Technical Note 98
supersedes TN 73

Fire performance of facades - Guide to the requirements of UK Building Regulations

This Technical Note was prepared by a committee drawn from CWCT member companies, and published in April 2017. It was based on knowledge, practice, third party guidance, and the industry interpretation of Regulations in force at that time.

Following the tragic Grenfell Tower Fire of June 2017, Building Regulations and the guidance in the Approved Documents have been amended, resulting in significant changes to the fire performance requirements of the building envelope. These amendments have superseded the guidance in this document and further relevant amendments may yet happen.

This Technical Note has not been updated, but is being maintained as a record of the guidance available when first published.

An updated Technical Note relating to the interpretation and application of current Statutory Guidance and Regulations will be published by CWCT in due course. Until such guidance becomes available, we would strongly advise that designers and contractors seek the advice of qualified and competent fire safety professionals and liaise with their Building Control officer on a project-by-project basis.

Technical Note 98
supersedes TN 73

Fire performance of facades - Guide to the requirements of UK Building Regulations

Introduction

UK Building Regulations require buildings to be designed and constructed to limit the spread of fire:

- Within the building
- Over the external surface of the building
- From one building to another.

In England this can be achieved by constructing the building in accordance with prescriptive guidance set out in Approved Document B: 2013 (ADB). ADB allows testing to be used as an alternative to some of the prescriptive guidance. The Building Regulations can also be satisfied in other ways and for more complex buildings a fire engineering approach may be adopted. Measures to be taken to satisfy the Regulations will affect the design of the whole building including the façade. For example compartment floors may be used to limit fire spread within a building and this will affect the façade design at interfaces with the compartment floors. The strategy to be adopted must therefore be coordinated by the building designer and the façade cannot be designed in isolation.

The measures taken to control the spread of fire include the use of fire resisting construction, limits on the use of combustible materials, limits on the response to fire of the surfaces of the building, division of the building into compartments and the provision of barriers in cavities.

For many buildings the approach adopted by the building designer is to satisfy the prescriptive guidance in ADB. This Technical Note provides a summary of this guidance as it relates to the design and construction of facades.

It should be noted that following the prescriptive guidance given in ADB is unlikely to be sufficient for large and complex buildings. In such situations the requirements for the façade will depend on the specific fire strategy for the building, as set out by the fire engineer.

Strict compliance with ADB does not necessarily guarantee adequate performance of a given facade in a fire. It is incumbent on the building designer to ensure that the guidance given in ABD is relevant to their building and what additional measures (if any) are required to ensure the façade achieves the required performance standard.

The Building Regulations are concerned with life safety. Additional measures may be required by clients or insurers to limit damage to property, for example the guidance given in The LPC design guide for the protection of buildings, published by the Fire Protection Association.

This Technical Note is primarily concerned with curtain walls and rainscreen cladding (i.e. excluding the back wall). Walls that are required to be fire resisting are outside the scope of this Technical Note.

ADB may be interpreted in different ways. It is important that the fire performance of the façade is discussed with all relevant parties early in the design process and an appropriate strategy agreed.

Definitions

Fire resistance (fire resisting)
The ability of a component or construction of a building to satisfy performance criteria for a stated period. In the case of a façade the performance criteria may be:

- Loadbearing capacity – does not apply to non-loadbearing facades
- Integrity – ability to prevent the passage of smoke and flame
- Insulation – ability to restrict the transfer of heat

Fire resistance does not necessarily require the use of non-combustible materials (timber is commonly used in fire doors) and the use of non-combustible materials does not necessarily ensure fire resistance (glass is non-combustible but does not normally provide fire resistance).

Reaction to fire

Reaction to fire is the response of a material or component to a heat source, in terms of spread of flame across the surface and release of heat. Materials may be classified in accordance with EN 13501-1 as A1, A2, B, C, D, E, or F with A1 being the highest performance and F being the lowest. ADB also allows performance to be tested, classified and specified in accordance with a National classification based on tests in accordance with BS 476. The relationship between National and European classification adopted in Approved document B is as follows;

European class	National class
A1	Non-combustible. Defined in Approved Document B Table A6
A2	Limited combustibility. Defined in Approved Document B Table A7
B	Class 0. Defined in Approved Document B Appendix A Clause 13
C	Class 1. Defined in BS 476 part 7

Note this Table shows the equivalence of classes in terms of the requirements of ADB. Materials can only be classified using the appropriate test methods and a material classified in accordance with the national classification may give a higher or lower classification than suggested in the Table when tested in accordance with the European tests. For example polyethylene cored aluminium composite material (ACM) panels are class 0 to the national classification but only class D to EN 13501-1 (note that 'fire resistant' ACM panels and limited combustibility ACM panels are available with class B and A2 respectively).

Materials classified in accordance with EN 13501-1 also have a smoke production (s) and flaming droplets/particles (d) classification, but this is not taken into account in ADB.

Where there is a harmonised product standard, for example insulation materials (EN13162 for mineral wool, EN13166 for phenolic, EN13165 for PUR/PIR and so on), relevant European Standards should be used, a declaration of performance produced and the product CE marked under the Construction Products Regulation. The reaction to fire of such products should be classified in accordance with EN13501-1, rather than BS476, and therefore the Building Regulations classification of 'Class 0' is no longer appropriate for such materials. For materials where there is no harmonised product standard, either method of test and classification is valid to meet the guidance in ADB: 2013. This may change in future revisions of ADB, where European methods are likely to be required.

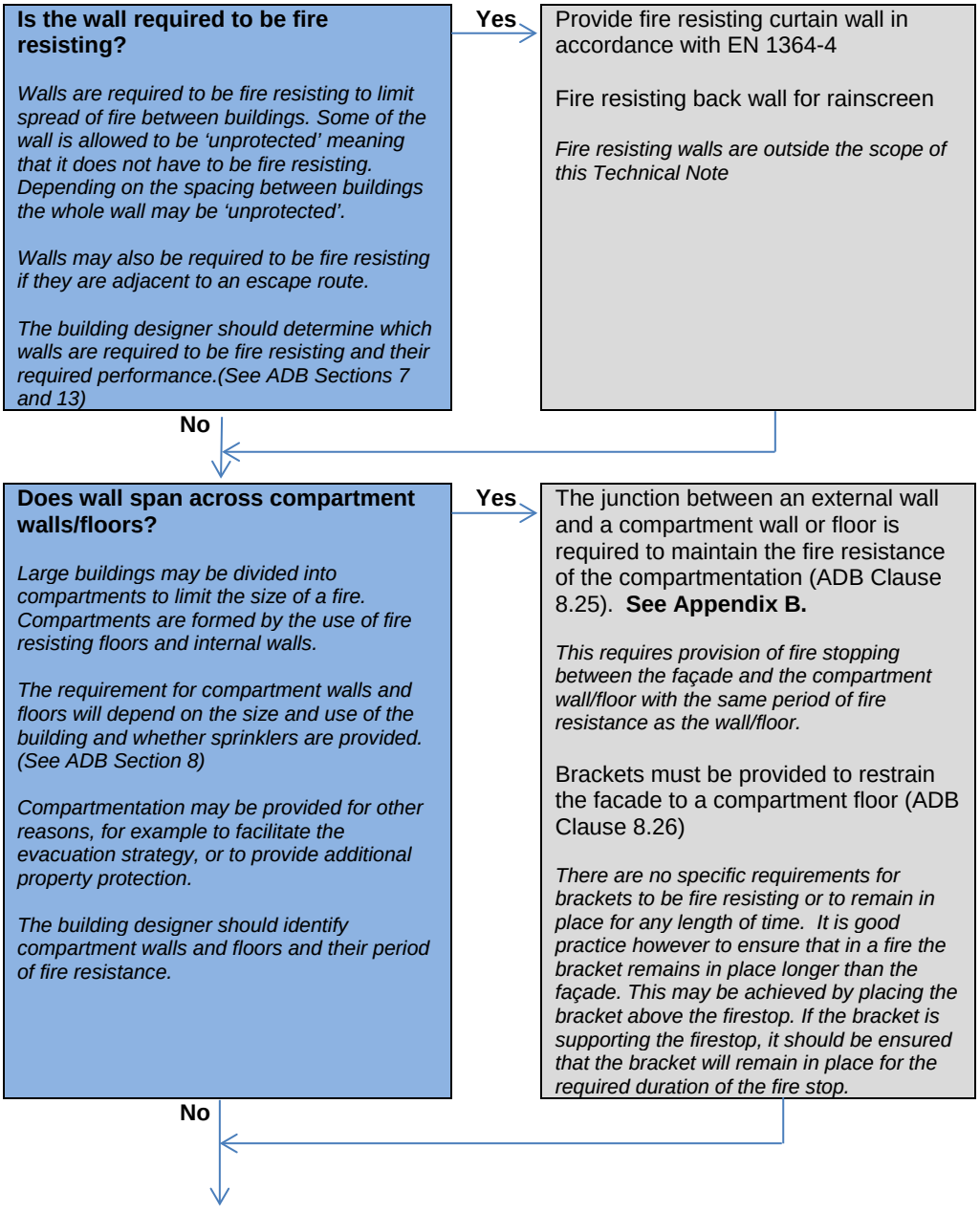
Limits on combustibility given in ADB apply to materials through the full thickness of the wall. Other requirements for reaction to fire apply to the exposed surface of a material, such as a rainscreen panel, regardless of its combustibility. In the latter case a combustible material may have a facing that is non-combustible hence the spread of fire over the surface of the façade is restricted. This would be the case for an insulated panel with a foam insulation core and a metal facing. Conversely a non-combustible material may have a combustible finish that allows fire spread over the surface. This could be the case for a metal panel with a paint finish.

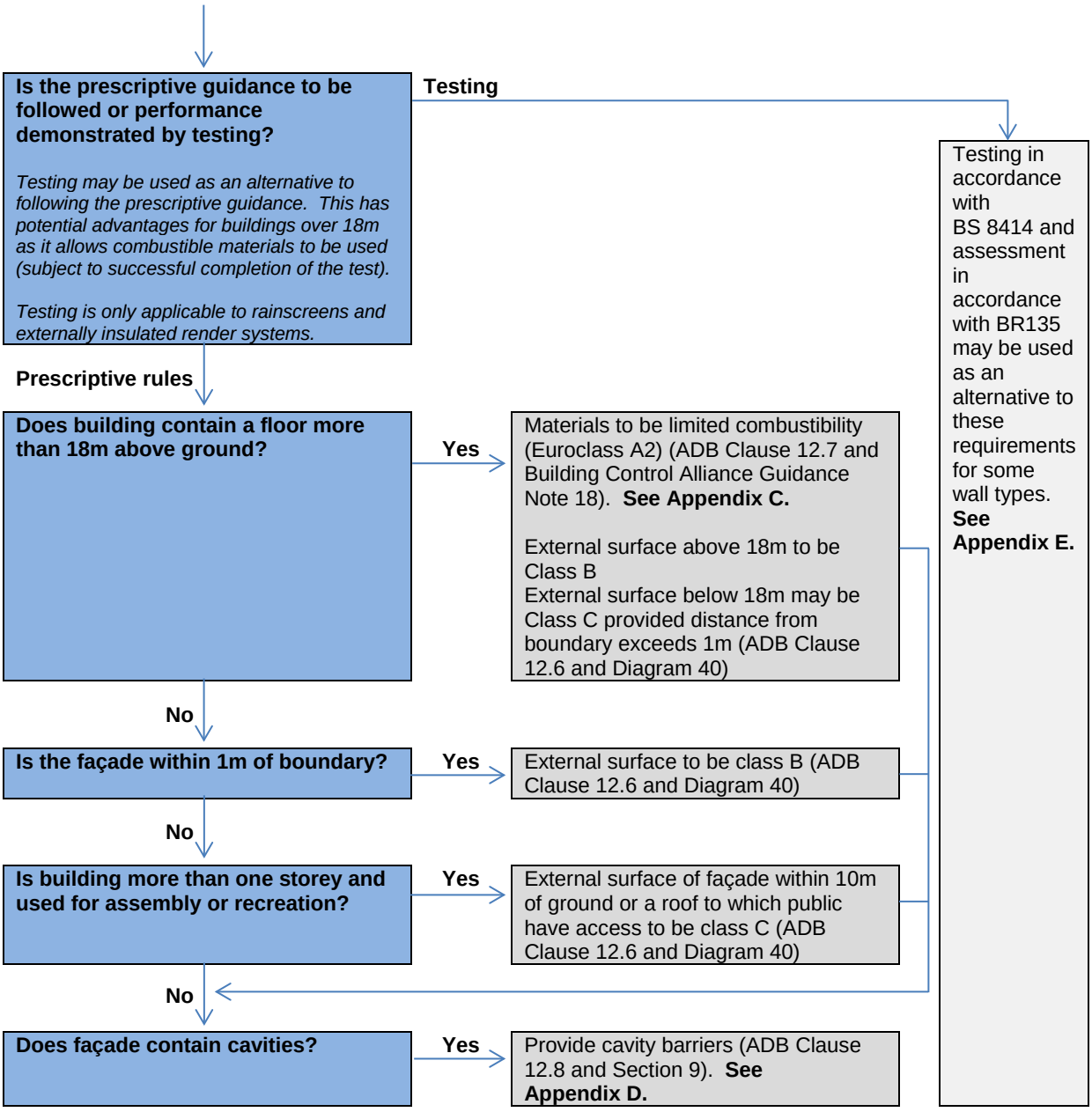
Combustible materials with non-combustible facings such as foil rely on the integrity of the facings. Damage to these facings will severely compromise the fire performance and so should be checked for punctures, cuts etc. and be suitably replaced or repaired.

Centre for Window and Cladding Technology
The Studio, Entry Hill, Bath, BA2 5LY
Tel: 01225 330945
email: cwct@cwct.co.uk
www.cwct.co.uk

Flowchart outlining prescriptive guidance in Approved Document B

In the flowchart below, the boxes on the left (shaded blue) may require input from the building designer. The façade designer is then responsible for designing the façade to satisfy the requirements in the boxes on the right (shaded grey). This flowchart relates to ADB for England. Other documents apply in other countries of the UK. Their requirements are similar but there are some differences which are described in Appendix A.




Is the prescriptive guidance to be followed or performance demonstrated by testing?
Testing may be used as an alternative to following the prescriptive guidance. This has potential advantages for buildings over 18m as it allows combustible materials to be used (subject to successful completion of the test).
Testing is only applicable to rainscreens and externally insulated render systems.
Testing
Testing in accordance with BS 8414 and assessment in accordance with BR135 may be used as an alternative to these requirements for some wall types. See Appendix E.
Prescriptive rules
Does building contain a floor more than 18m above ground?
Yes
Materials to be limited combustibility (Euroclass A2) (ADB Clause 12.7 and Building Control Alliance Guidance Note 18). See Appendix C.
External surface above 18m to be Class B
External surface below 18m may be Class C provided distance from boundary exceeds 1m (ADB Clause 12.6 and Diagram 40)
No
Is the façade within 1m of boundary?
Yes
External surface to be class B (ADB Clause 12.6 and Diagram 40)
No
Is building more than one storey and used for assembly or recreation?
Yes
External surface of façade within 10m of ground or a roof to which public have access to be class C (ADB Clause 12.6 and Diagram 40)
No
Does façade contain cavities?
Yes
Provide cavity barriers (ADB Clause 12.8 and Section 9). See Appendix D.

References

Building Regulations (England), Approved Document B Fire Safety,
http://www.planningportal.gov.uk/england/professionals/buildingregs

Building Regulations (Wales), Approved Document B Fire Safety,
http://gov.wales/topics/planning/buildingregs/approved-documents/?lang=en

Building (Scotland) Regulations, Building Standards Technical Handbook Section 2 Fire
http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards

Building Regulations (Northern Ireland) DFP Technical Booklet E Fire Safety,
http://www.dfpni.gov.uk/index/buildings-energy-efficiency-buildings/building-regulations.htm

Firecode – Fire safety in the NHS Health Technical Memorandum 05-02: Guidance in support of functional provisions for healthcare premises, ISBN 978-0-11-322767-9

Fire Protection Association The LPC design guide for the fire protection of buildings, ISBN 1 902790 02-2

Department for children schools and families, Building Bulletin 100 Design for fire safety in schools.

BR 135 Fire performance of external thermal insulation for walls of multi-storey buildings. 2nd edition

BRE Digest 501 BR135 Annex B Performance criteria and classification method for BS 8414-2:2005

BS 476-20 Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)

BS EN 1366-4 Fire resistance tests for service installations. Linear joint seals

BS EN 1364-4 Fire resistance tests for non-loadbearing elements. Curtain walling. Part configuration

BS 8414-1 Fire performance of external cladding systems. Test methods for non-loadbearing external cladding systems applied to the face of a building

BS 8414-2 Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame

BS EN 13501-1:2007+A1:2009 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests

Association for Specialist Fire Protection, ASFP Technical Guidance Document TGD 19 Fire resistance test for ‘open-state’ cavity barriers used in the external envelope or fabric of buildings, 2014

Building Control Alliance, BCA Technical Guidance Note 18, Use of combustible cladding materials on buildings exceeding 18m in height, 2015.

Appendix A

Building Regulations guidance in Wales, Northern Ireland and Scotland

The prescriptive guidance in Wales and Northern Ireland is broadly the same as ADB in England. Guidance in Wales is provided in the Welsh edition of ADB. The guidance relating to facades is the same as in England but the clause numbers are different due to additional requirements in other areas. Guidance in Northern Ireland is provided in Technical Handbook E which gives broadly the same guidance as ADB.

The Scottish Handbook contains some significant differences. The relevant clauses are given in Table A1, with further explanation given below.

		ADB2 Wales	Technical Handbook E Northern Ireland	Scottish Technical Handbook Section 2	
				Domestic	Non-domestic
Compartmentation	General	Section 9	Section 4	Section 2.1 & 2.2	Section 2.1 & 2.2
	Façade specific	Clause 9.25	Clause 4.20	Clause 2.2.10	Clauses 2.1.15 & 2.2.7
External surfaces	General	Section 13	Section 5	See below	
	Façade specific	Clause 13.6, Diagram 40	Clause 5.3, Diagram 5.1		
Combustibility	General	Section 13	Section 5	See below	
	Façade specific	Clause 13.7	Clause 5.4		
Cavity barriers	General	Section 10	Section 4	Section 2.4	Section 2.4
	Façade specific	Clause 13.8	Clause 4.36	Clause 2.4.1 & 2.4.2	Clause 2.4.1 & 2.4.2

Table A1 – Relevant sections and clauses in Wales, Northern Ireland and Scotland

Technical Handbook Section 2 Scotland

The Scottish Technical Handbook does not differentiate between non-combustible materials and materials of limited combustibility and uses the term non-combustible to include materials classed as being of limited combustibility elsewhere in the UK. The Scottish Technical Handbook also uses the term ‘low risk’ to describe Class 0 materials.

A further difference in approach is that ADB is split into Volume 1 which deals with dwelling houses and Volume 2 which deals with buildings other than dwelling houses. Thus flats are included in Volume 2. In Scotland, the Handbook is divided into ‘Domestic’ and ‘Non Domestic’ construction in which flats are included in the scope of the domestic construction document. There are special requirements for buildings such as hospitals which are not covered here.

The Scottish Technical Handbook refers to separating walls/floors and compartment walls/floors. A separating wall or separating floor divides a building into areas of different occupation. A compartment wall or compartment floor divides a building a building in single occupancy to limit the size of the area/potential fire. Where a separating wall/floor or a compartment wall/floor is specified, the requirements for compartmentation are the same.

Cavity barriers in Scotland are required to provide 30 minutes integrity (Table 2.19). Elsewhere in the UK they are required to provide 30 minutes integrity and 15 minutes insulation.

Domestic

Combustibility of materials (Clause 2.6.4/2.6.5)
Every part of an external wall including external wall cladding not more than 1m from a boundary or the external wall of a high rise domestic building (ie over 18m), should be constructed of non-combustible products (Class A2) (2.6.5). Certain exceptions are allowed which do not relate to curtain walls and rainscreeens.

Spread on external walls (Clause 2.7.1)
External wall cladding not more than 1m from a boundary should have a non-combustible classification except cladding to a house where:

- the cladding achieves a low risk reaction to fire classification, and
- the wall behind the cladding has the appropriate fire resistance duration from both sides.

High rise domestic buildings (defined in Appendix A of the Technical Handbook, as being a building with a floor more than 18m above ground level) - external wall cladding used on the external wall of a high rise domestic building should be constructed of non-combustible products. Certain exceptions are allowed which do not relate to curtain walls and rainscreens.

Non domestic

Combustibility of materials (2.6)
External wall cladding not more than 1m from a boundary should have a non-combustible classification (2.6.4).

Every part of an external wall (including external wall cladding, clause 2.6.4) not more than 1m from a boundary should be constructed of non-combustible products (2.6.6). Certain exceptions are allowed.

Spread on external walls (2.7)
The reaction to fire of the external wall cladding in a building more than 1m from the boundary and more than 18m above the ground, should be at least ‘low risk’ (clause 2.7.1, Table 2.9).

In a building with any storey at a height of more than 18m above the ground, any insulation material situated or exposed in a cavity formed by external wall cladding should be non-combustible (2.7.2). Certain exceptions are allowed.

Appendix B

Fire stopping of junctions between curtain walls and compartment floors and walls

Many buildings are divided into compartments to restrict fire spread. Where an external wall abuts a compartment wall or floor, it is necessary to provide fire stopping between the external wall and the compartment wall or floor to restrict fire spread through the junction. In some countries there is a requirement to provide a band of fire resisting construction approximately a metre high in the external wall in these areas. This is not generally required by UK Building Regulations but there are specific requirements relating to hospitals which are described below.

Building Regulations Guidance

ADB in England and Wales requires that a junction of a compartment floor or compartment wall with an external wall should maintain the fire resistance of the compartmentation. This is generally satisfied by the provision of a fire stop with the same fire resistance as the compartment floor or wall. Requirements given in Part 2 of the Scottish Technical Handbook and the Technical Booklet E for Northern Ireland are similar, as described in Appendix A.

The Scottish Technical Handbook also requires a 1m wide vertical strip of fire resisting construction in external walls of hospitals which abut compartment walls. The fire resisting construction is required to give the same period of fire resistance as the compartment wall and does not have to be centred on the compartment wall.

HTM 05-02 which applies to all NHS buildings also has this requirement but it does not apply where the areas on both sides of the compartment wall are provided with sprinklers.

The Building Regulations are primarily designed for life safety. The LPC Design Guide for the fire protection of buildings is concerned with the limitation of property damage. It recommends the provision of a strip of fire resisting construction in external walls which abut compartment walls. It also recommends similar measures to limit fire spread where external walls abut compartment floors, however, it accepts that these measures may not be fully effective and may not be practical as they may conflict with architectural design.

Fire stop materials

Fire stops are required to prevent transfer of heat and smoke. Proprietary materials are available which are generally based on rock fibre to control the passage of heat and aluminium foil or a liquid applied membrane to control the passage of smoke.

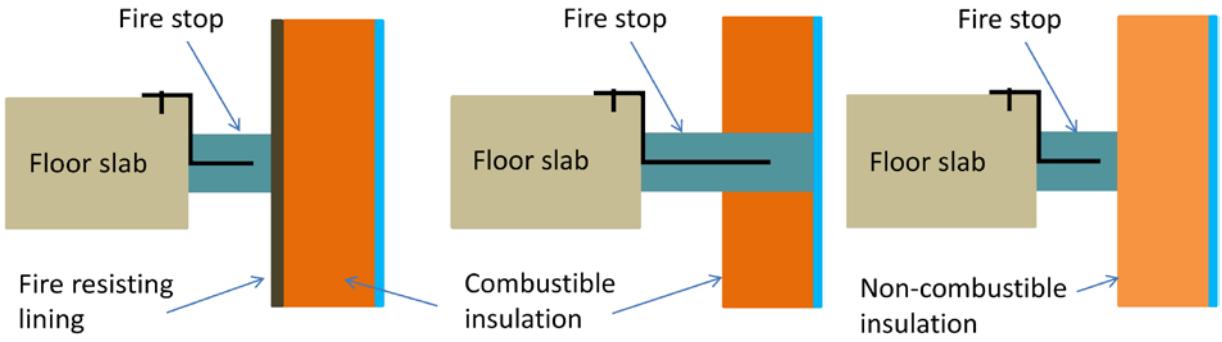
Fire stops should be tested to demonstrate performance. For compliance with ADB, fire stops are often tested following the principles of BS 476-20 or BS EN 1366-4, with the fire stop positioned between fire resisting construction (typically concrete or masonry). BS EN 1364-4 and BS EN 1364-3 give test procedures which can be used to assess the performance of fire stops in conjunction with a sample of curtain wall but the curtain wall must be effectively protected to carry out the test. The fire stop may behave differently when used in conjunction with an unprotected curtain wall, and therefore simply selecting a fire stop that has been tested to EN 1364-4 is no guarantee of its performance in service if the curtain wall is constructed in the normal way. **Testing in accordance with BS EN 1364-4 and BS EN 1364-3 is not required for Building Regulations compliance**, however it may be required to meet a specification or for 3rd party certification.

Curtain wall interface with fire stop

Although the curtain wall is not required to be fire resisting, the effectiveness of the fire stop will depend on the performance of the curtain wall.

Some facades adopt a rigid foam insulation such as polyisocyanurate (PIR) or similar within the spandrel area; these materials have no integrity against fire or hot smoke which may therefore simply bypass the barrier. It is worth noting that relatively early in a fire, the temperature of hot smoke can be as high as 500ºC. Solutions include:

- a fire resisting lining on the back of the insulation against which the fire stop can interface (Figure B1, 1). The lining could be steel sheet/mineral board to be agreed on a project basis,
- removing a strip of the insulation to allow the fire stop to continue to the back of the glazing or metal spandrel panel (Figure B1, 2),
- a fire resisting insulation for the whole of the spandrel panel (Figure B1, 3). This would normally be a rock fibre insulation as glass fibre can melt and form voids which allow the fire to bypass the fire stop. It should be noted that a smoke seal will also be required.



1. Combustible insulation, suitably protected

2. Combustible insulation, unprotected/exposed

3. Non-combustible insulation

Figure B1 – Fire stopping details – spandrel zones

Thermoplastic insulation materials such as polystyrene should not be used in a spandrel panel as they can produce burning droplets and will form voids, both of which will increase the risk of fire spread.

If the interface of the fire stop with the curtain wall is aligned with the transom location, the transoms may require protection by fire resisting boards to extend the fire resisting construction to the glazing. This may occur when storey height glazing is used, as in Figure B2.

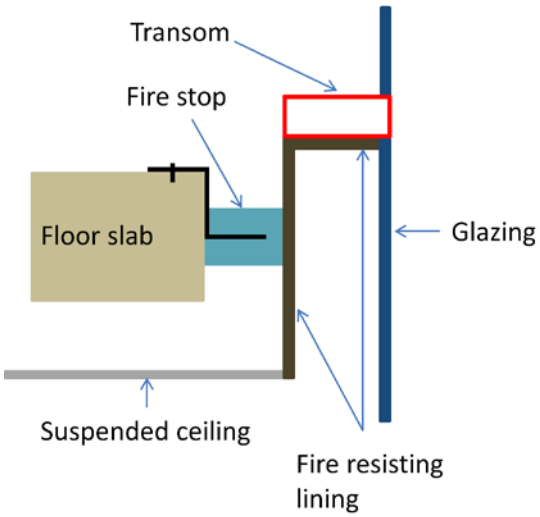


Figure B2 – Fire stopping details – storey height glazing

Metal components of the curtain wall which pass through the fire stop will provide a means of heat transfer past the fire stop by conduction. Metal components may include curtain wall brackets, metal facings on the back of spandrel panels, curtain wall mullions and transoms. In some cases the metal on the protected side of the fire stop may become sufficiently hot to ignite adjacent materials allowing the fire to spread. It may be necessary to take measures to prevent this happening and this could require insulation of brackets or the provision of mineral fire resisting boards on the back of spandrel panels.

To form a good seal, fire stops generally need to be compressed. The amount of compression required depends on the nature of the fire stop materials and should be as required by the fire stop manufacturer and as certified by the relevant compliance testing requirements. Compression of the fire stop may be reduced by:

- Tolerances, either because the gap between the façade and the structure is greater than anticipated or the fire stop is cut smaller than required.
- The back of the façade is not sufficiently dense and is compressed in preference to the fire stop.
- The façade bows away from the structure. Movement of the mullions should be prevented by brackets but the curtain wall may bow between mullions. Potential movements in the event of a fire should be evaluated and due allowance made.

Installation of fire stops

Fire stops should be installed in strict accordance with manufacturers' guidelines.

The width of fire stop must be sufficient to ensure adequate compression allowing for construction tolerances and movements as discussed above. Fire stops may be supplied as pre-cut strips of specified width or may be site cut from slabs. If pre-cut strips are used it may be necessary to have a range of sizes available to allow for variation in the gap width between the floor edge and the facade. Alternatively strips can be supplied at the upper end of the range likely to be required and trimmed where necessary. If site cut strips are used, allowance for cutting tolerances must be made.

Fire stops need to be continuous along the façade. Joints may be tight butt joints or half lap joints according to the system used. Joints in foil facings may require taping to ensure a good smoke seal.

Once in position, fire stops need to be fixed so that they do not drop out and they need to allow for movements that may occur both during the service life of the façade and in a fire. Metal strips which can be bent on site and fixed to the top surface of the floor slab are commonly used to fix fire stops and fire stop suppliers give guidance on frequency of fixings. An alternative method is to support the fire stop from below with a galvanised steel sheet fixed to the underside of the floor slab. Where this is done the sheet should not be fixed to the curtain wall as well as the floor as this can restrict movement of the wall. If the galvanised sheet is required to provide a smoke stop, an appropriate sealant can be used at the interface with the back of the curtain wall. A metal support below the fire stop will be exposed to the heat of the fire and may require additional protection.

Filling around fixing brackets can be awkward and is a regular scene of bad workmanship. If small infill sections of fire stop are used they must be securely fixed so that they cannot drop out. Intumescent sealant may be used to fill small gaps. Fire stop suppliers can provide guidance on appropriate techniques for their products.

Insulation in spandrel panels may be protected by a fire resisting casing or lining. This can either be part of the spandrel panel and held in the rebate of the curtain wall system but may sometimes be fixed separately to the curtain wall framing members, usually by aluminium angles. When the latter method is used, the fixing of the lining must not interfere with movement accommodation mechanisms of the curtain wall. For example if there is a mullion movement joint, a fire resisting board rigidly fixed to the transoms above and below the joint would prevent movement of the joint.

Appendix C

Combustibility of materials

Limits on combustibility of materials are given in Clause 12.7 of ADB. Clause 12.7 specifically refers to insulation materials and filler materials but is now being interpreted more generally (see BCA Guidance note 18). Therefore where a building has a storey 18m or more above ground level **all significant materials** should be of limited combustibility (Class A2 in accordance with EN 13501-1). This includes, but is not limited to:

- Rainscreen panels,
    - Standard ACM panels do not meet these requirements. Limited combustibility ACM panels are available,
- Insulation materials,
    - The only commonly used insulation material that will satisfy the definition of limited combustibility is mineral wool,
- Sheathing boards,
    - Note that standard cement particle boards are class B. Limited combustibility boards are available,
- Materials within the back wall such as plaster boards.

These requirements apply to the full height of the wall both above and below 18m, ie in a high rise building; materials below 18m would also have to be of limited combustibility.

Where the building does not have a storey 18m or more above ground level, there is no restriction on the combustibility of the components of the cladding system. It should however be noted that cavity barriers/fire stops will still be required to minimise fire spread. Depending on the distance of the facade to the boundary, the reaction to fire of the external surface may be limited (ADB2 Diagram 40).

The Scottish Handbook also requires every part of an external wall not more than 1m from a boundary to be constructed of non-combustible products, irrespective of height.

The Scottish Handbook requires compartment walls and floors in hospitals to be constructed of non-combustible materials. This requirement is sometimes extended to materials in external walls abutting the compartment wall or floor. This requirement is not included in HTM 05-02 for health care premises.

Other materials

The BCA does not define what constitutes a ‘significant material’. If all materials fell into this category, it would severely limit what could be constructed, and would be impractical. Examples of materials that might not be classified as significant are discussed below.

Membranes

Thin membranes for waterproofing, air tightness and vapour control may generally be excluded from the requirements, providing they are detailed in such a way that they do not increase the risk of fire spread by causing other materials to ignite.

In buildings above 18m a membrane sandwiched between the sheathing boards and insulation, both of limited combustibility is unlikely result in increased fire spread. Care should be taken when a membrane in placed on the cavity side of the insulation and membranes in this location should not

pass over the front of cavity barriers. Euroclass B rated membranes are available, and these may be specified in exposed/vulnerable areas.

Laminated glass

Under the current European test and classification methods, laminated glass is not of limited combustibility. Evidence from Glass for Europe suggests that interlayer thicknesses up to 0.76mm or glass thicknesses of 8mm or more give Class B to EN13501-1, whereas interlayers thicker than 0.76mm with glass ply thicknesses below 8mm may give Class C or D. The effect of interlayer material is small and can be ignored. Further information can be found at http://www.glassforeurope.com/images/cont/168_71637_file.pdf.

In laminated glass, the combustible interlayer is encapsulated between two non-combustible glass plies and so not exposed during the initial stages of the fire. Laminated glass is generally not considered to increase the risk of fire spread and its use is considered acceptable above 18m. It is mainly used to control other risks.

Paint finishes

Paint finishes are combustible but due to their thickness, can be excluded from the requirements, providing they are applied to a non-combustible substrate. Finishes will however need to comply with requirements for surface spread of flame, ie Class 0 (National) or Class B (EN) above 18m. Polyester powders used for coating aluminium generally meet these requirements; however advice from the manufacturers should be sought for particular colours.

Curtain wall and window frames

Whether framing members will contribute to the external fire spread will depend upon the materials used, and the configuration/extent of their use.

A single window in a punched opening, surrounded by materials which are of limited combustibility is unlikely to present a significant risk.

Curtain walling and window assemblies extending past the floor slab may pose more of a risk if the materials used for the framing members are combustible or contain large amounts of combustible materials. This will affect:

- PVC window frames,
- Timber/timber-composite frames,
- Aluminium frames with extensive thermal breaks.

The use of these materials is generally considered acceptable.

Appendix D

Cavity barriers

Cavity barriers in rainscreen construction

Fire and smoke spread in rainscreen cavities is particularly dangerous as it may be more rapid than on the outside face of the cladding, due to the creation of a flue, and it may be undetected by building users or firefighters. It is therefore normally necessary to incorporate cavity barriers in rainscreen cavities to limit the spread of fire and smoke.

Building Regulations Guidance

For rainscreen walls, ADB requires that cavity barriers are provided:

- To close the edges of cavities including around window openings,
- At the junction of the wall with a compartment wall or floor (and separating wall/floor in Scotland),
- To limit the maximum dimension of the cavity to 20m where the surfaces of the cavity are Class 0 or 1 (Class C-s3, d2 or better) and 10m in other cases. In England and Wales, where a rainscreen wall has a masonry or concrete inner wall at least 75mm thick, the cavity does not contain combustible insulation and the building is not used for residential or institutional purposes, this requirement does not apply.

The Scottish Technical Handbook has similar requirements but the requirement for cavity barriers on the line of compartment walls and floors is relaxed where the inner wall is of masonry or concrete construction and the surfaces of both the rainscreen and any insulation in the cavity are Class 0 or the materials are of limited combustibility.

Design of cavity barriers

The provision of cavity barriers in a rainscreen wall presents a number of conflicts. The obvious conflict is between the need to seal the cavity to prevent the spread of smoke and fire and the need for ventilation and drainage. Clause 3.4.4.4 of the CWCT Standard for systemised building envelopes requires that the cavity width is not reduced by more than 50% at fire barriers or support rails. This should be interpreted as 50% of the minimum width required by the Standard rather than 50% of the actual width where the latter is greater. This will require a residual gap of 13 to 25mm depending on the type of joints between the rainscreen panels.

This conflict can be overcome by the use of intumescent materials which allow a cavity to be maintained under normal circumstances but seal the cavity in the event of a fire. Proprietary cavity barriers are available which partially block the cavity and have a strip of intumescent material at the front that can expand to block the cavity in a fire. There are also cavity barriers available with perforated metal plates coated with intumescent materials.

Cavity barriers may be tested following the principles of BS 476-20 or BS EN 1366-4. Tests are generally conducted with the barrier in a cavity between walls of fire resisting construction and performance with rainscreen panels may be different. Intumescent materials react at approximately 150°C thus allowing passage of cool smoke. When the temperature does rise they may take a significant time to form a seal. This time delay may not be significant in a test where the cavity is empty but may be significant in practice if there is combustible insulation in the cavity which could be ignited in the time taken to seal the cavity. The Association for Specialist Fire Protection (www.asfp.org.uk) has published a test method for open-state cavity barriers, which is being developed into a European standard.

Research at BRE using large scale tests on rainscreen walls (BR135) has found that cavity barriers with a continuous strip of intumescent material are more effective than those with perforated plates and that to make barriers effective it may be necessary to break vertical cladding rails so that the cavity barrier can be continuous.

The other issue is the practicality of sealing the edges of the cavity. Most rainscreen systems have numerous joints and sealing the edge of the cavity may be of little practical effect if there are open

joints a short distance away. For example terracotta systems often have horizontal joints at 300mm intervals.

A practical approach is to detail flashings at the base of the cavity, including above windows, to inhibit the entry of rising flames and smoke. This will generally require galvanised steel flashings which extend to the outer face of the rainscreen. Flames emerging from the top of a cavity are of concern if they can cause fire spread to other parts of the building or other buildings. If the flames cannot be contained within the cavity the areas at risk could be protected.

Installation

Cavity barriers should be securely fixed to the back wall both to form a good fire seal with the back wall and prevent movement of the barrier which could block the drainage and ventilation of the cavity. Spikes which penetrate the full width of the fire barrier with tails that can be bent over are likely to be more effective than spikes that only penetrate part way through the barrier. A break in any thermal insulation in the cavity will be required at the location of the cavity barrier.

Cavity barriers must be continuous along the length of the cavity and any joints appropriately sealed as recommended by the barrier supplier. Joints may be tight butt joints or lap joints and joints in foil faced barriers should be sealed with foil tape. Consideration should be given to the junction between horizontal and vertical cavity barriers to ensure these provide a continuous closer.

Appendix E

Alternative means of compliance

Guidance documents throughout the UK allow testing in accordance with BS 8414, and assessment in accordance with BR 135 as an alternative to meeting the prescriptive guidance in terms of reaction to fire and provision of cavity barriers, in the cladding system. This applies to non-loadbearing external cladding systems, rainscreen overcladding systems and external wall insulation systems. BS 8414-1 deals with cladding onto a solid back wall and BS 8414-2 deals with cladding onto a framed back wall.

It should be noted that BS 8414 is a test of a **complete cladding system**. Any changes between the system tested and one proposed for use should be approved by the testing authority. The BS 8414 test includes an area of wall with an opening to represent a window. It is vital that other interfaces which exist in the actual façade are designed in the same way as those that have been tested.

The Building Control Alliance Technical Guidance Note 18 gives further information on the use of combustible cladding materials on buildings exceeding 18m in height. In addition to the means of compliance given in ADB described previously, it gives two further methods;

- Desktop study,
- Holistic fire engineering.

A desktop study can be used where no actual fire test data exists for a particular cladding arrangement. It is carried out by a suitably qualified fire specialist stating whether, in their opinion, the BRE 135 criteria would be met with the proposed system. This opinion must be backed up by test evidence (from an independent UKAS accredited testing body), either of a similar system, or data from an alternative testing standard. A number of insulation companies now provide details of systems that have been tested and/or assessed by fire consultants.

Finally a holistic fire engineering approach may be taken. This takes into account factors such as building use and geometry, ignition risk, and factors restricting fire spread. This approach is more suited to larger buildings. This is covered in BS 7974, Application of fire engineering principles to the design of buildings.