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Company:	GES	Page:	0
Address:	4640 E. Elwood St, Ste 5	Specifier:	richard finch
Phone   Fax:	8882701636	E-Mail:	rfinch@gesonline.com
Design:	Concrete - Feb 26, 2022	Date:	3/1/2022
Fastening point:	As skid, Revised axial load, 170 kin		

**Specifier's comments:** 4Hilti Optimized anchor, optimized base plate. 5/8 inch anchorGen Anchor Depth, optimized edge spacing of 22 inch

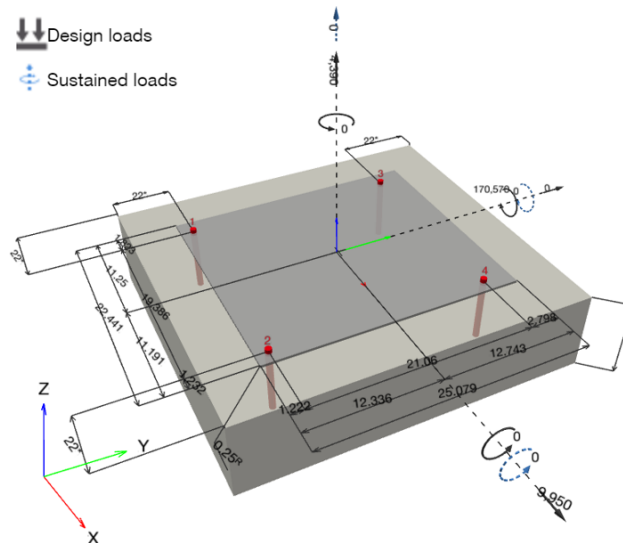
## 1 Input data



<b>Anchor type and diameter:</b>	<b>HIT-HY 200 + HAS-B-105 (ASTM F1554 Gr.105) 5/8</b>
Item number:	2197969 HAS-B-105 5/8"x8" (element) / 2022791 HIT-HY 200-A (adhesive)
Effective embedment depth:	$h_{ef,opti} = 6.235$ in. ( $h_{ef,limit} = 6.500$ in.)
Material:	ASTM F1554 Grade 105
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); $t = 0.250$ in.
Anchor plate <sup>R</sup> :	$l_x \times l_y \times t = 22.441$ in. x $25.079$ in. x $0.250$ in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 4000, $f'_c = 4,000$ psi; $h = 8.000$ in., Temp. short/long: 40/50 °F
<b>Installation:</b>	<b>hammer drilled hole, Installation condition: Dry</b>
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
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 [lb, in.lb]



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Company:	GES	Page:	1
Address:	4640 E. Elwood St, Ste 5	Specifier:	richard finch
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**1.1 Design results**

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 4,390; V <sub>x</sub> = 9,950; V <sub>y</sub> = 0; M <sub>x</sub> = 0; M <sub>y</sub> = 170,570; M <sub>z</sub> = 0; N <sub>sus</sub> = 0; M <sub>x,sus</sub> = 0; M <sub>y,sus</sub> = 0;	yes	100

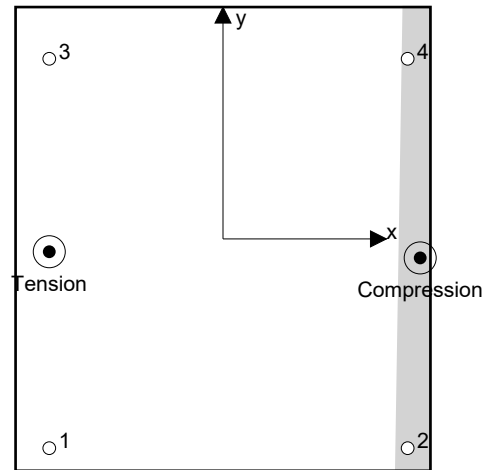
**2 Load case/Resulting anchor forces**

**Anchor reactions [lb]**

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	5,365	2,414	2,413	69
2	0	2,414	2,413	-69
3	5,463	2,563	2,562	69
4	0	2,563	2,562	-69

max. concrete compressive strain: 0.08 [‰]  
 max. concrete compressive stress: 350 [psi]  
 resulting tension force in (x/y)=(-9.397/-0.693): 10,828 [lb]  
 resulting compression force in (x/y)=(10.668/-1.028): 6,438 [lb]



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

**3 Tension load**

	Load N <sub>ua</sub> [lb]	Capacity $\phi N_n$ [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	5,463	21,187	26	OK
Bond Strength**	10,828	14,342	76	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	10,828	16,158	68	OK

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



# Hilti PROFIS Engineering 3.0.75

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Page: 2  
 Specifier: richard finch  
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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	125,000

#### Calculations

$N_{sa}$ [lb]
28,250

#### Results

$N_{sa}$ [lb]	$\phi_{steel}$	$\phi N_{sa}$ [lb]	$N_{ua}$ [lb]
28,250	0.750	21,187	5,463



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Company:	GES	Page:	3
Address:	4640 E. Elwood St, Ste 5	Specifier:	richard finch
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Design:	Concrete - Feb 26, 2022	Date:	3/1/2022
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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**

$\tau_{k,c,uncr}$ [psi]	$d_a$ [in.]	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [psi]
2,327	0.625	6.235	22.000	1.000	1,226
$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{ac}$ [in.]	$\lambda_a$	$\alpha_{N,seis}$	
0.000	0.095	16.831	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	655.08	327.54	1.000
$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$	$N_{ba}$ [lb]
1.000	0.990	1.000	14,863

**Results**

$N_{ag}$ [lb]	$\phi_{bond}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi N_{ag}$ [lb]	$N_{ua}$ [lb]
29,419	0.650	0.750	1.000	14,342	10,828



www.hilti.com

Company:	GES	Page:	4
Address:	4640 E. Elwood St, Ste 5	Specifier:	richard finch
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Design:	Concrete - Feb 26, 2022	Date:	3/1/2022
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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.]	$\psi_{c,N}$
6.235	0.000	0.095	22.000	1.000
$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f_c$ [psij]	
16.831	17	1.000	4,000	

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	$N_b$ [lb]
699.81	349.90	1.000	0.990	1.000	1.000	16,740

**Results**

$N_{cbg}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi N_{cbg}$ [lb]	$N_{ua}$ [lb]
33,145	0.650	0.750	1.000	16,158	10,828



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Company:	GES	Page:	5
Address:	4640 E. Elwood St, Ste 5	Specifier:	richard finch
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Design:	Concrete - Feb 26, 2022	Date:	3/1/2022
Fastening point:	As skid, Revised axial load, 170 kin		

## 4 Shear load

	Load $V_{ua}$ [lb]	Capacity $\phi V_n$ [lb]	Utilization $\beta_V = V_{ua} / \phi V_n$	Status
Steel Strength*	2,563	7,712	34	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)**	9,950	78,182	13	OK
Concrete edge failure in direction y-**	9,951	18,010	56	OK

\* 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	125,000	0.700

#### Calculations

$V_{sa,eq}$ [lb]
11,865

#### Results

$V_{sa,eq}$ [lb]	$\phi_{steel}$	$\phi V_{sa,eq}$ [lb]	$V_{ua}$ [lb]
11,865	0.650	7,712	2,563



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 Fastening point: As skid, Revised axial load, 170 kin

Page: 6  
 Specifier: richard finch  
 E-Mail: rfinch@gesonline.com  
 Date: 3/1/2022

**4.2 Pryout Strength (Bond Strength controls)**

$$V_{cpq} = k_{cp} \left[ \left( \frac{A_{Na}}{A_{Na0}} \right) \psi_{ec1,Na} \psi_{ec2,Na} \psi_{ed,Na} \psi_{cp,Na} N_{ba} \right] \quad \text{ACI 318-14 Eq. (17.5.3.1b)}$$

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

$A_{Na}$  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**

$k_{cp}$	$\alpha_{overhead}$	$\tau_{k,c,uncr}$ [psi]	$d_a$ [in.]	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\tau_{k,c}$ [psi]
2	1.000	2,327	0.625	6.235	22.000	1,226
$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{ac}$ [in.]	$\lambda_a$	$\alpha_{N,seis}$		
0.000	0.585	16.831	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	1,310.16	327.54	1.000
$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	$N_{ba}$ [lb]
1.000	0.939	1.000	14,863

**Results**

$V_{cpq}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cpq}$ [lb]	$V_{ua}$ [lb]
111,688	0.700	1.000	1.000	78,182	9,950



www.hilti.com

Company:	GES	Page:	7
Address:	4640 E. Elwood St, Ste 5	Specifier:	richard finch
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Design:	Concrete - Feb 26, 2022	Date:	3/1/2022
Fastening point:	As skid, Revised axial load, 170 kin		

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

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

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

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

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

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

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

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

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

**Variables**

$c_{a1}$ [in.]	$c_{a2}$ [in.]	$e_{cV}$ [in.]	$\Psi_{c,V}$	$h_a$ [in.]
14.667	22.000	0.134	1.000	8.000
$l_e$ [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> ]	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{h,V}$	$V_b$ [lb]
507.09	968.00	0.994	1.000	1.658	29,798

**Results**

$V_{cbg}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cbg}$ [lb]	$V_{ua}$ [lb]
25,729	0.700	1.000	1.000	18,010	9,951

**5 Combined tension and shear loads**

$\beta_N$	$\beta_V$	$\zeta$	Utilization $\beta_{N,V}$ [%]	Status
0.755	0.553	5/3	100	OK

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



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Company:	GES	Page:	8
Address:	4640 E. Elwood St, Ste 5	Specifier:	richard finch
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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 meets the design criteria!**

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 Design: Concrete - Feb 26, 2022  
 Fastening point: As skid, Revised axial load, 170 kin

Page: 9  
 Specifier: richard finch  
 E-Mail: rfinch@gesonline.com  
 Date: 3/1/2022

## 7 Installation data

Profile: no profile

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

Plate thickness (input): 0.250 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 + HAS-B-105 (ASTM F1554 Gr.105) 5/8

Item number: 2197969 HAS-B-105 5/8"x8" (element) / 2022791 HIT-HY 200-A (adhesive)

Maximum installation torque: 720 in.lb

Hole diameter in the base material: 0.750 in.

Hole depth in the base material: 6.235 in.

Minimum thickness of the base material: 7.735 in.

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

### 7.1 Recommended accessories

#### Drilling

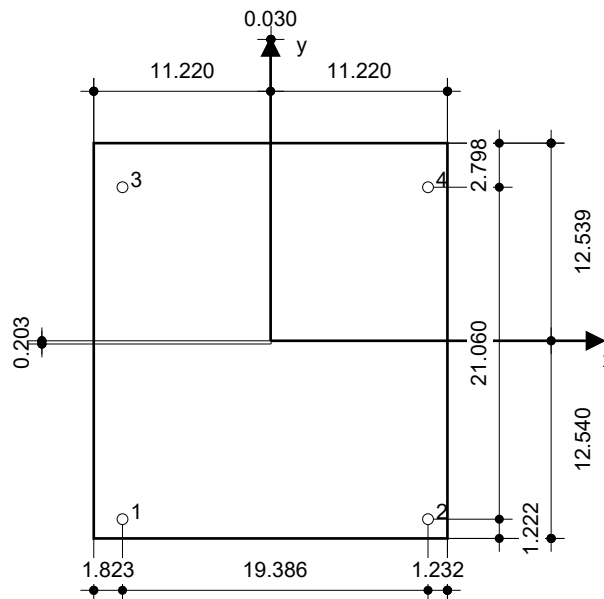
- Suitable Rotary Hammer
- Properly sized drill bit

#### Cleaning

- Compressed air with required accessories to blow from the bottom of the hole
- Proper diameter wire brush

#### Setting

- Dispenser including cassette and mixer
- Torque wrench



#### Coordinates Anchor [in.]

Anchor	x	y	c <sub>-x</sub>	c <sub>+x</sub>	c <sub>-y</sub>	c <sub>+y</sub>
1	-9.398	-11.318	22.000	41.386	22.000	43.060
2	9.988	-11.318	41.386	22.000	22.000	43.060
3	-9.398	9.742	22.000	41.386	43.060	22.000
4	9.988	9.742	41.386	22.000	43.060	22.000



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Company:	GES	Page:	10
Address:	4640 E. Elwood St, Ste 5	Specifier:	richard finch
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## 8 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.
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