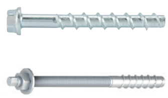
BONDED CONCRETE SCREW WIT-BS XL

150 ml 410 ml

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

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

Cartridge sizes		Art. no.
150 ml	coaxial	**0905 450 301**
410 ml	coaxial	**0905 450 302**

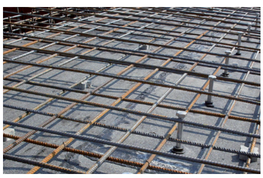
Special insert

✓

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

Drilling method		
Hammer drill	Diamond drill	Hollow drill
✓	✓	–

WIT-BS XL

Applications


Approvals and certificates


Description	Authority/laboratory	No./date of issue
General building authority approval (German)	DIBt, Berlin	Pending

Basic load 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 installation parameters
- 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
- Temperature range I: -40°C to +80°C (max. long term/short term base material temperature +50°C/+80°C)
- Dry or wet conditions of drill hole, hammer drilling
- Installation temperature range +5°C to +40°C

Characteristic loads

Screw size: Ø 10 – Ø 12

Screw Size				Ø 10	Ø 10	Ø 10	Ø 10	Ø 12	Ø 12	Ø 12	Ø 12
Effective anchorage depth		h_{ef}	[mm]	80	90	100	110	100	110	120	130
Non-cracked and cracked concrete											
Tension	C20/25	N_{Rk}	[kN]	24.6	29.4	34.4	39.7	40.7	47.0	53.5	60.3
	C50/60			39.0	42.0	42.0	42.0	64.0	64.0	64.0	64.0
Shear	≥ C20/25	V_{Rk}	[kN]	34.0	34.0	34.0	34.0	42.0	42.0	42.0	42.0

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size				Ø 14/ M16	Ø 14/ M16	Ø 14/ M16	Ø 14/ M16	Ø 16/ M18	Ø 16/ M18	Ø 16/ M18	Ø 16/ M18
Effective anchorage depth		h_{ef}	[mm]	100	110	125	140	100	125	140	160
Non-cracked and cracked concrete											
Tension	C20/25	N_{Rk}	[kN]	40.7	47.0	56.9	67.4	40.7	56.9	67.4	82.4
	C50/60			64.3	74.2	89.9	90.0	64.3	89.9	106.6	110.0
Shear	≥ C20/25	V_{Rk}	[kN]	64.0	64.0	64.0	64.0	81.4	96.0	96.0	96.0

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size				Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24
Effective anchorage depth		h_{ef}	[mm]	100	125	150	200	100	125	150	200
Non-cracked and cracked concrete											
Tension	C20/25	N_{Rk}	[kN]	40.7	56.9	74.8	115.1	40.7	56.9	74.8	115.1
	C50/60			64.3	89.9	118.2	174.0	64.3	89.9	118.2	181.9
Shear	≥ C20/25	V_{Rk}	[kN]	81.4	107.0	107.0	107.0	81.4	107.0	107.0	107.0

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Design loads

Screw size: Ø 10 – Ø 12

Screw Size				**Ø 10**	**Ø 10**	**Ø 10**	**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 12**
Effective anchorage depth		h_{ef}	[mm]	80	90	100	110	100	110	120	130
Non-cracked and cracked concrete											
Tension	C20/25	N_{Rd}	[kN]	16.4	19.6	23.0	26.5	27.1	31.3	35.7	40.2
	C50/60			26.0	30.0	30.0	30.0	42.9	45.7	45.7	45.7
Shear	≥ C20/25	V_{Rd}	[kN]	22.7	22.7	22.7	22.7	28.0	28.0	28.0	28.0

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size				**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**
Effective anchorage depth		h_{ef}	[mm]	100	110	125	140	100	125	140	160
Non-cracked and cracked concrete											
Tension	C20/25	N_{Rd}	[kN]	27.1	31.3	37.9	44.9	27.1	37.9	44.9	54.9
	C50/60			42.9	49.5	60.0	64.3	42.9	60.0	71.1	73.3
Shear	≥ C20/25	V_{Rd}	[kN]	42.7	42.7	42.7	42.7	54.3	64.0	64.0	64.0

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size				**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**
Effective anchorage depth		h_{ef}	[mm]	100	125	150	200	100	125	150	200
Non-cracked and cracked concrete											
Tension	C20/25	N_{Rd}	[kN]	27.1	37.9	49.8	76.7	27.1	37.9	49.8	76.7
	C50/60			42.9	60.0	78.8	116.0	42.9	60.0	78.8	121.2
Shear	≥ C20/25	V_{Rd}	[kN]	54.3	71.3	71.3	71.3	54.3	71.3	71.3	71.3

Recommended/allowable loads [1)]

Screw size: Ø 10 – Ø 12

Screw Size				**Ø 10**	**Ø 10**	**Ø 10**	**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 12**
Effective anchorage depth		h_{ef}	[mm]	80	90	100	110	100	110	120	130
Non-cracked and cracked concrete											
Tension	C20/25	N_{rec}	[kN]	11.7	14.0	16.4	18.9	19.4	22.4	25.5	28.7
	C50/60			18.6	21.4	21.4	21.4	30.6	32.7	32.7	32.7
Shear	≥ C20/25	V_{rec}	[kN]	16.2	16.2	16.2	16.2	20.0	20.0	20.0	20.0

[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.

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size				**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**
Effective anchorage depth		h_{ef}	[mm]	100	110	125	140	100	125	140	160
Non-cracked and cracked concrete											
Tension	C20/25	N_{rec}	[kN]	19.4	22.4	27.1	32.1	19.4	27.1	32.1	39.2
	C50/60			30.6	35.4	42.8	45.9	30.6	42.8	50.8	52.4
Shear	≥ C20/25	V_{rec}	[kN]	30.5	30.5	30.5	30.5	38.8	45.7	45.7	45.7

[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 22/M20 – Ø 22/M24

Screw Size				**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**
Effective anchorage depth		h_{ef}	[mm]	100	125	150	200	100	125	150	200
Non-cracked and cracked concrete											
Tension	C20/25	N_{rec}	[kN]	19.4	27.1	35.6	54.8	19.4	27.1	35.6	54.8
	C50/60			30.6	42.8	56.3	82.9	30.6	42.8	56.3	86.6
Shear	≥ C20/25	V_{rec}	[kN]	38.8	51.0	51.0	51.0	38.8	51.0	51.0	51.0

[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.

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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

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 10 – Ø 12

Screw Size			**Ø 10**	**Ø 10**	**Ø 10**	**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 12**
Effective anchorage depth	h_{ef}	[mm]	80	90	100	110	100	110	120	130
Design steel resistance	$N_{Rd,s}$	[kN]	30.0	30.0	30.0	30.0	45.7	45.7	45.7	45.7

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size			**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**
Effective anchorage depth	h_{ef}	[mm]	100	110	125	140	100	125	140	160
Design steel resistance	$N_{Rd,s}$	[kN]	64.3	64.3	64.3	64.3	73.3	73.3	73.3	73.3

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size			**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**
Effective anchorage depth	h_{ef}	[mm]	100	125	150	200	100	125	150	200
Design steel resistance	$N_{Rd,s}$	[kN]	116.0	116.0	116.0	116.0	142.7	142.7	142.7	142.7

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 10 – Ø 12

Screw Size			**Ø 10**	**Ø 10**	**Ø 10**	**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 12**
Effective anchorage depth	h_{ef}	[mm]	80	90	100	110	100	110	120	130
Non-cracked and cracked concrete										
Combined pull-out / breakout resistance	$N^0_{Rd,p}$	[kN]	26.5	26.5	26.5	26.5	40.2	40.2	40.2	40.2

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size			**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**
Effective anchorage depth	h_{ef}	[mm]	100	110	125	140	100	125	140	160
Non-cracked and cracked concrete										
Combined pull-out / breakout resistance	$N^0_{Rd,p}$	[kN]	44.9	44.9	44.9	44.9	54.9	54.9	54.9	54.9

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size			**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**
Effective anchorage depth	h_{ef}	[mm]	100	125	150	200	100	125	150	200
Non-cracked and cracked concrete										
Combined pull-out / breakout resistance	$N^0_{Rd,p}$	[kN]	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7

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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	1.12	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

Screw size: Ø 10 – Ø 12

Screw Size			Ø 10	Ø 10	Ø 10	Ø 10	Ø 12	Ø 12	Ø 12	Ø 12
Effective anchorage depth	h_{ef}	[mm]	80	90	100	110	100	110	120	130
Non-cracked and cracked concrete										
Concrete cone resistance	$N^0_{Rd,c}$	[kN]	16.4	19.6	23.0	26.5	27.1	31.3	35.7	40.2

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size			Ø 14/ M16	Ø 14/ M16	Ø 14/ M16	Ø 14/ M16	Ø 16/ M18	Ø 16/ M18	Ø 16/ M18	Ø 16/ M18
Effective anchorage depth	h_{ef}	[mm]	100	110	125	140	100	125	140	160
Non-cracked and cracked concrete										
Concrete cone resistance	$N^0_{Rd,c}$	[kN]	27.1	31.3	37.9	44.9	27.1	37.9	44.9	54.9

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size			Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24
Effective anchorage depth	h_{ef}	[mm]	100	125	150	200	100	125	150	200
Non-cracked and cracked concrete										
Concrete cone resistance	$N^0_{Rd,c}$	[kN]	27.1	37.9	49.8	76.7	27.1	37.9	49.8	76.7

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

Screw size: Ø 10 – Ø 12

Screw Size			Ø 10	Ø 10	Ø 10	Ø 10	Ø 12	Ø 12	Ø 12	Ø 12
Effective anchorage depth	h_{ef}	[mm]	80	90	100	110	100	110	120	130
Spacing	$s_{cr,N}$	[mm]	240	270	300	330	300	330	360	390
Edge distance	$c_{cr,N}$	[mm]	120	135	150	165	150	165	180	195

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size			Ø 14/ M16	Ø 14/ M16	Ø 14/ M16	Ø 14/ M16	Ø 16/ M18	Ø 16/ M18	Ø 16/ M18	Ø 16/ M18
Effective anchorage depth	h_{ef}	[mm]	100	110	125	140	100	125	140	160
Spacing	$s_{cr,N}$	[mm]	300	330	375	420	300	375	420	480
Edge distance	$c_{cr,N}$	[mm]	150	165	188	210	150	188	210	240

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size			Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24
Effective anchorage depth	h_{ef}	[mm]	100	125	150	200	100	125	150	200
Spacing	$s_{cr,N}$	[mm]	300	375	450	600	300	375	450	600
Edge distance	$c_{cr,N}$	[mm]	150	188	225	300	150	188	225	300

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	1.12	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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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
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

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 10 – Ø 12

Screw Size			**Ø 10**	**Ø 10**	**Ø 10**	**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 12**
Effective anchorage depth	h_{ef}	[mm]	80	90	100	110	100	110	120	130
Non-cracked and cracked concrete										
Design splitting resistance	$N^0_{Rd,sp}$	[kN]	16.4	19.6	23.0	26.5	27.1	31.3	35.7	40.2

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size			**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**
Effective anchorage depth	h_{ef}	[mm]	100	110	125	140	100	125	140	160
Non-cracked and cracked concrete										
Design splitting resistance	$N^0_{Rd,sp}$	[kN]	27.1	31.3	37.9	44.9	27.1	37.9	44.9	54.9

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size			**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**
Effective anchorage depth	h_{ef}	[mm]	100	125	150	200	100	125	150	200
Non-cracked and cracked concrete										
Design splitting resistance	$N^0_{Rd,sp}$	[kN]	27.1	37.9	49.8	76.7	27.1	37.9	49.8	76.7

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

Screw size: Ø 10 – Ø 12

Screw Size			**Ø 10**	**Ø 10**	**Ø 10**	**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 12**
Effective anchorage depth	h_{ef}	[mm]	80	90	100	110	100	110	120	130
Characteristic spacing	$s_{cr,sp}$	[mm]	320	360	400	440	400	440	480	520
Characteristic edge distance	$c_{cr,sp}$	[mm]	160	180	200	220	200	220	240	260
Minimum member thickness	h_{min}	[mm]	140	150	160	170	160	170	180	190

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size			**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**
Effective anchorage depth	h_{ef}	[mm]	100	110	125	140	100	125	140	160
Characteristic spacing	$s_{cr,sp}$	[mm]	400	440	500	560	400	500	560	640
Characteristic edge distance	$c_{cr,sp}$	[mm]	200	220	250	280	200	250	280	320
Minimum member thickness	h_{min}	[mm]	170	180	195	210	170	195	210	230

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size			**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**
Effective anchorage depth	h_{ef}	[mm]	100	125	150	200	100	125	150	200
Characteristic spacing	$s_{cr,sp}$	[mm]	400	500	600	800	400	500	600	800
Characteristic edge distance	$c_{cr,sp}$	[mm]	200	250	300	400	200	250	300	400
Minimum member thickness	h_{min}	[mm]	200	225	250	300	200	225	250	300

BONDED CONCRETE SCREW WIT-BS XL

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	1.12	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

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. Steel resistance

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

Screw size: Ø 10 – Ø 12

Screw Size			**Ø 10**	**Ø 10**	**Ø 10**	**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 12**
Effective anchorage depth	h_{ef}	[mm]	80	90	100	110	100	110	120	130
Design steel resistance	$V_{Rd,s}$	[kN]	22.7	22.7	22.7	22.7	28.0	28.0	28.0	28.0

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size			**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**
Effective anchorage depth	h_{ef}	[mm]	100	110	125	140	100	125	140	160
Design steel resistance	$V_{Rd,s}$	[kN]	42.7	42.7	42.7	42.7	64.0	64.0	64.0	64.0

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size			**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M20**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**	**Ø 22/ M24**
Effective anchorage depth	h_{ef}	[mm]	100	125	150	200	100	125	150	200
Design steel resistance	$V_{Rd,s}$	[kN]	71.3	71.3	71.3	71.3	71.3	71.3	71.3	71.3

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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 10 – Ø 12

Screw Size			**Ø 10**	**Ø 10**	**Ø 10**	**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 12**
Effective anchorage depth	h_{ef}	[mm]	80	90	100	110	100	110	120	130
Concrete pry-out resistance factor	k_8	[-]	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Screw size: Ø 14/M16 – Ø 16/M18

Screw Size			**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**
Effective anchorage depth	h_{ef}	[mm]	100	110	125	140	100	125	140	160
Concrete pry-out resistance factor	k_8	[-]	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Screw size: Ø 22/M20 – Ø 22/M24

Screw Size			**22/ M20**	**22/ M20**	**22/ M20**	**22/ M20**	**22/ M24**	**22/ M24**	**22/ M24**	**22/ M24**
Effective anchorage depth	h_{ef}	[mm]	100	125	150	200	100	125	150	200
Concrete pry-out resistance factor	k_8	[-]	2.0	2.0	2.0	2.0	2.0	2.0	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 $c \geq \max(10\, h_{ef}\,;\, 60\, d)$. 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

Screw size: Ø 10 – Ø 16/M18

Screw Size	Ø 10	Ø 10	Ø 10	Ø 10	Ø 12	Ø 12	Ø 12	Ø 12	Ø 14/ M16	Ø 14/ M16	Ø 14/ M16	Ø 14/ M16	Ø 16/ M18	Ø 16/ M18
h_{ef} [mm]	80	90	100	110	100	110	120	130	100	110	125	140	100	125
	Cracked Concrete													
Edge distance c_1	$V^0_{Rd,c}$													
40	2.5	2.5	2.6	2.7	-	-	-	-	-	-	-	-	-	-
45	2.9	3.0	3.0	3.1	-	-	-	-	-	-	-	-	-	-
50	3.3	3.4	3.5	3.5	3.6	3.7	3.8	3.9	-	-	-	-	-	-
55	3.7	3.8	3.9	4.0	4.1	4.2	4.2	4.3	-	-	-	-	-	-
60	4.2	4.3	4.4	4.5	4.5	4.6	4.7	4.8	4.7	4.8	4.9	5.1	-	-
65	4.6	4.7	4.9	5.0	5.0	5.1	5.2	5.3	5.2	5.3	5.5	5.6	-	-
70	5.1	5.2	5.3	5.4	5.5	5.6	5.8	5.9	5.7	5.8	6.0	6.2	5.8	6.2
75	5.6	5.7	5.8	6.0	6.0	6.2	6.3	6.4	6.2	6.3	6.5	6.7	6.4	6.7
80	6.1	6.2	6.4	6.5	6.6	6.7	6.8	6.9	6.7	6.9	7.1	7.3	6.9	7.3
85	6.6	6.7	6.9	7.0	7.1	7.2	7.4	7.5	7.3	7.4	7.7	7.9	7.5	7.9
90	7.1	7.3	7.4	7.6	7.6	7.8	7.9	8.1	7.9	8.0	8.2	8.5	8.0	8.4
95	7.7	7.8	8.0	8.1	8.2	8.4	8.5	8.7	8.4	8.6	8.8	9.1	8.6	9.0
100	8.2	8.4	8.5	8.7	8.8	8.9	9.1	9.3	9.0	9.2	9.4	9.7	9.2	9.7
110	9.3	9.5	9.7	9.8	10.0	10.1	10.3	10.5	10.2	10.4	10.7	10.9	10.4	10.9
120	10.5	10.7	10.9	11.1	11.2	11.4	11.6	11.7	11.4	11.6	11.9	12.2	11.7	12.2
130	11.7	11.9	12.1	12.3	12.4	12.6	12.8	13.0	12.7	12.9	13.3	13.6	13.0	13.5
140	12.9	13.2	13.4	13.6	13.7	14.0	14.2	14.4	14.0	14.3	14.6	14.9	14.3	14.9
150	14.2	14.5	14.7	14.9	15.1	15.3	15.5	15.7	15.4	15.6	16.0	16.3	15.7	16.3
160	15.5	15.8	16.0	16.3	16.4	16.7	16.9	17.1	16.8	17.0	17.4	17.8	17.1	17.8
170	16.9	17.1	17.4	17.7	17.8	18.1	18.3	18.6	18.2	18.5	18.9	19.3	18.5	19.3
180	18.2	18.5	18.8	19.1	19.3	19.5	19.8	20.1	19.6	19.9	20.4	20.8	20.0	20.8
190	19.7	20.0	20.3	20.5	20.7	21.0	21.3	21.6	21.1	21.4	21.9	22.3	21.5	22.3
200	21.1	21.4	21.7	22.0	22.2	22.5	22.8	23.1	22.6	23.0	23.5	23.9	23.0	23.9
250	28.7	29.1	29.5	29.9	30.1	30.5	30.9	31.2	30.7	31.1	31.7	32.2	31.1	32.2
300	37.0	37.5	38.0	38.4	38.7	39.2	39.6	40.1	39.4	39.9	40.6	41.2	39.9	41.2
350	45.9	46.5	47.1	47.6	47.9	48.5	49.0	49.5	48.7	49.3	50.1	50.8	49.3	50.8
400	55.4	56.1	56.7	57.3	57.7	58.3	58.9	59.5	58.6	59.2	60.2	61.0	59.3	61.0
450	65.4	66.2	66.9	67.5	68.0	68.7	69.4	70.0	69.0	69.7	70.8	71.8	69.8	71.7
500	75.9	76.8	77.5	78.3	78.8	79.6	80.3	81.0	79.9	80.7	81.9	83.0	80.8	83.0
550	86.9	87.8	88.7	89.5	90.1	90.9	91.7	92.5	91.3	92.2	93.5	94.7	92.3	94.7
600	98.3	99.3	100.3	101.1	101.8	102.7	103.6	104.5	103.1	104.1	105.5	106.8	104.3	106.8
650	110.1	111.2	112.3	113.2	113.9	115.0	115.9	116.9	115.4	116.5	118.0	119.4	116.6	119.4
700	122.4	123.6	124.7	125.7	126.5	127.6	128.6	129.6	128.0	129.2	130.9	132.4	129.4	132.4
750	135.0	136.3	137.5	138.6	139.4	140.6	141.8	142.8	141.1	142.4	144.2	145.8	142.6	145.8
800	148.0	149.4	150.7	151.9	152.8	154.0	155.3	156.4	154.6	155.9	157.8	159.6	156.1	159.6
850	-	162.9	164.3	165.5	166.5	167.8	169.1	170.4	168.4	169.8	171.9	173.7	170.1	173.7
900	-	176.7	178.2	179.6	180.5	182.0	183.4	184.7	182.6	184.1	186.3	188.3	184.4	188.3
950	-	-	192.5	193.9	194.9	196.5	197.9	199.3	197.1	198.7	201.0	203.1	199.0	203.1
1000	-	-	207.1	208.6	209.7	211.3	212.9	214.3	212.0	213.7	216.1	218.3	214.0	218.3
1100	-	-	-	239.0	-	242.0	243.7	245.3	-	244.6	247.3	249.8	-	249.8
1200	-	-	-	-	-	-	275.8	277.5	-	-	279.7	282.4	-	282.4
1300	-	-	-	-	-	-	-	311.0	-	-	-	316.3	-	-
1400	-	-	-	-	-	-	-	-	-	-	-	351.4	-	-

BONDED CONCRETE SCREW WIT-BS XL

Screw size: Ø 16/M18 – Ø 22/M24

Screw Size	Ø 16/ M18	Ø 16/ M18	Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24
h_{ef} [mm]	140	160	100	125	150	200	100	125	150	200
	Cracked Concrete									
Edge distance c_1	$V^0_{Rd,c}$									
[mm]	[kN]									
70	6.3	6.6	-	-	-	-	-	-	-	-
75	6.9	7.2	-	-	-	-	-	-	-	-
80	7.5	7.8	7.3	7.7	8.2	8.9	7.3	7.7	8.2	8.9
85	8.1	8.4	7.9	8.4	8.8	9.6	7.9	8.4	8.8	9.6
90	8.7	9.0	8.5	9.0	9.4	10.2	8.5	9.0	9.4	10.2
95	9.3	9.6	9.1	9.6	10.1	10.9	9.1	9.6	10.1	10.9
100	9.9	10.2	9.7	10.2	10.7	11.6	9.7	10.2	10.7	11.6
110	11.2	11.5	11.0	11.5	12.1	13.0	11.0	11.5	12.1	13.0
120	12.5	12.9	12.3	12.9	13.5	14.5	12.3	12.9	13.5	14.5
130	13.9	14.3	13.6	14.3	14.9	16.0	13.6	14.3	14.9	16.0
140	15.3	15.7	15.0	15.7	16.3	17.5	15.0	15.7	16.3	17.5
150	16.7	17.1	16.4	17.2	17.8	19.1	16.4	17.2	17.8	19.1
160	18.2	18.6	17.9	18.7	19.4	20.7	17.9	18.7	19.4	20.7
170	19.7	20.2	19.3	20.2	21.0	22.3	19.3	20.2	21.0	22.3
180	21.2	21.7	20.9	21.7	22.6	24.0	20.9	21.7	22.6	24.0
190	22.8	23.3	22.4	23.3	24.2	25.7	22.4	23.3	24.2	25.7
200	24.4	25.0	24.0	25.0	25.9	27.5	24.0	25.0	25.9	27.5
250	32.8	33.5	32.3	33.5	34.6	36.6	32.3	33.5	34.6	36.6
300	41.9	42.8	41.4	42.8	44.1	46.4	41.4	42.8	44.1	46.4
350	51.6	52.6	51.0	52.7	54.2	56.9	51.0	52.7	54.2	56.9
400	61.9	63.1	61.2	63.2	64.9	67.9	61.2	63.2	64.9	67.9
450	72.8	74.1	72.0	74.1	76.1	79.4	72.0	74.1	76.1	79.4
500	84.1	85.5	83.3	85.6	87.8	91.5	83.3	85.6	87.8	91.5
550	95.9	97.5	95.0	97.6	100.0	104.1	95.0	97.6	100.0	104.1
600	108.2	109.9	107.2	110.1	112.6	117.1	107.2	110.1	112.6	117.1
650	120.9	122.8	119.8	122.9	125.7	130.5	119.8	122.9	125.7	130.5
700	134.0	136.0	132.9	136.2	139.2	144.4	132.9	136.2	139.2	144.4
750	147.5	149.7	146.3	149.9	153.1	158.6	146.3	149.9	153.1	158.6
800	161.4	163.7	160.1	164.0	167.4	173.3	160.1	164.0	167.4	173.3
850	175.7	178.2	174.3	178.4	182.0	188.3	174.3	178.4	182.0	188.3
900	190.4	193.0	188.9	193.2	197.1	203.7	188.9	193.2	197.1	203.7
950	205.4	208.1	203.8	208.4	212.5	219.5	203.8	208.4	212.5	219.5
1000	220.7	223.6	219.1	223.9	228.2	235.6	219.1	223.9	228.2	235.6
1100	252.4	255.5	250.6	255.9	260.6	268.8	250.6	255.9	260.6	268.8
1200	285.3	288.8	283.3	289.2	294.4	303.3	283.3	289.2	294.4	303.3
1300	319.4	323.2	317.3	323.7	329.3	339.0	317.3	323.7	329.3	339.0
1400	354.7	358.8	-	-	365.5	375.9	-	-	365.5	375.9
1500	-	395.6	-	-	402.7	413.9	-	-	402.7	413.9
1600	-	433.4	-	-	-	453.0	-	-	-	453.0
1700	-	-	-	-	-	493.2	-	-	-	493.2
1800	-	-	-	-	-	534.4	-	-	-	534.4
1900	-	-	-	-	-	576.6	-	-	-	576.6
2000	-	-	-	-	-	619.8	-	-	-	619.8

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	1.12	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

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

Table 20: Influence of edge distance on concrete edge resistance

c_2/c_1 [1)]	1.00	1.10	1.20	1.30	1.40	1.50
$f_{c,V}$	0.75	0.80	0.85	0.90	0.95	1.00

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

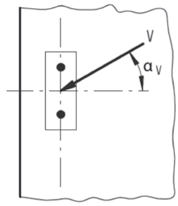
d. Influence of load direction

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

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	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	≥ 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

BONDED CONCRETE SCREW WIT-BS XL

Mechanical characteristics

Screw size: Ø 10 – Ø 12

Screw size			**Ø 10**	**Ø 10**	**Ø 10**	**Ø 10**	**Ø 12**	**Ø 12**	**Ø 12**	**Ø 12**
Effective anchorage depth	h_{ef}	[mm]	80	90	100	110	100	110	120	130
Stressed cross section of threaded part										
Stressed cross section	A_s	[mm²]	65.0	65.0	65.0	65.0	96.8	96.8	96.8	96.8
Section modulus	W	[mm³]	74.0	74.0	74.0	74.0	134.3	134.3	134.3	134.3
Yield strength	f_y	[N/mm²]	640	640	640	640	640	640	640	640
Tensile strength	f_u	[N/mm²]	800	800	800	800	800	800	800	800
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	56.0	56.0	56.0	56.0	123.0	123.0	123.0	123.0
Partial factor tension direction	γ_{Ms}	[-]	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Partial factor shear direction	γ_{Ms}	[-]	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Design bending moment	$M^0_{Rd,s}$	[Nm]	37.3	37.3	37.3	37.3	82.0	82.0	82.0	82.0

Screw size: Ø 14/M16 – Ø 16/M18

Screw size			**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 14/ M16**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**	**Ø 16/ M18**
Effective anchorage depth	h_{ef}	[mm]	100	110	125	140	100	125	140	160
Stressed cross section of threaded part										
Stressed cross section	A_s	[mm²]	134.8	134.8	134.8	134.8	172.0	172.0	172.0	172.0
Section modulus	W	[mm³]	220.7	220.7	220.7	220.7	318.3	318.3	318.3	318.3
Yield strength	f_y	[N/mm²]	640	640	640	640	640	640	640	640
Tensile strength	f_u	[N/mm²]	800	800	800	800	800	800	800	800
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	200.0	200.0	200.0	200.0	347.0	347.0	347.0	347.0
Partial factor tension direction	γ_{Ms}	[-]	1.40	1.40	1.40	1.40	1.50	1.50	1.50	1.50
Partial factor shear direction	γ_{Ms}	[-]	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Design bending moment	$M^0_{Rd,s}$	[Nm]	133.3	133.3	133.3	133.3	231.3	231.3	231.3	231.3

Screw size: Ø 22/M20 – Ø 22/M24

Screw size			Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M20	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24	Ø 22/ M24
Effective anchorage depth	h_{ef}	[mm]	100	125	150	200	100	125	150	200
Stressed cross section of threaded part										
Stressed cross section	A_s	[mm²]	330.1	330.1	330.1	330.1	330.1	330.1	330.1	330.1
Section modulus	W	[mm³]	845.8	845.8	845.8	845.8	845.8	845.8	845.8	845.8
Yield strength	f_y	[N/mm²]	640	640	640	640	640	640	640	640
Tensile strength	f_u	[N/mm²]	800	800	800	800	800	800	800	800
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	730.0	730.0	730.0	730.0	730.0	730.0	730.0	730.0
Partial factor tension direction	γ_{Ms}	[-]	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Partial factor shear direction	γ_{Ms}	[-]	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Design bending moment	$M^0_{Rd,s}$	[Nm]	486.7	486.7	486.7	486.7	486.7	486.7	486.7	486.7

Material specifications

Product name	Material
W-BS/S	- Steel EN 10263-4: 2018 galvanized acc. to EN ISO 4042:2018-11 - Zinc flake coating according to EN ISO 10683:2018-11 (≥ 5 µm)
W-BS/A4	1.4401; 1.4404; 1.4571; 1.4578
W-BS/HCR	1.4529

Working and curing times

Temperature of base material	Gelling – working time	Min. curing time – dry conditions[1)]
–5 °C to –1 °C	60 min	360 min
0 °C to 4 °C	60 min	180 min
5 °C to 9 °C	60 min	120 min
10 °C to 19 °C	45 min	80 min
20 °C to 29 °C	15 min	45 min
30 °C to 34 °C	5 min	25 min
≥ 35 °C	4 min	20 min

[1)] for wet base material the curing time must be doubled

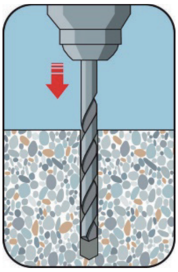
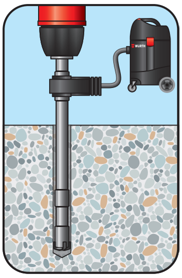
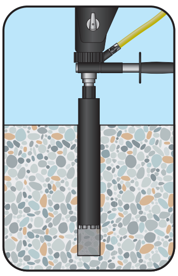
BONDED CONCRETE SCREW WIT-BS XL

Installation parameters

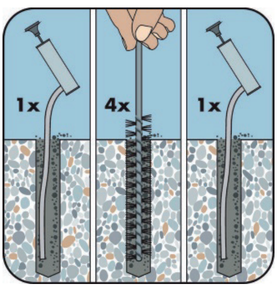
Screw type: W-BS XL, Ø 10 – Ø 22

Screw size			**Ø 10**	**Ø 12**	**Ø 14**	**Ø 16**	**Ø 22**
Effective anchorage depth	$h_{ef,min}$	[mm]	80	100	100	100	100
Nominal drill hole diameter	d_0	[mm]	10	12	14	16	22
Drill cuting diameter	$d_{cut} \leq$	[mm]	10.45	12.5	14.5	16.5	22.55
Drill-hole depth	$h_0 \geq$	[mm]	80	100	100	100	100
Diameter of steel brush	$d_b \geq$	[mm]	11	13	15	18	24
Diameter of clearance in hole	$d_f \leq$	[mm]	14	16	18	20	26
Maximum torque moment	$T_{inst} \leq$	[Nm]	40	60	80	100	200
Tangential impact wrench		[Nm]	Max. Nominal torque according to the manufacturer's information				
			400	650	650	650	1000
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 60		h_{ef} + 70		h_{ef} + 100
Minimum spacing	s_{min}	[mm]	40	50	60	70	80
Minimum edge distance	c_{min}	[mm]	40	50	60	70	80

Installation instructions

A) Bore hole drilling		
	**1a.**	**Hammer (HD) or compressed air drilling (CD)** Drill a hole into the base material to the size and embedment depth required by the selected reinforcing bar. Proceed with Step B1.
	**1b.**	**Hollow drill bit system (HDB)** 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.
	**1c.**	**Diamond drilling (DD)** Drill with diamond drill a hole into the base material to the size and embedment depth required by the selected anchor. Proceed with Step B2. In case of aborted drill hole, the drill hole shall be filled with mortar.

Attention! Standing water in the bore hole must be removed before cleaning.

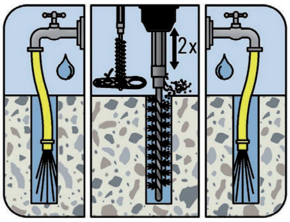
B1) Bore hole cleaning		
CAC: Cleaning for dry, wet and water-filled bore holes with all diameter in non-cracked and cracked concrete		
	**2a.**	Starting from the bottom or back of the bore hole, blow the hole clean using a hand pump.
	2b.	Check brush diameter. Brush the hole with an appropriate sized wire brush > $d_{b,min}$ a minimum of <u>four</u> times. If the bore hole ground is not reached with the brush, a brush extension shall be used. Cleaning with a brush attached to a drilling machine or battery screwdriver is also possible.
	2c.	Finally blow the hole clean again with a hand pump.

After cleaning, the bore hole has to be protected against re-contamination in an appropriate way until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must no contaminate the bore hole again.

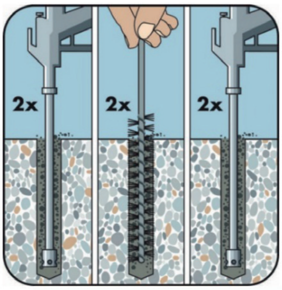
BONDED CONCRETE SCREW WIT-BS XL

B2) Bore hole cleaning

SPCAC: Cleaning for dry, wet and water-filled bore holes for all diameters in non-cracked concrete



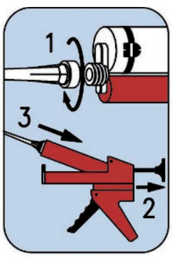
2a.	Rinsing with water until clear water comes out.
2b.	Check the brush diameter. Brush the hole with an appropriate sized wire brush > $d_{b,min}$ a minimum of <u>two</u> times in a twisting motion. If the bore hole ground is not reached with the brush, a brush extension must be used.
2c.	Rinsing again with water until clear water comes out.



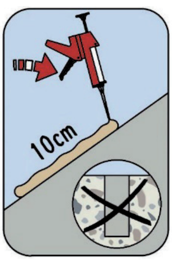
2a.	Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) a minimum of $_{two}$ times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used.
2b.	Check brush diameter. Brush the hole with an appropriate sized wire brush > $d_{b,min}$ a minimum of <u>two</u> times. If the bore hole ground is not reached with the brush, a brush extension shall be used. Cleaning with a brush attached to a drilling machine or battery screwdriver is also possible.
2c.	Finally blow the hole clean again with compressed air (min. 6 bar) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached, an extension shall be used.

After cleaning, the bore hole has to be protected against re-contamination in an appropriate way until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must no contaminate the bore hole again.

C) Preparation of bar and cartridge

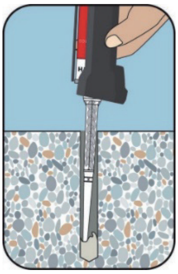
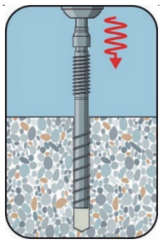
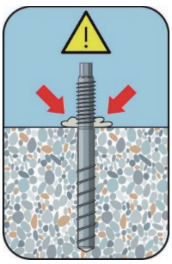
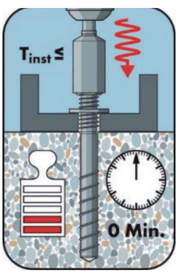
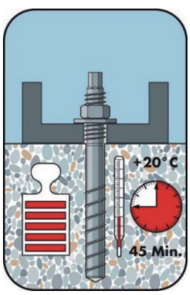


3a.	Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. For every working interruption longer than the recommended working time as well as for every new cartridge, a new static-mixer shall be used.

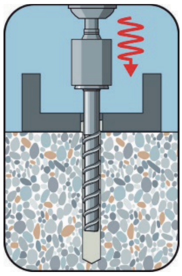
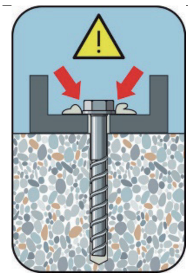
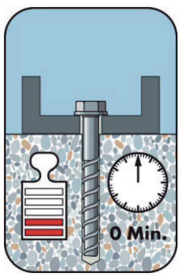
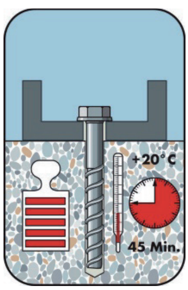


3b.	Prior to dispensing into the bore hole, squeeze out separately the mortar until it shows a consistent grey or red color (minimum of three full strokes) and discard non-uniformly mixed adhesive components.

WIT-BS XL

D) Filling the bore hole		
	**4.**	Starting from the bottom or back of the cleaned bore hole, fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used. Observe the gel-/working times.
E) Setting the Screw (Pre-positioned) or F) for Push-through		
	**5a.**	Screw in the concrete screw using a tangential impact wrench. Note the nominal torque of the tangential impact wrench.
	**5b.**	After reaching the screw-in depth, the composite mortar must emerge on the concrete surface.
	**5c.**	The attachment can be installed immediately. The concrete screw can be loaded immediately with the design load.
	**5d.**	After the full curing time has been reached, the concrete screw may be loaded with the maximum design load. The curing time must be observed accordingly.

BONDED CONCRETE SCREW WIT-BS XL

F) Setting the Screw (Push-through installation)		
	**5a.**	Screw in the concrete screw using a tangential impact wrench. Note the nominal torque of the tangential impact wrench.
	**5b.**	After reaching the screw-in depth, the composite mortar must emerge on the concrete surface
	**5c.**	The attachment can be installed immediately. The concrete screw can be loaded immediately with the design load.
	**5d.**	After the full curing time has been reached, the concrete screw may be loaded with the maximum design load. The curing time must be observed accordingly.

Filling Quantity

Screw type: W-BS XL, Ø 10 – Ø 22

Screw size			Ø 10	Ø 12	Ø 14	Ø 16	Ø 22
Nominal drill hole diameter	d_0	[mm]	10	12	14	18	22
Drill depth	h_0 / h_1	[mm]	= h_{ef}				
Filling volume per 10 mm embedment depth		[ml]	0.09	0.11	0.12	0.14	0.31

Assumed waste of 15 % included.