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Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Dec 3, 2024	Date:	12/3/2024
Fastening point:			

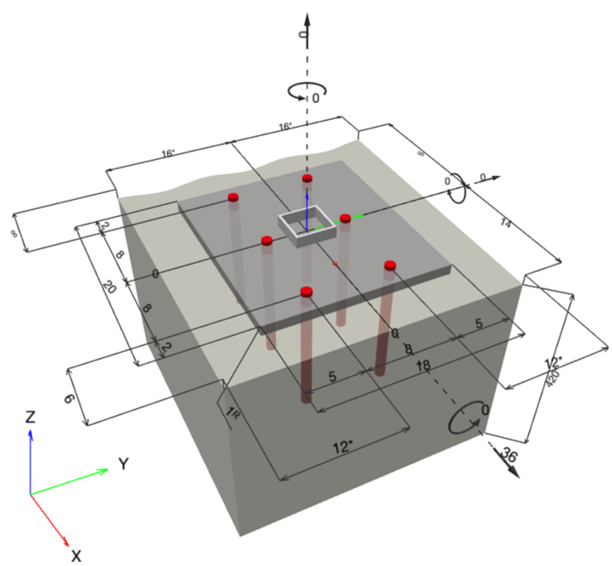
Specifier's comments:

1 Input data

Anchor type and diameter:	**Heavy Hex Head ASTM F 1554 GR. 36 1**
Item number:	not available
Specification text:	Hilti Heavy Hex Head headed stud anchor with 12 in embedment, 1, Steel galvanized, installation per instruction for use
Effective embedment depth:	h_{ef} = 12.000 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 = 20.000 in. x 18.000 in. x 1.000 in.; (Recommended plate thickness: not calculated)
Profile:	Square HSS (AISC), HSS4X4X.25; (L x W x T) = 4.000 in. x 4.000 in. x 0.250 in.
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 420.000 in.
Reinforcement:	tension: not present, shear: present;
	edge reinforcement: > No. 4 bar

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

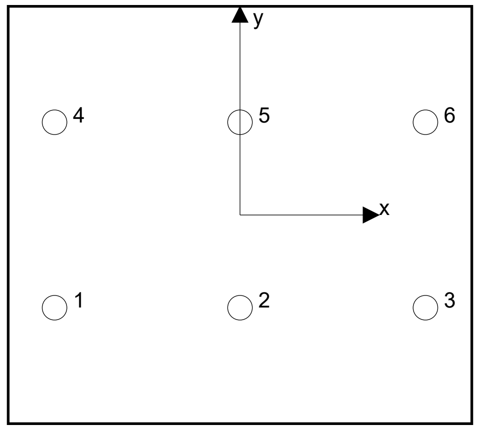
Geometry [in.] & Loading [kip, ft.kip]



1.1 Design results

Case	Description	Forces [kip] / Moments [ft.kip]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 0.000; V_x = 36.000; V_y = 0.000; M_x = 0.00000; M_y = 0.00000; M_z = 0.00000;	no	332

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	6.000	6.000	0.000
2	0.000	6.000	6.000	0.000
3	0.000	6.000	6.000	0.000
4	0.000	6.000	6.000	0.000
5	0.000	6.000	6.000	0.000
6	0.000	6.000	6.000	0.000

Max. concrete compressive strain: - [‰]
Max. concrete compressive stress: - [psi]
Resulting tension force in (x/y)=(-/-): 0.000 [kip]
Resulting compression force in (x/y)=(-/-): 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
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

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4 Shear load

	Load V_{ua} [kip]	Capacity ϕ V_n [kip]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	6.000	13.708	44	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	36.000	77.202	47	OK
Concrete edge failure in direction x+**	36.000	10.875	332	not recommended

* 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

$V_{sa} = 0.6\ A_{se,V}\ f_{uta}$	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	58,000

Calculations

V_{sa} [kip]
21.089

Results

V_{sa} [kip]	ϕ_{steel}	ϕ V_{sa} [kip]	V_{ua} [kip]
21.089	0.650	13.708	6.000

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)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ 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

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	8.000	0.000	0.000	6.000

$\psi_{c,N}$	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 [kip]
1,088.00	576.00	1.000	1.000	0.850	1.000	34.346

Results

V_{cpg} [kip]	$\phi_{concrete}$	$\phi \ V_{cpg}$ [kip]	V_{ua} [kip]
110.289	0.700	77.202	36.000

4.3 Concrete edge failure in direction x+

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$	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.]
6.000	12.000	0.000	1.200	420.000

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 [kip]
234.00	162.00	1.000	1.000	1.000	8.366

Results

V_{cbg} [kip]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [kip]	V_{ua} [kip]
14.500	0.750	10.875	36.000

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

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.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/

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Fastening does not meet the design criteria!

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6 Installation data

Profile: Square HSS (AISC), HSS4X4X.25; (L x W x T) = 4.000 in. x 4.000 in. x 0.250 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. 36 1

Item number: not available

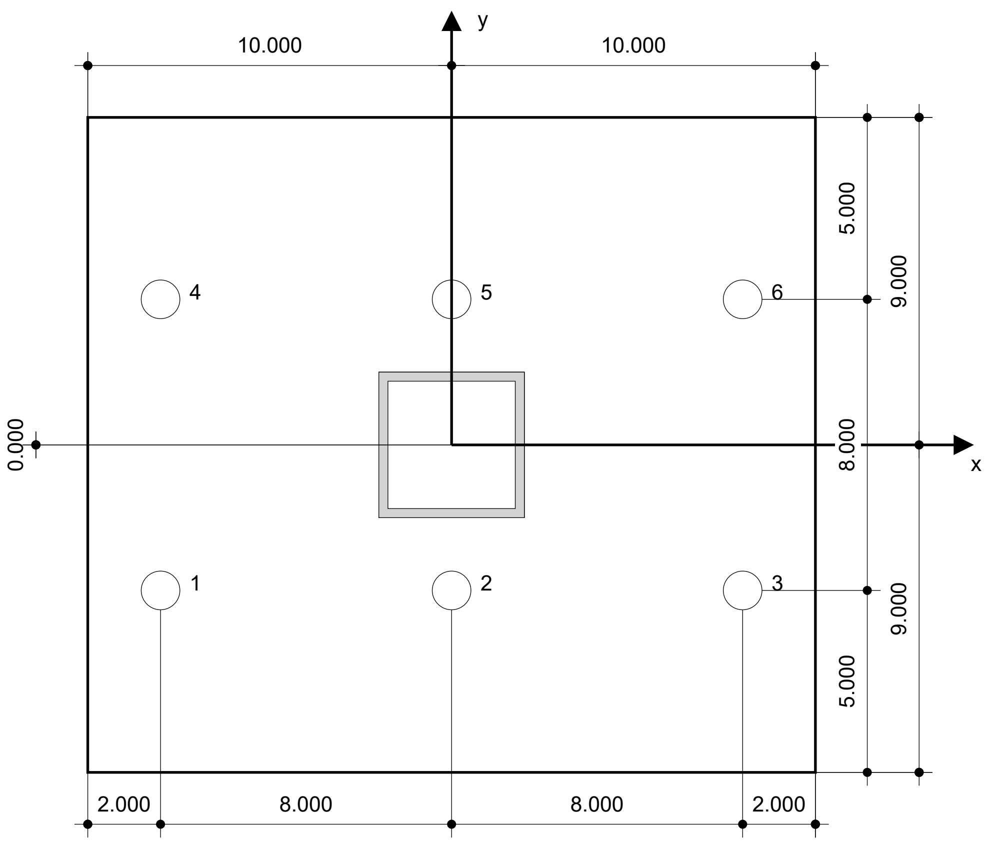
Maximum installation torque: -

Hole diameter in the base material: - in.

Hole depth in the base material: 12.000 in.

Minimum thickness of the base material: 13.172 in.

Hilti Heavy Hex Head headed stud anchor with 12 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	-8.000	-4.000	-	22.000	12.000	20.000
2	0.000	-4.000	-	14.000	12.000	20.000
3	8.000	-4.000	-	6.000	12.000	20.000
4	-8.000	4.000	-	22.000	20.000	12.000
5	0.000	4.000	-	14.000	20.000	12.000
6	8.000	4.000	-	6.000	20.000	12.000

7 Remarks; Your Cooperation Duties

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