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Company: Ashot Shagirian, P.E.
 Address: 11337 Runnymede St., Sun Valley, CA 91352
 Phone | Fax: (818) 731-4051 |
 Design: Sign S-2 2025-01 Concrete
 Fastening point: Sign S-2

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 Ashot Shagirian
 ashot@mac.com
 1/8/2025

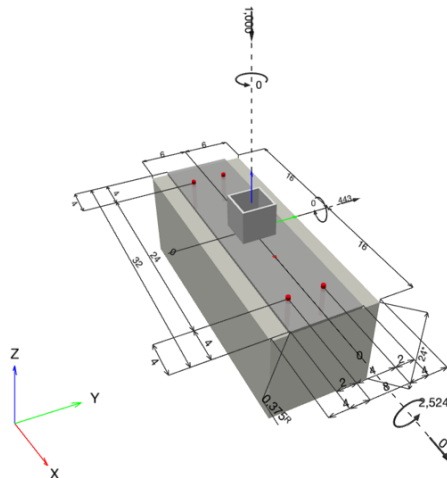
Specifier's comments: Unfactored LRFD Input

1 Input data

Anchor type and diameter:	Kwik Bolt TZ2 - CS 1/2 (3 1/4)	
Item number:	2210256 KB-TZ2 1/2x5 1/2	
Specification text:	Hilti \varnothing 1/2 in Kwik Bolt TZ2 - CS with 3.75 in nominal embedment depth per ICC-ES ESR-4266 , SAFEset - automatic cleaning installation per MPII	
Effective embedment depth:	$h_{ef,act} = 3.250$ in., $h_{nom} = 3.750$ in.	
Material:	Carbon Steel	
Evaluation Service Report:	ESR-4266	
Issued Valid:	12/1/2023 12/1/2025	
Proof:	Design Method ACI 318-19 / Mech	
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-19 Fig. R.17.7.2.1b)	
Stand-off installation:	$e_b = 0.000$ in. (no stand-off); $t = 0.375$ in.	
Anchor plate ^R :	$l_x \times l_y \times t = 32.000$ in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)	
Profile:	Square HSS (AISC), HSS4X4X.25; (L x W x T) = 4.000 in. x 4.000 in. x 0.250 in.	
Base material:	cracked concrete, 2500, $f'_c = 2,500$ psi; $h = 24.000$ in.	
Installation:	automatic cleaned drilled hole, Installation condition: Dry	
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar	

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

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





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1.1 Design results

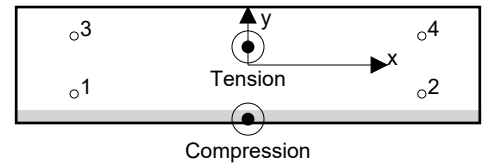
Case	Description	Forces [lb] / Moments [ft.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = -1,000; V _x = 0; V _y = 443; M _x = 2,524.000; M _y = 0.000; M _z = 0.000;	no	98

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	501	111	0	111
2	501	111	0	111
3	2,163	111	0	111
4	2,163	111	0	111



Max. concrete compressive strain: 0.11 [‰]
 Max. concrete compressive stress: 499 [psi]
 Resulting tension force in (x/y)=(0.000/1.247): 5,329 [lb]
 Resulting compression force in (x/y)=(0.000/-3.736): 6,329 [lb]

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

3 Tension load

	Load N _{ua} [lb]	Capacity ϕ N _n [lb]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	2,163	8,433	26	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	5,329	5,465	98	OK

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


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3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-4266
 $\phi N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in. ²]	f_{uta} [psi]
0.10	114,004

Calculations

N_{sa} [lb]
11,244

Results

N_{sa} [lb]	ϕ_{steel}	ϕN_{sa} [lb]	N_{ua} [lb]
11,244	0.750	8,433	2,163

3.2 Concrete Breakout Failure

$$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \quad \text{ACI 318-19 Eq. (17.6.2.1b)}$$

$$\phi N_{cbg} \geq N_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-19 Eq. (17.6.2.1.4)}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.3.1)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.4.1b)}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.6.1b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-19 Eq. (17.6.2.2.1)}$$

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
3.250	0.000	1.247	4.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
10.000	17	1.000	2,500

Calculations

A_{Nc} [in. ²]	A_{Nc0} [in. ²]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
213.00	95.06	1.000	0.796	0.946	1.000	4,980

Results

N_{cbg} [lb]	$\phi_{concrete}$	ϕN_{cbg} [lb]	N_{ua} [lb]
8,407	0.650	5,465	5,329



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4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_v = V_{ua} / \phi V_n$	Status
Steel Strength*	111	4,471	3	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	443	14,781	3	OK
Concrete edge failure in direction y+**	443	3,023	15	OK

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

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-4266
 $\phi V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in. ²]	f_{uta} [psi]
0.10	114,004

Calculations

V_{sa} [lb]
6,878

Results

V_{sa} [lb]	ϕ_{steel}	ϕV_{sa} [lb]	V_{ua} [lb]
6,878	0.650	4,471	111


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4.2 Pryout Strength

$$V_{cp,g} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b \right] \quad \text{ACI 318-19 Eq. (17.7.3.1b)}$$

$$\phi V_{cp,g} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-19 Eq. (17.6.2.1.4)}$$

$$\Psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.3.1)}$$

$$\Psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.4.1b)}$$

$$\Psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.6.1b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-19 Eq. (17.6.2.2.1)}$$

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	3.250	0.000	0.000	4.000
$\Psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	10.000	17	1.000	2,500

Calculations

A_{Nc} [in. ²]	A_{Nc0} [in. ²]	$\Psi_{ec1,N}$	$\Psi_{ec2,N}$	$\Psi_{ed,N}$	$\Psi_{cp,N}$	N_b [lb]
213.00	95.06	1.000	1.000	0.946	1.000	4,980

Results

$V_{cp,g}$ [lb]	$\phi_{concrete}$	$\phi V_{cp,g}$ [lb]	V_{ua} [lb]
21,116	0.700	14,781	443


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4.3 Concrete edge failure in direction y+

$$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-19 Eq. (17.7.2.1b)}$$

$$\phi V_{cbg} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Vc} \text{ see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)*}$$

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-19 Eq. (17.7.2.1.3)}$$

$$\Psi_{ec,V} = \left(\frac{1}{1 + \frac{e_v}{1.5c_{a1}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.3.1)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left(\frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.4.1b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.6.1)}$$

$$V_b = \left(7 \left(\frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-19 Eq. (17.7.2.2.1a)}$$

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\Psi_{c,V}$	h_a [in.]
4.000	4.000	0.000	1.000	24.000
l_e [in.]	λ_a	d_a [in.]	f_c [psi]	$\Psi_{parallel,V}$
3.250	1.000	0.500	2,500	1.000

Calculations

A_{Vc} [in. ²]	A_{Vc0} [in. ²]	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{h,V}$	V_b [lb]
120.00	72.00	1.000	0.900	1.000	2,879

Results

V_{cbg} [lb]	$\phi_{concrete}$	ϕV_{cbg} [lb]	V_{ua} [lb]
4,318	0.700	3,023	443

*Anchor row defined by: Anchor 3, 4; Case 3 controls

5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization β_{NV} [%]	Status
0.975	0.147	1.000	94	OK

$$\beta_{NV} = (\beta_N + \beta_V) / 1.2 \leq 1$$



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6 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!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- 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/>
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!



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7 Installation data

Profile: Square HSS (AISC), HSS4X4X.25; (L x W x T) = 4.000 in. x 4.000 in. x 0.250 in.

Hole diameter in the fixture: $d_f = 0.562$ in.

Plate thickness (input): 0.375 in.

Recommended plate thickness: not calculated

Drilling method: SafeSet - automatic cleaning

Cleaning: Automatically performed while drilling

Setting: Machine torquing with Torque controlled cordless impact tool module

Anchor type and diameter: Kwik Bolt TZ2 - CS 1/2 (3 1/4)

Item number: 2210256 KB-TZ2 1/2x5 1/2

Maximum installation torque: 50.154 ft.lb

Hole diameter in the base material: 0.500 in.

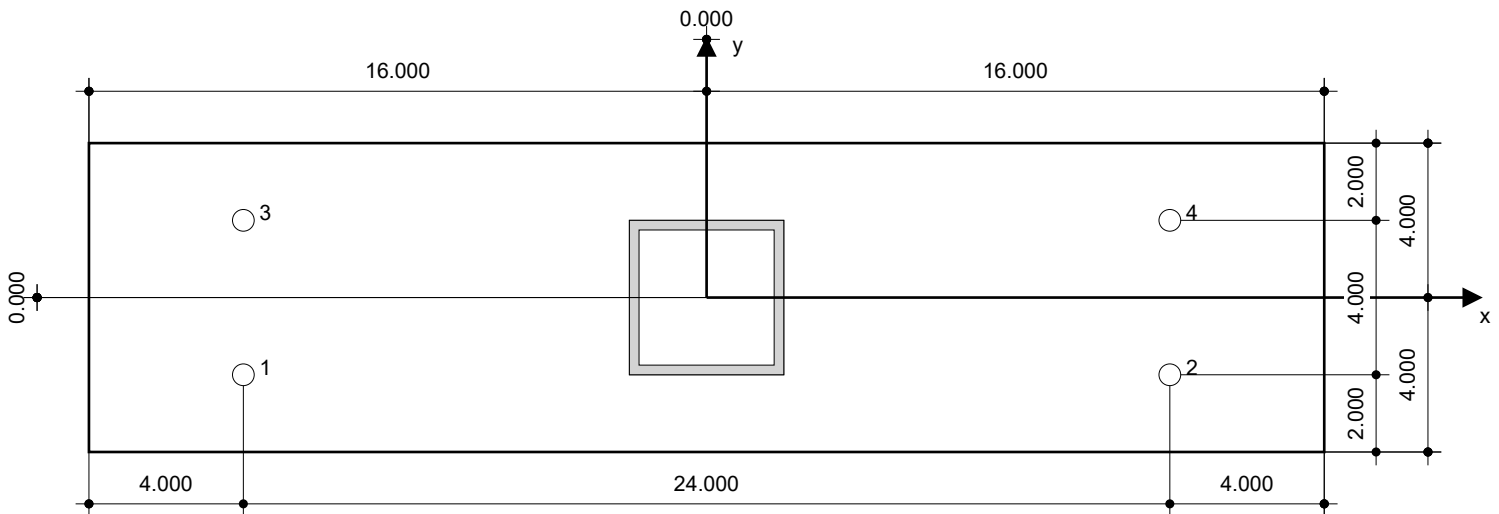
Hole depth in the base material: 4.250 in.

Minimum thickness of the base material: 5.500 in.

Hilti \varnothing 1/2 in Kwik Bolt TZ2 - CS with 3.75 in nominal embedment depth per ICC-ES ESR-4266 , SAFEset - automatic cleaning installation per MPII

7.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> Suitable Rotary Hammer Properly sized drill bit for SAFEset - automatic cleaning (TE-CD / TE-YD) Vacuum cleaner 	<ul style="list-style-type: none"> No accessory required 	<ul style="list-style-type: none"> Torque controlled cordless impact tool Torque wrench Hammer



Coordinates Anchor [in.]

Anchor	x	y	C _{-x}	C _{+x}	C _{-y}	C _{+y}
1	-12.000	-2.000	4.000	28.000	4.000	8.000
2	12.000	-2.000	28.000	4.000	4.000	8.000
3	-12.000	2.000	4.000	28.000	8.000	4.000
4	12.000	2.000	28.000	4.000	8.000	4.000



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8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- 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.