Deutsches Institut für Bautechnik DIBt

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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European Technical Assessment

ETA-19/0600 of 11 October 2023

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 Hilti HIT-HY 200-R V3 for rebar connections
Product family to which the construction product belongs	Systems for post-installed rebar connections with mortar
Manufacturer	Hilti Aktiengesellschaft Feldkircherstrasse 100 9494 SCHAAN FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Werke Hilti Plants
This European Technical Assessment contains	35 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	330087-01-0601, Edition 06/2021
This version replaces	ETA-19/0600 issued on 25 May 2023

This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission in accordance with Article 25(3) of Regulation (EU) No 305/2011.

Specific Part

1 Technical description of the product

The subject of this European Technical Assessment is the post-installed connection, by anchoring or overlap connection joint, of reinforcing bars (rebars) in existing structures made of normal weight concrete, using the injection mortar Hilti HIT-HY 200-A V3 and Hilti HIT-HY 200-R V3 in accordance with the regulations for reinforced concrete construction.

Reinforcing bars made of steel with a diameter ϕ from 8 to 40 mm or the Hilti tension anchor HZA-R in sizes M12, M16, M20 and M24 or the Hilti tension anchor HZA in sizes M12, M16, M20, M24 and M27 and Hilti HIT-HY 200-A V3 and Hilti HIT-HY 200-R V3 injection mortar are used for the rebar connection. The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between embedded element, 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 rebar connection 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 rebar connections 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 under static and quasi-static loading	See Annex C1 to C3
Characteristic resistance under seismic loading	See Annex B6, C4 and C5

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C6 and C7

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

In accordance with European Assessment Document EAD No. 330087-01-0601, 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 with Deutsches Institut für Bautechnik.

The following standards 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 1992-1-2:2004 + AC:2008	Eurocode 2: Design of concrete structures - Part 1-2: General rules - Structural fire design
- 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 1998-1:2004 + AC:2009	Eurocode 8: Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings
- EN 10088-1:2014	Stainless steels - Part 1: List of stainless steels
- EN 206:2013 + A1:2016	Concrete - Specification, performance, production and conformity

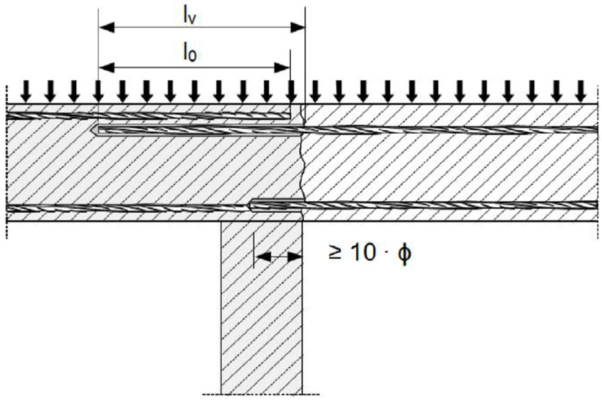
Issued in Berlin on 11 October 2023 by Deutsches Institut für Bautechnik

LBD Dipl.-Ing. Andreas Kummerow
Head of Department

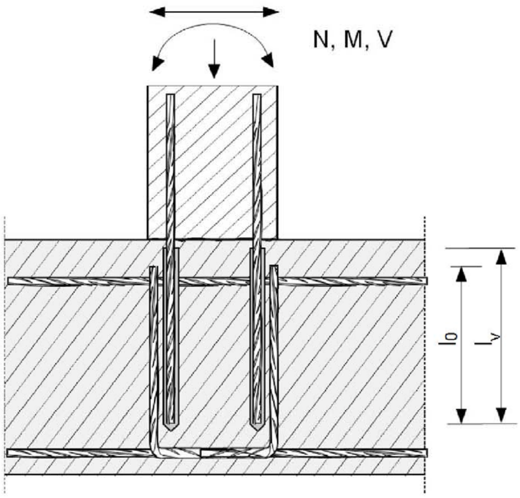
beglaubigt:
Baderschneider

Installed condition

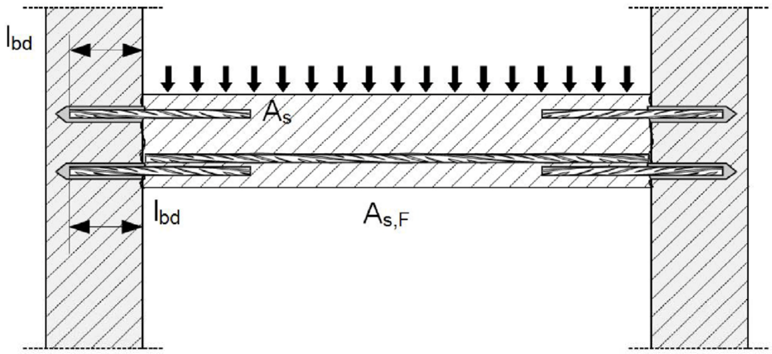
<u>Figure A1:</u>
Overlap joint with existing reinforcement for rebar connections of slabs and beams



<u>Figure A2:</u>
Overlap joint with existing reinforcement at a foundation of a column or wall where the rebars are stressed in tension



<u>Figure A3:</u>
End anchoring of slabs or beams



Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	**Annex A1**
Product description Installed condition and application examples of post-installed rebars	

Figure A4:
Rebar connection for components stressed primarily in compression

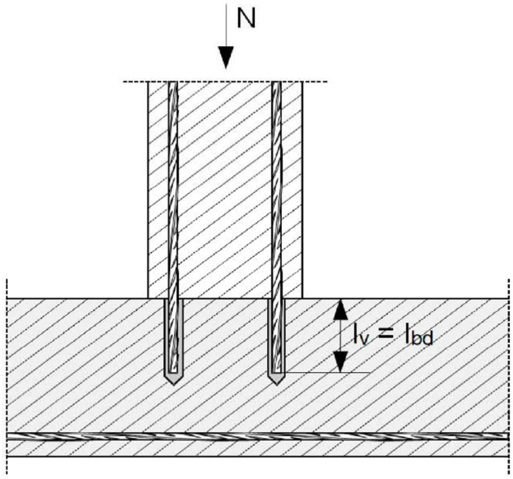
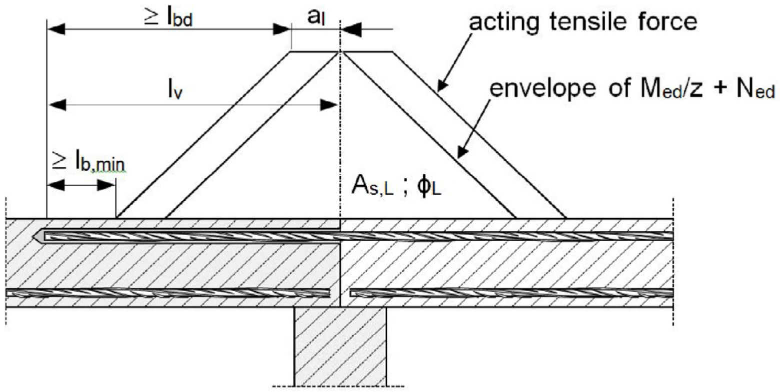


Figure A5:
Anchoring of reinforcement to cover the enveloped line of acting tensile force in the bending member



Note to Figure A1 to Figure A5:

- In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 or EN 1998-1 shall be present.
- The shear transfer between existing and new concrete shall be designed according to EN 1992-1-1 or EN 1998-1.
- Preparing of joints according to Annex B3.

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	**Annex A2**
Product description Installed condition and application examples of post-installed rebars	

Figure A6:
Overlap joint for the anchorage of a column stressed in bending to a foundation

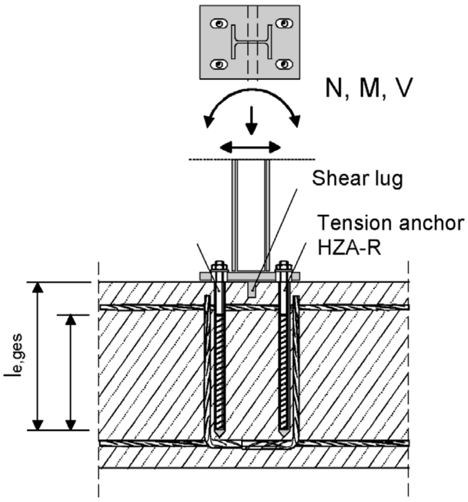


Figure A7:
Overlap joint for the anchorage of barrier posts

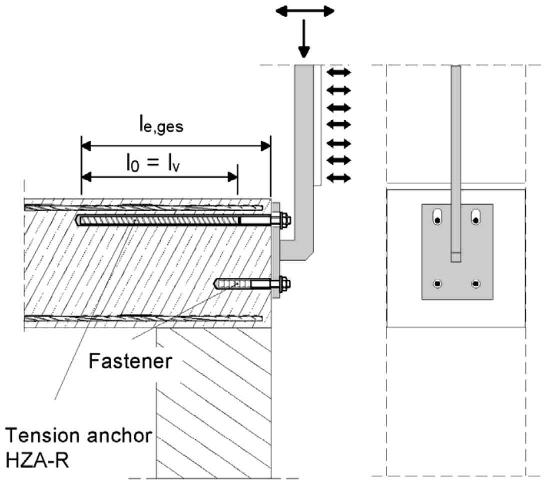
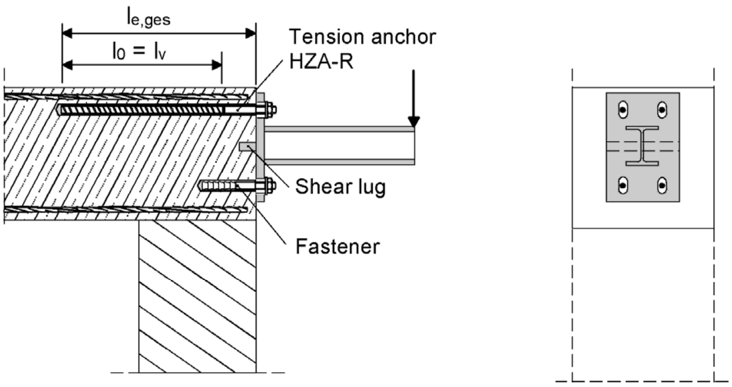


Figure A8:
Overlap joint for the anchorage of cantilever members



Note to Figure A6 to A8:
In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 shall be present.

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	Annex A3
Product description Installed condition and application examples of HZA and HZA-R	

Product description: Injection mortar and steel elements

Injection mortar Hilti HIT-HY 200-A V3 and Hilti 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"

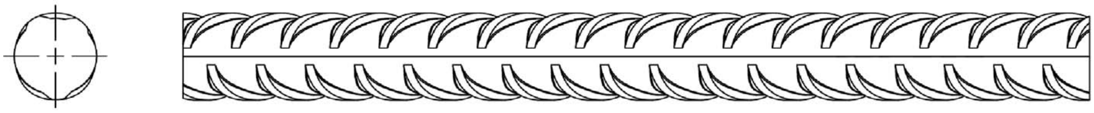
Marking:
HILTI-HIT
HY 200-R V3
Production time and production line
Expiry date mm/yyyy

Product name: "Hilti HIT-HY 200-R V3"

Static mixer Hilti HIT-RE-M

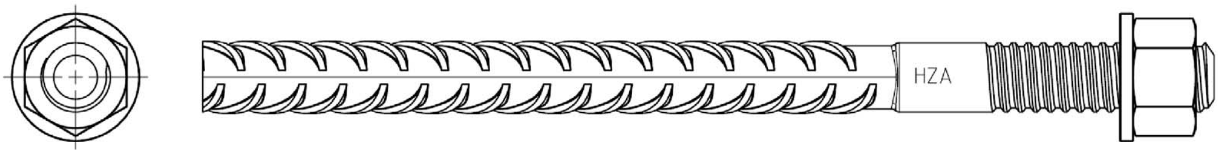
Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	Annex A4
Product description Injection mortar / Static mixer	

Steel elements



Reinforcing bar (rebar): ϕ 8 to ϕ 40

- Materials and mechanical properties according to Table A1.
- Minimum value of related rib area f_R according to EN 1992-1-1.
- Rib height of the bar h_{rib} shall be in the range:
  $0{,}05 \cdot \phi \leq h_{rib} \leq 0{,}07 \cdot \phi$
- The maximum outer rebar diameter over the ribs shall be:
  $\phi + 2 \cdot 0{,}07 \cdot \phi = 1{,}14 \cdot \phi$
  (ϕ: Nominal diameter of the bar; h_{rib}: Rib height of the bar)



Hilti Tension Anchor HZA: M12 to M27 and HZA-R: M12 to M24

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections

Product description
Steel elements

Annex A5

Table A1: Materials

Designation	**Material**
Reinforcing bars (rebars)	
Rebar EN 1992-1-1	Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCI of EN 1992-1-1 $f_{uk} = f_{tk} = k \cdot f_{yk}$
Metal parts made of zinc coated steel	
Hilti tension anchor HZA	Round steel with threaded part: electroplated zinc coated ≥ 5 µm Rebar: f_{yk} = 500 N/mm² class B according to NDP or NCI of EN 1992-1-1
Washer	Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 45 µm
Nut	Strength class of nut adapted to strength class of threaded rod. Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 45 µm
Metal parts made of stainless steel **corrosion resistance class III according EN 1993-1-4**	
Hilti tension anchor HZA-R	Round steel with threaded part: Stainless steel 1.4404, 1.4362, 1.4571 EN 10088-1 Rebar: f_{yk} = 500 N/mm² class B according to NDP or NCI of EN 1992-1-1
Washer	Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1
Nut	Strength class of nut adapted to strength class of threaded rod. Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1

Deutsches Institut für Bautechnik DIBt

Specifications of intended use

Hilti HIT-HY 200-A V3: Anchorages subject to:

- Static and quasi-static loading:
  rebar size ϕ 8 to ϕ 32 mm, HZA M12 to M27 and HZA-R M12 to M24.
- Seismic loading:
  rebar size ϕ 10 to ϕ 32 mm.
- Fire exposure:
  rebar size ϕ 8 to ϕ 32 mm, HZA M12 to M27 and HZA-R M12 to M24.

Hilti HIT-HY 200-R V3: Anchorages subject to:

- Static and quasi-static loading:
  rebar size ϕ 8 to ϕ 40 mm, HZA M12 to M27 and HZA-R M12 to M24.
- Seismic loading:
  rebar size ϕ 10 to ϕ 40 mm.
- Fire exposure:
  rebar size ϕ 8 to ϕ 40 mm, HZA M12 to M27 and HZA-R M12 to M24.

Base material:

- Compacted reinforced or unreinforced normal weight concrete without fibers in accordance with EN 206.
- Strength classes in accordance with EN 206:
  C12/15 to C50/60 for static and quasi-static loading and fire exposure
  C16/20 to C50/60 for seismic loading.
- Maximum chloride content of 0,40 % (CL 0.40) related to the cement content in accordance with EN 206.
- Non-carbonated concrete.
  Note: In case of a carbonated surface of the existing concrete structure the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of ϕ + 60 mm prior to the installation of the new rebar. The depth of concrete to be removed shall correspond at least to the minimum concrete cover in accordance with EN 1992-1-1. The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

Temperature in the base material:

- **at installation**
  -10 °C to +40 °C for rebar size ϕ 8 to ϕ 32 mm
  +5 °C to +25 °C for rebar size ϕ 34 to ϕ 40 mm
- **in-service**
  -40 °C to +80 °C (max. long term temperature +50 °C and max. short term temperature +80 °C)

Use conditions for HZA(-R) (Environmental conditions):

- Structures subject to dry internal conditions (all materials).
- For all other conditions according EN 1993-1-4 corresponding to corrosion resistance classes Annex A6 Table A1 (stainless steels).

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	Annex B1
Intended Use Specifications	

Design:

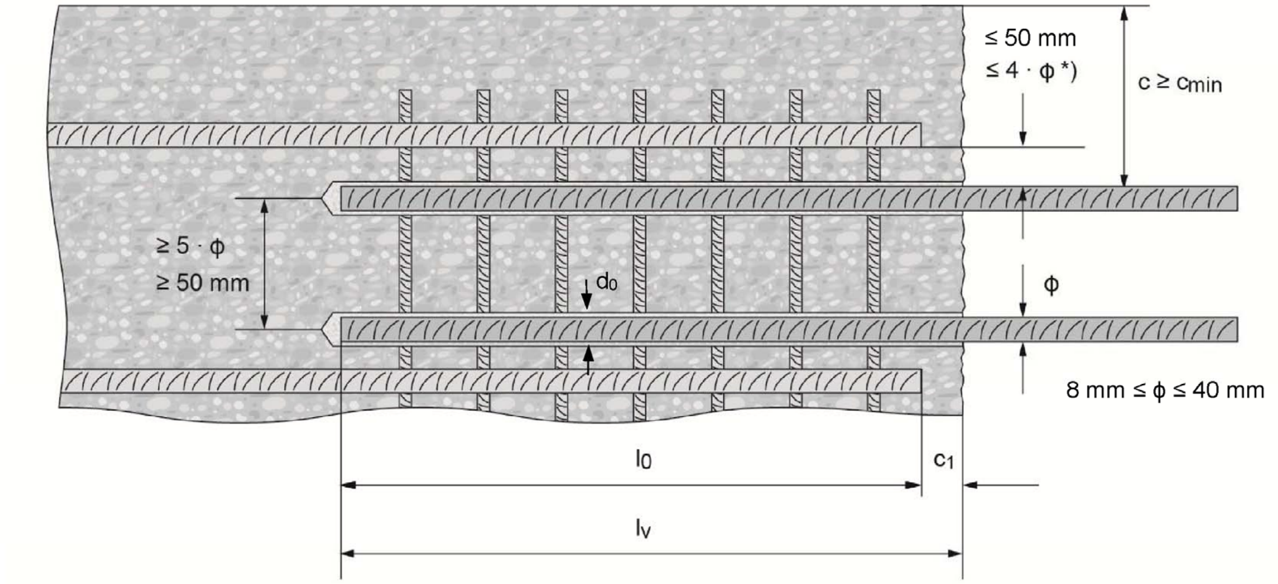
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- Design of rebar under static or quasi-static loading in accordance with EN 1992-1-1 and Annex B3 and under seismic action in accordance with EN 1998-1.
- Design of Hilti Tension anchor part embedded in the concrete under static or quasi-static loading in accordance with EN 1992-1-1 and Annex B4.
- Design of Hilti Tension anchor part extending above the concrete surface for steel failure under static or quasi-static tension load in accordance with EN 1992-4.
- Design under fire exposure in accordance with EN 1992-1-2 and for Hilti Tension anchor in addition in accordance with EN 1992-4, Annex D.
- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

Installation:

- Use category: dry or wet concrete (not in flooded holes).
- Drilling technique: Rebar size ϕ 8 to ϕ 32 mm:
  Hammer drilling (HD), hammer drilling with Hilti hollow drill bit TE-CD, TE-YD (HDB), compressed air drilling (CA), diamond coring with roughening with Hilti roughening tool TE-YRT (RT).
- Drilling technique: Rebar size ϕ 34 to ϕ 40 mm:
  hammer drilling (HD), compressed air drilling (CA).
- Overhead installation is admissible up to diameter 32 mm.
- Rebar installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Check the position of the existing rebars (if the position of existing rebars is not known, it shall be determined using a rebar detector suitable for this purpose as well as on the basis of the construction documentation and then marked on the building component for the overlap joint).

Figure B1: General construction rules for post-installed rebars

- Post-installed rebars may be designed for tension and compression forces only.
- The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1.
- The joints for concreting must be roughened to at least such an extent that aggregate protrudes.



*) If the clear distance between lapped bars exceeds 4 · ϕ or 50 mm, then the lap length shall be increased by the difference between the clear bar distance and the smaller of 4 · ϕ or 50 mm.

c	concrete cover of post-installed rebar
c_1	concrete cover at end-face of existing rebar
c_{min}	minimum concrete cover according to Table B3 and to EN 1992-1-1
ϕ	diameter of reinforcement bar
l_0	lap length according to EN 1992-1-1 for static loading and according to EN 1998-1, section 5.6.3 for seismic action
l_v	embedment length ≥ $l_0 + c_1$
d_0	nominal drill bit diameter, see Table B7 to B9

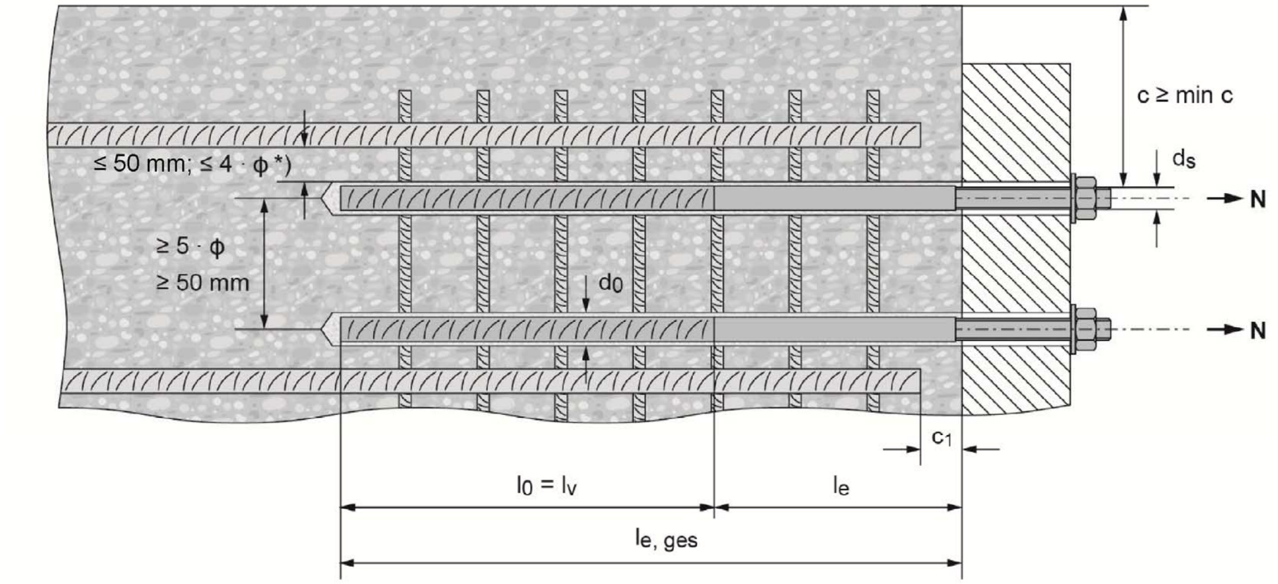
Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections

Intended Use
General construction rules for post-installed rebars

Annex B3

Figure B2: General construction rules for Hilti tension anchor HZA and HZA-R

- Hilti tension anchor HZA / HZA-R may be designed for tension forces only.
- The tension forces must be transferred via an overlap joint to the reinforcement in the existing structure.
- The length of the bonded-in smooth shaft may not be accounted as anchorage.
- The transfer of shear forces shall be ensured by appropriate additional measures, e.g. by shear lugs or by anchors with a European technical assessment (ETA).
- In the anchor plate the holes for the Hilti tension anchor shall be executed as elongated holes with the axis in the direction of the shear force.



*) If the clear distance between lapped bars exceeds 4 · ϕ or 50 mm, then the lap length shall be increased by the difference between the clear bar distance and the smaller of 4 · ϕ or 50 mm.

c	concrete cover of Hilti tension anchor HZA / HZA-R
c_1	concrete cover at end-face of existing rebar
c_{min}	minimum concrete cover according to Table B3 and to EN 1992-1-1
ϕ	diameter of reinforcement bar
l_0	lap length, according to EN 1992-1-1
l_v	embedment length
l_e	length of the smooth shaft or the bonded-in threaded part
$l_{e,ges}$	overall embedment length
d_0	nominal drill bit diameter, see Table B1 and Table B2 or Table B7 to B9

Table B1: Hilti tension anchor HZA dimensions

Hilti tension anchor HZA			M12	M16	M20	M24	M27
Rebar diameter	ϕ	[mm]	12	16	20	25	28
Overall embedment length and drill hole depth	$l_{e,ges}$	[mm]	90 to 800	100 to 1000	110 to 1000	120 to 1000	140 to 1000
Embedment length ($l_v = l_{e,ges} - l_e$)	l_v	[mm]	$l_{e,ges} - 20$				
Length of smooth shaft	l_e	[mm]	20				
Nominal diameter of drill bit	d_0	[mm]	16	20	25	32	35
Maximum diameter of clearance hole in the fixture	d_f	[mm]	14	18	22	26	30
Maximum torque moment	T_{max}	[Nm]	40	80	150	200	270

Table B2: Hilti tension anchor HZA-R dimensions

Hilti tension anchor HZA-R			M12	M16	M20	M24
Rebar diameter	ϕ	[mm]	12	16	20	25
Overall embedment length and drill hole depth	$l_{e,ges}$	[mm]	170 to 800	180 to 1000	190 to 1000	200 to 1000
Embedment length ($l_v = l_{e,ges} - l_e$)	l_v	[mm]	$l_{e,ges} - 100$			
Length of smooth shaft	l_e	[mm]	100			
Nominal diameter of drill bit	d_0	[mm]	16	20	25	32
Maximum diameter of clearance hole in the fixture	d_f	[mm]	14	18	22	26
Maximum torque moment	T_{max}	[Nm]	40	80	150	200

Hilti Tension Anchor HZA / HZA-R

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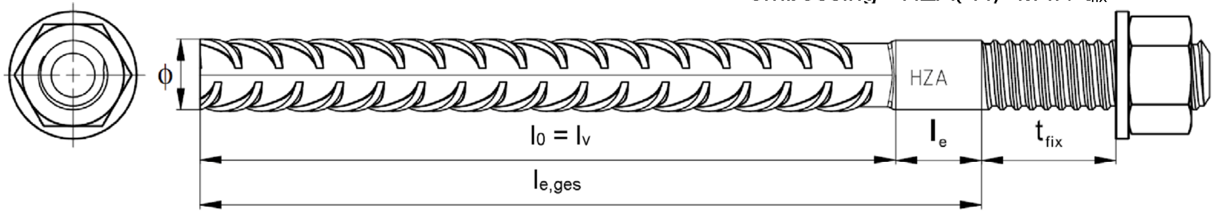
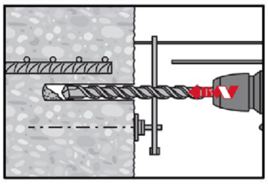


Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections

Intended Use
Installation parameters for HZA and HZA-R

Annex B5

Table B3: Minimum concrete cover c_{min}[1] of post-installed rebar or tension anchor HZA-(R) depending on drilling method and drilling tolerance

Drilling method	Bar diameter [mm]	Minimum concrete cover c_{min}[1] [mm]		
		Without drilling aid[3]	With drilling aid[3]	
Hammer drilling **(HD)** and **(HDB)**[2]	$\phi < 25$	$30 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$	$30 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$	
	$\phi \geq 25$	$40 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$	$40 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$	
Compressed air drilling **(CA)**	$\phi < 25$	$50 + 0{,}08 \cdot l_v$	$50 + 0{,}02 \cdot l_v$	
	$\phi \geq 25$	$60 + 0{,}08 \cdot l_v \geq 2 \cdot \phi$	$60 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$	
Diamond coring with roughening with Hilti Roughening tool TE-YRT **(RT)**	$\phi < 25$	$30 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$	$30 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$	
	$\phi \geq 25$	$40 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$	$40 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$	

1) See Annexes B2 and B3, Figures B1 and B2.
2) HDB = hollow drill bit Hilti TE-CD and TE-YD
Comments: The minimum concrete cover acc. EN 1992-1-1 must be observed.
The same minimum concrete covers apply for rebar elements in the case of seismic loading, i.e. $c_{min,seis} = 2\ \phi$.
3) For HZA(-R) $l_{e,ges}$ instead of l_v.

Table B4: Hilti HIT-HY 200-A V3, maximum embedment length $l_{v,max}$ ($l_{e,ges,max}$ for HZA-(R)) depending on bar diameter and dispenser

Elements		Dispensers	
Rebar	Hilti Tension Anchor	HDE 500 HDM 330, HDM 500	HDE 500
		Concrete temperature ≥ -10 °C	Concrete temperature ≥ 0 °C
Size	Size	$l_{v,max}$ or $l_{e,ges,max}$ [mm]	$l_{v,max}$ or $l_{e,ges,max}$ [mm]
ϕ 8 - 32	HZA M12 to M27 HZA-R M12 to M24	700	1000

Table B5: Hilti HIT-HY 200-R V3, maximum embedment length $l_{v,max}$ ($l_{e,ges,max}$ for HZA-(R)) depending on bar diameter and dispenser

Elements		Dispensers		
Rebar	Hilti Tension Anchor	HDE 500 HDM 330, HDM 500	HDE 500	HDE 500
		Concrete temperature ≥ -10 °C	Concrete temperature ≥ 0 °C	Concrete temperature 5 °C to 25 °C
Size	Size	$l_{v,max}$ or $l_{e,ges,max}$ [mm]	$l_{v,max}$ or $l_{e,ges,max}$ [mm]	$l_{v,max}$ or $l_{e,ges,max}$ [mm]
ϕ 8 - 32	HZA M12 to M27 HZA-R M12 to M24	700	1000	1000
ϕ 34 - 40	-	-	-	1300

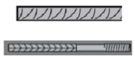
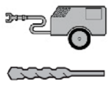
Table B6: Maximum working time and minimum curing time

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 hours
>30 °C to 40 °C	3 min	30 min	6 min	1 hours

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

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	Annex B7
Intended Use Maximum working time and minimum curing time	

Table B7: Parameters of drilling, cleaning and setting tools for hammer drilling (HD) and compressed air drilling (CA)

Element	**Drill and clean**					**Installation**		
Rebar / Hilti Tension Anchor	Hammer drilling (HD)	Compressed air drilling (CA)	Brush HIT-RB	Air nozzle HIT-DL	Extension for air nozzle	Piston plug HIT-SZ	Extension for piston plug	Maximum embedment length
							 1)	-
Size	d_0 [mm]	d_0 [mm]	Size	Size	[-]	Size	[-]	$l_{v,max}$ [2] [mm]
ϕ 8	10	-	10	10	HIT-DL 10/0,8 or HIT-DL V10/1	-	HIT-VL 9/1,0	250
	12	-	12	12		12		1000
ϕ 10	12	-	12	12		12		250
	14	-	14	14		14	HIT-VL 11/1,0	1000
ϕ 12	14	-	14	14		14		250
ϕ 12 / HZA-(R) M12	16	-	16	16		16		1000
ϕ 12	-	17	18	16		18		
ϕ 14	18	-	18	18		18		1000
	-	17	18	18		18		
ϕ 16 / HZA-(R) M16	20	-	20	20	HIT-DL 16/0,8 or HIT-DL B and/or HIT-VL 16/0,7 and/or HIT-VL 16	20	HIT-VL 16/0,7 and/or HIT-VL 16	1000
	-	20	22	20		22		
ϕ 18	22	22	22	22		22		1000
ϕ 20 / HZA-(R) M20	25	-	25	25		25		1000
	-	26	28	25		28		
ϕ 22	28	28	28	28		28		1000
ϕ 24	32	32	32	32		32		1000
ϕ 25 / HZA-(R) M24	32	32	32			32		1000
ϕ 26	35	35	35			35		1000
ϕ 28 / HZA M27	35	35	35			35		1000
ϕ 30	-	35	35			35		1000
	37	-	37			37		
ϕ 32	40	40	40			40		1000
ϕ 34	-	42	42	32		42		1300
	45	-	45	32		45		
ϕ 36	45	-	45	32		45		1300
ϕ 40	55	-	55	32		55		1300
	-	57	55	32		55		

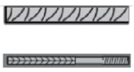
1) Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper drill holes.
2) For HZA(-R) $l_{e,ges,max}$ instead of $l_{v,max}$.

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections

Intended Use
Parameters of drilling, cleaning and setting tools for hammer drilling and compressed air drilling

Annex B8

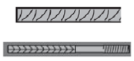
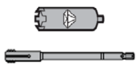
Table B8: Parameters of drilling and setting tools for hammer drilling with hollow drill bit (HDB)

Element	**Drill** (no cleaning required)				**Installation**		
Rebar / Hilti Tension Anchor	Hammer drilling, hollow drill bit[1] **(HDB)**	Brush HIT-RB	Air nozzle HIT-DL	Extension for air nozzle	Piston plug HIT-SZ	Extension for piston plug	Maximum embedment length
						 [2]	-
Size	d_0 [mm]	Size	Size	[-]	Size	[-]	$l_{v,max}$[3] [mm]
ϕ 8	12	No cleaning required			12	HIT-VL 9/1,0	400
ϕ 10	12				12		400
	14				14	HIT-VL 11/1.0	400
ϕ 12	14				14		400
ϕ 12 / HZA-(R) M12	16				16		1000
ϕ 14	18				18		1000
ϕ 16 / M16	20				20	HIT-VL 16/0,7 and/or HIT-VL 16	1000
ϕ 18	22				22		1000
ϕ 20 / HZA-(R) M20	25				25		1000
ϕ 22	28				28		1000
ϕ 24	32				32		1000
ϕ 25 / HZA-(R) M24	32				32		1000

1) With vacuum cleaner Hilti VC 10/20/40 (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.
2) Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper drill holes.
3) For HZA(-R) $l_{e,ges,max}$ instead of $l_{v,max}$.

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	**Annex B9**
Intended Use Parameters of drilling and setting tools for hammer drilling with hollow drill bit	

Table B9: Parameters of drilling, cleaning and setting tools for diamond coring with roughening tool (RT)

Element	Drill and clean				Installation		
Rebar / Hilti Tension Anchor	Diamond coring with roughening (RT)	Brush HIT-RB	Air nozzle HIT-DL	Extension for air nozzle	Piston plug HIT-SZ	Extension for piston plug	Maximum embedment length
						 1)	-
Size	d_0 [mm]	Size	Size	[-]	Size	[-]	$l_{v,max}$ 2) [mm]
ϕ 14	18	18	18	HIT-DL V10/1	18	HIT-VL 11/1,0	1000
ϕ 16 / HZA-(R) M16	20	20	20	HIT-DL 16/0,8 or HIT-DL B and/or HIT-VL 16/0,7 and/or HIT-VL 16	20	HIT-VL 16/0,7 and/or HIT-VL 16	1000
ϕ 18	22	22	22		22		1000
ϕ 20 / HZA-(R) M20	25	25	25		25		1000
ϕ 22	28	28	28		28		1000
ϕ 24	32	32	32		32		1000
ϕ 25 / HZA-(R) M24	32	32			32		1000
ϕ 26	35	35			35		1000
ϕ 28 / HZA M27	35	35			35		1000

1) Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper drill holes.
2) For HZA(-R) $l_{e,ges,max}$ instead of $l_{v,max}$.

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections

Intended Use
Parameters of drilling, cleaning and setting tools for diamond coring with roughening tool

Annex B10

Table B10: 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
30	29,9 to 30,2	30	30
32	31,9 to 32,2	32	32
35	34,9 to 35,2	35	35

Table B11: Hilti roughening tool TE-YRT – roughening and blowing times

	Roughening time $t_{roughen}$ 1)	Minimum blowing time $t_{blowing}$ 1)
l_v [mm]	$t_{roughen}$ [sec] = l_v [mm] / 10	$t_{blowing}$ [sec] = $t_{roughen}$ [sec] + 20
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] = l_v [mm] / 10	$t_{blowing}$ [sec] = $t_{roughen}$ [sec] + 20

1) For HZA(-R) $l_{e,ges}$ instead of l_v.

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 for rebar connections

Intended Use
Parameters for use of the Hilti roughening tool TE-YRT

Annex B11

Cleaning alternatives

Manual Cleaning (MC): Hilti hand pump for blowing out drill holes with diameters $d_0 \leq 20$ mm and drill hole depths $\leq 10 \cdot \phi$.	
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 for rebar connections	**Annex B12**
Intended Use Cleaning alternatives	

Installation instruction

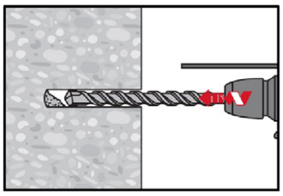
Safety Regulations:

Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling!
Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3.
Important: Observe the installation instruction provided with each foil pack.

Hole drilling

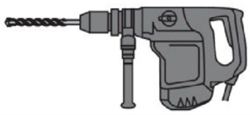
Before drilling remove carbonized concrete and clean contact areas (see Annex B1).
In case of aborted drill hole the drill hole shall be filled with mortar.

a) Hammer drilling

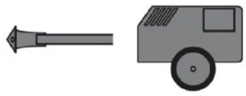


Drill hole to the required embedment length with a hammer drill set in rotation-hammer mode or a compressed air drill using an appropriately sized carbide drill bit.

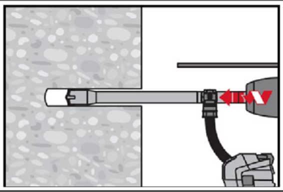
Hammer drill (HD)



Compressed air drill (CA)

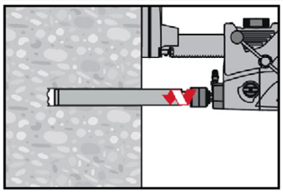


b) Hammer drilling with Hilti hollow drill bit TE-CD, TE-YD

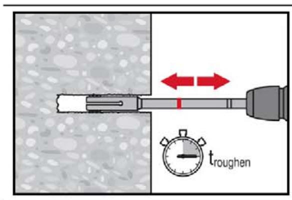


Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with vacuum attachment following the requirements given in Table B8. This drilling system removes the dust and cleans the drill hole during drilling when used in accordance with the user's manual. 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



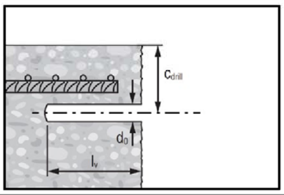
Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.
For the use in combination with Hilti roughening tool TE-YRT see parameters in Table B9 and Table B10.



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 l_v.
Roughening time $t_{roughen}$ see Table B11.

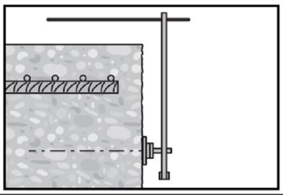
Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	**Annex B13**
Intended Use Installation instructions	

Splicing applications



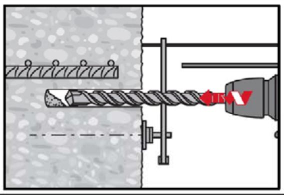
- Measure and control concrete cover c.
- $c_{drill} = c + d_0/2$.
- Drill parallel to edge and to existing rebar.
- Where applicable use Hilti drilling aid HIT-BH.

Drilling aid — For drill hole depths > 20 cm use drilling aid.



Ensure that the drill hole is parallel to the existing rebar.
Three different options can be considered:

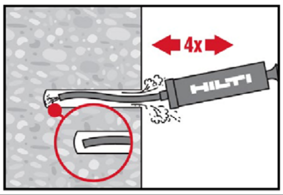
- Hilti drilling aid HIT-BH
- Lath or spirit level
- Visual check



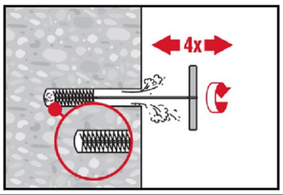
Hole drilling with Hilti drilling aid HIT-BH

Drill hole cleaning — Just before setting the bar the drill hole must be free of dust and debris.
Inadequate hole cleaning = poor load values.

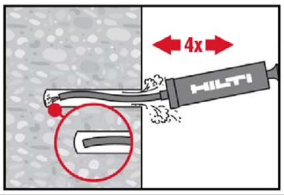
Manual Cleaning (MC) — For drill hole diameters $d_0 \leq 20$ mm and drill hole depths $\leq 10 \cdot \phi$.



The Hilti hand pump may be used for blowing out drill holes up to diameters $d_0 \leq 20$ mm and drill hole depths $\leq 10 \cdot \phi$.
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.

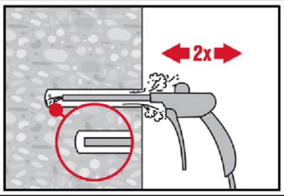


Blow out again with the Hilti hand pump at least 4 times until return air stream is free of noticeable dust.

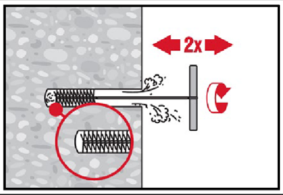
Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	**Annex B14**
Intended Use Installation instructions	

Compressed Air Cleaning (CAC)

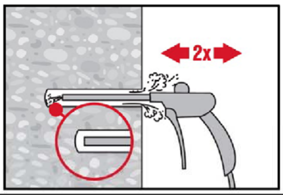
For ϕ 8 to ϕ 12 and drill hole depths ≤ 250 mm
or ϕ > 12 mm and drill hole depths ≤ 20 · ϕ.



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.
Safety tip:
Do not inhale concrete dust.



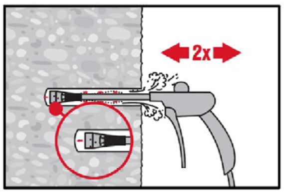
Brush 2 times with the specified brush (see Table B7) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole
(brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.



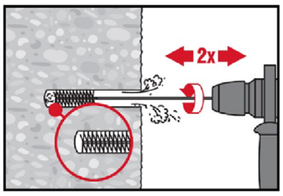
Blow again 2 times from the back of the hole over the whole length with compressed air until return air stream is free of noticeable dust.

Compressed Air Cleaning (CAC)

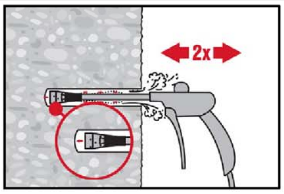
For ϕ 8 to ϕ 12 and drill hole depths > 250 mm
or ϕ > 12 mm and drill hole depths > 20 · ϕ.



Use the appropriate air nozzle Hilti HIT-DL (see Table B7).
Blow 2 times from the back of the hole over the whole length with oil-free compressed air 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.
Safety tip:
Do not inhale concrete dust.



Screw the round steel brush HIT-RB in one end of the brush extension(s) HIT-RBS, so that the overall length of the brush is sufficient to reach the base of the drill hole. Attach the other end of the extension to the TE-C/TE-Y chuck.
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) and removing it.
Safety tip:
Start machine brushing operation slowly.
Start brushing operation once the brush is inserted in the drill hole.



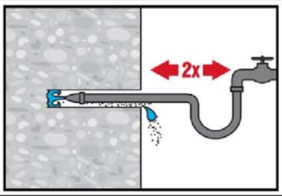
Use the appropriate air nozzle Hilti HIT-DL (see Table B7).
Blow 2 times from the back of the hole over the whole length with oil-free compressed air until return air stream is free of noticeable dust.

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections

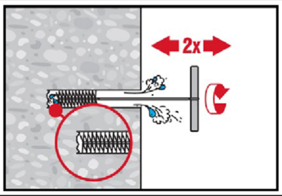
Intended Use
Installation instructions

Annex B15

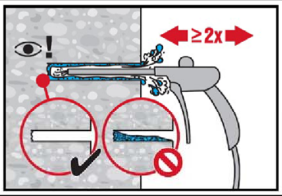
Cleaning of diamond cored holes with roughening with Hilti roughening tool TE-YRT:
For all drill hole diameters d_0 and all drill hole depths.



Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.

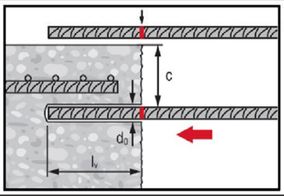


Brush 2 times with the specified brush (see Table B9) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.



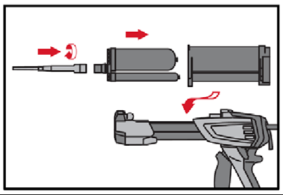
Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust and water. Remove all water from the drill hole until drill hole is completely dried before mortar injection. Blow time see Table B11. For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m³/h.

Rebar preparation

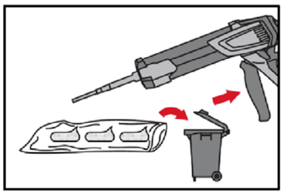


Before use, make sure the rebar is dry and free of oil or another residue.
Mark the embedment depth on the rebar (e.g. with tape) → l_v or $l_{e,ges.}$
Insert rebar in drill hole to verify hole and setting depth l_v or $l_{e,ges}$.

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.



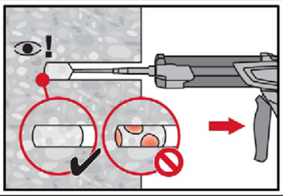
The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discarded quantities are:

2 strokes for 330 ml foil pack,
3 strokes for 500 ml foil pack,
4 strokes for 500 ml foil pack < 5°C.

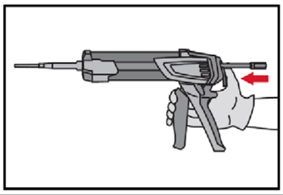
The minimum foil pack temperature is 0°C.

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

Injection method for drill hole depth ≤ 250 mm (without overhead applications)

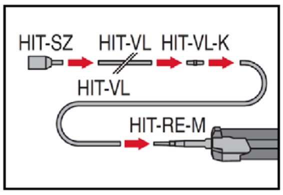


Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill approximately 2/3 of the drill hole to ensure that the annular gap between the rebar or Hilti tension anchor and the concrete is completely filled with adhesive along the embedment length.

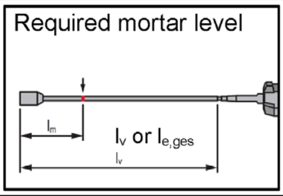


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

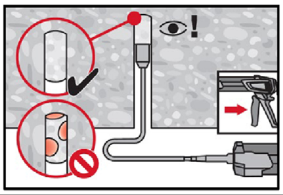
Injection method for drill hole depth > 250 mm or overhead applications



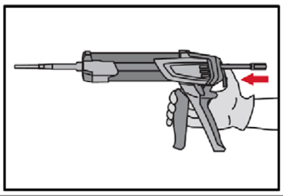
Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ (see Table B7 to Table B9).
For combinations of several injection extensions use coupler HIT-VL-K.
A substitution of the injection extension for a plastic hose or a combination of both is permitted.
The combination of HIT-SZ piston plug with HIT-VL 16 pipe and HIT-VL 16 tube supports proper injection.



Mark the required mortar level l_m and embedment depth l_v ($l_{e,ges}$ for HZA(-R)) with tape or marker on the injection extension.
Estimation:
$l_m = 1/3 \cdot l_v$ for rebar, $l_m = 1/3 \cdot l_{e,ges}$ for HZA(-R)
Precise formula for optimum mortar volume:
$l_m = l_v \cdot (1{,}2 \cdot (\phi^2 / d_0^2) - 0{,}2)$ for rebar, $l_m = l_{e,ges} \cdot (1{,}2 \cdot (\phi^2 / d_0^2) - 0{,}2)$ for HZA(-R)

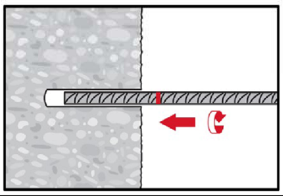
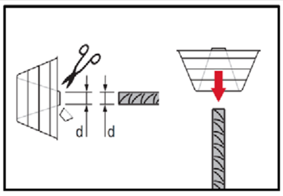
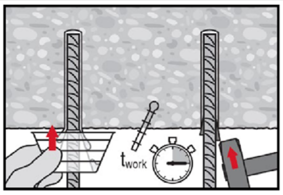
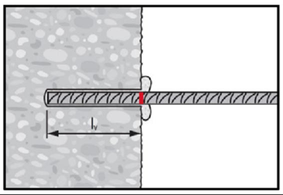
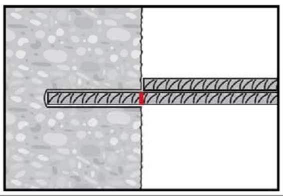
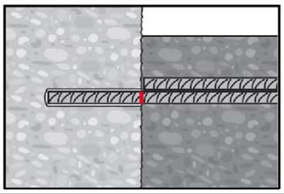


For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (see Table B7 to Table B9). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure.



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

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	**Annex B17**
Intended Use Installation instructions	

Setting the element	Before use, verify that the element is dry and free of oil and other contaminants.
	For easy installation insert the rebar into the drill hole while slowly twisting until the embedment mark is at the concrete surface level.
	For overhead application: During insertion of the rebar mortar might flow out of the drill hole. For collection of the flowing mortar overhead dripping cup HIT-OHC may be used.
	Support the rebar and secure it from falling until mortar has started to harden, e.g. using wedges HIT-OHW.
	After installing the rebar the annular gap must be completely filled with mortar. Proper installation: • desired anchoring embedment l_v is reached: embedment mark at concrete surface. • excess mortar flows out of the drill hole after the rebar has been fully inserted until the embedment mark.
	Observe the working time t_{work} (see Table B6), which varies according to temperature of base material. Minor adjustments to the rebar position may be performed during the working time.
	Full load may be applied only after the curing time t_{cure} has elapsed (see Table B6).

Minimum anchorage length and minimum lap length under static loading

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the respective amplification factor α_{lb} or $\alpha_{lb,100y}$ given in Table C1.

Table C1: Amplification factor α_{lb} and $\alpha_{lb,100y}$ for hammer drilling (HD) and (HDB), compressed air drilling (CA) and diamond coring with roughening with Hilti roughening tool TE-YRT (RT)

	Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ [-]								
Size	Concrete class								
[mm]	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 40 HZA M12 to M27 HZA-R M12 to M24	1,0								

Table C2: HIT-HY 200-A V3, bond efficiency factor k_b and $k_{b,100y}$ for hammer drilling (HD) and (HDB), compressed air drilling (CA) and diamond coring with roughening with Hilti roughening tool TE-YRT (RT)

	Bond efficiency factor $k_b = k_{b,100y}$ [-]								
Size	Concrete class								
[mm]	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 32 HZA M12 to M27 HZA-R M12 to M24	1,0								

Table C3: HIT-HY 200-R V3, bond efficiency factor k_b and $k_{b,100y}$ for hammer drilling (HD) and (HDB), compressed air drilling (CA) and diamond coring with roughening with Hilti roughening tool TE-YRT (RT)

	Bond efficiency factor $k_b = k_{b,100y}$ [-]								
Size	Concrete class								
[mm]	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 32 HZA M12 to M27 HZA-R M12 to M24	1,0								
ϕ 34	1,0								
ϕ 36	1,0								0,96
ϕ 40	1,0							0,92	0,86

$f_{bd,PIR} = k_b \cdot f_{bd}$

$f_{bd,PIR,100y} = k_{b,100y} \cdot f_{bd}$

f_{bd}: Design value of the bond strength in N/mm² considering

- the concrete strength class
- good bond condition (for all other bond conditions multiply the values by $\eta_1 = 0{,}7$)
- recommended partial factor $\gamma_c = 1{,}5$ according to EN 1992-1-1.
- rebar diameter for $\phi > 32$ mm ($\eta_2 = (132 - \phi) / 100$)

k_b, $k_{b,100y}$: Bond efficiency factor according to Table C2 and Table C3

Table C4: HIT-HY 200-A V3, design values of the bond strength $f_{bd,PIR}$ and $f_{bd,PIR,100y}$ for hammer drilling (HD) and (HDB), compressed air drilling (CA) and diamond coring with roughening with Hilti roughening tool TE-YRT (RT)

	Bond strength $f_{bd,PIR} = f_{bd,PIR,100y}$ [N/mm²]								
size	concrete class								
[mm]	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 32 HZA M12 to M27 HZA-R M12 to M24	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

Table C5: HIT-HY 200-R V3, design values of the bond strength $f_{bd,PIR}$ and $f_{bd,PIR,100y}$ for hammer drilling (HD) and (HDB), compressed air drilling (CA) and diamond coring with roughening with Hilti roughening tool TE-YRT (RT)

	Bond strength $f_{bd,PIR} = f_{bd,PIR,100y}$ [N/mm²]								
Size	Concrete class								
[mm]	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 32 HZA M12 to M27 HZA-R M12 to M24	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
ϕ 34	1,6	2,0	2,3	2,7	2,9	3,3	3,6	3,9	4,2
ϕ 36	1,6	1,9	2,2	2,6	2,9	3,3	3,6	3,8	3,8
ϕ 40	1,5	1,8	2,1	2,5	2,8	3,1	3,4	3,4	3,4

Tensile steel strength of Hilti tension anchor HZA / HZA-R

Table C6: Characteristic tensile yield strength for rebar part of Hilti tension anchor HZA / HZA-R

Hilti tension anchor HZA, HZA-R			M12	M16	M20	M24	M27
Rebar diameter	ϕ	[mm]	12	16	20	25	28
Characteristic tensile yield strength	f_{yk}	[N/mm²]	500	500	500	500	500[1)]
Partial factor for rebar part	$\gamma_{Ms,N}$[2)]	[-]	1,15				

1) HZA-R size M27 not available.
2) In absence of national regulations.

Table C7: Characteristic tensile steel strength for threaded/smooth part of Hilti tension anchor HZA / HZA-R

Hilti tension anchor HZA, HZA-R			M12	M16	M20	M24	M27
Steel failure							
Characteristic resistance HZA	$N_{Rk,s}$	[kN]	46	86	135	194	253
Characteristic resistance HZA-R	$N_{Rk,s}$	[kN]	62	111	173	248	-[1)]
Partial factor for threaded part	$\gamma_{Ms,N}$[2)]	[-]	1,4				

1) HZA-R size M27 not available.
2) In absence of national regulations.

Minimum anchorage length and minimum lap length under seismic action

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor α_{lb} or $\alpha_{lb,100y}$ given in Table C1.

The minimum concrete cover according to Table B3 and $c_{min,seis} = 2 \cdot \phi$ applies.

Table C8: HIT-HY 200-A V3, seismic bond efficiency factors $k_{b,seis}$ and $k_{b,seis,100y}$ for hammer drilling (HD) and (HDB), compressed air drilling (CA) and diamond coring with roughening with Hilti roughening tool TE-YRT (RT)

	Bond efficiency factor $k_{b,seis} = k_{b,seis,100y}$ [-]							
Size	Concrete class							
[mm]	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 10 to ϕ 18	1,0				0,90	0,82	0,76	0,71
ϕ 20 to ϕ 30	1,0						0,92	0,86
ϕ 32	1,0							

Table C9: HIT-HY 200-R V3, seismic bond efficiency factors $k_{b,seis}$ and $k_{b,seis,100y}$ for hammer drilling (HD) and (HDB), compressed air drilling (CA) and diamond coring with roughening with Hilti roughening tool TE-YRT (RT)

	Bond efficiency factor $k_{b,seis} = k_{b,seis,100y}$ [-]							
Size	Concrete class							
[mm]	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 10 to ϕ 18	1,0				0,90	0,82	0,76	0,71
ϕ 20 to ϕ 30	1,0						0,92	0,86
ϕ 32	1,0							
ϕ 34	1,0							
ϕ 36	1,0						0,92	0,86
ϕ 40	1,0			0,89	0,80	0,73	0,67	0,63

$f_{bd,PIR,seis} = k_{b,seis} \cdot f_{bd}$

$f_{bd,PIR,seis,100y} = k_{b,seis,100y} \cdot f_{bd}$

f_{bd}: Design value of the bond strength in N/mm² considering

- the concrete strength class
- good bond condition (for all other bond conditions multiply the values by $\eta_1 = 0{,}7$)
- recommended partial factor $\gamma_c = 1{,}5$ according to EN 1992-1-1.
- the rebar diameter

$k_{b,seis}$, $k_{b,seis,100y}$: Bond efficiency factor according to table C10 and Table C11

Table C10: HIT-HY 200-A V3, design values of the bond strength $f_{bd,PIR,seis}$ and $f_{bd,PIR,seis,100y}$ for seismic action for hammer drilling (HD) and (HDB), compressed air drilling (CA) and diamond coring with roughening with Hilti roughening tool TE-YRT (RT)

	Bond strength $f_{bd,PIR,seis} = f_{bd,PIR,seis,100y}$ [N/mm²]							
Size	Concrete class							
[mm]	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 10 to ϕ 18	2,0	2,3	2,7	3,0	3,0	3,0	3,0	3,0
ϕ 20 to ϕ 30	2,0	2,3	2,7	3,0	3,4	3,7	3,7	3,7
ϕ 32	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

Table C11: HIT-HY 200-R V3, design values of the bond strength $f_{bd,PIR,seis}$ and $f_{bd,PIR,seis,100y}$ for seismic action for hammer drilling (HD) and (HDB), compressed air drilling (CA) and diamond coring with roughening with Hilti roughening tool TE-YRT (RT)

	Bond strength $f_{bd,PIR,seis} = f_{bd,PIR,seis,100y}$ [N/mm²]							
Size	Concrete class							
[mm]	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 10 to ϕ 18	2,0	2,3	2,7	3,0	3,0	3,0	3,0	3,0
ϕ 20 to ϕ 30	2,0	2,3	2,7	3,0	3,4	3,7	3,7	3,7
ϕ 32	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
ϕ 34	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
ϕ 36	2,0	2,3	2,7	3,0	3,4	3,7	3,7	3,7
ϕ 40	2,0	2,3	2,7	2,7	2,7	2,7	2,7	2,7

Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections

Performances
Design values of the bond strengths $f_{bd,PIR,seis}$ and $f_{bd,PIR,seis,100y}$ for seismic action

Annex C5

Bond strengths $f_{bd,fi}$ and $f_{bd,fi,100y}$ at increased temperature for concrete strength classes C12/15 to C50/60 with all drilling methods under static loading

The bond strengths $f_{bd,fi}$ for a working life of 50 years and $f_{bd,fi,100y}$ for a working life of 100 years at increased temperature have to be calculated by the following equations:

$f_{bd,fi} = k_{fi}(\theta) \cdot f_{bd,PIR} \cdot \gamma_c / \gamma_{M,fi}$ for a working life of 50 years

$f_{bd,fi,100y} = k_{fi,100y}(\theta) \cdot f_{bd,PIR,100y} \cdot \gamma_c / \gamma_{M,fi}$ for a working life of 100 years

with: $\theta \leq 268$ °C: $k_{fi}(\theta) = 24{,}661 \cdot e^{(-0{,}013 \cdot \Theta)} / (f_{bd,PIR} \cdot 4{,}3) \leq 1{,}0$ 50 years

$k_{fi,100y}(\theta) = 24{,}661 \cdot e^{(-0{,}013 \cdot \Theta)} / (f_{bd,PIR,100y} \cdot 4{,}3) \leq 1{,}0$ 100 years

and $\theta > \theta_{max}$: $k_{fi}(\theta) = k_{fi,100y}(\theta) = 0{,}0$

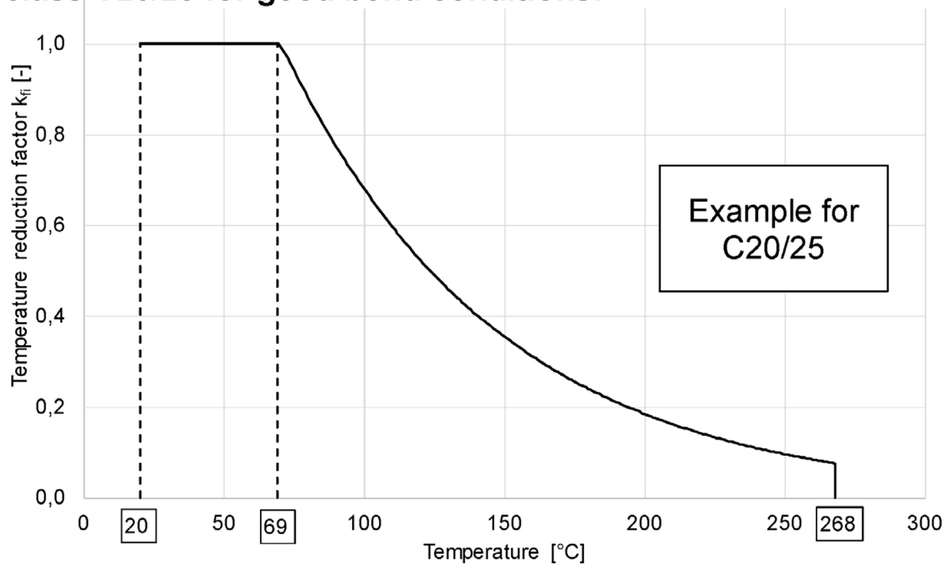
$\theta_{max} = 268$ °C

$f_{bd,fi}$; $f_{bd,fi,100y}$	Design value of bond strength at increased temperature in N/mm² for a working life of 50 years; 100 years
θ	Temperature in °C in the mortar
θ_{max}	Temperature in °C at which the mortar can no longer transfer bond stresses
$k_{fi}(\theta)$; $k_{fi,100y}(\theta)$	Temperature reduction factor for a working life of 50 years; 100 years
$f_{bd,PIR}$; $f_{bd,PIR,100y}$	Design value of bond strength in N/mm² in cold condition according to Table C4 and Table C5 considering concrete class, rebar diameter, drilling method and bond condition according to EN 1992-1-1 for a working life of 50 years; 100 years
γ_c	1,5 Partial factor according to EN 1992-1-1
$\gamma_{M,fi}$	1,0 Partial factor according to EN 1992-1-2

At increased temperature the anchorage length shall be calculated according to EN 1992-1-1 Equation 8.3 using the temperature-dependent ultimate bond strength $f_{bd,fi}$.

Please note that for a tension anchor application with HZA(-R) the temperature distribution in the concrete at increased temperature differs from the temperature distribution of an embedded post-installed rebar.

Figure C1 Example graph of reduction factor $k_{fi}(\theta) = k_{fi,100y}(\theta)$ for concrete strength class C20/25 for good bond conditions:



Injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for rebar connections	**Annex C6**
Performances Bond strengths $f_{bd,fi}$ and $f_{bd,fi,100y}$ at increased temperature Temperature reduction factors $k_{fi}(\theta)$ and $k_{fi,100y}(\theta)$ at increased temperature	

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Table C12: Characteristic tensile steel strength under direct fire exposure for Hilti tension anchor HZA, all drilling methods

Hilti tension anchor HZA				M12	M16	M20	M24	M27
Characteristic tensile strength	R30	$N_{Rk,s,fi}$	[kN]	1,7	3,1	4,9	7,1	9,2
	R60			1,3	2,4	3,7	5,3	6,9
	R90			1,1	2,0	3,2	4,6	6,0
	R120			0,8	1,6	2,5	3,5	4,6

Table C13: Characteristic tensile steel strength under direct fire exposure for Hilti tension anchor HZA-R, all drilling methods

Hilti tension anchor HZA-R				M12	M16	M20	M24
Characteristic tensile strength	R30	$N_{Rk,s,fi}$	[kN]	2,5	4,7	7,4	10,6
	R60			2,1	3,9	6,1	8,8
	R90			1,7	3,1	4,9	7,1
	R120			1,3	2,5	3,9	5,6