2015

Fire detailing

for non-combustible masonry structures

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1.0 INTRODUCTION

Introduction

The first records of regulations for building construction date back to the C12th when the elders of the City of London set down the measures that they hoped would bring a halt to a series of catastrophic fires in the city. Five centuries later the first legislation, in the form of the 1667 London Building Acts, appeared. Commonly regarded as the forerunner of modern Building Regulations, these were also implemented in the aftermath of the great fire in 1666. Both of these measures insisted that new buildings be constructed in masonry to resist the breakout of fire and prevent its rapid propagation.

This simple booklet is both a guide to the current requirements of the Building Regulations and a reminder of what has been recognised for centuries, namely that masonry buildings are inherently robust for energy efficiency, fire resistance and good sound insulation.

Masonry buildings are by their nature and materials resistant to fire. The designer or specifier should remember that this fundamental quality leads to simpler detailing and construction and this simplicity in turn benefits the thermal and acoustic detailing as well as the construction. Masonry is an excellent material for a ‘fabric first’ approach.

When compared with frame constructions, masonry buildings generally have fewer layers and fewer materials performing separate functions within the wall build-up. However, all buildings contain cavities and some concealed spaces where fire can spread undetected. To minimise the dangers of undetected fires the Building Regulations generally require that cavities are provided with barriers to reduce the area of the void space and to contain any spread of fire. The requirements for masonry buildings are far less onerous than for framed constructions. This guide explains the simple measures that are required to comply with the Building Regulations for detailing fire barriers and cavity barriers, in particular Section 8: Compartmentation and Section 9: Concealed spaces (cavities) of Approved Document B Volume 2. The focus is on multi-occupancy residential buildings but the principles also apply to houses and apartments.

‘Stay put’ evacuation policies

Fire detailing is particularly important in situations where parts of a building are intended to remain occupied whilst others are evacuated, for instance in multi-occupancy buildings such as care buildings and retirement accommodation. Here there is a general presumption that occupants not directly affected by a fire will ‘stay–put’, within the protected enclosure of their dwelling. Senior living and supported living accommodation (at various levels) is set to increase as we find new ways to meet the demands of a society experiencing social and demographic changes that will see people living longer and often in single households.

Fire safety for the elderly and possibly frail or incapacitated residents of multi-occupancy buildings is clearly an important priority for building designers, constructors and managers, who all have a legal responsibility for ensuring that fire safety has been properly considered and executed and remains in place once a building is handed over.

2.0 Building design: understanding the requirements of the Regulations

Generally in masonry buildings the materials used for wall constructions have good inherent fire resistance or are not combustible at all. Secondary layers of fire protection, which inevitably introduce voids and air gaps are not usually required. Combustible materials can be included within a masonry wall cavity providing all of the provisions for cavity barriers have been followed refer to Diagram 34 in Approved Document B, Volume 2 (ADBV2) reproduced below.

Building Regulations

Multi-occupancy buildings and care homes fall within the requirements of Approved Document B Volume 2 (ADBV2). Domestic properties are covered in Approved Document B Volume 1 (ADBV1).

Cavity barriers should be provided in accordance with ADBV2 paragraph 9.3:
a. at the junction between an external cavity wall (except where the cavity wall complies with Diagram 34) and every compartment floor and compartment wall; and
b. at the junction between an internal cavity wall (except where the cavity wall complies with Diagram 34) and every compartment floor, compartment wall, or other wall or door assembly which forms a fire-resisting barrier.

In a masonry wall a window frame or a door frame of any material can close the cavity, i.e. act as the cavity barrier.

Conversely, in a framed or partition wall there are limitations on the construction elements that can act as a cavity barrier. A window or door frame can close the cavity providing the frame is 38 mm thick for timber or 0.5 mm thick for metal. Historically openings would not have needed additional closers for timber windows. However, with the widespread use of UPVC windows the frame of the window itself is usually not adequate to close the cavity. Many standard details for framed or partition walls show an insulated cavity closer for thermal or construction efficiency but fail to point out that this closer must also be fire resisting.

Table A1 in Appendix A of ADBV2 states the requirements for fire resistance.

ADBV2 defines a cavity barrier as: a construction, other than a smoke curtain, provided to close a concealed space against penetration of smoke or flame, or provided to restrict the movement of smoke or flame within such a space.

Figure 1 - *[Masonry]* cavity wall excluded from provisions for cavity barriers *[that subdivide concealed spaces]*

Note that:
1. Domestic meter cupboards may be installed provided that:
   a) there are no more than two cupboards per dwelling
   b) the openings in the outer wall leaf is not more than 800x500mm for each cupboard
   c) the inner leaf is not penetrated except by a sleeve not more than 80x80mm, which is fire stopped.

2. Combustible materials may be placed within the cavity.

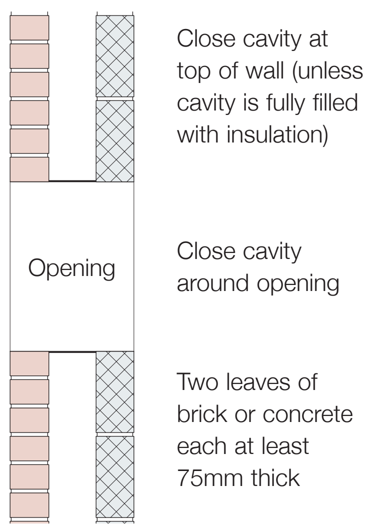


Figure reproduced from ADBV2 Diagram 34

3.0 Cavity barriers and fire stopping

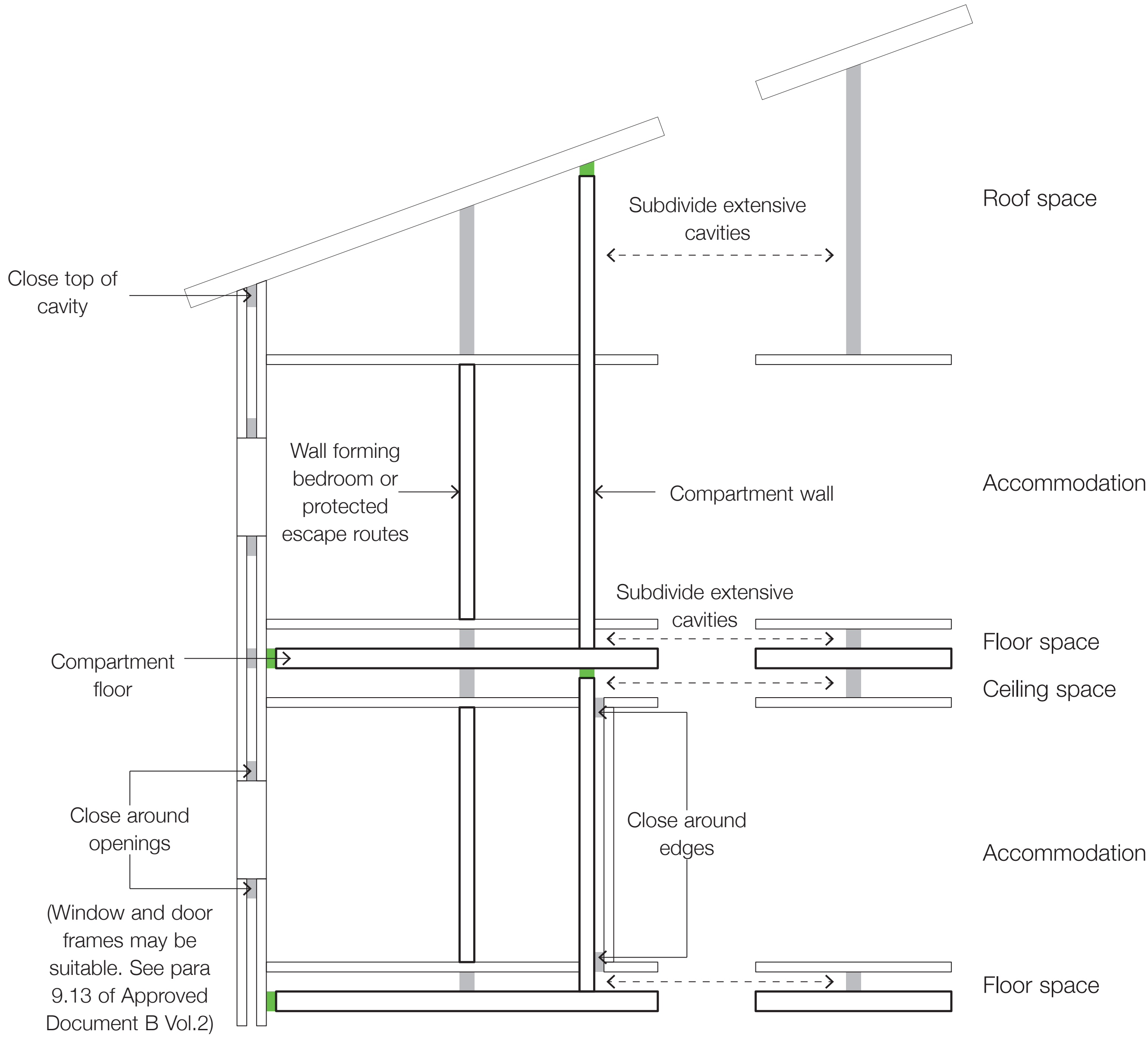


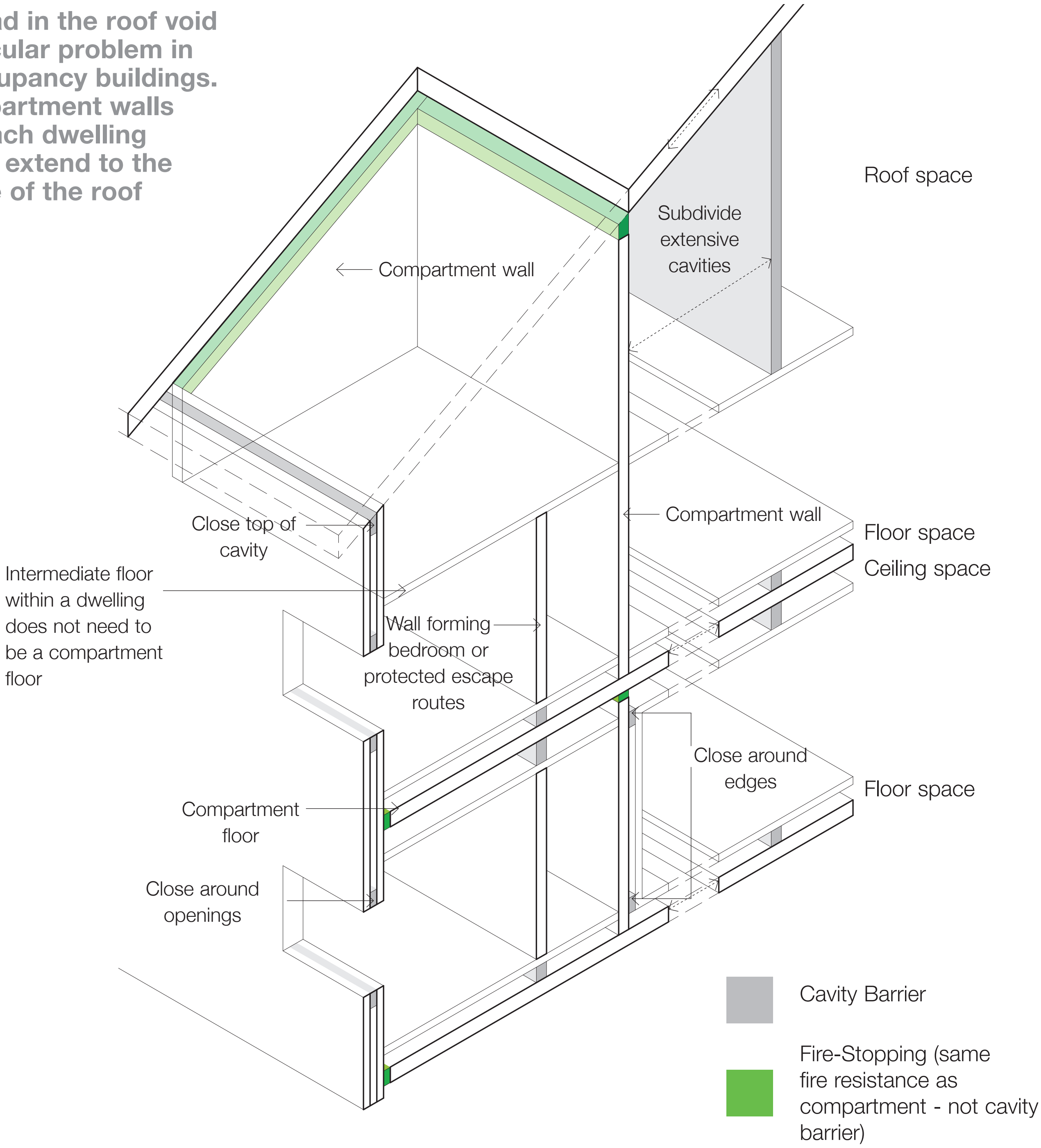
Figure 2 illustrates the requirements for cavity barriers

Cavity Barrier
Cavity barriers sub-divide concealed voids in the construction to prevent the spread of fire and smoke

Fire-Stopping (same fire resistance as compartment)
Fire-stopping seals the junction of compartment walls and floors to maintain the integrity of the construction. Fire-stopping also seals around penetrations and services.

4.0 Compartment floor and walls

Fire spread in the roof void is a particular problem in multi-occupancy buildings. The compartment walls around each dwelling should all extend to the underside of the roof covering.



Compartmentation

The speed of fire within a building can be restricted by sub-dividing it into compartments separated from one another by walls and/or floors of fire-resisting construction (ADBV2 Para 8.1). In buildings containing flats every floor and every wall separating a flat from any other part of the building should be a compartment floor or a compartment wall (excluding external balconies and access decks ADBV2 Para 8.13).

5.0 Construction details

Masonry buildings are also less vulnerable during construction, because the fire protection is in place as the construction goes up. However, voids and cavities, for instance an external wall cavity, can still allow the passage of smoke and may also contain materials such as insulants that have limited resistance to fire and may even be combustible.

Many of the measures illustrated in this section are simple to install and straightforward to specify with support from suppliers and manufacturers. Masonry construction does not introduce multiple layers and voids that occur in framing systems but the cavity barriers, particularly at the top of the cavity wall, are essential to the effectiveness of the passive fire protection and must not be overlooked.

This section describes where and how to install cavity closers and seals in common masonry constructions only. The design of fire resisting constructions and other passive elements is not within our scope but a comprehensive guide published by the ASFP (Ensuring Best Practice for Passive Fire Protection in Buildings) offers a complete introduction to all aspects of building design procurement and management.

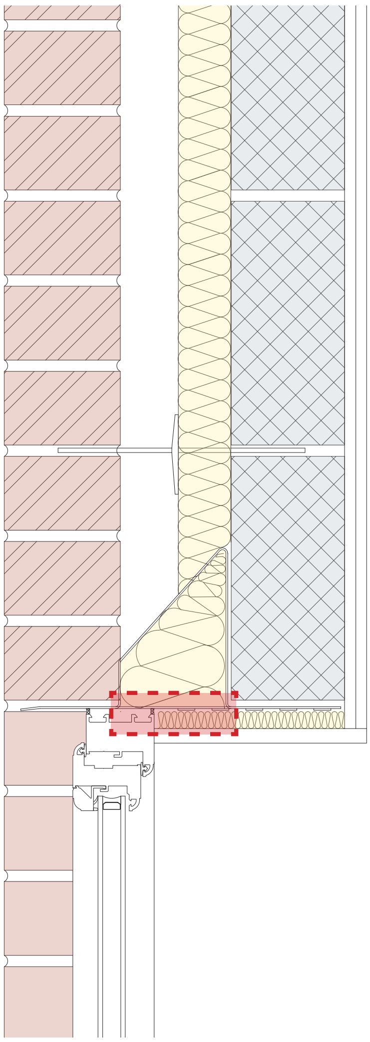
Details in this section are based on the LABC Registered Construction Details (see http://www.labc.co.uk/registration-schemes/construction-details) with the requirements for cavity barriers highlighted.

Fires during construction

In September 2014 a £20 million chemistry building for the University of Nottingham was completely destroyed by fire during construction. The building shell of timber laminated beams and CLT floors had been completed and internal fitting was due to start. Nobody was injured but 60 fire fighters were called to the scene. The cause is yet to be established.

E1: Insulated steel lintel

In a masonry wall the opening around a window or door head needs to be closed.



An insulated cavity closer may be required for thermal reasons (to reduce heat losses from thermal bridging)

Requirements

- In a masonry wall the opening around a window or door head needs to be closed.
- The cavity must be closed at the top of the wall for the provisions of Diagram 34 ADBV2 to apply.

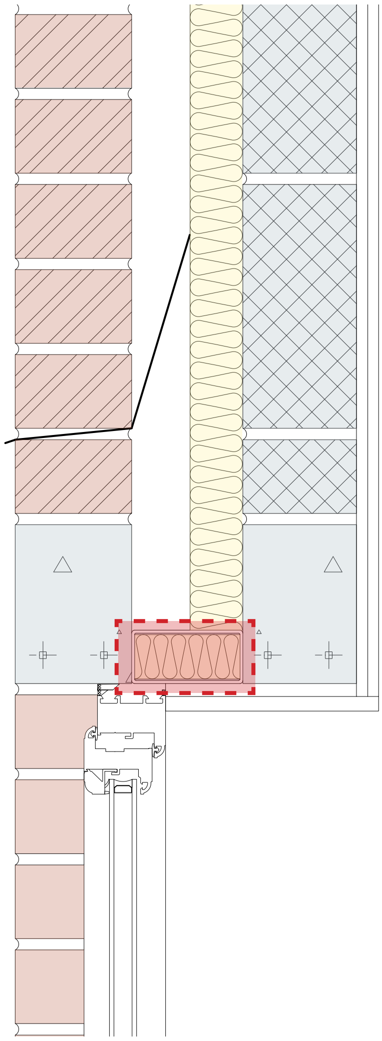
Notes :

See LABC Registered Construction Details for thermal performance and construction notes relating to different insulation thickness and block types.

When the window is in line with the outer leaf the cavity can also be closed by the plasterboard lining (12mm min). However, placing the window in this position is not good practice for thermal design.

E2: Independent concrete lintel

In a masonry wall the opening around a window or door head needs to be closed.



An insulated cavity closer may be required for thermal reasons (to reduce heat losses from thermal bridging)

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- In a masonry wall the opening around a window or door head needs to be closed.
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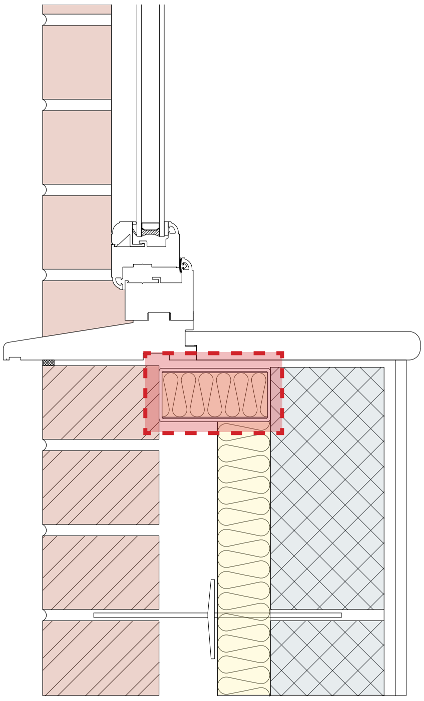
See LABC Registered Construction Details for thermal performance and construction notes relating to different insulation thickness and block types.

When the window is in line with the outer leaf the cavity can also be closed by the plasterboard lining (12mm min). However, placing the window in this position is not good practice for thermal design.

E3: Sill

In a masonry wall the opening around a window or door head needs to be closed.



An insulated cavity closer may be required for thermal reasons (to reduce heat losses from thermal bridging)

Requirements

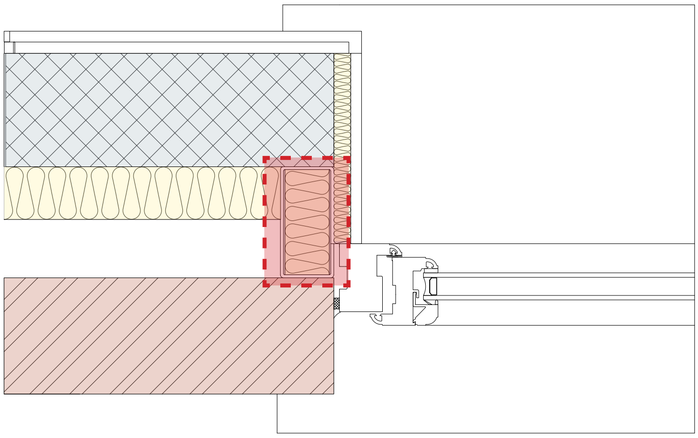
- In a masonry wall the opening around a window or door needs to be closed.
- The cavity must be closed at the top of the wall for the provisions of Diagram 34 ADBV2 to apply.

Notes :

See LABC Registered Construction Details for thermal performance and construction notes relating to different insulation thickness and block types.

When the window is in line with the outer leaf the cavity can also be closed by the plasterboard lining (12mm min). However, placing the window in this position is not good practice for thermal design.

E4: Jamb



In a masonry wall the opening around a window or door head needs to be closed.

An insulated cavity closer may be required for thermal reasons (to reduce heat losses from thermal bridging)

Requirements

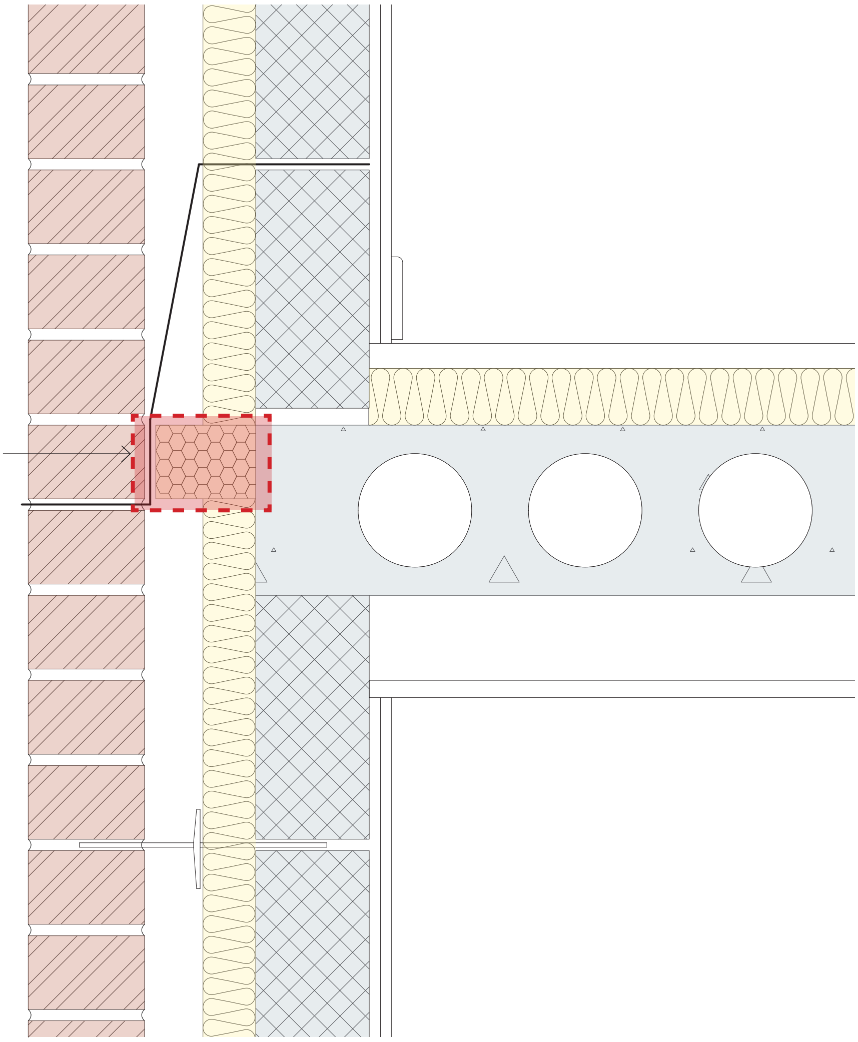
- In a masonry wall the opening around a window or door needs to be closed.
- The cavity must be closed at the top of the wall for the provisions of Diagram 34 ADBV2 to apply.

Notes :

See LABC Registered Construction Details for thermal performance and construction notes relating to different insulation thickness and block types.

When the window is in line with the outer leaf the cavity can also be closed by the plasterboard lining (12mm min). However, placing the window in this position is not good practice for thermal design.

E7: Concrete Intermediate Floor



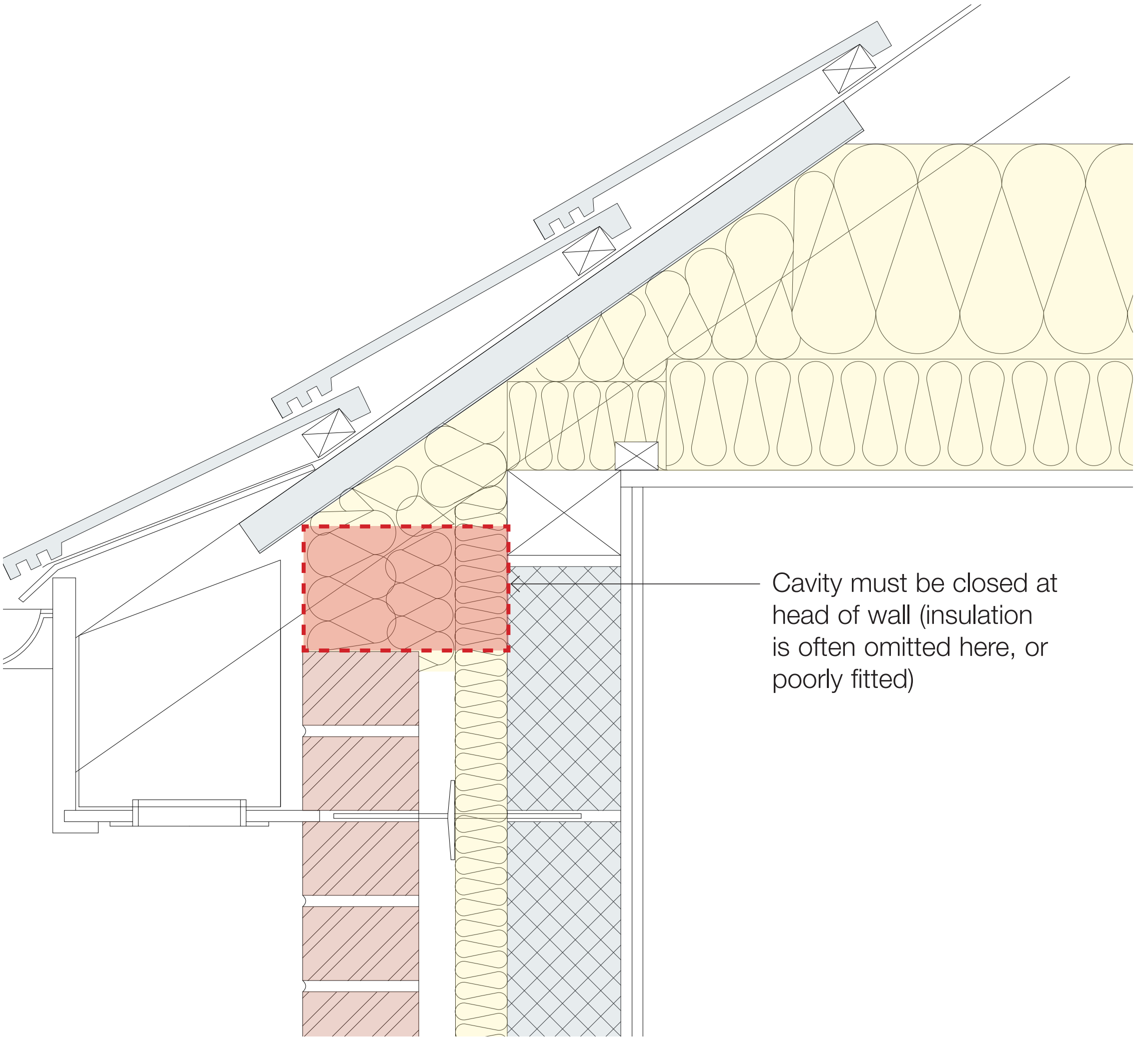
Requirements

- A cavity barrier is not required for ADB(V2) if the construction complies with Diagram 34, ie. two masonry leaves.

Notes :

See LABC Registered Construction Details for thermal performance and construction notes relating to different insulation thickness and block types.

E10: Pitched roof eaves insulation at ceiling level



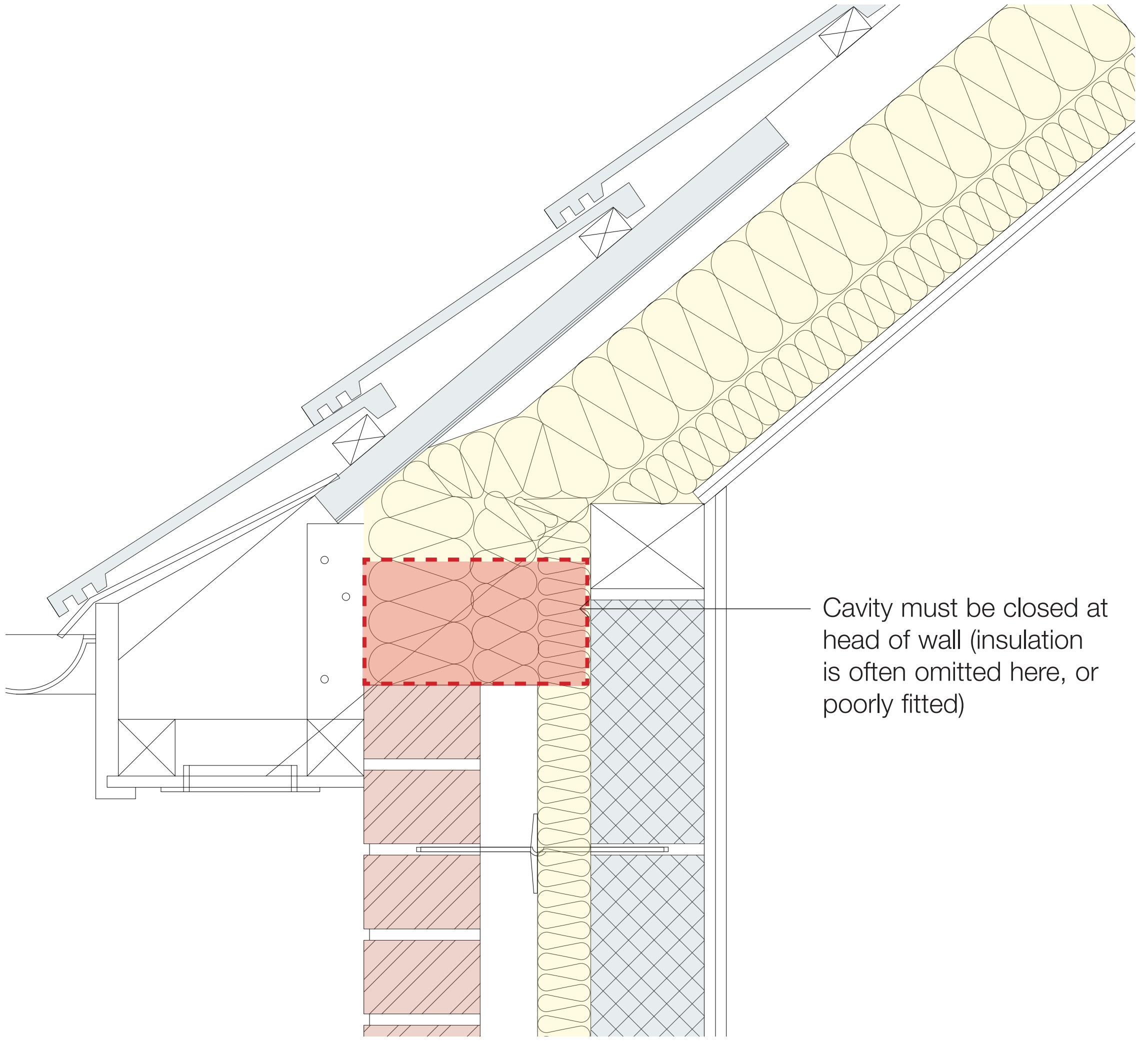
Requirements

- The cavity barrier must be closed at the top of the wall for the provisions of Diagram 34 ADB(V2) to apply.

Notes

See LABC Registered Construction Details for thermal performance and construction notes relating to different insulation thickness and block types.

E11: Pitched roof eaves insulation between rafters



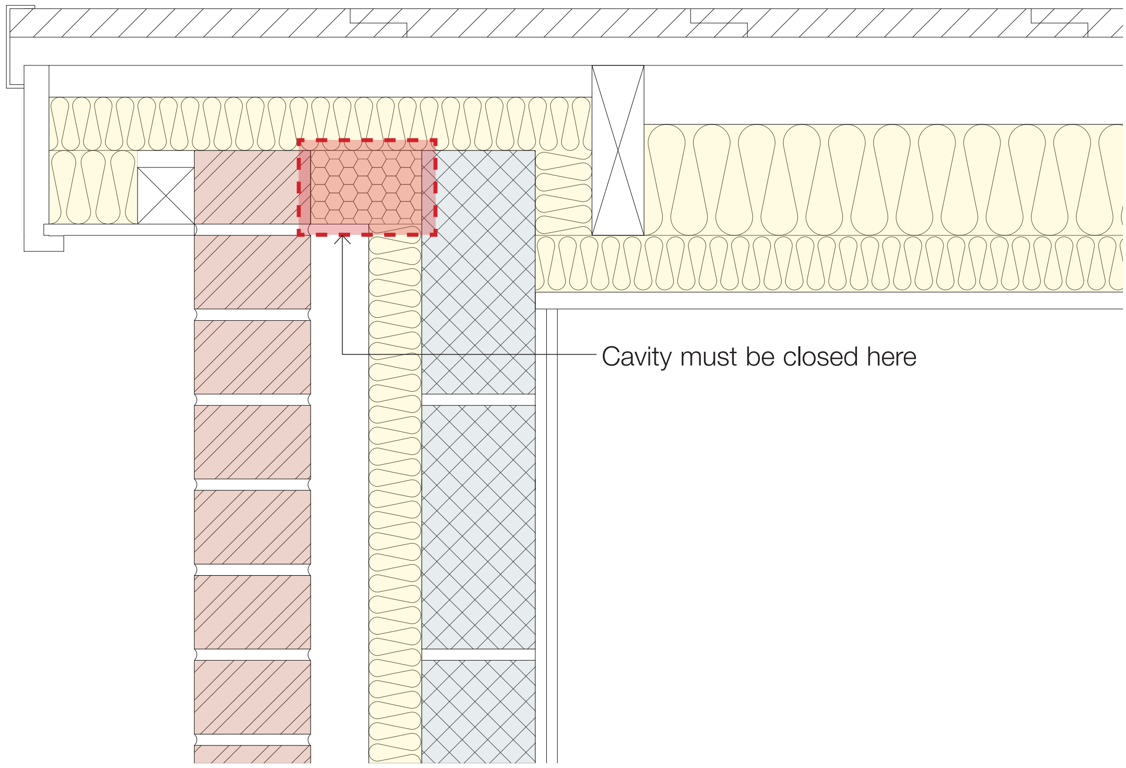
Requirements

- The cavity barrier must be closed at the top of the wall for the provisions of Diagram 34 ADB(V2) to apply.

Notes

See LABC Registered Construction Details for thermal performance and construction notes relating to different insulation thickness and block types.

E13: Pitched roof gable



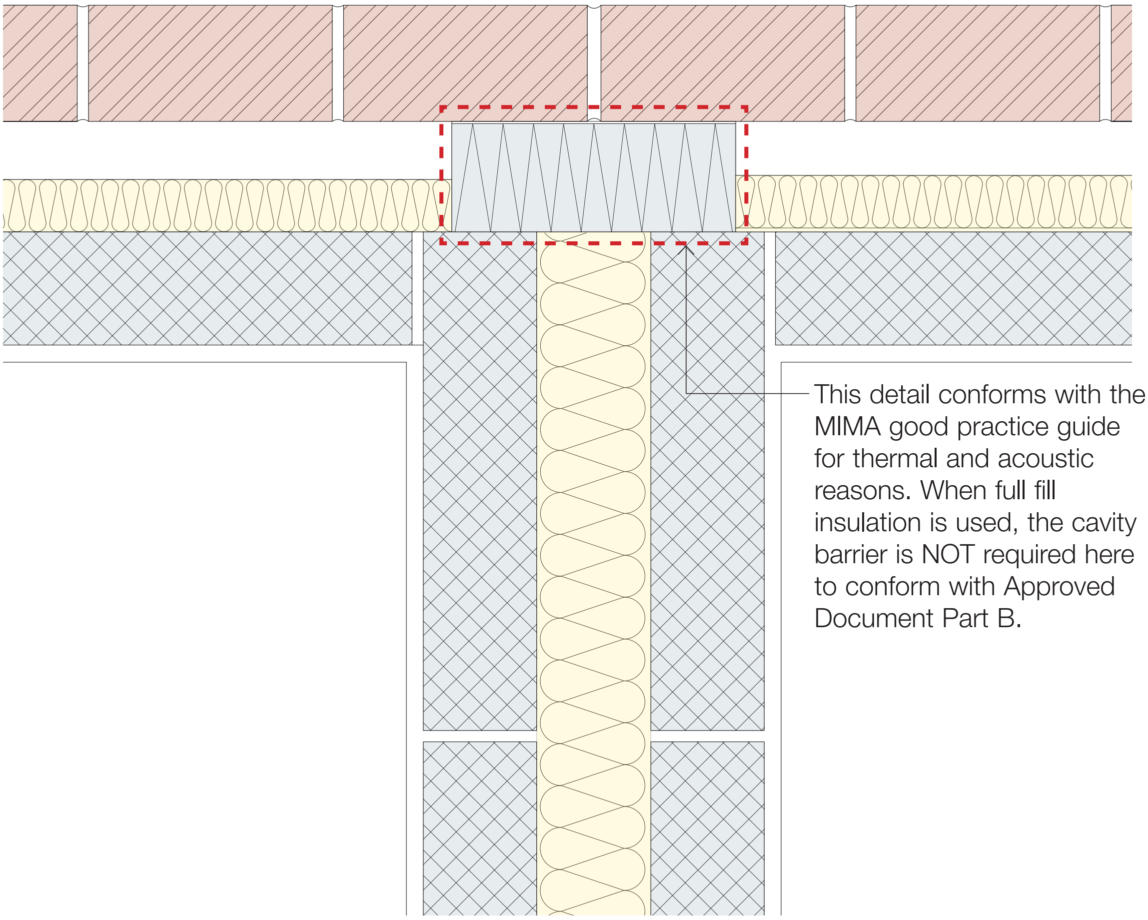
Requirements

- Note that a cavity barrier should, wherever possible, be tightly fitted to a rigid construction and mechanically fixed in position. ADBV2 Para 9.14 identifies conditions where this may not be possible, for instance at a wall/roof junction with slates or tiles. In this case the junction should be fire-stopped.
- Close the cavity below the timber verge ladder with a compressed closer

Notes :

See LABC Registered Construction Details for thermal performance and construction notes relating to different insulation thickness and block types.

E18: Masonry separating wall



Requirements

- The cavity must be closed at the top of the wall for the provisions of Diagram 34 ADBV2 to apply.

Notes :

See LABC Registered Construction Details for thermal performance and construction notes relating to different insulation thickness and block types.

See MIMA design guide, Preventing Thermal Bypasses in Party Separating Walls.

6.0 Installation practice

As a general rule, products that use a mechanical fixing should be favoured above friction fitted or self supporting barriers that rely on the accuracy of other trades for their effectiveness – for instance a consistent cavity width in the case of push-fit horizontal barriers.

Types of cavity barrier

Cavity barriers for wall constructions may have different functional requirements according to where they are located in the wall and where they are in relation to other elements, such as damp proof courses, trays and cloaks. Cavity barriers may also have the dual function of preventing heat loss (by sealing the cavity perimeter) and preventing the ingress of water (when combined with a vertical dpc in a single product). Similarly window and door surround closers may have a fire, water-proofing and thermal role.

These different applications have given rise to a wide variety of products, each with different installation requirements. Designers should establish the specific requirements for each condition and not assume that a single product will be equally effective in all locations. Even where products are suitable for two positions (vertical and horizontal applications) they will invariably have different support and fixing requirements. Designers should seek specialist manufacturers' advice for each condition and not allow the selection of the barrier to be left to chance.

Supported closers and barriers are generally preferable, both for long-term stability and for quality control of the installation process. Supported closers are less reliant on other construction elements being in place (both leaves of a cavity wall) and can often be inspected effectively before the construction is covered up. Supported closers are also less likely to be displaced by falling mortar and debris from the construction 'lifts' above.

Most of the cavity barrier and closer products come in defined lengths for handling and for ease of transportation but the junction between adjacent lengths is rarely illustrated on the design drawings. Designers should make sure that the method for jointing barriers is achievable within the construction and that the requirements are communicated effectively through drawings or specification.

Product innovation

Cavity barriers that allow the ventilation to continue through the cavity void have widespread applications in rainscreen and other cladding and facing systems. The closers have small perforated holes that close when a special intumescent coating expands when subject to heat.

Shaped semi-rigid closers are also available that simultaneously deal with waterproofing requirements simplifying the number of components and operations required to install an effective detail. Note that in most instances a horizontal closer will require a cavity tray above it to deflect water from the back face of the cavity forwards and to prevent pooling around the tray. Although these more sophisticated products may seem at first more expensive on an elemental basis when the other components are considered their increased simplicity will be attractive.

7.0 Fires in concealed spaces

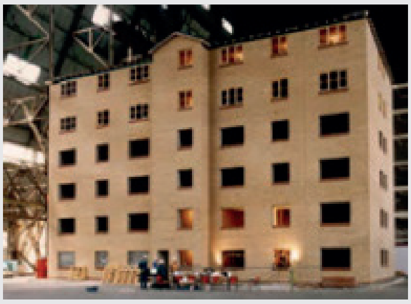
Although our current regulations provide for effective safety of the occupier they are not expressly written with the purpose of protecting property in the case of fire, nor do they safeguard a building from fire during construction – an increasing occurrence in some forms of construction but extremely rare in masonry. There have been a number of large scale building fires in timber frame construction in recent years.

Designer's responsibilities

The design of the passive protection elements will follow the statutory guidance in Approved Document B or the codes of practice (BS 9999 or BS 7974) that allow a more flexible approach to fire safety design through the use of a risk-based fire engineering. By whatever means the design of passive elements is achieved it is important to recognise that the integrity of the fire construction can easily be compromised by voids and cavities that breach the fire-resisting construction or by gaps and discontinuities in the construction itself, occurring either through movement and settlement or because of the imperfections of construction and the tolerances required around junctions of different materials. Any fire within a concealed space may present a greater danger than would a more obvious weakness in the fabric of the building.

Alarming instances of fire re-igniting

A multi-storey timber frame building was tested in a simulated fire at the BRE research facility at Cardington. The published results demonstrated that the multi-storey timber frame construction resisted the spread of fire for the necessary time period to allow occupants to escape. However, less-widely reported was the fact that the fire reignited after the controlled experiment was complete and the fire service had left. Smouldering embers within the cavities between construction elements re-ignited and the fire spread to the whole building, taking more than five hours before it was brought under control (Thomas Lane, Building Magazine issue 28, 2002). The fire spread because cavity barriers at floor level had become dislodged, others were missing from the outset. The potential issues with fires reigniting are investigated in NHBC NF 51. This example also highlights an important issue for building owners – that the design of a building to satisfy fire safety will usually only consider life safety, not necessarily the protection of the building fabric itself or the contents.



8.0 Fire stopping products for services, penetrations and ductwork

A comprehensive reference guide is produced by the Association for Specialist Fire Protection. Refer to the ASFP Red Book – Fire-stopping: linear joint seals and small cavity barriers, http://is.gd/HrATV1 www.asfp.org.uk

Stopping fire spread

Fire stopping generally refers to the sealants or jointing materials between construction elements (for instance at the head of a wall where it meets the underside of the floor above or around penetrations where services and pipe-work pass through a fire resisting construction). Fire stopping will often have to resist deflection or thermal movement at and around the junction. Although this guide is primarily concerned with cavity closures we have referred to common instances where the design and specification of fire stopping should be considered. The principal risk is the same as with cavity barriers - a fire passing through constructions in a concealed space is extremely dangerous because both the source and extent of the fire are not immediate.

In multi-occupancy buildings there will be common services that require additional consideration and the instances where services pass through a fire-resisting construction could be greater than in a scheme of self-contained apartments. Multi-occupancy buildings often have common ventilation extract systems with ducting passing through the separating walls and into the ceiling voids of common areas. Heating systems are also likely to be shared and pipework distributing hot water from a common plant room will also cross between corridor ceilings and into the ceiling void of each dwelling.

Designers should set out the requirements for cavity barriers, fire stopping, fire protected ductwork and services at the same time as the other elements of passive fire protection are being considered and wherever possible third party certified products and installers should be specified.

Fire spread

The fatal fire at Lakanal House in Peckham in 2009 spread rapidly between floors. Fire broke out on floors above and below the source. Replacement cladding panels were thought to have contributed but further enquiry also established that fire stopping measures had been removed during refurbishment works in the 1980s. Lakanal House had a single escape stair serving 98 properties. Six people perished, overcome by smoke and fumes after being instructed to stay in their home by the fire service. The escape strategy was later revised but the importance of maintaining the integrity of fire compartments within risers and concealed spaces was dramatically illustrated in this tragedy.

9.0 After handover: understanding the Fire Safety Orders

"The move within regulatory guidance from prescriptive rules to performance-based designs and risk assessment during occupation puts greater responsibility for safety on construction companies and building owners and occupiers. The establishment of the 'Responsible Person' under the RR(FS)O means that those who are responsible for the operation of a business within a building need to be aware of their responsibilities which include the installation and maintenance of passive fire protection systems."

ASFP

Maintaining fire safety measures

In this guide we have identified where cavity barriers are used to maintain the overall integrity of the 'passive' protection measures within a building. The passive protection measures include the fire protection to structure, the compartmentation of walls and floors and the various fire-resisting constructions that protect escape routes such as fire-resisting partitions and doors. The passive protection measures are generally installed at the time of construction and are distinguished from the active measures, which include detection and alarm systems, sprinklers and fire suppression systems and which require a command signal or a power supply to activate them.

Both active and passive measures require periodic inspection and maintenance, a responsibility of the building manager or someone designated by them under the requirements of the Regulatory Reform (Fire Safety) Order. Designers, contractors and building operators all have serious legal responsibilities in the delivery and operation of safe buildings. It is essential that designers and contractors ensure that the passive protection measures are adequate in the parts of the building which may not readily be inspected once the building is complete.

The correct installation of passive measures is particularly important in buildings that include multiple households, for instance, apartment buildings, retirement living accommodations and student accommodation because the escape strategy for these buildings is usually based on the principle that the fire safety measures are implemented only in the part of the building where the fire occurs and other residents 'stay put' protected by the fire resisting compartmentation of the building.

Further reading :

"Fire safety in purpose - built blocks of flats" *Local Government Group*

"NF51 - Fires in cavities in residential buildings" *NHBC*

"Ensuring Best Practice for Passive Fire Protection in Buildings" *ASFP*

Fire risk assessments: making sure protection is in place

The responsible person undertaking an annual risk assessment will need to be aware of any alterations to the building's occupancy and use and to any processes or equipment that may impact fire safety. The risk assessment should also check that routine maintenance or services installations have not displaced existing fire stopping.

"The 'responsible person' must either undertake these reviews or appoint a suitable qualified Fire Risk Assessor to do so. Where work is carried on the structure of the building it is recommended that this be done by certified installers wherever possible."
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Notes

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