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European Technical Assessment Body for construction products

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European Technical Assessment ETA-25/0669 of 7 January 2026

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC
Product family to which the construction product belongs	Bonded fasteners and bonded expansion fasteners for use in concrete (Alternative drilling methods, seismic and fire in steel fibre reinforced concrete, variable working life, time-to-failure assessment)
Manufacturer	Hilti Aktiengesellschaft Feldkircherstrasse 100 9494 SCHAAN FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti plants
This European Technical Assessment contains	52 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 330499-02-0601-v01

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Specific Part

1 Technical description of the product

The injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC is a bonded fastener consisting of a foil pack with injection mortar Hilti HIT-HY 200-A V3 or HIT-HY 200-R V3 and a steel element according to Annex A.

The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between metal part, injection mortar and concrete.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the fastener is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 and / or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C1 to C3, C5 to C6, C8 to C10, C12 to C14, B5 to B7
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C4, C7, C11, C15
Displacements under short-term and long-term loading	See Annex C16 to C19
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C20 to C24

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C25 to C28

3.3 Hygiene, health and the environment (BWR 3)

Essential characteristic	Performance
Content, emission and/or release of dangerous substances	No performance assessed

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with the European Assessment Document EAD 330499-02-0601-v01 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

The following standards and documents are referred to in this European Technical Assessment:

EN 1992-1-1:2004 + AC:2010	Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings
EN 1992-4:2018	Eurocode 2: Design of concrete structures - Part 4: Design of fastenings for use in concrete
EN 1993-1-4:2006 + A1:2015	Eurocode 3: Design of steel structures - Part 1-4: General rules - Supplementary rules for stainless steels
EN 10088-1:2014	Stainless steels - Part 1: List of stainless steels
EN ISO 10684-:2004 + AC:2009	Fasteners - Hot dip galvanized coatings
EN 206:2013 + A2:2021	Concrete - Specification, performance, production and conformity
EN 10204:2004	Metallic products – Types of inspection documents
DIN 488-1:2009-08	Reinforcing steels – Part 1: Grades, properties, marking
EOTA TR 055	Design of fastenings based on EAD 330232-00-0601, EAD 330499-00-0601 and EAD 330747-00-0601, February 2018
EOTA TR 082	Design of bonded fasteners in concrete under fire conditions, June 2023
EN 14889-1:2006	Fibres for concrete - Part 1: Steel fibres - Definitions, specifications and conformity
EOTA TR 086	Design of post-installed rebar connections, bonded fasteners, and mechanical fasteners for use in concrete for a service life up to 120 years, September 2025

Issued in Berlin on 7 January 2026 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Stiller

Installed condition

Figure A1: Threaded rod, HAS…, HAS-U-…, HAS-…, HIT-V-…, AM…8.8

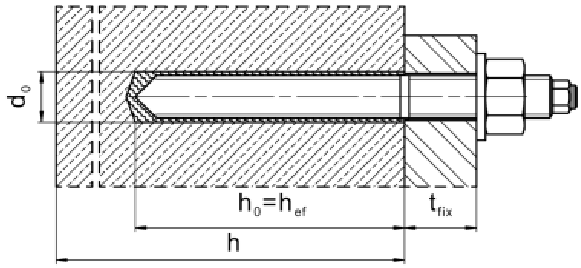


Figure A2: Threaded rod, HAS…, HAS-U-…, HIT-V-…, AM…8.8, with Hilti Filling Set…

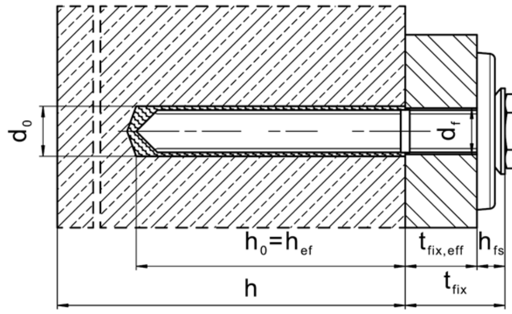


Figure A3: Internally threaded sleeve HIS-(R)N

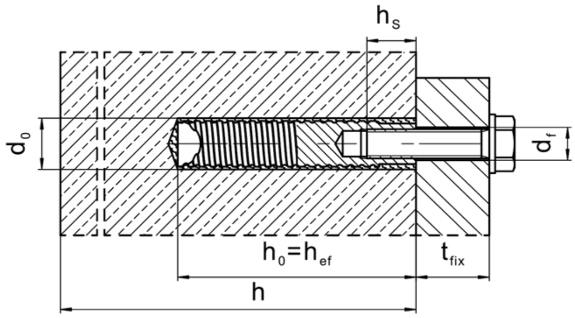
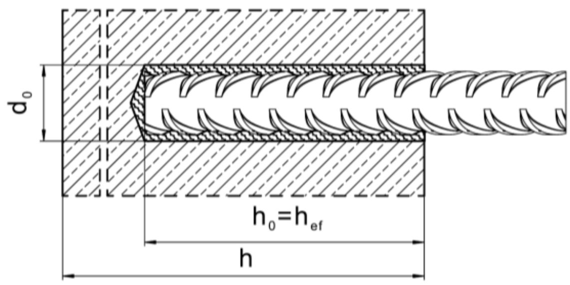


Figure A4: Reinforcing bar (rebar)



Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC	**Annex A1**
Product description Installed condition	

Product description: Injection mortar and steel elements

Injection mortar Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3: hybrid system with aggregate
330 ml and 500 ml

Marking:
HILTI-HIT
HY 200-A V3
Production time and production line
Expiry date mm/yyyy

Product name: “Hilti HIT-HY 200-A V3”

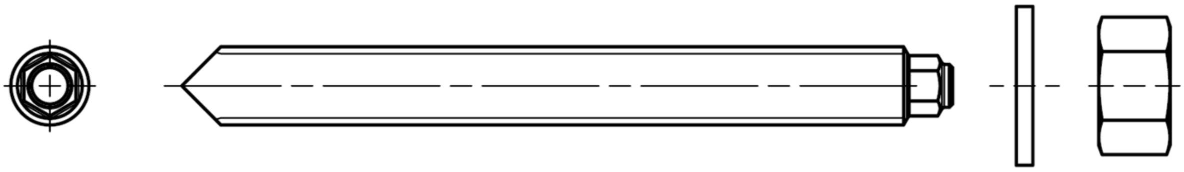
Marking:
HILTI-HIT
HY 200-R V3
Production time and production line
Expiry date mm/yyyy

Product name: “Hilti HIT-HY 200-R V3”

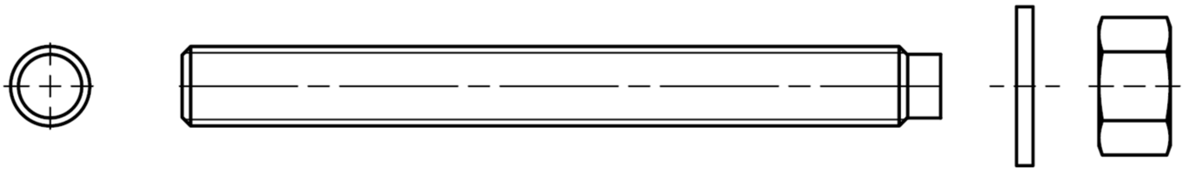
Static mixer Hilti HIT-RE-M

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC	Annex A2
Product description Injection mortar / Static mixer	

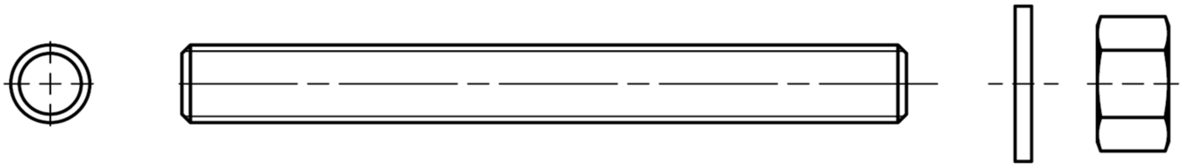
Steel elements



HAS-U-…: M12 to M24 washer nut



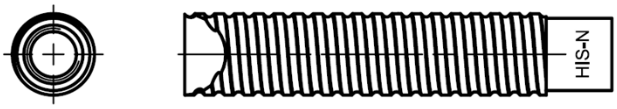
HIT-V-…: M12 to M24 washer nut



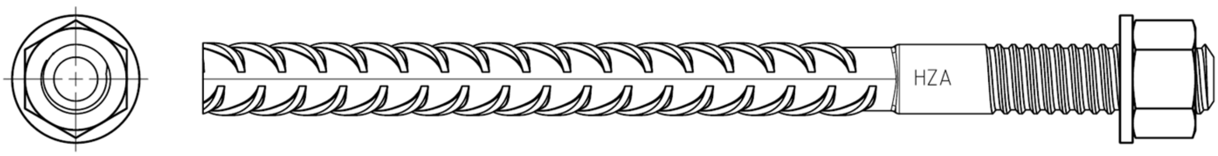
HAS…: M12 to M24
Threaded rod: M12 to M24 washer nut
Hilti AM 8.8 meter rod electroplated zinc coated: M12 to M24, 1m to 3m
Hilti AM HDG 8.8 meter rod hot dip galvanized: M12 to M24, 1m to 3m

Commercial standard threaded rod:

- Materials and mechanical properties according to Table A1.
- Inspection certificate 3.1 according to EN 10204. The document shall be stored.
- Marking of embedment depth.
- For hot dip galvanized elements, the requirements of standard EN ISO 10684 shall be considered, especially with regards to the specified selection, e.g. which combination of nuts and rods to be avoided.

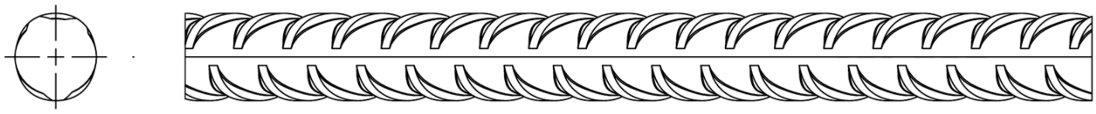


Internally threaded sleeve: HIS-(R)N M8 to M16



Hilti Tension Anchor: HZA M12 to M20 and HZA-R M12 to M20

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC	**Annex A3**
Product description Steel elements	



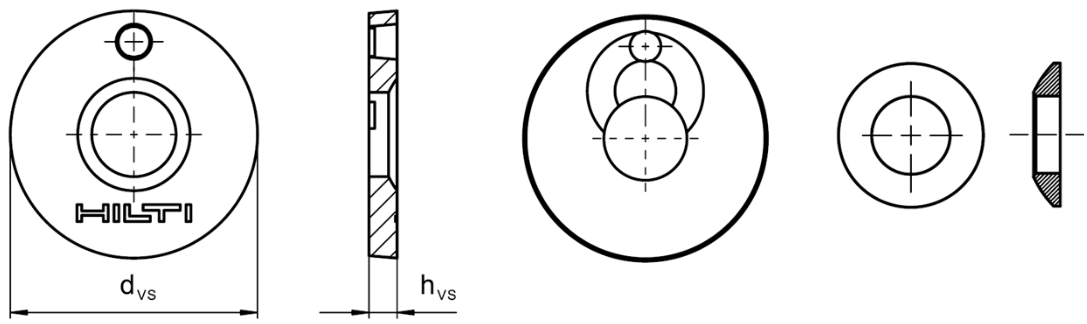
Reinforcing bar (rebar): ϕ 12 to ϕ 20

- Materials and mechanical properties according to Table A1
- Dimensions according to Annex B7

Hilti Filling Set to fill the annular gap between steel element and fixture

Sealing washer

Spherical washer



Hilti Filling Set			**M12**	**M16**	**M20**	**M24**
Diameter of sealing washer	d_{VS}	[mm]	44	52	60	70
Thickness of sealing washer	h_{VS}	[mm]	5	6	6	6
Thickness of Hilti Filling Set	h_{fs}	[mm]	10	11	13	15

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC

Product description
Steel elements / Hilti Filling Set

Annex A4

Table A1: Materials

Designation	Material
Reinforcing bars (rebars)	
Rebar EN 1992-1-1, Annex C	Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCI of EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$
Steel elements made of zinc coated steel	
HAS 5.8 (HDG), HAS-U 5.8 (HDG), HIT-V 5.8 (F), Threaded rod 5.8	Strength class 5.8, f_{uk} = 500 N/mm², f_{yk} = 400 N/mm², Elongation at fracture (l_0=5d) > 8% ductile Electroplated zinc coated ≥ 5 µm, (F) or (HDG) hot dip galvanized[1] ≥ 50 µm
Threaded rod 6.8	Strength class 6.8, f_{uk} = 600 N/mm², f_{yk} = 480 N/mm², Elongation at fracture (l_0=5d) > 8% ductile Electroplated zinc coated ≥ 5 µm or hot dip galvanized ≥ 50 µm
HAS 8.8 (HDG), HAS-U 8.8 (HDG), HIT-V 8.8 (F), AM 8.8 (HDG), Threaded rod 8.8	Strength class 8.8, f_{uk} = 800 N/mm², f_{yk} = 640 N/mm², Elongation at fracture (l_0=5d) > 12% ductile Electroplated zinc coated ≥ 5 µm, (F) or (HDG) hot dip galvanized[1] ≥ 50 µm
Hilti tension anchor HZA	Round steel with threaded part: electroplated zinc coated ≥ 5 µm Rebar: Bars class B according to NDP or NCI of EN 1992-1-1/NA
Internally threaded sleeve HIS-N	Electroplated zinc coated ≥ 5 µm
Washer	Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 50 µm
Nut	Strength class of nut adapted to strength class of threaded rod Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized[1] ≥ 50 µm
Hilti Filling Set (F)	Filling washer: Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 50 µm Spherical washer: Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 50 µm Lock nut: Electroplated zinc coated ≥ 5 µm, (F) Electroplated zinc-nickel coated ≥ 6 µm

[1] For commercial standard hot dip galvanized threaded rods and nuts, the requirements of the standard EN ISO 10684 shall be considered.

Table A1: continued

Steel elements made of stainless steel corrosion resistance class (CRC) II according EN 1993-1-4	
Threaded rod	For ≤ M24: strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; Elongation at fracture (l_0=5d) > 12% ductile Stainless steel 1.4301, 1.4307, 1.4311, 1.4541, 1.4306, 1.4567 EN 10088-1
Washer	Stainless steel 1.4301, 1.4307, 1.4311, 1.4541, 1.4306, 1.4567 EN 10088-1
Nut	For ≤ M24: strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; Stainless steel 1.4301, 1.4307, 1.4311, 1.4541, 1.4306, 1.4567 EN 10088-1
Steel elements made of stainless steel corrosion resistance class (CRC) III according EN 1993-1-4	
HAS A4,HAS-U A4, HIT-V-R	For ≤ M24: strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; Elongation at fracture (l_0=5d) > 12% ductile
Threaded rod	For ≤ M24: strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; Elongation at fracture (l_0=5d) > 12% ductile Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1
Hilti tension anchor HZA-R	Round steel with threaded part: Stainless steel 1.4404, 1.4362, 1.4571 EN 10088-1 Rebar: Bars class B according to NDP or NCI of EN 1992-1-1/NA
Internally threaded sleeve HIS-RN	Stainless steel 1.4401, 1.4571 EN 10088-1
Washer	Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1
Nut	For ≤ M24: strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1
Hilti Filling Set A4	Filling washer: Stainless steel according to EN 10088-1 Spherical washer: Stainless steel according to EN 10088-1 Lock nut: Stainless steel according to EN 10088-1
Steel elements made of high corrosion resistant steel corrosion resistance class (CRC) V according EN 1993-1-4	
HAS-U HCR, HIT-V-HCR	For ≤ M20: f_{uk} = 800 N/mm², f_{yk} = 640 N/mm², For > M20: f_{uk} = 700 N/mm², f_{yk} = 400 N/mm², Elongation at fracture (l_0=5d) > 12% ductile
Threaded rod	For ≤ M20: f_{uk} = 800 N/mm², f_{yk} = 640 N/mm², For > M20: f_{uk} = 700 N/mm², f_{yk} = 400 N/mm², Elongation at fracture (l_0=5d) > 12% ductile High corrosion resistant steel 1.4529, 1.4565 EN 10088-1
Washer	High corrosion resistant steel 1.4529, 1.4565 EN 10088-1
Nut	For ≤ M20: f_{uk} = 800 N/mm², f_{yk} = 640 N/mm², For > M20: f_{uk} = 700 N/mm², f_{yk} = 400 N/mm², High corrosion resistant steel 1.4529, 1.4565 EN 10088-1

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loading.
- Seismic performance category C1 and C2 (see Table B1).
- Fire exposure

Base material:

- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206 and steel fibre reinforced concrete (SFRC) according to EN 206 including steel fibres according to EN 14889-1 clause 5, group I. The maximum content of steel fibres is 80 kg/m³.
- Strength classes C20/25 to C50/60 according to EN 206.
- Cracked and uncracked concrete.

Temperature in the base material:

- **at installation**
  -10 °C to +40 °C for the standard variation of temperature after installation
- **in-service**
  Temperature range I: -40 °C to +40 °C
  (max. long term temperature +24 °C and max. short term temperature +40 °C)
  Temperature range II: -40 °C to +80 °C
  (max. long term temperature +50 °C and max. short term temperature +80 °C)
  Temperature range III: -40 °C to +120 °C
  (max. long term temperature +72 °C and max. short term temperature +120 °C)

Table B1: Specifications of intended use

	HIT-HY 200-A V3 and HIT-HY 200-R V3 with …			
Steel elements	Threaded rods according to Annex A	Rebar	HZA(-R)	HIS-(R)N
Hammer drilling with hollow drill bit TE-CD or TE-YD	✓	✓	✓	✓
Hammer drilling	✓	✓	✓	✓
Diamond drilling with roughening tool TE-YRT	✓	✓	✓	✓
Static and quasi static loading in uncracked and cracked concrete with and without fibres	M12 to M24	ϕ 12 to ϕ 20	M12 to M20	M8 to M16
Seismic performance category C1 in concrete with and without fibres	M12 to M24	ϕ 12 to ϕ 20	M12 to M20	-1)
Seismic performance category C2 in concrete with and without fibres	M12 to M24	-1)	-1)	-1)
Working life 50 or 100 years	50 and 100	50 and 100	50 and 100	50
Exposure under fire in concrete with and without fibres	✓	✓	-1)	-1)

1) No performance assessed.

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (all materials).
- For all other conditions according EN 1993-1-4
  corresponding to corrosion resistance classes Table A1 (stainless steels).

Design:

- Fastenings are designed under the responsibility of an engineer experienced in fastenings and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be fastened. The position of the fastener is indicated on the design drawings (e. g. position of the fastener relative to reinforcement or to supports, etc.).
- The anchorages are designed in accordance with:
  EN 1992-4 and EOTA TR 086.
- Design under fire exposure in accordance with:
  EOTA Technical Report TR 082 and EOTA TR 086.
- Fastenings in steel fibre reinforced concrete can be designed according to EN 1992-4 and EOTA TR 086. The performance for normal weight concrete of strength classes C20/25 to C50/60 without fibres applies.

Installation:

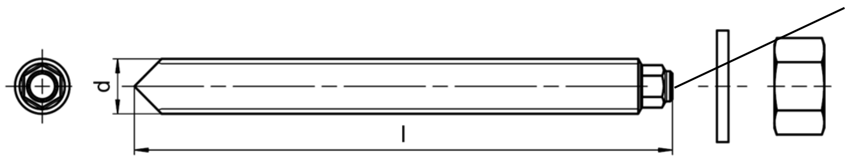
- Concrete condition I1: Installation in dry or wet (water saturated) concrete and use in service in dry or wet concrete for all drilling techniques
- Drilling technique:
  - Hammer drilling,
  - Hammer drilling with Hilti hollow drill bit TE-CD, TE-YD,
  - Diamond coring with roughening with Hilti roughening tool TE-YRT.
- Installation direction D3: downward, horizontal and upward (e.g. overhead) installation admissible for all elements.
- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Table B2: Installation parameters of threaded rods according to Annex A

Threaded rods according to Annex A				M12	M16	M20	M24
Diameter of element		d	[mm]	12	16	20	24
Nominal diameter of drill bit		d_0	[mm]	14	18	22	28
Effective embedment depth and drill hole depth		$h_{ef} = h_0$	[mm]	70 to 240	80 to 320	90 to 400	96 to 480
Maximum diameter of clearance hole in the fixture	pre-setting	d_f	[mm]	14	18	22	26
	through setting [1)]	d_f	[mm]	16	20 [2)]	24 [2)]	30 [2)]
Thickness of Hilti Filling Set		h_{fs}	[mm]	10	11	13	15
Effective fixture thickness with Hilti Filling Set		$t_{fix,eff}$	[mm]	$t_{fix,eff} = t_{fix} – h_{fs}$			
Minimum thickness of concrete member		h_{min}	[mm]	h_{ef} + 30 ≥ 100 mm	$h_{ef} + 2 \cdot d_0$		
Maximum installation torque		max T_{inst}	[Nm]	40	80	150	200
Minimum spacing		s_{min}	[mm]	60	75	90	115
Minimum edge distance		c_{min}	[mm]	45	50	55	60

1) For shear loaded anchors the provisions of EN 1992-4, §6.2.2, shall be considered.
2) If no Hilti Filling Set is used, a second washer is required (identical to specified one).

HAS-U…

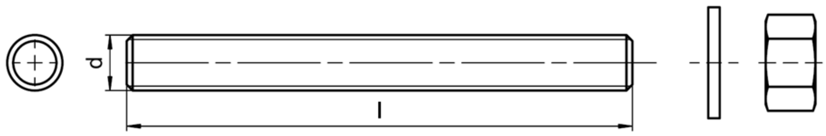


Marking:
Steel grade number and length identification letter: e.g. 8L
5 = HAS-U 5.8, 5.8 HDG
8 = HAS-U 8.8, 8.8 HDG
1 = HAS-U A4
2 = HAS-U HCR

HAS…, HIT-V-…

HIT-V Marking:
5.8 - l = HIT-V-5.8 M…x l
5.8F - l = HIT-V-5.8F M…x l
8.8 - l = HIT-V-8.8 M…x l
8.8F - l = HIT-V-8.8F M…x l
R - l = HIT-V-R M ...x l
HCR - l = HIT-V-HCR M ...x l

Hilti meter rod AM (HDG) 8.8



HAS, AM marking alternatives:
By color code:
5.8 = RAL 5010 (blue)
8.8 = RAL 1023 (yellow)
A4 = RAL 3000 (red)
By stamping:
Steel grade number and length identification letter (see HAS-U)

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC

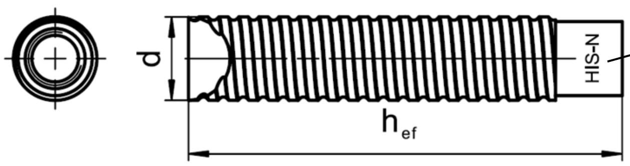
Intended use
Installation parameters of threaded rod, HAS…, HAS-U…, HIT-V-… and AM 8.8

Annex B4

Table B3: Installation parameters of internally threaded sleeve HIS-(R)N

Internally threaded sleeve HIS-(R)N…			**M8**	**M10**	**M12**	**M16**
Outer diameter of sleeve	d	[mm]	12,5	16,5	20,5	25,4
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	90	110	125	170
Maximum diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18
Minimum thickness of concrete member	h_{min}	[mm]	120	150	170	230
Maximum installation torque	max T_{inst}	[Nm]	10	20	40	80
Thread engagement length min-max	h_s	[mm]	8-20	10-25	12-30	16-40
Minimum spacing	s_{min}	[mm]	60	75	90	115
Minimum edge distance	c_{min}	[mm]	40	45	55	65

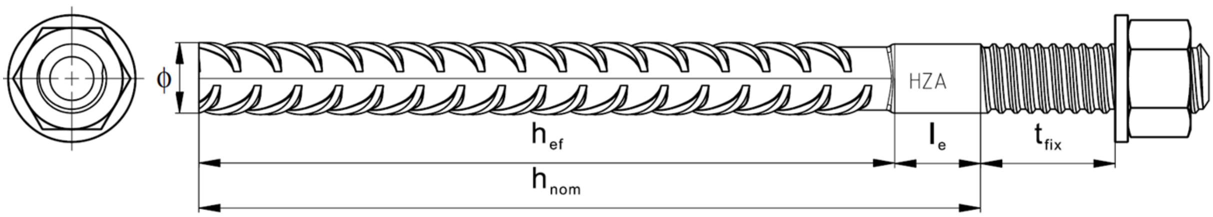
Internally threaded sleeve HIS-(R)N…



Marking:
Identifying mark - HILTI and
embossing "HIS-N" (for C-steel)
embossing "HIS-RN" (for stainless steel)

Table B4: Installation parameters of Hilti tension anchor HZA and HZA-R

			M12	M16	M20
Hilti tension anchor HZA			**M12**	**M16**	**M20**
Hilti tension anchor HZA-R			**M12**	**M16**	**M20**
Rebar diameter	ϕ	[mm]	12	16	20
Nominal embedment depth and drill hole depth HZA	$h_{nom} = h_0$	[mm]	90 to 240	100 to 320	110 to 400
Nominal embedment depth and drill hole depth HZA-R	$h_{nom} = h_0$	[mm]	170 to 240	180 to 320	190 to 400
Effective embedment depth ($h_{ef} = h_{nom} - l_e$) HZA	h_{ef}	[mm]	$h_{nom} - 20$		
Effective embedment depth ($h_{ef} = h_{nom} - l_e$) HZA-R	h_{ef}	[mm]	$h_{nom} - 100$		
Length of smooth shaft HZA	l_e	[mm]	20		
Length of smooth shaft HZA-R	l_e	[mm]	100		
Nominal diameter of drill bit	d_0	[mm]	16	20	25
Maximum diameter of clearance hole in the fixture	d_f	[mm]	14	18	22
Thickness of Hilti Filling Set	h_{fs}	[mm]	10	11	13
Effective fixture thickness with Hilti Filling Set	$t_{fix,eff}$	[mm]	$t_{fix,eff} = t_{fix} - h_{fs}$		
Maximum installation torque	max T_{inst}	[Nm]	40	80	150
Minimum thickness of concrete member	h_{min}	[mm]	$h_{nom} + 2 \cdot d_0$		
Minimum spacing	s_{min}	[mm]	65	80	100
Minimum edge distance	c_{min}	[mm]	45	50	55



Marking:
embossing “HZA(-R)” M .. / t_{fix}

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC

Intended use
Installation parameters of Hilti tension anchor HZA and HZA-R

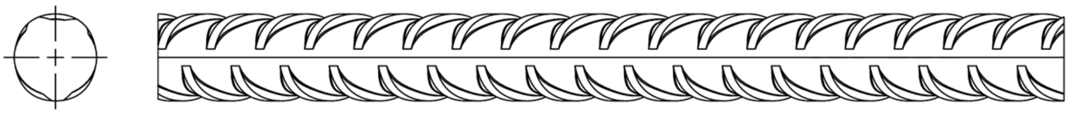
Annex B6

Table B5: Installation parameters of reinforcing bar

Reinforcing bar (rebar)			**ϕ 12**		**ϕ 14**	**ϕ 16**	**ϕ 20**
Diameter	ϕ	[mm]	12		14	16	20
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	70 to 240		75 to 280	80 to 320	90 to 400
Nominal diameter of drill bit	d_0	[mm]	14[1)]	16[1)]	18	20	25
Minimum thickness of concrete member	h_{min}	[mm]	h_{ef} + 30 ≥ 100 mm		$h_{ef} + 2 \cdot d_0$		
Minimum spacing	s_{min}	[mm]	60		70	80	100
Minimum edge distance	c_{min}	[mm]	45		50	50	65

1) Each of the two given values can be used.

Reinforcing bar



For rebar bolt

- Minimum value of related rib area $f_{R,min}$ according to EN 1992-1-1
- Rib height of the bar h_{rib} shall be in the range $0{,}05 \cdot \phi \leq h_{rib} \leq 0{,}07 \cdot \phi$
  (ϕ: Nominal diameter of the bar; h_{rib}: Rib height of the bar)

Table B6: Maximum working time and minimum curing time

Temperature in the base material T 1)	HIT-HY 200-A V3		HIT-HY 200-R V3	
	Maximum working time t_{work}	Minimum curing time t_{cure}	Maximum working time t_{work}	Minimum curing time t_{cure}
-10 °C to -5 °C	1,5 hours	7 hours	3 hours	20 hours
> -5 °C to 0 °C	50 min	4 hours	1,5 hours	8 hours
> 0 °C to 5 °C	25 min	2 hours	45 min	4 hours
>5 °C to 10 °C	15 min	75 min	30 min	2,5 hours
>10 °C to 20 °C	7 min	45 min	15 min	1,5 hours
>20 °C to 30 °C	4 min	30 min	9 min	1 hour
>30 °C to 40 °C	3 min	30 min	6 min	1 hour

1) The minimum foil pack temperature is 0 °C.

Table B7: Parameters of drilling, cleaning and setting tools

Steel elements				**Drill and clean**					**Installa-tion**
Threaded rods (Annex A)	HIS-(R)N	Rebar	HZA(-R)	Hammer drilling	Hollow drill bit[1)]	Diamond coring	Roughening tool	Brush	Piston plug
									
Size	size	size	size	d_0 [mm]	d_0 [mm]	d_0 [mm]	d_0 [mm]	HIT-RB	HIT-SZ
M12	M8	ϕ12	-	14	14	-	-	14	14
-	-	ϕ12	M12	16	16	-	-	16	16
M16	M10	ϕ14	-	18	18	18	18	18	18
-	-	ϕ16	M16	20	20	20	20	20	20
M20	M12	-	-	22	22	22	22	22	22
-	-	ϕ20	M20	25	25	25	25	25	25
M24	M16	-	-	28	28	28	28	28	28

1) With vacuum cleaner Hilti VC 4X/10/20/40/60 (automatic filter cleaning activated, eco mode off) or a vacuum cleaner providing equivalent cleaning performance in combination with the specified Hilti hollow drill bit TE-CD or TE-YD.

Cleaning alternatives

Manual Cleaning (MC):
Hilti hand pump for blowing out drill holes with diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot d$.

Compressed air cleaning (CAC):
Air nozzle with an orifice opening of minimum 3,5 mm in diameter.

Automatic Cleaning (AC):
Cleaning is performed during drilling with Hilti TE-CD and TE-YD drilling system including vacuum cleaner.

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC

Intended use
Parameters of drilling, cleaning and setting tools
Cleaning alternatives

Annex B9

Table B8: Hilti roughening tool TE-YRT – tool parameters

Associated components			
Diamond coring		Roughening tool TE-YRT	Wear gauge RTG…
			
d_0 [mm]		d_0 [mm]	size
nominal	measured		
18	17,9 to 18,2	18	18
20	19,9 to 20,2	20	20
22	21,9 to 22,2	22	22
25	24,9 to 25,2	25	25
28	27,9 to 28,2	28	28

Table B9: Hilti roughening tool TE-YRT – roughening and blowing times

h_{ef}	**Roughening time** $t_{roughen}$	**Minimum blowing time** $t_{blowing}$
[mm]	[sec]	[sec]
0 to 100	10	30
101 to 200	20	40
201 to 300	30	50
301 to 400	40	60
401 to 500	50	70
501 to 600	60	80
> 600	$t_{roughen}$ [sec] = h_{ef} [mm] / 10	$t_{blowing}$ [sec] = $t_{roughen}$ [sec] + 20

Hilti roughening tool TE-YRT and wear gauge RTG

Hilti roughening tool TE-YRT	
Wear gauge RTG	

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC

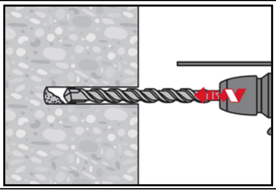
Intended use
Parameters for use of the Hilti Roughening tool TE-YRT

Annex B10

Installation instruction

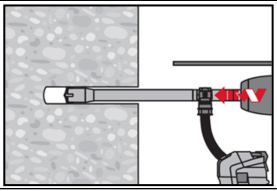
Hole drilling

a) Hammer drilling



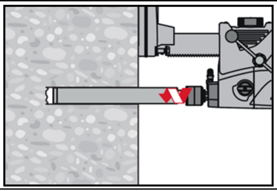
Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

b) Hammer drilling with Hilti hollow drill bit

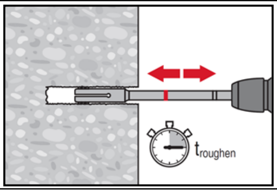


Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with vacuum attachment following the requirements given in Table B7. This drilling system removes the dust and cleans the drill hole during drilling when used in accordance with the user’s manual. After drilling is completed, proceed to the “injection preparation” step in the installation instruction.

c) Diamond coring with roughening with Hilti roughening tool TE-YRT:



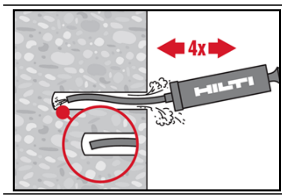
Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.
For the use in combination with Hilti roughening tool TE-YRT see parameters in Table B8.



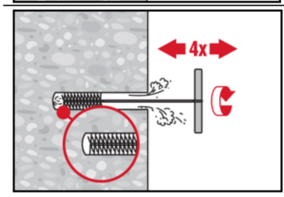
Before roughening water needs to be removed from the drill hole.
Check usability of the roughening tool with the wear gauge RTG.
Roughen the drill hole over the whole length to the required h_{ef}.
Roughening time $t_{roughen}$ see Table B9.

Drill hole cleaning Just before injection of the mortar, the drill hole must be free of dust and debris. Inadequate hole cleaning = poor load values.

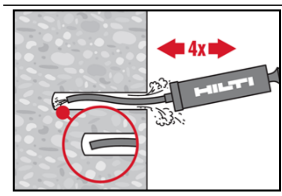
Manual Cleaning (MC) Uncracked concrete only.
For drill hole diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot d$.



The Hilti hand pump may be used for blowing out drill holes up to diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot d$.
Blow out at least 4 times from the back of the drill hole until return air stream is free of noticeable dust.

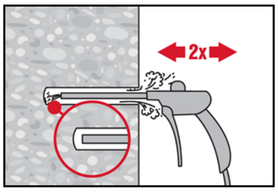
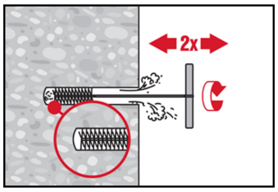
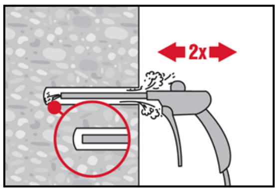
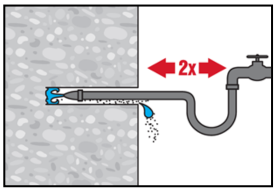
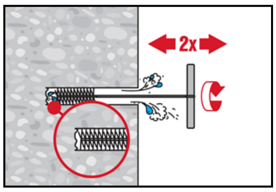
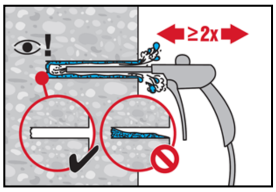


Brush 4 times with the specified brush (see Table B7) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.

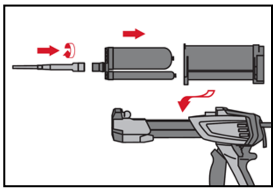


Blow out again with the Hilti hand pump at least 4 times until return air stream is free of noticeable dust.

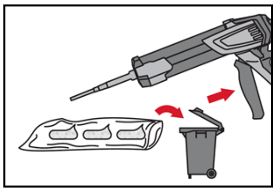
Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC	**Annex B11**
Intended use Installation instructions	

Compressed air cleaning (CAC) for all drill hole diameters d_0 and all drill hole depths h_0	
	Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust. For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m³/h.
	Brush 2 times with the specified brush (see Table B7) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.
	Blow again with compressed air 2 times until return air stream is free of noticeable dust.
Cleaning of diamond cored holes with roughening with Hilti roughening tool TE-YRT.	
	Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.
	Brush 2 times with the specified brush (see Table B7) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.
	Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust and water. Remove all water from the drillhole until drillhole is completely dried before mortar injection ($t_{blowing}$ see Table B9). For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m³/h.

Injection preparation

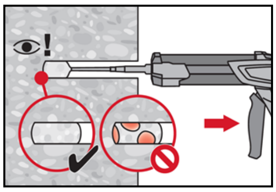


Tightly attach Hilti mixing nozzle HIT-RE-M to foil pack manifold. Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser.
Check foil pack holder for proper function. Insert foil pack into foil pack holder and put holder into dispenser.

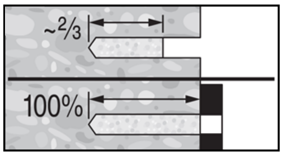


The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack, an initial amount of adhesive has to be discarded. Discarded quantities are
2 strokes for 330 ml foil pack,
3 strokes for 500 ml foil pack,
4 strokes for 500 ml foil pack ≤ 5 °C.
The minimum foil pack temperature is 0°C.

Inject adhesive from the back of the drill hole without forming air voids.

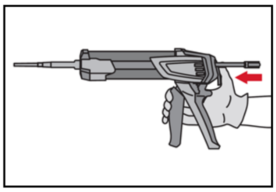


Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull. Fill approximately 2/3 of the drill hole to ensure that the annular gap between the steel element and the concrete is completely filled with adhesive along the embedment length.
In water saturated concrete it is required to set the fastener immediately after cleaning the drillhole.

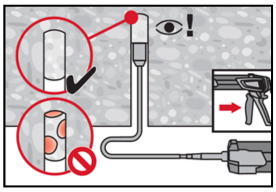


Pre-setting: Fill approximately 2/3 of the drill hole.

Through-setting: Fill 100% of the drill hole.



After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.



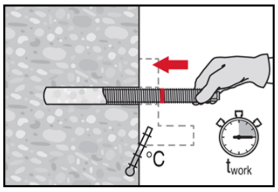
Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (see Table B7). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure.

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC

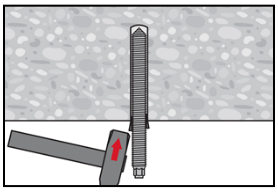
Intended use
Installation instructions

Annex B13

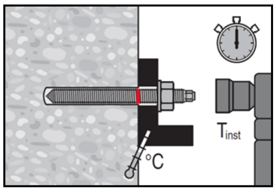
Setting the steel element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set steel element to the required embedment depth before working time t_{work} has elapsed. The working time t_{work} is given in Table B6.
After setting the element the annular gap between the anchor and the fixture (through-setting) or concrete (pre-setting) has to be filled with mortar.

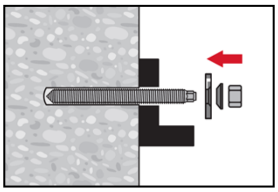


For overhead installation use piston plugs and fix embedded parts with e.g. wedges (Hilti HIT-OHW).

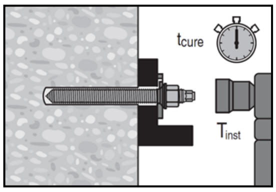


After required curing time t_{cure} (see Table B6) remove excess mortar, the fastening can be loaded. Do not damage thread of element while removing excess mortar.
The applied installation torque shall not exceed the values max T_{inst} given in Table B2 to Table B4.

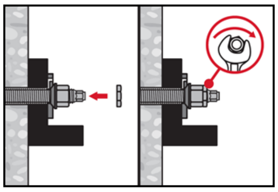
Installation of Hilti Filling Set



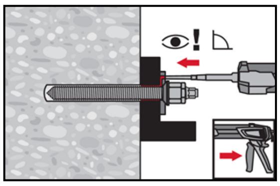
Use Hilti Filling Set with standard nut. Observe the correct orientation of filling washer and spherical washer.



The applied installation torque shall not exceed the values max T_{inst} given in Table B2 to Table B4.



Optional:
Installation of lock nut. Tighten with a ¼ to ½ turn. (Not for size M24.)



Fill the annular gap between steel element and fixture with 1-3 strokes of a Hilti injection mortar HIT-HY … or HIT-RE … .
Follow the installation instructions supplied with the respective Hilti injection mortar.
After required curing time t_{cure} the fastening can be loaded.

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC	**Annex B14**
Intended use Installation instructions	

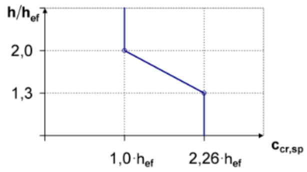
Essential characteristics under static and quasi-static loading in concrete with and without fibres

Table C1: Essential characteristics for threaded rods according to Annex A under tension load in concrete

Threaded rods according to Annex A				**M12**	**M16**	**M20**	**M24**
For a working life of 50 and 100 years							
Installation factor for installation in dry or wet (water saturated) concrete							
Hammer drilling (HD)		γ_{inst}	[-]	1,0			
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD (HDB)		γ_{inst}	[-]	1,0			
Diamond coring with roughening with Hilti roughening tool TE-YRT (DD+RT)		γ_{inst}	[-]	1)	1,0		
Steel failure							
Characteristic resistance – commercial threaded rod 5.8, 6.8, 8.8, CRC II, III, V		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$			
Characteristic resistance HAS, HAS-U, AM, HIT-V	5.8	$N_{Rk,s}$	[kN]	42,1	78,5	122,5	176,5
	5.8 HDG/ F			42,1	78,5	122,5	176,5
	8.8			67,4	125,6	196,0	282,4
	8.8 HDG/ F			67,4	125,6	196,0	282,4
	A4 (70 - 50)			59,0	109,9	171,5	247,1
	HCR (80 - 70)			67,4	125,6	196,0	247,1
Partial factor grade 5.8, 6.8 and 8.8 (Table A1)		$\gamma_{Ms,N}$ 2)	[-]	1,5			
Partial factor HAS A4, HAS-U A4, HIT-V-R, Threaded rod: CRC II and III (Table A1)		$\gamma_{Ms,N}$ 2)	[-]	1,87			
Partial factor HAS-U HCR, HIT-V-HCR, Threaded rod: CRC V (Table A1)		$\gamma_{Ms,N}$ 2)	[-]	1,5			2,1
Concrete cone failure							
Factor for uncracked concrete		$k_{ucr,N}$	[-]	11,0			
Factor for cracked concrete		$k_{cr,N}$	[-]	7,7			
Edge distance		$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$			
Spacing		$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$			

1) No performance assessed.
2) In absence of national regulations.

Table C1: continued (1)

Threaded rods according to Annex A		**M12**	**M16**	**M20**	**M24**
Splitting failure					
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2{,}0$	$1{,}0 \cdot h_{ef}$			
	$2{,}0 > h / h_{ef} > 1{,}3$	$4{,}6 \cdot h_{ef} - 1{,}8 \cdot h$			
	$h / h_{ef} \leq 1{,}3$	$2{,}26 \cdot h_{ef}$			
Spacing	$s_{cr,sp}$ [mm]	$2 \cdot c_{cr,sp}$			
Combined pullout and concrete cone failure for a working life of 50 years					
Characteristic bond resistance in uncracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)					
Temperature range I:	24°C/40°C $\tau_{Rk,ucr}$ [N/mm²]	18			
Temperature range II:	50°C/80°C $\tau_{Rk,ucr}$ [N/mm²]	15			
Temperature range III:	72°C/120°C $\tau_{Rk,ucr}$ [N/mm²]	13			
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)					
Temperature range I:	24°C/40°C $\tau_{Rk,cr}$ [N/mm²]	9,5			
Temperature range II:	50°C/80°C $\tau_{Rk,cr}$ [N/mm²]	8,0			
Temperature range III:	72°C/120°C $\tau_{Rk,cr}$ [N/mm²]	6,9			
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete					
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk(C20/25)} \cdot \psi_c$					
Temperature range I to III :	ψ_c [-]	$(f_{ck}/20)^{0,1}$			
Influence of sustained load					
Temperature range I:	24°C/40°C ψ^0_{sus} [-]	0,80			
Temperature range II:	50°C/80°C ψ^0_{sus} [-]	0,89			
Temperature range III:	72°C/120°C ψ^0_{sus} [-]	0,72			

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC

Performance
Essential characteristics under tension load in concrete

Annex C2

Table C1: continued (2)

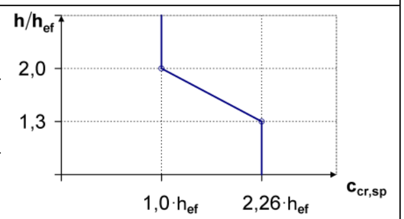
Threaded rods according to Annex A	M12	M16	M20	M24
Combined pullout and concrete cone failure for a working life of 100 years				
Characteristic bond resistance in uncracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)				
Temperature range I: 24°C/40°C $\tau_{Rk,ucr,100}$ [N/mm²]	17			
Temperature range II: 50°C/80°C $\tau_{Rk,ucr,100}$ [N/mm²]	14			
Temperature range III: 72°C/120°C $\tau_{Rk,ucr,100}$ [N/mm²]	12			
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)				
Temperature range I: 24°C/40°C $\tau_{Rk,cr,100}$ [N/mm²]	8,1			
Temperature range II: 50°C/80°C $\tau_{Rk,cr,100}$ [N/mm²]	7,0			
Temperature range III: 72°C/120°C $\tau_{Rk,cr,100}$ [N/mm²]	6,0			
Influence factors ψ on bond resistance $\tau_{Rk,100}$ in cracked and uncracked concrete				
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,100,(C20/25)} \cdot \psi_c$				
Temperature range I to III : ψ_c [-]	$(f_{ck}/20)^{0,1}$			
Influence of sustained load				
Temperature range I: 24°C/40°C $\psi^0_{sus,100}$ [-]	0,85			
Temperature range II: 50°C/80°C $\psi^0_{sus,100}$ [-]	0,95			
Temperature range III: 72°C/120°C $\psi^0_{sus,100}$ [-]	0,80			

Table C2: Essential characteristics for threaded rods according to Annex A under shear load in concrete

Threaded rods according to Annex A				M12	M16	M20	M24
For a working life of 50 and 100 years							
Steel failure without lever arm							
Characteristic resistance		$V^0_{Rk,s}$	[kN]	$k_6 \cdot N_{Rk,s}$			
Factor grade 5.8		k_6	[-]	0,6			
Factor grade 6.8 and 8.8		k_6	[-]	0,5			
Factor HAS A4, HAS-U A4, HIT-V-R, Threaded rod: CRC II and III (Table A1)		k_6	[-]	0,5			
Factor HAS-U HCR, HIT-V-HCR, Threaded rod: CRC V (Table A1)		k_6	[-]	0,5			
Partial factor grade 5.8, 6.8, 8.8		$\gamma_{Ms,V}$ 1)	[-]	1,25			
Partial factor HAS A4, HAS-U A4, HIT-V-R, Threaded rod CRC II and III (Table A1)		$\gamma_{Ms,V}$ 1)	[-]	1,56			
Partial factor HAS-U HCR, HIT-V-HCR, Threaded rod CRC V (Table A1)		$\gamma_{Ms,V}$ 1)	[-]	1,25			1,75
Ductility factor		k_7	[-]	1,0			
Steel failure with lever arm							
Characteristic resistance – commercial threaded rod 5.8, 6.8, 8.8, CRC II, III, V		$M^0_{Rk,s}$	[Nm]	$1{,}2 \cdot W_{el} \cdot f_{uk}$			
Characteristic resistance HAS, HAS-U, AM, HIT-V	5.8	$M^0_{Rk,s}$	[Nm]	65,4	166,2	324,6	561,0
	5.8 HDG/ F			65,4	166,2	324,6	561,0
	8.8			104,6	265,9	519,3	897,6
	8.8 HDG/ F			104,6	265,9	519,3	897,6
	A4 (70 - 50)			91,5	232,6	454,4	785,4
	HCR (80 - 70)			104,6	265,9	519,3	785,4
Ductility factor		k_7	[-]	1,0			
Concrete pry-out failure							
Pry-out factor		k_8	[-]	2,0			
Concrete edge failure							
Effective length of fastener		l_f	[mm]	min (h_{ef}; $12 \cdot d_{nom}$)			
Outside diameter of fastener		d_{nom}	[mm]	12	16	20	24

1) In absence of national regulations.

Table C3: Essential characteristics for internally threaded sleeve HIS-(R)N under tension load in concrete

HIS-(R)N			M8	M10	M12	M16
For a working life of 50 years						
Installation factor						
Hammer drilling	γ_{inst}	[-]	1,0			
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD	γ_{inst}	[-]	1,0			
Diamond coring with roughening with Hilti roughening tool TE-YRT	γ_{inst}	[-]	[1]	1,0		
Steel failure						
Characteristic resistance HIS-N with screw or threaded rod grade 8.8	$N_{Rk,s}$	[kN]	25	46	67	125
Partial factor	$\gamma_{Ms,N}$ [2]	[-]	1,50			
Characteristic resistance HIS-RN with screw or threaded rod grade 70	$N_{Rk,s}$	[kN]	26	41	59	110
Partial factor	$\gamma_{Ms,N}$ [2]	[-]	1,87			
Concrete cone failure						
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0			
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7			
Edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$			
Spacing	$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$			
Splitting failure						
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2,0$		$1,0 \cdot h_{ef}$			
	$2,0 > h / h_{ef} > 1,3$		$4,6\ h_{ef} - 1,8\ h$			
	$h / h_{ef} \leq 1,3$		$2,26\ h_{ef}$			
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$			

1) No performance assessed.
2) In absence of national regulations.

Table C3: continued

HIS-(R)N			M8	M10	M12	M16
Combined pullout and concrete cone failure for a working life of 50 years						
Effective embedment depth	h_{ef}	[mm]	90	110	125	170
Effective fastener diameter	d_1	[mm]	12,5	16,5	20,5	25,4
Characteristic bond resistance in uncracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)						
Temperature range I: 24°C/40°C	$\tau_{Rk,ucr}$	[N/mm²]	13			
Temperature range II: 50°C/80°C	$\tau_{Rk,ucr}$	[N/mm²]	11			
Temperature range III: 72°C/120°C	$\tau_{Rk,ucr}$	[N/mm²]	9,5			
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)						
Temperature range I: 24°C/40°C	$\tau_{Rk,cr}$	[N/mm²]	7			
Temperature range II: 50°C/80°C	$\tau_{Rk,cr}$	[N/mm²]	5,5			
Temperature range III: 72°C/120°C	$\tau_{Rk,cr}$	[N/mm²]	5			
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete						
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk(C20/25)} \cdot \psi_c$						
Temperature range I to III :	ψ_c	[-]	$(f_{ck}/20)^{0,1}$			
Influence of sustained load						
Temperature range I: 24°C/40°C	ψ^0_{sus}	[-]	0,80			
Temperature range II: 50°C/80°C	ψ^0_{sus}	[-]	0,89			
Temperature range III: 72°C/120°C	ψ^0_{sus}	[-]	0,72			

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Performance
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Annex C6

Table C4: Essential characteristics for internally threaded sleeve HIS-(R)N under shear load in concrete

HIS-(R)N			M8	M10	M12	M16
For a working life of 50 years						
Steel failure without lever arm						
Characteristic resistance HIS-N with screw or threaded rod grade 8.8	$V^0_{Rk,s}$	[kN]	13	23	34	63
Partial factor	$\gamma_{Ms,V}$ 1)	[-]	1,25			
Characteristic resistance HIS-RN with screw or threaded rod grade 70	$V^0_{Rk,s}$	[kN]	13	20	30	55
Partial factor	$\gamma_{Ms,V}$ 1)	[-]	1,56			
Ductility factor	k_7	[-]	1,0			
Steel failure with lever arm						
Characteristic resistance HIS-N with screw or threaded rod grade 8.8	$M^0_{Rk,s}$	[Nm]	30	60	105	266
Characteristic resistance HIS-RN with screw or threaded rod grade 70	$M^0_{Rk,s}$	[Nm]	26	52	92	233
Ductility factor	k_7	[-]	1,0			
Concrete pry-out failure						
Pry-out factor	k_8	[-]	2,0			
Concrete edge failure						
Effective length of fastener	l_f	[mm]	90	110	125	170
Outside diameter of fastener	d_{nom}	[mm]	12,5	16,5	20,5	25,4

1) In absence of national regulations.

Table C5: Essential characteristics for Hilti tension anchor HZA / HZA-R under tension load in concrete

Hilti tension anchor HZA, HZA-R				**M12**	**M16**	**M20**
For a working life of 50 and 100 years						
Installation factor for installation in dry or wet (water saturated) concrete						
Hammer drilling		γ_{inst}	[-]	1,0		
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD		γ_{inst}	[-]	1,0		
Diamond coring with roughening with Hilti roughening tool TE-YRT		γ_{inst}	[-]	1)	1,0	
Steel failure						
Characteristic resistance HZA		$N_{Rk,s}$	[kN]	46	86	135
Characteristic resistance HZA-R		$N_{Rk,s}$	[kN]	62	111	173
Partial factor		$\gamma_{Ms,N}$ 2)	[-]	1,4		
Concrete cone failure						
Effective anchorage depth	HZA	h_{ef}	[mm]	h_{nom}		
	HZA-R	h_{ef}	[mm]	h_{nom}		
Factor for uncracked concrete		$k_{ucr,N}$	[-]	11,0		
Factor for cracked concrete		$k_{cr,N}$	[-]	7,7		
Edge distance		$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$		
Spacing		$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$		
Splitting failure relevant for uncracked concrete						
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2{,}0$			$1{,}0 \cdot h_{ef}$		
	$2{,}0 > h / h_{ef} > 1{,}3$			$4{,}6 \cdot h_{ef} - 1{,}8 \cdot h$		
	$h / h_{ef} \leq 1{,}3$			$2{,}26 \cdot h_{ef}$		
Spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$		

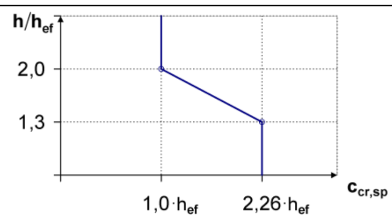

Table C5: continued (1)

Hilti tension anchor HZA, HZA-R				**M12**	**M16**	**M20**
Diameter of rebar		d	[mm]	12	16	20
Effective anchorage depth	HZA	h_{ef}	[mm]	$h_{nom} - 20$		
	HZA-R	h_{ef}	[mm]	$h_{nom} - 100$		
Combined pull-out and concrete cone failure for a working life of 50 years						
Characteristic bond resistance in uncracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)						
Temperature range I:	24°C/40°C	$\tau_{Rk,ucr}$	[N/mm²]	12		
Temperature range II:	50°C/80°C	$\tau_{Rk,ucr}$	[N/mm²]	10		
Temperature range III:	72°C/120°C	$\tau_{Rk,ucr}$	[N/mm²]	8,5		
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)						
Temperature range I:	24°C/40°C	$\tau_{Rk,cr}$	[N/mm²]	7		
Temperature range II:	50°C/80°C	$\tau_{Rk,cr}$	[N/mm²]	5,5		
Temperature range III:	72°C/120°C	$\tau_{Rk,cr}$	[N/mm²]	5		
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete						
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk(C20/25)} \cdot \psi_c$						
Temperature range I to III :		ψ_c	[-]	$(f_{ck}/20)^{0,1}$		
Influence of sustained load						
Temperature range I:	24°C/40°C	ψ^0_{sus}	[-]	0,80		
Temperature range II:	50°C/80°C	ψ^0_{sus}	[-]	0,89		
Temperature range III:	72°C/120°C	ψ^0_{sus}	[-]	0,72		

Table C5: continued (2)

Hilti tension anchor HZA, HZA-R				**M12**	**M16**	**M20**
Diameter of rebar		d	[mm]	12	16	20
Effective anchorage depth	HZA	h_{ef}	[mm]	h_{nom} – 20		
	HZA-R	h_{ef}	[mm]	h_{nom} – 100		
Combined pull-out and concrete cone failure for a working life 100 years						
Characteristic bond resistance in uncracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)						
Temperature range I:	24°C/40°C	$\tau_{Rk,ucr,100}$	[N/mm²]	12		
Temperature range II:	50°C/80°C	$\tau_{Rk,ucr,100}$	[N/mm²]	10		
Temperature range III:	72°C/120°C	$\tau_{Rk,ucr,100}$	[N/mm²]	8,5		
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)						
Temperature range I:	24°C/40°C	$\tau_{Rk,cr,100}$	[N/mm²]	7		
Temperature range II:	50°C/80°C	$\tau_{Rk,cr,100}$	[N/mm²]	5,5		
Temperature range III:	72°C/120°C	$\tau_{Rk,cr,100}$	[N/mm²]	5		
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete						
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,100,(C20/25)} \cdot \psi_c$						
Temperature range I to III :		ψ_c	[-]	$(f_{ck}/20)^{0,1}$		
Influence of sustained load						
Temperature range I:	24°C/40°C	$\psi^0_{sus,100}$	[-]	0,80		
Temperature range II:	50°C/80°C	$\psi^0_{sus,100}$	[-]	0,89		
Temperature range III:	72°C/120°C	$\psi^0_{sus,100}$	[-]	0,72		

1) No performance assessed.
2) In absence of national regulations.

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Performance
Essential characteristics under tension load in concrete

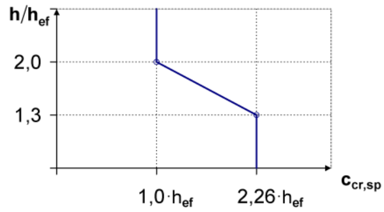
Annex C10

Table C6: Essential characteristics for Hilti tension anchor HZA, HZA-R under shear load in concrete

Hilti tension anchor HZA, HZA-R			M12	M16	M20
For a working life of 50 and 100 years					
Steel failure without lever arm					
Characteristic resistance HZA	$V^0_{Rk,s}$	[kN]	23	43	67
Characteristic resistance HZA-R	$V^0_{Rk,s}$	[kN]	31	55	86
Partial factor	$\gamma_{Ms,V}$ [1]	[-]		1,5	
Ductility factor	k_7	[-]		1,0	
Steel failure with lever arm					
Characteristic resistance HZA	$M^0_{Rk,s}$	[Nm]	72	183	357
Characteristic resistance HZA-R	$M^0_{Rk,s}$	[Nm]	97	234	457
Ductility factor	k_7	[-]		1,0	
Concrete pry-out failure					
Pry-out factor	k_8	[-]		2,0	
Concrete edge failure					
Effective length of fastener	l_f	[mm]		min (h_{nom}; 12 · d_{nom})	
Outside diameter of fastener	d_{nom}	[mm]	12	16	20

[1] In absence of national regulations.

Table C7: Essential characteristics for rebar under tension load in concrete

Rebar			**ϕ 12**	**ϕ 14**	**ϕ 16**	**ϕ 20**
For a working life of 50 and 100 years						
Installation factor for installation in dry or wet (water saturated) concrete						
Hammer drilling	γ_{inst}	[-]	1,0			
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD	γ_{inst}	[-]	1,0			
Diamond coring with roughening with Hilti roughening tool TE-YRT	γ_{inst}	[-]	1)	1,0		
Steel failure						
Characteristic resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$ 2)			
Characteristic resistance Rebar B500B acc. to DIN 488-1	$N_{Rk,s}$	[kN]	61,1	83,1	108,6	169,6
Partial factor	$\gamma_{Ms,N}$ 3)	[-]	1,4			
Concrete cone failure						
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0			
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7			
Edge distance	$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$			
Spacing	$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$			
Splitting failure relevant for uncracked concrete						
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2{,}0$	$1{,}0 \cdot h_{ef}$				
	$2{,}0 > h / h_{ef} > 1{,}3$	$4{,}6 \cdot h_{ef} - 1{,}8 \cdot h$				
	$h / h_{ef} \leq 1{,}3$	$2{,}26 \cdot h_{ef}$				
Spacing	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$			

1) No performance assessed.
2) f_{uk} according to rebar specification.
3) In absence of national regulations.

Table C7: continued (1)

Rebar				**ϕ 12**	**ϕ 14**	**ϕ 16**	**ϕ 20**
Diameter of rebar		d	[mm]	12	14	16	20
Combined pull-out and concrete cone failure for a working life of 50 years							
Characteristic bond resistance in uncracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)							
Temperature range I:	24°C/40°C	$\tau_{Rk,ucr}$	[N/mm²]	12			
Temperature range II:	50°C/80°C	$\tau_{Rk,ucr}$	[N/mm²]	10			
Temperature range III:	72°C/120°C	$\tau_{Rk,ucr}$	[N/mm²]	8,5			
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)							
Temperature range I:	24°C/40°C	$\tau_{Rk,cr}$	[N/mm²]	7,0			
Temperature range II:	50°C/80°C	$\tau_{Rk,cr}$	[N/mm²]	5,5			
Temperature range III:	72°C/120°C	$\tau_{Rk,cr}$	[N/mm²]	5,0			
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete							
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk(C20/25)} \cdot \psi_c$							
Temperature range I to III :		ψ_c	[-]	$(f_{ck}/20)^{0,1}$			
Influence of sustained load							
Temperature range I:	24°C/40°C	ψ^0_{sus}	[-]	0,80			
Temperature range II:	50°C/80°C	ψ^0_{sus}	[-]	0,89			
Temperature range III:	72°C/120°C	ψ^0_{sus}	[-]	0,72			

Table C7: continued (2)

Rebar	**ϕ 12**	**ϕ 14**	**ϕ 16**	**ϕ 20**
Diameter of rebar d [mm]	12	14	16	20
Combined pull-out and concrete cone failure for a working life of 100 years				
Characteristic bond resistance in uncracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)				
Temperature range I: 24°C/40°C $\tau_{Rk,ucr,100}$ [N/mm²]	12			
Temperature range II: 50°C/80°C $\tau_{Rk,ucr,100}$ [N/mm²]	10			
Temperature range III: 72°C/120°C $\tau_{Rk,ucr,100}$ [N/mm²]	8,5			
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete, all drilling methods (HD, HDB, DD + RT)				
Temperature range I: 24°C/40°C $\tau_{Rk,cr,100}$ [N/mm²]	7,0			
Temperature range II: 50°C/80°C $\tau_{Rk,cr,100}$ [N/mm²]	5,5			
Temperature range III: 72°C/120°C $\tau_{Rk,cr,100}$ [N/mm²]	5,0			
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete				
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,100,(C20/25)} \cdot \psi_c$				
Temperature range I to III : ψ_c [-]	$(f_{ck}/20)^{0,1}$			
Influence of sustained load				
Temperature range I: 24°C/40°C $\psi^0_{sus,100}$ [-]	0,80			
Temperature range II: 50°C/80°C $\psi^0_{sus,100}$ [-]	0,89			
Temperature range III: 72°C/120°C $\psi^0_{sus,100}$ [-]	0,72			

Table C8: Essential characteristics for rebar under shear load in concrete

Rebar			ϕ 12	ϕ 14	ϕ 16	ϕ 20
For a working life of 50 and 100 years						
Steel failure without lever arm						
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$0{,}5 \cdot A_s \cdot f_{uk}$ [1]			
Characteristic resistance Rebar B500B acc. to DIN 488-1	$V^0_{Rk,s}$	[kN]	30,5	41,6	54,3	84,8
Partial factor	$\gamma_{Ms,V}$ [2]	[-]	1,5			
Ductility factor	k_7	[-]	1,0			
Steel failure with lever arm						
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	$1{,}2 \cdot W_{el} \cdot f_{uk}$ [1]			
Characteristic resistance Rebar B500B acc. to DIN 488-1	$M^0_{Rk,s}$	[Nm]	109,9	174,6	260,6	508,9
Ductility factor	k_7	[-]	1,0			
Concrete pry-out failure						
Pry-out factor	k_8	[-]	2,0			
Concrete edge failure						
Effective length of fastener	l_f	[mm]	min (h_{ef}; $12 \cdot d_{nom}$)			
Outside diameter of fastener	d_{nom}	[mm]	12	14	16	20

[1] f_{uk} according to rebar specification
[2] In absence of national regulations.

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Essential characteristics under shear load in concrete

Annex C15

Table C9: Displacements under tension load

Threaded rods according to Annex A			M12	M16	M20	M24
Uncracked concrete temperature range I: 24°C / 40°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,03	0,04	0,06	0,07
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,08	0,10	0,13
Uncracked concrete temperature range II: 50°C / 80°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,05	0,06	0,08	0,09
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,09	0,11	0,13
Uncracked concrete temperature range III: 72°C / 120°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06	0,08	0,10	0,12
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07	0,09	0,11	0,13
Cracked concrete temperature range I: 24°C / 40°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,07			
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,16			
Cracked concrete temperature range II: 50°C / 80°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,10			
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,22			
Cracked concrete temperature range III: 72°C / 120°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,13			
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,29			

Table C10: Displacements under shear load

Threaded rods according to Annex A			M12	M16	M20	M24
Displacement	δ_{V0}	[mm/kN]	0,05	0,04	0,04	0,03
	$\delta_{V\infty}$	[mm/kN]	0,08	0,06	0,06	0,05

Table C11: Displacements under tension load

HIS-(R)N			M8	M10	M12	M16
Uncracked concrete temperature range I: 24°C / 40°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,03	0,05	0,06	0,07
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,09	0,11	0,13
Uncracked concrete temperature range II: 50°C / 80°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,05	0,06	0,08	0,10
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07	0,09	0,11	0,13
Uncracked concrete temperature range III: 72°C / 120°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06	0,08	0,10	0,13
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07	0,09	0,11	0,14
Cracked concrete temperature range I: 24°C / 40°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,11			
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,16			
Cracked concrete temperature range II: 50°C / 80°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,15			
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,22			
Cracked concrete temperature range III: 72°C / 120°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,20			
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,29			

Table C12: Displacements under shear load

HIS-(R)N			M8	M10	M12	M16
Displacement	δ_{V0}	[mm/kN]	0,06	0,06	0,05	0,04
	$\delta_{V\infty}$	[mm/kN]	0,09	0,08	0,08	0,06

Table C13: Displacements under tension load

Hilti tension anchor HZA, HZA-R			M12	M16	M20
Uncracked concrete temperature range I: 24°C / 40°C					
Displacement	δ_{N0}	[mm/(N/mm²)]	0,03	0,04	0,06
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,08	0,13
Uncracked concrete temperature range II: 50°C / 80°C					
Displacement	δ_{N0}	[mm/(N/mm²)]	0,05	0,06	0,08
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,09	0,14
Uncracked concrete temperature range III: 72°C / 120°C					
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06	0,08	0,10
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07	0,09	0,14
Cracked concrete temperature range I: 24°C / 40°C					
Displacement	δ_{N0}	[mm/(N/mm²)]		0,11	
	$\delta_{N\infty}$	[mm/(N/mm²)]		0,16	
Cracked concrete temperature range II: 50°C / 80°C					
Displacement	δ_{N0}	[mm/(N/mm²)]		0,15	
	$\delta_{N\infty}$	[mm/(N/mm²)]		0,22	
Cracked concrete temperature range III: 72°C / 120°C					
Displacement	δ_{N0}	[mm/(N/mm²)]		0,20	
	$\delta_{N\infty}$	[mm/(N/mm²)]		0,29	

Table C14: Displacements under shear load

Hilti tension anchor HZA, HZA-R			M12	M16	M20
Displacement	δ_{V0}	[mm/kN]	0,05	0,04	0,04
	$\delta_{V\infty}$	[mm/kN]	0,08	0,06	0,06

Table C15: Displacements under tension load

Rebar			**ϕ 12**	**ϕ 14**	**ϕ 16**	**ϕ 20**
Uncracked concrete temperature range I: 24°C / 40°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,03	0,04	0,04	0,06
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,07	0,08	0,10
Uncracked concrete temperature range II: 50°C / 80°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,05	0,05	0,06	0,08
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,07	0,09	0,11
Uncracked concrete temperature range III: 72°C / 120°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06	0,07	0,08	0,10
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07	0,08	0,09	0,11
Cracked concrete temperature range I: 24°C / 40°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,11			
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,16			
Cracked concrete temperature range II: 50°C / 80°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,15			
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,22			
Cracked concrete temperature range III: 72°C / 120°C						
Displacement	δ_{N0}	[mm/(N/mm²)]	0,20			
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,29			

Table C16: Displacements under shear load

Rebar			**ϕ 12**	**ϕ 14**	**ϕ 16**	**ϕ 20**
Displacement	δ_{V0}	[mm/kN]	0,05	0,04	0,04	0,04
	$\delta_{V\infty}$	[mm/kN]	0,07	0,06	0,06	0,05

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Essential characteristics under seismic loading in concrete with and without fibres

Table C17: Essential characteristics for threaded rods according to Annex A under tension load for seismic performance category C1

Threaded rods according to Annex A			M12	M16	M20	M24
For a working life of 50 and 100 years						
Steel failure						
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	$N_{Rk,s}$			
Combined pullout and concrete cone failure for a working life of 50 years						
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete all drilling methods (HD, HDB, DD + RT)						
Temperature range I: 24°C/40°C	$\tau_{Rk,C1}$	[N/mm²]	7,0			
Temperature range II: 50°C/80°C	$\tau_{Rk,C1}$	[N/mm²]	5,7			
Temperature range III: 72°C/120°C	$\tau_{Rk,C1}$	[N/mm²]	4,8			
Combined pullout and concrete cone failure for a working life of 100 years						
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete all drilling methods (HD, HDB, DD + RT)						
Temperature range I: 24°C/40°C	$\tau_{Rk,100,C1}$	[N/mm²]	6,3			
Temperature range II: 50°C/80°C	$\tau_{Rk,100,C1}$	[N/mm²]	5,2			
Temperature range III: 72°C/120°C	$\tau_{Rk,100,C1}$	[N/mm²]	4,4			
Influence factors ψ on bond resistance $\tau_{Rk,C1}$ and $\tau_{Rk,100,C1}$ in cracked concrete						
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$						
Temperature range I to III :	ψ_c	[-]	1,0			

Table C18: Essential characteristics for threaded rods according to Annex A under shear load for seismic performance category C1

Threaded rods according to Annex A			M12	M16	M20	M24
For a working life of 50 and 100 years						
Annular gap factor without Hilti filling set	α_{gap}	[-]	0,5			
Annular gap factor with Hilti filling set	α_{gap}	[-]	1,0			
Steel failure without lever arm						
Characteristic resistance HAS 5.8, HAS-U 5.8, HIT-V 5.8	$V_{Rk,s,C1}$	[kN]	$0,60 \cdot N_{Rk,s}$			
Characteristic resistance HAS 8.8, HAS-U 8.8, HIT-V 8.8, AM 8.8	$V_{Rk,s,C1}$	[kN]	$0,50 \cdot N_{Rk,s}$			
Characteristic resistance HAS A4, HAS-U A4, HIT-V-R HAS-U HCR, HIT-V-HCR	$V_{Rk,s,C1}$	[kN]	$0,50 \cdot N_{Rk,s}$			
Characteristic resistance Commercial standard threaded rod	$V_{Rk,s,C1}$	[kN]	$0,35 \cdot N_{Rk,s}$			

Table C19: Essential characteristics for Hilti tension anchor HZA, HZA-R under tension load for seismic performance category C1

Hilti tension anchor HZA, HZA-R			**M12**	**M16**	**M20**
For a working life of 50 and 100 years					
Steel failure					
Characteristic resistance HZA	$N_{Rk,s,C1}$	[kN]		$N_{Rk,s}$	
Characteristic resistance HZA-R	$N_{Rk,s,C1}$	[kN]		$N_{Rk,s}$	
Partial factor	$\gamma_{Ms,N,C1}$ [1)]	[-]		1,4	
Combined pull-out and concrete cone failure					
Diameter of rebar	d	[mm]	12	16	20
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete all drilling methods (HD, HDB, DD + RT)					
Temperature range I: 24°C/40°C	$\tau_{Rk,C1} = \tau_{Rk,100,C1}$	[N/mm²]		6,1	
Temperature range II: 50°C/80°C	$\tau_{Rk,C1} = \tau_{Rk,100,C1}$	[N/mm²]		4,8	
Temperature range III: 72°C/120°C	$\tau_{Rk,C1} = \tau_{Rk,100,C1}$	[N/mm²]		4,4	
Influence factors ψ on bond resistance $\tau_{Rk,C1}$ and $\tau_{Rk,100,C1}$ in cracked concrete					
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$					
Temperature range I to III :	ψ_c	[-]		1,0	

1) In absence of national regulations.

Table C20: Essential characteristics for Hilti tension anchor HZA, HZA-R under shear load for seismic performance category C1

Hilti tension anchor HZA, HZA-R			**M12**	**M16**	**M20**
For a working life of 50 and 100 years					
Annular gap factor without Hilti filling set	α_{gap}	[-]		0,5	
Annular gap factor with Hilti filling set	α_{gap}	[-]		1,0	
Steel failure without lever arm					
Characteristic resistance HZA	$V_{Rk,s,C1}$	[kN]		$V^0_{Rk,s}$	
Characteristic resistance HZA-R	$V_{Rk,s,C1}$	[kN]		$V^0_{Rk,s}$	
Partial factor	$\gamma_{Ms,V,C1}$ [1)]	[-]		1,5	

1) In absence of national regulations.

Table C21: Essential characteristics for rebar under tension load for seismic performance category C1

Rebar			ϕ 12	ϕ 14	ϕ 16	ϕ 20
For a working life of 50 and 100 years						
Steel failure						
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	$N_{Rk,s}$			
Characteristic resistance for rebar B500B acc. to DIN 488-1	$N_{Rk,s,C1}$	[kN]	$N_{Rk,s}$			
Combined pull-out and concrete cone failure						
Diameter of rebar	d	[mm]	12	14	16	20
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete all drilling methods (HD, HDB, DD + RT)						
Temperature range I: 24°C/40°C	$\tau_{Rk,C1} = \tau_{Rk,100,C1}$	[N/mm²]	6,1			
Temperature range II: 50°C/80°C	$\tau_{Rk,C1} = \tau_{Rk,100,C1}$	[N/mm²]	4,8			
Temperature range III: 72°C/120°C	$\tau_{Rk,C1} = \tau_{Rk,100,C1}$	[N/mm²]	4,4			
Influence factors ψ on bond resistance $\tau_{Rk,C1}$ and $\tau_{Rk,100,C1}$ in cracked concrete						
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$						
Temperature range I to III :	ψ_c	[-]	1,0			

Table C22: Essential characteristics for rebar under shear loads for seismic performance category C1

Rebar			ϕ 12	ϕ 14	ϕ 16	ϕ 20
For a working life of 50 and 100 years						
Annular gap factor without Hilti filling set	α_{gap}	[-]	0,5			
Steel failure without lever arm						
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	$0,35 \cdot N_{Rk,s}$			
Characteristic resistance for rebar B500B acc. to DIN 488-1	$V_{Rk,s,C1}$	[kN]	21,4	29,1	38,0	59,4

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC	Annex C22
Performance Essential characteristics under tension and shear load for seismic performance category C1	

Table C23: Essential characteristics for threaded rods according to Annex A under tension load for seismic performance category C2

Threaded rods according to Annex A			M12	M16	M20	M24
For a working life of 50 and 100 years						
Steel failure						
Characteristic resistance HAS (8.8, 8.8 HDG, A4), HAS-U (-8.8, -8.8 HDG, A4, HCR), HIT-V (-8.8, -8.8 F, -,R, HCR), AM (8.8, 8.8 HDG) Threaded rod (8.8, CRC II, CRC III and CRC V, see Table A1)	$N_{Rk,s,C2}$	[kN]	$N_{Rk,s}$			
Combined pullout and concrete cone failure						
Characteristic bond resistance in cracked concrete C20/25 for installation in dry or wet (water saturated) concrete, in hammer drilled holes and hammer drilled holes with Hilti hollow drill bit TE-CD or TE-YD						
Temperature range I: 24°C/40°C	$\tau_{Rk,C2} = \tau_{Rk,100,C2}$	[N/mm²]	2,7	4,6	4,6	3,5
Temperature range II: 50°C/80°C	$\tau_{Rk,C2} = \tau_{Rk,100,C2}$	[N/mm²]	2,3	3,9	3,9	2,9
Temperature range III: 72°C/120°C	$\tau_{Rk,C2} = \tau_{Rk,100,C2}$	[N/mm²]	2,0	3,3	3,3	2,5
Influence factors ψ on bond resistance $\tau_{Rk,C2}$ and $\tau_{Rk,100,C2}$ in cracked concrete						
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$						
Temperature range I to III :	ψ_c	[-]	1,0			

Table C24: Essential characteristics for threaded rods according to Annex A under shear load for seismic performance category C2

Threaded rods according to Annex A			M12	M16	M20	M24
For a working life of 50 and 100 years						
Annular gap factor without Hilti filling set	α_{gap}	[-]	0,5			
Annular gap factor with Hilti filling set	α_{gap}	[-]	1,0			
Steel failure without lever arm with Hilti Filling Set						
Characteristic resistance						
HAS 8.8, HAS-U 8.8, HIT-V 8.8, AM 8.8	$V_{Rk,s,C2}$	[kN]	28	46	77	103
Steel failure without lever arm without Hilti Filling Set						
Characteristic resistance						
HAS 8.8, HAS-U 8.8, HIT-V 8.8, AM 8.8	$V_{Rk,s,C2}$	[kN]	24	40	71	90
HAS A4, HAS-U A4, HIT-V-R	$V_{Rk,s,C2}$	[kN]	21	35	62	79
HAS-U-HCR, HIT-V-HCR	$V_{Rk,s,C2}$	[kN]	24	40	71	79
HAS 8.8 HDG, HAS-U 8.8 HDG, HIT-V-F 8.8, AM-HDG 8.8	$V_{Rk,s,C2}$	[kN]	18	30	46	66
Threaded rod, hot dip galvanized 8.8	$V_{Rk,s,C2}$	[kN]	13	21	32	46
Threaded rod, electroplated zinc coated 8.8	$V_{Rk,s,C2}$	[kN]	17	28	50	63
Threaded rod CRC II and CRC III (Table A1)	$V_{Rk,s,C2}$	[kN]	15	25	43	55
Threaded rod CRC V (Table A1)	$V_{Rk,s,C2}$	[kN]	17	28	50	55

Table C25: Displacements under tension load for seismic performance category C2

Threaded rods according to Annex A		M12	M16	M20	M24
Displacement DLS, HAS (8.8, 8.8 HDG, A4), HAS-U (-8.8, -8.8 HDG, A4, HCR), HIT-V (-8.8, -8.8 F, -,R, HCR), AM (8.8, 8.8 HDG), Threaded rod (8.8, CRC II, CRC III and CRC V, see Table A1)	$\delta_{N,C2(50\%)}$ [mm]	0,3	0,4	0,5	0,4
Displacement ULS, HAS (8.8, 8.8 HDG, A4), HAS-U (-8.8, -8.8 HDG, A4, HCR), HIT-V (-8.8, -8.8 F, -,R, HCR), AM (8.8, 8.8 HDG), Threaded rod (8.8, CRC II, CRC III and CRC V, see Table A1)	$\delta_{N,C2(100\%)}$ [mm]	1,2	1,1	0,7	0,9

Table C26: Displacements under shear load for seismic performance category C2

Threaded rods according to Annex A		M12	M16	M20	M24
Installation with Hilti Filling Set					
Displacement DLS, HAS 8.8, HAS-U 8.8, HIT-V 8.8, AM 8.8	$\delta_{V,C2(50\%)}$ [mm]	0,6	1,2	1,4	1,1
Displacement ULS, HAS 8.8, HAS-U 8.8, HIT-V 8.8, AM 8.8	$\delta_{V,C2(100\%)}$ [mm]	3,1	3,2	3,8	2,6
Installation without Hilti Filling Set					
Displacement DLS, HAS (8.8, A4), HAS-U (-8.8, A4, HCR), HIT-V (-8.8, -R, HCR), AM 8.8, Threaded rod (electroplated zinc coated 8.8, CRC II, CRC III and CRC V, see Table A1)	$\delta_{V,C2(50\%)}$ [mm]	1,9	3,2	2,5	3,5
Displacement DLS, HAS 8.8 HDG, HAS-U 8.8 HDG, HIT-V-F 8.8, AM HDG 8.8, Threaded rods 8.8 HDG	$\delta_{V,C2(50\%)}$ [mm]	2,2	2,3	3,8	3,7
Displacement ULS, HAS (-8.8, A4), HAS-U (-8.8, A4, HCR), HIT-V (-8.8, -R, HCR), AM 8.8, Threaded rod (electroplated zinc coated 8.8, CRC II, CRC III and CRC V, see Table A1)	$\delta_{V,C2(100\%)}$ [mm]	4,4	9,2	7,1	10,2
Displacement ULS, HAS 8.8 HDG, HAS-U 8.8 HDG, HIT-V-F 8.8, AM HDG 8.8, Threaded rods 8.8 HDG	$\delta_{V,C2(100\%)}$ [mm]	4,1	4,3	9,1	8,4

Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC

Performance
Displacements under tension and shear load for seismic performance category C2

Annex C24

Essential characteristics under fire exposure in concrete with and without fibres

Characteristic resistance to combined pull-out and concrete failure under fire for concrete strength classes C20/25 to C50/60 for threaded rods and rebars for all drilling methods

The characteristic bond resistance $\tau_{Rk,fi}(\theta)$ under fire shall be calculated by using the following equations:

$$\tau_{Rk,fi}(\theta) = k_{fi,p}(\theta) \cdot \tau_{Rk,cr,C20/25}$$
$$\tau_{Rk,fi,100}(\theta) = k_{fi,p}(\theta) \cdot \tau_{Rk,cr,100,C20/25}$$

Temperature reduction factor for threaded rods

with: $\theta \leq$ 392 °C: $k_{fi,p}(\theta) = 1{,}01 \cdot e^{(-0{,}013 \cdot \Theta)} \leq 1{,}0$

and $\theta > \theta_{max}$: $k_{fi,p}(\theta) = 0{,}0$

$\theta_{max} = 392$ °C

Temperature reduction factor for rebars

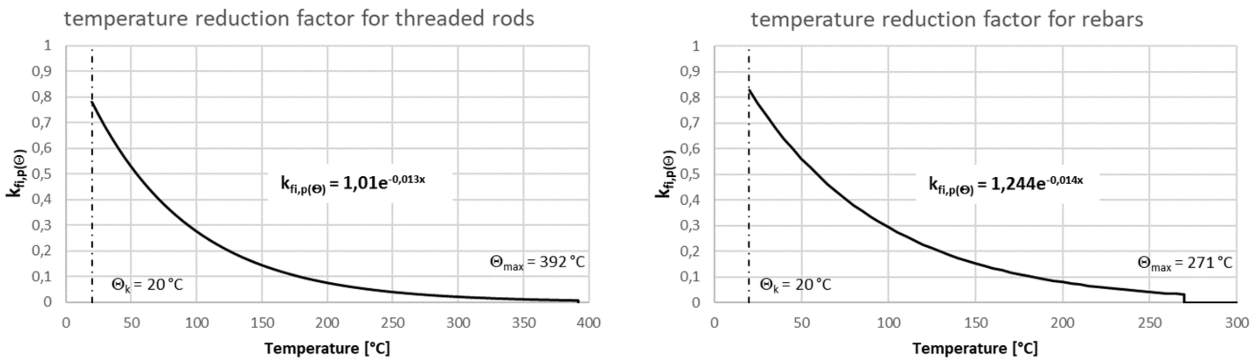
with: $\theta \leq$ 271 °C: $k_{fi,p}(\theta) = 1{,}244 \cdot e^{(-0{,}014 \cdot \Theta)} \leq 1{,}0$

and $\theta > \theta_{max}$: $k_{fi,p}(\theta) = 0{,}0$

$\theta_{max} = 271$ °C

$\tau_{Rk,fi}(\theta)$	=	characteristic bond resistance for cracked concrete under fire exposure for a given temperature
$k_{fi,p}(\theta)$	=	reduction factor for bond resistance under fire conditions
$\tau_{Rk,cr,C20/25}$	=	characteristic bond resistance for cracked concrete C20/25 for a working life of 50 years given in Table C1
$\tau_{Rk,cr,100,C20/25}$	=	characteristic bond resistance for cracked concrete C20/25 for a working life of 100 years given in Table C1

Figure C1: Reduction factor $k_{fi,p}(\theta)$



Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 in SFRC	**Annex C25**
Performance Characteristic bond resistance under fire conditions	

Table C27: Characteristic resistance to steel failure under tension loading for threaded rods in case of fire

Threaded rods according to Annex A			M12	M16	M20	M24
HAS 5.8, HAS-U 5.8, HIT-V 5.8, AM 8.8	$N_{Rk,s,fi(30)}$	[kN]	2,80	5,22	8,15	11,74
HAS 5.8 HDG, HAS-U 5.8 HDG, HIT-V-F 5.8, AM-HDG 5.8	$N_{Rk,s,fi(60)}$		2,05	3,83	5,98	8,62
HAS 8.8, HAS-U 8.8, HIT-V 8.8, AM 8.8	$N_{Rk,s,fi(90)}$		1,31	2,44	3,81	5,49
HAS 8.8 HDG, HAS-U 8.8 HDG, HIT-V-F 8.8, AM-HDG 8.8	$N_{Rk,s,fi(120)}$		0,93	1,74	2,72	3,92
HAS A4, HAS-U A4, HIT-V-R HAS-U-HCR, HIT-V-HCR Threaded rod CRC III and Threaded rod CRC V (Table A1)	$N_{Rk,s,fi(30)}$	[kN]	7,93	14,77	23,06	33,23
	$N_{Rk,s,fi(60)}$		5,56	10,37	16,18	23,31
	$N_{Rk,s,fi(90)}$		3,20	5,96	9,30	13,40
	$N_{Rk,s,fi(120)}$		2,01	3,75	5,86	8,44

Table C28: Characteristic resistance to steel failure under tension loading for rebar in case of fire

Rebars according to Annex A			ϕ 12	ϕ 14	ϕ 16	ϕ 20
Rebar	$N_{Rk,s,fi(30)}$	[kN]	2,3	3,1	4,0	6,3
	$N_{Rk,s,fi(60)}$		1,7	2,3	3,0	4,7
	$N_{Rk,s,fi(90)}$		1,5	2,0	2,6	4,1
	$N_{Rk,s,fi(120)}$		1,1	1,5	2,0	3,1

Table C29: Characteristic resistance under tension load for concrete cone failure in case of fire

Elements according to Annex A			M12	M16	M20	M24
HAS 5.8, HAS-U 5.8, HIT-V 5.8, AM 8.8 HAS 5.8 HDG, HAS-U 5.8 HDG, HIT-V-F 5.8, AM-HDG 5.8 HAS 8.8, HAS-U 8.8, HIT-V 8.8, AM 8.8 HAS 8.8 HDG, HAS-U 8.8 HDG, HIT-V-F 8.8, AM-HDG 8.8 HAS A4, HAS-U A4, HIT-V-R HAS-U-HCR, HIT-V-HCR Threaded rod CRC III and Threaded rod CRC V (Table A1) Rebar	$N^0_{Rk,c,fi(30)}$	[kN]	$h_{ef}/200 \cdot N^0_{Rk,c} \leq N^0_{Rk,c}$			
	$N^0_{Rk,c,fi(60)}$					
	$N^0_{Rk,c,fi(90)}$					
	$N^0_{Rk,c,fi(120)}$		$0{,}8 \cdot h_{ef}/200 \cdot N^0_{Rk,c} \leq N^0_{Rk,c}$			
Characteristic spacing	$s_{cr,N,fi}$	[mm]	$4 \cdot h_{ef}$			
Characteristic edge distance	$c_{cr,N,fi}$		$2 \cdot h_{ef}$			

Table C30: Characteristic resistance to steel failure under shear loading without lever arm for threaded rods in case of fire

Threaded rods according to Annex A			M12	M16	M20	M24
HAS 5.8, HAS-U 5.8, HIT-V 5.8, AM 8.8 HAS 5.8 HDG, HAS-U 5.8 HDG, HIT-V-F 5.8, AM-HDG 5.8 HAS 8.8, HAS-U 8.8, HIT-V 8.8, AM 8.8 HAS 8.8 HDG, HAS-U 8.8 HDG, HIT-V-F 8.8, AM-HDG 8.8	$V_{Rk,s,fi(30)}$	[kN]	2,80	5,22	8,15	11,74
	$V_{Rk,s,fi(60)}$		2,05	3,83	5,98	8,62
	$V_{Rk,s,fi(90)}$		1,31	2,44	3,81	5,49
	$V_{Rk,s,fi(120)}$		0,93	1,74	2,72	3,92
HAS A4, HAS-U A4, HIT-V-R HAS-U-HCR, HIT-V-HCR Threaded rod CRC III and Threaded rod CRC V (Table A1)	$V_{Rk,s,fi(30)}$	[kN]	7,93	14,77	23,06	33,23
	$V_{Rk,s,fi(60)}$		5,56	10,37	16,18	23,31
	$V_{Rk,s,fi(90)}$		3,20	5,96	9,30	13,40
	$V_{Rk,s,fi(120)}$		2,01	3,75	5,86	8,44

Table C31: Characteristic resistance to steel failure under shear loading without lever arm for rebars in case of fire

Rebars according to Annex A			ϕ 12	ϕ 14	ϕ 16	ϕ 20
Rebar	$V_{Rk,s,fi(30)}$	[kN]	2,3	3,1	4,0	6,3
	$V_{Rk,s,fi(60)}$		1,7	2,3	3,0	4,7
	$V_{Rk,s,fi(90)}$		1,5	2,0	2,6	4,1
	$V_{Rk,s,fi(120)}$		1,1	1,5	2,0	3,1

Table C32: Characteristic resistance to steel failure under shear loading with lever arm for threaded rods in case of fire

Threaded rods according to Annex A			M12	M16	M20	M24
HAS 5.8, HAS-U 5.8, HIT-V 5.8, AM 8.8	$M^0_{Rk,s,fi(30)}$	[Nm]	4,36	11,08	21,60	37,36
HAS 5.8 HDG, HAS-U 5.8 HDG, HIT-V-F 5.8, AM-HDG 5.8	$M^0_{Rk,s,fi(60)}$		3,19	8,13	15,85	27,41
HAS 8.8, HAS-U 8.8, HIT-V 8.8, AM 8.8	$M^0_{Rk,s,fi(90)}$		2,03	5,18	10,10	17,46
HAS 8.8 HDG, HAS-U 8.8 HDG, HIT-V-F 8.8, AM-HDG 8.8	$M^0_{Rk,s,fi(120)}$		1,45	3,70	7,22	12,49
HAS A4, HAS-U A4, HIT-V-R HAS-U-HCR, HIT-V-HCR Threaded rod CRC III and Threaded rod CRC V (Table A1)	$M^0_{Rk,s,fi(30)}$	[Nm]	12,33	31,34	61,10	105,6
	$M^0_{Rk,s,fi(60)}$		8,65	21,99	42,87	74,14
	$M^0_{Rk,s,fi(90)}$		4,97	12,64	24,64	42,61
	$M^0_{Rk,s,fi(120)}$		3,13	7,96	15,52	26,85

Table C33: Characteristic resistance to steel failure under shear loading with lever arm for rebars in case of fire

Rebars according to Annex A			ϕ 12	ϕ 14	ϕ 16	ϕ 20
Rebar	$M^0_{Rk,s,fi(30)}$	[Nm]	4,1	6,5	9,7	18,8
	$M^0_{Rk,s,fi(60)}$		3,1	4,8	7,2	14,1
	$M^0_{Rk,s,fi(90)}$		2,6	4,2	6,3	12,3
	$M^0_{Rk,s,fi(120)}$		2,0	3,2	4,8	9,4