

WPER500-S Chemical Anchoring System

Ultimate performance chemical anchoring system for cracked concrete and rebar connections

Walraven Injection System



Side-by-side Cartridge
WPER500-S 585ml

System Accessories

WIS BRS Brushes
WIS Dispensing Guns
WIS EF Mixer Nozzles
WIS Extension Pipes
WIS Threaded Rods

- WPER500-S is the ultimate performance pure-epoxy based chemical anchoring system for extreme loads and maximum load safety. It is approved for installations in cracked and non-cracked concrete under normal and seismic C1 and C2 conditions and for post-installed rebar connections' applications.
- WPER500-S has a market-leading performance in its product class.

Features and benefits

- ETA Option 1 approval for cracked and non-cracked concrete
- ETA TR023 for post-installed rebar connections
- Seismic performance categories C1 and C2 for design of anchorages under seismic actions
- ETA-approved for 100 years' service life
- Reduced concrete edge and anchor spacing distances
- Reduced drilling diameter for M20 and M24, resulting in 50% product saving during installation
- Cartridge may be used up over several times (each installation after a break requires a new mixing nozzle)
- Always correct mixing ratio thanks to the static mixer nozzle
- Installations in flooded holes without any negative effect on performance
- WRAS Material Approval for contact with potable water
- LEED v4.1 attestation
- A+ VOC emissions class

Suitable base materials



Concrete
(cracked)



Concrete
(non-cracked)

Approvals and certificates

- European Technical Assessment
Cracked and non-cracked concrete, M8-M30
- European Technical Assessment
Post-installed rebar connections
- LEED v4.1
- VOC Emissions Test Report
- WRAS Material Approval
for contact with drinking water
- ETA-19/0641 of 13/10/2019
- ETA 19/0640 of 13/10/2019
- 392-2017-10347007_H_EN_05
- 392-2015-0034601_E_EN_04
- MA5306/D, of 21/02/2020



Storage conditions and shelf life

Store in cool, dry place, out of direct sunlight or other sources of heat, within +5 °C to +25 °C temperature. Expiry date and batch number are printed on each cartridge.

1. Product and packaging details

Article	Description	Pack 1		Pack 2	
		[pcs]	EAN13	[pcs]	EAN13
6099160	WPER500-S 585ml	1	8719942030502	12	8719942030519

2. System accessories

Article	Description	For	Pack 1	
			[pcs]	EAN13
6099989	WIS Dispenser Gun	WPER500-S 585ml	1	8712993160211
6099363	WIS EF Mixer Nozzle	WPER500-S 585ml	12	8719942030663
6099992	WIS Extension Pipe	WIS Standard Nozzle	10	8712993160105
6099320	WIS BRS Brush 14mm	For M10 threaded rods	10	8719942030564
6099321	WIS BRS Brush 16mm	For M12 threaded rods	10	8719942030588
6099322	WIS BRS Brush 20mm	For M16 threaded rods	10	8719942030601
6099323	WIS BRS Brush 22mm	For M20 threaded rods	10	8719942030625
6099324	WIS BRS Brush 24mm	For M24 threaded rods	10	8719942030649

3. Installation data

3.1 Installation parameters for threaded rods in concrete

Anchor Type			WPER500-S							
			M8	M10	M12	M16	M20	M24	M27	M30
Anchor Size			M8	M10	M12	M16	M20	M24	M27	M30
Drill hole diameter	d_0	[mm]	10	12	14	18	22	26	30	35
Cleaning brush	d_b	[mm]	11	14	14/15	22	24	31	31	38
Installation torque	T_{inst}	[mm]	10	20	40	80	120	160	180	200
Embedment depth, min	$h_{ef,min}$	[mm]	60	60	70	80	90	96	108	120
Embedment depth, max	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Depth of drill hole	h_0	[mm]	$h_{ef} + 5mm$							
Min. edge distance	C_{min}	[mm]	40	40	40	40	50	50	50	60
Min. spacing	S_{min}	[mm]	40	40	40	40	50	50	50	60
Min. concrete member thickness	h_{min}	[mm]	$h_{ef} + 30mm \geq 100mm$			$h_{ef} + 2 d_0$				
Critical edge spacing distance for splitting failure	$C_{cr,sp}$	[mm]	$2 \cdot h_{ef}$							
Critical spacing distance for splitting failure	$S_{cr,sp}$	[mm]	$2 \cdot C_{cr,sp}$							
Critical edge spacing distance for concrete cone failure	$C_{cr,N}$	[mm]	$1.5 \cdot h_{ef}$							
<p>Installation data is provided for two anchoring depths: $h_{ef,min}$ = minimum embedment depth and $h_{ef,max}$ = maximum embedment depth. Any anchoring depth h_{ef} in between $h_{ef,min}$ and $h_{ef,max}$ is allowed and the intermediate values can be interpolated.</p>										

3.2 Installation parameters for rebars in concrete

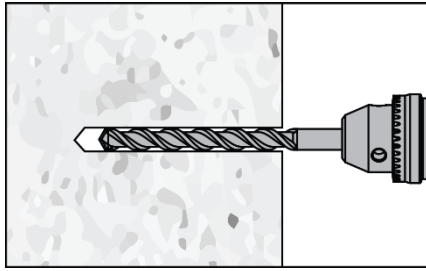
Anchor Type			WPER500-S							
Anchor Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	
Drill hole diameter	d_0	[mm]	12	14	16	20	25	32	40	
Cleaning brush	d_b	[mm]	12/13	14/15	18	22	27	35	43	
Installation torque	T_{inst}	[mm]	10	20	40	80	120	180	200	
Embedment depth, min	$h_{ef,min}$	[mm]	60	60	70	80	90	100	128	
Embedment depth, max	$h_{ef,max}$	[mm]	160	200	240	320	400	500	640	
Depth of drill hole	h_0	[mm]	$h_{ef} + 5mm$							
Min. edge distance	C_{min}	[mm]	40	40	40	40	50	50	70	
Min. spacing	S_{min}	[mm]	40	40	40	40	50	50	70	
Min. concrete member thickness	h_{min}	[mm]	$h_{ef} + 30mm \geq 100mm$			$h_{ef} + 2 d_0$				
Critical edge spacing distance for splitting failure	$C_{cr,sp}$	[mm]	$2 \cdot h_{ef}$							
Critical spacing distance for splitting failure	$S_{cr,sp}$	[mm]	$2 \cdot C_{cr,sp}$							
Critical edge spacing distance for concrete cone failure	$C_{cr,N}$	[mm]	$1.5 \cdot h_{ef}$							

3.3 Gelling and curing times

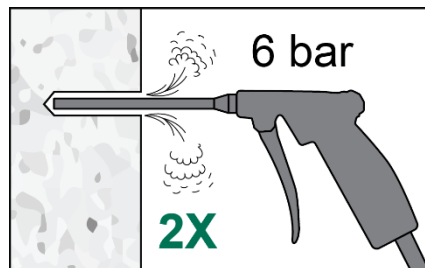
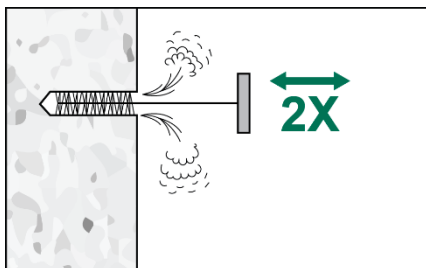
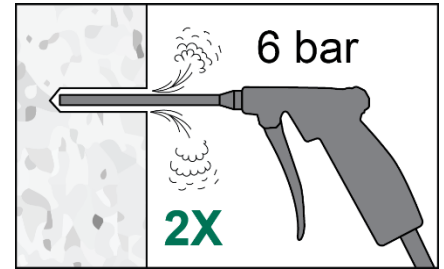
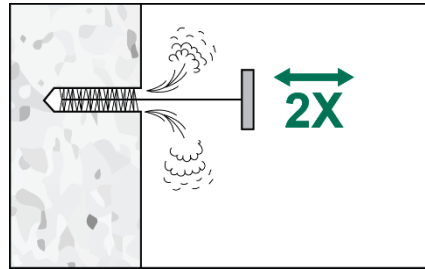
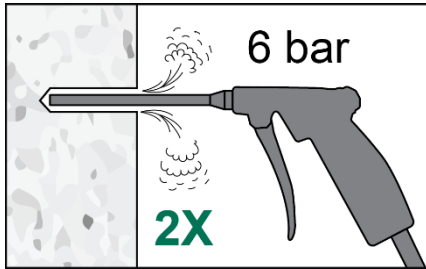
Base material temperature [°C]	Working time t_{work} [min]	Curing time t_{cure} [hrs]
5	300	24
5 - 10	150	24
10 - 15	40	18
15 - 20	25	12
20 - 25	18	8
25 - 30	12	6
30 - 35	8	4
35 - 40	6	2

Working time relates to the highest temperature in the range. Curing time relates to the lowest temperature in the range. Cartridge must be conditioned to a minimum of +10 °C before use.

3.4 Instructions for use in concrete

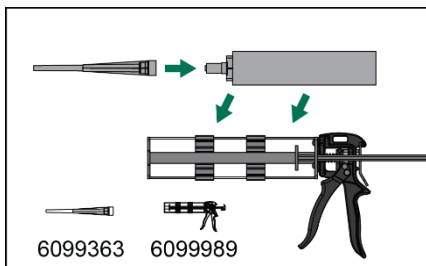


Drill hole in concrete to correct diameter d_0 and depth h_0 using hammer drilling mode

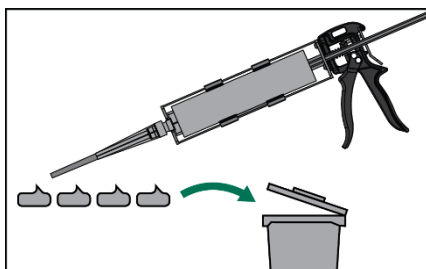


Clean the hole using compressed air with minimum pressure of 6 bar and WIS SBH Brush of appropriate diameter

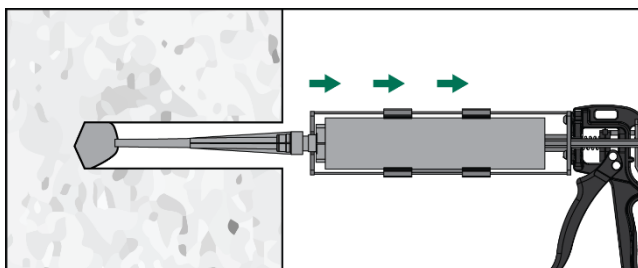
Observe the following cleaning sequence: 2x blow, 2x brush, 2x blow, 2x brush, 2x blow



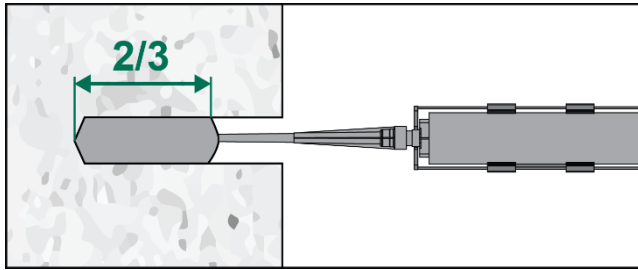
Apply the WIS Nozzle EF to the cartridge and place the cartridge in the dispensing tool



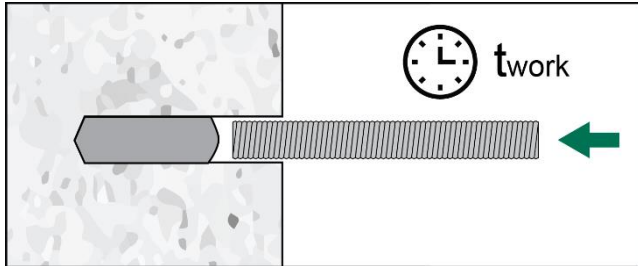
Extrude the first part waste until an even mixing colour is achieved



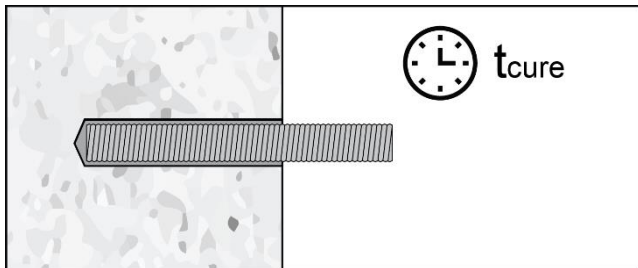
Inject the resin while slowly withdrawing the nozzle from the hole. Ensure no air voids are created as the nozzle is withdrawn



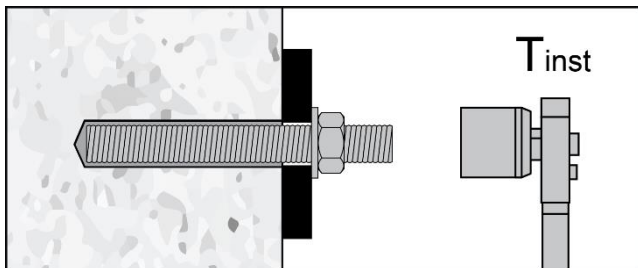
Inject the resin until the hole is approximately 2/3 full



Insert the correct diameter threaded rod with a slight forth and back twisting motion within working time t_{work}



Allow the curing time t_{cure} to elapse



Apply the fixture and tighten the nut without exceeding the maximum installation torque T_{inst}

4. Performance information

4.1 Loading in concrete with threaded rods

Tension and shear loads presented in paragraphs 4.1.1 - 4.1.9 apply to:

- correctly installed anchors
- C20/25 or C30/37 concrete
- threaded rod, steel grade 5.8 or 8.8
- holes drilled with a hammer drill
- anchors not affected by anchor spacing or concrete edge influence
- anchor in-service temperature range of -40°C to +70°C
- recommended loads include partial safety factor and an overall partial safety factor for action of 1.4. The partial safety factor for action depends on the type of loading and shall be taken from national regulations. All anchor failure modes and the entire relevant product European Technical Assessment must be considered during anchor design
- loads are applicable for the given effective embedment depth and concrete member thickness
- installation in dry/wet or water-filled concrete holes
- *steel failure*

4.1.1 Tension loads for threaded rods (steel grade 5.8) in non-cracked C20/25 concrete

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	hef	[mm]	60	60	70	80	90	96	108	120
Characteristic load	N _{Rk}	[kN]	18.00	22.86	28.81	35.20	42.00	46.27	55.21	64.66
Design load	N _{Rd}	[kN]	12.00	15.24	19.20	23.46	28.00	30.84	36.80	43.11
Recommended load	N _{Rec}	[kN]	8.57	10.89	13.71	16.76	20.00	22.03	26.29	30.79
Embedment depth	hef	[mm]	80	90	110	125	170	210	240	270
Characteristic load	N _{Rk}	[kN]	18.00	29.00	42.00	68.75	109.03	149.70	182.90	218.24
Design load	N _{Rd}	[kN]	12.00	19.33	28.00	45.83	72.69	99.80	121.93	145.49
Recommended load	N _{Rec}	[kN]	8.57	13.81	20.00	32.74	51.92	71.29	87.09	103.92
Embedment depth	hef	[mm]	160	200	240	320	400	480	540	600
Characteristic load	N _{Rk}	[kN]	18.00	29.00	42.00	79.00	123.00	177.00	230.00	281.00
Design load	N _{Rd}	[kN]	12.00	19.33	28.00	52.66	82.00	118.00	153.33	187.33
Recommended load	N _{Rec}	[kN]	8.57	13.81	20.00	37.61	58.57	84.29	109.52	133.81

4.1.2 Tension loads for threaded rods (steel grade 8.8) in non-cracked C20/25 concrete

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	hef	[mm]	60	60	70	80	90	96	108	120
Characteristic load	N _{Rk}	[kN]	22.86	22.86	28.81	35.20	42.00	46.27	55.21	64.66
Design load	N _{Rd}	[kN]	15.24	15.24	19.20	23.46	28.00	30.84	36.80	43.11
Recommended load	N _{Rec}	[kN]	10.89	10.89	13.71	16.76	20.00	22.03	26.29	30.79
Embedment depth	hef	[mm]	80	90	110	125	170	210	240	270
Characteristic load	N _{Rk}	[kN]	29.00	42.00	56.75	68.75	109.03	149.70	182.90	218.24
Design load	N _{Rd}	[kN]	19.33	28.00	37.83	45.83	72.69	99.80	121.93	145.49
Recommended load	N _{Rec}	[kN]	13.81	20.00	27.02	32.74	51.92	71.29	87.09	103.92
Embedment depth	hef	[mm]	160	200	240	320	400	480	540	600
Characteristic load	N _{Rk}	[kN]	29.00	46.00	67.00	126.00	196.00	282.00	367.00	449.00
Design load	N _{Rd}	[kN]	19.33	30.66	44.66	84.00	130.66	188.00	244.66	299.33
Recommended load	N _{Rec}	[kN]	13.81	21.90	31.90	60.00	93.33	134.29	174.76	213.81

4.1.3 Tension loads for threaded rods (steel grade 5.8) in non-cracked C30/37 concrete

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	hef	[mm]	60	60	70	80	90	96	108	120
Characteristic load	N_{Rk}	[kN]	18.00	28.00	35.28	43.11	51.44	56.67	67.62	79.20
Design load	N_{Rd}	[kN]	12.00	18.66	23.52	28.74	34.29	37.78	45.08	52.80
Recommended load	N_{Rec}	[kN]	8.57	13.33	16.80	20.53	24.49	26.99	32.20	37.71
Embedment depth	hef	[mm]	80	90	110	125	170	210	240	270
Characteristic load	N_{Rk}	[kN]	18.00	29.00	42.00	78.41	123.00	177.00	224.01	251.41
Design load	N_{Rd}	[kN]	12.00	19.33	28.00	52.27	82.00	118.00	149.34	167.61
Recommended load	N_{Rec}	[kN]	8.57	13.81	20.00	37.34	58.57	84.29	106.67	119.72
Embedment depth	hef	[mm]	160	200	240	320	400	480	540	600
Characteristic load	N_{Rk}	[kN]	18.00	29.00	42.00	79.00	123.00	177.00	230.00	281.00
Design load	N_{Rd}	[kN]	12.00	19.33	28.00	52.66	82.00	118.00	153.33	187.33
Recommended load	N_{Rec}	[kN]	8.57	13.81	20.00	37.61	58.57	84.29	109.52	133.81

4.1.4 Tension loads for threaded rods (steel grade 8.8) in non-cracked C30/37 concrete

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	hef	[mm]	60	60	70	80	90	96	108	120
Characteristic load	N_{Rk}	[kN]	25.63	28.00	35.28	43.11	51.44	56.67	67.62	79.20
Design load	N_{Rd}	[kN]	17.09	18.66	23.52	28.74	34.29	37.78	45.08	52.80
Recommended load	N_{Rec}	[kN]	12.21	13.33	16.80	20.53	24.49	26.99	32.20	37.71
Embedment depth	hef	[mm]	80	90	110	125	170	210	240	270
Characteristic load	N_{Rk}	[kN]	29.00	44.10	64.69	78.41	133.30	183.35	224.01	251.41
Design load	N_{Rd}	[kN]	19.33	29.40	43.12	52.27	88.86	122.23	149.34	167.61
Recommended load	N_{Rec}	[kN]	13.81	21.00	30.80	37.34	63.47	87.31	106.67	119.72
Embedment depth	hef	[mm]	160	200	240	320	400	480	540	600
Characteristic load	N_{Rk}	[kN]	29.00	46.00	67.00	126.00	196.00	282.00	367.00	449.00
Design load	N_{Rd}	[kN]	19.33	30.66	44.66	84.00	130.66	188.00	244.66	299.33
Recommended load	N_{Rec}	[kN]	13.81	21.90	31.90	60.00	93.33	134.29	174.76	213.81

4.1.5 Tension loads for threaded rods (steel grade 5.8) in cracked C20/25 concrete

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	hef	[mm]	60	60	70	80	90	96	108	120
Characteristic load	N_{Rk}	[kN]	15.07	16.00	20.16	24.64	29.40	32.39	38.64	45.26
Design load	N_{Rd}	[kN]	10.05	10.66	13.44	16.42	19.60	21.59	25.76	30.17
Recommended load	N_{Rec}	[kN]	7.18	7.61	9.60	11.73	14.00	15.42	18.40	21.55
Embedment depth	hef	[mm]	80	90	110	125	170	210	240	270
Characteristic load	N_{Rk}	[kN]	18.00	28.27	39.72	48.12	76.32	104.79	122.14	152.68
Design load	N_{Rd}	[kN]	12.00	18.84	26.48	32.08	50.88	69.86	81.43	101.78
Recommended load	N_{Rec}	[kN]	8.57	13.46	18.91	22.91	36.34	49.90	58.16	72.70
Embedment depth	hef	[mm]	160	200	240	320	400	480	540	600
Characteristic load	N_{Rk}	[kN]	18.00	29.00	42.00	79.00	123.00	177.00	230.00	281.00
Design load	N_{Rd}	[kN]	12.00	19.33	28.00	52.66	82.00	118.00	153.33	187.33
Recommended load	N_{Rec}	[kN]	8.57	13.81	20.00	37.61	58.57	84.29	109.52	133.81

4.1.6 Tension loads for threaded rods (steel grade 8.8) in cracked C20/25 concrete

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	hef	[mm]	60	60	70	80	90	96	108	120
Characteristic load	N _{Rk}	[kN]	15.07	16.00	20.16	24.64	29.40	32.39	38.64	45.26
Design load	N _{Rd}	[kN]	10.05	10.66	13.44	16.42	19.60	21.59	25.76	30.17
Recommended load	N _{Rec}	[kN]	7.18	7.61	9.60	11.73	14.00	15.42	18.40	21.55
Embedment depth	hef	[mm]	80	90	110	125	170	210	240	270
Characteristic load	N _{Rk}	[kN]	20.10	28.27	39.72	48.12	76.32	104.79	122.14	152.68
Design load	N _{Rd}	[kN]	13.40	18.84	26.48	32.08	50.88	69.86	81.43	101.78
Recommended load	N _{Rec}	[kN]	9.57	13.46	18.91	22.91	36.34	49.90	58.16	72.70
Embedment depth	hef	[mm]	160	200	240	320	400	480	540	600
Characteristic load	N _{Rk}	[kN]	29.00	46.00	67.00	126.00	196.00	282.00	274.82	339.29
Design load	N _{Rd}	[kN]	19.33	30.66	44.66	84.00	130.66	188.00	183.21	226.19
Recommended load	N _{Rec}	[kN]	13.81	21.90	31.90	60.00	93.33	134.29	130.86	161.56

4.1.7 Tension loads for threaded rods (steel grade 5.8) in cracked C30/37 concrete

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	hef	[mm]	60	60	70	80	90	96	108	120
Characteristic load	N _{Rk}	[kN]	15.07	19.60	24.70	30.17	36.00	39.66	47.33	55.44
Design load	N _{Rd}	[kN]	10.05	13.06	16.46	20.11	24.00	26.44	31.55	36.96
Recommended load	N _{Rec}	[kN]	7.18	9.33	11.76	14.36	17.14	18.89	22.54	26.40
Embedment depth	hef	[mm]	80	90	110	125	170	210	240	270
Characteristic load	N _{Rk}	[kN]	18.00	29.00	42.00	58.94	93.48	128.34	127.03	158.78
Design load	N _{Rd}	[kN]	12.00	19.33	28.00	39.29	62.32	85.56	84.68	105.85
Recommended load	N _{Rec}	[kN]	8.57	13.81	20.00	28.06	44.51	61.11	60.49	75.61
Embedment depth	hef	[mm]	160	200	240	320	400	480	540	600
Characteristic load	N _{Rk}	[kN]	18.00	29.00	42.00	79.00	123.00	177.00	230.00	281.00
Design load	N _{Rd}	[kN]	12.00	19.33	28.00	52.66	82.00	118.00	153.33	187.33
Recommended load	N _{Rec}	[kN]	8.57	13.81	20.00	37.61	58.57	84.29	109.52	133.81

4.1.8 Tension loads for threaded rods (steel grade 8.8) in cracked C30/37 concrete

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	hef	[mm]	60	60	70	80	90	96	108	120
Characteristic load	N _{Rk}	[kN]	15.07	19.60	24.70	30.17	36.00	39.66	47.33	55.44
Design load	N _{Rd}	[kN]	10.05	13.06	16.46	20.11	24.00	26.44	31.55	36.96
Recommended load	N _{Rec}	[kN]	7.18	9.33	11.76	14.36	17.14	18.89	22.54	26.40
Embedment depth	hef	[mm]	80	90	110	125	170	210	240	270
Characteristic load	N _{Rk}	[kN]	20.10	29.40	43.12	58.94	93.48	128.34	127.03	158.78
Design load	N _{Rd}	[kN]	13.40	19.60	28.75	39.29	62.32	85.56	84.68	105.85
Recommended load	N _{Rec}	[kN]	9.57	14.00	20.54	28.06	44.51	61.11	60.49	75.61
Embedment depth	hef	[mm]	160	200	240	320	400	480	540	600
Characteristic load	N _{Rk}	[kN]	29.00	46.00	67.00	126.00	196.00	282.00	285.81	352.86
Design load	N _{Rd}	[kN]	19.33	30.66	44.66	84.00	130.66	188.00	190.54	235.24
Recommended load	N _{Rec}	[kN]	13.81	21.90	31.90	60.00	93.33	134.29	136.10	168.03

4.1.9 Shear loads for threaded rods (steel grade 5.8 & 8.8) in cracked and non-cracked C20/25 & C30/37 concrete

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Effective embedment depth	h_{ef}	[mm]	80	90	110	125	170	210	240	270
Concrete member thickness	$\geq h$	[mm]	110	120	140	161	214	272	302	346
Characteristic shear loads in cracked and non-cracked concrete										
Shear Load, steel grade 5.8	V_{Rk}	[kN]	9.00	14.50	21.00	39.50	61.50	88.50	115.00	140.50
Shear Load, steel grade 8.8	V_{Rk}	[kN]	14.50	23.00	33.50	63.00	98.00	141.00	183.50	224.50
Design shear loads in cracked and non-cracked concrete										
Shear Load, steel grade 5.8	V_{Rd}	[kN]	7.00	11.50	16.50	31.50	49.00	70.50	92.00	112.00
Shear Load, steel grade 8.8	V_{Rd}	[kN]	11.50	18.00	26.50	50.00	78.00	112.50	146.50	179.50
Recommended shear loads in cracked and non-cracked concrete										
Shear Load, steel grade 5.8	V_{Rec}	[kN]	5.00	8.00	12.00	22.50	35.00	50.50	65.50	80.00
Shear Load, steel grade 8.8	V_{Rec}	[kN]	8.00	13.00	19.00	36.00	56.00	80.50	104.50	128.00

4.2 Seismic loading in concrete with threaded rods

Tension and shear loads presented in paragraphs from 4.2.1 to 4.2.4 apply to:

- correctly installed anchors
- C20/25 concrete
- threaded rod, steel grade 8.8
- holes drilled with a hammer drill
- anchors not affected by anchor spacing or concrete edge influence
- anchor in-service temperature range of -40°C to +70°C
- recommended loads include partial safety factor and an overall partial safety factor for action of 1.4. The partial safety factor for action depends on the type of loading and shall be taken from national regulations. All anchor failure modes and the entire relevant product European Technical Assessment must be considered during anchor design
- loads are applicable for the given effective embedment depth and concrete member thickness
- *steel failure*

Anchor type			WPER500-S							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Effective embedment depth	h_{ef}	[mm]	80	90	110	125	170	210	240	270
Concrete member thickness	$\geq h$	[mm]	110	120	140	161	214	272	302	346

4.2.1 Characteristic tension and shear loads for seismic performance category C1

Anchor type			WPER500-S								
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	
Cracked concrete											
Tension load	N_{Rk}	[kN]	Steel grade 8.8	18.5	24.0	41.0	53.5	79.0	117.0	116.0	124.5
Shear load	V_{Rk}	[kN]	Steel grade 8.8	11.0	17.0	25.0	41.0	64.0	56.0	73.0	90.0

4.2.2 Design tension and shear loads for seismic performance category C1

Anchor type			WPER500-S								
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	
Cracked concrete											
Tension load	N_{Rd}	[kN]	Steel grade 8.8	12.0	16.0	27.0	35.5	52.5	78.0	77.0	83.0
Shear load	V_{Rd}	[kN]	Steel grade 8.8	4.4	6.8	10.0	16.4	25.6	22.4	29.2	36.0

4.2.3 Design tension and shear loads for seismic performance category C2

Anchor type				WPER500-S							
Anchor size				M8	M10	M12	M16	M20	M24	M27	M30
Cracked concrete											
Tension load	N_{Rd}	[kN]	Steel grade 8.8	-	-	9.5	16.5	32.0	-	-	-
Shear load	V_{Rd}	[kN]	Steel grade 8.8	-	-	8.2	14.2	22.4	-	-	-

4.3 Loading in concrete with rebars

Tension loads presented in paragraphs from 4.3.1 to 4.3.6 apply to:

- correctly installed anchors
- rebar, BSt 500 S
- holes drilled with a hammer drill
- anchors not affected by anchor spacing or concrete edge influence
- anchor in-service temperature range of -40°C to +70°C
- recommended loads include partial safety factor and an overall partial safety factor for action of 1.4. The partial safety factor for action depends on the type of loading and shall be taken from national regulations. All anchor failure modes and the entire relevant product European Technical Assessment must be considered during anchor design
- loads are applicable for the given effective embedment depth and concrete member thickness required within European Technical Assessment ETA-19/0641
- installation in dry/wet holes
- *steel failure*

4.3.1 Tension loads for rebars BSt 500 S in non-cracked C20/25 concrete

Anchor type				WPER500-S							
Anchor size				Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	
Embedment depth	hef	[mm]		60	60	70	80	90	100	128	
Characteristic load	N_{Rk}	[kN]		19.60	22.86	28.81	35.20	42.00	49.19	71.23	
Design load	N_{Rd}	[kN]		13.06	15.24	19.20	23.46	28.00	32.79	47.49	
Recommended load	N_{Rec}	[kN]		6.53	7.62	9.60	11.73	14.00	16.40	23.75	
Embedment depth	hef	[mm]		80	90	110	128	170	250	300	
Characteristic load	N_{Rk}	[kN]		26.13	36.75	53.90	71.23	109.03	194.45	241.27	
Design load	N_{Rd}	[kN]		17.42	24.50	35.93	47.49	72.69	129.63	160.84	
Recommended load	N_{Rec}	[kN]		8.71	12.25	17.97	23.75	36.35	64.82	80.42	
Embedment depth	hef	[mm]		160	200	240	320	400	500	640	
Characteristic load	N_{Rk}	[kN]		28.00	43.00	63.00	111.00	173.00	270.00	442.00	
Design load	N_{Rd}	[kN]		20.00	30.71	45.00	79.28	123.57	192.85	315.71	
Recommended load	N_{Rec}	[kN]		10.00	15.36	22.50	39.64	61.79	96.43	157.86	

4.3.2 Tension loads for rebars BSt 500 S in non-cracked C30/37 concrete

Anchor type			WPER500-S						
Anchor size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Embedment depth	hef	[mm]	60	60	70	80	90	100	128
Characteristic load	N_{Rk}	[kN]	20.38	25.48	35.28	43.11	51.44	60.24	87.25
Design load	N_{Rd}	[kN]	13.59	16.98	23.52	28.74	34.29	40.16	58.16
Recommended load	N_{Rec}	[kN]	6.80	8.49	11.76	14.37	17.15	20.08	29.08
Embedment depth	hef	[mm]	80	90	110	128	170	250	300
Characteristic load	N_{Rk}	[kN]	27.18	38.22	56.06	80.29	133.30	238.15	250.92
Design load	N_{Rd}	[kN]	18.12	25.48	37.37	53.53	88.86	158.77	167.28
Recommended load	N_{Rec}	[kN]	9.06	12.74	18.69	26.77	44.43	79.39	83.64
Embedment depth	hef	[mm]	160	200	240	320	400	500	640
Characteristic load	N_{Rk}	[kN]	28.00	43.00	63.00	111.00	173.00	270.00	442.00
Design load	N_{Rd}	[kN]	20.00	30.71	45.00	79.28	123.57	192.85	315.71
Recommended load	N_{Rec}	[kN]	10.00	15.36	22.50	39.64	61.79	96.43	157.86

4.3.3 Tension loads for rebars BSt 500 S in cracked C20/25 concrete

Anchor type			WPER500-S						
Anchor size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Embedment depth	hef	[mm]	60	60	70	80	90	100	128
Characteristic load	N_{Rk}	[kN]	12.06	16.00	20.16	24.64	29.40	34.43	49.86
Design load	N_{Rd}	[kN]	8.04	10.66	13.44	16.42	19.60	22.95	33.24
Recommended load	N_{Rec}	[kN]	4.02	5.33	6.72	8.21	9.80	11.48	16.62
Embedment depth	hef	[mm]	80	90	110	128	170	250	300
Characteristic load	N_{Rk}	[kN]	16.08	29.40	39.72	49.86	76.32	136.11	178.93
Design load	N_{Rd}	[kN]	10.72	19.60	26.48	33.24	50.88	90.74	119.28
Recommended load	N_{Rec}	[kN]	5.36	9.80	13.24	16.62	25.44	45.37	59.64
Embedment depth	hef	[mm]	160	200	240	320	400	500	640
Characteristic load	N_{Rk}	[kN]	28.00	43.00	63.00	111.00	173.00	270.00	418.20
Design load	N_{Rd}	[kN]	20.00	30.71	45.00	79.28	123.57	192.85	278.80
Recommended load	N_{Rec}	[kN]	10.00	15.36	22.50	39.64	61.79	96.43	139.40

4.3.4 Tension loads for rebars BSt 500 S in cracked C30/37 concrete

Anchor type			WPER500-S						
Anchor size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Embedment depth	hef	[mm]	60	60	70	80	90	100	128
Characteristic load	N_{Rk}	[kN]	12.54	19.60	24.70	30.17	36.00	42.17	61.07
Design load	N_{Rd}	[kN]	8.36	13.06	16.46	20.11	24.00	28.11	40.71
Recommended load	N_{Rec}	[kN]	4.18	6.53	8.23	10.06	12.00	14.06	20.36
Embedment depth	hef	[mm]	80	90	110	128	170	250	300
Characteristic load	N_{Rk}	[kN]	16.72	32.34	43.12	61.07	93.48	166.70	203.87
Design load	N_{Rd}	[kN]	11.15	21.56	28.75	40.71	62.32	111.13	135.91
Recommended load	N_{Rec}	[kN]	5.58	10.78	14.38	20.36	31.16	55.57	67.96
Embedment depth	hef	[mm]	160	200	240	320	400	500	640
Characteristic load	N_{Rk}	[kN]	28.00	43.00	63.00	111.00	173.00	270.00	434.93
Design load	N_{Rd}	[kN]	20.00	30.71	45.00	79.28	123.57	192.85	289.95
Recommended load	N_{Rec}	[kN]	10.00	15.36	22.50	39.64	61.79	96.43	144.98

4.3.5 Tension loads for rebars BSt 500 S for seismic performance category C1 in C20/25 concrete

Anchor type			WPER500-S						
Anchor size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Embedment depth	hef	[mm]	60	60	70	80	90	100	128
Design load	N_{Rd}	[kN]	-	10.66	13.44	16.42	19.60	22.95	33.24
Embedment depth	hef	[mm]	80	90	110	128	170	250	300
Design load	N_{Rd}	[kN]	-	17.71	26.48	33.24	50.88	90.74	106.56
Embedment depth	hef	[mm]	160	200	240	320	400	500	640
Design load	N_{Rd}	[kN]	-	30.71	45.00	79.28	123.57	192.85	227.33

4.3.6 Tension loads for rebars for seismic performance category C1 in C30/37 concrete

Anchor type			WPER500-S						
Anchor size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Embedment depth	hef	[mm]	60	60	70	80	90	100	128
Design load	N_{Rd}	[kN]	-	12.28	16.46	20.11	24.00	28.11	40.71
Embedment depth	hef	[mm]	80	90	110	128	170	250	300
Design load	N_{Rd}	[kN]	-	18.42	28.17	40.71	62.32	108.90	110.82
Embedment depth	hef	[mm]	160	200	240	320	400	500	640
Design load	N_{Rd}	[kN]	-	30.71	45.00	79.28	123.57	192.85	236.42

4.4 Characteristic bond resistance for combined pullout and concrete cone failure

Characteristic bond resistance data allows calculations of resistance for combined pull-out and concrete cone failure in concrete at any allowed anchoring depth.

4.4.1 Threaded rods in concrete

Anchor type			WPER500-S									
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30		
Non-cracked concrete												
Characteristic bond resistance in dry, wet and flooded holes (temperature range -40°C to +70°C)			τ_{Rk}	[N/mm ²]	17	15	15	12	12	12	11	9.5
Partial safety factor			γ_{Mc}	[-]	1.5							
Increasing factor for concrete	C25/30	ψ_c	[-]	1.02								
	C30/37			1.04								
	C35/45			1.06								
	C40/50			1.07								
	C45/55			1.08								
	C50/60			1.09								
Cracked concrete												
Characteristic bond resistance in dry, wet and flooded holes (temperature range -40°C to +70°C)			τ_{Rk}	[N/mm ²]	10	10	10	9.5	9	9	6	6
Partial safety factor			γ_{Mc}	[-]	1.5							
Increasing factor for concrete	C25/30	ψ_c	[-]	1.02								
	C30/37			1.04								
	C40/50			1.07								
	C45/55			1.08								
	C50/60			1.09								

4.4.2 Threaded rods in concrete, seismic category C1

Anchor type			WPER500-S								
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	
Cracked concrete											
Characteristic bond resistance to pullout (temperature range -40°C to +70°C)			$\tau_{Rk,p,eq,C1}$ [N/mm ²]	9.4	8.5	10	8.7	7.4	7.7	5.78	4.9
Installation Safety Factor			γ_{inst} [-]	1.0							

4.4.3 Threaded rods in concrete, seismic category C2

Anchor type			WPER500								
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	
Cracked concrete											
Characteristic bond resistance to pullout (temperature range -40°C to +70°C)			$\tau_{Rk,p,eq,C2}$ [N/mm ²]	-	-	3.5	4.0	4.5	-	-	-
Installation Safety Factor			γ_{inst} [-]	1.0							

4.4.4 Rebars in concrete

Anchor type				WPER500-S							
Rebar size, BST 500 S				Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	
Non-cracked concrete											
Characteristic bond resistance in dry, wet and flooded holes (temperature range -40°C to +70°C)				τ_{Rk} [N/mm ²]	13	13	13	12	12	12	8
Partial safety factor for dry and wet concrete				γ_{Mc} [-]	1.5						
Partial safety factor for flooded holes				γ_{Mc} [-]	1.8						
Increasing factor for concrete	C25/30	ψ_c [-]		1.02							
	C30/37			1.04							
	C35/45			1.06							
	C40/50			1.07							
	C45/55			1.08							
	C50/60			1.09							
Cracked concrete											
Characteristic bond resistance in dry, wet and flooded holes (temperature range -40°C to +70°C)				τ_{Rk} [N/mm ²]	8	11	10	10	9	8.5	6.5
Partial safety factor for dry and wet concrete				γ_{Mc} [-]	1.5						
Partial safety factor for flooded holes				γ_{Mc} [-]	1.8						
Increasing factor for concrete	C25/30	ψ_c [-]		1.02							
	C30/37			1.04							
	C40/50			1.07							
	C45/55			1.08							
				C50/60			1.09				

4.4.5 Rebars in concrete, Seismic category C1

Anchor type			WPER500-S						
Rebar size, BST 500 S			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Non-cracked concrete									
Characteristic bond resistance in dry, wet and flooded holes (temperature range -40°C to +70°C)	τ_{Rk}	[N/mm ²]	-	9.4	9.8	9.5	8.8	8.0	5.3
Installation safety factor for dry and wet concrete	γ_{inst}	[-]	1.5						
Installation safety factor for flooded holes	γ_{inst}	[-]	1.8						

4.5 Steel failure information for threaded bars and rebars

4.5.1 Steel failure – threaded rods' characteristic resistance values to tension load

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Steel grade 4.6	$N_{Rk,s}$ [kN]	15	23	34	63	98	141	184	224
Partial safety factor	$\gamma_{Ms,N}$ [-]	2.00							
Steel grade 5.8	$N_{Rk,s}$ [kN]	18	29	42	79	123	177	230	281
Partial safety factor	$\gamma_{Ms,N}$ [-]	1.50							
Steel grade 8.8	$N_{Rk,s}$ [kN]	29	46	67	126	196	282	367	449
Partial safety factor	$\gamma_{Ms,N}$ [-]	1.50							
Steel grade 10.9	$N_{Rk,s}$ [kN]	37	58	84	157	245	353	459	561
Partial safety factor	$\gamma_{Ms,N}$ [-]	1.33							
Stainless steel grade A4-70	$N_{Rk,s}$ [kN]	26	41	59	110	172	247	321	393
Partial safety factor	$\gamma_{Ms,N}$ [-]	1.87							
Stainless steel grade A4-80	$N_{Rk,s}$ [kN]	29	46	67	126	196	282	367	449
Partial safety factor	$\gamma_{Ms,N}$ [-]	1.60							
Stainless steel grade 1,4529	$N_{Rk,s}$ [kN]	26	41	59	110	172	247	321	393
Partial safety factor	$\gamma_{Ms,N}$ [-]	1.50							
Stainless steel grade 1,4565	$N_{Rk,s}$ [kN]	26	41	59	110	172	247	321	393
Partial safety factor	$\gamma_{Ms,N}$ [-]	1.87							

4.5.2 Steel failure – threaded rods' characteristic resistance values to shear load without lever arm

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Steel grade 4.6	$V_{Rk,s}$ [kN]	7	12	17	31	49	71	92	112
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.67							
Steel grade 5.8	$V_{Rk,s}$ [kN]	9	15	21	39	61	88	115	140
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.25							
Steel grade 8.8	$V_{Rk,s}$ [kN]	15	23	34	63	98	141	184	224
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.25							
Steel grade 10.9	$V_{Rk,s}$ [kN]	18	29	42	79	123	177	230	281
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.50							
Stainless steel grade A4-70	$V_{Rk,s}$ [kN]	13	20	30	55	86	124	161	196
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.56							
Stainless steel grade A4-80	$V_{Rk,s}$ [kN]	15	23	34	63	98	141	184	224
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.33							
Stainless steel grade 1,4529	$V_{Rk,s}$ [kN]	13	20	30	55	86	124	161	196
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.25							
Stainless steel grade 1,4565	$V_{Rk,s}$ [kN]	13	20	30	55	86	124	161	196
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.56							

4.5.3 Steel failure – threaded rods' characteristic resistance values to shear load with lever arm

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Steel grade 4.6	$M^{\circ}_{RK,s}$ [kN]	15	30	52	133	260	449	666	900
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.67							
Steel grade 5.8	$M^{\circ}_{RK,s}$ [kN]	19	37	66	166	325	561	832	1125
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.25							
Steel grade 8.8	$M^{\circ}_{RK,s}$ [kN]	30	60	105	266	519	898	1332	1799
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.25							
Steel grade 10.9	$M^{\circ}_{RK,s}$ [kN]	37	75	131	333	649	1123	1664	2249
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.50							
Stainless steel grade A4-70	$M^{\circ}_{RK,s}$ [kN]	26	52	92	233	454	786	1165	1574
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.56							
Stainless steel grade A4-80	$M^{\circ}_{RK,s}$ [kN]	30	60	105	266	519	898	1332	1779
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.33							
Stainless steel grade 1,4529	$M^{\circ}_{RK,s}$ [kN]	26	52	92	233	454	786	1165	1574
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.25							
Stainless steel grade 1,4565	$M^{\circ}_{RK,s}$ [kN]	26	52	92	233	454	786	1165	1574
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.56							

4.5.4 Steel failure – rebar characteristic resistance values to tension load

Rebar size		Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar grade BST 500 S	$N_{RK,s}$ [kN]	28	43	62	111	173	270	442
Partial safety factor	$\gamma_{Ms,N}$ [-]	1.4	1.4	1.4	1.4	1.4	1.4	1.4

4.5.5 Steel failure – rebar characteristic resistance values to shear load without lever arm

Rebar size		Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar grade BST 500 S	$V_{RK,s}$ [kN]	14	22	31	55	86	135	221
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.5	1.5	1.5	1.5	1.5	1.5	1.5

4.5.6 Steel failure – rebar characteristic resistance values to shear load with lever arm

Rebar size		Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar grade BST 500 S	$M^{\circ}_{RK,s}$ [Nm]	33	65	112	265	518	1013	2122
Partial safety factor	$\gamma_{Ms,V}$ [-]	1.5	1.5	1.5	1.5	1.5	1.5	1.5

4.6 Post-installed rebar connections

4.6.1 pre-calculated values of anchorage length for characteristic steel strength, $f_{yk}=500$ N/mm², for hammer-drilling method

WPER500-S		Properties			Minimum Anchoring Lengths				Design Anchoring Length		
Rebar Diameter \varnothing	Steel Grade f_{yk}	Concrete Class	f_{bd} ¹⁾	Minimum Anchor Length $l_{b,min}$ ²⁾	N_{Rd}	Minimum Overlap length $l_{o,min}$ ³⁾	N_{Rd}	l_{bd} α_2 and $\alpha_5 = 1$ ⁴⁾	l_{bd} α_2 or $\alpha_5 = 0.7$ ⁵⁾	N_{Rd} (kN)	
[mm]	[N/mm ²]	-	[N/mm ²]	[mm]	[kN]	[mm]	[kN]	[mm]	[mm]	[kN]	
8	500	C20/25	2.3	114	6.5	200	11.5	379	265	21.5	
	500	C50/60	4.3	100	10.5	200	21.5	203	142	21.5	
10	500	C20/25	2.3	142	10	200	14	473	331	34	
	500	C50/60	4.3	100	13.5	200	27	253	177	34	
12	500	C20/25	2.3	171	14.5	200	17	568	398	49	
	500	C50/60	4.3	120	19	200	32	304	213	49	
14	500	C20/25	2.3	199	20	210	21	662	463	66.5	
	500	C50/60	4.3	140	26	210	39.5	354	248	66.5	
16	500	C20/25	2.3	228	26	240	27.5	757	530	87.5	
	500	C50/60	4.3	160	34.5	240	51.5	405	284	87.5	
20	500	C20/25	2.3	284	41	300	43	946	662	136.5	
	500	C50/60	4.3	200	54	300	81	506	354	136.5	
25	500	C20/25	2.3	300	54	375	67.5	1000	827	180.5	
	500	C50/60	4.3	250	84	375	126.5	632	443	213	
28	500	C20/25	2.3	300	60.5	420	84.5	1000	927	202	
	500	C50/60	4.3	420	158.5	630	238	708	496	267.5	
32	500	C20/25	2.3	320	73.5	480	110.5	1000	1000	231	
	500	C50/60	3.7	480	178.5	720	267.5	941	659	350	

1) Design bond strength of cast-in rebar according to EN 1992-1-1

2) Minimum anchorage length for simply supported connections

3) Minimum anchorage length for overlap joint

4) Anchorage length for simply supported connections where $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1$

5) Anchorage length for simply supported connections where $\alpha_1 = \alpha_3 = \alpha_4 = \alpha_5 = 1$; $\alpha_2 = 0.7$

5.0 Additional product information

5.1 Chemical resistance

Chemical environment	Concentration	Result
Aqueous Solution Acetic Acid	10%	C
Acetone	100%	✘
Aqueous Solution Aluminium Chloride	Saturated	✓
Aqueous Solution Aluminium Nitrate	10%	✓
Ammonia Solution	5%	✓
Jet Fuel	100%	C
Benzene	100%	C
Benzoic Acid	Saturated	✓
Benzyl Alcohol	100%	✘
Sodium Hypochlorite Solution	5 - 15%	✓
Butyl Alcohol	100%	C
Calcium Sulphate Aqueous Solution	Saturated	✓
Carbon Monoxide	Gas	✓
Carbon Tetrachloride	100%	C
Chlorine Water	Saturated	✘
Chloro Benzene	100%	✘
Citric Acid Aqueous Solution	Saturated	✓
Cyclohexanol	100%	✓
Diesel Fuel	100%	C
Diethylene Glycol	100%	✓
Ethanol	95%	✘
Ethanol Aqueous Solution	20%	C
Heptane	100%	C

Chemical environment	Concentration	Result
Hexane	100%	C
Hydrochloric Acid	10%	✓
Hydrochloric Acid	15%	✓
Hydrochloric Acid	25%	C
Hydrogen Sulphide Gas	100%	✓
Isopropyl Alcohol	100%	✘
Linseed Oil	100%	✓
Lubricating Oil	100%	✓
Mineral Oil	100%	✓
Paraffin / Kerosene (Domestic)	100%	C
Phenol Aqueous Solution	1%	C
Phosphoric Acid	50%	✓
Potassium Hydroxide	10% / pH13	✓
Sea Water	100%	C
Styrene	100%	C
Sulphur Dioxide Solution	10%	✓
Sulphur Dioxide (40°C)	5%	✓
Sulphuric Acid	10%	✓
Sulphuric Acid	50%	✓
Turpentine	100%	C
White Spirit	100%	✓
Xylene	100%	C

✓ = Resistant to 75°C with at least 80% of physical properties retained.

C = Contact only to a maximum of 25°C.

✘ = Not resistant.

5.2 Physical properties

Property		Unit	Value	Test Standard
Density		g/cm ³	1.5	ASTM D 1875 @ +20°C
Compressive Strength	24 hours	N/mm ²	75	ASTM D 695 @ +20°C
	7 days		95	
Tensile Strength	24 hours	N/mm ²	18	ASTM D 638 @ +20°C
	7 days		23	
Elongation at Break	24 hours	%	6.6	ASTM D 638 @ +20°C
	7 days		5.9	
Tensile Modulus	24 hours	GN/m ²	5.7	ASTM D 638 @ +20°C
	7 days		5.5	
Flexural Strength	7 days	N/mm ²	45	ASTM D 790 @ +20°C
HDT	7 days	°C	39	ASTM D 648 @ +20°C
VOC		g/l	4.5	ASTM D 2369