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Assembly of burglar resistant building components in high thermal insulating brick masonry

Interim status to the current research project

Introduction

The evidence as well as the classification of the burglar resistant properties of windows and doors are made by testing and classification of the building element according to the standards series DIN EN 1627 to DIN EN 1630 [1], [2], [3], [4]. Besides the burglar resistant characteristics of the pure construction element, DIN EN 1627 settles also the assembly of the element. In order to secure the burglar resistance, it is normatively mandatory that also the fixings in combination with the corresponding masonry resist the mechanical burglary attempts. The corresponding standard DIN EN 1627 contains the following specifications for assembly and/or walls (see table 1) in the national foreword:

Table 1 Extract of national annex of DIN EN 1627 [5]

NA.5 Montage/Beispiele für geeignete Wände/Montagebescheinigung

Einbruchhemmende Bauteile sind für den Einbau in dafür geeignete Wände (siehe Tabellen NA.2 bis NA.4) vorgesehen. Besondere Gegebenheiten der Mauerwerksöffnung, wie z. B. zweischaliges Mauerwerk, sind ebenso anzugeben wie die Lage des Elements in der Leibung oder die Art des Mauerwerks.

Tabelle NA.2 — Zuordnung der Widerstandsklassen von einbruchhemmenden Bauteilen zu Massivwänden

Widerstandsklasse des Bauteils nach DIN EN 1627	Umgebende Wände					
	aus Mauerwerk nach DIN 1053-1				aus Stahlbeton nach DIN 1045	
	Wanddicke (ohne Putz) mm	Druckfestigkeitsklasse der Steine (DFK)	Rohdichteklasse der Steine (RDK)	Mörtelgruppe	Nenndicke mm min.	Festigkeitsklasse min.
RC 1 N RC 2 N RC 2	≥ 115	≥ 12	-	min. MG II / DM	≥ 100	B 15
RC 3	≥ 115	≥ 12	-	min. MG II / DM	≥ 120	B 15
RC 4	≥ 240	≥ 12	-	min. MG II / DM	≥ 140	B 15
RC 5	≥ 240	≥ 20	≥ 1,8	DM	≥ 140	B 15
RC 6	≥ 240 [a])	≥ 20	≥ 1,8	DM	≥ 140	B 15

[a]) Anwendbar auf Formate der Höhe 238 mm, 498 mm, 623 mm und 648 mm.

As you can see, minimum strengths and thicknesses of the walls are mentioned as requirement for the RC classification of the elements to transfer resulting loads. For vertically perforated bricks, a compressive strength class of stones of minimum 12 at a minimum wall thickness of 115 mm (up to RC3) or 240 mm (from RC4) applies.

However, modern highly thermal insulating brickwork is generally produced with lower compressive strength. Thus, the installation of burglar resistant building components is not permitted in such walls. Further intensive single testing (each window system with each possible brick) would be necessary.

At ift Rosenheim, tests for burglar resistance have been carried out in the past, where the assembly as well as the transition to the highly thermal insulating masonry was identified as a possible weak point in the overall system. A detailed analysis regarding the properties that lead to failure and/or passing of the mechanical attack attempt is not available.

Therefore, in a research project ongoing since summer 2016, tests for burglar resistance of windows in highly thermal insulating brickwork are made. The project aims at the preparation of an addition to the national annex of DIN EN 1627 that makes it possible to use highly thermal insulating brickwork for burglar resistant building components. However, in order to justify an adequate extension and/or adaptation of table NA.2, an analysis of the existing situation as well as the main wall parameters that are leading to failure and/or passing of the manual burglary test, is needed. The focus of these tests is on the resistance classes RC2 as well as RC3. The research project is sponsored by Forschungsinitiative Zukunft Bau. The Arbeitsgemeinschaft Mauerziegel, company Pax as well as company Würth are supporting this project as project partners.

Tests

The project group agreed to hinge the planning and definition of the following wall structures on the results of the previous test specimen. The following properties of the components are taken into account:

- Definition of resistance class (RC2 and/or RC3)
- Construction of masonry
  - Wall thickness
  - Mechanical properties
  - Hole pattern (filigree/large chambers) and insulation (backfilled/unfilled)
  - Special stones
  - Formation of lintel beam as well as lower attachment
- Construction of window
  - Profile system
  - Reinforcements

  - Glazing
  - Hardware and locking points
  - Dimensions
- Fixing of window
  - Fixing distances
  - Upper fixing (roller shutter box simulation)
  - Construction of lower fixing
  - Compression resisting packing
  - Width of mounting gap
  - Method of fixing (dimensions and type)
- Construction of plaster
  - Plaster work (yes / no)
  - Type of plaster
  - Reinforcement plaster
  - Reinforcement fabric
  - Plaster strips
  - Special reinforcement

The defined specimen are placed in the surround frame with the dimensions 3.5 m x 3.5 m or 3.5 m x 2.5 m and then mounted in the test rig.

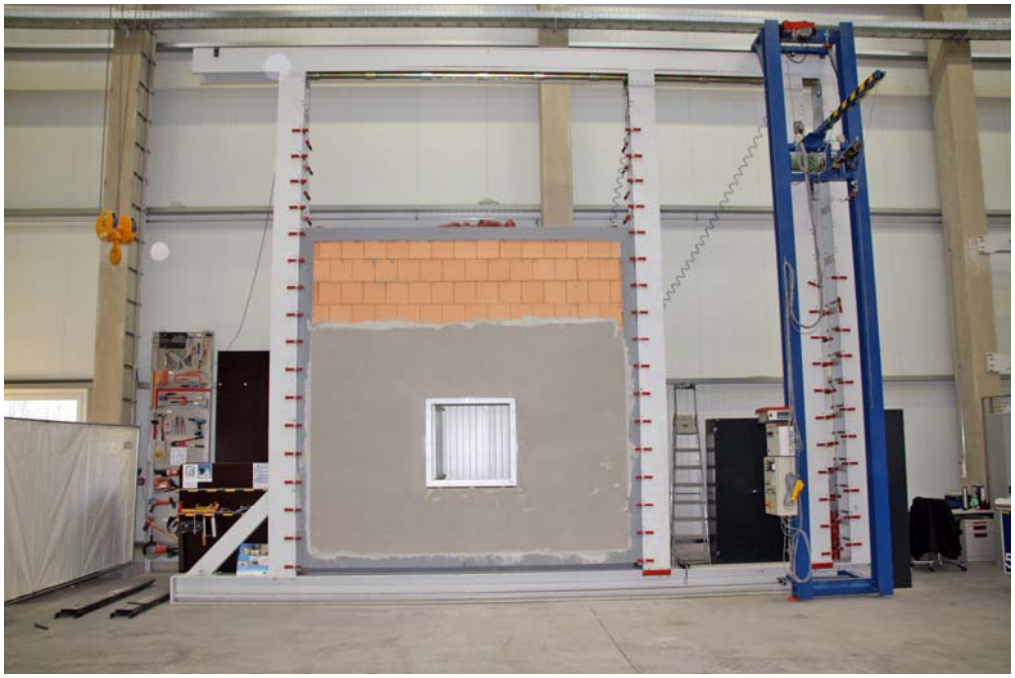

Fig. 1 Example wall structure

The examination of the test specimen regarding their resistance to static and dynamic loading is determined at the window or door element according to the normative guideline.

The examination of the resistance to manual attack is extended. This is “from the inside out”. This means that a pretest has to be initially performed at the window or door element in the defined class. The aim is to investigate whether the installation situation has an influence on the resistance class of the window. Subsequently, the assembly joints, assembly means and the fixing method of the assembly means are tested in the brick. An attack on the wall surface to achieve an accessible opening is also carried out within the project. The tool set appropriate for the class is used for extended attacks.

Present Results

So far, five wall structures with a total of eleven window and balcony door elements of different configurations of dimensions, assembly, brick as well as plaster design were tested for their resistance in class RC2. The results achieved were all positive. No accessible openings could be created during the attack on the window as well as on the fixings and the wall.

Fig. 2 Example attack on reveal with RC2 tool

Three wall elements with integrated windows were tested in resistance class RC3. The pretests have shown that, in particular, the protection of the fixing method is of high priority as the fixings can be demolished when trying to access with a crow bar. Therefore, examinations are executed, which measures can prevent the access to the mounting element or how the time can be increased for this, so that no accessible opening could be made within the test period of five minutes. The reinforcement of the plaster with adequate reinforcement fabric is checked as possible measure.

Fig. 3 Attack on reveal with crow bar

Summary

All previous tests regarding resistance class RC2 were positive. Furthermore, it has been shown that a resistance class of RC3 can be reached with appropriate measures within the reveal. Therefore, the project group is confident that appropriate proposals can be compiled within this project, by which the extension of the wall structures is possible according to EN 1627 for highly thermal insulating brickwork.

Literature

[1] DIN EN 1627:2011-09
Pedestrian doorsets, windows, curtain walling, grilles and shutters - Burglar resistance - Requirements and classification
Beuth Verlag GmbH, Berlin

[2] DIN EN 1628:2016-03
Pedestrian doorsets, windows, curtain walling, grilles and shutters - Burglar resistance - Test method for the determination of resistance under static loading
Beuth Verlag GmbH, Berlin

[3] DIN EN 1629:2016-03
Pedestrian doorsets, windows, curtain walling, grilles and shutters - Burglar resistance - Test method for the determination of resistance under dynamic loading
Beuth Verlag GmbH, Berlin

[4] DIN EN 1630:2016-03
Pedestrian doorsets, windows, curtain walling, grilles and shutters - Burglar resistance - Test method for the determination of resistance to manual burglary attempts
Beuth Verlag GmbH, Berlin

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