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Fastening Point:			

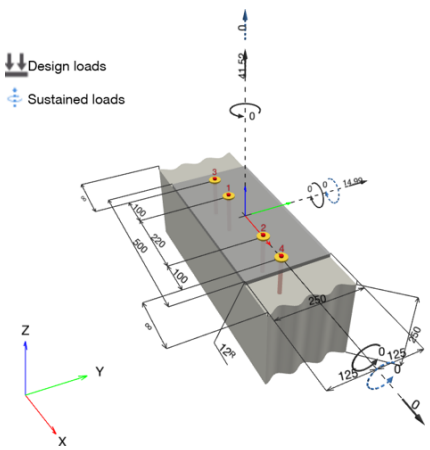
Specifier's comments:

1 Input data

Anchor type and size:	**HIT-HY 200-R V3 + HAS 5.8 M12**
Return period (service life in years):	50
Item number:	2390202 HAS 5.8 M12x160 (insert) / 2262134 HIT-HY 200-R V3 (mortar)
Hilti Filling Set or any suitable annular gap filling solution	
Specification text:	Hilti HAS-U 5.8 threaded rod with HIT-HY 200-R V3 injection mortar with 110 mm embedment hef, M12, Steel galvanized, Hammer drilling installation per ETA 19/0601, with annular gaps filled with Hilti Filling Set or any suitable gap solutions
Effective embedment depth:	$h_{ef,act}$ = 110.0 mm ($h_{ef,limit}$ = - mm)
Material:	5.8
Approval No.:	ETA 19/0601
Issued I Valid:	29/1/2024 | -
Proof:	SOFA based on EN 1992-4, Chemical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 12.0 mm
Baseplate[R] :	l_x x l_y x t = 500.0 mm x 250.0 mm x 12.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 32MPa, $f_{c,cyl}$ = 32.00 N/mm^2; h =250.0 mm, Temp. short/long: 0/0 °C, User-defined partial material safety factor γ_c = 1.500
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 Reinforcement to control splitting acc. to EN 1992-4, 7.2.1.7 (2) b) 2) present

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

Geometry [mm] & Loading [kN, kNm]



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1.1 Load combination

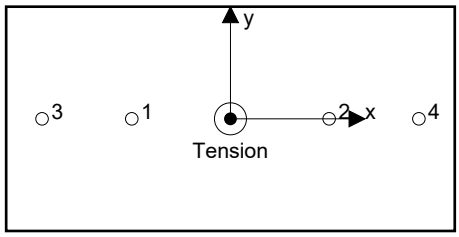
Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 41.520; V_x = 0.000; V_y = 14.990; M_x = 0.000; M_y = 0.000; M_z = 0.000; N_{sus} = 0.000; $M_{x,sus}$ = 0.000; $M_{y,sus}$ = 0.000;	no	no	112

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	10.380	3.748	0.000	3.748
2	10.380	3.748	0.000	3.748
3	10.380	3.748	0.000	3.748
4	10.380	3.748	0.000	3.748



Max. concrete compressive strain: - [‰]
Max. concrete compressive stress: - [N/mm^2]
Resulting tension force in (x/y)=(0.0/0.0): 41.520 [kN]
Resulting compression force in (x/y)=(-/-): 0.000 [kN]

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

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3 Tension load EN 1992-4, Section 7.2.1

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel failure*	10.380	28.100	37	OK
Combined pullout-concrete cone failure**	41.520	47.859	87	OK
Concrete Breakout failure**	41.520	53.487	78	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel failure

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

$N_{Rk,s}$ [kN]	γ_{Ms}	$N_{Rd,s}$ [kN]	N_{Ed} [kN]
42.150	1.500	28.100	10.380

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3.2 Combined pullout-concrete cone failure

$$N_{Ed} \le N_{Rd,p} = \frac{N_{Rk,p}}{\gamma_{Mp}}$$ EN 1992-4, Table 7.1

$$N_{Rk,p} = N^0_{Rk,p} \cdot \frac{A_{p,N}}{A^0_{p,N}} \cdot \psi_{g,Np} \cdot \psi_{s,Np} \cdot \psi_{re,Np} \cdot \psi_{ec1,Np} \cdot \psi_{ec2,Np}$$ 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)

$$s_{cr,Np} = 7.3 \cdot d \cdot \sqrt{\psi_{sus} \cdot \tau_{Rk}} \le 3 \cdot h_{ef}$$ EN 1992-4, Eq. (7.15)

$$\psi_{g,Np} = \psi^0_{g,Np} - \left(\frac{s}{s_{cr,Np}}\right)^{0,5} \cdot \left(\psi^0_{g,Np} - 1\right) \ge 1.00$$ EN 1992-4, Eq. (7.17)

$$\psi^0_{g,Np} = \sqrt{n} - (\sqrt{n} - 1) \cdot \left(\frac{\tau_{Rk}}{\tau_{Rk,c}}\right)^{1,5} \ge 1.00$$ 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)

$$\psi_{s,Np} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,Np}} \le 1.00$$ EN 1992-4, Eq. (7.20)

$$\psi_{ec1,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c1,N}}{s_{cr,Np}}\right)} \le 1.00$$ EN 1992-4, Eq. (7.21)

$$\psi_{ec2,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c2,N}}{s_{cr,Np}}\right)} \le 1.00$$ 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]
187,500	108,900	18.00	330.0	165.0	125.0	32.00

ψ_c	$\tau_{Rk,cr}$ [N/mm²]	k_3	$\tau_{Rk,c}$ [N/mm²]	$\psi^0_{g,Np}$	$\psi_{g,Np}$
1.048	9.96	7.700	12.12	1.255	1.089

$e_{c1,N}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,N}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$	$\psi_{re,Np}$
0.0	1.000	0.0	1.000	0.927	1.000

ψ^0_{sus}	α_{sus}	ψ_{sus}
0.800	0.000	1.000

$N^0_{Rk,p}$ [kN]	$N_{Rk,p}$ [kN]	γ_{Mp}	$N_{Rd,p}$ [kN]	N_{Ed} [kN]
41.291	71.789	1.500	47.859	41.520

Group anchor ID
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3.3 Concrete Breakout failure

$N_{Ed} \le N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{Mc}}$ 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)

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

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

$\psi_{ec2,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{N,2}}{s_{cr,N}}\right)} \le 1.00$ 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]	$f_{c,cyl}$ [N/mm²]
187,500	108,900	165.0	330.0	32.00

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	z [mm]
0.0	1.000	0.0	1.000	0.927	1.000	0.0

$\psi_{M,N}$	k_1	$N^0_{Rk,c}$ [kN]	γ_{Mc}	$N_{Rd,c}$ [kN]	N_{Ed} [kN]
1.000	7.700	50.252	1.500	53.487	41.520

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4 Shear load EN 1992-4, Section 7.2.2

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel failure (without lever arm)*	3.748	20.232	19	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	14.990	95.718	16	OK
Concrete edge failure in direction y+**	14.990	32.183	47	OK

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

4.1 Steel failure (without lever arm)

$V_{Ed} \leq V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{Ms}}$ 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]	γ_{Ms}	$V_{Rd,s}$ [kN]	V_{Ed} [kN]
25.290	1.000	25.290	1.250	20.232	3.748

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4.2 Pryout failure (bond relevant)

$V_{Ed} \le V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{Mc,p}}$ — 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)

$N_{Rk,p} = N^0_{Rk,p} \cdot \frac{A_{p,N}}{A^0_{p,N}} \cdot \psi_{g,Np} \cdot \psi_{s,Np} \cdot \psi_{re,Np} \cdot \psi_{ec1,Np} \cdot \psi_{ec2,Np}$ — 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)

$s_{cr,Np} = 7.3 \cdot d \cdot \sqrt{\psi_{sus} \cdot \tau_{Rk}} \le 3 \cdot h_{ef}$ — EN 1992-4, Eq. (7.15)

$\psi_{g,Np} = \psi^0_{g,Np} - \left(\frac{s}{s_{cr,Np}}\right)^{0,5} \cdot \left(\psi^0_{g,Np} - 1\right) \ge 1.00$ — EN 1992-4, Eq. (7.17)

$\psi^0_{g,Np} = \sqrt{n} - (\sqrt{n} - 1) \cdot \left(\frac{\tau_{Rk}}{\tau_{Rk,c}}\right)^{1,5} \ge 1.00$ — 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)

$\psi_{s,Np} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,Np}} \le 1.00$ — EN 1992-4, Eq. (7.20)

$\psi_{ec1,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c1,N}}{s_{cr,Np}}\right)} \le 1.00$ — EN 1992-4, Eq. (7.21)

$\psi_{ec2,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c2,N}}{s_{cr,Np}}\right)} \le 1.00$ — 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]
187,500	108,900	18.00	330.0	165.0	125.0	32.00

ψ_c	$\tau_{Rk,cr}$ [N/mm²]	k_3	$\tau_{Rk,c}$ [N/mm²]	k_8	$\psi^0_{g,Np}$
1.048	9.96	7.700	12.12	2.000	1.255

$\psi_{g,Np}$	$e_{c1,V}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,V}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$
1.089	0.0	1.000	0.0	1.000	0.927

$\psi_{re,Np}$	ψ^0_{sus}	α_{sus}	ψ_{sus}
1.000	0.800	0.000	1.000

$N^0_{Rk,p}$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{Mc,p}$	$V_{Rd,cp}$ [kN]	V_{Ed} [kN]
41.291	71.789	1.500	95.718	14.990

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4.3 Concrete edge failure in direction y+

$$V_{Ed} \le V_{Rd,c} = \frac{V_{Rk,c}}{\gamma_{Mc}}$$ 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)

$$V^0_{Rk,c} = k_9 \cdot d_{nom}^{\alpha} \cdot l_f^{\beta} \cdot \sqrt{f_{ck}} \cdot c_1^{1,5}$$ 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)

$$\psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5 \cdot c_1} \le 1.00$$ EN 1992-4, Eq. (7.45)

$$\psi_{h,V} = \left(\frac{1.5 \cdot c_1}{h}\right)^{0,5} \ge 1.00$$ EN 1992-4, Eq. (7.46)

$$\psi_{ec,V} = \frac{1}{1 + \left(\frac{2 \cdot e_V}{3 \cdot c_1}\right)} \le 1.00$$ EN 1992-4, Eq. (7.47)

$$\psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}} \ge 1.00$$ EN 1992-4, Eq. (7.48)

l_f [mm]	d_{nom} [mm]	k_9	α	β	$f_{c,cyl}$ [N/mm²]
110.0	12.00	1.700	0.094	0.063	32.00

c_1 [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]
125.0	149,062	70,312

$\psi_{s,V}$	$\psi_{h,V}$	α_V [°]	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
1.000	1.000	0.00	1.000	0.0	1.000	1.000

$V^0_{Rk,c}$ [kN]	k_T	γ_{Mc}	$V_{Rd,c}$ [kN]	V_{Ed} [kN]
22.771	1.0	1.500	32.183	14.990

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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
0.369	0.185	2.000	18	OK

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

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.868	0.466	1.000	112	not recommended

$(\beta_N + \beta_V) / 1.2 \leq 1.0$

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 7.689 [kN]
V_{Sk} = 2.776 [kN]

δ_N = 0.1298 [mm]
δ_V = 0.1388 [mm]
δ_{NV} = 0.1900 [mm]

Long term loading:

N_{Sk} = 7.689 [kN]
V_{Sk} = 2.776 [kN]

δ_N = 0.2967 [mm]
δ_V = 0.2221 [mm]
δ_{NV} = 0.3706 [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!

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7 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.
- 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
- Design is only valid if hole is filled to remove clearance, clearance as per EN 1992-4 Table 6.1
- Load transfer from supplementary reinforcement to the structural member shall be verified by the responsible structural engineer.
- With supplementary reinforcement and post-installed anchors, please ensure that in the jobsite the rebars are not drilled through.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening does not meet the design criteria!

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8 Installation data

Baseplate, steel: Grade 300; E = 200,000.00 N/mm^2; f_{yk} = 310.00 N/mm^2

Profile: no profile

Hole diameter in the fixture: d_f = 14.0 mm

Plate thickness (input): 12.0 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-R V3 + HAS 5.8 M12

Item number: 2390202 HAS 5.8 M12x160 (insert) / 2262134 HIT-HY 200-R V3 (mortar)

Maximum installation torque: 40 Nm

Hole diameter in the base material: 14.0 mm

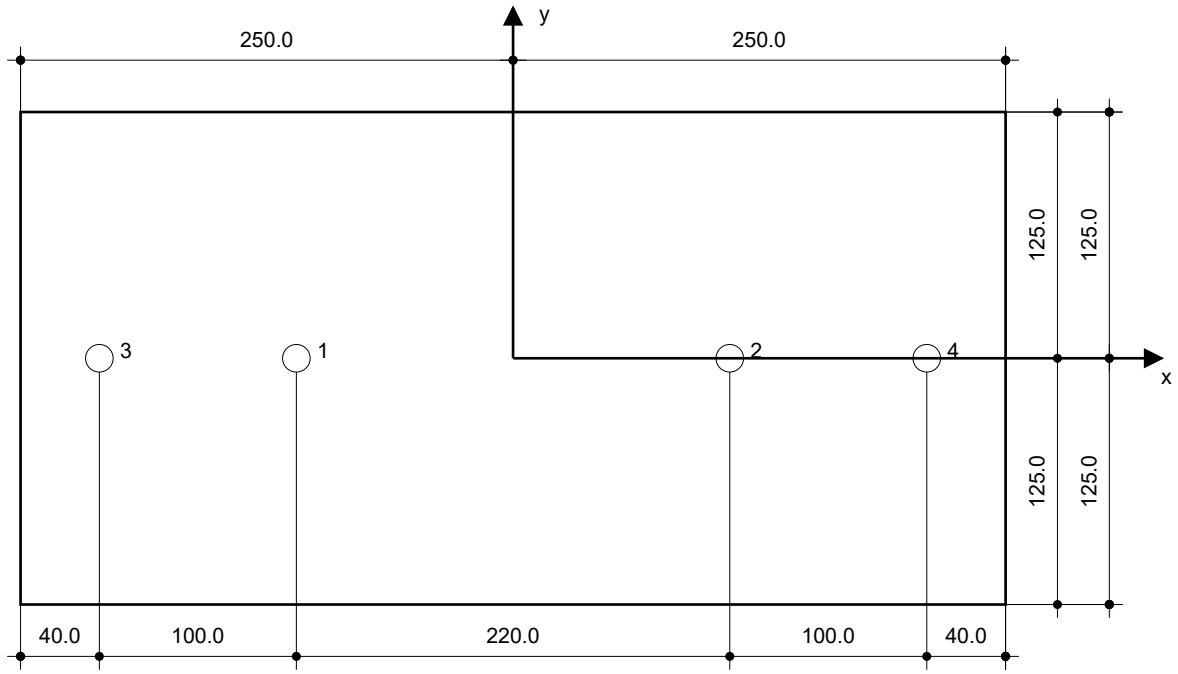
Hole depth in the base material: 110.0 mm

Minimum thickness of the base material: 140.0 mm

Hilti HAS-U 5.8 threaded rod with HIT-HY 200-R V3 injection mortar with 110 mm embedment hef, M12, Steel galvanized, Hammer drilling installation per ETA 19/0601, with annular gaps filled with Hilti Filling Set or any suitable gap solutions

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 • For deep installations, a piston plug is necessary • Torque wrench



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-110.0	0.0	-	-	125.0	125.0
2	110.0	0.0	-	-	125.0	125.0
3	-210.0	0.0	-	-	125.0	125.0
4	210.0	0.0	-	-	125.0	125.0

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9 Remarks; Your Cooperation Duties

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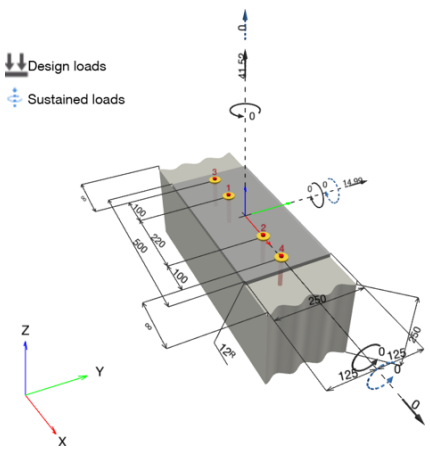
Specifier's comments:

1 Input data

Anchor type and size:	**HIT-HY 200-R V3 + HAS 5.8 M12**
Return period (service life in years):	50
Item number:	2390126 HAS 5.8 M12x120 (insert) / 2262134 HIT-HY 200-R V3 (mortar)
Hilti Filling Set or any suitable annular gap filling solution	
Specification text:	Hilti HAS-U 5.8 threaded rod with HIT-HY 200-R V3 injection mortar with 79 mm embedment hef, M12, Steel galvanized, Hammer drilling installation per ETA 19/0601, with annular gaps filled with Hilti Filling Set or any suitable gap solutions
Effective embedment depth:	$h_{ef,opti}$ = 79.0 mm ($h_{ef,limit}$ = 220.0 mm)
Material:	5.8
Approval No.:	ETA 19/0601
Issued I Valid:	29/1/2024 | -
Proof:	SOFA based on EN 1992-4, Chemical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 12.0 mm
Baseplate[R] :	l_x x l_y x t = 500.0 mm x 250.0 mm x 12.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 32MPa, $f_{c,cyl}$ = 32.00 N/mm^2; h =250.0 mm, Temp. short/long: 0/0 °C, User-defined partial material safety factor γ_c = 1.500
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 Reinforcement to control splitting acc. to EN 1992-4, 7.2.1.7 (2) b) 2) present

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

Geometry [mm] & Loading [kN, kNm]



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1.1 Load combination

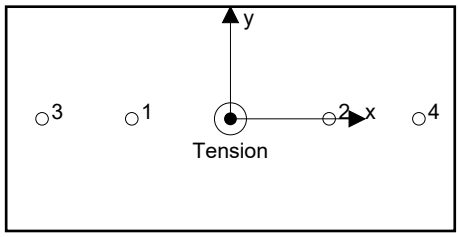
Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 41.520; V_x = 0.000; V_y = 14.990; M_x = 0.000; M_y = 0.000; M_z = 0.000; N_{sus} = 0.000; $M_{x,sus}$ = 0.000; $M_{y,sus}$ = 0.000;	no	no	100

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	10.380	3.748	0.000	3.748
2	10.380	3.748	0.000	3.748
3	10.380	3.748	0.000	3.748
4	10.380	3.748	0.000	3.748



Max. concrete compressive strain: - [‰]
Max. concrete compressive stress: - [N/mm^2]
Resulting tension force in (x/y)=(0.0/0.0): 41.520 [kN]
Resulting compression force in (x/y)=(-/-): 0.000 [kN]

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

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3 Tension load EN 1992-4, Section 7.2.1

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel failure*	10.380	28.100	37	OK
Combined pullout-concrete cone failure**	41.520	55.379	75	OK
Concrete Breakout failure**	41.520	56.524	74	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel failure

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

$N_{Rk,s}$ [kN]	γ_{Ms}	$N_{Rd,s}$ [kN]	N_{Ed} [kN]
42.150	1.500	28.100	10.380

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3.2 Combined pullout-concrete cone failure

$N_{Ed} \le N_{Rd,p} = \frac{N_{Rk,p}}{\gamma_{Mp}}$ EN 1992-4, Table 7.1

$N_{Rk,p} = N^0_{Rk,p} \cdot \frac{A_{p,N}}{A^0_{p,N}} \cdot \psi_{g,Np} \cdot \psi_{s,Np} \cdot \psi_{re,Np} \cdot \psi_{ec1,Np} \cdot \psi_{ec2,Np}$ 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)

$s_{cr,Np} = 7.3 \cdot d \cdot \sqrt{\psi_{sus} \cdot \tau_{Rk}} \le 3 \cdot h_{ef}$ EN 1992-4, Eq. (7.15)

$\psi_{g,Np} = \psi^0_{g,Np} - \left(\frac{s}{s_{cr,Np}}\right)^{0,5} \cdot \left(\psi^0_{g,Np} - 1\right) \ge 1.00$ EN 1992-4, Eq. (7.17)

$\psi^0_{g,Np} = \sqrt{n} - (\sqrt{n} - 1) \cdot \left(\frac{\tau_{Rk}}{\tau_{Rk,c}}\right)^{1,5} \ge 1.00$ 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)

$\psi_{s,Np} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,Np}} \le 1.00$ EN 1992-4, Eq. (7.20)

$\psi_{ec1,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c1,N}}{s_{cr,Np}}\right)} \le 1.00$ EN 1992-4, Eq. (7.21)

$\psi_{ec2,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c2,N}}{s_{cr,Np}}\right)} \le 1.00$ 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]
155,709	56,169	18.00	237.0	118.5	125.0	32.00

ψ_c	$\tau_{Rk,cr}$ [N/mm²]	k_3	$\tau_{Rk,c}$ [N/mm²]	$\psi^0_{g,Np}$	$\psi_{g,Np}$
1.048	9.96	7.700	10.27	1.045	1.010

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

ψ^0_{sus}	α_{sus}	ψ_{sus}
0.800	0.000	1.000

$N^0_{Rk,p}$ [kN]	$N_{Rk,p}$ [kN]	γ_{Mp}	$N_{Rd,p}$ [kN]	N_{Ed} [kN]
29.655	83.069	1.500	55.379	41.520

Group anchor ID
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3.3 Concrete Breakout failure

$$N_{Ed} \le N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{Mc}}$$ 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)

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

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

$$\psi_{ec2,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{N,2}}{s_{cr,N}}\right)} \le 1.00$$ 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]	$f_{c,cyl}$ [N/mm²]
155,709	56,169	118.5	237.0	32.00

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

$\psi_{M,N}$	k_1	$N^0_{Rk,c}$ [kN]	γ_{Mc}	$N_{Rd,c}$ [kN]	N_{Ed} [kN]
1.000	7.700	30.585	1.500	56.524	41.520

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4 Shear load EN 1992-4, Section 7.2.2

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel failure (without lever arm)*	3.748	20.232	19	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	14.990	110.758	14	OK
Concrete edge failure in direction y+**	14.990	30.422	50	OK

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

4.1 Steel failure (without lever arm)

$V_{Ed} \leq V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{Ms}}$ 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]	γ_{Ms}	$V_{Rd,s}$ [kN]	V_{Ed} [kN]
25.290	1.000	25.290	1.250	20.232	3.748

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4.2 Pryout failure (bond relevant)

$V_{Ed} \le V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{Mc,p}}$		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)
$N_{Rk,p}$	$= N^0_{Rk,p} \cdot \frac{A_{p,N}}{A^0_{p,N}} \cdot \psi_{g,Np} \cdot \psi_{s,Np} \cdot \psi_{re,Np} \cdot \psi_{ec1,Np} \cdot \psi_{ec2,Np}$	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)
ψ_{sus}	$= 1$	EN 1992-4, Eq. (7.14a)
$s_{cr,Np}$	$= 7.3 \cdot d \cdot \sqrt{\psi_{sus} \cdot \tau_{Rk}} \le 3 \cdot h_{ef}$	EN 1992-4, Eq. (7.15)
$\psi_{g,Np}$	$= \psi^0_{g,Np} - \left(\frac{s}{s_{cr,Np}}\right)^{0,5} \cdot \left(\psi^0_{g,Np} - 1\right) \ge 1.00$	EN 1992-4, Eq. (7.17)
$\psi^0_{g,Np}$	$= \sqrt{n} - (\sqrt{n} - 1) \cdot \left(\frac{\tau_{Rk}}{\tau_{Rk,c}}\right)^{1,5} \ge 1.00$	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)
$\psi_{s,Np}$	$= 0.7 + 0.3 \cdot \frac{c}{c_{cr,Np}} \le 1.00$	EN 1992-4, Eq. (7.20)
$\psi_{ec1,Np}$	$= \frac{1}{1 + \left(\frac{2 \cdot e_{c1,N}}{s_{cr,Np}}\right)} \le 1.00$	EN 1992-4, Eq. (7.21)
$\psi_{ec2,Np}$	$= \frac{1}{1 + \left(\frac{2 \cdot e_{c2,N}}{s_{cr,Np}}\right)} \le 1.00$	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]
155,709	56,169	18.00	237.0	118.5	125.0	32.00

ψ_c	$\tau_{Rk,cr}$ [N/mm²]	k_3	$\tau_{Rk,c}$ [N/mm²]	k_8	$\psi^0_{g,Np}$
1.048	9.96	7.700	10.27	2.000	1.045

$\psi_{g,Np}$	$e_{c1,V}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,V}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$
1.010	0.0	1.000	0.0	1.000	1.000

$\psi_{re,Np}$	ψ^0_{sus}	α_{sus}	ψ_{sus}
1.000	0.800	0.000	1.000

$N^0_{Rk,p}$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{Mc,p}$	$V_{Rd,cp}$ [kN]	V_{Ed} [kN]
29.655	83.069	1.500	110.758	14.990

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4.3 Concrete edge failure in direction y+

$$V_{Ed} \le V_{Rd,c} = \frac{V_{Rk,c}}{\gamma_{Mc}}$$ 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)

$$V^0_{Rk,c} = k_9 \cdot d_{nom}^{\alpha} \cdot l_f^{\beta} \cdot \sqrt{f_{ck}} \cdot c_1^{1,5}$$ 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)

$$\psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5 \cdot c_1} \le 1.00$$ EN 1992-4, Eq. (7.45)

$$\psi_{h,V} = \left(\frac{1.5 \cdot c_1}{h}\right)^{0,5} \ge 1.00$$ EN 1992-4, Eq. (7.46)

$$\psi_{ec,V} = \frac{1}{1 + \left(\frac{2 \cdot e_V}{3 \cdot c_1}\right)} \le 1.00$$ EN 1992-4, Eq. (7.47)

$$\psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}} \ge 1.00$$ EN 1992-4, Eq. (7.48)

l_f [mm]	d_{nom} [mm]	k_9	α	β	$f_{c,cyl}$ [N/mm²]
79.0	12.00	1.700	0.079	0.063	32.00

c_1 [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]
125.0	149,062	70,312

$\psi_{s,V}$	$\psi_{h,V}$	α_V [°]	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
1.000	1.000	0.00	1.000	0.0	1.000	1.000

$V^0_{Rk,c}$ [kN]	k_T	γ_{Mc}	$V_{Rd,c}$ [kN]	V_{Ed} [kN]
21.525	1.0	1.500	30.422	14.990

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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
0.369	0.185	2.000	18	OK

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

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.750	0.493	1.500	100	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 7.689 [kN] $\quad \delta_N$ = 0.1807 [mm]

V_{Sk} = 2.776 [kN] $\quad \delta_V$ = 0.1388 [mm]

δ_{NV} = 0.2279 [mm]

Long term loading:

N_{Sk} = 7.689 [kN] $\quad \delta_N$ = 0.4131 [mm]

V_{Sk} = 2.776 [kN] $\quad \delta_V$ = 0.2221 [mm]

δ_{NV} = 0.4690 [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 5216:2021, 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.
- 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
- Design is only valid if hole is filled to remove clearance, clearance as per EN 1992-4 Table 6.1
- Load transfer from supplementary reinforcement to the structural member shall be verified by the responsible structural engineer.
- With supplementary reinforcement and post-installed anchors, please ensure that in the jobsite the rebars are not drilled through.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

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8 Installation data

Baseplate, steel: Grade 300; E = 200,000.00 N/mm^2; f_{yk} = 310.00 N/mm^2

Profile: no profile

Hole diameter in the fixture: d_f = 14.0 mm

Plate thickness (input): 12.0 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-R V3 + HAS 5.8 M12

Item number: 2390126 HAS 5.8 M12x120 (insert) / 2262134 HIT-HY 200-R V3 (mortar)

Maximum installation torque: 40 Nm

Hole diameter in the base material: 14.0 mm

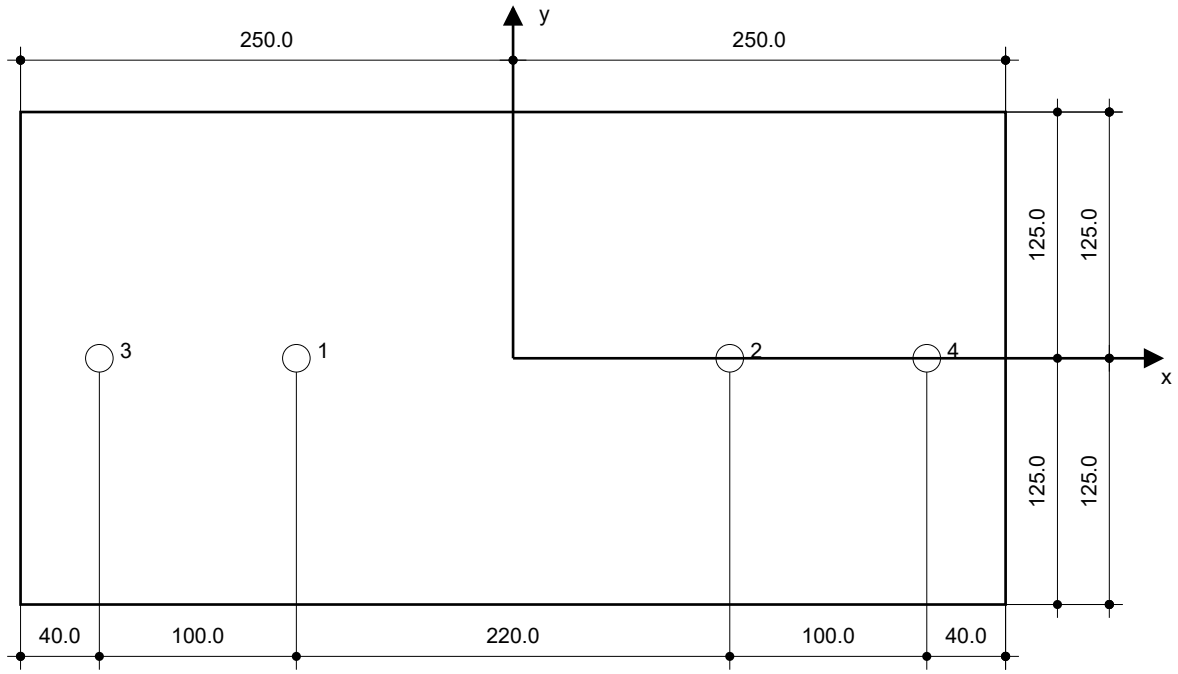
Hole depth in the base material: 79.0 mm

Minimum thickness of the base material: 109.0 mm

Hilti HAS-U 5.8 threaded rod with HIT-HY 200-R V3 injection mortar with 79 mm embedment hef, M12, Steel galvanized, Hammer drilling installation per ETA 19/0601, with annular gaps filled with Hilti Filling Set or any suitable gap solutions

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 • For deep installations, a piston plug is necessary • Torque wrench



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-110.0	0.0	-	-	125.0	125.0
2	110.0	0.0	-	-	125.0	125.0
3	-210.0	0.0	-	-	125.0	125.0
4	210.0	0.0	-	-	125.0	125.0

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9 Remarks; Your Cooperation Duties

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