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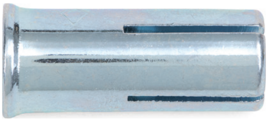


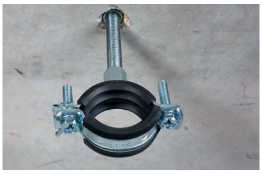
Galvanized (5 microns): M6 - M20

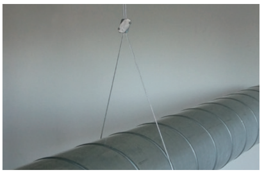
Approved for:
Concrete C20/25 to C50/60, non-cracked

Suitable for:
Concrete C12/15, Natural stone with dense structure

Type of installation		
Pre-positioned	In-place	Stand-off
✓	–	–

Applications





Approvals and certificates

ETA CE

Description	Authority/laboratory	Guideline for assessment	No./date of issue
European Technical Assessment	DiBt, Berlin	ETAG 001 Part 4	ETA-02/0044 / 2016-03-01
European Technical Assessment	DiBt, Berlin	ETAG 001 Part 6	ETA-05/0120 / 2017-02-14
Expert's Opinion tension load capacity in hollow slabs	Ing. Büro Thiele, Pirmasens		21732_2 / 2017-06-26
Expert's Opinion tension load capacity in COBIAX hollow slabs	MFPA Leipzig	TR020 ; DIN EN 1992-1-2:2010-12	GS 3.2/17-249-1 / 2017-07-31
Evaluation report fire resistance	Ing. Büro Thiele, Pirmasens	EN 1363-1:2012-10 / TR 020	21741_2 / 2017-08-12

Basic loading data (for a single anchor)

All data in this section applies when:

- Installation is correct (see installation instructions)
- No edge distance and spacing influence
- Base material thickness is according to anchor characteristics
- Anchor material is as specified in anchor material specification table
- Concrete C 20/25, f_{ck} = 20 N/mm²
- Concrete C 50/60, f_{ck} = 60 N/mm²

Mean ultimate resistance

Thread size				M6x30 [1]	M8x30 [1]	M8x40	M10x30 [1]	M10x40	M12x50	M12x80	M16x65 M16x80	M 20x80
Effective anchorage depth		h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Non-cracked concrete												
Tension	C20/25	$N_{Ru,m}$	[kN]	12.1	11.3	14.3	12.7	18.0	25.3	25.3	37.9	50.2
Shear	C20/25	$V_{Ru,m}$	[kN]	5.9	12.6	14.5	12.8	9.9	27.7	27.7	56.9	72.4

[1] Use restricted to anchoring of structural components that are statically indeterminate

Characteristic resistance

Thread size				M6x30 [1]	M8x30 [1]	M8x40	M10x30 [1]	M10x40	M12x50	M12x80	M16x65 M16x80	M 20x80
Effective anchorage depth		h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Non-cracked concrete												
Tension	C20/25	N_{Rk}	[kN]	8.1	8.1	9.0	8.1	12.4	17.4	17.4	25.8	35.2
	C50/60			10.0	12.8	14.2	12.8	19.7	27.5	27.5	40.8	55.7
Shear	C20/25	V_{Rk}	[kN]	5.0	6.9	6.9	8.1	7.2	19.4	21.1	33.5	53.2
	C50/60			5.0	6.9	6.9	10.1	7.2	19.4	21.1	33.5	53.2

[1] Use restricted to anchoring of structural components that are statically indeterminate

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Design resistance

Thread size				M6x30 [1]	M8x30 [1]	M8x40	M10x30 [1]	M10x40	M12x50	M12x80	M16x65 M16x80	M 20x80
Effective anchorage depth		h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Non-cracked concrete												
Tension	C20/25	N_{Rd}	[kN]	4.5	4.5	5.0	4.5	6.9	9.7	9.7	14.3	19.6
	C50/60			6.7	7.1	7.9	7.1	10.9	15.3	15.3	22.6	30.9
Shear	C20/25	V_{Rd}	[kN]	4.0	4.5	5.5	4.5	5.8	14.5	14.5	25.2	39.1
	C50/60			4.0	5.5	5.5	7.1	5.8	15.5	16.9	25.2	40.0

[1] Use restricted to anchoring of structural components that are statically indeterminate

Recommended/allowable loads [2]

Thread size				M6x30 [1]	M8x30 [1]	M8x40	M10x30 [1]	M10x40	M12x50	M12x80	M16x65 M16x80	M 20x80
Effective anchorage depth		h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Non-cracked concrete												
Tension	C20/25	N_{rec}	[kN]	3.2	3.2	3.6	3.2	4.9	6.9	6.9	10.2	14.0
	C50/60			4.8	5.1	5.6	5.1	7.8	10.9	10.9	16.2	22.1
Shear	C20/25	V_{rec}	[kN]	2.9	3.2	3.9	3.2	4.1	10.4	10.4	18.0	27.9
	C50/60			2.9	3.9	3.9	5.1	4.1	11.1	12.1	18.0	28.6

[1] Use restricted to anchoring of structural components that are statically indeterminate.
[2] Material safety factor γ_M and safety factor for action γ_L = 1.4 are included. The material safety factor depends on the failure mode.

Design method (simplified)

Simplified version of the design method according to Eurocode 2 - Design of concrete structures - Part 4: Design of fastenings for use in concrete (EN 1992-4):

- Influence factors related to concrete strength, edge distance, spacing and others must be considered when applicable
- Valid for a group of anchors. The influencing factors must then be considered for each edge distance and spacing. The calculated design resistances are on the safe side. They will be lower than the exact values according to EN 1992-4. For an economical optimization, we recommend using the anchor design module of the Würth Technical Software II
- The design method is based on the simplification that no different loads are acting on individual anchors (no eccentricity)
- Concrete strength for design load values is C20/25 unless stated otherwise
- Dry or wet conditions of drill hole, hammer drilling
- Anchor material as specified in anchor material specification table
- Anchorage depths hef < 40 mm are restricted to use of structural components with which are statically intdeterminate and subject to internal exposure conditions only

I. Tension loading

The decisive design resistance in tension is the lowest value of the following failure modes:

1. Steel failure $N_{Rd,s}$
2. Pull-out failure $N_{Rd,p} = N^0_{Rd,p} \cdot f_{b,N}$
3. Concrete cone failure $N_{Rd,c} = N^0_{Rd,c} \cdot f_{b,N} \cdot f_{sx} \cdot f_{sy} \cdot f_{cx,1} \cdot f_{cx,2} \cdot f_{cy}$
4. Concrete splitting failure $N_{Rd,sp} = N^0_{Rd,sp} \cdot f_{b,N} \cdot f_{sx,sp} \cdot f_{sy,sp} \cdot f_{cx,1,sp} \cdot f_{cx,2,sp} \cdot f_{cy,sp} \cdot f_h$

1. Design steel tensile resistance

Table 1: Design value of steel resistance under tension load $N_{Rd,s}$ of a single anchor

Thread size			**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M12x80**	**M16x65 M16x80**	**M20x80**
Effective anchorage depth	h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Design steel resistance	$N_{Rd,s}$	[kN]	6.7	11.7	12.2	12.0	13.5	26.8	28.1	41.9	66.5

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2. Design pullout resistance

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

Table 2: Basic design resistance $N^0_{Rd,p}$ in case of pull-out failure of a single anchor

Thread size			M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M12x80	M16x65 M16x80	M20x80
Effective anchorage depth	h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Design pull-out resistance	$N^0_{Rd,p}$	[kN]	4.5	4.5	5.0	4.5	6.9	9.7	9.7	14.3	19.6

a. Influence of concrete strength

Table 3: Influence of concrete strength on pull-out resistance

Concrete strength classes (EN 206:2000)			C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Characteristic compressive strength of concrete determined by testing cylinders[1]	f_{ck}	[N/mm²]	12	16	20	25	30	35	40	45	50
Characteristic compressive strength of concrete determined by testing cube[2]	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influencing factor	$f_{b,N}$	[-]	0.77	0.89	1.00	1.10	1.22	1.32	1.41	1.50	1.58

[1] strength at 28 days of 150 mm diameter by 300 mm cylinders

[2] strength at 28 days of 150 mm cubes

3. Design concrete cone resistance

$$N_{Rd,c} = N^0_{Rd,c} \cdot f_{b,N} \cdot f_{sx} \cdot f_{sy} \cdot f_{cx,1} \cdot f_{cx,2} \cdot f_{cy}$$

Table 4: Basic design resistance $N^0_{Rd,c}$ in case of concrete cone failure of a single anchor

Thread size			M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M12x80	M16x65 M16x80	M20x80
Effective anchorage depth	h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Design concrete cone resistance	$N^0_{Rd,c}$	[kN]	4.5	4.5	6.9	4.5	6.9	9.7	9.7	14.3	19.6

Table 5: Characteristic edge distance $c_{cr,N}$ and spacing $s_{cr,N}$

Thread size			M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M12x80	M16x65 M16x80	M20x80
Effective anchorage depth	h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Characteristic spacing	$s_{cr,N}$	[mm]	90	90	120	90	120	150	150	195	240
Characteristic edge distance	$c_{cr,N}$	[mm]	45	45	60	45	60	75	75	98	120

a. Influence of concrete strength

Table 6: Influence of concrete strength on concrete cone resistance

Concrete strength classes (EN 206:2000)			C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Characteristic compressive strength of concrete determined by testing cylinders [1)]	f_{ck}	[N/mm²]	12	16	20	25	30	35	40	45	50
Characteristic compressive strength of concrete determined by testing cube [2)]	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influencing factor	$f_{b,N}$	[-]	0.77	0.89	1.00	1.10	1.22	1.32	1.41	1.50	1.58

[1)] strength at 28 days of 150 mm diameter by 300 mm cylinders

[2)] strength at 28 days of 150 mm cubes

b. Influence of spacing

$$f_{sx} = f_{sy} = \left(1 + \left(n_{x(y)} - 1\right)\frac{s_{x(y)}}{s_{cr,N}}\right) \cdot \frac{1}{n_{x(y)}} \leq 1$$

Table 7: Influence of spacing on concrete cone resistance

Number of fixing per direction	$s/s_{cr,N}$ [1)]	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1.0
2	f_{sx}, f_{sy}	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00
3	f_{sx}, f_{sy}	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73	0.77	0.80	0.83	0.80	0.83	0.93	0.97	1.00
4	f_{sx}, f_{sy}	0.33	0.36	0.40	0.44	0.48	0.51	0.55	0.59	0.63	0.66	0.70	0.74	0.78	0.81	0.78	0.81	0.93	0.96	1.00
5	f_{sx}, f_{sy}	0.28	0.32	0.36	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.76	0.80	0.92	0.96	1.00

[1)] Choose always the lowest value of the spacings, when there are different spacings in one row

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c. Influence of edge distance

$$f_{cx,1} = 0.7 + 0.3\frac{c_x}{c_{cr,N}} \leq 1 \qquad f_{cx,2} = f_{cy} = \left(1 + \frac{c_{x(y)}}{c_{cr,N}}\right) \cdot \frac{1}{2} \leq 1$$

Table 8: Influence of edge distance on concrete cone resistance

$c/c_{cr,N}$	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1.0
$f_{cx,1}$	0.73	0.75	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.87	0.88	0.90	0.91	0.93	0.91	0.93	0.97	0.99	1.00
$f_{cx,2}$ f_{cy}	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00

4. Design splitting resistance

$$N_{Rd,sp} = N^0_{Rd,sp} \cdot f_{b,N} \cdot f_{sx,sp} \cdot f_{sy,sp} \cdot f_{cx,1,sp} \cdot f_{cx,2,sp} \cdot f_{cy,sp} \cdot f_h$$

No verification of splitting is required if at least one of the conditions is fulfilled:

a) The edge distance in all directions is $c \geq c_{cr,sp}$ for single fasteners and $c \geq 1.2\ c_{cr,sp}$ for fastener groups and the member depth is $h \geq h_{min}$ in both cases

b) The characteristic resistance for concrete cone failure and pull-out failure is calculated for cracked concrete and reinforcement resists the splitting forces and limits the crack width to $w_k \leq 0.3$ mm

Table 9: Design resistance $N^0_{Rd,sp}$ in case of concrete splitting failure of a single anchor

Thread size			**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M12x80**	**M16x 65/80**	**M20x80**
Effective anchorage depth	h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Non-cracked concrete											
Design splitting resistance	$N^0_{Rd,sp}$	[kN]	4.5	4.5	5.0	4.5	6.9	9.7	9.7	14.3	19.6

Table 10: Characteristic edge distance $c_{cr,sp}$ and spacing $s_{cr,sp}$

Thread size			**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M12x80**	**M16x 65/80**	**M20x80**
Effective anchorage depth	h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Characteristic spacing	$s_{cr,sp}$	[mm]	190	190	190	230	270	330	330	400	520
Characteristic edge distance	$c_{cr,sp}$	[mm]	95	95	95	115	135	165	165	200	260
Minimum member thickness	h_{min}	[mm]	100	100	100	120	120	130	130	160	200

a. Influence of concrete strength

Table 11: Influence of concrete strength on splitting resistance

Concrete strength classes (EN 206:2000)			C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Characteristic compressive strength of concrete determined by testing cylinders [1]	f_{ck}	[N/mm²]	12	16	20	25	30	35	40	45	50
Characteristic compressive strength of concrete determined by testing cube [2]	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influencing factor	$f_{b,N}$	[-]	0.77	0.89	1.00	1.10	1.22	1.32	1.41	1.50	1.58

1) strength at 28 days of 150 mm diameter by 300 mm cylinders

2) strength at 28 days of 150 mm cubes

b. Influence of spacing

$$f_{sx,sp} = f_{sy,sp} = \left(1 + \left(n_{x(y)} - 1\right)\frac{s_{x(y)}}{s_{cr,sp}}\right) \cdot \frac{1}{n_{x(y)}} \leq 1$$

Table 12: Influence of spacing on splitting resistance

Number of fixing per direction	$s/s_{cr,sp}$ [1]	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1.0
2	$f_{sx,sp}$, $f_{sy,sp}$	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00
3	$f_{sx,sp}$, $f_{sy,sp}$	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73	0.77	0.80	0.83	0.80	0.83	0.93	0.97	1.00
4	$f_{sx,sp}$, $f_{sy,sp}$	0.33	0.36	0.40	0.44	0.48	0.51	0.55	0.59	0.63	0.66	0.70	0.74	0.78	0.81	0.78	0.81	0.93	0.96	1.00
5	$f_{sx,sp}$, $f_{sy,sp}$	0.28	0.32	0.36	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.76	0.80	0.92	0.96	1.00

1) Choose always the lowest value of the spacing s, when there are different spacings in one row

c. Influence of edge distance

$$f_{cx,1,sp} = 0.7 + 0.3\frac{c_x}{c_{cr,sp}} \leq 1 \qquad f_{cx,2,sp} = f_{cy,sp} = \left(1 + \frac{c_{x(y)}}{c_{cr,sp}}\right) \cdot \frac{1}{2} \leq 1$$

Table 13: Influence of edge distance on splitting resistance

$c/c_{cr,sp}$	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1.0
$f_{cx,1,sp}$	0.73	0.75	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.87	0.88	0.90	0.91	0.93	0.91	0.93	0.97	0.99	1.00
$f_{cx,2,sp}$ $f_{cy,sp}$	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00

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d. Influence of concrete member thickness

$$f_h = \left(\frac{h}{h_{min}}\right)^{2/3} \leq max\left(1; \left(\frac{h_{ef} + 1.5c_1}{h_{min}}\right)^{2/3}\right)$$

Table 14: Influence of concrete member thickness on splitting resistance

h/h_{min}	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30	2.40	2.30	2.40	2.70	2.80	2.90
f_h	1.00	1.07	1.13	1.19	1.25	1.31	1.37	1.42	1.48	1.53	1.59	1.64	1.69	1.74	1.79	1.74	1.79	1.94	1.99	2.00

II. Shear loading

The decisive design resistance in shear is the lowest value of the following failure modes:

1. Steel failure V_{Rds}
2. Concrete pry-out failure $V_{Rd,c} = k \cdot N_{Rd,c}$
3. Concrete edge failure $V_{Rd,c} = V^0_{Rd,c} \cdot f_{b,V} \cdot f_{s,V} \cdot f_{c2,V} \cdot f_a \cdot f_h$

1. Design steel shear resistance

Table 15: Design value of steel resistance $V_{Rd,s}$ of a single anchor

Thread size			**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M12x80**	**M16x 65/80**	**M20x80**
Effective anchorage depth	h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Design steel resistance	$V_{Rd,s}$	[mm]	4.0	5.5	5.5	8.1	5.8	15.5	16.9	25.2	40.0

2. Concrete pry-out resistance

$$V_{Rd,c} = k_8 \cdot N_{Rd,c}$$

Table 16: factor k_8 for calculating design pry-out resistance

Thread size			**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M12x80**	**M16x 65/80**	**M20x80**
Effective anchorage depth	h_{ef}	[mm]	30	30	40	30	40	50	50	65	80
Concrete pry-out resistance factor	k_8	[-]	1.0	1.0	1.0	1.0	1.0	1.5	1.5	2.0	2.0

3. Concrete edge resistance

$$V_{Rd,c} = V^0_{Rd,c} \cdot f_{b,V} \cdot f_{s,V} \cdot f_{c2,V} \cdot f_a \cdot f_h$$

Verification of concrete edge failure may be omitted for single fasteners and groups with an edge distance in all directions c ≥ max (10 h_{ef} ; 60 d). For anchorages with more than one edge, the resistance for all edges shall be calculated. The smallest value should be used in the verification.

Table 17: Design resistance $V^0_{Rd,c}$ in case of concrete edge failure

Thread size	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M12x80**	**M16x 65/80**	**M20x80**
h_{ef} [mm]	30	30	40	30	40	50	50	65	80
Edge distance c_1	$V^0_{Rd,c}$								
[mm]	[kN]								
	non-cracked concrete								
95	9,2	9,4	9,7	-	-	-	-	-	-
100	9,8	10,1	10,4	-	-	-	-	-	-
110	11,3	11,5	11,9	-	-	-	-	-	-
120	12,7	13,0	13,4	13,2	-	-	-	-	-
130	14,2	14,5	15,0	14,8	-	-	-	-	-
140	15,8	16,1	16,7	16,4	17,0	-	-	-	-
150	17,4	17,8	18,3	18,0	18,7	-	-	-	-
160	19,1	19,5	20,1	19,7	20,4	-	-	-	-
170	20,8	21,2	21,9	21,5	22,2	23,4	23,4	-	-
180	22,6	23,0	23,7	23,3	24,1	25,3	25,3	-	-
190	24,4	24,8	25,6	25,2	26,0	27,2	27,2	-	-
200	26,2	26,7	27,5	27,0	27,9	29,3	29,3	31,2	-
250	36,1	36,6	37,6	37,1	38,2	39,9	39,9	42,4	-
300	46,8	47,5	48,8	48,1	49,4	51,5	51,5	54,5	57,3
350	58,4	59,2	60,7	59,9	61,5	63,9	63,9	67,5	70,8
400	70,8	71,7	73,4	72,5	74,4	77,2	77,2	81,2	85,0
450	83,9	85,0	86,9	85,9	87,9	91,1	91,1	95,8	100,0
500	-	98,9	101,1	99,9	102,2	105,8	105,8	111,0	115,8
550	-	113,5	115,9	114,6	117,2	121,1	121,1	126,9	132,1
600	-	128,6	131,3	129,9	132,7	137,1	137,1	143,4	149,2
650	-	-	-	145,8	148,9	153,7	153,7	160,5	166,8
700	-	-	-	162,2	165,6	170,8	170,8	178,2	185,0
750	-	-	-	-	-	188,5	188,5	196,5	203,8
800	-	-	-	-	-	206,7	206,7	215,3	223,2
850	-	-	-	-	-	225,5	225,5	234,6	243,0
900	-	-	-	-	-	244,7	244,7	254,5	263,4
950	-	-	-	-	-	-	-	274,8	284,3
1000	-	-	-	-	-	-	-	295,6	305,6
1100	-	-	-	-	-	-	-	338,6	349,7
1200	-	-	-	-	-	-	-	383,4	395,6
1300	-	-	-	-	-	-	-	-	443,2
1400	-	-	-	-	-	-	-	-	492,4
1500	-	-	-	-	-	-	-	-	543,2

DROP-IN ANCHOR W-ED/S

a. Influence of concrete strength

Table 18: Influence of concrete strength on concrete edge resistance

Concrete strength classes (EN 206:2000)			C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Characteristic compressive strength of concrete determined by testing cylinders[1]	f_{ck}	[N/mm²]	12	16	20	25	30	35	40	45	50
Characteristic compressive strength of concrete determined by testing cube[2]	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influencing factor	$f_{b,N}$	[-]	0.77	0.89	1.00	1.10	1.22	1.32	1.41	1.50	1.58

[1] strength at 28 days of 150 mm diameter by 300 mm cylinders

[2] strength at 28 days of 150 mm cubes

b. Influence of spacing

In groups loaded perpendicular to the edge only two adjacent anchors closest and parallel to the edge carry the load. The smallest spacing should be used for the verification.

$$f_{s,V} = \frac{1}{3} \cdot \frac{s}{c_1} + 1 \leq 2$$

Table 19: Influence of spacing on concrete edge resistance

s/c_1[1]	0.50	0.60	0.70	0.80	0.90	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	2.60	2.80
$f_{s,V}$	1.17	1.20	1.23	1.27	1.30	1.33	1.40	1.47	1.53	1.60	1.67	1.73	1.80	1.87	1.93	1.87	1.93

[1] Always choose the lowest value of the spacing s, when there are different spacing in the row closest to the edge.

c. Influence of edge distance

In groups loaded perpendicular to the edge only two adjacent anchors closest and parallel to the edge carry the load. The smallest spacing should be used for the verification.

$$f_{c2,V} = \left(\frac{1}{2} + \frac{1}{3}\frac{c_2}{c_1}\right)\left(0.7 + 0.3\,\frac{c_2}{1.5\,c_1}\right)$$

Table 20: Influence of edge distance on concrete edge resistance

c_2/c_1[1]	1	1.1	1.2	1.3	1.4	1.5
$f_{c,V}$	0.75	0.80	0.85	0.90	0.95	1.00

[1] Distance to the second edge: $c_1 \leq c_2$

W-ED/S

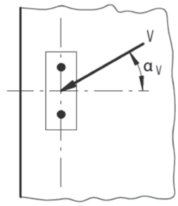
d. Influence of load direction

$$f_\alpha = \sqrt{\frac{1}{cos^2\alpha_V + \left(\frac{sin\alpha_V}{2}\right)^2}} \leq 2$$

Table 21: Influence of load direction on concrete edge resistance

α[1]	0	10	20	30	40	50	60	70	80	90
$f_{\alpha,V}$	1.00	1.01	1.05	1.11	1.20	1.34	1.51	1.72	1.92	2.00

[1] For a ≥ 90° the component of the shear load acting away from the edge may be neglected and the verification may be done with component acting parallel to the edge only.



e. Influence of concrete member thickness

$$f_{h,V} = \left(\frac{h}{1.5c_1}\right)^{1/2}$$

Table 22: Influence of concrete member thickness on concrete edge resistance

h/c_1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	≥ 1.50
$f_{h,V}$	0.26	0.37	0.45	0.52	0.58	0.63	0.68	0.73	0.77	0.82	0.86	0.89	0.93	0.97	1.00

Structural verification

N_{Ed} = Design value of tension load acting on a fastener
V_{Ed} = Design value of a shear load acting on a fastener

	Failure mode	Verification
1	Steel failure of fastener [1]	$\left(\frac{N_{Ed}}{N_{Rd}}\right)^2 + \left(\frac{V_{Ed}}{V_{Rd}}\right)^2 \leq 1$ If N_{Ed} and V_{Ed} are different for the individual fasteners of the group, the interaction shall be verified for all fasteners.
2	Failure modes other than steel failure	$\left(\frac{N_{Ed}}{N_{Rd,i}}\right)^{1.5} + \left(\frac{V_{Ed}}{V_{Rd,i}}\right)^{1.5} \leq 1$ or $\left(\frac{N_{Ed}}{N_{Rd,i}}\right) + \left(\frac{V_{Ed}}{V_{Rd,i}}\right) \leq 1.2$ With $N_{Ed} / N_{Rd,i} \leq 1$ and $V_{Ed} / V_{Rd,i} \leq 1$ The largest value of $N_{Ed} / N_{Rd,i}$ and $V_{Ed} / V_{Rd,i}$ for the different failure modes shall be taken.

[1] This verification is not required in case of shear load with lever arm

DROP-IN ANCHOR W-ED/S

Mechanical characteristics

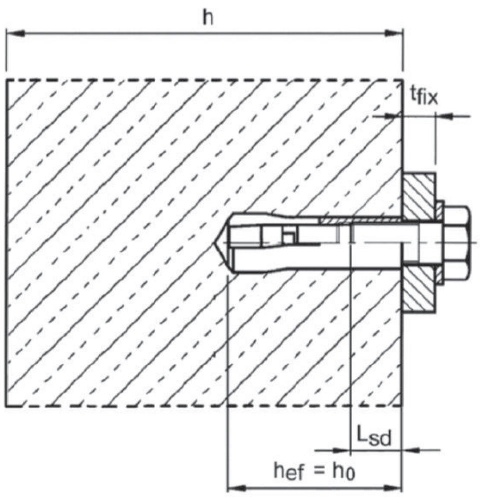
Thread size			M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M12x80	M16x65 M16x80	M 20x80
Screw											
Stressed cross section	A_s	[mm²]	20.1	36.6	36.6	58.0	58.0	84.3	84.3	156.7	244.8
Section modulus	W	[mm³]	12.7	31.2	31.2	62.3	62.3	109.1	109.1	276.6	540.2
Design bending moment (steel 4.6)	$M^0_{Rd,s}$	[Nm]	3.7	9	9	17.9	17.9	31.4	31.4	79.7	155.6
Design bending moment (steel 5.6)	$M^0_{Rd,s}$	[Nm]	4.6	11.2	11.2	22.4	22.4	39.3	39.3	99.6	194.5
Design bending moment (steel 5.8)	$M^0_{Rd,s}$	[Nm]	6.1	15.0	15.0	29.9	29.9	52.4	52.4	132.8	259.3
Design bending moment (steel 8.8)	$M^0_{Rd,s}$	[Nm]	9.8	24.0	24.0	47.8	47.8	83.8	83.8	212.4	414.9
Sleeve											
Stressed cross section	A_s	[mm²]	25.0	33.2	33.2	42.0	42.0	71.7	71.7	119.7	190.0
Section modulus	W	[mm³]	37.5	65.5	65.5	102.7	102.7	212.2	212.2	473.9	940.7
Yield strength	f_{yk}	[N/mm²]	480	480	480	384	384	480	480	420	420
Tensile strength	f_{uk}	[N/mm²]	600	600	600	480	480	600	600	560	560
Design bending moment	$M^0_{Rd,s}$	[Nm]	21.6	37.7	37.7	47.3	47.3	122.3	122.3	238.8	474.1

Material specifications

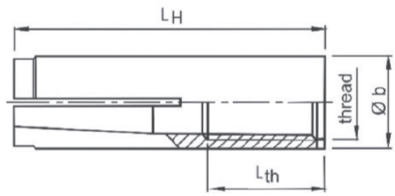
Part	**Steel, zinc plated**
Anchor sleeve	Cold formed or machining steel, zinc plated, EN ISO 4042:1999
Cone	Steel for cold forming acc. to EN 10263-2:2001

Installation parameters

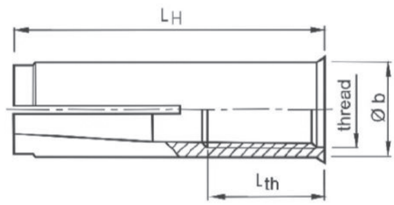
Thread size			M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M12x80	M16x65	M16x80	M20x80
Depth of drill hole	h_0	[mm]	30	30	40	30	40	50	80	65	80	80
Nominal drill hole diameter	d_0	[mm]	8	10	10	12	12	15	15	20	20	25
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8.45	10.45	10.45	12.5	12.5	15.5	15.5	20.55	20.55	25.55
Installation torque	$T_{inst} \leq$	[Nm]	4	8	8	15	15	35	35	60	60	120
Diameter of clearance in hole in the fixture	$d_f \leq$	[mm]	7	9	9	12	12	14	14	18	18	22
Available thread length	L_{th}	[mm]	13	13	20	12	15	18	45	23	38	34
Minimum screw-in depth	$L_{sd,min}$	[mm]	7	9	9	10	11	13	13	18	18	22
Minimum thick-ness of member	h_{min}	[mm]	100	100	100	120	120	130	130	160	160	200
Minimum spacing	s_{min}	[mm]	55	60	80	100	100	120	120	150	150	160
Minimum edge distance	c_{min}	[mm]	95	95	95	115	135	165	165	200	200	260



Anchor version without shoulder

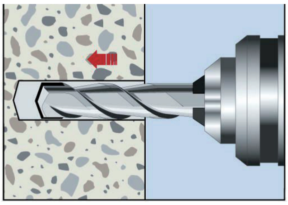
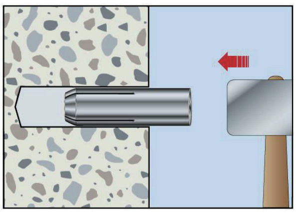
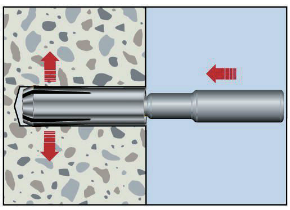
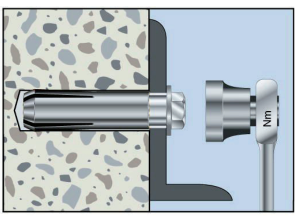


Anchor version with shoulder Type BND



DROP-IN ANCHOR W-ED/S

Installation instructions

A) Bore hole drilling		
	**1a.**	**Hammer (HD) or compressed air drilling (CD)** Drill the hole with a hammer drill. Drill bit diameter and its working length are determined by the diameter and depth of the drill hole of the selected anchor.
B) Bore hole cleaning		
	**2.**	Clean the bore hole from the bottom until the return air stream is dust free.
C) Setting the screw		
	**3a.**	Drive the anchor with some hammer strike or with the machine setting tool into the drill hole. Ensure the specified embedment depth.
	**3b.**	Drive in cone by using setting tool. Shoulder of setting tool must fit on anchor rim.
	**3c.**	Apply the required torque moment using a calibrated torque wrench.