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European Technical Assessment

ETA-01/0011 of 06/07/2015

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 autoverrouillante en acier galvanisé ou inoxydable, à expansion par vissage à couple contrôlé, de 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 evaluation contient: *This Assessment contains*	24 pages incluant 21 annexes qui font partie intégrante de cette évaluation 24 *pages including 21 annexes which form an integral part of this assessment*
Base de l'ETE *Basis of ETA*	ETAG 001, Version April 2013, utilisée en tant que EAD *ETAG 001, Edition April 2013 used as EAD*
Cette evaluation remplace: *This Assessment replaces*	ATE 01/0011, ATE 05/0013 valides 15/04/2013 – 15/04/2018 *ETA-01/0011, ETA-05/0013 with validity 15/04/2013 – 15/04/2018*

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 acc. ETAG001, Annex C	See Annexes C1, C2
Characteristic shear resistance acc. ETAG001, Annex C	See Annexes C3, C4
Characteristic tension resistance acc. CEN/TS 1992-4	See Annexes C8, C9
Characteristic shear resistance acc. CEN/TS 1992-4	See Annexes C10, C11
Displacements	See Annex C15, C16

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements 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
Characteristic tension resistance under fire acc. CEN/TS 1992-4	See Annex C12, C13
Characteristic shear resistance under fire acc. CEN/TS 1992-4	See Annex C14

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 06-07-2015 by

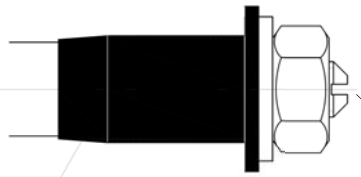
Charles Baloche *The original French version is signed*

Directeur technique

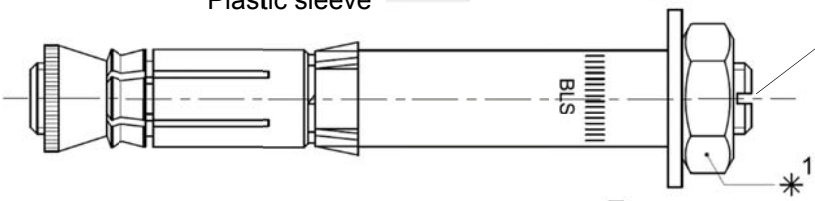
1 Official Journal of the European Communities L 254 of 08.10.1996

Sormat Liebig
Superplus™ self-undercutting anchor

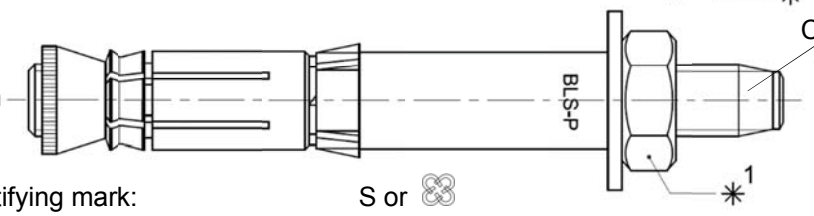
SD Type
Step Iron Anchor as per DIN 1211-3 / DIN 1212-3



BLS Type
In-place installation



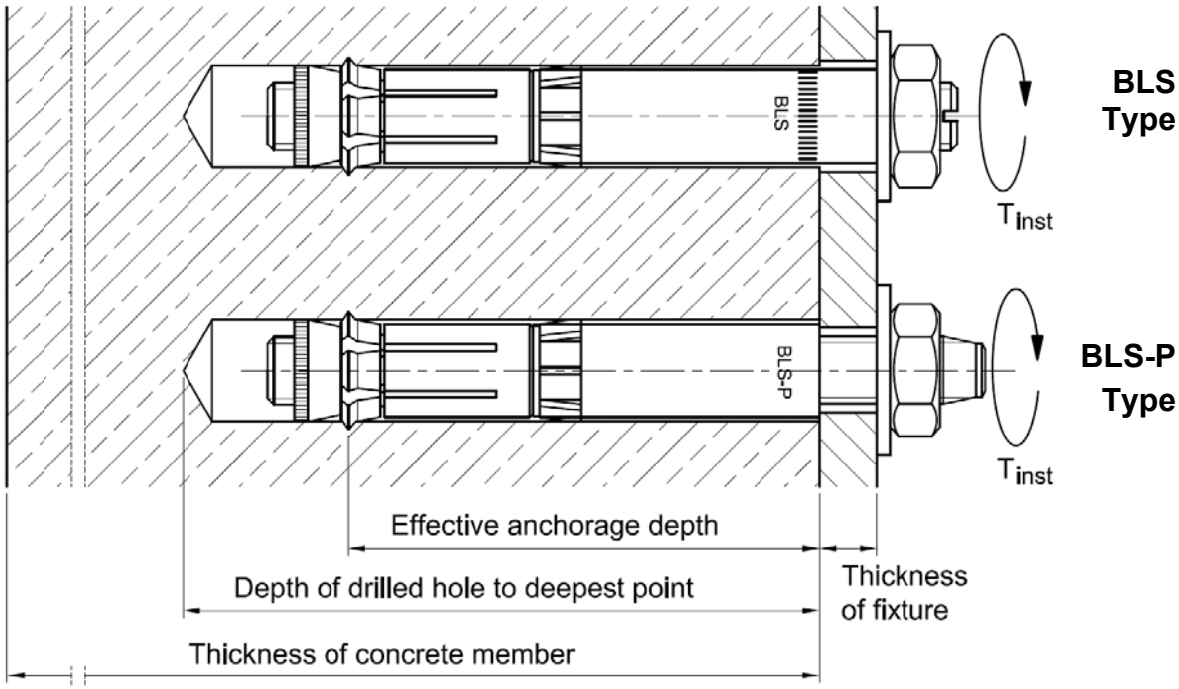
BLS-P Type
Pre-positioned installation



Marking: Identifying mark: S or
Anchor identity: BLS: 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 A4 type with plastic sleeve surrounding the distance sleeve.

Sormat Liebig
Superplus™ self-undercutting anchor after installation



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

Sormat Liebig
Superplus™ self-undercutting anchor

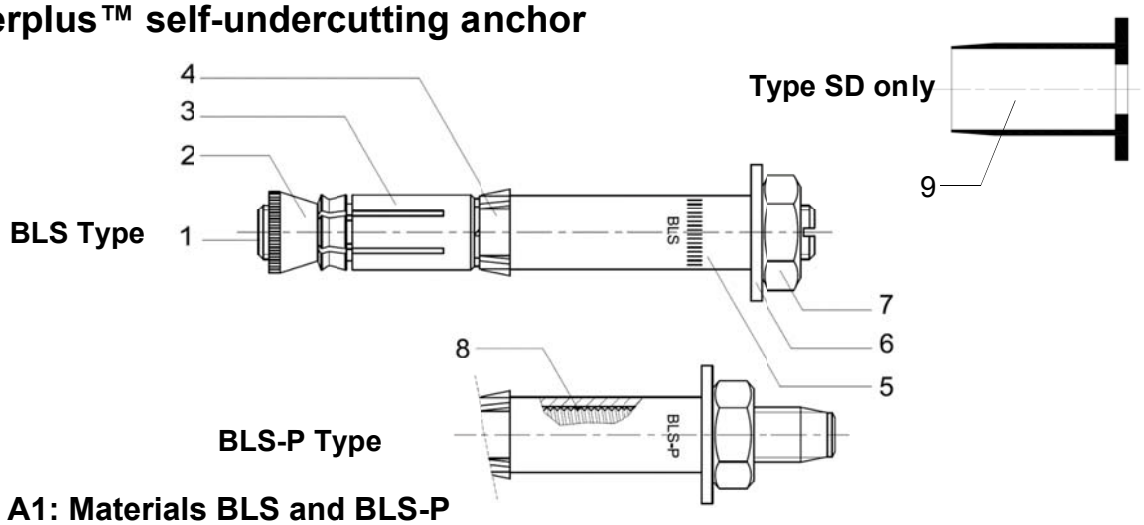


Table A1: Materials BLS and BLS-P

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; $f_u \geq 500$ N/mm²
6	Washer	Carbon steel EN 10139
7	Hexagonal nut	EN ISO 898-2; property class 8
8	Grip (only BLS-P)	Drop of glue, tape or rubber O-Ring

[1)] Coating: Parts 1 - 3 and 5 - 7 zinc electroplated according EN ISO 4042 ≥ 5µm, passivated.

Table A2: Materials BLS A4/HCR, BLS-P 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: A4-80
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; $f_u \geq 500$ 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: A4-80
8	Grip (only BLS-P)	Drop of glue, tape or rubber O-Ring
9	Plastic sleeve	PA; DIN EN ISO 1874-1

Sormat Liebig Superplus™ self-undercutting anchor	
Product description Materials	**Annex A2**

Specifications of intended use

Anchorages subject to:

- Static, quasi-static and loads under fire

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 and BLS-P anchors may only be used in structures subject to dry indoor conditions, indoor with temporary condensation.
- The BLS A4 and BLS-P 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 HCR and BLS-P 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).

Design:

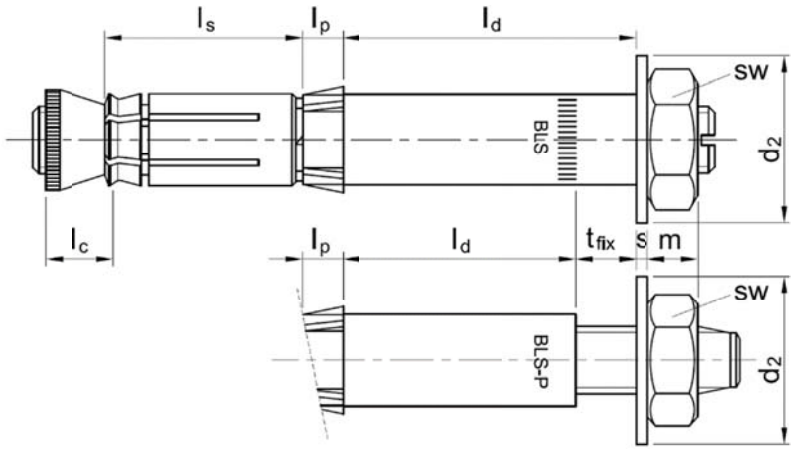
- The anchorages are designed in accordance with the ETAG001 Annex C “Design Method for Anchorages” or CEN/TS 1992-4-4 "Design of fastenings for use in concrete” under the responsibility of an engineer experienced in anchorages and concrete work.
- For application with resistance under fire exposure the anchorages are designed in accordance with method given in TR020 “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 version installed through fixture using an ordinary hammer and tightened to specified torque.
- BLS-P version 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	
Intended Use Specifications	**Annex B1**

Sormat Liebig
Superplus™ self-undercutting anchor



BLS Type

BLS-P Type

Table B1: Anchor dimensions

Main dimensions		Cone	Anchor sleeve	Plastic ring	Distance sleeve	Washer			Hexagonal nut	
Anchor type	t_{fix} [mm]	l_c [mm]	l_s [mm]	l_p [mm]	l_d [mm]	≥ s [mm]	≥ d_2 [mm]	d_1 [mm]	≥ m [mm]	≥ SW [mm]
BLS M8 - 14/40 (A4/HCR)	0 - 100	11.8	26	6.0	9-109	1.5	20	8.4	6.5	13
BLS-P M8 - 14/40 (A4/HCR)					9					
BLS M8 - 14/80 (A4/HCR)	0 - 150	11.8	26	6.0	49-199	1.5	20	8.4	6.5	13
BLS-P M8 - 14/80 (A4/HCR)					49					
BLS M12 - 20/80 (A4/HCR)	0 - 200	16.5	40	11.5	30-230	3.5	30	13.0	10.0	18
BLS-P M12 - 20/80 (A4/HCR)					30					
BLS M12 - 20/150 (A4/HCR)	0 - 250	16.5	40	11.5	100-350	3.5	30	13.0	10.0	18
BLS-P M12 - 20/150 (A4/HCR)					100					
BLS M16 - 25/150 (A4/HCR)	0 - 250	17.8	60	11.5	80-330	4.0	40	17.0	13.0	24
BLS-P M16 - 25/150 (A4/HCR)					80					
BLS M16 - 25/200 (A4/HCR)	0 - 300	17.8	60	11.5	130-430	4.0	40	17.0	13.0	24
BLS-P M16 - 25/200 (A4/HCR)					130					

Sormat Liebig
Superplus™ self-undercutting anchor

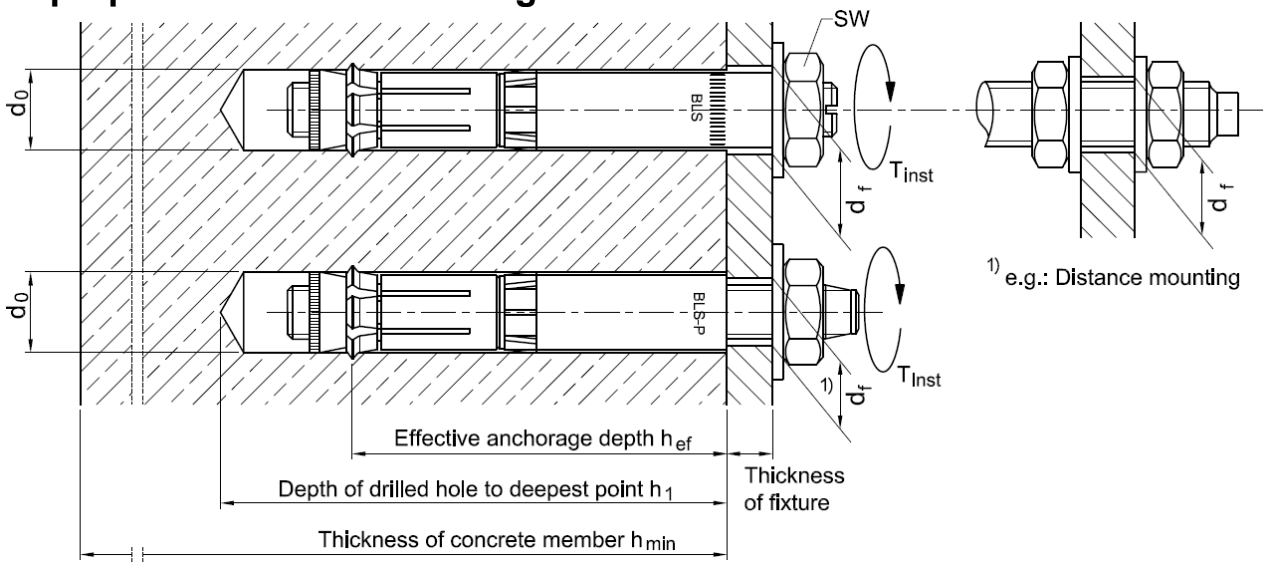


Table B2: Installation data

BLS / BLS-P / BLS A4/HCR / BLS-P A4/HCR / SD				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		SW	[mm]	≥ 13		≥ 18		≥ 24	
Torque moment		T_{inst}	[Nm]	25		80		180	
Minimum thickness of concrete member		h_{min}	[mm]	100	160	160	300	300	400
BLS / BLS-P	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
BLS / BLS-P A4 / HCR	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, BLS and BLS-P

BLS / 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								
Characteristic resistance in **cracked** concrete C20/25	$N^0_{Rk,c}$ [2)]	[kN]	9,1	25,8	25,8	66,1	66,1	101,8
Characteristic resistance in **non-cracked** concrete C20/25	$N^0_{Rk,c}$ [2)]	[kN]	12,8	36,1	36,1	92,6	92,6	142,5
Increasing factor for $N^0_{Rk,c}$	Ψ_C	C30/37	1,22					
		C40/50	1,41					
		C50/60	1,55					
Effective anchorage depth	h_{ef}	[mm]	40	80	80	150	150	200
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	$\gamma_{Mc}=\gamma_{Msp}$ [1)]	[-]	1,5 [2)]					

[1)] In absence of other national regulations

[2)] The installation safety factor of γ_2 = 1,0 is included.

[3)] Characteristic resistance values for the evaluation of one single anchor without influence of spacings ($s \geq s_{cr,N}$) or edge distances ($c \geq c_{cr,N}$). For evaluation of groups of anchors ($s < s_{cr,N}$) or anchors close to edges ($c < c_{cr,N}$), equation (5.2) of ETAG 001, part C has to be taken into account.

Table C2: Characteristic values for tension loads in case of static and quasi static loading for design method A acc. ETAG 001, Annex C, BLS A4/HCR, BLS-P A4/HCR and SD

BLS A4/HCR / BLS-P A4/HCR / SD			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								
Characteristic resistance in **cracked** concrete C20/25	$N^0_{Rk,c}$ 3)	[kN]	9,1	25,8	25,8	66,1	66,1	101,8
Characteristic resistance in **non-cracked** concrete C20/25	$N^0_{Rk,c}$ 3)	[kN]	12,8	36,1	36,1	92,6	92,6	142,5
Increasing factor for $N^0_{Rk,c}$	Ψ_C	C30/37	1,22					
		C40/50	1,41					
		C50/60	1,55					
Effective anchorage depth	h_{ef}	[mm]	40	80	80	150	150	200
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	$\gamma_{Mc}=\gamma_{Msp}$ 1)	[-]	1,5 2)					

1) In absence of other national regulations

2) The installation safety factor of γ_2 = 1,0 is included.

3) Characteristic resistance values for the evaluation of one single anchor without influence of spacings ($s \geq s_{cr,N}$) or edge distances ($c \geq c_{cr,N}$). For evaluation of groups of anchors ($s < s_{cr,N}$) or anchors close to edges ($c < c_{cr,N}$), equation (5.2) of ETAG 001, part C has to be taken into account.

Sormat Liebig Superplus™ self-undercutting anchor

Design according to ETAG 001, Annex C
Characteristic resistance under tension loads

Annexe C2

Table C3: Characteristic values for shear loads in case of static and quasi static loading for design method A acc. ETAG 001, Annex C, BLS and BLS-P

BLS / 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]	14,6		33,7		62,8	
	Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel failure with lever arm									
Characteristic bending resistance		$M^0_{Rk,s}$	[Nm]	30		105		266	
Partial safety factor		γ_{Ms} [1)]	[-]	1,25					
Concrete pryout failure									
Factor in equation (5.6) of ETAG Annex C, § 5.2.3.3		k	[-]	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		$\Psi_{ucr,V}$	[-]	1,00					
Cracked concrete with straight edge reinforcement > Ø12 mm				1,20					
Cracked concrete with edge reinforcement and closely spaced stirrups (a≤100mm) or **non-cracked concrete**				1,40					
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.

Sormat Liebig Superplus™ self-undercutting anchor

Design according to ETAG 001, Annex C
Characteristic resistance under shear loads

Annex C3

Table C4: Characteristic values for shear loads in case of static and quasi static loading for design method A acc. ETAG 001, Annex C, BLS A4/HCR, BLS-P A4/HCR and SD

BLS A4/HCR / BLS-P A4/HCR / SD				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]	14,6		33,7		62,8	
	Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Steel failure with lever arm									
Characteristic bending resistance		$M^0_{Rk,s}$	[Nm]	30		105		266	
Partial safety factor		γ_{Ms} [1)]	[-]	1,33					
Concrete pryout failure									
Factor in equation (5.6) of ETAG Annex C, § 5.2.3.3		k	[-]	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		$\Psi_{ucr,V}$	[-]	1,00					
Cracked concrete with straight edge reinforcement > Ø12 mm				1,20					
Cracked concrete with edge reinforcement and closely spaced stirrups (a≤100mm) or **non-cracked concrete**				1,40					
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.

Sormat Liebig Superplus™ self-undercutting anchor

Design according to ETAG 001, Annex C
Characteristic resistance under shear loads

Annex C4

Table C5:Characteristic tension resistance under fire exposure for design method A according to ETAG 001, Annex C, BLS, BLS-P, BLS A4/HCR, BLS-P A4/HCR and SD

BLS / BLS-P / BLS A4/HCR / BLS-P A4/HCR / SD				**Anchor size ($h_{ef,min}$)**		
				M8 - 14/40	**M12 - 20/80**	**M16 - 25/150**
Steel failure						
Characteristic resistance $N_{Rk,s,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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 $N_{Rk,p,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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]	$4 \times h_{ef}$		
		s_{min}	[mm]	80	150	150
Edge distance		$c_{cr,N,fi}$	[mm]	$2 \times h_{ef}$		
		c_{min}	[mm]	Fire attack from one side: $c_{min} = 2 \times h_{ef}$		
				Fire attack from more than one side: $c_{min} \geq 300$ mm and $\geq 2 \times h_{ef}$		

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

Sormat Liebig Superplus™ self-undercutting anchor	
Design according to ETAG 001, Annex C Characteristic tension resistance under fire exposure	**Annex C5**

Table C6: Characteristic tension resistance under fire exposure for design method A according to ETAG 001, Annex C, BLS, BLS-P, BLS A4/HCR, BLS-P A4/HCR and SD

BLS / BLS-P / BLS A4/HCR / BLS-P A4/HCR / SD				**Anchor size ($h_{ef,max}$)**		
				M8 - 14/80	**M12 - 20/150**	**M16 - 25/200**
Steel failure						
Characteristic resistance $N_{Rk,s,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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 $N_{Rk,p,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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]	$4 \times h_{ef}$		
		s_{min}	[mm]	80	150	180
Edge distance		$c_{cr,N,fi}$	[mm]	$2 \times h_{ef}$		
		c_{min}	[mm]	Fire attack from one side: $c_{min} = 2 \times h_{ef}$		
				Fire attack from more than one side: $c_{min} \geq 300$ mm and $\geq 2 \times h_{ef}$		

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

Sormat Liebig Superplus™ self-undercutting anchor	
Design according to ETAG 001, Annex C Characteristic tension resistance under fire exposure	**Annex C6**

Table C7: Characteristic shear resistance under fire exposure for design method A according to ETAG 001, Annex C, BLS, BLS-P, BLS A4/HCR, BLS-P A4/HCR and SD

BLS / BLS-P / BLS A4/HCR / BLS-P A4/HCR / SD				Anchor size		
				M8	M12	M16
Steel failure without lever arm						
Characteristic resistance $V_{Rk,s,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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 bending resistance $M^0_{Rk,s,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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 TR 020.

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

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 $c_{min} \geq 300$ mm and $\geq 2 \cdot h_{ef}$.

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

Sormat Liebig Superplus™ self-undercutting anchor

Design according to ETAG 001, Annex C
Characteristic shear resistance under fire exposure

Annex C7

Table C8: Characteristic values for tension loads in case of static and quasi static loading for design method A according to CEN/TS 1992-4, BLS and BLS-P

BLS / 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_{cr}	[-]	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	$\gamma_{Mc}=\gamma_{Msp}$ [1)]	[-]	1,5 [2)]					

[1)] In absence of other national regulations

[2)] The installation safety factor of γ_2 = 1,0 is included.

Table C9: Characteristic values for tension loads in case of static and quasi static loading for design method A according to CEN/TS 1992-4, BLS A4/HCR, BLS-P A4/HCR and SD

BLS A4/HCR / BLS-P A4/HCR / SD			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_{cr}	[-]	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	$\gamma_{Mc}=\gamma_{Msp}$ [1)]	[-]	1,5 [2)]					

[1)] In absence of other national regulations

[2)] The installation safety factor of γ_2 = 1,0 is included.

Table C10: Characteristic values for shear loads in case of static and quasi static loading for design method A according to CEN/TS 1992-4, BLS and BLS-P

BLS / 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]	14,6		33,7		62,8	
	Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Factor for considering ductility		k_2	[-]	1,0					
Steel failure with lever arm									
Characteristic bending resistance		$M^0_{Rk,s}$	[Nm]	30		105		266	
Partial safety factor		γ_{Ms} [1)]	[-]	1,25					
Concrete pryout failure									
Factor in eq. (16) of CEN/TS 1992-4-4, § 6.2.2.3		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		$\Psi_{ucr,V}$	[-]	1,00					
Cracked concrete with straight edge reinforcement > Ø12 mm				1,20					
Cracked concrete with edge reinforcement and closely spaced stirrups (a ≤ 100mm) or **non-cracked concrete**				1,40					
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.

Sormat Liebig Superplus™ self-undercutting anchor

Design according to CEN/TS 1992-4
Characteristic resistance under shear loads

Annex C10

Table C11: Characteristic values for shear loads in case of static and quasi static loading for design method A according to CEN/TS 1992-4, BLS A4/HCR, BLS-P A4/HCR and SD

BLS A4/HCR / BLS-P A4/HCR / SD				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]	14,6		33,7		62,8	
	Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Factor for considering ductility		k_2	[-]	1,0					
Steel failure with lever arm									
Characteristic bending resistance		$M^0_{Rk,s}$	[Nm]	30		105		266	
Partial safety factor		γ_{Ms} [1)]	[-]	1,33					
Concrete pryout failure									
Factor in equation (5.6) of ETAG Annex C, § 5.2.3.3		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		$\Psi_{ucr,V}$	[-]	1,00					
Cracked concrete with straight edge reinforcement > Ø12 mm				1,20					
Cracked concrete with edge reinforcement and closely spaced stirrups (a≤100mm) or **non-cracked concrete**				1,40					
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.

Sormat Liebig Superplus™ self-undercutting anchor

Design according to CEN/TS 1992-4
Characteristic resistance under shear loads

Annex C11

Table C12: Characteristic tension resistance under fire exposure for design method A according to CEN/TS 1992-4, BLS, BLS-P, BLS A4/HCR, BLS-P A4/HCR and SD

BLS / BLS-P / BLS A4/HCR / BLS-P A4/HCR / SD				**Anchor size ($h_{ef,min}$)**		
				M8 - 14/40	**M12 - 20/80**	**M16 - 25/150**
Steel failure						
Characteristic resistance $N_{Rk,s,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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 $N_{Rk,p,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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]	$4 \times h_{ef}$		
		s_{min}	[mm]	80	150	150
Edge distance		$c_{cr,N,fi}$	[mm]	$2 \times h_{ef}$		
		c_{min}	[mm]	Fire attack from one side: $c_{min} = 2 \times h_{ef}$		
				Fire attack from more than one side: $c_{min} \geq 300$ mm and $\geq 2 \times h_{ef}$		

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

Sormat Liebig Superplus™ self-undercutting anchor

Design according to CEN/TS 1992-4
Characteristic tension resistance under fire exposure

Annex C12

Table C13: Characteristic tension resistance under fire exposure for design method A according to CEN/TS 1992-4, BLS, BLS-P, BLS A4/HCR, BLS-P A4/HCR and SD

BLS / BLS-P / BLS A4/HCR / BLS-P A4/HCR / SD				**Anchor size ($h_{ef,max}$)**		
				M8 - 14/80	**M12 - 20/150**	**M16 - 25/200**
Steel failure						
Characteristic resistance $N_{Rk,s,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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 $N_{Rk,p,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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]	$4 \times h_{ef}$		
		s_{min}	[mm]	80	150	180
Edge distance		$c_{cr,N,fi}$	[mm]	$2 \times h_{ef}$		
		c_{min}	[mm]	Fire attack from one side: $c_{min} = 2 \times h_{ef}$		
				Fire attack from more than one side: $c_{min} \geq 300$ mm and $\geq 2 \times h_{ef}$		

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

Sormat Liebig Superplus™ self-undercutting anchor

Design according to CEN/TS 1992-4
Characteristic tension resistance under fire exposure

Annex C13

Table C14: Characteristic shear resistance under fire exposure for design method A according to CEN/TS 1992-4, BLS, BLS-P, BLS A4/HCR, BLS-P A4/HCR and SD

BLS / BLS-P / BLS A4/HCR / BLS-P A4/HCR / SD				Anchor size		
				M8	M12	M16
Steel failure without lever arm						
Characteristic resistance $V_{Rk,s,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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 bending resistance $M^0_{Rk,s,fi}$	BLS / BLS-P	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
	BLS / BLS-P A4/HCR	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:

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

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 TR 020.

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

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 $c_{min} \geq 300$ mm and $\geq 2 \cdot h_{ef}$.

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

Sormat Liebig Superplus™ self-undercutting anchor

Design according to CEN/TS 1992-4
Characteristic shear resistance under fire exposure

Annex C14

Table C15: Displacements under tension loads BLS and BLS-P

BLS / 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]	d_{N0} [mm]	$d_{N\infty}$ [mm]	N [kN]	d_{N0} [mm]	$d_{N\infty}$ [mm]	N [kN]	d_{N0} [mm]	$d_{N\infty}$ [mm]	N [kN]	d_{N0} [mm]	$d_{N\infty}$ [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 C16: Displacements under tension loads BLS A4/HCR, BLS-P A4/HCR and SD

BLS A4/HCR / BLS-P A4/HCR	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]	d_{N0} [mm]	$d_{N\infty}$ [mm]	N [kN]	d_{N0} [mm]	$d_{N\infty}$ [mm]	N [kN]	d_{N0} [mm]	$d_{N\infty}$ [mm]	N [kN]	d_{N0} [mm]	$d_{N\infty}$ [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 C17: Displacements under shear loads BLS and BLS-P

BLS / 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	d_{V0}	$d_{V\infty}$	V	d_{V0}	$d_{V\infty}$
	[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 C18: Displacements under shear loads BLS A4/HCR, BLS-P A4/HCR and SD

BLS A4/HCR / BLS-P A4/HCR	Displacements and shear loads in C20/25 to C50/60					
	Cracked concrete C20/25 - C50/60			Non-cracked concrete C20/25 - C50/60		
	V	d_{V0}	$d_{V\infty}$	V	d_{V0}	$d_{V\infty}$
	[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 table shows 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.