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Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Play Copy	Date:	28/03/2023
Fastening Point:			

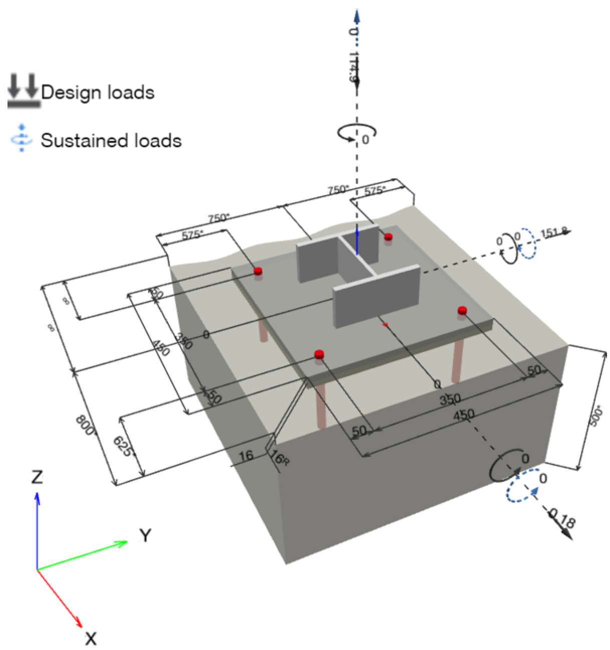
Specifier's comments:

1 Input data

Anchor type and size:	**HIT-HY 200-A + HAS-D M20x280 hmin1**
Return period (service life in years):	50
Item number:	2230641 HAS-D M20x280 (insert) / 2022696 HIT-HY 200-A (mortar)
Effective embedment depth:	h_{ef} = 170.0 mm, h_{nom} = 170.0 mm
Material:	8.8
Approval No.:	ETA-18/0972
Issued I Valid:	13/05/2020 | -
Proof:	Design Method EN 1992-4, Mechanical
Stand-off installation:	without clamping (anchor); restraint level (baseplate): 2.00; e_b = 16.0 mm; t = 16.0 mm
	Hilti Grout: CB-G EG, epoxy, $f_{c,Grout}$ = 120.00 N/mm^2
Baseplate[R] :	l_x x l_y x t = 450.0 mm x 450.0 mm x 16.0 mm; (Recommended plate thickness: not calculated)
Profile:	Advance UKC, 203 x 203 x 60; (L x W x T x FT) = 209.6 mm x 205.8 mm x 9.4 mm x 14.2 mm
Base material:	cracked concrete, C40/50, $f_{c,cyl}$ = 40.00 N/mm^2; h = 500.0 mm, Temp. short/long: -5/30 °C, User-defined partial material safety factor γ_c = 1.500
Installation:	**automatic cleaned 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

[R] - The anchor calculation is based on a rigid baseplate assumption.

Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	$N = -206.400; V_x = 0.020; V_y = 59.560; M_x = 0.000; M_y = 0.000; M_z = 0.000; N_{sus} = 0.000; M_{x,sus} = 0.000; M_{y,sus} = 0.000;$	no	no	61
2	Combination 2	$N = -114.900; V_x = 0.180; V_y = 151.800; M_x = 0.000; M_y = 0.000; M_z = 0.000; N_{sus} = 0.000; M_{x,sus} = 0.000; M_{y,sus} = 0.000;$	no	no	156
3	Combination 3	$N = -96.360; V_x = 14.220; V_y = 107.400; M_x = 0.000; M_y = 0.000; M_z = 0.000; N_{sus} = 0.000; M_{x,sus} = 0.000; M_{y,sus} = 0.000;$	no	no	111

2 Load case/Resulting anchor forces

Controlling load case: 2 Combination 2

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

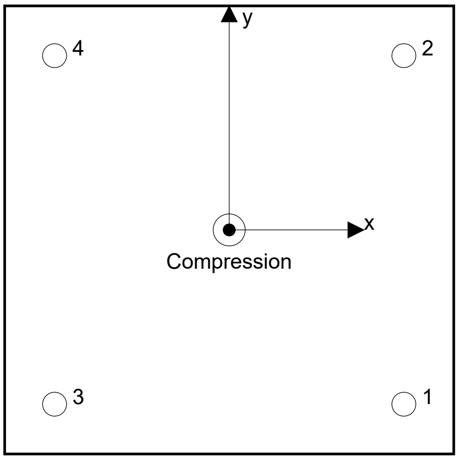
Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.000	37.950	0.045	37.950
2	0.000	37.950	0.045	37.950
3	0.000	37.950	0.045	37.950
4	0.000	37.950	0.045	37.950

max. concrete compressive strain: 0.02 [‰]

max. concrete compressive stress: 0.57 [N/mm^2]

resulting tension force in (x/y)=(0.0/0.0): 0.000 [kN]

resulting compression force in (x/y)=(0.0/0.0): 114.900 [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*	N/A	N/A	N/A	N/A
Concrete Breakout failure**	N/A	N/A	N/A	N/A
Splitting failure**	N/A	N/A	N/A	N/A

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

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

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel failure (without lever arm)*	37.950	119.200	32	OK
Steel failure (with lever arm)*	37.950	24.424	156	not recommended
Pryout failure**	151.800	409.251	38	OK
Concrete edge failure in direction y+**	151.800	112.504	135	not recommended

* 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]
149.000	1.000	149.000	1.250	119.200	37.950

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
34.0	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]
0.000	1.000	0.519	0.519

$V^M_{Rk,s} = \alpha_M * M_{Rk,s} / l$ [kN]	γ_{Ms}	$V^M_{Rd,s}$ [kN]	V_{Ed} [kN]
30.529	1.250	24.424	37.950

4.3 Pryout failure

$V_{Ed} \leq V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{M,c,p}}$	EN 1992-4, Table 7.2
$V_{Rk,cp} = k_8 \cdot N_{Rk,c}$	EN 1992-4, Eq. (7.39a)
$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N} \cdot \psi_{M,N}$	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]
739,600	260,100	255.0	510.0	2.000	40.00

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	$\psi_{M,N}$
0.0	1.000	0.0	1.000	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	107.943	1.500	409.251	151.800

Group anchor ID
1-4

4.4 Concrete edge failure in direction y+

$V_{Ed} \leq V_{Rd,c} = \frac{V_{Rk,c}}{\gamma_{M,c}}$	EN 1992-4, Table 7.2
$V_{Rk,c} = k_T \cdot V^0_{Rk,c} \cdot \frac{A_{c,V}}{A^0_{c,V}} \cdot \psi_{s,V} \cdot \psi_{h,V} \cdot \psi_{\alpha,V} \cdot \psi_{ec,V} \cdot \psi_{re,V}$	EN 1992-4, Eq. (7.40)
$V^0_{Rk,c} = k_9 \cdot d^{\alpha}_{nom} \cdot l^{\beta}_f \cdot \sqrt{f_{ck}} \cdot c_1^{1,5}$	EN 1992-4, Eq. (7.41)
$\alpha = 0.1 \cdot \left(\frac{l_f}{c_1}\right)^{0,5}$	EN 1992-4, Eq. (7.42)
$\beta = 0.1 \cdot \left(\frac{d_{nom}}{c_1}\right)^{0,2}$	EN 1992-4, Eq. (7.43)
$A^0_{c,V} = 4.5 \cdot c_1^2$	EN 1992-4, Eq. (7.44)
$\psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5 \cdot c_1} \leq 1.00$	EN 1992-4, Eq. (7.45)
$\psi_{h,V} = \left(\frac{1.5 \cdot c_1}{h}\right)^{0,5} \geq 1.00$	EN 1992-4, Eq. (7.46)
$\psi_{ec,V} = \frac{1}{1 + \left(\frac{2 \cdot e_V}{3 \cdot c_1}\right)} \leq 1.00$	EN 1992-4, Eq. (7.47)
$\psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}} \geq 1.00$	EN 1992-4, Eq. (7.48)

l_f [mm]	d_{nom} [mm]	k_9	α	β	$f_{c,cyl}$ [N/mm²]
170.0	20.00	1.700	0.054	0.051	40.00

c_1 [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]
575.0	918,750	1,487,812

$\psi_{s,V}$	$\psi_{h,V}$	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
0.917	1.313	1.000	0.0	1.000	1.000

$V^0_{Rk,c}$ [kN]	k_T	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Ed} [kN]
226.809	1.0	1.500	112.504	151.800

5 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} =	0.000 [kN]	δ_N =	0.0000 [mm]
V_{Sk} =	28.111 [kN]	δ_V =	1.6023 [mm]
		δ_{NV} =	1.6023 [mm]

Long term loading:

N_{Sk} =	0.000 [kN]	δ_N =	0.0000 [mm]
V_{Sk} =	28.111 [kN]	δ_V =	2.4457 [mm]
		δ_{NV} =	2.4457 [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!

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid baseplates 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 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) the minimum concrete cover defined in the design settings is used as the concrete cover of the edge reinforcement.
- The design (concrete edge verification) is not covered by EN 1992-4.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening does not meet the design criteria!

7 Installation data

Baseplate, steel: S 235; E = 210,000.00 N/mm^2; f_{yk} = 235.00 N/mm^2

Profile: Advance UKC, 203 x 203 x 60; (L x W x T x FT) = 209.6 mm x 205.8 mm x 9.4 mm x 14.2 mm

Hole diameter in the fixture (pre-setting) : d_f = 24.0 mm

Hole diameter in the fixture (through fastening) : d_f = 26.0 mm

Plate thickness (input): 16.0 mm

Recommended plate thickness: not calculated

Drilling method: SafeSet - automatic cleaning

Cleaning: Automatically performed while drilling

Anchor type and size: HIT-HY 200-A + HAS-D M20x280 hmin1

Item number: 2230641 HAS-D M20x280 (insert) / 2022696 HIT-HY 200-A (mortar)

Maximum installation torque: 80 Nm

Hole diameter in the base material: 24.0 mm

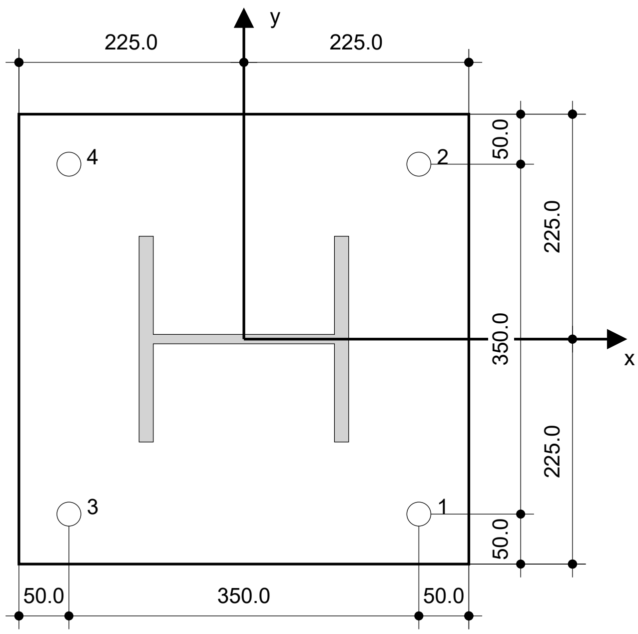
Hole depth in the base material: 200.0 mm

Minimum thickness of the base material: 340.0 mm

Hilti HAS-D threaded rod with HIT-HY 200 injection mortar with 170 mm embedment h_ef, M20x280 hmin1, Steel galvanized, SAFEset - automatic cleaning installation per ETA-18/0972

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit for SAFEset - automatic cleaning (TE-CD / TE-YD) • Vacuum cleaner	• No accessory required	• Dispenser including cassette and mixer • Torque wrench



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	175.0	-175.0	-	625.0	575.0	925.0
2	175.0	175.0	-	625.0	925.0	575.0
3	-175.0	-175.0	-	975.0	575.0	925.0
4	-175.0	175.0	-	975.0	925.0	575.0

8 Remarks; Your Cooperation Duties

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