PRCTI20231296

Breshears Engineering LLC 5956 NE 42nd Ave Portland, OR 9718 503-351-4304 | larrybreshears@outlook.com	Project Spirit Halloween Retail Stand Seismic Anchorage			Job No. 1832	
	Calcs for: Guy Gibson			Sheet no./rev. 1 of 9	
	Calc. by LBB	Date 7/3/2023			

FULL SIZED LEDGIBLE COLOR REPORT ARE REQUIRED TO BE PROVIDED BY THE PERMITTEE ON SITE FOR ALL INSPECTIONS

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City of Puyallup
Building
ACCEPTED
JMontgomery
10/09/2023
1:11:15 PM

Structural Calculations

Date: July 3, 2023

Project No.: 1832

Description: Seismic Anchorage of Temporary Indoor Wall Panels

Project Location: State of Washington

Prepared for: Guy Gibson

Design Code: 2021 IBC with Washington State Amendments

Prepared by: Larry Breshears, PE

LARRY BRESHEARS
STATE OF WASHINGTON
48023
REGISTERED
PROFESSIONAL ENGINEER

07/03/2023

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Project: Spirit Halloween Retail Stand Seismic Anchorage				Job No.: 1832	
Calcs for: Guy Gibson				Sheet no./rev.: 2 of 9	
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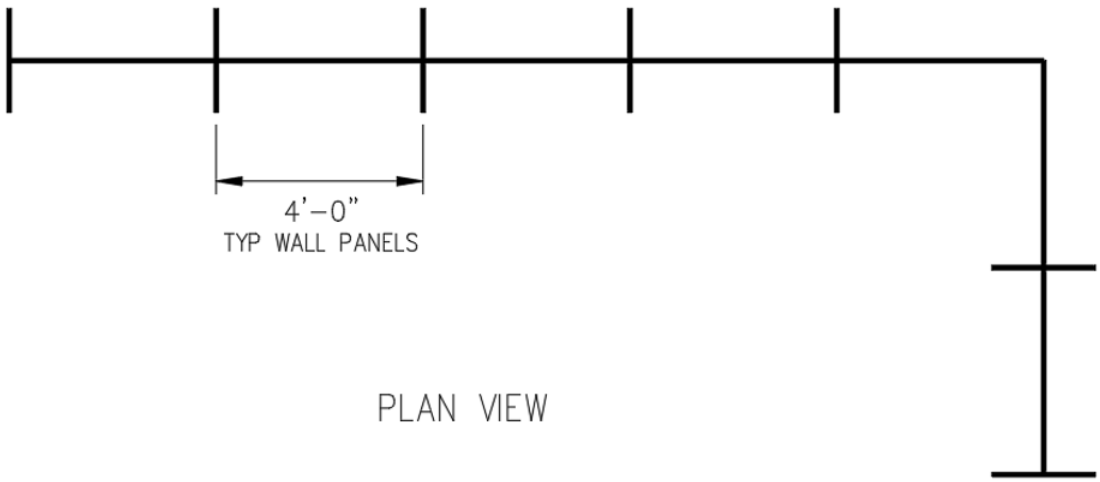
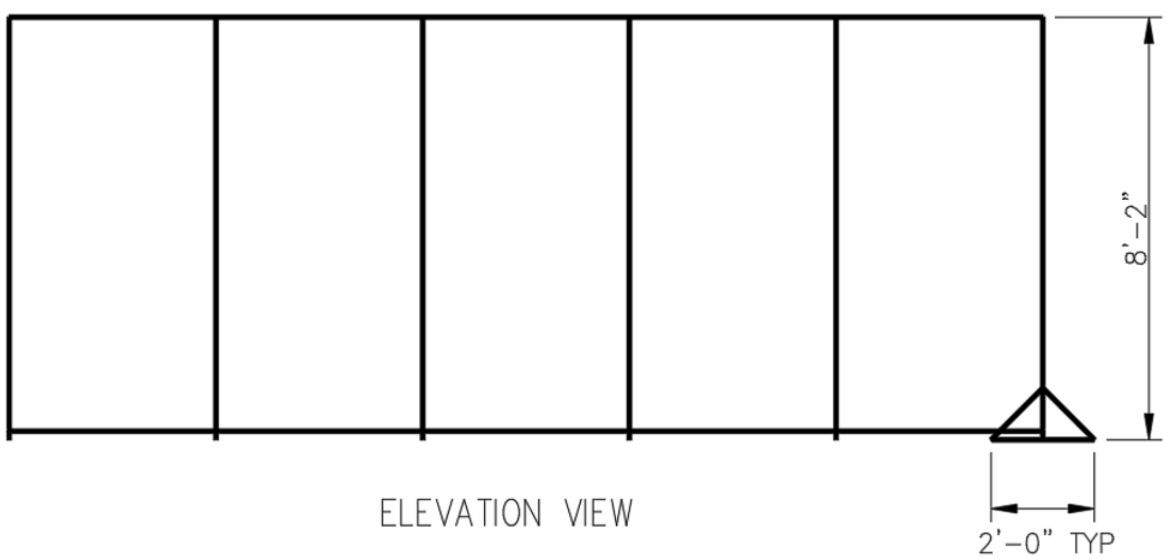
TYPICAL MOVABLE WALL LAYOUT





ASSUME EVERY OTHER T-LEG SUPPORT IS ANCHORED TO CONCRETE FLOOR → 8'-0" o/c

NOTE: T-LEG SUPPORTS ARE NECESSARY AT LOCATIONS WITHOUT OUT-OF-PLANE SUPPORT.
90 DEGREE CORNERS PROVIDE O-O-P SUPPORT, SO T-LEG SUPPORTS ARE NOT REQUIRED AT THOSE LOCATIONS.

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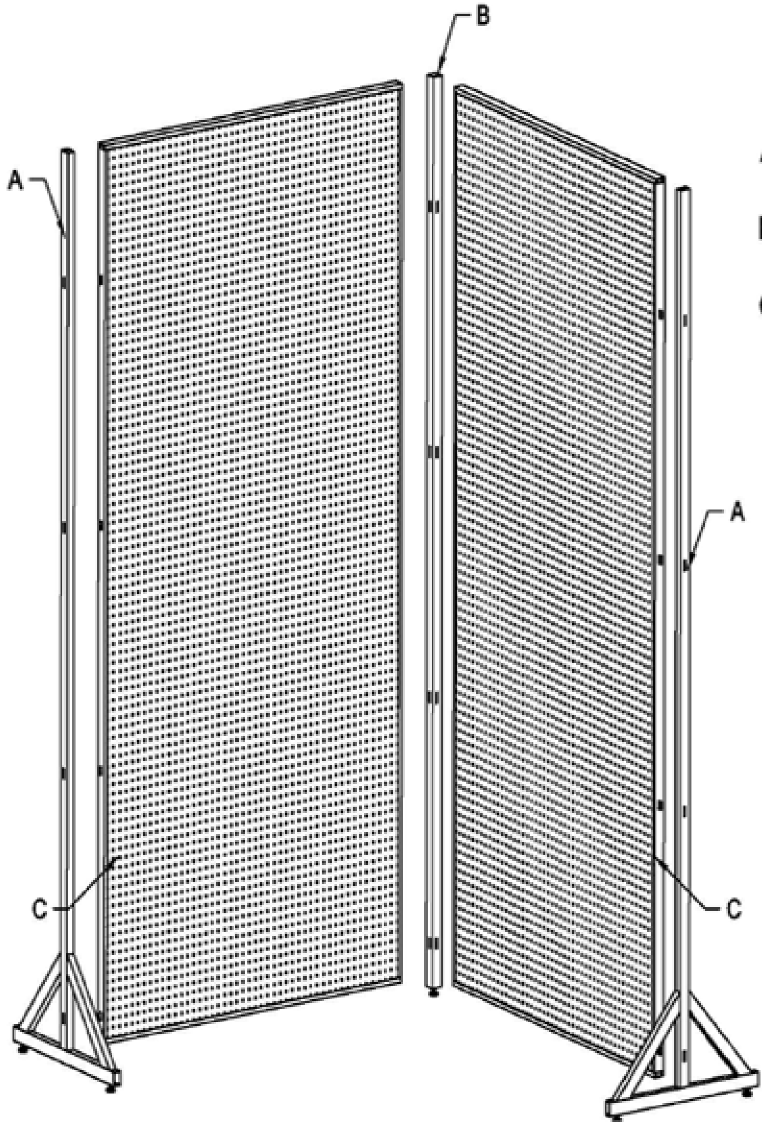

Components

A. 96" T-Leg
#82000

B. 96" Corner Leg
#82004

C. 48" x 96" Center Panel
#82001 & #82003

PANEL WEIGHT

From manufacturer: T-Leg = 13.0 lb
Wall frame without pegboard = 21.2 lb
Pegboard = 27.2 lb
Total dead load of 4' x 8' panel P_{DL} = **61.4** lb

Merchandise: Assume live load P_{LL} = **60** lb

TOTAL WEIGHT OF PANEL = **121.4** lb

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SEISMIC DESIGN DATA (FROM ASCE 7-16)

The following values cover most of the state of Washington:

Risk Category = II, Seismic Importance Factor $I_e = 1.00$

$S_s = 1.50$ $S_1 = 0.60$

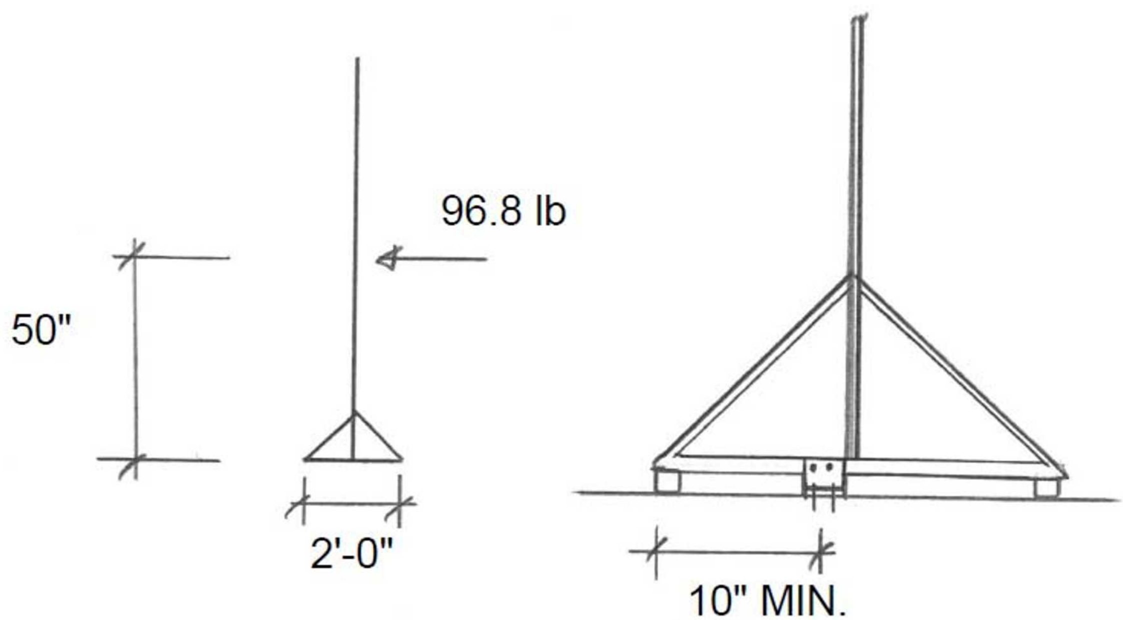
Site Class = D

$F_a = 1.0$ $F_v = 1.7$

$S_{MS} = F_a \times S_s =$ **1.50** $S_{M1} = F_v \times S_1 =$ **1.020**
$S_{DS} = 2/3 \times S_{MS} =$ **1.000** $S_{D1} = 2/3 \times S_{M1} =$ **0.680**
$a_p = 2.5$ $R_p = 2.5$ (Table 13.5-1, cantilever interior nonstructural walls)
$I_p = 1.0$ $z = 0$ ft $h = 8$ ft
$W_p = 121$ lb
$F_p = 0.4 \times a_p \times S_{DS} \times W_p / (R_p / I_p) \times (1 + 2 \times z/h) =$ **48.4** lbf ← **Governs**
$F_{p,max} = 1.6 \times S_{DS} \times I_p \times W_p =$ **194** lb
$F_{p,min} = 0.3 \times S_{DS} \times I_p \times W_p =$ **36.3** lb

➔ SEISMIC FORCE PER (2) 4' WALL PANELS: $2 \times F_p =$ **96.8** lb

SEISMIC UPLIFT FORCE



MAX. FACTORED UPLIFT FORCE @ SEISMIC ANCHOR:
$P_{UP} = 96.8 \text{ lb} \times 50 \text{ in} / 10 \text{ in} =$ **484** lb

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SCREW ANCHOR DESIGN

Assume (2) 1/4”ϕ Tapcon Screw Anchors, 2” apart, 1½” embedment

Total factored uplift force on holdown clip:

$N_{maxD,L}$ = 1.0 × 484 lb – (1.2 × 61.4 lb + 1.6 × 60 lb) = **314** lb ← Governs

N_{maxD} = 1.0 × (61.4 / 121.4) × 484 lb – (0.9 × 61.4 lb) = **190** lb

ANCHOR BOLT DESIGN

In accordance with ACI318-19 (22)

Tedds calculation version 2.1.10

Design summary

Description	Unit	Required	Provided	Util.	Result
Anchor tensile strength	(kips)	0.31	2.26	0.139	PASS
Concrete breakout	(kips)	0.31	1.35	0.233	PASS
Pullout strength	(kips)	0.31	0.58	0.537	PASS
Anchor shear strength	(kips)	0.10	2.35	0.040	PASS
Shear breakout (front)	(kips)	0.10	9.22	0.010	PASS
Side shear breakout (rear)	(kips)	0.10	35.33	0.003	PASS
Anchor pryout	(kips)	0.10	3.35	0.028	PASS
Interaction of forces		1.200	0.578	0.481	PASS

Anchor bolt geometry

Anchor bolt Proprietary bolt Diameter of anchor bolt d_a = **0.25** in

Total number of bolts n_{total} = **2** Total No. of bolts in tension n_{tens} = **1**

Effective area of anchor A_{se} = **0.024** in^2 Embed depth of anchor bolt h_{ef} = **1.5**in

Foundation geometry

Member thickness h_a = **6** in

CL baseplate - left edge x_{ce1} = **24** in CL baseplate - right edge x_{ce2} = **24** in

CL baseplate - bot. edge y_{ce1} = **24** in CL baseplate - top edge y_{ce2} = **24** in

Material details

Nom. tensile stress of steel f_{uta} = **125** ksi Compressive strength of conc f'_c = **3** ksi

Concrete modification factor λ = **1.00**

Mod. factor, concrete failure λ_a = **1.00**

Strength reduction factors

Tension of steel element $\phi_{t,s}$ = **0.75** Shear of steel element $\phi_{v,s}$ = **0.65**

Concrete tension $\phi_{t,c}$ = **0.75** Concrete shear $\phi_{v,c}$ = **0.75**

Concrete tension for pullout $\phi_{t,cB}$ = **0.70** Concrete shear for pryout $\phi_{v,cB}$ = **0.70**

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Seismic requirements

Seismic category D

Attachment undergoes ductile yielding - the attachment (not covered in this calculation) will undergo ductile yielding at a force level corresponding to anchor forces no greater than the calculated design strength of the anchors. Anchor tensile strengths associated with concrete failure modes will be taken to be 0.75 times the calculated strength.

Anchor forces

No. of bolt rows in tension N_{boltN} = **1**

Axial force in bolts for row 1 N_1 = **0.31** kips

Total axial force on bolt group N_R = **0.31** kips

Max axial force to single bolt $N_{max,s}$ = **0.31** kips

Eccentricity of axial load e'_N = **0.00** in

Shear force to bolt group V = **0.10** kips

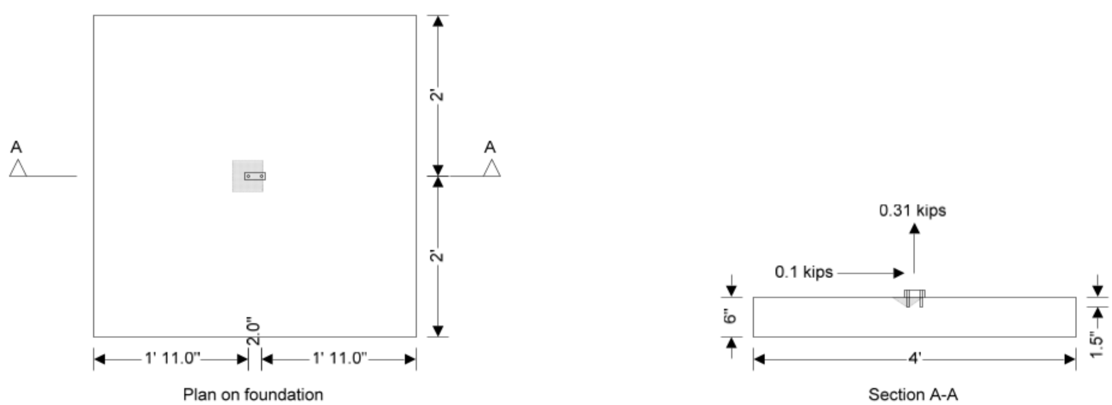
Steel strength of anchor in tension (17.6.1)

Nom strength of anchor N_{sa} = **3.01** kips

Steel strength of anchor ϕN_{sa} = **2.26** kips

PASS - Steel strength of anchor exceeds max tension in single bolt

Check concrete breakout strength of anchor bolt in tension (17.6.2)



Concrete breakout - tension

Coeff for basic breakout k_c = **17**

Breakout strgth single anchor N_b = **1.71** kips

Proj area - groups of anchors A_{Nc} = **20.25** in^2

Proj area - single anchor A_{Nco} = **20.25** in^2

Min dist to edge of concrete $c_{a,min}$ = **23.00** in

Ecc. mod factor for groups $\psi_{ec,N}$ = **1.00**

Mod factor for edge effects $\psi_{ed,N}$ = **1.00**

Mod factor for no cracking $\psi_{c,N}$ = **1.400**

Mod factor for uncracked conc $\psi_{cp,N}$ = **1.000**

Nom conc breakout strength N_{cb} = **2.39** kips

Concrete breakout strength ϕN_{cb} = **1.35** kips

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PASS - Breakout strength exceeds tension in bolts

Pullout strength (17.6.3)

Mod factor no cracking $\psi_{c,P}$ = **1.400** Pullout strength single anchor N_p = **0.80** kips

Nom pullout strength N_{pn} = **1.11** kips Pullout strength single anchor ϕN_{pn} = **0.58** kips

PASS - Pullout strength of single anchor exceeds maximum axial force in single bolt

Steel strength of anchor in shear (17.7.1)

Nom strength of anchor V_{sa} = **3.62** kips Steel strength of anchor ϕV_{sa} = **2.35** kips

PASS - Steel strength of anchor exceeds shear in bolts

Concrete breakout strength in shear perpendicular to edge - Case 2. All shear resisted by rear bolts (17.7.2)

The anchors are influenced by three or more edges where any edge distance is less than 1.5c_{a1} so value of c_{a1} is limited to c'_{a1} (17.7.2.1.2).

Bolt offset for limiting shear $x_{V,r}$ = **9.00** in Limiting edge distance c'_{a1} = **16.00** in

Applied shear V_{app} = **0.10** kips Edge dist x near corner c_{a1} = **25.00** in

Edge dist y near corner c_{a2} = **24.00** in Load bearing length of anchor l_e = **1.5** in

Basic conc breakout strength V_b = **17.56** kips Proj area - single anchor A_{Vco} = **1152.00** in^2

Proj area - group of anchors A_{Vc} = **288.00** in^2 Mod factor for edge effect $\psi_{ed.V}$ = **1.0**

Eccentricity of loading e'_V = **0.00** in Mod factor of eccentricity $\psi_{ec,V}$ = **1.00**

Mod factor for cracking $\psi_{c,V}$ = **1.4** Mod factor for edge distance $\psi_{h,V}$ = **2.0**

Nom conc breakout strength V_{cb} = **12.29** kips Conc break out strength ϕV_{cb} = **9.22** kips

PASS - Shear breakout perpendicular to edge strength exceeds shear in bolts

Concrete breakout strength in shear perpendicular to edge - Case 3. All shear resisted by front bolts (17.7.2)

The anchors are influenced by three or more edges where any edge distance is less than 1.5c_{a1} so value of c_{a1} is limited to c'_{a1} (17.7.2.1.2).

Bolt offset for limiting shear $x_{V,f}$ = **7.00** in Limiting edge distance c'_{a1} = **16.00** in

Applied shear V_{app} = **0.10** kips Edge dist x near corner c_{a1} = **23.00** in

Edge dist y near corner c_{a2} = **24.00** in Load bearing length of anchor l_e = **1.5** in

Basic conc breakout strength V_b = **17.56** kips Proj area - single anchor A_{Vco} = **1152.00** in^2

Proj area - group of anchors A_{Vc} = **288.00** in^2 Mod factor for edge effect $\psi_{ed.V}$ = **1.0**

Eccentricity of loading e'_V = **0.00** in Mod factor of eccentricity $\psi_{ec,V}$ = **1.00**

Mod factor for cracking $\psi_{c,V}$ = **1.4** Mod factor for edge distance $\psi_{h,V}$ = **2.0**

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Nom conc breakout strength V_{cb} = **12.29** kips Conc break out strength

ϕV_{cb} = **9.22** kips

PASS - Shear breakout perpendicular to edge strength exceeds shear in bolts

Concrete breakout strength in shear ()

The anchors are influenced by three or more edges where any edge distance is less than 1.5$c_{a1,p}$ so value of $c_{a1,p}$ is limited to $c'_{a1,p}$

Bolt offset for limiting shear $y_{V,r,p}$ = **8.67** in Limiting edge distance $c'_{a1,p}$ = **15.33** in

Applied shear V_{app} = **0.10** kips Edge distance x for shear $c_{a1,p}$ = **24** in

Edge distance y for shear $c_{a2,p}$ = **23** in Load bearing length of anchor l_e = **1.5** in

Basic conc breakout strength $V_{b,p}$ = **16.47** kips Proj area of single anchor

$A_{Vco,p}$ = **1058** in^2

Proj area of group of anchors $A_{Vc,p}$ = **552** in^2 Mod factor for edge effect

$\psi_{ed,V,p}$ = **1.000**

Eccentricity of loading $e'_{V,p}$ = **0** in Mod factor of eccentric load $\psi_{ec,V,p}$ = **1.000**

Mod factor for cracking $\psi_{c,V}$ = **1.400** Mod factor for edge distance $\psi_{h,V,p}$ = **1.958**

Nom breakout strength shear $V_{cb,p}$ = **47.11** kips Concbreak out strength

shear $\phi V_{cb,p}$ = **35.33** kips

PASS - Shear breakout strength parallel to edge exceeds shear in bolts

Pryout strength of anchor in shear (17.7.3)

Coefficient of pryout strength k_{cp} = **1.0** Nom pryout strength of

anchor V_{cp} = **4.79** kips

Pryout strength of anchor ϕV_{cp} = **3.35** kips

PASS - Pryout strength of anchor exceeds shear in bolts

Interaction of tensile and shear forces

Crit design strength tension ϕN_n = **0.58** kips Crit applied tensile force N_{ua} = **0.31** kips

Crit design strength shear ϕV_n = **2.35** kips Crit applied shear force V_{ua} = **0.10** kips

$N_{ua} / \phi N_n$ = **0.537** $V_{ua} / \phi V_n$ = **0.04**

As $V_{ua} / \phi V_n$ <= 0.2,Full strength in tension is permitted

Pass - Applied tension is less than tension capacity

Maximum Demand/Capacity ratio is 0.54 (applied loading is 54% of anchor capacity). → **OK**

- USE (2) 1/4"ϕ TAPCON SCREW ANCHORS, 2" APART, WITH 1 ½" EMBEDMENT. INSTALL PER MANUFACTURER'S INSTRUCTIONS.

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CHECK TEKS SCREWS INTO T-LEG FRAME

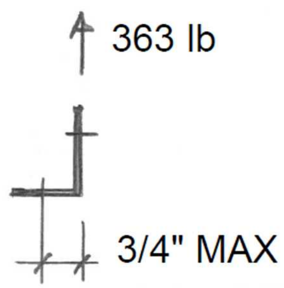
Non-factored uplift force on holdown clip P_{up} = 484 lb – 121.4 lb = **363** lb

FROM ESR-3223: #10 TEKS minimum allowable shear capacity = 331 lb each

- USE (2) #10 TEKS SELF-TAPPING SCREWS

CHECK SIMPSON A23 ANGLE, 18 GA (0.0516")

F_y = 33 ksi



M_{PL} = 363 lb × 0.75 in / 2 = **0.136** kip_in

$M_n = F_y \times 2.75 \text{ in} \times (0.0516 \text{ in})^2 / 4$ = **0.060** kip_in

$M_{PL} > M_n$ 18 GA ANGLE FAILS

DETERMINE REQUIRED THICKNESS: (ASSUME 3" LONG ANGLE)

$t_{req} = \sqrt{((6.67 \times M_{PL}) / (3.0 \text{ in} \times F_y))}$ = **0.096** in

- USE 3" LONG ANGLE WITH MIN. 12 GA (0.109") THICKNESS