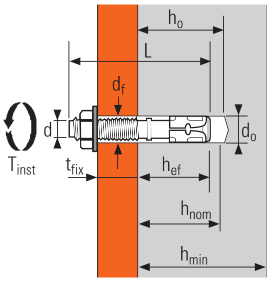
TRUBOLT

Zinc Coated Steel

Torque controlled expansion anchor, made of steel for use in non-cracked concrete

Performance	Material	Installation



Pre-assembled anchor

MATERIAL

Bolt M8-20:
Cold formed Carbon Steel

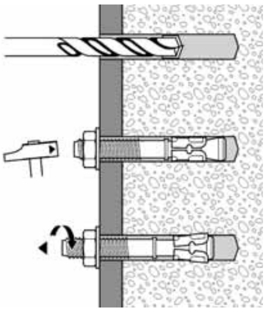
Sleeve:
Cold formed Carbon Steel

Washer:
Steel

Hexagonal nut:
Steel strength grade 6

Coating:
Zinc electroplated (5µm)

INSTALLATION



Technical Data

TRUBOLT	Minimum anchor depth				Maximum anchor depth									
	Min anchor depth (mm)	Max thick of fixture (mm)	Min drill depth (mm)	Min thick of base material (mm)	Max anchor depth (mm)	Max thick of fixture (mm)	Min drill depth (mm)	Min thick of base material (mm)	Ø Thread (mm)	Ø Drill bit (mm)	Total rod length (mm)	Max tighten torque (Nm)	Ramset power tool code	Drill bit type-size
	$h_{ef,min}$	t_{fix}	h_o	h_{min}	$h_{ef,max}$	t_{fix}	h_o	h_{min}	d	h_o	L	T_{inst}		
T06055	30	8	45	70	-	-	-	-	6	6	55	10	DD527	PLUS-6
T06085		38			40	28	55	85			85			
T06120		73				63					120			
T08065	35	10	50	75	-	-	-	-	8	8	65	20	DD527	PLUS-8
T08090		35			48	22	65	100			90			
T08120		65				52					120			
T10075	42	10	60	90	-	-	-	-	10	10	75	35	DD527	PLUS-10
T10090		25			50	17	65	100			90			
T10120		55				47					120			
T12080	50	8	70	100	-	-	-	-	12	12	80	50	DD527	PLUS-12
T12100		21			-	-	-	-			100			
T12120		43			70	23	95	145			120			
T12140		61				41					140			
T12180		101				81					180			
T16100	64	3	90	128	-	-	-	-	16	16	100	155	DD543	PLUS-16
T16125		21			-	-	-	-			125			
T16150		46			84	26	115	175			150			
T16175		71				51					175			
T20120	78	7	105	148	-	-	-	-	20	20	120	220	DD543	PLUS-20
T20160		37			103	12	130	195			160			
T20215		92				67					200			

Anchor Mechanical Properties

CARBON STEEL	M6	M8	M10	M12	M16	M20
f_{uk} (N/mm2) Min. tensile strength	570	540	470	410	370	450
f_{yk} (N/mm2) Yield strength	460	430	380	330	290	360
A_s (mm2) Stressed cross-section	20.1	36.6	58.0	84.3	157.0	245.0
W_{el} (mm3) Elastic section modulus	12.7	31.2	62.3	109.2	277.5	540.9
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	9	22	45	79	166	325
M (Nm) Recommended bending moment	3.7	9.0	18.4	32.2	67.8	132.7

TRUBOLT

Zinc Coated Steel

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
$N_{Ru,m}$ (kN)	9.3	12.5	20.2	24.6	40.7	56.3
N_{Rk} (kN)	5.3	9.8	13.5	19.2	31.3	39.3
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
$N_{Ru,m}$ (kN)	12.3	19.0	21.1	43.0	47.2	68.5
N_{Rk} (kN)	6.2	13.7	17.9	27.1	41.6	61.5

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
$V_{Ru,m}$ (kN)	7.1	12.3	16.9	21.4	36.0	56.1
V_{Rk} (kN)	5.7	9.8	13.5	17.1	28.8	44.9

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Mc,N}}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE

Anchor size	M6	M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
N_{Rd} (kN)	2.9	6.6	9.0	12.8	20.9	26.2
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
N_{Rd} (kN)	3.4	9.1	11.9	18.0	27.8	41.0

$\gamma_{Mc,N}$ = 1.8/1.5

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
V_{Rd} (kN)	3.8	6.5	9.0	11.4	19.2	29.9

$\gamma_{Ms,V}$ = 1.5

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Mc,N} \cdot \gamma_F}$$

$$V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
N_{rec} (kN)	2.1	4.7	6.4	9.2	14.9	18.7
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	68	84	103
N_{rec} (kN)	2.5	6.5	8.5	12.9	19.8	29.3

γ_F = 1.4

$\gamma_{Mc,N}$ = 1.8/1.5

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
V_{rec} (kN)	2.7	4.7	6.4	8.1	13.7	21.4

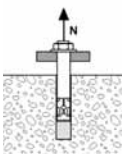
γ_F = 1.4

$\gamma_{Ms,V}$ = 1.5

TRUBOLT
Zinc Coated Steel

CC-Method

TENSILE in kN

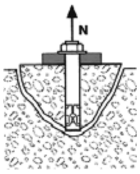


Pull-out resistance
Concrete strength 30 N/mm²

$N_{Rd,p} = N^0_{Rd,p} \cdot f_B \cdot f_T$

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
Design pull-out resistance						
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
$N^0_{Rd,p}$ (kN)	2.9	6.6	9.0	12.8	20.9	26.2
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
$N^0_{Rd,p}$ (kN)	3.4	9.1	11.9	18.0	27.8	41.0

$\gamma_{Mc,N}$ = 1.8/1.5

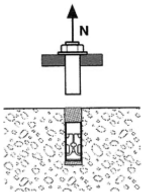


Concrete cone resistance
Concrete strength 30 N/mm²

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
Design cone resistance						
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
$N^0_{Rd,c}$ (kN)	5.1	6.4	8.4	10.9	15.7	21.2
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
$N^0_{Rd,c}$ (kN)	7.8	10.2	10.9	18.0	23.7	32.1

$\gamma_{Mc,N}$ = 1.8

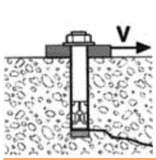


Steel resistance

$N_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
Steel design tensile resistance						
$N_{Rd,s}$ (kN)	7.6	13.2	18.2	23.0	38.7	73.5

$\gamma_{Ms,N}$ = 1.5

SHEAR in kN

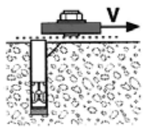


Concrete edge resistance
Concrete strength 30 N/mm²

$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$

$V^0_{Rd,c}$ Anchor size	M6	M8	M10	M12	M16	M20
Design concrete edge resistance at a minimum edge distance (c_{min})						
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
c_{min}	40	55	65	100	100	115
s_{min}	40	55	75	78	100	115
$V^0_{Rd,c}$ (kN)	2.0	3.6	5.1	10.6	12.1	16.7
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
c_{min}	45	60	65	85	110	125
s_{min}	40	50	55	75	95	100
$V^0_{Rd,c}$ (kN)	2.5	4.3	5.3	8.9	14.8	20.0

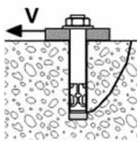
$\gamma_{Mc,V}$ = 1.5



Steel resistance

$V_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
Steel resistance shear resistance						
$V_{Rd,s}$ (kN)	3.8	6.5	9.0	11.4	19.2	29.9

$\gamma_{Ms,V}$ = 1.5



Concrete pry-out failure
Concrete Strength 30 N/mm²

$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp}$ Anchor size	M6	M8	M10	M12	M16	M20
Design pry-out resistance						
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
$V^0_{Rd,cp}$ (kN)	6.1	7.6	10.0	13.0	37.8	50.8
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
$V^0_{Rd,cp}$ (kN)	9.3	12.3	13.0	43.2	56.8	77.1

$\gamma_{Mc,V}$ = 1.5

$N_{Rd} = \min (N_{Rd,p} \, ; N_{Rd,c} \, ; N_{Rd,s})$
$\beta N = N_{Sd} / N_{Rd} \leq 1$

$V_{Rd} = \min (V_{Rd,c} \, ; V_{Rd,s} \, ; V_{Rd,cp})$
$\beta V = V_{Sd} / V_{Rd} \leq 1$

$\beta N + \beta V \leq 1.2$

f_B INFLUENCE OF CONCRETE

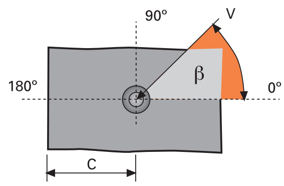
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$$f_T = \left(\frac{h_{act}}{h_{ef,min}}\right)^{1.5} \quad \text{where: } h_{ef,min} \leq h_{act} \leq h_{ef,max}$$

$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

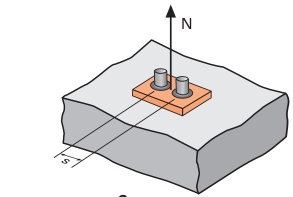
Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0



MECHANICAL ANCHORS

CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0.5 + \frac{s}{6h_{ef}}$$

$s_{min} < s < s_{cr,N}$

$s_{cr,N} = 3h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

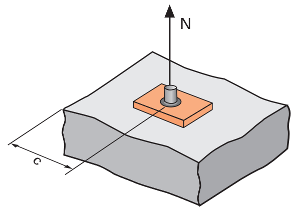
Spacing, s — Reduction Factor Ψ_s — Minimum anchorage depth

Spacing, s	M6	M8	M10	M12	M16	M20
30	0.69					
40	0.72	0.69				
50	0.78	0.74	0.70			
60	0.83	0.79	0.74	0.70		
75	0.92	0.86	0.81	0.75	0.70	
90	1.00	0.93	0.86	0.80	0.73	0.69
105		1.00	0.92	0.85	0.77	0.72
125			1.00	0.92	0.83	0.77
150				1.00	0.89	0.82
195					1.00	0.92
235						1.00

Spacing, s — Reduction Factor Ψ_s — Maximum anchorage depth

Spacing, s	M6	M8	M10	M12	M16	M20
45	0.69					
55	0.73	0.69				
60	0.75	0.71	0.70			
80	0.83	0.78	0.77	0.69		
95	0.90	0.83	0.82	0.73	0.69	
115	0.98	0.90	0.88	0.77	0.73	
120	1.00	0.92	0.90	0.79	0.74	0.69
145		1.00	0.98	0.85	0.79	0.73
150			1.00	0.86	0.80	0.74
210				1.00	0.92	0.84
250					1.00	0.90
310						1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_{c,N} = 0.23 + 0.51 \cdot \frac{c}{h_{ef}}$$

$c_{min} < c < c_{cr,N}$

$c_{cr,N} = 1.5 \cdot h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group

Edge, c — Reduction Factor $\Psi_{c,N}$ — Minimum anchorage depth

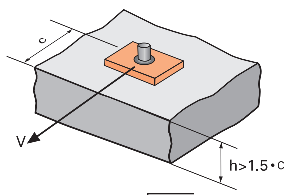
Edge, c	M6	M8	M10	M12	M16	M20
40	1.00					
55		1.00				
75			1.00			
100				1.00	1.00	
115						1.00

$\Psi_{c,N,min}$ = 1.0, no reduction is permitted

Edge, c — Reduction Factor $\Psi_{c,N}$ — Maximum anchorage depth

Edge, c	M6	M8	M10	M12	M16	M20
50	0.87					
60	1.00	0.87				
63		0.90	0.87			
70		0.97	0.94			
72		1.00	0.96			
75			1.00			
88				0.87		
105				1.00	0.87	
110					0.90	
126					1.00	0.85
155						1.00

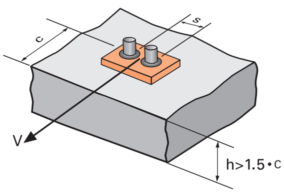
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



$$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR SINGLE ANCHOR FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Non-cracked concrete

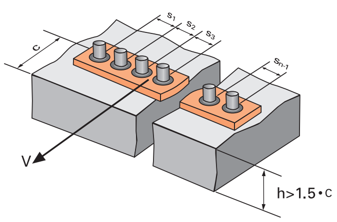
$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$$\Psi_{s\text{-}c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



FOR OTHER CASE OF FASTENINGS

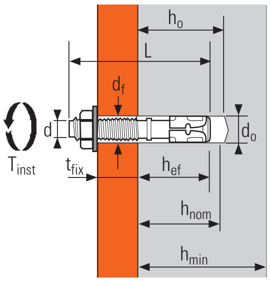
$$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + \ldots + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

TRUBOLT

Stainless Steel (SUS316)

Torque controlled expansion anchor, made of steel for use in non-cracked concrete

Performance	Material	Installation



Pre-assembled anchor

MATERIAL

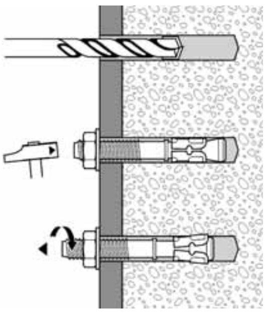
Bolt M8-20:
SUS316

Sleeve:
Cold formed SUS316

Washer:
SUS316

Hexagonal nut:
SUS316

INSTALLATION



Technical Data

TRUBOLT	Minimum anchor depth				Maximum anchor depth									
	Min anchor depth (mm)	Max thick of fixture (mm)	Min drill depth (mm)	Min thick of base material (mm)	Max anchor depth (mm)	Max thick of fixture (mm)	Min drill depth (mm)	Min thick of base material (mm)	Ø Thread (mm)	Ø Drill bit (mm)	Total rod length (mm)	Max tighten torque (Nm)	Ramset power tool code	Drill bit type-size
	$h_{ef,min}$	t_{fix}	h_o	h_{min}	$h_{ef,max}$	t_{fix}	h_o	h_{min}	d	h_o	L	T_{inst}		
T06055SS	30	8	45	70	40	-	55	85	6	6	55	10	DD527	PLUS-6
T06085SS		38				28					85			
T08065SS	35	10	50	75	-	-	-	-	8	8	65	20	DD527	PLUS-8
T08090SS		35			48	22	65	100			90			
T08120SS		65				52					120			
T10075SS	42	10	60	90	-	-	-	-	10	10	75	35	DD527	PLUS-10
T10090SS		25			50	17	65	100			90			
T10120SS		55				47					120			
T12080SS	50	8	70	100	-	-	-	-	12	12	80	50	DD527	PLUS-12
T12100SS		21			-	-	-	-			100			
T12120SS		43			70	23	95	145			120			
T12140SS		61				41					140			
T16100SS	64	3	90	128	-	-	-	-	16	16	100	155	DD543	PLUS-16
T16125SS		21			-	-	-	-			125			
T16150SS		46			84	26	115	175			150			
T16175SS		71				51					175			
T20120SS	78	7	105	148	-	-	-	-	20	20	120	220	DD543	PLUS-20
T20160SS		37			103	12	130	195			160			

Anchor Mechanical Properties

STAINLESS STEEL	M6	M8	M10	M12	M16	M20
f_{uk} (N/mm²) Min. tensile strength	590	600	600	600	600	600
f_{yk} (N/mm²) Yield strength	470	480	480	480	480	480
A_s (mm²) Stressed cross-section	20.1	36.6	58.0	84.3	157.0	245.0
W_{el} (mm³) Elastic section modulus	12.7	31.2	62.3	109.2	277.5	540.9
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	9	22	45	79	166	325
M (Nm) Recommended bending moment	3.7	9.0	18.4	32.2	67.8	132.7

TRUBOLT

Stainless Steel (SUS316)

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
$N_{Ru,m}$ (kN)	9.3	12.0	17.9	26.3	27.7	42.0
N_{Rk} (kN)	3.8	7.4	10.3	20.2	22.1	34.3
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
$N_{Ru,m}$ (kN)	11.7	18.2	21.3	27.0	55.0	65.7
N_{Rk} (kN)	6.1	12.6	12.8	22.4	41.0	45.6

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
$V_{Ru,m}$ (kN)	5.0	9.8	16.9	23.6	58.4	91.1
V_{Rk} (kN)	4.0	7.8	13.5	18.9	46.7	72.9

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Mc,N}}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE

Anchor size	M6	M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
N_{Rd} (kN)	2.1	4.1	5.7	11.2	12.3	19.1
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
N_{Rd} (kN)	3.4	7.0	7.1	12.4	22.8	25.3

$\gamma_{Mc,N} = 1.8$

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
V_{Rd} (kN)	2.7	5.2	9.0	12.6	31.1	48.6

$\gamma_{Ms,V} = 1.5$

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Mc,N} \cdot \gamma_F}$$

$$V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
N_{rec} (kN)	1.5	2.9	4.1	8.0	8.8	13.6
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	68	84	103
N_{rec} (kN)	2.4	5.0	5.1	8.9	16.3	18.1

$\gamma_F = 1.4$

$\gamma_{Mc,N} = 1.8$

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
V_{rec} (kN)	1.9	3.7	6.4	9.0	22.2	34.7

$\gamma_F = 1.4$

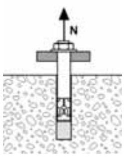
$\gamma_{Ms,V} = 1.5$

TRUBOLT

Stainless Steel (SUS316)

CC-Method

TENSILE in kN

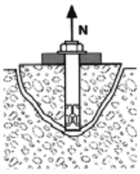


Pull-out resistance
Concrete strength 30 N/mm²

$N_{Rd,p} = N^0_{Rd,p} \cdot f_B \cdot f_T$

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design pull-out resistance					
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
$N^0_{Rd,p}$ (kN)	2.1	4.1	5.7	11.2	12.3	19.1
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
$N^0_{Rd,p}$ (kN)	3.4	7.0	7.1	12.4	22.8	25.3

$\gamma_{Mc,N} = 1.8$

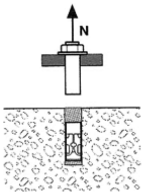


Concrete cone resistance
Concrete strength 30 N/mm²

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design cone resistance					
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
$N^0_{Rd,c}$ (kN)	5.1	6.4	8.4	10.9	15.7	21.2
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
$N^0_{Rd,c}$ (kN)	7.8	10.2	10.9	18.0	23.7	32.1

$\gamma_{Mc,N} = 1.8$



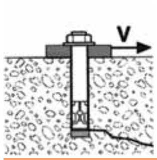
Steel resistance

$N_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
	Steel design tensile resistance					
$N_{Rd,s}$ (kN)	7.9	14.6	23.2	33.7	62.8	98.0

$\gamma_{Ms,N} = 1.5$

$N_{Rd} = \min (N_{Rd,p} ; N_{Rd,c} ; N_{Rd,s})$
$\beta N = N_{Sd} / N_{Rd} \leq 1$

SHEAR in kN

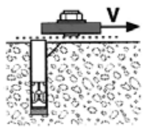


Concrete edge resistance
Concrete strength 30 N/mm²

$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$

$V^0_{Rd,c}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design concrete edge resistance at a minimum edge distance (c_{min})					
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
c_{min}	40	55	65	100	100	115
s_{min}	40	55	75	78	100	115
$V^0_{Rd,c}$ (kN)	2.0	3.6	5.1	10.6	12.1	16.7
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
c_{min}	45	60	65	85	110	125
s_{min}	40	50	55	75	95	100
$V^0_{Rd,c}$ (kN)	2.5	4.3	5.3	8.9	14.8	20.0

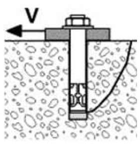
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
	Steel resistance shear resistance					
$V_{Rd,s}$ (kN)	2.7	5.2	9.0	12.6	31.1	48.6

$\gamma_{Ms,V} = 1.5$



Concrete pry-out failure
Concrete Strength 30 N/mm²

$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design pry-out resistance					
Minimum anchorage depth						
h_{ef} (mm)	30	35	42	50	64	78
$V^0_{Rd,cp}$ (kN)	6.1	7.6	10.0	13.0	37.8	50.8
Maximum anchorage depth						
h_{ef} (mm)	40	48	50	70	84	103
$V^0_{Rd,cp}$ (kN)	9.3	12.3	13.0	43.2	56.8	77.1

$\gamma_{Mc,V} = 1.5$

$V_{Rd} = \min (V_{Rd,c} ; V_{Rd,s} ; V_{Rd,cp})$
$\beta V = V_{Sd} / V_{Rd} \leq 1$

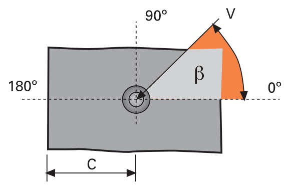
$\beta N + \beta V \leq 1.2$

f_B INFLUENCE OF CONCRETE

Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0

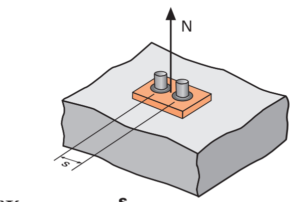


f_T INFLUENCE OF EMBEDMENT DEPTH

$f_T = \left(\frac{h_{act}}{h_{ef,min}}\right)^{1.5}$ where: $h_{ef,min} \leq h_{act} \leq h_{ef,max}$

CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$\Psi_s = 0.5 + \frac{s}{6h_{ef}}$

$s_{min} < s < s_{cr,N}$

$s_{cr,N} = 3h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

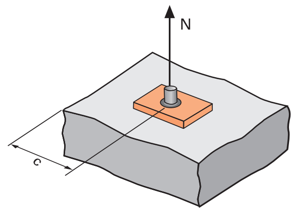
Spacing, s — Reduction Factor Ψ_s — Minimum anchorage depth

	M6	M8	M10	M12	M16	M20
35	0.69					
40	0.72	0.69				
50	0.78	0.74	0.70			
60	0.83	0.79	0.74	0.70		
75	0.92	0.86	0.80	0.75	0.70	
90	1.00	0.93	0.86	0.80	0.73	0.69
105		1.00	0.92	0.85	0.77	0.72
125			1.00	0.92	0.83	0.77
150				1.00	0.89	0.82
195					1.00	0.92
235						1.00

Spacing, s — Reduction Factor Ψ_s — Maximum anchorage depth

	M6	M8	M10	M12	M16	M20
45	0.69					
55	0.73	0.69				
60	0.75	0.71	0.70			
80	0.83	0.78	0.77	0.69		
95	0.90	0.83	0.82	0.73	0.69	
115	0.98	0.90	0.88	0.77	0.73	
120	1.00	0.92	0.90	0.79	0.74	0.69
145		1.00	0.98	0.85	0.79	0.73
150			1.00	0.86	0.80	0.74
210				1.00	0.92	0.84
250					1.00	0.90
310						1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$\Psi_{c,N} = 0.23 + 0.51 \cdot \frac{c}{h_{ef}}$

$c_{min} < c < c_{cr,N}$

$c_{cr,N} = 1.5 \cdot h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group

Edge, c — Reduction Factor $\Psi_{c,N}$ — Minimum anchorage depth

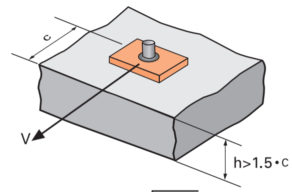
	M6	M8	M10	M12	M16	M20
40	1.00					
55		1.00				
75			1.00			
100				1.00	1.00	
115						1.00

$\Psi_{c,N,min}$ = 1.0, no reduction is permitted

Edge, c — Reduction Factor $\Psi_{c,N}$ — Maximum anchorage depth

	M6	M8	M10	M12	M16	M20
50	0.87					
60	1.00	0.87				
63		0.90	0.87			
70		0.97	0.94			
72		1.00	0.96			
75			1.00			
88				0.87		
105				1.00	0.87	
110					0.90	
126					1.00	0.85
155						1.00

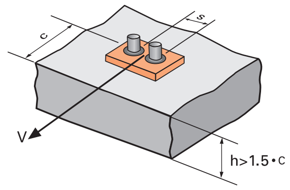
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$

FOR SINGLE ANCHOR FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Non-cracked concrete

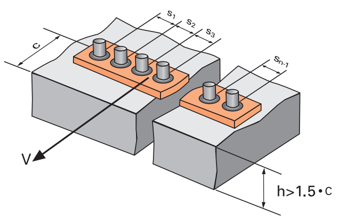
$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$\Psi_{s\text{-}c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



FOR OTHER CASE OF FASTENINGS

$$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + \ldots + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$