Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-16/0655 of 2 December 2021

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	Screwbolt TSM
Product family to which the construction product belongs	Mechanical fastener for use in concrete
Manufacturer	Sikla Holding GmbH Kornstraße 4 4614 MARCHTRENK ÖSTERREICH
Manufacturing plant	Sikla Herstellwerk 2
This European Technical Assessment contains	19 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
This version replaces	ETA-16/0655 issued on 19 May 2020

Deutsches Institut für Bautechnik
Kolonnenstraße 30 B | 10829 Berlin | GERMANY | Phone: +49 30 78730-0 | Fax: +49 30 78730-320 | Email: dibt@dibt.de | www.dibt.de

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Specific Part

1 Technical description of the product

The Screwbolt TSM 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) Method A	See Annex B 2, C 1
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1
Displacements	See Annex C 6
Characteristic resistance and displacements for seismic performance category C1 and C2	See Annex C 2 to C 4, C 7

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 5

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.

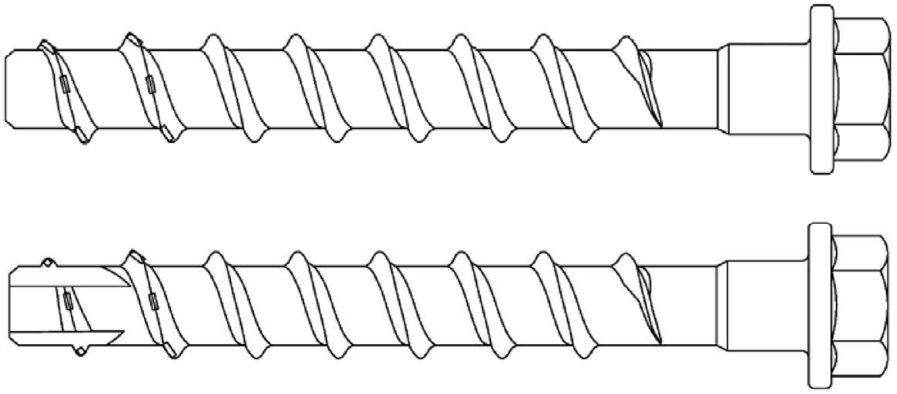
Issued in Berlin on 2 December 2021 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

Beglaubigt
Baderschneider

Deutsches Institut für Bautechnik DIBt

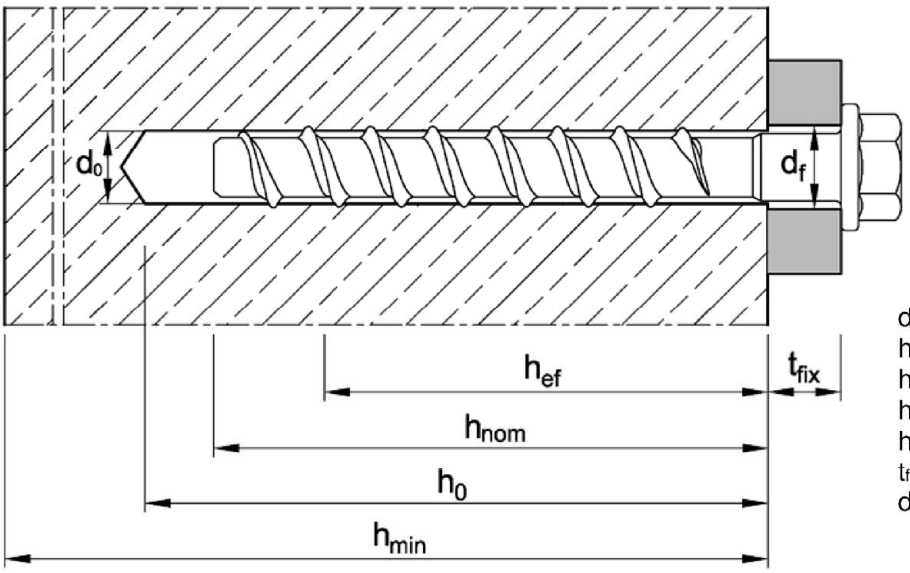
Screwbolt TSM



TSM zinc plated
TSM A4
TSM HCR

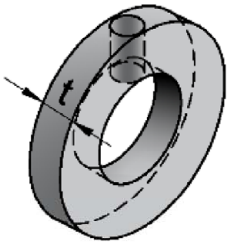
Installation situation in concrete

(e.g. Screwbolt TSM with hexagon head and pressed-on washer)

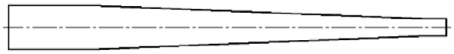


d_0 = nominal drill bit diameter
h_{ef} = effective anchorage depth
h_{nom} = nominal embedment depth
h_0 = depth of the drill hole
h_{min} = minimum thickness of member
t_{fix} = thickness of fixture
d_f = diameter of clearance hole in the fixture

Filling washer and reducing adapter for filling the annular gap between screwbolt and fixture



thickness of filling washer
t = 5 mm



Screwbolt TSM	Annex A1
Product description Product and installation situation	

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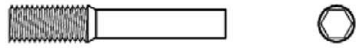
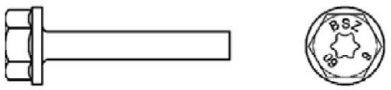
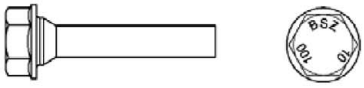
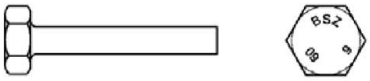
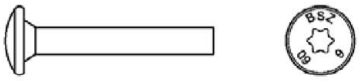
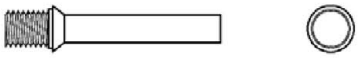
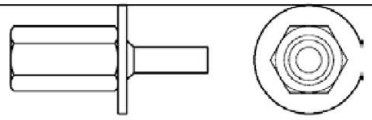
Table A1: Anchor types and description

	Anchor types	TSM -	Description
1		BI	Anchor version with metric connection thread and hexagon socked
2		B	Anchor version with metric connection thread and hexagon drive
3		SU...TX	Anchor version with hexagon head, pressed-on washer and TORX drive
4		SU	Anchor version with hexagon head and pressed-on washer
5		SUB	Anchor version with hexagon head and collar
6		S	Anchor version with hexagon head
7		SK	Anchor version with countersunk head and TORX drive
8		LK	Anchor version with pan head and TORX drive
9		LP	Anchor version with large pan head and TORX drive
10		BSK	Anchor version with countersunk head and metric connection thread
11		ST	Anchor version with hexagon drive and metric connection thread
12		IM	Anchor version with internal thread and hexagon drive

Screwbolt TSM

Product description
Anchor types and description

Annex A2

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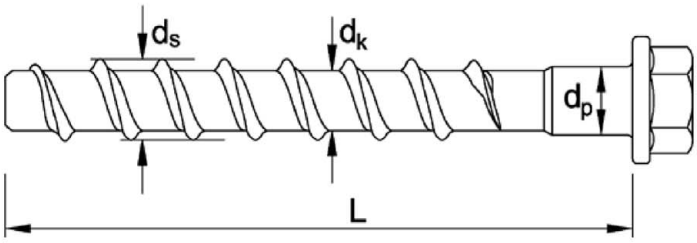
Table A2: Dimensions

Anchor size			TSM 6		TSM 8			TSM 10			TSM 12			TSM 14		
Nominal embedment depth	h_{nom}	[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Length of the anchor	L ≤	[mm]	500													
Core diameter	d_k	[mm]	5,1		7,1			9,1			11,1			13,1		
Outside diameter	d_s	[mm]	7,5		10,6			12,6			14,6			16,6		
Shaft diameter	d_p	[mm]	5,7		7,9			9,9			11,7			13,7		

Marking e.g.: ◇ BSZ 10 100
or TSM 10 100



◇ BSZ *or* TSM — Trade name (optional with manufacturer identification ◇)
10 — Anchor size
100 — Length of anchor
additional marking:
A4 — stainless steel
HCR — high corrosion resistant steel
BC ST — version with hexagon head and collar

Table A3: Materials

Version	Steel, zinc plated TSM	Stainless steel TSM A4	High corrosion resistant steel TSM HCR
Material	Steel EN 10263-4:2017 galvanized acc. to EN ISO 4042:2018 or zinc flake coating acc. to EN ISO 10683:2018 (≥ 5µm)	1.4401, 1.4404, 1.4571, 1.4578	1.4529
Nominal characteristic steel yield strength f_{yk}	560 N/mm²		
Nominal characteristic steel ultimate strength f_{uk}	700 N/mm²		
Elongation at fracture A_s	≤ 8%		

Screwbolt TSM

Product description
Dimensions, marking and materials

Annex A3

Deutsches Institut für Bautechnik DIBt

Specifications of Intended use

Screwbolt TSM		TSM 6		TSM 8			TSM 10			TSM 12			TSM 14		
Nominal embedment depth h_{nom} [mm]		40	55	45	55	65	55	75	85	65	85	100	75	100	115
Anchorages subject to	Static or quasi-static loading	✓													
	Fire exposure	✓													
	Seismic action C1 (zinc plated, A4, HCR)	Tension load: BI, B, SU…TX, SU, S, SK, LK, LP, BSK, ST, IM Shear load: BI, B, SU…TX, SU, S, SK, LK, LP													
		✓		1)	✓		✓	1)	✓	1)		✓	1)		✓
	Seismic action C2 (zinc plated)	Tension load and shear load: with filled annular gap: BI, B, SU…TX, SU, S, LK, LP without filled annular gap: BI, B, SU…TX, SU, S, SK [2], LK, LP													
		1)		1)		✓	1)	1)	✓	1)		✓	1)		✓
Base material	Cracked or uncracked concrete	✓													
	Reinforced or unreinforced concrete (without fibres) acc. to EN 206:2013+A1:2016	✓													
	Strength classes according to EN 206:2013+A1:2016, C20/25 to C50/60	✓													

[1] no performance assessed

[2] Version SK, TSM 8 and TSM 10

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions: all materials
- For all other conditions corresponding to corrosion resistance classes CRC according to EN 1993-1-4:2006 +A1:2015:
  - stainless steel A4, according to Annex A3, Table A3: CRC III
  - high corrosion resistant steel HCR, according to Annex A3, Table A3: CRC V

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- 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 (e.g. position of the anchor relative to reinforcement or to supports, etc.)
- Design method of anchorages according to EN 1992-4:2018 (if necessary in conection with EOTA Technical Report TR 055, version February 2018)

Installation:

- Making of drill hole by hammer drilling or vacuum drill bit.
  When using a vacuum drill bit no drill hole cleaning is required.
- Anchor installation carried out by appropriately qualified personal and under the responsibility of the person responsible for technical matters on site.
- After installation further turning of the anchor is not possible. The head of the anchor is supported on the fixture and is not damaged.
- The borehole may be filled with the Injection Systems VME or VME plus.
- Adjustment according to Annex B5 (except for anchorages with filled borehole and anchorages subject to seismic action).

Screwbolt TSM	
Intended use Specifications	**Annex B1**

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Table B1: Installation parameters

Anchor size			TSM 6		TSM 8			TSM 10			TSM 12			TSM 14		
Nominal embedment depth	h_{nom}	[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Nominal drill bit diameter	d_0	[mm]	6		8			10			12			14		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,40		8,45			10,45			12,50			14,50		
Effective anchorage depth	h_{ef}	[mm]	31	44	35	43	52	43	60	68	50	67	80	58	79	92
Depth of drill hole	$h_0 \geq$	[mm]	45	60	55	65	75	65	85	95	75	95	110	85	110	125
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	8		12			14			16			18		
Max. installation torque for screws with metric connection thread	$T_{inst} \leq$	[Nm]	10		20			40			60			80		
Tangential impact screw driver [1)]	$T_{imp,max}$	[Nm]	160		300			400			650			650		

[1)] Installation with tangential impact screw driver, with maximum power output $T_{imp,max}$ acc. to manufacturer's instructions is possible

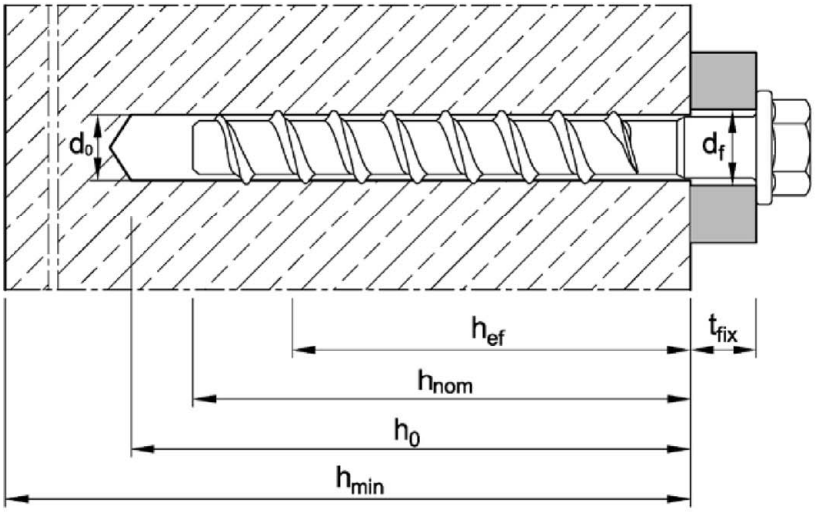


Table B2: Minimum thickness of member, minimum edge distance and minimum spacing

Anchor size			TSM 6		TSM 8			TSM 10			TSM 12			TSM 14		
Nominal embedment depth	h_{nom}	[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Minimum thickness of member	h_{min}	[mm]	100		100		120	100	130		120	130	150	130	150	170
Minimum spacing	s_{min}	[mm]	40		40	50		50			50		70	50	70	
Minimum edge distance	c_{min}	[mm]	40		40	50		50			50		70	50	70	

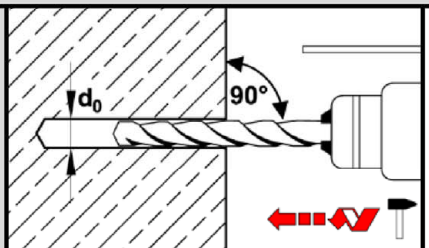
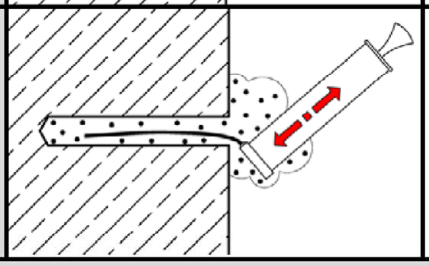
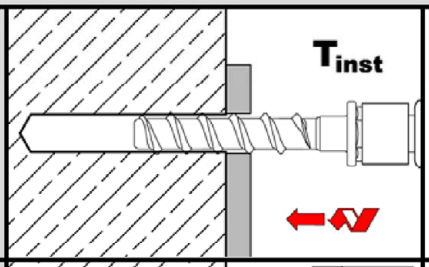
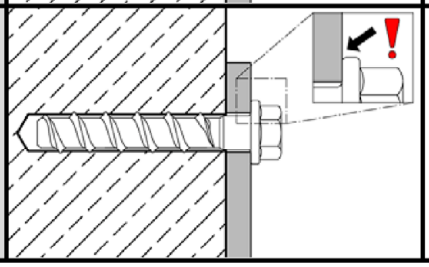
Screwbolt TSM

Intended use
Installation parameters / Minimum thickness of concrete member, minimum spacing and edge distance

Annex B2

Deutsches Institut für Bautechnik DIBt

Installation instructions

Drill hole preparation and cleaning		
1		Drill hole perpendicular to concrete surface. Using a vacuum drill, continue with step 3.
2		Blow out dust or alternatively vacuum clean down to the bottom of the hole.
Installation Screwbolt		
3		Screw in, e.g. with tangential impact screw driver or torque wrench.
4		After installation, the head of the anchor is supported on the fixture and must be undamaged.

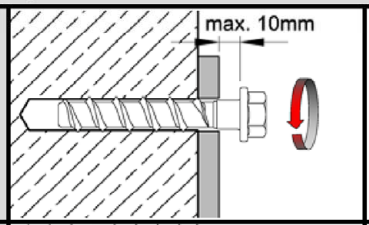
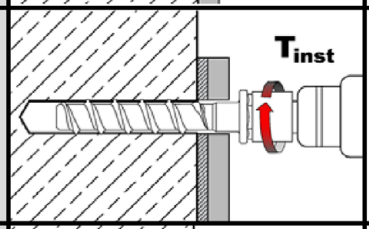
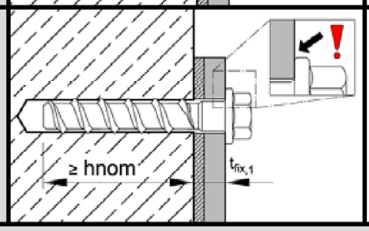
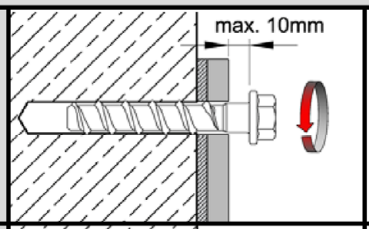
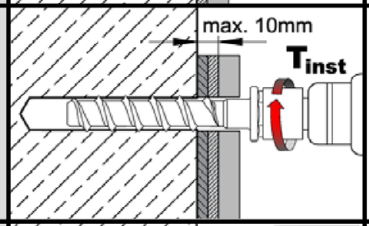
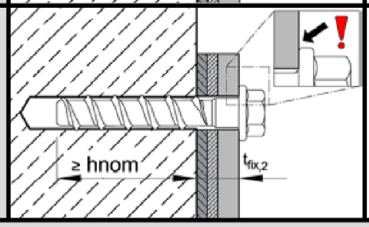
Screwbolt TSM

Intended use
Installation instructions

Annex B3

Deutsches Institut für Bautechnik DIBt

Installation instructions - Adjustment

1. Adjustment		
5		Screw may be untightened maximum 10mm.
6		After adjustment, screw in the concrete screw with tangential impact screw driver or torque wrench.
7		After installation, the head of the anchor is supported on the fixture must be undamaged.
2. Adjustment		
8		Screw may be untightened maximum 10mm.
9		After adjustment, screw in the concrete screw with tangential impact screw driver or torque wrench.
10		After installation, the head of the anchor is supported on the fixture and must be undamaged.

Note:
The fastener may be adjusted max. 2x. The fastener must not be screwed back by more than 10mm in each case. The relining carried out during adjustment must not exceed 10 mm in total.
Nominal embedment depth h_{nom} must still be maintained after the adjustment.

Screwbolt TSM

Intended use
Installation instructions - Adjustment

Annex B4

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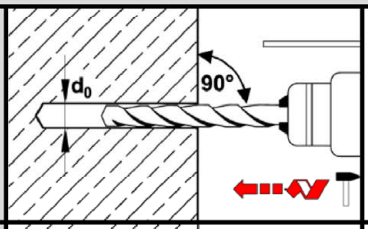
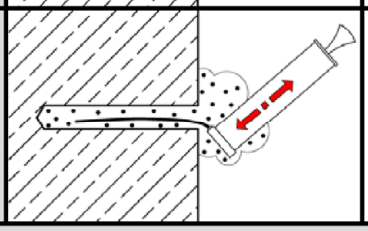
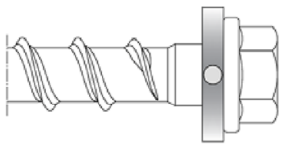
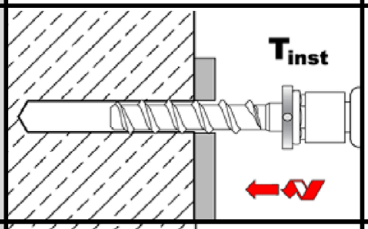
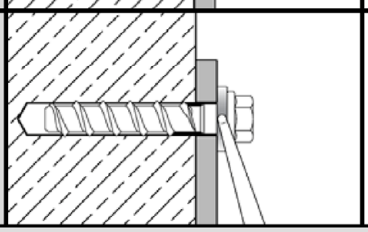
Installation instructions - filling of annular gap

Drill hole preparation and cleaning		
1		Drill hole perpendicular to concrete surface. Using a vacuum drill, continue with step 3.
2		Blow out dust or alternatively vacuum clean down to the bottom of the hole.
Installation Screwbolt with filling washer		
3		Fit the filling washer to the Screwbolt. The thickness of the filling washer must be taken into account with t_{fix}.
4		Screw in, e.g. with tangential impact screw driver or torque wrench.
5		Fill the annular gap between Screwbolt and fixture with mortar (compressive strength ≥ 40 N/mm², e.g. Injection mortar VMH, VMZ or VMU plus). Use enclosed reducing adapter. Observe information on processing of the mortar! The annular gap is completely filled, when excess mortar seeps out.
For seismic loading, the application with and without filling of annular gap is permitted (Annex C3-C4).		

Screwbolt TSM

Intended use
Installation instructions with filling of annular gap

Annex B5

Deutsches Institut für Bautechnik DIBt

Table C1: Characteristic values for **static** or **quasi-static loads**

Anchor size				**TSM 6**		**TSM 8**			**TSM 10**			**TSM 12**			**TSM 14**		
Nominal embedment depth		h_{nom}	[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Installation factor		γ_{inst}	[-]	1,0													
Tension load																	
Steel failure																	
Characteristic resistance		$N_{Rk,s}$	[kN]	14		27			45			67			94		
Partial factor		$\gamma_{Ms,N}$	[-]	1,5													
Pull-out																	
Characteristic resistance in concrete C20/25	cracked	$N_{Rk,p}$	[kN]	2,0	4,0	5,0	9,0	12	9,0	≥ $N^0_{Rk,c}$ [1]		12	≥ $N^0_{Rk,c}$ [1]		≥ $N^0_{Rk,c}$ [1]		
	uncracked	$N_{Rk,p}$	[kN]	4,0	9,0	7,5	12	16	12	20	26	16					
Increasing factor for $N_{Rk,p}$ $N_{Rk,p} = \psi_c \cdot N_{Rk,p}$ (C20/25)		ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$													
Concrete cone failure																	
Effective anchorage depth		h_{ef}	[mm]	31	44	35	43	52	43	60	68	50	67	80	58	79	92
Spacing		$s_{cr,N}$	[mm]	3 h_{ef}													
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}													
Factor k_1	cracked	$k_{cr,N}$	[-]	7,7													
	uncracked	$k_{ucr,N}$	[-]	11,0													
Splitting																	
Characteristic resistance		$N^0_{Rk,sp}$	[kN]	min [$N_{Rk,p}$; $N^0_{Rk,c}$ [1]]													
Spacing		$s_{cr,sp}$	[mm]	120	160	120	140	150	140	180	210	150	210	240	180	240	280
Edge distance		$c_{cr,sp}$	[mm]	60	80	60	70	75	70	90	105	75	105	120	90	120	140
Shear load																	
Steel failure <u>without</u> lever arm																	
Characteristic resistance		$V^0_{Rk,s}$	[kN]	7,0		13,5		17,0	22,5	34,0		33,5	42,0		56,0		
Partial factor		$\gamma_{Ms,V}$	[-]	1,25													
Ductility factor		k_7	[-]	0,8													
Steel failure <u>with</u> lever arm																	
Characteristic bending resistance		$M^0_{Rk,s}$	[Nm]	10,9		26			56			113			185		
Concrete pry-out failure																	
Pry-out factor		k_8	[-]	1,0		1,0			1,0	2,0		1,0	2,0		1,0	2,0	
Concrete edge failure																	
Effective length of anchor		$l_f = h_{ef}$	[mm]	31	44	35	43	52	43	60	68	50	67	80	58	79	92
Outside diameter of anchor		d_{nom}	[mm]	6		8			10			12			14		

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

Screwbolt TSM

Performance
Characteristic values for **static** or **quasi-static loads**

Annex C1

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Table C2: Characteristic values for **seismic loading**, performance category **C1**

Anchor size			**TSM 6**		**TSM 8**	**TSM 10**		**TSM 12**	**TSM 14**
Nominal embedment depth	h_{nom}	[mm]	40	55	65	55	85	100	115
Installation factor	γ_{inst}	[-]	1,0						
Tension load	**Version: BI, B, SU…TX, SU, S, SK, LK, LP, BSK, ST, IM**								
Steel failure									
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	14		27	45		67	94
Partial factor	γ_{Ms}	[-]	1,5						
Pull-out									
Characteristic resistance	$N_{Rk,p,C1}$	[kN]	2,0	4,0	12	9,0	≥ $N^0_{Rk,c}$ [1)]		
Concrete cone failure									
Effective anchorage depth	h_{ef}	[mm]	31	44	52	43	68	80	92
Spacing	$s_{cr,N}$	[mm]	$3h_{ef}$						
Edge distance	$c_{cr,N}$	[mm]	$1{,}5h_{ef}$						
Shear load	**Version: BI, B, SU…TX, SU, S, SK, LK, LP**								
Steel failure <u>without</u> lever arm									
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	4,7	5,5	8,5	13,5	15,3	21,0	22,4
Partial factor	γ_{Ms}	[-]	1,25						
Concrete pry-out failure									
Pry-out factor	k_8	[-]	1,0			2,0			
Concrete edge failure									
Effective length of anchor	$l_f = h_{ef}$	[mm]	31	44	52	43	68	80	92
Outside diameter of anchor	d_{nom}	[mm]	6		8	10		12	14
Factor for filling of annular gap									
<u>with</u> filling of annular gap (acc. to Annex B5, figure 5)	α_{gap}	[-]	1,0						
<u>without</u> filling of annular gap (acc. to Annex B3)	α_{gap}	[-]	0,5						

[1)] $N^0_{Rk,c}$ for concrete strength class C20/25, according to EN 1992-4:2018

Screwbolt TSM

Performance
Characteristic resistance for **seismic loading**, performance category **C1**

Annex C2

Deutsches Institut für Bautechnik DIBt

Table C3: Characteristic values for **seismic loading**, performance category **C2**, **with filling of annular gap,** Screwbolt TSM zinc plated

Anchor size			**TSM 8**	**TSM 10**	**TSM 12**	**TSM 14**
Nominal embedment depth	h_{nom}	[mm]	65	85	100	115
Installation factor	γ_{inst}	[-]	1,0			
Tension load	**Version: BI, B, SU…TX, SU, S, LK, LP**					
Steel failure						
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	27	45	67	94
Partial factor	γ_{Ms}	[-]	1,5			
Pull-out						
Characteristic resistance	$N_{Rk,p,C2}$	[kN]	2,4	5,4	7,1	10,5
Concrete cone failure						
Effective anchorage depth	h_{ef}	[mm]	52	68	80	92
Spacing	$s_{cr,N}$	[mm]	$3h_{ef}$			
Edge distance	$c_{cr,N}$	[mm]	$1{,}5h_{ef}$			
Shear load	**Version: BI, B, SU…TX, SU, S, LK, LP**					
Steel failure without lever arm						
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	9,9	18,5	31,6	40,7
Partial factor	γ_{Ms}	[-]	1,25			
Concrete pry-out failure						
Pry-out factor	k_8	[-]	1,0	2,0		
Concrete edge failure						
Effective length of anchor	$l_f = h_{ef}$	[mm]	52	68	80	92
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	14
Factor for filling of annular gap						
with filling of annular gap (acc. to Annex B5, figure 5)	α_{gap}	[-]	1,0			

Screwbolt TSM

Performance
Characteristic resistance for **seismic loading**, performance category **C2**
with filling of annular gap

Annex C3

Deutsches Institut für Bautechnik DIBt

Table C4: Characteristic values for **seismic loading**, performance category **C2**, **without filling of annular gap,** Screwbolt TSM zinc plated

Anchor size			**TSM 8**	**TSM 10**	**TSM 12**	**TSM 14**
Nominal embedment depth	h_{nom}	[mm]	65	85	100	115
Installation factor	γ_{inst}	[-]	1,0			
Tension loads						
Steel failure	**Version: BI, B, SU…TX, SU, S, LK, LP**					
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	27	45	67	94
Partial factor	γ_{Ms}	[-]	1,5			
Pull-out	**Version: BI, B, SU…TX, SU, S, LK, LP**					
Characteristic resistance	$N_{Rk,p,C2}$	[kN]	2,4	5,4	7,1	10,5
Steel failure	**Version: SK**					
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	27	45	no performance assessed	
Partial factor	γ_{Ms}	[-]	1,5			
Pull-out	**Version: SK**					
Characteristic resistance	$N_{Rk,p,C2}$	[kN]	2,4	5,4	no performance assessed	
Concrete cone failure	**Version: BI, B, SU…TX, SU, S, SK, LK, LP**					
Effective anchorage depth	h_{ef}	[mm]	52	68	80	92
Spacing	$s_{cr,N}$	[mm]	3 h_{ef}			
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}			
Shear loads						
Steel failure <u>without</u> lever arm	**Version: BI, B, SU…TX, SU, S, SK, LK, LP**					
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	10,3	21,9	24,4	23,3
Partial factor	γ_{Ms}	[-]	1,25			
Steel failure <u>without</u> lever arm	**Version: SK**					
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	3,6	13,7	no performance assessed	
Partial factor	γ_{Ms}	[-]	1,25			
Concrete pry-out failure	**Version: BI, B, SU…TX, SU, S, SK, LK, LP**					
Pry-out factor	k_8	[-]	1,0	2,0		
Concrete edge failure	**Version: BI, B, SU…TX, SU, S, SK, LK, LP**					
Effective length of anchor	$l_f = h_{ef}$	[mm]	52	68	80	92
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	14
Factor for annular gap **<u>without</u>** filling of annular gap	α_{gap}	[-]	0,5			

Screwbolt TSM

Performance
Characteristic resistance for **seismic loading**, performance category **C2**
<u>without</u> filling of annular gap

Annex C4

Deutsches Institut für Bautechnik DIBt

Table C5: Characteristic values of resistance under **fire exposure**

Anchor size				**TSM 6**		**TSM 8**			**TSM 10**			**TSM 12**			**TSM 14**		
Nominal anchorage depth		h_{nom}	[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Steel failure (tension and shear resistance)																	
Characteristic resistance	R30	$N_{Rk,s,fi}$ = $V_{Rk,s,fi}$	[kN]	0,9		2,4			4,4			7,3			10,3		
	R60			0,8		1,7			3,3			5,8			8,2		
	R90			0,6		1,1			2,3			4,2			5,9		
	R120			0,4		0,7			1,7			3,4			4,8		
Steel failure <u>with</u> lever arm																	
Characteristic bending resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	0,7		2,4			5,9			12,3			20,4		
	R60			0,6		1,8			4,5			9,7			15,9		
	R90			0,5		1,2			3,0			7,0			11,6		
	R120			0,3		0,9			2,3			5,7			9,4		
Edge distance		$c_{cr,fi}$	[mm]	2 h_{ef}													
In case of fire attack from more than one side, the minimum edge distance shall be ≥ 300 mm																	
Spacing		$s_{cr,fi}$	[mm]	4 h_{ef}													
The characteristic resistance for pull-out $N_{Rk,p,fi}$, concrete cone failure $N^0_{Rk,c,fi}$, concrete pry-out $V_{Rk,cp,fi}$ and concrete edge failure $V^0_{Rk,c,fi}$ shall be calculated according to EN 1992-4:2018.																	
The anchorage depth has to be increased for wet concrete by at least 30 mm compared to the given values																	

Screwbolt TSM

Performance
Characteristic values of resistance under **fire exposure**

Annex C5

Deutsches Institut für Bautechnik DIBt

Table C6: Displacements under static or quasi-static loads

Anchor size				TSM 6		TSM 8			TSM 10			TSM 12			TSM 14		
Nominal embedment depth		h_{nom}	[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Tension load																	
cracked concrete	Tension load	N	[kN]	0,95	1,9	2,4	4,3	5,7	4,3	7,9	9,6	5,7	9,4	12,3	7,6	12,0	15,1
	Displacement	δ_{N0}	[mm]	0,3	0,6	0,6	0,7	0,8	0,6	0,5	0,9	0,9	0,5	1,0	0,5	0,8	0,7
		$\delta_{N\infty}$	[mm]	0,4	0,4	0,6	1,0	0,9	0,4	1,2	1,2	1,0	1,2	1,2	0,9	1,2	1,0
uncracked concrete	Tension load	N	[kN]	1,9	4,3	3,6	5,7	7,6	5,7	9,5	11,9	7,6	13,2	17,2	10,6	16,9	21,2
	Displacement	δ_{N0}	[mm]	0,4	0,6	0,7	0,9	0,5	0,7	1,1	1,0	1,0	1,1	1,2	0,9	1,2	0,8
		$\delta_{N\infty}$	[mm]	0,4	0,4	0,6	1,0	0,9	0,4	1,2	1,2	1,0	1,2	1,2	0,9	1,2	1,0
Shear load																	
Shear load		V	[kN]	3,3		8,6			16,2			20,0			30,5		
Displacement		δ_{V0}	[mm]	1,55		2,7			2,7			4,0			3,1		
		$\delta_{V\infty}$	[mm]	3,1		4,1			4,3			6,0			4,7		

Screwbolt TSM

Performance
Displacements under static or quasi-static loads

Annex C6

Deutsches Institut für Bautechnik DIBt

Table C7: Displacements under **seismic loading**, performance category **C2** **with filling of annular gap,** Screwbolt TSM zinc plated

Anchor size			**TSM 8**	**TSM 10**	**TSM 12**	**TSM 14**
Nominal embedment depth	h_{nom}	[mm]	65	85	100	115
Tension load						
Version: BI, B, SU…TX, SU, S, LK, LP						
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
Shear load						
Version: BI, B, SU…TX, SU, S, LK, LP (with clearance hole)						
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 C8: Displacements under **seismic loading**, performance category **C2** **without filling of annular gap,** Screwbolt TSM zinc plated

Anchor size			**TSM 8**	**TSM 10**	**TSM 12**	**TSM 14**
Nominal embedment depth	h_{nom}	[mm]	65	85	100	115
Tension load						
Version: BI, B, SU…TX, SU, S, LK, LP						
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
Version: SK						
Displacement DLS	$\delta_{N,C2DLS)}$	[mm]	0,66	0,32	no performance assessed	
Displacement ULS	$\delta_{N,C2(ULS)}$	[mm]	1,74	1,36		
Shear load						
Version: BI, B, SU…TX, SU, S, LK, LP (with clearance hole)						
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
Version: SK (with clearance hole)						
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		

Screwbolt TSM

Performance
Displacements under **seismic loading,** performance category **C2**

Annex C7