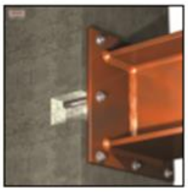
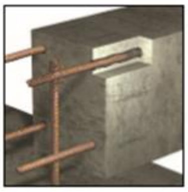
V-500

V-500 is a styrene-free vinyl ester resin based 2-component-reaction resin mortar delivered in a standard coaxial cartridge system. It is specially designed for the anchoring of threaded rods or reinforcing bars into concrete including porous and lightweight concrete with a wide range of applications including seismic C1+C2 with an installation temperature from -10°C and an application temperature up to 80°C. This cost-effective product may be used in combination with a hand and battery or a pneumatic tool and static mixer.





ETA Post-Installed Rebar
ETA-20/0648
EAD 330087-00-0601

ETA Option 1 and Seismic C1+C2
ETA-20/0649
EAD 330499-01-0601

Areas of Usage

• Fixation of facades, roofs, wood, or metal constructions; metal profiles, columns, beams, consoles, railings, sanitary devices, cable trays, piping, post-installed rebar connection (reconstruction or reinforcement), etc.
• Underground: cracked and non-cracked concrete, lightweight concrete, porous concrete, natural stone. Note that, natural stone can discolor; hence, it should be checked in advance,
• Anchor elements: Threaded rods (zinc plated or hot dip, stainless steel, and high corrosion resistance steel), reinforcing bars, internal threaded rods, profiled rod, steel section with undercuts (e.g. perforated section),
• Installation temperature: -10°C up to +40°C, cartridge temperature: +5°C up to +40°C (optimal +20°C), service temperature (base material temperature after full curing): -40°C to +80°C.

Advantages

• European Assessment according to EAD 330499-01-0601 (Option 1) no: ETA-20/0649,
• European Assessment according to TR 049 (Seismic C1 and C2) no: ETA-20/0649,
• European Assessment according to EAD 330087-00-0601 (rebar) no: ETA-20/0648,
• For heavy anchoring - anchoring and post-installed rebar connection,
• Overhead application,
• Thanks to being free of expansion forces, suitability for attachment points with small edge and axial distances,
• Standard chemical resistance,
• Low odor,
• High bending and compressive strength,
• Reusability till the end of the shelf life by replacing the static mixer or resealing cartridge with the sealing cap.

Handling & Storage

V-500 should be stored in a cool and dark place between +5°C and +25 °C. The shelf life of the standard cartridge is 18 months.

Mechanical Properties (Mortar)

Mechanical Properties	Test Method	V-500
UV Resistance	-	Pass
Water tightness	DIN EN 12390-8	0 mm
Temperature Stability	-	≤ 120°C
Density	-	1,77 g/cm^3
Compressive Strength	DIN EN 196-1	100 MPa
Flexural Strength	-	15 MPa
Elasticity Modulus	DIN EN ISO 527-2	14 GPa
Shrinkage	-	< 0,3%
Hardness Shore D	-	90
Electrical Resistance	IEC 93	3,6
Thermal Conductivity	IEC 60093	0,65 W/mK

Table 1 Mortar Mechanical Properties

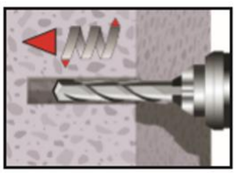
Reactivity

Concrete Temperature		V-500	
Min.	Max.	Max. Working Time	Min. Curing Time
-10°C	-6°C	-	-
-5°C	-1°C	90 min.	6 h
0°C	+4°C	45 min.	3 h
+5°C	+9°C	25 min.	2 h
+10°C	+14°C	20 min.	100 min.
+15°C	+19°C	15 min.	80 min.
+20°C	+29°C	6 min.	45 min.
+30°C	+34°C	4 min.	25 min.
+35°C	+40°C	2 min.	20 min.

Table 2 Reactivity

V-500 has a curing time indicator by changing its color from blue to gray after the minimum curing time. For the application, the cartridge temperature should be between +5°C and +40°C.

Installation Instructions in Concrete



1) Drill a hole into the base material using a hammer drill following the size and the embedment depth given on Table 4 “Threaded Rod Setting Parameters in Concrete” or Table 5 “Rebar Setting Parameters in Concrete”. Aborted holes should also be filled with mortar.

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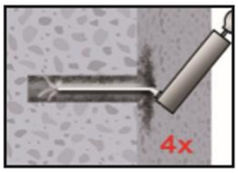
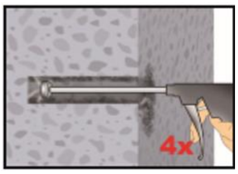
NL Office: Amsterdam Arena Boulevard 65-71, Amsterdam, 1101 DL, The Netherlands + 31 318 728 148 www.tic-m.com

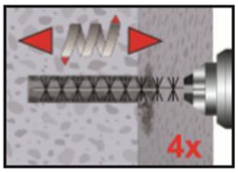
Factory: Ankara-Izmir Road Turgutlu 8. Km Manisa/Turkey + 90 212 276 62 62 www.tic-m.com



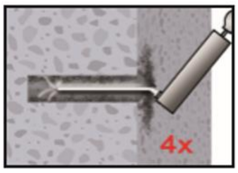
2) Ensure there is no free water in the borehole. Starting from the bottom of the hole, blow clean, compressed air (min. 6 bar) or use a hand pump a minimum of four times. Hand pump can be used for borehole sizes up to Ø20mm or 240mm depth. Above these values, compressed air (min. 6 bar) must be used.



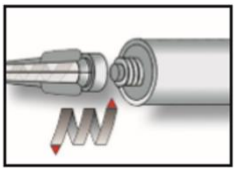
If the bottom of the hole cannot be reached, an extension should be used.



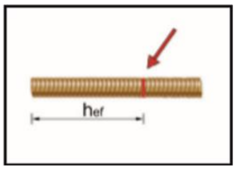
3) Attach the suitable-sized brush to a drilling machine or a battery screwdriver. Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (see Table 3 “Anchor, Drill & Brush Diameters”) a minimum of four times. If the bottom of the hole cannot be reached, an extension should be used.



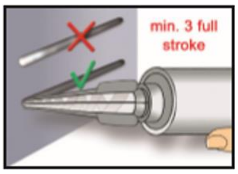
4) After brushing, blow the hole again with compressed air (min. 6 bar) or a hand pump following the instructions given above.
The hole should be protected against recontamination prior to injecting the mortar. If necessary, the cleaning steps should be repeated.



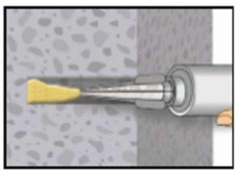
5) Remove the cap and attach a suitable static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. For every working period longer than the recommended working time (see Table 2 “Reactivity”) as well as for new cartridges, a new static-mixer should be used.



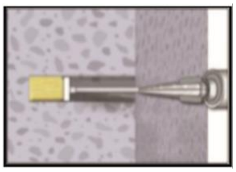
6) Prior to inserting the anchor rod into the filled borehole, the position of the embedment depth should be marked on the anchor rods.



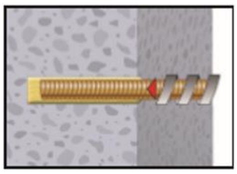
7) Before injecting the mortar into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent blue color.



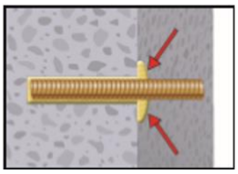
8) Starting from the bottom of the clean anchor hole, fill up to approximately two-thirds with adhesive. Slowly withdraw the static-mixing nozzle as the hole is filled avoiding creating air pockets. If the bottom of the hole is not reached, an appropriate extension nozzle must be used. Follow the working times given on Table 2 “Reactivity”.



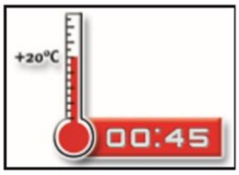
9) Piston plugs and mixer nozzle extensions should be used according to Table 7 “Brushes, Piston Plugs, Anchorage Depth, Extension & Drilling” for the following applications:
   - Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): Drill bit-$Ød_0 \geq 18$ mm and embedment depth $h_{ef} \geq 250$ mm.
   - Overhead assembly (vertical upwards direction): Drill bit-$Ød_0 \geq 18$ mm



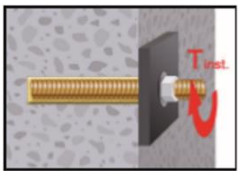
10) Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. The anchor should be free of dirt, grease, oil, or other foreign material.



11) Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible, at the top of the hole. If these requirements are not maintained, the application must be renewed. For overhead applications, the anchor rod should be fixed using wedges etc.



12) Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (see Table 2 “Reactivity”).



13) After full curing, the add-on parts can be installed with up to the max. torque (see Table 4 “Threaded Rod Setting Parameters in Concrete”) by using a calibrated torque wrench. Optionally, the gap between the anchor and the fixture can be filled with mortar to ooze out the washer.

Installation Accessories in Concrete

- **MAC – Hand Pump (volume 750 ml)**
  Drill bit diameter (d_0): 10 mm to 20 mm and anchorage depth up to 240 mm

- **CAC – Compressed Air Tool (min. 6 bar)**
  Drill bit diameter (d_0): All diameters

					
Threaded Rod (mm)	Rebar (mm)	d_0 Drill bit-Ø HD, CA (mm)	d_b Brush-Ø (mm)		$d_{b,min}$ min. Brush-Ø (mm)
M8	-	10	RBT 10	12	10,5
M10	8	12	RBT 12	14	12,5
M12	10	14	RBT 14	16	14,5
-	12	16	RBT 16	18	16,5
M16	14	18	RBT 18	20	18,5
-	16	20	RBT 20	22	20,5
M20	-	24	RBT 24	26	24,5
-	20	25	RBT 25	27	25,5
M24	-	28	RBT 28	30	28,5
-	25	32	RBT 32	34	32,5

Table 3 Anchor, Drill & Brush Diameters

Setting Parameters in Concrete

Parameter	Symbol & Unit	Anchor Size (Threaded Rod)					
		M8	M10	M12	M16	M20	M24
Diameter of Element	$d = d_{nom}$ (mm)	8	10	12	16	20	24
Nominal Drill Hole Diameter	d_0 (mm)	10	12	14	18	24	28
Effective Embedment Depth	$h_{ef,min}$ (mm)	60	60	70	80	90	96
	$h_{ef,max}$ (mm)	160	200	240	320	400	480
Diameter of Clearance Hole in the Fixture	Prepositioned installation d_f (mm)	9	12	14	18	22	26
	Push through installation d_f (mm)	12	14	16	20	24	30
Thickness of Fixture	$t_{fix,min}$ (mm)	0					
	$t_{fix,max}$ (mm)	1500					
Max. Torque Moment	T_{max} (Nm)	10	20	40	80	120	160
Min. Thickness of Member	h_{min} (mm)	$h_{ef} + 30 \geq 100$			$h_{ef} + 2d0$		
Min. Spacing	S > (mm)	40	50	60	80	100	120
Min. Edge Distance	C > (mm)	40	50	60	80	100	120

Table 4 Threaded Rod Setting Parameters in Concrete

Parameter	Symbol & Unit	Anchor Size (Rebar)						
		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Diameter of Element	$d = d_{nom}$ (mm)	8	10	12	14	16	20	25
Nominal Drill Hole Diameter	d_0 (mm)	12	14	16	18	20	25	32
Effective Embedment Depth	$h_{ef,min}$ (mm)	60	60	70	75	80	90	100
	$h_{ef,max}$ (mm)	160	200	240	280	320	400	500
Min. Thickness of Member	h_{min} (mm)	$h_{ef} + 30 \geq 100$		$h_{ef} + 2d_0$				
Min. Spacing	S > (mm)	50	55	65	70	80	100	130
Min. Edge Distance	C > (mm)	50	55	65	70	80	100	130

Table 5 Rebar Setting Parameters in Concrete

Recommended Loads for Threaded Rods in Concrete

The recommended loads are only valid for single anchors for a rough design in dry / wet concrete or cleaned borehole where the following conditions are valid:

- $c \geq 1{,}5 \times h_{ef}$ $s \geq 3{,}0 \times h_{ef}$ $h \geq 2 \times h_{ef}$
- $\psi_{sus} = 1{,}0$; percentage of dead load ≤ ψ_{sus}^0 (see Table 6 "Recommended Loads for Threaded Rods")
- Cleaning: Compressed Air Cleaning - CAC (for uncracked MAC as well)
- The recommended loads have been calculated using the partial safety factors for resistances stated in ETA(s) and with a partial safety factor for actions of γ_f=1.4. The partial safety factor for seismic action is γ_1 = 1,0

If the conditions are not fulfilled, the loads must be calculated according to EN 1992-4.

Parameters (Steel Grade 5.8 & Concrete C20/25)			Symbol & Unit	Anchor Size (Threaded Rod)					
				M8	M10	M12	M16	M20	M24
Recommended Tension Load	40°C/24°C* ψ_{sus}^0=0,60	Uncracked Concrete	$N_{Rec,stat}$ (kN)	6,8	9,0	13,2	19,9	33,9	50,3
		Cracked Concrete	$N_{Rec,stat}$ (kN)	3,6	5,0	7,4	11,2	NPA	
			$N_{Rec,eq,C1}$ (kN)	2,6	3,5	5,3	7,7		
			$N_{Rec,eq,C2}$ (kN)	NPA		1,7	3,3		
	80°C/50°C* ψ_{sus}^0=0,60	Uncracked Concrete	$N_{Rec,stat}$ (kN)	5,2	6,7	9,9	15,0	25,4	37,7
		Cracked Concrete	$N_{Rec,stat}$ (kN)	2,8	3,9	5,8	8,7	NPA	
			$N_{Rec,eq,C1}$ (kN)	2,1	2,8	4,1	6,1		
			$N_{Rec,eq,C2}$ (kN)	NPA		1,4	2,6		
Recommended Shear Load w/o Lever Arm**/***		Uncracked Concrete	$V_{Rec,stat}$ (kN)	6,3	9,7	14,3	23,4	38,4	54,1
		Cracked Concrete	$V_{Rec,stat}$ (kN)	6,3	9,4	13,2	16,6	NPA	
			$V_{Rec,eq,C1}$*** (kN)	4,2	5,8	8,5	12,5		
			$V_{Rec,eq,C2}$*** (kN)	NPA		2,8	5,3		
Embedment Depth			h_{ef} (mm)	80	90	110	125	170	210
Edge Distance			C > (mm)	120	135	165	190	255	315
Axial Distance			S > (mm)	240	270	330	375	510	630

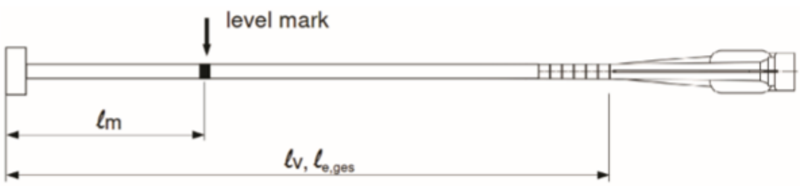
* Short term temperature / Long term temperature.
** Gap between the anchor rod and the clearance hole of fixture must be filled with mortar; if not, a_{gap} must be considered.
*** Shear loads are valid for the specified temperature ranges.
$N_{Rec,stat}$ & $V_{Rec,stat}$: Recommended load under static and quasi-static action
$N_{Rec,eq}$ & $V_{Rec,eq}$: Recommended load under seismic action

Table 6 Recommended Loads for Threaded Rods

Brushes, Piston Plugs, Max Anchorage Depth and Mixer Extension, Hammer (HD) and Compressed Air (CD) Drilling

<table>
<tr><th rowspan="2">Bar Size Ø (mm)</th><th rowspan="2">Tension Anchor-ZA Ø (mm)</th><th colspan="2">Drill Bit-Ø (mm)</th><th colspan="2" rowspan="2">d_b Brush-Ø (mm)</th><th rowspan="2">d_{b,min} min. Brush-Ø (mm)</th><th rowspan="2">Piston Plug (No.)</th><th colspan="2">Hand or Battery Tool</th><th colspan="2">Pneumatic Tool</th></tr>
<tr><th>HD</th><th>CD</th><th>l_{v,max} (cm)</th><th>Mixer Extension</th><th>l_{v,max} (cm)</th><th>Mixer Extension</th></tr>
<tr><td>8</td><td>-</td><td>12</td><td>-</td><td>RBT12</td><td>13,5</td><td>12,5</td><td>-</td><td rowspan="5">70</td><td rowspan="10">VL 10/0,75</td><td>80</td><td rowspan="10">VL 10/0,75</td></tr>
<tr><td>10</td><td>-</td><td>14</td><td>-</td><td>RBT14</td><td>15,5</td><td>14,5</td><td>VS 14</td><td rowspan="4">100</td></tr>
<tr><td>12</td><td>M12</td><td colspan="2">16</td><td>RBT16</td><td>17,5</td><td>16,5</td><td>VS 16</td></tr>
<tr><td>14</td><td>-</td><td colspan="2">18</td><td>RBT18</td><td>20,0</td><td>18,5</td><td>VS 18</td></tr>
<tr><td>16</td><td>M16</td><td colspan="2">20</td><td>RBT20</td><td>22,0</td><td>20,5</td><td>VS 20</td></tr>
<tr><td rowspan="2">20</td><td>M20</td><td>25</td><td>-</td><td>RBT25</td><td>27,0</td><td>25,5</td><td>VS 25</td><td rowspan="5">50</td><td rowspan="3">70</td></tr>
<tr><td>-</td><td>-</td><td>26</td><td>RBT26</td><td>28,0</td><td>26,5</td><td>VS 25</td></tr>
<tr><td>22</td><td>-</td><td colspan="2">28</td><td>RBT28</td><td>30,0</td><td>28,5</td><td>VS 25</td></tr>
<tr><td>24</td><td>-</td><td colspan="2">32</td><td>RBT32</td><td>34,0</td><td>32,5</td><td>VS 32</td><td rowspan="2">50</td></tr>
<tr><td>25</td><td>M24</td><td colspan="2">32</td><td>RBT32</td><td>34,0</td><td>32,5</td><td>VS 32</td></tr>
</table>

Table 7 Brushes, Piston Plugs, Anchorage Depth, Extension & Drilling



Injection tool must be marked by mortar level mark l_m and anchorage depth l_V resp. $l_{e,ges}$ with tape or marker.
Quick estimation: $l_m = 1/3 * l_V$
Continue injection until mortar level mark l_m becomes visible.
Optimum mortar volume: l_m (mm) = l_V resp. $l_{e,ges} * (1{,}2 * Ø^2 / d_0^2) - 0{,}2$

Recommended Loads for Rebars in Concrete

The recommended loads are only valid for single anchors for a rough design in dry / wet concrete or cleaned borehole where the following conditions are valid:

- $c \geq 1{,}5 \times h_{ef}$ $s \geq 3{,}0 \times h_{ef}$ $h \geq 2 \times h_{ef}$
- $\psi_{sus} = 1{,}0$; percentage of dead load $\leq \psi_{sus}^0$ (see Table 8 "Recommended Loads for Rebars")
- Cleaning: All methods
- The recommended loads have been calculated using the partial safety factors for resistances stated in ETA(s) and with a partial safety factor for actions of γ_f=1.4.

If the conditions are not fulfilled, the loads must be calculated according to EN 1992-4.

Parameters (BSt 500 & Concrete C20/25)			Symbol & Unit	Anchor Size (Rebar)						
				Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Recommended Tension Load	40°C/24°C* ψ_{sus}^{0}=0,60	Uncracked Concrete	$N_{Rec,stat}$ (kN)	7,8	11,0	16,1	19,7	22,7	38,6	59,6
	80°C/50°C* ψ_{sus}^{0}=0,60		$N_{Rec,stat}$ (kN)	6,1	8,6	12,7	15,5	19,2	29,7	45,8
Recommended Shear Load w/o Lever Arm**/***			$V_{Rec,stat}$ (kN)	6,7	10,5	14,8	20,3	23,4	38,4	54,4
Embedment Depth			h_{ef} (mm)	80	90	110	115	125	170	210
Edge Distance			C > (mm)	120	135	165	175	185	255	315
Axial Distance			S > (mm)	240	270	330	345	375	510	630

* Short term temperature / Long term temperature.

** Gap between the anchor rod and the clearance hole of fixture must be filled with mortar; if not, a_{gap} must be considered.

*** Shear loads are valid for the specified temperature ranges.

$N_{Rec,stat}$ & $V_{Rec,stat}$: Recommended load under static and quasi-static action

$N_{Rec,eq}$ & $V_{Rec,eq}$: Recommended load under seismic action

Table 8 Recommended Loads for Rebars

Design Anchorage & Lap Length for Rebars

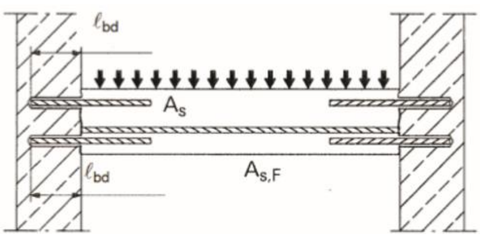
The calculation of the design anchoring lengths of reinforcing bars, if used as end anchoring or as overlapping joint, has to consider the details and provisions of the approval ETA (European Technical Assessment) and the EN 1992-1-1:2004+AC:2010.

The design load with corresponding failure mode ("pull-out failure" or "steel failure") is determined for selected rebar diameters and anchorage lengths. The results for end anchoring and overlapping joints are given in the Table 9 "Design Loads of End Anchoring & Overlapping Joints for Rebars".

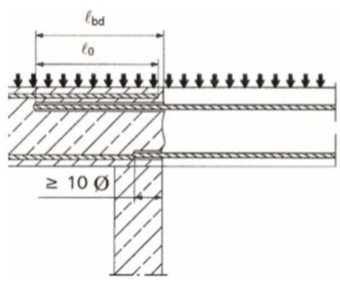
The calculations are based on the following assumptions:

- Rebar BSt 500 S, f_{yk} = 500 N/mm², material safety factor of γ_s = 1,15.
- Concrete class C20/25 and "good bond conditions" according to EN 1992-11:2004+AC:2010 are considered. Rebar diameters ≤ d = 32 mm.
- The bond properties of the bars are considered by the coefficients as follows:
  α_1 = 1,0; is for the effect of the form of the bars assuming adequate cover; 1,0 for straight rebars.
  α_2 = 1,0; is for the effect of concrete minimum cover; has to be checked.
  α_3 = 1,0; is for the effect of confinement by transverse reinforcement; 1,0 for no transverse reinforcement.
  α_4 = 1,0; is for the influence of one or more welded transverse bars; 1,0 for no welded transverse reinforcement.
  α_5 = 1,0; is for the effect of the pressure transverse; 1,0 if no transverse pressure is assumed.
  α_6 = 1,5; is for the percentage of lapped bars relative to the total cross-section area, 1,5 due to the given situation on the construction site.
- All drilling methods (hammer drilling (HD), compressed air drilling (CD) or hollow drill bit) are considered by the amplification factor α_{lb} = 1,0.

End anchoring of slabs or beams (e.g. designed as simply supported)



Overlapping joint for rebar connections of slabs & beams



Design Load N_{Rd} of End Anchoring & Overlapping Joint for Rebars

Rebar Ø8 – Ø25			End Anchoring			Overlapping Joint		
• Concrete class C20/25 • "Good bond condition" assumed, (for "poor bonding", N_{Rd} has to be multiplied by 0,7) • Rebar BSt 500 S, f_{yk} = 500 N/mm² • Drilling HD or CD			$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1{,}0$ $\alpha_{lb} = 1{,}0$			$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1{,}0$ $\alpha_6 = 1{,}5$ $\alpha_{lb} = 1{,}0$		
d (mm)	$N_{Rd,s}$ (kN)	$l_{v,max}$ (mm)	l_{bd} (mm)	N_{Rd} (kN)	Mortar Volume (ml)	l_0 (mm)	N_{Rd} (kN)	Mortar Volume (ml)*
Ø8	21,9	1000	113	6,6	9	200	7,7	15
			200	11,6	15	320	12,3	24
			290	16,8	22	440	17,0	33
			378	21,9	29	567	21,9	43
Ø10	34,1	1000	142	10,2	13	213	10,2	19
			250	18,1	23	380	18,3	34
			360	26,0	33	550	26,5	50
			473	34,1	43	709	34,1	64
Ø12	49,2	1000	170	14,8	18	255	14,8	27
			300	26,0	32	450	26,0	48
			430	37,3	45	650	37,6	69
			567	49,2	60	851	49,2	90
Ø14	66,9	1000	198	20,1	24	298	20,1	36
			350	35,4	42	530	35,7	64
			500	50,6	60	760	51,3	92
			662	66,9	80	992	66,9	120
Ø16	87,4	1000	227	26,2	31	340	26,2	46
			400	46,2	54	600	46,2	81
			580	67,1	79	860	66,3	117
			756	87,4	103	1134	87,4	154
Ø20	136,6	1000	284	41,0	60	425	41,0	90
			500	72,3	106	760	73,2	161
			720	104,0	153	1090	105,0	231
			945	136,6	200	1418	136,6	301
Ø22	165,3	1000	312	49,6	22	468	49,6	132
			540	85,8	38	650	68,9	184
			770	122,4	54	830	88,0	235
			1000	159,0	71	1000	106,0	283
Ø24	196,7	1000	30	59,0	144	510	59,0	216
			560	97,1	236	670	77,5	283
			780	135,3	329	830	96,0	350
			1000	173,4	422	1000	115,6	422
Ø25	213,4	1000	354	64,0	133	532	64,0	200
			570	103,0	214	690	83,1	259
			790	142,7	297	850	102,4	320
			1000	180,6	376	1000	120,4	376

*mortar volume of the lap length. Concrete cover c_1, at end-face of existing rebar, is not included.

Table 9 Design Loads of End Anchoring & Overlapping Joints for Rebars

The specified design load N_{Rd} (end anchoring & overlapping joints) can be converted to further concrete classes, while maintaining the previously accepted boundary conditions and anchorage lengths l_{bd} or lap length l_0, with the approach as follows:

$N_{Rd,con}$ = min ($N_{Rd,S}$; N_{Rd} * $f_{bd,con}$) [kN]

The conversion factor $f_{bd,con}$ can be taken from the table below:

Concrete Class	Rebar-Ø (mm)	f_{bd} (N/mm^2)	$f_{bd,con}$ - Factor
C12/15	8 to 25 mm	1,6	0,70
C16/20		2,0	0,87
C20/25		2,3	1,00
C25/30		2,7	1,17
C30/37		3,0	1,30
C35/45		3,4	1,48
C40/50		3,7	1,61
C45/50		4,0	1,74
C50/60		4,3	1,87

Table 10 Conversion Factors of Rebar Design Load for Different Concrete Classes