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European Technical Assessment

ETA-01/0011 of 22/12/2016

English translation prepared by CSTB - Original version in French language

General Part

Nom commercial *Trade name*	**Sormat Liebig Superplus™ self-undercutting anchor**
Famille de produit *Product family*	**Cheville métallique en acier galvanisé ou inoxydable, à expansion par vissage à couple contrôlé, avec verrou autoformé, pour fixation dans le béton: diamètres M8, M12 et M16.** ***Torque-controlled self undercutting anchor, made of galvanised or stainless steel, for use in concrete: sizes M8, M12 and M16.***
Titulaire *Manufacturer*	SORMAT OY Harjutie 5 FIN-21290 Rusko Finland
Usine de fabrication *Manufacturing plants*	Sormat Plant 1
Cette évaluation contient: *This assessment contains*	19 pages incluant 16 annexes qui font partie intégrante de cette évaluation 19 *pages including 16 annexes which form an integral part of this assessment*
Base de l'ETE *Basis of ETA*	DEE 330232-00-0601, version octobre 2016 et TR049 *EAD 330232-00-0601, Edition October 2016 and TR049*
Cette évaluation remplace: *This assessment replaces*	ETE-01/0011, issu le 06/07/2015 *ETA-01/0011, issued on 06/07/2015*

Specific Part

1 Technical description of the product

The Sormat Liebig Superplus™ self-undercutting anchor in the sizes of M8, M12 and M16 is an anchor made of galvanised or stainless steel, which is placed into a drilled hole and anchored by torque controlled expansion.

The illustration and the description of the product are given in Annexes A.

2 Specification of the intended use

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

The provisions made in this European technical assessment are based on an assumed working life of the anchor of 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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic tension resistance for static and quasi-static action	See Annexes C1, C2
Characteristic shear resistance for static and quasi-static action	See Annexes C3, C4
Displacements under static and quasi-static action	See Annex C8, C9
Characteristic resistance for Seismic Performance Category C1 and C2 Displacements for Seismic Performance Category C2	See Annex C10

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy re - quirements for Class A1
Characteristic tension resistance under fire acc. ETAG001, Annex C	See Annex C5, C6
Characteristic shear resistance under fire acc. ETAG001, Annex C	See Annex C7

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances contained in this European technical approval, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

For Basic requirement Safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability.

3.5 Protection against noise (BWR 5)

Not relevant.

3.6 Energy economy and heat retention (BWR 6)

Not relevant.

3.7 Sustainable use of natural resources (BWR 7)

For the sustainable use of natural resources no performance was determined for this product.

3.8 General aspects relating to fitness for use

Durability and Serviceability are only ensured if the specifications of intended use according to Annex B1 are kept.

4 Assessment and verification of constancy of performance (AVCP)

According to the Decision 96/582/EC of the European Commission[1], as amended, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table apply.

Product	**Intended use**	**Level or Class**	**System**
Metal anchors for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units	—	1

5 Technical details necessary for the implementation of the AVCP system

Technical details necessary for the implementation of the Assessment and verification of constancy of performance (AVCP) system are laid down in the control plan deposited at Centre Scientifique et Technique du Bâtiment.

The manufacturer shall, on the basis of a contract, involve a notified body approved in the field of anchors for issuing the certificate of conformity CE based on the control plan.

Issued in Marne La Vallée on 22-12-2016 by
Charles Baloche
Directeur technique

The original French version is signed

1 Official Journal of the European Communities L 254 of 08.10.1996

Sormat Liebig
Superplus™ self-undercutting anchor

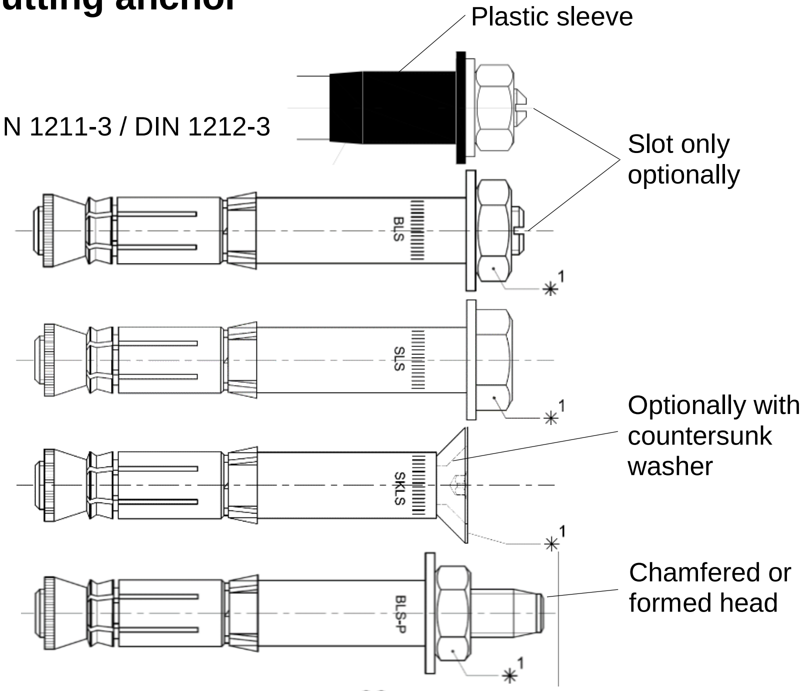
SD Type
Step Iron Anchor as per DIN 1211-3 / DIN 1212-3

BLS Type
In-place installation

SLS Type
In-place installation

SKLS Type
In-place installation

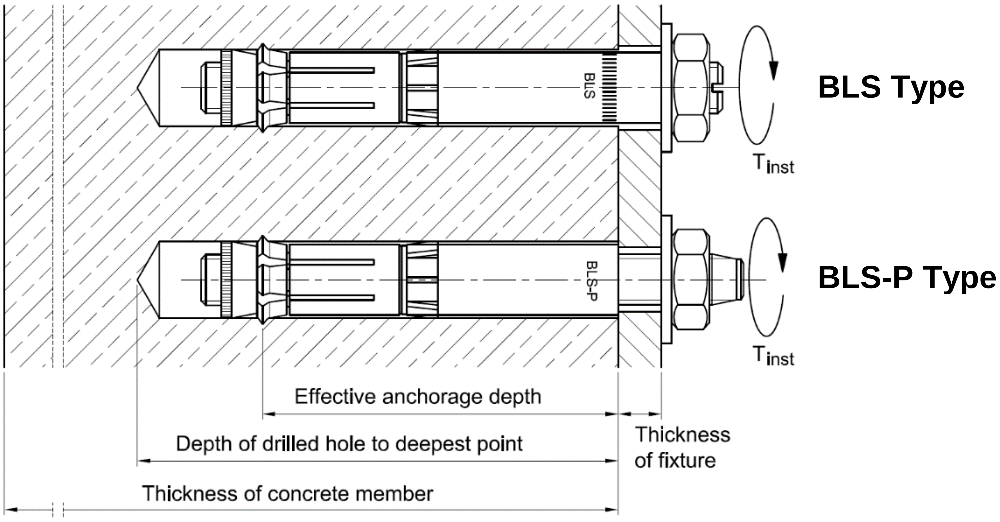
BLS-P Type
Pre-positioned installation



Marking:	Identifying mark:	S or ⚘
	Anchor identity: BLS; SLS; SKLS:	e.g. BLS M8 14/40/15
	BLS-P:	e.g. BLS-P M8 14/40
	Setting depth marking:	knurl or groove
	Category	A4 or HCR (where applicable)
	✳[1] – Setting depth identification:	Embossed dot for deeper depth per size

NOTE: The SD type corresponds to the BLS M8 A4 type with plastic sleeve surrounding the distance sleeve.

Sormat Liebig
Superplus™ self-undercutting anchor after installation



Sormat Liebig Superplus™ self-undercutting anchor	Annex A1
Product description Installation condition	

Sormat Liebig
Superplus™ self-undercutting anchor

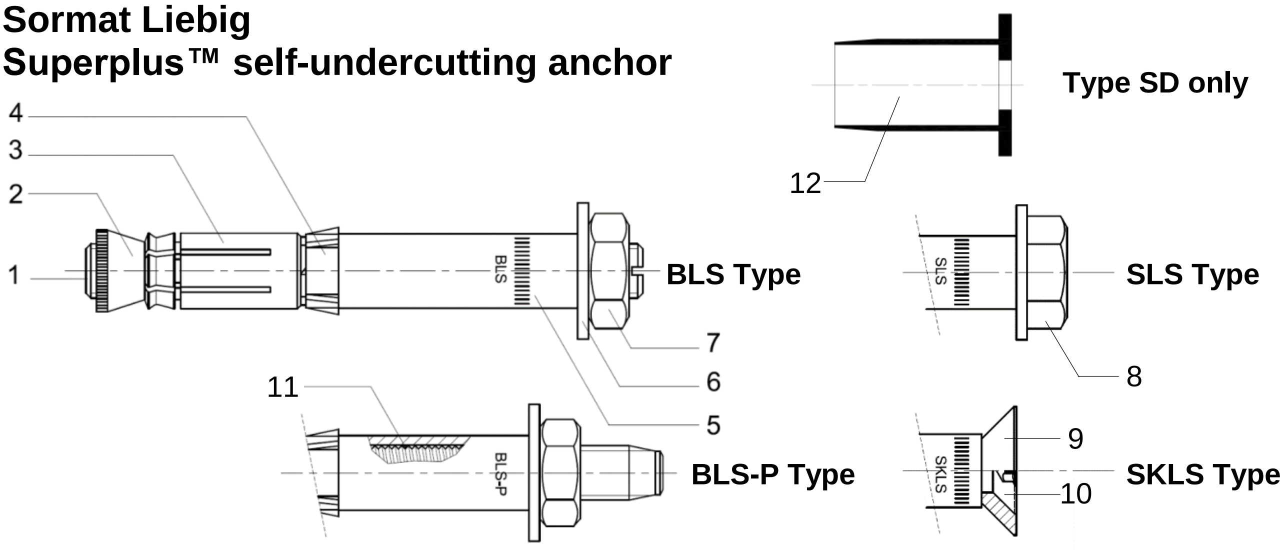


Table A1: Materials BLS, SLS, SKLS and BLS-P

Part	Designation	Material: Zinc electroplated [1)]
1	Threaded bolt	EN ISO 898-1; property class 8.8
2	Cone	Carbon steel
3	Anchor sleeve	Carbon steel
4	Plastic ring	PE
5	Distance sleeve	Carbon steel; f_u ≥ 500 N/mm²
6	Washer	Carbon steel EN 10139
7	Hexagonal nut	EN ISO 898-2; property class 8
8	Hexagonal screw	EN ISO 898-1; property class 8
9	Countersunk washer	EN 10025: 1.0037 / EN 10087: 1.0718
10	Countersunk screw	EN ISO 898-1; property class 8
11	Grip (only BLS-P)	Drop of glue, tape or rubber O-Ring

[1)] Coating: Parts 1 - 3 and 5 - 10 zinc electroplated according EN ISO 4042 ≥ 5μm, passivated.

Table A2: Materials BLS, SLS, SKLS and BLS-P in A4/HCR and SD

Part	Designation	Material: Stainless steel A4/HCR
1	Threaded bolt	EN 10088: 1.4401 / 1.4404 / 1.4571 / 1.4529; EN ISO 3506-1: class 80
2	Cone	EN 10088: 1.4401 / 1.4404 / 1.4571 / 1.4529
3	Anchor sleeve	EN 10088: 1.4401 / 1.4404 / 1.4571 / 1.4529
4	Plastic ring	PE
5	Distance sleeve	EN 10088: 1.4401 / 1.4404 / 1.4571 / 1.4529; f_u ≥ 500 N/mm²
6	Washer	EN 10088: 1.4401 / 1.4404 / 1.4571 / 1.4529
7	Hexagonal nut	EN 10088: 1.4401 / 1.4404 / 1.4571 / 1.4529; EN ISO 3506-2: class 80
8	Hexagonal screw	EN 10088: 1.4401 / 1.4404 / 1.4571 / 1.4529; EN ISO 3506-1: class 80
9	Countersunk washer	EN 10088: 1.4401 / 1.4404 / 1.4571 / 1.4529
10	Countersunk screw	EN 10088: 1.4401 / 1.4404 / 1.4571 / 1.4529; EN ISO 3506-1: class 80
11	Grip (only BLS-P)	Drop of glue, tape or rubber O-Ring
12	Plastic sleeve	PA; DIN EN ISO 1874-1

Specifications of intended use

Anchorages subject to:

- Static, quasi-static loads
- Fire exposure

Zinc plated - BLS, SLS, SKLS and BLS-P **Stainless Steel** - BLS, SLS, SKLS in A4 / HCR - BLS-P in A4 / HCR - SD (M8)	M8	14/40
		14/80
	M12	20/80
		20/150
	M16	25/150
		25/200

- Seismic actions for Performance Category C1 and C2

Zinc plated - BLS, SLS, SKLS and BLS-P	M12	20/80
		20/150
	M16	25/150
		25/200

Base materials:

- Cracked and Non-cracked concrete
- Reinforced or unreinforced normal weight concrete of strength classes C 20/25 at least to C50/60 at most according to EN 206: 2000-12

Use conditions (Environmental conditions):

- The BLS, SLS, SKLS and BLS-P anchors may only be used in structures subject to dry indoor conditions, indoor with temporary condensation.
- The BLS, SLS, SKLS in A4 and BLS-P in A4 may be used in concrete subject to dry internal conditions and also in concrete subject to external atmospheric exposure (including industrial and marine environment), or exposure in permanently damp internal conditions, if no particular aggressive conditions exist.
- The BLS, SLS, SKLS in HCR and BLS-P in HCR may be used in concrete subject to dry internal conditions and also in concrete subject to external atmospheric exposure, in permanently damp internal conditions or in other particular aggressive conditions.

  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Specifications of intended use

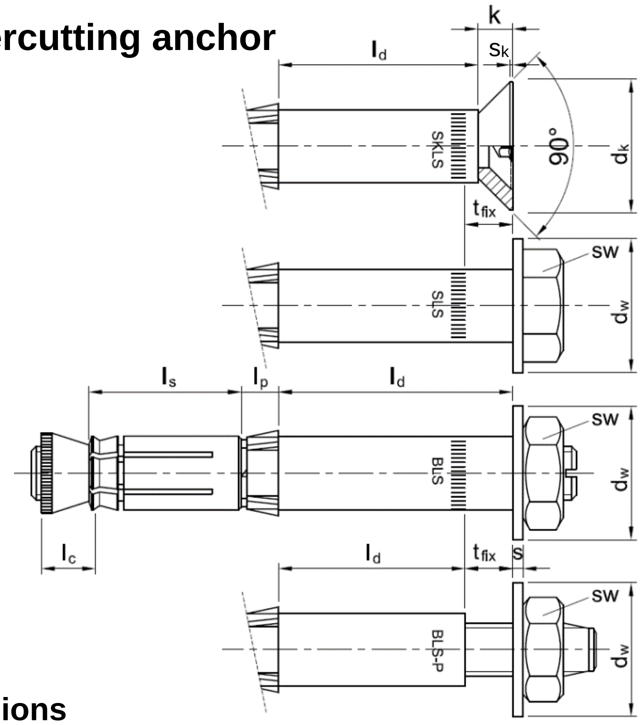
Design:

- The anchorages are designed in accordance with the ETAG001 Annex C “Design Method for Anchorages” or CEN/TS 1992-4-4 "Design of fastenings for use in concrete” under the responsibility of an engineer experienced in anchorages and concrete work.
- For application with resistance under fire exposure the anchorages are designed in accordance with method given in EOTA TR 020 “Evaluation of Anchorage in Concrete concerning Resistance to Fire”.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings.

Installation:

- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor.
- Anchor installation in accordance with the manufacturer’s specifications and drawings and using the appropriate tools.
- Effective anchorage depth, edge distances and spacing not less than the specified values without minus tolerances.
- Hole drilling by hammer drill.
- Cleaning of the hole of drilling dust
- BLS, SLS, SKLS and SD versions installed through fixture using an ordinary hammer and tightened to specified torque.
- BLS-P versions installed into drill-hole using an ordinary hammer. Then, nut and washer are removed, fixture installed, washer and nut installed, and tightened to specified torque.
- Application of specified torque moment using a calibrated torque tool
- In case of aborted hole, drilling of new hole at a minimum distance of twice the depth of the aborted hole, or smaller distance provided the aborted drill hole is filled with high strength mortar and no shear or oblique tension loads in the direction of aborted hole.

Sormat Liebig
Superplus™ self-undercutting anchor



SKLS Type

SLS Type

BLS Type

BLS-P Type

Table B1: Anchor dimensions

Main dimensions		Cone	Sleeve	Ring	Distance	Washer		CS head			Wrench
Anchor type	t_{fix} [mm]	l_c [mm]	l_s [mm]	l_p [mm]	l_d [mm]	≥ s [mm]	≥ d_w [mm]	d_k [mm]	k [mm]	s_k [mm]	≥ SW [mm]
BLS, SLS, SKLS M8–14/40 (A4/HCR/SD)	0 - 100	11.8	26	6.0	9-109 2,5-102,5 (SKLS)	1.5	20	24	6,5	0,5	13
BLS–P M8–14/40 (A4/HCR)					9						
BLS, SLS, SKLS M8–14/80 (A4/HCR/SD)	0 - 150	11.8	26	6.0	49-199 42,5-192,5 (SKLS)	1.5	20	24	6,5	0,5	13
BLS–P M8–14/80 (A4/HCR)					49						
BLS, SLS, SKLS M12–20/80 (A4/HCR)	0 - 200	16.5	40	11.5	30-230 22-222 (SKLS)	3.5	30	33	8,0	1,0	18
BLS–P M12–20/80 (A4/HCR)					30						
BLS, SLS, SKLS M12–20/150 (A4/HCR)	0 - 250	16.5	40	11.5	100-350 92-342 (SKLS)	3.5	30	33	8,0	1,0	18
BLS–P M12–20/150 (A4/HCR)					100						
BLS, SLS, SKLS M16–25/150 (A4/HCR)	0 - 250	17.8	60	11.5	80-330 66-316 (SKLS)	4.0	40	50	14,0	1,0	24
BLS–P M16–25/150 (A4/HCR)					80						
BLS, SLS, SKLS M16–25/200 (A4/HCR)	0 - 300	17.8	60	11.5	130-430 116-416 (SKLS)	4.0	40	50	14,0	1,0	24
BLS–P M16–25/200 (A4/HCR)					130						

Sormat Liebig
Superplus™ self-undercutting anchor

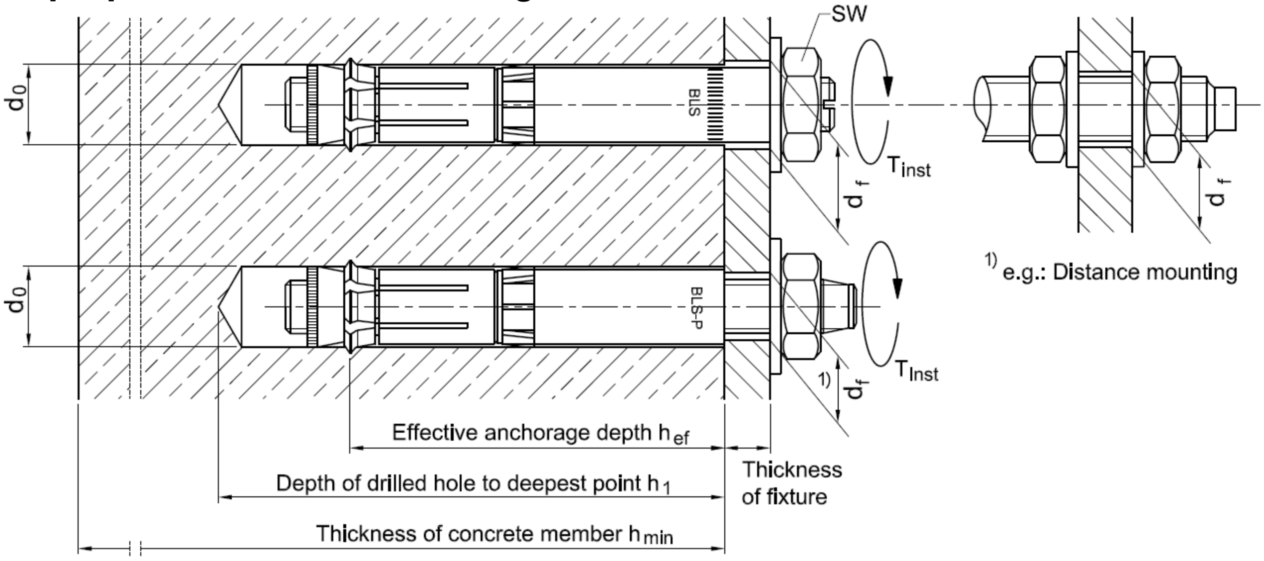


Table B2: Installation data

Zinc plated - BLS, SLS, SKLS - BLS-P	**Stainless Steel** - BLS, SLS, SKLS A4/HCR - BLS-P A4/HCR - SD (M8)			**Anchor type**					
				M8 - 14		**M12 - 20**		**M16 - 25**	
				/40	**/80**	**/80**	**/150**	**/150**	**/200**
Drill hole diameter		d_o	[mm]	14		20		25	
Cutting diameter at the upper tolerance limit (maximum diameter bit)		$d_{cut,max} \leq$	[mm]	14.50		20.55		25.55	
Depth of drilled hole to deepest point		$h_1 \geq$	[mm]	60	100	105	175	185	235
Effective anchorage depth		$h_{ef} \geq$	[mm]	40	80	80	150	150	200
Diameter of clearance hole in the fixture	In-place installation (BLS)	$d_f \leq$	[mm]	16		21		26	
	Mounting on the threaded bolt [1)] (BLS-P / dist. mounting)	$d_f \leq$	[mm]	10		14		18	
Thickness of fixture		t_{fix}	[mm]	0-100	0-150	0-200	0-250	0-250	0-300
Width across flats BLS, SLS, BLS-P		SW	[mm]	≥ 13		≥ 18		≥ 24	
Width across flats / T- drive SKLS		SW / T-	[mm / -]	5 / 40		8 / ≥ 50		10 / ≥ 50	
Torque moment		T_{inst}	[Nm]	25		80		180	
Minimum thickness of concrete member		h_{min}	[mm]	100	160	160	300	300	400
Zinc plated	Minimum allowable spacing	s_{min}	[mm]	100	80	120	150	200	150
	Minimum allowable edge dist.	c_{min}	[mm]	80	50	100	80	150	100
Stainless steel	Minimum allowable spacing	s_{min}	[mm]	80	80	150	150	150	180
	Minimum allowable edge dist.	c_{min}	[mm]	60	50	100	80	100	100

Table C1: Characteristic values for tension loads in case of static and quasi static loading for design method A acc. ETAG 001, Annex C or CEN/TS 1992-4

Zinc plated - BLS, SLS, SKLS - BLS-P			**Anchor type**					
			M8 - 14		**M12 - 20**		**M16 - 25**	
			/40	**/80**	**/80**	**/150**	**/150**	**/200**
Steel failure								
Characteristic resistance	$N_{Rk,s}$	[kN]	29,3		67,4		125,6	
Partial safety factor	γ_{Ms} [1]	[-]	1,5					
Pull-out failure								
Characteristic resistance in **cracked** concrete C20/25	$N_{Rk,p}$	[kN]	9	16	25	40	50	75
Characteristic resistance in **non-cracked** concrete C20/25	$N_{Rk,p}$	[kN]	not decisive failure mode					
Increasing factor for $N_{Rk,p}$	ψ_C	C30/37	1,22					
		C40/50	1,41					
		C50/60	1,55					
Partial safety factor	γ_{Mp} [1]	[-]	1,5 [2]					
Concrete cone failure and splitting failure								
Effective anchorage depth	h_{ef}	[mm]	40	80	80	150	150	200
Factor for cracked concrete	k_{cr}	[-]	7,2					
Factor for non-cracked concrete	k_{ucr}	[-]	10,1					
Center Spacing	$s_{cr,N}$	[mm]	120	240	240	450	450	600
Edge distance	$c_{cr,N}$	[mm]	60	120	120	225	225	300
Center Spacing (splitting)	$s_{cr,sp}$	[mm]	140	360	360	540	560	560
Edge distance (splitting)	$c_{cr,sp}$	[mm]	70	180	180	270	280	280
Partial safety factor	γ_{Mc} [1] γ_{Msp} [1]	[-]	1,5 [2]					

[1] In absence of other national regulations
[2] The installation safety factor of γ_2 = 1,0 is included

Table C2: Characteristic values for tension loads in case of static and quasi static loading for design method A acc. ETAG 001, Annex C or CEN/TS 1992-4

Stainless Steel - BLS, SLS, SKLS A4/HCR - BLS-P A4/HCR - SD (M8)			**Anchor type**					
			M8 - 14		**M12 - 20**		**M16 - 25**	
			/40	**/80**	**/80**	**/150**	**/150**	**/200**
Steel failure								
Characteristic resistance	$N_{Rk,s}$	[kN]	29,3		67,4		125,6	
Partial safety factor	γ_{Ms} 1)	[-]	1,6					
Pull-out failure								
Characteristic resistance in **cracked** concrete C20/25	$N_{Rk,p}$	[kN]	9	12	25	40	60	60
Characteristic resistance in **non-cracked** concrete C20/25	$N_{Rk,p}$	[kN]	not decisive failure mode					
Increasing factor for $N_{Rk,p}$	Ψ_C	C30/37	1,22					
		C40/50	1,41					
		C50/60	1,55					
Partial safety factor	γ_{Mp} 1)	[-]	1,5 2)					
Concrete cone failure and splitting failure								
Effective anchorage depth	h_{ef}	[mm]	40	80	80	150	150	200
Factor for cracked concrete	k_{cr}	[-]	7,2					
Factor for non-cracked concrete	k_{ucr}	[-]	10,1					
Center Spacing	$s_{cr,N}$	[mm]	120	240	240	450	450	600
Edge distance	$c_{cr,N}$	[mm]	60	120	120	225	225	300
Center Spacing (splitting)	$s_{cr,sp}$	[mm]	140	360	360	540	560	560
Edge distance (splitting)	$c_{cr,sp}$	[mm]	70	180	180	270	280	280
Partial safety factor	γ_{Mc} 1) γ_{Msp} 1)	[-]	1,5 2)					

1) In absence of other national regulations
2) The installation safety factor of γ_2 = 1,0 is included

Sormat Liebig Superplus™ self-undercutting anchor	**Annexe C2**
Performance Characteristic resistance under tension loads	

Table C3: Characteristic values for shear loads in case of static and quasi static loading for design method A acc. ETAG 001, Annex C or CEN/TS 1992-4

Zinc plated - BLS, SLS, SKLS - BLS-P				**Anchor type**					
				M8 - 14		**M12 - 20**		**M16 - 25**	
				/40	**/80**	**/80**	**/150**	**/150**	**/200**
Steel failure without lever arm									
BLS	Characteristic resistance for In-place installation	$V_{Rk,s}$	[kN]	41,4		70,0		118,0	
	Partial safety factor	γ_{Ms} 1)	[-]	1,25					
BLS-P	Characteristic resistance for Pre-positioned installation	$V_{Rk,s}$	[kN]	15		34		63	
	Partial safety factor	γ_{Ms} 1)	[-]	1,25					
Factor for considering ductility		k_2	[-]	1,0					
Steel failure with lever arm									
Characteristic resistance		$M^0_{Rk,s}$	[Nm]	30		105		266	
Partial safety factor		γ_{Ms} 1)	[-]	1,25					
Concrete pryout failure									
k-factor		$k_{(3)}$	[-]	1	2	2		2	
Partial safety factor		γ_{Mc} 1)	[-]	1,5 2)					
Concrete edge failure									
Effective length of anchor under shear load		ℓ_f	[mm]	40	80	80	150	150	200
Outside diameter of anchor		d_{nom}	[mm]	14		20		25	
Cracked concrete without any edge reinforcement		$\Psi_{ucr,V}$	[-]	1,0					
Cracked concrete with straight edge reinforcement > Ø12 mm				1,2					
Cracked concrete with edge reinforcement and closely spaced stirrups (a ≤ 100mm) or **non-cracked concrete**				1,4					
Partial safety factor		γ_{Mc} 1)	[-]	1,5 2)					

1) In absence of other national regulations
2) The installation safety factor of γ_2 = 1,0 is included

Table C4: Characteristic values for shear loads in case of static and quasi static loading for design method A acc. <u>ETAG 001, Annex C</u> or CEN/TS 1992-4

<u>Stainless Steel</u> - BLS, SLS, SKLS A4/HCR - BLS-P A4/HCR - SD (M8)				**Anchor type**					
				M8 - 14		**M12 - 20**		**M16 - 25**	
				/40	**/80**	**/80**	**/150**	**/150**	**/200**
Steel failure without lever arm									
BLS	Characteristic resistance for In-place installation	$V_{Rk,s}$	[kN]	44,6		90,3		169,8	
	Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
BLS-P	Characteristic resistance for Pre-positioned installation	$V_{Rk,s}$	[kN]	15		34		63	
	Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Factor for considering ductility		k_2	[-]	1,0					
Steel failure with lever arm									
Characteristic resistance		$M^0_{Rk,s}$	[Nm]	30		105		266	
Partial safety factor		γ_{Ms} [1)]	[-]	1,33					
Concrete pryout failure									
k-factor		$k_{(3)}$	[-]	1	2	2		2	
Partial safety factor		γ_{Mc} [1)]	[-]	1,5 [2)]					
Concrete edge failure									
Effective length of anchor under shear load		ℓ_f	[mm]	40	80	80	150	150	200
Outside diameter of anchor		d_{nom}	[mm]	14		20		25	
Cracked concrete without any edge reinforcement		$\Psi_{ucr,V}$	[-]	1,0					
Cracked concrete with straight edge reinforcement > Ø12 mm				1,2					
Cracked concrete with edge reinforcement and closely spaced stirrups (a≤100mm) or **non-cracked concrete**				1,4					
Partial safety factor		γ_{Mc} [1)]	[-]	1,5 [2)]					

1) In absence of other national regulations

2) The installation safety factor of $\gamma_2 = 1{,}0$ is included

Sormat Liebig Superplus™ self-undercutting anchor	**Annex C4**
Performance Characteristic resistance under shear loads	

Table C5: Characteristic tension resistance under fire exposure for design method A according to ETAG 001, Annex C or CEN/TS 1992-4

Zinc plated - BLS, SLS, SKLS - BLS-P	**Stainless Steel** - BLS, SLS, SKLS A4/HCR - BLS-P A4/HCR - SD (M8)			**Anchor size ($h_{ef,min}$)**		
				M8 - 14/40	**M12 - 20/80**	**M16 - 25/150**
Steel failure						
Characteristic resistance $N_{Rk,s,fi}$	Zinc plated	R30	[kN]	0,37	1,70	3,10
		R60	[kN]	0,33	1,30	2,30
		R90	[kN]	0,26	1,10	0,84
		R120	[kN]	0,18	0,84	1,60
	Stainless steel	R30	[kN]	0,73	2,5	4,7
		R60	[kN]	0,59	2,1	3,9
		R90	[kN]	0,44	1,7	3,1
		R120	[kN]	0,37	1,3	2,5
Pull-out failure						
Characteristic resistance $N_{Rk,p,fi}$	Zinc plated	R30	[kN]	2,3	6,3	12,5
		R60	[kN]	2,3	6,3	12,5
		R90	[kN]	2,3	6,3	12,5
		R120	[kN]	1,8	5,0	10,0
Characteristic resistance $N_{Rk,p,fi}$	Stainless steel	R30	[kN]	2,3	6,3	15,0
		R60	[kN]	2,3	6,3	15,0
		R90	[kN]	2,3	6,3	15,0
		R120	[kN]	1,8	5,0	12,0
Concrete cone and splitting failure [1)]						
Characteristic resistance $N_{Rk,c,fi}$		R30	[kN]	1.8	10,3	49,6
		R60	[kN]	1.8	10,3	49,6
		R90	[kN]	1.8	10,3	49,6
		R120	[kN]	1.5	8,2	39,7
Spacing		$s_{cr,N,fi}$	[mm]	4 x h_{ef}		
		s_{min}	[mm]	80	150	150
Edge distance		$c_{cr,N,fi}$	[mm]	2 x h_{ef}		
		c_{min}	[mm]	Fire attack from one side: c_{min} = 2 x h_{ef} Fire attack from more than one side: $c_{min} \geq$ 300 mm and $\geq$ 2 x h_{ef}		

1) As a rule, splitting failure can be neglected when cracked concrete and reinforcement is assumed.

Design under fire exposure is performed according to the design method given in EOTA TR 020.
Under fire exposure usually cracked concrete is assumed. The design equations are given in EOTA TR 020 § 2.2.1.

In the absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{M,fi}$ = 1,0 is recommended.

Table C6: Characteristic tension resistance under fire exposure for design method A according to <u>ETAG 001, Annex C</u> or CEN/TS 1992-4

<u>Zinc plated</u> - BLS, SLS, SKLS - BLS-P	**<u>Stainless Steel</u>** - BLS, SLS, SKLS A4/HCR - BLS-P A4/HCR - SD (M8)			Anchor size ($h_{ef,max}$)		
				M8 - 14/80	**M12 - 20/150**	**M16 - 25/200**
Steel failure						
Characteristic resistance $N_{Rk,s,fi}$	Zinc plated	R30	[kN]	0,37	1,70	3,10
		R60	[kN]	0,33	1,30	2,30
		R90	[kN]	0,26	1,10	0,84
		R120	[kN]	0,18	0,84	1,60
	Stainless steel	R30	[kN]	0,73	2,5	4,7
		R60	[kN]	0,59	2,1	3,9
		R90	[kN]	0,44	1,7	3,1
		R120	[kN]	0,37	1,3	2,5
Pull-out failure						
Characteristic resistance $N_{Rk,p,fi}$	Zinc plated	R30	[kN]	4,0	10,0	18,8
		R60	[kN]	4,0	10,0	18,8
		R90	[kN]	4,0	10,0	18,8
		R120	[kN]	3,2	8,0	15,0
Characteristic resistance $N_{Rk,p,fi}$	Stainless steel	R30	[kN]	3,0	10,0	15,0
		R60	[kN]	3,0	10,0	15,0
		R90	[kN]	3,0	10,0	15,0
		R120	[kN]	2,4	8,0	12,0
Concrete cone and splitting failure [1)]						
Characteristic resistance $N_{Rk,c,fi}$		R30	[kN]	10,3	49,6	101,8
		R60	[kN]	10,3	49,6	101,8
		R90	[kN]	10,3	49,6	101,8
		R120	[kN]	8,2	39,7	81,5
Spacing		$s_{cr,N,fi}$	[mm]	4 x h_{ef}		
		s_{min}	[mm]	80	150	180
Edge distance		$c_{cr,N,fi}$	[mm]	2 x h_{ef}		
		c_{min}	[mm]	Fire attack from one side: c_{min} = 2 x h_{ef} Fire attack from more than one side: c_{min} ≥ 300 mm and ≥ 2 x h_{ef}		

[1)] As a rule, splitting failure can be neglected when cracked concrete and reinforcement is assumed.

Design under fire exposure is performed according to the design method given in EOTA TR 020.
Under fire exposure usually cracked concrete is assumed. The design equations are given in EOTA TR 020 § 2.2.1.

In the absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{M,fi}$ = 1,0 is recommended.

Table C7: Characteristic shear resistance under fire exposure for design method A according to ETAG 001, Annex C or CEN/TS 1992-4

Zinc plated - BLS, SLS, SKLS - BLS-P	**Stainless Steel** - BLS, SLS, SKLS A4/HCR - BLS-P A4/HCR - SD (M8)			**Anchor size**		
				M8	**M12**	**M16**
Steel failure without lever arm						
Characteristic resistance $V_{Rk,s,fi}$	Zinc plated	R30	[kN]	0,37	1,7	3,1
		R60	[kN]	0,33	1,3	2,3
		R90	[kN]	0,26	1,1	2,0
		R120	[kN]	0,18	0,84	1,6
	Stainless steel	R30	[kN]	0,73	2,5	4,7
		R60	[kN]	0,59	2,1	3,9
		R90	[kN]	0,44	1,7	3,1
		R120	[kN]	0,37	1,3	2,5
Steel failure with lever arm						
Characteristic resistance $M^0_{Rk,s,fi}$	Zinc plated	R30	[Nm]	0,38	2,6	6,6
		R60	[Nm]	0,34	2,0	5,0
		R90	[Nm]	0,26	1,7	4,3
		R120	[Nm]	0,19	1,3	3,3
	Stainless steel	R30	[Nm]	0,75	3,9	9,9
		R60	[Nm]	0,60	3,3	8,3
		R90	[Nm]	0,45	2,6	6,6
		R120	[Nm]	0,38	2,1	5,3
Concrete pryout failure				**M8 - 14/40**	**M12 - 20/80**	**M16 - 25/150**
Factor in eq. (5.6) of ETAG Annex C, § 5.2.3.3		k	[-]	1	2	
Characteristic resistance $V_{Rk,cp,fi}$		R30	[kN]	1,8	20,6	99,2
		R60	[kN]	1,8	20,6	99,2
		R90	[kN]	1,8	20,6	99,2
		R120	[kN]	1,5	16,4	79,4
Concrete pryout failure				**M8 - 14/80**	**M12 - 20/150**	**M16 - 25/200**
Factor in eq. (5.6) of ETAG Annex C, § 5.2.3.3		k	[-]	2		
Characteristic resistance $V_{Rk,cp,fi}$		R30	[kN]	20,6	99,2	203,6
		R60	[kN]	20,6	99,2	203,6
		R90	[kN]	20,6	99,2	203,6
		R120	[kN]	16,4	79,4	163,0
Concrete edge failure						

The initial value $V^0_{Rk,c,fi}$ of the characteristic resistance in concrete C20/25 to C50/60 under fire exposure may be determined by:

$V^0_{Rk,c,fi} = 0,25 \times V^0_{Rk,c}$ (≤ R90) $V^0_{Rk,c,fi} = 0,20 \times V^0_{Rk,c}$ (R120)

with $V^0_{Rk,c}$ initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature.

Design under fire exposure is performed according to the design method given in EOTA TR 020.

Under fire exposure usually cracked concrete is assumed. The design equations are given in EOTA TR 020 § 2.2.1.

EOTA TR 020 covers design for fire exposure from one side. For fire attack from more than one side the edge distance must be increased to c_{min} ≥ 300 mm and ≥ 2 · h_{ef}.

In the absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{M,fi}$ = 1,0 is recommended.

Table C8: Displacements under tension loads for static and quasi-static loading

Zinc plated - BLS, SLS, SKLS - BLS-P	Displacements and tensile loads in C20/25 to C50/60											
	Cracked concrete						Non-cracked concrete					
	C20/25			C50/60			C20/25			C50/60		
	N [kN]	δ_{N0} [mm]	$\delta_{N\infty}$ [mm]	N [kN]	δ_{N0} [mm]	$\delta_{N\infty}$ [mm]	N [kN]	δ_{N0} [mm]	$\delta_{N\infty}$ [mm]	N [kN]	δ_{N0} [mm]	$\delta_{N\infty}$ [mm]
M8 - 14/40	1.6	0.1	0.2	2.5	0.1	0.2	5.1	0.1	0.2	7.8	0.1	0.2
M8 - 14/80	5.9	0.2	0.4	15.1	0.2	0.4	10.8	0.2	0.4	15.1	0.2	0.4
M12 - 20/80	5.9	0.1	0.2	9.2	0.1	0.2	14.3	0.1	0.2	22.2	0.1	0.2
M12 - 20/150	15.9	0.2	0.5	39.7	0.2	0.5	28.4	0.2	0.5	39.7	0.2	0.5
M16 - 25/150	15.9	2.0	2.0	24.6	2.0	2.0	36.7	2.0	2.0	52.9	2.0	2.0
M16 - 25/200	29.8	2.0	2.0	74.1	2.0	2.0	52.9	2.0	2.0	74.1	2.0	2.0

Table C9: Displacements under tension loads for static and quasi-static loading

Stainless Steel - BLS, SLS, SKLS A4/HCR - BLS-P A4/HCR - SD (M8)	Displacements and tensile loads in C20/25 to C50/60											
	Cracked concrete						Non-cracked concrete					
	C20/25			C50/60			C20/25			C50/60		
	N [kN]	δ_{N0} [mm]	$\delta_{N\infty}$ [mm]	N [kN]	δ_{N0} [mm]	$\delta_{N\infty}$ [mm]	N [kN]	δ_{N0} [mm]	$\delta_{N\infty}$ [mm]	N [kN]	δ_{N0} [mm]	$\delta_{N\infty}$ [mm]
M8 - 14/40	3.6	0.3	1.1	5.5	0.3	1.1	3.4	0.2	0.6	5.5	0.1	0.6
M8 - 14/80	5.7	0.5	1.7	5.7	0.5	1.7	13.9	2.0	2.0	13.9	2.0	2.0
M12 - 20/80	9.9	0.5	0.9	15.4	0.7	0.9	14.3	0.4	0.6	32.1	1.0	1.0
M12 - 20/150	15.9	0.9	1.4	15.4	0.7	1.4	32.1	3.8	3.8	32.1	1.0	1.0
M16 - 25/150	23.8	0.9	1.4	36.9	1.4	1.4	36.7	0.7	0.7	59.8	3.4	3.4
M16 - 25/200	23.8	1.2	1.6	36.9	1.4	1.6	59.8	5.0	5.0	59.8	3.4	3.4

Table C10: Displacements under shear loads for static and quasi-static loading

Zinc plated - BLS, SLS, SKLS - BLS-P	**Displacements and shear loads in C20/25 to C50/60**					
	Cracked concrete C20/25 - C50/60			**Non-cracked concrete C20/25 - C50/60**		
	V	δ_{V0}	$\delta_{V\infty}$	V	δ_{V0}	$\delta_{V\infty}$
	[kN]	[mm]	[mm]	[kN]	[mm]	[mm]
M8 - 14/40	11.4	5.0 (+1.2)	7.5 (+1.2)	11.4	2.1 (+1.2)	3.1 (+1.2)
M8 - 14/80	11.4	5.0 (+1.2)	7.5 (+1.2)	11.4	2.1 (+1.2)	3.1 (+1.2)
M12 - 20/80	22.9	5.0 (+1.3)	7.5 (+1.3)	22.9	2.5 (+1.3)	3.8 (+1.3)
M12 - 20/150	22.9	5.0 (+1.3)	7.5 (+1.3)	22.9	2.5 (+1.3)	3.8 (+1.3)
M16 - 25/150	45.7	4.0 (+1.3)	6.0 (+1.3)	45.7	3.3 (+1.3)	5.0 (+1.3)
M16 - 25/200	45.7	4.0 (+1.3)	6.0 (+1.3)	45.7	3.3 (+1.3)	5.0 (+1.3)

Table C11: Displacements under shear loads for static and quasi-static loading

Stainless Steel - BLS, SLS, SKLS A4/HCR - BLS-P A4/HCR - SD (M8)	**Displacements and shear loads in C20/25 to C50/60**					
	Cracked concrete C20/25 - C50/60			**Non-cracked concrete C20/25 - C50/60**		
	V	δ_{V0}	$\delta_{V\infty}$	V	δ_{V0}	$\delta_{V\infty}$
	[kN]	[mm]	[mm]	[kN]	[mm]	[mm]
M8 - 14/40	25.5	6.3 (+1.7)	9.5 (+1.7)	25.5	6.3 (+1.7)	9.5 (+1.7)
M8 - 14/80	25.5	6.3 (+1.7)	9.5 (+1.7)	25.5	6.3 (+1.7)	9.5 (+1.7)
M12 - 20/80	51.6	8.0 (+1.7)	12.0 (+1.7)	51.6	8.0 (+1.7)	12.0 (+1.7)
M12 - 20/150	51.6	8.0 (+1.7)	12.0 (+1.7)	51.6	8.0 (+1.7)	12.0 (+1.7)
M16 - 25/150	96.5	8.8 (+1.7)	13.2 (+1.7)	96.5	8.8 (+1.7)	13.2 (+1.7)
M16 - 25/200	96.5	8.8 (+1.7)	13.2 (+1.7)	96.5	8.8 (+1.7)	13.2 (+1.7)

Displacement: the tables C10 and C11 show the deformation to be expected from the anchor itself, whilst the bracket value indicates the movement between the anchor body and the hole drilled in the concrete member or the hole in the fixture.

Table C12: Characteristic resistances in case of seismic action
Design acc. EOTA TR 045: Performance Category C1 and C2

<u>Zinc plated</u> - BLS, SLS, SKLS - BLS-P			Anchor size			
			M12-20		M16-25	
			/80	/150	/150	/200
Steel failure						
Characteristic resistance **C1**	$N_{Rk,s,seis,C1}$	[kN]	67,4	67,4	125,6	125,6
Characteristic resistance **C2**	$N_{Rk,s,seis,C2}$	[kN]	67.4	51,2	125,6	125,6
Partial safety factor	$\gamma_{Ms,seis}$ [1)]	[-]	1,5			
Steel failure without lever arm						
Characteristic resistance **C1**	$V_{Rk,s,seis,C1}$	[kN]	30,3		62,8	
Characteristic resistance **C2**	$V_{Rk,s,seis,C2}$	[kN]	18,2		51,5	
Partial safety factor	$\gamma_{Ms,seis}$ [1)]	[-]	1,25			
Pull-out failure						
Characteristic resistance **C1**	$N_{Rk,p,seis,C1}$	[kN]	25	40	50	50
Characteristic resistance **C2**	$N_{Rk,p,seis,C2}$	[kN]	25	40	50	50
Partial safety factor	$\gamma_{Mp,seis}$ [1)]	[-]	1,5 [2)]			
Concrete cone and splitting failure [3)]						
Effective anchorage depth	h_{ef}	[mm]	80	150	150	200
Partial safety factor	$\gamma_{Mc,seis}$ [1)] $\gamma_{Msp,seis}$ [1)]	[-]	1,5 [2)]			
Concrete pryout and concrete edge failure [3)]						
Effective anchorage depth	h_{ef}	[mm]	80	150	150	200
Partial safety factor	$\gamma_{Mc,seis}$ [1)]	[-]	1,5 [2)]			

1) In absence of other national regulations
2) The installation safety factor of γ_2 = 1,0 is included
3) For concrete cone, splitting, pryout and edge failure, see EOTA TR 045

Table C13: Displacements in case of seismic action
Desgin acc. EOTA TR 045: Performance Category C2

<u>Zinc plated</u> - BLS, SLS, SKLS - BLS-P			Anchor size			
			M12-20		M16-25	
			/80	/150	/150	/200
Displacement **DLS**	$\delta_{N,seis}$	[mm]	4.6	7.3	7.2	7.2
Displacement **ULS**	$\delta_{N,seis}$	[mm]	9.2	13.1	10.9	10.9
Displacement **DLS**	$\delta_{V,seis}$	[mm]	6.2	6.2	5.6	5.6
Displacement **ULS**	$\delta_{V,seis}$	[mm]	10.9	10.9	11.1	11.1