Fire safety of multi-storey building facades
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PURPOSE AND SCOPE OF THE DOCUMENT

This document has been drafted in the light of the recent facade fires that took place in high-rise buildings, and more particularly as a consequence of the Grenfell Tower tragedy in London in June this year.

The objectives are notably:

- to give an overview of the current regulatory and normative framework concerning the fire safety in Belgium, and more particularly with regard to the risk of fire spreading via the facades. This document will present the revision work to the regulation currently under way as well as some proposed initial approaches;
- to outline the key points and constructional features making it possible to guarantee the correct design and installation of the commonly used facade systems, taking into account the current and future requirements in Belgium.

We would like to point out that this document is partly based on the proposals of modifications to the regulation issued in February 2017 by the working group ‘Façades’ (Facades), founded by the ‘Conseil supérieur de la sécurité contre l’incendie et l’explosion’ (Belgian High Council for Fire and Explosion Safety). These proposals are provisional and consequently liable to change. We therefore invite the reader to consult the final version of the regulation, which should be submitted to the Belgian High Council in the course of 2018.
1. INTRODUCTION

1.1 IMPACT OF FIRES

In Belgium, there were more than 19,000 fires recorded that required the intervention of the firefighters in 2014 (information supplied by 195 of the 250 fire services in the country, that is almost 80%). According to the same information, the number of civilians killed in these fires amounted to over 70 people that year. Additionally, more than 1,200 civilians and over 20 firefighters were injured in 2014. Furthermore, we noted that as an overall gross average, the arrival time of the fire services to the site (time between the alert and arrival) is less than 10 minutes [1].

On a European scale, 5,000 fires are recorded each day, leading to the hospitalisation of some 70,000 people per year and causing close to 4,000 deaths [2]. These figures remind us that fire prevention is of paramount importance for our society.

The damage caused by fires also has an economic impact estimated at close to €126 billion per year in Europe [2]. In addition to the direct damage (buildings, ...), many companies find themselves unable to overcome the consequences of a significant fire (loss of merchandise, infrastructure, temporary interruption of the operations, etc.) and are therefore forced to close.

The environmental impact of a fire should also not be underestimated.
1.2 RETURNING TO THE GRENFELL TOWER BLAZE IN LONDON ON 14 JUNE 2017

Important: this section is based on the information in our possession, which has not been officially confirmed by the experts responsible for the inquiry into the fire. At the time of drafting this report, the inquiry is currently in progress. The data provided hereafter can therefore not be considered as definitive and proven.

During the night of 13 to 14 June 2017, a fire broke out in the building known as the Grenfell Tower in London. The high number of victims (over 79 deaths and 70 injured) and the speed at which the fire spread, urged the concerned parties (project owners, architects, contractors, public bodies, manufacturers, suppliers, ...) in Europe and elsewhere, to undertake an in-depth evaluation of the regulatory framework regarding fire safety. Built in the 1970s, Grenfell Tower was a residential block of 24 floors, some 67 m high with more than 120 apartments.

The typical floor plan was comprised of 6 apartments located around a central stairwell with lifts.

![Figure 1 – Typical floor plan of the Grenfell Tower [3]](image)

Energy renovation work to the facade was carried out in 2016. According to the currently disclosed information, the renovated facade was composed as follows (see figure 2).
The fire allegedly started in an apartment on the 4th floor and is likely to have been caused by a faulty refrigerator. The fire services arrived on site quickly, but the fire had rapidly spread vertically via the facade. Moreover, it is probable that ‘secondary’ spreading also took place inside the building (via the vertical technical service shafts, the stairwell, ...). In several places, the fire got into the building again, completely destroying several apartments and trapping the occupants who had not been able to evacuate the premises by the only available stairwell, likely rendered inaccessible at some point.

The circumstances and the causes of the fire are still being investigated at the time of drafting this document. Nevertheless, it is clear that the circumstances of a tragedy such as this are multiple and cannot be traced back to one single parameter. Questions are now being raised regarding the rapid vertical spread of the fire (figure 3) via the facade system (combustible insulation, ventilated...
air cavity and composite panels with a polyethylene core). The means of evacuation for the occupants in the over 60 m high building also seemed particularly limited, as the building only had a single stairwell\(^1\). In view of their crucial importance, the compartmentation and safety of the evacuation means (fire-resistant walls and doors, fire sealing and stopping of service installations penetrating fire-resistant walls, ventilation openings, putting the stairwell in overpressure, ...) and the apartments (fire-resistant doors, vertical shafts and penetrations of service installations, ...) also need to be taken into consideration.

Finally, at the present time, we do not have any information concerning the presence or the correct functioning of active prevention methods (detection, alarm, extinguishing methods, ...).

\(^1\) In Belgium, it is mandatory to foresee two stairwells in high-rise buildings.
2. Basic Fire Safety Principles

2.1 Fire Prevention

The first axis of the so-called passive fire protection consists of slowing down the development of a fire and its rapid spread by using construction materials with low flammability and combustibility. This measure is related to the reaction to fire (see § 2.2) of materials such as wall, floor, ceiling and facade claddings as well as materials (such as insulation) that are in the vicinity of the exposed surface. When a fire occurs, it needs to be detected and extinguished as quickly as possible. Active fire protection measures (see below) will also have an important role to play in this regard.

When the fire has been able to fully develop and enters into its second phase (flashover), the second axis of the passive fire protection strategy kicks in: this firstly relates to preventing the fire from spreading too quickly beyond the location(s) in which it has started, and secondly to ensuring the stability of the building during a specific time frame. This measure refers to the fire resistance of construction elements (see § 2.3), which must be able to maintain their load-bearing and/or separating functions for a defined period of time, in order to be able to evacuate the occupants and to allow the intervention of the emergency services. The compartmentation of the building, or in other words the division of the building into volumes which are delimited by walls with a sufficient fire resistance, is of vital importance in this context.

Passive fire protection relates to the building’s structure as well as to the building’s finishing and relies on the following principles:

- the use of cladding materials with good reaction-to-fire characteristics, in order to delay the development of an incipient fire
- the realisation of compartmentation to confine the fire, for a defined period of time, to the compartment in which it started
- to preserve the load-bearing function of structural elements (columns, beams, walls) during the fire
- to provide a sufficient number of exits to ensure the smooth evacuation of people
- the use of stairwells and evacuation routes as specific compartments in order to facilitate the evacuation of people in complete safety and the access to the building for the fire services
- a clear signalling system to facilitate the evacuation of the residents.
The so-called **active fire protection** includes, amongst others, the fire detection, alert and extinguishing and the smoke and heat extraction. These measures relate to the equipment of the building and complement the passive prevention measures.

The *detection and warning systems* are intended to signal the start of a fire. Timely detection makes it possible to wake the inhabitants of an apartment or to alert nearby occupants of the incipient fire. Centralised detection is intended to warn the occupants, the prevention services of the building or even the fire department, in order to reduce the evacuation and intervention time.

*Smoke and heat extraction systems (SHE)* by definition aim to extract the smoke and heat released by an incipient fire, in order to limit its development and its spreading. The objective of these systems is to facilitate the evacuation of people and the intervention of the fire services and to reduce smoke damage.

*Extinguishing equipments* (fire extinguishers, fire hose reels, ...) allow occupants (primary response team) to act quickly and effectively to extinguish a recently started fire. Fire hose reels and fire hydrants are also available for the fire services to facilitate their intervention.

*Automatic fire extinguishing systems* (sprinkler installations) are logically intended to operate automatically in the event of an incipient fire. Generally, they are not intended to put out the fire, but rather to stop it from spreading in order to limit the adverse consequences and facilitate the intervention of the fire department.

Furthermore, we want to point out that it is important that the inhabitants of the building are aware of the fire safety aspects, particularly regarding the correct functioning of the fire doors, the first things to do after the start of the fire and the fact that it is forbidden to store flammable goods in stairwells and evacuation routes, …
2.2 Reaction to Fire

Reaction to fire is the response of a construction product that contributes, through its own decomposition, to a fire to which it is exposed under specified conditions [4] [5]. The European classification for the reaction to fire is divided into seven principal classes (A1, A2, B, C, D, E and F) with the following additions:

- class s for smoke production (s1 and s2 for floor coverings; s1, s2 and s3 for other construction products)
- class d for flaming droplets and particles (d0, d1 and d2 for all products except floor coverings).

![Figure 4 – Schematic representation of the reaction-to-fire categories.](image)

For products for which the reaction to fire has not been evaluated, the letters ‘NPD’ (no performance determined) is used [30].

The table below indicates the reaction-to-fire classes of some materials frequently used in the composition of facades.
### Table 1 Reaction-to-fire classes of several commonly used materials.

<table>
<thead>
<tr>
<th>Product</th>
<th>Reaction-to-fire class of the product itself</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals, masonry, concrete, ...</td>
<td>A1</td>
</tr>
<tr>
<td>Glass wool and rock wool</td>
<td>A1 - A2</td>
</tr>
<tr>
<td>Cellular glass</td>
<td>A1</td>
</tr>
<tr>
<td>Extruded polystyrene (XPS) and expanded polystyrene (EPS)</td>
<td>E</td>
</tr>
<tr>
<td>Polyurethane (PUR)</td>
<td>D - E</td>
</tr>
<tr>
<td>Polyisocyanurate (PIR)</td>
<td>B - D</td>
</tr>
<tr>
<td>Wood-based panels and solid wood panels</td>
<td>C - E</td>
</tr>
<tr>
<td>Fibro-cement panels, plasterboards, ...</td>
<td>A1 - A2</td>
</tr>
<tr>
<td>Cellulose</td>
<td>B (treated) - D (untreated)</td>
</tr>
<tr>
<td>Wood wool</td>
<td>D - E</td>
</tr>
</tbody>
</table>

Moreover, we want to point out that several decisions of the European Commission detail the reaction-to-fire classes of certain materials, without the necessity to conduct a test\(^2\).

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2.3 RESISTANCE TO FIRE AND COMPARTMENTATION

The **resistance to fire** is the ability of a **construction element** to maintain for a certain period of time its fire stability, integrity, thermal insulation and/or any other required function [4] [6]:

- **load-bearing capacity** (also called fire stability) (criterion ‘R’) is the ability of a construction element to withstand fire exposure, under specified mechanical actions, on one or several sides during a given period without loss of its structural stability.
- **fire integrity** (criterion ‘E’) is the ability of a construction element with a separating function that is exposed to fire on one side only, to prevent the transmission of fire to the unexposed side as a result of the passage of flames and hot gases.
- **thermal insulation** (criterion ‘I’) is the ability of a construction element with a separating function to withstand fire exposure on one side only, without the transmission of fire as a result of a significant transfer of heat from the exposed side to the unexposed side.

![Diagram of fire resistance classes for various construction elements](image)

**Figure 5 – Illustration of the fire resistance classes for various construction elements.**
The fire resistance of construction elements can be evaluated by means of one or more levels of thermal attack, represented by a temperature-time curve [7]. According to the regulations applicable to new buildings in Belgium (see § 3.2), the fire resistance performance of a construction element must be determined on the basis of tests (since 1 December 2016, exclusively according to the European standards3) or on the basis of a calculation (according to the Eurocodes, ‘fire’ sections’) – see figure 64.

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3 According to the series of testing standards mentioned in the classification standards [6] [8] [9], with the exception of fire-resistant doors and suspended ceilings for which the Belgian standard NBN 713-020 [10] still can be used.

4 Based on article 2.1 of annex 1 to the Belgian Royal Decree ‘Normes de base’ (Basic Standards) [11].
3. REGULATORY AND NORMATIVE FIRE SAFETY FRAMEWORK IN BELGIUM

3.1 GENERAL FRAMEWORK

The European Construction Products Regulation [12] sets out seven basic requirements with which structures need to comply in their entirety\(^5\). One of the requirements concerns fire safety and applies to buildings designed and built in such a way as to:

- ensure the stability of load-bearing elements for a specific period of time in the event of an outbreak of fire
- limit the generation and spread of fire and smoke
- limit the spread of fire to neighbouring structures
- allow occupants to leave the building unharmed or to be rescued in another way
- take into consideration the safety of rescue teams.

The Construction Products Regulation does not establish construction rules for buildings. The drafting of the provisions implementing the seven basic requirements are the responsibility of the Member States, which may decide whether or not to integrate the specified construction measures into their national legislation. In Belgium, such provisions have been elaborated for the fire safety of buildings.

The Belgian law of 30 July 1979 relating to fire and explosion prevention as well as compulsory third party liability insurance in these same circumstances, forms the basis for the Belgian regulation relating to fire safety. This law gave rise to the Belgian Royal Decree of 7 July 1994 (and its modifications) [11], setting out the mandatory basic standards applicable to new buildings in the field of fire prevention (see § 3.3). The basic prevention regulation, which is issued by the Service public fédéral Intérieur (Belgian Federal Public Service (FPS) Interior), does not exclude that other regulations relating to fire prevention may also apply. As a consequence of the various State reforms, the competences regarding fire safety regulations of buildings have been divided between the Belgian Federal Authority and the Regions. The Federal Authority is responsible for the drafting of the regulations regarding the fire prevention in different types of buildings, whether intended for the current or future use of the building. The Regions can, for their part, issue specific regulations in order to supplement or adapt the Belgian Royal Decree ‘Normes de base’ (Basic Standards), without compromising the rules set out in the Royal Decree in such a way that these become globally more or less stringent.

Beside these regulatory texts, the Belgian and European standards also have an important role. The application of a standard is not obligatory, unless an explicit reference is made in a regulatory text. The compliance to these standards is also obligatory if they are mentioned in the specifications, as this is often the case in public contracts and in some private contracts. Although the application of the Belgian standards is voluntary, they are nevertheless regarded as best practice rules as far as decennial liability of designers and contractors is concerned. Complying with these standards leads to a presumption of technical quality, whilst deviating from these standards creates a need for technical justification [13]. In Belgium several fire safety standards are applicable (testing standards, classification standards, standards relating to active fire safety, …). Furthermore, some of these standards formulate additional fire requirements applicable to certain types of buildings\textsuperscript{6}.

The \textit{Spécifications techniques unifiées} (STS) (Technical Specifications) issued by the \textit{Service Public Fédéral Economie} (Belgian Federal Public Service Economy) are documents that should help the building owner or designer to draft the technical specifications for a specific project. They describe how one can prescribe a product, depending on its specific application, how it can be verified and processed, and how one can evaluate its execution. Some design data may also be included in these specifications. Clearly, these STS only acquire an obligatory nature if the building owner and contractor make reference to them in the contractual documentation, as is generally the case in the majority of the public contracts.

The STS 71-2 \textit{‘Systèmes d’isolation extérieure des façades’} (External facade insulation systems) [15] is currently being drafted and should cover the following subjects:

- facade cladding (section 1)
- systems where the cladding is glued onto the insulation (section 2)
- systems with external masonry cladding (section 3).

\textsuperscript{6} Amongst others the NBN S 21-204 (1982) [14] regarding school buildings (currently being revised).
Finally, the Technical Information Notes (TINs – Note d’information technique (NIT)) of the BBRI can be considered as guidelines allowing to correctly specify and execute work according to the rules of best practice. Although the recommendations are not compulsory, these documents are nevertheless considered as references in the event of problems relating to parts of the building subject to decennial liability. The following TINs, drafted in consultation with the construction sector and in close collaboration with the representatives of the fire services and FPS Interior, are specifically related to the subject of fire safety:

- NIT 256 Conception et mise en œuvre de bâtiments industriels conformes aux exigences de sécurité contre l’incendie (TIN 256 Design and execution of industrial buildings in compliance with fire safety requirements) [16]
- NIT 254 Obturation résistant au feu des traversées de parois résistant au feu. Prescriptions et mise en œuvre (TIN 254 Fire-resistant sealing and stopping of service installations penetrating fire-resistant walls. Requirements and installation) [17]
- NIT 238 L’application de systèmes de peinture intumescente sur structures en acier (TIN 238 Application of intumescent paint systems on steel structures) [18]
- NIT 234 Le placement des portes résistant au feu (TIN 234 Installation of fire-resistant doors) [19]
- NIT 226 L’entretien des portes résistant au feu (TIN 226 Maintenance of fire-resistant doors) [20].

A TIN relating to the fire safety of lightweight facades is currently being drafted.

![Figure 7 – Regulatory and normative fire safety framework in Belgium.](image)
3.2 Belgian Royal Decree ‘Basic Standards’

The Belgian Royal Decree of 7 July 1994 (and its modifications) stipulates the basic standards for fire and explosion prevention [11] with which all new buildings must comply [11]. This decree, which will be referred to as the RD ‘Basic Standards’, currently comprises seven annexes:

- annex 1: terminology
- annex 2: low-rise buildings (height < 10 m)
- annex 3: mid-rise buildings (10 m ≤ height ≥ 25 m)
- annex 4: high-rise buildings (height > 25 m)
- annex 5: reaction to fire
- annex 6: industrial buildings
- annex 7: common requirements.

These Basic Standards apply to all new buildings. Renovation works no longer fall within their scope since the modification of 4 April 2003. The regulations therefore do not apply to existing buildings, nor to renovation works on existing buildings, neither
to **single-family dwellings**. The following section of this document therefore does not apply to single-family dwellings⁷.

The Basic Standards define the minimum conditions for the design and the construction of new buildings in order to:

- prevent the outbreak, the development and the propagation of a fire
- ensure the safety of people
- facilitate the intervention of the fire services.

### 3.3 OTHER REGULATIONS AND STANDARDS

The Belgian Regions and Communities have the competence to issue other decrees supplementing the Basic Standards, in order to take the specific nature of certain buildings into account. It should also be noted that the Belgian Act on the well-being of workers in their performance of their work and article 52 of the Belgian General Regulation on the protection at work are at the base of the fire regulations within the employment contract context. These documents are applicable to all companies, public services and public-interest bodies at a national, provincial or municipal level, as well as their staff.

The Standards Service Antenna ‘*Prévention du feu*’ (Fire Prevention) of the BBRI ([www.normes.be/feu](http://www.normes.be/feu)) offers a database⁸ with all applicable regulations for each Region and building type in Belgium.

### 3.4 SCOPE OF THE FIRE SERVICE REPORTS

The fire services must comply with the regulations for fire prevention when providing an advice. The requirements of the fire department may not be more stringent than those stipulated in the regulations. In the absence of regulations or when a certain aspect is not regulated or if the existing regulation is clearly incomplete, the rescue

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services may propose requirements to ensure a minimum safety level. As stipulated in the Belgian circular relating the fire prevention report [21]: the rescue services cannot substitute the legislator and arbitrarily impose additional requirements. The emergency services must ensure that its proposals and conditions are proportional and reasonable in relation to the intended purpose.
Fire spread via the facades mainly occurs in one of the following three manners. The measures that need to be taken to reduce these risks are detailed in § 5.1.

1. **Fire spread via the surface of the facade cladding:** to slow down this type of spreading, one generally needs to take measures relating to the reaction to fire of the facade cladding.

2. **Fire spread from one compartment to another** (from floor to floor, for example):
   - either internally, via the junction between the floor and the facade element
   - or externally, when the flames are coming out of the facade by passing, for example, through glazed elements that are not fire-resistant (see figure 10, left arrow: the fire comes out of the facade via the window of the burning floor and affects the window on the floor above).

To remedy this type of spreading, it is necessary to ensure the fire resistance of the junction (between the floor and the facade) and that of the facade element at floor level.
Fire spread within the facade system via combustible components (e.g. the insulation), the ventilated air cavity located behind the cladding (chimney effect), ... One can reduce this risk by using, amongst others, non-combustible or low-combustible elements, by interrupting the combustible insulation layers, the ventilated air cavity, ...

Figure 10 – Internal and external fire spread. Left: schematic drawing; right: flames coming out of a burning floor.

Figure 11 – Fire spread within the facade system.
5. REGULATORY REQUIREMENTS INTENDED TO REDUCE THE RISKS OF FIRE SPREAD VIA
THE FACADES

5.1 REGULATORY PROVISIONS APPLICABLE TO NEW BUILDINGS

5.1.1 Reaction to fire of the facade cladding

The Belgian Royal Decree of 7 July 1994 establishing the basic standards in terms
of fire prevention [11] defines the requirements intended to limit or to slow down the fire
spread via facade claddings. These requirements relate to the reaction to fire of the
facade cladding9 and allow to avoid the risk 1 (fire spread across the facade surface)
identified in chapter 4.

‘Facade cladding on low-rise buildings shall be class D-s3, d1. Facade cladding on mid-
and high-rise buildings shall be class B-s3, d1. A maximum of 5% of the visible surface
of these facades is exempted from this requirement.’

- Industrial buildings: no requirements
- Low-rise buildings (h < 10 m): D-s3, d1
- Mid- and high-rise buildings: B-s3, d1

It is important to stipulate that the requirements apply to construction projects in their
final application conditions, i.e. including the possible impact of underlying layers of
materials and their method of fixing. The facade cladding on which the reaction-to-fire
requirement applies cannot therefore be considered individually, but as it is executed
on site.

Thus, in the case of an external thermal insulation composite system (ETICS)10, the
aforementioned requirements do not apply to the top-coat rendering alone, but to the
entire system as executed, that is to say the rendering, the underlying layers
(insulation) and the method of fixing. The reaction to fire of ETICS is declared by the
manufacturer (‘closed’ system – see ETA and ATG technical approvals). It can reach

9 Article 6 of annex 5/1 to the Belgian Royal Decree ‘Basic Standards’ [11].
10 Abbreviation of External Thermal Insulation Composite Systems with Rendering.
the B-s3, d1 class required for high-rise buildings in Belgium, even if the insulation used is highly combustible (EPS class E for example).

Figure 12 – The reaction-to-fire requirement for ETICS applies to the entire system.

For facade cladding, the reasoning is identical: the requirements apply to the complete system, that is to say the cladding, the ventilated air cavity, any underlying panel, the insulation and the method of fixing.

Figure 13 – The reaction-to-fire requirement for a weatherboard applies to the entire system.

1. Substructure
2. Adhesive
3. Thermal insulation
4. Mechanical fixation (where necessary)
5. Base coat
6. Reinforcement mesh
7. Finishing coat

1 Facade cladding (type, thickness, density, vertical/horizontal arrangement, ...)
2 Ventilated air cavity behind the cladding
3 System and method of fixing
4 Layers located behind the air cavity (insulation, wood panels, ...)
The Belgian Royal Decree ‘Basic Standards’ stipulates however that the underlying layers must not be taken into account if they are protected by a construction element providing a sufficient ‘fire protection capacity’\(^\text{11}\), as shown in table 2.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|}
\hline
Applications for which at least class A2-s3, d2 is required & Applications for which at most class B-s1, d0 is required \\
\hline
K\(_2\) 30 & K\(_2\) 10 \\
\hline
\end{tabular}
\caption{Fire protection capacity classes K.}
\end{table}

In other words, as far as facades are concerned (maximum requirement B-s3, d1 for mid- and high-rise buildings), the materials located behind the cladding (insulation, panels, etc.) must not be taken into account if they are protected by an element with a K\(_2\) 10 protection class which preserves them from excessive heating and triggering combustion or charring during a period of 10 minutes.

The principle that the reaction-to-fire requirement applies to the cladding and, where appropriate, the materials located behind the cladding is often poorly assimilated by professionals. For the contractor, it is often difficult to find the necessary information (technical data sheets from manufacturers, information accompanying CE marking, European Technical Approval Guidelines, ...). And when such information is available, the data is generally insufficient to allow professionals to make the correct choices. Moreover, the K\(_2\) 10 protection classes are still too rarely mentioned in technical data sheets of materials.

Let us consider two examples by way of illustration.

1) The cladding system illustrated in figure 14 must meet the B-s3, d1 or D-s3, d1 reaction-to-fire requirement. It is therefore necessary to evaluate it by means of a test performed on the entire system as installed: with its ventilated air cavity \(\odot\) (20 mm for example), its method of fixing \(\odot\) (battens and counter-battens) and the materials behind the air cavity, that is to say the panels and the insulation. However, if the panels behind the air cavity belong to the K\(_2\) 10 class, the insulation does not have to be part of the test (but the panels do).

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\(^{11}\) According to NBN EN 13501-2 [6]: The fire protection capacity K is the ability of a cladding to protect the materials behind the cladding against ignition, charring and other damage for a specific period.
2) The facade system on the Grenfell Tower in London consisted of a 3 mm composite panel (aluminium – polyethylene – aluminium), a 50 mm ventilated air cavity, a 150 mm polyisocyanurate thermal insulation and a concrete substructure (see figure 15). Given its composition, the composite panel alone could possibly achieve the required reaction-to-fire class, but it does not reach K2 10 protection class. Consequently, in accordance with European standards and Belgian regulations, the reaction-to-fire class must be evaluated on the composite panel in the end-use conditions, that is to say, in this specific case, with the ventilated air cavity and the thermal insulation (depending on the type of material used in the core of the composite panel). In view of the specified composition, this system is not expected to reach the B-s3, d1 class required for high-rise buildings in Belgium, as the cladding does not protect the insulation and the latter is therefore liable to play a significant role in the development of heat and smoke in the event of a fire.
5.1.2 Internal and external fire spread from one floor to another

The Belgian Royal Decree ‘Basic Standards’ establishes measures intended to limit or to slow down the fire spread from one compartment to another via the facades both vertically (towards the top) and horizontally. These measures\(^{12}\) aim to limit the risk (internal and external fire spread from one compartment to another) identified in chapter 4.

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\(^{12}\) Belgian Royal Decree ‘Basic Standards’ [11], article 3.5.1 of annexes 2/1, 3/1 and 4/1 concerning single-wall facades and article 3.5.2 of annexes 2/1, 3/1 and 4/1 concerning double-wall facades.
A. Internal fire spread

In order to limit the risk of internal fire spread, the junction between the compartment elements (floors for example) and the facade must at least have an EI 60 fire resistance, except in low-rise buildings (see table 3). The linear junction between the compartment floor or wall and the facade must be compatible with the presumed deformation of the facade in the event of a fire.

Table 3 Resistance to fire of the junction between compartment walls and the facade.

<table>
<thead>
<tr>
<th>Type of building</th>
<th>Resistance to fire of the junction between the floor and the facade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-rise building (h &lt; 10 m)</td>
<td>EI 60, unless the linear joint is less than or equal to 20 mm in width, in which case it is sufficient to seal it using a deformable airtight product (flexible mastic for example) in order to prevent cold smoke from penetrating between the facade and the compartment floor.</td>
</tr>
<tr>
<td>Mid-rise building (10 m ≤ h ≤ 25 m)</td>
<td>EI 60</td>
</tr>
<tr>
<td>High-rise building (h &lt; 25 m)</td>
<td>EI 60</td>
</tr>
</tbody>
</table>

Moreover, the framework of the lightweight facade must be fixed on each level to the supporting structure of the building to avoid the facade from collapsing in case of fire. The fixing anchors must show a R 60 fire resistance (low-, mid- and high-rise buildings) or be protected against fires occurring in the compartment immediately below. They may be positioned under the floor, at the floor nosing or on the floor (see figure 17).
In the event of a fire in the lower compartment, the anchor located above the floor is protected by the fire-resistant compartment floor and by the EI 60 fire-resistant sealing between the compartment floor and the facade. Thus, it meets the requirements without further protection.

The anchors positioned above the floor are the most frequently used in practice, so that their R 60 fire resistance does not generally pose any problems as long as the EI 60 fire-resistant sealing between the floor and the facade element is correctly realised.

B. **External fire spread**

In order to prevent the external fire spread from one compartment to another, the facade element at the level of each compartment wall (storey floor for example) must show a certain level of fire resistance.

In low-rise buildings (≤ 10 m) no prescription is required in this regard, since the intervention of the fire services and the evacuation of occupants are facilitated by the limited height of the building. However, it should be noted that for certain buildings such as schools, other regulatory texts may impose additional provisions (see § 5.2).
For mid- or high-rise buildings, one of the following three requirements must be met in order to limit the risk of external fire spread:

1. the facade shall be fitted with a fire-resistant construction element E 60 and shall have a minimum developed length of 1 m at the compartment floor level (figure 18)

![Figure 18 – Diagram of the facade element with an E 60 fire resistance](image)

2. the facade shall provide at least a fire resistance E 30 for the entire building height or at least E 60 every two levels

3. the compartments located along the facade shall be equipped with an automatic sprinkler system. In this case, it is not necessary to take additional measures to limit the external fire spread.

![Figure 19 – Limiting the risk of external fire spread in mid- and high-rise buildings.](image)
An alternative to the 1 m vertical E 60 facade element (solution 1) is to provide for a 60 cm horizontal E 60 projection (see also § 7.1.2 regarding masonry and cast concrete facades).

The E 60 fire-resistant element must also be installed at the vertical compartment walls level (internal compartment walls perpendicular to the facade – see figure 21).

We would like to emphasise that this last point only applies to vertical compartment walls. By compartment walls, we mean fire-resistant walls separating two compartments. A fire-resistant wall separating two apartments or two hotel rooms is not considered as a compartment wall. In this case, an E 60 fire-resistant facade element is therefore not required.
The method of determining the minimum developed length of 1 m is explained in § 7.2.

5.1.3 Fire spread within the facade

At present, the risks of fire spread within the facade system itself (see § 4, ❸) cannot be evaluated directly according to European testing standards. These are thus not explicitly covered by the regulatory requirements in Belgium. The regulation is currently being revised in this regard (see § 6.1 and § 6.2). In accordance with the stipulations of the Belgian ministerial circular relating to the fire services report (see § 3.4), the fire service may suggest recommendations on this subject within the framework of its advice related to the permit application.

5.2 Regulatory provisions applicable to specific buildings

As specified in § 3.3 ‘Other regulations and standards’, regulatory texts and standards supplement the Belgian Royal Decree ‘Basic Standards’. As far as requirements relating to facades are concerned, it should be noted for example that the standard for schools (currently being revised) and the regulation for retirement homes in Flanders require the installation of an E 60 facade element with a length of 1 m (see § 5.1.2) in all cases, including for low-rise buildings. Thus, for example, a two-storey school building (low-rise building) that must meet the standard shall have an E 60 facade element at the compartment floor level between the first and second floors.

5.3 Renovation of existing building facades

Renovation works on a building for which a permit application has been submitted after the entry into force of the Belgian Royal Decree ‘Basic Standards’ of 7 July 1994 must clearly be executed according to the requirements of this decree. Example: a building built in 1999 and renovated in 2017 shall continue, after renovation, to meet the requirements that were in force when it was built.
These requirements are not intended for renovation works on a building for which the permit application was submitted prior to the entry into force of the Belgian Royal Decree. The fire service shall nevertheless be consulted during the permit application process and will generally base its response on the rules applicable to new buildings.

If the building is subject to complete renovation, the fire safety assessment shall be based on the building as a whole and more specifically on the compartmentation between floors, evacuation routes and stairwells as well as the possibilities for evacuation and intervention.

In the case of energy renovation works to the facade, the fire service will generally recommend, for the renovated elements, compliance with the requirements of the Belgian Royal Decree.
6. ONGOING REVISION OF THE FIRE SAFETY REQUIREMENTS FOR FACADES

6.1 RISK OF SPREAD WITHIN THE FACADE

At present, the risk of ‘Spread within the facade’ described in chapter 4 is not directly covered by the European testing methods nor explicitly considered in the regulations in force in Belgium. This risk relates to fire spread via the combustible components of the facade (insulation notably) and via the ventilated air cavity located behind the cladding and which can cause a chimney effect, …

The fire services may possibly propose recommendations to cover this risk within the framework of their advice related to permit applications (see § 3.4). However, in the absence of harmonised directives, these recommendations vary from one fire service to another.

The Belgian High Council for Fire and Explosion Safety is looking into this issue in order to propose new fire safety rules for facades (see § 6.2).

6.2 FUTURES REQUIREMENTS: INITIAL TRENDS

A ‘Facades’ working group was created in December 2015 on the initiative of the Belgian High Council for Fire and Explosion Safety. This group brings together experts and sector players; it operates under the leadership of the engineers of the Belgian Federal Public Service Interior, who also provide the secretariat. It aims to propose new rules for the fire safety of building facades, particularly with regard to high-rise buildings.

The information provided in the following text is based on trends which emerged from the group and on its most recent conclusions (February 2017). The latter have not yet been approved by the working group nor by the Belgian High Council. They are provisional and subject to modification. The reader shall consult the final version which will likely supplement the Belgian Royal Decree ‘Basic Standards’ in the future.
Table 4 details the proposed requirements according to the height of the building. In addition to high-rise buildings (height > 25 m), a distinction is now made for ‘very high-rise’ buildings higher than 36 m.

*Table 4 Provisional proposals from the ‘Facades’ working group of the Belgian High Council for Fire and Explosion Safety.*

<table>
<thead>
<tr>
<th>High-rise buildings &gt; 36 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large-scale test</td>
</tr>
<tr>
<td>OR</td>
</tr>
<tr>
<td>Non-combustible</td>
</tr>
<tr>
<td>End use: A2-s3,d1</td>
</tr>
<tr>
<td>Substantial component: A2-s3,d0</td>
</tr>
<tr>
<td>Maximum percentage of secondary frame which is not subject to any reaction-to-fire requirement: 10%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mid-rise and high-rise buildings ≤ 36 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large-scale test</td>
</tr>
<tr>
<td>OR</td>
</tr>
<tr>
<td>End use: B-s3,d1</td>
</tr>
<tr>
<td>Maximum percentage of secondary frame which is not subject to any reaction-to-fire requirement: 10-20%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ventilated facade</th>
<th>Non-ventilated facade – ETICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustible</td>
<td>Non-fusible insulation (PUR, PIR, ...)</td>
</tr>
<tr>
<td></td>
<td>Fusible insulation (EPS, XPS)</td>
</tr>
<tr>
<td></td>
<td>DIBT standard solutions</td>
</tr>
<tr>
<td></td>
<td>Interruption by a non-combustible strip:</td>
</tr>
<tr>
<td></td>
<td>- either every two levels</td>
</tr>
<tr>
<td></td>
<td>- or above the windows</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low-rise buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>End use: D-s3,d1</td>
</tr>
<tr>
<td>Substantial component: E</td>
</tr>
</tbody>
</table>

Fire safety of multi-storey building facades – BBRI – September 2017
The traditional masonry cavity wall is not considered as a ventilated facade nor as a non-ventilated one. We refer the reader to § 7.4 dealing with key points for the execution of traditional masonry cavity walls.

A substantial component is defined as follows [22]:

‘a material which constitutes a significant part of a non-homogeneous product. A layer with a mass per unit area ≥ 1.0 kg/m² or a thickness ≥ 1.0 mm is considered as a substantial component’.

A non-substantial component would therefore be a material that does not constitute a significant part of a non-homogeneous product. Thus, a layer with a mass per unit area ≤ 1.0 kg/m² and a thickness of ≤ 1.0 mm would be considered as a non-substantial component.

For low-rise buildings (height < 10 m), the requirements currently in force would remain largely unchanged; in other words:

- the facade cladding must have a D-s3, d1 (or better) reaction-to-fire class in its final application (end-use conditions – see § 5.1.1)
- the other facade components must have an E reaction-to-fire class (or better)
- the junction between the floor and the facade element must show an EI 60 resistance, except if the clearance is less than 20 mm (see § 5.1.2).

As regards very high-rise buildings (height > 36 m), all facade components must be non-combustible (class A2-s3, d1). We refer here to all substantial facade components, i.e. insulation, cladding, panels, ... The facade materials which are completely protected by a K2 30 component as well as the non-substantial components (thin rain barrier membrane for example) do not have to meet this requirement. The rules relating to internal fire spread (EI 60 fire-resistant sealing between the floor and the facade element) and external fire spread (E 60 facade element at the compartment floor level) remain nonetheless applicable (see § 5.1.2).

As for mid- and high-rise buildings (h ≥ 10 m and h ≤ 36 m), in addition to the aforementioned rules relating to internal and external fire spread, one of the following solutions would be necessary:

1. either the facade cladding reaches the B-s3, d1 class in the end-use conditions, the other substantial facade components (insulation for example) being non-combustible (A2-s3, d1), except those fully protected by a K2 10 element
2. or a standard solution incorporating ‘fire-resistant barriers’ within the facade must be implemented.

The aforementioned standard solutions are subdivided into two categories:
- external thermal insulation composite systems with rendering (ETICS systems, widened in principle to hard coverings glued onto insulation): the principle would consist in interrupting the combustible insulation with continuous non-combustible insulation strips, at all levels for fusible combustible insulation (EPS, XPS) and every two levels for non-fusible combustible insulation (PUR, PIR, …)
- ventilated facades: the principle would be to install an appropriate system that is able to interrupt the ventilated air cavity (and the combustible insulation) in the event of a fire.

Instead of the standard solutions proposed for mid-, high- and very high-rise buildings, it would also be possible to prove the conformity of the facade system by subjecting it to a large-scale laboratory test. This test would allow manufacturers to demonstrate that their system does not present any risk of fire spread. Currently, there is no standardised test of this type in Europe but a large number of national methods, which are all very different\(^\text{13}\). The development of a harmonised method is under way at European level.

The recommendations relating to the good design and proper execution of the standard solutions detailed above are presented in § 7.3 for external thermal insulation composite systems with rendering and in § 7.4 for ventilated facades.

\(^{13}\) Notably BS 8414-1 (United Kingdom, Austria), LEPIR II (France), SP Fire 105 (Sweden, Denmark), DIN E 4102-20 and DIBT Procedure (Germany), Önorm B 3800-5 (Austria), NFPA 285 and NFPA 268 (USA), ISO 13785-1 and -2, …
7. **KEY POINTS FOR THE DESIGN AND THE EXECUTION**

This chapter presents the key points and constructional features that will ensure the good design and proper execution of facade systems, and thus make it possible to meet the requirements currently in force as well as those which may be introduced in the future. These constructional features are notably based on the provisional proposals detailed in table 4 of § 6.2.

7.1 **REALISATION OF THE E 60 FACADE ELEMENT AND ITS JUNCTION WITH THE STRUCTURE**

7.1.1 _Determination of the developed length of 1 m_

As indicated in § 5.1.2, one of the options to slow down the external fire spread in mid- or high-rise buildings is the execution of an E 60 fire-resistant facade element (fire integrity lasting 60 minutes) with a minimum developed length of 1 m (a + b + c + d). This length must be calculated according to the Belgian Royal Decree ‘Basic Standards’ [11] (see figure 22).

![Figure 22 – Calculation principle of the 1 m developed length of the E 60 fire-resistant facade element (extract from the Belgian Royal Decree ‘Basic Standards’) [11].](image-url)
Only elements with an E 60 fire resistance are recorded, which therefore in principle excludes aluminium thresholds, aluminium or PVC frames, external thermal EPS insulation composite systems with rendering, … (see also illustration in § 7.1.2). Moreover, all penetrations (ventilation ducts for example) and weak points in these E 60 elements shall be made fire-resistant (see TIN 254) [17].

![warning]

In practice, it is regularly noted that the minimum developed length of 1 m is not calculated correctly. If the E 60 facade element does not have the required length right from the design phase, it can prove particularly complicated to rectify it at a later date. The correct fixing of the E 60 element on the structure is also significant.

### 7.1.2 Masonry or on-site cast concrete facades

In the case of ‘solid’ facades composed of load-bearing masonry or on-site cast concrete walls, the E 60 fire-resistant element is generally formed by the load-bearing structure, i.e. the apron, the lintel and the concrete floor thickness. The correct calculation of the developed length of 1 m when designing the building remains nevertheless important (see § 7.1.1 and figure 23 for illustration).
The E 60 fire resistance is ensured by the load-bearing rough structure (apron wall, lintel and concrete floor). The external thermal insulation composite system with rendering (ETICS with EPS) does not offer an E 60 fire resistance; its thickness cannot therefore be taken into account.

Similarly, the aluminium threshold (2) and the aluminium frame (1) do not have an E 60 fire resistance. In this example, the distance ‘a’ is equal to 0; the developed length of 1 m shall consequently be guaranteed by distances ‘b’, ‘c’ and ‘d’.

Figure 23 – Example of the calculation of the 1 m developed length (a + b + c + d) for an external thermal insulation composite system with rendering.
Figure 24 shows a diagram of how to obtain an E 60 fire-resistant element in a traditional cavity wall composed of facade masonry and load-bearing masonry or cast concrete elements.

Solid wood panel facades (CLT panels for example) are treated in a similar way. Depending on their type and thickness, solid wood panels in general have an E 60 fire resistance (or RE 60 if they support floors).

As stipulated in § 5.1.2, an alternative vertical E 60 facade element consists of an E 60 horizontal projection (balcony) of at least 60 cm. Given that concrete balconies generally form a thermal bridge, there are often fitted with a thermal break in order to meet thermal regulations. This break is generally realised using rigid combustible insulation panels, which in principle cannot ensure the fire integrity during 60 minutes. The combustible insulation may be replaced with a non-combustible material (minimum reaction-to-fire class A2-s1, d0) such as cellular glass or rock wool over a minimum height of 8 cm (see figure 25). Another option would be to place a
fire-resistant panel at the level of the thermal break or the junction between the window and the insulation. In all cases, one needs to ensure that the reinforcement intended to anchor the balcony to the floor maintains a sufficiently low temperature, so as to guarantee the stability of the assembly for a period of 60 minutes.

Figure 25 – Balcony fitted with a non-combustible thermal break.

7.1.3 Curtain walls

Curtain walls are made of a framework usually consisting of horizontal and vertical profiles and containing glass or opaque filling elements.

The solutions proposed hereafter were the subject of an article published in CSTC-Contact in 2013 [23]. Other solutions are possible, provided that they have been validated by means of a laboratory test. A Technical Information Note on the subject is currently being drafted.
Figure 26 – Example of an E 60 fire-resistant element and its junction with a concrete floor in the case of a curtain wall.

Figure 27 – E 60 facade element consisting of internal steel sheets (Fire Brigade Leuven).

1. E 60 facade element with a minimum length ≥ 1 m (metal sheet and rock wool)
2. Fixation of the curtain wall frame to the supporting structure at each level
3. EI 60 rock wool sealing
4. Compartment floor (REI 60 or REI 120)
5. Thin steel sheet under the floor
6. Thin steel sheet above the floor
The EI 60 fire-resistant sealing between the compartment floor nosing and the E 60 facade element may be realised in the following way (see photos below):

- filling by means of rock wool panels and/or loose rock wool
- over a height of 150 mm for example, for a panel with a density of 45 kg/m³ compressed by 20%
- across the entire distance between the slab nosing and the fire-resistant facade element, without interruptions, by pressing the material firmly in order to ensure complete sealing of all joints (no openings can remain).

The distance between the slab nosing and the fire-resistant facade element cannot exceed 100 mm. Failing that, additional reinforcements must be placed to guarantee the stability of the facade system in the event of a fire.

Under the floor, steel sheets make it possible to hold the rock wool insulation in place in the event of a deformation of the facade element in a fire. These sheets have a maximum thickness of 1 mm and are placed with a minimum overlap of 100 mm; they are fixed on both sides of the sealing (on the fire-resistant facade element and on the compartment floor) using steel screws with a minimum section of 20 mm² (diameter > 5 mm) anchored every 200 mm maximum in the concrete over a minimum depth of 40 mm.
Above the floor, steel sheets ❶ with a maximum thickness of 1 mm seal the joint between the fire-resistant facade element ❶ and the compartment floor ❹. They allow to fix the fire-resistant facade element to the supporting structure and to guarantee the fire integrity of the junction.

### 7.1.4 Timber frame facades

This type of facade is comprised of a frame made of vertical wood components (studs) placed at regular intervals (generally every 400 or 600 mm) and linked together by horizontal wood elements. An insulation material is inserted between the studs. The frame is covered with panels on the inside and/or the outside.

In order to meet the fire safety requirements, the research project ‘DO-IT Houtbouw’\(^{14}\) led to the development of new solutions for E 60 fire-resistant timber frame facades that are positioned against the slab nosing\(^{15}\). Some of these solutions are presented hereafter. Other options are possible both for the E 60 facade element and for the EI 60 sealing, provided that they have been validated by means of a laboratory test.

The EI 60 sealing between the slab nosing and the facade is realised as follows:

- filling using rock wool with a minimum thickness of 15 cm (minimum compression of 20%, minimum density of 55 kg/m\(^3\) after compression; for example: insulation panel with a density of 45 kg/m\(^3\) compressed by 20%)
- installation of a panel on the inside of the timber facade element in order to allow the correct compression of the insulation
- possible installation of a continuous airtight membrane (maximum thickness of 1.5 mm) between the panel and the rock wool filling.

\(^{14}\) Project conducted in collaboration with WOOD.BE, with the financial support of VLAIO (Agentschap Innoveren & Ondernemen).

\(^{15}\) See also the article ‘*Nouvelles solutions de façades à ossature en bois répondant aux prescriptions de sécurité incendie*’ (‘New solutions for wood-frame facades meeting the fire safety requirements’) published in CSTC-Contact 2015/3.
The E 60 fire-resistant timber frame facade element must be executed in accordance with the following provisions:

● vertical timber studs (class C24, min. average density of 420 kg/m³) with a minimum section of 38 x 190 or 44 x 183, with a maximum space of 600 mm between them

● complete filling using rock wool panels:
  o with a thickness equal to that of the timber studs in the case of rock wool with a density of 45 kg/m³
  o with a thickness equal to that of the timber studs + 20 mm in the case of rock wool with a density of 35 kg/m³

● juxtaposition of different modules one on top of another. The space between the top rail of the lower module and the bottom rail of the upper module shall be filled with rock wool (minimum density: 45 kg/m³; compression: 20%). If the space is less than 1 mm, it can remain unfilled

● the facade element shall have a minimum developed length of 1 m (see figure 29). It may be designed as a lintel (A), an apron (B) or a combination of both (C).

![Figure 29 - Fire-resistant facade element designed as a lintel (A), an apron (B) or a combination of both (C) (a + b + c + d ≥ 1 m).](image)

The stability of the timber frame in the event of a fire is guaranteed by fixings in the floor of each storey. These anchors being positioned above the floor, they are protected from a fire raging under the floor. In this configuration, the panels are optional both on the inside and on the outside to ensure fire resistance. They shall be
selected according to other considerations, notably their acoustic, hygrothermal and/or aesthetic properties.

![E 60 wood-frame facade element, R 60 fixing on the slab and EI 60 sealing with the slab nosing. Left: installed lower and upper modules; right: installed lower module (photos BBRI – URBICOON worksite, Antwerp – MBS).](image)

This solution has been completed with a series of other configurations for timber facade elements with an E 60 fire integrity. The latter are made up of specific inner and outer panels surrounding an insulation material (rock wool, glass wool or cellulose). Some configurations include rectangular timber studs, others I-shape wood joists (more commonly known as I-joists). In some cases, the sealing between the facade element and the slab nosing can be carried out by using an appropriate fire-resistant foam. Two examples are illustrated in figure 31. One must ensure that these solutions are implemented while respecting all parameters, in accordance with the tests conducted (type and thickness of inside/outside panels, type of insulation, type and section of timber elements, type of sealing, …).
7.2 **Key points for the design and execution of ventilated facades**

These facades feature, behind the cladding, a ventilated air cavity likely to create a chimney effect and thus to accelerate the fire spread (see chapter 4, risk 3 ‘Spread within the facade’). One of the options to counter this would be to interrupt the air cavity (and the thermal insulation, if it is combustible), as suggested for buildings higher than 10 m by the ‘Facades’ working group of the Belgian High Council for Fire and Explosion Safety (see § 6.2).

To this end, it is possible to divide up the air cavity (and the combustible insulation) using non-combustible horizontal strips or rain flaps that are resistant to corrosion and placed with a 5% gradient to allow water to run off to the outside.
There are also devices that interrupt the air cavity in the event of a fire (intumescent water-resistant products for example); the air cavity remains thus ventilated under normal circumstances.

7.3 KEY POINTS FOR THE DESIGN AND EXECUTION OF ETICS

In recent years, an increase in external thermal insulation facade surfaces and in the thicknesses of insulation has been noted, and consequently as have the combustible masses within facades. The risk of fire migrating ‘into the core’ of the facade system, notably via the combustible insulation of an ETICS (EPS for example), is therefore real (see chapter 4, risk ❸ ‘Spread within the facade’).

This risk is not directly covered by the European testing methods and the regulations currently in force in Belgium. In practice, however, some fire services recommend building solutions to avoid this in their prevention report related to the planning permit. One of the options would be to interrupt the combustible insulation by means of continuous non-combustible insulating strips [24], as suggested for buildings between 10 and 36 m high by the ‘Facades’ working group of the Belgian High Council for Fire and Explosion Safety (see § 6.2).

This principle is also found in the requirements currently in force in Germany [25] and in France [26] [27]. Generally, it consists of interrupting the combustible EPS insulation by using continuous non-combustible strips. These strips (in rock wool for example – A1 reaction-to-fire class) are fixed with anchors and fully bonded to the substrate
(concrete or masonry substructure). They have the same thickness as the EPS insulation and a minimum height of 200 mm. An additional reinforcement is installed with the aim of reducing the risk of the rendering cracking. In order to prevent appearance defects, efforts will be made to avoid excessive thickness of the base coat and to press the underlying reinforcement by exerting stronger pressure on the level of the overlap [28].

The continuous strips are placed at the base of the facades to take into account the possibility of a fire at this level (burning dustbins, cars, ...). To cover the risk of fire coming from inside (flames exiting the windows), these strips are required at each level in France, while in Germany they must be installed on the first and the third floor. For the subsequent floors, two possibilities are considered in Germany: either one continuous strip every two floors or a protection around every opening. It should be noted that the latter solution (protection around the openings) is contrary to the principles of TIN 257 [28] intended to limit the risk of cracking in stress concentration areas.

Figure 33 – Continuous non-combustible insulating strips with a height of 200 mm placed at the base of the facade and on each level (recommendation in force in France).

7.4 Key points for the design and execution of traditional cavity walls (systems with external masonry cladding)

The continuous reinforcement of thermal regulations has had the effect of increasing the thicknesses of insulation inside facades. Consequently, the external joinery no longer fully seals the gap in cavity walls, which implies the risk of a fire spreading this
way into the upper compartment in spite of the presence of a fire-resistant element with a length of 1 m.

However, the risk of fire spread within the cavity of the walls is smaller than in a ventilated facade or even in an ETICS system. Indeed, the air cavity for water draining is in general not ventilated intentionally, which strongly limits the intake of combustion air. Compared to an ETICS system, facade masonry offers a much higher level of protection against fire than that provided by a thin rendering (< 15 mm), so that only the lower section of the insulation (level with the joinery junctions) will be exposed to the flames. In all cases, the fire spread via the cavity can be contained if the passage of flames is prevented by realising a fire-resistant sealing in the spaces between the joinery and the internal masonry or the facade masonry (see figure 34).

Figure 34 – Containing the risk of fire spread within the cavity of a wall.
In practice, this would notably be the case when the following conditions are met:

- the joinery is made of wood (minimum frame section of 50 mm for example) or shows an E 60 fire resistance
- the internal sealings are realised using a plaster or similar layer, natural stone elements (window sills for example), …
- the external sealings are realised with steel plates or ideally with a facade brick return.
CONCLUSIONS

This document has made it possible to demonstrate that the fire regulations applicable to new buildings in Belgium cover the majority of risks, even if their interpretation is not always easy. In particular, we are referring to the reaction-to-fire requirements for facade cladding, which must be evaluated while taking into account the influence of the underlying layers (panels, insulation, ...) and the execution conditions (ventilated air cavity, ...).

As for the renovation of existing buildings, no regulations currently in force deal with the subject. However, some works require the submission of a permit application. The fire service can thus be consulted within this context and propose recommendations in this regard. In the case of significant renovation works, the requirements for new buildings will generally need to be applied.

At present, the risk of fire spread within the facade is insufficiently considered in European standards. The ‘Facades’ working group of the Belgian Federal Public Service Interior is addressing the issue of this shortcoming in Belgian regulations.

Finally, we would highlight that the BBRI has been working for many years in collaboration with the sector on proposing practical solutions that make it possible to satisfy regulations and to take into consideration all criteria imposed to today’s buildings (airtightness, thermal insulation, acoustic performances, ...).

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[22] Decision of the European Commission of 8 February 2000 regarding the classification of reaction to fire characteristics for building products.


Wärmedämmverbundsystemen mit EPS-Dämmstoff. Deutsches Institut für Bautechnik DIBT, 05/2015.


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