Deutsches Institut für Bautechnik DIBt

Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body for construction products

Member of EOTA
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European Technical Assessment

ETA-25/0251 of 11 March 2025

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	CLR plus concrete screw
Product family to which the construction product belongs	Mechanical fasteners for use in concrete
Manufacturer	Friulsider S.p.A. Via Trieste 1 33048 SAN GIOVANNI AL NATISONE (UD) ITALIEN
Manufacturing plant	Friulsider Plant
This European Technical Assessment contains	22 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 330232-01-0601, Edition 05/2021

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Specific Part

1 Technical description of the product

The CLR plus concrete screw is an anchor in size 6, 8, 10, 12 and 14 mm made of galvanised steel respectively steel with zinc flake coating, made of stainless or high corrosion resistant steel. The anchor is screwed into a predrilled cylindrical drill hole. The special thread of the anchor cuts an internal thread into the member while setting. The anchorage is characterised by mechanical interlock in the special thread.

Product and product description are given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex B4, C1 and C2
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C1 and C2
Displacements (static and quasi-static loading)	See Annex C7
Characteristic resistance and displacements for seismic performance category C1 and C2	See Annex C3 to C5, C8

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C6

3.3 Aspects of durability linked with the Basic Works Requirements

Essential characteristic	Performance
Durability	See Annex B1

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with European Assessment Document EAD No. 330232-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 11 March 2025 by Deutsches Institut für Bautechnik

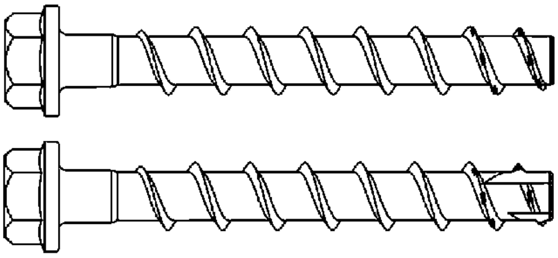
Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Tempel

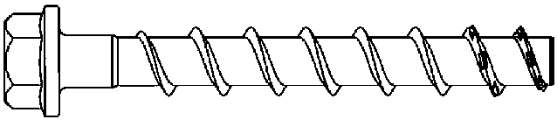
Product in installed condition

CLR plus concrete screw

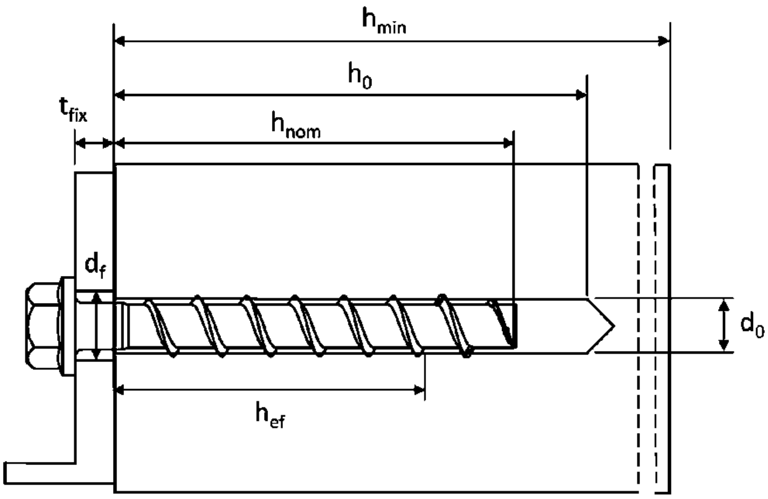
- Galvanized carbon steel
- Zinc flakes coated carbon steel



- Stainless steel A4
- Stainless steel HCR



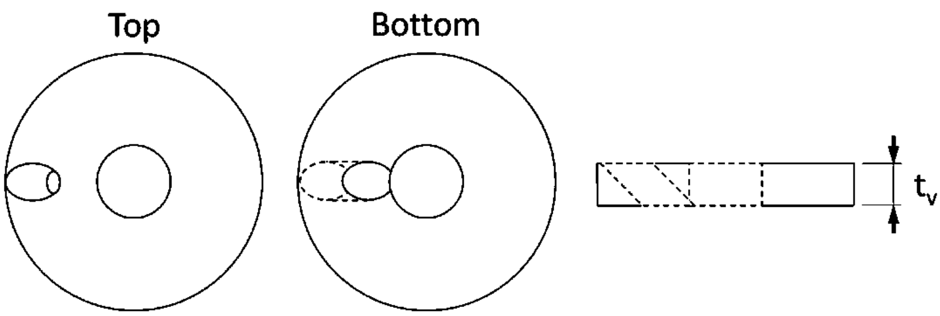
e.g. CLR plus concrete screw, zinc flakes coated, configuration with hexagon head and fixture



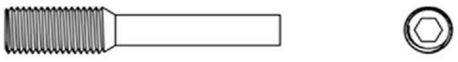
d_0 = nominal drill hole diameter
t_{fix} = thickness of fixture
d_f = clearance hole diameter

h_{min} = minimum thickness of member
h_{nom} = nominal embedment depth
h_0 = drill hole depth
h_{ef} = effective embedment depth

Filling washer (optional) to fill annular gap



CLR plus concrete screw	Annex A1
Product description Product in installed condition	



Configuration with metric connection threat and hexagon socket; Type ST

Configuration with metric connection threat and hexagon drive; Type ST

Configuration with washer and hexagon head; Type H

Configuration with washer, hexagon head and TORX drive; Type H

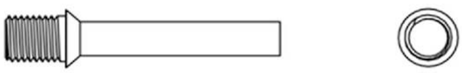
Configuration with washer and bund; Type BND

Configuration with hexagon head; Type S

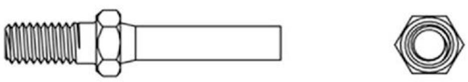
Configuration with countersunk head and TORX drive; Type SK

Configuration with pan head and TORX drive; Type P

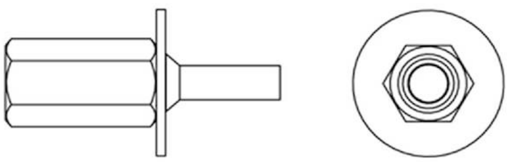
Configuration with large pan head and TORX drive; Type P



Configuration with countersunk head and connection thread; Type ST-6



Configuration with hexagon drive and connection thread; Type ST-6



Configuration with internal thread and hexagon drive; Type I

CLR plus concrete screw	**Annex A2**
Product description Screw types	

Table 1: Material

Part	Product name	Material
all types	CLR plus	Steel EN 10263-4:2017 galvanized acc. to EN ISO 4042:2018
	CLR plus ZF	Zinc flake coating according to EN ISO 10683:2018 (≥5µm)
	CLR plus A4	1.4401; 1.4404; 1.4571; 1.4578
	CLR plus HCR	1.4529

Part	Product name	Nominal characteristic steel Yield strength f_{yk} [N/mm²]	Nominal characteristic steel Ultimate strength f_{uk} [N/mm²]	Rupture elongation A_5 [%]
all types	CLR plus	560	700	≤ 8
	CLR plus ZF			
	CLR plus A4			
	CLR plus HCR			

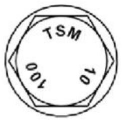
Table 2: Dimensions

Anchor size			6		8			10			12			14		
Nominal embedment depth		h_{nom}	1	2	1	2	3	1	2	3	1	2	3	1	2	3
		[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Screw length	≤ L	[mm]	500													
Core diameter	d_K	[mm]	5,1		7,1			9,1			11,1			13,1		
Thread outer diameter	d_s	[mm]	7,5		10,6			12,6			14,6			16,6		
Thickness of filling washer	t_v	[mm]	-		5			5			5			5		

Marking:

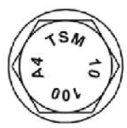
CLR plus (ZF)

Screw type: TSM
Screw size: 10
Screw length: 100



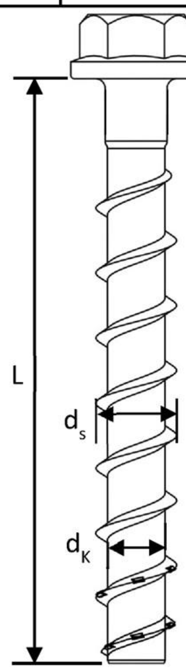
CLR plus A4

Screw type: TSM
Screw size: 10
Screw length: 100
Material: A4



CLR plus HCR

Screw type: TSM
Screw size: 10
Screw length: 100
Material: HCR



CLR plus concrete screw	**Annex A3**
Product description Material, Dimensions and markings	

Specification of Intended use

Table 3: Anchorages subject to

<table>
<tr><td colspan="2">CLR plus concrete screw size</td><td colspan="2">6</td><td colspan="3">8</td><td colspan="3">10</td><td colspan="3">12</td><td colspan="3">14</td></tr>
<tr><td rowspan="2">Nominal embedment depth</td><td></td><td>h_{nom1}</td><td>h_{nom2}</td><td>h_{nom1}</td><td>h_{nom2}</td><td>h_{nom3}</td><td>h_{nom1}</td><td>h_{nom2}</td><td>h_{nom3}</td><td>h_{nom1}</td><td>h_{nom2}</td><td>h_{nom3}</td><td>h_{nom1}</td><td>h_{nom2}</td><td>h_{nom3}</td></tr>
<tr><td>[mm]</td><td>40</td><td>55</td><td>45</td><td>55</td><td>65</td><td>55</td><td>75</td><td>85</td><td>65</td><td>85</td><td>100</td><td>65</td><td>85</td><td>115</td></tr>
<tr><td colspan="2">Static and quasi-static loads</td><td colspan="14" rowspan="2">All sizes and all embedment depths</td></tr>
<tr><td colspan="2">Fire exposure</td></tr>
<tr><td colspan="2">C1 category - seismic</td><td>ok</td><td>ok</td><td colspan="2" rowspan="2">1)</td><td rowspan="2">ok</td><td>ok</td><td rowspan="2">1)</td><td rowspan="2">ok</td><td colspan="2" rowspan="2">1)</td><td rowspan="2">ok</td><td colspan="2" rowspan="2">1)</td><td rowspan="2">ok</td></tr>
<tr><td colspan="2">C2 category – seismic
(A4 and HCR: no performance assessed)</td><td colspan="2">1)</td><td>1)</td></tr>
</table>

1) no performance assessed

Base materials:

- Compacted reinforced and unreinforced concrete without fibers according to EN 206:2013.
- Strength classes C20/25 to C50/60 according to EN 206:2013.
- Cracked and uncracked concrete.

Use conditions (Environmental conditions):

- Concrete screws subject to dry internal conditions: all screw types.
- For all other conditions corresponding to corrosion resistance classes CRC according to EN 1993-1-4:2006 + A1:2015
  - Stainless steel according to Annex A3, screw type CLR plus A4 with marking A4: CRC III
  - High corrosion resistant steel acc. to Annex A3, screw type CLR plus HCR with marking HCR: CRC V

Specification of Intended use - continuation

Design:

- Anchorages are to be designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed according to EN 1992-4:2018 and EOTA Technical Report TR 055, Edition February 2018.

  The design for shear load according to EN 1992-4:2018, Section 6.2.2 applies for all specified diameters d_f of clearance hole in the fixture in Annex B3, Table 4.

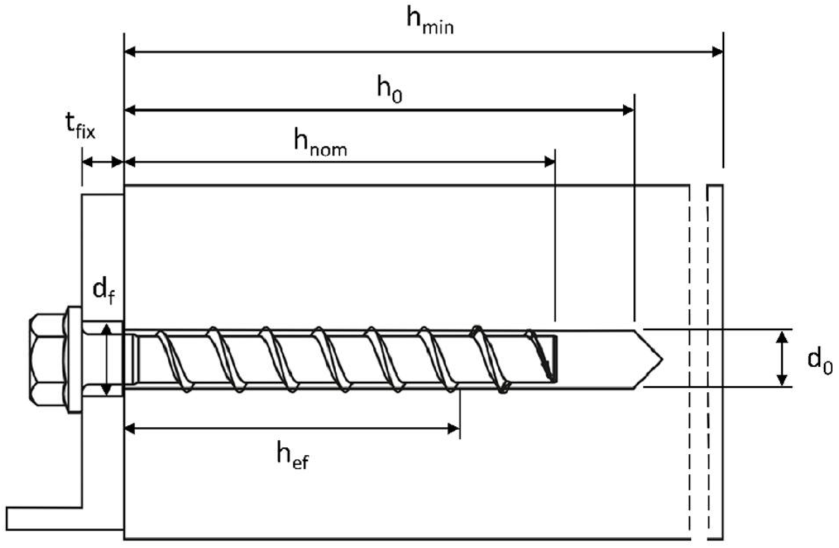
Installation:

- Hammer drilling or hollow drilling.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters on site.
- In case of aborted hole: new drilling must be drilled at a minimum distance of twice the depth of aborted hole or closer, if the aborted hole is filled with high strength mortar and only if the hole is not in the direction of the oblique tensile or shear load.
- After installation further turning of the anchor must not be possible. The head of the anchor is supported in the fixture and is not damaged.
- The borehole may be filled with injection mortar CF-T 300V or ATA 2004C.
- Adjustability according to Annex B6 for sizes 6-14, all embedment depths except for seismic application.
- Cleaning of borehole is not necessary, if using a hollow drill.

Table 4: Installation parameters

CLR plus concrete screw size			6		8			10		
Nominal embedment depth		h_{nom}	h_{nom1}	h_{nom2}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
		[mm]	40	55	45	55	65	55	75	85
Nominal drill hole diameter	d_0	[mm]	6		8			10		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,40		8,45			10,45		
Drill hole depth	$h_0 \geq$	[mm]	45	60	55	65	75	65	85	95
Clearance hole diameter	$d_f \leq$	[mm]	8		12			14		
Installation torque (version with connection thread)	T_{inst}	[Nm]	10		20			40		
Torque impact screw driver		[Nm]	Max. torque according to manufacturer's instructions							
			160		300			400		

CLR plus concrete screw size			12			14		
Nominal embedment depth		h_{nom}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
		[mm]	65	85	100	75	100	115
Nominal drill hole diameter	d_0	[mm]	12			14		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,50			14,50		
Drill hole depth	$h_0 \geq$	[mm]	75	95	110	85	110	125
Clearance hole diameter	$d_f \leq$	[mm]	16			18		
Installation torque (version with connection thread)	T_{inst}	[Nm]	60			80		
Torque impact screw driver		[Nm]	Max. torque according to manufacturer's instructions					
			650			650		

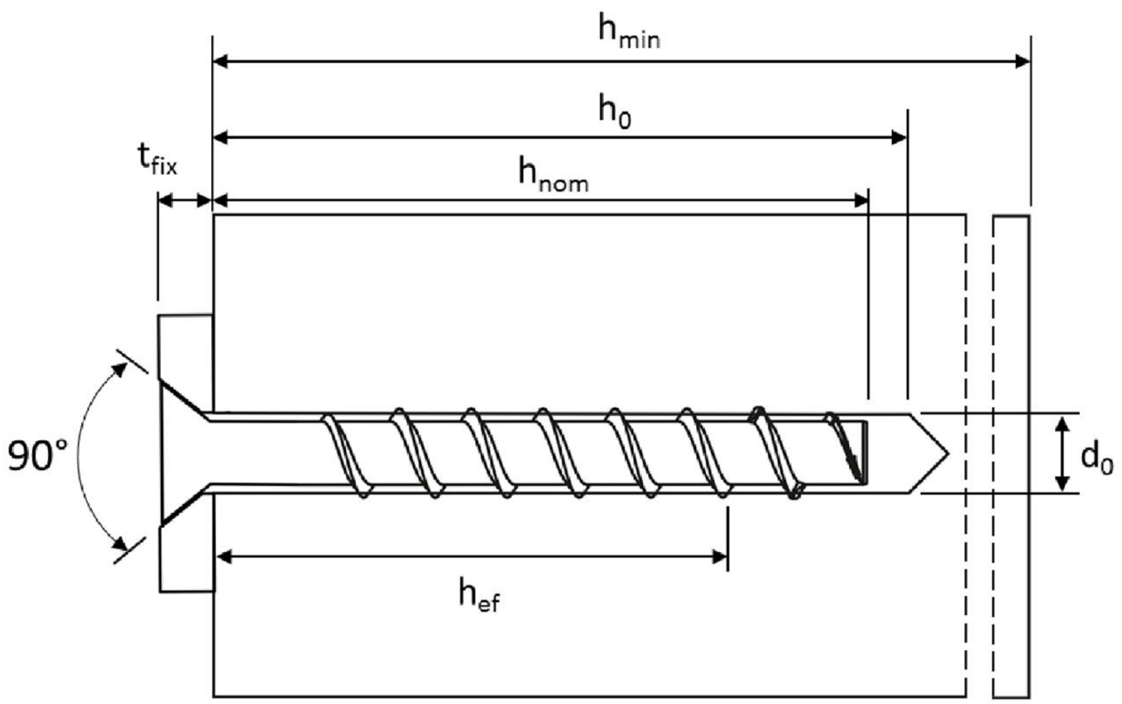


CLR plus concrete screw	**Annex B3**
Intended use Installation parameters	

Table 5: Minimum thickness of member, minimum edge distance and minimum spacing

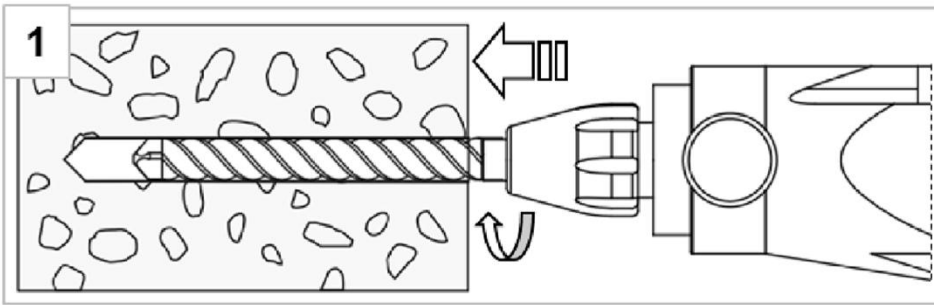
CLR plus concrete screw size			6		8			10		
Nominal embedment depth		h_{nom}	h_{nom1}	h_{nom2}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
		[mm]	40	55	45	55	65	55	75	85
Minimum thickness of member	h_{min}	[mm]	100		100		120	100	130	
Minimum edge distance	c_{min}	[mm]	40		40	50		50		
Minimum spacing	s_{min}	[mm]	40		40	50		50		

CLR plus concrete screw size			12			14		
Nominal embedment depth		h_{nom}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
		[mm]	65	85	100	75	100	115
Minimum thickness of member	h_{min}	[mm]	120	130	150	130	150	170
Minimum edge distance	c_{min}	[mm]	50		70	50	70	
Minimum spacing	s_{min}	[mm]	50		70	50	70	

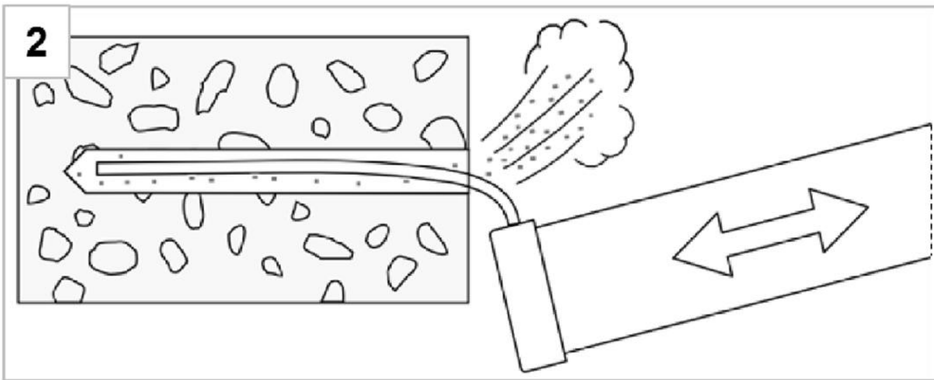


CLR plus concrete screw	Annex B4
Intended use Minimum thickness of member, minimum edge distance and minimum spacing	

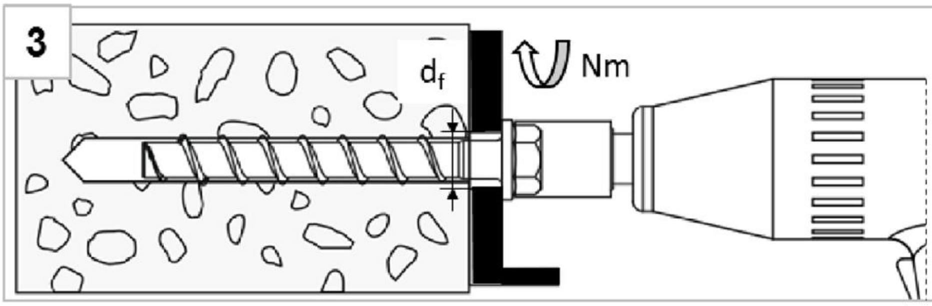
Installation Instructions



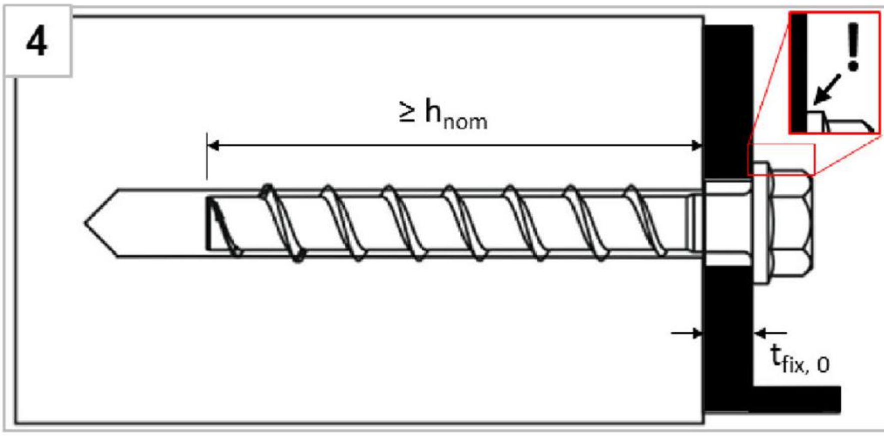
Create hammer drilled or hollow drilled borehole



Remove drill dust by vacuuming or blowing of



Install with torque impact screw driver or torque wrench



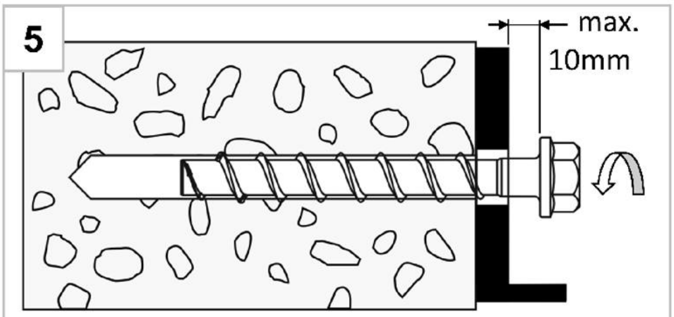
The head must be undamaged and in contact with the fixture

Note:
Cleaning of borehole is not necessary when using a hollow drill

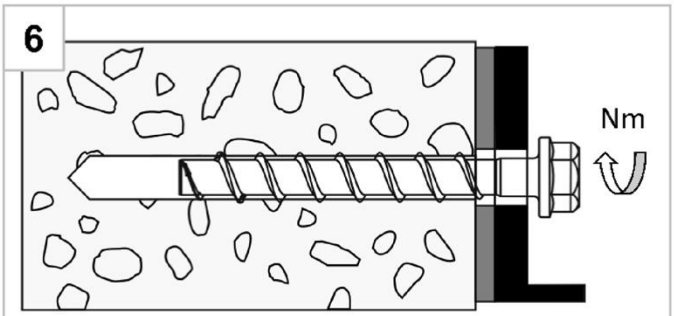
CLR plus concrete screw	Annex B5
Intended use Installation instructions	

Installation Instructions – Adjustment

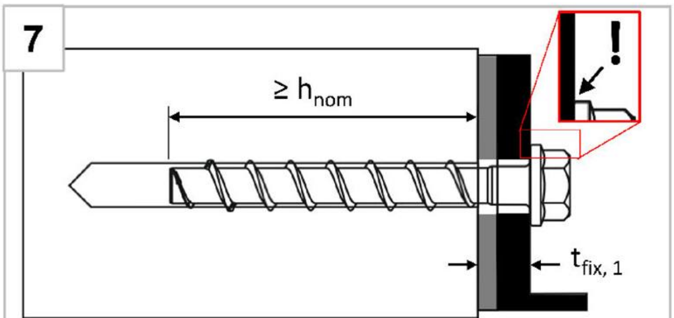
1. Adjustment



Screw may be untightened maximum 10mm

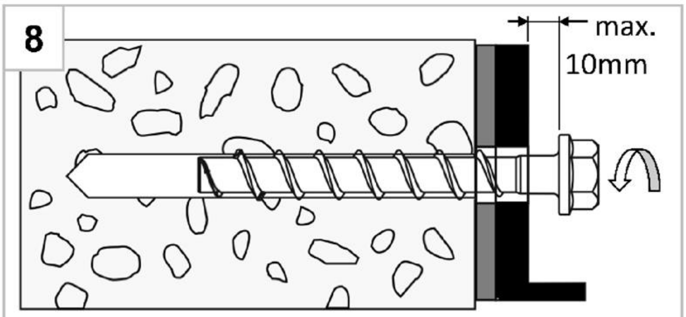


After adjustment, tighten the screw again

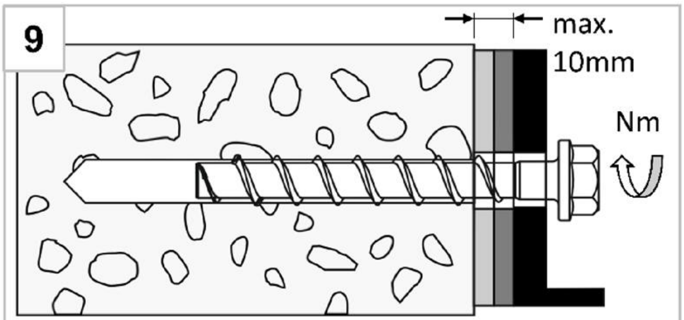


The head must be undamaged and in contact with the fixture

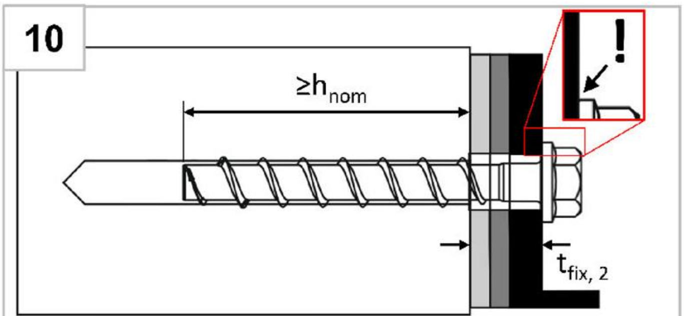
2. Adjustment



Screw may be untightened maximum 10mm



After adjustment, tighten the screw again



The head must be undamaged and in contact with the fixture

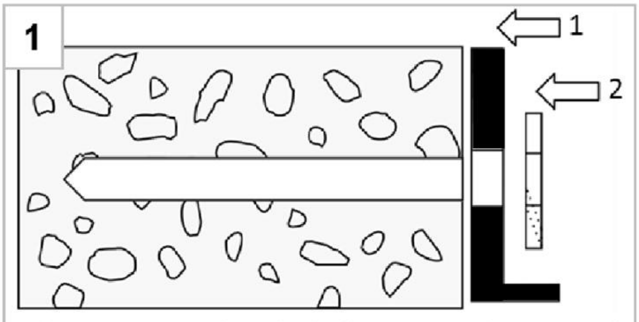
Note:
The fastener can be adjusted maximum two times. The total allowed thickness of shims added during the adjustment process is 10mm. The final embedment depth after adjustment process must be larger or equal than h_{nom}.

CLR plus concrete screw	**Annex B6**
Intended use Installation instructions - Adjustment	

Installation Instructions – Filling annular gap

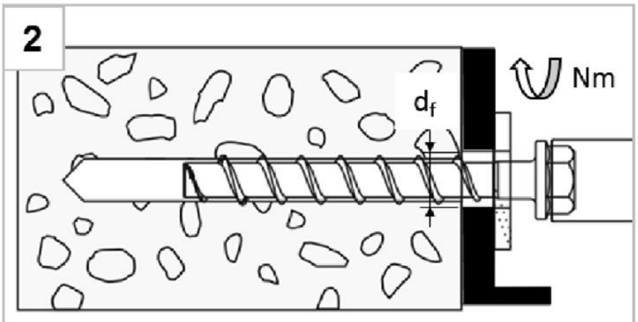
Positioning of fixture and filling washer

1



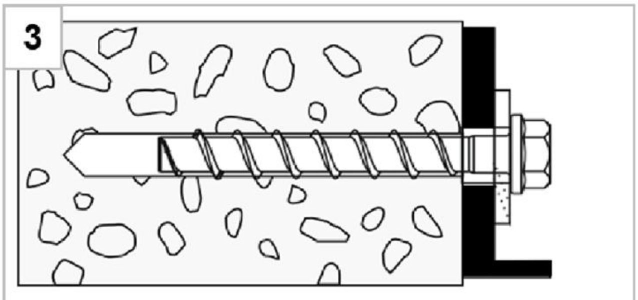
After preparing borehole (Annex B5, figure 1+2), position first fixture (1), than filling washer (2)

2



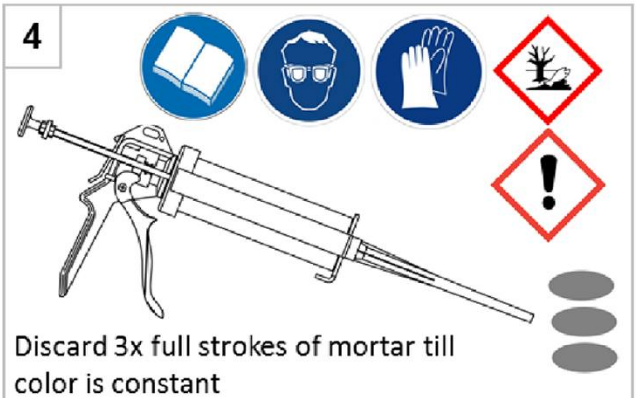
Install with torque impact screw driver or torque wrench

3



Installed condition without injected mortar in the filling washer

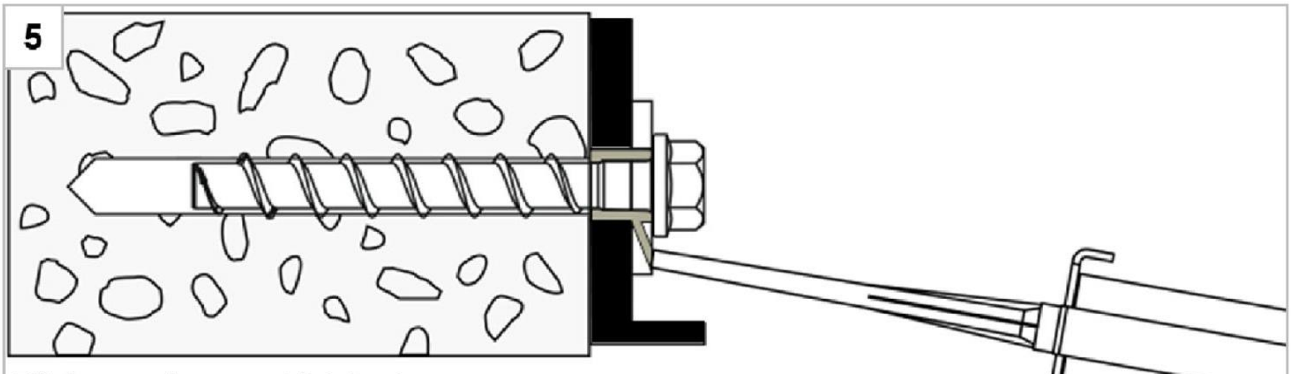
4



Discard 3x full strokes of mortar till color is constant

Filling the annular gap

5



Fill the annular gap with injection mortar (minimum compression strength of 40 N/mm²)

Note:
For seismic loading the installation with filled and without filled annular gap is approved. Differences in performance can be found in Annex C5 - C7.

CLR plus concrete screw	**Annex B7**
Intended use Installation instructions - Filling annular gap	

Deutsches Institut für Bautechnik DIBt

Table 6: Characteristic values for static and quasi-static loading, sizes 6-10

CLR plus concrete screw size				6		8			10		
Nominal embedment depth		h_{nom}		h_{nom1}	h_{nom2}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
			[mm]	40	55	45	55	65	55	75	85
Steel failure for tension and shear loading											
Characteristic resistance		$N_{Rk,s}$	[kN]	14,0		27,0			45,0		
Partial safety factor		$\gamma_{Ms,N}$	[-]	1,5							
Characteristic resistance		$V^0_{Rk,s}$	[kN]	7,0		13,5		17,0	22,5	34,0	
Partial safety factor		$\gamma_{Ms,V}$	[-]	1,25							
Ductility factor		k_7	[-]	0,8							
Characteristic bending load		$M^0_{Rk,s}$	[Nm]	10,9		26,0			56,0		
Pull-out failure											
Characteristic resistance in C20/25	cracked	$N_{Rk,p}$	[kN]	2,0	4,0	5,0	9,0	12,0	9,0	$\geq N^0_{Rk,c}$ 1)	
	uncracked	$N_{Rk,p}$	[kN]	4,0	9,0	7,5	12,0	16,0	12,0	20,0	26,0
Increasing factor for $N_{Rk,p} = N_{Rk,p(C20/25)} * \psi_c$	C25/30	Ψ_c	[-]	1,12							
	C30/37			1,22							
	C40/50			1,41							
	C50/60			1,58							
Concrete failure: Splitting failure, concrete cone failure and pry-out failure											
Effective embedment depth		h_{ef}	[mm]	31	44	35	43	52	43	60	68
k-factor	cracked	k_{cr}	[-]	7,7							
	uncracked	k_{ucr}	[-]	11,0							
Concrete cone failure	spacing	$s_{cr,N}$	[mm]	3 x h_{ef}							
	edge distance	$c_{cr,N}$	[mm]	1,5 x h_{ef}							
Splitting failure	resistance	$N^0_{Rk,sp}$	[kN]	4,0	9,0	7,5	12,0	16,0	12,0	20,0	26,0
	spacing	$s_{cr,Sp}$	[mm]	120	160	120	140	150	140	180	210
	edge distance	$c_{cr,Sp}$	[mm]	60	80	60	70	75	70	90	105
Factor for pry-out failure		k_8	[-]	1,0						2,0	
Installation factor		γ_{inst}	[-]	1,0							
Concrete edge failure											
Effective length in concrete		$l_f = h_{ef}$	[mm]	31	44	35	43	52	43	60	68
Nominal outer diameter of screw		d_{nom}	[mm]	6		8			10		

1) $N^0_{Rk,c}$ according to EN 1992-4:2018

CLR plus concrete screw

Performances
Characteristic values for static and quasi-static loading, sizes 6-10

Annex C1

Table 7: Characteristic values for static and quasi-static loading, sizes 12-14

CLR plus concrete screw size				12			14	
Nominal embedment depth			h_{nom}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
			[mm]	65	85	100	75	100	115
Steel failure for tension and shear loading									
Characteristic tension load		$N_{Rk,s}$	[kN]	67,0			94,0		
Partial safety factor		$\gamma_{Ms,N}$	[-]	1,5					
Characteristic shear load		$V^0_{Rk,s}$	[kN]	33,5	42,0		56,0		
Partial safety factor		$\gamma_{Ms,V}$	[-]	1,25					
Ductility factor		k_7	[-]	0,8					
Characteristic bending load		$M^0_{Rk,s}$	[Nm]	113,0			185,0		
Pull-out failure									
Characteristic resistance in C20/25	cracked	$N_{Rk,p}$	[kN]	12,0	$\geq N^0_{Rk,c}$ 1)				
	uncracked	$N_{Rk,p}$	[kN]	16,0					
Increasing factor for $N_{Rk,p} = N_{Rk,p(C20/25)} * \psi_c$	C25/30	ψ_c	[-]	1,12					
	C30/37			1,22					
	C40/50			1,41					
	C50/60			1,58					
Concrete failure: Splitting failure, concrete cone failure and pry-out failure									
Effective embedment depth		h_{ef}	[mm]	50	67	80	58	79	92
k-factor	cracked	$k_1 = k_{cr}$	[-]	7,7					
	uncracked	$k_1 = k_{ucr}$	[-]	11,0					
Concrete cone failure	spacing	$s_{cr,N}$	[mm]	3 x h_{ef}					
	edge distance	$c_{cr,N}$	[mm]	1,5 x h_{ef}					
Splitting failure	resistance	$N^0_{Rk,sp}$	[kN]	16,0	27,0	35,0	21,5	34,5	43,5
	spacing	$s_{cr,Sp}$	[mm]	150	210	240	180	240	280
	edge distance	$c_{cr,Sp}$	[mm]	75	105	120	90	120	140
Factor for pry-out failure		k_8	[-]	1,0	2,0		1,0	2,0	
Installation factor		γ_{inst}	[-]	1,0					
Concrete edge failure									
Effective length in concrete		$l_f = h_{ef}$	[mm]	50	67	80	58	79	92
Nominal outer diameter of screw		d_{nom}	[mm]	12			14		

1) $N^0_{Rk,c}$ according to EN 1992-4:2018

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Table 8: Seismic category C1 – Characteristic load values (type H/S, type SK, type ST, type ST-6[1]), type P and type I[1]))

CLR plus concrete screw size			6		8	10		12	14
Nominal embedment depth		h_{nom}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom3}	h_{nom3}	h_{nom3}
		[mm]	40	55	65	55	85	100	115
Steel failure for tension and shear load (version **type H/S**, **type SK, type ST, type ST-6[1])**, **type P, type I[1])**)									
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	14,0		27,0	45,0		67,0	94,0
Partial safety factor	$\gamma_{Ms,N}$	[-]	1,5						
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	4,7	5,5	8,5	13,5	15,3	21,0	22,4
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,25						
With filling of the annular gap [2)]	α_{gap}	[-]	1,0						
Without filling of the annular gap [3)]	α_{gap}	[-]	0,5						
Pull-out failure (version **type H/S**, **type SK, type ST, type ST-6[1])**, **type P, type I[1])**)									
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p,C1}$	[kN]	2,0	4,0	12,0	9,0	$\geq N^0_{Rk,c}$ [4)]		
Concrete cone failure (version **type H/S**, **type SK, type ST, type ST-6[1])**, **type P, type I[1])**)									
Effective embedment depth	h_{ef}	[mm]	31	44	52	43	68	80	92
Edge distance	$c_{cr,N}$	[mm]	$1{,}5 \times h_{ef}$						
Spacing	$s_{cr,N}$	[mm]	$3 \times h_{ef}$						
Installation factor	γ_{inst}	[-]	1,0						
Concrete pry-out failure (version **type H/S**, **type SK, type ST, type P**)									
Factor for pry-out failure	k_8	[-]	1,0				2,0		
Concrete edge failure (version **type H/S**, **type SK, type ST, type P**)									
Effective length in concrete	$l_f = h_{ef}$	[mm]	31	44	52	43	68	80	92
Nominal outer diameter of screw	d_{nom}	[mm]	6	6	8	10	10	12	14

1) only tension load
2) With filling of the annular gap according to annex B7, figure 5
3) Without filling of the annular gap according to annex B5
4) $N^0_{Rk,c}$ according to EN 1992-4:2018

CLR plus concrete screw	**Annex C3**
Performances Seismic category C1 – Characteristic load values	

Table 9: Seismic category C2 [1)] – Characteristic load values **with filled annular gap according to annex B7, figure 5** (type H/S, type ST, type P)

CLR plus concrete screw size			8	10	12	14
Nominal embedment depth		h_{nom}	h_{nom3}			
		[mm]	65	85	100	115
Steel failure for tension and shear load (version **type H/S, type ST, type P**)						
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	27,0	45,0	67,0	94,0
Partial safety factor	$\gamma_{Ms,N}$	[-]	1,5			
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	9,9	18,5	31,6	40,7
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,25			
With filling of the annular gap	α_{gap}	[-]	1,0			
Pull-out failure (version **type H/S, type ST, type P**)						
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p,C2}$	[kN]	2,4	5,4	7,1	10,5
Concrete cone failure (version **type H/S, type ST, type P**)						
Effective embedment depth	h_{ef}	[mm]	52	68	80	92
Edge distance	$c_{cr,N}$	[mm]	1,5 x h_{ef}			
Spacing	$s_{cr,N}$	[mm]	3 x h_{ef}			
Installation factor	γ_{inst}	[-]	1,0			
Concrete pry-out failure (version **type H/S, type ST, type P**)						
Factor for pry-out failure	k_8	[-]	1,0	2,0		
Concrete edge failure (version **type H/S, type ST, type P**)						
Effective length in concrete	$l_f = h_{ef}$	[mm]	52	68	80	92
Nominal outer diameter of screw	d_{nom}	[mm]	8	10	12	14

1) A4 and HCR not suitable

CLR plus concrete screw

Performances
Seismic category C2 – Characteristic load values with filled annular gap

Annex C4

Table 10: Seismic category C2 [1)] – Characteristic load values **without filled annular gap according to annex B5** (type H/S, type ST, type P and type SK)

CLR plus concrete screw size			8	10	12	14
Nominal embedment depth	h_{nom}		h_{nom3}			
		[mm]	65	85	100	115
Steel failure for tension and shear load (version **type H/S, type ST, type P**)						
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	27,0	45,0	67,0	94,0
Partial safety factor	$\gamma_{Ms,N}$	[-]	1,5			
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	10,3	21,9	24,4	23,3
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,25			
Without filling of the annular gap	α_{gap}	[-]	0,5			
Pull-out failure (version **type H/S, type ST, type P**)						
Characteristic resistance in cracked concrete	$N_{Rk,p,C2}$	[kN]	2,4	5,4	7,1	10,5
Steel failure for tension and shear load (version **type SK**)						
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	27,0	45,0	no performance assessed	
Partial safety factor	$\gamma_{Ms,N}$	[-]	1,5			
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	3,6	13,7		
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,25			
Without filling of the annular gap	α_{gap}	[-]	0,5			
Pull-out failure (version **type SK**)						
Characteristic resistance in cracked concrete	$N_{Rk,p,C2}$	[kN]	2,4	5,4	no performance assessed	
Concrete cone failure (version **type H/S, type SK, type ST, type P**)						
Effective embedment depth	h_{ef}	[mm]	52	68	80	92
Edge distance	$c_{cr,N}$	[mm]	1,5 x h_{ef}			
Spacing	$s_{cr,N}$	[mm]	3 x h_{ef}			
Installation factor	γ_{inst}	[-]	1,0			
Concrete pry-out failure (version **type H/S, type SK, type ST, type P**)						
Factor for pry-out failure	k_8	[-]	1,0	2,0		
Concrete edge failure (version **type H/S, type SK, type ST, type P**)						
Effective length in concrete	$l_f = h_{ef}$	[mm]	52	68	80	92
Nominal outer diameter of screw	d_{nom}	[mm]	8	10	12	14

[1)] A4 and HCR not suitable

CLR plus concrete screw

Performances
Seismic category C2 – Characteristic load values without filled annular gap

Annex C5

Table 11: Fire exposure – characteristic values of resistance

CLR plus concrete screw size				6		8			10			12			14		
Nominal embedment depth			h_{nom}	1	2	1	2	3	1	2	3	1	2	3	1	2	3
			[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Steel failure for tension and shear load																	
Characteristic Resistance	R30	$N_{Rk,s,fi30}$	[kN]	0,9		2,4			4,4			7,3			10,3		
	R60	$N_{Rk,s,fi60}$	[kN]	0,8		1,7			3,3			5,8			8,2		
	R90	$N_{Rk,s,fi90}$	[kN]	0,6		1,1			2,3			4,2			5,9		
	R120	$N_{Rk,s,fi120}$	[kN]	0,4		0,7			1,7			3,4			4,8		
	R30	$V_{Rk,s,fi30}$	[kN]	0,9		2,4			4,4			7,3			10,3		
	R60	$V_{Rk,s,fi60}$	[kN]	0,8		1,7			3,3			5,8			8,2		
	R90	$V_{Rk,s,fi90}$	[kN]	0,6		1,1			2,3			4,2			5,9		
	R120	$V_{Rk,s,fi120}$	[kN]	0,4		0,7			1,7			3,4			4,8		
	R30	$M^0_{Rk,s,fi30}$	[Nm]	0,7		2,4			5,9			12,3			20,4		
	R60	$M^0_{Rk,s,fi60}$	[Nm]	0,6		1,8			4,5			9,7			15,9		
	R90	$M^0_{Rk,s,fi90}$	[Nm]	0,5		1,2			3,0			7,0			11,6		
	R120	$M^0_{Rk,s,fi120}$	[Nm]	0,3		0,9			2,3			5,7			9,4		
Pull-out failure																	
Characteristic Resistance	R30-R90	$N_{Rk,p,fi}$	[kN]	0,5	1,0	1,3	2,3	3,0	2,3	4,0	4,8	3,0	4,7	6,2	3,8	6,0	7,6
	R120	$N_{Rk,p,fi}$	[kN]	0,4	0,8	1,0	1,8	2,4	1,8	3,2	3,9	2,4	3,8	4,9	3,0	4,8	6,1
Concrete cone failure																	
Characteristic Resistance	R30-R90	$N^0_{Rk,c,fi}$	[kN]	0,9	2,2	1,2	2,1	3,4	2,1	4,8	6,6	3,0	6,3	9,9	4,4	9,6	14,0
	R120	$N^0_{Rk,c,fi}$	[kN]	0,7	1,8	1,0	1,7	2,7	1,7	3,8	5,3	2,4	5,1	7,9	3,5	7,6	11,2
Edge distance																	
R30 to R120		$c_{cr,fi}$	[mm]	$2 \times h_{ef}$													
In case of fire attack from more than one side, the minimum edge distance shall be ≥300mm.																	
Spacing																	
R30 to R120		$s_{cr,fi}$	[mm]	$4 \times h_{ef}$													
The anchorage depth has to be increased for wet concrete by at least 30 mm compared to the given value.																	

CLR plus concrete screw

Performances
Fire exposure – characteristic values of resistance

Annex C6

Table 12: Displacements under static and quasi-static tension load

CLR plus concrete screw size				6		8			10		
Nominal embedment depth			h_{nom}	h_{nom1}	h_{nom2}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
			[mm]	40	55	45	55	65	55	75	85
Cracked concrete	tension load	N	[kN]	0,95	1,9	2,4	4,3	5,7	4,3	7,9	9,6
	displacement	δ_{N0}	[mm]	0,3	0,6	0,6	0,7	0,8	0,6	0,5	0,9
		$\delta_{N\infty}$	[mm]	0,4	0,4	0,6	1,0	0,9	0,4	1,2	1,2
Uncracked concrete	tension load	N	[kN]	1,9	4,3	3,6	5,7	7,6	5,7	9,5	11,9
	displacement	δ_{N0}	[mm]	0,4	0,6	0,7	0,9	0,5	0,7	1,1	1,0
		$\delta_{N\infty}$	[mm]	0,4	0,4	0,6	1,0	0,9	0,4	1,2	1,2

CLR plus concrete screw size				12			14		
Nominal embedment depth			h_{nom}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
			[mm]	65	85	100	75	100	115
Cracked concrete	tension load	N	[kN]	5,7	9,4	12,3	7,6	12,0	15,1
	displacement	δ_{N0}	[mm]	0,9	0,5	1,0	0,5	0,8	0,7
		$\delta_{N\infty}$	[mm]	1,0	1,2	1,2	0,9	1,2	1,0
Uncracked concrete	tension load	N	[kN]	7,6	13,2	17,2	10,6	16,9	21,2
	displacement	δ_{N0}	[mm]	1,0	1,1	1,2	0,9	1,2	0,8
		$\delta_{N\infty}$	[mm]	1,0	1,2	1,2	0,9	1,2	1,0

Table 13: Displacements under static and quasi-static shear load

CLR plus concrete screw size				6		8			10		
Nominal embedment depth			h_{nom}	h_{nom1}	h_{nom2}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
			[mm]	40	55	45	55	65	55	75	85
Cracked and uncracked concrete	shear load	V	[kN]	3,3		8,6			16,2		
	displacement	δ_{V0}	[mm]	1,55		2,7			2,7		
		$\delta_{V\infty}$	[mm]	3,1		4,1			4,3		

CLR plus concrete screw size				12			14		
Nominal embedment depth			h_{nom}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
			[mm]	65	85	100	75	100	115
Cracked and uncracked concrete	shear load	V	[kN]	20,0			30,5		
	displacement	δ_{V0}	[mm]	4,0			3,1		
		$\delta_{V\infty}$	[mm]	6,0			4,7		

CLR plus concrete screw

Performances
Displacements under static and quasi-static loads

Annex C7

Table 14: Seismic category C2 [1)] – Displacements **with filled annular gap according to annex B7, figure 5** (type H/S, type ST, type P)

CLR plus concrete screw size			8	10	12	14
Nominal embedment depth		h_{nom}	h_{nom3}			
		[mm]	65	85	100	115
Displacements under tension loads (version **type H/S, type ST, type P**)						
Displacement DLS	$\delta_{N,C2(DLS)}$	[mm]	0,66	0,32	0,57	1,16
Displacement ULS	$\delta_{N,C2(ULS)}$	[mm]	1,74	1,36	2,36	4,39
Displacements under shear loads (version **type H/S, type ST, type P** with hole clearance)						
Displacement DLS	$\delta_{V,C2(DLS)}$	[mm]	1,68	2,91	1,88	2,42
Displacement ULS	$\delta_{V,C2(ULS)}$	[mm]	5,19	6,72	5,37	9,27

Table 15: Seismic category C2 [1)] – Displacements **without filled annular gap according to annex B5** (only version type H/S, type SK, type ST, type P)

CLR plus concrete screw size			8	10	12	14
Nominal embedment depth		h_{nom}	h_{nom3}			
		[mm]	65	85	100	115
Displacements under tension loads (version **type H/S, type ST, type P**)						
Displacement DLS	$\delta_{N,C2(DLS)}$	[mm]	0,66	0,32	0,57	1,16
Displacement ULS	$\delta_{N,C2(ULS)}$	[mm]	1,74	1,36	2,36	4,39
Displacements under tension loads (version **type SK**)						
Displacement DLS	$\delta_{N,C2(DLS)}$	[mm]	0,66	0,32	no performance assessed	
Displacement ULS	$\delta_{N,C2(ULS)}$	[mm]	1,74	1,36		
Displacements under shear loads (version **type H/S, type ST, type P** with hole clearance)						
Displacement DLS	$\delta_{V,C2(DLS)}$	[mm]	4,21	4,71	4,42	5,60
Displacement ULS	$\delta_{V,C2(ULS)}$	[mm]	7,13	8,83	6,95	12,63
Displacements under shear loads (version **type SK** with hole clearance)						
Displacement DLS	$\delta_{V,C2(DLS)}$	[mm]	2,51	2,98	no performance assessed	
Displacement ULS	$\delta_{V,C2(ULS)}$	[mm]	7,76	6,25		

[1)] A4 and HCR not suitable

CLR plus concrete screw	Annex C8
Performances Displacements under seismic loads	