ETA-Danmark A/S
Göteborg Plads 1
DK-2150 Nordhavn
Tel. +45 72 24 59 00
Fax +45 72 24 59 04
Internet ww.etadanmark.dk

Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

European Technical Assessment ETA-22/0468 of 2025/03/31

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	BOSSONG BCR E-PLUS for rebar connections
Product family to which the above construction product belongs:	Post-installed rebar connections of the sizes 8 to 40 mm with BOSSONG BCR E-PLUS injection mortar
Manufacturer:	BOSSONG SPA Via Enrico Fermi 51 IT-24050 Grassobbio (Bg) Tel. +39 035 3846 011 Fax +39 035 3846 012 Internet www.bossong.com
Manufacturing plant:	BOSSONG SPA Via Enrico Fermi 51 IT-24050 Grassobbio (Bg)
This European Technical Assessment contains:	25 pages including 20 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	EAD 330087-01-0601, Systems for post-installed rebar connections with mortar
This version replaces:	The ETA with the same number issued on 2023-02-24

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

The subject of this assessment are the post-installed connections, by anchoring or overlap connection joint consisting of steel reinforcing bars (rebars) in existing structures made of normal weight concrete, using injection mortar BOSSONG BCR E-PLUS in accordance with the regulations for reinforced concrete construction.

Reinforcing bars with diameters from 8 to 40 mm and BOSSONG BCR E-PLUS injection mortar according to Annex A3 are used for the post-installed rebar connections covered by this ETA. The steel element is placed into a drilled hole previously injected with a mortar and is anchored by the bond between embedded element, injection mortar and concrete.

The characteristic material values, dimensions and tolerances of the anchors not indicated in Annexes shall correspond to the respective values laid down in the technical documentation[1] of this European Technical Assessment.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

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 provisions made in this European Technical Assessment are based on an assumed intended working life of the anchor of 50 years and 100 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, 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.

1 The technical documentation of this European Technical Assessment is deposited at ETA-Danmark and, as far as relevant for the tasks of the Notified bodies involved in the attestation of conformity procedure, is handed over to the notified bodies.

3 Performance of the product and references to the methods used for its assessment

3.1 Characteristics of product

Mechanical resistance and stability (BWR1):
The essential characteristics are detailed in the Annex C.

Safety in case of fire (BWR2):
Reaction to fire: Rebar connections satisfy requirements for Class A1.

Resistance to fire: See Annex C

3.2 Methods of assessment

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Basic Requirements 1 and 2 has been made in accordance with the EAD 330087-01-0601, Systems for post-installed rebar connections with mortar.

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

4.1 AVCP system

According to the decision 96/582/EC of the European Commission, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 1.

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking

Issued in Copenhagen on 2025-03-31 by

Thomas Bruun
Manager, ETA-Danmark

Examples of post-installed rebar connections

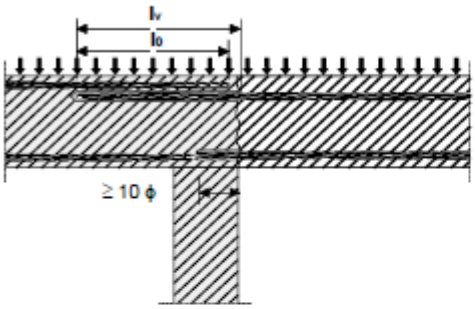


Figure 1.2 Overlap joint for rebar connections of slabs and beams

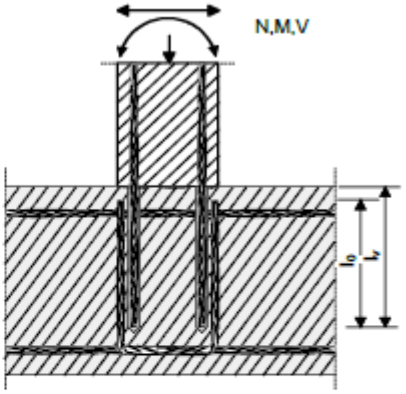


Figure 1.3 Overlap joint at a foundation of a column or wall where the rebar is stressed in tension

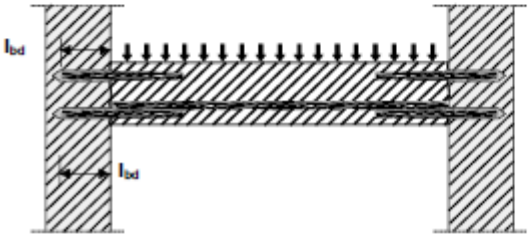


Figure 1.4 End anchoring of slabs or beams, designed as simply supported

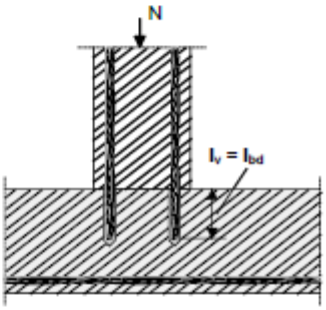
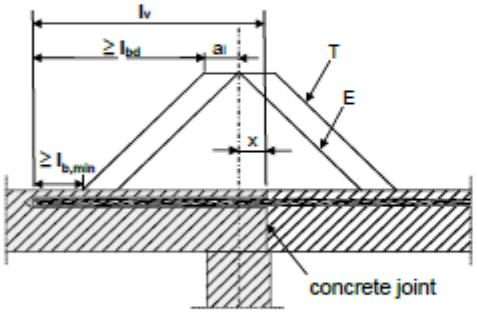


Figure 1.5 rebar connection for components stressed primarily in compression; rebar is stressed in compression



(only post-installed rebar is plotted)

Key to Figure 1.6

T acting tensile force

E envelope of $M_{Ed}/z + N_{Ed}$ (see EN 1992-1-1 [1], Figure 9.2)

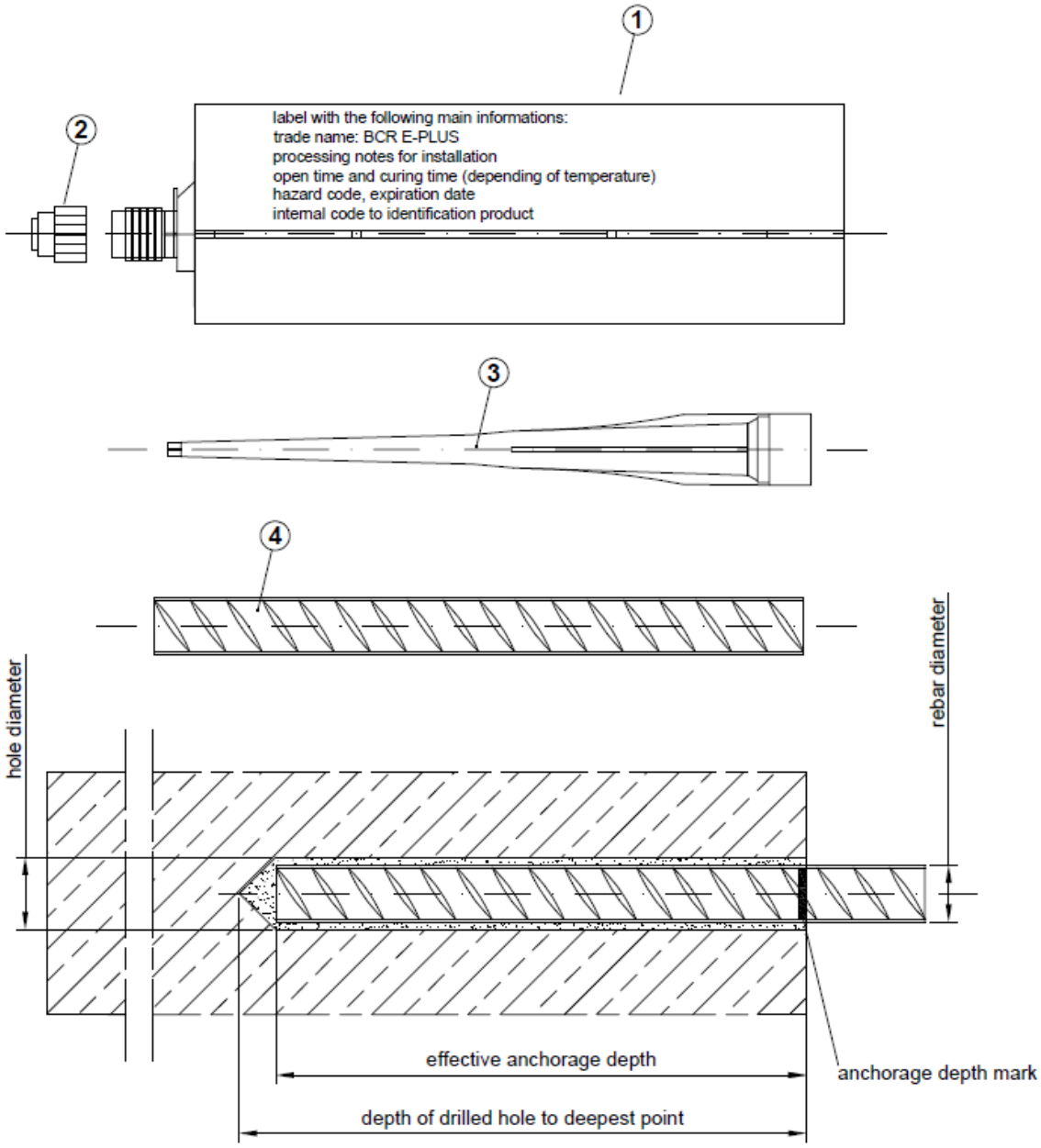
x distance between the theoretical point of support and concrete joint

Note to Figure 1.2 to 1.6:

In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 [1] shall be present.

The shear transfer between old and new concrete shall be designed according to EN 1992-1-1 [1].

Figure 1.6 Anchoring of reinforcement to cover the line of acting tensile force



① **Cartridge BCR E-PLUS**
② **Sealing cap**
③ **Mixer**
④ **Rebar - Reinforced bar**

BOSSONG BCR E-PLUS for post-installed rebar connections	**Annex A2** of European Technical Assessment ETA-22/0468
Product description Injection system	

Table A1: Reinforcing bars (Rebar)

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

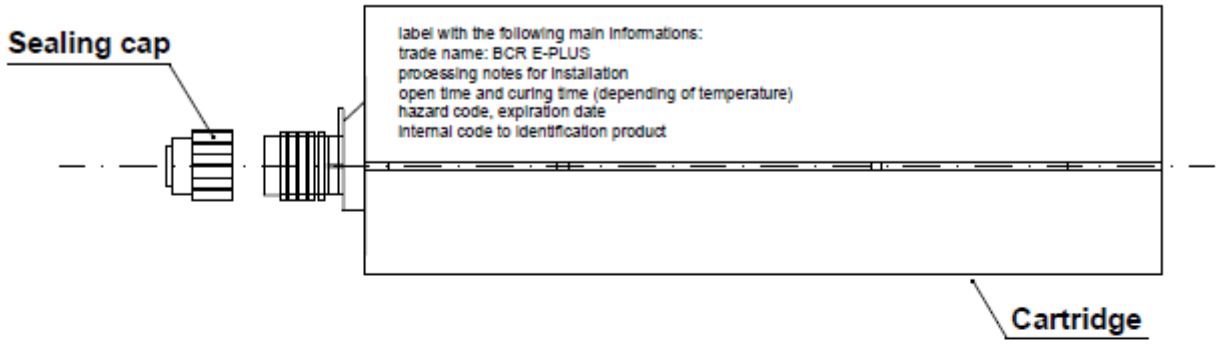
Rib height h: The rib height h should be: $0{,}05 \cdot Ø \leq h_{rib} \leq 0{,}07 \cdot Ø$

Ø = nominal bar diameter

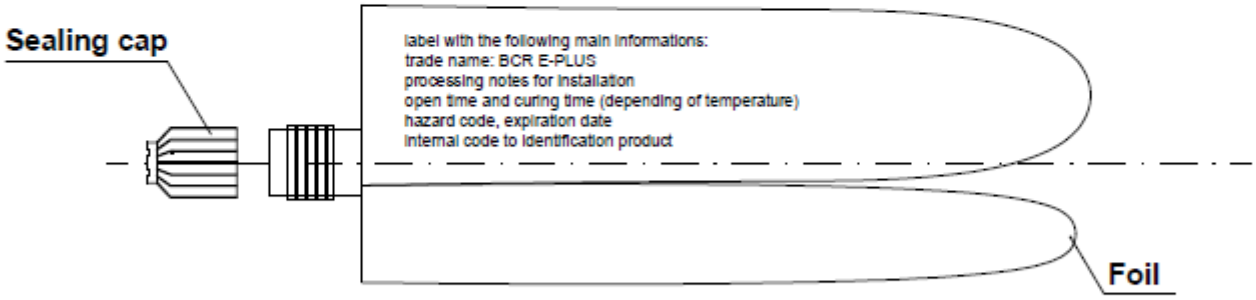
Table A2: Injection mortar

Designation	Material
BOSSONG BCR E-PLUS two components injection mortar	Additive: quartz Bonding agent: epoxy resin

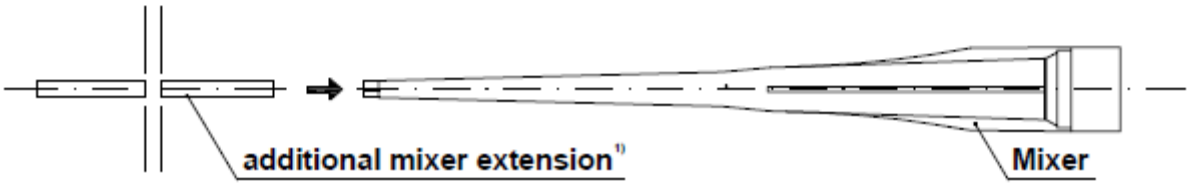
BCR E-PLUS - from 385 to 1400 ml cartridge - side by side cartridge



BCR E-PLUS - 600 ml - foil system



MIXER - the mixer is suitable for each type of cartridge



1) Variable length from 380 mm up to 1000 mm

BOSSONG BCR E-PLUS for post-installed rebar connections	**Annex A4** of European Technical Assessment ETA-22/0468
Product description Cartridge types and sizes	

Specification of intended use

Anchorages subject to:

- Static and quasi-static load: from Ø8 to Ø40 mm. For a working life of 50 and 100 years.
- Seismic load: from Ø12 to Ø32 mm. For a working life of 50 and 100 years.
- Fire exposure: from Ø8 to Ø40 mm. For a working life of 50 and 100 years.

Base materials:

- Reinforced or unreinforced normal weight concrete of strength class C12/15 at minimum to C50/60 at maximum according to EN 206-1:2013+A1:2016 for static and quasi-static load and for fire exposure;
- Reinforced or unreinforced normal weight concrete of strength class C16/20 at minimum to C50/60 at maximum according to EN 206-1:2013+A1:2016 for seismic load.
- Maximum chloride content of 0,40% (Cl 0,40) related to the cement content according to EN 206-1:2013+A1:2016.
- Non-carbonated concrete.
- Note: In case of a carbonated surface of the existing concrete structure the carbonate layer shall be removed in the area of the post-installed rebar connections with a diameter of ds + 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 according to EN 1992-1-1.
- The above may be neglected if building components are new and not carbonated and if building components are in dry conditions.

Temperature range:

- The anchors may be used in the following temperature range:

  -40°C to +80°C (max. short term temperature +80°C and max. long term temperature +50°C).

  Temperature of the base material according to Annex B4.

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking into account of the forces to be transmitted.
- Design according to EN 1992-1-1:2011 and EN 1998-1:2004+AC:2009 (see also Annex B2).
- 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:

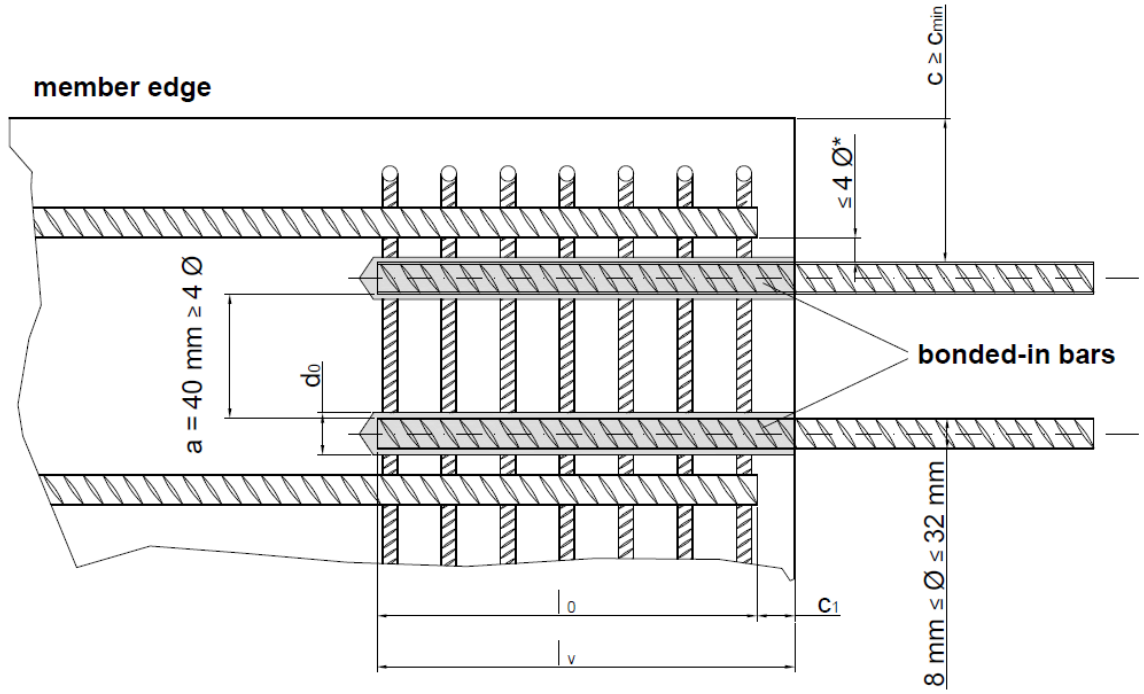
- Dry or wet concrete (use category I1).
- It must not be installed in flooded holes.
- Installation direction D3 (downward and horizontal and upwards installation).
- Hole drilling by hammer drill (HD), hollow drill bit (HDB), compressed air drill (CA) and diamond drilling machine with dry and wet cutting system (DD).
- Installation of the post-installed rebars shall be done only by suitable trained installer and under supervision on the site.
- Check the position of the existing rebars (if the position of existing rebars in 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).

General design rules of construction for post-installed rebars

Post installed rebar may be designed for tension forces only.

The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1:2011.

The joints for concreting must be roughened to at least such an extended that aggregate protrude.



* If the clear distance between overlapping rebars is greater than 4·Ø the overlap length shall be enlarged by the difference between the clear distance and 4·Ø.

l_0 – lap length according to EN 1992-1-1:2011. for static and quasi-static loading or

EN 1998-1:2004+AC:2009 for seismic loading.

l_v – effective embedment depth; $l_v \geq l_0 + c_1$

c – concrete cover of post-installed rebar

c_{min} – minimum concrete cover acc. to Annex B3 and EN 1992-1-1, clause 4.4.1.2.

c_1 – concrete cover at end-face of existing rebar

d_0 – nominal drill bit diameter acc. to Annex B3

Ø – rebar diameter (ds)

BOSSONG BCR E-PLUS for post-installed rebar connections	**Annex B2** of European Technical Assessment ETA-22/0468
Intended use General construction rules for post-installed rebars	

Table B1: Installation data

Rebar diameter [mm]	Ø8		Ø10		Ø12		Ø14	Ø16	Ø20	Ø22	Ø24-26	Ø28	Ø30	Ø32	Ø36	Ø40
Drill bit diameter [mm]	10	12	12	14	14	16	18	20	25	26-28	30-32	40	35-37	40	45	50-52
Brush diameter [mm]	12	14	14	16	16	18	20	22	27	27-32	32-37	42	37-42	42	47	53-55
Maximum embedment depth lv, max [mm]	250	700	250	900	250	1100	1300	1400	1800	2000	2200	2500	2500	2500	2500	2500

Installation data for seismic load are valid only from Ø12 to Ø32

Table B2: Minimum concrete cover c_{min} without drilling aid

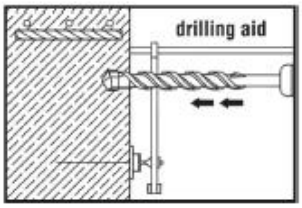
Drilling method	Rebar diameter ϕ	c_{min}
Hammer drilling (HD) Hollow drill bit (HDB) Diamond drilling (DD)	< 25mm	30 mm+0,06 x lv ≥ 2ϕ
	≥ 25mm	40 mm+0,06 x lv ≥ 2ϕ
Compressed air drilling (CA)	< 25mm	50 mm+0,08 x lv
	≥ 25mm	60 mm+0,08 x lv ≥ 2ϕ

Table B3: Minimum concrete cover c_{min} when using a drilling aid

Drilling method	Rebar diameter ϕ	c_{min}
Hammer drilling (HD) Hollow drill bit (HDB) Diamond drilling (DD)	< 25mm	30 mm+0,02 x lv ≥ 2ϕ
	≥ 25mm	40 mm+0,02 x lv ≥ 2ϕ
Compressed air drilling (CA)	< 25mm	50 mm+0,02 x lv
	≥ 25mm	60 mm+0,02 x lv ≥ 2ϕ

The minimum concrete cover according to EN 1992-1-1:2011 shall be observed.

For minimum concrete cover in case of seismic action $c_{min,seis}$ see Annex C2



Example of drilling aid

Minimum clear spacing between two post-installed rebars:

a = 40 mm ≥ 4 · Ø

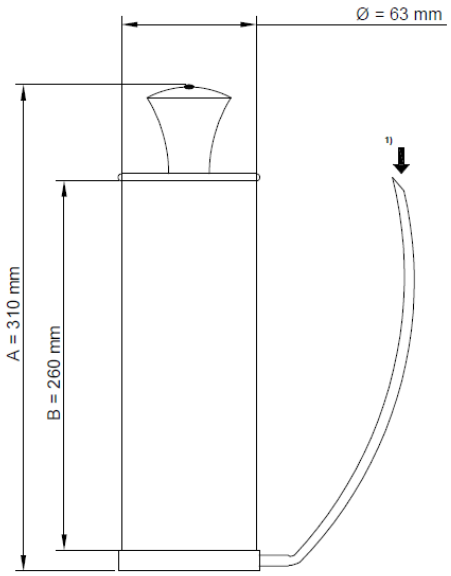
BOSSONG BCR E-PLUS for post-installed rebar connections	**Annex B3**
Intended use Installation data	of European Technical Assessment ETA-22/0468

Table B4: Minimum curing time[1)]

Concrete temperature	Working time	Minimum curing time[3)]
0°C[2)]	2 h	96 h
5°C[2)]	1 h 15 min	48 h
10°C	1 h	24 h
15°C	45 min	18 h
20°C	30 min	12 h
25°C	20 min	10 h
30°C	15 min	5 h
35°C	12 min	5 h
40°C	8 min	5 h

1) The minimum time from the end of the mixing to the time when the anchor is loaded
2) Minimum resin temperature recommended, for injection between 5°C and 0°C, equal to 10°C.
3) In presence of water the curing time must be doubled
4) Max resin temperature of 24°C for installation at maximum setting depth

Manual Blower pump: nominal dimensions



It is possible to use the mixer extension (see Annex 6) with the manual blower pump.

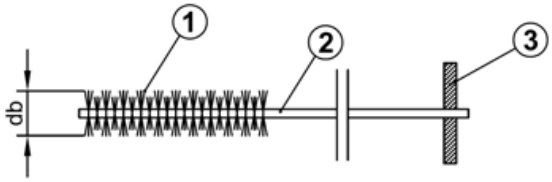
However it is possible to blow the hole using the mechanical air system (compressed air) also with the mixer estension

1)

Suitable min pressure 6 bar at 6 m³/h
Oil-free compressed air
Recommended air gun with an orifice opening of minimum 3.5 mm in diameter

1) Position to insert the mixer extension

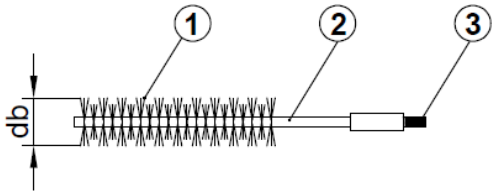
Mixer extension (from 380 mm to 1000 mm) with nominal diameter equal to 10 mm
For the hole with depth greater than 380 mm up to 2500 mm it is possible use the special mixer extension (see Annex B8) for blower operation.



① **Steel bristles**
② **Steel stem**
③ **Wood handle**

Table B5: Standard brush details (manual brush)

Rebar diameter [mm]		**Ø8**		**Ø10**		**Ø12**		**Ø14**	**Ø16**
d_0	Nominal drill hole [mm]	10	12	12	14	14	16	18	20
d_b	Brush diameter [mm]	12	14	14	16	16	18	20	22



1. Steel bristles
2. Steel stem
3. Threaded connection for drilling tool extension
4. Extension special brush
5. Drilling tool connection (SDS connection)

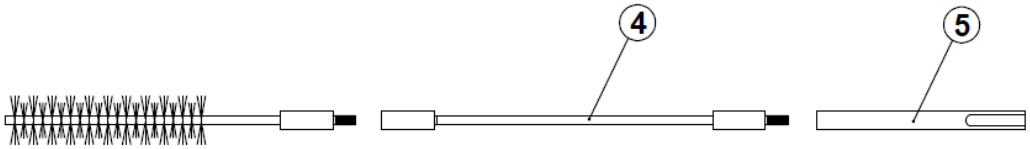


Table B6: Special brush details (mechanical brush)

Rebar diameter [mm]		Ø8		Ø10		Ø12		Ø14	Ø16
d_0	Nominal drill hole [mm]	10	12	12	14	14	16	18	20
d_b	Brush diameter [mm]	12	14	14	16	16	18	20	22

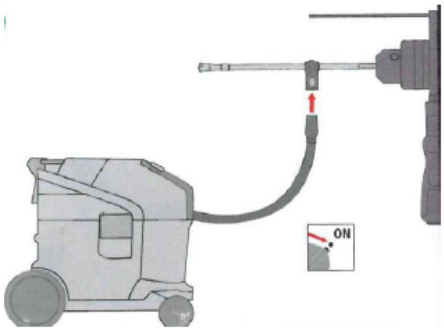
Rebar diameter [mm]		Ø20	Ø22	Ø24-26	Ø28	Ø30	Ø32	Ø36	Ø40
d_0	Nominal drill hole [mm]	25	26-28	30-32	35	35-37	40	42-45	50-52
d_b	Brush diameter [mm]	27	27-32	32-37	37	37-42	42	45-47	55

Installation with hollow drill bit (HDB)

This drilling method is a hammer drilling method.

This drilling system removes the dust and cleans the bore hole during the drilling operation when used in accordance with the user's manual.

This drilling system include a vacuum cleaner. A suitable dust extraction system must be used.
e.g. Bosch GAS 35 M AFC or a comparable dust extraction system with equivalent performance data.

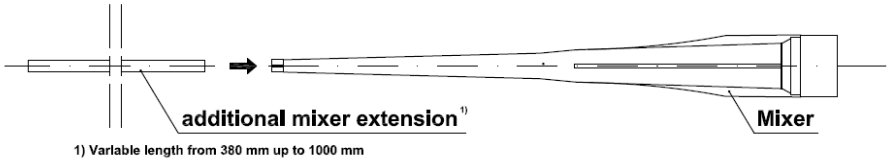


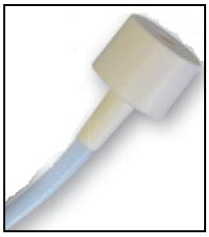
Switch-on the vacuum cleaner before to drill!!!

Table B7: HDB installation diameters

Rebar diameter [mm]		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø22	Ø24-26	Ø28	Ø30
d_0	Nominal drill hole [mm]	10-12	12-14	14-16	18	20	25	26-28	30-32	35	35

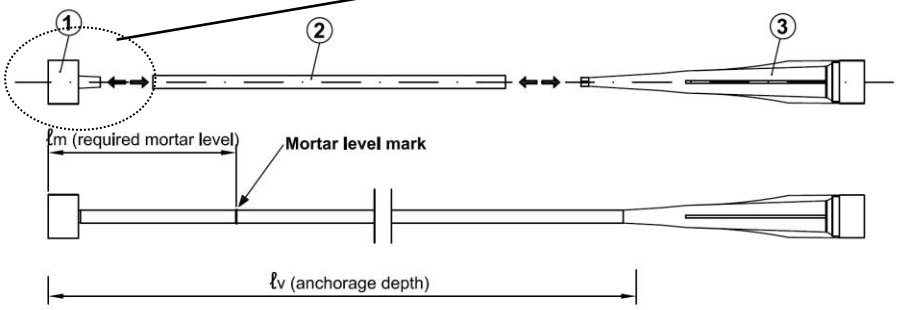
Use the mixer extension (assembled on the standard mixer) for the injection up to 300 mm if necessary.



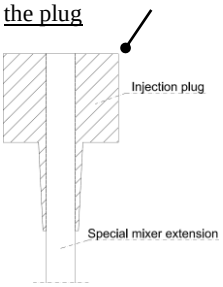


Use this system for special conditions:

Tools for installation in special condition



Insert the special mixer extension in the inner diameter of the injection plug up to reach the top of the plug



① **Injection plug (nominal diameter according to the nominal diameter of drilled hole)**

② **Special mixer extension (variable length with nominal diameter 10 mm)**

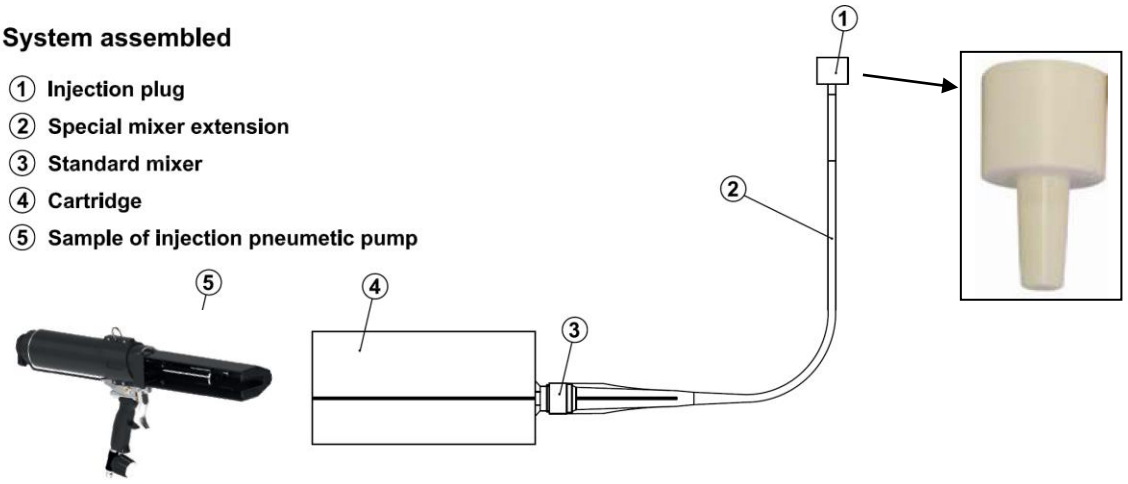
Mark the required mortar level ℓ_m and embedment depth ℓ_v with tape or marker on the injection extension. Quick estimation: $\ell_m = 1/3 \cdot \ell_v$
Continue injection until the mortar level mark ℓ_m becomes visible.

③ **Standard mixer (suitable for all size of cartirge)**

These tools allow the application in special conditions:
- installation with anchorage depth greater than 300 mm
- overhead installation.
For these applications is recommanded the use of the injection pneumatic pump.

System assembled

① **Injection plug**
② **Special mixer extension**
③ **Standard mixer**
④ **Cartridge**
⑤ **Sample of injection pneumetic pump**

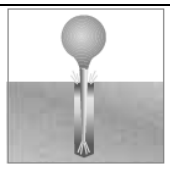
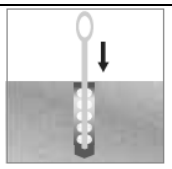
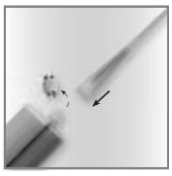
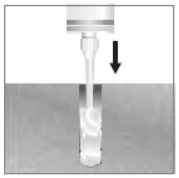
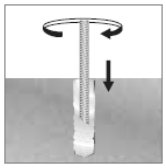
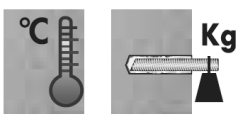


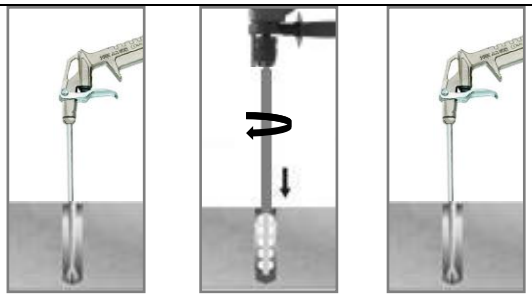
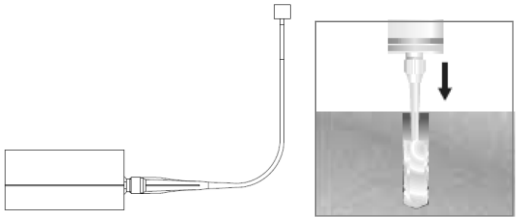
BOSSONG BCR E-PLUS for post-installed rebar connections	**Annex B8** of European Technical Assessment ETA-22/0468
Intended use Tools for injection (1)	

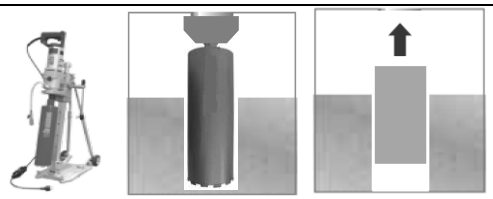
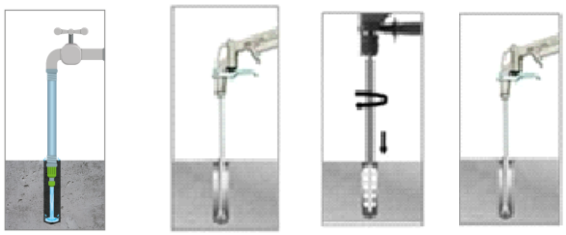
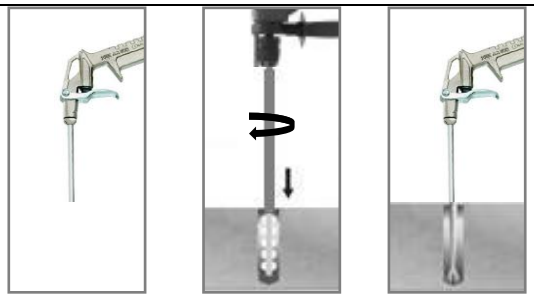
Table B8: Mortar injection dispensers

Injection dispensers	Cartridges	Clean hole tools	Maximum depth of the drill hole
 *Manual*	385 ml 585 ml	Blower pump or compressed air and standard brush or special brush or HDB	300 mm*
 *Manual+ Cartridge Adaptor*	600 ml Foil system	Blower pump or compressed air and standard brush or special brush or HDB	300 mm*
 *Battery*	385 ml 585 ml	Compressed air and special brush or HDB	300 mm to 1000 mm*
 *Pneumatic*	385 ml 585 ml 1000 ml 1400 ml	Compressed air and special brush or HDB	300 mm to 2500 mm*

* Note: use the mixer extension described in Annex B8 for the injection of the mortar

1		Drill the hole with the correct diameter and depth using a rotary percussive machine. Check the perpendicularity of the hole during the drilling operation. In case of use of hollow drill bit (Annex B7) proceed directly to the point 3
2	   **4x Blower Manual Pump** **4x Standard Brush** **4x Blower Manual Pump** **if necessary use a mixer extension for the blower operation (see Annex B5)**	Clean the hole from drilling dust: the hole shall be cleaned by at least 4 blowing operations, by at least 4 brushing operations followed again by at least 4 blowing operations; before brushing clean the brush and check (see Annex B5, standard brush) if the brush diameter is sufficient. For the blower tools see Annex B5.
3		Unscrew the front cup, screw on the mixer and insert the cartridge in the gun.
4	 	Before starting to use the cartridge, eject a first part of the product, being sure that the two components are completely mixed. The complete mixing is reached only after that the product, obtained by mixing the two components, comes out from the mixer with a uniform color.
5	 **if necessary, use a mixer extension for the injection (see Annex B8)**	Fill the drilled hole uniformly starting from the drilled hole bottom, in order to avoid entrapment of the air; remove the mixer slowly bit by bit during pressing-out; filling the drill hole with a quantity of the injection mortar corresponding to 2/3 of the drill hole depth.
6	  **ATTENTION: Use the rods dry and free oil and other contaminants**	Insert immediately the rod, marked according to the proper anchorage depth, slowly and with a slight twisting motion, removing excess of injection mortar around the rod. Observe the processing time according Annex B4. Wait the curing time according Annex B4.

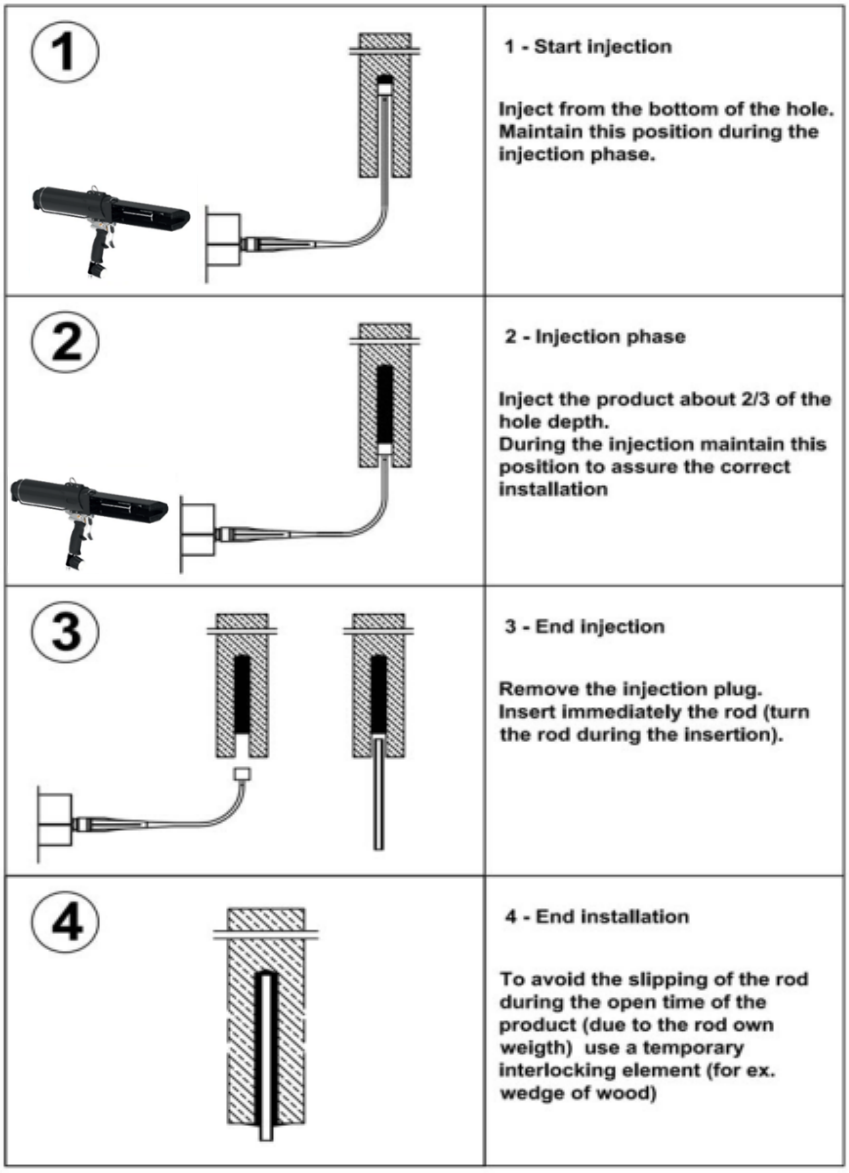
1	See point 1 Annex B10. In case of use of hollow drill bit (HDB) proceed directly to the point 3.	
2	 **4 x 5 seconds** **4x** **4 x 5 seconds** **ATTENTION: compressed air free oil**	Clean the hole from drilling dust: the hole shall be cleaned by at least 4 blowing operations (5 seconds for single operation) with compressed air, by at least 4 brushing operations with special brush followed again by at least 4 blowing operations (5 seconds for single operation) with compressed air. Before brushing clean the brush and check (see Annex B6, special brush) if the brush diameter is sufficient. For the blower tools see the Annex B5.
3	See point 3 Annex B10	
4	See point 4 Annex B10	
5		Before starting the injection, assemble the system according to Annex B8. After that, fill the drilled hole uniformly from the drilled hole bottom, in order to avoid entrapment of the air; remove the special mixer extension with injection plug slowly bit by bit during pressing-out; filling the drill hole with a quantity of the injection mortar corresponding to 2/3 of the drill hole depth. Procedure for overhead application is detailed in Annex B13.
6	See point 6 Annex B10	

1		Drill the hole with the correct diameter and depth using a core drill machine. Check the perpendicularity of the hole during the drilling operation. Remove completely the core from the hole.
2	 **flush hole until water runs clear** — **4x blower with compressed air** — **4x special brush** — **4x blower with compressed air**	After operation 1, if the diamond drilling machine used has a dry cutting system to proceed with the installation procedure according to the point 3. Instead, if it is used a wet cutting system before of the point 4 the following operation must be done: - flush hole 2 times by inserting a water hose to the back of the hole until water runs clear; - brush 2 times with the proper special brush. Before brushing clean the brush and check (see Annex B6, special brush) if the brush diameter is sufficient; - flush again 2 times until water runs clear; - remove all standing water completely (using for example vacuum system or compressed air free oil).
3	 **4 x 5 seconds** — **6x** — **4 x 5 seconds** **ATTENTION: compressed air free oil**	Clean the hole from drilling dust: the hole shall be cleaned by at least 4 blowing operations (5 seconds for single operation) with compressed air, by at least 4 brushing operations with special brush followed again by at least 4 blowing operations (5 seconds for single operation) with compressed air. Before brushing clean the brush and check (see Annex B6, special brush) if the brush diameter is sufficient. For the blower tools see the Annex B5.
4	After the operation above, proceed according to the operations from 4 to 6 on the previous Annex B9 and B10 in function of the depth of the hole.	

BOSSONG BCR E-PLUS for post-installed rebar connections	**Annex B12** of European Technical Assessment ETA-22/0468
Intended use Procedure with diamond drilling (DD) for all depths	

Overhead installation procedure

In addition to standard procedure, for overhead installation, following the below procedure

	**1 - Start injection** **Inject from the bottom of the hole. Maintain this position during the injection phase.** **2 - Injection phase** **Inject the product about 2/3 of the hole depth.** **During the injection maintain this position to assure the correct installation** **3 - End injection** **Remove the injection plug.** **Insert immediately the rod (turn the rod during the insertion).** **4 - End installation** **To avoid the slipping of the rod during the open time of the product (due to the rod own weigth) use a temporary interlocking element (for ex. wedge of wood)**

Minimum anchorage length and minimum lap length under static loading

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1:2011 shall be multiplied by the relevant amplification factor α_{lb} - $\alpha_{lb,100y}$ given in table C1.

The design bond strength $f_{bd,PIR}$ - $f_{bd,PIR,100y}$ is given in table C3. It is obtained by multiplying the bond strength f_{bd} according to EN 1992-1-1:2011 with the factor k_b - $k_{b,100y}$ according to table C2.

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

Concrete Class	Drilling method	Bar size	Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$
C 12/15 to C50/60	All drilling method	8mm to 40 mm	1,0

Table C2: Bond efficiency factor $k_b = k_{b,100y}$ related to concrete class and drilling method for 50 and 100 years

Drilling method and bar size	**Concrete class**								
for perforation with hammer drill (HD), hollow drill bit (HDB) and compressed air drill (CA)	**C12/15**	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
da Ø8 a Ø30	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Ø32	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,93
Ø36	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,92	0,86
Ø40	1,00	1,00	1,00	1,00	1,00	1,00	0,91	0,84	0,79
for perforation with diamond drilling machine (DD), dry and wet cutting system.	**C12/15**	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
da Ø8 a Ø25	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Ø28	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,92	0,86
Ø30	1,00	1,00	1,00	1,00	1,00	1,00	0,91	0,84	0,79
Ø32	1,00	1,00	1,00	1,00	1,00	0,90	0,82	0,76	0,71
Ø36	1,00	1,00	1,00	1,00	1,00	0,90	0,82	0,76	0,71
Ø40	1,00	1,00	1,00	1,00	1,00	0,90	0,82	0,84	0,79

Table C3: Design values of the ultimate bond resistance $f_{bd,PIR} = f_{bd,PIR,100y}$ for 50 and 100 years[1)]

Drilling method and bar size	**Concrete class**								
Design bond strength [N/mm²] for perforation with hammer drill (HD), hollow drill bit (HDB) and compressed air drill (CA)	**C12/15**	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
da Ø8 a Ø30	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,30
Ø32	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00
Ø36	1,50	1,90	2,20	2,60	2,90	3,30	3,60	3,60	3,60
Ø40	1,50	1,80	2,10	2,50	2,80	3,10	3,10	3,10	3,10
Design bond strength [N/mm²] for perforation with diamond drilling machine (DD), dry and wet cutting system.	**C12/15**	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
da Ø8 a Ø25	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,30
Ø28	1,60	2,00	2,30	2,70	3,00	3,40	3,70	3,70	3,70
Ø30	1,60	2,00	2,30	2,70	3,00	3,40	3,40	3,40	3,40
Ø32	1,60	2,00	2,30	2,70	3,00	3,00	3,00	3,00	3,00
Ø36	1,50	1,90	2,20	2,60	2,90	2,90	2,90	2,90	2,90
Ø40	1,50	1,80	2,10	2,50	2,80	2,80	2,80	3,10	3,10

[1)] Values valid only for good bond condition according to EN 1992-1-1:2011.
For other bond conditions multiply the values for 0,7
Parameter η_2 already included for diameter > 32 mm

Minimum anchor length and minimum lap length under seismic loading

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1:2011 shall be multiplied by the relevant amplification factor $\alpha_{lb,seis}$ - $\alpha_{lb,seis,100y}$ given in table C4.
The design bond strength $f_{bd,seis}$ - $f_{bd,seis,100y}$ is given in table C7. It is obtained by multiplying the bond strength f_{bd} according to EN 1992-1-1:2011 with the factor $k_{b,seis}$ - $k_{b,seis,100y}$ according to table C6.
The minimum concrete cover according to Annex B3 and cmin,seis = 2 Ø applies.

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

Concrete Class	Drilling method	Bar size	Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$
C 16/20 to C50/60	Hammer drilling (HD) Hollow drill bit (HDB) Compressed air drilling (CA)	12mm to 32mm	1,0

Table C5: $c_{min,seis}$ – minimum edge distance in case of seismic condition

Design condition	Distance of 1st edge	Distance of 2nd edge
Edge	≥4ϕ	≥8ϕ
Corner	≥6ϕ	≥6ϕ

Ø = nominal bar diameter

Table C6: Bond efficiency factor $k_{b,seis} = k_{b,seis,100y}$ related to concrete class and drilling method for 50 and 100 years

Drilling method and bar size	Concrete class							
for perforation with hammer drill (HD), hollow drill bit (HDB) and compressed air drill (CA)	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
Ø12 to Ø30	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Ø32	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,93

Table C7: Design values of the ultimate bond resistance $f_{bd,PIR,seis} = f_{bd,PIR,seis,100y}$ for 50 and 100 years[1)]

Drilling method and bar size	Concrete class							
Design bond strength [N/mm²] for perforation with hammer drill (HD), hollow drill bit (HDB) and compressed air drill (CA)	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
Ø12 to Ø30	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,30
Ø32	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00

[1)] Values valid only for good bond condition according to EN 1992-1-1:2011.
For other bond conditions multiply the values for 0,7

Design value of the ultimate bond stress $f_{bd,fi} = f_{bd,fi,100y}$ under fire exposure for concrete classes C12/15 to C50/60, (all drilling methods) for 50 and 100 years:

The design value of the bond strength $f_{bd,fi}$ under fire exposure has to be calculated by the following equation:

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

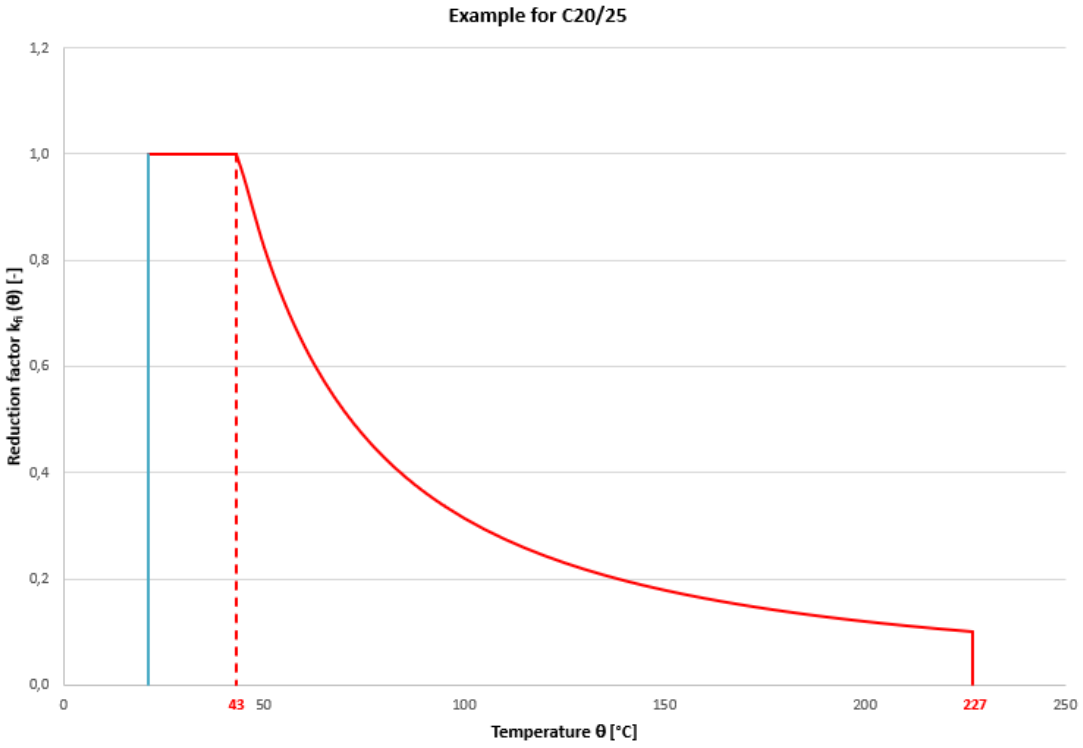
If 21°C ≤ θ ≤ 227°C: $k_{fi}(\theta) = \frac{1887{,}34 \cdot \theta^{-1{,}392}}{f_{bd,PIR} \cdot 4{,}3} \leq 1{,}0$

If θ > 227°C: $k_{fi}(\theta) = 0$

$f_{bd,fi}(\theta)$ = Design value of the ultimate bond stress in case of fire in N/mm²
(θ) = Temperature in °C in the mortar layer
$k_{fi}(\theta)$ = Reduction factor under fire exposure
$f_{bd,PIR}$ = Design value of the ultimate bond stress in N/mm² in cold condition according to Table C3 considering the concrete classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1
γ_c = Partial safety factor according to EN 1992-1-1:2011
$\gamma_{M,fi}$ = Partial safety factor according to EN 1992-1-2:2011

For evidence under fire exposure the anchorage length shall be calculated according to EN 1992-1-1:2011, equation 8.3 using the temperature-dependent ultimate bond stress $f_{bd,fi}$.

Figure C1: Example graph of Reduction factor $k_{fi}(\theta) = k_{fi,100y}(\theta)$ for concrete classes C20/25 for good bond conditions for 50 and 100 years:



BOSSONG BCR E-PLUS for post-installed rebar connections	**Annex C3** of European Technical Assessment ETA-22/0468
Performances Design values of bond strength $f_{bd,fi}$ - $f_{bd,fi,100y}$ under fire exposure with temperature reduction factor $k_{fi,}(\theta)$ - $k_{fi,100y}(\theta)$	