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 Design: (1) S545 Clip to 6" Stem Wall (Vmax)
 Fastening point:

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 Specifier:
 E-Mail:
 Date: 9/1/2023

Specifier's comments:

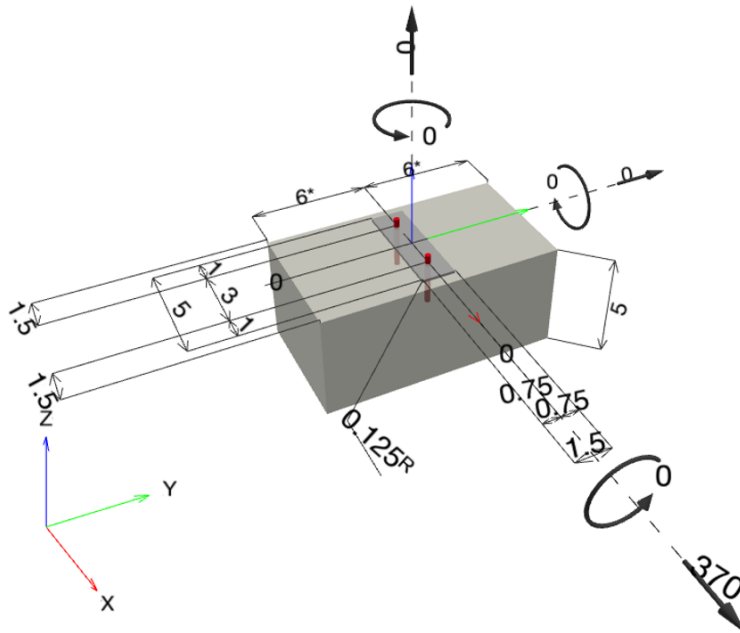
1 Input data



Anchor type and diameter:	KWIK HUS-EZ (KH-EZ) 1/4 (2 1/2)
Item number:	418045 KH-EZ 1/4"x2 5/8"
Effective embedment depth:	$h_{ef} = 1.920$ in., $h_{nom} = 2.500$ in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-3027
Issued Valid:	4/1/2022 12/1/2023
Proof:	Design Method ACI 318 / AC193
Stand-off installation:	$e_b = 0.000$ in. (no stand-off); $t = 0.125$ in.
Anchor plate ^R :	$l_x \times l_y \times t = 5.000$ in. x 1.500 in. x 0.125 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 3000, $f'_c = 3,000$ psi; $h = 5.000$ in.
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

^R - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]



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1.1 Design results

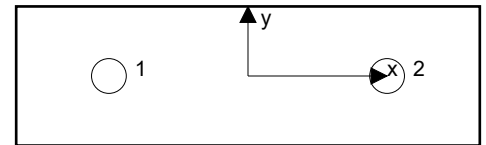
Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 0; V _x = 370; V _y = 0; M _x = 0; M _y = 0; M _z = 0;	no	100

2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	185	185	0
2	0	185	185	0



max. concrete compressive strain: - [%]
 max. concrete compressive stress: - [psi]
 resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
 resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

Convert to LRFD

	Load N _{ua} [lb]	Capacity ϕ N _n [lb]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (anchors in tension)



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4 Shear load

Convert to LRFD

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_v = V_{ua}/\phi V_n$	Status
Steel Strength*	185	930	20	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	370	1,547	24	OK
Concrete edge failure in direction x+**	370	371	100	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-3027
 $\phi V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

$A_{se,v}$ [in. ²]	f_{uta} [psi]	$\alpha_{v,seis}$
0.05	125,000	0.900

Calculations

V_{sa} [lb]
1,550

Results

V_{sa} [lb]	ϕ_{steel}	ϕV_{sa} [lb]	V_{ua} [lb]
1,550	0.600	930	185



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4.2 Pryout Strength

$$V_{cp,g} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \right] \quad \text{ACI 318-08 Eq. (D-31)}$$

$$\phi V_{cp,g} \geq V_{ua} \quad \text{ACI 318-08 Eq. (D-2)}$$

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-08 Eq. (D-6)}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-08 Eq. (D-9)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-08 Eq. (D-11)}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-08 Eq. (D-13)}$$

$$N_b = k_c \lambda \sqrt{f_c} h_{ef}^{1.5} \quad \text{ACI 318-08 Eq. (D-7)}$$

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
1	1.920	0.000	0.000	1.500
$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c [psi]
1.000	2.780	17	1	3,000

Calculations

A_{Nc} [in. ²]	A_{Nc0} [in. ²]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
34.56	33.18	1.000	1.000	0.856	1.000	2,477

Results

$V_{cp,g}$ [lb]	$\phi_{concrete}$	$\phi V_{cp,g}$ [lb]	V_{ua} [lb]
2,209	0.700	1,547	370

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4.3 Concrete edge failure in direction x+

$$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-08 Eq. (D-21)}$$

$$\phi V_{cb} \geq V_{ua} \quad \text{ACI 318-08 Eq. (D-2)}$$

 A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-08 Eq. (D-23)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left(\frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-08 Eq. (D-28)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-08 Eq. (D-29)}$$

$$V_b = \left(7 \left(\frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-08 Eq. (D-24)}$$

Variables

c_{a1} [in.]	c_{a2} [in.]	$\Psi_{c,V}$	h_a [in.]	l_e [in.]
1.500	6.000	1.000	5.000	1.920
λ	d_a [in.]	f_c [psi]	$\Psi_{parallel,V}$	
1.000	0.250	3,000	1.000	

Calculations

A_{Vc} [in. ²]	A_{Vc0} [in. ²]	$\Psi_{ed,V}$	$\Psi_{h,V}$	V_b [lb]
10.12	10.12	1.000	1.000	529

Results

V_{cb} [lb]	$\phi_{concrete}$	ϕV_{cb} [lb]	V_{ua} [lb]
529	0.700	371	370

5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to <https://submittals.us.hilti.com/PROFISAnchorDesignGuide/>

Fastening meets the design criteria!

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6 Installation data

Profile: no profile

Hole diameter in the fixture: $d_f = 0.375$ in.

Plate thickness (input): 0.125 in.

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: KWIK HUS-EZ (KH-EZ) 1/4 (2 1/2)

Item number: 418045 KH-EZ 1/4"x2 5/8"

Maximum installation torque: 216 in.lb

Hole diameter in the base material: 0.250 in.

Hole depth in the base material: 2.875 in.

Minimum thickness of the base material: 4.125 in.

Hilti KH-EZ screw anchor with 2.5 in embedment, 1/4 (2 1/2), Carbon steel, installation per ESR-3027

6.1 Recommended accessories

Drilling

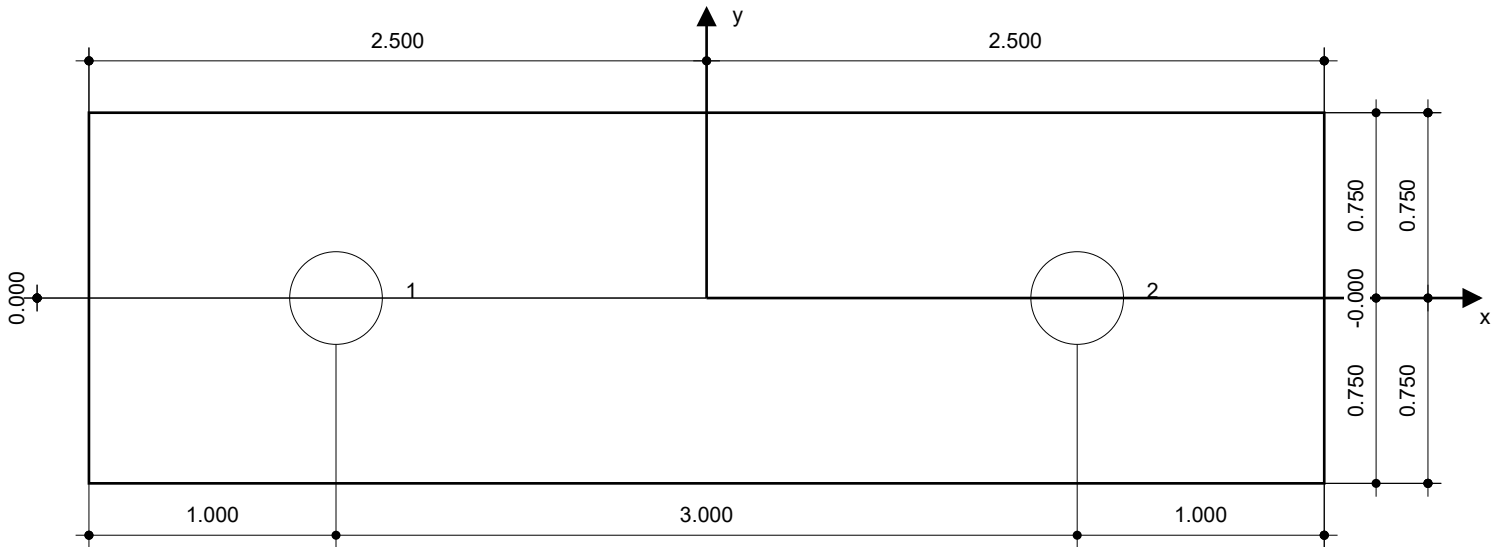
- Suitable Rotary Hammer
- Properly sized drill bit

Cleaning

- Manual blow-out pump

Setting

- Torque wrench



Coordinates Anchor [in.]

Anchor	x	y	c _{-x}	c _{+x}	c _{-y}	c _{+y}
1	-1.500	0.000	1.500	4.500	6.000	6.000
2	1.500	-0.000	4.500	1.500	6.000	6.000



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7 Remarks; Your Cooperation Duties

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- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.



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1. Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General

Design method: ACI 318-19
Units: Imperial units

Anchor Information:

Anchor type: Concrete screw
Material: Carbon Steel
Diameter (inch): 0.250
Nominal Embedment depth (inch): 1.625
Effective Embedment depth, h_{ef} (inch): 1.190
Code report: ICC-ES ESR-2713
Anchor category: 1
Anchor ductility: No
 h_{min} (inch): 3.25
 c_{ac} (inch): 3.00
 C_{min} (inch): 1.50
 S_{min} (inch): 1.50

Base Material

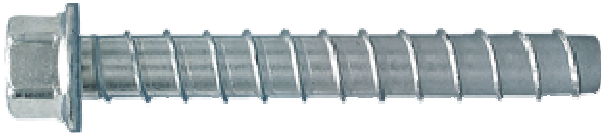
Concrete: Normal-weight
Concrete thickness, h (inch): 5.00
State: Cracked
Compressive strength, f'_c (psi): 3000
 $\Psi_{c,v}$: 1.0
Reinforcement condition: Supplementary reinforcement not present
Supplemental edge reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate

Length x Width x Thickness (inch): 1.50 x 5.00 x 0.10

Recommended Anchor

Anchor Name: Titen HD® - 1/4"Ø Titen HD, h_{nom} : 1.625" (41mm)
Code Report: ICC-ES ESR-2713





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Load and Geometry

Load factor source: ACI 318 Section 5.3

Load combination: not set

Seismic design: No

Anchors subjected to sustained tension: Not applicable

Apply entire shear load at front row: No

Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0

V_{uax} [lb]: 0

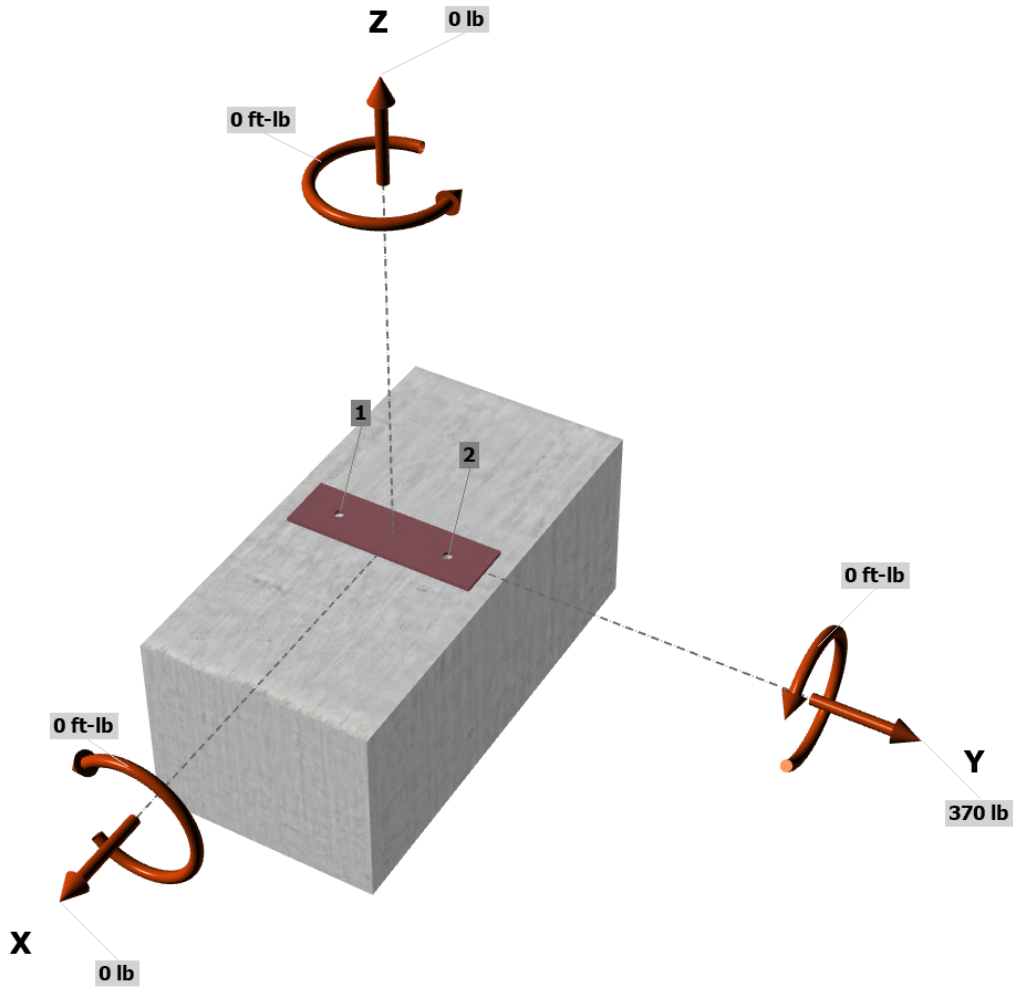
V_{uay} [lb]: 370

M_{ux} [ft-lb]: 0

M_{uy} [ft-lb]: 0

M_{uz} [ft-lb]: 0

<Figure 1>

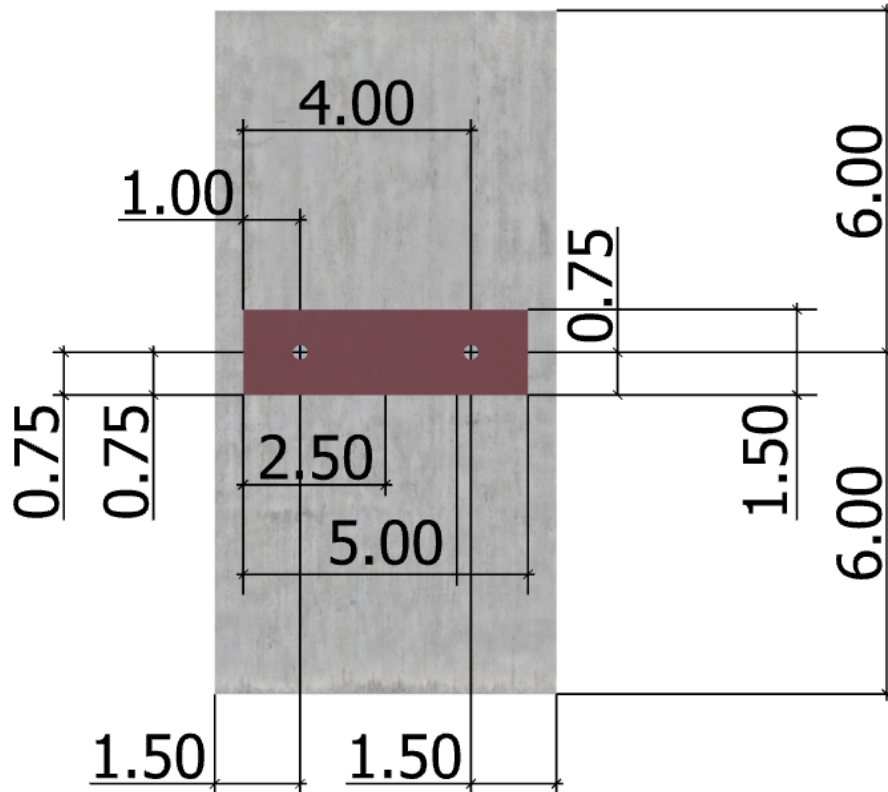


Input data and results must be checked for agreement with the existing circumstances, the standards and guidelines must be checked for plausibility.



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<Figure 2>





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3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2 + (V_{uay})^2}$ (lb)
1	0.0	0.0	185.0	185.0
2	0.0	0.0	185.0	185.0
Sum	0.0	0.0	370.0	370.0

Maximum concrete compression strain (%): 0.00

Maximum concrete compression stress (psi): 0

Resultant tension force (lb): 0

Resultant compression force (lb): 0

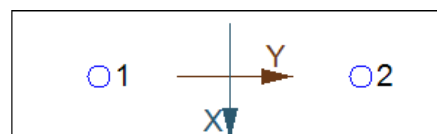
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00

Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00

Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
2020	1.0	0.60	1212

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.7.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min[7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f_c}c_{a1}^{1.5}]$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f_c (psi)	c_{a1} (in)	V_{by} (lb)
1.19	0.250	1.00	3000	1.50	481

$\phi V_{cbgy} = \phi (A_{Vc} / A_{Vco}) \Psi_{ed,v} \Psi_{c,v} \Psi_{h,v} V_{by}$ (Sec. 17.5.1.2 & Eq. 17.7.2.1a)

A_{Vc} (in ²)	A_{Vco} (in ²)	$\Psi_{ed,v}$	$\Psi_{c,v}$	$\Psi_{h,v}$	V_{by} (lb)	ϕ	ϕV_{cbgy} (lb)
10.13	10.13	1.000	1.000	1.000	481	0.70	337

Shear parallel to edge in x-direction:

$V_{by} = \min[7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f_c}c_{a1}^{1.5}]$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f_c (psi)	c_{a1} (in)	V_{by} (lb)
1.19	0.250	1.00	3000	3.33	1594

$\phi V_{cbgx} = \phi (2)(A_{Vc} / A_{Vco}) \Psi_{ec,v} \Psi_{ed,v} \Psi_{c,v} \Psi_{h,v} V_{by}$ (Sec. 17.5.1.2, 17.7.2.1(c) & Eq. 17.7.2.1b)

A_{Vc} (in ²)	A_{Vco} (in ²)	$\Psi_{ec,v}$	$\Psi_{ed,v}$	$\Psi_{c,v}$	$\Psi_{h,v}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
30.00	50.00	1.000	1.000	1.000	1.000	1594	0.70	1339

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

Input data and results must be checked for agreement with the existing circumstances, the standards and guidelines must be checked for plausibility.



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$$\phi V_{cpq} = \phi K_{cp} N_{cbg} = \phi K_{cp} (A_{Nc} / A_{Nco}) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \text{ (Sec. 17.5.1.2 \& Eq. 17.7.3.1b)}$$

K_{cp}	A_{Nc} (in ²)	A_{Nco} (in ²)	$\psi_{ec,N}$	$\psi_{ed,N}$	$\psi_{c,N}$	$\psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cpq} (lb)
1.0	21.42	12.74	1.000	0.952	1.000	1.000	1209	0.70	1354

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	185	1212	0.15	Pass
T Concrete breakout y+	185	337	0.55	Pass (Governs)
 Concrete breakout x-	370	1339	0.28	Pass (Governs)
Pryout	370	1354	0.27	Pass

1/4"Ø Titen HD, hnom:1.625" (41mm) meets the selected design criteria.

12. Warnings

- Designer must exercise own judgement to determine if this design is suitable.
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

370 / 2 = 185 lbs