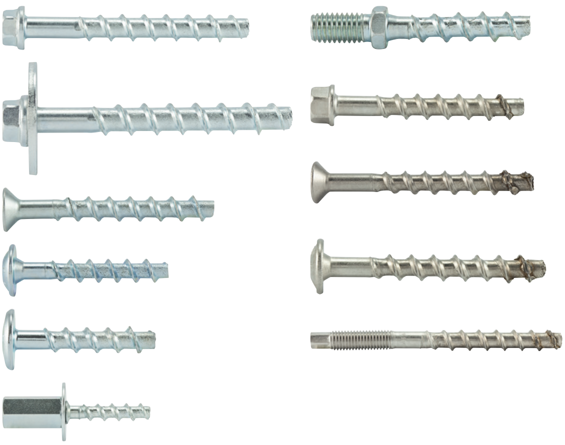
CONCRETE SCREW W-BS



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

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

Type of installation

Pre-positioned	In-place	Stand-off
✓	✓	–

Applications




Approvals and certificates

Description	Authority / laboratory	Guideline for assessment	No./date of issue
European Technical Assessment	DiBt, Berlin	EAD 330232-01-0601	ETA-16/0043 / 2019-06-29
European Technical Assessment	DiBt, Berlin	ETAG 001 Part 6	ETA-16/0128 / 2018-04-06
German approval abZ/aBG	DiBt, Berlin		Z-21.8-2090 / 2020-08-27
Report tension load capacity in hollow slabs	Ing. Büro Thiele, Pirmasens	ETAG 001	21641 / 2016-09-25
Expert Opinion	iBMB MPA, Braunschweig	EN 1363-1:2012-10 / Din 4102-4	2101/173/18 / 2018-08-13

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/mm^2
- Concrete C 50/60, f_{ck} = 60 N/mm^2

Characteristic resistance

Screw size: Ø 6 – Ø 10

Screw size					Ø 6		Ø 8				Ø 10
Effective anchorage depth			h_{ef}	[mm]	31[1]	44	35[1]	43	52	43	60
Non-cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{Rk}	[kN]	4.0	9.0	7.5	12.0	16.0	12.0	20.0
		C50/60			6.3	14.0	11.9	19.0	25.3	19.0	31.6
Shear		C20/25	V_{Rk}	[kN]	7.0	7.0	10.2	13.5	17.0	13.9	34.0
		C50/60			7.0	7.0	13.5	13.5	17.0	21.9	34.0
Cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{Rk}	[kN]	2.0	4.0	5.0	9.0	12.0	9.0	16.0
		C50/60			3.2	6.3	7.9	14.2	19.0	14.2	25.3
Shear		C20/25	V_{Rk}	[kN]	5.9	7.0	7.1	9.7	12.9	9.7	32.0
		C50/60			7.0	7.0	11.3	13.5	17.0	15.4	34.0

Screw size: Ø 10 – Ø 14

Screw size					Ø 10	Ø 12			Ø 14		
Effective anchorage depth			h_{ef}	[mm]	68	50	67	80	58	79	92
Non-cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{Rk}	[kN]	26.0	16.0	27.0	35.2	21.7	34.5	43.4
		C50/60			41.1	25.3	42.7	55.7	34.4	54.6	68.6
Shear		C20/25	V_{Rk}	[kN]	34.0	17.4	40.0	40.0	21.7	56.0	56.0
		C50/60			34.0	27.5	40.0	40.0	34.4	56.0	56.0
Cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{Rk}	[kN]	19.3	12.0	18.9	24.6	15.2	24.2	30.4
		C50/60			30.5	19.0	29.9	39.0	24.1	38.2	48.0
Shear		C20/25	V_{kR}	[kN]	34.0	12.2	37.8	40.0	15.2	48.4	56.0
		C50/60			34.0	19.3	40.0	40.0	24.1	56.0	56.0

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

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Design resistance

Screw size: Ø 6 – Ø 10

Screw size					Ø 6		Ø 8				Ø 10
Effective anchorage depth			h_{ef}	[mm]	31[1)]	44	35[1)]	43	52	43	60
Non-cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{Rd}	[kN]	2.7	6.0	5.0	8.0	10.7	8.0	13.3
		C50/60			4.2	9.3	7.9	12.6	16.9	12.6	21.1
Shear		C20/25	V_{Rd}	[kN]	5.6	5.6	6.8	9.2	12.3	9.2	27.2
		C50/60			5.6	5.6	10.7	10.8	13.6	14.6	27.2
Cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{Rd}	[kN]	1.3	2.7	3.3	6.0	8.0	6.0	10.7
		C50/60			2.1	4.2	5.3	9.5	12.6	9.5	16.9
Shear		C20/25	V_{Rd}	[kN]	4.0	5.6	4.8	6.5	8.6	6.5	21.3
		C50/60			5.6	5.6	7.5	10.2	13.6	10.2	27.2

Screw size: Ø 10 – Ø 14

Screw size					Ø 10	Ø 12			Ø 14		
Effective anchorage depth			h_{ef}	[mm]	68	50	67	80	58	79	92
Non-cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{Rd}	[kN]	17.3	10.7	18.0	23.5	14.5	23.0	28.9
		C50/60			27.4	16.9	28.4	37.1	22.9	36.4	45.8
Shear		C20/25	V_{Rd}	[kN]	27.2	11.6	32.0	32.0	14.5	44.8	44.8
		C50/60			27.2	18.3	32.0	32.0	22.9	44.8	44.8
Cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{Rd}	[kN]	12.9	8.0	12.6	16.4	10.1	16.1	20.3
		C50/60			20.4	12.6	19.9	26.0	16.0	25.5	32.0
Shear		C20/25	V_{Rd}	[kN]	25.7	8.1	25.2	32.0	10.1	32.2	40.5
		C50/60			27.2	12.8	32.0	32.0	16.0	44.8	44.8

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

Recommended/allowable loads [1)]

Screw size: Ø 6 – Ø 10

Screw size					Ø 6		Ø 8				Ø 10
Effective anchorage depth			h_{ef}	[mm]	31[2)]	44	35[2)]	43	52	43	60
Non-cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{rec}	[kN]	1.9	4.3	3.6	5.7	7.6	5.7	9.5
		C50/60			3.0	6.7	5.6	9.0	12.0	9.0	15.1
Shear		C20/25	V_{rec}	[kN]	4.0	4.0	4.9	6.6	8.8	6.6	19.4
		C50/60			4.0	4.0	7.7	7.7	9.7	10.4	19.4
Cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{rec}	[kN]	1.0	1.9	2.4	4.3	5.7	4.3	7.6
		C50/60			1.5	3.0	3.8	6.8	9.0	6.8	12.0
Shear		C20/25	V_{rec}	[kN]	2.8	4.0	3.4	4.6	6.1	4.6	15.2
		C50/60			4.0	4.0	5.4	7.3	9.7	7.3	19.4

[1)] 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.

Screw size: Ø 10 – Ø 14

Screw size					Ø 10	Ø 12			Ø 14		
Effective anchorage depth			h_{ef}	[mm]	68	50	67	80	58	79	92
Non-cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{rec}	[kN]	12.4	7.6	12.8	16.8	10.3	16.4	20.7
		C50/60			19.6	12.0	20.3	26.5	16.4	26.0	32.7
Shear		C20/25	V_{rec}	[kN]	19.4	8.3	22.9	22.9	10.3	32.0	32.0
		C50/60			19.4	13.1	22.9	22.9	16.4	32.0	32.0
Cracked concrete											
Tension	W-BS-S, SK; /S ; /A4 ; / HCR	C20/25	N_{rec}	[kN]	9.2	5.7	9.0	11.7	7.2	11.5	14.5
		C50/60			14.5	9.0	14.2	18.6	11.5	18.2	22.9
Shear		C20/25	V_{rec}	[kN]	18.4	5.8	18.0	22.9	7.2	23.0	28.9
		C50/60			19.4	9.2	22.9	22.9	11.5	32.0	32.0

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

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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 h_{ef} < 40 mm are restricted to use of structural components with which are statically indeterminate 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

Screw size: Ø 6 – Ø 10

Screw size			Ø 6		Ø 8				Ø 10
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60
Design steel resistance	$N_{Rd,s}$	[kN]	9.3	9.3	18.0	18.0	18.0	30.0	30.0

Screw size: Ø 10 – Ø 14

Screw size			Ø 10	Ø 12			Ø 14		
Effective anchorage depth	h_{ef}	[mm]	68	50	67	80	58	79	92
Design steel resistance	$N_{Rd,s}$	[kN]	30.0	44.7	44.7	44.7	62.7	62.7	62.7

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

Screw size: Ø 6 – Ø 10

Screw size			Ø 6		Ø 8				Ø 10
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60
Non-cracked concrete									
Pull-out resistance	$N^0_{Rd,p}$	[kN]	2.7	6.0	5.0	8.0	10.7	8.0	13.3
Cracked concrete									
Pull-out resistance	$N^0_{Rd,p}$	[kN]	1.3	2.7	3.3	6.0	8.0	6.0	10.7

Screw size: Ø 10 – Ø 14

Screw size			Ø 10	Ø 12			Ø 14		
Effective anchorage depth	h_{ef}	[mm]	68	50	67	80	58	79	92
Non-cracked concrete									
Pull-out resistance	$N^0_{Rd,p}$	[kN]	17.3	10.7	18.0	23.5	14.5	23.0	28.9
Cracked concrete									
Pull-out resistance	$N^0_{Rd,p}$	[kN]	12.9	8.0	12.6	16.4	10.1	16.1	20.3

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

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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

Screw size: Ø 6 – Ø 10

Screw size			Ø 6		Ø 8				Ø 10
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60
Non-cracked concrete									
Cone resistance	$N^0_{Rd,c}$	[kN]	5.7	9.6	6.8	9.2	12.3	9.2	15.2
Cracked concrete									
Cone resistance	$N^0_{Rd,c}$	[kN]	4.0	6.7	4.8	6.5	8.6	6.5	10.7

Screw size: Ø 10 – Ø 14

Screw size			Ø 10	Ø 12			Ø 14		
Effective anchorage depth	h_{ef}	[mm]	68	50	67	80	58	79	92
Non-cracked concrete									
Cone resistance	$N^0_{Rd,c}$	[kN]	18.4	11.6	18.0	23.5	14.5	23.0	28.9
Cracked concrete									
Cone resistance	$N^0_{Rd,c}$	[kN]	12.9	8.1	12.6	16.4	10.1	16.1	20.3

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

Screw size: Ø 6 – Ø 10

Screw size			Ø 6		Ø 8				Ø 10
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60
Characteristic spacing	$s_{cr,N}$	[kN]	93	132	105	129	156	129	180
Characteristic edge distance	$c_{cr,N}$	[kN]	47	66	53	65	78	65	90

Screw size: Ø 10 – Ø 14

Screw size			Ø 10	Ø 12			Ø 14		
Effective anchorage depth	h_{ef}	[mm]	68	50	67	80	58	79	92
Characteristic spacing	$s_{cr,N}$	[kN]	204	150	201	240	174	237	276
Characteristic edge distance	$c_{cr,N}$	[kN]	102	75	101	120	87	119	138

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 spacing s, when there are different spacings in one row

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

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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

Screw size: Ø 6 – Ø 10

Screw size			Ø 6		Ø 8				Ø 10
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60
Non-cracked concrete									
Splitting resistance	$N^0_{Rd,sp}$	[kN]	2.7	6.0	5.0	8.0	10.7	8.0	13.3

Screw size: Ø 10 – Ø 14

Screw size			Ø 10	Ø 12			Ø 14		
Effective anchorage depth	h_{ef}	[mm]	68	50	67	80	58	79	92
Non-cracked concrete									
Splitting resistance	$N^0_{Rd,sp}$	[kN]	17.3	10.7	18.0	23.5	14.5	23.0	28.9

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

Screw size: Ø 6 – Ø 10

Screw size			Ø 6		Ø 8				Ø 10
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60
Characteristic spacing	$s_{cr,sp}$	[mm]	120	160	120	140	150	140	180
Characteristic edge distance	$c_{cr,sp}$	[mm]	60	80	60	70	75	70	90
Minimum member thickness	h_{min}	[mm]	100	100	100	100	120	100	130

Screw size: Ø 10 – Ø 14

Screw size			Ø 10	Ø 12			Ø 14		
Effective anchorage depth	h_{ef}	[mm]	68	50	67	80	58	79	92
Characteristic spacing	$s_{cr,sp}$	[mm]	210	150	210	240	180	240	280
Characteristic edge distance	$c_{cr,sp}$	[mm]	105	75	105	120	90	120	140
Minimum member thickness	h_{min}	[mm]	130	120	130	150	130	150	170

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

Screw size: Ø 6 – Ø 10

Screw size			**Ø 6**		**Ø 8**				**Ø 10**
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60
Design steel resistance	$V_{Rd,s}$	[kN]	5.6	5.6	10.8	10.8	13.6	18.0	27.2

Screw size: Ø 10 – Ø 14

Screw size			**Ø 10**	**Ø 12**			**Ø 14**		
Effective anchorage depth	h_{ef}	[mm]	68	50	67	80	58	79	92
Design steel resistance	$V_{Rd,s}$	[kN]	27.2	26.8	32.0	32.0	44.8	44.8	44.8

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

Screw size: Ø 6 – Ø 10

Screw size			Ø 6		Ø 8				Ø 10
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60
Concrete pry-out resistance factor	k_8	[-]	1.0	1.0	1.0	1.0	1.0	1.0	2.0

Screw size: Ø 10 – Ø 14

Screw size			Ø 10	Ø 12			Ø 14		
Effective anchorage depth	h_{ef}	[mm]	68	50	67	80	58	79	92
Concrete pry-out resistance factor	k_8	[-]	2.0	1.0	2.0	2.0	1.0	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.

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CONCRETE SCREW W-BS

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

Screw size: Ø 6 – Ø 10

Screw size	Ø 6				Ø 8						Ø 10			
h_{ef} [mm]	31		44		35		43		52		43		60	
Edge distance c_1	$V^0_{Rd,c}$													
[mm]	[kN]													
	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked
40	2.7	1.9	2.8	2.0	2.8	2.0	-	-	-	-	-	-	-	-
45	3.2	2.2	3.3	2.4	3.3	2.4	-	-	-	-	-	-	-	-
50	3.6	2.6	3.8	2.7	3.9	2.7	4.0	2.8	4.1	2.9	4.1	2.9	4.4	3.1
55	4.2	2.9	4.4	3.1	4.4	3.1	4.5	3.2	4.7	3.3	4.7	3.3	5.0	3.5
60	4.7	3.3	4.9	3.5	4.9	3.5	5.1	3.6	5.3	3.7	5.3	3.7	5.6	3.9
65	5.3	3.7	5.5	3.9	5.5	3.9	5.7	4.0	5.9	4.1	5.9	4.1	6.2	4.4
70	5.8	4.1	6.1	4.3	6.1	4.3	6.3	4.5	6.5	4.6	6.5	4.6	6.8	4.8
75	6.4	4.5	6.7	4.7	6.7	4.8	6.9	4.9	7.1	5.0	7.1	5.0	7.5	5.3
80	7.0	5.0	7.3	5.2	7.4	5.2	7.6	5.4	7.8	5.5	7.8	5.5	8.2	5.8
85	7.6	5.4	8.0	5.6	8.0	5.7	8.2	5.8	8.4	6.0	8.4	6.0	8.9	6.3
90	8.3	5.9	8.6	6.1	8.7	6.1	8.9	6.3	9.1	6.5	9.1	6.5	9.6	6.8
95	8.9	6.3	9.3	6.6	9.3	6.6	9.6	6.8	9.8	7.0	9.8	7.0	10.3	7.3
100	9.6	6.8	10.0	7.1	10.0	7.1	10.3	7.3	10.6	7.5	10.6	7.5	11.1	7.8
110	11.0	7.8	11.4	8.1	11.5	8.1	11.7	8.3	12.0	8.5	12.0	8.5	12.6	8.9
120	12.4	8.8	12.9	9.1	12.9	9.2	13.3	9.4	13.6	9.6	13.6	9.6	14.2	10.1
130	13.9	9.9	14.4	10.2	14.5	10.3	14.8	10.5	15.2	10.7	15.2	10.7	15.8	11.2
140	15.5	11.0	16.0	11.4	16.1	11.4	16.4	11.6	16.8	11.9	16.8	11.9	17.5	12.4
150	17.1	12.1	17.7	12.5	17.7	12.5	18.1	12.8	18.5	13.1	18.5	13.1	19.3	13.7
160	18.7	13.3	19.4	13.7	19.4	13.7	19.8	14.0	20.3	14.3	20.3	14.3	21.1	14.9
170	20.4	14.5	21.1	14.9	21.1	15.0	21.6	15.3	22.0	15.6	22.0	15.6	22.9	16.2
180	22.1	15.7	22.9	16.2	22.9	16.2	23.4	16.6	23.9	16.9	23.9	16.9	24.8	17.6
190	23.9	16.9	24.7	17.5	24.7	17.5	25.3	17.9	25.8	18.3	25.8	18.2	26.8	19.0
200	25.8	18.2	26.6	18.8	26.6	18.8	27.2	19.2	27.7	19.6	27.7	19.6	28.7	20.4
250	35.5	25.1	36.5	25.8	36.6	25.9	37.2	26.4	37.9	26.9	37.9	26.9	39.3	27.8
300	46.1	32.6	47.3	33.5	47.4	33.6	48.3	34.2	49.1	34.8	49.1	34.8	50.7	35.9
350	57.5	40.8	59.0	41.8	59.1	41.9	60.1	42.6	61.1	43.3	61.1	43.3	63.0	44.6
400	-	-	71.5	50.7	71.6	50.7	72.8	51.6	73.9	52.4	73.9	52.3	76.1	53.9
450	-	-	-	-	84.8	60.1	86.2	61.0	87.5	61.9	87.4	61.9	90.0	63.7
500	-	-	-	-	-	-	-	-	101.7	72.0	101.7	72.0	104.5	74.0
550	-	-	-	-	-	-	-	-	-	-	116.5	82.5	119.7	84.8
600	-	-	-	-	-	-	-	-	-	-	132.0	93.5	135.5	96.0

Screw size: Ø 10 – Ø 14

Screw size	**Ø 10**		**Ø 12**						**Ø 14**					
h_{ef} [mm]	68		50		67		80		58		79		92	
Edge distance c_1	$V^0_{Rd,c}$													
[mm]	[kN]													
	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked	non-cracked	cracked
50	4.5	3.2	4.4	3.1	4.6	3.3	-	-	4.6	3.3	-	-	-	-
55	5.1	3.6	4.9	3.5	5.2	3.7	-	-	5.2	3.7	-	-	-	-
60	5.7	4.0	5.5	3.9	5.9	4.2	-	-	5.8	4.1	-	-	-	-
65	6.3	4.5	6.2	4.4	6.5	4.6	-	-	6.5	4.6	-	-	-	-
70	7.0	5.0	6.8	4.8	7.2	5.1	7.4	5.3	7.2	5.1	7.6	5.4	7.9	5.6
75	7.7	5.4	7.5	5.3	7.9	5.6	8.1	5.8	7.8	5.6	8.3	5.9	8.6	6.1
80	8.4	5.9	8.1	5.8	8.6	6.1	8.9	6.3	8.5	6.0	9.1	6.4	9.3	6.6
85	9.1	6.4	8.8	6.3	9.3	6.6	9.6	6.8	9.3	6.6	9.8	6.9	10.1	7.2
90	9.8	6.9	9.5	6.8	10.0	7.1	10.3	7.3	10.0	7.1	10.6	7.5	10.9	7.7
95	10.5	7.5	10.3	7.3	10.8	7.6	11.1	7.9	10.7	7.6	11.4	8.0	11.7	8.3
100	11.3	8.0	11.0	7.8	11.5	8.2	11.9	8.4	11.5	8.2	12.1	8.6	12.5	8.9
110	12.8	9.1	12.5	8.9	13.1	9.3	13.5	9.6	13.1	9.3	13.8	9.8	14.2	10.0
120	14.5	10.2	14.1	10.0	14.8	10.5	15.2	10.8	14.7	10.4	15.5	11.0	15.9	11.3
130	16.1	11.4	15.8	11.2	16.5	11.7	16.9	12.0	16.4	11.6	17.2	12.2	17.7	12.5
140	17.8	12.6	17.5	12.4	18.2	12.9	18.7	13.2	18.1	12.9	19.0	13.5	19.5	13.8
150	19.6	13.9	19.2	13.6	20.0	14.2	20.5	14.5	19.9	14.1	20.9	14.8	21.4	15.2
160	21.4	15.2	21.0	14.9	21.8	15.5	22.4	15.9	21.8	15.4	22.8	16.1	23.4	16.5
170	23.3	16.5	22.8	16.2	23.7	16.8	24.3	17.2	23.7	16.8	24.8	17.5	25.3	17.9
180	25.2	17.9	24.7	17.5	25.7	18.2	26.3	18.6	25.6	18.1	26.8	18.9	27.4	19.4
190	27.2	19.3	26.7	18.9	27.7	19.6	28.3	20.1	27.6	19.5	28.8	20.4	29.4	20.9
200	29.2	20.7	28.6	20.3	29.7	21.0	30.4	21.5	29.6	21.0	30.9	21.9	31.6	22.4
250	39.8	28.2	39.1	27.7	40.4	28.7	41.3	29.3	40.3	28.6	41.9	29.7	42.8	30.3
300	51.4	36.4	50.5	35.8	52.1	36.9	53.2	37.7	52.0	36.9	53.9	38.2	55.0	38.9
350	63.8	45.2	62.8	44.5	64.7	45.8	66.0	46.7	64.6	45.7	66.8	47.3	68.0	48.2
400	77.0	54.6	75.9	53.7	78.1	55.3	79.5	56.3	77.9	55.2	80.5	57.0	81.9	58.0
450	91.0	64.4	89.7	63.5	92.2	65.3	93.8	66.4	92.0	65.2	94.9	67.2	96.5	68.3
500	105.6	74.8	104.2	73.8	107.0	75.8	108.8	77.0	106.8	75.6	110.0	77.9	111.8	79.2
550	120.9	85.7	119.3	84.5	122.4	86.7	124.4	88.1	122.2	86.5	125.8	89.1	127.7	90.5
600	136.9	97.0	135.1	95.7	138.5	98.1	140.7	99.7	138.2	97.9	142.2	100.7	144.3	102.2
650	153.4	108.7	151.5	107.3	155.2	109.9	157.6	111.6	154.9	109.7	159.2	112.8	161.5	114.4
700	-	-	168.4	119.3	172.4	122.1	175.0	124.0	172.2	121.9	176.8	125.3	179.3	127.0
750	-	-	-	-	-	-	193.1	136.8	189.9	134.5	195.0	138.1	197.7	140.0
800	-	-	-	-	-	-	211.6	149.9	208.3	147.5	213.7	151.4	216.6	153.4
850	-	-	-	-	-	-	-	-	-	-	-	-	236.0	167.1
900	-	-	-	-	-	-	-	-	-	-	-	-	255.9	181.3

W-BS

CONCRETE SCREW W-BS

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: $c_1 \leq c_2$

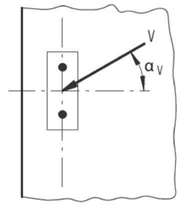
d. Influence of load direction

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

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

W-BS

CONCRETE SCREW W-BS

Mechanical characteristics

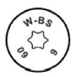
Screw size: Ø 6 – Ø 10

Screw size			Ø 6	Ø 6	Ø 8	Ø 8	Ø 8	Ø 8	Ø 10
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60
Stressed cross section of threaded part									
Stressed cross section	A_s	[mm²]	20.4	20.4	39.6	39.6	39.6	65.0	65.0
Section modulus	W	[mm³]	13.0	13.0	35.1	35.1	35.1	74.0	74.0
Yield strength	f_y	[N/mm²]	560	560	560	560	560	560	560
Tensile strength	f_u	[N/mm²]	700	700	700	700	700	700	700
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	10.9	10.9	26.0	26.0	26.0	56.0	56.0
Partial factor	γ_{Ms}	[-]	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Design bending moment	$M^0_{Rd,s}$	[Nm]	8.7	8.7	20.8	20.8	20.8	44.8	44.8

Screw size: Ø 10 – Ø 14

Screw size			Ø 10	Ø 12	Ø 12	Ø 12	Ø 14	Ø 14	Ø 14
Effective anchorage depth	h_{ef}	[mm]	68	50	67	80	58	79	92
Stressed cross section of threaded part									
Stressed cross section	A_s	[mm²]	65.0	96.8	96.8	96.8	134.8	134.8	134.8
Section modulus	W	[mm³]	74.0	134.3	134.3	134.3	220.7	220.7	220.7
Yield strength	f_y	[N/mm²]	560	560	560	560	560	560	560
Tensile strength	f_u	[N/mm²]	700	700	700	700	700	700	700
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	56.0	113.0	113.0	113.0	185.0	185.0	185.0
Partial factor	γ_{Ms}	[-]	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Design bending moment	$M^0_{Rd,s}$	[Nm]	44.8	90.4	90.4	90.4	148.0	148.0	148.0

Material specifications

Part	Profile	Head configuration	Product description
1			Configuration with metric stud and hexagon socket e.g. W-BS 8x105 Type ST M10 SW5
2			Configuration with metric stud and hexagon drive e.g. W-BS 8x105 Type ST M10 SW7
3			Configuration with washer and hexagon head e.g. W-BS 8x80 Type S SW13
4			Configuration with washer and hexagon head with TX drive e.g. W-BS 8x80 Type S TX 40
5			Configuration with hexagon head e.g. W-BS 80x80 Type S SW13
6			Configuration with countersunk head and TX drive e.g. W-BS 8x80 Type SK TX 40
7			Configuration with pan head and TX drive e.g. W-BS 8x80 Type P TX 40
8			Configuration with large pan head and TX drive e.g. W-BS 8x80 Type P TX 40
9			Configuration with hexagon drive and metric stud e.g. W-BS 6x55 Type ST M8 SW 10
10			Configuration with internal thread and hexa-gon drive e.g. W-BS 6x55 Type I M8/M10

Part	Product name	Material
1–10	**W-BS/S**	- Steel EN 10263-42017 galvanized acc. to EN ISO 4042:2018 - Zinc flake coating according to EN ISO 10683:2018 (≥ 5 µm)
	W-BS/A4	1.4401; 1.4404; 1.4571; 1.4578
	W-BS/HCR	1.4529

CONCRETE SCREW W-BS

Installation parameters

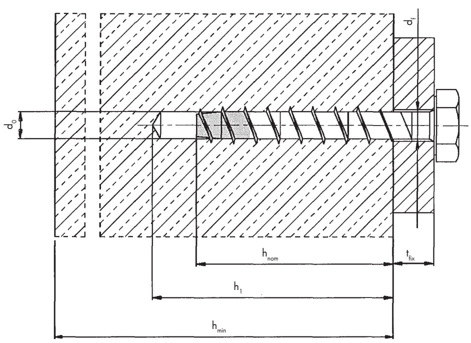
Screw size: Ø 6 – Ø 10

Screw size			**Ø 6**	**Ø 6**	**Ø 8**	**Ø 8**	**Ø 8**	**Ø 10**	**Ø 10**
Nominal embedment depth	h_{nom}	[mm]	40	55	45	55	65	55	75
Nominal drill hole diameter	d_0	[mm]	6		8			10	
Cutting diameter of drill bit	$d_{cut} \geq$	[mm]	6.4		8.45			10.45	
Drill hole depth	$h_1 \geq$	[mm]	45	60	55	65	75	65	85
Diameter of clearance in hole in the fixture	$d_f \leq$	[mm]	8		12			14	
Installation torque (version with connection thread)	T_{inst}	[Nm]	10		20			40	
Torque impact screw driver [1]	$T_{im.max}$	[Nm]	160		300			400	
Minimum thickness of member	h_{min}	[mm]	100		100		120	100	130
Minimum edge distance	c_{min}	[mm]	40		40	50		50	
Minimum spacing	s_{min}	[mm]	40		40	50		50	

Screw size: Ø 10 – Ø 14

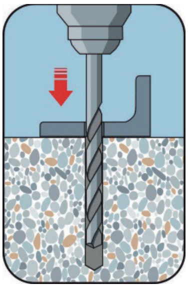
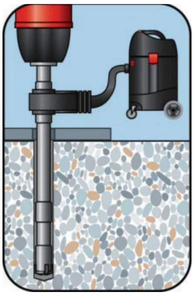
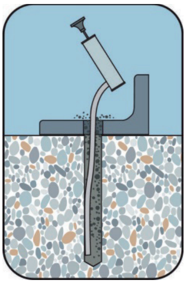
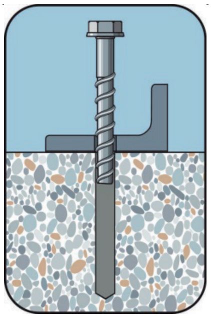
Screw size			**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 14**	**Ø 14**	**Ø 14**
Nominal embedment depth	h_{nom}	[mm]	85	65	85	100	75	100	115
Nominal drill hole diameter	d_0	[mm]	10	12			14		
Cutting diameter of drill bit	$d_{cut} \geq$	[mm]	10.45	12.5			14.5		
Drill hole depth	$h_1 \geq$	[mm]	95	75	95	110	85	110	125
Diameter of clearance in hole in the fixture	$d_f \leq$	[mm]	14	16			18		
Installation torque (version with connection thread)	T_{inst}	[Nm]	40	60			80		
Torque impact screw driver [1]	$T_{im.max}$	[Nm]	400	650			650		
Minimum thickness of member	h_{min}	[mm]	130	120	130	150	130	150	170
Minimum edge distance	c_{min}	[mm]	50	50		70	50	70	
Minimum spacing	s_{min}	[mm]	50	50		70	50	70	

[1] Max. torque according to manufacturer's instructions

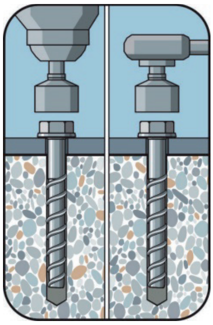
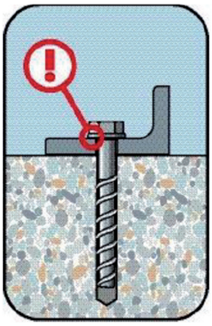
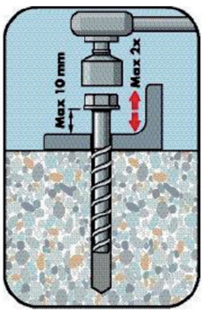
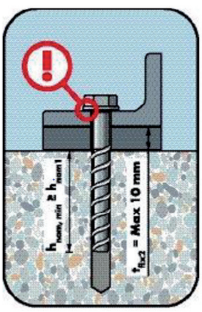


W-BS

Installation instructions

A) Bore hole drilling		
	1a.	**Hammer drilling (HD)** Drill a hole into the base material to the size and embedment depth required by the selected reinforcing bar. Proceed with Step B.
	1b.	**Hollow drill bit system (HDB) (only Ø 8-14)** Drill a hole into the base material to the size and embedment depth required by the selected reinforcing bar. This drilling system removes the dust and cleans the bore hole during drilling. Proceed with Step C.
B) Bore hole cleaning		
	2.	Clean the bore hole from the bottom until the return air stream is without dust.
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.

CONCRETE SCREW W-BS

	**3b.**	Apply the required torque moment using a calibrated torque wrench. Consider $T_{imp,max}$ and T_{inst}.
	**3c.**	Installation was successful when the head of the anchor is fully supported and in contact to the fixture without damaging it.
Adjustability for only screw sizes Ø 8-14		
	**3d.**	The anchor may be adjusted max. two times while the anchor may turn back at most 10 mm.
	**3e.**	Install the screw again after the adjustment. The total allowed thickness of shims added during the adjustment process is 10 mm. The final embedment depth after adjustment process must be equal or larger than h_{nom}.
Note: Adjustment for seismic loading is not allowed.		