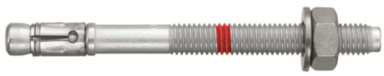
www.hilti.group/content/hilti/CP/XX/en/non-transactional/light-pages/middle-east.html

Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Jun 28, 2024	Date:	6/28/2024
Fastening point:			

Specifier's comments:

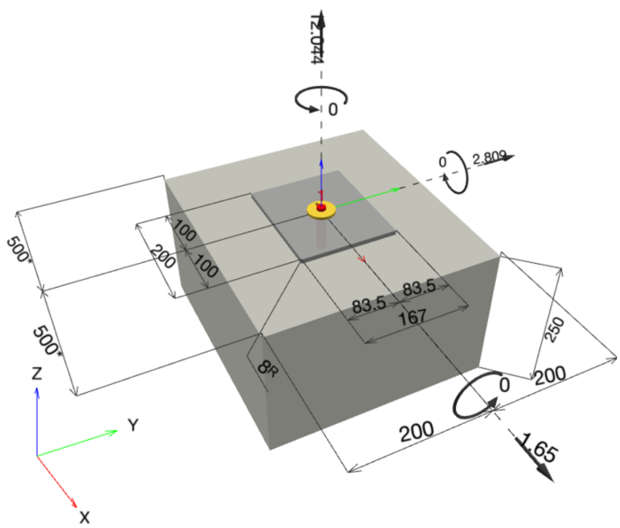
1 Input data



Anchor type and diameter:	**HST3 M16 hef1**
Return period (service life in years):	50
Item number:	2114053 HST3 M16x115 15/-
Filling set or any suitable annular gap filling solution	
Specification text:	Hilti HST3 stud anchor with 65 mm embedment, M16 hef1, Steel galvanized, installation per ETA 98/0001, with annular gaps filled with Hilti Filling set or any suitable gap solutions
Effective embedment depth:	$h_{ef,opti}$ = 65.0 mm ($h_{ef,limit}$ = 84.0 mm), h_{nom} = 78.0 mm
Material:	
Evaluation Service Report:	ETA 98/0001
Issued I Valid:	7/20/2023 | -
Proof:	SOFA based on EN 1992-4 and fib bulletin 58, Mechanical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 8.0 mm
Anchor plate[R] :	l_x x l_y x t = 200.0 mm x 167.0 mm x 8.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C25/30, $f_{c,cyl}$ = 25.00 N/mm^2; h =250.0 mm, 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

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

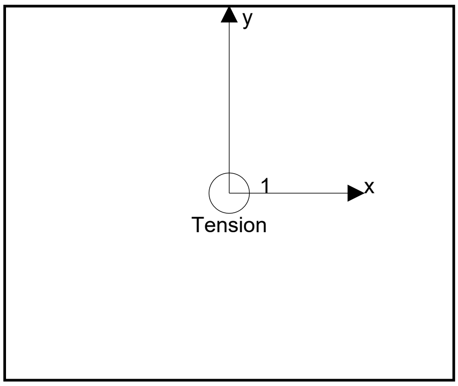
Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 12.044; V_x = 1.650; V_y = 2.809; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	no	90

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	12.044	3.258	1.650	2.809

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0.0/0.0): 12.044 [kN]
resulting compression force in (x/y)=(-/-): 0.000 [kN]

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

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

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	12.044	54.286	23	OK
Pullout Strength*	12.044	13.451	90	OK
Concrete Breakout Failure**	12.044	13.451	90	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

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

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Ed} [kN]
76.000	1.400	54.286	12.044

3.2 Pullout Strength

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

$N_{Rk,p}$ [kN]	ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Ed} [kN]
18.046	1.118	1.500	13.451	12.044

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]
38,025	38,025	97.5	195.0	25.00

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0.0	1.000	0.0	1.000	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	20.176	1.500	13.451	12.044

Group anchor ID
1

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

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	3.258	43.600	8	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	3.258	45.866	8	OK
Concrete edge failure in direction x+**	3.258	18.479	18	OK

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

4.1 Steel Strength (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]
54.500	1.000	54.500	1.250	43.600	3.258

4.2 Pryout Strength

$V_{Ed} \leq V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{M,c,p}}$ 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)

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k_8	$f_{c,cyl}$ [N/mm^2]
38,025	38,025	97.5	195.0	3.410	25.00

$e_{c1,V}$ [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	20.176	1.500	45.866	3.258

Group anchor ID
1

4.3 Concrete edge failure in direction x+

$V_{Ed} \leq V_{Rd,c} = \dfrac{V_{Rk,c}}{\gamma_{M,c}}$	fib Bulletin 58, Table (10.2-1)
$V_{Rk,c} = V^0_{Rk,c} \cdot \psi_{A,V} \cdot \psi_{h,V} \cdot \psi_{s,V} \cdot \psi_{ec,V} \cdot \psi_{\alpha,V} \cdot \psi_{re,V}$	fib Bulletin 58, Eq. (10.2-5)
$V^0_{Rk,c} = k_v \cdot d^{\alpha}_{nom} \cdot l^{\beta}_f \cdot \sqrt{f_{ck}} \cdot c_1^{1.5}$	fib Bulletin 58, Eq. (10.2-5a)
$\alpha = 0.1 \cdot \left(\dfrac{l_f}{c_1}\right)^{0,5}$	fib Bulletin 58, Eq. (10.2-5a$_1$)
$\beta = 0.1 \cdot \left(\dfrac{d_{nom}}{c_1}\right)^{0,2}$	fib Bulletin 58, Eq. (10.2-5a$_2$)
$A^0_{c,V} = 4.5 \cdot c_1^2$	fib Bulletin 58, Eq. (10.2-5b)
$\psi_{A,V} = \dfrac{A_{c,V}}{A^0_{c,V}}$	fib bulletin 58 (07/2011) Section 10.2.5.1.1 b)
$A_{c,V}$	fib bulletin 58 (07/2011) Figure 10.2-4
$\psi_{s,V} = 0.7 + 0.3 \cdot \dfrac{c_2}{1.5 \cdot c_1} \leq 1.00$	fib Bulletin 58, Eq. (10.2-5d)
$\psi_{h,V} = \left(\dfrac{1.5 \cdot c_1}{h}\right)^{0,5} \geq 1.00$	fib Bulletin 58, Eq. (10.2-5c)
$\psi_{ec,V} = \dfrac{1}{1 + \left(\dfrac{2 \cdot e_V}{3 \cdot c_1}\right)} \leq 1.00$	fib Bulletin 58, Eq. (10.2-5e)
$\psi_{\alpha,V} = \sqrt{\dfrac{1}{(\cos \alpha_V)^2 + \left(\dfrac{\sin \alpha_V}{\psi_{90°,V}}\right)^2}} \geq 1.00$	fib Bulletin 58, Eq. (10.2-5f))
$c_1' = \max\left(\dfrac{c_{2,max}}{1.5}, \dfrac{h}{1.5}, \dfrac{s_{2,max}}{3}\right)$	fib Bulletin 58, Eq. (10.2-5h$_2$)

l_f [mm]	d_{nom} [mm]	k_V	α	β	$f_{c,cyl}$ [N/mm^2]
65.0	16.00	1.700	0.062	0.063	25.00

c_1 [mm]	c_1' [mm]	$A_{c,V}$ [mm^2]	$A^0_{c,V}$ [mm^2]	$\psi_{A,V}$
500.0	166.7	100,000	125,000	0.800

$\psi_{s,V}$	$\psi_{h,V}$	α_V [°]	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
0.940	1.000	59.57	1.305	0.0	1.000	1.000

$\psi_{90°,V}$	$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Ed} [kN]
1.500	28.239	1.500	18.479	3.258

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
0.222	0.075	2.000	6	OK

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

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.895	0.176	1.000	90	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk}	=	8.921 [kN]	δ_N	=	0.5948 [mm]
V_{Sk}	=	2.413 [kN]	δ_V	=	0.3414 [mm]
			δ_{NV}	=	0.6858 [mm]

Long term loading:

N_{Sk}	=	8.921 [kN]	δ_N	=	1.6852 [mm]
V_{Sk}	=	2.413 [kN]	δ_V	=	0.5121 [mm]
			δ_{NV}	=	1.7613 [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 anchor plate! 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 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!
- Design is only valid if hole is filled to remove clearance, clearance as per EN 1992-4 Table 6.1
- 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 characteristic bond resistances depend on the return period (service life in years): 50

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Address:		Specifier:	
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Fastening meets the design criteria!

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Address:		Specifier:	
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Design:	Concrete - Jun 28, 2024	Date:	6/28/2024
Fastening point:			

8 Installation data

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

Profile: no profile

Hole diameter in the fixture: d_f = 18.0 mm

Plate thickness (input): 8.0 mm

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: HST3 M16 hef1

Item number: 2114053 HST3 M16x115 15/-

Maximum installation torque: 110 Nm

Hole diameter in the base material: 16.0 mm

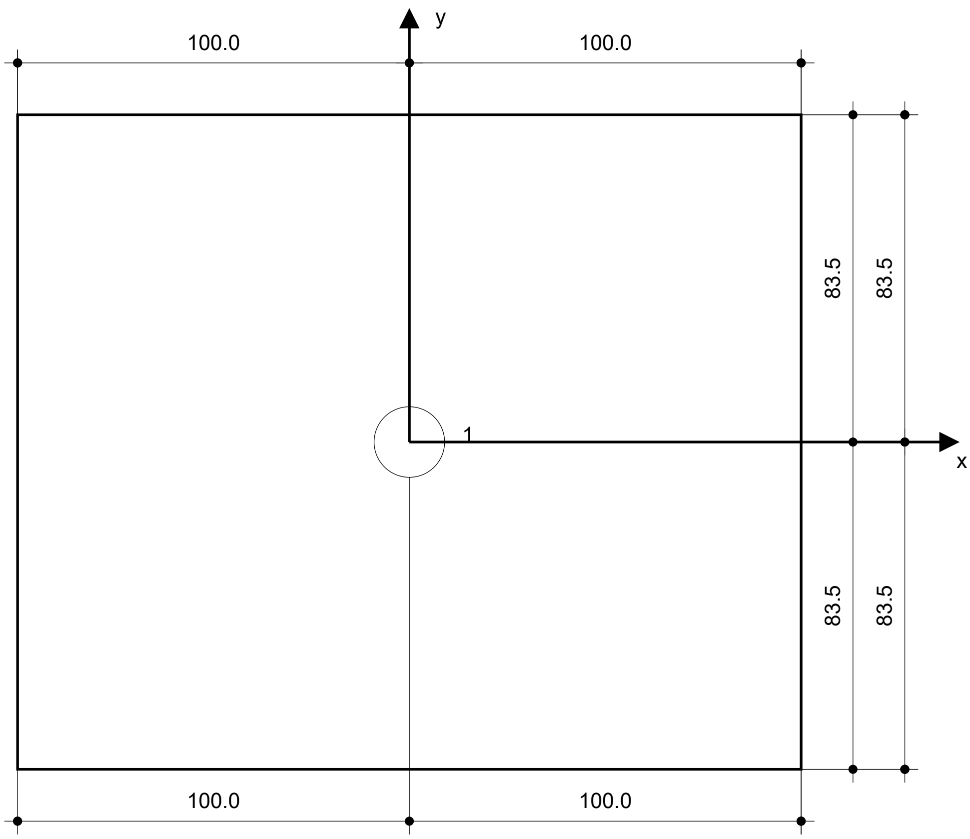
Hole depth in the base material: 98.0 mm

Minimum thickness of the base material: 120.0 mm

Hilti HST3 stud anchor with 65 mm embedment, M16 hef1, Steel galvanized, installation per ETA 98/0001, 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	• No accessory required	• Torque controlled cordless impact tool • Torque wrench • Hammer

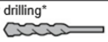
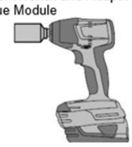


Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.0	0.0	500.0	500.0	200.0	200.0

9 Drilling and installation

HST3 (-R) subject to:

Anchor size	M8	M10	M12	M16	M20	M24
Hammer drilling* 	TE2(-A) – TE30(-A)				TE40 – TE70	
Diamond core drilling* 	DD-30W, DD-EC1					
Setting tool* 	Setting tool HS-SC				-	
Hollow drill bit drilling* 	-		TE-CD, TE-YD			
Seismic Set/ Filling Set** 	Seismic/Filling Set M8-M20 (Carbon and Stainless Steel A4)					-
Impact Wrench and Adaptive Torque Module 	Impact Wrench SIW 6AT-A22 and adaptive torque module SI-AT-A22				-	

***Installation methods provided in ETA-98/0001**
**Seismic set needed to fill the annular gap between anchor and fixture:
No annular gap, double design resistance (agap=1)

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.
- 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.