Flat roofs

Managing fire risk in the fifth façade

ROCKWOOL®

Contents

Introduction

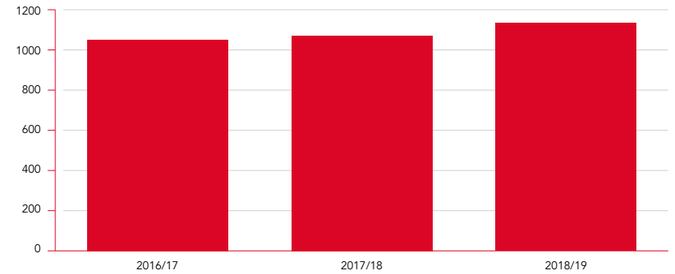
The concept of the roof as the fifth façade, to highlight the increasingly important role it plays in the overall architectural design of the building, has gained traction in recent years.

Primarily driven by Part L of the Building Regulations and the use of insulation to achieve low U-values through the building fabric, the function of the roof has evolved far beyond delivering a watertight structure.

While a recent change to legislation has banned the use of combustible materials in the external walls of relevant buildings over 18m* (as defined by Regulation 7), this ban only partially extends beyond walls and associated attachments to upstands, balconies and roof terraces – leaving the majority of roofs open to a greater fire risk than the walls.

This fifth façade fire risk is further compounded by common industry misconceptions, specifically surrounding testing protocols and rising confusion between BROOF(t4), and the Euroclass reaction to fire ratings for products: A1, A2, B, C, D, E and F.

Number of roof fires



Source: https://www.gov.uk/government/statistical-data-sets/fire-statistics-data-tables

The following paper addresses these misconceptions, and examines the wider social and economic impacts that roof fires have on people's lives, explaining the differences in fire classifications, and providing best practice advice on the specification of insulation for flat roofing applications.

*The ban in Scotland applies to relevant buildings above 11m in height.

Role of the roof

While one of the principal functions of the roof is to make a building watertight, the declining availability of land for development has resulted in the roof emerging as a valuable and practical commodity.

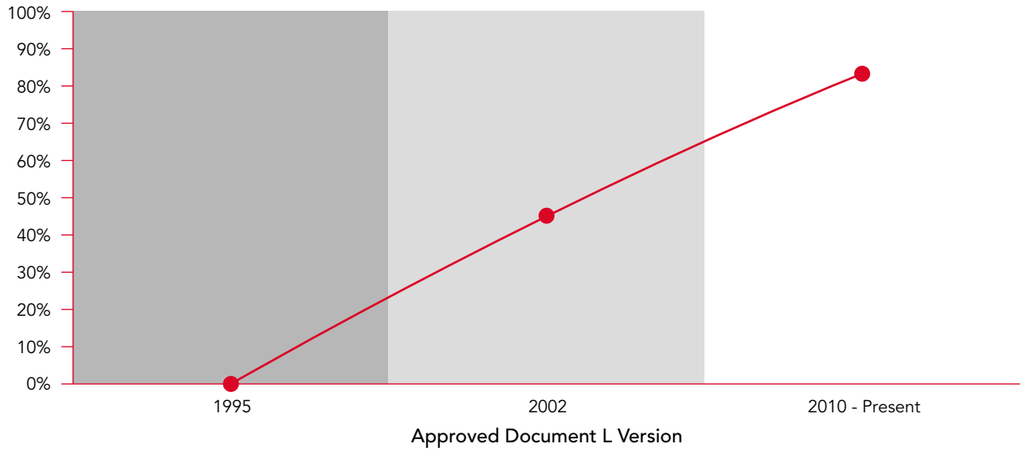
Rooftops have long housed plant and machinery, a design strategy which preserves building space and aesthetics. Usage of the roof space has continued to evolve in recent times. This is evidenced by an increasing number of solar panel installations, helping to meet sustainable energy targets; and the creation of green and blue roofs, facilitating rainwater management.

These practical roof applications extend even further with the trend for high rise residential developments to utilise the area for garden terraces, or the provision of additional residential space.

Moreover, the roof may also provide a means of escape or place of refuge in the event of a fire.

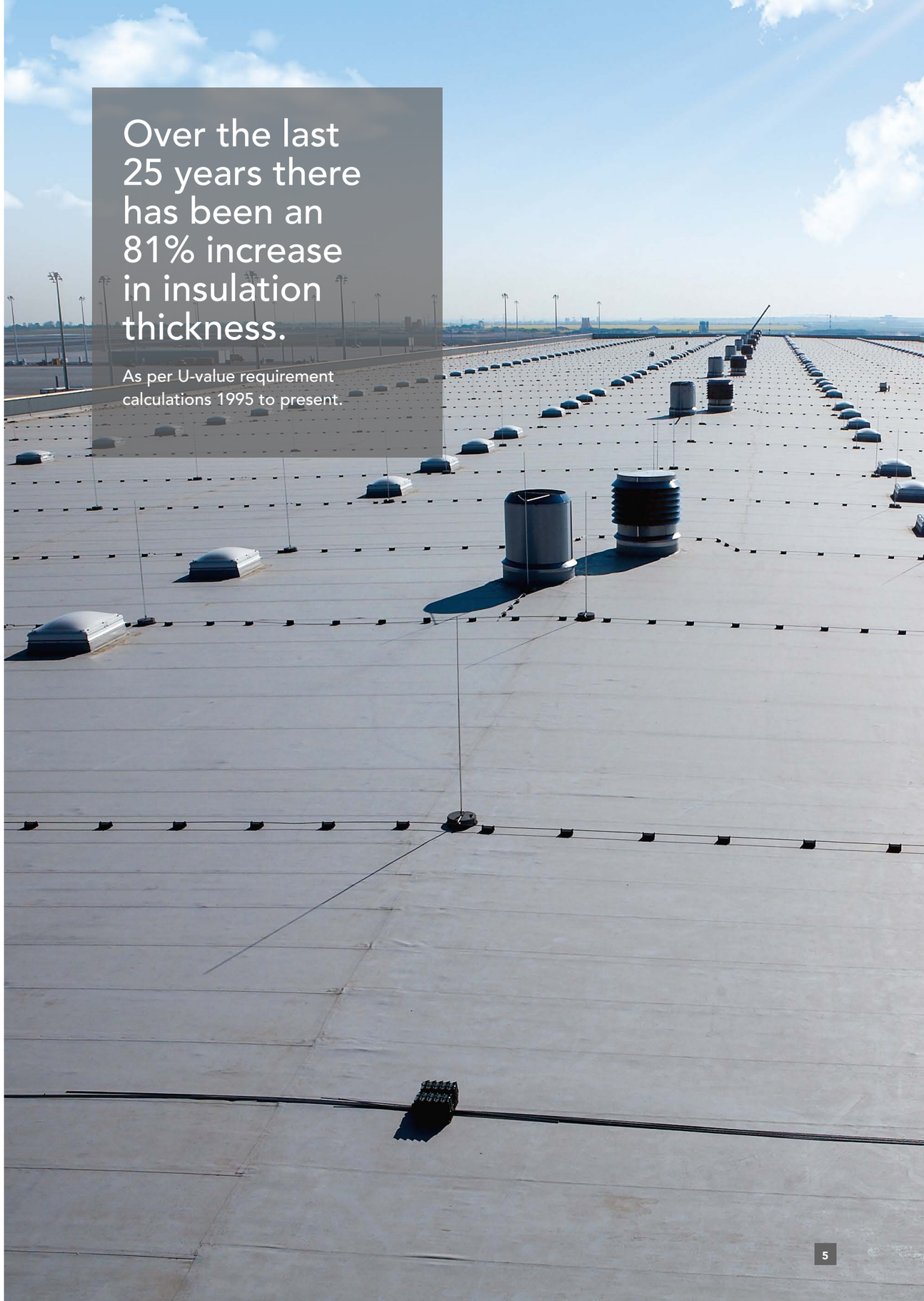
Beyond the use of the roof space, the roof construction is vital to the thermal efficiency of the building envelope. Traditionally a flat roof would have been a 'cold' construction, with a nominal amount of insulation beneath the substrate or deck. However, due to tightening thermal requirements, an ever-increasing amount of insulation is now commonly placed above the deck.

Flat roof insulation thickness, average increase (1995 baseline)



This means that if a combustible insulation is used, the fire load will be significantly increased – offering more fuel to fires that start on or spread to the roof.

In contrast, the use of non-combustible insulation such as stone wool allows for the highest levels of thermal efficiency to be attained without compromising fire performance.



Fifth façade and fire risk

It is of fundamental importance to consider fire performance at the outset of a project, before establishing other design considerations that may result in a compromised approach to fire.

This begins with the legal requirements in Part B of the Building Regulations and associated guidance provided by Approved Document B. Together they stipulate minimum requirements to provide building occupants with a safe passage of exit in the event of a fire. They also consider access by firefighters and compartmentation, keeping people safe should evacuation not be possible.

External fire spread is covered by Part B4 of the Building Regulations. While it uses virtually identical language to describe the legal requirement for both the roof and the walls, the recent ban on the use of combustible materials does not currently apply to all roofs - meaning combustible insulation could be specified in a warm flat roof application.

But what are the implications of this in the context of fire risk? Firstly, remember that Part B protects the safety of people. It does not protect property contents nor the viability of the building post-fire.

So, what are the main fire risks to which a flat roof is exposed?

These typically comprise the following:

Arson

The most common cause of fire in the UK, annually accounting for 50.5% of fire service call-outs*.

Fire spread

When a fire takes hold of the roof from an adjacent building or spreads from within the same building.

Hot works

Fire caused by building maintenance or refurbishment works that require the application of heat, such as grinding, welding or torch-applied roofing.

Plant failure

There are known incidences of solar panel faults causing fires by ‘arcing’.

Lanterns / fireworks

As sources of external ignition landing on the roof

Clearly all flat roofs are at risk from these fire sources, but when combustible insulation is installed, the consequences for the building may be heightened.

In every instance of fire, loss of life is the greatest loss of all, which Part B regulatory requirements help to safeguard. However, when fire is able to take hold of a roof, the consequences can extend much further than the risk of building collapse – as was seen when a major retail fire occurred in Northern Ireland.

***Zurich, Human impact of fire.*

Fire in the fifth façade – the real impact

In August 2018, when undergoing a £30m refurbishment and renovation, Primark's landmark Belfast city centre store suffered a catastrophic fire which broke out at the top of the five-storey Bank Buildings and took hold in the roof.

While the building was quickly evacuated and nobody was injured, the blaze took the Northern Ireland Fire Service three days to put out and left the historical building at risk of collapse.

Primark suffered immediate financial losses, but it wasn't only the retailer and its 360 employees who were directly affected by the fire. For public safety, a cordon was established which essentially divided the main thoroughfare of the city into two and closed 14 businesses within the zone. Even those businesses on the periphery of the cordon experienced an 80-90% decrease in footfall, leading to a drop in revenue. For example, one shop owner could only afford to pay one member of staff after the fire, when previously there were four employees.

Staff from a nearby Tesco store and McDonalds restaurant also had to be relocated, which would have had an impact on their personal lives and circumstances.

Financially, Primark did not only have trading and stock losses to contend with, it committed to paying its employees for at least a month and donated £500,000 to support local businesses affected by the fire. Belfast City Council also sought to recover from Primark, security costs incurred by managing the city cordon, which was estimated to be in the region of £33,000 per month.

Sources:
www.belfastlive.co.uk/news/belfast-news/primark-fire-affected-businesses-given-15183143
www.bbc.co.uk/news/uk-northern-ireland-45943794
www.bbc.co.uk/news/uk-northern-ireland-45437223

Counting the cost of the Primark fire

- **14 businesses closed** for 5 months.
- Belfast City centre **lost up to £3m per month.**
- CastleCourt shopping complex **footfall down 49%**
- Car parking revenue **down 12%**
- Public transport passenger numbers down **28,250 (4%)** year-on-year.
- **1,000 workers affected by closures.**

The economic, social and human impacts experienced because of the Primark fire are not unique. The below summarises a series of other roof fires and the subsequent consequences.

Ocado warehouse - *Andover*

The initial fire started due to an electrical fault in the battery of a factory floor robot, but this spread to the roof and caused the whole building to collapse. Fortunately, there was no loss of life, but it did lead to sustained damage to the building and its contents.

The facility was subsequently destroyed which resulted in a financial cost to Ocado of £110 million.

Source: www.bbc.co.uk/news/business-48919285

> *£110 million in losses*

Epping Forest housing - *Essex*

Epping Forest District Council's partially-constructed £10 million Burton Road residential development in Debden, Essex, caught fire during hot works on the roof.

As one of the first local authorities to launch a new build programme of council homes to rent, the fire had a social impact on Epping Forest residents by delaying access to much needed affordable housing.

Source: www.guardian-series.co.uk/news/16683245.the-insulation-in-the-burton-road-development-was-flammable/

> *£10 million development*

St Alban's Primary School - *Wednesfield*

After arsonists gained access to a flat roof at St. Albans Primary School, a blaze spread across the whole surface and required dozens of firefighters to bring it under control.

With the school closed for weeks its 177 pupils had to be relocated to various other schools, causing severe disruption and impacting educational attainment.

> *"It has not only disrupted education and learning for more than 100 of our young people, but has also caused a great deal of distress to pupils, parents and teachers."*
>
> *Councillor Phil Page*

Source: www.wolverhampton.gov.uk/news/arsonists-condemned-after-blaze-primary-school

As is documented by these examples, the real impact of fire is far reaching, but it is not always possible to quantify. While the purpose of Part B is to protect people, ensuring the viability of a building post-fire may require higher standards than those that exist currently – particularly while we await the outcome of a recent government consultation on extending the scope of Building Regulations to include protection of property. As such, it should be considered best practice to minimise risk as much as possible.

To effectively manage fire risk, it is important to understand the regulations which specifically govern roofs.

Product combustibility

Building Regulations classifies product combustibility in accordance with the reaction-to-fire rating system found in EN 13501-1, often referred to as the 'Euroclass system'.

This evaluates the contribution a material can make to fire growth and development, which is particularly important in the early stages of a fire. The reaction to fire classification of building insulation is determined through a series of tests which measure performance against several key characteristics.

Euroclass	Combustibility
A1 **A2-s1, d0**	Non-combustible
B **C** **D** **E** **F**	Combustible

Heat release
Heat energy released during combustion

Character changes
Does the product melt, drip, or char?

Flame spread
The rate fire spreads across a surface

Smoke emission
The level of smoke produced when burning

Ignitability
Does the product catch fire?

Using a product's Euroclass rating as guidance is the only way to determine a product's full Reaction to Fire performance. Products classified A1 or A2-s1, d0 are considered non-combustible and those classified B – F are considered combustible.

Combustible materials are those that burn, whereas Euroclass A1 and A2-s1, d0 non-combustible materials do not contribute significantly to fire.

Regulating roofs

> *"The main objective in relation to all elements of construction, including roofs, is that they should not significantly contribute to the growth and spread of fire, either internally or externally. In this respect it is important that the complete building design is analysed to ensure that as a result of its behaviour in a fire, no element of fire protection will be compromised."*
>
> *Source: LPC Design Guide 99*

At present, the following is one method that can be used to assess how a roof will react to the spread of fire when exposed to an external fire source:

EN 13501-5 'Fire classification of construction products and building elements – Part 5: Classification using data from external fire exposure to roofs tests'.

The proposed roof system is tested by exposure to burning brands, simulated winds and radiant heat – the results of which are used to give a classification. Within the UK these ratings run from the highest-achievable BROOF(t4) down to FROOF(t4).

Approved Document B allows roof coverings achieving BROOF(t4) to be used without further consideration of the building type or relevant boundaries.

However, it is important to note that EN 13501-5 only assesses how a roof will behave when exposed to an external fire source.

It does not provide any indication as to how the roof system will perform when exposed to fire from inside the building, nor does it assess the combustibility of the roof system and its component parts – which may fuel a fire and emit toxic gasses and smoke.

It is important to note that roof systems incorporating combustible insulation products as low as Euroclass F can achieve a rating of BROOF(t4).

As such, the BROOF(t4) classification does not automatically allow such roof systems to be continued uninterrupted over compartment walls, where it is necessary for the substrate or deck material* to be Euroclass A2-s3,d2 or better.

**In our view, this is taken to mean the material directly beneath the waterproofing layer.*

Roof systems incorporating combustible insulation products as low as Euroclass F can achieve a rating of BROOF(t4).

Clarifying classifications

A simple and straightforward way to determine the combustibility of a building product is by checking its Euroclass reaction-to-fire rating. When managing fire risk in the roof and determining the correct specification for compliance, confirming the Euroclass rating of insulation is key.

This product rating might be supplemented by an 'in-use' reaction to fire classification, which applies to a specific combination of products tested together. Details of the exact construction tested are required to determine the scope of an 'in-use' classification, and any limitations on positioning the components relative to the direction of fire.

For example, a product may have achieved its stated Euroclass rating by undergoing reaction-to-fire tests when affixed to a steel substrate. This limits the product's field of application, since its Euroclass rating is not valid when used in conjunction with poorer-performing substrates.

Minimise risk today, futureproof for tomorrow

One of the main commercial benefits of a flat roof system is the guarantees which are offered through the system suppliers*, where one company takes liability for workmanship as well as all components, offering reassurance often up to 30 years.

However, in the context of minimising fire risk, understanding how each of the component parts perform is crucial. Where an insulation product is concerned, the surest way to confirm its reaction to fire properties is by its Euroclass rating, which the manufacturer should evidence by making available a Declaration of Performance (DOP) certificate. When reviewing system cost and performance, ensure all the relevant documentation is available before making a final decision.

Looking ahead to the future, a government consultation reviewing the combustible material ban has recently ended, and we wait to see if this will lead to the extension proposed to the scope of the ban.

Conclusion

There is increasing recognition that the use of combustible materials anywhere in the building envelope severely increases the potential consequences of a fire.

We consider that making the transition to non-combustible materials now is not only best-practice strategy for securing a higher degree of protection from fire today, but in the face of legislative changes and evolving client demand, will also serve to futureproof specifications and buildings.

Moreover, in recognition of the far-reaching social and economic impacts that fire has on people's lives, minimising the potential consequences of a fire from the outset is the safest strategy of all.

*ROCKWOOL Ltd do not supply flat roof systems and do not offer flat roof system guarantees.

Case study

Client: Cobham Free School

Architect: Stride Treglown

Main contractor: Willmott Dixon Construction

Roofing contractor: Southern Industrial Roofing

The challenge

With a warm flat roof specified for Cobham Free School, Southern Industrial Roofing had to balance multiple design considerations, starting with BS 6229: 'Flat roofs with continuously supported flexible waterproof coverings' and compliance with specific education sector building regulations. While BB93 specified acceptable levels of rain noise transfer into various spaces, BB100 outlined fire protection considerations.

Simultaneously addressing these requirements was compounded by mechanical and electrical plant being housed on the flat roof, which demanded non-combustible zones to provide safe access for maintenance. Internal fire rated walls in the building below also required the flat roof to contribute to effective compartmentation.

The solution

Across the school's two new buildings, over 2000m² of ROCKWOOL HARDROCK® Multi-Fix (DD) was installed to provide all-in-one acoustic, thermal and fire performance.

Where the roof deck interfaced with the heads of internal compartmentation walls, ROCKWOOL Trapezoidal Fire Stops were installed.

The results

Andy Towns, Designer at Southern Industrial Roofing, explains why using non-combustible ROCKWOOL insulation removed any concerns about roof zoning for maintenance access to the rooftop plant: "Flat roof construction has become more complex in recent years, having to navigate what are sometimes conflicting design criteria. Using a single insulation product greatly streamlined the whole process for us. Not just design, but installation too. We didn't have to worry about coordinating zones with different materials – it was ROCKWOOL across the board which simultaneously delivered the acoustic, fire and thermal performance we needed."

Read the full case study here:
www.rockwool.com/uk/cobham

Further reading

www.rockwool.com/uk/redbook

www.rockwool.com/syssiteassets/rw-uk/downloads/brochures/firepro-book.pdf

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