...eine starke Verbindung

SUORITUSTASOILMOITUS

DoP Nro: **MKT-2.1-200_fi**

✧ **Tuotetyypin yksilöllinen tunniste:** **Ruiskutusjärjestelmä VME betoniin**

✧ **Aiottu käyttötarkoitus (aiotut käyttötarkoitukset):** Injektionestojärjestelmä ankkurointi betoniin, katso liite/Annex B

✧ **Valmistaja:** MKT Metall-Kunststoff-Technik GmbH & Co.KG
Auf dem Immel 2
67685 Weilerbach

✧ **Suoritustason pysyvyyden arvioinnissa ja varmentamisessa käytetty järjestelmä/käytetyt järjestelmät:** 1

✧ **Eurooppalainen arviointiasiakirja:** **ETAG 001-5**
Eurooppalainen tekninen arviointi: **ETA-09/0350, 12.12.2017**
Teknisestä arvioinnista vastaava laitos: DIBt, Berlin
Ilmoitettu laitos/ilmoitetut laitokset: NB 2873 – Technische Universität Darmstadt

✧ **Ilmoitettu suoritustaso/ilmoitetut suoritustasot:**

Olennaiset ominaisuudet	Suoritustaso
Mekaaninen lujuus ja vakaus (BWR 1)	
Karakteristiset vastukset staattisille ja kvasi-staattisille kuormille ja sminaisvastukset seismisten suorituskykyluokkien C1 + C2 osalta	Liite/Annex C1 – C7
Vuorossa	Liite/Annex C8 – C10
Paloturvallisuus (BWR 2)	
Palokäyttäytyminen	Luokka A1
Palonkestävyys	NPD (No Performance Determined) suoritustasoa ei ole määritelty

Edellä yksilöidyn tuotteen suoritustaso on ilmoitettujen suoritustasojen joukon mukainen. Tämä suoritustasoilmoitus on asetuksen (EU) N:o 305/2011 mukaisesti annettu edellä ilmoitetun valmistajan yksinomaisella vastuulla.

Valmistajan puolesta allekirjoittanut:

Stefan Weustenhagen
(Toimitusjohtaja)
Weilerbach, 01.01.2021

p.p.
Dipl.-Ing. Detlef Bigalke
(Tuotekehityksen johtaja)

ETA CE

Tämän suoritusilmoituksen alkuperäinen teksti on kirjoitettu saksaksi. Jos käännökset poikkeavat toisistaan, saksankielinen versio on pätevä.

Specifications of intended use

Injection system VME	Anchor rod: VMU-A, V-A, VM-A, commercial standard threaded rod	Internally threaded anchor rod: VMU-IG	rebar
Static or quasi-static action	M8 - M30 (zinc plated, A4, HCR)	IG M6 - IG M20 (electroplated, A4, HCR)	Ø8 - Ø32
Seismic action Performance Category C1	M8 - M30 (zinc plated[1], A4, HCR)	-	Ø8 - Ø32
Seismic action Performance Category C2	M12 and M16 (zinc plated[1] (class 8.8), A4, HCR)	-	-
Base material	Reinforced or unreinforced normal weight concrete acc. to EN 206-1:2000		
	Strength classes C20/25 to C50/60 acc. to EN 206-1:2000		
	Cracked and uncracked concrete		
Temperature Range I -40 °C to +40 °C	max long term temperature +24 °C and max short term temperature +40 °C		
Temperature Range II -40 °C to +60 °C	max long term temperature +43 °C and max short term temperature +60 °C		
Temperature Range III -40 °C to +72 °C	max long term temperature +43 °C and max short term temperature +72 °C		

[1] except hot-dip galvanised

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (zinc coated steel, stainless steel or high corrosion resistant steel)
- 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 or high corrosion resistant steel)
- 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).

Design:

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.)
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work
- Anchorages under static or quasi-static actions are designed in accordance with:
  - EOTA Technical Report TR 029 "Design of bonded anchors", Edition September 2010 or
  - CEN/TS 1992-4:2009
- Anchorages under seismic actions (cracked concrete) are designed in accordance with:
  - EOTA Technical Report TR 045 "Design of Metal Anchors under Seismic Action", Edition February 2013
  - Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure.
  - Fastenings in stand-off installation or with a grout layer are not allowed.

Installation:

- Dry or wet concrete, flooded holes (not sea water)
- Hole drilling by hammer or compressed air drill mode or vacuum drill mode
- Overhead installation allowed
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- Fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internally threaded anchor rod

Table B1: Installation parameters for threaded rod

Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Nominal drill hole diameter	d_0 =	[mm]	10	12	14	18	24	28	32	35
Effective anchorage depth	$h_{ef,min}$ =	[mm]	60	60	70	80	90	96	108	120
	$h_{ef,max}$ =	[mm]	96	120	144	192	240	288	324	360
Diameter of clearance hole in the fixture[1)]	d_f ≤	[mm]	9	12	14	18	22	26	30	33
Installation torque	T_{inst} ≤	[Nm]	10	20	40	80	120	160	180	200
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			h_{ef} + $2d_0$				
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	135	150

[1)] For larger clearance hole see TR029 section 1.1; for application under seismic loading the diameter of clearance hole in the fixture shall be at maximum dnom + 1mm or alternatively the annular gap between fixture and threaded rod shall be completely filled with mortar

Table B2: Installation parameters for internally threaded anchor rod

Internally threaded anchor rod			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
Internal diameter of sleeve	d_2 =	[mm]	6	8	10	12	16	20
Outer diameter of sleeve[2)]	d_{nom} =	[mm]	10	12	16	20	24	30
Nominal drill hole diameter	d_0 =	[mm]	12	14	18	24	28	35
Effective anchorage depth	$h_{ef,min}$ =	[mm]	60	70	80	90	96	120
	$h_{ef,max}$ =	[mm]	120	144	192	240	288	360
Diameter of clearance hole in the fixture[1)]	d_f ≤	[mm]	7	9	12	14	18	22
Installation torque	T_{inst} ≤	[Nm]	10	10	20	40	60	100
Minimum screw-in depth	l_{IG}	[mm]	8	8	10	12	16	20
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm		h_{ef} + $2d_0$			
Minimum spacing	s_{min}	[mm]	50	60	80	100	120	150
Minimum edge distance	c_{min}	[mm]	50	60	80	100	120	150

[1)] For larger clearance hole see TR029 section 1.1
[2)] With metric thread according to EN 1993-1-8:2005+AC:2009

Table B3: Installation parameters for rebar

Rebar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Nominal drill hole diameter	d_0 =	[mm]	12	14	16	18	20	24	32	35	40
Effective anchorage depth	$h_{ef,min}$ =	[mm]	60	60	70	75	80	90	100	112	128
	$h_{ef,max}$ =	[mm]	96	120	144	168	192	240	300	336	384
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm		h_{ef} + $2d_0$						
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	100	125	140	160
Minimum edge distance	c_{min}	[mm]	40	50	60	70	80	100	125	140	160

Table B4: Parameter cleaning and setting tools

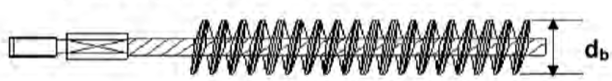
Threaded rod	Rebar	Internally threaded anchor rod	Drill bit Ø	Brush Ø	min. Brush Ø	Retaining washer		
							Installation direction and use of retaining washer	
[-]	Ø [mm]	[-]	d_0 [mm]	d_b [mm]	$d_{b,min}$ [mm]	[-]	⬇	➡	⬆
M8			10	12	10,5	-	No **retaining washer** required		
M10	8	VMU-IG M6	12	14	12,5	-			
M12	10	VMU-IG M8	14	16	14,5	-			
	12		16	18	16,5	-			
M16	14	VMU-IG M10	18	20	18,5	VM-IA 18	h_{ef} > 250mm	h_{ef} > 250mm	all
	16		20	22	20,5	VM-IA 20			
M 20	20	VMU-IG M12	24	26	24,5	VM-IA 24			
M 24		VMU-IG M16	28	30	28,5	VM-IA 28			
M 27	25		32	34	32,5	VM-IA 32			
M 30	28	VMU-IG M20	35	37	35,5	VM-IA 35			
	32		40	41,5	40,5	VM-IA 40			

Blow-out pump (volume 750ml)
Drill bit diameter (d_0): 10 mm to 20 mm
Bore hole depth $h_0 \leq 10\ d_{nom}$
see annex B4

Recommended compressed air tool (min 6 bar)
Drill bit diameter (d_0): all diameters

Retaining washer for overhead or horizontal installation
Drill bit diameter (d_0):
18 mm to 40 mm

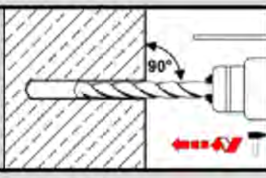
Steel brush



Installation instructions

Drilling of the hole

1.



Drill a hole into the base material to the size and embedment depth required by the selected anchor (Annex B2). In case of aborted drill hole: the drill hole shall be filled with mortar.

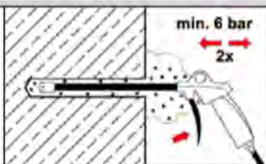
Cleaning

2.

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

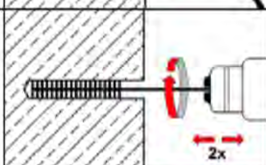
<u>Cleaning with compressed air</u>
cracked and uncracked concrete, all diameters

2a.



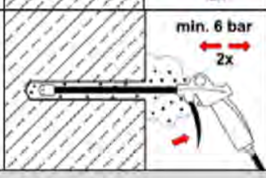
Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) a minimum of **two** times. If the bore hole ground is not reached an extension shall be used.

2b.



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

2c.

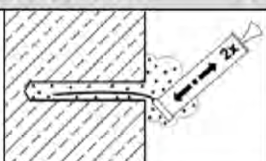


Finally blow the hole clean again with compressed air (min. 6 bar) a minimum of **two** times. If the bore hole ground is not reached an extension shall be used.

<u>Manual cleaning</u>

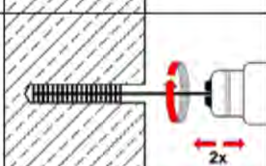
uncracked concrete:	**Bore hole diameter $d_0 \leq 20$mm and bore hole depth $h_0 \leq 10\ d_{nom}$**
cracked concrete:	**Bore hole diameter 14mm $\leq d_0 \leq 20$mm and bore hole depth $h_0 \leq 10\ d_{nom}$**

2a.



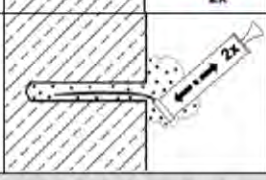
Starting from the bottom or back of the bore hole, blow the hole clean with the blow-out pump minimum of **two** times. If the bore hole ground is not reached an extension shall be used.

2b.



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

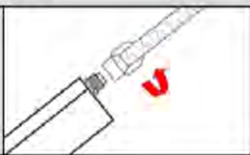
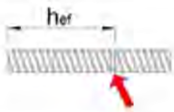
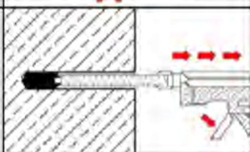
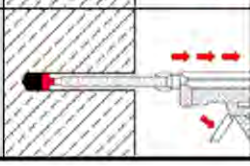
2c.



Finally blow the hole clean again with the blow-out pump a minimum of **two** 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.

Installation instructions (continuation)

Injection		
3.		Attach a supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. For every working interruption longer than the recommended working time (Table B5) 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 rod or rebar.
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 or red colour.
6a.		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 curing and working times given in Table B5.
6b.		For overhead and horizontal installation a retaining washer (Annex B 3) and extension nozzle shall be used. Observe the curing and working times given in Table B5.

Installation instructions (continuation)

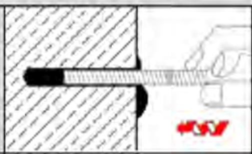
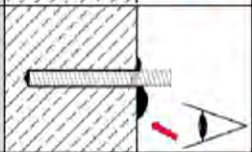
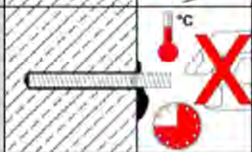
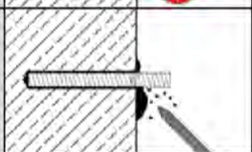
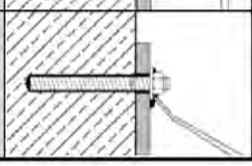
Inserting the anchor		
7.		Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. The anchor shall be free of dirt, grease, oil or other foreign material.
8.		Be sure that the rod is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead application the anchor rod should be fixed (e.g. wedges).
9.		Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the rod until it is fully cured (attend Table B5).
10.		Remove excess mortar.
11.		After full curing, the add-on part can be installed with up to the max. torque (Table B1 or B2) by using a calibrated torque wrench.
12.		Annular gap between anchor rod and attachment may optionally be filled with mortar. Therefore replace regular washer by washer with bore and plug on reducing adapter on static mixer. Annular gap is completely filled, when excess mortar seeps out.

Table B5: Working and curing time

Bore hole temperature	Maximum working time	Minimum curing time	
		dry concrete	wet concrete
+5°C to +9°C	120 min	50 h	100 h
+10°C to +19°C	90 min	30 h	60 h
+20°C to +29°C	30 min	10 h	20 h
+30°C to +39°C	20 min	6 h	12 h
+40°C	12 min	4 h	8 h
Cartridge temperature	+ 5°C to + 40°C		

Table C1: Characteristic **steel resistances** for **threaded rods** under tension and shear load

Threaded rod				M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
Steel failure											
Tension load											
Characteristic tension resistance	Steel, Property class 4.6 and 4.8	$N_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
	Steel, Property class 5.6 and 5.8	$N_{Rk,s}$	[kN]	18	29	42	78	122	176	230	280
	Steel, Property class 8.8	$N_{Rk,s}$	[kN]	29	46	67	125	196	282	368	449
	Stainless steel A4 and HCR, Property class 50	$N_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281
	Stainless steel A4 and HCR, Property class 70	$N_{Rk,s}$	[kN]	26	41	59	110	171	247	-	-
Partial factor	Steel, Property class 4.6	$\gamma_{Ms,N}$	[-]	2,0							
	Steel, Property class 4.8	$\gamma_{Ms,N}$	[-]	1,5							
	Steel, Property class 5.6	$\gamma_{Ms,N}$	[-]	2,0							
	Steel, Property class 5.8 and 8.8	$\gamma_{Ms,N}$	[-]	1,5							
	Stainless steel A4 and HCR, Property class 50	$\gamma_{Ms,N}$	[-]	2,86							
	Stainless steel A4 and HCR, Property class 70	$\gamma_{Ms,N}$	[-]	1,87						-	-
Shear load											
Steel failure <u>without</u> lever arm											
Characteristic shear resistance	Steel, Property class 4.6 and 4.8	$V_{Rk,s}$	[kN]	7	12	17	31	49	71	92	112
	Steel, Property class 5.6 and 5.8	$V_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
	Steel, Property class 8.8	$V_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
	Stainless steel A4 and HCR, Property class 50	$V_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
	Stainless steel A4 and HCR, Property class 70	$V_{Rk,s}$	[kN]	13	20	30	55	86	124	-	-
Steel failure <u>with</u> lever arm											
Characteristic bending moment	Steel, Property class 4.6 and 4.8	$M_{Rk,s}$	[Nm]	15	30	52	133	260	449	666	900
	Steel, Property class 5.6 and 5.8	$M_{Rk,s}$	[Nm]	19	37	65	166	324	560	833	1123
	Steel, Property class 8.8	$M_{Rk,s}$	[Nm]	30	60	105	266	519	896	1333	1797
	Stainless steel A4 and HCR, Property class 50	$M_{Rk,s}$	[Nm]	19	37	66	167	325	561	832	1125
	Stainless steel A4 and HCR, Property class 70	$M_{Rk,s}$	[Nm]	26	52	92	232	454	784	-	-
Partial factor	Steel, Property class 4.6	$\gamma_{Ms,V}$	[-]	1,67							
	Steel, Property class 4.8	$\gamma_{Ms,V}$	[-]	1,25							
	Steel, Property class 5.6	$\gamma_{Ms,V}$	[-]	1,67							
	Steel, Property class 5.8 and 8.8	$\gamma_{Ms,V}$	[-]	1,25							
	Stainless steel A4 and HCR, Property class 50	$\gamma_{Ms,V}$	[-]	2,38							
	Stainless steel A4 and HCR, Property class 70	$\gamma_{Ms,V}$	[-]	1,56						-	-

Table C2: Characteristic values of **tension loads** for **threaded rods** under static, quasi-static action and seismic action C1 + C2

Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel failure											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	see Table C1							
		$N_{Rk,s,C1}$	[kN]	1,0 • $N_{Rk,s}$							
		$N_{Rk,s,C2}$	[kN]	NPD		1,0 • $N_{Rk,s}$		No Performance Determined (NPD)			
Partial factor		$\gamma_{Ms,N}$	[-]	see Table C1							
Combined pull-out and concrete failure											
Characteristic bond resistance in uncracked concrete C20/25											
Temperature range I: 40°C / 24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	15	15	15	14	13	12	12	12
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	15	14	13	10	9,5	8,5	7,5	7,0
Temperature range II: 60°C / 43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	9,5	9,5	9,0	8,5	8,0	7,5	7,5	7,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	9,5	9,5	9,0	8,5	7,5	7,0	6,5	6,0
Temperature range III: 72°C / 43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	7,5	7,0	7,0	6,5	6,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	7,5	7,0	6,0	5,5	5,5
Characteristic bond resistance in cracked concrete C20/25											
Temperature range I: 40°C / 24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,0	7,5	6,5	6,0	5,5	5,5	5,5
		$\tau_{Rk,C1}$	[N/mm²]	5,9	7,0	7,1	6,2	5,7	5,5	5,5	5,5
		$\tau_{Rk,C2}$	[N/mm²]	NPD		2,4	2,2	No Performance Determined (NPD)			
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,0	7,5	6,0	5,0	4,5	4,0	4,0
		$\tau_{Rk,C1}$	[N/mm²]	5,9	7,0	7,1	5,8	4,8	4,5	4,0	4,0
		$\tau_{Rk,C2}$	[N/mm²]	NPD		2,4	2,1	No Performance Determined (NPD)			
Temperature range II: 60°C / 43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4,5	4,5	4,5	4,0	3,5	3,5	3,5	3,5
		$\tau_{Rk,C1}$	[N/mm²]	3,7	4,5	4,3	3,8	3,4	3,5	3,5	3,5
		$\tau_{Rk,C2}$	[N/mm²]	NPD		1,4	1,4	No Performance Determined (NPD)			
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4,5	4,5	4,5	4,0	3,5	3,5	3,5	3,5
		$\tau_{Rk,C1}$	[N/mm²]	3,7	4,5	4,3	3,8	3,4	3,5	3,5	3,5
		$\tau_{Rk,C2}$	[N/mm²]	NPD		1,4	1,4	No Performance Determined (NPD)			
Temperature range III: 72°C / 43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4,0	4,0	4,0	3,5	3,0	3,0	3,0	3,0
		$\tau_{Rk,C1}$	[N/mm²]	3,2	4,0	3,9	3,4	3,0	3,0	3,0	3,0
		$\tau_{Rk,C2}$	[N/mm²]	NPD		1,3	1,2	No Performance Determined (NPD)			
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4,0	4,0	4,0	3,5	3,0	3,0	3,0	3,0
		$\tau_{Rk,C1}$	[N/mm²]	3,2	4,0	3,9	3,4	3,0	3,0	3,0	3,0
		$\tau_{Rk,C2}$	[N/mm²]	NPD		1,3	1,2	No Performance Determined (NPD)			
Increasing factor for concrete		ψ_c	C25/30	1,02							
			C30/37	1,04							
			C35/45	1,07							
			C40/50	1,08							
			C45/55	1,09							
			C50/60	1,10							
Factor acc. CEN/TS1992-4-5 section 6.2.2.3	uncracked concrete	k_8	[-]	10,1							
	cracked concrete			7,2							
Concrete cone failure											
Factor acc. CEN/TS1992-4-5 section 6.2.3.1	uncracked concrete	k_{ucr}	[-]	10,1							
	cracked concrete	k_{cr}	[-]	7,2							
Edge distance		$c_{cr,N}$	[-]	1,5 h_{ef}							
Spacing		$s_{cr,N}$	[-]	3,0 h_{ef}							
Splitting failure											
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 h_{ef}							
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef} (2,5 - h/h_{ef})$							
	$h/h_{ef} \leq 1,3$			2,4 h_{ef}							
Spacing		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$							
Installation factor (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,2				1,4			
Installation factor (flooded bore hole)		$\gamma_2 = \gamma_{inst}$	[-]	1,4							

Table C3: Characteristic values of **shear loads** for **threaded rods** under static, quasi-static action and seismic action C1 + C2

Threaded rod			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Steel failure without lever arm										
Characteristic shear resistance	$V_{Rk,s}$	[kN]	see Table C1							
	$V_{Rk,s,C1}$	[kN]	$0{,}86 \cdot V_{Rk,s}$		$0{,}88 \cdot V_{Rk,s}$			$0{,}80 \cdot V_{Rk,s}$		
	$V_{Rk,s,C2}$	[kN]	NPD		$0{,}80 \cdot V_{Rk,s}$		No Performance Determined (NPD)			
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Steel failure with lever arm										
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	see Table C1							
	$M^0_{Rk,s,C1}$	[Nm]	No Performance Determined (NPD)							
	$M^0_{Rk,s,C2}$	[Nm]								
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Concrete pry-out failure										
Factor k in equation (5.7) acc. to Technical Report TR 029 Factor k_3 in equation (27) acc. to CEN/TS 1992-4-5 section 6.3.3	$k_{(3)}$	[-]	2,0							
Concrete edge failure										
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$							
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Installation factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0							

Table C4: Characteristic values of **tension loads** for **internally threaded anchor rods** under static and quasi-static action

Internally threaded anchor rod				**IG-M 6**	**IG-M 8**	**IG-M 10**	**IG-M 12**	**IG-M 16**	**IG-M 20**
Steel failure[1)]									
Characteristic tension resistance, Steel, strength class 5.8		$N_{Rk,s}$	[kN]	10	18	29	42	79	123
Partial factor		$\gamma_{Ms,N}$	[-]	1,5					
Characteristic tension resistance, Steel, strength class 8.8		$N_{Rk,s}$	[kN]	16	27	46	67	121	196
Partial factor		$\gamma_{Ms,N}$	[-]	1,5					
Characteristic tension resistance, Stainless steel A4 / HCR, strength class 70		$N_{Rk,s}$	[kN]	14	26	41	59	110	124 [2)]
Partial factor		$\gamma_{Ms,N}$	[-]	1,87					2,86
Combined pull-out and concrete failure									
Characteristic bond resistance in <u>uncracked</u> concrete C20/25									
Temperature range I: 40°C / 24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	15	15	14	13	12	12
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	14	13	10	9,5	8,5	7,0
Temperature range II: 60°C / 43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	9,5	9,0	8,5	8,0	7,5	7,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	9,5	9,0	8,5	7,5	7,0	6,0
Temperature range III: 72°C / 43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8,0	7,5	7,0	7,0	6,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8,0	7,5	7,0	6,0	5,5
Characteristic bond resistance in <u>cracked</u> concrete C20/25									
Temperature range I: 40°C / 24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,5	6,5	6,0	5,5	5,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,5	6,0	5,0	4,5	4,0
Temperature range II: 60°C / 43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4,5	4,5	4,0	3,5	3,5	3,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4,5	4,5	4,0	3,5	3,5	3,5
Temperature range III: 72°C / 43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4,0	4,0	3,5	3,0	3,0	3,0
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4,0	4,0	3,5	3,0	3,0	3,0
Increasing factor for concrete		ψ_c	C25/30	1,02					
			C30/37	1,04					
			C35/45	1,07					
			C40/50	1,08					
			C45/55	1,09					
			C50/60	1,10					
Factor acc. to CEN/TS1992-4-5 section 6.2.2.3	uncracked concrete	k_8	[-]	10,1					
	cracked concrete			7,2					
Concrete cone failure									
Factor acc. to CEN/TS1992-4-5 section 6.2.3.1	uncracked concrete	k_{ucr}	[-]	10,1					
	cracked concrete	k_{cr}	[-]	7,2					
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}					
Spacing		$s_{cr,N}$	[mm]	3,0 h_{ef}					
Splitting failure									
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 h_{ef}					
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef} (2,5 - h/h_{ef})$					
	$h/h_{ef} \leq 1,3$			2,4 h_{ef}					
Spacing		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$					
Installation factor (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,2			1,4		
Installation factor (flooded bore hole)		$\gamma_2 = \gamma_{inst}$	[-]	1,4					

1) Fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internally threaded anchor rod. The characteristic tension resistance for steel failure of the given strength class are valid for the internally threaded anchor rod and the fastening element

2) For VMU-IG M20: Internally threaded rod: strength class 50; Fastening screws or threaded rods (incl. nut and washer): strength class 70

Table C5: Characteristic values of **shear loads** for **internally threaded anchor rods** under static and quasi-static action

Internally threaded anchor rod			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
Steel failure without lever arm[1]								
Characteristic shear resistance Steel, strength class 5.8	$V_{Rk,s}$	[kN]	5	9	15	21	39	61
Partial factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic shear resistance Steel, strength class 8.8	$V_{Rk,s}$	[kN]	8	14	23	34	60	98
Partial factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic shear resistance Stainless steel A4 / HCR strength class 70	$V_{Rk,s}$	[kN]	7	13	20	30	55	62 [2]
Partial factor	$\gamma_{Ms,V}$	[-]	1,56					2,38
Steel failure with lever arm[1]								
Characteristic bending moment, Steel, strength class 5.8	$M^0_{Rk,s}$	[Nm]	8	19	37	66	167	325
Partial factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic bending moment, Steel, strength class 8.8	$M^0_{Rk,s}$	[Nm]	12	30	60	105	267	519
Partial factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic bending moment, Stainless steel A4 / HCR strength class 70	$M^0_{Rk,s}$	[Nm]	11	26	53	92	234	643 [2]
Partial factor	$\gamma_{Ms,V}$	[-]	1,56					2,38
Concrete pry-out failure								
Factor k in equation (5.7) of Technical Report TR 029 Factor k_3 in equation (27) of CEN/TS 1992-4-5 section 6.3.3	$k_{(3)}$	[-]	2,0					
Concrete edge failure								
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$					
Outside diameter of anchor	d_{nom}	[mm]	10	12	16	20	24	30
Installation factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0					

[1] Fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internally threaded anchor rod. The characteristic shear resistance for steel failure of the given strength class are valid for the internally threaded anchor rod and the fastening element

[2] For VMU-IG M20: Internally threaded rod: strength class 50; Fastening screws or threaded rods (incl. nut and washer): strength class 70

Table C6: Characteristic values of **tension loads** for **rebar** under static, quasi-static action and seismic action C1

Reinforcing bar				**Ø 8**	**Ø 10**	**Ø 12**	**Ø 14**	**Ø 16**	**Ø 20**	**Ø 25**	**Ø 28**	**Ø 32**
Steel failure												
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$ [1]								
		$N_{Rk,s,C1}$	[kN]	$1{,}0 \cdot N_{Rk,s}$								
Cross section area		A_s	[mm²]	50	79	113	154	201	314	491	616	804
Partial factor		$\gamma_{Ms,N}$	[-]	1,4 [2]								
Combined pull-out and concrete failure												
Characteristic bond resistance in uncracked concrete C20/25												
Temperature range I: 40°C / 24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	14	14	13	13	12	12	11	11	11
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	14	13	11	10	9,5	8,5	7,5	7,0	6,0
Temperature range II: 60°C / 43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	8,0	7,5	7,0	7,0	6,5	6,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	8,0	7,5	7,0	6,0	5,5	5,0
Temperature range III: 72°C / 43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	7,5	7,5	7,5	7,0	7,0	6,5	6,0	6,0	6,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,5	7,5	7,5	7,0	7,0	6,0	5,5	5,0	4,5
Characteristic bond resistance in cracked concrete C20/25												
Temperature range I: 40°C / 24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,0	7,5	7,0	6,5	6,0	5,5	5,5	5,5
		$\tau_{Rk,C1}$	[N/mm²]	5,9	7,0	7,1	6,4	6,2	5,7	5,5	5,5	5,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,0	7,5	6,5	6,0	5,0	4,5	4,0	4,0
		$\tau_{Rk,C1}$	[N/mm²]	5,9	7,0	7,1	6,0	5,7	4,8	4,5	4,0	4,0
Temperature range II: 60°C / 43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4,5	4,5	4,5	4,0	4,0	3,5	3,5	3,5	3,5
		$\tau_{Rk,C1}$	[N/mm²]	3,7	4,5	4,3	3,7	3,8	3,3	3,5	3,5	3,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4,5	4,5	4,5	4,0	4,0	3,5	3,5	3,5	3,0
		$\tau_{Rk,C1}$	[N/mm²]	3,7	4,5	4,3	3,7	3,8	3,3	3,5	3,5	3,0
Temperature range III: 72°C / 43°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4,0	4,0	4,0	3,5	3,5	3,0	3,0	3,0	3,0
		$\tau_{Rk,C1}$	[N/mm²]	3,2	4,0	3,9	3,2	3,3	2,9	3,0	3,0	3,0
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4,0	4,0	4,0	3,5	3,5	3,0	3,0	3,0	3,0
		$\tau_{Rk,C1}$	[N/mm²]	3,2	4,0	3,9	3,2	3,3	2,9	3,0	3,0	3,0
Increasing factor for concrete		ψ_c	C25/30	1,02								
			C30/37	1,04								
			C35/45	1,07								
			C40/50	1,08								
			C45/55	1,09								
			C50/60	1,10								
Factor acc.CEN/TS1992-4-5 section 6.2.2.3	uncracked concrete	k_8	[-]	10,1								
	cracked concrete			7,2								
Concrete cone failure												
Factor acc. CEN/TS1992-4-5 section 6.2.3.1	uncracked concrete	k_{ucr}	[-]	10,1								
	cracked concrete	k_{cr}	[-]	7,2								
Edge distance		$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$								
Spacing		$s_{cr,N}$	[mm]	$3{,}0\ h_{ef}$								
Splitting failure												
Edge distance	$h/h_{ef} \geq 2{,}0$	$c_{cr,sp}$	[mm]	$1{,}0\ h_{ef}$								
	$2{,}0 > h/h_{ef} > 1{,}3$			$2 \cdot h_{ef}\ (2{,}5 - h/h_{ef})$								
	$h/h_{ef} \leq 1{,}3$			$2{,}4\ h_{ef}$								
Spacing		$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$								
Installation factor (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,2					1,4			
Installation factor (flooded bore hole)		$\gamma_2 = \gamma_{inst}$	[-]	1,4								

[1] f_{uk} shall be taken from the specifications of reinforcing bar
[2] in absence of national regulation

Table C7: Characteristic values of **shear loads** for **rebar** under static, quasi-static action and seismic action C1

Reinforcing bar			**Ø 8**	**Ø 10**	**Ø 12**	**Ø 14**	**Ø 16**	**Ø 20**	**Ø 25**	**Ø 28**	**Ø 32**
Steel failure without lever arm											
Characteristic shear resistance	$V_{Rk,s}$	[kN]	$0{,}50 \cdot A_s \cdot f_{uk}$ [1]								
	$V_{Rk,s,C1}$	[kN]	$0{,}80 \cdot V_{Rk,s}$	$0{,}88 \cdot V_{Rk,s}$							
Cross section area	A_s	[mm²]	50	79	113	154	201	314	491	616	804
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 [2]								
Steel failure with lever arm											
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1.2 \cdot W_{el} \cdot f_{uk}$ [1]								
	$M^0_{Rk,s,C1}$	[Nm]	No Performance Determined (NPD)								
Elastic section modulus	W_{el}	[mm³]	50	98	170	269	402	785	1534	2155	3217
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 [2]								
Concrete pry-out failure											
Factor k in equation (5.7) of Technical Report TR 029 Factor k_3 in equation (27) of CEN/TS 1992-4-5 section 6.3.3	$k_{(3)}$	[-]	2,0								
Concrete edge failure											
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$								
Outside diameter of rebar	d_{nom}	[mm]	8	10	12	14	16	20	25	28	32
Installation factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0								

[1] f_{uk} shall be taken from the specifications of reinforcing bars
[2] in absence of national regulation

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

Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Uncracked concrete C20/25 under static and quasi-static action										
Temperature range I: 40°C / 24°C	δ_{N0}- factor	[mm/(N/mm²)]	0,011	0,013	0,015	0,020	0,024	0,029	0,032	0,035
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,044	0,052	0,061	0,079	0,096	0,114	0,127	0,140
Temperature range II: 60°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,023	0,028	0,033	0,037	0,043
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,091	0,111	0,131	0,146	0,161
Temperature range III: 72°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,023	0,028	0,033	0,037	0,043
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,091	0,111	0,131	0,146	0,161
Cracked concrete C20/25 under static and quasi-static action										
Temperature range I: 40°C / 24°C	δ_{N0}- factor	[mm/(N/mm²)]	0,032	0,032	0,032	0,037	0,042	0,048	0,053	0,058
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,210	0,210	0,210	0,210	0,210	0,210	0,210	0,210
Temperature range II: 60°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,032	0,032	0,037	0,043	0,049	0,055	0,061	0,067
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,240	0,240	0,240	0,240	0,240	0,240	0,240	0,240
Temperature range III: 72°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,032	0,032	0,037	0,043	0,049	0,055	0,061	0,067
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,240	0,240	0,240	0,240	0,240	0,240	0,240	0,240
Cracked concrete C20/25 under seismic action (C2)										
All temperature ranges	$\delta_{N,seis\,(DLS)}$ – factor	[mm/(N/mm²)]	NPD		0,03	0,05	No Performance Determined (NPD)			
	$\delta_{N,seis\,(ULS)}$ – factor	[mm/(N/mm²)]			0,06	0,09				

[1] Calculation of the displacement

$\delta_{N0} = \delta_{N0}$- factor $\cdot \tau$; $\delta_{N,seis(DLS)} = \delta_{N,seis(DLS)}$- factor $\cdot \tau$; τ: action bond stress for tension

$\delta_{N\infty} = \delta_{N\infty}$- factor $\cdot \tau$; $\delta_{N,seis(ULS)} = \delta_{N,seis(ULS)}$- factor $\cdot \tau$;

Table C9: **Displacements** under **shear load**[1] (threaded rod)

Threaded rod			M 8	M 10	M 12	M 16	M 20	M 24	M 27	M 30
Uncracked and cracked concrete C20/25 under static and quasi-static action										
All temperature ranges	δ_{V0}- factor	[mm/(kN)]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$- factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
Cracked concrete C20/25 under seismic action (C2)										
All temperature ranges	$\delta_{V,seis(DLS)}$ - factor	[mm/(kN)]	NPD		0,2	0,1	No Performance Determined (NPD)			
	$\delta_{V,seis(ULS)}$ - factor	[mm/(kN)]			0,2	0,1				

[1] Calculation of the displacement

$\delta_{V0} = \delta_{V0}$- factor $\cdot$ V; $\delta_{V,seis(DLS)} = \delta_{V,seis(DLS)}$- factor $\cdot$ V; V: action shear load

$\delta_{V\infty} = \delta_{V\infty}$- factor $\cdot$ V; $\delta_{V,seis(ULS)} = \delta_{V,seis(ULS)}$- factor $\cdot$ V;

Table C10: **Displacements** under **tension load**[1)] (internally threaded anchor rod)

Internally threaded anchor rod			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Uncracked concrete C20/25 under static and quasi-static action								
Temperature range I: 40°C / 24°C	δ_{N0}-factor	[mm/(N/mm²)]	0,013	0,015	0,020	0,024	0,029	0,035
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,052	0,061	0,079	0,096	0,114	0,140
Temperature range II: 60°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,015	0,018	0,023	0,028	0,033	0,043
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,060	0,070	0,091	0,111	0,131	0,161
Temperature range III: 72°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,015	0,018	0,023	0,028	0,033	0,043
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,060	0,070	0,091	0,111	0,131	0,161
Cracked concrete C20/25 under static and quasi-static action								
Temperature range I: 40°C / 24°C	δ_{N0}- factor	[mm/(N/mm²)]	0,032	0,032	0,037	0,042	0,048	0,058
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,210	0,210	0,210	0,210	0,210	0,210
Temperature range II: 60°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,032	0,037	0,043	0,049	0,055	0,067
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,240	0,240	0,240	0,240	0,240	0,240
Temperature range III: 72°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,032	0,037	0,043	0,049	0,055	0,067
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,240	0,240	0,240	0,240	0,240	0,240

[1)] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; τ: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

Table C11: **Displacements** under **shear load**[1)] (internally threaded anchor rod)

Internally threaded anchor rod			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Uncracked and cracked concrete C20/25 under static and quasi-static action								
All temperature ranges	δ_{V0}- factor	[mm/(kN)]	0,07	0,06	0,06	0,05	0,04	0,04
	$\delta_{V\infty}$- factor	[mm/(kN)]	0,10	0,09	0,08	0,08	0,06	0,06

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

Table C12: **Displacements** under **tension load**[1)] (rebar)

Reinforcing bar			**Ø 8**	**Ø 10**	**Ø 12**	**Ø 14**	**Ø 16**	**Ø 20**	**Ø 25**	**Ø 28**	**Ø 32**
Uncracked concrete C20/25 under static and quasi-static action											
Temperature range I: 40°C / 24°C	δ_{N0}- factor	[mm/(N/mm²)]	0,011	0,013	0,015	0,018	0,020	0,024	0,030	0,033	0,037
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,044	0,052	0,061	0,070	0,079	0,096	0,118	0,132	0,149
Temperature range II: 60°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,020	0,023	0,028	0,034	0,038	0,043
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,081	0,091	0,111	0,136	0,151	0,172
Temperature range III: 72°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,020	0,023	0,028	0,034	0,038	0,043
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,081	0,091	0,111	0,136	0,151	0,172
Cracked concrete C20/25 under static and quasi-static action											
Temperature range I: 40°C / 24°C	δ_{N0}- factor	[mm/(N/mm²)]	0,032	0,032	0,032	0,035	0,037	0,042	0,049	0,055	0,061
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,210	0,210	0,210	0,210	0,210	0,210	0,210	0,210	0,210
Temperature range II: 60°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,032	0,032	0,037	0,040	0,043	0,049	0,056	0,063	0,070
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,240	0,240	0,240	0,240	0,240	0,240	0,240	0,240	0,240
Temperature range III: 72°C / 43°C	δ_{N0}- factor	[mm/(N/mm²)]	0,032	0,032	0,037	0,040	0,043	0,049	0,056	0,063	0,070
	$\delta_{N\infty}$- factor	[mm/(N/mm²)]	0,240	0,240	0,240	0,240	0,240	0,240	0,240	0,240	0,240

[1)] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau;$ τ: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau;$

Table C13: **Displacements** under **shear load**[1)] (rebar)

Reinforcing bar			**Ø 8**	**Ø 10**	**Ø 12**	**Ø 14**	**Ø 16**	**Ø 20**	**Ø 25**	**Ø 28**	**Ø 32**
For concrete C20/25 under static and quasi-static action											
All temperature ranges	δ_{V0}- factor	[mm/(kN)]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$- factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04

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