Vinyl ester styrene-free mortar anchor, for use in non-cracked concrete

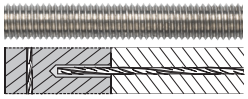
MO-VS

Assessed ETA Option 7 (non-cracked concrete).

PRODUCT INFORMATION

DESCRIPTION
Vinyl ester styrene-free, chemical anchor.

OFFICIAL DOCUMENTATION
- ETA 18/0400 option 7, de M8 to M24 for non-cracked concrete (100 years).
- ETA 20/0090 for post-installed rebar installation (100 years).
- ETA 20/0091 for installation in masonry.
- Certificate 1020-CPD-090-029883 for use in concrete.
- Certificate EVCP 1020-CPR-090-046621 for post-installed rebars.
- Certificate EVCP 1020-CPR-090-046619 for installation in masonry
- Declaration features DoP MO-VS.

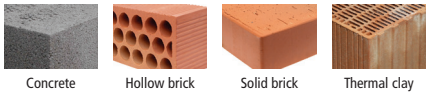
VALID FOR

Stud

Post-installed rebar

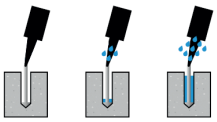
DIMENSIONS
Stud M8 - M24
Post-installed rebars Ø8 - Ø20

RANGE OF CACULATION LOADS
From 11,2 to 81,0 kN (non-cracked).

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


Concrete | Hollow brick | Solid brick | Thermal clay

ASSESSMENTS
- ETA 18/0400 Option 7: non-cracked concrete.
- ETA 20/0090 Post-installed rebars.
- ETA 20/0091 Masonry.

DRILL HOLE CONDITION

Dry | Wet | Flooded

CHARACTERISTICS AND BENEFITS
- Easy installation.
- For use in non-cracked concrete,
- Used for high loads.
- Temperature range -40°C to +80°C (maximum long-term temperature +50°C).
- Variety of lengths and diameters: M8-M24-assessed studs, flexible assembly.
- For static or quasi-static loads.
- Version in zinc plated steel, stainless steel A4.
- Available in INDEXcal.

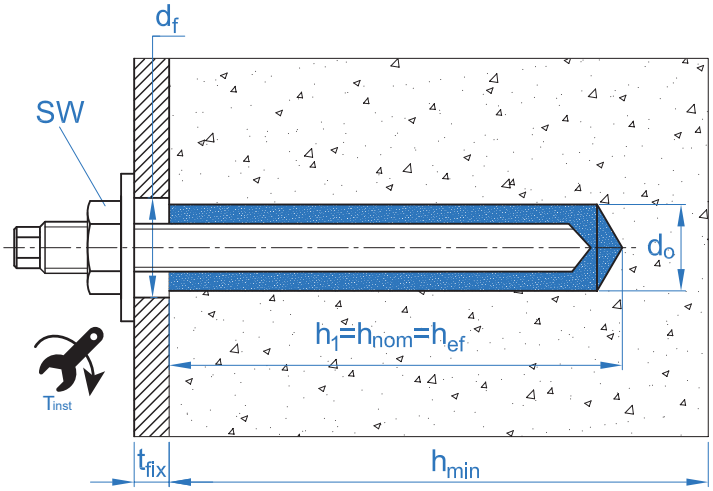
MATERIALS
Standard stud:
Carbon steel 5.8, 8.8.

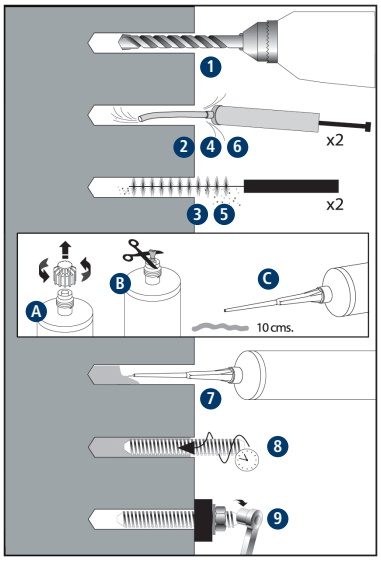
Stainless standard stud:
Stainless steel A2-70 and A4-70.

APPLICATIONS
- For indoor and outdoor use.
- Structural applications.
- Safety barriers.
- Fixing of road fences.
- Fixing of posters, machinery, boilers, signs, billboards, etc.

CONCRETE INSTALLATION PARAMETERS

METRIC			M8	M10	M12	M16	M20	M24
d_0	nominal diameter	[mm]	10	12	14	18	22	26
d_f	diameter in anchor plate ≤	[mm]	9	12	14	18	22	26
T_{inst}	tightening torque ≤	[Nm]	10	20	40	80	150	200
Circular cleaning brush			Ø14		Ø20		Ø29	
$h_{ef,min}$ = 8d								
h_1	depth of the drill hole	[mm]	64	80	96	128	160	192
$s_{cr,N}$	critical distance between anchors	[mm]	192	240	288	384	480	576
$c_{cr,N}$	critical distance from the edge	[mm]	96	120	144	192	240	288
c_{min}	minimum distance from the edge	[mm]	35	40	50	65	80	96
s_{min}	minimum distance between anchors	[mm]	35	40	50	65	80	96
h_{min}	minimum concrete thickness	[mm]	100	110	126	158	204	244
Standard stud								
h_1	depth of the drill hole	[mm]	80	90	110	128	170	210
$s_{cr,N}$	critical distance between anchors	[mm]	240	270	330	384	510	630
$c_{cr,N}$	critical distance from the edge	[mm]	120	135	165	192	255	315
c_{min}	minimum distance from the edge	[mm]	43	45	56	65	85	105
s_{min}	minimum distance between anchors	[mm]	43	45	56	65	85	105
h_{min}	minimum concrete thickness	[mm]	110	120	140	158	214	262
$h_{ef,max}$ = 12d								
h_1	depth of the drill hole	[mm]	96	120	144	192	240	288
$s_{cr,N}$	critical distance between anchors	[mm]	288	360	432	576	720	864
$c_{cr,N}$	critical distance from the edge	[mm]	144	180	216	288	360	432
c_{min}	minimum distance from the edge	[mm]	50	60	70	95	120	145
s_{min}	minimum distance between anchors	[mm]	50	60	70	95	120	145
h_{min}	minimum concrete thickness	[mm]	126	150	174	222	284	340
Zinc-plated stud code 5.8 / 8.8 			EQAC08110 EQ8808110	EQAC10130 EQ8810130	EQAC12160 EQ8812160	EQAC16190 EQ8816190	EQAC20260 EQ8820260	EQAC24300 EQ8824300
Stainless steel stud code A2 / A4 			EQA208110 EQA408110	EQA210130 EQA410130	EQA212160 EQA412160	EQA216190 EQA416190	EQA220260 EQA420260	EQA224300 EQA424300



INSTALLATION ACCESSORIES			INSTALLATION PROCEDURE
CODE	PRODUCT	MATERIAL	CONCRETE
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	

MINIMUM CURING TIME			
TYPE	BASE MATERIAL TEMPERATURE [ºC]	HANDLING TIME [min]	CURING TIME [min]
MO-VS	min +5	18	120
	+5 a +10	12	120
	+10 a +20	6	80
	+20 a +25	4	40
	+25 a +30	3	30
	+30 a +35	2	20
	+35 a +40	1.5	15
	40	1.5	10

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
N_{Rk}	Non-cracked concrete	[kN]	*18,0*	28,3	49,8	64,3	90,8	118,8
Calculated tensile strength N_{Rd}								
Metric			M8	M10	M12	M16	M20	M24
N_{Rd}	Non-cracked concrete	[kN]	*12,0*	15,7	27,6	35,7	50,4	66,0
Maximum recommended tensile load N_{rec}								
Metric			M8	M10	M12	M16	M20	M24
N_{rec}	Non-cracked concrete	[kN]	*8,6*	11,2	19,7	25,5	36,0	47,1
Characteristic resistance to shear stress V_{Rk}								
Metric			M8	M10	M12	M16	M20	M24
V_{Rk}	Zinc-plated stud 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*
	Zinc-plated stud 8.8	[kN]	*15,0*	*23,0*	*34,0*	*63,0*	*98,0*	*141,0*
	Stainless steel stud (A2/A4)	[kN]	*13,0*	*20,0*	*30,0*	*55,0*	*86,0*	*124,0*
Calculated resistance to shearing V_{Rd}								
Metric			M8	M10	M12	M16	M20	M24
V_{Rd}	Zinc-plated stud 5.8	[kN]	*7,2*	*12,0*	*16,8*	*31,2*	*48,8*	*70,4*
	Zinc-plated stud 8.8	[kN]	*12,0*	*18,4*	*27,2*	*50,4*	*78,4*	*112,8*
	Stainless steel stud (A2/A4)	[kN]	*8,3*	*12,8*	*19,2*	*35,3*	*55,1*	*79,5*
Maximum recommended load to shear stress V_{rec}								
Metric			M8	M10	M12	M16	M20	M24
V_{rec}	Zinc-plated stud 5.8	[kN]	*5,1*	*8,6*	*12,0*	*22,3*	*34,9*	*50,3*
	Zinc-plated stud 8.8	[kN]	*8,6*	*13,1*	*19,4*	*36,0*	*56,0*	*80,6*
	Stainless steel stud (A2/A4)	[kN]	*6,0*	*9,2*	*13,7*	*25,2*	*39,4*	*56,8*
Effective depth of studs EQ-AC / EQ-A2 / EQ-A4								
Metric			M8	M10	M12	M16	M20	M24
Effective depth		[mm]	80	90	110	128	170	210

The values underlined and in italics indicate steel failure

Simplified calculation method. European Technical Assessment ETA 18/0400

Simplified version of the calculation method according to Eurocode 2 EN 1992-4. Resistance is calculated according to the data shown in assessment ETA 18/0400.

- 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

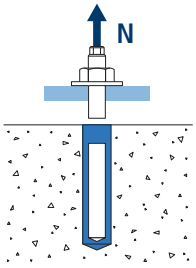
MO-VS

- 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

$N_{Rd,s}$

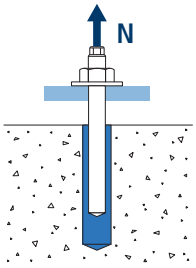
	Metric		M8	M10	M12	M16	M20	M24
$N^{o}_{Rd,s}$	Steel class 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0
	Steel class 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0
	Steel class 10.9	[kN]	27,8	43,6	63,2	118,0	184,2	265,4
	Stainless steel Class A2-70, A4-70	[kN]	13,9	21,9	31,6	58,8	92,0	132,1



Calculated extraction resistance

$N_{Rd,p} = N^{o}_{Rd,p} \cdot \Psi_{c} \cdot \Psi_{hef,p}$

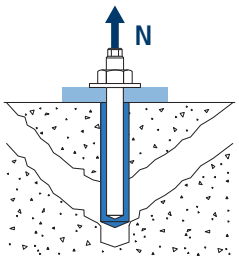
	Metric		M8	M10	M12	M16	M20	M24
$N^{o}_{Rd,p}$	Non-cracked concrete	[kN]	13,4	15,7	27,6	35,7	50,4	66,0



Calculated concrete cone resistance

$N_{Rd,c} = N^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{s,N} \cdot \Psi_{c,N} \cdot \Psi_{re,N} \cdot \Psi_{hef,N}$

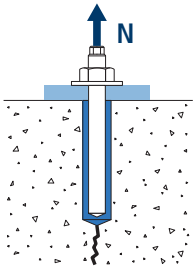
	Metric		M8	M10	M12	M16	M20	M24
$N^{o}_{Rd,c}$	Non-cracked concrete	[kN]	19,6	23,3	31,5	39,6	60,6	83,2



Calculated concrete cracking resistance

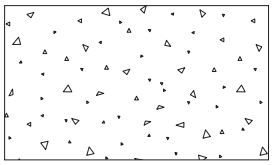
$N_{Rd,sp} = N^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{s,sp} \cdot \Psi_{c,sp} \cdot \Psi_{re,N} \cdot \Psi_{h,sp} \cdot \Psi_{hef,N}$

	Métrica		M8	M10	M12	M16	M20	M24
$N^{o}_{Rd,sp}$	Non-cracked concrete	[kN]	19,6	23,3	31,5	39,6	60,6	83,2



MO-VS

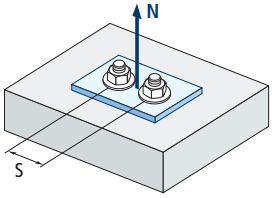
Influence coefficients



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	1,12	1,19	1,30

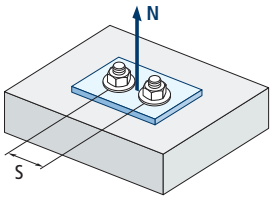
$$\Psi_b = \sqrt{\frac{f_{ck,cube}}{25}} \geq 1$$

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



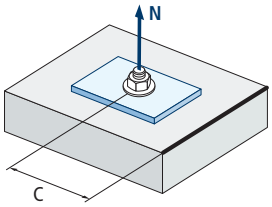
Influence of spacing between anchors (concrete cone) $\Psi_{s,N}$										
$s/s_{cr,N}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0
$\Psi_{s,N}$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1,00

$$\Psi_{s,N} = 0{,}5\left(1+\frac{s}{S_{cr,N}}\right) \leq 1$$



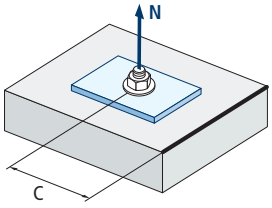
Influence of spacing between anchors (cracking) $\Psi_{s,N}$										
$s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0
$\Psi_{s,sp}$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1,00

$$\Psi_{s,sp} = 0{,}5\left(1+\frac{s}{S_{cr,sp}}\right) \leq 1$$



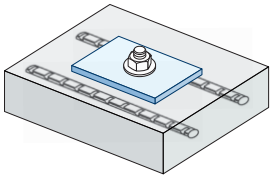
Influence of the distance from the edge of the concrete (concrete cone) $\Psi_{c,N}$												
$c/C_{cr,N}$	0,1	0,2	0,3	0,5	0,6	0,8	0,9	1,1	1,2	1,4	1,5	1,6
$\Psi_{c,N}$	0,40	0,46	0,51	0,45	0,49	0,55	0,61	0,67	0,75	0,83	0,91	1,00

$$\Psi_{c,N} = 0{,}35 + \frac{0{,}5 \cdot c}{C_{cr,N}} + \frac{0{,}15 \cdot c^2}{C_{cr,N}^{\ 2}} \leq 1$$



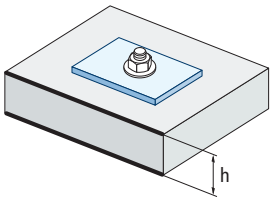
Influence of the distance from the edge of the concrete (cracking) $\Psi_{c,sp}$												
$c/C_{cr,sp}$	0,1	0,2	0,3	0,5	0,6	0,8	0,9	1,1	1,2	1,4	1,5	1,6
$\Psi_{c,sp}$	0,40	0,46	0,51	0,45	0,49	0,55	0,61	0,67	0,75	0,83	0,91	1,00

$$\Psi_{c,sp} = 0{,}35 + \frac{0{,}5 \cdot c}{C_{cr,sp}} + \frac{0{,}15 \cdot c^2}{C_{cr,sp}^{\ 2}} \leq 1$$



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

$$\Psi_{re,N} = 0{,}5 + \frac{h_{ef}}{200} \leq 1$$



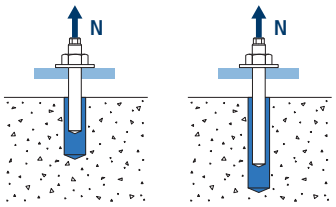
Influence of the base material thickness $\Psi_{h,sp}$										
$\Psi_{h,sp}$	h/h_{ef}	2,00	2,20	2,40	2,60	2,80	3,00	3,20	3,40	3,60	3,68
	fh	1,00	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,50

$$\Psi_{h,sp} = \left(\frac{h}{2 \cdot h_{ef}}\right)^{2/3} \leq 1{,}5$$

M0-VS

Influence of the effective depth for the extraction combination $\Psi_{hef,p}$						
Metric h_{ef}	M8	M10	M12	M16	M20	M24
64	0.80					
80	1.00	0.89				
90	1.13	1.00	0.82			
96	1.20	1.07	0.87			
110		1.22	1.00			
120		1.33	1.09			
128			1.16	1.00		
144			1.31	1.13		
160				1.25	0.94	
170				1.33	1.00	
192				1.50	1.13	0.91
210					1.24	1.00
240					1.41	1.14
288						1.37

Value not permitted

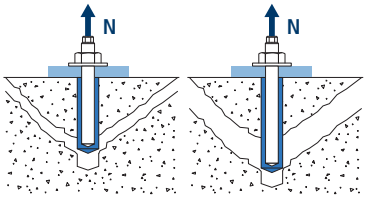


$$\Psi_{hef,p} = \frac{h_{ef}}{h_{stand}}$$

Influence of the effective depth for the concrete cone $\Psi_{hef,N}$						
Metric h_{ef}	M8	M10	M12	M16	M20	M24
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			
120	1.84	1.54	1.14	0.91		
128	2.02	1.70	1.26	1.00	0.65	
144		2.02	1.50	1.19	0.78	
160		2.37	1.75	1.40	0.91	0.67
170		2.60	1.92	1.53	1.00	0.73
192			2.31	1.84	1.20	0.87
210			2.64	2.10	1.37	1.00
240			3.22	2.57	1.68	1.22
288				3.38	2.21	1.61

Value not permitted

Value not permitted

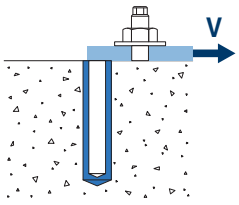


$$\Psi_{hef,N} = \left(\frac{h_{ef}}{h_{stand}}\right)^{1,5}$$

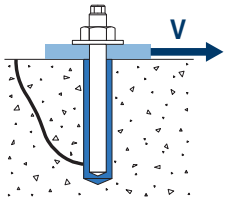
MO-VS

SHEARING LOADS

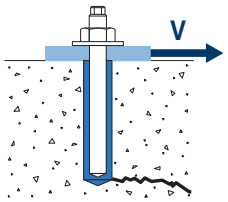
- Calculated steel resistance without lever arm: $V_{Rd,s}$
- Calculated spalling resistance: $V_{Rd,cp} = k \cdot N^{o}_{Rd,c}$
- Calculated concrete edge resistance: $V_{Rd,c} = V^{o}_{Rd,c} \cdot \Psi_b \cdot \Psi_{se,V} \cdot \Psi_{c,V} \cdot \Psi_{re,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{h,V}$



Calculated steel resistance to shearing $V_{Rd,s}$							
Metric			M8	M10	M12	M16	M20	M24
$V^{o}_{Rd,s}$	Steel class 5.8	[kN]	7,2	12	16,8	31,2	48,8	70,4
	Steel class 8.8	[kN]	12	18,4	27,2	50,4	78,4	112,8
	Steel class 10.9	[kN]	12	19,3	28	52,7	82	118
	Stainless steel Class A2-70, A4-70	[kN]	8,3	12,8	19,2	35,3	55,1	79,5

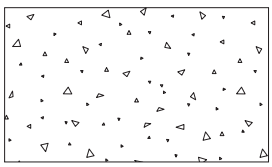


Calculated spalling resistance $V_{Rd,cp} = k \cdot N^{o}_{Rd,c}$						
Metric	M8	M10	M12	M16	M20	M24
k	2					



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
$V^{o}_{Rd,c}$	Non-cracked concrete	[kN]	5,7	8,6	11,8	19,0	28,3	36,4

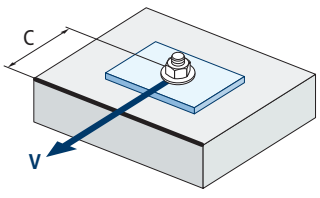
Influence coefficients

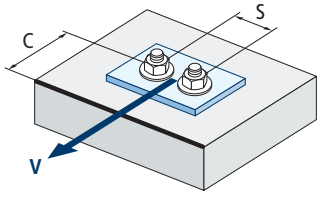


$$\Psi_b = \sqrt{\frac{f_{ck,cube}}{25}} \geq 1$$

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





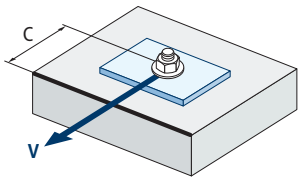
$$\Psi_{se,V} = \left(\frac{c}{h_{ef}}\right)^{1,5}$$

$$\Psi_{se,V} = \left(\frac{c}{h_{ef}}\right)^{1,5} \cdot \left(1 + \frac{s}{3 \cdot c}\right) \cdot 0,5 \leq \left(\frac{c}{h_{ef}}\right)^{1,5}$$

MO-VS

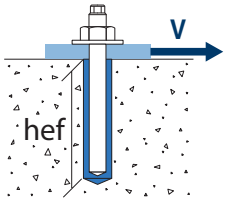
Influence of the distance from the edge of the concrete $\Psi_{c,V}$								
c/d	4	5	7	10	15	20	25	30
$\Psi_{c,V}$	0,76	0,72	0,68	0,63	0,58	0,55	0,53	0,51

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

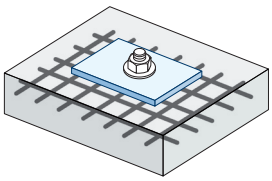


Influence of the effective depth $\Psi_{hef,V}$					
h_{ef}/d	8	9	10	11	12
$\Psi_{hef,V}$	1,65	2,04	2,47	2,93	3,42

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

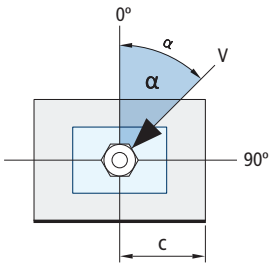


Influence of the rebars $\Psi_{re,v}$				
		Without perimeter rebar	Perimeter rebar ≥Ø12mm	Perimeter rebar with abutments at≤100mm
$\Psi_{re,v}$	Hormigón no fisurado	1	1	1



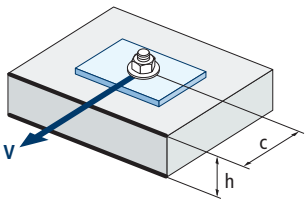
Influence of the load application angle $\Psi_{\alpha,v}$										
Angle, α(°)	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
$\Psi_{\alpha,v}$	1,00	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

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



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

$$\Psi_{h,V} = \left(\frac{h}{1,5 \cdot c}\right)^{0,5} \geq 1,0$$

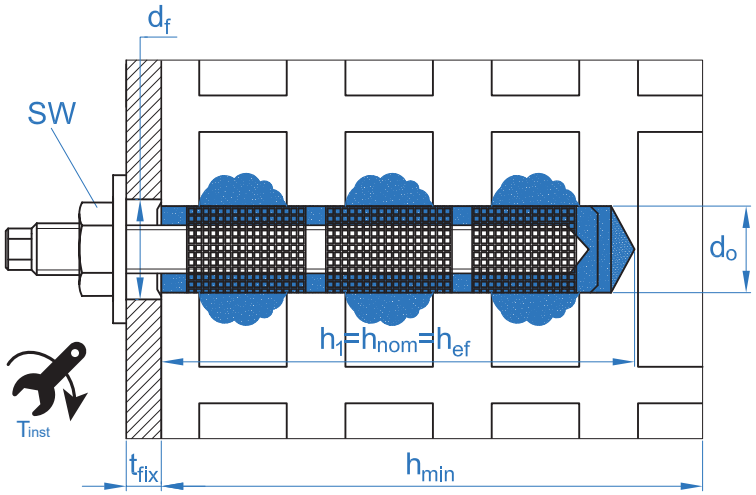


MO-VS

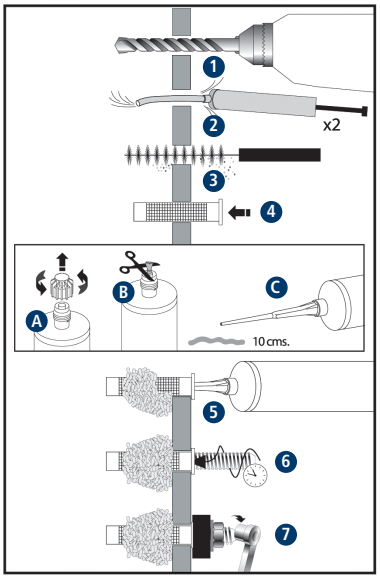
FIXING IN BRICKS

INSTALLATION PARAMETERS IN BRICKS. PLASTIC SLEEVE					
DIMENSION			M8	M10	M12
Plastic sleeve		ls		85	
		d_o	15	15	20
Mortar volume per sleeve		[ml]	15	15	27
h_1	drill hole depth ≥	[mm]	90	90	90
h_{nom}	sleeve installation depth	[mm]	85	85	85
h_{ef}	stud depth ≥	[mm]	80	80	80
t_{fix}	thickness material to be fixed ≤	[mm]	22	25	18
h_{min}	base material thickness ≥	[mm]	110	110	110
d_f	diameter in metal sheet ≤	[mm]	9	12	14
T_{ins}	tightening torque ≤	[Nm]	2	2	2
Circular brush				ø20	
Stud code 			MOES08110	MOES10115	MOES12110
Sleeve code			MOTN15085	MOTN15085	MOTN20085

BASE MATERIAL		PLASTIC SLEEVE								
		M8			M10			M12		
Minimum distances and from the edge		$c_{cr} = c_{min}$	$s_{cr\,II} = s_{min\,II}$	$s_{min\,\perp} = c_{min\,\perp}$	$c_{cr} = c_{min}$	$s_{cr\,II} = s_{min\,II}$	$s_{min\,\perp} = c_{min\,\perp}$	$c_{cr} = c_{min}$	$s_{cr\,II} = s_{min\,II}$	$s_{min\,\perp} = c_{min\,\perp}$
Brick number 1	[mm]	100	235	115	100	235	115	120	235	115
Brick number 2	[mm]	100	240	113	100	240	113	120	240	113
Brick number 3	[mm]	100	237	237	100	237	237	120	250	237
Brick number 4	[mm]	128	255	255	128	255	255	128	255	255
Brick number 5	[mm]	128	255	255	128	255	255	128	255	255
Brick number 6	[mm]	100	250	240	100	250	240	120	250	240
Brick number 7	[mm]	100	250	248	100	250	248	-	-	-



MO-VS

INSTALLATION ACCESSORIES			INSTALLATION PROCEDURE
CODE	PRODUCT	MATERIAL	BRICK
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	
MO-ES	STUD	Threaded stud	
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	
MO-TN	NYLON SLEEVE	Plastic white or grey	
MO-TM	METAL SLEEVE	Metal sleeve ø12, ø16 and ø22 mm	

MINIMUM CURING TIME			
TYPE	BASE MATERIAL TEMPERATURE [°C]	HANDLING TIME [min]	CURING TIME [min]
MO-VS	min +5	18	120
	+5 a +10	12	120
	+10 a +20	6	80
	+20 a +25	4	40
	+25 a +30	3	30
	+30 a +35	2	20
	+35 a +40	1.5	15
	40	1.5	10

MO-VS

Characteristic resistances (F_{Rk})			
Base material	Threaded studs Tensile and shear force [kN]		
	M8	M10	M12
Brick number 1	2,00	2,00	2,00
Brick number 2	2,00	1,50	2,50
Brick number 3	1,50	1,50	2,50
Brick number 4	1,20	1,20	1,20
Brick number 5	1,20	0,90	0,90
Brick number 6	0,75	0,75	1,20
Brick number 7	0,75	0,50	0,50

Calculated resistances (F_{Rd})			
Base material	Threaded studs Tensile and shear force [kN]		
	M8	M10	M12
Brick number 1	0,80	0,80	0,80
Brick number 2	0,80	0,60	1,00
Brick number 3	0,60	0,60	1,00
Brick number 4	0,48	0,48	0,48
Brick number 5	0,48	0,36	0,36
Brick number 6	0,30	0,30	0,48
Brick number 7	0,30	0,20	0,20

Recommended maximum loads (F_{recom}) (with andF= 1.4)			
Base material	Threaded studs Tensile and shear force [kN]		
	M8	M10	M12
Brick number 1	0,57	0,57	0,57
Brick number 2	0,57	0,43	0,71
Brick number 3	0,43	0,43	0,71
Brick number 4	0,34	0,34	0,34
Brick number 5	0,34	0,26	0,26
Brick number 6	0,21	0,21	0,34
Brick number 7	0,21	0,14	0,14

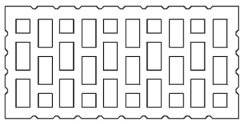
MO-VS

BRICK TYPES

Brick no. 1
Hollow baked clay brick HLz 12-1, 0-2DF according to EN 771-1

Length / width / height: 235 mm / 112 mm / 115 mm

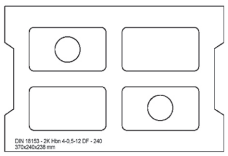
fb ≥ 12 N/mm2 / ρ ≥ 1,0 kg/dm³



Brick no. 2
Concrete block Hbn 4-12DF according to EN 771-3

Length / width / height: 370 mm / 240 mm / 238 mm

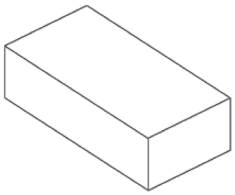
fb ≥ 4 N/mm2 / ρ ≥ 1,2 kg/dm³



Brick no. 3
Solid baked clay brick Mz 12-2, 0-NF according to EN 771-1

Length / width / height: 240 mm / 116 mm / 71 mm

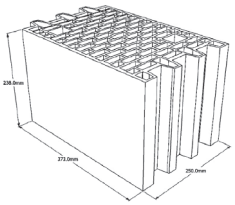
fb ≥ 12 N/mm2 / ρ ≥ 2,0 kg/ dm³



Brick no. 4
Hollow clay brick Porotherm P+W according to EN 771-1

Length / width / height: 373 mm / 250 mm / 238 mm

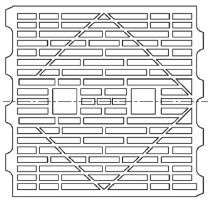
fb ≥ 12 N/mm2 / ρ ≥ 0,9 kg/dm³



Brick no. 5
Hollow baked clay brick HLzW 6-0,7-8DF according to EN 771-1

Length / width / height: 250 mm / 240 mm / 240 mm

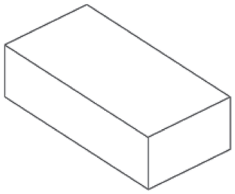
fb ≥ 6 N/mm2 / ρ ≥ 0,8 kg/dm³



Brick no. 6
olid sillico calcareous brick KS 12-2, 0-NF according to EN 771-2.

Length / width / height: 240 mm / 115 mm / 70 mm

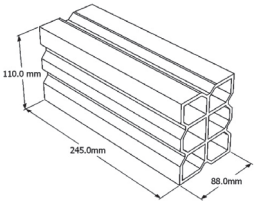
fb ≥ 12 N/mm2 / ρ ≥ 2,0 kg/dm³



Brick no. 7
Hollow clay brick Hueco Doble according to EN 771-1

Length / width / height: 245 mm / 110 mm / 88 mm

fb ≥ 2,5 N/mm2 / ρ ≥ 0,74 kg/dm³



MO-VS

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).**

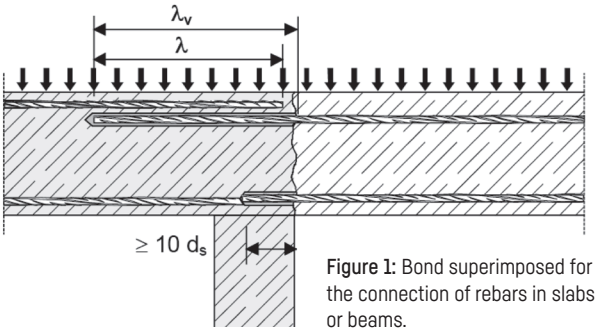


Figure 1: Bond superimposed for the connection of rebars in slabs or beams.

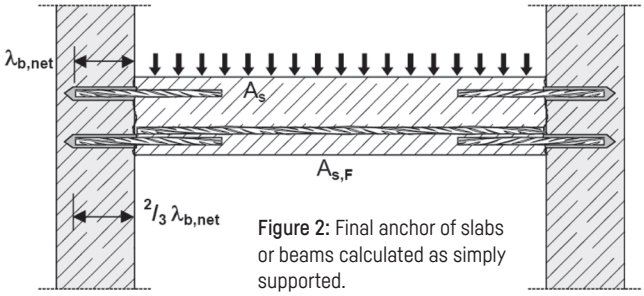


Figure 2: Final anchor of slabs or beams calculated as simply supported.

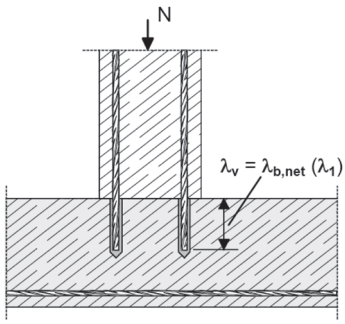


Figure 3: Rebar connections for items primarily subjected to compression. The rebars are subjected to compression.

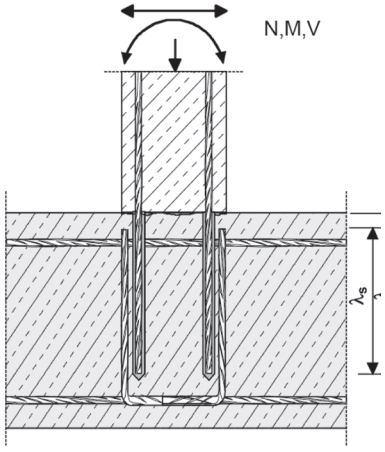


Figure 4: Bond superimposed to a foundation of a column or a wall where the rebars is subjected to tensile force.

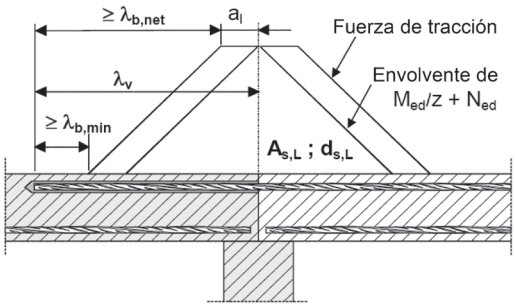


Figure 5: Reinforcement anchor to cover the action line of the tensile force.

*** 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.

MO-VS

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	

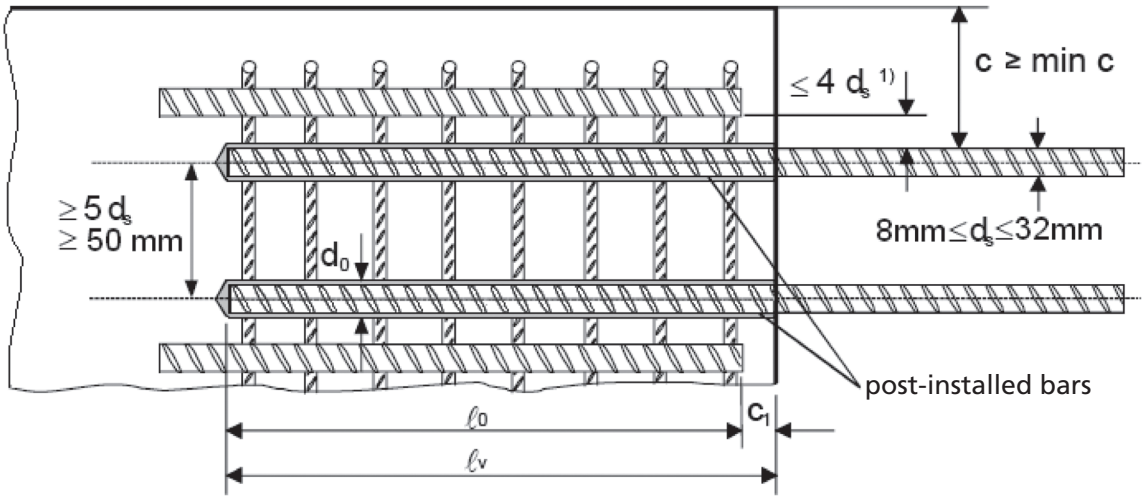
Minimum / maximum installation length ℓ_{max}				
Corrugated bars		Minimum		Maximum
		Anchor $\ell_{b,min}$	Overlapped connection $\ell_{0,min}$	ℓ_{max}
$Ød_s$ [mm]	fy,k [N/mm²]	[mm]	[mm]	[mm]
8	500	114	200	400
10	500	142	200	500
12	500	171	200	600
14	500	199	210	700
16	500	227	240	800
20	500	284	300	1000
25	500	355	375	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 16	1.6	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.3
20								3.7	
25						3.0			

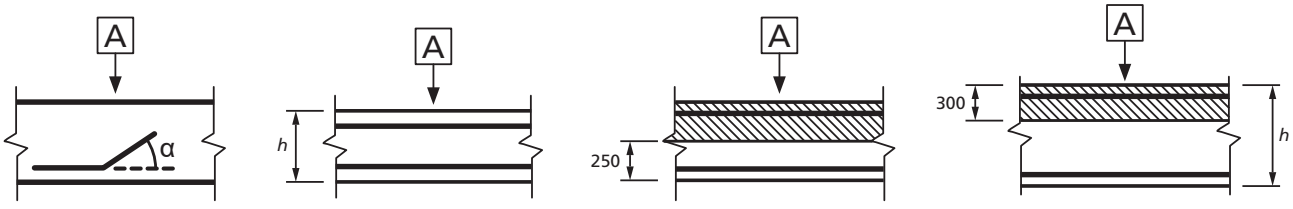
$$N = f_{bd} \cdot \Phi \cdot L_b \cdot \pi$$

MO-VS

- 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:



a) 45° ≤ α ≤ 90° b) *h* ≤ 250 mm c) *h* > 250 mm d) *h* > 600 mm

A Direction of the concreting

(a) and (b) "good" bonding conditions for all types of bars.
(c) and (d) without shaded area - "good" bonding conditions.
Shaded area- "poor" bonding conditions.

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

M0-VS

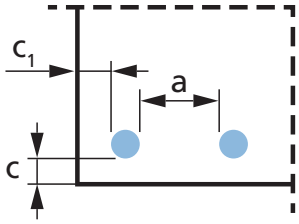
Resistance values may increase in the following situations:

- 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	

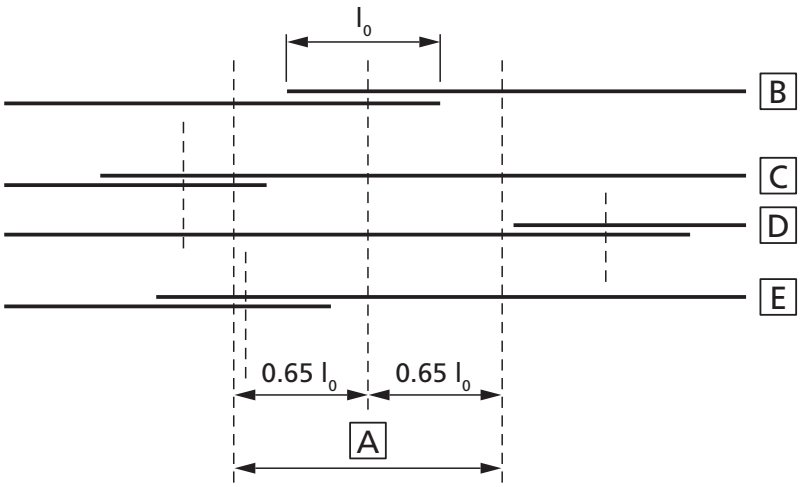
Where:

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



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

MO-VS

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
Bar size	d_s	[mm]	8	10	12	14	16	20
Cross-sectional area	A_s	[mm²]	50,3	78,5	113,1	201,1	314,2	314,2
Yield stress of the steel	f_{yd}	[kN]	500	500	500	500	500	500
Safety factor	$\gamma_{M,s}$	[mm²]	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	87,4	136,6	136,6
Calculated bonding resistance	f_{bd}	[N/mm²]	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
Spacing between bars ≥	s	[mm]	50	50	60	80	100	100
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]					
171,0	9,9					
213,0	12,3	15,4				
256,0	14,8	18,5	22,2			
298,0	17,2	21,5	25,8	30,1		
300,0	17,3	21,7	26,0	30,3		
315,0	18,2	22,8	27,3	31,9		
341,0	19,7	24,6	29,6	34,5	39,4	
360,0	20,8	26,0	31,2	36,4	41,6	
400,0	**21,9**	28,9	34,7	40,5	46,2	
426,0		30,8	36,9	43,1	49,3	61,6
450,0		32,5	39,0	45,5	52,0	65,0
500,0		**34,1**	43,4	50,6	57,8	72,3
600,0			**49,2**	60,7	69,4	86,7
700,0				**66,9**	80,9	101,2
800,0					**87,4**	115,6
1000,0						**136,6**
Length for reaching the yield stress of the steel, $L_{b,rqd}$ [mm]	**378**	**473**	**567**	**662**	**756**	**945**

Area not permitted

Yield stress area of the bar

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)

TABLES OF PRECALCULATED VALUES

MO-VS

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
Bar size	d_s	[mm]	8	10	12	14	16	20
Cross-sectional area	A_s	[mm²]	50,3	78,5	113,1	201,1	314,2	314,2
Yield stress of the steel	f_{yd}	[kN]	500	500	500	500	500	500
Safety factor	$\gamma_{M,s}$	[mm²]	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	87,4	136,6	136,6
Calculated bonding resistance	f_{bd}	[N/mm²]	2,70	2,70	2,70	2,70	2,70	2,30
Diameter of the drilled hole	d_h	[mm]	12	14	16	18	20	25
Spacing between bars ≥	s	[mm]	50	50	60	80	100	100
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]					
150,0	10,2					
182,0	12,4	15,4				
218,0	14,8	18,5	22,2			
254,0	17,2	21,5	25,9	30,2		
290,0	19,7	24,6	29,5	34,4	39,4	
300,0	20,4	25,4	30,5	35,6	40,7	
315,0	21,4	26,7	32,1	37,4	42,8	
360,0	**21,9**	30,5	36,6	42,8	48,9	
400,0	**21,9**	33,9	40,7	47,5	54,3	
426,0		**34,1**	43,4	50,6	57,8	61,6
450,0		**34,1**	45,8	53,4	61,1	65,0
500,0		**34,1**	**49,2**	59,4	67,9	72,3
600,0			**49,2**	**66,9**	81,4	86,7
700,0				**66,9**	**87,4**	101,2
800,0					**87,4**	115,6
1000,0						**136,6**
Length for reaching the yield stress of the steel, $L_{b,rqd}$ [mm]	**322**	**403**	**483**	**564**	**644**	**945**

Area not permitted

Yield stress area of the bar

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)

MO-VS

TABLES OF PRECALCULATED VALUES

Concrete class 40/50								
Resistance to concrete compression [$f_{ck,cube}$]: 50 N/mm²								
Bar Ø	d_s	[mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20
Bar size	d_s	[mm]	8	10	12	14	16	20
Cross-sectional area	A_s	[mm²]	50,3	78,5	113,1	201,1	314,2	314,2
Yield stress of the steel	f_{yd}	[kN]	500	500	500	500	500	500
Safety factor	$\gamma_{M,s}$	[mm²]	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	87,4	136,6	136,6
Calculated bonding resistance	f_{bd}	[N/mm²]	2,3	2,3	2,3	2,3	2,3	2,3
Diameter of the drilled hole	d_h	[mm]	10 ~ 12	12 ~ 14	16	18	20	25
Spacing between bars ≥	s	[mm]	50	50	60	80	100	100
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]					
150.0	10,2					
182,0	12,4	15,4				
218,0	14,8	18,5	22,2			
254,0	17,2	21,5	25,9	30,2		
290,0	19,7	24,6	29,5	34,4	39.4	
300,0	20,4	25,4	30,5	35,6	40,7	
315,0	21,4	26,7	32,1	37,4	42,8	
360,0	**21,9**	30,5	36,6	42,8	48,9	
400,0	**21,9**	33,9	40,7	47,5	54,3	
426,0		**34,1**	43,4	50,6	57,8	61,6
450,0		**34,1**	45,8	53,4	61,1	65,0
500,0		**34,1**	**49,2**	59,4	67,9	72,3
600,0			**49,2**	**66,9**	81,4	86,7
700,0				**66,9**	**87,4**	101,2
800,0					**87,4**	115,6
1000,0						**136,6**
Length for reaching the yield stress of the steel, $L_{b,rqd}$ [mm]	**322**	**403**	**483**	**564**	**644**	**945**

Area not permitted

Yield stress area of the bar

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)

TABLES OF PRECALCULATED VALUES

MO-VS

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
Bar size	d_s	[mm]	8	10	12	14	16	20
Cross-sectional area	A_s	[mm²]	50,3	78,5	113,1	201,1	314,2	314,2
Yield stress of the steel	f_{yd}	[kN]	500	500	500	500	500	500
Safety factor	$\gamma_{M,s}$	[mm²]	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	87,4	136,6	136,6
Calculated bonding resistance	f_{bd}	[N/mm²]	2,70	2,70	2,70	2,70	2,70	2,70
Diameter of the drilled hole	d_h	[mm]	12	14	16	18	20	25
Spacing between bars ≥	s	[mm]	50	50	60	80	100	100
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]					
150,0	10,2					
182,0	12,4	15,4				
218,0	14,8	18,5	22,2			
254,0	17,2	21,5	25,9	30,2		
290,0	19,7	24,6	29,5	34,4	39,4	
300,0	20,4	25,4	30,5	35,6	40,7	
315,0	21,4	26,7	32,1	37,4	42,8	
360,0	**21,9**	30,5	36,6	42,8	48,9	
363,0	**21,9**	30,8	36,9	43,1	49,3	61,6
400,0	**21,9**	33,9	40,7	47,5	54,3	67,9
450,0		**34,1**	45,8	53,4	61,1	76,3
500,0		**34,1**	**49,2**	59,4	67,9	84,8
600,0			**49,2**	**66,9**	81,4	101,8
700,0				**66,9**	**87,4**	118,8
800,0					**87,4**	135,7
1000,0						**136,6**
Length for reaching the yield stress of the steel, $L_{b,rqd}$ [mm]	**322**	**403**	**483**	**564**	**644**	**805**

Area not permitted

Yield stress area of the bar

Values shaded in blue are not valid for overlap bonds

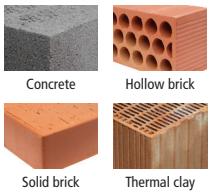
* For C50/60 concrete (f_{bd} = 2,3 N/mm²), good bond conditions, α_6=1 and rebar (f_{yk} = 500 N/mm²)

MO-VS

RANGE

VINYL ESTER STYRENE-FREE

CODE	DIMENSION	
NORMAL		
MOVS300	300 ml	12
MOVS410	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
MOTN12080	12 x 80
MOTN15085	15 x 85
MOTN15130	15 x 130
MOTN20085	20 x 85

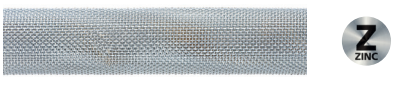
MO-AC Mixing tubes and miscellaneous

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

MO-ES Threaded stud

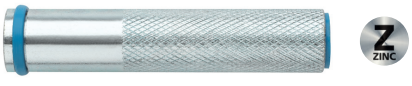
CODE	DIMENSION
MOES06070	M6 x 70
MOES08110	M8 x 110
MOES10115	M10 x 115
MOES12110	M12 x 110

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

M0-VS

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

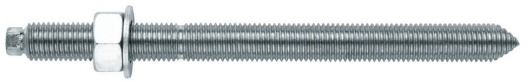
EQ-A2 Stainless steel A2

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