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European Technical Assessment Body for construction products



# European Technical Assessment

## ETA-18/0275 of 26 February 2025

English translation prepared by DIBt - Original version in German language

#### **General Part**

Trade name of the construction productMapei Injection system Mapefix UM Hybrid for concreteProduct family to which the construction product belongsBonded fasteners and bonded expansion fasteners for use in concreteManufacturerMapei S.p.A. Via Cafiero, 22	Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
to which the construction product belongsfasteners for use in concreteManufacturerMapei S.p.A.	Trade name of the construction product	Mapei Injection system Mapefix UM Hybrid for concrete
	•	•
20158 MILANO (Italy) ITALIEN	Manufacturer	Via Cafiero, 22 20158 MILANO (Italy)
Manufacturing plant Mapei S.p.A., Plant1 Germany	Manufacturing plant	Mapei S.p.A., Plant1 Germany
This European Technical Assessment contains43 pages including 3 annexes which form an integral part of this assessment	•	
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis ofEAD 330499-02-0601, Edition 11/2023	issued in accordance with Regulation (EU)	EAD 330499-02-0601, Edition 11/2023
This version replaces     ETA-18/0275 issued on 4 September 2018	This version replaces	ETA-18/0275 issued on 4 September 2018



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#### **Specific Part**

#### 1 Technical description of the product

The "Mapei Injection system Mapefix UM Hybrid for concrete" is a bonded anchor consisting of a cartridge with injection mortar Mapefix UM Hybrid and a steel element according to Annex A 3 and A 5.

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.

#### 2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 and/or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

#### 3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1 to C 4, C 6 to C 7, C 9 to C 10, B 3
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1, C 5, C 8, C 11
Displacements under short-term and long-term loading	See Annex C 12 to C 14
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 15 to C 23

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

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 24 to C 26

#### 3.3 Hygiene, health and the environment (BWR 3)

Essential characteristic	Performance
Content, emission and/or release of dangerous substances	No performance assessed



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

In accordance with EAD 330499-02-0601 the applicable European legal act is: [96/582/EC]. The system to be applied is: 1

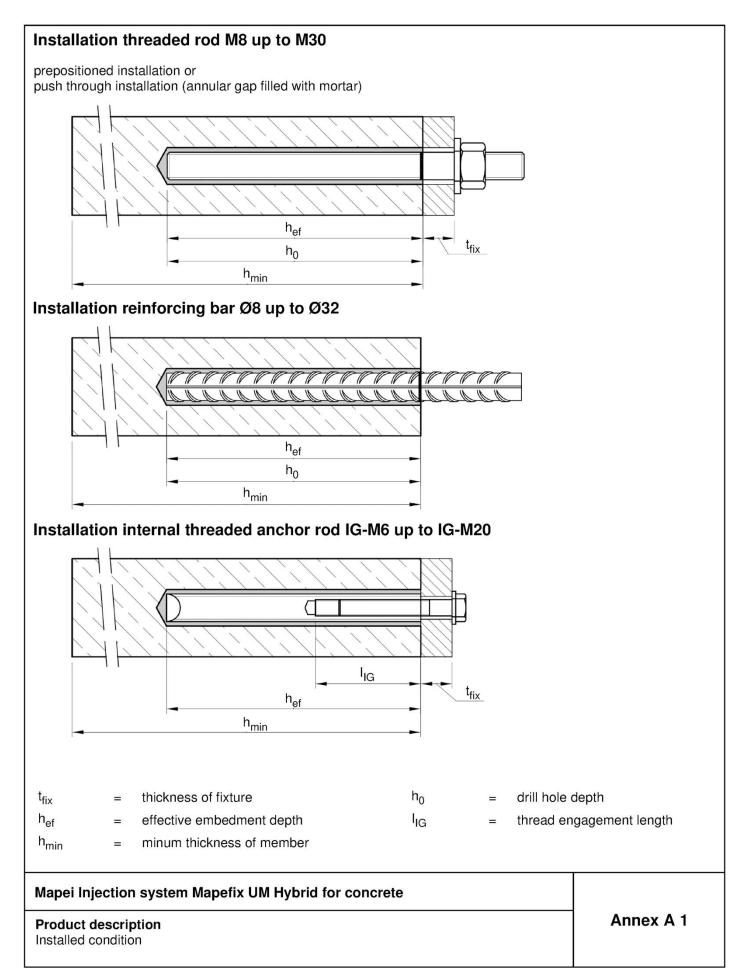
# 5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 26 February 2025 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock Head of Section *beglaubigt:* Baderschneider

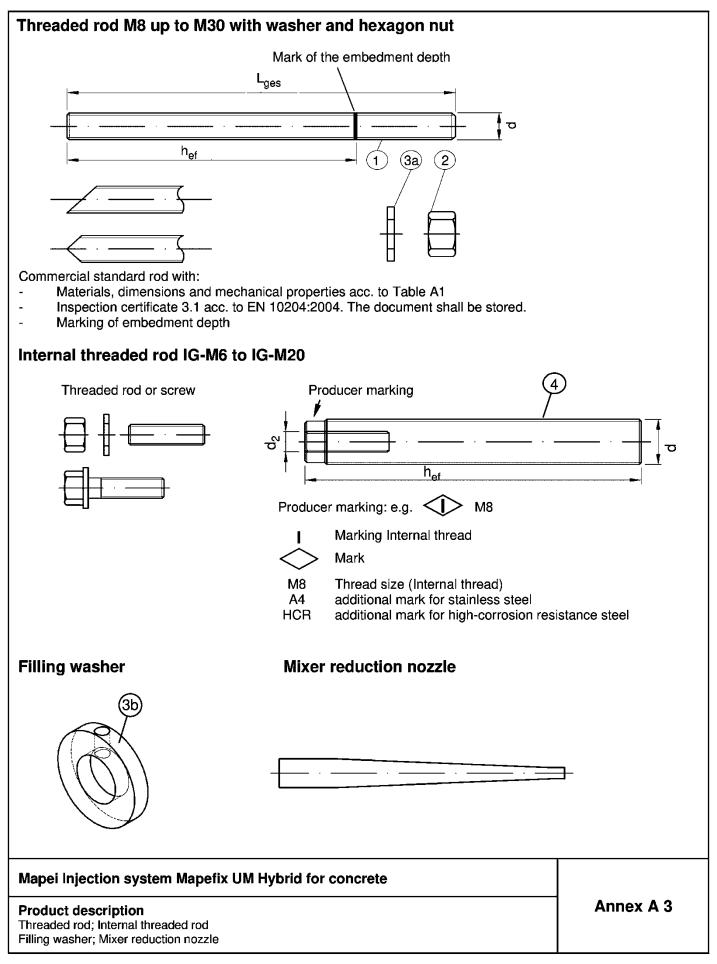






Cartridge system	
Coaxial Cartridge: 150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml Imprint: Mapefix UM Hybrid Processing and safety instructions, s number, manufacturer's information,	
Side-by-Side Cartridge: 235 ml, 345 ml up to 360 ml and 825 ml Imprint: Mapefix UM Hybrid Processing and safety instructions, s number, manufacturer's information,	
Static mixer PM-19E	
	0
Piston plug VS and mixer extension VL	
Mapei Injection system Mapefix UM Hybrid for concrete	
Product description Injection system	Annex A 2







art	Designation	Material				
		acc. to EN ISO 683-4:	2018	or EN 10263:2017)		
zi	nc plated ≥ !	5 µm acc. to EN ISO	404	2:2022 or		
				1:2022 and EN ISO 10684:	2004+AC:2009 or	
- sr	nerardized ≥4	45 μm acc. to EN ISO Property class	176	Characteristic steel ultimate tensile strength	Characteristic stee	el Elongation at fracture
			46	$f_{uk} = 400 \text{ N/mm}^2$	$f_{vk} = 240 \text{ N/mm}^2$	A <sub>5</sub> > 8%
				$f_{uk} = 400 \text{ N/mm}^2$	$f_{vk} = 320 \text{ N/mm}^2$	A <sub>5</sub> > 8%
1	Threaded rod	acc. to		$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 300 \text{ N/mm}^2$	A <sub>5</sub> > 8%
		EN ISO 898-1:2013	-	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 400 \text{ N/mm}^2$	A <sub>5</sub> > 8%
				f <sub>uk</sub> = 800 N/mm <sup>2</sup>	$f_{vk} = 640 \text{ N/mm}^2$	$A_5 \ge 12\%^{(3)}$
				for anchor rod class 4.6 o	1	A5 2 12 /0 -/
2	Hexagon nut	acc. to	4	for anchor rod class 5.6 o		
-	liezagon not	EN ISO 898-2:2022	<u>5</u> 8	for anchor rod class 8.8	1 3.0	
<u> </u>	Machar	Steel, zinc plated, ho		galvanised or sherardized		
3a	Washer	(e.g.: EN ISO 887:20	06, E	EN ISO 7089:2000, EN ISC	7093:2000 or EN	ISO 7094:2000)
3b	Filling washer	Steel, zinc plated, ho	ot-dip	galvanised or sherardized	1	
		Property class		Characteristic steel	Characteristic stee	el Elongation at fracture
4	Internal threaded		5.0	ultimate tensile strength f <sub>uk</sub> = 500 N/mm <sup>2</sup>	yield strength f <sub>vk</sub> = 400 N/mm <sup>2</sup>	A <sub>5</sub> > 8%
	anchor rod	acc. to EN ISO 898-1:2013			$f_{vk} = 640 \text{ N/mm}^2$	A <sub>5</sub> > 8%
01!					1	v
				1 / 1.4567 or 1.4541, acc. t 1 / 1.4362 or 1.4578, acc. t		
				r 1.4565, acc. to EN 10088		")
		Property class		Characteristic steel	Characteristic stee	el Elongation at
		Toperty class		ultimate tensile strength	yield strength	fracture
1	Threaded rod <sup>1)4)</sup>			f <sub>uk</sub> = 500 N/mm²	f <sub>yk</sub> = 210 N/mm <sup>2</sup>	A <sub>5</sub> ≥ 8%
		acc. to EN ISO 3506-1:2020	70	f <sub>uk</sub> = 700 N/mm²	f <sub>yk</sub> = 450 N/mm <sup>2</sup>	A <sub>5</sub> ≥ 12% <sup>3)</sup>
			80	f <sub>uk</sub> = 800 N/mm <sup>2</sup>	$f_{yk} = 600 \text{ N/mm}^2$	A <sub>5</sub> ≥ 12% <sup>3)</sup>
			50	for anchor rod class 50		
2	Hexagon nut <sup>1)4)</sup>	acc. to EN ISO 3506-1:2020		for anchor rod class 70		
			80	for anchor rod class 80		
3a	Washer	A4: Material 1.4401 / HCR: Material 1.452 (e.g.: EN ISO 887:20	′ 1.44 9 or <sup>-</sup> 106, E	307 / 1.4311 / 1.4567 or 1.4 404 / 1.4571 / 1.4362 or 1.4 1.4565, acc. to EN 10088-1 EN ISO 7089:2000, EN ISC	578, acc. to EN 10 : 2014	088-1:2014
3b	Filling washer	Stainless steel A4, H	ligh c	corrosion resistance steel	Ohana taut t	
		Property class		Characteristic steel ultimate tensile strength	Characteristic stee yield strength	el Elongation at fracture
4	Internal threaded anchor rod <sup>1)2)</sup>	acc. to	50	$f_{uk} = 500 \text{ N/mm}^2$	$f_{vk} = 210 \text{ N/mm}^2$	A <sub>5</sub> > 8%
		EN ISO 3506-1:2020			f <sub>vk</sub> = 450 N/mm <sup>2</sup>	A <sub>5</sub> > 8%
2) 3)	for IG-M20 only property A <sub>5</sub> > 8% fracture elongat	or anchor rods and hexago	n nuts erform	s up to M24 and Internal threade	1 2	•
Pro	oduct description	em Mapefix UM Hyt		for concrete		Annex A 4



Re	einforcing bar: ø8 up to ø32		
Ril (d:	nimum value of related rip area f <sub>R,min</sub> acco b height of the bar shall be in the range 0,0 c Nominal diameter of the bar; h <sub>rib</sub> : Rib heig able A2: Materials Reinforcing	95d ≤ h <sub>rib</sub> ≤ 0,07d µht of the bar)	
Par	t Designation	Material	
Rek		·	
1	Reinforcing steel according to EN 1992 1 1:2004+AC:2010, Annex C	Bars and rebars from ring class B or C $f_{yk}$ and k according to NDP or NCI according $f_{uk} = f_{tk} = k \cdot f_{yk}$	to EN 1992-1-1/NA



	Working lif	e 50 years	Working	ife 100 years
Base material	uncracked concrete	cracked concrete	uncracked concrete	cracked concrete
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to Ø8 to IG-M6 to	Ø32,	Ø8	to M30, to Ø32, to IG-M20
Temperature Range:	II: - 40 °C III: - 40 °C	to +40 °C <sup>1)</sup> to +80 °C <sup>2)</sup> to +120 °C <sup>3)</sup> to +160 °C <sup>4)</sup>		C to +40 °C <sup>1)</sup> C to +80 °C <sup>2)</sup>
Fasteners subject to (seismic ac	tion):			
	Performance	Category C1	Performant	ce Category C2
Base material		Cracked and un	cracked concrete	
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to Ø8 to		M12	2 to M24
Temperature Range:	II: - 40 °C III: - 40 °C	to $+40 \ ^{\circ}C^{1)}$ to $+80 \ ^{\circ}C^{2)}$ to $+120 \ ^{\circ}C^{3)}^{5)}$ to $+160 \ ^{\circ}C^{4)}^{5)}$	: - 40 °(    : - 40 °(	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$
Fasteners subject to (Fire exposi	ure):			
Base material		uncracked and	cracked concrete	
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling		Ø8 to	o M30, o Ø32, o IG-M20	
Temperature Range:		ll: - 40 °C lll: - 40 °C	C to +40 °C <sup>1)</sup> C to +80 °C <sup>2)</sup> C to +120 °C <sup>3)</sup> C to +160 °C <sup>4)</sup>	
<ol> <li>(max. long-term temperature +24°C a</li> <li>(max. long-term temperature +50°C a</li> <li>(max. long-term temperature +72°C a</li> <li>(max. long-term temperature +100°C</li> <li>Only for working life of 50 years</li> </ol>	and max. short-term te and max. short-term te	mperature +80°C) mperature +120°C)		
Mapei Injection system Mapefix	UM Hybrid for co	ncrete		



#### **Base materials:**

- Compacted, reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 + A2:2021.
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A2:2021.

#### Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (all materials).
- For all other conditions according to EN 1993-1-4:2006+ A2:2020 corresponding to corrosion resistance class:
  - Stainless steel Stahl A2 according to Annex A 4, Table A1: CRC II
  - Stainless steel Stahl A4 according to Annex A 4, Table A1: CRC III
  - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

#### Design:

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored.
   The position of the fastener is indicated on the design drawings (e. g. position of the fastener relative to reinforcement or to supports, etc.).
- Fasteners are designed under the responsibility of an engineer experienced in fasteners and concrete work.
- The fasteners are designed in accordance to EN 1992-4:2018 and Technical Report TR 055, Edition February 2018
- The fasteners under fire exposure are designed in accordance to Technical Report TR 082, Edition June 2023.

#### Installation:

- Dry, wet concrete or flooded bore holes (not sea-water).
- Hole drilling by hammer (HD), hollow (HDB) or compressed air (CD).
- Overhead installation allowed.
- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Installationtemperature in concrete:
   -5°C up to +40°C for the standard variation of temperature after installation.

#### Mapei Injection system Mapefix UM Hybrid for concrete

## Intended use

Specifications (Continued)

Annex B 2



Installation pa	arameters	for thre	eaded	rod						
			M8	M10	M12	M16	M20	M24	M27	M30
t	d = d <sub>nom</sub>	[mm]	8	10	12	16	20	24	27	30
ameter	d <sub>0</sub>	[mm]	10	12	14	18	22	28	30	35
at dooth	h <sub>ef,min</sub>	[mm]	60	60	70	80	90	96	108	120
ii depin	h <sub>ef,max</sub>	[mm]	160	200	240	320	400	480	540	600
Prepositioned ins		[mm]	9	12	14	18	22	26	30	33
Push through in	nstallation d <sub>f</sub>	[mm]	12	14	16	20	24	30	33	40
n torque	max T <sub>inst</sub>	[Nm]	10	20	40 <sup>2)</sup>	60	100	170	250	300
of member	h <sub>min</sub>	[mm]	-	-			ł	n <sub>ef</sub> + 2do	)	
	s <sub>min</sub>	[mm]	40	50	60	75	95	115	125	140
nce	c <sub>min</sub>	[mm]	35	40	45	50	60	65	75	80
	ameter at depth Prepositioned ins Push through in n torque of member	$d = d_{nom}$ ameter $d_0$ ameter $d_0$ h ef,min h ef,max Prepositioned installation df ≤ Push through installation df n torque max T <sub>inst</sub> of member $h_{min}$ nce $c_{min}$	$d = d_{nom}  [mm]$ $ameter \qquad d_0  [mm]$ $h_{ef,min}  [mm]$ $h_{ef,max}  [mm]$ $h_{ef,max}  [mm]$ $Prepositioned installation d_f \leq  [mm]$ $Push through installation d_f  [mm]$ $n torque \qquad max T_{inst}  [Nm]$ $of member \qquad h_{min}  [mm]$ $nce \qquad c_{min}  [mm]$	M8ddmm]8ameter $d_0$ [mm]10ameter $d_0$ [mm]10ameter $h_{ef,min}$ [mm]60hhef,max[mm]160Prepositioned installation $d_f \leq$ [mm]9Push through installation $d_f$ [mm]12n torquemax Tinst[Nm]10of member $h_{min}$ [mm]40nce $c_{min}$ [mm]35	$\frac{d = d_{nom}}{m} [mm] = 8 = 10$ $\frac{d = d_{nom}}{m} [mm] = 10 = 12$ $\frac{h_{ef,min}}{h_{ef,max}} [mm] = 10 = 12$ $\frac{h_{ef,max}}{h_{ef,max}} [mm] = 160 = 200$ $\frac{h_{ef,max}}{m} [mm] = 160 = 200$ $\frac{h_{ef,max}}{m} [mm] = 160 = 200$ $\frac{h_{ef,max}}{m} [mm] = 12 = 14$ $\frac{h_{ef}}{m} [mm] = 12 = 14$ $\frac{h_{ef}}{m} [mm] = 12 = 14$ $\frac{h_{ef}}{m} [mm] = 10 = 20$	$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	$\begin{tabular}{ c c c c c c c c c c c } \hline M8 & M10 & M12 & M16 \\ \hline M8 & M10 & M12 & M16 \\ \hline M16 & M10 & 12 & 16 \\ \hline M16 & M10 & 12 & 14 & 18 \\ \hline M16 & M10 & 12 & 14 & 18 \\ \hline M16 & M10 & 10 & 12 & 14 & 18 \\ \hline M16 & M10 & M11 & M10 & 200 & 240 & 320 \\ \hline M16 & M10 & M10 & M10 & 200 & 240 & 320 \\ \hline M16 & M10 & M10 & M10 & M10 & 20 & 40^{21} & 60 \\ \hline M16 & M10 & M10$	$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$

<sup>1)</sup> For application under seismic loading the diameter of clearance hole in the fixture shall be at maximum d<sub>1</sub> + 1mm or alternatively the annular gap between fixture and threaded rod shall be filled force-fit with mortar.

2) Maximum installation torque for M12 with steel Grade 4.6 is 35 Nm

#### Table B2: Installation parameters for reinforcing bar

Reinforcing bar			Ø 81)	Ø 10 <sup>1)</sup>	Ø 12 <sup>1)</sup>	Ø 14	Ø 16	Ø 20	Ø 241)	Ø 25 <sup>1)</sup>	Ø 28	Ø 32
Diameter of element	d = d <sub>nom</sub>	[mm]	8	10	12	14	16	20	24	25	28	32
Nominal drill hole diameter	d <sub>0</sub>	[mm]	10 12	12 14	14 16	18	20	25	30 32	30 32	35	40
Effective embedment depth	h <sub>ef,min</sub>	[mm]	60	60	70	75	80	90	96	100	112	128
Effective embedment depth	h <sub>ef,max</sub>	[mm]	160	200	240	280	320	400	480	500	560	640
Minimum thickness of member	h <sub>min</sub>	[mm]		30 mm )0 mm	≥			h <sub>e</sub>	<sub>f</sub> + 2d <sub>0</sub>			
Minimum spacing	s <sub>min</sub>	[mm]	40	50	60	70	75	95	120	120	130	150
Minimum edge distance	с <sub>тіп</sub>	[mm]	35	40	45	50	50	60	70	70	75	85
4),			-	-	-	-		-		-		

1) both nominal drill hole diameter can be used

### Table B3: Installation parameters for Internal threaded anchor rod

Internal threaded anchor rod			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Internal diameter of anchor rod	d <sub>2</sub>	[mm]	6	8	10	12	16	20
Outer diameter of anchor rod <sup>1)</sup>	d = d <sub>nom</sub>	[mm]	10	12	16	20	24	30
Nominal drill hole diameter	d <sub>0</sub>	[mm]	12	14	18	22	28	35
	h <sub>ef,min</sub>	[mm]	60	70	80	90	96	120
Effective embedment depth	h <sub>ef,max</sub>		200	240	320	400	480	600
Diameter of clearance hole in the fixture	d <sub>f</sub> ≤	[mm]	7	9	12	14	18	22
Maximum installation torque	max T <sub>inst</sub>	[Nm]	10	10	20	40	60	100
Thread engagement length min/max	l <sub>IG</sub>	[mm]	8/20	8/20	10/25	12/30	16/32	20/40
Minimum thickness of member	h <sub>min</sub>	[mm]	•••	30 mm 0 mm		h <sub>ef</sub> ⊦	⊦ 2d <sub>0</sub>	
Minimum spacing	s <sub>min</sub>	[mm]	50	60	75	95	115	140
Minimum edge distance	C <sub>min</sub>	[mm]	40	45	50	60	65	80

#### Mapei Injection system Mapefix UM Hybrid for concrete

Intended use

Installation parameters

## Annex B 3



	1: Para	meter cle	anng ana	iiistai						
					romu	HAMAN		6		
Threaded Rod	Re- inforcing bar	Internal threaded anchor rod	d <sub>0</sub> Drill bit - Ø HD, HDB, CD	d <sub>t</sub> Brusł		d <sub>b,min</sub> min. Brush - Ø	Piston plug		n direction piston plu	
[mm]	[mm]	[mm]	[mm]		[mm]	[mm]			$\rightarrow$	1
M8	8		10	BR10	11,5	10,5		v		
M10	8 / 10	IG-M6	12	BR12	13,5	12,5		Na alua	roouteral	
M12	10/12	IG-M8	14	BR14	15,5	14,5		No plug	required	
	12		16	BR16	17,5	16,5				
M16	14	IG-M10	18	BR18	20,0	18,5	VS18			
	16		20	BR20	22,0	20,5	VS20	]		
M20		IG-M12	22	BR22	24,0	22,5	VS22	]		
	20		25	BR25	27,0	25,5	VS25	h	h .	
M24		IG-M16	28	BR28	30,0	28,5	VS28	h <sub>ef</sub> >	h <sub>ef</sub> > 250 mm	all
M27	24 / 25		30	BR30	31,8	30,5	VS30	250 mm	250 mm	
	24 / 25		32	BR32	34,0	32,5	VS32			
M30	28	IG-M20	35	BR35	37,0	35,5	VS35			
A CONTRACTOR AND A CONT					0.,0	00,0	1000			
Cleaning	32 g and insta	allation to	40	BR40	43,5	40,5	VS40	-		
Cleanin	32	allation to	40	BR40	43,5		VS40 system co d a class M ure of 253	1 vacuum cle	eaner with a	minimur
Cleaning HDB – Ho ———— Hand pun	32 g and insta llow drill bit	allation to	40 ols	BR40	43,5	40,5 The hollow drill Hohlbohrer and negative press	VS40 d a class M ure of 253 s).	1 vacuum cle	eaner with a	minimun
Cleaning HDB – Ho Hand pun (Volume 75	32 g and insta llow drill bit	allation to	40 ols	BR40	43,5	40,5 The hollow drill Hohlbohrer and hegative press 150 m <sup>3</sup> /h (42 l/s <b>Compressed</b>	VS40 d a class M ure of 253 s).	1 vacuum cle	eaner with a	minimun
Cleaning HDB – Ho Hand pun (Volume 75	32 g and insta llow drill bit	allation to	40 ols	BR40	43,5	40,5 The hollow drill Hohlbohrer and negative press 150 m <sup>3</sup> /h (42 l/s Compressed min 6 bar)	VS40 d a class M ure of 253 s).	1 vacuum cle	eaner with a	minimur
Cleaning HDB – Ho Hand pun (Volume 75 Offer Brush BR	32 g and insta llow drill bit $p_0$ ml, $h_0 \le 10$ c a cension	allation to system	40 ols		43,5	40,5 The hollow drill Hohlbohrer and negative press 150 m <sup>3</sup> /h (42 l/s Compressed min 6 bar)	VS40 d a class M ure of 253 s).	1 vacuum cle	eaner with a	minimur
Cleaning HDB – Ho Hand pun (Volume 75 Olive Brush BR	32 g and insta llow drill bit	allation to system	40 ols		43,5	40,5 The hollow drill Hohlbohrer and negative press 150 m <sup>3</sup> /h (42 l/s Compressed min 6 bar) Piston Plug Y	VS40 d a class M ure of 253 s).	1 vacuum cle	eaner with a	minimur



Table B5:	Workin	g time and cu	ring time	
Tempera	ature in bas	e material	Maximum working time	Minimum curing time <sup>1)</sup>
	Т		t <sub>work</sub>	t <sub>cure</sub>
- 5°C	to	- 1 °C	50 min	5 h
0°C	to	+ 4 °C	25 min	3,5 h
+ 5°C	to	+ 9°C	15 min	2 h
+ 10°C	to	+ 14 °C	10 min	1 h
+ 15°C	to	+ 19°C	6 min	40 min
+ 20 °C	to	+ 29 °C	3 min	30 min
+ 30 °C	to	+ 40 °C	2 min	30 min
Car	tridge tempe	erature	+5°C to	) +40°C

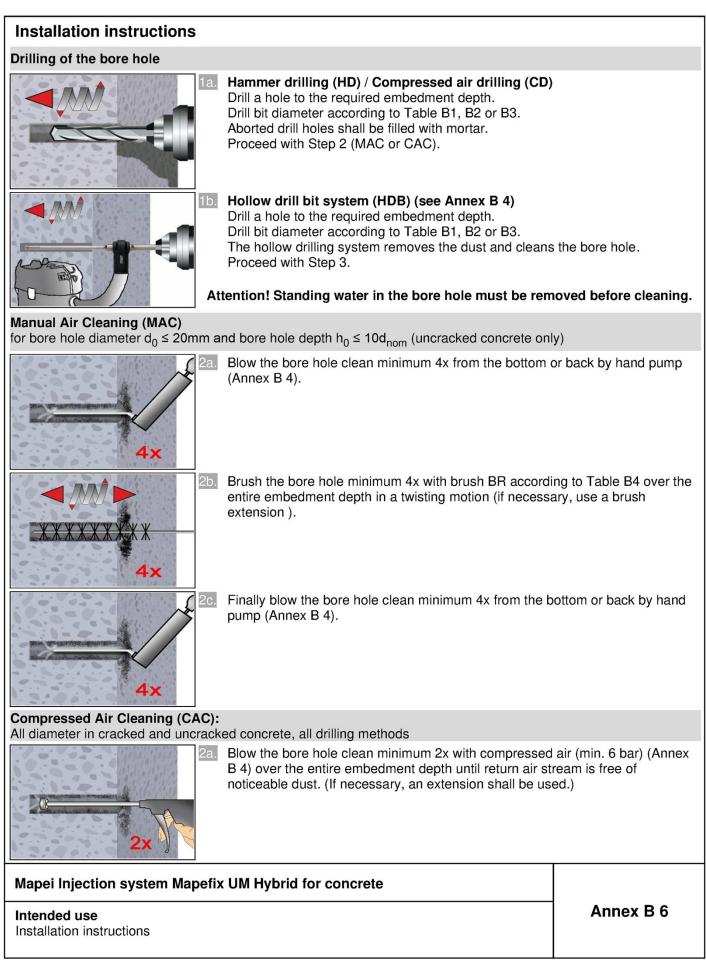
1) The minimum curing time is only valid for dry base material.

In wet base material the curing time must be doubled.

## Mapei Injection system Mapefix UM Hybrid for concrete

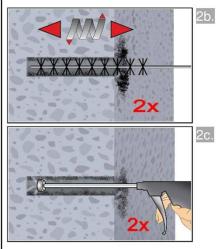
Intended use Working time and curing time Annex B 5





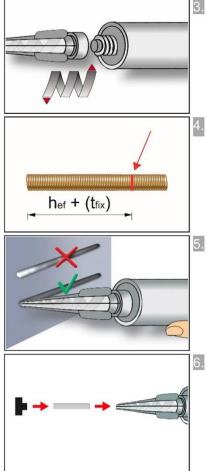


#### Installation instructions (continuation)



- Brush the bore hole minimum 2x with brush BR according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used .)
- Finally blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

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



Screw on static-mixing nozzle PM-19E and load the cartridge into an appropriate dispensing tool.

For every working interruption longer than the maximum working time t<sub>work</sub> (Annex B 5) as well as for new cartridges, a new static-mixer shall be used.

Mark embedment depth on the anchor rod. Consider  ${\rm t}_{\rm fix}$  in case of push through installations.

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

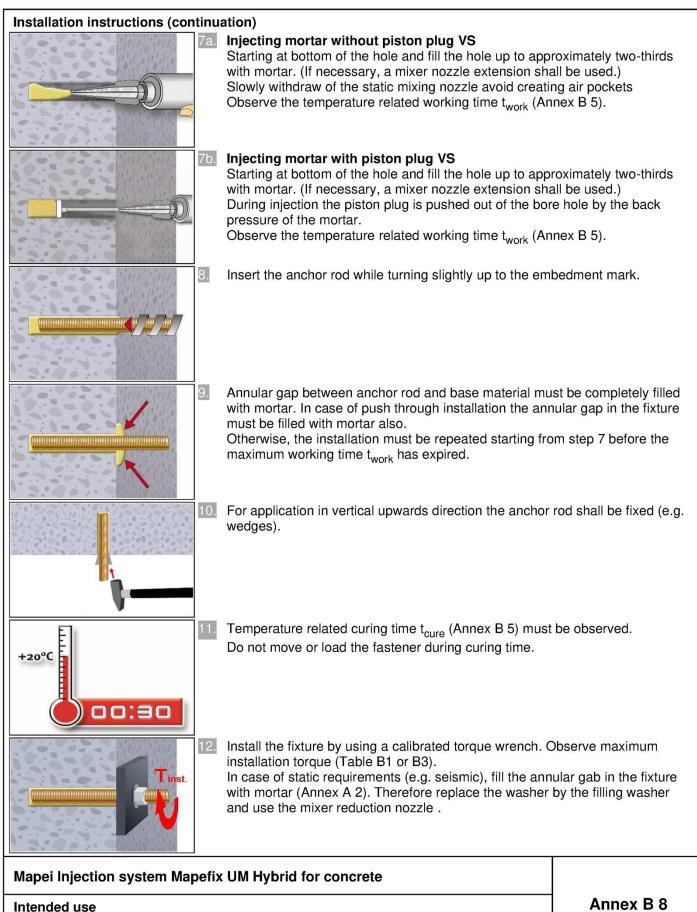
Not proper mixed mortar is not sufficient for fastening. Dispense and discard mortar until an uniform grey colour is shown (at least 3 full strokes).

- Piston plugs VS and mixer nozzle extensions VL shall be used according to Table B4 for the following applications:
- Horizontal and vertical downwards direction: Drill bit-Ø d<sub>0</sub> ≥ 18 mm and embedment depth h<sub>ef</sub> > 250mm
- Vertical upwards direction: Drill bit-Ø d<sub>0</sub> ≥ 18 mm
   Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.

#### Mapei Injection system Mapefix UM Hybrid for concrete

Intended use Installation instructions (continuation) Annex B 7





Installation instructions (continuation)

Annex B 8



T	able C1: Characteristic values resistance of threade			ension	resist	ance	and s	teel s	hear		
Th	readed rod			M8	M10	M12	M16	M20	M24	M27	M30
Cr	oss section area	A <sub>s</sub>	[mm²]	36,6	58	84,3	157	245	353	459	561
Cł	naracteristic tension resistance, Steel failu	re <sup>1)</sup>									
St	eel, Property class 4.6 and 4.8	N <sub>Rk,s</sub>	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
St	eel, Property class 5.6 and 5.8	N <sub>Rk,s</sub>	[kN]	18 (17)	29 (27)	42	78	122	176	230	280
St	eel, Property class 8.8	N <sub>Rk,s</sub>	[kN]	29 (27)	46 (43)	67	125	196	282	368	449
Sta	ainless steel A2, A4 and HCR, class 50	N <sub>Rk,s</sub>	[kN]	18	29	42	7 <b>9</b>	123	177	230	281
St	ainless steel A2, A4 and HCR, class 70	N <sub>Rk,s</sub>	[kN]	26	41	59	110	171	247	_3)	_3)
St	ainless steel A4 and HCR, class 80	N <sub>Rk,s</sub>	[kN]	29	46	67	126	196	282	_3)	_3)
Cł	naracteristic tension resistance, Partial fac	tor <sup>2)</sup>									
St	eel, Property class 4.6 and 5.6	γ <sub>Ms,N</sub>	[-]				2,0	C			
St	eel, Property class 4.8, 5.8 and 8.8	γ <sub>Ms,N</sub>	[-]				1,	5			
Sta	ainless steel A2, A4 and HCR, class 50	γ <sub>Ms,N</sub>	[-]				2,8	6			
Sta	ainless steel A2, A4 and HCR, class 70	γ <sub>Ms,N</sub>	[-]				1,8	7			
Sta	ainless steel A4 and HCR, class 80	γ <sub>Ms,N</sub>	[-]				1,6	6			
Cł	naracteristic shear resistance, Steel failure	1)	1								
۶	Steel, Property class 4.6 and 4.8	V <sup>0</sup> Rk,s	[kN]	9 (8)	14 (13)	20	38	59	85	110	135
r arm	Steel, Property class 5.6 and 5.8	V <sup>0</sup> Rk,s	[kN]	11 (10)	17 (16)	25	47	74	106	138	168
lever	Steel, Property class 8.8	V <sup>0</sup> Rk,s	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
	Stainless steel A2, A4 and HCR, class 50	V <sup>0</sup> Rk,s	[kN]	9	15	21	3 <del>9</del>	61	88	115	140
Without	Stainless steel A2, A4 and HCR, class 70	V <sup>0</sup> Rk,s	[kN]	13	20	30	55	86	124	_3)	_3)
5	Stainless steel A4 and HCR, class 80	V <sup>0</sup> <sub>Rk,s</sub>	[kN]	15	23	34	63	98	141	_3)	_3)
	Steel, Property class 4.6 and 4.8	M <sup>0</sup> <sub>Rk,s</sub>	[Nm]	15 (13)	30 (27)	52	133	260	449	666	900
arm	Steel, Property class 5.6 and 5.8	M <sup>0</sup> <sub>Rk,s</sub>	[Nm]	19 (16)	37 (33)	65	166	324	560	833	1123
	Steel, Property class 8.8	M <sup>0</sup> Rk,s	[Nm]	30 (26)	60 (53)	105	266	519	896	1333	1797
h lever	Stainless steel A2, A4 and HCR, class 50	M <sup>0</sup> Rk,s	[Nm]	19	37	66	167	325	561	832	1125
_	Stainless steel A2, A4 and HCR, class 70	M <sup>0</sup> <sub>Rk,s</sub>	[Nm]	26	52	92	232	454	784	_3)	_3)
	Stainless steel A4 and HCR, class 80	M <sup>0</sup> Rk,s	[Nm]	30	59	105	266	519	896	_3)	_3)
Cł	naracteristic shear resistance, Partial facto										
St	eel, Property class 4.6 and 5.6	γ <sub>Ms,V</sub>	[-]				1,6	7			
St	eel, Property class 4.8, 5.8 and 8.8	γ <sub>Ms,V</sub>	[-]				1,2	5			
St	ainless steel A2, A4 and HCR, class 50	γ <sub>Ms,V</sub>	[-]				2,3	8			
St	ainless steel A2, A4 and HCR, class 70	γ <sub>Ms,V</sub>	[-]				1,5	6			
Sta	ainless steel A4 and HCR, class 80	γ <sub>Ms,V</sub>	[-]				1,3	3			
1	) Values are only valid for the given stress area	A <sub>s</sub> , Value	s in bra	ckets are	e valid for	unders	ized thr	eaded r	ods with	smaller	r

 Values are only valid for the given stress area A<sub>s</sub>. Values in brackets are valid for undersized threaded rods with smaller stress area A<sub>s</sub> for hot-dip galvanised threaded rods according to EN ISO 10684:2004+AC:2009.

2) in absence of national regulation

3) Fastener type not part of the ETA

#### Mapei Injection system Mapefix UM Hybrid for concrete

#### Performances

Characteristic values for steel tension resistance and steel shear resistance of threaded rods

Annex C 1



#### Table C2: Characteristic values of tension loads under static and quasi-static action for a working life of 50 and 100 years Fastener All Anchor types and sizes Concrete cone failure k<sub>ucr,N</sub> Uncracked concrete [-] 11,0 Cracked concrete k<sub>cr,N</sub> 7,7 [-] 1,5 h<sub>ef</sub> Edge distance [mm] C<sub>cr.N</sub> Axial distance 2 c<sub>cr,N</sub> s<sub>cr,N</sub> [mm] Splitting $h/h_{ef} \ge 2,0$ 1,0 h<sub>ef</sub> h 2 · h<sub>ef</sub> 2,5 2,0 > h/h<sub>ef</sub> > 1,3 Edge distance c<sub>cr,sp</sub> [mm] h/h<sub>ef</sub> ≤ 1,3 2,4 h<sub>ef</sub> 2 c<sub>cr,sp</sub> Axial distance [mm] s<sub>cr,sp</sub>

#### Mapei Injection system Mapefix UM Hybrid for concrete

**Performances** Characteristic values of tension loads under static and quasi-static action for a working life of 50 and 100 years Annex C 2



Tabl		acteristic va working life			s uno	der st	atic a	and q	uasi-	static	actio	on
Thread	led rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel fa			1	1								
	teristic tension resi	stance	N <sub>Rk,s</sub>	[kN]			A <sub>s</sub> ∙ f <sub>l</sub>	ık (or s		le C1)		
Partial			Ϋ́Ms,N	[-]				see Ta	ible C1			
	ned pull-out and one teristic bond resistation bond resis		d concrete C20	/25								
				1	47	47	10	4.5	14	10	10	10
ranç	I: 24°C/40°C	Dr. wet	<sup>7</sup> Rk,ucr	[N/mm <sup>2</sup> ]	17	17	16	15	14	13	13	13
Temperature range	II: 50°C/80°C	Dry, wet concrete and flooded bore	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	17	17	16	15	14	13	13	13
upera	III: 72°C/120°C	hole	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	15	14	14	13	12	12	11	11
Ter	IV: 100°C/160°C		<sup>τ</sup> Rk,ucr	[N/mm²]	12	11	11	10	9,5	9,0	9,0	9,0
	teristic bond resista	ance in cracked c	oncrete C20/2	5								
Temperature range	I: 24°C/40°C	Day wat	<sup>τ</sup> Rk,cr	[N/mm <sup>2</sup> ]	7,0	7,5	8,0	9,0	8,5	7,0	7,0	7,0
ture	II: 50°C/80°C	Dry, wet concrete and	<sup>τ</sup> Rk,cr	[N/mm <sup>2</sup> ]	7,0	7,5	8,0	9,0	8,5	7,0	7,0	7,0
Ipera	III: 72°C/120°C	flooded bore hole	<sup>τ</sup> Rk,cr	[N/mm <sup>2</sup> ]	6,0	6,5	7,0	7,5	7,0	6,0	6,0	6,0
· · · · · · · · · · · · · · · · · · ·	IV: 100°C/160°C		<sup>τ</sup> Rk,cr	[N/mm²]	5,5	5,5	6,0	6,5	6,0	5,5	5,5	5,5
	tion factor ψ <sup>0</sup> sus in c	cracked and uncr	acked concrete	e C20/25								
Temperature range	I: 24°C/40°C							0,	90			
ture r	II: 50°C/80°C	Dry, wet concrete and	Ψ <sup>0</sup> sus	[-]				0,	87			
ipera:	III: 72°C/120°C	flooded bore hole	+ sus					0,	75			
Tem	IV: 100°C/160°C							0,0	66			
Increas	sing factors for conc	crete	Ψc	[-]				(f <sub>ck</sub> / 2	20) <sup>0,1</sup>			
I	teristic bond resista			τ <sub>Rk,ucr</sub> =				• <sup>τ</sup> Rk,u				
	concrete strength c	1455		<sup>τ</sup> Rk,cr =			Ψ	: <sup>• τ</sup> Rk,α	cr,(C20/2	25)		
	ete cone failure nt parameter							see Ta	hle C2			
Splittir								300 10				
	nt parameter							see Ta	ble C2			
Installa	ation factor	I	T	1							_	
forday	and wat concrete	МАС					1,2			No Per ass	formar essed	ice
	and wet concrete	CAC	γ <sub>inst</sub>	[-]					,0			
for floo	ded bore hole	HDB CAC	-						,2 ,4			
				1					, <del>-</del>			
Маре	i Injection syste	m Mapefix UM	Hybrid for c	oncrete								
Chara	r <b>mances</b> cteristic values of ter vorking life of 50 yea		static and quas	i-static actio	n					Anne	x C 3	



Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel failure						• •	,				
Characteristic tension res	istance	N <sub>Rk,s</sub>	[kN]					ee Tab			
Partial factor		γ <sub>Ms,N</sub>	[-]				see Ta	able C1			
Combined pull-out and											
Characteristic bond resist	tance in uncracke	ed concrete C2	0/25								
I: 24°C/40°C auge II: 50°C/80°C	Dry, wet concrete and	<sup>τ</sup> Rk,ucr,100	[N/mm <sup>2</sup> ]	17	17	16	15	14	13	13	13
법 <sup>변</sup> II: 50°C/80°C	flooded bore hole	<sup>τ</sup> Rk,ucr,100	[N/mm²]	17	17	16	15	14	13	13	13
Characteristic bond resis	tance in cracked	concrete C20/2	25								
Temperature range II: 24°C/40°C II: 50°C/80°C	Dry, wet concrete and	<sup>7</sup> Rk,cr,100	[N/mm²]	5,5	6,0	6,5	6,5	6,5	6,5	6,5	6,5
ور ال: 20°C/80°C	flooded bore hole	<sup>τ</sup> Rk,cr,100	[N/mm²]	5,5	6,0	6,5	6,5	6,5	6,5	6,5	6,5
Reduktion factor $\psi^0_{sus,10}$	o in cracked and	uncracked con	crete C20/2	5							
,	Dry, wet concrete and						0,	90			
Temperature I: 24°C/40°C II: 50°C/80°C	flooded bore hole	Ψ <sup>0</sup> sus,100	[-]				0,	87			
Increasing factors for con	crete	Ψc	[-]				(f <sub>ck</sub> /	<b>20</b> ) <sup>0,1</sup>			
Characteristic bond resist			Rk,ucr,100 =			Ψ.		r,100,(C	20/25)		
on the concrete strength								,100,(C2			
Concrete cone failure			<sup>c</sup> Rk,cr,100 =			τc	*HK,Cr	,100,(02	.0/25)		
Relevant parameter							see Ta	able C2	2		
Splitting											
Relevant parameter							see Ta	able C2	2		
Installation factor	-	-									
for dry and wet concrete	MAC	_				1,2				rformar sessed	ice
····, ····	CAC HDB	γ <sub>inst</sub>	[-]					,0 ,2			
for flooded bore hole	CAC	-						, <u>2</u> ,4			
Mapei Injection systemeters	em Mapefix UM	l Hybrid for c	concrete						Anne	ex C 4	



Table C5: Characteristic for a working I					nder s	tatic a	nd qu	asi-sta	atic acti	on
Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure without lever arm										
Characteristic shear resistance Steel, strength class 4.6, 4.8 and 5.6, 5.8	V <sup>0</sup> Rk,s	[kN]			0,6 •	A <sub>s</sub> ∙f <sub>uk</sub>	(or see	Table C	1)	
Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A2, A4 and HCR, all strength classes	V <sup>0</sup> Rk,s	[kN]			0,5 ·	A <sub>s</sub> ∙f <sub>uk</sub>	(or see	Table C	1)	
Partial factor	γ <sub>Ms</sub> ,∨	[-]				see	Table C	1		
Ductility factor	k7	[-]					1,0			
Steel failure with lever arm										
Characteristic bending moment	M <sup>0</sup> Rk,s	[Nm]			1,2•	W <sub>el</sub> • f <sub>uk</sub>	(or see	Table C	;1)	
Elastic section modulus	W <sub>el</sub>	[mm³]	31	62	109	277	541	935	1387	1874
Partial factor	γ <sub>Ms,V</sub>	[-]				see	Table C	1		
Concrete pry-out failure										
Factor	k <sub>8</sub>	[-]					2,0			
Installation factor	γ <sub>inst</sub>	[-]					1,0			
Concrete edge failure										
Effective length of fastener	<sub>f</sub>	[mm]		m	nin(h <sub>ef</sub> ; 1	2 · d <sub>nor</sub>	m)		min(h <sub>ef</sub> ;	300mm)
Outside diameter of fastener	d <sub>nom</sub>	[mm]	8	10	12	16	20	24	27	30
Installation factor	γinst	[-]					1,0			

#### Mapei Injection system Mapefix UM Hybrid for concrete

**Performances** Characteristic values of shear loads under static and quasi-static action for a working life of 50 and 100 years (threaded rod) Annex C 5



Table		aracteristi a working				bads ur	ider sta	tic and	quasi-s	static ac	tion
Interna	I threaded anc	nor rods				IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Steel fa	ailure <sup>1)</sup>						•	•			
Charac	teristic tension r	esistance,	5.8	N <sub>Rk,s</sub>	[kN]	10	17	29	42	76	123
Steel, s	trength class		8.8	N <sub>Rk,s</sub>	[kN]	16	27	46	67	121	196
Partial f	factor, strength	lass 5.8 and l	8.8	γ <sub>Ms,N</sub>	[-]		1	1	,5	I	
	teristic tension r 4 and HCR, Stre			N <sub>Rk,s</sub>	[kN]	14	26	41	59	110	124
Partial 1	factor	_		γ <sub>Ms,N</sub>	[-]		•	1,87	•		2,86
Combi	ned pull-out an	d concrete c	one failu	re							
Charac	teristic bond res	istance in unc	racked co	oncrete C	20/25			1			
nre	I: 24°C/40°C			<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	17	16	15	14	13	13
nperati range	II: 50°C/80°C	Dry, wet c	oncrete	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	17	16	15	14	13	13
Temperature range	III: 72°C/120°C	flooded bo	ore hole	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	14	14	13	12	12	11
Te	IV: 100°C/160	C		<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	11	11	10	9,5	9,0	9,0
Charac	teristic bond res	istance in crac	cked cond	crete C20	)/25				<b>_</b>		
nre	I: 24°C/40°C			<sup>τ</sup> Rk,cr	[N/mm <sup>2</sup> ]	7,5	8,0	9,0	8,5	7,0	7,0
Temperature range	II: 50°C/80°C	Dry, wet c	oncrete	<sup>τ</sup> Rk,cr	[N/mm <sup>2</sup> ]	7,5	8,0	9,0	8,5	7,0	7,0
rar rar	III: 72°C/120°C	flooded bo	ore hole	<sup>τ</sup> Rk,cr	[N/mm²]	6,5	7,0	7,5	7,0	6,0	6,0
Te	IV: 100°C/160	rc 🛛		<sup>τ</sup> Rk,cr	[N/mm <sup>2</sup> ]	5,5	6,0	6,5	6,0	5,5	5,5
Redukt	ion factor $\psi^0_{sus}$	in cracked and	d uncrack	ed conci	rete C20/2	5					
e	I: 24°C/40°C							0,	90		
ge	II: 50°C/80°C	Dry, wet c	oncrete					0,	87		
Temperature range	III: 72°C/120°C	and flooded bo	ore hole	$\Psi^0$ sus	[-]			0,	75		
Ten	IV: 100°C/160							0,	66		
Increas	ing factors for c	oncrete		Ψc	[-]			(f <sub>ck</sub> /	<b>20</b> ) <sup>0,1</sup>		
Charac	teristic bond res	istance dener	ding on		τ <sub>Rk,ucr</sub> =				ucr,(C20/25)	1	
	crete strength c				$\tau_{\rm Rk,cr} =$				cr,(C20/25)		
Concre	ete cone failure				110,01			· • • • • •	01,(020/20/		
Releva	nt parameter							see Ta	able C2		
Splittin	g failure										
-	nt parameter							see Ta	able C2		
Installa	tion factor			T			10				
for dry	and wet concret	MAC e CAC		-			1,2	1	,0	ormance a	issessed
		HDB		γinst	[-]				,0 ,2		
for flood	ded bore hole	CAC		1					<u>,-</u> ,4		
The	tenings (incl. nut characteristic te IG-M20 strength	nsion resistanc	e for stee	ly with the I failure is	appropria valid for th	te materia e internal	l and prop threaded r	erty class o od and the	of the internet fastening	nal threade element.	ed rod.
Маре	i Injection sys	stem Mapefi	x UM Hy	/brid fo	r concret	e					
Charac	mances cteristic values o rorking life of 50 y					iction				Annex (	C 6



Interna	al threaded ancho	r rods			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Steel fa	ailure <sup>1)</sup>							I		
Charac	teristic tension res	istance, 5.8	N <sub>Rk,s</sub>	[kN]	10	17	29	42	76	123
Steel, s	strength class	8.8	N <sub>Rk,s</sub>	[kN]	16	27	46	67	121	196
Partial	factor, strength cla	ss 5.8 and 8.8	γ <sub>Ms,N</sub>	[-]			. 1	,5		
	teristic tension res 4 and HCR, Streng		N <sub>Rk,s</sub>	[kN]	14	26	41	59	110	124
Partial	factor		γ <sub>Ms,N</sub>	[-]			1,87			2,86
	•	concrete cone fail								
	teristic bond resist	ance in uncracked	concrete C	20/25		Т		1	r	
Temperature range	l: 24°C/40°C	Dry, wet concrete and	<sup>τ</sup> Rk,ucr,100	[N/mm²]	17	16	15	14	13	13
Temp rai	II: 50°C/80°C	flooded bore hole	<sup>τ</sup> Rk,ucr,100	[N/mm²]	17	16	15	14	13	13
Charac	teristic bond resist	ance in cracked co	ncrete C20/	(25		1			1	
Temperature range	l: 24°C/40°C	Dry, wet concrete and	<sup>τ</sup> Rk,cr,100	[N/mm²]	6,0	6,5	6,5	6,5	6,5	6,5
Tempe rar	II: 50°C/80°C	flooded bore hole	<sup>τ</sup> Rk,cr,100	[N/mm²]	6,0	6,5	6,5	6,5	6,5	6,5
Redukt	tion factor $\psi^0_{sus,100}$	0 in cracked and ur	cracked co	ncrete C2	20/25				•	
Temperature range	l: 24°C/40°C	Dry, wet concrete	Ψ <sup>0</sup> sus,100	[-]			0,	.90		
Tempe rar	II: 50°C/80°C	flooded bore hole	♥ SUS,100				0,	.87		
Increas	sing factors for con	crete	Ψς	[-]			(f <sub>ck</sub> /	20) <sup>0,1</sup>		
Charac	teristic bond resist	ance depending	τ <sub>Rk,ι</sub>	ucr,100 =		ų	ν <sub>c</sub> •τ <sub>Rk,uc</sub>	r,100,(C20/2	25)	
	concrete strength o			,cr,100 =		۱	Ψc <sup>• τ</sup> Rk,cr	.100.(C20/2	5)	
Concre	ete cone failure			,,				, , (	- /	
	nt parameter						see Ta	able C2		
	ng failure									
	nt parameter ation factor						see Ta	able C2		
instana	ation factor	MAC				1,2			ormance a	eeneen
for drv	and wet concrete	CAC	-			۲,۲	1	,0	ormanoe a	13303300
		HDB	<sup>Y</sup> inst	[-]				,2		
for floo	ded bore hole	CAC	]				1	,4		
The		d washer) must con on resistance for ste ass 50 is valid								ed rod.
Mape	i Injection syste	m Manefix IIM I		concret	·A					

for a working life of 100 years (internal threaded anchor rod)



Internal threaded anchor rods				IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Steel failure without lever arm <sup>1</sup>	)							•	
Characteristic shear resistance.	5.8	V <sup>0</sup> Rk,s	[kN]	5	9	15	21	38	61
Steel, strength class	8.8	V <sup>0</sup> Rk,s	[kN]	8	14	23	34	60	98
Partial factor, strength class 5.8 a	and 8.8	γ <sub>Ms,V</sub>	[-]			•	1,25		
Characteristic shear resistance, Stainless Steel A4 and HCR, Strength class 70 <sup>2)</sup>		V <sup>0</sup> Rk,s	[kN]	7	13	20	30	55	40
Partial factor		γ <sub>Ms,V</sub>	[-]		-	1,56			2,38
Ductility factor		k <sub>7</sub>	[-]				1,0		
Steel failure with lever arm <sup>1)</sup>									
Characteristic bending moment,	5.8	M <sup>0</sup> Rk,s	[Nm]	8	19	37	66	167	325
Steel, strength class	8.8	M <sup>0</sup> Rk,s	[Nm]	12	30	60	105	267	519
Partial factor, strength class 5.8 a	and 8.8	γ <sub>Ms,V</sub>	[-]				1,25		
Characteristic bending moment, Stainless Steel A4 and HCR, Strength class 70 <sup>2)</sup>		M <sup>0</sup> Rk,s	[Nm]	11	26	52	92	233	456
Partial factor		γ <sub>Ms,V</sub>	[-]			1,56			2,38
Concrete pry-out failure									
Factor		k <sub>8</sub>	[-]				2,0		
Installation factor		γ <sub>inst</sub>	[-]				1,0		
Concrete edge failure									
Effective length of fastener		l <sub>f</sub>	[mm]		min	(h <sub>ef</sub> ; 12 • c	h <sub>nom</sub> )		min(h <sub>ef</sub> ; 300mr
Outside diameter of fastener		d <sub>nom</sub>	[mm]	10	12	16	20	24	30
Installation factor		γ <sub>inst</sub>	[-]		1		1,0		1
<ol> <li>Fastenings (incl. nut and washe The characteristic tension resis</li> <li>For IG-M20 strength class 50 is</li> </ol>	tance for								
								r	



Tabl		acteristic working l			n loa	ds u	nder	stati	c and	d qua	asi-si	tatic	actio	n
Reinfo	rcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel f	ailure		T											
Charac	cteristic tension resi	stance	N <sub>Rk,s</sub>	[kN]					A <sub>s</sub> ·	f <sub>uk</sub> 1)				
Cross :	section area		A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial			γ <sub>Ms,N</sub>	[-]					1,	4 <sup>2)</sup>				
	ined pull-out and o													
	cteristic bond resista								10	10			10	
Temperature range	l: 24°C/40°C	Dry, wet concrete	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	14	14	14	14	13	13	13	13	13	13
nperat ange	II: 50°C/80°C	and	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	14	14	14	14	13	13	13	13	13	13
emp	III: 72°C/120°C	flooded	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	13	12	12	12	12	11	11	11	11	11
	IV: 100°C/160°C	bore hole	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	9,5	9,5	9,5	9,0	9,0	9,0	9,0	9,0	8,5	8,5
-	steristic bond resista						0.0	0.5	0.5	0.5	0.5	7.0	7.0	70
ture	I: 24°C/40°C	Dry, wet concrete	<sup>τ</sup> Rk,cr	[N/mm <sup>2</sup> ]	5,5	5,5	6,0	6,5	6,5	6,5	6,5	7,0	7,0	7,0
Temperature range	II: 50°C/80°C	and	<sup>τ</sup> Rk,cr	[N/mm²]	5,5	5,5	6,0	6,5	6,5	6,5	6,5	7,0	7,0	7,0
emp ra	III: 72°C/120°C	flooded	<sup>τ</sup> Rk,cr	[N/mm²]	4,5	5,0	5,0	5,5	5,5	5,5	5,5	6,0	6,0	6,0
-	IV: 100°C/160°C	bore hole	<sup>τ</sup> Rk,cr	[N/mm <sup>2</sup> ]	4,0	4,5	4,5	5,0	5,0	5,0	5,0	5,0	5,0	5,0
Redukt	tion factor $\psi^0_{sus}$ in $c$	cracked and u	incracked co	oncrete C2	20/25									
l en	l: 24°C/40°C	Dry, wet							0,	90				
nperatu range	II: 50°C/80°C	concrete and	$\Psi^0$ sus	[-]					0,	87				
Temperature range	III: 72°C/120°C	flooded bore hole	1 303						0,	75				
	IV: 100°C/160°C								0,					
	sing factors for conc		Ψc	[-]					(f <sub>ck</sub> / :	20) 0,1				
	teristic bond resista			τ <sub>Rk,ucr</sub> =					• <sup>τ</sup> Rk,ι					
class				<sup>τ</sup> Rk,cr =				Ψc	• <sup>τ</sup> Rk,	cr,(C20	/25)			
	ete cone failure								see Ta					
Splittir	int parameter								see 1a		<u> </u>			
	nt parameter								see Ta	ble C2	>			
	ation factor										-			
		MAC					1,2			No	Perfor	mance	asses	ssed
for dry	and wet concrete	CAC	γ <sub>inst</sub>	[-]					1	,0				
		HDB	inst -							,2				
	ded bore hole	CAC							1	,4				
	shall be taken from t bsence of national re		ns of reinford	ang bars										
Perfo Chara	ei Injection syste rmances acteristic values of ten vorking life of 50 yea	nsion loads un	•			ion					А	nnex	c C 9	



	racteristic working l			n Ioa	ds ui	nder	stati	c an	d qua	asi-st	atic	actio	n
Reinforcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure													•
Characteristic tension res	sistance	N <sub>Rk,s</sub>	[kN]					As	• f <sub>uk</sub> 1)				
Cross section area		As	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γ <sub>Ms,N</sub>	[-]					1.	,4 <sup>2)</sup>				
Combined pull-out and													
Characteristic bond resist		cked concre	te C20/25						1				
H: 24°C/40°C	Dry, wet concrete and	<sup>τ</sup> Rk,ucr,100	[N/mm <sup>2</sup> ]	14	14	14	14	13	13	13	13	13	13
0 ₪ II: 50°C/80°C	flooded bore hole	<sup>τ</sup> Rk,ucr,100	[N/mm²]	14	14	14	14	13	13	13	13	13	13
Characteristic bond resist	tance in crack	ed concrete	C20/25			1							
L: 24°C/40°C	Dry, wet concrete and	<sup>τ</sup> Rk,cr,100	[N/mm²]	4,5	4,5	4,5	4,5	4,5	4,0	4,0	4,0	4,0	4,0
	flooded bore hole	<sup>τ</sup> Rk,cr,100	[N/mm²]	4,5	4,5	4,5	4,5	4,5	4,0	4,0	4,0	4,0	4,0
Reduktion factor $\psi^0_{sus,10}$	<sub>0</sub> in cracked a	nd uncracke	d concrete	e C20/2	25								
L: 24°C/40°C	Dry, wet concrete and	Ψ <sup>0</sup> sus,100	[-]					0	,90				
u u u u u u u u u u u u u u	flooded bore hole	+ sus,100							,87				
Increasing factors for con	crete	Ψc	[-]					(f <sub>ck</sub> /	20) <sup>0,1</sup>				
Characteristic bond resist depending on the concret		<sup>τ</sup> Rk	.,ucr,100 =				$\psi_{c}$ .	<sup>τ</sup> Rk,uc	r,100,(C	20/25)			
class	le stiengtri	τ <sub>R</sub>	k,cr,100 =				Ψ <b>c</b> •	$\tau$ Rk,cr	,100,(C	20/25)			
Concrete cone failure													
Relevant parameter								see Ta	able C	2			
Splitting Belowert recorder								T		<u> </u>			
Relevant parameter								see 1	able C	2			
	MAC	1				1,2			No	Perfor	mance	9556	sed
for dry and wet concrete	CAC	-				1,5		1	,0		manoc	. 4000.	3300
	HDB	γ <sub>inst</sub>	[-]						,2 ,2				
for flooded bore hole	CAC							1	,4				
<ol> <li><sup>1)</sup> f<sub>uk</sub> shall be taken from</li> <li><sup>2)</sup> in absence of national i</li> </ol>		ons of reinford	cing bars										
Mapei Injection system Performances Characteristic values of te for a working life of 100 ye	- ension loads ur	-			on					A	nnex	C 10	)



		Ø8	~								
		-	01 ש	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
								t			
V <sup>0</sup> Rk,s	[kN]					0,50	۰As・	f <sub>uk</sub> 1)			
A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
γ <sub>Ms,</sub> ∨	[-]						1,5 <sup>2)</sup>				
k <sub>7</sub>	[-]						1,0				
M <sup>0</sup> Rk,s	[Nm]					1.2 •	w <sub>el</sub> ·	f <sub>uk</sub> 1)			
W <sub>el</sub>	[mm³]	50	98	170	269	402	785	1357	1534	2155	3217
γ <sub>Ms,V</sub>	[-]						1,5 <sup>2)</sup>				
k <sub>8</sub>	[-]						2,0				
γ <sub>inst</sub>	[-]						1,0				
l <sub>f</sub>	[mm]		r	nin(h <sub>e</sub>	,;12 ∙	d <sub>nom</sub>	)		min(l	h <sub>ef</sub> ; 300	mm)
d <sub>nom</sub>	[mm]	8	10	12	14	16	20	24	25	28	32
γ <sub>inst</sub>	[-]						1,0				
	YMs,V         k7         M <sup>0</sup> Rk,s         Wel         YMs,V         k8         Yinst         If         dnom         Yinst         ons of reinfo	A <sub>s</sub> [mm <sup>2</sup> ]         YMs,V       [-]         k <sub>7</sub> [-]         M <sup>0</sup> <sub>Rk,s</sub> [Nm]         W <sub>el</sub> [mm <sup>3</sup> ]         YMs,V       [-]         YMs,V       [-]         YMs,V       [-]         Ymst       [-]         Yinst       [-]	A <sub>s</sub> [mm²]         50           YMs,V         [-]            k <sub>7</sub> [-]            M <sup>0</sup> <sub>Rk,s</sub> [Nm]            W <sub>el</sub> [mm³]         50           YMs,V         [-]            K <sub>8</sub> [-]            Yinst         [-]            I <sub>f</sub> [mm]         8           Yinst         [-]		As       [mm²]       50       79       113 $\gamma_{Ms,V}$ [-]	$A_s$ [mm²]       50       79       113       154 $\gamma_{Ms,V}$ [-]	A <sub>s</sub> [mm²]         50         79         113         154         201           YMs,V         [-]	$A_s$ [rmm²]         50         79         113         154         201         314 $\gamma_{Ms,V}$ [-]	As       [mm2]       50       79       113       154       201       314       452         YMs,V       [-]       I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> I.0         M <sup>0</sup> <sub>Rk,s</sub> [Nm]       I.2 · Vell · fuk <sup>1)</sup> Vell · fuk <sup>1)</sup> Wel       [mm <sup>3</sup> ]       50       98       170       269       402       785       1357         YMs,V       [-]       I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> Mel       [mm <sup>3</sup> ]       50       98       170       269       402       785       1357         YMs,V       [-]       I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> K8       [-]       I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> K9       [-]       I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> K9       [-]       I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> K9       [-]       I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> K9       [-]       I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> I.5 <sup>2</sup> K9       [-]       IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$\begin{array}{ c c c c c c c c c c c c c c c c c c c$

**Performances** Characteristic values of shear loads under static and quasi-static action for a working life of 50 and 100 years (rebar) Annex C 11



Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Uncracked concrete C	20/25 under s	tatic and quasi-s	tatic acti	on for a	working	g life of	50 and 1	100 year	s	
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,031	0,032	0,034	0,037	0,039	0,042	0,044	0,046
I: 24°C/40°C II: 50°C/80°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,040	0,042	0,044	0,047	0,051	0,054	0,057	0,06
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,032	0,034	0,035	0,038	0,041	0,044	0,046	0,04
III: 72°C/120°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,042	0,044	0,045	0,049	0,053	0,056	0,059	0,06
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,121	0,126	0,131	0,142	0,153	0,163	0,171	0,17
IV: 100°C/160°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,124	0,129	0,135	0,146	0,157	0,168	0,176	0,18
Cracked concrete und	er static and o	quasi-static actio	n for a w	orking l	ife of 50	and 10	0 years			
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,081	0,083	0,085	0,090	0,095	0,099	0,103	0,10
l: 24°C/40°C ll: 50°C/80°C	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,104	0,107	0,110	0,116	0,122	0,128	0,133	0,13
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,084	0,086	0,088	0,093	0,098	0,103	0,107	0,11
III: 72°C/120°C	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,108	0,111	0,114	0,121	0,127	0,133	0,138	0,14
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,312	0,321	0,330	0,349	0,367	0,385	0,399	0,41
IV: 100°C/160°Č	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,321	0,330	0,340	0,358	0,377	0,396	0,410	0,42
		ction bond stress fo	r load <sup>1)</sup>	r	1	]	1			
$     \delta_{N\infty} = \delta_{N\infty} $ -factor · τ; <b>Table C13: Dis</b> [hreaded rod	र: a placement	s under shea	r load <sup>1)</sup> M8	M10	M12	M16	M20	M24	M27	МЗ
$     \delta_{N\infty} = \delta_{N\infty} - factor + τ; $ Table C13: Dis Threaded rod Uncracked and cracke	τ: a placement d concrete un	s under shear	r load <sup>1)</sup> M8 Jasi-stati	M10	for a w	orking li	ife of 50	and 100	) years	
$ δ_{N\infty} = δ_{N\infty} - factor + τ; $ Table C13: Dis Threaded rod Jncracked and cracke All temperature $ δ_V $	τ: a placement d concrete un r <sub>0</sub> -factor	s under shear	r load <sup>1)</sup> M8 Jasi-stati	M10 ic action 0,06	<b>for a w</b> 0,05	orking li 0,04	ife of 50	and 100	<b>) years</b> 0,03	0,0
$\delta_{N\infty} = \delta_{N\infty} - factor + \tau;$ <b>Table C13: Dis Threaded rod Uncracked and cracke</b> All temperature $\frac{\delta_V}{\delta_V}$ <sup>1)</sup> Calculation of the disp	τ: a placement d concrete un $r_0$ -factor $r_\infty$ -factor placement	s under shear der static and qu [mm/kN] [mm/kN]	r load <sup>1)</sup> M8 Jasi-stati	M10	for a w	orking li	ife of 50	and 100	) years	<b>M3</b> ( 0,03
$     \delta_{N\infty} = \delta_{N\infty} - factor + τ; $ <b>Table C13: Dis</b> <b>Threaded rod</b> <b>Jncracked and cracke</b> All temperature $\frac{\delta_V}{\delta_V}$	τ: a placement d concrete un $r_0$ -factor $r_\infty$ -factor placement	s under shear	r load <sup>1)</sup> M8 Jasi-stati	M10 ic action 0,06	<b>for a w</b> 0,05	orking li 0,04	ife of 50	and 100	<b>) years</b> 0,03	0,0



Internal threaded	anchor rods			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Uncracked concr	ete under statio	and quasi-	static actio	on for a w	orking life	of 50 and	100 years	-1	
Temperature ra		or [mm	/( <b>N</b> /mm²)]	0,032	0,034	0,037	0,039	0,042	0,046
I: 24°C/40°C II: 50°C/80°C		tor [mm,	/(N/mm²)]	0,042	0,044	0,047	0,051	0,054	0,060
Temperature ra	S 1	or [mm	/(N/mm²)]	0,034	0,035	0,038	0,041	0,044	0,048
III: 72°C/120°		tor [mm.	/(N/mm²)]	0,044	0,045	0,049	0,053	0,056	0,062
Temperature ra		or [mm	/(N/mm²)]	0,126	0,131	0,142	0,153	0,163	0,179
IV: 100°C/160	°C δ <sub>N∞</sub> -fac	tor [mm.	/(N/mm²)]	0,129	0,135	0,146	0,157	0,168	0,184
Cracked concrete			tic action	for a work	ting life o	f 50 and 10	0 years		
Temperature ra		or [mm,	/(N/mm²)]	0,083	0,085	0,090	0,095	0,099	0,106
II: 50°C/80°C		tor [mm,	/(N/mm²)]	0,170	0,110	0,116	0,122	0,128	0,137
Temperature ra			/(N/mm²)]	0,086	0,088	0,093	0,098	0,103	0,110
III: 72°C/120°	-11000		/(N/mm²)]	0,111	0,114	0,121	0,127	0,133	0,143
Temperature ra			/(N/mm²)]	0,321	0,330	0,349	0,367	0,385	0,412
IV: 100°C/160	°C  δ <sub>N∞</sub> -fac	tor [mm,	/(N/mm²)]	0,330	0,340	0,358	0,377	0,396	0,424
	Displaceme	ents unde	r shear l	oad <sup>1)</sup>		IG-M10	IG-M12	IG-M16	IG-M20
δ <sub>№</sub> = δ <sub>№</sub> -factor Table C15:	Displaceme anchor rods	ents unde	r shear l IG-I	oad <sup>1)</sup> M6 G		IG-M10	IG-M12	IG-M16	
δ <sub>№</sub> = δ <sub>№</sub> -factor Table C15:	Displaceme anchor rods racked concret	ents unde	r shear l IG-I c and quas	Oad <sup>1)</sup> M6 IG si-static a	ction for	a working	life of 50 a	nd 100 year	rs
$\delta_{N\infty} = \delta_{N\infty}$ -factor <b>Table C15:</b> Internal threaded Uncracked and c All temperature	Displaceme anchor rods racked concrete δ <sub>V0</sub> -factor	ents unde	r shear l IG-I	Oad <sup>1)</sup> M6 IG si-static a					<b>IG-M20</b> r <b>s</b> 0,04
$\delta_{N\infty} = \delta_{N\infty}$ -factor <b>Table C15:</b> Internal threaded Uncracked and c All temperature ranges <sup>1)</sup> Calculation of th	or $\cdot$ t; <b>Displacement</b> <b>anchor rods</b> <b>racked concret</b> $\delta_{V0}$ -factor $\delta_{V\infty}$ -factor the displacement	ents unde under stati [mm/kN] [mm/kN]	r shear l IG-I c and quas 0,0 0,1	oad <sup>1)</sup> M6 IG si-static a	ction for	a working	life of 50 a	nd 100 year	rs
$\delta_{N\infty} = \delta_{N\infty}$ -factor <b>Table C15:</b> <b>nternal threaded</b> <b>Jncracked and c</b> All temperature anges	or $\cdot$ t; <b>Displacement</b> <b>anchor rods</b> <b>racked concret</b> $\delta_{V0}$ -factor $\delta_{V\infty}$ -factor the displacement or $\cdot$ V;	ents unde	r shear l IG-I c and quas 0,0 0,1	oad <sup>1)</sup> M6 IG si-static a	ction for	a working 0,06	life of 50 a 0,05	nd 100 year 0,04	r <b>s</b> 0,04

Displacements under static and quasi-static action for a working life of 50 and 100 years (internal threaded anchor rod)



Reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Uncracked concre	ete under sta	atic and quasi-s	tatic ad	ction for	r <mark>a wor</mark> l	king life	e of 50 a	and 100	years			
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,031	0,032	0,034	0,035	0,037	0,039	0,042	0,043	0,045	0,048
I: 24°C/40°C II: 50°C/80°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,040	0,042	0,044	0,045	0,047	0,051	0,054	0,055	0,058	0,063
Temperature	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,032	0,034	0,035	0,036	0,038	0,041	0,044	0,045	0,047	0,050
range III: 72°C/120°C	δ <sub>N∞</sub> -factor	[mm/(N/mm²)]	0,042	0,044	0,045	0,047	0,049	0,053	0,056	0,057	0,060	0,065
Temperature	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,121	0,126	0,131	0,137	0,142	0,153	0,163	0,164	0,172	0,186
range IV: 100°C/160°C	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,124	0,129	0,135	0,141	0,146	0,157	0,168	0,169	0,177	0,192
Cracked concrete	under statio	and quasi-stat	tic actio	on for a	workin	g life of	f 50 and	d 100 ye	ears			
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,081	0,083	0,085	0,087	0,090	0,095	0,099	0,099	0,103	0,108
l: 24°C/40°C ll: 50°C/80°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,104	0,107	0,110	0,113	0,116	0,122	0,128	0,128	0,133	0,141
Temperature	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,084	0,086	0,088	0,090	0,093	0,098	0,103	0,103	0,107	0,113
range III: 72°C/120°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,108	0,111	0,114	0,118	0,121	0,127	0,133	0,133	0,138	0,148
Temperature	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,312	0,321	0,330	0,340	0,349	0,367	0,385	0,385	0,399	0,425
range	$\delta_{N\infty}$ -factor	[	0,321	0.000	0.040	0,349	0.050	0 277	0.000	0.000	0.440	0 4 4 0
IV: 100°C/160°C 1) Calculation of th $\delta_{N0} = \delta_{N0}$ -facto $\delta_{N\infty} = \delta_{N\infty}$ -facto <b>Table C17:</b>	e displacemer r · τ; or · τ;	[mm/(N/mm²)] nt τ: action bond ments undei	stress f			0,349	0,358	0,377	0,396	0,396	0,410	0,448
1) Calculation of th $\delta_{N0} = \delta_{N0}$ -facto $\delta_{N\infty} = \delta_{N\infty}$ -facto	e displacemer r · τ; or · τ;	nt τ: action bond ments under	stress f	or tensio	n 1)			Ø 20	Ø 24	Ø 25	Ø 28	
<sup>1)</sup> Calculation of th	e displacemer r · τ; or · τ; <b>Displace</b>	nt τ: action bond	stress f r <b>shea</b> Ø 8	or tensioner load	n 1) Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	0,449 Ø 32
<sup>1)</sup> Calculation of th $δ_{N0} = δ_{N0}$ -facto $δ_{N∞} = δ_{N∞}$ -facto <b>Table C17:</b> Reinforcing bar Uncracked and cr	e displacemer r · τ; or · τ; <b>Displace</b> acked conci	nt τ: action bond ments under rete under statio	stress f shea Ø 8 c and q	or tension <b>Ir Ioad</b> Ø 10	n 1) Ø 12 atic acti	Ø 14 ion for a	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	
1) Calculation of th $\delta_{N0} = \delta_{N0}$ -facto $\delta_{N\infty} = \delta_{N\infty}$ -facto <b>Table C17:</b> <b>Reinforcing bar</b> <b>Uncracked and cr</b> All temperature ranges	e displacemen r $\cdot \tau$ ; or $\cdot \tau$ ; <b>Displace</b> <b>acked concu</b> $\delta_{V0}$ -factor $\delta_{V\infty}$ -factor	nt τ: action bond ments under rete under statio [mm/kN] [mm/kN]	stress f r shea Ø 8 c and q 0,06	or tensioner load	n 1) Ø 12 atic acti	Ø 14 ion for a 0,04	Ø 16 a worki	Ø 20 ng life (	Ø 24 of 50 ar	Ø 25 nd 100 y	Ø 28 years	Ø 32
<sup>1)</sup> Calculation of th $δ_{N0} = δ_{N0}$ -facto $δ_{N∞} = δ_{N∞}$ -facto <b>Table C17:</b> <b>Reinforcing bar</b> <b>Uncracked and cr</b> All temperature	e displacemen e displacement $r \cdot \tau;$ or $\cdot \tau;$ <b>Displace</b> <b>acked concu-</b> $\delta_{V0}$ -factor $\delta_{V\infty}$ -factor e displacement $r \cdot V;$	nt τ: action bond ments under rete under statio [mm/kN] [mm/kN]	stress f r shea Ø 8 c and q 0,06 0,09	or tensioner load	n 1) Ø 12 atic acti 0,05	Ø 14 ion for a 0,04	Ø 16 a worki 0,04	Ø 20 ng life 0,04	Ø 24 of 50 ar	Ø 25 nd 100 1 0,03	Ø 28 years 0,03	Ø 32 0,03



# Table C18:Characteristic values of tension loads under seismic action<br/>(performance category C1) for a working life of 50 years

Thread	ded rod		M8	M10	M12	M16	M20	M24	M27	M30		
Steel f	ailure					•		•				
Charac	cteristic tension resis	tance	N <sub>Rk,s,eq,C1</sub>	[kN]				1, <b>0</b> •	N <sub>Rk,s</sub>			
Partial	factor		γ <sub>Ms,N</sub> [-] see Table C1									
Combi	ined pull-out and co	oncrete failure										
Charac	cteristic bond resista	concrete C2	20/25									
ē	I: 24°C/40°C	Decimat	<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	7,0	7,5	8,0	9,0	8,5	7,0	7,0	7,0
nperatu range	Drv. wet		<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	7,0	7,5	8,0	9,0	8,5	7,0	7,0	7,0
mpe	III: 72°C/120°C	flooded bore	<sup>t</sup> Rk,eq,C1	[N/mm²]	6,0 6,5 7,0 7,5 7,0 6,0 6						6,0	6,0
Te	IV: 100°C/160°C	- hole	<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	5,5	5,5	6,0	6,5	6,0	5,5	5,5	5,5
Increas	sing factors for concr	ete	Ψc	[-]				1	,0			
	Characteristic bond resistance depending on the concrete strength class											
Installation factor												
for dry	CAC							1	,0			
	r dry and wet concrete HDB r flooded bore hole CAC		γinst	[-]				1	,2			
for floo	ded bore hole						1	,4				

#### Mapei Injection system Mapefix UM Hybrid for concrete

**Performances** Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 years (threaded rod) Annex C 15



#### Table C19: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 100 years M10 M12 Threaded rod M8 M16 M20 M24 M27 M30 Steel failure 1,0 • N<sub>Rk,s</sub> Characteristic tension resistance N<sub>Rk,s,eq,C1</sub> [kN] Partial factor [-] see Table C1 γ<sub>Ms,N</sub> Combined pull-out and concrete failure Characteristic bond resistance in cracked and uncracked concrete C20/25 Temperature range I: 24°C/40°C [N/mm<sup>2</sup>] 5,5 6 6.5 6,5 6.5 6.5 6.5 Dry, wet <sup>τ</sup>Rk,eq,C1 6.5 concrete and flooded bore II: 50°C/80°C [N/mm<sup>2</sup>] 5,5 6 6,5 6,5 6,5 hole 6,5 6.5 6.5 <sup>τ</sup>Rk,eq,C1 Increasing factors for concrete [-] 1,0 $\psi_{\bm{C}}$ Characteristic bond resistance depending <sup>τ</sup>Rk,eq,C1 = Ψc <sup>•</sup> <sup>τ</sup>Rk,eq,C1,(C20/25) on the concrete strength class Installation factor CAC 1,0 for dry and wet concrete HDB [-] 1,2 γinst for flooded bore hole CAC 1,4

#### Mapei Injection system Mapefix UM Hybrid for concrete

**Performances** Characteristic values of tension loads under seismic action (performance category C1) for a working life of 100 years (threaded rod) Annex C 16



Threaded rod     M8     M10     M12     M16     M20     M24     M27     M3       Steel failure     Characteristic shear resistance     VRk.s.eq.C1     [KN]     0.70 · V <sup>0</sup> Rk.s       Partial factor     7 <sub>MS</sub> ,V     [-]     see Table C1       Factor for annular gap     etagap     [-]     0.5 (1.0) <sup>10</sup>	-	ce category			-	_			-		
Characteristic shear resistance (Seismic C1) $V_{Rk,s,eq,C1}$ [kN] $0,70 \cdot V^0_{Rk,s}$ Partial factor $\gamma_{Ms,V}$ [-]see Table C1Factor for annular gap $\alpha_{gap}$ [-] $0,5 (1,0)^{1)}$ 1) Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washer	Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
(Seismic C1) $\vee$ Rk,s,eq,C1       [KN]       0,70 * $\vee^{\circ}$ Rk,s         Partial factor $\gamma_{Ms,V}$ [-]       see Table C1         Factor for annular gap $\alpha_{gap}$ [-]       0,5 (1,0)^1)         1) Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washed		1									
Factor for annular gap $\alpha_{gap}$ [-] $0,5 (1,0)^{1)}$ 1) Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washed		V <sub>Rk,s,eq,C1</sub>	[kN]				0,70	) ∙ V <sup>0</sup> Rk	.,S		
<sup>1)</sup> Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washe	Partial factor	ŶMs,V	[-]				see	Table C	21		
	Factor for annular gap				0,	5 (1,0) <sup>1)</sup>					
1											
Mapei Injection system Mapefix UM Hybrid for concrete	Mapei Injection system Mape	efix UM Hybrid	d for co	oncret	e						

(threaded rod)



#### Table C21: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 years Ø 8 Ø 10 Ø 12 Ø 14 Ø 16 Ø 20 Ø 24 Ø 25 Ø 28 Ø 32 **Reinforcing bar** Steel failure $1,0 \cdot A_{s} \cdot f_{uk}^{(1)}$ N<sub>Rk,s,eq,C1</sub> Characteristic tension resistance [kN] 201 314 452 Cross section area As [mm<sup>2</sup>] 50 79 113 154 491 616 804 1,42) Partial factor γ<sub>Ms.N</sub> [-] Combined pull-out and concrete failure Characteristic bond resistance in cracked and uncracked concrete C20/25 emperature range I: 24°C/40°C [N/mm<sup>2</sup>] 5,5 5,5 6,0 6,5 6.5 6,5 6,5 7.0 7,0 7,0 <sup>τ</sup>Rk,eq,C1 Dry, wet 6.5 7.0 II: 50°C/80°C concrete [N/mm<sup>2</sup>] 5.5 5,5 6.0 6.5 6,5 6.5 7.0 7.0 <sup>τ</sup>Rk,eq,C1 and 5.0 5.5 6.0 III: 72°C/120°C flooded [N/mm<sup>2</sup>] 4,5 5,0 5,5 5,5 5,5 6.0 6,0 <sup>τ</sup>Rk,eq,C1 bore hole IV: 100°C/160°C 4.5 5,0 [N/mm<sup>2</sup>] 4,0 4,5 5,0 5.0 5,0 5,0 5.0 5,0 <sup>τ</sup>Rk,eq,C1 Increasing factors for concrete $\Psi_{\mathbf{C}}$ [-] 1,0 Characteristic bond resistance depending on the concrete strength $\tau$ Rk,eq,C1 = Ψc • <sup>τ</sup>Rk,eq,C1,(C20/25) class Installation factor CAC 1,0 for dry and wet concrete HDB 1,2 [-] γinst for flooded bore hole CAC 1,4 1) f<sub>uk</sub> shall be taken from the specifications of reinforcing bars 2) in absence of national regulation Mapei Injection system Mapefix UM Hybrid for concrete Annex C 18 Performances Characteristic values of tension loads under seismic action (performance category C1)

for a working life of 50 years (rebar)



	aracteristic erformance									n			
Reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure			1							41			
Characteristic tension re	esistance	N <sub>Rk,s,eq,C1</sub>						1,0 · A		I			
Cross section area		A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γ <sub>Ms,N</sub>	[-]					1,	4 <sup>2)</sup>				
Combined pull-out an				C	00/05								
								4,0	4,0	4,0	4,0	4,0	
Cemperature range D°08/D°02:II D°08/D°02:II	and flooded bore hole	<sup>τ</sup> Rk,eq,C1	[N/mm²]	n <sup>2</sup> ] 4,5 4,5 4,5 4,5 4,5 4,0 4,0						4,0	4,0	4,0	
Increasing factors for co	1	Ψc	[-]					1	,0			1	1
Characteristic bond res	haracteristic bond resistance epending on the concrete strength ass						Ψ <b>c</b> •	<sup>τ</sup> Rk,ec	I,C1,(C	20/25)			
Installation factor													
for dry and wet concrete	e CAC HDB								,0				
for flooded bore hole	γinst	[-]						<u>,2</u> ,4					
Mapei Injection sys	item Mapefix	UM Hybrid	for cond	rete						<b>A</b>	nnex	C 19	)

Characteristic values of tension loads under seismic action (performance category C1)

for a working life of 100 years (rebar)



Table C23:	Characterist (performanc		* • • • • • •								ears		
Reinforcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure				-	•				•				
Characteristic shea	ar resistance	V <sub>Rk,s,eq</sub>	[kN]					0,35	· A <sub>s</sub>	fuk <sup>1)</sup>			
Cross section area		A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γ <sub>Ms,V</sub>	[-]					-	1,5 <sup>2)</sup>				
Factor for annula	r gap	α <sub>gap</sub>	[-]					0	,5 (1,0	) <sup>3)</sup>			
<ol> <li>f<sub>uk</sub> shall be take</li> <li>in absence of na</li> <li>Value in bracket Annex A 3 is rec</li> </ol>	ational regulation is valid for filled ani				d clea	rance	hole ir	the fi	xture.	Use of	special	filling wa	sher

#### Mapei Injection system Mapefix UM Hybrid for concrete

**Performances** Characteristic values of shear loads under seismic action (performance category C1) for a working life of 50 and 100 years (rebar) Annex C 20



	icteristic va ormance cat					on	
Threaded rod				M12	M16	M20	M24
Steel failure							
Characteristic tension resist Steel, strength class 8.8 Stainless Steel A4 and HCF Strength class ≥70	·	N <sub>Rk,s,eq,C2</sub>	[kN]		1,0 •	N <sub>Rk,s</sub>	
Partial factor		γ <sub>Ms,N</sub>	[-]		see Ta	ble C1	
Combined pull-out and co	ncrete failure	- 110,14					
Characteristic bond resistar		nd uncracked	concrete C2	0/25			
ଥ୍ l: 24°C/40°C	<b>.</b> .	<sup>T</sup> Rk,eq,C2	[N/mm²]	3,6	3,5	3,3	2,3
II: 50°C/80°C	Dry, wet concrete and	<sup>T</sup> Rk,eq,C2	[N/mm²]	3,6	3,5	3,3	2,3
11:50°C/80°C = 11:50°C/80°C III:72°C/120°C	flooded bore	<sup>T</sup> Rk,eq,C2	[N/mm <sup>2</sup> ]	3,1	3,0	2,8	2,0
end         i: 24°C/40°C           i: 50°C/80°C           i: 72°C/120°C           III: 72°C/120°C           IV: 160°C/100°C	hole		[N/mm <sup>2</sup> ]	2,5	2,7	2,5	1,8
		<sup>T</sup> Rk,eq,C2		2,0		,0	1,0
Increasing factors for concre Characteristic bond resistar		Ψc	[-]			,0	
on the concrete strength cla			τ <sub>Rk,eq,C2</sub> =		Ψc <sup>• τ</sup> Rk,eq	,C2,(C20/25)	
Installation factor		1.					
for dry and wat concrete	CAC				1	,0	
for dry and wet concrete	HDB	γinst	[-]			,2	
for flooded bore hole	CAC				1	,4	
Mapei Injection system Mapefix UM Hybrid for concrete       Annex C 21         Performances       Characteristic values of tension loads under seismic action (performance category C2) for a							
working life of 50 years (thre				• • • -/			



	acteristic va ormance cat						
Threaded rod				M12	M16	M20	M24
Steel failure						•	t
Characteristic tension resis Steel, strength class 8.8 Stainless Steel A4 and HCI Strength class ≥70	·	N <sub>Rk,s,eq,C2</sub>	[kN]		1,0 •	N <sub>Rk,s</sub>	
Partial factor		γ <sub>Ms,N</sub>	[-]		see Ta	able C1	
Combined pull-out and co		•					
Characteristic bond resistar	nce in cracked a	nd uncracked	concrete C2	0/25	1		
Cosk/2°65:II Temperature Cosk/2°65:II Temperature Cosk/2°65:II Temperature	Dry, wet concrete and flooded bore	<sup>T</sup> Rk,eq,C2	[N/mm²]	3,6	3,5	3,3	2,3
ਙਿੱ Ⅱ: 50°C/80°C	hole	<sup>τ</sup> Rk,eq,C2	[N/mm²]	3,6	2,3		
Increasing factors for concr	ete	Ψc	[-]		1	,0	
Characteristic bond resistan			<sup>τ</sup> Rk,eq,C2 =	Ψc <sup>• τ</sup> Rk,ec	I,C2,(C20/25)		
Installation factor							
for dry and wet concrete	CAC	_				,0	
for flooded bore hole	HDB CAC	γinst	[-]			,2 ,4	
Mapei Injection system	Mapefix UM H	lybrid for con	crete			Anne	(C 22
Performances Characteristic values of ten working life of 100 years (th		seismic action	(performance	e category C2	) for a		

Partial factor

Factor for annular gap



see Table C1

 $0,5(1,0)^{1}$ 

#### Table C26: Characteristic values of shear loads under seismic action (performance category C2) for a working life of 50 and 100 years M12 Threaded rod M16 M20 M24 Steel failure Characteristic shear resistance Steel, strength class 8.8 0,70 · V<sup>0</sup><sub>Rk,s</sub> V<sub>Rk,s,eq,C2</sub> [kN] Stainless Steel A4 and HCR, Strength class ≥70

 Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended

[-]

[-]

## Table C27: Displacements under tension load

γMs,V

 $\alpha_{gap}$ 

Threaded rod			M12	M16	M20	M24
	under seismic actio of 50 and 100 years	n (performance	e category C2)			
All temperature	$\delta_{N,eq,C2(50\%)} = \delta_{N,eq,C2(DLS)}$	[mm]	0,24	0,27	0,29	0,27
ranges	$\delta_{N,eq,C2(100\%)} = \delta_{N,eq,C2(ULS)}$	[mm]	0,55	0,51	0,50	0,58

### Table C28: Displacements under shear load

Threaded rod			M12	M16	M20	M24
	e under seismic actic of 50 and 100 years		ce category C2)			
All temperature	$\delta_{V,eq,C2(50\%)} = \delta_{V,eq,C2(DLS)}$	[mm]	3,6	3,0	3,1	3,5
anges	$\delta_{V,eq,C2(100\%)} = \delta_{V,eq,C2(ULS)}$	[mm]	7,0	6,6	7,0	9,3
Aapei Injection	svstem Mapefix UM	/ Hybrid for c	oncrete			
Mapei Injection	system Mapefix UN	1 Hybrid for c	oncrete			nex C 23



Table C29: Characte hammer drilled he	drilled h	oles	(HD), co	ompres	sed ai							ner
Threaded rod					M8	M10	M12	M16	M20	M24	M27	M30
Steel failure												
Characteristic tension			Fire	30	1,1	1,7	3,0	5,7	8,8	12,7	16,5	20,2
resistance; Steel, Stainless Steel A2, A4 and HCR,	N <sub>Rk,s,fi</sub>	[kN]	exposure	60	0,9	1,4	2,3	4,2	6,6	9,5	12,4	15,1
strength class 5.8 resp. 50	TRK,S,II		time [min]	90	0,7	1,0	1,6	3,0	4,7	6,7	8,7	10,7
and higher				120	0,5	0,8	1,2	2,2	3,4	4,9	6,4	7,9
Characteristic bond resista given temperature θ	ance in cra	cked a	and uncra	cked con	crete C	:20/25 ι	up to C	50/60 u	nder fi	re cono	ditions	for a
Temperature reduction			θ < 2					1	,0			
factor	k <sub>fi,p</sub> (θ)	[-]	24°C ≤ θ		-		1,3	01•e-(		1,0		
			θ > 3	79°C	~			0	,0			
<b>Beduction Factor k</b> ( <b>()</b> ) <b>Control Factor k</b> (	100		150	200 emperatu	250 re θ [°C]		00	350	4	00	450	
Characteristic bond resistance for a given temperature ( $\theta$ )	τ <sub>Rk,fi</sub> (θ)		[N/mm²	-			k <sub>fi,p</sub> (	θ)•τ <sub>Rk</sub>	.,cr,(C20/	/25) <sup>1)</sup>		
Steel failure without lever a	arm	т								·		
Characteristic shear			Fire	30	1,1	1,7	3,0	5,7	8,8	12,7	16,5	20,2
resistance; Steel, Stainless Steel A2, A4 and HCR,	V <sub>Rk,s,fi</sub>	[kN]	exposure	60	0,9	1,4	2,3	4,2	6,6	9,5	12,4	15,1
strength class 5.8 resp. 50	1.1.1		time [min]	90	0,7	1,0	1,6	3,0	4,7	6,7	8,7	10,7
and higher Steel failure with lever arm				120	0,5	0,8	1,2	2,2	3,4	4,9	6,4	7,9
		1		30	1,1	2,2	4,7	12,0	23,4	40,4	59,9	81,0
Characteristic bending moment; Steel, Stainless			Fire exposure	60	0,9	1,8	3,5	9,0	17,5	30,3	44,9	60,7
Steel A2, A4 and HCR,	M <sup>0</sup> Rk,s,fi	[Nm]	time	90	0,7	1,3	2,5	6,3	12,3	21,3	31,6	42,7
strength class 5.8 resp. 50 and higher			[min]	120	0,5	1,0	1,8	4,7	9,1	15,7	23,3	31,5
<ol> <li><sup>1)</sup> <sup>7</sup><sub>Rk,cr,(C20/25)</sub> characteristi temperature range</li> </ol>	ic bond resis	stance	for cracked			0.000			10000 A.U.A.			0.,0
Mapei Injection system I Performances Characteristic values of tensi		-		A CONCOLU	(threade	ed rod)				Anne	x C 2	4



#### Table C30: Characteristic values of tension and shear loads under fire exposure in hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB) Internal threaded anchor rods IG-M6 IG-M8 IG-M10 **IG-M12 IG-M16 IG-M20** Steel failure 30 0,3 1,1 1,7 3,0 5,7 8,8 Characteristic tension Fire 0,2 2,3 60 0,9 1,4 4,2 6,6 resistance; Steel, Stainless exposure N<sub>Rk,s,fi</sub> [kN] Steel A4 and HCR, strength time 90 0.2 0,7 1,0 1,6 4,7 3,0 class 5.8 and 8.8 resp. 70 [min] 120 0,1 0,5 0,8 1,2 2,2 3,4 Characteristic bond resistance in cracked and uncracked concrete C20/25 up to C50/60 under fire conditions for a given temperature $\theta$ $\theta < 24^{\circ}C$ 1.0 Temperature reduction $1,301 \cdot e^{-0,011 \cdot \theta} \le 1,0$ k<sub>fi,p</sub>(θ) [-] $24^{\circ}C \le \theta \le 379^{\circ}C$ factor θ > 379°C 0,0 1,0 **Reduction Factor k<sub>fi</sub>(θ) [-]** 0,0 0 50 100 150 200 250 300 350 400 450 Temperature θ [°C] Characteristic bond $k_{fi,p}(\theta) \cdot \tau_{Rk,cr,(C20/25)}^{(1)}$ resistance for a given $\tau_{\mathsf{Bk fi}}(\theta)$ [N/mm<sup>2</sup>] temperature ( $\theta$ ) Steel failure without lever arm 30 0,3 1,1 1,7 3,0 5,7 8,8 Characteristic shear Fire 0,2 0,9 1,4 2,3 60 4,2 6,6 resistance; Steel, Stainless exposure V<sub>Rk,s,fi</sub> [kN] Steel A4 and HCR, strength time 0,2 90 0,7 1,0 1,6 3,0 4,7 class 5.8 and 8.8 resp. 70 [min] 120 0.1 0,5 0.8 1.2 2.2 3.4 Steel failure with lever arm 12,0 30 0,2 1,1 2,2 4,7 23,4 Fire Characteristic bending 0.2 0.9 60 1.8 3.5 9.0 17,5 moment; Steel, Stainless exposure M<sup>0</sup><sub>Rk,s,fi</sub> [Nm] Steel A4 and HCR, strength time 90 0,1 0,7 1,3 2,5 12,3 6,3 class 5.8 and 8.8 resp. 70 [min] 120 0.1 1.0 0.5 1.8 4.7 9.1 1) TRk.cr.(C20/25) characteristic bond resistance for cracked concrete for concrete strength class C20/25 for the relevant temperature range Mapei Injection system Mapefix UM Hybrid for concrete Annex C 25 Performances Characteristic values of tension and shear loads under fire exposure (internal threaded anchor rod)



Table C31: Charact hammer drilled h	drilled	hole	es (HD), o	compre	esse	d air								er
Reinforcing bar					Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure							1040			2001 000				
				30	0,5	1,2	2,3	3,1	4,0	6,3	9,0	9,8	12,3	16,1
Characteristic tension			Fire	60	0,5	1,0	1,7	2,3	3,0	4,7	6,8	7,4	9,2	12,1
resistance; BSt 500	N <sub>Rk,s,fi</sub>	[kN]	exposure time [min]	90	0,4	0,8	1,5	2,0	2,6	4,1	5,9	6,4	8,0	10,5
				120	0,3	0,6	1,1	1,5	2,0	3,1	4,5	4,9	6,2	8,0
Characteristic bond resist	ance in c	racke	d and unc	racked c	oncre	te C2	)/25 u	p to C	50/60	unde	r fire o	condit	ions f	or a
given temperature θ			θ < 2	200					1	,0				
Temperature reduction	k <sub>fi,p</sub> (θ)	[-]	0 < 2 22°C ≤ θ :					1 26		,0 0,011•θ	< 1.0			
factor	(`fi,p(`)		$\theta > 37$	01.15.1001.1001				1,20		,0	_ 1,0			
- 8,0 <b>F</b> - 8,0 <b>F</b> - 9,0 <b>F</b> - 9,0 - 2,0  														
0 50	10	0	150	200		250	30	0	350		400		450	
Characteristic bond	1			Tempera	ature t	['C]								
resistance for a given temperature $(\theta)$	τ <sub>Rk,fi</sub> (θ)		[N/mm <sup>2</sup> ]	[				k <sub>fi,p</sub> (€	))•τ <sub>R</sub>	k,cr,(C2	:0/25) <sup>1)</sup>			
Steel failure without lever	arm			30	0,5	1,2	2,3	3,1	4,0	6,3	9,0	9,8	12,3	16,1
Chavesteristic shoer			Fire	60	0,5	1,2	2,3	2,3	3,0	4,7	9,0 6,8	9,0 7,4	9,2	12,1
Characteristic shear resistance; BSt 500	V <sub>Rk,s,fi</sub>	[kN]	exposure	90	0,0	0,8	1,5	2,0	2,6	4,1	5,9	6,4	8,0	10,5
			time [min]	120	0,3	0,6	1,1	1,5	2,0	3,1	4,5	4,9	6,2	8,0
Steel failure with lever arm	n			20100	,-		200 <b>1</b> 00		,-	,			,	
				30	0,6	1,8	4,1	6,5	9,7	18,8	32,6	36,8	51,7	77,2
Characteristic bending	M <sup>0</sup> DL	[Nm]	Fire exposure	60	0,5	1,5	3,1	4,8	7,2	14,1	24,4	27,6	38,8	57,9
moment; BSt 500	HK,S,fi	[[1411]]	time [min]	90	0,4	1,2	2,6	4,2	6,3	12,3			33,6	50,2
				120	0,3	0,9	2,0	3,2	4,8	9,4		18,4		38,6
<ol> <li><sup>1)</sup> τ<sub>Rk,cr,(C20/25)</sub> characteris temperature range</li> </ol>	tic bond re	sistan	ce for crack	ed concre	ete for	concre	te stre	ngth c	lass C	20/25	for the	releva	nt	
Mapei Injection system Performances Characteristic values of tens						inforcir	ng bar)				Aı	nnex	C 26	6