# European technical assessment

MKT Injection system VMU Plus for masonry

valid for

## Injection anchor XV Plus

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Deutsches Institut für Bautechnik

Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body for construction products

Member of EOTA www.eota.eu

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

# European Technical Assessment ETA-13/0909 of 10 December 2024

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 for masonry |
| Product family to which the construction product belongs | Injection system for use in masonry |
| Manufacturer | MKT<br>Metall-Kunststoff-Technik GmbH & Co. KG<br>Auf dem Immel 2<br>67685 Weilerbach<br>DEUTSCHLAND |
| Manufacturing plant | Werk 1, D<br>Werk 2, D |
| This European Technical Assessment contains | 81 pages including 3 annexes which form an integral part of this assessment |
| This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of | EAD 330076-01-0604, Edition 10/2022 |
| This version replaces | ETA-13/0909 issued on 8 December 2016 |

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## Specific Part

### 1 Technical description of the product

The "Injection System VMU plus for masonry" is a bonded anchor (injection type) consisting of a mortar cartridge with injection mortar VMU plus or VMU plus Polar, a perforated sleeve and an anchor rod with hexagon nut and washer or an Internal threaded rod. 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 fastener 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 fastener 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 static and quasi-static loading | See Annexes B6, B7<br>C1 to C60 |
| Characteristic resistance and displacements for seismic loading | No performance assessed |

#### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Class A1 |
| Resistance to fire under tension and shear loading with and without lever arm. Minimum edge distances and spacing | See Annexes C4, C9, C10, C15, C16, C19, C21, C22, C23, C40, C42, C47, C48, C49, C50, C55 and C56 |

#### 3.3 Hygiene, health and the environment (BWR 3)

| Essential characteristic | Performance |
|---|---|
| Content, emission and/or release of dangerous substances | No performance assessed |

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

In accordance with the European Assessment Document EAD 330076-01-0604 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 10 December 2024 by Deutsches Institut für Bautechnik

Beatrix Wittstock
Head of Section

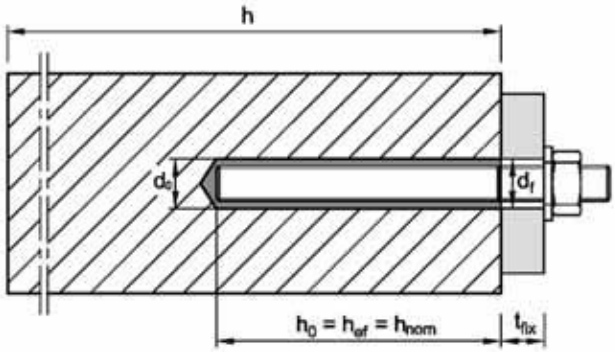
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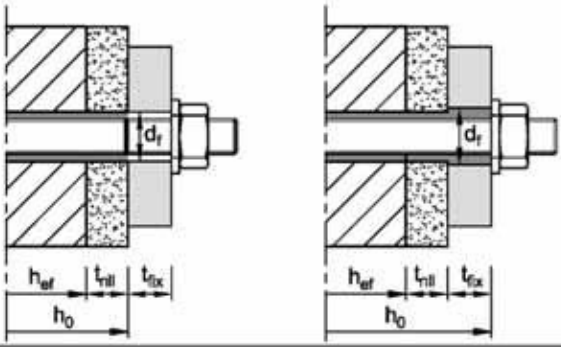
## Installation in solid brick with or without non-loadbearing layer

### Threaded rod M8 – M16 / Internally threaded anchor rod IG-M6 – IG-M10

**Pre-setting installation**

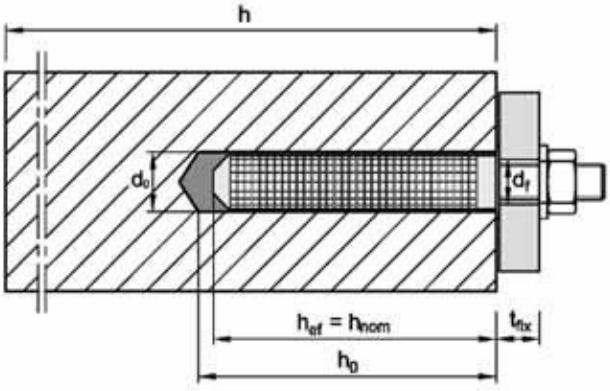



**Through-setting installation**

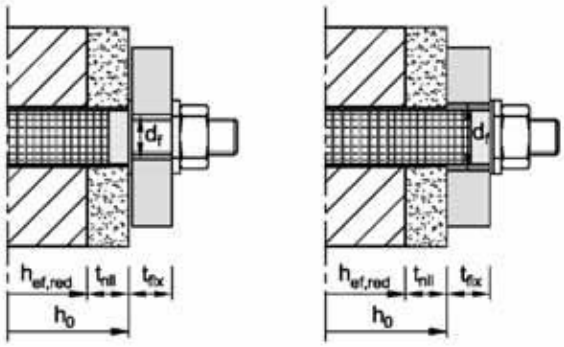



### Threaded rod M8 – M16 / Internally threaded anchor rod IG-M6 – IG-M10 with sleeve

**Pre-setting installation**




**Through-setting installation**




For through-setting installation, the annular gap between the anchor rod and the fixture must be filled with mortar.

**Legend** (Annex A1 and Annex A2):

| | |
|---|---|
| $h_{ef}$ | = effective anchorage depth |
| $h_{nom}$ | = overall anchor embedment depth |
| $h_0$ | = depth of drill hole |
| h | = thickness of masonry member |
| $d_0$ | = nominal drill hole diameter |
| $d_f$ | = diameter of clearance hole in the fixture |
| $t_{fix}$ | = thickness of fixture |
| $t_{nll}$ | = thickness of non-loadbearing layer |

**Injection System VMU plus for masonry**

**Product description**
Installation condition – solid brick

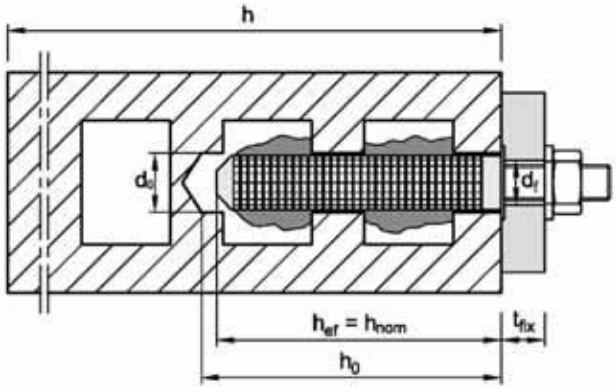
**Annex A1**

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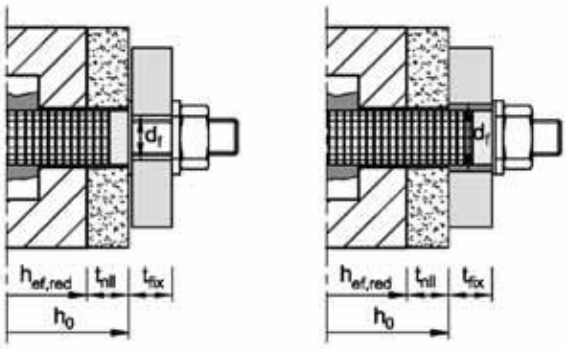
## Installation in hollow brick with or without non-loadbearing layer

**Threaded rod M8 – M16 / Internally threaded anchor rod IG-M6 – IG-M10 with sleeve**

**Pre-setting installation**



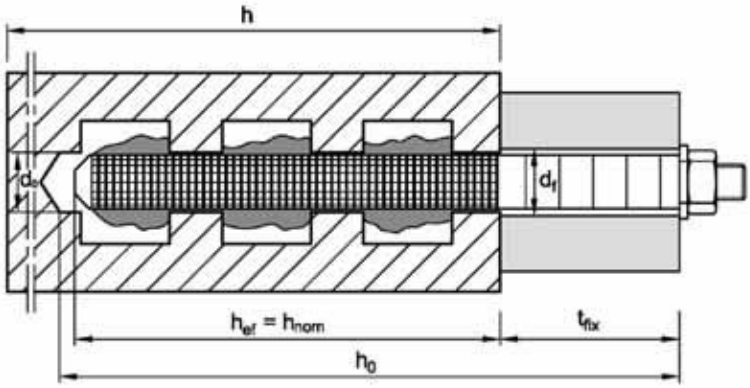

**Through-setting installation**



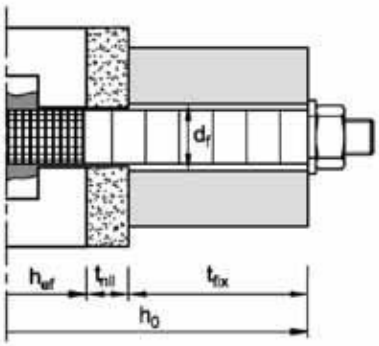

## Installation in hollow brick with or without non-loadbearing layer and/or thermal isolation

**Threaded rod M8 – M10 / Internally threaded anchor rod IG-M6 with sleeve SH 16x130/330**

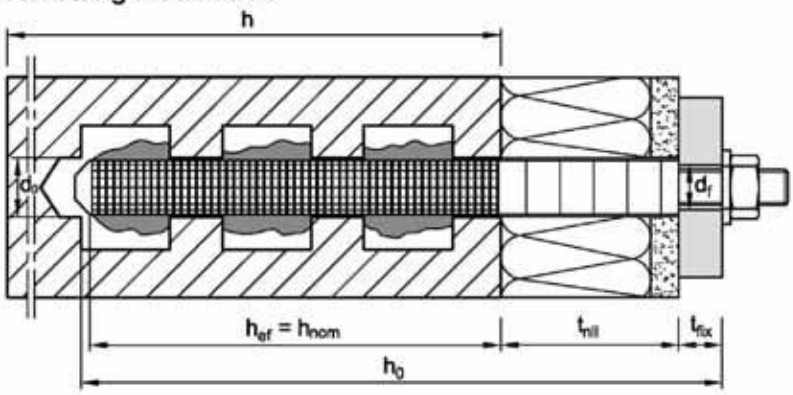
**Pre-setting installation**



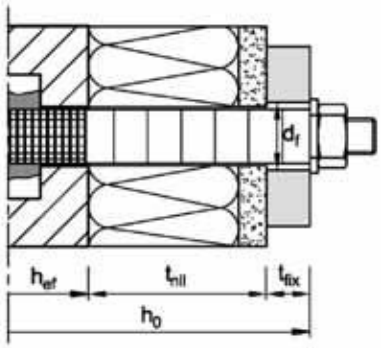

**Through-setting installation**




**Pre-setting installation**




**Through-setting installation**




**Injection System VMU plus for masonry**

**Product description**
Installation condition – hollow brick

**Annex A2**

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## Cartridge: Injection mortar VMU plus or VMU plus Polar

**Coaxial cartridge**
150 ml, 160ml, 280 ml,
300 ml to 330 ml,
380 ml to 420 ml



**Side-by-side cartridge**
235 ml,
345 ml to 360 ml,
825 ml



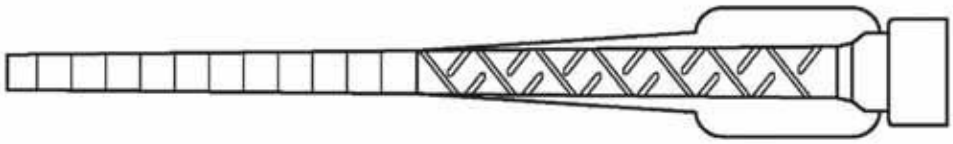
**Foil tube cartridge**
165 ml
300 ml



**Cartridge imprint**:
VMU plus or VMU plus Polar
processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

**Static mixer**

**VM-X**



**VM-XHP**



**Mixer extension**



| Injection System VMU plus for masonry | Annex A3 |
|---|---|
| **Product description**<br>Injection system | |

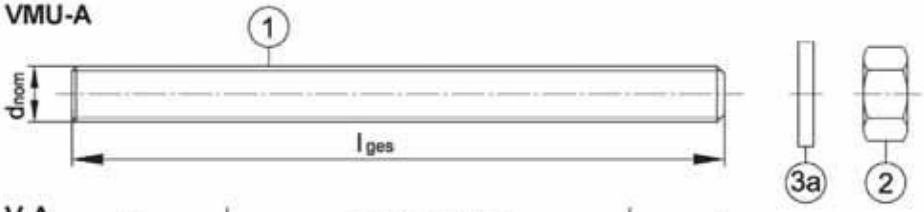
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## Threaded rod

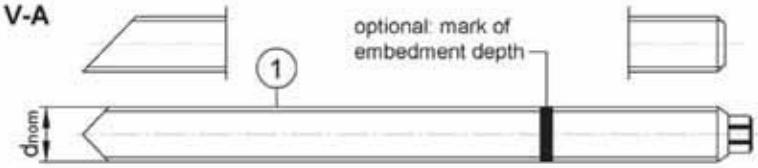
**Threaded rod VMU-A and V-A**

**M8, M10, M12, M16** (zinc plated, A4, HCR)
with washer and hexagon nut

**VMU-A**




**V-A**




Marking e.g.: ◇ M10

| | |
|---|---|
| ◇ | identifying mark of manufacturing plant |
| M10 | size of thread |

additional marking:

| | |
|---|---|
| -8 | strength class 8.8 |
| A4 | stainless steel |
| HC | high corrosion resistant steel |

**Threaded rod VM-A** (material sold by the metre, to be cut at the required length)

**M8, M10, M12, M16** (zinc plated, A2, A4, HCR)

- Materials, dimensions and mechanical properties see Table A1

**Commercial standard threaded rod with:**

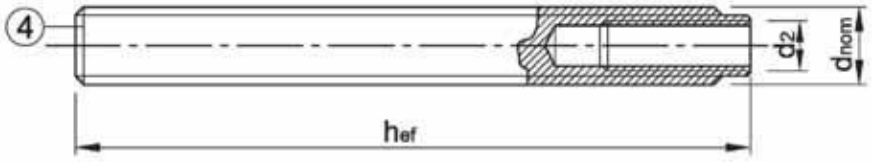
**M8, M10, M12, M16** (zinc plated, A2, A4, HCR)

- Materials, dimensions and mechanical properties see Table A1
- Inspection certificate 3.1 acc. to EN 10204:2004 (documents must be retained)

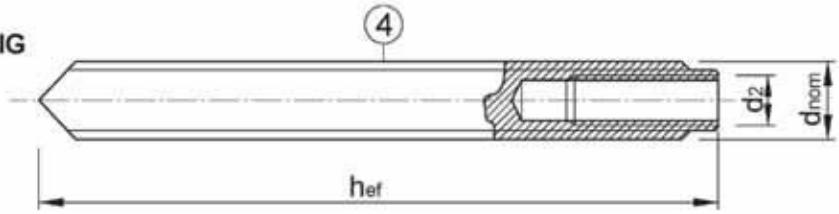
## Internally threaded anchor rod VMU-IG and VZ-IG

**IG M6, IG M8, IG M10**
(zinc plated, A4, HCR)

**VMU-IG**




**VZ-IG**




Marking e.g.: ◇ M8

| | |
|---|---|
| ◇ | identifying mark of manufacturing plant |
| I | internal thread (optional) |
| M8 | size of internal thread |

additional marking:

| | |
|---|---|
| -8 | strength class 8.8 |
| A4 | stainless steel |
| HCR | high corrosion resistant steel |

| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex A4** |
| **Product description**<br>Threaded rods and internally threaded anchor rods | |

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## Table A1: Material

| Part | Designation | | Material and mechanical properties | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Steel, zinc plated**<br>electroplated ≥ 5 µm acc. to EN ISO 4042:2022 or<br>hot-dip galvanized ≥ 50 µm in average acc. to EN ISO 1461:2022, EN ISO 10684:2004+AC:2009 or<br>sherardized ≥ 45 µm acc. to EN ISO 17668:2016 | | | | | | | | |
| 1 | Threaded rod | Property class | characteristic ultimate strength | | characteristic yield strength | | fracture elongation | EN ISO 683-4:2018, EN 10263:2017<br>Commercial standard threaded rod: EN ISO 898-1:2013 |
| | | 4.6 | $f_{uk}$ [N/mm²] | 400 | $f_{yk}$ [N/mm²] | 240 | $A_5$ > 8 % | |
| | | 4.8 | | 400 | | 320 | $A_5$ > 8 % | |
| | | 5.6 | | 500 | | 300 | $A_5$ > 8 % | |
| | | 5.8 | | 500 | | 400 | $A_5$ > 8 % | |
| | | 8.8 | | 800 | | 640 | $A_5$ > 8 % | |
| 2 | Hexagon nut | 4 | for class 4.6 or 4.8 rods | | | | | EN ISO 898-2:2022 |
| | | 5 | for class 4.6, 4.8, 5.6 or 5.8 rods | | | | | |
| | | 8 | for class 4.6, 4.8, 5.6, 5.8 or 8.8 rods | | | | | |
| 3 | Washer | | e.g.: EN ISO 7089:2000, EN ISO 7093:2000, EN ISO 7094:2000, EN ISO 887:2006 | | | | | |
| 4 | Internally threaded anchor rod[3] | 5.8 | Steel, electroplated or sherardized | | | | $A_5$ > 8% | EN ISO 683-4:2018 |
| | | 8.8 | | | | | $A_5$ > 8% | |
| **Stainless steel A2** [1]<br>**Stainless steel A4**<br>**High corrosion resistant steel HCR** | | | **CRC II** (1.4301 / 1.4307 / 1.4311 / 1.4567 / 1.4541)<br>**CRC III** (1.4401 / 1.4404 / 1.4571 / 1.4578)<br>**CRC V** (1.4529 / 1.4565) | | | | | |
| 1 | Threaded rod | Property class | characteristic ultimate strength | | characteristic yield strength | | fracture elongation | EN 10088-1:2014<br>EN ISO 3506-1:2020 |
| | | 50 | $f_{uk}$ [N/mm²] | 500 | $f_{yk}$ [N/mm²] | 210 | $A_5$ > 8% | |
| | | 70 | | 700 | | 450 (560) [2] | $A_5$ > 8 % | |
| | | 80 | | 800 | | 600 (640) [2] | $A_5$ > 8 % | |
| 2 | Hexagon nut | 50 | for class 50 rods | | | | | EN 10088-1:2014<br>EN ISO 3506-2:2020 |
| | | 70 | for class 50 or 70 rods | | | | | |
| | | 80 | for class 50, 70 or 80 rods | | | | | |
| 3 | Washer | | e.g.: EN ISO 7089:2000, EN ISO 7093:2000, EN ISO 7094:2000; EN ISO 887:2006 | | | | | EN 10088-1:2014 |
| 4 | Internally threaded anchor rod [3] | 70 | stainless steel A4; high corrosion resistant steel HCR | | | | $A_5$ > 8 % | EN 10088-1:2014 |
| Perfo Sleeve VM-SH | | | Polypropylene (PP) | | | | | |

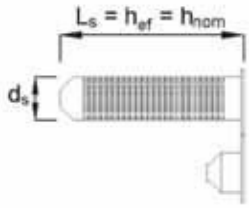
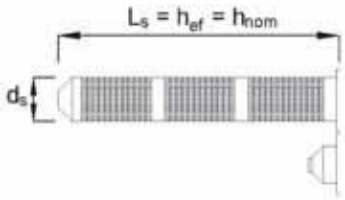
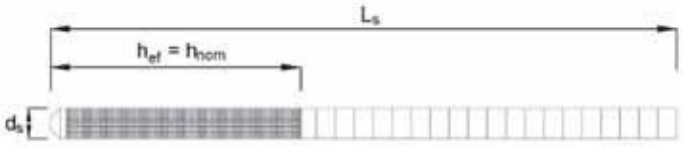
[1] Property class 50 and 70
[2] Value in brackets for anchor rods VMU-A and V-A
[3] Using VMU-IG or VZ-IG, screws or threaded rods (incl. nut and washer) must at least correspond to the material and strength class of the internally threaded anchor rod used.

| **Injection System VMU plus for masonry** | **Annex A5** |
|---|---|
| **Product description**<br>Materials | |

## Table A2: Dimensions of threaded rods and internally threaded anchor rods

| **Threaded rod** | | | **M8** | **M10** | **M12** | **M16** |
|---|---|---|---|---|---|---|
| Diameter | $d = d_{nom}$ | [mm] | 8 | 10 | 12 | 16 |
| Total length | $l_{ges}$ | [mm] | $h_{ef} + t_{fix} + 9,5$ | $h_{ef} + t_{fix} + 11,5$ | $h_{ef} + t_{fix} + 17,5$ | $h_{ef} + t_{fix} + 20,0$ |
| **Internally threaded anchor rod** | | | **-** | **IG M6** | **IG M8** | **IG M10** |
| Internal diameter | $d_2$ | [mm] | - | 6 | 8 | 10 |
| Outer diameter | $d = d_{nom}$ | [mm] | - | 10 | 12 | 16 |
| min. screw-in depth | $L_{IG,min}$ | [mm] | - | 8 | 10 | 10 |
| Total length | $l_{ges}$ | [mm] | - | with sleeve: $h_{ef}$ – 5mm<br>without sleeve: $h_{ef}$ | | |

## Table A3: Dimensions of sleeves VM-SH

| Type | Size | $d_s$ [mm] | $L_s$ [mm] | $h_{ef} = h_{nom}$ [mm] |
|---|---|---|---|---|
|  | **VM-SH 12x80** | 12 | 80 | 80 |
| | **VM-SH 16x85** | 16 | 85 | 85 |
| | **VM-SH 20x85** | 20 | 85 | 85 |
|  | **VM-SH 16x130** | 16 | 130 | 130 |
| | **VM-SH 20x130** | 20 | 130 | 130 |
| | **VM-SH 20x200** | 20 | 200 | 200 |
|  for installation through insulation up to a thickness of 20 cm or through-setting installation | **VM-SH 16x130/330[1)]** | 16 | 330 | 130 |

[1)] In Annex C this sleeve is covered with the VM-SH 16x130

| **Injection System VMU plus for masonry** | **Annex A6** |
|---|---|
| **Product description**<br>Dimensions of threaded rods and sleeves | |

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## Specifications of intended use

| | | | |
|---|---|---|---|
| **Anchorages subject to** | Static and quasi-static loads | | **M8 – M16**<br>**IG M6 – IG M10**<br>(with and without sleeve) |
| | Fire exposure | | |
| | Tension and shear loads | | |
| **Base Material** | Masonry group b: | Solid brick masonry | Annex B 3 |
| | Masonry group c: | Hollow brick masonry | Annex B 3 to B 5 |
| | Masonry group d: | Autoclaved Aerated Concrete | Annex B 3 |
| | Mortar strength class of the masonry M2,5 at minimum according to EN 998-2:2016<br>For other bricks in solid masonry, hollow masonry or in autoclaved aerated concrete, the characteristic resistance of the anchor may be determined by job site tests according to EOTA TR 053, Edition July 2022 under consideration of the β-factor according to Annex C1, Table C1 | | |
| **Temperature range** | $T_a$: - 40°C to +40°C<br>(max. short term temperature +40°C and max. long term temperature +24°C)<br>$T_b$: - 40°C to +80°C<br>(max. short term temperature +80°C and max. long term temperature +50°C)<br>$T_c$: - 40°C to +120°C<br>(max. short term temperature +120°C and max. long term temperature +72°C) | | |
| **Hole drilling** | See Annex C | | |
| **Use conditions (Environmental conditions):** | Structures subject to dry internal conditions (all materials).<br>For all other conditions acc. to EN 1993-1-4:2006+ A2:2020 corresponding to corrosion resistance classes Annex A (stainless steel and high corrosion resistant steel) | | |
| **Use category** | • Condition d/d | Installation and use in dry masonry | |
| | • Condition w/w | Installation and use in dry or wet masonry<br>(incl. w/d, installation in wet masonry and use in dry masonry) | |

Note: The characteristic resistance for solid bricks and autoclaved aerated concrete are also valid for larger brick sizes and larger compressive strength of the masonry unit.

| | |
|---|---|
| **Injection System VMU plus for masonry** | |
| **Intended Use**<br>Specifications | **Annex B1** |

## Specifications of intended use (continued)

**Design:**

- 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.
- The anchorages are designed in accordance with the EOTA TR 054, Edition July 2022, under the responsibility of an engineer experienced in anchorages and masonry work.
- Applies to all bricks if no other values are specified:
  - $N_{Rk} = N_{Rk,b} = N_{Rk,p} = N_{Rk,b,c} = N_{Rk,p,c}$
  - $V_{Rk} = V_{Rk,b} = V_{Rk,c,II} = V_{Rk,c,\perp}$
- For the calculation of pulling out a brick under tension loading $N_{Rk,pb}$ or pushing out a brick under shear loading $V_{Rk,pb}$ see EOTA Technical Report TR 054, Edition July 2022.
- $N_{Rk,s}$, $V_{Rk,s}$ and $M^0_{Rk,s}$ see annexes C2 – C4
- For application with sleeve with drill bit size ≤ 15mm installed in joints not filled with mortar:
  - $N_{Rk,p,j} = 0{,}18 * N_{Rk,p}$ and $N_{Rk,b,j} = 0{,}18 * N_{Rk,b}$ ($N_{Rk,p} = N_{Rk,b}$ see Annex C)
  - $V_{Rk,c,j} = 0{,}15 * V_{Rk,c}$ and $V_{Rk,b,j} = 0{,}15 * V_{Rk,b}$ ($V_{Rk,b}$ see Annex C; and $V_{Rk,c}$ see Annex C5)
- Applications without sleeve installed in unfilled joints are not permitted.

**Installation:**

- Anchor Installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- Using internally threaded anchor rod (VMU-IG or VZ-IG) screws and threaded rods (incl. nut and washer) must at least correspond to the material and strength class of the internally threaded anchor rod used.

| Injection System VMU plus for masonry | Annex B2 |
|---|---|
| **Intended use**<br>Specifications | |

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## Table B1: Overview brick types and properties

| Designation<br>Density [kg/dm³]<br>Dimension LxBxH [mm] | Picture | Perfo Sleeve VM-SH | Fire exposure | Annex | Designation<br>Density [kg/dm³]<br>Dimension LxBxH [mm] | Picture | Perfo Sleeve VM-SH | Fire exposure | Annex |
|---|---|---|---|---|---|---|---|---|---|
| **Hollow light weight concrete brick acc. to EN 771-4:2011+A1:2015** | | | | | **Hollow light weight concrete brick acc. to EN 771-3:2011+A1:2015** | | | | |
| AAC<br>ρ = 0,35-0,60<br>≥ 499x240x249 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | – | C6<br>–<br>C8 | VBL<br>ρ ≥ 0,6<br>≥240x300x113 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | – | C59<br>-<br>C60 |
| **Hollow light weight concrete brick acc. to EN 771-3: 2011+A1:2015** | | | | | | | | | |
| HBL 16DF<br>ρ ≥ 1,0<br>500x250x240 |  | 16x85<br>16x130<br>20x85<br>20x130<br>20x200 | ✓ | C55<br>-<br>C56 | Bloc creux B40<br>ρ ≥ 0,8<br>495x195x190 |  | 16x130<br>20x130 | – | C57<br>-<br>C58 |
| **Calcium silica bricks acc. to EN 771-2:2011+A1:2015** | | | | | | | | | |
| KS-NF<br>ρ ≥ 2,0<br>≥ 240x115x71 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | ✓ | C9<br>–<br>C10 | KSL-3DF<br>ρ ≥ 1,4<br>240x175x113 |  | 16x85<br>16x130<br>20x85<br>20x130 | – | C11<br>-<br>C12 |
| KSL-8DF<br>ρ ≥ 1,4<br>248x240x238 |  | 16x130<br>20x130<br>20x200 | – | C13<br>-<br>C14 | KSL-12DF<br>ρ ≥ 1,4<br>498x175x238 |  | 16x130<br>20x130 | ✓ | C15<br>-<br>C16 |
| **Solid clay bricks acc. to EN 771-1:2011+A1:2015** | | | | | | | | | |
| MZ-1DF<br>ρ ≥ 2,0<br>≥ 240x115x55 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | – | C17<br>-<br>C18 | MZ – 2 DF<br>ρ ≥ 2,0<br>≥ 240x115x113 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | ✓ | C19<br>-<br>C21 |

| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex B3** |
| **Intended use**<br>Brick types and properties | |

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## Continuation **Table B1: Overview brick types and properties**

| Designation Density [kg/dm³] Dimension LxBxH [mm] | Picture | Perfo Sleeve VM-SH | Fire exposure | Annex | Designation Density [kg/dm³] Dimension LxBxH [mm] | Picture | Perfo Sleeve VM-SH | Fire exposure | Annex |
|---|---|---|---|---|---|---|---|---|---|
| **Hollow clay bricks acc. to EN 771-1:2011+A1:2015** | | | | | | | | | |
| Hlz-10DF<br>ρ ≥ 1,25<br>300x240x249 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | ✓ | C22<br>-<br>C23 | Porotherm Homebric<br>ρ ≥ 0,7<br>500x200x299 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130 | – | C24<br>-<br>C25 |
| BGV Thermo<br>ρ ≥ 0,6<br>500x200x314 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130 | – | C26<br>-<br>C27 | Brique creuse C40<br>ρ ≥ 0,7<br>500x200x200 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130 | – | C32<br>-<br>C33 |
| Calibric R+<br>ρ ≥ 0,6<br>500x200x314 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130 | – | C28<br>-<br>C29 | Blocchi Leggeri<br>ρ ≥ 0,6<br>250x120x250 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130 | – | C34<br>-<br>C35 |
| Urbanbric<br>ρ ≥ 0,7<br>560x200x274 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130 | – | C30<br>-<br>C31 | Doppio Uni<br>ρ ≥ 0,9<br>250x120x120 |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130 | – | C36<br>-<br>C37 |
| **Hollow clay bricks with thermal insulation acc. to EN 771-1:2011+A1:2015** | | | | | | | | | |
| Coriso WS07<br>ρ ≥ 0,55<br>248x365x249<br>Mineral wool |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | – | C38<br>-<br>C39 | T8 P<br>ρ ≥ 0,56<br>248x365x249<br>Perlite |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | – | C43<br>-<br>C44 |
| T7 MW<br>ρ ≥ 0,59<br>248x365x249<br>Mineral wool |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | ✓ | C40<br>-<br>C42 | MZ90-G<br>ρ ≥ 0,68<br>248x365x249<br>Mineral wool |  | 12x80<br>16x85<br>16x130<br>20x85<br>20x130<br>20x200 | – | C45<br>-<br>C46 |

**Injection System VMU plus for masonry**

**Intended use**
Brick types and properties

**Annex B4**

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## Continuation **Table B1: Overview brick types and properties**

| Designation Density [kg/dm³] Dimension LxBxH [mm] | Picture | Perfo Sleeve VM-SH | Fire exposure | Annex | Designation Density [kg/dm³] Dimension LxBxH [mm] | Picture | Perfo Sleeve VM-SH | Fire exposure | Annex |
|---|---|---|---|---|---|---|---|---|---|
| **Hollow clay bricks with thermal insulation acc. to EN 771-1:2011+A1:2015** | | | | | | | | | |
| Poroton FZ7,5 ρ ≥ 0,90 248x365x249 Mineral wool |  | 12x80 16x85 16x130 20x85 20x130 20x200 | ✓ | C47 - C48 | Poroton FZ9 ρ ≥ 0,90 248x365x249 Mineral wool |  | 12x80 16x85 16x130 20x85 20x130 20x200 | ✓ | C49 - C50 |
| Poroton S9 ρ ≥ 0,85 248x365x249 Perlite |  | 12x80 16x85 16x130 20x85 20x130 20x200 | – | C51 - C52 | Thermopor TV8+ ρ ≥ 0,7 248x365x249 Mineral wool |  | 12x80 16x85 16x130 20x85 20x130 20x200 | – | C53 - C54 |

**Injection System VMU plus for masonry**

**Intended Use**
Brick types and properties

**Annex B5**

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## Table B2: Installation parameters for autoclaved aerated concrete AAC and solid masonry (without sleeve) for pre- or through-setting installation

| Threaded rod | | | | M8 | M10 IG-M6 | M12 IG-M8 | M16 IG-M10 |
|---|---|---|---|---|---|---|---|
| Nominal drill hole diameter | | $d_0$ | [mm] | 10 | 12 | 14 | 18 |
| Depth of drill hole | | $h_0$ | [mm] | $h_{ef} + t_{fix}$ [1] | | | |
| Effective anchorage depth | | $h_{ef}$ | [mm] | 80 | ≥ 90 | ≥ 100 | ≥ 100 |
| Diameter of clearance hole in the fixture | pre-setting installation | $d_f \leq$ | [mm] | 9 | 7 (IG-M6)<br>12 (M10) | 9 (IG-M8)<br>14 (M12) | 12 (IG-M10)<br>18 (M16) |
| | through-setting installation | $d_f \leq$ | [mm] | 12 | 14 | 16 | 20 |
| Brush | | | [-] | RB 10 | RB 12 | RB 14 | RB 18 |
| Minimum brush diameter | | $d_b$ | [mm] | 10,5 | 12,5 | 14,5 | 18,5 |
| Maximum installation torque | | $T_{inst}$ | [Nm] | see Annex C | | | |
| Minimum member thickness | | $h_{min}$ | [mm] | $h_{ef}$ + 30 | | | |
| Minimum spacing | | $s_{min}$ | [mm] | see Annex C | | | |
| Minimum edge distance | | $c_{min}$ | [mm] | see Annex C | | | |

[1] Consider $t_{fix}$ in case of through-setting installation

## Table B3: Installation parameters in solid and hollow masonry (with sleeve) for pre-setting Installation

| Threaded rod | | | M8 | M8 / M10 IG-M6 | | | M12 / M16 IG-M8 / IG-M10 | | |
|---|---|---|---|---|---|---|---|---|---|
| Sleeve VM-SH | | | 12x80 | 16x85 | 16x130 | 16x130 /330 | 20x85 | 20x130 | 20x200 |
| Nominal drill hole diameter | $d_0$ | [mm] | 12 | 16 | | | 20 | | |
| Depth of drill hole | $h_0$ | [mm] | 85 | 90 | 135 | 330 | 90 | 135 | 205 |
| Effective anchorage depth | $h_{ef}$ | [mm] | 80 | 85 | 130 | 130 | 85 | 130 | 200 |
| Diameter of clearance hole in the fixture | $d_f \leq$ | [mm] | 9 | 7 (IG-M6)<br>9 (M8)<br>12 (M10) | | | 9 (IG-M8)<br>12 (IG-M10)<br>14 (M12)<br>18 (M16) | | |
| Brush | | [-] | RB 12 | RB 16 | | | RB 20 | | |
| Minimum brush diameter | $d_b$ | [mm] | 12,5 | 16,5 | | | 20,5 | | |
| Maximum installation torque | $T_{inst}$ | [Nm] | see Annex C | | | | | | |
| Minimum member thickness | $h_{min}$ | [mm] | 115 | 115 | 195 | 195 | 115 | 195 | 240 |
| Minimum spacing | $s_{min}$ | [mm] | see Annex C | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | see Annex C | | | | | | |

**Injection System VMU plus for masonry**

**Intended Use**
Installation parameters

**Annex B6**

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## Table B4: Installation parameters in solid and hollow masonry (with sleeve) for pre-setting installation through non-load-bearing layers and/or through-setting installation

| Threaded rod | | | | M8 / M10 IG-M6 | | M12 / M16 IG-M8 / IG-M10 | |
|---|---|---|---|---|---|---|---|
| **Sleeve VM-SH** | | | | **16x130** | **16x130/330** | **20x130** | **20x200** |
| Nominal drill hole diameter | | $d_0$ | [mm] | 16 | | 20 | |
| Depth of drill hole | | $h_0$ | [mm] | $h_{ef}$ + 5mm + $t_{nll}$ + $t_{fix}$ [1] | | | |
| Effective anchorage depth | pre-setting installation | $h_{ef}$ | [mm] | 130 | 130 | 130 | 200 |
| | through-setting installation | $h_{ef}$ | [mm] | 85 | 130 | 85 | 85 |
| Maximum thickness of non-loadbearing layer | | max. $t_{nll}$ | [mm] | 45 | 200 | 45 | 115 |
| Diameter of clearance hole in the fixture | pre-setting installation | $d_f \leq$ | [mm] | 7 (IG-M6)<br>9 (M8)<br>12 (M10) | | 9 (IG-M8)<br>12 (IG-M10)<br>14 (M12)<br>18 (M16) | |
| | through-setting installation | $d_f \leq$ | [mm] | 18 | | 22 | |
| Brush | | | [-] | RB 16 | | RB 20 | |
| Minimum brush diameter | | $d_b$ | [mm] | 16,5 | | 20,5 | |
| Maximum installation torque | | $T_{inst}$ | [Nm] | see Annex C | | | |
| Minimum member thickness | | $h_{min}$ | [mm] | 195 (115) | 195 | 195 (115) | 240 (115) |
| Minimum spacing | | $s_{min}$ | [mm] | see Annex C | | | |
| Minimum edge distance | | $c_{min}$ | [mm] | see Annex C | | | |

[1] Consider $t_{nll}$ and/or $t_{fix}$ in case of non-loadbearing layers and/or through-setting installation.

## Cleaning and installation tools

**Compressed air tool (min. 6 bar)**



**Blow out pump** (Volume ≥ 750 ml)



**Brush RB**




**Brush extension**



| Injection System VMU plus for masonry | Annex B7 |
|---|---|
| **Intended use**<br>Installation parameters and cleaning and installation tools | |

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## Table B5: Working and curing time - VMU plus

| Temperature in the base material [°C] | Maximum working time | Minimum curing time in | |
|---|---|---|---|
| | | in dry base material | in wet base material |
| - 10°C to - 6°C | 90 min | 24 h | 48 h |
| - 5°C to - 1°C | 90 min | 14 h | 28 h |
| 0°C to + 4°C | 45 min | 7 h | 14 h |
| + 5°C to + 9°C | 25 min | 2 h | 4 h |
| + 10°C to + 19°C | 15 min | 80 min | 160 min |
| + 20°C to + 29°C | 6 min | 45 min | 90 min |
| + 30°C to + 34°C | 4 min | 25 min | 50 min |
| + 35°C to + 39°C | 2 min | 20 min | 40 min |
| + 40°C | 1,5 min | 15 min | 30 min |
| **Cartridge temperature** [1] | +5°C to +40°C | | |

[1] At temperatures in the base material of -10°C to -6°C, the cartridge temperature must be at least +15°C.

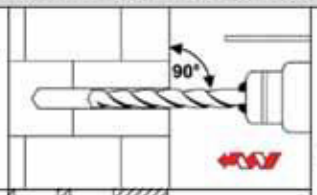
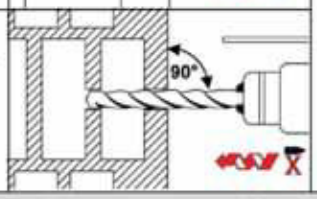
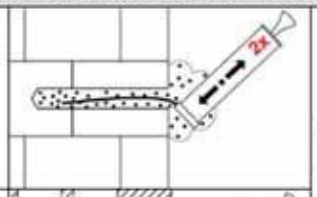
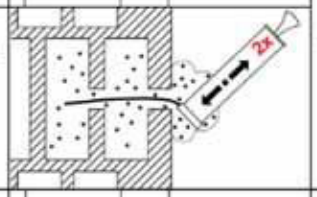
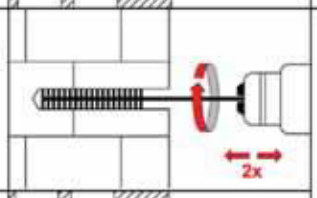
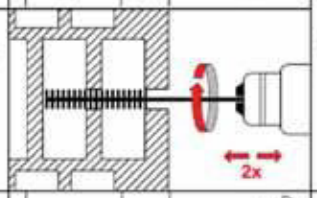
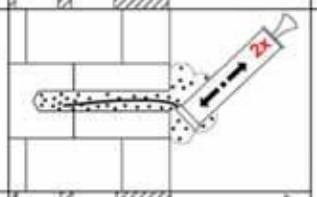
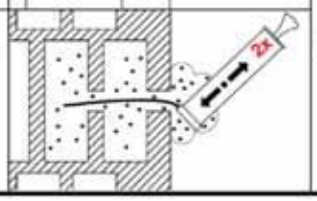
## Table B6: Working and curing time - VMU plus Polar

| Temperature in the base material [°C] | Maximum working time | Minimum curing time | |
|---|---|---|---|
| | | in dry base material | in dry base material |
| - 20°C to - 16°C | 75 min | 24 h | 48 h |
| - 15°C to - 11°C | 55 min | 16 h | 32 h |
| - 10°C to - 6°C | 35 min | 10 h | 20 h |
| - 5°C to - 1°C | 20 min | 5 h | 10 h |
| 0°C to +4°C | 10 min | 2,5 h | 5 h |
| +5°C to +9°C | 6 min | 80 min | 160 min |
| + 10°C | 6 min | 60 min | 2 h |
| **Cartridge temperature** | -20°C to +10°C | | |

| Injection System VMU plus for masonry | Annex B8 |
|---|---|
| **Intended use**<br>Working and curing times | |

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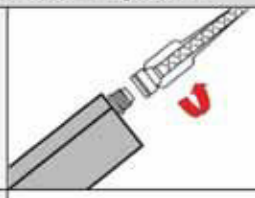
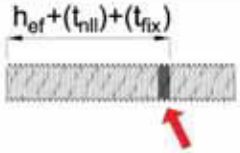
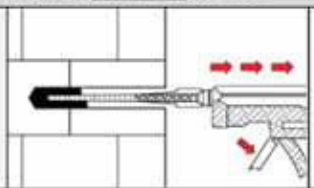
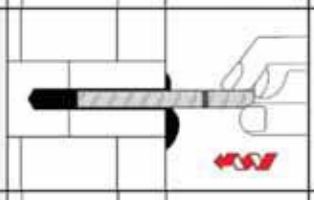
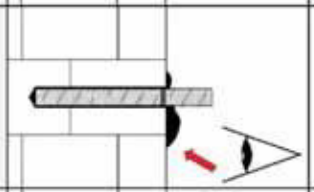
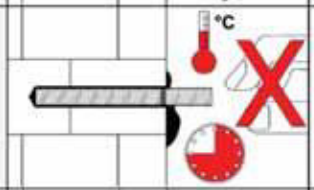
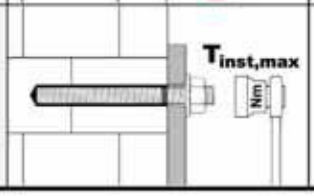
## Installation instructions

| | | | |
|---|---|---|---|
| **Drilling of the drill hole in solid masonry and hollow masonry** | | | |
| 1 | solid masonry |  | Drill the hole perpendicular to the surface of the base material using the drilling method according to Annex C, with the specified drill hole diameter and depth of drill hole corresponding to the anchor size and anchorage depth of the selected anchor.<br>In case of aborted drill hole, the drill hole shall be filled with mortar. |
| | hollow masonry |  | |
| **Cleaning in solid masonry and hollow masonry** | | | |
| 2a | solid masonry |  | Blow out from the bottom of the bore hole with the blow out pump (Annex B7) a minimum of **two** times.<br>For applications in solid masonry with a bore hole depth $h_0$ > 100mm cleaning with compressed air is required. |
| | hollow masonry |  | |
| 2b | solid masonry |  | Brush the hole with an appropriately sized wire brush ≥ $d_{b,min}$ (Table B2, B3 and B4, check minimum brush diameter $d_{b,min}$) a minimum of **two** times using a drilling machine or battery screwdriver.<br>If the drill hole ground is not reached, an appropriate brush extension must be used. |
| | hollow masonry |  | |
| 2c | solid masonry |  | Finally starting from the bottom or back of the drill hole blow out the hole with the blow out pump again a minimum of **two** times.<br>For applications in solid masonry with a bore hole depth $h_0$ > 100mm cleaning with compressed air is required. |
| | hollow masonry |  | |

| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex B9** |
| **Intended use**<br>Installation instruction: drilling of drill hole / cleaning in solid and hollow masonry | |

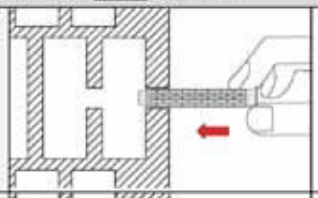
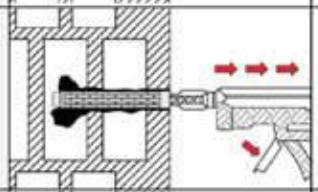
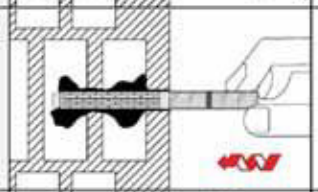
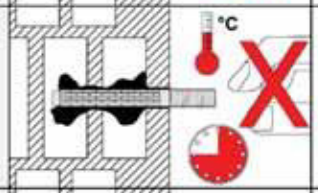
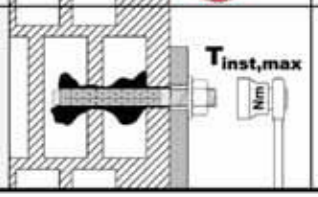
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## Installation instructions - continuation

| | | |
|---|---|---|
| **Preparation injection** | | |
| 3 |  | Remove the cap and attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. In case of a foil tube cartridge, cut off the clip before use. For every working interruption longer than the recommended working time (Table B5 and B6) as well as for new cartridges, a new static-mixer shall be used. |
| 4 |   | Mark position of embedment depth on the threaded rod. Consider $t_{nll}$ and/or $t_{fix}$ in case of installation through non-loadbearing layers and/or through setting installation.<br>The threaded rod shall be free of dirt, grease, oil or other foreign material. |
| 5 |   | Prior to dispensing into the drill hole, squeeze out separately (a minimum of three full strokes, for foil tube cartridges at least 6 full strokes) and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey color. |
| **Installation <u>without</u> sleeve** | | |
| 6 |  | Starting at the bottom of the drill hole and fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid air pockets. Use mixer extension if necessary.<br>Observe temperature dependent working time (Table B5 or B6). |
| 7 |  | Insert fastener while turning slightly up to the embedment mark. |
| 8 |  | Annular gap between threaded rod and base material must be completely filled with mortar. For through setting installation the annular gap between threaded rod and fixture must also be filled with mortar.<br>Otherwise, the installation must be repeated starting from step 6 before the maximum working time has expired. |
| 9 |   | Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (Table B5 or B6).<br>After full curing time remove excess mortar. |
| 10 |   | Install the fixture using a torque wrench, observing the maximum installation torque $T_{inst}$ according to Annex C. |

| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex B10** |
| **Intended use**<br>Installation instruction: Preparation injection / Installation without sleeve | |

## Installation instructions - continuation

| Installation with sleeve | | |
|---|---|---|
| 6 |  | Insert the perforated sleeve flush with the surface of the masonry. Only use sleeves that have the right length. Never cut the sleeve in the anchoring area. For through-setting installation with perforated sleeve VM SH 16x130/330 through a non-load-bearing layer and/or add-on part, the clamping area may be shortened to the thickness of the non-load-bearing layer and/or attachment. |
| 7 |  | Fill the perforated sleeve with mortar from the bottom or back. Use mixer extension if necessary. Refer to the cartridge label or the installation instructions for the exact quantity of mortar. For through setting installation, the perforated sleeve must be completely filled with mortar up to the fixture. Observe the working and curing times given in Table B5 and B6. |
| 8 |  | To optimize the distribution of the mortar, insert the fastener with slight rotation to the defined embedment depth. |
| 9 |  | Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (Table B5 and B6). |
| 10 |  | Install the fixture using a torque wrench, observing the maximum installation torque $T_{inst}$ according to Annex C. |

| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex B11** |
| **Intended use**<br>Installation instruction: Installation with sleeve | |

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**Table C1: β - factor for job-site testing under tension loading**

| Brick type | Anchor size | Perfo sleeve VM-SH | anchorage depth $h_{ef}$ | β-factor $T_a$: 24°C / 40°C | | $T_b$: 50°C / 80°C | | $T_c$: 72°C/120°C | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | d/d | w/d w/w | d/d | w/d w/w | d/d | w/d w/w |
| Autoclaved aerated concrete | all sizes | with or without VM-SH | all | 0,95 | 0,86 | 0,81 | 0,73 | 0,81 | 0,73 |
| Calcium silica bricks | $d_0 \leq 14$ mm | VM-SH | all | 0,93 | 0,80 | 0,87 | 0,74 | 0,65 | 0,56 |
| | $d_0 \geq 16$ mm | | | 0,93 | 0,93 | 0,87 | 0,87 | 0,65 | 0,65 |
| | $d_0 \leq 14$ mm | – | ≤ 100mm | 0,93 | 0,80 | 0,87 | 0,74 | 0,65 | 0,56 |
| | $d_0 \geq 16$ mm | | | 0,93 | 0,93 | 0,87 | 0,87 | 0,65 | 0,65 |
| | all sizes | | > 100mm | 0,93 | 0,56 | 0,87 | 0,52 | 0,65 | 0,40 |
| Clay bricks | all sizes | VM-SH | all | 0,86 | 0,86 | 0,86 | 0,86 | 0,73 | 0,73 |
| | | – | ≤ 100mm | 0,86 | 0,86 | 0,86 | 0,86 | 0,73 | 0,73 |
| | | | > 100mm | 0,86 | 0,43 | 0,86 | 0,43 | 0,73 | 0,37 |
| Concrete bricks | $d_0 \leq 12$ mm | with or without VM-SH | all | 0,93 | 0,80 | 0,87 | 0,74 | 0,65 | 0,56 |
| | $d_0 \geq 16$ mm | | | 0,93 | 0,93 | 0,87 | 0,87 | 0,65 | 0,65 |

**Injection System VMU plus for masonry**

**Performances**
β-factors for job site testing under tension load

**Annex C1**

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## Table C2: Characteristic steel resistance under tension and shear load for threaded rods

| Threaded rod | | | | M 8 | M 10 | M 12 | M 16 |
|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | |
| Cross sectional area | | $A_s$ | [mm²] | 36,6 | 58,0 | 84,3 | 157 |
| **Characteristic resistance under tension load** [1] | | | | | | | |
| steel, zinc plated | Property class 4.6 and 4.8 | $N_{Rk,s}$ | [kN] | 15 (13)[1] | 23 (21)[1] | 34 | 63 |
| | Property class 5.6 and 5.8 | $N_{Rk,s}$ | [kN] | 18 (17)[1] | 29 (27)[1] | 42 | 79 |
| | Property class 8.8 | $N_{Rk,s}$ | [kN] | 29 (27)[1] | 46 (43)[1] | 67 | 126 |
| stainless steel | Property class 50 (A2/A4/HCR) | $N_{Rk,s}$ | [kN] | 18 | 29 | 42 | 79 |
| | Property class 70 (A2/A4/HCR) | $N_{Rk,s}$ | [kN] | 26 | 41 | 59 | 110 |
| | Property class 80 (A4/HCR) | $N_{Rk,s}$ | [kN] | 29 | 46 | 67 | 126 |
| **Partial factors** [2] | | | | | | | |
| steel, zinc plated | Property class 4.6 and 5.6 | $\gamma_{Ms,N}$ | [-] | 2,0 | | | |
| | Property class 4.8, 5.8 and 8.8 | $\gamma_{Ms,N}$ | [-] | 1,5 | | | |
| stainless steel | Property class 50 (A2/A4/HCR) | $\gamma_{Ms,N}$ | [-] | 2,86 | | | |
| | Property class 70 (A2/A4/HCR) | $\gamma_{Ms,N}$ | [-] | 1,87 (1,5)[3] | | | |
| | Property class 80 (A4/HCR) | $\gamma_{Ms,N}$ | [-] | 1,6 (1,5)[3] | | | |
| **Characteristic resistance under shear load** [1] | | | | | | | |
| **Steel failure <u>without</u> lever arm** | | | | | | | |
| steel, zinc plated | Property class 4.6 and 4.8 | $V^0_{Rk,s}$ | [kN] | 7 (6)[1] | 12 (10)[1] | 17 | 31 |
| | Property class 5.6 and 5.8 | $V^0_{Rk,s}$ | [kN] | 9 (8)[1] | 15 (13)[1] | 21 | 39 |
| | Property class 8.8 | $V^0_{Rk,s}$ | [kN] | 15 (13)[1] | 23 (21)[1] | 34 | 63 |
| stainless steel | Property class 50 (A2/A4/HCR) | $V^0_{Rk,s}$ | [kN] | 9 | 15 | 21 | 39 |
| | Property class 70 (A2/A4/HCR) | $V^0_{Rk,s}$ | [kN] | 13 | 20 | 30 | 55 |
| | Property class 80 (A4/HCR) | $V^0_{Rk,s}$ | [kN] | 15 | 23 | 34 | 63 |
| **Steel failure <u>with</u> lever arm – characteristic bending moment** | | | | | | | |
| steel, zinc plated | Property class 4.6 and 4.8 | $M^0_{Rk,s}$ | [Nm] | 15 (13)[1] | 30 (27)[1] | 52 | 133 |
| | Property class 5.6 and 5.8 | $M^0_{Rk,s}$ | [Nm] | 19 (16)[1] | 37 (33)[1] | 65 | 166 |
| | Property class 8.8 | $M^0_{Rk,s}$ | [Nm] | 30 (26)[1] | 60 (53)[1] | 105 | 266 |
| stainless steel | Property class 50 (A2/A4/HCR) | $M^0_{Rk,s}$ | [Nm] | 19 | 37 | 65 | 166 |
| | Property class 70 (A2/A4/HCR) | $M^0_{Rk,s}$ | [Nm] | 26 | 52 | 92 | 233 |
| | Property class 80 (A4/HCR) | $M^0_{Rk,s}$ | [Nm] | 30 | 60 | 105 | 266 |
| **Partial factors** [2] | | | | | | | |
| steel, zinc plated | Property class 4.6 and 5.6 | $\gamma_{Ms,V}$ | [-] | 1,67 | | | |
| | Property class 4.8, 5.8 and 8.8 | $\gamma_{Ms,V}$ | [-] | 1,25 | | | |
| stainless steel | Property class 50 (A2/A4/HCR) | $\gamma_{Ms,V}$ | [-] | 2,38 | | | |
| | Property class 70 (A2/A4/HCR) | $\gamma_{Ms,V}$ | [-] | 1,56 (1,25)[3] | | | |
| | Property class 80 (A4/HCR) | $\gamma_{Ms,V}$ | [-] | 1,33 (1,25)[3] | | | |

[1] The characteristic resistances apply for all anchor rods with the cross-sectional area $A_s$ specified here: VMU-A, V-A, VM-A. For commercial standard threaded rods with a smaller cross-sectional area (e.g. hot-dip galvanized threaded rods M8, M10 according to EN ISO 10684:2004 + AC:2009), the value in bracket is valid.

[2] In absence of national regulation

[3] Value in bracket only valid for anchor rod VMU-A or V-A

**Injection System VMU plus for masonry**

**Performances**
Characteristic steel resistance under tension and shear load for **threaded rods**

**Annex C2**

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## Table C3: Characteristic steel resistance under tension and shear load for internally threaded anchor rod

| Internally threaded anchor rod | | | | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|
| **Steel failure** [1] | | | | | | |
| **Characteristic resistance under tension load** | | | | | | |
| steel, zinc plated | Property class 5.8 | $N_{Rk,s}$ | [kN] | 10 | 17 | 29 |
| | Property class 8.8 | $N_{Rk,s}$ | [kN] | 16 | 27 | 46 |
| stainless steel | Property class 70 (A4/HCR) | $N_{Rk,s}$ | [kN] | 14 | 26 | 41 |
| **Partial factors** [2] | | | | | | |
| steel, zinc plated | Property class 5.8 | $\gamma_{Ms,N}$ | [-] | 1,5 | | |
| | Property class 8.8 | $\gamma_{Ms,N}$ | [-] | 1,5 | | |
| stainless steel | Property class 70 (A4/HCR) | $\gamma_{Ms,N}$ | [-] | 1,87 | | |
| **Characteristic resistance under shear load** | | | | | | |
| **Steel failure <u>without</u> lever arm** | | | | | | |
| steel, zinc plated | Property class 5.8 | $V^0_{Rk,s}$ | [kN] | 5 | 9 | 15 |
| | Property class 8.8 | $V^0_{Rk,s}$ | [kN] | 8 | 14 | 23 |
| stainless steel | Property class 70 (A4/HCR) | $V^0_{Rk,s}$ | [kN] | 7 | 13 | 20 |
| **Steel failure <u>with</u> lever arm – characteristic bending moment** | | | | | | |
| steel, zinc plated | Property class 5.8 | $M^0_{Rk,s}$ | [Nm] | 8 | 19 | 37 |
| | Property class 8.8 | $M^0_{Rk,s}$ | [Nm] | 12 | 30 | 60 |
| stainless steel | Property class 70 (A4/HCR) | $M^0_{Rk,s}$ | [Nm] | 11 | 26 | 52 |
| **Partial factors** [2] | | | | | | |
| steel, zinc plated | Property class 5.8 | $\gamma_{Ms,V}$ | [-] | 1,25 | | |
| | Property class 8.8 | $\gamma_{Ms,V}$ | [-] | 1,25 | | |
| stainless steel | Property class 70 (A4/HCR) | $\gamma_{Ms,V}$ | [-] | 1,56 | | |

[1] Fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internally threaded anchor rod. The characteristic tension resistance for steel failure of the given strength class are valid for the internally threaded anchor rod and the fastening element.

[2] In absence of national regulation

| **Injection System VMU plus for masonry** | **Annex C3** |
|---|---|
| **Performances**<br>Characteristic steel resistance under tension and shear load for **internally threaded anchor rod** | |

Deutsches Institut für Bautechnik DIBt

## Table C4: Characteristic steel resistance under fire exposure - Threaded rod

| Threaded rod | | | | M 8 | M 10 | M 12 | M 16 |
|---|---|---|---|---|---|---|---|
| **Characteristic resistance under tension load** | | | | | | | |
| Steel, property class 5.8 and 8.8; Stainless steel (A2/ A4/ HCR) property class ≥ 50 | R30 | $N_{Rk,s,fi}$ | [kN] | 1,1 | 1,7 | 3,0 | 5,7 |
| | R60 | $N_{Rk,s,fi}$ | [kN] | 0,9 | 1,4 | 2,3 | 4,2 |
| | R90 | $N_{Rk,s,fi}$ | [kN] | 0,7 | 1,0 | 1,6 | 3,0 |
| | R120 | $N_{Rk,s,fi}$ | [kN] | 0,5 | 0,8 | 1,2 | 2,2 |
| **Characteristic resistance under shear load** [1)] | | | | | | | |
| **Steel failure without lever arm** | | | | | | | |
| Steel, property class 5.8 and 8.8; Stainless steel (A2/ A4/ HCR) property class ≥ 50 | R30 | $V^0_{Rk,s,fi}$ | [kN] | 1,1 | 1,7 | 3,0 | 5,7 |
| | R60 | $V^0_{Rk,s,fi}$ | [kN] | 0,9 | 1,4 | 2,3 | 4,2 |
| | R90 | $V^0_{Rk,s,fi}$ | [kN] | 0,7 | 1,0 | 1,6 | 3,0 |
| | R120 | $V^0_{Rk,s,fi}$ | [kN] | 0,5 | 0,8 | 1,2 | 2,2 |
| **Steel failure with lever arm – characteristic bending moment** | | | | | | | |
| Steel, property class 5.8 and 8.8; Stainless steel (A2/ A4/ HCR) property class ≥ 50 | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 1,1 | 2,2 | 4,7 | 12,0 |
| | R60 | $M^0_{Rk,s,fi}$ | [Nm] | 0,9 | 1,8 | 3,5 | 9,0 |
| | R90 | $M^0_{Rk,s,fi}$ | [Nm] | 0,7 | 1,3 | 2,5 | 6,3 |
| | R120 | $M^0_{Rk,s,fi}$ | [Nm] | 0,5 | 1,0 | 1,8 | 4,7 |
| **Partial factor** | all | $\gamma_{Ms,fi}$ | [-] | 1,0 | | | |

## Table C5: Characteristic steel resistance under fire exposure - Internally threaded anchor rod

| Internally threaded anchor rod | | | | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|
| **Characteristic resistance under tension load** | | | | | | |
| Steel, property class 5.8 and 8.8; Stainless steel (A4 / HCR) property class 70 | R30 | $N_{Rk,s,fi}$ | [kN] | 0,3 | 1,1 | 1,7 |
| | R60 | $N_{Rk,s,fi}$ | [kN] | 0,2 | 0,9 | 1,4 |
| | R90 | $N_{Rk,s,fi}$ | [kN] | 0,2 | 0,7 | 1,0 |
| | R120 | $N_{Rk,s,fi}$ | [kN] | 0,1 | 0,5 | 0,8 |
| **Characteristic resistance under shear load** | | | | | | |
| **Steel failure without lever arm** | | | | | | |
| Steel, property class 5.8 and 8.8; Stainless steel (A4 / HCR) property class 70 | R30 | $V^0_{Rk,s,fi}$ | [kN] | 0,3 | 1,1 | 1,7 |
| | R60 | $V^0_{Rk,s,fi}$ | [kN] | 0,2 | 0,9 | 1,4 |
| | R90 | $V^0_{Rk,s,fi}$ | [kN] | 0,2 | 0,7 | 1,0 |
| | R120 | $V^0_{Rk,s,fi}$ | [kN] | 0,1 | 0,5 | 0,8 |
| **Steel failure with lever arm – characteristic bending moment** | | | | | | |
| Steel, property class 5.8 and 8.8; Stainless steel (A4 / HCR) property class 70 | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 0,2 | 1,1 | 2,2 |
| | R60 | $M^0_{Rk,s,fi}$ | [Nm] | 0,2 | 0,9 | 1,8 |
| | R90 | $M^0_{Rk,s,fi}$ | [Nm] | 0,1 | 0,7 | 1,3 |
| | R120 | $M^0_{Rk,s,fi}$ | [Nm] | 0,1 | 0,5 | 1,0 |
| **Partial factor** | all | $\gamma_{Ms,fi}$ | [-] | 1,0 | | |

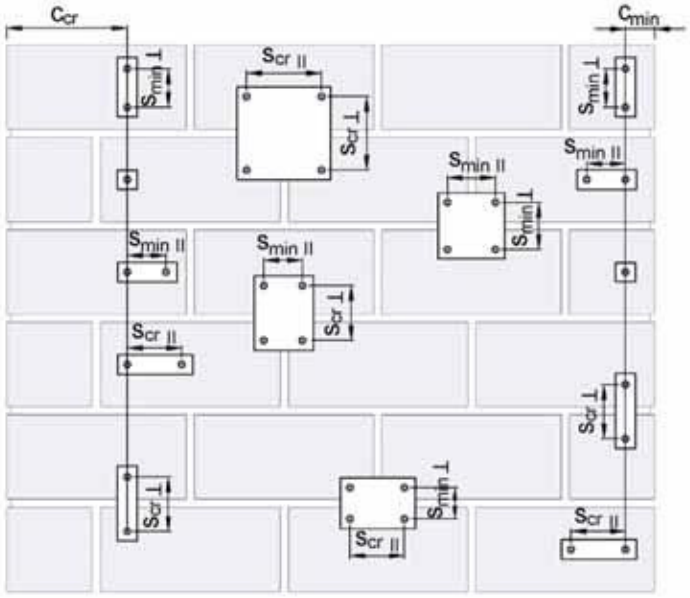
**Injection System VMU plus for masonry**

**Performance**
Characteristic steel resistance under **fire exposure**

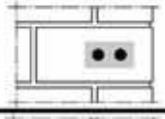
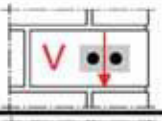
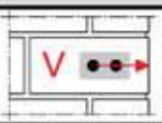
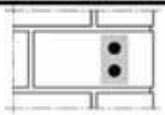
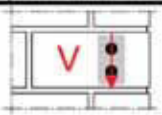
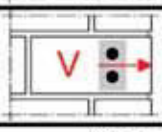
**Annex C4**

## Edge distance and spacing

| | | |
|---|---|---|
| $c_{cr}$ | = | Characteristic edge distance |
| $c_{min}$ | = | Minimum edge distance |
| $c_{cr,fi}$ | = | Characteristic edge distance under fire exposure |
| $s_{cr\,\parallel}$ ($s_{min,\parallel}$) | = | Characteristic (minimum) spacing for anchor placed parallel to horizontal joint |
| $s_{cr\,\perp}$ ($s_{min,\perp}$) | = | Characteristic (minimum) spacing for anchor placed perpendicular to horizontal joint |
| $s_{cr,fi,\parallel}$ ($s_{cr,fi,\perp}$) | = | Characteristic spacing for anchor placed perpendicular to horizontal (perpendicular) joint |




## Definition of reduction- and group factors

| Load direction / Anchor position | Tension load | Shear load parallel to free edge $V_{\parallel}$ | Shear load perpendicular to free edge $V_{\perp}$ |
|---|---|---|---|
| Anchors parallel to horizontal joint $s_{cr,\parallel}$ ($s_{min,\parallel}$) |  $\alpha_{g\,\parallel,N}$ |  $\alpha_{g\,\parallel,V\,\parallel}$ |  $\alpha_{g\,\parallel,V\,\perp}$ |
| Anchors vertical to horizontal joint $s_{cr\,\perp}$ ($s_{min,\perp}$) |  $\alpha_{g\,\perp,N}$ |  $\alpha_{g\,\perp,V\,\parallel}$ |  $\alpha_{g\,\perp,V\,\perp}$ |

| | | | |
|---|---|---|---|
| $\alpha_{edge,N}$ | = | Reduction factor for tension loads at the free edge (single anchor) | (for $c_{min} \le c < c_{cr}$) |
| $\alpha_{edge,V\perp}$ | = | Reduction factor for shear loads perpendicular to the free edge (single anchor) | (for $c_{min} \le c < c_{cr}$) |
| $\alpha_{edge,V\parallel}$ | = | Reduction factor for shear loads parallel to the free edge (single anchor) | (for $c_{min} \le c < c_{cr}$) |
| $\alpha_{g\,\parallel,N}$ | = | Group factor for anchors parallel to horizontal joint under tension load | |
| $\alpha_{g\,\perp,N}$ | = | Group factor for anchors perpendicular to horizontal joint under tension load | |
| $\alpha_{g\,\parallel,V\,\parallel}$ | = | Group factor for anchors parallel to horizontal joint under shear load parallel to the free edge | |
| $\alpha_{g\,\perp,V\,\parallel}$ | = | Group factor for anchors perpendicular to horizontal joint under shear load parallel to the free edge | |
| $\alpha_{g\,\parallel,V\,\perp}$ | = | Group factor for anchors parallel to horizontal joint under shear load perpendicular to the free edge | |
| $\alpha_{g\,\perp,V\perp}$ | = | Group factor for anchors perpendicular to hor. joint under shear load perpendicular to the free edge | |

| | | | | | |
|---|---|---|---|---|---|
| Single anchor at the edge: | $N_{Rk,b,c} = \alpha_{edge,N} * N_{Rk,b}$ | | resp. | $N_{Rk,p,c} = \alpha_{edge,N} * N_{Rk,p}$ | |
| | $V_{Rk,c\,\parallel} = \alpha_{edge,V\,\parallel} * V_{Rk,b}$ | | | | |
| | $V_{Rk,c\,\perp} = \alpha_{edge,V\,\perp} * V_{Rk,b}$ | | | | |
| Group of 2 anchors: | $N^{g}_{Rk} = \alpha_{g,N} * N_{Rk,b}$ | | | | |
| | $V^{g}_{Rk\,\parallel} = \alpha_{g,V\,\parallel} * V_{Rk,b}$ | | resp. | $V^{g}_{Rk\,\perp} = \alpha_{g,V\,\perp} * V_{Rk,b}$ | (for $c \ge c_{cr}$) |
| | $V^{g}_{Rk,c\,\parallel} = \alpha_{g,V\,\parallel} * V_{Rk,b}$ | | resp. | $V^{g}_{Rk,c\,\perp} = \alpha_{g,V\,\perp} * V_{Rk,b}$ | (for $c \ge c_{min}$) |
| Group of 4 anchors: | $N^{g}_{Rk} = \alpha_{g\,\parallel,N} * \alpha_{g\,\perp,N} * N_{Rk,b}$ | | | | |
| | $V^{g}_{Rk\,\parallel} = \alpha_{g\,\parallel,V\,\parallel} * \alpha_{g\,\perp,V\,\parallel} * V_{Rk,b}$ | | resp. | $V^{g}_{Rk\,\perp} = \alpha_{g\,\parallel,V\,\perp} * \alpha_{g\,\perp,V\,\perp} * V_{Rk,b}$ | (for $c \ge c_{cr}$) |
| | $V^{g}_{Rk,c\,\parallel} = \alpha_{g\,\parallel,V\,\parallel} * \alpha_{g\,\perp,V\,\parallel} * V_{Rk,b}$ | | resp. | $V^{g}_{Rk,c\,\perp} = \alpha_{g\,\parallel,V\,\perp} * \alpha_{g\,\perp,V\,\perp} * V_{Rk,b}$ | (for $c \ge c_{min}$) |

Equations depend on anchor position and load direction (see table above). Reduction factor, group factor and resistances see Annex C. Reduction for installation in joints see Annex B1.

**Injection System VMU plus for masonry**

**Performance**
Definition of spacing and edge distance and reduction- and group factors α

**Annex C5**

## Brick type: Autoclaved aerated concrete AAC

### Table C6: Description

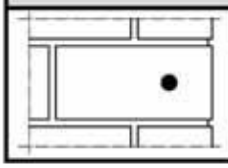
| Brick type | | | Autoclaved aerated concrete AAC |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | 0,35 – 0,6 |
| Normalised mean compressive strength | $f_b \geq$ | [N/mm²] | 2, 4 or 6 |
| Norm | | [-] | EN 771-4:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Porit (DE) |
| Brick dimensions | | [mm] | ≥ 499 x 240 x 249 |
| Drilling method | | [-] | Rotary drilling |

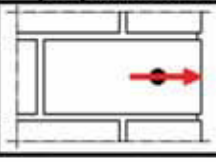


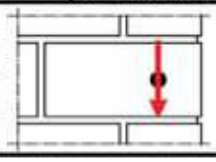
### Table C7: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 5 | ≤ 5 | ≤ 10 | ≤ 10 | ≤ 5 | ≤ 5 | ≤ 10 |
| Edge distance | $c_{cr}$ | [mm] | 150 (for shear loads perpendicular to the free edge: $c_{cr}$ = 210) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 300 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 250 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ | [mm] | 50 | | | | | | |
| | $s_{min,\perp}$ | [mm] | | | | | | | |

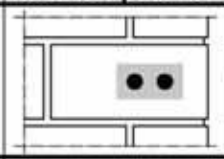
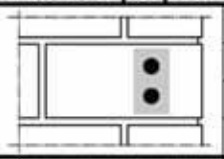
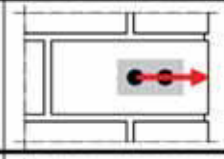
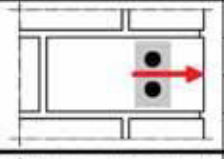
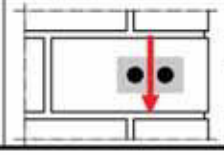
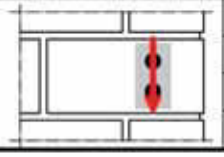
### Table C8: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load parallel to the free edge | |
|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | with c ≥ | $\alpha_{edge,V\perp}$ | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 50 | 0,85 | 50 | 0,12 | 50 | 0,70 |
| | | | 125 | 0,50 | 125 | 0,85 |
| | 150 | 1,00 | 210 | 1,00 | 150 | 1,00 |





### Table C9: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| Tension load |  | with c ≥ | with s ≥ | $\alpha_{g\parallel,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,10 | | 50 | 50 | 0,75 |
| | | 150 | 50 | 1,25 | | 150 | 50 | 0,90 |
| | | 1500,56 | 300 | 2,00 | | 150 | 250 | 2,00 |
| Shear load perpendicular to the free edge |  | with c ≥ | with s ≥ | $\alpha_{g\parallel,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,20 | | 50 | 50 | 0,25 |
| | | 210 | 50 | 1,60 | | 210 | 50 | 1,80 |
| | | 210 | 300 | 2,00 | | 210 | 250 | 2,00 |
| Shear load parallel to the free edge |  | With c ≥ | with s ≥ | $\alpha_{g\parallel,V\parallel}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\parallel}$ |
| | | 50 | 50 | 1,15 | | 50 | 50 | 0,80 |
| | | 150 | 50 | 1,60 | | 150 | 50 | 1,10 |
| | | 150 | 300 | 2,00 | | 150 | 250 | 2,00 |

**Injection System VMU plus for masonry**

**Performances - Autoclaved aerated concrete AAC**
Description, installation parameters, reduction- and group factors

**Annex C6**

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## Brick type: Autoclaved aerated concrete AAC - continuation

**Table C10: Characteristic resistance under tension and shear load**

| Anchor size | Perforated Sleeve | Effective anchorage depth | Characteristic resistance with $c \geq c_{cr}$ and $s \geq s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 2$ N/mm² Density $\rho \geq 0{,}35$ kg/dm³** | | | | | | | | | |
| M8 | - | 80 | 1,2 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 1,5 |
| M10 / IG-M6 | - | 90 | 1,2 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 2,5 |
| M12 / M16 IG-M8 / IG-M10 | - | 100 | 2,0 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 2,5 |
| M8 | VM-SH 12 | 80 | 1,2 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 1,5 |
| M8 / M10 IG-M6 | VM-SH 16 | ≥ 85 | 1,2 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 2,5 |
| M12 / M16 IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | 2,0 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 2,5 |
| **Normalised mean compressive strength $f_b \geq 4$ N/mm² Density $\rho \geq 0{,}50$ kg/dm³** | | | | | | | | | |
| M8 | - | 80 | 3,0 | 2,5 | 2,0 | 2,5 | 2,0 | 2,0 | 4,5 |
| M10 / IG-M6 | - | 90 | 3,0 | 2,5 | 2,0 | 2,5 | 2,0 | 2,0 | 7,5 |
| M12 / M16 IG-M8 / IG-M10 | - | 100 | 5,0 | 4,5 | 4,0 | 4,5 | 4,0 | 4,0 | 7,5 |
| M8 | VM-SH 12 | 80 | 3,0 | 2,5 | 2,0 | 2,5 | 2,0 | 2,0 | 4,5 |
| M8 / M10 IG-M6 | VM-SH 16 | ≥ 85 | 3,0 | 2,5 | 2,0 | 2,5 | 2,0 | 2,0 | 7,5 |
| M12 / M16 IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | 5,0 | 4,5 | 4,0 | 4,5 | 4,0 | 4,0 | 7,5 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\,\perp}$ according to Annex C5

**Injection System VMU plus for masonry**

**Performances - Autoclaved aerated concrete AAC**
Characteristic resistance

**Annex C7**

Deutsches Institut für Bautechnik DIBt

## Brick type: Autoclaved aerated concrete AAC - continuation

### Characteristic resistance - continuation:

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with $c \geq c_{cr}$ and $s \geq s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 6$ N/mm² Density $\rho \geq 0{,}60$ kg/dm³** | | | | | | | | | |
| M8 | - | 80 | 4,0 | 3,5 | 3,0 | 3,5 | 3,0 | 3,0 | 6,0 |
| M10 / IG-M6 | - | 90 | 4,0 | 3,5 | 3,0 | 3,5 | 3,0 | 3,0 | 10,0 |
| M12 / M16 IG-M8 / IG-M10 | - | 100 | 7,0 | 6,0 | 5,5 | 6,5 | 5,5 | 5,5 | 10,0 |
| M8 | VM-SH 12 | 80 | 4,0 | 3,5 | 3,0 | 3,5 | 3,0 | 3,0 | 6,0 |
| M8 / M10 IG-M6 | VM-SH 16 | ≥ 85 | 4,0 | 3,5 | 3,0 | 3,5 | 3,0 | 3,0 | 10,0 |
| M12 / M16 IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | 7,0 | 6,0 | 5,5 | 6,5 | 5,5 | 5,5 | 10,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

### Table C11: Displacements

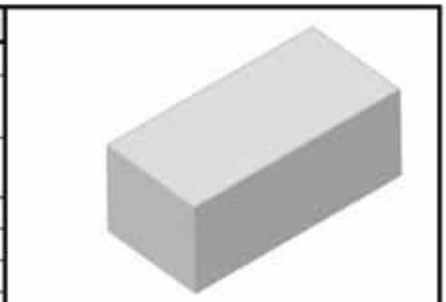
| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,1 | $0{,}1 \cdot N_{Rk} / 2{,}8$ | $2 \cdot \delta_{N0}$ | 0,3 | $0{,}3 \cdot V_{Rk} / 2{,}8$ | $1{,}5 \cdot \delta_{V0}$ |
| M16 | | | | | 0,1 | $0{,}1 \cdot V_{Rk} / 2{,}8$ | |

| Injection System VMU plus for masonry | Annex C8 |
|---|---|
| **Performances - Autoclaved aerated concrete AAC**<br>Characteristic resistance and displacements | |

## Brick type: Solid calcium silica brick KS-NF

### Table C12: Description

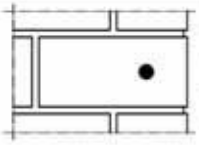
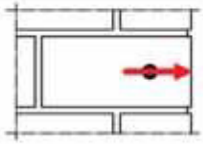
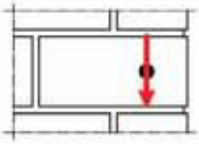
| Brick type | | | Solid calcium silica brick KS-NF |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 2,0 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 28 |
| Conversion factor for lower compressive strengths | | | $(f_b / 28)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-2: 2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Wemding (DE) |
| Brick dimensions | | [mm] | ≥ 240 x 115 x 71 |
| Drilling method | | [-] | Hammer drilling |



### Table C13: Installation parameter

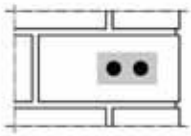
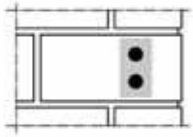
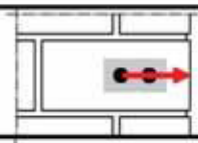
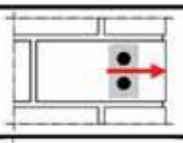
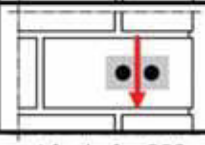
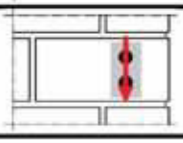
| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 10 | ≤ 10 | ≤ 15 | ≤ 15 | ≤ 10 | ≤ 10 | ≤ 10 |
| Edge distance (under fire exposure) | $c_{cr}$; ($c_{cr,fi}$) | [mm] | 150 (2 $h_{ef}$) (for shear loads perpendicular to the free edge: $c_{cr}$ = 240) | | | | | | |
| Minimum Edge Distance | $c_{min}$ | [mm] | 60 | | | | | | |
| Spacing (under fire exposure) | $s_{cr,II}$; ($s_{cr,fi,II}$) | [mm] | 240 (4 $h_{ef}$) | | | | | | |
| | $s_{cr,\perp}$; ($s_{cr,fi,\perp}$) | [mm] | 150 (4 $h_{ef}$) | | | | | | |
| Minimum Spacing | $s_{min,II}$; $s_{min,\perp}$ | [mm] | 75 | | | | | | |

### Table C14: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load parallel to the free edge | |
|---|---|---|---|---|---|---|
|  | with c ≥ | $\alpha_{edge,N}$ |  | with c ≥ | $\alpha_{edge,V\perp}$ |  | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 60[1] | 0,50 | | 60 | 0,30 | | 60 | 0,60 |
| | 100[1] | 0,50 | | 100 | 0,50 | | 100 | 1,00 |
| | 150[1] | 1,00 | | 240 | 1,00 | | 150 | 1,00 |
| | 180 | 1,00 | | | | | | |

[1] All applications, except for hef = 200mm and without sleeve

### Table C15: Factors for anchor groups

| Position parallel to horizontal joint | | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| Tension load |  | with c ≥ | with s ≥ | $\alpha_{g\parallel,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 60[1] | 75 | 0,70 | | 60[1] | 75 | 1,15 |
| | | 150[1] | 75 | 1,40 | | 150[1] | 75 | 2,00 |
| | | 150[1] | 240 | 2,00 | | 150[1] | 150 | 2,00 |
| | | 180[2] | 75 | 1,00 | | 180[2] | 75 | 1,15 |
| | | 180[2] | 240 | 1,70 | | 180[2] | 150 | 2,00 |
| | | 240[2] | 240 | 2,00 | | | | |
| Shear load perpendicular to the free edge |  | with c ≥ | with s ≥ | $\alpha_{g\parallel,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 60 | 75 | 0,75 | | 60 | 75 | 0,90 |
| | | 150 | 75 | 2,00 | | 150 | 75 | 2,00 |
| | | 150 | 250 | 2,00 | | 150 | 150 | 2,00 |
| Shear load parallel to the free edge |  | with c ≥ | with s ≥ | $\alpha_{g\parallel,V\parallel}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\parallel}$ |
| | | 60 | 75 | 2,00 | | 60 | 75 | 2,00 |
| | | 150 | 75 | 2,00 | | 150 | 75 | 2,00 |
| | | 150 | 250 | 2,00 | | 150 | 150 | 2,00 |

[1] All applications, except for hef = 200mm and without sleeve
[2] Only for application with $h_{ef}$ = 200mm and without sleeve

**Injection System VMU plus for masonry**

**Performance - Solid calcium silica brick KS-NF**
Description, installation parameters, reduction- and group factors

**Annex C9**

## Brick type: Solid calcium silica brick KS-NF – continuation

### Table C16: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with $c \geq c_{cr}$ and $s \geq s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 28$ N/mm² [2]** | | | | | | | | | |
| M8 | - | 80 | 7,0 | 6,5 | 5,0 | 6,0 | 5,5 | 4,0 | 7,0 |
| M10 / IG-M6 | - | ≥ 90 | 7,0 | 6,5 | 5,0 | 6,0 | 5,5 | 4,0 | |
| M12 / IG-M8 | - | ≥ 100 | 7,0 | 6,5 | 5,0 | 6,0 | 5,5 | 4,0 | |
| M16 / IG-M10 | - | ≥ 100 | 7,0 | 6,5 | 5,0 | 7,0 | 6,5 | 5,0 | |
| M10 - M16 IG-M6 - IG-M10 | - | 200 | 9,0 | 8,5 | 6,5 | 5,5 | 5,0 | 4,0 | |
| M8 | VM-SH 12 | 80 | 7,0 | 6,5 | 5,0 | 6,0 | 5,5 | 4,0 | |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | 7,0 | 6,5 | 5,0 | 7,0 | 6,5 | 5,0 | |
| M12 / M16 IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | 7,0 | 6,5 | 5,0 | 7,0 | 6,5 | 5,0 | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\,\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C12. For stones with higher strengths, the shown values are valid without conversion.

### Table C17: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,1 | $0,1*N_{Rk} / 3,5$ | $2*\delta_{N0}$ | 0,3 | $0,3*V_{Rk} / 3,5$ | $1,5*\delta_{V0}$ |
| M16 | | | | | 0,1 | $0,1*V_{Rk} / 3,5$ | |

### Table C18: Characteristic resistance under fire exposure

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance $N_{Rk,b,fi} = N_{Rk,p,fi} = V_{Rk,b,fi}$ | | | |
|---|---|---|---|---|---|---|
| | | $h_{ef}$ | R30 | R60 | R90 | R120 |
| | | [mm] | [kN] | | | |
| M8 | - | 80 | 0,48 | 0,41 | 0,34 | 0,30 |
| M10 / IG-M6 | - | ≥ 90 | | | | |
| M12 / IG-M8 | - | ≥ 100 | | | | |
| M16 / IG-M10 | - | ≥ 100 | | | | |
| M8 | VM-SH 12 | 80 | 0,47 | 0,26 | No performance assessed | No performance assessed |
| M8 / M10 / IG-M6 | VM-SH 16 | ≥ 85 | | | | |
| M12 / M16 IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | | | | |

**Injection System VMU plus for masonry**

**Performance**
Characteristic resistance, displacements, characteristic resistance under fire exposure

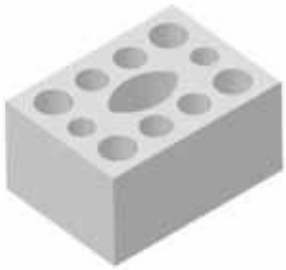
**Annex C10**

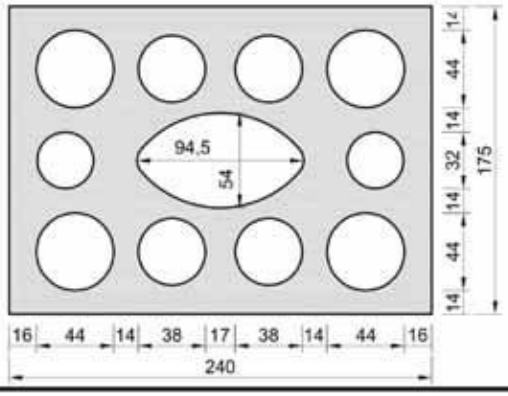
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## Brick type: Hollow calcium silica brick KSL-3DF

### Table C19: Description

| Brick type | | | Hollow calcium silica brick KSL-3DF |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 1,4 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 14 |
| Conversion factor for lower compressive strengths | | | $(f_b / 14)^{0,75} \leq 1,0$ |
| Norm | | [-] | EN 771-2:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. KS-Wemding (DE) |
| Brick dimensions | | [mm] | ≥ 240 x 175 x 113 |
| Drilling method | | [-] | Rotary drilling |






### Table C20: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 5 | ≤ 5 | ≤ 8 | ≤ 8 | ≤ 5 | ≤ 8 | ≤ 8 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 240) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 60 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 240 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 120 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$; $s_{min,\perp}$ | [mm] | 120 | | | | | | |

### Table C21: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load parallel to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 60 | 1,00 | | 60 | 0,30 | | 60 | 1,00 |
| | 120 | 1,00 | | 240 | 1,00 | | 120 | 1,00 |

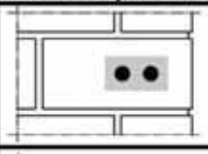
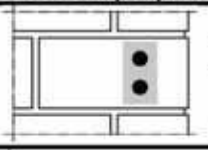
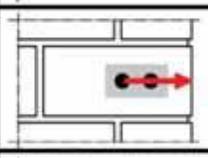
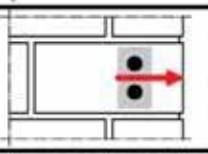
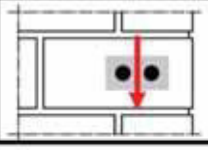
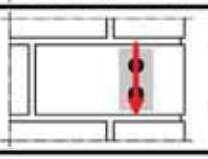
**Injection System VMU plus for masonry**

**Performances - Hollow calcium silica brick KSL-3DF**
Description, installation parameters, reduction factors

**Annex C11**

## Brick type: Hollow calcium silica brick KSL-3DF – continuation

### Table C22: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 60 | 120 | 1,50 | | 60 | 120 | 1,00 |
| | | 120 | 120 | 2,00 | | 60 | 120 | 1,00 |
| | | 120 | 240 | 2,00 | | 120 | 120 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 60 | 120 | 0,30 | | 60 | 120 | 0,30 |
| | | 120 | 120 | 1,00 | | 60 | 120 | 0,30 |
| | | 120 | 240 | 2,00 | | 240 | 120 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 60 | 120 | 1,00 | | 60 | 120 | 1,00 |
| | | 120 | 120 | 1,60 | | | | |
| | | 120 | 240 | 2,00 | | 120 | 120 | 2,00 |

### Table C23: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 14$ N/mm² [2]** | | | | | | | | | |
| M8 / M10 IG-M6 | VM-SH 16 | ≥ 85 | 2,5 | 2,5 | 1,5 | 2,5 | 2,5 | 1,5 | 6,0 |
| | | 130 | 2,5 | 2,5 | 2,0 | 2,5 | 2,5 | 2,0 | |
| M12 / M16 IG-M8 IG-M10 | VM-SH 20 | ≥ 85 | 6,5 | 6,0 | 4,5 | 6,5 | 6,0 | 4,5 | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5
[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C19. For stones with higher strengths, the shown values are valid without conversion.

### Table C24: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performance - Hollow calcium silica brick KSL-3DF**
Group factors, characteristic resistances and displacements

**Annex C12**

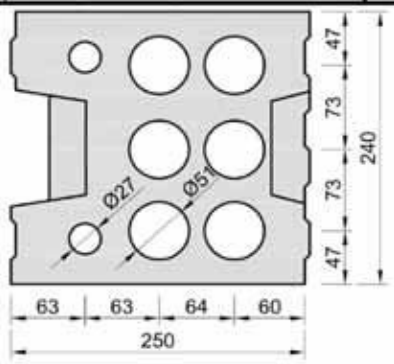
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## Brick type: Hollow calcium silica brick KSL-8DF

### Table C25: Description

| Brick type | | | Hollow calcium silica brick KSL-8DF |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 1,4 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 12 |
| Conversion factor for lower compressive strengths | | | $(f_b / 12)^{0,75} \leq 1,0$ |
| Norm | | [-] | EN 771-2:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. KS-Wemding (DE) |
| Brick dimensions | | [mm] | ≥ 248 x 240 x 238 |
| Drilling method | | [-] | Rotary drilling |






### Table C26: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 5 | ≤ 5 | ≤ 8 | ≤ 8 | ≤ 5 | ≤ 8 | ≤ 8 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 250 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 120 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C27: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 50 | 1,00 | | 50 | 0,30 | | 50 | 1,00 |
| | 120 | 1,00 | | 250 | 1,00 | | 120 | 1,00 |

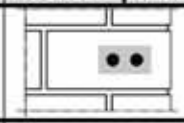
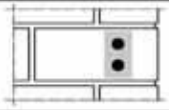
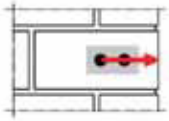
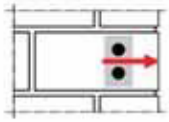
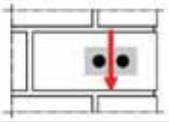
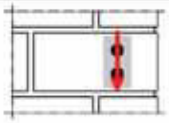
**Injection System VMU plus for masonry**

**Performances - Hollow calcium silica brick KSL-8DF**
Description, installation parameters, reduction factors

**Annex C13**

## Brick type: Hollow calcium silica brick KSL-8DF – continuation

### Table C28: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\,\perp,N}$ |
| | | 50 | 50 | 1,00 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 120 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,45 | | 50 | 50 | 0,45 |
| | | 250 | 50 | 1,15 | | 250 | 50 | 1,20 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,30 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C29: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 12$ N/mm² [2]** | | | | | | | | | |
| M8 / M10 IG-M6 | VM-SH 16 | 130 | 5,0 | 4,5 | 3,5 | 5,0 | 4,5 | 3,5 | 3,5 |
| M12 / M16 IG-M8 IG-M10 | VM-SH 20 | ≥ 130 | 5,0 | 4,5 | 3,5 | 5,0 | 4,5 | 3,5 | 6,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\,\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C25. For stones with higher strengths, the shown values are valid without conversion.

### Table C30: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances - Hollow calcium silica brick KSL-8DF**
Group factors, characteristic resistances and displacements

**Annex C14**

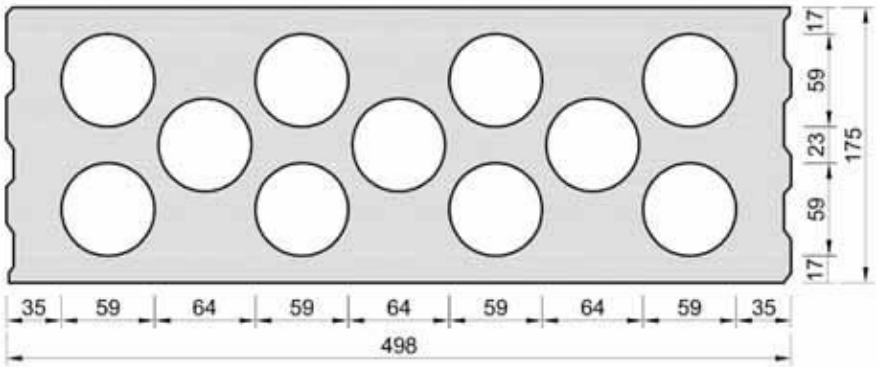
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## Brick type: Hollow calcium silica brick KSL-12DF

### Table C31: Description

| Brick type | | | Hollow calcium silica brick KSL-12DF |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 1,4 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 12 |
| Conversion factor for lower compressive strengths | | | $(f_b / 12)^{0,75} \leq 1,0$ |
| Norm | | [-] | EN 771-2:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. KS-Wemding (DE) |
| Brick dimensions | | [mm] | ≥ 498 x 175 x 238 |
| Drilling method | | [-] | Rotary drilling |






### Table C32: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 4 | ≤ 4 | ≤ 5 | ≤ 5 | ≤ 4 | ≤ 5 | ≤ 5 |
| Edge distance (under fire exposure) | $c_{cr}$; ($c_{cr,fi}$) | [mm] | 120 (2 $h_{ef}$) (for shear loads perpendicular to the free edge: $c_{cr}$ = 500) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing (under fire exposure) | $s_{cr,II}$; ($s_{cr,fi,II}$) | [mm] | 500 (4 $h_{ef}$) | | | | | | |
| | $s_{cr,\perp}$; ($s_{cr,fi,\perp}$) | [mm] | 120 (4 $h_{ef}$) | | | | | | |
| Minimum spacing | $s_{min,II}$; $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C33: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load parallel to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\,II}$ |
| | 50 | 1,00 | | 50 | 0,45 | | 50 | 1,00 |
| | 120 | 1,00 | | 500 | 1,00 | | 120 | 1,00 |

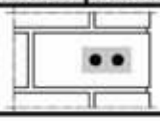
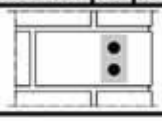
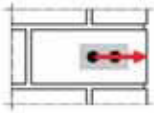
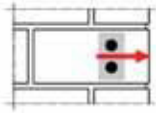
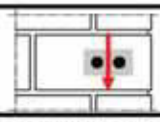
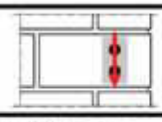
**Injection System VMU plus for masonry**

**Performance - - Hollow calcium silica brick KSL-12DF**
Description, installation parameters, reduction factors

**Annex C15**

## Brick type: Hollow calcium silica brick KSL-12DF – continuation

### Table C34: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\,\perp,N}$ |
| | | 50 | 50 | 1,50 | | 50 | 50 | 1,00 |
| | | 120 | 500 | 2,00 | | 120 | 240 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\,\perp,V\perp}$ |
| | | 50 | 50 | 0,55 | | 50 | 50 | 0,50 |
| | | 500 | 50 | 1,00 | | 500 | 50 | 1,00 |
| | | 500 | 500 | 2,00 | | 500 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\,\perp,V\,II}$ |
| | | 50 | 50 | 2,00 | | 50 | 50 | 1,30 |
| | | 120 | 500 | 2,00 | | 120 | 250 | 2,00 |

### Table C35: Characteristic resistance under tension and shear load

| Anchor size | Sleeve VM-SH | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 12$ N/mm² [2]** | | | | | | | | | |
| M8 / M10 IG-M6 | VM-SH 16 | 130 | 3,5 | 3,5 | 2,5 | 3,5 | 3,5 | 2,5 | 3,5 |
| M12 / M16 IG-M8 / IG-M10 | VM-SH 20 | ≥ 130 | 3,5 | 3,5 | 2,5 | 3,5 | 3,5 | 2,5 | 7,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\,\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C31. For stones with higher strengths, the shown values are valid without conversion.

### Table C36: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

### Table C37: Characteristic resistance under fire exposure

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance $N_{Rk,b,fi} = N_{Rk,p,fi} = V_{Rk,b,fi}$ | | | |
|---|---|---|---|---|---|---|
| | | $h_{ef}$ | R30 | R60 | R90 | $h_{ef}$ |
| | | [mm] | [kN] | | | |
| M8/M10/IG-M6 | VM-SH 16 | 130 | 0,37 | 0,27 | 0,17 | no performance assessed |
| M12/ IG-M8 | VM-SH 20 | ≥ 130 | | | | |
| M16/IG-M10 | VM-SH 20 | ≥ 130 | | | | 0,12 |

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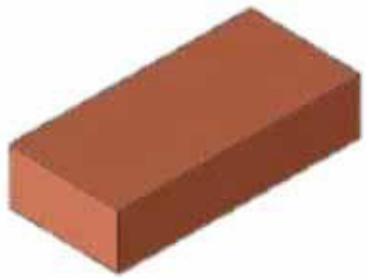
**Performances - Hollow calcium silica brick KSL-12DF**
Group factors, characteristic resistances and displacements

**Annex C16**

## Brick type: Solid clay brick MZ-1DF

### Table C38: Description

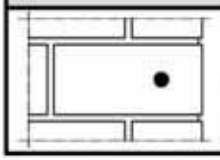
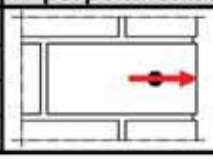
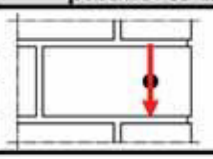
| Brick type | | | Solid clay brick MZ-1DF |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 2,0 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 20 |
| Conversion factor for lower compressive strengths | | | $(f_b / 20)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Wienerberger (DE) |
| Brick dimensions | | [mm] | ≥ 240 x 115 x 55 |
| Drilling method | | [-] | Hammer drilling |



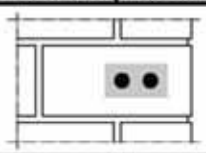
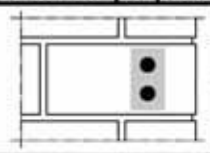
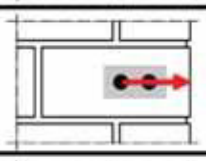
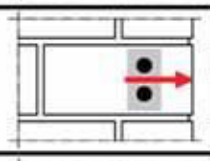
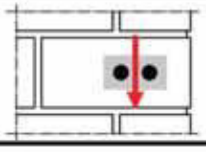
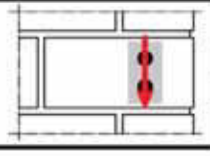
### Table C39: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 10 | ≤ 10 | ≤ 10 | ≤ 10 | ≤ 10 | ≤ 10 | ≤ 10 |
| Edge distance | $c_{cr}$ | [mm] | 150 (for shear loads perpendicular to the free edge: $c_{cr}$ = 240) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 60 | | | | | | |
| Spacing | $s_{cr,II}$ | [mm] | 240 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 130 | | | | | | |
| Minimum spacing | $s_{min,II}$, $s_{min,\perp}$ | [mm] | 65 | | | | | | |

### Table C40: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load parallel to the free edge | | |
|---|---|---|---|---|---|---|---|---|
|  | with c ≥ | $\alpha_{edge,N}$ |  | with c ≥ | $\alpha_{edge,V\perp}$ |  | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 60 | 0,75 | | 60 | 0,10 | | 60 | 0,30 |
| | 150 | 1,00 | | 100 | 0,50 | | 100 | 0,65 |
| | 180 | 1,00 | | 240 | 1,00 | | 150 | 1,00 |

### Table C41: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\parallel,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 60 | 65 | 0,85 | | 60 | 65 | 1,00 |
| | | 150 | 65 | 1,15 | | 150 | 65 | 1,20 |
| | | 150 | 240 | 2,00 | | 150 | 130 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\parallel,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 60 | 65 | 0,40 | | 60 | 65 | 0,30 |
| | | 240 | 65 | 2,00 | | 240 | 65 | 2,00 |
| | | 240 | 240 | 2,00 | | 240 | 130 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\parallel,V\parallel}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\parallel}$ |
| | | 60 | 65 | 1,75 | | 60 | 65 | 1,10 |
| | | 150 | 65 | 2,00 | | 150 | 65 | 2,00 |
| | | 150 | 240 | 2,00 | | 150 | 130 | 2,00 |

**Injection System VMU plus for masonry**

**Performances – Solid clay brick MZ-1DF**
Description, installation parameters, reduction factors

**Annex C17**

## Brick type: Solid clay brick MZ-1DF – continuation

### Table C42: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with $c \geq c_{cr}$ and $s \geq s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 20$ N/mm² [2]** | | | | | | | | | |
| M8 | - | 80 | 7,0 | 6,0 | 6,0 | 7,0 | 6,0 | 6,0 | 8,0 |
| M10 / IG-M6 | - | ≥ 90 | 7,0 | 6,0 | 6,0 | 7,0 | 6,0 | 6,0 | 8,0 |
| M12 / IG-M8 | - | ≥ 100 | 7,0 | 6,0 | 6,0 | 7,0 | 6,0 | 6,0 | 8,0 |
| M16 / IG-M10 | - | ≥ 100 | 8,0 | 6,5 | 6,5 | 8,0 | 6,5 | 6,5 | 12,0 |
| M8 | VM-SH 12 | 80 | 7,0 | 6,0 | 6,0 | 7,0 | 6,0 | 6,0 | 8,0 |
| M8 / M10 IG-M6 | VM-SH 16 | ≥ 85 | 7,0 | 6,0 | 6,0 | 7,0 | 6,0 | 6,0 | 8,0 |
| M12 IG-M8 | VM-SH 20 | ≥ 85 | 7,0 | 6,0 | 6,0 | 7,0 | 6,0 | 6,0 | 8,0 |
| M16 IG-M10 | VM-SH 20 | ≥ 85 | 8,0 | 6,5 | 6,5 | 8,0 | 6,5 | 6,5 | 12,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\,\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C38. For stones with higher strengths, the shown values are valid without conversion.

### Table C43: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,1 | $0,1*N_{Rk} / 3,5$ | $2*\delta_{N0}$ | 0,3 | $0,3*V_{Rk} / 3,5$ | $1,5*\delta_{V0}$ |
| M16 | | | | | 0,1 | $0,1*V_{Rk} / 3,5$ | |

**Injection System VMU plus for masonry**

**Performances - Solid clay brick MZ-1DF**
Characteristic resistance and displacements

**Annex C18**

## Brick type: Solid clay brick MZ-2DF

### Table C44: Description

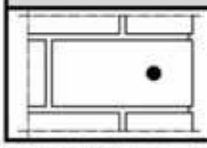
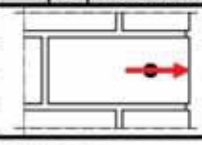
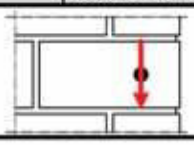
| Brick type | | | Solid clay brick MZ-2DF |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 2,0 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 28 |
| Conversion factor for lower compressive strengths | | | $(f_b / 28)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Wienerberger (DE) |
| Brick dimensions | | [mm] | ≥ 240 x 115 x 113 |
| Drilling method | | [-] | Hammer drilling |



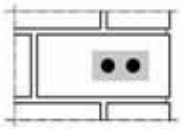
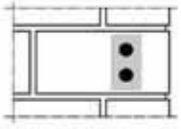
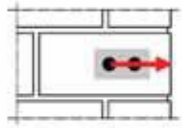
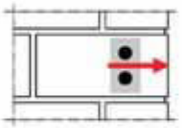
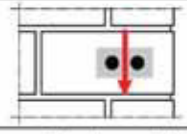
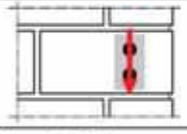
### Table C45: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 10 | ≤ 10 | ≤ 10 | ≤ 10 | ≤ 10 | ≤ 10 | ≤ 10 |
| Edge distance (under fire exposure) | $c_{cr,}$ ($c_{cr,fi}$) | [mm] | 150 (2 $h_{ef}$) (for shear loads perpendicular to the free edge: $c_{cr}$ = 240) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing (under fire exposure) | $s_{cr,II}$ ($s_{cr,fi,II}$) | [mm] | 240 (4 $h_{ef}$) | | | | | | |
| | $s_{cr,\perp}$ ($s_{cr,fi,\perp}$) | [mm] | 240 (4 $h_{ef}$) | | | | | | |
| Minimum spacing | $s_{min,II}$; $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C46: Reduction factors for single anchors at the edge

| Tension load | | | Shear load | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | perpendicular to the free edge | | | parallel to the free edge | | |
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\,II}$ |
|  | 50[1] | 1,00 |  | 50 | 0,20 |  | 50 | 1,00 |
| | 150[1] | 1,00 | | 125 | 0,50 | | | |
| | 150 | 1,00 | | 240 | 1,00 | | 150 | 1,00 |

### Table C47: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\,\perp,N}$ |
| | | 50[1] | 50 | 1,50 | | 50[1] | 50 | 0,80 |
| | | 150[1] | 240 | 2,00 | | 150[1] | 240 | 2,00 |
| | | 180[2] | 60 | 1,00 | | 180[2] | 60 | 1,00 |
| | | 180[2] | 240 | 1,55 | | 180[2] | 120 | 2,00 |
| | | 240[2] | 240 | 2,00 | | 180[2] | 120 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,40 | | 50 | 50 | 0,20 |
| | | 240 | 50 | 1,20 | | 240 | 50 | 0,60 |
| | | 240 | 240 | 2,00 | | 240 | 125 | 1,00 |
| | | | | | | 240 | 240 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,20 | | 50 | 50 | 1,00 |
| | | 150 | 240 | 2,00 | | 50 | 125 | 1,00 |
| | | | | | | 150 | 240 | 2,00 |

[1] All applications, except for $h_{ef}$ = 200mm and without sleeve (for Table C46 and C47)
[2] Only for application with $h_{ef}$ = 200mm and without sleeve

**Injection System VMU plus for masonry**

**Performances – Solid clay brick MZ-2DF**
Description, installation parameters, reduction- and group factors

**Annex C19**

## Brick type: Solid clay brick MZ-2DF – continuation

### Table C48: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with $c \geq c_{cr}$ and $s \geq s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 28$ N/mm² [2]** | | | | | | | | | |
| M8 | - | 80 | 9,0 | 9,0 | 7,5 | 9,0 | 9,0 | 7,5 | 9,5 |
| M10 / IG-M6 | - | ≥ 90 | 9,0 | 9,0 | 7,5 | 9,0 | 9,0 | 7,5 | 9,5 |
| M12 / IG-M8 | - | ≥ 100 | 9,0 | 9,0 | 7,5 | 9,0 | 9,0 | 7,5 | 12,0 |
| M16 / IG-M10 | - | ≥ 100 | 9,0 | 9,0 | 7,5 | 9,0 | 9,0 | 7,5 | 12,0 [3] |
| M10 / M12 IG-M6 / IG-M8 | - | 200 | 11,5 | 11,5 | 10,0 | 6,0 | 6,0 | 5,0 | 8,0 |
| M16 / IG-M10 | - | 200 | 11,5 | 11,5 | 10,0 | 6,0 | 6,0 | 5,0 | 12,0 |
| M8 | VM-SH 12 | 80 | 9,0 | 9,0 | 7,5 | 9,0 | 9,0 | 7,5 | 9,5 |
| M8 / M10 IG-M6 | VM-SH 16 | ≥ 85 | 9,0 | 9,0 | 7,5 | 9,0 | 9,0 | 7,5 | 9,5 |
| M12 / IG-M8 | VM-SH 20 | ≥ 85 | 9,0 | 9,0 | 7,5 | 9,0 | 9,0 | 7,5 | 12,0 |
| M16 / IG-M10 | VM-SH 20 | ≥ 85 | 9,0 | 9,0 | 7,5 | 9,0 | 9,0 | 7,5 | 12,0 [3] |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\,\perp}$ according to Annex C5
[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C44. For stones with higher strengths, the shown values are valid without conversion.
[3] Valid for all stone strengths with min. 10 N/mm²

### Table C49: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,1 | $0,1*N_{Rk} / 3,5$ | $2*\delta_{N0}$ | 0,3 | $0,3*V_{Rk} / 3,5$ | $1,5*\delta_{V0}$ |
| M16 | | | | | 0,1 | $0,1*V_{Rk} / 3,5$ | |

| Injection System VMU plus for masonry | |
|---|---|
| **Performance - Solid clay brick MZ-2DF**<br>Characteristic resistance and displacements | **Annex C20** |

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**Table C50: Characteristic resistance under fire exposure**

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance $N_{Rk,b,fi} = N_{Rk,p,fi} = V_{Rk,b,fi}$ | | | |
|---|---|---|---|---|---|---|
| | | $h_{ef}$ | R30 | R60 | R90 | R120 |
| | | [mm] | [kN] | | | |
| M8 | - | 80 | 0,51 | 0,44 | 0,36 | 0,33 |
| M10 / IG-M6 | - | ≥ 90 | | | | |
| M12 / IG-M8 | - | ≥ 100 | | | | |
| M16 / IG-M10 | - | ≥ 100 | | | | |
| M8 | VM-SH 12 | 80 | 0,36 | 0,26 | 0,15 | 0,10 |
| M8 / M10 / IG-M6 | VM-SH 16 | ≥ 85 | 0,36 | 0,26 | 0,15 | 0,10 |
| | | 130 | 0,92 | 0,74 | 0,57 | 0,49 |
| M12 / M16 IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | 0,36 | 0,26 | 0,15 | 0,10 |
| | | ≥ 130 | 0,92 | 0,74 | 0,57 | 0,49 |

**Injection System VMU plus for masonry**

**Performance - Solid clay brick MZ-2DF**
Characteristic resistance under fire exposure

**Annex C21**

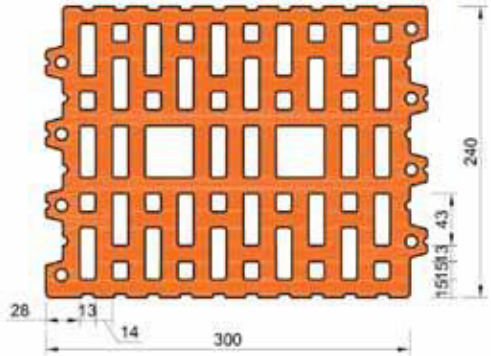
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## Brick type: Hollow clay brick HLZ-10 DF

### Table C51: Description

| Brick type | | | Hollow clay brick HLZ-10 DF |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 1,25 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 20 |
| Conversion factor for lower compressive strengths | | | $(f_b / 20)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Wienerberger (DE) |
| Brick dimensions | | [mm] | 300 x 240 x 249 |
| Drilling method | | [-] | Rotary drilling |

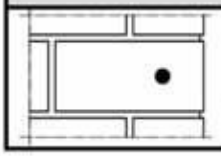
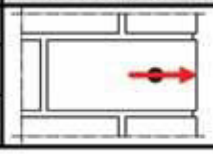
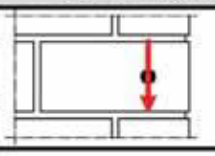





### Table C52: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 5 | ≤ 10 | ≤ 10 | ≤ 10 | ≤ 5 | ≤ 5 | ≤ 10 |
| Edge distance (under fire exposure) | $c_{cr}$; ($c_{cr,fi}$) | [mm] | 120 (2 $h_{ef}$) (for shear loads perpendicular to the free edge: $c_{cr}$ = 300) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Characteristic spacing (under fire exposure) | $s_{cr,II}$ ($s_{cr,fi,II}$) | [mm] | 300 (4 $h_{ef}$) | | | | | | |
| | $s_{cr,\perp}$ ($s_{cr,fi,\perp}$) | [mm] | 250 (4 $h_{ef}$) | | | | | | |
| Minimum spacing | $s_{min,II}$; $s_{min,\perp}$ | [mm] | 50 | | | | | | |

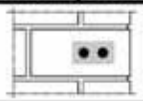
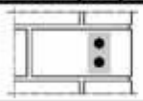
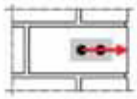
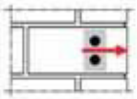
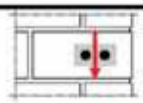
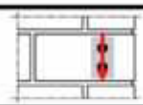
### Table C53: Reduction factors for single anchors at the edge

| Tension load | | | Shear load | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | perpendicular to the free edge | | | parallel to the free edge | | |
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\,II}$ |
|  | 50 | 1,00 |  | 50 | 0,20 |  | 50 | 1,00 |
| | 120 | 1,00 | | 300 | 1,00 | | 120 | 1,00 |

| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex C22** |
| **Performances – Hollow clay brick HLZ 10DF**<br>Description, installation parameters, reduction factors | |

## Brick type: Hollow clay brick HLZ-10 DF – continuation

### Table C54: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,55 | | 50 | 50 | 1,00 |
| | | 120 | 300 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,30 | | 50 | 50 | 0,20 |
| | | 300 | 50 | 1,40 | | 300 | 50 | 1,00 |
| | | 300 | 300 | 2,00 | | 300 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,85 | | 50 | 50 | 1,00 |
| | | 120 | 300 | 2,00 | | 120 | 250 | 2,00 |

### Table C55: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w | |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges | |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] | |
| | | [mm] | [kN] | | | | | | [kN] | |
| **Normalised mean compressive strength $f_b \geq 20$ N/mm² [2]** | | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 2,5 | 2,5 | 2,0 | 2,5 | 2,5 | 2,0 | 8,0 | |
| M8 / M10 /IG-M6 | VM-SH 16 | ≥ 85 | 2,5 | 2,5 | 2,0 | 2,5 | 2,5 | 2,0 | 8,0 | |
| M12 / IG-M8 | VM-SH 20 | ≥ 85 | 5,0 | 5,0 | 4,5 | 5,0 | 5,0 | 4,5 | 8,0 | |
| M16 / IG-M10 | VM-SH 20 | ≥ 85 | 5,0 | 5,0 | 4,5 | 5,0 | 5,0 | 4,5 | 11,5 | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C51. For stones with higher strengths, the shown values are valid without conversion.

### Table C56: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

### Table C57: Characteristic resistance under fire exposure

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance $N_{Rk,b,fi} = N_{Rk,p,fi} = V_{Rk,b,fi}$ | | | |
|---|---|---|---|---|---|---|
| | | $h_{ef}$ | R30 | R60 | R90 | R120 |
| | | [mm] | [kN] | | | |
| M8 / M10 / IG-M6 | VM-SH 16 | 130 | 0,57 | 0,39 | 0,21 | 0,12 |
| M12 / M16 IG-M8 / IG-M10 | VM-SH 20 | ≥ 130 | | | | |

**Injection System VMU plus for masonry**

**Performances – Hollow clay brick HLZ 10DF**
Group factors, characteristic resistance and displacements

**Annex C23**

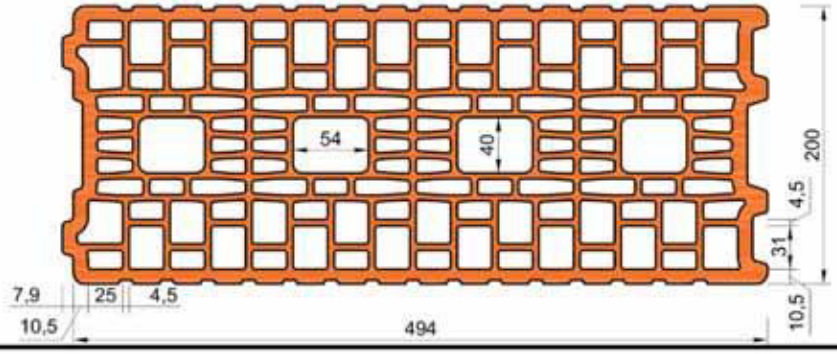
Deutsches Institut für Bautechnik DIBt

## Brick type: Hollow clay brick Porotherm Homebric

### Table C58: Description

| Brick type | | | Hollow clay brick Porotherm Homebric |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 0,70 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 10 |
| Conversion factor for lower compressive strengths | | | $(f_b / 10)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Wienerberger (FR) |
| Brick dimensions | | [mm] | 500 x 200 x 299 |
| Drilling method | | [-] | Rotary drilling |

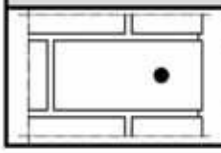
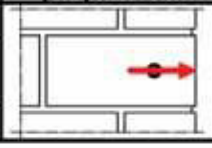
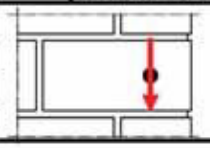





### Table C59: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 500) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 120 | | | | | | |
| Spacing | $s_{cr,II}$ | [mm] | 500 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 300 | | | | | | |
| Minimum spacing | $s_{min,II}$<br>$s_{min,\perp}$ | [mm] | 120 | | | | | | |

### Table C60: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load parallel to the free edge | |
|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | with c ≥ | $\alpha_{edge,V\perp}$ | with c ≥ | $\alpha_{edge,V\,II}$ |
|  | 120 | 1,00 | 120 | 0,30 | 120 | 0,60 |
| | 120 | 1,00 | 250 | 0,60 | | |
|  | | | 500 | 1,00 | | |
|  | | | | | 200 | 1,00 |

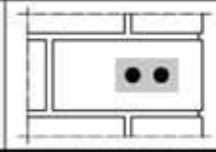
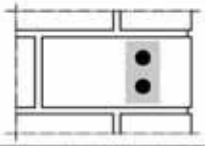
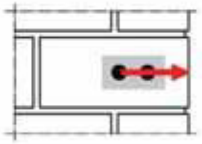
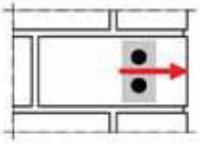
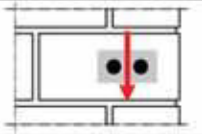
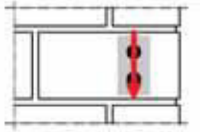
**Injection System VMU plus for masonry**

**Performances – Hollow clay brick Porotherm Homebric**
Description, installation parameters, reduction factors

**Annex C24**

## Brick type: Hollow clay brick Porotherm Homebric – continuation

### Table C61: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 200 | 100 | 2,00 | | 200 | 100 | 1,20 |
| | | 120 | 500 | 2,00 | | 120 | 300 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 120 | 100 | 0,30 | | 120 | 100 | 0,30 |
| | | 250 | 100 | 0,60 | | 250 | 100 | 0,60 |
| | | 500 | 100 | 1,00 | | 120 | 300 | 2,00 |
| | | 120 | 500 | 2,00 | | | | |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 120 | 500 | 2,00 | | 120 | 300 | 2,00 |

### Table C62: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 10$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 1,2 | | | | | | 3,0 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | 1,2 | | | | | | 3,0 |
| | | 130 | 1,5 | | | | | | 3,5 |
| M12 / M16/ IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | 1,2 | | | | | | 4,0 |
| | | ≥ 130 | 1,5 | | | | | | 4,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5
[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C58. For stones with higher strengths, the shown values are valid without conversion.

### Table C63: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow clay brick Porotherm Homebric**
Group factors, characteristic resistance and displacements

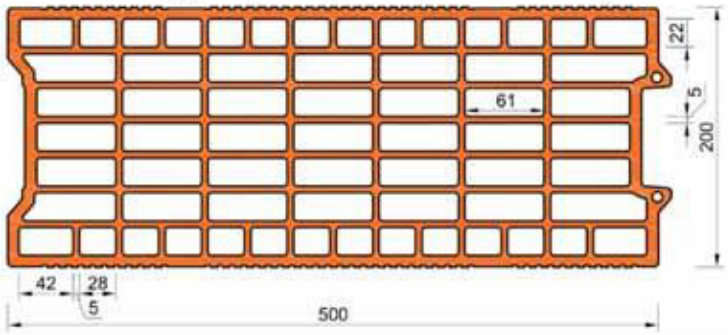
**Annex C25**

## Brick type: Hollow clay brick BGV Thermo

### Table C64: Description

| Brick type | | | Hollow clay brick BGV Thermo |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 0,60 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 10 |
| Conversion factor for lower compressive strengths | | | $(f_b / 10)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Leroux (FR) |
| Brick dimensions | | [mm] | 500 x 200 x 314 |
| Drilling method | | [-] | Rotary drilling |

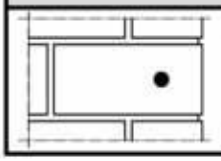


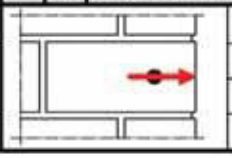


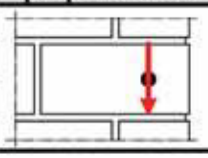

### Table C65: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 500) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 120 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 500 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 315 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 120 | | | | | | |

### Table C66: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load perpendicular to the free edge | |
|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | with c ≥ | $\alpha_{edge,V\perp}$ | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 120 | 1,00 | 120 | 0,30 | 120 | 0,60 |
| | | | 250 | 0,60 | | |
| | 120 | 1,00 | 500 | 1,00 | 250 | 1,00 |

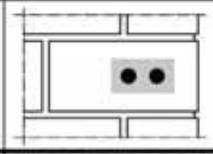
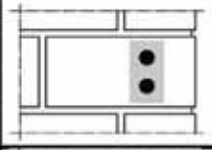
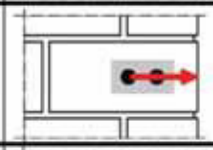
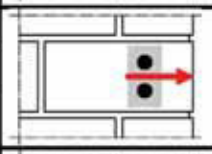
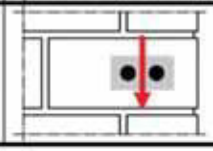
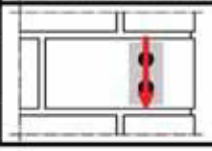




| Injection System VMU plus for masonry | Annex C26 |
|---|---|
| **Performance - Hollow clay brick BGV Thermo**<br>Description, Installation parameters and reduction factors | |

## Brick type: Hollow clay brick BGV Thermo – continuation

### Table C67: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 200 | 100 | 1,70 | | 200 | 100 | 1,10 |
| | | 120 | 500 | 2,00 | | 120 | 315 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 120 | 500 | 2,00 | | 120 | 315 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 120 | 500 | 2,00 | | 120 | 315 | 2,00 |

### Table C68: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 10$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 0,9 | | | | | | 3,5 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | 0,9 | | | | | | 3,5 |
| | | 130 | 2,0 | 2,0 | 1,5 | 2,0 | 2,0 | 1,5 | 4,0 |
| M12 / M16/ IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | 0,9 | | | | | | 4,0 |
| | | ≥ 130 | 2,0 | 2,0 | 1,5 | 2,0 | 2,0 | 1,5 | 4,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C64. For stones with higher strengths, the shown values are valid without conversion.

### Table C69: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex C27** |
| **Performances – Hollow clay brick BGV Thermo**<br>Group factors, characteristic resistance and displacements | |

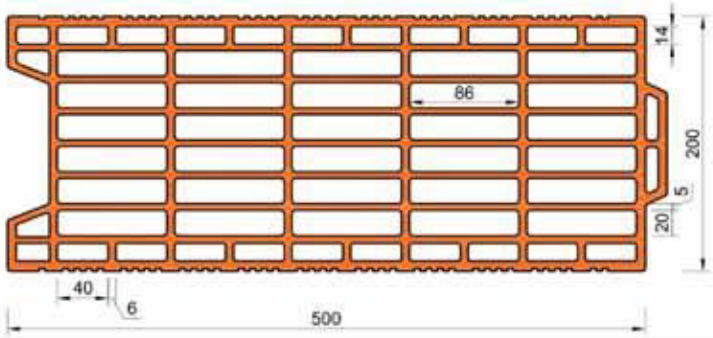
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## Brick type: Hollow clay brick Calibric R+

### Table C70: Description

| Brick type | | | Hollow clay brick Calibric R+ |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 0,60 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 12 |
| Conversion factor for lower compressive strengths | | | $(f_b / 12)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Leroux (FR) |
| Brick dimensions | | [mm] | 500 x 200 x 314 |
| Drilling method | | [-] | Rotary drilling |

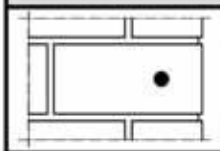
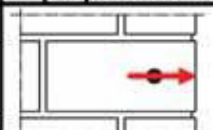
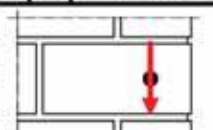





### Table C71: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 500) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 120 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 500 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 315 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 120 | | | | | | |

### Table C72: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load perpendicular to the free edge | |
|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | with c ≥ | $\alpha_{edge,V\perp}$ | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 120 | 1,00 | 120 | 0,15 | 120 | 0,30 |
| | 120 | 1,00 | 250 | 0,30 | 250 | 1,00 |
|  | | | 500 | 1,00 | | |
|  | | | | | | |

**Injection System VMU plus for masonry**

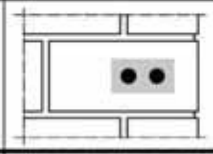
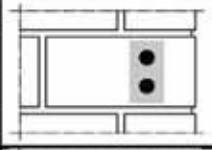
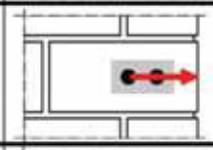
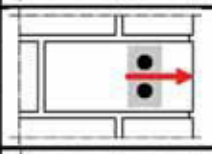
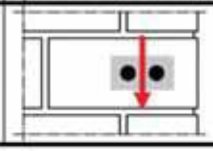
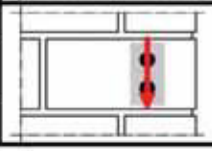
**Performances – Hollow clay brick Calibric R+**
Description, installation parameters, reduction factors

**Annex C28**

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## Brick type: Hollow clay brick Calibric R+ – continuation

### Table C73: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 175 | 100 | 1,70 | | 175 | 100 | 1,10 |
| | | 120 | 500 | 2,00 | | 120 | 315 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 120 | 500 | 2,00 | | 120 | 315 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 120 | 500 | 2,00 | | 120 | 315 | 2,00 |

### Table C74: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 12$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 1,2 | 1,2 | 0,9 | 1,2 | 1,2 | 0,9 | 4,0 |
| M8 / M10/ IG-M6 | VM-SH16 | ≥ 85 | 1,2 | 1,2 | 0,9 | 1,2 | 1,2 | 0,9 | 5,5 |
| | | 130 | 1,5 | 1,5 | 1,2 | 1,5 | 1,5 | 1,2 | 5,5 |
| M12 / M16 IG-M8 /IG-M10 | VM-SH20 | ≥ 85 | 1,2 | 1,2 | 0,9 | 1,2 | 1,2 | 0,9 | 8,5 |
| | | ≥ 130 | 1,5 | 1,5 | 1,2 | 1,5 | 1,5 | 1,2 | 8,5 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C70. For stones with higher strengths, the shown values are valid without conversion.

### Table C75: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow clay brick Calibric R+**
Group factors, characteristic resistance and displacements

**Annex C29**

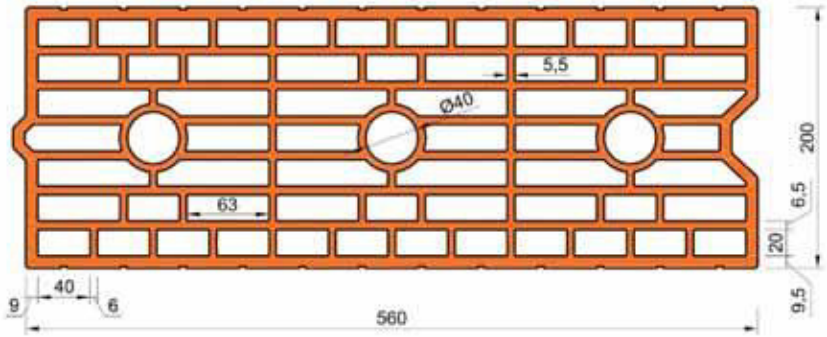
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## Brick type: Hollow clay brick Urbanbric

### Table C76: Description

| Brick type | | | Hollow clay brick Urbanbric |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 0,70 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 12 |
| Conversion factor for lower compressive strengths | | | $(f_b / 12)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Imerys (FR) |
| Brick dimensions | | [mm] | 560 x 200 x 274 |
| Drilling method | | [-] | Rotary drilling |

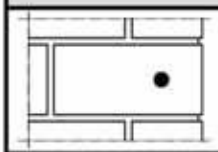
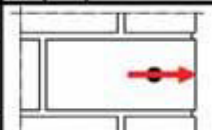
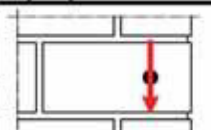





### Table C77: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 500) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 120 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 560 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 275 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 100 | | | | | | |

### Table C78: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load perpendicular to the free edge | |
|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | with c ≥ | $\alpha_{edge,V\perp}$ | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 120 | 1,00 | 120 | 0,25 | 120 | 0,50 |
| | 120 | 1,00 | 250 | 0,50 | 250 | 1,00 |
|  | | | 500 | 1,00 | | |
|  | | | | | | |

**Injection System VMU plus for masonry**

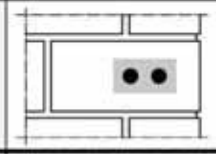
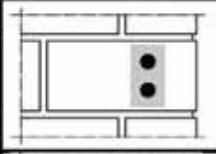
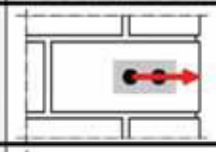
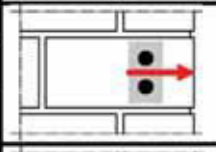
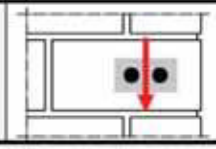
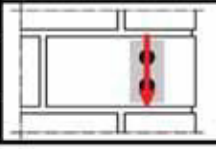
**Performances – Hollow clay brick Urbanbric**
Description, installation parameters, reduction factors

**Annex C30**

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## Brick type: Hollow clay brick Urbanbric – continuation

### Table C79: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 185 | 100 | 1,90 | | 185 | 100 | 1,10 |
| | | 120 | 560 | 2,00 | | 120 | 275 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 120 | 560 | 2,00 | | 120 | 275 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 120 | 560 | 2,00 | | 120 | 275 | 2,00 |

### Table C80: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 12$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 1,2 | 1,2 | 0,9 | 1,2 | 1,2 | 0,9 | 4,5 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | 1,2 | 1,2 | 0,9 | 1,2 | 1,2 | 0,9 | 4,5 |
| | | 130 | 3,0 | 3,0 | 2,5 | 3,0 | 3,0 | 2,5 | 4,5 |
| M12 / M16 IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | 1,2 | 1,2 | 0,9 | 1,2 | 1,2 | 0,9 | 5,0 |
| | | ≥ 130 | 3,0 | 3,0 | 2,5 | 3,0 | 3,0 | 2,5 | 5,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5
[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C76. For stones with higher strengths, the shown values are valid without conversion.

### Table C81: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow clay brick Urbanbric**
Group factors, characteristic resistance and displacements

**Annex C31**

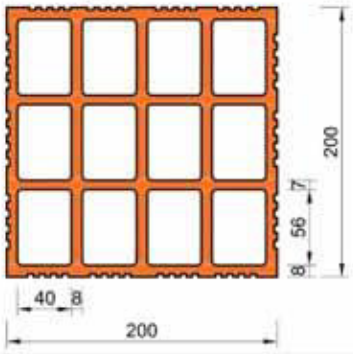
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## Brick type: Hollow Clay brick Brique Creuse C40

### Table C82: Description

| Brick type | | | Hollow clay brick Brique Creuse C40 |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 0,70 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 12 |
| Conversion factor for lower compressive strengths | | | $(f_b / 12)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Terreal (FR) |
| Brick dimensions | | [mm] | 500 x 200 x 200 |
| Drilling method | | [-] | Rotary drilling |

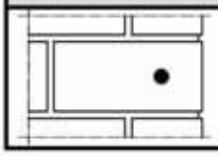
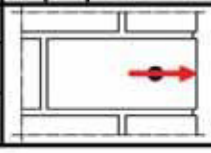
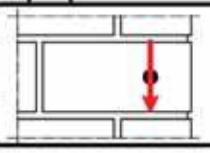





### Table C83: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 500) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 120 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 500 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 200 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 200 | | | | | | |

### Table C84: Reduction factors for single anchors at the edge

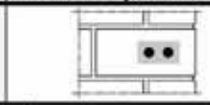
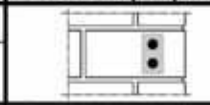
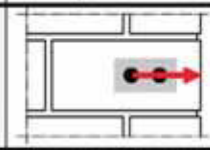
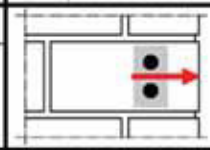
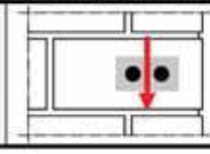
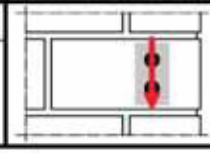
| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 120 | 1,00 |  | 120 | 0,83 |  | 120 | 1,00 |
| | 120 | 1,00 | | 500 | 1,00 | | 250 | 1,00 |

| Injection System VMU plus for masonry | |
|---|---|
| **Performances – Hollow clay brick Brique Creuse C40**<br>Description, installation parameters, reduction factors | **Annex C32** |

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## Brick type: Hollow Clay brick Brique Creuse C40 – continuation

### Table C85: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 120 | 500 | 2,00 | | 120 | 200 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 120 | 500 | 2,00 | | 120 | 200 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 120 | 500 | 2,00 | | 120 | 200 | 2,00 |

### Table C86: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 12$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 1,2 | 1,2 | 0,9 | 1,2 | 1,2 | 0,9 | 1,5 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / M16 / IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5
[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C82. For stones with higher strengths, the shown values are valid without conversion.

### Table C87: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow clay brick Brique Creuse C40**
Group factors, characteristic resistance and displacements

**Annex C33**

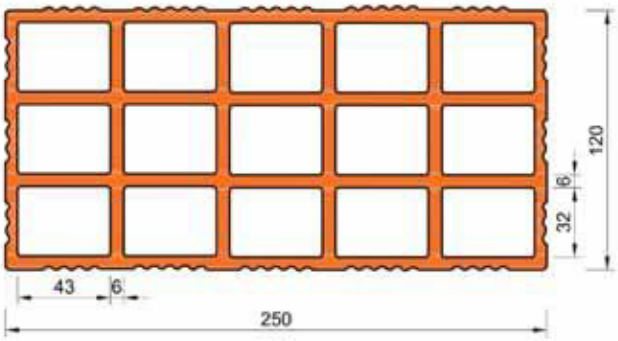
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## Brick type: Hollow clay brick Blocchi Leggeri

### Table C88: Description

| Brick type | | | Hollow clay brick Blocchi Leggeri |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 0,60 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 12 |
| Conversion factor for lower compressive strengths | | | $(f_b / 12)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Wienerberger (IT) |
| Brick dimensions | | [mm] | 250 x 120 x 250 |
| Drilling method | | [-] | Rotary drilling |

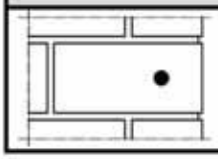


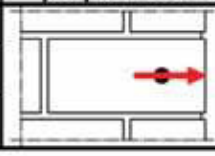


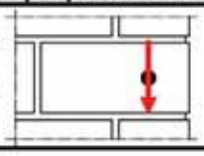

### Table C89: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 60 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 250 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 250 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 100 | | | | | | |

### Table C90: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load perpendicular to the free edge | |
|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | with c ≥ | $\alpha_{edge,V\perp}$ | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 60 | 1,00 | 60 | 0,40 | 60 | 0,40 |
| | 120 | 1,00 | 250 | 1,00 | 120 | 1,00 |

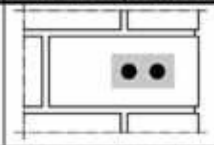
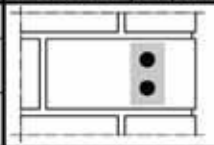
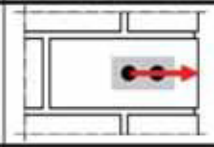
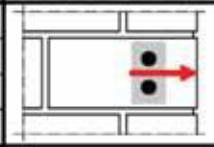
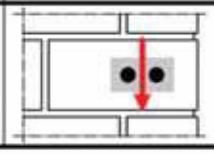
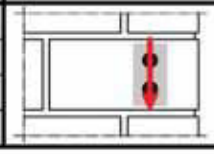




| Injection System VMU plus for masonry | |
|---|---|
| **Performances – Hollow clay brick Blocchi Leggeri**<br>Description, installation parameters, reduction factors | **Annex C34** |

## Brick type: Hollow clay brick Blocchi Leggeri – continuation

### Table C91: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 60 | 100 | 1,00 | | 60 | 100 | 2,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 60 | 100 | 0,40 | | 60 | 100 | 0,40 |
| | | 250 | 100 | 1,00 | | 250 | 100 | 1,00 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 60 | 100 | 0,40 | | 60 | 100 | 0,40 |
| | | 120 | 100 | 1,00 | | 120 | 100 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C92: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 12$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 3,5 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / M16 / IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C88. For stones with higher strengths, the shown values are valid without conversion.

### Table C93: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow clay brick Blocchi Leggeri**
Group factors, characteristic resistance and displacements

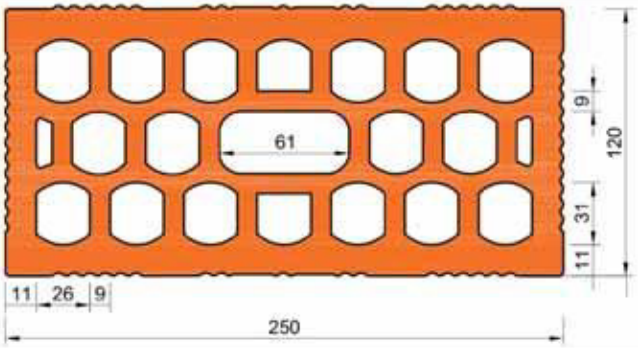
**Annex C35**

## Brick type: Hollow Clay brick Doppio Uni

### Table C94: Description

| Brick type | | | Hollow clay brick Doppio Uni |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 0,90 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 28 |
| Conversion factor for lower compressive strengths | | | $(f_b / 28)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Wienerberger (IT) |
| Brick dimensions | | [mm] | 250 x 120 x 120 |
| Drilling method | | [-] | Rotary drilling |

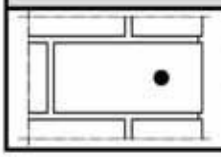
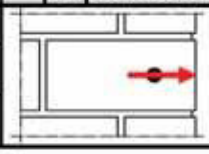
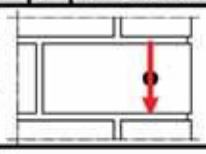





### Table C95: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 100 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 250 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 120 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 100 | | | | | | |

### Table C96: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 100 | 1,00 |  | 100 | 0,50 |  | 100 | 1,00 |
| | 120 | 1,00 | | 250 | 1,00 | | 120 | 1,00 |

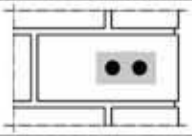
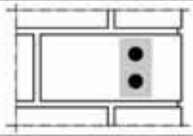
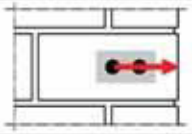
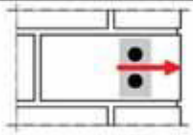
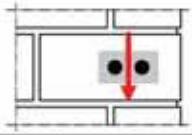
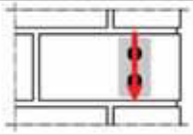
**Injection System VMU plus for masonry**

**Performances – Hollow Clay brick Doppio Uni**
Description, installation parameters, reduction factors

**Annex C36**

## Brick type: Hollow Clay brick Doppio Uni – continuation

### Table C97: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 100 | 100 | 1,00 | | 100 | 120 | 2,00 |
| | | 120 | 250 | 2,00 | | 120 | 120 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 100 | 100 | 1,00 | | 100 | 100 | 1,00 |
| | | 250 | 250 | 2,00 | | 250 | 120 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 100 | 100 | 1,00 | | 100 | 100 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 120 | 2,00 |

### Table C98: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 28$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 1,2 | 1,2 | 0,9 | 1,2 | 1,2 | 0,9 | 2,5 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / M16 / IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C94. For stones with higher strengths, the shown values are valid without conversion.

### Table C99: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow Clay brick Doppio Uni**
Group factors, characteristic resistance and displacements

**Annex C37**

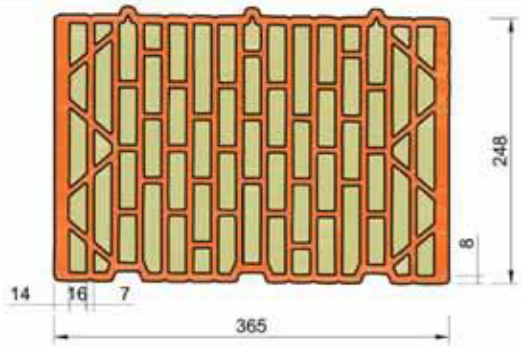
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## Brick type: Hollow clay brick Coriso WS07 with insulation

### Table C100: Description

| Brick type | | | Hollow clay brick Coriso WS07 |
|---|---|---|---|
| Insulation material | | | Rock wool |
| Density | $\rho$ | [kg/dm³] | ≥ 0,55 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 6 |
| Conversion factor for lower compressive strengths | | | $(f_b / 6)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Unipor (DE) |
| Brick dimensions | | [mm] | 248 x 365 x 249 |
| Drilling method | | [-] | Rotary drilling |






### Table C101: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 5 | ≤ 5 | ≤ 10 | ≤ 10 | ≤ 5 | ≤ 5 | ≤ 5 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 250 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 250 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C102: Reduction factors for single anchors at the edge

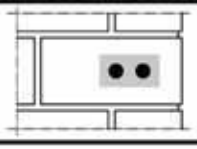
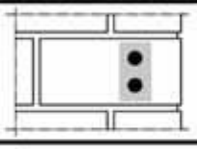
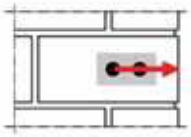
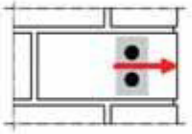
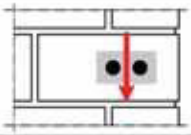
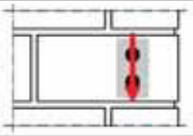
| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 50 | 1,00 | | 50 | 0,30 | | 50 | 1,00 |
| | 120 | 1,00 | | 250 | 1,00 | | 120 | 1,00 |

| | |
|---|---|
| **Injection System VMU plus for masonry** | |
| **Performances – Hollow clay brick Coriso WS07**<br>Description, installation parameters, reduction factors | **Annex C38** |

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## Brick type: Hollow clay brick Coriso WS07 with insulation – continuation

### Table C103: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,50 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,40 | | 50 | 50 | 0,40 |
| | | 250 | 50 | 1,00 | | 250 | 50 | 1,20 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,65 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C104: Characteristic resistance under tension and shear load

| Anchor size | Sleeve VM-SH | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 6$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 5,0 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / M16 / IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C100. For stones with higher strengths, the shown values are valid without conversion.

### Table C105: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow clay brick Coriso WS07 with insulation**
Group factors, characteristic resistance and displacements

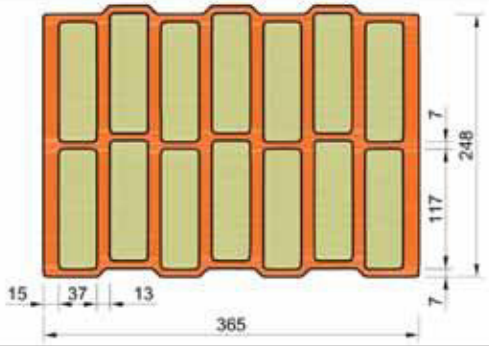
**Annex C39**

## Brick type: Hollow clay brick T7 MW with insulation

### Table C106: Description

| Brick type | | | Hollow clay brick T7 MW |
|---|---|---|---|
| Insulation material | | | Rock wool |
| Density | $\rho$ | [kg/dm³] | ≥ 0,59 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 8 |
| Conversion factor for lower compressive strengths | | | $(f_b / 8)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Wienerberger (DE) |
| Brick dimensions | | [mm] | 248 x 365 x 249 |
| Drilling method | | [-] | Rotary drilling |






### Table C107: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 5 | ≤ 5 | ≤ 10 | ≤ 10 | ≤ 5 | ≤ 5 | ≤ 5 |
| Edge distance (under fire exposure) | $c_{cr,}$ ($c_{cr,fi}$) | [mm] | 120 (2 $h_{ef}$) (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing (under fire exposure) | $s_{cr,\parallel}$ ($s_{cr,fi,\parallel}$) | [mm] | 250 (4 $h_{ef}$) | | | | | | |
| | $s_{cr,\perp}$ ($s_{cr,fi,\perp}$) | [mm] | 250 (4 $h_{ef}$) | | | | | | |
| Minimum spacing | $s_{min,\parallel}$; $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C108: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 50 | 1,00 | | 50 | 0,35 | | 50 | 1,00 |
| | 120 | 1,00 | | 250 | 1,00 | | 120 | 1,00 |

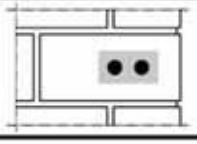
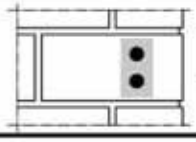
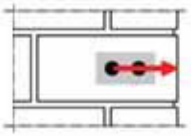
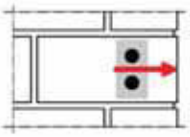
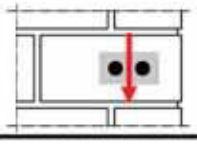
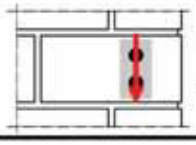
**Injection System VMU plus for masonry**

**Performances – Hollow clay brick T7 MW**
Description, installation parameters, reduction factors

**Annex C40**

## Brick type: Hollow clay brick T7 MW with insulation – continuation

### Table C109: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,40 | | 50 | 50 | 1,15 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,60 | | 50 | 50 | 0,40 |
| | | 250 | 50 | 1,55 | | 250 | 50 | 1,00 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 2,00 | | 50 | 50 | 1,20 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C110: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 8$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 2,0 | 2,0 | 1,5 | 2,0 | 2,0 | 1,5 | 3,0 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / IG-M8 | VM-SH 20 | ≥ 85 | | | | | | | |
| M16 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | 4,5 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5
[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C106. For stones with higher strengths, the shown values are valid without conversion.

### Table C111: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performance**
**Performances – Hollow clay brick T7 MW**
Group factors, characteristic resistances and displacements

**Annex C41**

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**Table C112: Characteristic resistance under fire exposure**

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance $N_{Rk,b,fi} = N_{Rk,p,fi} = V_{Rk,b,fi}$ | | | |
|---|---|---|---|---|---|---|
| | | $h_{ef}$ | R30 | R60 | R90 | R120 |
| | | [mm] | [kN] | | | |
| M8 / M10 /IG-M6 | VM-SH 16 | 130 | 0,64 | 0,37 | 0,11 | no performance assessed |
| M12 / M16 / IG-M8 IG-M10 | VM-SH 20 | ≥ 130 | | | | |

| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex C42** |
| **Performances – Hollow clay brick T7 MW with insulation**<br>Characteristic resistance under fire exposure | |

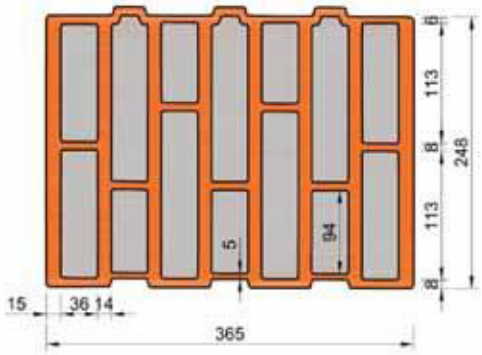
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## Brick type: Hollow clay brick T8 P with insulation

### Table C113: Description

| Brick type | | | Hollow clay brick T8 P |
|---|---|---|---|
| Insulation material | | | Perlite |
| Density | $\rho$ | [kg/dm³] | ≥ 0,56 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 6 |
| Conversion factor for lower compressive strengths | | | $(f_b / 6)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Wienerberger (DE) |
| Brick dimensions | | [mm] | 248 x 365 x 249 |
| Drilling method | | [-] | Rotary drilling |






### Table C114: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 4 | ≤ 4 | ≤ 10 | ≤ 10 | ≤ 4 | ≤ 4 | ≤ 4 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 250 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 250 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C115: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 50 | 1,00 | | 50 | 0,25 | | 50 | 1,00 |
| | 120 | 1,00 | | 250 | 1,00 | | 120 | 1,00 |

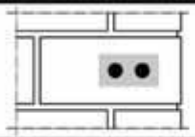
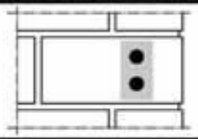
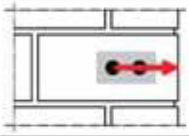
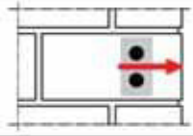
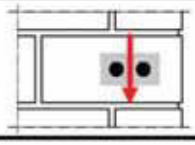
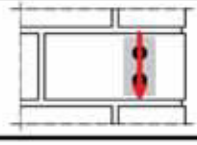
**Injection System VMU plus for masonry**

**Performances – Hollow Clay brick T8 P with insulation**
Description, installation parameters, reduction factors

**Annex C43**

## Brick type: Hollow clay brick T8 P– continuation

### Table C116: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,30 | | 50 | 50 | 1,10 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,40 | | 50 | 50 | 0,30 |
| | | 250 | 50 | 1,35 | | 250 | 50 | 1,20 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,70 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C117: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 6$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 4,5 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / IG-M8 | VM-SH 20 | ≥ 85 | | | | | | | |
| M16 / IG-M10 | VM-SH 20 | ≥ 85 | 2,5 | 2,5 | 2,0 | 2,5 | 2,5 | 2,0 | 7,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C113. For stones with higher strengths, the shown values are valid without conversion.

### Table C118: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow Clay brick T8 P with insulation**
Group factors, characteristic resistance and displacements

**Annex C44**

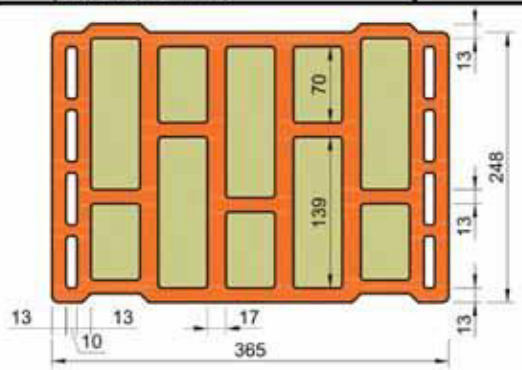
Deutsches Institut für Bautechnik DIBt

## Brick type: Hollow clay brick Thermoplan MZ90-G with insulation

### Table C119: Installation parameter

| Brick type | | | Hollow clay brick Thermoplan MZ90-G |
|---|---|---|---|
| Insulation material | | | Rock wool |
| Density | $\rho$ | [kg/dm³] | ≥ 0,68 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 12 |
| Conversion factor for lower compressive strengths | | | $(f_b / 12)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Mein Ziegelhaus (DE) |
| Brick dimensions | | [mm] | 248 x 365 x 249 |
| Drilling method | | [-] | Rotary drilling |

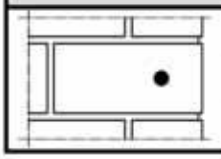


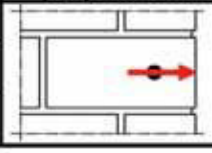


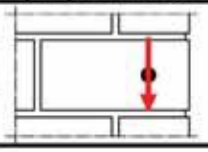

### Table C120: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 4 | ≤ 4 | ≤ 10 | ≤ 10 | ≤ 4 | ≤ 4 | ≤ 4 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 250 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 250 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C121: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load perpendicular to the free edge | |
|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | with c ≥ | $\alpha_{edge,V\perp}$ | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 50 | 1,00 | 50 | 0,25 | 50 | 1,00 |
| | 120 | 1,00 | 250 | 1,00 | 120 | 1,00 |

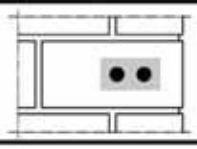
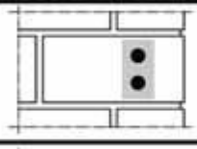
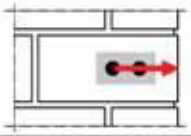
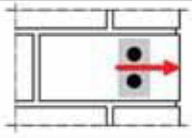
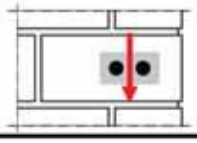
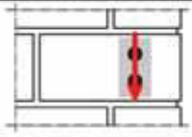




| Injection System VMU plus for masonry | |
|---|---|
| **Performances – Hollow clay brick Thermoplan MZ90-G**<br>Description, installation parameters, reduction factors | **Annex C45** |

## Brick type: Lochziegel Thermoplan MZ90-G – continuation

### Table C122: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,00 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,75 | | 50 | 50 | 0,50 |
| | | 250 | 50 | 2,00 | | 250 | 50 | 1,70 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,65 | | 50 | 50 | 1,15 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C123: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 12$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 3,0 | 3,0 | 2,5 | 3,0 | 3,0 | 2,5 | 4,0 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / IG-M8 | VM-SH 20 | ≥ 85 | | | | | | | |
| M16 / IG-M10 | VM-SH 20 | ≥ 85 | 3,5 | 3,5 | 3,0 | 3,5 | 3,5 | 3,0 | 7,5 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5
[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C119. For stones with higher strengths, the shown values are valid without conversion.

### Table C124: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow clay brick Thermoplan MZ90-G with insulation**
Group factors, characteristic resistance and displacements

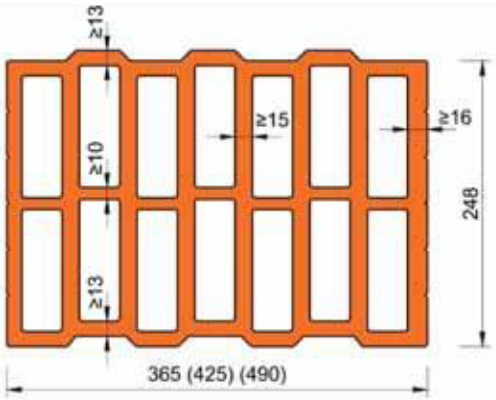
**Annex C46**

## Brick type: Hollow clay brick Poroton FZ7,5 with insulation

### Table C125: Description

| Brick type | | | Hollow clay brick Poroton FZ7,5 |
|---|---|---|---|
| Insulation material | | | Rock wool |
| Density | $\rho$ | [kg/dm³] | ≥ 0,70 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 8 |
| Conversion factor for lower compressive strengths | | | $(f_b / 8)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Schlagmann (DE) |
| Brick dimensions | | [mm] | 248 x 365 x 249 |
| Drilling method | | [-] | Rotary drilling |

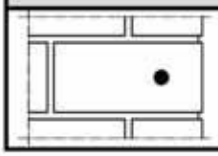
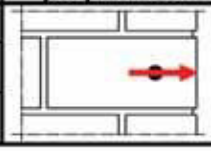
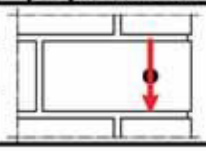





### Table C126: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 5 | ≤ 5 | ≤ 10 | ≤ 10 | ≤ 5 | ≤ 5 | ≤ 5 |
| Edge distance (under fire exposure) | $c_{cr}$; ($c_{cr,fi}$) | [mm] | 120 (2 $h_{ef}$) (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing (under fire exposure) | $s_{cr,\parallel}$ ($s_{cr,fi,\parallel}$) | [mm] | 250 (4 $h_{ef}$) | | | | | | |
| | $s_{cr,\perp}$ ($s_{cr,fi,\perp}$) | [mm] | 250 (4 $h_{ef}$) | | | | | | |
| Minimum Spacing | $s_{min,\parallel}$; $s_{min,\perp}$ | [mm] | 50 | | | | | | |

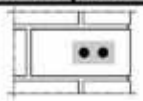
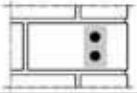
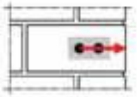
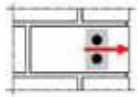
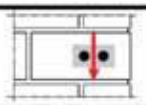
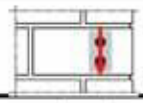
### Table C127: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load perpendicular to the free edge | |
|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | with c ≥ | $\alpha_{edge,V\perp}$ | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 50 | 1,00 |  50 | 0,35 |  50 | 1,00 |
| | 120 | 1,00 | 250 | 1,00 | 120 | 1,00 |

| | |
|---|---|
| **Injection System VMU plus for masonry** | |
| **Performances – Hollow clay brick FZ7,5 MW**<br>Description, installation parameters, reduction factors | **Annex C47** |

## Brick type: Hollow clay brick FZ7,5 with insulation – continuation

### Table C128: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,40 | | 50 | 50 | 1,15 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,60 | | 50 | 50 | 0,40 |
| | | 250 | 50 | 1,55 | | 250 | 50 | 1,00 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 2,00 | | 50 | 50 | 1,20 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C129: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 8$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 2,0 | 2,0 | 1,5 | 2,0 | 2,0 | 1,5 | 3,0 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / IG-M8 | VM-SH 20 | ≥ 85 | | | | | | | |
| M16 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | 4,5 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C125. For stones with higher strengths, the shown values are valid without conversion.

### Table C130: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

### Table C131: Characteristic resistance under fire exposure

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance $N_{Rk,b,fi} = N_{Rk,p,fi} = V_{Rk,b,fi}$ | | | |
|---|---|---|---|---|---|---|
| | | $h_{ef}$ | R30 | R60 | R90 | R120 |
| | | [mm] | [kN] | | | |
| M8 / M10 /IG-M6 | VM-SH 16 | 130 | 0,64 | 0,37 | 0,11 | no performance assessed |
| M12 / M16 / IG-M8 IG-M10 | VM-SH 20 | ≥ 130 | | | | |

**Injection System VMU plus for masonry**

**Performance – Hollow clay brick FZ7,5 MW**
Group factors, characteristic resistance and displacements

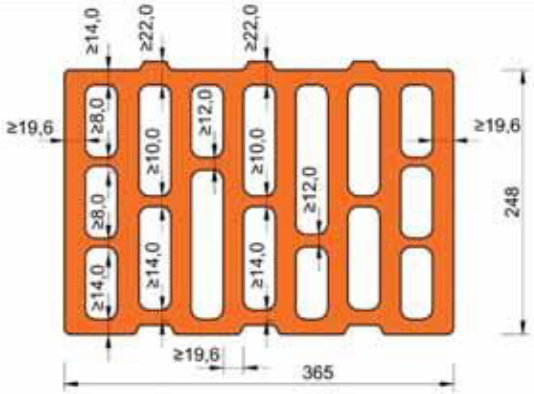
**Annex C48**

## Brick type: Hollow clay brick Poroton FZ9 with insulation

### Table C132: Description

| Brick type | | | Hollow clay brick Poroton FZ9 |
|---|---|---|---|
| Insulation material | | | Rock wool |
| Density | $\rho$ | [kg/dm³] | ≥ 0,90 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 10 |
| Conversion factor for lower compressive strengths | | | $(f_b / 10)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Schlagmann (DE) |
| Brick dimensions | | [mm] | 248 x 365 x 249 |
| Drilling method | | [-] | Rotary drilling |






### Table C133: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 5 | ≤ 5 | ≤ 10 | ≤ 10 | ≤ 5 | ≤ 5 | ≤ 5 |
| Edge distance (under fire exposure) | $c_{cr,}$ ($c_{cr,fi}$) | [mm] | 120 (2 $h_{ef}$) (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing (under fire exposure) | $s_{cr,\parallel}$ ($s_{cr,fi,\parallel}$) | [mm] | 250 (4 $h_{ef}$) | | | | | | |
| | $s_{cr,\perp}$ ($s_{cr,fi,\perp}$) | [mm] | 250 (4 $h_{ef}$) | | | | | | |
| Minimum spacing | $s_{min,\parallel}$; $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C134: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 50 | 1,00 | | 50 | 0,35 | | 50 | 1,00 |
| | 120 | 1,00 | | 250 | 1,00 | | 120 | 1,00 |

**Injection System VMU plus for masonry**

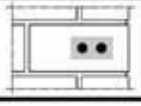
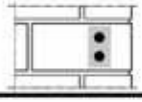
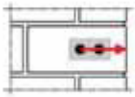
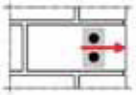
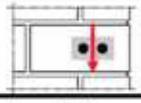
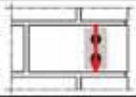
**Performances – Hollow clay brick FZ9 MW with insulation**
Description, installation parameters, reduction factors

**Annex C49**

Deutsches Institut für Bautechnik DIBt

## Brick type: Hollow clay brick FZ9 with insulation – continuation

### Table C135: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,40 | | 50 | 50 | 1,15 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,60 | | 50 | 50 | 0,40 |
| | | 250 | 50 | 1,55 | | 250 | 50 | 1,00 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 2,00 | | 50 | 50 | 1,20 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C136: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 10$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 2,0 | 2,0 | 1,5 | 2,0 | 2,0 | 1,5 | 3,0 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / IG-M8 | VM-SH 20 | ≥ 85 | | | | | | | |
| M16 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | 4,5 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C132. For stones with higher strengths, the shown values are valid without conversion.

### Table C137: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

### Table C138: Characteristic resistance under fire exposure

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance $N_{Rk,b,fi} = N_{Rk,p,fi} = V_{Rk,b,fi}$ | | | |
|---|---|---|---|---|---|---|
| | | $h_{ef}$ | R30 | R60 | R90 | R120 |
| | | [mm] | [kN] | | | |
| M8 / M10 /IG-M6 | VM-SH 16 | 130 | 0,64 | 0,37 | 0,11 | no performance assessed |
| M12 / M16 / IG-M8 IG-M10 | VM-SH 20 | ≥ 130 | | | | |

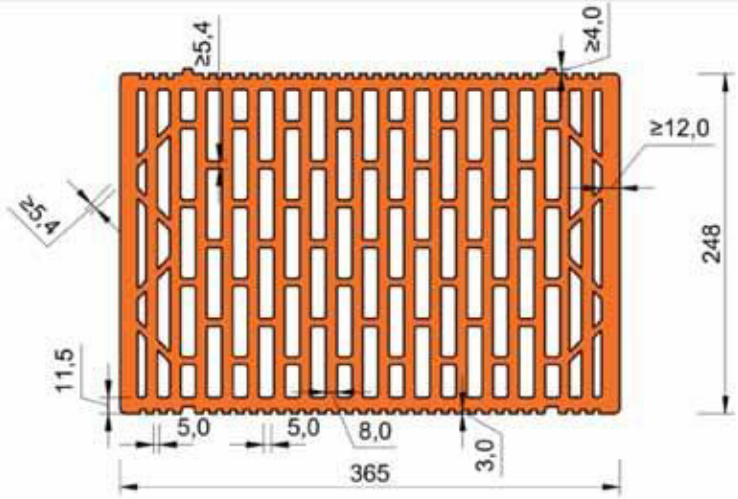
| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex C50** |
| **Performance – Hollow clay brick FZ9**<br>Group factors, characteristic resistance and displacements | |

## Brick type: Hollow clay brick Poroton S9 with insulation

### Table C139: Description

| Brick type | | | Hollow clay brick Poroton S9 |
|---|---|---|---|
| Insulation material | | | Perlite |
| Density | $\rho$ | [kg/dm³] | ≥ 0,85 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 12 |
| Conversion factor for lower compressive strengths | | | $(f_b / 12)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Schlagmann (DE) |
| Brick dimensions | | [mm] | 248 x 365 x 249 |
| Drilling method | | [-] | Rotary drilling |

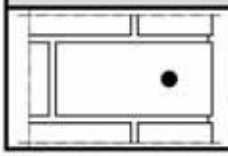
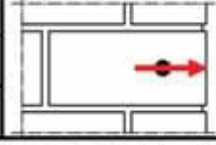
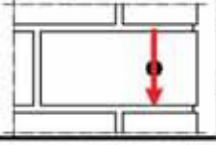





### Table C140: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 5 | ≤ 5 | ≤ 10 | ≤ 10 | ≤ 5 | ≤ 5 | ≤ 5 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 250 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 250 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C141: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | Shear load perpendicular to the free edge | |
|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 50 | 1,00 |  | 50 | 0,30 |  | 50 | 1,00 |
| | 120 | 1,00 | | 250 | 1,00 | | 120 | 1,00 |

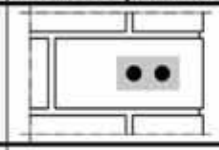
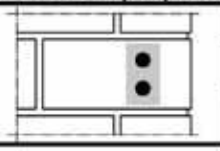
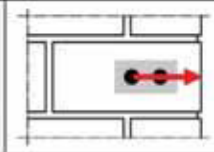
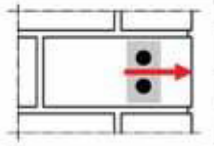
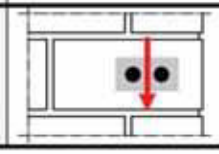
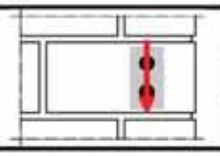
**Injection System VMU plus for masonry**

**Performances – Hollow Clay brick Poroton S9**
Description, installation parameters, reduction factors

**Annex C51**

## Brick type: Hollow clay brick Poroton S9 with insulation – continuation

### Table C142: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,50 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,40 | | 50 | 50 | 0,40 |
| | | 250 | 50 | 1,00 | | 250 | 50 | 1,20 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,65 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C143: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 12$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 5,0 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / M16 / IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C139. For stones with higher strengths, the shown values are valid without conversion.

### Table C144: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow Clay brick Poroton S9**
Group factors, characteristic resistance and displacements

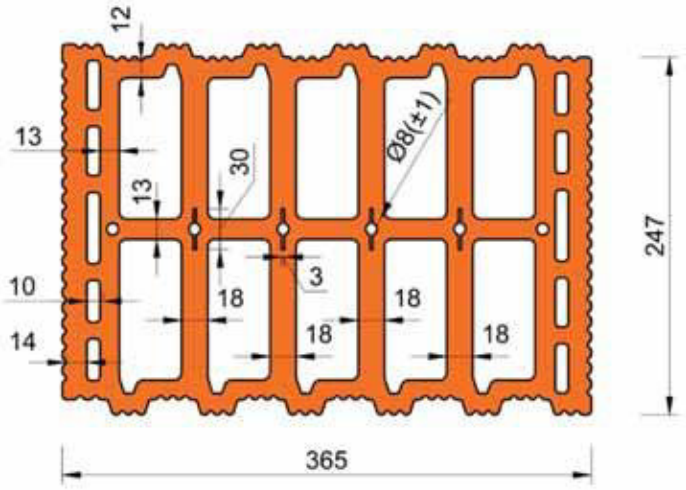
**Annex C52**

## Brick type: Hollow clay brick Thermopor TV8+ with insulation

### Table C145: Description

| Brick type | | | Hollow clay brick Thermopor TV8+ |
|---|---|---|---|
| Insulation material | | | Rock wool |
| Density | $\rho$ | [kg/dm³] | ≥ 0,70 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 10 |
| Conversion factor for lower compressive strengths | | | $(f_b / 10)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-1:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. THERMOPOR GmbH (DE) |
| Brick dimensions | | [mm] | 247 x 365 x 249 |
| Drilling method | | [-] | Rotary drilling |






### Table C146: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 4 | ≤ 4 | ≤ 10 | ≤ 10 | ≤ 4 | ≤ 4 | ≤ 4 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 250 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 250 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C147: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 50 | 1,00 | | 50 | 0,25 | | 50 | 1,00 |
| | 120 | 1,00 | | 250 | 1,00 | | 120 | 1,00 |

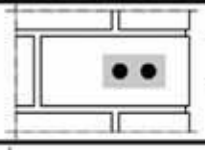
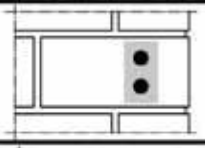
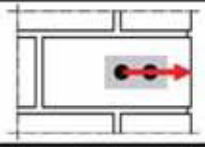
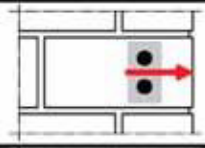
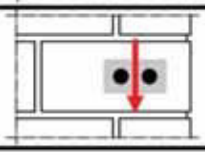
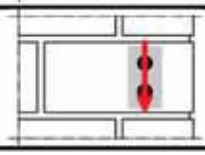
**Injection System VMU plus for masonry**

**Performances – Hollow Clay brick Thermopor TV8+**
Description, installation parameters, reduction factors

**Annex C53**

## Brick type: Hollow clay brick Thermopor TV8+ with insulation – continuation

### Table C148: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,00 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,75 | | 50 | 50 | 0,50 |
| | | 250 | 50 | 2,00 | | 250 | 50 | 1,70 |
| | | 250 | 250 | 2,00 | | 250 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,65 | | 50 | 50 | 1,15 |
| | | 120 | 250 | 2,00 | | 120 | 250 | 2,00 |

### Table C149: Characteristic resistance under tension and shear load

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 10$ N/mm² [2]** | | | | | | | | | |
| M8 | VM-SH 12 | 80 | 3,0 | 3,0 | 2,5 | 3,0 | 3,0 | 2,5 | 3,5 |
| M8 / M10/ IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / IG-M8 | VM-SH 20 | ≥ 85 | | | | | | | |
| M16 / IG-M10 | VM-SH 20 | ≥ 85 | 3,5 | 3,5 | 3,0 | 3,5 | 3,5 | 3,0 | 7,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C145. For stones with higher strengths, the shown values are valid without conversion.

### Table C150: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow Clay brick Thermopor TV8+**
Group factors, characteristic resistance and displacements

**Annex C54**

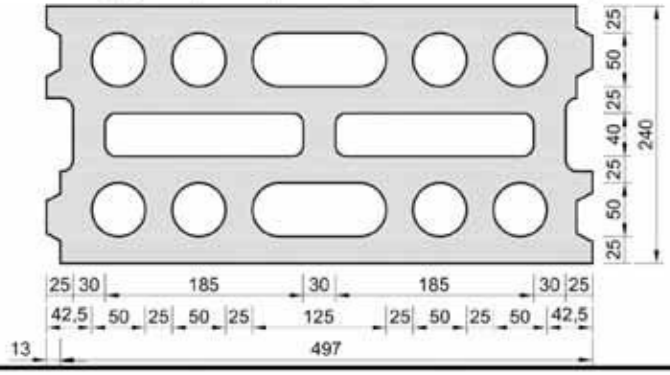
Deutsches Institut für Bautechnik DIBt

## Brick type: Hollow light weight concrete brick HBL 16DF

### Table C151: Description

| Brick type | | | Hollow light weight concrete brick HBL 16DF |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 1,0 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 3,1 |
| Conversion factor for lower compressive strengths | | | $(f_b / 3{,}1)^{0,5} \leq 1{,}0$ |
| Norm | | [-] | EN 771-3:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. KLB Klimaleichtblock (DE) |
| Brick dimensions | | [mm] | 500 x 250 x 240 |
| Drilling method | | [-] | Rotary drilling |






### Table C152: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 2 | ≤ 2 | ≤ 5 | ≤ 5 | ≤ 2 | ≤ 5 | ≤ 5 |
| Edge distance (under fire exposure) | $c_{cr}$; ($c_{cr,fi}$) | [mm] | 120 (2 $h_{ef}$) (for shear loads perpendicular to the free edge: $c_{cr}$ = 250) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing (under fire exposure) | $s_{cr,\parallel}$ ($s_{cr,fi,\parallel}$) | [mm] | 500 (4 $h_{ef}$) | | | | | | |
| | $s_{cr,\perp}$ ($s_{cr,fi,\perp}$) | [mm] | 250 (4 $h_{ef}$) | | | | | | |
| Minimum spacing | $s_{min,\parallel}$; $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C153: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 50 | 1,00 | | 50 | 0,30 | | 50 | 1,00 |
| | 120 | 1,00 | | 250 | 1,00 | | 120 | 1,00 |

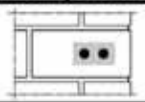
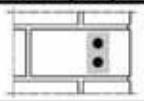
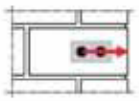
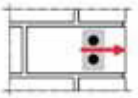
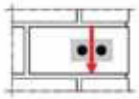
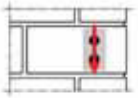
**Injection System VMU plus for masonry**

**Performances – Hollow light weight concrete brick HBL 16DF**
Description, installation parameters, reduction factors

**Annex C55**

## Brick type: Hollow light weight concrete brick HBL 16DF – continuation

### Table C154: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 2,00 | | 50 | 50 | 1,55 |
| | | 120 | 500 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,60 | | 50 | 50 | 0,35 |
| | | 120 | 50 | 2,00 | | 120 | 50 | 1,15 |
| | | 120 | 500 | 2,00 | | 120 | 250 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,30 | | 50 | 50 | 1,00 |
| | | 120 | 250 | 2,00 | | | | |
| | | 120 | 500 | 2,00 | | 120 | 250 | 2,00 |

### Table C155: Characteristic resistance under tension and shear load

| Anchor size | Sleeve VM-SH | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 3{,}1$ N/mm² [2]** | | | | | | | | | |
| M8 / M10/IG-M6 | VM-SH 16 | ≥ 85 | 1,2 | 1,2 | 0,9 | 1,2 | 1,2 | 0,9 | 2,0 |
| M12 / IG-M8 | VM-SH 20 | ≥ 85 | 1,5 | 1,5 | 1,2 | 1,5 | 1,5 | 1,2 | 3,0 |
| M16 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | 5,0 |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C151. For stones with higher strengths, the shown values are valid without conversion.

### Table C156: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

### Table C157: Characteristic resistance under fire exposure

| Anchor size | Sleeve | Effective anchorage depth | Characteristic resistance $N_{Rk,b,fi} = N_{Rk,p,fi} = V_{Rk,b,fi}$ | | | |
|---|---|---|---|---|---|---|
| | | $h_{ef}$ | R30 | R60 | R90 | R120 |
| | | [mm] | [kN] | | | |
| M8 / M10 /IG-M6 | VM-SH 16 | 130 | 0,29 | 0,21 | no performance assessed | no performance assessed |
| M12 / IG-M8 | VM-SH 20 | ≥ 130 | | | | |
| M16 / IG-M10 | VM-SH 20 | ≥ 130 | 0,29 | 0,21 | 0,12 | |

**Injection System VMU plus for masonry**

**Performances – Hollow light weight concrete brick HBL 16DF**
Group factors, characteristic resistance and displacements

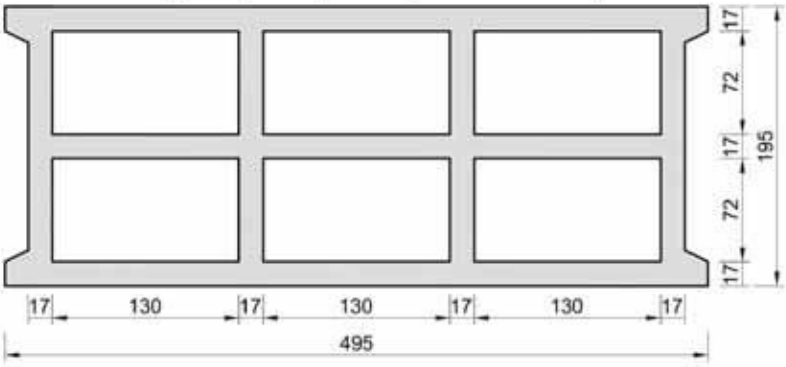
**Annex C56**

## Brick type: Hollow concrete brick Bloc Creux B40

### Table C158: Description

| Brick type | | | Hollow concrete brick Bloc Creux B40 |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 0,8 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 5,2 |
| Conversion factor for lower compressive strengths | | | $(f_b / 5{,}2)^{0,5} \leq 1{,}0$ |
| Norm | | [-] | EN 771-3:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Leroux (FR) |
| Brick dimensions | | [mm] | 500 x 200 x 200 |
| Drilling method | | [-] | Rotary drilling |

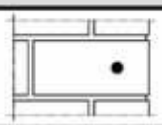
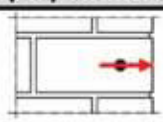
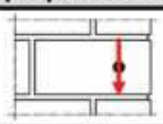





### Table C159: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 4 | ≤ 4 | ≤ 4 | ≤ 4 | ≤ 4 | ≤ 4 | ≤ 4 |
| Edge distance | $c_{cr}$ | [mm] | 120 (for shear loads perpendicular to the free edge: $c_{cr}$ = 170) | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 170 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 200 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ / $s_{min,\perp}$ | [mm] | 50 | | | | | | |

### Table C160: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
|  | 50 | 1,00 |  | 50 | 0,35 |  | 50 | 1,00 |
| | 120 | 1,00 | | 170 | 1,00 | | 120 | 1,00 |

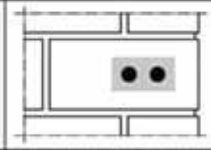
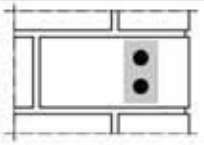
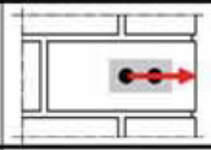
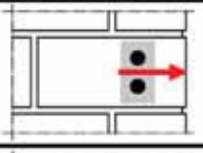
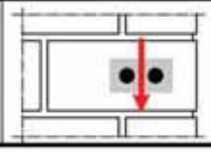
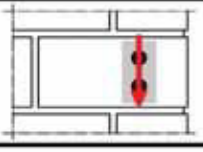
**Injection System VMU plus for masonry**

**Performances – Hollow concrete brick Bloc Creux B40**
Description, installation parameters, reduction factors

**Annex C57**

## Brick type: Hollow concrete brick Bloc Creux B40 – continuation

### Table C161: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| **Tension load** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,N}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| | | 50 | 50 | 1,50 | | 50 | 50 | 1,40 |
| | | 50 | 170 | 2,00 | | 50 | 200 | 2,00 |
| | | 120 | 170 | 2,00 | | 120 | 200 | 2,00 |
| **Shear load perpendicular to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\perp}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| | | 50 | 50 | 0,55 | | 50 | 50 | 0,35 |
| | | 120 | 50 | 1,30 | | 120 | 50 | 0,85 |
| | | 120 | 170 | 2,00 | | 120 | 200 | 2,00 |
| **Shear load parallel to the free edge** |  | with c ≥ | with s ≥ | $\alpha_{g\,II,V\,II}$ |  | with c ≥ | with s ≥ | $\alpha_{g\perp,V\,II}$ |
| | | 50 | 50 | 1,10 | | 50 | 50 | 1,00 |
| | | | | | | 50 | 200 | 2,00 |
| | | 120 | 170 | 2,00 | | 120 | 200 | 2,00 |

### Table C162: Characteristic resistance under tension and shear load

| Anchor size | Sleeve VM-SH | Effective anchorage depth | Characteristic resistance with c ≥ $c_{cr}$ and s ≥ $s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 5{,}2$ N/mm² [2]** | | | | | | | | | |
| M8 / M10 IG-M6 | VM-SH 16 | 130 | 2,0 | 1,5 | 1,2 | 2,0 | 1,5 | 1,2 | 6,0 |
| M12 / M16 IG-M8 /IG-M10 | VM-SH 20 | ≥ 130 | | | | | | | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C158. For stones with higher strengths, the shown values are valid without conversion.

### Table C163: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,13 | 0,13*$N_{Rk}$ / 3,5 | 2*$\delta_{N0}$ | 0,55 | 0,55*$V_{Rk}$ / 3,5 | 1,5*$\delta_{V0}$ |
| M16 | | | | | 0,31 | 0,31*$V_{Rk}$ / 3,5 | |

**Injection System VMU plus for masonry**

**Performances – Hollow concrete brick Bloc Creux B40**
Group factors, characteristic resistance and displacements

**Annex C58**

## Brick type: Solid light weight concrete brick VBL

### Table C164: Description

| Brick type | | | Solid light weight concrete brick VBL |
|---|---|---|---|
| Density | $\rho$ | [kg/dm³] | ≥ 0,6 |
| Normalised mean compressive strength | $f_b$ | [N/mm²] | ≥ 2 |
| Conversion factor for lower compressive strengths | | | $(f_b / 2)^{0,5} \leq 1,0$ |
| Norm | | [-] | EN 771-3:2011+A1:2015 |
| Producer (country code) | | [-] | e.g. Bisotherm (DE) |
| Brick dimensions | | [mm] | ≥ 240 x 300 x 113 |
| Drilling method | | [-] | Rotary drilling |



### Table C165: Installation parameter

| Anchor size | | | M8 | M10 | M12 | M16 | IG-M6 | IG-M8 | IG-M10 |
|---|---|---|---|---|---|---|---|---|---|
| Installation torque | $T_{inst}$ | [Nm] | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 | ≤ 2 |
| Edge distance | $c_{cr}$ | [mm] | 150 | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 60 | | | | | | |
| Spacing | $s_{cr,\parallel}$ | [mm] | 300 | | | | | | |
| | $s_{cr,\perp}$ | [mm] | 300 | | | | | | |
| Minimum spacing | $s_{min,\parallel}$ $s_{min,\perp}$ | [mm] | 120 | | | | | | |

### Table C166: Reduction factors for single anchors at the edge

| Tension load | | | Shear load perpendicular to the free edge | | | Shear load perpendicular to the free edge | | |
|---|---|---|---|---|---|---|---|---|
| | with c ≥ | $\alpha_{edge,N}$ | | with c ≥ | $\alpha_{edge,V\perp}$ | | with c ≥ | $\alpha_{edge,V\parallel}$ |
| | 60 | 1,00 | | 60 | 0,25 | | 60 | 0,40 |
| | 150 | 1,00 | | 150 | 1,00 | | 100 | 1,00 |

### Table C167: Factors for anchor groups

| | Position parallel to horizontal joint | | | | Position perpendicular to horizontal joint | | | |
|---|---|---|---|---|---|---|---|---|
| | | with c ≥ | with s ≥ | $\alpha_{g\parallel,N}$ | | with c ≥ | with s ≥ | $\alpha_{g\perp,N}$ |
| Tension load | | 60 | 120 | 1,00 | | 60 | 120 | 1,00 |
| | | 150 | 300 | 2,00 | | 150 | 300 | 2,00 |
| | | with c ≥ | with s ≥ | $\alpha_{g\parallel,V\perp}$ | | with c ≥ | with s ≥ | $\alpha_{g\perp,V\perp}$ |
| Shear load perpendicular to the free edge | | 60 | 120 | 0,25 | | 60 | 120 | 0,25 |
| | | 150 | 120 | 1,00 | | 150 | 120 | 1,00 |
| | | 150 | 300 | 2,00 | | 150 | 300 | 2,00 |
| | | with c ≥ | with s ≥ | $\alpha_{g\parallel,V\parallel}$ | | with c ≥ | with s ≥ | $\alpha_{g\perp,V\parallel}$ |
| Shear load parallel to the free edge | | 60 | 120 | 0,40 | | 60 | 120 | 0,40 |
| | | 100 | 120 | 1,00 | | 100 | 120 | 1,00 |
| | | 150 | 300 | 2,00 | | 150 | 300 | 2,00 |

**Injection System VMU plus for masonry**

**Performances – Solid light weight concrete brick VBL**
Description, installation parameters, reduction- and group factors

**Annex C59**

## Brick type: Solid light weight concrete brick VBL – continuation

### Table C168: Characteristic resistance under tension and shear load

| Anchor size | Sleeve VM-SH | Effective anchorage depth | Characteristic resistance with $c \geq c_{cr}$ and $s \geq s_{cr}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Use condition | | | | | | |
| | | | d/d | | | w/d w/w | | | d/d w/d w/w |
| | | | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | 24°C / 40°C | 50°C / 80°C | 72°C / 120°C | all temperature ranges |
| | | $h_{ef}$ | $N_{Rk,b} = N_{Rk,p}$ [1] | | | | | | $V_{Rk,b}$ [1] |
| | | [mm] | [kN] | | | | | | [kN] |
| **Normalised mean compressive strength $f_b \geq 2$ N/mm² [2]** | | | | | | | | | |
| M8 | - | 80 | 3,0 | 2,5 | 2,0 | 2,5 | 2,0 | 1,5 | 3,0 |
| M10 / IG-M6 | - | 90 | | | | | | | |
| M12 / M16 / IG-M8 / IG-M10 | - | 100 | | | | | | | |
| M8 | VM-SH 12 | 80 | 2,5 | 2,5 | 2,0 | 2,5 | 2,0 | 1,5 | |
| M8 / M10 IG-M6 | VM-SH 16 | ≥ 85 | | | | | | | |
| M12 / M16 / IG-M8 / IG-M10 | VM-SH 20 | ≥ 85 | | | | | | | |

[1] $N_{Rk,b,c} = N_{Rk,p,c}$ and $V_{Rk,c\,II} = V_{Rk,c\perp}$ according to Annex C5

[2] For lower compressive strengths resistances must be multiplied by the conversion factor according to Table C164. For stones with higher strengths, the shown values are valid without conversion.

### Table C169: Displacements

| Anchor size | $h_{ef}$ | $\delta_N$ / N | $\delta_{N0}$ | $\delta_{N\infty}$ | $\delta_V$ / V | $\delta_{V0}$ | $\delta_{V\infty}$ |
|---|---|---|---|---|---|---|---|
| | [mm] | [mm/kN] | [mm] | [mm] | [mm/kN] | [mm] | [mm] |
| M8 – M12 / IG-M6 – IG-M10 | all | 0,10 | $0,10*N_{Rk} / 3,5$ | $2*\delta_{N0}$ | 0,30 | $0,30*V_{Rk} / 3,5$ | $1,5*\delta_{V0}$ |
| M16 | | | | | 0,10 | $0,10*V_{Rk} / 3,5$ | |

| | |
|---|---|
| **Injection System VMU plus for masonry** | **Annex C60** |
| **Performances – Solid light weight concrete brick VBL**<br>Characteristic resistance and displacements | |