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Address:		Specifier:	Sterling Wallstrum, PE
Phone Fax:	7077036899	E-Mail:	swallstrum@onguardseismic.com
Design:	Waterfowl 2B03 Concrete - Mar 9, 2023	Date:	3/10/2023
Fastening point:			

Specifier's comments:

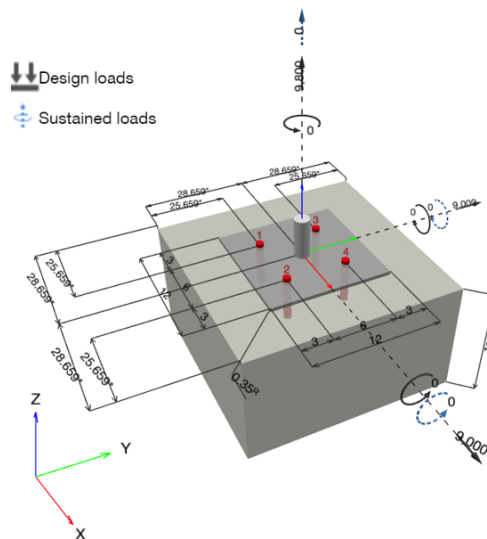
1 Input data

Anchor type and diameter:	HIT-RE 500 V3 + HAS-R 304/316 SS 3/4	
Item number:	2045010 HAS-R 316 SS 3/4"x9 5/8" (element) / 2123401 HIT-RE 500 V3 (adhesive)	
Effective embedment depth:	$h_{ef,opti} = 3.894$ in. ($h_{ef,limit} = 10.250$ in.)	
Material:	ASTM F 593	
Evaluation Service Report:	ESR-3814	
Issued Valid:	3/1/2021 1/1/2023	
Proof:	Design Method ACI 318-19 / Chem	
Stand-off installation:	$e_b = 0.000$ in. (no stand-off); $t = 0.350$ in.	
Anchor plate ^R :	$l_x \times l_y \times t = 12.000$ in. x 12.000 in. x 0.350 in.; (Recommended plate thickness: not calculated)	
Profile:	Round bars (AISC), 1 1/2; (L x W x T) = 1.500 in. x 1.500 in.	
Base material:	cracked concrete, 5000, $f'_c = 5,000$ psi; $h = 12.000$ in., Temp. short/long: 32/100 °F	
Installation:	hammer drilled hole, Installation condition: Dry	
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar	

Application also possible with HVU2 + HAS-R 304/316 SS 3/4 under the selected boundary conditions.
More information in section Alternative fastening data of this report.

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

Geometry [in.] & Loading [lb, in.lb]





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1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 9,800; V _x = 9,000; V _y = 9,000; M _x = 0; M _y = 0; M _z = 0;	no	100

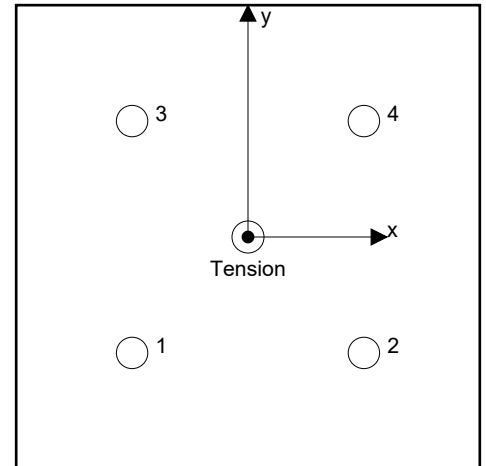
2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2,450	3,182	2,250	2,250
2	2,450	3,182	2,250	2,250
3	2,450	3,182	2,250	2,250
4	2,450	3,182	2,250	2,250

max. concrete compressive strain: - [%]
 max. concrete compressive stress: - [psi]
 resulting tension force in (x/y)=(0.000/0.000): 9,800 [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 ϕ N _n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2,450	18,479	14	OK
Bond Strength**	9,800	13,231	75	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	9,800	13,754	72	OK

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



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Date: 3/10/2023

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-3814
 $\phi N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in. ²]	f_{uta} [psi]
0.33	85,000

Calculations

N_{sa} [lb]
28,430

Results

N_{sa} [lb]	ϕ_{steel}	ϕN_{sa} [lb]	N_{ua} [lb]
28,430	0.650	18,479	2,450



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3.2 Bond Strength

$$N_{ag} = \left(\frac{A_{Na}}{A_{Na0}} \right) \Psi_{ec1,Na} \Psi_{ec2,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} \quad \text{ACI 318-19 Eq. (17.6.5.1b)}$$

$$\phi N_{ag} \geq N_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Na} \text{ see ACI 318-19, Section 17.6.5.1, Fig. R 17.6.5.1(b)}$$

$$A_{Na0} = (2 c_{Na})^2 \quad \text{ACI 318-19 Eq. (17.6.5.1.2a)}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{1100}} \quad \text{ACI 318-19 Eq. (17.6.5.1.2b)}$$

$$\Psi_{ec,Na} = \left(\frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.5.3.1)}$$

$$\Psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.5.4.1b)}$$

$$\Psi_{cp,Na} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.5.5.1b)}$$

$$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef} \quad \text{ACI 318-19 Eq. (17.6.5.2.1)}$$

Variables

$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [psi]
2,533	0.750	3.894	25.659	1.000	1,387
$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	λ_a		
0.000	0.000	5.913	1.000		

Calculations

c_{Na} [in.]	A_{Na} [in. ²]	A_{Na0} [in. ²]	$\Psi_{ed,Na}$
11.330	821.36	513.45	1.000
$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$	N_{ba} [lb]
1.000	1.000	1.000	12,724

Results

N_{ag} [lb]	ϕ_{bond}	ϕN_{ag} [lb]	N_{ua} [lb]
20,355	0.650	13,231	9,800



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3.3 Concrete Breakout Failure

$$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \quad \text{ACI 318-19 Eq. (17.6.2.1b)}$$

$$\phi N_{cbg} \geq N_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Nc} \text{ see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-19 Eq. (17.6.2.1.4)}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.3.1)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.4.1b)}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.6.1b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-19 Eq. (17.6.2.2.1)}$$

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
3.894	0.000	0.000	25.659	1.000
c_{ac} [in.]	k_c	λ_a	f'_c [psij]	
5.913	17	1.000	5,000	

Calculations

A_{Nc} [in. ²]	A_{Nc0} [in. ²]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
312.62	136.45	1.000	1.000	1.000	1.000	9,236

Results

N_{cbg} [lb]	$\phi_{concrete}$	ϕN_{cbg} [lb]	N_{ua} [lb]
21,161	0.650	13,754	9,800



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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*	3,182	10,236	32	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)**	12,728	28,497	45	OK
Concrete edge failure in direction y+**	12,728	22,542	57	OK

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

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-3814
 $\phi V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in. ²]	f_{uta} [psi]
0.33	85,000

Calculations

V_{sa} [lb]
17,060

Results

V_{sa} [lb]	ϕ_{steel}	ϕV_{sa} [lb]	V_{ua} [lb]
17,060	0.600	10,236	3,182



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4.2 Pryout Strength (Bond Strength controls)

$$V_{cpq} = k_{cp} \left[\left(\frac{A_{Na}}{A_{Na0}} \right) \psi_{ec1,Na} \psi_{ec2,Na} \psi_{ed,Na} \psi_{cp,Na} N_{ba} \right] \quad \text{ACI 318-19 Eq. (17.7.3.1b)}$$

$$\phi V_{cpq} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

A_{Na} see ACI 318-19, Section 17.6.5.1, Fig. R 17.6.5.1(b)

$$A_{Na0} = (2 c_{Na})^2 \quad \text{ACI 318-19 Eq. (17.6.5.1.2a)}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{1100}} \quad \text{ACI 318-19 Eq. (17.6.5.1.2b)}$$

$$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.5.3.1)}$$

$$\psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.5.4.1b)}$$

$$\psi_{cp,Na} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.5.5.1b)}$$

$$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef} \quad \text{ACI 318-19 Eq. (17.6.5.2.1)}$$

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	2,533	0.750	3.894	25.659	1,387
$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	λ_a			
0.000	0.000	5.913	1.000			

Calculations

c_{Na} [in.]	A_{Na} [in. ²]	A_{Na0} [in. ²]	$\psi_{ed,Na}$
11.330	821.36	513.45	1.000
$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	N_{ba} [lb]
1.000	1.000	1.000	12,724

Results

V_{cpq} [lb]	$\phi_{concrete}$	ϕV_{cpq} [lb]	V_{ua} [lb]
40,710	0.700	28,497	12,728



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4.3 Concrete edge failure in direction y+

$$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-19 Eq. (17.7.2.1b)}$$

$$\phi V_{cbg} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Vc} \text{ see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)}$$

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-19 Eq. (17.7.2.1.3)}$$

$$\Psi_{ec,V} = \left(\frac{1}{1 + \frac{e_v}{1.5c_{a1}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.3.1)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left(\frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.4.1b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.6.1)}$$

$$V_b = \left(7 \left(\frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f'_c} c_{a1}^{1.5} \quad \text{ACI 318-19 Eq. (17.7.2.2.1a)}$$

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\Psi_{c,V}$	h_a [in.]
17.106	25.659	0.000	1.000	12.000
l_e [in.]	λ_a	d_a [in.]	f'_c [psi]	$\Psi_{parallel,V}$
3.894	1.000	0.750	5,000	1.000

Calculations

A_{Vc} [in. ²]	A_{Vc0} [in. ²]	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{h,V}$	V_b [lb]
687.83	1,316.81	1.000	1.000	1.462	42,161

Results

V_{cbg} [lb]	$\phi_{concrete}$	ϕV_{cbg} [lb]	V_{ua} [lb]
32,203	0.700	22,542	12,728

5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.741	0.565	5/3	100	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/>
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

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7 Installation data

Profile: Round bars (AISC), 1 1/2; (L x W x T) = 1.500 in. x 1.500 in.

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

Plate thickness (input): 0.350 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-RE 500 V3 + HAS-R
 304/316 SS 3/4

Item number: 2045010 HAS-R 316 SS 3/4"x9 5/8"
 (element) / 2123401 HIT-RE 500 V3 (adhesive)

Maximum installation torque: 1,200 in.lb

Hole diameter in the base material: 0.875 in.

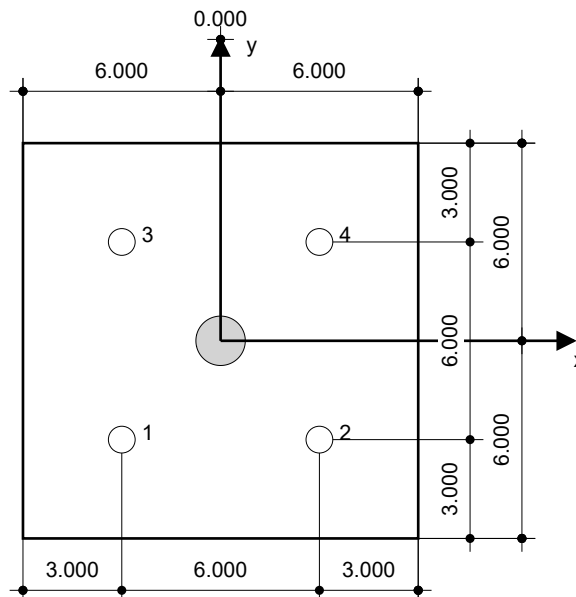
Hole depth in the base material: 3.894 in.

Minimum thickness of the base material: 5.644 in.

3/4 Hilti HAS Stainless steel threaded rod with Hilti HIT-RE 500 V3

7.1 Recommended accessories

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



Coordinates Anchor [in.]


Anchor	x	y	c _{-x}	c _{+x}	c _{-y}	c _{+y}
1	-3.000	-3.000	25.659	31.659	25.659	31.659
2	3.000	-3.000	31.659	25.659	25.659	31.659
3	-3.000	3.000	25.659	31.659	31.659	25.659
4	3.000	3.000	31.659	25.659	31.659	25.659

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8 Alternative fastening

8.1 Alternative fastening data

Anchor type and diameter:	HVU2 + HAS-R 304/316 SS 3/4	
Item number:	2045010 HAS-R 316 SS 3/4"x9 5/8" (element) / 2234723 HVU2 3/4" x 6 5/8" (capsule)	
Effective embedment depth:	$h_{ef,act} = 6.625$ in., $h_{nom} = 6.625$ in.	
Material:	ASTM F 593	
Evaluation Service Report:	ESR-4372	
Issued Valid:	6/1/2022 6/1/2024	
Proof:	Design Method ACI 318-19 / Chem	
Stand-off installation:	$e_b = 0.000$ in. (no stand-off); $t = 0.350$ in.	
Anchor plate ^R :	$l_x \times l_y \times t = 12.000$ in. x 12.000 in. x 0.350 in.; (Recommended plate thickness: not calculated)	
Profile:	Round bars (AISC), 1 1/2; (L x W x T) = 1.500 in. x 1.500 in.	
Base material:	cracked concrete, 5000, $f'_c = 5,000$ psi; $h = 12.000$ in., Temp. short/long: 32/100 °F	
Installation:	hammer drilled hole, Installation condition: Dry, Installation direction: vertical downward	
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar	

Max. Utilization with HVU2 + HAS-R 304/316 SS 3/4: 68 %
Fastening meets the design criteria!

8.2 Installation data

Profile: Round bars (AISC), 1 1/2; (L x W x T) = 1.500 in. x 1.500 in.	Anchor type and diameter: HVU2 + HAS-R 304/316 SS 3/4
Hole diameter in the fixture: $d_f = 0.812$ in.	Item number: 2045010 HAS-R 316 SS 3/4"x9 5/8" (element) / 2234723 HVU2 3/4" x 6 5/8" (capsule)
Plate thickness (input): 0.350 in.	Maximum installation torque: 1,200 in.lb
Recommended plate thickness: not calculated	Hole diameter in the base material: 0.875 in.
Drilling method: Hammer drilled	Hole depth in the base material: 6.625 in.
Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required	Minimum thickness of the base material: 8.375 in.

3/4 Hilti HAS-U Stainless steel threaded rod with Hilti HVU2

8.2.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> • Suitable Rotary Hammer • Properly sized drill bit 	<ul style="list-style-type: none"> • Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush 	<ul style="list-style-type: none"> • HVA square drive shafts • Torque wrench



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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.