Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - 16 May 2023 (3)	Date:	16/05/2023
Fastening Point:			

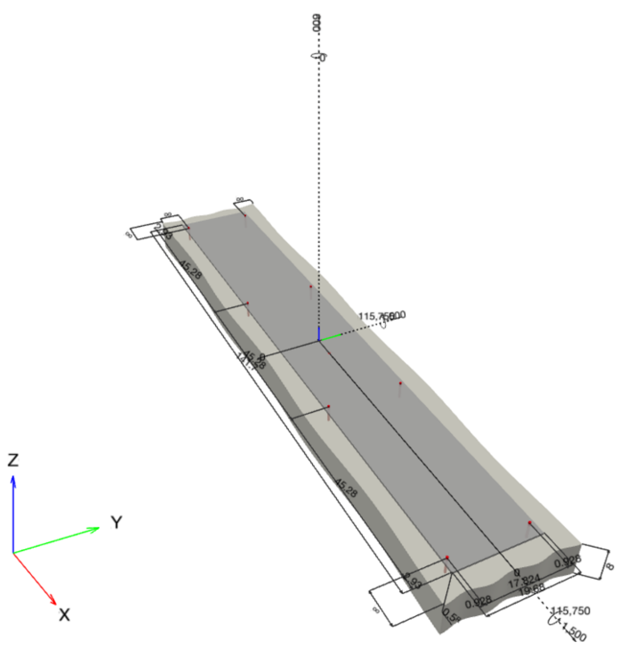
Specifier's comments:

1 Input data

Anchor type and size:	**Kwik Bolt 1 - CS 1/2 (3 1/4) hnom2**
Item number:	2231460 KB1 1/2x5 1/2
Effective embedment depth:	$h_{ef,act}$ = 3.250 in., h_{nom} = 3.625 in.
Material:	Carbon Steel
Approval No.:	ER-678
Issued I Valid:	04/11/2022 | 30/11/2023
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Baseplate[R] :	l_x x l_y x t = 141.700 in. x 19.680 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 8.000 in.
Installation:	**hammer 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 baseplate assumption.

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



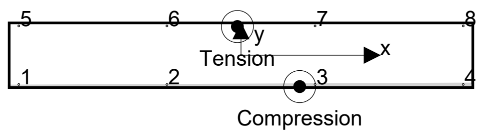
1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 600; V_x = 1,500; V_y = 1,500; M_x = 115,750; M_y = 115,750; M_z = 0;	no	206

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	41	265	188	188
2	23	265	188	188
3	4	265	188	188
4	0	265	188	188
5	1,671	265	188	188
6	1,653	265	188	188
7	1,635	265	188	188
8	1,617	265	188	188



max. concrete compressive strain: 0.03 [‰]
max. concrete compressive stress: 145 [psi]
resulting tension force in (x/y)=(-1.102/8.729): 6,645 [lb]
resulting compression force in (x/y)=(17.938/-9.554): 6,045 [lb]

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

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel failure*	1,671	8,148	21	OK
Pull-out failure*	N/A	N/A	N/A	N/A
Concrete Breakout failure**	6,645	3,241	206	not recommended

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

3.1 Steel failure

N_{sa} = ESR value refer to ICC-ES ER-678
$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.10	105,942

Calculations

N_{sa} [lb]
10,864

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
10,864	0.750	8,148	1,671

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3.2 Concrete Breakout failure

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

$\phi\ N_{cbg} \geq N_{ua}$ 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)

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

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

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

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

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ 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	8.601	7.456	∞	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]
665.44	95.06	0.362	0.395	1.000	1.000	4,980

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
4,986	0.650	3,241	6,645

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel failure*	265	3,394	8	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	2,121	55,778	4	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

4.1 Steel failure

V_{sa} = ESR value refer to ICC-ES ER-678

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.10	105,942

Calculations

V_{sa} [lb]
5,222

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
5,222	0.650	3,394	265

4.2 Pryout failure

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

$\phi\ V_{cpg} \geq V_{ua}$ 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)

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

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

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

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

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ 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	∞

$\psi_{c,N}$	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]
760.50	95.06	1.000	1.000	1.000	1.000	4,980

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
79,683	0.700	55,778	2,121

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
2.050	0.078	1.000	178	not recommended

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

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid baseplates 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 baseplate are not considered - the baseplate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required baseplate thickness with CBFEM to limit the stress of the baseplate based on the assumptions explained above. The proof if the rigid baseplate 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/
- 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 does not meet the design criteria!

7 Installation data

Anchor type and size: Kwik Bolt 1 - CS 1/2 (3 1/4) hnom2

Item number: 2231460 KB1 1/2x5 1/2

Maximum installation torque: 480 in.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: 6.000 in.

Profile: no profile

Hole diameter in the fixture: d_f = 0.562 in.

Plate thickness (input): 0.500 in.

Recommended plate thickness: not calculated

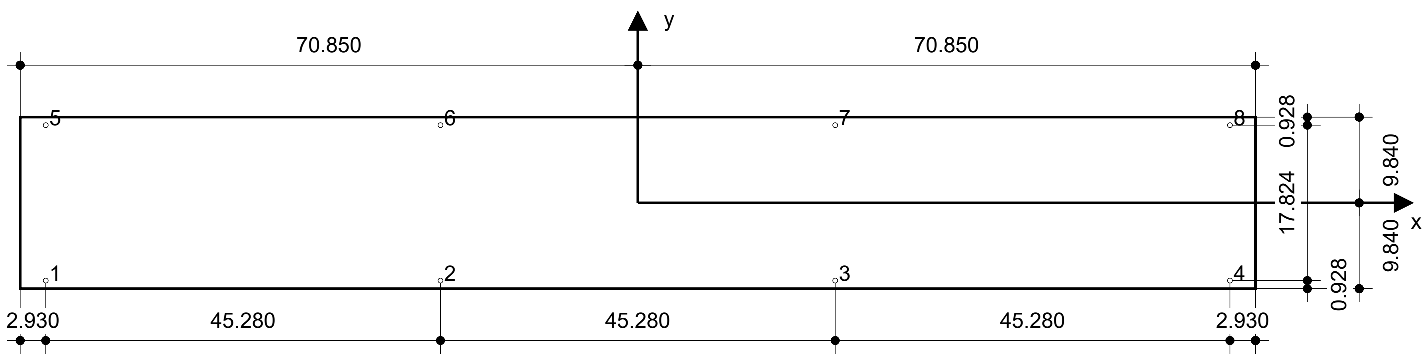
Drilling method: Hammer drilled

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

Hilti KB1 stud anchor with 3.625 in embedment, 1/2 (3 1/4) hnom2, Carbon steel, installation per ER-678

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Hilti SIW 6AT-A22 + SI AT-A22 • Torque wrench • Hammer



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-67.920	-8.912	-	-	-	-
2	-22.640	-8.912	-	-	-	-
3	22.640	-8.912	-	-	-	-
4	67.920	-8.912	-	-	-	-

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
5	-67.920	8.912	-	-	-	-
6	-22.640	8.912	-	-	-	-
7	22.640	8.912	-	-	-	-
8	67.920	8.912	-	-	-	-

8 Remarks; Your Cooperation Duties

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