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Company:		Page:	1
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	W18 Reinforcement Anchorage	Date:	10/17/2023
Fastening point:			

Specifier's comments:

1 Input data

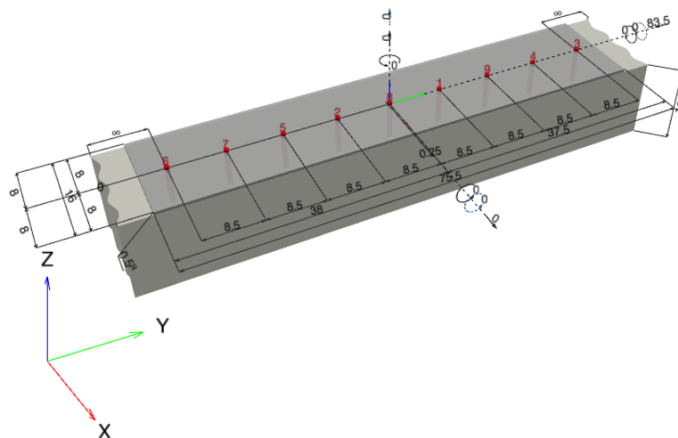


Anchor type and diameter:	KWIK-X 3/4 (4 1/2) hnom2
Item number:	418085 KH-EZ 3/4"x7" (element) / 2346813 KHC 3/4" LARGE (capsule)
Effective embedment depth:	$h_{ef,act} = 5.375$ in. ($h_{ef,limit} = -$ in.), $h_{nom} = 5.375$ in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-5065
Issued Valid:	1/1/2023 12/1/2023
Proof:	Design Method ACI 318-14 / Chem
Stand-off installation:	$e_b = 0.000$ in. (no stand-off); $t = 0.500$ in.
Anchor plate ^R :	$l_x \times l_y \times t = 16.000$ in. x 75.500 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 3000, $f'_c = 3,000$ psi; $h = 16.000$ in., Temp. short/long: 32/32 °F
Installation:	hammer drilled hole, Installation condition: Dry
Reinforcement:	tension: condition B, shear: condition A; no supplemental splitting reinforcement present edge reinforcement: > No. 4 bar with stirrups

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

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

- Design loads
- Sustained loads





www.hilti.com

Company:	Page: 2
Address:	Specifier:
Phone Fax:	E-Mail:
Design: W18 Reinforcement Anchorage	Date: 10/17/2023
Fastening point:	

1.1 Design results

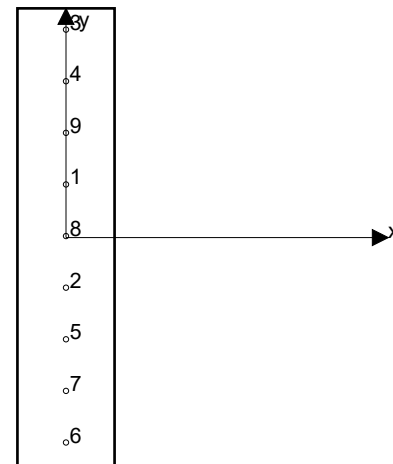
Case	Description	Forces [kip] / Moments [ft.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 0.000; V _x = 0.000; V _y = -83.500; M _x = 0.000; M _y = 0.000; M _z = 0.000; N _{sus} = 0.000; M _{x,sus} = 0.000; M _{y,sus} = 0.000;	no	100

2 Load case/Resulting anchor forces

Anchor reactions [kip]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.000	9.278	0.000	-9.278
2	0.000	9.278	0.000	-9.278
3	0.000	9.278	0.000	-9.278
4	0.000	9.278	0.000	-9.278
5	0.000	9.278	0.000	-9.278
6	0.000	9.278	0.000	-9.278
7	0.000	9.278	0.000	-9.278
8	0.000	9.278	0.000	-9.278
9	0.000	9.278	0.000	-9.278



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

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

3 Tension load

	Load N _{ua} [kip]	Capacity ϕ N _n [kip]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Bond Strength**	N/A	N/A	N/A	N/A
Sustained Tension Load Bond 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)



www.hilti.com

Company:		Page:	3
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	W18 Reinforcement Anchorage	Date:	10/17/2023
Fastening point:			

4 Shear load

	Load V_{ua} [kip]	Capacity ϕV_n [kip]	Utilization $\beta_v = V_{ua} / \phi V_n$	Status
Steel Strength*	9.278	9.996	93	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	83.500	83.896	100	OK
Concrete edge failure in direction x+**	83.500	89.677	94	OK

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

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-5065
 $\phi V_{steel} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$A_{se,v}$ [in. ²]	f_{uta} [psi]
0.39	81,600

Calculations

V_{sa} [kip]
16.659

Results

V_{sa} [kip]	ϕ_{steel}	ϕV_{sa} [kip]	V_{ua} [kip]
16.659	0.600	9.996	9.278



www.hilti.com

Company:		Page:	4
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	W18 Reinforcement Anchorage	Date:	10/17/2023
Fastening point:			

4.2 Pryout Strength (Concrete Breakout Strength controls)

$$V_{cp,g} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \right] \quad \text{ACI 318-14 Eq. (17.5.3.1b)}$$

$$\phi V_{cp,g} \geq V_{ua} \quad \text{ACI 318-14 Table 17.3.1.1}$$

A_{Nc} see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-14 Eq. (17.4.2.1c)}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.4)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.5b)}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.7b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-14 Eq. (17.4.2.2a)}$$

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	5.375	0.000	0.000	8.000
$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	7.860	17	1.000	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 [kip]
1,346.00	260.02	1.000	1.000	0.998	1.000	11.603

Results

$V_{cp,g}$ [kip]	$\phi_{concrete}$	$\phi V_{cp,g}$ [kip]	V_{ua} [kip]
119.851	0.700	83.896	83.500

www.hilti.com

Company:		Page:	5
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	W18 Reinforcement Anchorage	Date:	10/17/2023
Fastening point:			

4.3 Concrete edge failure in direction x+

$$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-14 Eq. (17.5.2.1b)}$$

$$\phi V_{cbg} \geq V_{ua} \quad \text{ACI 318-14 Table 17.3.1.1}$$

 A_{Vc} see ACI 318-14, Section 17.5.2.1, Fig. R 17.5.2.1(b)

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-14 Eq. (17.5.2.1c)}$$

$$\Psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_v}{3c_{a1}}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.5.2.5)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left(\frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.5.2.6b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-14 Eq. (17.5.2.8)}$$

$$V_b = \left(7 \left(\frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f'_c} c_{a1}^{1.5} \quad \text{ACI 318-14 Eq. (17.5.2.2a)}$$

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\Psi_{c,V}$	h_a [in.]
8.000	-	0.000	1.400	16.000
l_e [in.]	λ_a	d_a [in.]	f'_c [psi]	$\Psi_{parallel,V}$
5.375	1.000	0.750	3,000	2.000

Calculations

A_{Vc} [in. ²]	A_{Vc0} [in. ²]	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{h,V}$	V_b [kip]
1,104.00	288.00	1.000	1.000	1.000	11.140

Results

V_{cbg} [kip]	$\phi_{concrete}$	ϕV_{cbg} [kip]	V_{ua} [kip]
119.570	0.750	89.677	83.500



www.hilti.com

Company:		Page:	6
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	W18 Reinforcement Anchorage	Date:	10/17/2023
Fastening point:			

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.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to <https://submittals.us.hilti.com/PROFISAnchorDesignGuide/>
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-14, Section 17.8.1.

Fastening meets the design criteria!

www.hilti.com

Company:
 Address:
 Phone | Fax: |
 Design: W18 Reinforcement Anchorage
 Fastening point:

Page: 7
 Specifier:
 E-Mail:
 Date: 10/17/2023

6 Installation data

Profile: no profile

Hole diameter in the fixture: $d_f = 0.875$ in.

Plate thickness (input): 0.500 in.

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: KWIK-X 3/4 (4 1/2) hnom2
 Item number: 418085 KH-EZ 3/4"x7" (element) / 2346813

KHC 3/4" LARGE (capsule)

Maximum installation torque: -

Hole diameter in the base material: 0.750 in.

Hole depth in the base material: 6.375 in.

Minimum thickness of the base material: 7.875 in.

3/4 (4 1/2) hnom2 Hilti KH-EZ Carbon steel screw anchor with Hilti KHC

6.1 Recommended accessories

Drilling

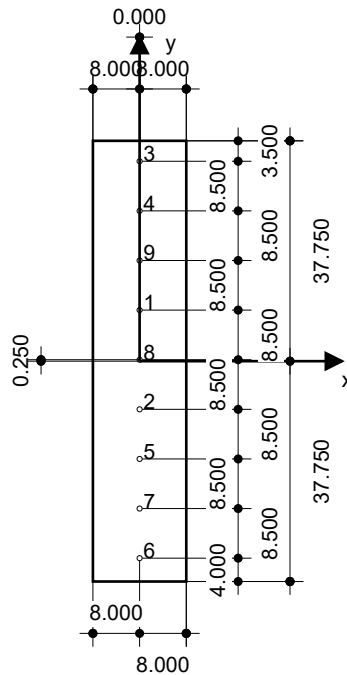
- Suitable Rotary Hammer
- Properly sized drill bit

Cleaning

- No accessory required

Setting

- SIW 6-A22 Impact Screw Driver



Coordinates Anchor [in.]

Anchor	x	y	C _{-x}	C _{+x}	C _{-y}	C _{+y}	Anchor	x	y	C _{-x}	C _{+x}	C _{-y}	C _{+y}
1	0.000	8.750	8.000	8.000	-	-	6	0.000	-33.750	8.000	8.000	-	-
2	0.000	-8.250	8.000	8.000	-	-	7	0.000	-25.250	8.000	8.000	-	-
3	0.000	34.250	8.000	8.000	-	-	8	0.000	0.250	8.000	8.000	-	-
4	0.000	25.750	8.000	8.000	-	-	9	0.000	17.250	8.000	8.000	-	-
5	0.000	-16.750	8.000	8.000	-	-							



www.hilti.com

Company:		Page:	8
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	W18 Reinforcement Anchorage	Date:	10/17/2023
Fastening point:			

7 Remarks; Your Cooperation Duties

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