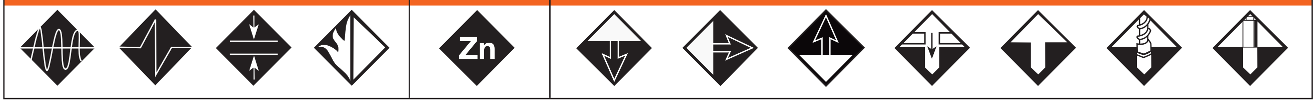
TRIGA Z (TYPE V)

Zinc Coated Steel

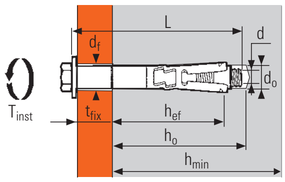
Torque controlled expansion anchor, made of zinc coated steel for use in cracked and non-cracked concrete

Performance	Material	Installation



ETA Option 1

n° 05/0044



MATERIAL

Bolt M8-20:
Steel grade 8.8

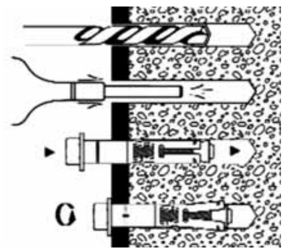
Washer:
Steel

Sleeve:
Steel

Expansion cone:
Steel

Coating:
Zinc coated (5µm)

INSTALLATION



Technical Data

Triga Z	Min anchor depth (mm)	Max thick of fixture (mm)	Min thick of base material (mm)	Ø Thread (mm)	Drill depth (mm)	Ø Drill bit (mm)	Ø Hole clearance (mm)	Total anchor length (mm)	Max tighten torque (Nm)	Ramset power tool code	Drill bit type-size
	h_{ef}	t_{fix}	h_{min}	d	h_o	d_o	d_f	L	T_{inst}		
V6-10/5	50	5	100	M6	70	10	12	65	10	DD527	R3 PLUS-10
V6-10/20		20						80			
V8-12/1*	60	1	120	M8	80	12	14	65	25	DD527	R3 PLUS-12
V8-12/10		10						80			
V8-12/20		20						90			
V8-12/50		50						120			
V10-15/1*	70	1	140	M10	90	15	17	75	50	DD527	R3 PLUS-15
V10-15/10		10						95			
V10-15/20		20						105			
V10-15/55		55						140			
V12-18/10	80	10	160	M12	105	18	20	105	80	DD543	R3 PLUS-18
V12-18/25		25						120			
V12-18/55		55						150			
V16-24/10	100	10	200	M16	131	24	26	130	120	DD565	R3 MAX-24
V16-24/25		25						145			
V16-24/50		50						170			
V20-28/25	125	25	250	M20	157	28	31	170	200	DD565	R3 MAX-28

*do not have ETA

Anchor Mechanical Properties

CARBON STEEL	M6	M8	M10	M12	M16	M20
$\mathbf{f_{uk}}$ (N/mm2) Min. tensile strength	800	800	800	800	800	830
$\mathbf{f_{yk}}$ (N/mm2) Yield strength	640	640	640	640	640	660
$\mathbf{S_{eq,V}}$ (N/mm2) Equivalent stressed cross-section	39.2	76.1	108.8	175.3	335.1	520.2
$\mathbf{W_{el}}$ (mm3) Elastic section modulus	12.7	31.2	62.3	109.2	277.5	541.0
$\mathbf{M^0_{Rk,s}}$ (Nm) Characteristic bending moment	12.2	30.0	59.8	104.8	266.4	538.8
M (Nm) Recommended bending moment	5.8	12.4	24.8	43.5	110.7	216.0

TRIGA Z (TYPE V)

Zinc Coated Steel

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
$N_{Ru,m}$ (kN)	20.0	30.3	50.5	59.8	114.0	136.8
N_{Rk} (kN)	17.6	21.9	39.6	37.6	68.1	94.5

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
$V_{Ru,m}$ (kN)	32.1	45.9	74.8	105.3	174.9	251.0
V_{Rk} (kN)	28.5	42.5	64.7	91.6	155.8	226.6

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
N_{Rd} (kN)	11.7	14.6	26.4	25.1	45.4	63.0

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
V_{Rd} (kN)	22.8	34.0	51.7	73.3	124.6	181.3

$\gamma_{Ms,V} = 1.25$

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
N_{rec} (kN)	8.4	10.4	18.9	17.9	32.4	45.0

$\gamma_F = 1.4$

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
V_{rec} (kN)	16.3	24.3	37.0	52.4	89.0	129.5

$\gamma_F = 1.4$

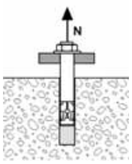
$\gamma_{Ms,V} = 1.25$

TRIGA Z (TYPE V)

Zinc Coated Steel

CC-Method - Non cracked concrete

TENSILE in kN

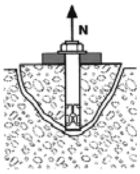


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design pull-out resistance					
h_{ef} (mm)	50	60	70	80	100	125
$N^0_{Rd,p}$ (kN)	-	14.6	-	-	-	-

$\gamma_{Mc,N} = 1.5$

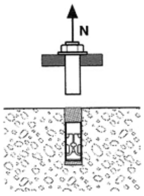


Concrete cone resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design cone resistance					
h_{ef} (mm)	50	60	70	80	100	125
$N^0_{Rd,c}$ (kN)	13.1	17.2	21.7	26.4	37.0	51.7

$\gamma_{Mc,N} = 1.5$

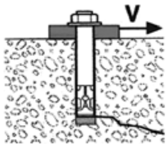


Steel resistance

$N_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
	Steel design tensile resistance					
$N_{Rd,s}$ (kN)	10.7	19.5	30.9	44.9	83.7	130.7

$\gamma_{Ms,N} = 1.5$

SHEAR in kN

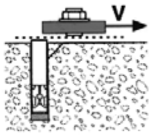


Concrete edge resistance
Concrete strength 30 N/mm²

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

$V^0_{Rd,c}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design concrete edge resistance at a minimum edge distance (c_{min})					
h_{ef} (mm)	50	60	70	80	100	125
c_{min}	50	60	70	80	100	150
s_{min}	100	100	160	200	220	300
$V^0_{Rd,c}$ (kN)	3.7	5.4	7.5	10.2	15.0	28.7

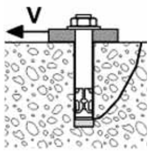
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
	Steel design shear resistance					
$V_{Rd,s}$ (kN)	18.7	26.1	39.3	58.2	93.8	138.8

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure

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

$V^0_{Rd,cp}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design pry-out resistance					
h_{ef} (mm)	50	60	70	80	100	125
$V^0_{Rd,cp}$ (kN)	13.1	34.3	43.3	52.9	73.9	103.3

$\gamma_{Mc,V} = 1.5$

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

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

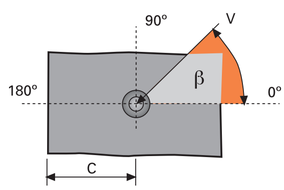
$\beta N + \beta V \leq 1.2$

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

$f_{\beta,V}$ 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

TRIGA Z (TYPE V)

Zinc Coated Steel

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
$N_{Ru,m}$ (kN)	16.6	22.3	36.6	55.3	97.4	124.6
N_{Rk} (kN)	12.7	16.3	29.2	40.3	77.4	99.1

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
$V_{Ru,m}$ (kN)	32.1	45.9	74.8	105.3	174.9	251.0
V_{Rk} (kN)	28.5	42.5	64.7	91.6	155.8	226.6

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
N_{Rd} (kN)	8.4	10.9	19.4	26.8	51.6	66.1

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
V_{Rd} (kN)	22.8	34.0	51.7	73.3	124.6	181.3

$\gamma_{Ms,V} = 1.25$

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
N_{rec} (kN)	6.0	7.8	13.9	19.2	36.9	47.2

$\gamma_F = 1.4$

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
V_{rec} (kN)	16.3	24.3	37.0	52.4	89.0	129.5

$\gamma_F = 1.4$

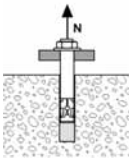
$\gamma_{Ms,V} = 1.25$

TRIGA Z (TYPE V)

Zinc Coated Steel

CC-Method - Cracked concrete

TENSILE in kN

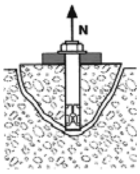


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$	Design pull-out resistance					
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
h_{ef} (mm)	50	60	70	80	100	125
$N^0_{Rd,p}$ (kN)	3.6	8.8	11.7	-	-	-

$\gamma_{Mc,N} = 1.5$

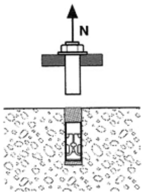


Concrete cone resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$	Design cone resistance					
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
h_{ef} (mm)	50	60	70	80	100	125
$N^0_{Rd,c}$ (kN)	9.4	12.3	15.5	18.9	26.4	36.9

$\gamma_{Mc,N} = 1.5$

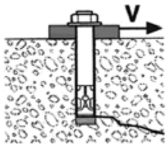


Steel resistance

$N_{Rd,s}$	Steel design tensile resistance					
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
$N_{Rd,s}$ (kN)	10.7	19.5	30.9	44.9	83.7	130.7

$\gamma_{Ms,N} = 1.5$

SHEAR in kN

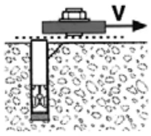


Concrete edge resistance
Concrete strength 30 N/mm²

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

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})					
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
h_{ef} (mm)	50	60	70	80	100	125
c_{min}	250	60	70	80	100	150
s_{min}	100	100	160	200	220	300
$V^0_{Rd,c}$ (kN)	2.6	3.9	5.3	7.3	10.7	20.6

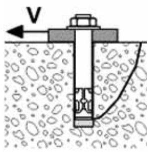
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$	Steel design shear resistance					
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
$V_{Rd,s}$ (kN)	18.7	26.1	39.3	58.2	93.8	138.8

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure

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

$V^0_{Rd,cp}$	Design pry-out resistance					
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
h_{ef} (mm)	50	60	70	80	100	125
$V^0_{Rd,cp}$ (kN)	9.4	24.5	30.9	37.7	52.8	73.8

$\gamma_{Mc,V} = 1.5$

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

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

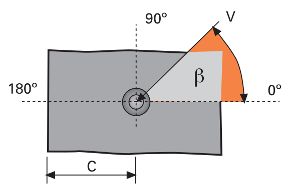
$\beta N + \beta V \leq 1.2$

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

$f_{\beta,V}$ 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

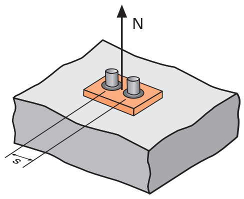


TRIGA Z (TYPE V)

Zinc Coated Steel

CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



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

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

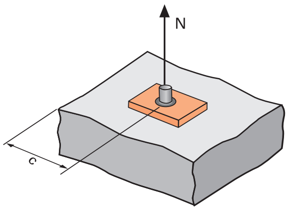
$s_{cr,N} = 3h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

Spacing, s — Reduction Factor Ψ_s — Cracked and non-cracked concrete

	M6	M8	M10	M12	M16	M20
50	0.67					
60	0.70	0.67				
70	0.73	0.69	0.67			
80	0.77	0.72	0.69	0.67		
100	0.83	0.78	0.74	0.71	0.67	
125	0.92	0.85	0.80	0.76	0.71	0.67
150	1.00	0.92	0.86	0.81	0.75	0.70
180		1.00	0.93	0.88	0.80	0.74
210			1.00	0.94	0.85	0.78
240				1.00	0.90	0.82
300					1.00	0.90
375						1.00

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



$\Psi_{c,N} = 0.25 + 0.5 \cdot \frac{c}{h_{ef}}$

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

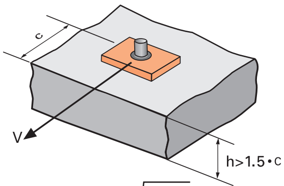
$c_{cr,N} = 1.5 \cdot h_{ef}$

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

Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked and non-cracked concrete

	M6	M8	M10	M12	M16	M20
50	0.75					
60	0.85	0.75				
70	0.95	0.83	0.75			
80	1.00	0.92	0.83	0.75		
90		1.00	0.89	0.81		
100			0.96	0.88	0.75	
120			1.00	1.00	0.85	0.73
150					1.00	0.85
170						0.93
190						1.00

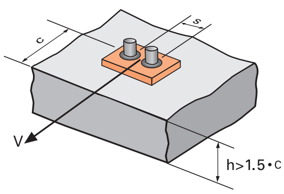
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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

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

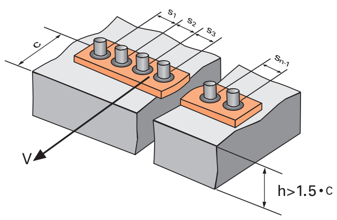
$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Cracked and 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



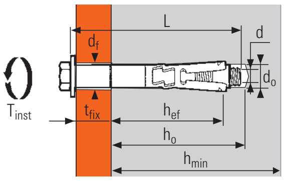
FOR OTHER CASE OF FASTENINGS

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

TRIGA Z (TYPE V)

Stainless Steel (A4)

Performance	Material	Installation
	A4 316	



MATERIAL

Bolt M8-16:
Steel grade A4

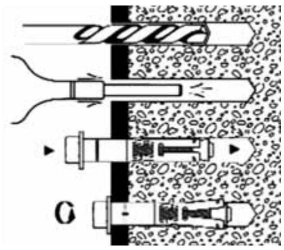
Washer:
A4

Sleeve:
A4

Expansion cone:
A4

Expansion sleeve:
A4

INSTALLATION



Technical Data

Triga Z	Min anchor depth (mm)	Max thick of fixture (mm)	Min thick of base material (mm)	Ø Thread (mm)	Drill depth (mm)	Ø Drill bit (mm)	Ø Hole clearance (mm)	Total anchor length (mm)	Max tighten torque (Nm)	Ramset power tool code	Drill bit type-size
	h_{ef}	t_{fix}	h_{min}	d	h_o	d_o	d_f	L	T_{inst}		
V6-10/10	50	10	100	M6	70	10	12	70	10	DD527	R3 PLUS-10
V8-12/10	60	10	120	M8	80	12	14	80	25	DD527	R3 PLUS-12
V8-12/25		25						100			
V10-15/25	70	25	140	M10	90	15	17	115	50	DD527	R3 PLUS-15
V12-18/25	80	25	160	M12	105	18	20	120	80	DD543	R3 PLUS-18

Anchor Mechanical Properties

STAINLESS STEEL A4	M6	M8	M10	M12
f_{uk} (N/mm2) Min. tensile strength	800	800	800	800
f_{yk} (N/mm2) Yield strength	600	600	600	600
$S_{eq,V}$ (N/mm2) Equivalent stressed cross-section	39.2	76.1	108.8	175.3
W_{el} (mm3) Elastic section modulus	12.7	31.2	62.3	109.2
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	12.2	30.0	59.8	104.8
M (Nm) Recommended bending moment	5.8	12.4	24.8	43.5

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12
h_{ef} (mm)	50	60	70	80
$N_{Ru,m}$ (kN)	18.4	24.6	42.6	45.4
N_{Rk} (kN)	17.6	18.7	28.6	30.8

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12
$V_{Ru,m}$ (kN)	29.5	41.4	77.1	74.1
V_{Rk} (kN)	23.8	34.4	64.2	66.1

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12
h_{ef} (mm)	50	60	70	80
N_{Rd} (kN)	11.7	12.5	19.1	20.5

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12
V_{Rd} (kN)	17.9	25.9	48.3	49.7

$\gamma_{Ms,V} = 1.33$

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12
h_{ef} (mm)	50	60	70	80
N_{rec} (kN)	8.4	8.9	13.6	14.7

$\gamma_F = 1.4$

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12
V_{rec} (kN)	12.8	18.5	34.5	35.5

$\gamma_F = 1.4$

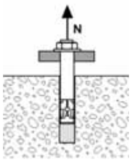
$\gamma_{Ms,V} = 1.33$

TRIGA Z (TYPE V)

Stainless Steel (A4)

CC-Method - Non cracked concrete

TENSILE in kN

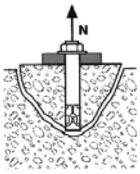


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Design pull-out resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**
h_{ef} (mm)	50	60	70	80
$N^0_{Rd,p}$ (kN)	-	11.7	14.6	18.3

$\gamma_{Mc,N} = 1.5$

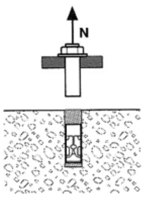


Concrete cone resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Design cone resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**
h_{ef} (mm)	50	60	70	80
$N^0_{Rd,c}$ (kN)	13.1	17.2	21.7	26.4

$\gamma_{Mc,N} = 1.5$

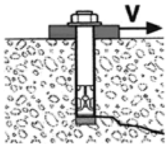


Steel resistance

$N_{Rd,s}$ Steel design tensile resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**
$N_{Rd,s}$ (Type V) (kN)	10.0	18.2	28.8	42.0

$\gamma_{Ms,N} = 1.6$

SHEAR in kN

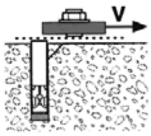


Concrete edge resistance
Concrete strength 30 N/mm²

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

$V^0_{Rd,c}$ Design concrete edge resistance at a minimum edge distance (c_{min})				
Anchor size	**M6**	**M8**	**M10**	**M12**
h_{ef} (mm)	50	60	70	80
c_{min}	50	60	70	80
s_{min}	100	100	160	200
$V^0_{Rd,c}$ (kN)	3.7	5.4	7.5	10.2

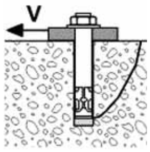
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$ Steel design shear resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**
$V_{Rd,s}$ (kN)	16.2	23.6	36.9	45.2

$\gamma_{Ms,V} = 1.33$



Concrete pry-out failure
Concrete strength 30 N/mm²

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

$V^0_{Rd,cp}$ Design pry-out resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**
h_{ef} (mm)	50	60	70	80
$V^0_{Rd,cp}$ (kN)	13.1	34.3	43.3	52.9

$\gamma_{Mc,V} = 1.5$

$N_{Rd} = \min(N_{Rd,p} ; N_{Rd,c} ; N_{Rd,s})$

$\beta N = N_{Sd} / N_{Rd} \leq 1$

$V_{Rd} = \min(V_{Rd,c} ; V_{Rd,s} ; V_{Rd,cp})$

$\beta V = V_{Sd} / V_{Rd} \leq 1$

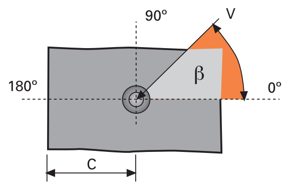
$\beta N + \beta V \leq 1.2$

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

$f_{\beta,V}$ 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



TRIGA Z (TYPE V)

Stainless Steel (A4)

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

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12
h_{ef} (mm)	50	60	70	80
$N_{Ru,m}$ (kN)	16.3	27.7	37.2	44.4
N_{Rk} (kN)	12.1	23.1	27.5	31.7

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12
$V_{Ru,m}$ (kN)	29.5	41.4	77.1	74.1
V_{Rk} (kN)	23.8	34.4	64.2	66.1

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

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

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

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12
h_{ef} (mm)	50	60	70	80
N_{Rd} (kN)	8.1	15.4	18.3	21.1

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12
V_{Rd} (kN)	17.9	25.9	48.3	49.7

$\gamma_{Ms,V} = 1.33$

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

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

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

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12
h_{ef} (mm)	50	60	70	80
N_{rec} (kN)	5.8	11.0	13.1	15.1

$\gamma_F = 1.4$

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12
V_{rec} (kN)	12.8	18.5	34.5	35.5

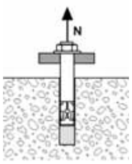
$\gamma_F = 1.4$

$\gamma_{Ms,V} = 1.33$

TRIGA Z (TYPE V)
Stainless Steel (A4)

CC-Method - Cracked concrete

TENSILE in kN

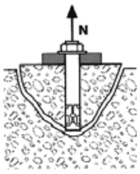


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$	Design pull-out resistance			
Anchor size	**M6**	**M8**	**M10**	**M12**
h_{ef} (mm)	50	60	70	80
$N^0_{Rd,p}$ (kN)	3.6	6.6	11.7	-

$\gamma_{Mc,N} = 1.5$

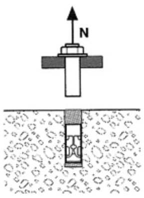


Concrete cone resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$	Design cone resistance			
Anchor size	**M6**	**M8**	**M10**	**M12**
h_{ef} (mm)	50	60	70	80
$N^0_{Rd,c}$ (kN)	9.4	12.3	15.5	18.9

$\gamma_{Mc,N} = 1.5$

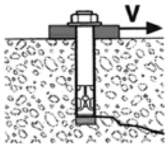


Steel resistance

$N_{Rd,s}$	Steel design tensile resistance			
Anchor size	**M6**	**M8**	**M10**	**M12**
$N_{Rd,s}$ (kN)	10.0	18.2	28.8	42.0

$\gamma_{Ms,N} = 1.6$

SHEAR in kN

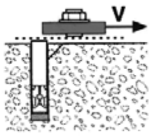


Concrete edge resistance
Concrete strength 30 N/mm²

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

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})			
Anchor size	**M6**	**M8**	**M10**	**M12**
h_{ef} (mm)	50	60	70	80
c_{min}	50	60	70	80
s_{min}	100	100	160	200
$V^0_{Rd,c}$ (kN)	2.6	3.9	5.3	7.3

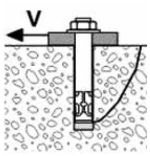
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$	Steel design shear resistance			
Anchor size	**M6**	**M8**	**M10**	**M12**
$V_{Rd,s}$ (kN)	16.2	23.6	36.9	45.2

$\gamma_{Ms,V} = 1.33$



Concrete pry-out failure
Concrete strength 30 N/mm²

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

$V^0_{Rd,cp}$	Design pry-out resistance			
Anchor size	**M6**	**M8**	**M10**	**M12**
h_{ef} (mm)	50	60	70	80
$V^0_{Rd,cp}$ (kN)	9.4	24.5	30.9	37.7

$\gamma_{Mc,V} = 1.5$

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

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

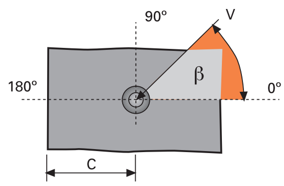
$\beta N + \beta V \leq 1.2$

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

$f_{\beta,V}$ 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

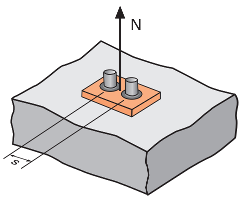


TRIGA Z (TYPE V)

Stainless Steel (A4)

CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



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

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

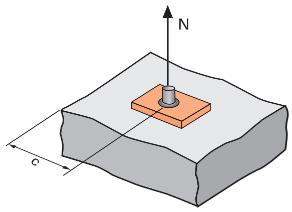
$s_{cr,N} = 3h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

Spacing, s — Reduction Factor Ψ_s — Cracked and non-cracked concrete

	M6	M8	M10	M12
50	0.67			
60	0.70	0.67		
70	0.73	0.69	0.67	
80	0.77	0.72	0.69	0.67
100	0.83	0.78	0.74	0.71
125	0.92	0.85	0.80	0.76
150	1.00	0.92	0.86	0.81
180		1.00	0.93	0.88
210			1.00	0.94
240				1.00

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



$$\Psi_{c,N} = 0.25 + 0.5 \cdot \frac{c}{h_{ef}}$$

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

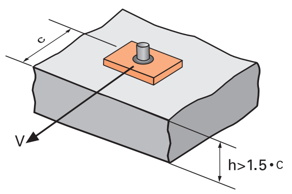
$c_{cr,N} = 1.5 \cdot h_{ef}$

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

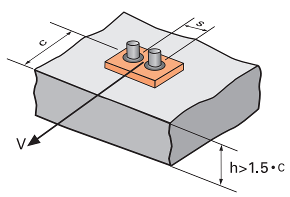
Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked and non-cracked concrete

	M6	M8	M10	M12
50	0.75			
60	0.85	0.75		
70	0.95	0.83	0.75	
80	1.00	0.92	0.82	0.75
90		1.00	0.89	0.81
100			0.96	0.88
120			1.00	1.00

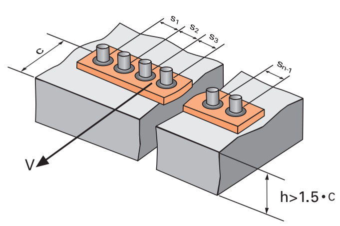
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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



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



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

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

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

s/c_{min} \ 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

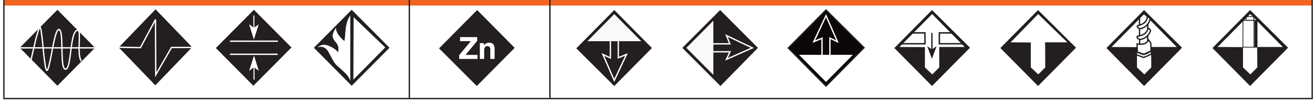
$$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + ... + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

TRIGA Z (TYPE E)

Zinc Coated Steel

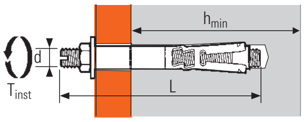
Torque controlled expansion anchor, made of zinc coated steel for use in cracked and non-cracked concrete

Performance	Material	Installation



ETA Option 1

n° 05/0044



MATERIAL

Threaded stud:
Steel grade 8.8

Hexagonal nut:
Steel grade 8.8

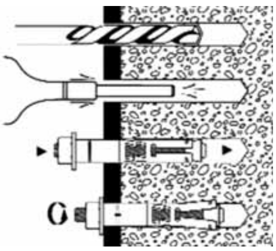
Washer:
Steel

Sleeve:
Steel

Expansion cone:
Steel

Coating:
Zinc electroplated (5µm)

INSTALLATION



Technical Data

Triga Z	Min anchor depth (mm)	Max thick of fixture (mm)	Min thick of base material (mm)	Ø Thread (mm)	Drill depth (mm)	Ø Drill bit (mm)	Ø Hole clearance (mm)	Total anchor length (mm)	Max tighten torque (Nm)	Ramset power tool code	Drill bit type-size
	h_{ef}	t_{fix}	h_{min}	d	h_o	d_o	d_f	L	T_{inst}		
E6-10/50	50	50	100	M6	70	10	12	117	10	DD527	R3 PLUS-10
E8-12/20	60	20	120	M8	80	12	14	99	25	DD527	R3 PLUS-12
E8-12/35		35						114			
E8-12/55		55						134			
E8-12/95		95						174			
E10-15/20	70	20	140	M10	90	15	17	114	50	DD527	R3 PLUS-15
E10-15/35		35						129			
E10-15/55		55						149			
E10-15/100		100						194			
E12-18/25	80	25	160	M12	105	18	20	132	80	DD543	R3 PLUS-18
E12-18/45		45						152			
E12-18/65		65						172			
E12-18/100		100						207			
E16-24/25	100	25	200	M16	131	24	26	159	120	DD565	R3 MAX-24
E16-24/55		55						189			
E16-24/100		100						234			
E20-28/25	125	25	250	M20	157	28	31	192	200	DD565	R3 MAX-28
E20-28/60		60						227			
E20-28/100		100						267			

Anchor Mechanical Properties

CARBON STEEL	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
$\mathbf{f_{uk}}$ (N/mm2) Min. tensile strength	800	800	800	800	800	830
$\mathbf{f_{yk}}$ (N/mm2) Yield strength	640	640	640	640	640	660
$\mathbf{S_{eq,E}}$ (mm2) Equivalent stressed	35.2	61.8	82.0	104.1	183.3	277.3
$\mathbf{W_{el}}$ (mm3) Elastic section modulus	12.7	31.2	62.3	109.2	277.5	541.0
$\mathbf{M^0_{Rk,s}}$ (Nm) Characteristic bending moment	12.2	30.0	59.8	104.8	266.4	538.8
M (Nm) Recommended bending moment	5.8	12.4	24.8	43.5	110.7	216.0

TRIGA Z (TYPE E)

Zinc Coated Steel

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
$N_{Ru,m}$ (kN)	20.0	30.3	50.5	59.8	114.0	136.8
N_{Rk} (kN)	17.6	21.9	39.6	37.6	68.1	94.5

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
$V_{Ru,m}$ (kN)	22.0	28.8	47.4	62.7	127.6	149.5
V_{Rk} (kN)	17.3	24.2	40.0	57.2	121.0	137.4

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
N_{Rd} (kN)	11.7	14.6	26.4	25.1	45.4	63.0

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
V_{Rd} (kN)	13.8	19.4	32.0	45.8	96.8	109.9

$\gamma_{Ms,V} = 1.25$

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
N_{rec} (kN)	8.4	10.4	18.9	17.9	32.4	45.0

$\gamma_F = 1.4$

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16	M20
V_{rec} (kN)	9.9	13.8	22.9	32.7	69.1	78.5

$\gamma_F = 1.4$

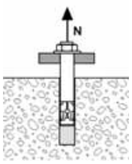
$\gamma_{Ms,V} = 1.25$

TRIGA Z (TYPE E)

Zinc Coated Steel

CC-Method - Non cracked concrete

TENSILE in kN

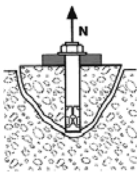


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design pull-out resistance					
h_{ef} (mm)	50	60	70	80	100	125
$N^0_{Rd,p}$ (kN)	-	14.6	-	-	-	-

$\gamma_{Mc,N} = 1.5$

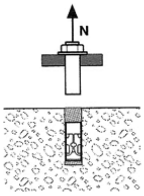


Concrete cone resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design cone resistance					
h_{ef} (mm)	50	60	70	80	100	125
$N^0_{Rd,c}$ (kN)	13.1	17.2	21.7	26.4	37.0	51.7

$\gamma_{Mc,N} = 1.5$

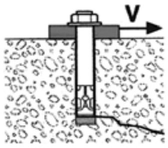


Steel resistance

$N_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
	Steel design tensile resistance					
$N_{Rd,s}$ (kN)	10.7	19.5	30.9	44.9	83.7	130.7

$\gamma_{Ms,N} = 1.5$

SHEAR in kN

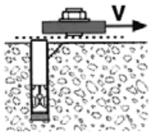


Concrete edge resistance
Concrete strength 30 N/mm²

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

$V^0_{Rd,c}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design concrete edge resistance at a minimum edge distance (c_{min})					
h_{ef} (mm)	50	60	70	80	100	125
c_{min}	50	60	70	80	100	150
s_{min}	100	100	160	200	220	300
$V^0_{Rd,c}$ (kN)	3.7	5.4	7.5	10.2	15.0	28.7

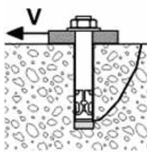
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
	Steel design shear resistance					
$V_{Rd,s}$ (kN)	11.4	15.2	24.8	37.9	74.5	87.9

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure

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

$V_{Rd,cp}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design pry-out resistance					
h_{ef} (mm)	50	60	70	80	100	125
$V^0_{Rd,cp}$ (kN)	13.1	34.3	43.3	52.9	73.9	103.3

$\gamma_{Mc,V} = 1.5$

$N_{Rd} = \min(N_{Rd,p} ; N_{Rd,c} ; N_{Rd,s})$

$\beta N = N_{Sd} / N_{Rd} \leq 1$

$V_{Rd} = \min(V_{Rd,c} ; V_{Rd,s} ; V_{Rd,cp})$

$\beta V = V_{Sd} / V_{Rd} \leq 1$

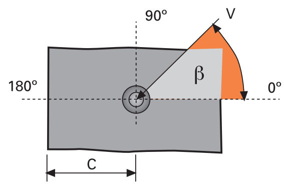
$\beta N + \beta V \leq 1.2$

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

$f_{\beta,V}$ 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



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

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
$N_{Ru,m}$ (kN)	16.6	22.3	36.6	55.3	97.4	124.6
N_{Rk} (kN)	12.7	16.3	29.2	40.3	77.4	99.1

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
$V_{Ru,m}$ (kN)	22.0	28.8	47.4	62.7	127.6	149.5
V_{Rk} (kN)	17.3	24.2	40.0	57.2	121.0	137.4

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

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Mc,N}} \qquad V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
N_{Rd} (kN)	8.4	10.9	19.4	26.8	51.6	66.1

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
V_{Rd} (kN)	13.8	19.4	32.0	45.8	96.8	109.9

$\gamma_{Ms,V} = 1.25$

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

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Mc,N} \cdot \gamma_F} \qquad V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
h_{ef} (mm)	50	60	70	80	100	125
N_{rec} (kN)	6.0	7.8	13.9	19.2	36.9	47.2

$\gamma_F = 1.4$

$\gamma_{Mc,N} = 1.5$

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16	M20
V_{rec} (kN)	9.9	13.8	22.9	32.7	69.1	78.5

$\gamma_F = 1.4$

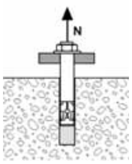
$\gamma_{Ms,V} = 1.25$

TRIGA Z (TYPE E)

Zinc Coated Steel

CC-Method - Cracked concrete

TENSILE in kN

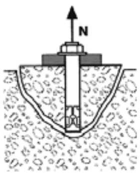


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design pull-out resistance					
h_{ef} (mm)	50	60	70	80	100	125
$N^0_{Rd,p}$ (kN)	3.6	8.8	11.7	-	-	-

$\gamma_{Mc,N} = 1.5$

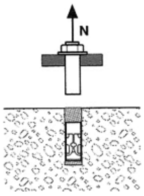


Concrete cone resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design cone resistance					
h_{ef} (mm)	50	60	70	80	100	125
$N^0_{Rd,c}$ (kN)	9.4	12.3	15.5	18.9	26.4	36.9

$\gamma_{Mc,N} = 1.5$

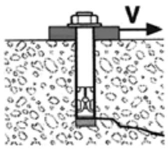


Steel resistance

$N_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
	Steel design tensile resistance					
$N_{Rd,s}$ (kN)	10.7	19.5	30.9	44.9	83.7	130.7

$\gamma_{Ms,N} = 1.5$

SHEAR in kN

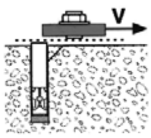


Concrete edge resistance
Concrete strength 30 N/mm²

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

$V^0_{Rd,c}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design concrete edge resistance at a minimum edge distance (c_{min})					
h_{ef} (mm)	50	60	70	80	100	125
c_{min}	250	60	70	80	100	150
s_{min}	100	100	160	200	220	300
$V^0_{Rd,c}$ (kN)	2.6	3.9	5.3	7.3	10.7	20.6

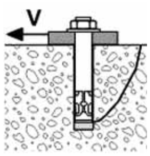
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$ Anchor size	M6	M8	M10	M12	M16	M20
	Steel design shear resistance					
$V_{Rd,s}$ (kN)	11.4	15.2	24.8	37.9	74.5	87.9

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure

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

$V_{Rd,cp}$ Anchor size	M6	M8	M10	M12	M16	M20
	Design pry-out resistance					
h_{ef} (mm)	50	60	70	80	100	125
$V^0_{Rd,cp}$ (kN)	9.4	24.5	30.9	37.7	52.8	73.8

$\gamma_{Mc,V} = 1.5$

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

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

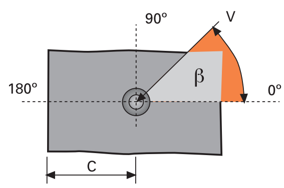
$\beta N + \beta V \leq 1.2$

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

$f_{\beta,V}$ 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



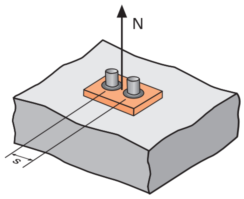
MECHANICAL ANCHORS

TRIGA Z (TYPE E)

Zinc Coated Steel

CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



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

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

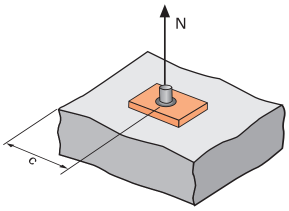
$s_{cr,N} = 3h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

Spacing, s — Reduction Factor Ψ_s, Cracked and non-cracked concrete

	M6	M8	M10	M12	M16	M20
50	0.67					
60	0.70	0.67				
70	0.73	0.69	0.67			
80	0.77	0.72	0.69	0.67		
100	0.83	0.78	0.74	0.71	0.67	
125	0.92	0.85	0.80	0.76	0.71	0.67
150	1.00	0.92	0.86	0.81	0.75	0.70
180		1.00	0.93	0.88	0.80	0.74
210			1.00	0.94	0.85	0.78
240				1.00	0.90	0.82
300					1.00	0.90
375						1.00

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



$\Psi_{c,N} = 0.25 + 0.5 \cdot \frac{c}{h_{ef}}$

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

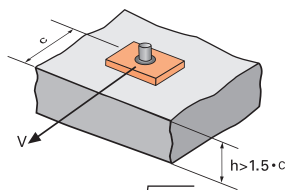
$c_{cr,N} = 1.5 \cdot h_{ef}$

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

Edge, c — Reduction Factor $\Psi_{c,N}$, Cracked and non-cracked concrete

	M6	M8	M10	M12	M16	M20
50	0.75					
60	0.85	0.75				
70	0.95	0.83	0.75			
80	1.00	0.92	0.82	0.75		
90		1.00	0.89	0.81		
100			0.96	0.88	0.75	
120			1.00	1.00	0.85	0.73
150					1.00	0.85
170						0.93
190						1.00

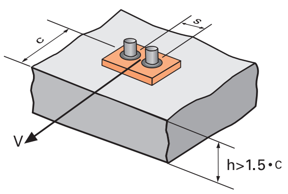
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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

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

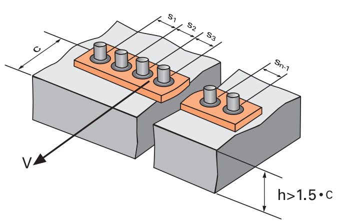
$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$, Cracked and 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



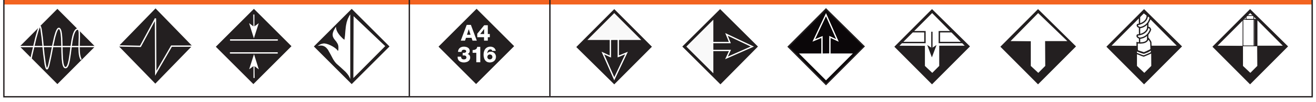
FOR OTHER CASE OF FASTENINGS

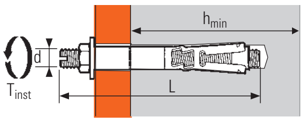
$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + ... + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$

TRIGA Z (TYPE E)

Stainless Steel (A4)

Performance	Material	Installation





MATERIAL

Threaded stud:
Steel grade A4

Hexagonal nut:
Steel grade A4

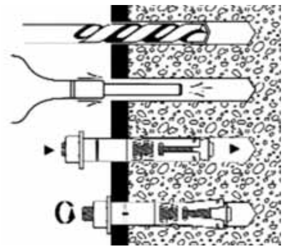
Washer:
A4

Sleeve:
A4

Expansion cone:
A4

Expansion sleeve:
A4

INSTALLATION



Technical Data

Triga Z	Min anchor depth (mm)	Max thick of fixture (mm)	Min thick of base material (mm)	Ø Thread (mm)	Drill depth (mm)	Ø Drill bit (mm)	Ø Hole clearance (mm)	Total anchor length (mm)	Max tighten torque (Nm)	Ramset power tool code	Drill bit type-size
	h_{ef}	t_{fix}	h_{min}	d	h_o	d_o	d_f	L	T_{inst}		
E8-12/45	60	45	120	M8	80	12	14	124	25	DD527	R3 PLUS-12
E10-15/45	70	45	140	M10	90	15	17	139	50	DD527	R3 PLUS-15
E12-18/15	80	15	160	M12	105	18	20	122	80	DD543	R3 PLUS-18
E12-18/45		45						152			
E16-24/25	95	25	200	M16	130	24	26	157	120	DD565	R3 MAX-24

Anchor Mechanical Properties

STAINLESS STEEL A4	M6	M8	M10	M12	M16
f_{uk} (N/mm2) Min. tensile strength	700	700	700	700	700
f_{yk} (N/mm2) Yield strength	350	350	350	350	350
$S_{eq,E}$ (N/mm2) Equivalent stressed cross-section	35.2	61.8	82.0	104.1	183.3
W_{el} (mm3) Elastic section modulus	39.2	31.2	62.3	109.2	277.5
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	10.6	26.2	52.3	91.7	233.1
M (Nm) Recommended bending moment	4.4	10.9	21.8	38.2	97.1

TRIGA Z (TYPE E)

Stainless Steel (A4)

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	95
$N_{Ru,m}$ (kN)	18.4	24.6	42.6	45.4	70.6
N_{Rk} (kN)	17.6	18.7	28.6	30.8	61.6

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16
$V_{Ru,m}$ (kN)	19.3	25.2	41.5	54.9	111.7
V_{Rk} (kN)	16.1	21.0	34.5	45.7	93.1

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	95
N_{Rd} (kN)	11.7	12.5	19.1	20.5	34.2

$\gamma_{Mc,N}$ = 1.5 for M6 to M12

$\gamma_{Mc,N}$ = 1.8 for M16

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16
V_{Rd} (kN)	8.0	10.5	17.3	22.8	46.5

$\gamma_{Ms,V}$ = 2.00

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

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

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

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	95
N_{rec} (kN)	8.4	8.9	13.6	14.7	24.4

γ_F = 1.4

$\gamma_{Mc,N}$ = 1.5 for M6 to M12

$\gamma_{Mc,N}$ = 1.8 for M16

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M6	M8	M10	M12	M16
V_{rec} (kN)	5.7	7.5	12.3	16.3	33.2

γ_F = 1.4

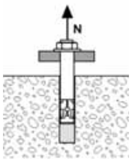
$\gamma_{Ms,V}$ = 2.00

TRIGA Z (TYPE E)

Stainless Steel (A4)

CC-Method - Non cracked concrete

TENSILE in kN

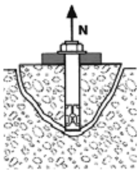


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Anchor size	Design pull-out resistance M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	95
$N^0_{Rd,p}$ (kN)	-	11.7	14.6	18.3	-

$\gamma_{Mc,N}$ = 1.5 for M6 to M12
$\gamma_{Mc,N}$ = 1.8 for M16

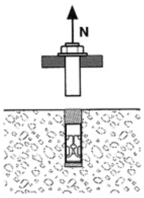


Concrete cone resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Anchor size	Design cone resistance M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	95
$N^0_{Rd,c}$ (kN)	13.1	17.2	21.7	26.4	28.5

$\gamma_{Mc,N}$ = 1.5 for M6 to M12
$\gamma_{Mc,N}$ = 1.8 for M16

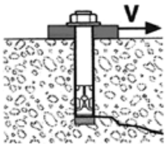


Steel resistance

$N_{Rd,s}$ Anchor size	Steel design tensile resistance M6	M8	M10	M12	M16
$N_{Rd,s}$ (kN)	5.8	10.6	16.8	24.4	45.9

$\gamma_{Ms,N}$ = 2.4

SHEAR in kN

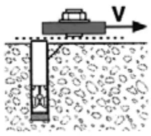


Concrete edge resistance
Concrete strength 30 N/mm²

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

$V^0_{Rd,c}$ Anchor size	Design concrete edge resistance at a minimum edge distance (c_{min}) M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	100
c_{min}	50	60	70	80	100
s_{min}	100	100	160	200	220
$V^0_{Rd,c}$ (kN)	3.7	5.4	7.5	10.2	15.0

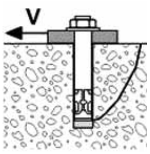
$\gamma_{Mc,V}$ = 1.5



Steel resistance

$V_{Rd,s}$ Anchor size	Steel design shear resistance M6	M8	M10	M12	M16
$V_{Rd,s}$ (kN)	6.3	8.3	13.6	20.7	40.7

$\gamma_{Ms,V}$ = 2.00



Concrete pry-out failure
Concrete strength 30 N/mm²

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

$V_{Rd,cp}$ Anchor size	Design pry-out resistance M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	95
$V^0_{Rd,cp}$ (kN)	13.1	34.3	43.3	52.9	68.4

$\gamma_{Mc,V}$ = 1.5

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

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

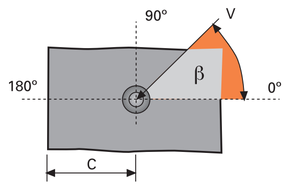
$\beta N + \beta V \leq 1.2$

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

$f_{\beta,V}$ 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



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

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	95
$N_{Ru,m}$ (kN)	16.3	27.7	37.2	44.4	61.5
N_{Rk} (kN)	12.1	23.1	27.5	31.7	41.8

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16
$V_{Ru,m}$ (kN)	19.3	25.2	41.5	54.9	111.7
V_{Rk} (kN)	16.1	21.0	34.5	45.7	93.1

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

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

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

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	95
N_{Rd} (kN)	8.1	15.4	18.3	21.1	23.2

$\gamma_{Mc,N}$ = 1.5 for M6 to M12

$\gamma_{Mc,N}$ = 1.8 for M16

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16
V_{Rd} (kN)	8.0	10.5	17.3	22.8	46.5

$\gamma_{Ms,V}$ = 2.00

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

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

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

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16
h_{ef} (mm)	50	60	70	80	95
N_{rec} (kN)	5.8	11.0	13.1	15.1	16.6

γ_F = 1.4

$\gamma_{Mc,N}$ = 1.5 for M6 to M12

$\gamma_{Mc,N}$ = 1.8 for M16

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M6	M8	M10	M12	M16
V_{rec} (kN)	5.7	7.5	12.3	16.3	33.2

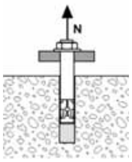
γ_F = 1.4

$\gamma_{Ms,V}$ = 2.00

TRIGA Z (TYPE E)
Stainless Steel (A4)

CC-Method - Cracked concrete

TENSILE in kN

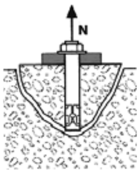


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$	Design pull-out resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**
h_{ef} (mm)	50	60	70	80	95
$N^0_{Rd,p}$ (kN)	3.6	6.6	11.7	-	-

$\gamma_{Mc,N}$ = 1.5 for M6 to M12
$\gamma_{Mc,N}$ = 1.8 for M16

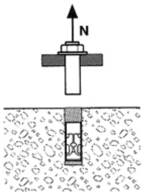


Concrete cone resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$	Design cone resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**
h_{ef} (mm)	50	60	70	80	95
$N^0_{Rd,c}$ (kN)	9.4	12.3	15.5	18.9	20.4

$\gamma_{Mc,N}$ = 1.5 for M6 to M12
$\gamma_{Mc,N}$ = 1.8 for M16

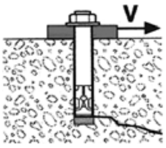


Steel resistance

$N_{Rd,s}$	Steel design tensile resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**
$N_{Rd,s}$ (kN)	5.8	10.6	16.8	24.4	45.9

$\gamma_{Ms,N}$ = 2.4

SHEAR in kN

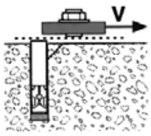


Concrete edge resistance
Concrete strength 30 N/mm²

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

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})				
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**
h_{ef} (mm)	50	60	70	80	95
c_{min}	50	60	70	80	100
s_{min}	100	100	160	200	220
$V^0_{Rd,c}$ (kN)	2.6	3.9	5.3	7.3	10.7

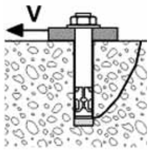
$\gamma_{Mc,V}$ = 1.5



Steel resistance

$V_{Rd,s}$	Steel design shear resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**
$V_{Rd,s}$ (kN)	6.3	8.3	13.6	20.7	40.7

$\gamma_{Ms,V}$ = 2.00



Concrete pry-out failure
Concrete strength 30 N/mm²

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

$V_{Rd,cp}$	Design pry-out resistance				
Anchor size	**M6**	**M8**	**M10**	**M12**	**M16**
h_{ef} (mm)	50	60	70	80	95
$V^0_{Rd,cp}$ (kN)	9.4	24.5	30.9	37.7	48.8

$\gamma_{Mc,V}$ = 1.5

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

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

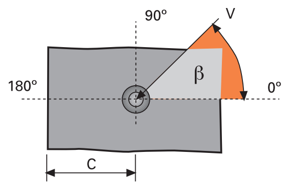
$\beta N + \beta V \leq 1.2$

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

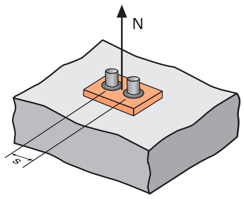
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

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



CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



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

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

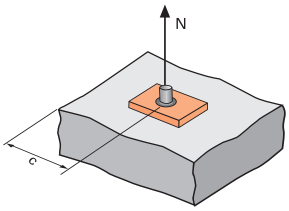
$s_{cr,N} = 3h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

Spacing, s — Reduction Factor Ψ_s, Cracked and non-cracked concrete

	M6	M8	M10	M12	M16
50	0.67				
60	0.70	0.67			
70	0.73	0.69	0.67		
80	0.77	0.72	0.69	0.67	
100	0.83	0.78	0.74	0.71	0.67
125	0.92	0.85	0.80	0.76	0.71
150	1.00	0.92	0.86	0.81	0.75
180		1.00	0.93	0.88	0.80
210			1.00	0.94	0.85
240				1.00	0.90
300					1.00

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



$$\Psi_{c,N} = 0.25 + 0.5 \cdot \frac{c}{h_{ef}}$$

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

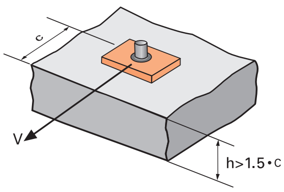
$c_{cr,N} = 1.5 \cdot h_{ef}$

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

Edge, c — Reduction Factor $\Psi_{c,N}$, Cracked and non-cracked concrete

	M6	M8	M10	M12	M16
50	0.75				
60	0.85	0.75			
70	0.95	0.83	0.75		
80	1.00	0.92	0.82	0.75	
90		1.00	0.89	0.81	0.72
100			0.96	0.88	0.78
120			1.00	1.00	0.88
145					1.00

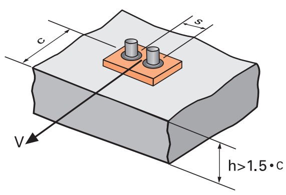
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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

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

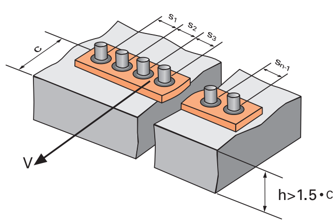
$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$, Cracked and 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

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