Deutsches Institut für Bautechnik DIBt

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European Technical Assessment Body for construction products

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European Technical Assessment

ETA-23/0420 of 17 April 2026

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Rotho Blaas Injection System EPO-FIX for rebar connection
Product family to which the construction product belongs	Systems for post-installed rebar connections with mortar
Manufacturer	Rotho Blaas s.r.l Via dell'Adige 2/1 39040 CORTACCIA (BZ) ITALY
Manufacturing plant	Plant C2
This European Technical Assessment contains	20 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Article 95(4) of Regulation (EU) 2024/3110, on the basis of	EAD 330087-01-0601
This version replaces	ETA-23/0420 issued on 2 November 2023

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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 "Rotho Blaas injection system EPO-FIX for rebar connection" in accordance with the regulations for reinforced concrete construction.

Reinforcing bars made of steel with a diameter ϕ from 8 to 40 mm according to Annex A and injection mortar EPO-FIX are used for rebar connections. The rebar is placed into a drilled hole filled with injection mortar and is anchored via the bond between rebar, 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 C 1
Characteristic resistance under seismic loading	See Annex B 4 and C 2

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 3

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.

Issued in Berlin on 17 April 2026 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock	*beglaubigt:*
Head of Section	Baderschneider

Installation post installed rebar

Figure A1: Overlapping joint for rebar connections of slabs and beams

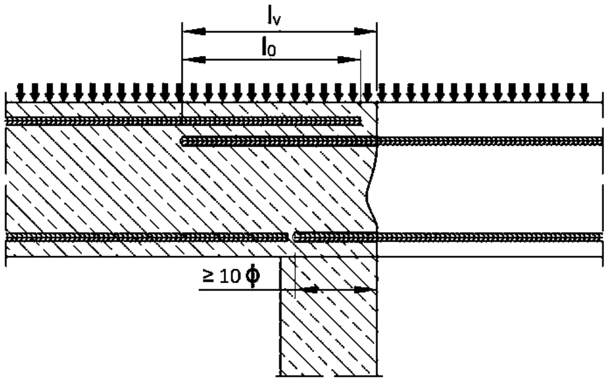


Figure A2: Overlapping joint at a foundation of a wall or column where the rebars are stressed in tension

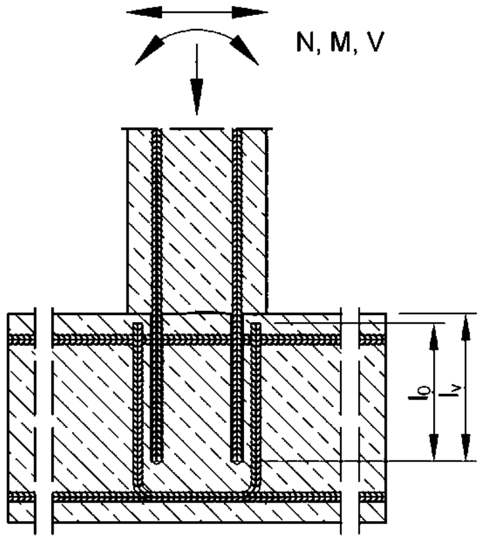


Figure A3: End anchoring of slabs or beams (e.g. designed as simply supported)

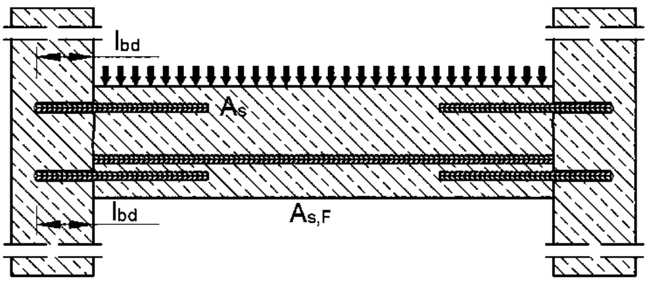


Figure A4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

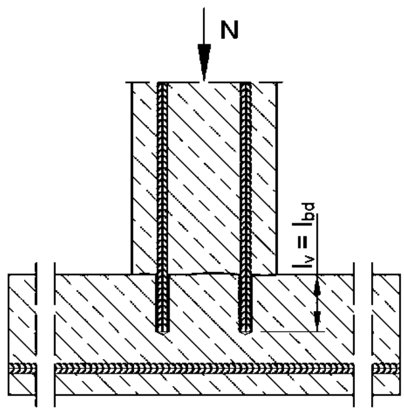
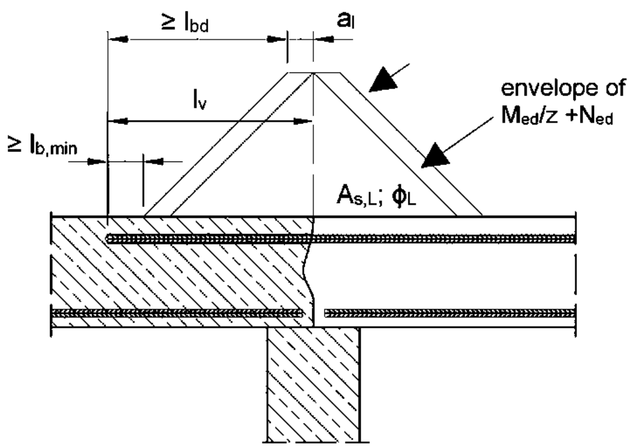


Figure A5: Anchoring of reinforcement to cover the line of acting tensile force



Note to Figure A1 to A5:

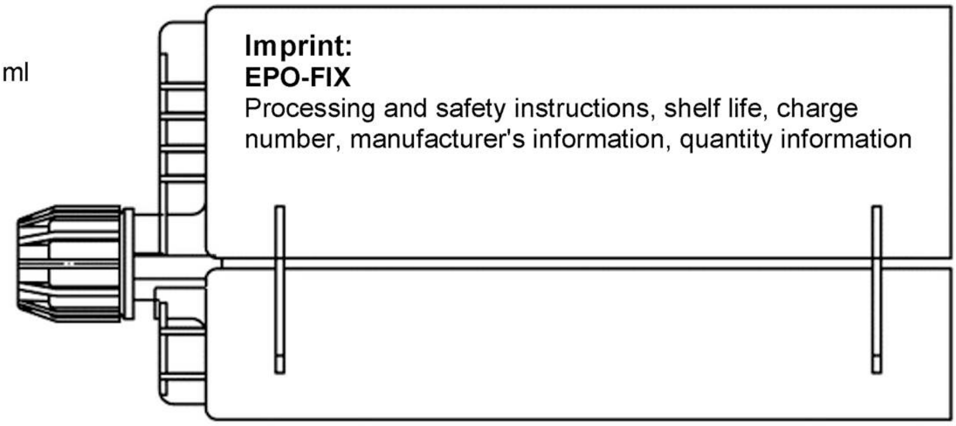
In the Figures no transverse reinforcement is plotted, the transverse reinforcement shall comply with EN 1992-1-1:2004+AC:2010.

Preparing of joints according to Annex B 2

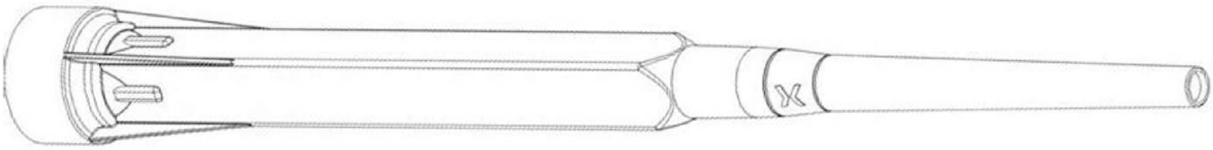
Cartridge system

Side-by-Side Cartridge:
440 ml, 500 ml up to 540 ml, 585 ml and 1400 ml

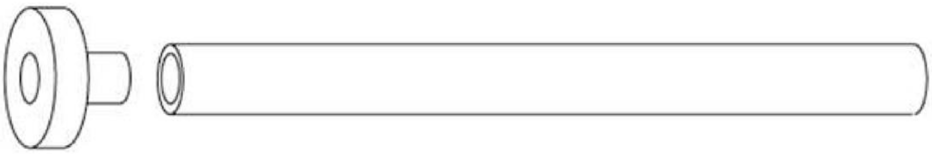
Imprint:
EPO-FIX
Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information



Static mixer

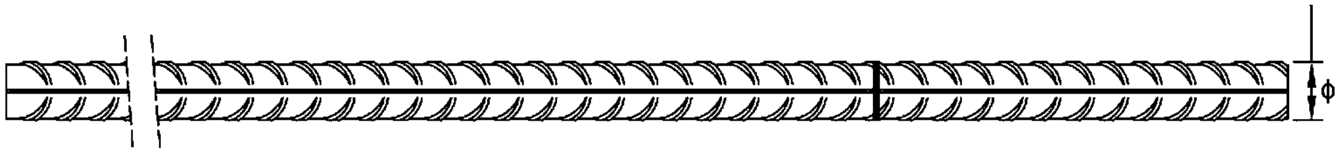


Piston plug PL and mixer extension



Rotho Blaas Injection System EPO-FIX for rebar connection	Annex A2
Product description Injection system	

Reinforcing bar (rebar): ø8 up to ø40



- Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-1:2004+AC:2010
- Rib height of the bar shall be in the range $0,05\phi \leq h_{rib} \leq 0,07\phi$
  (ϕ: Nominal diameter of the bar; h_{rib}: Rib height of the bar)

Table A1: Materials Rebar

Designation	Material
Rebar EN 1992-1-1:2004+AC:2010, Annex C	Bars and de-coiled rods class B or C f_{yk} and k according to NDP or NCL of EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$

Rotho Blaas Injection System EPO-FIX for rebar connection

Product description
Specifications Rebar

Annex A3

Specification of the intended use

Anchorages subject to:		Working life 50 years	Working life 100 years
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling DD: Diamond drilling	static and quasi-static loads	Ø8 to Ø40	Ø8 to Ø40
	seismic action	Ø10 to Ø40	Ø10 to Ø40
	fire exposure	Ø8 to Ø40	Ø8 to Ø40
Temperature Range:	- 40°C to +80°C (max long-term temperature +50 °C and max short-term temperature +80 °C)		

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206:2013 + A1:2016.
- Strength classes C12/15 to C50/60 according to EN 206:2013 + A1:2016.
- 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 1992-1-1:2004+AC:2010. The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

Design:

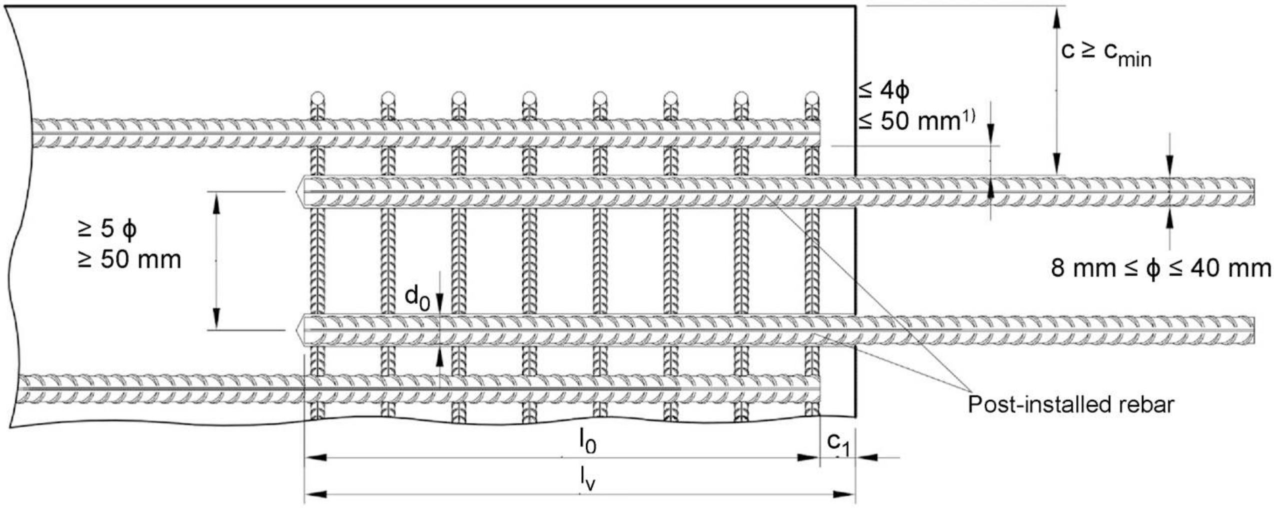
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- Design according to EN 1992-1-1:2004+AC:2010, EN 1992-1-2:2004+AC:2010 and Annex B 2 and B 3.
- 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:

- Dry or wet concrete. It must not be installed in flooded holes.
- Overhead installation allowed.
- Hole drilling by hammer drill (HD), hollow drill (HDB), diamond drill (DD) or compressed air drill mode (CD).
- The installation of post-installed rebar resp. tension anchors shall be done only by suitable trained installer and under supervision on site; the conditions under which an installer may be considered as suitable trained and the conditions for supervision on site are up to the Member States in which the installation is done.
- 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

- Only tension forces in the axis of the rebar may be transmitted.
- The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1:2004+AC:2010.
- The joints for concreting must be roughened to at least such an extent that aggregate protrude.



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

The following applies to Figure B1:

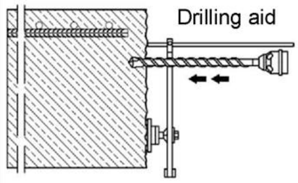
c	concrete cover of post-installed rebar
c_1	concrete cover at end-face of existing rebar
c_{min}	minimum concrete cover according to Table B1 and to EN 1992-1-1:2004+AC:2010, Section 4.4.1.2
ϕ	diameter of post-installed rebar
l_0	lap length, according to EN 1992-1-1:2004+AC:2010, Section 8.7.3 for static loading and according to EN 1998-1:2004+AC:2009, section 5.6.3 for seismic action
l_v	effective embedment depth, ≥ $l_0 + c_1$
d_0	nominal drill bit diameter, see Annex B 4

Rotho Blaas Injection System EPO-FIX for rebar connection

Intended use
General construction rules for post-installed rebars

Annex B2

Table B1: Minimum concrete cover c_{min}[1)] of post-installed rebar depending of drilling method

Drilling method	Rebar diameter	Without drilling aid	With drilling aid	
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit	< 25 mm	30 mm + 0,06 · l_v ≥ 2 ϕ	30 mm + 0,02 · l_v ≥ 2 ϕ	
	≥ 25 mm	40 mm + 0,06 · l_v ≥ 2 ϕ	40 mm + 0,02 · l_v ≥ 2 ϕ	
DD: Diamond drilling	< 25 mm	Drill rig used as drilling aid	30 mm + 0,02 · l_v ≥ 2 ϕ	
	≥ 25 mm		40 mm + 0,02 · l_v ≥ 2 ϕ	
CD: Compressed air drilling	< 25 mm	50 mm + 0,08 · l_v	50 mm + 0,02 · l_v	
	≥ 25 mm	60 mm + 0,08 · l_v ≥ 2 ϕ	60 mm + 0,02 · l_v ≥ 2 ϕ	

1) see Annex B 2, Figure B1 and Annex B 3, Figure B2
Comments: The minimum concrete cover acc. EN 1992-1-1:2004+AC:2010 must be observed.
For the minimum concrete cover cmin,seis in case of a seismic action, see Table B2.

Table B2: Minimum concrete cover min $c_{min,seis}$

Drilling method	Design conditions	Distance to 1st edge	Distance to 2nd edge
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	Edge	≥ 2 ϕ	≥ 2 ϕ
	Corner	≥ 2 ϕ	≥ 2 ϕ
DD: Diamond drilling	Edge	≥ 4 ϕ	≥ 8 ϕ
	Corner	≥ 6 ϕ	≥ 6 ϕ

Table B3: Dispensing tools

Cartridge type/size	Hand tool	Pneumatic tool
Side-by-side cartridges 440 ml, 585 ml	 e.g. MAMDB	-
Side-by-side cartridges 1400 ml	-	 e.g. TS 472

All cartridges could also be extruded by a battery tool.

Rotho Blaas Injection System EPO-FIX for rebar connection	**Annex B3**
Intended use Minimum concrete cover Dispensing tools	

Table B4: Brushes, piston plugs, max anchorage depth and mixer extension, hammer (HD), diamond (DD) and compressed air (CD) drilling

Bar size	Drill bit - ∅			d_b Brush - ∅		$d_{b,min}$ min. Brush - ∅	Piston plug	Cartridge: 440 or 585 ml				Cartridge: 1400 ml	
								Hand or battery tool		Pneumatic tool		Pneumatic tool	
ϕ	HD	DD	CD					$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension
[mm]	[mm]			BRU	[mm]	[mm]		[mm]		[mm]		[mm]	
8	10		-	H10	11,5	10,5	-	250	V10/0,75 or V16/1,8	250	V10/0,75 or V16/1,8	250	V10/0,75 or V16/1,8
				H12	13,5	12,5	-	700		800		800	
10	12		-					250		250		250	
				H14	15,5	14,5	PL14	700		1000		1000	
12	14		-					250		250		250	
	16			H16	17,5	16,5	PL16	700		1300		1200	V16/1,8
14	18			H18	20,0	18,5	PL18					1400	
16	20			H20	22,0	20,5	PL20					1600	
20	25		-	H25	27,0	25,5	PL25	500		1000		2000	
	-		26	H26	28,0	26,5	PL25						
22	28			H28	30,0	28,5	PL28						
24/25	30			H30	32,0	30,5	PL30						
	32			H32	34,0	32,5	PL32						
28	35			H35	37,0	35,5	PL35						
32/34	40			H40	43,5	40,5	PL40						
36	45			H45	47,0	45,5	PL45	-	-				
40	-	52	52	H52	54,0	52,5	PL52						
	55	-	55	H55	58,0	55,5	PL55						

Table B5: Brushes, piston plugs, max anchorage depth and mixer extension, hammer drilling with hollow drill bit system (HDB)

Bar size	Drill bit - ∅	d_b Brush - ∅	$d_{b,min}$ min. Brush - ∅	Piston plug	Cartridge: 440 or 585 ml				Cartridge: 1400 ml	
					Hand or battery tool		Pneumatic tool		Pneumatic tool	
ϕ	HDB				$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension
[mm]	[mm]				[mm]		[mm]		[mm]	
8	10	No cleaning required		-	250	V10/0,75 or V16/1,8	250	V10/0,75 or V16/1,8	250	V10/0,75 or V16/1,8
	12			-	700		800		800	
10					250		250		250	
	14			PL14	700		1000		1000	
12					250		250		250	
	16			PL16	700		1000		1000	
14	18			PL18						
16	20			PL20						
20	25			PL25	500					
22	28			PL28						
24/25	30			PL30						
	32			PL32						
28	35			PL35						
32/34	40			PL40						

Rotho Blaas Injection System EPO-FIX for rebar connection

Intended use
Parameter brushes, piston plugs, max anchorage depth and mixer extension

Annex B4

Cleaning and installation tools

HDB – Hollow drill bit system

The hollow drill system consists of Heller Duster Expert hollow drill bit or a hollow drill bit with equivalent performance and a class M vacuum cleaner with a minimum negative pressure of 253 hPa and a flow rate of minimum 150 m³/h (42 l/s).

Hand pump

(Volume 750 ml, $h_0 \leq 10\ d_s$, $d_0 \leq 20$mm)

Manual slide valve

(min 6 bar)

Brush BR

Piston Plug PL

Brush extension

Table B6: Working time and curing time

Temperature in base material			Maximum working time	Initial curing time[1)]	Minimum curing time[2)]
T			t_{work}	$t_{cure,ini}$	t_{cure}
0 °C	up to	+ 4 °C	80 min	30 h	144 h
+ 5 °C	up to	+ 9 °C	80 min	20 h	48 h
+ 10 °C	up to	+ 14 °C	60 min	15 h	28 h
+ 15 °C	up to	+ 19 °C	40 min	9 h	18 h
+ 20 °C	up to	+ 24 °C	30 min	6 h	12 h
+ 25 °C	up to	+ 34 °C	12 min	4 h	9 h
+ 35 °C	up to	+ 39 °C	8 min	3 h	6 h
+40°C			8 min	1,5 h	4 h
Cartridge temperature			+5°C up to +40°C		

1) After Initial curing time has elapsed, the installation of the connecting reinforcement and the construction of the formwork can be continued

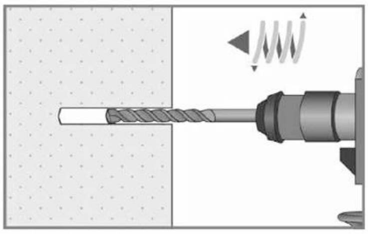
2) The minimum curing time is only valid for dry base material.
In wet base material the curing time must be doubled.

Rotho Blaas Injection System EPO-FIX for rebar connection	Annex B5
Intended use Cleaning and installation tools Working time and curing time	

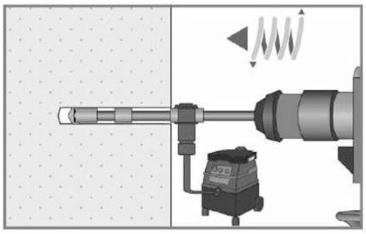
Installation instructions

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

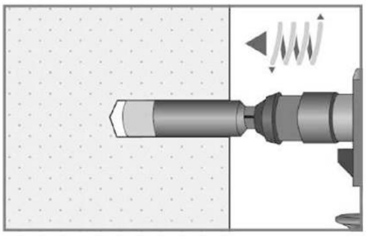
Drilling of the bore hole



1a. **Hammer drilling (HD) / Compressed air drilling (CD)**
Drill a hole to the required embedment depth.
Drill bit diameter according to Table B4.
Proceed with Step 2 (MAC or CAC).



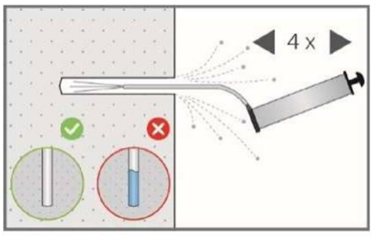
1b. **Hollow drill bit system (HDB) (see Annex B 6)**
Drill a hole to the required embedment depth.
Drill bit diameter according to Table B5.
The hollow drilling system removes the dust and cleans the bore hole.
Proceed with Step 3.



1c. **Diamond drilling (DD)**
Drill a hole to the required embedment depth
Drill bit diameter according to Table B4.
Proceed with Step 2 (SPCAC).

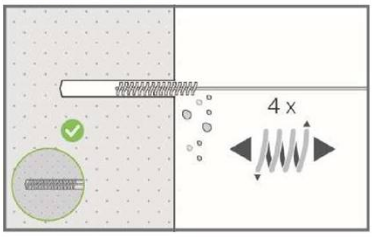
Installation instructions (continuation)

Manual Air Cleaning (MAC)
for drill hole diameter $d_0 \leq 20mm$ and drill hole depth $h_0 \leq 10\phi$ with drilling method HD/CD

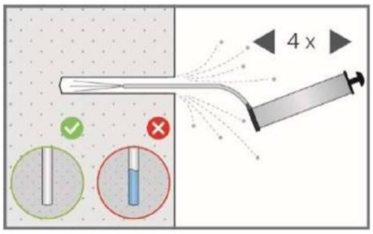


Attention! Standing water in the bore hole must be removed before cleaning.

2a. Blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 6).

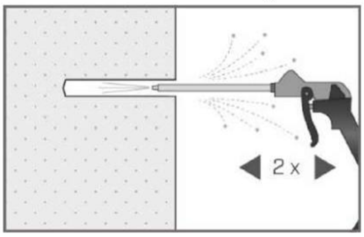


2b. Brush the bore hole minimum 4x with brush BRUH according to Table B4 over the entire embedment depth in a twisting motion (if necessary, use a brush extension RBL).



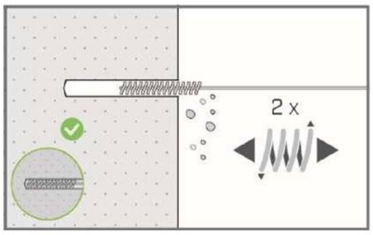
2c. Finally blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 5).

Compressed Air Cleaning (CAC):
All diameter with drilling method HD/CD

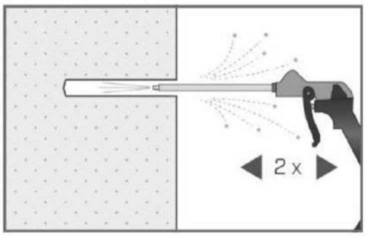


Attention! Standing water in the bore hole must be removed before cleaning.

2a. Blow the bore hole clean minimum 2x with compressed air (min. 6 bar, oil-free) (Annex B 6) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)



2b. Brush the bore hole minimum 2x with brush BRUH according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used.)



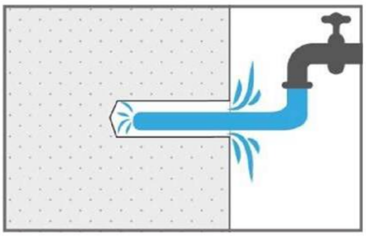
2c. Finally blow the bore hole clean minimum 2x with compressed air (min. 6 bar, oil-free) (Annex B 6) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

Protect cleaned bore hole against re-contamination in an appropriate way. If necessary, repeat cleaning process directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.

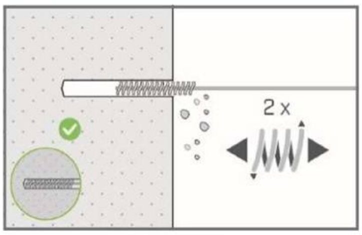
Rotho Blaas Injection System EPO-FIX for rebar connection	**Annex B7**
Intended use Installation instructions (continuation)	

Installation instructions (continuation)

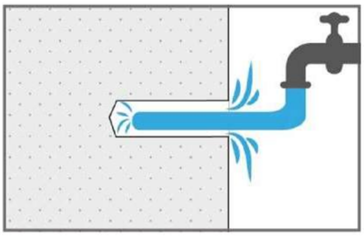
Flush & Compressed Air Cleaning (SPCAC):
All diameter with drilling method DD



2a. Flushing with water until clear water comes out.

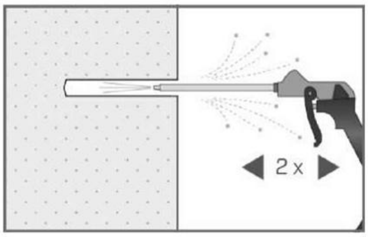


2b. Brush the bore hole minimum 2x with brush BRUH according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used.)

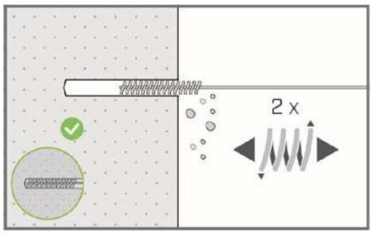


2c. Flushing again with water until clear water comes out.

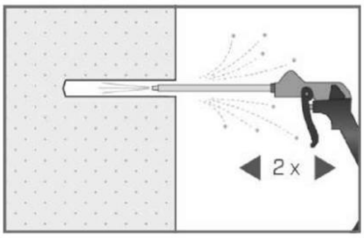
Attention! Standing water in the bore hole must be removed before proceeding.



2d. Blow the bore hole clean minimum 2x with compressed air (min. 6 bar, oil-free) (Annex B 6) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)



2e. Brush the bore hole minimum 2x with brush BRUH according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used.)

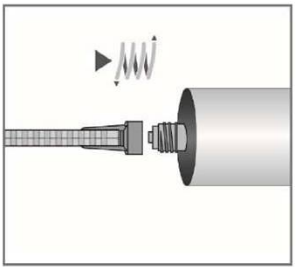


2f. Finally blow the bore hole clean minimum 2x with compressed air (min. 6 bar, oil-free) (Annex B 6) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

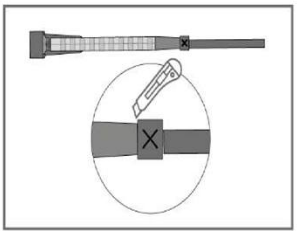
Protect cleaned bore hole against re-contamination in an appropriate way. If necessary, repeat cleaning process directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.

Rotho Blaas Injection System EPO-FIX for rebar connection	**Annex B8**
Intended use Installation instructions (continuation)	

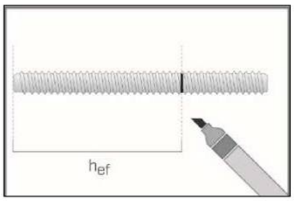
Installation instructions (continuation)



3. Screw on static-mixing nozzle , and load the cartridge into an appropriate dispensing tool.
For every working interruption longer than the maximum working time t_{work} (Annex B5) as well as for new cartridges, a new static-mixer shall be used.

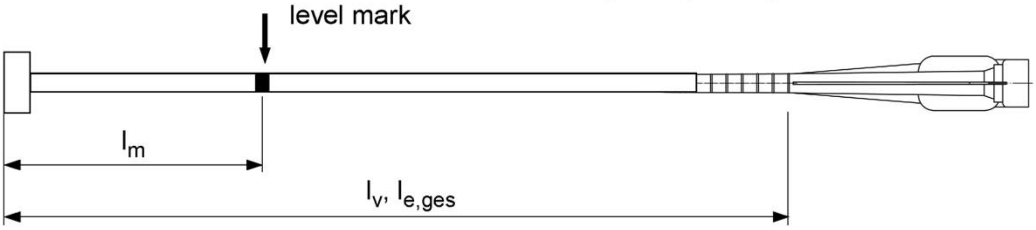


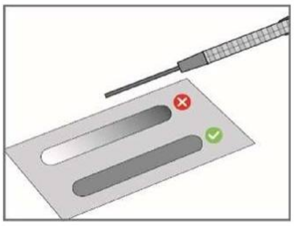
3a. In case of using the mixer extension V16/1,8, cut off the tip of the mixer nozzle at position „X".



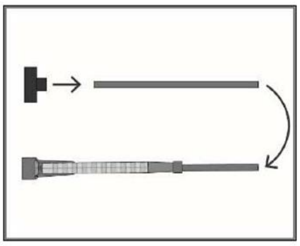
4.. Mark embedment depth on the reinforcing bar .
The reinforcing bar shall be free of dirt, grease, oil or other foreign material.

5. Mark mixer nozzle and extension with mortar level mark lm and anchorage depth lv resp. $l_{e,ges}$
Quick estimation: $l_m = 1/3 \cdot l_v$
Optimum mortar volume: $l_m = l_v \text{ resp. } l_{e,ges} \cdot \left(1{,}2 \cdot \frac{\phi^2}{d_0^2} - 0{,}2\right)$





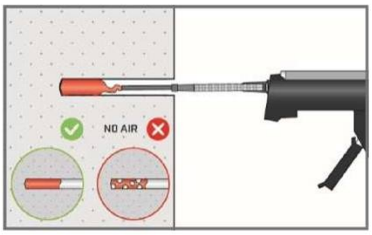
6. Not proper mixed mortar is not sufficient for fastening.
Dispense and discard mortar until an uniform grey or red colour is shown (at least 3 full strokes).



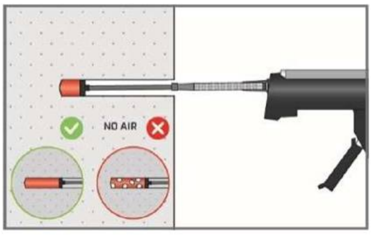
7. Piston plugs PL and mixer nozzle extensions V shall be used according to Table B4 or B5.
Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.

Rotho Blaas Injection System EPO-FIX for rebar connection	**Annex B9**
Intended use Installation instructions (continuation)	

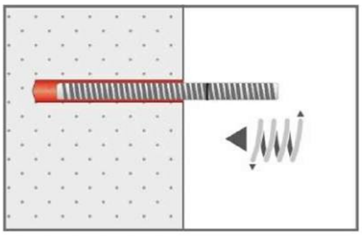
Installation instructions (continuation)



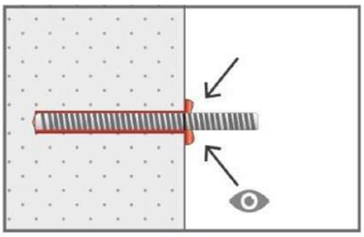
8a. **Injecting mortar without piston plug PL:**
Starting at bottom of the hole and fill the hole with adhesive until the mortar level mark is visible. (If necessary, a mixer nozzle extension shall be used.)
Slowly withdraw of the static mixing nozzle avoid creating air pockets
Observe the temperature related working time t_{work} (Annex B 5).



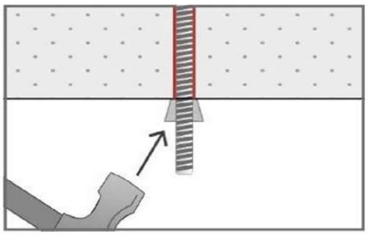
8b. **Injecting mortar with piston plug PL:**
Insert piston plug to bottom of the hole and fill the hole with mortar until mortar level mark l_m is visible. (If necessary, a mixer nozzle extension shall be used.)
During injection the piston plug is pushed out of the bore hole by the back pressure of the mortar.
Observe the temperature related working time t_{work} (Annex B 5).



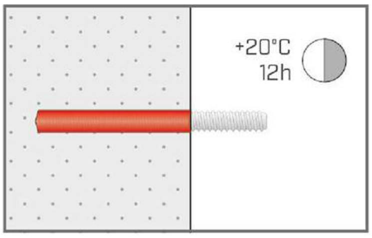
9. Insert the reinforcing bar while turning slightly up to the embedment mark.



10. Annular gap between reinforcing bar and base material must be completely filled with mortar. Otherwise, the installation must be repeated starting from step 8 before the maximum working time t_{work} has expired.



11. For application in vertical upwards direction the reinforcing bar shall be fixed (e.g. wedges).



12. Temperature related curing time t_{cure} (Annex B 5) must be observed.
After initial curing time $t_{cure,ini}$ has elapsed, the installation of the connecting reinforcement and the formwork can be continued. The full load to the reinforcing bar may be applied after the full curing time t_{cure} has elapsed.

Rotho Blaas Injection System EPO-FIX for rebar connection	**Annex B10**
Intended use Installation instructions (continuation)	

Minimum anchorage length and minimum lap length under static or quasi-static loading

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1:2004+AC:2010 ($l_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $l_{0,min}$ acc. to Eq. 8.11) shall be multiply by the amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ according to Table C1.

Table C1: Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ related to concrete class and drilling method; working life 50 and 100 years

Concrete class	Drilling method	Bar size	Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$
C12/15 to C50/60	all drilling methods	8 mm to 40 mm	1,0

Table C2: Reduction factor $k_b = k_{b,100y}$ for all drilling methods; working life 50 and 100 years

Rebar	Concrete class								
ϕ	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 40 mm	1,0								

Table C3: Design values of the ultimate bond stress $f_{bd,PIR}$ and $f_{bd,PIR,100y}$ in N/mm² for all drilling methods and for good conditions; working life 50 and 100 years

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

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

with

f_{bd}: Design value of the ultimate bond stress in N/mm² considering the concrete classes, the rebar diameter, the drilling method for good bond condition (for all other bond conditions multiply the values by η_1 =0.7) and recommended partial factor γ_c = 1,5 according to EN 1992-1-1:2004 +AC:2010.

k_b, $k_{b,100y}$: Reduction factor according to Table C2

Rebar	Concrete class								
ϕ	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 32 mm	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
34 mm	1,6	2,0	2,3	2,6	2,9	3,3	3,6	3,9	4,2
36 mm	1,5	1,9	2,2	2,6	2,9	3,3	3,6	3,8	4,1
40 mm	1,5	1,8	2,1	2,5	2,8	3,1	3,4	3,7	4,0

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 1992-1-1:2004+AC:2010 ($l_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $l_{0,min}$ acc. to Eq. 8.11) shall be multiply by the amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$ according to Table C4.

Table C4: Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$ related to concrete class and drilling method; working life 50 and 100 years

Concrete class	Drilling method	Bar size	Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$
C16/20 to C50/60	all drilling methods	10 mm to 40 mm	1,0

Table C5: Reduction factor $k_{b,seis} = k_{b,seis,100y}$ for all drilling methods; working life 50 and 100 years

Rebar	Concrete classes								
ϕ	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
10 to 40 mm	No performance assessed	1,0							

Table C6: Design values of the ultimate bond stress $f_{bd,PIR,seis}$ and $f_{bd,PIR,seis,100y}$ in N/mm² for all drilling methods and for good conditions; working life 50 and 100 years

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

with

f_{bd}: Design value of the ultimate bond stress in N/mm² considering the concrete classes, the rebar diameter, the drilling method for good bond condition (for all other bond conditions multiply the values by η_1 =0.7) and recommended partial factor γ_c = 1,5 according to EN 1992-1-1:2004 +AC:2010.

$k_{b,seis}$, $k_{b,seis,100y}$: Reduction factor according to Table C6

Rebar	Concrete classes								
ϕ	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
10 to 32 mm	No performance assessed	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
34 mm		2,0	2,3	2,6	2,9	3,3	3,6	3,9	4,2
36 mm		1,9	2,2	2,6	2,9	3,3	3,6	3,8	4,1
40 mm		1,8	2,1	2,5	2,8	3,1	3,4	3,7	4,0

Rotho Blaas Injection System EPO-FIX for rebar connection

Performances
Minimum anchorage length and minimum lap length, Amplification factor, Reduction factor and Design values of ultimate bond stress under seismic action

Annex C 2

Design value of the ultimate bond stress $f_{bd,fi}$, $f_{bd,fi,100y}$ at increased temperature for concrete classes C12/15 to C50/60, (all drilling methods); working life 50 and 100 years:

The design value of the bond stress $f_{bd,fi}$ at increased temperature has to be calculated by the following equation:

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

with: $\theta \leq 278°C$: $k_{fi}(\theta) = 4673{,}8 \cdot \theta^{-1{,}598} / (f_{bd,PIR} \cdot 4{,}3) \leq 1{,}0$

$\theta > 278°C$: $k_{fi}(\theta) = 0$

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

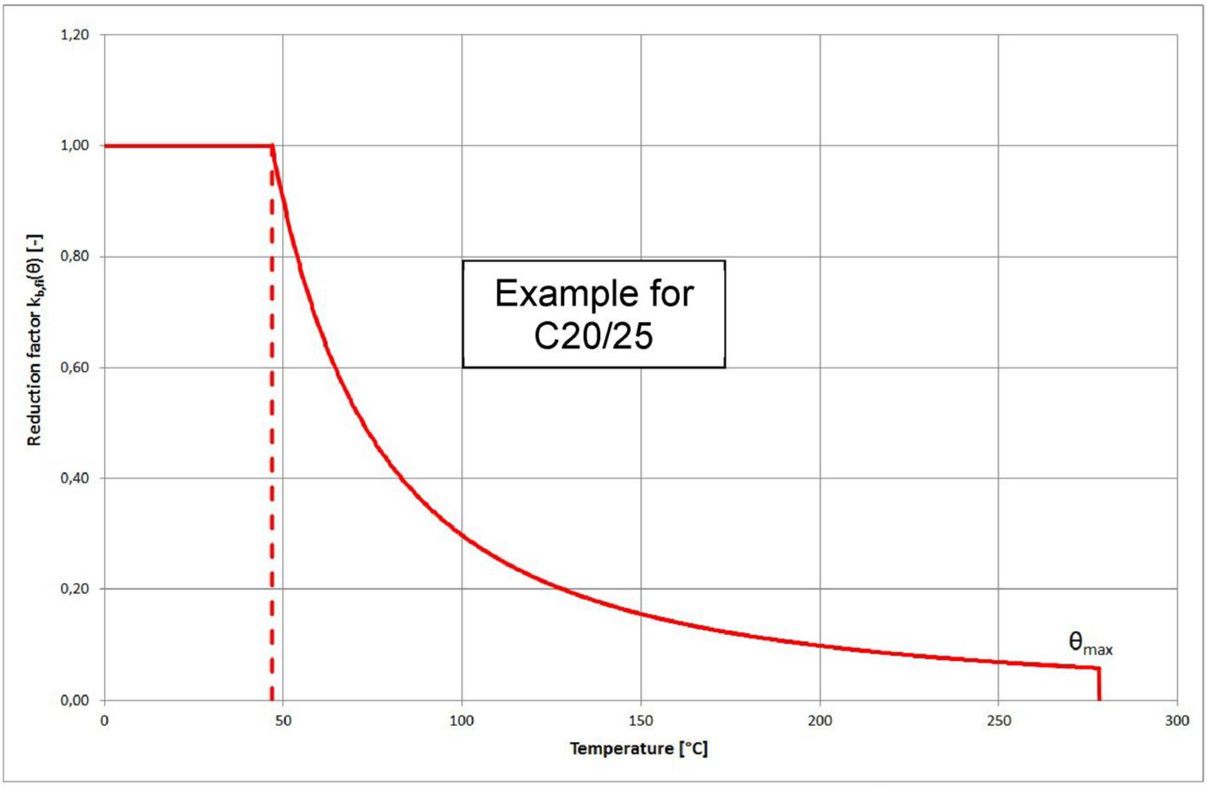
with: $\theta \leq 278°C$: $k_{fi,100y}(\theta) = 4673{,}8 \cdot \theta^{-1{,}598} / (f_{bd,PIR,100y} \cdot 4{,}3) \leq 1{,}0$

$\theta > 278°C$: $k_{fi,100y}(\theta) = 0$

$f_{bd,fi}$, $f_{bd,fi,100y}$	Design value of the ultimate bond stress at increased temperature in N/mm²
θ	Temperature in °C in the mortar layer.
$k_{fi}(\theta)$, $k_{fi,100y}(\theta)$	Reduction factor at increased temperature.
$f_{bd,PIR}$, $f_{bd,PIR,100y}$	Design value of the bond stress $f_{bd,PIR} = f_{bd,PIR,100y}$ in N/mm² in cold condition according to Table C4 considering the concrete classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1:2004+AC:2010.
γ_c	= 1,5, recommended partial factor according to EN 1992-1-1:2004+AC:2010
$\gamma_{M,fi}$	= 1,0, recommended partial factor according to EN 1992-1-2:2004+AC:2008

For evidence at increased temperature the anchorage length shall be calculated according to EN 1992-1-1:2004+AC:2010 Equation 8.3 using the temperature-dependent design value of ultimate bond stress $f_{bd,fi}$, $f_{bd,fi,100y}$.

Example graph of Reduction factor $k_{fi}(\theta)$, $k_{fi,100y}(\theta)$ f or concrete classes C20/25 for good bond conditions:



Rotho Blaas Injection System EPO-FIX for rebar connection	Annex C 3
Performances Design value of ultimate bond stress at increased temperature	