November 2020

Gebrik Fire Performance v8

Introduction

Rigid polyurethane (PUR) foams are widely used as an insulation material in a variety of building applications. Since the first oil crisis in the seventies and the resulting increase in energy cost, insulation materials have been gradually utilised more and more in buildings. Since then, regulatory requirements and recommendations to achieve a certain U value have come into force in several countries. Consequently, the majority of new buildings have, to a varying extent, insulation installed.

The insulation capacity of PUR is exemplary and extremely competitive. It has excellent physical properties, eg mechanical strength, dimensional stability, water resistance, etc. Furthermore, it is light-weight, quick to install and its ability to be used to create composite panels and sandwich panels in a factory offer several advantages in comparison to site-assembled constructions. However, polyurethane foams are combustible and their use is controlled by the Building Regulations. All building products must therefore comply with the fire standards described therein.

A combustible material is something that can combust (burn) in air. Flammable materials are combustible materials that ignite easily at ambient temperatures. In other words, a combustible material ignites with some effort and a flammable material catches fire immediately on exposure to flame. It is therefore recognised that a fire will spread quickly subject to the degree of flammability or combustibility of a material and the temperature to which it is exposed. The use of appropriate materials will, as a consequence, dramatically reduce the speed with which flames spread through and across a building, whilst also minimising its contribution to the fire.

Statistically, the probability of a fire starting in a dwelling is very low, but the majority of fire deaths occur in dwellings. It is generally accepted that the most common cause of death in a fire is to be overcome by smoke and gases, which is confirmed by UK and US data. In the US however, 66 per cent to 75 per cent of deaths are caused this way, compared with 40 per cent in the UK. The prevalence of greater compartmentalisation and use of fire doors in UK home design, so that fires are more likely to stay small, may be the reason why fire conditions differ between the US and the UK. It is when the fire extends beyond the room of origin that the majority of fire deaths occur. Therefore, where a cavity is used in the superstructure, it too should be compartmentalised to minimise fire spread, which is typically done by applying intumescent strips to the outer face of the inner substrate at appropriate vertical and horizontal locations.

Many misconceptions have occurred concerning the performance in a fire situation of polyurethane based building products. This statement has therefore been produced to provide information on the rigorous testing of Gebrik, its conformance with the UK Building Regulations and its actual performance in a fire situation.

Meeting Building Regulations for Fire Safety

Following the tragic loss of life caused by the fire at Grenfell Tower in 2017 and other large-scale fires across the world, governments and fire experts have been carrying out rigorous assessments of the fire performance of numerous types of insulation and cladding used on buildings. In the UK, governments have generally concluded that on certain types of building only materials with a Euroclass (EN13501) rating of A1 (Non-Combustible) or A2 (Limited Combustible) should be used without additional large-scale test evidence.

On the 29th November 2018, the Government of England announced that with effect from 21st December 2018, a number of amendments would be made to Approved Document B, Volume 1: Dwellings of the Building Regulations for use in England. The relevant amendment in terms of external cladding is as follows:

An extract from Approved Document B, Volume 1: Dwellings

Requirement

Requirement	*Limits on application*
External fire spread	
B4. (1) The external walls of the building shall adequately resist the spread of fire over the walls and from one building to another having regard to the height, use and position of the building.	
(2) The roof of the building shall adequately resist the spread of fire over the roof and from one building to another, having regard to the use and position of the building.	

Regulation

Materials and workmanship

7. (1) Building work shall be carried out—

(a) with adequate and proper materials which—

(i) are appropriate for the circumstances in which they are used,

(ii) are adequately mixed or prepared, and

(iii) are applied, used or fixed so as adequately to perform the functions for which they are designed; and

(b) in a workmanlike manner.

(2) Subject to paragraph (3), building work shall be carried out so that materials which become part of an external wall, or specified attachment, of a relevant building are of European Classification A2-s1, d0 or A1, classified in accordance with BS EN 13501-1:2007+A1:2009 entitled "Fire classification of construction products and building elements. Classification using test data from reaction to fire tests" (ISBN 978 0 580 59861 6) published by the British Standards Institution on 30th March 2007 and amended in November 2009.

(3) Paragraph (2) does not apply to—

(a) cavity trays when used between two leaves of masonry;

(b) any part of a roof (other than any part of a roof which falls within paragraph (iv) of regulation 2(6)) if that part is connected to an external wall;

(c) door frames and doors;

(d) electrical installations;

(e) insulation and water proofing materials used below ground level;

(f) intumescent and fire stopping materials where the inclusion of the materials is necessary to meet the requirements of Part B of Schedule 1;

(g) membranes;

(h) seals, gaskets, fixings, sealants and backer rods;

(i) thermal break materials where the inclusion of the materials is necessary to meet the thermal bridging requirements of Part L of Schedule 1; or

(j) window frames and glass.

(4) In this regulation—

(a) a "relevant building" means a building with a storey (not including roof-top plant areas or any storey consisting exclusively of plant rooms) at least 18 metres above ground level and which—

(i) contains one or more dwellings;

(ii) contains an institution; or

(iii) contains a room for residential purposes (excluding any room in a hostel, hotel or boarding house); and

(b) "above ground level" in relation to a storey means above ground level when measured from the lowest ground level adjoining the outside of a building to the top of the floor surface of the storey.

As a result of the amendments, if the finished floor level of the top (occupied) floor exceeds 18m (see Diagram D6 in Appendix D of the Building Regulations), only A1 or A2-rated materials, as defined in EN13501-1, should be used where the building either contains one or more dwelling; is an institution, e.g. hospital, care home, residential school, sheltered accommodation, student halls of residence; contains a room for residential purposes (excluding hostels, hotels & boarding houses). This also applies to the 'material change of use' of a building type covered within the list.

Volume 2 of the Building Regulations for England applies to buildings other than dwellings and in the associated Approved Document B: Fire Safety, §12.4 **Combustibility of external walls** states that "*The external walls of buildings other than those described in Regulation 7(4) of the Building Regulations should either meet the guidance given in paragraphs 12.5 to 12.8 or meet the performance criteria given in the BRE Report 'Fire performance of external thermal insulation for walls of multistorey buildings (BR135)' for external walls using full-scale test data from BS8414-1:2015 or BS8414-2:2015. The total amount of combustible materials may also be limited in practice by the provisions for space separation in Section 13.*"

Typically, the regulations in Wales and Northern Ireland mirror those in England however, as this can change, it is important to ensure to check before any design, specification and construction.

In Scotland, the building standards handbooks provide guidance on achieving the standards set in the Building (Scotland) Regulations 2004. They were also amended post-Grenfell and apply to any building warrant submitted on or after 1st October 2019 and to building work

which does not require a warrant commenced from that date. §2.7.1 **External wall cladding** reduces the maximum height from 18m down to 11m (based on the reach capability of a fire and rescue service ground mounted water jet where there is sufficient pressure and flow in the water main), however there is alternative guidance for the use of combustible materials provided they are used in strict accordance with BR135. In the Domestic Handbook it states:

2.7.1 External wall cladding

External wall cladding includes non load-bearing external wall cladding systems attached to the structure, for example, composite panels, clay or concrete tiles, slates, pre-cast concrete panels, stone panels, masonry, profiled metal sheeting including sandwich panels, timber panels, weather boarding, thermally insulated external wall rendered systems, and other ventilated cladding systems. For the purposes of compliance with Standard 2.7, external wall cladding includes spandrel panels and infill panels.

External wall cladding more than 1m to the boundary may be constructed from combustible products more than 1mm thick which is European Classifications B, C, D or E (see annex 2.B). This guidance does not apply to domestic buildings having a storey more than 11m above ground level.

External wall cladding not more than 1m from a boundary should achieve European Classification A1 or A2 except cladding to a house where:
• the cladding achieves a European Classification B, and
• the wall behind the cladding has the appropriate fire resistance duration from both sides.

Storey height more than 11m – Where the building has a storey at a height of more than 11m above the ground the external wall cladding system should be constructed of products achieving European Classification A1 or A2.

Alternative guidance - BR 135, 'Fire Performance of external thermal insulation for walls of multi-storey buildings' and BS 8414: Part 1: 2015+A1: 2017 or BS 8414: Part 2: 2015+A1: 2017 provides guidance on fire spread on external wall cladding systems. The guidance provided in these publications may be used as an alternative to European Classification A1 or A2 external wall cladding and for European Classification A1 and A2 products exposed in a cavity. BS 9414: 2019 (Draft June 2019) provides additional information on the application of results from BS 8414 tests.

The Non-Domestic Handbook varies slightly as follows:

2.7.1 External wall cladding

External wall cladding includes non load-bearing external wall cladding systems attached to the structure, for example, composite panels, clay or concrete tiles, slates, pre-cast concrete panels, stone panels, masonry, profiled metal sheeting including sandwich panels, timber panels, weather boarding, thermally insulated external wall rendered systems, and other ventilated cladding systems. For the purposes of compliance with Standard 2.7, external wall cladding includes spandrel panels and infill panels.

A cavity formed by external wall cladding should be protected in accordance with the guidance to Standard 2.4 and fire spread to neighbouring buildings in accordance with the guidance to Standard 2.6.

External wall cladding not more than 1m from a boundary should achieve European Classification A1 or A2.

Where the cladding is more than 1m from the boundary and is constructed from combustible products more than 1mm thick, that has a European Classification B, C, D or E (as described in annex 2.E), the cladding should be constructed from products with a reaction to fire in accordance with the following table:

Table 2.9 Reaction to fire of external wall cladding more than 1m from Boundary

Building Use	Topmost storey height above ground [1]	European Classification [2]
Entertainment and Assembly Building	Any	A1 or A2
Entertainment and Assembly Building with a total storey area not more than 500 m^2	11m	B, C, D or E
Hospital and residential care building	Any	A1 or A2
Hospital and residential care building with a total storey area not exceeding 200 m^2	11m	B, C, D or E
Any other building	More than 11m	A1 or A2
	Not more than 11m	B, C, D or E

Additional information:

1. Includes single-storey buildings
2. See exemptions in annex 2.E

Alternative guidance - BR 135, 'Fire Performance of external thermal insulation for walls of multi-storey buildings' and BS 8414: Part 1: 2015+A1: 2017 or BS 8414: Part 2: 2015+A1: 2017 provides guidance on fire spread on external wall cladding systems. The guidance provided in these publications may be used as an alternative to European Classification A1 or A2 external wall cladding and for European Classification A1 and A2 products exposed in a cavity. BS 9414: 2019 (Draft June 2019) provides additional information on the application of results from BS 8414 tests.

Clearly, when designing a building, the safety of its structure, occupants and surrounding community are paramount regardless of location. Fire safety is a key consideration and should never be a 'tick-box exercise'. As new materials and methods of construction become available, clearly it has never been more important to take a professional, balanced and informed approach to ensure the most appropriate solution is specified and used for the safety of the building occupiers and owners.

When appropriately tested and proven, combustible materials can be used. Dame Judith Hackett has always expressed a preference for evidence-based decisions, rather than a prescriptive approach. With professional guidance and advice, safe buildings can be achieved using materials that are not A-rated. The materials used on the Grenfell Tower were not appropriately tested and proven and, when tested to BS8414 after the event, the materials used did not meet BR135 'Pass' criteria.

Gebrik Insulating Brick Cladding System

Introduction

Gebrik is a factory-produced insulating brick cladding system. Panels and corners are formed by casting brick slips in polyurethane, with a thin layer of sand combined with the PU during manufacture to encase the slips and create a 10mm gap to apply fixings, which mechanically secure the system to the substrate. Panel chambers are created where panels abut and are site-injected with expandable PU foam to complete a watertight seal. Matching slips are then site-applied with system adhesive to maintain stretcher bond (none is required in the case of stack bond). Finally, the system is pointed with lime, sand, cement mortar. The system is therefore intended to provide a decorative, non-load bearing facade which will insulate and protect the inner leaf from heat loss and water ingress.

BS8414/BR135

The Gebrik system has been tested in accordance with BS8414-1:2002 and BS8414-2:2005 on a number of occasions and on each occasion, when classified in accordance with Annex A and B of BRE Report (BR 135) Fire Performance of External Insulation for Walls of Multi-Storey Buildings, it has been shown to have met the performance criteria.

As a consequence of the BR135 Classification, Gebrik meets the fire safety requirements of the Building Regulations/Standards for external fire spread in accordance with Approved Documents B Volume 2, Technical Handbooks Section 2 and Building Control Alliance Technical Guidance Note 18.

Furthermore, a BR135 Assessment has been carried out, which is based on a desktop study of the Gebrik system and its application to light gauge steel framing and masonry substrates - both with and without cavities. The Assessment evaluates the various layers of the substrate that have been tested and provides a guide for façade designers in terms of which layers can vary from the material type and thickness tested.

EN13501-1:2007+A1:2009

The harmonized European Fire Standards are a set of test standards that have been accepted by all countries within the European Economic Community. This allows manufacturers to produce or import products that have been tested to a common standard without the need to test in each member state. Testing to these standards is now accepted in all EEC countries. Compliance with European standards and regulations is mandatory.

All certified European test laboratories ("Notified Bodies") who are listed with EOTA (European Organisation for Technical Approval) may perform these tests and issue the corresponding test reports (ITT – Initial Type Testing). In addition, there may be a national test or building regulation requirements that need to be observed.

The European standard EN 13501-1: Reaction to Fire provides a number of performance criteria to measure the fire characteristics of building products. The criteria covers the spread of flame and contribution to fire as well as the generation of smoke and the production of burning droplets. The following table provides an overview of the available classifications:

Additional requirements		European class according to EN13501-1
No Smoke	No burning droplets falling/dripping	
✓	✓	*A1*
✓	✓	*A2-s1,d0*
✓	✓	*B-s1,d0*
✓	✓	*C-s1,d0*
	✓	*A2-s2,d0*
	✓	*A2-s3,d0*
	✓	*B,C-s2,d0*
	✓	*B,C-s3,d0*
✓		*A2-s1,d1*
✓		*A2-s1,d2*
✓		*B,C-s1,d1*
✓		*B,C-s1,d2*
		A2-s3,d2
		B-s3,d2
		BA2-s3,d2
✓	✓	*D-s1,d0*
	✓	*D-s2,d0*
	✓	*D-s3,d0*
		E
✓		*D-s1,d2*
		D-s2,d2
		D-s3,d2
		E-d2
		F

Class A1 *products will not contribute to the fire growth nor to the fully developed fire*
Class A2 *products will not significantly contribute to the fire growth and fire load in a fully developed fire*
Class B *products will not lead to a flashover situation, however, they will contribute to the fully developed fire*
Class C *products may lead to a flashover situation, but only in the second part of the reference scenario test, ie after more than 10 minutes*
Class D *products may lead to a flashover situation, within the first part of the reference scenario test, i.e. within 10 minutes, but not within less than 2 minutes*
Class E *products may quickly lead to a flashover situation, possibly within the first two minutes of the reference scenario test.*
The additional designations are:

Smoke	***Burning droplets***
s1, s2, s3	*d0, d1, d2*
s1 = little or no smoke generation	*d0 = no droplets within 600 seconds*
S2 = medium smoke generation	*d1 = droplet form within 600 seconds but do not burn for more than 10 seconds*
S3 = heavy smoke generation	*d2 = Not as d0 or d1*

The Gebrik system has been tested in accordance with EN13501-1:2007+A1:2009 to produce a classification of Reaction to Fire Performance and has been classified as **B - s1, d0**, i.e.

B - will not lead to a flashover situation, however it will contribute to the fully developed fire
s1 - little or no smoke generation
d0 - no droplets within 600 seconds

Internal Testing Procedure

The data obtained by the BBA is as a result of tests carried out in accordance with the German test DIN 4102. Part B1 is carried out off-site and Part B2 is carried out in the factory laboratories. Details of each test are detailed below:

Part B1

A 4-sided 'chimney' is built with the face of the panels facing inwards. A fire is lit within the chimney to test the spread of flames across the surface. The results of which prove the system will withstand fire. (Results are available upon request).

Part B2

A section of the panel is placed in a chamber and held above a naked flame (photo 1). The foam is calibrated at 10mm intervals between 100mm and 150mm from the flame. The size of the flame is measured and held at the bottom edge of the test sample.

Photo 1

Photo 2

The foam chars (photo 2) but neither melts nor spreads the flame beyond the 150mm mark. Once the flame is removed from the test sample, the foam ceases to burn. (Tested samples are available upon request).

An Example of the Performance of Gebrik in Fire

Gebrik has been exposed to real examples of fire exposure on actual buildings and one example can be seen in the photos below of a project in Gosport, Hampshire which involved the refurbishment of a series of social houses. It was used to predominantly clad gable ends whilst insulated render was used to clad the remainder of the buildings. As a result of vandalism, a house was set alight and at its peak, it was reported locally that approximately 3m high flames could be seen rising from the windows.

The expanded polystyrene (EPS) within the render system melted to virtually remove the entire render system from the building around the fire outbreak. The heat was so intense that the bordering fence was heavily charred. The Gebrik remains intact and the only damage has been caused by smoke and the fire service, who removed 7 slips to check the fire wouldn't continue behind the slips. There was no damage to the substrate so the damaged Gebrik area was simply replaced with another corner.