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ift RESEARCH REPORT
Short Report
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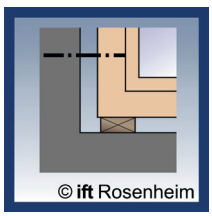
Burglar resistance with highly thermally insulating clay masonry

Analysis of the actual condition,
development of construction and verification criteria





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Short Report

Topic	Burglary resistance with highly thermally insulated clay masonry - analysis of the actual condition, development of construction and verification criteria
Short title	Burglary resistance clay masonry
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The authors are responsible for the contents of this report.

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1 Motivation and aim of the project

The testing and classification of the burglary-resistance properties of windows and doors is regulated by the series of standards DIN EN 1627 to 1630 [1], [2], [3], [4]. In the national preface of DIN EN 1627, depending on the resistance class of the building element, the suitable masonry is defined via specifications for wall thickness, compressive strength and bulk density class of the bricks as well as for mortar group (Table 1).

Table 1 Required properties of massive walls depending on the resistance class of the component to be installed. Excerpt from the national foreword to DIN EN 1627

Resistance class according to DIN EN 1627	Surrounding walls			
	Of masonry according to DIN 1053-1			
	Wall thickness (without render) mm	Compressive strength class of the blocks	Density class of the blocks	Mortar group
RC 1 N RC 2 N RC 2	≥ 115	≥ 12	-	min. M 2,5 / TLM
RC 3	≥ 115	≥ 12	-	min. M 2,5 / TLM
RC 4	≥ 240	≥ 12	-	min. M 2,5 / TLM
RC 5	≥ 240	≥ 20	≥ 1,8	TLM
RC 6	≥ 240 [a)]	≥ 20	≥ 1,8	TLM
[a)] applicable for units with heights 238 mm, 498 mm, 623 mm und 648 mm				

As a result of the constantly increasing requirements of the energy saving regulations for the reduction of the thermal transmission heat losses in the building envelope and the associated thermal optimisation of modern clay masonry materials, modern clay masonry is produced in low density and compressive strength classes, which are not included in the table in DIN EN 1627. For this reason, the installation of burglary-resistant building elements in highly thermally insulating clay masonry is not covered by standards.

The objective of the research project was therefore to be able to make generally valid statements about the suitability of highly thermally insulating clay masonry with regard to the installation of burglary-resistant building elements in accordance with DIN EN 1627. The focus was on the resistance classes RC2 and RC3.

2 Course of action

The key part of the practical investigation was the testing according to DIN EN 1627 of already classified burglary-resistant building elements of resistance classes RC2 and RC3 in a real installation situation, i.e. in different walls of thermally insulated clay masonry.

The test specimens were examined according to DIN EN 1628 and DIN EN 1629 for their resistance to static and dynamic loading on the component.

The testing of the resistance against a manual attack in accordance with DIN EN 1630 has been extended. The procedure was "from inside to outside". This means that the component was first subjected to a normative burglary test in the classified resistance class. The objective was to investigate whether the installation in the corresponding clay masonry had an influence on the resistance class of the window itself in comparison to the installation in a rigid testing frame.

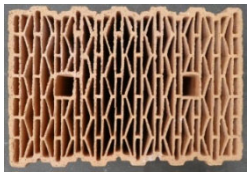
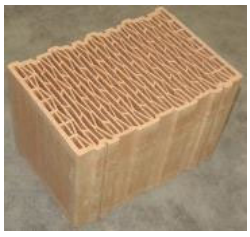
The surrounding joint, the fasteners and the anchoring of the fastener in the clay masonry were then examined. An attack on the wall surface in order to achieve an accessible opening was also carried out as part of the research project. For these extended and not normatively intended attacks, the tool kit belonging to the corresponding class was used.

2.1 Examined clay masonry units

At a wall thickness of 365 mm a representative selection of modern clay masonry was examined. Both, clay masonry units with small-chamber coring with thin web structure and insulated large-chamber units with wide webs were tested. The compressive strength classes were between 4 and 10, the density classes between 0.5 and 0.65. These properties were determined in an independent material test.

For the wall constructions the regular clay masonry units were used. In the reveal clay units with a smooth surface were used, if available. If not and the reveal side brick surface was too uneven for window installation, a levelling layer was applied.

Table 2 Overview of the examined clay masonry with wall thickness 365 mm

No.	Name	Image	Characteristics
1	Unipor Coriso W07		Compressive strength class 6 Bulk density class 0,60
2	Purus PL-075		Compressive strength class 10 Bulk density class 0,65
3	Planziegel U9		Compressive strength class 6 Bulk density class 0,65
4	Planziegel U8		Compressive strength class 4 Bulk density class 0,60
5	Thermopor TV9		Compressive strength class 8 Bulk density class 0,65
6	Thermopor TV7		Compressive strength class 6 Bulk density class 0,50

For one wall construction special clay masonry units for the fastening of windows in the reveal were used in addition. In two further wall constructions, clay masonry units with a wall thickness of 240 mm were tested in order to gain knowledge for the renovation.

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2.2 Examined Windows

The study focused mainly on plastic windows (PaXsecura 200, PaXsecura 300) of resistance classes RC2 and RC3 with the opening types turn/tilt and tilt. The sizes of approx. 0.5 m x 0.75 m, approx. 1 m x 1 m and approx. 1 m x 2 m were selected according to hardware and practical considerations. In addition, wooden windows, also PaXsecura 200 and PaXsecura 300, were used in two wall constructions.

2.3 Examined Installation

The windows were installed in the mean third of the reveal.
Sideways a push-through installation with fixings of the type Würth AMO Combi 7.5/11.5 and associated plastic dowels was carried out. At the bottom, the Würth JB-DK mounting bracket was used and anchored to the inner facing surface using a deflection angle. The width of the circumferential assembly joint was usually 15-20 mm.

For resistance class RC2, no pressure-resistant backing was provided between frame and masonry. At the top there was no fixing or backing to simulate a roller shutter connection.
The elements of resistance class RC3 were additionally anchored above into an insulated lintel of clay masonry. Therefore fixings of the type AMO Combi 7.5/11.5 and associated plastic dowels were used. In the area of the fixing points between frame an clay masonry a pressure-resistant block was arranged.

As an alternative to the lower fastening with the mounting bracket, the anchoring in a turned thermal insulation lintel was also tested.

2.4 Examined wall structures

From the different clay masonry units 19 wall sections were built and the windows installed. An external render was applied at the wall surface up to the window frame.

Variations from single-layer lightweight render to multi-layer lightweight and reinforcement render structures were investigated. The inside wall surface and the inside reveal were not plastered.

3 Results

The clay masonry units examined represent the majority of highly insulating clay masonry units on the German market. On the basis of the experience gained during the tests on 19 wall structures with a total of 41 window installations, generally valid statements can be derived on the use of burglary-resistant construction elements in highly thermally insulating clay masonry. These generally valid statements are presented in Table 3 in the form of an update to Table NA.2 of DIN EN 1627. The additions made to the original table are inserted in red.

Table 3 Proposal to extend table NA.2

Resistance class of the component according to DIN EN 1627	Surrounding walls of masonry according to DIN 1053-1 or DIN EN 1996			
	Wall thickness (without render) mm	Compressive strength class of the blocks (DFK)	Density class of the blocks (RDK)	Mortar group and exterior render [e]
RC 1 N RC 2 N RC 2	≥ 115	≥ 12	-	min. MG II / DM
	≥ 240 [b] [f]	≥ 6 [b] [f]	≥ 0,8 [b] [f]	min MG II / DM and exterior render [d]
	≥ 360 [b]	≥ 6 [b]	≥ 0,50 [b]	min MG II / DM and exterior render [c]
RC 3	≥ 115	≥ 12	-	min. MG II / DM
	≥ 240 [b] [f]	≥ 6 [b] [f]	≥ 0,8 [b] [f]	min MG II / DM and exterior render [d] and suitable design of the parapet [g]
	≥ 360 [b]	≥ 6 [b]	≥ 0,50 [b]	min MG II / DM and exterior render [d] and suitable design of the parapet [g]
RC 4	≥ 240	≥ 12	-	min. MG II / DM
RC 5	≥ 240	≥ 20	≥ 1,8	DM
RC 6	≥ 240 [a]	≥ 20	≥ 1,8	DM

[a] Applicable to formats of height 238 mm, 498 mm, 623 mm und 648 mm

[b] Valid for plane bricks according to EN 771-1 or national technical approval. Assembly of the component in the middle third of the wall.

[c] A minimum of 20 mm light render type II of compressive strength CS II is required.

[d] At least 20 mm light render type II of compressive strength CS II and at least 5 mm light render mortar of compressive strength CS III with inlaid reinforcement fabric as upper render are required.

[e] The external render must be applied on the wall surface and in the reveal up to the window frame.

[f] Applicable only on planar perforated bricks with perforation B according to DIN 20000-401

[g] A suitable parapet design is e.g. the arrangement of a rotated built-in thermal insulation lintel, the arrangement of a massive window sill etc.

With a wall thickness of at least 360 mm, clay masonry units from compressive strength class 6 and density class of the blocks 0.50 can also be used. In the tests, no significant influence of such bricks on the burglary resistance of the elements was found. However, depending on the resistance class of the building element, a corresponding standard exterior render must still be applied. This extends the resistance time against attacks on the fasteners and the clay masonry unit itself and must be applied to the wall surface and the reveal and led to the frame.

The burglary-resistant element must be installed in the middle third of the wall. The aim here is to use the clay masonry material to protect the fastener from an attack or to increase the resistance time. For all vertically perforated bricks with compressive strength class ≤ 12, in conjunction with resistance class RC3, the parapet or the bearing surface of the brick below the structural element must also be protected against an attack with suitable measures. A suitable solution is e.g. the arrangement of a rotated installed thermal insulation lintel or a solid window sill.

In the research project, fasteners were used that were screwed into the brick approx. 18 cm deep in the side area during standard installation and approx. 9 cm into the brick lintel in the upper area in resistance class RC3. The diameter of the fasteners was 7.5 mm in the brick and 11.5 mm in the frame. In addition, the dowel associated with the fastener was used during installation.
As the numerous tests have shown, it is not only the bricks and the elements themselves that have an influence on burglary resistance. The type of installation and the fasteners used can also have a considerable influence. DIN EN 1630 refers to the manufacturer's responsibility to also provide instructions for fastening the product in the assembly instructions. The described instructions must be suitable for the corresponding resistance class of burglary resistance. It is therefore recommended to qualify fasteners separately for suitability for installation of burglary-resistant windows and doors in high thermal insulation clay masonry. For this purpose, burglary attempts should be carried out according to DIN EN 1627 ff with additional attack on the fasteners on a wall made of clay masonry units with small-chamber coring and a wall made of large-chamber units.

Experience from the research project shows that a French door can withstand an attack longer than a small window with only a few lateral fixing points due to the higher number of lateral fixing points. In the RC3 resistance class, at least two fasteners should be arranged on each side to increase the resistance time in the event of an attack on the fasteners. As a general rule, the more fasteners are used, the longer the resistance time when attacking them.

Special clay masonry units for the reveal have proven to be obvious positive when attacking the fasteners. When using such bricks, however, the reinforced render structure cannot be dispensed with in resistance class RC3. This is still needed to protect the wall surface.

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In conjunction with resistance class RC3, a pressure-resistant underlay was arranged between the frame and the masonry in the area of the fasteners. This prevents the sash frame from being levered out of the frame. In addition, the research project has shown that it is advantageous to pass the fastener through the pressure-resistant backing. This is because when the fastener is attacked, it is protected by the material of the backing lining.

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