DTFC -
DOUBLE-TEE FLEXIBLE CONNECTION FOR PARKING GARAGES

NORTHFORD STRUCTURAL CONNECTIONS

DTFC - Technical Supplement

NORTHFORD STRUCTURAL CONNECTIONS

PRODUCT DESCRIPTION

Double-Tee Flexible Connection for Parking Garages

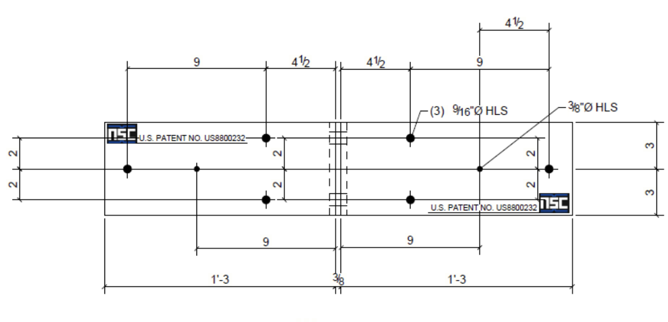
		Benefits

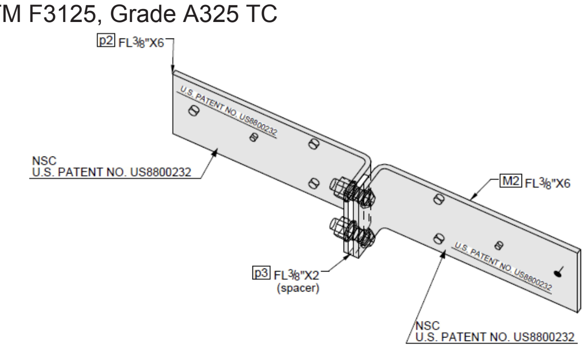
	DTFC	• Retrofit double-tee flange connection for replacement of existing connections
		• Eliminates welding and concrete repairs
		• Transmits seismic forces and vertical shear loads from vehicles while allowing expansion and contraction across the joint to reduce stress in the deck.
		• TC bolts are not subject to fatigue and eliminate failures of the connection
		• Erection anchors hold brackets in place overhead for safe and easy installation.
		
		• Anchorage of connection can be designed with Hilti PROFIS Engineering software for varying project conditions.
		• Recommended(1) and designed for anchorage with anchors(2):
		  ○ Hilti HIT-HY-200 V3 w/ 1/2" HAS-R-316 SS Threaded Rod
		    ▪ h_{nom} = 3-3/4-in.
		  ○ Hilti SS Kwik-X Dual Action Anchor 1/2"
		    ▪ h_{nom} = 3-in.

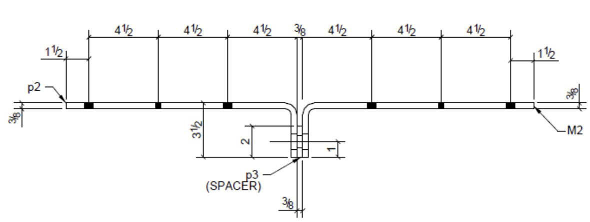
1 See Design of Anchorage section of this document for information on post-installed anchor design
2 System Load Capability is dependent upon anchorage and base-material, verify with Engineer of Record

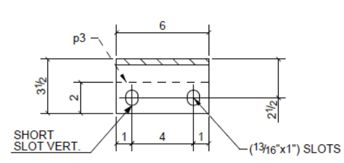
Materials

Part	Material/Mechanical properties or standard
Bracket Plate	ASTM A-240, Grade 304
Bracket Control Plate	ASTM A-240, Grade 304
Tension Control Botls	ASTM F3125, Grade A325 TC







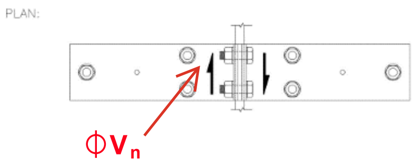


Information Regarding Load Data

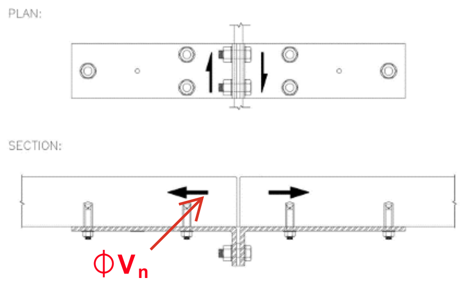
The following data tables are based on example anchorage design calculations where one side of the double-tee connection is considered (see "Design of Anchorage"). For the vertical/out-of-plane calculations, per PCI Design Handbook 7th Edition the vertical load is distributed between the two adjascent double-tees. Please reach out to Northford Structural Connections for additional information regarding the loading data and calculation methods used.

Example Loading Calculations

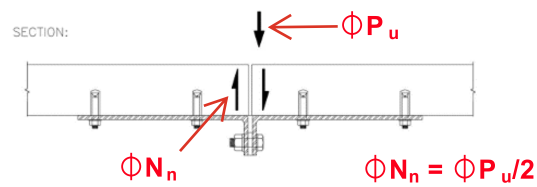
Shear



Shear and Tension



Out of Plane Loading (Vehicle Loading)



Concrete (5,000 psi)	Anchor System	Anchor Dimensions (diameter x embedment)(in. x in.)	Vertical/Out-of-Plane Shear Load (ϕNn) @ Max. Utilization (lbs)	Vertical/Out-of-Plane Load (ϕPn) @ Max. Utilization (lbs)
4.0"	HY 200 V3 w/HAS-R 316 SS	1/2 x 2 3/4	2425	4850
	SS Kwik-X	n/a	n/a	n/a
4.5"	HY 200 V3 w/HAS-R 316 SS	1/2 x 3 1/4	2850	5700
	SS Kwik-X	3/8 x 2 1/2	1825	3650
5.0"	HY 200 V3 w/HAS-R 316 SS	1/2 x 3 3/4	3300	6600
	SS Kwik-X	3/8 x 3 1/4	3500	7000
5.5"	HY 200 V3 w/HAS-R 316 SS	1/2 x 4 1/4	3750	7500
	SS Kwik-X	3/8 x 3 1/4	3500	7000
6"	HY 200 V3 w/HAS-R 316 SS	1/2 x 4 3/4	4175	8350
	SS Kwik-X	3/8 x 3 1/4	3500	7000

Anchor Failure Controlling

Concrete (5,000 psi)	Anchor System	Anchor Dimensions (diameter x embedment)(in. x in.)	Shear Load Parallel to Joint (ϕVn) @ Max. Utilization (lbs)		Simultanuous Shear due to joint: 1,500 lbs Shear Load[1] normal to joint — Shear Load (ϕVn) Parallel to Joint @ Max. Utilization (lbs)		Simultanuous Shear due to joint: -1,500 lbs Shear Load[1] normal to joint — Shear Load (ϕVn) Parallel to Joint @ Max. Utilization (lbs)	
Thickness			Rigid	CBFEM	Rigid	CBFEM	Rigid	CBFEM
4.0"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 2 3/4	2040	1625	1700	1375	2130	1300
4.5"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 3 1/4	2260	1900	1940	1685	2360	1925
5"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 3 3/4	2475	2155	2150	1975	2575	2300
5"	SS Kwik-X	3/8 x 3 1/4	2275	2535	1975	2250	2345	2945
5.5"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 4 1/4	2650	2400	2350	2225	2750	2635
5.5"	SS Kwik-X	3/8 x 3 1/4	2350	2600	2075	2335	2425	2945
6"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 4 3/4	2825	2625	2500	2450	2900	2865
6"	SS Kwik-X	3/8 x 3 1/4	2450	2675	2150	2425	2525	2945

Note 1: Positive shear indicates joint opening; negative shear indicates joint closing.

Concrete Failure Controlling

Concrete (5,000 psi)	Anchor System	Anchor Dimensions (diameter x embedment)(in. x in.)	Shear Load Parallel to Joint (ϕVn) @ Max. Utilization (lbs)		Simultanuous Shear due to joint: 1,500 lbs Shear Load[1] normal to joint — Shear Load (ϕVn) Parallel to Joint @ Max. Utilization (lbs)		Simultanuous Shear due to joint: -1,500 lbs Shear Load[1] normal to joint — Shear Load (ϕVn) Parallel to Joint @ Max. Utilization (lbs)	
Thickness			Rigid	CBFEM	Rigid	CBFEM	Rigid	CBFEM
4.0"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 2 3/4	2040	1625	1700	1375	2130	1300
4.5"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 3 1/4	2260	1900	1940	1685	2360	1925
5"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 3 3/4	2475	2155	2150	1850	2575	2300
5"	SS Kwik-X	3/8 x 3 1/4	2275	2075	1975	2100	2345	2845
5.5"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 4 1/4	2650	2275	2350	1875	2750	2635
5.5"	SS Kwik-X	3/8 x 3 1/4	2350	2100	2075	2160	2425	2845
6"	HY 200 V3 w/ HAS-R 316 SS	1/2 x 4 3/4	2825	2300	2500	1875	2900	2845
6"	SS Kwik-X	3/8 x 3 1/4	2450	2150	2150	2185	2525	2850

Note 1: Positive shear indicates joint opening; negative shear indicates joint closing.

Important Notes

The concrete deck to which the DTFC attaches must be in good sound condition. Any visible cracking, spalling, or other signs of deterioration or corrosion are unacceptable. Do not install DTFC within 6" of existing double-tee flange connections.

Design of anchorage

The design of the anchorage for the DTFC must be ensured for varying load conditions (i.e. varying directions, dynamic effects, etc.). The anchorage for the DTFC has to be designed according to extreme load cases: a concrete anchor can only be considered as suitable for use with the DTFC if the approved anchor satisfies the following load scenarios (e.g. by PROFIS calculation) based on post-installed anchor design provisions per ACI 318-19 Chapter 17 or CSA A23.3-14 Annex D.

The use of the recommended HIT-HY 200 V3 and Kwik-X anchor systems are based on the design assumptions noted below. In case of different design parameters, a new calculation should be performed.

Load conditions:
Load values from the above data tables are based on the anchorage design in PROFIS Engineering. Values are input as the total static load resulting in a max. utilization of 100% (see example calculation). PROFIS will only provide the design limit of the anchoring system, and strength and deflection limits for the brackets will be provided seperately through the results of laboratory testing

Design parameters per ACI 318-19 Chapter 17 or CSA A23.3-14 Annex D:

- Design Method: Strength Design ACI-318 19
- Cracked section of concrete
- Seismic design – Non seismic load
- Concrete strength: 5000 PSI
- Base material thickness – varies as per table
- Anchor Spacing & Plate Size – as per DTFC - Technical Supplement:

Recommended Hilti anchors (not provided):

- Hilti HIT-HY 200 V3 with 1/2" HAS-R-316 SS threaded rod at 3 3/4" nominal embedment
  - Design parameters from ICC-ES ESR-4868

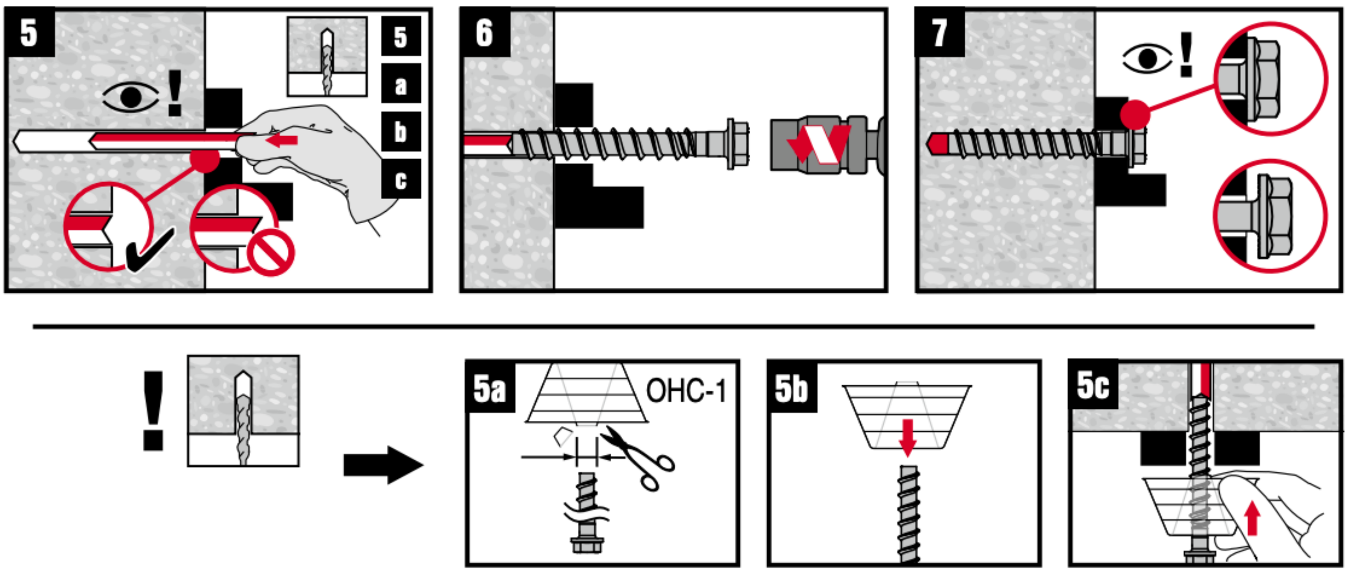
- Hilti SS Kwik-X Dual Action Anchor 3/8" diameter at 3" nominal embedment
  - 3/8" x 4" KH-EZ SS (element)
  - KHC 3/8" SMALL (adhesive capsule)
  - Design parameters from ICC-ES ESR-5065
- *Post-installed anchor selection based on base material geometry/ conditions

Setting instructions

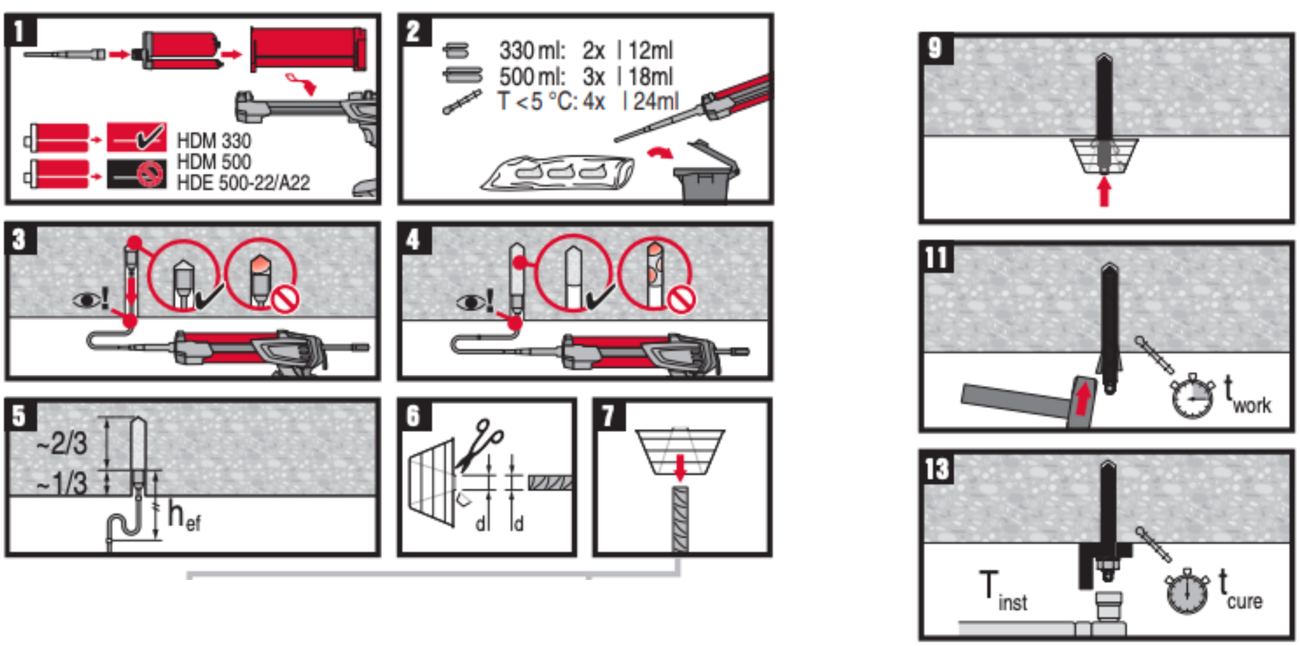
*For detailed information on Hilti HIT-HY 200V3 or Kwik-X installations see instruction for use included with the package of the product.

Setting Instructions Hilti Fasteners:

KWIK-X



Hilti HIT-HY 200-A/R V3



Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	SS DTFC HY200 5 - R S	Date:	1/20/2026
Fastening point:			

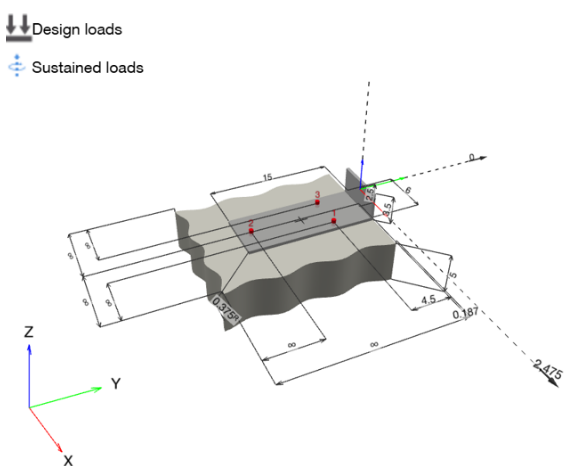
Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 V3 + HAS-R 304/316 SS 1/2**
Item number:	2045003 HAS-R 316 SS 1/2"x6 1/2" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Specification text:	Hilti ⌀ 1/2 in HIT-HY 200 V3 + HAS-R 304/316 SS with 3.75 in nominal embedment depth per ICC-ES ESR-4868 , Hammer drill bit installation per MPII
Effective embedment depth:	$h_{ef,act}$ = 3.750 in. ($h_{ef,limit}$ = - in.)
Material:	ASTM F 593
Evaluation Service Report:	ESR-4868
Issued I Valid:	11/1/2024 | 11/1/2026
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 in. (no stand-off); t = 0.375 in.
Ledger Angle^R :	L_1 x L_2 x t_{L1} x t_{L2} x l = 3.500 in. x 15.000 in. x 0.375 in. x 0.375 in. x 6.000 in.;
Load Point Height:	h_{pl} = 2.500 in.
Base material:	cracked concrete, 5000, f_c' = 5,000 psi; h = 5.000 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: none or < No. 4 bar

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

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



1.1 Design results

Case	Description	Forces [lb] / Moments [ft.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 0; V_x = 2,475; V_y = 0; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	100

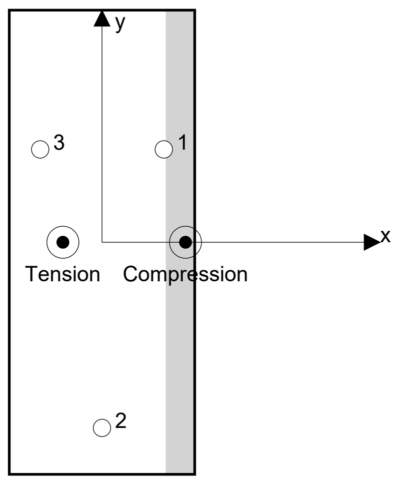
2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	26	1,798	1,701	-584
2	520	926	-926	0
3	1,013	1,798	1,701	584

Max. concrete compressive strain: 0.05 [‰]
Max. concrete compressive stress: 233 [psi]
Resulting tension force in (x/y)=(-1.266/0.000): 1,559 [lb]
Resulting compression force in (x/y)=(2.702/0.000): 1,559 [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*	1,013	9,223	11	OK
Bond Strength**	1,559	5,769	28	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	1,559	8,795	18	OK

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

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-4868

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.14	100,000

Calculations

N_{sa} [lb]
14,190

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
14,190	0.650	9,223	1,013

3.2 Bond Strength

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

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

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

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

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

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

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

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

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ 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]
2,379	0.500	3.750	4.500	1.000	1,216

$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	λ_a
1.266	0.000	10.287	1.000

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
7.320	352.11	214.35	0.884

$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	N_{ba} [lb]
0.853	1.000	1.000	7,166

Results

N_{ag} [lb]	ϕ_{bond}	$\phi\ N_{ag}$ [lb]	N_{ua} [lb]
8,876	0.650	5,769	1,559

3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$	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)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$	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

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
3.750	1.266	0.000	4.500	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
10.287	17	1.000	5,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
255.66	126.56	0.816	1.000	0.940	1.000	8,729

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
13,531	0.650	8,795	1,559

Company:		Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	SS DTFC HY200 5 - R S	Date:	1/20/2026
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	1,798	5,109	36	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)*	1,798	3,913	46	OK
Concrete edge failure in direction y+**	3,451	3,718	93	OK

* highest loaded anchor **anchor group (relevant anchors)
When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-4868
ϕ $V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.14	100,000

Calculations

V_{sa} [lb]
8,515

Results

V_{sa} [lb]	ϕ $_{steel}$	ϕ V_{sa} [lb]	V_{ua} [lb]
8,515	0.600	5,109	1,798

4.2 Pryout Strength (Bond Strength controls)

$V_{cp} = k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}\right]$ ACI 318-19 Eq. (17.7.3.1a)

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

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

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

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

$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e'_N}{c_{Na}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.5.3.1)

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

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

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

Variables

k_{cp}	$\alpha_{overhead}$	$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\tau_{k,c}$ [psi]
2	1.000	2,379	0.500	3.750	4.500	1,216

$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	λ_a
0.000	0.000	10.287	1.000

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
7.320	94.53	214.35	0.884

$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	N_{ba} [lb]
1.000	1.000	1.000	7,166

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
5,589	0.700	3,913	1,798

4.3 Concrete edge failure in direction y+

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-19 Eq. (17.7.2.1b)

$\phi\ V_{cbg} \geq V_{ua}$ 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)*

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

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{e_V'}{1.5c_{a1}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.3.1)

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

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

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
4.500	-	0.338	1.000	5.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
3.750	1.000	0.500	5,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
87.50	91.13	0.952	1.000	1.162	4,999

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
5,311	0.700	3,718	3,451

*Anchor row defined by: Anchor 1, 3; Case 3 controls

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.270	0.928	5/3	100	OK

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

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (EN1992-4, AS5216, 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 FEM 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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Company:		Page:	10
Address:		Specifier:	
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Design:	SS DTFC HY200 5 - R S	Date:	1/20/2026
Fastening point:			

7 Installation data

Hole diameter in the fixture: d_f = 0.562 in.

Plate thickness (input): 0.375 in.

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 V3 + HAS-R 304/316 SS 1/2

Item number: 2045003 HAS-R 316 SS 1/2"x6 1/2" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 30.000 ft.lb

Hole diameter in the base material: 0.562 in.

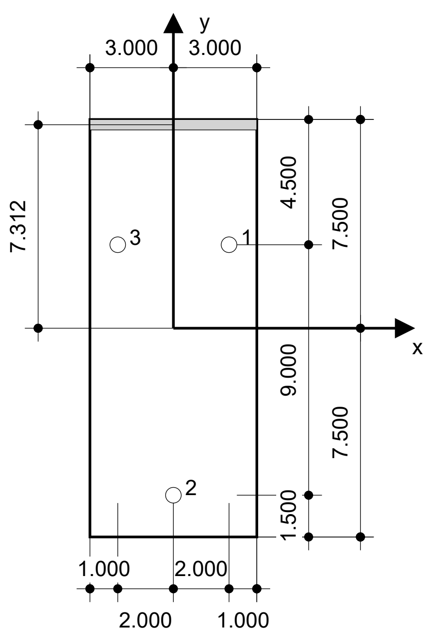
Hole depth in the base material: 3.750 in.

Minimum thickness of the base material: 5.000 in.

Hilti ∅ 1/2 in HIT-HY 200 V3 + HAS-R 304/316 SS with 3.75 in nominal embedment depth per ICC-ES ESR-4868 , Hammer drill bit installation per MPII

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush	• Dispenser including cassette and mixer • Torque wrench



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	2.000	3.000	-	-	-	4.500
2	-0.000	-6.000	-	-	-	13.500
3	-2.000	3.000	-	-	-	4.500

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

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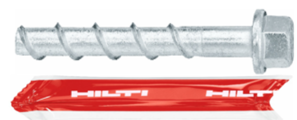
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Drafts_SS DTFC KWIKX 5- R S	Date:	1/20/2026
Fastening point:			

Specifier's comments:

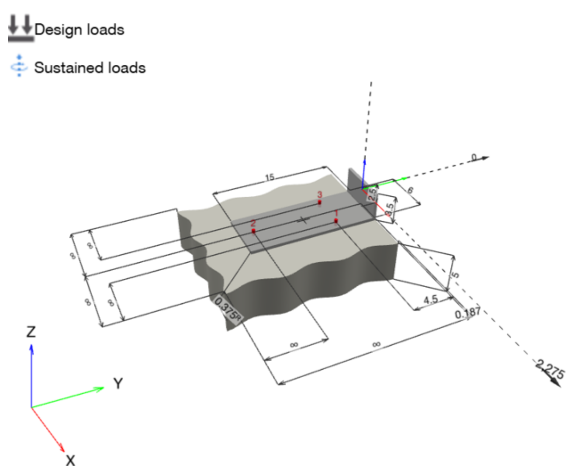
1 Input data



Anchor type and diameter:	**KWIK-X-SS316 3/8 (3) hnom2**
Item number:	2245627 KH-EZ SS316 3/8"x4" (element) / 2346659 KHC 3/8" LARGE (capsule)
Specification text:	Hilti ⌀ 3/8 in KWIK-X-SS316 with KH-EZ with KHC 3/8" LARGE with 3.25 in nominal embedment depth per ICC-ES ESR-5065, Hammer drill bit installation per MPII
Effective embedment depth:	$h_{ef,act}$ = 3.250 in. ($h_{ef,limit}$ = - in.), h_{nom} = 3.250 in.
Material:	AISI 316
Evaluation Service Report:	ESR-5065
Issued I Valid:	10/1/2025 | 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 in. (no stand-off); t = 0.375 in.
Ledger Angle[R] :	L_1 x L_2 x t_{L1} x t_{L2} x l = 3.500 in. x 15.000 in. x 0.375 in. x 0.375 in. x 6.000 in.;
Load Point Height:	h_{pl} = 2.500 in.
Base material:	cracked concrete, 5000, f_c' = 5,000 psi; h = 5.000 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: none or < No. 4 bar

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

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



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Design:	Drafts_SS DTFC KWIKX 5- R S	Date:	1/20/2026
Fastening point:			

1.1 Design results

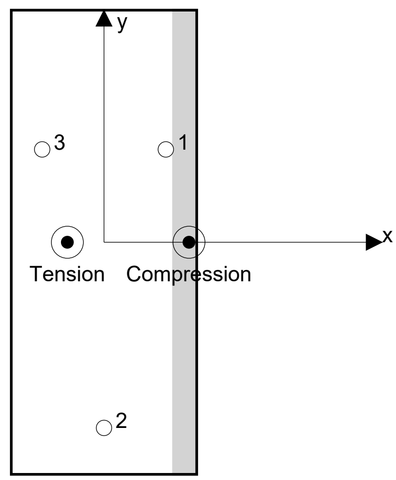
Case	Description	Forces [lb] / Moments [ft.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 0; V_x = 2,275; V_y = 0; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	100

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	53	1,653	1,563	-537
2	482	852	-852	0
3	910	1,653	1,563	537



Max. concrete compressive strain: 0.06 [‰]
Max. concrete compressive stress: 257 [psi]
Resulting tension force in (x/y)=(-1.186/0.000): 1,445 [lb]
Resulting compression force in (x/y)=(2.750/0.000): 1,445 [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*	910	9,821	10	OK
Bond Strength**	1,445	6,452	23	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	1,445	8,199	18	OK

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

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]
0.09	139,300

Calculations

N_{sa} [lb]
13,094

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
13,094	0.750	9,821	910

3.2 Bond Strength

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

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

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

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

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

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

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

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

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ 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]
2,304	0.375	3.250	4.500	1.000	1,594

$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	λ_a
1.186	0.000	8.652	1.000

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
5.403	243.87	116.76	0.950

$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	N_{ba} [lb]
0.820	1.000	1.000	6,101

Results

N_{ag} [lb]	ϕ_{bond}	$\phi\ N_{ag}$ [lb]	N_{ua} [lb]
9,926	0.650	6,452	1,445

3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ — 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	1.186	0.000	4.500	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
8.652	17	1.000	5,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
216.66	95.06	0.804	1.000	0.977	1.000	7,043

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
12,614	0.650	8,199	1,445

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	1,653	2,831	59	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)*	1,653	4,826	35	OK
Concrete edge failure in direction y+**	3,172	3,262	98	OK

* highest loaded anchor **anchor group (relevant anchors)
When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

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]
0.09	139,300

Calculations

V_{sa} [lb]
4,355

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
4,355	0.650	2,831	1,653

4.2 Pryout Strength (Bond Strength controls)

V_{cp}	$= k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right)\psi_{ed,Na}\,\psi_{cp,Na}\,N_{ba}\right]$	ACI 318-19 Eq. (17.7.3.1a)
$\phi\ V_{cp}$	$\geq V_{ua}$	ACI 318-19 Table 17.5.2
A_{Na}	see ACI 318-19, Section 17.6.5.1, Fig. R 17.6.5.1(b)	
A_{Na0}	$= (2\ c_{Na})^2$	ACI 318-19 Eq. (17.6.5.1.2a)
c_{Na}	$= 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$	ACI 318-19 Eq. (17.6.5.1.2b)
$\psi_{ec,Na}$	$= \left(\frac{1}{1 + \frac{e_N'}{c_{Na}}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.5.3.1)
$\psi_{ed,Na}$	$= 0.7 + 0.3\left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.5.4.1b)
$\psi_{cp,Na}$	$= \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.5.5.1b)
N_{ba}	$= \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$	ACI 318-19 Eq. (17.6.5.2.1)

Variables

k_{cp}	$\alpha_{overhead}$	$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\tau_{k,c}$ [psi]
2	1.000	2,304	0.375	3.250	4.500	1,594

$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	λ_a
0.000	0.000	8.652	1.000

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
5.403	69.46	116.76	0.950

$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	N_{ba} [lb]
1.000	1.000	1.000	6,101

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
6,895	0.700	4,826	1,653

4.3 Concrete edge failure in direction y+

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-19 Eq. (17.7.2.1b)

$\phi\ V_{cbg} \geq V_{ua}$ 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)*

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

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

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

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

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
4.500	-	0.338	1.000	5.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
3.000	1.000	0.375	5,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
87.50	91.13	0.952	1.000	1.162	4,386

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
4,659	0.700	3,262	3,172

*Anchor row defined by: Anchor 1, 3; Case 3 controls

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.224	0.973	1.000	100	OK

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

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (EN1992-4, AS5216, 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 FEM 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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Design:	Drafts_SS DTFC KWIKX 5- R S	Date:	1/20/2026
Fastening point:			

7 Installation data

Hole diameter in the fixture: d_f = 0.500 in.

Plate thickness (input): 0.375 in.

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: KWIK-X-SS316 3/8 (3) hnom2

Item number: 2245627 KH-EZ SS316 3/8"x4" (element) / 2346659 KHC 3/8" LARGE (capsule)

Maximum installation torque: -

Hole diameter in the base material: 0.375 in.

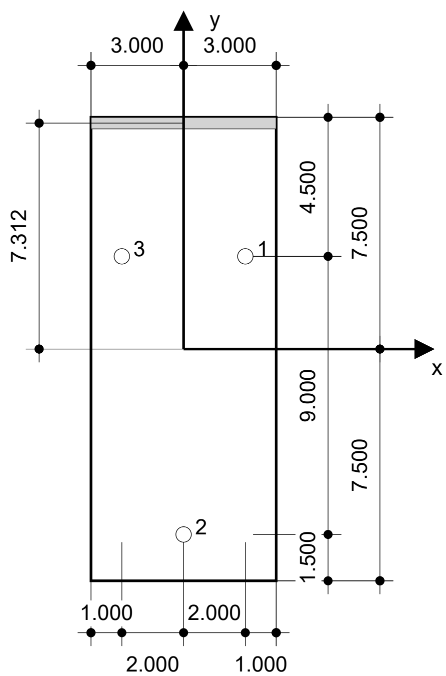
Hole depth in the base material: 3.625 in.

Minimum thickness of the base material: 4.875 in.

Hilti ∅ 3/8 in KWIK-X-SS316 with KH-EZ with KHC 3/8" LARGE with 3.25 in nominal embedment depth per ICC-ES ESR-5065, Hammer drill bit installation per MPII

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Compressed air with required accessories to blow from the bottom of the hole	• SIW 6-A22 Impact Screw Driver



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	2.000	3.000	-	-	-	4.500
2	-0.000	-6.000	-	-	-	13.500
3	-2.000	3.000	-	-	-	4.500

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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