Pure epoxy mortar anchor, for use in cracked and non-cracked concrete

MOPUR3

ETA assessed Option 1 (cracked and non-cracked concrete).

PRODUCT INFORMATION

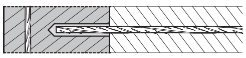
DESCRIPTION
Pure epoxy, chemical anchor.

OFFICIAL DOCUMENTATION
- ETA 17/0659 option 1, M8 to M30 for cracked and non-cracked concrete (100 years).
- ETA 17/0658 for post-installed rebar installation (100 years).
- Declaration features DoP MOPUR3.
- Certificate EVCP 1020-CPR-090-039159 for use in concrete.
- Certificate EVCP 1020-CPD-090-039161 for post-installed rebars.

VALID FOR

Stud


Rebar


Post-installed rebar

DIMENSIONS
Stud M8 - M30
Rebar as stud Ø8 - Ø32
Post-installed rebars Ø8 - Ø32

RANGE OF CACULATION LOADS
From 12,0 to 153,6 kN (non-cracked).
From 10,7 to 88,0 kN (cracked).

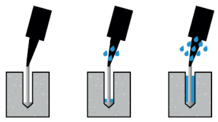
BASE MATERIAL
Concrete quality C20/25 to C50/60 cracked or non-cracked and masonry.


Concrete


Reinforced concrete

Cracked concrete

ASSESSMENTS
- ETA 17/0659 Option 1: Cracked and non-cracked concrete.
- ETA 17/0658 Post-installed rebars.

DRILL HOLE CONDITION


CHARACTERISTICS AND BENEFITS
- Use in cracked and non-cracked concrete.
- Use for very high loads.
- Fire resistance certificate.
- Temperature range -40°C to +70°C (maximum long-term temperature +50°C).
- Variety of lengths and diameters: M8-M30-assessed studs, including M27. Use of rebars as anchor from Ø8 to Ø32, assembly flexibility.
- For static or quasi-static loads and category C1 and C2 seismic applications.
- Approved for use in contact with drinking water.
- Version in zinc plated steel, stainless steel A2 and A4.
- Available in INDEXcal.

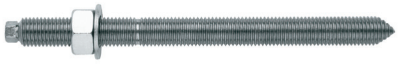
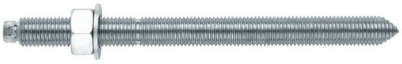
MATERIALS
Standard stud:
Carbon steel 5.8, 8.8.

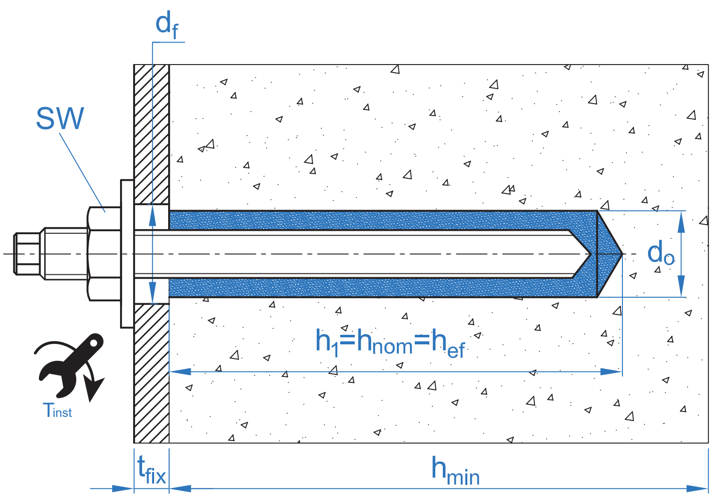
Stainless standard stud:
Stainless steel A2-70 and A4-70.

APPLICATIONS


- For indoor and outdoor use.
- Structural applications and elements subject to vibrations.
- Rebars and start rebars.
- Applications at high temperature.
- Safety barriers, retaining walls, heavy machinery, etc.
- Large metric sizes, retaining walls.
- Substructure fixing to the building.

CONCRETE INSTALLATION PARAMETERS

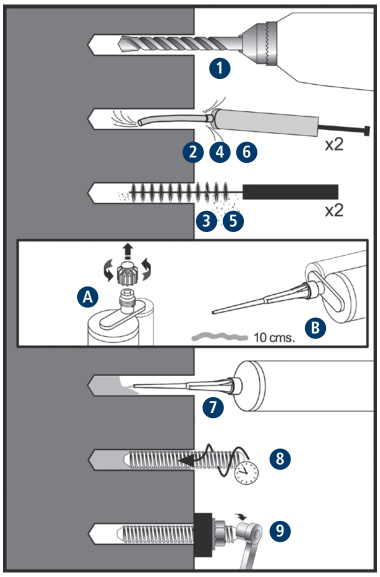
METRIC			M8	M10	M12	M16	M20	M24	M27	M30
d_0	nominal diameter	[mm]	10	12	14	18	22	26	30	35
d_f	diameter in anchor plate ≤	[mm]	9	12	14	18	22	26	30	33
T_{inst}	tightening torque ≤	[Nm]	10	20	40	80	120	160	180	200
Circular cleaning brush			Ø14		Ø20		Ø29		Ø40	
$h_{ef,min}$ = 8d										
h_1	depth of the drill hole	[mm]	60	60	70	80	90	96	108	120
$s_{cr,N}$	critical distance between anchors	[mm]	180	180	210	240	270	288	324	360
$c_{cr,N}$	critical distance from the edge	[mm]	90	90	105	120	135	144	162	180
c_{min}	minimum distance from the edge	[mm]	40	40	40	40	50	50	50	50
s_{min}	minimum distance between anchors	[mm]	40	40	40	40	50	50	50	50
h_{min}	minimum concrete thickness	[mm]	100	100	105	120	135	150	170	185
Standard stud										
h_1	depth of the drill hole	[mm]	80	90	110	128	170	210	-	280
$s_{cr,N}$	critical distance between anchors	[mm]	240	270	330	384	510	630	-	840
$c_{cr,N}$	critical distance from the edge	[mm]	120	135	165	192	255	315	-	420
c_{min}	minimum distance from the edge	[mm]	43	45	56	65	85	105	-	140
s_{min}	minimum distance between anchors	[mm]	43	45	56	65	85	105	-	140
h_{min}	minimum concrete thickness	[mm]	115	125	145	165	215	263	-	345
$h_{ef,max}$ = 20d										
h_1	depth of the drill hole	[mm]	160	200	240	320	400	480	540	600
$s_{cr,N}$	critical distance between anchors	[mm]	480	600	720	960	1200	1440	1620	1800
$c_{cr,N}$	critical distance from the edge	[mm]	240	300	360	480	600	720	810	900
c_{min}	minimum distance from the edge	[mm]	80	100	120	160	200	240	270	300
s_{min}	minimum distance between anchors	[mm]	80	100	120	160	200	240	270	300
h_{min}	minimum concrete thickness	[mm]	195	235	275	360	445	535	600	665
Zinc-plated stud code 5.8 / 8.8 			EQAC08110 EQ8808110	EQAC10130 EQ8810130	EQAC12160 EQ8812160	EQAC16190 EQ8816190	EQAC20260 EQ8820260	EQAC24300 EQ8824300	-	EQAC30330 EQ8830330
Stainless steel stud code A2 / A4 			EQA208110 EQA408110	EQA210130 EQA410130	EQA212160 EQA412160	EQA216190 EQA416190	EQA220260 EQA420260	EQA224300 EQA424300	-	EQA230330 EQA430330



INSTALLATION ACCESSORIES		
CODE	PRODUCT	MATERIAL
MOPISSI	APPLICATION GUNS	Gun for 300 ml cartridges
MOPISTO		Guns for 410 ml cartridges, professional use
MOPISNEU		Pneumatic gun for 410 ml coaxial cartridges, professional use
EQ-AC **EQ-8.8** **EQ-A2** **EQ-A4**	STUD	Studs threaded steel, class 5.8 ISO 898-1 Studs threaded steel, class 8.8 ISO 898-1 Studs stainless steel A2-70 Studs stainless steel A4-70
MORCEPKIT	CLEANING BRUSHES	Kit with 3 cleaning brushes measuring ø14, ø20 and ø29 mm
MOBOMBA	CLEANING PUMP	Pump for cleaning leftover dust and fragments in the drill hole
MORCAPU	MIXING TUBE	Plastic. Static labyrinth mixture

INSTALLATION PROCEDURE

CONCRETE



MINIMUM CURING TIME			
TYPE	BASE MATERIAL TEMPERATURE [ºC]	HANDLING TIME [min]	CURING TIME [min]
MOPUR3	+5	300	24
	+5 to +10	150	24
	+10 to +15	40	18
	+15 to +20	25	12
	+20 to +25	18	8
	+25 to +30	12	6
	+30 to +35	8	4
	+35 to +40	6	2

Resistance in concrete C20/25 for an insulated anchor, without effects of distance from the edge or spacing between anchors, with a standard stud EQ-AC, EQ-8.8, EQ-A2 or EQ-A4.

Characteristic tensile strength N_{Rk}

	Metric		M8	M10	M12	M16	M20	M24	M27	M30
N_{Rk}	Non-cracked concrete 5.8	[kN]	*18*	*29*	*42*	71,2	109	149,7	-	230,5
	Non-cracked concrete 8.8	[kN]	28,1	36,8	53,9	71,2	109	149,7	-	230,5
	Cracked concrete 5.8	[kN]	16,0	22,6	31,1	48,2	74,7	104,7	-	131,9
	Cracked concrete 8.8	[kN]	16,0	22,6	31,1	48,2	74,7	104,7	-	131,9

Calculated tensile strength N_{Rd}

	Metric		M8	M10	M12	M16	M20	M24	M27	M30
N_{Rd}	Non-cracked concrete 5.8	[kN]	*12*	*19,3*	*28*	47,4	72,6	99,8	-	153,6
	Non-cracked concrete 8.8	[kN]	18,7	24,5	35,9	47,4	72,6	99,8	-	153,6
	Cracked concrete 5.8	[kN]	10,7	15	20,7	32,1	49,8	69,8	-	87,9
	Cracked concrete 8.8	[kN]	10,7	15	20,7	32,1	49,8	69,8	-	87,9

Maximum recommended tensile load N_{rec}

	Metric		M8	M10	M12	M16	M20	M24	M27	M30
N_{rec}	Non-cracked concrete 5.8	[kN]	*8,5*	*13,8*	*20*	33,9	51,9	71,2	-	109,7
	Non-cracked concrete 8.8	[kN]	13,4	17,5	25,6	33,9	51,9	71,2	-	109,7
	Cracked concrete 5.8	[kN]	7,6	10,7	14,8	22,9	35,6	49,9	-	62,8
	Cracked concrete 8.8	[kN]	7,6	10,7	14,8	22,9	35,6	49,9	-	62,8

Characteristic resistance to shear stress V_{Rk}

	Metric		M8	M10	M12	M16	M20	M24	M27	M30
V_{Rk}	Zinc-plated stud 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*
	Zinc-plated stud 8.8	[kN]	*15,0*	*23,0*	*34,0*	*63,0*	*98,0*	*141,0*	*184,0*	*224,0*
	Stainless steel stud (A2/A4)	[kN]	*13,0*	*20,0*	*30,0*	*55,0*	*86,0*	*124,0*	*161,0*	*196,0*

Calculated resistance to shearing V_{Rd}

	Metric		M8	M10	M12	M16	M20	M24	M27	M30
V_{Rd}	Zinc-plated stud 5.8	[kN]	*7,2*	*12*	*16,8*	*31,2*	*48,8*	*70,4*	*92*	*112*
	Zinc-plated stud 8.8	[kN]	*12*	*18,4*	*27,2*	*50,4*	*78,4*	*112,8*	*147,2*	*179,2*
	Stainless steel stud (A2/A4)	[kN]	*8,3*	*12,8*	*19,2*	*35,2*	*55,1*	*79,4*	*103,2*	*125,6*

Maximum recommended load to shear stress V_{rec}

	Metric		M8	M10	M12	M16	M20	M24	M27	M30
V_{rec}	Zinc-plated stud 5.8	[kN]	*5,1*	*8,5*	*12*	*22,2*	*34,8*	*50,2*	*65,7*	*80*
	Zinc-plated stud 8.8	[kN]	*8,5*	*13,1*	*19,4*	*36*	*56*	*80,5*	*105,1*	*128*
	Stainless steel stud (A2/A4)	[kN]	*5,9*	*9,1*	*13,7*	*25,1*	*39,3*	*56,7*	*73,7*	*89,7*

Effective depth of studs EQ-AC / EQ-A2 / EQ-A4

Metric		M8	M10	M12	M16	M20	M24	M27	M30
Effective depth	[mm]	80	90	110	128	170	210	-	280

The values underlined and in italics indicate steel failure

Simplified calculation method. European Technical Assessment ETA 17/0659

Simplified version of the calculation method according to Eurocode 2 EN 1992-4. Resistance is calculated according to the data shown in assessment ETA 17/0659.

- Influence of concrete resistance.
- Influence of the distance from the edge of the concrete.
- Influence of the spacing between anchors.
- Influence of rebars.
- Influence of the base material thickness.
- Influence of the load application angle.
- Influence of the effective depth.
- Valid for a group of two anchors.
- Valid for dry or wet drill holes.

The calculation method is based on the following simplification:
No different loads act on individual anchors, without eccentricity.

INDEXcal
For a more precise calculation and taking into account more constructive arrangements we recommend the use of our INDEXcal calculation program. It can be downloaded free from our website **www.indexfix.com**

TENSILE LOADS

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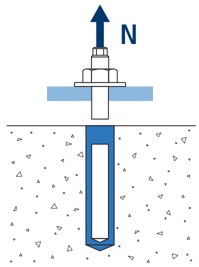
- Calculated steel resistance: $N_{Rd,s}$
- Calculated extraction resistance: $N_{Rd,p} = N^o_{Rd,p} \cdot \Psi_c \cdot \Psi_{hef,p}$
- Calculated concrete cone resistance: $N_{Rd,c} = N^o_{Rd,c} \cdot \Psi_b \cdot \Psi_{s,N} \cdot \Psi_{c,N} \cdot \Psi_{re,N} \cdot \Psi_{hef,N}$
- Calculated concrete cracking resistance: $N_{Rd,sp} = N^o_{Rd,c} \cdot \Psi_b \cdot \Psi_{s,sp} \cdot \Psi_{c,sp} \cdot \Psi_{re,N} \cdot \Psi_{h,sp} \cdot \Psi_{hef,N}$

Calculated steel resistance

$N_{Rd,s}$

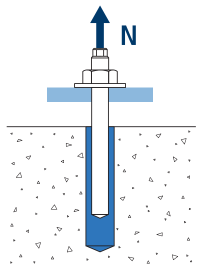
	Metric		M8	M10	M12	M16	M20	M24	M27	M30
$N^o_{Rd,s}$	Steel class 4.6	[kN]	7,5	11,5	17	31,5	49	70,5	92	112
	Steel class 5.8	[kN]	12	19,3	28	52,7	82	118	153,3	187,3
	Steel class 8.8	[kN]	19,3	30,7	44,7	84	130,7	188	244,7	299,3
	Steel class 10.9	[kN]	27,8	43,6	63,2	118	184,2	265,4	345,1	421,8
	Stainless steel class A2-70, A4-70	[kN]	13,9	21,9	31,6	58,8	92	132,1	171,7	210,2



Calculated extraction resistance

$N_{Rd,p} = N^o_{Rd,p} \cdot \Psi_c \cdot \Psi_{hef,p}$

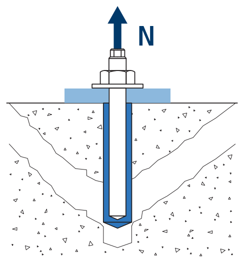
	Metric		M8	M10	M12	M16	M20	M24	M27	M30
$N^o_{Rd,p}$	Non-cracked concrete	[kN]	18,8	24,5	35,9	51,5	85,5	116,1	137,4	158,3
	Cracked concrete	[kN]	-	15,1	20,7	32,2	49,8	73,9	-	-



Calculated concrete cone resistance

$N_{Rd,c} = N^o_{Rd,c} \cdot \Psi_b \cdot \Psi_{s,N} \cdot \Psi_{c,N} \cdot \Psi_{re,N} \cdot \Psi_{hef,N}$

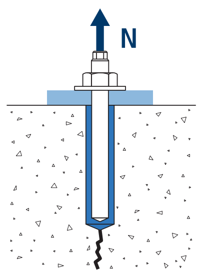
	Metric		M8	M10	M12	M16	M20	M24	M27	M30
$N^o_{Rd,c}$	Non-cracked concrete	[kN]	23,5	28,0	37,8	47,5	72,7	99,8	-	153,6
	Cracked concrete	[kN]	16,4	19,6	26,5	33,3	50,9	69,9	-	107,6



Calculated concrete cracking resistance

$N_{Rd,sp} = N^o_{Rd,c} \cdot \Psi_b \cdot \Psi_{s,sp} \cdot \Psi_{c,sp} \cdot \Psi_{re,N} \cdot \Psi_{h,sp} \cdot \Psi_{hef,N}$

	Metric		M8	M10	M12	M16	M20	M24	M27	M30
$N^o_{Rd,sp}$	Non-cracked concrete	[kN]	23,5	28,0	37,8	47,5	72,7	99,8	-	153,7



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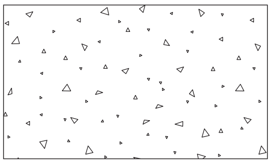
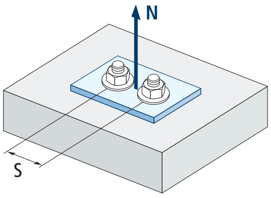
Influence coefficients



Influence of concrete resistance for extraction Ψ_c					
	Concrete type	C20/25	C30/37	C40/50	C50/60
Ψ_c	Non-cracked concrete	1.0			
	Cracked concrete	1.00	1.04	1.07	1.09

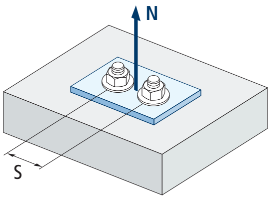
$$\Psi_b = \sqrt{\frac{f_{ck,cube}}{25}} \geq 1$$

Influence of concrete resistance for concrete cone and concrete cracking Ψ_b					
	Concrete type	C20/25	C30/37	C40/50	C50/60
Ψ_b		1.00	1.22	1.41	1.55



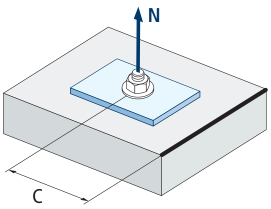
Influence of spacing between anchors (concrete cone) $\Psi_{s,N}$										
$s/s_{cr,N}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
$\Psi_{s,N}$	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00

$$\Psi_{s,N} = 0.5\left(1 + \frac{s}{s_{cr,N}}\right) \leq 1$$



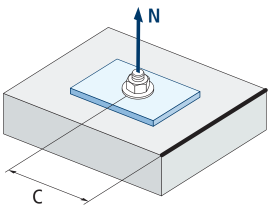
Influence of spacing between anchors (cracking) $\Psi_{s,N}$										
$s/s_{cr,sp}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
$\Psi_{s,sp}$	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00

$$\Psi_{s,sp} = 0.5\left(1 + \frac{s}{s_{cr,sp}}\right) \leq 1$$



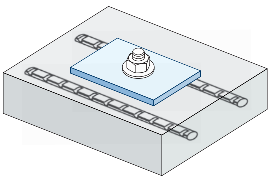
Influence of the distance from the edge of the concrete (concrete cone) $\Psi_{c,N}$												
$c/C_{cr,N}$	0.1	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.6
$\Psi_{c,N}$	0.40	0.46	0.51	0.45	0.49	0.55	0.61	0.67	0.75	0.83	0.91	1.00

$$\Psi_{c,N} = 0.35 + \frac{0.5 \cdot c}{C_{cr,N}} + \frac{0.15 \cdot c^2}{C_{cr,N}^{\,2}} \leq 1$$



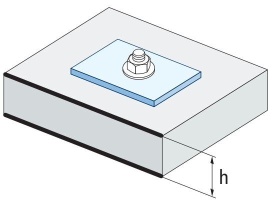
Influence of the distance from the edge of the concrete (cracking) $\Psi_{c,sp}$												
$c/C_{cr,sp}$	0.1	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.6
$\Psi_{c,sp}$	0.40	0.46	0.51	0.45	0.49	0.55	0.61	0.67	0.75	0.83	0.91	1.00

$$\Psi_{c,sp} = 0.35 + \frac{0.5 \cdot c}{C_{cr,sp}} + \frac{0.15 \cdot c^2}{C_{cr,sp}^{\,2}} \leq 1$$



Influence of the rebars $\Psi_{re,N}$					
h_{ef} (mm)	64	70	80	90	100
$\Psi_{re,N}$	0.82	0.85	0.90	0.95	1.00

$$\Psi_{re,N} = 0.5 + \frac{h_{ef}}{200} \leq 1$$



Influence of the base material thickness $\Psi_{h,sp}$											
$\Psi_{h,sp}$	h/h_{ef}	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40	3.60	3.68
	fh	1.00	1.07	1.13	1.19	1.25	1.31	1.37	1.42	1.48	1.50

$$\Psi_{h,sp} = \left(\frac{h}{2 \cdot h_{ef}}\right)^{2/3} \leq 1.5$$

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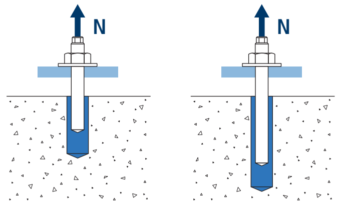
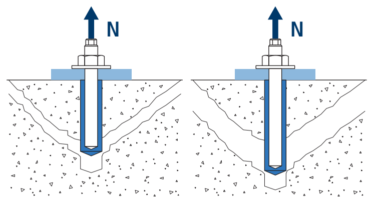
Influence of the effective depth for the extraction combination $\Psi_{hef,p}$								
Metric h_{ef}	M8	M10	M12	M16	M20	M24	M27	M30
64	0.80							
80	1.00	0.89						
90	1.13	1.00						
96	1.20	1.07	0.87			**Value not permitted**		
110	1.38	1.22	1.00					
128	1.60	1.42	1.16	1.00				
160	2.00	1.78	1.45	1.25	0.94			
170		1.89	1.55	1.33	1.00			
192		2.13	1.75	1.50	1.13	0.91		
200		2.22	1.82	1.56	1.18	0.95		
210			1.91	1.64	1.24	1.00		
216			1.96	1.69	1.27	1.03	0.89	
240			2.18	1.88	1.41	1.14	0.99	0.86
243				1.90	1.43	1.16	1.00	0.87
280				2.19	1.65	1.33	1.15	1.00
320				2.50	1.88	1.52	1.32	1.14
400					2.35	1.90	1.65	1.43
480			**Value not permitted**			2.29	1.98	1.71
540							2.22	1.93
600								2.14



$$\Psi_{hef,p} = \frac{h_{ef}}{h_{stand}}$$

Influence of the effective depth for the concrete cone $\Psi_{hef,N}$								
Metric h_{ef}	M8	M10	M12	M16	M20	M24	M27	M30
64	0.72							
80	1.00	0.84						
90	1.19	1.00			**Value not permitted**			
96	1.31	1.10	0.82					
110	1.61	1.35	1.00					
128	2.02	1.70	1.26	1.00				
160	2.83	2.37	1.75	1.40	0.91			
170		2.60	1.92	1.53	1.00			
192		3.12	2.31	1.84	1.20	0.87		
200		3.31	2.45	1.95	1.28	0.93		
210			2.64	2.10	1.37	1.00		
216			2.75	2.19	1.43	1.04	0.84	
240			3.22	2.57	1.68	1.22	0.98	0.79
243				2.62	1.71	1.24	1.00	0.81
280				3.24	2.11	1.54	1.24	1.00
320				3.95	2.58	1.88	1.51	1.22
400					3.61	2.63	2.11	1.71
480			**Value not permitted**			3.46	2.78	2.24
540							3.31	2.68
600								3.14



$$\Psi_{hef,N} = \left(\frac{h_{ef}}{h_{stand}}\right)^{1.5}$$

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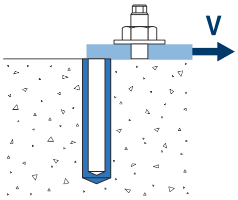
SHEARING LOADS

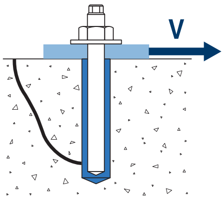
- Calculated steel resistance without lever arm: $V_{Rd,s}$
- Calculated spalling resistance: $V_{Rd,cp} = k \cdot N^{o}_{Rd,c}$
- Calculated concrete edge resistance: $V_{Rd,c} = V^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{se,V} \cdot \Psi_{c,V} \cdot \Psi_{re,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{h,V}$



Calculated steel resistance to shearing

$V_{Rd,s}$

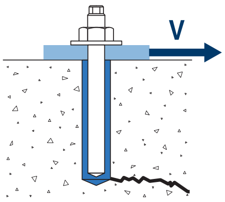
	Metric		M8	M10	M12	M16	M20	M24	M27	M30
$V^{o}_{Rd,s}$	Steel class 4.6	[kN]	4.2	7.2	10.2	18.6	29.3	42.5	55.1	67.1
	Steel class 5.8	[kN]	7.2	12.0	16.8	31.2	48.8	70.4	92.0	112.0
	Steel class 8.8	[kN]	12.0	18.4	27.2	50.4	78.4	112.8	147.2	179.2
	Steel class 10.9	[kN]	12.0	19.3	28.0	52.7	82.0	118.0	153.3	187.3
	Stainless steel class A2-70, A4-70	[kN]	8.3	12.8	19.2	35.3	55.1	79.5	103.2	125.6



Calculated spalling resistance

$V_{Rd,cp} = k \cdot N^{o}_{Rd,c}$

Metric	M8	M10	M12	M16	M20	M24	M27	M30
k	2							

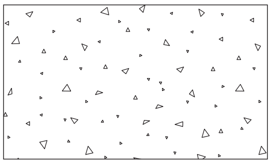


Calculated concrete edge resistance

$V_{Rd,c} = V^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{se,V} \cdot \Psi_{c,V} \cdot \Psi_{re,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{h,V}$

	Metric		M8	M10	M12	M16	M20	M24	M27	M30
$V^{o}_{Rd,c}$	Non-cracked concrete	[kN]	5.7	8.6	11.8	19.0	28.3	36.4	-	55.5
	Cracked concrete	[kN]	4.1	6.1	8.4	13.4	20.1	25.8	-	39.5

Influence coefficients



$$\Psi_{b} = \sqrt{\frac{f_{ck,cube}}{25}} \geq 1$$

Influence of concrete resistance for concrete cone and concrete cracking Ψ_{b}

Concrete type	C20/25	C30/37	C40/50	C50/60
Ψ_{b}	1.00	1.22	1.41	1.55

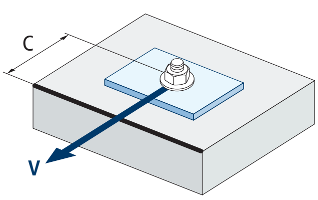
Influence of the distance from the edge and spacing between anchors $\Psi_{se,V}$

For one anchor

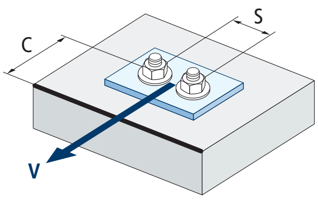
c/h_{ef}	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.50	5.00
Insulated	0.35	0.65	1.00	1.40	1.84	2.32	2.83	3.38	3.95	4.56	5.20	5.86	6.55	7.26	8.00	9.55	11.18

For two anchors

	c/h_{ef}	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.50	5.00
s/c	1.0	0.24	0.43	0.67	0.93	1.22	1.54	1.89	2.25	2.64	3.04	3.46	3.91	4.37	4.84	5.33	6.36	7.45
	1.5	0.27	0.49	0.75	1.05	1.38	1.74	2.12	2.53	2.96	3.42	3.90	4.39	4.91	5.45	6.00	7.16	8.39
	2.0	0.29	0.54	0.83	1.16	1.53	1.93	2.36	2.81	3.29	3.80	4.33	4.88	5.46	6.05	6.67	7.95	9.32
	2.5	0.32	0.60	0.92	1.28	1.68	2.12	2.59	3.09	3.62	4.18	4.76	5.37	6.00	6.66	7.33	8.75	10.25
	≥ 3.0	0.35	0.65	1.00	1.40	1.84	2.32	2.83	3.38	3.95	4.56	5.20	5.86	6.55	7.26	8.00	9.55	11.18



$$\Psi_{se,V} = \left(\frac{c}{h_{ef}}\right)^{1.5}$$



$$\Psi_{se,V} = \left(\frac{c}{h_{ef}}\right)^{1.5} \cdot \left(1 + \frac{s}{3 \cdot c}\right) \cdot 0.5 \leq \left(\frac{c}{h_{ef}}\right)^{1.5}$$

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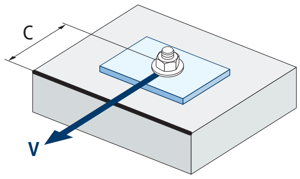
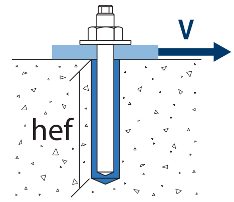
Influence of the distance from the edge of the concrete $\Psi_{c,V}$								
c/d	4	5	7	10	15	20	25	30
$\Psi_{c,V}$	0.76	0.72	0.68	0.63	0.58	0.55	0.53	0.51

$$\Psi_{c,V} = \left(\frac{d}{c}\right)^{0.20}$$

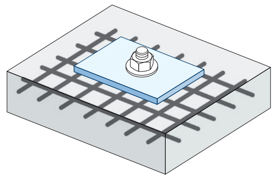


Influence of the effective depth $\Psi_{hef,V}$													
h_{ef}/d	8	9	10	11	12	13	14	15	16	17	18	19	20
$\Psi_{hef,V}$	1.65	2.04	2.47	2.93	3.42	3.94	4.50	5.10	5.72	6.38	7.06	7.78	8.53

$$\Psi_{hef,V} = 0.04 \cdot \left(\frac{h_{ef}}{d}\right)^{1.79}$$

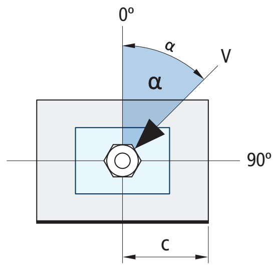


Influence of the rebars $\Psi_{re,v}$				
		Without perimeter rebar	Perimeter rebar ≥Ø12mm	Perimeter rebar with abutments at≤100mm
$\Psi_{re,v}$	Non-cracked concrete	1	1	1
	Cracked concrete	1	1.2	1.4



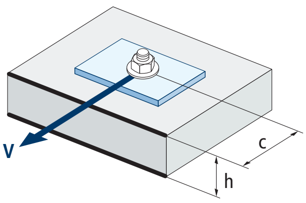
Influence of the load application angle $\Psi_{\alpha,v}$										
Angle, α(º)	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
$\Psi_{\alpha,v}$	1.00	1.01	1.05	1.13	1.24	1.40	1.64	1.97	2.32	2.50

$$\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\alpha_v)^2 + \left(\frac{\sin\alpha_v}{2.5}\right)^2}} \geq 1$$



Influence of the base material thickness $\Psi_{h,V}$										
h/c	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	≥ 1.5
$\Psi_{h,v}$	0.32	0.45	0.55	0.63	0.71	0.77	0.84	0.89	0.95	1.00

$$\Psi_{h,V} = \left(\frac{h}{1.5 \cdot c}\right)^{0.5} \geq 1.0$$



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RETROFITTED REBAR CONNECTIONS

This technical document covers post-installed rebar connections in non-carbonate concrete under the assumption that post-installed rebar connections are generally calculated according to Eurocode 2. The rebar anchor system comprises the bonding of the material and a straight, recessed reinforcement rebar with the properties specified in Eurocode 2, Annex C; classes B and C.

Dynamic, fatigue or seismic loads on post-installed rebar connections are not covered by this technical document.

Intended use

This technical document covers application in non-carbonate concrete only from C12/15 to C50/60 (EN 206) for the following applications:

- Overlapping bond with an existing rebar in a building component **(Figures 1 and 4).**
- Fixing of rebar in a slab or in a support. Support at one end of a slab calculated as simply supported as well as its rebars for retention forces **(Figure 2).**
- Fixing of rebar of construction components mainly subjected to compression **(Figure 3).**
- Fixing of rebar to cover the action line of the tensile force **(Figure 5).**

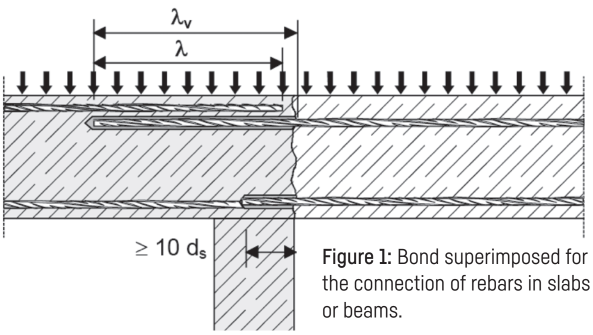

Figure 1: Bond superimposed for the connection of rebars in slabs or beams.

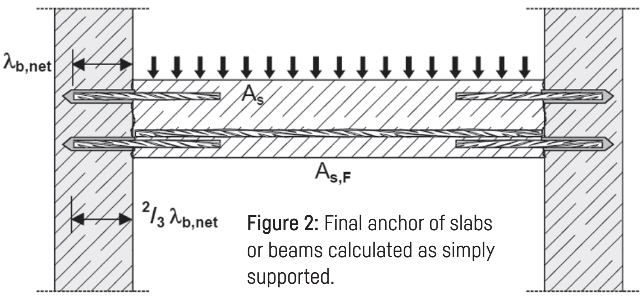

Figure 2: Final anchor of slabs or beams calculated as simply supported.

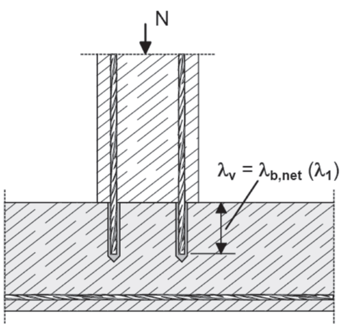

Figure 3: Rebar connections for items primarily subjected to compression. The rebars are subjected to compression.

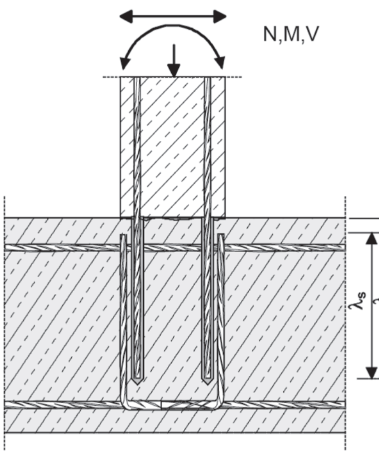

Figure 4: Bond superimposed to a foundation of a column or a wall where the rebars is subjected to tensile force.

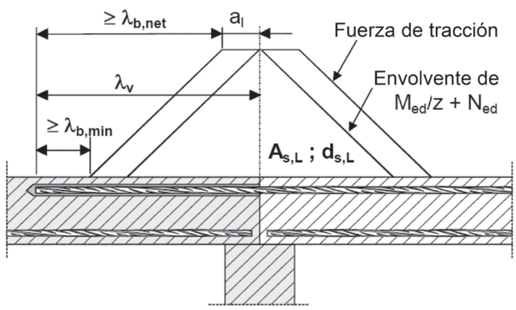

Figure 5: Reinforcement anchor to cover the action line of the tensile force.

* **Note for Figure 1 and 5:** In the figures the transversal reinforcements have not been represented, the transversal reinforcements as required by the Eurocode 2 must be present. The shear stress transferred between the anterior and posterior concrete must be calculated according to Eurocode 2.

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The tables shown below refer to Eurocode 2 Annex C, Table C.1 and C2N, rebar properties.

Properties of the start rebars				
Product form		Rebars and unwound rods		
Class		B	C	
Characteristic yield stress f_{yk} or $f_{0.2k}$ (MPa)		400 to 600		
Minimum value of $k = (f_t / f_y)_k$		≥ 1.08	≥ 1.15 < 1.35	
Characteristic maximum tensile deformation ε_{uk} (%)		≥ 5.0	≥ 7.5	
Flexibility		Bending/folding test		
Maximum deviation from the nominal weight (individual bar or wire) (%)	Nominal size of the rebar (mm) ≤ 8 > 8	± 6.0 ± 4.5		
Bonding: Minimum relative corrugated area, $f_{R,min}$	Nominal size of the rebar (mm) 8 to 12 > 12	0.040 0.056		

Minimum / maximum installation length ℓ_{max}				
Corrugated bars		Minimum		Maximum
		Anchor $\ell_{b,min}$	Overlapped connection $\ell_{0,min}$	ℓ_{max}
$Ød_s$ [mm]	fy,k [N/mm²]	[mm]	[mm]	[mm]
8	500	113	200	400
10	500	142	200	500
12	500	170	200	600
14	500	198	210	700
16	500	227	240	800
20	500	284	300	1000
25	500	354	375	1000
28	500	397	420	1000
32	500	454	480	1000

Calculated bonding resistance [N/mm²] f_{bd}									
Bar Ø d_s [mm]	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 28	1.6	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.3
32	1.6	2.0	2.3	2.7	3.0	3.4	3.7	3.7	

$$N = f_{bd} \cdot \Phi \cdot L_b \cdot \pi$$

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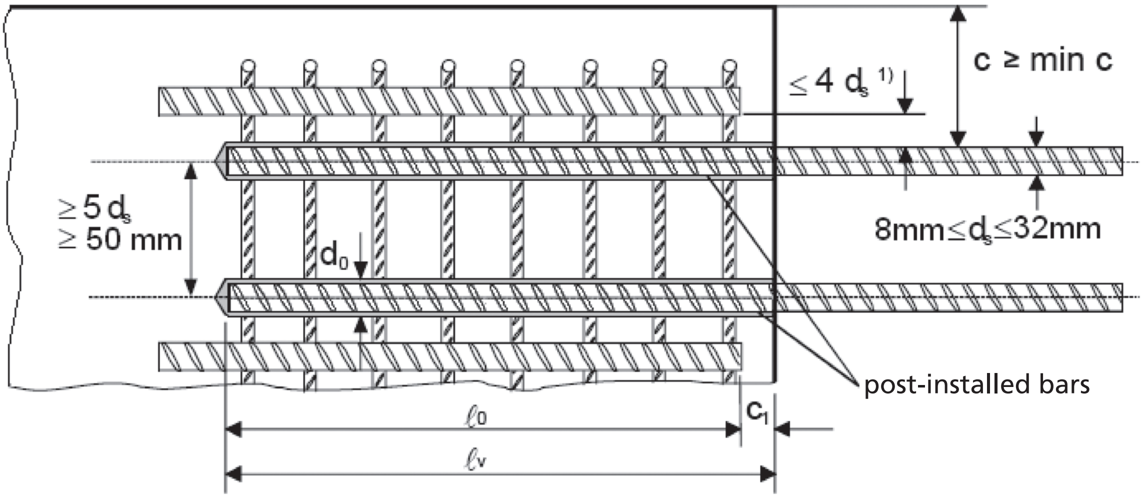
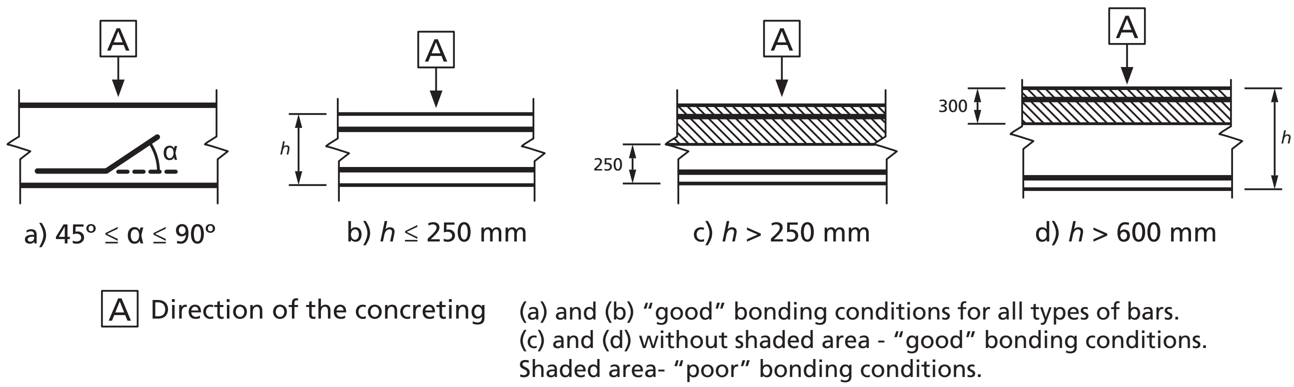
Calculated load values according to Eurocode 2 and EOTA technical report TR 023.

- Information according to ETA 17/0658.
- Non-cracked concrete, conditions in dry or wet conditions.
- Temperature range: -40°C to +80°C (maximum long-term temperature +50°C).
- Minimum spacing conditions between bars ≥5d_s, min. 50 mm:



- Minimum concrete coating:
  - drilling with compressed air ≥ 50 + 0.06 Lb
  - drilling in percussion mode ≥ 30 + 0.08 Lb ≥ 2Φ
- Good bonding conditions:



* In case of poor bonding conditions, multiply values by 0.7.

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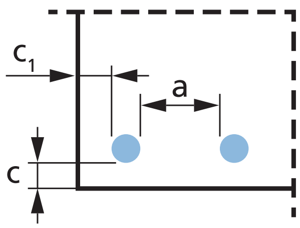
Resistance values may increase in the following situations:
- With transverse tension/compression pressure (α_2)
- In case of concrete coating (α_5)
- In case of overlapping rebars (α_6)

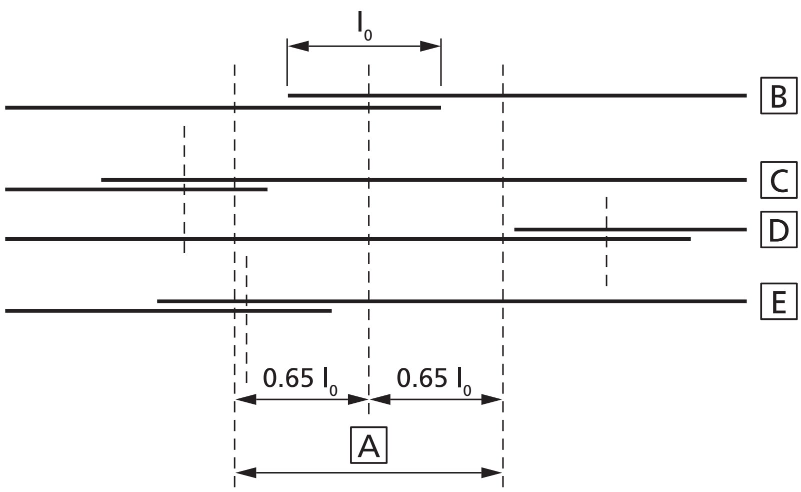
Values for α_2 , α_5 and α_6		
Influence factor	Reinforcement bar	
	A tension	A compression
Concrete coating	$\alpha_2 = 1 - 0.15\,(cd - Ø)/Ø$ ≥ 0.7 ≤ 1.0	$\alpha_2 = 1.0$
Transverse pressure confinement	$\alpha_5 = 1 - 0.004p$ ≥ 0.7 ≤ 1.0	$\alpha_5 = 1.0$
Overlapping length	$\alpha_6 = (p_1/25)^{0.25}$ ≥ 1.0 ≤ 1.5	

Where:

$c_d = \min(a/_2, c_1, c)$



p: transverse pressure [MPa] in the ultimate limit state l_{bd}
p_1 is the percentage of the overlapped reinforcement bar within $0.65 \cdot l_0$ from the centre of the length of the overlap considered



[A] Section considered [B] Bar I [C] Bar II [D] Bar III [E] Bar IV

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TABLES OF PRECALCULATED VALUES

Concrete class 20/25											
Resistance to concrete compression [$f_{ck,cube}$]: 25 N/mm²											
Bar Ø	d_s	[mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Bar size	d_s	[mm]	8	10	12	14	16	20	25	28	32
Cross-sectional area	A_s	[mm²]	50.3	78.5	113.1	153.9	201.1	314.2	490.9	615.8	804.2
Yield stress of the steel	f_{yd}	[kN]	500	500	500	500	500	500	500	500	500
Safety factor	$\gamma_{M,s}$	[mm²]	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Calculated steel resistance	$N_{Rd,s}$	[kN]	21.9	34.1	49.2	66.9	87.4	136.6	213.4	267.7	349.7
Calculated bonding resistance	f_{bd}	[N/mm²]	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Diameter of the drilled hole	d_h	[mm]	12	14	16	18	20	25	32	35	40
Spacing between bars ≥	s	[mm]	50	50	60	70	80	100	125	140	160
Distance from the edge (drilled using compressed air) ≥	c	[mm]	$50 + 0.06\ L_b$								
Distance from the edge (drilled in percussion mode) ≥	c	[mm]	$30 + 0.08\ L_b \geq 2\Phi$								
Anchor length, L_b [mm]			Calculated extraction resistance by bonding*, N_{Rd} [kN]								
113			6.5	Area not permitted							
142			8.2	10.3							
170			9.8	12.3	14.7						
198			11.4	14.3	17.2	20.0					
200			11.6	14.5	17.3	20.2					
210			12.1	15.2	18.2	21.2					
227			13.1	16.4	19.7	23.0	26.2				
240			13.9	17.3	20.8	24.3	27.7				
284			16.4	20.5	24.6	28.7	32.8	41.0			
300			17.3	21.7	26.0	30.3	34.7	43.4			
354			20.5	25.6	30.7	35.8	40.9	51.2	63.9		
375			21.7	27.1	32.5	37.9	43.4	54.2	67.7		
397			**21.9**	28.7	34.4	40.2	45.9	57.4	71.7	80.3	
400			**21.9**	28.9	34.7	40.5	46.2	57.8	72.3	80.9	
420				30.3	36.4	42.5	48.6	60.7	75.9	85.0	
454				32.8	39.4	45.9	52.5	65.6	82.0	91.9	105.0
480				**34.1**	41.6	48.6	55.5	69.4	86.7	97.1	111.0
500				**34.1**	43.4	50.6	57.8	72.3	90.3	101.2	115.6
600					**49.2**	60.7	69.4	86.7	108.4	121.4	138.7
700						**66.9**	80.9	101.2	126.4	141.6	161.9
800			Yield stress area of the bar				**87.4**	115.6	144.5	161.9	185.0
1000								**136.6**	180.6	202.3	231.2
Length for reaching the yield stress of the steel, $L_{b,rqd}$ [mm]			378	473	567	662	756	945	1,181	1,323	1,512

Values shaded in blue are not valid for overlap bonds

* For C20/25 concrete (f_{bd} = 2,3 N/mm²), good bond conditions, α_6=1 and rebar (f_{yk} = 500 N/mm²)

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TABLES OF PRECALCULATED VALUES

Concrete class 30/37											
Resistance to concrete compression [$f_{ck,cube}$]: 37 N/mm²											
Bar Ø	d_s	[mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Bar size	d_s	[mm]	8	10	12	14	16	20	25	28	32
Cross-sectional area	A_s	[mm²]	50.3	78.5	113.1	153.9	201.1	314.2	490.9	615.8	804.2
Yield stress of the steel	f_{yd}	[kN]	500	500	500	500	500	500	500	500	500
Safety factor	$\gamma_{M,s}$	[mm²]	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Calculated steel resistance	$N_{Rd,s}$	[kN]	21.9	34.1	49.2	66.9	87.4	136.6	213.4	267.7	349.7
Calculated bonding resistance	f_{bd}	[N/mm²]	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.70
Diameter of the drilled hole	d_h	[mm]	12	14	16	18	20	25	32	35	40
Spacing between bars ≥	s	[mm]	50	50	60	70	80	100	125	140	160
Distance from the edge (drilled using compressed air) ≥	c	[mm]	$50 + 0.06\ L_b$								
Distance from the edge (drilled in percussion mode) ≥	c	[mm]	$30 + 0.08\ L_b \geq 2\Phi$								
Anchor length, L_b [mm]			Calculated extraction resistance by bonding*, N_{Rd} [kN]								
113			8.5								
142			10.7	13.4							
170			12.8	16.0	19.2			Area not permitted			
198			14.9	18.7	22.4	26.1					
200			15.1	18.8	22.6	26.4					
210			15.8	19.8	23.8	27.7					
227			17.1	21.4	25.7	30.0	34.2				
240			18.1	22.6	27.1	31.7	36.2				
284			21.4	26.8	32.1	37.5	42.8	53.5			
300			**21.9**	28.3	33.9	39.6	45.2	56.5			
354			**21.9**	33.4	40.0	46.7	53.4	66.7	83.4		
375			**21.9**	**34.1**	42.4	49.5	56.5	70.7	88.4		
397			**21.9**	**34.1**	44.9	52.4	59.9	74.8	93.5	104.8	
400			**21.9**	**34.1**	45.2	52.8	60.3	75.4	94.2	105.6	
420				**34.1**	47.5	55.4	63.3	79.2	99.0	110.8	
454				**34.1**	**49.2**	59.9	68.5	85.6	107.0	119.8	136.9
480				**34.1**	**49.2**	63.3	72.4	90.5	113.1	126.7	144.8
500				**34.1**	**49.2**	66.0	75.4	94.2	117.8	131.9	150.8
600					**49.2**	**66.9**	**87.4**	113.1	141.4	158.3	181.0
700						**66.9**	**87.4**	131.9	164.9	184.7	164.9
800				Yield stress area of the bar			**87.4**	**136.6**	188.5	211.1	188.5
1000								**136.6**	**213.4**	263.9	301.6
Length for reaching the yield stress of the steel, $L_{b,rqd}$ [mm]			290	362	435	507	580	725	906	1,014	1,288

Values shaded in blue are not valid for overlap bonds

* For C30/37 concrete (f_{bd} = 2,3 N/mm²), good bond conditions, α_6=1 and rebar (f_{yk} = 500 N/mm²)

MOPUR3

TABLES OF PRECALCULATED VALUES

Concrete class 40/50											
Resistance to concrete compression [$f_{ck,cube}$]: 50 N/mm^2											
Bar Ø	d_s	[mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Bar size	d_s	[mm]	8	10	12	14	16	20	25	28	32
Cross-sectional area	A_s	[mm²]	50.3	78.5	113.1	153.9	201.1	314.2	490.9	615.8	804.2
Yield stress of the steel	f_{yd}	[kN]	500	500	500	500	500	500	500	500	500
Safety factor	$\gamma_{M,s}$	[mm²]	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Calculated steel resistance	$N_{Rd,s}$	[kN]	21.9	34.1	49.2	66.9	87.4	136.6	213.4	267.7	349.7
Calculated bonding resistance	f_{bd}	[N/mm²]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	2.70
Diameter of the drilled hole	d_h	[mm]	12	14	16	18	20	25	32	35	40
Spacing between bars ≥	s	[mm]	50	50	60	70	80	100	125	140	160
Distance from the edge (drilled using compressed air) ≥	c	[mm]	$50 + 0.06\ L_b$								
Distance from the edge (drilled in percussion mode) ≥	c	[mm]	$30 + 0.08\ L_b \geq 2\Phi$								
Anchor length, L_b [mm]			Calculated extraction resistance by bonding*, N_{Rd} [kN]								
113			10.5	Area not permitted							
142			13.2	16.5							
170			15.8	19.8	23.7						
198			18.4	23.0	27.6	32.2					
200			18.6	23.2	27.9	32.5					
210			19.5	24.4	29.3	34.2					
227			21.1	26.4	31.7	36.9	42.2				
240			**21.9**	27.9	33.5	39.1	44.6				
284			**21.9**	33.0	39.6	46.2	52.8	66.0			
300			**21.9**	**34.1**	41.8	48.8	55.8	69.7			
354			**21.9**	**34.1**	**49.2**	57.6	65.8	82.3	102.9		
375			**21.9**	**34.1**	**49.2**	61.0	69.7	87.2	109.0		
397			**21.9**	**34.1**	**49.2**	64.6	73.8	92.3	115.4	129.2	
400			**21.9**	**34.1**	**49.2**	65.1	74.4	93.0	116.2	130.2	
420				**34.1**	**49.2**	**66.9**	78.1	97.6	122.1	136.7	
454				**34.1**	**49.2**	**66.9**	84.4	105.5	131.9	147.8	168.9
480				**34.1**	**49.2**	**66.9**	**87.4**	111.6	139.5	156.2	178.5
500				**34.1**	**49.2**	**66.9**	**87.4**	116.2	145.3	162.7	186.0
600					**49.2**	**66.9**	**87.4**	**136.6**	174.4	195.3	223.2
700						**66.9**	**87.4**	**136.6**	203.4	227.8	260.4
800			Yield stress area of the bar				**87.4**	**136.6**	**213.4**	260.4	297.6
1000								**136.6**	**213.4**	**267.7**	**349.7**
Length for reaching the yield stress of the steel, $L_{b,rqd}$ [mm]			235	294	352	411	470	587	734	822	940

Values shaded in blue are not valid for overlap bonds

* For C40/50 concrete (f_{bd} = 2,3 N/mm²), good bond conditions, α_6=1 and rebar (f_{yk} = 500 N/mm²)

MOPUR3

TABLES OF PRECALCULATED VALUES

Concrete class 50/60											
Resistance to concrete compression [$f_{ck,cube}$]: 60 N/mm²											
Bar Ø	d_s	[mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Bar size	d_s	[mm]	8	10	12	14	16	20	25	28	32
Cross-sectional area	A_s	[mm²]	50.3	78.5	113.1	153.9	201.1	314.2	490.9	615.8	804.2
Yield stress of the steel	f_{yd}	[kN]	500	500	500	500	500	500	500	500	500
Safety factor	$\gamma_{M,s}$	[mm²]	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Calculated steel resistance	$N_{Rd,s}$	[kN]	21.9	34.1	49.2	66.9	87.4	136.6	213.4	267.7	349.7
Calculated bonding resistance	f_{bd}	[N/mm²]	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.70	2.70
Diameter of the drilled hole	d_h	[mm]	12	14	16	18	20	25	32	35	40
Spacing between bars ≥	s	[mm]	50	50	60	70	80	100	125	140	160
Distance from the edge (drilled using compressed air) ≥	c	[mm]	$50 + 0.06\ L_b$								
Distance from the edge (drilled in percussion mode) ≥	c	[mm]	$30 + 0.08\ L_b \geq 2\Phi$								
Anchor length, L_b [mm]			Calculated extraction resistance by bonding*, N_{Rd} [kN]								
113			12.2								
142			15.3	19.2							
170			18.4	23.0	27.6			Area not permitted			
198			21.4	26.7	32.1	37.4					
200			21.6	27.0	32.4	37.8					
210			**21.9**	28.4	34.0	39.7					
227			**21.9**	30.7	36.8	42.9	49.1				
240			**21.9**	32.4	38.9	45.4	51.9				
284			**21.9**	**34.1**	46.0	53.7	61.4	76.7			
300			**21.9**	**34.1**	48.6	56.7	64.8	81.1			
354			**21.9**	**34.1**	**49.2**	**66.9**	76.5	95.6	119.6		
375			**21.9**	**34.1**	**49.2**	**66.9**	81.1	101.3	126.6		
397			**21.9**	**34.1**	**49.2**	**66.9**	85.8	107.3	134.1	150.2	
400			**21.9**	**34.1**	**49.2**	**66.9**	86.5	108.1	135.1	151.3	
420				**34.1**	**49.2**	**66.9**	**87.4**	113.5	141.8	158.9	
454				**34.1**	**49.2**	**66.9**	**87.4**	122.7	153.3	171.7	168.9
480				**34.1**	**49.2**	**66.9**	**87.4**	129.7	162.1	181.6	178.5
500				**34.1**	**49.2**	**66.9**	**87.4**	135.1	168.9	189.1	186.0
600					**49.2**	**66.9**	**87.4**	**136.6**	202.6	226.9	223.2
700						**66.9**	**87.4**	**136.6**	**213.4**	264.8	260.4
800			Yield stress area of the bar				**87.4**	**136.6**	**213.4**	**267.7**	297.6
1000								**136.6**	**213.4**	**267.7**	**349.7**
Length for reaching the yield stress of the steel, $L_{b,rqd}$ [mm]			202	253	303	354	404	505	632	708	940

Values shaded in blue are not valid for overlap bonds

* For C50/60 concrete (f_{bd} = 2,3 N/mm²), good bond conditions, α_6=1 and rebar (f_{yk} = 500 N/mm²)

MOPUR3

RANGE

PURE EPOXY 3:1

CODE	DIMENSION	
NORMAL		
MOPUR3385	385 ml	12
MOPUR3585	585 ml	12

Concrete
Reinforced concrete
Cracked concrete

Accessories for chemical anchor cartridges

MO-PIS Application guns

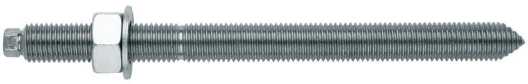
CODE	MODEL
MOPISP3385	Manual 385 ml
MOPISP3585	Manual 585 ml

MO-AC Mixing tubes and miscellaneous

MORCEPKIT
Kit 3 brushes (ø15, ø20, ø30)

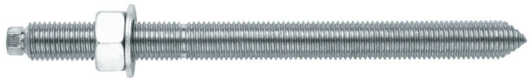
CODE	MODEL
MOBOMBA	Blower pump
MORCAPU	Tube 385 - 585 ml
MORCEPKIT	Kit 3 brushes

EQ-AC Zinc-plated 5.8



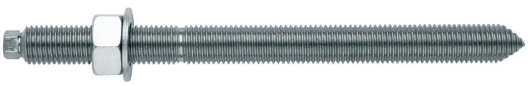
CODE	DIMENSION
EQAC08110	M8 x 110
EQAC10130	M10 x 130
EQAC10190	M10 x 190
EQAC12160	M12 x 160
EQAC12220	M12 x 220
EQAC16190	M16 x 190
EQAC16250	M16 x 250
EQAC20260	M20 x 260
EQAC20350	M20 x 350
EQAC24300	M24 x 300
EQAC24380	M24 x 380
EQAC30330	M30 x 330

EQ-A2 Stainless steel A2



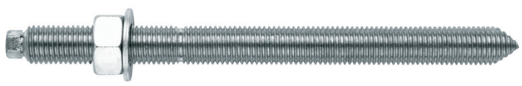
CODE	DIMENSION
EQA208110	M8 x 110
EQA210130	M10 x 130
EQA212160	M12 x 160
EQA216190	M16 x 190
EQA220260	M20 x 260
EQA224300	M24 x 300
EQA230330	M30 x 330

EQ-8.8 Zinc-plated 8.8



CODE	DIMENSION
EQ8808110	M8 x 11040
EQ8810130	M10 x 130
EQ8812160	M12 x 160
EQ8816190	M16 x 190
EQ8820260	M20 x 260
EQ8824300	M24 x 300

EQ-A4 Stainless steel A4



CODE	DIMENSION
EQA408110	M8 x 110
EQA410130	M10 x 130
EQA412160	M12 x 160
EQA416190	M16 x 190
EQA420260	M20 x 260
EQA424300	M24 x 300
EQA430330	M30 x 330