



# European Technical Assessment **ETA 08/0173** of 12/08/2019

## I General Part

|   |   |
|---|---|
| <b>Technical Assessment Body issuing the ETA</b>  | <b>Eurofins Expert Services Oy</b>  |
| <b>Trade name of the construction product</b>   | <b>Sormat through bolts S-KA, S-KAK, S-KAH, S-KAH HCR</b>   |
| <b>Product family to which the construction product belongs</b>   | Torque controlled expansion anchors of sizes M8, M10, M12 and M16 for use in concrete                             |
| <b>Manufacturer</b>   | <b>Sormat Oy</b><br>Harjutie 5<br>FI-21290 Rusko<br>Finland<br><a href="http://www.sormat.com">www.sormat.com</a> |
| <b>Manufacturing plant</b>  | Sormat Plant 1  |
| <b>This European Technical Assessment contains</b>  | 14 pages including 11 annexes which form an integral part of this assessment                                      |
| <b>This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of</b> | EAD 330232-00-0601  |
| <b>This ETA replaces</b>  | ETA 08/0173, issued on September 8, 2016  |

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## II Specific Part

### 1. Technical description of the product

The SORMAT through bolt S-KA is an anchor made of galvanized steel (designated as S-KA). The SORMAT through bolt S-KAK is an anchor made of hot dip galvanized steel (designated as S-KAK). The SORMAT through bolt S-KAH is an anchor made of stainless steel (designated as S-KAH). The SORMAT through bolt S-KAH HCR is an anchor made of high corrosion resistant stainless steel (designated as S-KAH HCR). The anchors are made in sizes M8, M10, M12 and M16. Anchors are placed into a drilled hole and anchored by torque-controlled expansion.

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

### 2. Specification of the intended use in accordance with the applicable European Assessment Document, EAD

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

The provisions made in this European technical assessment are based on an assumed working life of the anchor of 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 tension resistance for static and quasi-static action acc. EN 1992-4:2018 or EOTA TR 055:2018-02 | See Annex C1 |
| Characteristic shear resistance for static and quasi-static action acc. EN 1992-4:2018 or EOTA TR 055:2018-02   | See Annex C2 |
| Characteristic resistance for Seismic Performance Category C1   | See Annex C6 |
| Displacements under static and quasi-static action  | See Annex C5 |

#### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic                              | Performance                                 |
|---|---|
| Reaction to fire                                      | Anchorage satisfy requirements for Class A1 |
| Characteristic tension resistance under fire exposure | See Annex C3                                |
| Characteristic shear resistance under fire exposure   | See Annex C4                                |

#### 3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances contained in this European technical assessment, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the regulation (EU) No 305/2011, these requirements need also to be complied with, when and where they apply.

### **3.4 Safety in use (BWR 4)**

For basic requirement Safety in use the same criteria are valid for Basic Requirement Mechanical resistance and stability (BWR1).

### **3.5 Protection against noise (BWR5):**

Not relevant.

### **3.6 Energy economy and heat retention (BWR6):**

Not relevant.

### **3.7 Sustainable use of natural resources (BWR7)**

The sustainable use of natural resources was not investigated.

### **3.8 General aspects relating to fitness for use**

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

## **4. Assessment and verification of constancy of performance (AVCP)**

According to the Decision 96/582/EC of the European Commission<sup>1</sup>, as amended, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is System 1.

## **5. Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD**

Technical details necessary for the implementation of the Assessment and verification of constancy of performance (AVCP) system are laid down in the control plan deposited at Eurofins Expert Services Oy.

Issued in Espoo on August 12, 2019  
by Eurofins Expert Services Oy

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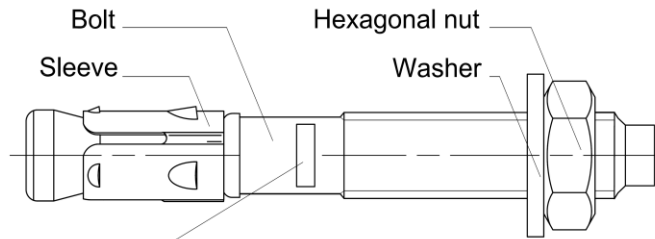
Pertti Jokinen  
Product Manager

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<sup>1</sup>

Official Journal of the European Communities L 254 of 08.10.1996

## SORMAT through bolt

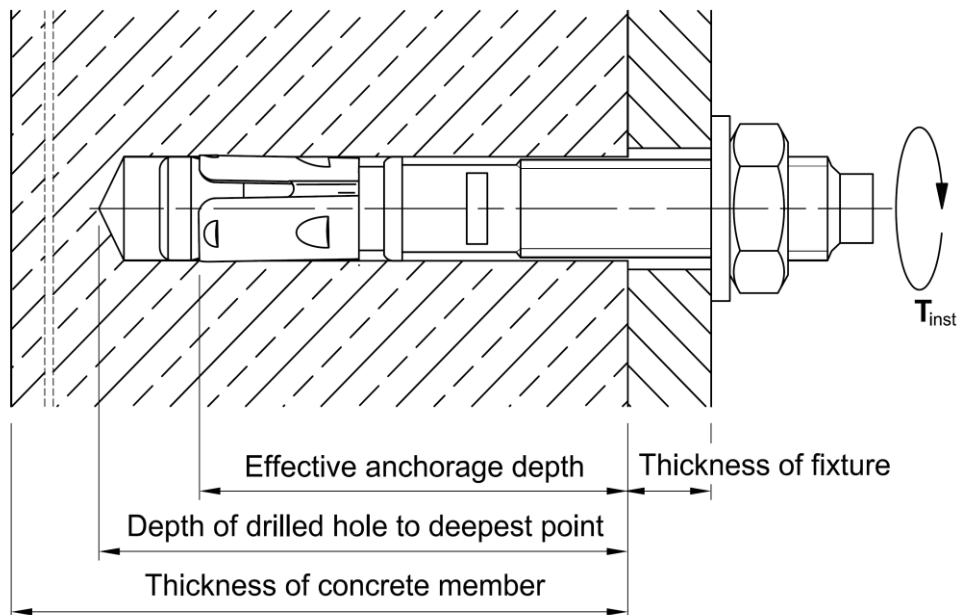


**Marking:** Identifying mark: S  
 Anchor identity: KA  
 Category \*<sup>1</sup>): H (stainless steel)  
 K (hot dip galvanized)  
 Thread size: M8 ... M16  
 Max. fixture thickness:  $t_{fix}$   
 Material \*<sup>1</sup>): HCR

**Examples:** S-KA 10/20 - zinc plated  
 S-KAK 10/20 - hot dip galvanized  
 S-KAH 10/20 - stainless steel A4  
 S-KAH 10/20 HCR - stainless steel HCR

\*<sup>1</sup>) : Where applicable

## SORMAT through bolt after installation

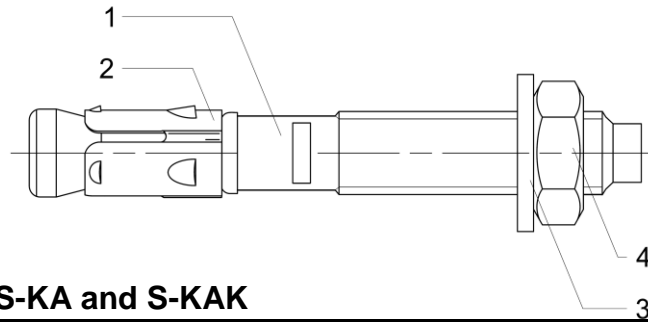


**Sormat through bolt**

**Product description**  
 Installation condition

**Annex A1**

## SORMAT through bolt



**Table A1: Materials S-KA and S-KAK**

| Part | Designation   | Diameter | Material <sup>1) 2)</sup>  |
|------|---------------|----------|--|
| 1    | Bolt          | M8 - M16 | Cold forged steel, EN 10263-2  |
| 2    | Sleeve        | M8 - M16 | Cold rolled galvanized steel strip, EN 10346   |
| 3    | Washer        | M8 - M16 | Electroplated steel, DIN 125 (EN ISO 7089),<br>DIN 440 (EN ISO 7094), DIN 9021 (EN ISO 7093) |
| 4    | Hexagonal Nut | M8 - M16 | Steel, electroplated, property class 8,<br>DIN 934 (EN ISO 4032)                             |

<sup>1)</sup> **S-KA:** Parts 1, 3 and 4 are zinc electroplated according to EN ISO 4042  $\geq 5 \mu\text{m}$  and bright passivated

<sup>2)</sup> **S-KAK:** Parts 1, 3 and 4 are hot dip galvanized  $> 50 \mu\text{m}$  mean thickness according to EN ISO 10684

**Table A2: Materials S-KAH**

| Part | Designation   | Diameters | Material   |
|------|---------------|-----------|--|
| 1    | Bolt          | M8 - M16  | Cold forged stainless steel, EN 10088-3  |
| 2    | Sleeve        | M8 - M16  | Stainless steel strip, EN 10088-2  |
| 3    | Washer        | M8 - M16  | Stainless steel, DIN 125 (EN ISO 7089), DIN 440 (EN ISO 7094),<br>DIN 9021 (EN ISO 7093) |
| 4    | Hexagonal Nut | M8 - M16  | Stainless steel, property class 80, DIN 934 (EN ISO 4032)                                |

**Table A3: Materials S-KAH HCR**

| Part | Designation   | Diameters | Material  |
|------|---------------|-----------|---|
| 1    | Bolt          | M8 - M16  | Cold forged stainless steel, EN 10088-3, 1.4529 / 1.4565  |
| 2    | Sleeve        | M8 - M16  | Stainless steel strip, EN 10088-2   |
| 3    | Washer        | M8 - M16  | Stainless steel, W 1.4529 / 1.4565, DIN 125 (EN ISO 7089),<br>DIN 440 (EN ISO 7094), DIN 9021 (EN ISO 7093) |
| 4    | Hexagonal Nut | M8 - M16  | Stainless steel, property class 70, W 1.4529 / 1.4565<br>DIN 934 (EN ISO 4032)                              |

**Sormat through bolt**

**Product description**  
Materials

**Annex A2**

## Specifications of intended use

### Anchorage subject to:

- Static, quasi-static loads
- Seismic actions for Performance Category C1
- Fire exposure

### Base materials:

- Cracked and non-cracked concrete
- Reinforced or unreinforced normal weight concrete of strength classes C20/25 to C50/60 according to EN 206.

### Use conditions (Environmental conditions):

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

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

### Design:

- The anchorages are designed in accordance with EN 1992-4:2018 or EOTA TR 055:2018-02 under the responsibility of an engineer experienced in anchorages and concrete work.
- For seismic application the anchorages are designed in accordance with EOTA TR 045 "Design of Metal Anchors For Use In Concrete Under Seismic Actions".
- For application with resistance under fire exposure the anchorages are designed in accordance with the method given in EOTA TR 020 "Evaluation of Anchorage in Concrete concerning Resistance to Fire".
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings.

### Installation:

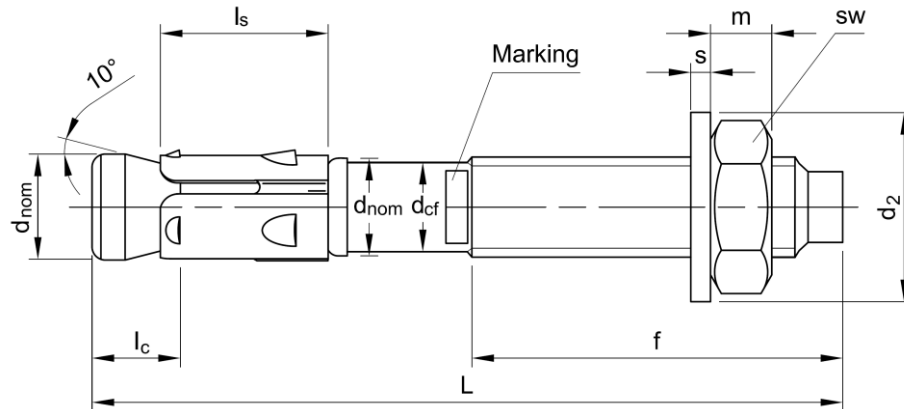
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- Use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor
- Anchor installation in accordance with the manufacturer's specifications and drawings and using the appropriate tools
- Effective anchorage depth, edge distances and spacings not less than the specified values without minus tolerances
- Hole drilling by hammer drill
- Cleaning of the hole of drilling dust
- Application of specified torque moment using a calibrated torque tool
- In case of aborted hole, drilling of new hole at a minimum distance of twice the depth of the aborted hole, or smaller distance provided the aborted drill hole is filled with high strength non-shrinkage mortar. No shear or oblique tension loads are allowed in the direction of a not filled aborted hole.

**Sormat through bolt**

**Intended Use**  
Specifications

**Annex B1**

## SORMAT through bolt



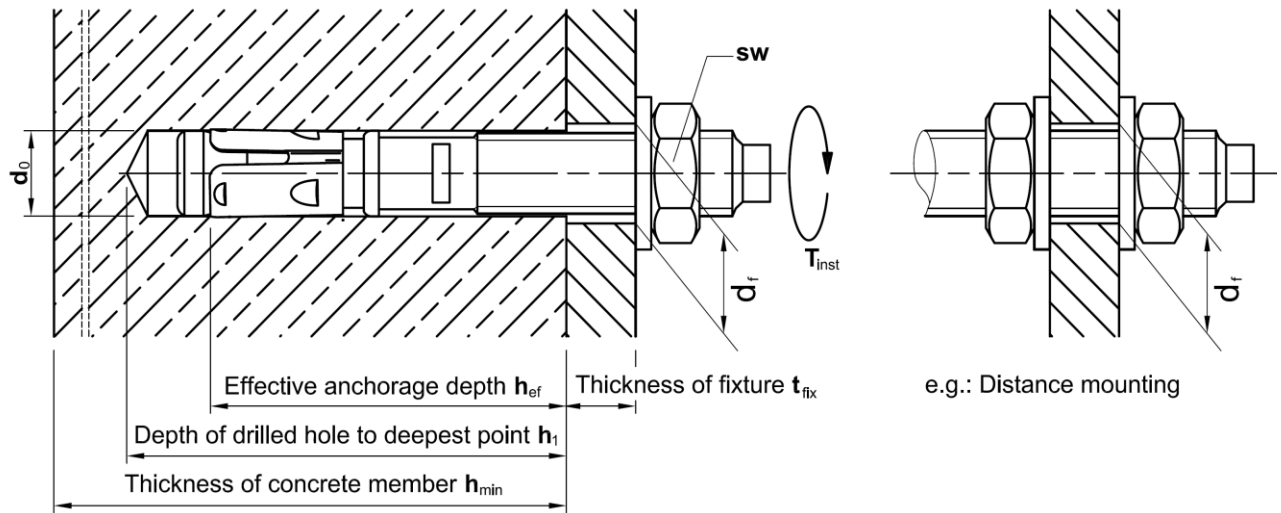
**Table B1: Dimensions of the anchor**

| Main dimensions |           | Stud bolt |                         | Cone bolt                |                        | Expansion sleeve       | Washer    |                        |                        | Hexagonal nut |           |
|-----------------|-----------|-----------|-------------------------|--------------------------|------------------------|------------------------|-----------|------------------------|------------------------|---------------|-----------|
| Size            | L<br>[mm] | f<br>[mm] | d <sub>cf</sub><br>[mm] | d <sub>nom</sub><br>[mm] | l <sub>c</sub><br>[mm] | l <sub>s</sub><br>[mm] | s<br>[mm] | d <sub>1</sub><br>[mm] | d <sub>2</sub><br>[mm] | SW<br>[mm]    | m<br>[mm] |
| <b>M8</b>       | 62...420  | 22...220  | 7,1                     | 8                        | 20,9                   | 15,9                   | ≥1,6      | ≥8,4                   | ≥16                    | 13            | ≥6,5      |
| <b>M10</b>      | 82...420  | 37...215  | 9,0                     | 10                       | 25,7                   | 17,9                   | ≥2,0      | ≥10,5                  | ≥20                    | ≥16           | ≥8,0      |
| <b>M12</b>      | 98...420  | 48...210  | 10,8                    | 12                       | 30,3                   | 19,1                   | ≥2,5      | ≥13,0                  | ≥24                    | ≥18           | ≥10,0     |
| <b>M16</b>      | 118...420 | 60...202  | 14,6                    | 16                       | 38,1                   | 26,3                   | ≥3,0      | ≥17,0                  | ≥30                    | 24            | ≥13,0     |

**Sormat through bolt**

**Intended Use**  
Anchor dimensions

**Annex B2**



**Table B2: Installation data**

| SORMAT through bolt  |                         | Anchor size           |           |           |      |
|--|-------------------------|-----------------------|-----------|-----------|------|
|  |                         | M8                    | M10       | M12       | M16  |
| Drill hole diameter  | $d_0$ [mm]              | 8                     | 10        | 12        | 16   |
| Cutting diameter at the upper tolerance limit (maximum diameter bit) | $d_{cut,max} \leq$ [mm] | 8,45                  | 10,45     | 12,5      | 16,5 |
| Depth of drilled hole to deepest point                               | $h_1 \geq$ [mm]         | 60                    | 75        | 90        | 110  |
| Effective anchorage depth  | $h_{ef}$ [mm]           | 45                    | 60        | 70        | 85   |
| Diameter of clearance hole in the fixture                            | $d_f \leq$ [mm]         | 9                     | 12        | 14        | 18   |
| Thickness of fixture   | $t_{fix,max}$ [mm]      | 358                   | 338       | 322       | 302  |
| Width across flats   | SW [mm]                 | 13                    | $\geq 16$ | $\geq 18$ | 24   |
| Required torque<br>S-KA / S-KAK<br>S-KAH / S-KAH HCR                 | $T_{inst}$ [Nm]         | 20 / 15 <sup>1)</sup> | 35        | 50        | 120  |
|  |                         | 20                    | 35        | 70        | 120  |

<sup>1)</sup> Installation torque for S-KA is 20 Nm and for S-KAK 15 Nm

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

| SORMAT through bolt                  |                | Anchor size |     |     |     |
|--------------------------------------|----------------|-------------|-----|-----|-----|
|                                      |                | M8          | M10 | M12 | M16 |
| Minimum thickness of concrete member | $h_{min}$ [mm] | 100         | 120 | 140 | 170 |
| Minimum spacing                      | $s_{min}$ [mm] | 50          | 55  | 60  | 70  |
|                                      | $c \geq$ [mm]  | 50          | 80  | 90  | 120 |
| Minimum edge distance                | $c_{min}$ [mm] | 50          | 50  | 55  | 85  |
|                                      | $s \geq$ [mm]  | 50          | 100 | 145 | 150 |

Intervals may be interpolated linearly

**Sormat through bolt**

Intended Use  
Installation data

**Annex B3**



**Table C1: Characteristic resistances under tension loads in case of static and quasi-static loading for design according to EN 1992-4:2018 or EOTA TR 055:2018-02**

| SORMAT through bolt   |                                 |        | Anchor size       |     |     |                   |
|---|---------------------------------|--------|-------------------|-----|-----|-------------------|
|   |                                 |        | M8                | M10 | M12 | M16               |
| <b>Steel failure</b>  |                                 |        |                   |     |     |                   |
| Characteristic resistance S-KA / S-KAK                          | $N_{Rk,s}$                      | [kN]   | 13                | 26  | 38  | 69                |
| Characteristic resistance S-KAH / S-KAH HCR                     | $N_{Rk,s}$                      | [kN]   | 15                | 24  | 35  | 75                |
| Partial safety factor   | $\gamma_{Ms}^{1)}$              | [ - ]  | 1,4               |     |     |                   |
| <b>Pull-out failure</b>   |                                 |        |                   |     |     |                   |
| Characteristic resistance in <b>cracked</b> concrete C20/25     | $N_{Rk,p}$                      | [kN]   | 5                 | 9   | 12  | 20                |
| Characteristic resistance in <b>non-cracked</b> concrete C20/25 | $N_{Rk,p}$                      | [kN]   | 9                 | 16  | 20  | 35                |
| Increasing factor for $N_{Rk,p}$                                | $\Psi_C$                        | C25/30 | 1,06              |     |     |                   |
|   |                                 | C30/37 | 1,11              |     |     |                   |
|   |                                 | C35/45 | 1,14              |     |     |                   |
|   |                                 | C40/50 | 1,20              |     |     |                   |
|   |                                 | C45/55 | 1,25              |     |     |                   |
|   |                                 | C50/60 | 1,31              |     |     |                   |
| Partial safety factor   | $\gamma_{inst}^{1)}$            | [ - ]  | 1,2               |     |     | 1,0               |
|   | $\gamma_{Mp}$                   | [ - ]  | 1,8 <sup>2)</sup> |     |     | 1,5 <sup>3)</sup> |
| <b>Concrete cone and splitting failure</b>                      |                                 |        |                   |     |     |                   |
| Effective anchorage depth                                       | $h_{ef}$                        | [mm]   | 45                | 60  | 70  | 85                |
| Factor for cracked concrete                                     | $k_{cr}$                        | [ - ]  | 7,7               |     |     |                   |
| Factor for non-cracked concrete                                 | $k_{ucr}$                       | [ - ]  | 11,0              |     |     |                   |
| Spacing   | $s_{cr,N}$                      | [mm]   | 135               | 180 | 210 | 255               |
| Edge distance   | $c_{cr,N}$                      | [mm]   | 68                | 90  | 105 | 128               |
| Spacing ( splitting )   | $s_{cr,sp}$                     | [mm]   | 180               | 240 | 280 | 340               |
| Edge distance ( splitting )                                     | $c_{cr,sp}$                     | [mm]   | 90                | 120 | 140 | 170               |
| Partial safety factor   | $\gamma_{inst}^{1)}$            | [ - ]  | 1,2               |     |     | 1,0               |
|   | $\gamma_{Mc}$<br>$\gamma_{Msp}$ | [ - ]  | 1,8 <sup>2)</sup> |     |     | 1,5 <sup>3)</sup> |

<sup>1)</sup> In absence of other national regulations

<sup>2)</sup> The installation safety factor of  $\gamma_{inst} = 1,2$  is included

<sup>3)</sup> The installation safety factor of  $\gamma_{inst} = 1,0$  is included

**Sormat through bolt**

**Performance**

Characteristic resistance under tension loads

**Annex C1**

**Table C2: Characteristic resistances under shear loads in case of static and quasi-static loading for design according to EN 1992-4:2018 or EOTA TR 055:2018-02**

| SORMAT through bolt  |                    |       | Anchor size |     |     |     |
|--|--------------------|-------|-------------|-----|-----|-----|
|  |                    |       | M8          | M10 | M12 | M16 |
| <b>Steel failure without lever arm</b>   |                    |       |             |     |     |     |
| Characteristic resistance S-KA / S-KAK   | $V_{Rk,s}$         | [kN]  | 10          | 18  | 23  | 44  |
| Characteristic resistance S-KAH / S-KAH HCR  | $V_{Rk,s}$         | [kN]  | 11          | 17  | 25  | 47  |
| Partial safety factor  | $\gamma_{Ms}^{1)}$ | [ - ] | 1,25        |     |     |     |
| Factor for considering ductility   | $k_7$              | [ - ] | 1,0         |     |     |     |
| <b>Steel failure with lever arm</b>  |                    |       |             |     |     |     |
| Characteristic resistance S-KA / S-KAK   | $M^0_{Rk,s}$       | [Nm]  | 21          | 48  | 72  | 186 |
| Characteristic resistance S-KAH / S-KAH HCR  | $M^0_{Rk,s}$       | [Nm]  | 22          | 45  | 79  | 200 |
| Partial safety factor  | $\gamma_{Ms}^{1)}$ | [ - ] | 1,25        |     |     |     |
| <b>Concrete pryout failure</b>   |                    |       |             |     |     |     |
| k-factor   | $k_8$              | [ - ] | 1           | 2   |     |     |
| Partial safety factor  | $\gamma_{Mc}^{1)}$ | [ - ] | 1,5         |     |     |     |
| <b>Concrete edge failure</b>   |                    |       |             |     |     |     |
| Effective length of anchor under shear load  | $l_f$              | [mm]  | 45          | 60  | 70  | 85  |
| Outside diameter of anchor   | $d_{nom}$          | [mm]  | 8           | 10  | 12  | 16  |
| <b>Cracked concrete</b> without any edge reinforcement   | $\Psi_{re,v}$      | [ - ] | 1,0         |     |     |     |
| <b>Cracked concrete</b> with straight edge reinforcement > Ø12 mm  |                    |       | 1,2         |     |     |     |
| <b>Cracked concrete</b> with edge reinforcement and closely spaced stirrups ( $a \leq 100\text{mm}$ ) or <b>non-cracked concrete</b> |                    |       | 1,4         |     |     |     |
| Partial safety factor  | $\gamma_{Mc}^{1)}$ | [ - ] | 1,5         |     |     |     |

<sup>1)</sup> In absence of other national regulations

**Sormat through bolt**

**Performance**

Characteristic resistance under shear loads

**Annex C2**

**Table C3: Characteristic resistances under tension loads in case of fire exposure for design according to EN 1992-4:2018 or EOTA TR 055:2018-02**

| Sormat through bolt                                      |                   |      |  | Anchor size |     |      |      |
|--|-------------------|------|--|-------------|-----|------|------|
|  |                   |      |  | M8          | M10 | M12  | M16  |
| <b>Steel failure</b>                                     |                   |      |  |             |     |      |      |
| Characteristic resistance<br>$N_{Rk,s,fi}$               | S-KA / S-KAK      | R30  | [kN]   | 1,3         | 2,3 | 3,6  | 5,3  |
|  |                   | R60  | [kN]   | 0,7         | 1,3 | 2,0  | 3,0  |
|  |                   | R90  | [kN]   | 0,4         | 0,8 | 1,3  | 1,8  |
|  |                   | R120 | [kN]   | 0,3         | 0,5 | 0,9  | 1,3  |
|  | S-KAH / S-KAH HCR | R30  | [kN]   | 5,7         | 9,1 | 13,2 | 24,5 |
|  |                   | R60  | [kN]   | 3,9         | 6,1 | 8,9  | 16,6 |
|  |                   | R90  | [kN]   | 2,0         | 3,2 | 4,7  | 8,7  |
|  |                   | R120 | [kN]   | 1,1         | 1,8 | 2,6  | 4,8  |
| <b>Pull-out failure</b>                                  |                   |      |  |             |     |      |      |
| Characteristic resistance<br>$N_{Rk,p,fi}$               | S-KA / S-KAK      | R30  | [kN]   | 1,3         | 2,3 | 3,0  | 5,0  |
|  |                   | R60  | [kN]   | 1,3         | 2,3 | 3,0  | 5,0  |
|  |                   | R90  | [kN]   | 1,3         | 2,3 | 3,0  | 5,0  |
|  |                   | R120 | [kN]   | 1,0         | 1,8 | 2,4  | 4,0  |
| Characteristic resistance<br>$N_{Rk,p,fi}$               | S-KAH / S-KAH HCR | R30  | [kN]   | 1,3         | 2,3 | 3,0  | 5,0  |
|  |                   | R60  | [kN]   | 1,3         | 2,3 | 3,0  | 5,0  |
|  |                   | R90  | [kN]   | 1,3         | 2,3 | 3,0  | 5,0  |
|  |                   | R120 | [kN]   | 1,0         | 1,8 | 2,4  | 4,0  |
| <b>Concrete cone and splitting failure <sup>1)</sup></b> |                   |      |  |             |     |      |      |
| Characteristic resistance $N^0_{Rk,c,fi}$                | R30               | [kN] | 2,4  | 5,0         | 7,4 | 12,0 |      |
|  | R60               | [kN] | 2,4  | 5,0         | 7,4 | 12,0 |      |
|  | R90               | [kN] | 2,4  | 5,0         | 7,4 | 12,0 |      |
|  | R120              | [kN] | 2,0  | 4,0         | 5,9 | 9,6  |      |
| Spacing  | $s_{cr,N,fi}$     | [mm] | 4 x $h_{ef}$   |             |     |      |      |
|  | $s_{min}$         | [mm] | 50   | 55          | 60  | 70   |      |
| Edge distance  | $c_{cr,N,fi}$     | [mm] | 2 x $h_{ef}$   |             |     |      |      |
|  | $c_{min}$         | [mm] | Fire attack from one side: $c_{min} = 2 \times h_{ef}$<br>Fire attack from more than one side:<br>$c_{min} \geq 300 \text{ mm}$ and $\geq 2 \times h_{ef}$ |             |     |      |      |

<sup>1)</sup> As a rule, splitting failure can be neglected when cracked concrete and reinforcement is assumed

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

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

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

**Sormat through bolt**

**Performance**

Characteristic tension resistance under fire exposure

**Annex C3**

**Table C4: Characteristic resistances under shear loads in case of fire exposure for design according to EN 1992-4:2018 or EOTA TR 055:2018-02**

| Sormat through bolt   |                   |      |      | Anchor size |      |      |      |
|---|-------------------|------|------|-------------|------|------|------|
|   |                   |      |      | M8          | M10  | M12  | M16  |
| <b>Steel failure without lever arm</b>  |                   |      |      |             |      |      |      |
| Characteristic resistance<br>$V_{Rk,s,fi}$  | S-KA / S-KAK      | R30  | [kN] | 1,3         | 2,3  | 3,6  | 5,3  |
|   |                   | R60  | [kN] | 0,7         | 1,3  | 2,0  | 3,0  |
|   |                   | R90  | [kN] | 0,4         | 0,8  | 1,3  | 1,8  |
|   |                   | R120 | [kN] | 0,3         | 0,5  | 0,9  | 1,3  |
|   | S-KAH / S-KAH HCR | R30  | [kN] | 5,7         | 9,1  | 13,2 | 24,5 |
|   |                   | R60  | [kN] | 3,9         | 6,1  | 8,9  | 16,6 |
|   |                   | R90  | [kN] | 2,0         | 3,2  | 4,7  | 8,7  |
|   |                   | R120 | [kN] | 1,1         | 1,8  | 2,6  | 4,8  |
| <b>Steel failure with lever arm</b>   |                   |      |      |             |      |      |      |
| Characteristic resistance<br>$M^0_{Rk,s,fi}$  | S-KA / S-KAK      | R30  | [Nm] | 1,8         | 3,6  | 6,4  | 16,2 |
|   |                   | R60  | [Nm] | 1,3         | 2,6  | 4,6  | 11,7 |
|   |                   | R90  | [Nm] | 0,8         | 1,6  | 2,8  | 7,2  |
|   |                   | R120 | [Nm] | 0,6         | 1,1  | 1,9  | 4,9  |
|   | S-KAH / S-KAH HCR | R30  | [Nm] | 5,8         | 11,7 | 20,4 | 52,0 |
|   |                   | R60  | [Nm] | 4,0         | 7,9  | 13,9 | 35,2 |
|   |                   | R90  | [Nm] | 2,1         | 4,2  | 7,3  | 18,5 |
|   |                   | R120 | [Nm] | 1,1         | 2,3  | 4,0  | 10,2 |
| <b>Concrete pryout failure</b>  |                   |      |      |             |      |      |      |
| k-factor  | $k_8$             | [-]  | 1    | 2           |      |      |      |
| Characteristic resistance $V_{Rk,cp,fi}$  | R30               | [kN] | 2,4  | 10,0        | 14,8 | 24,0 |      |
|   | R60               | [kN] | 2,4  | 10,0        | 14,8 | 24,0 |      |
|   | R90               | [kN] | 2,4  | 10,0        | 14,8 | 24,0 |      |
|   | R120              | [kN] | 2,0  | 8,0         | 11,8 | 19,2 |      |
| <b>Concrete edge failure</b>  |                   |      |      |             |      |      |      |
| The initial value $V^0_{Rk,c,fi}$ of the characteristic resistance in concrete C20/25 to C50/60 under fire exposure may be determined by: |                   |      |      |             |      |      |      |
| $V^0_{Rk,c,fi} = 0,25 \times V^0_{Rk,c} \quad (\leq R90) \qquad V^0_{Rk,c,fi} = 0,20 \times V^0_{Rk,c} \quad (R120)$                      |                   |      |      |             |      |      |      |
| with $V^0_{Rk,c}$ initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature.                     |                   |      |      |             |      |      |      |

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

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

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

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

**Sormat through bolt**

**Performance**

Characteristic shear resistance under fire exposure

**Annex C4**

**Table C5: Displacements under tension loads for static and quasi-static loading**

| SORMAT through bolt                                 |                    |      | Anchor size |     |     |     |
|---|--------------------|------|-------------|-----|-----|-----|
|   |                    |      | M8          | M10 | M12 | M16 |
| Cracked and non-cracked concrete<br>C20/25 - C50/60 | N                  | [kN] | 2,0         | 3,6 | 4,8 | 9,5 |
|   | $\delta_{N0}$      | [mm] | 0,3         | 0,6 | 0,6 | 0,7 |
|   | $\delta_{N\infty}$ | [mm] | 1,8         | 1,6 | 2,0 | 1,4 |

**Table C6: Displacements under shear loads for static and quasi-static loading**

| SORMAT through bolt                                 |                    |      | Anchor size |      |      |      |
|---|--------------------|------|-------------|------|------|------|
|   |                    |      | M8          | M10  | M12  | M16  |
| Cracked and non-cracked concrete<br>C20/25 - C50/60 | V                  | [kN] | 5,7         | 10,3 | 13,1 | 25,1 |
|   | $\delta_{V0}$      | [mm] | 1,7         | 1,7  | 2,4  | 3,2  |
|   | $\delta_{V\infty}$ | [mm] | 2,6         | 2,6  | 3,6  | 4,8  |

**Sormat through bolt**

**Performance**

Displacements under tension and shear loads

**Annex C5**

**Table C7: Characteristic resistances under tension loads in case of seismic action**

**Design acc. EOTA TR 045: Performance Category C1**

| SORMAT through bolt   |   |       | Anchor size       |     |     |                   |
|---|---|-------|-------------------|-----|-----|-------------------|
|   |   |       | M8                | M10 | M12 | M16               |
| <b>Steel failure</b>  |   |       |                   |     |     |                   |
| Characteristic resistance S-KA                              | $N_{Rk,s,seis}$                                     | [kN]  | 13                | 26  | 38  | 69                |
| Characteristic resistance S-KAH                             | $N_{Rk,s,seis}$                                     | [kN]  | 15                | 24  | 35  | 75                |
| Partial safety factor                                       | $\gamma_{Ms,seis}^{1)}$                             | [ - ] | 1,4               |     |     |                   |
| <b>Pull-out failure</b>                                     |   |       |                   |     |     |                   |
| Characteristic resistance in <b>cracked</b> concrete C20/25 | $N_{Rk,p,seis}$                                     | [kN]  | 5                 | 9   | 12  | 20                |
| Partial safety factor                                       | $\gamma_{Mp,seis}^{1)}$                             | [ - ] | 1,8 <sup>2)</sup> |     |     | 1,5 <sup>3)</sup> |
| <b>Concrete cone and splitting failure<sup>4)</sup></b>     |   |       |                   |     |     |                   |
| Effective anchorage depth                                   | $h_{ef}$  | [mm]  | 45                | 60  | 70  | 85                |
| Partial safety factor                                       | $\gamma_{Mc,seis}^{1)}$<br>$\gamma_{Msp,seis}^{1)}$ | [ - ] | 1,8 <sup>2)</sup> |     |     | 1,5 <sup>3)</sup> |

<sup>1)</sup> In absence of other national regulations

<sup>2)</sup> The installation safety factor of  $\gamma_{inst} = 1,2$  is included

<sup>3)</sup> The installation safety factor of  $\gamma_{inst} = 1,0$  is included

<sup>4)</sup> For concrete cone and splitting failure, see EOTA TR 045

**Table C8: Characteristic resistances under shear loads in case of seismic action**

**Design acc. EOTA TR 045: Performance Category C1**

| SORMAT through bolt   |                         |       | Anchor size |      |      |      |
|---|-------------------------|-------|-------------|------|------|------|
|   |                         |       | M8          | M10  | M12  | M16  |
| <b>Steel failure without lever arm</b>                        |                         |       |             |      |      |      |
| Characteristic resistance S-KA                                | $V_{Rk,s,seis}$         | [kN]  | 5,6         | 11,9 | 15,4 | 31,2 |
| Characteristic resistance S-KAH                               | $V_{Rk,s,seis}$         | [kN]  | 8,7         | 11,2 | 18,3 | 31,5 |
| Partial safety factor   | $\gamma_{Ms,seis}^{1)}$ | [ - ] | 1,25        |      |      |      |
| <b>Concrete pryout and concrete edge failure<sup>2)</sup></b> |                         |       |             |      |      |      |
| Effective anchorage depth                                     | $h_{ef}$                | [mm]  | 45          | 60   | 70   | 85   |
| Partial safety factor   | $\gamma_{Mc,seis}^{1)}$ | [ - ] | 1,5         |      |      |      |

<sup>1)</sup> In absence of other national regulations

<sup>2)</sup> For concrete pryout and edge failure, see EOTA TR 045

**Sormat through bolt**

**Performance**

Characteristic tension and shear resistances under seismic action,  
Performance Category C1

**Annex C6**