ETA

HOBSON XCHEM™ E701
PURE EPOXY
XCHEM™ PRO

ETA 24/0514 (07/06/2024)

Option 1†

Seismic C1/C2

DOC Link 0514

† Suitable for use in Cracked and Non-Cracked Concrete.

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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

MEMBER OF EOTA

European Technical Assessment ETA-24/0514 of 2024/06/07

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:	Hobson Engineering Epoxy E701
Product family to which the above construction product belongs:	Bonded injection type anchor for use in concrete
Manufacturer:	Hobson Engineering Company Pty Ltd 10 Clay Place Eastern Creek NSW 2766 Australia Tel. +61 2 8818 0288 Internet www.hobson.com.au
Manufacturing plant:	Plant 5
This European Technical Assessment contains:	30 pages including 23 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 330499-01-0601, “Bonded fasteners for use in concrete”
This version replaces:	

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

Technical description of the product
The Hobson Engineering Epoxy E701 injection system for concrete is a bonded anchor consisting of a cartridge with Hobson Engineering Epoxy E701 injection mortar and a steel element. The steel element consists of a commercial threaded rod with washer and hexagon nut in the range of M8 to M30 or a reinforcing bar in the range of diameter 8 to 32 mm.

The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between metal part, injection mortar and concrete.

The product description is given in Annex A.

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.

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 anchor 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 for all drilling methods and 100 years working life for hammer drilling (HD).

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.

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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 (BWR 1):
The essential characteristics are detailed in the Annex C.

Safety in case of fire (BWR 2):
Anchorages satisfy requirements for Class A1.

No performance is assessed for resistance to fire.

Hygiene, health and the environment (BWR3):
No performance assessed

Safety in use (BWR4):
For basic requirement Safety in use the same criteria are valid for Basic Requirement Mechanical resistance and stability (BWR1).

Sustainable use of natural resources (BWR7)
No performance assessed

Other Basic Requirements are not relevant.

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 4 has been made in accordance with EAD 330499-01-0601, “Bonded fasteners for use in concrete”.

4 Assessment and verification of constancy of performance (AVCP)

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.

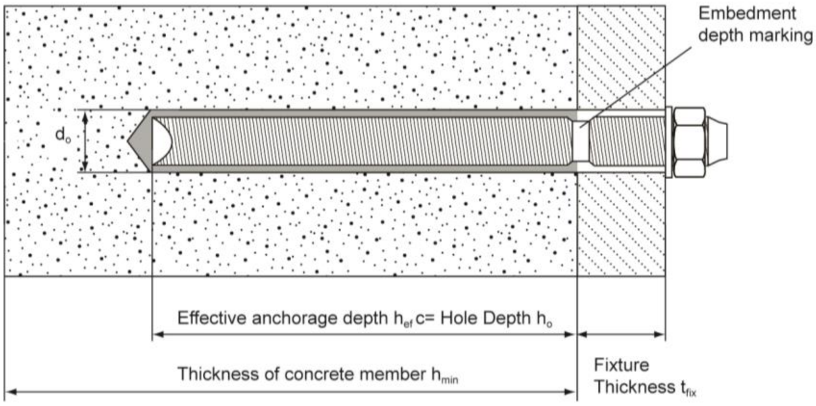
5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

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

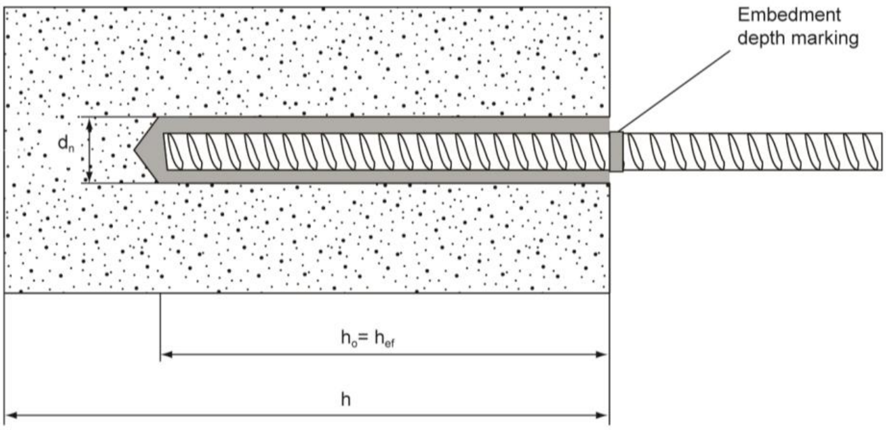
Issued in Copenhagen on 2024-06-07 by

Thomas Bruun
Managing Director, ETA-Danmark

Installation threaded rod M8 up to M30



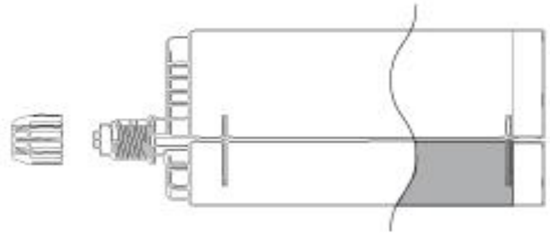
Installation reinforcing bar Ø8 up to Ø32



t_{fix}	=	thickness of fixture
h_{ef}	=	effective anchorage depth
h_0	=	depth of drill hole
h_{min}	=	minimum thickness of member

Hobson Engineering Epoxy E701 Injection System for concrete	**Annex A1**
Product description Installed condition	

Hobson Engineering Epoxy E701 Injection System
Side by Side Cartridge 3:1 ratio
385ml / 585ml / 1400ml

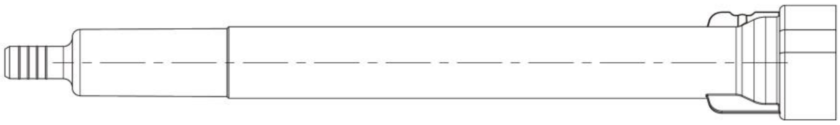


Hobson Engineering Epoxy E701 Injection system
Cartridge
250ml / 280ml / 300ml

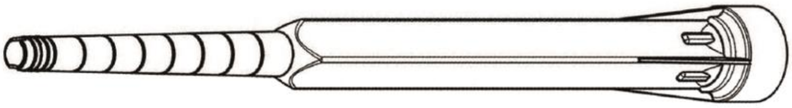
Cartridge Print: Hobson Engineering Epoxy E701
Including - Installation procedure, Production Batch code, Expiry Date, Storage conditions, Health & Safety warning, Gel & Cure time according to temperatures.

Static Mixer

Mixer



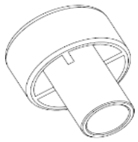
Epoxy mixer



Mixer Extension

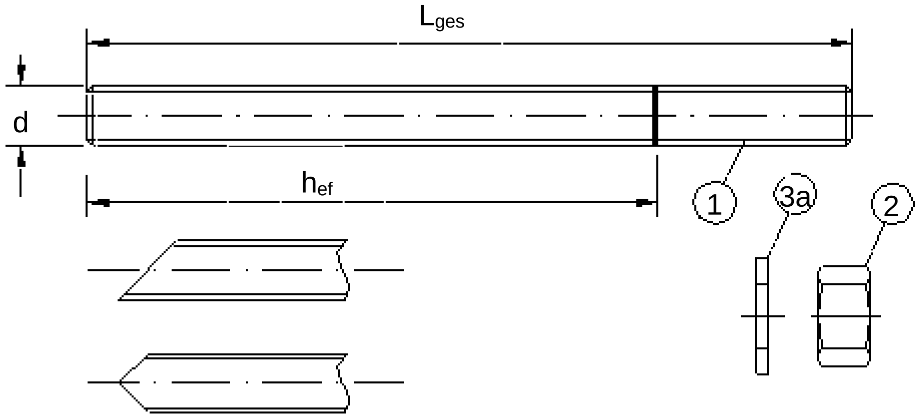
Piston plug for overhead application for M27, M30 and 28 and 32mm rebars

Mixer Extension Short



Mixer Extension Long

Threaded rod M8, M10, M12, M16, M20, M24, M27, M30 with washer and hexagon nut



Commercial standard threaded rod with:

- Materials, dimensions and mechanical properties acc. Table A1
- Inspection certificate 3.1 acc. to EN 10204:2004
- Marking of embedment depth

Hobson Engineering Epoxy E701 Injection System for concrete

Product description
Mixers, extensions and Threaded rod

Annex A3

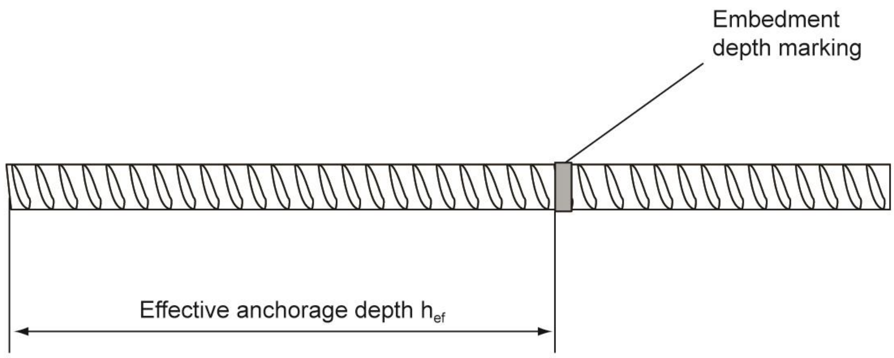
Table A1: Materials

Designation		Material		
Steel, zinc plated (Steel acc. to EN 10087:1998 or EN 10263:2001) zinc plated ≥ 5 µm acc. to EN ISO 4042:1999 or hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009 or sherardized ≥ 40 µm acc. to DIN EN 17668:2016-06				
1	Anchor rod (Threaded rod)	Property class acc. to EN ISO 898-1:2013	4.6	f_{uk}=400 N/mm²; f_{yk}=240 N/mm²; A_5 > 8% fracture elongation
			4.8	f_{uk}=400 N/mm²; f_{yk}=320 N/mm²; A_5 > 8% fracture elongation
			5.6	f_{uk}=500 N/mm²; f_{yk}=300 N/mm²; A_5 > 8% fracture elongation
			5.8	f_{uk}=500 N/mm²; f_{yk}=400 N/mm²; A_5 > 8% fracture elongation
			8.8	f_{uk}=800 N/mm²; f_{yk}=640 N/mm²; A_5 > 12%[3] fracture elongation
			10.9	f_{uk}=1000 N/mm²; f_{yk}=900 N/mm²; A_5 > 12%[3]fracture elongation
			12.9	f_{uk}=1200 N/mm²; f_{yk}=900 N/mm²; A_5 > 12%[3] fracture elongation
2	Hexagon nut	Property class acc. to EN ISO 898-2:2012	4	for anchor rod class 4.6 or 4.8
			5	for anchor rod class 5.6 or 5.8
			8	for anchor rod class 8.8
			10	for anchor rod class 10.9
			12	for anchor rod class 12.9
3a	Washer, (z.B.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	Steel, zinc plated, hot-dip galvanized or sherardized		
Stainless steel A2 (Material 1.4301 / 1.4303 / 1.4307 / 1.4567 and 1.4541, acc. to EN 10088-1:2014) and Stainless steel A4 (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014)				
1	Anchor rod (Threaded rod)[1)2)]	Property class acc. to EN ISO 3506-1:2009	50	f_{uk}=500 N/mm²; f_{yk}=210 N/mm²; A_5>8%[4] fracture elongation
			70	f_{uk}=700 N/mm²; f_{yk}=450 N/mm²; A_5 > 12%[3] fracture elongation
			80	f_{uk}=800 N/mm²; f_{yk}=600 N/mm²; A_5 > 12%[3] fracture elongation
2	Hexagon nut [1)2)]	Property class acc. to EN ISO 3506-1:2009	50	for anchor rod class 50
			70	for anchor rod class 70
			80	for anchor rod class 80
3a	Washer, (z.B.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	A2: Material 1.4301 / 1.4303 / 1.4307 / 1.4567 or 1.4541, EN 10088-1:2014 A4: Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, EN 10088-1:2014		
High corrosion resistance steel (Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014)				
1	Anchor rod[1)]	Property class acc. to EN ISO 3506-1:2009	50	f_{uk}=500 N/mm²; f_{yk}=210 N/mm²; A_5>8%fracture elongation
			70	f_{uk}=700 N/mm²; f_{yk}=450 N/mm²; A_5>12%[3] fracture elongation
			80	f_{uk}=800 N/mm²; f_{yk}=600 N/mm²; A_5>12%[3] fracture elongation
2	Hexagon nut [1)]	Property class acc. to EN ISO 3506-1:2009	50	for anchor rod class 50
			70	for anchor rod class 70
			80	for anchor rod class 80
3a	Washer, (z.B.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014		

1) Property class 70 for anchor rods up to M24
2) Property class 80 only for stainless steel A4 and HCR
3) A5>8% fracture elongation if no use for seismic performances category C2

Hobson Engineering Epoxy E701 Injection System for concrete	**Annex A4**
Product description Materials threaded rod	

Reinforcing bar ∅ 8, ∅ 10, ∅ 12, ∅ 14, ∅ 16, ∅ 20, ∅ 24, ∅ 25, ∅ 28, ∅ 30, ∅ 32



- 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 0,05d ≤ h ≤ 0,07d
  (d: Nominal diameter of the bar; h: Rip height of the bar)

Table A2: Materials

Part	Designation	Material
Reinforcing bars		
1	Rebar EN 1992-1-1:2004+AC:2010, Annex C	Bars and de-coiled rods class B or C f_{yk} and k according to NDP or NCL of EN 1992-1-1/NA:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Hobson Engineering Epoxy E701 Injection System for concrete

Product description
Materials reinforcing bar

Annex A5

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads: M8 to M30, Rebar Ø8 to Ø32 for 50 years working life for all drilling methods and 100 years working life for hammer drilling (HD)
- Subject to seismic action category C1 (M8 to M30) and C2 (M12 to M24) for 50 and 100 years working life for hammer drilling (HD).

Base materials:

- Reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 + A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A1:2016.
- Cracked and non-cracked concrete: M8 to M30, Rebar Ø8 to Ø32.

Temperature Range:

- I: - 40 °C to +40 °C (max long term temperature +24 °C and max short term temperature +40 °C)
- II: - 40 °C to +60 °C (max long term temperature +40 °C and max short term temperature +60 °C)

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (all materials).
- For all other conditions according to EN 1993-1-4:2006+A1:2015 corresponding to corrosion resistance class:
  - Stainless steel A2 according to Annex A4, Table A1: CRC II
  - Stainless steel A4 according to Annex A4, Table A1: CRC III
  - High corrosion resistance steel HCR according Annex A4, Table A1: CRC V

Design:

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- The Anchorages are designed in accordance to:
  - EN 1992-4:2018
  - Technical Report TR055, edition 2018

Installation:

- Dry and wet concrete.
- Flooded holes (not sea water).
- Hole drilling by hammer drilling (HD) or compressed air drilling (CD) used in Category 1 (dry and wet concrete) and Category 2 (flooded holes)
- Hole drilling by hollow drill bits for dust free drilling (HDB) (e.g. Bosch self-cleaning system including vacuum cleaner) used in Category 1 – dry and wet concrete
- Hole drilling by diamond coring method (DD) used in Category 1 (dry and wet concrete) and Category 2 (flooded holes)
- Overhead installation allowed.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Table B1: Installation parameters for threaded rod

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Outer diameter of anchor	$d = d_{nom}$ [mm] =	8	10	12	16	20	24	27	30
Nominal drill hole diameter	d_0 [mm] =	10	12	14	18	22	28	30	35
Effective anchorage depth	$h_{ef,min}$ [mm] =	60	60	70	80	90	96	108	120
	$h_{ef,max}$ [mm] =	160	200	240	320	400	480	540	600
Diameter of clearance hole in the fixture	d_f [mm] ≤	9	12	14	18	22	26	30	33
Diameter of steel brush	d_b [mm] ≥	10	12	14	18	22	28	30	35
Maximum torque moment	T_{inst} [Nm] ≤	10	20	40	60	120	160	250	300
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm				$h_{ef} + 2d_0$			
Minimum spacing	s_{min} [mm]	40	40	60	75	95	115	125	140
Minimum edge distance	c_{min} [mm]	35	40	45	50	60	65	75	80

Table B2: Installation parameters for rebar

Rebar size		**∅ 8**	**∅ 10**	**∅ 12**	**∅ 14**	**∅ 16**	**∅ 20**	**∅ 24**	**∅ 25**	**∅ 28**	**∅ 30**	**∅ 32**
Outer diameter of anchor	d_{nom} [mm] =	8	10	12	14	16	20	24	25	28	30	32
Nominal drill hole diameter	d_0 [mm] =	10/12	12/14	14/16	18	20	24	30/32	32	32/35	35	40
Effective anchorage depth	$h_{ef,min}$ [mm] =	60	60	70	75	80	90	96	100	112	120	128
	$h_{ef,max}$ [mm] =	160	200	240	280	320	400	480	500	560	600	640
Diameter of steel brush	d_b [mm] ≥	10/12	12/14	14/16	18	20	24	30/32	32	32/35	35	40
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm					$h_{ef} + 2d_0$					
Minimum spacing	s_{min} [mm]	40	40	60	60	75	95	120	120	130	140	150
Minimum edge distance	c_{min} [mm]	35	40	45	50	50	60	70	70	75	115	120

Table B3: Parameter cleaning and setting tools

					
Threaded Rod	**Rebar**	**d_0 Drill bit - ∅** HD, CD, HDB, Diamond	**d_b Brush - ∅**	**$d_{b,min}$ min. Brush - ∅**	**Piston plug d_p for M27/M30 and 28/32mm rebar** ***overhead only applications***
(mm)	**(mm)**	**(mm)**	**(mm)**	**(mm)**	**(mm)**
M8	8	10	10	10	N/A
M10	8 / 10	12	12	12	N/A
M12	10 / 12	14	14	14	N/A
	12	16	16	16	N/A
M16	14	18	18	18	N/A
	16	20	20	20	N/A
M20		22	22	22	N/A
	20	24	24	24	N/A
M24		28	28	28	N/A
M27	24 / 25	32	32	32	32
	28	32	32	32	32
M30	28 / 30	35	35	35	35
	32	40	40	40	40

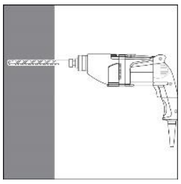
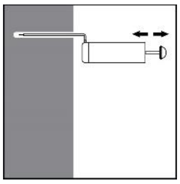
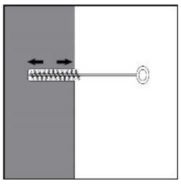
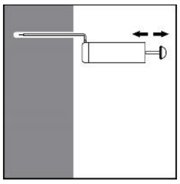
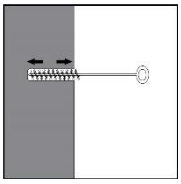
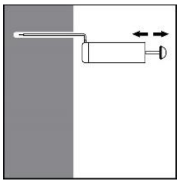
Push Pump
Drill bit diameter (d_0): 10 mm to 20 mm
Drill hole depth (h_0): < 10 d_{nom}
Only in non-cracked concrete

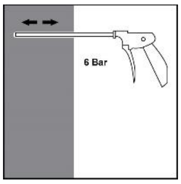
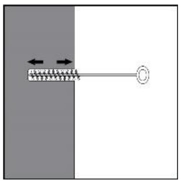
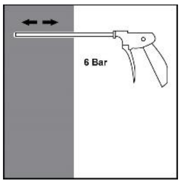
CAC - Compressed air tool (min 6 bar)
Drill bit diameter (d_0): all diameters

HDB – (e.g. Bosch® Hollow Drilling and Vacuum)

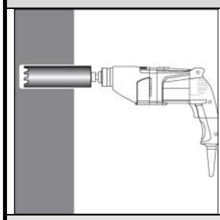
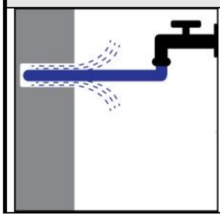
d_h

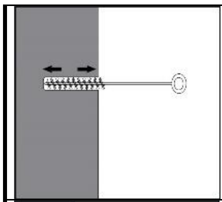
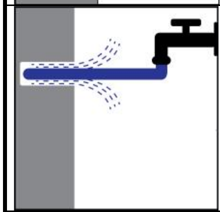
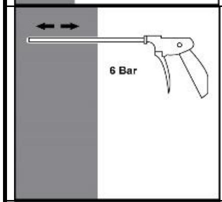
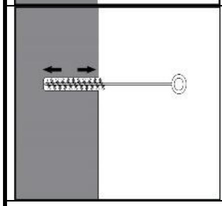
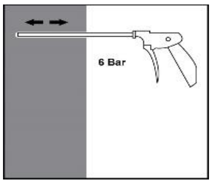
Steel Brush
Drill bit diameter (d_0): all diameters

Instructions for use – Hammer drilling (HD) and Compressed air drilling (CD)		
Bore hole drilling		
		Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.(see table B3)
Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.		
a) Manual air cleaning (MAC) for bore hole diameters $d_o \leq$ 18mm and bore hole depth $h_o \leq$ 10d		
	X 2	The manual pump may be used for blowing out bore holes up to diameters $d_o \leq$ 20mm and embedment depths up to $h_{ef} \leq$ 10d. Blow out at least 2 times from the back of the bore hole until return air stream is free of noticeable dust.
	X 2	Brush 2 times with the specified brush size (brush Ø ≥ bore hole Ø, see Table B3) by inserting the steel brush to the back of the hole (if needed with an extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole. If not, the brush is too small and must be replaced with the proper brush diameter.
	X 2	Blow out again with manual pump at least 2 times until return air stream is free from noticeable dust.
	X 2	Brush 2 times again by inserting the steel brush to the back of the hole (if needed with an extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole. If not, the brush is too small and must be replaced with the proper brush diameter.
	X 2	Blow out again with manual pump at least 2 times until return air stream is free from noticeable dust.

b) Compressed air cleaning (CAC) for all bore hole diameters d_o and all bore hole depth h_o		
	**X 2**	Blow 2 times (for at least 5 seconds) from the back of the hole (if needed with a nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6m³/h) until return air stream is free from noticeable dust.
	**X 2**	Brush 2 times with the specified brush size (brush Ø ≥ bore hole Ø, see Table B3) by inserting the steel brush to the back of the hole (if needed with an extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole. If not, the brush is too small and must be replaced with the proper brush diameter.
	**X 2**	Blow out again with compressed air at least 2 times until return air stream is free from noticeable dust (for at least 5 seconds).

Instructions for use – Hollow drill bits for dust free drilling (HDB)		
Bore hole drilling and cleaning		
		Select a suitable hollow drill bit (see table B3) and install it into the hammer drilling machine. Connect the dust extraction system to the aperture in the hollow drill bit. (e.g: Bosch system) Drill hole to the required embedment depth with the hammer drill set in rotation-hammer mode and with the dust extraction system working permanently at full power.
Bore hole cleaning: Manual cleaning is not necessary when using the self-cleaning drilling method.		

Instructions for use – Diamond drilling (DD) -wet drilling with diamond drill bits		
Bore hole drilling		
		Drill with a diamond drills a hole into the base material to size and embedment depth required by the selected anchor (see table B3)
Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.		
		Rinsing with water until clean water comes out.

	X 2	Brush 2 times with the specified brush size (brush Ø ≥ bore hole Ø, see Table B3) by inserting the steel brush to the back of the hole (if needed with an extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole. If not, the brush is too small and must be replaced with the proper brush diameter.
		Rinsing with water until clean water comes out. **ATTENTION! STANDING WATER IN THE BORE HOLE MUST BE REMOVED BEFORE CLEANING**
	X 2	Starting from the bottom or back hole, blow the hole clean with compressed air (min 6 bar at 6m³/h for at least 5 seconds) a minimum of 2 times until return air stream is free from noticeable dust or concrete particle. If the bore hole ground is nor reached an extension shall be used.
	X 2	Brush 2 times with the specified brush size (brush Ø ≥ bore hole Ø, see Table B3) by inserting the steel brush to the back of the hole (if needed with an extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole. If not, the brush is too small and must be replaced with the proper brush diameter.
	X 2	Finally, blow the hole clean again with compressed air (min 6 bar at 6m³/h for at least 5 seconds) a minimum of 2 times until return air stream is free from noticeable dust or concrete particle. If the bore hole ground is nor reached an extension shall 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 has to be repeated directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.**

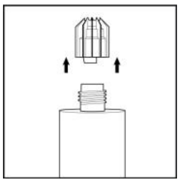
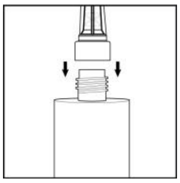
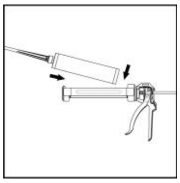
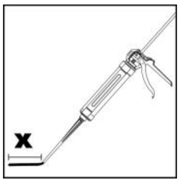
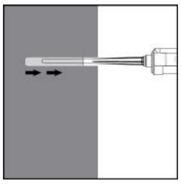
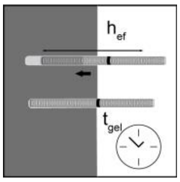
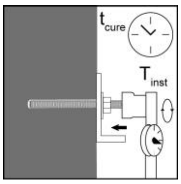
Instructions for use – all types of drilling	
	Remove the threaded cap from the cartridge.
	Attach the supplied mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. Cut off the foil tube clip before use if necessary. For every working interruption longer than the recommended working time (Table B4) as well as for new cartridges, a new mixer shall be used. After changing the mixer, discard the waste until the mortar shows a consistent colour.
	Insert the cartridge into the dispenser. Press the release trigger to retract the plunger and insert the cartridge neatly into the cradle without any distortion. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.
	Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent colour. For foil tube cartridges it must be discarded a minimum of six full strokes. If you interrupt the job and restart using the same mixer inside the working time frame, discard the waste until the mortar shows a consistent colour.
	Starting from the bottom or back of the cleaned anchor hole, fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets. If needed, an extension nozzle shall be used. Observe the gel-/ working times given in Table B4. For M27 and M30 / 28mm to 32mm rebar in overhead application, a piston plug with the same diameter as the hole shall be attached to the mixer or extension.
	Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. The anchor shall be free of dirt, grease, oil or other foreign material. Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead application the anchor rod shall be fixed (e.g. wedges).
	Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (attend Table B4). After full curing, the add-on part can be installed with up to the max. torque (Table B1) by using a calibrated torque wrench. It can be optionally filled the annular gap between anchor and fixture with mortar.

Table B4: Maximum Working time and minimum curing time

Concrete temperature	Gelling- / working time	Minimum curing time in dry concrete [1)]
+ 5 °C	70 min	60 h
+ 10 °C	32 min	40 h
+ 15 °C	28 min	30 h
+ 20 °C	25 min	18 h
+ 25 °C	22 min	17 h
+ 30 °C	20 min	16 h
+ 40 °C	18 min	12 h
Cartridge temperature	+ 15 °C to + 35 °C	

[1)] In wet concrete or flooded holes the curing time must be doubled.

Table B5: Dispensing tools

Resin injection pump details		
Image	**Size Cartridge**	**Type**
 	**400 ml 1:1** **600 ml 1:1** **385 / 585 ml 3:1** **250 / 280 / 300 ml**	**Manual**
	**400 ml 1:1** **600 ml 1:1** **385 / 585 ml 3:1** **250 / 280 / 300 ml** **7.4v Tool**	**Battery**
	**400 ml 1:1** **600 ml 1:1** **385 / 585 ml 3:1** **250 / 280 / 300 ml**	**Pneumatic**
	**1400 ml 3:1** **1500 ml 1:1**	**Pneumatic**

Table C1: Characteristic values for steel tension resistance and steel shear resistance of threaded rods

Size				M8	M10	M12	M16	M20	M24	M27	M30
Cross section area		A_s	[mm²]	36.6	58	84.3	157	245	353	459	561
Characteristic tension resistance, Steel failure											
Steel, Property class 4.6 and 4.8		$N_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
Steel, Property class 5.6 and 5.8		$N_{Rk,s}$	[kN]	18	29	42	78	122	176	230	281
Steel, Property class 8.8		$N_{Rk,s}$	[kN]	29	46	67	125	196	282	367	449
Steel, Property class 10.9		$N_{Rk,s}$	[kN]	37	58	84	157	245	353	459	561
Steel, Property class 12.9		$N_{Rk,s}$	[kN]	44	70	101	188	294	424	551	673
Stainless steel A2, A4 and HCR, Property class 50		$N_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281
Stainless steel A2, A4 and HCR, Property class 70		$N_{Rk,s}$	[kN]	26	41	59	110	171	247	321	393
Stainless steel A4 and HCR, Property class 80		$N_{Rk,s}$	[kN]	29	46	67	126	196	282	367	449
Characteristic tension resistance, Partial factor											
Steel, Property class 4.6 and 5.6		$\gamma_{Ms,N}$ 1)	[-]	2,0							
Steel, Property class 4.8, 5.8 and 8.8		$\gamma_{Ms,N}$ 1)	[-]	1,5							
Steel, Property class 10.9 and 12.9		$\gamma_{Ms,N}$ 1)	[-]	1.4							
Stainless steel A2, A4 and HCR, Property class 50		$\gamma_{Ms,N}$ 1)	[-]	2,86							
Stainless steel A2, A4 and HCR, Property class 70		$\gamma_{Ms,N}$ 1)	[-]	1,87							
Stainless steel A4 and HCR, Property class 80		$\gamma_{Ms,N}$ 1)	[-]	1,6							
Characteristic shear resistance, Steel failure											
Without lever arm	Steel, Property class 4.6 and 4.8	$V^0_{Rk,s}$	[kN]	7	12	17	31	49	71	92	112
	Steel, Property class 5.6 and 5.8	$V^0_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
	Steel, Property class 8.8	$V^0_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
	Steel, Property class 10.9	$V^0_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281
	Steel, Property class 12.9	$V^0_{Rk,s}$	[kN]	22	35	51	94	147	212	275	337
	Stainless steel A2, A4 and HCR, Property class 50	$V^0_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
	Stainless steel A2, A4 and HCR, Property class 70	$V^0_{Rk,s}$	[kN]	13	20	30	55	86	124	161	196
	Stainless steel A4 and HCR, Property class 80	$V^0_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
With lever arm	Steel, Property class 4.6 and 4.8	$M^0_{Rk,s}$	[Nm]	15	30	52	133	260	449	666	900
	Steel, Property class 5.6 and 5.8	$M^0_{Rk,s}$	[Nm]	19	37	65	166	324	560	833	1123
	Steel, Property class 8.8	$M^0_{Rk,s}$	[Nm]	30	60	105	266	519	896	1333	1797
	Steel, Property class 10.9	$M^0_{Rk,s}$	[Nm]	37	75	131	333	649	1123	1664	2249
	Steel, Property class 12.9	$M^0_{Rk,s}$	[Nm]	45	90	157	400	778	1347	1997	2699
	Stainless steel A2, A4 and HCR, Property class 50	$M^0_{Rk,s}$	[Nm]	19	37	66	167	325	561	832	1125
	Stainless steel A2, A4 and HCR, Property class 70	$M^0_{Rk,s}$	[Nm]	26	52	92	232	454	784	1165	1574
	Stainless steel A4 and HCR, Property class 80	$M^0_{Rk,s}$	[Nm]	30	59	105	266	519	896	1332	1766
Characteristic shear resistance, Partial factor											
Steel, Property class 4.6 and 5.6		$\gamma_{Ms,V}$ 1)	[-]	1,67							
Steel, Property class 4.8, 5.8 and 8.8		$\gamma_{Ms,V}$ 1)	[-]	1,25							
Steel, Property class 10.9 and 12.9		$\gamma_{Ms,V}$ 1)	[-]	1,50							
Stainless steel A2, A4 and HCR, Property class 50		$\gamma_{Ms,V}$ 1)	[-]	2,38							
Stainless steel A2, A4 and HCR, Property class 70		$\gamma_{Ms,V}$ 1)	[-]	1,56							
Stainless steel A4 and HCR, Property class 80		$\gamma_{Ms,V}$ 1)	[-]	1,33							

1) in absence of national regulation

Table C2: Characteristic values of tension loads under static and quasi-static action for 50 years' service life and 100 years' service life for hammer drilling only

Anchor size threaded rod				M 8	M 10	M 12	M 16	M 20	M24	M27	M30
Steel failure											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	see Table C1							
Partial factor		$\gamma_{Ms,N}$	[-]	see Table C1							
Combined pull-out and concrete failure											
Characteristic bond resistance in non-cracked concrete C20/25 hammer drilling (HD) and compressed air drilling (CD)											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	19	18	18	17	16	16	15	15
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	19	18	18	17	14	12	11	11
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	17	17	16	15	15	14	14	14
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	17	17	16	15	13	11	10	9,5
Characteristic bond resistance in cracked concrete C20/25 hammer drilling (HD) and compressed air drilling (CD)											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	10	9,5	9	8,5	8,5	8	7,5	7,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	10	9,5	9	8,5	8	6,5	6	5,5
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	9	9	8	7,5	7,5	7,5	7	7
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	9	9	8	7,5	7	6	5,5	5
Installation factor for HD and CD in dry and wet concrete (for T I and T II):		γ_{inst} 1)	[-]	1,0							
Installation factor for HD and CD in flooded bore hole (for T I and T II):		γ_{inst} 1)	[-]	1,0	1,2			1,4			
Characteristic bond resistance in non-cracked concrete C20/25 hollow drill bits for dust free drilling (HDB)											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	16	16	16	16	16	16	16	16
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	15	15	15	15	15	15	14	14
Characteristic bond resistance in cracked concrete C20/25 hollow drill bits for dust free drilling (HDB)											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	9	8,5	8,5	8	7,5	7,5
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	8,5	8	7,5	7,5	6,5	6,5
Installation factor for HDB (for T I and T II):		γ_{inst} 1)	[-]	1,0							
Characteristic bond resistance in non-cracked concrete C20/25 Diamond drilling (DD)											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	13	12	12	12	11	11	11	11
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	13	12	12	12	11	11	11	11
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	12	11	11	11	11	10	10	10
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	12	11	11	11	11	10	10	10
Characteristic bond resistance in cracked concrete C20/25 Diamond drilling (DD)											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	5,5	5	4,5	4,5	4,5	5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	-	-	5,5	5	4,5	4,5	4,5	5
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	5	4,5	4,5	4	4	4,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	-	-	5	4,5	4,5	4	4	4,5
Installation factor for DD (dry/wet concrete)		γ_{inst} 1)	[-]	1,2							
Installation factor for DD (flooded bore hole)		γ_{inst} 1)	[-]	1,2			1,4				
Reduction factor ψ^0_{sus} in cracked and non-cracked concrete C20/25 for all drilling methods in dry/wet concrete or flooded holes for 50 years' service life											
Temp. range I: 40°C/24°C		ψ^0_{sus}	[-]	0.798							
Temp. range II: 60°C/40°C		ψ^0_{sus}	[-]	0.718							
Increasing factors for **non-cracked** concrete (for all type of drilling) in any temperature range and service life 50 or 100 years ψ_c		C25/30		1,05							1,11
		C30/37		1,10							1,21
		C35/45		1,15							1,30
		C40/50		1,18							1,38
		C45/55		1,22							1,45
		C50/60		1,25							1,52

Table C2: continuation

Anchor size threaded rod		M 8	M 10	M 12	M 16	M 20	M24	M27	M30
Increasing factors for **cracked** concrete (for all type of drilling in any temperature range and service life 50 or 100 years ψ_c	C25/30	1,05	1,07						1,11
	C30/37	1,09	1,13						1,22
	C35/45	1,13	1,18						1,32
	C40/50	1,16	1,23						1,41
	C45/55	1,19	1,28						1,49
	C50/60	1,22	1,32						1,58

[1)] in the absence of national regulation

Table C3: Characteristic values for concrete cone failure and splitting with all kind of actions for 50 years' service life and 100 years' service life for hammer drilling only

Concrete cone failure (all drilling methods) in any temperature range				
Non-cracked concrete		$k_{ucr,N}$	[-]	11,0
Cracked concrete		$k_{cr,N}$	[-]	7,7
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}
Axial distance		$s_{cr,N}$	[mm]	2 $c_{cr,N}$
Splitting (all drilling methods)				
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 h_{ef}
	$2,0 > h/h_{ef} > 1,3$			3,86 h_{ef} - 1,43 h
	$h/h_{ef} \leq 1,3$			2 h_{ef}
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$

[1)] in the absence of national regulation

Table C4: Characteristic values of shear loads under static and quasi-static action for threaded bars, all drilling methods for 50 years' service life and 100 years' service life for hammer drilling only

Anchor size threaded rod			M 8	M 10	M 12	M 16	M 20	M24	M27	M30
Steel failure without lever arm										
Characteristic shear resistance	$V^0_{Rk,s}$	[kN]	see Table C1							
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Ductility factor	k_7	[-]	1,0							
Steel failure with lever arm										
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	1,2 x W_{el} x f_{uk} (or see Table C1)							
Elastic section modulus	W_{el}	[mm³]	31	62	109	277	541	935	1387	1874
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Concrete pry-out failure										
Factor	k_8	[-]	2,0							
Installation factor	γ_{inst}	[-]	1,0							
Concrete edge failure										
Effective length of fastener	l_f	[mm]	l_f = min(h_{ef}; 12 d_{nom})						l_f = min (h_{ef}; 300mm)	
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Installation factor	γ_{inst}	[-]	1,0							

Table C5: Characteristic values of tension loads under static and quasi-static action for rebars for 50 years' service life and 100 years' service life for hammer drilling only

Anchor size reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 30	Ø 32
Steel failure													
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$[1]									
Cross section area		A_s	[mm²]	50	79	113	154	201	314	491	616	707	804
Partial factor		$\gamma_{Ms,N}$	[-]	1,4[2][3]									
Combined pull-out and concrete failure													
Characteristic bond resistance in non-cracked concrete C20/25 for hammer drilling (HD) and compressed air drilling (CAD)													
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	11	11	11	11	11	11	11	11	11	11
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	11	11	11	11	11	9,5	8,5	8	7,5	7,5
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	10	10	10	10	10	10	10	10	10	10
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	10	10	10	10	10	9	7,5	7,5	7	7
Characteristic bond resistance in cracked concrete C20/25 for hammer drilling (HD) and compressed air drilling (CAD)													
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	6,5	7	7	7	7	7,5	7,5	7,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	-	-	6,5	7	7	6	6	6	6	6
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	6	6	6,5	6,5	6,5	7	7	7
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	-	-	6	6	6,5	6,5	5,5	5,5	5,5	5,5
Installation factor (dry and wet concrete)		γ_{inst}[2]	[-]	1,0									
Installation factor (flooded bore hole)		γ_{inst}[2]	[-]	1,0	1,2				1,4				
Characteristic bond resistance in non-cracked concrete C20/25 for hollow drill bits for dust free system (HDB)													
Temperature range I:40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	12	12	11	11	11	10	10	9,5	9,5	9,5
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	11	11	11	10	10	9,5	9	9	9	8,5
Characteristic bond resistance in cracked concrete C20/25 for hollow drill bits for dust free system (HDB)													
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	6,5	7	7	7	7	7,5	7,5	7,5
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	6	6	6,5	6,5	6,5	6,5	6,5	6,5
Installation factor (dry and wet concrete)		γ_{inst}[2]	[-]	1,0									
Characteristic bond resistance in non-cracked concrete C20/25 for Diamond drilling (DD)													
Temperature range I:40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	9,5	10	10	10	10	10	11	11	11	11
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	9,5	10	10	10	10	10	11	11	11	11
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	9	9	9	9,5	9,5	9,5	10	10	10	10
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	9	9	9	9,5	9,5	9,5	10	10	10	10
Characteristic bond resistance in cracked concrete C20/25 for Diamond drilling (DD)													
Temperature range I:40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	6,5	6,5	6,5	6,5	6,5	6,5	7,5	7,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	-	-	6,5	6,5	6,5	6,5	6,5	6,5	7,5	7,5
Temperature range II: 60°C/40°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	-	-	6	6	6	6	6	6	6,5	6,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	-	-	6	6	6	6	6	6	6,5	6,5
Installation factor (dry and wet concrete)		γ_{inst}[2]	[-]	1,2									
Installation factor (flooded bore hole)		γ_{inst}[2]	[-]	1,2			1,4						
Reduction factor ψ^0_{sus} in cracked and non-cracked concrete C20/25 for all drilling methods in dry/wet concerte or flooded holes for 50 years working life													
Temperature range I: 40°C/24°C		ψ^0_{sus}	[-]	0.798									
Temperature range II: 60°C/40°C		ψ^0_{sus}	[-]	0.718									

1) f_{uk} shall be taken from the specifications of reinforcing bars
2) in absence of national regulation
3) values need to be calculated in accordance with EN 1992-4:2018, Table 4.1

Table C5: continuation

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 30	Ø 32
Increasing factors for **non-cracked** concrete (all type of drilling) ψ_c	C25/30		1,04							1,06	1,08	1,04
	C30/37		1,08							1,13	1,17	1,08
	C35/45		1,11							1,17	1,24	1,11
	C40/50		1,15							1,23	1,30	1,15
	C45/55		1,18							1,17	1,36	1,18
	C50/60		1,20							1,32	1,42	1,20
Increasing factors for **cracked** concrete (all type of drilling) ψ_c	C25/30		1,0	1,0	1,08	1,08	1,08	1,08	1,11	1,04	1,04	1,04
	C30/37		1,0	1,0	1,18	1,18	1,18	1,18	1,22	1,08	1,08	1,08
	C35/45		1,0	1,0	1,25	1,25	1,25	1,25	1,31	1,12	1,12	1,12
	C40/50		1,0	1,0	1,32	1,32	1,32	1,32	1,41	1,15	1,15	1,15
	C45/55		1,0	1,0	1,38	1,38	1,38	1,38	1,49	1,17	1,17	1,17
	C50/60		1,0	1,0	1,44	1,44	1,44	1,44	1,58	1,20	1,20	1,20
Concrete cone failure												
Non-cracked concrete	$k_{ucr,N}$	[-]	11,0									
Cracked concrete	$k_{cr,N}$	[-]	7,7									
Edge distance	$c_{cr,N}$	[mm]	$1,5\ h_{ef}$									
Axial distance	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$									
Splitting												
Edge distance, $h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	$1,0\ h_{ef}$									
Edge distance, $2,0 > h/h_{ef} > 1,3$	$c_{cr,sp}$	[mm]	$3,86\ h_{ef} - 1,43\ h$									
Edge distance, $h/h_{ef} \leq 1,3$	$c_{cr,sp}$	[mm]	$2\ h_{ef}$									
Axial distance	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$									

Table C6: Characteristic values of shear loads under static and quasi-static action for rebar for 50 years' service life and 100 years' service life for hammer drilling only

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 30	Ø 32
Steel failure without lever arm												
Characteristic shear resistance	$V^0_{Rk,s}$	[kN]	$0,50 \cdot A_s \cdot f_{uk}$ [1]									
Cross section area	A_s	[mm²]	50	79	113	154	201	314	491	616	707	804
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 [2) 3)]									
Ductility factor	k_7	[-]	1,0									
Steel failure with lever arm												
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1.2 \cdot W_{el} \cdot f_{uk}$ [1]									
Elastic section modulus	W_{el}	[mm³]	50	98	170	269	402	785	1534	2155	2651	3217
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 [2]									
Concrete pry-out failure												
Factor	k_8	[-]	2,0									
Installation factor	γ_{inst}	[-]	1,0									
Concrete edge failure												
Effective length of fastener	l_f	[mm]	$l_f = \min(h_{ef};\ 12\ d_{nom})$							$l_f = \min(h_{ef};\ 300mm)$		
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	14	16	20	25	28	30	32
Installation factor	γ_{inst}	[-]	1,0									

1) f_{uk} shall be taken from the specifications of reinforcing bars
2) in absence of national regulation
3) values need to be calculated in accordance with EN 1992-4:2018, Table 4.1

Table C7: Displacements under tension load[1)] (threaded rod)

Anchor size threaded rod			**M 8**	**M 10**	**M 12**	**M 16**	**M 20**	**M24**	**M27**	**M30**
Non-cracked concrete C20/25 Hammer Drilling (HD)										
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	0,04	0,03	0,08	0,04	0,04	0,22	0,13	0,12
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,04	0,03	0,08	0,04	0,04	0,22	0,13	0,12
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	0,04	0,03	0,08	0,04	0,04	0,22	0,13	0,12
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,04	0,03	0,08	0,04	0,04	0,22	0,13	0,12
Non-cracked concrete C20/25 Hollow Drilling (HDB)										
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	0,04	0,04	0,04	0,07	0,07	0,06	0,11	0,13
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,04	0,04	0,04	0,07	0,07	0,06	0,11	0,13
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	0,04	0,04	0,04	0,07	0,07	0,06	0,11	0,13
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,04	0,04	0,04	0,07	0,07	0,06	0,11	0,13
Non-cracked concrete C20/25 Diamond Drilling (DD)										
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	0,01	0,01	0,01	0,02	0,03	0,03	0,15	0,09
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,01	0,01	0,01	0,02	0,03	0,03	0,15	0,09
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	0,01	0,01	0,01	0,02	0,03	0,03	0,15	0,09
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,01	0,01	0,01	0,02	0,03	0,03	0,15	0,09
Cracked concrete C20/25 Hammer Drilling (HD) and Hollow Drilling (HDB)										
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	0,06	0,06	0,09	0,12	0,12	0,11	0,14	0,16
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,06	0,06	0,09	0,12	0,12	0,11	0,14	0,16
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	0,06	0,06	0,09	0,12	0,12	0,11	0,14	0,16
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,06	0,06	0,09	0,12	0,12	0,11	0,14	0,16
Cracked concrete C20/25 Diamond Drilling (DD)										
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	-	-	0,05	0,06	0,05	0,05	0,55	0,30
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	-	-	0,05	0,06	0,05	0,05	0,55	0,30
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	-	-	0,05	0,06	0,05	0,05	0,55	0,30
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	-	-	0,05	0,06	0,05	0,05	0,55	0,30

[1)] Calculation of the displacement

$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; τ: action bond stress for tension

$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

Table C8: Displacements under shear load[1)] (threaded rod)

Anchor size threaded rod			M 8	M 10	M 12	M 16	M 20	M24	M27	M30
For non-cracked concrete C20/25										
Temperature range I: 40°C/24°C	δ_{V0}-factor	[mm/kN]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$-factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
Temperature range II: 60°C/40°C	δ_{V0}-factor	[mm/kN]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$-factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
For cracked concrete C20/25										
Temperature range I: 40°C/24°C	δ_{V0}-factor	[mm/kN]	0,12	0,12	0,11	0,10	0,09	0,08	0,08	0,07
	$\delta_{V\infty}$-factor	[mm/kN]	0,16	0,16	0,17	0,15	0,14	0,13	0,12	0,10
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/kN]	0,12	0,12	0,11	0,10	0,09	0,08	0,08	0,07
	$\delta_{N\infty}$-factor	[mm/kN]	0,16	0,16	0,17	0,15	0,14	0,13	0,12	0,10

[1)] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

Table C9: Displacements under tension load[1] (rebar)

Anchor size reinforcing bar			∅ 8	∅ 10	∅ 12	∅ 14	∅ 16	∅ 20	∅ 25	∅ 28	∅ 30	∅ 32
Non-cracked concrete C20/25 Hammer Drilling (HD)												
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	0,03	0,01	0,03	0,08	0,08	0,05	0,09	0,14	0,08	0,06
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,09	0,03	0,08	0,24	0,24	0,13	0,27	0,39	0,24	0,18
,Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	0,03	0,01	0,03	0,08	0,08	0,05	0,09	0,14	0,08	0,06
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,09	0,03	0,08	0,24	0,24	0,13	0,27	0,39	0,24	0,18
Non-cracked concrete C20/25 Hollow Drilling (HDB)												
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	0,02	0,03	0,05	0,05	0,04	0,05	0,06	0,10	0,12	0,15
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,06	0,10	0,13	0,13	0,11	0,15	0,18	0,29	0,36	0,42
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	0,02	0,03	0,05	0,05	0,04	0,05	0,06	0,10	0,12	0,15
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,06	0,10	0,13	0,13	0,11	0,15	0,18	0,29	0,36	0,42
Non-cracked concrete C20/25 Diamond Drilling (DD)												
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	0,03	0,02	0,02	0,03	0,03	0,04	0,05	0,14	0,15	0,16
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,07	0,07	0,07	0,10	0,10	0,11	0,13	0,40	0,43	0,46
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	0,03	0,02	0,02	0,03	0,03	0,04	0,05	0,14	0,15	0,16
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,07	0,07	0,07	0,10	0,10	0,11	0,13	0,40	0,43	0,46
Cracked concrete C20/25 Hammer Drilling (HD) and Hollow Drilling (HDB)												
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	-	-	0,07	0,07	0,05	0,10	0,14	0,17	0,17	0,17
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	-	-	0,07	0,07	0,05	0,10	0,14	0,17	0,17	0,17
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	-	-	0,07	0,07	0,05	0,10	0,14	0,17	0,17	0,17
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	-	-	0,07	0,07	0,05	0,10	0,14	0,17	0,17	0,17
Cracked concrete C20/25 Diamond Drilling (DD)												
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	-	-	0,02	0,04	0,04	0,05	0,07	0,14	0,14	0,14
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	-	-	0,07	0,05	0,05	0,10	0,14	0,17	0,17	0,17
Temperature range II: 60°C/40°C	δ_{N0}-factor	[mm/(N/mm²)]	-	-	0,02	0,04	0,04	0,05	0,07	0,14	0,14	0,14
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	-	-	0,07	0,05	0,05	0,10	0,14	0,17	0,17	0,17

[1] Calculation of the displacement

$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; τ: action bond stress for tension

$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

Hobson Engineering Epoxy E701 Injection System for concrete

Performances
Displacements under tension load (rebars)

Annex C8

Table C10: Displacement under shear load[1)] (rebar)

Anchor size reinforcing bar			∅ 8	∅ 10	∅ 12	∅ 14	∅ 16	∅ 20	∅ 25	∅ 28	∅ 30	∅ 32
Non-cracked concrete C20/25												
Temperature range I: 40°C/24°C	δ_{V0}-factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,03
	$\delta_{V\infty}$-factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04	0,04
Temperature range II: 60°C/40°C	δ_{V0}-factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,03
	$\delta_{V\infty}$-factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04	0,04
Cracked concrete C20/25												
Temperature range I: 40°C/24°C	δ_{V0}-factor	[mm/kN]	0,12	0,12	0,11	0,11	0,10	0,09	0,08	0,07	0,07	0,06
	$\delta_{V\infty}$-factor	[mm/kN]	0,18	0,18	0,17	0,16	0,15	0,14	0,12	0,11	0,11	0,10
Temperature range II: 60°C/40°C	δ_{V0}-factor	[mm/kN]	0,12	0,12	0,11	0,11	0,10	0,09	0,08	0,07	0,07	0,06
	$\delta_{V\infty}$-factor	[mm/kN]	0,18	0,18	0,17	0,16	0,15	0,14	0,12	0,11	0,11	0,10

[1)] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$;   V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

Table C11: Characteristic values of tension load under seismic action (performance category C1 and C2) for 50 and 100 years' service life for hammer drilling

Anchor size threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel failure											
Characteristic tension resistance (seismic C1)		$N_{Rk,s,C1}$	[kN]	1,0 x $N_{Rk,,s}$							
Characteristic tension resistance (seismic C2)		$N_{Rk,s,C2}$	[kN]	N/A		1,0 x $N_{Rk,s}$				N/A	
Partial factor		$\gamma_{Ms,N}$	[-]	see Table C1							
Combined pull-out and concrete failure											
Characteristic bond resistance in cracked and non-cracked concrete C20/25 in hammer drilling (HD), under **seismic action category C1**											
Temperature range I: 40°C/24°C	Dry and wet concrete	$\tau_{Rk,C1}$	[N/mm]	10	8,6	9	8,3	8,2	7,7	6,5	5,9
	Flooded bore holes	$\tau_{Rk,C1}$	[N/mm]	10	8,6	9	8,3	7,8	6,3	5,2	4,3
Temperature range II: 60°C/40°C	Dry/wet concrete	$\tau_{Rk,C1}$	[N/mm]	9	8,2	8	7,3	7,3	7,2	6,1	5,5
	Flooded bore holes	$\tau_{Rk,C1}$	[N/mm]	9	8,2	8	7,3	6,8	5,8	4,7	3,9
Characteristic bond resistance in cracked and non-cracked concrete C20/25 in hammer drilling (HD), under **seismic action category C2**											
Temperature range I: 40°C/24°C	Dry and wet concrete	$\tau_{Rk,C2}$	[N/mm]	-	-	4,1	2,4	2,6	4,3	-	-
	Flooded bore holes	$\tau_{Rk,C2}$	[N/mm]	-	-	4,1	2,4	2,3	3,3	-	-
Temperature range II: 60°C/40°C	Dry/wet concrete	$\tau_{Rk,C2}$	[N/mm]	-	-	3,7	2,2	2,4	3,9	-	-
	Flooded bore holes	$\tau_{Rk,C2}$	[N/mm]	-	-	3,7	2,2	2,1	3	-	-
Increasing factor for concrete ψ_c		C25/30	**[-]**	1,05	1,07						1,11
		C30/37	**[-]**	1,09	1,13						1,22
		C35/45	**[-]**	1,13	1,18						1,32
		C40/50	**[-]**	1,16	1,23						1,41
		C45/55	**[-]**	1,19	1,28						1,49
		C50/60	**[-]**	1,22	1,32						1,58
Installation factor for seismic C1 and C2											
Installation factor for HD and CD in dry and wet concrete (for T I and T II):		γ_{inst}	**[-]**	1,0							
Installation factor for HD and CD in flooded bore hole (for T I and T II):		γ_{inst}	[-]	1,0	1,2			1,4			

Table C12: Characteristic values of shear load under seismic action (performance category C1 and C2) for 50 and 100 years' service life for hammer drilling

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure										
Characteristic shear resistance (seismic C1)	$V_{Rk,s,C1}$	[kN]	$0,7 \times V^0_{Rk,s}$							
Characteristic tension resistance (seismic C2)	$V_{Rk,s,C2}$	[kN]	N/A		$0,86 \times V^0_{Rk,s}$	$0.91 \times V^0_{Rk,s}$	$0.62 \times V^0_{Rk,s}$	$0.67 \times V^0_{Rk,s}$	N/A	
Partial factor	$\gamma_{Ms,N}$	[-]	see Table C1							
Factor for annular gap	α_{gap}	[-]	0,5							

Table C13: Displacement under tension load (threaded rods)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked and cracked concrete under seismic action (category C2)										
All temperature ranges:	$\delta_{N,C2(DSL)}$	[mm]	-	-	0,68	0,34	0,41	0,83	-	-
	$\delta_{N,C2(USL)}$	[mm]	-	-	1,87	1,53	0,89	2,04	-	-

Table C14: Displacement under shear load (threaded rods)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked and cracked concrete under seismic action (category C2)										
All temperature ranges:	$\delta_{V,C2(DSL)}$	[mm]	-	-	3,37	3,44	4,21	4,91	-	-
	$\delta_{V,C2(USL)}$	[mm]	-	-	4,55	8,37	9,08	9,65	-	-

Table C15: Resistance to fire

ESSENTIAL CHARACTERISTICS	PERFORMANCE
Resistance to fire	No performance assessed

Table C16: Reaction to fire

ESSENTIAL CHARACTERISTICS	PERFORMANCE
Reaction to fire	In the final application, the thickness of the mortar layer is about 1 to 2 mm and most of the mortar is material classified class A1 according to EC Decision 96/603/EC. Therefore, it may be assumed that the bonding material (synthetic mortar or a mixture of synthetic mortar and cementitious mortar) in connection with the metal anchor in the end use application do not contribute to fire growth or to the fully developed fire and they have no influence to the smoke hazard.