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Designated
according to
Article 29 of
Regulation (EU)
No 305/2011

Member of
EOTA
www.eota.eu

European Technical Assessment   ETA-08/0276
of 8/9/2016

GENERAL PART

TECHNICAL ASSESSMENT BODY ISSUING THE ETA AND DESIGNATED ACCORDING TO ARTICLE 29 OF THE REGULATION (EU) NO 305/2011	VTT EXPERT SERVICES LTD
TRADE NAME OF THE CONSTRUCTION PRODUCT	**SIMPSON STRONG-TIE® THROUGHBOLT BOAX-II, BOAX-II HDG, BOAX-II A4, AND BOAX-II HCR**
PRODUCT FAMILY TO WHICH THE CONSTRUCTION PRODUCT BELONGS	TORQUE CONTROLLED EXPANSION ANCHORS OF SIZES M8, M10, M12 AND M16 FOR USE IN CONCRETE
MANUFACTURER	**SIMPSON STRONG-TIE® GMBH** HUBERT-VERGÖLST-STRASSE 6-14 D-61231 BAD NAUHEIM GERMANY
MANUFACTURING PLANT	SIMPSON STRONG-TIE® MANUFACTURING FACILITIES
THIS EUROPEAN TECHNICAL ASSESSMENT CONTAINS	14 PAGES INCLUDING 11 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	GUIDELINES FOR EUROPEAN TECHNICAL APPROVAL ETAG 001 METAL ANCHORS FOR USE IN CONCRETE PART 1 AND PART 2, APRIL 2013, USED AS EUROPEAN ASSESSMENT DOCUMENT (EAD).
THIS VERSION REPLACES	EUROPEAN TECHNICAL APPROVAL ETA-08/0276 from 06/06/2013

SPECIFIC PART

1. Technical description of the product

SIMPSON STRONG-TIE® Throughbolt BOAX-II is an anchor made of galvanized steel (designated as S-KA). SIMPSON STRONG-TIE® Throughbolt BOAX-II HDG is an anchor made of hot dip galvanized steel (designated as S-KAK). SIMPSON STRONG-TIE® Throughbolt BOAX-II A4 is an anchor made of stainless steel (designated as S-KAH). SIMPSON STRONG-TIE® Throughbolt BOAX-II 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. ETAG 001, Annex C or CEN/TS 1992-4:2009	See Annex C1
Characteristic shear resistance for static and quasi-static action acc. ETAG 001, Annex C or CEN/TS 1992-4:2009	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	Anchorages 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 approval, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

For basic requirement Safety in use the same criteria are valid 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[1], as amended, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table applies:

Product	Intended use	Level or Class	System
Metal anchors for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units	—	1

5. Technical details necessary for the implementation of the AVCP system, 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 VTT Expert Services Ltd.

The manufacturer shall, on the basis of a contract, involve a notified body approved in the field of anchors for issuing the certificate of conformity CE based on the control plan.

Issued in Espoo on September 8, 2016
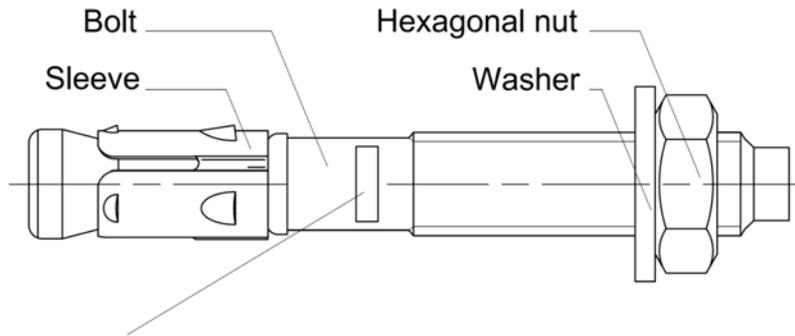by VTT Expert Services Ltd

Tiina Ala-Outinen   Pertti Jokinen
Business Manager   Product Manager

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[1]   Official Journal of the European Communities L 254 of 08.10.1996

SIMPSON STRONG-TIE®

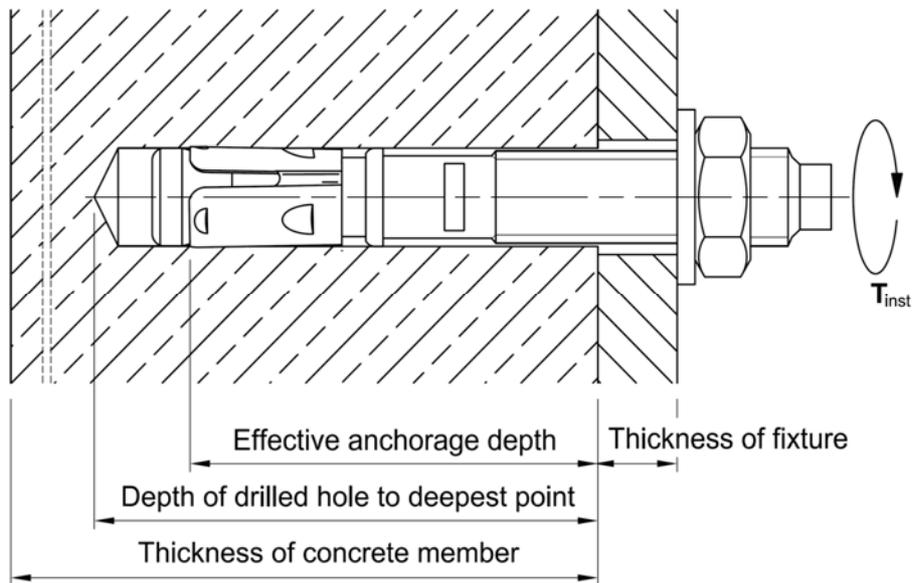**Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR**

Bolt — Hexagonal nut

Sleeve — Washer

Marking:	Identifying mark:	≠ or S	
	Anchor identity:	BoAX-II or KA	
	Category *1):	A4 or H	(stainless steel)
		HDG or K	(hot dip galvanized)
	Thread size:	M8 … M16	
	Max. fixture thickness:	t_{fix}	
	Material *1):	HCR	

Examples: ≠ BoAX-II 10/20   or   S-KA 10/20   - zinc plated
 ≠ BoAX-II 10/20 HDG   or   S-KAK 10/20   - hot dip galvanized
 ≠ BoAX-II 10/20 A4   or   S-KAH 10/20   - stainless steel A4
 ≠ BoAX-II 10/20 HCR   or   S-KAH 10/20 HCR - stainless steel HCR

*1) : Where applicable

SIMPSON STRONG-TIE®

Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR after installation

T_{inst}

Effective anchorage depth | Thickness of fixture

Depth of drilled hole to deepest point

Thickness of concrete member

SIMPSON STRONG-TIE®	
Throughbolt BOAX-II. BOAX-II HDG. BOAX-II A4 and BOAX-II HCR	
Product description	**Annex A1**
Installation condition	

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR
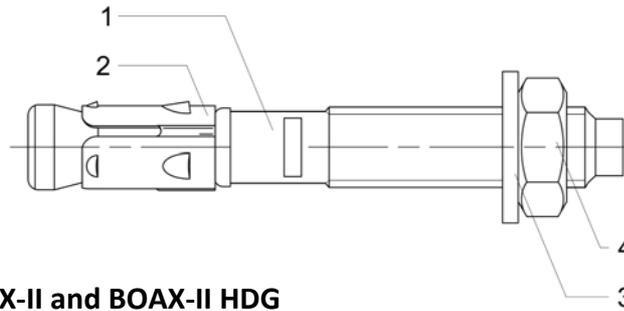
Table A1: Materials BOAX-II and BOAX-II HDG

Part	Designation	Diameter	Material [1] [2]
1	Bolt	M8 - M16	Cold forged steel, EN 10263-2
2	Sleeve	M8 - M16	Cold rolled galvanized steel strip, EN 10147
3	Washer	M8 - M16	Electroplated steel, DIN 125 (EN ISO 7089), DIN 440 (EN ISO 7094), DIN 9021 (EN ISO 7093)
4	Hexagonal Nut	M8 - M16	Steel, electroplated, property class 8, DIN 934 (EN ISO 4032)

[1] **BOAX-II:** Parts 1, 3 and 4 are zinc electroplated according to EN ISO 4042 ≥ 5µm and bright passivated
[2] **BOAX-II HDG:** Parts 1, 3 and 4 are hot dip galvanized > 40µm according to EN ISO 10684

Table A2: Materials BOAX-II A4

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), DIN 9021 (EN ISO 7093)
4	Hexagonal Nut	M8 - M16	Stainless steel, property class 80, DIN 934 (EN ISO 4032)

Table A3: Materials BOAX-II 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), 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 DIN 934 (EN ISO 4032)

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR	Annex A2
Product description Materials	

Specifications of intended use

Anchorages 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: 2013

Use conditions (Environmental conditions):
- The BOAX-II and BOAX-II HDG anchors may only be used in structures subject to dry indoor conditions, indoor with temporary condensation.
- The BOAX-II A4 and BOAX-II HCR 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 BOAX-II 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 ETAG 001 Annex C "Design Method for Anchorages" or CEN/TS 1992-4-4 "Design of fastenings for use in concrete" under the responsibility of an engineer experienced in anchorages and concrete work.
- For 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.

SIMPSON STRONG-TIE® **Throughbolt BOAX-II. BOAX-II HDG. BOAX-II A4 and BOAX-II HCR**	**Annex B1**
Intended Use Specifications	

SIMPSON STRONG-TIE®

Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR
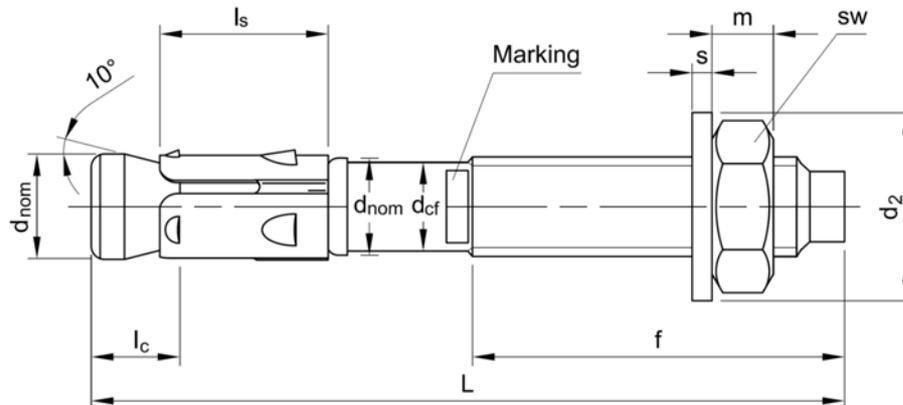
Table B1: Dimensions of the anchor

Main dimensions			Stud bolt		Cone bolt		Expansion sleeve	Washer			Hexagonal nut	
Anchor type	Size	L [mm]	f [mm]	d_{cf} [mm]	d_{nom} [mm]	l_c [mm]	l_s [mm]	s [mm]	d_1 [mm]	d_2 [mm]	SW [mm]	m [mm]
BOAX-II BOAX-II HDG BOAX-II A4 BOAX-II HCR	M8	62…420	22…220	7,1	8	20,9	15,9	≥1,6	≥8,4	≥16	13	≥6,5
	M10	82…420	37…215	9,0	10	25,7	17,9	≥2,0	≥10,5	≥20	≥16	≥8,0
	M12	98…420	48…210	10,8	12	30,3	19,1	≥2,5	≥13,0	≥24	≥18	≥10,0
	M16	118..420	60…202	14,6	16	38,1	26,3	≥3,0	≥17,0	≥30	24	≥13,0

SIMPSON STRONG-TIE® **Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR** **Intended Use** Anchor dimensions	**Annex B2**
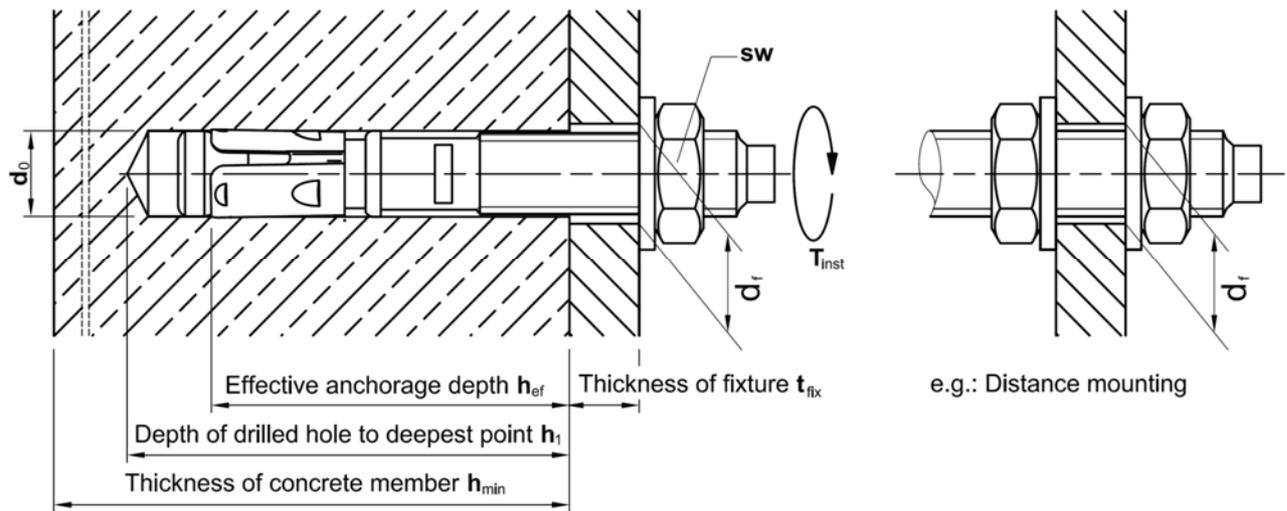
Table B2: Installation data

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR			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	≥16	≥18	24
Required torque BOAX-II / BOAX-II HDG	T_{inst}	[Nm]	20 / 15 [1]	35	50	120
BOAX-II A4 / BOAX-II HCR			20	35	70	120

[1] Installation torque for BOAX-II is 20 Nm and for BOAX-II HDG 15 Nm

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

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR			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

Intervalues may be interpolated linearly

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR	
Intended Use Installation data	**Annex B3**

Table C1: Characteristic resistances under tension loads in case of static and quasi-static loading for design method A according to ETAG 001, Annex C or CEN/TS 1992-4

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR			Anchor size			
			M8	M10	M12	M16
Steel failure						
Characteristic resistance BOAX-II / BOAX-II HDG	$N_{Rk,s}$	[kN]	13	26	38	69
Characteristic resistance BOAX-II A4 / BOAX-II HCR	$N_{Rk,s}$	[kN]	15	24	35	75
Partial safety factor	γ_{Ms} [1]	[-]	1,4			
Pull-out failure						
Characteristic resistance in **cracked** concrete C20/25	$N_{Rk,p}$	[kN]	5	9	12	20
Characteristic resistance in **non-cracked** concrete C20/25	$N_{Rk,p}$	[kN]	9	16	20	35
Increasing factor for $N_{Rk,p}$	Ψ_C	C25/30	1,04			
		C30/37	1,10			
		C35/45	1,16			
		C40/50	1,20			
		C45/55	1,24			
		C50/60	1,28			
Partial safety factor	γ_{Mp} [1]	[-]	1,8 [2]			1,5 [3]
Concrete cone and splitting failure						
Effective anchorage depth	h_{ef}	[mm]	45	60	70	85
Factor for cracked concrete	k_{cr}	[-]	7,2			
Factor for non-cracked concrete	k_{ucr}	[-]	10,1			
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	γ_{Mc} [1] γ_{Msp} [1]	[-]	1,8 [2]			1,5 [3]

[1] In absence of other national regulations
[2] The installation safety factor of $\gamma_2 = 1,2$ is included
[3] The installation safety factor of $\gamma_2 = 1,0$ is included

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR	
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 method A according to ETAG 001, Annex C or CEN/TS 1992-4

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR			Anchor size			
			M8	M10	M12	M16
Steel failure without lever arm						
Characteristic resistance BOAX-II / BOAX-II HDG	$V_{Rk,s}$	[kN]	10	18	23	44
Characteristic resistance BOAX-II A4 / BOAX-II HCR	$V_{Rk,s}$	[kN]	11	17	25	47
Partial safety factor	γ_{Ms} [1]	[-]	1,25			
Factor for considering ductility	k_2	[-]	1,0			
Steel failure with lever arm						
Characteristic resistance BOAX-II / BOAX-II HDG	$M^0_{Rk,s}$	[Nm]	21	48	72	186
Characteristic resistance BOAX-II A4 / BOAX-II HCR	$M^0_{Rk,s}$	[Nm]	22	45	79	200
Partial safety factor	γ_{Ms} [1]	[-]	1,25			
Concrete pry-out failure						
k-factor	$k_{(3)}$	[-]	1	2		
Partial safety factor	γ_{Mc} [1]	[-]	1,5			
Concrete edge failure						
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
Cracked concrete without any edge reinforcement	$\Psi_{ucr,V}$	[-]	1,0			
Cracked concrete with straight edge reinforcement > Ø12 mm			1,2			
Cracked concrete with edge reinforcement and closely spaced stirrups (a ≤ 100mm) or **non-cracked concrete**			1,4			
Partial safety factor	γ_{Mc} [1]	[-]	1,5			

[1] In absence of other national regulations

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR	Annex C2
Performance Characteristic resistance under shear loads	

Table C3: Characteristic resistances under tension loads in case of fire exposure for design method A according to EOTA TR 020 and ETAG 001, Annex C or CEN/TS 1992-4

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR				Anchor size			
				M8	M10	M12	M16
Steel failure							
Characteristic resistance $N_{Rk,s,fi}$	BOAX-II / BOAX-II HDG	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
	BOAX-II A4 / BOAX-II 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
Pull-out failure							
Characteristic resistance $N_{Rk,p,fi}$	BOAX-II / BOAX-II HDG	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 $N_{Rk,p,fi}$	BOAX-II A4 / BOAX-II 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
Concrete cone and splitting failure [1]							
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 x h_{ef} / Fire attack from more than one side: $c_{min} \geq 300$ mm and $\geq$ 2 x h_{ef}			

[1] As a rule, splitting failure can be neglected when cracked concrete and reinforcement is assumed

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

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR	
Performance Characteristic tension resistance under fire exposure	**Annex C3**

Table C4: Characteristic resistances under shear loads in case of fire exposure for design method A according to EOTA TR 020 and ETAG 001, Annex C or CEN/TS 1992-4

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR				Anchor size			
				M8	**M10**	**M12**	**M16**
Steel failure without lever arm							
Characteristic resistance $V_{Rk,s,fi}$	BOAX-II / BOAX-II HDG	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
	BOAX-II A4 / BOAX-II 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
Steel failure with lever arm							
Characteristic resistance $M^0_{Rk,s,fi}$	BOAX-II / BOAX-II HDG	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
	BOAX-II A4 / BOAX-II 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
Concrete pry-out failure							
k-factor		$k_{(3)}$	[-]	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

Concrete edge failure

The initial value $V^0_{Rk,c,fi}$ of the characteristic resistance in concrete C20/25 to C50/60 under fire exposure may be determined by:

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

with $V^0_{Rk,c}$ initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature.

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

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR	
Performance Characteristic shear resistance under fire exposure	**Annex C4**

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

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR			Anchor size			
			M8	**M10**	**M12**	**M16**
Cracked and non-cracked concrete C20/25 - C50/60	N	[kN]	2,0	3,6	4,8	9,5
	δ_{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

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR			Anchor size			
			M8	**M10**	**M12**	**M16**
Cracked and non-cracked concrete C20/25 - C50/60	V	[kN]	5,7	10,3	13,1	25,1
	δ_{V0}	[mm]	1,7	1,7	2,4	3,2
	$\delta_{V\infty}$	[mm]	2,6	2,6	3,6	4,8

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR	
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

SIMPSON STRONG-TIE® Throughbolt BOAX-II, and BOAX-II A4			Anchor size			
			M8	M10	M12	M16
Steel failure						
Characteristic resistance BOAX-II	$N_{Rk,s,seis}$	[kN]	13	26	38	69
Characteristic resistance BOAX-II A4	$N_{Rk,s,seis}$	[kN]	15	24	35	75
Partial safety factor	$\gamma_{Ms,seis}$ [1]	[-]	1,4			
Pull-out failure						
Characteristic resistance in **cracked** concrete C20/25	$N_{Rk,p,seis}$	[kN]	5	9	12	20
Partial safety factor	$\gamma_{Mp,seis}$ [1]	[-]		1,8 [2]		1,5 [3]
Concrete cone and splitting failure [4]						
Effective anchorage depth	h_{ef}	[mm]	45	60	70	85
Partial safety factor	$\gamma_{Mc,seis}$ [1] $\gamma_{Msp,seis}$ [1]	[-]		1,8 [2]		1,5 [3]

[1] In absence of other national regulations
[2] The installation safety factor of $\gamma_2 = 1,2$ is included
[3] The installation safety factor of $\gamma_2 = 1,0$ is included
[4] 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

SIMPSON STRONG-TIE® Throughbolt BOAX-II and BOAX-II A4			Anchor size			
			M8	M10	M12	M16
Steel failure without lever arm						
Characteristic resistance BOAX-II	$V_{Rk,s,seis}$	[kN]	5,6	11,9	15,4	31,2
Characteristic resistance BOAX-II A4	$V_{Rk,s,seis}$	[kN]	8,7	11,2	18,3	31,5
Partial safety factor	$\gamma_{Ms,seis}$ [1]	[-]	1,25			
Concrete pry-out and concrete edge failure [2]						
Effective anchorage depth	h_{ef}	[mm]	45	60	70	85
Partial safety factor	$\gamma_{Mc,seis}$ [1]	[-]	1,5			

[1] In absence of other national regulations
[2] For concrete pry-out and edge failure, see EOTA TR 045

SIMPSON STRONG-TIE® Throughbolt BOAX-II, BOAX-II HDG, BOAX-II A4 and BOAX-II HCR	
Performance	**Annex C6**
Characteristic tension and shear resistances under seismic action, Performance Category C1	