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European Technical Assessment ETA-21/0624 of 16/12/2022

English translation prepared by CSTB - Original version in French language

General Part

Nom commercial: *Trade name*	**Injection system Hilti HIT-FP 700 R for rebar connection**
Famille de produit: *Product family*	Scellement d'armatures rapportées, diamètres 8 à 40mm, avec Système à injection Hilti HIT-FP 700 R pour une durée d'utilisation de 100 ans, sous chargement statique et sismique **Post installed rebar connections diameter 8 to 40 mm made with Hilti HIT-FP 700 R injection mortar for a working life of 100 years, under static and seismic loading**
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*	23 pages incluant 21 pages d'annexes qui font partie intégrante de cette évaluation 23 *pages including 21 pages of annexes which form an integral part of this assessment*
Base de l'ETE : *Basis of ETA*	DEE 330087-02-0601 *EAD 330087-02-0601*
Cette évaluation remplace: *This Assessment replaces*	ETA-21/0624 of 17/06/2022

Specific Part

1 Technical description of the product

The Hilti HIT-FP 700 R 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.

This ETA covers anchoring systems consisting of Hilti HIT-FP 700 R bonding material and an embedded straight deformed reinforcing bar diameter, d, from 8 to 40 mm with properties according to Annex C of EN 1992-1-1:2004 and EN 10080:2005. The classes B and C of the rebar are recommended. The illustration and the description of the product are given in Annexes 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 Annexes B.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	**Performance**
Characteristic resistance under static and quasi static loading	
Bond strength of post-installed rebar	See Annex C2
Bond efficiency factor	See Annex C1
Amplification factor for minimum anchorage length	See Annex C1
Characteristic resistance to steel failure for rebar tension anchor	No performance determined
Characteristic resistance under seismic loading	
Bond strength under seismic loading, seismic bond efficiency factor	See Annex C3
Minimum concrete cover under seismic loading	See Annex B3

3.2 Safety in case of fire (BWR 2)

Essential characteristic	**Performance**
Reaction to fire	Anchorages satisfy requirements for Class A1
Bond strength at increased temperature for post-installed rebar assessed for 50 years and 100 years	See Annex C4
Characteristic resistance to steel failure for rebar tension anchors under fire exposure	No performance determined

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).

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

Anca Cronopol
Head of the division

[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

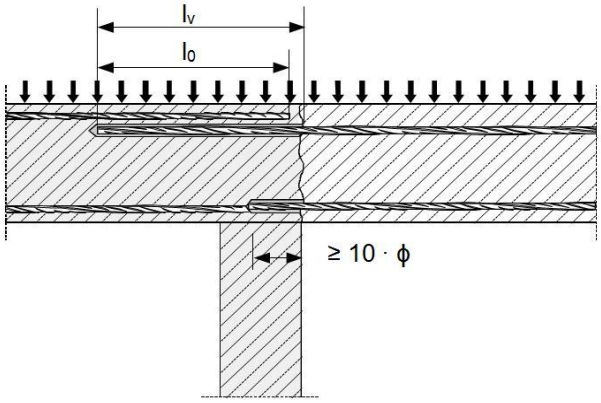


Figure A2:

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

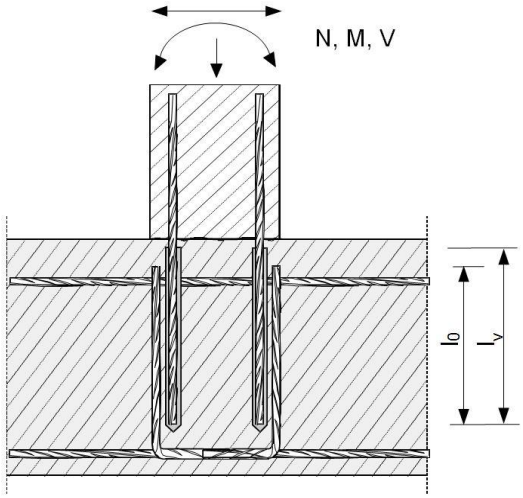
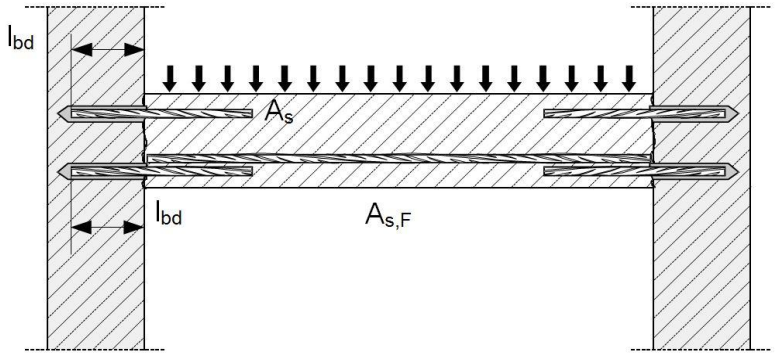


Figure A3:

End anchoring of slabs or beams



Injection system Hilti HIT-FP 700 R for rebar connections	
Product description Installed condition: application examples of post-installed rebars	**Annex A1**

Figure A4:

Rebar connection for components stressed primarily in compression

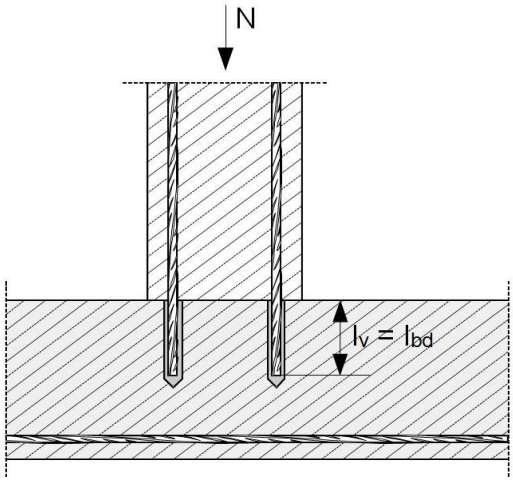
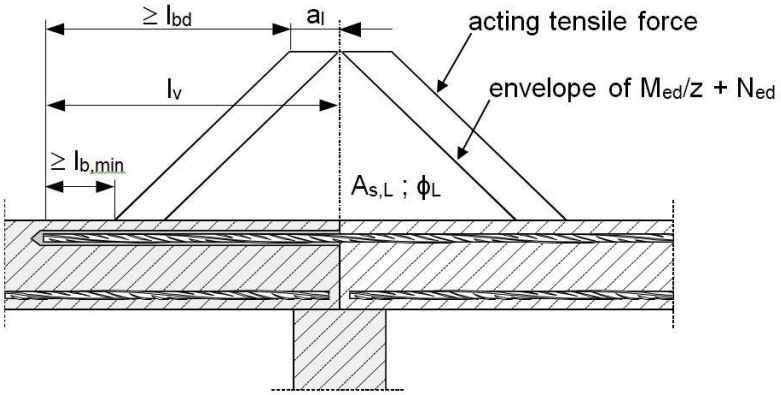


Figure A5:

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 1992-1-1:2004+AC:2010 shall be present.
- The shear transfer between existing and new concrete shall be designed according to EN 1992-1-1:2004+AC:2010.
- Preparing of joints according to Annex B2.

The reference to EN 1992-1-1:2004+AC:2010 is cited in the following as EN 1992-1-1 only.

Product description: Injection mortar and steel elements

Injection mortar Hilti HIT-FP 700 R: water based cementitious technology

Packaging size 490 ml

Marking:
HILTI HIT
Lot number and
production line
Expiry date mm/yyyy

Product name: “Hilti HIT-FP 700 R”

Static mixer Hilti HIT-RE-M

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

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 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Specifications of intended use

Anchorages subject to:

- Static and quasi static loading: rebar ϕ 8 to ϕ 40 mm.
- Seismic loading: rebar ϕ 12 to ϕ 32 and ϕ 40 mm.
- Fire exposure: rebar ϕ 8 to ϕ 40 mm.

Base material:

- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013+A1:2016.
- Strength classes C12/15 to C50/60 according to EN 206:2013+A1:2016 for static and quasi static loading and under fire exposure.
- Strength classes C16/20 to C50/60 according to EN 206:2013+A1:2016 for seismic loading.
- Maximum chloride content of 0,40 % (CL 0.40) related to the cement content according to EN 206:2013+A1:2016.
- 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 +160 °C (max. long term temperature +100 °C and max. short term temperature +160 °C)

Design:

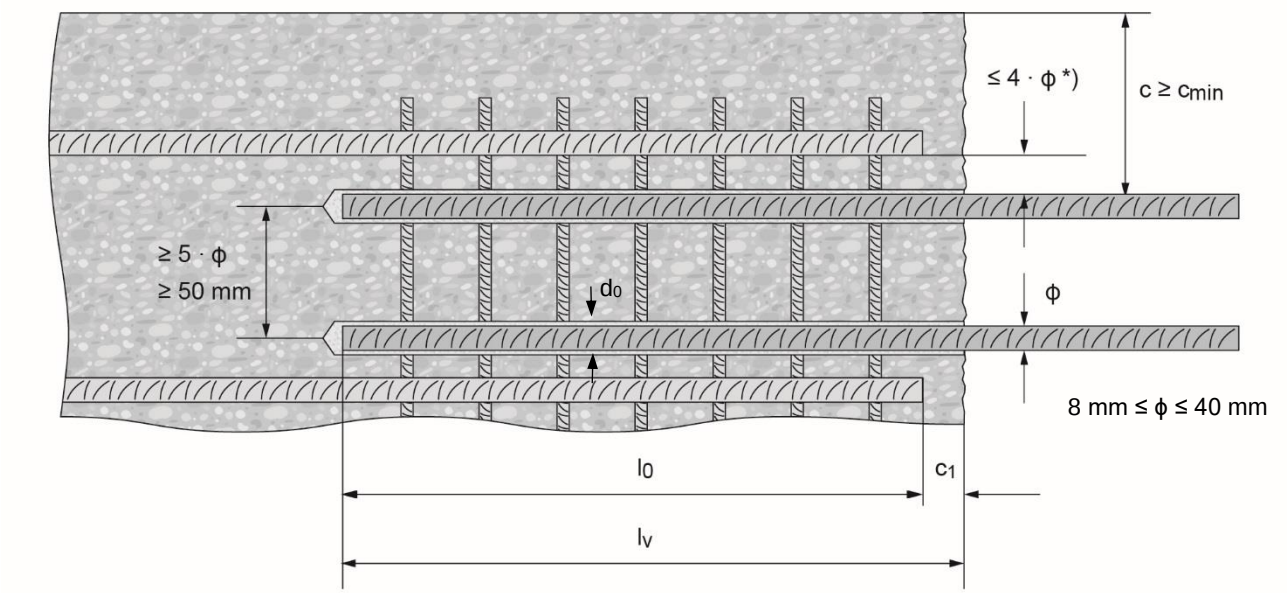
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- Design of rebar under static or quasi static loading in accordance with EN 1992-1-1 and under seismic action in accordance with EN 1998-1.
- Design under fire exposure in accordance with EN 1992-1-2.
- 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), or diamond coring with roughening with Hilti roughening tool TE-YRT (RT).
- 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

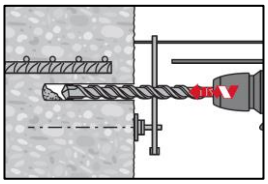
- Post-installed rebar may be designed for tension forces only.
- The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1.
- The joints for concreting must be roughened to at least such an extent that aggregate protrudes.



*) 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 B1 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, chapter 5.6.3 for seismic loading
l_v embedment length ≥ $l_0 + c_1$
d_0 nominal drill bit diameter

Table B1: Minimum concrete cover c_{min}[1)] of 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 (**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.

Comments: The minimum concrete cover acc. EN 1992-1-1. The same minimum concrete covers apply for rebar elements in the case of seismic loading, i.e. $c_{min,seis} = 2\ \phi$.

2) HDB = hollow drill bit Hilti TE-CD and TE-YD
Comments: The minimum concrete cover acc. EN 1992-1-1 must be observed.

Table B2: Maximum embedment length $l_{v,max}$

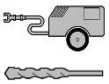
Elements	Dispensers	
Rebar	HDM 500	HDE 500
Size	$l_{v,max}$ [mm]	$l_{v,max}$ [mm]
ϕ 8 - 10	1000	1000
ϕ 12		1200
ϕ 14		1400
ϕ 16		1600
ϕ 18		1800
ϕ 20	1400	2000
ϕ 22		2200
ϕ 24		2400
ϕ 25	1500	2500
ϕ 26	1200	
ϕ 30		
ϕ 32		
ϕ 36	900	
ϕ 40	500	

Table B3: Maximum working time and minimum curing time [1)]

Temperature in the base material T	Maximum working time t_{work}	Assembly time $t_{assembly}$	Pre-loading time $t_{pre\text{-}loading}$	Minimum curing time t_{cure}
5 °C ≤ T ≤ 10 °C	50 min	36 hours	14 days	50 days
10 °C < T ≤ 15 °C	40 min	30 hours	7 days	28 days
15 °C < T ≤ 20 °C	35 min	24 hours	6 days	18 days
20 °C < T ≤ 30 °C	20 min	12 hours	5 days	10 days
30 °C < T < 40 °C	15 min	6 hours	3 days	7 days
40 °C	12 min	3 hours	2 days	4 days

1) The minimum temperature of the foil pack is +5° C.

Table B4: Parameters of drilling, cleaning and setting tools for hammer drilling (HD) and compressed air drilling (CA)

Element		Drill and clean				Installation		
Rebar	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	[-]	$l_{v,max}$ [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
	16		16	16		16		1200
	-	17	18	16		16		1200
ϕ 14	18	-	18	18		18		1400
ϕ 16	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	1600
ϕ 18	22	22	22	22		22		1800
ϕ 20	25		25	25		25		2000
	-	26	28	25		25		2000
ϕ 22	28	28	28	28		28		2200
ϕ 24	32	32	32	32		32		2400
ϕ 25	32	32	32			32		2500
ϕ 26	35	35	35			35		
ϕ 28	35	35	35			35		
ϕ 30	37	37	37			37		
ϕ 32	40	40	40			40		
ϕ 34	45	-	45			45		
ϕ 36	45	45	45			45		
ϕ 40	55	-	55			55		
	-	55	55			55		

1) Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper drill holes.

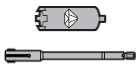
Table B5: Parameters of drilling and setting tools for hammer drilling with hollow drill bit (HDB)

Element	**Drill** (no cleaning required)				**Installation**		
Rebar	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
							-
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	16				16		1000
ϕ 14	18				18		1000
ϕ 16	20				20	HIT-VL 16/0,7 and/or HIT-VL 16	1000
ϕ 18	22				22		1000
ϕ 20	25				25		1000
ϕ 22	28				28		1000
ϕ 24	32				32		1000
ϕ 25	32				32		1000
ϕ 26	35				35		1000
ϕ 28	35				35		1000

[1] With vacuum cleaner Hilti VC 20/40/60 (automatic filter cleaning activated) or vacuum cleaner with activated automatic filter cleaning as well as volumetric flow rate at turbine ≥ 57 l/s, volumetric flow rate at end of hose ≥ 106 m³/h and partial vacuum ≥ 16 kPa.

[2] Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper drill holes.

Table B6: Parameters of drilling, cleaning and setting tools for diamond coring with roughening tool (RT)

Element	**Drill and clean**				**Installation**		
Rebar	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	[-]	$l_{v,max}$ [mm]
ϕ 14	18	18	18	HIT-DL V10/1	18	HIT-VL 11/1,0	900
ϕ 16	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		1200
ϕ 20	25	25	25		25		1300
ϕ 22	28	28	28		28		1400
ϕ 24	32	32	32		32		1600
ϕ 25	32	32			32		1600
ϕ 26	35	35			35		1600
ϕ 28	35	35			35		1800

[1)] Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper drill holes.

Table B7: 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.

Table B8: Parameters for use of the Hilti Roughening tool TE-YRT

Diamond coring		Roughening tool TE-YRT	Wear gauge RTG…
			
d_0 [mm]			
nominal	measured	d_0 [mm]	size
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

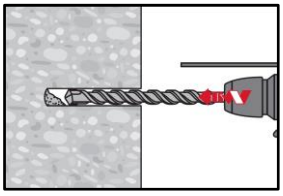
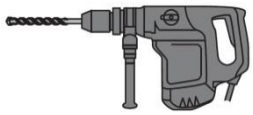
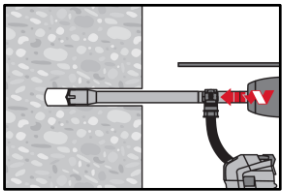
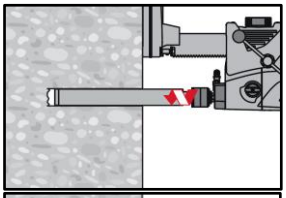
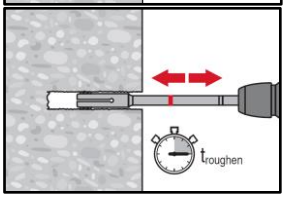
Table B9: Installation parameters for use of the Hilti Roughening tool TE-YRT

	Roughening time $t_{roughen}$	Minimum blowing time $t_{blowing}$
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

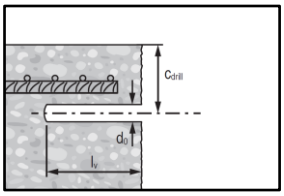
Table B10: Hilti Roughening tool TE-YRT and wear gauge RTG

Hilti roughening tool TE-YRT	
Wear gauge RTG	

Installation instruction

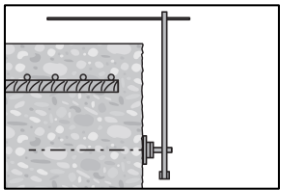
Safety Regulations: 	Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling! Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-FP 700 R. Important: Observe the installation instruction provided with each foil pack.
Hole drilling	Before 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 
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 attached to Hilti vacuum cleaner VC 20/40/60 or with a vacuum cleaner according to Table B5, in each case with automatic cleaning of the filter activated. 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 B6.
	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 B9.

Splicing applications

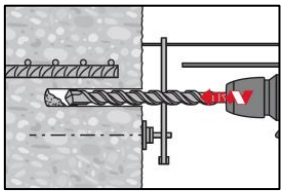


Measure and control concrete cover c.
$c_{drill} = c + d_0/2$.
Drill parallel to surface edge and to existing rebar.
Where applicable use Hilti drilling aid HIT-BH.

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



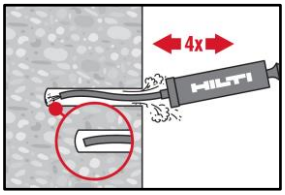
Ensure that the drill hole is parallel to the existing rebar.
Three different options can be considered:
- Hilti drilling aid HIT-BH
- Lath or spirit level
- Visual check



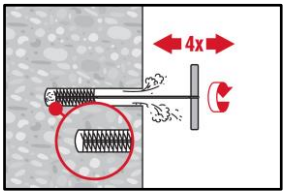
Hole drilling with Hilti drilling aid HIT-BH

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

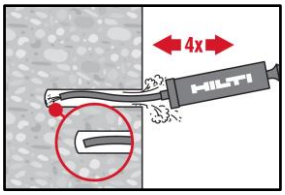
Manual Cleaning (MC) for hammer drilled holes:
for drill hole diameters $d_0 \leq 20$ mm and all drill hole depths $\leq 10 \cdot \phi$.



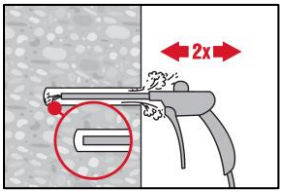
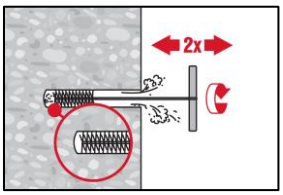
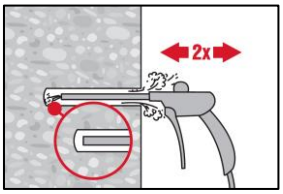
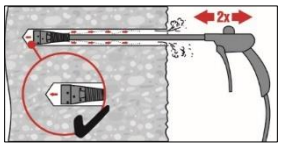
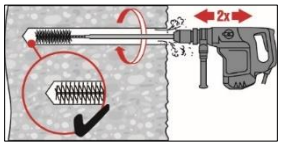
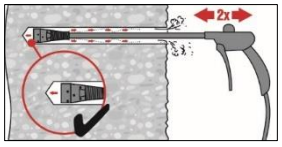
The Hilti hand pump may be used for blowing out drill holes up to diameters $d_0 \leq 20$ mm and drill hole depths $\leq 10 \cdot \phi$.
Blow out at least 4 times from the back of the drill hole until return air stream is free of noticeable dust.



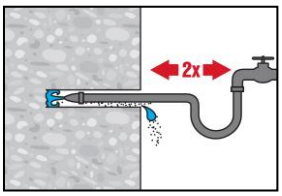
Brush 4 times with the specified brush (see Table B4) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.



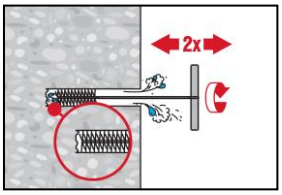
Blow again with the Hilti hand pump at least 4 times until return air stream is free of noticeable dust.

Compressed Air Cleaning (CAC)	For 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 **Erreur ! Source du renvoi introuvable.** Table 4) 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 drill holes deeper than 250 mm (for ϕ 8 to ϕ 12) or deeper than 20 · ϕ (for ϕ > 12 mm)
	Use the appropriate air nozzle Hilti HIT-DL (see Table 4**Erreur ! Source du renvoi introuvable.**). 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. Use of the dust collector 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. Brush 2 times with the specified brush (see Table 4) 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 B4). 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 is recommended.

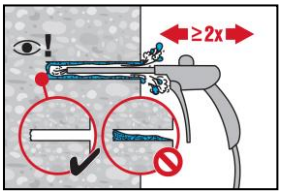
Cleaning of diamond cored holes with roughening with Hilti roughening tool TE-YRT:
For all drill hole diameters d_0 and all drill hole depths.



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

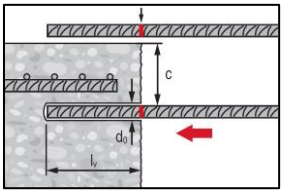


Brush 2 times with the specified brush (see Table B3) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.



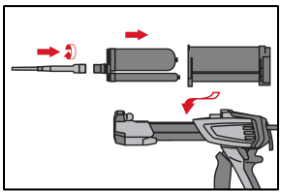
Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust and water. Remove all water from the drill hole until drill hole is completely dried before mortar injection. Blow time see Table B10. For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m³/h.

Rebar preparation

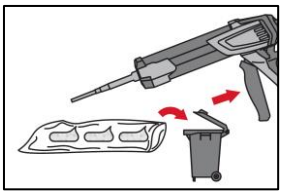


Before use, make sure the rebar is dry and free of oil or another residue.
Mark the embedment depth on the rebar (e.g. with tape) → l_v.
Insert rebar in drill hole to verify hole and setting depth l_v.

Injection preparation



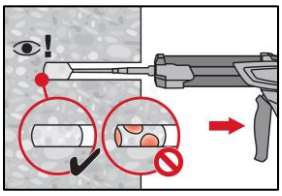
Tightly attach Hilti mixing nozzle HIT-RE-M to foil pack manifold. Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser.
Check foil pack holder for proper function. Insert foil pack into foil pack holder and put holder into dispenser.



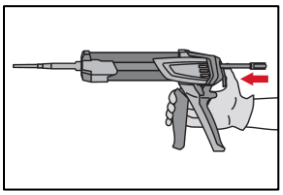
The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discarded quantities are:
4 strokes for 490 ml foil pack
The minimum foil pack temperature is ≥ 5°C.

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

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

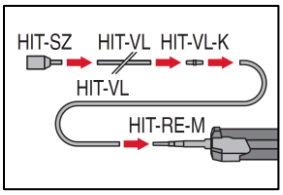


Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill approximately 2/3 of the drill hole to ensure that the annular gap between the rebar or Hilti tension anchor and the concrete is completely filled with adhesive along the embedment length.



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

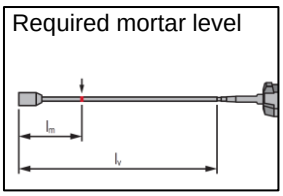
Injection method for drill hole depth > 250 mm or overhead applications



Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ (see Table B4 to Table B6).

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.

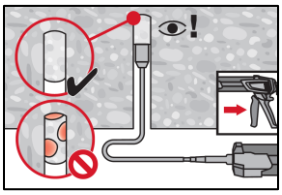
The combination of HIT-SZ piston plug with HIT-VL 16 pipe and HIT-VL 16 tube supports proper injection.



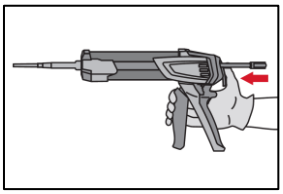
Mark the required mortar level l_m with tape or marker on the injection extension.

Estimation:
$l_m = 1/3 \cdot l_v$ for rebar

Precise formula for optimum mortar volume:
$l_m = l_v \cdot (1{,}2 \cdot (\phi^2 / d_o^2) - 0{,}2)$ for rebar

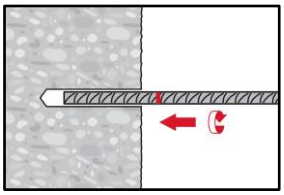


For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (see Table B4 to Table B6). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure.

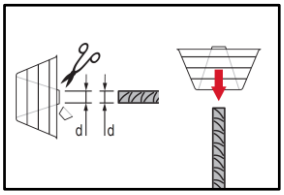


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

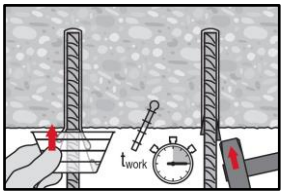
Setting the element: before use, verify that the element is dry and free of oil and other contaminants.



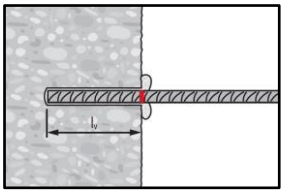
For easy installation insert the rebar into the drill hole while slowly twisting until the embedment mark is at the concrete surface level.



For overhead application:
During insertion of the rebar mortar might flow out of the drill hole. For collection of the flowing mortar overhead dripping cup HIT-OHC may be used.

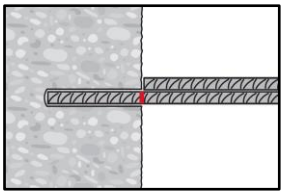


Support the rebar and secure it from falling until mortar has started to harden, e.g. using wedges HIT-OHW.

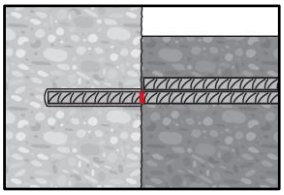


After installing the rebar the annular gap must be completely filled with mortar.
Proper installation:

- desired anchoring embedment l_v or $l_{e,ges}$ 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 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 under static loading

Minimum anchorage length, minimum lap length and design values of the bond strength for a working life of 50 and 100 years for following drilling techniques:

- hammer drilling,
- hammer drilling with Hilti hollow drill bit TE-CD, TE-YD,
- diamond coring with roughening with Hilti Roughening tool TE-YRT.

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 amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ given in Table C1.

The design values of the bond strength $f_{bd,PIR}$ and $f_{bd,PIR,100y}$ are given in Table C3. It is obtained by multiplying the design value of the bond strength f_{bd} according to EN 1992-1-1 (Eq. 8.3) by the bond efficiency factor $k_b = k_{b,100y}$ according to Table C2.

Table C1: Amplification factor α_{lb} and $\alpha_{lb,100y}$

Rebar diameter	Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ [-]								
	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 40	1,5								

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

Rebar diameter	Bond efficiency factor $k_b = k_{b,100y}$ [-]								
	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8	1,00	0,80	0,70	0,59	0,53	0,47	0,43	0,40	0,37
ϕ 10	1,00		0,87	0,74	0,67	0,59	0,54	0,50	0,47
ϕ 12	1,00			0,85	0,77	0,68	0,62	0,58	0,53
ϕ 14	1,00			0,85	0,77	0,68	0,62	0,58	0,53
ϕ 16	1,00			1,00	0,90	0,79	0,73	0,68	0,63
ϕ 18	1,00			1,00	0,90	0,79	0,73	0,68	0,63
ϕ 20	1,00			1,00	0,90	0,79	0,73	0,68	0,63
ϕ 22	1,00			1,00	0,90	0,79	0,73	0,68	0,63
ϕ 25	1,00			1,00	0,90	0,79	0,73	0,68	0,63
ϕ 26	1,00			0,85	0,77	0,68	0,62	0,58	0,53
ϕ 28	1,00			0,85	0,77	0,68	0,62	0,58	0,53
ϕ 30	1,00			0,85	0,77	0,68	0,62	0,58	0,53
ϕ 32	1,00			0,85	0,77	0,68	0,62	0,58	0,53
ϕ 34	1,00			0,74	0,67	0,59	0,54	0,50	0,47
ϕ 36	1,00			0,74	0,67	0,59	0,54	0,50	0,47
ϕ 40	1,00			0,85	0,77	0,68	0,62	0,58	0,53

Table C3: Design values of the bond strength $f_{bd,PIR}$[1)] and $f_{bd,PIR,100y}$[1)]

Rebar diameter	Bond strength $f_{bd,PIR} = f_{bd,PIR,100y}$ [N/mm²]								
	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6
ϕ 10	1,6	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
ϕ 12	1,6	2,0	2,3	2,3	2,3	2,3	2,3	2,3	2,3
ϕ 14	1,6	2,0	2,3	2,3	2,3	2,3	2,3	2,3	2,3
ϕ 16	1,6	2,0	2,3	2,7	2,7	2,7	2,7	2,7	2,7
ϕ 18	1,6	2,0	2,3	2,7	2,7	2,7	2,7	2,7	2,7
ϕ 20	1,6	2,0	2,3	2,7	2,7	2,7	2,7	2,7	2,7
ϕ 22	1,6	2,0	2,3	2,7	2,7	2,7	2,7	2,7	2,7
ϕ 25	1,6	2,0	2,3	2,7	2,7	2,7	2,7	2,7	2,7
ϕ 26	1,6	2,0	2,3	2,3	2,3	2,3	2,3	2,3	2,3
ϕ 28	1,6	2,0	2,3	2,3	2,3	2,3	2,3	2,3	2,3
ϕ 30	1,6	2,0	2,3	2,3	2,3	2,3	2,3	2,3	2,3
ϕ 32	1,6	2,0	2,3	2,3	2,3	2,3	2,3	2,3	2,3
ϕ 34[2)]	1,6	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
ϕ 36[2)]	1,5	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9
ϕ 40[2)]	1,5	1,8	2,1	2,1	2,1	2,1	2,1	2,1	2,1

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

2) According to EN 1992-1-1, provided design values for the ultimate bond strength, $f_{bd} = 2{,}25\ \eta_1\ \eta_2\ f_{ctd}$ include reduction related to the bar diameter and for rebar diameter $\Phi > 32$mm, $\eta_2 = (132 - \Phi)/100$)

Essential characteristics under seismic loading

Minimum anchorage length, minimum lap length and design values of the bond strength for a working life of 50 and 100 years for following drilling techniques:

- hammer drilling,

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 $\alpha_{lb} = \alpha_{lb,100y}$ given in Table C4.

The design values of the bond strength $f_{bd,PIR,seis}$ and $f_{bd,PIR,seis,100y}$ are given in Table C6. It is obtained by multiplying the design value of the bond strength f_{bd} according to EN 1992-1-1 (Eq. 8.3) by the seismic bond efficiency factor $k_{b,seis} = k_{b,seis,100y}$ according to Table C5.

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

Table C4: Amplification factor α_{lb} and $\alpha_{lb,100y}$

Rebar diameter	Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ [-]							
	Concrete class							
	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 12 to ϕ 40	1,5							

Table C5: Seismic bond efficiency factor $k_{b,seis}$ and $k_{b,seis,100y}$

Rebar diameter	Seismic bond efficiency factor $k_{b,seis} = k_{b,seis,100y}$ [-]							
	Concrete class							
	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 12 to ϕ 32	1,0		0,85	0,77	0,68	0,62	0,58	0,53
ϕ 40	1,0	0,87	0,74	0,67	0,59	0,54	0,50	0,47

Table C6: Design values of the bond strength $f_{bd,PIR,seis}$[1)] and $f_{bd,PIR,seis,100y}$[1)]

Rebar diameter	Bond strength $f_{bd,PIR,seis} = f_{bd,PIR,seis,100y}$ [N/mm²]							
	Concrete class							
	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 12 to ϕ 32	2,0	2,3						
ϕ 40[2)]	1,8							

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

2) According to EN 1992-1-1, provided design values for the ultimate bond strength, $f_{bd} = 2{,}25\ \eta_1\ \eta_2\ f_{ctd}$ include reduction related to the bar diameter and for rebar diameter $\Phi > 32$mm, $\eta_2 = (132 - \Phi)/100$)

Essential characteristics under fire exposure

Design value of the bond strength $f_{bd,fi}$ for a working life of 50 years and design value of the bond strength $f_{bd,fi,100y}$ for a working life of 100 years, under fire exposure for concrete classes C12/15 to C50/60 for all drilling techniques have to be calculated by the following equations:

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

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

with

$$k_{b,fi}(\theta) = \frac{-0{,}0038 \cdot \theta + 8{,}6867}{f_{bd,PIR} \cdot\ 4{,}3} \leq 1{,}0$$ for a working life of 50 years

$$k_{b,fi,100y}(\theta) = \frac{-0{,}0038 \cdot \theta + 8{,}6867}{f_{bd,PIR,100y} \cdot\ 4{,}3} \leq 1{,}0$$ for a working life of 100 years

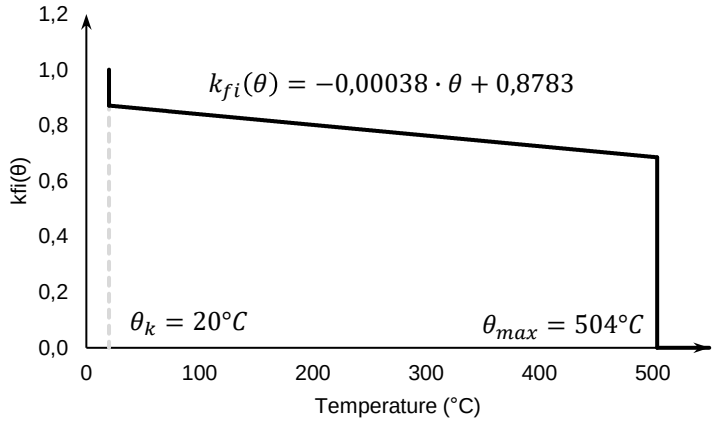
$\theta = \theta_{max}$ $\quad k_{b,fi}(\theta) = k_{b,fi,100y}(\theta) = 0{,}0$

$\theta_{max} = 504°C$

$f_{bd,fi}$	Design value of the bond strength in case of fire in N/mm² for a working life of 50 years.
$f_{bd,fi,100y}$	Design value of the bond strength in case of fire in N/mm² for a working life of 100 years.
(θ)	Temperature in °C in the mortar layer.
θ_{max}	Temperature in °C at which the mortar can no longer transfer bond stresses
$k_{b,fi}(\theta)$	Reduction factor under fire exposure for a working life of 50 years.
$k_{b,fi,100y}(\theta)$	Reduction factor under fire exposure for a working life of 100 years.
$f_{bd,PIR}$	Design value of the bond strength in N/mm² in cold condition according to Table C3 or Table C6 considering the concrete classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1 for a working life of 50 years.
$f_{bd,PIR,100y}$	Design value of the bond strength in N/mm² in cold condition according to Table C3 or Table C6 considering the concrete classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1 for a working life of 100 years.
γ_c	Partial factor according to EN 1992-1-1.
$\gamma_{M,fi}$	Partial factor according to EN 1992-1-2.

For evidence under fire exposure the anchorage length shall be calculated according to EN 1992-1-1:2004+AC:2010 Equation 8.3 using the temperature-dependent bond strength $f_{bd,fi}$.

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



Injection system Hilti HIT-FP 700 R for rebar connections

Performances
Bond strength at increased temperature for post-installed rebar assessed for 50 years and 100 years

Annex C4