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Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

European Technical Assessment ETA-24/0741 of 2024/09/10

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	Tecfi Concrete Screw HXE
Product family to which the above construction product belongs:	Mechanical fasteners for use in concrete
Manufacturer:	Tecfi SpA Strada Statale Appia, Km. 193 IT-81050 Pastorano (CE) Tel. +39 0823 88 33 38 Fax +39 0823 88 32 60 Internet www.tecfi.it
Manufacturing plant:	Tecfi S.p.A. plant 1 and 2
This European Technical Assessment contains:	19 pages including 14 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	EAD 330232-01-0601, “Mechanical fasteners for use in concrete”
This version replaces:	

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Tecfi Concrete Screw HXE is a concrete screw made of carbon steel. The anchor is installed in a drilled hole and anchored by mechanical interlock in the special thread.

The HXE fastener is made of steel (f_{uk}=750 MPa; f_{yk}=640MPa) in two different coating versions:
- Zinc plated;
- Special Tecfi “Steel Saver” coating

An illustration of the product is given in Annex A.

The fastener is placed into pre-drilled hole perpendicular to the surface (maximum deviation 5°) in concrete and it is anchored therein by mechanical means.

The characteristic material values, dimensions and tolerances of the anchors not indicated in Annexes shall correspond to the respective values laid down in the technical documentation of this European Technical Assessment.

The anchors are intended to be used with embedment depth given in Annex B, Table B1. The intended use specifications of the product are detailed in the Annex B1

2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

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

The provisions made in this European Technical Assessment are based on an assumed intended working life of the anchor of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, 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 Characteristics of product

Mechanical resistance and stability (BWR 1):
The essential characteristics are detailed in Annex C1 – C4 and C9.

Safety in case of fire (BWR 2):
The essential characteristics are detailed in Annex C5 – C8.

Other Basic Requirements are not relevant.

3.2 Methods of assessment

The assessment of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 has been made in accordance with EAD 330232-01-0601; Mechanical fasteners for use in concrete and EOTA Technical Report 049 Post-installed fasteners in concrete under seismic action.

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

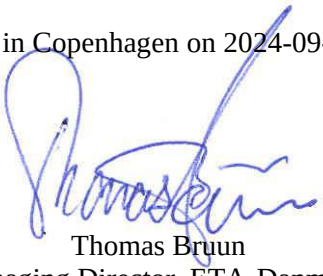
4.1 AVCP system

According to the decision 1996/582/EC of the European Commission, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 1.

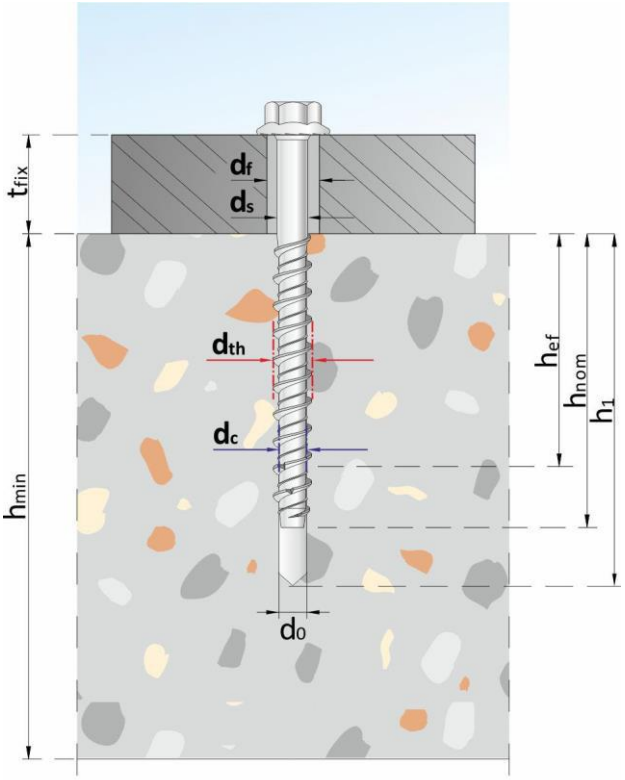
5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

Issued in Copenhagen on 2024-09-10 by



Thomas Bruun
Managing Director, ETA-Danmark

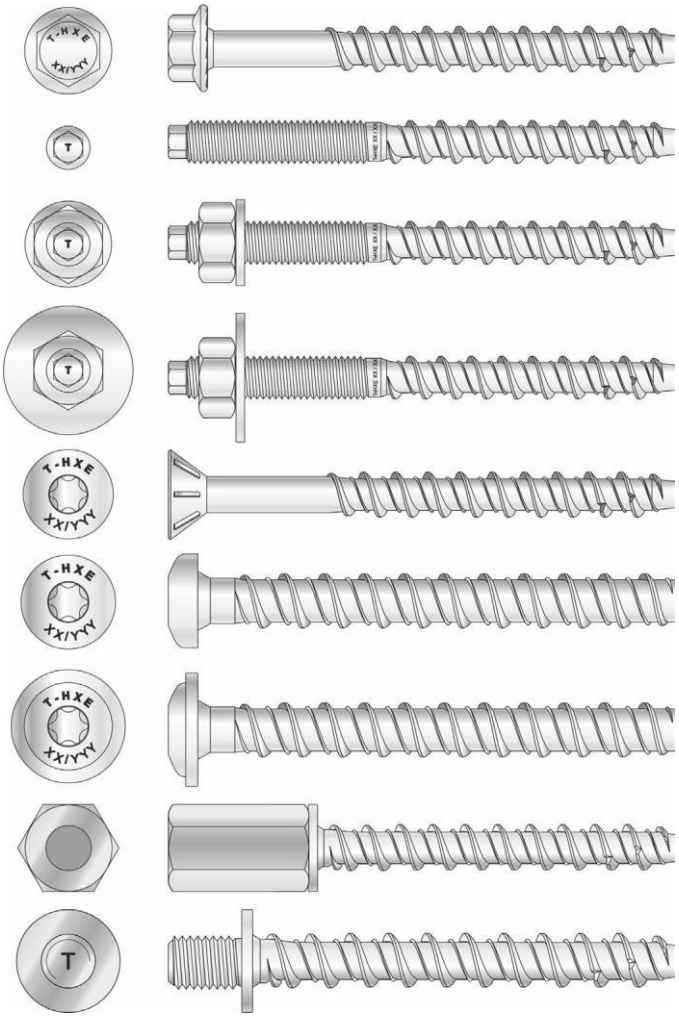


d_o	Nominal drill hole diameter
d_{th}	Nominal external thread diameter
d_c	Core diameter
d_s	Shaft diameter
d_{cut}	Maximum cutting diameter of the drill bit
d_f	Diameter of the clearance hole in the fixture
h_{nom}	Overall fastener embedment depth
h_{ef}	Effective embedment depth
h_1	Drill hole depth
h_{min}	Minimum thickness of concrete member
t_{fix}	Thickness of the fixtures

Tecfi Concrete Screw HXE

Product description
Installed condition

ANNEX A1

	Carbon steel, electroplated coating of zinc version	Carbon steel, Tecfi Steel Saver coating version
	HXE 01	HXE 41
	HXE 85	HXE 39
	HXE 02	HXE 42
	HXE 12	HXE 40
	HXE 03	HXE 43
	HXE 05	HXE 45
	HXE 06	HXE 46
	HXE 07	HXE 49 [1)]
	HXE 87	HXE 47

[1)] Also available with Tecfi Steel Saver coating screw and galvanized coupling nut as HXE 48.

Table for head marks (or body marks) of concrete screws HXE

New marking	Old marking
T-HXE: Tecfi S.p.A., concrete screw HXE range	T-HXE: Tecfi S.p.A., concrete screw HXE range
XX: ID (a letter) for the drill hole diameter (d_0) and the corresponding nominal external thread diameter (d_{th}), as shown in Table 1	XX: Nominal external thread diameter (d_{th})
YYY: Screw length	YYY: Thickness of fixture

Table1

ID	d_0	d_{th}
V	5	6
K	6	8
H	8	10
E	10	12
M	12	14
N	14	16
P	16	18
A	18	20

Tecfi Concrete Screw HXE

Product description
Fastener type, item code and marking

ANNEX A2

Item code	Description	Mechanical properties	
		f_{yk} [Mpa]	f_{uk} [Mpa]
HXE 01 - HXE 41	Hexagonal flanged washer head screw	640	750
HXE 85 - HXE 39	Dual thread screw with hexagonal shank		
HXE 02 - HXE 42	Dual thread screw with hexagonal shank, nut and washer according to ISO 7089		
HXE 12 - HXE 40	Dual thread screw with hexagonal shank, nut and washer according to ISO 7093		
HXE 03 - HXE 43	Flat countersunk head with ribs screw		
HXE 05 - HXE 45	Pan head screw		
HXE 06 - HXE 46	Pan washer head screw		
HXE 07 - HXE 48- HXE 49	Dual thread (with collar) screw assembled with metric hexagonal coupling nut		
HXE 87 - HXE 47	Dual thread with collar screw		

Item code	Material	Coating
HXE 01, HXE 85, HXE 02, HXE 12, HXE 03, HXE 05, HXE 06, HXE 07, HXE 87	Carbon steel	Electroplated coating of zinc (zinc plated) ≥ 5µm according to ISO 4042
HXE 41, HXE 39, HXE 42, HXE 43, HXE40 HXE 45, HXE 46, HXE 47, HXE 49	Carbon steel	Tecfi Steel Saver 1000h – ZL
HXE 48	Carbon steel	Screw: Tecfi Steel Saver 1000h – ZL Coupling nut: Electroplated coating of zinc (zinc plated) ≥ 5µm according to ISO 4042

Size [d_0(d_{th})]	6(8)		8(10)		10(12)		14(16)	
Nominal embedment depth h_{nom}	45	60	45	70	55	80	65	110
Static and quasi-static loads in cracked and non-cracked concrete	✓	✓	✓	✓	✓	✓	✓	✓
Fire exposure	✓	✓	✓	✓	✓	✓	✓	✓
Seismic action for Performance Category C1		✓	✓	✓	✓	✓	✓	✓
Seismic action for Performance Category C2[1)]					✓	✓	✓	✓

[1)] Zinc plated version only and item codes HXE07, HXE48 and HXE49 not included

Base materials:
- Reinforced or unreinforced normal weight concrete according to EN 206:2013+A2:2021;
- Strength classes C20/25 to C50/60 according to EN 206:2013+A2:2021;
- Cracked or uncracked concrete.

Use conditions (Environmental conditions):
- Anchorages subject to dry internal conditions;

Design:
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work;
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the fastener is indicated on the design drawings (e.g. position of the fastener relative to reinforcement or to supports, etc.);
- Anchorages in concrete under static or quasi-static actions and under fire exposure are designed in accordance with:
  - EN 1992-4 Design method A and EOTA Technical report TR055;
  - In case of requirements for resistance to fire exposure it must be ensured that local spalling of the concrete cover does not occur.

Installation:
- Hole drilling by rotary plus hammer mode only;
- The installation of the fastener must be carried out by professional personnel and under the supervision of the technical site manager;
- In case of aborted hole: new hole must be drilled at a minimum distance away of twice the depth of the aborted hole, or a smaller distance may be chosen if the aborted hole is filled with high strength mortar and if the aborted hole is not in the direction of the load application under shear or under oblique tension load;
- No further screw turns are permitted after installation. The screw head must be fully positioned on the fixture and must not show any damage.

Tecfi Concrete Screw HXE

Intended use
Specifications

ANNEX B1

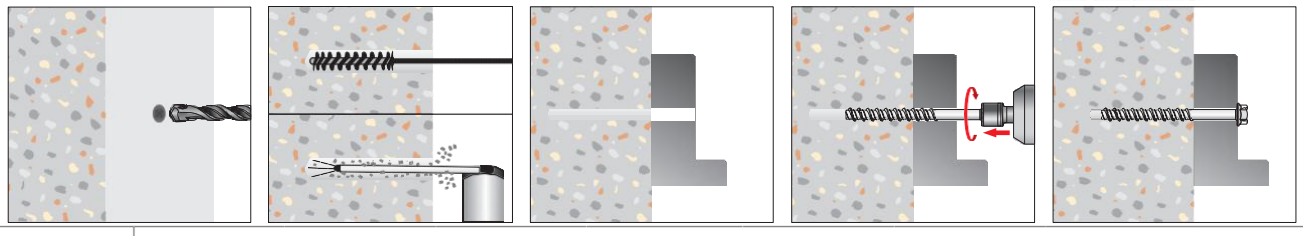
Table B1: installation details

	$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
Nominal drill hole diameter	d_0 = [mm]	6		8		10		14	
Nominal external thread diameter	d_{th} = [mm]	8		10		12		16	
Core diameter	d_c = [mm]	5,8		7,5		9,7		12,7	
Shaft diameter	d_s = [mm]	6		8		10		13,5	
Maximum cutting diameter of the drill bit	$d_{cut} \leq$ [mm]	6,40		8,45		10,45		14,50	
Diameter of clearance in the fixture	d_f = [mm]	9		12		14		18	
Overall anchor embedment depth in the concrete	**h_{nom}=[mm]**	**45**	**60**	**45**	**70**	**55**	**80**	**65**	**110**
Effective anchorage depth	h_{ef} = [mm]	36	49	33	56	43	64	53	85
Depth of drill hole	h_1 = [mm]	60	75	60	85	70	95	80	125
Minimum thickness of concrete member	h_{min} = [mm]	80	100	90	110	100	130	110	170
Minimum edge distance	c_{min} = [mm]	35	35	40	40	40	40	60	60
Minimum spacing	s_{min} = [mm]	35	35	40	40	40	40	60	60
Required output of the impact wrench	[Nm]	200		200		200		305	

Table B2: head related installation details

	$d_0(d_{th})$	6(8)	8(10)	10(12)	14(16)
HXE 01- HXE 41 Wrench Size	SW	10	13	15	21
HXE 85 – HXE 39 – HXE 02 – HXE 42 – HXE 12 – HXE 40 Wrench Size (shank/nut)	AF/SW	5/13	7/17	8/19	-
HXE 03- HXE 43 Hexalobular recess size	T	30	40	50	-
HXE 05 – HXE 45 Hexalobular recess size	T	30	30	-	-
HXE 06 – HXE 46 Hexalobular recess size	T	30	30	-	-
HXE 07 – HXE 48 – HXE 49 – HXE 87 – HXE 47 Wrench size of the coupling nut	SW	13	17 (13 for thread size M8)	-	-

Installation instructions



Step 1	Drill a hole into the concrete in rotary plus hammer mode
Step 2	Remove dust from the hole using a brush and a blowing pump
Step 3	Place the fixture
Step 4	Install the fastener using an impact screw driver

Tecfi Concrete Screw HXE

Intended use
Installation parameters and installation instructions

ANNEX B2

Table C1: Performances for design method A, tension, static and quasi static loads in concrete C20/25 to C50/60 for carbon steel, zinc plated version

		d_0(d_{th})	6(8)		8(10)		10(12)		14(16)	
STEEL FAILURE										
Characteristic Resistance	$N_{Rk,s}$	[kN]	21,2		37,7		58,9		107,4	
Partial safety factor[1)]	γ_{Ms}	[-]	1,41							
PULL-OUT FAILURE										
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
Characteristic Resistance in uncracked concrete C20/25	$N_{Rk,p}$	[kN]	6,5	16	9	20	13	25	19	29
Characteristic Resistance in uncracked concrete C20/25 HXE 06 version	$N_{Rk,p}$	[kN]	6,5	11	-	-	-	-	-	-
Characteristic Resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	2	4	3	10	9	12	10	20
Partial safety factor accounting for sensitivity to installation	γ_{inst}	[-]	1,2	1,4	1,2		1,2		1,2	
Increasing factors for $N_{Rk,p}$ for uncracked concrete	ψ_c	C30/37	1,18	1,06	1,09	1,22	1,11	1,22	1,06	1,18
		C40/50	1,32	1,11	1,16	1,41	1,19	1,41	1,11	1,32
		C50/60	1,44	1,15	1,22	1,58	1,26	1,58	1,15	1,44
Increasing factors for $N_{Rk,p}$ for cracked concrete	ψ_c	C30/37	1,00	1,11	1,22	1,13	1,22	1,13	1,00	1,00
		C40/50	1,00	1,19	1,41	1,23	1,41	1,23	1,00	1,00
		C50/60	1,00	1,26	1,58	1,32	1,58	1,32	1,00	1,00
CONCRETE CONE FAILURE AND SPLITTING FAILURE										
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
Factor for concrete cone failure	k_{ucr}	[-]	11,0							
	k_{cr}	[-]	7,7							
Characteristic spacing	$s_{cr,N}$	[mm]	3 x h_{ef}							
Characteristic edge distance	$c_{cr,N}$	[mm]	1,5 x h_{ef}							
Characteristic spacing (Splitting)	$s_{cr,sp}$	[mm]	150	160	160	175	240	195	200	255
Characteristic edge distance (Splitting)	$c_{cr,sp}$	[mm]	75	80	80	85	120	95	100	130

[1)] In absence of other national regulations

Table C2: Performances for design method A, shear, static and quasi static loads in concrete C20/25 to C50/60 for carbon steel, zinc plated version

		d_0(d_{th})	6(8)		8(10)		10(12)		14(16)	
STEEL FAILURE WITHOUT LEVEL ARM										
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Characteristic Resistance	$V^0_{Rk,s}$	[kN]	8,7		20,4	22,8	29,1	37,2	53,9	75,8
Ductility factor[1)]	k_7	[-]	0,80		0,80		0,80		0,74	0,79
Partial safety factor[2)]	γ_{Ms}	[-]	1,50							
STEEL FAILURE WITH LEVEL ARM										
Characteristic Resistance	$M^0_{Rk,s}$	[Nm]	19		45		88		217	
Partial safety factor[2)]	γ_{Ms}	[-]	1,50							
CONCRETE PRYOUT FAILURE										
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
Factor for pryout	K_8	[-]	1,0	1,0	1,0	1,0	1,0	2,0	1,0	2,0
CONCRETE EDGE FAILURE										
Nominal diameter of the screw	d_{nom}	[mm]	6		8		10		14	
Effective length of the fastener in concrete	l_f	[mm]	36	49	33	56	43	64	53	85

[1)] The diameter of the clearance hole does not meet the values given in EN 1992-4, Table 6.1. However, the group resistance under shear loading has been verified in the assessment through testing and accounted for in the factor k7

[2)] In absence of other national regulations.

Table C3: Performances for design method A, tension, static and quasi static loads in concrete C20/25 to C50/60 for carbon steel, Steel Saver coating version

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
STEEL FAILURE										
Characteristic Resistance	$N_{Rk,s}$	[kN]	21,2		37,7		58,9		107,4	
Partial safety factor[1)]	γ_{Ms}	[-]	1,41							
PULL-OUT FAILURE										
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
Characteristic Resistance in uncracked concrete C20/25	$N_{Rk,p}$	[kN]	6,5	16	9	20	13	25	19	29
Characteristic Resistance in uncracked concrete C20/25 HXE 06 version	$N_{Rk,p}$	[kN]	6,5	11	-	-	-	-	-	-
Characteristic Resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	2	4	1,5	7,5	9	11	10	20
Partial safety factor accounting for sensitivity to installation	γ_{inst}	[-]	1,2	1,4	1,2		1,2		1,2	
Increasing factors for $N_{Rk,p}$ for uncracked concrete	ψ_c	C30/37	1,18	1,06	1,09	1,22	1,11	1,22	1,06	1,18
		C40/50	1,32	1,11	1,16	1,41	1,19	1,41	1,11	1,32
		C50/60	1,44	1,15	1,22	1,58	1,26	1,58	1,15	1,44
Increasing factors for $N_{Rk,p}$ for cracked concrete	ψ_c	C30/37	1,00	1,11	1,22	1,13	1,22	1,13	1,00	1,00
		C40/50	1,00	1,19	1,41	1,23	1,41	1,23	1,00	1,00
		C50/60	1,00	1,26	1,58	1,32	1,58	1,32	1,00	1,00
CONCRETE CONE FAILURE AND SPLITTING FAILURE										
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
Factor for concrete cone failure	k_{ucr}	[-]	11,0							
	k_{cr}	[-]	7,7							
Characteristic spacing	$s_{cr,N}$	[mm]	$3 \times h_{ef}$							
Characteristic edge distance	$c_{cr,N}$	[mm]	$1,5 \times h_{ef}$							
Characteristic spacing (Splitting)	$s_{cr,sp}$	[mm]	150	160	160	175	240	195	200	255
Characteristic edge distance (Splitting)	$c_{cr,sp}$	[mm]	75	80	80	85	120	95	100	130

[1)] In absence of other national regulations

Table C4: Performances for design method A, shear, static and quasi static loads in concrete C20/25 to C50/60 for carbon steel, Steel Saver coating version

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
STEEL FAILURE WITHOUT LEVEL ARM										
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Characteristic Resistance	$V^0_{Rk,s}$	[kN]	8,7		20,4	22,8	29,1	37,2	53,9	75,8
Ductility factor[1)]	k_7	[-]	0,80		0,80		0,80		0,74	0,79
Partial safety factor[2)]	γ_{Ms}	[-]	1,50							
STEEL FAILURE WITH LEVEL ARM										
Characteristic Resistance	$M^0_{Rk,s}$	[Nm]	19		45		88		217	
Partial safety factor[2)]	γ_{Ms}	[-]	1,50							
CONCRETE PRYOUT FAILURE										
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
Factor for pryout	K_8	[-]	1,0	1,0	1,0	1,0	1,0	2,0	1,0	2,0
CONCRETE EDGE FAILURE										
Nominal diameter of the screw	d_{nom}	[mm]	6		8		10		14	
Effective length of the fastener in concrete	l_f	[mm]	36	49	33	56	43	64	53	85

[1)] The diameter of the clearance hole does not meet the values given in EN 1992-4, Table 6.1. However, the group resistance under shear loading has been verified in the assessment through testing and accounted for in the factor k7

[2)] In absence of other national regulations

Table C5: Performances for design method A, seismic performance category C1 in concrete C20/25 to C50/60 for carbon steel, zinc plated version

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,C1}$	[kN]	21,2		37,7		58,9		107,4	
Partial safety factor[1] - tension	γ_{Ms}	[-]	1,41							
Characteristic Resistance - shear	$V_{Rk,s,C1}$	[kN]	NPD	8,7	18,4	20,6	24,7	31,6	43,1	60,7
Partial safety factor[1] - shear	γ_{Ms}	[-]	1,50							
PULL-OUT FAILURE										
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
Characteristic Resistance in uncracked concrete C20/25	$N_{Rk,p,C1}$	[kN]	NPD	2,1	2,3	7,0	6,3	8,3	7,0	13,5
Partial safety factor accounting for sensitivity to installation	γ_{inst}	[-]	NPD	1,4	1,2		1,2		1,2	
Increasing factors for $N_{Rk,p}$ for cracked concrete	ψ_c	C30/37	NPD	1,11	1,22	1,13	1,22	1,13	1,00	1,00
		C40/50	NPD	1,19	1,41	1,23	1,41	1,23	1,00	1,00
		C50/60	NPD	1,26	1,58	1,32	1,58	1,32	1,00	1,00

[1] In absence of other national regulations

Table C6: Performances for design method A, seismic performance category C1 in concrete C20/25 to C50/60 for carbon steel, Steel Saver coating version

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,C1}$	[kN]	21,2		37,7		58,9		107,4	
Partial safety factor[1] - tension	γ_{Ms}	[-]	1,41							
Characteristic Resistance - shear	$V_{Rk,s,C1}$	[kN]	NPD	8,7	18,4	20,6	24,7	31,6	43,1	60,7
Partial safety factor[1] - shear	γ_{Ms}	[-]	1,50							
PULL-OUT FAILURE										
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
Characteristic Resistance in uncracked concrete C20/25	$N_{Rk,p,C1}$	[kN]	NPD	2,1	0,9	5,3	6,3	7,6	7,0	13,5
Partial safety factor accounting for sensitivity to installation	γ_{inst}	[-]	NPD	1,4	1,2		1,2		1,2	
Increasing factors for $N_{Rk,p}$ for cracked concrete	ψ_c	C30/37	NPD	1,11	1,22	1,13	1,22	1,13	1,00	1,00
		C40/50	NPD	1,19	1,41	1,23	1,41	1,23	1,00	1,00
		C50/60	NPD	1,26	1,58	1,32	1,58	1,32	1,00	1,00

[1] In absence of other national regulations

Table C7: Performances for design method A, seismic performance category C2 in concrete C20/25 to C50/60 for carbon steel, zinc plated version

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,C2}$	[kN]	NPD		NPD		58,9		107,4	
Partial safety factor[1] - tension	γ_{Ms}	[-]	1,41							
Characteristic Resistance - shear	$V_{Rk,s,C2}$	[kN]	NPD	NPD	NPD	NPD	14,0	17,7	31,8	39,8
Partial safety factor[1] - shear	γ_{Ms}	[-]	1,50							
PULL-OUT FAILURE										
Overall fastener embedment depth	h_{nom}	[mm]	NPD	NPD	NPD	NPD	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	NPD	NPD	NPD	NPD	43	64	53	85
Characteristic Resistance in uncracked concrete C20/25	$N_{Rk,p,C2}$	[kN]	NPD	NPD	NPD	NPD	2,7	2,7	3,6	7,2
Partial safety factor accounting for sensitivity to installation	γ_{inst}	[-]	NPD	NPD	NPD		1,2		1,2	
Increasing factors for $N_{Rk,p}$ for cracked concrete	ψ_c	C30/37	NPD	NPD	NPD	NPD	1,22	1,13	1,00	1,00
		C40/50	NPD	NPD	NPD	NPD	1,41	1,23	1,00	1,00
		C50/60	NPD	NPD	NPD	NPD	1,58	1,32	1,00	1,00

[1] In absence of other national regulations

Table C8: Performances for design method A, tension, fire exposure, in concrete C20/25 to C50/60 for carbon steel, zinc plated version

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
FIRE EXPOSURE 30 MINUTES										
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,fi,30}$	[kN]	0,3	0,3	0,8	0,8	1,6	1,6	2,9	2,9
PULL-OUT FAILURE										
Characteristic Resistance	$N_{Rk,p,fi,30}$	[kN]	0,5	1,0	0,8	2,5	2,3	3,0	2,5	5,0
CONCRETE CONE FAILURE										
Characteristic Resistance	$N_{Rk,c,fi,30}$	[kN]	1,3	2,9	1,1	4,0	2,1	5,6	3,5	11,5
FIRE EXPOSURE 60 MINUTES										
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,fi,60}$	[kN]	0,3	0,3	0,7	0,7	1,2	1,2	2,1	2,1
PULL-OUT FAILURE										
Characteristic Resistance	$N_{Rk,p,fi,60}$	[kN]	0,5	1,0	0,8	2,5	2,3	3,0	2,5	5,0
CONCRETE CONE FAILURE										
Characteristic Resistance	$N_{Rk,c,fi,60}$	[kN]	1,3	2,9	1,1	4,0	2,1	5,6	3,5	11,5
FIRE EXPOSURE 90 MINUTES										
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,fi,90}$	[kN]	0,2	0,2	0,5	0,5	1,0	1,0	1,9	1,9
PULL-OUT FAILURE										
Characteristic Resistance	$N_{Rk,p,fi,90}$	[kN]	0,5	1,0	0,8	2,5	2,3	3,0	2,5	5,0
CONCRETE CONE FAILURE										
Characteristic Resistance	$N_{Rk,c,fi,90}$	[kN]	1,3	2,9	1,1	4,0	2,1	5,6	3,5	11,5
FIRE EXPOSURE 120 MINUTES										
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,fi,120}$	[kN]	0,1	0,1	0,4	0,4	0,8	0,8	1,4	1,4
PULL-OUT FAILURE										
Characteristic Resistance	$N_{Rk,p,fi,120}$	[kN]	0,4	0,8	0,6	2,0	1,8	2,4	2,0	4,0
CONCRETE CONE FAILURE										
Characteristic Resistance	$N_{Rk,c,fi,120}$	[kN]	1,1	2,3	0,9	3,2	1,7	4,5	2,8	9,2
Spacing	$s_{cr,N}$	[mm]	$4 \times h_{ef}$							
Edge distance	$c_{cr,N}$	[mm]	$2 \times h_{ef}$							
Partial safety factor accounting for sensitivity to installation	c_{min}	[mm]	$2 \times h_{ef}$; If fire attack comes from more than one side, the edge distance of the anchor has to be ≥ 300 mm or ≥ $2 \times h_{ef}$							

Table C9: Performances for design method A, shear, fire exposure, in concrete C20/25 to C50/60 for carbon steel, zinc plated version

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
FIRE EXPOSURE 30 MINUTES										
STEEL FAILURE WITHOUT LEVEL ARM										
Characteristic Resistance	$V_{Rk,s,fi,30}$	[kN]	0,3	0,3	0,8	0,8	1,6	1,6	2,9	2,9
STEEL FAILURE WITH LEVEL ARM										
Characteristic Resistance	$M^0_{Rk,s,fi,30}$	[Nm]	0,3	0,3	0,9	0,9	2,4	2,4	5,8	5,8
PRYOUT FAILURE										
Characteristic Resistance	$V_{Rk,cp,fi,30}$	[kN]	1,3	2,9	1,1	4,0	2,1	11,3	3,5	22,9
FIRE EXPOSURE 60 MINUTES										
STEEL FAILURE WITHOUT LEVEL ARM										
Characteristic Resistance	$V_{Rk,s,fi,60}$	[kN]	0,3	0,3	0,7	0,7	1,2	1,2	2,1	2,1
STEEL FAILURE WITH LEVEL ARM										
Characteristic Resistance	$M^0_{Rk,s,fi,60}$	[Nm]	0,2	0,2	0,8	0,8	1,8	1,8	4,3	4,3
PRYOUT FAILURE										
Characteristic Resistance	$V_{Rk,cp,fi,60}$	[kN]	1,3	2,9	1,1	4,0	2,1	11,3	3,5	22,9
FIRE EXPOSURE 90 MINUTES										
STEEL FAILURE WITHOUT LEVEL ARM										
Characteristic Resistance	$V_{Rk,s,fi,90}$	[kN]	0,2	0,2	0,5	0,5	1,0	1,0	1,9	1,9
STEEL FAILURE WITH LEVEL ARM										
Characteristic Resistance	$M^0_{Rk,s,fi,90}$	[Nm]	0,2	0,2	0,6	0,6	1,5	1,5	3,8	3,8
PRYOUT FAILURE										
Characteristic Resistance	$V_{Rk,cp,fi,90}$	[kN]	1,3	2,9	1,1	4,0	2,1	11,3	3,5	22,9
FIRE EXPOSURE 120 MINUTES										
STEEL FAILURE WITHOUT LEVEL ARM										
Characteristic Resistance	$V_{Rk,s,fi,120}$	[kN]	0,1	0,1	0,4	0,4	0,8	0,8	1,4	1,4
STEEL FAILURE WITH LEVEL ARM										
Characteristic Resistance	$M^0_{Rk,s,fi,120}$	[Nm]	0,1	0,1	0,5	0,5	1,2	1,2	2,9	2,9
PRYOUT FAILURE										
Characteristic Resistance	$V_{Rk,cp,fi,120}$	[kN]	1,1	2,3	0,9	3,2	1,7	9,0	2,8	18,4
Concrete edge failure										

The characteristic resistance $V_{rk,cp,fi,Ri}$ in concrete C20/25 to C50/60 is determined by:
$V^0_{Rk,c,fi(90)}$ = 0,25 x $V^0_{Rk,c}$ (R30, R60, R90) and **$V^0_{Rk,c,fi(120)}$ = 0,20 x $V^0_{Rk,c}$** (R120) with
$V^0_{Rk,c}$ as an initial value of the characteristic resistance of a single fastener in cracked concrete C20

Table C10: Performances for design method A, tension, fire exposure, in concrete C20/25 to C50/60 for carbon steel, Steel Saver coating version

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
FIRE EXPOSURE 30 MINUTES										
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,fi,30}$	[kN]	0,3	0,3	0,8	0,8	1,6	1,6	2,9	2,9
PULL-OUT FAILURE										
Characteristic Resistance	$N_{Rk,p,fi,30}$	[kN]	0,5	1,0	0,4	1,9	2,3	2,8	2,5	5,0
CONCRETE CONE FAILURE										
Characteristic Resistance	$N_{Rk,c,fi,30}$	[kN]	1,3	2,9	1,1	4,0	2,1	5,6	3,5	11,5
FIRE EXPOSURE 60 MINUTES										
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,fi,60}$	[kN]	0,3	0,3	0,7	0,7	1,2	1,2	2,1	2,1
PULL-OUT FAILURE										
Characteristic Resistance	$N_{Rk,p,fi,60}$	[kN]	0,5	1,0	0,4	1,9	2,3	2,8	2,5	5,0
CONCRETE CONE FAILURE										
Characteristic Resistance	$N_{Rk,c,fi,60}$	[kN]	1,3	2,9	1,1	4,0	2,1	5,6	3,5	11,5
FIRE EXPOSURE 90 MINUTES										
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,fi,90}$	[kN]	0,2	0,2	0,5	0,5	1,0	1,0	1,9	1,9
PULL-OUT FAILURE										
Characteristic Resistance	$N_{Rk,p,fi,90}$	[kN]	0,5	1,0	0,4	1,9	2,3	2,8	2,5	5,0
CONCRETE CONE FAILURE										
Characteristic Resistance	$N_{Rk,c,fi,90}$	[kN]	1,3	2,9	1,1	4,0	2,1	5,6	3,5	11,5
FIRE EXPOSURE 120 MINUTES										
STEEL FAILURE										
Characteristic Resistance - tension	$N_{Rk,s,fi,120}$	[kN]	0,1	0,1	0,4	0,4	0,8	0,8	1,4	1,4
PULL-OUT FAILURE										
Characteristic Resistance	$N_{Rk,p,fi,120}$	[kN]	0,4	0,8	0,3	1,5	1,8	2,2	2,0	4,0
CONCRETE CONE FAILURE										
Characteristic Resistance	$N_{Rk,c,fi,120}$	[kN]	1,1	2,3	0,9	3,2	1,7	4,5	2,8	9,2
Spacing	$s_{cr,N}$	[mm]	$4 \times h_{ef}$							
Edge distance	$c_{cr,N}$	[mm]	$2 \times h_{ef}$							
Partial safety factor accounting for sensitivity to installation	c_{min}	[mm]	$2 \times h_{ef}$; If fire attack comes from more than one side, the edge distance of the anchor has to be ≥ 300 mm or ≥ $2 \times h_{ef}$							

Table C11: Performances for design method A, shear, fire exposure, in concrete C20/25 to C50/60 for carbon steel, Steel Saver coating version

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
FIRE EXPOSURE 30 MINUTES										
STEEL FAILURE WITHOUT LEVER ARM										
Characteristic Resistance	$V_{Rk,s,fi,30}$	[kN]	0,3	0,3	0,8	0,8	1,6	1,6	2,9	2,9
STEEL FAILURE WITH LEVER ARM										
Characteristic Resistance	$M^0_{Rk,s,fi,30}$	[Nm]	0,3	0,3	0,9	0,9	2,4	2,4	5,8	5,8
PRYOUT FAILURE										
Characteristic Resistance	$V_{Rk,cp,fi,30}$	[kN]	1,3	2,9	1,1	4,0	2,1	11,3	3,5	22,9
FIRE EXPOSURE 60 MINUTES										
STEEL FAILURE WITHOUT LEVER ARM										
Characteristic Resistance	$V_{Rk,s,fi,60}$	[kN]	0,3	0,3	0,7	0,7	1,2	1,2	2,1	2,1
STEEL FAILURE WITH LEVER ARM										
Characteristic Resistance	$M^0_{Rk,s,fi,60}$	[Nm]	0,2	0,2	0,8	0,8	1,8	1,8	4,3	4,3
PRYOUT FAILURE										
Characteristic Resistance	$V_{Rk,cp,fi,60}$	[kN]	1,3	2,9	1,1	4,0	2,1	11,3	3,5	22,9
FIRE EXPOSURE 90 MINUTES										
STEEL FAILURE WITHOUT LEVER ARM										
Characteristic Resistance	$V_{Rk,s,fi,90}$	[kN]	0,2	0,2	0,5	0,5	1,0	1,0	1,9	1,9
STEEL FAILURE WITH LEVER ARM										
Characteristic Resistance	$M^0_{Rk,s,fi,90}$	[Nm]	0,2	0,2	0,6	0,6	1,5	1,5	3,8	3,8
PRYOUT FAILURE										
Characteristic Resistance	$V_{Rk,cp,fi,90}$	[kN]	1,3	2,9	1,1	4,0	2,1	11,3	3,5	22,9
FIRE EXPOSURE 120 MINUTES										
STEEL FAILURE WITHOUT LEVER ARM										
Characteristic Resistance	$V_{Rk,s,fi,120}$	[kN]	0,1	0,1	0,4	0,4	0,8	0,8	1,4	1,4
STEEL FAILURE WITH LEVER ARM										
Characteristic Resistance	$M^0_{Rk,s,fi,120}$	[Nm]	0,1	0,1	0,5	0,5	1,2	1,2	2,9	2,9
PRYOUT FAILURE										
Characteristic Resistance	$V_{Rk,cp,fi,120}$	[kN]	1,1	2,3	0,9	3,2	1,7	9,0	2,8	18,4

Concrete edge failure

The characteristic resistance $V_{rk,cp,fi,Ri}$ in concrete C20/25 to C50/60 is determined by:
$V^0_{Rk,c,fi(90)}$ = 0,25 x $V^0_{Rk,c}$ (R30, R60, R90) and **$V^0_{Rk,c,fi(120)}$ = 0,20 x $V^0_{Rk,c}$** (R120) with
$V^0_{Rk,c}$ as an initial value of the characteristic resistance of a single fastener in cracked concrete C20

Table C12: Performances for design method A, Displacements

		$d_0(d_{th})$	6(8)		8(10)		10(12)		14(16)	
Overall fastener embedment depth	h_{nom}	[mm]	45	60	45	70	55	80	65	110
Effective embedment depth	h_{ef}	[mm]	36	49	33	56	43	64	53	85
TENSION LOADS IN UNCRACKED CONCRETE - ZINC PLATED AND SPECIAL COATING VERSIONS										
Service tension load in uncracked concrete C20/25	N_{ucr}	[kN]	3,10	7,62	4,29	9,52	6,19	11,90	9,05	13,81
Service tension load in uncracked concrete C20/25 HXE 06 version	N_{ucr}	[kN]	3,10	5,24	-	-	-	-	-	-
Displacements	$\delta_{N0,ucr}$	[mm]	0,09	0,15	0,07	0,15	0,10	0,10	0,10	0,15
	$\delta_{N\infty,ucr}$	[mm]	0,11	0,54	0,25	0,41	0,40	0,39	0,34	0,67
Displacements HXE 06 version	$\delta_{N0,ucr}$	[mm]	0,09	0,10	-	-	-	-	-	-
	$\delta_{N\infty,ucr}$	[mm]	0,11	0,42	-	-	-	-	-	-
TENSION LOADS IN CRACKED CONCRETE - ZINC PLATED VERSION										
Service tension load in uncracked concrete C20/25	N_{cr}	[kN]	0,95	1,90	1,43	4,76	4,29	5,71	4,76	9,52
Displacements	$\delta_{N0,cr}$	[mm]	0,07	0,27	0,08	0,19	0,18	0,22	0,16	0,25
	$\delta_{N\infty,cr}$	[mm]	0,31	0,53	0,43	0,49	0,71	0,72	1,14	1,13
TENSION LOADS IN CRACKED CONCRETE - STEEL SAVER COATING VERSION										
Service tension load in uncracked concrete C20/25	N_{cr}	[kN]	0,95	1,90	0,71	3,57	4,29	5,24	4,76	9,52
Displacements	$\delta_{N0,cr}$	[mm]	0,07	0,13	0,04	0,14	0,18	0,20	0,16	0,25
	$\delta_{N\infty,cr}$	[mm]	0,41	0,78	0,42	0,71	0,95	0,40	0,83	1,27
SHEAR LOADS IN CRACKED AND UNCRACKED CONCRETE - ZINC PLATED AND SPECIAL COATING VERSIONS										
Service shear load in uncracked concrete C20/25	V_u	[kN]	4,1		9,7	10,9	13,9	17,7	25,6	36,1
Displacements	δ_{V0}	[mm]	0,52		2,22	1,21	1,70	1,69	4,54	6,29
	$\delta_{V\infty}$	[mm]	0,77		3,33	1,81	2,55	2,53	6,8	9,43
SEISMIC PERFORMANCE CATEGORY C2 – ZINC PLATED VERSION										
Damage limit state										
Tension	$\delta_{N,seis(DLS)}$	[mm]	NPD		NPD		0,21	0,16	0,40	0,56
Shear	$\delta_{V,seis(DLS)}$	[mm]	NPD		NPD		4,85	5,65	6,22	5,54
Ultimate limit state										
Tension	$\delta_{N,seis(ULS)}$	[mm]	NPD		NPD		1,04	1,02	2,34	2,23
Shear	$\delta_{V,seis(ULS)}$	[mm]	NPD		NPD		9,06	10,08	11,64	8,78