Hilti PROFIS Engineering 3.0.81

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Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Nov 22, 2022 (3)	Date:	2022-11-23
Fastening point:			

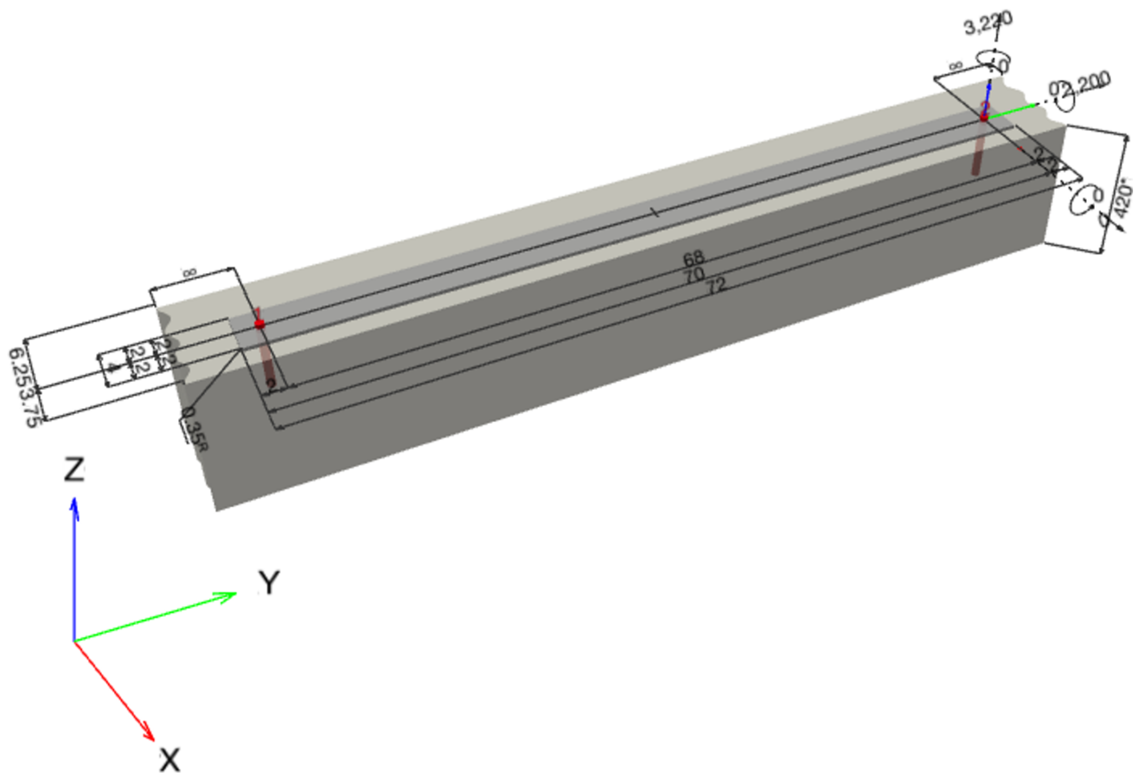
Specifier's comments:

1 Input data

Anchor type and diameter:	**KWIK HUS-EZ (KH-EZ) 3/4 (7 1/4)**
Item number:	not available
Effective embedment depth:	$h_{ef,act}$ = 5.690 in., h_{nom} = 7.250 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-3027
Issued I Valid:	- | -
Proof:	Design Method CSA A23.3-14 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.350 in.
Anchor plate[R] :	l_x x l_y x t = 4.000 in. x 72.000 in. x 0.350 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, f_c' = 4,000 psi; h = 420.000 in.
Installation:	**automatic cleaned drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present
	edge reinforcement: none or < 15M bar

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

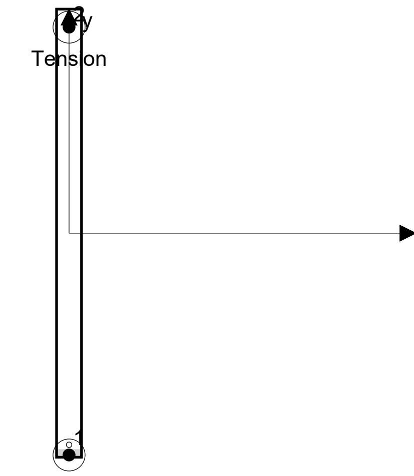
Geometry [in.] & Loading [lb, in.lb]



1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 3{,}220$; $V_x = 0$; $V_y = 2{,}200$; $M_x = 0$; $M_y = 0$; $M_z = 0$;	no	73

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	43	1,100	0	1,100
2	3,219	1,100	0	1,100

max. concrete compressive strain:	0.00 [‰]
max. concrete compressive stress:	19 [psi]
resulting tension force in (x/y)=(0.000/33.106):	3,262 [lb]
resulting compression force in (x/y)=(0.000/-35.639):	42 [lb]

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

3 Tension load

	Load N_f [lb]	Capacity N_r [lb]	Utilization $\beta_N = N_f/N_r$	Status
Steel Strength*	3,219	19,048	17	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	3,262	4,528	73	OK

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

3.1 Steel Strength

$N_{s,uta} = A_{se}\, f_{uta}$	= ESR value	refer to ICC-ES ESR-3027
N_{sar}	$= A_{se}\ \phi_s\ f_{uta}\ R$	CSA A23.3-14 Eq. D.2
N_{sar}	$\geq N_{fa}$	CSA A23.3-14 Table D.1

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.39	81,600

Calculations

$N_{s,uta}$ [lb]
32,013

Results

$N_{s,uta}$ [lb]	ϕ_s	R	N_{sar} [lb]	N_{fa} [lb]
32,013	0.850	0.700	19,048	3,219

3.2 Concrete Breakout Failure

$N_{cbgr} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_{br}$	CSA A23.3-14 Eq. D.4
$N_{cbgr} \geq N_{fa,g}$	CSA A23.3-14 Table D.1
A_{Nc} see CSA A23.3-14, Part D.6.2.1, Fig. D.7	
$A_{Nc0} = 9\ h_{ef}^2$	CSA A23.3-14 Eq. D.5
$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$	CSA A23.3-14 Eq. D.8
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$	CSA A23.3-14 Eq. D.11
$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$	CSA A23.3-14 Eq. D.13
$N_{br} = k_c\ \phi_c\ \lambda_a \sqrt{f'_c}\ h_{ef}^{1.5}\ R$	CSA A23.3-14 Eq. D.6

Variables

h_{ef} [in.]	$e'_{1,N}$ [in.]	$e'_{2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
5.690	0.000	33.106	3.750	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
22.800	17.0	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$
341.40	291.38	1.000	0.205	0.832	1.000

Results

ϕ_c	R	N_{br} [lb]	N_{cbgr} [lb]	$N_{fa,g}$ [lb]
0.650	1.000	22,666	4,528	3,262

4 Shear load

	Load V_f [lb]	Capacity V_r [lb]	Utilization $\beta_V = V_f/V_r$	Status
Steel Strength*	1,100	9,205	12	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	2,200	44,181	5	OK
Concrete edge failure in direction x+**	2,200	10,701	21	OK

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

4.1 Steel Strength

$V_{s,uta}$ = ESR value	refer to ICC-ES ESR-3027
$V_{sar} = 0.6\ A_{se,V}\ \phi_s\ f_{uta}\ R$	CSA A23.3-14 Eq. D.31
$V_{sar} \geq V_{fa}$	CSA A23.3-14 Table D.1

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.39	81,600

Calculations

$V_{s,uta}$ [lb]
16,660

Results

$V_{s,uta}$ [lb]	ϕ_s	R	V_{sar} [lb]	V_{fa} [lb]
16,660	0.850	0.650	9,205	1,100

4.2 Pryout Strength

$V_{cpgr} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_{br} \right] R$ CSA A23.3-14 Eq. D.45

$V_{cpgr} \geq V_{fa,g}$ CSA A23.3-14 Table D.1

A_{Nc} see CSA A23.3-14, Part D.6.2.1, Fig. D.7

$A_{Nc0} = 9\ h_{ef}^2$ CSA A23.3-14 Eq. D.5

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ CSA A23.3-14 Eq. D.8

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ CSA A23.3-14 Eq. D.11

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ CSA A23.3-14 Eq. D.13

$N_{br} = k_c\ \phi_c\ \lambda_a\ \sqrt{f_c'}\ h_{ef}^{1.5}$ CSA A23.3-14 Eq. D.6

Variables

k_{cp}	h_{ef} [in.]	$e_{1,N}'$ [in.]	$e_{2,N}'$ [in.]	$c_{a,min}$ [in.]
2	5.690	0.000	0.000	3.750

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f_c' [psi]
1.000	22.800	17.0	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$
341.40	291.38	1.000	1.000	0.832	1.000

Results

ϕ_c	N_{br} [lb]	V_{cpg} [lb]	R	V_{cpgr} [lb]	$V_{fa,g}$ [lb]
0.650	22,666	44,181	1.000	44,181	2,200

4.3 Concrete edge failure in direction x+

$V_{cbgr} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{\alpha,V(D.7.2.1(c))}\ V_{br}$ — CSA A23.3-14 Eq. D.33

$V_{cbgr} \geq V_{fa,g}$ — CSA A23.3-14 Table D.1

A_{Vc} see CSA A23.3-14, Part D.7.2.1, Fig. D.13

$A_{Vc0} = 4.5\ c_{a1}^2$ — CSA A23.3-14 Eq. D.34

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ — CSA A23.3-14 Eq. D.38

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — CSA A23.3-14 Eq. D.41

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — CSA A23.3-14 Eq. D.42

$V_{br} = 3.75\ \lambda_a\ \phi_c\ \sqrt{f_c'}\ c_{a1}^{1.5}\ R$ — CSA A23.3-14 Eq. D.36

Variables

c_{a1} [in.]	c_{a2} [in.]	e_V' [in.]	$\psi_{c,V}$	h_a [in.]
3.750	-	0.000	1.000	420.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{\alpha,V(D.7.2.1(c))}$
5.690	1.000	0.750	4,000	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$
126.56	63.28	1.000	1.000	1.000

Results

ϕ_c	R	V_{br} [lb]	V_{cbgr} [lb]	$V_{fa,g}$ [lb]
0.650	1.000	2,675	10,701	2,200

5 Combined tension and shear loads

$\beta_N = N_f/N_r$	$\beta_V = V_f/V_r$	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.720	0.206	5/3	66	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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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!
- Condition A applies when supplementary reinforcement is used. The R factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Checking the transfer of loads into the base material is required in accordance with CSA A23.3!
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference CSA A23.3-14 Annex D, Clause D.10.1

Fastening meets the design criteria!

7 Installation data

Anchor type and diameter: KWIK HUS-EZ (KH-EZ) 3/4 (7 1/4)

Item number: not available

Maximum installation torque: 129 Nm

Hole diameter in the base material: 0.750 in.

Hole depth in the base material: 7.625 in.

Minimum thickness of the base material: 11.500 in.

Profile: no profile

Hole diameter in the fixture: d_f = 0.875 in.

Plate thickness (input): 0.350 in.

Recommended plate thickness: not calculated

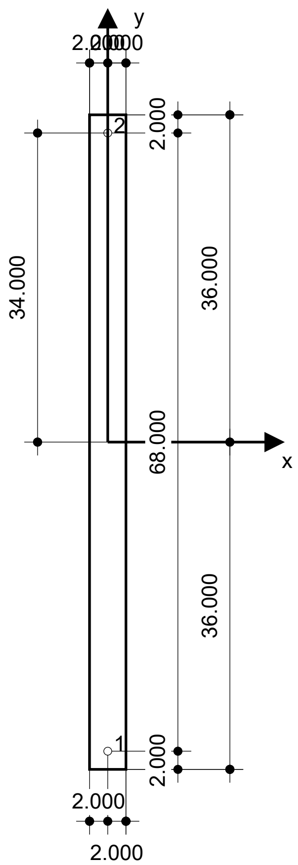
Drilling method: SafeSet - automatic cleaning

Cleaning: Automatically performed while drilling

Hilti KH-EZ screw anchor with 7.25 in embedment, 3/4 (7 1/4), Carbon steel, installation per ESR-3027

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Vacuum cleaner	• No accessory required	• Torque wrench • Hilti SIW 9-A22 Impact Wrench



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	-34.000	6.250	3.750	-	-
2	0.000	34.000	6.250	3.750	-	-

8 Remarks; Your Cooperation Duties

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