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Phone I Fax:	|	E-Mail:	
Design:	Concrete - Nov 14, 2022	Date:	11/15/2022
Fastening point:			

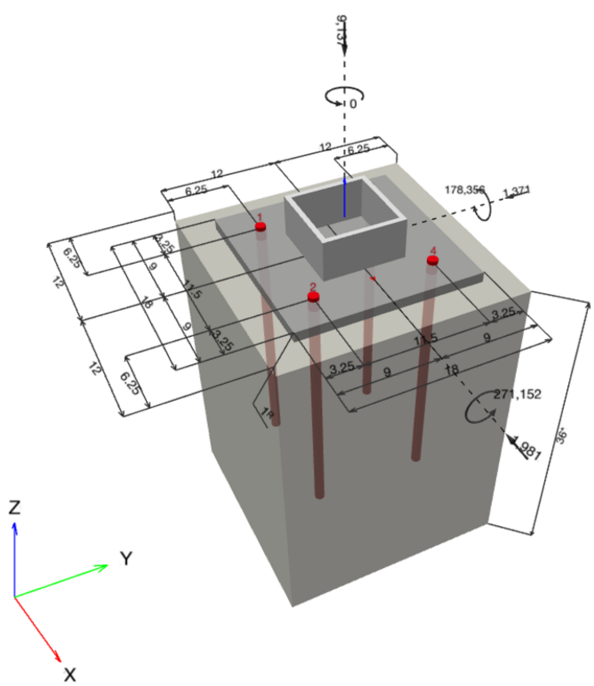
Specifier's comments:

1 Input data

Anchor type and diameter:	**Heavy Hex Head ASTM F 1554 GR. 55 1**
Item number:	not available
Effective embedment depth:	h_{ef} = 25.000 in.
Material:	ASTM F 1554
Evaluation Service Report:	Hilti Technical Data
Issued I Valid:	- | -
Proof:	Design Method ACI 318-19 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 1.000 in.
Anchor plate[R] :	l_x x l_y x t = 18.000 in. x 18.000 in. x 1.000 in.; (Recommended plate thickness: not calculated)
Profile:	Square HSS (AISC), HSS8X8X.500; (L x W x T) = 8.000 in. x 8.000 in. x 0.500 in.
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 36.000 in.
Reinforcement:	tension: not present, shear: not present;
	edge reinforcement: none or < No. 4 bar

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

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



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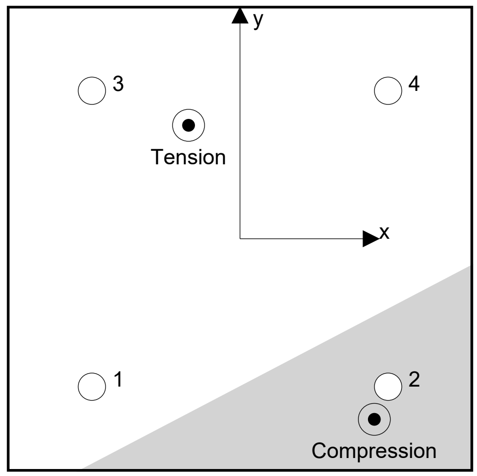
1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = -9,137; V_x = -1,981; V_y = -1,371; M_x = 271,152; M_y = 178,356; M_z = 0;	no	112

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	2,114	602	-495	-343
2	0	602	-495	-343
3	10,093	602	-495	-343
4	5,913	602	-495	-343

max. concrete compressive strain:	0.31 [‰]
max. concrete compressive stress:	1,362 [psi]
resulting tension force in (x/y)=(-1.997/4.408):	18,120 [lb]
resulting compression force in (x/y)=(5.216/-7.017):	27,257 [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*	10,093	34,087	30	OK
Pullout Strength*	10,093	33,622	31	OK
Concrete Breakout Failure**	18,120	18,116	101	not recommended
Concrete Side-Face Blowout, direction y+**	16,006	70,873	23	OK

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

3.1 Steel Strength

$N_{sa} = A_{se,N}\, f_{uta}$ ACI 318-19 Eq. (17.6.1.2)

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

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.61	75,000

Calculations

N_{sa} [lb]
45,450

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
45,450	0.750	34,087	10,093

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-19 Eq. (17.6.3.1)

$N_p = 8\, A_{brg}\, f'_c$ ACI 318-19 Eq. (17.6.3.2.2a)

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

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	λ_a	f'_c [psi]
1.000	1.50	1.000	4,000

Calculations

N_p [lb]
48,032

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
48,032	0.700	33,622	10,093

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.]	$\psi_{c,N}$
4.167	0.081	2.492	6.250	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
-	24	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
443.75	156.25	0.987	0.715	1.000	1.000	12,910

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
25,879	0.700	18,116	18,120

3.4 Concrete Side-Face Blowout, direction y+

$N_{sb} = 160\ c_{a1} \sqrt{A_{brg}}\ \lambda_a \sqrt{f'_c}$ ACI 318-19 Eq. (17.6.4.1)

$N_{sbg} = \alpha_{group} N_{sb}$ ACI 318-19 Eq. (17.6.4.2)

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

$\alpha_{group} = \left(1 + \frac{s}{6\ c_{a1}}\right)$ see ACI 318-19, Section 17.6.4.2, Eq. (17.6.4.2)

Variables

c_{a1} [in.]	c_{a2} [in.]	A_{brg} [in.^{2}]	λ_a	f'_c [psi]	s [in.]
6.250	6.250	1.50	1.000	4,000	11.500

Calculations

α_{group}	N_{sb} [lb]
1.307	77,485

Results

N_{sbg} [lb]	$\phi_{concrete}$	$\phi\ N_{sbg}$ [lb]	$N_{ua,edge}$ [lb]
101,248	0.700	70,873	16,006

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	602	17,725	4	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	2,409	66,628	4	OK
Concrete edge failure in direction y-**	2,409	7,172	34	OK

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

4.1 Steel Strength

$V_{sa} = 0.6\ A_{se,V}\ f_{uta}$	ACI 318-19 Eq. (17.7.1.2b)
$\phi\ V_{steel} \geq V_{ua}$	ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.61	75,000

Calculations

V_{sa} [lb]
27,270

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
27,270	0.650	17,725	602

4.2 Pryout Strength

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

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	4.167	0.000	0.000	6.250

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	∞	24	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
576.00	156.25	1.000	1.000	1.000	1.000	12,910

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
95,182	0.700	66,628	2,409

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)

$V_b = 9\ \lambda_a\ \sqrt{f_c'}\ c_{a1}^{1.5}$ 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.]
6.250	6.250	0.000	1.000	36.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
8.000	1.000	1.000	4,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
225.00	175.78	1.000	0.900	1.000	8,894

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
10,246	0.700	7,172	2,409

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
1.000	0.336	1.000	112	not recommended

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

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (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.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/

Fastening does not meet the design criteria!

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7 Installation data

Profile: Square HSS (AISC), HSS8X8X.500; (L x W x T) = 8.000 in. x 8.000 in. x 0.500 in.

Hole diameter in the fixture: d_f = 1.062 in.

Plate thickness (input): 1.000 in.

Recommended plate thickness: not calculated

Anchor type and diameter: Heavy Hex Head ASTM F 1554 GR. 55 1

Item number: not available

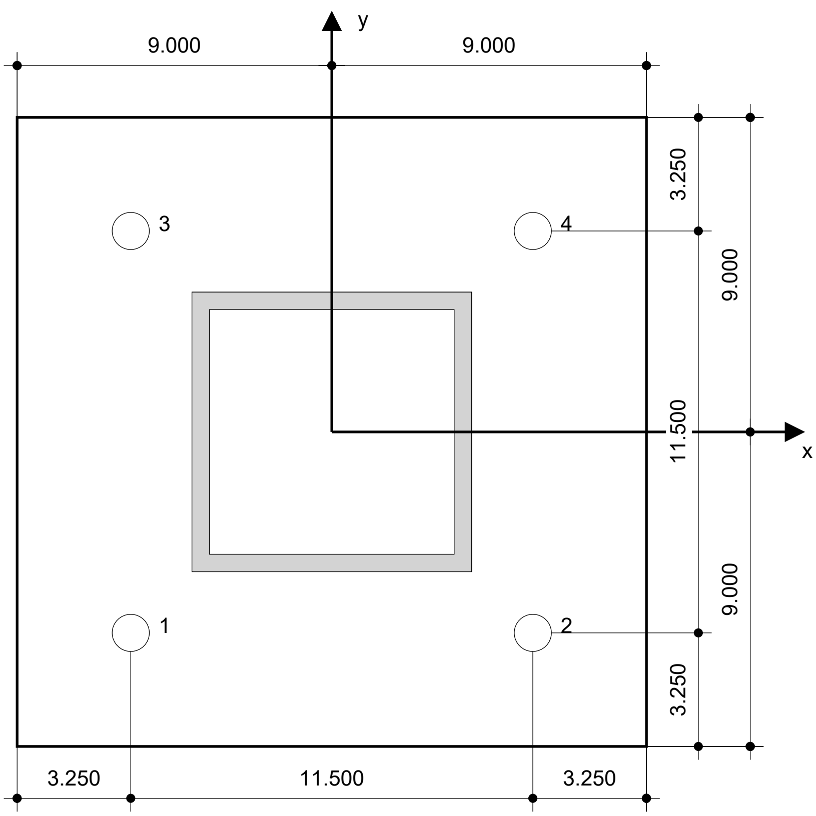
Maximum installation torque: -

Hole diameter in the base material: - in.

Hole depth in the base material: 25.000 in.

Minimum thickness of the base material: 26.172 in.

Hilti Heavy Hex Head headed stud anchor with 25 in embedment, 1, Steel galvanized, installation per instruction for use



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-5.750	-5.750	6.250	17.750	6.250	17.750
2	5.750	-5.750	17.750	6.250	6.250	17.750
3	-5.750	5.750	6.250	17.750	17.750	6.250
4	5.750	5.750	17.750	6.250	17.750	6.250

8 Remarks; Your Cooperation Duties

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