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Design:	Drafts_3 4 dia 12.5 embed 20 edge	Date:	4/4/2023
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**1.1 Design results**

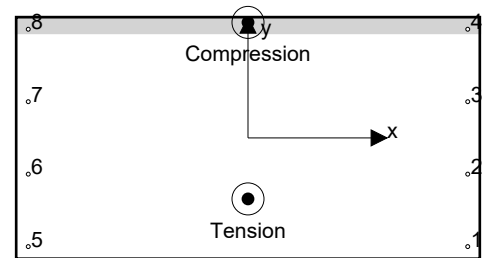
Case	Description	Forces [kip] / Moments [ft.kip]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = -11.700; V <sub>x</sub> = 0.000; V <sub>y</sub> = 24.900; M <sub>x</sub> = -144.40000; M <sub>y</sub> = 0.00000; M <sub>z</sub> = 0.00000; N <sub>sus</sub> = 0.000; M <sub>x,sus</sub> = 0.00000; M <sub>y,sus</sub> = 0.00000;	yes	65

**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	10.024	3.113	0.000	3.113
2	6.626	3.113	0.000	3.113
3	3.228	3.113	0.000	3.113
4	0.000	3.113	0.000	3.113
5	10.024	3.113	0.000	3.113
6	6.626	3.113	0.000	3.113
7	3.228	3.113	0.000	3.113
8	0.000	3.113	0.000	3.113



max. concrete compressive strain: 0.08 [%]  
 max. concrete compressive stress: 0.330 [ksi]  
 resulting tension force in (x/y)=(0.000/-12.628): 39.758 [kip]  
 resulting compression force in (x/y)=(0.000/23.917): 51.458 [kip]

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

**3 Tension load**

	Load N <sub>ua</sub> [kip]	Capacity $\phi N_n$ [kip]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	10.024	30.108	34	not recommended
Bond Strength**	39.758	100.663	40	not recommended <sup>A</sup>
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	39.758	101.352	40	not recommended <sup>A</sup>

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

<sup>A</sup> When 17.2.3.4.3 (a) is selected for seismic design, the design steel strength must be the governing design strength having the highest utilization.



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### 3.1 Steel Strength

$N_{sa}$  = ESR value refer to ICC-ES ESR-4868  
 $\phi N_{sa} \geq N_{ua}$  ACI 318-14 Table 17.3.1.1

#### Variables

$A_{se,N}$ [in. <sup>2</sup> ]	$f_{uta}$ [ksi]
0.33	75.000

#### Calculations

$N_{sa}$ [kip]
25.090

#### Results

$N_{sa}$ [kip]	$\phi_{steel}$	$\phi N_{sa}$ [kip]	$N_{ua}$ [kip]
25.090	1.200	30.108	10.024



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### 3.2 Bond Strength

$$N_{ag} = \left( \frac{A_{Na}}{A_{Na0}} \right) \Psi_{ec1,Na} \Psi_{ec2,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} \quad \text{ACI 318-14 Eq. (17.4.5.1b)}$$

$$\phi N_{ag} \geq N_{ua} \quad \text{ACI 318-14 Table 17.3.1.1}$$

$A_{Na}$  see ACI 318-14, Section 17.4.5.1, Fig. R 17.4.5.1(b)

$$A_{Na0} = (2 c_{Na})^2 \quad \text{ACI 318-14 Eq. (17.4.5.1c)}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{1100}} \quad \text{ACI 318-14 Eq. (17.4.5.1d)}$$

$$\Psi_{ec,Na} = \left( \frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.5.3)}$$

$$\Psi_{ed,Na} = 0.7 + 0.3 \left( \frac{c_{a,min}}{c_{Na}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.5.4b)}$$

$$\Psi_{cp,Na} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.5.5b)}$$

$$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \alpha_{N,seis} \cdot \pi \cdot d_a \cdot h_{ef} \quad \text{ACI 318-14 Eq. (17.4.5.2)}$$

#### Variables

$\tau_{k,c,uncr}$ [ksi]	$d_a$ [in.]	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [ksi]
2.327	0.750	10.000	19.500	1.000	1.321
$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{ac}$ [in.]	$\lambda_a$	$\alpha_{N,seis}$	
0.000	5.128	23.049	1.000	1.000	

#### Calculations

$c_{Na}$ [in.]	$A_{Na}$ [in. <sup>2</sup> ]	$A_{Na0}$ [in. <sup>2</sup> ]	$\Psi_{ed,Na}$
10.859	2,246.37	471.66	1.000
$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$	$N_{ba}$ [kip]
1.000	0.679	1.000	31.117

#### Results

$N_{ag}$ [kip]	$\phi_{bond}$	$\phi_{seismic}$	$\phi N_{ag}$ [kip]	$N_{ua}$ [kip]
100.663	1.000	1.000	100.663	39.758



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**3.3 Concrete Breakout Failure**

$$N_{cbg} = \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \quad \text{ACI 318-14 Eq. (17.4.2.1b)}$$

$$\phi N_{cbg} \geq N_{ua} \quad \text{ACI 318-14 Table 17.3.1.1}$$

$$A_{Nc} \text{ see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-14 Eq. (17.4.2.1c)}$$

$$\psi_{ec,N} = \left( \frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.4)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.5b)}$$

$$\psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.7b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-14 Eq. (17.4.2.2a)}$$

**Variables**

$h_{ef}$ [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
10.000	0.000	5.128	19.500	1.000
$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psij]	
23.049	17	1.000	4,000	

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	$N_b$ [kip]
3,600.00	900.00	1.000	0.745	1.000	1.000	34.000

**Results**

$N_{cbg}$ [kip]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi N_{cbg}$ [kip]	$N_{ua}$ [kip]
101.352	1.000	1.000	101.352	39.758



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## 4 Shear load

	Load $V_{ua}$ [kip]	Capacity $\phi V_n$ [kip]	Utilization $\beta_v = V_{ua} / \phi V_n$	Status
Steel Strength*	3.113	9.786	32	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	24.900	238.000	11	OK
Concrete edge failure in direction y+**	24.900	41.019	61	OK

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

### 4.1 Steel Strength

$V_{sa,eq}$  = ESR value      refer to ICC-ES ESR-4868  
 $\phi V_{steel} \geq V_{ua}$       ACI 318-14 Table 17.3.1.1

#### Variables

$A_{se,V}$ [in. <sup>2</sup> ]	$f_{uta}$ [ksi]	$\alpha_{v,seis}$
0.33	75.000	1.000

#### Calculations

$V_{sa,eq}$ [kip]
15.055

#### Results

$V_{sa,eq}$ [kip]	$\phi_{steel}$	$\phi V_{sa,eq}$ [kip]	$V_{ua}$ [kip]
15.055	0.650	9.786	3.113



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**4.2 Pryout Strength (Concrete Breakout Strength controls)**

$$V_{cp,g} = k_{cp} \left[ \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \right] \quad \text{ACI 318-14 Eq. (17.5.3.1b)}$$

$$\phi V_{cp,g} \geq V_{ua} \quad \text{ACI 318-14 Table 17.3.1.1}$$

$A_{Nc}$  see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-14 Eq. (17.4.2.1c)}$$

$$\psi_{ec,N} = \left( \frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.4)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.5b)}$$

$$\psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.7b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-14 Eq. (17.4.2.2a)}$$

**Variables**

$k_{cp}$	$h_{ef}$ [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	10.000	0.000	0.000	19.500
$\psi_{c,N}$	$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psi]
1.000	23.049	17	1.000	4,000

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	$N_b$ [kip]
4,500.00	900.00	1.000	1.000	1.000	1.000	34.000

**Results**

$V_{cp,g}$ [kip]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cp,g}$ [kip]	$V_{ua}$ [kip]
340.000	0.700	1.000	1.000	238.000	24.900

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**4.3 Concrete edge failure in direction y+**

$$V_{cbg} = \left( \frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-14 Eq. (17.5.2.1b)}$$

$$\phi V_{cbg} \geq V_{ua} \quad \text{ACI 318-14 Table 17.3.1.1}$$

 $A_{Vc}$  see ACI 318-14, Section 17.5.2.1, Fig. R 17.5.2.1(b)

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-14 Eq. (17.5.2.1c)}$$

$$\Psi_{ec,V} = \left( \frac{1}{1 + \frac{2e_v}{3c_{a1}}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.5.2.5)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left( \frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.5.2.6b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-14 Eq. (17.5.2.8)}$$

$$V_b = 9 \lambda_a \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-14 Eq. (17.5.2.2b)}$$

**Variables**

$c_{a1}$ [in.]	$c_{a2}$ [in.]	$e_{cV}$ [in.]	$\Psi_{c,V}$	$h_a$ [in.]
19.500	20.000	0.000	1.000	18.000
$l_e$ [in.]	$\lambda_a$	$d_a$ [in.]	$f_c$ [psi]	$\Psi_{parallel,V}$
6.000	1.000	0.750	4,000	1.000

**Calculations**

$A_{Vc}$ [in. <sup>2</sup> ]	$A_{Vc0}$ [in. <sup>2</sup> ]	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{h,V}$	$V_b$ [kip]
1,773.00	1,711.12	1.000	0.905	1.275	49.014

**Results**

$V_{cbg}$ [kip]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cbg}$ [kip]	$V_{ua}$ [kip]
58.599	0.700	1.000	1.000	41.019	24.900

**5 Combined tension and shear loads**

$\beta_N$	$\beta_V$	$\zeta$	Utilization $\beta_{NV}$ [%]	Status
0.395	0.607	5/3	65	OK

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



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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.
- 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://submittals.us.hilti.com/PROFISAnchorDesignGuide/>
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-14, Chapter 17, Section 17.2.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.2.3.4.3 (b), Section 17.2.3.4.3 (c), or Section 17.2.3.4.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.2.3.5.3 (a), Section 17.2.3.5.3 (b), or Section 17.2.3.5.3 (c).
- Section 17.2.3.4.3 (b) / Section 17.2.3.5.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.2.3.4.3 (c) / Section 17.2.3.5.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.2.3.4.3 (d) / Section 17.2.3.5.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by  $\omega_0$ .
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-14, Section 17.8.1.

**Fastening does not meet the design criteria!**

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## 7 Installation data

Profile: no profile

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

Plate thickness (input): 1.000 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-E-55 (ASTM F1554 Gr.55) 3/4

Item number: 2198001 HAS-E-55 3/4"x12" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 0.10000 ft.kip

Hole diameter in the base material: 0.875 in.

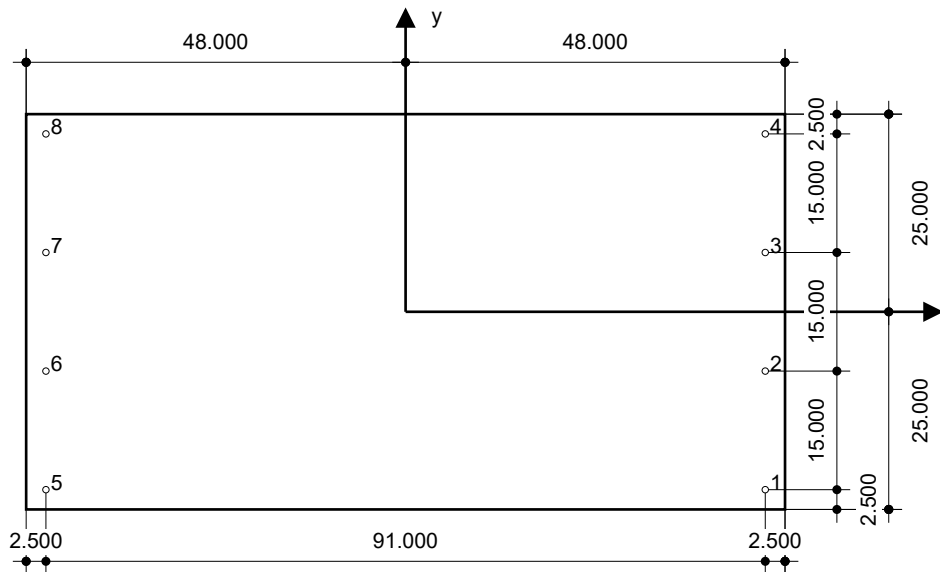
Hole depth in the base material: 10.000 in.

Minimum thickness of the base material: 11.750 in.

3/4 Hilti HAS Carbon steel threaded rod with Hilti HIT-HY 200 V3 Safe Set System

### 7.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> <li>Suitable Rotary Hammer</li> <li>Properly sized drill bit</li> </ul>	<ul style="list-style-type: none"> <li>Compressed air with required accessories to blow from the bottom of the hole</li> <li>Proper diameter wire brush</li> </ul>	<ul style="list-style-type: none"> <li>Dispenser including cassette and mixer</li> <li>Torque wrench</li> </ul>



Coordinates Anchor [in.]

Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>	Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>
1	45.500	-22.500	111.000	20.000	19.500	64.500	5	-45.500	-22.500	20.000	111.000	19.500	64.500
2	45.500	-7.500	111.000	20.000	34.500	49.500	6	-45.500	-7.500	20.000	111.000	34.500	49.500
3	45.500	7.500	111.000	20.000	49.500	34.500	7	-45.500	7.500	20.000	111.000	49.500	34.500
4	45.500	22.500	111.000	20.000	64.500	19.500	8	-45.500	22.500	20.000	111.000	64.500	19.500

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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