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**European Technical Assessment Body  
for construction products**



## European Technical Assessment

**ETA-14/0212  
of 8 October 2025**

English translation prepared by DIBt - Original version in German language

### General Part

Technical Assessment Body issuing the European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

Injection system TILCA TIM V+ for rebar connection

Product family  
to which the construction product belongs

Systems for post-installed  
rebar connections with mortar

Manufacturer

EFCO Befestigungstechnik AG  
Grabenstraße 1  
8606 NÄNIKON  
SCHWEIZ

Manufacturing plant

Plant 2

This European Technical Assessment  
contains

22 pages including 3 annexes which form an integral part  
of this assessment

This European Technical Assessment is  
issued in accordance with Regulation (EU)  
No 305/2011, on the basis of

EAD 330087-01-0601, Edition 06/2021

This version replaces

ETA-14/0212 issued on 27 June 2014

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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 "Injection system TILCA TIM V+ for rebar connection" in accordance with the regulations for reinforced concrete construction.

Reinforcing bars made of steel with a diameter  $\phi$  from 8 to 32 mm or the tension anchor ZA from sizes M12 to M24 according to Annex A and mortar TILCA® TIM V+ 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 connection of at least 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 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	No performance assessed

#### 3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 2 and 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(s) to be applied is (are): 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.

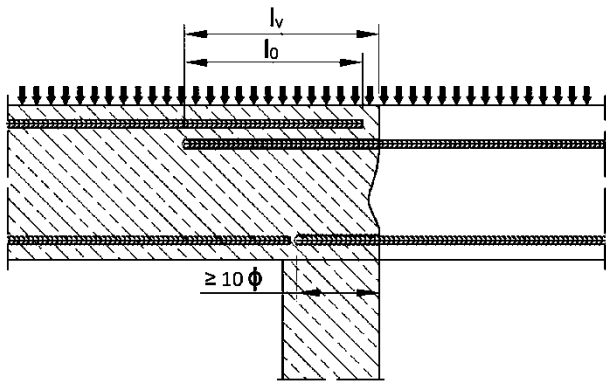
Issued in Berlin on 8 October 2025 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock  
Head of Section

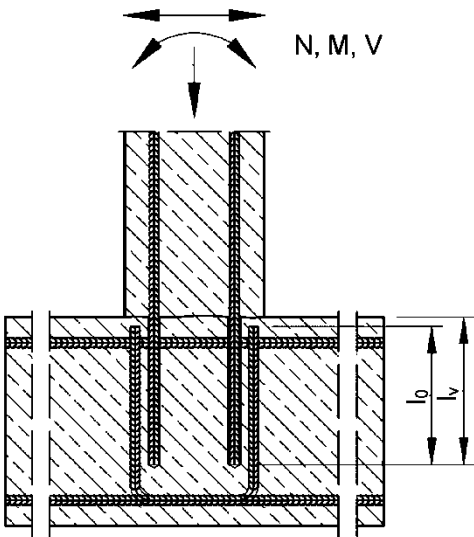
*beglaubigt:*  
Baderschneider

Installation post installed rebar

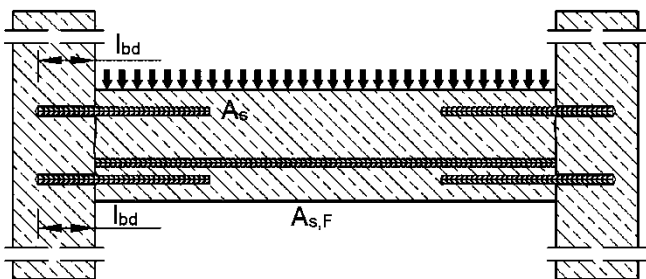
**Figure A1:** Overlapping joint for rebar connections of slabs and beams



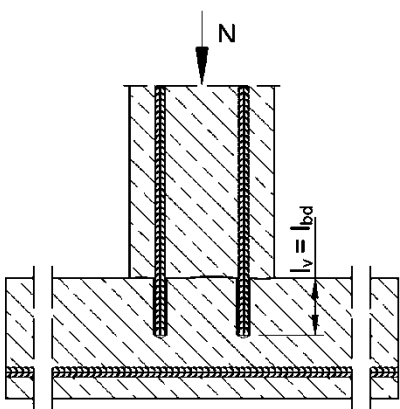
**Figure A2:** Overlapping joint at a foundation of a wall or column where the rebars are stressed in tension



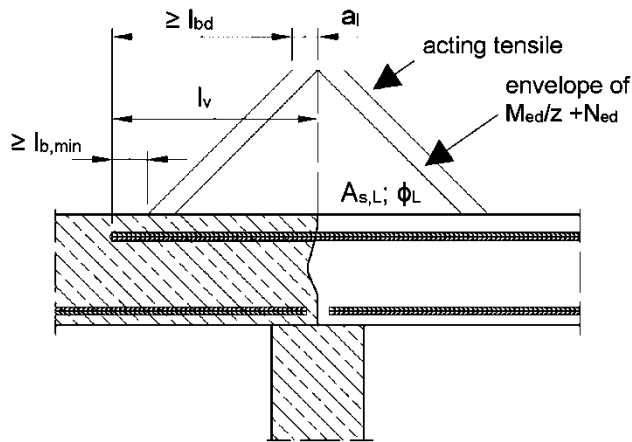
**Figure A3:** End anchoring of slabs or beams (e.g. designed as simply supported)



**Figure A4:** Rebar connection for components stressed primarily in compression.



**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 1992-1-1:2011.

Preparing of joints according to Annex B 2

Injection system TILCA TIM V+ for rebar connection

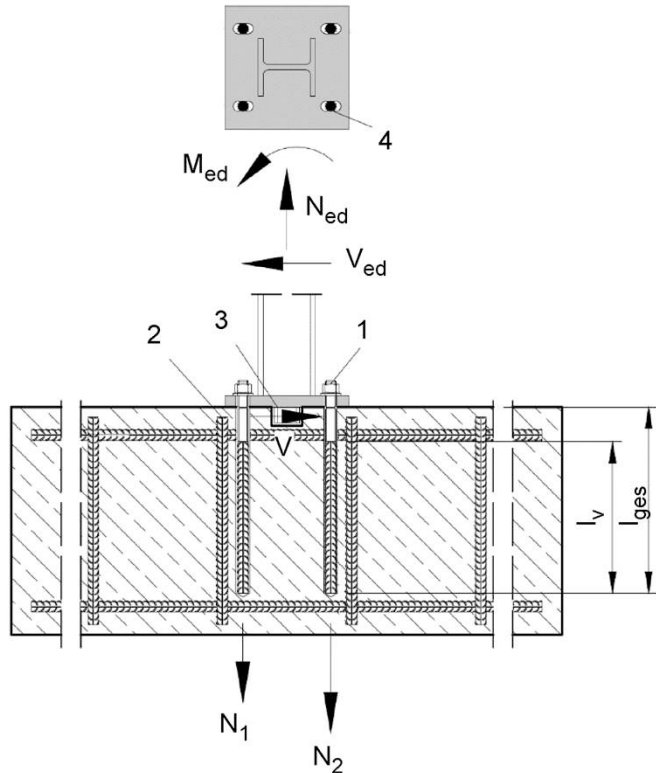
**Product description**

Installed condition and examples of use for rebars

**Annex A 1**

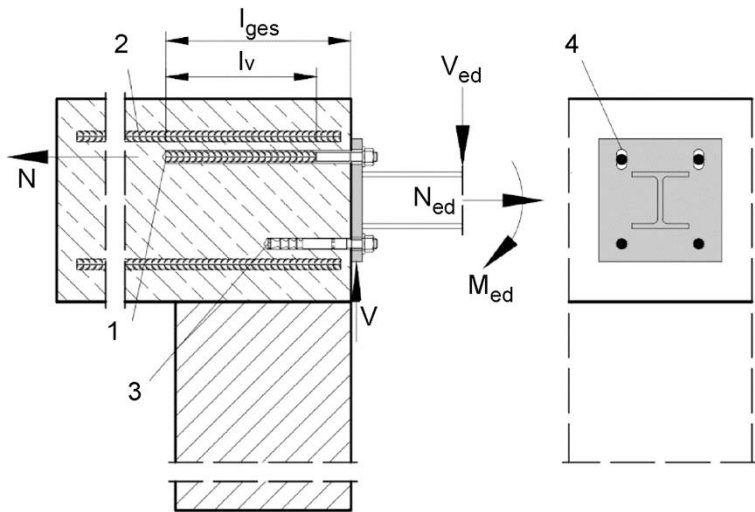
Installation tension anchor ZA

Figure A6: Anchorage of column to foundation with tension anchor ZA.



- 1 Tension anchor ZA (tension only)
- 2 Existing stirrup / reinforcement for overlap (lap splice)
- 3 Shear lug (or fastener loaded in shear)
- 4 Slotted hole with axial direction to the shear force

Figure A7: Anchorage of guardrail posts or cantilevered building components with tension anchor ZA and fastener.



- 1 Tension anchor ZA (tension only)
- 2 Existing stirrup / reinforcement for overlap (lap splice)
- 3 Fastener (or shear lug loaded in shear)
- 4 Slotted hole with axial direction to the shear force

**Note to Figure A6 and A7:** In the Figures no transverse reinforcement is plotted, the transverse reinforcement shall comply with EN 1992-1-1:2011. The tension anchor may be only used for axial tensile force. The tensile force must be transferred by lap to the existing reinforcement of the building. The transfer of the shear force has to be ensured by suitable measures, e.g. by means of shear lugs or anchors with European Technical Assessment (ETA). General construction rules see Annex B 3

Injection system TILCA TIM V+ for rebar connection

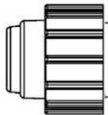
**Product description**  
Installed condition and examples of use for tension anchors ZA

**Annex A 2**

Cartridge system

Coaxial Cartridge

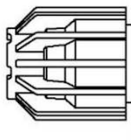
150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml



**Imprint:**  
**TILCA® TIM V+**  
Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

Side-by-Side Cartridge:

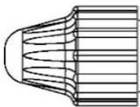
235 ml, 345 ml up to 360 ml and 825 ml



**Imprint:**  
**TILCA® TIM V+**  
Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

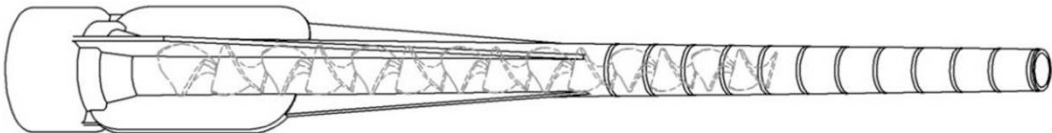
Foil tube Cartridge:

165 ml and 300 ml

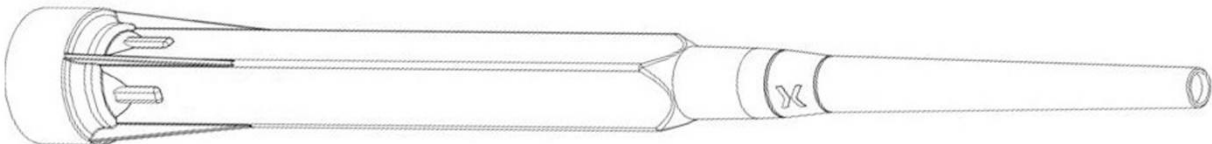


**Imprint:**  
**TILCA® TIM V+**  
Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

Static mixer TIM SM 14



Static mixer TIM SM Quadro



Piston plug IA and mixer extension VL



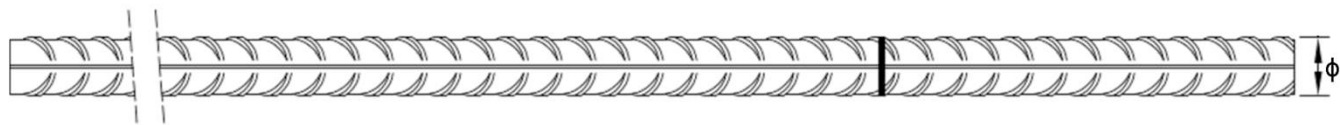
Injection system TILCA TIM V+ for rebar connection

**Product description**  
Injection system

**Annex A 3**



Reinforcing bar (rebar):  $\varnothing 8$  up to  $\varnothing 32$



- Minimum value of related rip area  $f_{R,min}$  according to EN 1992-1-1:2011
- Rib height of the bar shall be in the range  $0,05\phi \leq h_{rib} \leq 0,07\phi$   
( $\phi$ : Nominal diameter of the bar;  $h_{rib}$ : Rib height of the bar)

Table A1:      Materials Rebar

Designation	Material
Rebar EN 1992-1-1:2011, Annex C	Bars and de-coiled rods class B or C $f_{yk}$ and $k$ according to NDP or NCI of EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$


Injection system TILCA TIM V+ for rebar connection


Product description  
Specifications Rebar

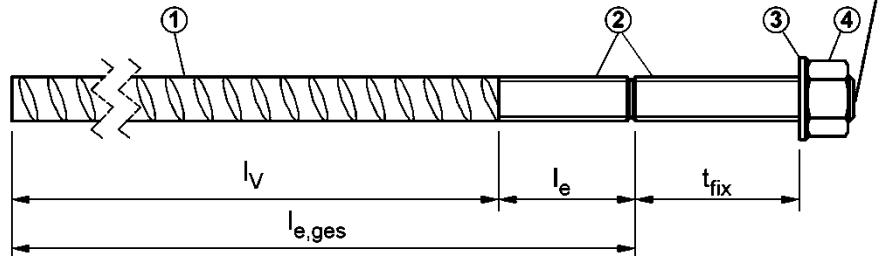
Annex A 4



## Tension Anchor: ZA-M12 up to ZA-M24

Marking: e.g.  12 A4

-  Mark of the producer  
ZA Trade name  
12 Rod diameter/thread  
A4 for stainless steel A4  
HCR for high corrosion resistance steel



**Table A2: Materials Tension Anchor ZA**

Part	Designation	Material											
		ZA vz				ZA A4				ZA HCR			
		M12	M16	M20	M24	M12	M16	M20	M24	M12	M16	M20	M24
1	Reinforcement bar	Class B according to NDP or NCI of EN 1992-1-1/NA $f_{yk} = f_{tk} = k \cdot f_{yk}$											
	$f_{yk}$ [N/mm <sup>2</sup> ]	500				500				500			
2	Threaded rod	Steel, zinc plated according to EN ISO 683-4:2018 or EN 10263:2021				Stainless steel, 1.4362, 1.4401, 1.4404, 1.4571, EN 10088-1:2014				High corrosion resistant steel, 1.4529, 1.4565, EN 10088-1:2014			
3	Washer	Steel, zinc plated according to EN ISO 683-4:2018 or EN 10263:2021				Stainless steel, 1.4362, 1.4401, 1.4404, 1.4571, EN 10088-1:2014				High corrosion resistant steel, 1.4529, 1.4565, EN 10088-1:2014			
4	Nut												

**Table A3: Dimensions and installation parameters**

Size			ZA-M12	ZA-M16	ZA-M20	ZA-M24
Diameter of threaded rod	$d_s$	[mm]	12	16	20	24
Diameter of reinforcement bar	$\phi$	[mm]	12	16	20	25
Drill hole diameter	$d_o$	[mm]	16	20	25	32
Diameter of clearance hole in fixture	$d_f$	[mm]	14	18	22	26
With across nut flats	SW	[mm]	19	24	30	36
Stress area	$A_s$	[mm <sup>2</sup> ]	84	157	245	353
Effective embedment depth	$l_v$	[mm]	according to static calculation			
Length of bonded thread	plated	$l_e$	[mm]	$\geq 20$	$\geq 20$	$\geq 20$
	A4/HCR			$\geq 100$	$\geq 100$	$\geq 100$
Minimum thickness of fixture	$\min t_{fix}$	[mm]	5	5	5	5
Maximum thickness of fixture	$\max t_{fix}$	[mm]	3000	3000	3000	3000
Maximum installation torque	$\max T_{inst}$	[Nm]	50	100	150	150

Injection system TILCA TIM V+ for rebar connection

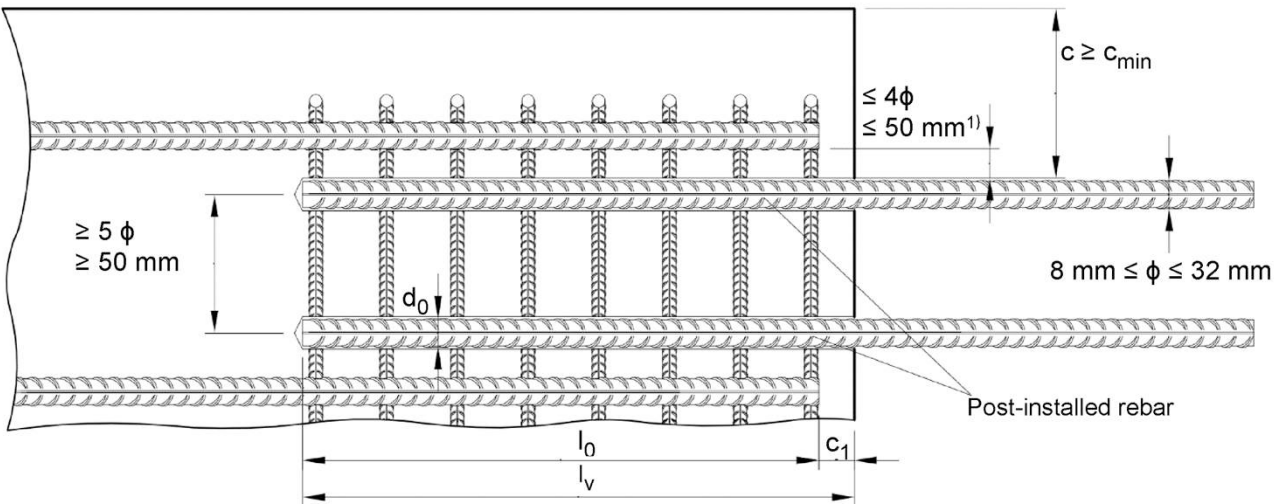
Product description  
Specifications Tension Anchor ZA

**Annex A 5**

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	static and quasi-static loads	Ø8 to Ø32 ZA-M12 to ZA-M24	No performance assessed
	seismic action	No performance assessed	No performance assessed
	Fire exposure	Ø8 to Ø32 ZA-M12 to ZA-M24	No performance assessed
Temperature Range:	- 40°C to +80°C (max long-term temperature +50 °C and max short-term temperature +80 °C)		
<b>Base materials:</b> <ul style="list-style-type: none"><li>- Reinforced or unreinforced normal weight concrete according to EN 206:2013 + A1:2016.</li><li>- Strength classes C12/15 to C50/60 according to EN 206:2013 + A1:2016.</li><li>- Maximum chloride content of 0,40% (CL 0.40) related to the cement content according to EN 206:2013 + A1:2016.</li><li>- Non-carbonated concrete.</li></ul> <p>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 <math>\phi + 60</math> mm prior to the installation of the new rebar.</p> <p>The depth of concrete to be removed shall correspond to at least the minimum concrete cover in accordance with EN 1992-1-1:2011. The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.</p>			
<b>Use conditions (Environmental conditions) with tension anchor ZA:</b> <ul style="list-style-type: none"><li>- Structures subject to dry internal conditions (all materials).</li><li>- For all other conditions according to EN 1993-1-4:2006 + A1:2015 corresponding to corrosion resistance class:<ul style="list-style-type: none"><li>• Stainless steel Stahl A4 according to Annex A 4, Table A1: CRC III</li><li>• High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V</li></ul></li></ul>			
<b>Design:</b> <ul style="list-style-type: none"><li>- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.</li><li>- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.</li><li>- Design according to EN 1992-1-1:2011, EN 1992-1-2:2011 and Annex B 2 and B 3.</li><li>- 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.</li></ul>			
<b>Installation:</b> <ul style="list-style-type: none"><li>- Dry or wet concrete. It must not be installed in flooded holes.</li><li>- Overhead installation allowed.</li><li>- Hole drilling by hammer drill (HD), hollow drill (HDB) or compressed air drill mode (CD).</li><li>- 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.</li><li>- 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).</li></ul>			
Injection system TILCA TIM V+ for rebar connection			Annex B 1
Intended use Specifications			

**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 1992-1-1:2011.
- 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  $4\phi$  or  $50\text{ mm}$ , then the lap length shall be increased by the difference between the clear bar distance and the smaller of  $4\phi$  or  $50\text{ mm}$ .

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 1992-1-1:2011, Section 4.4.1.2
$\phi$	diameter of post-installed rebar
$l_0$	lap length, according to EN 1992-1-1:2011, Section 8.7.3
$l_v$	effective embedment depth, $\geq l_0 + c_1$
$d_0$	nominal drill bit diameter, see Annex B 5

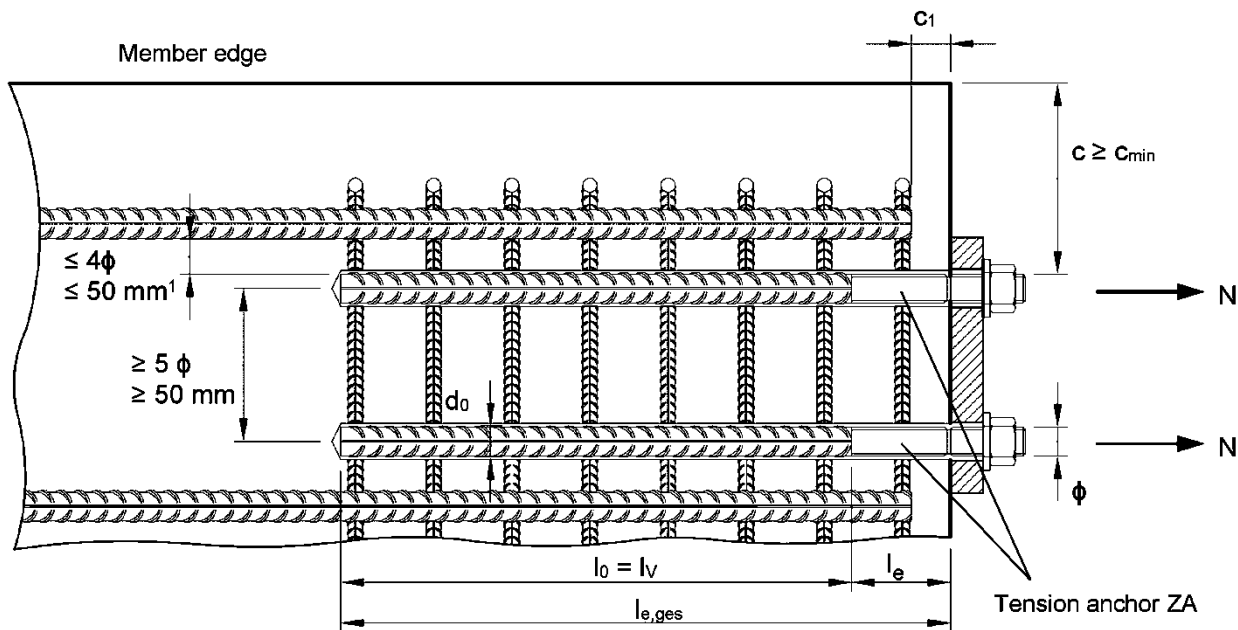
Injection system TILCA TIM V+ for rebar connection

**Intended use**  
General construction rules for post-installed rebars

**Annex B 2**

**Figure B2: General construction rules for tension anchors ZA**

- The length of the bonded-in thread may not be accounted as anchorage.
- Only tension forces in the direction of the bar axis may be transmitted by the tension anchor ZA.
- The tension force must be transferred via an overlap joint to the reinforcement in the building part.
- The transfer of shear forces shall be ensured by appropriate additional measures, e.g. shear lugs or by anchors with an European technical assessment.
- In the anchor plate, the holes for the tension anchors shall be executed as elongated holes with axis in the direction of the shear force.



<sup>1)</sup> If the clear distance between lapped bars exceeds  $4\phi$  or 50 mm, then the lap length shall be increased by the difference between the clear bar distance and the smaller of  $4\phi$  or 50 mm.

The following applies to Figure B2:

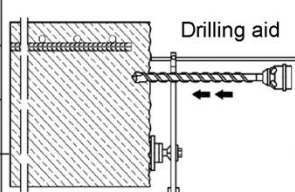
$c$	concrete cover of tension anchor ZA
$c_1$	concrete cover at end-face of existing rebar
$c_{min}$	minimum concrete cover according to Table B1 and to EN 1992-1-1:2011, Section 4.4.1.2
$\phi$	diameter of tension anchor
$l_0$	lap length, according to EN 1992-1-1:2011, Section 8.7.3
$l_v$	effective embedment depth
$l_e$	Length of bonded thread
$l_{e,ges}$	overall embedment depth, $\geq l_0 + c_2$
$d_0$	nominal drill bit diameter, see Annex B 5

Injection system TILCA TIM V+ for rebar connection

Intended use  
General construction rules for tension anchors ZA

**Annex B 3**










**Table B1: Minimum concrete cover  $c_{\min}^{1)}$  of post-installed rebar and tie rod ZA depending of drilling method**

Drilling method	Rebar diameter	Without drilling aid	With drilling aid	
Hammer drilling (HD) Hammer drilling with hollow drill (HDB)	< 25 mm	$30 \text{ mm} + 0,06 \cdot l_v \geq 2 \phi$	$30 \text{ mm} + 0,02 \cdot l_v \geq 2 \phi$	
	$\geq 25 \text{ mm}$	$40 \text{ mm} + 0,06 \cdot l_v \geq 2 \phi$	$40 \text{ mm} + 0,02 \cdot l_v \geq 2 \phi$	
Compressed air drilling (CD)	< 25 mm	$50 \text{ mm} + 0,08 \cdot l_v$	$50 \text{ mm} + 0,02 \cdot l_v$	
	$\geq 25 \text{ mm}$	$60 \text{ mm} + 0,08 \cdot l_v \geq 2 \phi$	$60 \text{ mm} + 0,02 \cdot l_v \geq 2 \phi$	

<sup>1)</sup> see Annex B 2, Figure B1 and Annex B 3, Figure B2

Comments: The minimum concrete cover acc. EN 1992-1-1:2011 must be observed.

**Table B2: Dispensing tools**

Cartridge type/size	Hand tool		Pneumatic tool
Coaxial cartridges and foil tube cartridges 150, 165, 280, 300 up to 333 ml	 e.g. Type H297 / H244C		 e.g. Type TS 492 X
Coaxial cartridges 380 up to 420 ml	 e.g. Type CCM 380/10	 e.g. Type H 285 or H244C	 e.g. Type TS 485 LX
Side-by-side cartridges 235, 345 ml	 e.g. Type CBM 330A	 e.g. Type H 260	 e.g. Type TS 477 LX
Side-by-side cartridge 825 ml	-	-	 e.g. Type TS 498X

All cartridges could also be extruded by a battery tool.

Injection system TILCA TIM V+ for rebar connection

Intended use  
Minimum concrete cover  
Dispensing tools

**Annex B 4**



**Table B3: Brushes, piston plugs, max anchorage depth and mixer extension, hollow drill bit system (HDB), hammer (HD) and compressed air (CD) drilling**

Bar size - $\phi$	Tension Anchor - $\phi$	Drill bit - $\phi$		$d_b$ Brush - $\phi$	$d_{b,min}$ min. Brush - $\phi$	Piston plug	Cartridge: All sizes				Cartridge: 825 ml		
		HD HDB	CD				Hand or battery tool		Pneumatic tool		Pneumatic tool		
							$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension	
[mm]	[mm]	[mm]			[mm]	[mm]		[mm]		[mm]		[mm]	
8	-	10	-	RBS10	12	10,5	-	250	VL10/0,75 or VL16/1,8	250	VL10/0,75 or VL16/1,8	250	VL10/0,75 or VL16/1,8
	-			RBS12	14	12,5	-	700		800		800	
10	-	12	-	RBS14	16	14,5	IA14	250		250		250	
	-							700		1000		1000	
12	ZA-M12	14	-					250		250		250	
				16	RBS16	18	16,5	IA16		1200		VL16/1,8	
14	-	18	RBS18	20	18,5	IA18	1400						
16	ZA-M16	20	RBS20	22	20,5	IA20	1600						
20	ZA-M20	25	-	RBS25	27	25,5	IA25	700		VL10/0,75 or VL16/1,8			2000
		-	26	RBS26	28	26,5	IA25						
22	-	28	RBS28	30	28,5	IA28	500						
24/25	ZA-M24	32	RBS32	34	32,5	IA32							
28	-	35	RBS35	37	35,5	IA35							
32	-	40	RBS40	41,5	40,5	IA40							

### Cleaning and installation tools

#### Hand pump

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



#### Manual slide valve

(min 6 bar)



#### Brush RBS



#### Piston Plug IA



#### Brush extension RBL



Injection system TILCA TIM V+ for rebar connection

#### Intended use

Parameter brushes, piston plugs, max anchorage depth and mixer extension  
Cleaning and installation tools

**Annex B 5**

**Table B4: Working time and curing time**

Temperature in base material			Maximum working time	Minimum curing time <sup>1)</sup>
T			$t_{\text{work}}$	$t_{\text{cure}}$
- 10 °C	up to	- 6 °C	90 min <sup>2)</sup>	24 h
- 5 °C	up to	- 1 °C	90 min <sup>3)</sup>	14 h
0 °C	up to	+ 4 °C	45 min <sup>3)</sup>	7 h
+ 5 °C	up to	+ 9 °C	25 min <sup>3)</sup>	2 h
+ 10 °C	up to	+ 19 °C	15 min <sup>3)</sup>	80 min
+ 20 °C	up to	+ 24 °C	6 min <sup>3)</sup>	45 min
+ 25 °C	up to	+ 29 °C	4 min <sup>3)</sup>	25 min
+ 30 °C	up to	+ 40 °C	2,5 min <sup>4)</sup>	15 min
Cartridge temperature			+5 °C up to +40 °C	

1) The minimum curing time is only valid for dry base material.

In wet base material the curing time must be doubled.

2) Cartridge temperature must be at least +15 °C

3) Cartridge temperature must be between +5 °C and +25 °C

4) Cartridge temperature must be below +20 °C

Injection system TILCA TIM V+ for rebar connection

Intended use  
Working and curing time

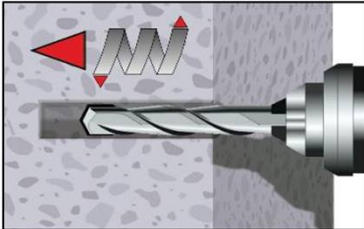
**Annex B 6**



## Installation instructions

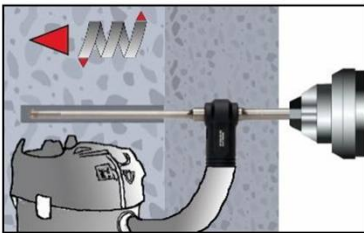
**Attention: Before drilling, remove carbonated concrete and clean contact areas (see Annex B1)**  
**In case of aborted drill hole: the drill hole shall be filled with mortar.**

### 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 B3.  
Proceed with Step 2 (MAC or CAC).

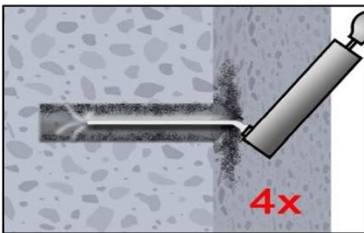


#### 1b. Hollow drill bit system (HDB)

Drill a hole to the required embedment depth.  
Drill bit diameter according to Table B3.  
Proceed with Step 2 (MAC or CAC).

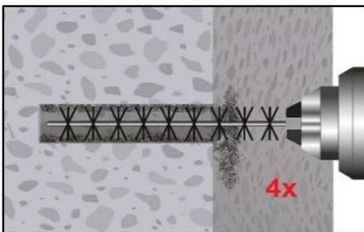
### Manual Air Cleaning (MAC)

for drill hole diameter  $d_0 \leq 20\text{mm}$  and drill hole depth  $h_0 \leq 10\phi$  with drilling method HD, HDB and CD

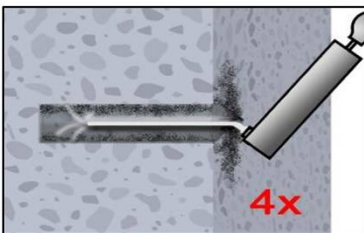


#### Attention! Standing water in the bore hole must be removed before cleaning.

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



2b. Brush the bore hole minimum 4x with brush RBS according to Table B3 over the entire embedment depth in a twisting motion (if necessary, a brush extension RBL shall be used).



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

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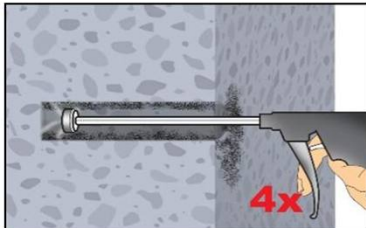
Intended use  
Installation instruction

Annex B 7

## Installation instructions (continuation)

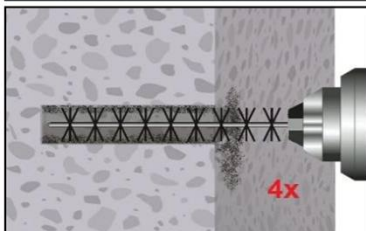
### Compressed Air Cleaning (CAC):

All diameter with drilling method HD, HDB and CD

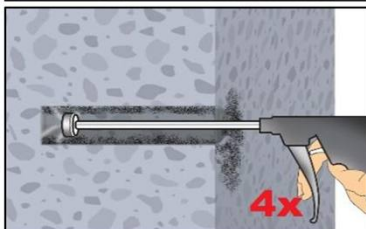


**Attention! Standing water in the bore hole must be removed before cleaning.**

**2a.** Blow the bore hole clean minimum 4x with compressed air (min. 6 bar) (Annex B 5) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

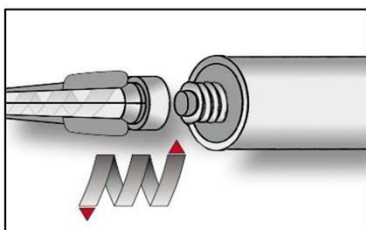


**2b.** Brush the bore hole minimum 4x with brush RBS according to Table B3 over the entire embedment depth in a twisting motion (If necessary, a brush extension RBL shall be used.).

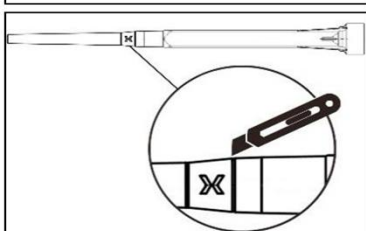


**2c.** Finally blow the bore hole clean minimum 4x with compressed air (min. 6 bar) (Annex B 5) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.).

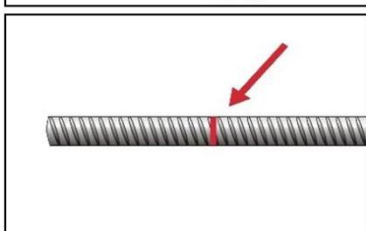
**Protect cleaned bore hole against re-contamination in an appropriate way. If necessary, repeat cleaning process directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.**



**3.** Screw on static-mixing nozzle TIM SM 14 or TIM SM Quadro, and load the cartridge into an appropriate dispensing tool. Cut off the foil tube clip before use. For every working interruption longer than the maximum working time  $t_{work}$  (Annex B 6) as well as for new cartridges, a new static-mixer shall be used.



**3a.** In case of using the mixer extension VL16/1,8 cut off the tip of the mixer nozzle TIM SM Quadro 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.

Injection system TILCA TIM V+ for rebar connection

Intended use  
Installation instruction (continuation)

**Annex B 8**

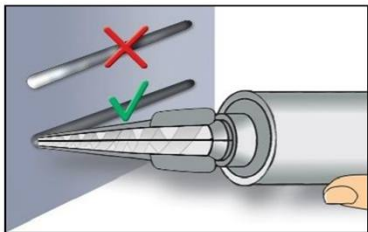
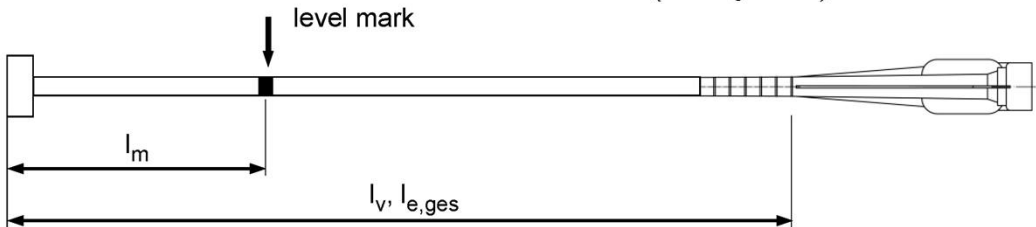
Installation instructions (continuation)

5. Mark mixer nozzle and extension with mortar level mark  $l_m$  and anchorage depth  $l_v$  resp.  $l_{e,ges}$

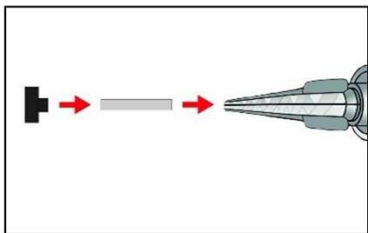
Quick estimation:  $l_m = 1/3 \cdot l_v$

Optimum mortar volume:

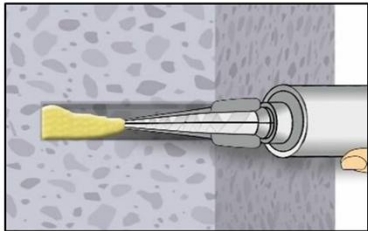
$$l_m = l_v \text{ bzw. } l_{e,ges} \cdot \left( 1,2 \cdot \frac{\phi^2}{d_0^2} - 0,2 \right)$$



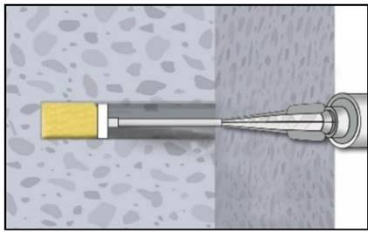
6. Not proper mixed mortar is not sufficient for fastening.  
Dispense and discard mortar until an uniform grey colour is shown, at least 3 full strokes. For foil tube cartridges it must be discarded a minimum of 6 full strokes.



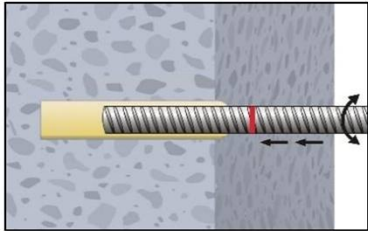
7. Piston plugs IA and mixer nozzle extensions VL shall be used according to Table B3.  
Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.



- 8a. **Injecting mortar without piston plug IA:**  
Starting at bottom of the hole and fill the hole with adhesive until the mortar level mark  $l_m$  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 6).



- 8b. **Injecting mortar with piston plug IA:**  
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 6).



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

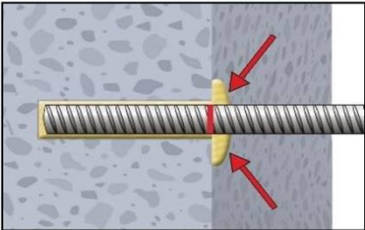
Injection system TILCA TIM V+ for rebar connection

Intended use  
Installation instruction (continuation)

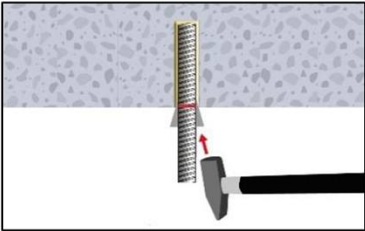
Annex B 9



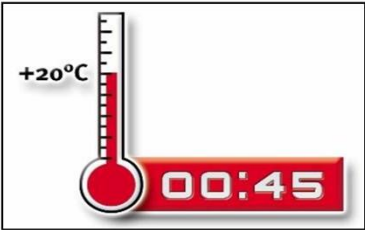
Installation instructions (continuation)



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 6) must be observed. The full load to the reinforcing bar may be applied after the full curing time  $t_{cure}$  has elapsed.

Injection system TILCA TIM V+ for rebar connection

Intended use  
Installation instruction (continuation)

Annex B 10

**Table C1: Characteristic tension resistance for tension anchor ZA**

Tension Anchor			M12	M16	M20	M24
Steel, zinc plated (ZA vz)						
Characteristic tension resistance	N <sub>Rk,s</sub>	[kN]	67	125	196	282
Partial factor	γ <sub>Ms,N</sub>	[-]	1,4			
Stainless Steel (ZA A4 or ZA HCR)						
Characteristic tension resistance	N <sub>Rk,s</sub>	[kN]	67	125	171	247
Partial factor	γ <sub>Ms,N</sub>	[-]	1,4		1,3	1,4

**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 1992-1-1:2011 ( $l_{b,min}$  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  $\alpha_{lb}$  according to Table C2.

**Table C2: Amplification factor  $\alpha_{lb}$  related to concrete class and drilling method**

Concrete class	Drilling method	Bar size	Amplification factor $\alpha_{lb}$
C12/15 to C50/60	all drilling methods	8 mm to 32 mm ZA-M12 to ZA-M24	1,0

**Table C3: Reduction factor  $k_b$  for all drilling methods**

Rebar	Concrete class								
$\phi$	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 25 mm ZA-M12 to ZA-M24	1,0								
28 to 32 mm	1,0						0,92	0,86	

**Table C4: Design values of the ultimate bond stress  $f_{bd,PIR}$  in N/mm<sup>2</sup> for all drilling methods and for good conditions**

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

with

$f_{bd}$ : Design value of the ultimate bond stress in N/mm<sup>2</sup> considering the concrete classes, the rebar diameter, the drilling method for good bond condition (for all other bond conditions multiply the values by  $\eta_1 = 0,7$ ) and recommended partial factor  $\gamma_c = 1,5$  according to EN 1992-1-1:2011.

$k_b$ : Reduction factor according to Table C3

Rebar	Concrete class								
$\phi$	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 25 mm ZA-M12 to ZA-M24	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
28 to 32 mm	1,6	2,0	2,3	2,7	3,0	3,4	3,7	3,7	3,7

**Injection system TILCA TIM V+ for rebar connection**

**Performances**

Characteristic tension resistance for tension anchor, Minimum anchorage length and minimum lap length, Amplification factor, Reduction factor and Design values of ultimate bond resistance

**Annex C 1**

**Design value of the ultimate bond stress  $f_{bd,fi}$  at increased temperature for concrete classes C12/15 to C50/60, (all drilling methods):**

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

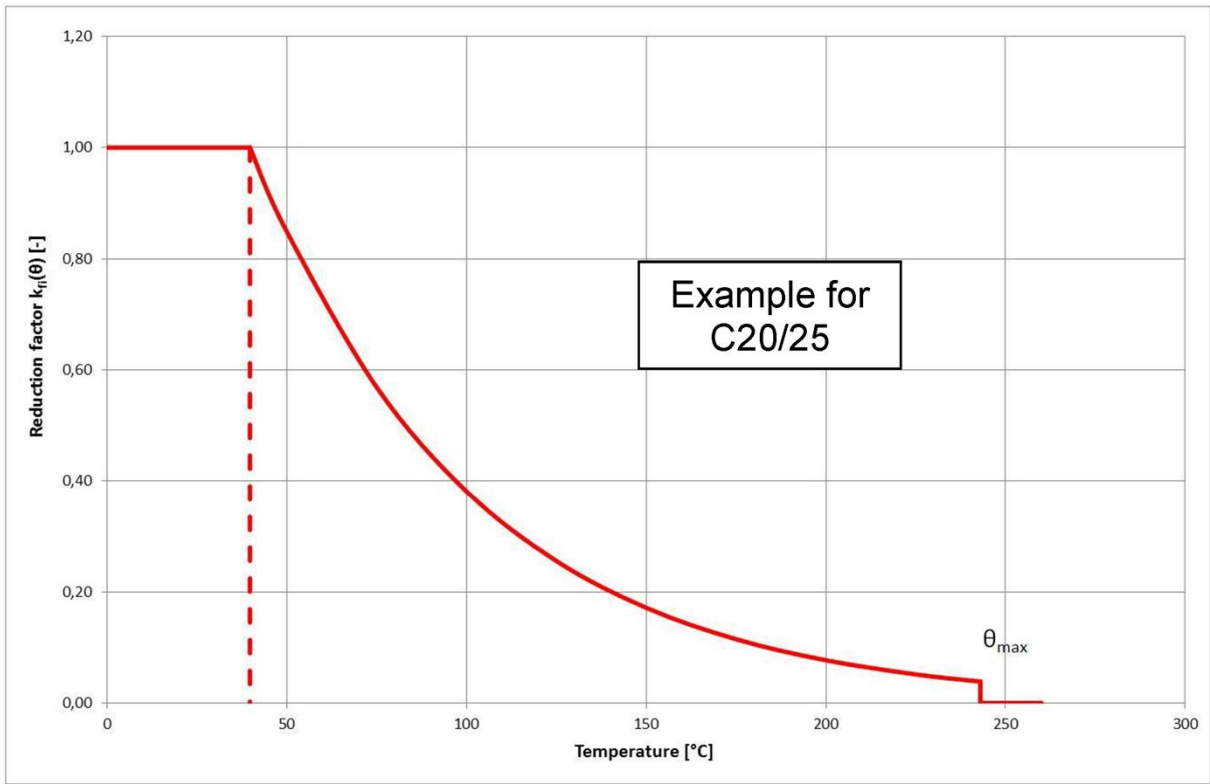
mit:  $\theta \leq 243^{\circ}\text{C}$ :  $k_{fi}(\theta) = 18,88 \cdot e^{(\theta \cdot -0,016)} / (f_{bd,PIR} \cdot 4,3) \leq 1,0$

$\theta > 243^{\circ}\text{C}$ :  $k_{fi}(\theta) = 0$

- $f_{bd,fi}$  Design value of the ultimate bond stress at increased temperature in N/mm<sup>2</sup>
- $\theta$  Temperature in °C in the mortar layer.
- $k_{fi}(\theta)$  Reduction factor at increased temperature.
- $f_{bd,PIR}$  Design value of the bond stress in N/mm<sup>2</sup> in cold condition according to Table C4 considering the concrete classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1:2011.
- $\gamma_c$  = 1,5 recommended partial factor according to EN 1992-1-1:2011
- $\gamma_{M,fi}$  = 1,0 recommended partial factor according to EN 1992-1-2:2011

For evidence at increased temperature the anchorage length shall be calculated according to EN 1992-1-1:2011 Equation 8.3 using the temperature-dependent design value of ultimate bond stress  $f_{bd,fi}$ .

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



Injection system TILCA TIM V+ for rebar connection

**Performances**  
Design value of ultimate bond stress at increased temperature

**Annex C 2**

Table C5: Characteristic tension resistance for tension anchor ZA under fire exposure							
Tension Anchor				M12	M16	M20	M24
Steel, zinc plated (ZA vz)							
Characteristic tension resistance	R30	N <sub>RK,s,fi</sub>	[kN]	2,3	4,0	6,3	9,0
	R60			1,7	3,0	4,7	6,8
	R90			1,5	2,6	4,1	5,9
	R120			1,1	2,0	3,1	4,5
Stainless Steel (ZA A4 or ZA HCR)							
Characteristic tension resistance	R30	N <sub>RK,s,fi</sub>	[kN]	3,4	6,0	9,4	13,6
	R60			2,8	5,0	7,9	11,3
	R90			2,3	4,0	6,3	9,0
	R120			1,8	3,2	5,0	7,2
Injection system TILCA TIM V+ for rebar connection						Annex C 3	
Performances Characteristic tension resistance for tension anchor ZA under fire exposure							