Deutsches Institut für Bautechnik

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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

European Technical Assessment ETA-07/0337 of 6 March 2018

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	MFR Multifunction frame plug
Product family to which the construction product belongs	Plastic anchor for multiple use in concrete and masonry for non-structural applications
Manufacturer	Apolo MEA Befestigungssysteme GmbH Industriestraße 6 86551 Aichach DEUTSCHLAND
Manufacturing plant	Werk I, Aichach, Germany
This European Technical Assessment contains	26 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	ETAG 020, Edition March 2012, used as EAD according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011

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Specific Part

1 Technical description of the product

The Multifunction frame plug in the range of MFR 8, MFR 10 and MFR 14 is a plastic anchor consisting of a plastic sleeve made of polyamide and an accompanying specific screw of galvanised steel or stainless steel.

The plastic sleeve is expanded by screwing in the specific screw which presses the sleeve against the wall of the drilled hole.

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 anchors 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)

The essential characteristics regarding mechanical resistance and stability are included under the Basic Works Requirement Safety in use.

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A 1
Resistance to fire	See Annex C 3

3.3 Safety and accessibility (BWR 4)

Essential characteristic	Performance
Characteristic resistance for tension and shear loads	See Annexes C 1 - C 9
Characteristic resistance for bending moments	See Annex C 1
Displacements under shear and tension loads	See Annex C 3, C 7 – C 10
Anchor distances and dimensions of members	See Annex B 3 - B 5

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

In accordance with guideline for European technical approval ETAG 020, March 2012 used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011 the applicable European legal act is: 97/463/EC.

The system to be applied is: 2+

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 6 March 2018 by Deutsches Institut für Bautechnik

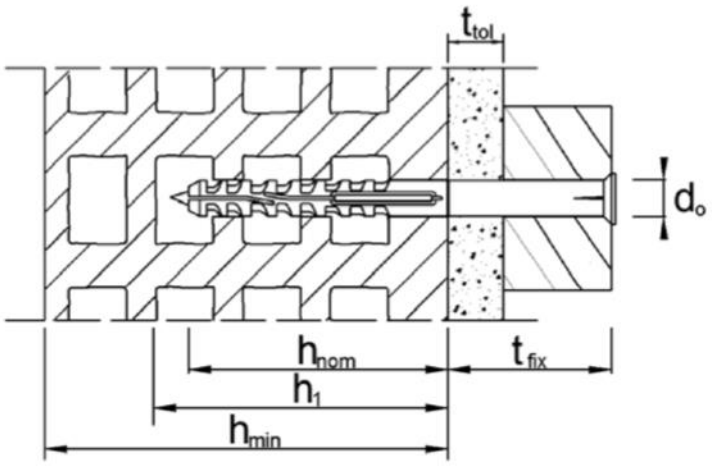
Dr.-Ing. Lars Eckfeldt
p. p. Head of Department

beglaubigt:
Aksünger

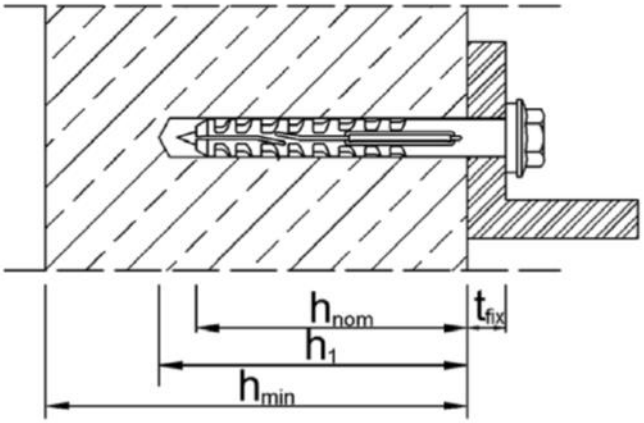
Deutsches Institut für Bautechnik

DIBt

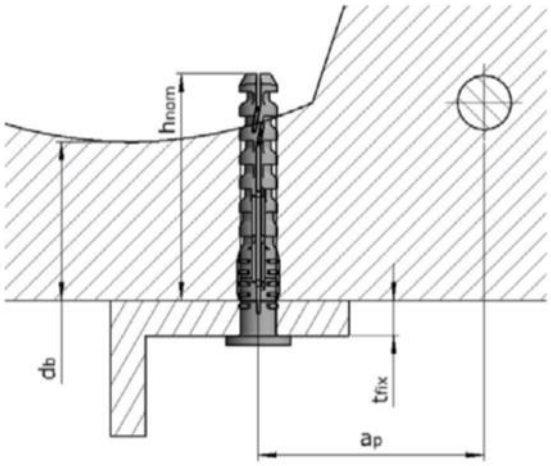
Intended use in hollow brick



Intended use in concrete or solid base material



Intended use in precast prestressed hollow core slabs



h_{nom}	=	overall plastic anchor embedment depth in the base material
h_1	=	depth of drilled hole to deepest point
h_{min}	=	Minimum thickness of member
t_{fix}	=	thickness of fixture
t_{tol}	=	thickness of layer or non-load bearing coating
d_b	=	mirror thickness
a_p	=	distance between plug and reinforcement

Apolo MEA multifunction frame plug

Product description
Installed condition

Annex A1

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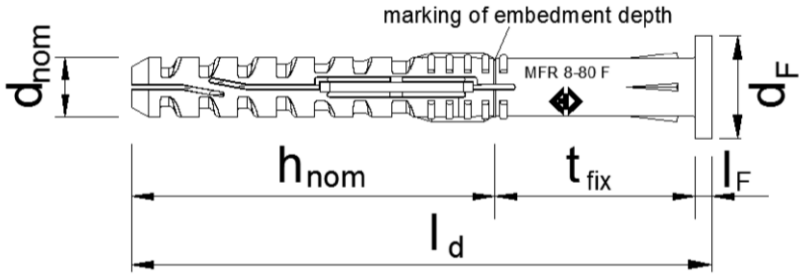
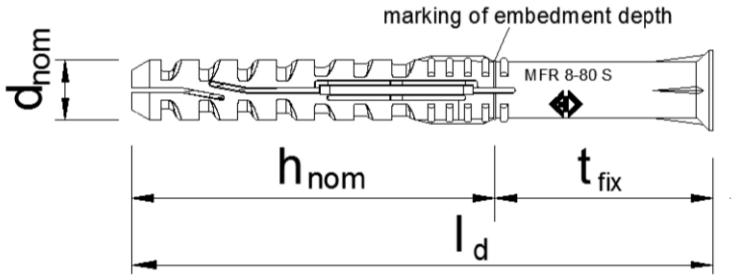
Anchor sleeve MFR 8

Sleeve with plan head (FB) or countersunk head (SB)



MFR 8 FB

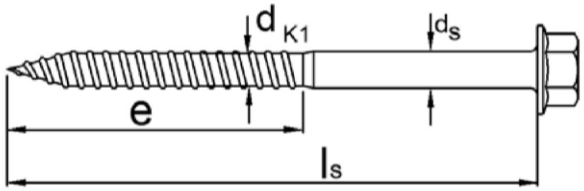


MFR 8 SB

Marking:	Brand	Type	diameter (d_{nom}) - length (l_d)			head form
Example:	**apolo (or CELO or Logo)**	**MFR**	**8**	**-**	**80**	**F (F = FB) (S = SB)**

Special screw (for MFR 8)

Screw head with different tool fittings



Type SSKS (or SSKS A4)
blue passivated or stainless steel (A4)

Type SSK (or SSK A4)
blue passivated or stainless steel (A4)

Type TX (or TX A4)
blue passivated or stainless steel (A4)

Marking:	Brand	Code No screw length	manufacturer code
Example:	**X**	**12**	**1**

Apolo MEA multifunction frame plug

Production description
MFR 8 - Anchor types, screw specification, marking

Annex A2

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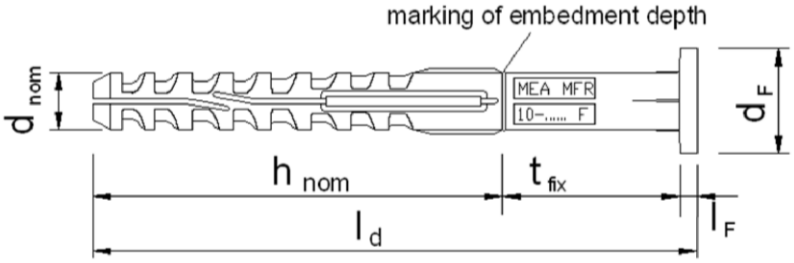
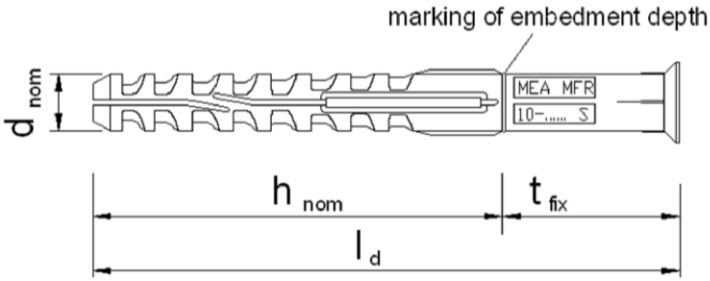
Anchor sleeve MFR 10

Sleeve with plan head (FB) or countersunk head (SB)



MFR 10 FB

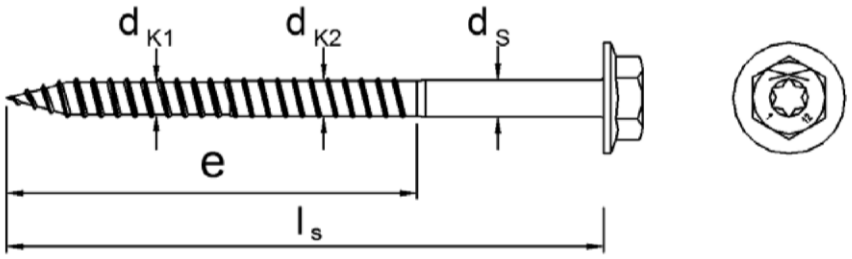


MFR 10 SB

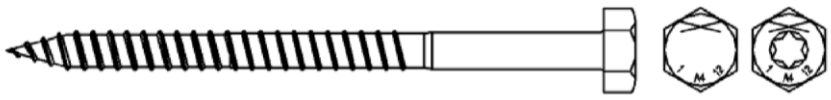
Marking:	Brand	Type	diameter (d_{nom}) - length (l_d)	head form
Example:	**MEA** (or CELO or Logo)	**MFR**	**10 - 100**	**F (F = FB) (S = SB)**

Special screw (for MFR 10)

Screw head with different tool fittings



Type SSKS (or SSKS A4)
blue passivated or
stainless steel (A4)



Type SSK (or SSK A4)
blue passivated or
stainless steel (A4)

Type TX (or TX A4)
blue passivated or
stainless steel (A4)

Marking:	Brand	Code No screw length	manufacturer code
Example:	**X**	**12**	**1**

Apolo MEA multifunction frame plug

Production description
MFR 10 - Anchor types, screw specification, marking

Annex A3

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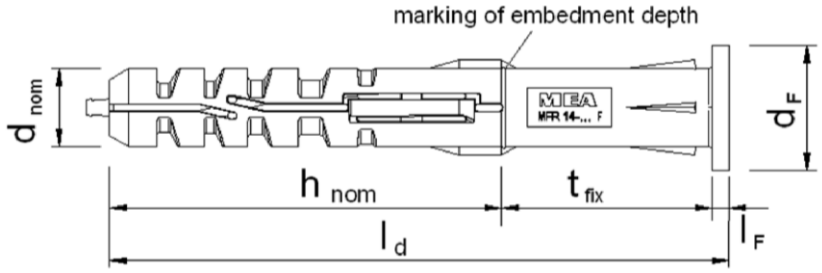
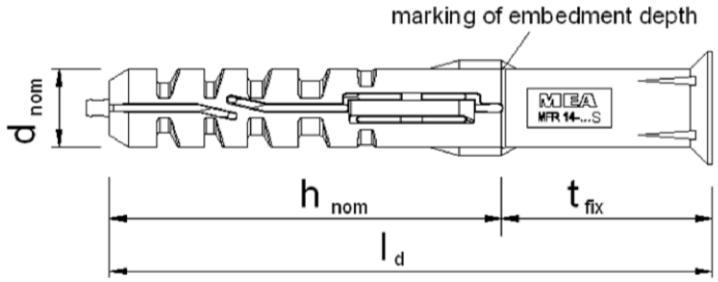
Anchor sleeve MFR 14

Sleeve with plan head (FB) or countersunk head (SB)



MFR 14 FB

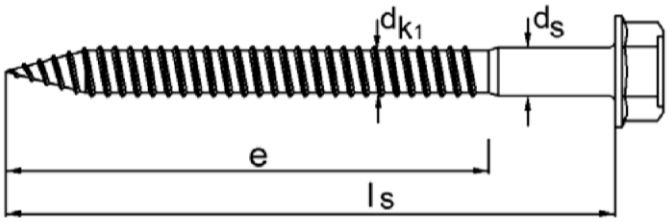


MFR 14 SB

Marking:	Brand	Type	diameter (d_{nom}) - length (l_d)			head form
Example:	**MEA** (or CELO or Logo)	**MFR**	**14**	**-**	**110**	**F (F = FB) (S = SB)**

Special screw (for MFR 14)

Screw head with different tool fittings



Type SSKS (or SSKS A4) blue passivated or stainless steel (A4), optional with glide coating

Type TX (or TX A4) blue passivated or stainless steel (A4), optional with glide coating

Marking:	Brand	Code No screw length	manufacturer code
Example:	**X**	**11**	**4**

Apolo MEA multifunction frame plug	
Production description MFR 14 - Anchor types, screw specification, marking	**Annex A4**

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Table A5.1: Dimension [mm]

	Anchor sleeve						
	l_d	Ø d_{nom}	t_{fix} min	t_{fix} max	h_{nom}	l_F 2)	Ø d_F
MFR 8	≥60	8	≥ 1	110	50	2,3	14
MFR 10	≥80	10	≥ 1	1000	70	3	18
MFR 14	≥80	14	≥ 1	1000	70	3	22

	Special screw				
	l_s 1)	Ø d_s	Ø d_{k1}	Ø d_{k2}	e
for MFR 8	≥65	6	5,2	-	48
for MFR 10	≥85	7	5,8	6,3	75
for MFR 14	≥85	10	8,4	-	75

1) To insure, that the screw penetrates the anchor sleeve, l_s must be $l_d + l_F$ 2) + 5 mm

2) Only valid for flat collar version

Table A5.2: Materials

Designation	Material
anchor sleeve	Polyamid PA 6
special screw (steel, zinc plated)	Steel, galvanised ≥ 5 µm acc. EN ISO 4042:1999 f_{yk} ≥ 480 N/mm², f_{uk} ≥ 600 N/mm² (≥ 6.8 screw)
special screw (stainless steel)	Stainless steel A4 according to EN 10088-3:2014, material 1.4401 or 1.4571 f_{yk} ≥ 450 N/mm², f_{uk} ≥ 700 N/mm² strength class 70

Apolo MEA multifunction frame plug	
Production description Dimensions and materials	**Annex A5**

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Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads.
- Multiple fixing of non-structural applications

Base materials:

- Reinforced or unreinforced normal weight concrete with strength classes ≥ C12/15 (use category a) according to EN 206-1:2000, Annex C2 .
- Precast precast prestressed hollow core slabs with strength classes ≥ C45/55 (use category a) according Annex C2
- Solid brick masonry (use category b) according to Annex C4-C6
  Note: The characteristic resistance is also valid for larger brick sizes and higher compressive strength of the masonry unit.
- Hollow brick masonry (use category c) according to Annex C4-C6
- Aerated concrete (use category d) according to Annex C10
- Mortar strength class of the masonry ≥ M2,5 according to EN 998-2:2010.
- For other base materials of the use categories a, b or c the characteristic resistance of the anchor may be determined by job site tests according to ETAG 020, Annex B, Edition March 2012.

Temperature Range for use:

- a: - 40° C to + 40° C (max. short term temperature + 40° C and max long term temperature + 24° C)
- b: - 40° C to + 80° C (max. short term temperature + 80° C and max long term temperature + 50° C)

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (screw with zinc coated steel, stainless steel)
- The specific screw made of galvanised steel may also be used in structures to external atmospheric exposure, if the area of the head of the screw is protected against moisture and driving rain after mounting of the fixing unit in this way, that intrusion of moisture into the anchor shaft is prevented. Therefore there shall be an external cladding or a ventilated rainscreen mounted in front of the head of the screw and the head of the screw itself shall be coated with a soft plastic, permanently elastic bitumen-oil-combination coating (e. g. undercoating or body cavity protection for cars)
- Structures subject to external atmospheric exposure (includ. industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel).

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

Design:

- The anchorages are to be designed in accordance with the ETAG 020, Annex C under the responsibility of an engineer experienced in anchorages and masonry work.
- Verifiable calculation notes and drawings shall be prepared taking account of the loads to be anchored, the nature and strength of the base materials and the dimensions of the anchorage members as well as of the relevant tolerances. The position of the anchor is indicated on the design drawings.
- Fasteners are only to be used for multiple use for non-structural application according to ETAG 020, Edition March 2012.

Installation:

- Hole drilling by the drill methodes according to Annex C4, C5 or C6 for use category b and c, hammer drilling is to use for use category a.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- Temperature of the plug at installation from 0°C to + 50°C
- Exposure to UV due to solar radiation of the anchor not protected ≤ 6 weeks

Apolo MEA multifunction frame plug	
Intended use Specification of intended use	**Annex B1**

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Table B2.1: Installation parameter in concrete, masonry and AAC

Anchor type			MFR 8	MFR 10	MFR 14
Drill hole diameter	d_0 <	[mm]	8	10	14
Cutting diameter of drill bit	d_{cut} ≤	[mm]	8,45	10,45	14,50
Depth of drill hole to the deepest point [1)]	h_1 ≥	[mm]	60	80	80
Overall plastic anchor embedment depth in the base material [1), 2)]	h_{nom} ≥	[mm]	50	70	70
Diameter of clearence hole in the fixture	d_f ≤	[mm]	9,0	10,5	15

1) See Annex A1

2) For hollow and perforated masonry the influence of h_{nom} > 70 mm (MFR 10 and 14) or h_{nom} > 50 mm (MFR 8) has to be detected by job site tests

Table B2.2: Installation parameter in precast prestressed hollow core slabs

Anchor type			MFR 8	MFR 10
Drill hole diameter	d_0 <	[mm]	8	10
Cutting diameter of drill bit	d_{cut} ≤	[mm]	8,45	10,45
Depth of drill hole to the deepest point [1)]	h_1 ≥	[mm]	60	80
Overall plastic anchor embedment depth in the concrete core slab	h_{nom} ≥	[mm]	50	70
Diameter of clearence hole in the fixture	d_f ≤	[mm]	9,0	10,5
Bottom flange thickness	d_b ≥	[mm]	35	35
Distance between plug position and prestressing steel	a_p ≥	[mm]	50	50

1) See Annex A1

Apolo MEA multifunction frame plug	
Intended use Installation parameters in concrete, masonry, AAC and hollow core slabs	**Annex B2**

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Table B3.1: Minimum thickness of member, edge distance and anchor spacing in concrete

MFR 8: Fixing points with a spacing a ≤ 55 mm are considered as a group with a max. characteristic resistance $N_{Rk,p}$ acc. to Table C2.1. For a > 55 mm the anchors are considered as single anchors, each with a characteristic resistance $N_{Rk,p}$ acc. to Table C2.1. and C2.2.

MFR 10: Fixing points with a spacing a ≤ 75 mm are considered as a group with a max. characteristic resistance $N_{Rk,p}$ acc. to Table C2.1. For a > 75 mm the anchors are considered as single anchors, each with a characteristic resistance $N_{Rk,p}$ acc. to Table C2.1. and C2.2.

MFR 14: Fixing points with a spacing a ≤ 80 mm are considered as a group with a max. characteristic resistance $N_{Rk,p}$ acc. to Table C2.1. For a > 80 mm the anchors are considered as single anchors, each with a characteristic resistance $N_{Rk,p}$ acc. to Table C2.1.

	Minimum thickness h_{min} [mm]	Characteristic edge distance $c_{cr,N}$ [mm]	Minimum edge distances c_{min} [mm]	Minimum spacing s_{min} [mm]
MFR 8				
Concrete ≥ C16/20	100	50	60	50
Concrete C12/15	100	70	85	70
MFR 10				
Concrete ≥ C16/20	110	70	60	50
Concrete C12/15	110	100	85	70
MFR 14				
Concrete ≥ C16/20	120	80	100	100
Concrete C12/15	120	112	140	140

Table B3.2: Minimum thickness of member, edge distance and anchor spacing in precast prestressed hollow core slabs

	Minimum thickness h_{min} [mm]	Characteristic edge distance $c_{cr,N}$ [mm]	Minimum edge distances c_{min} [mm]	Minimum spacing s_{min} [mm]
MFR 8				
Concrete ≥ C45/55	200	50	60	50
MFR 10				
Concrete ≥ C45/55	200	70	60	50

Apolo MEA multifunction frame plug

Intended use
Min. thickness, spacing, edge distance in concrete and hollow core slabs

Annex B3

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Table B4: Minimum thickness of member, edge distance and anchor spacing in masonry

Base material [1]	Minimum thickness of member	Minimum edge distance	Minimum spacing		
			Single anchor	Anchor Group [2]	
				perpendicular to free edge	parallel to free edge
	h_{min} [mm]	c_{min} [mm]	a_{min} [mm]	$s_{1,min}$ [mm]	$s_{2,min}$ [mm]
MFR 8					
Clay brick **Mz-1.8 - NF**	115	100	250	200	400
Sand-lime solid brick **KS - NF**	115	100	250	200	400
Hollow clay brick **HLz 12-1.0 - 16DF**	240	100	250	200	400
Hollow sandlime brick **KSL 12-1.4 - 3DF**	175	100	250	200	400
Hollow light concrete bl. **Hbl 2-0.8 - 16DF**	240	100	250	200	400
Hollow concrete block **Hbn 1.4 - 12DF**	240	100	250	200	400
MFR 10					
Clay brick **Mz-1.8 NF**	115	100	250	200	400
Sand-lime solid brick **KS - NF**	115	100	250	200	400
Hollow clay brick **HLz 12-1.0 - 2DF**	115	100	250	200	400
Hollow sandlime brick **KSL 12-1.4 - 8DF**	115	100	250	200	400
Hollow clay brick Brique Creuse **C 3-0.7**	200	100	250	200	400
Hollow concrete block **Hbn 1.4 - 12DF**	240	100	250	200	400
MFR 14					
Clay brick **Mz-1.8 NF**	115	100	250	200	400
Sand-lime solid brick **KS - 8DF**	240	100	250	200	400
Sand-lime solid brick **KS - 2DF**	115	100	250	200	400
Hollow clay brick **HLz 12-1.0 - 2DF**	115	120	250	240	480
Hollow sandlime brick **KSL 12-1.4 - 8DF**	240	100	250	200	400

[1] Information for base material masonry: see Annex C4, Table C4

[2] The design method is valid for single anchors and anchor groups with two or four anchors.

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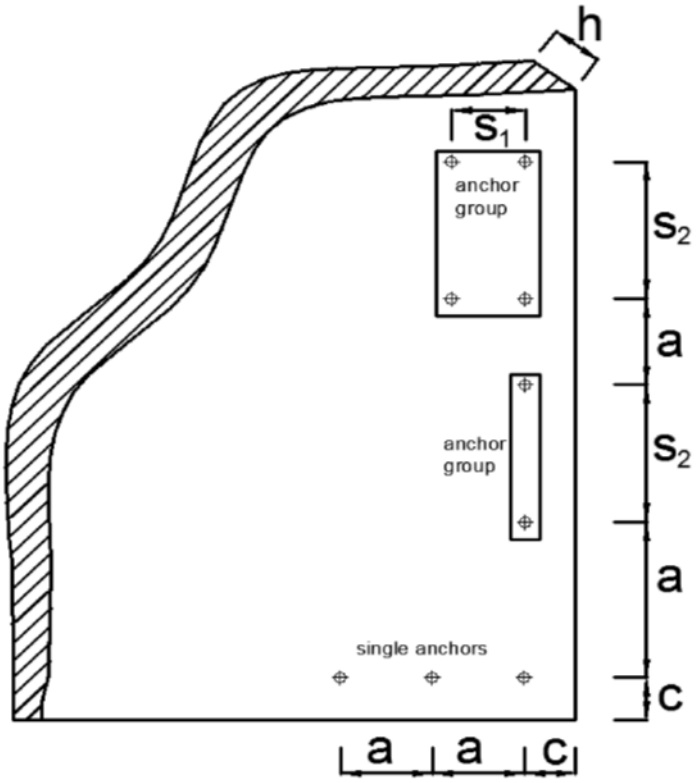
Table B5: Minimum thickness of member, edge distance and anchor spacing in AAC (Autoclaved aerated concrete)

MFR 10 and MFR 14	Minimum thickness of member	Minimum edge distance	Minimum spacing		
			Single anchor	**Anchor Group** [1]	
				perpendicular to free edge	parallel to free edge
Base material	h_{min} [mm]	c_{min} [mm]	a_{min} [mm]	$s_{1,min}$ [mm]	$s_{2,min}$ [mm]
EN 771-4 AAC 2	100	50	250	100	200
EN 771-4 AAC 4	100	75	250	150	300
EN 771-4 AAC 6	100	150	250	200	400

[1] The design method is valid for single anchors and anchor groups with two or four anchors.



Apolo MEA multifunction frame plug	
Intended use Min. thickness, spacing, edge distance in AAC	**Annex B5**

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Table B6: Geometry of stones

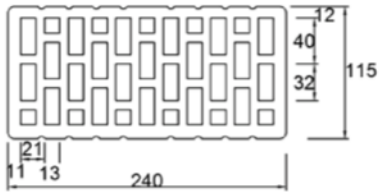


Fig. 1 HLZ 12 2DF

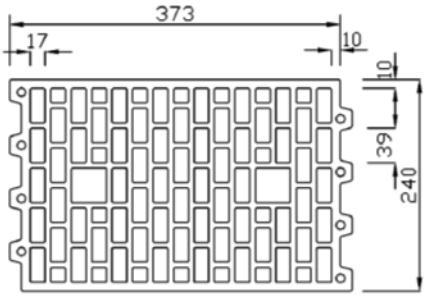


Fig. 2 HLZ 12 16DF

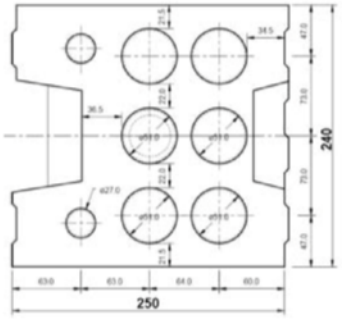


Fig. 3 KSL 12 8DF

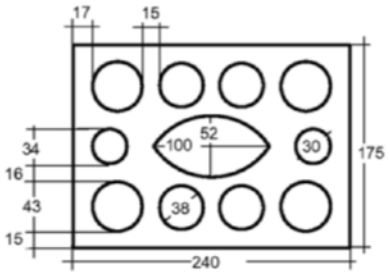


Fig. 4 KSL 12-1.4 – 3DF

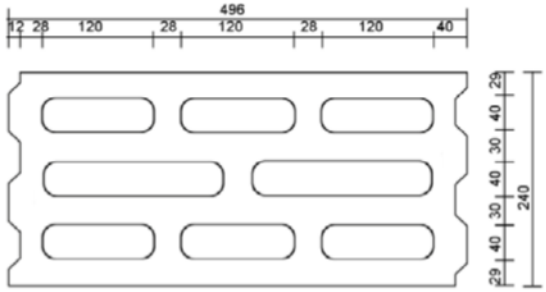


Fig. 5 HBL 2-0,8 16DF

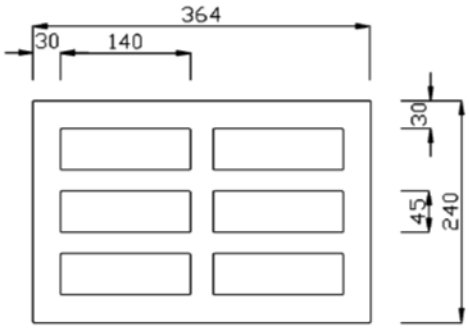


Fig. 6 HBN 1,4 16DF

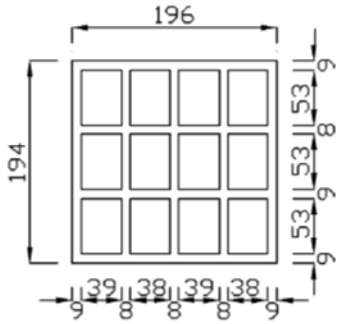


Fig. 7 Brique Creuse C

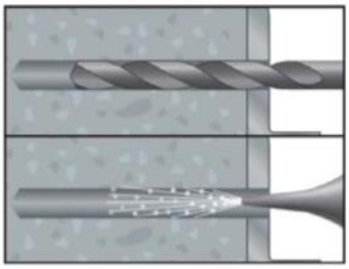
Apolo MEA multifunction frame plug	
Intended use Geometry of stones	**Annex B6**

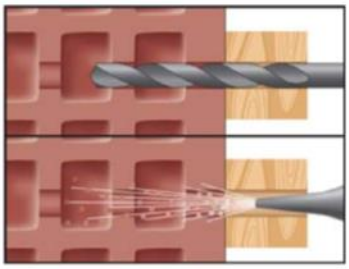
Deutsches Institut für Bautechnik DIBt

Installation instruction MFR

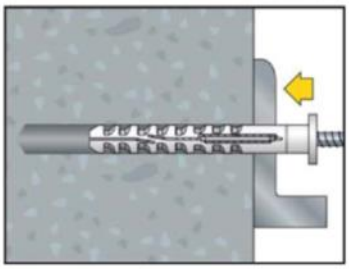
in concrete or hollow core slabs

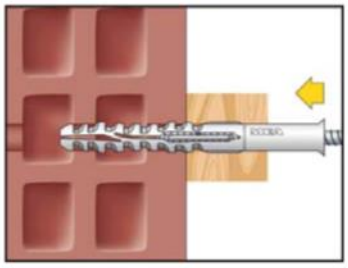
in Masonry



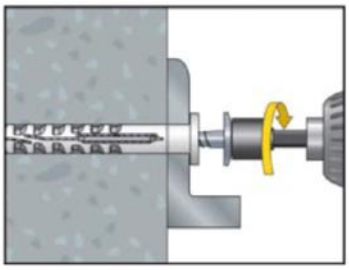


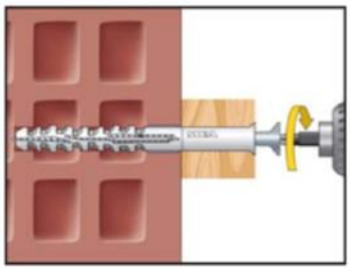
1. Drill the borehole and clean the hole. Drilling methode:
Concrete: hammer drill
Masonry: According Tab. C4, C5, C6



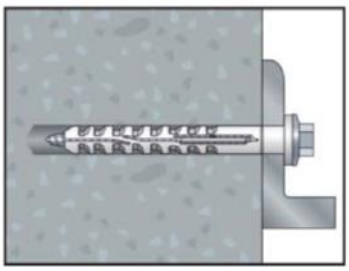


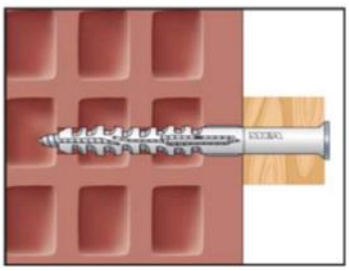
2. Hammer in the plug slightly through the fixture part till the plug is flush to this. Minimum setting depth must be observed.



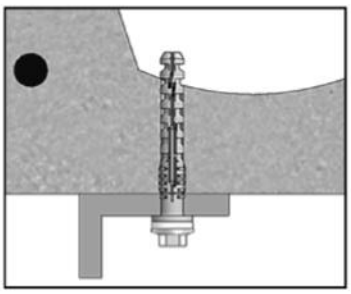


3. Tighten the screw with screw driver till the screw touches the collar of the sleeve. The screw must fit tight on the surface of the fixture part.





4. Correctly installed plug with screw in concrete or in masonry.



4. Correctly installed plug with screw in hollow concrete core slab.

Apolo MEA multifunction frame plug	
Intended use Installation instruction	**Annex B7**

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Table C1.1: Characteristic bending resistance of the screw

Screw Ø 6 mm for MFR 8		galvanised steel	stainless steel
Characteristic bending resistance	$M_{Rk,s}$ [Nm]	8,8	10,3
Partial safety factor	γ_{Ms} [1)]	1,25	1,56
Screw Ø 7 mm for MFR 10		galvanised steel	stainless steel
Characteristic bending resistance	$M_{Rk,s}$ [Nm]	15,3	17,8
Partial safety factor	γ_{Ms} [1)]	1,25	1,56
Screw Ø 10 mm for MFR 14		galvanised steel	stainless steel
Characteristic bending resistance	$M_{Rk,s}$ [Nm]	36,7	42,9
Partial safety factor	γ_{Ms} [1)]	1,25	1,56

1) in absence of other national regulations

Table C1.2: Characteristic resistance of the screw

Failure of expansion element (special screw)			
Special screw Ø 6 mm for MFR 8		galvanised steel	stainless steel
Characteristic tension resistance	$N_{Rk,s}$ [kN]	11,7	13,7
Partial safety factor	γ_{Ms} [1)]	1,5	1,87
Characteristic shear resistance	$V_{Rk,s}$ [kN]	5,8	6,8
Partial safety factor	γ_{Ms} [1)]	1,25	1,56
Special screw Ø 7 mm for MFR 10		galvanised steel	stainless steel
Characteristic tension resistance	$N_{Rk,s}$ [kN]	17,0	19,8
Partial safety factor	γ_{Ms} [1)]	1,5	1,87
Characteristic shear resistance	$V_{Rk,s}$ [kN]	8,5	9,9
Partial safety factor	γ_{Ms} [1)]	1,25	1,56
Special screw Ø 10 mm for MFR 14		galvanised steel	stainless steel
Characteristic tension resistance	$N_{Rk,s}$ [kN]	30,5	35,5
Partial safety factor	γ_{Ms} [1)]	1,5	1,87
Characteristic shear resistance	$V_{Rk,s}$ [kN]	15,2	17,8
Partial safety factor	γ_{Ms} [1)]	1,25	1,56

1) in absence of other national regulations

Apolo MEA multifunction frame plug	
Performances Characteristic resistance and characteristic bending resistance of the screw	**Annex C1**

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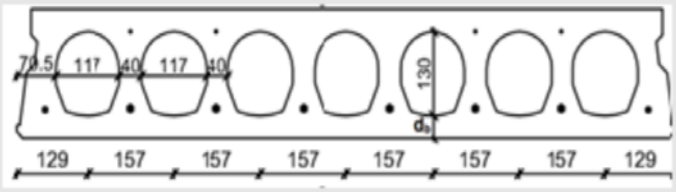
Table C2.1: Characteristic resistance for use in cracked and uncracked concrete (use category "a")

Pull-out failure (plastic sleeve)			**Concrete ≥ C16/20**		**Concrete C12/15**	
			ϑ = 24/40 °C	ϑ = 50/80 °C	ϑ = 24/40 °C	ϑ = 50/80 °C
MFR 8						
Characteristic resistance	$N_{Rk,p}$	[kN]	2,5	2,5	1,5	1,5
Partial safety factor	γ_{Mc} [1)]		1,8	1,8	1,8	1,8
MFR 10						
Characteristic resistance	$N_{Rk,p}$	[kN]	4,0	3,0	2,5	2,0
Partial safety factor	γ_{Mc} [1)]		1,8	1,8	1,8	1,8
MFR 14						
Characteristic resistance	$N_{Rk,p}$	[kN]	4,5	3,0	3,0	2,0
Partial safety factor	γ_{Mc} [1)]		1,8	1,8	1,8	1,8

1) In absence of other national regulations

Table C2.2: Characteristic resistance for use in precast prestressed hollow core slabs (use category "a")

Pull-out failure (plastic sleeve)			**Precast prestressed hollow core slabs, Concrete ≥ C45/55**	
			Producer: DW Systembau, D-29640 Schneverdingen	
MFR 8			Bottom flange thickness	
Characteristic resistance	$N_{Rk,p}$	[kN]	$d_b \geq 35$ mm	3,50
Partial safety factor	γ_{Mc} [1)]			1,8
MFR 10				
Characteristic resistance	$N_{Rk,p}$	[kN]	$d_b \geq 35$ mm	1,20
Partial safety factor	γ_{Mc} [1)]			1,8

1) In absence of other national regulations

Apolo MEA multifunction frame plug	
Performances Characteristic resistance for use in concrete and in precast hollow core slabs.	**Annex C2**

Deutsches Institut für Bautechnik DIBt

Table C3.1: Displacements under tension and shear loading in concrete

	Tension load			Shear load		
Concrete ≥ C16/20	**N** [1]	δ_{NO}	$\delta_{N\infty}$	**V** [1]	δ_{VO}	$\delta_{V\infty}$
MFR 8	[kN]	[mm]	[mm]	[kN]	[mm]	[mm]
temperature ϑ = 24/40 °C	0,99	0,25	0,05	2,47	0,80	1,20
temperature ϑ = 50/80 °C	0,99	0,25	0,06	2,47	0,80	1,20
MFR 10	[kN]	[mm]	[mm]	[kN]	[mm]	[mm]
temperature ϑ = 24/40 °C	1,59	0,12	0,15	3,37	2,20	3,30
temperature ϑ = 50/80 °C	1,19	0,11	0,15	3,37	2,20	3,30
MFR 14						
temperature ϑ = 24/40 °C	1,79	0,30	0,60	6,04	2,50	3,75
temperature ϑ = 50/80 °C	1,19	0,25	0,50	6,04	2,50	3,75

[1] Intermediate values by linear interpolation

Table C 3.2: Value under fire exposure in concrete C20/25 to C50/60 in any load direction, no permanent centric tension load and without lever arm, fastening of facade systems

Anchor type	Fire resistance class	**F** [1]
MFR 10	R 90	0,8 kN
MFR 14	R 90	0,8 kN

[1] $F = F_{Rk} / \gamma_{Mc} / \gamma_F$

Apolo MEA multifunction frame plug	
Performances Displacement under tension and shear loading in concrete. Value under fire exposure	**Annex C3**

Deutsches Institut für Bautechnik DIBt

Table C4 : Characteristic resistance F_{Rk} [kN] in solid and hollow or perforated masonry (use categories "b" + "c") for MFR 8

MFR 8 Base material	Bulk density class ρ [kg/dm³]	Minimum compres-sive Strength f_b [N/mm²]	Minimum DF or minimum size **(L x W x H)** [mm]	figure/ geometry	drill method H= hammer R= rotary	Characteristic resistance F_{Rk} [1)] [kN] ϑ = 24/40 °C ϑ = 50/80 °C
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	≥ 20	NF (240*115*71)		H	**1,50**
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	$10 \le f_b < 20$	NF (240*116*71)		H	**0,90**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	≥ 20	2DF (240*115*113)		H	**3,00**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	$10 \le f_b < 20$	2DF (240*115*113)		H	**2,00**
Hollow clay brick **HLz** EN 771-1:2011+A1:2015	1,0	12	16 DF (373*240*249)	Annex B6 figure 2	R only	**0,50**
Hollow Sand-lime brick **KSL** EN 771-2:2011+A1:2015	≥ 1,4	17	3 DF (240*175*113)	Annex B6 figure 4	R	**1,20**
		12				**0,75**
Hollow light concrete block **Hbl** EN 771-3:2011+A1:2015	≥ 0,8	2	16 DF 500*240*248	Annex B6 figure 5	R	**0,30**
Hollow concrete block **Hbn** EN 771-3:2011+A1:2015	≥ 1,4	25	12 DF 365*240*238	Annex B6 figure 6	H	**1,20**
Partial safety factor [2)]					γ_{Mm}	**2,5**

1) Characteristic resistance for tension, shear or combined tension and shear loading
2) In absence of other national regulations

Apolo MEA multifunction frame plug	
Performances MFR 8 - Characteristic resistance for use in masonry	**Annex C4**

Deutsches Institut für Bautechnik DIBt

Table C5: Characteristic resistance F_{Rk} [kN] in solid and hollow or perforated masonry (use categories "b" + "c") for MFR 10

MFR 10 Base material	Bulk density class ρ [kg/dm³]	Minimum compres-sive strength f_b [N/mm²]	Minimum DF or minimum size **(L x W x H)** [mm]	figure/ geo-metry	drill method H= hammer R= rotary	Characteristic resistance F_{Rk} [1)] [kN] ϑ = 24/40 °C	 ϑ = 50/80 °C
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	≥ 20	NF (240*116*71)		H	**3,0**	**2,5**
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	$10 \le f_b < 20$	NF (240*116*71)		H	**2,0**	**1,5**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	≥ 20	NF (240*115*70)		H	**3,0**	**2,5**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	$10 \le f_b < 20$	NF (240*115*70)		H	**2,0**	**2,0**
Hollow clay brick **HLz** EN 771-1:2011+A1:2015	≥ 1,0	12	2 DF (235*112*115)	Annex B6 figure 1	R only	**0,75**	**0,60**
Hollow Sand-lime brick **KSL** EN 771-2:2011+A1:2015	≥ 1,4	12	8 DF (250*240*237)	Annex B6 figure 3	R	**0,90**	**0,60**
Hollow concrete block **Hbn** EN 771-3:2011+A1:2015	≥ 1,4	25	12 DF 365*240*238	Annex B6 figure 6	H	**0,75**	**0,75**
Hollow clay brick Brique Creuse C **LD 3-0,7-500x200x200** EN 771-1:2011+A1:2015	≥ 0,7	3	496*196*194	Annex B6 figure 7	R only	**0,30**	**0,30**
Partial safety factor [2)]					γ_{Mm}	**2,5**	

[1)] Characteristic resistance for tension, shear or combined tension and shear loading
[2)] In absence of other national regulations

Apolo MEA multifunction frame plug	
Performances MFR 10 - Characteristic resistance for use in masonry	**Annex C5**

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Table C6: Characteristic resistance F_{Rk} [kN] in solid and hollow or perforated masonry (use categories "b" + "c") for MFR 14

MFR 14 Base material	Bulk density class ρ [kg/dm³]	Minimum Compres-sive strength f_b [N/mm²]	Minimum DF or minimum size **(L x W x H)** [mm]	figure/ geometry	drill method H= hammer R= rotary	Characteristic resistance F_{Rk} [1] [kN] ϑ = 24/40 °C	Characteristic resistance F_{Rk} [1] [kN] ϑ = 50/80 °C
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	≥ 20	NF (240*116*71)		H	**4,5**	**3,0**
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	10 ≤ f_b < 20	NF (240*116*71)		H	**3,0**	**2,0**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	≥ 20	8 DF (250*240*237)		H	**5,0**	**4,5**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	10 ≤ f_b < 20	8 DF (250*240*237)		H	**3,5**	**3,0**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	≥ 20	2 DF (240*115*113)		H	**4,5**	**4,0**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	10 ≤ f_b < 20	2 DF (240*115*113)		H	**3,0**	**2,5**
Hollow clay brick **HLz** EN 771-1:2011+A1:2015	≥ 1,0	12	2 DF (235*115*113)	Annex B6 figure 1	R only	**0,75**	**0,5**
Hollow Sand-lime brick **KSL** EN 771-2:2011+A1:2015	≥ 1,4	12	8 DF (250*240*237)	Annex B6 figure 3	R	**1,2**	**0,75**
Partial safety factor [2]					γ_{Mm}	**2,5**	

[1] Characteristic resistance for tension, shear or combined tension and shear loading
[2] In absence of other national regulations

Apolo MEA multifunction frame plug

Performances
MFR 14 - Characteristic resistance for use in masonry

Annex C6

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Table C7: Displacements under tension and shear loading in masonry for temperature ϑ = 24/40 °C

Base material	Displacements Tension load			Displacements Shear load		
	N	δ_{NO}	$\delta_{N\infty}$	V	δ_{VO}	$\delta_{V\infty}$
MFR 8	[kN]	[mm]	[mm]	[kN]	[mm]	[mm]
Clay brick **Mz - NF**	0,26	0,02	0,04	0,26	0,22	0,33
Sand-lime solid brick **KS – 2 DF**	0,57	0,33	0,66	0,57	0,48	0,72
Hollow clay brick **HLz 12**	0,14	0,01	0,02	0,42	0,08	0,12
Hollow Sand-lime brick **KSL 12**	0,25	0,11	0,22	0,20	0,37	0,55
Hollow light concrete block **Hbl 2**	0,09	0,02	0,04	0,13	0,02	0,03
Hollow concrete block **Hbn**	0,08	0,02	0,04	0,09	0,08	0,11
MFR 10						
Clay brick **Mz - NF**	0,86	0,2	0,4	0,86	0,71	1,07
Sand-lime solid brick **KS - NF**	0,86	0,2	0,4	0,86	0,71	1,07
Hollow clay brick **HLz 12-1.0**	0,21	0,1	0,2	0,21	0,43	0,64
Hollow Sand-lime brick **KS L 12-1,4**	0,26	0,1	0,2	0,26	0,51	0,77
Brique Creuse C **LD 3-0,7**	0,09	0,2	0,4	0,09	0,17	0,26
Hollow concrete block **Hbn**	0,08	0,01	0,02	0,23	0,16	0,23
MFR 14						
Clay brick **Mz - NF**	1,29	0,2	0,4	1,29	1,07	1,61
Sand-lime solid brick **KS - 8 DF**	1,43	0,2	0,4	1,43	1,19	1,79
Sand-lime solid brick **KS - 2 DF**	1,29	0,2	0,4	1,29	1,07	1,61
Hollow clay brick **HLz 12 - 1.0**	0,21	0,1	0,2	0,21	0,43	0,64
Hollow Sand-lime brick **KS L 12 - 1,4**	0,34	0,1	0,2	0,34	0,69	1,03

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Table C8: Displacements under tension and shear loading in masonry for temperature ϑ = 50/80 °C

Base material	Displacements Tension load			Displacements Shear load		
	N	δ_{NO}	$\delta_{N\infty}$	V	δ_{VO}	$\delta_{V\infty}$
MFR 8	[kN]	[mm]	[mm]	[kN]	[mm]	[mm]
Clay brick **Mz - NF**	0,26	0,02	0,04	0,26	0,22	0,33
Sand-lime solid brick **KS – 2 DF**	0,57	0,33	0,66	0,57	0,48	0,72
Hollow clay brick **HLz 12**	0,14	0,01	0,02	0,42	0,08	0,12
Hollow Sand-lime brick **KSL 12**	0,25	0,11	0,22	0,20	0,37	0,55
Hollow light concrete block **Hbl 2**	0,09	0,02	0,04	0,13	0,02	0,03
Hollow concrete block **Hbn**	0,08	0,02	0,04	0,09	0,08	0,11
MFR 10						
Clay brick **Mz - NF**	0,71	0,2	0,4	0,71	0,60	0,89
Sand-lime solid brick **KS - NF**	0,71	0,2	0,4	0,71	0,60	0,89
Hollow clay brick **HLz 12-1.0**	0,17	0,1	0,2	0,17	0,34	0,51
Hollow Sand-lime brick **KS L 12-1,4**	0,17	0,1	0,2	0,17	0,34	0,51
Brique Creuse C **LD 3-0,7**	0,09	0,2	0,4	0,09	0,17	0,26
Hollow concrete block **Hbn**	0,08	0,01	0,02	0,23	0,16	0,23
MFR 14						
Clay brick **Mz - NF**	0,86	0,2	0,4	0,86	0,71	1,07
Sand-lime solid brick **KS - 8 DF**	1,29	0,2	0,4	1,29	1,07	1,61
Sand-lime solid brick **KS - 2 DF**	1,14	0,2	0,4	1,14	0,95	1,43
Hollow clay brick **HLz 12 - 1.0**	0,14	0,1	0,2	0,14	0,29	0,43
Hollow Sand-lime brick **KS L 12 - 1,4**	0,21	0,1	0,2	0,21	0,43	0,64

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Base material solid masonry: Autoclaved Aerated Concrete (AAC)

Table C9.1: Brick Data

Description of brick			AAC
Type of brick			Autoclaved Aerated Concrete AAC
Bulk density	$\rho \geq$	[kg/dm³]	0,35
European Standard			EN 771-4:2011+A1:2015
Minimum thickness of member	h_{min} =	[mm]	100

Installation parameters see Annex B2

Table C9.2: Characteristic resistance F_{Rk} [kN] in AAC

Base material	Drill method		Characteristic resistance F_{Rk} 1)	
			ϑ = 24/40 °C	ϑ = 50/80 °C
MFR 10				
AAC 2	Hammer drilling	[kN]	**0,4**	**0,3**
AAC 4	Hammer drilling	[kN]	**1,2**	**0,9**
AAC 6	Hammer drilling	[kN]	**2,0**	**1,5**
MFR 14				
AAC 2	Hammer drilling	[kN]	**0,3**	**0,3**
AAC 4	Hammer drilling	[kN]	**1,2**	**1,2**
AAC 6	Hammer drilling	[kN]	**2,0**	**2,0**
Partial safety factor 2)	$\gamma_{M,AAC}$	[-]	**2,0**	**2,0**

1) Characteristic resistance F_{Rk} for tension, shear or combined tension and shear loading
2) In absence of other national regulations

Apolo MEA multifunction frame plug	
Performances MFR 10/14 - Characteristic resistance for use in autoclaved aerated concrete	**Annex C9**

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Table C10: Displacements under tension and shear loading in AAC

Base material	Temperature range	Tension load			Shear load		
		N [kN]	δ_{NO} [mm]	$\delta_{N\infty}$ [mm]	V [kN]	δ_{VO} [mm]	$\delta_{V\infty}$ [mm]
MFR 10							
AAC 2	temperature ϑ = 24/40 °C	0,14	0,1	0,2	0,14	0,3	0,4
	temperature ϑ = 50/80 °C	0,11	0,1	0,2	0,11	0,2	0,3
AAC 4	temperature ϑ = 24/40 °C	0,43	0,1	0,2	0,43	0,9	1,3
	temperature ϑ = 50/80 °C	0,32	0,1	0,2	0,32	0,6	1,0
AAC 6	temperature ϑ = 24/40 °C	0,71	0,1	0,2	0,71	1,4	2,1
	temperature ϑ = 50/80 °C	0,54	0,1	0,2	0,54	1,1	1,6
MFR 14							
AAC 2	ϑ = 24/40 °C and ϑ = 50/80 °C	0,11	0,1	0,2	0,11	0,2	0,3
AAC 4	ϑ = 24/40 °C and ϑ = 50/80 °C	0,43	0,1	0,2	0,43	0,9	1,3
AAC 6	ϑ = 24/40 °C and ϑ = 50/80 °C	0,71	0,1	0,2	0,71	1,4	2,1