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CPD Article

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Fire Safety Considerations When Specifying Insulation for an Inverted Flat Roof

Introduction

It is a legal requirement for buildings to be designed to prevent the spread of fire from one structure to another and consideration must be given to this while designing and specifying building materials for use in an inverted flat roof. There has been an increased focus on fire safety in residential buildings following the 2017 Grenfell Tower fire, where combustible materials used in the cladding of the tower are believed to have contributed to the spread of fire. However, this does not mean that only non-combustible materials can be used safely in an inverted flat roof.

Key Learning outcomes

- How Approved Document B applies to inverted flat roofs
- Understanding of Broof(t4) classification and testing regime
- The impact of EC Decision 2000/553/EC on testing requirements
- The importance of selecting appropriate insulation material

1.0 Approved Document B and Broof(t4)

Approved Document B requirement B.4 (2) states “The roof of the building shall adequately resist the spread of fire over the roof and from one building to another, having regard to the use and position of the building.” Table 12.1 of Approved Document B Volume 1 Section 12: Resisting fire spread over roof coverings shows that only roof coverings that achieve the Broof(t4) classification can be used on any part of the roof. Such systems are defined as being “unrestricted with respect to proximity to a relevant boundary”, whereas coverings that meet lower classifications cannot be used within varying distances of the relevant boundary (see table).

Appendix B Sections B15 to B18 of Approved Document B Volume 1 and 2 describe how Broof(t4) is the highest performing classification for a roof system as defined in BS EN 13501-5:2016, assessing the reaction when exposed to external fire. To achieve this, fire cannot penetrate a roof system within 60 minutes and during preliminary testing there must be a flame spread of less than 0.38m across the region of burning.

The (t4) designates that the system has been tested in accordance with test 4 of DD CEN/TS 1187:2012, the most intensive test and the only one which meets UK fire safety requirements. This is a two-stage test using burning brands, wind and supplementary radiant heat to assess the spread of fire across the external surface of a roof, fire penetration and the production of flaming droplets or other debris.

Approved Document B Table 12.1 – Limitations on roof coverings

Designation of covering of roof or part of roof	Distance from any point on relevant boundary			
	Less than 6m	At least 6m	At least 12m	At least 20m
Broof(t4)	✓	✓	✓	✓
Croof(t4)		✓	✓	✓
Droof(t4)		✓	✓	✓
Eroof(t4)		✓	✓	✓
Froof(t4)				✓

NOTES: Additional qualifications may apply for specific applications of roof coverings not meeting Broof(t4) classification

Approved Document B outlines what fire classification is required within various distances of the relevant boundary

2.0 Exemptions from the testing regime

Roof covering products (and/or materials) defined in European Commission Decision 2000/553/EC of 6 September 2000, implementing European Council Directive 89/106/EEC, can be considered to fulfil all the requirements for the performance characteristic 'external fire performance' without the need for testing, provided that any national provisions on the design and execution of works are fulfilled, and can be used without restriction.

The Annex of European Commission Decision 2000/553/EC explicitly states that roof systems that are fully covered by non-combustible coverings are deemed to meet these external fire performance requirements, without testing. It states, "The external fire performance of many roof covering products/materials is well established and sufficiently well known to fire regulators in the Member States that they do not require testing for this particular performance characteristic." As a consequence, the fire properties of insulation used in an inverted roof have no relevance to fire safety as the material is sandwiched between non-combustible material – there is no pathway along which flames can spread due to protection below from the concrete deck and the gravel ballast (minimum 50mm depth or 80kg/m²) or paving slabs above.

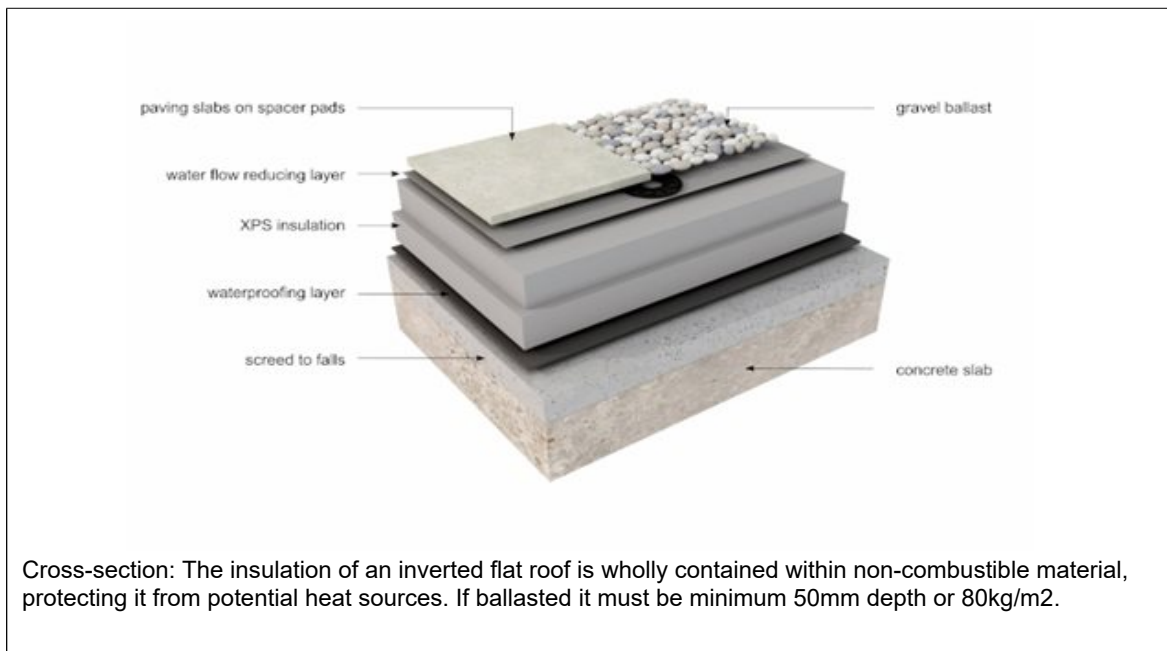
While European regulations do not provide clarity on green roofs, assurance of compliance is provided by a guidance document issued by the Department for Communities and Local Government, the predecessor department to the Ministry of Housing, Communities and Local Government. Fire Performance of Green Roofs and Walls, published in August 2013, states that "In order for green roofs to comply with requirement B4 it is recommended that for all types of green roof the depth of the growing layer should be a minimum of 80mm and the organic content should not exceed 50%."

However, given the increased emphasis on fire safety and out of an abundance of caution, roof systems using XPS products have recently passed test 4 of DD CEN/TS 1187:2012, achieving the Broof(t4) classification with little difficulty. This demonstrated that the exemption from the testing requirements exists for a reason – it's simply not necessary to test established knowledge based on decades of safe usage.

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32000D0553&from=EN>

<https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:31989L0106&from=en>

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/230510/130819_SW3529R_-_Issue_3_-_Green_Roofs_and_Walls_Project_web_version_v3.pdf



3.0 Ensuring high performance

BS 6229:2018 describes best practice for the design, construction and maintenance of flat roofs, based on accepted interpretations of the relevant Approved Documents and widely adopted industry best practice. This includes both Approved Document B and Approved Document L which addresses thermal performance.

In some recent instances, stonewool or cellular glass insulation has been promoted for inverted roof applications, with the implication that these offer superior fire safety protection. As previously outlined, it is the non-combustibility of the materials covering the insulation that dictate the real-world fire performance of an inverted flat roof, therefore the long-term thermal performance of insulation materials should be the priority when selecting materials. Closed-cell insulation materials like XPS have a proven track record of high performance based on decades of use and have very low water absorption rates, demonstrated by rigorous water absorption tests such as immersion, diffusion and freeze-thaw.

None of the above-mentioned insulation types has been tested to the same standards and they are not recommended as insulation within ETAG 031 Guideline for European Technical Approval of Inverted Roof Insulation Kits. This is because thermal performance of insulation is lowered when water can occupy voids, like those found in both stonewool and cellular glass products, increasing their conductivity. Repeated freezing and thawing in colder weather damages the material, further depleting performance and reducing the lifespan of the material.

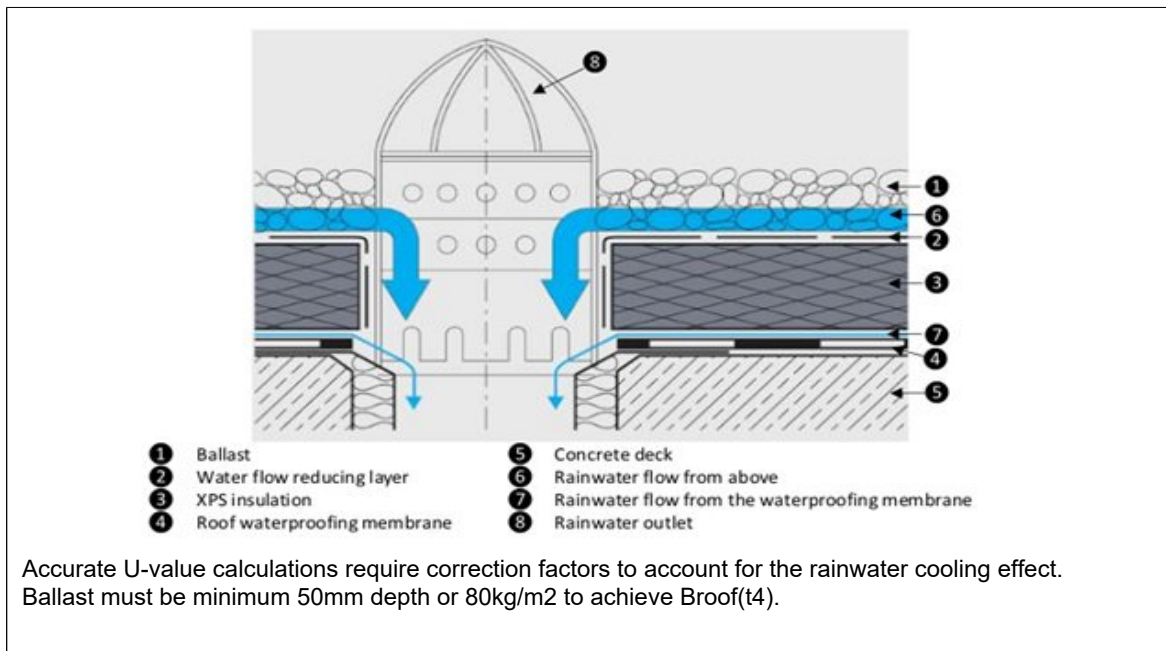
Furthermore, untested and unproven materials have unknown correction factors to account for the impact of the rainwater cooling effect. These are essential for accurate U-value calculations as was made clear by the recently revised BBA Bulletin 4 Inverted Roofs – Drainage and U value corrections.

<https://shop.bsigroup.com/ProductDetail?pid=000000000030371977>

<https://www.gov.uk/government/publications/conservation-of-fuel-and-power-approved-document-l>

<https://www.eota.eu/handlers/download.ashx?filename=endorsed-etags%5cetag031%2fetag31-part1-en.pdf>

https://www.bbacerts.co.uk/wp-content/uploads/2020/11/Datasheet_Bulletin_No4i8_2020_Final.pdf



4.0 Health & Safety and Sustainable architecture & construction

As is true of the manufacture, production, distribution and application of all construction products, due care and attention should be paid to prevent harm or injury. Suitable PPE should always be worn around manufacturing and construction sites. It is the user's responsibility to determine the conditions necessary for the safe use of any product.

XPS insulation is not a hazardous substance or mixture. Nevertheless, care should be taken to prevent injury whilst handling and installing, following the advice set out in the Control of Substances Hazardous to Health (CoSHH) 2002 Regulations. Mechanical cutting, grinding or sawing can produce dusts, which may cause respiratory irritation or discomfort. To limit this, adequate ventilation should be ensured. Eye protection should not be necessary when installing, but appropriate gloves are recommended to protect from mechanical injury. During shipment, storage, installation and use, XPS should not be exposed to flame or other ignition sources.

Most XPS insulation uses carbon dioxide as a blowing agent, which gives it an Ozone Depleting Potential (ODP) of zero and a Global Warming Potential of less than five. The material is 100% recyclable.

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