Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-23/0141 of 3 May 2023

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	SIKLA Injection System AN VME basic RB
Product family to which the construction product belongs	Systems for post-installed rebar connections with mortar
Manufacturer	Sikla Holding GmbH Ägydiplatz 3 A-4600 THALHEIM BEI WELS ÖSTERREICH
Manufacturing plant	Sikla Herstellwerk 1 Sikla Herstellwerk 3
This European Technical Assessment contains	26 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

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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 "SIKLA Injection System AN VME basic RB" in accordance with the regulations for reinforced concrete construction.
Reinforcing bars made of steel with a diameter ϕ from 8 to 40 mm or the tension anchor ZA of sizes M12 to M24 according to Annex A and SIKLA injection mortar AN VME basic RB 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 and C 2
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 3 and C 4

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.

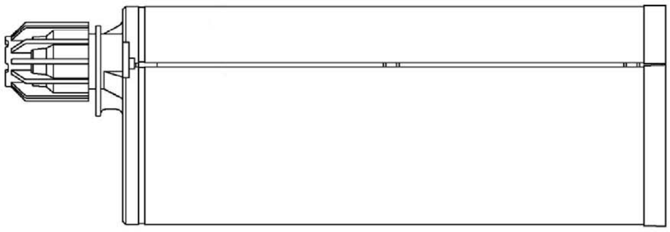
Issued in Berlin on 3 May 2023 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Baderschneider

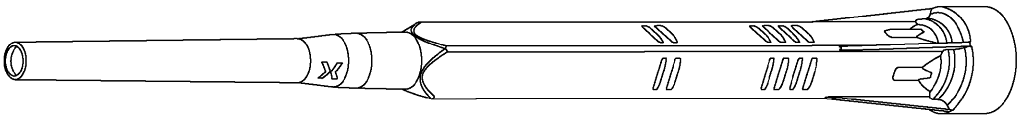
Cartridge: SIKLA Injection Mortar AN VME basic RB

Side-by-side cartridge
440 ml,
585 ml,
1400 ml

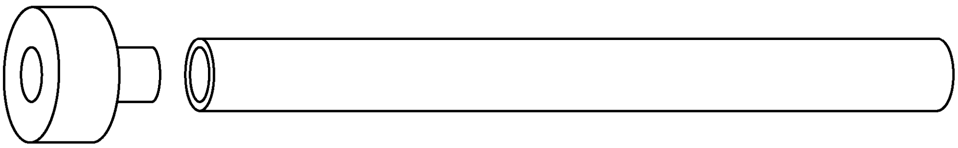


Imprint:
AN VME basic RB,
processing notes, batch number, shelf life, hazard-number, storage temperature, curing- and processing time (depending on temperature), optional with travel scale

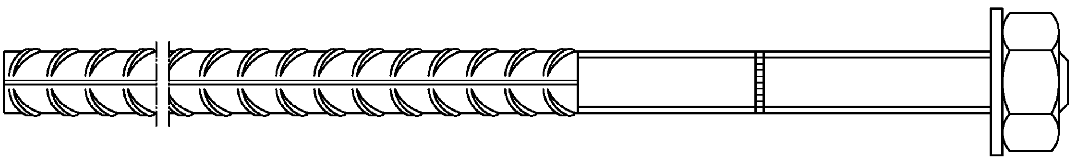
Static Mixer



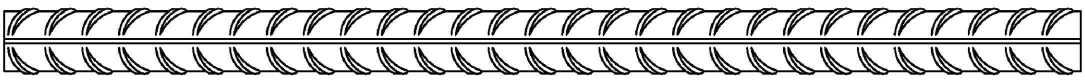
Retaining washer and extension pipe



Tension Anchor ZA: M12, M16, M20, M24



Reinforcing bar: Ø8, Ø10, Ø12, Ø14, Ø16, Ø20, Ø22, Ø24, Ø25, Ø28, Ø32, Ø34, Ø36, Ø40



SIKLA Injection System AN VME basic RB	Annex A1
Product description Cartridge / Static mixer / Retaining washer + extension pipe / Tension Anchor / Reinforcing bar	

Application examples for reinforcing bar

Figure A1: Overlap joint in slabs and beams

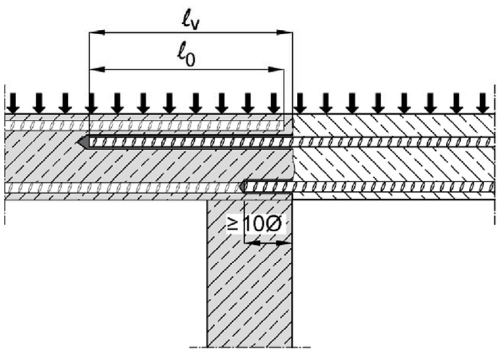


Figure A2: Overlap joint in a foundation of a column or wall where the rebars are stressed in tension

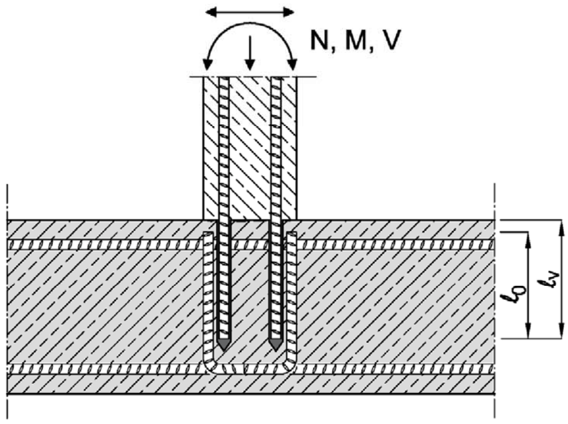


Figure A3: End anchoring of slabs or beams, designed as simply supported

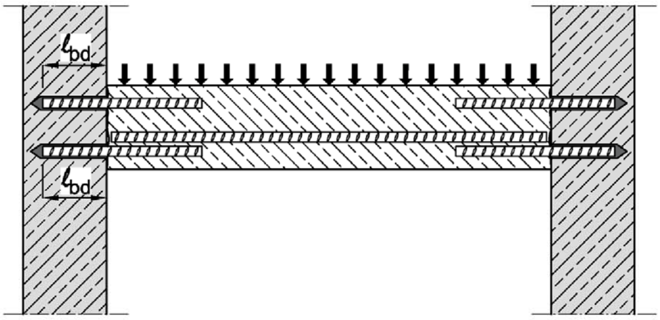


Figure A4: Rebar connection of components stressed primarily in compression.

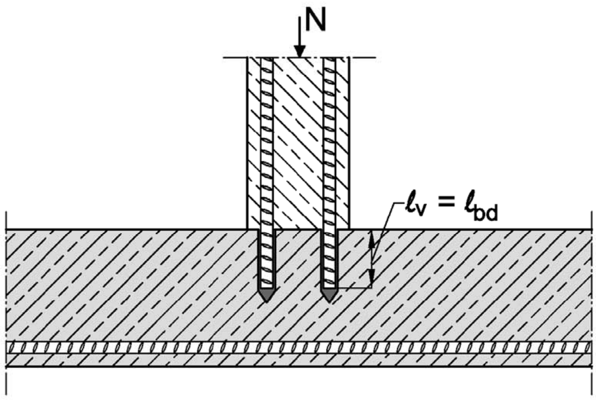
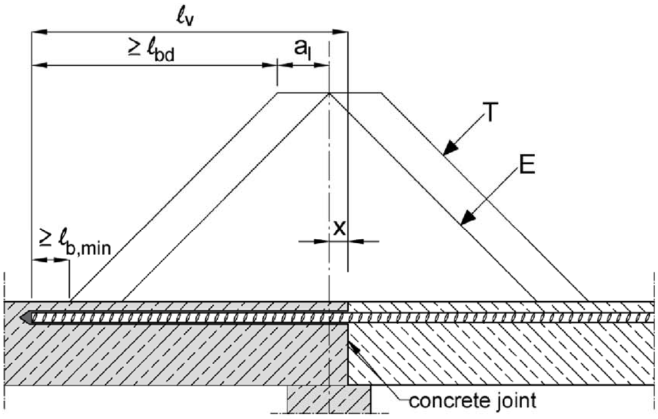


Figure A5: Anchoring of reinforcement to cover the line of acting tensile force



(only post-installed rebar is plotted)

Note to Figure A1 to A5

No transverse reinforcement acc. to EN 1992-1-1:2004+AC:2010 is pictured.
The shear transfer between old and new concrete shall be designed according to EN 1992-1-1:2004+AC:2010.
Notations and definitions of anchorages and overlap joints see Annex B4.

Figure A5:

T= acting tensile force
E= envelope of $M_{Ed}/Z + N_{Ed}$
(see EN 1992-1-1:2004+AC:2010, Figure 9.2)
x= distance between the theoretical point of support and concrete joint

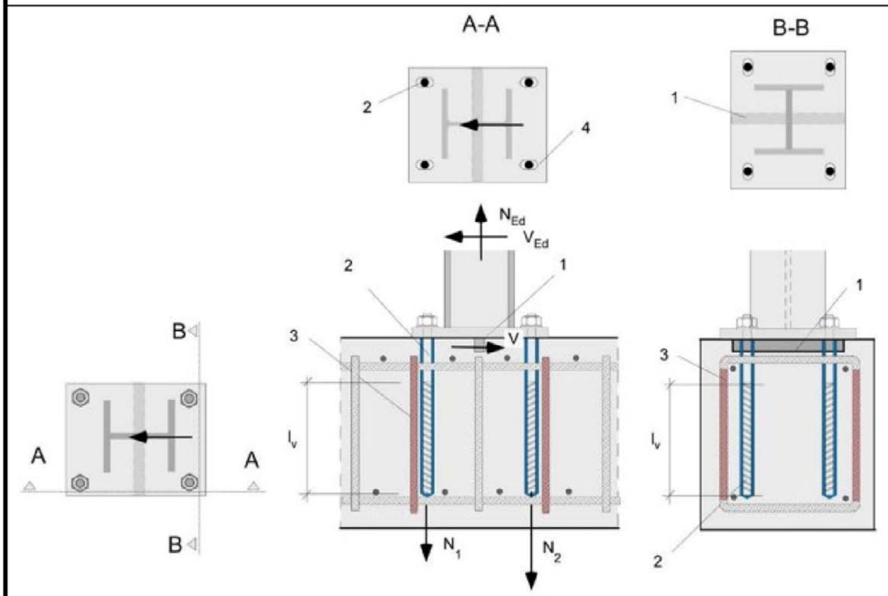
SIKLA Injection System AN VME basic RB

Product description
Application examples for post-installed rebar

Annex A2

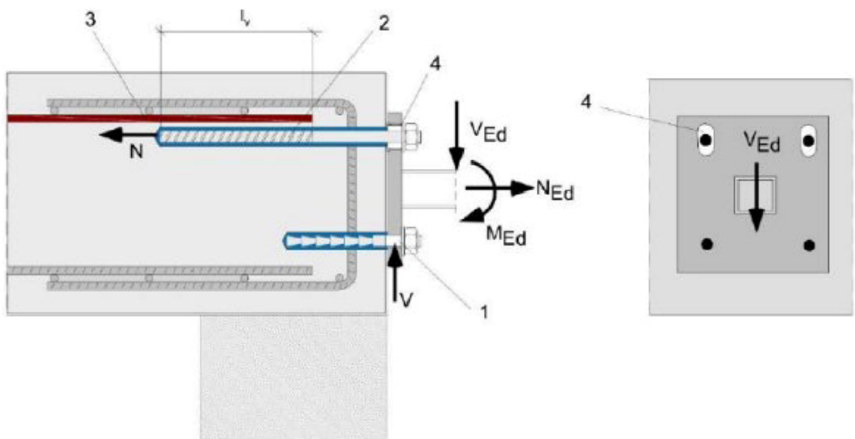
Application examples for Tension Anchor ZA

Figure A6: Lap to a foundation of a column under bending.



1. Shear lug (or fastener loaded in shear)
2. Tension anchor (tension only)
3. Existing stirrup / reinforcement for overlap(lap splice)
4. Slotted hole

Figure A7: Lap of the anchoring of guardrail posts for anchoring of cantilevered building components. In the anchor plate, the drill holes for the tension anchors have to be designed as slotted holes with axial direction to the shear force.



1. Fastener for shear load transfer
2. Tension anchor (tension only)
3. Existing stirrup / reinforcement for overlap (lap splice)
4. Slotted hole

Note to Figure A6 and A7: The required transverse reinforcement acc. to EN 1992-1-1:2004+AC:2010 is not shown in the figures. 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 force or anchors with European Technical Assessment (ETA). General construction rules see Annex B3.

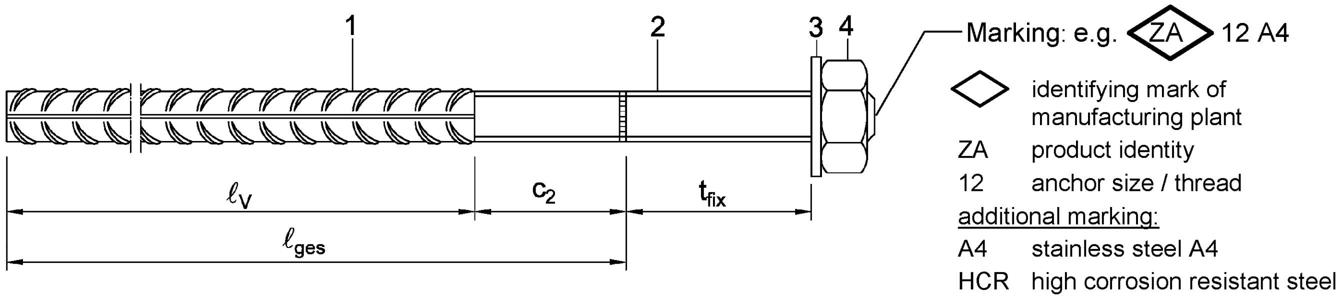
SIKLA Injection System AN VME basic RB	Annex A3
Product description Application examples for Tension Anchor ZA	

Deutsches Institut für Bautechnik DIBt

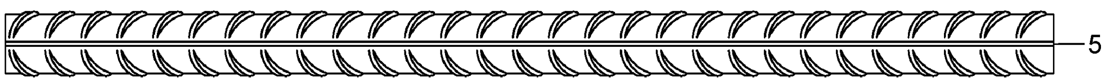
Table A1: Material

<table>
<tr><th>Part</th><th>Description</th><th colspan="12">Material</th></tr>
<tr><td colspan="2" rowspan="2">Tension Anchor</td><td colspan="4">ZA vz</td><td colspan="4">ZA A4</td><td colspan="4">ZA HCR</td></tr>
<tr><td>M12</td><td>M16</td><td>M20</td><td>M24</td><td>M12</td><td>M16</td><td>M20</td><td>M24</td><td>M12</td><td>M16</td><td>M20</td><td>M24</td></tr>
<tr><td rowspan="2">1</td><td>Rebar</td><td colspan="12">Class B according to NDP or NCI acc. to EN 1992-1-1/NA
$f_{uk} = f_{tk} = k \cdot f_{yk}$</td></tr>
<tr><td>f_{yk} [N/mm²]</td><td colspan="4">500</td><td colspan="4">500</td><td colspan="4">500</td></tr>
<tr><td rowspan="2">2</td><td>Threaded rod</td><td colspan="4">steel, zinc plated acc. to EN ISO 683-4:2018 or EN 10263:2017</td><td colspan="4">stainless steel, 1.4401, 1.4404, 1.4571, EN 10088-1:2014</td><td colspan="4">high corrosion resistant steel, 1.4529, 1.4565, EN 10088-1:2014</td></tr>
<tr><td>f_{yk} [N/mm²]</td><td colspan="4">640</td><td colspan="3">640</td><td>560</td><td colspan="3">640</td><td>560</td></tr>
<tr><td>3</td><td>Washer</td><td colspan="4">steel, zinc plated</td><td colspan="4">stainless steel</td><td colspan="4">high corrosion resistant steel</td></tr>
<tr><td>4</td><td>Hexagon nut</td><td colspan="4">steel, zinc plated acc. to EN ISO 683-4:2018 or EN 10263:2017</td><td colspan="4">stainless steel, 1.4401, 1.4404, 1.4571, EN 10088-1:2014</td><td colspan="4">high corrosion resistant steel, 1.4529, 1.4565, EN 10088-1:2014</td></tr>
<tr><td colspan="14">Rebar</td></tr>
<tr><td>5</td><td>Rebar acc. EN 1992-1-1:2004+ AC:2010, Annex C</td><td colspan="12">Bars and de-coiled rods class B or C
f_{yk} and k according to NDP or NCI of EN 1992-1-1/NA
$f_{uk} = f_{tk} = k \cdot f_{yk}$</td></tr>
</table>

Tension Anchor ZA: M12, M16, M20, M24



Rebar: ∅8, ∅10, ∅12, ∅14, ∅16, ∅20, ∅22, ∅24, ∅25, ∅28, ∅32, ∅34, ∅36, ∅40



- 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 $0{,}05\varnothing \leq h_{rib} \leq 0{,}07\varnothing$
  ($\varnothing$: nominal diameter of the bar; h_{rib}: rip height of the bar)

SIKLA Injection System AN VME basic RB	**Annex A4**
Product description Material / Marking	

Specifications of intended use

	Rebar	Tension Anchor ZA
	Ø8 - Ø40	M12 - M24
Static or quasi-static action	✓	✓
Fire exposure	✓	✓
Hammer drill	✓	✓
Compressed air drill	✓	✓
Diamond drilling	✓	✓
Vacuum drill	✓	✓
Base material	Compacted, reinforced or unreinforced normal weight concrete without fibers acc. to EN 206:2013+A1:2016	
	strength classes C12/15 to C50/60 acc. to EN 206:2013+A1:2016	
	maximum chloride content of 0,40 % (CL 0,40) related to the cement content acc. to EN 206:2013+A1:2016	
	non-carbonated concrete[1)]	
Temperature range -40°C to +80°C	max. short term temperature +80°C and max. long term temperature +50°C	

[1)] 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 ∅ + 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.

Use conditions (Environmental conditions) Tension Anchor ZA:

- Structures subject to dry internal conditions: all materials
- For all other conditions corresponding to corrosion resistance classes CRC according to EN 1993-1-4:2006 +A1:2015:
  - stainless steel A4, according to Annex A4, Table A1: CRC III
  - high corrosion resistant steel HCR, according to Annex A4, Table A1: CRC V

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 loads to be anchored.
- Anchorages are designed in accordance with EN 1992-1-1:2004+AC:2010, EN 1992-1-2:2004+AC:2008 and Annex B3 and B4.
- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

Specifications of intended use - continuation

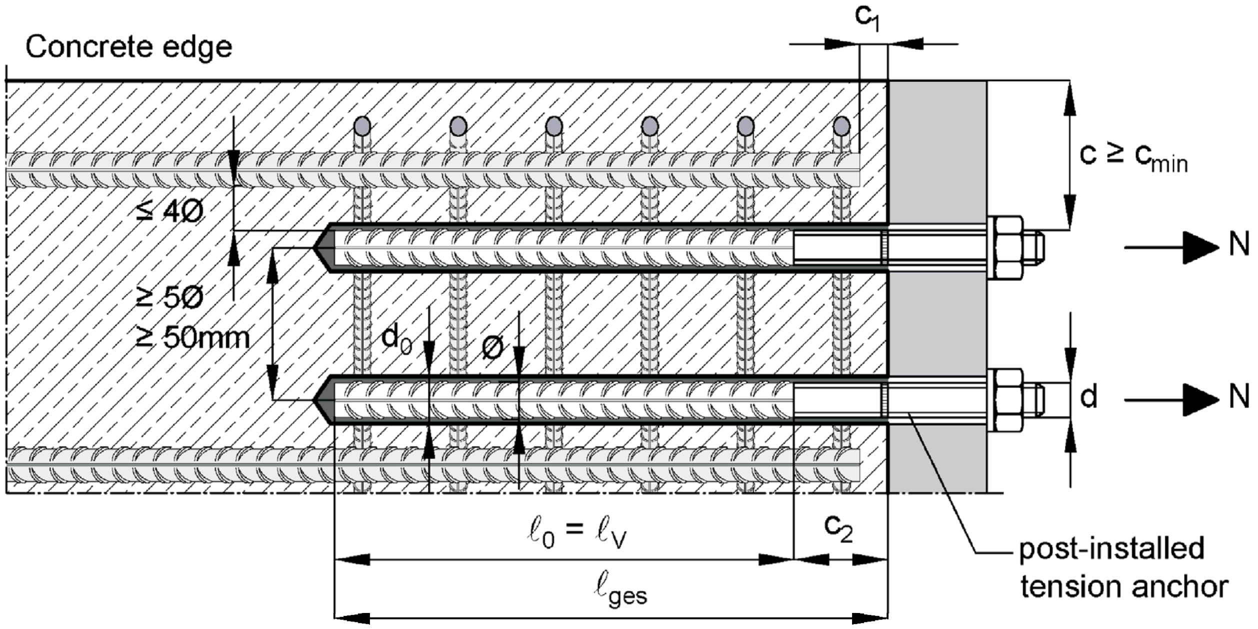
Installation:

- Dry or wet concrete
- Installation in water filled bore holes is not admissible.
- Hole drilling by hammer drill, compressed air drill, vacuum drill or diamond drill.
- The installation of post-installed rebar or Tension Anchor ZA 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).
- Minimum concrete cover acc. to EN 1992-1-1:2004+AC:2010 must be observed.

General construction rules for Tension Anchor ZA

- Tension anchors ZA must be designed for the welded-on rebar.
- The length for the post-installed thread must not be added to the anchoring length.
- The Tension Anchor ZA can only transfer forces towards the bar axis.
- Tension forces must be transferred by an overlap joint into the present reinforcement of the member.
- The transmission of shear forces must be ensured by additional measures, e.g. by shear cleats or anchors with an European Technical Assessment (ETA).
- In the anchor plate the holes for the tension anchors must be executed as elongated holes with axis in the direction of the shear force.
- If the clear distance of overlapping bars is greater than 4Ø, the lap length must be increased by a length equal to the clear space where it exceeds 4Ø.

Tension Anchor ZA



c	concrete cover of Tension Anchor ZA
c_1	concrete cover at front end of cast-in-place rebar
c_2	length of bonded thread
c_{min}	minimum concrete cover according Table B1 and EN 1992-1-1:2004+AC:2010, section 4.4.1.2
Ø	diameter of tension anchor (rebar part)
d	diameter of tension anchor (threaded part)
ℓ_0	lap length acc. to EN 1992-1-1:2004+AC:2010, section 8.7.3
ℓ_v	embedment depth $\ell_v \geq \ell_0 + c_1$
ℓ_{ges}	overall embedment depth $\ell_{ges} \geq \ell_0 + c_2$
d_0	nominal drill bit diameter according Annex B6

SIKLA Injection System AN VME basic RB

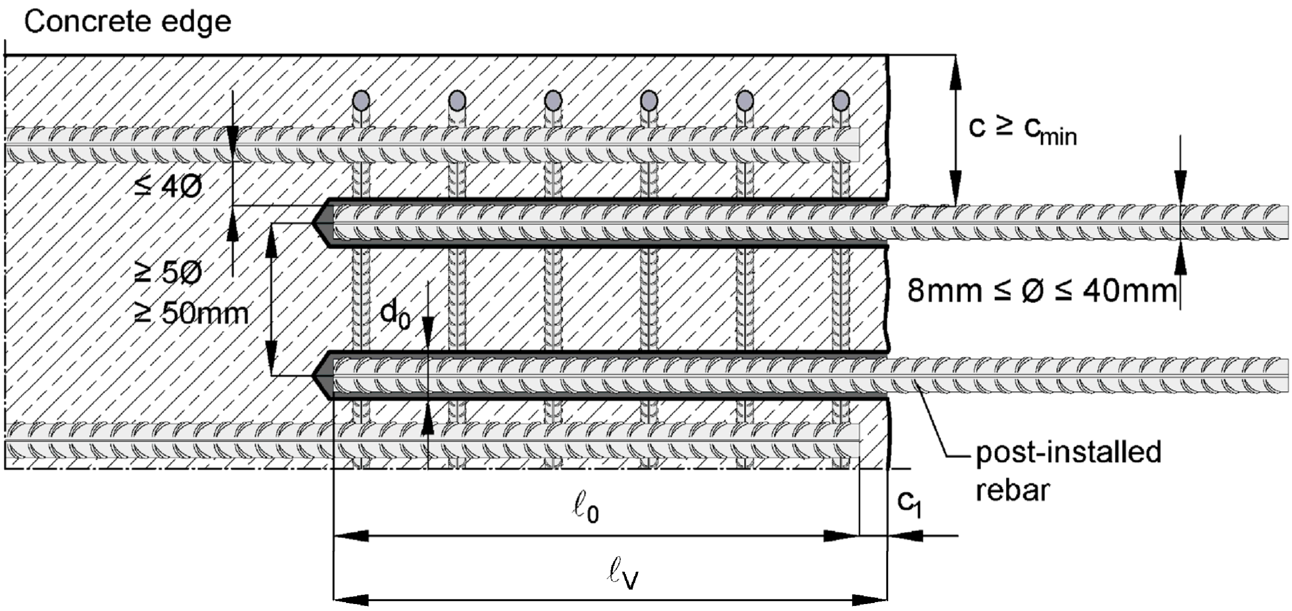
Intended use
General construction rules **(Tension Anchor ZA)**

Annex B3

General construction rules for post-installed rebars

- The shear transfer between old and new concrete shall be designed acc. to EN 1992-1-1:2004+AC:2010.
- Only tension forces in the axis of the rebar may be transmitted.
- The joints for concreting must be roughened to at least such an extent that aggregate protrude.
- If the clear distance of overlapping bars is greater than 4Ø, the lap length must be increased by a length equal to the clear space where it exceeds 4Ø.

Post-installed rebars

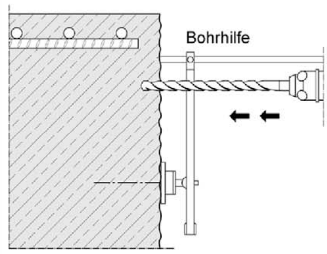


c	concrete cover of post-installed rebar
c_1	concrete cover at front end of cast-in-place rebar
c_{min}	minimum concrete cover according Table B1 and EN 1992-1-1:2004+AC:2010, section 4.4.1.2
Ø	diameter of post-installed rebar
ℓ_0	lap length acc. to EN 1992 1 1:2004+AC:2010, section 8.7.3
ℓ_v	embedment depth $\ell_v \geq \ell_0 + c_1$
d_0	nominal drill bit diameter according to Annex B6

SIKLA Injection System AN VME basic RB	**Annex B4**
Intended use General construction rules (**post-installed rebar**)	

Table B1: Minimum concrete cover c_{min}[1)] of post-installed rebar and Tension Anchor ZA depending on drill method

Drilling method	Rod diameter	c_{min} <u>without</u> drilling aid	c_{min} <u>with</u> drilling aid
Hammer drilling Vacuum drilling	< 25 mm	30 mm + 0,06 ℓ_v ≥ 2 Ø	30 mm + 0,02 ℓ_v ≥ 2 Ø
	≥ 25 mm	40 mm + 0,06 ℓ_v ≥ 2 Ø	40 mm + 0,02 ℓ_v ≥ 2 Ø
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	60 mm + 0,02 ℓ_v
Diamond drilling	< 25 mm	drill rig used as drilling aid	30 mm + 0,02 ℓ_v ≥ 2 Ø
	≥ 25 mm		40 mm + 0,02 ℓ_v ≥ 2 Ø



[1)] See Annex B3 and B4; Minimum concrete cover acc. to EN 1992-1-1:2004+AC:2010 must be observed

Table B2: Dimensions and installation parameters of Tension Anchor ZA

Anchor size				M12	M16	M20	M24
Thread diameter		d	[mm]	12	16	20	24
Rebar diameter		Ø	[mm]	12	16	20	25
Nominal drill hole diameter		d_0	[mm]	see Table B4 and B5			
Diameter of clearance hole in fixture		d_f	[mm]	14	18	22	26
Width across nut flats		SW	[mm]	19	24	30	36
Cross section area (threaded part)		A_s	[mm²]	84	157	245	353
Effective embedment depth		ℓ_v	[mm]	According to static calculation			
Length of bonded thread	steel, zinc plated	c_2	[mm]	≥ 20			
	A4 / HCR			≥ 100			
Minimum thickness of fixture		$t_{fix,min}$	[mm]	5	5	5	5
Maximum thickness of fixture		$t_{fix,max}$	[mm]	3000	3000	3000	3000
Maximum installation torque		T_{inst}	[Nm]	50	100	150	150

Table B3: Working and curing time

Bore hole temperature	Working time [1)]	Minimum curing time dry concrete	Minimum curing time wet concrete
+5°C to +9°C	80 min	60 h	120 h
+ 10°C to + 14°C	60 min	48 h	96 h
+ 15°C to + 19°C	40 min	24 h	48 h
+ 20°C to + 24°C	30 min	12 h	24 h
+ 25°C to + 34°C	12 min	10 h	20 h
+ 35°C to + 39°C	8 min	7 h	14 h
+40 °C	8 min	4 h	8 h
Cartridge temperature	+5°C to +40°C		

[1)] Maximum time from starting of mortar injection to completing of rebar setting

Table B4: Installation tools and max. embedment depth
Hammer drilling (HD), Diamond drilling (DD) and Compressed air drilling (CD)

Rebar size Ø	Tension Anchor ZA	Drill bit diameter d_0			Brush- Ø d_b		Brush- Ø $d_{b,min}$	Retaining washer [1]	Cartridge 440ml or 585ml			Cartridge 1400 ml	
		HD	DD	CD					Hand- or akku tool $\ell_{v,max}$	Compressed air tool $\ell_{v,max}$	Extension pipe	Compressed air tool $\ell_{v,max}$	Extension pipe
[mm]	[-]	[mm]			[-]	[mm]	[mm]	[-]	[cm]	[cm]		[cm]	[-]
8	-	10	10	-	RB10	11,5	10,5	-	25	25	VM-XE 10 or VM-XLE16	25	VM-XE 10 VM-XLE16
	-	12	12	-	RB12	13,5	12,5	-	70	80		80	
10	-	12	12	-	RB12	13,5	12,5	-	25	25		25	
	-	14	14	-	RB14	15,5	14,5	VM-IA 14	70	100		100	
12	M12	14	14	-	RB14	15,5	14,5	VM-IA 14	25	25		25	
		16	16	16	RB16	17,5	16,5	VM-IA 16	70	130		120	VM-XLE 16
14	-	18	18	18	RB18	20,0	18,5	VM-IA 18	70	130		140	
16	M16	20	20	20	RB20	22,0	20,5	VM-IA 20	70	130		160	
20	M20	25	25	-	RB25	27,0	25,5	VM-IA 25	50	100		200	
		-	-	26	RB26	28,0	26,5	VM-IA 25	50	100		200	
22	-	28	28	28	RB28	30,0	28,5	VM-IA 28	50	100		200	
24	-	32	32	32	RB32	34,0	32,5	VM-IA 32	50	100		200	
25	M24	32	32	32	RB32	34,0	32,5	VM-IA 32	50	100		200	
28	-	35	35	35	RB35	37,0	35,5	VM-IA 35	50	100		200	
32/34	-	40	40	40	RB40	43,5	40,5	VM-IA 40	50	100		200	
36	-	45	45	45	RB45	47,0	45,5	VM-IA 45	-	100		200	
40	-	-	52	-	RB52	54,0	52,5	VM-IA 52	-	100		200	
	-	55	-	55	RB55	58,0	55,5	VM-IA 55	-	100		200	

[1] For horizontal or overhead installation and bore holes deeper than 240mm

Table B5: Installation tools and max. embedment depth – Vacuum Drilling (VD)

Rebar size Ø	Tension Anchor ZA	Drill bit diameter d_0	Brush- Ø d_b $d_{b,min}$	Retaining washer [1]	Cartridge 440ml or 585ml			Cartridge 1400 ml	
		VD			Hand- or akku tool $\ell_{v,max}$	Compressed air tool $\ell_{v,max}$	Extension pipe	Compressed air tool $\ell_{v,max}$	Extension pipe
[mm]	[-]	[mm]		[-]	[cm]	[cm]	[-]	[cm]	[-]
8	-	10	no cleaning required	-	25	25	VM-XE 10 or VM-XLE 16	25	VM-XE 10 or VM-XLE 16
	-	12		-	70	80		80	
10	-	12		-	25	25		25	
	-	14		VM-IA 14	70	100		100	
12	M12	14		VM-IA 14	25	25		25	
		16		VM-IA 16	70	100		100	
14	-	18		VM-IA 18	70	100		100	
16	M16	20		VM-IA 20	70	100		100	
20	M20	25		VM-IA 25	50	100		100	
22	-	28		VM-IA 28	50	100		100	
24	-	32		VM-IA 32	50	100		100	
25	M24	32		VM-IA 32	50	100		100	
28	-	35		VM-IA 35	50	100		100	
32/34	-	40		VM-IA 40	50	100		100	

[1] For horizontal or overhead installation and bore holes deeper than 240mm

SIKLA Injection System AN VME basic RB

Intended use
Installation tools and max. embedment depth – all drilling methods

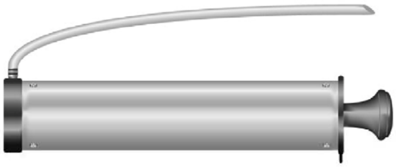
Annex B6

Cleaning and installation tools

Vacuum drill bit (MKT Hollow drill bit SB, Würth Hammer drill bit with suction or Heller Duster Expert hollow drill bit system) and a class M vacuum cleaner with minimum negative pressure of 253 hPa and flow rate of min. 150m³/h (42 l/s)

Compressed air hose (min. 6 bar) with air valve

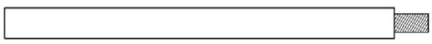
Recommended compressed air tool (min. 6 bar)



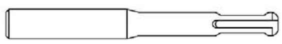
Blow-out pump (Volume 750ml)
Drill bit diameter (d_0): ≤ 20 mm
Drill hole depth (h_0): ≤ 10 d_{nom}

Retaining washer

Brush RB



Brush extension



SDS Plus Adapter

Table B6: Dispensing tools

Cartridge Type	Cartridge Size	Hand tool	Pneumatic tool
side-by-side	440 ml, 585 ml	e.g. VM-P 585 Profi or VM-P 585 Standard	e.g. VM-P 585 Pneumatic
	1400 ml	-	e.g. VM-P 1400 Pneumatic

All cartridges can be used with battery tool as well.

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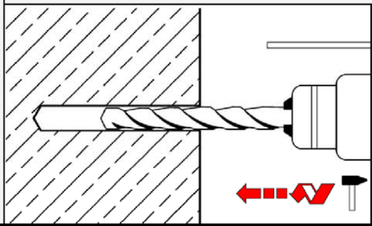
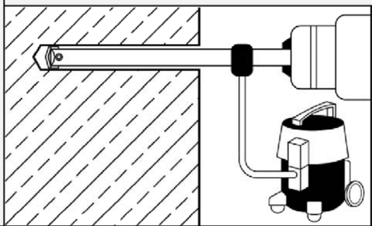
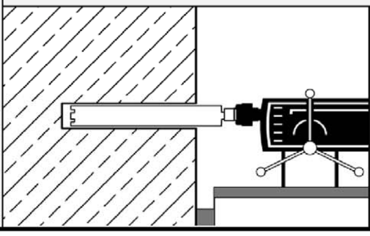
Installation instructions

Bore hole drilling

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.

1		**HD / CD - Hammer drilling or Compressed air drilling**	
	1a		Drill the borehole with the specified drill bit diameter (Table B4) and the selected borehole depth. Continue with step 2 (HD / CD).
		VD - Vacuum drilling	
	1b		Drill the borehole into base material up to the size and embedment depth required by the selected rebar or tension anchor (Table B5). This drilling system removes dust and cleans the drill hole during drilling. Continue with step 3.
		DD - Diamond drilling	
	1c		Drill the borehole perpendicular to the surface of the anchoring base with the prescribed borehole diameter (Table B4) and selected borehole depth using the diamond core drill. Continue with step 2 (DD).

SIKLA Injection System AN VME basic RB

Intended use
Installation instructions: Bore hole drilling

Annex B8

Installation instructions - continuation

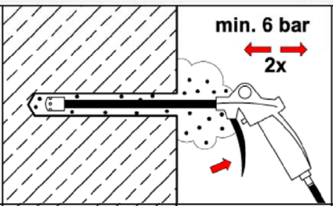
Cleaning: HD / CD - Hammer or compressed air drilled holes

2

Attention: remove standing water before cleaning

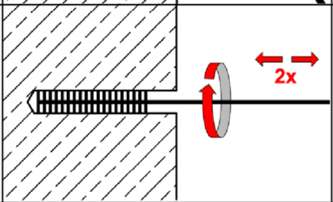
Cleaning with compressed air
all drill hole diameters and depths

2a



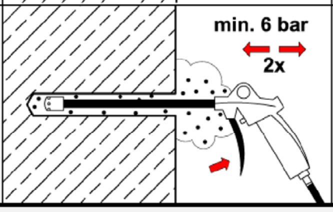
Starting from the bottom or back of the drill hole, blow out the hole with compressed air (min. 6 bar) (Annex B7) a minimum of **two** times until return air stream is free of noticeable dust.
If the drill hole ground is not reached, an extension must be used.

2b



Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B4) a minimum of **two** times.
If the drill hole ground is not reached, a brush extension shall be used.

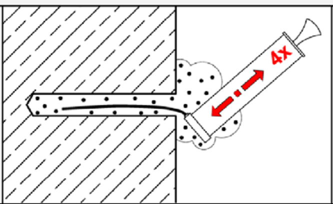
2c



Starting from the bottom or back of the drill hole, blow out the hole with compressed air (min. 6 bar) (Annex B7) again a minimum of **two** times until return air stream is free of noticeable dust.
If the drill hole ground is not reached, an extension must be used.

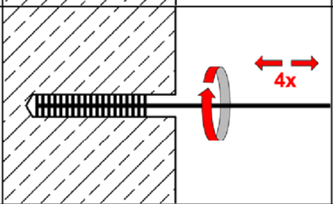
Manual cleaning
bore hole diameter $d_0 \leq$ 20mm and bore hole depth $h_0 \leq 10\ d_{nom}$

2a



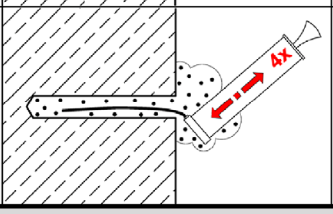
Starting from the bottom or back of the bore hole, blow the hole clean with the blow-out pump (Annex B7) minimum of **four** times until return air stream is free of noticeable dust.

2b



Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B4) a minimum of **four** times.
If the bore hole ground is not reached, a brush extension shall be used.

2c

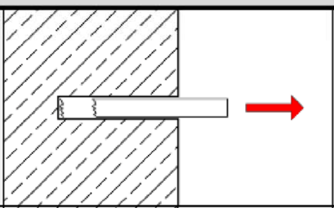
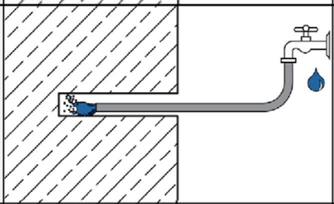
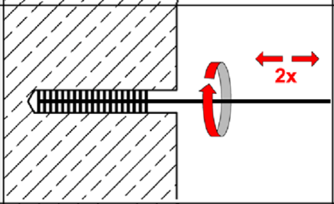
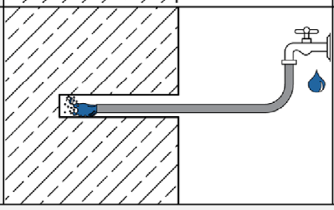
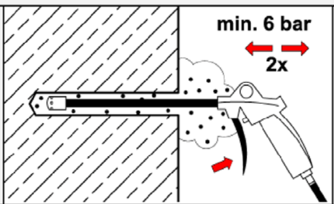
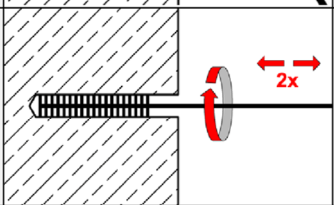
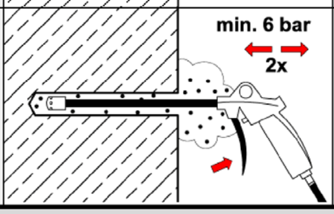


Starting from the bottom or back of the bore hole, blow the hole clean with the blow-out pump again a minimum of **four** times until return air stream is free of noticeable dust.

After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning repeated has to be directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.

SIKLA Injection System AN VME basic RB	**Annex B9**
Intended use Installation instructions (continuation): **Cleaning HD / CD (Hammer- and Compressed air drilling)**	

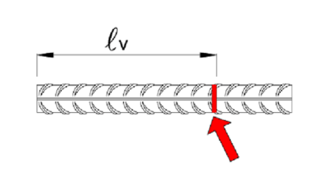
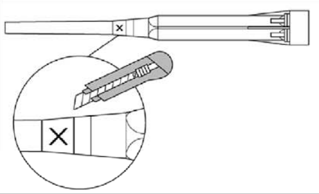
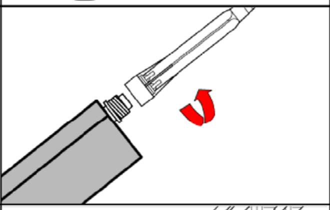
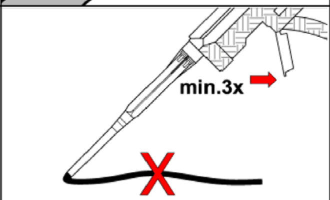
Installation instructions - continuation

Cleaning: DD - diamond drilled bore holes (all bore hole diameter and bore hole depth)			
2	**2a**		Remove drill core at least up to the nominal hole depth and check drill hole depth.
	2b		Flush drill hole with water, starting from the bottom, until clear water is coming out of the drill hole.
	2c		Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B4) a minimum of **two** times. If the drill hole ground is not reached, a brush extension shall be used.
	2d		Flush drill hole with water again, starting from the bottom, until clear water gets out of the drill hole.
	Attention: standing water in the bore hole must be removed before cleaning		
	2e		Starting from the bottom or back of the drill hole, blow out the hole with compressed air (min. 6 bar) (Annex B7) a minimum of **two** times until return air stream is free of noticeable dust. If the drill hole ground is not reached, an extension must be used.
	2f		Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B4) a minimum of **two** times. If the bore hole ground is not reached, a brush extension shall be used.
	2g		Starting from the bottom or back of the drill hole, blow out the hole with compressed air (min. 6 bar) (Annex B7) again a minimum of **two** times until return air stream is free of noticeable dust. If the drill hole ground is not reached, an extension must be used.

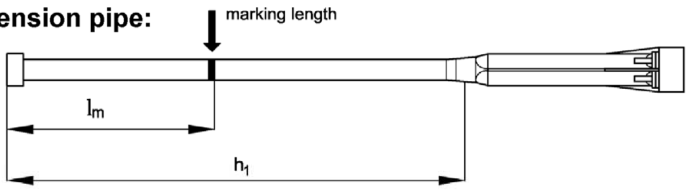
After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning repeated has to be directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again..

SIKLA Injection System AN VME basic RB	**Annex B10**
Intended use Installation instructions (continuation): **Cleaning DD (Diamond drilling)**	

Installation instructions - continuation

Preparation of bar and cartridge		
3		Mark (e.g. with adhesive tape) the position of the embedment depth ℓ_v on the rebar or tension anchor. Check drill hole depth by inserting rebar or tension anchor into the empty hole. The fastening element shall be free of dirt, grease, oil or other foreign material.
4		When extension pipe VM-XLE 16 is used, the tip oft he mixer has to be cut off at the position „X“.
5		Prepare cartridge with static mixer (if necessary with extension pipe and retaining washer). Attach the supplied static-mixer to the cartridge and load the cartridge into the correct dispensing tool (Table B6). For every working interruption longer than the recommended working time (Table B3) as well as for new cartridges, a new static-mixer shall be used.
6		Prior to applying, discard mortar (forerun) until the mortar shows a consistent red or grey colour, but at least three full strokes. Never use this mortar!

Marking for static mixer or extension pipe:



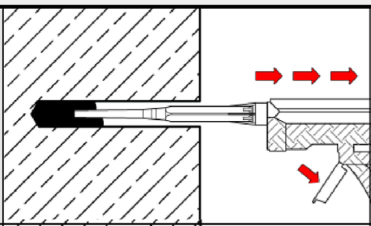
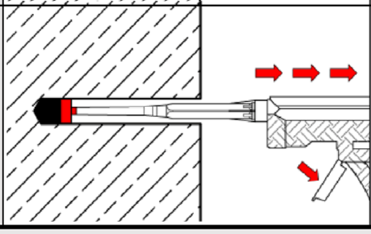
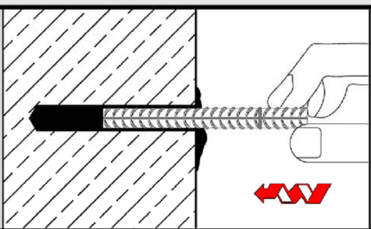
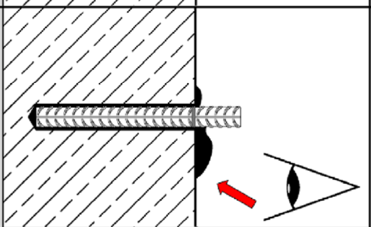
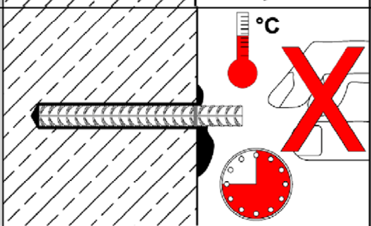
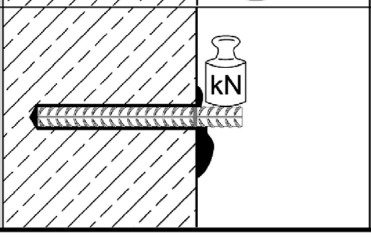
On the static mixer and the extension pipe the mortar filling mark l_m and the drill hole depth h_1 must be marked with an adhesive tape or text marker. Rough estimate: $l_m = \frac{1}{3} \cdot h_1$
Fill in the mortar as long until the filling mark l_m will be visible.

Optimal mortar volume: $l_m = h_1 * (1{,}2 * \frac{Ø^2}{d_0^2} - 0{,}2)$ [mm]

l_m length from the end of the retaining washer to the mark on the mixer extension
h_1 drill hole depth = embedment depth (ℓ_v resp. ℓ_{ges})
Ø rebar diameter
d_0 nominal drill bit diameter

SIKLA Injection System AN VME basic RB	Annex B11
Intended use Installation instructions (continuation): Preparation of the injection / marking of extension pipe or static mixer	

Installation instructions - continuation

Injection into bore hole		
7a		Fill injection mortar from the bottom of the borehole until the filling mark on the extension pipe (Annex B11) appears at the beginning of the borehole. Slowly moving the static mixer out of the borehole prevents the formation of air inclusions. If the bore hole ground is not reached, an extension pipe (Annex B6) shall be used. Observe the working- and curing time given in table B3.
7b		Retaining washers shall be used according to Table B4 and B5 for the following applications: • horizontal installation or overhead installation • vertical downwards direction with drill holes deeper than 240mm
Installation of rebar or tension anchor		
8		Immediately insert the rebar or tension anchor into the hole while turning slightly (to improve the mortar distribution) until the embedment depth is reached. The fastening element shall be free of dirt, grease, oil or other foreign material.
9		Be sure that the fastening element is inserted in the bore hole until the embedment mark is at the concrete surface and that excess mortar is visible at the top of the hole. If these requirements are not maintained, repeat application before end of working time! For overhead installation, the anchor should be fixed (e.g. by wedges).
10		Observe and keep curing time according to Table B3. Attention: the working time may vary due to different underground temperatures (Table B3). Do not move or load the anchor or rebar during curing time.
11		After the curing time has elapsed, the rebar or tension anchor can be loaded.

SIKLA Injection System AN VME basic RB	**Annex B12**
Intended use Installation instructions (continuation): Injection / Installation	

Table C1: Characteristic tension resistance for Tension Anchor ZA

Tension Anchor ZA			M12	M16	M20	M24
Steel, zinc plated						
Characteristic tension resistance	$N_{Rk,s}$	[kN]	67	125	196	282
Partial factor	$\gamma_{Ms,N}$	[-]	1,4			
Stainless steel A4, HCR						
Characteristic tension resistance	$N_{Rk,s}$	[kN]	67	125	171	247
Partial factor	$\gamma_{Ms,N}$	[-]	1,4	1,4	1,3	1,4

Minimum anchorage length and minimum lap length

The minimum anchorage length $\ell_{b,min}$ and the minimum lap length $\ell_{0,min}$ acc. to EN 1992-1-1:2004+AC:2010 ($\ell_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $\ell_{0,min}$ acc. to Eq. 8.11) shall be multiplied by the amplification factor α_{lb} to Table C2.

Table C2: Amplification factor α_{lb}

Amplification factor		Rod diameter	Concrete strength class								
			C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Hammer drilling, compressed air drilling, vacuum drilling											
α_{lb}	[-]	Ø8 to Ø40 ZA-M12 to ZA-M24	1,0								
Diamond drilling											
α_{lb}	[-]	Ø8 to Ø40 ZA-M12 to ZA-M24	1,5								

Table C3: Reduction factor k_b

Reduction factor		Rod diameter	Concrete strength class								
			C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Hammer drilling, compressed air drilling, vacuum drilling											
k_b	[-]	Ø8 to Ø40 ZA-M12 to ZA-M24	1,0								
Diamond drilling											
k_b	[-]	Ø8 to Ø40 ZA-M12 to ZA-M24	1,0				0,90	0,79	0,73	0,68	0,63

SIKLA Injection System AN VME basic RB	Annex C1
Performances Amplification factor α_{lb} / Reduction factor k_b	

Table C4: Design values of the ultimate bond stress $f_{bd,PIR}$ in N/mm² for all drilling methods and for good bond conditions

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

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 conditions multiply the values by η=0,7) and recommended partial safety factor γ_c = 1,5 according to EN 1992-1-1:2004+AC:2010

k_b: Reduction factor according to Table C2

Bond strength	Rod diameter	Concrete strength class								
		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Hammer drilling, compressed air drilling, vacuum drilling										
$f_{bd,PIR}$ [N/mm²]	Ø8 to Ø32 ZA-M12 to ZA-M24	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
	Ø34	1,6	2,0	2,3	2,6	2,9	3,3	3,6	3,9	4,2
	Ø36	1,5	1,9	2,2	2,6	2,9	3,3	3,6	3,8	4,1
	Ø40	1,5	1,8	2,1	2,5	2,8	3,1	3,4	3,7	4,0
Diamond drilling										
$f_{bd,PIR}$ [N/mm²]	Ø8 to Ø32 ZA-M12 to ZA-M24	1,6	2,0	2,3	2,7					
	Ø34	1,6	2,0	2,3	2,6					
	Ø36	1,5	1,9	2,2	2,6					
	Ø40	1,5	1,8	2,1	2,5					

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

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

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

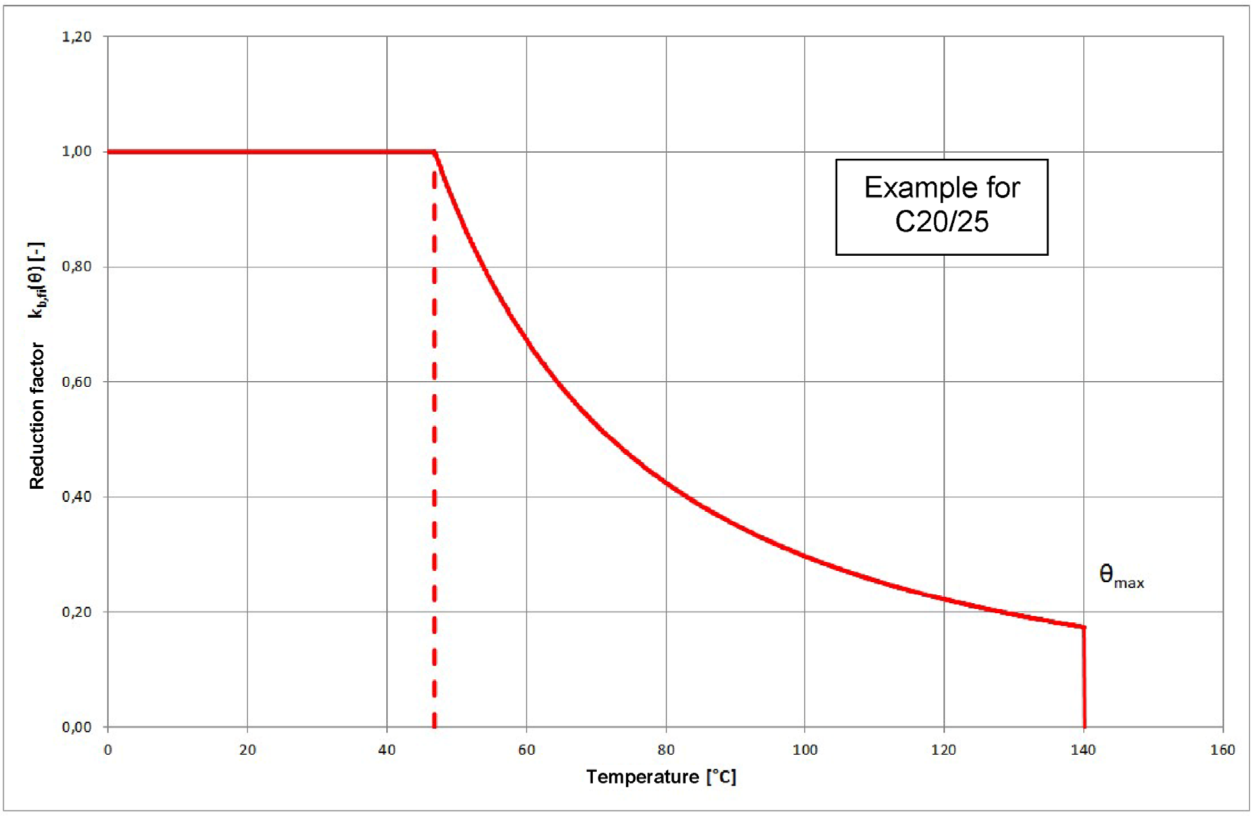
with: $\theta \leq 140°C$: $k_{fi}(\theta) = 5862 * \theta^{-1,657} / (f_{bd,PIR} * 4,3) \leq 1,0$

$\theta > 140°C$: $k_{fi}(\theta) = 0$

$f_{bd,fi}$	design value of ultimate bond stress at increased temperature in N/mm²
θ	Temperature in °C in the mortar layer
$k_{fi}(\theta)$	Reduction factor at increased temperature
$f_{bd,PIR}$	Design value of the ultimate bond stress in N/mm² in cold condition according to Table C3 considering concrete class, rebar diameter, drilling method and the bond conditions according to EN 1992-1-1:2004+AC:2010.
γ_c	partial factor acc. to EN 1992-1-1:2004+AC:2010
$\gamma_{M,fi}$	partial factor acc. to EN 1992-1-2:2004+AC:2008

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 ultimate bond stress $f_{bd,fi}$.

Example graph of reduction factor $k_{fi}(\theta)$ in concrete strength class C20/25 for good bond conditions



SIKLA Injection System AN VME basic RB	Annex C3
Performances Design value of ultimate bond stress $f_{bd,fi}$ at increased temperature for rebar	

Table C5: Characteristic tension resistance for Tension Anchor ZA under fire exposure

Tension Anchor ZA				M12	M16	M20	M24
Steel failure							
Steel, zinc plated							
Characteristic tension resistance	R30	$N_{Rk,s,fi}$	[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 A4, HCR							
Characteristic tension resistance	R30	$N_{Rk,s,fi}$	[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