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Design:	P4 Landing Ramp Stage 2 Concrete REV1 - APRIL 0	Date:	4/9/2025
Fastening point:			

Specifier's comments:

1 Input data

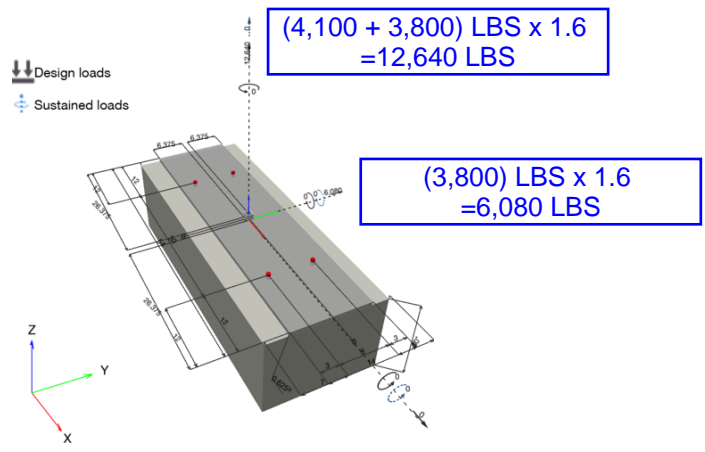


Anchor type and diameter:	KWIK-X (Carbon Steel) 3/4 (4 1/2) hnom2
Item number:	418086 KH-EZ 3/4"x8" (element) / 2346813 KHC 3/4" LARGE (capsule)
Specification text:	Hilti Ø 3/4 in KWIK-X (Carbon Steel) with KH-EZ with KHC 3/4" LARGE with 7.25 in nominal embedment depth per ICC-ES ESR-5065, Hammer drill bit installation per MPII,
Effective embedment depth:	$h_{ef,act} = 7.250 \text{ in.}$ ($h_{ef,limit} = - \text{ in.}$), $h_{nom} = 7.250 \text{ in.}$ MAXIMUM EMBEDMENT
Material:	Carbon Steel
Evaluation Service Report:	ESR-5065
Issued Valid:	12/1/2023 12/1/2025
Proof:	Design Method ACI 318-19 / Chem
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-19 Fig. R.17.7.2.1b)
Stand-off installation:	$e_b = 0.000 \text{ in.}$ (no stand-off); $t = 0.625 \text{ in.}$
Anchor plate ^R :	$l_x \times l_y \times t = 54.000 \text{ in.} \times 14.000 \text{ in.} \times 0.625 \text{ in.}$; (Recommended plate thickness: not calculated)
Profile:	Square HSS (AISC), HSS1-1/4X1-1/4X.125; (L x W x T) = 1.250 in. x 1.250 in. x 0.125 in.
Base material:	cracked concrete, 2500, $f_c' = 2,500 \text{ psi}$; $h = 60.000 \text{ in.}$, Temp. short/long: 32/32 °F
Installation:	Hammer drilled hole, Installation condition: Dry
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: > No. 4 bar with stirrups

@ 5 IN EMBEDMENT, THE UTILIZATION IS 100 %

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

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



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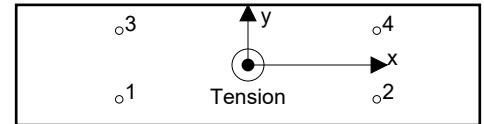
1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 12,640; V _x = 0; V _y = 6,080; M _x = 0; M _y = 0; M _z = 0;	no	84

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	3,160	1,520	0	1,520
2	3,160	1,520	0	1,520
3	3,160	1,520	0	1,520
4	3,160	1,520	0	1,520



Max. concrete compressive strain: - [%]
 Max. concrete compressive stress: - [psi]
 Resulting tension force in (x/y)=(0.000/0.000): 12,640 [lb]
 Resulting compression force in (x/y)=(-/-): 0 [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*	3,160	20,809	16	OK
Bond Strength**	12,640	35,524	36	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	12,640	18,026	71	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-5065
 $\phi N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

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

Calculations

N_{sa} [lb]
32,013

Results

N_{sa} [lb]	ϕ_{steel}	ϕN_{sa} [lb]	N_{ua} [lb]
32,013	0.650	20,809	3,160



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3.2 Bond Strength

$$N_{ag} = \left(\frac{A_{Na}}{A_{Na0}} \right) \Psi_{ec1,Na} \Psi_{ec2,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} \quad \text{ACI 318-19 Eq. (17.6.5.1b)}$$

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

$$A_{Na} \text{ see ACI 318-19, Section 17.6.5.1, Fig. R 17.6.5.1(b)}$$

$$A_{Na0} = (2 c_{Na})^2 \quad \text{ACI 318-19 Eq. (17.6.5.1.2a)}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{1100}} \quad \text{ACI 318-19 Eq. (17.6.5.1.2b)}$$

$$\Psi_{ec,Na} = \left(\frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.5.3.1)}$$

$$\Psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.5.4.1b)}$$

$$\Psi_{cp,Na} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.5.5.1b)}$$

$$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef} \quad \text{ACI 318-19 Eq. (17.6.5.2.1)}$$

Variables

$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [psi]
1,916	0.750	7.250	6.000	1.000	1,701
$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	λ_a		
0.000	0.000	10.853	1.000		

Calculations

c_{Na} [in.]	A_{Na} [in. ²]	A_{Na0} [in. ²]	$\Psi_{ed,Na}$
9.853	827.63	388.30	0.883
$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$	N_{ba} [lb]
1.000	1.000	1.000	29,050

Results

N_{ag} [lb]	ϕ_{bond}	ϕN_{ag} [lb]	N_{ua} [lb]
54,653	0.650	35,524	12,640

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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3.3 Concrete Breakout Failure

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

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

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

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

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

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

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

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

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
7.250	0.000	0.000	6.000	1.000
c_{ac} [in.]	k_c	λ_a	f_c [psij]	
10.853	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]
913.50	473.06	1.000	1.000	0.866	1.000	16,593

Results

N_{cbg} [lb]	$\phi_{concrete}$	ϕN_{cbg} [lb]	N_{ua} [lb]
27,733	0.650	18,026	12,640



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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*	1,520	9,996	16	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	6,080	38,826	16	OK
Concrete edge failure in direction y+**	6,080	12,963	47	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 318-19 Table 17.5.2

Variables

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

Calculations

V_{sa} [lb]
16,659

Results

V_{sa} [lb]	ϕ_{steel}	ϕV_{sa} [lb]	V_{ua} [lb]
16,659	0.600	9,996	1,520



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4.2 Pryout Strength (Concrete Breakout Strength controls)

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

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

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	7.250	0.000	0.000	6.000
$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	10.853	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]
913.50	473.06	1.000	1.000	0.866	1.000	16,593

Results

$V_{cp,g}$ [lb]	$\phi_{concrete}$	$\phi V_{cp,g}$ [lb]	V_{ua} [lb]
55,465	0.700	38,826	6,080



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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} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)*

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

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

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

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

$$V_b = 9 \lambda_a \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-19 Eq. (17.7.2.2.1b)}$$

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\Psi_{c,V}$	h_a [in.]
6.000	12.000	0.000	1.400	60.000
l_e [in.]	λ_a	d_a [in.]	f_c [psi]	$\Psi_{parallel,V}$
6.000	1.000	0.750	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]
324.00	162.00	1.000	1.000	1.000	6,614

Results

V_{cbg} [lb]	$\phi_{concrete}$	ϕV_{cbg} [lb]	V_{ua} [lb]
18,518	0.700	12,963	6,080

*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 $\beta_{N,V}$ [%]	Status
0.701	0.469	5/3	84	OK

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

@ 5 IN EMBEDMENT, THE UTILIZATION IS 100 %



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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.
- 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://viewer.joomag.com/profis-design-guide-us-en-summer-2021/0841849001625154758?short&/>
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

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7 Installation data

Profile: Square HSS (AISC), HSS1-1/4X1-1/4X.125; (L x W x T) = 1.250 in. x 1.250 in. x 0.125 in.

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

Plate thickness (input): 0.625 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 (Carbon Steel) 3/4 (4 1/2) hnom2

Item number: 418086 KH-EZ 3/4"x8" (element) / 2346813 KHC 3/4" LARGE (capsule)

Maximum installation torque: -

Hole diameter in the base material: 0.750 in.

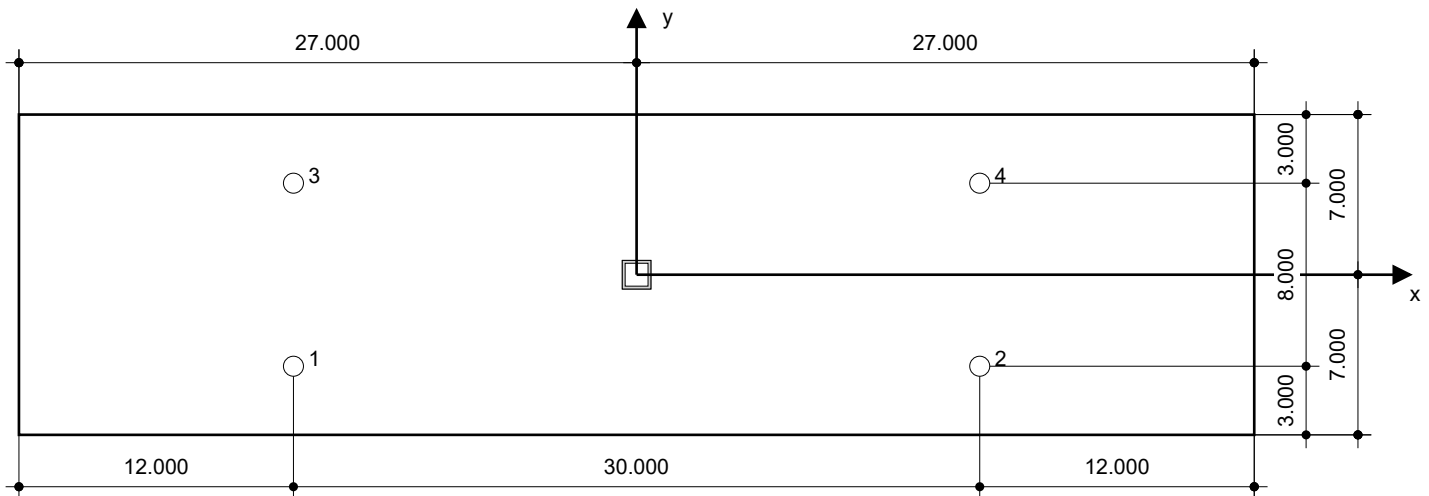
Hole depth in the base material: 8.250 in.

Minimum thickness of the base material: 9.750 in.

Hilti \varnothing 3/4 in KWIK-X (Carbon Steel) with KH-EZ with KHC 3/4" LARGE with 7.25 in nominal embedment depth per ICC-ES ESR-5065, Hammer drill bit installation per MPII

7.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> • Suitable Rotary Hammer • Properly sized drill bit 	<ul style="list-style-type: none"> • No accessory required 	<ul style="list-style-type: none"> • SIW 6-A22 Impact Screw Driver



Coordinates Anchor [in.]

Anchor	x	y	C _{-x}	C _{+x}	C _{-y}	C _{+y}
1	-15.000	-4.000	12.000	42.000	7.000	14.000
2	15.000	-4.000	42.000	12.000	7.000	14.000
3	-15.000	4.000	12.000	42.000	15.000	6.000
4	15.000	4.000	42.000	12.000	15.000	6.000



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8 Remarks; Your Cooperation Duties

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