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Specifier's comments:

## 1 Input data

### Anchor type and diameter:

HIT-HY 200 + HAS-R 304/316 SS 5/8

Item number:

not available (element) / 2022791 HIT-HY 200-A (adhesive)

Effective embedment depth:

$h_{ef,act} = 12.000$  in. ( $h_{ef,limit} = -$  in.)

Material:

ASTM F 593

Evaluation Service Report:

ESR-3187

Issued | Valid:

5/1/2021 | 3/1/2022

Proof:

Design Method ACI 318-14 / Chem

Stand-off installation:

$e_b = 0.000$  in. (no stand-off);  $t = 0.875$  in.

Anchor plate<sup>R</sup>:

$l_x \times l_y \times t = 13.000$  in. x  $13.000$  in. x  $0.875$  in.;

Profile:

Square HSS (AISC), HSS8X8X.250; (L x W x T) =  $8.000$  in. x  $8.000$  in. x  $0.250$  in.

Base material:

cracked concrete,  $4000$ ,  $f'_c = 4,000$  psi;  $h = 36.000$  in., Temp. short/long:  $32/32$  °F

### Installation:

**hammer drilled hole, Installation condition: Dry**

Reinforcement:

tension: condition B, shear: condition B; no supplemental splitting reinforcement present

Seismic loads (cat. C, D, E, or F)

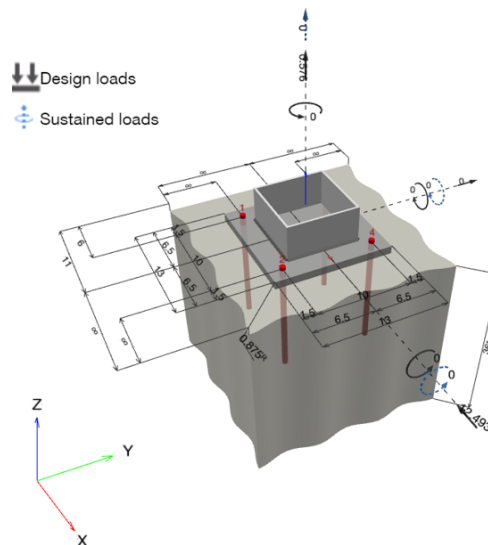
Tension load: yes (17.2.3.4.3 (d))

Shear load: yes (17.2.3.5.3 (c))



<sup>R</sup> - The anchor calculation is based on a rigid anchor plate assumption.

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



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### 1.1 Design results

Case	Description	Forces [kip] / Moments [in.kip]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 0.576; V <sub>x</sub> = -12.493; V <sub>y</sub> = 0.000; M <sub>x</sub> = 0.000000; M <sub>y</sub> = 0.000000; M <sub>z</sub> = 0.000000; N <sub>sus</sub> = 0.000; M <sub>x,sus</sub> = 0.000000; M <sub>y,sus</sub> = 0.000000;	yes	148

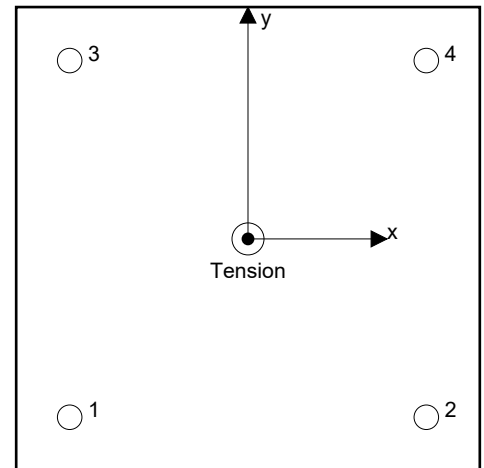
## 2 Load case/Resulting anchor forces

### Anchor reactions [kip]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.144	3.123	-3.123	0.000
2	0.144	3.123	-3.123	0.000
3	0.144	3.123	-3.123	0.000
4	0.144	3.123	-3.123	0.000

max. concrete compressive strain: - [%]  
max. concrete compressive stress: - [psi]  
resulting tension force in (x/y)=(0.000/0.000): 0.576 [kip]  
resulting compression force in (x/y)=(0.000/0.000): 0.000 [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*	0.144	14.690	1	OK
Bond Strength**	0.576	26.937	3	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	0.576	21.035	3	OK

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



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### 3.1 Steel Strength

$N_{sa}$  = ESR value refer to ICC-ES ESR-3187  
 $\phi N_{sa} \geq N_{ua}$  ACI 318-14 Table 17.3.1.1

#### Variables

$A_{se,N}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]
0.23	100,000

#### Calculations

$N_{sa}$ [kip]
22.600

#### Results

$N_{sa}$ [kip]	$\phi_{steel}$	$\phi_{nonductile}$	$\phi N_{sa}$ [kip]	$N_{ua}$ [kip]
22.600	0.650	1.000	14.690	0.144

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### 3.2 Bond Strength

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

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

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

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

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

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

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

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

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

#### Variables

$\tau_{k,c,uncr}$ [psi]	$d_a$ [in.]	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [psi]
2,327	0.625	12.000	6.000	1.000	1,226
$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{ac}$ [in.]	$\lambda_a$	$\alpha_{N,seis}$	
0.000	0.000	22.194	1.000	0.990	

#### Calculations

$c_{Na}$ [in.]	$A_{Na}$ [in. <sup>2</sup> ]	$A_{Na0}$ [in. <sup>2</sup> ]	$\psi_{ed,Na}$
9.049	703.83	327.54	0.899
$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	$N_{ba}$ [kip]
1.000	1.000	1.000	28.605

#### Results

$N_{ag}$ [kip]	$\phi_{bond}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi N_{ag}$ [kip]	$N_{ua}$ [kip]
55.254	0.650	0.750	1.000	26.937	0.576

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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.]	$\psi_{c,N}$
12.000	0.000	0.000	6.000	1.000
$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f_c$ [psi]	
22.194	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]
1,564.00	1,296.00	1.000	1.000	0.800	1.000	44.694

#### Results

$N_{cbg}$ [kip]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi N_{cbg}$ [kip]	$N_{ua}$ [kip]
43.149	0.650	0.750	1.000	21.035	0.576



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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*	3.123	5.695	55	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	12.493	60.409	21	OK
Concrete edge failure in direction x-**	12.493	8.490	148	not recommended

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

#### 4.1 Steel Strength

$V_{sa,eq}$  = ESR value      refer to ICC-ES ESR-3187  
 $\phi V_{steel} \geq V_{ua}$       ACI 318-14 Table 17.3.1.1

#### Variables

$A_{se,V}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]	$\alpha_{V,seis}$
0.23	100,000	0.700

#### Calculations

$V_{sa,eq}$ [kip]
9.492

#### Results

$V_{sa,eq}$ [kip]	$\phi_{steel}$	$\phi_{nonductile}$	$\phi V_{sa,eq}$ [kip]	$V_{ua}$ [kip]
9.492	0.600	1.000	5.695	3.123

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

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

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

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

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

$$\psi_{ec,N} = \left( \frac{1}{1 + \frac{2 e_{c1,N}}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.4)}$$

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

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

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

#### Variables

$k_{cp}$	$h_{ef}$ [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	12.000	0.000	0.000	6.000
$\psi_{c,N}$	$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psi]
1.000	22.194	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]
1,564.00	1,296.00	1.000	1.000	0.800	1.000	44.694

#### Results

$V_{cp}$ [kip]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cp}$ [kip]	$V_{ua}$ [kip]
86.298	0.700	1.000	1.000	60.409	12.493

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#### 4.3 Concrete edge failure in direction x-

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

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

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

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

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

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

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

$$V_b = \left( 7 \left( \frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f'_c} c_{a1}^{1.5} \quad \text{ACI 318-14 Eq. (17.5.2.2a)}$$

#### Variables

$c_{a1}$ [in.]	$c_{a2}$ [in.]	$e_{cV}$ [in.]	$\psi_{c,V}$	$h_a$ [in.]
6.000	-	0.000	1.000	36.000
$l_e$ [in.]	$\lambda_a$	$d_a$ [in.]	$f'_c$ [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	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]
252.00	162.00	1.000	1.000	1.000	7.797

#### Results

$V_{cbg}$ [kip]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cbg}$ [kip]	$V_{ua}$ [kip]
12.128	0.700	1.000	1.000	8.490	12.493

#### 5 Combined tension and shear loads

$\beta_N$	$\beta_V$	$\zeta$	Utilization $\beta_{N,V}$ [%]	Status
0.027	1.472	1.000	125	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!
- User is responsible for evaluating the hole bearing capacity in case of shear forces.
- 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 Anchor plate and concrete bearing stress check

	Load	Capacity	Utilization [%]	Status
Concentric Compression	N/A	N/A	N/A	N/A
Concrete bearing	N/A	N/A	N/A	N/A
Tension Interface	72.00 [in.lb/in.]	8,613.28 [in.lb/in.]	1	OK
Uniaxial Moment (Strong Axis)	N/A	N/A	N/A	N/A
Uniaxial Moment (Weak Axis)	N/A	N/A	N/A	N/A

### 7.1 Plate bending, tension (per AISC DG1, sections 3.2, 3.3)

$$m = \frac{N - 0.95d}{2}$$

$$n = \frac{B - 0.95b_f}{2}$$

$$M_{pl} = \frac{T_u \cdot x}{b_{eff}}$$

$$\phi M_n = \phi \cdot F_y \cdot \frac{t_p^2}{4}$$

$$M_{pl} \leq \phi M_n$$

#### Variables

B [in.]	N [in.]	d [in.]	b <sub>f</sub> [in.]	F <sub>y</sub> [psi]
13.000	13.000	8.000	8.000	50,000
φ	t <sub>p</sub> [in.]	P <sub>u</sub> [kip]	M <sub>u</sub> [in.kip]	
0.900	0.875	0.576	0.000000	

#### Calculations

m [in.]	n [in.]	
2.700	2.700	
T <sub>u</sub> [kip]	x [in.]	b <sub>eff</sub> [in.]
0.144	1.200	2.400

#### Results

M <sub>n</sub> [in.lb/in.]	φ	φ M <sub>n</sub> [in.lb/in.]	M <sub>pl</sub> [in.lb/in.]
9,570.32	0.900	8,613.28	72.00

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## 8 Installation data

Profile: Square HSS (AISC), HSS8X8X.250; (L x W x T) = 8.000 in. x 8.000 in. x 0.250 in.

Hole diameter in the fixture:  $d_f = 0.687$  in.

Plate thickness (input): 0.875 in.

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 + HAS-R 304/316  
SS 5/8

Item number: not available (element) / 2022791 HIT-HY 200-A (adhesive)

Maximum installation torque: 0.720001 in.kip

Hole diameter in the base material: 0.750 in.

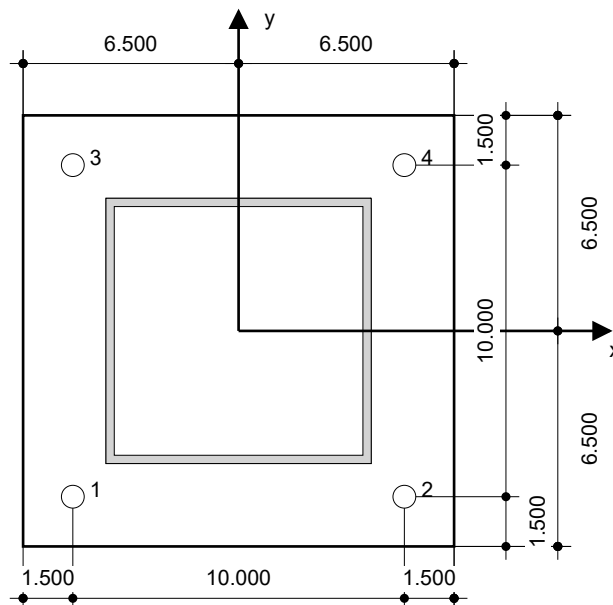
Hole depth in the base material: 12.000 in.

Minimum thickness of the base material: 13.500 in.

5/8 Hilti HAS Stainless steel threaded rod with Hilti HIT-HY 200 Safe Set System

### 8.1 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>
1	-5.000	-5.000	6.000	-	-	-
2	5.000	-5.000	16.000	-	-	-
3	-5.000	5.000	6.000	-	-	-
4	5.000	5.000	16.000	-	-	-



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## 9 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.