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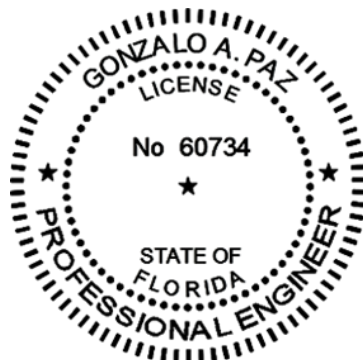
EVA VACCARO

Job. No: 25-0904

MISC. SHOP DRAWINGS

12940 SW 63rd Ave,
Pinecrest, FL 33156

STRUCTURAL CALCULATION



Digitally signed by Gonzalo A Paz
Date: 2025.10.06 11:21:37-04'00'

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Prepared By:
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DESIGN CRITERIA:

Calculations based on:

1. Florida Building Code 8th Edition 2023
2. Minimum Design Loads for Buildings and Other Structures ASCE 7-22
3. Building Code Requirements for Structural Concrete ACI 318-19
4. American Institute of Steel Construction AISC 360-16
5. Aluminum Design Manual 2020
6. Specifications for the Design of Cold-Formed Stainless Steel Structural Members SEI/ASCE8-02

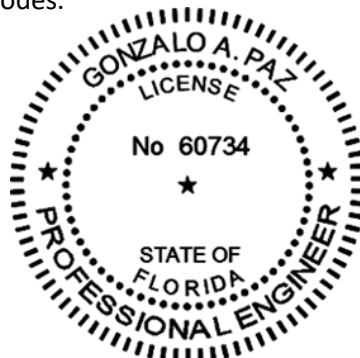
CALCULATION INDEX:

- | | | |
|------|--------------------------------------|-------|
| I. | Wind load analysis | 3-4 |
| II. | Exterior railing at balconies design | 5-20 |
| III. | Interior railing at stair design | 21-39 |

Total Pages = 39

CALCULATION STATEMENT:

To the best of my knowledge, ability, belief and professional judgment, I hereby attest that the manual calculations and computer-generated calculations are in compliance with the existing governing codes.



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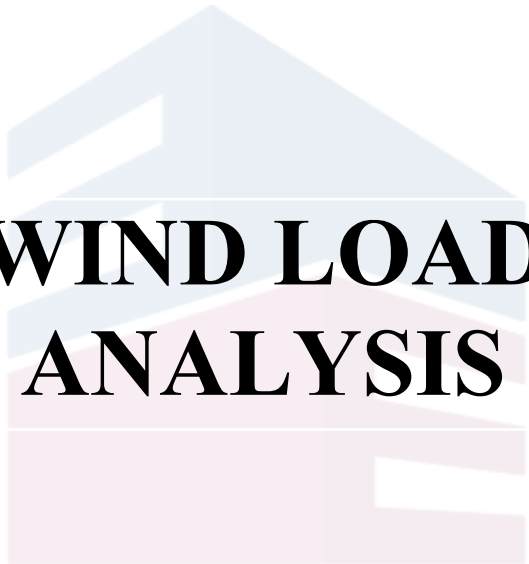
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WIND LOAD ANALYSIS

Wind for Others Structures & Opening Signs Design ($\epsilon < 70\%$) ASCE 7-22

General Wind Data:

Miami Dade

Category II.....V=175 mph

$$V := 175.00$$

Wind Velocity (mph)

$$K_{zt} := 1.00$$

Topographic Factor

$$K_d := 0.85$$

Wind Directionality Factor (see table 26.6-1) ASCE 7-22**K_d=0.85**

$$G := 0.85$$

Gust Factor (Rigid Structure)

$$C_f := 1.80$$

Net Force Coefficients C_f (see Figure 29.5-2) Flat-Side Members Rounded Members

for $\epsilon \leq 0.1$ -----	2.0	1.2-----0.8
for 0.1 to 0.29-----	1.8	1.3-----0.9
for 0.3 to 0.7-----	1.6	1.5-----1.1

$$\alpha := 11.50$$

Values for Terrain exposure constants α and z_g:

Exposure B----- Value $\alpha = 7.5$, Value z_g=3,280

Exposure C----- Value $\alpha = 9.8$, Value z_g=2,460

Exposure D----- Value $\alpha = 11.5$, Value z_g=1,935

$$z_g := 1935.00$$

General Sign Data:

$$Z := 14.33$$

Height of Top of Sign (ft) **conservative**

$$\epsilon := 16.7$$

Solidity Ratio of Sign (%)

Then

$$Z := \text{if}(Z < 15, 15, Z)$$

$$K_z := 2.41 \left(\frac{Z}{z_g} \right)^{\frac{2}{\alpha}}$$

$$K_z = 1.04$$

$$q_z := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2$$

$$q_z = 68.98 \quad \text{psf}$$

Allowable Design Wind Loads:

$$p_z := 0.6(q_z \cdot G \cdot C_f)$$

$$p_z = 63.32$$

Gross Wind per Actual Solid Area (psf)

$$p_{z,EQ} := \max\left(p_z \cdot \frac{\epsilon}{100}, 10\right)$$

$$p_{z,EQ} = 10.57$$

Equivalent Wind in Overall Area (psf)

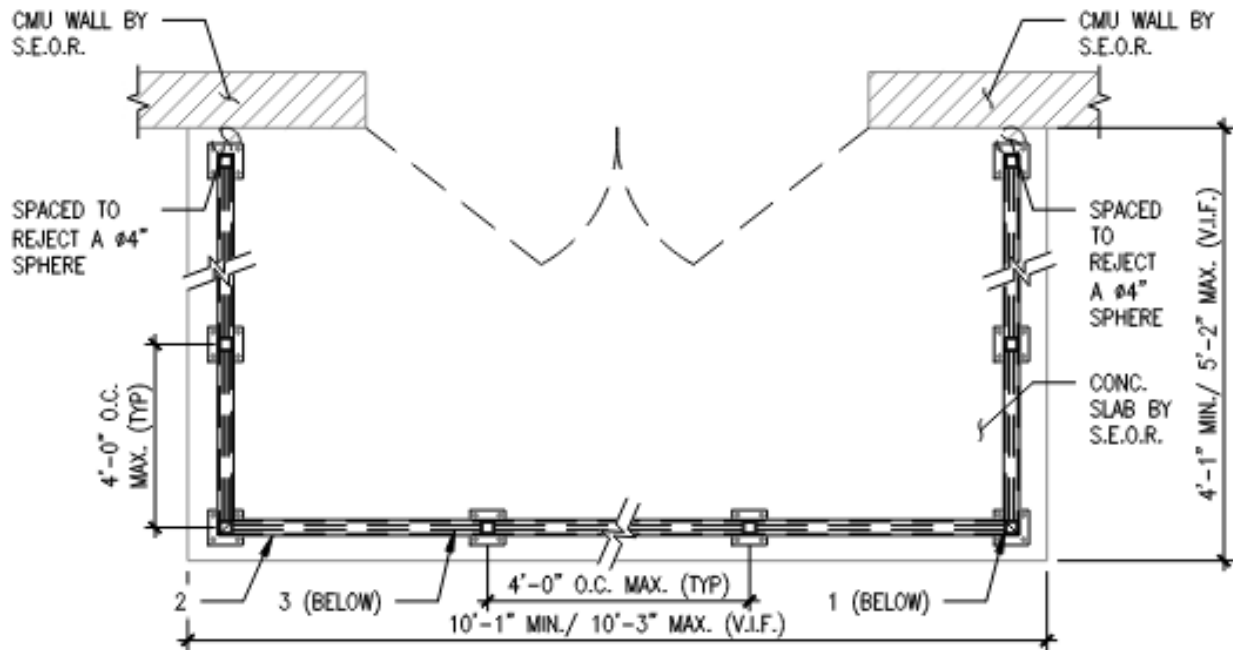


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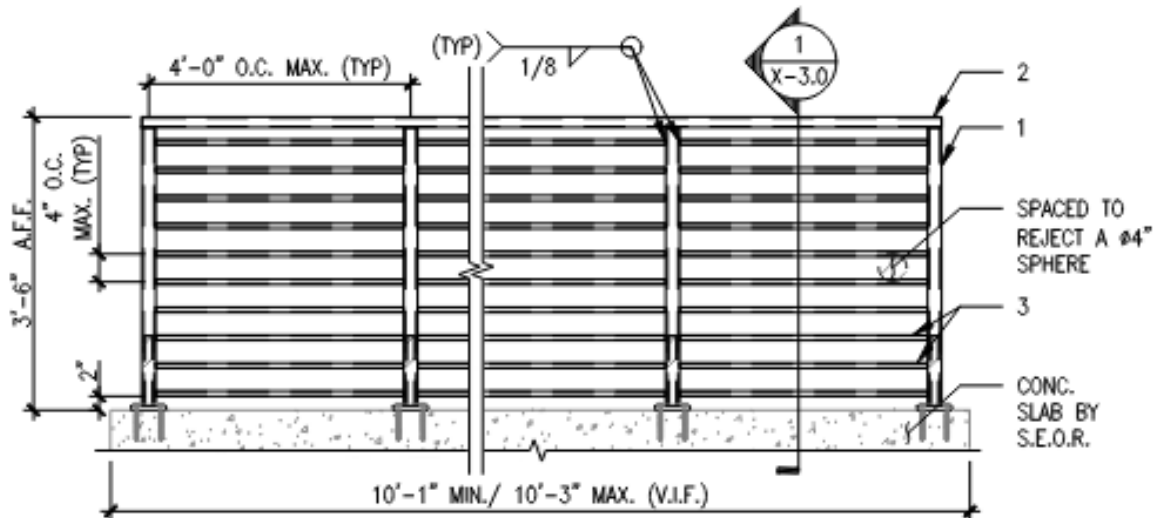
EXTERIOR RAILING AT BALCONIES DESIGN



**EXTERIOR RAILING AT
BALCONIES PLAN VIEW (TYP)**

A
X-3.0

SCALE: 1/2"=1'-0"



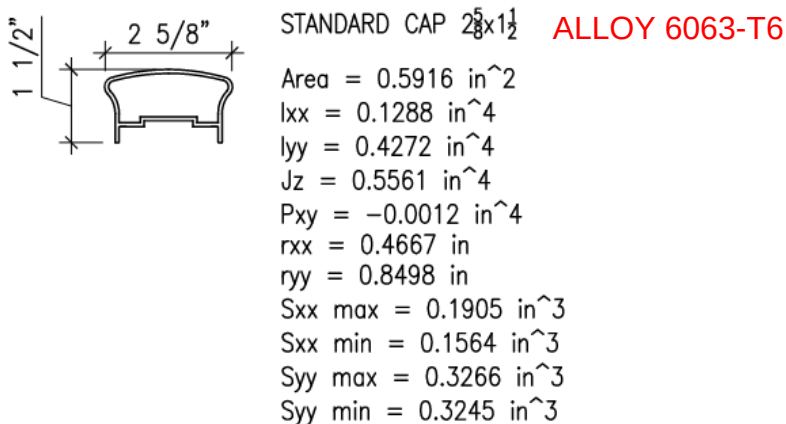
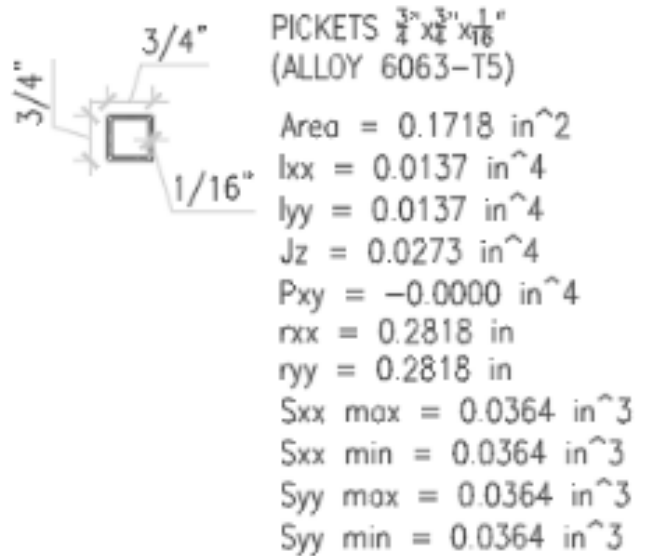
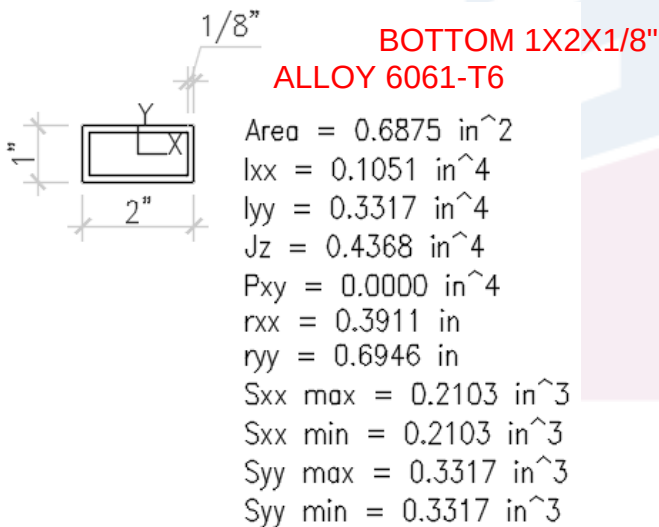
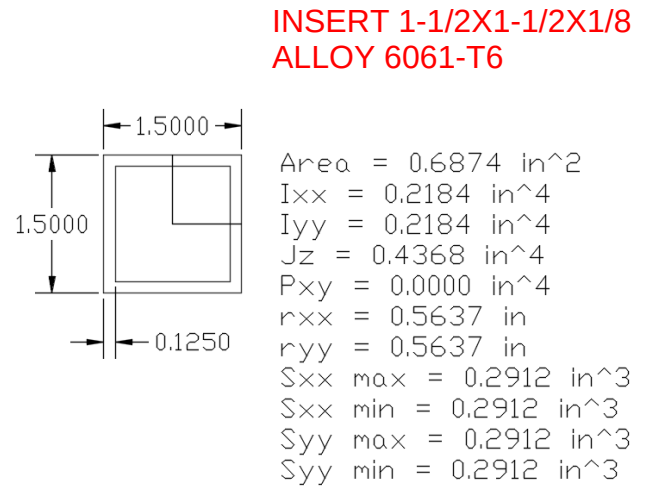
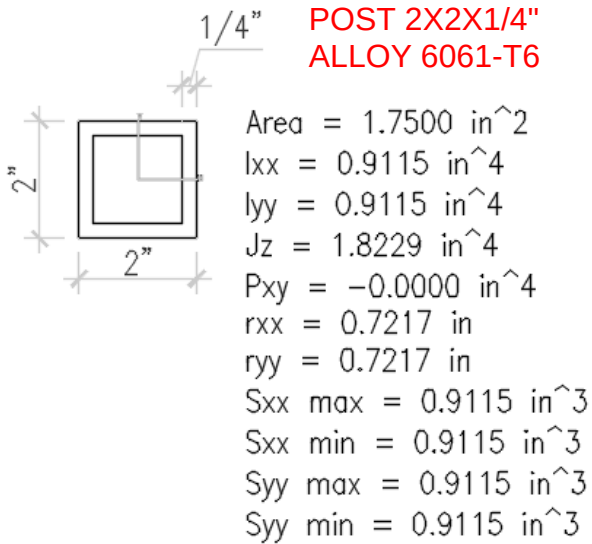
**EXTERIOR RAILING AT
BALCONIES ELEVATION (TYP)**

B
X-3.0

SCALE: 1/2"=1'-0"



SECTION PROPERTIES



Picket Horizontal Railing Design (Top, Bottom, Post)

Allowable Stresses for Aluminum				
	6063-T6 (psi)	6063-T5 (psi)	6061-T6 (psi)	6005-T5 (psi)
Fb (Tubes & Shapes)	15000 4800	9500 4800	19000 9000	19000 8000
Fb (Round & Oval)	18000 5500	11500 5500	24000 10500	24000 9000
Fv Tubes, Shapes & Round	8500 2800	5500 2800	12000 5000	12000 4500
E	10100 ksi	10100 ksi	10100 ksi	10100 ksi

White bars apply to nonwelded members and to welded members at loc. farther than 1.0 in from a weld
Shaded bars apply to within 1.0 in of a weld

Allowable Stress for Aluminum Welding:
 Aluminum Filler Alloy 5356 Fv=7000 psi

Allowable Stress for Steel
 Strong and Weak Axis Allowables Stress for Tube **Steel** Shape:
 Fb=23760 psi, Fv=14400 psi for Fy=36 ksi E=29000 Ksi
 Fb=33000 psi, Fv=20000 psi for Fy=50 ksi E=29000 Ks

Allowable Stress for Steel Welding:
 Welding: E-70XX Fv=21000 psi

Allowable Stress for Stainless Steel
 Strong and Weak Axis Allowables Stress for Tube Steel Shape:
 Fb=16216 psi, Fv=9189 psi for (SS 304) Fy=30 ksi E=28000 Ksi
 Fb=34730 psi, Fv=20838 psi for (S32304 Duplex SS) Fy=58 ksi E=28000 Ksi
 Fb=62870 psi, Fv=37720 psi for (S17400-H1150) Fy=105 ksi E=28000 Ksi

Allowable Stress for Steel Welding:
 Welding: E318 or E309 Fv=19200 psi

Allowable Stress for Wood
 Strong and Weak Axis Allowables Stress for Lumber No.2 Non Dense (2"-4" thick):
 Fb=1350 psi, Fv=175 psi for 2"-4" Wide E=1400 Ksi
 Fb=1150 psi, Fv=175 psi for 5"-6" Wide E=1400 Ksi

DESIGN INFORMATION:

Florida Building Code 2023

AISC Manual of Steel Construction 2017 ANSI/AISC 360-16, ANSI/AWC NDS—2018 NDS for Wood
 Construction, ASCE 7-22, AISC Design Guide 27 -Structural Stainless Steel, Aluminum Design Manual 2020

DESIGN LOADS:

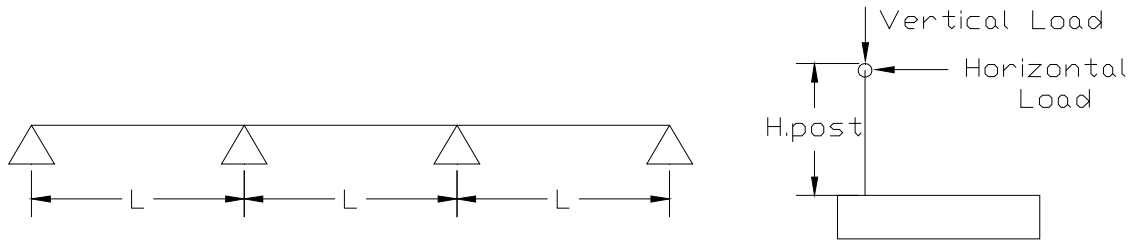
Handrail Design Loads: Concentrated Load = 200 lbs. applied at any point in any direction.

Uniform Load = 50 plf applied in any direction (other than dwelling units).

Guardrail System Loads: Concentrated Load = 200 lbs. applied at any point in any direction at the top of the guardrail.

Concentrated horizontal load of 50 lbs applied on a 1 sq ft. area at any point in the system (FBC 1607.9.1.2 and Section 4.5.1.2 of ASCE 7).

Handrail Design:



General Data:

$L := 48.00$ Railing Span (in)
 $H_{\text{post}} := 42.00$ Post Height (in)
 $d_{\text{picket}} := 4.00$ Distance center/center of Picket (in)

General Loads:

$q_{\text{wind}} := 10.57$ Wind Pressure (psf)
 $P_{200} := 200.00$ Single Concentrated Load (lbs)Railing P=200.00, Fence P=0.00
 $q_{50} := 50.00$ Uniform Distributed Load (plf).....Railing q=50.00, Fence q=0.00
 $P_{50} := 50.00$ Single Concentrated Load (lbs)Railing P=50.00, Fence P=0.00

Top Railing Data:

$Fb_{\text{TR}} := 15000.00$ psi
 $Fv_{\text{TR}} := 2800.00$ psi
 $Sx_{\text{TR}} := 0.1564$ Vertical Loads in^3
 $At_{\text{TR}} := 0.5916$ in^2
 $Sy_{\text{TR}} := 0.3245$ Horizontal Loads in^3

Post Data:

$Fb_{\text{PT}} := 9000.00$ psi
 $Fv_{\text{PT}} := 5000.00$ psi
 $Sx_{\text{PT}} := 0.9115$ in^3
 $Ap_{\text{T}} := 1.75$ in^2

Picket Data:

$Fb_{\text{PK}} := 9000.00$ psi
 $Fv_{\text{PK}} := 2800.00$ psi
 $Sx_{\text{PK}} := 0.0364$ in^3
 $Ap_{\text{K}} := 0.1718$ in^2

Top Railing Design:

Actual Moment:

Concentrated Load = 200 lbs.

$$M_{TR.200} := \frac{P_{200} \cdot L}{5}$$

$$M_{TR.200} = 1920.00 \text{ in} - \text{lb}$$

Uniform Load = 50 plf

$$M_{TR.50} := 0.1012 \cdot \left(\frac{q_{50}}{12} \right) \cdot L^2$$

$$M_{TR.50} = 971.52 \text{ in} - \text{lb}$$

For Wind Pressure

$$M_{TR.wind} := 0.1012 \cdot \left(\frac{q_{wind}}{144} \right) \cdot \frac{d_{picket}}{2} \cdot L^2$$

$$M_{TR.wind} = 34.23 \text{ in} - \text{lb}$$

$$M_{TR} := \max(M_{TR.200}, M_{TR.50}, M_{TR.wind})$$

$$M_{TR} = 1920.00 \text{ in} - \text{lb}$$

Actual Shear:

Concentrated Load = 200 lbs.

$$V_{TR.200} := P_{200} \text{ lbs}$$

$$V_{TR.200} = 200.00 \text{ lbs}$$

Uniform Load = 50 plf

$$V_{TR.50} := 0.6 \cdot \left(\frac{q_{50}}{12} \right) \cdot L$$

$$V_{TR.50} = 120.00 \text{ lbs}$$

For Wind Pressure

$$V_{TR.wind} := 0.6 \cdot \left(\frac{q_{wind}}{144} \right) \cdot \frac{d_{picket}}{2} \cdot L$$

$$V_{TR.wind} = 4.23 \text{ lbs}$$

$$V_{TR} := \max(V_{TR.200}, V_{TR.50}, V_{TR.wind})$$

$$V_{TR} = 200.00 \text{ lbs}$$

Section Required:

Bending Design: Section Modulus Required

$$S_{TR.min} := \frac{M_{TR}}{F_b_{TR}}$$

$$S_{TR.min} = 0.13 \text{ in}^3$$

Shear Design: Area Required

$$A_{TR.min} := \frac{1.5 \cdot V_{TR}}{F_v_{TR}}$$

$$A_{TR.min} = 0.11 \text{ in}^2$$

Section Provided:

$$BENDING_{top} := \text{if}(S_{TR.min} \geq \min(S_{x_{TR}}, S_{y_{TR}}), "N.G.", "OK")$$

$$BENDING_{top} = "OK"$$

$$SHEAR_{top} := \text{if}(A_{TR.min} \geq A_{TR}, "N.G.", "OK")$$

$$SHEAR_{top} = "OK"$$

Post Design:

Actual Reaction:

Concentrated Load = 200 lbs.

$$R_{PT.200} := P_{200}$$

$$R_{PT.200} = 200.00 \text{ lbs}$$

Uniform Load = 50 plf

$$R_{PT.50} := \left(\frac{q_{50}}{12} \right) \cdot L$$

$$R_{PT.50} = 200.00 \text{ lbs}$$

For Wind Pressure

$$R_{PT.wind} := \left[\left(\frac{q_{wind}}{144} \right) \right] \cdot H_{post} \cdot L$$

$$R_{PT.wind} = 147.98 \text{ lbs}$$

$$R_{PT} := \max(R_{PT.200}, R_{PT.50}, R_{PT.wind})$$

$$R_{PT} = 200.00 \text{ lbs}$$

Actual Moment:

$$M_{PT} := \max \left(\max(R_{PT.200}, R_{PT.50}) \cdot H_{post}, R_{PT.wind} \cdot \frac{H_{post}}{2} \right)$$

$$M_{PT} = 8400.00 \text{ in - lb}$$

Actual Shear:

$$V_{PT} := R_{PT}$$

$$V_{PT} = 200.00 \text{ lbs.}$$



POST AND INSERTS ANALYSIS

Post to be RT2x2x1/4 Aluminum Alloy 6061-T6

$$S_x = 0.9115 \text{ in}^3$$

$$I = 0.9115 \text{ in}^4$$

Insert to be RT1.5x1.5x1/8 Aluminum Alloy 6061-T6

$$S_x = 0.2912 \text{ in}^3$$

$$I = 0.2184 \text{ in}^4$$

$F_{cy} = 15000 \text{ psi}$ (Alum. Welded), Alloy 6061-T6

$M_{max} = 8400 \text{ #-in}$ (See previous calculations)

$$I_{system} = 0.9115 \text{ in}^4 + 0.2184 \text{ in}^4$$

$$I_{system} = 1.1299 \text{ in}^4$$

Moment Ratio per Member (Post vs Inserts)

$$\text{Ratio Post} = 0.9115 \text{ in}^4 / 1.1299 \text{ in}^4 = 0.8067$$

$$\text{Ratio Insert} = 0.2184 \text{ in}^4 / 1.1299 \text{ in}^4 = 0.1933$$

$$\text{Post Moment} = 8400 \text{ #-in} \times 0.8067 = 6776.28 \text{ #-in}$$

$$\text{Insert 1 Moment} = 8400 \text{ #-in} \times 0.1933 = 1623.72 \text{ #-in}$$

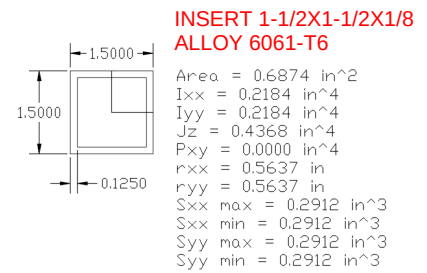
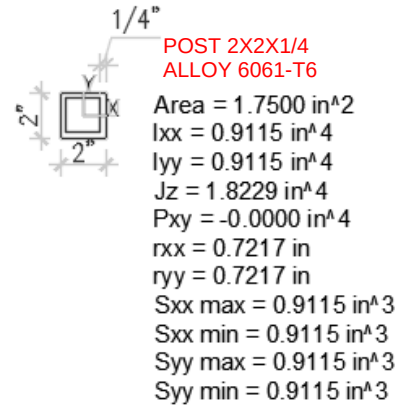
Post Design:

$$\text{Mallowable} = F_b \times S_x = 9000 \text{ psi} \times 0.9115 \text{ in}^3 = 8203.5 \text{ #-in} > M_{actual} = 6776.28 \text{ #-in} \quad (\text{OK})$$

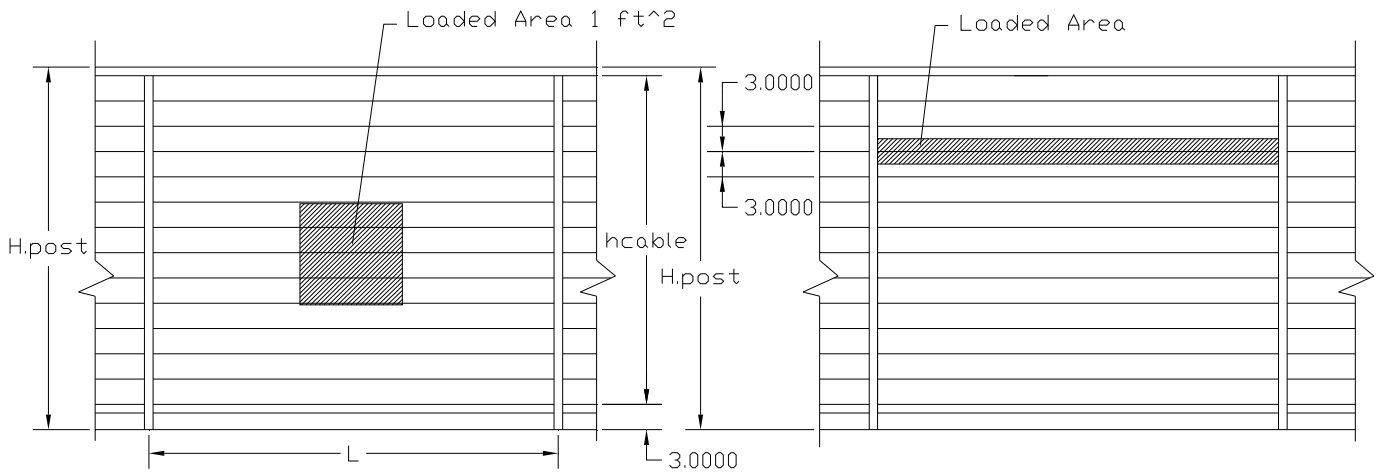
Insert 1 Design:

$$\text{Mallowable} = F_b \times S_x = 9000 \text{ psi} \times 0.2912 \text{ in}^3 = 2620.8 \text{ #-in} > M_{actual} = 1623.72 \text{ #-in} \quad (\text{OK})$$

SECTION PROPERTIES



Picket Design:



Assume three pickets acting simultaneously

$$\omega_{\text{picket}} := \frac{P_{50}}{12} \cdot \frac{1}{3}$$

$$\omega_{\text{picket}} = 1.39 \quad \frac{\text{lbs}}{\text{in}}$$

$$q_{\text{picket}} := \max(10, q_{\text{wind}})$$

$$q_{\text{picket}} = 10.57 \quad \text{psf}$$

$$M_{\text{PK}} := \max \left(6 \cdot \omega_{\text{picket}} \cdot \frac{L}{2} - \omega_{\text{picket}} \cdot 18, \frac{q_{\text{picket}} \cdot d_{\text{picket}} \cdot L^2}{144 \cdot 8} \right)$$

$$M_{\text{PK}} = 175.00 \quad \text{in-lb}$$

$$V_{\text{PK}} := \max \left[12 \cdot \omega_{\text{picket}} \cdot \frac{(L - 6)}{L}, \frac{q_{\text{picket}} \cdot d_{\text{picket}} \cdot L}{144 \cdot 2} \right]$$

$$V_{\text{PK}} = 14.58 \quad \text{lb}$$

Section Required:

Bending Design: Section Modulus Required:

$$S_{\text{PK.min}} := \frac{M_{\text{PK}}}{F_{b_{\text{PK}}}}$$

$$S_{\text{PK.min}} = 0.019 \quad \text{in}^3$$

Shear Design: Area Required:

$$A_{\text{PK.min}} := \frac{1.5 \cdot V_{\text{PK}}}{F_{v_{\text{PK}}}}$$

$$A_{\text{PK.min}} = 0.008 \quad \text{in}^2$$

Section Provided:

$$\text{BENDING}_{\text{picket}} := \text{if}(S_{\text{PK.min}} \geq S_{x_{\text{PK}}}, \text{"N.G"}, \text{"OK"})$$

$$\text{BENDING}_{\text{picket}} = \text{"OK"}$$

$$\text{SHEAR}_{\text{picket}} := \text{if}(A_{\text{PK.min}} \geq A_{\text{PK}}, \text{"N.G"}, \text{"OK"})$$

$$\text{SHEAR}_{\text{picket}} = \text{"OK"}$$



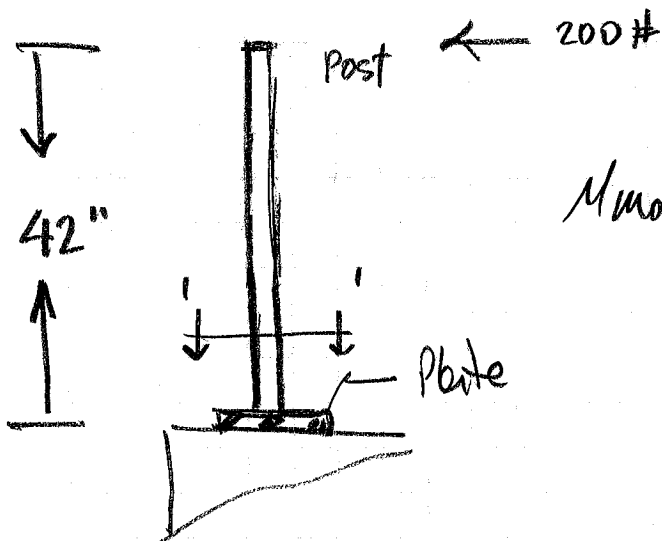
PROJ. NAME: _____

PROJ No.: _____ DATE: _____

DESIGNED BY: _____ PAGE: _____

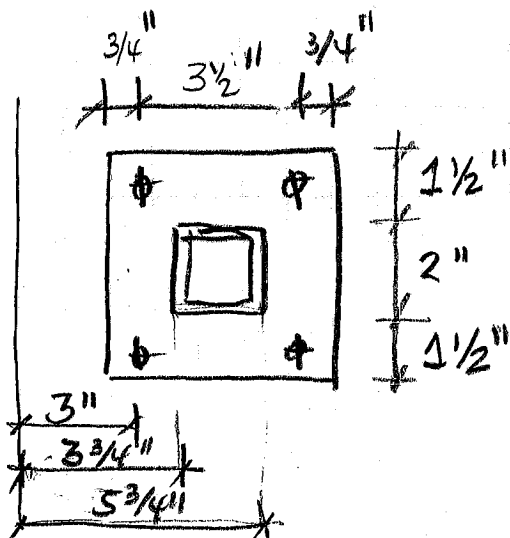
REVIEWED BY: _____ R.L. OR G.P. _____

Post Connection

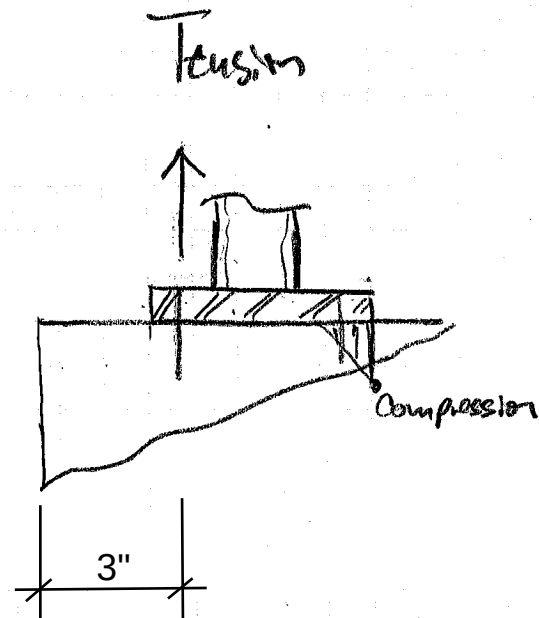


$$M_{max} = 200 \# \times 42 = 8400 \#-in.$$

Trans Section



Section 1-1



Connection Force Resultant from Statics Analysis

Connection to concrete

Data Input:

$n := 2.00$ Number of Anchor Bolts in Tension due to Bending Only

$d := 4.25$ Distance from Tension Force to Outermost Compression Fiber (in)

$h := 5.00$ High plate (in)

$b := 5.00$ Width of Compression Area (Post Section) (in)

$f'_c := 3000.00$ Maximum Concrete Compressive Strength (psi)

$M_{ext} := 8400.00$ External Cantilever End Moment (lbs-in)

$P_{ext} := 0.00$ Additional Tension (lbs-in)

Analysis:

Compression Force:

$$C_{force} = \left(\frac{1}{2}\right) \cdot 0.7 \cdot f'_c \cdot kd \cdot b$$

Sum of Moments about Compression Force:

$$\left[0 = C_{force} \cdot \left[d - \left(\frac{1}{3}\right) \cdot kd \right] - M_{ext} + P_{ext} \cdot \left(d - \frac{h}{2} \right) \right]$$

Calculation of kd:

$x := 1$ (Required Iteration Initial Guess)

Given

$$-\frac{1}{6} \cdot 0.7 \cdot f'_c \cdot x^2 \cdot b + \left(\frac{1}{2}\right) \cdot (x) \cdot 0.7 \cdot f'_c \cdot b \cdot d - M_{ext} + P_{ext} \cdot \left(d - \frac{h}{2} \right) = 0$$

$kd := \text{Find}(x)$

Height of Compression Prism:

$kd = 0.3883$

in

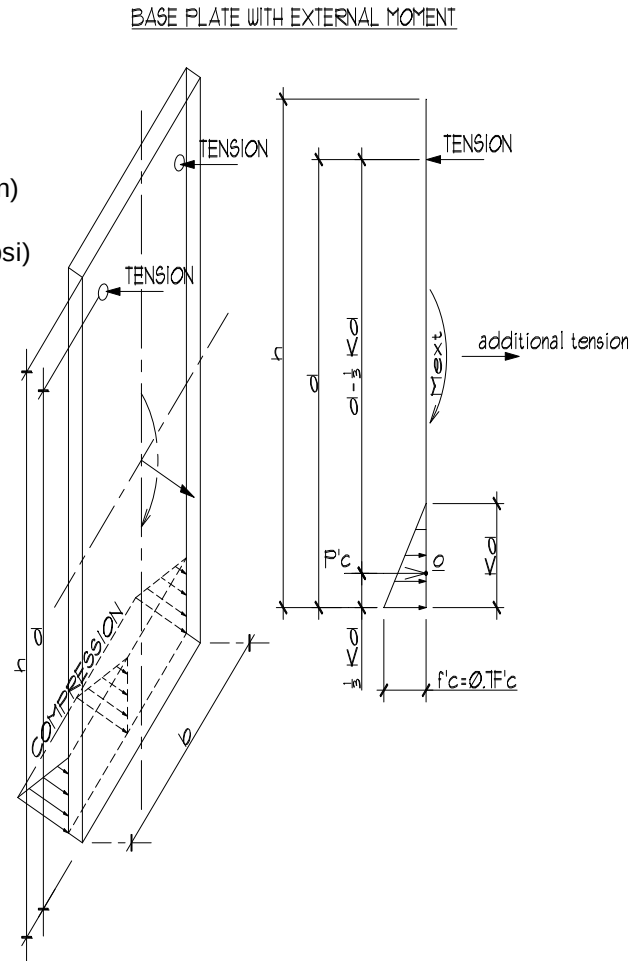
Tension in Bolts:

$$T_{bolt} := \text{if} \left[kd > 0, \frac{\left(\frac{1}{2}\right) \cdot 0.7 \cdot f'_c \cdot kd \cdot b}{n} + \frac{P_{ext}}{2 \cdot n}, \frac{M_{ext}}{n(2d - h)} + \frac{P_{ext}}{2 \cdot n} \right]$$

Tension per Bolt:

$T_{bolt} = 1019.3$

lbs




Allowable Load Capacities for Screw-Bolt+ in Normal-Weight Concrete^{1,2,3,4,5}

Nominal Anchor Diameter in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)		f'c = 8,000 psi (55.2 MPa)	
		Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1 (25)	330 (1.5)	415 (1.8)	350 (1.6)	440 (2.0)	385 (1.7)	480 (2.1)	430 (1.9)	520 (2.3)	430 (1.9)	520 (2.3)
	1-5/8 (41)	710 (3.2)	415 (1.8)	750 (3.3)	440 (2.0)	815 (3.6)	480 (2.1)	815 (3.6)	520 (2.3)	815 (3.6)	520 (2.3)
	2-1/2 (64)	915 (4.1)	505 (2.2)	965 (4.3)	535 (2.4)	1,050 (4.7)	585 (2.6)	1,070 (4.8)	635 (2.8)	1,070 (4.8)	635 (2.8)
3/8	1-1/2 (38)	660 (2.9)	890 (4.0)	720 (3.2)	975 (4.3)	835 (3.7)	1,125 (5.0)	1,020 (4.5)	1,375 (6.1)	1,020 (4.5)	1,590 (7.1)
	2 (51)	920 (4.1)	1,080 (4.8)	1,005 (4.5)	1,185 (5.3)	1,160 (5.2)	1,365 (6.1)	1,180 (5.2)	1,585 (7.1)	1,365 (6.1)	1,585 (7.1)
	3-1/4 (83)	1,855 (8.3)	1,580 (7.0)	2,035 (9.1)	1,735 (7.7)	2,265 (10.1)	2,000 (8.9)	2,265 (10.1)	2,140 (9.5)	2,590 (11.5)	2,140 (9.5)
	4-1/2 (114)	2,725 (12.1)	1,580 (7.0)	2,985 (13.3)	1,735 (7.7)	3,450 (15.3)	2,000 (8.9)	3,770 (16.8)	2,140 (9.5)	3,770 (16.8)	2,140 (9.5)
1/2	1-3/4 (44)	710 (3.2)	1,495 (6.7)	780 (3.5)	1,640 (7.3)	900 (4.0)	1,895 (8.4)	1,100 (4.9)	2,320 (10.3)	1,100 (4.9)	2,675 (11.9)
	2-1/2 (64)	1,670 (7.4)	2,010 (8.9)	1,830 (8.1)	2,200 (9.8)	2,115 (9.4)	2,540 (11.3)	2,115 (9.4)	2,885 (12.8)	2,115 (9.4)	2,885 (12.8)
	4-1/4 (108)	3,315 (14.7)	2,350 (10.5)	3,630 (16.1)	2,575 (11.5)	4,120 (18.3)	2,970 (13.2)	4,120 (18.3)	3,380 (15.0)	4,120 (18.3)	3,380 (15.0)
	5-1/2 (140)	3,935 (17.5)	2,350 (10.5)	4,310 (19.2)	2,575 (11.5)	4,975 (22.1)	2,970 (13.2)	5,330 (23.7)	3,380 (15.0)	5,330 (23.7)	3,380 (15.0)
	2-1/2 (64)	1,435 (6.4)	2,655 (11.8)	1,570 (7.0)	2,910 (12.9)	1,815 (8.1)	3,355 (14.9)	2,220 (9.9)	4,110 (18.3)	2,220 (9.9)	4,295 (19.1)
5/8	3-1/4 (83)	2,440 (10.9)	3,015 (13.4)	2,670 (11.9)	3,305 (14.7)	3,085 (13.7)	3,815 (17.0)	3,085 (13.7)	4,295 (19.1)	3,085 (13.7)	4,295 (19.1)
	5 (127)	3,615 (16.1)	3,420 (15.2)	3,960 (17.6)	3,745 (16.7)	4,570 (20.3)	4,325 (19.2)	4,825 (21.5)	4,870 (21.7)	5,570 (24.8)	4,870 (21.7)
	6-1/4 (159)	5,130 (22.8)	3,420 (15.2)	5,620 (25.0)	3,745 (16.7)	6,490 (28.9)	4,325 (19.2)	7,945 (35.3)	4,870 (21.7)	7,945 (35.3)	4,870 (21.7)
	2-1/2 (64)	1,510 (6.7)	2,905 (12.9)	1,655 (7.4)	3,180 (14.1)	1,910 (8.5)	3,675 (16.3)	2,340 (10.4)	4,500 (20.0)	2,340 (10.4)	5,195 (23.1)
3/4	4-1/4 (108)	2,975 (13.2)	4,265 (19.0)	3,260 (14.5)	4,670 (20.8)	3,765 (16.7)	5,395 (24.0)	4,435 (19.7)	6,070 (27.0)	5,125 (22.8)	6,070 (27.0)
	5 (127)	4,755 (21.2)	4,265 (19.0)	5,210 (23.2)	4,670 (20.8)	6,015 (26.8)	5,395 (24.0)	7,365 (32.8)	6,070 (27.0)	7,365 (32.8)	6,070 (27.0)
	6-1/4 (159)	5,125 (22.8)	4,265 (19.0)	5,615 (25.0)	4,670 (20.8)	6,480 (28.8)	5,395 (24.0)	7,940 (35.3)	6,070 (27.0)	7,940 (35.3)	6,070 (27.0)

1. Tabulated load values are for anchors installed in uncracked concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor 4.0.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
5. Anchors may be used in lightweight concrete provided the allowable load capacities are multiplied by a reduction factor of 0.60.

LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE
Edge Distance Reduction Factors - Tension (F_{NC})

		Edge Distance Reduction Factors - Tension (F _T)																					
		Diameter (in)				1/4				3/8				1/2				5/8				3/4	
Nominal Embedment h _{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4			
Min. Edge Distance c _{min} (in)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4			
Edge Distance (inches)	1-1/2	1.00	0.77	0.64	0.85	0.74	0.59	0.55	-	-	-	-	-	-	-	-	-	-	-	-			
	1-3/4	1.00	0.83	0.67	0.93	0.79	0.62	0.57	0.87	0.71	0.58	0.54	0.73	0.65	0.56	0.53	0.73	0.59	0.56	0.53			
	2	1.00	0.88	0.71	1.00	0.84	0.65	0.59	0.94	0.76	0.60	0.56	0.78	0.68	0.58	0.54	0.78	0.61	0.58	0.54			
	2-1/4	1.00	0.94	0.75	1.00	0.89	0.68	0.61	1.00	0.80	0.63	0.57	0.82	0.71	0.60	0.56	0.82	0.63	0.60	0.56			
	2-1/2	1.00	1.00	0.78	1.00	0.95	0.71	0.63	1.00	0.84	0.65	0.59	0.87	0.75	0.62	0.57	0.87	0.66	0.62	0.57			
	2-3/4	1.00	1.00	0.82	1.00	1.00	0.74	0.65	1.00	0.88	0.67	0.61	0.91	0.78	0.64	0.59	0.91	0.68	0.64	0.59			
	3	1.00	1.00	0.86	1.00	1.00	0.77	0.67	1.00	0.92	0.69	0.62	0.96	0.81	0.66	0.60	0.96	0.70	0.66	0.60			
	3-1/2	1.00	1.00	0.93	1.00	1.00	0.83	0.71	1.00	1.00	0.74	0.65	1.00	0.87	0.69	0.63	1.00	0.75	0.69	0.63			
	4	1.00	1.00	1.00	1.00	1.00	0.88	0.75	1.00	1.00	0.78	0.69	1.00	0.94	0.73	0.66	1.00	0.79	0.73	0.66			
	4-1/2	1.00	1.00	1.00	1.00	1.00	0.94	0.79	1.00	1.00	0.82	0.72	1.00	1.00	0.77	0.69	1.00	0.84	0.77	0.69			
	5	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.87	0.75	1.00	1.00	0.81	0.72	1.00	0.89	0.81	0.72			
	5-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.91	0.79	1.00	1.00	0.85	0.75	1.00	0.93	0.85	0.75			
	6	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.96	0.82	1.00	1.00	0.89	0.78	1.00	0.98	0.89	0.78			
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.85	1.00	1.00	0.92	0.81	1.00	1.00	0.92	0.81			
	7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.96	0.84	1.00	1.00	0.96	0.84			
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	1.00	0.87	1.00	1.00	1.00	0.87			
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	0.90	1.00	1.00	1.00	0.90			
8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	0.93	1.00	1.00	1.00	0.93				
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.96				
9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99				
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				

Spacing Reduction Factors - Tension (F_{NS})

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)	1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4	
Minimum Spacing s_{min} (in)	1-1/2	1-1/2	1-1/2	2	2	2	2	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	3	3	3	3	
Spacing Distance (inches)	1-1/2	0.89	0.73	0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	1-3/4	0.94	0.77	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2	1.00	0.80	0.70	0.88	0.77	0.67	0.63	-	-	-	-	-	-	-	-	-	-	-	
	2-1/4	1.00	0.83	0.72	0.93	0.80	0.69	0.64	-	-	-	-	-	-	-	-	-	-	-	
	2-1/2	1.00	0.86	0.74	0.97	0.83	0.70	0.65	-	-	-	-	-	-	-	-	-	-	-	
	2-3/4	1.00	0.89	0.76	1.00	0.86	0.72	0.66	0.92	0.78	0.67	0.64	0.80	0.73	0.65	0.63	-	-	-	-
	3	1.00	0.92	0.78	1.00	0.89	0.74	0.67	0.95	0.80	0.68	0.65	0.83	0.74	0.66	0.64	0.83	0.69	0.66	0.64
	3-1/2	1.00	0.99	0.82	1.00	0.94	0.77	0.70	1.00	0.85	0.71	0.67	0.88	0.78	0.68	0.65	0.88	0.71	0.68	0.65
	4	1.00	1.00	0.86	1.00	1.00	0.80	0.72	1.00	0.89	0.73	0.68	0.92	0.81	0.70	0.67	0.93	0.74	0.71	0.67
	4-1/2	1.00	1.00	0.90	1.00	1.00	0.83	0.74	1.00	0.93	0.75	0.70	0.97	0.85	0.72	0.68	0.97	0.76	0.73	0.69
	5	1.00	1.00	0.94	1.00	1.00	0.86	0.76	1.00	0.98	0.78	0.72	1.00	0.88	0.75	0.70	1.00	0.79	0.75	0.70
	5-1/2	1.00	1.00	0.97	1.00	1.00	0.89	0.78	1.00	1.00	0.80	0.74	1.00	0.92	0.77	0.72	1.00	0.81	0.77	0.72
	6	1.00	1.00	1.00	1.00	1.00	0.93	0.81	1.00	1.00	0.82	0.75	1.00	0.95	0.79	0.73	1.00	0.84	0.79	0.73
	6-1/2	1.00	1.00	1.00	1.00	1.00	0.96	0.83	1.00	1.00	0.85	0.77	1.00	0.98	0.81	0.75	1.00	0.86	0.81	0.75
	7	1.00	1.00	1.00	1.00	1.00	0.99	0.85	1.00	1.00	0.87	0.79	1.00	1.00	0.83	0.76	1.00	0.89	0.83	0.77
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00	1.00	0.90	0.81	1.00	1.00	0.85	0.78	1.00	0.91	0.85	0.78
	8	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	0.92	0.83	1.00	1.00	0.87	0.80	1.00	0.94	0.87	0.80
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.94	0.84	1.00	1.00	0.89	0.81	1.00	0.96	0.89	0.81
	9	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.97	0.86	1.00	1.00	0.91	0.83	1.00	0.99	0.91	0.83
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.99	0.88	1.00	1.00	0.93	0.84	1.00	1.00	0.93	0.85
10	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	0.90	1.00	1.00	0.95	0.86	1.00	1.00	0.95	0.86	
10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.97	0.88	1.00	1.00	0.97	0.88	
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.99	0.89	1.00	1.00	0.99	0.89	
11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	0.91	1.00	1.00	1.00	0.91	
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.92	1.00	1.00	1.00	0.93	
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.96	
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99	
15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

Edge Distance Reduction Factors - Shear (F_{VC})

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Min. Edge Distance C_{min} (in)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4
Edge Distance (inches)	1-1/2	0.58	0.63	0.59	0.40	0.37	0.31	0.32	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.68	0.73	0.69	0.46	0.43	0.36	0.38	0.35	0.31	0.30	0.31	0.27	0.26	0.25	0.26	0.26	0.22	0.22	0.23
	2	0.78	0.84	0.78	0.53	0.49	0.41	0.43	0.41	0.35	0.35	0.36	0.30	0.29	0.29	0.30	0.30	0.25	0.26	0.27
	2-1/4	0.87	0.94	0.88	0.59	0.55	0.46	0.48	0.46	0.40	0.39	0.40	0.34	0.33	0.32	0.33	0.33	0.28	0.29	0.30
	2-1/2	0.97	1.00	0.98	0.66	0.61	0.51	0.54	0.51	0.44	0.43	0.45	0.38	0.36	0.36	0.37	0.37	0.31	0.32	0.33
	2-3/4	1.00	1.00	1.00	0.73	0.67	0.56	0.59	0.56	0.49	0.48	0.49	0.42	0.40	0.40	0.41	0.41	0.34	0.35	0.37
	3	1.00	1.00	1.00	0.79	0.73	0.61	0.64	0.61	0.53	0.52	0.54	0.46	0.44	0.43	0.45	0.44	0.38	0.39	0.40
	3-1/2	1.00	1.00	1.00	0.92	0.85	0.72	0.75	0.71	0.62	0.61	0.63	0.53	0.51	0.50	0.52	0.52	0.44	0.45	0.47
	4	1.00	1.00	1.00	1.00	0.97	0.82	0.86	0.81	0.71	0.69	0.72	0.61	0.58	0.57	0.59	0.59	0.50	0.51	0.53
	4-1/2	1.00	1.00	1.00	1.00	1.00	0.92	0.97	0.91	0.80	0.78	0.81	0.68	0.66	0.65	0.67	0.67	0.56	0.58	0.60
	5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.87	0.90	0.76	0.73	0.72	0.74	0.74	0.63	0.64	0.66
	5-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.95	0.99	0.84	0.80	0.79	0.82	0.82	0.69	0.71	0.73
	6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.88	0.86	0.89	0.89	0.75	0.77	0.80
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.95	0.93	0.97	0.96	0.81	0.84	0.86
	7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	0.90	0.93
7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.96	1.00	
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

Spacing Reduction Factors - Shear (F_{VS})

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Minimum Spacing S_{min} (in)		1-1/2	1-1/2	1-1/2	2	2	2	2	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	3	3	3	3
Spacing Distance (inches)	1-1/2	0.60	0.60	0.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.61	0.62	0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.63	0.64	0.63	0.59	0.58	0.57	0.57	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.65	0.66	0.65	0.60	0.59	0.58	0.58	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.66	0.67	0.66	0.61	0.60	0.59	0.59	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	0.68	0.69	0.68	0.62	0.61	0.59	0.60	0.59	0.58	0.58	0.58	0.57	0.57	0.57	0.57	-	-	-	-
	3	0.69	0.71	0.70	0.63	0.62	0.60	0.61	0.60	0.59	0.59	0.59	0.58	0.57	0.57	0.57	0.57	0.56	0.56	0.57
	3-1/2	0.73	0.74	0.73	0.65	0.64	0.62	0.63	0.62	0.60	0.60	0.60	0.59	0.59	0.58	0.59	0.59	0.57	0.57	0.58
	4	0.76	0.78	0.76	0.68	0.66	0.64	0.64	0.64	0.62	0.62	0.62	0.60	0.60	0.60	0.60	0.60	0.58	0.59	0.59
	4-1/2	0.79	0.81	0.79	0.70	0.68	0.65	0.66	0.65	0.63	0.63	0.63	0.61	0.61	0.61	0.61	0.61	0.59	0.60	0.60
	5	0.82	0.85	0.83	0.72	0.70	0.67	0.68	0.67	0.65	0.64	0.65	0.63	0.62	0.62	0.62	0.62	0.60	0.61	0.61
	5-1/2	0.86	0.88	0.86	0.74	0.72	0.69	0.70	0.69	0.66	0.66	0.66	0.64	0.63	0.63	0.64	0.64	0.61	0.62	0.62
	6	0.89	0.92	0.89	0.76	0.74	0.70	0.71	0.70	0.68	0.67	0.68	0.65	0.65	0.64	0.65	0.65	0.63	0.63	0.63
	6-1/2	0.92	0.95	0.92	0.79	0.76	0.72	0.73	0.72	0.69	0.69	0.69	0.66	0.66	0.66	0.66	0.66	0.64	0.64	0.64
	7	0.95	0.99	0.96	0.81	0.78	0.74	0.75	0.74	0.71	0.70	0.71	0.68	0.67	0.67	0.67	0.67	0.65	0.65	0.66
	7-1/2	0.99	1.00	0.99	0.83	0.80	0.76	0.77	0.75	0.72	0.72	0.72	0.69	0.68	0.68	0.69	0.69	0.66	0.66	0.67
	8	1.00	1.00	1.00	0.85	0.82	0.77	0.79	0.77	0.74	0.73	0.74	0.70	0.69	0.69	0.70	0.70	0.67	0.67	0.68
	9	1.00	1.00	1.00	0.90	0.87	0.81	0.82	0.80	0.77	0.76	0.77	0.73	0.72	0.72	0.72	0.72	0.69	0.69	0.70
	10	1.00	1.00	1.00	0.94	0.91	0.84	0.86	0.84	0.80	0.79	0.80	0.75	0.74	0.74	0.75	0.75	0.71	0.71	0.72
	11	1.00	1.00	1.00	0.98	0.95	0.87	0.89	0.87	0.82	0.82	0.83	0.78	0.77	0.76	0.77	0.77	0.73	0.74	0.74
	12	1.00	1.00	1.00	1.00	0.99	0.91	0.93	0.91	0.85	0.85	0.86	0.80	0.79	0.79	0.80	0.80	0.75	0.76	0.77
	13	1.00	1.00	1.00	1.00	1.00	0.94	0.96	0.94	0.88	0.88	0.89	0.83	0.82	0.81	0.82	0.82	0.77	0.78	0.79
	14	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.97	0.91	0.90	0.92	0.85	0.84	0.84	0.85	0.85	0.79	0.80	0.81
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.93	0.95	0.88	0.86	0.86	0.87	0.87	0.81	0.82	0.83
16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.96	0.98	0.91	0.89	0.88	0.90	0.90	0.83	0.84	0.85	
17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.93	0.91	0.91	0.92	0.92	0.86	0.86	0.88	
18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.94	0.93	0.95	0.94	0.88	0.89	0.90	
19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.96	0.95	0.97	0.97	0.90	0.91	0.92	
20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	1.00	0.99	0.92	0.93	0.94	
21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.95	0.97	
22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.97	0.99	
23	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.99	1.00	
24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	



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PROJ. NAME: _____
PROJ No.: _____ DATE: _____
DESIGNED BY: _____ PAGE: _____
REVIEWED BY: _____ R.L. OR G.P. _____

4x4

Using $3/8"$ screw Bolt +

with $3.25"$ Embedment Allowable

$$T = 2035 \#$$

$$S = 1735 \#$$

with $4\frac{1}{2}"$ Emb. Allowable.

$$T = 2985 \#$$

$$S = 1735 \#$$

Tension factors

w/ $3"$ Edge Distance. | factor for $3\frac{1}{4}"$ Emb. = 0.77
E.D. = $3"$ | for $4\frac{1}{2}"$ Emb = 0.67

w/ $3\frac{1}{2}"$ Spacing | factor for $3\frac{1}{4}"$ Emb = 0.77
@ = $3\frac{1}{2}"$ | for $4\frac{1}{2}"$ Emb = 0.70

Allowable Tension for

$$3\frac{1}{4}" \text{ Embedment} = 1050 \#$$

$$4\frac{1}{2}" \text{ Embedment} = 1400 \#$$

Shear factors

E.D. = $3"$ | factor for $3\frac{1}{4}"$ = 0.61
" $4\frac{1}{2}"$ = 0.64

@ = $3\frac{1}{2}"$ | factor for $3\frac{1}{4}"$ = 0.62
" $4\frac{1}{2}"$ = 0.63

Allowable Shear for

$$3\frac{1}{4}" \text{ Emb} = 656 \#$$

$$4\frac{1}{2}" \text{ Emb} = 699 \#$$



PROJ. NAME: _____

PROJ No.: _____ DATE: _____

DESIGNED BY: _____ PAGE: _____

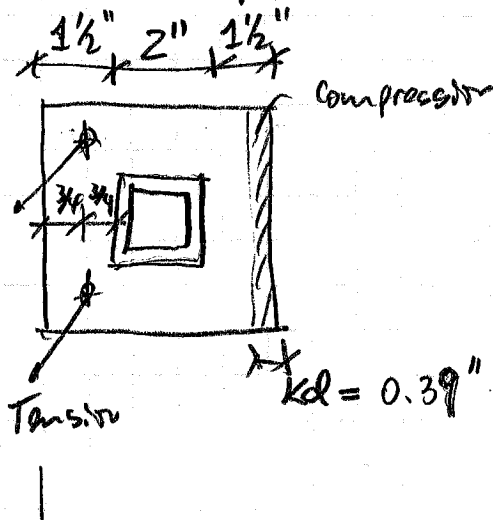
REVIEWED BY: _____ R.L. OR G.P. _____

$$\text{Actual Tension} = 1019 \# \leq 1400 \# \text{ (OK)}$$

$$\text{Actual Shear} = 200/4 = 50 \# \leq 699 \# \text{ (OK)}$$

$$\text{Combine } \frac{1019}{1400} + \frac{50}{699} = 0.8 \leq 1.0 \text{ OK}$$

$$\text{Max Compression} = 2040 \#$$



$$M_{\text{plate due to Tens.}} = 2040 \times 0.15" = 1530 \# - \text{in}$$

$$M_{\text{plate due to Comp.}} = 2040 \times \left(15" - \frac{0.39}{3}\right) = 2795 \# - \text{in}$$

Using 5/8" plate ($F_b = 9000 \text{ psi}$) Alloy 6061 T6

$$M_{\text{allowable}} = \frac{0.625^2 \times 5"}{6} \times 9000 = 2929 \# - \text{in}$$

$$M_{\text{allowable}} \geq M_{\text{max actual}} = 2795 \text{ (OK)}$$

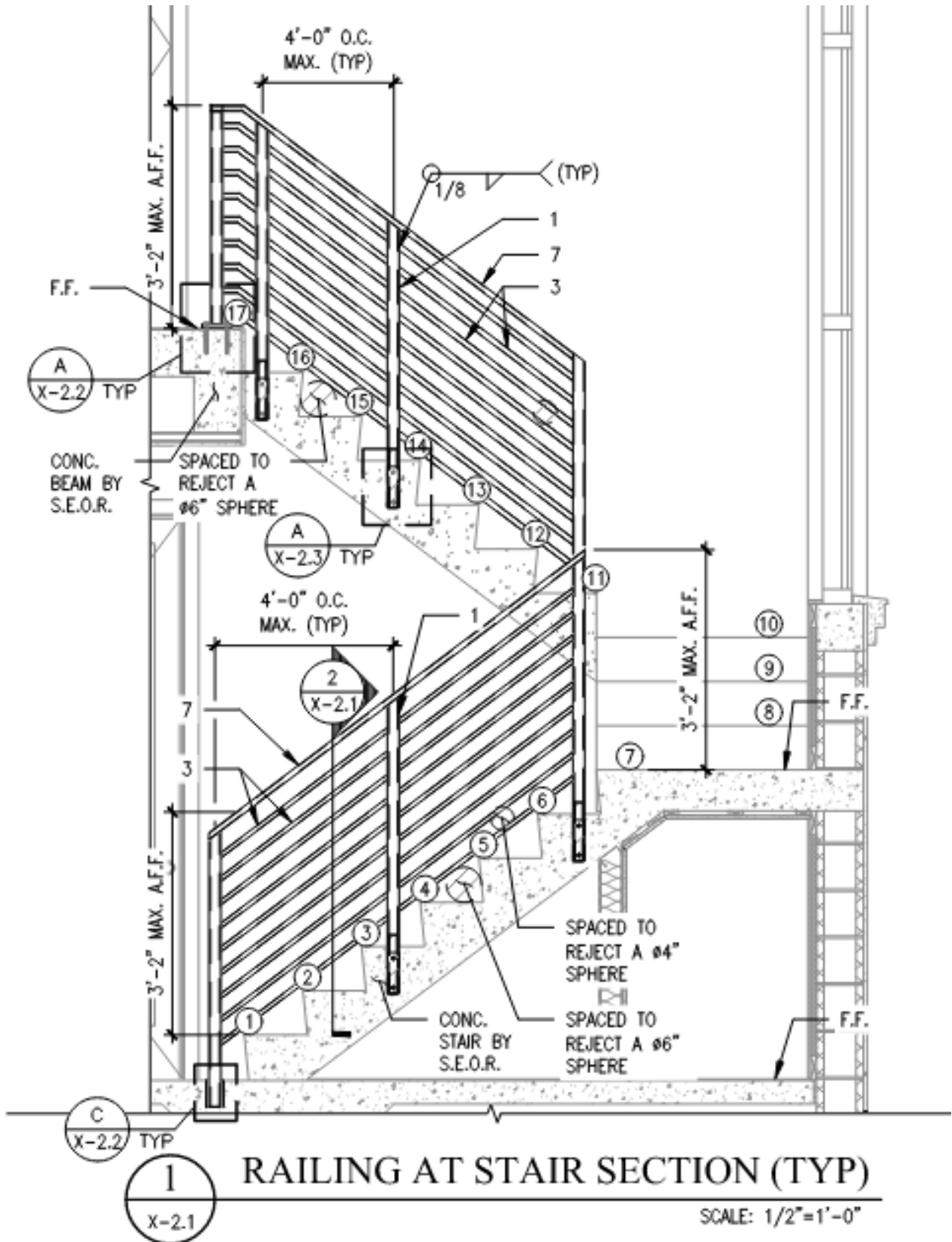


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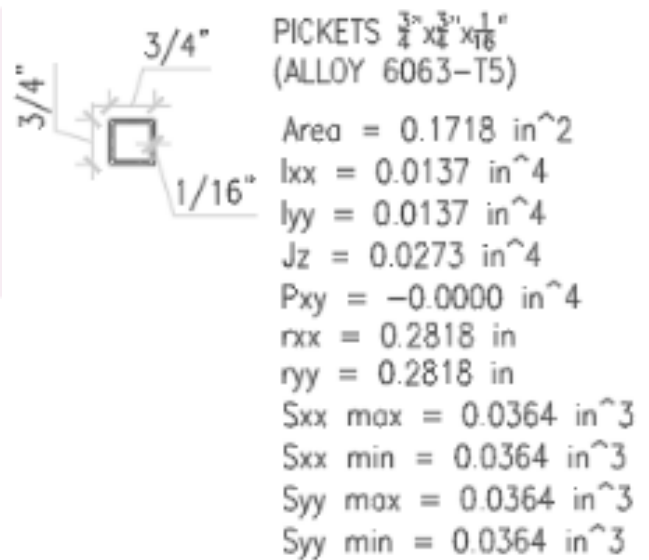
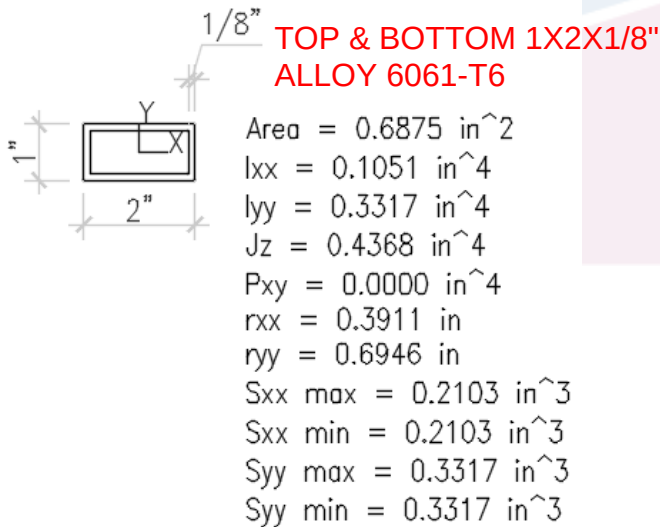
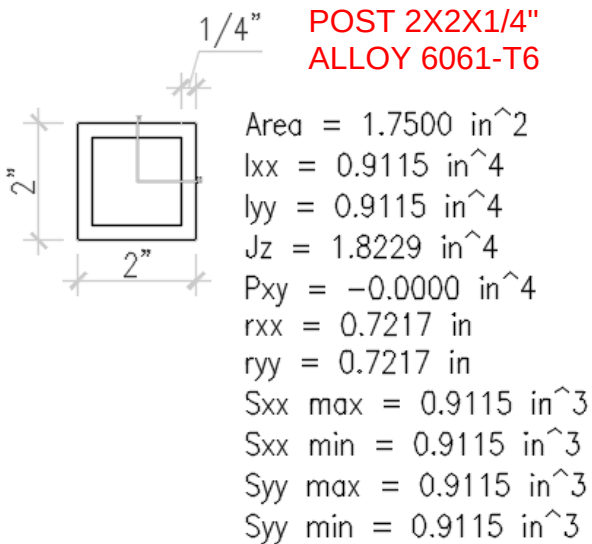


INTERIOR RAILING AT STAIR DESIGN





SECTION PROPERTIES



Picket Horizontal Railing Design (Top, Bottom, Post)

Allowable Stresses for Aluminum				
	6063-T6 (psi)	6063-T5 (psi)	6061-T6 (psi)	6005-T5 (psi)
Fb (Tubes & Shapes)	15000 4800	9500 4800	19000 9000	19000 8000
Fb (Round & Oval)	18000 5500	11500 5500	24000 10500	24000 9000
Fv Tubes, Shapes & Round	8500 2800	5500 2800	12000 5000	12000 4500
E	10100 ksi	10100 ksi	10100 ksi	10100 ksi

White bars apply to nonwelded members and to welded members at loc. farther than 1.0 in from a weld
Shaded bars apply to within 1.0 in of a weld

Allowable Stress for Aluminum Welding:
 Aluminum Filler Alloy 5356 Fv=7000 psi

Allowable Stress for Steel
 Strong and Weak Axis Allowables Stress for Tube **Steel** Shape:
 Fb=23760 psi, Fv=14400 psi for Fy=36 ksi E=29000 Ksi
 Fb=33000 psi, Fv=20000 psi for Fy=50 ksi E=29000 Ks

Allowable Stress for Steel Welding:
 Welding: E-70XX Fv=21000 psi

Allowable Stress for Stainless Steel
 Strong and Weak Axis Allowables Stress for Tube Steel Shape:
 Fb=16216 psi, Fv=9189 psi for (SS 304) Fy=30 ksi E=28000 Ksi
 Fb=34730 psi, Fv=20838 psi for (S32304 Duplex SS) Fy=58 ksi E=28000 Ksi
 Fb=62870 psi, Fv=37720 psi for (S17400-H1150) Fy=105 ksi E=28000 Ksi

Allowable Stress for Steel Welding:
 Welding: E318 or E309 Fv=19200 psi

Allowable Stress for Wood
 Strong and Weak Axis Allowables Stress for Lumber No.2 Non Dense (2"-4" thick):
 Fb=1350 psi, Fv=175 psi for 2"-4" Wide E=1400 Ksi
 Fb=1150 psi, Fv=175 psi for 5"-6" Wide E=1400 Ksi

DESIGN INFORMATION:

Florida Building Code 2023

AISC Manual of Steel Construction 2017 ANSI/AISC 360-16, ANSI/AWC NDS—2018 NDS for Wood
 Construction, ASCE 7-22, AISC Design Guide 27 -Structural Stainless Steel, Aluminum Design Manual 2020

DESIGN LOADS:

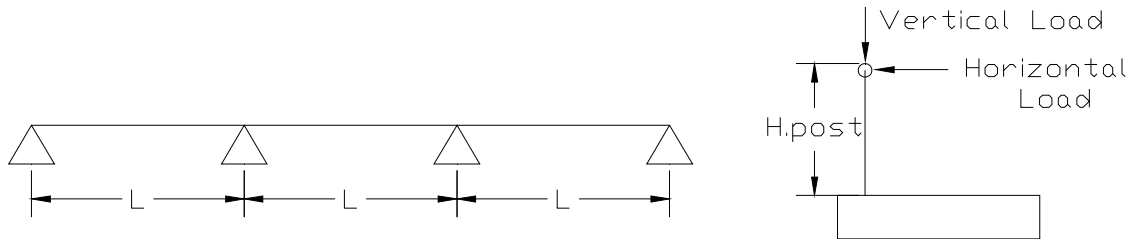
Handrail Design Loads: Concentrated Load = 200 lbs. applied at any point in any direction.

Uniform Load = 50 plf applied in any direction (other than dwelling units).

Guardrail System Loads: Concentrated Load = 200 lbs. applied at any point in any direction at the top of the guardrail.

Concentrated horizontal load of 50 lbs applied on a 1 sq ft. area at any point in the system (FBC 1607.9.1.2 and Section 4.5.1.2 of ASCE 7).

Handrail Design:



General Data:

$L_r := 48.00$ Railing Span (in)

$H_{post} := 38.00$ Post Height (in)

$d_{picket} := 4.00$ Distance center/center of Picket (in)

General Loads:

$q_{wind} := 0.00$ Wind Pressure (psf)

$P_{200} := 200.00$ Single Concentrated Load (lbs)Railing P=200.00, Fence P=0.00

$q_{50} := 50.00$ Uniform Distributed Load (plf).....Railing q=50.00, Fence q=0.00

$P_{50} := 50.00$ Single Concentrated Load (lbs)Railing P=50.00, Fence P=0.00

Top Railing Data:

$Fb_{TR} := 19000.00$ psi

$Fv_{TR} := 5000.00$ psi

$Sx_{TR} := 0.2103$ Vertical Loads in^3

$A_{TR} := 0.6875$ in^2

$Sy_{TR} := 0.331$ Horizontal Loads in^3

Picket Data:

$Fb_{PK} := 9000.00$ psi

$Fv_{PK} := 2800.00$ psi

$Sx_{PK} := 0.0364$ in^3

$A_{PK} := 0.1718$ in^2

Top Railing Design:

Actual Moment:

Concentrated Load = 200 lbs.

$$M_{TR.200} := \frac{P_{200} \cdot L}{5}$$

$$M_{TR.200} = 1920.00 \text{ in} - \text{lb}$$

Uniform Load = 50 plf

$$M_{TR.50} := 0.1012 \cdot \left(\frac{q_{50}}{12} \right) \cdot L^2$$

$$M_{TR.50} = 971.52 \text{ in} - \text{lb}$$

For Wind Pressure

$$M_{TR.wind} := 0.1012 \cdot \left(\frac{q_{wind}}{144} \right) \cdot \frac{d_{picket}}{2} \cdot L^2$$

$$M_{TR.wind} = 0 \text{ in} - \text{lb}$$

$$M_{TR} := \max(M_{TR.200}, M_{TR.50}, M_{TR.wind})$$

$$M_{TR} = 1920.00 \text{ in} - \text{lb}$$

Actual Shear:

Concentrated Load = 200 lbs.

$$V_{TR.200} := P_{200} \text{ lbs}$$

$$V_{TR.200} = 200.00 \text{ lbs}$$

Uniform Load = 50 plf

$$V_{TR.50} := 0.6 \cdot \left(\frac{q_{50}}{12} \right) \cdot L$$

$$V_{TR.50} = 120.00 \text{ lbs}$$

For Wind Pressure

$$V_{TR.wind} := 0.6 \cdot \left(\frac{q_{wind}}{144} \right) \cdot \frac{d_{picket}}{2} \cdot L$$

$$V_{TR.wind} = 0.00 \text{ lbs}$$

$$V_{TR} := \max(V_{TR.200}, V_{TR.50}, V_{TR.wind})$$

$$V_{TR} = 200.00 \text{ lbs}$$

Section Required:

Bending Design: Section Modulus Required

$$S_{TR.min} := \frac{M_{TR}}{F_b_{TR}}$$

$$S_{TR.min} = 0.1 \text{ in}^3$$

Shear Design: Area Required

$$A_{TR.min} := \frac{1.5 \cdot V_{TR}}{F_v_{TR}}$$

$$A_{TR.min} = 0.06 \text{ in}^2$$

Section Provided:

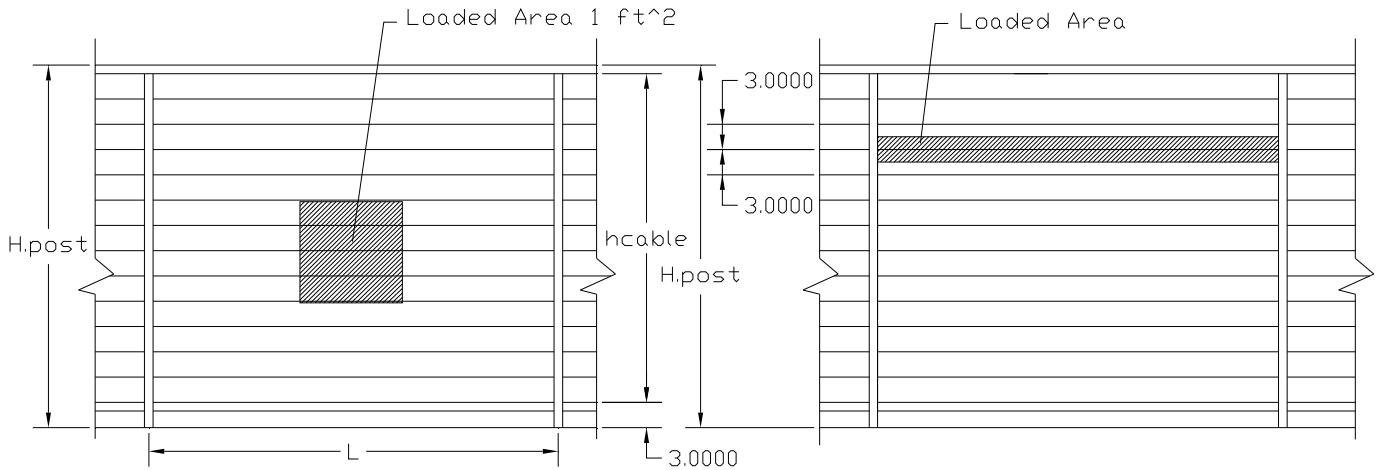
$$BENDING_{top} := \text{if}(S_{TR.min} \geq \min(S_{x_{TR}}, S_{y_{TR}}), "N.G.", "OK")$$

$$BENDING_{top} = "OK"$$

$$SHEAR_{top} := \text{if}(A_{TR.min} \geq A_{TR}, "N.G.", "OK")$$

$$SHEAR_{top} = "OK"$$

Picket Design:



Assume three pickets acting simultaneously

$$\omega_{\text{picket}} := \frac{P_{50}}{12} \cdot \frac{1}{3}$$

$$\omega_{\text{picket}} = 1.39 \quad \frac{\text{lbs}}{\text{in}}$$

$$q_{\text{picket}} := \max(10, q_{\text{wind}})$$

$$q_{\text{picket}} = 10.00 \quad \text{psf}$$

$$M_{\text{PK}} := \max \left(6 \cdot \omega_{\text{picket}} \cdot \frac{L}{2} - \omega_{\text{picket}} \cdot 18, \frac{q_{\text{picket}} \cdot d_{\text{picket}} \cdot L^2}{144 \cdot 8} \right)$$

$$M_{\text{PK}} = 175.00 \quad \text{in-lb}$$

$$V_{\text{PK}} := \max \left[12 \cdot \omega_{\text{picket}} \cdot \frac{(L - 6)}{L}, \frac{q_{\text{picket}} \cdot d_{\text{picket}} \cdot L}{144 \cdot 2} \right]$$

$$V_{\text{PK}} = 14.58 \quad \text{lb}$$

Section Required:

Bending Design: Section Modulus Required:

$$S_{\text{PK.min}} := \frac{M_{\text{PK}}}{Fb_{\text{PK}}}$$

$$S_{\text{PK.min}} = 0.019 \quad \text{in}^3$$

Shear Design: Area Required:

$$A_{\text{PK.min}} := \frac{1.5 \cdot V_{\text{PK}}}{Fv_{\text{PK}}}$$

$$A_{\text{PK.min}} = 0.008 \quad \text{in}^2$$

Section Provided:

$$\text{BENDING}_{\text{picket}} := \text{if}(S_{\text{PK.min}} \geq S_{\text{PK}}, \text{"N.G."}, \text{"OK"})$$

$$\text{BENDING}_{\text{picket}} = \text{"OK"}$$

$$\text{SHEAR}_{\text{picket}} := \text{if}(A_{\text{PK.min}} \geq A_{\text{PK}}, \text{"N.G."}, \text{"OK"})$$

$$\text{SHEAR}_{\text{picket}} = \text{"OK"}$$



Post Design

Loads:

LL=200#

Load Processing:

*Due to LL= 200#

Mactual= 0.667k-ft= 8 004#-in

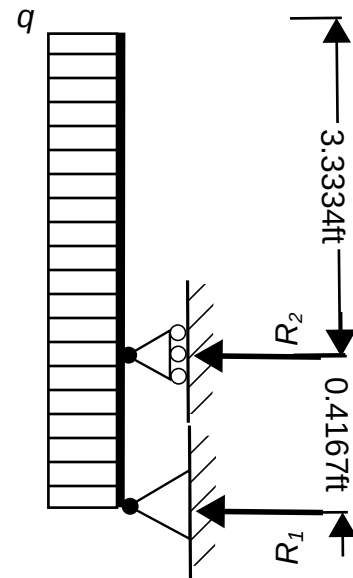
*For Post analysis see spreadsheet printout

*Using RT2x2x1/4" Alloy 6061-T6 (welded)
INSERT RT1-1/2X1-1/2X1/8" Alloy 6061-T6

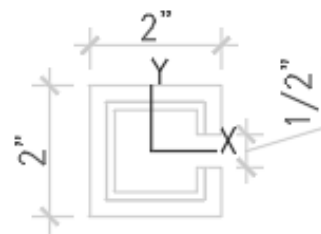
Mallow= Fb*Sx

Mallow= 9000psi*0.9306in³

Mallow= 8 375.4 #-in > Mactual= 8 004#-in (OK)



F.B.D



Area = 2.2500 in²

Ixx = 1.1260 in⁴

Iyy = 0.9936 in⁴

Jz = 2.1196 in⁴

Pxy = 0.0000 in⁴

rx = 0.7074 in

ry = 0.6645 in

Sxx max = 1.1260 in³

Sxx min = 1.1260 in³

Syy max = 1.0658 in³

Syy min = 0.9306 in³

General Beam Analysis

Project File: post design.ec6

LIC# : KW-06018068, Build:20.25.07.09

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DESCRIPTION: Post

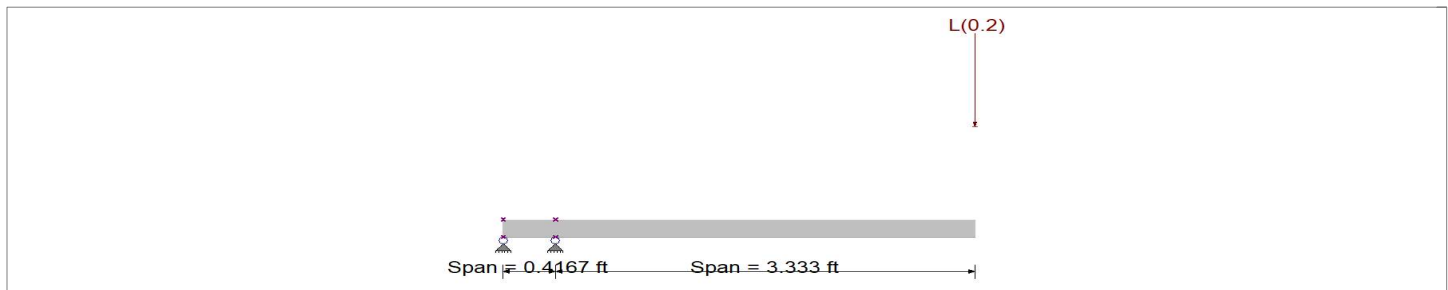
Code References

Calculations per IBC 2018, CBC 2019

Load Combinations Used : ASCE 7-22 / IBC 2024

General Beam Properties

Elastic Modulus	10,100.0 ksi				
Span #1	Span Length =	0.4167 ft	Area =	1.750 in^2	Moment of Inertia = 0.9115 in^4
Span #2	Span Length =	3.333 ft	Area =	1.750 in^2	Moment of Inertia = 0.9115 in^4



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Load(s) for Span Number 2

Point Load : L = 0.20 k @ 3.333 ft

DESIGN SUMMARY

Maximum Bending =	0.667 k-ft	Maximum Shear =	1.60 k
Load Combination	L Only	Load Combination	L Only
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1
Location of maximum on span	0.417 ft	Location of maximum on span	0.000 ft
Maximum Deflection	Deflection	Ratio	Span
Max Downward Transient Deflection	0.000 in	0	Span #1
Max Upward Transient Deflection	0.000 in	0	Span #2
Max Downward Total Deflection	0.000 in	0	Span #1
Max Upward Total Deflection	-0.001 in	3551	Span #1 L Only

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values (k-ft)					Shear Values (k)	
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega Cb	Rm	Va Max
Overall MAXimum Envelope										
Dsgn. L = 0.42 ft	1				-0.67	0.67				1.60
Dsgn. L = 3.33 ft	2				-0.67	0.67				0.20
Dsgn. L = 0.42 ft	1									-0.00
Dsgn. L = 3.33 ft	2									-0.00
L Only										
Dsgn. L = 0.42 ft	1				-0.67	0.67				1.60
Dsgn. L = 3.33 ft	2				-0.67	0.67				0.20

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
L Only	1	0.0000	0.000	L Only	-0.0014	0.244
	2	0.5187	3.333		0.0000	0.244

Vertical Reactions

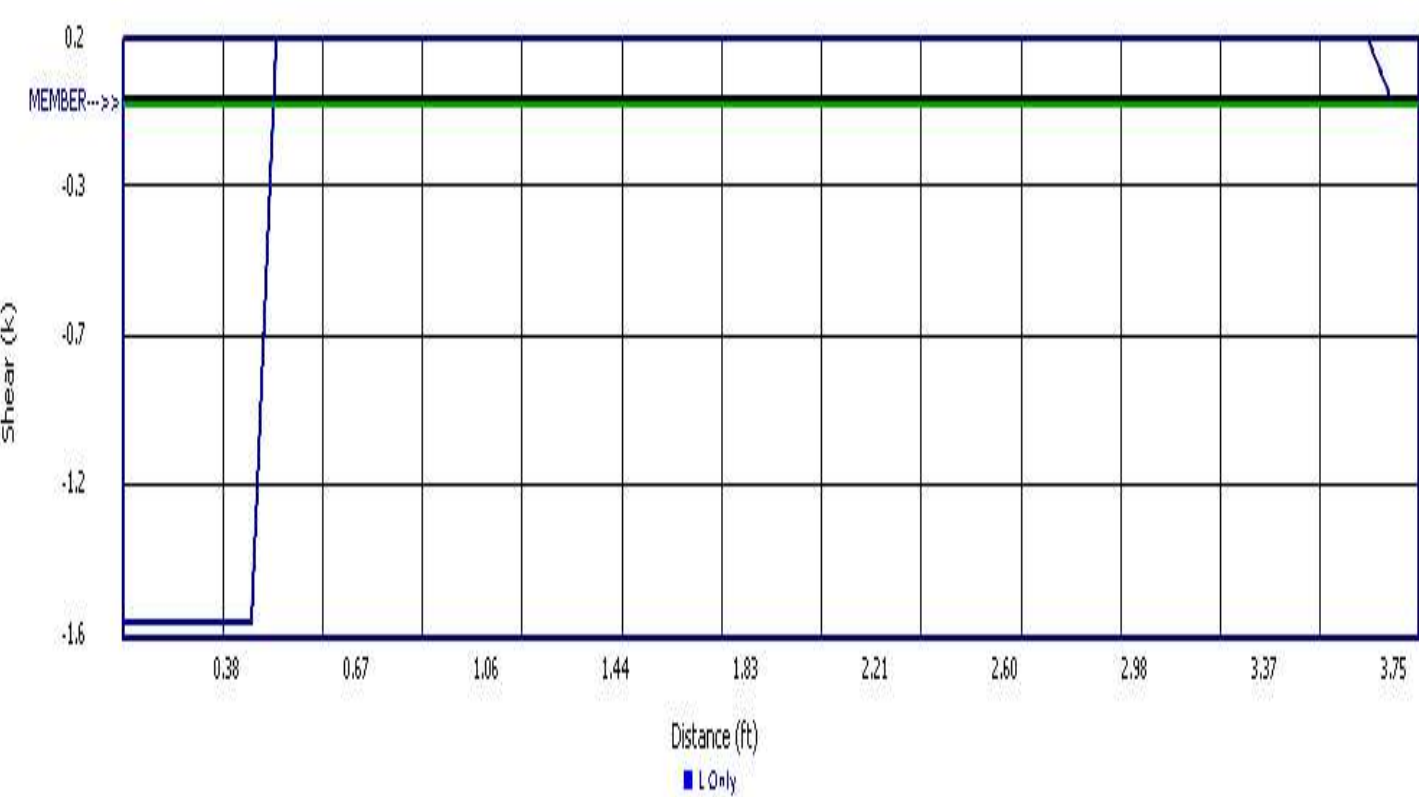
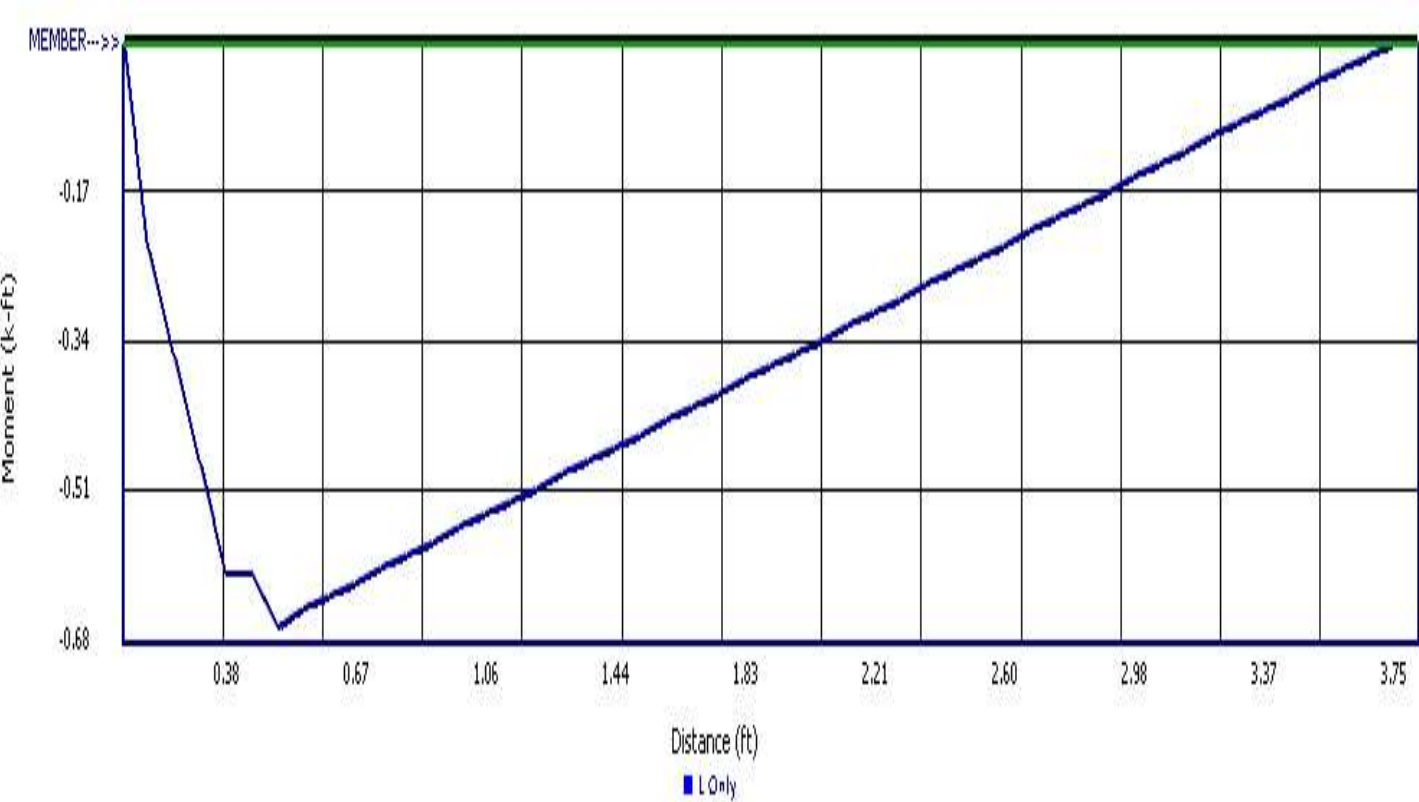
Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	-1.600	1.800	
Overall MINimum	-1.600		
L Only	-1.600	1.800	

Worst Reaction in Conn.

General Beam Analysis

Project File: post design.ec6
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DESCRIPTION: Post



General Beam Analysis

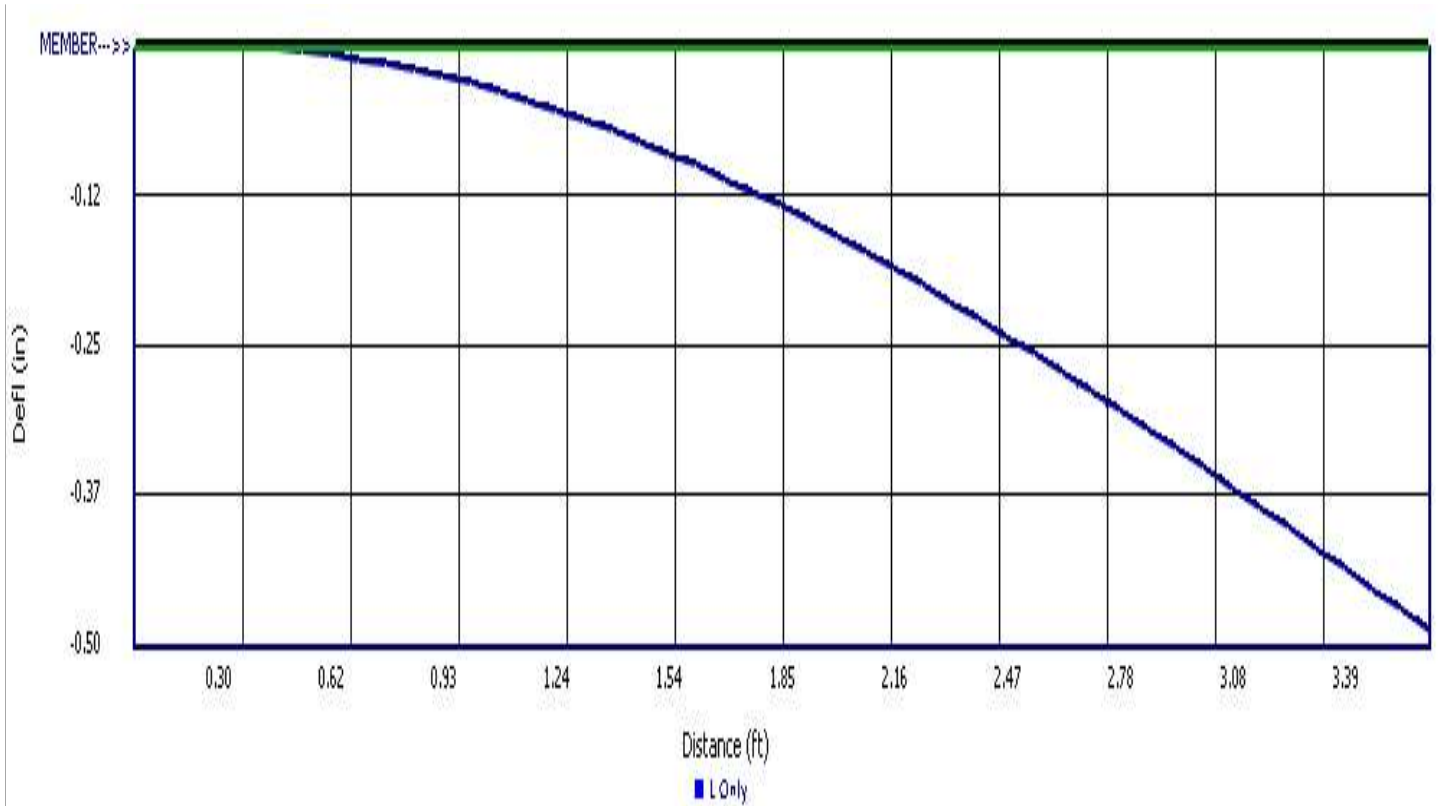
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LIC# : KW-06018068, Build:20.25.07.09

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DESCRIPTION: Post



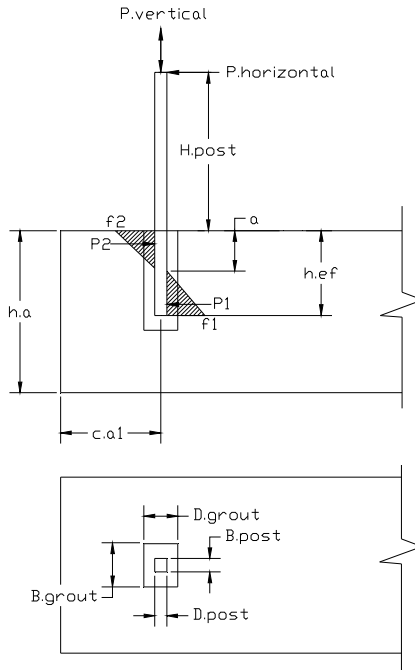
Summary of Values per Beam Span

Beam Span Moments & Shears at Incremental Locations

Load Type/ Combination	Span Location (ft)	Span ID	Shear (k)	Moment (ft-k)
Overall MAXimum Envelope	0.00	Span 1	-1.600	0.000
Overall MAXimum Envelope	0.04	Span 1	-1.600	-0.067
Overall MAXimum Envelope	0.08	Span 1	-1.600	-0.133
Overall MAXimum Envelope	0.13	Span 1	-1.600	-0.200
Overall MAXimum Envelope	0.17	Span 1	-1.600	-0.267
Overall MAXimum Envelope	0.21	Span 1	-1.600	-0.333
Overall MAXimum Envelope	0.25	Span 1	-1.600	-0.400
Overall MAXimum Envelope	0.29	Span 1	-1.600	-0.467
Overall MAXimum Envelope	0.33	Span 1	-1.600	-0.533
Overall MAXimum Envelope	0.38	Span 1	-1.600	-0.600
Overall MAXimum Envelope	0.42	Span 1	-1.600	-0.667
Overall MAXimum Envelope	0.72	Span 2	0.200	-0.605
Overall MAXimum Envelope	1.06	Span 2	0.200	-0.538
Overall MAXimum Envelope	1.39	Span 2	0.200	-0.472
Overall MAXimum Envelope	1.72	Span 2	0.200	-0.405
Overall MAXimum Envelope	2.06	Span 2	0.200	-0.338
Overall MAXimum Envelope	2.39	Span 2	0.200	-0.272
Overall MAXimum Envelope	2.72	Span 2	0.200	-0.205
Overall MAXimum Envelope	3.06	Span 2	0.200	-0.138
Overall MAXimum Envelope	3.39	Span 2	0.200	-0.072
Overall MAXimum Envelope	3.72	Span 2	0.200	-0.005
Overall MAXimum Envelope	3.75	Span 2	0.000	0.000
Overall MAXimum Envelope	0.00	Span 1	0.000	0.000

CONNECTION DESIGN AT START OF THE STAIR

Post Anchorage to Concrete:



Post Data:

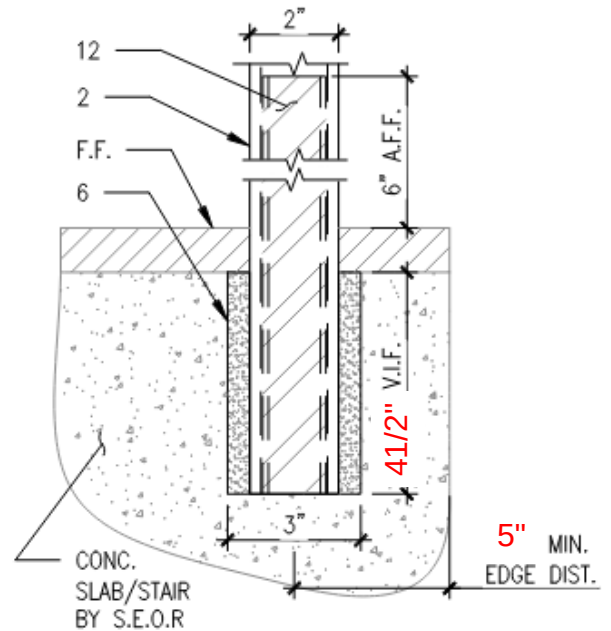
$B_{post} := 2.00$	Post Width (in)
$D_{post} := 2.00$	Post Depth (in)
$h_{ef} := 4.50$	Post Embedment (in)
$C_{a1} := 5.00$	Minimum Edge Distance (in)

Grout Size Data:

$B_{grout} := 2.66$	Equivalent Grout Width (in)
$D_{grout} := 2.66$	Equivalent Grout Depth (in)
$f_{c_{grout}} := 8000.00$	Grout Strength (psi)

Concrete Slab Data:

$f_{c_{concrete}} := 3000.00$	Concrete Strength (psi)
$d_o := 3.00$	Hold diameter (Grout Diameter) (in)
$h_a := 8.00$	Concrete Slab Deep (in)



SKETCH

Equivalent Actual Horizontal Load at Top Railing Height (Pd)

$$P_d := \frac{M_{PT}}{H_{post}}$$

$$P_d = 200.00 \text{ lbs}$$

Arm Effect:

$$a := \frac{2 \cdot h_{ef}^2 + 3 \cdot H_{post} \cdot h_{ef}}{3 \cdot h_{ef} + 6 \cdot H_{post}}$$

$$a = 2.29 \text{ in}$$

$$P_2 := \frac{P_d \cdot a^2}{h_{ef} \cdot (2 \cdot a - h_{ef})}$$

$$P_2 = 2784.27 \text{ lbs}$$

$$P_1 := P_2 - P_d$$

$$P_1 = 2584.27 \text{ lbs}$$

$$M_{external} := P_d \cdot (H_{post} + a)$$

$$M_{external} = 8058.39 \text{ lbs} - \text{in}$$

$$M_{internal} := P_2 \cdot \frac{2}{3} \cdot a + P_1 \cdot \frac{2}{3} \cdot (h_{ef} - a)$$

$$M_{internal} = 8058.39 \text{ lbs} - \text{in}$$

$$V_u := 1.6 \cdot (\max(P_1, P_2))$$

$$V_u = 4454.82 \text{ lbs}$$

Stress Analysis Between Post and Grout:

$$f_{2,\text{grout}} := 1.6 \cdot \frac{2 \cdot P_2}{a \cdot B_{\text{post}}}$$

$$f_{2,\text{grout}} = 1943.70$$

psi

$$f_{1,\text{grout}} := 1.6 \cdot \frac{2 \cdot P_1}{(h_{\text{ef}} - a) \cdot B_{\text{post}}}$$

$$f_{1,\text{grout}} = 1872.59$$

psi

Bearing Stress for Grout :

$$Fp_{\text{grout}} := \left[0.65 \cdot (0.85 f_{c,\text{grout}}) \right] \cdot 1.5$$

$$Fp_{\text{grout}} = 6630.00$$

psi

$$\text{Stress}_{\text{grout}} := \begin{cases} \text{"N.G."} \\ \text{"O.K."} & \text{if } \max(f_{1,\text{grout}}, f_{2,\text{grout}}) \leq Fp_{\text{grout}} \end{cases}$$

$$\text{Stress}_{\text{grout}} = \text{"O.K."}$$

Stress Analysis Between Grout and Concrete:

$$f_{2,\text{concrete}} := 1.6 \cdot \frac{2 \cdot P_2}{a \cdot B_{\text{grout}}}$$

$$f_{2,\text{concrete}} = 1461.43$$

psi

$$f_{1,\text{concrete}} := 1.6 \cdot \frac{2 \cdot P_1}{(h_{\text{ef}} - a) \cdot B_{\text{grout}}}$$

$$f_{1,\text{concrete}} = 1407.96$$

psi

Bearing Stress for Concrete :

$$Fp_{\text{concrete}} := \left[0.65 \cdot (0.85 \cdot f_{c,\text{concrete}}) \right] \cdot 1.5$$

$$Fp_{\text{concrete}} = 2486.25$$

psi

$$\text{Stress}_{\text{concrete}} := \begin{cases} \text{"N.G."} \\ \text{"O.K."} & \text{if } \max(f_{1,\text{concrete}}, f_{2,\text{concrete}}) \leq Fp_{\text{concrete}} \end{cases}$$

$$\text{Stress}_{\text{concrete}} = \text{"O.K."}$$

Shear Analysis-Concrete Breakout Strength:

$$A_{Vco} := 4.5 \cdot C_{a1}^2$$

$$A_{Vco} = 112.5 \text{ in}^2$$

$$A_{Vc} := \begin{cases} 2 \cdot (1.5 \cdot C_{a1}) \cdot h_a & \text{if } h_a < 1.5 \cdot C_{a1} \\ 2 \cdot (1.5 \cdot C_{a1}) \cdot (1.5 \cdot C_{a1}) & \text{if } h_a \geq 1.5 \cdot C_{a1} \end{cases}$$

$$A_{Vc} = 112.50 \text{ in}^2$$

$$\psi_{ed,V} := 1.00 \quad \text{Modification factor for edge effect}$$

$$\psi_{c,V} := 1.40 \quad \begin{array}{l} \text{Modification Factor in No cracked concrete at service loads} \\ \psi_{c,V}=1.4 \\ \text{Modification Factor in cracked concrete with} \\ \psi_{c,V}=1 \text{ w/ No supplementary reinforcement.} \\ \psi_{c,V}=1.2 \text{ w/ Supplementary reinforcement of a No 4 Bar between the anchor and the edge.} \\ \psi_{c,V}=1.4 \text{ w/ Supplementary reinforcement of No 4 Bar and stirrups spaced at not more than 4 in.} \end{array}$$

$$l_e := \text{if}(h_{ef} > 8 \cdot d_o, 8 \cdot d_o, h_{ef})$$

$$l_e = 4.50 \text{ in}$$

$$V_b := \begin{cases} 7 \cdot \left[\left(\frac{l_e}{d_o} \right)^{0.2} \sqrt{d_o} \cdot \sqrt{f_{c_{concrete}}} \cdot C_{a1}^{1.5} \right] \\ 9 \cdot \left(\sqrt{f_{c_{concrete}}} \cdot C_{a1}^{1.5} \right) \end{cases}$$

$$V_b = 5511.35 \text{ lbs.}$$

$$V_{cb} := \frac{A_{Vc}}{A_{Vco}} \cdot \psi_{ed,V} \cdot \psi_{c,V} \cdot V_b$$

$$V_{cb} = 7715.89 \text{ lbs.}$$

$$\phi := 0.70 \quad \begin{array}{l} \text{Conditions} \\ \phi=0.75 \text{ w/ Supplementary reinforcement are crossing} \\ \text{concrete failure prism.} \\ \phi=0.70 \text{ w/ No supplementary reinforcement are crossing} \\ \text{concrete failure prism.} \end{array}$$

$$\phi \cdot V_{cb} = 5401.12 \text{ lbs}$$

$$\text{BREAKOUT}_{\text{shear}} := \text{if}(V_u > \phi \cdot V_{cb}, \text{"N.G."}, \text{"OK"})$$

$$\text{BREAKOUT}_{\text{shear}} = \text{"OK"}$$

Shear Analysis-Concrete Burst-Out Strength:

$$C_{alc} := \begin{cases} C_{al} \\ \text{"N/A"} & \text{if } h_a < C_{al} \end{cases}$$

$$C_{alc} = 5.00 \quad \text{in}$$

Total Cone Area for Failure Plane

$$A_{cone.total} := \sqrt{2} \cdot C_{alc} \cdot \pi \cdot \left(C_{alc} - \frac{D_{grout}}{2} + \frac{B_{grout}}{2} \right)$$

$$A_{cone.total} = 111.07 \quad \text{in}^2$$

Cone Area for Failure Plane at Post

$$A_{cone.post} := \sqrt{2} \cdot \left(\frac{B_{grout}}{2} \right)^2 \cdot \pi$$

$$A_{cone.post} = 7.86 \quad \text{in}^2$$

Final Cone Area for Failure Plane

$$A_{cone.final} := \frac{A_{cone.total} - A_{cone.post}}{2}$$

$$A_{cone.final} = 51.61 \quad \text{in}^2$$

Final Area for Failure Plane

$$V_{cone.cb} := 4 \cdot \sqrt{f_{c.concrete}} \cdot A_{cone.final}$$

$$V_{cone.cb} = 11306.42 \quad \text{lbs}$$

$$\phi := 0.70$$

Conditions
 $\phi=0.75$ w/ Supplementary reinforcement are crossing concrete failure prism.
 $\phi=0.70$ w/ No supplementary reinforcement are crossing concrete failure prism.

$$\phi \cdot V_{cone.cb} = 7914.50 \quad \text{lbs}$$

$$\text{BURSTOUT}_{\text{shear}} := \text{if}(V_u > \phi \cdot V_{cone.cb}, \text{"N.G."}, \text{"OK"})$$

$$\text{BURSTOUT}_{\text{shear}} = \text{"OK"}$$



Conn Design

Loads:

R= 1.800k= 1 800#
LL=200#

Load Processing:

Tper anchor= R= 1.800k= 1 800#
Sper anchor= 200#/2= 100#

*USING $\varnothing$ 1/2" S.S.THREADED ROD W/ A7+ EPOXY BY RED HEAD ASTM A307, W/ 4-1/2 MIN. EMBEDMENT, 2" MIN. EDGE DISTANCE AND 5" SPACING.

- For bolts calculations, see spreadsheet printout

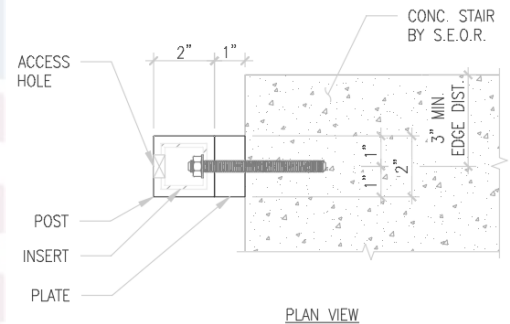
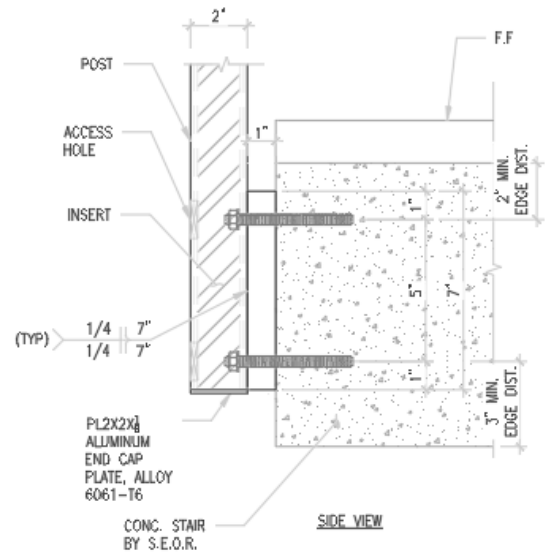


Plate Analysis

Load:

Tper anchor= 1 800#

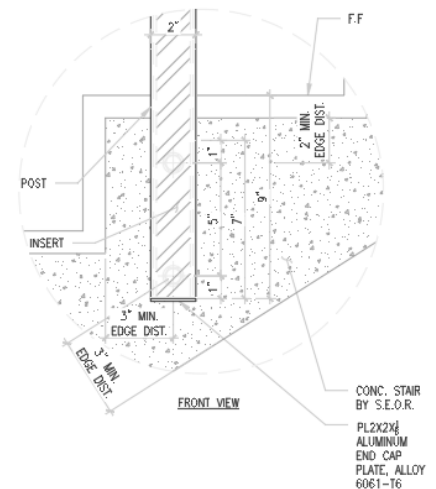
Loads Processing:

Mplate= Tper anchor *ecc
Mplate= 1 800#*1in= 1800#-in

$S_x = (beffct. * thk^2) / 6$; beffct.=2*ecc= 2in ; $F_y = 15000\text{psi (weld)}$

Mallow= fb *Sx
1800#-in= 9000psi * b*thk²/6
thk= 0.7748in

*Using Plate PL1"x2x7 Alloy 6061-T6





A7+

The Most Versatile Quick-Cure

Concrete	3000
Diameter	Ø 1/2
Embed	4 1/2
Steel Strength	ASTM A307
Spacing=	5.00
Edge Dist.=	2.00
Double Edge Dist	Yes
by Design	Tbolt = 1800.00
	Vbolt = 100.00
by Manuf.	T = 3495.00
	V = 1870.00

Threaded Rod and Rebar Installation in Solid Concrete Edge / Spacing Distance Load Factor Summary^{1,2}

LOAD FACTOR	DISTANCE FROM EDGE OF CONCRETE
Critical Edge Distance—Tension	
100% Tension Load	→ 0.75 x Anchor Embedment
Minimum Edge Distance—Tension	
70% Tension Load	→ 0.25 x Anchor Embedment
Critical Edge Distance—Shear	
100% Shear Load	→ 1.25 x Anchor Embedment
Minimum Edge Distance—Shear	
10% Shear Load	→ 0.25 x Anchor Embedment
LOAD FACTOR	DISTANCE FROM ANOTHER ANCHOR
Critical Spacing—Tension	
100% Tension Load	→ 1.25 x Anchor Embedment
Minimum Spacing—Tension	
80% Tension Load	→ 0.25 x Anchor Embedment
Critical Spacing—Shear	
100% Shear Load	→ 1.25 x Anchor Embedment
Minimum Spacing—Shear	
25% Shear Load	→ 0.25 x Anchor Embedment

Find interpolated value of 'B' for the given value of 'A' from table of data below:

Tension			Tension		
	Edge Dist.	2		Spacing=	5
0.75 x Embed	3.375	1	1.25 x Embed	5.625	1
	2.00	0.67		5.00	0.97
0.25 x Embed	1.125	0.7	0.25 x Embed	1.125	0.75
Shear			Shear		
	Edge Dist.	2		Spacing=	5
1.25 x Embed	5.625	1	1.25 x Embed	5.625	1
	2.00	0.19		5.00	0.90
0.25 x Embed	1.125	0.3	0.25 x Embed	1.125	0.3

Tallow & Vallow	Tallow=	2250.00	>	Tbolt	O.K.
	Vallow=	321.00	>	Vbolt	O.K.

Combine	$= \left(\frac{T_{bolt}}{T_{allow}} \right)^{\frac{5}{3}} + \left(\frac{V_{bolt}}{V_{allow}} \right)^{\frac{5}{3}} =$	0.83	<	1.00	O.K.
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A7+*The most Versatile Quick Cure***Allowable Tension Loads for Threaded Rod Installed in Solid Concrete**

THREADED ROD DIA. (In.)	MIN. EMBEDMENT DEPTH (In.)	ALLOWABLE TENSION LOAD BASED ON EPOXY BOND STRENGTH			ALLOWABLE TENSION LOAD BASED ON STEEL STRENGTH		
		2000	3000	4000	ASTM A307	ASTM A193GR	ASTM F593
Ø 3/8	1 1/2	N/A	N/A	934.0	2080.0	4340.0	3995.0
	3 3/8	1460.0	2100.0	2740.0	2080.0	4340.0	3995.0
	4 1/2	1930.0	2422.5	2915.0	2080.0	4340.0	3995.0
Ø 1/2	2	N/A	N/A	1505.0	3730.0	7780.0	7155.0
	4 1/2	2700.0	3495.0	4290.0	3730.0	7780.0	7155.0
	6	3550.0	3945.0	4340.0	3730.0	7780.0	7155.0
Ø 5/8	2 1/2	N/A	N/A	1832.0	5870.0	12230.0	11250.0
	5 5/8	4100.0	5362.5	6625.0	5870.0	12230.0	11250.0
	7 1/2	4685.0	6015.0	7345.0	5870.0	12230.0	11250.0
Ø 3/4	3	N/A	N/A	2158.0	8490.0	17690.0	14860.0
	6 3/4	4655.0	6042.5	7430.0	8490.0	17690.0	14860.0
	9	5980.0	7705.0	9430.0	8490.0	17690.0	14860.0
Ø 7/8	3 1/2	N/A	N/A	3413.0	11600.0	25510.0	20835.0
	7 7/8	N/A	N/A	11230.0	11600.0	25510.0	20835.0
	10 1/2	9220.0	10650.0	12080.0	11600.0	25510.0	20834.0
Ø 1	4	N/A	N/A	4067.0	15180.0	31620.0	26560.0
	9	8050.0	10050.0	12050.0	15180.0	31620.0	26560.0
	12	11515.0	13750.0	15985.0	15180.0	31620.0	26560.0
Ø 1 1/4	5	N/A	N/A	5460.0	23800.0	49580.0	34670.0
	11 1/4	11490.0	12832.5	14175.0	23800.0	49580.0	34670.0
	15	15550.0	18322.5	21095.0	23800.0	49580.0	34670.0

A7+*The most Versatile Quick Cure***Allowable Shear Loads for Threaded Rod Installed in Solid Concrete**

THREADED ROD DIA. (In.)	MIN. EMBEDMENT DEPTH (In.)	ALLOWABLE TENSION LOAD BASED ON EPOXY BOND STRENGTH			ALLOWABLE TENSION LOAD BASED ON STEEL STRENGTH		
		2000	3000	4000	ASTM A307	ASTM A193GR	ASTM F593
Ø 3/8	1 1/2	N/A	N/A	1031.0	1040.0	2170.0	1995.0
	3 3/8	1305.0	1305.0	1305.0	1040.0	2170.0	1995.0
	4 1/2	N/A	N/A	N/A	N/A	N/A	N/A
Ø 1/2	2	N/A	N/A	2005.0	1870.0	3895.0	3585.0
	4 1/2	2005.0	2005.0	2005.0	1870.0	3895.0	3585.0
	6	N/A	N/A	N/A	N/A	N/A	N/A
Ø 5/8	2 1/2	N/A	N/A	2814.0	2940.0	6125.0	5635.0
	5 5/8	3990.0	3990.0	3990.0	2940.0	6125.0	5635.0
	7 1/2	N/A	N/A	N/A	N/A	N/A	N/A
Ø 3/4	3	N/A	N/A	5030.0	4250.0	8855.0	7440.0
	6 3/4	5030.0	5030.0	5030.0	4250.0	8855.0	7440.0
	9	N/A	N/A	N/A	N/A	N/A	N/A
Ø 7/8	3 1/2	N/A	N/A	5230.0	5800.0	12760.0	10730.0
	7 7/8	7465.0	7465.0	7465.0	5800.0	12760.0	10730.0
	10 1/2	N/A	N/A	N/A	N/A	N/A	N/A
Ø 1	4	N/A	N/A	8288.0	7590.0	15810.0	13285.0
	9	9385.0	9385.0	9385.0	7590.0	15810.0	13285.0
	12	N/A	N/A	N/A	N/A	N/A	N/A
Ø 1 1/4	5	N/A	N/A	8288.0	11900.0	24790.0	18840.0
	11 1/4	14600.0	14600.0	14600.0	11900.0	24790.0	18840.0
	15	N/A	N/A	N/A	N/A	N/A	N/A