STRUCTURAL CALCULATIONS

Project name:

12700 Rolling Road

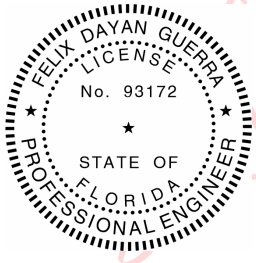
Job No.:

25-1944

Project address:

12700 Rolling Rd Dr, Miami, FL 33156, USA

These calculations are strictly valid for the address above. Use in other projects is unauthorized and may constitute fraud.



Digitally signed by Felix D Guerra
DN: c=US, o=D and SG Engineering Group INC, dnQualifier=A01410D0000019B951B44DB002D6574, cn=Felix D Guerra
Date: 2026.07.23 09:13:09 -04'00'

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. American Wood Council NDS 2024

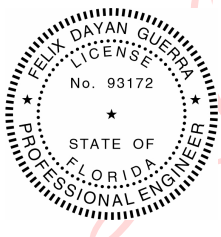
CALCULATION INDEX:

I.	Wind Load Analysis	3-6
II.	Pool Gates Design	7-18
III.	Pool Fence Design	17-29
IV.	Front Fence Design	30-42
V.	Pedestrian Gate Design	43-50
VI.	Rolling Gate Design	51-64

Total Pages = 64

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.



Digitally signed by Felix D Guerra
DN: c=US, o=D and SG Engineering Group INC, dnQualifier=A01410D0000019B951B44DB002D6574, cn=Felix D Guerra
Date: 2026.07.23 09:13:25 -04'00'

WIND LOAD ANALYSIS

WIND ANALYSIS FOR ROLLING GATE & PEDESTRIAN GATE

Wind for Solid Freestanding Walls & Signs Design (ε>70%) ASCE 7-22

General Wind Data:

$V := 115.00$ Wind Velocity (mph)

$K_{zt} := 1.00$ Topographic Factor

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

$G := 0.85$ Gust Factor (Rigid Structure)

$C_f := 1.85$ Net Force Coefficients (Figure 29.3-1)

For Solid Signs: s/h<0.16 & 0.2<B/s<10.....Cf=1.85

For Freestanding Walls: s/h>=1 & B/s=1.....Cf=1.45

s/h>=1 & B/s=2.....Cf=1.40

s/h>=1 & B/s=5.....Cf=1.35

s/h>=1 & B/s=10.....Cf=1.30

$\alpha := 9.8$

$zg := 2460$

Values for Terrain exposure constants α and zg:

Exposure B------ Value α =7.5 , Value zg=3,280

Exposure C------ Value α =9.8 , Value zg=2,460

Exposure D------ Value α =11.5 , Value zg=1,935

General Sign Data:

$Z := 5.0$ Height of Top of Sign (ft)

$\varepsilon := 100.00$ Solidity Ratio of Sign (%)

$$\lambda := 1 - \left(1 - \frac{\varepsilon}{100}\right)^{1.5}$$

$\lambda = 1.00$ Solidity Ratio of Sign (%)

Then

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

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

$K_z = 0.85$

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

$q_z = 24.49$ psf

Allowable Design Wind Loads:

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

$p_z = 23.11$ Gross Wind per Actual Solid Area (psf)

$p_{z.EQ} := \max\left(\lambda \cdot p_z, 10\right)$

$p_{z.EQ} = 23.11$ Equivalent Wind in Overall Area (psf)

WIND ANALYSIS FOR FRONT FENCE

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

General Wind Data:

$V := 115.00$ Wind Velocity (mph)

$K_{zt} := 1.00$ Topographic Factor

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

$G := 0.85$ Gust Factor (Rigid Structure)

$C_f := 1.80$

Net Force Coefficients Cf (see Figure 29.4-2)	Flat-Side Members	Rounded Members
for ε<=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

$\alpha := 9.8$

$zg := 2460.00$

Values for Terrain exposure constants α and zg:
Exposure B------ Value α =7.5 , Value zg=3,280
Exposure C------ Value α =9.8 , Value zg=2,460
Exposure D------ Value α =11.5 , Value zg=1,935

General Sign Data:

$Z := 5.0$ Height of Top of Sign (ft)

$\varepsilon := 65.00$ Solidity Ratio of Sign (%)

Then

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

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

$K_z = 0.85$

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

$q_z = 24.49$ psf

Allowable Design Wind Loads:

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

$p_z = 22.49$ Gross Wind per Actual Solid Area (psf)

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

$p_{z.EQ} = 14.62$ Equivalent Wind in Overall Area (psf)

WIND ANALYSIS FOR SIDE FENCE & GATES

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

General Wind Data:

$V := 115.00$ Wind Velocity (mph)

$K_{zt} := 1.00$ Topographic Factor

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

$G := 0.85$ Gust Factor (Rigid Structure)

$C_f := 1.80$

Net Force Coefficients Cf (see Figure 29.4-2)	Flat-Side Members	Rounded Members
for ε<=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

$\alpha := 9.8$

$zg := 2460.00$

Values for Terrain exposure constants α and zg:
Exposure B------ Value α =7.5 , Value zg=3,280
Exposure C------ Value α =9.8 , Value zg=2,460
Exposure D------ Value α =11.5 , Value zg=1,935

General Sign Data:

$Z := 5.0$ Height of Top of Sign (ft)

$\varepsilon := 25.00$ Solidity Ratio of Sign (%)

Then

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

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

$K_z = 0.85$

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

$q_z = 24.49$ psf

Allowable Design Wind Loads:

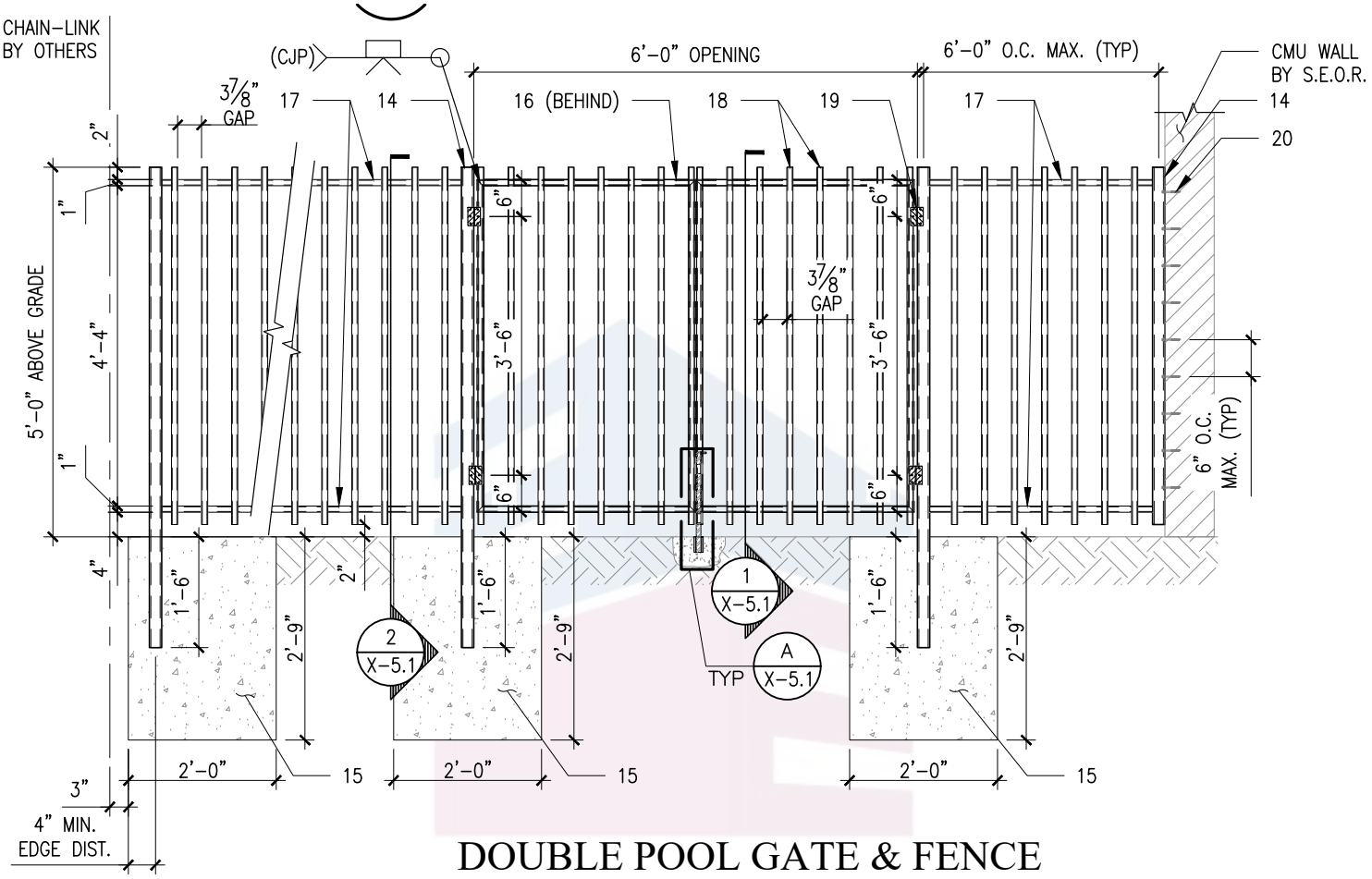
$p_z := 0.6\left(q_z \cdot G \cdot C_f\right)$

$p_z = 22.49$ Gross Wind per Actual Solid Area (psf)

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

$p_{z.EQ} = 10.00$ Equivalent Wind in Overall Area (psf)

DOUBLE POOL GATE DESIGN



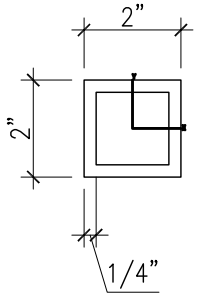
DOUBLE POOL GATE & FENCE
ELEVATION (TYP)

B
X–5.0

SCALE: 1/2"=1'–0"

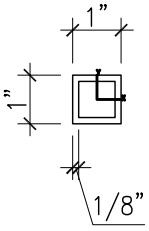
POOL FENCE & GATE SKETCH

POOL GATES SECTION PROPERTIES



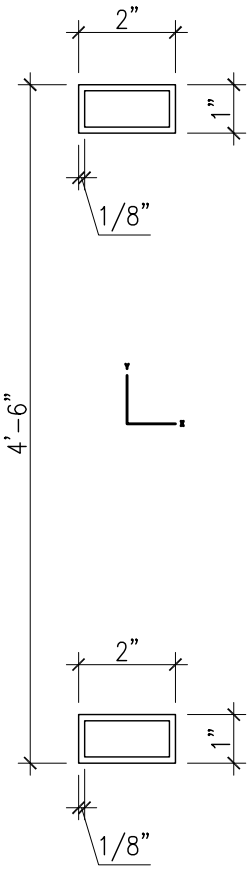
POST RT2"x2"x ¼"
ALLOY 6061-T6

Area = 1.7500 in^2
Ixx = 0.9115 in^4
Iyy = 0.9115 in^4
Jz = 1.8229 in^4
Pxy = 0.0000 in^4
rxx = 0.7217 in
ryy = 0.7217 in
Sxx max = 0.9115 in^3
Sxx min = 0.9115 in^3
Syy max = 0.9115 in^3
Syy min = 0.9115 in^3



PICKET RT1"x1"x ⅛"
ALLOY 6061-T6

Area = 0.4375 in^2
Ixx = 0.0570 in^4
Iyy = 0.0570 in^4
Jz = 0.1139 in^4
Pxy = -0.0000 in^4
rxx = 0.3608 in
ryy = 0.3608 in
Sxx max = 0.1139 in^3
Sxx min = 0.1139 in^3
Syy max = 0.1139 in^3
Syy min = 0.1139 in^3



FRAME RT2"x1"x ⅛"
ALLOY 6061-T6

Area = 1.3720 in^2
Ixx = 965.8040 in^4
Iyy = 0.6615 in^4
Jz = 966.4656 in^4
Pxy = 0.0000 in^4
rxx = 26.5323 in
ryy = 0.6944 in
Sxx max = 35.7705 in^3
Sxx min = 35.7705 in^3
Syy max = 0.6615 in^3
Syy min = 0.6615 in^3

PARTIAL WELDING (BOTTOM FENCE AT POST)

Partial Welding

General Data:

$F_N := 19000.00$ psi — Allowable stress for non welded members.

$F_W := 9000.00$ psi — Allowable stress for weld-affected members.

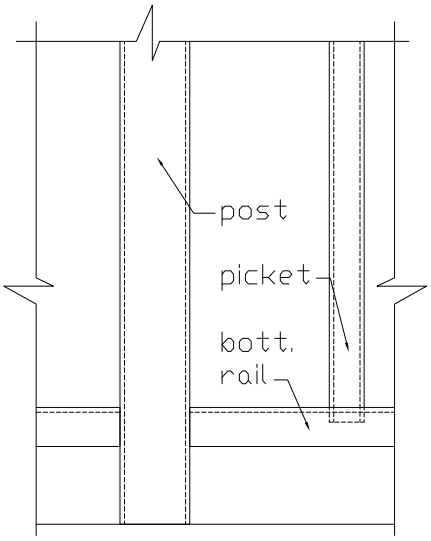
Partial Welding.

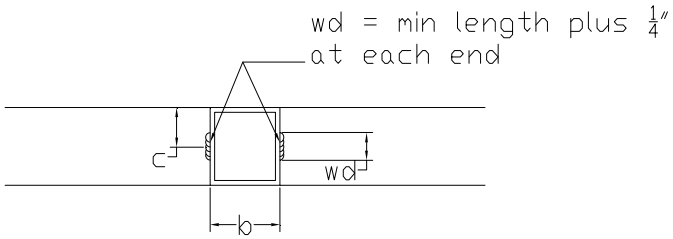
As per Aluminum Code 2020, section 7

Fpw = Fn - (An/A)*(Fn-Fw)

Aw= wd*tw
Aw= (1"+ 1/4"+1/4") x (1/8"x0.707)
Aw= 0.1325 in²

A = (2sides)*(⅔c)*(tw)+b(tw)
A = (4/3 c+b) * tw





$A_w := 0.1325$ (times thickness) — weld-affected cross sectional area

$c := 1.00$ in — distance from neutral axis to extreme comp fiber.

$b := 2.00$ in — post width.

$A_c := \frac{4}{3} \cdot c + b$ (times thickness) — net cross sectional area of the compression flange of a beam, consisting of the portion of the section farther than 2c/3 from the neutral axis, where c is the distance from the neutral axis to the extreme fiber.

Stress for part weld-affected section (Fpw):

$$F_{PW} := F_N - \frac{A_w}{A_c} \cdot (F_N - F_W)$$

$F_{PW} = 18602.50$ psi

Double Swing Gate Design

Swing Gate Design (Frame, Pickets and Post)

DESIGN INFORMATION:

Florida Building Code 2023
AISC Manual of Steel Construction, NDS-ASD for Wood Construction, ASCE 07-22 Specification for the Design of Cold-Formed Stainless Steel Structural Members, Aluminum Design Manual 2020
Wind Loads, ASCE 7 - 22

Gate Analysis w/ Vertical Pickets:

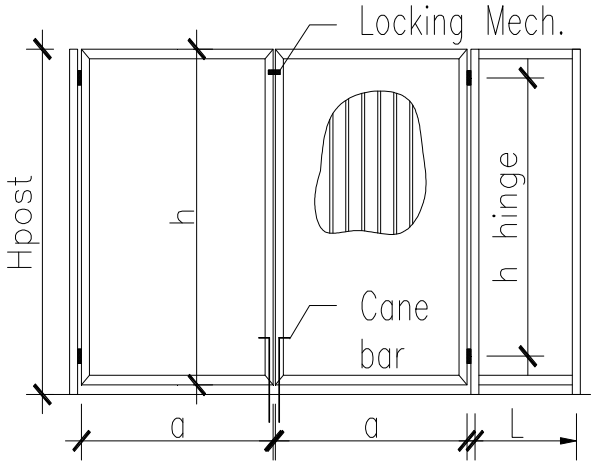
General Data:

$a := 3.00$ Leaf width (ft)

$H_{post} := 5.00$ Gate Height (ft)

$L := 6.00$ Post Span at Fence (ft)

$h_{hinge} := 3.833$ Hinges Spacing (ft)



General Loads:

$WL := 10.00$ Wind Pressure (psf)

$DL := 5.00$ Dead Load (psf)

Frame Data:

$Fb_{bend.frame} := 9000.00$ psi

$Fv_{shear.frame} := 5000.00$ psi

$Sx_{frame} := 35.77$ in^3

$Sy_{frame} := 0.6615$ in^3

$A_{frame} := 1.3720$ in^2

Picket Data:

$Fb_{bend.picket} := 19000.00$ psi

$Fv_{shear.picket} := 5000.00$ psi

$Sx_{picket} := 0.1139$ in^3

$A_{picket} := 0.4375$ in^2

Post Data:

$Fb_{bend.post} := 18602.5$ psi

$Fv_{shear.post} := 5000.00$ psi

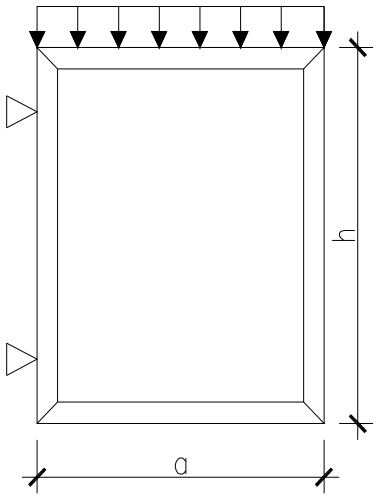
$Sx_{post} := 0.9115$ in^3

$Sy_{post} := 0.9115$ in^3

$A_{post} := 1.75$ in^2

Frame Design:

X-X Moment :



For Dead Load:

$$h := H_{post} - \frac{2}{12}$$

$$M_{DL.frame} := 0.5 \cdot DL \cdot h \cdot a^2 \cdot 12$$

$M_{DL.frame} = 1305.00$ in − lb

Section Required:

Bending Design:

Section Modulus Required:

$$Sframereqx := \frac{M_{DL.frame}}{Fb_{bend.frame}}$$

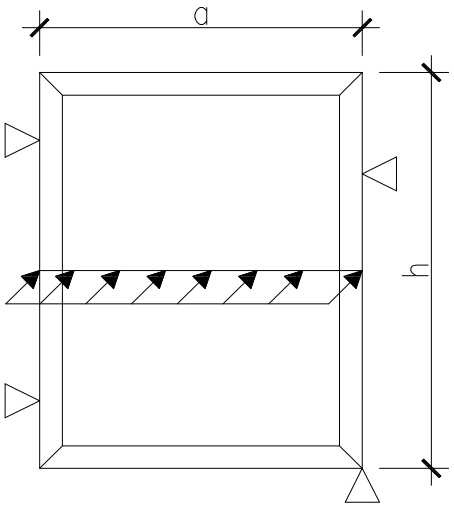
$Sframereqx = 0.15$ in^3

Section Provided:

$$BENDING_{frame.x} := if\left(Sframereqx \geq Sx_{frame}, "N.G" , "OK" \right)$$

$BENDING_{frame.x} = "OK"$

Y-Y Moment :



For Wind Pressure:

$$M_{Wind.frame} := 0.125 \cdot WL \cdot h \cdot a^2 \cdot 12$$

$M_{Wind.frame} = 652.50$ in − lb

Section Required:

Bending Design:

Section Modulus Required:

$$Sframereqy := \frac{M_{Wind.frame}}{Fb_{bend.frame}}$$

$Sframereqy = 0.07$ in^3

Section Provided:

$BENDING_{frame.y} := if\left(Sframereqy \geq Sy_{frame}, "N.G" , "OK" \right)$ $BENDING_{frame.y} = "OK"$

Combined Analysis:

$fbend_x := \frac{M_{DL.frame}}{Sx_{frame}}$ $fbend_x = 36.48$ psi

$fbend_y := \frac{M_{Wind.frame}}{Sy_{frame}}$ $fbend_y = 986.39$ psi

$Comb_{frame} := if\left(\frac{fbend_x}{Fb_{bend.frame}} + \frac{fbend_y}{Fb_{bend.frame}} \geq 1 , "N.G" , "OK" \right)$ $Comb_{frame} = "OK"$

Hinges Reaction:

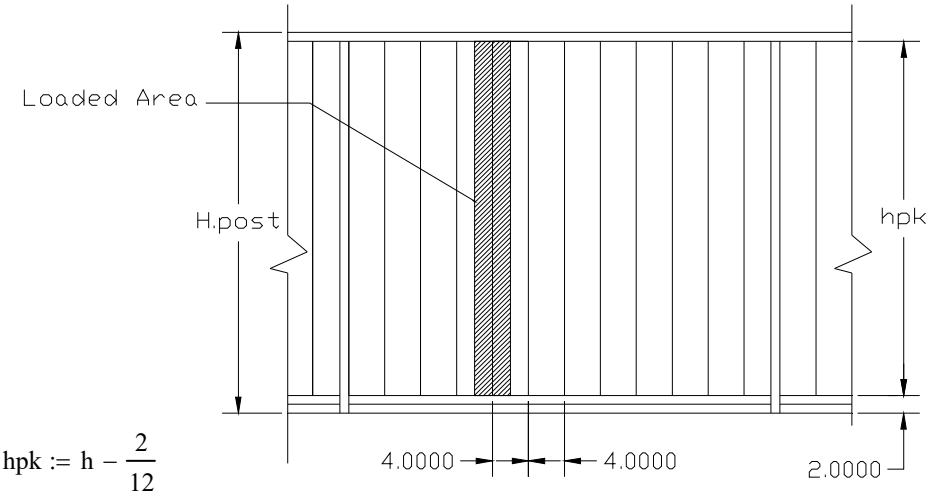
$Rx := \frac{DL \cdot h \cdot \frac{a^2}{2}}{h_{hinge}}$ $Rx = 28.37$ lb

$Ry := WL \cdot a \cdot \frac{h}{2}$ $Ry = 72.5$ lb

$Rz := DL \cdot a \cdot \frac{h}{2}$ $Rz = 36.25$ lb

$ResultantForce := \sqrt{Rx^2 + Ry^2 + Rz^2}$ $ResultantForce = 85.88$ lb

Picket Design:



$hpk := h - \frac{2}{12}$

$q_{picket} := WL$ → $q_{picket} = 10.00$ psf

$Mmaxpk := \frac{q_{picket} \cdot 4 \cdot hpk^2}{8}$ → $Mmaxpk = 108.89$ in-lb

$Vmaxpk := \frac{q_{picket} \cdot 4 \cdot hpk}{12 \cdot 2}$ → $Vmaxpk = 7.78$ lb

Section Required:

Bending Design:

Section Modulus Required:

$Spkreq := \frac{Mmaxpk}{Fb_{bend.picket}}$ → $Spkreq = 0.006$ in^3

Shear Design:

Area Required:

$Apktreq := \frac{2 \cdot Vmaxpk}{Fv_{shear.picket}}$ → $Apktreq = 0.003$ in^2

Section Provided:

$BENDING_{picket} := if(Spkreq \geq Sx_{picket}, "N.G", "OK")$ → $BENDING_{picket} = "OK"$

$SHEAR_{picket} := if(Apktreq \geq A_{picket}, "N.G", "OK")$ → $SHEAR_{picket} = "OK"$

Post Design:

Moment due to DL:

$$M_{DL.post} := DL \cdot H_{post} \cdot a \cdot \frac{a}{2} \cdot 12$$

$M_{DL.post} = 1350.00$ in - lb

Section Required:

Bending Design:

Section Modulus Required:

$$Spostreq_x := \frac{M_{DL.post}}{Fb_{bend.post}}$$

$Spostreq_x = 0.07$ in^3

Section Provided:

$$BENDING_{post.x} := if\left(Spostreq_x \geq Sx_{post}, "N.G" , "OK"\right)$$

$BENDING_{post.x} = "OK"$

Moment due to Wind:

$$M_{wind.post} := WL \cdot \left(\frac{L}{2} + a\right) \cdot \frac{H_{post}^{2}}{2} \cdot 12$$

$M_{wind.post} = 9000.00$ in - lb

Shear Analysis:

$$V_{post} := WL \cdot H_{post} \cdot \left(\frac{L}{2} + a\right)$$

$V_{post} = 300.00$ lbs.

Section Required:

Bending Design:

Section Modulus Required:

$$Spostreq_y := \frac{M_{wind.post}}{Fb_{bend.post}}$$

$Spostreq_y = 0.48$ in^3

Shear Design:

Area Required:

$$Apostreq := \frac{2 \cdot V_{post}}{Fv_{shear.post}}$$

$Apostreq = 0.12$ in^2

Section Provided:

$$BENDING_{post.y} := if\left(Spostreq_y \geq Sy_{post}, "N.G" , "OK"\right)$$

$BENDING_{post.y} = "OK"$

$$SHEAR_{post} := if\left(Apostreq \geq A_{post}, "N.G" , "OK"\right)$$

$SHEAR_{post} = "OK"$

Combined Analysis:

$$f_{post.bend.x} := \frac{M_{DL.post}}{Sx_{post}}$$

$f_{post.bend.x} = 1481.08$ psi

$$f_{post.bend.y} := \frac{M_{wind.post}}{Sy_{post}}$$

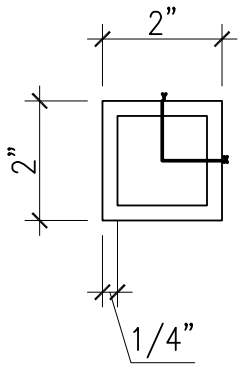
$f_{post.bend.y} = 9873.83$ psi

$$Combined_{post} := if\left(\frac{f_{post.bend.x}}{Fb_{bend.post}} + \frac{f_{post.bend.y}}{Fb_{bend.post}} \geq 1 , "N.G" , "OK"\right)$$

$Combined_{post} = "OK"$

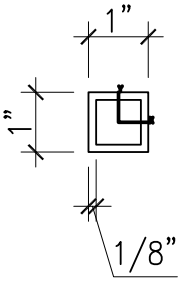
POOL FENCE DESIGN

POOL FENCE SECTION PROPERTIES



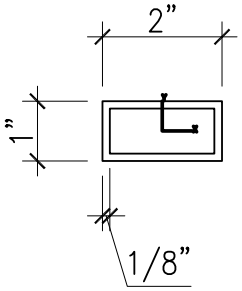
POST RT2"x2"x ¼"
ALLOY 6061–T6

Area = 1.7500 in^2
Ixx = 0.9115 in^4
Iyy = 0.9115 in^4
Jz = 1.8229 in^4
Pxy = 0.0000 in^4
rxx = 0.7217 in
ryy = 0.7217 in
Sxx max = 0.9115 in^3
Sxx min = 0.9115 in^3
Syy max = 0.9115 in^3
Syy min = 0.9115 in^3



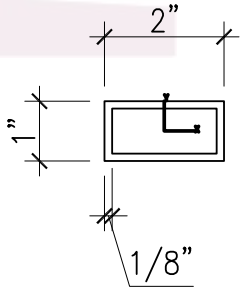
PICKET RT1"x1"x ⅛"
ALLOY 6061–T6

Area = 0.4375 in^2
Ixx = 0.0570 in^4
Iyy = 0.0570 in^4
Jz = 0.1139 in^4
Pxy = −0.0000 in^4
rxx = 0.3608 in
ryy = 0.3608 in
Sxx max = 0.1139 in^3
Sxx min = 0.1139 in^3
Syy max = 0.1139 in^3
Syy min = 0.1139 in^3



TOP RT2"x1"x ⅛"
ALLOY 6061–T6

Area = 0.6875 in^2
Ixx = 0.1051 in^4
Iyy = 0.3317 in^4
Jz = 0.4368 in^4
Pxy = 0.0000 in^4
rxx = 0.3911 in
ryy = 0.6946 in
Sxx max = 0.2103 in^3
Sxx min = 0.2103 in^3
Syy max = 0.3317 in^3
Syy min = 0.3317 in^3



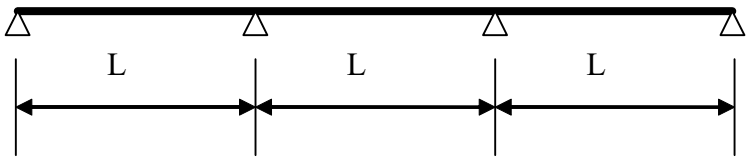
BOTTOM RT2"x1"x ⅛"
ALLOY 6061–T6

Area = 0.6875 in^2
Ixx = 0.1051 in^4
Iyy = 0.3317 in^4
Jz = 0.4368 in^4
Pxy = 0.0000 in^4
rxx = 0.3911 in
ryy = 0.6946 in
Sxx max = 0.2103 in^3
Sxx min = 0.2103 in^3
Syy max = 0.3317 in^3
Syy min = 0.3317 in^3

Pool Fence Design

Fence Design (Top, Bottom, Post and Picket)

Top Element Design:



General Data:

$L := 6.00$ Railing Span (ft)

$H_{post} := 60.00$ Post Heigh (in)

General Loads:

$q_{wind} := 10.00$ Wind Pressure (psf)

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

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

Top Fence Data:

$Fb_{bend.top} := 9000.00$ psi

$Fv_{shear.top} := 5000.00$ psi

$Sy_{top} := 0.3317$ in^3

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

6063-t52 or better
Max Bending and Shear of top and bottom elements near to weld

Bottom Data:

$Fb_{bend.bott} := 9000.00$ psi

$Fv_{shear.bott} := 5000.00$ psi

$Sy_{bott} := 0.3317$ in^3

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

Post Data:

$Fb_{bend.post} := 18602.5$ psi

$Fv_{shear.post} := 5000$ psi

$Sx_{post} := 0.9115$ in^3

$A_{post} := 1.75$ in^2

6061-T6 or better
Max Bending and Shear of post near to weld

Picket Data:

$Fb_{bend.picket} := 19000.00$ psi

$Fv_{shear.picket} := 5000.00$ psi

$Sx_{picket} := 0.1139$ in^3

$A_{picket} := 0.4375$ in^2

6063-t52 or better
Max Bending of picket far from weld.
Max Shear near to weld

Top and Bottom Fence Design:

Maximum Moment:

For Wind Pressure

$$Mwindmax := 0.1012 \cdot q_{wind} \cdot \frac{H_{post}}{2 \cdot 12} \cdot L^2$$

Mwindmax = 91.08 ft – lb

$$Mmax := Mwindmax$$

Mmax = 91.08 ft – lb

Maximum Shear:

For Wind Pressure

$$Vwindmax := 0.6 \cdot q_{wind} \cdot \frac{H_{post}}{2 \cdot 12} \cdot L$$

Vwindmax = 90.00 lbs

$$Vmax := Vwindmax$$

Vmax = 90.00 lbs

Section Required:

Bending Design:

Section Modulus Required

$$Shr := \frac{Mmax \cdot 12}{Fb_{bend.top}}$$

Shr = 0.12 in^3

Shear Design:

Area Required

$$Ahr := \frac{2 \cdot Vmax}{Fv_{shear.top}}$$

Ahr = 0.04 in^2

Section Provided:

$$BENDING_{top} := if(Shr \geq Sy_{top}, "N.G", "OK")$$

$BENDING_{top}$ = "OK"

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

$SHEAR_{top}$ = "OK"

$$BENDING_{bottom} := if(Shr \geq Sy_{bott}, "N.G", "OK")$$

$BENDING_{bottom}$ = "OK"

$$SHEAR_{bottom} := if(Ahr \geq A_{bott}, "N.G", "OK")$$

$SHEAR_{bottom}$ = "OK"

Post Design:

Maximum Reaction:

For Wind Pressure

$$R_{max} := q_{wind} \cdot \frac{H_{post}}{12} \cdot L$$

$R_{max} = 300.00$ lbs

Maximum Moment:

$$M_{post} := R_{max} \cdot \frac{H_{post}}{2}$$

$M_{post} = 9000.00$ in - lb

Maximum Shear:

$$V_{post} := R_{max}$$

$V_{post} = 300.00$ lbs.

Section Required:

Bending Design:

Section Modulus Required:

$$Spostreq := \frac{M_{post}}{Fb_{bend.post}}$$

$Spostreq = 0.48$ in^3

Shear Design:

Area Required:

$$Apostreq := \frac{2 \cdot V_{post}}{Fv_{shear.post}}$$

$Apostreq = 0.12$ in^2

Section Provided:

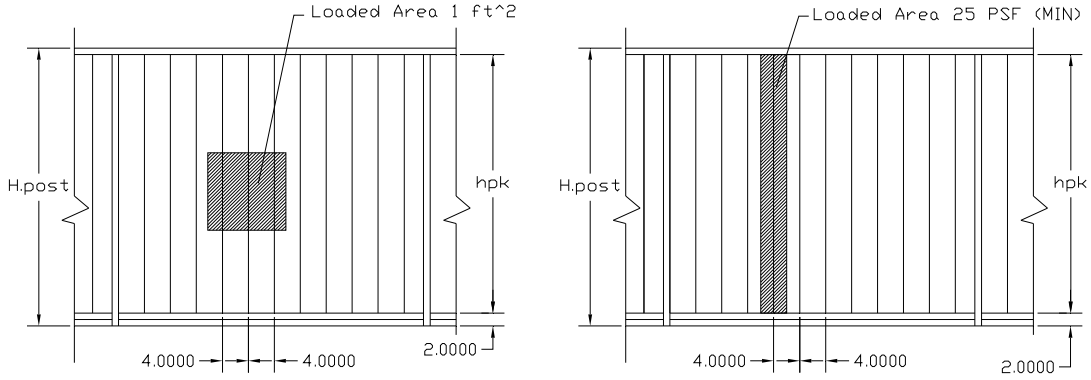
$$BENDING_{post} := if\left(Spostreq \geq Sx_{post}, "N.G" , "OK"\right)$$

$BENDING_{post} = "OK"$

$$SHEAR_{post} := if\left(Apostreq \geq A_{post}, "N.G" , "OK"\right)$$

$SHEAR_{post} = "OK"$

Picket Design:



$hpk := H_{post} - 2$

$q_{picket} := \max(25, q_{wind})$ $\quad q_{picket} = 25.00$ psf

$$Mmaxpk := \frac{q_{picket} \cdot 4 \cdot hpk^2}{8 \cdot 144}$$ $\quad Mmaxpk = 292.01$ in-lb

$$Vmaxpk := \frac{q_{picket} \cdot 4 \cdot hpk}{144 \cdot 2}$$ $\quad Vmaxpk = 20.14$ lb

Section Required:

Bending Design:

Section Modulus Required:

$$Spkreq := \frac{Mmaxpk}{Fb_{bend.picket}}$$ $\quad Spkreq = 0.015$ in^3

Shear Design:

Area Required:

$$Apktreq := \frac{2 \cdot Vmaxpk}{Fv_{shear.picket}}$$ $\quad Apktreq = 0.008$ in^2

Section Provided:

$BENDING_{picket} := \text{if}(Spkreq \geq Sx_{picket}, \text{"N.G"}, \text{"OK"})$ $\quad BENDING_{picket} = \text{"OK"}$

$SHEAR_{picket} := \text{if}(Apktreq \geq A_{picket}, \text{"N.G"}, \text{"OK"})$ $\quad SHEAR_{picket} = \text{"OK"}$

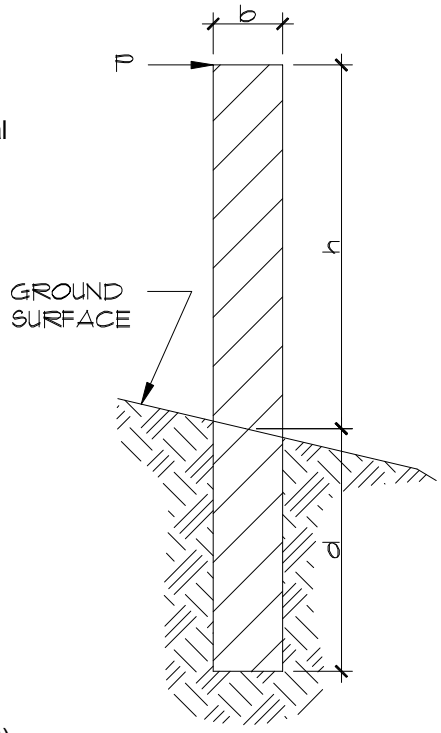
Poles or Posts Embedment Depth into Earth

Pole/Post Data:

$b := 2.00$ feet — Diameter of round post or footing or diagonal dimension of square post or footing

$P := 300.00$ lbs — Applied lateral force

$h := 2.50$ feet — Distance from ground surface to point of application of force P



Soil Data:

$S := 150.00$ $\frac{psf}{ft}$ — Allowable lateral bearing pressure per foot below natural grade:

200...Sandy gravel and/or gravel
150...Sand, silty sand, clayey sand, silty gravel and clayey gravel
100...Clay, sandy clay, silty clay, clayey silt, silt and sandy silt

$f_{iso} := 2.0$ — Isolaed Member Factor (FBC 2014 1806.3.3)
1.0 for N/A, 2.0 for isolated members

$x := 1.0 \quad y := 1.0 \quad z := 1.0$

Given

$$x = 0.33 \cdot z \cdot S \cdot f_{iso} \qquad y = 2.34 \cdot \left(\frac{P}{x \cdot b}\right) \qquad z = 0.5 \cdot y \cdot \left[1 + \left[1 + \left(4.36 \cdot \frac{h}{y}\right)\right]^{\frac{1}{2}}\right]$$

$$\begin{pmatrix} S_1 \\ A \\ d_{uc} \end{pmatrix} := \text{Find}(x, y, z)$$

Minimum Depth of Embedment without Surface Constraint:

$d_{uc} = 2.68$ feet

$x_2 := 1.0 \quad y_2 := 1.0$

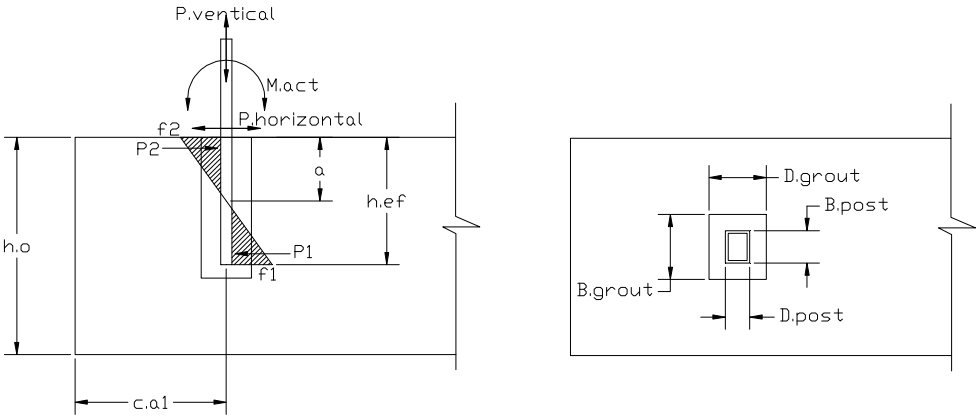
Given $\qquad x_2 = y_2 \cdot S \cdot f_{iso} \qquad y_2 = \sqrt{\frac{4.25 \cdot P \cdot h}{x_2 \cdot b}}$

$$\begin{pmatrix} S_3 \\ d_c \end{pmatrix} := \text{Find}(x_2, y_2)$$

Minimum Depth of Embedment with Surface Constraint:

$d_c = 1.74$ feet

Post Anchorage to Concrete:



Load Data:

$P_{horizontal} := 300.00$ Horizontal Load (lbs)....P=200 lbs or 50 lbs/ft....for Life Load
P=Pwind.....for Wind Load

$P_{vertical} := 0.00$ Vertical Load (lbs).....P=200 lbs or 50 lbs/ft

$M_{act} := 9000.00$ Moment (#-in)

Post Data:

$B_{post} := 2.00$ Post Width (in)

$D_{post} := 2.00$ Post Depth (in)

$h_{ef} := 18.00$ Post Embedment (in)

$C_{a1} := 4.0$ Minimum Edge Distance (in)

Grout Size Data:

$B_{grout} := 2.00$ Equivalent Grout Width (in)

$D_{grout} := 2.00$ Equivalent Grout Depth (in)

$f'c_{grout} := 3000.00$ Grout Strength (psi)

Concrete Slab Data:

$f'c_{concrete} := 3000.00$ Concrete Strength (psi)

$d_o := 24.00$ Hold diameter (Grout Diameter) (in)

$h_a := 33.00$ Concrete Slab Deep (in)

Arm Effect:

$$a := \frac{2 \cdot h_{ef}^{2} + 3 \cdot \left(\frac{M_{act}}{P_{horizontal}} \cdot h_{ef} \right)}{3 \cdot h_{ef} + 6. \frac{M_{act}}{P_{horizontal}}}$$

$a = 9.69$ in

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

$P_2 = 1130.77$ lbs

$$P_1 := P_2 - P_{horizontal}$$

$P_1 = 830.77$ lbs

$$M_{external} := M_{act} + (P_{horizontal} \cdot a)$$

$M_{external} = 11907.69$ lbs – in

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

$M_{internal} = 11907.69$ lbs – in

$$Vu_{horizontal} := 1.6 \cdot (\max(P_1, P_2))$$

$Vu_{horizontal} = 1809.23$ lbs

$$Vu_{vertical} := 1.6 \cdot P_{vertical}$$

$Vu_{vertical} = 0.00$ lbs

Stress Analysis Between Post and Grout:

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

$f_{2.grout} = 186.67$ psi

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

$f_{1.grout} = 160.00$ psi

Bearing Stress for Grout :

$$Fp_{grout} := \left[0.65 \cdot \left(0.85 f'c_{grout}\right)\right] \cdot 1.5$$

$Fp_{grout} = 2486.25$ psi

$$Stress_{grout} := \begin{cases} \text{"N.G."} \\ \text{"O.K."} \quad \text{if } \max\left(f_{1.grout}, f_{2.grout}\right) \le Fp_{grout} \end{cases}$$

$Stress_{grout} = \text{"O.K."}$

Stress Analysis Between Grout and Concrete:

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

$f_{2.concrete} = 186.67$ psi

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

$f_{1.concrete} = 160.00$ psi

Bearing Stress for Concrete :

$$Fp_{concrete} := \left[0.65 \cdot \left(0.85 \cdot f'c_{concrete}\right)\right] \cdot 1.5$$

$Fp_{concrete} = 2486.25$ psi

$$Stress_{concrete} := \begin{cases} \text{"N.G."} \\ \text{"O.K."} \quad \text{if } \max\left(f_{1.concrete}, f_{2.concrete}\right) \le Fp_{concrete} \end{cases}$$

$Stress_{concrete} = \text{"O.K."}$

Shear Analysis-Concrete Breakout Strength:

$A_{Vco} := 4.5 \cdot C_{a1}^{2}$ $\quad A_{Vco} = 72$ in^2

$$A_{Vc} := \begin{cases} 2 \cdot (1.5 \cdot C_{a1}) \cdot h_a & \text{if } h_a < 1.5 \cdot C_{a1} \\ 2 \cdot (1.5 \cdot C_{a1}) \cdot (1.5 \cdot C_{a1}) & \text{if } h_a \geq 1.5 \cdot C_{a1} \end{cases}$$ $\quad A_{Vc} = 72.00$ in^2

$\psi_{ed.V} := 1.00$ Modification factor for edge effect

$\psi_{c.V} := 1.00$ Modification Factor in No cracked concrete at service loads
ψc.v=1.4
Modification Factor in cracked concrete with
ψc.v=1 w/ No supplementary reinforcement.
ψc.v=1.2 w/ Supplementary reinforcement of a No 4 Bar between the anchor and the edge.
ψc.v=1.4 w/ Supplementary reinforcement of No 4 Bar and stirrups spaced at not more than 4 in.

$l_e := \text{if}(h_{ef} > 8 \cdot d_o, 8 \cdot d_o, h_{ef})$ $\quad l_e = 18.00$ in

$$V_b := \begin{cases} 7 \cdot \left[\left(\frac{l_e}{d_o} \right)^{0.2} \sqrt{d_o} \cdot \sqrt{f'c_{concrete}} \cdot C_{a1}^{1.5} \right] \\ 9 \cdot \left(\sqrt{f'c_{concrete}} \cdot C_{a1}^{1.5} \right) \end{cases}$$ $\quad V_b = 3943.6$

$V_{cb} := \frac{A_{Vc}}{A_{Vco}} \cdot \psi_{ed.V} \cdot \psi_{c.V} \cdot V_b$ $\quad V_{cb} = 3943.6$ lbs.

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

$\phi \cdot V_{cb} = 2760.52$ lbs

$BREAKOUT_{shear} := \text{if}(Vu_{horizontal} > \phi \cdot V_{cb}, \text{"N.G."}, \text{"OK"})$ $\quad BREAKOUT_{shear} = \text{"OK"}$

Shear Analysis-Concrete Burst-Out Strength:

$$C_{a1c} := \begin{cases} C_{a1} \\ \text{"N/A"} \quad \text{if } h_a < C_{a1} \end{cases}$$

$C_{a1c} = 4.00$ in

Total Cone Area for Failure Plane

$$A_{cone.total} := \sqrt{2} \cdot C_{a1c} \cdot \pi \cdot \left(C_{a1c} - \frac{D_{grout}}{2} + \frac{B_{grout}}{2} \right)$$

$A_{cone.total} = 71.09$ in^2

Cone Area for Failure Plane at Post

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

$A_{cone.post} = 4.44$ in^2

Final Cone Area for Failure Plane

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

$A_{cone.final} = 33.32$ in^2

Final Area for Failure Plane

$$V_{cone.cb} := 4 \cdot \sqrt{f'c_{concrete}} \cdot A_{cone.final}$$

$V_{cone.cb} = 7300.40$ lbs

$\phi := 0.70$

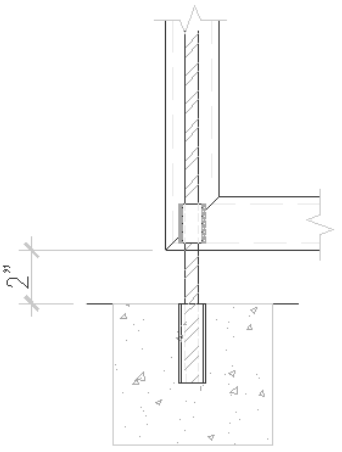
Conditions
ϕ=0.75 w/ Supplementary reinforcement are crossing concrete failure prism.
ϕ=0.70 w/ No supplementary reinforcement are crossing concrete failure prism.

$\phi \cdot V_{cone.cb} = 5110.28$ lbs

$$BURSTOUT_{shear} := \text{if}\left(Vu_{horizontal} > \phi \cdot V_{cone.cb}, \text{"N.G."}, \text{"OK"} \right)$$

$BURSTOUT_{shear} = \text{"OK"}$

Cane bar (Pool Double Swing Gate) calculations:



skecth

Loads:

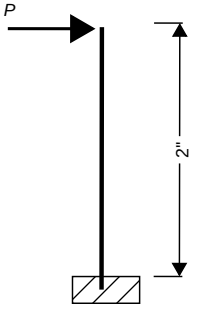
WL =10.00 psf

Loads Processing:

R (canebar) = WL x widht x height

R (canebar) = 10.00 psf x 3.0 ft x 5 ft

R (canebar) = 150 #



F.B.D

M (canebar) = R (canebar) x L

M (canebar) = 150 # x 4''

M (canebar) = 600 #-in

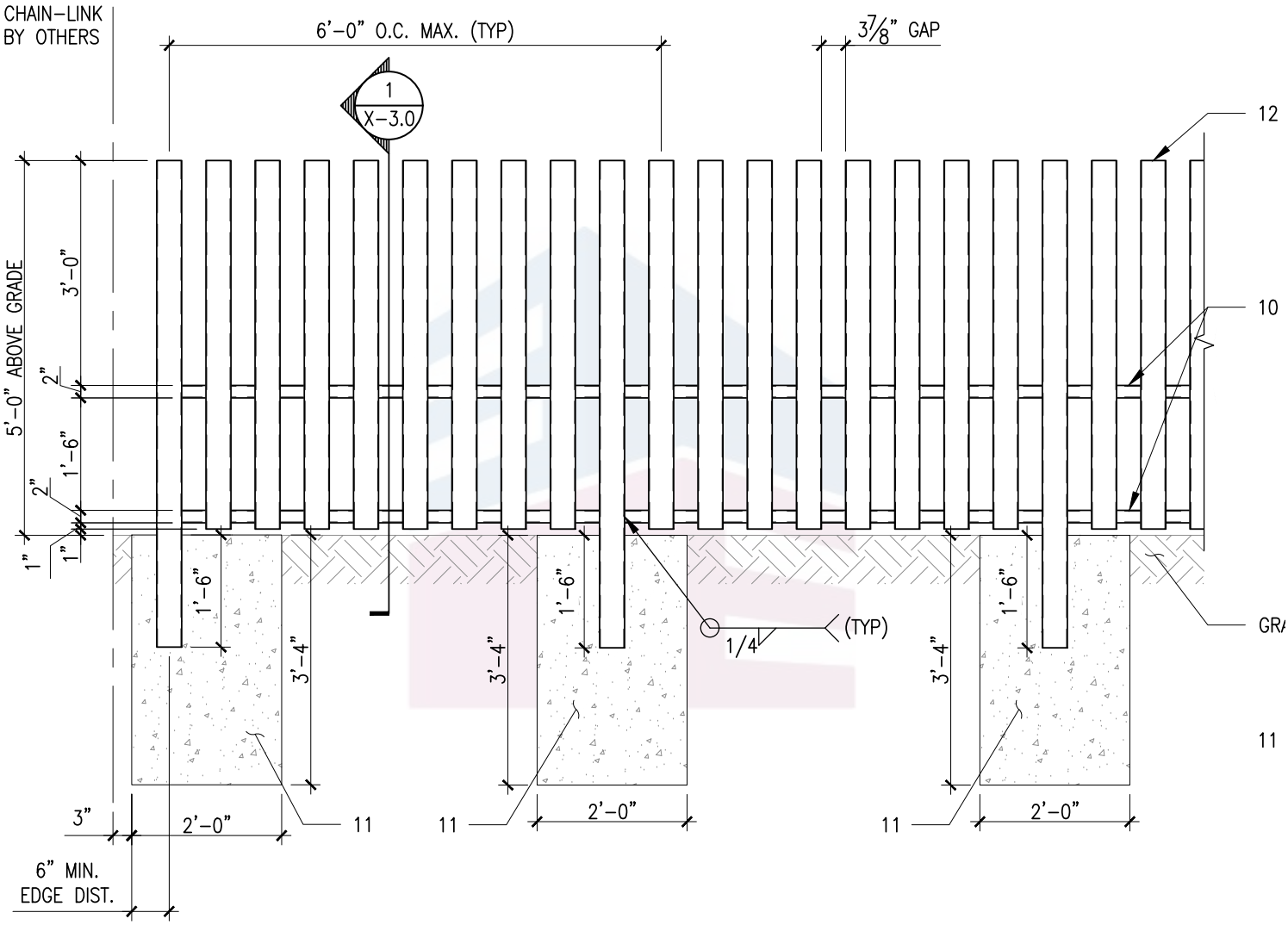
Fb = 24000 psi (Alloy 6061-T6, not welded)

$$Sx\ req = \frac{M\ (canebar)}{Fb} = 0.025\ in^3$$

$$Sx\ req = \frac{\pi\ d^3}{32} = 0.025\ in^3$$

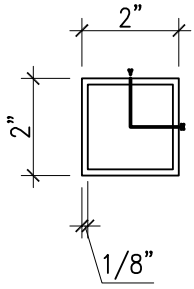
d = 0.63 in ≈3/4''

FRONT FENCE DESIGN



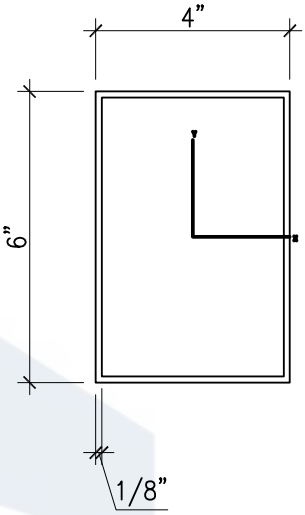
FRONT FENCE SKETCH

FRONT FENCE SECTION PROPERTIES



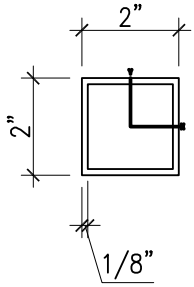
TOP RT2"x2"x ⅛"
ALLOY 6061–T6

Area = 0.9375 in^2
Ixx = 0.5518 in^4
Iyy = 0.5518 in^4
Jz = 1.1035 in^4
Pxy = 0.0000 in^4
rxx = 0.7672 in
ryy = 0.7672 in
Sxx max = 0.5518 in^3
Sxx min = 0.5518 in^3
Syy max = 0.5518 in^3
Syy min = 0.5518 in^3



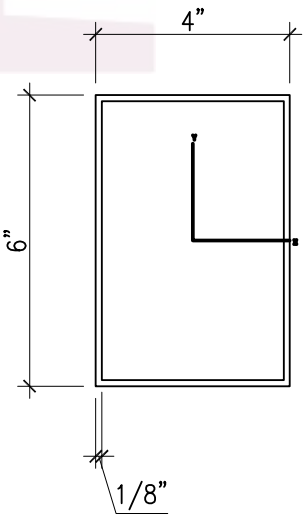
POST RT6"x4"x ⅛"
ALLOY 6063–T5

Area = 2.4368 in^2
Ixx = 12.5908 in^4
Iyy = 6.7297 in^4
Jz = 19.3205 in^4
Pxy = 0.0000 in^4
rxx = 2.2731 in
ryy = 1.6619 in
Sxx max = 4.1969 in^3
Sxx min = 4.1969 in^3
Syy max = 3.3663 in^3
Syy min = 3.3634 in^3



BOTTOM RT2"x2"x ⅛"
ALLOY 6061–T6

Area = 0.9375 in^2
Ixx = 0.5518 in^4
Iyy = 0.5518 in^4
Jz = 1.1035 in^4
Pxy = 0.0000 in^4
rxx = 0.7672 in
ryy = 0.7672 in
Sxx max = 0.5518 in^3
Sxx min = 0.5518 in^3
Syy max = 0.5518 in^3
Syy min = 0.5518 in^3

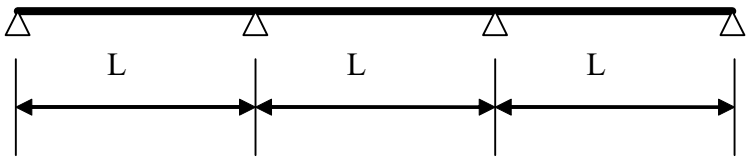


PICKET RT6"x4"x ⅛"
ALLOY 6063–T5

Area = 2.4368 in^2
Ixx = 12.5908 in^4
Iyy = 6.7297 in^4
Jz = 19.3205 in^4
Pxy = 0.0000 in^4
rxx = 2.2731 in
ryy = 1.6619 in
Sxx max = 4.1969 in^3
Sxx min = 4.1969 in^3
Syy max = 3.3663 in^3
Syy min = 3.3634 in^3

Fence Design (Top, Bottom, Post and Picket)

Top Element Design:



General Data:

$L := 6.00$ Railing Span (ft)

$H_{post} := 60.00$ Post Heigh (in)

General Loads:

$q_{wind} := 14.62$ Wind Pressure (psf)

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

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

Top Fence Data:	Bottom Data:	Post Data:	Picket Data:
$Fb_{bend.top} := 9000.00$ psi	$Fb_{bend.bott} := 9000.00$ psi	$Fb_{bend.post} := 4800.00$ psi	$Fb_{bend.picket} := 4800.00$ psi
$Fv_{shear.top} := 5000.00$ psi	$Fv_{shear.bott} := 5000.00$ psi	$Fv_{shear.post} := 2800.00$ psi	$Fv_{shear.picket} := 2800.00$ psi
$Sy_{top} := 0.5518$ in^3	$Sy_{bott} := 0.5518$ in^3	$Sx_{post} := 4.1969$ in^3	$Sx_{picket} := 4.1969$ in^3
$A_{top} := 0.9375$ in^2	$A_{bott} := 0.9375$ in^2	$A_{post} := 2.4368$ in^2	$A_{picket} := 2.4368$ in^2

Top and Bottom Fence Design:

Maximum Moment:

For Wind Pressure

$$Mwindmax := 0.125 \cdot q_{wind} \cdot \frac{0.8 \cdot H_{post}}{12} \cdot L^2$$

$Mwindmax = 263.16$ ft – lb

$Mmax := Mwindmax$

$Mmax = 263.16$ ft – lb

Maximum Shear:

For Wind Pressure

$$Vwindmax := 0.5 \cdot q_{wind} \cdot \frac{0.8 H_{post}}{12} \cdot L$$

$Vwindmax = 175.44$ lbs

$Vmax := Vwindmax$

$Vmax = 175.44$ lbs

Section Required:

Bending Design:

Section Modulus Required

$$Shr := \frac{Mmax \cdot 12}{Fb_{bend.top}}$$

$Shr = 0.35$ in^3

Shear Design:

Area Required

$$Ahr := \frac{2 \cdot Vmax}{Fv_{shear.top}}$$

$Ahr = 0.07$ in^2

Section Provided:

$BENDING_{top} := if(Shr \geq Sy_{top}, "N.G", "OK")$

$BENDING_{top} = "OK"$

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

$SHEAR_{top} = "OK"$

$BENDING_{bottom} := if(Shr \geq Sy_{bott}, "N.G", "OK")$

$BENDING_{bottom} = "OK"$

$SHEAR_{bottom} := if(Ahr \geq A_{bott}, "N.G", "OK")$

$SHEAR_{bottom} = "OK"$

Post Design:

Maximum Reaction:

For Wind Pressure

$$R_{max} := q_{wind} \cdot \frac{H_{post}}{12} \cdot L$$

$R_{max} = 438.60$ lbs

Maximum Moment:

$$M_{post} := R_{max} \cdot \frac{H_{post}}{2}$$

$M_{post} = 13158.00$ in - lb

Maximum Shear:

$$V_{post} := R_{max}$$

$V_{post} = 438.60$ lbs.

Worst Case

Section Required:

Bending Design:

Section Modulus Required:

$$Spostreq := \frac{M_{post}}{Fb_{bend.post}}$$

$Spostreq = 2.74$ in^3

Shear Design:

Area Required:

$$Apostreq := \frac{2 \cdot V_{post}}{Fv_{shear.post}}$$

$Apostreq = 0.31$ in^2

Section Provided:

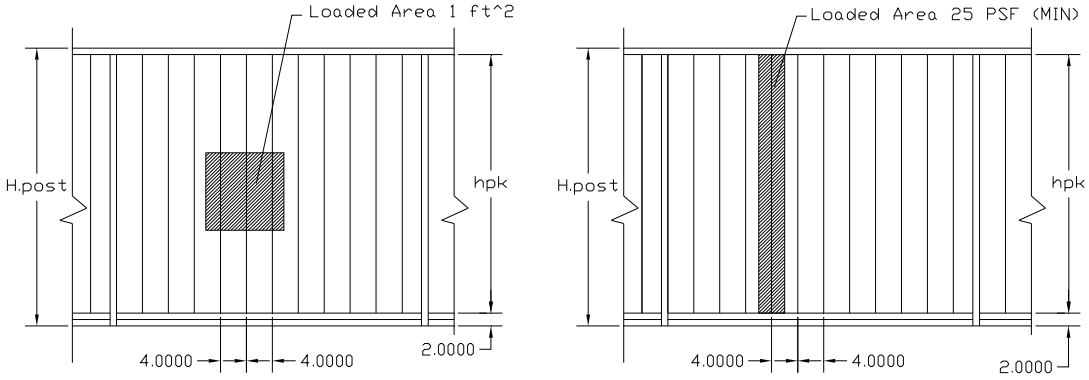
$$BENDING_{post} := if\left(Spostreq \geq Sx_{post}, "N.G" , "OK"\right)$$

$BENDING_{post} = "OK"$

$$SHEAR_{post} := if\left(Apostreq \geq A_{post}, "N.G" , "OK"\right)$$

$SHEAR_{post} = "OK"$

Picket Design:



$hpk := H_{post} - 2$

$q_{picket} := \max(25, q_{wind})$ → $q_{picket} = 25.00$ psf

$$Mmaxpk := \frac{q_{picket} \cdot 4 \cdot hpk^2}{2 \cdot 144}$$ → $Mmaxpk = 1168.06$ in-lb

$$Vmaxpk := \frac{q_{picket} \cdot 4 \cdot hpk}{144}$$ → $Vmaxpk = 40.28$ lb

Section Required:

Bending Design:

Section Modulus Required:

$$Spkreq := \frac{Mmaxpk}{Fb_{bend.picket}}$$ → $Spkreq = 0.243$ in^3

Shear Design:

Area Required:

$$Apktreq := \frac{2 \cdot Vmaxpk}{Fv_{shear.picket}}$$ → $Apktreq = 0.029$ in^2

Section Provided:

$BENDING_{picket} := \text{if}(Spkreq \geq Sx_{picket}, \text{"N.G"}, \text{"OK"})$ → $BENDING_{picket} = \text{"OK"}$

$SHEAR_{picket} := \text{if}(Apktreq \geq A_{picket}, \text{"N.G"}, \text{"OK"})$ → $SHEAR_{picket} = \text{"OK"}$

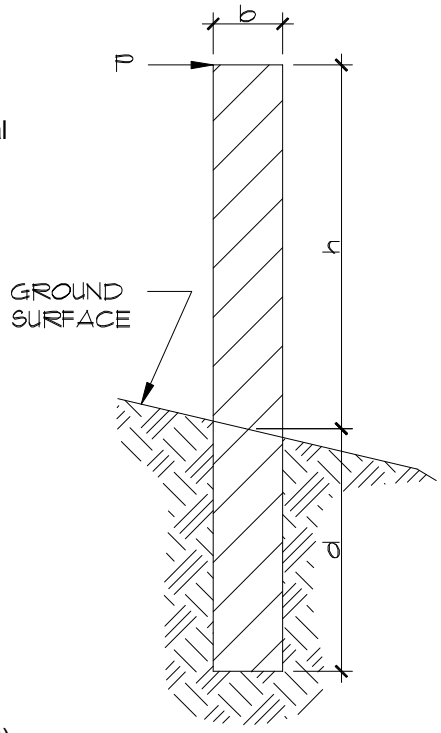
Poles or Posts Embedment Depth into Earth

Pole/Post Data:

$b := 2.00$ feet — Diameter of round post or footing or diagonal dimension of square post or footing

$P := 438.60$ lbs — Applied lateral force

$h := 2.50$ feet — Distance from ground surface to point of application of force P



Soil Data:

$S := 150.00$ $\frac{psf}{ft}$ — Allowable lateral bearing pressure per foot below natural grade:

200...Sandy gravel and/or gravel
150...Sand, silty sand, clayey sand, silty gravel and clayey gravel
100...Clay, sandy clay, silty clay, clayey silt, silt and sandy silt

$f_{iso} := 2.0$ — Isolaed Member Factor (FBC 2014 1806.3.3)
1.0 for N/A, 2.0 for isolated members

$x := 1.0 \quad y := 1.0 \quad z := 1.0$

Given

$$x = 0.33 \cdot z \cdot S \cdot f_{iso} \qquad y = 2.34 \cdot \left(\frac{P}{x \cdot b} \right) \qquad z = 0.5 \cdot y \cdot \left[1 + \left[1 + \left(4.36 \cdot \frac{h}{y} \right) \right]^{\frac{1}{2}} \right]$$

$$\begin{pmatrix} S_1 \\ A \\ d_{uc} \end{pmatrix} := \text{Find}(x, y, z)$$

Minimum Depth of Embedment without Surface Constraint:

$d_{uc} = 3.12$ feet

$x_2 := 1.0 \quad y_2 := 1.0$

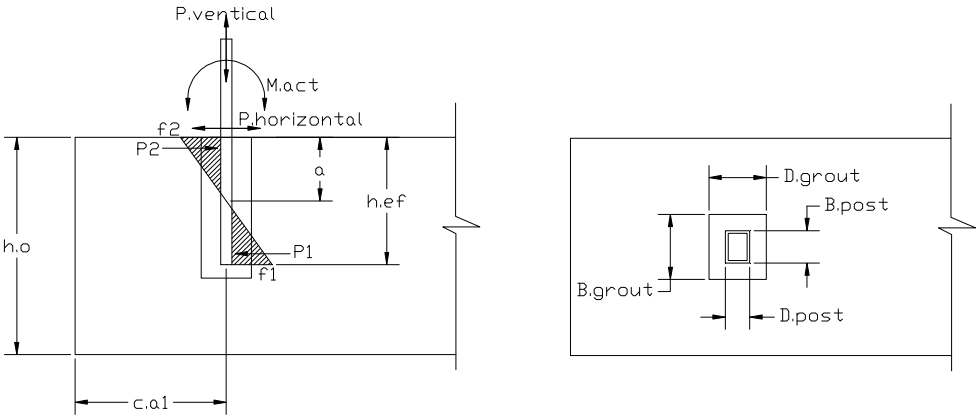
Given $\qquad x_2 = y_2 \cdot S \cdot f_{iso} \qquad y_2 = \sqrt{\frac{4.25 \cdot P \cdot h}{x_2 \cdot b}}$

$$\begin{pmatrix} S_3 \\ d_c \end{pmatrix} := \text{Find}(x_2, y_2)$$

Minimum Depth of Embedment with Surface Constraint:

$d_c = 1.98$ feet

Post Anchorage to Concrete:



Load Data:

$P_{horizontal} := 438.60$ Horizontal Load (lbs)....P=200 lbs or 50 lbs/ft....for Life Load
P=Pwind.....for Wind Load

$P_{vertical} := 0.00$ Vertical Load (lbs).....P=200 lbs or 50 lbs/ft

$M_{act} := 13158.00$ Moment (#-in)

Post Data:

$B_{post} := 4.00$ Post Width (in)

$D_{post} := 6.00$ Post Depth (in)

$h_{ef} := 18.00$ Post Embedment (in)

$C_{a1} := 5.0$ Minimum Edge Distance (in)

Grout Size Data:

$B_{grout} := 4.00$ Equivalent Grout Width (in)

$D_{grout} := 6.00$ Equivalent Grout Depth (in)

$f'c_{grout} := 3000.00$ Grout Strength (psi)

Concrete Slab Data:

$f'c_{concrete} := 3000.00$ Concrete Strength (psi)

$d_o := 24.00$ Hold diameter (Grout Diameter) (in)

$h_a := 38.00$ Concrete Slab Deep (in)

Arm Effect:

$$a := \frac{2 \cdot h_{ef}^{2} + 3 \cdot \left(\frac{M_{act}}{P_{horizontal}} \cdot h_{ef} \right)}{3 \cdot h_{ef} + 6. \frac{M_{act}}{P_{horizontal}}}$$

$a = 9.69$ in

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

$P_2 = 1653.18$ lbs

$$P_1 := P_2 - P_{horizontal}$$

$P_1 = 1214.58$ lbs

$$M_{external} := M_{act} + (P_{horizontal} \cdot a)$$

$M_{external} = 17409.05$ lbs – in

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

$M_{internal} = 17409.05$ lbs – in

$$Vu_{horizontal} := 1.6 \cdot (\max(P_1, P_2))$$

$Vu_{horizontal} = 2645.10$ lbs

$$Vu_{vertical} := 1.6 \cdot P_{vertical}$$

$Vu_{vertical} = 0.00$ lbs

Stress Analysis Between Post and Grout:

$$f_{2.grout} := 1.6 \cdot \frac{2 \cdot P_2}{a \cdot B_{post}}$$ $f_{2.grout} = 136.45$ psi

$$f_{1.grout} := 1.6 \cdot \frac{2.P_1}{(h_{ef} - a) \cdot B_{post}}$$ $f_{1.grout} = 116.96$ psi

Bearing Stress for Grout :

$$Fp_{grout} := \left[0.65 \cdot \left(0.85 f'c_{grout}\right)\right] \cdot 1.5$$ $Fp_{grout} = 2486.25$ psi

$$Stress_{grout} := \begin{cases} \text{"N.G."} \\ \text{"O.K."} \quad \text{if } \max\left(f_{1.grout}, f_{2.grout}\right) \le Fp_{grout} \end{cases}$$ $Stress_{grout} = \text{"O.K."}$

Stress Analysis Between Grout and Concrete:

$$f_{2.concrete} := 1.6 \frac{2 \cdot P_2}{a \cdot B_{grout}}$$ $f_{2.concrete} = 136.45$ psi

$$f_{1.concrete} := 1.6 \cdot \frac{2.P_1}{(h_{ef} - a) \cdot B_{grout}}$$ $f_{1.concrete} = 116.96$ psi

Bearing Stress for Concrete :

$$Fp_{concrete} := \left[0.65 \cdot \left(0.85 \cdot f'c_{concrete}\right)\right] \cdot 1.5$$ $Fp_{concrete} = 2486.25$ psi

$$Stress_{concrete} := \begin{cases} \text{"N.G."} \\ \text{"O.K."} \quad \text{if } \max\left(f_{1.concrete}, f_{2.concrete}\right) \le Fp_{concrete} \end{cases}$$

$Stress_{concrete} = \text{"O.K."}$

Shear Analysis-Concrete Breakout Strength:

$A_{Vco} := 4.5 \cdot C_{a1}^{2}$ $\quad A_{Vco} = 112.5$ in^2

$A_{Vc} := \begin{cases} 2 \cdot (1.5 \cdot C_{a1}) \cdot h_a & \text{if } h_a < 1.5 \cdot C_{a1} \\ 2 \cdot (1.5 \cdot C_{a1}) \cdot (1.5 \cdot C_{a1}) & \text{if } h_a \geq 1.5 \cdot C_{a1} \end{cases}$ $\quad A_{Vc} = 112.50$ in^2

$\psi_{ed.V} := 1.00$ Modification factor for edge effect

$\psi_{c.V} := 1.00$ Modification Factor in No cracked concrete at service loads
ψc.v=1.4
Modification Factor in cracked concrete with
ψc.v=1 w/ No supplementary reinforcement.
ψc.v=1.2 w/ Supplementary reinforcement of a No 4 Bar between the anchor and the edge.
ψc.v=1.4 w/ Supplementary reinforcement of No 4 Bar and stirrups spaced at not more than 4 in.

$l_e := \text{if}(h_{ef} > 8 \cdot d_o, 8 \cdot d_o, h_{ef})$ $\quad l_e = 18.00$ in

$V_b := \begin{cases} 7 \cdot \left[\left(\frac{l_e}{d_o} \right)^{0.2} \sqrt{d_o} \cdot \sqrt{f'c_{concrete}} \cdot C_{a1}^{1.5} \right] \\ 9 \cdot \left(\sqrt{f'c_{concrete}} \cdot C_{a1}^{1.5} \right) \end{cases}$ $\quad V_b = 5511.35$

$V_{cb} := \frac{A_{Vc}}{A_{Vco}} \cdot \psi_{ed.V} \cdot \psi_{c.V} \cdot V_b$ $\quad V_{cb} = 5511.35$ lbs.

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

$\phi \cdot V_{cb} = 3857.95$ lbs

$BREAKOUT_{shear} := \text{if}(Vu_{horizontal} > \phi \cdot V_{cb}, \text{"N.G."}, \text{"OK"})$ $\quad BREAKOUT_{shear} = \text{"OK"}$

Shear Analysis-Concrete Burst-Out Strength:

$$C_{a1c} := \begin{cases} C_{a1} \\ \text{"N/A"} \quad \text{if } h_a < C_{a1} \end{cases}$$

$C_{a1c} = 5.00$ in

Total Cone Area for Failure Plane

$$A_{cone.total} := \sqrt{2} \cdot C_{a1c} \cdot \pi \cdot \left(C_{a1c} - \frac{D_{grout}}{2} + \frac{B_{grout}}{2} \right)$$

$A_{cone.total} = 88.86$ in^2

Cone Area for Failure Plane at Post

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

$A_{cone.post} = 17.77$ in^2

Final Cone Area for Failure Plane

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

$A_{cone.final} = 35.54$ in^2

Final Area for Failure Plane

$$V_{cone.cb} := 4 \cdot \sqrt{f'c_{concrete}} \cdot A_{cone.final}$$

$V_{cone.cb} = 7787.10$ lbs

$\phi := 0.70$

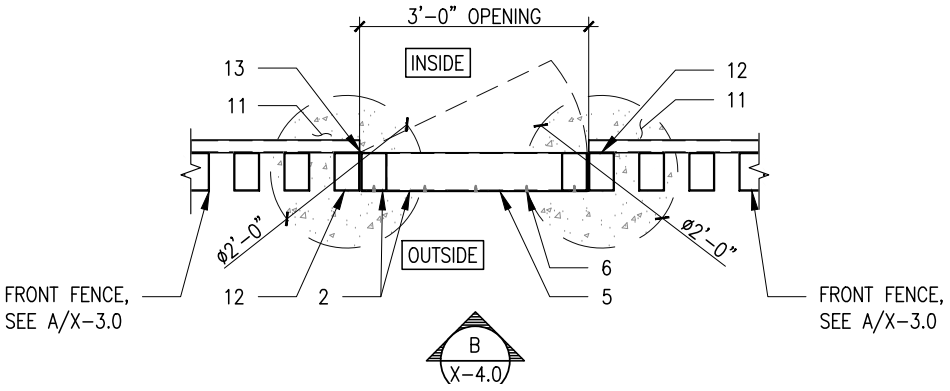
Conditions
ϕ=0.75 w/ Supplementary reinforcement are crossing concrete failure prism.
ϕ=0.70 w/ No supplementary reinforcement are crossing concrete failure prism.

$\phi \cdot V_{cone.cb} = 5450.97$ lbs

$$BURSTOUT_{shear} := \text{if}\left(Vu_{horizontal} > \phi \cdot V_{cone.cb}, \text{"N.G."}, \text{"OK"} \right)$$

$BURSTOUT_{shear} = \text{"OK"}$

PEDESTRIAN GATE DESIGN



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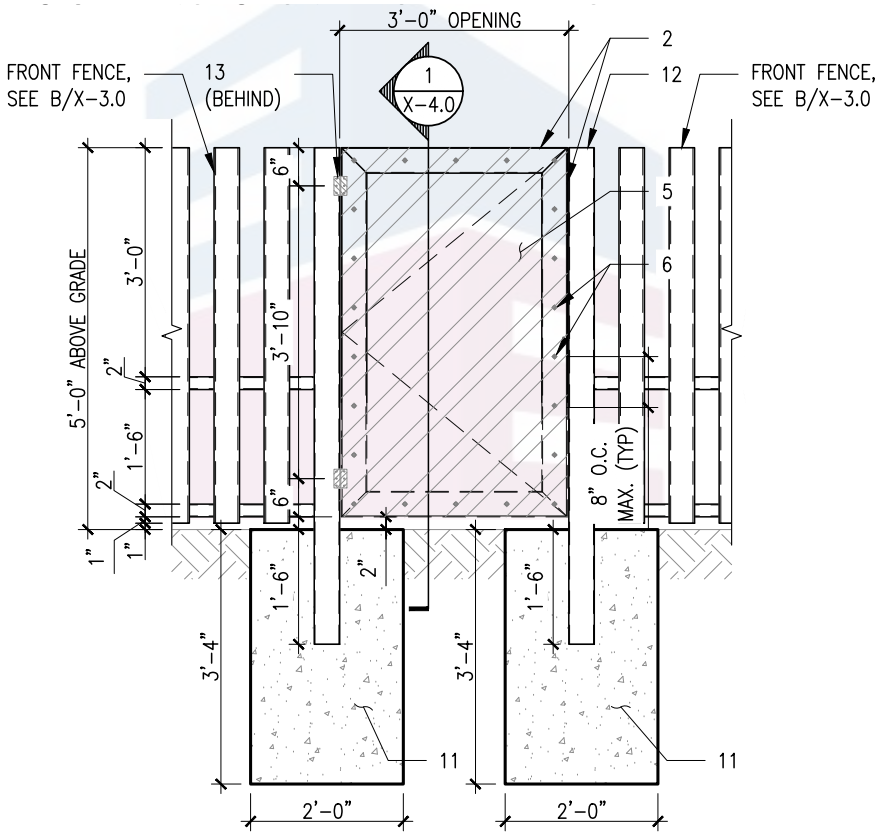

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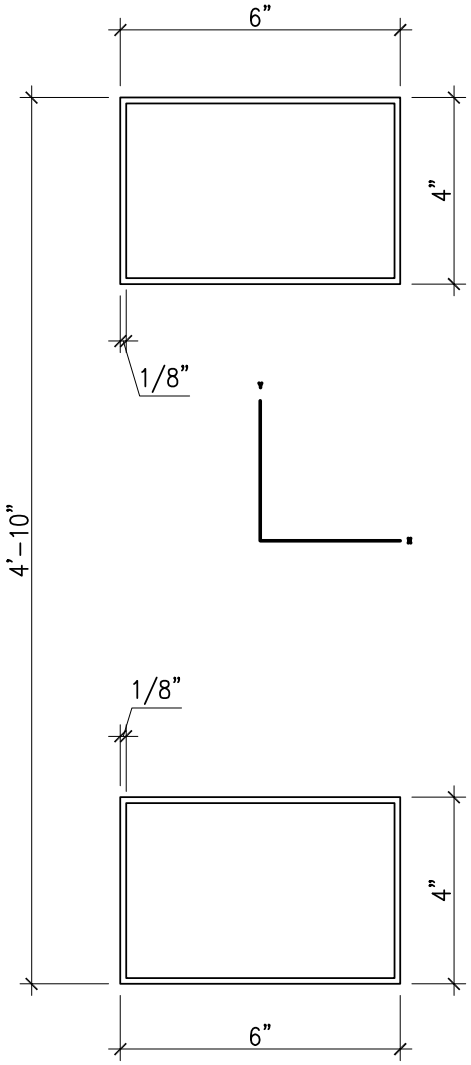
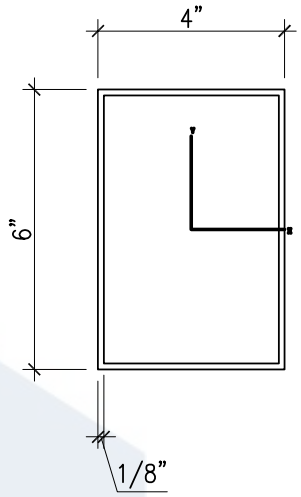
PEDESTRIAN GATE SKETCH

PEDESTRIAN GATE SECTION PROPERTIES



FRAME RT6"x4"x 1/8"
ALLOY 6063-T5

Area = 4.9039 in^2
Ixx = 3565.1474 in^4
Iyy = 25.3550 in^4
Jz = 3590.5024 in^4
Pxy = 0.0000 in^4
rxx = 26.9630 in
ryy = 2.2738 in
Sxx max = 122.9361 in^3
Sxx min = 122.9361 in^3
Syy max = 8.4517 in^3
Syy min = 8.4517 in^3



POST RT6"x4"x 1/8"
ALLOY 6063-T5

Area = 2.4368 in^2
Ixx = 12.5908 in^4
Iyy = 6.7297 in^4
Jz = 19.3205 in^4
Pxy = 0.0000 in^4
rxx = 2.2731 in
ryy = 1.6619 in
Sxx max = 4.1969 in^3
Sxx min = 4.1969 in^3
Syy max = 3.3663 in^3
Syy min = 3.3634 in^3

Swing Gate Design (Frame, Pickets and Post)

DESIGN INFORMATION:

Florida Building Code 2023
AISC Manual of Steel Construction, NDS-ASD for Wood Construction, ASCE 07-22 Specification for the Design of Cold-Formed Stainless Steel Structural Members, Aluminum Design Manual 2020
Wind Loads, ASCE 7 - 22

Gate Analysis w/ Vertical Pickets:

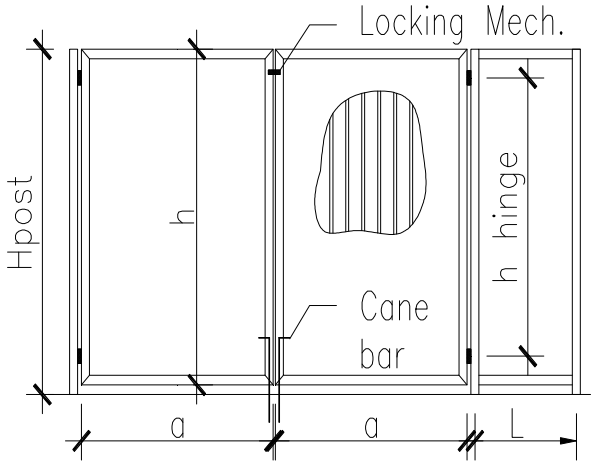
General Data:

$a := 3.00$ Leaf width (ft)

$H_{post} := 5.00$ Gate Height (ft)

$L := 6.00$ Post Span at Fence (ft)

$h_{hinge} := 3.833$ Hinges Spacing (ft)



General Loads:

$WL := 23.11$ Wind Pressure (psf)

$DL := 5.00$ Dead Load (psf)

Frame Data:

$Fb_{bend.frame} := 4800.00$ psi

$Fv_{shear.frame} := 2800.00$ psi

$Sx_{frame} := 122.93$ in^3

$Sy_{frame} := 8.45$ in^3

$A_{frame} := 4.90$ in^2

Post Data:

$Fb_{bend.post} := 4800.00$ psi

$Fv_{shear.post} := 2800.00$ psi

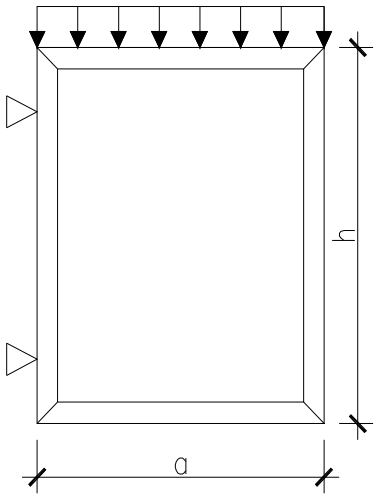
$Sx_{post} := 3.3663$ in^3

$Sy_{post} := 4.1969$ in^3

$A_{post} := 2.4368$ in^2

Frame Design:

X-X Moment :



For Dead Load:

$$h := H_{post} - \frac{2}{12}$$

$$M_{DL.frame} := 0.5 \cdot DL \cdot h \cdot a^2 \cdot 12$$

$M_{DL.frame} = 1305.00$ in − lb

Section Required:

Bending Design:

Section Modulus Required:

$$Sframereqx := \frac{M_{DL.frame}}{Fb_{bend.frame}}$$

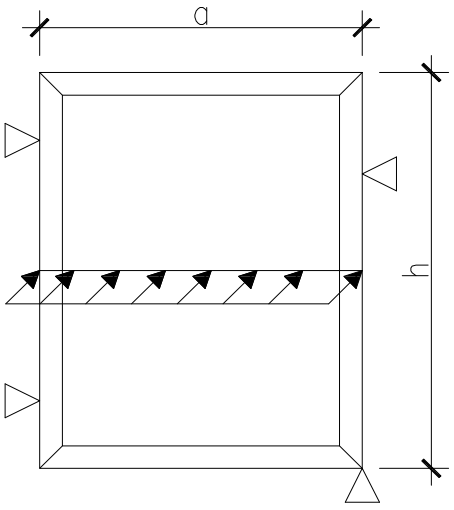
$Sframereqx = 0.27$ in^3

Section Provided:

$$BENDING_{frame.x} := if\left(Sframereqx \geq Sx_{frame}, "N.G" , "OK" \right)$$

$BENDING_{frame.x} = "OK"$

Y-Y Moment :



For Wind Pressure:

$$M_{Wind.frame} := 0.125 \cdot WL \cdot h \cdot a^2 \cdot 12$$

$M_{Wind.frame} = 1507.93$ in − lb

Section Required:

Bending Design:

Section Modulus Required:

$$Sframereqy := \frac{M_{Wind.frame}}{Fb_{bend.frame}}$$

$Sframereqy = 0.31$ in^3

Section Provided:

$BENDING_{frame.y} := if\left(Sframereqy \geq Sy_{frame}, "N.G" , "OK" \right)$ $BENDING_{frame.y} = "OK"$

Combined Analysis:

$fbend_x := \frac{M_{DL.frame}}{Sx_{frame}}$ $fbend_x = 10.62$ psi

$fbend_y := \frac{M_{Wind.frame}}{Sy_{frame}}$ $fbend_y = 178.45$ psi

$Comb_{frame} := if\left(\frac{fbend_x}{Fb_{bend.frame}} + \frac{fbend_y}{Fb_{bend.frame}} \geq 1 , "N.G" , "OK" \right)$ $Comb_{frame} = "OK"$

Hinges Reaction:

$Rx := \frac{DL \cdot h \cdot \frac{a^2}{2}}{h_{hinge}}$ $Rx = 28.37$ lb

$Ry := WL \cdot a \cdot \frac{h}{2}$ $Ry = 167.55$ lb

$Rz := DL \cdot a \cdot \frac{h}{2}$ $Rz = 36.25$ lb

$ResultantForce := \sqrt{Rx^2 + Ry^2 + Rz^2}$ $ResultantForce = 173.76$ lb

Post Design:

Moment due to DL:

$$M_{DL.post} := DL \cdot H_{post} \cdot a \cdot \frac{a}{2} \cdot 12$$

$M_{DL.post} = 1350.00$ in - lb

Section Required:

Bending Design:

Section Modulus Required:

$$Spostreq_x := \frac{M_{DL.post}}{Fb_{bend.post}}$$

$Spostreq_x = 0.28$ in^3

Section Provided:

$$BENDING_{post.x} := if\left(Spostreq_x \geq Sx_{post}, "N.G" , "OK"\right)$$

$BENDING_{post.x} = "OK"$

Moment due to Wind:

$$M_{wind.post} := WL \cdot \left(\frac{0.7L}{2} + \frac{a}{2}\right) \cdot \frac{H_{post}^{2}}{2} \cdot 12$$

$M_{wind.post} = 12479.40$ in - lb

Shear Analysis:

$$V_{post} := WL \cdot H_{post} \cdot \left(\frac{0.7L}{2} + \frac{a}{2}\right)$$

$V_{post} = 415.98$ lbs.

Section Required:

Bending Design:

Section Modulus Required:

$$Spostreq_y := \frac{M_{wind.post}}{Fb_{bend.post}}$$

$Spostreq_y = 2.6$ in^3

Shear Design:

Area Required:

$$Apostreq := \frac{2 \cdot V_{post}}{Fv_{shear.post}}$$

$Apostreq = 0.297$ in^2

Section Provided:

$$BENDING_{post.y} := if\left(Spostreq_y \geq Sy_{post}, "N.G" , "OK"\right)$$

$BENDING_{post.y} = "OK"$

$$SHEAR_{post} := if\left(Apostreq \geq A_{post}, "N.G" , "OK"\right)$$

$SHEAR_{post} = "OK"$

Combined Analysis:

$$f_{post.bend.x} := \frac{M_{DL.post}}{Sx_{post}}$$

$f_{post.bend.x} = 401.03$ psi

$$f_{post.bend.y} := \frac{M_{wind.post}}{Sy_{post}}$$

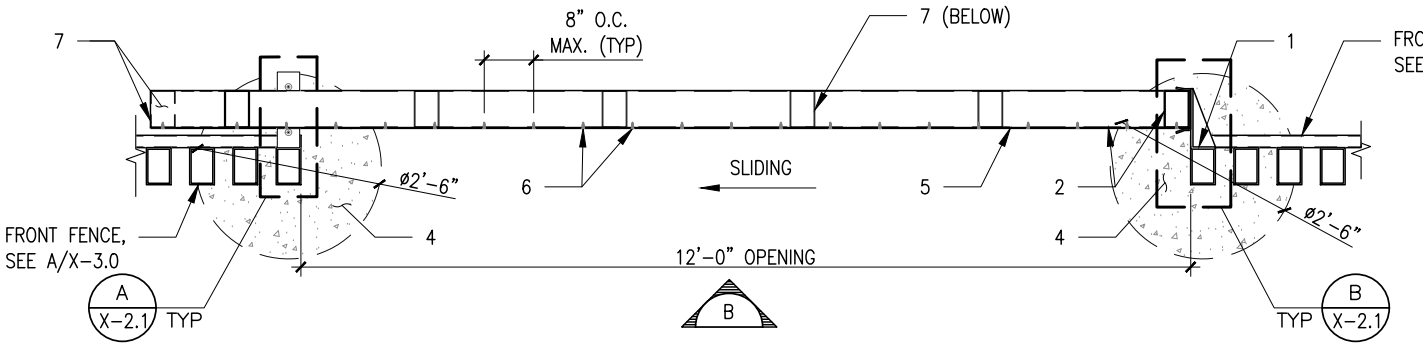
$f_{post.bend.y} = 2973.48$ psi

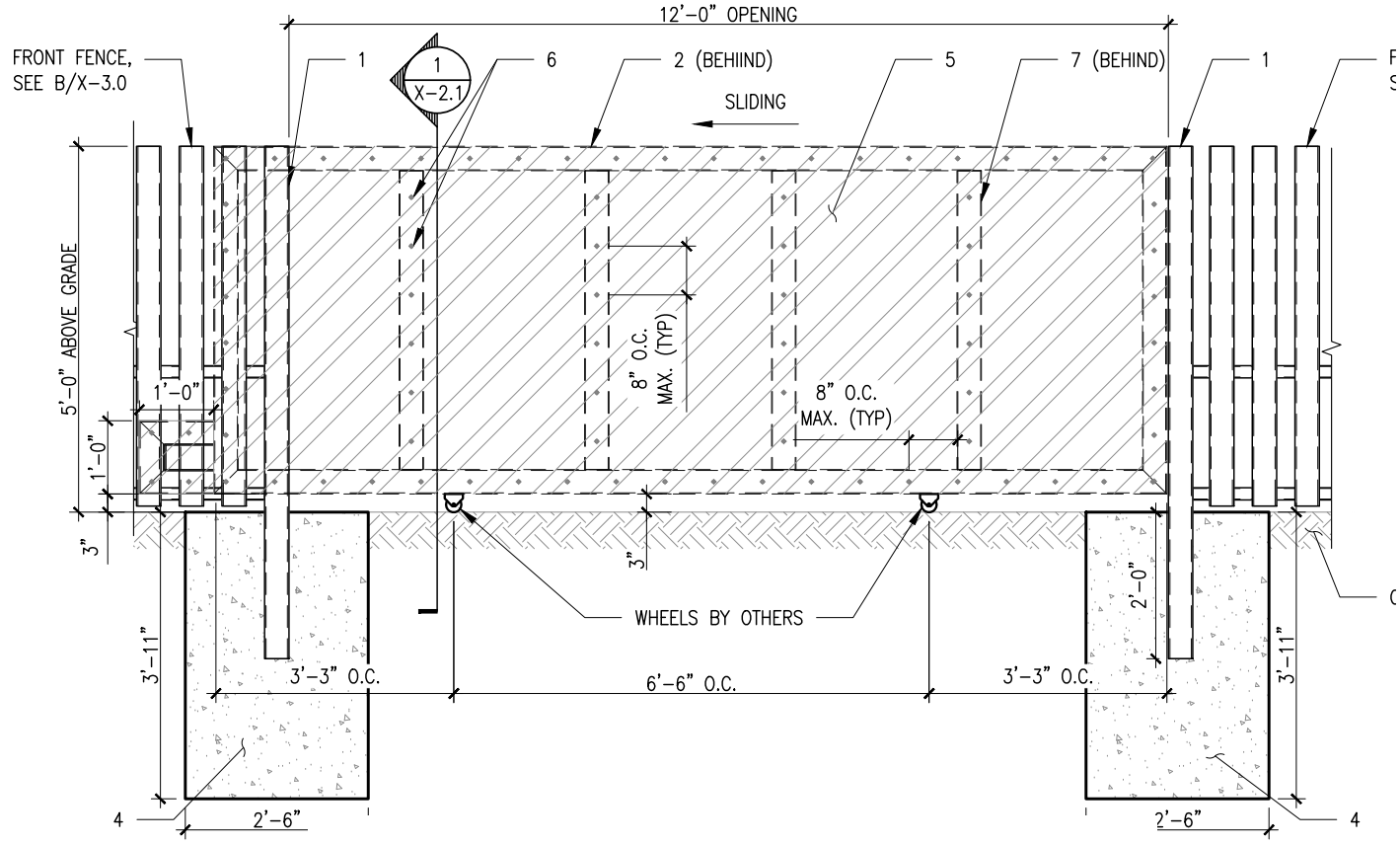
$$Combined_{post} := if\left(\frac{f_{post.bend.x}}{Fb_{bend.post}} + \frac{f_{post.bend.y}}{Fb_{bend.post}} \geq 1 , "N.G" , "OK"\right)$$

$Combined_{post} = "OK"$

ROLLING GATE DESIGN

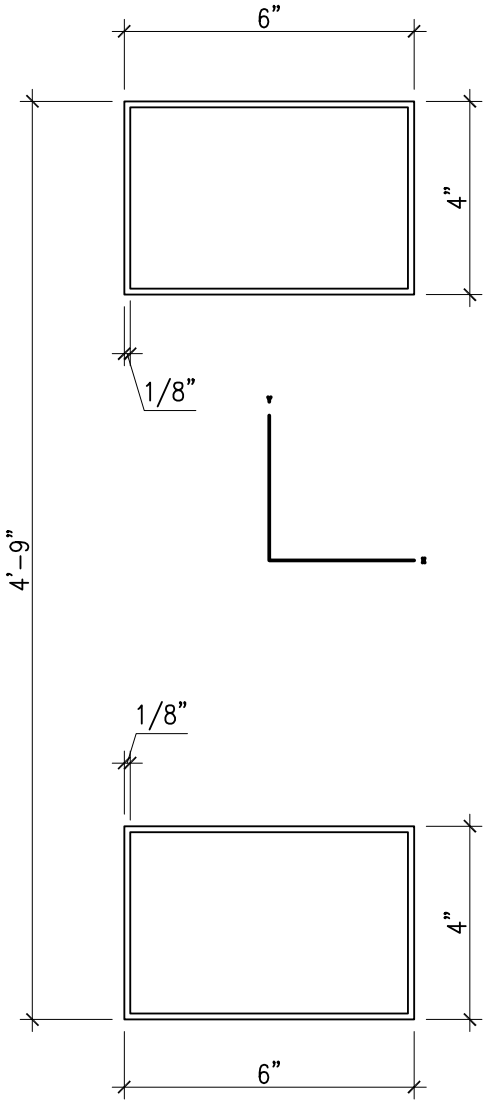
SEE X-2.0 (SHOP DRAWINGS)





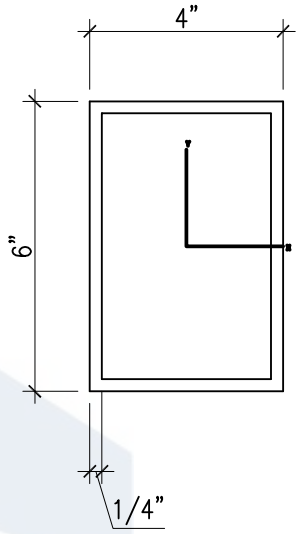
ROLLING GATE SKETCH

ROLLING GATE SECTION PROPERTIES



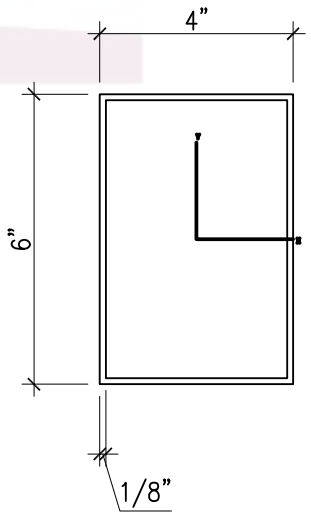
FRAME RT6”x4”x ⅛”
ALLOY 6063–T5

Area = 4.8785 in^2
Ixx = 3434.8214 in^4
Iyy = 25.2130 in^4
Jz = 3460.0344 in^4
Pxy = 0.0000 in^4
rxx = 26.5345 in
ryy = 2.2734 in
Sxx max = 120.5200 in^3
Sxx min = 120.5200 in^3
Syy max = 8.4043 in^3
Syy min = 8.4043 in^3



POST RT6”x4”x ¼”
ALLOY 6061–T6

Area = 4.7507 in^2
Ixx = 23.4740 in^4
Iyy = 12.3504 in^4
Jz = 35.8244 in^4
Pxy = −0.0000 in^4
rxx = 2.2229 in
ryy = 1.6124 in
Sxx max = 7.8247 in^3
Sxx min = 7.8247 in^3
Syy max = 6.1752 in^3
Syy min = 6.1752 in^3



VERTICAL TUBE
PICKET RT6”x4”x ⅛”
ALLOY 6063–T5

Area = 2.4368 in^2
Ixx = 12.5908 in^4
Iyy = 6.7297 in^4
Jz = 19.3205 in^4
Pxy = 0.0000 in^4
rxx = 2.2731 in
ryy = 1.6619 in
Sxx max = 4.1969 in^3
Sxx min = 4.1969 in^3
Syy max = 3.3663 in^3
Syy min = 3.3634 in^3

Rolling Gate Design

Rolling Gate Design (Frame, Pickets and Post)

DESIGN INFORMATION:

Florida Building Code 2023
AISC Manual of Steel Construction, NDS-ASD for Wood Construction, ASCE 7-22 Specification for the Design of Cold-Formed Stainless Steel Structural Members, Aluminum Design Manual 2020

Wind Loads, ASCE 7-22

Gate Analysis w/ Vertical Pickets:

General Data:

$a := 12.0$ Width (ft)

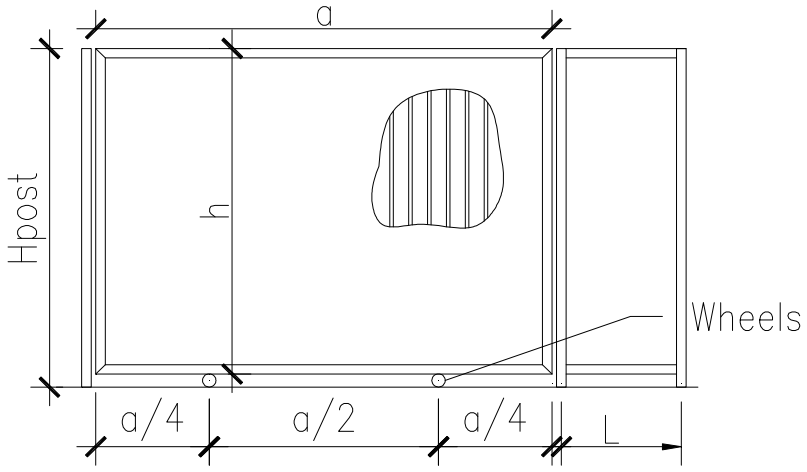
$H_{post} := 5.00$ Gate Height (ft)

$L := 6.0$ Post Span at Fence (ft)

General Loads:

$WL := 23.11$ Wind Pressure (psf)

$DL := 7.00$ Dead Load (psf)



Frame Data:

$Fb_{frame} := 4800.00$ psi

$Fv_{frame} := 2800.00$ psi

$Sx_{frame} := 120.52$ in^3

$Sy_{frame} := 8.4043$ in^3

$A_{frame} := 4.8785$ in^2

Post Data:

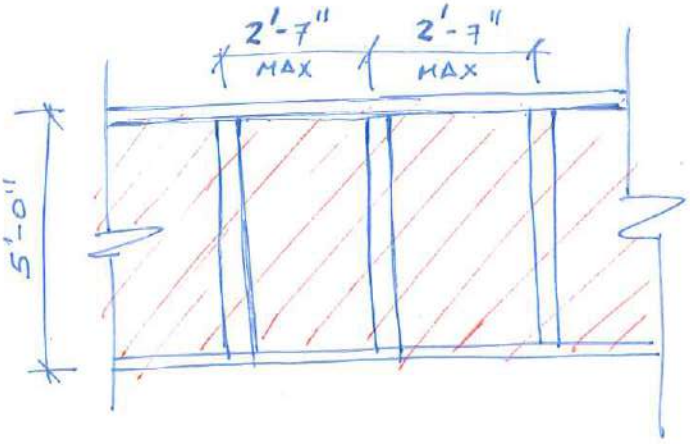
$Fb_{post} := 9000.00$ psi

$Fv_{post} := 5000.00$ psi

$Sy_{post} := 6.1752$ in^3

$A_{post} := 4.7507$ in^2

VERTICAL TUBE ANALYSIS.



LOADS:

$W_L = 23,11$ psf.

LOADS PROCESSING:

T.S = 2,58 ft

$q = 23,11\ \#/ft^2 \times 2,58\ ft$

$\boxed{q = 59,7\ \#/ft}$

$$M_{DEM} = \frac{q \cdot L^2}{8} = \frac{59,7\ \#/ft \times (5\ ft)^2}{8}$$

$M_{DEM} = 186,6\ \#-ft \times 12 = 2239\ \#-in.$

$\boxed{M_{DEM} = 2239\ \#-in.}$

$M_{ALLOW} = 9500\ psi \times 4,19\ in^3$
(Fb)

$\boxed{M_{ALLOW} = 39805\ \#-in.}$

$M_{ALLOW} = 39805\ \#-in. > M_{DEM} = 2239\ \#-in.$ OK PASS.

Frame Design:

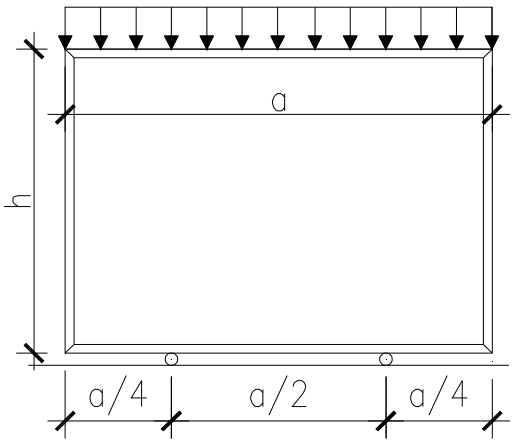
X-X Moment :

For Dead Load:

$h := H_{post} - \frac{2}{12}$

$M_{DL.frame} := 0.125 \cdot DL \cdot h \cdot \left(\frac{a}{2}\right)^2 \cdot 12$

$M_{DL.frame} = 1827.00$ in − lb



Section Required:

Bending Design (Section Modulus Required):

$Sframereqx := \frac{M_{DL.frame}}{Fb_{frame}}$

$Sframereqx = 0.38$ in^3

Section Provided:

$BENDING_{frame.x} := if\left(Sframereqx \geq Sx_{frame}, "N.G" , "OK"\right)$

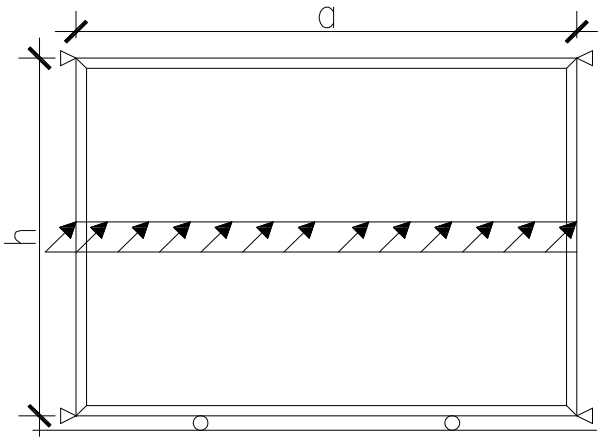
$BENDING_{frame.x} = "OK"$

Y-Y Moment :

For Wind Pressure:

$M_{Wind.frame} := 0.125 \cdot WL \cdot h \cdot a^2 \cdot 12$

$M_{Wind.frame} = 24126.84$ in − lb



Section Required:

Bending Design (Section Modulus Required):

$Sframereqy := \frac{M_{Wind.frame}}{Fb_{frame}}$

$Sframereqy = 5.03$ in^3

Section Provided:

$BENDING_{frame.y} := if\left(Sframereqy \geq Sy_{frame}, "N.G" , "OK"\right)$

$BENDING_{frame.y} = "OK"$

Combined Analysis:

$$fbending_x := \frac{M_{DL.frame}}{Sx_{frame}}$$

$fbending_x = 15.16$ psi

$$fbending_y := \frac{M_{Wind.frame}}{Sy_{frame}}$$

$fbending_y = 2870.77$ psi

$$Combined_{frame} := if\left(\frac{fbending_x}{Fb_{frame}} + \frac{fbending_y}{Fb_{frame}} \geq 1, "N.G", "OK"\right)$$

$Combined_{frame} = "OK"$

Post Design:

Moment due to Wind:

$$M_{wind.post} := WL \cdot \left(\frac{0.7L}{2} + \frac{a}{2}\right) \cdot \frac{H_{post}^{2}}{2} \cdot 12$$

$M_{wind.post} = 28078.65$ in - lb

Shear Analysis:

$$V_{post} := WL \cdot \left(\frac{0.7L}{2} + \frac{a}{2}\right) \cdot H_{post}$$

$V_{post} = 935.95$ lbs.

Section Required:

Bending Design (Section Modulus Required):

$$Spostreq_y := \frac{M_{wind.post}}{Fb_{post}}$$

$Spostreq_y = 3.12$ in^3

Shear Design (Area Required):

$$Apostreq := \frac{2 \cdot V_{post}}{Fv_{post}}$$

$Apostreq = 0.374$ in^2

Section Provided:

$$BENDING_{post.y} := if\left(Spostreq_y \geq Sy_{post}, "N.G", "OK"\right)$$

$BENDING_{post.y} = "OK"$

$$SHEAR_{post} := if\left(Apostreq \geq A_{post}, "N.G", "OK"\right)$$

$SHEAR_{post} = "OK"$

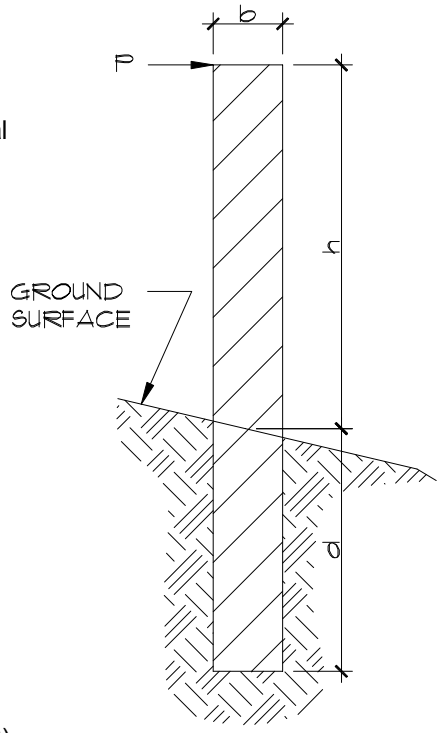
Poles or Posts Embedment Depth into Earth

Pole/Post Data:

$b := 2.0$ feet — Diameter of round post or footing or diagonal dimension of square post or footing

$P := 935.95$ lbs — Applied lateral force

$h := 2.50$ feet — Distance from ground surface to point of application of force P



Soil Data:

$S := 200.0$ $\frac{psf}{ft}$ — Allowable lateral bearing pressure per foot below natural grade:

200...Sandy gravel and/or gravel
150...Sand, silty sand, clayey sand, silty gravel and clayey gravel
100...Clay, sandy clay, silty clay, clayey silt, silt and sandy silt

$f_{iso} := 2.0$ — Isolaed Member Factor (FBC 2014 1806.3.3)
1.0 for N/A, 2.0 for isolated members

$x := 1.0 \quad y := 1.0 \quad z := 1.0$

Given

$$x = 0.33 \cdot z \cdot S \cdot f_{iso} \qquad y = 2.34 \cdot \left(\frac{P}{x \cdot b} \right) \qquad z = 0.5 \cdot y \cdot \left[1 + \left[1 + \left(4.36 \cdot \frac{h}{y} \right) \right]^{\frac{1}{2}} \right]$$

$$\begin{pmatrix} S_1 \\ A \\ d_{uc} \end{pmatrix} := \text{Find}(x, y, z)$$

Minimum Depth of Embedment without Surface Constraint:

$d_{uc} = 3.78$ feet

$x_2 := 1.0 \quad y_2 := 1.0$

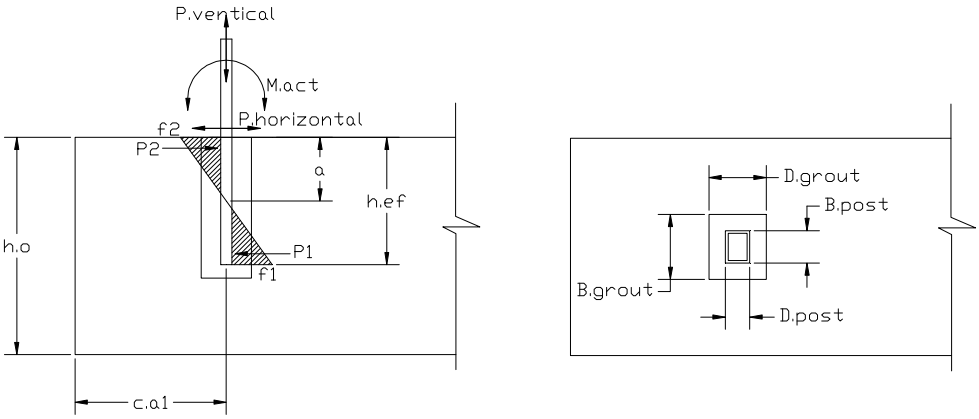
Given $\quad x_2 = y_2 \cdot S \cdot f_{iso} \qquad y_2 = \sqrt{\frac{4.25 \cdot P \cdot h}{x_2 \cdot b}}$

$$\begin{pmatrix} S_3 \\ d_c \end{pmatrix} := \text{Find}(x_2, y_2)$$

Minimum Depth of Embedment with Surface Constraint:

$d_c = 2.32$ feet

Post Anchorage to Concrete:



Load Data:

$P_{horizontal} := 935.95$ Horizontal Load (lbs)....P=200 lbs or 50 lbs/ft....for Life Load
P=Pwind.....for Wind Load

$P_{vertical} := 0.00$ Vertical Load (lbs).....P=200 lbs or 50 lbs/ft

$M_{act} := 28078.65$ Moment (#-in)

Post Data:

$B_{post} := 4.00$ Post Width (in)

$D_{post} := 6.00$ Post Depth (in)

$h_{ef} := 18.00$ Post Embedment (in)

$C_{a1} := 6.00$ Minimum Edge Distance (in)

Grout Size Data:

$B_{grout} := 4.00$ Equivalent Grout Width (in)

$D_{grout} := 6.00$ Equivalent Grout Depth (in)

$f'c_{grout} := 3000.00$ Grout Strength (psi)

Concrete Slab Data:

$f'c_{concrete} := 3000.00$ Concrete Strength (psi)

$d_o := 24.00$ Hold diameter (Grout Diameter) (in)

$h_a := 46.00$ Concrete Slab Deep (in)

Arm Effect:

$$a := \frac{2 \cdot h_{ef}^{2} + 3 \cdot \left(\frac{M_{act}}{P_{horizontal}} \cdot h_{ef} \right)}{3 \cdot h_{ef} + 6. \frac{M_{act}}{P_{horizontal}}}$$

$a = 9.69$ in

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

$P_2 = 3527.82$ lbs

$$P_1 := P_2 - P_{horizontal}$$

$P_1 = 2591.87$ lbs

$$M_{external} := M_{act} + (P_{horizontal} \cdot a)$$

$M_{external} = 37150.16$ lbs – in

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

$M_{internal} = 37150.16$ lbs – in

$$Vu_{horizontal} := 1.6 \cdot (\max(P_1, P_2))$$

$Vu_{horizontal} = 5644.52$ lbs

$$Vu_{vertical} := 1.6 \cdot P_{vertical}$$

$Vu_{vertical} = 0.00$ lbs

Stress Analysis Between Post and Grout:

$$f_{2.grout} := 1.6 \cdot \frac{2 \cdot P_2}{a \cdot B_{post}}$$ $f_{2.grout} = 291.19$ psi

$$f_{1.grout} := 1.6 \cdot \frac{2.P_1}{(h_{ef} - a) \cdot B_{post}}$$ $f_{1.grout} = 249.59$ psi

Bearing Stress for Grout :

$$Fp_{grout} := \left[0.65 \cdot \left(0.85 f'c_{grout}\right)\right] \cdot 1.5$$ $Fp_{grout} = 2486.25$ psi

$$Stress_{grout} := \begin{cases} \text{"N.G."} \\ \text{"O.K."} \quad \text{if } \max\left(f_{1.grout}, f_{2.grout}\right) \le Fp_{grout} \end{cases}$$ $Stress_{grout} = \text{"O.K."}$

Stress Analysis Between Grout and Concrete:

$$f_{2.concrete} := 1.6 \frac{2 \cdot P_2}{a \cdot B_{grout}}$$ $f_{2.concrete} = 291.19$ psi

$$f_{1.concrete} := 1.6 \cdot \frac{2.P_1}{(h_{ef} - a) \cdot B_{grout}}$$ $f_{1.concrete} = 249.59$ psi

Bearing Stress for Concrete :

$$Fp_{concrete} := \left[0.65 \cdot \left(0.85 \cdot f'c_{concrete}\right)\right] \cdot 1.5$$ $Fp_{concrete} = 2486.25$ psi

$$Stress_{concrete} := \begin{cases} \text{"N.G."} \\ \text{"O.K."} \quad \text{if } \max\left(f_{1.concrete}, f_{2.concrete}\right) \le Fp_{concrete} \end{cases}$$

$Stress_{concrete} = \text{"O.K."}$

Shear Analysis-Concrete Breakout Strength:

$A_{Vco} := 4.5 \cdot C_{a1}^{2}$ $\quad A_{Vco} = 162$ in^2

$A_{Vc} := \begin{cases} 2 \cdot (1.5 \cdot C_{a1}) \cdot h_a & \text{if } h_a < 1.5 \cdot C_{a1} \\ 2 \cdot (1.5 \cdot C_{a1}) \cdot (1.5 \cdot C_{a1}) & \text{if } h_a \geq 1.5 \cdot C_{a1} \end{cases}$ $\quad A_{Vc} = 162.00$ in^2

$\psi_{ed.V} := 1.00$ Modification factor for edge effect

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

$l_e := \text{if}(h_{ef} > 8 \cdot d_o, 8 \cdot d_o, h_{ef})$ $\quad l_e = 18.00$ in

$V_b := \begin{cases} 7 \cdot \left[\left(\frac{l_e}{d_o} \right)^{0.2} \cdot \sqrt{d_o} \cdot \sqrt{f'c_{concrete}} \cdot C_{a1}^{1.5} \right] \\ 9 \cdot \left(\sqrt{f'c_{concrete}} \cdot C_{a1}^{1.5} \right) \end{cases}$ $\quad V_b = 7244.86$

$V_{cb} := \frac{A_{Vc}}{A_{Vco}} \cdot \psi_{ed.V} \cdot \psi_{c.V} \cdot V_b$ $\quad V_{cb} = 10142.8$ lbs.

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

$\phi \cdot V_{cb} = 7099.96$ lbs

$BREAKOUT_{shear} := \text{if}(Vu_{horizontal} > \phi \cdot V_{cb}, \text{"N.G."}, \text{"OK"})$ $\quad BREAKOUT_{shear} = \text{"OK"}$

Shear Analysis-Concrete Burst-Out Strength:

$$C_{a1c} := \begin{cases} C_{a1} \\ \text{"N/A"} \quad \text{if } h_a < C_{a1} \end{cases}$$

$C_{a1c} = 6.00$ in

Total Cone Area for Failure Plane

$$A_{cone.total} := \sqrt{2} \cdot C_{a1c} \cdot \pi \cdot \left(C_{a1c} - \frac{D_{grout}}{2} + \frac{B_{grout}}{2} \right)$$

$A_{cone.total} = 133.29$ in^2

Cone Area for Failure Plane at Post

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

$A_{cone.post} = 17.77$ in^2

Final Cone Area for Failure Plane

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

$A_{cone.final} = 57.76$ in^2

Final Area for Failure Plane

$$V_{cone.cb} := 4 \cdot \sqrt{f'c_{concrete}} \cdot A_{cone.final}$$

$V_{cone.cb} = 12654.03$ lbs

$\phi := 0.70$

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

$\phi \cdot V_{cone.cb} = 8857.82$ lbs

$$BURSTOUT_{shear} := \text{if}\left(Vu_{horizontal} > \phi \cdot V_{cone.cb}, \text{"N.G."}, \text{"OK"} \right)$$

$BURSTOUT_{shear} = \text{"OK"}$

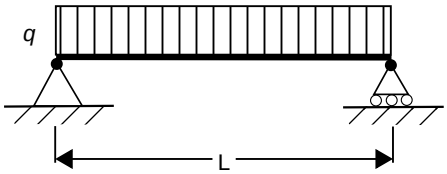
PLATE DESING:

LOADS:

Wind = 23.11psf

LOADS PROCESSING:

L=2.6'
Tributary Strip = 1'



F.B.D

$M=q*L^2/8 * 12 = 235\#\text{-in}$
fb=M /Sx
$Sx= b*h^2/6=0.03125in^3$ b=12", h=0.125"

fb=7520psi < Fb=19000psi OK

using: 1/8" THK Aluminum Plate Alloy 6061-T6