Technical and Test Institute for Construction Prague
Prosecká 811/76a
190 00 Prague
Czech Republic
eota@tzus.cz

Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA
www.eota.eu

European Technical Assessment

ETA 17/0347 of 31/07/2018

Technical Assessment Body issuing the ETA: Technical and Test Institute for Construction Prague	
Trade name of the construction product	G&B Fissagi Gebofix EPO PLUS RE
Product family to which the construction product belongs	Product area code: 33 Bonded injection type anchor for use in cracked and uncracked concrete
Manufacturer	G&B FISSAGGI Corso Savona, 22 10029 Villatellone (TO) ITALY
Manufacturing plant	G&B Fissaggi S.R.L., Plant 4
This European Technical Assessment contains	20 pages including 17 Annexes which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	EAD 330499-00-0601
This version replaces	ETA 17/0347 issued on 24/04/2017

1. Technical description of the product

The G&B Fissagi Gebofix EPO PLUS RE with steel elements is bonded anchor (injection type).

Steel elements can be galvanized or stainless steel threaded rods or rebars.

Steel element is placed into a drilled hole filled with injection mortar. The steel element is anchored via the bond between metal part, injection mortar and concrete. The anchor is intended to be used with various embedment depth up to 20 diameters.

The illustration and the description of the product are given in Annex A.

2. Specification of the intended use in accordance with the applicable 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 working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	**Performance**
Static and quasi-static loading	
Resistance to steel failure (tension)	See Annex C1, C2, C4, C5
Resistance to combined pull-out and concrete failure	See Annex C1, C2, C4, C5
Resistance to concrete cone failure	See Annex C1, C2, C4, C5
Edge distance to prevent splitting under load	See Annex C1, C2, C4, C5
Robustness	See Annex C1, C2, C4, C5
Maximum setting torque moment	See Annex B2
Minimum edge distance and spacing	See Annex B2
Resistance to steel failure (shear)	See Annex C3, C6
Resistance to pry-out failure	See Annex C3, C6
Resistance to concrete edge failure	See Annex C3, C6
Displacements under short term and long term loading	See Annex C7
Durability of metal parts	See Annex A4
Seismic performance C2	
Resistance to steel failure	See Annex C8
Resistance to pull-out	See Annex C8
Factor for annular gap	See Annex C8
Displacement	See Annex C8

3.2 Hygiene, health and environment (BWR 3)

No performance determined.

3.3 General aspects relating to fitness for use

Durability and serviceability are only ensured if the specifications of intended use according to Annex B 1 are kept.

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

According to the Decision 96/582/EC of the European Commission[1] the system of assessment verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table apply.

Product	Intended use	Level or class	System
Metal anchors for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units	-	1

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

5.1 Tasks of the manufacturer

The manufacturer may only use raw materials stated in the technical documentation of this European Technical Assessment.

The factory production control shall be in accordance with the control plan which is a part of the technical documentation of this European Technical Assessment. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited at Technický a zkušební ústav stavební Praha, s.p.[2] The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

5.2 Tasks of the notified bodies

The notified body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The notified certification body involved by the manufacturer shall issue a certificate of constancy of performance of the product stating the conformity with the provisions of this European Technical Assessment.

In cases where the provisions of the European Technical Assessment and its control plan are no longer fulfilled the notified body shall withdraw the certificate of constancy of performance and inform Technický a zkušební ústav stavební Praha, s.p without delay.

Issued in Prague on 31.07.2018

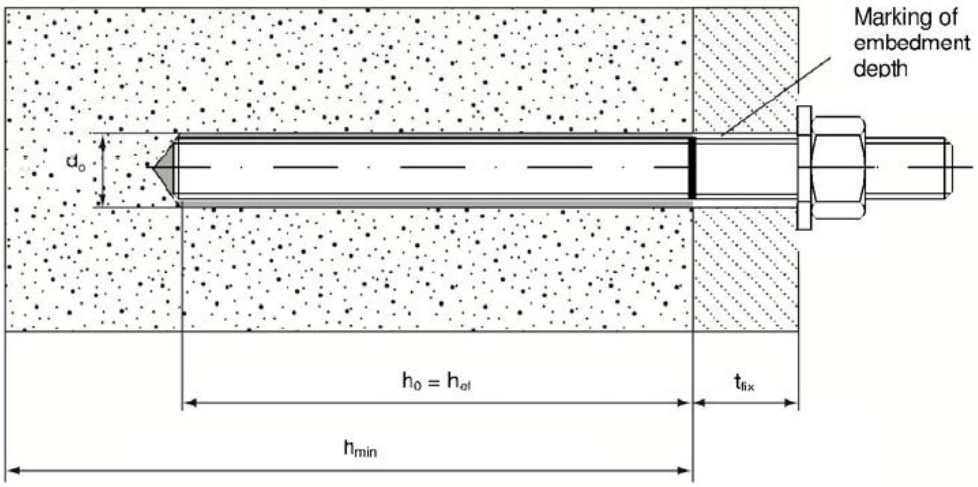
By

Ing. Mária Schaan
Head of the Technical Assessment Body

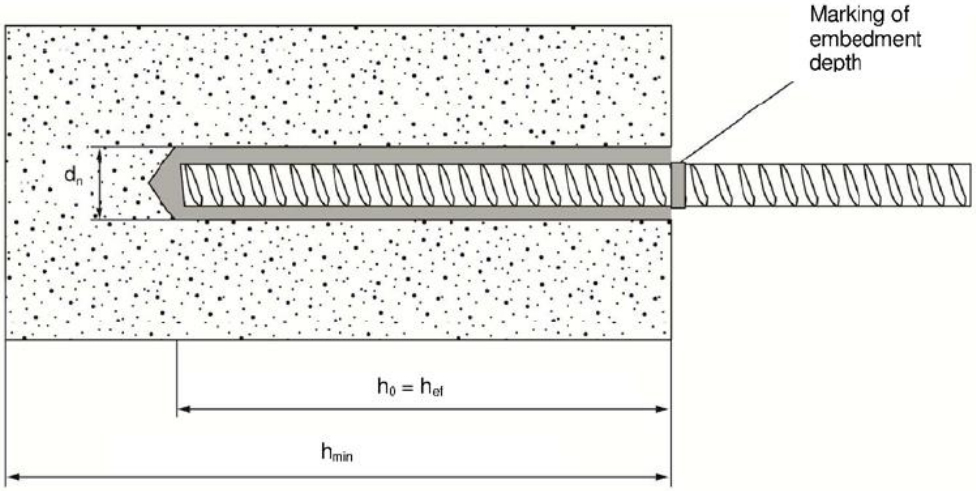
[1] Official Journal of the European Communities L 254 of 08.10.1996

[2] The control plan is a confidential part of the documentation of the European Technical Assessment, but not published together with the ETA and only handed over to the approved body involved in the procedure of AVCP.

Installation threaded rod



Installation reinforcing bar

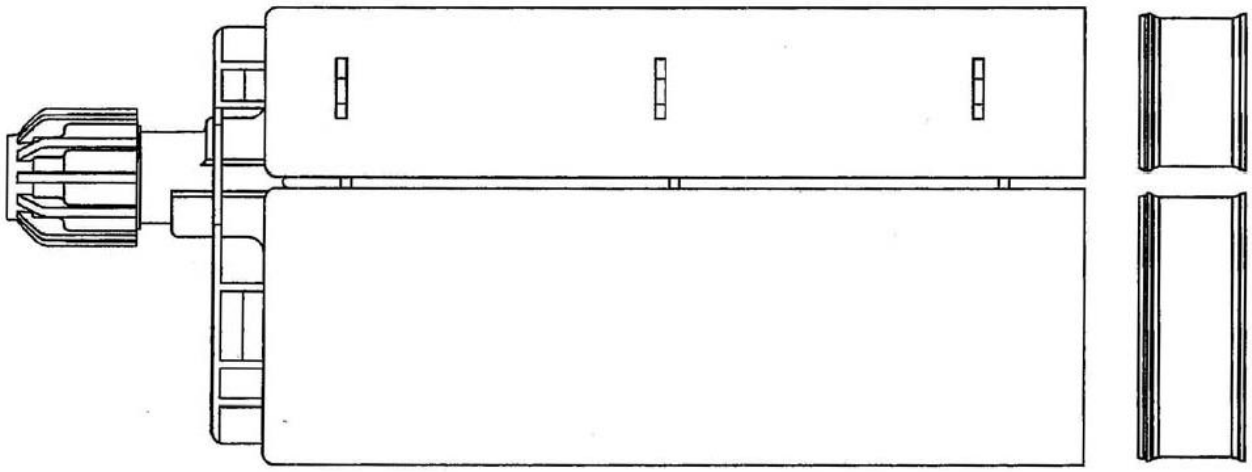


d_0 = diameter of bore hole
t_{fix} = thickness of fixture
h_{ef} = effective anchorage depth
h_0 = depth of drill hole
h_{min} = minimum member thickness

G&B Fissagi Gebofix EPO PLUS RE for concrete	**Annex A 1**
Product description Installed conditions	

Injection mortar: G&B Fissagi Gebofix EPO PLUS RE

Side by side cartridge
385ml and 585ml

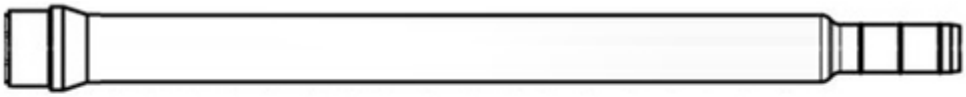


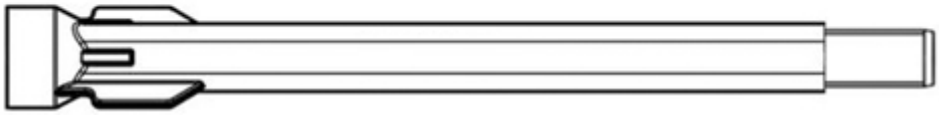
Cartridge label: G&B Fissagi Gebofix EPO PLUS RE, processing notes, charge-code, shelf life, hazard-code, curing- and processing time (depending on the temperature), with as well as without travel scale.

Static mixer

Standard Mixer

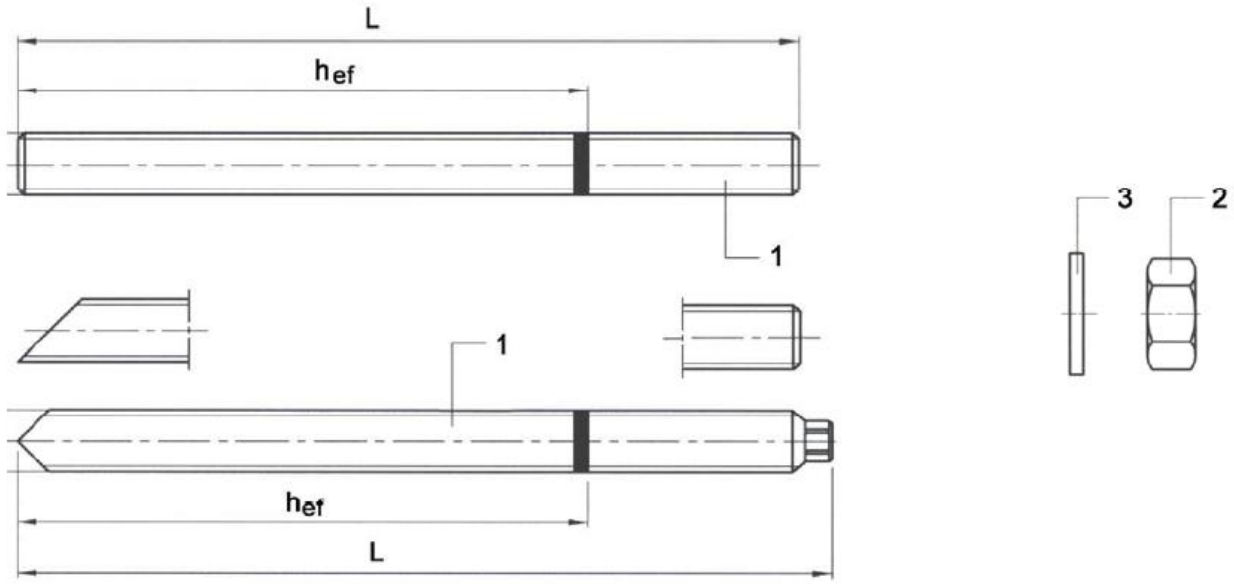
High Flow Mixer





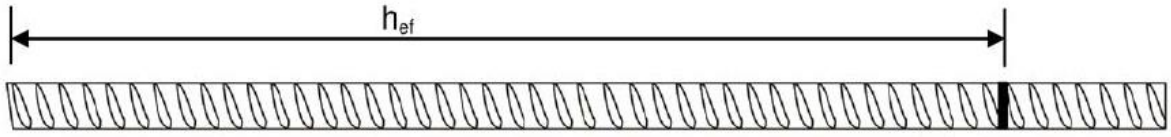
G&B Fissagi Gebofix EPO PLUS RE for concrete	**Annex A 2**
Product description Injection system	

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



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

Reinforcing Bar Ø8, Ø10, Ø12, Ø16, Ø20, Ø25, Ø32



Minimum value of related rib area $f_{R,min}$ according to EN 1992-1-12004+AC:2010
Rib height of the bar shall be in the range $0,05 * d \leq h_{rib} \leq 0,07 * d$
(d = Nominal diameter of the rebar; h: Rib height of the rebar)

G&B Fissagi Gebofix EPO PLUS RE for concrete	**Annex A 3**
Product description Threaded rod and reinforcing bar	

Table A1: Materials

Part	Designation	Material
Steel, zinc plated ≥ 5 µm acc. to EN ISO 4042 or Steel, Hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009		
1	Anchor rod	Steel, EN 10087:1998 or EN 10263:2001 Property class 4.6, 5.8, 8.8, EN 1993-1-8:2005+AC:2009
2	Hexagon nut, EN ISO 4032:2012	Steel acc. to EN 10087:1998 or EN 10263:2001 Property class 4 (for 4.6 rod) EN ISO 898-2-2012, Property class 5 (for 5.8 rod) EN ISO 898-2-2012, Property class 8 (for 8.8 rod) EN ISO 898-2-2012,
3	Washer, EN ISO 887:2006, EN ISO 7094:2000	Steel, zinc plated or hot-dip galvanised
Stainless steel		
1	Anchor rod	Material: A2-70, A4-70, A4-80, EN ISO 3506
2	Hexagon nut, EN ISO 4032:2012	According to the threaded rod
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	According to the threaded rod
High corrosion resistance steel		
1	Anchor rod	Material: 1.4529, 1.4565, EN 10088-1
2	Hexagon nut, EN ISO 4032:2012	According to the threaded rod
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	According to the threaded rod
Reinforcing bars		
1	Rebar EN 1992-1-1:2004+AC2010, 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 $f_{uk} = f_{tk} = k*f_{yk}$

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads: M8 to M30 and Rebar Ø8 to Ø32.
- Seismic actions category C2 (max w = 0,8 mm): threaded rod size M12, M16, M20

Base materials

- Reinforced or unreinforced normal weight concrete of strength class C20/25 at minimum and C50/60 at maximum according EN 206:2013
- Uncracked concrete: M8 to M30, Rebar Ø8 to Ø32
- Cracked concrete: M12 to M30, Rebar Ø12 to Ø32

Temperature range:

- T1: -40°C to +40°C (max. short. term temperature +40°C and max. long term temperature +24°C)
- T3a: -40°C to +60°C (max. short. term temperature +60°C and max. long term temperature +43°C)
- T3b: -40°C to +72°C (max. short. term temperature +72°C and max. long term temperature +43°C)

Use conditions (Environmental conditions)

- (X1) Structures subject to dry internal conditions (zinc coated steel, stainless steel, high corrosion resistance steel).
- (X2) Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel A4, high corrosion resistant steel).
- (X3) Structures subject to external atmospheric exposure and to permanently damp internal condition, if other particular aggressive conditions exist (high corrosion resistant steel).

Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Concrete conditions:

- I1 – installation in dry or wet (water saturated) concrete and use in service in dry or wet concrete.
- I2 – installation in water-filled (not sea water) and use in service in dry or wet concrete

Design:

- The anchorages are designed in accordance with the EN 1992-4 or EOTA Technical Report TR 055 under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings.
- Anchorages under seismic actions (cracked concrete) have to be designed in accordance with EN 1992-4.

Installation:

- Hole drilling by hammer drill mode.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Installation direction:

- D3 – downward and horizontal and upwards (e.g. overhead) installation

G&B Fissagi Gebofix EPO PLUS RE for concrete	**Annex B 1**
Intended use Specifications	

Table B1: Installation parameters for threaded rod

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Nominal drill hole diameter	d_0 [mm]	10	12	14	18	22	26	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 fixture	d_f [mm]	9	12	14	18	22	26	30	33
Diameter of steel brush	d_b [mm]	11	14	15	22	24	31	31	38
Torque moment	max T_{inst} [Nm]	10	20	40	80	120	160	180	200
Thickness of fixture	$t_{fix,min}$ [mm]	0							
	$t_{fix,max}$ [mm]	1500							
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm			h_{ef} + $2d_0$				
Minimum spacing	s_{min} [mm]	$s_{min} = \max(h_{ef}/2; 5d_{nom})$							
Minimum edge distance	c_{min} [mm]	$c_{min} = \max(h_{ef}/2; 5d_{nom})$							

Table B2: Installation parameters for rebar

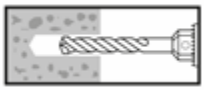
Anchor size		Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Nominal drill hole diameter	d_0 [mm]	12	14	16	20	25	32	40
Effective anchorage depth	$h_{ef,min}$ [mm]	60	60	70	80	90	100	128
	$h_{ef,max}$ [mm]	160	200	240	320	400	500	640
Diameter of steel brush	d_b [mm]	12	14	18	22	27	35	43
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm			h_{ef} + $2d_0$			
Minimum spacing, $h_{ef,min}$	s_{min} [mm]	40	40	40	40	50	50	70
Minimum spacing, $h_{ef,max}$	s_{min} [mm]	80	100	120	160	200	250	320
Minimum edge distance, $h_{ef,min}$	c_{min} [mm]	40	40	40	40	50	50	70
Minimum edge distance, $h_{ef,max}$	c_{min} [mm]	80	100	120	160	200	250	320

G&B Fissagi Gebofix EPO PLUS RE for concrete

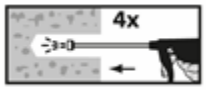
Intended use
Installation parameters

Annex B 2

Installation instructions

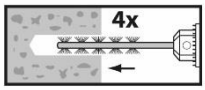


1. Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B2).

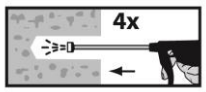


Attention! Standing water in the bore hole must be removed before cleaning.

2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air a minimum of four times. If the bore hole ground is not reached an extension shall be used.

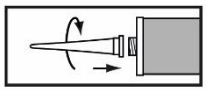


2b. Check brush diameter (Table B1) and attach the brush to a drilling machine or a battery screwdriver. Brush the hole with an appropriate sized wire brush > db,min (Table B1) a minimum of four times. If the bore hole ground is not reached with the brush, a brush extension shall be used (Table B1).

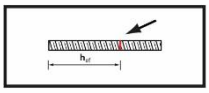


2c. Finally blow the hole clean again with compressed air a minimum of four times. If the bore hole ground is not reached an extension shall be used.

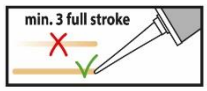
After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning repeated has to be directly before dispensing the mortar.
In-flowing water must not contaminate the bore hole again



3. Attach a supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. For foil tube cartridges, cut off the foil tube clip before use.
For every working interruption longer than the recommended working time (Table B3) as well as for new cartridges, a new static-mixer shall be used.



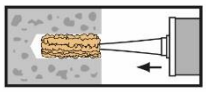
4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods



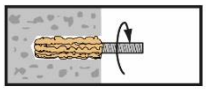
5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey colour.

G&B Fissagi Gebofix EPO PLUS RE for concrete	
Intended use Installation instructions	**Annex B 3**

Installation instructions (continuation)

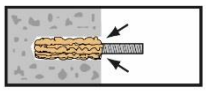


6. Starting from the bottom or back of the cleaned anchor hole fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. For embedment larger than 190 mm an extension nozzle shall be used. Observe the gel-/ working times given in Table B3.



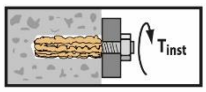
7. Push the threaded rod into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

   The anchor should be free of dirt, grease, oil or other foreign material.



8. 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.

9. 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 B3).



10. After full curing, the add-on part can be installed with the max. torque (Table B2) by using a calibrated torque wrench.

Table B3: Minimum curing time

Base material temperature	Gel time (working time)	Minimum curing time in dry concrete	Minimum curing time in wet concrete
+5°C to +9°C	120 min	50 h	100 h
+10°C to +14°C	45 min	30 h	60 h
+15°C to +19°C	25 min	18 h	36 h
+20°C to +29°C	12 min	10 h	20 h
+30°C to +39°C	6 min	6 h	12 h
+40°C	5 min	4 h	8 h

G&B Fissagi Gebofix EPO PLUS RE for concrete	
Intended use Installation instructions (continuation) Curing time	**Annex B 4**

Table B4: Parameter cleaning and setting tools

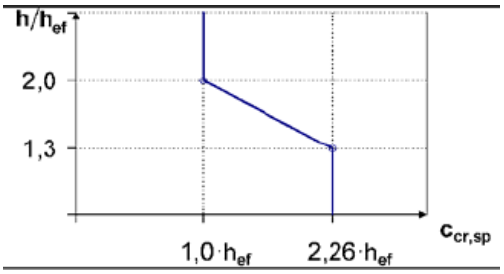
Anchor	Size (mm)	Nominal drill bit diameter d_0 (mm)	Steel Brush d_b (mm)	Piston plug
Threaded Rod 	M8	10	11	Not necessary
	M10	12	14	
	M12	14	15	
	M16	18	22	
	M20	22	24	#24
	M24	26	31	#28
	M27	30	31	#32
	M30	35	38	#35
Rebar 	Ø8	12	12	Not necessary
	Ø10	14	14	
	Ø12	16	18	
	Ø16	20	22	
	Ø20	25	27	#24
	Ø25	32	35	#32
	Ø32	40	43	#38

Compressed air tool (min 6 bar)
Drill bit diameter (d_0): 10 mm to 40 mm

G&B Fissagi Gebofix EPO PLUS RE for concrete	**Annex B 5**
Intended use Cleaning and setting tools	

Table C1: Characteristic values of resistance for threaded rods under tension loads in uncracked concrete (Design according to EN 1992-4)

Anchor size threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel failure											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \times f_{uk}$							
Combined pull-out and concrete cone failure											
Characteristic bond resistance in uncracked concrete C20/25											
Temperature range T1:40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	15	15	15	12	12	12	11	9.5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	15	14	13	10	9.5	8.5	7.5	7
Temperature range T3a:60°C/43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	9.5	9.5	9	8.5	8	7.5	7.5	7.5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	9.5	9.5	9	8.5	7.5	7	6.5	6
Temperature range T3b:72°C/43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	8.5	8.5	8	7.5	7	7	6.5	6.5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8.5	8.5	8	7.5	7	6	5.5	5.5
Increasing factors for concrete Ψ_c		C30/37		1.04							
		C40/50		1.07							
		C50/60		1.09							
Concrete cone failure											
Factor for concrete cone failure for uncracked concrete		k_1 [1)]		10.1							
		$k_{ucr,N}$ [2)]		11							
Edge distance		$c_{cr,N}$	[mm]	$1.5h_{ef}$							
Splitting failure											
Edge distance		$h / h_{ef} \geq 2,0$		$1,0\ h_{ef}$							
		$2,0 > h / h_{ef} > 1,3$		$4,6\ h_{ef} - 1,8\ h$							
		$h / h_{ef} \leq 1.3$		$2,26\ h_{ef}$							
Axial distance		$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$							
Installation safety factor (dry and wet concrete)		γ_2 [1)] = γ_{inst} [2)]		1.0							
Installation safety factor (flooded bore hole)		γ_2 [1)] = γ_{inst} [2)]		1.0							



[1)] Design according EOTA Technical Report TR 055
[2)] Design according EN 1992-4:2016

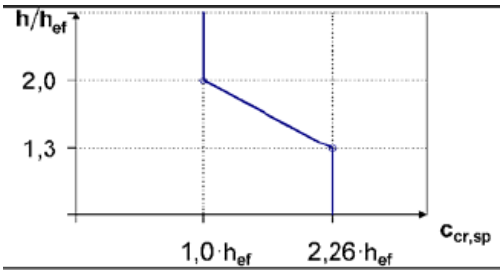
G&B Fissagi Gebofix EPO PLUS RE for concrete

Performances
Characteristic resistance for tension loads - threaded rod
Design according to EN 1992-4

Annex C 1

Table C2: Characteristic values of resistance for threaded rods under tension loads in cracked concrete (Design according to EN 1992-4)

Anchor size threaded rod				M12	M16	M20	M24	M27	M30
Steel failure									
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \times f_{uk}$					
Combined pull-out and concrete cone failure									
Characteristic bond resistance in cracked concrete C20/25									
Temperature range T1: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	7.5	6.5	6	5.5	5.5	5.5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	7.5	6	5	4.5	4	4
Temperature range T3a: 60°C/43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4.5	4	3.5	3.5	3.5	3.5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4.5	4	3.5	3.5	3.5	3.5
Temperature range T3b: 72°C/43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4	3.5	3	3	3	3
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4	3.5	3	3	3	3
Increasing factor for concrete (only static or quasi-static actions) ψ_c		C30/37		1.04					
		C40/50		1.07					
		C50/60		1.09					
Concrete cone failure									
Factor for concrete cone failure for cracked concrete		k_1 [1]		7.2					
		$k_{cr,N}$ [2]		7.7					
Edge distance		$c_{cr,N}$	[mm]	$1.5h_{ef}$					
Splitting failure									
Edge distance		$h / h_{ef} \geq 2,0$		$1,0\ h_{ef}$					
		$2,0 > h / h_{ef} > 1,3$		$4,6\ h_{ef} - 1,8\ h$					
		$h / h_{ef} \leq 1.3$		$2,26\ h_{ef}$					
Axial distance		$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$					
Installation safety factor (dry and wet concrete)		γ_2 [1] = γ_{inst} [2]		1.0					
Installation safety factor (flooded bore hole)		γ_2 [1] = γ_{inst} [2]		1.0					



[1] Design according EOTA Technical Report TR 055
[2] Design according EN 1992-4:2016

G&B Fissagi Gebofix EPO PLUS RE for concrete

Performances
Characteristic resistance for tension loads – threaded rod
Design according to EN 1992-4

Annex C 2

Table C3: Characteristic values of resistance for threaded rods under shear loads in cracked and uncracked concrete (Design according to EN 1992-4)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure without lever arm										
Characteristic shear resistance	$V_{Rk,s}$	[kN]	$0.5 \times A_s \times f_{uk}$							
Characteristic resistance of group of fasteners										
Ductility factor			$k_7 = 1{,}0$ for steel with rupture elongation $A_5 > 8\%$							
Steel failure with lever arm										
Characteristic bending moment	M^0_{Rk}	[Nm]	$1.2 \times W_{el} \times f_{uk}$							
Concrete pry-out failure										
Factor for resistance to pry-out failure			2.0							
Installation safety factor	γ_2 [1] = γ_{inst} [2]		1.0							
Concrete edge failure										
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Effective length of fastener	ℓ_f	[mm]	$\min (h_{ef}, 8\, d_{nom})$							
Installation safety factor	γ_2 [1] = γ_{inst} [2]		1.0							

[1] Design according EOTA Technical Report TR 055
[2] Design according EN 1992-4:2016

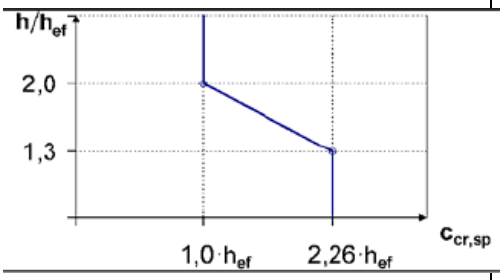
G&B Fissagi Gebofix EPO PLUS RE for concrete

Performances
Characteristic values of resistance for threaded rods under shear loads in cracked and uncracked concrete, Design according to EN 1992-4

Annex C 3

Table C4: Characteristic values of resistance for rebar under tension loads in uncracked concrete (Design according to EN 1992-4)

Anchor size threaded rod				**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Steel failure										
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \times f_{uk}$						
Combined pull-out and concrete cone failure										
Characteristic bond resistance in uncracked concrete C20/25										
Temperature range T1: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	13	13	13	12	12	11	8
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	13	13	11	9.5	8.5	7.5	6
Temperature range T3a: 60°C/43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	8.5	8.5	8	7.5	7	7	6.5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8.5	8.5	8	7.5	7	6	5
Temperature range T3b: 72°C/43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	7.5	7.5	7.5	7	6.5	6	6
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7.5	7.5	7.5	7	6	5.5	4.5
Increasing factors for concrete Ψ_c		C30/37		1.04						
		C40/50		1.07						
		C50/60		1.09						
Concrete cone failure										
Factor for concrete cone failure for uncracked concrete		k_1 [1]		10.1						
		$k_{ucr,N}$ [2]		11						
Edge distance		$c_{cr,N}$	[mm]	$1.5h_{ef}$						
Splitting failure										
Edge distance		$h / h_{ef} \geq 2,0$		$1,0\ h_{ef}$						
		$2,0 > h / h_{ef} > 1,3$		$4,6\ h_{ef} - 1,8\ h$						
		$h / h_{ef} \leq 1.3$		$2,26\ h_{ef}$						
Axial distance		$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$						
Installation safety factor (dry and wet concrete)		γ_2 [1] = γ_{inst} [2]		1.0						
Installation safety factor (flooded bore hole)		γ_2 [1] = γ_{inst} [2]		1.2						



[1] Design according EOTA Technical Report TR 055
[2] Design according EN 1992-4:2016

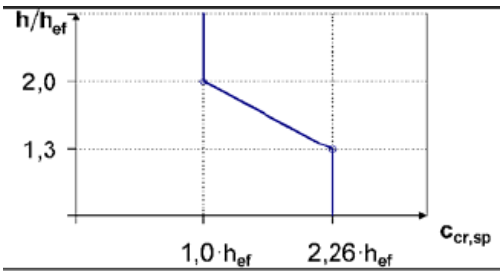
G&B Fissagi Gebofix EPO PLUS RE for concrete

Performances
Characteristic values of resistance for rebar under tension loads in uncracked concrete, Design according to EN 1992-4

Annex C 4

Table C5: Characteristic values of resistance for rebar under tension loads in cracked concrete (Design according to EN 1992-4)

Anchor size threaded rod				**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Steel failure								
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \times f_{uk}$				
Combined pull-out and concrete cone failure								
Characteristic bond resistance in uncracked concrete C20/25								
Temperature range T1: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	7.5	6.5	6	5.5	5.5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	7.5	6	5	4.5	4
Temperature range T3a: 60°C/43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4.5	4	3.5	3.5	3.5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4.5	4	3.5	3.5	3
Temperature range T3b: 72°C/43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4	3.5	3	3	3
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4	3.5	3	3	3
Increasing factors for concrete Ψ_c		C30/37		1.04				
		C40/50		1.07				
		C50/60		1.09				
Concrete cone failure								
Factor for concrete cone failure for cracked concrete		k_1 [1)]		7.2				
		$k_{cr,N}$ [2)]		7.7				
Edge distance		$c_{cr,N}$	[mm]	$1.5h_{ef}$				
Splitting failure								
Edge distance		$h / h_{ef} \geq 2,0$		$1,0\ h_{ef}$				
		$2,0 > h / h_{ef} > 1,3$		$4,6\ h_{ef} - 1,8\ h$				
		$h / h_{ef} \leq 1.3$		$2,26\ h_{ef}$				
Axial distance		$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$				
Installation safety factor (dry and wet concrete)		γ_2 [1)]=γ_{inst} [2)]		1.0				
Installation safety factor (flooded bore hole)		γ_2 [1)]=γ_{inst} [2)]		1.2				



[1)] Design according EOTA Technical Report TR 055
[2)] Design according EN 1992-4:2016

G&B Fissagi Gebofix EPO PLUS RE for concrete

Performances
Characteristic values of resistance for rebar under tension loads in cracked concrete, Design according to EN 1992-4

Annex C 5

Table C6: Characteristic values of resistance for rebar under shear loads in cracked and uncracked concrete (Design according to EN 1992-4)

Anchor size threaded rod			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Steel failure without lever arm									
Characteristic shear resistance	$V_{Rk,s}$	[kN]	$0.5 \times A_s \times f_{uk}$						
Characteristic resistance of group of fasteners									
Ductility factor			k_7 = 1,0 for steel with rupture elongation $A_5 > 8\%$						
Steel failure with lever arm									
Characteristic bending moment	M^0_{Rk}	[N.m]	$1.2 \times W_{el} \times f_{uk}$						
Concrete pry-out failure									
Factor for resistance to pry-out failure	k_8		2.0						
Installation safety factor	γ_2 [1] = γ_{inst} [2]		1.0						
Concrete edge failure									
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	25	32
Effective length of fastener	ℓ_f	[mm]	min (h_{ef}, 8 d_{nom})						
Installation safety factor	γ_2 [1] = γ_{inst} [2]		1.0						

[1] Design according EOTA Technical Report TR 055
[2] Design according EN 1992-4:2016

G&B Fissagi Gebofix EPO PLUS RE for concrete

Performances
Characteristic values of resistance for rebar under shear loads in cracked and uncracked concrete, Design according to EN 1992-4

Annex C 6

Table C7: Displacement of threaded rod under tension and shear load

Size		M8	M10	M12	M16	M20	M24	M27	M30
Tension load									
Uncracked concrete									
F	[kN]	11.9	14.3	19.0	23.8	35.7	35.7	45.2	45.2
δ_{N0}	[mm]	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5
$\delta_{N\infty}$	[mm]	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cracked concrete									
F	[kN]			14.3	16.7	23.8	28.6	28.6	28.6
δ_{N0}	[mm]			0.4	0.5	0.5	0.6	0.6	0.7
$\delta_{N\infty}$	[mm]			2.0	2.0	2.0	2.0	2.0	2.0
Shear load									
F	[kN]	3.5	5.5	8.0	15.0	23.3	33.6	43.7	53.4
δ_{N0}	[mm]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$\delta_{N\infty}$	[mm]	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7

Table C8: Displacement of rebar under tension and shear load

Size		Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Tension load								
Uncracked concrete								
F	[kN]	7.6	11.9	16.7	28.6	35.7	45.2	66.7
δ_{N0}	[mm]	0.3	0.3	0.4	0.4	0.4	0.5	0.5
$\delta_{N\infty}$	[mm]	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cracked concrete								
F	[kN]			11.9	19.0	23.8	28.6	35.7
δ_{N0}	[mm]			0.4	0.5	0.5	0.6	0.6
$\delta_{N\infty}$	[mm]			2.0	2.0	2.0	2.0	2.0
Shear load								
F	[kN]	6.6	10.3	14.8	26.3	41.1	64.3	105.3
δ_{N0}	[mm]	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$\delta_{N\infty}$	[mm]	3.7	3.7	3.7	3.7	3.7	3.7	3.7

G&B Fissagi Gebofix EPO PLUS RE for concrete

Performances
Displacement for threaded rods and rebar

Annex C 7

Table C9: Seismic performance category C2

Anchor size threaded rod				M12	M16	M20
Tension load						
Steel failure						
Characteristic tension resistance, Steel, property class 4.6		$N_{Rk,s,eq,C2}$	[kN]	34	63	98
Characteristic tension resistance, Steel, property class 5.8		$N_{Rk,s,eq,C2}$	[kN]	42	78	122
Characteristic tension resistance, Steel, property class 8.8		$N_{Rk,s,eq,C2}$	[kN]	67	125	196
Characteristic tension resistance, Stainless steel A4 and HCR		$N_{Rk,s,eq,C2}$	[kN]	59	110	171
Characteristic resistance to pull-out						
Temperature range T1:40°C/24°C	dry and wet concrete	$\tau_{Rk,p,eq,C2}$	[N/mm²]	3.5	3.2	3.0
	flooded bore hole	$\tau_{Rk,p,eq,C2}$	[N/mm²]	3.5	3.2	3.0
Temperature range T3a:60°C/43°C	dry and wet concrete	$\tau_{Rk,p,eq,C2}$	[N/mm²]	3.0	2.7	2.5
	flooded bore hole	$\tau_{Rk,p,eq,C2}$	[N/mm²]	3.0	2.7	2.5
Temperature range T3b:72°C/43°C	dry and wet concrete	$\tau_{Rk,p,eq,C2}$	[N/mm²]	2.8	2.5	2.3
	flooded bore hole	$\tau_{Rk,p,eq,C2}$	[N/mm²]	2.8	2.5	2.3
Installation safety factor (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$		1.0		
Installation safety factor (flooded bore hole)		$\gamma_2 = \gamma_{inst}$		1.0		
Shear load						
Steel failure without lever arm						
Characteristic shear resistance, Steel, property class 4.6		$V_{Rk,s,eq,C2}$	[kN]	13	18	28
Characteristic shear resistance, Steel, property class 5.8		$V_{Rk,s,eq,C2}$	[kN]	16	22	35
Characteristic shear resistance, Steel, property class 8.8		$V_{Rk,s,eq,C2}$	[kN]	25	36	56
Characteristic shear resistance, Stainless steel A4 and HCR		$V_{Rk,s,eq,C2}$	[kN]	22	31	49
Characteristic shear load resistance $V_{Rk,s,eq}$ in the Table C8 shall be multiplied by following reduction factor for **hot-dip galvanized** commercial standard rods						
Reduction factor for hot-dip galvanized rods		$\alpha_{v,h\text{-}dg,c2}$		0.46	0.61	0.61
Factor for annular gap		α_{gap}		0.5		

Table C10: Displacement of threaded rod under tension and shear load – seismic performance category C2

Anchor size threaded rod		M12	M16	M20
$\delta_{N,eq(DLS)}$	[mm]	0.20	0.40	0.77
$\delta_{N,eq(ULS)}$	[mm]	0.76	0.74	1.68
$\delta_{V,eq(DLS)}$	[mm]	5.29	4.12	4.94
$\delta_{V,eq(ULS)}$	[mm]	10.20	90.5	10.99

The anchor shall be used with minimum rupture elongation after fracture A_5 equal to 19%.

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Performances
Seismic performance category C2

Annex C 8