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Phone Fax:		E-Mail:	
Design:	Copy - Concrete - Sep 30, 2022	Date:	9/30/2022
Fastening point:			

1.1 Design results

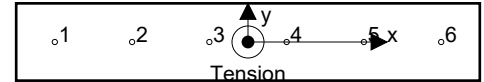
Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 22,800; $V_x = 0$; $V_y = 22,800$; $M_x = 0$; $M_y = 0$; $M_z = 0$;	no	174

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	3,800	3,800	0	3,800
2	3,800	3,800	0	3,800
3	3,800	3,800	0	3,800
4	3,800	3,800	0	3,800
5	3,800	3,800	0	3,800
6	3,800	3,800	0	3,800



max. concrete compressive strain: - [%]
 max. concrete compressive stress: - [psi]
 resulting tension force in (x/y)=(0.000/0.000): 22,800 [lb]
 resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	3,800	21,547	18	OK
Pullout Strength*	3,800	17,584	22	OK
Concrete Breakout Failure**	22,800	40,916	56	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 318-11 Eq. (D-2)
 $\phi N_{sa} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$A_{se,N}$ [in. ²]	f_{uta} [psi]
0.44	65,000

Calculations

N_{sa} [lb]
28,730

Results

N_{sa} [lb]	ϕ_{steel}	ϕN_{sa} [lb]	N_{ua} [lb]
28,730	0.750	21,547	3,800

3.2 Pullout Strength

$N_{pN} = \psi_{c,p} N_p$ ACI 318-11 Eq. (D-13)
 $N_p = 8 A_{brg} f'_c$ ACI 318-11 Eq. (D-14)
 $\phi N_{pN} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$\psi_{c,p}$	A_{brg} [in. ²]	λ_a	f'_c [psi]
1.000	0.79	1.000	4,000

Calculations

N_p [lb]
25,120

Results

N_{pn} [lb]	$\phi_{concrete}$	ϕN_{pn} [lb]	N_{ua} [lb]
25,120	0.700	17,584	3,800



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3.3 Concrete Breakout Failure

$$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \quad \text{ACI 318-11 Eq. (D-4)}$$

$$\phi N_{cbg} \geq N_{ua} \quad \text{ACI 318-11 Table D.4.1.1}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-11 Eq. (D-5)}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-8)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-10)}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-12)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-11 Eq. (D-6)}$$

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
5.907	0.000	0.000	6.000	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]
932.65	314.03	1.000	1.000	0.903	1.000	21,792

Results

N_{cbg} [lb]	$\phi_{concrete}$	ϕN_{cbg} [lb]	N_{ua} [lb]
58,451	0.700	40,916	22,800



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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*	3,800	18,674	21	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	22,800	81,832	28	OK
Concrete edge failure in direction x-**	22,800	14,898	154	not recommended

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

4.1 Steel Strength

$V_{sa} = A_{se,V} f_{uta}$ ACI 318-11 Eq. (D-28)
 $\phi V_{steel} \geq V_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$A_{se,V}$ [in. ²]	f_{uta} [psi]
0.44	65,000

Calculations

V_{sa} [lb]
28,730

Results

V_{sa} [lb]	ϕ_{steel}	ϕV_{sa} [lb]	V_{ua} [lb]
28,730	0.650	18,674	3,800



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4.2 Pryout Strength

$$V_{cp,g} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \right] \quad \text{ACI 318-11 Eq. (D-41)}$$

$$\phi V_{cp,g} \geq V_{ua} \quad \text{ACI 318-11 Table D.4.1.1}$$

A_{Nc} see ACI 318-11, Part D.5.2.1, Fig. RD.5.2.1(b)

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-11 Eq. (D-5)}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-8)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-10)}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-12)}$$

$$N_b = k_c \lambda_a \sqrt{f_c} h_{ef}^{1.5} \quad \text{ACI 318-11 Eq. (D-6)}$$

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	5.907	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 [lb]
932.65	314.03	1.000	1.000	0.903	1.000	21,792

Results

$V_{cp,g}$ [lb]	$\phi_{concrete}$	$\phi V_{cp,g}$ [lb]	V_{ua} [lb]
116,903	0.700	81,832	22,800

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4.3 Concrete edge failure in direction x-

$$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-11 Eq. (D-30)}$$

$$\phi V_{cb} \geq V_{ua} \quad \text{ACI 318-11 Table D.4.1.1}$$

$$A_{Vc} \text{ see ACI 318-11, Part D.6.2.1, Fig. RD.6.2.1(b)}$$

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-11 Eq. (D-32)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left(\frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-38)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-11 Eq. (D-39)}$$

$$V_b = 9 \lambda_a \sqrt{f'_c} c_{a1}^{1.5} \quad \text{ACI 318-11 Eq. (D-34)}$$

Variables

c_{a1} [in.]	c_{a2} [in.]	$\Psi_{c,V}$	h_a [in.]	l_e [in.]
11.145	6.000	1.400	16.718	5.907
λ_a	d_a [in.]	f'_c [psi]	$\Psi_{parallel,V}$	
1.000	0.750	4,000	2.000	

Calculations

A_{Vc} [in. ²]	A_{Vc0} [in. ²]	$\Psi_{ed,V}$	$\Psi_{h,V}$	V_b [lb]
200.62	558.98	1.000	1.000	21,179

Results

V_{cb} [lb]	$\phi_{concrete}$	ϕV_{cb} [lb]	V_{ua} [lb]
21,283	0.700	14,898	22,800

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.557	1.530	1.000	174	not recommended

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



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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!
- 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: Rectangular plates and bars (AISC), 12 - 5/16; (L x W x T) = 12.000 in. x 0.312 in.

Hole diameter in the fixture: $d_f = 0.812$ in.

Plate thickness (input): 0.282 in.

Recommended plate thickness: not calculated

Anchor type and diameter: AWS D1.1 GR. B 3/4

Item number: not available

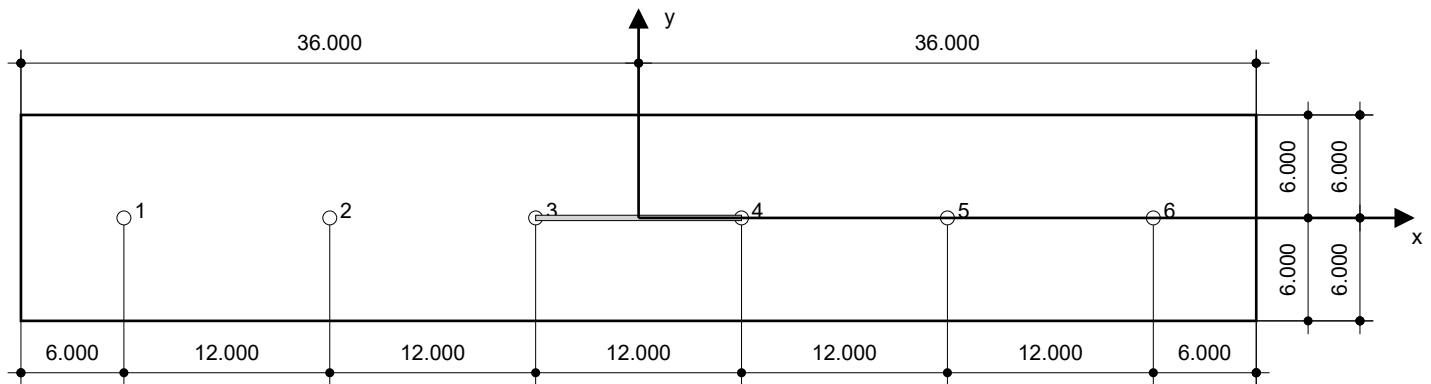
Maximum installation torque: -

Hole diameter in the base material: - in.

Hole depth in the base material: 5.907 in.

Minimum thickness of the base material: 6.782 in.

Hilti AWS welded headed stud anchor with 5.907 in embedment, 3/4, Steel galvanized, installation per instruction for use



Coordinates Anchor [in.]

Anchor	x	y	c _{-x}	c _{+x}	c _{-y}	c _{+y}	Anchor	x	y	c _{-x}	c _{+x}	c _{-y}	c _{+y}
1	-30.000	-0.000	12.000	72.000	6.000	6.000	4	6.000	-0.000	48.000	36.000	6.000	6.000
2	-18.000	-0.000	24.000	60.000	6.000	6.000	5	18.000	-0.000	60.000	24.000	6.000	6.000
3	-6.000	-0.000	36.000	48.000	6.000	6.000	6	30.000	-0.000	72.000	12.000	6.000	6.000

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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8 Remarks; Your Cooperation Duties

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