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European Technical Assessment

ETA-11/0390 of 01/11/2016

English translation prepared by CSTB - Original version in French language

General Part

Nom commercial *Trade name*	**Injection system Hilti HIT-CT 1 for rebar connections**
Famille de produit *Product family*	Scellement d'armatures rapportées, diamètres 8 à 25mm, avec Système d'injection Hilti HIT-CT 1. **Post installed rebar connections diameter 8 to 25mm made with Hilti HIT-CT 1 injection mortar.**
Titulaire *Manufacturer*	Hilti Corporation Feldkircherstrasse 100 FL-9494 Schaan Principality of Liechtenstein
Usine de fabrication *Manufacturing plants*	Hilti plants
Cette evaluation contient: *This Assessment contains*	22 pages incluant 19 annexes qui font partie intégrante de cette évaluation 222 *pages including 19 annexes which form an integral part of this assessment*
Base de l'ETE *Basis of ETA*	DEE 330087-00-0601, Edition juillet 2015 *EAD 330087-00-0601, Version July 2015*
Cette évaluation remplace: *This Assessment replaces*	*ETE-11/0390 du 27/08/2012* *ETA-11/0390 dated 27/08/2012*

Specific Part

1 Technical description of the product

The Hilti HIT-CT 1 is used for the connection, by anchoring or overlap joint, of reinforcing bars (rebars) in existing structures made of ordinary non-carbonated concrete C12/15 to C50/60. The design of the post-installed rebar connections is done in accordance with EN 1992-1-1 and EN 1992-1-2.

Covered are rebar anchoring systems consisting of Hilti HIT-CT 1 bonding material and the Hilti tension anchors HZA and HZA-R sizes M12, M16 and M20 or an embedded straight deformed reinforcing bar diameter, d, from 8 to 25 mm with properties according to Annex C of EN 1992-1-1 and EN 10080. The classes B and C of the rebar are recommended. The illustration and the description of the product are given in Annex A.

2 Specification of the intended use

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

The provisions made in this European technical assessment are based on an assumed working life of the anchor of 50 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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance under static and quasi-static loading	See Annex C1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	See Annex C2

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances contained in this European technical approval, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

For Basic requirement Safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability.

3.5 Protection against noise (BWR 5)

Not relevant.

3.6 Energy economy and heat retention (BWR 6)

Not relevant.

3.7 Sustainable use of natural resources ((BWR 7)

For the sustainable use of natural resources no performance was determined for this product.

3.8 General aspects relating to fitness for use

Durability and Serviceability are only ensured if the specifications of intended use according to Annex B1 are kept.

4 Assessment and verification of constancy of performance (AVCP)

According to the Decision 96/582/EC of the European Commission[1], as amended, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table apply.

Product	Intended use	Level or class	System
Metal anchors for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units	—	1

5 Technical details necessary for the implementation of the AVCP system

Technical details necessary for the implementation of the Assessment and verification of constancy of performance (AVCP) system are laid down in the control plan deposited at Centre Scientifique et Technique du Bâtiment.

The manufacturer shall, on the basis of a contract, involve a notified body approved in the field of anchors for issuing the certificate of conformity CE based on the control plan.

The original French version is signed by

Charles Baloche
Technical Director

1 Official Journal of the European Communities L 254 of 08.10.1996

Installed condition

Figure A1:

Overlap joint with existing reinforcement for rebar connections of slabs and beams

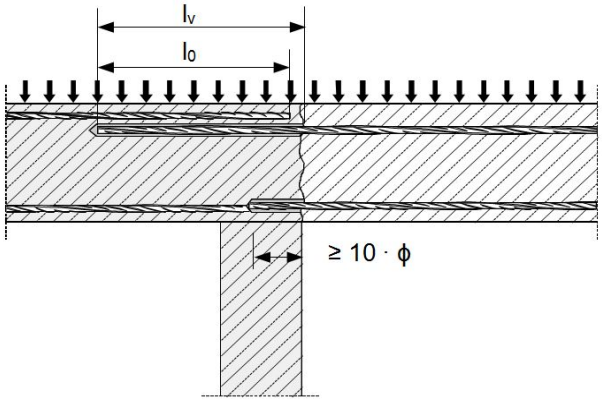


Figure A2:

Overlap joint with existing reinforcement at a foundation of a column or wall where the rebars are stressed in tension

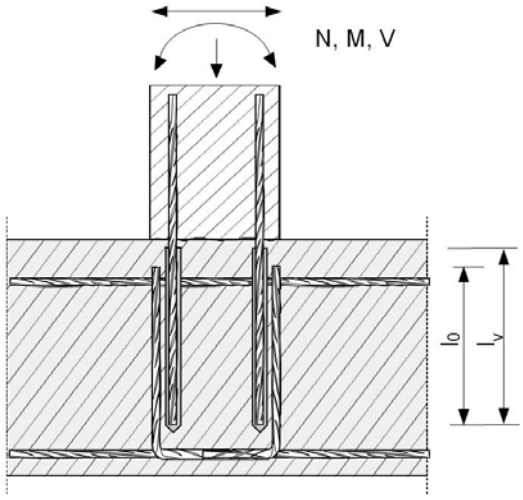
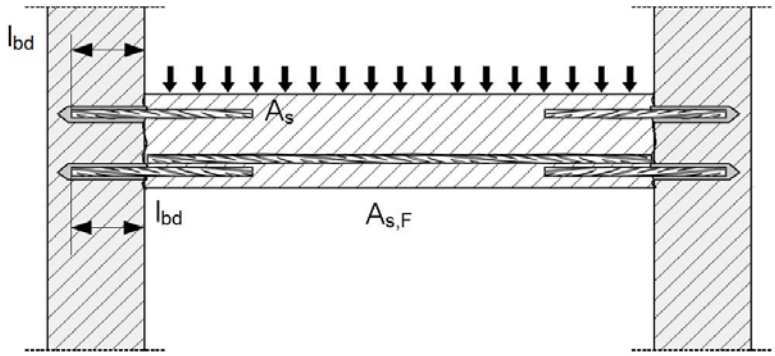


Figure A3:

End anchoring of slabs or beams



Injection system Hilti HIT-CT 1	
Product description Installed condition: application examples of post-installed rebars.	**Annex A1**

Figure A4:
Rebar connection for components stressed primarily in compression

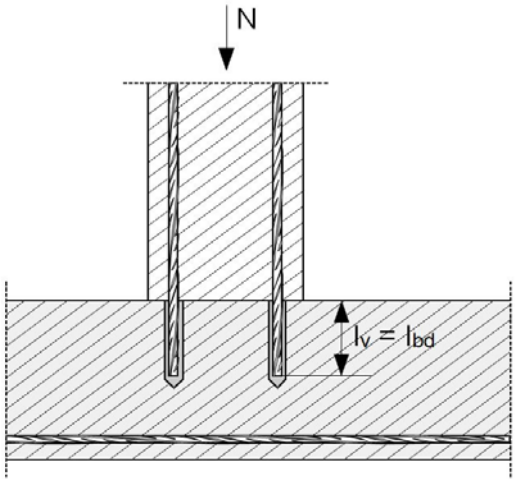
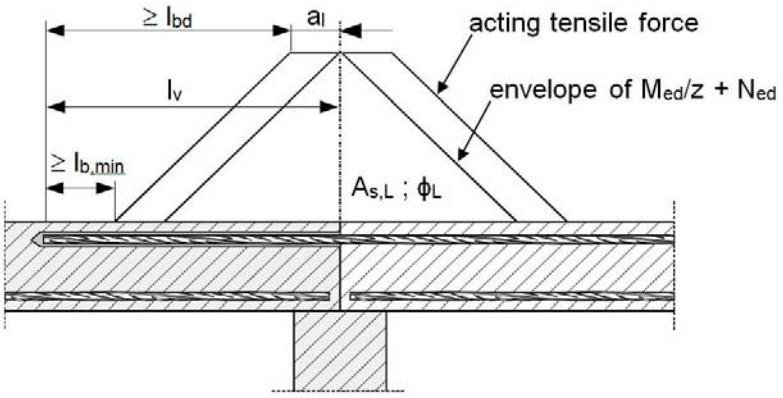


Figure A5:
Anchoring of reinforcement to cover the enveloped line of acting tensile force in the bending member



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 shall be present.
- The shear transfer between existing and new concrete shall be designed according to EN 1992-1-1.
- Preparing of joints according to Annex B2.

Injection system Hilti HIT-CT 1	
Product description Installed condition: application examples of post-installed rebars.	**Annex A2**

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

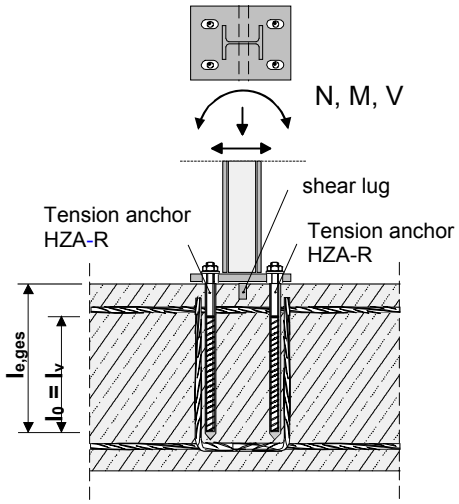


Figure A7:
Overlap joint for the anchorage of barrier posts

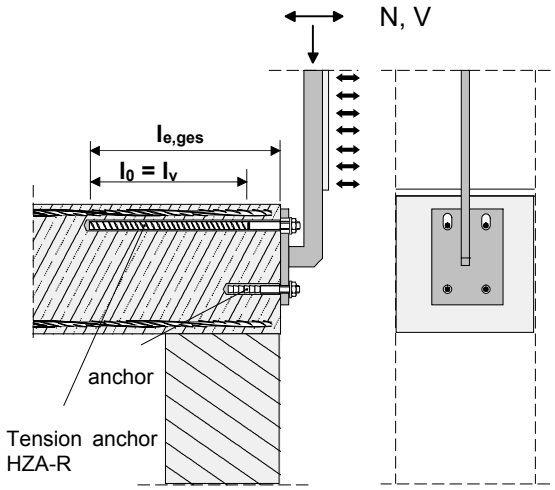
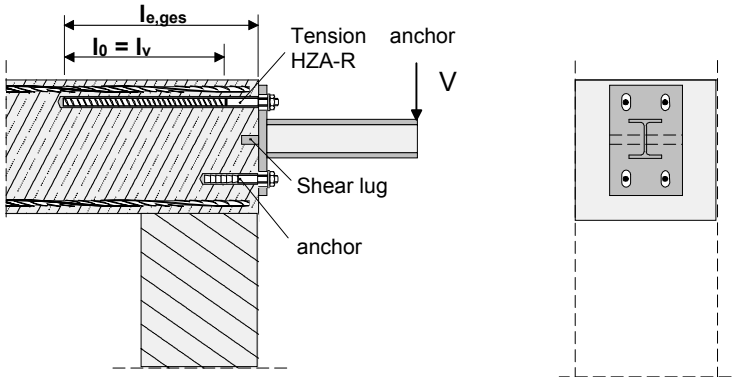


Figure A8:
Overlap joint for the anchorage of cantilever members



Note to Figure A6 to Figure 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-CT 1	
Product description Installed condition: application examples of HZA and HZA-R	**Annex A3**

Product description: Injection mortar and steel elements

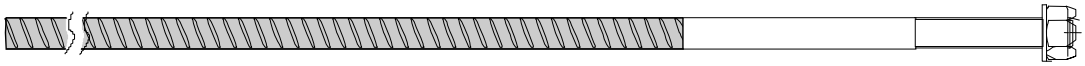
Injection mortar Hilti HIT-CT 1

330 ml and 500 ml

Product name: “Hilti HIT-CT 1”

Static mixer Hilti HIT-RE-M

Steel elements



Hilti Tension Anchor HZA / HZA-R: M12, M16 and M20

Reinforcing bar (rebar): ϕ 8 to ϕ 25

- 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:
  $0{,}05 \cdot \phi \le h_{rib} \le 0{,}07 \cdot \phi$
- 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)

Injection system Hilti HIT-CT 1	
Product description Injection mortar / Static mixer / Steel elements.	**Annex A4**

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 NCL 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: Bars class B according to NDP or NCL of EN 1992-1-1/NA:2013
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	
Hilti tension anchor HZA-R	Round steel with threaded part: Stainless steel 1.4404, 1.4571, 1.4362 EN 10088-1:2014 Rebar: Bars class B according to NDP or NCL of EN 1992-1-1/NA:2013
Washer	Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014
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 10088-1:2014

Specifications of intended use

Anchorages subject to:

- Static and quasi static loading.
- Fire exposure.

Base material:

- Reinforced or unreinforced normal weight concrete according to EN 206.
- Strength classes C12/15 to C50/60 according to EN 206.
- Maximum chloride content of 0,40 % (CL 0.40) related to the cement content according to EN 206-1.
- 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 to at least 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**
  +5 °C to +40 °C
- **in-service**
  -40 °C to +80 °C (max. long term temperature +50 °C and max. short term temperature +80 °C)

Design:

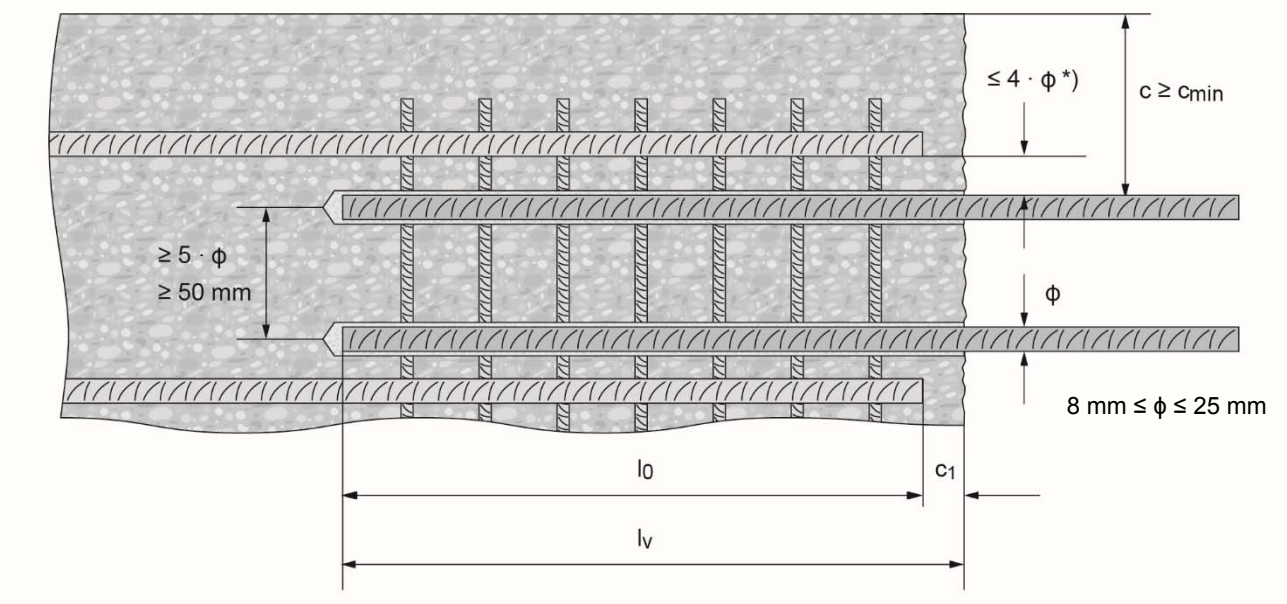
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- Design under static or quasi-static loading in accordance with EN 1992-1-1, Annex B2 and Annex B4.
- 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:
  - hammer drilling (HD),
  - hammer drilling with Hilti hollow drill bit TE-CD, TE-YD (HDB),
  - compressed air drilling (CA)
- Overhead installation is admissible.
- 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 rebar may be designed for tension 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, then the lap length shall be increased by the difference between the clear bar distance and 4 · ϕ.

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
l_v effective embedment depth ≥ $l_0 + c_1$
d_0 nominal drill bit diameter, see Annex B6 to B8

Table B1: Hilti tension anchor HZA-R, dimensions

Hilti tension anchor HZA-R			**M12**	**M16**	**M20**	**M24**
Rebar diameter	ϕ	[mm]	12	16	20	25
Nominal embedment depth and drill hole depth	$l_{e,ges}$	[mm]	170 to 800	180 to 1300	190 to 1300	200 to 1300
Effective embedment depth ($l_v = l_{e,ges} - l_e$)	l_v	[mm]	$l_{e,ges} - 100$			
Length of smooth shaft	l_e	[mm]	100			
Maximum diameter of clearance hole in the fixture [1)]	d_f	[mm]	14	18	22	26
Maximum torque moment	T_{max}	[Nm]	40	80	150	200

[1)] For larger clearance hole see EAD 330087-00-0601

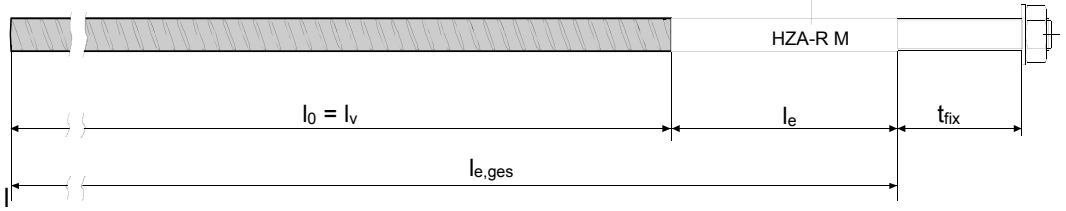
Table B2: Hilti tension anchor HZA, dimensions

Hilti tension anchor HZA			**M12**	**M16**	**M20**	**M24**	**M27**
Rebar diameter	ϕ	[mm]	12	16	20	25	28
Nominal embedment depth and drill hole depth	$l_{e,ges}$	[mm]	90 to 800	100 to 1300	110 to 1300	120 to 1300	140 to 1300
Effective embedment depth ($l_v = l_{e,ges} - l_e$)	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 [1)]	d_f	[mm]	14	18	22	26	30
Maximum torque moment	T_{max}	[Nm]	40	80	150	200	270

[1)] For larger clearance hole see EAD 330087-00-0601

Hilti Tension Anchor HZA/ HZA-R

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



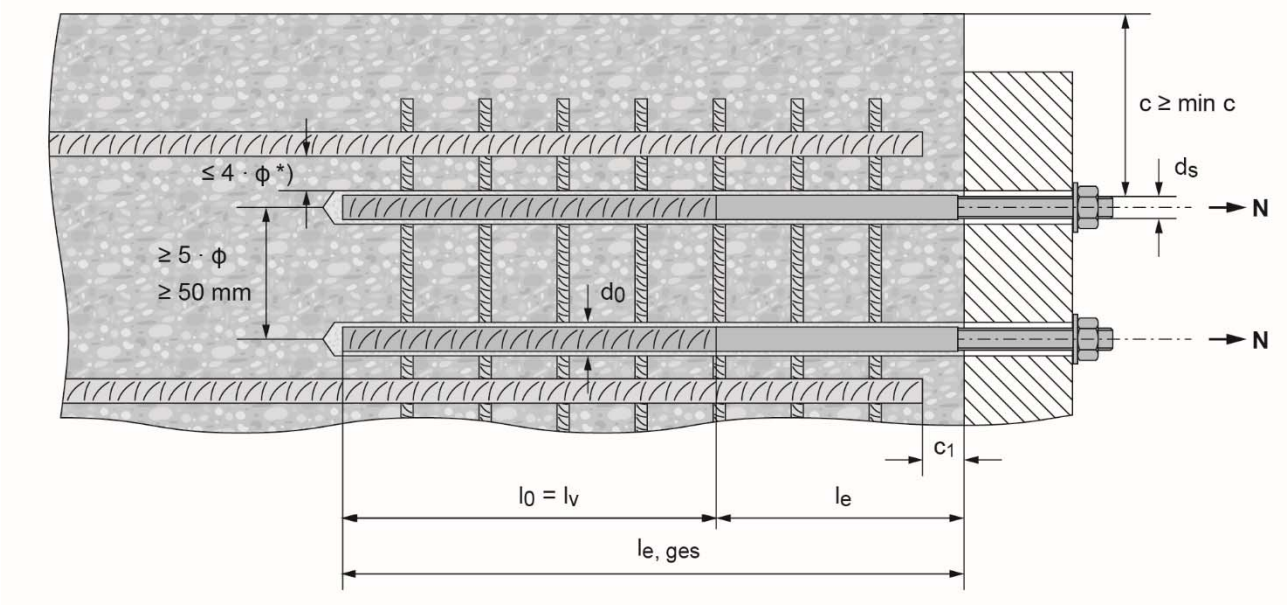
Injection system Hilti HIT-CT 1

Intended Use
Installed condition: dimensions for HZA / HZA-R.

Annex B3

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

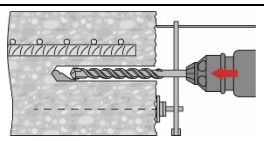
- Hilti tension anchor HZA / HZA-R may be designed for tension forces only.
- The tension forces must be transferred via an overlap joint to the reinforcement in the existing structure.
- The length of the bonded-in smooth shaft may not be accounted as anchorage.
- The transfer of shear forces shall 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, then the lap length shall be increased by the difference between the clear bar distance and 4 · ϕ.

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 effective embedment depth,
l_e length of the smooth shaft or the bonded-in threaded part
$l_{e,ges}$ overall embedment depth
d_0 nominal drill bit diameter, see Table B6 and Table B7

Table B3: Minimum concrete cover c_{min}[1)] of the post-installed rebar depending on drilling method and drilling tolerance

Drilling method	Bar diameter [mm]	Minimum concrete cover c_{min}[1)] [mm]		
		Without drilling aid	With drilling aid	
Hammer drilling (HD) and hammer drilling with Hilti hollow drill bit TE-CD, TE-YD (HDB)	$\phi \le 24$	$30 + 0{,}06 \cdot l_v \ge 2 \cdot \phi$	$30 + 0{,}02 \cdot l_v \ge 2 \cdot \phi$	
	$\phi = 25$	$40 + 0{,}06 \cdot l_v \ge 2 \cdot \phi$	$40 + 0{,}02 \cdot l_v \ge 2 \cdot \phi$	
Compressed air drilling (CA)	$\phi \le 24$	$50 + 0{,}08 \cdot l_v$	$50 + 0{,}02 \cdot l_v$	
	$\phi = 25$	$60 + 0{,}08 \cdot l_v \ge 2 \cdot \phi$	$60 + 0{,}02 \cdot l_v \ge 2 \cdot \phi$	

[1)] See Annex B2, Figure B1.
Comments: The minimum concrete cover acc. EN 1992-1-1.

Table B4: Maximum embedment depth $l_{v,max}$ depending on bar diameter and dispenser

Elements		Dispensers
rebar	Hilti Tension anchor	HDM 330, HDM 500, HDE 500
size	size	$l_{v,max}$ [mm]
ϕ 8 to ϕ 16	HZA(-R) M12 HZA(-R) M16	700
ϕ 18 to ϕ 25	HZA(-R) M20	500

Table B5: Maximum working time and minimum curing time[1)]

Temperature in the base material T			Maximum working time t_{work}	Minimum curing time t_{cure}
-5 °C	to	-1 °C	60 min	6 h
0 °C	to	4 °C	40 min	3 h
5 °C	to	9 °C	25 min	2 h
10 °C	to	19 °C	10 min	90 min
20 °C	to	29 °C	4 min	75 min
30 °C	to	40 °C	2 min	60 min

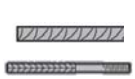
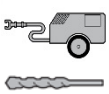
[1)] The curing time data are valid for dry base material only.
In wet base material the curing times must be doubled.

Injection system Hilti HIT-CT 1

Intended Use.
Minimum concrete cover, maximum embedment depth,
Maximum working time and minimum curing time.

Annex B5

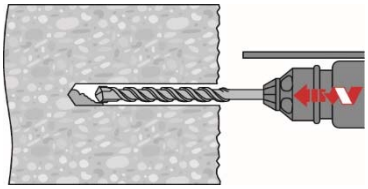
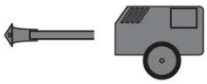
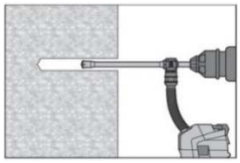
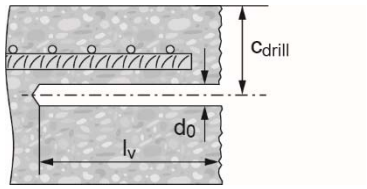
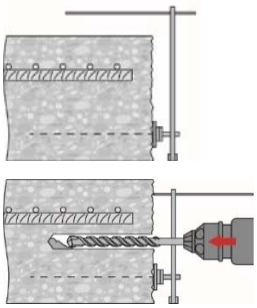
Table B6: Parameters of drilling, cleaning and setting tools, hammer drilling and compressed air drilling

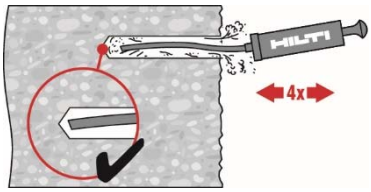
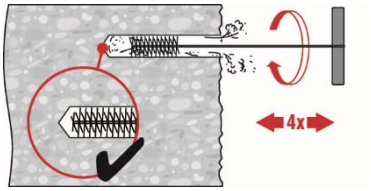
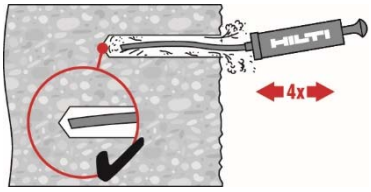
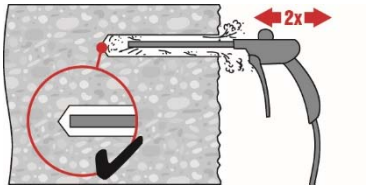
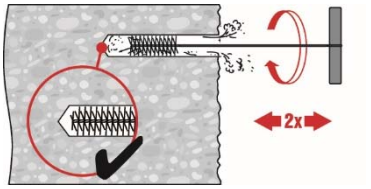
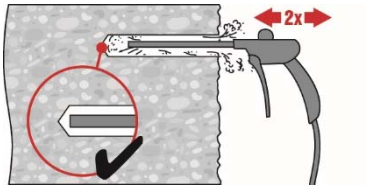
Elements	**Drill and clean**					**Installation**		
Rebar / Hilti Tension Anchor	Hammer drilling (HD)	Compressed air drilling (CA)	Brush HIT-RB	Air nozzle HIT-DL	Extension for air nozzle	Piston plug HIT-SZ	Extension for piston plug	Maximum embedment depth
								-
size	d_0 [mm]	d_0 [mm]	size	size	[-]	size	[-]	$l_{v,max}$ [mm]
ϕ 8	10	-	10	-	HIT-DL 10/0,8 or HIT-DL V10/1	-	HIT-VL 9/1,0	250
	12	-	12	12		12		700
ϕ 10	12	-	12	12		12		250
	14	-	14	14		14	HIT-VL 11/1,0	700
ϕ 12 / HZA(-R) M12	14	-	14	14		14		250
	16	-	16	16		16		700
	-	17	18	16		16		
ϕ 14	18	-	18	18		18		700
	-	17	18	16		16		
ϕ 16 / HZA(-R) M16	20	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	700
ϕ 18	22	22	22	22		22		500
ϕ 20 / HZA(-R) M20	25	-	25	25		25		500
	-	26	28	25		25		
ϕ 22	28	28	28	28		28		500
ϕ 24	32	32	32	32		32		500
ϕ 25	32	32	32	32		32		500

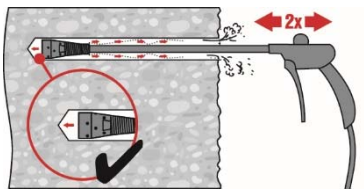
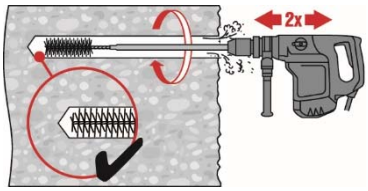
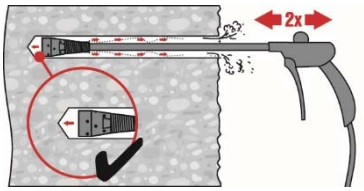
Cleaning alternatives for hammer drilling

Automatic Cleaning (AC): Cleaning is performed during drilling with Hilti hollow drill bit TE-CD, TE-YD including vacuum cleaner.		
Compressed Air Cleaning (CAC): air nozzle with an orifice opening of minimum 3,5 mm in diameter. + brush HIT-RB		recommended for blowing out with compressed air (min. 6 bar at 6 m^3/h)
Manual Cleaning (MC): Hilti hand pump + brush HIT-RB		for cleaning of drill holes with diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot d$.

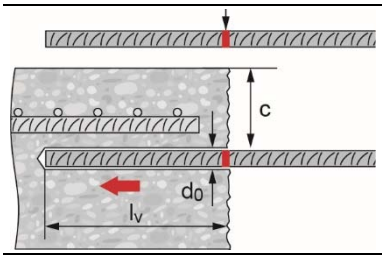
Installation instruction

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 depth 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 Hilti vacuum attachment. 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.
Splicing applications	
	Measure and control concrete cover c. $c_{drill} = c + d_0/2$. Drill parallel to surface edge and to existing rebar. Where applicable use Hilti drilling aid HIT-BH.
Drilling aid	For holes l_v > 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

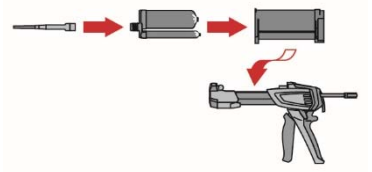
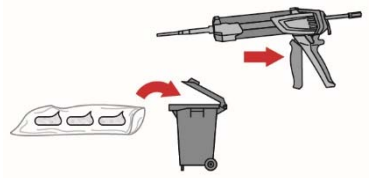
Drill hole cleaning	Just before setting the bar the drill hole must be free of dust and debris. Inadequate hole cleaning = poor load values.
Manual Cleaning (MC) for hammer drilled holes	For drill hole diameters $d_0 \leq 20$ mm and all drill hole depths $h_0 \leq 10 \cdot \phi$.
	The Hilti hand pump may be used for blowing out drill holes up to diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot \phi$. 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 B6) 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 the Hilti hand pump at least 4 times until return air stream is free of noticeable dust.
Compressed Air Cleaning (CAC) for hammer drilled holes	For all drill hole diameters d_0 and all drill hole depths $h_0 \leq 20 \cdot \phi$.
	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.
	Brush 2 times with the specified brush (see Table B6) 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.

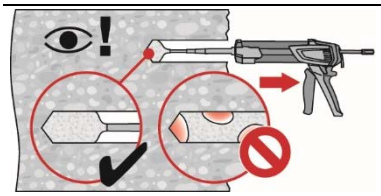
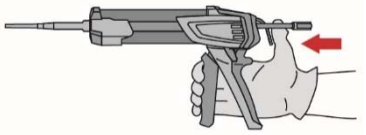
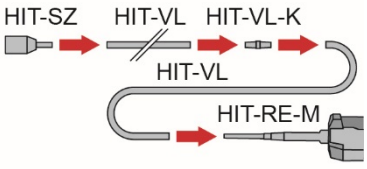
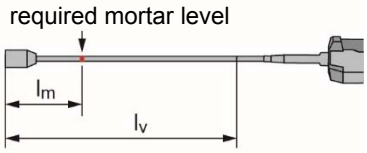
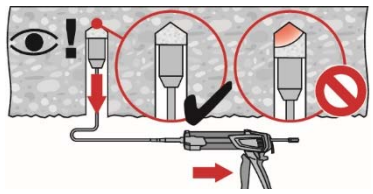
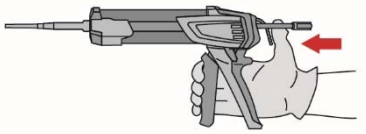
Compressed Air Cleaning (CAC) for hammer drilled holes	For drill holes deeper than 250 mm (for rebar $\phi \leq 12$ mm) or deeper than $20 \cdot \phi$ (for rebar $\phi > 12$ mm)
	Use the appropriate air nozzle Hilti HIT-DL (see Table B6). Blow 2 times from the back of the hole over the whole length with oil-free compressed air until return air stream is free of noticeable dust. Safety tip: Do not inhale concrete dust. Use of the dust collector Hilti HIT-DRS is recommended.
	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. Safety tip: Start machine brushing operation slowly. Start brushing operation once the brush is inserted in the borehole.
	Use the appropriate air nozzle Hilti HIT-DL (see Table B6). Blow 2 times from the back of the whole over the hole length with oil-free compressed air until return air stream is free of noticeable dust. Safety tip: Do not inhale concrete dust. Use of the dust collector Hilti HIT-DRS is recommended.

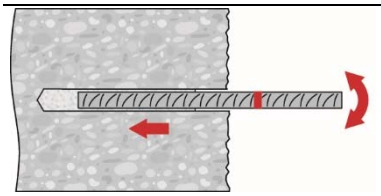
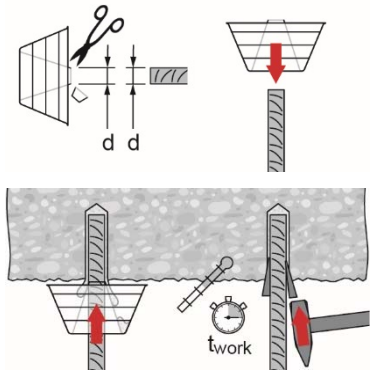
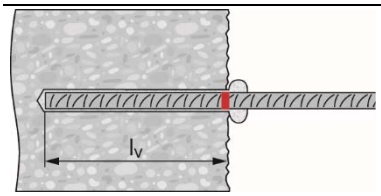
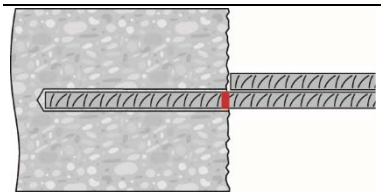
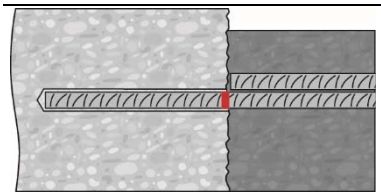
Rebar preparation

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

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.

Inject adhesive	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 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 B6). For combinations of several injection extensions use coupler HIT-VL-K. A substitution of the injection extension with a plastic hose or a combination of both is permitted. The combination of HIT-SZ piston plug with HIT-VL 16 pipe and then HIT-VL 16 tube support proper injection.
	Mark the required mortar level l_m and embedment depth l_v with tape or marker on the injection extension. estimation: $l_m = 1/3 \cdot l_v$ precise formula for optimum mortar volume: $l_m = l_v \cdot (1{,}2 \cdot (\phi^2 / d_0^2) - 0{,}2)$
	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 B6). 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.

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 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. For overhead installation use piston plugs and fix embedded parts with e.g. wedges.
	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 borehole after the rebar has been fully inserted until the embedment mark.
	Observe the working time t_{work} (see Table B5), 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 B5).

Minimum anchorage length and minimum lap length

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} given in Table C1.

Table C1: Amplification factor α_{lb} for hammer drilling, hammer drilling with Hilti hollow drill bit TE-CD, TE-YD, compressed air drilling

Bar diameter	Units	Concrete class								
		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 25	[-]	1,0			1,2	1,4				

Table C2: Bond efficiency value k_b for hammer drilling, hammer drilling with Hilti hollow drill bit TE-CD, TE-YD, compressed air drilling

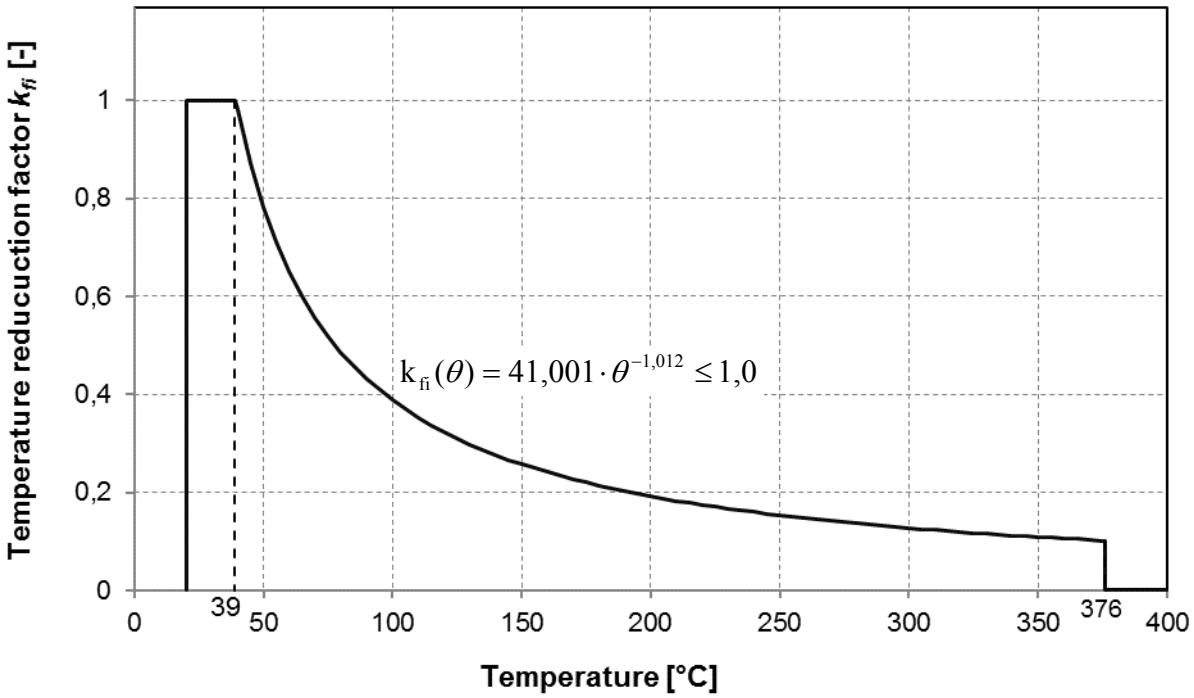
Bar diameter	Units	Concrete class								
		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 25	[-]	1,00	1,00	1,00	1,00	1,00	0,90	0,82	0,76	0,71

Table C3: Design values of the ultimate bond resistance f_{bd}[1)] in N/mm² for hammer drilling, hammer drilling with Hilti hollow drill bit TE-CD, TE-YD, compressed air drilling

Bar diameter	Units	Concrete class								
		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 25	[N/mm²]	1,6	2,0	2,3	2,7	3,0	3,0	3,0	3,0	3,0

1) According to EN 1992-1-1 for good bond conditions. For all other bond conditions multiply the values by 0,7.

Figure C1: Temperature reduction factor $k_{fi}(\theta)$ vs. temperature



The analytic equation that describes the variation of $k_{fi}(\theta)$ with temperature is given by the following function:

If $39°C \leq \theta \leq 376°C$: $k_{fi}(\theta) = 41{,}001 \times \theta^{-1{,}012} \leq 1.0 \quad \theta \; in \; °C$

If $\theta < 39°C$: $k_{fi}(\theta) = 1.0$

If $\theta > 376°C$: $k_{fi}(\theta) = 0.0$

The design value of ultimate bond strength $f_{bd,fi}$ under fire exposure is calculated according to following equation:

$$f_{bd,fi} = k_{fi}(\theta) \cdot f_{bd} \cdot \gamma_c / \gamma_{M,fi}$$

with:

$k_{fi}(\theta)$ … temperature reduction factor under fire exposure, see Figure C1

f_{bd} ... design values of the ultimate bond resistance according to Table C1

$\gamma_c = 1{,}5$ … recommended safety factor according to EN 1992-1-1

$\gamma_{M,fi}$ … safety factor according to EN 1992-1-2 under fire exposure

Injection system Hilti HIT-CT 1	**Annex C2**
Performance. Temperature reduction factor $k_{fi}(\theta)$ and bond strength under fire exposure	