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Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Apr 8, 2026	Date:	4/8/2026
Fastening point:			

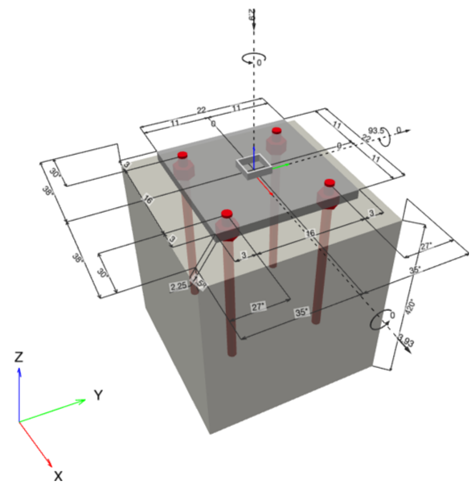
Specifier's comments:

1 Input data

Anchor type and diameter:	**Heavy Hex Head ASTM F 1554 GR. 36 1 1/2**
Item number:	not available
Specification text:	∅ 1 1/2 IN HEAVY HEX HEAD ASTM F 1554 GR. 36 WITH 25 IN NOMINAL EMBEDMENT DEPTH PER TECHNICAL DATA , CAST IN PLACE INSTALLATION PER MPII
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 318-08 / CIP
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-11 Appendix D Fig. RD.6.2.1(b))
Stand-off installation:	without clamping (anchor); restraint level (anchor plate): 1.00; e_b = 2.250 in.; t = 1.500 in.
Anchor plate[R] :	l_x x l_y x t = 22.000 in. x 22.000 in. x 1.500 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: condition A, shear: condition A;
	edge reinforcement: > No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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

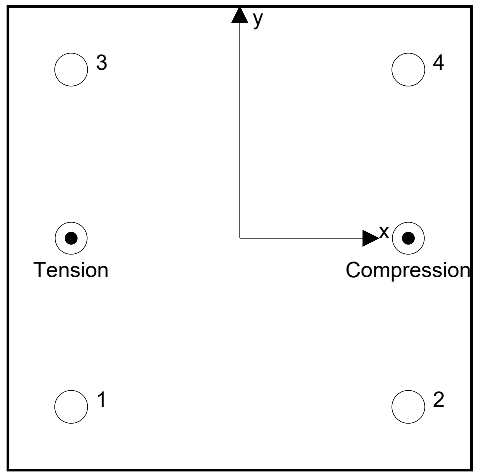
Geometry [in.] & Loading [kip, ft.kip]



1.1 Design results

Case	Description	Forces [kip] / Moments [ft.kip]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = -2.900; V_x = 3.930; V_y = 0.000; M_x = 0.00000; M_y = 93.50000; M_z = 0.00000;	no	120

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	34.338	0.983	0.983	0.000
2	-35.787	0.983	0.983	0.000
3	34.338	0.983	0.983	0.000
4	-35.787	0.983	0.983	0.000

Max. concrete compressive strain:	- [‰]
Max. concrete compressive stress:	- [psi]
Resulting tension force in (x/y)=(-8.000/0.000):	68.675 [kip]
Resulting compression force in (x/y)=(8.000/0.000):	71.575 [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*	-35.787	61.335	59	OK
Pullout Strength*	34.338	69.843	50	OK
Concrete Breakout Failure**	68.675	126.565	55	OK
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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3.1 Steel Strength

$N_{sa} = A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1.41	58,000

Calculations

N_{sa} [kip]
81.780

Results

N_{sa} [kip]	ϕ_{steel}	$\phi\ N_{sa}$ [kip]	N_{ua} [kip]
81.780	0.750	61.335	-35.787

The steel proof was done for the highest absolute force per anchor - in this case compression loading. Please note that the user is responsible for the buckling check in case of compression loading !!

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)

$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)

$\phi\ N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.000	3.12	4,000

Calculations

N_p [kip]
99.776

Results

N_{pn} [kip]	$\phi_{concrete}$	$\phi\ N_{pn}$ [kip]	N_{ua} [kip]
99.776	0.700	69.843	34.338

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = 16\ \lambda\ \sqrt{f'_c}\ h_{ef}^{5/3}$ ACI 318-08 Eq. (D-8)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
20.000	0.000	0.000	27.000	1.000

c_{ac} [in.]	k_c	λ	f'_c [psi]
-	16	1	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]
4,200.00	3,600.00	1.000	1.000	0.970	1.000	149.119

Results

N_{cbg} [kip]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [kip]	N_{ua} [kip]
168.753	0.750	126.565	68.675

4 Shear load

	Load V_{ua} [kip]	Capacity ϕV_n [kip]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	0.983	25.515	4	OK
Steel failure (with lever arm)*	0.983	1.134	87	OK
Pryout Strength**	3.930	299.255	2	OK
Concrete edge failure in direction x+**	3.930	83.187	5	OK

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

4.1 Steel Strength

$V_{sa} = 0.6\, A_{se,V}\, f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\, V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1.41	58,000

Calculations

V_{sa} [kip]
49.068

Results

V_{sa} [kip]	ϕ_{steel}	$\phi\, V_{sa}$ [kip]	V_{ua} [kip]
49.068	0.650	25.515	0.983

4.2 Steel failure (with lever arm)

V_s^M	$= \frac{\alpha_M \cdot M_s}{L_b}$	bending equation for stand-off
M_s	$= M_s^0 \left(1 - \frac{N_{ua}}{\phi\, N_{sa}}\right)$	resultant flexural resistance of anchor
M_s^0	$= (1.2)\ (S)\ (f_{u,min})$	characteristic flexural resistance of anchor
$\left(1 - \frac{N_{ua}}{\phi\, N_{sa}}\right)$		reduction for tensile force acting simultaneously with a shear force on the anchor
S	$= \frac{\pi(d)^3}{32}$	elastic section modulus of anchor bolt at concrete surface
L_b	$= z + (n)(d_0)$	internal lever arm adjusted for spalling of the surface concrete
$\phi\, V_s^M$	$\geq V_{ua}$	ACI 318-08 Eq. (D-2)

Variables

α_M	$f_{u,min}$ [psi]	N_{ua} [kip]	$\phi\, N_{sa}$ [kip]	z [in.]	n	d_0 [in.]
1.00	58,000	-35.787	61.335	3.000	0.500	1.500

Calculations

M_s^0 [ft.kip]	$\left(1 - \frac{N_{ua}}{\phi\, N_{sa}}\right)$	M_s [ft.kip]	L_b [in.]
1.30845	0.417	0.54500	3.750

Results

V_s^M [kip]	ϕ steel	$\phi\, V_s^M$ [kip]	V_{ua} [kip]
1.744	0.650	1.134	0.983

4.3 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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = 16\ \lambda\ \sqrt{f'_c}\ h_{ef}^{5/3}$ ACI 318-08 Eq. (D-8)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	20.000	0.000	0.000	27.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f'_c [psi]
1.000	-	16	1	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]
5,320.00	3,600.00	1.000	1.000	0.970	1.000	149.119

Results

V_{cpg} [kip]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [kip]	V_{ua} [kip]
427.508	0.700	299.255	3.930

4.4 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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ — ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)*

$A_{Vc0} = 4.5\ c_{a1}^2$ — ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_v'}{3c_{a1}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda\ \sqrt{f_c'}\ c_{a1}^{1.5}$ — ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
30.000	27.000	0.000	1.200	420.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
12.000	1.000	1.500	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]
3,150.00	4,050.00	1.000	0.880	1.000	135.043

Results

V_{cbg} [kip]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [kip]	V_{ua} [kip]
110.916	0.750	83.187	3.930

*Anchor row defined by: Anchor 2, 4; Case 3 controls

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.583	0.867	5/3	120	not recommended

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

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.
- ACI 318 does not specifically address anchor bending when a stand-off condition exists. PROFIS Engineering calculates a shear load corresponding to anchor bending when stand-off exists and includes the results as a shear Design Strength!
- 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&/
- Attention! In case of compressive anchor forces a buckling check as well as the proof of the local load transfer into and within the base material (incl. punching) has to be done separately.

Fastening does not meet the design criteria!

7 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 = 1.562 in.

Plate thickness (input): 1.500 in.

Recommended plate thickness: not calculated

Anchor type and diameter: Heavy Hex Head ASTM F 1554 GR. 36 1 1/2

Item number: not available

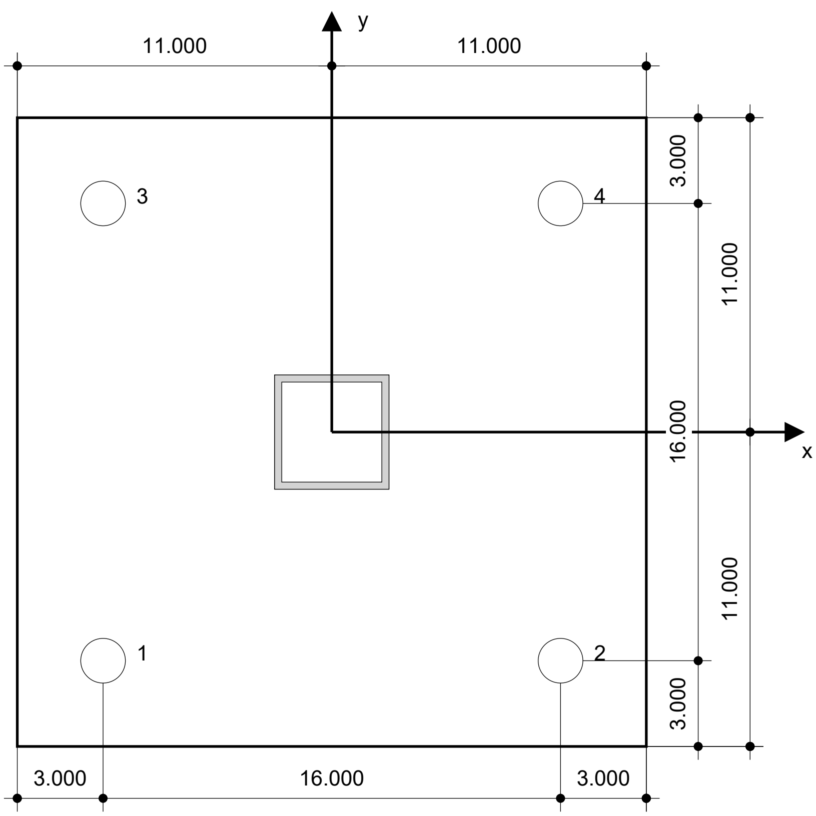
Maximum installation torque: -

Hole diameter in the base material: - in.

Hole depth in the base material: 25.000 in.

Minimum thickness of the base material: 26.500 in.

∅ 1 1/2 in Heavy Hex Head ASTM F 1554 GR. 36 with 25 in nominal embedment depth per Technical data , cast in place installation per MPII



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-8.000	-8.000	30.000	46.000	27.000	43.000
2	8.000	-8.000	46.000	30.000	27.000	43.000
3	-8.000	8.000	30.000	46.000	43.000	27.000
4	8.000	8.000	46.000	30.000	43.000	27.000

8 Remarks; Your Cooperation Duties

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