Deutsches Institut für Bautechnik

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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-07/0337 of 15 September 2023

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	CELO Multifunction frame plug MFR
Product family to which the construction product belongs	Plastic anchors for redundant non-structural systems in concrete and masonry
Manufacturer	CELO Befestigungssysteme GmbH Industriestraße 6 86551 Aichach DEUTSCHLAND
Manufacturing plant	CELO Werk I Industriestrasse 6 D-86551 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	330284-00-0604, edition 12/2020
This version replaces	ETA-07/0337 issued on 6 November 2020

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Specific part

1 Technical description of the product

The CELO Multifunction frame plug MFR is a plastic anchor consisting of a plastic sleeve made of polyamide and an accompanying specific screw of galvanised steel or of 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 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C3

3.2 Mechanical resistance and stability (BWR 4)

Essential characteristic	Performance
Resistance to steel failure under tension loading	See Annex C1
Resistance to steel failure under shear loading	See Annex C1
Resistance to pull-out or concrete failure under tension loading (base material group a)	See Annex C2
Resistance in any load direction without lever arm (base material group b, c, d)	See Annexes C4 – C6 and C8
Edge distance and spacing (base material group a)	See Annex B3
Edge distance and spacing (base material group b, c, d)	See Annex B4 and B5
Displacements under short-term and long-term loading	See Annex C3, C7, C9
Durability	See Annex B1

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

In accordance with European Assessment Document EAD 330284-00-0604 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 EAD

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

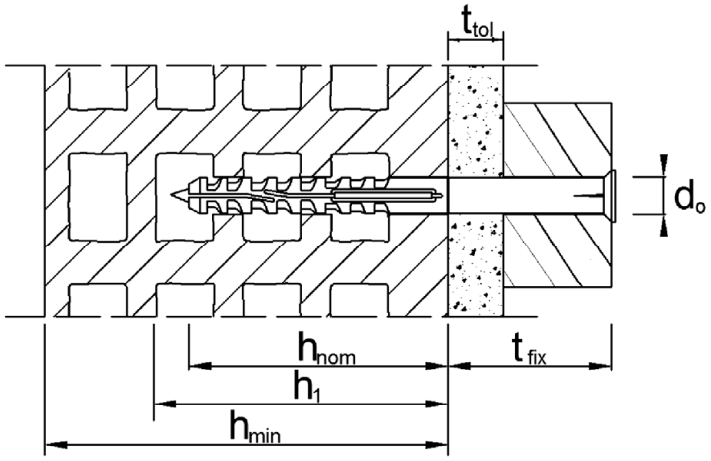
Issued in Berlin on 15 September 2023 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

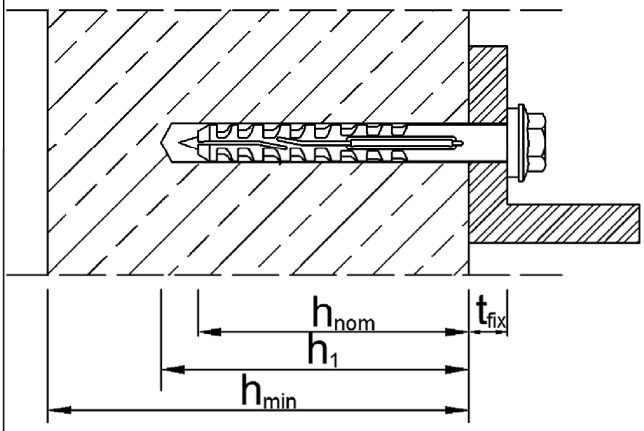
beglaubigt:
Ziegler

Deutsches Institut für Bautechnik DIBt

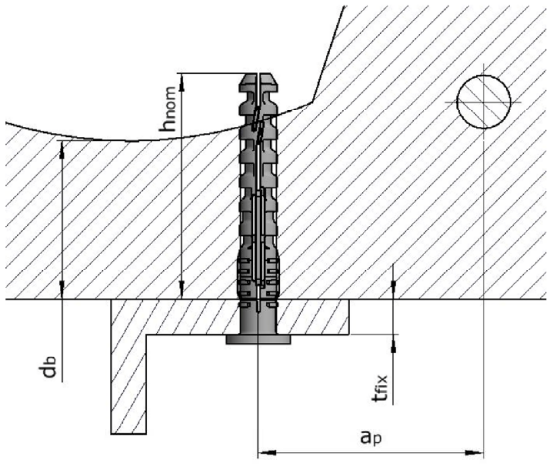
Intended use in hollow brick



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

CELO Multifunction frame plug MFR

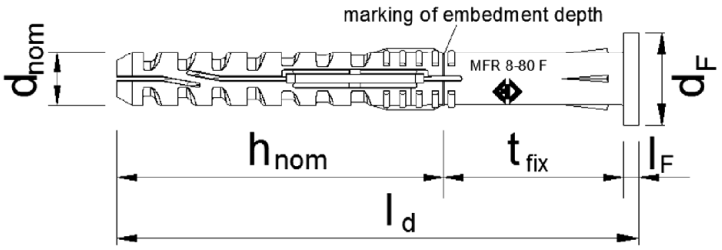
Product description
Installed condition

Annex A1

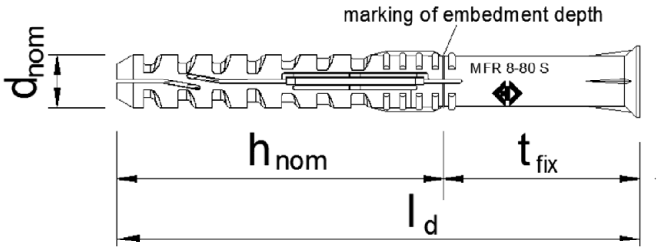
Deutsches Institut für Bautechnik DIBt

Anchor sleeve MFR 8

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



MFR 8 FB

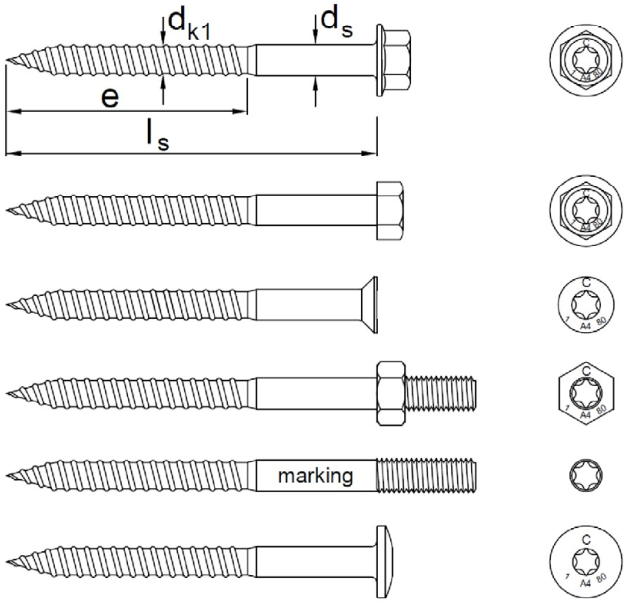


MFR 8 SB

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

Special screw (for MFR 8)

Screw head with different tool fittings



Type SSKS (or SSKS A4)
galvanised steel or stainless steel (A4)

Type SSK (or SSK A4)
galvanised steel or stainless steel (A4)

Type TX (or TX A4)
galvanised steel or stainless steel (A4)

Type E (or E A4)
galvanised steel or stainless steel (A4)

Type M (or M A4)
galvanised steel or stainless steel (A4)

Type PT (or PT A4)
galvanised steel or stainless steel (A4)

Marking:	Brand	Code No plug length	manufacturer code	if stainless steel
Example:	**X or C**	**12 or 120**	**1**	**A4**

CELO Multifunction frame plug MFR

Product description
MFR 8 – Anchor types, screw specification, marking

Annex A2

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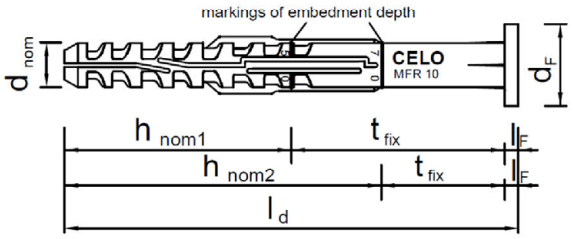
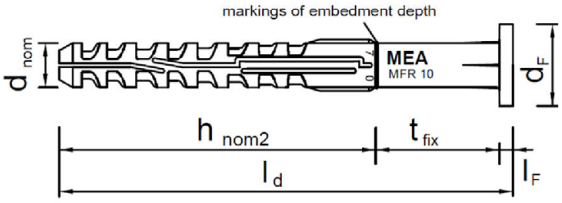
Anchor sleeve MFR 10

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

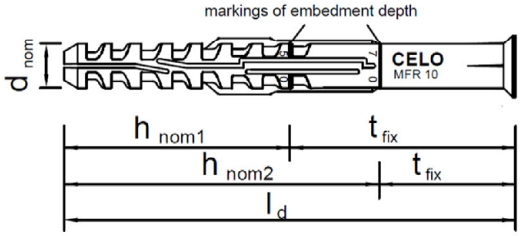
MFR 10 FB



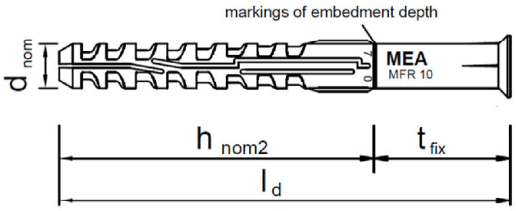
MFR 10 FB (alternative)



MFR 10 SB



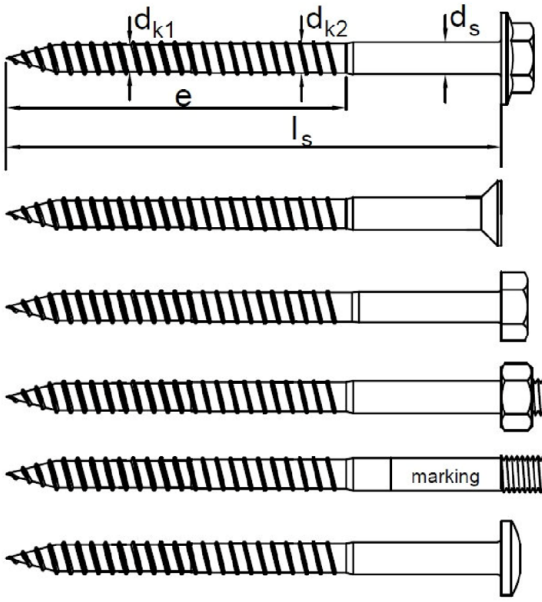
MFR 10 SB (alternative)

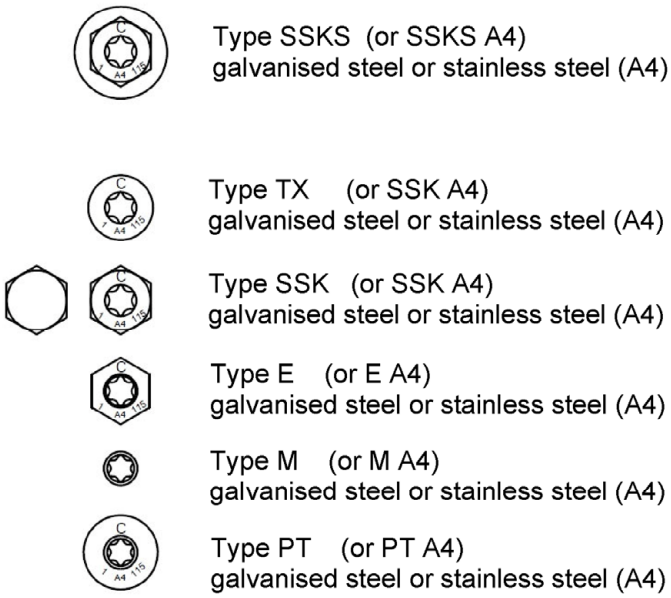


Marking:	Brand	Type	diameter (d_{nom}) - length (l_d)		plug head form (optional)
Example:	**CELO (or MEA or Logo)**	**MFR**	**10**	**100**	**F or S (F = FB) (S = SB)**

Special screw (for MFR 10)

Screw head with different tool fittings





Type SSKS (or SSKS A4)
galvanised steel or stainless steel (A4)

Type TX (or SSK A4)
galvanised steel or stainless steel (A4)

Type SSK (or SSK A4)
galvanised steel or stainless steel (A4)

Type E (or E A4)
galvanised steel or stainless steel (A4)

Type M (or M A4)
galvanised steel or stainless steel (A4)

Type PT (or PT A4)
galvanised steel or stainless steel (A4)

Marking:	Brand	Code No plug length	manufacturer code	if stainless steel
Example:	**X or C**	**12 or 115**	**1**	**A4**

CELO Multifunction frame plug MFR

Product description
MFR 10 – Anchor types, screw specification, marking

Annex A3

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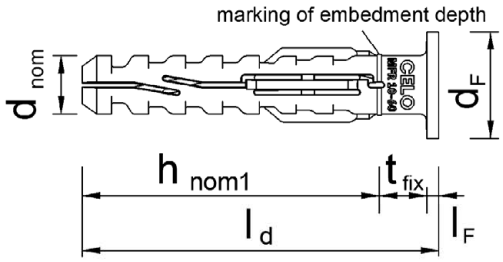
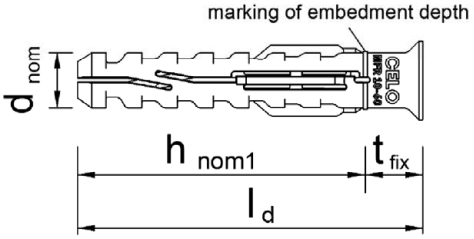
Anchor sleeve MFR 10-60

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



MFR 10-60 FB

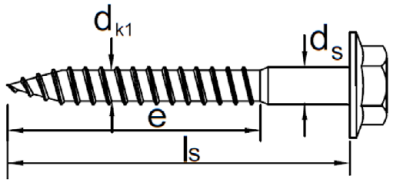


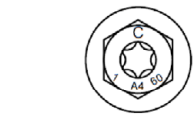
MFR 10-60 SB

Marking:	Brand	Type	diameter (d_{nom}) - length (l_d)		plug head form (optional)
Example:	**CELO (or Logo)**	**MFR**	**10**	**60**	**F or S**

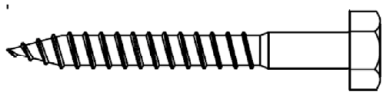
Special screw (for MFR 10-60)

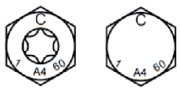
Screw head with different tool fittings



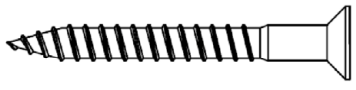


Type SSKS (or SSKS A4)
galvanised steel or
stainless steel (A4)





Type SSK (or SSK A4)
galvanised steel or
stainless steel (A4)



Type TX (or TX A4)
galvanised steel or
stainless steel (A4)

Marking:	Brand	Code No plug length	manufacturer code	if stainless steel
Example:	**X or C**	**6 or 60**	**1**	**A4**

CELO Multifunction frame plug MFR

Product description
MFR 10-60 – Anchor types, screw specification, marking

Annex A4

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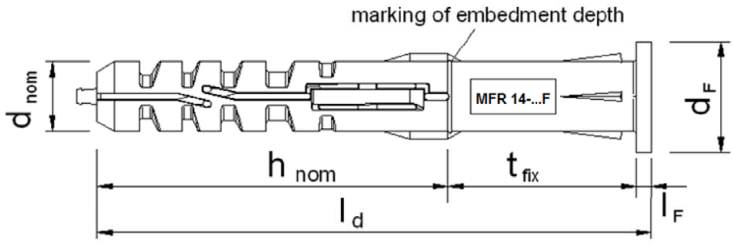
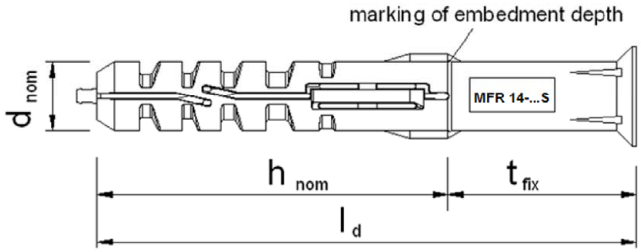
Anchor sleeve MFR 14

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



MFR 14 FB

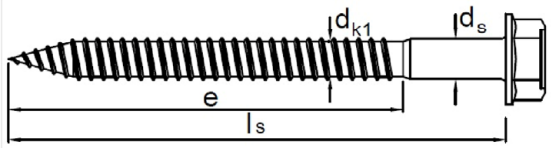


MFR 14 SB

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

Special screw (for MFR 14)

Screw head with different tool fittings

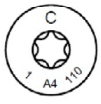


Type SSKS (or SSKS A4)
galvanised steel or stainless steel (A4), optional with glide coating

Type TX (or TX A4)
galvanised steel or stainless steel (A4)
optional with glide coating

Type E (or E A4)
galvanised steel or stainless steel (A4)
optional with glide coating

Type M (or M A4)
galvanised steel or stainless steel (A4)
optional with glide coating



Type PT (or PT A4)
galvanised steel or stainless steel (A4)
optional with glide coating

Marking:	Brand	Code No plug length	manufacturer code	if stainless steel
Example:	**X or C**	**11 or 110**	**1**	**A4**

CELO Multifunction frame plug MFR	Annex A5
Product description MFR 14 – Anchor types, screw specification, marking	

Deutsches Institut für Bautechnik DIBt

Table A5.1: Dimensions [mm]

	Anchor sleeve							
	l_d	Ø d_{nom}	t_{fix} min	t_{fix} max	h_{nom1}	h_{nom2}	l_F [2)]	Ø d_F
MFR 8	≥60	8	≥ 1	110	50		2,3	14
MFR 10	≥80	10	≥ 1	500	50	70	3	18
MFR 10-60	60	10	≥ 1	10	50		2	18
MFR 14	≥80	14	≥ 1	500	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 10-60	65	7	5,8	-	≤48
for MFR 14	≥85	10	8,4	-	≤75

[1)] To insure, that the screw penetrates the anchor sleeve, l_s must be l_d + 5 mm

[2)] only valid for plan head version

Table A5.2: Materials

Designation	Material
anchor sleeve	Polyamid PA 6
special screw (steel, zinc plated)	Steel, zinc plated galvanised ≥ 5 µm acc. EN ISO 4042:2018 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

CELO Multifunction frame plug MFR	Annex A6
Product description Dimensions and materials	

Deutsches Institut für Bautechnik DIBt

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads.
- Redundant non-structural systems.

Base materials:

- Reinforced or unreinforced normal weight concrete without fibres with strength classes ≥ C12/15 (base material group a) according to EN 206:2013+A1:2016, Annex C2 and Annex C3.
- Precast prestressed hollow core slabs with strength classes ≥ C20/25 (base material group a) according to EN 206:2013+A1:2016, see Annex C2
- Solid brick masonry (base material group b) according to EN 771-1/-2/-3:2011+A1:2015, see 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 (base material group c) according to EN 771-1/-2/-3:2011+A1:2015, see Annex C4-C6
- Autoclaved aerated concrete (base material group d) according to EN 771-4:2011+A1:2015, see Annex C8
- Mortar strength class of the masonry ≥ M2,5 according to EN 998-2:2010.
- For other base materials of the base material groups a, b, c or d the characteristic resistance of the anchor may be determined by job site tests according to EOTA TR 051:2018-04.

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 made of 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 (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (screw made of 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 EOTA TR 064:2018-05 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.

Installation:

- Hole drilling by the drill methods according to Annex C4, C5 or C6 for base material group b and c and according to Annex C8 for base material group d, hammer drilling is to be used for base material group 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.
- No ingress of water in the borehole at temperatures < 0°C

CELO Multifunction frame plug MFR	Annex B1
Intended use Specification of intended use	

Deutsches Institut für Bautechnik DIBt

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

Anchor type			**MFR 8**	**MFR 10-60/ MFR 10**	**MFR 10**	**MFR 14**
Overall plastic anchor embedment depth in the base material [1), 2)]	h_{nom} ≥	[mm]	50	50	70	70
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	60	80	80
Diameter of clearance hole in the fixture	d_f ≤	[mm]	9,0	11		15

[1)] See Annex A1

[2)] For hollow and perforated masonry the influence of
h_{nom} > 50 mm (MFR 8)
h_{nom1} > 50 mm respectively h_{nom2} > 70 mm (MFR 10)
h_{nom} > 70 mm (MFR 14)
has to be detected by job site tests according to EOTA TR 051

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

Anchor type			**MFR 8**	**MFR 10-60/ MFR 10**	**MFR 10**
Overall plastic anchor embedment depth in the base material	h_{nom} ≥	[mm]	50	50	70
Drill hole diameter	d_0 <	[mm]	8	10	10
Cutting diameter of drill bit	d_{cut} ≤	[mm]	8,45	10,45	10,45
Depth of drill hole to the deepest point [1)]	h_1 ≥	[mm]	60	60	80
Diameter of clearance hole in the fixture	d_f ≤	[mm]	9,0	11	11
Bottom flange thickness	d_b ≥	[mm]	35	35	35
Distance between plug position and prestressing steel	a_p ≥	[mm]	50	50	50

[1)] See Annex A1

CELO Multifunction frame plug MFR	Annex B2
Product description Installation parameters in concrete, masonry, autoclaved aerated concrete and hollow core slabs	

Deutsches Institut für Bautechnik DIBt

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

	Minimum member thickness h_{min} [mm]	Characteris-tic edge distance $c_{cr,N}$ [mm]	Charac-teristic spacing $s_{cr,N}$ [mm]	Minimum edge distance c_{min} [mm]	Minimum spacing s_{min} [mm]
MFR 8					
Beton ≥ C16/20	100	50	55	60	50
Beton C12/15	100	70	80	85	70
MFR 10-60/ MFR 10 h_{nom1} = 50 mm					
Beton ≥ C16/20	100	50	75	50	50
Beton C12/15	100	70	105	70	70
MFR 10 h_{nom2} = 70 mm					
Beton ≥ C16/20	110	70	75	60	50
Beton C12/15	110	100	105	85	70
MFR 14					
Beton ≥ C16/20	120	80	100	100	100
Beton C12/15	120	112	140	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/ MFR 10-60 h_{nom1}=50 mm				
Concrete ≥ C20/25	200	70	60	50
MFR 10 h_{nom2}=70 mm				
Concrete ≥ C45/55	200	70	60	50

CELO Multifunction frame plug MFR

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

Annex B3

Deutsches Institut für Bautechnik DIBt

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
MFR 8	h_{min} [mm]	c_{min} [mm]	a_{min} [mm]	$s_{1,min}$ [mm]	$s_{2,min}$ [mm]
Clay brick **Mz-1.8 – NF**	115	100	[3]	200	400
Sand-lime solid brick **KS – 2DF**	115	100	[3]	200	400
Hollow clay brick **HLz 12-1.0 - 12DF**	240	100	[3]	200	400
Hollow clay brick **HLz 1** (Gero Tochana)	125	100	[3]	200	400
Hollow clay brick **HLz 2** (Gero Tejala)	135	100	[3]	200	400
Hollow light concrete block **Hbl 7** (Bloque hormigon)	200	100	[3]	200	400
Hollow sand-lime brick **KSL 12-1.4 - 3DF**	175	100	[3]	200	400
Hollow light concrete block **Hbl 2-0.8-16DF**	240	100	[3]	200	400
Hollow concrete block **Hbn 1.4 - 12DF**	240	100	[3]	200	400
MFR 10-60/ MFR 10 h_{nom1} = 50 mm					
Clay brick **Mz-1.8 2DF**	115	100	[3]	200	400
Sand-lime solid brick **KS - 3DF**	175	100	[3]	200	400
Hollow clay brick **HLz 12-1.0 - 12DF**	240	100	[3]	200	400
Hollow clay brick **HLz 1** (Gero Tochana)	125	100	[3]	200	400
Hollow clay brick **HLz 2** (Gero Tejala)	135	100	[3]	200	400
Hollow light concrete block **Hbl 7** (Bloque hormigon)	200	100	[3]	200	400
Hollow sand-lime brick **KSL 12-1.4 - 8DF**	240	100	[3]	200	400
Hollow concrete block **Hbn 1.4 - 12DF**	240	100	[3]	200	400
MFR 10 h_{nom2} = 70 mm					
Clay brick **Mz-1.8 - 2DF**	115	100	[3]	200	400
Sand-lime solid brick **KS - 2DF**	115	100	[3]	200	400
Hollow clay brick **HLz 12-1.0 - 2DF**	115	100	[3]	200	400
Hollow sand-lime brick **KSL 12-1.4 - 8DF**	240	100	[3]	200	400
Hollow clay brick Brique Creuse **C 3-0.7**	200	100	[3]	200	400
Hollow concrete block **Hbn 1.4 - 12DF**	240	100	[3]	200	400
MFR 14					
Clay brick **Mz-1.8 NF**	115	100	[3]	200	400
Sand-lime solid brick **KS - 8DF**	240	100	[3]	200	400
Sand-lime solid brick **KS - 2DF**	115	100	[3]	200	400
Hollow clay brick **HLz 12-1.0 - 2DF**	115	120	[3]	240	480
Hollow sand-lime brick **KSL 12-1.4 - 8DF**	240	100	[3]	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.
[3] a_{min} = max (250 mm; $s_{1,min}$; $s_{2,min}$)

CELO Multifunction frame plug MFR	Annex B4
Intended use Minimum thickness, spacing, edge distance in masonry	

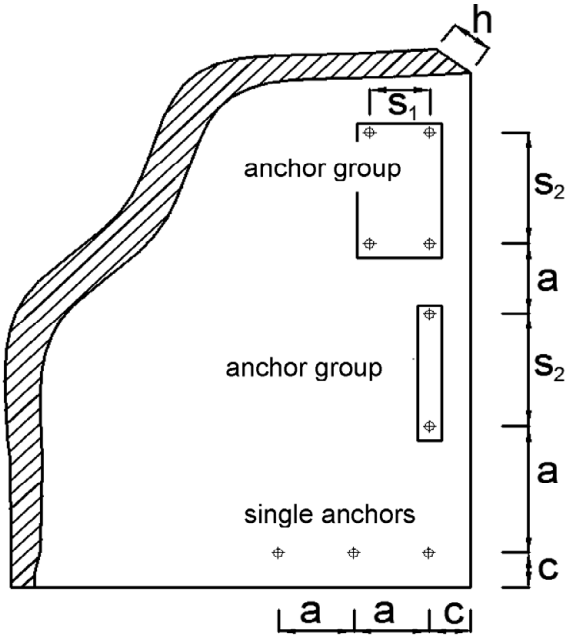
Deutsches Institut für Bautechnik DIBt

Table B5: Minimum thickness of member, edge distance and anchor spacing in autoclaved aerated concrete

	Minimum thickness of member	Minimum edge distance	Minimum spacing		
			Single anchor	**Anchor Group** [1]	
				perpendicular to free edge	parallel to free edge
Autoclaved aerated concrete with mean compressive strength according to EN 771-4	h_{min} [mm]	c_{min} [mm]	a_{min} [mm]	$s_{1,min}$ [mm]	$s_{2,min}$ [mm]
MFR 8 **h_{nom} = 50 mm**					
$f_{cm,decl} \geq 2$ N/mm²	240	50	[2]	200	400
$f_{cm,decl} \geq 3{,}5$ N/mm²	240	90	[2]	200	400
$f_{cm,decl} \geq 6$ N/mm²	240	150	[2]	200	400
MFR 10 and MFR 14 **h_{nom2} = 70 mm**					
$f_{cm,decl} \geq 2$ N/mm²	100	50	[2]	100	200
$f_{cm,decl} \geq 4$ N/mm²	100	75	[2]	150	300
$f_{cm,decl} \geq 6$ N/mm²	100	150	[2]	200	400

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

[2] a_{min} = max (250 mm; $s_{1,min}$; $s_{2,min}$)



CELO Multifunction frame plug MFR	Annex B5
Intended use Minimum thickness, spacing, edge distance in autoclaved aerated concrete	

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Table B6: Geometry of stones

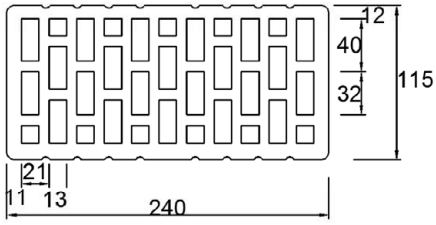


Figure 1 HLz 12 2DF

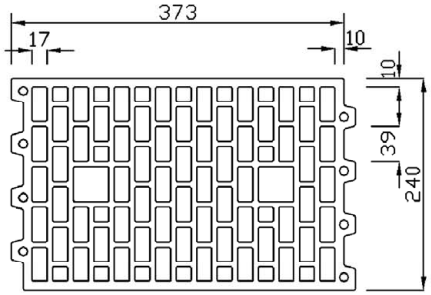


Figure 2 HLz 12 12DF

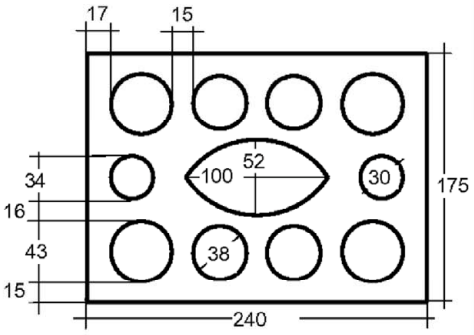


Figure 3 KSL 12-1.4– 3DF

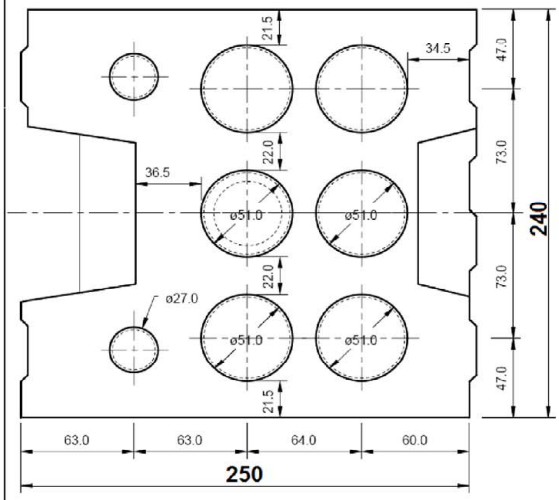


Figure 4 KSL 12 8DF

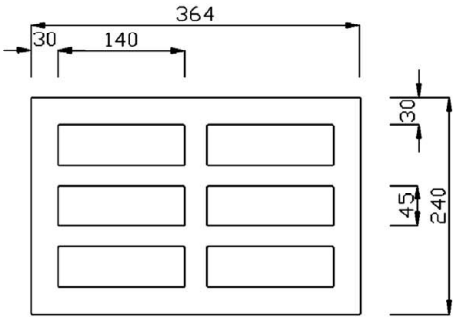


Figure 5 Hbn 1,4 12DF

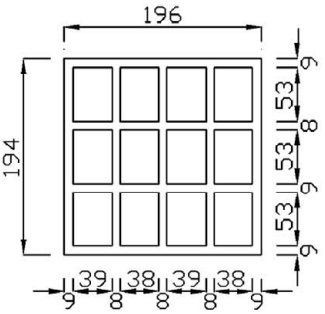


Figure 6 Brique Creuse

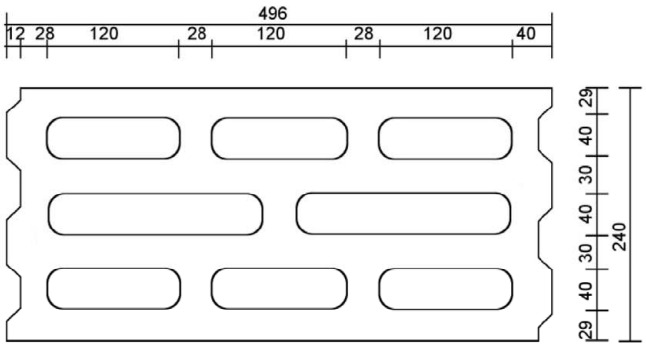


Figure 7 Hbl 2-0,8 16DF

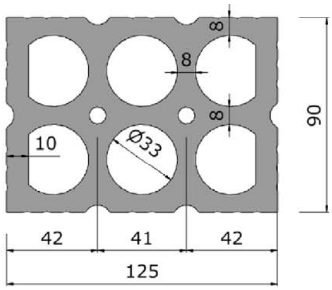


Fig. 8 HLz 1 brick with round holes (Gero Tochana)

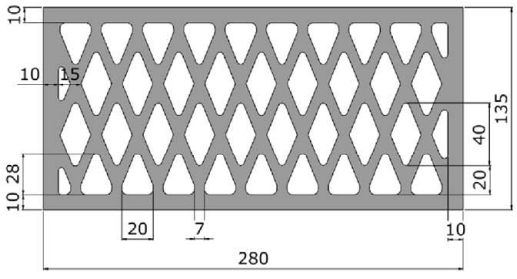


Fig. 9 HLz 2 brick with rhomb holes (Gero Tejala)

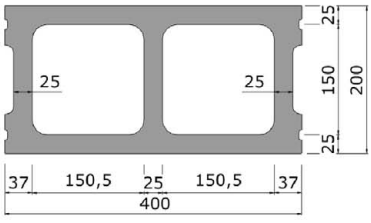


Fig 10 Hbl 7 hollow concrete block (Bloque hormigon)

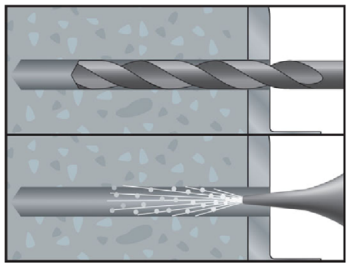
CELO Multifunction frame plug MFR	Annex B6
Intended use Geometry of stones	

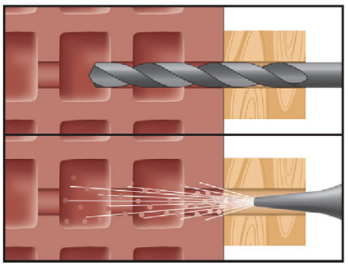
Deutsches Institut für Bautechnik DIBt

Installation instruction MFR

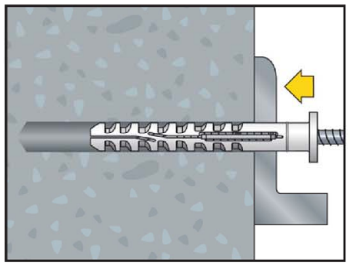
in concrete or in hollow core slabs

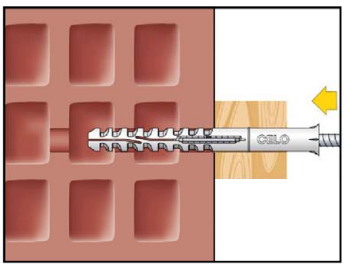
in masonry



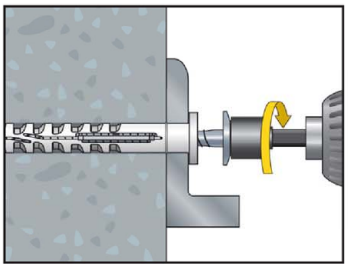


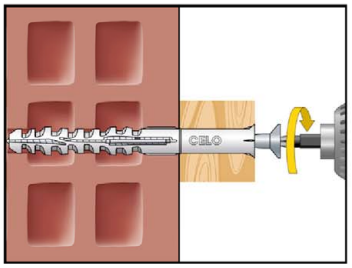
1. Drill the borehole and clean the hole.
Drilling method:
Concrete: hammer drill
Masonry: According Table C4, C5, C6



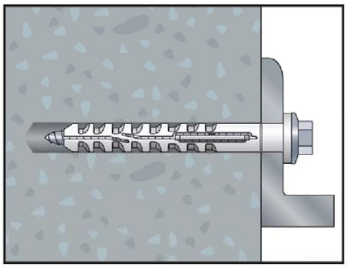


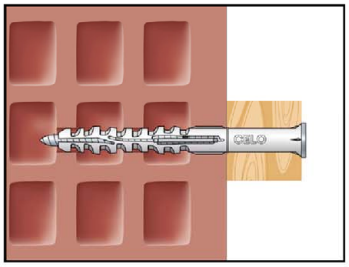
2. Hammer in the plug slightly through the fixture part till the plug is flush to this. Minimum setting depth (50 mm or 70 mm) must be observed.



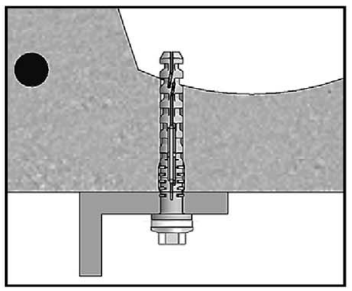


3. Tighten the screw with screw driver till the screw touches the collar of the sleeve. The screw must fit tight on the surface of the fixture part.





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



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

CELO Multifunction frame plug MFR	Annex B7
Intended use Installation instruction	

Deutsches Institut für Bautechnik DIBt

Table C1.1: Characteristic bending resistance of the screws

Screw Ø 6 mm for MFR 8		galvanised steel 6.8	stainless steel
Characteristic bending resistance	$M_{Rk,s}$ [Nm]	14,1	16,5
Partial safety factor	γ_{Ms} 1)	1,25	1,56
Screw Ø 7 mm for MFR 10-60/ MFR 10		galvanised steel 6.8	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 6.8	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 screws

Failure of expansion element (special screw)			
Special screw Ø 6 mm for MFR 8		galvanised steel 6.8	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]	8,1	9,4
Partial safety factor	γ_{Ms} 1)	1,25	1,56
Special screw Ø 7 mm for MFR 10-60/ MFR 10		galvanised steel 6.8	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 6.8	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

CELO Multifunction frame plug MFR	Annex C1
Performances Characteristic resistance and characteristic bending resistance of the screws	

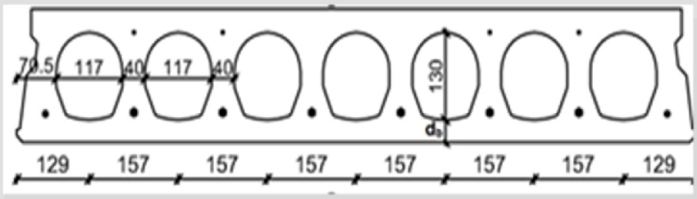
Deutsches Institut für Bautechnik DIBt

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

Pull-out failure (plastic sleeve)			**Concrete ≥ C16/20**		**Concrete C12/15**	
		ϑ =	24/40 °C	50/80 °C	24/40 °C	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 10-60/ MFR 10 h_{nom1} = 50 mm						
Characteristic resistance	$N_{Rk,p}$	[kN]	2,5	2,0	1,5	1,5
Partial safety factor	γ_{Mc} 1)		1,8	1,8	1,8	1,8
MFR 10 h_{nom2} = 70 mm						
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 (base material group "a"), temperature range a (+24°/ +40°) and b (+50°/ +80°)

Pull-out failure (plastic sleeve)			**Precast prestressed hollow core slabs**	
			Producer: DW Systembau, D-29640 Schneverdingen or ANC TEC Leipzig	
MFR 8 Concrete ≥ C45/55			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 10-60/ MFR 10 h_{nom1} = 50 mm Concrete ≥ C20/25				
Characteristic resistance	$N_{Rk,p}$	[kN]	$d_b \geq 35$ mm	2,00
Partial safety factor	γ_{Mc} 1)			1,8
MFR 10 h_{nom2} = 70 mm Concrete ≥ C45/55				
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

CELO Multifunction frame plug MFR

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 for both temperature ranges

	Tension load	Displacement		Shear load	Displacement	
Concrete ≥ C16/20	**N** [1]	δ_{NO}	$\delta_{N\infty}$	**V** [1]	δ_{VO}	$\delta_{V\infty}$
	[kN]	[mm]	[mm]	[kN]	[mm]	[mm]
MFR 8	0,99	0,25	0,05	2,47	0,80	1,20
MFR 10-60/ MFR 10 h_{nom1} = 50 mm	0,99	0,17	0,34	1,04	0,81	1,22
MFR 10 h_{nom2} = 70 mm	1,59	0,12	0,15	3,37	2,20	3,30
MFR 14	1,79	0,30	0,60	6,04	2,50	3,75

[1] Intermediate values by linear interpolation

Table C 3.2: Values 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	$F_{Rk,fi,90}$	$\gamma_{M,fi}$ [1]
MFR 10	R 90	0,8 kN	1,0
MFR 14	R 90	0,8 kN	1,0

[1] In absence of other national regulations.

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

MFR 8	Bulk density ρ	Compres-sive Strength f_b	Minimum DF or minimum size **(L x W x H)**	figure/ geometry	drill method H= hammer R= rotary	Characteristic resistance F_{Rk} [1]
Base material	[kg/dm³]	[N/mm²]	[mm]			[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	**1,5**
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	≥ 10 < 20	NF (240*116*71)		H	**0,9**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	≥ 20	2DF (240*115*113)		H	**3,0**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	≥ 10 < 20	2DF (240*115*113)		H	**2,0**
Hollow clay brick **HLz** EN 771-1:2011+A1:2015	≥ 1,0	≥ 12	12 DF (373*240*249)	Annex B6 figure 2	R only	**0,5**
Hollow clay brick **HLz 1** (Gero Tochana)	≥ 0,8	≥ 3	(285*125*90)	Annex B6 figure 8	R only	**0,9**
Hollow clay brick **HLz 2** (Gero Tejala)	≥ 1,0	≥ 5,9	(280*135*90)	Annex B6 figure 9	R only	**0,9**
Hollow Sand-lime brick **KSL** EN 771-2:2011+A1:2015	≥ 1,4	≥ 17	3 DF (240*175*113)	Annex B6 figure 3	R	**1,2**
		≥ 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 7	R	**0,3**
Hollow light concrete block **Hbl 7** (Bloque hormigon)	≥ 1,0	≥ 6	(400*200*200)	Annex B6 figure 10	R	**0,9**
Hollow concrete block **Hbn** EN 771-3:2011+A1:2015	≥ 1,4	≥ 25	12 DF (365*240*238)	Annex B6 figure 5	H	**1,2**
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

CELO Multifunction frame plug MFR	Annex C4
Performances MFR 8 – Characteristic resistance for use in masonry	

Deutsches Institut für Bautechnik DIBt

Table C5: Characteristic resistance F_{Rk} [kN] in solid and hollow or perforated masonry (base material group "b" + "c") for MFR 10 and MFR 10-60

MFR 10-60/ MFR 10	Bulk density **ρ**	Compres-sive strength **f_b**	Minimum DF or minimum size **(L x W x H)**	figure/ geo-metry	drill method H= hammer R= rotary	Characteristic resistance **F_{Rk} 1)** **h_{nom1} = 50 mm**		Characteristic resistance **F_{Rk} 1)** **h_{nom2} = 70 mm**	
Base material	[kg/dm³]	[N/mm²]	[mm]			[kN]	[kN]	[kN]	[kN]
						ϑ = 24/40 °C	ϑ = 50/80 °C	ϑ = 24/40 °C	ϑ = 50/80 °C
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	≥ 20	2DF (240*116*113)		H	**3,0**	**2,5**	**3,0**	**2,5**
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	≥ 10 < 20	2DF (240*116*113)		H	**2,0**	**1,5**	**2,0**	**1,5**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	≥ 20	2DF (240*115*113)		H	**4,0**	**3,5**	**3,0**	**2,5**
Sand-lime solid brick **KS** EN 771-2:2011+A1:2015	≥ 1,8	≥ 10 < 20	2DF (240*115*113)		H	**2,5**	**2,5**	**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	3)	3)	**0,75**	**0,6**
Hollow clay brick **HLz** EN 771-1:2011+A1:2015	≥ 1,0	≥ 12	12 DF (373*240*249)	Annex B6 figure 2	R only	**1,2**	**1,0**	3)	3)
Hollow clay brick **HLz 1** (Gero Tochana)	0,8	≥ 3	(285*125*90)	Annex B6 figure 8	R only	**1,2**	**0,9**	3)	3)
Hollow clay brick **HLz 2** (Gero Tejala)	1,0	≥ 5,9	(280*135*90)	Annex B6 figure 9	R only	**0,75**	**0,6**	3)	3)
Hollow sand-lime brick **KSL** EN 771-2:2011+A1:2015	≥ 1,4	≥ 12	8 DF (250*240*237)	Annex B6 figure 4	R	**1,5**	**1,2**	**0,9**	**0,6**
Hollow concrete block **Hbn** EN 771-3:2011+A1:2015	≥ 1,4	≥ 25	12 DF (365*240*238)	Annex B6 figure 5	H	**2,5**	**2,0**	**0,75**	**0,75**
Hollow light concrete block **Hbl 7** (Bloque hormigon)	≥ 1,0	≥ 6	(400*200*200)	Annex B6 figure 10	R	**0,6** MFR 10-60	**0,5** MFR 10-60	3)	3)
Hollow light concrete block **Hbl 7** (Bloque hormigon)	≥ 1,0	≥ 6	(400*200*200)	Annex B6 figure 10	R	**0,75** MFR 10	**0,6** MFR 10	3)	3)
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 6	R only	3)	3)	**0,3**	**0,3**
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
3) No performance assessed

CELO Multifunction frame plug MFR

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 (base material group "b" + "c") for MFR 14

MFR 14	Bulk density ρ	Compres-sive strength f_b	Minimum DF or minimum size **(L x W x H)**	figure/ geometry	drill method H= hammer R= rotary	Characteristic resistance F_{Rk} [1]	
Base material	[kg/dm³]	[N/mm²]	[mm]			[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	**4,5**	**3,0**
Clay brick **Mz** EN 771-1:2011+A1:2015	≥ 1,8	≥ 10 < 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 < 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 < 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 4	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

CELO Multifunction frame plug MFR	Annex C6
Performances MFR 14 – Characteristic resistance for use in masonry	

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Table C7: Displacements under tension and shear loading in masonry for both temperature ranges

	Tension load	Displacements		Shear load	Displacements	
	N	δ_{NO}	$\delta_{N\infty}$	V	δ_{VO}	$\delta_{V\infty}$
	[kN]	[mm]	[mm]	[kN]	[mm]	[mm]
MFR 8	0,57	0,33	0,66	0,57	0,48	0,72
MFR 10-60/ MFR 10 h_{nom1} = 50 mm	0,71	0,29	0,58	0,71	0,62	0,93
MFR 10 h_{nom2} = 70 mm	0,86	0,20	0,40	0,86	0,71	1,07
MFR 14	1,43	0,20	0,40	1,43	1,19	1,79

CELO Multifunction frame plug MFR

Performances
Displacements for use in masonry

Annex C7

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Base material solid masonry: Autoclaved Aerated Concrete

Table C8.1: Brick Data

Description of brick			Autoclaved aerated concrete
Type of brick			unreinforced autoclaved aerated concrete
Bulk density	$\rho \geq$	[kg/dm³]	0,35
European Standard			EN 771-4:2011+A1:2015
Minimum thickness of member MFR 8	h_{min} =	[mm]	240
Minimum thickness of member MFR 10/14	h_{min} =	[mm]	100

Installation parameters see Annex B2

Table C8.2: Characteristic resistance F_{Rk} [kN] in autoclaved aerated concrete (base material group "d")

Base material	mean compressive strength according to EN 771-4:2011 +A1:2015 $f_{cm,decl}$ [N/mm²]	Drill method	Characteristic resistance F_{Rk} [1] [kN] ϑ = 24/40 °C	Characteristic resistance F_{Rk} [1] [kN] ϑ = 50/80 °C
MFR 8 h_{nom} = 50 mm				
Autoclaved aerated concrete	≥ 2	Rotary drilling	**0,3**	**0,3**
	≥ 3,5	Rotary drilling	**1,2**	**0,9**
	≥ 6	Rotary drilling	**2,0**	**1,5**
MFR 10 h_{nom2} = 70 mm				
Autoclaved aerated concrete	≥ 2	Rotary drilling	**0,4**	**0,3**
	≥ 4	Rotary drilling	**1,2**	**0,9**
	≥ 6	Rotary drilling	**2,0**	**1,5**
MFR 14 h_{nom} = 70 mm				
Autoclaved aerated concrete	≥ 2	Rotary drilling	**0,3**	**0,3**
	≥ 4	Rotary drilling	**1,2**	**1,2**
	≥ 6	Rotary drilling	**2,0**	**2,0**
Partial safety factor [2]		$\gamma_{M,AAC}$	**2,0**	

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

CELO Multifunction frame plug MFR	Annex C8
Performances MFR 8/10/14 – Characteristic resistance for use in autoclaved aerated concrete	

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Table C9: Displacements under tension and shear loading in autoclaved aerated concrete for both temperature ranges

Autoclaved aerated concrete with mean compressive strength according to EN 771-4:2011 +A1:2015	**Tension load N** [kN]	**Displacements** δ_{NO} [mm]	$\delta_{N\infty}$ [mm]	**Shear load V** [kN]	**Displacements** δ_{VO} [mm]	$\delta_{V\infty}$ [mm]
MFR 8 h_{nom} = 50 mm						
$f_{cm,decl}$ ≥ 2 N/mm²	0,11	0,04	0,09	0,11	0,11	0,16
$f_{cm,decl}$ ≥ 3,5 N/mm²	0,43	0,05	0,10	0,43	0,33	0,50
$f_{cm,decl}$ ≥ 6 N/mm²	0,71	0,19	0,38	0,71	0,55	0,82
MFR 10 h_{nom2} = 70 mm						
$f_{cm,decl}$ ≥ 2 N/mm²	0,14	0,10	0,20	0,14	0,30	0,40
$f_{cm,decl}$ ≥ 4 N/mm²	0,43	0,10	0,20	0,43	0,90	1,30
$f_{cm,decl}$ ≥ 6 N/mm²	0,71	0,10	0,20	0,71	1,40	2,10
MFR 14						
$f_{cm,decl}$ ≥ 2 N/mm²	0,11	0,10	0,20	0,11	0,20	0,30
$f_{cm,decl}$ ≥ 4 N/mm²	0,43	0,10	0,20	0,43	0,90	1,30
$f_{cm,decl}$ ≥ 6 N/mm²	0,71	0,10	0,20	0,71	1,40	2,10