

Approval body for construction products
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and
Laender Governments



European Technical Assessment

ETA-13/0401
of 4 December 2015

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

DEMU Bolt anchor

Product family
to which the construction product belongs

Cast-in anchor with internal threaded socket

Manufacturer

Halfen GmbH
Liebigstraße 14
40764 Langenfeld
DEUTSCHLAND

Manufacturing plant

HALFEN Herstellwerke

This European Technical Assessment
contains

19 pages including 3 annexes which form an integral part
of this assessment

This European Technical Assessment is
issued in accordance with Regulation (EU)
No 305/2011, on the basis of

European Assessment Document (EAD)
330012-00-0601

European Technical Assessment

ETA-13/0401

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Specific part**1 Technical description of the product**

The DEMU bolt anchor in the size of M12, M16, M20, M24, M30, M36 and M42 as type 1985 and 1988 is an anchor consisting of a bolt and an internal threaded socket screwed and pressed on the thread of the bolt. The socket is made of electroplated steel, hot-dipped galvanised steel or stainless steel. The anchor is imbedded surface-flush or sunk in the concrete. The anchorage is characterised by mechanical interlock at the head of the bolt.

The product description is given in Annex A.

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

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

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

3 Performance of the product and references to the methods used for its assessment**3.1 Mechanical resistance and stability (BWR 1)**

Essential characteristic	Performance
Characteristic values for resistance for static and quasi-static loads and displacements	See Annex C1 to C4

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorage satisfy requirements for Class A1
Resistance to fire	See Annex C5

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

In accordance with EAD No. 330012-00-0601, the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

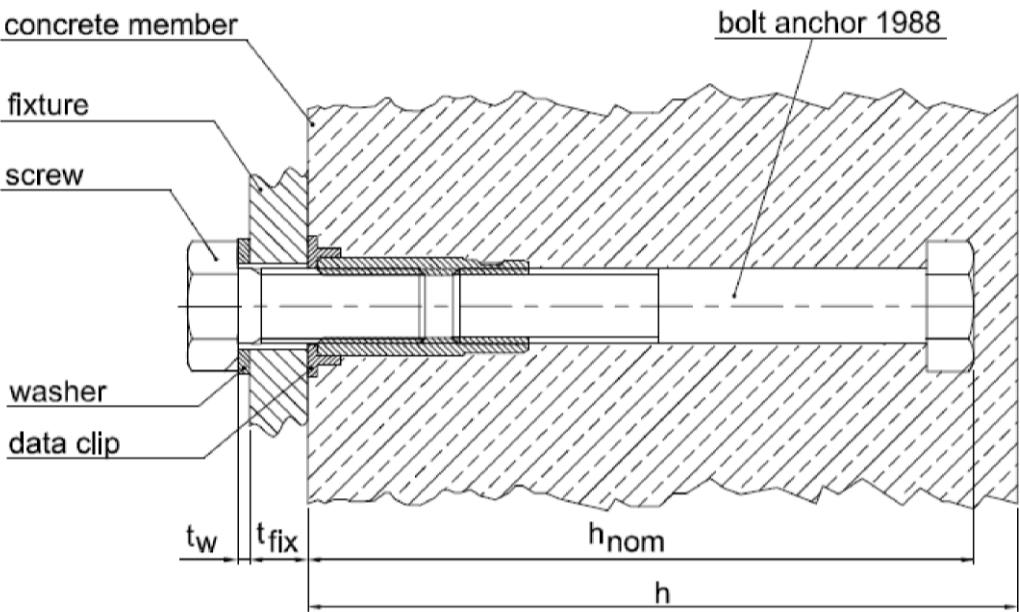
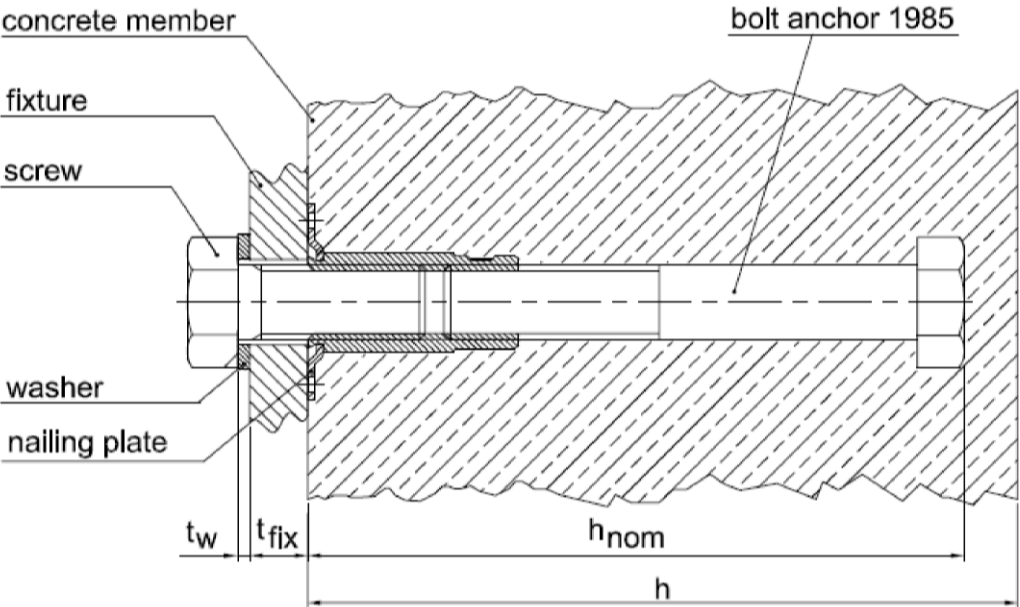
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 4 December 2015 by Deutsches Institut für Bautechnik

Uwe Bender
Head of Department

beglaubigt:
Tempel

DEMU Bolt anchor

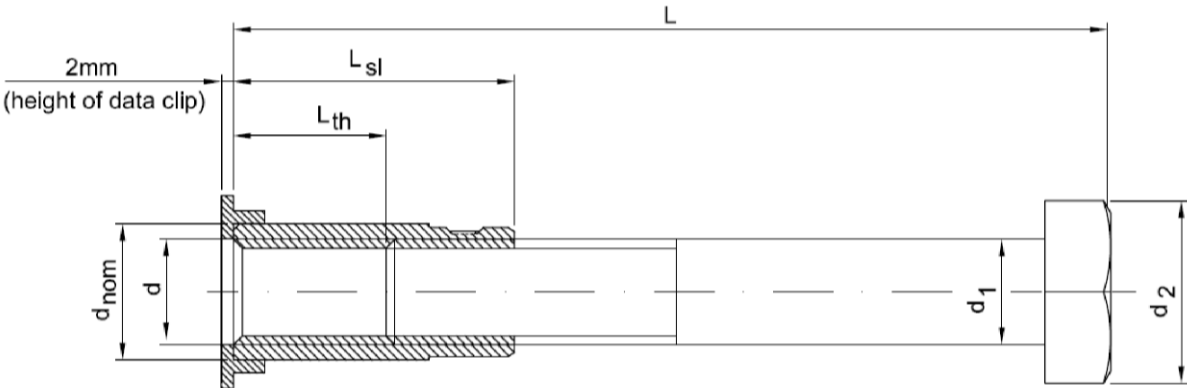


- h = thickness of concrete member
 t_{fix} = thickness of fixture
 t_w = thickness of washer
 h_{nom} = embedment depth

DEMU Bolt anchor

Product description
Installed condition

Annex A1



There are 4 different materials available for the DEMU Bolt anchor 1988:

- Material 1: Sleeve electroplated
- Material 2: Sleeve hot-dipped galvanised
- Material 3: Sleeve in stainless steel A4-50
- Material 4: Sleeve in stainless steel A4-80

Table A1: Dimensions of DEMU Bolt anchor 1988 with sleeves made of material 1 or 2

d	d _{nom}	L _{sl}	L _{th}	d ₁	d ₂	L
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
M12	15.5	35.0	23.0 - 25.4	12.0	18.0	55 / 100 / 150
M16	21.0	45.0	29.0 - 32.2	16.0	24.0	75 / 140 / 220
M20	26.0	55.0	35.0 - 39.0	20.0	30.0	90 / 150 / 180 / 270
M24	32.0	70.0	46.0 - 50.8	24.0	36.0	110 / 200 / 320
M30	40.0	90.0	60.0 - 66.0	30.0	46.0	160 / 240 / 380
M36	47.5	110.0	74.0 - 81.2	36.0	55.0	300 ¹⁾ / 420
M42	54.0	110.0	68.0 - 76.4	42.0	65.0	300 ¹⁾ / 460 ¹⁾

¹⁾ only available with sleeve made of material 1

Table A2: Dimensions of DEMU Bolt anchor 1988 with sleeves made of material 3 or 4

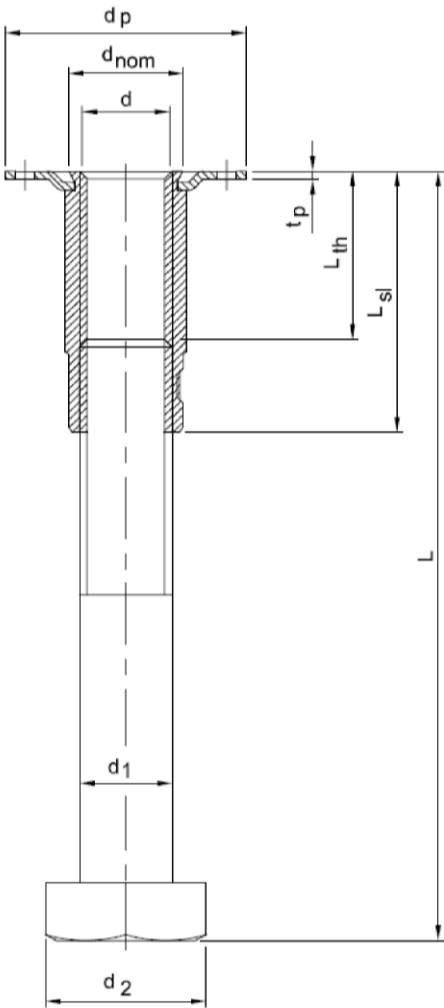
d	d _{nom}	L _{sl}	L _{th}	d ₁	d ₂	L
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
M12	15.5	35.0	23.0 - 25.4	12.0	18.0	100 / 150
M16	21.0	45.0	29.0 - 32.2	16.0	24.0	140 / 220
M20	26.0	55.0	35.0 - 39.0	20.0	30.0	150 / 180 / 270
M24	32.0	70.0	46.0 - 50.8	24.0	36.0	200 ²⁾
M30	40.0	90.0	60.0 - 66.0	30.0	46.0	240 ²⁾

²⁾ only available with sleeve made of material 4

DEMU Bolt anchor

Product description
Dimensions type 1988

Annex A2



The bolt anchor 1985 is available with a sleeve made of the following material:

Material 1: Sleeve electroplated

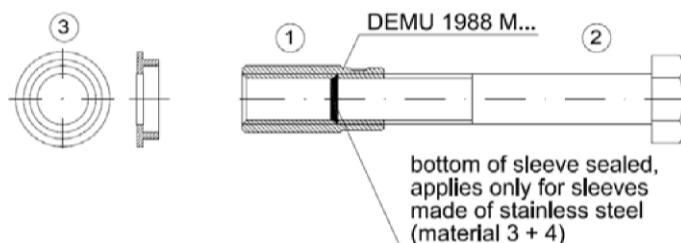
Table A3: Dimensions of DEMU Bolt anchor 1985 with sleeve / nailing plate made of material 1								
d	d _{nom}	L _{sl}	L _{th}	d ₁	d ₂	L	d _p	t _p
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
M12	15.5	35.0	23.0 - 25.4	12.0	18.0	150	40.0	1.0
M16	21.0	45.0	29.0 - 32.2	16.0	24.0	140	44.0	1.5
M20	26.0	55.0	35.0 - 39.0	20.0	30.0	180	48.2	1.5
M24	32.0	70.0	46.0 - 50.8	24.0	36.0	200	57.0	1.5

DEMU Bolt anchor

Product description
Dimensions type 1985

Annex A3

bolt anchor 1988



Marking:

e.g.: DEMU 1988 M16x140 GV

DEMU: identifying mark of the producer

1988: name of the anchor

M16x140: size

GV: material

Material:

GV: sleeve electroplated

FV: sleeve hot-dipped galvanised

A4-50: sleeve made of stainless steel A4-50

A4-80: sleeve made of stainless steel A4-80

bolt anchor 1985

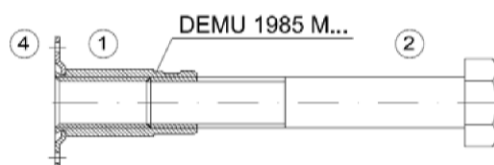


Table A4: Marking/specification and materials of bolt anchor

Item	Component	Material 1 Sleeve in electroplated steel (GV)	Material 2 Sleeve in hot-dipped galvanised steel (FV)
1	Sleeve	Mecaval 147M +N, E355 +N (1.0580), 20MnV6 +N (1.5217), acc. EN 10305-1, electroplated ¹⁾	Mecaval 147M +N, E355 +N (1.0580), 20MnV6 +N (1.5217), acc. EN 10305-1, hot-dipped galvanised ²⁾
2	Bolt	Hexagon head bolts acc. DIN 931 respect. hexagon head screws with thread up to the head acc. DIN 933, strength grade 8.8	
3	Data clip	for sleeve made of material 1+2: HDPE / RAL 7035 / (light-) grey	
4	Nailing plate	Sheet steel DC01 (1.0330), acc. EN 10130, electroplated ¹⁾	---
Item	Component	Material 3 Sleeve in stainless steel A4-50	Material 4 Sleeve in stainless steel A4-80
1	Sleeve	Stainless steel 1.4401 / 1.4404 / 1.4571 / 1.4362 / 1.4578 / 1.4062 / 1.4162 / 1.4662 / 1.4439 / 1.4462 / 1.4539 / 1.4565 / 1.4529 / 1.4547, acc. EN 10088-3, bottom of sleeve sealed ³⁾	Stainless steel 1.4401 / 1.4404 / 1.4571 / 1.4362 / 1.4578 / 1.4062 / 1.4162 / 1.4662 / 1.4439 / 1.4462 / 1.4539 / 1.4565 / 1.4529 / 1.4547, acc. EN 10297-2, bottom of sleeve sealed ³⁾
2	Bolt	Hexagon head bolts acc. DIN 931 respect. hexagon head screws with thread up to the head acc. DIN 933, strength grade 8.8, hot-dipped galvanised ⁴⁾	
3	Data clip	for sleeve made of material 3: HDPE / RAL 9003 / (signal-) white for sleeve made of material 4: HDPE / RAL 9005 / (jet-) black	

¹⁾ thickness of coating $\geq 5\mu\text{m}$ acc. EN ISO 4042

²⁾ thickness of coating $\geq 45\mu\text{m}$ (M12), $\geq 55\mu\text{m}$ (\geq M16) acc. EN ISO 1461

³⁾ protection of the front end of the screw against corrosion; for corrosion resistance requirements according to level 3a) mentioned in Annex A5, Table A5, the sealing may be omitted

⁴⁾ thickness of coating $\geq 40\mu\text{m}$ acc. EN ISO 10684

DEMU Bolt anchor

Product description
Marking and materials

Annex A4

Table A5: **Materials and intended use**

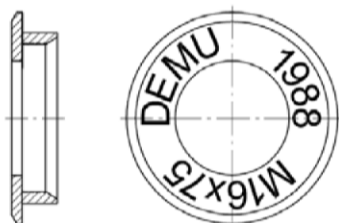
(washer, screw and suppl. reinforcement not included with the fixing system)

1	Specification	Intended use			
		1	2	3	
		Dry internal rooms, Insignificant corrosion exposure	Low corrosion exposure	Medium corrosion exposure	
		Bolt anchors may only be used in structures subject to dry internal conditions (e. g. accommodations, bureaus, schools, hospitals, shops).	Bolt anchors may also be used in structures in unheated / uninsulated buildings where condensation may occur (e. g. warehouses, sport halls), as well as in structures not exposed to rain in outside atmosphere with low level of pollution (mostly rural areas).	Bolt anchors may also be used in structures subject to external atmospheric exposure (including industrial and marine environment) or exposure in permanently damp internal conditions, if no particular aggressive conditions (e. g. permanent, alternating immersion in seawater) exist.	
				3a	3b
				Moderate level	Increased level
Medium exposure to chlorides, i. e. sufficient distance from the sea (> 1km) and offside from roads with road salt application (> 10m); with contact to low acidic substances (pH > 3); low exposure to sulfur, nitrogen (urban atmosphere).	High exposure to chlorides, e. g. inshore (≤ 1km) or next to busy roads with road salt application (≤ 10m); exposure to acids (pH ≤ 3); medium exposure to sulfur, nitrogen (industrial area); non-accessible structures (e. g. rear ventilated facades).				
Materials					
2	Bolt anchor	Bolt anchor acc. Table A4, material 1 ¹⁾	Bolt anchor acc. Table A4, material 2 ¹⁾	Bolt anchor acc. Table A4, material 3 and 4, without sealing of the bottom of the sleeve ¹⁾	Bolt anchor acc. Table A4, material 3 and 4, with special sealing of the bottom of the sleeve
3	Washer acc. EN ISO 7089/7093-1	Steel acc. EN 10025, galvanised ²⁾	Steel acc. EN 10025, hot-dipped galvanised ³⁾	Stainless steel 1.4401 / 1.4404 / 1.4571 / 1.4362 / 1.4578 / 1.4062 / 1.4162 / 1.4662 / 1.4439 / 1.4462 / 1.4539 / 1.4565 / 1.4529 / 1.4547, acc. EN 10088	
4	Screw	Steel acc. EN ISO 898-1, galv. ²⁾ , strength grade 4.6, 5.6 or 8.8	Steel acc. EN ISO 898-1, hot-dipped galv. ³⁾ , strength grade 4.6, 5.6 or 8.8	Stainless steel 1.4401 / 1.4404 / 1.4571 / 1.4362 / 1.4578 / 1.4062 / 1.4162 / 1.4662 / 1.4439 / 1.4462 / 1.4539 / 1.4565 / 1.4529 / 1.4547, acc. EN ISO 3506-1, strength grade A4-50, A4-70 or A4-80	
5	Suppl. Reinforcement	B500A or B500B	B500A or B500B	Stainless reinforcement steel respect. B500A or B500B meeting the requirements for concrete cover c _{nom} acc. EN 1992-1	

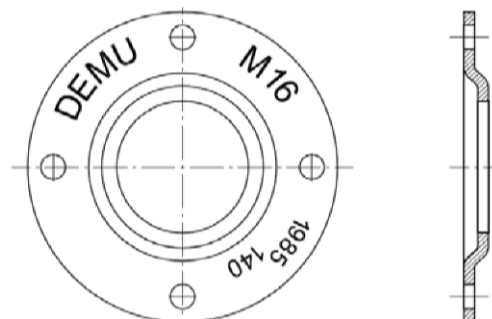
¹⁾ the inner area of the socket has to be protected against ingress of water, e. g. by using DEMU sealing cap or a screw acc. line 4

²⁾ thickness of coating ≥ 5 µm acc. EN ISO 4042

³⁾ thickness of coating ≥ 40 µm acc. EN ISO 10684



Data clip: section and top view (with example for marking)



Nailing plate: top view (with example for marking) and section

DEMU Bolt anchor

Product description
Materials and intended use, marking

Annex A5

Specifications of Intended use

Anchorage subject to:

- Static and quasi-static loads.
- Fire exposure: only for concrete C20/25 to C50/60.

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206:2013.
- Strength classes C20/25 to C90/105 according to EN 206:2013.
- Cracked or uncracked concrete.

Use conditions (Environmental conditions)

- according to Annex A5

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 anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages under static or quasi-static actions are designed in accordance with:
 - CEN/TS 1992-4:2009, part 1 and 2
- Anchorages under fire exposure are designed in accordance with:
 - CEN/TS 1992-4:2009, part 1, Annex D
(local spalling of the concrete cover must be avoided)
- The screw is chosen with corresponding screw-in length acc. to Annex B2, Table B1 and with the strength class acc. to Annex C1 and C3 subject to the required steel resistance and with the material acc. to Annex A5, Table A5.

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 any manipulation or exchanging the components.
- The anchors are fixed on the formwork so that no movement of the anchors will occur during the time of laying the reinforcement and of placing and compacting the concrete.
- Adequate compaction close to the anchor particularly at head of the bolt, e. g. without significant voids. The cast-in anchor is protected against ingress of concrete into the threaded socket.
- The setting torques given in Annex B2 are not exceeded.
- The inner area of the socket of the anchor without sealing of the bottom of the sleeve has to be protected against ingress water.

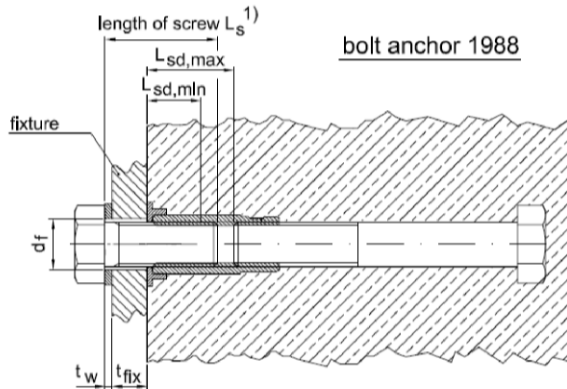
DEMU Bolt anchor

Intended use
Specifications

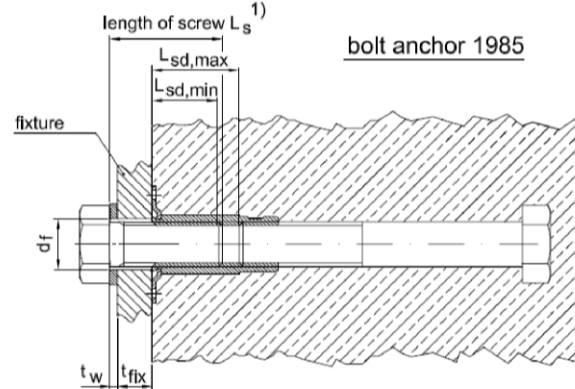
Annex B1

Direct contact between fixture and data clip / nailing plate

The fixture is braced to data clip / nailing plate, if necessary by suitable washer.



bolt anchor 1988

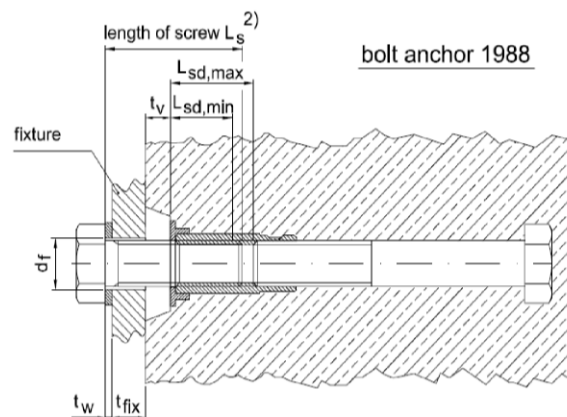


bolt anchor 1985

$$1) t_w + t_{fix} + L_{sd,min} \leq L_s \leq t_w + t_{fix} + L_{sd,max}$$

General application

The fixture is braced to concrete (anchor is embedded sunk in the concrete) resp. braced to concrete and data clip / nailing plate (anchor is embedded flush in the concrete).



bolt anchor 1988

$$2) t_w + t_{fix} + t_v + L_{sd,min} \leq L_s \leq t_w + t_{fix} + t_v + L_{sd,max}$$

Table B1: Installation parameters

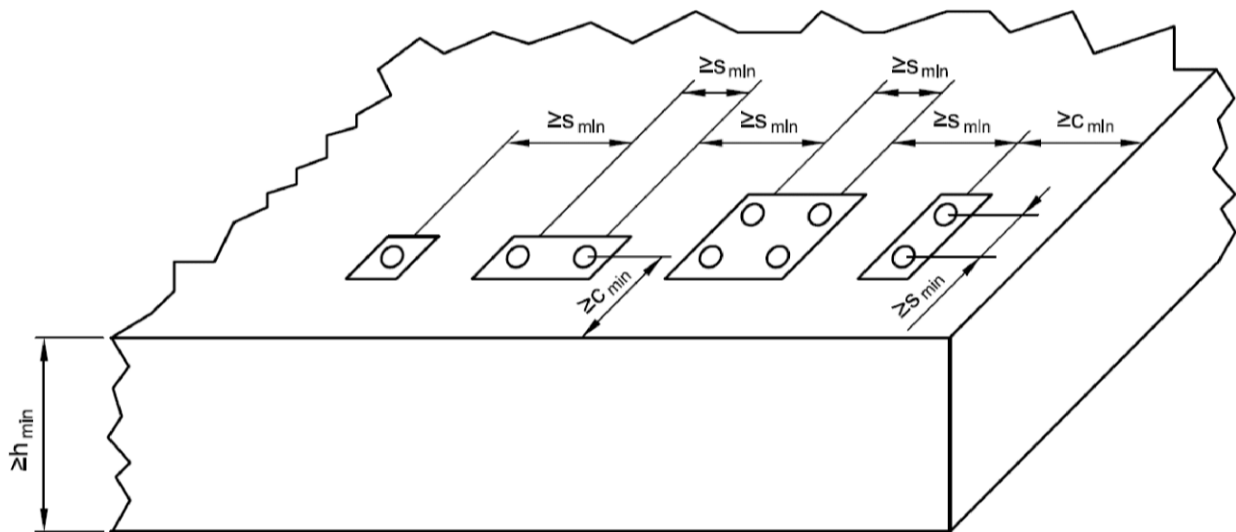
Thread size	d	[mm]	M12	M16	M20	M24	M30	M36	M42
Maximum torque moment	max. T _{inst}	[Nm]	≤ 10	≤ 30	≤ 50	≤ 90	≤ 180	≤ 250	≤ 300
Minimum screw-in length - 1988	L _{sd,min}	[mm]	16.4	21.2	26.0	30.8	38.0	45.2	52.4
Minimum screw-in length - 1985	L _{sd,min}	[mm]	18.0	24.0	30.0	36.0			
Maximum screw-in length - 1988	L _{sd,max} ¹⁾	[mm]	25.0	31.0	37.0	48.0	62.0	76.0	70.0
Maximum screw-in length - 1985	L _{sd,max}	[mm]	23.0	29.0	35.0	46.0			
Diameter of clearance hole in fixture	d _f	[mm]	14.0	18.0	22.0	26.0	33.0	39.0	45.0

¹⁾ For bolt anchors with sealing on bottom of sleeve (material 3 + 4) the values have to be decreased by 3.0 mm.

DEMU Bolt anchor

Intended use
Positions of the fixture, installation parameters

Annex B2



The mentioned spacings, edge distances and member thicknesses apply also for anchors installed in the front edge.

Table B2: Min. thickness of concrete member, min. edge distances and spacing									
Thread size	d	[mm]	M12	M16	M20	M24	M30	M36	M42
Minimum spacing	s _{min}	[mm]	100	100	120	150	180	220	260
Minimum edge distance	c _{min}	[mm]	50	50	60	75	90	110	130
Minimum thickness of concrete member	h _{min}	[mm]	h _{nom} + c _{nom} ¹⁾						
¹⁾ c _{nom} acc. EN 1992-1 with c _{nom} ≥ 20									

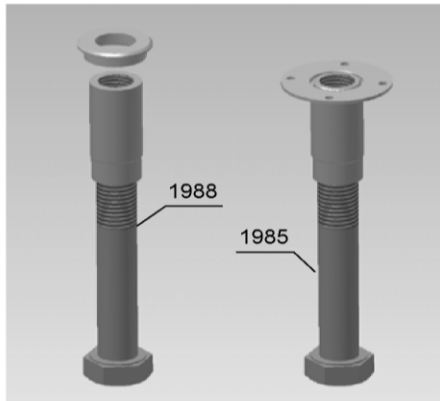
DEMU Bolt anchor

Intended use
Arrangement of anchors and member thickness

Annex B3

Installation instruction - part 1

1. Scope of delivery

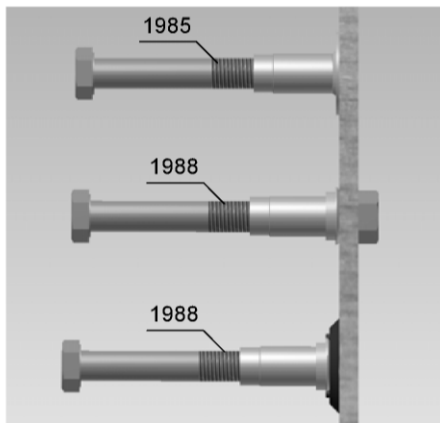


- 1) Selection of bolt anchor in accordance with the planning documents.

1a) DEMU Bolt anchor 1988 GV / FV / A4-50 / A4-80 or DEMU Bolt anchor 1985 GV

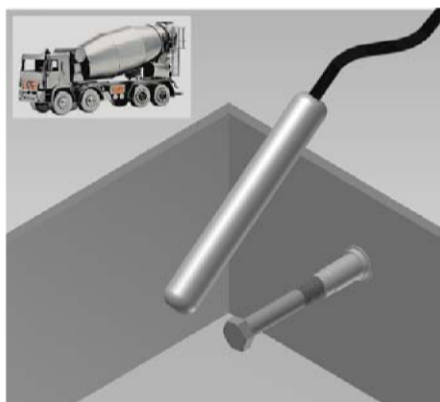
- 1b) Data clip for bolt anchor 1988 GV / FV, colour: grey;
Data clip for bolt anchor 1988 A4-50, colour: white;
Data clip for bolt anchor 1988 A4-80, colour: black.

2. Fixing of the anchor to the formwork



- 1) Attach data clip to the bolt anchor (this does not apply for type 1985).
- 2) Fix the anchor to the formwork with the help of DEMU assembly accessories (e. g. nailing plate) or alternatively by hexagon bolts.
→ The inside of the threaded socket must be protected against ingress of dirt and water.
- 3) If necessary, supplementary reinforcement has to be placed according to the planning documents.

3. Pouring and compacting of concrete



- 1) Pour concrete carefully, make sure the anchor stays in place!
- 2) Compact concrete carefully, avoid direct contact between compacting device and bolt anchor.
→ The anchor must not be moved by force or damaged!

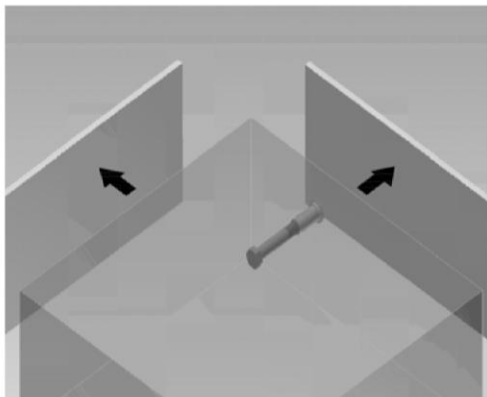
DEMU Bolt anchor

Intended use
Installation instruction – part 1

Annex B4

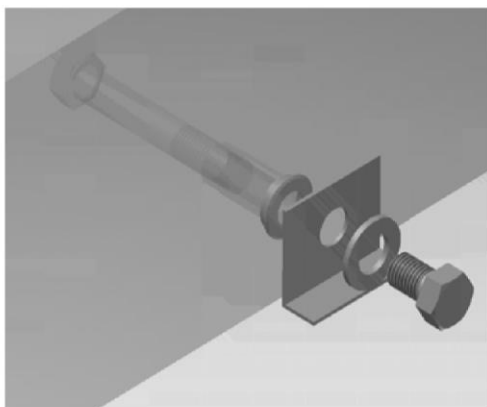
Installation instruction - part 2

4. Hardening of the concrete, striking the formwork



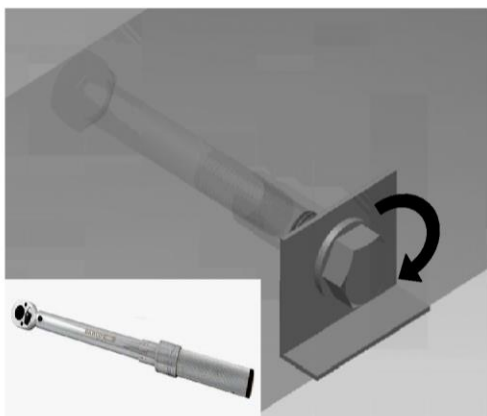
- 1) Remove assembly accessories and formwork.
- 2) Check if the inside of the threaded sleeve is free from dirt, otherwise clean it; further protection against ingress of water, dirt, etc. until required for use (e. g. by using DEMU-sealing cap).

5. Mounting of fixture



- 1) Make sure that the concrete has reached its final strength.
- 2) Check the length of the required bolt.
→ Maximum / minimum screw-in length according to Annex B2!
- 3) Mounting of the fixture
→ Use fixing components according to Annex A5, Table A5.
→ Maximum torque moments, see table below!
→ Take additionally care of assembly advices for the fixture.

6. Maximum torque moments



Apply torque moment with the help of a torque wrench.
 T_{inst} must not be exceeded.

Maximum torque moment T_{inst}						
Thread	d	[mm]	M12	M16	M20	M24
Max. torque moment	max. T_{inst}	[Nm]	≤ 10	≤ 30	≤ 50	≤ 90
Thread	d	[mm]	M30	M36	M42	
Max. torque moment	max. T_{inst}	[Nm]	≤ 180	≤ 250	≤ 300	

DEMU Bolt anchor

Intended use
Installation instruction – part 2

Annex B5

Table C1a: Characteristic values for tension loads										
Thread size	d	[mm]	M12	M16	M20	M24	M30	M36	M42	
Steel failure, bolt anchor (material 1 or 2) and screw (min. steel strength 4.6) made of electroplated / hot-dipped galvanised steel										
Characteristic resistance	N _{Rk,s}	[kN]	33.7	62.8	98.0	141.2	224.4	326.8	448.4 ²⁾	
Partial safety factor	γ _{M,s}	[-]				2.00				
Steel failure, bolt anchor (material 1 or 2) and screw (min. steel strength 5.6) made of electroplated / hot-dipped galvanised steel										
Characteristic resistance	N _{Rk,s}	[kN]	42.2	78.5	122.5	176.5	280.5	408.5	560.5 ²⁾	
Partial safety factor	γ _{M,s}	[-]				2.00				
Steel failure, bolt anchor (material 1 or 2) and screw (min. steel strength 8.8) made of electroplated / hot-dipped galvanised steel										
Characteristic resistance	N _{Rk,s}	[kN]	45.8	93.1	139.6	219.5	335.0	490.5	588.1 ²⁾	
Partial safety factor	γ _{M,s}	[-]				1.58				
zugehöriger Teilsicherheitsbeiwert										
Steel failure, bolt anchor (material 3: A4-50) and screw (min. steel strength A4-50) made of stainless steel										
Characteristic resistance	N _{Rk,s}	[kN]	42.2	81.0	110.3					
Partial safety factor	γ _{M,s}	[-]	2.86		3.09					
Steel failure, bolt anchor (material 3: A4-50) and screw (min. steel strength A4-70) made of stainless steel										
Characteristic resistance	N _{Rk,s}	[kN]	46.4	81.0	110.3					
Partial safety factor	γ _{M,s}	[-]	3.09							
Steel failure, bolt anchor (material 4: A4-80) and screw (min. steel strength A4-80) made of stainless steel										
Characteristic resistance	N _{Rk,s}	[kN]	59.0	125.6	180.1	282.4	448.8			
Partial safety factor	γ _{M,s}	[-]	1.48	1.60	1.48		1.60			
Pull-out failure										
Charact. resistance in cracked concrete	N _{Rk,p}	[kN]	25.1	44.7	69.8	100.5	168.9	240.3	341.0	
Charact. resistance in uncracked concrete	N _{Rk,p}	[kN]	35.2	62.5	97.7	140.7	236.4	336.4	477.4	
Increasing factors for N _{Rk,p} in cracked and uncracked concrete	C25/30	ψ _c				1.20				
	C30/37	ψ _c				1.48				
	C35/45	ψ _c				1.80				
	C40/50	ψ _c				2.00				
	C45/55	ψ _c				2.20				
	C50/60	ψ _c				2.40				
Partial safety factor	γ _{M,p}	[-]				1.50				
¹⁾ in absence of other national regulations; ²⁾ only available in GV (material 1 acc. to Annex A4)										

DEMU Bolt anchor

Performances
Characteristic values for tension loads

Annex C1

Table C1b: Characteristic values for tension loads																
Thread size	d	[mm]	M12	M16	M20	M24	M30	M36	M42							
Concrete cone failure																
Effective anchorage depth	$h_{ef}^{1)}$	[mm]	M12x55:	49.0	M16x75:	67.0	M20x90:	79.0	M24x110:	97.0	M30x160:	143.0	M36x300:	279.0	M42x300:	276.0
			M12x100:	94.0	M16x140:	132.0	M20x150:	139.0	M24x200:	187.0	M30x240:	223.0	M36x420:	399.0	M42x460:	436.0
			M12x150:	144.0	M16x220:	212.0	M20x180:	169.0	M24x320:	307.0	M30x380:	363.0				
Factor to take into account the influence of load transfer mechanisms in cracked and uncracked concrete	k_{cr}	[-]	-	-	M20x270:	259.0	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Characteristic spacing	$s_{cr,N}$	[mm]	8.5													
Characteristic edge distance	$c_{cr,N}$	[mm]	11.9													
Partial safety factor	$\gamma_{Mc}^{2)}$	[-]	3.0 • h_{ef}													
			1.5 • h_{ef}													
			1.50													
Splitting																
Effective anchorage depth	$h_{ef}^{1)}$	[mm]	M12x55:	49.0	M16x75:	67.0	M20x90:	79.0	M24x110:	97.0	M30x160:	143.0	M36x300:	279.0	M42x300:	276.0
			M12x100:	94.0	M16x140:	132.0	M20x150:	139.0	M24x200:	187.0	M30x240:	223.0	M36x420:	399.0	M42x460:	436.0
			M12x150:	144.0	M16x220:	212.0	M20x180:	169.0	M24x320:	307.0	M30x380:	363.0				
Characteristic spacing	$s_{cr,sp}$	[mm]	-	-	M20x270:	259.0	-	-	-	-	-	-	-	-	-	-
Characteristic edge distance	$c_{cr,sp}$	[mm]	4.0 • h_{ef}													
Partial safety factor	$\gamma_{Msp}^{2)}$	[-]	2.0 • h_{ef}													
			1.50													
¹⁾ for bolt anchor type 1985 the values have to be decreased by 2.0 mm; ²⁾ in absence of other national regulations																

Table C2: Displacements under tension loads									
Thread size	d	[mm]	M12	M16	M20	M24	M30	M36	M42
Displacements δ_{N0} to 0.7 mm for short term loading in cracked and uncracked concrete under following tension loads ¹⁾	N	[kN]	14.0	20.0	29.0	40.0	63.0	83.0	113.0
¹⁾ for long term tension loading the displacements $\delta_{N\infty}$ can be increased to 1.8 mm									

DEMU Bolt anchor

Performances
Characteristic values for tension loads, displacements under tension loads

Annex C2

Table C3a: Characteristic values for shear loads																
Thread size		d	[mm]	M12	M16	M20	M24	M30	M36	M42						
Shear loads without lever arm																
Group factor (CEN/TS 1992-4-2, 6.3.3.1)		k ₂	[-]	1,0												
Steel failure, bolt anchor (material 1 or 2) and screw (min. steel strength 4.6) made of electroplated / hot-dipped galvanised steel																
Characteristic resistance	V _{Rk,s}	[kN]	16,9	31,4	49,0	70,6	112,2	163,4	224,2 ²⁾							
Partial safety factor	V _{Mls} ¹⁾	[-]	1,67													
Steel failure, bolt anchor (material 1 or 2) and screw (min. steel strength 5.6) made of electroplated / hot-dipped galvanised steel																
Characteristic resistance	V _{Rk,s}	[kN]	21,1	39,3	61,3	88,3	140,3	204,3	280,3 ²⁾							
Partial safety factor	V _{Mls} ¹⁾	[-]	1,67													
Steel failure, bolt anchor (material 1 or 2) and screw (min. steel strength 8.8) made of electroplated / hot-dipped galvanised steel																
Characteristic resistance	V _{Rk,s}	[kN]	22,9	46,5	69,8	109,7	167,5	245,2	294,1 ²⁾							
Partial safety factor	V _{Mls} ¹⁾	[-]	1,32													
Steel failure, bolt anchor (material 3: A4-50) and screw (min. steel strength A4-50) made of stainless steel																
Characteristic resistance	V _{Rk,s}	[kN]	21,1	40,5	55,1											
Partial safety factor	V _{Mls} ¹⁾	[-]	2,38	2,58												
Steel failure, bolt anchor (material 3: A4-50) and screw (min. steel strength A4-70) made of stainless steel																
Characteristic resistance	V _{Rk,s}	[kN]	23,2	40,5	55,1											
Partial safety factor	V _{Mls} ¹⁾	[-]	2,58													
Steel failure, bolt anchor (material 4: A4-80) and screw (min. steel strength A4-80) made of stainless steel																
Characteristic resistance	V _{Rk,s}	[kN]	29,5	62,8	90,0	141,2	224,4									
Partial safety factor	V _{Mls} ¹⁾	[-]	1,23	1,33	1,23	1,33										
Shear loads with lever arm: see Annex C4, Table C3b																
Pry-out failure																
Factor	k ₃	[-]	M12x55:	1,0	2,0		2,0	2,0	2,0	2,0						
			M12x100:	2,0												
			M12x150:	2,0												
Partial safety factor	V _{Mcp} ¹⁾	[-]	1,50													
Concrete edge failure (without suppl. reinforcement)																
Effective length of fixing anchor (for shear loads)	l _f	[mm]	M12x55:	47,0	M16x75:	65,0	M20x90:	77,0	M24x110:	95,0	M30x160:	141,0	M36x300:	277,0	M42x300:	274,0
			M12x100:	92,0	M16x140:	130,0	M20x150:	137,0	M24x200:	185,0	M30x240:	221,0	M36x420:	380,0	M42x460:	432,0
			M12x150:	124,0	M16x220:	168,0	M20x180:	167,0	M24x320:	256,0	M30x380:	320,0				
							M20x270:		208,0							
Effective outside diameter	d _{nom}	[mm]			21,0		26,0		32,0		40,0		47,5		54,0	
Partial safety factor	V _{Mce} ¹⁾	[-]	1,50													
¹⁾ in absence of other national regulations, ²⁾ only available in GV (material 1 acc. to Annex A4)																

DEMU Bolt anchor

Performances
Characteristic values for shear loads

Annex C3

Table C3b: Characteristic values for shear loads									
Thread size	d	[mm]	M12	M16	M20	M24	M30	M36	M42
Shear loads with lever arm									
Steel failure, bolt anchor (material 1 or 2) and screw (min. steel strength 4.6) made of electroplated / hot-dipped galvanised steel									
Characteristic resistance	M ⁰ _{RK,s}	[Nm]	52.4	133.2	259.6	449.0	899.6	1581.0	2541.1 ²⁾
Partial safety factor	γ _{M5}	[-]	1.67						
Steel failure, bolt anchor (material 1 or 2) and screw (min. steel strength 5.6) made of electroplated / hot-dipped galvanised steel									
Characteristic resistance	M ⁰ _{RK,s}	[Nm]	65.5	166.5	324.5	561.3	1124.5	1976.3	3176.3 ²⁾
Partial safety factor	γ _{M5}	[-]	1.67						
Steel failure, bolt anchor (material 1 or 2) and screw (min. steel strength 8.8) made of eletroplated / hot-dipped galvanised steel									
Characteristic resistance	M ⁰ _{RK,s}	[Nm]	104.8	266.4	519.3	898.0	1799.2	3162.1	5082.1 ²⁾
Partial safety factor	γ _{M5}	[-]	1.25						
Steel failure, bolt anchor (material 3: A4-50) and screw (min. steel strength A4-50) made of stainless steel									
Characteristic resistance	M ⁰ _{RK,s}	[Nm]	65.5	166.5	324.5				
Partial safety factor	γ _{M5}	[-]	2.38						
Steel failure, bolt anchor (material 3: A4-50) and screw (min. steel strength A4-70) made of stainless steel									
Characteristic resistance	M ⁰ _{RK,s}	[Nm]	91.7	383.7	659.4				
Partial safety factor	γ _{M5}	[-]	1.56	2.58					
Steel failure, bolt anchor (material 3: A4-50) and screw (min. steel strength A4-80) made of stainless steel									
Characteristic resistance	M ⁰ _{RK,s}	[Nm]	161.6	383.7	659.4				
Partial safety factor	γ _{M5}	[-]	2.58						
Steel failure, bolt anchor (material 4: A4-80) and screw (min. steel strength A4-80) made of stainless steel									
Characteristic resistance	M ⁰ _{RK,s}	[Nm]	104.8	266.4	519.3	898.0	1799.2		
Partial safety factor	γ _{M5}	[-]	1.33						
¹⁾ in absence of other national regulations; ²⁾ only available in GV (material 1 acc. to Annex A4)									

Table C4: Displacements under shear loads									
Thread size	d	[mm]	M12	M16	M20	M24	M30	M36	M42
Displacements δ _{v0} to 1.5 mm for short term loading in cracked and uncracked concrete under following shear loads ¹⁾									
	V	[kN]	13.0	23.0	36.0	52.0	82.0	120.0	160.0
¹⁾ for long term shear loading the displacements δ _{v,∞} can be increased to 2.0 mm									

DEMU Bolt anchor

Performances
Characteristic values for shear loads, displacements under shear loads

Annex C4

Table C5: Characteristic values for resistance to fire

Thread size	d	[mm]	M12	M16	M20	M24	M30	M36	M42	
Steel failure for tension and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$), bolt anchor (material 1 or 2) and screw made of electroplated / hot-dipped galvanised steel										
Characteristic resistance	R30	$F_{Rk,s,fi}$	[kN]	1.5	3.0	4.5	7.1	10.8	15.8	19.0
	R60	$F_{Rk,s,fi}$	[kN]	1.1	2.3	3.4	5.3	8.1	11.9	14.2
	R90	$F_{Rk,s,fi}$	[kN]	1.0	2.0	2.9	4.6	7.0	10.3	12.3
	R120	$F_{Rk,s,fi}$	[kN]	0.7	1.5	2.3	3.5	5.4	7.9	9.5
Partial safety factor		$\gamma_{Ms,fi}^{1)}$	[-]	1.00						
Characteristic resistance	R30	$M_{Rk,s,fi}^0$	[Nm]	2.6	6.7	13.0	22.5	45.0	79.1	127.1
	R60	$M_{Rk,s,fi}^0$	[Nm]	2.0	5.0	9.7	16.8	33.7	59.3	95.3
	R90	$M_{Rk,s,fi}^0$	[Nm]	1.7	4.3	8.4	14.6	29.2	51.4	82.6
	R120	$M_{Rk,s,fi}^0$	[Nm]	1.3	3.3	6.5	11.2	22.5	39.5	63.5
Partial safety factor		$\gamma_{Ms,fi}^{1)}$	[-]	1.00						
Steel failure for tension and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$), bolt anchor (material 3 or 4) and screw made of stainless steel										
Characteristic resistance	R30	$F_{Rk,s,fi}$	[kN]	2.2 / 2.5 ²⁾	4.5 / 4.6 ²⁾	6.8	10.6	16.2	-	-
	R60	$F_{Rk,s,fi}$	[kN]	1.8 / 2.1 ²⁾	3.8 / 3.9 ²⁾	5.6	8.8	13.5		
	R90	$F_{Rk,s,fi}$	[kN]	1.5 / 1.6 ²⁾	3.0 / 3.1 ²⁾	4.5	7.1	10.8		
	R120	$F_{Rk,s,fi}$	[kN]	1.2 / 1.3 ²⁾	2.4 / 2.5 ²⁾	3.6	5.6	8.6		
Partial safety factor		$\gamma_{Ms,fi}^{1)}$	[-]	1.00						
Characteristic resistance	R30	$M_{Rk,s,fi}^0$	[Nm]	3.9	10.0	19.5	33.7	67.5	-	-
	R60	$M_{Rk,s,fi}^0$	[Nm]	3.3	8.3	16.2	28.1	56.2		
	R90	$M_{Rk,s,fi}^0$	[Nm]	2.6	6.7	13.0	22.5	45.0		
	R120	$M_{Rk,s,fi}^0$	[Nm]	2.1	5.3	10.4	18.0	36.0		
Partial safety factor		$\gamma_{Ms,fi}^{1)}$	[-]	1.00						
Pull-out failure										
Characteristic resistance	R90	$N_{Rk,p,fi}$	[kN]	$N_{Rk,p,fi(90)} = 0.25 \cdot N_{Rk,p}$						
	R120	$N_{Rk,p,fi}$	[kN]	$N_{Rk,p,fi(120)} = 0.20 \cdot N_{Rk,p}$						
Partial safety factor		$\gamma_{Mp,fi}^{1)}$	[-]	1.00						
Concrete cone failure										
Characteristic resistance	R90	$N_{Rk,c,fi}$	[kN]	$N_{Rk,c,fi(90)}^0 = h_{ef}/200 \cdot N_{Rk,c}^0 \leq N_{Rk,c}^0$						
	R120	$N_{Rk,c,fi}$	[kN]	$N_{Rk,c,fi(120)}^0 = 0.8 \cdot h_{ef}/200 \cdot N_{Rk,c}^0 \leq N_{Rk,c}^0$						
Characteristic spacing		$s_{cr,N,fi}$	[mm]	$4.0 \cdot h_{ef}$						
Characteristic edge distance		$c_{cr,N,fi}$	[mm]	$2.0 \cdot h_{ef}$						
Partial safety factor		$\gamma_{Mc,fi}^{1)}$	[-]	1.00						
Concrete pry-out failure										
Characteristic resistance	R90	$V_{Rk,cp,fi}$	[kN]	$V_{Rk,cp,fi(90)} = k_3 \cdot N_{Rk,c,fi(90)}$						
	R120	$V_{Rk,cp,fi}$	[kN]	$V_{Rk,cp,fi(120)} = k_3 \cdot N_{Rk,c,fi(120)}$						
Partial safety factor		$\gamma_{Mc,fi}^{1)}$	[-]	1.00						
Concrete edge failure										
Characteristic resistance	R90	$V_{Rk,c,fi}$	[kN]	$V_{Rk,c,fi(90)}^0 = 0.25 \cdot V_{Rk,c}^0$						
	R120	$V_{Rk,c,fi}$	[kN]	$V_{Rk,c,fi(120)}^0 = 0.20 \cdot V_{Rk,c}^0$						
Partial safety factor		$\gamma_{Mc,fi}^{1)}$	[-]	1.00						
1) in absence of other national regulations; 2) higher value applies for material 3 (acc. to Annex A4)										

DEMU Bolt anchor

Performances
Characteristic values for resistance to fire

Annex C5