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The fire safety aspects of building design and construction in England and Wales are controlled by the requirements of the Building Regulations, 2000 (requirements B1 to B5). The regulations are set out in functional form and set performance objectives rather than prescribing specific fire safety measures. These functional requirements can be met by;

a) following the recommendations set out in Approved Document B [2] or

b) adopting an alternative approach (e.g. using fire engineering).

Whilst there is no overriding requirement to adopt the recommendations given in the Approved Document this represents the most common approach, particularly for relatively small and straightforward buildings. However, fire engineering techniques are increasingly being applied in large or complex developments.

Northern Ireland

The design and construction for fire safety in buildings in Northern Ireland is controlled by the Building Regulations (Northern Ireland) 1994. Recommended fire safety measures are detailed in sections 1 to 5 of Technical Booklet E [4] for fire safety.

There are some minor differences between Technical Booklet E and Approved Document B that applies in England and Wales. In particular the critical height at which additional provisions regarding the external flame spread classification apply is 20m rather than the 18m stated in Approved Document B. However in other respects the guidance given in this section relating to Approved Document B will generally be applicable.

3.1 Functional requirements

The functional requirements of the Building Regulations require that 'reasonable', 'adequate' and 'appropriate' steps be taken to ensure health and safety of people in and around buildings. These requirements are summarised below.

3.1.1. Escape

Requirement B1 requires that adequate escape routes be provided to enable the occupants to reach a safe location outside of the building. Suitable means of giving warning of a fire are also required.

3.1.2. Fire spread across surfaces

Requirement B2 requires that materials used as wall and ceiling linings do not promote rapid fire spread or unduly contribute to the heat produced by a fire.

3.1.3. Building structure

Requirement B3 requires that appropriate measures be taken to ensure that:

- the structural stability of the building will be maintained;
- a wall between two buildings will resist fire spread between the buildings;
- buildings are subdivided into compartments to restrict the size of a fire;
- unseen voids are subdivided to inhibit hidden fire spread.

These objectives are generally achieved by providing fire resisting constructions (section 12).

3.1.4. External fire spread

Requirement B4 is primarily intended to prevent the spread of fire from one building to another as a result of heat radiation or airborne burning brands. This is generally achieved by:

a) controlling external surfaces of walls and roofs;

b) providing fire resisting external walls when appropriate.

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3.1.5. Facilities for the fire service

Requirement B5 requires that reasonable facilities are available to enable fire appliances to gain access to the building and to enable fire fighters to protect life.

3.2 Approved Document B

Approved B provides guidance on how the functional requirements of the regulations may be met taking account of the use, occupancy, height (of top storey) and area of the building.

3.2.1. Building occupancy

The fire safety measures recommended in Approved Document B are specified in terms of the proposed use of the building. Table D1 of the Approved Document defines seven purpose groups, which provide a generic means of categorising the use of a building in context with the likely fire risk. The purpose groups covered in this design guide are summarised in table 1.

Table 1. Classification of purpose groups

Title	Group	Purpose for which the building or compartment of a building is intended to be used
Residential (Institutional)	2(a)	Hospital, home, school or other similar establishment used as living accommodation for, or for the treatment, care or maintenance of persons suffering from disabilities due to illness or old age or other physical or mental incapacity, or under the age of five years, or place of lawful detention, where such persons sleep on the premises.
(Other)	2(b)	Hotel, boarding house, residential college, hall of residence, hostel, and any other residential purpose not described above.
Office	3	Offices or premises used for the purpose of administration, clerical work (including writing, book keeping, sorting papers, filing, typing, duplicating, machine calculating, drawing and the editorial preparation of matter for publication, police and fire service work), handling money (including banking and building society work), and communications (including postal, telegraph and radio communications) or radio, television, film, audio or video recording, or performance {not open to the public} and their control.
Shop and Commercial	4	Shops or premises used for a retail trade or business (including the sale to members of the public of food or drink for immediate consumption and retail by auction, self-selection and over-the-counter wholesale trading, the business of lending books or periodicals for gain and the business of a barber or hairdresser) and premises to which the public is invited to deliver or collect goods in connection with their hire, repair or other treatment, or (except in the case of repair of motor vehicles) where they themselves may carry out such repairs or other treatments.
Assembly and Recreation	5	Place of assembly, entertainment or recreation; including bingo halls, broadcasting , recording and film studios open to the public, casinos, dance halls; entertainment, conference, exhibition and leisure centres; funfairs and amusement arcades; museums and art galleries; non-residential clubs, theatres, cinemas and concert halls; education establishments, dancing schools, gymnasia, swimming pool buildings, riding schools, skating rinks, sports pavilions, sports stadia; law courts; churches and other buildings of worship, crematoria; libraries open to the public, non-residential day centres, clinics, health centres and surgeries; passenger stations and termini for air, rail, road or sea travel; public toilets; zoos and menageries.
Industrial	6	Factories and other premises used for manufacturing, altering, repairing, cleaning, washing, breaking-up, adapting or processing any article; generating power or slaughtering livestock.
Storage and other non-residential	7(a)	Place for the storage or deposit of goods or materials [other than described under 7(b)] and any building not within any of the purpose groups 1 to 6.
	7(b)	Car parks designed to admit and accommodate only cars, motorcycles and passenger or light goods vehicles weighing no more then 2500 kg gross.

3.3 Approved Document B and the external envelope

The main recommendations of Approved Document B that impact on the specification of external cladding systems are summarised in the following sections. The two principle parts that affect the specification and use of insulated panels are requirement B2 – Fire spread across surfaces and B4 – External fire spread between buildings.

3.3.1. Fire spread across surfaces – Requirement B2

Approved Document B sets performance standards that are intended to ensure that internal lining materials do not promote rapid flame spread. In escape routes and general circulation areas it is also necessary to limit the rate at which materials release heat.

The surface spread of flame classification of materials is assessed in accordance with BS 476: Part 7 [5] and materials are designated Class 1 to 4 (where class 1 is the best). The heat release potential is determined in accordance with BS 476: Part 6 [6] [section 10].

Class 0 materials are specified for areas where both the flame spread and heat release rate is controlled (e.g. on escape routes). To achieve a Class 0 rating a product must achieve Class 1 in BS 476: Part 7 and also achieve a specified level of performance in BS 476: Part 6. It will also shortly be acceptable to demonstrate compliance with the fire spread requirements by performance classifications in designated European test standards.

The recommended performance levels for internal linings to walls and ceilings based on British Standards and European Standards is summarised in table 2. For the majority of buildings, the internal lining should exhibit a Class 1 surface spread of flame except where it forms part of a circulation or protected route in which case it should have a Class 0 rating.

Insulated panels with metal facings and standard pvc/pvdf protective coatings intended for use in the external envelope will generally achieve Class 0 and will therefore meet the most onerous guidance for internal linings.

Table 2. Classification of internal linings in accordance with British and European Standards

Location	British Standards	Euroclass
Internal walls and rooms	1	C*
Circulation spaces (corridors, lobbies, stairways)	0	B*

** The corresponding Euroclasses above are the proposed classes set out in the draft European Supplement to Approved Document – B which at the time of printing is out for public comment. They are given for informative guidance only.*

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3.3.2. External fire spread between buildings – Regulation B4

Requirement B4 is intended to ensure that fire does not spread from one building to another as a result of heat radiation or airborne burning brands.

Figures 3a and 3b give an illustration of radiation and airborne burning brands spreading fire from one building to another.

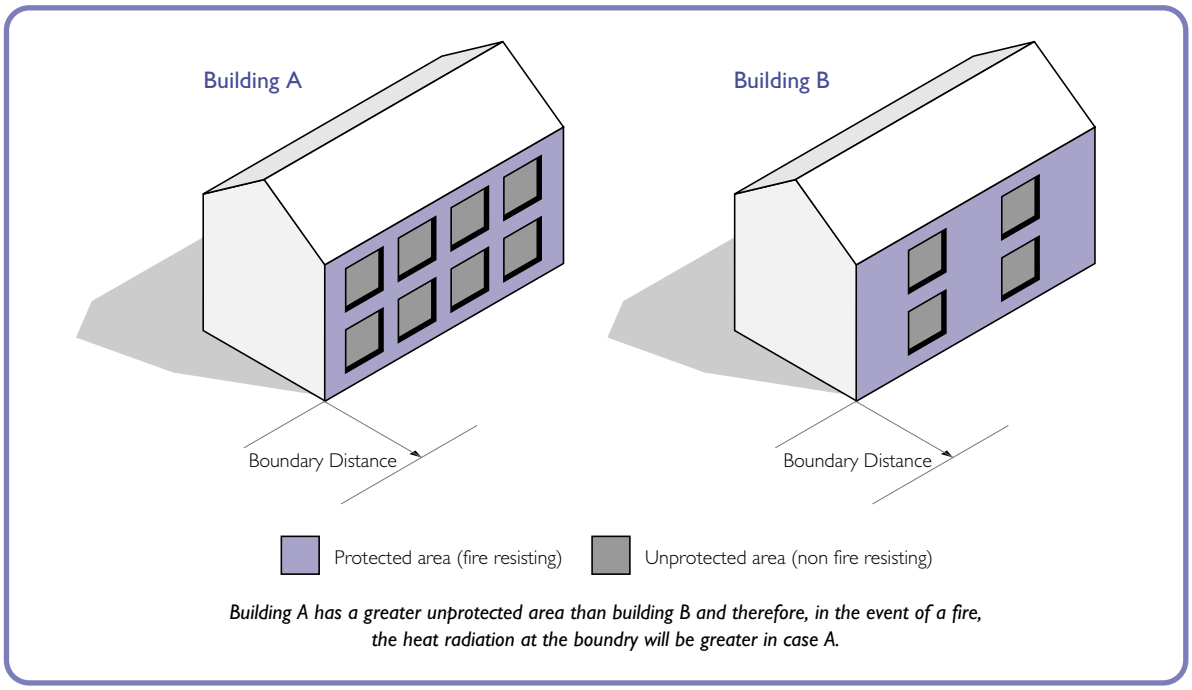

Figure 3a. External fire spread between buildings

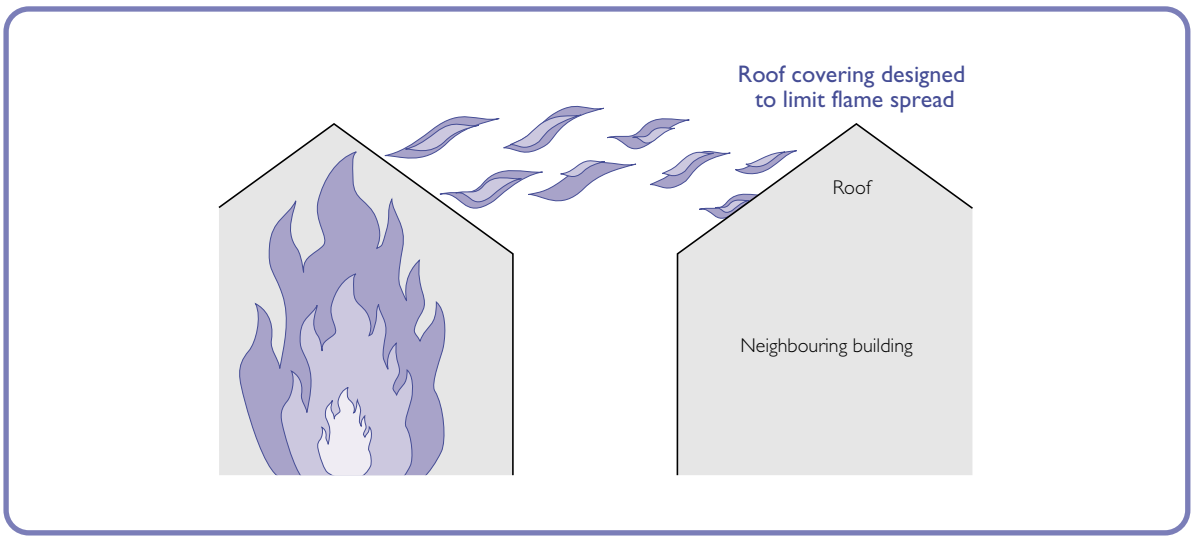

Figure 3b. Fire spread by airborne burning brands

Where there is the potential for fire spread from one building to another (e.g. when it is located close to a site boundary) the Approved Document may recommend restrictions on the flame spread characteristics of roof coverings and external wall surfaces. It may also be necessary to make all or part of an external wall fire resisting, to restrict the heat radiation to an adjacent building or boundary.

The extent to which any external wall of a building will require fire resistance and the extent to which the external surfaces need to be controlled depend on the distance of the wall from the boundary [see table 3, page 19].

The relevant boundary will normally be the site boundary and there is no statutory requirement to control external fire spread between two buildings in common ownership and occupation on the same site (provided that one of the buildings is not in the assembly or residential purpose groups). Where one (or both) of the adjacent buildings is in the residential purpose group it is necessary to draw a 'notional boundary' between the two buildings and the extent of allowable unprotected areas should be calculated accordingly.

The main recommendations of the Approved Document are summarised below.

The requirements will be met if the external walls are constructed so that the risk of ignition from an external source and the spread of fire over their surfaces are restricted by specifying their flame spread and heat release properties. This can be achieved by using materials with a Class 0 surface (see section 3.3.1).

Secondly, the amount of unprotected area in the side of a building is restricted to limit the amount of thermal radiation that can pass through the wall, taking the distance between the wall and boundary into account. This is can be achieved by having walls that resist fire according to BS476: Part 22 [7] except for the allowable unprotected areas (without fire resistance).

3.3.2.1. External walls within 1000mm of boundary

Any part of an external wall within 1000mm of a relevant boundary should have:

a) Class 0 external surface;

b) fire resistance (integrity and insulation) to the same standard as required for the building structure;

c) very restricted window openings (see diagram 44 of Approved Document B).

3.3.2.2. External walls more than 1000mm from boundary

If a wall is located more than 1m from the boundary it may still be necessary for all or part of it to be fire resisting. The area of window openings and other un-protected areas must therefore be restricted and the wall be constructed using a proven fire resisting construction (section 12).

Methods of calculating the required level of protected area are given in Approved Document B and BRE Report BR187 (1991) [8].

When the allowable extent of unprotected areas (i.e. the area that does not require fire resistance) has been determined the remaining protected areas of the wall should satisfy the following criteria:

a) external surface to be non-combustible; or any combustible surface more than 1mm thick to be Class 0;

b) fire resistance as regards integrity to the same standard as the other building elements and an insulation value of 15 minutes (when tested from the inside);

A special case is made for non-loadbearing external walls in single storey buildings up to 10m in height in that there may be no need for them to possess *any* fire resistance providing that:

– the wall does not form part of a compartment wall or a wall common to two or more buildings.

– it is more than 25m from the boundary for industrial, commercial, or storage buildings and more than 12.5m for office, assembly and recreation buildings.

– Where sprinklers are provided throughout the building in accordance with BS 5306: Part 2 (including the requirements for life safety) the values given above may be halved to 12.5m and 6.25m respectively.

If an external wall is located at a sufficient distance from the boundary (or adjacent residential or assembly building) that there is no restriction on unprotected areas then the provisions for surface classification only apply. The most onerous of these are satisfied by the Class 0 rating of most commercially available insulated panels.

3.3.2.3. Roof coverings

Approved Document B gives specifications for roof coverings where a building is located near to a boundary. These specifications vary according to the distance of the building from the boundary. No restriction is placed on the use of roof coverings designated AA, AB or AC to BS 476 Part 3: 1958 [9] but lower ratings are only acceptable if the building is at least 6m from the relevant boundary.

Insulated panels with metal facings and standard pvc/pvdf protective coatings intended for use in the external envelope generally have a test designation AA or AB and are suitable for all distances from any point or relevant boundary. However, if plastic roof lights are provided they should comply with the recommendations of Approved Document B.

Roof decking is not normally required to exhibit any fire resistance unless it is used as an escape route, or parking etc., as it is not normally considered to be an element of structure [Section 3.3.3].

3.3.3. Escape – Requirement B1

Section B1 of the Approved Document makes few recommendations that are directly relevant to the external building envelope. However, where external escape stairs are located within 1.8m of the external wall certain areas of the wall will need to provide a 30-minute standard of fire resistance (integrity only). The areas of wall that are required to be 30 minute fire resisting are illustrated in figure 4.

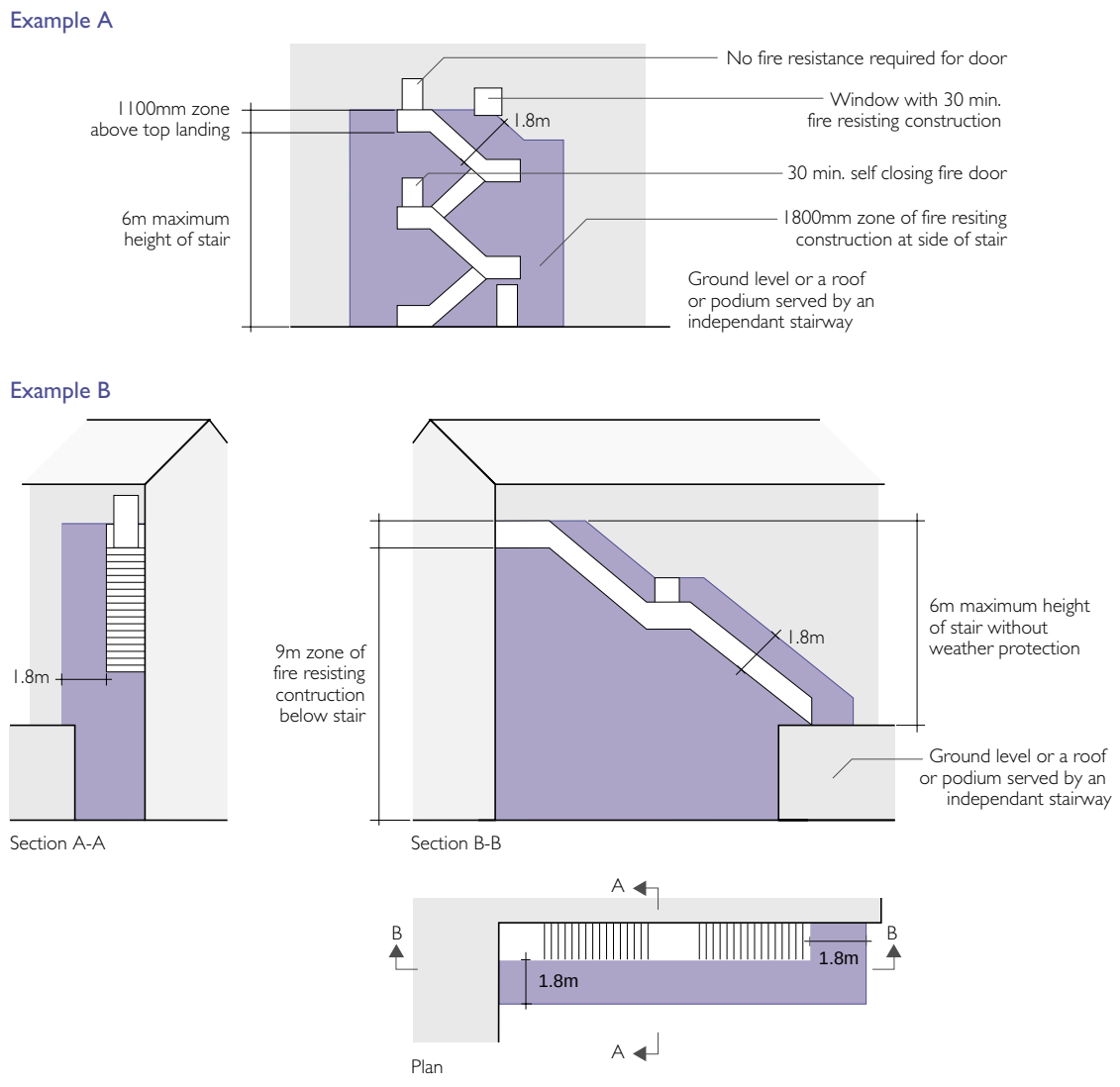

Figure 4. Fire resistance of areas adjacent to external stairs

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Roofs used as escape routes

Any part of a roof that forms an escape route should provide a fire resistance of at least 30 minutes fire resistance with regard to load bearing capacity, integrity and insulation. Similarly if the roof performs the function of a floor it should have the same fire resistance as is required for other floors within the building. This requirement would generally preclude the use of insulated panels for sections of a roof that form part of an escape route.

3.3.4. Junctions with compartment walls and cavity barriers – Requirement B3

Section B3 of the Approved Document exempts non-loadbearing cladding (panels) from the provision of any fire resistance except where recommended to restrict the spread of fire between buildings [see 3.2 re B4 of AD-B]. However in some circumstances it is necessary to subdivide a building into separate fire resisting compartments to limit the potential extent of fire spread [Figure 5].

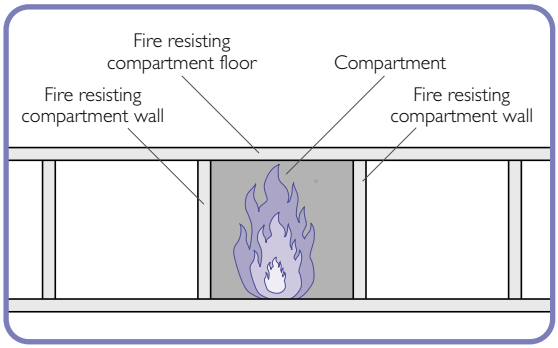

Figure 5. Illustration of the concept of compartmentation

Junctions with external walls

This guide does not deal with the construction of internal compartment walls but where a roof or external wall meets a compartment wall it is necessary to ensure that the junction does not compromise the fire resistance.

In relation to external walls, Paragraph 9.27 of the Approved Document states:

> Where a compartment wall or compartment floor meets an external wall the junction should maintain the fire resistance of the compartmentation.

This is usually achieved by fire stopping the junction with materials of limited combustibility to seal any gaps in the construction. There are a number of different techniques that may be used to fire stop such junctions but figure 6 shows an effective means of achieving a satisfactory junction detail.

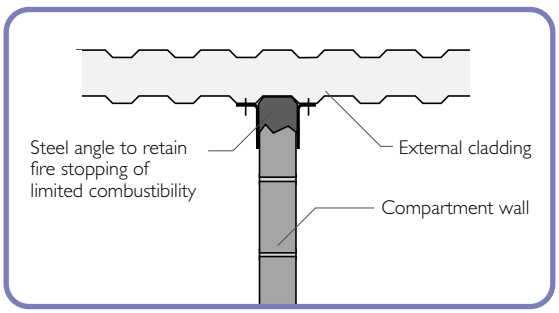

Figure 6. Illustration (on plan) of recommended fire stopping detail

Junctions with roofs

Where an insulated panel is used in roof construction and passes over a compartment wall the Approved Document recommends that a 300mm wide band of material of limited combustibility should be provided where a composite panel passes over the wall.

This implies the use of a mineral fibre core panel or removal of a 300mm wide strip of combustible core material and its replacement with an alternate material of limited combustibility (e.g. mineral fibre). This is difficult to achieve in practice. However some rigid urethane insulated panel systems, fully filled and auto-adhesively bonded, are acceptable without the 300mm strip if the performance of the specific product is proven by an appropriate fire resistance test.

At compartment wall junctions it is also recommended that the roof covering should be designated AA, AB or AC for a distance of 1500mm on each side of the compartment wall. This is satisfied by metal faced insulated panels intended for external roof applications, which in general have AA or AB classification.

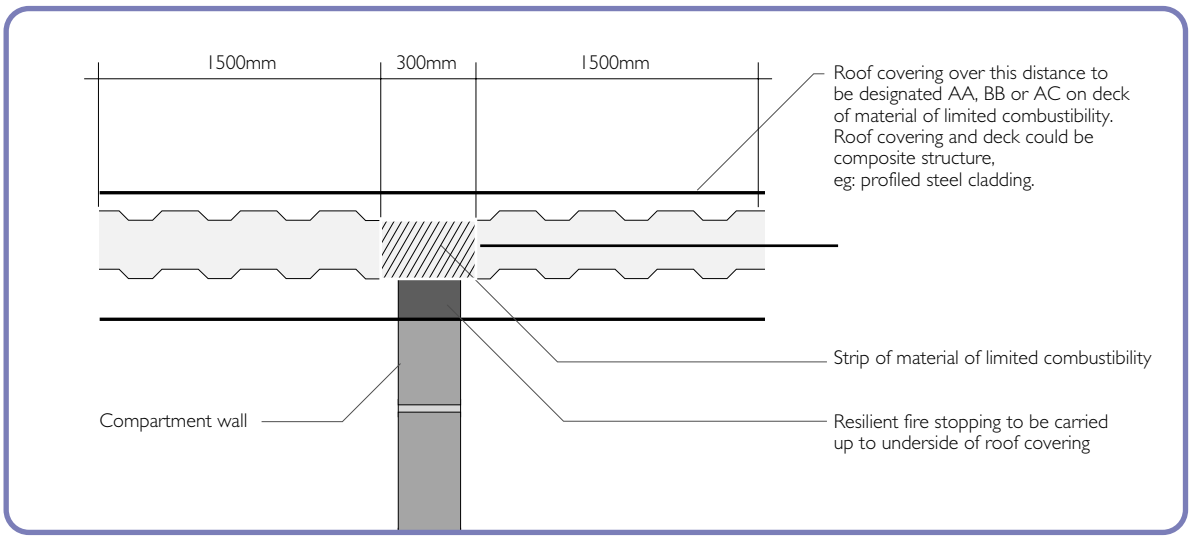

Figure 7. Illustration of the 1500 extent of AA, AB or AC material and the 300mm wide strip of material of limited combustibility

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Cavity barriers in concealed spaces

An important part of requirement of B3 is the recommendation to close off the perimeter of hidden voids and provide protection where a void passes a compartment wall or floor.

Cavity barriers are also usually required to subdivide large concealed spaces such as the void behind a suspended ceiling at 20m intervals (This is reduced to 10m if the internal surfaces of the void are not Class 1 or Class 0).

There are no cavities associated with insulated panels because the insulating core completely fills the space between the two faces of the panel. However an area that is relevant to the external envelope, where the necessity to provide cavity barriers or continue a fire resisting wall is often forgotten, is at the eaves where a pitched roof meets an external wall [Figure 8].

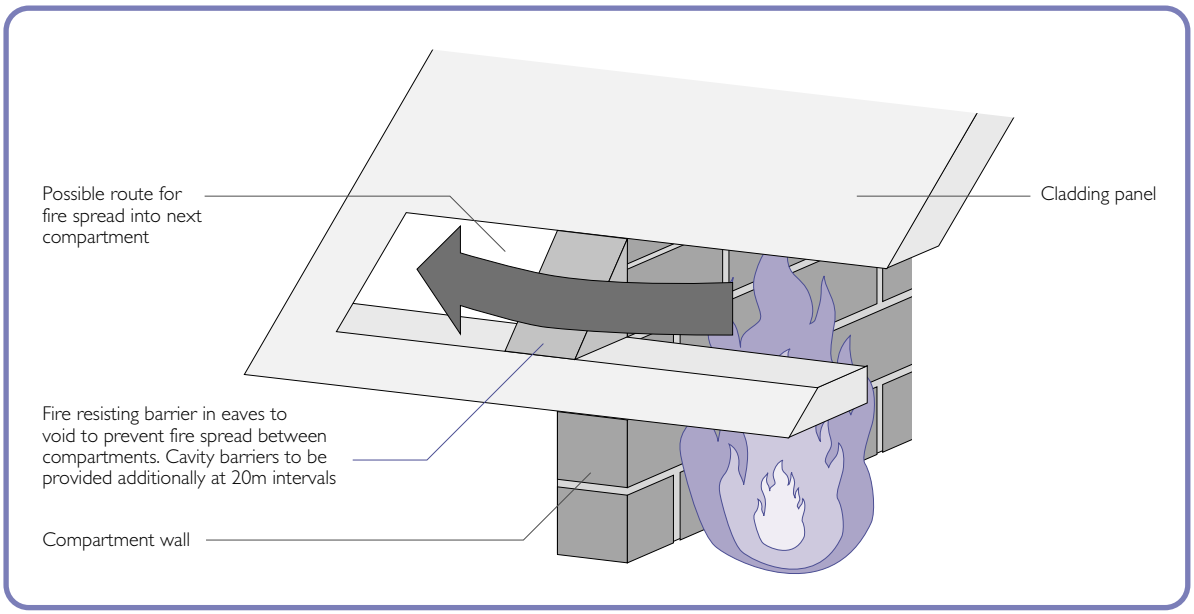

Figure 8. Illustration of required fire resisting barrier and cavity barrier at eaves

3.3.5. Access and facilities for the fire service – Regulation B5

Appendix F of the Approved Document provides guidance on the use of insulated panels *within* a building (e.g. internal panels used for cold store insulation) because of the difficulties these can present for fire fighting operations.

However no specific provisions are made regarding insulated panels used in the external building envelope that are securely fixed to the building framework, thereby preventing collapse with the result that the risk is not perceived to be significant.

3.4 Approved Document B – summary of recommendations relevant to external insulated panels

Table 3 summarises the main recommendations of Approved Document B that are relevant to the specification of insulated panels used in external walls and Table 4 summarises the recommendations applicable to their use in roof construction.

Table 3. Main recommendations of Approved Document B for external walls

Room size	Internal face*	External face*	Fire resistance	
			integrity	Insulation
Small rooms less than 30m^2 Other rooms Circulation spaces	Class 3 Class 1 Class 0			
Boundary distance				
Less than 1m Greater than 1m protected areas unprotected areas		Class 0 Class 0 N/A	Yes[1] Yes[1] N/A	Yes[1] 15mins N/A
Height of wall above ground				
Less than 18m Greater than 18m		N/A[2] Class 0[3]		
External escape stair				
Stair located within 1.8m of wall			30	N/A

Notes to table 3

** Most commercially available external insulated panels will achieve Class 0 and will therefore satisfy the most onerous flame spread requirements of the Approved Document.*

1. Fire resistance period as required for the building structure.

2. In assembly and recreation buildings (purpose group 5) the external face should have an index (I) = 20 when tested to BS 476: Part 6 to a height of 10m above any external level to which the public have access.

3. In any part of the wall below 18m this may me reduced to index (I) = 20 when tested to BS 476: Part 6. Panels with Class '0' meet this requirement.

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Table 4. Main recommendations of Approved Document B for roofs

Room size	Internal face*	Roof covering	Material of limited combustibility
Small rooms less than 30m² Other rooms Circulation spaces	Class 3 Class 1 Class 0		
Compartment wall junction			
		AA, AB or AC² for 1500mm on each side of junction	300mm strip of non-combustible material over compartment wall¹
Boundary distance			
Less than 6m		AA, AB or AC²	
Greater than 6m		Lesser designations acceptable	

Notes to table 4

**Most commercially available external insulated panels will achieve Class 0 and will therefore satisfy the most onerous flame spread recommendations of the Approved Document.*

1. 300mm wide strip of material of limited combustibility to replace combustible core where roof passes over compartment wall unless demonstrated otherwise by suitable fire resistance test. [see 3.3.4 Junctions with roofs]

2. Insulated panels intended for external roof applications in general have AA or AB classification.