HECO SCHRAUBEN

European Technical Assessment – Option 1 for cracked concrete

ETA-15/0784

MULTI-MONTI®-plus

European Technical Assessment ETA-15/0784

Mechanical fasteners for use in concrete

Deutsches Institut für Bautechnik

Member of EOTA
www.eota.eu

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-15/0784 of 2 June 2021

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	MULTI-MONTI-plus
Product family to which the construction product belongs	Mechanical fasteners for use in concrete
Manufacturer	HECO-Schrauben GmbH & Co. KG Dr.-Kurt-Steim-Straße 28 78713 Schramberg DEUTSCHLAND
Manufacturing plant	HECO-Schrauben GmbH & Co. KG Werk Schramberg
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	EAD 330232-01-0601, Edition 05/2021
This version replaces	ETA-15/0784 issued on 23 April 2018

Deutsches Institut für Bautechnik
Kolonnenstraße 30 B | 10829 Berlin | GERMANY | Phone: +49 30 78730-0 | Fax: +49 30 78730-320 | Email: dibt@dibt.de | www.dibt.de

The European Technical Assessment is issued by the Technical Assessment Body in its official language. Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and shall be identified as such.

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full. However, partial reproduction may only be made with the written consent of the issuing Technical Assessment Body. Any partial reproduction shall be identified as such.

This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission in accordance with Article 25(3) of Regulation (EU) No 305/2011.

Specific Part

1 Technical description of the product

The Screw anchor MULTI-MONTI-plus is an anchor in size 6, 7.5, 10, 12, 16 and 20 mm made of galvanised or stainless steel. The anchor is screwed into a predrilled cylindrical drill hole. The special thread of the anchor cuts an internal thread into the member while setting. The anchorage is characterised by mechanical interlock in the special thread.

Product and product description is given in Annex A.

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

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

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

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1 and C 2
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1 and C 2
Displacements	See Annex C 6 and C 7
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 3 and C 4

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 5

3.3 Aspects of durability linked with the Basic Works Requirements

Essential characteristic	Performance
Durability	See Annex B 1

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

In accordance with the European Assessment Document EAD 330232-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

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

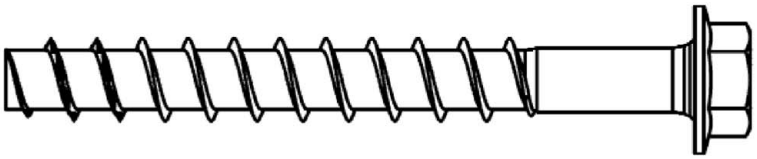
Issued in Berlin on 2 June 2021 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Referatsleiterin

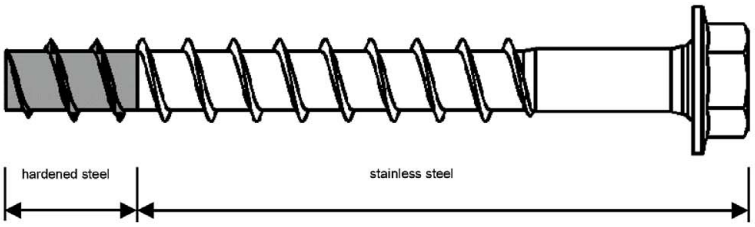
beglaubigt:
Tempel

Deutsches Institut für Bautechnik DIBt

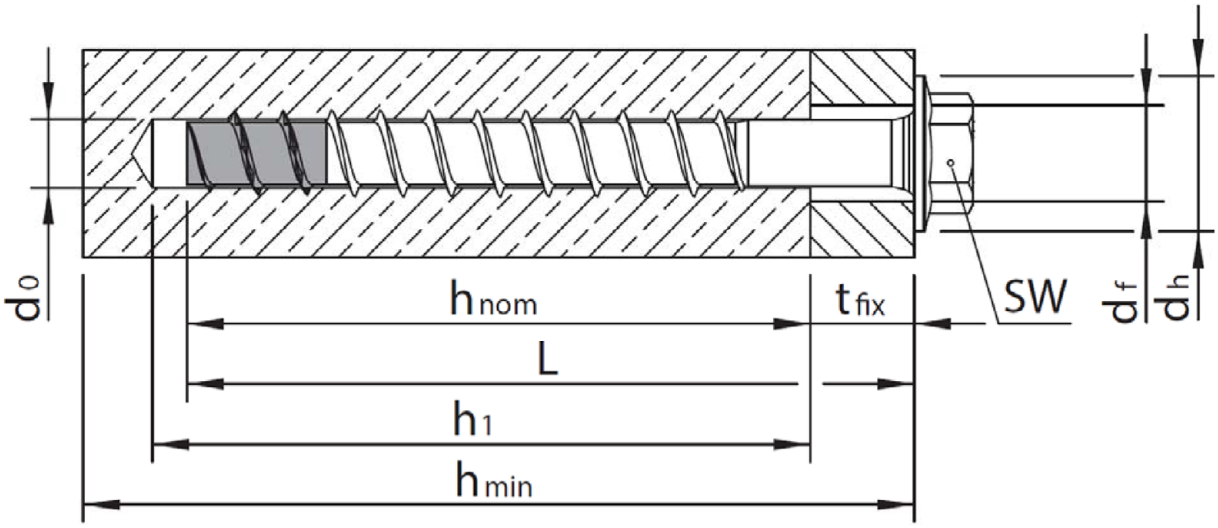
Installed condition



MMS-plus / carbon steel



MMS-plus / stainless steel



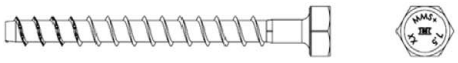
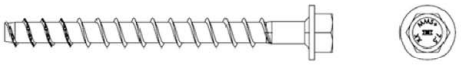
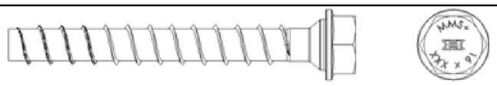
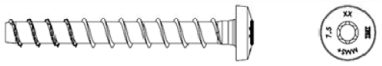
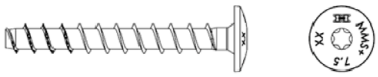
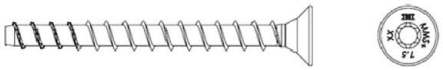
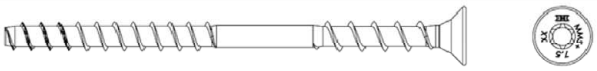
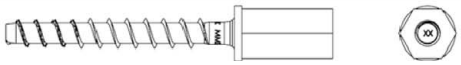
e.g. MMS-plus A4 SS stainless steel with hexagon head and washer

d_0	=	nominal borehole diameter
h_{nom}	=	nominal anchorage depth
h_1	=	borehole depth
h_{min}	=	minimum thickness of concrete member
t_{fix}	=	thickness of fixture
d_f	=	diameter of clearance hole in the fixture

MULTI-MONTI-plus	**Annex A 1**
Product description Product in the installed state	

Deutsches Institut für Bautechnik DIBt

Table A1: Screw types

Type	Marking
	1) Hexagon Head with and without washer (alternative design with cone under the head) **(S)**
	2) Hexagon Head and washer **(SS)**
	3) Hexagon Head and washer (alternative design with cone under the head) **(SSK)**
	4) PanHead, with small Pan Head **(P)**
	5) Mounting bar-anchor, with large Pan Head **(MS)**
	6) Countersunk head **(F)**
	7) Countersunk head with under head thread and single- or multi-start thread **(FT)**
	8) Cylinder Head with under head thread and single- or multi-start thread **(ZT, SST & PT)**
	9) Anchor with metric stud **(ST)**
	10) Anchor with metric stud for mounting of nuts (pre-assembled with sleeve) **(I)**
	11) Anchor with metric stud **(V)**
	12) Pan Head with under head thread and single- or multi-start thread, different diameters compared to the concrete thread (others expression possible) **(DWC)**
	13) Countesunk Head with under head thread, different diameters compared to the concrete thread **(TC)**

MULTI-MONTI-plus

Product description
Dimensions and screw types

Annex A 2

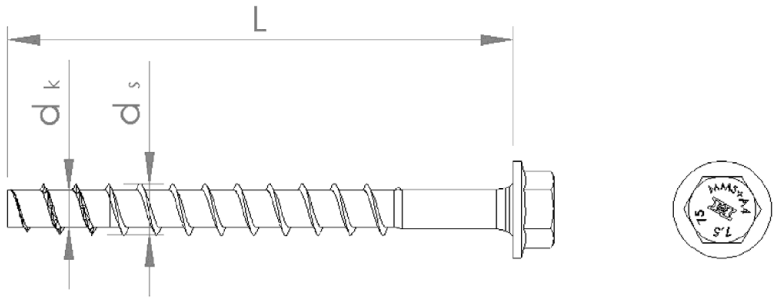
Deutsches Institut für Bautechnik DIBt

Table A2: Dimensions, materials and head markings

carbon steel [1]			Ø					
			6	7,5	10	12	16	20
Thread diameter	d_s	[mm]	6,65	7,75	10,5	12,6	16,7	21,2
Core diameter	d_k	[mm]	4,3	5,45	7,3	9,05	13,3	17,4
Length	L ≥	[mm]	35	35	50	75	100	140
	L ≤	[mm]	500	500	500	600	800	800
Rupture elongation	A_5	[%]	≤ 8					
1) galvanized steel EN 10263-4:2001 (multi-layered coating systems are possible)								

stainless steel [2]			Ø		
			7,5	10	12
Thread diameter	d_s	[mm]	7,65	10,5	12,6
Core diameter	d_k	[mm]	5,45	7,3	9,25
Length	L ≥	[mm]	35	60	90
	L ≤	[mm]	500	500	500
Rupture elongation	A_5	[%]	≥ 8		
2) stainless steel 1.4401, 1.4462, 1.4578, 1.4529 und 1.4571 according EN 10088-1:2005					

Identification



Marking	Attribute
H	Factory sign
MMS+	Anchor type
z.B. 7,5	Anchor size
z.B. 75	Anchor length
A4 + A5	adtional marking for stainless steel and CRC III
FA	adtional marking for stainless steel and CRC IV
KK	adtional marking for high corrosion resistance steel and CRC V

Materials	Marking
carbon steel	MMS+
1.4401 / 1.4578	MMS+ A4
1.4462	MMS+ FA
1.4571	MMS+ A5
1.4529	MMS+ KK

Deutsches Institut für Bautechnik DIBt

Specifications of intended use

Table B1: Use of the anchoring:

Size MMS-plus			**6**	**7,5**	**10**	**12**	**16**	**20**
Embedment depth	h_{nom}	[mm]	alle					
Head shapes			alle					
Static and quasi static loads			ok					
Fire exposure								
Size MMS-plus			**10**		**12**		**16**	**20**
Embedment depth	h_{nom}	[mm]	65		75	90	115	140
Head shapes			1 – 13		1 – 13		1 – 13	1 – 13
Seismic actions [1) 2)]		C1	ok		ok		ok	ok
		C2	no performance assessed					

1) Only Carbon Stahl (A4-/HCR-Steel not assessed)
2) With head shape 9 + 10 und use of metric thread only axial seismic actions are allowed

Base Materials:

- Compacted reinforced or non-reinforced normal weight concrete without fibres according to EN 206:2013 + A1:2016
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A1:2016
- Cracked and uncracked concrete

Conditions of use (Environmental conditions):

- Structures subject to dry internal conditions
- For all other conditions according to EN 1993-1-4:2015, Table A.1 corresponding to corrosion resistance classes:
  - CRC III: screw with head marking MMS+ A4, MMS+ A5
  - CRC IV: screw with head marking MMS+ FA
  - CRC V: screw with head marking MMS+ KK

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.)
- The design of the anchoring under static or quasi-static actions and fire exposure have to be carried out in accordance with EN 1992-4:2018 and EOTA Technical Report TR 055
- The design under shear load according to EN 1992-4:2018, section 6.2.2 applies to all in appendix B2, table B1 specified diameter df the diameter of clearance hole in the fixture

Installation:

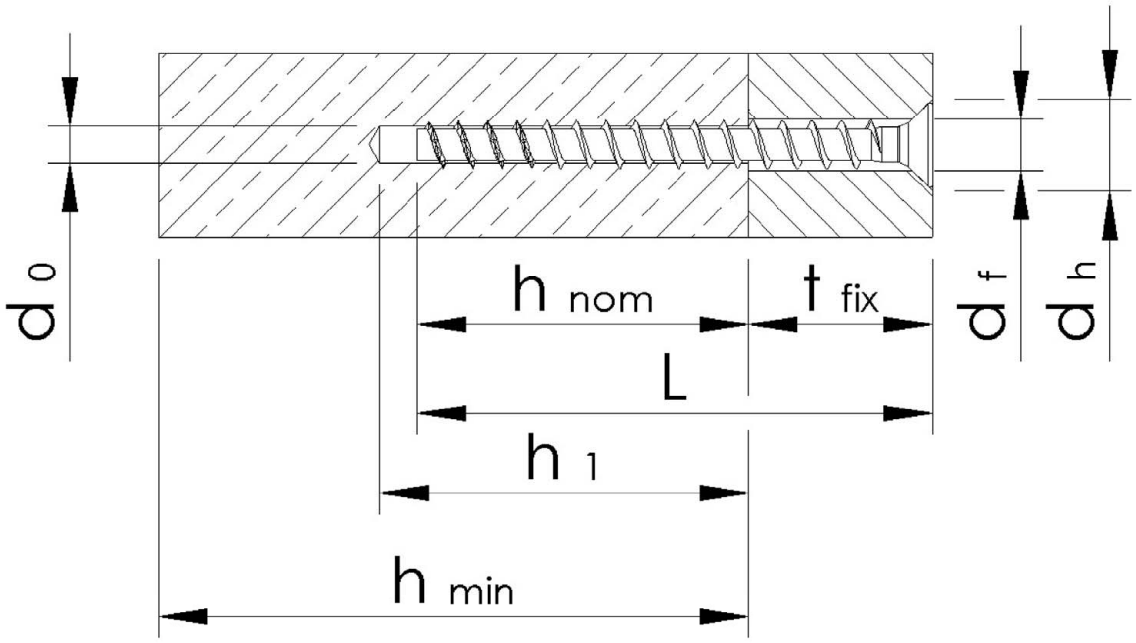
- Hole drilling by hammer-drilling only
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- After installation further turning of the anchor must not be possible
- The head of the anchor is attached to the fixture and is not damaged, respectively the required embedment depth is reached.

MULTI-MONTI-plus	**Annex B 1**
Intended Use Specification	

Deutsches Institut für Bautechnik DIBt

Table B2: Installation parameters MMS-plus carbon steel

Size MMS-plus			**6**		**7,5**		**10**		**12**		**16**		**20**
Embedment depth	h_{nom}	[mm]	35	45	35	55	50	65	75	90	100	115	140
Norminal drill diameter	d_0	[mm]	5		6		8		10		14		18
Drill bit cutting-Ø	$d_{cut} \leq$	[mm]	5,40		6,40		8,45		10,45		14,50		18,50
Borehole depth	$h_1 \geq$	[mm]	40	50	40	65	60	75	85	100	115	130	160
Diameter of clearance hole	$d_f \leq$	[mm]	7		9		12,5		14,5		19		23
Diameter Countersunk	d_h	[mm]	11,5		15,5		19,5		24		-		-
Min. thickness of the concrete member	h_{min}	[mm]	100		100		100	115	125	150	150		180
cracked and uncracked concrete — min. spacing	s_{min}	[mm]	30		35		35		40		60		80
cracked and uncracked concrete — min. edge distance	c_{min}	[mm]	30		30		35		40		60		80
Recommended installation tool		[Nm]	Impact screw driver, max. power output T_{max} according manufacturer information										
			75	100	120		250		250		600		800
Torque moment for threaded version (MMS-plus V)	T_{inst}	[Nm]	-		15		20		30		55	70	140



MULTI-MONTI-plus

Intended Use
Installation parameters

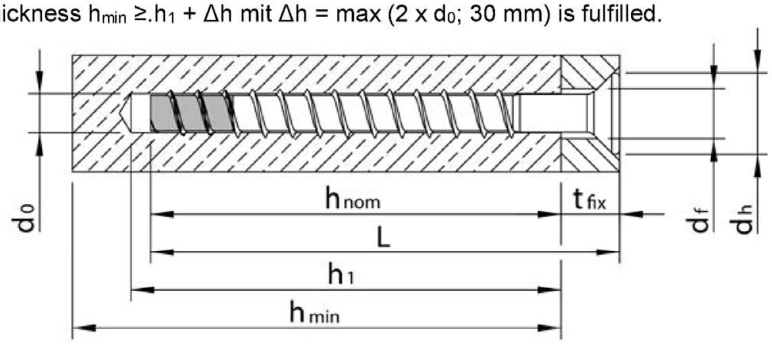
Annex B 2

Deutsches Institut für Bautechnik DIBt

Table B3: Installation parameters MMS-plus stainless steel

Size MMS-plus A4				**7,5**			**10**		**12**	
Norminal drill diameter		d_0	[mm]	6			8		10	
Drill bit cutting-Ø		$d_{cut} \leq$	[mm]	6,40			8,45		10,45	
Embedment depth $h_{nom,standard}$		h_{nom}	[mm]	40	55	75	70	85	100	115
Borehole depth with cleaning		$h_1 \geq$	[mm]	45	60	85	80	95	110	125
Borehole depth without cleaning[1)]		$h_1 \geq$	[mm]	$h_{nom} + 2 \times d_o$						
Borehole depth with adjustment[1)]		$h_{1,adj} \geq$	[mm]	-	$h_{nom,adj,0} + 10$ mm					
Borehole depth without cleaning and with adjustment[1)]		$h_{1,adj} \geq$	[mm]	-	$h_{nom,adj,0} + 2 \times d_0$					
Embedment depth $h_{nom,reduced}$		h_{nom}	[mm]	35	50	65	60	75	90	105
Borehole depth with cleaning		$h_1 \geq$	[mm]	40	55	75	70	85	100	115
Borehole depth without cleaning[1)]		$h_1 \geq$	[mm]	$h_{nom} + 2 \times d_o$						
Borehole depth with adjustment[1)]		$h_{1,adj} \geq$	[mm]	-	$h_{nom,adj,0} + 10$ mm					
Borehole depth without cleaning and with adjustment[1)]		$h_{1,adj} \geq$	[mm]	-	$h_{nom,adj,0} + 2 \times d_0$					
Diameter of clearance hole		$d_f \leq$	[mm]	9,0			12,5		14,5	
Diameter Countersunk		d_h	[mm]	13,6			17		21	
Min. thickness of the concrete member		h_{min}	[mm]	100			115	125	150	
cracked and unscracked concrete	min. spacing	s_{min}	[mm]	35			35		40	
	min. edge distance	c_{min}	[mm]	30			35		40	
Recommended installation tool			[Nm]	Impact screw driver, max. power output T_{max} according manufacturer information						
				185	200		450		600	

1) It should be ensured that the requirement for the minimum component thickness $h_{min} \geq h_1 + \Delta h$ mit Δh = max (2 x d_0; 30 mm) is fulfilled.



MULTI-MONTI-plus

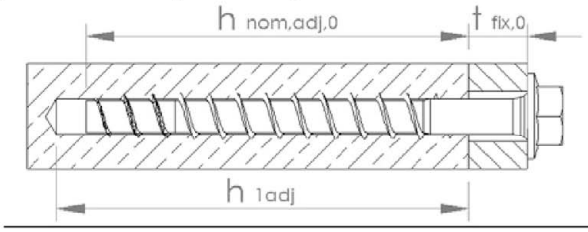
Intended Use
Installation parameters

Annex B 3

Deutsches Institut für Bautechnik DIBt

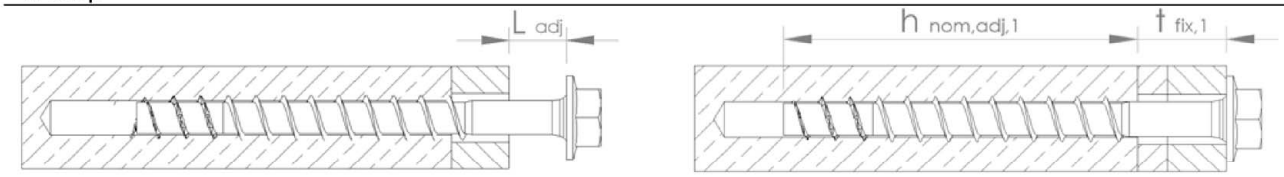
Adjustment MMS-plus stainless steel

Borehole depth for adjustment

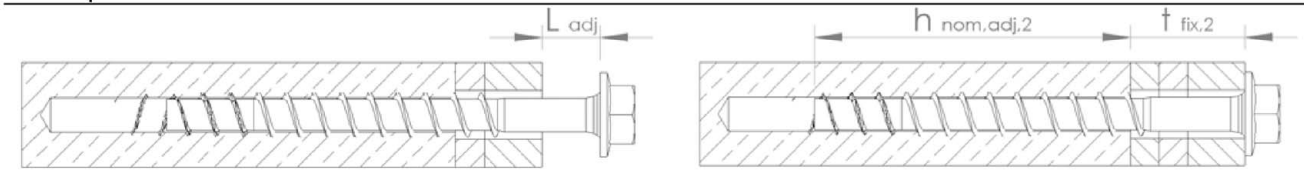


Adjustment

1. Step



2. Step



Controlling of adjustment and mounting

A screw can be adjusted maximum two times. The screw may be loosened up to a maximum L_{adj} = 10 mm from the surface of the attachment. The borehole depth for adjustment should be $h_{1,adj}$ (see table B3 Annex B3). The total allowed thickness of the shims added during the adjustment process is 10 mm. The final embedment depth after adjustment process must be larger or equal than h_{nom1} and h_{nom2}, or h_{nom2} and h_{nom3} for 7,5.

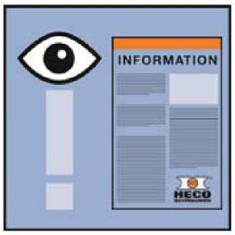
MULTI-MONTI-plus

Intended Use
Installation parameters

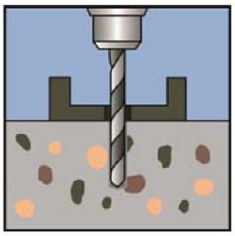
Annex B 4

Deutsches Institut für Bautechnik DIBt

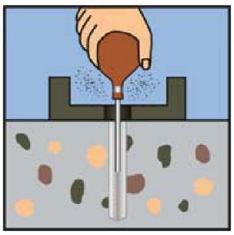
Installation instructions



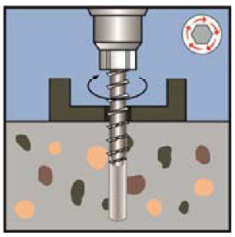
Note the information of the approval!



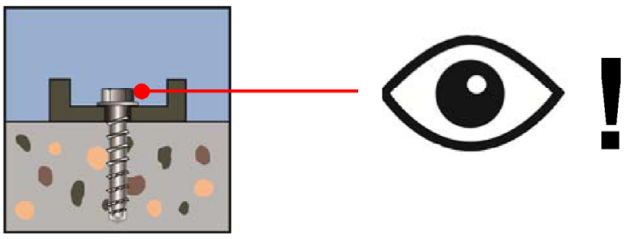
Create borehole using a Rotary Hammer.



Clean borehole, e.g. with blowing out.



Install of the screw anchor with an impact wrench or by hand.



Check: The anchor head is fully supported on the fixture an not damaged.

MULTI-MONTI-plus	**Annex B 5**
Intended Use Installation instruction	

Deutsches Institut für Bautechnik DIBt

Table C1: Characteristic values for static and quasi-static loading MMS-plus carbon steel

Size MMS-plus				**6**		**7,5**		**10**		**12**		**16**		**20**
Embedmend depth		h_{nom}	[mm]	35[1)]	45	35[1)]	55	50	65	75	90	100	115	140
Steel failure for tension- and shear load														
Characteristic resistance		$N_{Rk,s}$	[kN]	10,8		17,6		32,1		49,9		111,1		190,2
Partial safety factor		$\gamma_{Ms,N}$	[-]	1,50										
Characteristic resistance		$V^0_{Rk,s}$	[kN]	4,1		6,1		13,7		24,1		50,2		85,3
Partial safety factor		$\gamma_{Ms,V}$	[-]	1,25										
Ductility factor		k_7	[-]	0,8										
Characteristic resistance		$M^0_{Rk,s}$	[Nm]	6,7		14,1		34,5		66,8		207,6		464,3
Pullout														
Characteristic resistance in uncracked concrete C20/25		$N_{Rk,p}$	[kN]	5,5	8	4	≥ $N^0_{Rk,c}$							
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	1	1,5	2	4	6	9	12	16	20	30	44
Increasing factor for concrete	C30/37	Ψ_c	[-]	1,22										
	C40/50			1,41										
	C50/60			1,58										
Concrete cone failure and splitting failure														
Effective anchorage depth		h_{ef}	[mm]	26	35	26	43	36	50	57	70	77	90	114
Factor for	cracked	$k_{cr,N}$	[-]	7,7										
	uncracked	$k_{ucr,N}$	[-]	11,0										
Concrete cone	edge distance	$c_{cr,N}$	[mm]	1.5 h_{ef}										
	spacing	$s_{cr,N}$	[mm]	3 h_{ef}										
Splitting	Characteristic resistance	$N^0_{Rk,sp}$	[kN]	1	1,5	2	4	6	9	12	16	20	30	44
	edge distance	$c_{cr,sp}$	[mm]	1.5 h_{ef}										
	spacing	$s_{cr,sp}$	[mm]	3 h_{ef}										
Installation factor		γ_{inst}	[-]	1,0										
Concrete pryout failure														
k-Factor		k_8	[-]	1,0							2,0			
Concrete edge failure														
Effective length of the anchor		$l_f = h_{ef}$	[mm]	26	35	26	43	36	50	57	70	77	90	114
Effective diameter of the anchor		d_{nom}	[mm]	5		6		8		10		14		18

[1)] Only for non-structural applications

MULTI-MONTI-plus

Performance
Characteristic values for static and quasi static tensions load

Annex C 1

Deutsches Institut für Bautechnik DIBt

Table C2: Characteristic values for static and quasi-static loading MMS-plus stainless steel

Size MMS-plus				**7,5**			**10**		**12**	
Steel failure for tension- and shear load										
Characteristic resistance		$N_{Rk,s}$	[kN]	16			29		45	
Partial safety factor		$\gamma_{Ms,N}$	[-]	1,4						
Characteristic resistance		$V^0_{Rk,s}$	[kN]	2	11	14	18	28	23	27
Partial safety factor		$\gamma_{Ms,V}$	[-]	1,4						
Ductility factor		k_7	[-]	1,0						
Characteristic resistance		$M^0_{Rk,s}$	[Nm]	13,3			32,1		61,1	
Pullout										
Embedmend depth $h_{nom,standard}$		h_{nom}	[mm]	40	55	75	70	85	100	115
Characteristic resistance in uncracked concrete C20/25		$N_{Rk,p}$	[kN]	5,5	4,5	13	12	20	20	32
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	3,5	2	4	6	9	12	16
Embedmend depth $h_{nom,reduced}$		h_{nom}	[mm]	35[1)]	50	65	60	75	90	105
Characteristic resistance in uncracked concrete C20/25		$N_{Rk,p}$	[kN]	4	4	10	10	17	16	26
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	2,5	1,5	3	5	7	9,5	13
Increasing factor for $N_{Rk,p}$										
Increasing factor for concrete	C30/37	Ψ_c	[-]	1,22						
	C40/50			1,41						
	C50/60			1,58						
Concrete cone failure and splitting failure										
Effective anchorage depth		$h_{ef,standard}$	[mm]	23	36	49	44	56	65	77
Effective anchorage depth		$h_{ef,reduced}$	[mm]	19	32	40	35	48	56	69
Factor for	cracked	$k_{cr,N}$	[-]	7,7						
	uncracked	$k_{urc,N}$	[-]	11,0						
Concrete cone	edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}						
	spacing	$s_{cr,N}$	[mm]	3 h_{ef}						
Splitting	Characteristic resistance	$N^0_{Rk,sp}$	[kN]	$N^0_{Rk,sp} = N_{Rk,p}$[2)]						
	edge distance	$c_{cr,sp}$	[mm]	1,5 h_{ef}						
	spacing	$s_{cr,sp}$	[mm]	3 h_{ef}						
Installation factor		γ_{inst}	[-]	1,2				1,0		
Concrete pryout failure										
k-factor for $h_{ef,standard}$		k_8	[-]	1,0					2,0	
k-factor for $h_{ef,standard}$		k_8	[-]	1,0						2,0
Concrete edge failure										
Effective length of the anchor		l_f	[mm]	l_f = corresponding h_{ef}						
Effective diameter of the anchor		d_{nom}	[mm]	6			8		10	

[1)] Only for non-structural applications, only under dry internal conditions
[2)] For $N_{Rk,p}$ the value in cracked concrete is decisive

Deutsches Institut für Bautechnik DIBt

Table C3.1: Characteristic values for seismic actions C1 MMS-plus carbon steel

Size MMS-plus			**10**	**12**		**16**	**20**
Embedment depth	h_{nom}	[mm]	65	75	90	115	140
Steel failure for tension- and shear load							
Characteristic resistance and partial safety factor	$N_{Rk,s,c1}$	[kN]	24,1	37,4		100,0	142,7
	$\gamma_{Ms,c1}$	[-]	1,5				
	$V_{Rk,s,c1}$	[kN]	9,6	16,9		45,2	91,0
	$\gamma_{Ms,c1}$	[-]	1,25				
Factor for annular gap	α_{gap}	[-]	0,5				
Pullout							
Characteristic resistance in cracked concrete	$N_{Rk,p,c1}$	[kN]	6,8	9,0	12,0	21,0	33,0
Concrete cone failure							
Effective anchorage depth	h_{ef}	[mm]	50	57	70	90	114
concrete cone: edge distance	$c_{cr,N}$	[mm]	1.5 h_{ef}				
concrete cone: spacing	$s_{cr,N}$	[mm]	3 h_{ef}				
Installation factor	γ_{inst}	[-]	1,0				
Concrete pryout failure							
k-Factork	k_8	[-]	1,0		2,0		
Concrete edge failure							
Effective length of the anchor	$l_f = h_{ef}$	[mm]	50	57	70	90	114
Effective diameter-Ø	d_{nom}	[mm]	8	10		14	18

MULTI-MONTI-plus

Performance
Characteristic value for seismic actions C1 and C2

Annex C 3

Deutsches Institut für Bautechnik DIBt

Table C3.2: Characteristic values for seismic actions C2 MMS-plus carbon steel [1)]

Size MMS-plus				**16**	**20**
Steel failure for tension- and shear load					
Embedment depth		h_{nom}	[mm]	115	140
Steel failure for tension- and shear load					
Characteristic resistance and partial safety factor		$N_{Rk,s,c2}$	[kN]	100,0	142,7
		$\gamma_{Ms,c2}$	[-]	1,5	
		$V_{Rk,s,c2}$	[kN]	27,6	57,2
		$\gamma_{Ms,c2}$	[-]	1,25	
Factor for annular gap		α_{gap}	[-]	0,5	
Pullout					
Characteristic resistance in cracked concrete		$N_{Rk,p,c2}$	[kN]	14,0	18,1
Concrete cone failure					
Effective anchorage depth		h_{ef}	[mm]	90	114
concrete cone	edge distance	$c_{cr,N}$	[mm]	1.5 h_{ef}	
	spacing	$s_{cr,N}$	[mm]	3 h_{ef}	
Installation safety factor		γ_{inst}	[-]	1,0	
Concrete pryout failure					
k-Factor		k_8	[-]	2,0	
Concrete edge failure					
Effective length of the anchor		$l_f = h_{ef}$	[mm]	90	114
Effective diameter-Ø		d_{nom}	[mm]	14	18

[1)] displacements $\delta_{N,c2}$ and $\delta_{V,c2}$ are not assessed

Deutsches Institut für Bautechnik DIBt

Table C4: Characteristic values under fire exposure MMS-plus carbon steel

Size MMS-plus				**6**		**7,5**		**10**		**12**		**16**		**20**
Embedment depth		h_{nom}	[mm]	35	45	35	55	50	65	75	90	100	115	140
Characteristic resistance for tension and shear / $F_{Rk,fi}$ = $N_{Rk,s,fi}$ = $N_{Rk,p,fi}$ = $V_{Rk,s,fi}$														
Characteristic resistance	R30	$F_{Rk,fi}$	[kN]	0,3	0,4	0,5	1,1	1,4	2,3	3,0	3,9	5,0	7,5	11,0
	R60	$F_{Rk,fi}$	[kN]	0,3	0,4	0,5	0,8	1,4	1,4	2,1	2,1	4,5	4,5	7,7
	R90	$F_{Rk,fi}$	[kN]	0,3	0,4	0,5	0,5	1,0	1,0	1,5	1,5	3,3	3,3	5,6
	R120	$F_{Rk,fi}$	[kN]	0,2	0,3	0,4	0,4	0,8	0,8	1,2	1,2	2,6	2,6	4,5
	R30	$M^0_{Rk,s,fi}$	[Nm]	0,5		1,1		2,7		5,3		16,4		36,6
	R60	$M^0_{Rk,s,fi}$	[Nm]	0,3		0,6		1,5		2,8		8,9		19,8
	R90	$M^0_{Rk,s,fi}$	[Nm]	0,2		0,4		1,1		2,0		6,4		14,2
	R120	$M^0_{Rk,s,fi}$	[Nm]	0,2		0,3		0,9		1,6		5,1		11,4
Edge distance														
	R30 bis R120	$c_{cr,fi}$	[mm]	2 h_{ef}										
Spacing														
	R30 bis R120	$s_{cr,fi}$	[mm]	2 $c_{cr,fi}$										

Table C5: Characteristic values under fire exposure MMS-plus stainless steel

Size MMS-plus			**7,5**			**10**		**12**	
Embedment depth $h_{nom,standard}$		[mm]	40	55	75	70	85	100	115
Embedment depth $h_{nom,reduced}$		[mm]	35	50	65	60	75	90	105
Characteristic resistance for tension and shear / $F_{Rk,fi}$ = $N_{Rk,s,fi}$ = $N_{Rk,p,fi}$ = $V_{Rk,s,fi}$									
	R30	$F_{Rk,fi}$	[kN]	0,5	1,1		1,4	2,3	3,0	3,9
	R60	$F_{Rk,fi}$	[kN]	0,5	0,8		1,4	1,4	2,1	2,1
	R90	$F_{Rk,fi}$	[kN]	0,5	0,5		1,0	1,0	1,5	1,5
	R120	$F_{Rk,fi}$	[kN]	0,4	0,4		0,8	0,8	1,2	1,2
	R30	$M^0_{Rk,s,fi}$	[Nm]	1,1			2,7		5,3	
	R60	$M^0_{Rk,s,fi}$	[Nm]	0,6			1,5		2,8	
	R90	$M^0_{Rk,s,fi}$	[Nm]	0,4			1,1		2,0	
	R120	$M^0_{Rk,s,fi}$	[Nm]	0,3			0,9		1,6	
Edge distance										
	R30 - R120	$c_{cr,fi}$	[mm]	2 h_{ef}						
Spacing										
	R30 - R120	$s_{cr,fi}$	[mm]	2 $c_{cr,fi}$						

MULTI-MONTI-plus

Performance
Characteristic values under fire exposure

Annex C 5

Deutsches Institut für Bautechnik DIBt

Table C6: Displacements under tension loads MMS-plus carbon steel

Size MMS-plus			**6**		**7,5**		**10**		**12**		**16**		**20**
Embedment depth	h_{nom}	[mm]	35	45	35	55	50	65	75	90	100	115	140
Tension load uncracked concrete	N	[kN]	1,9	3,0	1,9	5,3	5,7	7,9	10,7	12,8	16,2	20,1	29,3
Displacement	δ_{N0}	[mm]	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,2	0,1	0,1	0,1
	$\delta_{N\infty}$	[mm]	0,3	0,3	0,4	1,1	0,8	0,7	0,7	0,6	0,1	0,1	0,1
Tension load cracked concrete	N	[kN]	0,5	0,7	0,9	2,0	2,9	4,3	5,7	6,4	9,5	14,2	20,9
Displacement	δ_{N0}	[mm]	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
	$\delta_{N\infty}$	[mm]	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,2	1,4	1,4	0,7

Table C7: Displacements under tension loads MMS-plus stainless steel

Size MMS-plus			**7,5**			**10**		**12**	
Embedment depth $h_{nom,standard}$		[mm]	40	55	75	70	85	100	115
Embedment depth $h_{nom,reduced}$		[mm]	35	50	65	60	75	90	105
Tension load uncracked concrete	N	[kN]	2,4	2,1	6,2	5,7	9,5	9,5	14,3
Displacement	δ_{N0}	[mm]	1,4	1,3	2,5	2,3	2,7	10,3	3,7
	$\delta_{N\infty}$	[mm]	2,1	1,9	3,8	3,5	4,0	15,9	5,5
Tension load cracked concrete	N	[kN]	1,4	0,7	1,9	2,9	4,3	5,7	7,6
Displacement	δ_{N0}	[mm]	1,3	0,2	0,3	0,6	0,5	1,3	1,4
	$\delta_{N\infty}$	[mm]	1,9	0,3	0,5	0,9	0,8	1,9	2,2

MULTI-MONTI-plus

Performance
Displacements under tension loads

Annex C 6

Deutsches Institut für Bautechnik DIBt

Table C8: Displacements under shear loads MMS-plus carbon steel

Size MMS-plus			**6**		**7,5**		**10**		**12**		**16**		**20**
Embedment depth	h_{nom}	[mm]	35	45	35	55	50	65	75	90	100	115	140
Shear load uncracked concrete	V	[kN]	2,0		4,0		8,0		12,0		22,6		42,8
Displacement	δ_{V0}	[mm]	0,1	0,1	0,1	0,1	0,2	0,1	0,2		2,9		3,4
	$\delta_{V\infty}$	[mm]	0,2	0,2	0,1	0,2	0,2	0,2	0,3		4,4		5,1

Table C9: Displacements under shear loads MMS-plus stainless steel

Size MMS-plus			**7,5**			**10**		**12**	
Embedment depth $h_{nom,standard}$		[mm]	40	55	75	70	85	100	115
Embedment depth $h_{nom,reduced}$		[mm]	35	50	65	60	75	90	105
Shear load uncracked concrete	V	[kN]	3,9	4,8	6,2	8,1	12,9	10,5	12,4
Displacement	δ_{V0}	[mm]	2,7	3,5	3,1	2,7	3,3	3,2	3,3
	$\delta_{V\infty}$	[mm]	4,0	5,3	4,6	4,1	4,9	4,8	5,0

MULTI-MONTI-plus

Performance
Displacements under shear loads

Annex C 7

HECO-Schrauben GmbH & Co.KG
Dr.-Kurt-Steim-Straße 28 · D-78713 Schramberg
Tel.: +49 (0) 74 22 / 9 89-0 · Fax: +49 (0) 74 22 / 9 89-200
Mail: info@heco-schrauben.de · www.heco-schrauben.de

XXXX-06/2021