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WA-S7 WEDGE ANCHOR

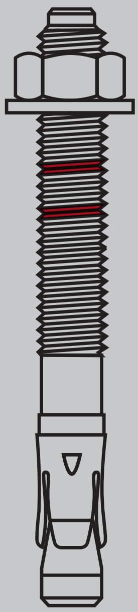
316 (A4) STAINLESS STEEL

316

CERTIFICATION | TDS

Technical Data Sheet

ETAG 001 - Annex C Design Tables



NCC Compliant AS 5216

Design tables in accordance with AS 5216 and ETAG 001- Annex C, essential for NCC compliance for safety critical applications.

The ETA document meets anchor testing and reporting requirements of AS 5216, essential for compliance with the NCC.

NCC COMPLIANT AS 5216

For Install Support techadvice@allfasteners.com.au

For Specification Support engineering@allfasteners.com.au

For Customer Support 1800 255 349

TECHNICAL DATA SHEET:

WA-S7 WEDGE ANCHOR

A through-bolt expansion wedge anchor with controlled torque,
for use in non cracked concrete.

ETA assessed option 7 anchor. Stainless steel 316 (A4) grade, with 316 (A4) grade stainless steel expansion clip.

GENERAL INFORMATION

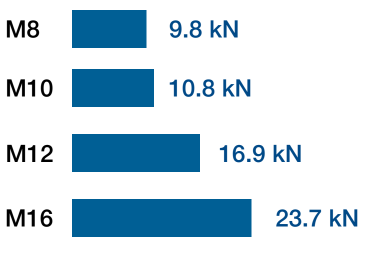
CHARACTERISTICS AND BENEFITS

- Easy installation.
- Use in un-cracked concrete.
- Use for medium-heavy duty loads.
- Pre-install in concrete or through fixture.
- Variety of lengths and diameters: flexibility in assembly.
- For static and quasi-static loads.
- Two installation depths in M8, M10 and M12 allowing the use in thick anchor plates.

APPLICATIONS

- Coastal areas.
- Industrial areas.
- Food industries.
- Curtain walls.
- Fixings in tunnels.
- Pipe supports.
- Rehabilitation of facades.
- For outdoor use in general.

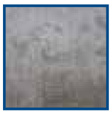
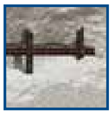
DESIGN LOAD RANGE



In Tension (C30/37 un-cracked)

BASE MATERIAL

Concrete class from C20/25 to C50/60
in un-cracked.


- Concrete
- Reinforced
- Stone

APPROVALS / CERTIFICATES

European technical assessment issued by CSIC, Madrid. This is according to ETAG 001 guideline, option 7 for diameters M6 to M24.

- ETA 17/0487 option 7.
- CE-1219-CPR-0006.
- Declaration of Performance DoP WA-S7
- Satisfies the performance requirements SA TS101:2015 as referenced by the National Construction Code

The anchors are to be used only for anchorages subject to static or quasi-static loading in reinforced or unreinforced normal weight concrete un-cracked concrete of strength class C20/25 to C50/60, according to EN 206.

ETA

NCC

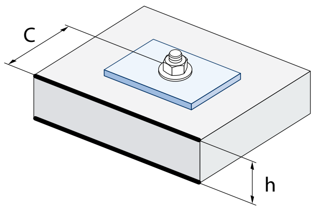
FIRE
RESISTANCE

BASIC LOADING DATA (FOR SINGLE ANCHOR)

Static and quasi-static resistance

Data in this section applies to the following:

1. Correct setting (see installation parameters)
2. No edge and spacing distance influence
3. Minimum concrete base material thickness
4. C20/25, $f_{ck,cube}$ = 25N/mm², concrete



For details see Simplified design method page 7

CHARACTERISTIC RESISTANCE

Anchor size		M8		M10		M12		M16
Effective anchor depth h_{ef}	[mm]	48	35*	55	42*	65	50*	84
Un-cracked Concrete								
Tension N_{Rk}	[kN]	12	9	16	12	25	16	35
Shear V_{Rk}	[kN]	10.9	10.9	17.4	17.4	25.2	25.2	47.1

*Reduced embedment values assessed under ETA only for M8, M10, M12

DESIGN RESISTANCE

Anchor size			M8		M10		M12		M16
Effective anchor depth h_{ef}		[mm]	48	35	55	42	65	50	84
Un-cracked Concrete	Concrete								
Tension N_{Rk}	**C20/25**	[kN]	8.0	5.0	8.9	6.7	13.9	8.9	19.4
Shear V_{Rk}		[kN]	7.2	7.2	11.4	11.4	16.6	16.6	31.0
Tension N_{Rk} a)	**C30/37**	[kN]	9.8	6.1	10.8	8.1	16.9	10.8	23.7
Shear V_{Rk} a)		[kN]	8.7	8.7	14.0	14.0	20.2	20.2	37.8

a) Values calculated using increasing factor for concrete strength $N_{rk,p}$ and partial safety factor coefficient for tension γ_{Mp} and shear γ_{Msp}.

RECOMMENDED LOADS

Anchor size			M8		M10		M12		M16
Effective anchor depth h_{ef}		[mm]	48	35	55	42	65	50	84
Un-cracked Concrete	Concrete								
Tension N_{Rk}	**C20/25**	[kN]	5.7	3.6	6.3	4.8	9.9	6.3	13.9
Shear V_{Rk}		[kN]	5.1	5.1	8.2	8.2	11.8	11.8	22.1
Tension N_{Rk} b)	**C30/37**	[kN]	7.0	4.4	7.7	5.8	12.1	7.7	16.9
Shear V_{Rk} b)		[kN]	6.2	6.2	10.0	10.0	14.4	14.4	27.0

b) Values calculated with an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

WA-S7 WEDGE ANCHOR

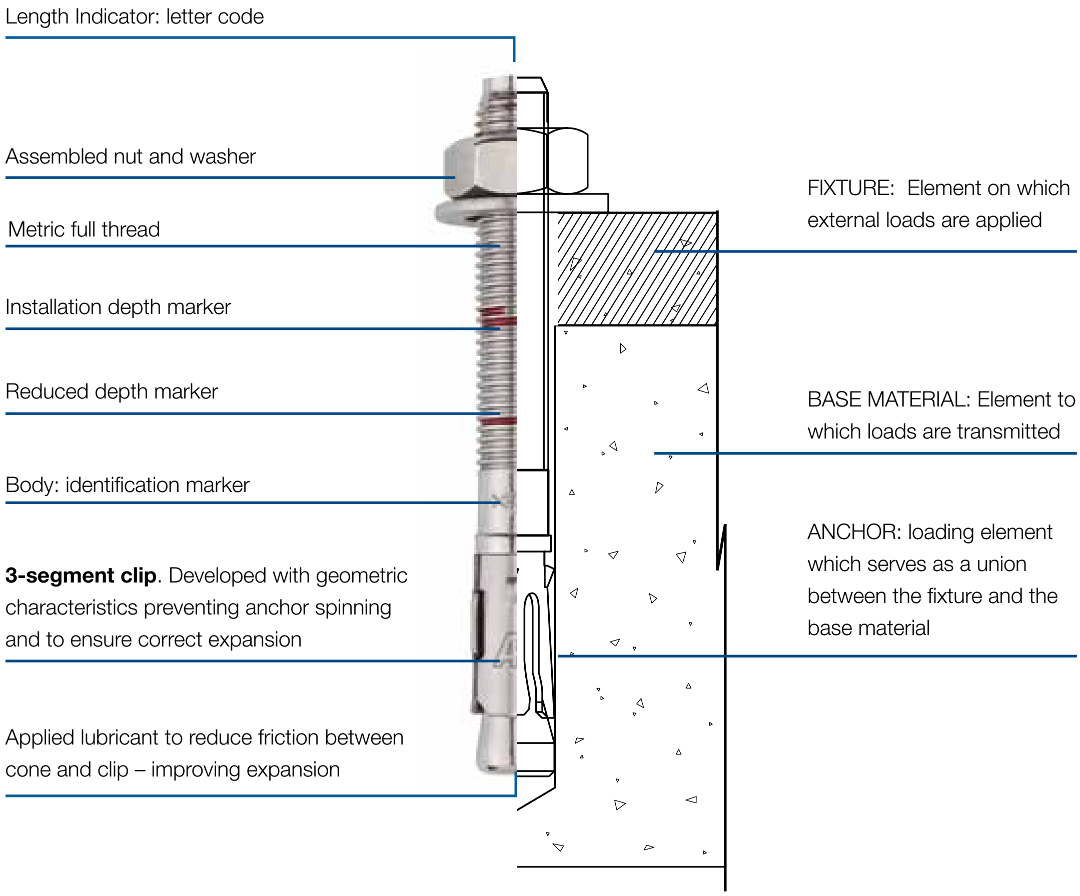
MECHANICAL PROPERTIES

MECHANICAL PROPERTIES			M8	M10	M12	M16	M20
Cone area section							
A_s	[mm^2]	Cone area section	27,3	49,0	70,9	122,7	201,1
$f_{u,s}$	[N/mm^2]	Characteristic tension resistance	700	700	700	700	700
$f_{y,s}$	[N/mm^2]	Yield strength	500	500	500	500	500
Threaded area section							
A_s	[mm^2]	Cone area section	36.6	58.0	84.3	157.0	245.0
$f_{u,s}$	[N/mm^2]	Characteristic tension resistance	600	600	600	600	600
$f_{y,s}$	[N/mm^2]	Yield Strength	400	400	400	400	400

MATERIAL SPECIFICATIONS

WA-S7	Anchor	Stainless steel, grade A4
	Washer	DIN 125, DIN 9021 or DIN 440, stainless steel grade A4
	Hex Nut	DIN 934, stainless steel, grade A4
	Expansion Clip	Stainless steel, grade A4

IDENTIFICATION



Anchor tip: overall length letter code, as per table below
Thread: embedment depth blue ring marker
Anchor body: metric x length
Expansion clip: AF (logo) + WA-S7 + metric

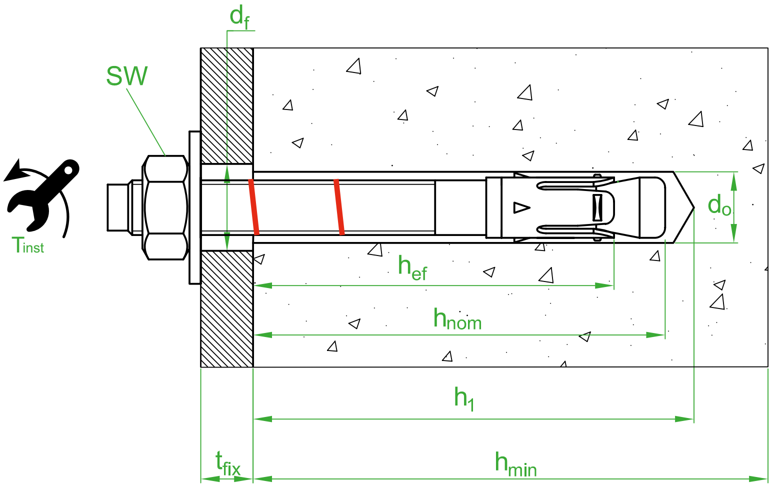
Letter code	Length [mm]
C	68 – 76
D	76 – 89
E	89 – 102
F	102 – 114
G	114 – 127
H	127 –139
I	140 – 152

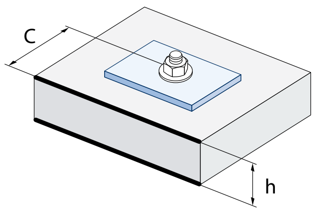
Letter code	Length [mm]
J	152 – 165
K	165 – 178
L	178 – 191
M	191 – 203
N	203 – 216
O	216 – 229

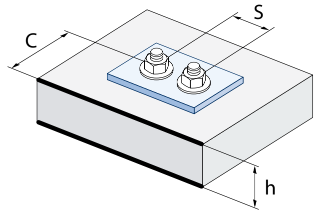
Letter code	Length [mm]
P	229 – 241
Q	241 – 254
R	254 – 267
S	267 – 300

INSTALLATION PARAMETERS

Standard embedment depth



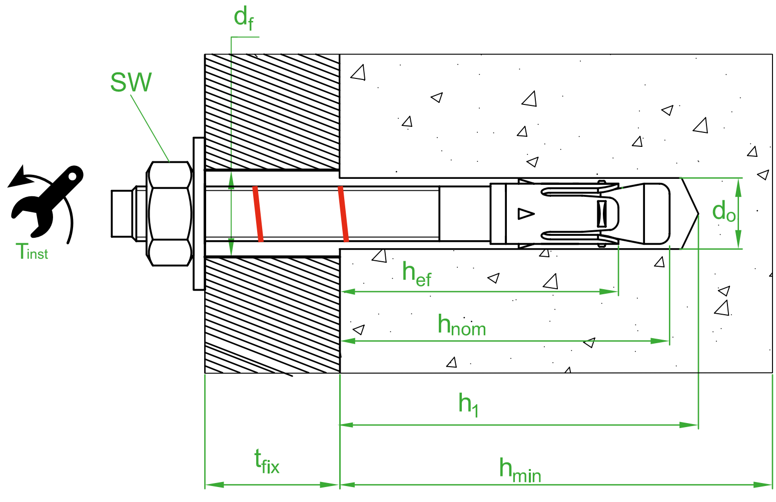


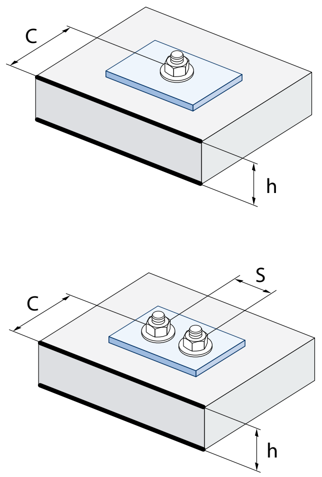


INSTALLATION DATA - Standard embedment depth							
		SIZE:	M8	M10	M12	M16	M20
		Code:	1ETBS08xxx	1ETBS10xxx	1ETBS12xxx	1ETBS16xxx	1ETBS20xxx
d_0	[mm]	Nominal diameter of drill bit	8	10	12	16	20
T_{ins}	[Nm]	Installation torque moment	20	35	60	120	240
$d_f \leq$	[mm]	Diameter of clearance hole in the fixture	9	12	14	18	22
h_1	[mm]	Minimum drill hole depth	65	75	85	110	135
h_{nom}	[mm]	Installation depth	59,5	66,5	77	103,5	125
h_{ef}	[mm]	Effective embedment depth	48	55	65	84	103
h_{min}	[mm]	Minimum base material thickness	100	110	130	168	206
t_{fix}	[mm]	Maximum thickness of fixture	L - 70	L - 80	L - 92	L - 122	L - 147
$s_{cr,N}$	[mm]	Critical spacing	144	165	195	252	309
$c_{cr,N}$	[mm]	Critical edge distance	72	83	98	126	155
$s_{cr,sp}$	[mm]	Critical distance (splitting)	192	220	260	336	412
$c_{cr,sp}$	[mm]	Critical edge distance (splitting)	96	110	130	168	206
s_{min}	[mm]	Minimum spacing	65	70	85	110	135
c_{min}	[mm]	Minimum edge distance	65	70	85	110	135
SW		Installation wrench	13	17	19	24	30

L = total anchor length

Reduced embedment depth – M8, M10, M12





INSTALLATION DATA - Reduced embedment depth – M8, M10, M12							
		SIZE:	M8	M10	M12	M16	M20
		Code:	1ETBS08xxx	1ETBS10xxx	1ETBS12xxx	1ETBS16xxx	1ETBS20xxx
d_0	[mm]	Nominal diameter of drill bit	8	10	12	16	20
T_{ins}	[Nm]	Installation torque moment	20	35	60	120	240
$d_f \leq$	[mm]	Diameter of clearance hole in the fixture	9	12	14	18	22
h_1	[mm]	Minimum drill hole depth	50	60	70	-	-
h_{nom}	[mm]	Installation depth	46,5	53,5	62	-	-
h_{ef}	[mm]	Effective embedment depth	35	42	50	-	-
h_{min}	[mm]	Minimum base material thickness	100	100	100	-	-
t_{fix}	[mm]	Maximum thickness of fixture	L - 57	L - 67	L - 77	-	-
$s_{cr,N}$	[mm]	Critical spacing	105	126	150	-	-
$c_{cr,N}$	[mm]	Critical edge distance	53	63	75	-	-
$s_{cr,sp}$	[mm]	Critical distance (splitting)	140	168	200	-	-
$c_{cr,sp}$	[mm]	Critical edge distance (splitting)	70	84	100	-	-
s_{min}	[mm]	Minimum spacing	65	70	85	110	135
c_{min}	[mm]	Minimum edge distance	65	70	85	110	135
SW		Installation wrench	13	17	19	24	30

L = total anchor length

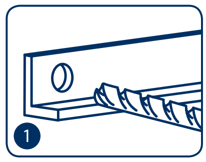
INSTALLATION STEPS

1. Use fixture template to plot hole positions. Select the correct drill bit (part: 8DSPE) size (d_0) and drill hole 90° to the concrete surface. Observe the required drill depth prior to drilling:

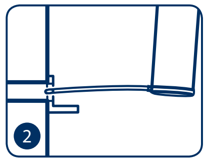
Installation depth, h_{nom} = anchor length – (nut,washer + fixture t_{fix})

Drill depth, h_1 = h_{nom} + cavity allowance

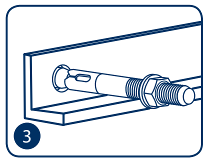
SEE TABLE BELOW.



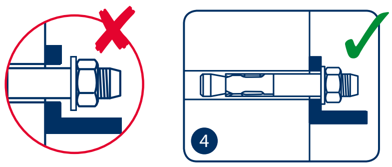
2. Clear hole of concrete dust and debris using a hand blow pump (part: 12BPUMP) or compressed air. Always wear eye protection (part: 12M-EBR330).



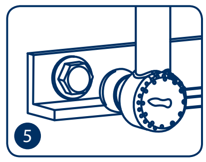
3. Insert anchors through fixture into the drilled hole.



4. Using a mallet tap the anchor into place ensure it is seated against the fixture all the way. Avoid damage to the hex nut by only tapping the end of the anchor.



5. Fasten the anchor securely applying the correct minimum torque setting (T_{ins}) with a wrench and socket.



CODE:	WA-S7	Socket	Torque	Drill Depth	Max. Fixture*	Nut,washer	Cavity allowance
		SW [mm]	T_{ins} [Nm]	$h_{1,min}$ [mm]	$t_{fix,max}$ [mm]	[mm]	[mm]
1ETBS08080	M8 x 65mm	13	20	50**	8	11	5
1ETBS08100	M8 x 90mm			75	20		
1ETBS10090	M10 x 90mm	17	35	75	10	12	10
1ETBS10120	M10 x 120mm			75	40		

*Maximum fixture thickness are based on ETA assessed standards. Anchor embedment depths are marked by the coloured rings on anchors.

**Reduced embedment used

The drill depth (h_1) is always greater then the installation depth (h_{nom}) of the anchor. This allows for a small cavity to ensure the effective (h_{ef}) embedment depth is achieved.

SIMPLIFIED DESIGN METHOD

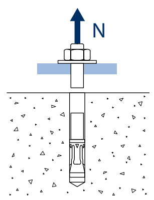
Simplified version of the design method according to ETAG 001, annex C or CEN/TS 1992-4:2009, design method A. Design resistance according to the data given in ETA 17/0487, issue 02/06/2017 for concrete classes C20/25 to C50/60.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing between anchors
- Influence of reinforcements
- Influence of base material thickness
- Influence of load application angle
- For static and quasi-static loading
- Valid for a group of two anchors.

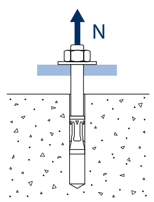
The design method is based on the following simplification: **Different loads do not act on individual anchors (no eccentricity).**
The values are valid for one anchor.

TENSION LOAD RESISTANCE

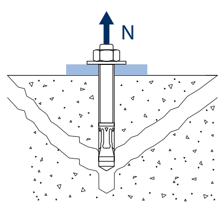
- Steel design resistance: $N_{Rd,s}$
- Pull-out design resistance: $N_{Rd,p} = N^{o}_{Rd,p} \cdot \psi_c$
- Concrete cone design resistance: $N_{Rd,c} = N^{o}_{Rd,c} \cdot \psi_b \cdot \psi_{s,N} \cdot \psi_{c,N} \cdot \psi_{re,N}$
- Concrete splitting design resistance: $N_{Rd,sp} = N^{o}_{Rd,c} \cdot \psi_b \cdot \psi_{s,sp} \cdot \psi_{c,sp} \cdot \psi_{re,N} \cdot \psi_{h,sp}$

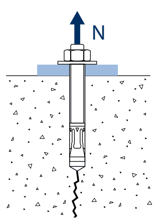


STEEL DESIGN RESISTANCE							
$N_{Rd,s}$							
			M8	M10	M12	M16	M20
N_{Rd}	[kN]	Standard depth	11.4	20.4	29.5	51.1	83.8



PULL-OUT DESIGN RESISTANCE							
$N_{Rd,p} = N^{o}_{Rd,p} \cdot \psi_c$							
			M8	M10	M12	M16	M20
$N^{o}_{Rd,p}$	[kN]	Standard depth	8.0	8.9	13.9	19.4	27.8
$N^{o}_{Rd,p}$	[kN]	Reduced depth	5.0	6.7	8.9	-	-



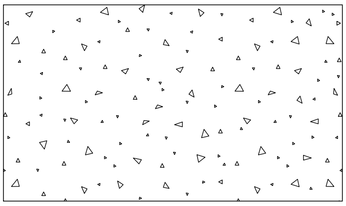


CONCRETE CONE DESIGN RESISTANCE							
$N_{Rd,c} = N^{o}_{Rd,c} \cdot \psi_b \cdot \psi_{s,N} \cdot \psi_{c,N} \cdot \psi_{re,N}$							
CONCRETE SPLITTING DESIGN RESISTANCE*							
$N_{Rd,sp} = N^{o}_{Rd,c} \cdot \psi_b \cdot \psi_{s,sp} \cdot \psi_{c,sp} \cdot \psi_{re,N} \cdot \psi_{h,sp}$							
			M8	M10	M12	M16	M20
$N^{o}_{Rd,p}$	[kN]	Standard depth	11.2	11.1	14.7	21.6	29.3
$N^{o}_{Rd,p}$	[kN]	Reduced depth	7.0	9.2	11.9	-	-

* Concrete splitting design resistance must only be considered for non-cracked concrete.

INFLUENCE FACTORS IN TENSION

INFLUENCE OF CONCRETE STRENGTHS

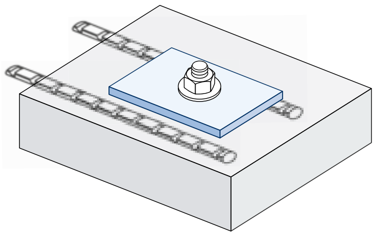


$$\psi_b = \sqrt{\frac{f_{ck,cube}}{25}} \geq 1$$

Concrete coefficients for pull-out resistance failure ψ_c						
		M8	M10	M12	M16	M20
Concrete Strength ψ_c	C 20/25	1,00				
	C 30/37	1,22				
	C 40/50	1,41				
	C 50/60	1,55				

Concrete coefficients for combined cone and splitting failure ψ_b						
		M8	M10	M12	M16	M20
Concrete Strength ψ_b	C 20/25	1,00				
	C 30/37	1,22				
	C 40/50	1,41				
	C 50/60	1,55				

INFLUENCE OF REINFORCED CONCRETE

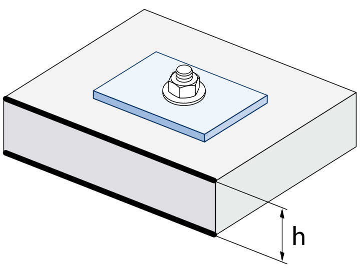


$$\psi_{re,N} = 0,5 + \frac{h_{ef}}{200} \leq 1$$

Influence of reinforcements $\psi_{re,N}$					
	M8	M10	M12	M16	M20
$\psi_{re,N}$	Standard Depth				
	0,74	0,775	0,825	0,92	1,015
	Reduced Depth				
	0,675	0,71	0,75	-	-

*This factor only applies for a high density of reinforcements. If in the area of the anchor there are reinforcements with a distancing of ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a distancing of ≥ 100 mm, a $f_{re,N}$ = 1 factor may be applied.

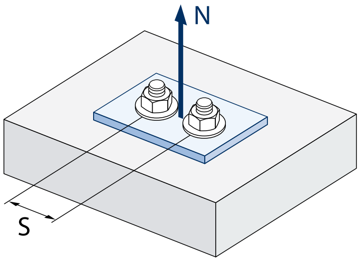
INFLUENCE OF CONCRETE THICKNESS



Influence of base material thickness $\psi_{h,sp}$										
$\psi_{h,sp}$	h/hef	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

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

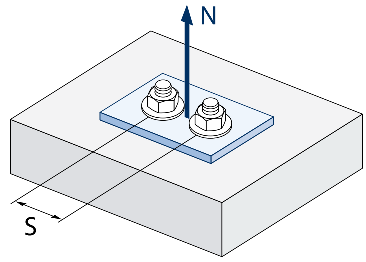
INFLUENCE OF ANCHOR SPACING



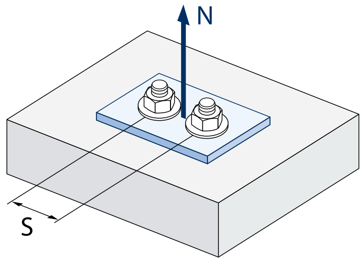
$$\Psi_{s,N} = 0{,}5 + \frac{s}{2 \cdot S_{cr,N}} \leq 1$$

Influence of anchor spacing (concrete cone failure) $\psi_{s,N}$					
Standard Depth					
s [mm]	M8	M10	M12	M16	M20
50	Invalid Value				
55					
60	0,67				
65	0,73				
70	0,74	0,71			
85	0,80	0,76	0,72		
100	0,85	0,80	0,76		
105	0,86	0,82	0,77		
110	0,88	0,83	0,78	0,72	
120	0,92	0,86	0,81	0,74	
125	0,93	0,88	0,82	0,75	
126	0,94	0,88	0,82	0,75	
128	0,94	0,89	0,83	0,75	
130	0,95	0,89	0,83	0,76	
135	0,97	0,91	0,85	0,77	0,72
144	1,00	0,94	0,87	0,79	0,73
150		0,95	0,88	0,80	0,74
165		1,00	0,92	0,83	0,77
170			0,94	0,84	0,78
180			0,96	0,86	0,79
195			1,00	0,89	0,82
200				0,90	0,82
210				0,92	0,84
220				0,94	0,86
225				0,95	0,86
252				1,00	0,91
255	Value without reduction = 1				0,91
260					0,92
300					0,99
309					1.00

Influence of anchor spacing (concrete cone failure) $\psi_{s,N}$					
Reduced Depth					
s [mm]	**M8**	**M10**	**M12**	**M16**	**M20**
65	0,81				
70	0,83	0,78		Invalid Value	
85	0,90	0,84	0,78		
100	0,98	0,90	0,83		
105	1,00	0,92	0,85		
110		0,94	0,87		
120		0,98	0,90		
125		1,00	0,92		
126			1,00	0,92	
128				0,93	
130				0,93	
135		Value without reduction = 1		0,95	
144				0,98	
150				1.00	



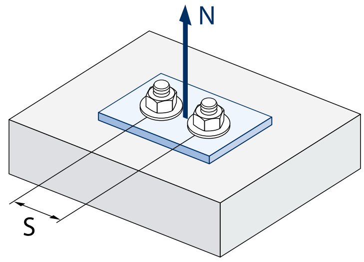
$$\Psi_{s,N} = 0{,}5 + \frac{s}{2 \cdot S_{cr,N}} \leq 1$$



$$\Psi_{s,sP} = 0,5 + \frac{s}{2 \cdot S_{cr,sp}} \leq 1$$

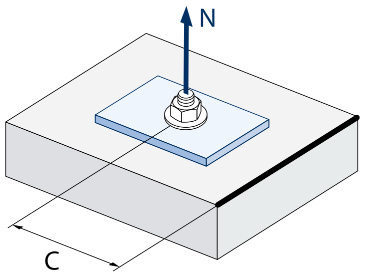
Influence of anchor spacing (concrete splitting failure) $\psi_{s,sP}$					
Standard Depth					
s [mm]	M8	M10	M12	M16	M20
50					
55					
60			Invalid value		
65	0,67				
70	0,68	0,66			
85	0,72	0,69	0,66		
100	0,76	0,73	0,69		
110	0,79	0,75	0,71	0,66	
125	0,83	0,78	0,74	0,69	
128	0,83	0,79	0,75	0,69	
135	0,85	0,81	0,76	0,70	0,66
140	0,86	0,82	0,77	0,71	0,67
150	0,89	0,84	0,79	0,72	0,68
160	0,92	0,86	0,81	0,74	0,69
165	0,93	0,88	0,82	0,75	0,70
168	0,94	0,88	0,82	0,75	0,70
180	0,97	0,91	0,85	0,77	0,72
192	1,00	0,94	0,87	0,79	0,73
200		0,95	0,88	0,80	0,74
210		0,98	0,90	0,81	0,75
220		1,00	0,92	0,83	0,77
260			1,00	0,89	0,82
288				0,93	0,85
300				0,95	0,86
336		Value without reduction = 1		1,00	0,91
350					0,92
412					1,00

Influence of anchor spacing (concrete splitting failure) $\psi_{s,sP}$					
Reduced Depth					
s [mm]	**M8**	**M10**	**M12**	**M16**	**M20**
65	0,73				
70	0,75	0,71		Invalid value	
85	0,80	0,75	0,71		
100	0,86	0,80	0,75		
110	0,89	0,83	0,78		
125	0,95	0,87	0,81		
128	0,96	0,88	0,82		
135	0,98	0,90	0,84		
140	1,00	0,92	0,85		
150		0,95	0,88		
160		0,98	0,90		
165		0,99	0,91		
168		1,00	0,92		
180			0,95		
192	Value without reduction = 1		0,98		
200			1,00		



$$\Psi_{s,sP} = 0{,}5 + \frac{s}{2 \cdot S_{cr,sp}} \leq 1$$

INFLUENCE OF ANCHOR EDGE DISTANCE

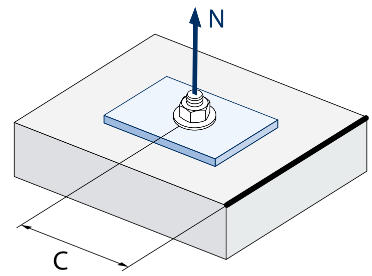


$$\Psi_{c,sp} = 0,35 + \frac{0,5 \cdot c}{C_{cr,sp}} + \frac{0,15 \cdot c^2}{C_{cr,sp}^{2}} \leq 1$$

Influence of anchor edge distance (concrete splitting failure) $\psi_{c,sP}$					
Standard Depth					
s [mm]	**M8**	**M10**	**M12**	**M16**	**M20**
50					
60					
65	0,76			Invalid value	
70	0,79	0,73			
75	0,83	0,76			
80	0,87	0,79			
82,5	0,89	0,81			
84	0,90	0,82			
85	0,91	0,83	0,74		
90	0,95	0,86	0,77		
96	1,00	0,90	0,80		
100		0,93	0,82		
105		0,96	0,85		
110		1,00	0,88	0,74	
125			0,97	0,81	
128			0,99	0,82	
130			1,00	0,83	
135				0,85	0,74
144				0,89	0,77
150				0,92	0,79
168		Value without reduction = 1		1,00	0,86
175					0,88
206					1,00

Influence of anchor edge distance (concrete splitting failure) $\psi_{c,sP}$					
Reduced Depth					
s [mm]	**M8**	**M10**	**M12**	**M16**	**M20**
65	0,94	0,94			
70	1,00	0,87	0,87		
75		0,92	0,92	Invalid value	
80		0,96	0,96		
82,5		0,99	0,99		
84		1,00	1,00		
85		0,88	0,88		
90	Value without reduction = 1	0,92	0,92		
96		0,97	0,97		
100		1,00	1,00		

Influence of anchor edge distance (concrete cone failure) $\psi_{c,N}$					
Standard Depth					
s [mm]	**M8**	**M10**	**M12**	**M16**	**M20**
50					
53					
60				Invalid value	
63					
65	0,92				
70	0,98	0,88			
72	1,00	0,90			
75		0,92			
82,5		1,00			
83		1,00			
85			0,90		
90			0,94		
98			1,00		
100					
105					
110				0,90	
113				0,92	
125				0,99	
126				1,00	
128					
135		Value without reduction = 1			0,90
150					0,97
155					1,00

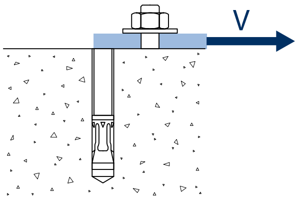


$$\Psi_{c,sp} = 0,35 + \frac{0,5 \cdot c}{c_{cr,N}} + \frac{0,15 \cdot c^2}{c_{cr,N}^{2}} \le 1$$

Influence of anchor edge distance (concrete cone failure) $\psi_{c,N}$					
Reduced Depth					
s [mm]	**M8**	**M10**	**M12**	**M16**	**M20**
65	1.00				
70		1.00			
72				Invalid value	
75					
82,5	Value without reduction = 1				
83					
85			1.00		

SHEAR LOAD RESISTANCE

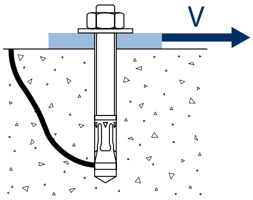
- Steel design resistance: $V_{Rd,s}$
- Pry-out design resistance: $V_{Rd,cp} = k \cdot N^{o}_{Rd,c}$
- Concrete edge design resistance: $V_{Rd,c} = V^{o}_{Rd,c} \cdot \psi_b \cdot \psi_{se,V} \cdot \psi_{c,V} \cdot \psi_{re,V} \cdot \psi_{h,V}$



STEEL DESIGN RESISTANCE:

$V_{Rd,s}$

			M8	M10	M12	M16	M20
$V_{Rd,s}$	[kN]	Standard depth	7,2	11,4	16,6	31,0	48,4
$V_{Rd,s}$	[kN]	Reduced depth	7,2	11,4	16,6	-	-

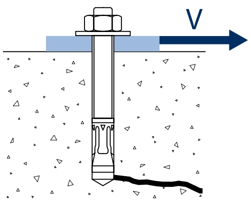


PRY-OUT DESIGN RESISTANCE*

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

			M8	M10	M12	M16	M20
K	[kN]	Standard depth	1	1	2	2	2
K	[kN]	Reduced depth	1	1	1	-	-

* $N^{o}_{Rd,c}$ Concrete cone design resistance for tension load



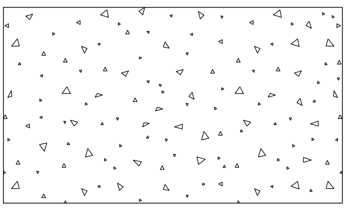
CONCRETE EDGE RESISTANCE:

$V_{Rd,c} = V^{o}_{Rd,c} \cdot \psi_b \cdot \psi_{se,V} \cdot \psi_{c,V} \cdot \psi_{re,V} \cdot \psi_{h,V}$

			M8	M10	M12	M16	M20
$V_{Rd,c}$	[kN]	Standard depth	6,2	7,7	10,2	15,6	21,8
	[kN]	Reduced depth	3,7	4,9	6,6	-	-

INFLUENCE FACTORS IN SHEAR

INFLUENCE OF CONCRETE STRENGTHS



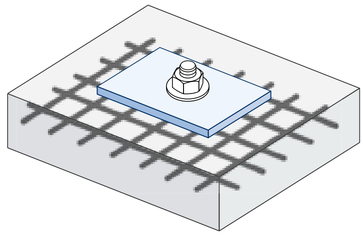
Concrete coefficients for pull-out resistance failure ψ_c

		M8	M10	M12	M16	M20
Concrete Strength ψ_c	**C 20/25**	1,00				
	C 30/37	1,22				
	C 40/50	1,41				
	C 50/60	1,55				

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

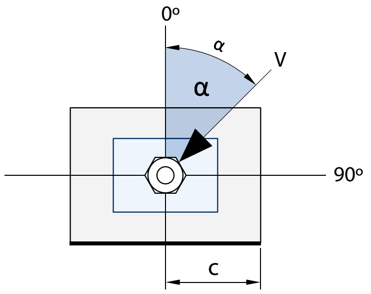
INFLUENCE OF REINFORCED CONCRETE

Influence of reinforcements $\psi_{re,V}$			
	Without perimeter reinforcements	Perimeter reinforcements ≥ Ø12 mm	Perimeter reinforcements with brackets ≤ 100 mm
Un-cracked concrete	1	1	1
Cracked concrete	1	1,2	1,4



INFLUENCE OF LOAD ANGLE

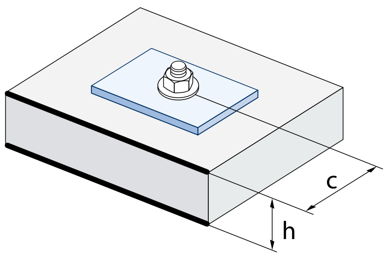
Influence of load application angle										
Angle, α(º)	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
$\psi_{\alpha,V}$	1,00	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50



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

INFLUENCE OF CONCRETE THICKNESS

Influence of base material thickness $\psi_{h,V}$										
c/h	0,67	0,75	0,85	0,95	1,10	1,30	1,65	2,25	3,30	6,65
$\mathbf{f_{h,V}}$	1,00	1,06	1,13	1,19	1,28	1,40	1,57	1,84	2,22	3,16



$$\Psi_{h,V} = \left(\frac{1,5 \cdot C}{h}\right)^{1/2} \geq 1$$

INFLUENCE OF ANCHOR EDGE DISTANCE AND SPACING IN SHEAR

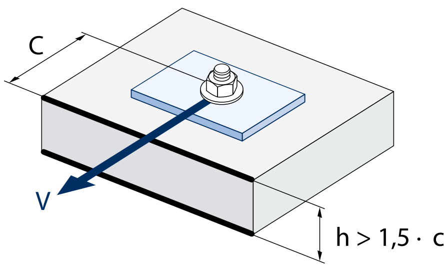
Influence of edge distance and spacing $\psi_{se,V}$

FOR ONE ANCHOR ONLY

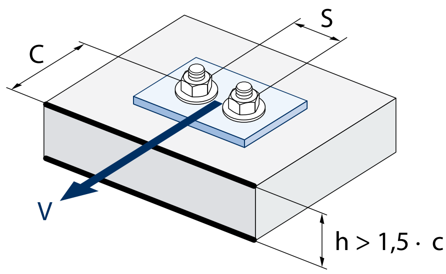
c/h_{ef}	0,50	0,75	1,00	1,25	1,50	1,75	2,00	2,25	2,50	2,75	3,00	3,25	3,50	3,75	4,00	4,50	5,00
Isolated	0,35	0,65	1,00	1,40	1,84	2,32	2,83	3,38	3,95	4,56	5,20	5,86	6,55	7,26	8,00	9,55	11,18

FOR TWO ANCHORS

	c/h_{ef}	0,50	0,75	1,00	1,25	1,50	1,75	2,00	2,25	2,50	2,75	3,00	3,25	3,50	3,75	4,00	4,50	5,00
s/c	1,0	0,24	0,43	0,67	0,93	1,22	1,54	1,89	2,25	2,64	3,04	3,46	3,91	4,37	4,84	5,33	6,36	7,45
s/c	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
s/c	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
s/c	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
s/c	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



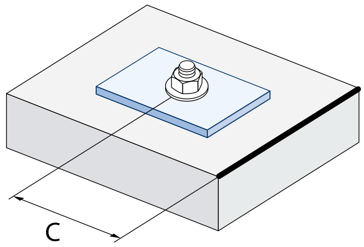
$$\Psi_{se,V} = \left(\frac{c}{h_{ef}}\right)^{1,5}$$



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

INFLUENCE OF ANCHOR EDGE DISTANCE

Influence of anchor edge distance $\psi_{c,V}$					
c [mm]	**M8**	**M10**	**M12**	**M16**	**M20**
50					
60					
65	0,66			Invalid value	
70	0,65	0,68			
80	0,63	0,66			
85	0,62	0,65	0,68		
90	0,62	0,64	0,67		
100	0,60	0,63	0,65	0,67	
110		0,62	0,64	0,66	0,68
120		0,61	0,63	0,65	0,67
125		0,60	0,63	0,65	0,66
130		0,60	0,62	0,64	0,66
135		0,59	0,62	0,64	0,65
140		0,59	0,61	0,63	0,65
150			0,60	0,62	0,64
160			0,60	0,61	0,63
170			0,59	0,61	0,62
175			0,59	0,60	0,62
180				0,60	0,62
190				0,59	0,61
200				0,59	0,60
210					0,60
220		Value without reduction = 1			0,59
230					0,59
240					0,58
250					0,58
260					0,57



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

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