Hybrid resin vinilester styrene-free mortar anchor, for use in cracked, non-cracked concrete and masonry

MO-VH

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

PRODUCT INFORMATION

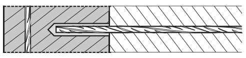
DESCRIPTION
Hybrid resin vinilester styrene-free chemical anchor.

OFFICIAL DOCUMENTATION
- ETA 24/0867 option 1, M8 to M30 for non-cracked concrete and M10 to M24 for cracked concrete (100 years).
- ETA 24/0868 for post-installed rebar installation (100 years).
- Declaration features DoP MO-VH.
- Certificate EVCP 1020-CPR-090-032411 for use in concrete.
- Certificate EVCP 1020-CPD-090-030058 for post-installed rebars.

VALID FOR

Stud


Rebar


Post-installed rebar

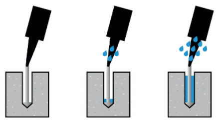
DIMENSIONS
Stud M8 - M30
Rebar as stud Ø8 - Ø32
Post-installed rebars Ø8 - Ø32

RANGE OF CACULATION LOADS
From 12,0 to 116,1 kN (non-cracked).
From 9,9 to 77,4 kN (cracked).

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


Concrete | Reinforced concrete | Cracked concrete | Thermal clay | Hollow brick

ASSESSMENTS
- ETA 24/0867 Option 1: Cracked and non-cracked concrete.
- ETA 24/0868 Post-installed rebars.

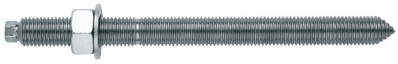
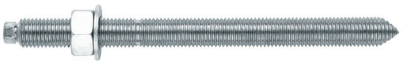
DRILL HOLE CONDITION

Seco | Húmedo | Inundado

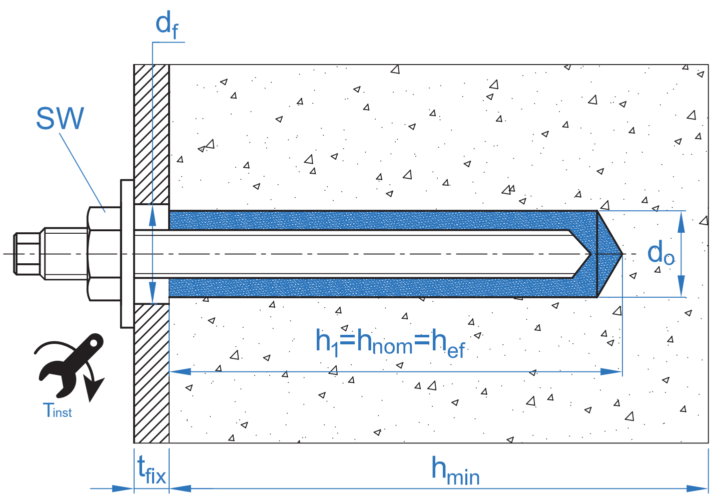
CHARACTERISTICS AND BENEFITS
- Use in cracked and non-cracked concrete.
- Used for high loads.
- Temperature range -40°C to +80°C (maximum long-term temperature +50°C).
- Two versions, standard and low temperatures.
- Variety of lengths and diameters: M8-M30-assessed studs, including M27. Use of rebars as anchor from Ø8 to Ø32, assembly flexibility.
- For static or quasi-static loads and category C1&C2 seismic applications.
- Approved for use in contact with drinking water.
- Fire resistance certificate for studs.
- Version in zinc plated steel, stainless steel A2 and A4.
- Available in INDEXcal.

MATERIALS
Standard stud:
Acero al carbono, 5.8, 8.8.

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

APPLICATIONS
- For indoor and outdoor use.
- Structural applications.
- Substructure fixing to the building.
- Rebars and start rebars.
- For fixing machinery, balconies, awnings, shelving units, billboards, catenaries, safety barriers, railings, handrails, etc.
- Large metric sizes, retaining walls.

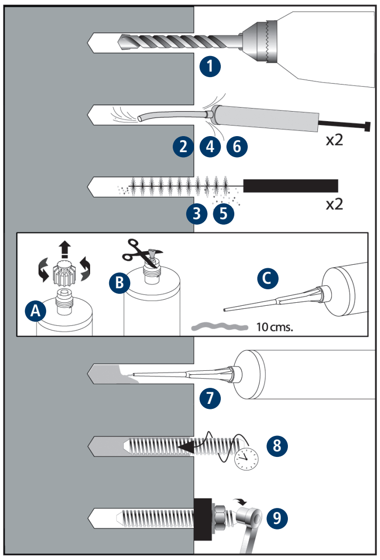
CONCRETE INSTALLATION PARAMETERS										
METRIC			M8	M10	M12	M16	M20	M24	M27	M30
d_0	nominal diameter	[mm]	10	12	14	18	22	26	30	35
d_f	diameter in anchor plate ≤	[mm]	9	12	14	18	22	26	30	33
T_{inst}	tightening torque ≤	[Nm]	10	20	40	80	150	200	240	275
Circular cleaning brush			Ø14		Ø20		Ø29		Ø40	
$h_{ef,min}$ = 8d										
h_1	depth of the drill hole	[mm]	40	40	48	64	80	96	108	120
$s_{cr,N}$	critical distance between anchors	[mm]	120	120	144	192	240	288	324	360
$c_{cr,N}$	critical distance from the edge	[mm]	60	60	72	96	120	144	162	180
c_{min}	minimum distance from the edge	[mm]	35	40	50	65	80	96	110	120
s_{min}	minimum distance between anchors	[mm]	35	40	50	65	80	96	110	120
h_{min}	minimum concrete thickness	[mm]	100	100	100	100	120	144	164	180
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]	35	40	50	65	80	96	-	120
s_{min}	minimum distance between anchors	[mm]	35	40	50	65	80	96	-	120
h_{min}	minimum concrete thickness	[mm]	110	120	140	158	210	258	-	360
$h_{ef,max}$ = 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]	35	40	50	65	80	96	110	120
s_{min}	minimum distance between anchors	[mm]	35	40	50	65	80	96	110	120
h_{min}	minimum concrete thickness	[mm]	190	230	270	350	440	528	594	660
Zinc-plated stud code 			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
MORCANU	MIXING TUBE	Plastic. Static labyrinth mixture

INSTALLATION PROCEDURE

CONCRETE



MINIMUM CURING TIME				
TYPE	Cartridge temperature [ºC]	Handling time [min]	Base material temperature [ºC]	Curing time [min]
MO-VH	10	30	-10 a -5	1440
	5	20	-5 a 0	300
	0 a +5	15	0 a +5	210
	+5 a +10	10	+5 a +10	145
	+10 a +15	8	+10 a +15	85
	+15 a +20	6	+15 a +20	75
	+20 a +25	5	+20 a +25	50
	+25 a +30	4	+25 a +30	40
MO-VHW	20	40	-20 a -15	1440
	20	30	-15 a -10	1080
	5	20	-10 a -5	720
	5	5	-5 a 0	100
	0 a +5	10	0 a +5	75
	+5 a +20	5	+5 a +20	50
	20	100 s	20	20

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]	18,0	29,0	42,0	65,6	105,7	121,9	-	174,1
	Non-cracked concrete 8.8	[kN]	26,1	31,3	46,0	65,6	105,7	121,9	-	174,1
	Cracked concrete 5.8	[kN]	14,8	20,9	30,6	39,8	65,1	88,7	-	116,1
	Cracked concrete 8.8	[kN]	14,8	20,9	30,6	39,8	65,1	88,7	-	116,1

Calculated tensile strength N_{Rd}

	Metric		M8	M10	M12	M16	M20	M24	M27	M30
N_{Rd}	Non-cracked concrete 5.8	[kN]	12,0	19,3	28,0	43,7	70,5	81,2	-	116,1
	Non-cracked concrete 8.8	[kN]	17,4	20,9	30,6	43,7	70,5	81,2	-	116,1
	Cracked concrete 5.8	[kN]	9,9	13,9	20,4	26,5	43,4	59,1	-	77,4
	Cracked concrete 8.8	[kN]	9,9	13,9	20,4	26,5	43,4	59,1	-	77,4

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	20,0	31,2	50,3	58,0	-	82,9
	Non-cracked concrete 8.8	[kN]	12,4	14,9	21,9	31,2	50,3	58,0	-	82,9
	Cracked concrete 5.8	[kN]	7,0	9,9	14,6	19,0	31,0	42,2	-	55,2
	Cracked concrete 8.8	[kN]	7,0	9,9	14,6	19,0	31,0	42,2	-	55,2

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*	-	*140,0*
	Zinc-plated stud 8.8	[kN]	*15,0*	*23,0*	*34,0*	*63,0*	*98,0*	*141,0*	-	*224,0*
	Stainless steel stud	[kN]	*13,0*	*20,0*	*30,0*	*55,0*	*86,0*	*124,0*	-	*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*	*12,0*	*16,8*	*31,2*	*48,8*	*70,4*	-	*112,0*
	Zinc-plated stud 8.8	[kN]	*12,0*	*18,4*	*27,2*	*50,4*	*78,4*	*112,8*	-	*179,2*
	Stainless steel stud	[kN]	*8,3*	*12,8*	*19,2*	*35,3*	*55,1*	*79,5*	-	*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*	*12,0*	*22,2*	*34,8*	*50,2*	-	*80,0*
	Zinc-plated stud 8.8	[kN]	*8,5*	*13,1*	*19,4*	*36,0*	*56,0*	*80,5*	-	*128,0*
	Stainless steel stud	[kN]	*5,9*	*9,1*	*13,7*	*25,1*	*39,3*	*56,7*	-	*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 24/0867

Simplified version of the calculation method according to Eurocode 2 EN 1992-4. Resistance is calculated according to the data shown in assessment ETA 24/0867.

- 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

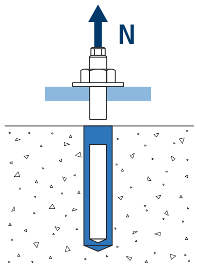
MO-VH

- 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

$N_{Rd,s}$

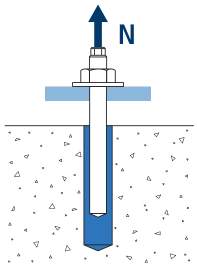
Metric			M8	M10	M12	M16	M20	M24	M27	M30
$N^o_{Rd,s}$	Steel class 4.6	[kN]	7,5	11,5	17,0	31,5	49,0	70,5	92,0	112,0
	Steel class 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3
	Steel class 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0	244,7	299,3
	Steel class 10.9	[kN]	27,8	43,6	63,2	118,0	184,2	265,4	345,1	421,8
	Stainless steel class A2-70, A4-70	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	171,7	210,2



Calculated extraction resistance

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

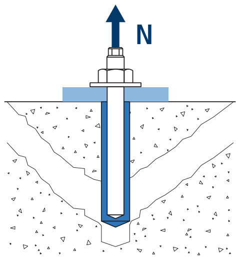
Metric			M8	M10	M12	M16	M20	M24	M27	M30
$N^o_{Rd,p}$	Non-cracked concrete	[kN]	17,4	20,9	30,7	43,8	70,5	81,3	93,4	116,1
	Cracked concrete	[kN]	9,9	13,9	20,5	26,6	43,4	59,1	66,0	77,4



Calculated concrete cone resistance

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

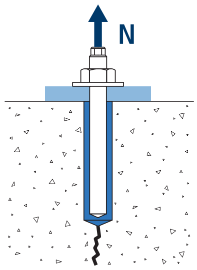
Metric			M8	M10	M12	M16	M20	M24	M27	M30
$N^o_{Rd,c}$	Non-cracked concrete	[kN]	23,5	28,0	37,8	47,5	72,7	99,8	124,2	153,7
	Cracked concrete	[kN]	16,4	19,6	26,5	33,2	50,9	69,9	87,0	107,6



Calculated concrete cracking resistance

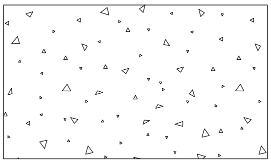
$N_{Rd,sp} = N^o_{Rd,c} \cdot \Psi_b \cdot \Psi_{s,sp} \cdot \Psi_{c,sp} \cdot \Psi_{re,N} \cdot \Psi_{h,sp} \cdot \Psi_{hef,N}$

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	124,2	153,7



MO-VH

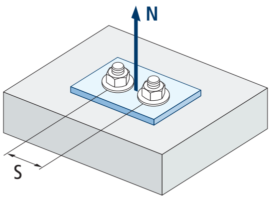
Influence coefficients



Influence of concrete resistance for extraction Ψ_c					
	Concrete type	C20/25	C30/37	C40/50	C50/60
Ψ_c	Non-cracked concrete	1,00	1,04	1,07	1,09

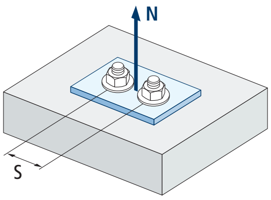
$$\Psi_b = \sqrt{\frac{f_{ck,cube}}{25}} \geq 1$$

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



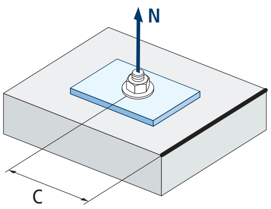
Influence of spacing between anchors (concrete cone) $\Psi_{s,N}$										
$s/s_{cr,N}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
$\Psi_{s,N}$	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00

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



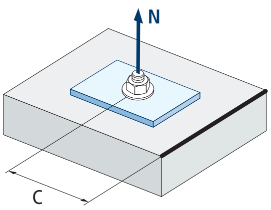
Influence of spacing between anchors (cracking) $\Psi_{s,N}$										
$s/s_{cr,sp}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
$\Psi_{s,sp}$	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00

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



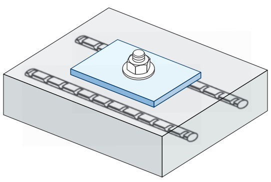
Influence of the distance from the edge of the concrete (concrete cone) $\Psi_{c,N}$												
$c/C_{cr,N}$	0.1	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.6
$\Psi_{c,N}$	0.40	0.46	0.51	0.45	0.49	0.55	0.61	0.67	0.75	0.83	0.91	1.00

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



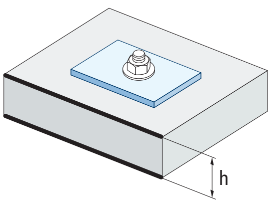
Influence of the distance from the edge of the concrete (cracking) $\Psi_{c,sp}$												
$c/C_{cr,sp}$	0.1	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.6
$\Psi_{c,sp}$	0.40	0.46	0.51	0.45	0.49	0.55	0.61	0.67	0.75	0.83	0.91	1.00

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



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

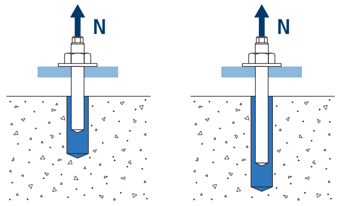
$$\Psi_{re,N} = 0.5 + \frac{h_{ef}}{200} \leq 1$$



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

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

MO-VH

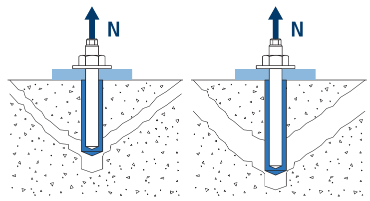


$$\Psi_{hef,p} = \frac{h_{ef}}{h_{stand}}$$

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					
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						2,29	1,98	1,71
540							2,22	1,93
600								2,14

Value not permitted (upper right area)

Value not permitted (lower left area)



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

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						
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						3,46	2,78	2,24
540							3,31	2,68
600								3,14

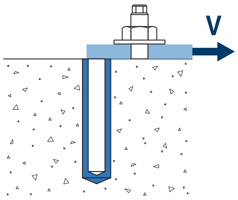
Value not permitted (upper right area)

Value not permitted (lower left area)

MO-VH

SHEARING LOADS

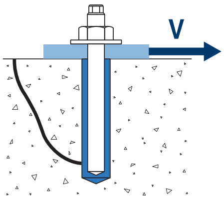
- Calculated steel resistance without lever arm: $V_{Rd,s}$
- Calculated spalling resistance: $V_{Rd,cp} = k \cdot N^o_{Rd,c}$
- Calculated concrete edge resistance: $V_{Rd,c} = V^o_{Rd,c} \cdot \Psi_b \cdot \Psi_{se,V} \cdot \Psi_{c,V} \cdot \Psi_{re,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{h,V}$



Calculated steel resistance to shearing

$V_{Rd,s}$

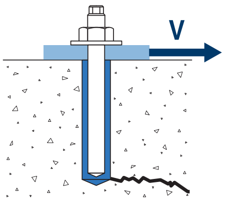
	Metric		M8	M10	M12	M16	M20	M24	M27	M30
$V^o_{Rd,s}$	Steel class 4.6	[kN]	4,2	7,2	10,2	18,6	29,3	42,5	55,1	67,1
	Steel class 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	Steel class 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	Steel class 10.9	[kN]	12.0	19,3	28,0	52,7	82,0	118,0	153,3	187,3
	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							

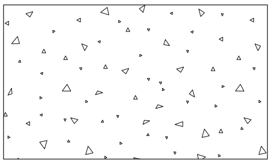


Calculated concrete edge resistance

$V_{Rd,c} = V^o_{Rd,c} \cdot \Psi_b \cdot \Psi_{se,V} \cdot \Psi_{c,V} \cdot \Psi_{re,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{h,V}$

	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

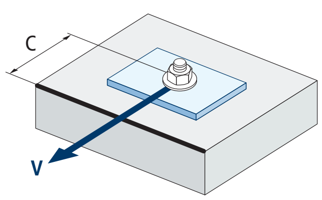
Influence of the distance from the edge and spacing between anchors $\Psi_{se,V}$

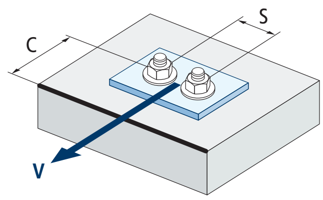
For one anchor

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

s/c	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
	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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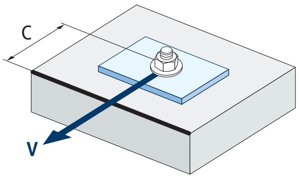
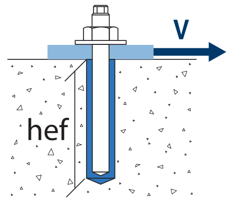
Influence of the distance from the edge of the concrete $\Psi_{c,V}$								
c/d	4	5	7	10	15	20	25	30
$\Psi_{c,V}$	0,76	0,72	0,68	0,63	0,58	0,55	0,53	0,51

$$\Psi_{c,V} = \left(\frac{d}{c}\right)^{0,20}$$

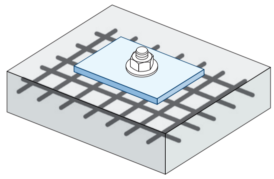


Influence of the effective depth $\Psi_{hef,V}$													
h_{ef}/d	8	9	10	11	12	13	14	15	16	17	18	19	20
$\Psi_{hef,V}$	1,65	2,04	2,47	2,93	3,42	3,94	4,50	5,10	5,72	6,38	7,06	7,78	8,53

$$\Psi_{hef,V} = 0,04 \cdot \left(\frac{h_{ef}}{d}\right)^{1,79}$$

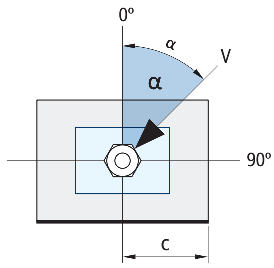


Influence of the rebars $\Psi_{re,V}$				
		Without perimeter rebar	Perimeter rebar ≥Ø12mm	Perimeter rebar with abutments at≤100mm
$\Psi_{re,V}$	Non-cracked concrete	1	1	1
	Cracked concrete	1	1,2	1,4



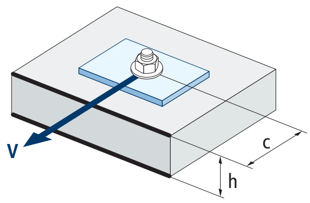
Influence of the load application angle $\Psi_{\alpha,V}$										
Angle, α(º)	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
$\Psi_{\alpha,V}$	1,00	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

$$\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + \left(\frac{\sin \alpha_V}{2,5}\right)^2}} \geq 1$$



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).**

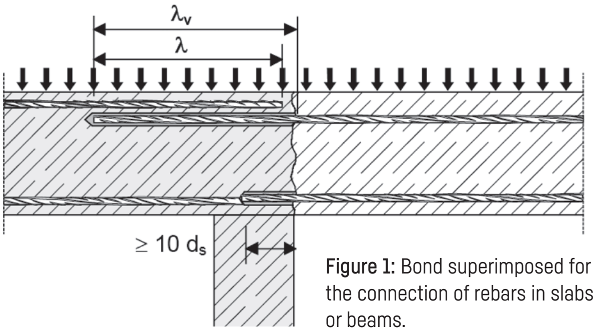

Figure 1: Bond superimposed for the connection of rebars in slabs or beams.

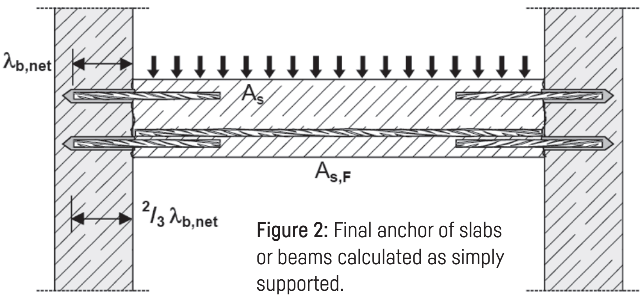

Figure 2: Final anchor of slabs or beams calculated as simply supported.

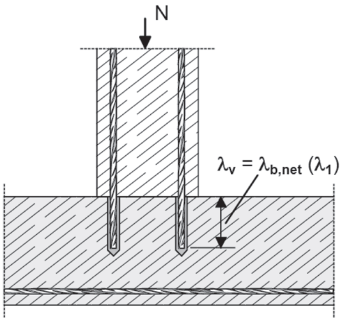

Figure 3: Rebar connections for items primarily subjected to compression. The rebars are subjected to compression.

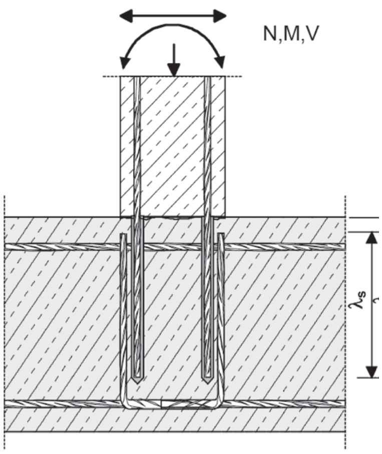

Figure 4: Bond superimposed to a foundation of a column or a wall where the rebars is subjected to tensile force.

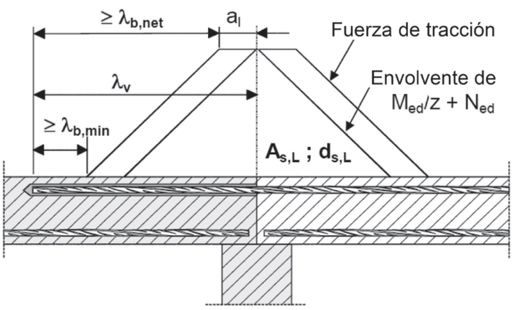

Figure 5: Reinforcement anchor to cover the action line of the tensile force.

* **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.

The tables below are referred to EN 1992-1-1 Annex C Table C.1 and C.2N Properties of reinforcement.

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Rebar properties			
Product form		Bars and de-coiled rods	
Class		B	C
Characteristic yield strength 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 strain at maximum force ε_{uk} (%)		≥ 5,0	≥ 7,5
Flexibility		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) ≤ 8 > 8	± 6,0 / ± 4,5	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	0,040 / 0,056	

Minimum/maximum lengths*				
Rebar	Minimum			Maximum
$Ød_s$ [mm]	fy,k [N/mm²]	Anchorage $\ell_{b,min}$ [mm]	Overlap $\ell_{0,min}$ [mm]	ℓ_{max}
8	500	114	200	400
10	500	142	200	500
12	500	171	200	600
14	500	199	210	700
16	500	227	240	800
18	500	256	270	900
20	500	284	300	1000
22	500	312	330	1000
24	500	341	360	1000
25	500	355	375	1000
26	500	369	390	1000
28	500	397	420	1000
32	500	454	480	1000

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

Design bond resistance ($f_{bd,PIR}$) [N/mm²] and reduction factor (k_b)										
Rebar Ø	Resistance and factor	Concrete class								
d_s [mm]		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 16	k_b*	1	1	1	1	1	1	1	1	1
	$f_{bd,PIR}$	1,6	2	2,3	2,7	3	3,4	3,7	4	4,3
18	k_b*	1	1	1	1	1	1	1	1	0,93
	$f_{bd,PIR}$	1,6	2	2,3	2,7	3	3,4	3,7	4	
20	k_b*	1	1	1	1	1	1	1	0,92	0,86
	$f_{bd,PIR}$	1,6	2	2,3	2,7	3	3,4	3,7		
22	k_b*	1	1	1	1	1	1	0,91	0,84	0,79
	$f_{bd,PIR}$	1,6	2	2,3	2,7	3	3,4			
24 to 26	k_b*	1	1	1	1	1	0,9	0,82	0,76	0,71
	$f_{bd,PIR}$	1,6	2	2,3	2,7	3				
28	k_b*	1	1	1	1	0,88	0,8	0,73	0,67	0,63
	$f_{bd,PIR}$	1,6	2	2,3	2,7					
32	k_b*	1	1	1	0,86	0,76	0,69	0,63	0,58	0,54
	$f_{bd,PIR}$	1,6	2	2,3						
Rebar Ø	Amplification factor	Concrete class								
d_s [mm]		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 26	$\alpha_{lb} = \alpha_{lb,100y}$	1	1	1	1	1	1	1	1	1
28		1	1	1	1	1	1	1	1	1,1
32		1	1	1	1	1	1,1	1,2	1,3	1,4

*For all drilling methods with good bond conditions

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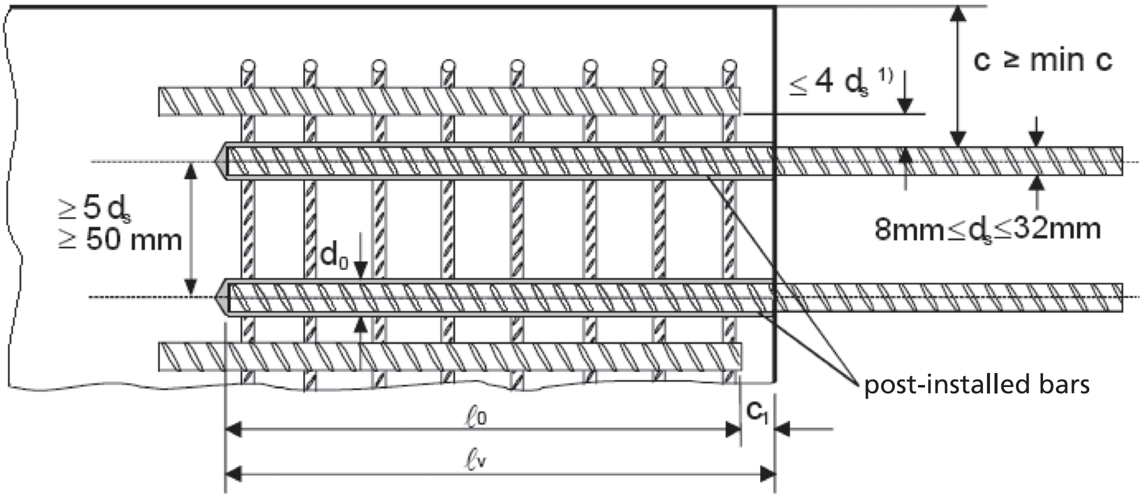
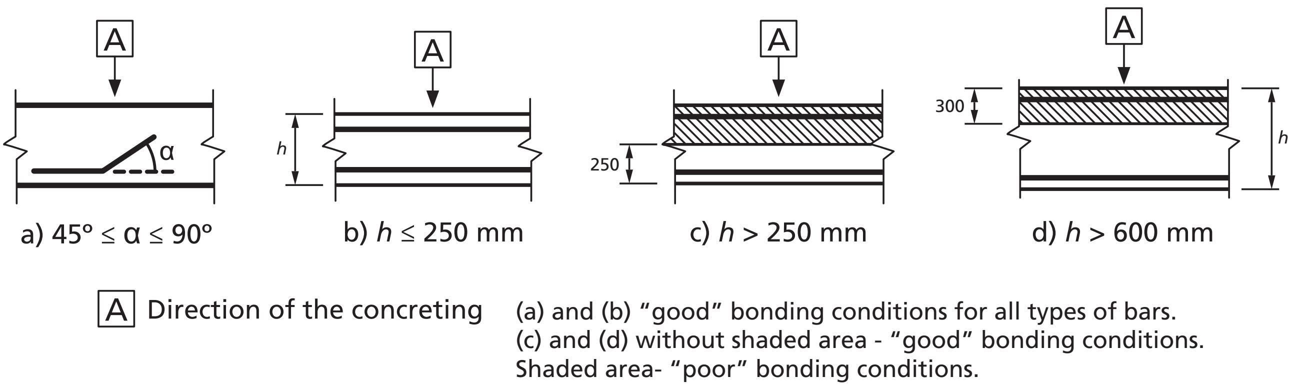
- Calculated load values according to Eurocode 2 and EOTA technical report TR 023.
- Information according to ETA 13/0780.
- Non-cracked concrete, conditions in dry or wet conditions.
- Temperature range: -40°C to +80°C (maximum long-term temperature +50°C).
- Minimum spacing conditions between bars ≥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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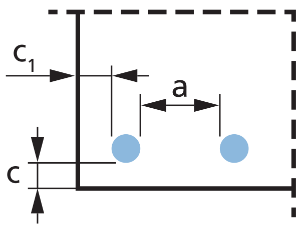
Resistance values may increase in the following situations:
- With transverse tension/compression pressure (α_2)
- In case of concrete coating (α_5)
- In case of overlapping rebars (α_6)

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	

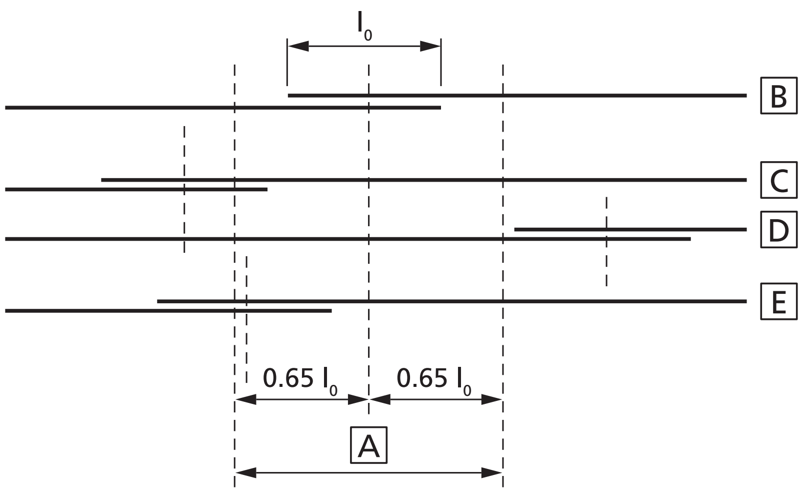
Where:

$c_d = \min(a/2, c_1, c)$



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															
Concrete compressive strength [$f_{ck,cube}$]: 25 N/mm²															
Rebar Ø	d_s	[mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25	Ø26	Ø28	Ø32
Rebar Size	d_s	[mm]	8	10	12	14	16	18	20	22	24	25	26	28	32
Cross-sectional area	A_s	[mm²]	50,3	78,5	113,1	153,9	201,1	254,5	314,2	380,1	452,4	490,9	530,9	615,8	804,2
Characteristic yield strength of rebar	f_{yk}	[N/mm²]	500	500	500	500	500	500	500	500	500	500	500	500	500
Partial safety factor	$\gamma_{M,s}$	[-]	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
Design yield strength of rebar	f_{yd}	[N/mm²]	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78
Design steel resistance	$N_{Rd,s}$	[kN]	21,9	34,1	49,2	66,9	87,4	110,6	136,6	165,3	196,7	213,4	230,8	267,7	349,7
Bond stress	f_{bd}	[N/mm²]	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
Amplification factor for minimum anchorage length	α_{lb}	[-]	1	1	1	1	1	1	1	1	1	1	1	1	1
Basic Anchorage Length - Applied	$l_{b,rqd}$	[mm]	0	0	0	0	0	0	0	0	0	0	0	0	0
Basic Anchorage Length - Yield	$l_{b,rqd,fyd}$	[mm]	378,07	472,59	567,11	661,63	756,14	850,66	945,18	1039,7	1134,22	1181,47	1228,73	1323,25	1512,29
Minimum anchorage Length	$l_{b,min}$	[mm]	113,42	141,78	170,13	198,49	226,84	255,2	283,55	311,91	340,26	354,44	368,62	396,98	453,69
Minimum lap length	$l_{0,min}$	[mm]	200	200	200	210	240	270	300	330	360	375	390	420	480
Max permissible embedment depth	$l_{v,max}$	[mm]	400	500	600	700	800	900	1000	1000	1000	1000	1000	1000	1000
Drilled hole diameter	d_h	[mm]	12	14	16	18	20	22	25	28	32	32	32	35	40
Bar spacing ≥	s	[mm]	50	50	60	70	80	90	100	110	120	125	130	140	160
Edge distance (compressed air drilling) ≥	c	[mm]	$50 + 0{,}06\ L_b$												
Edge distance (hammer drilling) ≥	c	[mm]	$30 + 0{,}08\ L_b \geq 2\Phi$												
Anchorage Length, L_b [mm]			Design tensile pull-out bond resistance, N_{Rd}												
114			6,6												
142			8,2	10,3											
171			11,5	12,4	14,8										
199			11,6	14,4	17,3	20,1									
200			12,1	14,5	17,3	20,2									
210			13,1	15,2	18,2	21,2					Not allowed area				
227			13,9	16,4	19,7	23	26,2								
240			14,8	17,3	20,8	24,3	27,7								
256			15,6	18,5	22,2	25,9	29,6	33,3							
270			16,4	19,5	23,4	27,3	31,2	35,1							
284			17,3	20,5	24,6	28,7	32,8	36,9	41						
300			18	21,7	26	30,3	34,7	39	43,4						
312			19,1	22,5	27,1	31,6	36,1	40,6	45,1	49,6					
330			19,7	23,8	28,6	33,4	38,2	42,9	47,7	52,5					
341			20,5	24,6	29,6	34,5	39,4	44,4	49,3	54,2	59,1				
355			20,8	25,7	30,8	35,9	41	46,2	51,3	56,4	61,6	64,1			
360			21,3	26	31,2	36,4	41,6	46,8	52	57,2	62,4	65			
369			21,7	26,7	32	37,3	42,7	48	53,3	58,7	64	66,7	69,3		
375			**21,9**	27,1	32,5	37,9	43,4	48,8	54,2	59,6	65	67,7	70,5		
390			**21,9**	28,2	33,8	39,5	45,1	50,7	56,4	62	67,6	70,5	73,3	78,9	
397			**21,9**	28,7	34,4	40,2	45,9	51,6	57,4	63,1	68,8	71,7	74,6	80,3	
400				28,9	34,7	40,5	46,2	52	57,8	63,6	69,4	72,3	75,1	80,9	
420				30,3	36,4	42,5	48,6	54,6	60,7	66,8	72,8	75,9	78,9	85	
454				32,8	39,4	45,9	52,5	59	65,6	72,2	78,7	82	85,3	91,9	105
480				**34,1**	41,6	48,6	55,5	62,4	69,4	76,3	83,2	86,7	90,2	97,1	111
500				**34,1**	43,4	50,6	57,8	65	72,3	79,5	86,7	90,3	93,9	101,2	115,6
600					**49,2**	60,7	69,4	78	86,7	95,4	104	108,4	112,7	121,4	138,7
700						**66,9**	80,9	91	101,2	111,3	121,4	126,4	131,5	141,6	161,9
800							**87,4**	104	115,6	127,2	138,7	144,5	150,3	161,9	185
900					Not allowed area			**110,6**	130,1	143,1	156,1	162,6	169,1	182,1	208,1
1000									**136,6**	159	173,4	180,6	187,9	202,3	231,2
Length to develop steel yield, $L_{b,rqd}$ [mm]			378	473	567	662	756	851	945	1.040	1.134	1.181	1.229	1.323	1.512

Values shaded in blue are not allowed for overlapping joints

MO-VH

TABLES OF PRECALCULATED VALUES

Concrete class 30/37															
Concrete compressive strength [$f_{ck,cube}$]: 37 N/mm²															
Rebar Ø	d_s	[mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25	Ø26	Ø28	Ø32
Rebar Size	d_s	[mm]	8	10	12	14	16	18	20	22	24	25	26	28	32
Cross-sectional area	A_s	[mm²]	50,3	78,5	113,1	153,9	201,1	254,5	314,2	380,1	452,4	490,9	530,9	615,8	804,2
Characteristic yield strength of rebar	f_{yk}	[N/mm²]	500	500	500	500	500	500	500	500	500	500	500	500	500
Partial safety factor	$\gamma_{M,s}$	[-]	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
Design yield strength of rebar	f_{yd}	[N/mm²]	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78
Design steel resistance	$N_{Rd,s}$	[kN]	21,9	34,1	49,2	66,9	87,4	110,6	136,6	165,3	196,7	213,4	230,8	267,7	349,7
Bond stress	f_{bd}	[N/mm²]	3	3	3	3	3	3	3	3	3	3	3	2,7	2,3
Amplification factor for minimum anchorage length	α_{lb}	[-]	1	1	1	1	1	1	1	1	1	1	1	0,88	0,76
Basic Anchorage Length - Applied	$l_{b,rqd}$	[mm]	0	0	0	0	0	0	0	0	0	0	0	0	0
Basic Anchorage Length - Yield	$l_{b,rqd,fyd}$	[mm]	289,86	362,32	434,78	507,25	579,71	652,17	724,64	797,1	869,57	905,8	942,03	1127,21	1512,29
Minimum anchorage Length	$l_{b,min}$	[mm]	100	108,7	130,43	152,17	173,91	195,65	217,39	239,13	260,87	271,74	282,61	297,58	344,8
Minimum lap length	$l_{0,min}$	[mm]	200	200	200	210	240	270	300	330	360	375	390	369,6	364,8
Max permissible embedment depth	$l_{v,max}$	[mm]	400	500	600	700	800	900	1000	1000	1000	1000	1000	1000	1000
Drilled hole diameter	d_h	[mm]	12	14	16	18	20	22	25	28	32	32	32	35	40
Bar spacing ≥	s	[mm]	50	50	60	70	80	90	100	110	120	125	130	140	160
Edge distance (compressed air drilling) ≥	c	[mm]	$50 + 0,06\ L_b$												
Edge distance (hammer drilling) ≥	c	[mm]	$30 + 0,08\ L_b \geq 2\Phi$												
Anchorage Length, L_b [mm]			Design tensile pull-out bond resistance, N_{Rd}												
100			7,5												
109			8,2	10,3											
131			9,9	12,3	14,8										
153			11,5	14,4	17,3	20,2									
174			13,1	16,4	19,7	23	26,2								
196			14,8	18,5	22,2	25,9	29,6	33,3					Not allowed area		
200			15,1	18,8	22,6	26,4	30,2	33,9							
210			15,8	19,8	23,8	27,7	31,7	35,6							
218			16,4	20,5	24,7	28,8	32,9	37	41,1						
240			18,1	22,6	27,1	31,7	36,2	40,7	45,2	49,8					
241			18,2	22,7	27,3	31,8	36,3	40,9	45,4	50					
261			19,7	24,6	29,5	34,4	39,4	44,3	49,2	54,1	59				
270			20,4	25,4	30,5	35,6	40,7	45,8	50,9	56	61,1				
272			20,5	25,6	30,8	35,9	41	46,1	51,3	56,4	61,5	64,1			
283			21,3	26,7	32	37,3	42,7	48	53,3	58,7	64	66,7	69,3		
298			21,9	28,1	33,7	39,3	44,9	50,6	56,2	61,8	67,4	70,2	73	70,8	
300			21,9	28,3	33,9	39,6	45,2	50,9	56,5	62,2	67,9	70,7	73,5	71,3	
330			21,9	31,1	37,3	43,5	49,8	56	62,2	68,4	74,6	77,8	80,9	78,4	
345			21,9	32,5	39	45,5	52	58,5	65	71,5	78	81,3	84,5	81,9	79,8
360			21,9	33,9	40,7	47,5	54,3	61,1	67,9	74,6	81,4	84,8	88,2	85,5	83,2
365			21,9	34,1	41,3	48,2	55	61,9	68,8	75,7	82,6	86	89,4	86,7	84,4
370			21,9	34,1	41,8	48,8	55,8	62,8	69,7	76,7	83,7	87,2	90,7	87,9	85,6
375			21,9	34,1	42,4	49,5	56,5	63,6	70,7	77,8	84,8	88,4	91,9	89,1	86,7
390			21,9	34,1	44,1	51,5	58,8	66,2	73,5	80,9	88,2	91,9	95,6	92,6	90,2
400			21,9	34,1	45,2	52,8	60,3	67,9	75,4	82,9	90,5	94,2	98	95	92,5
500				34,1	49,2	66	75,4	84,8	94,2	103,7	113,1	117,8	122,5	118,8	115,6
600					49,2	66,9	87,4	101,8	113,1	124,4	135,7	141,4	147	142,5	138,7
700						66,9	87,4	110,6	131,9	145,1	158,3	164,9	171,5	166,3	161,9
800							87,4	110,6	136,6	165,3	181	188,5	196	190	185
900					Not allowed area			110,6	136,6	165,3	196,7	212,1	220,5	213,8	208,1
1000									136,6	165,3	196,7	213,4	230,8	237,5	231,2
Length to develop steel yield, $L_{b,rqd}$ [mm]			290	362	435	507	580	652	725	797	870	906	942	1.127	1.512

Values shaded in blue are not allowed for overlapping joints

MO-VH

TABLES OF PRECALCULATED VALUES

Concrete class 40/50															
Concrete compressive strength [$f_{ck,cube}$]: 50 N/mm²															
Rebar Ø	d_s	[mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25	Ø26	Ø28	Ø32
Rebar Size	d_s	[mm]	8	10	12	14	16	18	20	22	24	25	26	28	32
Cross-sectional area	A_s	[mm²]	50,3	78,5	113,1	153,9	201,1	254,5	314,2	380,1	452,4	490,9	530,9	615,8	804,2
Characteristic yield strength of rebar	f_{yk}	[N/mm²]	500	500	500	500	500	500	500	500	500	500	500	500	500
Partial safety factor	$\gamma_{M,s}$	[-]	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
Design yield strength of rebar	f_{yd}	[N/mm²]	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78
Design steel resistance	$N_{Rd,s}$	[kN]	21,9	34,1	49,2	66,9	87,4	110,6	136,6	165,3	196,7	213,4	230,8	267,7	349,7
Bond stress	f_{bd}	[N/mm²]	3	3	3	3	3	3	3	3	3	3	3	2,7	2,3
Amplification factor for minimum anchorage length	α_{lb}	[-]	1	1	1	1	1	1	1	1	1	1	1	0,88	0,76
Basic Anchorage Length - Applied	$l_{b,rqd}$	[mm]	0	0	0	0	0	0	0	0	0	0	0	0	0
Basic Anchorage Length - Yield	$l_{b,rqd,fyd}$	[mm]	289,86	362,32	434,78	507,25	579,71	652,17	724,64	797,1	869,57	905,8	942,03	1127,21	1512,29
Minimum anchorage Length	$l_{b,min}$	[mm]	100	108,7	130,43	152,17	173,91	195,65	217,39	239,13	260,87	271,74	282,61	297,58	344,8
Minimum lap length	$l_{0,min}$	[mm]	200	200	200	210	240	270	300	330	360	375	390	369,6	364,8
Max permissible embedment depth	$l_{v,max}$	[mm]	400	500	600	700	800	900	1000	1000	1000	1000	1000	1000	1000
Drilled hole diameter	d_h	[mm]	12	14	16	18	20	22	25	28	32	32	32	35	40
Bar spacing ≥	s	[mm]	50	50	60	70	80	90	100	110	120	125	130	140	160
Edge distance (compressed air drilling) ≥	c	[mm]	$50 + 0,06\ L_b$												
Edge distance (hammer drilling) ≥	c	[mm]	$30 + 0,08\ L_b \geq 2\Phi$												
Anchorage Length, L_b [mm]			Design tensile pull-out bond resistance, N_{Rd}												
100			9,3	11,6											
120			11,2	13,9	16,7										
140			13	16,3	19,5	22,8									
160			14,9	18,6	22,3	26	29,8				Not allowed area				
180			16,7	20,9	25,1	29,3	33,5	37,7							
200			18,6	23,2	27,9	32,5	37,2	41,8	46,5						
201			18,7	23,4	28	32,7	37,4	42,1	46,7	47,2					
210			19,5	24,4	29,3	34,2	39,1	43,9	48,8	49,3					
214			19,9	24,9	29,9	34,8	39,8	44,8	49,8	50,3	48,4				
223			20,7	25,9	31,1	36,3	41,5	46,7	51,8	52,4	50,4	52,5			
232			21,6	27	32,4	37,8	43,1	48,5	53,9	54,5	52,5	54,7	56,9		
240			21,9	27,9	33,5	39,1	44,6	50,2	55,8	56,4	54,3	56,5	58,8		
247			21,9	28,7	34,5	40,2	45,9	51,7	57,4	58	55,9	58,2	60,5	58,7	
270			21,9	31,4	37,7	43,9	50,2	56,5	62,8	63,4	61,1	63,6	66,2	64,1	
286			21,9	33,2	39,9	46,5	53,2	59,8	66,5	67,2	64,7	67,4	70,1	67,9	66,1
296			21,9	34,1	41,3	48,2	55,1	61,9	68,8	69,6	67	69,7	72,5	70,3	68,4
300			21,9	34,1	41,8	48,8	55,8	62,8	69,7	70,5	67,9	70,7	73,5	71,3	69,4
301			21,9	34,1	42	49	56	63	70	70,7	68,1	70,9	73,8	71,5	69,6
303			21,9	34,1	42,3	49,3	56,4	63,4	70,4	71,2	68,5	71,4	74,2	72	70,1
307			21,9	34,1	42,8	50	57,1	64,2	71,4	72,1	69,4	72,3	75,2	72,9	71
308			21,9	34,1	43	50,1	57,3	64,4	71,6	72,4	69,7	72,6	75,5	73,2	71,2
320			21,9	34,1	44,6	52,1	59,5	67	74,4	75,2	72,4	75,4	78,4	76	74
400			21,9	34,1	49,2	65,1	74,4	83,7	93	94	90,5	94,2	98	95	92,5
500				34,1	49,2	66,9	87,4	104,6	116,2	117,5	113,1	117,8	122,5	118,8	115,6
600					49,2	66,9	87,4	110,6	136,6	141	135,7	141,4	147	142,5	138,7
700						66,9	87,4	110,6	136,6	164,5	158,3	164,9	171,5	166,3	161,9
800							87,4	110,6	136,6	165,3	181	188,5	196	190	185
900			Not allowed area					110,6	136,6	165,3	196,7	212,1	220,5	213,8	208,1
1000									136,6	165,3	196,7	213,4	230,8	237,5	231,2
Length to develop steel yield, $L_{b,rqd}$ [mm]			235	294	353	411	470	529	588	703	870	906	942	1.127	1.512

Values shaded in blue are not allowed for overlapping joints

MO-VH

TABLES OF PRECALCULATED VALUES

Concrete class 50/60																
Concrete compressive strength [$f_{ck,cube}$]: 60 N/mm²																
Rebar Ø	d_s	[mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25	Ø26	Ø28	Ø32
Rebar Size	d_s	[mm]	8	10	12	14	16	18	20	22	24	25	26	28	32
Cross-sectional area	A_s	[mm²]	50,3	78,5	113,1	153,9	201,1	254,5	314,2	380,1	452,4	490,9	530,9	615,8	804,2
Characteristic yield strength of rebar	f_{yk}	[N/mm²]	500	500	500	500	500	500	500	500	500	500	500	500	500
Partial safety factor	$\gamma_{M,s}$	[-]	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
Design yield strength of rebar	f_{yd}	[N/mm²]	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78	434,78
Design steel resistance	$N_{Rd,s}$	[kN]	21,9	34,1	49,2	66,9	87,4	110,6	136,6	165,3	196,7	213,4	230,8	267,7	349,7
Bond stress	f_{bd}	[N/mm²]	4,3	4,3	4,3	4,3	4,3	4	3,7	3,4	3	3	3	2,7	2,3
Amplification factor for minimum anchorage length	α_{lb}	[-]	1	1	1	1	1	0,93	0,86	0,79	0,71	0,71	0,71	0,63	0,54
Basic Anchorage Length - Applied	$l_{b,rqd}$	[mm]	0	0	0	0	0	0	0	0	0	0	0	0	0
Basic Anchorage Length - Yield	$l_{b,rqd,fyd}$	[mm]	202,22	252,78	303,34	353,89	404,45	489,13	587,54	703,32	869,57	905,8	942,03	1127,21	1512,29
Minimum anchorage Length	$l_{b,min}$	[mm]	100	100	120	140	160	167,4	172	173,8	185,22	192,93	200,65	213,04	244,99
Minimum lap length	$l_{0,min}$	[mm]	200	200	200	210	240	251,1	258	260,7	255,6	266,25	276,9	264,6	259,2
Max permissible embedment depth	$l_{v,max}$	[mm]	400	500	600	700	800	900	1000	1000	1000	1000	1000	1000	1000
Drilled hole diameter	d_h	[mm]	12	14	16	18	20	22	25	28	32	32	32	35	40
Bar spacing ≥	s	[mm]	50	50	60	70	80	90	100	110	120	125	130	140	160
Edge distance (compressed air drilling) ≥	c	[mm]	$50 + 0{,}06\ L_b$												
Edge distance (hammer drilling) ≥	c	[mm]	$30 + 0{,}08\ L_b \geq 2\Phi$												
Anchorage Length, L_b [mm]			Design tensile pull-out bond resistance, N_{Rd}												
100			10,8	13,5											
120			13	16,2	19,5										
140			15,1	18,9	22,7	26,5									
160			17,3	21,6	25,9	30,3	34,6						Not allowed area		
168			18,2	22,7	27,2	31,8	36,3	38							
172			18,6	23,2	27,9	32,5	37,2	38,9	40						
174			18,8	23,5	28,2	32,9	37,6	39,4	40,5	40,9					
186			20,1	25,1	30,2	35,2	40,2	42,1	43,2	43,7	42,1				
193			20,9	26,1	31,3	36,5	41,7	43,7	44,9	45,4	43,7	45,5			
200			21,6	27	32,4	37,8	43,2	45,2	46,5	47	45,2	47,1			
201			21,7	27,2	32,6	38	43,4	45,5	46,7	47,2	45,5	47,4	49,3		
210			21,9	28,4	34	39,7	45,4	47,5	48,8	49,3	47,5	49,5	51,5		
214			21,9	28,9	34,7	40,5	46,3	48,4	49,8	50,3	48,4	50,4	52,4	50,8	
240			21,9	32,4	38,9	45,4	51,9	54,3	55,8	56,4	54,3	56,5	58,8	57	
245			21,9	33,1	39,7	46,3	53	55,4	57	57,6	55,4	57,7	60	58,2	56,6
252			21,9	34	40,9	47,7	54,5	57	58,6	59,2	57	59,4	61,8	59,9	58,3
256			21,9	34,1	41,5	48,4	55,3	57,9	59,5	60,2	57,9	60,3	62,7	60,8	59,2
258			21,9	34,1	41,8	48,8	55,8	58,4	60	60,6	58,4	60,8	63,2	61,3	59,7
260			21,9	34,1	42,1	49,2	56,2	58,8	60,4	61,1	58,8	61,3	63,7	61,8	60,1
261			21,9	34,1	42,3	49,4	56,4	59	60,7	61,3	59	61,5	64	62	60,3
265			21,9	34,1	43	50,1	57,3	59,9	61,6	62,3	59,9	62,4	64,9	62,9	61,3
267			21,9	34,1	43,3	50,5	57,7	60,4	62,1	62,7	60,4	62,9	65,4	63,4	61,7
277			21,9	34,1	44,9	52,4	59,9	62,7	64,4	65,1	62,7	65,3	67,9	65,8	64
400				34,1	49,2	66,9	86,5	90,5	93	94	90,5	94,2	98	95	92,5
500					49,2	66,9	87,4	110,6	116,2	117,5	113,1	117,8	122,5	118,8	115,6
600						66,9	87,4	110,6	136,6	141	135,7	141,4	147	142,5	138,7
700							87,4	110,6	136,6	164,5	158,3	164,9	171,5	166,3	161,9
800					Not allowed area			110,6	136,6	165,3	181	188,5	196	190	185
900									136,6	165,3	196,7	212,1	220,5	213,8	208,1
1000									136,6	165,3	196,7	213,4	230,8	237,5	231,2
Length to develop steel yield, $L_{b,rqd}$ [mm]			202	253	303	354	404	489	588	703	870	906	942	1.127	1.512

Values shaded in blue are not allowed for overlapping joints

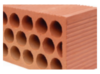
MO-VH


Concrete


Reinforced concrete


Cracked concrete


Thermal clay


Hollow brick

GAMA

HYBRID RESIN VINILESTER STYRENE-FREE

CODE	DIMENSION	
NORMAL		
MOVH300	300 ml	12
MOVH410	410 ml	12
COLOUR STONE		
MOVHW300	300 ml	12
MOVHW410	410 ml	12

Accessories for chemical anchor cartridges

MO-PIS Application guns

CODE	MODEL
MOPISTO	Manual
MOPISPR	Professional 410 ml
MOPISSI	Silicone 300 ml
MOPISNEU	Pneumatic

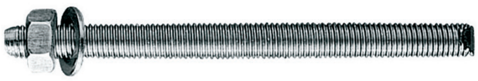
MO-TN Plastic sleeve

CODE	DIMENSION
MOTN12050	12 x 50
MOTN15085	15 x 85
MOTN15130	15 x 130
MOTN20085	20 x 85

MO-AC Mixing tubes and miscellaneous

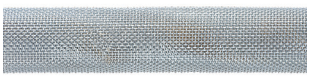
CODE	MODEL
MOBOMBA	Blower pump
MORCANU	Tube 170 - 300 - 410 ml
MORCEPKIT	Kit 3 brushes

MO-ES Threaded stud



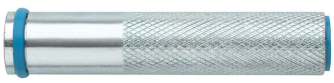
CODE	DIMENSION
MOES06070	M6 x 70
MOES08110	M8 x 110
MOES10115	M10 x 115
MOES12110	M12 x 110

MO-TM Metal sleeve



CODE	DIMENSION
MOTM12100	12 x 1000
MOTM16100	16 x 1000
MOTM22100	22 x 1000

MO-TR Threaded sleeve



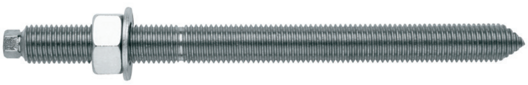
CODE	DIMENSION
MOTRO08	M8/12 x 80
MOTRO10	M10/14 x 80
MOTRO12	M12/16 x 80

MO-VH

Accessories for chemical anchor cartridges

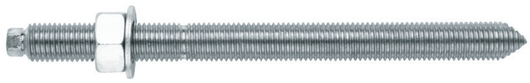
Stud for chemical anchor with nut and washer

EQ-AC Zinc-plated 5.8



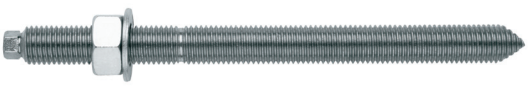
CODE	DIMENSION
EQAC08110	M8 x 110
EQAC10130	M10 x 130
EQAC10190	M10 x 190
EQAC12160	M12 x 160
EQAC12220	M12 x 220
EQAC16190	M16 x 190
EQAC16250	M16 x 250
EQAC20260	M20 x 260
EQAC20350	M20 x 350
EQAC24300	M24 x 300
EQAC24380	M24 x 380
EQAC30330	M30 x 330

EQ-A2 Stainless steel A2



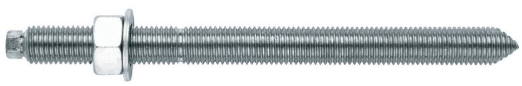
CODE	DIMENSION
EQA208110	M8 x 110
EQA210130	M10 x 130
EQA212160	M12 x 160
EQA216190	M16 x 190
EQA220260	M20 x 260
EQA224300	M24 x 300
EQA230330	M30 x 330

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

Notes