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Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	407233 Sidewall FPs w/ Prying (4-Bolt)	Date:	12/2/2022
Fastening point:			

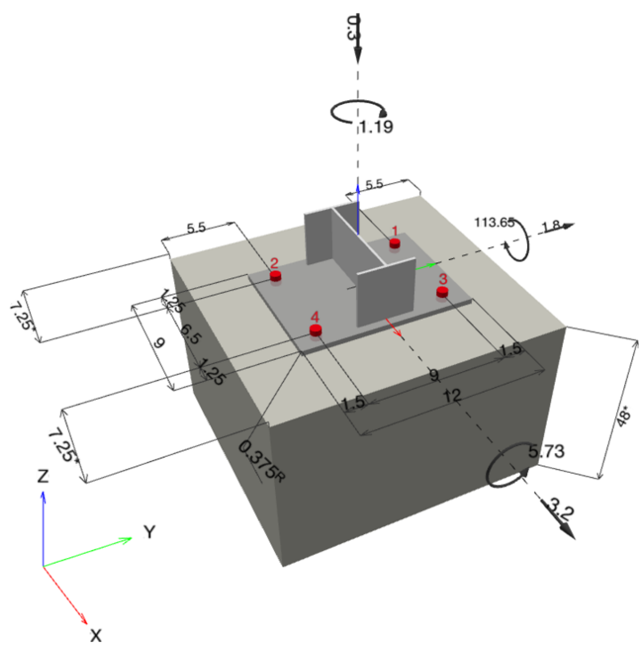
Specifier's comments:

1 Input data

Anchor type and diameter:	**KWIK HUS-EZ (KH-EZ) 3/4 (6 1/4)**
Item number:	418085 KH-EZ 3/4"x7"
Effective embedment depth:	$h_{ef,act}$ = 4.840 in., h_{nom} = 6.250 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 = 0.375 in.
Anchor plate^R :	l_x x l_y x t = 9.000 in. x 12.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	W shape (AISC), W8X10; (L x W x T x FT) = 7.890 in. x 3.940 in. x 0.170 in. x 0.205 in.
Base material:	cracked concrete, f_c' = 4.625 ksi; h = 48.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition A, shear: condition A; no supplemental splitting reinforcement present
	edge reinforcement: > 15M bar with stirrups (s <= 100 mm)

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

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



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1.1 Load combination and design results

Case	Description	Forces [kip] / Moments [in.kip]	Seismic	Max. Util. Anchor [%]
1	71 1.25(D+CL)+1.5BSL	N = -6.100; V_x = -2.900; V_y = 0.000; M_x = 0.000000; M_y = -59.730000; M_z = 0.000000;	no	49
2	82 .9D+1.4(WPERP+ EDGE STRIP PERP -IP)	N = -0.300; V_x = 3.200; V_y = 1.800; M_x = 5.730000; M_y = -113.650000; M_z = -1.190000;	no	150
3	72 1.25(D+CL)+1.5USL	N = -8.300; V_x = 2.400; V_y = 0.000; M_x = 0.000000; M_y = -0.620000; M_z = 0.000000;	no	26
4	83 .9D+1.4(WIND PAR (-Z) +EDGE STRIP PAR (-Z) +IP)	N = 8.600; V_x = -0.200; V_y = -2.700; M_x = -10.300000; M_y = -36.910000; M_z = -3.320000;	no	107
5	83 .9D+1.4(WIND PAR (-Z) +EDGE STRIP PAR (-Z) +IP)	N = 8.600; V_x = -0.200; V_y = -2.700; M_x = -10.300000; M_y = -36.910000; M_z = -3.320000;	no	107
6	86 .9D+1.4(WIND PAR (+Z) +EDGE STRIP PAR (-Z) -IP)	N = 5.000; V_x = -0.100; V_y = 3.000; M_x = 13.140000; M_y = -39.990000; M_z = -1.310000;	no	88
7	83 .9D+1.4(WIND PAR (-Z) +EDGE STRIP PAR (-Z) +IP)	N = 8.600; V_x = -0.200; V_y = -2.700; M_x = -10.300000; M_y = -36.910000; M_z = -3.320000;	no	107
8	86 .9D+1.4(WIND PAR (+Z) +EDGE STRIP PAR (-Z) -IP)	N = 5.000; V_x = -0.100; V_y = 3.000; M_x = 13.140000; M_y = -39.990000; M_z = -1.310000;	no	88
9	83 .9D+1.4(WIND PAR (-Z) +EDGE STRIP PAR (-Z) +IP)	N = 0.100; V_x = 0.200; V_y = -0.200; M_x = -4.950000; M_y = -23.930000; M_z = -8.640000;	no	32
10	76 1.25(D+CL)+1.4(WIND PAR (+Z) +EDGE STRIP PAR (+Z) +IP)	N = 1.000; V_x = -1.700; V_y = -0.100; M_x = -4.030000; M_y = -64.490000; M_z = 9.010000;	no	86
11	82 .9D+1.4(WPERP+ EDGE STRIP PERP -IP)	N = -0.300; V_x = 3.200; V_y = 1.800; M_x = 5.730000; M_y = 113.650000; M_z = -1.190000;	no	150
12	72 1.25(D+CL)+1.5USL	N = -3.000; V_x = -2.200; V_y = 0.000; M_x = 0.000000; M_y = -85.900000; M_z = 0.000000;	no	97

2 Load case/Resulting anchor forces

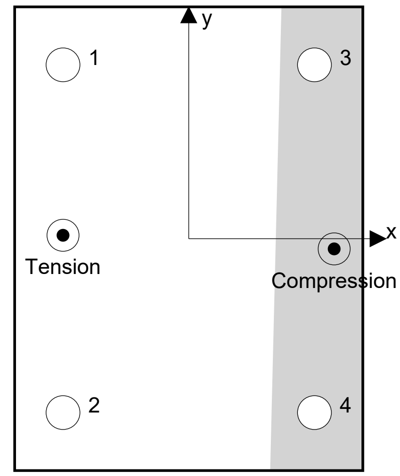
Controlling load case: 11 82 .9D+1.4(WPERP+ EDGE STRIP PERP -IP)

Anchor reactions [kip]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	8.185	0.971	0.843	0.481
2	7.868	0.897	0.757	0.481
3	0.000	0.942	0.843	0.419
4	0.000	0.865	0.757	0.419

max. concrete compressive strain: 0.30 [‰]
max. concrete compressive stress: 1.310 [ksi]
resulting tension force in (x/y)=(-3.250/0.089): 16.053 [kip]
resulting compression force in (x/y)=(3.760/-0.263): 16.353 [kip]



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

3 Tension load

	Load N_f [kip]	Capacity N_r [kip]	Utilization $\beta_N = N_f/N_r$	Status
Steel Strength*	8.185	19.048	43	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	16.053	11.420	141	not recommended

* 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} [ksi]
1	0.39	81.600

Calculations

$N_{s,uta}$ [kip]
32.013

Results

$N_{s,uta}$ [kip]	ϕ_s	R	N_{sar} [kip]	N_{fa} [kip]
32.013	0.850	0.700	19.048	8.185

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

$\psi_{cp,N} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ 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.]	$\psi_{c,N}$
4.833	0.000	0.089	5.500	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [ksi]
7.280	7.0	1.000	4.625

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$
290.00	210.25	1.000	0.988	0.928	1.000

Results

ϕ_c	R	N_{br} [kip]	N_{cbgr} [kip]	$N_{fa,g}$ [kip]
0.650	1.150	9.036	11.420	16.053

4 Shear load

	Load V_f [kip]	Capacity V_r [kip]	Utilization $\beta_V = V_f/V_r$	Status
Steel Strength*	0.971	9.205	11	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	3.672	27.425	14	OK
Concrete edge failure in direction x+**	3.672	9.374	40	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} [ksi]
1	0.39	81.600

Calculations

$V_{s,uta}$ [kip]
16.660

Results

$V_{s,uta}$ [kip]	ϕ_s	R	V_{sar} [kip]	V_{fa} [kip]
16.660	0.850	0.650	9.205	0.971

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	4.833	0.159	0.282	5.500

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [ksi]
1.000	7.280	7.0	1.000	4.625

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$
420.00	210.25	0.979	0.962	0.928	1.000

Results

ϕ_c	N_{br} [kip]	V_{cpg} [kip]	R	V_{cpgr} [kip]	$V_{fa,g}$ [kip]
0.650	7.857	27.425	1.000	27.425	3.672

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

$V_{br} = 0.58\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\ \phi_c\ \lambda_a \sqrt{f'_c}\ c_{a1}^{1.5}\ R$ — CSA A23.3-14 Eq. D.35

Variables

c_{a1} [in.]	c_{a2} [in.]	e'_V [in.]	$\psi_{c,V}$	h_a [in.]
7.250	5.500	0.213	1.400	48.000

l_e [in.]	λ_a	d_a [in.]	f'_c [ksi]	$\psi_{\alpha,V(D.7.2.1(c))}$
4.840	1.000	0.750	4.625	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$
217.50	236.53	0.981	0.852	1.000

Results

ϕ_c	R	V_{br} [kip]	V_{cbgr} [kip]	$V_{fa,g}$ [kip]
0.650	1.150	8.716	9.374	3.672

5 Combined tension and shear loads

$\beta_N = N_f/N_r$	$\beta_V = V_f/V_r$	ζ	Utilization $\beta_{N,V}$ [%]	Status
1.406	0.392	1.000	150	not recommended

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

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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 does not meet the design criteria!

7 Installation data

Profile: W shape (AISC), W8X10; (L x W x T x FT) = 7.890 in. x 3.940 in. x 0.170 in. x 0.205 in.

Hole diameter in the fixture: d_f = 0.875 in.

Plate thickness (input): 0.375 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) 3/4 (6 1/4)

Item number: 418085 KH-EZ 3/4"x7"

Maximum installation torque: 129 Nm

Hole diameter in the base material: 0.750 in.

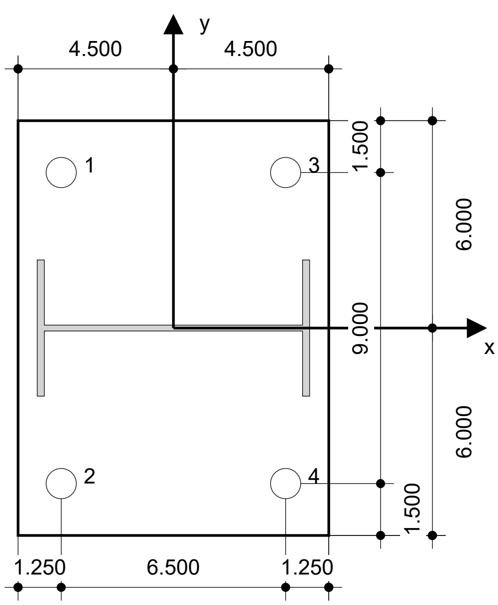
Hole depth in the base material: 6.625 in.

Minimum thickness of the base material: 8.125 in.

Hilti KH-EZ screw anchor with 6.25 in embedment, 3/4 (6 1/4), Carbon steel, installation per ESR-3027

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque wrench • Hilti SIW 9-A22 Impact Wrench



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-3.250	4.500	7.250	13.750	14.500	5.500
2	-3.250	-4.500	7.250	13.750	5.500	14.500
3	3.250	4.500	13.750	7.250	14.500	5.500
4	3.250	-4.500	13.750	7.250	5.500	14.500

8 Remarks; Your Cooperation Duties

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