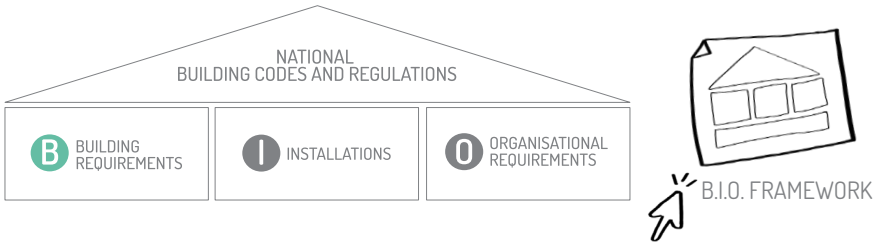
B.I.O. framework factsheet: FIRE SAFETY OF FAÇADES

MODERN BUILDING ALLIANCE
Safe and sustainable construction with plastics

This factsheet aims at presenting façade systems and key factors affecting their fire performance. A rapid fire spread on a façade may jeopardize the fire compartmentation strategy in a building and compromise people's safety. This must therefore be avoided. Fire safe façades are an element of the B.I.O framework for fire safe buildings.



Introduction

The fire safety of façades is not a new topic. With increasing height of buildings, fire spread on façades has become more relevant, because evacuation of occupants and firefighting are more difficult than for small buildings. Since 1970, several European large-scale tests have been developed. Recent major fires (Torre dei Moro, Milan August 2021, Tore Ambar, Madrid in August 2020, Grenfell Tower, London in June 2017, The Marina Torch, Dubai in 2015...) showed the risk of large façade fires on tower buildings.

Façade systems are very complex. There are different ways to build façades to adapt with different climate conditions and with different intended performances, such as energy performance, resistance against wind pressure and weather, aesthetics, brightness, etc... Building a façade requires a lot of different materials and components that all have their own specific fire performance.

In case of fire, the reaction to fire of the different components and their interaction, depending on the design of the complete façade system, determines the fire performance of the façade system.

Façade definition

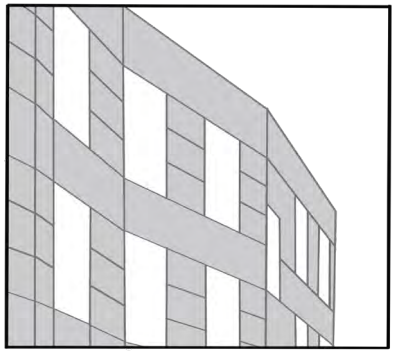


Figure 1. Typical façade

There is no clear definition of what a façade is. For some, the façade is attached or suspended on the outside of the loadbearing external wall, for others it is the complete wall. In all cases, the façade is a complex structure consisting of several layers and different materials.

When it comes to adding an insulation layer to an existing or new building, different designs can be used. Two typical façade systems are given here, however, other designs are possible:

Ventilated façades:

Fixed to the outer wall of the existing building, it comprises, a thermal insulation layer adhered and/or mechanically fixed to the support wall, an air cavity, a supporting structure, and cladding panels (the exterior finish and weather protection of the building). Spacers and cavity barriers are typically included as well in the system construction.

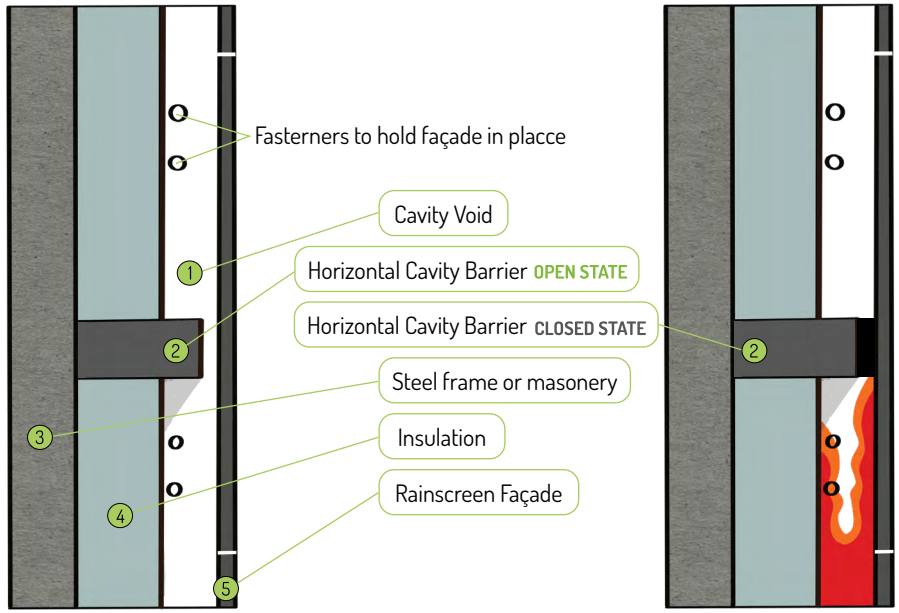


Figure 2. Example of a ventilated Façade with cavity barrier

ETICS:

External Thermal Insulation Composite Systems are kits consisting of specified components (thermal insulation, adhered and/or mechanically fixed to the outer wall, adhesive or mechanical fasteners, reinforcing mesh, base coat and finishing coat or in some cases other finishing products like ceramic tiles) to be applied on the outer wall of the building. Depending on the insulation product used, building type, height and regulatory requirements, fire barriers are applied in the insulation layer.

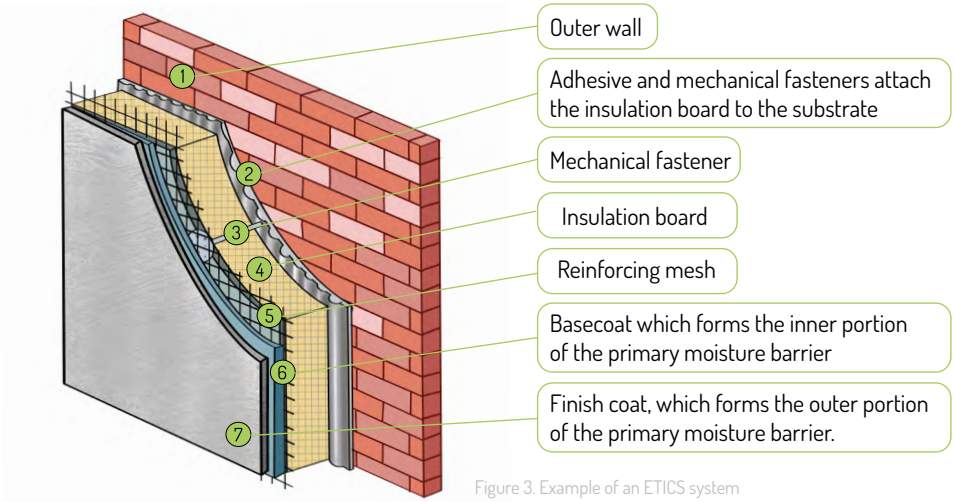
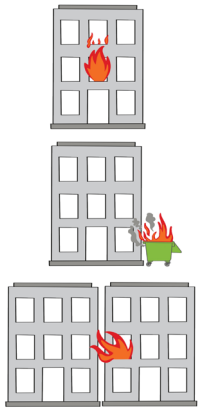


Figure 3. Example of an ETICS system

Fire scenarios related to façade

There are different ways façade fires can start, which include the following:



Fire inside a room and spreading outside a window

Fire at the exterior of the building close to the façade

Fire from a neighbouring building

Façade tests in the EU: an attempt of harmonisation

Fire safety regulations are set at national level to define safety levels and satisfy local construction traditions. Some Member States have national standards to test the fire performance of façades on a larger scale while others refer to standards from other countries. Some countries are not using any large-scale façade test standards.

Nowadays, several different tests co-exist in the EU, however, only a few have a long track record of use. Various test methods have been identified as being either currently in use, or referenced in the regulations, throughout Europe.

Test methods	Countries using the test method
PN-B-02867:2013	Poland
BS 8414-1:2020 and BS 8414-2:2020	UK, Republic of Ireland, Belgium
DIN 4102-20	Switzerland, Germany, Belgium
ÖNORM B 3800-5	Switzerland, Austria
Prüfbestimmung für Aussenwandbekleidungssysteme	Switzerland/Lichtenstein
DIN 4102-24:2022-12	Germany
LEPIR 2	France, Belgium
MSZ 14800-6:2009	Hungary
SP Fire 105	Sweden, Norway, Denmark
Engineering guidance 16 (unofficial test method)	Finland
ISO 13785-2:2002	Slovakia
ISO 13785-1:2002	Czech Republic, Italy

These test methods have different characteristics such as size, and shape of specimen, fire load. Etc. The British Standard test (BS-8414) is considered one of the most demanding (or severe) tests around the world. It requires a nine (9) meters tall wall (approximately 3 storeys building) in a corner configuration and mimics a fire breaking out of a window and exposing the façade to a severe – 30 min fire. Also the criteria to be assessed may be different – vertical and lateral fire spread, size and weight of falling parts and glowing and smouldering performance are some of the frequently used parameters.

Against this backdrop, EU regulators agreed a decade ago that an EU harmonised façade test method would help to provide a clear assessment and communication about façade system fire performance. A European approach to assess the fire performance of façades would allow national regulators to set specific façade system performance requirements. On the industry side, a harmonised method allows to lower the high cost of testing and to simplify the assessment of innovative façades systems. This allows proper access of these systems to the EU single market.

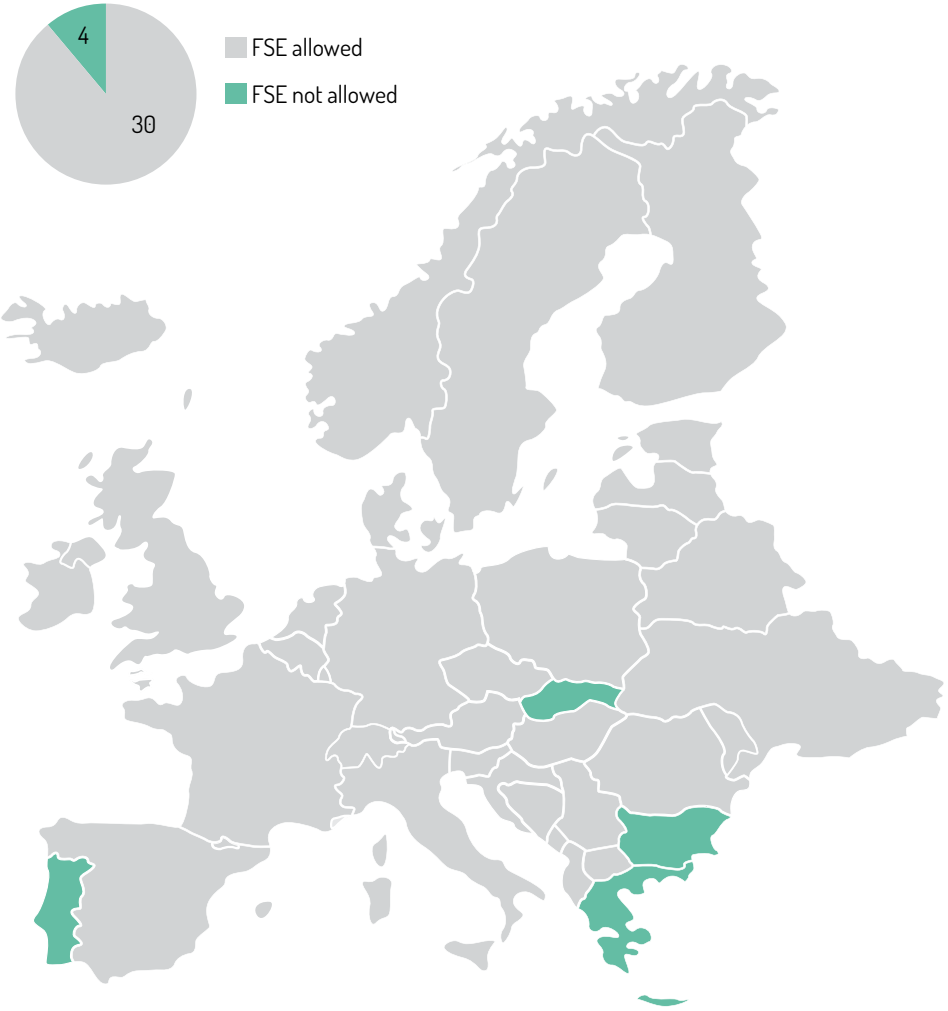
The European Commission is currently sponsoring the development of such a harmonised method with two levels of exposure based on the existing BS 8414 and DIN 4102-20 methods. It is important however to mention that there is still a lot of work to do before this test method is ready to use and it will take some time.

Prescriptive route vs performance-based regulatory approach

In Europe, prescriptive regulatory methods are still prevalent throughout the different countries. Nevertheless big differences exist between them, namely, from 100% prescriptive to 100% performance-based regulation (ref. survey EC JRC 2023). Almost all countries accept performance-based principles and fire safety engineering to some extent, but experience may be lacking.

Fire safety engineering (FSE) is a tool for introducing performance-based approaches and is currently mainly applied for complex or special buildings. High-rise buildings are such complex buildings and fire safety approaches are being developed.

Use of FSE approach in construction works



Countries/regions allowing/not allowing for the use of FSE approach in construction works in the framework of the national regulatory system (copied from ref. survey EC JRC 2023)

Fire performance of building materials: the prescriptive (linear route)

The prescriptive route sets the classes of the products that can be used. For high rise façades, this implies in many countries that most of its components must meet Euroclass A1 or A2. To define whether a construction material is Euroclass A1, it is required to conduct an ISO 1716 and an ISO 1182 test (assessed to EN13501-1 classification standard). For A2, one of these tests and an additional EN 13823 SBI test is needed. It is important to highlight that both ISO tests rely on the combustion of a small sample of a few grams to determine, respectively, the calorific value or the temperature increase in a small furnace. The amount of energy released by the combustion determines whether a material can be Euroclass A1 or A2 or not.

The use of this type of material classification as basis for setting requirements for façades is a silo approach. If this is applied, for example the chimney effect in a ventilated façade is ignored. This effect "can lead to flame extension of five to ten times that of the original flame lengths regardless of the materials used to line the cavities" [1]. The tests also cannot detect interactive effects in a system and the effect of the overall construction.

Fire performance of the system as a whole: the performance-based route

There exists an alternative approach to the prescriptive one, namely, the performance-based route. It is based on performance testing of the entire system. Passing the test will confirm the compliance of the defined complete façade with fire safety requirements. Experiments have shown that systems do not always behave as one would have predicted based on material classification alone.

For example, this was illustrated by the UK government test programme that was run after the Grenfell Tower Fire. It has shown that small scale material or product testing was not sufficient to assess the façade fire safety. The UK Government independent expert panel on safety advised further testing, based on the large-scale test BS 8414 and conclusions were based on these results. The data showed that the combination of ACM cladding with a non-FR PE core combined with any type of insulation material failed system testing in the selected ventilated façade systems. Hence this is the reason why it is important, as described in BR135, that you cannot predict a system performance based on a material or product testing approach. Based on the large-scale tests, a guidance to building owners could be provided on safe combinations of façade components/systems.

Our recommendations for a fire safe façade

In case of a fire at the exterior or next to a building or inside a building, a façade can be exposed to heat, radiation, and flames. Fire performance of the façade is then an important factor for fire safety, especially for taller buildings, along with all the other building aspects, e.g., compartmentation, safe evacuation routes, structural fire safety etc. (see also the B.I.O. framework for fire safe buildings). A façade cannot be assessed by a prescriptive approach only – a holistic approach is used for assessing the complete system.

Fire performance of façades includes:

- Fire spread on the outside of the façade system
- Fire spread within the façade system
- Burning and non-burning falling parts
- Ongoing glowing and smouldering behind the outer layers of a façade system

Relevant factors for a fire safe façade system are:

- Selection of products and the construction based on large scale tests or a fire safety engineering assessment
- Inclusion of fire barriers in all ventilated façades (independent of the reaction to fire classification of the products used)
- Inclusion of fire barriers in the insulation layers in other façade systems like ETICS, when required according to large scale tests
- Appropriate protective measures around windows and other openings
- Appropriate mounting and fixing of the façade system

Key factors for sound decision making on selection and application of façade systems are:

- Design of the façade system by competent specialists
- Selection of products based on test evidence,
- Evaluation of variations from the tested façade system by a qualified Fire Safety Engineer.
- Control and detailed documentation of mounting and fixing of the façade

Further considerations: Quality of the construction and manufacturer's information

Ensuring the fire safety of façades is not limited to the compliance with applicable regulations and standards and the selection of a fit for purpose system based on either the prescriptive or the performance-based route. It is important to ensure that the system installed corresponds to the system tested or is within the allowed variations based on extended applications rules. The components must therefore be described precisely, and the quality of the construction must be assured and be legally compliant. Attention must be paid to all construction details, such as, number and widths of joints, the connections with the windows, the penetrations or the type, number, and position of the fire barriers. All these aspects require products and system manufacturers to develop knowledge and information based on multiple tests, design teams to involve qualified fire safety engineers and construction teams to rely on skilled professionals and on quality control. The information should not just be relevant to the direct customer, but also for the entire building and construction value chain. This applies also to the other elements of the B.I.O framework for fire safe buildings, of which fire safe façades is one.

Conclusions

In conclusion, fire safety of façades is important especially for taller buildings. Regulators need to put in place an articulated approach to ensure they are fire safe. Fire safety engineering allows the proper and effective use of innovative materials. Large-scale testing is the best basis on which to validate the fire performance of a façade system. In addition, other elements of the fire safety of the final buildings should not be neglected. Finally, accurate information, provided by manufacturers of façade components and systems, is key to ensure a correct selection process.

To know more

1. Information on EU harmonised method ri.se
2. Webinar 'Façade Fire Safety' organised by NEN on the 6 October 2020.
3. https://www.researchgate.net/publication/325695094_Study_of_fire_behaviour_of_façade_mock-ups_equipped_with_aluminium_composite_material-based_claddings_using_intermediate-scale_test_method
4. The conclusion of the government test programme is available here: https://www.gov.uk/guidance/aluminium-composite-material-cladding
5. Website of the European Association for External Thermal Insulation Composite Systems, EAE, https://www.ea-etics.eu/etics/about-etics
6. Website of Kingspan, https://www.kingspan.com/ie/en/
7. Guillaume, E., Fateh, T., Schillinger, R., Chiva, R., Ukleja, S., (2018), Study of fire behaviour of façade mock-ups equipped with Aluminium composite material-based claddings using intermediate-scale test method. Fire Mater. 2018; 42: 1- 17.
8. Van Hees, P., (2016), The Urgent Need for System Thinking in Fire Safety – The Only Way Forward for Testing, Engineering and Education, 14th Interflam conference, keynote lecture, London, 2016
9. Anderson et al., (2019), European approach to assess the fire performance of façades. https://www.researchgate.net/publication/342383458_European_approach_to_assess_the_fire_performance_of_façades

10. Building safety: independent expert advisory panel - GOV.UK (www.gov.uk)
11. Modern Building Alliance position paper on the development of a European approach to assess the fire performance of façades, published in November 2018. https://www.modernbuildingalliance.eu/assets/uploads/2018/11/MBA-position-paper-on-façade-testing_final-1.pdf

References

1. Fire Performance of external thermal insulation for walls of multistorey buildings (163_BR135-third-ed-2013.pdf (bre.co.uk)

Glossary

1. ACM: Aluminium Composite Material
2. non FR-PE core: non Fire Retardant - Polyethylene core

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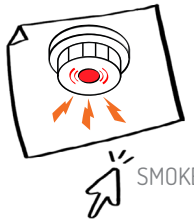
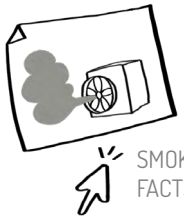
SPRINKLERS FACTSHEET



SMOKE DETECTION



SMOKE MANAGEMENT FACTSHEET

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