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-15/0450 of 7 August 2015

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Injection system VMU plus II for masonry
Product family to which the construction product belongs	Injection system for use in masonry
Manufacturer	MKT Metall-Kunststoff-Technik GmbH & Co. KG Auf dem Immel 2 67685 Weilerbach DEUTSCHLAND
Manufacturing plant	Werk 1, D und Werk 2, D
This European Technical Assessment contains	38 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	Guideline for European technical approval of "Metal Injection Anchors for Use in Masonry", ETAG 029, April 2013, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011.

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This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission in accordance with Article 25(3) of Regulation (EU) No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 MKT Injection system VMU plus II for use in masonry is a bonded anchor (injection type) consisting of a mortar cartridge with MKT injection mortar VMU plus, a perforated sieve sleeve and an anchor rod with hexagon nut and washer in the range of M6 to M12 or an internal threaded rod in the range of M6 and M8. The steel elements are made of zinc coated steel, stainless steel or high corrosion resistant steel.

The anchor rod is placed into a drilled hole filled with injection mortar and is anchored via the bond between steel element, injection mortar and masonry and mechanical interlock.

The product description is given in Annex A.

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

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

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

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance for tension and shear loads	See Annex C1, C5 – C25
Characteristic resistance for bending moments	See Annex C1
Displacements under shear and tension loads	See Annex C26
Reduction Factor for job site tests (β-Factor)	See Annex C26
Edge distances and spacing	See Annex C4 – C25

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	No performance assessed

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances there may be requirements (e.g. transposed European legislation and national laws, regulations and administrative provisions) applicable to the products falling within the scope of this European Technical Assessment. In order to meet the provisions of Regulation (EU) No 305/2011, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

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

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 029, April 2013, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011, the applicable European legal act is: [97/177/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 7 August 2015 by Deutsches Institut für Bautechnik

Uwe Bender
Head of Department

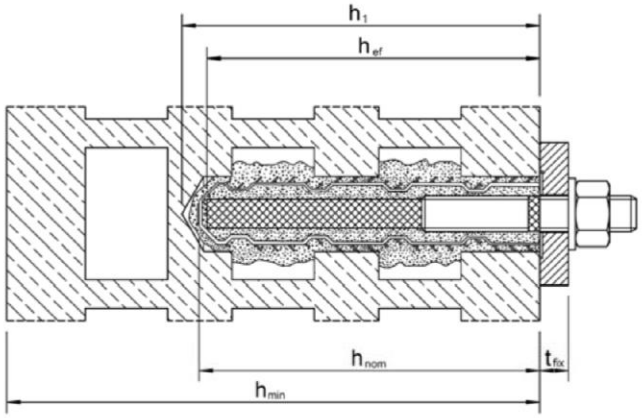
beglaubigt:
Baderschneider

Deutsches Institut für Bautechnik DIBt

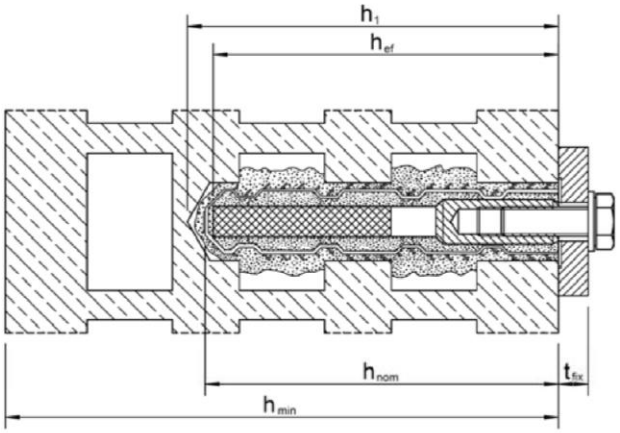
Installation anchor

Installation in perforated and solid brick masonry

a) Installation with perforated sleeve and anchor rod

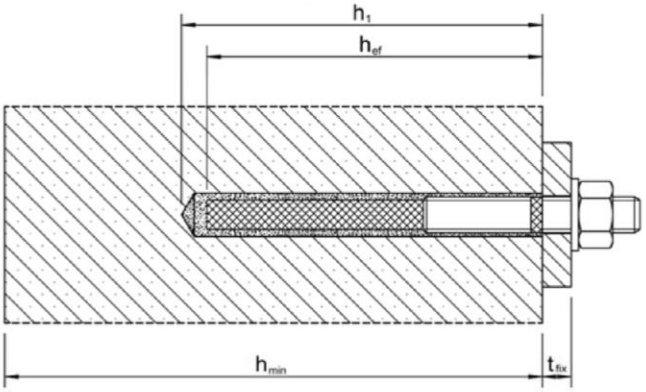


b) Installation with perforated sleeve and internal threaded rod



Installation in solid brick masonry without perforated sleeve

c) Installation without perforated sleeve and anchor rod (Installation with internal threaded rod: Not pictured)



h_{nom}:	Embedment depth in the base material
h_1:	Depth of drill hole to deepest point
h_{min}:	Thickness of member
t_{fix}:	Thickness of fixture
h_{ef}:	Effective anchorage depth

Injection System VMU plus II for masonry

Product description
Installed condition

Annex A1

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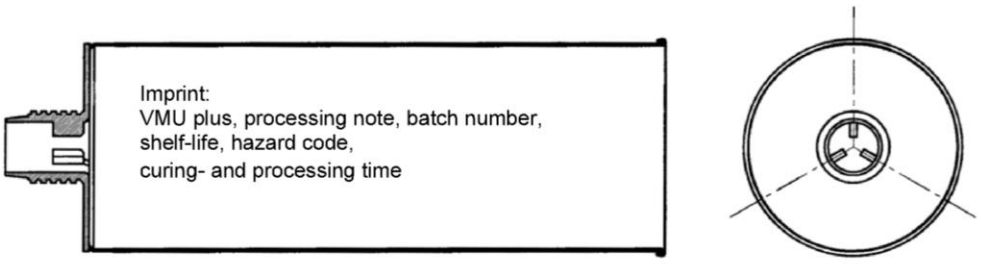
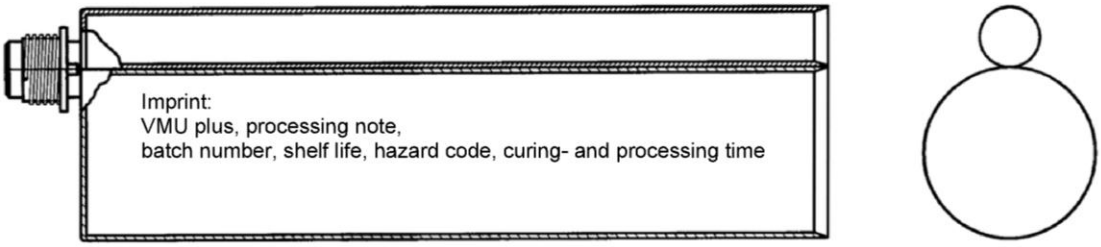
Cartridge: VMU plus

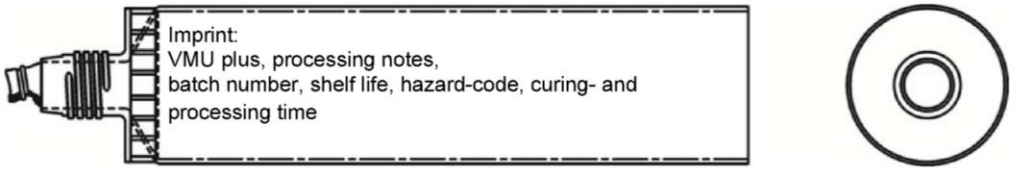
Type: coaxial (150 ml, 280 ml, 300 ml, 310 ml, 330 ml, 380 ml, 410 ml and 420 ml)



Type: „side-by-side“ (235 ml, 345 ml and 825 ml)

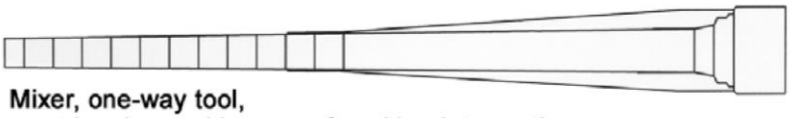


Type: „foil-tube” (165 ml and 300 ml)



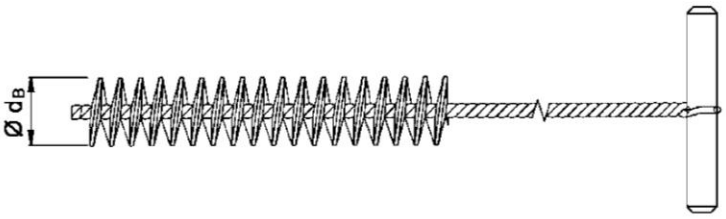
Sealing cap

Static mixer



Mixer, one-way tool,
must be changed in case of working interruption

Cleaning brush



Injection System VMU plus II for masonry	**Annex A2**
Product description Mortar cartridge, static mixer, cleaning brush	

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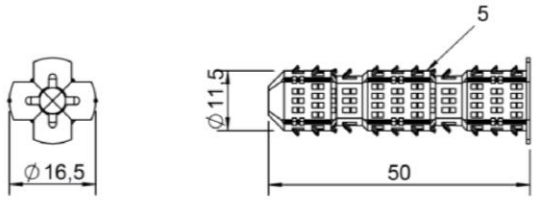
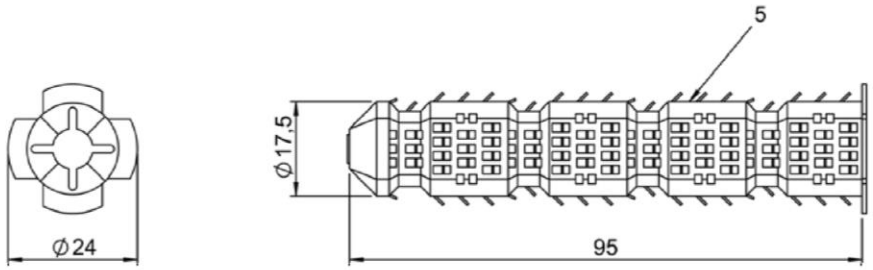
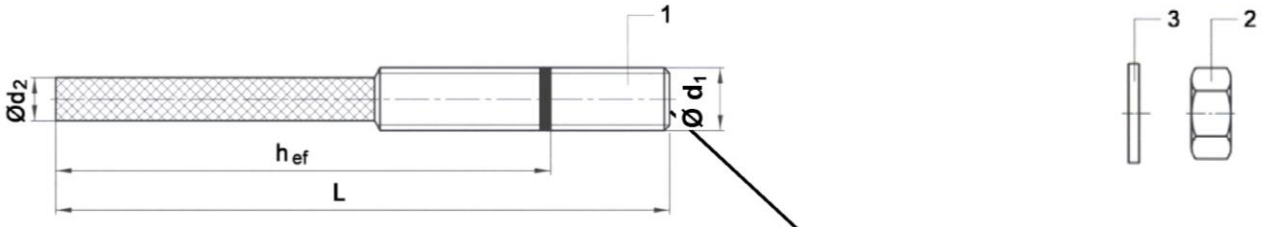
Perforated sleeve VMU-SH 12x50



Perforated sleeve VMU-SH 18x95



Anchor rod VMU-AH



Marking: e.g M12

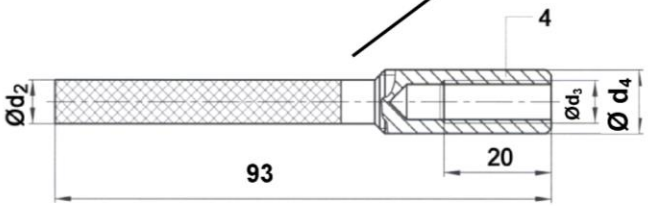
Identifying mark of manufacturer

M... Anchor size

for stainless steel 1.4401, 1.4404 or 1.4571
additional A4

for high corrosion resistant steel 1.4529 / 1.4565
additional HCR.

Internal threaded rod VMU-IGH



Injection System VMU plus II for masonry	Annex A3
Product description Perforated sleeve, anchor rod and internal threaded rod	

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Table A1: Materials

Part	Designation	**Steel, zinc plated** ≥ 5 µm acc. to EN ISO 4042:2001 **Steel, hot-dip galvanized** ≥ 40 µm acc. to EN ISO 1461:2009 or EN ISO 10684:2011	**Stainless steel A4, High corrosion resistant steel HCR**
1	Anchor rod	Steel property class 5.8 or 8.8, acc. to EN ISO 898-1:2013	EN 10088:2012, 1.4401 / 1.4404 / 1.4571 EN ISO 3506:2010 A4-70, A4-80 or EN 10088:2012, 1.4529 / 1.4565 with $f_{uk} \geq 700$ N/mm^2, $f_{yk} \geq 350$ N/mm^2
2	Hexagon nut acc. to DIN 934, EN ISO 4032:2013	Steel, property class 5 or 8 acc. to EN ISO 898-2:2012	EN 10 088:2012, 1.4401 / 1.4404 / 1.4571 EN ISO 3506:2010, A4-70, A4-80 or EN 10088:2012, 1.4529 / 1.4565 with $f_{uk} \geq 700$ N/mm^2, $f_{yk} \geq 350$ N/mm^2
3	Washer EN ISO 7089:2000 EN ISO 7093-1:2000	Steel	EN 10088:2012, 1.4401 / 1.4404 / 1.4571 or EN 10088:2012, 1.4529 / 1.4565
4	Internal threaded rod	Steel, property class 5.8 or 8.8, acc. to EN ISO 898-1:2013	EN 10088:2012, 1.4401 / 1.4404 / 1.4571 EN ISO 3506:2010 A4-70, A4-80 or EN 10088:2012, 1.4529 / 1.4565 with $f_{uk} \geq 700$ N/mm^2, $f_{yk} \geq 350$ N/mm^2
5	Perforated sleeve	Polypropylene	
6	Injection mortar	Vinylester resin, styrene free, mixing ratio 1:10	

Table A2: Anchor dimensions

Anchor rod	Size	Perforated sleeve	Anchor rod				
			Ø d_1 [mm]	Ø d_2 [mm]	h_{ef} [mm]	L_{min} [mm]	L_{max} [mm]
VMU-AH	M6/50	VMU-SH 12x50	6	6.2	49	65	500
VMU-AH	M8/50	VMU-SH 12x50	8	6.2	49	65	500
VMU-AH	M8	VMU-SH 18x95	8	8.2	93	110	500
VMU-AH	M10	VMU-SH 18x95	10	8.2	93	120	500
VMU-AH	M12	VMU-SH 18x95	12	8.2	93	125	500

Table A3: Internal threaded rod dimensions

Internal threaded rod	Size	Perforated sleeve	Internal threaded rod			Minimum and maximum screw in depth	
			Ø d_2 [mm]	Ø d_3 [mm]	Ø d_4 [mm]	min s [mm]	max s [mm]
VMU-IGH	M6	VMU-SH 18x95	8.2	6	12	8	20
VMU-IGH	M8	VMU-SH 18x95	8.2	8	12	8	20

Injection System VMU plus II for masonry

Product description
Materials, anchor dimensions

Annex A4

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Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads

Base materials:

- Solid brick masonry (use category b) and autoclaved aerated concrete masonry (use category d), according to Annex C2.

  Note: The characteristic resistances are also valid for larger brick sizes and larger compressive strength of the masonry unit.
- Hollow brick masonry (use category c), according to Annex C3.
- Mortar strength class of the masonry M2.5 at minimum according to EN 998-2:2010.
- For other bricks in solid masonry and in hollow or perforated masonry, the characteristic resistance of the anchor may be determined by job site tests according to ETAG 029, Annex B under consideration of the β-factor according to Annex C26, Table C6.

Temperature Range:

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

Use conditions (Environmental conditions):

- Dry and wet structure (regarding injection mortar).
- Structures subject to dry internal conditions
  (zinc coated steel, stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist
  (stainless steel or high corrosion resistant steel).
- Structures subject to permanently damp internal condition or in other particular aggressive conditions
  (high corrosion resistant 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 designed in accordance with the ETAG 029, Annex C, Design method A or Design method B under the responsibility of an engineer experienced in anchorages and masonry work.
- Verifiable calculation notes and drawings are prepared taking account the relevant masonry in the region of the anchorage, the loads to be transmitted and their transmission to the supports of the structure. The position of the anchor is indicated on the design drawings.

Installation:

- Dry or wet structures.
- Perforated sleeve VMU-SH 18x95: Use category c and d.
- Perforated sleeve VMU-SH 12x50: Use category c.
- Hole drilling by rotary drill mode or hammer drill mode according to Annex C.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Fastening screws or threaded rods (including nut and washer) must comply with the appropriate material and property class ≥ 5.8 of the internal threaded anchor VMU-IGH.

Injection System VMU plus II for masonry	Annex B1
Intended Use Specifications	

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Table B1.1: Installation parameters for installation without perforated sleeve

Anchor size	**Anchor rod VMU-AH**		**M6/50**	**M8/50**	**M8**	**M10**	**M12**	**-**	**-**
Anchor size	**Internal threaded rod VMU-IGH**		**-**	**-**	**-**	**-**	**-**	**M6**	**M8**
Drill hole diameter	d_0	[mm]	8	10	10	12	14	14	14
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	55		100[1)]				
Effective embedment depth	$h_{ef} \geq$	[mm]	49		93				
Diameter of clearance hole in the fixture VMU-AH	$d_f \leq$	[mm]	7	9	9	12	14	-	-
Diameter of clearance hole in the fixture VMU-IGH	$d_f \leq$	[mm]	-	-	-	-	-	7	9
Diameter of steel brush	$d_B \geq$	[mm]	9	11	11	13	15	15	15
Maximum torque moment	$T_{inst} \leq$	[Nm]	2						

1) The remote face of the masonry member shall be inspected to ensure there has been no break-through by drilling. In case of break-through the ground of the drill hole shall be closed with high strength mortar. The full bonded length h_{ef} shall be achieved and any potential loss of injection mortar shall be compensated.

Table B1.2: Installation parameters for installation with perforated sleeve

Anchor size	**Anchor rod VMU-AH**		**M6/50**	**M8/50**	**M8**	**M10**	**M12**	**-**	**-**
Anchor size	**Internal threaded rod VMU-IGH**		**-**	**-**	**-**	**-**	**-**	**M6**	**M8**
Perforated sleeve			VMU-SH 12x50		VMU-SH 18x95				
Drill hole diameter	d_0	[mm]	12		18				
Depth of drill hole to deepest point	h_1	[mm]	55		100[1)]				
Effective embedment depth	h_{ef}	[mm]	49		93				
Installation depth of the perforated sleeve	h_{nom}	[mm]	50		95				
Diameter of clearance hole in the fixture VMU-AH	$d_f \leq$	[mm]	7	9	9	12	14	-	-
Diameter of clearance hole in the fixture VMU-IGH	$d_f \leq$	[mm]	-	-	-	-	-	7	9
Diameter of steel brush	$d_B \geq$	[mm]	13		19				
Maximum torque moment	$T_{inst} \leq$	[Nm]	2						

1) The remote face of the masonry member shall be inspected to ensure there has been no break-through by drilling. In case of break-through the ground of the drill hole shall be closed with high strength mortar. The full bonded length h_{ef} shall be achieved and any potential loss of injection mortar shall be compensated.

Table B2: Working time and curing time

Temperature [°C] in the drill hole	**Maximum working time**	**Minimum curing time[1)]**	
		Dry masonry	**Wet masonry**
> +40°C	1.5 min	15 min	30 min
> +35°C to +40°C	2 min	20 min	40 min
> +30°C to +35°C	4 min	25 min	50 min
> +20°C to +30°C	6 min	45 min	1:30 h
> +10°C to +20°C	15 min	1:20 h	2:40 h
> +5°C to +10°C	25 min	2 h	4 h
> 0°C to +5°C [2)]	45 min	7 h	14 h
> -5°C to 0°C[2)]	90 min	14 h	28 h
-10°C to -5°C[2)3)]	90 min	24 h	48 h

1) The cartridge temperature must exceed ≥ + 5°C
2) Not for Autoclaved aerated concrete (AAC). Minimum base ground temperature is + 5°C for AAC.
3) The cartridge temperature must exceed ≥ + 15°C

Injection System VMU plus II for masonry

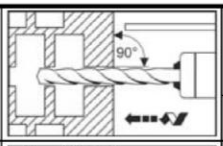
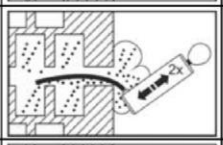
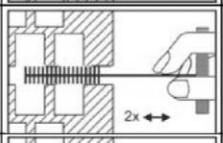
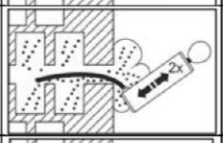
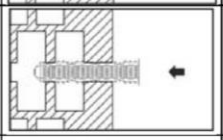
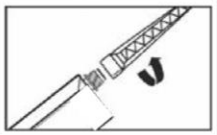
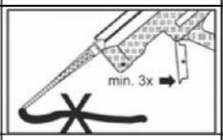
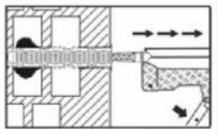
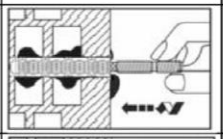
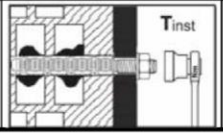
Intended Use
Installation parameters, working time and curing time

Annex B2

Deutsches Institut für Bautechnik DIBt

Installation instructions (Installation with perforated sleeve)

Suitable for: Hollow brick, sand-lime perforated brick, hollow brick lightweight concrete, autoclaved aerated concrete.

1.		Drill the hole. For depth of drill hole h_1 and drill hole diameter d_0 see Table B1.2. Drill method according to Annex C5 to C25. In case of aborted drill hole, the drill hole shall be filled with mortar. **Drill hole must be cleaned directly prior to installation of the anchor.**
2a.		Blow out drill hole from the bottom with Blow-out Pump at least two times.
2b.		Clean drill hole with brush at least two times.
2c.		Afterwards blow out drill hole again from the bottom with the Blow-out Pump at least two times.
3.		Insert the perforated sleeve into the bore hole. Make sure that the sleeve fits well into the hole – the collar of the perforated sleeve is located on the masonry surface. Never cut the sleeve! Only use sleeves that have the right length.
4.		Screw the supplied Mixer Nozzle tied onto the cartridge. Cartridge type "foil tube": Cut off the foil tube clip before use. **Never us the static mixer, if the helix is not present!** For every working interruption longer than the recommended processing time (Table B2) as well as for new cartridges, a new Mixer Nozzle shall be used**.**
5.		Insert cartridge in dispenser. Before injecting discard mortar (at least 3 full strokes, for foil tube 6 full strokes) until it shows a consistent grey color. **Never use this mortar!**
6.		**Perforated sleeve VMU-SH 18x95** Completely fill the perforated sleeve starting from the bottom with VMU plus mortar. **Perforated sleeve VMU-SH 12x50** Completely fill the perforated sleeve starting from the beginning of the perforated sleeve with VMU plus mortar. For the correct quantity of mortar see manufacturer's specification. Observe the processing time given in Table B2.
7.		Push the threaded stud into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. The anchor should be free of dirt, grease or oil.
8.		Follow minimum curing time shown in Table B2. During curing time threaded stud must not be moved or loaded. After the curing time remove excess mortar.
9.		The fixture can be mounted after curing time. Apply installation torque max. T_{inst} according to Table B1.2 by using a calibrated torque wrench.

Injection System VMU plus II for masonry

Intended Use
Installation instructions with perforated sleeve

Annex B3

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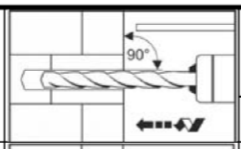
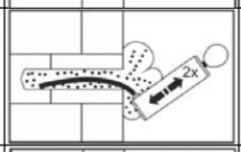
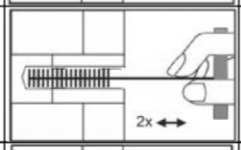
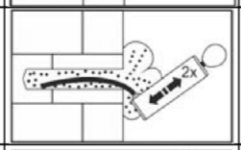
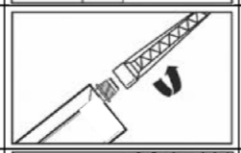
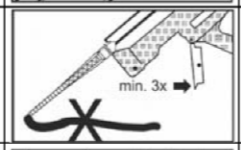
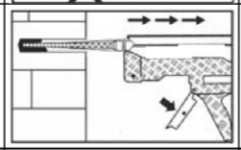
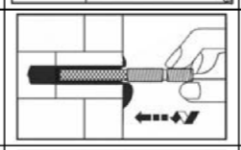
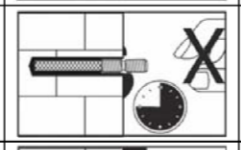
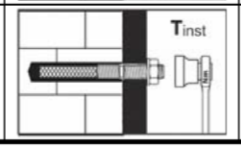
Installation instructions (Installation without perforated sleeve)

Suitable for: Solid brick, sand-lime brick, concrete solid brick, lightweight concrete solid brick

1.		Drill the hole. For depth of drill hole h_1 and drill hole diameter d_0 see Table B1.1. Drill method according to Annex C5 to C25. In case of aborted drill hole, the drill hole shall be filled with mortar.
		Drill hole must be cleaned directly prior to installation of the anchor.
2a.		Blow out drill hole from the bottom with Blow-out Pump at least two times. For drill hole diameter ≤ 8 mm, use a reduce-attachment for the Blow-out Pump.
2b.		Clean drill hole with brush at least two times.
2c.		Afterwards blow out drill hole again from the bottom with the Blow-out Pump at least two times. For drill hole diameter ≤ 8 mm, use a reduce-attachment for the Blow-out pump.
3.		Screw the supplied Mixer Nozzle tied onto the cartridge. Cartridge type "foil tube": Cut off the foil tube clip before use. **Never us the static mixer, if the helix is not present!** For every working interruption longer than the recommended processing time (Table B2) as well as for new cartridges, a new Mixer Nozzle shall be used**.**
4.		Insert cartridge in dispenser. Before injecting discard mortar (at least 3 full strokes, for foil tube 6 full strokes) until it shows a consistent grey color. **Never use this mortar!**
5.		Starting from the bottom or back of the cleaned anchor hole fill the hole up to min. two-thirds with adhesive. Slowly withdrawn the mixing nozzle as the hole fills to avoid creating air pockets. Observe the processing time given in Table B2.
6.		Insert the threaded stud by hand, rotating slightly up to the full embedment depth as marked on the anchor stud. The anchor stud is properly set when excess mortar seeps from the hole. If the hole is not completely filled, pull out anchor stud, let mortar cure, drill out hole and start again from No. 2. The anchor stud should be free of dirt, grease and oil.
7.		Follow minimum curing time shown in Table B2. During curing time threaded stud must not be moved or loaded. After the curing time remove excess mortar.
8.		The fixture can be mounted after curing time. Apply installation torque max. T_{inst} according to Table B1.1 by using a calibrated torque wrench.

Injection System VMU plus II for masonry

Intended Use
Installation instructions without perforated sleeve

Annex B4

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Table C1: Characteristic values for tension loads (Design method A)

Anchor size	Anchor rod VMU-AH		M6/50	M8/50	M8	M10	M12	-	-
Anchor size	**Internal threaded rod VMU-IGH**		-	-	-	-	-	**M6**	**M8**
Perforated sleeve			**VMU-SH 12x50**		**VMU-SH 18x95**				
Steel failure for anchor rods made of steel, strength 5.8, 8.8									
Characteristic resistance	$N_{Rk,s}$	[kN]	10.1	15.1	15.1	26.4	26.4	10.1	15.1
Steel failure for anchor rods made of stainless steel, strength class 70, 80									
Characteristic resistance	$N_{Rk,s}$	[kN]	14.1	21.1	21.1	37.0	37.0	14.1	21.1
Steel failure for anchor rods made of high corrosion resistant steel, HCR									
Characteristic resistance	$N_{Rk,s}$	[kN]	14.1	21.1	21.1	37.0	37.0	14.1	21.1
Pull out failure of the anchor in dry and wet masonry		$N_{Rk,p}$	see Annex C5 to C25						
Brick breakout failure in dry and wet masonry		$N_{Rk,b}$	see Annex C5 to C25						
Pull out of one brick		$N_{Rk,pb}$	see ETAG 029 Annex C						
Displacements under tension load		δ_N	see Annex C26, Table C5						
Influence of joints		$N_{Rk,p}$	see ETAG 029 Annex C						

Table C2: Characteristic values for shear loads (Design method A)

Anchor size	Anchor rod VMU-AH		M6/50	M8/50	M8	M10	M12	-	-
Anchor size	**Internal threaded rod VMU-IGH**		-	-	-	-	-	**M6**	**M8**
Perforated sleeve			**VMU-SH 12x50**		**VMU-SH 18x95**				
Steel failure without lever arm, for anchor rods made of steel, strength 5.8, 8.8									
Characteristic resistance	$V_{Rk,s}$	[kN]	5.0	7.5	9.2	14.5	21.1	5.0	9.2
Steel failure without lever arm, for anchor rods made of stainless steel, strength class 70, 80									
Characteristic resistance	$V_{Rk,s}$	[kN]	7.0	10.6	12.8	20.3	29.5	7.0	12.8
Steel failure without lever arm, for anchor rods made of high corrosion resistant steel, HCR									
Characteristic resistance	$V_{Rk,s}$	[kN]	7.0	10.6	12.8	20.3	29.5	7.0	12.8
Steel failure with lever arm, for anchor rods made of steel, strength 5.8, 8.8									
Characteristic resistance	$M_{Rk,s}$	[Nm]	7.6	14.0	18.7	32.5	32.5	7.6	18.7
Steel failure with lever arm, for anchor rods made of stainless steel, strength class 70, 80									
Characteristic resistance	$M_{Rk,s}$	[Nm]	10.7	18.7	26.2	45.5	45.5	10.7	26.2
Steel failure with lever arm, for anchor rods made of high corrosion resistant steel, HCR									
Characteristic resistance	$M_{Rk,s}$	[Nm]	10.7	18.7	26.2	45.5	45.5	10.7	26.2
Local brick failure		$V_{Rk,b}$	see Annex C5 to C25						
Brick edge failure		$V_{Rk,c}$	see ETAG 029 Annex C						
Push out of one brick		$V_{Rk,pb}$	see ETAG 029 Annex C						
Displacements under shear load		δ_V	see Annex C26, Table C5						
Influence of joints		$V_{Rk,p}$	see ETAG 029 Annex C						

Injection System VMU plus II for masonry

Performances
Characteristic values for tension and shear loads (Design method A)

Annex C1

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Table C3.1: Base material: Solid masonry

Base material	Format	Measurement [mm]	Minimum compressive strength [N/mm²]	Bulk-density-class [kg/dm³]	Annex
Solid masonry (use category "b", "d")					
Solid brick Mz DIN 105-1 DIN V 105-1:2002-06 DIN V 105-100:2005-10 EN 771-1	≥ NF	≥ 240x115x71	10 20 28 36	≥ 1.8	**Annex C5** AX 771-1-020
Sand-lime solid brick Silka XL Basic, **Sand-lime solid brick Silka XL Plus** EN 771-2		≥ 498x200x498	10 20	≥ 2.0	**Annex C12**
Concrete solid block Vn and Vbn DIN 18153 EN 771-3	≥ NF	≥ 240x115x71	10 20 28	≥ 2.0	**Annex C14** O 771-3-004
Lightweight concrete solid brick V DIN V 18152-100 EN 771-3 e.g. Bisoclassic V Bisot erm GmbH	≥ NF	≥ 240x115x71	2 4	≥ 0.9	**Annex C15** AI 771-3-008
Lightweight concrete solid brick V DIN V 18152-100 EN 771-3 e.g. BisoBims V Bisotherm GmbH	≥ NF	≥ 240x115x71	2 4	≥ 1.0	**Annex C16** AH 771-3-007
Lightweight concrete solid block – Vbl DIN 18152, EN 771-3 e.g. Liapor Massive Wall Liapor GmbH & Co.	≥ 24DF	≥ 500x365x238	2	≥ 0.6	**Annex C21** LAC2
Concrete solid block – Vbn DIN 18153, EN 771-3 e.g. Liapor Element Wall Liapor GmbH & Co. KG	≥ 12DF	≥ 500x175x238	12 16	≥ 1.4	**Annex C22** LC16/18
Autoclaved aerated concrete ACC DIN 4165 EN 771-1		≥ 499x175x249	1.6 - 7	≥ 0.35	**Annex C23 – C25**

Injection System VMU plus II for masonry

Base material: Concrete and Solid masonry (use category "b" and "d")
Format, measurement, minimum compressive strength, bulk-density-class, annex

Annex C2

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Table C3.2: Base material: Hollow or perforated masonry

Base material	Format	Measurement [mm]	Minimum - compressive-strength [N/mm²]	Bulk-density-class [kg/dm³]	Annex
Hollow or perforated masonry (use category "c")					
Hollow brick HLz DIN 105-1 EN 771-1	2DF	240x115x113	8 12 20	≥ 1.2	**Annex C6** AY 771-1-021
e.g. Wienerberger Ziegelindustrie GmbH e.g. Schlagmann Baustoffwerke GmbH & Co. KG	12DF	373x240x238	6 8	≥ 1.2	**Annex C7** AB 771-1-010
Hollow brick UNIPOR WS14 **Hollow brick UNIPOR WS12 CORISO** EN 771-1 Z-17.1-883 Unipor-Ziegel, Marketing GmbH	10DF	247x300x249	10 12	≥ 0.8	**Annex C8** AM 771-1-016
Hollow brick POROTON Plan-T14 EN 771-1 Z-17.1-651 Wienerberger Ziegelindustrie GmbH Schlagmann Baustoffwerke GmbH & Co. KG	10DF	248x300x249	6	≥ 0.7	**Annex C9** AT 771-1-019
Hollow brick for ceiling-DIN 4160-BN 0,8-530-250-210 (system Filigran) DIN 4160 e.g. Wienerberger Ziegelindustrie GmbH		530x250x210	4	0.8	**Annex C10** W16 771-1-031
Hollow brick Blocchi Leggeri EN 771-1 Wienerberger Brunori s.r.l.; Italien		250x120x330	6	≥ 0.6	**Annex C11** AD 771-1-012
Sand-lime perforated brick KS L DIN 106-1 EN 771-2 e.g. Xella Deutschland GmbH	8DF	248x240x238	10 12 16	≥ 1.4	**Annex C13** AK 771-2-005
Hollow brick lightweight concrete 3K Hbl DIN 18151 EN 771-3 e.g. Heinzmann Baustoffe GmbH, Liapor GmbH & Co. KG	16DF	498x240x238	2 4	≥ 0.7	**Annex C17** R3K 771-3-005
Hollow brick lightweight concrete Liapor-Super-K EN 771-3 Z-17.1-501 Liapor GmbH & Co. KG	16DF	495x240x238	2 4	≥ 0.8	**Annex C18** S 771-3-006
Hollow brick lightweight concrete Gisoton Thermo Schall Z-15.2-18 Gisoton Wandsysteme, e.g. Baustoffwerke Gebhart & Söhne GmbH & Co.		498x300x248	2	≥ 0.45	**Annex C19** AP 771-3-010
Hollow brick lightweight concrete 1K Hbl DIN 18151 EN 771-3 e.g. Stark Betonwerk GmbH & Co. KG	12DF	490x175x238	2 4	≥ 1.2	**Annex C20** AU 771-3-002

Injection System VMU plus II for masonry

Base material: Hollow masonry (use category "c")
Format, measurement, minimum compressive strength, bulk-density-class, annex

Annex C3

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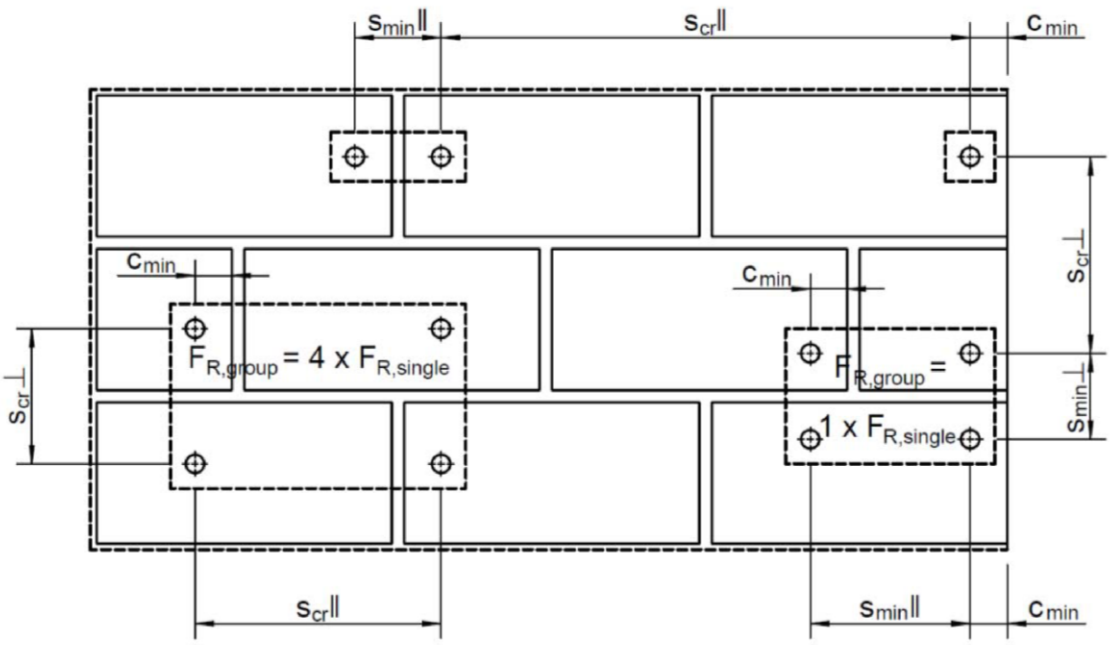


$s_{min,II}$ =	Minimum spacing anchor group parallel to bed joint
$s_{min,\perp}$ =	Minimum spacing anchor group vertical to bed joint
$s_{cr,II}$ =	Characteristic spacing anchor group parallel to bed joint
$s_{cr,\perp}$ =	Characteristic spacing anchor group vertical to bed joint
c_{min} =	Minimum edge distance
c_{cr} =	Characteristic edge distance
$F_{R,single}$ =	$N_{Rk,p}$ / $N_{Rk,b}$ / $V_{Rk,b}$ according to Annex C5 to C25 for design method A, respectively F_{Rd} for design method B

Injection System VMU plus II for masonry	**Annex C4**
Edge distances, spacing and anchor groups	

Deutsches Institut für Bautechnik DIBt

Base material masonry, solid brick Mz, NF

Table C4.1.1: Brick data

Description of brick	AX 771-1-020	**Mz**
Type of brick		Solid brick Mz
Bulk density $\rho \geq$	[kg/dm³]	1.8
Standard, approval		DIN 105, EN 771-1
Format (measurement) (l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ NF (≥ 240x115x71)
Minimum thickness of member h_{min} =	[mm]	115

Table C4.1.2: Installation parameters, characteristic and design values of resistance

Effective embedment depth $h_{ef} \geq$	**[mm]**	**50**	**90**
Anchor size **Anchor rod VMU-AH**		**M6/50, M8/50**	**M8, M10, M12**
Anchor size **Internal threaded rod VMU-IGH**		**-**	**M6, M8**
Perforated sleeve		without	without
Drill method		Hammer drilling	Hammer drilling
Drill hole diameter d_0	[mm]	M6 = 8 mm M8 = 10 mm	M8 = 10 mm M10 = 12 mm M12, IGH M6, IGH M8 = 14mm
Depth of drill hole to deepest point $h_1 \geq$	[mm]	55	100
Minimum spacing II & ⊥ for tension load $s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	150	200
Minimum and characteristic edge distance for tension load $c_{min,N} = c_{cr,N}$	[mm]	75	100
Characteristic spacing II & ⊥ $s_{cr,II}$ $s_{cr,\perp}$	[mm]	150	270
Minimum and characteristic edge distance for shear load $c_{min,V} = c_{cr,V}$	[mm]	250	250
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry			
Solid brick Mz, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$ **$f_b \geq 10$ N/mm²**	[kN]	0.75	1.5
$f_b \geq 20$ N/mm²	[kN]	0.9	2.0
$f_b \geq 28$ N/mm²	[kN]	1.2	2.5
$f_b \geq 36$ N/mm²	[kN]	1.5	2.5
Design method A: Shear load - Local brick failure in dry and wet masonry			
Solid brick Mz, Characteristic shear resistance $V_{Rk,b}$ **$f_b \geq 10$ N/mm²**	[kN]	2.5	4.0
$f_b \geq 20$ N/mm²	[kN]	3.5	5.5
$f_b \geq 28$ N/mm²	[kN]	4.0	6.5
$f_b \geq 36$ N/mm²	[kN]	5.0	7.5
Design method B: All load directions - All failure modes in dry and wet masonry			
Solid brick Mz, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$) **$f_b \geq 36$ N/mm²**	[kN]	0.5	0.75

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Solid brick Mz, NF
Brick data, installation parameters, characteristic and design values of resistance

Annex C5

Deutsches Institut für Bautechnik DIBt

Base material masonry, hollow brick HLz, 2 DF

Table C4.2.1: Brick data

Description of brick	AY 771-1-021	**HLz**
Type of brick		Hollow brick
Bulk density $\rho \geq$	[kg/dm³]	1.2
Standard, approval		DIN 105, EN 771-1
Producer of brick		e.g. Wienerberger Ziegelindustrie GmbH
Format (measurement) (l_{brick}/ b_{brick}/ h_{brick})	[mm]	2 DF (240x115x113)
Minimum thickness of member $h_{min=}$	[mm]	115

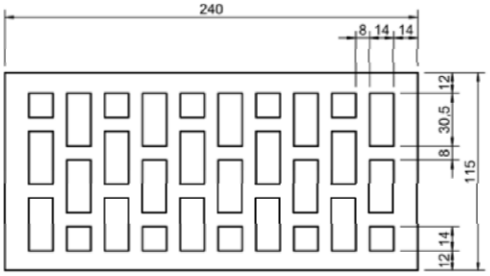


Table C4.2.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M6/50, M8/50**	**M8, M10, M12**	
Anchor size	**Internal threaded rod VMU-IGH**		**-**	**M6, M8**	
Perforated sleeve			**VMU-SH 12x50**	**VMU-SH 18x95**	
Drill method			Rotary drilling	Rotary drilling	
Drill hole diameter	d_0	[mm]	12	18	
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	55	100	
Minimum spacing II for tension load	$s_{min,II,N}$	[mm]	200	170	200
Minimum spacing ⊥ for tension load	$s_{min,\perp,N}$	[mm]	113	113	113
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	100	85	100
Characteristic spacing II	$s_{cr,II}$	[mm]	240	240	
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	113	113	
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	250	100	250
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry					
Hollow brick HLz, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 8$ N/mm²**	[kN]	0.5	1.5	1.5
	$f_b \geq 12$ N/mm²	[kN]	0.5	2.0	2.0
	$f_b \geq 20$ N/mm²	[kN]	0.75	2.5	2.5
Design method A: Shear load - Local brick failure in dry and wet masonry					
Hollow brick HLz, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 8$ N/mm²**	[kN]	0.5	0.5	3.5
	$f_b \geq 12$ N/mm²	[kN]	0.5	0.75	4.0
	$f_b \geq 20$ N/mm²	[kN]	0.9	0.9	5.5
Design method B: All load directions - All failure modes in dry and wet masonry					
Hollow brick HLz, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 20$ N/mm²**	[kN]	0.2	0.3	0.75

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Hollow brick HLz, 2 DF
Brick data, installation parameters, characteristic and design values of resistance

Annex C6

Deutsches Institut für Bautechnik DIBt

Base material masonry, hollow brick HLz, 12 DF

Table C4.3.1: Brick data

Description of brick		AB 771-1-010	**HLz**
Type of brick			Hollow brick
Bulk density	$\rho \geq$	[kg/dm³]	1.2
Standard, approval			DIN 105, EN 771-1
Producer of brick			e.g. Schlagmann Baustoffwerke GmbH & Co. KG
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	12 DF (373x240x238)
Minimum thickness of member	$h_{min=}$	[mm]	240

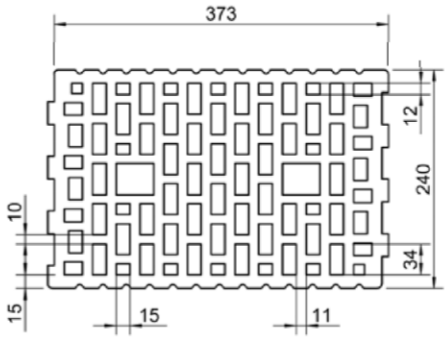


Table C4.3.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**	
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**	
Perforated sleeve			**VMU-SH 18x95**	
Drill method			Rotary drilling	
Drill hole diameter	d_0	[mm]	18	
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100	
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	220	
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	110	
Characteristic spacing II	$s_{cr,II}$	[mm]	373	
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	238	
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	250	373
Design method A: Tension load – Pull out and brick breakout failure in dry and wet masonry				
Hollow brick HLz, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 6$ N/mm²**	[kN]	0.9	
	$f_b \geq 8$ N/mm²	[kN]	1.2	
Design method A: Shear load - Local brick failure in dry and wet masonry				
Hollow brick HLz, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 6$ N/mm²**	[kN]	2.5	4.0
	$f_b \geq 8$ N/mm²	[kN]	2.5	4.5
Design method B: All load directions - All failure modes in dry and wet masonry				
Hollow brick HLz, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 8$ N/mm²**	[kN]	0.4	

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Hollow brick HLz, 12 DF
Brick data, installation parameters, characteristic and design values of resistance

Annex C7

Deutsches Institut für Bautechnik DIBt

Base material masonry, hollow brick UNIPOR WS14 and UNIPOR WS12 CORISO

Table C4.4.1: Brick data

Description of brick		AM 771-1-016	**UNIPOR WS14 and UNIPOR WS12 CORISO**
Type of brick			Hollow brick
Bulk density	$\rho \geq$	[kg/dm³]	0.8
Standard, approval			EN 771-1, Z-17.1-883, DIN V 105-2
Producer of brick			UNIPOR Ziegel, Marketing GmbH, Landsberger Straße 392, D-81241 München
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	10DF (247x300x249)
Minimum thickness of member	h_{min}=	[mm]	300

Table C4.4.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**	
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**	
Perforated sleeve			**VMU-SH 18x95**	
Drill method			Rotary drilling	
Drill hole diameter	d_0	[mm]	18	
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100	
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	200	220
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	100	110
Characteristic spacing II	$s_{cr,II}$	[mm]	247	
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	249	
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	100	250
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry				
Hollow brick UNIPOR WS 14 and UNIPOR WS 12 CORISO, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	1.2	1.2
	$f_b \geq 12$ N/mm²	[kN]	1.2	1.2
Design method A: Shear load - Local brick failure in dry and wet masonry				
Hollow brick UNIPOR WS 14 and UNIPOR WS 12 CORISO, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	0.75	2.5
	$f_b \geq 12$ N/mm²	[kN]	0.9	2.5
Design method B: All load directions - All failure modes in dry and wet masonry				
Hollow brick UNIPOR WS 14 and UNIPOR WS 12 CORISO, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 12$ N/mm²**	[kN]	0.3	0.4

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Hollow brick UNIPOR WS14, 10DF and UNIPOR WS12 CORISO, 10 DF
Brick data, installation parameters, characteristic and design values of resistance

Annex C8

Deutsches Institut für Bautechnik DIBt

Base material masonry, hollow brick POROTON Plan-T14, 10 DF

Table C4.5.1: Brick data

Description of brick		AT 771-1-019	Hollow brick POROTON Plan-T14
Type of brick			Hollow brick
Bulk density	$\rho \geq$	[kg/dm³]	0.7
Standard, approval			EN 771-1, Z-17.1-625
Producer of brick			Schlagmann Baustoffwerke GmbH & Co. KG Ziegeleistraße 1, D-84367 Zeilarn
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	10 DF (248x300x249)
Minimum thickness of member	$h_{min=}$	[mm]	298

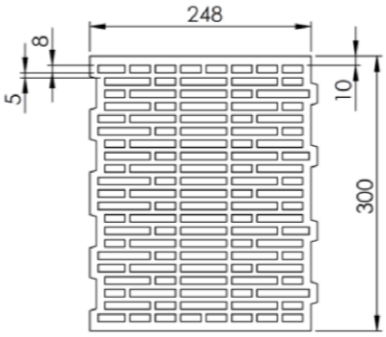


Table C4.5.2: Installation parameters, characteristic and design values of resistance

Anchor size	Anchor rod VMU-AH		M8, M10, M12		
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**		
Perforated sleeve			**VMU-SH 18x95**		
Drill method			Rotary drilling		
Drill hole diameter	d_0	[mm]	18		
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100		
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	160	200	220
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	80	100	110
Characteristic spacing II	$s_{cr,II}$	[mm]	248		
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	249		
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	-	100	250
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry					
Hollow brick POROTON Planziegel T14, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 6$ N/mm²**	[kN]	1.2		
Design method A: Shear load - Local brick failure in dry and wet masonry					
Hollow brick POROTON Planziegel T14, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 6$ N/mm²**	[kN]	-	0.9	2.5
Design method B: All load directions - All failure modes in dry and wet masonry					
Hollow brick POROTON Planziegel T14, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 6$ N/mm²**	[kN]	-	0.3	0.3

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Hollow brick POROTON Plan-T14, 10 DF
Brick data, installation parameters, characteristic and design values of resistance

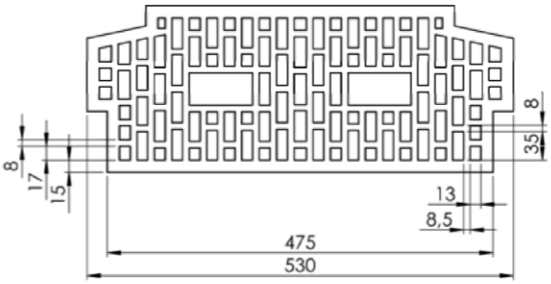
Annex C9

Deutsches Institut für Bautechnik DIBt

Base material ceiling, hollow brick for ceiling-DIN 4160-BN 0.8-530-250-210 (System Filigran)

Table C4.6.1: Brick data

Description of brick	W16 771-1-031	**Brick for ceiling (system Filigran)**
Type of brick		Brick for ceiling
Bulk density $\rho \geq$	[kg/dm³]	0.8
Standard, approval		DIN 4160
Producer of brick		Wienerberger Ziegelindustrie GmbH Oldenburger Allee 26, 30659 Hannover
Format (measurement) (l_{brick}/ b_{brick}/ h_{brick})	[mm]	530x250x210
Minimum thickness of member h_{min}=	[mm]	210



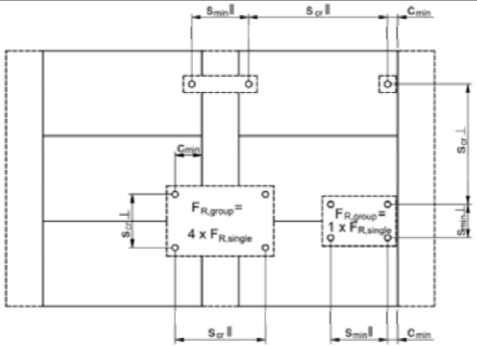


Table C4.6.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M6/50, M8/50**	
Anchor size	**Internal threaded rod VMU-IGH**		-	
Perforated sleeve			**VMU-SH 12x50**	
Drill method			Rotary drilling	
Drill hole diameter	d_0	[mm]	12	
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	55	
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	80	200
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	40	100
Characteristic spacing II	$s_{cr,II}$	[mm]	530	
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	250	
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	100	
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry				
Brick for ceiling (system Filigran), Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 4$ N/mm²**	[kN]	0.6	0.6
Design method A: Shear load - Local brick failure in dry and wet masonry				
Brick for ceiling (system Filigran), Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 4$ N/mm²** [2)]	[kN]	-	1.5
Design method B: All load directions - All failure modes in dry and wet masonry				
Brick for ceiling (system Filigran), Design value of resistance F_{Rd} [1)] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 4$ N/mm²**	[kN]	-	0.2

[1)] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Brick for ceiling (system Filigran)
Brick data, installation parameters, characteristic and design values of resistance

Annex C10

Deutsches Institut für Bautechnik DIBt

Base material masonry, hollow brick Blocchi Leggeri

Table C4.7.1: Brick data

Description of brick		AD 771-1-012	**Blocchi Leggeri**
Type of brick			Hollow brick
Bulk density	$\rho \geq$	[kg/dm³]	0.6
Standard, approval			EN 771-1
Producer of brick			Wienerberger Brunori s.r.l..Via Ringhiera 1 I-40020 Mordano (Bologna) fraz. Bubano, Italy
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	250x120x330
Minimum thickness of member	h_{min}=	[mm]	120

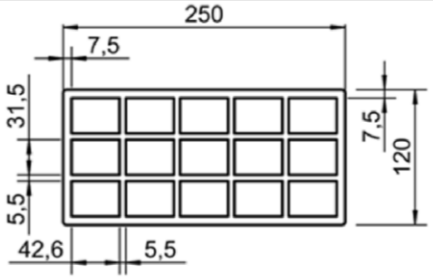


Table C4.7.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M6/50, M8/50**	**M8, M10, M12**
Anchor size	**Internal threaded rod VMU-IGH**		**-**	**M6, M8**
Perforated sleeve			**VMU-SH 12x50**	**VMU-SH 18x95**
Drill method			Rotary drilling	
Drill hole diameter	d_0	[mm]	12	18
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	55	100
Minimum spacing II for tension load	$s_{min,II,N}$	[mm]	200	200
Minimum spacing ⊥ for tension load	$s_{min,\perp,N}$	[mm]	330	330
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	100	100
Characteristic spacing II	$s_{cr,II}$	[mm]	250	250
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	330	330
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	250	250
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry				
Hollow brick Blocchi Leggeri, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 6$ N/mm²**	[kN]	0.3	0.3
Design method A: Shear load - Local brick failure in dry and wet masonry				
Hollow brick Blocchi Leggeri, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 6$ N/mm²**	[kN]	1.2	0.9
Design method B: All load directions - All failure modes in dry and wet masonry				
Hollow brick Blocchi Leggeri, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 6$ N/mm²**	[kN]	0.1	0.3

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Blocchi Leggeri
Brick data, installation parameters, characteristic and design values of resistance

Annex C11

Deutsches Institut für Bautechnik DIBt

Base material masonry, sand-lime solid brick Silka XL Basic, Silka XL Plus

Table C4.8.1: Brick data

Description of brick			**KS**
Type of brick			Sand-lime solid brick
Bulk density	$\rho \geq$	[kg/dm³]	2.0
Standard, approval			DIN 106, EN 771-2
Producer of brick			Xella International GmbH Dr. Hammacher-Straße 49, 47119 Duisburg
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ 498x200x498
Minimum thickness of member	h_{min} =	[mm]	200

Table C4.8.2: Installation parameters, characteristic and design values of resistance

Effective embedment depth	**$h_{ef} \geq$**	**[mm]**	**50**	**90**
Anchor size	**Anchor rod VMU-AH**		**M6/50, M8/50**	**M8, M10, M12**
Anchor size	**Internal threaded rod VMU-IGH**		**-**	**M6, M8**
Perforated sleeve			without	
Drill method			Hammer drilling	
Drill hole diameter	d_0	[mm]	M6 = 8 mm M8 = 10 mm	M8 = 10 mm M10 = 12 mm M12, IGH M6, IGH M8 = 14mm
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	55	100
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	150	270
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	75	135
Characteristic spacing II & ⊥	$s_{cr,II}$ $s_{cr,\perp}$	[mm]	150	270
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	100	100
Design method A: Tension load - Pull out and brick breakout failure in wet masonry				
Sand-lime solid brick Silka XL Basic, Silka XL Plus, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	0.75	0.9
	$f_b \geq 20$ N/mm²	[kN]	0.9	1.2
Design method A: Tension load - Pull out and brick breakout failure in dry masonry				
Sand-lime solid brick Silka XL Basic, Silka XL Plus, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	2.0	2.5
	$f_b \geq 20$ N/mm²	[kN]	3.0	3.5
Design method A: Shear load - Local brick failure in dry and wet masonry				
Sand-lime solid brick Silka XL Basic, Silka XL Plus, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	1.2	1.2
	$f_b \geq 20$ N/mm²	[kN]	1.2	1.2
Design method B: All load directions - All failure modes in dry and wet masonry				
Sand-lime solid brick Silka XL Basic, Silka XL Plus, Design value of resistance F_{Rd} [1)] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 20$ N/mm²**	[kN]	0.3	0.3

1) F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Sand-lime solid brick Silka XL Basic, Silka XL Plus
Brick data, installation parameters, characteristic and design values of resistance

Annex C12

Deutsches Institut für Bautechnik DIBt

Base material masonry, sand-lime perforated brick KS L, 8 DF

Table C4.9.1: Brick data

Description of brick	AK 771-2-005		**KS L**
Type of brick			Sand-lime perforated brick
Bulk density	$\rho \geq$	[kg/dm³]	1.4
Standard, approval			DIN 106, EN 771-2
Producer of brick			e.g. Xella International GmbH
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	8DF (248x240x238)
Minimum thickness of member	h_{min} =	[mm]	240

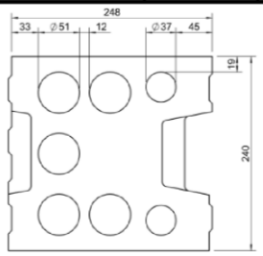


Table C4.9.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**
Perforated sleeve			**VMU-SH 18x95**
Drill method			Rotary drilling
Drill hole diameter	d_0	[mm]	18
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	220
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	110
Characteristic spacing II	$s_{cr,II}$	[mm]	248
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	238
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	250
Design method A: Tension load - Pull out and brick breakout failure in wet masonry			
Sand-lime perforated brick KS L, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	0.9
	$f_b \geq 12$ N/mm²	[kN]	0.9
	$f_b \geq 16$ N/mm²	[kN]	1.2
Design method A: Tension load - Pull out and brick breakout failure in dry masonry			
Sand-lime perforated brick KS L, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	1.2
	$f_b \geq 12$ N/mm²	[kN]	1.2
	$f_b \geq 16$ N/mm²	[kN]	1.5
Design method A: Shear load - Local brick failure in dry and wet masonry			
Sand-lime perforated brick KS L, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	4.0
	$f_b \geq 12$ N/mm²	[kN]	4.5
	$f_b \geq 16$ N/mm²	[kN]	5.5
Design method B: All load directions - All failure modes in dry and wet masonry			
Sand-lime perforated brick KS L, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 16$ N/mm²**	[kN]	0.4

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Sand-lime perforated brick KS L, 8 DF
Brick data, installation parameters, characteristic and design values of resistance

Annex C13

Deutsches Institut für Bautechnik DIBt

Base material masonry, concrete solid block Vbn, NF (Bisophon V12)

Table C4.10.1: Brick data

Description of brick	O 771-3-004	**Vbn**
Type of brick		Concrete solid block Vbn
Bulk density $\rho \geq$	[kg/dm³]	2.0
Standard, approval		DIN 18153, EN 771-3
Producer of brick		e.g. Bisotherm Bisotherm GmbH, Eisenbahnstraße 12, D-56218 Mühlheim-Kärlich
Format (measurement) (l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ NF (≥ 240x115x71)
Minimum thickness of member h_{min} =	[mm]	115

Table C4.10.2: Installation parameters, characteristic and design values of resistance

Effective embedment depth	$h_{ef} \geq$	**[mm]**	**50**	**90**
Anchor size	**Anchor rod VMU-AH**		**M6/50, M8/50**	**M8, M10, M12**
Anchor size	**Internal threaded rod VMU-IGH**		**-**	**M6, M8**
Perforated sleeve			without	without
Drill method			Hammer drilling	Hammer drilling
Drill hole diameter	d_0	[mm]	M6 = 8 mm M8 = 10 mm	M8 = 10 mm M10 = 12 mm M12, IGH M6, IGH M8 = 14mm
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	55	100
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	150	270
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	75	135
Characteristic spacing II & ⊥	$s_{cr,II}$ $s_{cr,\perp}$	[mm]	150	270
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	100	135
Design method A: Tension load - Pull out and brick breakout failure in wet and dry masonry				
Concrete solid block Vbn, NF, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	0.75	3.0
	$f_b \geq 20$ N/mm²	[kN]	1.2	4.5
	$f_b \geq 28$ N/mm²	[kN]	1.5	5.5
Design method A: Shear load - Local brick failure in dry and wet masonry				
Concrete solid block Vbn, NF, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 10$ N/mm²**	[kN]	0.75	5.0
	$f_b \geq 20$ N/mm²	[kN]	0.75	5.0
	$f_b \geq 28$ N/mm²	[kN]	0.75	5.0
Design method B: All load directions - All failure modes in dry and wet masonry				
Concrete solid block Vbn, NF, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 28$ N/mm²**	[kN]	0.4	1.2

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Concrete solid block Vbn, NF
Brick data, installation parameters, characteristic and design values of resistance

Annex C14

Deutsches Institut für Bautechnik DIBt

Base material masonry, lightweight concrete solid brick V, NF

Table C4.11.1: Brick data

Description of brick		Al 771-3-008	**V**
Type of brick			Lightweight concrete solid brick
Bulk density	$\rho \geq$	[kg/dm³]	0.9
Standard, approval			EN 771-3, DIN V 18152-100
Producer of brick			e.g. Bisoclassic Bisotherm GmbH, Eisenbahnstraße 12, D-56218 Mühlheim-Kärlich
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ NF (≥ 240x115x71)
Minimum thickness of member	h_{min} =	[mm]	115

Table C4.11.2: Installation parameters, characteristic and design values of resistance

Effective embedment depth	**$h_{ef} \geq$**	**[mm]**	**50**	**90**	
Anchor size	**Anchor rod VMU-AH**		**M6/50, M8/50**	**M8, M10, M12**	
Anchor size	**Internal threaded rod VMU-IGH**		**-**	**M6, M8**	
Perforated sleeve			without	without	
Drill method			Hammer drilling	Hammer drilling	
Drill hole diameter	d_0	[mm]	M6 = 8 mm M8 = 10 mm	M8 = 10 mm M10 = 12 mm M12, IGH M6, IGH M8 = 14mm	
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	55	100	
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	150	160	270
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	75	80	135
Characteristic spacing II & ⊥	$s_{cr,II}$ $s_{cr,\perp}$	[mm]	150	270	
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	100	100	250
Design method A: Tension load - Pull out and brick breakout failure in wet and dry masonry					
Lightweight concrete solid block V, NF Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.75	0.9	0.9
	$f_b \geq 4$ N/mm²	[kN]	0.9	1.5	1.5
Design method A: Shear load - Local brick failure in dry and wet masonry					
Lightweight concrete solid block V, NF Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.6	0.75	1.5
	$f_b \geq 4$ N/mm²	[kN]	0.75	0.9	2.5
Design method B: All load directions, all failure modes in dry and wet masonry					
Lightweight concrete solid block V, NF Design value of resistance F_{Rd} [1)] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 4$ N/mm²**	[kN]	0.25	0.3	0.4

1) F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Lightweight concrete solid block V, NF
Brick data, installation parameters, characteristic and design values of resistance

Annex C15

Deutsches Institut für Bautechnik DIBt

Base material masonry, lightweight concrete solid brick V, NF

Table C4.12.1: Brick data

Description of brick	AH 771-3-007	**V**
Type of brick		Lightweight concrete solid brick
Bulk density	$\rho \geq$ [kg/dm³]	1.0
Standard, approval		EN 771-3, DIN V 18152-100
Producer of brick		e.g. BisoBims, Bisotherm GmbH, Eisenbahnstraße 12, D-56218 Mühlheim-Kärlich
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ NF (≥ 240x115x71)
Minimum thickness of member	h_{min} =	[mm]	115

Table C4.12.2: Installation parameters, characteristic and design values of resistance

Effective embedment depth	$h_{ef} \geq$	**[mm]**	**50**	**90**	
Anchor size	**Anchor rod VMU-AH**		**M6/50, M8/50**	**M8, M10, M12**	
Anchor size	**Internal threaded rod VMU-IGH**		**-**	**M6, M8**	
Perforated sleeve			without	without	
Drill method			Hammer drilling	Hammer drilling	
Drill hole diameter	d_0	[mm]	M6 = 8 mm M8 = 10 mm	M8 = 10 mm M10 = 12 mm M12, IGH M6, IGH M8 = 14mm	
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	55	100	
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	150	160	270
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	75	80	135
Characteristic spacing II & ⊥	$s_{cr,II}$ $s_{cr,\perp}$	[mm]	150	270	
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	100	100	250
Design method A: Tension load - Pull out and brick breakout failure in wet and dry masonry					
Lightweight concrete solid block V, NF, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.6	1.2	1.2
	$f_b \geq 4$ N/mm²	[kN]	0.9	1.5	2.0
Design method A: Shear load - Local brick failure in dry and wet masonry					
Lightweight concrete solid block V, NF, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.6	1.2	1.5
	$f_b \geq 4$ N/mm²	[kN]	0.9	2.0	2.5
Design method B: All load directions - All failure modes in dry and wet masonry					
Lightweight concrete solid block V, NF, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 4$ N/mm²**	[kN]	0.25	0.5	0.5

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Lightweight concrete solid block V, NF
Brick data, installation parameters, characteristic and design values of resistance

Annex C16

Deutsches Institut für Bautechnik DIBt

Base material masonry, hollow brick lightweight concrete 3K Hbl, 16 DF

Table C4.13.1: Brick data

Description of brick		R 771-3-005	**3K Hbl**
Type of brick			Hollow brick lightweight concrete 3K Hbl
Bulk density	$\rho \geq$	[kg/dm³]	0.7
Standard, approval			DIN 18151, EN 771-3
Producer of brick			e.g. Heinzmann Baustoffe GmbH, Liapor GmbH & Co. KG
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	16 DF (498x240x238)
Minimum thickness of member	h_{min} =	[mm]	240

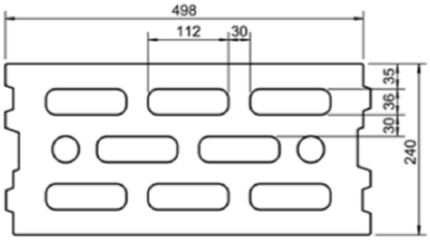


Table C4.13.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M6/50, M8/50**
Anchor size	**Internal threaded rod VMU-IGH**		-
Perforated sleeve			**VMU-SH 12x50**
Drill method			Rotary drilling
Drill hole diameter	d_0	[mm]	12
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	55
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	200
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	100
Characteristic spacing II	$s_{cr,II}$	[mm]	498
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	238
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	100
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry			
Hollow brick lightweight concrete 3K Hbl, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.6
	$f_b \geq 4$ N/mm²	[kN]	0.75
Design method A: Shear load - Local brick failure in dry and wet masonry			
Hollow brick lightweight concrete 3K Hbl, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.9
	$f_b \geq 4$ N/mm²	[kN]	1.5
Design method B: All load directions - All failure modes in dry and wet masonry			
Hollow brick lightweight concrete 3K Hbl, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 4$ N/mm²**	[kN]	0.25

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Hollow brick lightweight concrete 3K Hbl, 16 DF
Brick data, installation parameters, characteristic and design values of resistance

Annex C17

Deutsches Institut für Bautechnik DIBt

Base material masonry, hollow brick lightweight concrete Liapor-Super-K, 16 DF

Table C4.14.1: Brick data

Description of brick		S 771-3-006	**Liapor-Super-K**
Type of brick			Hollow brick lightweight concrete 7K
Bulk density	$\rho \geq$	[kg/dm³]	0.8
Standard, approval			EN 771-3, Z-17.1-501
Producer of brick			Liapor GmbH & Co. KG, D-91352 Hallerndorf
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	16 DF (495x240x238)
Minimum thickness of member	h_{min} =	[mm]	240

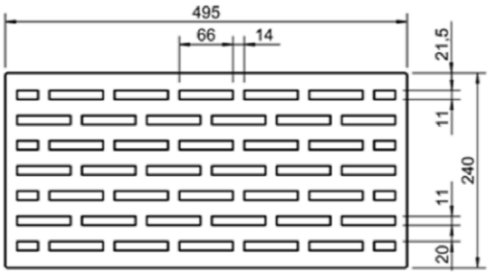


Table C4.14.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**			
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**			
Perforated sleeve			**VMU-SH 18x95**			
Drill method			Rotary drilling			
Drill hole diameter	d_0	[mm]	18			
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100			
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	160	200	220	
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	80	100	110	
Characteristic spacing II	$s_{cr,II}$	[mm]	495			
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	238			
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	-	100	250	495
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry						
Hollow brick lightweight concrete Liapor-Super-K, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	1.2	1.5	1.5	
	$f_b \geq 4$ N/mm²	[kN]	1.5	2.5	2.5	
Design method A: Shear load - Local brick failure in dry and wet masonry						
Hollow brick lightweight concrete Liapor-Super-K, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	-	0.75	2.5	3.0
	$f_b \geq 4$ N/mm²	[kN]	-	0.9	2.5	4.0
Design method B: All load directions - All failure modes in dry and wet masonry						
Hollow brick lightweight concrete Liapor-Super-K, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 4$ N/mm²**	[kN]	-	0.3	0.6	

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Hollow brick lightweight concrete Liapor-Super-K, 16 DF
Brick data, installation parameters, characteristic and design values of resistance

Annex C18

Deutsches Institut für Bautechnik DIBt

Base material masonry, hollow brick lightweight concrete Gisoton Thermo Schall

Table C4.15.1: Brick data

Description of brick	AP 771-3-010	**Gisoton Thermo Schall**
Type of brick		Hollow brick lightweight concrete
Bulk density $\rho \geq$	[kg/dm³]	0.45
Standard, approval		Z-15.2-18
Producer of brick		Gisoton Wandsysteme, Baustoffwerke Gebhart & Söhne GmbH & Co, Hochstraße 2, D-88317 Aichstetten
Format (measurement) (l_{brick}/ b_{brick}/ h_{brick})	[mm]	498x300x248
Minimum thickness of member h_{min}=	[mm]	300

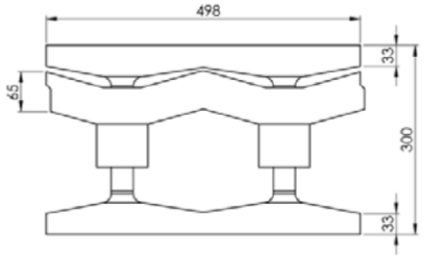


Table C4.15.2: Installation parameters characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**		
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**		
Perforated sleeve			**VMU-SH 18x95**		
Drill method			Rotary drilling		
Drill hole diameter	d_0	[mm]	18		
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100		
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	160	220	
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	80	110	
Characteristic spacing II	$s_{cr,II}$	[mm]	498		
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	248		
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	100	250	498
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry					
Gisoton Thermo Schall, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.9	1.2	
Design method A: Shear load - Local brick failure in dry and wet masonry					
Gisoton Thermo Schall, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.9	2.5	3.5
Design method B: All load directions - All failure modes in dry and wet masonry					
Gisoton Thermo Schall, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 2$ N/mm²**	[kN]	0.3	0.3	

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Gisoton Thermo Schall
Brick data, installation parameters, characteristic and design values of resistance

Annex C19

Deutsches Institut für Bautechnik DIBt

Base material masonry, hollow brick lightweight concrete 1K Hbl, 12 DF

Table C4.16.1: Brick data

Description of brick	AU 771-3-002	**1K Hbl**
Type of brick		Hollow brick lightweight concrete 1K Hbl
Bulk density $\rho \geq$	[kg/dm³]	1.2
Standard, approval		DIN 18151, EN 771-3
Producer of brick		e.g. Stark Betonwerk GmbH & Co. KG D-74547 Untermünkheim-Kupfer
Format (measurement) (l_{brick}/ b_{brick}/ h_{brick})	[mm]	12 DF (490x175x238)
Minimum thickness of member h_{min}=	[mm]	175

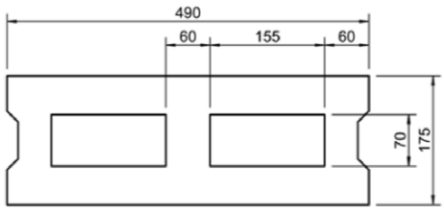


Table C4.16.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**		
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**		
Perforated sleeve			**VMU-SH 18x95**		
Drill method			Rotary drilling		
Drill hole diameter	d_0	[mm]	18		
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100		
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	200	238	
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	100	245	
Characteristic spacing II	$s_{cr,II}$	[mm]	490		
Characteristic spacing ⊥	$s_{cr,\perp}$	[mm]	238		
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	100	250	490
Design method A: Tension load - Pull out and brick breakout failure in dry and wet masonry					
Hollow brick lightweight concrete 1K Hbl, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.9	1.2	
	$f_b \geq 4$ N/mm²	[kN]	1.2	1.5	
Design method A: Shear load - Local brick failure in dry and wet masonry					
Hollow brick lightweight concrete 1K Hbl, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.75	2.5	4.0
	$f_b \geq 4$ N/mm²	[kN]	0.9	2.5	5.5
Design method B: All load directions - All failure modes in dry and wet masonry					
Hollow brick lightweight concrete 1K Hbl, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 4$ N/mm²**	[kN]	0.3	0.4	

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Hollow brick lightweight concrete 1K Hbl, 12 DF
Brick data, installation parameters, characteristic and design values of resistance

Annex C20

Deutsches Institut für Bautechnik DIBt

Base material masonry, lightweight concrete solid block Vbl

Table C4.17.1: Brick data

Description of brick			**Vbl 2-0.6-24DF**
Type of brick			Lightweight Aggregate Concrete
Bulk density	$\rho \geq$	[kg/dm³]	0.6
Standard, approval			DIN 18152
Producer of brick			e.g. Liapor Massivwand LAC2 by: Liapor GmbH & Co. KG D-91352 Hallerndorf
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ 24 DF
Minimum thickness of member	h_{min}=	[mm]	365

Table C4.17.2: Installation parameters, characteristic and design values of resistance

Effective embedment depth	**$h_{ef} \geq$**	**[mm]**	**90**
Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**
Perforated sleeve			without
Drill method			Hammer drilling
Drill hole diameter	d_0	[mm]	M8 = 10 mm M10 = 12 mm M12, IGH M6, IGH M8 = 14mm
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	140
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	70
Characteristic spacing II & ⊥ for tension and shear load	$s_{cr,II}$ $s_{cr,\perp}$	[mm]	270
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	250
Design method A: Tension load - Pull out and brick breakout failure in wet and dry masonry			
Lightweight Aggregate Concrete Vbl, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	1.5
Design method A: Shear load - Local brick failure in dry and wet masonry			
Lightweight Aggregate Concrete Vbl, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	2.5
Design method B: All load directions - All failure modes in dry and wet masonry			
Lightweight Aggregate Concrete Vbl, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 2$ N/mm²**	[kN]	0.5

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Lightweight concrete solid block Vbl
Brick data, installation parameters, characteristic and design values of resistance

Annex C21

Deutsches Institut für Bautechnik DIBt

Base material masonry, concrete solid block Vbn

Table C4.18.1: Brick data

Description of brick			**Vbn 12-1,4-12DF**
Type of brick			Concrete
Bulk density	$\rho \geq$	[kg/dm³]	1.4
Standard, approval			DIN 18153
Producer of brick			e.g. Liapor Elementwand LC16/18 by: Liapor GmbH & Co. KG D-91352 Hallerndorf
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ 12 DF
Minimum thickness of member	h_{min}=	[mm]	175

Table C4.18.2: Installation parameters, characteristic and design values of resistance

Effective embedment depth	**$h_{ef} \geq$**	**[mm]**	**90**
Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**
Perforated sleeve			without
Drill method			Hammer drilling
Drill hole diameter	d_0	[mm]	M8 = 10 mm M10 = 12 mm M12, IGH M6, IGH M8 = 14mm
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	140
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	70
Characteristic spacing II & ⊥	$s_{cr,II}$ $s_{cr,\perp}$	[mm]	270
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	250
Design method A: Tension load - Pull out and brick breakout failure in wet and dry masonry			
Concrete solid block Vbn, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 12$ N/mm²**	[kN]	3.5
	$f_b \geq 16$ N/mm²	[kN]	4.0
Design method A: Shear load - Local brick failure in dry and wet masonry			
Concrete solid block Vbn, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 12$ N/mm²**	[kN]	8.0
	$f_b \geq 16$ N/mm²	[kN]	9.5
Design method B: All load directions - All failure modes in dry and wet masonry			
Concrete solid block Vbn, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 16$ N/mm²**	[kN]	0.75

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Concrete solid block Vbn
Brick data, installation parameters, characteristic and design values of resistance

Annex C22

Deutsches Institut für Bautechnik DIBt

Base material masonry, Autoclaved Aerated Concrete AAC

Table C4.19.1: Brick data

Description of brick			**AAC**
Type of brick			Autoclaved Aerated Concrete
Bulk density	$\rho \geq$	[kg/dm³]	0.35
Standard, approval			DIN 4165, EN 771-4
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ 499x175x249
Minimum thickness of member	h_{min} =	[mm]	175

Table C4.19.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**
Perforated sleeve			**VMU-SH 18x95**
Drill method			Rotary drilling
Drill hole diameter	d_0	[mm]	18
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	270
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	135
Characteristic spacing II & ⊥	$s_{cr,II}$ $s_{cr,\perp}$	[mm]	270
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	250
Design method A: Tension load - Pull out and brick breakout failure in wet and dry masonry			
Autoclaved Aerated Concrete AAC, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 1.6$ N/mm²**	[kN]	0.9
Design method A: Shear load - Local brick failure in dry and wet masonry			
Autoclaved Aerated Concrete AAC, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 1.6$ N/mm²**	[kN]	2.0
Design method B: All load directions - All failure modes in dry and wet masonry			
Autoclaved Aerated Concrete AAC, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 1.6$ N/mm²**	[kN]	0.3

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Autoclaved Aerated Concrete AAC
Brick data, installation parameters, characteristic and design values of resistance

Annex C23

Deutsches Institut für Bautechnik DIBt

Base material masonry, Autoclaved Aerated Concrete AAC

Table C4.20.1: Brick data

Description of brick			**AAC**
Type of brick			Autoclaved Aerated Concrete
Bulk density	$\rho \geq$	[kg/dm³]	0.4
Standard, approval			DIN 4165, EN 771-4
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ 499x175x249
Minimum thickness of member	h_{min} =	[mm]	175

Table C4.20.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**
Perforated sleeve			**VMU-SH 18x95**
Drill method			Rotary drilling
Drill hole diameter	d_0	[mm]	18
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	270
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	135
Characteristic spacing II & ⊥	$s_{cr,II}$ $s_{cr,\perp}$	[mm]	270
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	250
Design method A: Tension load - Pull out and brick breakout failure in wet and dry masonry			
Autoclaved Aerated Concrete AAC, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	0.9
Design method A: Shear load - Local brick failure in dry and wet masonry			
Autoclaved Aerated Concrete AAC, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 2$ N/mm²**	[kN]	2.5
Design method B: All load directions - All failure modes in dry and wet masonry			
Autoclaved Aerated Concrete AAC, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 2$ N/mm²**	[kN]	0.4

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Autoclaved Aerated Concrete AAC
Brick data, installation parameters, characteristic and design values of resistance

Annex C24

Deutsches Institut für Bautechnik DIBt

Base material masonry, Autoclaved Aerated Concrete AAC

Table C4.21.1: Brick data

Description of brick			**AAC**
Type of brick			Autoclaved Aerated Concrete
Bulk density	$\rho \geq$	[kg/dm³]	0.6
Standard, approval			DIN 4165, EN 771-4
Format (measurement)	(l_{brick}/ b_{brick}/ h_{brick})	[mm]	≥ 499x175x249
Minimum thickness of member	h_{min} =	[mm]	175

Table C4.21.2: Installation parameters, characteristic and design values of resistance

Anchor size	**Anchor rod VMU-AH**		**M8, M10, M12**
Anchor size	**Internal threaded rod VMU-IGH**		**M6, M8**
Perforated sleeve			**VMU-SH 18x95**
Drill method			Rotary drilling
Drill hole diameter	d_0	[mm]	18
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	100
Minimum spacing II & ⊥ for tension load	$s_{min,II,N}$ $s_{min,\perp,N}$	[mm]	270
Minimum and characteristic edge distance for tension load	$c_{min,N} = c_{cr,N}$	[mm]	70
Characteristic spacing II & ⊥	$s_{cr,II}$ $s_{cr,\perp}$	[mm]	270
Minimum and characteristic edge distance for shear load	$c_{min,V} = c_{cr,V}$	[mm]	250
Design method A: Tension load: Pull out and brick breakout failure in wet and dry masonry			
Autoclaved Aerated Concrete AAC, Characteristic resistance $N_{Rk,p}/N_{Rk,b}$	**$f_b \geq 7$ N/mm²**	[kN]	2.0
Design method A: Shear load: Local brick failure in dry and wet masonry			
Autoclaved Aerated Concrete AAC, Characteristic shear resistance $V_{Rk,b}$	**$f_b \geq 7$ N/mm²**	[kN]	5.0
Design method B: All load directions, all failure modes in dry and wet masonry			
Autoclaved Aerated Concrete AAC, Design value of resistance F_{Rd} [1] ($c \geq c_{cr,N}$ and $c_{cr,V}$; $s \geq s_{cr}$)	**$f_b \geq 7$ N/mm²**	[kN]	0.75

[1] F_{Rd} includes all failure modes and the influence of joints

Injection System VMU plus II for masonry

Autoclaved Aerated Concrete AAC
Brick data, installation parameters, characteristic and design values of resistance

Annex C25

Deutsches Institut für Bautechnik DIBt

Table C5: Displacements under tension- and shear load

	Anchor size: M6, M8, M10, M12 with and without perforated sleeve					
	Displacements under tension load			Displacements under shear load		
Perforated sleeve	**max N** [kN]	**Displacement** δ_{N0} [mm]	$\delta_{N\infty}$ [mm]	**max V** [kN]	**Displacement** δ_{V0} [mm]	$\delta_{V\infty}$ [mm]
VMU-SH 12x50	$N=\frac{N_{Rk}}{1.4 \times \gamma_M}$	0.2	0.4	$V=\frac{V_{Rk}}{1.4 \times \gamma_M}$	2.0	3.0
VMU-SH 18x95		1.5	3.0		0.9	1.2

Table C6: β-factors, reduction factors for tests at the construction site

Masonry	**Solid**			**Hollow**		
	Mz, Vn, Vbn V, Vbl, LC, LAC	**KS**	**AAC**	**Hbl**	**HLz**	**KSL**
Drill method	Hammer drilling		Rotary drilling	Rotary drilling		
β for dry masonry and $h_{ef} \geq 49$ m	0.35	0.35	0.3	0.35	0.35	0.35
β for dry masonry and $h_{ef} \geq 93$ mm	0.43	0.43	0.37	0.43	0.43	0.43
β for wet masonry and $h_{ef} \geq 49$ mm	0.35	0.12	0.3	0.35	0.35	0.28
β for wet masonry and $h_{ef} \geq 93$ mm	0.43	0.15	0.37	0.43	0.43	0.34

Design method A: To convert the characteristic resistances $N_{Rk,b}$, $V_{Rk,b}$ of a masonry unit given in Annex C5 to Annex C25 related to the strength $f_{b,nom}^{Table}$ to a lower nominal strength $f_{b,nom}$ the following equation can be used:

$$N_{Rk,b}(f_{b,nom}) = N_{Rk,b}^{Table} \times \left(\frac{f_{b,nom}}{f_{b,nom}^{Table}}\right)^{\alpha}$$

$$V_{Rk,b}(f_{b,nom}) = V_{Rk,b}^{Table} \times \left(\frac{f_{b,nom}}{f_{b,nom}^{Table}}\right)^{\alpha}$$

with $N_{Rk,b}$ = Characteristic resistance in masonry with a strength $f_{b,nom} < f_{b,nom}^{Table}$ as given in Annex C5 to C25

$N_{Rk,b}^{Table}$ = Characteristic resistance in masonry with a strength $f_{b,nom}^{Table}$ as given in Annex C5 to C25

$V_{Rk,b}$ = Characteristic resistance in masonry with a strength $f_{b,nom} < f_{b,nom}^{Table}$ as given in Annex C5 to C25

$V_{Rk,b}^{Table}$ = Characteristic resistance in masonry with a strength $f_{b,nom}^{Table}$ as given in Annex C5 to C25

α = 0,5 for masonry units of clay, concrete, lightweight concrete and solid units of calcium silicate

α = 0,75 for masonry units of perforated calcium silicate

Injection System VMU plus II for masonry

Displacements, β-factors

Annex C26