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Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	TEST	Date:	22/05/2020
Fastening Point:	Base plate		

Specifier's comments:

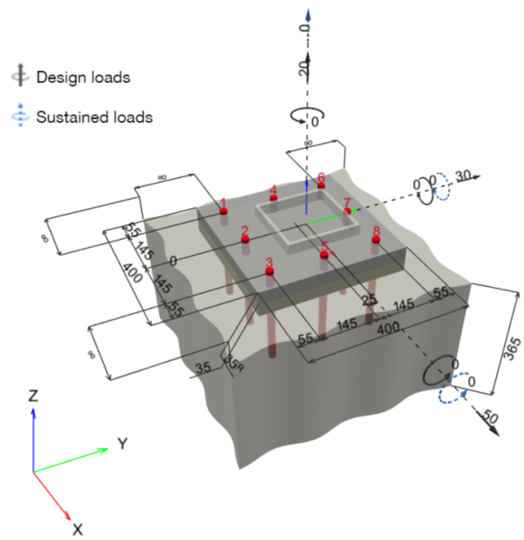
1 Input data

Anchor type and size:	**HIT-HY 200-A + HAS-U A4 M20**
Return period (service life in years):	50
Item number:	2223929 HAS-U A4 M20x350 (insert) / 2022696 HIT-HY 200-A (mortar)
Effective embedment depth:	$h_{ef,act}$ = 200.0 mm ($h_{ef,limit}$ = - mm)
Material:	A4
Approval No.:	ETA 11/0493
Issued I Valid:	30/08/2019 | -
Proof:	Design Method EN 1992-4, Chemical
Stand-off installation:	without clamping (anchor); restraint level (baseplate): 2.00; e_b = 35.0 mm; t = 35.0 mm
	Hilti Grout: , multipurpose, $f_{c,Grout}$ = 30.00 N/mm^2
Baseplate^R :	l_x x l_y x t = 400.0 mm x 400.0 mm x 35.0 mm; (Recommended plate thickness: not calculated)
Profile:	Square hollow, 200 x 200 x 10,0; (L x W x T) = 200.0 mm x 200.0 mm x 10.0 mm
Base material:	cracked concrete, C40/50, $f_{c,cyl}$ = 40.00 N/mm^2; h = 365.0 mm, Temp. short/long: 0/0 °C
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	No reinforcement or Reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm)
	no longitudinal edge reinforcement

Application also possible with HVU2 + HAS-U A4 M20 under the selected boundary conditions.
More information in section Alternative fastening data of this report.

^{R} - The anchor calculation is based on a rigid baseplate assumption.

Geometry [mm] & Loading [kN, kNm]



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Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	TEST	Date:	22/05/2020
Fastening Point:	Base plate		

1.1 Load combination

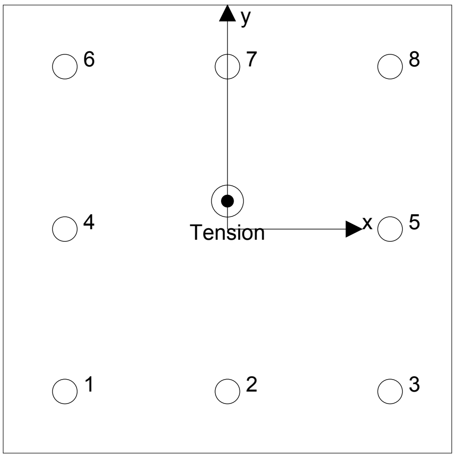
Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	$N = 20.000$; $V_x = 50.000$; $V_y = 30.000$; $M_x = 0.000$; $M_y = 0.000$; $M_z = 0.000$; $N_{sus} = 0.000$; $M_{x,sus} = 0.000$; $M_{y,sus} = 0.000$;	no	no	92

2 Load case/Resulting anchor forces

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1.925	7.111	5.532	4.468
2	1.925	6.683	5.532	3.750
3	1.925	6.308	5.532	3.032
4	2.500	7.683	6.250	4.468
5	2.500	6.946	6.250	3.032
6	3.075	8.278	6.968	4.468
7	3.075	7.913	6.968	3.750
8	3.075	7.599	6.968	3.032



max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0.0/25.0): 20.000 [kN]
resulting compression force in (x/y)=(0.0/0.0): 0.000 [kN]

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

3 Tension load (EN 1992-4, Section 7.2.1)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel failure*	3.075	91.711	4	OK
Combined pullout-concrete cone failure**	20.000	190.094	11	OK
Concrete Breakout failure**	20.000	186.505	11	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel failure

$N_{Ed} \leq N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{M,s}}$ EN 1992-4, Table 7.1

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Ed} [kN]
171.500	1.870	91.711	3.075

3.2 Combined pullout-concrete cone failure

$N_{Ed} \leq N_{Rd,p} = \frac{N_{Rk,p}}{\gamma_{M,p}}$	EN 1992-4, Table 7.1
$N_{Rk,p} = N^0_{Rk,p} \cdot \frac{A_{p,N}}{A^0_{p,N}} \cdot \psi_{g,Np} \cdot \psi_{s,Np} \cdot \psi_{re,N} \cdot \psi_{ec1,Np} \cdot \psi_{ec2,Np}$	EN 1992-4, Eq. (7.13)
$N^0_{Rk,p} = \psi_{sus} \cdot \tau_{Rk} \cdot \pi \cdot d \cdot h_{ef}$	EN 1992-4, Eq. (7.14)
$\psi_{sus} = 1$	EN 1992-4, Eq. (7.14a)
$s_{cr,Np} = 7.3 \cdot d \cdot \sqrt{\psi_{sus} \cdot \tau_{Rk}} \leq 3 \cdot h_{ef}$	EN 1992-4, Eq. (7.15)
$\psi_{g,Np} = \psi^0_{g,Np} - \left(\frac{s}{s_{cr,Np}}\right)^{0,5} \cdot \left(\psi^0_{g,Np} - 1\right) \geq 1.00$	EN 1992-4, Eq. (7.17)
$\psi^0_{g,Np} = \sqrt{n} - (\sqrt{n} - 1) \cdot \left(\frac{\tau_{Rk}}{\tau_{Rk,c}}\right)^{1,5} \geq 1.00$	EN 1992-4, Eq. (7.18)
$\tau_{Rk,c} = \frac{k_3}{\pi \cdot d} \cdot \sqrt{h_{ef} \cdot f_{ck}}$	EN 1992-4, Eq. (7.19)
$\psi_{s,Np} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,Np}} \leq 1.00$	EN 1992-4, Eq. (7.20)
$\psi_{ec1,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c1,N}}{s_{cr,Np}}\right)} \leq 1.00$	EN 1992-4, Eq. (7.21)
$\psi_{ec2,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c2,N}}{s_{cr,Np}}\right)} \leq 1.00$	EN 1992-4, Eq. (7.21)

$A_{p,N}$ [mm²]	$A^0_{p,N}$ [mm²]	$\tau_{Rk,ucr,20}$ [N/mm²]	$s_{cr,Np}$ [mm]	$c_{cr,Np}$ [mm]	c_{min} [mm]	$f_{c,cyl}$ [N/mm²]
792,100	360,000	18.00	600.0	300.0	∞	40.00

ψ_c	$\tau_{Rk,cr}$ [N/mm²]	k_3	$\tau_{Rk,c}$ [N/mm²]	$\psi^0_{g,Np}$	$\psi_{g,Np}$
1.079	9.17	7.700	10.96	1.429	1.218

$e_{c1,N}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,N}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$	$\psi_{re,Np}$
0.0	1.000	25.0	0.923	1.000	1.000

ψ^0_{sus}	α_{sus}	ψ_{sus}
0.740	0.000	1.000

$N^0_{Rk,p}$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Ed} [kN]
115.277	285.141	1.500	190.094	20.000

Group anchor ID
1-8

3.3 Concrete Breakout failure

$N_{Ed} \leq N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{M,c}}$		EN 1992-4, Table 7.1
$N_{Rk,c}$	$= N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N} \cdot \psi_{M,N}$	EN 1992-4, Eq. (7.1)
$N^0_{Rk,c}$	$= k_1 \cdot \sqrt{f_{ck}} \cdot h_{ef}^{1,5}$	EN 1992-4, Eq. (7.2)
$A^0_{c,N}$	$= s_{cr,N} \cdot s_{cr,N}$	EN 1992-4, Eq. (7.3)
$\psi_{s,N}$	$= 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leq 1.00$	EN 1992-4, Eq. (7.4)
$\psi_{ec1,N}$	$= \frac{1}{1 + \left(\frac{2 \cdot e_{N,1}}{s_{cr,N}}\right)} \leq 1.00$	EN 1992-4, Eq. (7.6)
$\psi_{ec2,N}$	$= \frac{1}{1 + \left(\frac{2 \cdot e_{N,2}}{s_{cr,N}}\right)} \leq 1.00$	EN 1992-4, Eq. (7.6)
$\psi_{M,N}$	$= 1$	EN 1992-4, Eq. (7.7)

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	$f_{c,cyl}$ [N/mm^2]
792,100	360,000	300.0	600.0	40.00

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0.0	1.000	25.0	0.923	1.000	1.000

z [mm]	$\psi_{M,N}$	k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Ed} [kN]
0.0	1.000	7.700	137.742	1.500	186.505	20.000

Group anchor ID
1-8

4 Shear load (EN 1992-4, Section 7.2.2)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel failure (without lever arm)*	8.278	55.000	16	OK
Steel failure (with lever arm)*	8.278	9.009	92	OK
Pryout failure**	58.310	367.260	16	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

4.1 Steel failure (without lever arm)

$$V_{Ed} \leq V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{M,s}}$$ EN 1992-4, Table 7.2

$$V_{Rk,s} = k_7 \cdot V^0_{Rk,s}$$ EN 1992-4, Eq. (7.35)

$V^0_{Rk,s}$ [kN]	k_7	$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Ed} [kN]
85.800	1.000	85.800	1.560	55.000	8.278

4.2 Steel failure (with lever arm)

$$V_{Ed} \leq V_{Rd,s,M} = \frac{V_{Rk,s,M}}{\gamma_{M,s}}$$ EN 1992-4, Table 7.2

$$V_{Rk,s,M} = \frac{\alpha_M \cdot M_{Rk,s}}{l_a}$$ EN 1992-4, Eq. 7.37

$$M_{Rk,s} = M^0_{Rk,s} \cdot \left(1 - \frac{N_{Ed}}{N_{Rd,s}}\right)$$ EN 1992-4, Eq. 7.38

$$l_a = e_c + \frac{t}{2} + a_3$$ EN 1992-4, Eq. 6.2

l [mm]	α_M
62.5	2.00

$N_{Ed} / N_{Rd,s}$	$1 - N_{Ed} / N_{Rd,s}$	$M^0_{Rk,s}$ [kNm]	$M_{Rk,s} = M^0_{Rk,s} (1 - N_{Ed}/N_{Rd,s})$ [kNm]
0.034	0.966	0.454	0.439

$V^M_{Rk,s} = \alpha_M * M_{Rk,s} / l$ [kN]	γ_{Ms}	$V^M_{Rd,s}$ [kN]	V_{Ed} [kN]
14.053	1.560	9.009	8.278

4.3 Pryout failure (concrete cone relevant)

$V_{Ed} \leq V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{M,c,p}}$ EN 1992-4, Table 7.2

$V_{Rk,cp} = k_8 \cdot \min\{N_{Rk,c}; N_{Rk,p}\}$ EN 1992-4, Eq. (7.39c)

$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N} \cdot \psi_{M,N}$ EN 1992-4, Eq. (7.1)

$N^0_{Rk,c} = k_1 \cdot \sqrt{f_{ck}} \cdot h_{ef}^{1,5}$ EN 1992-4, Eq. (7.2)

$A^0_{c,N} = s_{cr,N} \cdot s_{cr,N}$ EN 1992-4, Eq. (7.3)

$\psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leq 1.00$ EN 1992-4, Eq. (7.4)

$\psi_{ec1,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{V,1}}{s_{cr,N}}\right)} \leq 1.00$ EN 1992-4, Eq. (7.6)

$\psi_{ec2,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{V,2}}{s_{cr,N}}\right)} \leq 1.00$ EN 1992-4, Eq. (7.6)

$\psi_{M,N} = 1$ EN 1992-4, Eq. (7.7)

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k_8	$f_{c,cyl}$ [N/mm²]
792,100	360,000	300.0	600.0	2.000	40.00

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	$\psi_{M,N}$
11.0	0.965	18.4	0.942	1.000	1.000	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Ed} [kN]
7.700	137.742	1.500	367.260	58.310

Group anchor ID
1-8

5 Combined tension and shear loads (EN 1992-4, Section 7.2.3)

Steel failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.034	0.151	2.000	3	OK

$\beta_N^\alpha + \beta_V^\alpha \leq 1.0$

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.107	0.159	1.500	10	OK

$\beta_N^\alpha + \beta_V^\alpha \leq 1.0$

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 2.278 [kN] δ_N = 0.0127 [mm]

V_{Sk} = 6.132 [kN] δ_V = 0.2453 [mm]

δ_{NV} = 0.2456 [mm]

Long term loading:

N_{Sk} = 2.278 [kN] δ_N = 0.0290 [mm]

V_{Sk} = 6.132 [kN] δ_V = 0.3679 [mm]

δ_{NV} = 0.3691 [mm]

Comments: Tension displacements are valid with half of the required installation torque moment for uncracked concrete! Shear displacements are valid without friction between the concrete and the baseplate! The gap due to the drilled hole and clearance hole tolerances are not included in this calculation!

The acceptable anchor displacements depend on the fastened construction and must be defined by the designer!

7 Warnings

- The anchor design methods in PROFIS Engineering require rigid baseplates per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the baseplate are not considered - the baseplate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required baseplate thickness with CBFEM to limit the stress of the baseplate based on the assumptions explained above. The proof if the rigid baseplate 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!
- Checking the transfer of loads into the base material is required in accordance with EN 1992-4, Annex A!
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 6.1 of EN 1992-4! For larger diameters of the clearance hole see section 6.2.2 of EN 1992-4!
- The accessory list in this report is for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- For the determination of the $\psi_{re,v}$ (concrete edge failure) a concrete cover of the edge reinforcement c = 30 mm is assumed
- Drilled hole cleaning must be performed according to instructions for use (blow twice with oil-free compressed air (min. 6 bar), brush twice, blow twice with oil-free compressed air (min. 6 bar)).
- Characteristic bond resistances depend on short- and long-term temperatures.
- Edge reinforcement is not required to avoid splitting failure
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

8 Installation data

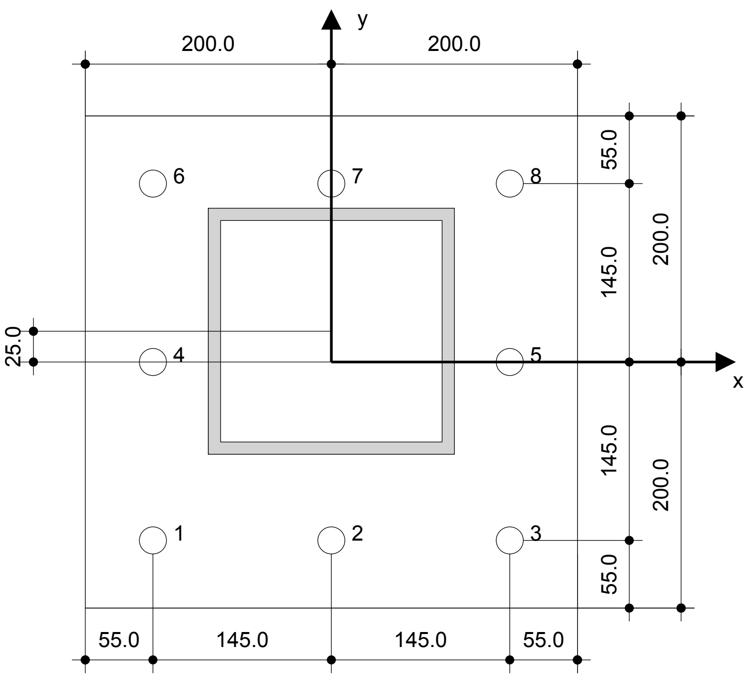
Baseplate, steel: S 275; E = 210,000.00 N/mm^2; f_{yk} = 275.00 N/mm^2
Profile: Square hollow, 200 x 200 x 10,0; (L x W x T) = 200.0 mm x 200.0 mm x 10.0 mm
Hole diameter in the fixture: d_f = 22.0 mm
Plate thickness (input): 35.0 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and size: HIT-HY 200-A + HAS-U A4 M20
Item number: 2223929 HAS-U A4 M20x350 (insert) / 2022696 HIT-HY 200-A (mortar)
Installation torque: 150 Nm
Hole diameter in the base material: 22.0 mm
Hole depth in the base material: 200.0 mm
Minimum thickness of the base material: 244.0 mm

Hilti HAS-U threaded rod with HIT-HY 200 injection mortar with 200 mm embedment h_ef, M20, Stainless steel, SAFEset Auto cleaning Hammer drilling installation per ETA 11/0493

8.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush	• Dispenser including cassette and mixer • Torque wrench

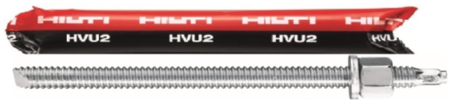


Coordinates Anchor mm

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-145.0	-145.0	-	-	-	-
2	0.0	-145.0	-	-	-	-
3	145.0	-145.0	-	-	-	-
4	-145.0	0.0	-	-	-	-
5	145.0	0.0	-	-	-	-
6	-145.0	145.0	-	-	-	-
7	0.0	145.0	-	-	-	-
8	145.0	145.0	-	-	-	-

9 Alternative fastening

9.1 Alternative fastening data



Anchor type and size:	**HVU2 + HAS-U A4 M20**
Return period (service life in years):	50
Item number:	2223928 HAS-U A4 M20x300 (insert) / 2164509 HVU2 M20x170 (capsule)
Effective embedment depth:	$h_{ef,act}$ = 170.0 mm, h_{nom} = 170.0 mm
Material:	A4
Approval No.:	ETA-16/0515
Issued I Valid:	13/11/2019 | -
Proof:	Design Method EN 1992-4, Chemical
Stand-off installation:	without clamping (anchor); restraint level (baseplate): 2.00; e_b = 35.0 mm; t = 35.0 mm
	Hilti Grout: , multipurpose, $f_{c,Grout}$ = 30.00 N/mm^2
Baseplate^R :	l_x x l_y x t = 400.0 mm x 400.0 mm x 35.0 mm; (Recommended plate thickness: not calculated)
Profile:	Square hollow, 200 x 200 x 10,0; (L x W x T) = 200.0 mm x 200.0 mm x 10.0 mm
Base material:	cracked concrete, C40/50, $f_{c,cyl}$ = 40.00 N/mm^2; h = 365.0 mm, Temp. short/long: 0/0 °C
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	No reinforcement or Reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm)
	no longitudinal edge reinforcement

Max. Utilisation with HVU2 + HAS-U A4 M20: 92 %
Fastening meets the design criteria!

9.2 Installation data

Baseplate, steel: S 275; E = 210,000.00 N/mm^2; f_{yk} = 275.00 N/mm^2
Profile: Square hollow, 200 x 200 x 10,0; (L x W x T) = 200.0 mm x 200.0 mm x 10.0 mm
Hole diameter in the fixture: d_f = 22.0 mm
Plate thickness (input): 35.0 mm
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 size: HVU2 + HAS-U A4 M20
Item number: 2223928 HAS-U A4 M20x300 (insert) / 2164509 HVU2 M20x170 (capsule)
Installation torque: 150 Nm
Hole diameter in the base material: 22.0 mm
Hole depth in the base material: 170.0 mm
Minimum thickness of the base material: 220.0 mm

Hilti HAS-U threaded rod with HVU2 capsule mortar with 170 mm embedment h_ef, M20, Stainless steel, SAFEset Auto cleaning Hammer drilling installation per ETA-16/0515

9.2.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush	• HVA square drive shafts • Torque wrench

10 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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