate designed by others
7. Standard Anchor Bolts to be ***Hilti Hit HY150*** Adhesive Anchors with 2-1/2" Minimum Edge Distance and 3-1/2" Minimum Embedment

Design Summary:

Recommended Post Spacing for the Horizontal Guardrail System as Shown in the Calculations: ***6'-0" Maximum***

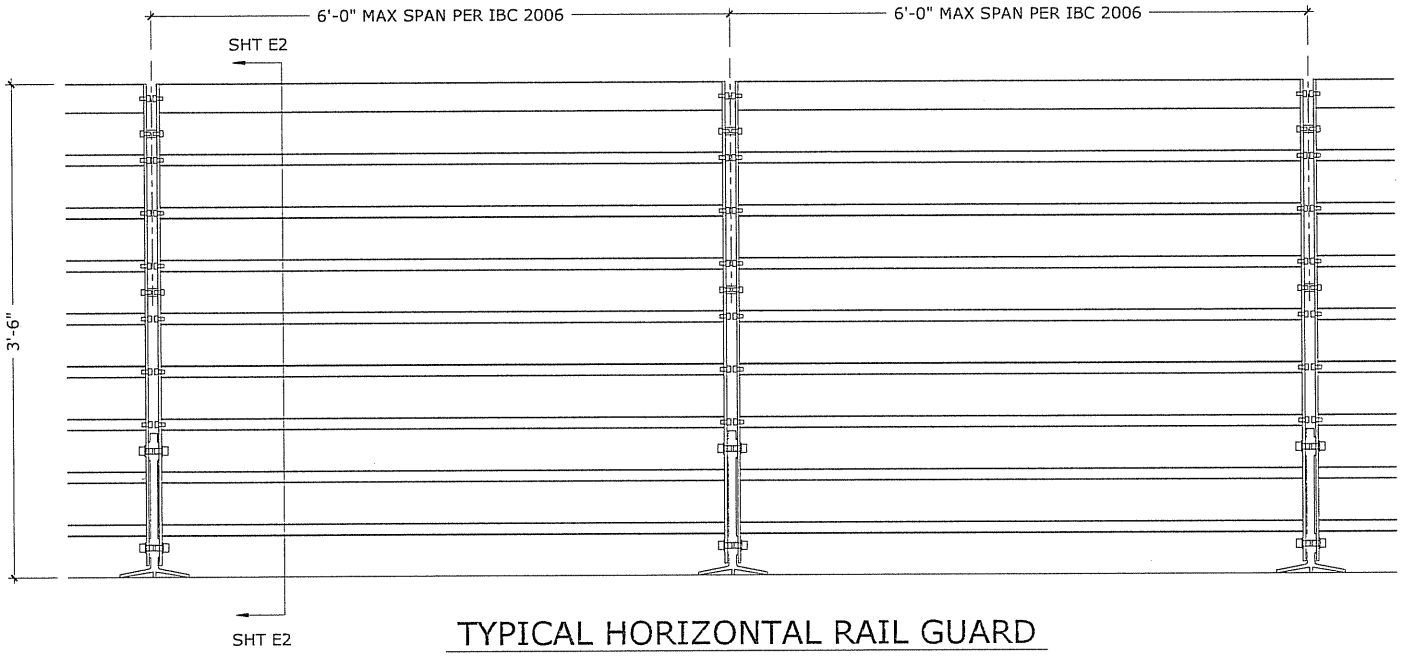
Recommended Post Spacing for the Vertical Guardrail System as Shown in the Calculations: ***6'-0" Maximum***

Recommended Post Spacing for the Glass Guardrail System as Shown in the Calculations: ***6'-0" Maximum***

6'-0" Maximum for Live Loads (IBC 2006), Maximum 27 PSF for Wind Loads
5'-6" Spans, Maximum 30 PSF for Wind Loads
5'-0" Spans, Maximum 33 PSF for Wind Loads
4'-6" Spans, Maximum 37 PSF for Wind Loads
4'-0" Spans, Maximum 41 PSF for Wind Loads

This Certification is limited to the structural design of structural components of this handrail system. It does NOT include responsibility for: • Structural design of misc. hardware (latches, hinges, etc.). • Concrete slabs and other masonry units designed by others • The manufacture, assembly, or installation of the system. • Quantities of materials or dimensional accuracy of drawings	Engineers Design Approval Stamp:

Elevation- Horizontal Rails	SHT E1

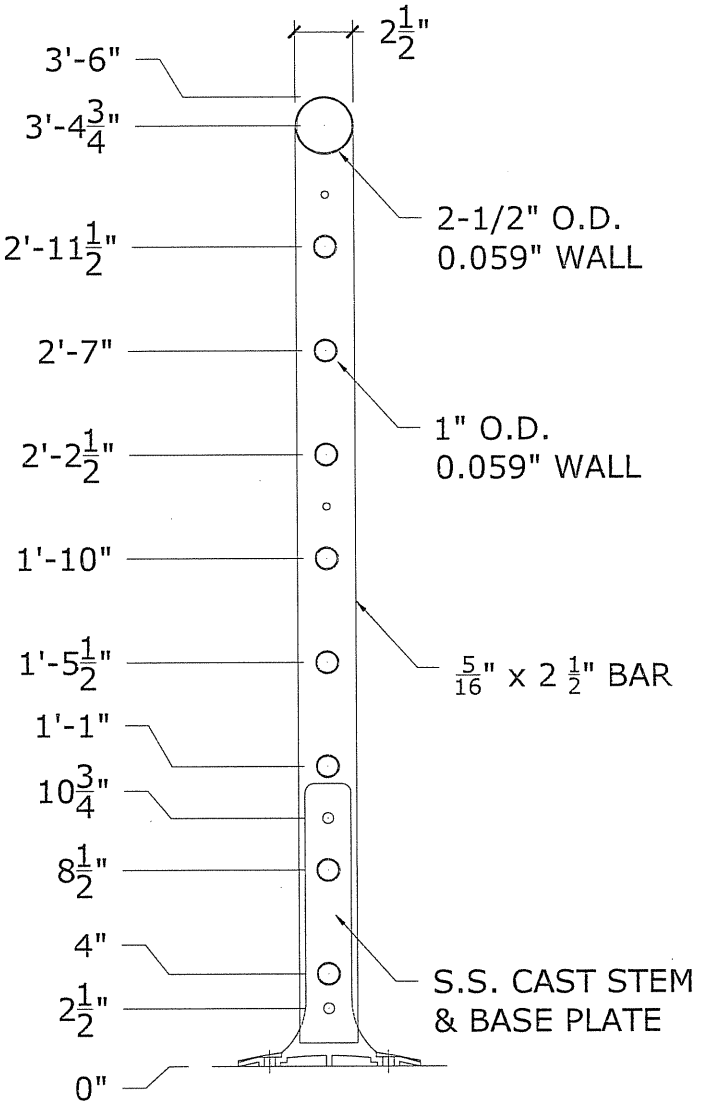


TYPICAL HORIZONTAL RAIL GUARD

* ***Top Rail, See Sht 1-1A***
* ***Mid-Rail, See Sht 2-2A***
* ***Posts, See Sht 3***
* ***Anchorage, See Sht 4***
* ***Cast Post Stem & Base Plate, See Sht 7***

RICE ***ENGINEERING*** Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No:	08-01-15C	
			Engineer: KEP	Sheet No: E1	
			Date: 1/24/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

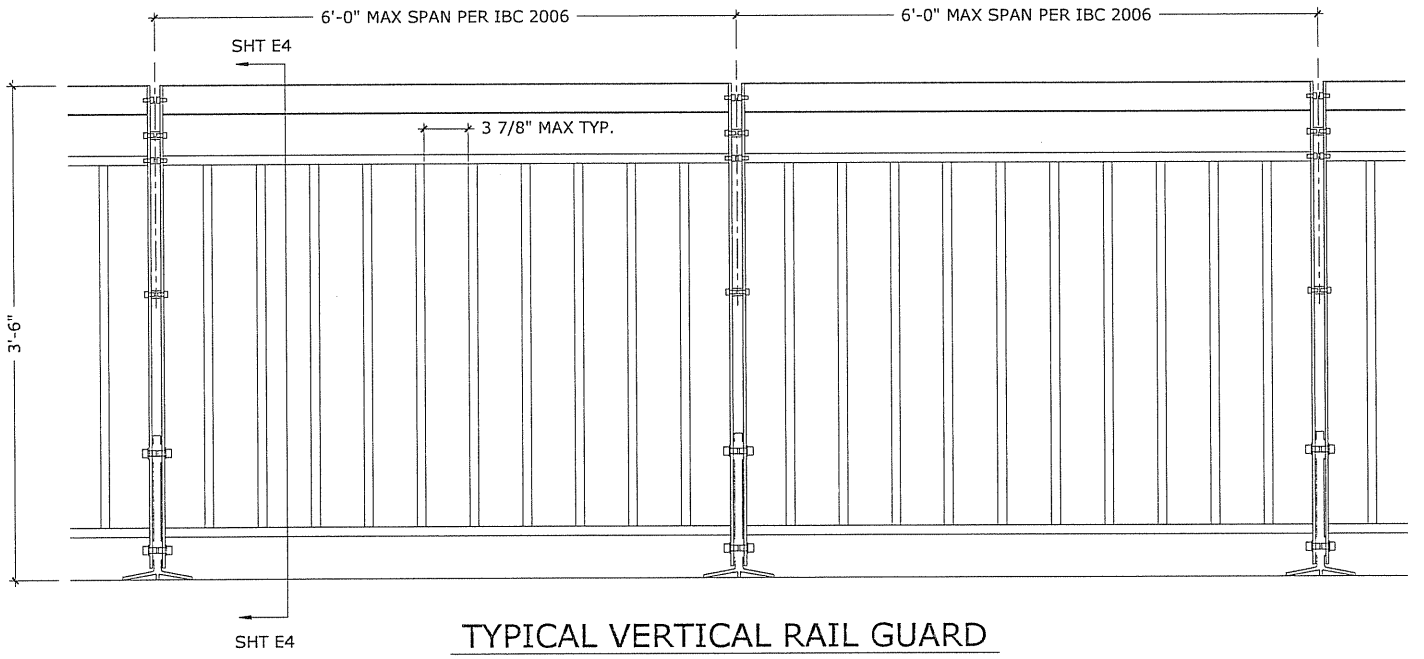
Section- Horizontal Rails	SHT E2



HORIZONTAL RAIL SECTION

RICE *ENGINEERING* Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No:	08-01-15C	
			Engineer: KEP	Sheet No: E2	
			Date: 1/24/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

Elevation- Vertical Rails	SHT E3

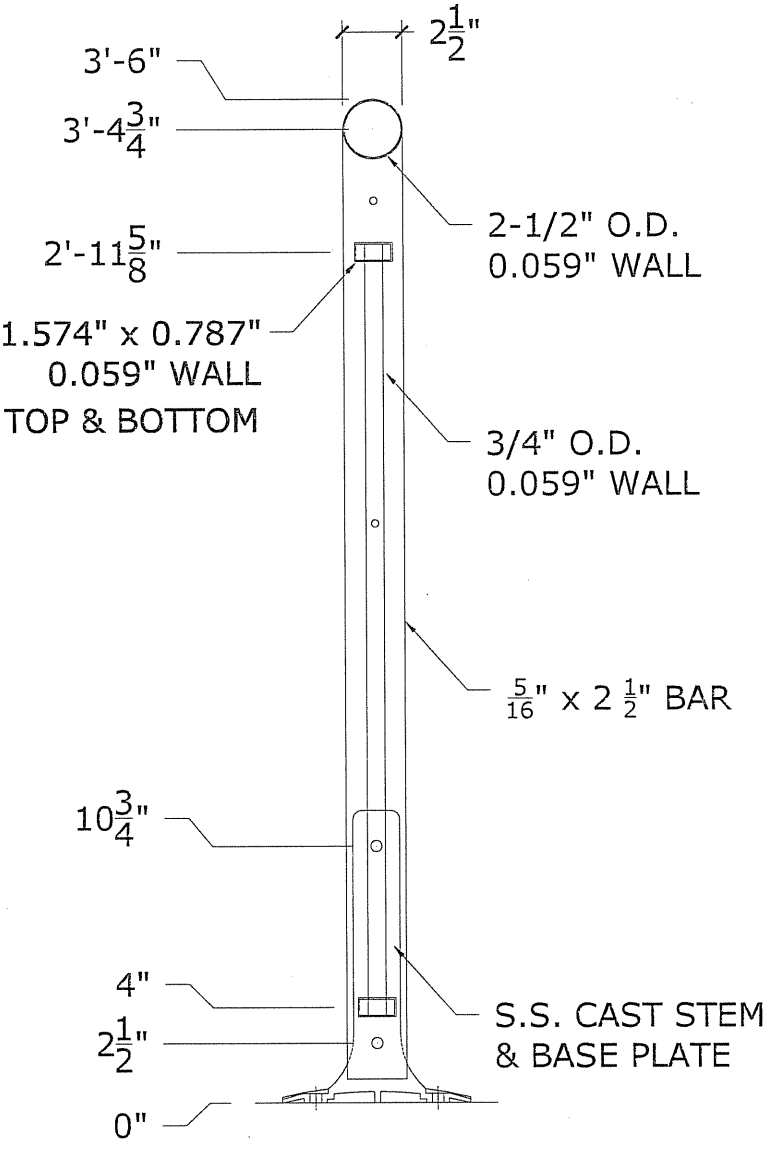


TYPICAL VERTICAL RAIL GUARD

* ***Top Rail, See Sht 1-1A***
* ***Picket Infill System, See Sht 2B***
* ***Posts, See Sht 3***
* ***Anchorage, See Sht 4***
* ***Cast Post Stem & Base Plate, See Sht 7***

RICE ***ENGINEERING*** Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No:	08-01-15C	
			Engineer: KEP	Sheet No: E3	
			Date: 3/31/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

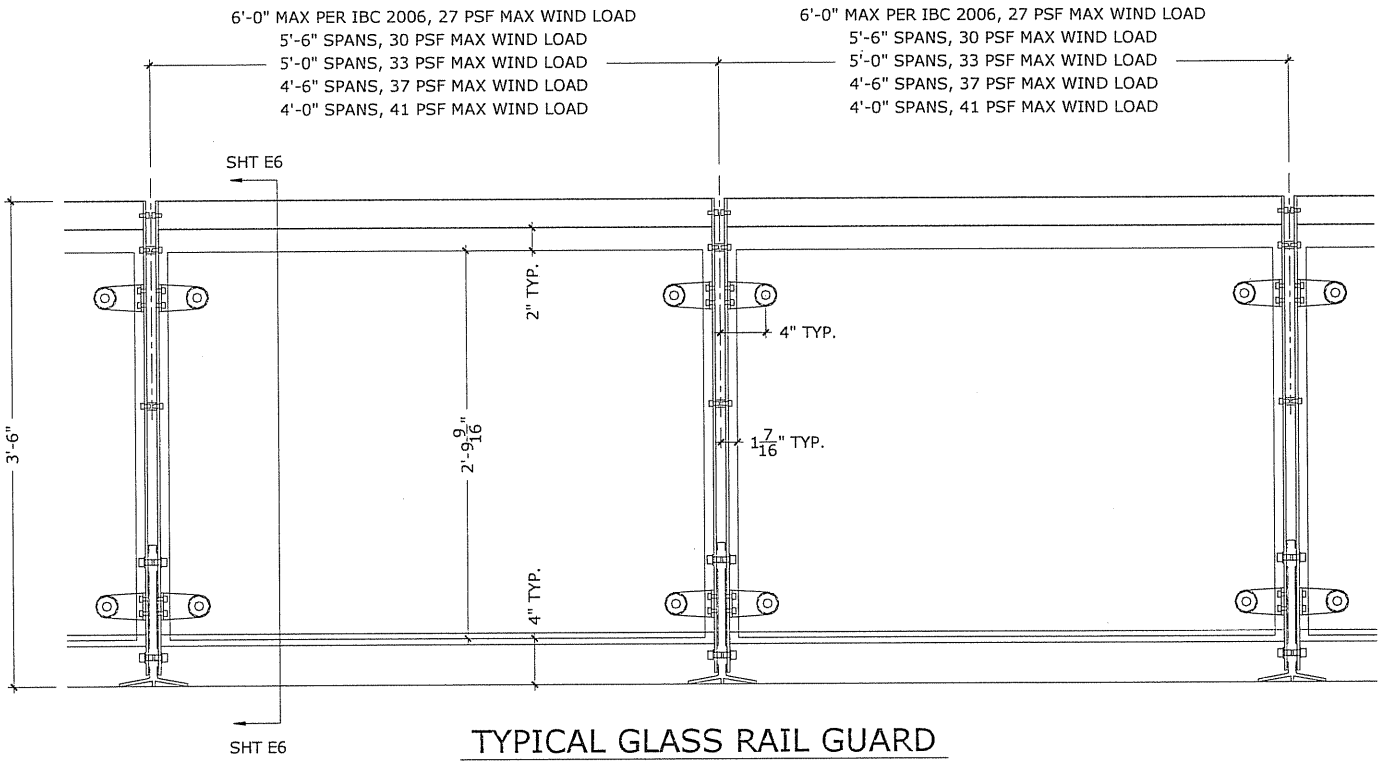
Section- Vertical Rails	SHT E4



VERTICAL RAIL SECTION

RICE *ENGINEERING* Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No:	08-01-15C	
			Engineer: KEP	Sheet No: E4	
			Date: 1/24/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

Elevation- Glass Rails	SHT E5

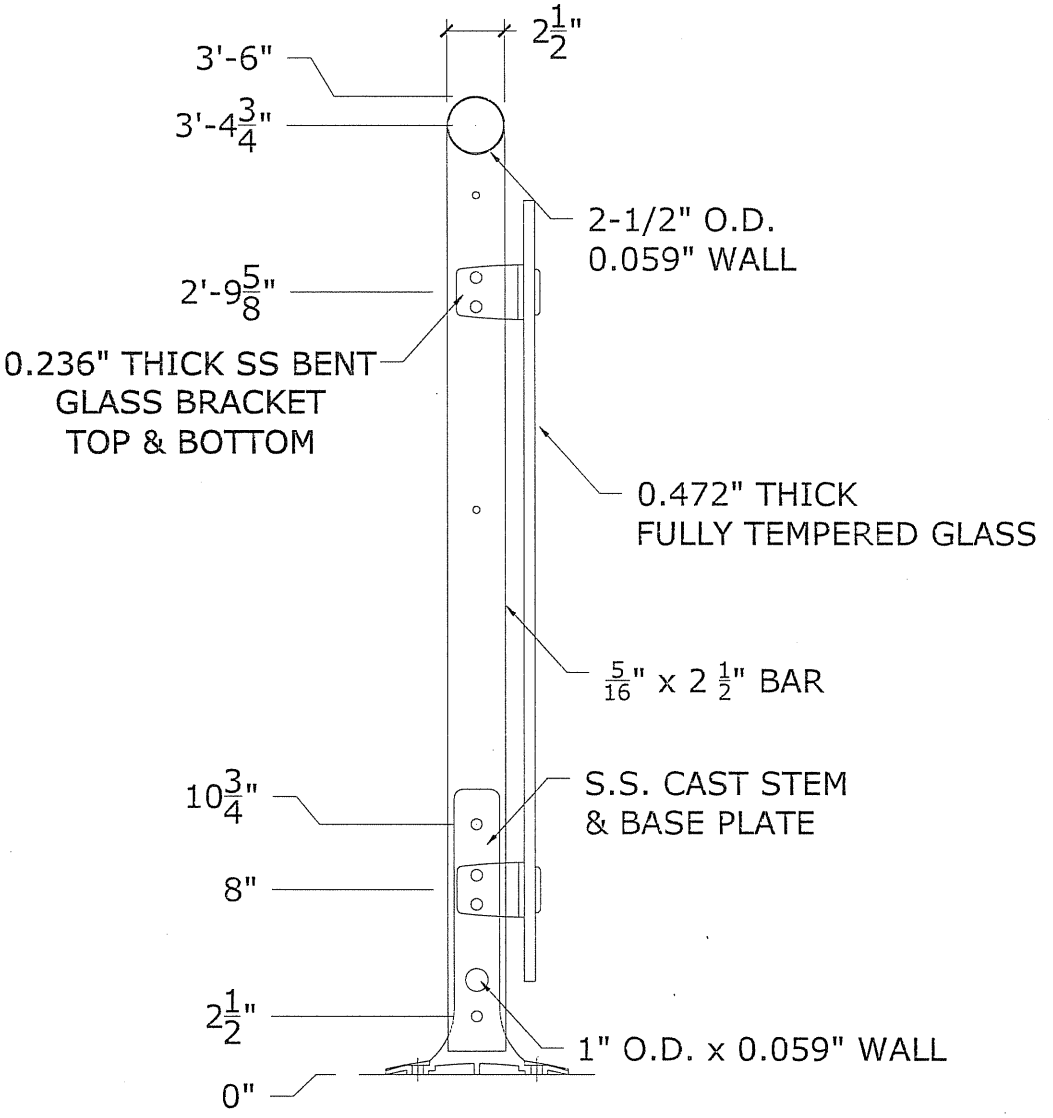


TYPICAL GLASS RAIL GUARD

* *Top Rail, See Sht 1-1A*
* *Posts, See Sht 3*
* *Glass & Glass Brackets, See Shts 5-5E*
* *Anchorage, See Shts 4 & 6*
* *Cast Post Stem & Base Plate, See Sht 7*

RICE ENGINEERING Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No: 08-01-15C		
			Engineer: KEP	Sheet No: E5	
			Date: 3/31/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

Section- Glass Rails	SHT E6



GLASS RAIL SECTION

RICE ENGINEERING Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No:	08-01-15C	
			Engineer: KEP	Sheet No: E6	
			Date: 3/31/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

Pipe Handrail

These calculations are based on emperical test data performed by Julius Blum & Co., Inc.

Top Rail Analysis	SHT 1

Input Variables:

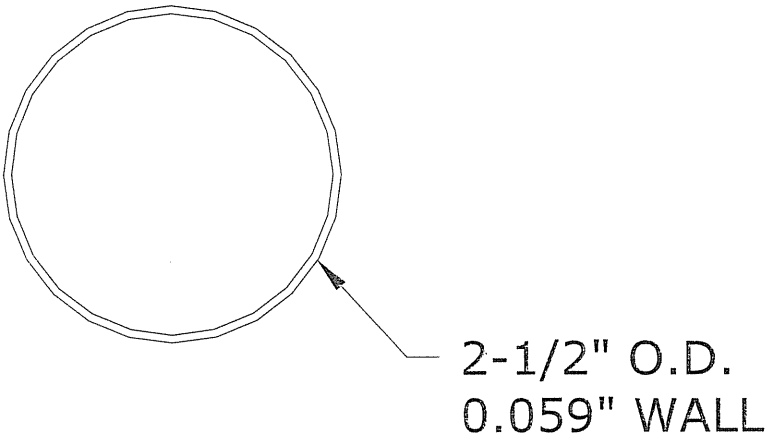
$F_H := 50$	$\frac{lb}{ft}$	Load Case 1 (Uniform Load)
$F_V := 0$	$\frac{lb}{ft}$	Optional vertical uniform load
$P := 200$	lb	Load Case 2 (Point Load)
$L := 72$	in	***MAX POST SPACING (cl to cl)***

Number of Railing Spans:

- [x] 1 span
- [ ] 2 span
- [ ] 3 or more spans

Railing Section:

- [x] 2-1/2" O.D. x 0.059" Wall
- [ ] 1 1/4" Schd. 80
- [ ] 1 1/2" Schd. 40
- [ ] 1 1/2" Schd. 80
- [ ] 1 1/2" tube
- [ ] 2" Schd. 40
- [ ] 2" Schd. 80



Railing Temper:

- [ ] 6063-T5
- [ ] 6063-T6
- [x] Stainless Steel (304A or 316A)

- [x] *4/3 increase allowed*

All calculations below this line are automatic

Railing Properties

Ixr=	0.337
Iyr=	0.337
Sxr=	0.27
Syr=	0.27
R=	1.25
t=	0.059

Computational Factors

$K_1 := (8 \cdot q1) + (8 \cdot q2) + (9.5 \cdot q3)$ $K_1 = 8$

$K_2 := (4 \cdot q1) + (5 \cdot q2) + (5 \cdot q3)$ $K_2 = 4$

$K_3 := (48 \cdot q1) + (66 \cdot q2) + (87 \cdot q3)$ $K_3 = 48$

$I_{xtotr} := I_{xr}$

$I_{ytotr} := I_{yr}$

RICE ENGINEERING Template: REI-MC-5703	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: Steel Studio USA Guardrails	Job No:	08-01-15C	
			Engineer: KEP	Sheet No: 1	
			Date: 1/25/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

Railing Analysis:

Top Rail Analysis	SHT 1 A

$L_{br} := L$

$E_r := \begin{cases} 28000000 & \text{if } S_r = 1 \\ 10100000 & \text{otherwise} \end{cases}$

Case 1 Uniform Load:

$\Delta_{yr1} := \left[\frac{5\cdot\left(\frac{F_H}{12}\right)\cdot L^4}{384\cdot E_r I_{ytotr}}\right]$ $\quad \Delta_{yr1} = 0.155$ in Modeled as a simple span

$\Delta_{xr1} := \left[\frac{5\cdot\left(\frac{F_V}{12}\right)\cdot L^4}{384\cdot E_r I_{xtotr}}\right]$ $\quad \Delta_{xr1} = 0$ in

$\Delta_{allr} := \frac{L}{120}$ $\quad \Delta_{allr} = 0.6$ in

$M_{yrmax} := \frac{\frac{F_H}{12}\cdot L^2}{K_1}$ $\quad M_{yrmax} = 2700$ lb·in

$M_{xrmax} := \frac{\frac{F_V}{12}\cdot L^2}{K_1}$ $\quad M_{xrmax} = 0$ lb·in

$F_{bry1} := 0.66\cdot(35000)$ $\quad F_{bry1} = 23100$ psi

$F_{brx1} := F_{bry1}$ $\quad F_{brx1} = 23100$ psi

$f_{bry1} := \frac{M_{yrmax}\cdot\left[I_{yr}\left(1 + 1.8S_r\right)\right]}{S_{yr} I_{ytotr}}$ $\quad f_{bry1} = 28000$ psi

$f_{brx1} := \frac{M_{xrmax}\cdot\left[I_{xr}\left(1 + 1.8\cdot S_r\right)\right]}{S_{xr} I_{xtotr}}$ $\quad f_{brx1} = 0$ psi

Case 1 Point Load:

$\Delta_{y3r} := \frac{P\cdot L^3}{K_3\cdot E_r I_{ytotr}}$ $\quad \Delta_{y3r} = 0.165$ in

$\Delta_{y4r} := \frac{P\cdot L^3}{K_3\cdot E_r I_{xtotr}}$ $\quad \Delta_{y4r} = 0.165$ in

$M_{yrmax2} := \frac{P\cdot L}{K_2}$ $\quad M_{yrmax2} = 3600$ lb·in

$M_{xrmax2} := \frac{P\cdot L}{K_2}$ $\quad M_{xrmax2} = 3600$ lb·in

$f_{bry2} := \frac{M_{yrmax2}\cdot I_{yr}}{S_{yr} I_{ytotr}}$

$f_{brx2} := \frac{M_{xrmax2}\cdot I_{xr}}{S_{xr} I_{xtotr}}$ $\quad f_{brx2} = 13333$ psi

$f_{bry2} = 13333$ psi

$F_{bry} := \begin{cases} \left(F_{bry1}\cdot 1.34\right) & \text{if IBC} = 1 \\ F_{bry1} & \text{otherwise} \end{cases}$

Calculation Results:

$Int_{r1} := \left(\frac{f_{brx1}}{F_{brx1}}\right) + \left(\frac{f_{bry1}}{F_{bry}}\right)$ $\quad Int_{r2} := \max\left[\left(\frac{f_{brx2}}{F_{brx1}}\right), \left(\frac{f_{bry2}}{F_{bry1}}\right)\right]$

$Rail := \begin{cases} \text{"HANDRAIL OK"} & \text{if } \max\left(Int_{r1}, Int_{r2}\right) \le 1.07 \\ \text{"HANDRAIL OVERSTRESSED"} & \text{otherwise} \end{cases}$

$Int_{r1} = 0.9$ $\quad Int_{r2} = 0.58$ $\quad$ Rail = "HANDRAIL OK"

RICE ENGINEERING Template: REI-M C-5703	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description:	Job No:	08-01-15C	
		Steel Studio USA Guardrails	Engineer: KEP	Sheet No: 1	
			Date: 1/25/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

Pipe Handrail

These calculations are based on emperical test data performed by Julius Blum & Co., Inc.

Mid Rail Analysis	SHT 2

Input Variables:

$F_H := 0$ $\frac{lb}{ft}$ Load Case 1 (Uniform Load)

$F_V := 0$ $\frac{lb}{ft}$ Optional vertical uniform load

$P := 50$ lb Load Case 2 (Point Load)

$L := 72$ in ***MAX POST SPACING (cl to cl)***

Number of Railing Spans:

1 span ☑

2 span ☐

3 or more spans ☐

Railing Section:

☑ 1" O.D. x 0.059" Wall

☐ 1 1/4" Schd. 80

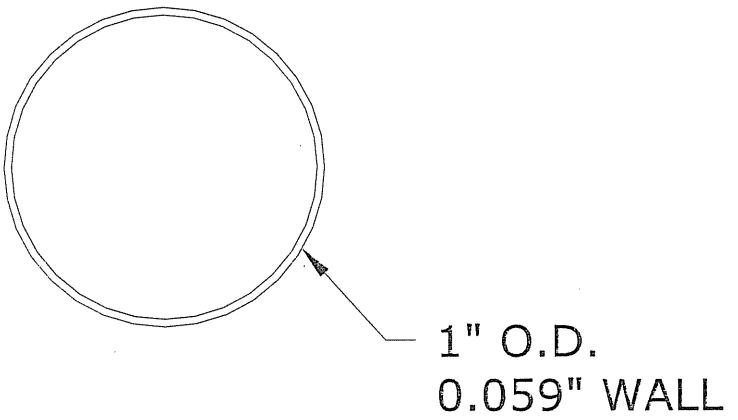
☐ 1 1/2" Schd. 40

☐ 1 1/2" Schd. 80

☐ 1 1/2" tube

☐ 2" Schd. 40

☐ 2" Schd. 80



Railing Temper:

☐ 6063-T5

☐ 6063-T6

☑ Stainless Steel (304A or 316A)

All calculations below this line are automatic

Railing Properties

Ixr=	0.019
Iyr=	0.019
Sxr=	0.039
Syr=	0.039
R=	0.5
t=	0.059

Computational Factors

$K_1 := (8 \cdot q1) + (8 \cdot q2) + (9.5 \cdot q3)$ $K_1 = 8$

$K_2 := (4 \cdot q1) + (5 \cdot q2) + (5 \cdot q3)$ $K_2 = 4$

$K_3 := (48 \cdot q1) + (66 \cdot q2) + (87 \cdot q3)$ $K_3 = 48$

$I_{xtotr} := I_{xr}$

$I_{ytotr} := I_{yr}$

RICE ENGINEERING
Template: REI-MC-5703

105 School Creek Trail
Luxemburg, WI 54217
Phone: (920)845-1042
Fax: (920)845-1048
www.rice-inc.com

Project Description: Steel Studio USA Guardrails

Job No:	08-01-15C		
Engineer:	KEP	Sheet No:	2
Date:	1/25/08	Rev:	
Chk By:	MPM	Date:	4/4/08

Railing Analysis:

Mid Rail Analysis	SHT 2 A

Case 1 Uniform Load:

$L_{br} := L$

$E_r := \begin{cases} 28000000 & \text{if } S_r = 1 \\ 10100000 & \text{otherwise} \end{cases}$

$\Delta_{yr1} := \left[\frac{5\cdot\left(\frac{F_H}{12}\right)\cdot L^4}{384\cdot E_r I_{ytotr}}\right]$ $\quad \Delta_{yr1} = 0$ in Modeled as a simple span

$\Delta_{xr1} := \left[\frac{5\cdot\left(\frac{F_V}{12}\right)\cdot L^4}{384\cdot E_r I_{xtotr}}\right]$ $\quad \Delta_{xr1} = 0$ in

$\Delta_{allr} := \frac{L}{120}$ $\quad \Delta_{allr} = 0.6$ in Per ASTM Specification E985

$M_{yrmax} := \frac{\frac{F_H}{12}\cdot L^2}{K_1}$ $\quad M_{yrmax} = 0$ lb·in

$M_{xrmax} := \frac{\frac{F_V}{12}\cdot L^2}{K_1}$ $\quad M_{xrmax} = 0$ lb·in

$F_{bry1} := 0.66\cdot(35000)$ $\quad F_{bry1} = 23100$ psi

$F_{brx1} := F_{bry1}$ $\quad F_{brx1} = 23100$ psi

$f_{bry1} := \frac{M_{yrmax}\cdot\left[I_{yr}\left(1 + 1.8S_r\right)\right]}{S_{yr} I_{ytotr}}$ $\quad f_{bry1} = 0$ psi

$f_{brx1} := \frac{M_{xrmax}\cdot\left[I_{xr}\left(1 + 1.8\cdot S_r\right)\right]}{S_{xr} I_{xtotr}}$ $\quad f_{brx1} = 0$ psi

Case 1 Point Load:

$\Delta_{y3r} := \frac{P\cdot L^3}{K_3\cdot E_r I_{ytotr}}$ $\quad \Delta_{y3r} = 0.731$ in

$\Delta_{y4r} := \frac{P\cdot L^3}{K_3\cdot E_r I_{xtotr}}$ $\quad \Delta_{y4r} = 0.731$ in

$M_{yrmax2} := \frac{P\cdot L}{K_2}$ $\quad M_{yrmax2} = 900$ lb·in

$M_{xrmax2} := \frac{P\cdot L}{K_2}$ $\quad M_{xrmax2} = 900$ lb·in

$f_{bry2} := \frac{M_{yrmax2}\cdot I_{yr}}{S_{yr} I_{ytotr}}$

$f_{brx2} := \frac{M_{xrmax2}\cdot I_{xr}}{S_{xr} I_{xtotr}}$

$f_{brx2} = 23077$ psi

$f_{bry2} = 23077$ psi

Calculation Results:

$Int_{r1} := \left(\frac{f_{brx1}}{F_{brx1}}\right) + \left(\frac{f_{bry1}}{F_{bry1}}\right)$ $\quad Int_{r2} := \max\left[\left(\frac{f_{brx2}}{F_{brx1}}\right), \left(\frac{f_{bry2}}{F_{bry1}}\right)\right]$

$Rail := \begin{cases} \text{"HANDRAIL OK"} & \text{if } \max\left(Int_{r1}, Int_{r2}\right) \le 1.07 \\ \text{"HANDRAIL OVERSTRESSED"} & \text{otherwise} \end{cases}$

Rail = "HANDRAIL OK"

$Int_{r1} = 0$ $\quad Int_{r2} = 1$

RICE ENGINEERING	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description:	Job No:	08-01-15C	
		Steel Studio USA Guardrails	Engineer: KEP	Sheet No:	2
			Date: 1/25/08	Rev:	
Template: REI-MC-5703			Chk By: MPM	Date:	4/4/08

Extruded Railing and Post

These calculations are based on emperical test data performed by Julius Blum & Co., Inc.

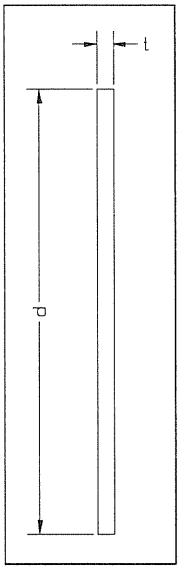
Post Analysis	SHT 3

Input Variables:

$F_H := 50$	$\frac{lb}{ft}$	Load Case 1 (Uniform Load)
$F_V := 0$	$\frac{lb}{ft}$	Optional vertical uniform load
$P := 200$	lb	Load Case 2 (Point Load)
$L_{bp} := 13.5$	in	Unbraced Length of Post
$h := 34.5$	in	Railing Height
$L := 72$	in	***POST SPACING (cl to cl)***

Number of Railing Spans:

- [x] 1 span
- [ ] 2 span
- [ ] 3 or more spans



Input d: 2.5 in.

Input t: 0.313 in.

Input L_b: 13.5 in.

==========

Post Section:

5in16 x 2 1/2

$A=$ 0.7825 in^2

$I_x=$ 0.4076 in^4

$I_y=$ 0.0064 in^4

$S_x=$ 0.3260 in^3

$S_y=$ 0.0408 in^3

Post Temper:

- [x] S.S. 304A
- [ ] 6061-T6

- [ ] *4/3 increase allowed*
- [ ] Post Welded to Base Plate

All calculations below this line are automatic

Post Properties

Ixp=	0.408
Iyp=	0.0064
Sxp=	0.326
Syp=	0.041
Jp=	0.026
Ep=	10100000
dp=	2.5

Computational Factors

$K_1 := (8 \cdot q1) + (8 \cdot q2) + (9.5 \cdot q3)$ $K_1 = 8$

$K_2 := (4 \cdot q1) + (5 \cdot q2) + (5 \cdot q3)$ $K_2 = 4$

$K_3 := (48 \cdot q1) + (66 \cdot q2) + (87 \cdot q3)$ $K_3 = 48$

$I_{xtotp} := I_{xp}$ $I_{xtotp} = 0.408$ in^4

$I_{ytotp} := I_{yp}$ $I_{ytotp} = 0.006$ in^4

RICE ENGINEERING
Template: REI-MC-5701

105 School Creek Trail
Luxemburg, WI 54217
Phone: (920)845-1042
Fax: (920)845-1048
www.rice-inc.com

Project Description: Steel Studio USA Guardrails

Job No:	08-01-15C		
Engineer:	KEP	Sheet No:	3
Date:	3/6/08	Rev:	
Chk By:	MPM	Date:	4/4/08

Post Analysis:

Case 1 - Uniform Load:

$$\Delta_{xp1} := \frac{\left(\frac{F_H}{12}\right)\cdot L\cdot h^3}{3\cdot E_p\cdot I_{xtotp}}$$ $\Delta_{xp1} = 0.996$ in

$\Delta_{allp} := \frac{h}{12}$ $\Delta_{allp} = 2.88$ in Per ASTM E985

$M_{xp} := \left(\frac{F_H}{12}\cdot L\cdot h\right) + \left(\frac{F_V}{12}\cdot L\right)\cdot\Delta_{xp1}$ $M_{xpmax} := 0.5\cdot M_{xp}\cdot q1 + M_{xp}q2 + M_{xp}\cdot q3$ $M_{xpmax} = 5175$ lb·in

$F_{bpx1} := 0.6\cdot(35000)$ $F_{bpx1} = 21000$ psi

$f_{bpx1} := \frac{M_{xpmax}\cdot I_{xp}}{S_{xp}\cdot I_{xtotp}}$ $f_{bpx1} = 15874$ psi

Case 2 - Point Load:

$\Delta_{xp2} := \frac{P\cdot h^3}{3\cdot E_p\cdot I_{xtotp}}$ $\Delta_{xp2} = 0.664$ in

$\Delta_{allp} := \frac{h}{12}$ $\Delta_{allp} = 2.88$ in Per ASTM E985

$M_{xpmax2} := P\cdot(h)\cdot(0.85)$ $M_{xpmax2} = 5865$ lb·in

$f_{bpx2} := \frac{M_{xpmax2}\cdot I_{xp}}{S_{xp}\cdot I_{xtotp}}$ $f_{bpx2} = 17991$ psi

$F_{bpx} := \begin{cases} (F_{bpx1}\cdot 1.34) & \text{if IBC = 1} \\ F_{bpx1} & \text{otherwise} \end{cases}$

Calculation Results:

$Int_{p1} := \left(\frac{f_{bpx1}}{F_{bpx}}\right)$ $Int_{p1} = 0.76$

$Int_{p2} := \left(\frac{f_{bpx2}}{F_{bpx}}\right)$ $Int_{p2} = 0.86$

$Post := \begin{cases} \text{"POST OK"} & \text{if } \max(Int_{p1}, Int_{p2}) \le 1.0 \\ \text{"POST OVERSTRESSED"} & \text{otherwise} \end{cases}$ Post = "POST OK"

Calculations for Hilti Hit HY150

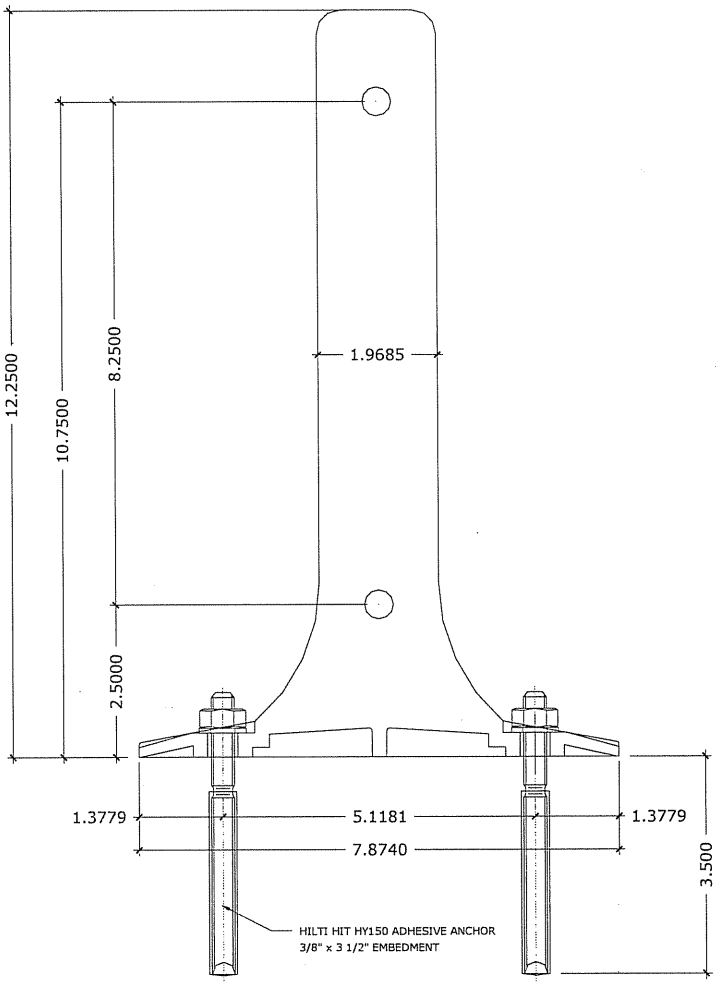
Anchor Bolts Live Loads	SHT 4

Assumptions:

Concrete: f'c = 4,000 psi

Edge Distance: 2-1/2"

Embedment: 3-1/2"



From Sht A1, Maximum Anchor Allowables are:

$T_{all} := 1848$ lb (See Sht A1)

$V_{all} := 551$ lb (See Sht A1)

Inputs:

$L := 6.5$ in

$CF := 0.85$ (Compression Factor)

$h := 34.5$ in (Height of Rail)

Per Sheet 3A, Design Reactions per IBC 2006 are:

$M_1 := 5175 \cdot (2)$ $M_1 = 10350$ in·lb

$V_1 := \frac{M_1}{h}$ $V_1 = 300$ lb

$M_{tot} := 5175 \cdot (2) + V_1 \cdot (6.625)$ $M_{tot} = 12338$ in·lb

Calculated Tension and Shear (per Anchor):

$T_{max} := \frac{M_{tot}}{L \cdot (CF)}$ $T_{max} = 2233$ lb

$V_{max} := \frac{V_1}{2}$ $V_{max} = 150$ lb

Interaction:

$$I := \left(\frac{T_{max}}{T_{all} \cdot 1.33}\right)^{\frac{5}{3}} + \left(\frac{V_{max}}{V_{all} \cdot 1.33}\right)^{\frac{5}{3}}$$

$I = 0.92$ < 1.0 "OK"

Use (2) - 3/8" Dia. S.S. HAS Rods w/Hilti Hit HY150 As Shown
Emb.= 3-1/2" ED.= 2-1/2"

** 4/3 Allowable Load Increase on Anchors Permitted per IBC2006*

RICE ENGINEERING Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No:	08-01-15C	
			Engineer: KEP	Sheet No: 4	
			Date: 3/6/08	Rev: 3/31/08	
			Chk By: MPM	Date: 4/4/08	

Glass Infill Railings

48" Span Loads Based on Wind Pressures	SHT 5

Input Variables:

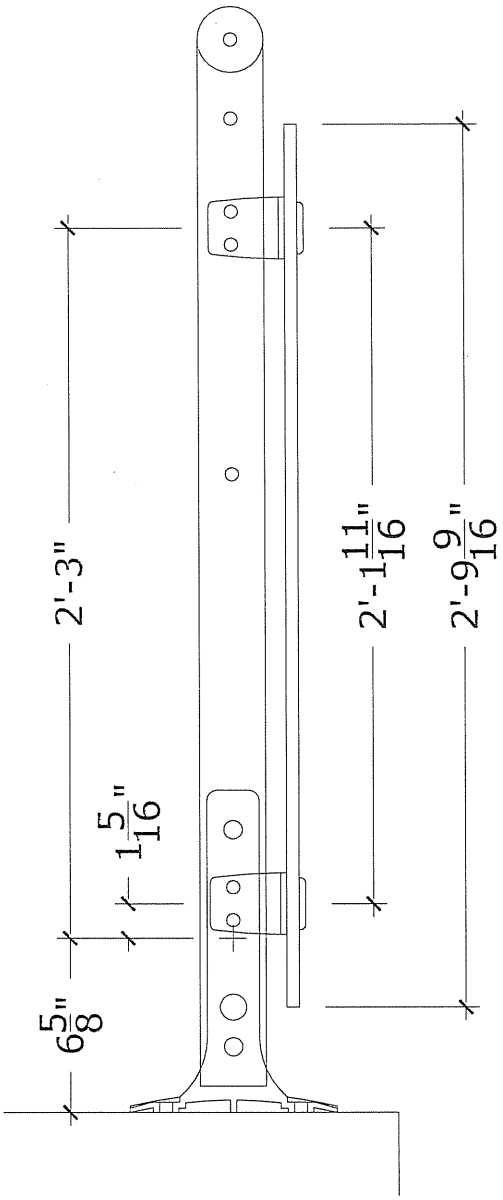
$H := 33.625$ in *(Glass height)*

$W := 45.25$ in *(Glass width)*

$t := 0.472$ in *(Glass thickness)*

$h_1 := 27$ in *(Post height - top bracket to CL Screws)*

$h_2 := 1.313$ in *(Post height - bottom bracket to CL Screws)*



Anchor Loads per 41 PSF:

$WL_1 := 41$ psf *(Wind Load)*

$R_{g1} := \frac{H \cdot WL_1 \cdot W}{2 \cdot 144}$ $R_{g1} = 217$ lb

$M_{p1} := (R_{g1} \cdot h_1) + (R_{g1} \cdot h_2)$ $M_{p1} = 6133$ in·lb

Check 12mm Glass:

$w := \frac{WL_1 \cdot H}{144}$ $w = 9.57$ pli

$M_g := \frac{w \cdot (48 - 4)^2}{8}$ $M_g = 2317$ in·lb

$S_{glass} := \frac{H \cdot t^2}{6}$ $S_{glass} = 1.25$ in^3

$f_{bglass} := \frac{M_g}{S_{glass}}$ $f_{bglass} = 1856$ psi < 6000 psi

$I_{glass} := \frac{H \cdot t^3}{12}$ $I_{glass} = 0.29$ in^4

$\Delta_g := \frac{5 \cdot w \cdot W^4}{384 \cdot 10400000 \cdot I_{glass}}$ $\Delta_g = 0.17$ in

$\Delta_{allg} := \frac{2W}{120}$ $\Delta_{allg} = 0.75$ in (3/4" Max)

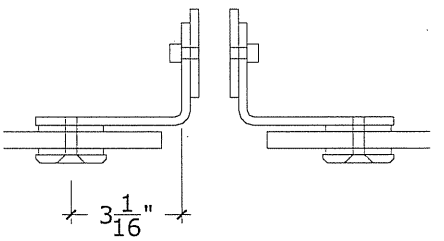
Use 12mm Fully Tempered Glass
as shown

Check 6mm Glass Bracket:

$t_2 := \frac{6}{25.4}$ $t_2 = 0.24$ in

$M_{pl} := 0.5 R_{g1} \cdot (3.0625)$ $M_{pl} = 332$ in·lb

$t_{req} := \sqrt{\frac{6 \cdot M_{pl}}{26250 \cdot (2.375)}}$ $t_{req} = 0.18$ in



Use 6mm SS Glass Bracket
as shown, 304A Minimum

RICE ENGINEERING Template: REI-MC-5709	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: Steel Studio USA Guardrails	Job No: 08-01-15C		
			Engineer: KEP	Sheet No: 5	
			Date: 3/31/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

Glass Infill Railings

54" Span Loads Based on Wind Pressures	SHT 5A

Input Variables:

$H := 33.625$ in *(Glass height)*

$W := 51.25$ in *(Glass width)*

$t := 0.472$ in *(Glass thickness)*

$h_1 := 27$ in *(Post height - top bracket to CL Screws)*

$h_2 := 1.313$ in *(Post height - bottom bracket to CL Screws)*

Anchor Loads per 37 PSF:

$WL_1 := 37$ psf *(Wind Load)*

$R_{g1} := \frac{H \cdot WL_1 \cdot W}{2 \cdot 144}$ $R_{g1} = 221$ lb

$M_{p1} := (R_{g1} \cdot h_1) + (R_{g1} \cdot h_2)$ $M_{p1} = 6268$ in·lb

Check 12mm Glass:

$w := \frac{WL_1 \cdot H}{144}$ $w = 8.64$ pli

$M_g := \frac{w \cdot (54 - 4)^2}{8}$ $M_g = 2700$ in·lb

$S_{glass} := \frac{H \cdot t^2}{6}$ $S_{glass} = 1.25$ in^3

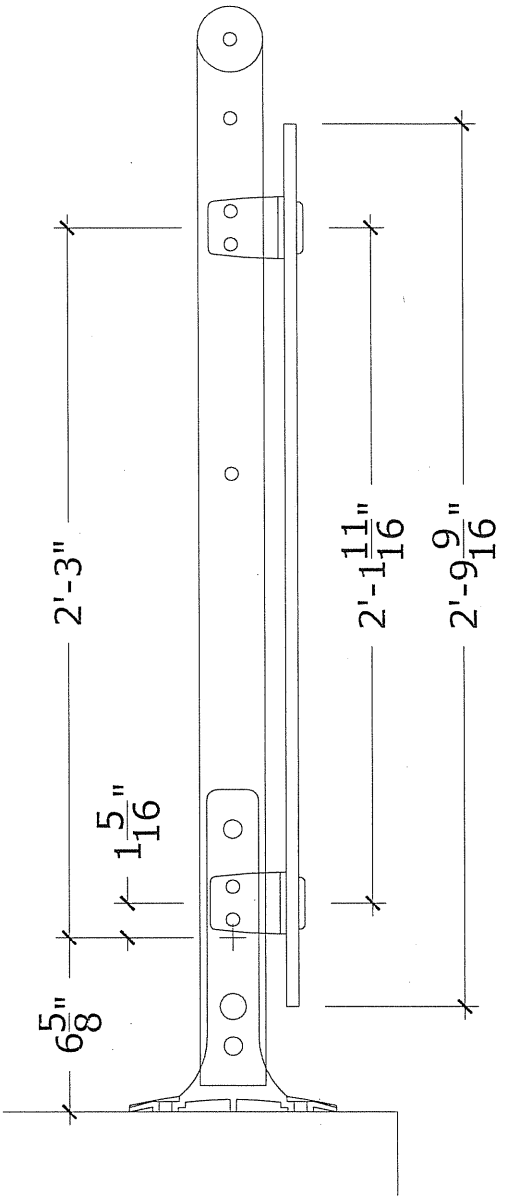
$f_{bglass} := \frac{M_g}{S_{glass}}$ $f_{bglass} = 2163$ psi < 6000 psi

$I_{glass} := \frac{H \cdot t^3}{12}$ $I_{glass} = 0.29$ in^4

$\Delta_g := \frac{5 \cdot w \cdot W^4}{384 \cdot 10400000 \cdot I_{glass}}$ $\Delta_g = 0.25$ in

$\Delta_{allg} := \frac{2W}{120}$ $\Delta_{allg} = 0.85$ in (3/4" Max)

Use 12mm Fully Tempered Glass
as shown

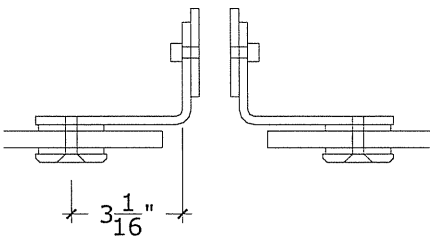


Check 6mm Glass Bracket:

$t_2 := \frac{6}{25.4}$ $t_2 = 0.24$ in

$M_{pl} := 0.5 R_{g1} \cdot (3.0625)$ $M_{pl} = 339$ in·lb

$t_{req} := \sqrt{\frac{6 \cdot M_{pl}}{26250 \cdot (2.375)}}$ $t_{req} = 0.18$ in



Use 6mm SS Glass Bracket
as shown, 304A Minimum

RICE *ENGINEERING* Template: REI-MC-5709	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: Steel Studio USA Guardrails	Job No: 08-01-15C; Engineer: KEP; Sheet No: 5A; Date: 3/31/08; Rev: ; Chk By: MPM; Date: 4/4/08

Glass Infill Railings

60" Span Loads Based on Wind Pressures	SHT 5B

Input Variables:

$H := 33.625$ in *(Glass height)*

$W := 57.25$ in *(Glass width)*

$t := 0.472$ in *(Glass thickness)*

$h_1 := 27$ in *(Post height - top bracket to CL Screws)*

$h_2 := 1.313$ in *(Post height - bottom bracket to CL Screws)*

Anchor Loads per 33 PSF:

$WL_1 := 33$ psf *(Wind Load)*

$R_{g1} := \frac{H \cdot WL_1 \cdot W}{2 \cdot 144}$ $R_{g1} = 221$ lb

$M_{p1} := (R_{g1} \cdot h_1) + (R_{g1} \cdot h_2)$ $M_{p1} = 6245$ in·lb

Check 12mm Glass:

$w := \frac{WL_1 \cdot H}{144}$ $w = 7.71$ pli

$M_g := \frac{w \cdot (60 - 4)^2}{8}$ $M_g = 3021$ in·lb

$S_{glass} := \frac{H \cdot t^2}{6}$ $S_{glass} = 1.25$ in^3

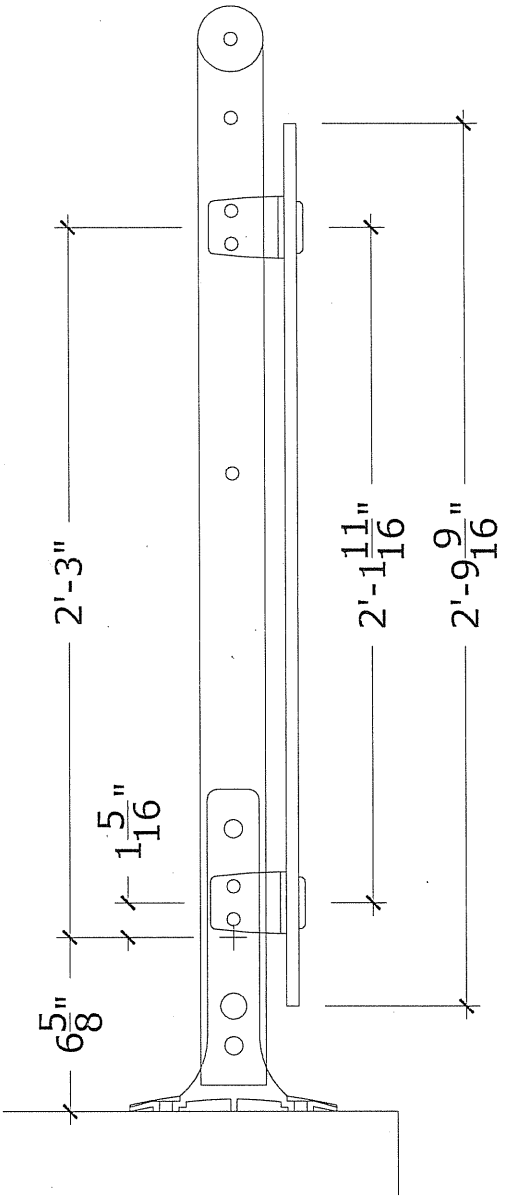
$f_{bglass} := \frac{M_g}{S_{glass}}$ $f_{bglass} = 2419$ psi < 6000 psi

$I_{glass} := \frac{H \cdot t^3}{12}$ $I_{glass} = 0.29$ in^4

$\Delta_g := \frac{5 \cdot w \cdot W^4}{384 \cdot 10400000 \cdot I_{glass}}$ $\Delta_g = 0.35$ in

$\Delta_{allg} := \frac{2W}{120}$ $\Delta_{allg} = 0.95$ in (3/4" Max)

Use 12mm Fully Tempered Glass
as shown

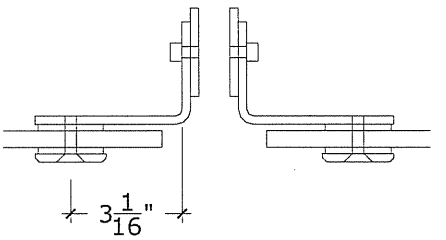


Check 6mm Glass Bracket:

$t_2 := \frac{6}{25.4}$ $t_2 = 0.24$ in

$M_{pl} := 0.5 R_{g1} \cdot (3.0625)$ $M_{pl} = 338$ in·lb

$t_{req} := \sqrt{\frac{6 \cdot M_{pl}}{26250 \cdot (2.375)}}$ $t_{req} = 0.18$ in



Use 6mm SS Glass Bracket
as shown, 304A Minimum

RICE *ENGINEERING* Template: REI-MC-5709	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: Steel Studio USA Guardrails	Job No: 08-01-15C; Engineer: KEP; Sheet No: 5B; Date: 3/31/08; Rev: ; Chk By: MPM; Date: 4/4/08

Glass Infill Railings

66" Span Loads Based on Wind Pressures	SHT 5C

Input Variables:

$H := 33.625$ in *(Glass height)*

$W := 63.25$ in *(Glass width)*

$t := 0.472$ in *(Glass thickness)*

$h_1 := 27$ in *(Post height - top bracket to CL Screws)*

$h_2 := 1.313$ in *(Post height - bottom bracket to CL Screws)*

Anchor Loads per 30 PSF:

$WL_1 := 30$ psf *(Wind Load)*

$R_{g1} := \frac{H \cdot WL_1 \cdot W}{2 \cdot 144}$ $R_{g1} = 222$ lb

$M_{p1} := (R_{g1} \cdot h_1) + (R_{g1} \cdot h_2)$ $M_{p1} = 6272$ in·lb

Check 12mm Glass:

$w := \frac{WL_1 \cdot H}{144}$ $w = 7.01$ pli

$M_g := \frac{w \cdot (66 - 4)^2}{8}$ $M_g = 3366$ in·lb

$S_{glass} := \frac{H \cdot t^2}{6}$ $S_{glass} = 1.25$ in^3

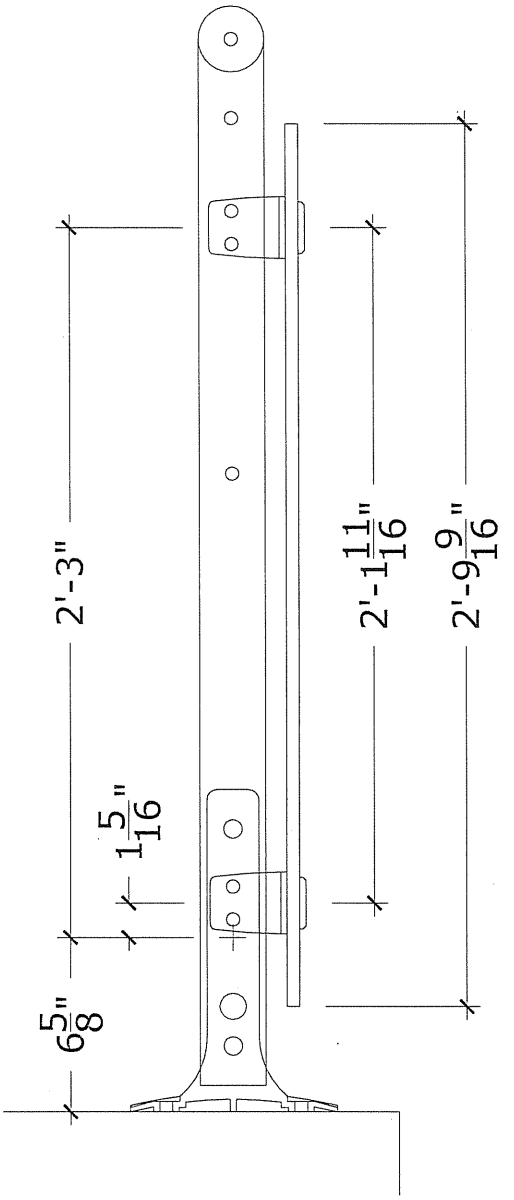
$f_{bglass} := \frac{M_g}{S_{glass}}$ $f_{bglass} = 2696$ psi < 6000 psi

$I_{glass} := \frac{H \cdot t^3}{12}$ $I_{glass} = 0.29$ in^4

$\Delta_g := \frac{5 \cdot w \cdot W^4}{384 \cdot 10400000 \cdot I_{glass}}$ $\Delta_g = 0.48$ in

$\Delta_{allg} := \frac{2W}{120}$ $\Delta_{allg} = 1.05$ in (3/4" Max)

Use 12mm Fully Tempered Glass
as shown

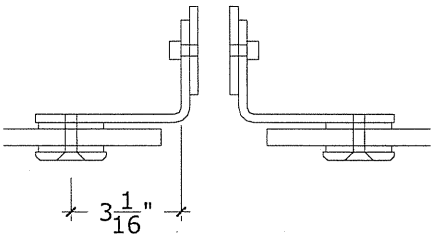


Check 6mm Glass Bracket:

$t_2 := \frac{6}{25.4}$ $t_2 = 0.24$ in

$M_{pl} := 0.5 R_{g1} \cdot (3.0625)$ $M_{pl} = 339$ in·lb

$t_{req} := \sqrt{\frac{6 \cdot M_{pl}}{26250 \cdot (2.375)}}$ $t_{req} = 0.18$ in



Use 6mm SS Glass Bracket
as shown, 304A Minimum

RICE ENGINEERING Template: REI-MC-5709	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: Steel Studio USA Guardrails	Job No: 08-01-15C Engineer: KEP — Sheet No: 5C Date: 3/31/08 — Rev: Chk By: MPM — Date: 4/4/08

Glass Infill Railings

72" Span Loads Based on Wind Pressures	SHT 5D

Input Variables:

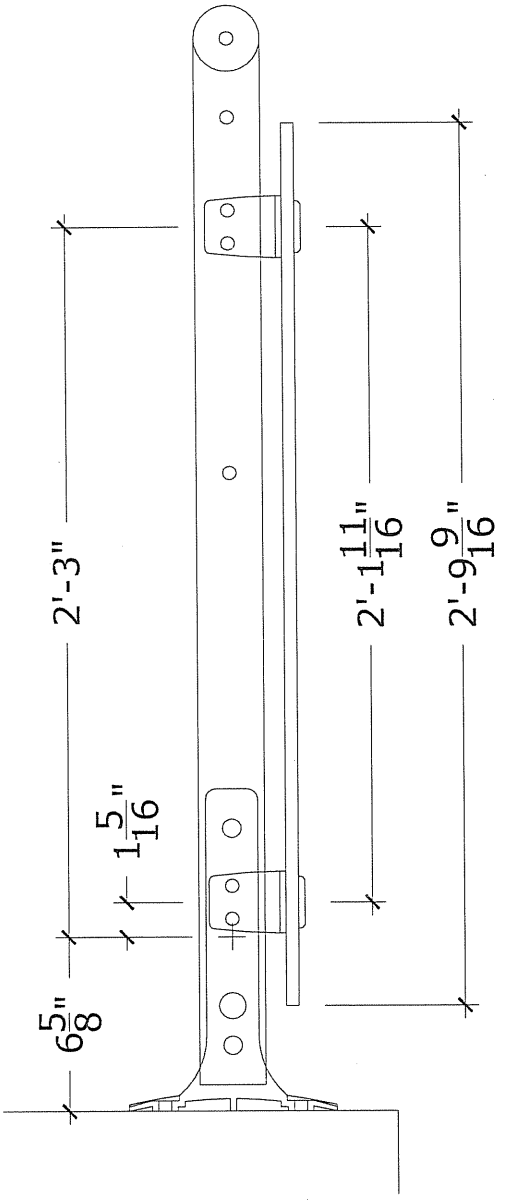
$H := 33.625$ in *(Glass height)*

$W := 69.25$ in *(Glass width)*

$t := 0.472$ in *(Glass thickness)*

$h_1 := 27$ in *(Post height - top bracket to CL Screws)*

$h_2 := 1.313$ in *(Post height - bottom bracket to CL Screws)*



Anchor Loads per 27 PSF:

$WL_1 := 27$ psf *(Wind Load)*

$R_{g1} := \frac{H \cdot WL_1 \cdot W}{2 \cdot 144}$ $R_{g1} = 218$ lb

$M_{p1} := (R_{g1} \cdot h_1) + (R_{g1} \cdot h_2)$ $M_{p1} = 6181$ in·lb

Check 12mm Glass:

$w := \frac{WL_1 \cdot H}{144}$ $w = 6.3$ pli

$M_g := \frac{w \cdot (66 - 4)^2}{8}$ $M_g = 3029$ in·lb

$S_{glass} := \frac{H \cdot t^2}{6}$ $S_{glass} = 1.25$ in^3

$f_{bglass} := \frac{M_g}{S_{glass}}$ $f_{bglass} = 2426$ psi < 6000 psi

$I_{glass} := \frac{H \cdot t^3}{12}$ $I_{glass} = 0.29$ in^4

$\Delta_g := \frac{5 \cdot w \cdot W^4}{384 \cdot 10400000 \cdot I_{glass}}$ $\Delta_g = 0.62$ in

$\Delta_{allg} := \frac{2W}{120}$ $\Delta_{allg} = 1.15$ in (3/4" Max)

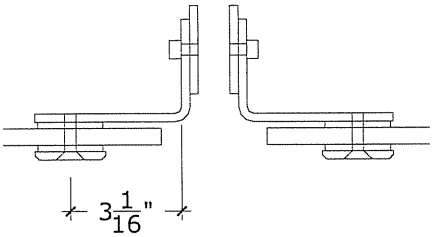
Use 12mm Fully Tempered Glass
as shown

Check 6mm Glass Bracket:

$t_2 := \frac{6}{25.4}$ $t_2 = 0.24$ in

$M_{pl} := 0.5 R_{g1} \cdot (3.0625)$ $M_{pl} = 334$ in·lb

$t_{req} := \sqrt{\frac{6 \cdot M_{pl}}{26250 \cdot (2.375)}}$ $t_{req} = 0.18$ in



Use 6mm SS Glass Bracket
as shown, 304A Minimum

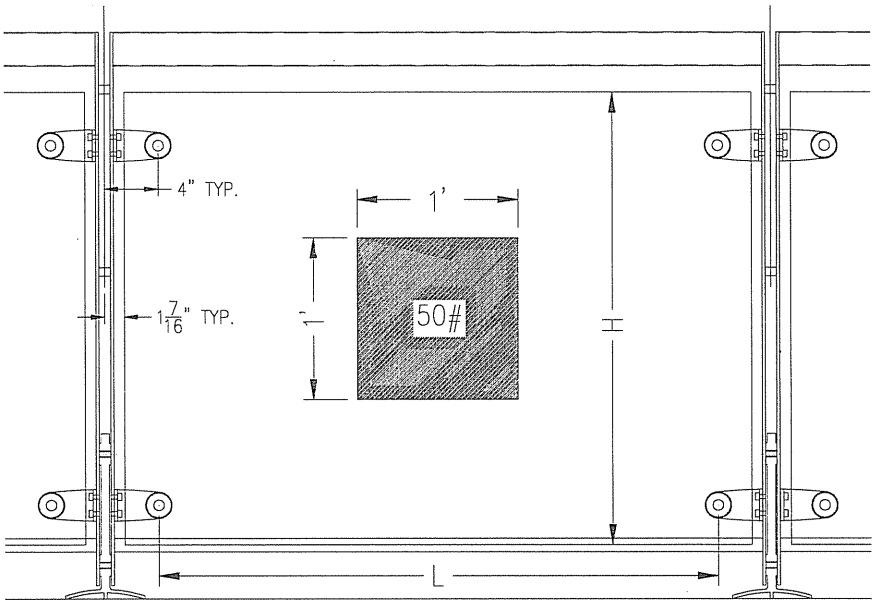
RICE ENGINEERING
Template: REI-MC-5709

105 School Creek Trail
Luxemburg, WI 54217
Phone: (920)845-1042
Fax: (920)845-1048
www.rice-inc.com

Project Description: Steel Studio USA Guardrails

Job No:	08-01-15C		
Engineer:	KEP	Sheet No:	5D
Date:	3/31/08	Rev:	
Chk By:	MPM	Date:	4/4/08

Glass Infill Check per IBC 2006	SHT 5E



Glass Analysis:

Case 1 - Live Load:

$H := 33.625$ in

$L := 69.25$ in

$t := 0.472$ in

$I_y := \frac{L \cdot t^3}{12}$ $I_y = 0.607$ in^4

$S_y := \frac{L \cdot t^2}{6}$ $S_y = 2.57$ in^3

$E := 10100000$

$Load := 50$ psf

$M := \frac{Load \cdot L}{4}$ $M = 865.63$ lb·in

$f_b := \frac{M}{S_y}$ $f_b = 337$ psi

$F_b := 6000$ psi

$\Delta := \frac{Load \cdot L^3}{48E \cdot I_y}$ $\Delta = 0.0564$ in

$\Delta_{all} := \frac{2H}{175}$ $\Delta_{all} = 0.38$ in

Use 12mm thick fully tempered glass w/ polished edges, as shown

RICE ENGINEERING Template:	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: Steel Studio USA Guardrails	Job No:	08-01-15C	
			Engineer: KEP	Sheet No:	5E
			Date: 3/31/08	Rev:	
			Chk By: MPM	Date:	4/4/08

Calculations for Hilti Hit HY150

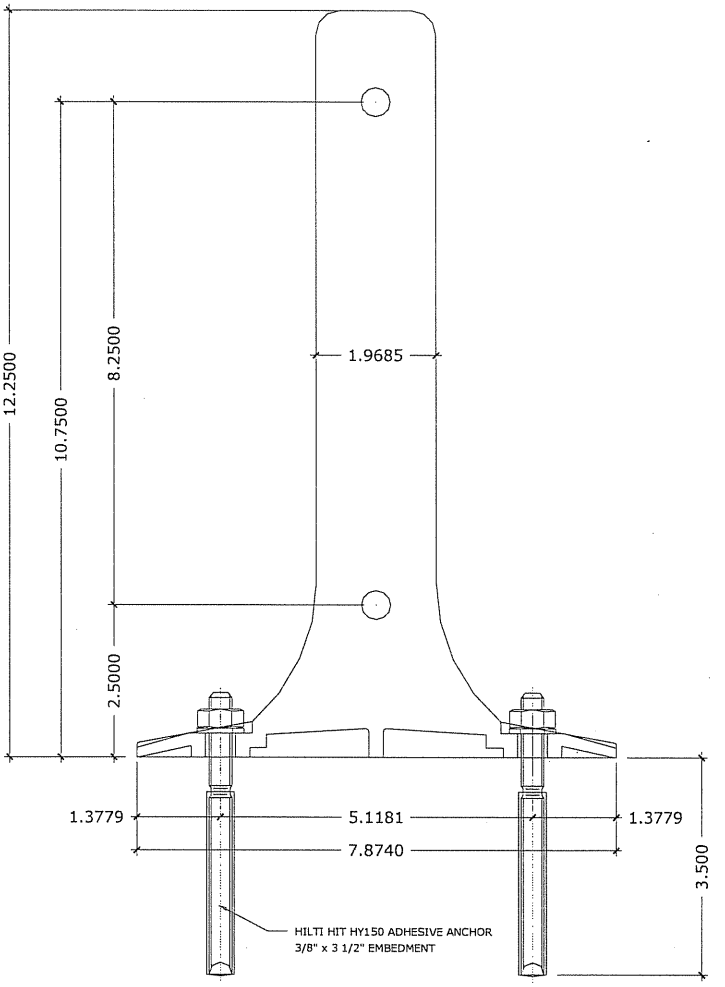
Worse Case Anchor Bolts per Wind Loads	SHT 6

Assumptions:

Concrete: f'c = 4,000 psi

Edge Distance: 2-1/2"

Embedment: 3-1/2"



From Sht A1, Maximum Anchor Allowables are:

$T_{all} := 1848$ lb (See Sht A1)

$V_{all} := 551$ lb (See Sht A1)

Inputs:

$L := 6.5$ in

$CF := 0.85$ (Compression Factor)

$h := 27$ in (Height of Rail)

Per Sheet 5C, Design Reactions are:

$M_1 := 6272$ in·lb

$V_1 := 221 \cdot (2)$ $V_1 = 442$ lb

$M_{tot} := M_1 + V_1 \cdot (6.625)$ $M_{tot} = 9200$ in·lb

Calculated Tension and Shear (per Anchor):

$$T_{max} := \frac{M_{tot}}{L \cdot (CF)}$$ $T_{max} = 1665$ lb

$$V_{max} := \frac{V_1}{2}$$ $V_{max} = 221$ lb

Interaction:

$$I := \left(\frac{T_{max}}{T_{all}}\right)^{\frac{5}{3}} + \left(\frac{V_{max}}{V_{all}}\right)^{\frac{5}{3}}$$

$I = 1.06$ 7% over "OK"

Use (2) - 3/8" Dia. or M10 S.S. HAS Rods w/Hilti Hit HY150 As Shown
Emb.= 3-1/2" ED.= 2-1/2"

RICE ENGINEERING Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No:	08-01-15C	
			Engineer: KEP	Sheet No: 6	
			Date: 3/31/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

Calculations for Cast Post Stem and Base

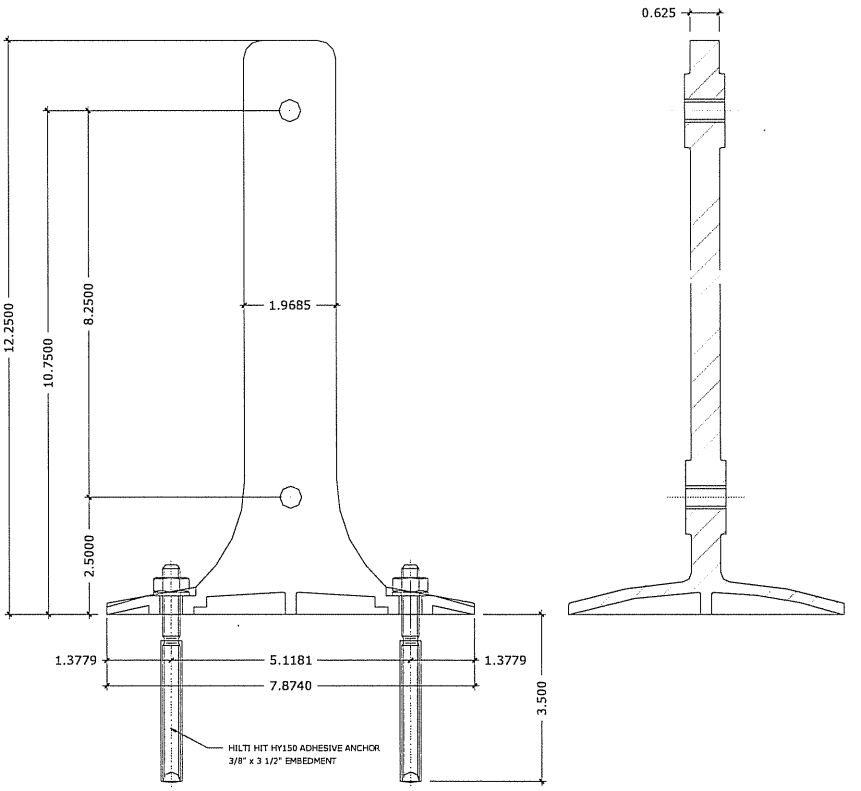
Cast Post Stem and Base Plate	SHT 7

Assumptions:

S.S. Yield Strength: Fy= 45,000 psi

S.S. Strong Axis: Fbx= 29,700 psi

S.S. Weak Axis: Fby= 33,750 psi



Per Sheet 4, Design Reactions are:

$M_{max} := 12338$ in·lb

$T := 2233$ lb

Inputs:

$S_x := \frac{0.625 \cdot 1.9685^2}{6}$ $S_x = 0.4$ in^3

$S_1 := 0.0974$ in^3 (at 1/2")

$S_2 := 0.162$ in^3 (at 1")

$S_3 := 0.638$ in^3 (at 1-1/2")

Cast Post Stem Analysis:

$f_b := \frac{M_{max}}{S_x}$ $f_b = 30566$ psi

$M_{wk1} := T \cdot (0.5)$ $M_{wk1} = 1117$ in·lb

$M_{wk2} := T \cdot (1)$ $M_{wk2} = 2233$ in·lb

$M_{wk3} := T \cdot (1.5)$ $M_{wk3} = 3350$ in·lb

$f_{bwk1} := \frac{M_{wk1}}{S_1}$ $f_{bwk1} = 11463$ psi

$f_{bwk2} := \frac{M_{wk2}}{S_2}$ $f_{bwk2} = 13784$ psi

$f_{bwk3} := \frac{M_{wk3}}{S_3}$ $f_{bwk3} = 5250$ psi

Interactions:

$I := \frac{f_b}{29700}$ $I = 1.03$ < 7% over "OK"

Use S.S. Post Stem and Base, as shown 304A or 316A S.S., Fy=45 ksi

RICE ENGINEERING
Template: REI-MC-2002

105 School Creek Trail
Luxemburg, WI 54217
Phone: (920)845-1042
Fax: (920)845-1048
www.rice-inc.com

Project Description: **Steel Studio USA Guardrails**

Job No:	08-01-15C		
Engineer:	KEP	Sheet No:	7
Date:	3/31/08	Rev:	
Chk By:	MPM	Date:	4/4/08

Attached are page(s) from the 2006 Hilti North American Product Technical Guide. For complete details on this product, including data development, product specifications, general suitability, installation, corrosion, and spacing & edge distance guidelines, please refer to the Technical Guide, or contact Hilti.

Max Loads For Hilti Hit HY 150	SHT A1

4.2.5 HIT-ICE/HIT HY 150 Adhesive Anchor

HIT-ICE/HY 150 Allowable and Ultimate Bond/Concrete Capacity for HAS Rods in Normal-Weight Concrete[1,2,3]

Anchor Diameter in (mm)	Embedment Depth in (mm)	HIT-ICE/HIT HY 150 Allowable Bond/Concrete Capacity				HIT-ICE/HIT HY 150 Ultimate Bond/Concrete Capacity			
		Tensile		Shear		Tensile		Shear	
		f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)
3/8 (9.5)	1-3/4 (44)	720 (3.2)	1265 (5.6)	1395 (6.2)	1970 (8.8)	2710 (12.1)	4750 (21.1)	4175 (18.6)	5900 (26.2)
	3-1/2 (89)	1895 (8.4)	2705 (12.0)	3335 (14.8)	4715 (21.0)	7120 (31.7)	10160 (45.2)	10000 (44.5)	14140 (62.9)
	5-1/4 (133)	2635 (11.7)	2800 (12.5)	6120 (27.2)	8655 (38.5)	9880 (44.0)	10510 (46.8)	18360 (81.7)	25960 (115.5)
1/2 (12.7)	2-1/8 (54)	1220 (5.4)	1575 (7.0)	1980 (8.8)	2800 (12.5)	4580 (20.4)	5910 (26.3)	5940 (26.4)	8400 (37.4)
	4-1/4 (108)	2725 (12.1)	3935 (17.5)	5150 (22.9)	7280 (32.4)	10220 (44.5)	14760 (65.7)	15440 (68.7)	21840 (97.1)
	6-3/8 (162)	4300 (19.1)	5295 (23.6)	9455 (42.1)	13375 (59.5)	16140 (71.8)	19860 (88.3)	28360 (126.2)	40120 (178.5)

Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing Tension/Shear

$s_{min} = 0.5\ h_{ef}$, $s_{cr} = 1.5\ h_{ef}$

$f_A = 0.3(s/h_{ef}) + 0.55$

for $s_{cr} > s > s_{min}$

Edge Distance Tension

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 1.5\ h_{ef}$

$f_{RN} = 0.4(c/h_{ef}) + 0.40$

for $c_{cr} > c > c_{min}$

Edge Distance Shear (⊥ toward edge)

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV1} = 0.54(c/h_{ef}) - 0.09$

for $c_{cr} > c > c_{min}$

Edge Distance Shear (II to or away from edge)

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV2} = 0.36(c/h_{ef}) + 0.28$

for $c_{cr} > c > c_{min}$

Load Adjustment Factors for 3/8" Diameter Anchor

Anchor Diameter	3/8" diameter											
Adjustment Factor	Spacing Tension/Shear, f_A			Edge Distance Tension, f_{RN}			Edge Distance Shear (⊥ toward edge), f_{RV1}			Edge Distance Shear (II to or away from edge), f_{RV2}		
Embedment Depth, in.	1-3/4	3-1/2	5-1/4	1-3/4	3-1/2	5-1/4	1-3/4	3-1/2	5-1/4	1-3/4	3-1/2	5-1/4
Spacing (s)/Edge Distance (c), in. 7/8	0.70			0.60			0.18			0.46		
1-1/4	0.76			0.69			0.30			0.54		
1-3/4	0.85	0.70		0.80	0.60		0.45	0.18		0.64	0.46	
2	0.89	0.72		0.86	0.63		0.53	0.22		0.69	0.49	
2-5/8	1.00	0.78	0.70	1.00	0.70	0.60	0.72	0.32	0.18	0.82	0.55	0.46
3		0.81	0.72		0.74	0.63	0.84	0.37	0.22	0.90	0.59	0.49
3-1/2		0.85	0.75		0.80	0.67	1.00	0.45	0.27	1.00	0.64	0.52
4		0.89	0.78		0.86	0.70		0.53	0.32		0.69	0.55
4-1/2		0.94	0.81		0.91	0.74		0.60	0.37		0.74	0.59
5-1/4		1.00	0.85		1.00	0.80		0.72	0.45		0.82	0.64

Hilti Hit HY150 Allowable Loads:

$V_{all} := 1875 \cdot 0.99 \cdot 0.99 \cdot 0.3$ $\boxed{V_{all} = 551}$ lb

$T_{all} := 2705 \cdot 0.99 \cdot 0.69$ $\boxed{T_{all} = 1848}$ lb

RICE ENGINEERING	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No: 08-01-15C		
			Engineer: KEP	Sheet No: A1	
			Date: 1/24/08	Rev:	
Template: REI-MC-2002			Chk By: MPM	Date: 4/4/08	

Fasteners	SHT A2

Calculations for Connection Fasteners:

Assumptions:

All SS Fasteners to be Minimum Grade A2-70:

$F_u := 700$ MPa

$F_{u2} := \frac{700000000}{6895}$ $F_{u2} = 101523$ psi

$F_t := 0.4 \cdot F_{u2}$ $F_t = 40609$ psi

$F_v := \frac{0.4 \cdot F_{u2}}{\sqrt{3}}$ $F_v = 23446$ psi

Check M12 Post Stem Screws:

$M_1 := 10350$ in·lb

$V_1 := 300$ lb

$V_2 := \frac{M_1}{8.25}$ $V_2 = 1255$ lb

$V_{tot} := \sqrt{V_1^2 + V_2^2}$ $V_{tot} = 1290$ lb

$f_v := \frac{V_{tot}}{2 \cdot (0.151)}$ $f_v = 4271$ psi

$f_p := \frac{V_{tot}}{2 \cdot (0.313)(0.472)}$ $f_p = 4366$ psi

Use M12 SS Cap Screws As Shown
A2-70 SS Minimum, Fu = 101 ksi

Check M8 SS Screws:

$V_{max} := 200$ lb (Worse Case)

$f_{v2} := \frac{V_{max}}{0.077}$ $f_{v2} = 2597$ psi

$f_{p2} := \frac{V_{max}}{0.315 \cdot (0.197)}$ $f_{p2} = 3223$ psi

Use M8 SS Cap Screws All Locations Shown
A2-70 SS Minimum, Fu = 101 ksi

Section Properties	SHT S1

Input d: 2.5 in.

Input t: 0.313 in.

Input L_b: 13.5 in.

==========

A= 0.7825 in^2

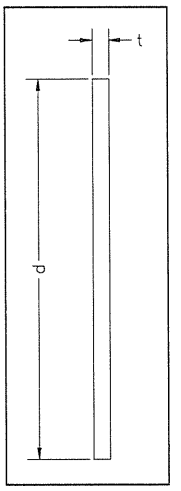
I_x= 0.4076 in^4

I_y= 0.0064 in^4

S_x= 0.3260 in^3

S_y= 0.0408 in^3

S_r= 18.5606



Input D: 2.5 in.

Input t: 0.059 in.

==========

A_m= 4.793576 in^2

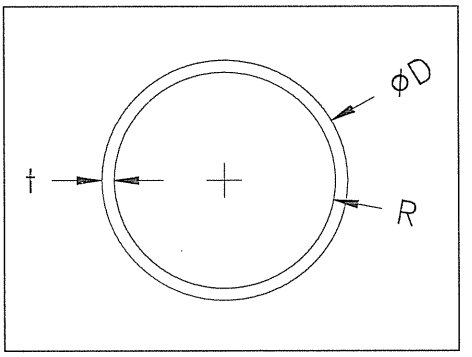
P_m= 7.761305 in.

J= 0.699 in^4

I= 0.337183 in^4

S= 0.269749 in^3

S_r= 20.68644



Input D: 1 in.

Input t: 0.059 in.

==========

A_m= 0.739743 in^2

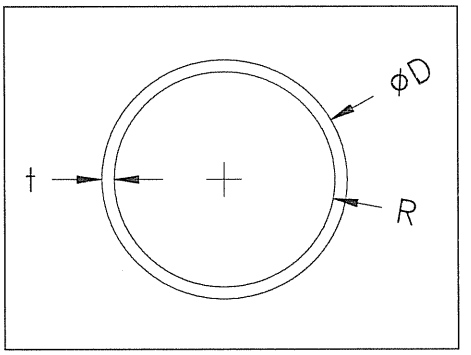
P_m= 3.048916 in.

J= 0.042 in^4

I= 0.019381 in^4

S= 0.038763 in^3

S_r= 7.974576



RICE *ENGINEERING* Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No: 08-01-15C Engineer: KEP Sheet No: S1 Date: 1/24/08 Rev: Chk By: MPM Date: 4/4/08

Section Properties	SHT S2

Input B: 0.787 in.
Input D: 1.574 in.
Input t: 0.059 in.
Input L_b: 4.5 in.

==========

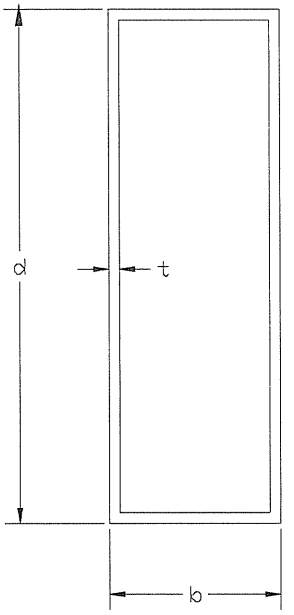
A_m= 1.10292 in^2

A= 0.264674 in^2

P_m= 4.486 in.

J= 0.064 in^4

I_x= 0.083666 in^4
I_y= 0.027607 in^4
S_x= 0.10631 in^3
S_y= 0.070157 in^3



Input D: 0.75 in.

Input t: 0.059 in.

==========

A_m= 0.407716 in^2

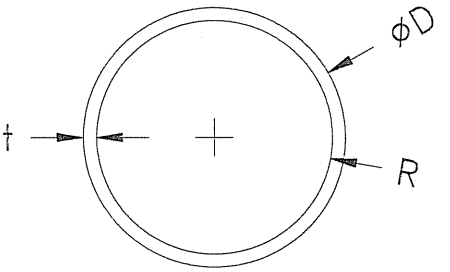
P_m= 2.263518 in.

J= 0.017 in^4

I= 0.0077 in^4

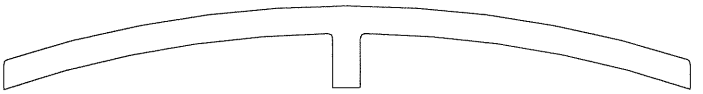
S= 0.020534 in^3

S_r= 5.855932

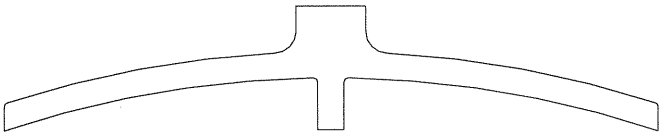


RICE *ENGINEERING* Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No:	08-01-15C	
			Engineer: KEP	Sheet No: S2	
			Date: 3/31/08	Rev:	
			Chk By: MPM	Date: 4/4/08	

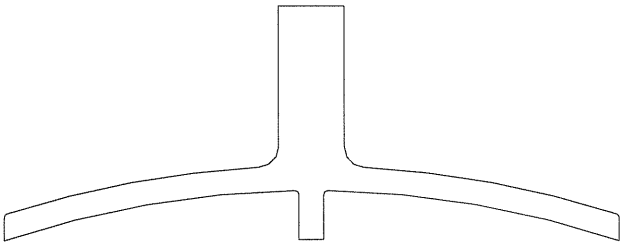
Section Properties	SHT S3



Area:	1.5312 sq in
Perimeter:	13.4079 in
Bounding box:	X: -2.9527 -- 2.9528 in
	Y: -0.4291 -- 0.2924 in
Centroid:	X: 0.0000 in
	Y: 0.0000 in
Moments of inertia:	X: 0.0418 in4
	Y: 4.1805 in4
Section Modulii:	X: 0.0974 in3
	Y: 1.417 in3



Area:	1.8095 sq in
Perimeter:	14.0983 in
Bounding box:	X: -2.9527 -- 2.9528 in
	Y: -0.5045 -- 0.6333 in
Centroid:	X: 0.0000 in
	Y: 0.0000 in
Moments of inertia:	X: 0.1027 in4
	Y: 4.1911 in4
Section Modulii:	X: 0.162 in3
	Y: 1.420 in3



Area:	2.5182 sq in
Perimeter:	16.3483 in
Bounding box:	X: -2.9528 -- 2.9528 in
	Y: -0.8410 -- 1.4218 in
Centroid:	X: 0.0000 in
	Y: 0.0000 in
Moments of inertia:	X: 0.9056 in4
	Y: 4.2146 in4
Section Modulii:	X: 0.638 in3
	Y: 1.428 in3

RICE ***ENGINEERING*** Template: REI-MC-2002	105 School Creek Trail Luxemburg, WI 54217 Phone: (920)845-1042 Fax: (920)845-1048 www.rice-inc.com	Project Description: **Steel Studio USA Guardrails**	Job No: 08-01-15C Engineer: KEP Sheet No: S3 Date: 3/31/08 Rev: Chk By: MPM Date: 4/4/08