Deutsches Institut für Bautechnik
DIBt

Member of EOTA
www.eota.eu

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-16/0308 of 11 December 2019

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	TURBO SMART
Product family to which the construction product belongs	Mechanical fasteners for use in concrete
Manufacturer	pgb - Polska Sp. z o.o. ul. Fryderyka Wilhelma Redena 3 41-807 ZABRZE POLEN
Manufacturing plant	manufacturing plant 3
This European Technical Assessment contains	22 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 330232-00-0601
This version replaces	ETA-16/0308 issued on 23 May 2016

The European Technical Assessment is issued by the Technical Assessment Body in its official language. Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and shall be identified as such.

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full. However, partial reproduction may only be made with the written consent of the issuing Technical Assessment Body. Any partial reproduction shall be identified as such.

This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission in accordance with Article 25(3) of Regulation (EU) No 305/2011.

Specific Part

1 Technical description of the product

The TURBO SMART concrete screw is an anchor of 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 is given in Annex A.

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

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

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

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	**Performance**
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1 and C 2
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1 and C 2
Displacements (static and quasi-static loading)	See Annex C 7
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 3, C 4, C 5 and C 8

3.2 Safety in case of fire (BWR 2)

Essential characteristic	**Performance**
Reaction to fire	Class A1
Resistance to fire	See Annex C 6

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. 330232-00-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

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

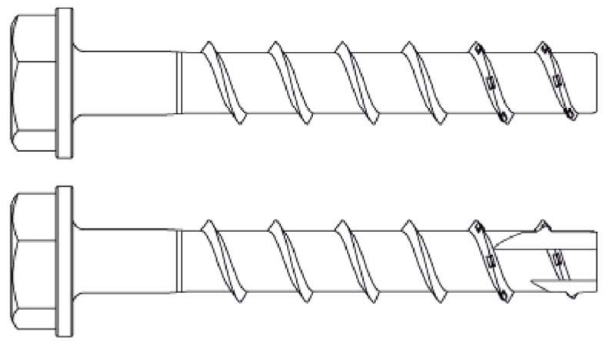
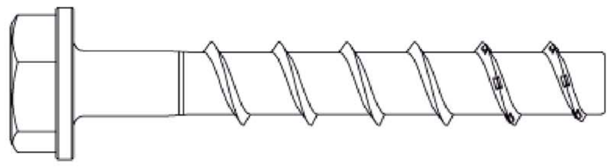
Issued in Berlin on 11 December 2019 by Deutsches Institut für Bautechnik

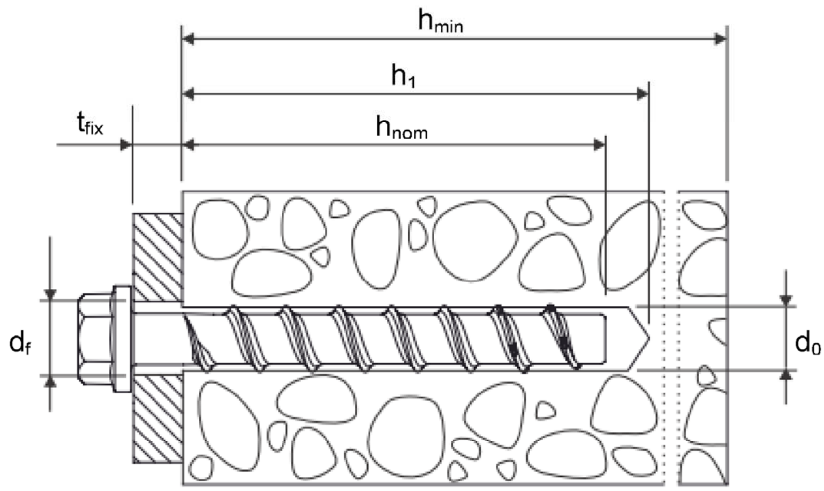
Dr.-Ing. Lars Eckfeldt
p. p. Head of Department

beglaubigt:
Tempel

Product and installed condition

TURBO SMART concrete screw

	Carbon steel, zinc-plated and zinc-flake coating
	Stainless steel A4 and HCR



d_0	=	nominal drill bit diameter
h_{nom}	=	nominal anchorage depth
h_1	=	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

TURBO SMART concrete screw

Product description
Installed condition

Annex A1

Deutsches Institut für Bautechnik DIBt

1		TURBO SMART S-BSZ	Concrete screw version with hexagon head with pressed-on washer
2		TURBO SMART S-BSM	Concrete screw version with hexagon head with pressed-on washer and T-drive
3		TURBO SMART S-BSH	Concrete screw version with hexagon head
4		TURBO SMART S-BSV	Concrete screw with countersunk head
5		TURBO SMART S-BSP	Concrete screw with pan head
6		TURBO SMART S-BSF	Concrete screw with large pan head
7		TURBO SMART S-BSE	Concrete screw with countersunk head and connection thread
8		TURBO SMART S-BSB	Concrete screw with hexagonal head and connection thread
9		TURBO SMART S-BSS	Concrete screw with hexagon drive and connection thread
10		TURBO SMART S-BSA	Concrete screw with connection thread and hexagon socket drive
11		TURBO SMART S-BSI	Concrete screw with internal metric thread and hexagon drive

TURBO SMART concrete screw	**Annex A2**
Product description Versions	

Table A1: Materials

Part	Name	Type	Material	f_{yk}	f_{uk}
1 2 3 4 5 6 7 8 9 10 11	Concrete screw	TURBO SMART	Steel EN 10263-4:2017, zinc-plated acc. to EN ISO 4042:2018 or zinc flake coating acc. to EN ISO 10683:2018 (≥ 5µm)	560 N/mm²	700 N/mm²
		TURBO SMART A4	1.4401, 1.4404, 1.4571, 1.4578		
		TURBO SMART HCR	1.4529		

f_{yk} = nominal characteristic steel yield strength
f_{uk} = nominal characteristic steel ultimate strength

Table A2: Dimensions

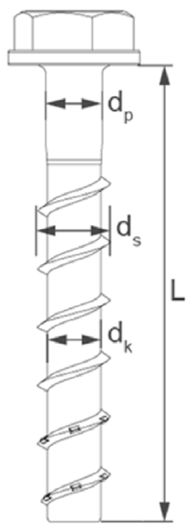
Anchor size			6		8			10			12			14		
Nominal embedment depth		h_{nom}	1	2	1	2	3	1	2	3	1	2	3	1	2	3
		[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Screw length	≤ L	[mm]	500													
Core diameter	d_k	[mm]	5,1		7,1			9,1			11,1			13,1		
Thread outer diameter	d_s	[mm]	7,5		10,6			12,6			14,6			16,6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

Marking:

TURBO SMART (Zinc plated and Zinc flake)
Anchor type: TSM
Anchor size: 10
Length of the anchor: 100

TURBO SMART A4
Anchor type: TSM
Anchor size: 10
Length of the anchor: 100
Material: A4

TURBO SMART HCR
Anchor type: TSM
Anchor size: 10
Length of the anchor: 100
Material: HCR



TURBO SMART concrete screw

Product description
Materials, dimensions and markings

Annex A3

Deutsches Institut für Bautechnik DIBt

Intended use

Table B1: Anchorages subject to

TURBO SMART concrete screw		**6**		**8**			**10**			**12**			**14**		
Nominal embedment depth	h_{nom}	h_{nom1}	h_{nom2}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
	[mm]	40	55	45	55	65	55	75	85	65	85	100	65	85	115
Static and quasi-static loads		All sizes and all embedment depths													
Fire exposure															
C1 category - seismic performance		x		x		ok	x		ok	x		ok	x		ok
C2 category – seismic (A4 and HCR not suitable)															

Base materials:

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

Use conditions (Environmental conditions):

- Concrete screws subject to dry internal conditions: all screw types.
- Structural subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition no particular aggressive conditions exist screw types made of stainless steel with marking A4.
- Structural subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition if particular aggressive conditions exist: screw types made of stainless steel with marking HCR.
  Note: Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in desulphurization plants or road tunnels where
  de-icing materials are used).

Intended use

Design:

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

  The design for shear load according to EN 1992-4:2018, Section 6.2.2 applies for all specified diameters d_f of clearance hole in the fixture in Annex B3, Table B2.

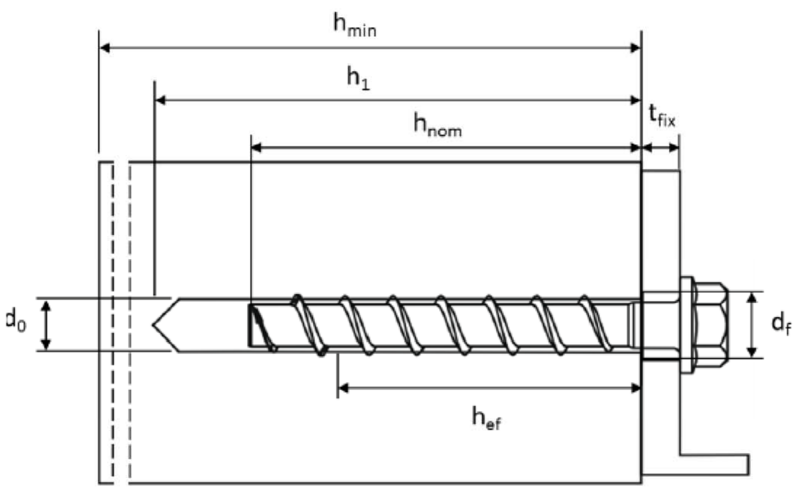
Installation:

- Hammer drilling or hollow drilling; hollow drilling only for sizes 8-14.
- Anchor installation carried out by appropriately qualified personal and under the supervision of the person responsible for technical matters on site.
- In case of aborted hole: new drilling must be drilled at a minimum distance of twice the depth of aborted hole or closer, if the aborted hole is filled with high strength mortar and only if the hole is not in the direction of the oblique tensile or shear load.
- After installation further turning of the anchor must not be possible. The head of the anchor is supported in the fixture and is not damaged.
- The borehole may be filled with injection mortar SMART S-IRV, S-IRW or S-IRE.
- Adjustability according to Annex B6 for sizes 8-14, all embedment depths, but not for seismic loading
- Cleaning of borehole is not necessary, if using a hollow drill bit.

Table B2: Installation parameters

TURBO SMART concrete screw size			6		8			10		
Nominal embedment depth		h_{nom}	h_{nom1}	h_{nom2}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
		[mm]	40	55	45	55	65	55	75	85
Nominal drill hole diameter	d_0	[mm]	6		8			10		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,40		8,45			10,45		
Drill hole depth	$h_1 \geq$	[mm]	45	60	55	65	75	65	85	95
Clearance hole diameter	$d_f \leq$	[mm]	8		12			14		
Installation torque (version with connection thread)	T_{inst}	[Nm]	10		20			40		
Torque impact screw driver		[Nm]	Max. torque according to manufacturer's instructions							
			160		300			400		

TURBO SMART concrete screw size			12			14		
Nominal embedment depth		h_{nom}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
		[mm]	65	85	100	75	100	115
Nominal drill hole diameter	d_0	[mm]	12			14		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,50			14,50		
Drill hole depth	$h_1 \geq$	[mm]	75	95	110	85	110	125
Clearance hole diameter	$d_f \leq$	[mm]	16			18		
Installation torque (version with connection thread)	T_{inst}	[Nm]	60			80		
Torque impact screw driver		[Nm]	Max. torque according to manufacturer's instructions					
			650			650		



TURBO SMART concrete screw

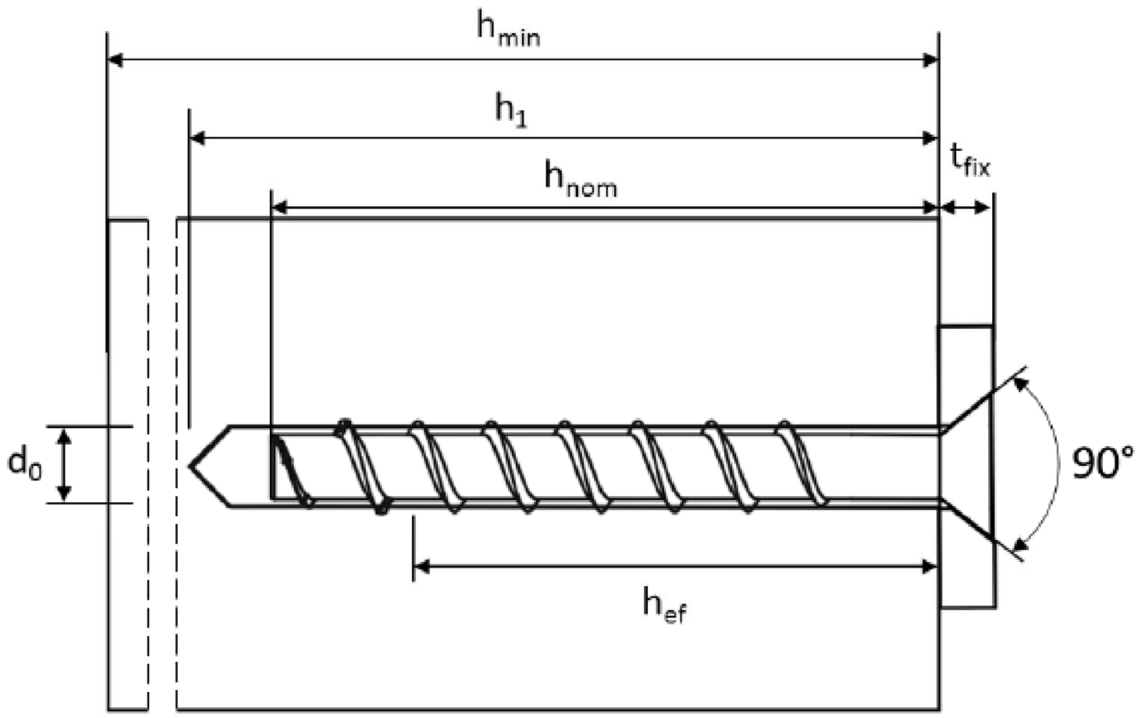
Intended use
Installation parameters

Annex B3

Table B3: Minimum thickness of member, minimum edge distance and minimum spacing

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

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

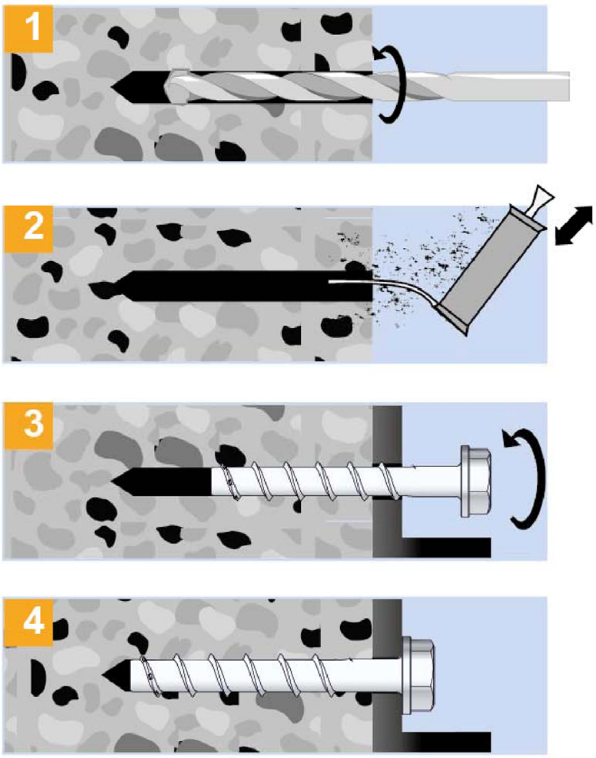


TURBO SMART concrete screw

Intended use
Installation instructions

Annex B4

Installation instructions



1. **Drilling:**
   Create hammer drilled or hollow drilled borehole.

2. **Cleaning of the drill hole**:
   Remove drill dust by vacuuming or blowing.

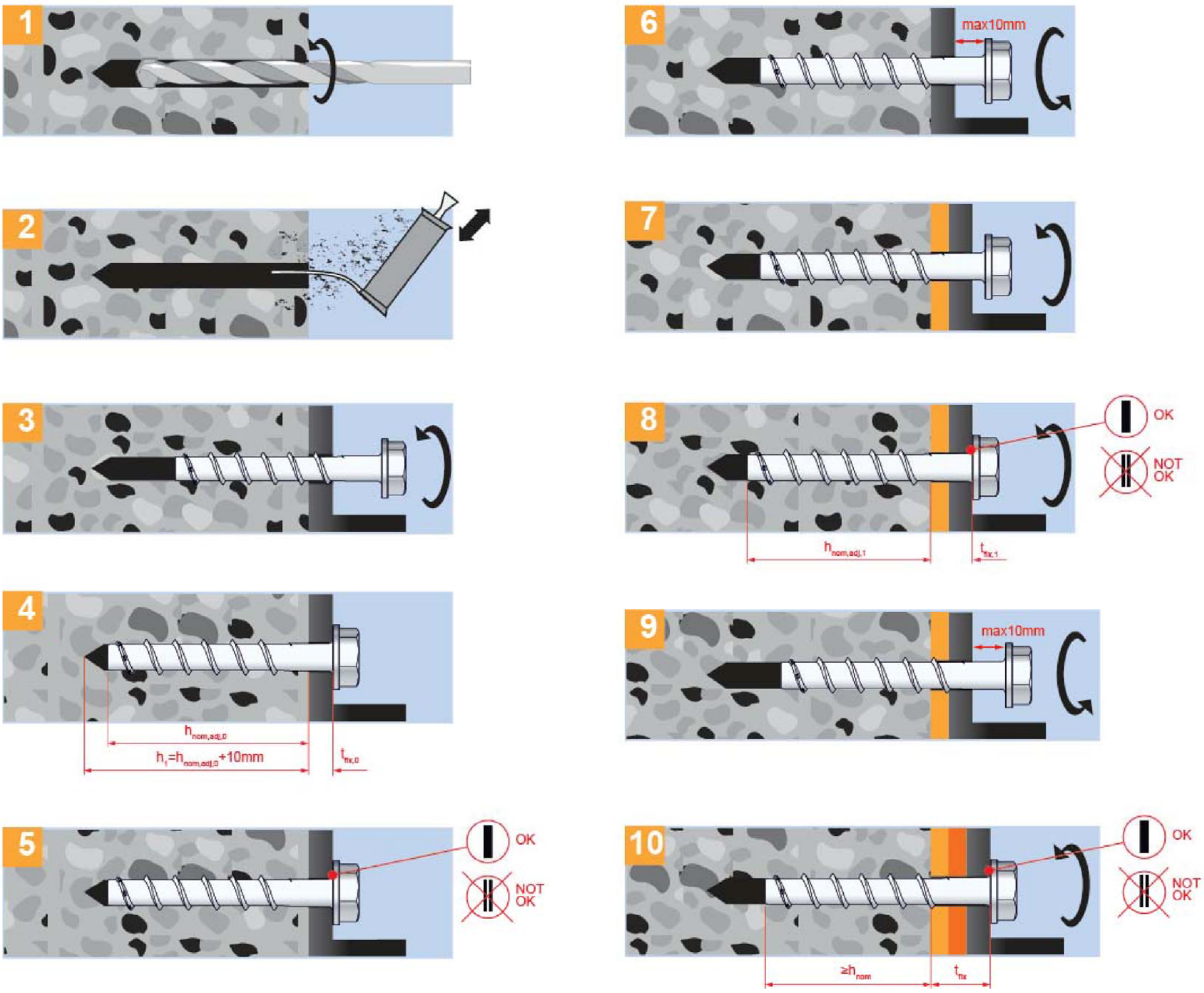
3. **Installation:**
   Install the anchor by impact screwdriver or torque wrench.

4. **Complete:**
   verify that the head is pressed to the fixture.

Remark: cleaning of borehole is not necessary when using an hollow drill bit

TURBO SMART concrete screw	Annex B5
Intended use Installation instructions	

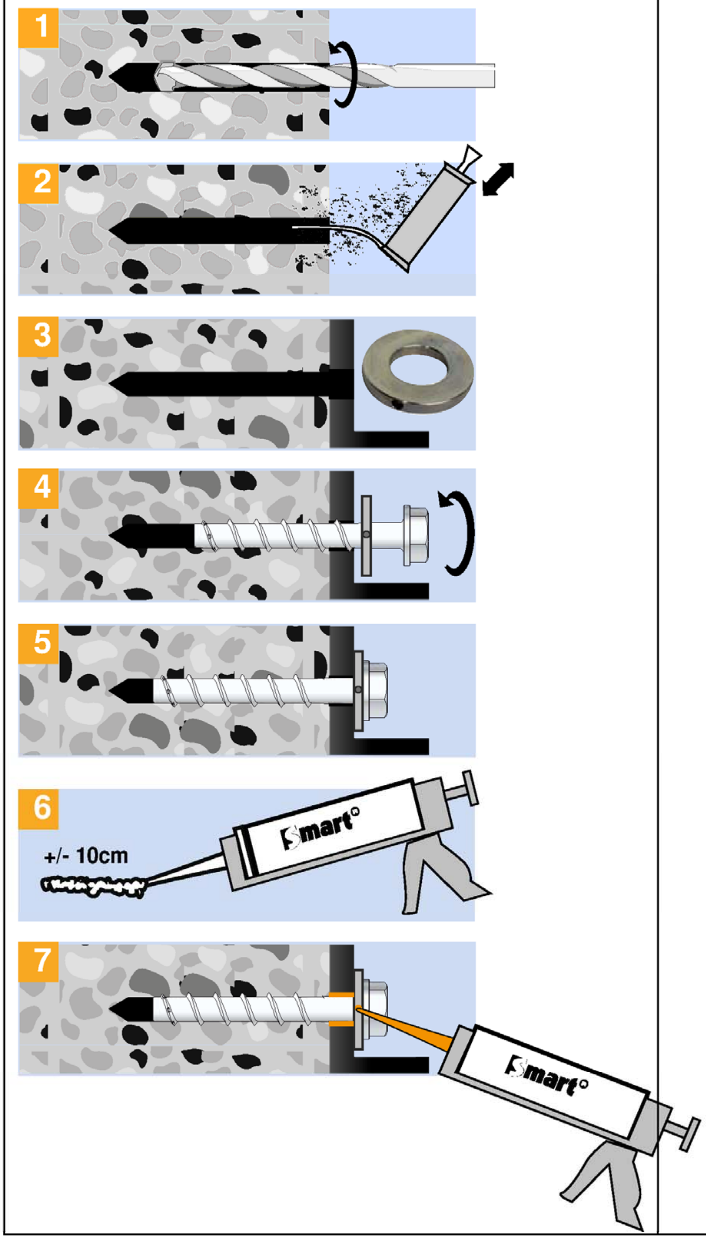
Installation instructions for adjustability



Installation instructions

TURBO SMART anchor may be adjusted maximum two times while the anchor may turn back at most 10 mm.
The total allowed thickness of shims added during the adjustment process is 10mm.
The final embedment depth after adjustment process must be equal or larger than h_{nom}.

Installation instructions – filling annular gap



1. **Drilling:**
   Create hammer drilled or hollow drilled borehole.
2. **Cleaning of the drill hole**:
   Remove drill dust by vacuuming or blowing.
3. **Filling washer:**
   After preparing the borehole (Annex B5, figure 1+2), position first the fixture and then the filling washer.
4. **Installation:**
   Install the anchor by impact screwdriver or torque wrench.
5. Installed condition without injected mortar in the filling washer
6. Follow the instructions displayed on the **chemical anchor** cartridge and discard the mortar until the colour is constant.
7. **Filling the annular gap:**
   Fill the annular gap with the injection mortar (minimum compression strength of 20 N/mm², e.g. SMART S-IRV, S-IRW or S-IRE)

Notes:

- For seismic loading the installation with filled and without filled annular gap is approved. Difference in performance can be found in Annex C3 – C5.
- No consideration of curing time is necessary.

TURBO SMART concrete screw	**Annex B7**
Intended use Installation instructions - Filling annular gap	

Table C1: Characteristic values for static and quasi-static loading, sizes 6, 8 and 10

TURBO SMART concrete screw size				6		8			10		
Nominal embedment depth			h_{nom}	h_{nom1}	h_{nom2}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
			[mm]	40	55	45	55	65	55	75	85
Steel failure for tension and shear loading											
Characteristic tension load		$N_{Rk,s}$	[kN]	14,0		27,0			45,0		
Partial factor tension load		$\gamma_{Ms,N}$	[-]	1,5							
Characteristic shear load		$V_{Rk,s}$	[kN]	7,0		13,5		17,0	22,5	34,0	
Partial factor shear load		$\gamma_{Ms,V}$	[-]	1,25							
Ductility factor		k_7	[-]	0,8							
Characteristic bending load		$M^0_{Rk,s}$	[Nm]	10,9		26,0			56,0		
Pull-out failure											
Characteristic tension load C20/25	cracked	$N_{Rk,p}$	[kN]	2,0	4,0	5,0	9,0	12,0	9,0	$\geq N^0_{Rk,c}$	
	uncracked	$N_{Rk,p}$	[kN]	4,0	9,0	7,5	12,0	16,0	12,0	20,0	26,0
Increasing factor for $N_{Rk,p}$	C20/25	ψ_c	[-]	1,12							
	C30/37			1,22							
	C40/50			1,41							
	C50/60			1,58							
Concrete failure: Splitting failure, concrete cone failure and pry-out failure											
Effective embedment depth		h_{ef}	[mm]	31	44	35	43	52	43	60	68
k-factor	cracked	$k_1 = k_{cr}$	[-]	7,7							
	uncracked	$k_1 = k_{ucr}$	[-]	11,0							
Concrete cone failure	spacing	$s_{cr,N}$	[mm]	3 x h_{ef}							
	edge distance	$c_{cr,N}$	[mm]	1,5 x h_{ef}							
Splitting failure	spacing	$s_{cr,Sp}$	[mm]	120	160	120	140	150	140	180	210
	edge distance	$c_{cr,Sp}$	[mm]	60	80	60	70	75	70	90	105
Factor for pry-out failure		k_8	[-]	1,0						2,0	
Installation factor		γ_{inst}	[-]	1,0							
Concrete edge failure											
Effective length in concrete		$l_f = h_{ef}$	[mm]	31	44	35	43	52	43	60	68
Nominal outer diameter of screw		d_{nom}	[mm]	6		8			10		

TURBO SMART concrete screw

Performances
Characteristic values for static and quasi-static loading, sizes 6,8,10

Annex C1

Deutsches Institut für Bautechnik DIBt

Table C2: Characteristic values for static and quasi-static loading, sizes 12 and 14

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

TURBO SMART concrete screw

Performances
Characteristic values for static and quasi-static loading, sizes 12 and 14

Annex C2

Table C3: Seismic category C1 – Characteristic load values

TURBO SMART concrete screw size			8	10	12	14
Nominal embedment depth		h_{nom}	h_{nom3}			
		[mm]	65	85	100	115
Steel failure for tension and shear load						
Characteristic load	$N_{Rk,s,eq}$	[kN]	27,0	45,0	67,0	94,0
Partial factor tension load	γ_{Ms}	[-]	1,5			
Characteristic load	$V_{Rk,s,eq}$	[kN]	8,5	15,3	21,0	22,4
Partial factor shear load	γ_{Ms}	[-]	1,25			
With filling of the annular gap [1)]	α_{gap}	[-]	1,0			
Without filling of the annular gap	α_{gap}	[-]	0,5			
Pull-out failure						
Characteristic tension load in cracked concrete C20/25	$N_{Rk,p,eq}$	[kN]	12,0	$\geq N^0_{Rk,c}$		
Concrete cone failure						
Effective embedment depth	h_{ef}	[mm]	52	68	80	92
Edge distance	$c_{cr,N}$	[mm]	1,5 x h_{ef}			
Spacing	$s_{cr,N}$	[mm]	3 x h_{ef}			
Installation safety factor	γ_{inst}	[-]	1,0			
Concrete pry-out failure						
Factor for pry-out failure	k_8	[-]	1,0	2,0		
Concrete edge failure						
Effective length in concrete	$l_f = h_{ef}$	[mm]	52	68	80	92
Nominal outer diameter of screw	d_{nom}	[mm]	8	10	12	14

1) Filling of the annular gap according to annex B7, figure 7

Deutsches Institut für Bautechnik DIBt

Table C4: Seismic category C2 1) – Characteristic load values <u>with filled annular gap according to annex B7, figure 7</u>

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

1) A4 and HCR not suitable

TURBO SMART concrete screw

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

Annex C4

Table C5: Seismic category C2 [1] – Characteristic load values <u>without filled annular gap according to annex B7, figure 5</u>

TURBO SMART concrete screw size			8	10	12	14
Nominal embedment depth		h_{nom}	h_{nom3}			
		[mm]	65	85	100	115
Steel failure for tension (**hexagon** head type)						
Characteristic load	$N_{Rk,s,eq}$	[kN]	27,0	45,0	67,0	94,0
Partial factor tension load	γ_{Ms}	[-]	1,5			
Pull-out failure (**hexagon** head type)						
Characteristic load in cracked concrete	$N_{Rk,p,eq}$	[kN]	2,4	5,4	7,1	10,5
Steel failure for shear load (**hexagon** head type)						
Characteristic load	$V_{Rk,s,eq}$	[kN]	10,3	21,9	24,4	23,3
Partial factor shear load	γ_{Ms}	[-]	1,25			
Without filling of the annular gap	α_{gap}	[-]	0,5			
Steel failure for tension (**countersunk** head type)						
Characteristic load	$N_{Rk,s,eq}$	[kN]	27,0	45,0	-	
Partial factor tension load	γ_{Ms}	[-]	1,5			
Pull-out failure (**countersunk** head type)						
Characteristic load in cracked concrete	$N_{Rk,p,eq}$	[kN]	2,4	5,4	-	
Steel failure for shear load (**countersunk** head type)						
Characteristic load	$V_{Rk,s,eq}$	[kN]	3,6	13,7	-	
Partial factor shear load	γ_{Ms}	[-]	1,25			
Without filling of the annular gap	α_{gap}	[-]	0,5			
Concrete cone failure						
Effective embedment depth	h_{ef}	[mm]	52	68	80	92
Edge distance	$c_{cr,N}$	[mm]	1,5 x h_{ef}			
Spacing	$s_{cr,N}$	[mm]	3 x h_{ef}			
Installation safety factor	γ_{inst}	[-]	1,0			
Concrete pry-out failure						
Factor for pry-out failure	k_8	[-]	2,0			
Concrete edge failure						
Effective length in concrete	$l_f = h_{ef}$	[mm]	52	68	80	92
Nominal outer diameter of screw	d_{nom}	[mm]	8	10	12	14

1) A4 and HCR not suitable

TURBO SMART concrete screw

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

Annex C5

Deutsches Institut für Bautechnik DIBt

Table C6: Fire exposure – characteristic values of resistance

TURBO SMART concrete screw size				6		8			10			12			14		
Nominal embedment depth			h_{nom}	1	2	1	2	3	1	2	3	1	2	3	1	2	3
			[mm]	40	55	45	55	65	55	75	85	65	85	100	75	100	115
Steel failure for tension and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)																	
Characteristic resistance	R30	$F_{Rk,s,fi30}$	[kN]	0,9		2,4			4,4			7,3			10,3		
	R60	$F_{Rk,s,fi60}$	[kN]	0,8		1,7			3,3			5,8			8,2		
	R90	$F_{Rk,s,fi90}$	[kN]	0,6		1,1			2,3			4,2			5,9		
	R120	$F_{Rk,s,fi120}$	[kN]	0,4		0,7			1,7			3,4			4,8		
	R30	$M^0_{Rk,s,fi30}$	[Nm]	0,7		2,4			5,9			12,3			20,4		
	R60	$M^0_{Rk,s,fi60}$	[Nm]	0,6		1,8			4,5			9,7			15,9		
	R90	$M^0_{Rk,s,fi90}$	[Nm]	0,5		1,2			3,0			7,0			11,6		
	R120	$M^0_{Rk,s,fi120}$	[Nm]	0,3		0,9			2,3			5,7			9,4		
Pull-out failure																	
Characteristic resistance	R30-R90	$N_{Rk,p,fi}$	[kN]	0,5	1,0	1,3	2,3	3,0	2,3	4,0	4,8	3,0	4,7	6,2	3,8	6,0	7,6
	R120	$N_{Rk,p,fi}$	[kN]	0,4	0,8	1,0	1,8	2,4	1,8	3,2	3,9	2,4	3,8	4,9	3,0	4,8	6,1
Concrete cone failure																	
Characteristic resistance	R30-R90	$N^0_{Rk,c,fi}$	[kN]	0,9	2,2	1,2	2,1	3,4	2,1	4,8	6,6	3,0	6,3	9,9	4,4	9,6	14,0
	R120	$N^0_{Rk,c,fi}$	[kN]	0,7	1,8	1,0	1,7	2,7	1,7	3,8	5,3	2,4	5,1	7,9	3,5	7,6	11,2
Edge distance																	
R30 bis R120		$c_{cr,fi}$	[mm]	$2 \times h_{ef}$													
In case of fire attack from more than one side, the minimum edge distance shall be ≥300mm.																	
Spacing																	
R30 bis R120		$s_{cr,fi}$	[mm]	$4 \times h_{ef}$													
Pry-out failure																	
R30 bis R120		k_8	[-]	1,0						2,0		1,0	2,0		1,0	2,0	
The anchorage depth has to be increased for wet concrete by at least 30 mm compared to the given value.																	

TURBO SMART concrete screw

Performances
Fire exposure – characteristic values of resistance

Annex C6

Deutsches Institut für Bautechnik DIBt

Table C7: Displacements under static and quasi-static tension load

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

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

Table C8: Displacements under static and quasi-static shear load

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

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

TURBO SMART concrete screw

Performances
Displacements under static and quasi-static loads

Annex C7

Table C9: Seismic category C2 [1)] – Displacements with filled annular gap according to annex B7, figure 7

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

Table C10: Seismic category C2 [1)] – Displacements without filled annular gap according to annex B7, figure 5

TURBO SMART concrete screw size			8	10	12	14
Nominal embedment depth		h_{nom}	h_{nom3}			
		[mm]	65	85	100	115
Displacements under tension loads (**hexagon** head type)						
Displacement DLS	$\delta_{N,eq(DLS)}$	[mm]	0,66	0,32	0,57	1,16
Displacement ULS	$\delta_{N,eq(ULS)}$	[mm]	1,74	1,36	2,36	4,39
Displacements under tension loads (**countersunk** head type)						
Displacement DLS	$\delta_{N,eq(DLS)}$	[mm]	0,66	0,32	-	
Displacement ULS	$\delta_{N,eq(ULS)}$	[mm]	1,74	1,36		
Displacements under shear loads (**hexagon** head type with hole clearance)						
Displacement DLS	$\delta_{V,eq(DLS)}$	[mm]	4,21	4,71	4,42	5,60
Displacement ULS	$\delta_{V,eq(ULS)}$	[mm]	7,13	8,83	6,95	12,63
Displacements under shear loads (**countersunk** head type with hole clearance)						
Displacement DLS	$\delta_{V,eq(DLS)}$	[mm]	2,51	2,98	-	
Displacement ULS	$\delta_{V,eq(ULS)}$	[mm]	7,76	6,25		

1) A4 and HCR not suitable