Deutsches Institut für Bautechnik

Approval body for construction products
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments



# European Technical Assessment — ETA-15/0514 of 28 May 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 | TSM high performance, TSM high performance A4, TSM high performance HCR |
| Product family to which the construction product belongs | Mechanical fasteners for use in concrete |
| Manufacturer | TOGE Dübel GmbH & Co. KG<br>Illesheimer Straße 10<br>90431 Nürnberg<br>DEUTSCHLAND |
| Manufacturing plant | TOGE Dübel GmbH & Co. KG |
| 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-15/0514 issued on 2 December 2016 |

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## Specific Part

## 1 Technical description of the product

The TOGE Concrete screw TSM high performance 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 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 28 May 2019 by Deutsches Institut für Bautechnik

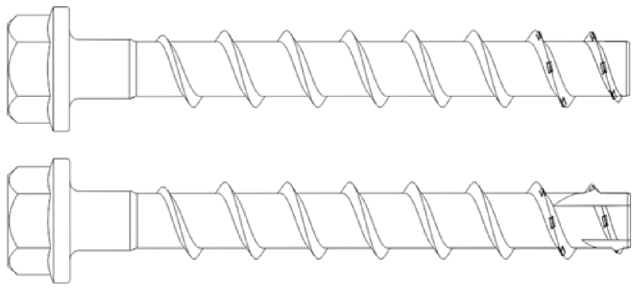
Dr.-Ing. Lars Eckfeldt
p. p. Head of Department

*beglaubigt:*
Tempel

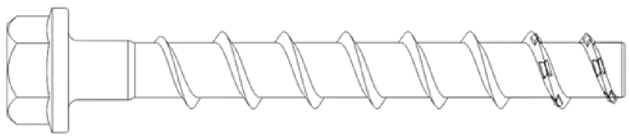
# Product in installed condition

## TOGE concrete screw TSM high performance

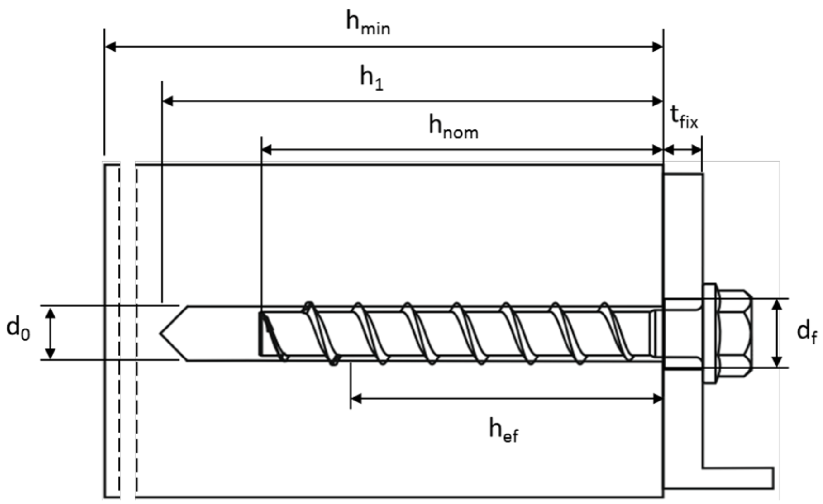
- Galvanized carbon steel
- Zinc flakes coated carbon steel



- Stainless steel A4
- Stainless steel HCR



e.g. TOGE concrete screw, zinc flakes coated, with hexagon head and fixture

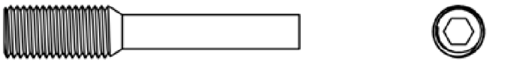



$d_0$ = nominal drill hole diameter
$t_{fix}$ = thickness of fixture
$d_f$ = clearance hole diameter

$h_{min}$ = minimum thickness of member
$h_{nom}$ = nominal embedment depth
$h_1$ = drill hole depth
$h_{ef}$ = effective embedment depth

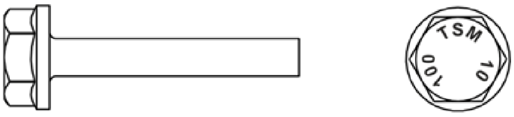


| TOGE concrete screw TSM High Performance | Annex A1 |
|---|---|
| **Product description**<br>Product in installed condition | |

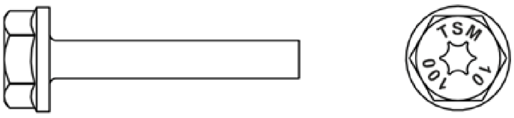


1. Configuration with metric connection threat and hexagon socket e.g. TSM 8x105 M10 SW5

2. Configuration with metric connection threat and hexagon drive e.g. TSM 8x105 M10 SW7

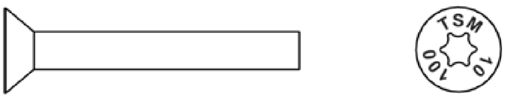


3. Configuration with washer and hexagon head e.g. TSM 8x80 SW13 VZ 40

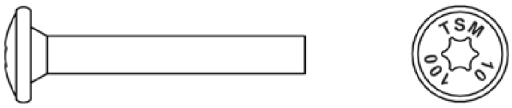


4. Configuration with washer, hexagon head and TORX drive e.g. TSM 8x80 SW13

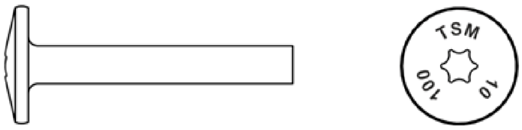
5. Configuration with hexagon head e.g. TSM 8x80 SW13 OS



6. Configuration with countersunk head and TORX drive e.g. TSM 8x80 C VZ 40

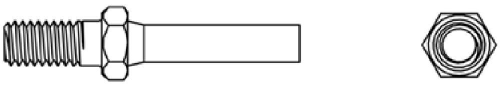


7. Configuration with pan head and TORX drive e.g. TSM 8x80 P VZ 40

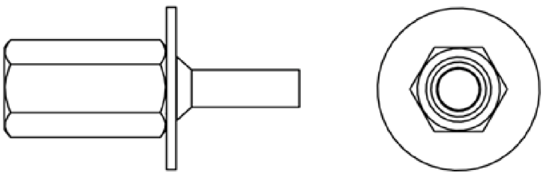


8. Configuration with large pan head and TORX drive e.g. TSM 8x80 LP VZ 40

9. Configuration with countersunk head and connection thread e.g. TSM 6x55 AG M8



10. Configuration with hexagon drive and connection thread e.g. TSM 6x55 M8 SW10



11. Configuration with internal thread and hexagon drive e.g. TSM 6x55 IM M8/10

| | |
|---|---|
| **TOGE concrete screw TSM High Performance** | **Annex A2** |
| **Product description**<br>Screw types | |

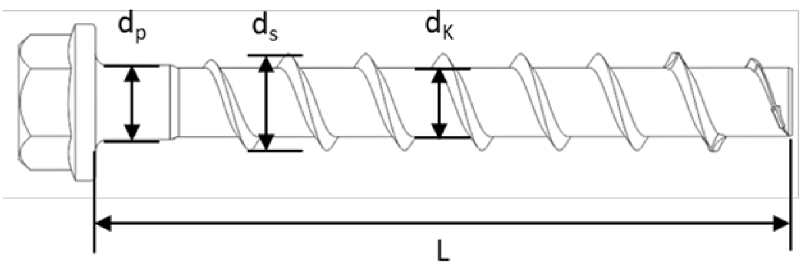
### Table 1: Material

| Part | Product name | Material |
|---|---|---|
| all types | TSM high performance | - Steel EN 10263-4:2017 galvanized acc. to EN ISO 4042:2018<br>- Zinc flake coating according to EN ISO 10683:2018 (≥5µm) |
| | TSM high performance A4 | 1.4401; 1.4404; 1.4571; 1.4578 |
| | TSM high performance HCR | 1.4529 |

| Part | Product name | Nominal characteristic steel Yield strength $f_{yk}$ [N/mm²] | Nominal characteristic steel Ultimate strength $f_{uk}$ [N/mm²] | Rupture elongation $A_5$ [%] |
|---|---|---|---|---|
| all types | TSM high performance | 560 | 700 | ≤ 8 |
| | TSM high performance A4 | | | |
| | TSM high performance HCR | | | |

### Table 2: Dimensions

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

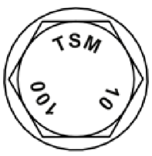


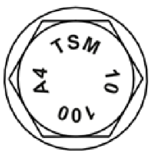

**Marking:**

**TSM high performance**
Screw type: TSM
Screw size: 10
Screw length: 100

**TSM high performance A4**
Screw type: TSM
Screw size: 10
Screw length: 100
Material: A4

**TSM high performance HCR**
Screw type: TSM
Screw size: 10
Screw length: 100
Material: HCR





**TOGE concrete screw TSM High Performance**

**Product description**
Material, Dimensions and markings

**Annex A3**

# Specification of Intended use

Table 3: Anchorages subject to

<table>
<tr><td colspan="2">TSM concrete screw size</td><td colspan="2">6</td><td colspan="3">8</td><td colspan="3">10</td><td colspan="3">12</td><td colspan="3">14</td></tr>
<tr><td rowspan="2">Nominal embedment depth</td><td></td><td>$h_{nom1}$</td><td>$h_{nom2}$</td><td>$h_{nom1}$</td><td>$h_{nom2}$</td><td>$h_{nom3}$</td><td>$h_{nom1}$</td><td>$h_{nom2}$</td><td>$h_{nom3}$</td><td>$h_{nom1}$</td><td>$h_{nom2}$</td><td>$h_{nom3}$</td><td>$h_{nom1}$</td><td>$h_{nom2}$</td><td>$h_{nom3}$</td></tr>
<tr><td>[mm]</td><td>40</td><td>55</td><td>45</td><td>55</td><td>65</td><td>55</td><td>75</td><td>85</td><td>65</td><td>85</td><td>100</td><td>65</td><td>85</td><td>115</td></tr>
<tr><td colspan="2">Static and quasi-static loads</td><td colspan="14" rowspan="2">All sizes and all embedment depths</td></tr>
<tr><td colspan="2">Fire exposure</td></tr>
<tr><td colspan="2">C1 category - seismic</td><td colspan="2" rowspan="2">x</td><td colspan="2" rowspan="2">x</td><td rowspan="2">ok</td><td colspan="2" rowspan="2">x</td><td rowspan="2">ok</td><td colspan="2" rowspan="2">x</td><td rowspan="2">ok</td><td colspan="2" rowspan="2">x</td><td rowspan="2">ok</td></tr>
<tr><td colspan="2">C2 category – seismic<br>(A4 and HCR unsuitable)</td></tr>
</table>

## 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 exits: 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 exits: 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).



| | |
|---|---|
| **TOGE concrete screw TSM High Performance** | **Annex B1** |
| **Intended use**<br>Specification | |

# Specification of Intended use - continuation

## Design:

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

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

## Installation:

- Hammer drilling or hollow drilling; hollow drilling only for sizes 8-14.
- Anchor installation carried out by appropriately qualified personnal 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 Chemofast C-FT 300V or ATA 2004C.
- 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

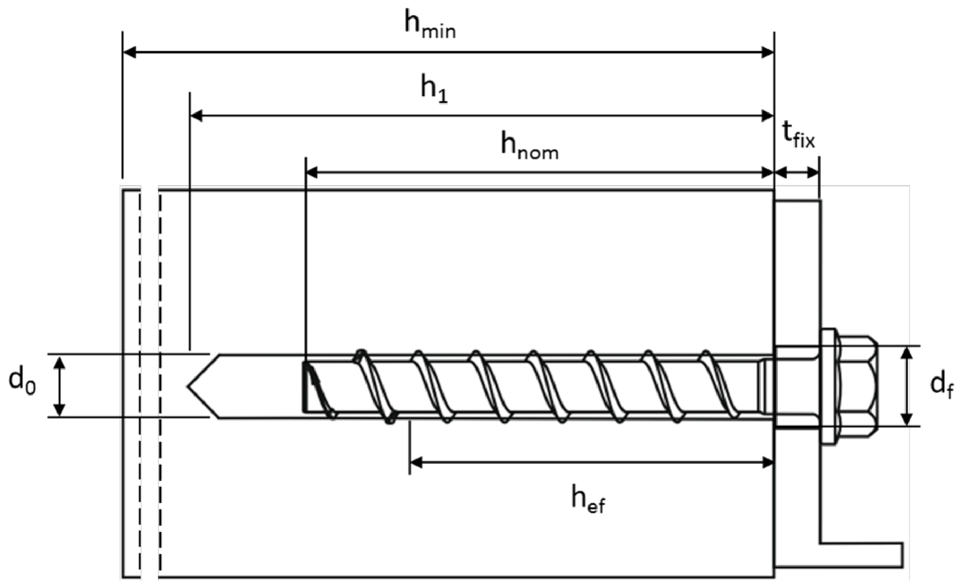


| | |
|---|---|
| **TOGE concrete screw TSM High Performance** | **Annex B2** |
| **Intended use**<br>Specification continuation | |

## Table 4: Installation parameters

| TSM 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 | | |

| TSM 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 | | |

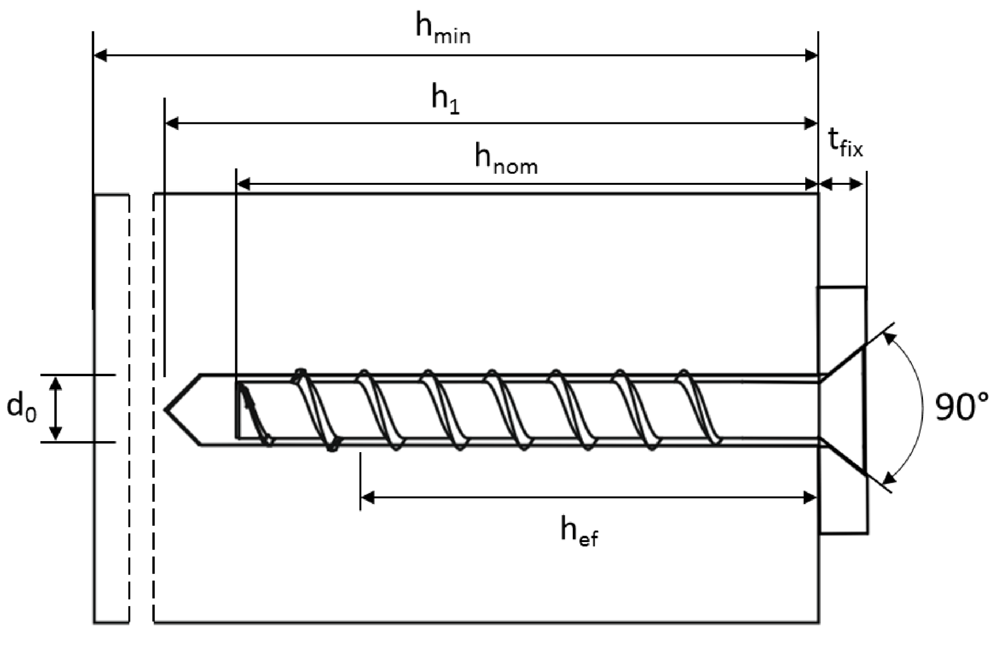



| | |
|---|---|
| **TOGE concrete screw TSM High Performance** | **Annex B3** |
| **Intended use**<br>Installation parameters | |

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

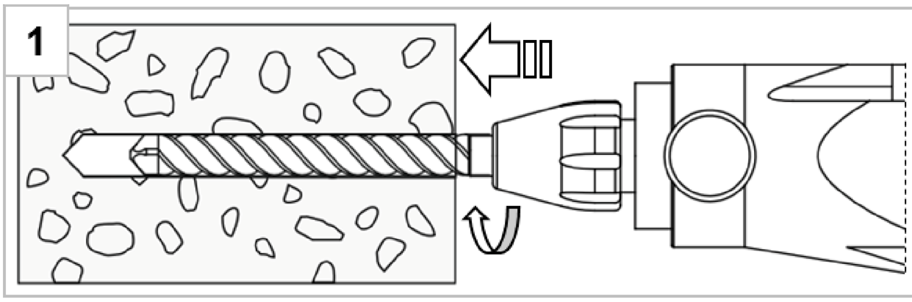
| TSM concrete screw size | | | 6 | | 8 | | | 10 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Nominal embedment depth | | $h_{nom}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | [mm] | 40 | 55 | 45 | 55 | 65 | 55 | 75 | 85 |
| 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 | | |

| TSM 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 | |

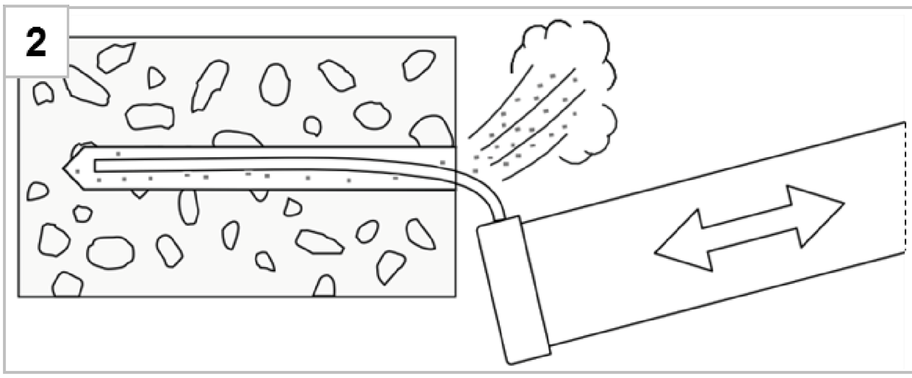



| TOGE concrete screw TSM High Performance | Annex B4 |
|---|---|
| **Intended use**<br>Minimum thickness of member, minimum edge distance and minimum spacing | |

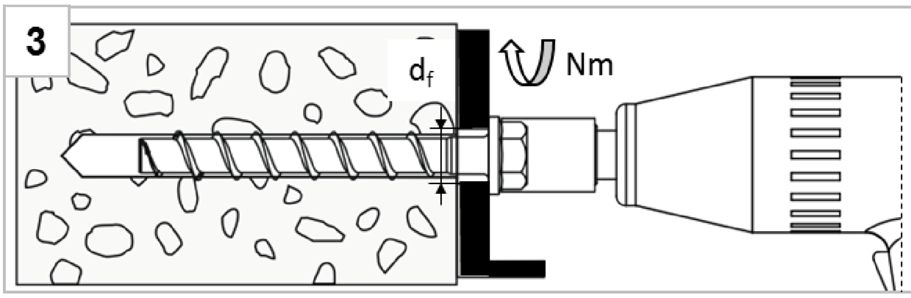
## Installation Instructions



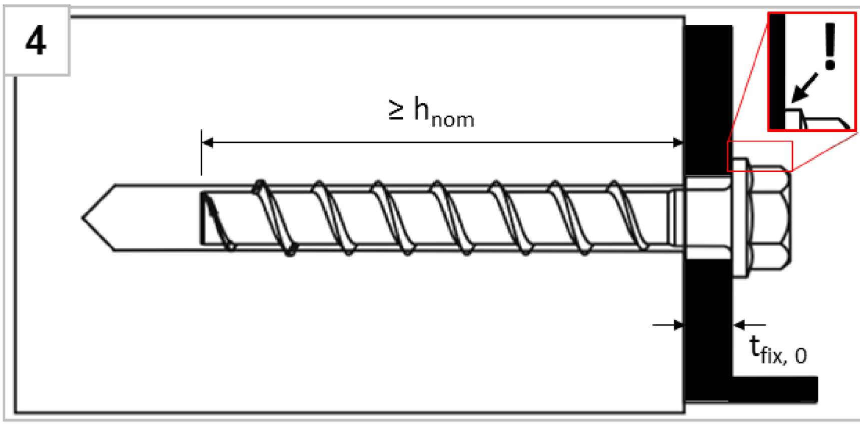

Create hammer drilled or hollow drilled borehole




Remove drill dust by vacuuming or blowing of




Install with torque impact screw driver or torque wrench




The head must be undamaged and in contact with the fixture

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

| TOGE concrete screw TSM High Performance | Annex B5 |
|---|---|
| **Intended use**<br>Installation instructions | |

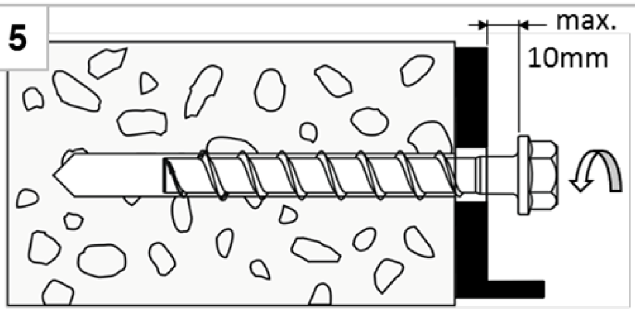
Deutsches Institut für Bautechnik DIBt

## Installation Instructions – Adjustment

**1. Adjustment**

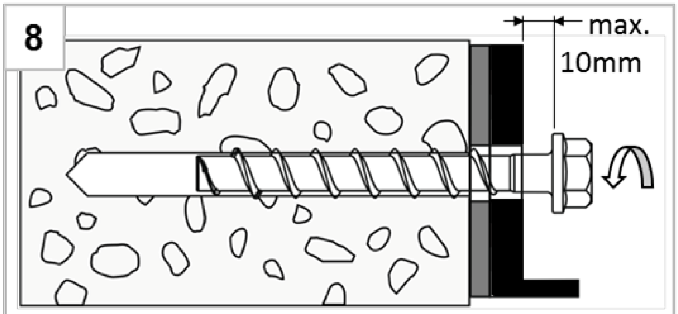
**2. Adjustment**

**5**



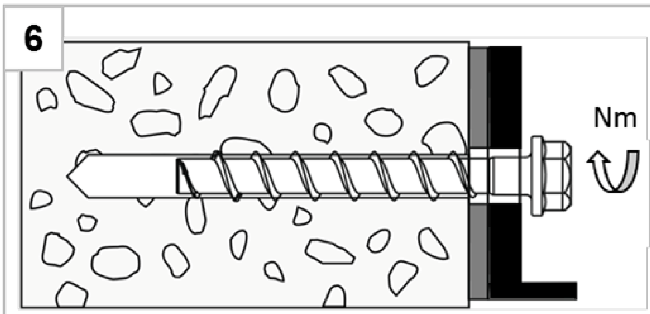

Screw may be untightened maximum 10mm

**8**



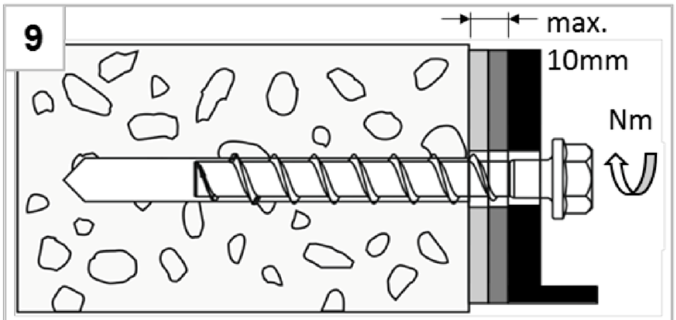

Screw may be untightened maximum 10mm

**6**



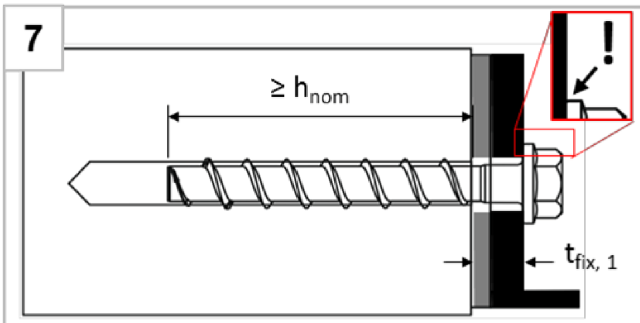

After adjustment, tighten the screw again

**9**



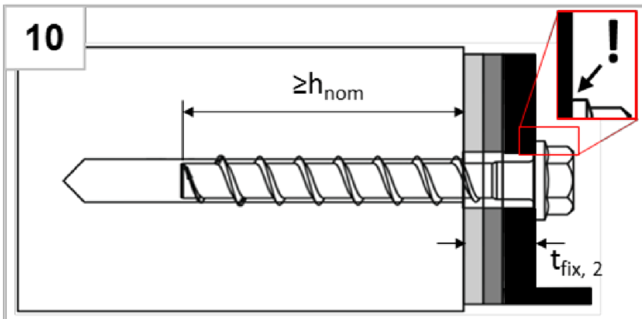

After adjustment, tighten the screw again

**7**




The head must be undamaged and in contact with the fixture

**10**




The head must be undamaged and in contact with the fixture

Notes:

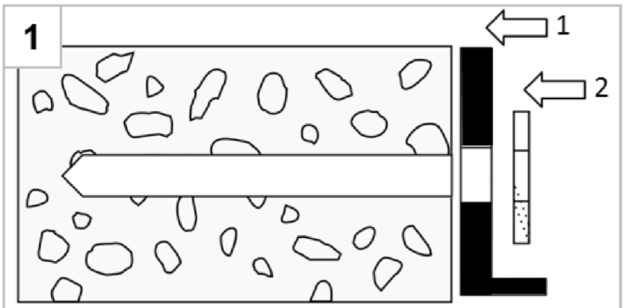
1. Adjustment for seismic loading is not allowed
2. The fastener can be adjusted maximum two times. The total allowed thickness of shims added during the adjustment process is 10mm. The final embedment depth after adjustment process must be larger or equal than $h_{nom}$.

| | |
|---|---|
| **TOGE concrete screw TSM High Performance** | **Annex B6** |
| **Intended use**<br>Installation instructions - Adjustment | |

## Installation Instructions – Filling annular gap

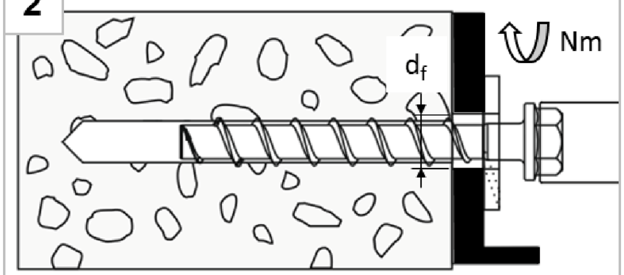
### Positioning of fixture and filling washer

**1**



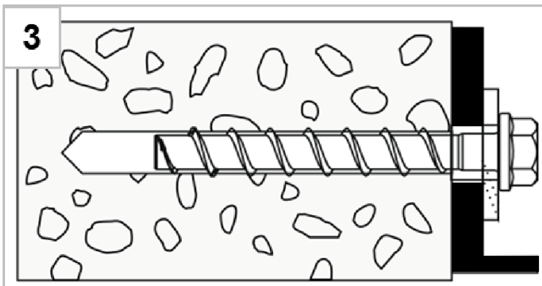

After preparing borehole (Annex B5, figure 1+2), position first fixture (1), than filling washer (2)

**2**



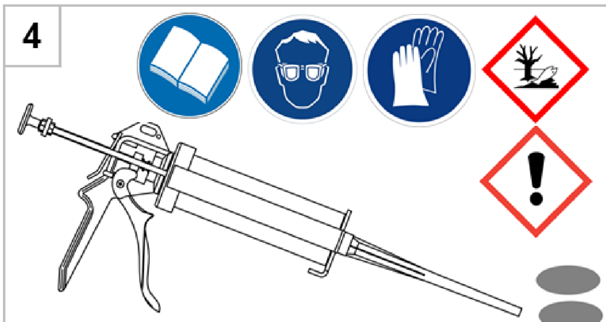

Install with torque impact screw driver or torque wrench

**3**



Installed condition without injected mortar in the filling washer

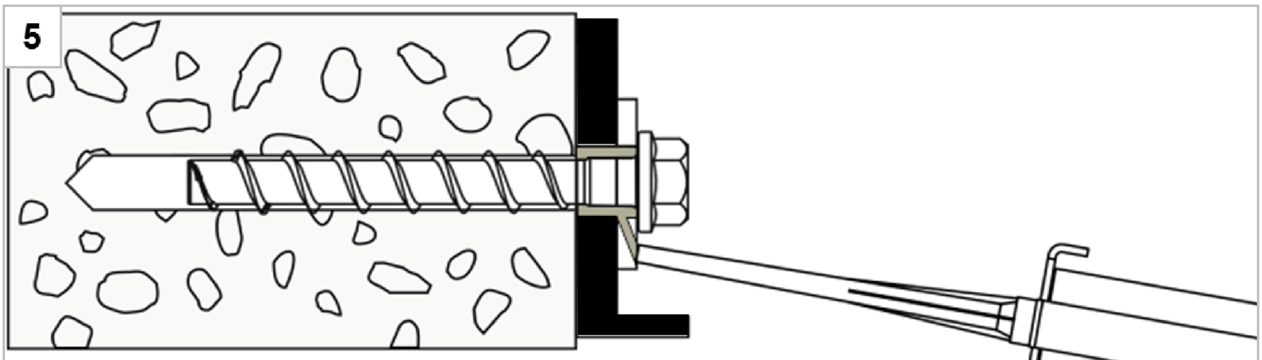
**4**



Discard 3x full strokes of mortar till color is constant

### Filling the annular gap

**5**



Fill the annular gap with injection mortar (minimum compression strength of 20 N/mm² e.g. ATA 2004C or C-FT300V)

Notes:
1. For seismic loading the installation with filled and without filled annular gap is approved. Differences in performance can be found in Annex C5 - C7.
2. No consideration of curing time is necessary.

| **TOGE concrete screw TSM High Performance** | **Annex B7** |
|---|---|
| **Intended use**<br>Installation instructions - Filling annular gap | |

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

| TSM 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 | $\Psi_c$ | [-] | 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 | | $\gamma_{inst}$ | [-] | 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 | | |

**TOGE concrete screw TSM High Performance**

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

**Annex C1**

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

| TSM 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 | $\Psi_c$ | [-] | 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 | | $\gamma_{inst}$ | [-] | 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 | | |

## Table 8: Seismic category C1 – Characteristic load values

| TSM 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 | $\gamma_{Ms}$ | [-] | 1,5 | | | |
| Characteristic load | $V_{Rk,s,eq}$ | [kN] | 8,5 | 15,3 | 21,0 | 22,4 |
| Partial factor shear load | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| With filling of the annular gap [1)] | $\alpha_{gap}$ | [-] | 1,0 | | | |
| Without filling of the annular gap | $\alpha_{gap}$ | [-] | 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 | $\gamma_{inst}$ | [-] | 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 5



**TOGE concrete screw TSM High Performance**

**Performances**
Seismic category C1 – Characteristic load values

**Annex C3**

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## Table 9: Seismic category C2 1) – Characteristic load values **with filled annular gap according to annex B7, figure 5**

| TSM 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 | $\gamma_{Ms}$ | [-] | 1,5 | | | |
| With filling of the annular gap | $\alpha_{gap}$ | [-] | 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 | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| With filling of the annular gap | $\alpha_{gap}$ | [-] | 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 | $\gamma_{inst}$ | [-] | 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

**Table 10: Seismic category C2 1) – Characteristic load values without filled annular gap according to annex B7, figure 3**

| TSM 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 | $\gamma_{Ms}$ | [-] | 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 | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| Without filling of the annular gap | $\alpha_{gap}$ | [-] | 0,5 | | | |
| **Steel failure for tension (countersunk head type)** | | | | | | |
| Characteristic load | $N_{Rk,s,eq}$ | [kN] | 27,0 | 45,0 | - | |
| Partial factor tension load | $\gamma_{Ms}$ | [-] | 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 | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| Without filling of the annular gap | $\alpha_{gap}$ | [-] | 0,5 | | | |
| **Concrete cone failure** | | | | | | |
| Effective embedment depth | $h_{ef}$ | [mm] | 52 | 68 | 80 | 92 |
| Edge distance | $c_{cr,N}$ | [mm] | $1,5 \times h_{ef}$ | | | |
| Spacing | $s_{cr,N}$ | [mm] | $3 \times h_{ef}$ | | | |
| Installation safety factor | $\gamma_{inst}$ | [-] | 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

**TOGE concrete screw TSM High Performance**

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

**Annex C5**

## Table 11: Fire exposure – characteristic values of resistance

| TSM 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 x $h_{ef}$ | | | | | | | | | | | | | |
| 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 x $h_{ef}$ | | | | | | | | | | | | | |
| 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. | | | | | | | | | | | | | | | | | |

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

| TSM 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 | $\delta_{N0}$ | [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 | $\delta_{N0}$ | [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 |

| TSM 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 | $\delta_{N0}$ | [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 | $\delta_{N0}$ | [mm] | 1,0 | 1,1 | 1,2 | 0,9 | 1,2 | 0,8 |
| | | $\delta_{N\infty}$ | [mm] | 1,0 | 1,2 | 1,2 | 0,9 | 1,2 | 1,0 |

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

| TSM 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 | $\delta_{V0}$ | [mm] | 1,55 | | 2,7 | | | 2,7 | | |
| | | $\delta_{V\infty}$ | [mm] | 3,1 | | 4,1 | | | 4,3 | | |

| TSM 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 | $\delta_{V0}$ | [mm] | 4,0 | | | 3,1 | | |
| | | $\delta_{V\infty}$ | [mm] | 6,0 | | | 4,7 | | |

## Table 14: Seismic category C2 1) – Displacements **with filled annular gap according to annex B7, figure 5**

| TSM 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 15: Seismic category C2 1) – Displacements **without filled annular gap according to annex B7, figure 3**

| TSM 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