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Fire safety in the design, management and use of residential buildings – Code of practice

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Summary of pages

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Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 December 2011. It was prepared by Technical Committee FSH/14, *Fire precautions in buildings.* A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 5588-1:1990, which is withdrawn.

Relationship with other publications

This standard complements BS 9999, *Code of practice for fire safety in the design, management and use of buildings*, which excludes individual dwelling houses from its scope.

Information about this document

This is a full revision of BS 5588-1:1990.

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

NOTE References are made throughout this British Standard to legislation and guidance applicable in the UK. However, it is recognized that the standard might be used outside the UK, and in such circumstances, readers of the standard need to be aware of the legislative requirements and sources of further information applicable in their own countries.

Broadly speaking, fire safety legislation in the UK sets out fire safety objectives for various types of premises and their associated activities, and specifies who is responsible for ensuring that they are met. Individual items of legislation generally refer to, and give legal force to, named sets of regulations that are more detailed than the parent legislation. They either specify how certain activities are to be performed, and duties discharged, or they state functional requirements, i.e. they describe the outcome(s) required. When functional requirements are given, the regulations usually refer to other technical guidance and/or standards, including British Standards. Reference is made throughout the text to legislative material of which users of this British Standard need to be aware.

Attention is particularly drawn to regulatory requirements in respect of the following principal stages in the lifetime of a building:

a) *planning* – type, size, use, appearance, access and location of a proposed building;

b) *construction* – materials, methods, nature and extent of both structural and installed fire safety features, internal and external arrangements for access, and proximity to other buildings;

c) *use* – occupants' activities, including storage and use of materials, provision of first aid fire-fighting equipment and fire safety training for occupants, and maintaining means of escape;

d) *maintenance* – maintenance of fire safety systems and equipment in occupied and unoccupied buildings;

e) *material alterations and extensions* – changes in fire risk or fire safety provisions; fire safety arrangements during construction work;

f) *change of use* – changes in fire risk or fire safety provisions;

g) *demolition* – fire safety arrangements during demolition work;

h) *when empty* – empty buildings are particularly vulnerable to arson.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

In particular, attention is drawn to the following regulations which may be amended from time to time. The commentary in this British Standard reflects the state of the regulations in 2011.

- The Building (Amendment) Regulations 2011 [1];
- The Regulatory Reform (Fire Safety) Order 2005 [2];
- The Housing Act 2004 [3];
- The Equality Act 2010 [4];
- The Gas Safety (Installation and Use) Regulations 1998 [5];
- The Pipelines Safety Regulations 1996 [6];
- The Petroleum (Consolidation) Act 1928 [7];
- The Dangerous Substances and Explosive Atmospheres Regulations 2002 [8];
- The Construction (Design and Management) Regulations 2007 [9];
- The Furniture and Furnishings (Fire) (Safety) Regulations 1988 [10].

Section 1: General

Introduction

0.1 General principles

The design of buildings for fire safety relies upon an understanding of the sources of fire, materials and systems likely to be involved in fire, and the likely spread of fire.

The recommendations and guidance given in this British Standard are based on the assumption that under normal circumstances (i.e. except in the case of arson) a fire is unlikely to start in two different places in a building. Further information on the spread of fire is given in **4.1**.

All fire safety measures, procedures, etc., need to take into account the particular circumstances of the individual building or complex concerned. The same recommendations generally apply to both existing and new buildings, but existing buildings, especially historic buildings, often pose problems which are unlikely to arise in new buildings. In assessing the fire safety management needs of an existing building which is being modified, it is essential to have a full understanding of the existing structure and any fire safety provisions incorporated, and to take into account all of the following:

a) any change in use of the premises which could affect the fire risk profile (e.g. increased fire load and process risks, changes to sleeping risk, seasonal changes);

b) how the necessary fire safety levels can be practicably achieved in the existing premises and whether they are appropriate;

c) historic and environmental aspects of the premises and to what extent they need to be disturbed;

d) legislation and guidance introduced since the premises were originally constructed, or last altered, or since their fire safety was last assessed;

e) the interrelationship between life safety and measures to protect property/contents;

f) business continuity.

Historic buildings present particular challenges, as many are listed and permitted material alterations are therefore limited without the agreement of the appropriate authorities. For such buildings, it is advisable to seek the advice of consultative bodies, such as English Heritage, in the early stages of design. The appropriate authorities sometimes agree to limited modifications to improve life safety where, in turn, there will be added long-term protection and preservation of the original building fabric. Specific issues relating to historic buildings can be divided into four areas:

1) the preservation of the ambience and important features of the building such as timber linings to accommodation stairs and slender cast iron structure, both of which can sometimes conflict with the desired fire safety construction but can be accommodated with suitable compensating features;

2) the existing construction of the building, including hidden features such as the extent of cavities through which fire could spread and the quality of walls, partitions and floors (the fire resistance of which might be unknown or questionable). Life safety can often be addressed by the use of suitable compensating features, but these do not always cover property protection and business interests;

3) the fire performance of the building structure. Although modern construction standards seldom apply to historic buildings, action to improve the level of fire and life safety might be necessary based on change of use or due to the need to reduce the fire risk and potential for loss of the structure and/or interior in any other context;

4) the sensitivity of historic structures and interiors (finishes and contents) to fire and smoke damage.

In both new construction and upgrading existing buildings, the various aspects of fire precautions are interrelated and weaknesses in some areas can be compensated for by strengths in others. A higher standard under one of the areas might be of benefit in respect of one or more of the other areas. BS 9991 provides a level of flexibility that allows the fire protection measures and the risks to be assessed to enable reasonable practical solutions to be designed.

Fire precautions in all premises – however old – need to be seen as a whole, a package aimed at achieving an acceptable standard of fire safety. In modifying existing structures, if the new work can be shown not to have a negative impact on the remainder, it is likely that no work will be needed on the remainder, although it might be possible to offer improvement as good practice.

The principles and recommendations in this British Standard apply straightforwardly where premises have a single main use and are contained in a single, separate building. However, complications might arise where a building comprises two or more different main uses. In such cases it is important to consider the effect of one risk on another. A fire in a shop or unattended office could have serious consequences on, for example, a residential use in the same building. Similarly, a high fire risk in one part of a building could seriously affect other areas in another part of that building.

Amongst the factors that need to be taken into account in establishing a minimum package of fire protection measures are:

i) the potential users of the building;

ii) the hazard posed by one occupancy to another;

iii) provision for giving warning in case of fire, including any automatic fire detection;

iv) the provision of automatic fire suppression systems and smoke control arrangements;

v) the overall management and control of the building or development, from a fire safety point of view;

vi) structural fire protection and compartmentation.

BS 9991 provides guidance on the provision of measures to control or mitigate the effects of fire. The primary objective is to ensure that an adequate standard of life safety can be achieved in the event of fire in the building. This can also have the effect of assisting the fire and rescue service and/or of providing some property and environmental protection. There are references throughout this British Standard to occupant safety, fire-fighter safety and property protection, to draw attention to the different considerations these could raise.

0.2 Flats and maisonettes

0.2.1 General principles

The means of escape from a flat or a maisonette of limited height is relatively simple. With increasing height more complex provisions are needed because emergency egress through upper windows becomes increasingly hazardous.

The provisions for means of escape for flats or maisonettes are based on the assumptions that:

a) fire will occur within the flat or maisonette (e.g. not in a stairwell);

b) there can be no reliance on external rescue (e.g. a portable ladder);

c) the flat or maisonette will have a high degree of compartmentation and therefore there will be a low probability of fire spread beyond the flat or maisonette of origin, so simultaneous evacuation of the building is unlikely to be necessary; and

d) where fires do occur in the common parts of the building, the materials and construction used in such areas will prevent the fire from spreading beyond the immediate vicinity (although in some cases communal facilities exist which require additional measures to be taken).

Whilst a simultaneous evacuation is normally unnecessary (see **E.1** regarding stay put strategy), there will be some occasions where operational conditions are such that the fire and rescue service decide to evacuate the building. In these situations the occupants of the building will need to use the common stair, sometimes whilst fire-fighting is in progress. As such, the measures in this British Standard for the protection of common stairs are designed to ensure they remain available for use over an extended period.

0.2.2 Protection of common escape routes

When making provision for the protection of common escape routes, i.e. from the exit of an individual dwelling to the final exit, it is essential to have a full understanding of the existing structure and any fire safety provisions incorporated, and to take into account the considerations given in **0.1**a) to **0.1**f).

Further guidance and recommendations regarding compartmentation and common escape routes can be found in Clause **28** and Section **2**.

0.2.3 Smoke control in common parts

It is probable that some smoke from a fire in a flat or maisonette will enter the common parts of the building, i.e. the common corridor and/or lobby, for example as a result of occupants escaping or through the operational procedures of fire-fighters. It is therefore necessary to provide some means of controlling smoke in the common corridors/lobbies to provide protection to the common areas.

Smoke can be controlled in the common areas through fitted ventilation systems which are either natural or mechanical. These ventilation systems have two main purposes: the first of which is to provide some protection to the stair core and the second of which is to aid fire-fighters when tackling a fire. Ventilation systems can also be used to compensate for extended travel distances within the common corridor leading to the stairs and thereby help occupants to escape safely. Where smoke control is used to provide compensation for extended travel distances, it is the responsibility of the designers to demonstrate that the ventilation system can provide tenable conditions (see Annex E) for the occupants using the route with extended travel distances.

0.2.4 Protection of common stairs

Common stairs need to be able to conform to the applicable travel distance recommendations and provide alternative directions of travel from any dwelling served by those stairs other than accepted dead ends to enable occupants to exit the building safely. All common stairs need to have a level of fire protection involving fire-resisting construction and a smoke control system which enables them to provide occupants of the building with a safe means of escape.

The fire-resisting enclosure of a common stair is provided to prevent smoke and heat from entering the stairway and rendering it impassable for escape purpose and fire spreading from one storey to another. The use of space within a protected stairway is restricted (further information is detailed in this British Standard). Once inside a protected stairway, a person can be considered to be safe from the immediate danger of flame and smoke. They can then proceed to a place of ultimate safety at their own pace. While unprotected stairways are acceptable for daily human traffic around buildings, their vulnerability to fire and smoke mean that it is vital that they are not used extensively as a means of escape from fire.

Special provision needs to be given to basement stairs, as it is more probable that the stairs at this level will become filled with smoke and heat, than ground or upper stories if a fire occurs at basement level.

0.2.5 Fire alarm and fire detection system

In most flats, the installation of smoke alarms or fire detection and alarm systems can significantly increase the level of safety by automatically giving an early warning of fire. Generally a common fire alarm and/or fire detection system would not be provided for the evacuation of the occupants. This is to ensure that during the initial stages of a fire in a flat or maisonette, only those persons in the immediate area of the fire are alerted. Recommendations for fire alarm and fire detection systems are given in Section **5**.

0.2.6 Fire suppression system

The installation of an automatic fire suppression system can offer designers considerable flexibility. For example, a sprinkler system in combination with improved detection can permit flats to have inner rooms where they would otherwise not be acceptable. A sprinkler system controls the fire to a small size, reducing the production of smoke and toxic gases and preventing the fire from spreading beyond the room or dwelling of origin. This means that there can be flexibility achieved in the design of the building.

0.3 Sheltered, extra care and other special housing

Where residents are likely to be less mobile, have other impairments or are otherwise vulnerable to emergency situations, designers need to consider the characteristics of the residents of the building and incorporate an appropriate range of fire precautionary measures that will secure a full level of fire safety that is compatible with both the residents' needs and abilities and a feasible and reasonable supporting management regime.

Buildings within this category of residence are diverse and can include housing for the elderly, children and people with a physical or mental impairment. Residents are likely to display varying levels of physical ability and mental cognizance and many will therefore require assistance to respond to a fire event. Fire strategies will need to apply graduated fire precautionary measures dependent upon the occupancy profile, the size, height and population of the building and the degree of management support being provided.

The recommendations in this standard cover those buildings that are designed for independent living, i.e. designed as houses or flats and that may include the provision of various levels of on-site support and communal facilities (this category is likely to include all levels of sheltered housing, extra care and certain other specific special housing uses).

0.4 Management of fire safety

It is a fundamental assumption that features described in this British Standard will require management and maintenance throughout the life of the building.

Managing fire safety is the whole process throughout the life of a building, starting with the initial design, which is intended both to minimize the incidence of fire and to ensure that, when a fire does occur, appropriate fire safety systems (including active, passive, and procedural systems) are in place and are fully functional. Fire safety procedures and maintenance schedules are developed at the design stage and included in the building manual which is handed over to the person responsible for fire safety of the building in order to enable a suitable and sufficient fire risk assessment to be carried out.

NOTE Attention is drawn to the Regulation 38 of the Building (Amendment) Regulations 2011 [1] and the Regulatory Reform (Fire Safety) Order 2005 [2].

The management of fire safety is thus an essential element in averting the loss of life in the event of a fire. Although many buildings will never have a serious life-threatening fire, it is essential for fire safety procedures to be planned for every building. Often, the one common element in multi-fatality fires is that, when fire is discovered or when the alarm is raised, the occupants of premises, be they staff or members of the public, react and respond in ways which are different from those assumed or expected by the building designer. There are a number of stages by which people react to a fire alarm. Initially they tend to seek information regarding the validity of the warning. They then gather belongings or seek associates or family. Only then do they seek to travel to a place of ultimate safety. The management of fire safety is intended to increase awareness and increase the probability of appropriate behaviour, to minimize the threat from the fire.

There have been numerous fire incidents, both large and small, where there have been lives lost or put at risk as a result of the safety systems provided being inappropriate or not being used effectively.

It is now widely acknowledged that the design and engineering put into a building for life safety can only do its job properly if it can be managed, maintained and tested over the whole life of the building, and if any staff who might be present are trained to handle incidents and operate effective and tested emergency plans.

Once the designer or engineer has handed over the building, then good management of fire safety becomes the key element to fire safety for the life of the building.

Effective management of fire safety can contribute to the protection of the building occupants in many ways:

a) by working to prevent fires occurring in the first place;

b) by monitoring the fire risks on an ongoing basis and taking appropriate action to eliminate or reduce the risk;

c) by being aware of the types of people in the building (such as disabled people, elderly people, children, pregnant women, etc.) and any special risks or needs;

d) by ensuring that all of the fire safety measures in the building are kept in working order, and in particular that the means of escape are always available;

e) by training any staff in the appropriate action to be taken in the event of a fire.

These tasks differ in detail depending on the occupancy of the building.

1 Scope

This British Standard gives recommendations and guidance on the design, management and use of the following building types, to achieve reasonable standards of fire safety for all people in and around:

a) dwellings (single-family dwelling houses, self-contained flats or maisonettes);

b) residential accommodation blocks (e.g. for students or hospital staff), with individual bedrooms and the provision of kitchen/sanitary facilities constructed within a fire compartment, accommodating not more than six persons;

c) sheltered housing and extra care housing.

It is not applicable to hotels, caravans/mobile homes, hospitals, residential care/nursing homes, places of lawful detention, hostels or houses of multiple occupancy.

This British Standard is applicable to the design of new buildings, and to material alterations, extensions and material change of use of an existing building. It also provides guidance on the ongoing management of fire safety in a building throughout the entire life cycle of the building, including guidance for designers to ensure that the overall design of a building assists and enhances the management of fire safety. It can be used as a tool for assessing existing buildings, although fundamental change in line with the guidelines might well be limited or not practicable.

NOTE 1 See the Building (Amendment) Regulations 2011 [1] regarding the definition of material alterations, extensions and material change of use.

The recommendations and guidance given in this British Standard are intended to safeguard the lives of building occupants and fire-fighters. Whilst some of the recommendations and guidance might also assist in the achievement of other fire safety objectives – such as protection of property, the environment, communities and business/service viability – additional measures might be necessary which are outside the scope of this British Standard.

This British Standard does not cover fire safety design strategies for extreme events such as terrorist actions.

NOTE 2 Requirements for means of escape from caravans and mobile homes are given in BS 3632.

NOTE 3 Refer to section 255 of the Housing Act 2004 [3] regarding the definition of an HMO.

2 Normative references

Standards publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476 (all parts), *Fire tests on building materials and structures*

BS 799-5, *Oil burning equipment – Part 5: Carbon steel oil storage tanks – Specification*

BS 3251, *Specification – Indicator plates for fire hydrants and emergency water supplies*

BS 4514, *Unplasticized PVC soil and ventilating pipes of 82.4 mm minimum mean outside diameter, and fittings and accessories of 82.4 mm and of other sizes – Specification*

BS 5234 (both parts), *Partitions (including matching linings)*

BS 5255, *Specification for thermoplastics waste pipe and fittings*

BS 5266-1, *Emergency lighting – Part 1: Code of practice for the emergency lighting of premises*

BS 5306-0, *Fire protection installations and equipment on premises – Part 0: Guide for selection of installed systems and other fire equipment*

BS 5306-3, *Fire extinguishing installations and equipment on premises – Part 3: Commissioning and maintenance of portable fire extinguishers – Code of practice*

BS 5306-8, *Fire extinguishing installations and equipment on premises – Part 8: Selection and installation of portable fire extinguishers – Code of practice*

BS 5395-1, *Stairs – Part 1: Code of practice for the design of stairs with straight stairs and winders*

BS 5410-1, *Code of practice for oil firing – Part 1: Installations up to 45 kW output capacity for space heating and hot water supply purposes*

BS 5410-2, *Code of practice for oil firing – Part 2: Installations of 45 kW and above output capacity for space heating, hot water and steam supply services*

BS 5852, *Methods of test for assessment of the ignitability of upholstered seating by smouldering and flaming ignition sources*

BS 5839-1, *Fire detection and fire alarm systems for buildings – Part 1: Code of practice for system design, installation, commissioning and maintenance*

BS 5839-6, *Fire detection and fire alarm systems for buildings – Part 6: Code of practice for the design, installation and maintenance of fire detection and fire alarm systems in dwellings*

BS 5867-2, *Fabrics for curtains, drapes and window blinds – Part 2: Flammability requirements – Specification*

BS 5906, *Waste management in buildings – Code of practice*

BS 6180, *Barriers in and about buildings – Code of practice*

BS 6262-4, *Glazing for buildings – Part 4: Code of practice for safety related to human impact*

BS 6263-2, *Care and maintenance of floor surfaces – Part 2: Code of practice for resilient sheet and tile flooring*

BS 6400 (all parts), *Specification for installation, exchange, relocation and removal of gas meters with a maximum capacity not exceeding 6 m*

BS 6644, *Specification for installation of gas-fired hot water boilers of rated inputs between 70 kW (net) and 1.8 MW (net) (2nd and 3rd family gases)*

BS 6798, *Specification for installation of gas-fired boilers of rated input not exceeding 70 kW net*

BS 7157:1989, *Method of test for ignitability of fabrics used in the construction of large tented structures*

BS 7176, *Specification for resistance to ignition of upholstered furniture for non-domestic seating by testing composites*

BS 7273-4, *Code of practice for the operation of fire protection measures – Part 4: Actuation of release mechanisms for doors*

BS 7346-3, *Components for smoke and heat control systems – Part 3: Specification for smoke curtains*

BS 7346-7, *Components for smoke and heat control systems – Part 7: Code of practice on functional recommendations and calculation methods for smoke and heat control systems for covered car parks*

BS 7671, *Requirements for electrical installations – IEE wiring regulations – Seventeenth edition*

BS 8214, *Code of practice for fire door assemblies with non-metallic leaves*

BS 8313, *Code of practice for accommodation of building services in ducts*

BS 8414-1, *Fire performance of external cladding systems – Part 1: Test methods for non-loadbearing external cladding systems applied to the face of a building*

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

BS 8519:2010, *Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications – Code of practice*

BS 9251, *Sprinkler systems for residential and domestic occupancies – Code of practice*

BS 9990:2006, *Code of practice for non-automatic fire-fighting systems in buildings*

BS 9999:2008, *Code of practice for fire safety in the design, management and use of buildings*

BS EN 3 (all parts), *Portable fire extinguishers*

BS EN 81 (all parts), *Safety rules for the construction and installation of lifts*

BS EN 1154, *Building hardware – Controlled door closing devices – Requirements and test methods*

BS EN 1363 (all parts), *Fire resistance tests*

BS EN 1364 (all parts), *Fire resistance tests for non-loadbearing elements*

BS EN 1365 (all parts), *Fire resistance tests for loadbearing elements*

BS EN 1366 (all parts), *Fire resistance tests for service installations*

BS EN 1634-1, *Fire resistance tests for door and shutter assemblies – Part 1: Fire resistance tests for doors, shutters and openable windows*

BS EN 1634-3, *Fire resistance tests for door and shutter assemblies – Part 3: Smoke control doors and shutters*

BS EN 12101 (all parts), *Smoke and heat control systems*

BS EN 12101-1, *Smoke and heat control systems – Part 1: Specification for smoke barriers*

BS EN 12101-3, *Smoke and heat control systems – Part 3: Specification for powered smoke and heat exhaust ventilators*

BS EN 12101-6, *Smoke and heat control systems – Part 6: Specification for pressure differential systems – Kits*

BS EN 12845, *Fixed firefighting systems – Automatic sprinkler systems – Design, installation and maintenance*

BS EN 13501 (all parts), *Fire classification of construction products and building elements*

BS EN 13501-1, *Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests*

BS EN 13501-2, *Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services*

BS EN 13501-3, *Fire classification of construction products and building elements – Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers*

BS ISO 3864-1, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

DD 8458-1, *Fixed fire protection systems – Part 1: Residential and domestic watermist systems – Code of practice for design and installation*

DD 8489-1, *Fixed fire protection systems – Industrial and commercial watermist systems – Part 1: Code of practice for design and installation*

Other publications

[N1] COLWELL, S. and MARTIN, B. *Fire performance of external thermal insulation for walls of multi-storey buildings*. BR 135. Second edition. Watford: Building Research Establishment, 2003. ISBN 978 1 860 81622 3.

[N2] UKLPG. *Code of practice 1: Part 2 – Bulk LPG storage at fixed installations for domestic purposes*. Incorporating amendment 2. UKLPG, 2000.

[N3] HEALTH AND SAFETY EXECUTIVE. *The keeping of LPG in cylinders and other containers*. Guidance note CS4. HSE, 1986.

3 Terms and definitions

For the purposes of this British Standard the following definitions apply.

3.1 access level
level used for normal access to the building that either incorporates, or leads directly to, a place of ultimate safety

3.2 access room
room through which the only escape route from an inner room passes

3.3 alternative escape route (from a house)
route from any point within a room of a house that gives easy access to a second stair, a balcony or a flat roof by means of which a person can reach a place of ultimate safety

3.4 alternative exit (from a flat or maisonette)
one of two or more exits from within a flat or maisonette, each of which is separate from the other giving access to a route leading to a place of ultimate safety

3.5 ancillary accommodation
all parts of the building that are ancillary to the dwellings, such as rooms associated with engineering services, common amenity areas, refuse rooms and covered car parks

*NOTE See **3.10** for common amenity area.*

3.6 atrium (plural: atria)
space within a building, not necessarily vertically aligned, passing through one or more structural floor

NOTE Enclosed lift wells, enclosed escalator structural openings, building services ducts and stairways are not classified as atria.

3.7 balcony approach
design in which each dwelling is approached externally via an open balcony

3.8 basement
storey of a building that is below the ground storey

3.9 Class 0 (material or surface)
material or surface that is either:

a) of limited combustibility throughout; or

b) classified as Class 1 when tested in accordance with BS 476-7, which has a fire propagation index of not more than 12, and a subindex i_1 of not more than 6, when tested in accordance with BS 476-6.

NOTE Class 0 is not identified in any British Standard test. European Classification B-s3, d2 is the general equivalent of Class 0. The European classifications are described in BS EN 13501-1. They are based on a combination of four European test methods, namely: BS EN ISO 1182; BS EN ISO 1716; BS EN 13823; and BS EN ISO 11925-2:2002. The national classifications do not automatically equate with the equivalent classification in Europe, therefore, products cannot typically assume a European class, unless they have been tested accordingly.

3.10 common amenity area
area containing household facilities that are remote from individual dwellings

NOTE Examples of common amenity areas include kitchens, laundries, drying areas and occupiers' stores.

3.11 common stair
stairway serving more than one flat or occupancy

3.12 competent person
person, suitably trained and qualified by knowledge and practical experience, and provided with the necessary instructions, to enable the required task(s) to be carried out correctly

3.13 corridor access
design in which each dwelling is approached via a common horizontal internal access or circulation space which may include a common entrance hall

NOTE This is also referred to as a corridor approach.

3.14 dead end
area from which escape is possible in one direction only

3.15 deck approach
design in which each dwelling is approached externally via a wide approach balcony that is not enclosed

NOTE This is also known as a deck access.

3.16 dual-entry fire-fighting lift
fire-fighting lift provided with two sets of doors, one used for normal operations and the other in the fire-fighting mode

3.17 dwelling
unit of residential accommodation, occupied (whether or not as a sole or main residence):

a) by a single person or by people living together as a family; or

b) by not more than six residents living together as a single household, including a household where care is provided for residents

3.18 dwelling of origin
dwelling in which a fire has originated

3.19 emergency escape lighting
lighting provided, for use when the normal lighting fails, to ensure illumination of the escape route(s) at all times

3.20 escape route
route forming part of the means of escape from any point in a building to a final exit

3.21 extra care housing
accommodation in a housing scheme for which specialized accommodation and support services are available to residents 24 hours a day

NOTE Residents receive a more intensive level of support in extra care housing than is usually provided in sheltered housing.

3.22 final exit
termination of an escape route from a building giving direct access to a street, passageway, walkway or open space sited so that people can rapidly disperse from a building

NOTE Rapid dispersal from a building allows people to get out of danger from fire and/or smoke from a fire within the building.

3.23 fire door
door or shutter device, including any frame and all dedicated fittings, provided for the passage of persons, air or objects, which is intended, when closed, to resist the passage of fire and/or gaseous products of combustion and is capable of meeting specified performance criteria to those ends

3.24 fire-fighting lift
lift designed with additional protection and controls that enable it to be used under the direct control of the fire and rescue service when fighting a fire

*NOTE See **19.3.2.2**.*

3.25 fire-fighting lobby
protected lobby providing access from a fire-fighting stair to dwellings and the fire-fighting lift

3.26 fire-fighting shaft
protected enclosure containing a fire-fighting stair, fire-fighting lobbies, a fire main and, if provided, a fire-fighting lift together with any machinery space

3.27 fire-fighting stair
protected stairway providing access to dwellings directly through a fire-fighting lobby

3.28 fire resistance
ability of an item to fulfil for a stated period of time the required fire stability and/or integrity and/or thermal insulation, and/or other expected duty specified in a standard fire resistance test, e.g. the relevant part of BS 476

3.29 flat
dwelling, forming part of a larger building, that has all of its rooms on one level or, in the case of split level flats, not more than half a storey height apart

3.30 free area
total unobstructed cross sectional area of an opening, vent, etc., measured in the plane where the area is at a minimum and at right angles to the direction of air flow

NOTE The free areas of openings, vents etc. refer to the geometric free area.

3.31 gallery
floor or balcony which does not extend across the full extent of a building's footprint and is open to the floor below

3.32 ground storey
storey, the floor of which is situated at such a level or levels that any given point on its perimeter is at, or about, or not more than 1.2 m below, the level of the finished surface of the ground adjoining the building in the vicinity of that point

3.33 habitable room
any room in a dwelling with the exception of any kitchen, utility room, bathroom or WC

3.34 higher fire risk area
area with a fire risk higher than that of a dwelling

3.35 house
self-contained building used as a single-family dwelling having one or more storeys or levels, that is not horizontally separated from any other dwelling forming part of the building, and that has its own main entrance door situated at ground level or at any level that serves as access level

3.36 independent alternative escape route
one of two or more escape routes from a dwelling, with its own separate exit from the dwelling and which follows a route that is separate from the other(s)

3.37 inner room
room from which escape is possible only by passing through the access room

*NOTE For access room, see **3.2**.*

3.38 maisonette
dwelling, forming part of a larger building, having rooms divided between two or more levels which are more than half a storey height apart

3.39 (material of) limited combustibility
either:

a) a non-combustible material; or

b) any material of density 300 kg/m^3 or more which, when tested in accordance with BS 476-11, does not flame and the rise in temperature on the furnace thermocouple is not more than 20 °C; or

c) any material with a non-combustible core of 8 mm thick or more, having combustible facings (on one or both sides) not more than 0.5 mm thick

3.40 means of escape
structural means whereby a safe route (or routes) is (or are) provided for persons to travel from any point in a building to a place of ultimate safety

3.41 mixed-use building
building containing dwellings together with other types of occupancy and where the dwellings are not ancillary to the other use

3.42 open-plan
internal living arrangements that are almost entirely undivided by partitions

3.43 place of ultimate safety
place in which persons are in no danger from fire

3.44 pressurization
method of protecting escape routes against the ingress of smoke by maintaining the air within them at pressures higher than those in adjoining parts of the building

3.45 protected circuit
electrical circuit protected against fire

3.46 protected corridor
circulation area consisting of a corridor enclosed with fire-resisting construction

NOTE The protected corridor does not include any external walls of a building.

3.47 protected entrance hall/protected landing
circulation area consisting of a hall or space within the dwelling that is enclosed with fire-resisting construction

NOTE The protected entrance hall/protected landing does not include any external walls of a building.

3.48 protected lobby
circulation area consisting of a lobby enclosed with fire-resisting construction

NOTE The protected lobby does not include any external walls of a building.

3.49 protected stairway
stair discharging through a final exit to a place of ultimate safety (including any exit passageway between the foot of the stair and the final exit) that is adequately protected from fire elsewhere in the building by fire-resisting construction

3.50 self-closing fire door
fire door fitted with a device which fully closes the door, overriding the resistance of any latch

3.51 sheltered housing
block(s) of flats and/or maisonettes, with each dwelling incorporating its own cooking and sanitary facilities, designed specifically to accommodate persons who might require assistance but who are otherwise independent

NOTE Examples of persons who might require assistance are elderly people. Sheltered housing might offer residents some form of assistance.

3.52 single stair
common stair which is the only one to which dwellings in a block of flats or maisonettes have access

3.53 storey
part of a building comprising all the rooms that are on the same level including any gallery having an area of more than half that of the space into which it projects and any roof, unless it is accessible only for maintenance or repair

3.54 storey exit
final exit, or a doorway, giving direct access to a protected stairway or external escape route

3.55 travel distance
actual distance to be travelled by a person along an escape route

NOTE Recommendations for maximum travel distances may apply to travel within dwellings and ancillary accommodation, and from dwellings and ancillary accommodation to storey exits.

4 General recommendations and background

4.1 Spread of fire and smoke

A common basis for designing fire safety measures lies in the identification of the possible causes and/or sources of fire and the evaluation of the manner in which it is likely to develop and spread through a building.

The recommendations and guidance given in this British Standard are based on the assumption that under normal circumstances (i.e. except in the case of arson) a fire is unlikely to start in two different places in a building at the same time.

Initially, a fire creates a hazard only in the part of the building in which it starts and is unlikely to involve a large area, although it can subsequently spread to other parts of the building. Fire is less likely to spread if passages, corridors, lobbies or stairways intended for use only for access or means of escape are kept clear of combustible materials.

It is unlikely that fire will originate in the building structure itself. Outbreak of fire is more likely to occur in furnishings, decorations, finished goods, raw materials and/or chemicals, equipment, electrical services, process plant or service plant in the building. The point of origin is therefore likely to be in bedrooms, kitchens, living rooms, offices, common rooms, storerooms or possibly in the service installations.

NOTE A fire can also originate outside the building in refuse, vehicles, goods etc. and spread to the building (e.g. via combustible materials); this might be accidental or it might be a result of arson. The potential impact on the building, the occupants and society at large needs to be assessed, and measures might be necessary to mitigate for the potential loss of social amenity to the community. This standard does not cover fires that originate outside a building, although it does give guidance on external fire spread between buildings.

When a fire occurs in an enclosed space, hot smoke-laden gases rise to form a layer, which at first has a tendency to flow under the ceiling and then deepens to fill the whole space. The fire tends to grow in area, the flames spreading to nearby combustible furnishings, fittings, exposed papers, etc. The flames increase in height until they reach the ceiling where they are deflected horizontally and, radiating downwards, accelerate fire growth. If the ceiling is combustible, it can ignite and add to the volume of flame and speed of fire growth. If the space has insufficient openings to provide a continuing air supply, the burning rate of the fire diminishes as it draws on increasingly vitiated air, but the gases generated are then extremely toxic.

Once ignited, combustible products give off hot smoke-laden and toxic gases. Convection and radiation also occur rapidly and, because of the extremely high temperature of the gases, other combustible materials and products within the area of the fire will ignite more easily, further accelerating the progress of the fire. It cannot always be assumed that the effects of the fire will be confined to the space in which it originated. If the enclosing walls have no fire resistance or do not form a fire compartment with a fire-resisting floor (or ceiling) above, the fire will soon penetrate at ceiling level, where the attack from the flames or hot gases is most severe, to the adjoining space. Even with fire-resisting construction, the buoyancy and expansion of the fire gases can cause them to be driven out of the space to affect other parts of the building.

If the fire gases penetrate into a vertical shaft, such as a stairwell, lift well or duct, they will rise rapidly, attacking the top of the shaft and spreading elsewhere if there are any openings in the shaft. In such circumstances, if a substantial flow of air reaches the fire through an aperture such as a window or door, the vertical shaft can act as a chimney and can greatly accelerate fire growth.

A fire occurring anywhere within a compartment of a building has, therefore, to be regarded as presenting a hazard to all occupants within that compartment, even though in the initial stages of fire development it might seem that the hazard is small and people are in no immediate danger. The extent of the risk to persons in other parts of the building is generally dependant on the level of fire compartmentation and more specifically on the measures provided to safeguard the common escape routes.

In the early stages of a fire, the most significant effects are usually those of smoke and other products of combustion. Smoke is often the first evidence of fire and is thus likely to be the first cause of alarm. When smoke extends down to head height it produces difficulty in breathing and impairs visibility, which interferes with the efforts of occupants to find their way towards the exits. People who are prevented or delayed from escaping by dense smoke can suffer from the toxic effects of the products of combustion that accompany the smoke. The asphyxiating effect caused by lack of oxygen, toxic properties or by the intense heat of the gases making up the smoke can cause intoxication, disorientation, incapacity, unconsciousness and, in the worst scenario, death.

The speed at which a space becomes untenable is mainly dependent on its volume and the fire growth rate. For higher and larger spaces the time taken to fill with smoke is longer and so there is more time for escape and longer travel distances are possible.

To facilitate escape it is thus necessary, in the development of a means of escape strategy:

a) to ensure that protected escape routes are provided and that they are adequately safeguarded against the ingress of smoke;

b) to limit the time people have to travel before they reach a protected route and/or a final exit;

c) to consider reverse flows that might occur as a result of a particular escape route being unavailable or as a feature of an evacuation plan for disabled people.

After the outbreak of fire, the time during which the actions necessary for ensuring the safety of occupants can be carried out will vary depending on their location with respect to the fire and the design of the building. Where a fire in an occupied flat or maisonette is discovered by the occupants, who make their way out, leave the door closed and call the fire and rescue service, then the fire is expected to present little or no risk to the occupants of other dwellings, as it is unlikely to break out of the dwelling of origin for some considerable time (see also **0.2.1**).

If extinction of the fire is delayed, there might be a direct risk to persons using any common access, through smoke and heat affecting the route. If the dwelling entrance door fails to close properly after the occupants' departure, the common corridor will be quickly filled with the products of combustion, and other occupants trying to use the corridor could be in serious difficulty.

If a fire starts (or is started) in an unoccupied dwelling, with no one to give the alarm, the fire may develop fully within the dwelling before occupants of nearby or adjacent dwellings are aware of it. After a time the dwelling entrance door might be penetrated with the consequence that the common corridor would be prejudiced by heat and smoke. If the dwelling entrance door opens on to an open balcony rather than an internal corridor, smoke might be of little consequence but, at a later stage, there could be difficulty in passing the door.

A fire can start (or be started) in an access corridor, lobby or stairway, or in ancillary accommodation, in a building containing flats or maisonettes. This is capable of rendering all circulation spaces, including stairways, impassable in a short period of time unless provision has been made in the design of the building

to prevent it. Complete safety cannot be assured, moreover, while there is any risk of a fire starting in an escape route or circulation space. It is essential, therefore, that the building is furnished and used in such a way as to reduce the risk of a fire occurring in circulation spaces.

In mixed-use buildings it is important to consider the effect of one risk upon another. A fire in an unattended office or shop premises could have serious consequences on any dwelling in the same building.

4.2 Variation of guidance

The guidance on means of escape in Section **2** permits variations to be made to travel distances on the basis that the level of risk can be reduced by the provision of additional fire protection measures. Such measures include:

- the provision of an active fire-fighting system (e.g. sprinklers);
- the provision of an enhanced smoke management system;
- the provision of an additional level of automatic fire detection.

Equally, the guidance on fire-fighting in Section **4** and on designing the building structure in Section **6** permits certain variations when such measures as an automatic sprinkler system are provided.

Designers, occupiers and approving authorities are thus able to allow a degree of flexibility in the provision of fire safety measures as part of the overall design package. However, there are limits on the extent of variation permitted within the scope of this British Standard.

4.3 Property and business continuity protection

The guidance and recommendations in this British Standard are primarily concerned with the protection of life. The provision of fire safety systems for life safety does not necessarily give adequate protection to property or to business continuity.

Property and business continuity protection is equally important within the housing sector as in any other business activity. Businesses that provide housing should assess their business continuity arrangements and provide appropriate measures to mitigate the effects of fire. This could also include the potential societal loss of people's homes and the need for re-housing and care following a fire. This should be an integral part of the design stage of a building and should also include an assessment of the ongoing maintenance requirements of the building as well as an assessment of the fire protection needs during construction.

It is therefore recommended that the potential for property and business loss is assessed so that such risks are understood and addressed. Carrying out such an assessment should be in accordance with guidance given in Annex A. Advice and guidance on the provision of fire precautions for the protection of property and the continuity of the business can also be found in Annex A and BS 9999:2008, **44.8**.

4.4 Environment

Many fires or emissions from combustion processes damage the environment. The contents of, and activities within, any building catching fire are likely to cause pollution to a greater extent than products used in the fabric of the building itself.

This British Standard is concerned largely with accidental fires, and the main area for consideration of the environmental impact of such fires is the loss of control of pollutants as a consequence.

Appropriate steps at the design stage of any building can minimize the impact of accidental fire on the environment and, whist the emphasis is likely to be on the

potential contents of the building, it would be responsible to consider the effects of using combustible materials in the building specification.

NOTE Fires that have been deliberately set might require additional measures to be taken which are outside the scope of this British Standard.

4.5 Atria

The primary objective is to ensure that the incorporation of an atrium into a new or existing building does not present an increased risk to life as a result of fire and smoke spread.

This British Standard is concerned only with those additional measures that might be required to compensate for any increased risk resulting from the inclusion of an atrium within a building. It is not intended to provide a fire-engineered solution for any particular design.

In atria, several storeys are contained in one volume. Atria are created by, for example:

a) split-level floors;

b) floors arranged as a spiral throughout the height of the building;

c) balconies or gallery floors overlooking a central well or courtyard.

Atria can result in smoke and heat travelling readily throughout all levels of the building.

Atria should be designed in accordance with Annex B, using the occupancy category decision process given in Figure B.1 to determine whether the atrium building falls within the scope of this British Standard and, if it does, to determine a design solution.

NOTE The wide range of designs possible in atrium buildings makes it impossible for this British Standard to cover every conceivable scheme and its associated fire risk, therefore it deals only with atria up to a height of 18 m. Other buildings with a void through structural floors are covered in BS 9999:2008, Annex B. Design solutions and exemplars for atria that do not fall within the scope of this standard are given in BS 9999:2008, Annex C.

4.6 Inclusive design

Accessible means of escape, and the associated fire safety strategy, should be considered as an integral part of the design process, and not as a separate issue. Where a building is designed and managed inclusively to provide access for all users, the facilities provided should, where appropriate, be used to improve egress arrangements.

Special management procedures might be required where it is reasonably foreseeable that the proportion of disabled persons in a building will be relatively high. See Section **9** for guidance on building management.

NOTE Attention is drawn to the Equality Act 2010 [4] which places a duty of all employers and service providers not to discriminate against disabled people. It is vital to ensure that when making plans for the fire safety and management of buildings, the requirements of disabled people are properly taken into account at all times. It is important to note that the recommendations made in this British Standard are for escape not access. For example, certain dimensions might not provide suitable access for all people with impairments. Further guidance for access requirements can be found in BS 8300 which deals with the design of buildings and their approaches to meet the needs of disabled people. This explains how the built environment can be designed to anticipate, and overcome, restrictions that prevent disabled people making full use of premises and their surroundings.

Section 2: Designing means of escape

*NOTE 1 Section **2** gives design guidance for means of escape in houses, flats and maisonettes. Some guidance is common to all three and is given first. The guidance that follows is specific, first for houses and then for flats and maisonettes.*

NOTE 2 Means of escape for atria are covered in Annex B.

NOTE 3 Methods of measurements such as floor heights, heights of buildings and fire and rescue service access can be found in the Building Regulations 2000 – Approved Document B [11].

NOTE 4 Guidance on fire and safety signage can be found in the Building Regulations 2000 – Approved Document B [11].

5 General

5.1 Escape by way of doors and windows

Doors and windows that are to be used for means of escape or rescue should conform to the following recommendations.

a) Escape windows should have an unobstructed openable area that is a minimum of 0.33 m^2, having the minimum dimensions of 450 mm in height and 450 mm in width.

NOTE The route through the window may be at an angle rather than on a horizontal plane.

b) The bottom of any openable area should be not more than 1 100 mm above the floor of the room in which it is situated.

c) Doors and windows that are provided for escape or rescue purposes from a room above ground level should conform to the follow recommendations.

1) If a window is a dormer window or a roof light, the distance from the eaves of the roof to the sill or vertical plane of the window or sill of the roof light should not exceed 1.5 m when measured along the roof.

2) Any doors (including a French window or a patio window) should be guarded with a protective barrier in accordance with BS 6180.

3) The ground beneath the window or balcony should be clear of any obstructions (such as iron railings or horizontally hung windows) and should be of a size and material that is suitable and safe for supporting a ladder.

4) For security purposes many windows are kept locked with a key. Occupants should be advised to keep the key close to the escape window where it can be easily located.

A door or window should not face onto an internal shaft or enclosure unless escape to a place of ultimate safety is possible without re-entering the building.

5.2 Escape from basements

Any basement in which a bedroom is situated should be provided with:

a) an alternative escape route; or

b) a protected route via the ground floor leading to a final exit; or

c) a door or window provided for means of escape conforming to **5.1**.

A basement flat that is not provided with its own external entrance at the level of the basement should be provided with an alternative exit (see **7.2**).

6 Means of escape and provision for rescue from houses

6.1 Single and two-storey houses

In single and two-storey houses the means of escape may be through the main entrance via the hall or alternatively through the window. Consequently, unless a protected escape route is provided, each bedroom should have a window in accordance with **5.1**.

6.2 Escape from inner rooms in houses

For houses, a habitable room should not be an inner room unless it is on the ground level or one floor above ground level and is provided with a door or window conforming to **5.1** for escape or rescue purposes.

6.3 Houses with one floor more than 4.5 m above ground level

Houses with one floor more than 4.5 m above ground level should conform to one of the following:

a) the top storey or level of the house should be separated from the lower storeys by fire-resisting construction and should be provided with an alternative escape route leading to its own final exit; or

b) the internal stairway should be constructed as a protected stairway, connecting the ground and all upper storeys; and either deliver directly to a final exit [see Figure 1a)] or allow access to at least two independent escape routes leading to alternative final exits [see Figure 1b)]; or

c) where an open-plan arrangement exists at ground level, in order to separate the ground floor from the upper storeys, either:

   1) a protected stairway should be provided; or

   2) the house should be fitted throughout with a sprinkler system designed and installed in accordance with BS 9251 in conjunction with a fire resisting partition and door, in order to separate the ground floor from the upper storeys. The fire-resisting door should be arranged such that occupants on the upper floors can access an escape window at first floor level, in accordance with **5.1**, in the event of a fire in the open-plan area.

6.4 Houses with more than one floor higher than 4.5 m above ground level

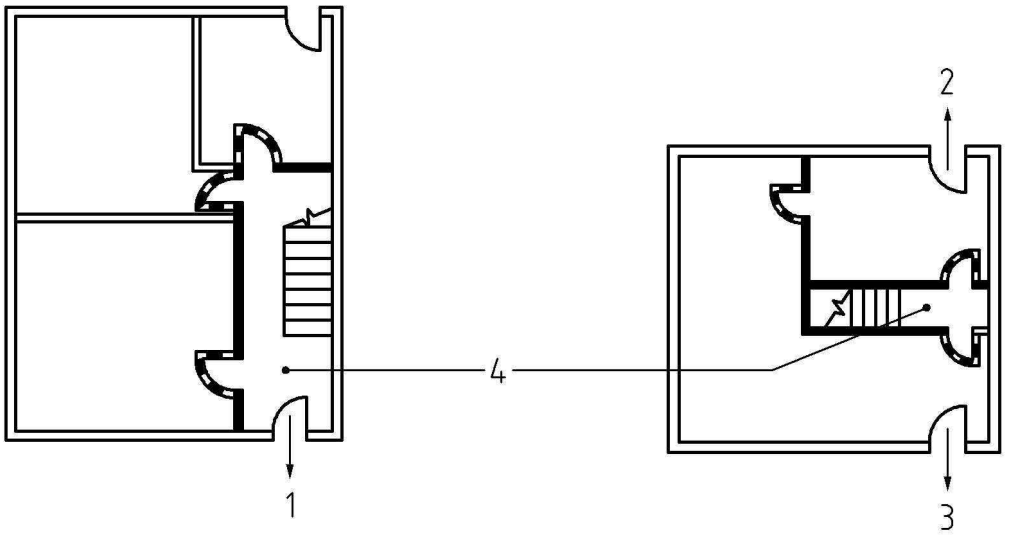
Houses with more than one floor over 4.5 m above ground level should conform to **6.3** and the following.

Each storey or level situated 7.5 m or more above ground level should have either:

a) an alternative escape route; or

b) a protected stairway and a sprinkler system, designed and installed in accordance with BS 9251, fitted throughout the house.

Figure 1 **Alternative arrangements for escape via the ground storey in houses exceeding 4.5 m in height**



a) Protected stairway delivering directly to the final exit

b) Protected stairway allowing access to two independent escape routes

Key

1 Final exit
2 Final exit (1)
3 Final exit (2)
4 Protected stairway

30 min fire-resisting construction
FD 30 Fire door

6.5 Loft conversions

Where a new storey is added by converting an existing roof space, provisions for escape should be protected throughout the full extent of the escape route.

A loft conversion to a two-storey house should have fire-resisting construction in the form of fire-resisting doors and fire-resisting partitions to protect the stairway.

This protected stairway should;

a) be protected at all levels; and

b) extend to the final exit; or

c) allow access to at least two escape routes at ground level that are separated from each other by fire-resisting construction and fire doors.

Where an open-plan arrangement exists at ground level, one of the following should be provided:

1) a fire-resisting partition to enclose the escape route conforming to **6.5**b) or **6.5**c); or

2) sprinkler protection to the open-plan area, in conjunction with a fire-resisting partition and door, in order to separate the ground floor from the upper storeys. This door should be arranged such that the occupants of the new loft room are able to access an escape window conforming to **5.1** at first floor level in the event of a fire in the open-plan area.

Houses having a floor level of a loft conversion higher than 4.5 m above ground level should conform to **6.3** or **6.4**, as applicable.

7 Means of escape from flats and maisonettes

*COMMENTARY ON CLAUSE **7***

The aim is to ensure that a fire which starts in any one dwelling will not obstruct the escape route of the occupants of any other dwelling. The planning of this part of the escape route depends on the number of common stairs serving the storey, the arrangement of the dwellings within the building and, in particular, the normal method of approach to dwellings having a common access (i.e. by an internal corridor or lobby or an external balcony or deck).

The provisions for means of escape for flats and maisonettes are based on the assumptions that:

a) the fire is likely to occur in a flat or maisonette;

b) there is no reliance on external rescue (e.g. by portable ladder);

c) the building is provided with a high degree of compartmentation and therefore a low probability of fire spread beyond the dwelling of origin, so that simultaneous evacuation of the building is unlikely to be necessary;

d) although fires might occur in the common parts of the building, the materials and construction in those parts will prevent the fabric from being involved beyond the immediate vicinity; and

e) escape routes enable a person confronted by an outbreak of fire to make a safe escape without outside assistance.

*To facilitate escape it might be necessary that common escape routes are safeguarded by some form of smoke control (see Clause **26**).*

The reliance of fire safety on manipulative apparatus, e.g. lowering lines or throw-out ladders, for means of escape, or on external rescue from the lower storeys of a building by the fire and rescue service using mobile ladders, is not advisable.

General advice and recommendations on private and communal balconies can be found in Annex C.

For guidance on live-work units refer to the Building Regulations 2000 – Approved Document B [11].

7.1 General

Flats or maisonettes that are entered directly from outside the building at ground or access level should be considered as houses and conform to Clause **6** for the purposes of means of escape, instead of Clause **7**.

Means of escape from small buildings should conform to **7.5**.

All buildings with a floor higher than 30 m above ground level should be fitted with a sprinkler system (see Clause **23**).

Enclosed private balconies serving a single dwelling should be treated as inner rooms and in accordance with Annex C.

Under normal conditions, lifts should not be used for escape from fire. Due consideration in the building design should be given to the use of evacuation lifts for disabled persons. Where lifts are to be used for evacuation purposes, they should conform to **8.4**.

NOTE The misuse or malfunctioning of lifts can cause deaths, attributed amongst other things to failure of the power supply or from lifts being called to or held at the fire floor.

7.2 Alternative exits from flats and maisonettes

Alternative exits for flats and maisonettes should be provided in accordance with Clause **9**.

Alternative exits from flats and maisonettes should:

a) be sited away from the main entrance door to the dwelling such that it can still be used as an escape route;

b) be in accordance with the approaches illustrated in Figure 2, Figure 3, Figure 4, Figure 12 or Figure 15;

c) lead to a final exit or common stair:

1) via a door leading onto an access corridor, common balcony or deck at the same or another level; or

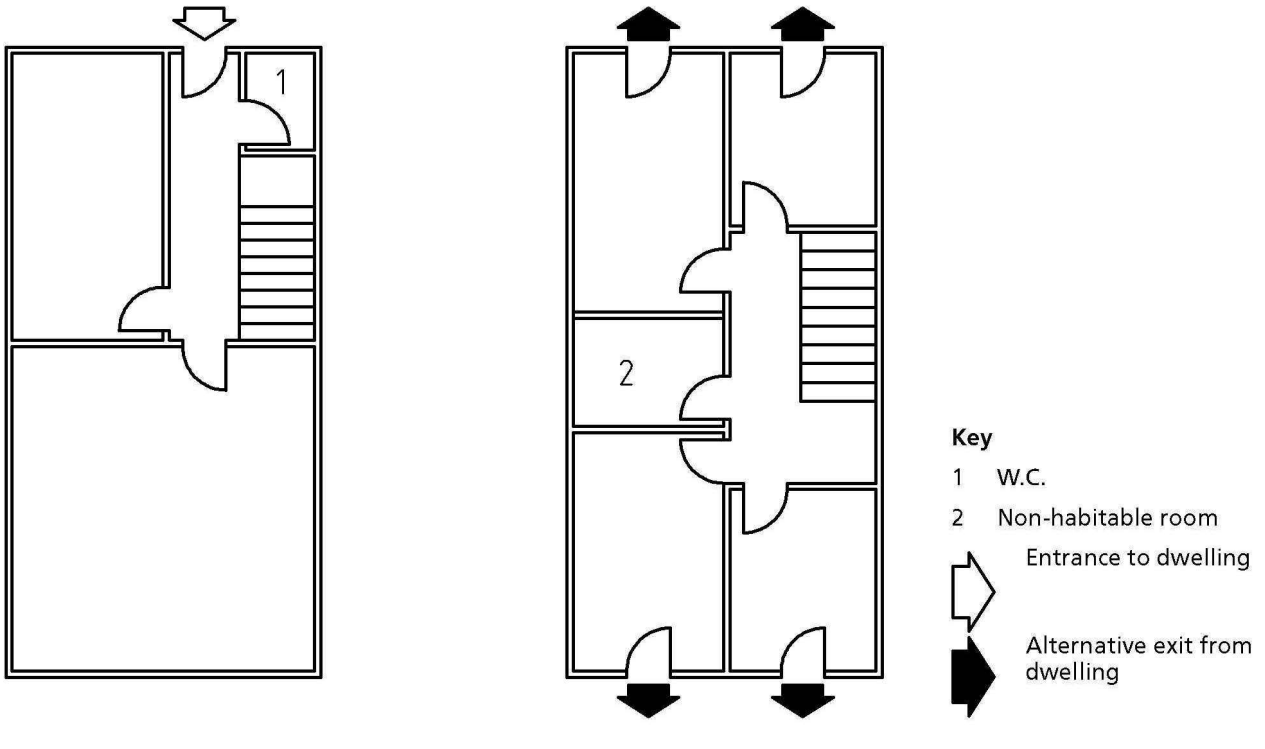
2) via a protected stairway leading to an access corridor, common balcony or deck at another level; or

3) via a door leading onto an external stair or a protected stairway; or

4) via a door leading onto an escape route across a flat roof leading to the head of a common or external stair.

The internal arrangement of any dwelling having an alternative exit should be such that access is possible from all habitable rooms either to the main entrance or to the alternative exit. Fire-resisting separation should be provided, to safeguard the occupants who need to use the alternative exit. It is not normally advisable to link balconies and pass doors between dwellings to provide escape via a flat roof into an adjoining building.

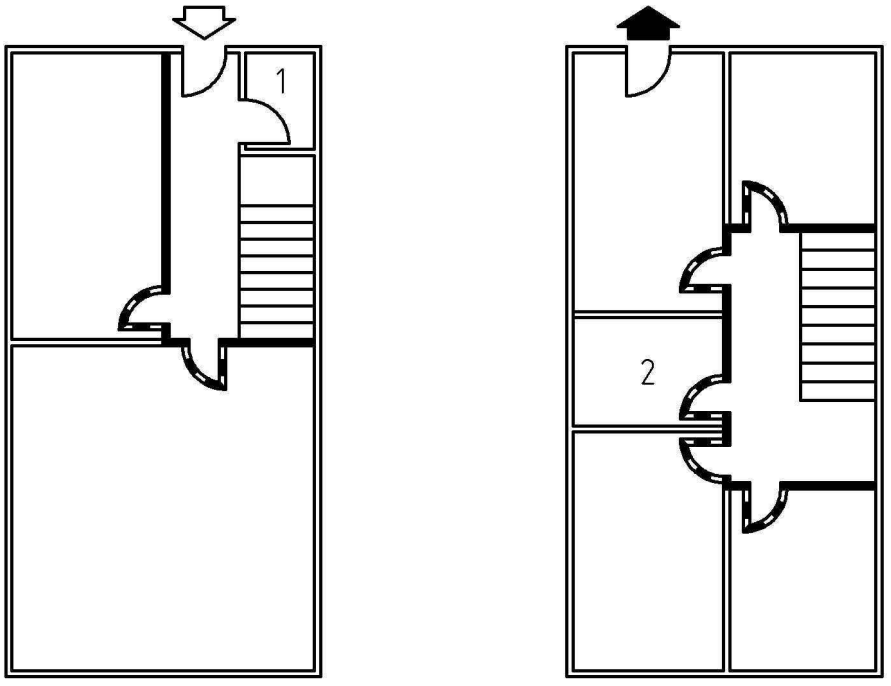
Figure 2 **Maisonette with alternative exits from each room not on the floor of entrance**



*NOTE 1 The entrance and alternative exit doors might need to be fire doors (see **35.1**).*

*NOTE 2 Compartment walls need to be fire-resisting (see **27.2**).*

Figure 3 **Maisonette with protected entrance hall and protected landing**



Key

1 W.C.

2 Bathroom

Entrance to dwelling

Alternative exit from dwelling

30 min fire-resisting construction

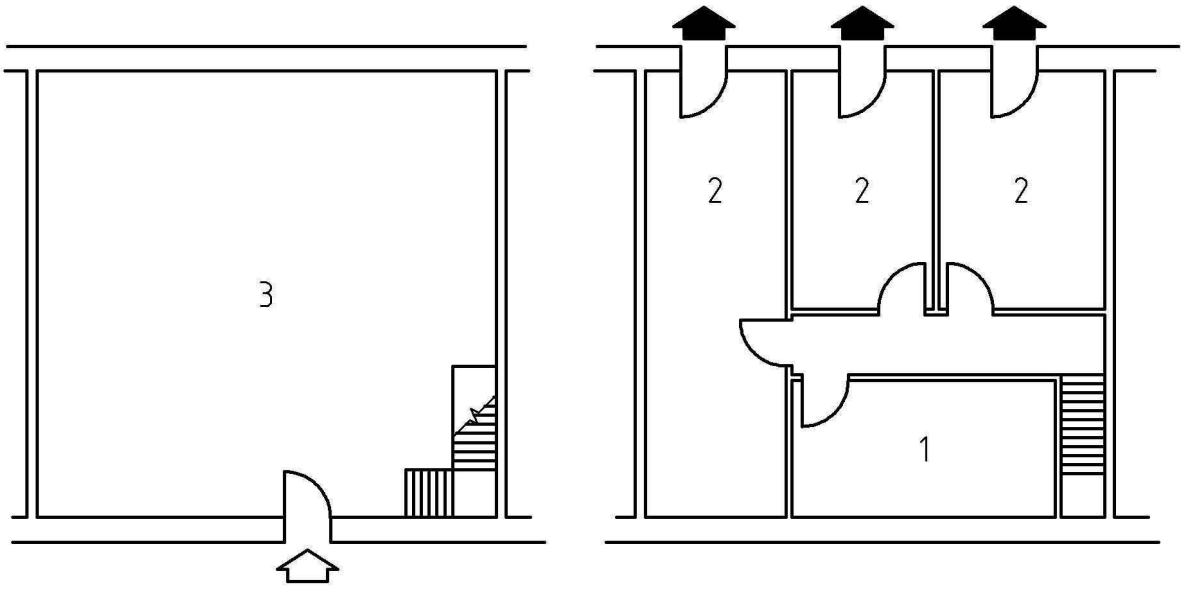
FD 30 fire door

*NOTE 1 The entrance door might need to be a fire door (see **35.1**).*

NOTE 2 If the partitions between the bathroom and the adjacent rooms have a 30 min fire resistance then the partition between the bathroom and the hall need not be fire-resisting and the bathroom door need not be a fire door.

*NOTE 3 Compartment walls need to be fire-resisting (see **27.2**).*

Figure 4 **Open-plan maisonette**



Key

1 Bathroom

2 Bedroom

3 Living area

Entrance to dwelling

Alternative exit from dwelling

*NOTE 1 The entrance and alternative exit doors might need to be fire doors (see **35.1**).*

*NOTE 2 Compartment walls need to be fire-resisting (see **27.2**).*

7.3 Escape routes from flats and maisonettes with balcony approach or deck approach

In general there is little risk of a balcony or deck becoming smoke-logged and there is thus no need to impose a limitation on the travel distance from the dwelling entrance to the stairway, although consideration should be given to the needs of the fire and rescue service, such as the distance between the nearest connection to a fire main and the flat and maisonette (see **19.1.3** and **20.1**).

NOTE 1 Where an approach is via a balcony or deck having a width of more than 2 m or via a balcony that is adjoined to the building wall only where there is an entrance to a flat or maisonette, there is a risk that the balconies might become smoke-logged both laterally along the balcony and upon levels above.

Where there is only a single direction of escape, provision should be made for the safety of persons who might have to escape past the flat or maisonette on fire (see Figure 5).

NOTE 2 In order to avoid impediment to means of escape, it is inadvisable to allow storage of any kind on the balcony or deck approach.

Escape routes should conform to Figure 5.

Balconies and decks should conform to the following recommendations.

a) The construction should provide a minimum fire resistance of 30 min.

b) The walking surface should be imperforate.

c) The sectional profile should be such that any fire plume breaking out of a flat or maisonette is directed outwards and upwards, and should be arranged such that smoke does not leak laterally along the soffit.

d) The soffit above a balcony or deck having a width of more than 2 m should be designed with down-stands placed at 90° to the face of the building (on the line of separation between individual flats or maisonettes). Down-stands should project 0.3 m to 0.6 m below any other beam or down-stand parallel to the face of the building, or should be defined by calculation.

NOTE 3 Suitable calculations are given in the BS 7346 series and BRE Report 368 [12].

e) Where the balcony or deck is adjoined to the building wall only at the place where there is an entrance to a flat or maisonette, unless it is a minimum of 1.8 m away from the face of the building, it should, in the case of single direction escape routes, be proven by calculation that the escape route is not subjected to hazardous exposure levels or smoke logging.

NOTE 4 Suitable calculations are given in the BS 7346 series and BRE Report 368 [12].

f) Balconies providing a single direction of escape should be further safeguarded by the following provisions.

1) The face of the building (excluding window openings) should provide at least 30 min fire resistance.

2) Doors opening onto the balcony should be FD30 self closing doors.

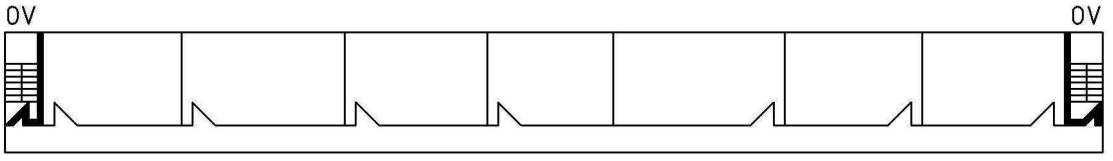
3) Window openings should not extend below a height of 1.1 m above the deck level.

4) The external balustrade should be imperforate.

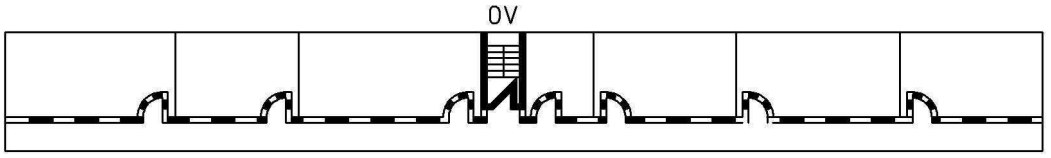
5) Surface materials of the facing wall, balcony soffit and balustrade should be of a Class 0 rating.

g) The length of balconies should be such that no point in any flat or maisonette is more than 45 m from a rising main landing valve or the approach position of a fire appliance (measured along the fire-fighting route of access).

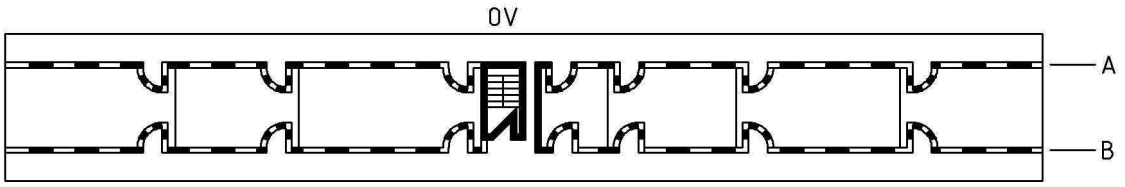
Figure 5 **Common escape routes in balcony/deck approach buildings**



a) Multi-stair building



b) Single-stair building



NOTE 1 Either external enclosure A or external enclosure B should be fire-resisting.

c) Single-stair building with an alternative exit from every dwelling

Key

OV Openable vent for fire and rescue service use from the top storey (1.0 m^2 minimum)

Fire-resisting construction

Fire-resisting construction up to a height of 1.1 m above deck level

Self-closing FD30 fire door

Self-closing FD 30S fire door

NOTE 2 Although there are no limitations on travel distance, all parts of the building need to be within 45 m of a fire main, measured along a line on which hose can be laid.

*NOTE 3 The openable vents to the stairway may be replaced by an openable vent over the stair with remote operation in accordance with **26.2.3.3**.*

All doors breaching the 1.1 m high fire-resisting separation should be self-closing FD 30 fire doors.

7.4 Escape routes from flats and maisonettes with corridor or lobby approach

To prevent exposure of escaping occupants to smoke and heat in the internal corridor or lobby, either:

a) the travel distance between the exit doors from the dwellings and a smoke-free area should be limited, and the amount of smoke and other combustion products in the internal corridor or lobby kept to a minimum by providing either cross-corridor fire doors and ventilation, or a mechanical smoke control system; or

*NOTE 1 Smoke control is covered in Clause **26**.*

b) an independent alternative escape route should be provided from each dwelling either by way of a corridor at another level or through an external common balcony in accordance with **7.3**.

NOTE 2 The options given in a) and b) allow designers of flats and maisonettes with corridor or lobby approaches some flexibility.

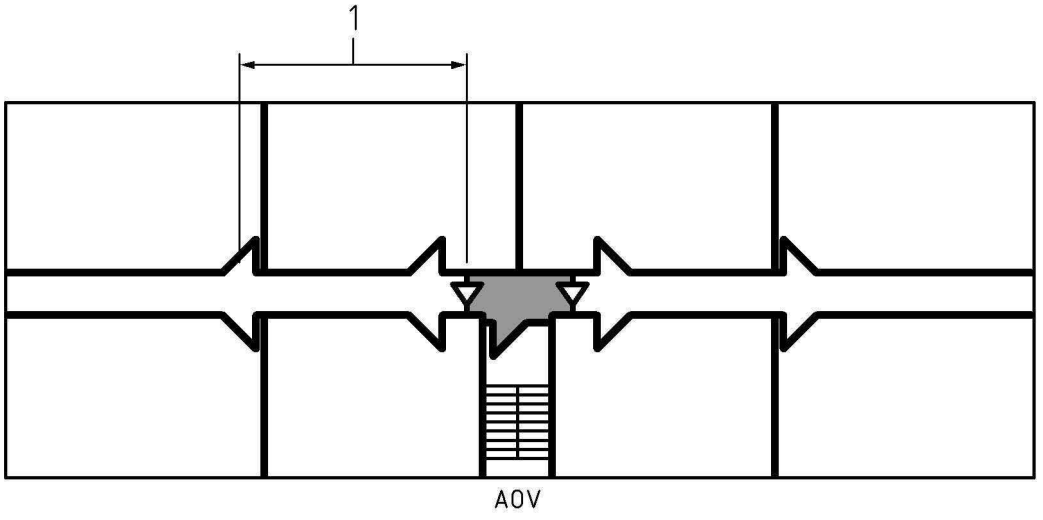
Where travel distances from the furthest dwelling entrance door to the means of escape staircase cannot be met then consideration may be given to the provision of a mechanical smoke ventilation system and the use of sprinkler systems, see **26.1.3** and Clause **23**.

For buildings not provided with a mechanical smoke control system, escape routes should be provided that conform to Figure 6 and Figure 7.

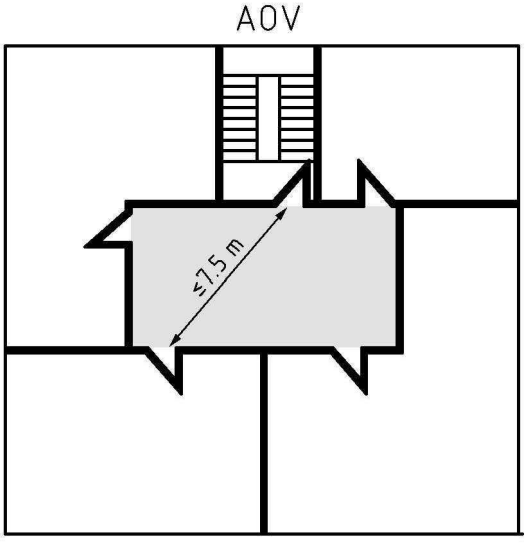
For buildings provided with a mechanical smoke control system, escape routes should also be provided that conform to Figure 6 and Figure 7, with the exception that cross-corridor fire doors and openable or automatically opening vents may be omitted.

*NOTE 3 For smoke control recommendations, see Clause **26**.*

Figure 6 **Common escape routes in single-stair buildings more than 11 m in height**



a) Corridor access dwellings



b) Lobby access dwellings

Key

1 Maximum travel distance 7.5 m

AOV Automatically opening vent (1.0 m^2 minimum)

Fire-resisting construction

Self-closing FD 30S fire door (double swing)

Self-closing FD 30S fire door

NOTE 1 Where all dwellings on a storey have independent alternative means of escape, the maximum travel distance may be increased to 30 m.

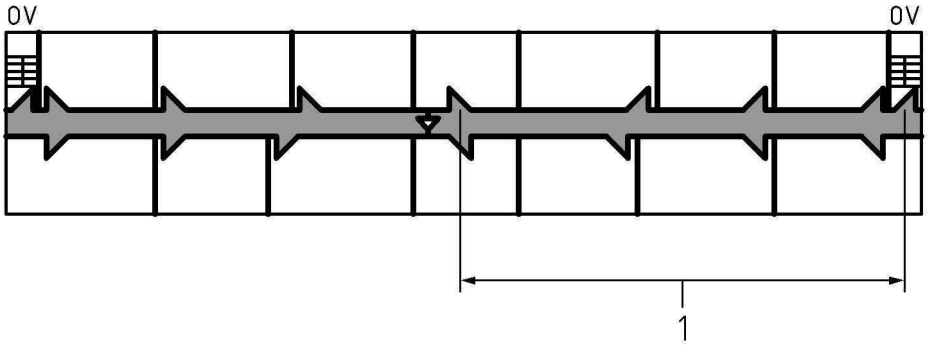
NOTE 2 Where a fire-fighting lift is required, it should be sited not more than 7.5 m from the door to the stair.

NOTE 3 The shaded area indicates the area requiring a smoke control system.

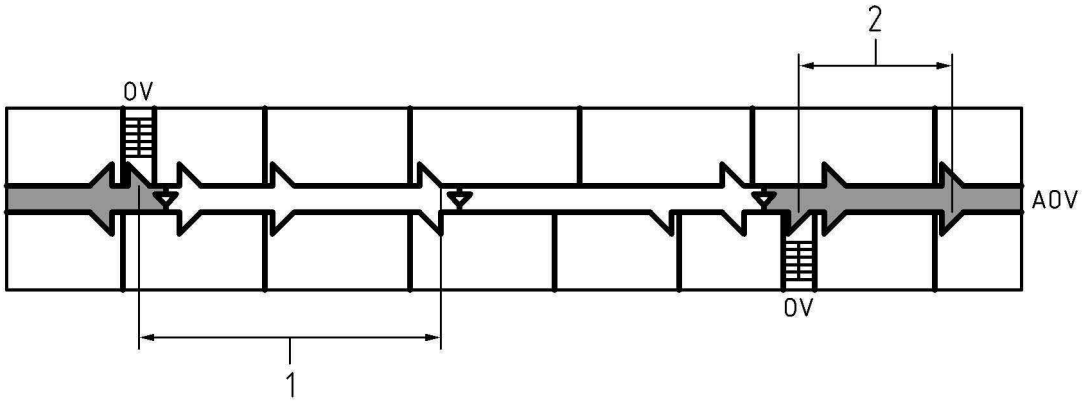
NOTE 4 The arrangements shown in a) and b) also apply to the top storey.

Where travel distance is measured to a stair lobby door, the lobby should not directly connect with any dwelling, storage space or any other space containing a potential fire hazard.

Figure 7 **Common escape routes in multi-stair buildings**

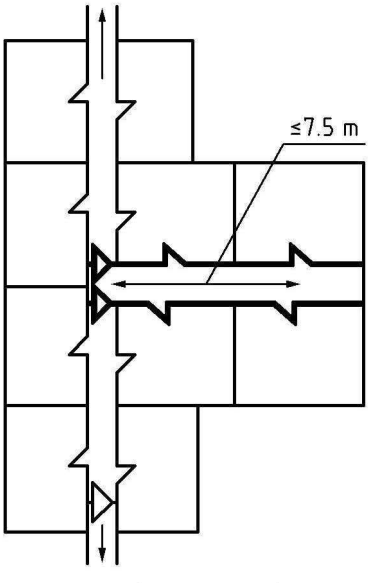


a) Corridor access dwellings (no dead ends)



NOTE 1 The central fire door may be omitted where the maximum travel distance does not exceed 15 m.

b) Corridor access dwellings with dead ends



Key

1 30 m

2 7.5 m

AOV Automatically opening vent (1.5 m^2 minimum)

OV Openable vent for fire and rescue service use (1.0 m^2 minimum)

Self-closing FD 30S fire door (double swing)

Self-closing FD 30S fire door

c) T-junction with main corridor

NOTE 2 Where all dwellings on a storey have independent alternative means of escape, there are no limitations on travel distance. However, all parts of the building need to be within 45 m of a fire main, measured along a line on which hose can be laid.

NOTE 3 The openable vents to the stairway may be replaced by an openable vent over the stair.

NOTE 4 Shaded area indicates the area requiring a smoke control system.

NOTE 5 The arrangements shown also apply to the top storey.

7.5 Small buildings

Where a building does not exceed 11 m in height and has no more than three storeys above ground storey and has a single stair:

a) escape routes should be provided that conform to Figure 8;

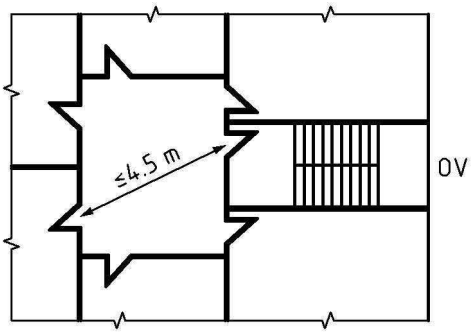
b) the stair should only connect to a covered car park at ground level or above if the car park is provided with permanent natural ventilation equivalent to 2.5% of the floor area of the car park, or is mechanically ventilated in accordance with BS 7346-7, and is separated by a protected, ventilated lobby (see **26.1.6);**

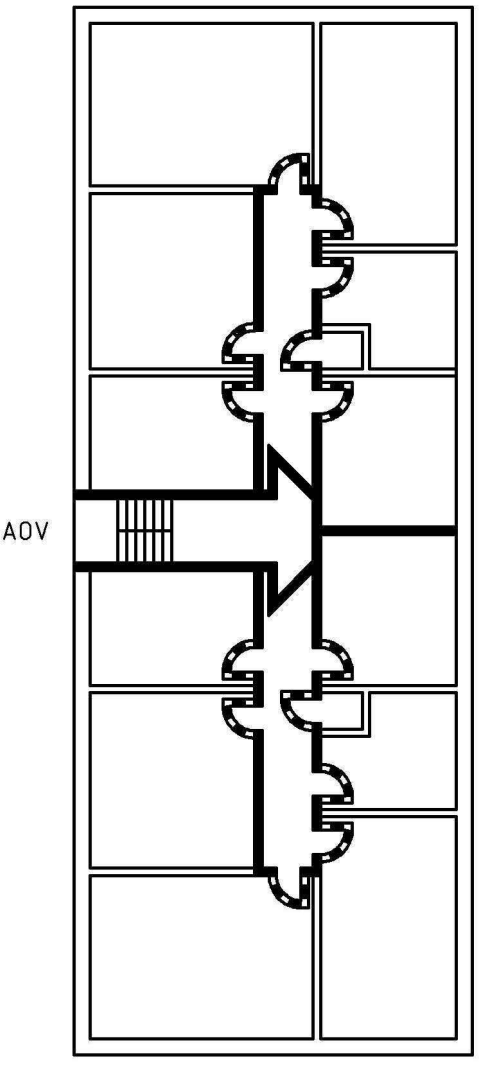
c) the stair should not serve ancillary accommodation unless the ancillary accommodation is separated from the stair by a protected lobby or corridor that is provided with permanent ventilation of not less than 0.4 m^2 for the control of smoke (see **26.1.6**) or protected by a mechanical smoke control system;

d) a high level openable vent should be provided at each floor level with a minimum free area of 1 m^2. Alternatively, a single openable vent which can be remotely operated from fire and rescue service access level may be provided at the head of the stair.

*NOTE For connection to basement levels, see **13.2**.*

Figure 8 **Common escape routes in small single-stair buildings**





NOTE 1 If the lobby is provided with an AOV (1.5 m² minimum), the maximum travel distance may be increased to 7.5 m.

a) Small single-stair building

b) Small building of not more than two dwellings per storey and protected internal entrance halls

Key

AOV Automatic opening vent (1.0 m² minimum)

OV Openable vent for fire and rescue service use (1.0 m² minimum)

FD 30 fire door

Self-closing FD 30S fire door (double swing)

Self-closing FD 30S fire door

Fire-resisting construction

*NOTE 2 The openable vents to the stairway may be replaced by a remotely openable vent over the stair (see **26.2.3.3**).*

8 Means of escape from sheltered, extra care and other special housing

8.1 General

These buildings should be designed as self-contained flats in accordance with all the appropriate recommendations contained within this British Standard. In addition it may be necessary to augment the basic provisions with the applicable recommendations given in **8.2** to **8.7**.

8.2 Travel distances

Protected stairway enclosures and protected corridor layouts incorporating fire subdivisions should be planned and constructed so that no person would have to travel more than 7.5 m from the flat entrance door along a corridor or lobby before reaching a fire door accessing either a protected stairway enclosure or another protected corridor zone.

Internal travel distances within the sheltered, extra care or special housing unit should be limited to 9 m or an alternative exit should be provided.

8.3 Protected stairways and corridor zones

When deciding on the dimensions of protected stairways and corridor zones, provision needs to be made for adequate refuge space for occupants to await further progressive evacuation.

NOTE This might have to include space for more than one wheelchair, which will be dependent on the building occupancy.

8.4 Vertical transportation

Consideration should be given to the numbers of residents who would need assistance to evacuate vertically. Where it is deemed necessary to assist vertical evacuation with an evacuation lift, the lift should conform to BS 9999:2008, **16.7**, **46.9** and Annex G.

Where it is desired to use an ordinary passenger lift for the evacuation of disabled people, a risk assessment in accordance with BS 9999:2008, **46.9**, should be carried out to assess the suitability of a particular lift.

8.5 Furnished areas in corridors

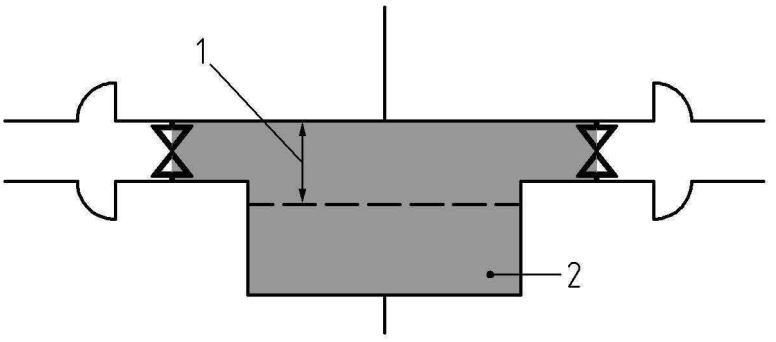
Furniture may be provided within common corridors in accordance with Figure 9.

Where furniture is provided in communal areas, it should conform to the medium hazard resistance to ignition classification specified in BS 7176. Curtains in communal areas should meet the performance requirements for classification as Type B or Type C when tested in accordance with BS 5867-2.

8.6 Doors

The needs of the sheltered, extra care or special housing should be assessed and the appropriate door closing devices and other door hardware should be selected and installed. Where self-closing doors might present an obstacle to the occupants of the building, then free swing door closers and hold-open devices within circulation spaces conforming to BS EN 1155 might be appropriate.

Figure 9 **Furnished areas in sheltered housing corridors**



Key

1 Width of corridor maintained free from furniture (1.0 m min)

2 Area containing furniture

Self-closing FD30S fire door (double swing)

Furnished area (10 m^2 max.)

8.7 Electric wheelchairs and mobility scooters

Consideration should be given to the storage and charging points associated with electric wheelchairs and scooters.

Where an area has been designated for storage of electric wheelchairs and scooters within the building, this area should be separated from the means of escape by fire-resisting construction of not less than 30 min. Electric charging points could introduce a fire risk into areas through which occupants might need to make their escape and as such should not be located in common access corridors or protected stairways.

Electric charging points installed within flats should not be located on an escape route.

9 Internal planning of flats

*COMMENTARY ON CLAUSE **9***

*Clause **9** is concerned with the safety of occupants within their dwellings. The aim is to ensure that a fire that starts in a dwelling will not prejudice the escape of the occupants of that dwelling. The recommendations for the internal planning of a dwelling depend on whether it is a flat or maisonette, on its size, on whether it is situated at or close to ground level and whether it has an independent final exit.*

*There are several ways of providing safe escape routes: through the provision of an alternative exit (see **7.2**); by ensuring that the escape route from any habitable room is by way of a protected entrance hall within which no likely source of fire exists, and within which the travel distance is limited; or by the limitation of the travel distance from any point in the flat to the flat entrance door.*

These constraints are unnecessary in the case of ground floor flats entered from outside the building and for flats situated above the ground floor provided with their own external entrance at ground level. Similar considerations apply to flats entered from a podium deck.

9.1 General

Cooking facilities in open-plan flats or maisonettes should be located in such a way that they do not prevent exit if they are involved in a fire.

Flats or maisonettes having an independent external entrance at ground or access level should conform to Section **2**.

Flats or maisonettes having more than one storey and not having an independent external entrance at ground or access level should:

a) have an alternative exit from each habitable room that is not on the entrance floor of the dwelling; or

b) have one alternative exit from each floor (other than the entrance floor), with a protected landing entered directly from all the habitable rooms on that floor; or

c) where the vertical distance between the floor of the entrance storey and the floor above and the floor below it does not exceed 7.5 m, provide a protected stairway and a Grade D LD1 fire alarm system in accordance with BS 5839-6; or

d) have a protected stairway and a sprinkler system (see Clause **23**).

9.2 Basement flats

Any habitable room in a basement flat should not be an inner room, unless the room is provided with a door or window conforming to **5.1** for escape purposes.

9.3 Flats or maisonettes situated not more than 4.5 m above ground or access level

Any habitable room should not be an inner room unless the room is provided with a door or window conforming to **5.1** for escape purposes or with a Grade D LD1 fire alarm system in accordance with BS 5839-6 and a sprinkler system in accordance with BS 9251 or BS EN 12845 (see **9.7**).

9.4 Flats situated more than 4.5 m above ground or access level

9.4.1 General

Flats that are situated more than 4.5 m above the ground or access level should conform to either **9.4.2**, **9.4.3**, **9.4.4**, as applicable.

9.4.2 Flats entered on the same level as the flat

Flats having an entrance on the same level as the flat should conform to one of the following recommendations:

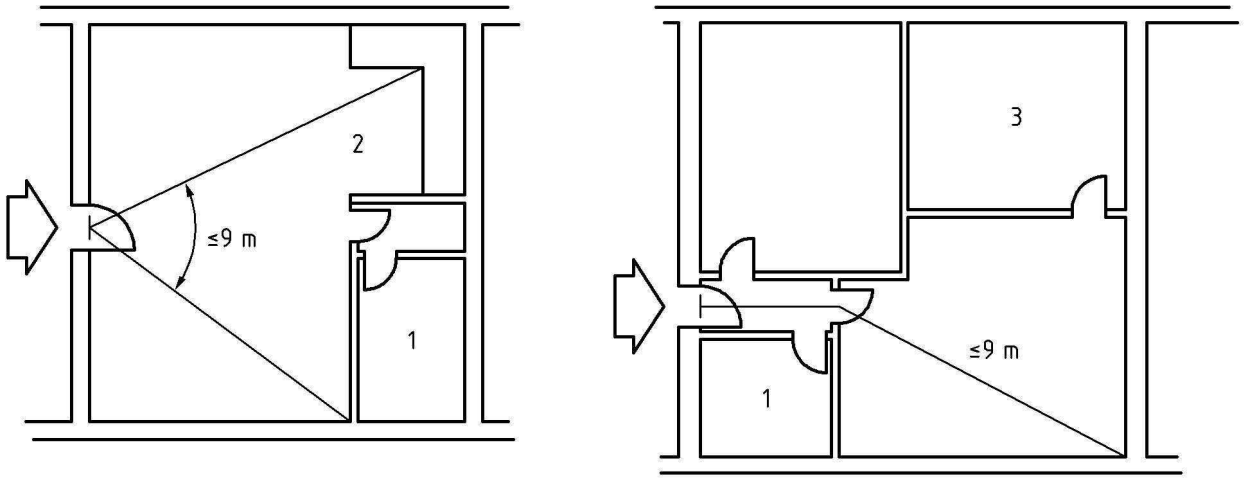
a) the total travel distance from any point of the flat to the entrance door of the flat should be limited to 9 m. Cooking facilities should be sited away from the flat entrance door and the internal escape route (see Figure 10); or

b) a protected internal hallway leading off to all habitable rooms having a travel distance not exceeding 9 m from the flat entrance door to the door of any habitable room (see Figure 11) should be provided; or

c) all habitable rooms should be accessible from an internal hallway and have an alternative exit from the flat [see Figure 12a)]; or

d) a 30 min fire-resisting construction should be provided between the living and sleeping areas of the flat and an alternative exit from the bedroom area should also be provided [see Figure 12b)].

Figure 10 **Flat with restricted travel distance**



a) Open-plan flat (bedsit)

b) Flat with separate habitable rooms

Key

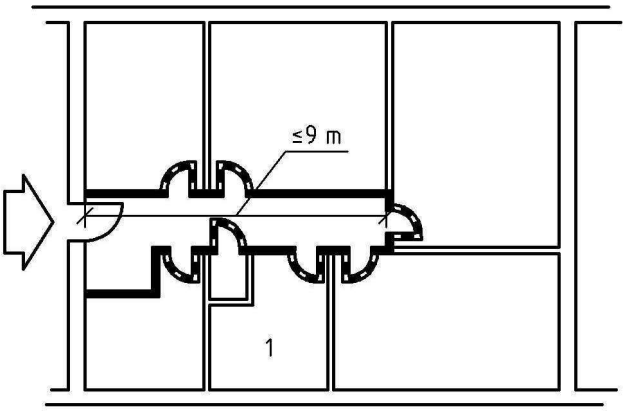
Entrance to dwelling

1 Bathroom
2 Kitchen area
3 Kitchen

*NOTE 1 The entrance door might need to be a fire door (see **35.1**).*

*NOTE 2 Compartment walls need to be fire-resisting (see **27.2**).*

Figure 11 **Flat with a protected entrance hall and restricted travel distance**



Key

1 Bathroom

FD 30 fire door

Entrance to dwelling

30 min fire-resisting construction

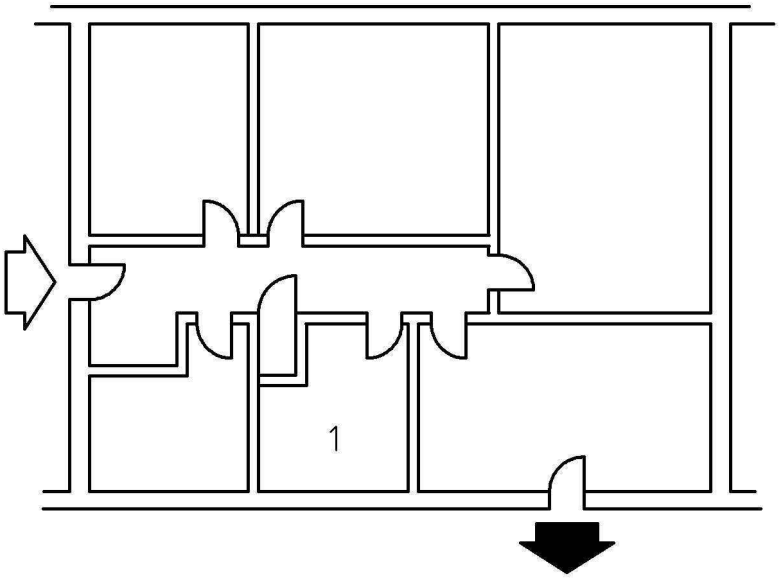
*NOTE 1 The entrance door might need to be a fire door (see **35.1**).*

NOTE 2 If the partitions between the bathroom and the adjacent rooms have a 30 min fire resistance then the partition between the bathroom and the hall need not be fire-resisting and the bathroom door need not be a fire door.

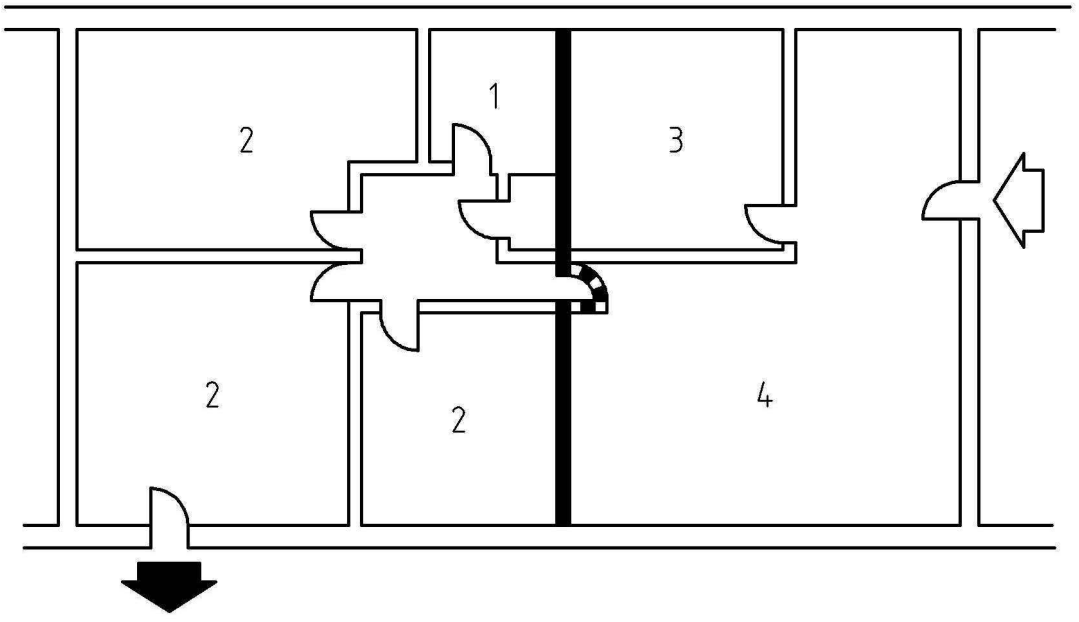
NOTE 3 The door of the cupboard (in the corner of the bathroom) need not be self-closing.

*NOTE 4 Compartment walls need to be fire-resisting (see **27.2**).*

Figure 12 **Flat with an alternative exit**



a) Flat where all habitable rooms have direct access to an entrance hall



NOTE 1 The fire-resisting partition separates living and sleeping accommodation.

NOTE 2 The bedrooms are not classed as inner rooms because escape is possible in two directions.

b) Flat where all habitable rooms do not have direct access to an entrance hall

Key

1 Bathroom
2 Bedroom
3 Kitchen
4 Living area

Entrance to dwelling

Alternative exit from dwelling

30 min fire-resisting construction

FD 30 fire door

*NOTE 3 The entrance and alternative exit doors might need to be fire doors (see **35.1**).*

*NOTE 4 Compartment walls need to be fire-resisting (see **27.2**).*

9.4.3 Flats entered from a floor below the flat

Flats with the entrance on a floor below the flat should conform to one of the following recommendations:

a) the total travel distance from any point of the flat to the head of the stair should be limited to 9 m. Cooking facilities should be sited away from the flat entrance door and the internal escape route (see Figure 13); or

b) a protected internal hallway from which all habitable rooms can be accessed should be provided, having a travel distance not exceeding 9 m from the top of the stair to the door of any habitable room (see Figure 14); or

c) all habitable rooms should be accessible from an internal hallway and an alternative exit should be provided from the upper floor of the flat [see Figure 15a)]; or

d) a line of fire separation should be provided between the living and sleeping areas of the flat and should have an alternative exit from the bedroom area [see Figure 15b)].

9.4.4 Flats entered from a floor above the flat

Flats with the entrance on a floor above the flat should conform to one of the following recommendations:

a) an alternative exit should be provided from the bedroom area of the lower floor level. Where habitable rooms do not have direct access to an enclosed hallway or landing, fire-resisting construction and fire-resisting doors should separate the living and sleeping areas [see Figure 15a) and Figure 15b)]; or

b) a protected internal stairway and hallway or landing should be provided together with a Grade D LD1 automatic fire detection system conforming to BS 5839-6.

9.5 Internal planning of maisonettes

9.5.1 Maisonettes having no storey higher than 4.5 m above ground or access level

Maisonettes that do not have a storey that is situated higher than 4.5 m above the ground level or the access level can follow the same recommendations as those given for houses and should therefore conform to the relevant clauses in Section **2**.

9.5.2 Maisonettes having a floor level higher than 4.5 m above ground or access level

Maisonettes that have a floor level that is situated higher than 4.5 m above the ground level or the access level should have the following:

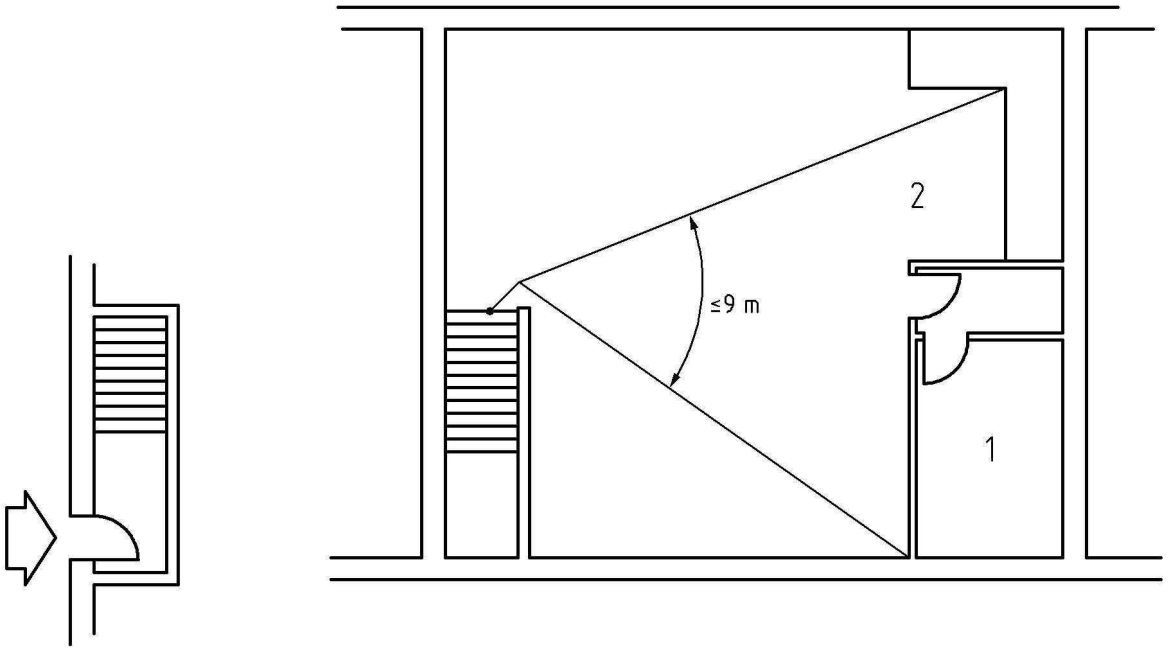
a) an alternative exit from any habitable room that is not on the entrance level of the maisonette (see Figure 2); or

b) a protected stairway enclosure serving all habitable rooms and one alternative exit from every floor level other than the entrance level (see Figure 3); or

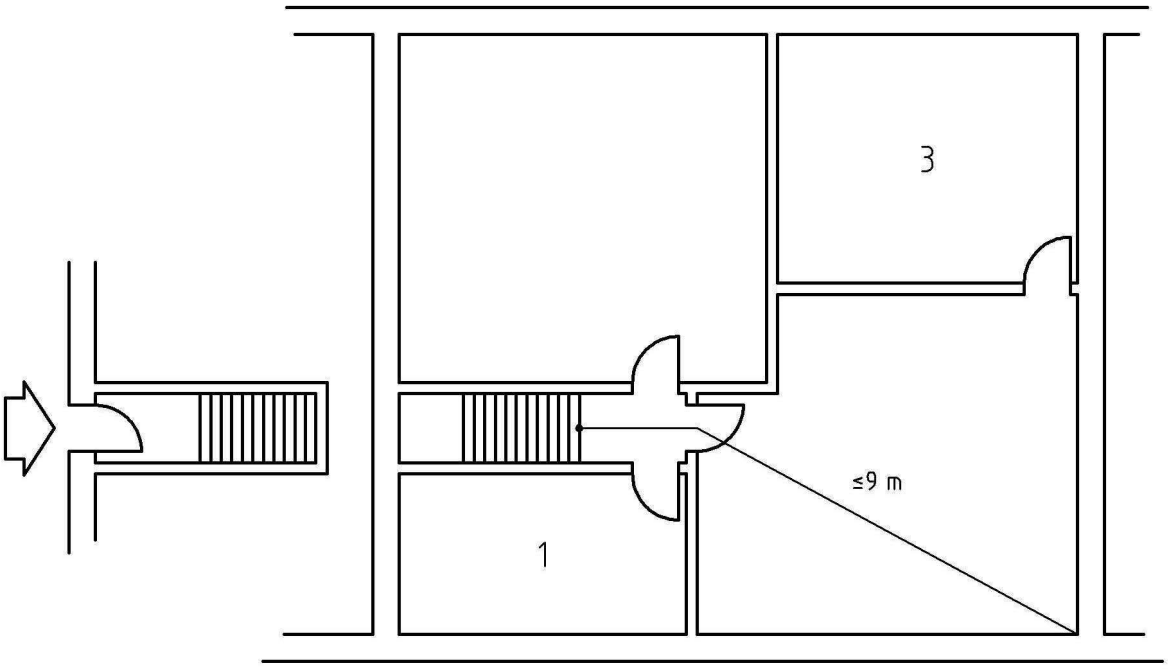
c) a protected stairway enclosure and an LD1 automatic fire detection system conforming to BS 5839-6, if no floor is more than 7.5 m above or below the level of the entrance of the maisonette; or

d) a protected stairway enclosure and domestic sprinkler coverage in accordance with BS 9251 or BS EN 12845.

Figure 13 **Flat (entered from below) with a restricted travel distance**



a) Open-plan flat (bedsitter)



b) Flat with separate habitable rooms

Key

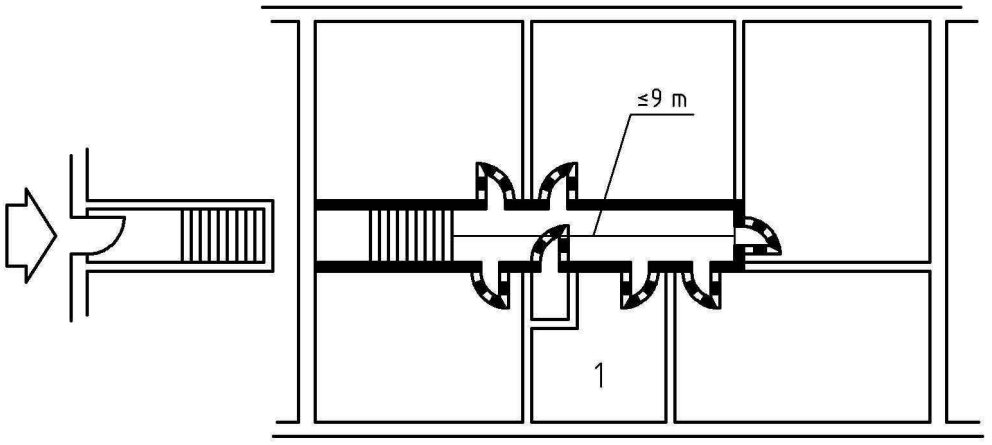
Entrance to dwelling

1 Bathroom
2 Kitchen area
3 Kitchen

*NOTE 1 The entrance door might need to be a fire door (see **35.1**).*

*NOTE 2 Compartment walls need to be fire-resisting (see **27.2**).*

Figure 14 **Flat (entered from below) with a protected entrance hall and restricted travel distance**



Key

1 Bathroom

Entrance to dwelling

30 min fire-resisting construction

FD 30 fire door

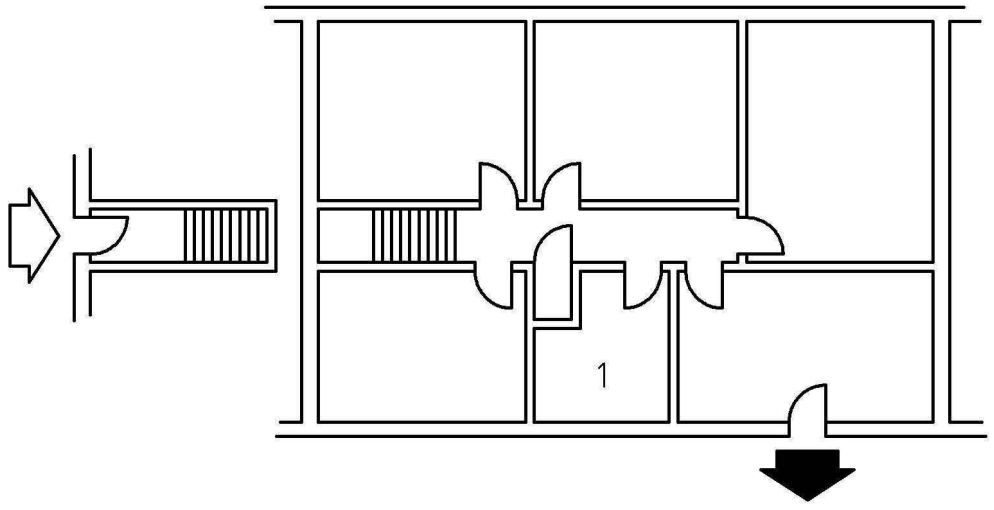
*NOTE 1 The entrance door might need to be a fire door (see **35.1**).*

NOTE 2 If the partitions between the bathroom and the adjacent rooms have a 30 min fire resistance then the partition between the bathroom and the hall need not be fire-resisting and the bathroom door need not be a fire door.

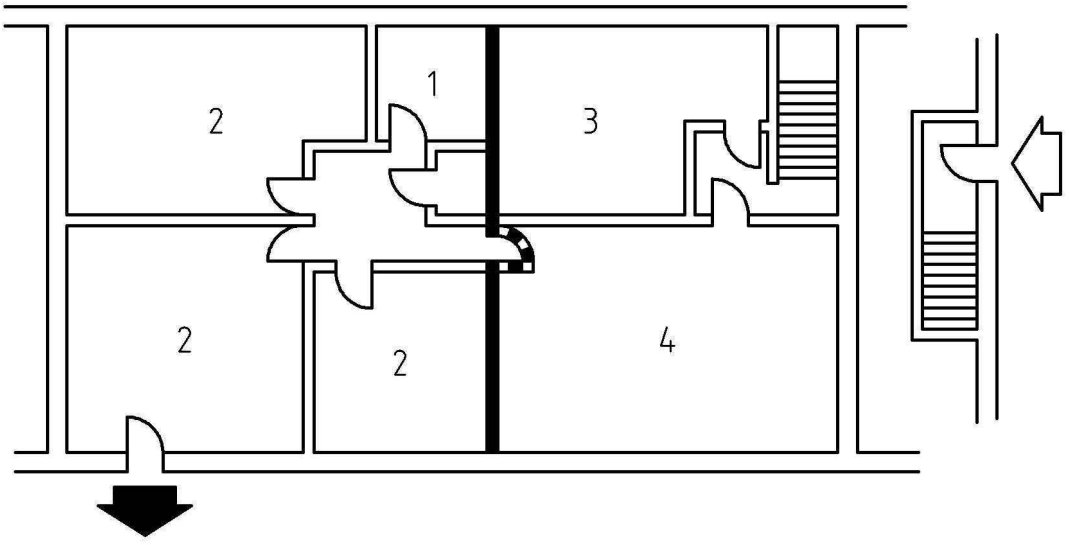
NOTE 3 The cupboard door need not be self-closing.

*NOTE 4 Compartment walls need to be fire-resisting (see **27.2**).*

Figure 15 **Flat (entered from above or below) with an alternative exit**



a) Flat where all habitable rooms have direct access to an entrance hall



b) Flat where all habitable rooms do not have direct access to an entrance hall

NOTE 1 The fire-resisting partition separates living and sleeping accommodation.

NOTE 2 The bedrooms are not classed as inner rooms because escape is possible in two directions.

Key

30 min fire-resisting construction

FD 30 fire door

Entrance to dwelling

Alternative exit from dwelling

*NOTE 3 The entrance and alternative exit doors might need to be fire doors (see **35.1**).*

*NOTE 4 Compartment walls need to be fire-resisting (see **27.2**).*

9.6 Flats with galleries

Flats with galleries should conform to the following recommendations.

a) The main level of the flat should be planned and constructed in accordance with Figure 12a), Figure 12b) or Figure 11, as applicable.

b) Any cooking facilities within a room containing a gallery should, where practicable, be enclosed with fire-resisting construction. Where cooking facilities are not enclosed with fire-resisting construction, they should be positioned such that they do not create an obstruction to the escape route from the gallery or from the flat.

c) The distance from the foot of the access stair to the gallery and the entrance door of the flat or a door leading to a protected entrance hall should not exceed 3 m.

d) Where the travel distance from the head of the access stair to the gallery to any point in the gallery exceeds 7.5 m, an alternative exit should be provided from the gallery.

e) Where the gallery exceeds 50% of the area of the floor below, the gallery should be treated as an inner room.

9.7 Open-plan flat design

Open-plan flats should not be used for sheltered housing or extra care housing.

Open-plan flats that do not have protected corridors or hallways but that have bedrooms that are inner rooms without having an alternative means of escape, and that are accessed directly from a lounge or similar type accommodation may be permitted as flats and basement flats, provided the open-plan flat is fitted throughout with a sprinkler system designed and installed in accordance with BS EN 12845 or BS 9251 and a fire alarm system in accordance with BS 5839-6, Grade D, LD1.

Open-plan flats should conform to the following.

a) The size of the open-plan flat should not exceed 16 m x 12 m.

b) Open-plan flats should be situated on a single level only.

NOTE 1 Single level flats exclude flats with galleries.

c) The ceilings within the open-plan flat should have a minimum height of 2.25 m.

d) The kitchen should be enclosed in open-plan flats having an area exceeding 10 m × 8 m. Cooking appliances in open-plan flats having an area smaller than 10 m × 8 m should not be adjacent to the entrance of the flat.

NOTE An open-plan flat design is not compatible with small, single staircase buildings reliant upon internal protected entrance halls for lobby protection to the staircase enclosure.

9.8 Internal planning of sheltered housing

Internal planning of sheltered housing should be in accordance with the appropriate provisions of Clause **8**, and **9.1** to **9.5**.

Section 3: Stairs and final exits

10 Number and siting of common stair

In buildings or parts of buildings occupied for non-residential purposes a single common stair would be considered acceptable only in very limited circumstances. However, in buildings comprising flats and/or maisonettes, because of the degree of compartmentation provided and the special provisions made for controlling the spread of smoke within common horizontal escape routes, whether or not a single common stair is acceptable depends entirely on any limitations imposed in respect of travel distances or, for balcony or deck approach dwellings, fire-fighting purposes.

A minimum of one common stair should be available from each storey providing access to dwellings.

Where necessary, additional common stairs should be provided to enable dwellings to conform to travel distance recommendations or, for balcony or deck approach dwellings, fire-fighting purposes (see Figure 5). Additional common stairs should be sited such that they provide effective alternative directions of travel from any dwelling served by those stairs other than accepted dead ends [see Figure 7b)].

11 Width of common stairs

The unobstructed width (measured between the walls and/or balustrades) of each common stair should be not less than 750 mm; a common stair which is a fire-fighting stair should have an unobstructed width (measured between the walls and/or balustrades) of 1.1 m. The width should be kept clear for a vertical distance of 2.0 m.

NOTE Handails and strings that do not intrude more than 100 mm into these widths may be discounted when calculating the common stair width.

Where two or more common stairs are provided they should be located such that they are situated remotely from each other. Where a common corridor connects two or more storey exits, measures should be provided to prevent both stairs from being affected by the smoke from a single fire. Such measures may include subdivision by a self-closing fire door with, if necessary, an associated fire screen. The door should be positioned such that smoke is not likely to affect access to more than one storey exit.

12 Enclosure of common stairs

In buildings exceeding 18 m in height, one or more common stairs should be designed as fire-fighting stairs.

*NOTE 1 See **19.3.2** and BS 9999:2008, Clause **21**, for further information.*

The following recommendations should be met for common stairs that are not fire-fighting stairs.

a) No store room should open directly into a common stair.

*NOTE 2 For recommendations for engineering services such as gas, electricity and refuse disposal, see Section **8**.*

b) If a common stair projects beyond, is recessed from, or is an internal angle of, the external enclosures to a building:

1) the distance between any opening in the external enclosure to the building and any opening in the enclosure to the stair should be not less than 1.8 m (see Figure 16);

2) the enclosures within that distance [see 1)] and up to 9 m vertically below should be of fire-resisting construction that may have fixed fire-resisting glazed areas.

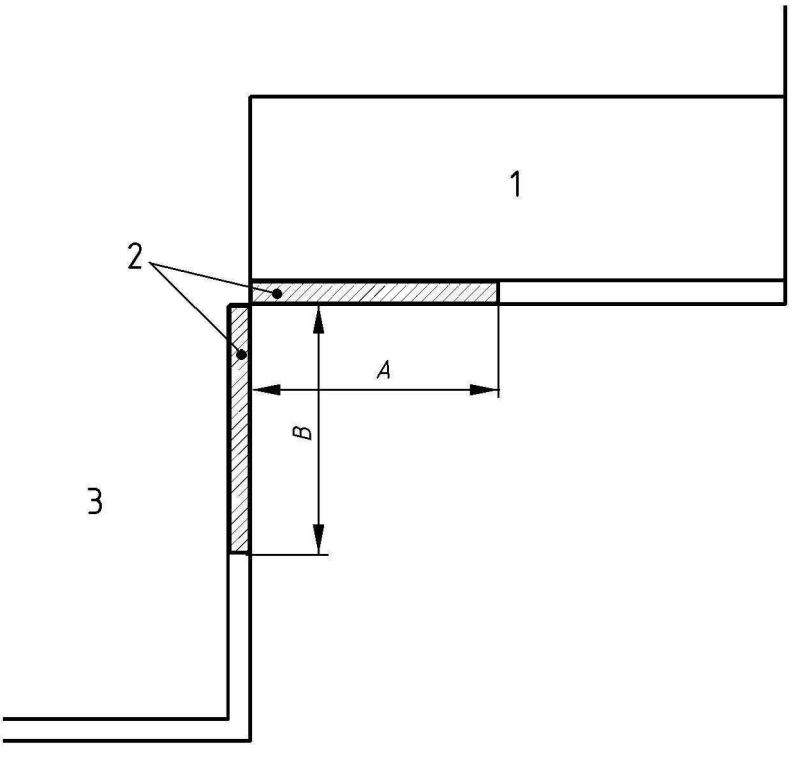
c) Where two common stairs are adjoining, they should be separated by imperforate construction.

NOTE 3 No openings, doors, etc. are permitted in the separating elements common to both stairway enclosures.

d) If any storey of a building (or part) is required to have more than one escape route, common stairs should be sited so that access to alternative common stairs is possible from any point on that storey without passing through any other such stairway.

e) If a common stair forms part of the only escape route from a dwelling it should not be connected to any ancillary accommodation on the same storey as that dwelling, unless it conforms to **7.5** and **13.2**.

Figure 16 **Protected routes forming an internal angle**



Key

1 Protected route or protected stairway

2 Fire-resisting construction equivalent to that required for the building, including insulation performance

3 Accommodation

Either A or B should be 1 800 mm where the protected route is for means of escape.

13 Basement stairs

13.1 Multiple stair buildings

Where there is more than one common stair from an upper storey (or part) of a building, at least one such stair serving the upper storeys (or part) of the building should terminate at ground level; any other stair may connect with the basement storey(s), provided that it is separated from each basement level by a protected lobby.

13.2 Single stair residential buildings

For buildings where the top floor of the building is no more than 11 m above ground level or where there are no more than three storeys above ground level or, where the basement of the building has a sprinkler system in accordance with BS EN 12845 and a single stair within a residential building connects with the basement level, then it should conform to the following.

a) The basement and upper storeys should be separated within the staircase at ground floor level by fire-resisting construction including an FD30S self closing door.

b) A fire resisting lobby should be provided at basement level between the accommodation and the staircase and any associated lift shaft.

c) A dry falling main should be provided.

d) The lobby should be provided with a vent in accordance with Table 1.

Table 1 **Lobby ventilation**

Item	Accommodation area[A) B)]	Ventilation to lobby
1	Flats	In accordance with Clause **26**
2	Communal lounges and common amenity areas	1 m^2 permanent ventilation; or 0.4 m^2 permanent ventilation with provision of automatic sprinkler protection in accordance with BS EN 12845 throughout the basement.
3	Transformer, switchgear and battery rooms for low voltage or extra low voltage equipment	
4	Engineering service installation rooms, excluding those covered by item 2 and items 6–8 inclusive	
5	Refuse chutes and refuse storage areas/bicycle stores	
6	Installation rooms for engineering services housing fixed internal combustion engines	1 m^2 automatic opening vent
7	Boiler rooms and fuel storage spaces	
8	Transformer and switchgear for equipment above low voltage	
9	Car park areas	

A) Places of special fire hazard should be provided with separate smoke outlets in accordance with Clause **26**.

B) Car park areas should be provided with a smoke control system in accordance with Clause **26**.

14 Stairs within mixed-use developments

A mixed-use development is one that contains one or more dwelling and at least one other non-residential occupancy. Any stair serving a dwelling within a mixed-use development should not communicate with any other occupancy, unless in accordance with a) or b).

Mixed-use developments should conform to the following recommendations.

a) In buildings having not more than three storeys above ground or access level, common stairs that serve both dwellings and other occupancies should be separated from each occupancy by protected lobbies at all levels.

b) In buildings having more than three storeys above ground or access level:

   1) all stairs serving dwellings, which are not ancillary to the main use of the building, should not communicate with any other occupancy in that building;

   2) any stair serving a dwelling, which is ancillary to the main use of the building, may communicate with any other occupancy only if security measures do not prevent escape and:

      i) the stair is separated from any lower storeys by protected lobbies; and

      ii) an independent alternative escape route is provided from the dwelling; and

      iii) where the main building is fitted with an automatic fire detection and alarm system (see Clause **22**), this system also covers the dwelling.

15 Access lobbies and corridors to protected stairways

Access lobbies and corridors to protected stairways should conform to the following recommendations.

a) If a stair in a mixed-use building, having not more than three storeys above ground or access level, serves both dwellings and other non-residential occupancies, then a protected lobby should be provided between each occupancy and the stairway at all levels.

b) If a stair provides access to ancillary accommodation, there should be a ventilated protected lobby or ventilated protected corridor at that level.

c) If a stair provides access to an enclosed car park, there should be a ventilated protected lobby at every car park access level.

d) If a stair serves an area of higher fire risk there should be a ventilated protected lobby or ventilated protected corridor at that level.

e) If a stair connects the ground or upper storeys with a basement storey(s) or serves only basement storeys, there should be a protected lobby or protected corridor at every basement level.

f) In a small single-stair building, any protected lobby or protected corridor separating ancillary accommodation from the stair should be ventilated (see Clause **26**).

NOTE For ventilated lobbies, refer to Table 1.

16 External stairs

External escape stairs, whilst not desirable, may, in exceptional circumstances, be provided for small buildings (see **7.5**) or from storeys near to ground level or a roof or podium with its own escape route.

The following recommendations should be met for external stairs.

a) External stairs should not form part of an escape route except in the case of:

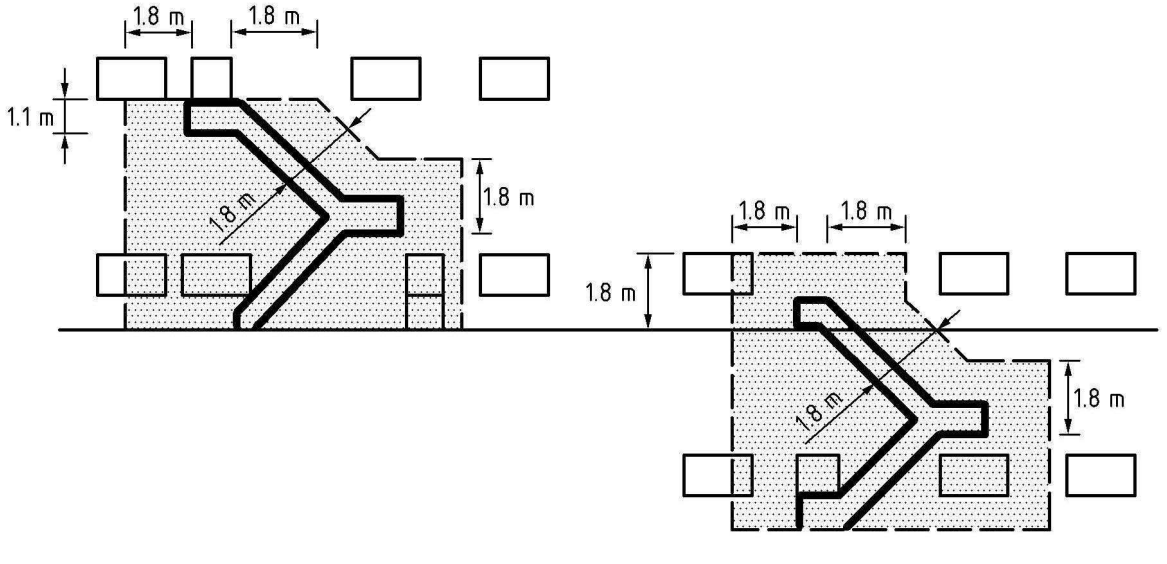
1) flats or maisonettes having an exit to a storey not more than 6 m above ground level;

2) flats or maisonettes having an exit to a storey not more than 6 m above a roof or podium which is itself served by an independent protected escape route.

b) Any wall or portion (unless higher than 1.1 m above the top floor level of a stair that is not a basement stair) within 1.8 m of, or within 9 m vertically below, any external escape stair should be of fire-resisting construction. This fire-resisting construction may have fixed fire-resisting glazed areas, and the doors to the stair (other than the door at the top floor level of a stair serving storeys above ground level) should be fire-resisting and self-closing (see Figure 17).

c) Where the escape route from the stair is in one direction only, any ventilation outlets or extract systems and any doors or windows that are not fire-resisting should not be sited within 3 m of the escape route.

Figure 17 **Fire resistance of areas adjacent to external stairs**



a) Stair serving storeys above ground level

b) Stair serving a basement

NOTE 1 Areas enclosed in dashed lines are required to be of fire-resisting construction.

NOTE 2 The door at the top of the stair need not be fire-resisting and self-closing.

17 Discharge from common stairs and final exits

Discharge from common stairs and final exits should conform to the following recommendations.

a) Protected stairways should either discharge:

   1) directly to a final exit; or

   2) into a protected corridor leading to a final exit.

   NOTE 1 It is important that any protected corridor leading to a final exit has the same standard of fire resisting enclosure and lobby protection as the stairway it serves and that it is not the common access corridor serving the dwellings at the exit level.

b) An arrangement in which two stairs terminate in the same enclosure at final exit level should not be employed because an outbreak of fire leading to penetration of the enclosure at that level would render both stairs simultaneously unusable.

c) Where the exit passageways from two common stairs adjoin they should be separated by imperforate construction, i.e. there should be no openings, doors, etc. in the separating element common to both passageways.

d) Any final exit should be immediately apparent to any person using a common stair that serves storeys both above and below the point of final exit.

   NOTE 2 A final exit can be made immediately apparent through the use of signage.

e) Final exits should discharge directly to a street, passageway, walkway or open space that allows for the rapid dispersal of persons away from the vicinity of the building.

f) Final exits should have a level threshold and preferably lead to level ground. Where there is no level ground, a suitable ramp or a step should be provided. Where a step is provided there should be a suitable and apparent landing.

g) Final exits should be sited such that that they are clear of any risk from fire or smoke. If a protected route projects beyond, is recessed from, or is an internal angle of, the external enclosures to a building, the distance between any opening in the external enclosure to the building and any opening in the enclosure to the stairway should be not less than 1.8 m (see Figure 16).

h) Transformer chambers, boiler rooms and refuse storage rooms and similar risk areas should not have any openings, for example doors that open onto escape routes, which could impede escape from residential accommodation.

Where a tower block rises above a podium, it is preferable that the common stair(s) forming part of the escape route from the tower descend through the podium to ground level; any fire-fighting stair should certainly do so. Where other stairs cannot be so arranged and occupants are required to use the stairs of the podium, there should be adequate protection of the escape route connecting the two stairs to safeguard the occupants of the building until street level is reached. Similarly, any part of the escape route that leads (for example) across a concourse, a pedestrian walkway or roof should be clearly defined and protected.

Section 4: Access and facilities for fire-fighting

18 General recommendations for fire-fighting facilities

Fire-fighters need to be able to reach a fire quickly with their equipment. Physical safety and lives, both those of the fire-fighters and those of the occupants of the building, and the preservation of the building and its contents, can be jeopardized by delays in reaching the area of the fire.

When designing new buildings and provisions for occupant evacuation, consideration should be given to the requirements for fire and rescue service access into and around buildings for fire-fighting purposes.

Fire-fighting facilities should be selected and designed to assist the fire and rescue service in protecting life, protecting fire-fighters, reducing building losses, salvaging property and goods and minimizing environmental damage. Early consultation with the appropriate approving authorities (including the fire and rescue service and building control bodies) is advised when deciding which facilities should be provided.

NOTE 1 The exact choice of facilities depends on the use, size or layout of the building, the nature of its contents, and the site upon which it is situated.

Fire-fighting facilities should include, where appropriate:

a) the provision of vehicular access for fire appliances to the perimeter of the building or site;

b) provision of easy and speedy entry to the site and/or the interior of the building for fire-fighters and their equipment;

c) provision of and access to sufficient supplies of a fire-fighting medium, as determined by a risk assessment;

NOTE 2 The usual fire-fighting medium is water, but other media might be required.

d) means of enabling fire-fighters, once they have entered a building, to reach any point within that building in the shortest time possible, including the provision of fire-fighting lifts, where appropriate;

e) means of ensuring that once fire-fighters have arrived at a location within a building, they can remain there in relative safety whilst they carry out their fire-fighting operations;

f) provision for fire and rescue service communications;

g) provision of facilities to release, or extract, smoke and heat from the building or site;

h) provision for removing spent fire-fighting extinguishing medium (e.g. drainage).

19 Fire-fighting access

19.1 Access for fire appliances

19.1.1 General

Every building should be provided with suitable access for fire-fighting purposes; roadways should be constructed to allow access for fire appliances and entry points to buildings should be readily identifiable to the fire and rescue service.

The vehicular access requirements for a residential building are based on whether the building requires a fire main, see **19.1.3** and **20.1**.

The location of residential buildings can create issues for fire and rescue service access due to the increased demand for the development of areas with restricted access. Fire appliance access to buildings should be discussed with the fire and rescue service at the concept stage.

19.1.2 Buildings not fitted with fire mains

Houses not fitted with fire mains should allow access for a fire appliance to within 45 m of all points within the house, measured on a route suitable for laying hose.

Blocks of flats not fitted with fire mains should have vehicle access for a fire appliance not more than 45 m from all points within each dwelling, measured on a route suitable for laying hose.

*NOTE Permitted variations are given in **23.2**.*

19.1.3 Buildings fitted with fire mains

Fire mains enable fire-fighters within a building to connect their hoses to a water supply. In buildings fitted with fire mains, pumping appliances should have access to the perimeter at points near the mains, so that fire-fighters can enter the building to make a hose connection from the fire appliance to pump water into the main. Fire mains should be provided in accordance with **20.1**.

Buildings fitted with dry fire mains should have access for a fire appliance to within 18 m of each fire main inlet connection point, typically on the face of the building close to the entrance point leading to the fire-fighting shaft, with the inlet visible from the fire appliance.

Multi-storey buildings fitted with wet fire mains should have fire appliance access:

a) within l8 m of, and within sight of, a suitable entrance giving access to the wet fire main; and;

b) within sight of the inlet for the emergency replenishment of the suction tank for the wet fire main.

19.2 Access for fire-fighters

19.2.1 General

Buildings with a floor higher than 18 m above fire and rescue service access level, or with a basement more than 10 m below fire and rescue service access level, should be provided with fire-fighting shaft(s) containing fire-fighting lifts.

NOTE General recommendations regarding fire-fighting shafts can also be found in BS 9999.

A sufficient number of fire-fighting shafts should be provided to meet the maximum hose distance set out in **19.2.2**, and at least two fire-fighting shafts should be provided in buildings with a storey of 900 m^2 or more in area.

Security features can cause problems for fire-fighters trying to access the building in an emergency. To avoid potential conflicts between access and the security arrangements for the building, the local fire and rescue service should be consulted at an early stage in the design of the building.

19.2.2 Siting fire-fighting shafts

Fire-fighting shafts should serve every storey through which they pass.

Access should be provided to enable fire-fighters to create a bridgehead from where they can operate at a level below the fire floor. Liaison with the local fire and rescue service regarding access requirements is recommended.

Wherever practicable, fire-fighting shafts should be sited against an exterior wall. Where this is not practicable, the route from the fire and rescue service entrance to the fire-fighting shaft should be as short as possible and the fire-fighting shaft should be protected by fire-resisting construction to prevent fire from affecting the route or cutting off the means of escape for either the fire and rescue service or other persons within the building.

Where fire-fighting shafts are required they should be located such that they conform to the maximum hose distances set out in a) and b).

a) If the building is fitted throughout with an automatic sprinkler system, then sufficient fire-fighting shafts should be provided that every part of every storey is no more than 60 m from a fire main outlet in a fire-fighting shaft, as measured on a route suitable for laying hose.

b) If the building is not fitted with sprinklers, then every part of every storey should be no more than 45 m from a fire main outlet contained in a protected stairway and 60 m from a fire main in a fire-fighting shaft, as measured on a route suitable for laying hose.

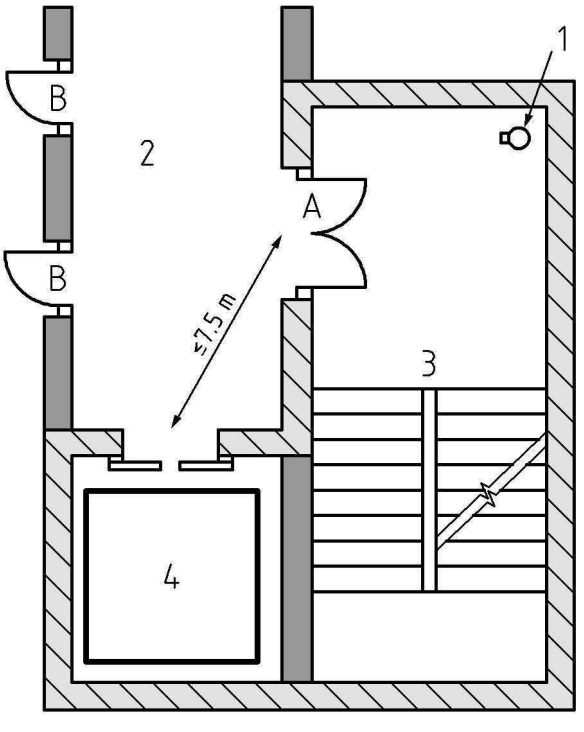
NOTE In order to meet the 45 m hose criterion in b), it might be necessary to provide additional fire mains in escape stairs. This does not imply that these stairs need to be designed as fire-fighting shafts.

19.2.3 Layout of fire-fighting shafts

In blocks of flats the protected corridor or protected lobby provided for means of escape purposes is considered to be the fire-fighting lobby. It is therefore not necessary to provide an additional fire-fighting lobby between the protected corridor or protected lobby and the fire-fighting stair. Similarly, the fire-fighting lift may open directly into the protected corridor or protected lobby, but the fire-fighting lift landing doors should not be placed more than 7.5 m from the fire-fighting stair.

Fire-fighting lifts should be located within the protected corridor or protected lobby and should not be located within the stair enclosure even if the building is being refurbished.

Figure 18 **Components of a residential fire-fighting shaft**



Key

1 Fire main outlet
2 Common corridor
3 Fire-fighting stairs
4 Fire-fighting lift in lift shaft
120 min fire-resisting construction
60 min fire-resisting construction
A FD 60S fire door
B FD 30S fire door

19.3 Construction of fire-fighting shafts

19.3.1 General

Fire-fighting shafts should be constructed in accordance with BS 9999:2008, **21.2.4**, **21.2.5** and **21.2.6**.

Any glazing incorporated into the fire-fighting shaft should conform to Clause **33**.

Only services associated with the fire-fighting shaft, such as ventilation systems and lighting for the shaft, should pass through or be contained within the fire-fighting stair.

19.3.2 Fire-fighting stairs and lifts

19.3.2.1 Fire-fighting stairs

Fire-fighting stairs should be sufficiently wide to be easily used by fire-fighting personnel carrying fire-fighting equipment. Fire-fighting stair enclosures should be provided with facilities for smoke control (see Clause **26**) so that they remain relatively smoke-free.

A fire-fighting stair should not contain any cupboards or provide access to service shafts serving the remainder of the building.

To prevent smoke from basement storeys penetrating the stair enclosure above ground level, fire-fighting stairs serving floors both above and below ground level should be separated at ground floor level by a fire door.

Fire-fighting stairs should be designed in accordance with BS 5395-1, with a width between the walls or balustrades of not less than 1.1 m. This width should be kept clear for a vertical distance of 2.0 m, as measured from the pitch line or landing floor level, with the following exceptions:

a) stringers, each intruding into the stair by not more than 30 mm; and

b) handrails, each intruding into the stair by not more than 100 mm.

Scissor stairs should not be used to form a fire-fighting staircase as their design includes features that are not compatible with the recommendations for a fire-fighting stair.

Emergency lighting in fire-fighting stair enclosures should conform to BS 5266-1.

Both the fire-fighting lift and stair are used together during fire-fighting operations. Because it is the line of retreat if the fire-fighting lift fails, the fire-fighting stair should serve every storey that is served by the fire-fighting lift.

19.3.2.2 Fire-fighting lifts

A fire-fighting lift installation includes the lift car itself, the lift well and the lift machinery space, together with the lift control system and the fire and rescue service communications system. Fire-fighting lift installations should conform to BS EN 81-72, and to BS EN 81-1 or BS EN 81-2, as appropriate for the particular type of lift.

NOTE 1 A fire-fighting lift, unlike a normal passenger lift, is designed to operate, for as long as is practicable, when there is a fire in parts of the building beyond the confines of the fire-fighting shaft, as it is used to transport fire-fighters and their equipment to a floor of their choice. Fire-fighting lifts do not need to serve any storey on which there is no entrance to any accommodation or the top storey of the building if it consists exclusively of plant rooms.

If a fire-fighting shaft contains a fire-fighting lift, the fire-fighting stair in that shaft should serve every storey served by the fire-fighting lift.

Fire-fighting lifts should be located within the protected corridor or protected lobby no more than 7.5 m from the fire-fighting stair and should not be located within the stair enclosure, even if the building is being refurbished.

The use of dual-entry fire-fighting lifts is not recommended in residential buildings.

It is important to ensure that the fire-fighting lift remains operational. The power supply of the lift and lighting should consist of primary and secondary (emergency, stand-by or alternative) supplies. There should also be means to minimize the effect of water penetration. Electrical equipment within the fire-fighting lift well and on the car should be protected against water in accordance with BS EN 81-72.

NOTE 2 The minimum flow rate from a wet fire main recommended in BS 9990:2006 is 1 500 L/min, and this is considered to be representative of the maximum possible flow rates into the lift shafts in the worst case conditions. The flow from a dry main will be dependent on a number of factors including the pumping pressure and height of the building. The actual flow of water into the lift shaft will also be dependent on the location of the outlet. These factors can be considered when assessing potential water ingress into the lift shaft.

Access points into the fire-fighting lift shaft should be provided in accordance with BS EN 81-72.

20 Water supplies for fire and rescue service fire-fighting use

20.1 Fire mains

Fire mains should be designed and installed in accordance with BS 9990.

Fire mains should be installed in buildings where any floor is higher than 18 m above ground level. Where there are no floors higher than 50 m above ground level, wet or dry fire mains may be installed. Where there are floors higher than 50 m above fire-fighting access level, wet fire mains should be installed because of the pressures required to provide adequate water supplies at the landing valves at upper floors and also to ensure that water is immediately available at all floor levels.

Fire mains should be installed in any building provided with a fire-fighting shaft and located within the stair enclosure (see Figure 18).

20.2 Location and access to external water supply

All premises should be provided with a supply of water for fire-fighting. Fire-fighters have to lay out hose between the water supply and the fire appliance, so these distances should be kept to a minimum.

Hydrants should be located in positions that are near to building entry points (including entry points to fire-fighting shafts containing fire mains) and fire appliance parking positions as follows.

a) For buildings provided with dry fire mains, hydrants should be provided within 90 m of dry fire main inlets.

b) For buildings not provided with fire mains (or where the building is fitted with a wet fire main), hydrants should be provided within 90 m of an entry point to the building and not more than 90 m apart.

Water mains and hydrants should be capable of delivering a sufficient flow of water to enable effective fire-fighting to be undertaken. If the water supply takes the form of a static tank or dam, the capacity should be related to the size of the building and the risk involved. An unlimited and guaranteed natural water source providing the right quantities is also expected to be acceptable, subject to access and hard-standing for the fire appliances being provided.

Prior to the construction of the building, consultation should be undertaken with the water authority, fire and rescue service and building control body on the nature of the water supply and the quantities or capacity to be provided.

NOTE 1 Attention is drawn to any relevant water legislation for the area.

The water supply should comprise one or a combination of the following:

a) hydrants provided by the water supply company on the street mains;

b) private hydrants designed and installed in accordance with BS 9990, ideally forming part of a ring main system;

c) a static or natural water supply.

All hydrants should have signage in accordance with BS 3251.

21 Information for fire and rescue service use

In large or complex residential buildings, particularly high buildings or those having extensive accommodation below ground level, it is of considerable advantage to the fire and rescue service if appropriate information about the building is made available to them. Where appropriate this should include:

a) simple floor plan layouts, indicating any relevant fire resistance provisions, internal access provisions, fire-fighting facilities, building services and any specific hazards;

b) relevant information (including operating instructions) relating to equipment/fixed installations provided for means of escape or fire-fighting;

c) information regarding the implications of any fire-engineering strategy on the performance of the building during a fire, e.g. reduced fire resistance of elements of structure or areas of the building with additional fire protection measures;

d) information relevant to preventing environmental damage.

Depending on the structural complexity of the building, it might also be appropriate to make schematic fire system plans available. An isometric or cut-away view might be appropriate as the best means of illustrating the building. Fire protection facilities shown on any of these plans should be labelled, and where plan symbols are used, a key to the symbols should be provided.

Where a plans box is used to store this information on site, a photo-luminescent identification sign should be provided on the outer face of the box door. This sign should remain prominent so that if the building's lighting fails, the location of the box is still visible. Where a plans box is not used, the information pack should be clearly identified by an appropriate method.

Section 5: Active fire protection

22 Fire detection and alarm systems

22.1 General

A fire alarm and detection system designed and installed in accordance with BS 5839-6 should be provided in all dwellings in order to warn occupants of fire within the dwelling, to provide them with time to evacuate the premises and to call the fire and rescue service.

NOTE 1 BS 5839-6 does not apply to the communal parts of purpose-built sheltered housing and blocks of flats or maisonettes. With the exception of dwellings such as sheltered housing or extra care housing, it is not necessary to install fire detection and alarm systems in communal areas. The level of compartmentation that exists within most dwellings is generally considered to provide an adequate level of fire protection that only the evacuation of the compartment of origin of a fire is required.

In dwellings where the self-evacuation of residents might prove difficult, such as sheltered housing and extra care housing, the fire alarm signal from individual dwelling units should be set up to be relayed to the same location as alarm signals from any social alarm systems installed in the dwelling units. Where there is an on-site warden, fire alarm signals should be investigated by the warden. Where no on-site warden is present, fire alarm signals should be transmitted to an alarm receiving centre.

NOTE 2 Further information on alarm receiving centres can be found in BS 50518 (all parts).

It might be appropriate for some common areas, for example those associated with sheltered housing or communal roof gardens to be provided with a fire detection and/or alarm system. This should be considered based on the extent and use of these common areas, the fire risk and the management response available. Where a fire alarm is required, it should be provided in accordance with BS 5839-1.

Where rapid summoning of the fire and rescue service is considered critical to the safety of occupants (e.g. on the basis of a fire risk assessment), facilities should be provided for the automatic transmission of alarm signals to an alarm receiving centre, unless there are reliable arrangements for summoning the fire and rescue service by persons in the building. Automatic transmission should also be considered if occupants are mobility impaired to a degree that would cause them to be at high risk in the event of fire, or if there is any reason to suspect that occupants would be unlikely or unable to alert the fire and rescue service.

Where fire alarm systems are required in areas other than individual dwellings, for example to activate smoke control systems, a system conforming to BS 5839-1 should be installed.

Where warning devices are installed in sheltered housing and extra care housing, they should cater for the applicable sensory conditions and therefore include sounders, visual displays. Warning devices should also allow for supplementation where personal emergency evacuation plans (PEEP) dictate a particular need, for example the provision of vibrating pillow alarms.

22.2 Automatic fire detection and alarm systems for mixed-use buildings

Where any part of a mixed-use building is expected to have non-residential occupancy groups, the occupancy groups should be separated by fire-resisting construction and have independent escape routes, with the exception of certain small buildings (see Clause **14**). Each type of occupancy should be provided with the appropriate fire alarm system in accordance with the relevant part of BS 5839.

Where flats are part of a building containing different occupancy groups, the fire alarm should be designed in accordance with the relevant part of BS 5839 to facilitate the evacuation and management strategy appropriate for that building. In small mixed-use buildings (see Clause **14**) which share a common escape route, the flats should have individual fire alarms in accordance with BS 5839-6, and the other occupancy (or occupancies) should have a fire alarm system in accordance with BS 5839-1. These alarms do not need to be interlinked.

23 Sprinkler and watermist systems

*COMMENTARY ON CLAUSE **23***
Fire suppression systems are designed to detect a fire and automatically release an extinguishing agent to extinguish the fire or prevent its spread.

Water is the most common extinguishing agent, as used in sprinkler systems and watermist systems. Individual sprinklers react to heat to release water onto the fire below.

Sprinkler and watermist systems:

a) cool the room to prevent flashover;

b) limit the size of the fire, often extinguishing it;

c) prevent structural fire damage; and

d) reduce toxic smoke emissions.

For these reasons, sprinkler systems can permit fire resistance specifications to be reduced, escape routes to be lengthened, fire and rescue access and facilities requirements to be relaxed and, in certain cases, the internal layouts of houses and flats to be open-plan.

23.1 General

All buildings with a floor higher than 30 m above ground should be fitted with sprinklers.

Sheltered housing and extra care housing should contain sprinkler coverage in all areas.

Sprinkler systems should be designed and installed in accordance with BS 9251 or BS EN 12845.

Watermist systems may be considered as an alternative to sprinkler systems where agreed with the relevant enforcing authority. Watermist systems should be designed and installed in accordance with DD 8458-1 or DD 8489-1.

23.2 Permitted variations of guidance

Where a sprinkler system is fitted throughout a three-storey house in conjunction with a fire-resisting partition and fire-resisting door to enable occupants on the upper floors to access an escape window at first floor level, the internal layout of the ground floor may be open plan (see **6.3**).

Where a sprinkler system is fitted throughout a house having four or more storeys in conjunction with a protected stairway, a second stairway is not required (see **6.4**).

Where a flat is fitted with a sprinkler system and an LD1 fire detection system in accordance with BS 5839-6, it may have an open-plan living room with inner rooms leading off it (see **9.7**).

Where sprinklers are fitted throughout a house or block of flats, the minimum distance between the side of the building and the relevant boundary may be halved.

Where attendance time of the local fire and rescue service is expected to be no more than 10 min:

a) the distance between the fire appliance and any point within the house (in houses having no floor more than 4.5 m above ground level and having a sprinkler system throughout) may be up to 90 m;

b) the distance between the fire and rescue service pumping appliance and any point within the house or flat may be up to 75 m (in houses or flats having one floor more than 4.5 m above ground level and a sprinkler system installed throughout).

NOTE Attendance times can be subject to variation and consultation with the fire and rescue service is advised.

With the exception of sheltered housing and extra care housing (see **23.1**), where a block of flats is fitted with a sprinkler system, the maximum travel distance for escape in common corridors in one direction only may be increased from 7.5 m to 15 m and for escape in more than one direction it may be increased from 30 m to 60 m.

24 Manual fire-fighting equipment

A fire risk assessment should be undertaken to determine the need for manual fire-fighting equipment in common access corridors and in other areas of the premises.

NOTE 1 In common access corridors, manual fire-fighting equipment is not normally required.

Where provided, portable fire extinguishers should conform to BS EN 3 (all parts) and should be selected, installed and maintained in accordance with BS 5306-3 and BS 5306-8.

As the residents of sheltered housing cannot be expected to use manual fire-fighting equipment, its provision should be restricted to higher fire risk areas such as communal lounges, communal kitchens, and wardens' accommodation.

NOTE 2 Where manual fire-fighting equipment is provided, it is important that there are persons on the premises who are familiar with the use of the equipment.

25 Special risk protection

Automatic fire extinguishing systems and equipment on premises should be selected in accordance with BS 5306-0 and in consultation with the enforcing authority.

NOTE 1 Special risks, such as oil storage tank chambers and oil-fired boiler rooms, might require the installation of an automatic extinguishing system associated with the risk alone.

Ancillary accommodation leading from a common stair should be separated by a protected lobby having a minimum area of permanent ventilation of 0.4 m^2, providing the common stair is not the only escape route from a flat.

Places of special fire hazard should be enclosed with fire-resisting construction conforming to Table 2. Travel distances in places of special fire hazard should be limited to 9 m in a single direction or 18 m where escape is available in more than one direction.

NOTE 2 Additional risk protection measures, such as increased fire resistance, might be needed to separate a flat from any storage area where fuels, such as petrol and liquefied petroleum gas (LPG) are present.

NOTE 3 Places of special fire hazard include oil-filled transformer and switch gear rooms, boiler rooms, storage spaces for fuel or other highly flammable substances and rooms housing a fixed internal combustion engine. Places of special fire hazard might need to have smoke or heat detectors fitted to give early warning of fire and sprinklers fitted to control the fire.

Separate smoke outlets should be provided from places of special fire hazard located below ground level (see **26.2.2.4.2**).

Elements of construction enclosing places of special fire hazard should conform to Table 2.

Where a common stair forms part of the only escape route from a flat, unless it is designated as a small single-stair building in accordance with **7.5**, it should not also serve any covered car park, boiler room, fuel storage space or other ancillary accommodation of similar fire risk.

Refuse chutes and refuse storage areas (see Clause **49**) should be separated from other parts of the building by fire-resisting construction in accordance with Table 2. They should not be located in protected stairways or protected lobbies.

26 Smoke control

26.1 Smoke control for means of escape

26.1.1 General

In residential buildings designed with a stay put strategy (see **E.1**), additional protection to the staircase should be provided in the form of a smoke control system.

*COMMENTARY ON **26.1.1***
Whilst the primary aim of smoke control in residential buildings is to protect the staircase enclosure it can also provide some protection to the adjacent protected corridor or lobby.

In extended corridors, the primary objective of the smoke control system is to protect both the common corridor and the staircase enclosure for means of escape.

There are three main methods of smoke control; natural smoke ventilation, mechanical smoke ventilation and pressurization. Further information on these may be found in Annex E and in BS EN 12101-6.

See Diagram C.7 in the Building Regulations 2000 – Approved Document B [11] regarding the free area of smoke ventilators.

26.1.2 Small buildings with a single stair

Small buildings having a single stair that conform to **7.5** should be designed and constructed in accordance with the following recommendations.

a) Small buildings having a single stair and a common lobby approach to the dwellings [see Figure 8a)] should have:

   1) an openable vent having a minimum free area of 1 m^2, that is inserted at the highest level practicable at each floor level within the staircase; or

   2) an openable vent having a minimum free area of 1 m^2 at the top of the staircase that can be remotely operated at fire and rescue service access level.

b) Small buildings having a single stair [see Figure 8b)] should have an automatic opening ventilator (AOV) with a minimum free area of 1 m^2 at the top of the staircase that operates on detection of smoke anywhere within the staircase enclosure.

This smoke control strategy should not be used with an open-plan flat layout design.

Vents that can be opened remotely should conform to **26.2.3.3**.

Automatic opening vents should conform to **26.2.3.4**.

26.1.3 Buildings with a single stair above 11 m in height

In a building which has accommodation on two (or more) sides of the common stair, the various wings of the building should be isolated by fire doors conforming to Clause **35** in order to prevent corridors from becoming contaminated by smoke [see Figure 6a)].

For protected corridor or protected lobby access dwellings [see Figure 6a) and Figure 6b)], the smoke control system should have either:

a) automatic opening ventilators (AOVs) to the exterior of the building with a minimum free area of 1.5 m^2, that are fitted in the common corridor or lobby directly adjacent to the stair at as high a level as is practicable and an automatic openable vent sited at as high a level as is practicable on the top storey of the stairway having a minimum free area of 1 m^2; or

b) a smoke shaft conforming to **26.2.4** that is fitted in the protected lobby or corridor directly adjacent to the staircase enclosure and an automatic openable vent that is sited at as high a level as is practicable on the top storey of the stairway and having a minimum free area of 1 m^2; or

c) a mechanical smoke ventilation system conforming to **26.2.5** that is fitted in the protected lobby or protected corridor, directly adjacent to the staircase enclosure and an automatic openable vent that is sited at as high a level as is practicable on the top storey of the stairway and having a minimum free area of 1 m^2; or

d) a pressure differential system.

NOTE *See Annex E for further information.*

The automatic opening vents should operate in accordance with **26.2.3.4**.

Where travel distances are in excess of those recommended in Figure 6, a mechanical smoke ventilation system may be considered (see **E.5**).

Where all dwellings on a storey have independent alternative means of escape the maximum travel distance may be increased to 30 m.

Where a fire-fighting lift is required it should be sited not more than 7.5 m from the door to the stair (see Figure 17).

26.1.4 Multiple-stair buildings

The smoke control provisions in buildings having multiple stairs should conform to **26.1.3**; however, any vents to the exterior of the building may also be manually operated. Where manually operated vents are used, the smoke control system should be designed to open the vent at the head of the stair either before, or at the same time as the vent on the fire floor.

Where the vents discharge into a smoke shaft, automatic detection should be included in their design. On detection of smoke in the common corridor or lobby, the vents on the fire floor, the vents at the top of the smoke shaft and on the stairway should all be configured to open simultaneously. The vents from the corridors or lobbies on all other storeys should be configured to remain closed.

NOTE There is no requirement for smoke detection within common parts to operate the smoke control system (see Figure 7).

Manually openable vents should conform to **26.2.3.2**.

26.1.5 Smoke control in balcony approach or deck approach buildings

Buildings with a balcony approach or a deck approach should be provided with an openable vent with a free area of 1 m^2 at the top of any enclosed staircase that can be remotely operated at fire and rescue service access level (see Figure 5).

26.1.6 Smoke control for protected lobbies and corridors

Protected lobbies and protected corridors separating protected stairways from ancillary accommodation in small single-stair buildings such as enclosed car parks with permanent natural ventilation equivalent to 2.5% of the floor area of the car park and higher fire risk areas should be provided with an area of permanent ventilation of not less than 0.4 m^2.

Any common stair which does not form part of the only escape route from a flat may also serve ancillary accommodation if it is separated from the ancillary accommodation by a protected lobby or protected corridor

If the stair serves an enclosed car park or an area with a higher fire risk the lobby or corridor should be provided with an area of permanent ventilation of not less than 0.4 m^2 or be protected from the ingress of smoke by a mechanical smoke control system.

NOTE Smoke control in corridors where every dwelling is provided with an alternative escape route to a common stair do not have to use their normal means of access as their only escape route. On this basis, it is only necessary for their normal access route to be provided with ventilation to clear smoke that can be operated manually by the fire and rescue service.

26.2 Heat and smoke control for fire-fighting

26.2.1 Background

The build-up of smoke and heat emanating from a fire can seriously inhibit the ability of the fire and rescue service to carry out rescue and fire-fighting operations within a building.

Smoke should be prevented from restricting the use of fire-fighting shafts in accordance with **26.2.2** and smoke should also be removed from basements and car parks in accordance with **26.2.2.4** and **26.2.2.5**.

26.2.2 Smoke control for fire-fighting shafts

26.2.2.1 General

Fire-fighting shafts should be provided with a smoke control system as follows:

a) fire-fighting shafts serving basements more than 10 m below ground level should be provided with a pressure differential system in accordance with BS EN 12101-6;

b) all other fire-fighting shafts should be provided with a pressure differential system in accordance with BS EN 12101-6; however, natural ventilation can be used in fire-fighting shafts less than 10 m below ground level or up to 30 m above ground level (see **26.2.2.2**).

26.2.2.2 Venting of fire-fighting shafts by natural means

26.2.2.2.1 General

Fire fighting shafts above ground level that only serve flats should be provided with a natural smoke control system in accordance with **26.2.2.1**b).

Fire fighting lobbies at basement level should be provided with a manually openable 1 m^2 free area vent at high level, direct to open air or to a smoke shaft serving only that level. Permanently open vents should not be installed.

26.2.2.2.2 Basement smoke shafts

Smoke shafts serving basements should discharge smoke directly into open air at ground level. The smoke shafts should not discharge smoke by the building exits or fire and rescue access.

Basement smoke shafts should only serve a single basement level.

Basement smoke shafts should be covered with either:

a) a metal grille designed to prevent the shaft becoming blocked by rubbish; or

b) a breakable material, which is easily accessible from the fire and rescue service access level.

26.2.2.3 Venting of fire-fighting shafts by mechanical means

Where a pressure differential system is not implemented, smoke control by mechanical smoke ventilation systems may be considered.

NOTE Further information can be found in Annex E and BS EN 12101-6.

26.2.2.4 Venting of smoke and heat from basements

26.2.2.4.1 General

A system of smoke and heat ventilation should be provided from every basement, except for any basement storey that has:

a) a floor area of not more than 200 m^2; and

b) a floor level not more than 3 m below the adjacent ground level.

NOTE 1 Basement compartments having external doors or windows do not need smoke outlets, as long as the floor area recommendations are met. It is common for basements to be open to the air on one or more elevations.

Systems may be either natural, using one or more smoke outlets conforming to **26.2.2.4.2**, or mechanical, conforming to **26.2.2.4.3**.

*NOTE 2 For recommendations regarding smoke and heat ventilation systems from basement car parks, see **26.2.2.5**. For recommendations regarding basement smoke shafts, see **26.2.2.4**.*

26.2.2.4.2 Natural smoke and heat ventilation

Smoke outlets provide a route for smoke to escape to the open air from the basement level(s). If a basement is compartmented, each compartment should have direct access to vents without having to open doors, for example, into another compartment.

NOTE 1 Smoke outlets are often referred to as smoke vents.

Smoke outlets should:

a) be not less than 2.5% of the floor area of each storey;

b) be sited at the highest level practicable, either in the ceiling or in the wall of the space they serve;

c) be evenly distributed around the perimeter of the building, to discharge into the open air outside the building;

d) be located such that they would not prevent the use of escape routes from the building.

If an outlet terminates at a point that is not readily accessible, it should be unobstructed, and should be covered only with a non-combustible grille or louvre.

If an outlet terminates in a readily accessible position, it may be covered by a panel, stallboard or pavement light that can be broken out or opened. The position of such covered outlets should be suitably marked.

NOTE 2 The fire and rescue service can be consulted for further information regarding suitable marking of smoke outlets.

Separate outlets should be provided from places of special fire hazard.

26.2.2.4.3 Mechanical smoke and heat ventilation

A system of mechanical smoke and heat ventilation may be provided within the basement as an alternative to natural venting, to remove smoke and heat from basements, provided that the basement storey(s) are fitted with a sprinkler system.

The sprinkler system in the basement should be in accordance with BS EN 12845.

Where a powered extract system is used, it should:

a) provide ten air changes per hour;

b) be capable of handling gas temperatures of 300 °C for a continuous period of not less than 60 min;

c) operate automatically either on activation of the sprinkler system or by an automatic fire detection system conforming to BS 5839-1 at a minimum standard of L3.

NOTE For further guidance on powered smoke and heat exhaust ventilators,refer to BS EN 12101-3.

In addition:

1) replacement air should be provided and open automatically, using the same activation method as that selected in **26.2.2.4.3**c);

2) the system should have an independent power supply that operates in the event of failure of the main power supply;

3) the ductwork and fixings should be constructed of materials with an elevated rating of not less than 600 °C or the equivalent to the fire-resistance rating of any compartment boundary through which it passes, whichever is the greater;

4) all wiring associated with the fans should be in accordance with BS 8519.

26.2.2.5 Venting of smoke and heat from covered car parks

A smoke and heat ventilation system should be provided from every car park storey, designed in accordance with BS 7346-7 and having the objective of clearing smoke during a fire and/or after a fire has been suppressed.

NOTE 1 This British Standard does not cover car stacking systems.

NOTE 2 Further information and guidance regarding car parks (open-sided and non-open-sided car parks, mechanical and natural ventilation) can be found in the Building Regulations 2000 – Approved Document B [11].

26.2.3 Vents

26.2.3.1 General

The top of all lobby or corridor vents should be located as closely to the ceiling of the lobby or corridor as is practicable, and should be, as a minimum, as high as the top of the door connecting the lobby or corridor to the stairwell.

The top of all staircase vents should be located as closely to the ceiling of the floor level served as is practicable.

26.2.3.2 Manually openable vents

All manually openable vents provided for smoke control, whether in the stairs, in the protected lobby or protected corridor or into a shaft should:

a) achieve the relevant free area (see **26.1.1**);

b) be outward opening;

c) not be top-hung;

d) open to a minimum of 30°;

e) be clearly identifiable and accessible;

f) be fitted with:

1) simple lever handles; or

2) rotary drives to simple rack or gear operated devices; or

3) locks that can be readily and easily operated by the fire and rescue service.

NOTE It might be advisable to seek advice from the fire and rescue service.

Openings should be guarded to a height of not less than 1.1 m from floor level.

Manually openable vents opening into a shaft should provide a fire resistance of at least E30S.

26.2.3.3 Remotely openable vents

Openable vents situated above a stair should be provided with a remote control located adjacent to the fire and rescue service access doorway. The function and means of operation of the remote control should be clearly marked. The remote control should be capable of opening and closing the vent. All connections between the remote control and actuator mechanism should be within the fire-fighting shaft. Where any part of the remote control mechanism is powered by electricity, a secondary supply should be provided.

26.2.3.4 Automatic opening vents

Automatic opening vents opening to outside air should conform to BS EN 12101-2.

Automatic opening vents in small single-stair buildings should be configured to open upon detecting smoke anywhere in the staircase enclosure.

Vents designed to open automatically from the top storey of the stairs in buildings other than small single-stair buildings should be configured to operate upon smoke detection within any of the protected corridors or protected lobbies directly adjacent to the staircase enclosure.

Only the automatic vent leading from the protected corridor or protected lobby where the smoke has been detected should be configured to open. This should open either to external air or into a smoke shaft; all other protected lobby vents should be configured to remain closed. Fire and rescue service override controls should not permit multiple lobby vents to be open simultaneously.

NOTE 1 This applies whether the vent opens to outside air or into a natural or mechanical shaft.

Unless a simultaneous evacuation arrangement is deemed appropriate, there should be no sounders attached to the smoke detectors within common parts.

NOTE 2 The purpose of smoke detectors is to operate the smoke control system, not to raise an alarm.

All connections between the smoke detection, vent control panels and actuator mechanisms should be within an environment that provides protection from expected fire conditions.

Where any part of the control mechanism is powered by electricity, a secondary supply should be provided.

26.2.4 Smoke shafts

26.2.4.1 General

Any smoke shaft that penetrates a fire compartment should, as a minimum, maintain the same level of fire compartmentation as that which has been breached.

26.2.4.2 Natural smoke shafts situated above ground level

Smoke shafts serving storeys above ground level should conform to the following.

a) The smoke shaft should be fully open to the external air at the top and closed at the base.

b) The opening at the top of the smoke shaft should be located at least 0.5 m above any surrounding structures that fall within a 2 m radius on a horizontal plane so that it is not subject to adverse wind effects (i.e. it should always have negative wind pressure coefficients).

c) The shaft should extend a minimum length of 2.5 m above the ceiling of the highest storey which is served by the shaft.

d) The cross-sectional area (free area) of the smoke shaft should be at least 1.5 m^2, with a minimum dimension of 0.85 m in any direction.

e) The lobby or corridor vent, the opening at the head of the shaft and all internal locations (such as safety grilles) within the shaft should have a free area of at least 1.0 m^2.

f) The top of the lobby or corridor vent should be located as close to the ceiling of the lobby or corridor as is practicable, and should be at least as high as the top of the door connecting the lobby or corridor to the stairwell.

g) The lobby or corridor vents, in the closed position, should have a minimum fire and smoke resistance performance of 30 min and a leakage rate no greater than 200 $m^3/h/m^2$ when tested in accordance with BS EN 1366-2.

h) The smoke shaft should be constructed of either non-combustible materials conforming to BS 476-4 or of any material which when tested in accordance with BS 476-11 does not flame or cause any rise in the temperature on either the centre of the specimen or the furnace thermocouples. The smoke shaft should run vertically from top to bottom with no more than 4 m of the shaft at an inclined angle (max 30°).

i) No services other than those relating to the smoke shaft should be contained within the smoke shaft.

26.2.5 Mechanical smoke ventilation systems

Where a mechanical smoke ventilation system uses a shaft, it should conform to **26.2.4.2**a), f), g), h) and i).

A mechanical smoke ventilation system should demonstrate equivalent or better conditions in the lobby or corridor and stairs than the natural ventilation system that it replaces.

NOTE 1 This is usually shown by a comparative computational fluid dynamics analysis.

The design of the mechanical smoke ventilation system should limit pressure differentials so that door opening forces do not exceed 100 N at the door handle when the system is in operation.

Additional consideration should be given to door opening forces, where applicable (see **35.1.6.1**, Note 1).

A secondary power supply should be provided to the fans and all actuators and controls.

Fans should be provided with a standby fan that operates automatically upon failure of the duty fan.

NOTE 2 Further information regarding mechanical smoke ventilation systems can be found in Annex E.

Section 6: Design for construction

27 Fire resistance

*COMMENTARY ON CLAUSE **27***
*For the purposes of complying with the recommendations for means of escape in case of fire, a 30 min period of fire resistance is generally considered adequate. However, increased periods of fire resistance might be necessary: firstly to allow a fire in a dwelling to burn out while occupants of other dwellings remain in place (see **E.1** regarding stay-put strategy), and secondly to provide adequate safety for fire-fighting.*

*Elements of structure (columns, floors, walls, etc.) might not inherently possess sufficient fire resistance. A variety of methods of additional fire protection is available in the form of protective coverings, casings or membranes, but designers need to take into account the risk of mechanical or other damage. As an alternative, a sprinkler system may be fitted to limit temperatures and protect the structure (see Clause **23**).*

*For the fire resistance of compartmentation, see Clause **28**.*

27.1 General

Fire resistance should be not less than 30 min when tested in accordance with the relevant part of BS 476 for:

a) load-bearing walls, for load-bearing capacity, integrity and insulation from either side;

b) non-load-bearing walls and partitions, for integrity and insulation from either side;

c) fire doors for integrity from either side, with the exception of doors to lift wells where performance is in respect of exposure of the landing side only;

d) floors, for load-bearing capacity, integrity and insulation with respect to exposure of the underside only.

27.2 Minimum levels of fire resistance for elements of structure

27.2.1 General

When tested in accordance with the relevant part of BS 476, BS EN 1363, BS EN 1364, BS EN 1365 or BS EN 1366, the elements of structure identified in Table 2 should have a fire resistance not less than the minimum values recommended in Table 3 or Table 4. To use these tables, the fire resistance (load-bearing capacity, integrity and insulation) should first be determined from Table 2; then the fire resistance periods should be determined either from Table 2 if a specific recommendation is given, or from Table 3 or Table 4, depending on whether or not ventilation conditions are to be taken into account.

Table 3 gives recommendations for fire resistance of elements of structure and other parts of a building based upon the fuel load density and assuming an unventilated fire. Table 4 gives recommendations for fire resistance of elements of structure based upon ventilation conditions. Table 4 should be used only if the ventilation conditions can be met; if these conditions cannot be met then Table 3 should be used.

Fire loads are built into Tables 3 and 4, which reflect the normal fire loadings within a residential building.

The provision of an automatic sprinkler system significantly reduces the severity of a fire. The fire resistance of compartment walls and floors can be changed if sprinklers are provided. This is reflected in Table 4.

Traditionally, standards of fire resistance have been based upon the fire load or the fuel load density. However, there are other factors which may be taken into account.

The level of heating that an element will experience is influenced primarily by the fuel load density in the compartment, the insulation properties or thermal inertia, the geometry and ventilation conditions of the fire compartment. These variables, which determine the level of heating in a real fire, can be linked to the standard fire resistance test conditions by the concept of time equivalency (*t*-equivalency).

The *t*-equivalent period of fire resistance is a means of calculating a time for which an element in a compartment subject to a real fire would undergo a heating equivalent to the same time period in a standard furnace test. This approach models the heating effects of a real fire by taking into account the actual fuel load density, the thermal inertia of the lining materials, the compartment geometry and ventilation conditions within the compartment.

In order to determine an appropriate fire resistance period for elements of structure, the *t*-equivalent values can be used as a basis. The values obtained in this way are then factored to take into account the three purposes of structural fire resistance, namely:

a) to minimize the risk to occupants, some of whom might have to remain in the building for some length of time due to the stay put strategy (see **E.1**);

b) to reduce the risk to fire-fighters who might be engaged in search or rescue operations; and

c) to reduce the danger to people in the vicinity of the building, who might be hurt by falling debris or as a result of the impact of the collapsing structure on other buildings.

Background to Table 3

Table 3 has been derived by considering the risk assessment, fire growth rate and occupants of the building. It largely follows the guidance given in the Building Regulations 2000 – Approved Document B [11].

Background to the derivation of Table 4

Table 4 has been developed using fundamental fire safety engineering principles which use a combination of deterministic analysis combined with a risk and consequence evaluation to reflect the severity of a real fire and the threat to life safety in residential buildings.

The deterministic analysis employed a time equivalent approach based upon the validated parametric expressions given in BS EN 1991-1-2, for post-flashover fires. This considers basic factors such as the fire load density, ventilation, the thermal properties of the enclosure, compartment size and geometry. In order to cover a wide range of variables for the parametric fire, a Monte Carlo analysis was carried out involving many thousands of fires to ensure the extreme combination of variables were captured. The analysis assumes a total burn-out of the fire.

The effectiveness of sprinklers in reducing the fire severity was considered in the form of applying a multiplication factor based upon risk, to the fire load density.

From the Monte Carlo analysis, the cumulative distributions of time equivalent were subsequently analysed based upon the fundamental premise that risk = frequency × probability × consequence of failure. The frequency was linked with the height of the building following the principles of the Building Regulations 2000, and consequence of failure was linked to both the building height and risk profile of the occupancy taking account of the familiarity and mobility of the occupants within the building and the sleeping risk. The probability of failure is directly related to the cumulative distribution curves that resulted from the Monte Carlo analysis.

NOTE 1 The fire resistance periods given in Table 3 are based on the minimum levels required for life safety given in the Building Regulations 2000 – Approved Document B [11] and are not necessarily adequate for property and business continuity protection.

NOTE 2 Table 3 gives recommendations for fire resistance of elements of structure for basement storeys. These elements are not covered in Table 4.

*NOTE 3 Minimum levels of fire resistance for fire doors are given in Clause **35**.*

Table 2 **Minimum fire resistance performance**

Part of building	**Minimum provisions when tested to the relevant parts of BS 476**, in minutes[A]			**Minimum provisions when tested to the relevant European standard**, in minutes[B]			**Method of exposure**
	Load-bearing capacity[C]	**Integrity**	**Insulation**	**Load-bearing capacity**[C]	**Integrity**	**Insulation**	
Structural frame, beam or column	See Table 3 or Table 4	Not applicable	Not applicable	See Table 3 or Table 4	Not applicable	Not applicable	Exposed faces
Load-bearing wall element	See Table 3 or Table 4	Not applicable	Not applicable	See Table 3 or Table 4	Not applicable	Not applicable	Each side separately
Floor[D]							
Between a shop and a flat above	60 or see Table 3 or Table 4[F]	60 or see Table 3 or Table 4[F]	60 or see Table 3 or Table 4[F]	60 or see Table 3 or Table 4[F]	60 or see Table 3 or Table 4[F]	60 or see Table 3 or Table 4[F]	From underside[E]
Any other floor, including compartment floors	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	From underside[E]
Roof							
Any part forming an escape route	30	30	30	30	30	30	
Any roof that performs the function of a floor	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	From underside[E]
External wall							
Any part less than 1 m away from any point on the relevant boundary	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	Each side separately
Any part 1 m or more from the relevant boundary[G]	See Table 3 or Table 4	See Table 3 or Table 4	15	See Table 3 or Table 4	See Table 3 or Table 4	15	From inside the building
Any part adjacent to an external escape route	30	30	No provision[H, I]	30	30	No provision[H, I]	From inside the building

Table 2 **Minimum fire resistance performance** *(continued)*

Part of building	Minimum provisions when tested to the relevant parts of BS 476, in minutes[A)]			Minimum provisions when tested to the relevant European standard, in minutes[B)]			Method of exposure
	Load-bearing capacity[C)]	Integrity	Insulation	Load-bearing capacity[C)]	Integrity	Insulation	
Compartment wall							
Walls separating occupancies (see Clause **28**)	60 or see Table 3 or Table 4[J)]	60 or see Table 3 or Table 4[J)]	60 or see Table 3 or Table 4[J)]	60 or see Table 3 or Table 4[J)]	60 or see Table 3 or Table 4[J)]	60 or see Table 3 or Table 4[J)]	Each side separately
Any other compartment walls	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	Each side separately
Protected shaft, excluding any fire-fighting shafts							
Glazed screen separating protected shaft from lobby or corridor	Not applicable	30	No provision[K), L)]	Not applicable	30	No provision[K), L)]	Each side separately
Any other part between the shaft and a protected corridor/lobby	30	30	30	30	30	30	Each side separately
Any other part not described above	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	See Table 3 or Table 4	Each side separately
Fire-fighting shaft							
Construction separating fire-fighting shaft from rest of building	120	120	120	120	120	120	From side remote from shaft
	60	60	60	60	60	60	From shaft side
Construction separating fire-fighting stair, fire-fighting lift shaft and fire-fighting lobby	60	60	60	60	60	60	Each side separately

Table 2 **Minimum fire resistance performance** *(continued)*

Part of building	**Minimum provisions when tested to the relevant parts of BS 476**, in minutes[A)]			**Minimum provisions when tested to the relevant European standard**, in minutes[B)]			**Method of exposure**
	Load-bearing capacity[C)]	**Integrity**	**Insulation**	**Load-bearing capacity**[C)]	**Integrity**	**Insulation**	
Enclosure							
Not forming part of a compartment wall or a protected shaft, to a protected lobby or a protected corridor	30	30	30[K)]	30	30	30[K)]	Each side separately
In a flat, to a protected entrance hall or a protected landing	30	30	30[K)]	30	30	30[K)]	Each side separately
Subdivision of a corridor	30	30	30[K)]	30	30	30[K)]	Each side separately
Fire-resisting construction							
Enclosing communal areas in sheltered housing	30	30	30[K)]	30	30	30[K)]	Each side separately
Enclosing places of special fire hazard	30	30	30	30	30	30	Each side separately
Cavity barrier	Not applicable	30	15	Not applicable	30	15	Each side separately
Duct[M)]	Not applicable	30	No provision	Not applicable	30	No provision	From outside
Casing around a drainage system[N)]	Not applicable	30	No provision	Not applicable	30	No provision	From outside
Flue walls[O)]	Not applicable	Half the period given in Table 3 or Table 4 for compartment wall/floor	Half the period given in Table 3 or Table 4 for compartment wall/floor	Not applicable	Half the period given in Table 3 and Table 4 for compartment wall/floor	Half the period given in Table 3 and Table 4 for compartment wall/floor	From outside

Table 2 **Minimum fire resistance performance** *(continued)*

Part of building	**Minimum provisions when tested to the relevant parts of BS 476**, in minutes[A]			**Minimum provisions when tested to the relevant European standard**, in minutes[B]			**Method of exposure**
	Load-bearing capacity[C]	**Integrity**	**Insulation**	**Load-bearing capacity**[C]	**Integrity**	**Insulation**	
Fire door	See Table 30	See Table 30	See Table 30	See Table 30	See Table 30	See Table 30	
Construction enclosing a roadway	120	120	120	120	120	120	From the roadway side

A) Part 21 for load-bearing elements, Part 22 for non-load-bearing elements, Part 23 for fire-protecting suspended ceilings, and Part 24 for ventilation ducts. BS 476-8 results are acceptable for items tested or assessed before 1st January 1988.

B) The national classifications do not automatically equate with the equivalent classifications in the European column, therefore products cannot typically assume a European class unless they have been tested accordingly.

C) Applies to load-bearing elements only.

D) Guidance on increasing the fire resistance of existing timber floors is given in BRE Digest 208 [13].

E) If a suspended ceiling is used it should conform to **27.2.5** and **31.2**.

F) Whichever is greater.

G) The guidance in Clause **29** allows such walls to contain areas which need not be fire-resisting (unprotected areas).

H) Unless needed to meet the recommendations given in Clause **29**.

I) Except for any limitations on glazed elements given in Clause **33**.

J) Whichever is less.

K) See **33.1** for permitted extent of uninsulated glazed elements.

L) See **33.2**.

M) See **30.3**v).

N) See Figure 32.

O) See Figure 31.

Table 3 **Fire resistance periods for elements of structure (independent of ventilation conditions)**

Condition	Minimum periods of fire resistance, in minutes					
	Depth below access level of basement level		Height of top occupied storey above access level			
	>10 m	≤10 m	≤5 m	≤18 m	≤30 m	>30 m
Sprinklered[A)]	90	60	30	60	90	120
Unsprinklered	90	60	30	60	—	—

A) Sprinkler systems should conform to BS 9251.

Table 4 **Fire resistance periods for elements of structure (based on ventilation conditions[A)])**

Condition	Minimum periods of fire resistance, in minutes					
	Height of top occupied storey above access level					
	≤5 m	≤11 m	≤18 m	≤30 m	≤60 m	>60 m
Sprinklered[B)]	45	60	75	75	90	105
Unsprinklered	60	90	105	120	—	—

A) The ventilation conditions for an individual residential building are as follows:

- minimum potential area as a percentage of the floor area: 10%;
- height of opening as a percentage of the compartment height (i.e. from floor to ceiling): 30% to 90%;
- where the opening height is the weighted mean height (by ventilation area) of the potential openings. If a compartment has openings each with an area of A_1, A_2, A_3,...A_n and heights of h_1, h_2, h_3,...h_n, then the total area of the openings $A = A_1 + A_2 + A_3 + ...A_n$, and the weighted mean height, h, is given by:

$$h = \frac{A_1h_1 + A_2h_2 + A_3h_3 + ...A_nh_n}{A}$$

NOTE In the calculation of the weighted mean height it is also acceptable to selectively consider only the height(s) of the openings that achieve the minimum ventilation area.

If h is the weighted mean height of all the openings and H is the height of the compartment then h/H should be between the values given in the end column.

If these ventilation conditions cannot be met then Table 3 should be used instead.

B) Sprinkler systems should conform to BS EN 12845.

C) Where a product or system is not available to meet this recommendation, it is acceptable to use a product or system having the next highest available classification. The classification periods 75, 105 and 135 do not exist in European classification system BS EN 13501-2.

27.2.2 Buildings over 30 m high

Buildings having an occupied storey over 30 m above access level should be sprinkler-protected in accordance with BS EN 12845 or BS 9251 and Table 3.

27.2.3 Single-storey buildings

In single-storey buildings where there are compartment walls, or where an external wall is close enough to the relevant boundary to require it, structural fire resistance should be provided.

27.2.4 Roof structure

The structure of a roof, and structure that supports only a roof, does not generally require fire resistance unless the roof forms part of an escape route or functions as a floor, e.g. as a car park, or is part of a portal frame structure where the roof and the supporting stanchions form a single structural element.

27.2.5 Suspended ceilings

A suspended ceiling can contribute to the overall fire resistance of a floor/ceiling assembly. If a suspended ceiling is used it should conform to Table 5.

Table 5 **Limitations on fire-protecting suspended ceilings**

Height of building or separated part	Type of floor	Provision for fire resistance of floor	Description of suspended ceiling [A)]
M		min	
<18	Not compartment	≤60	Type W, X, Y or Z
<18	Compartment	<60	Type W, X, Y or Z
<18	Compartment	60	Type X, Y or Z
≥18	Any	≤60	Type Y or Z
No limit	Any	>60	Type Z

Any access panels provided in fire protecting suspended ceilings of type Y or Z should be secured in position by releasing devices or screw fixings, and they should be shown to have been tested in the ceiling assembly in which they are incorporated.

NOTE 1 The national classifications do not automatically equate with the equivalent European classifications, therefore products cannot typically assume a European class unless they have been tested accordingly.

NOTE 2 When a classification includes "s3, d2" this means that there is no limit set for smoke production and/or flaming droplets/particles.

A) Ceiling type and description:
W = Surface of ceiling exposed to the cavity should be Class 0 or Class 1 (national) or Class C-s3, d2 or better (European).
X = Surface of ceiling exposed to the cavity should be Class 0 (national) or Class B-s3, d2 or better (European).
Y = Surface of ceiling exposed to the cavity should be Class 0 (national) or Class B-s3, d2 or better (European). Ceiling should not contain easily openable access panels.
Z = Ceiling should be of a material of limited combustibility (national) or of Class A2-s3, d2 or better (European) and not contain easily openable access panels. Any insulation above the ceiling should be of a material of limited combustibility (national) or Class A2-s3, d2 or better (European).

28 Compartmentation

The following should be constructed with a fire resistance of not less than 60 min:

a) in houses, any wall separating one dwelling from another dwelling or separating the dwelling from accommodation that does not form part of the dwelling;

b) in flats and maisonettes situated more than 5 m above ground or access level, any floor (unless it is within a maisonette), and any wall separating a flat or maisonette from another part of the building;

c) any wall enclosing a refuse storage chamber.

A wall common to two or more buildings should be constructed as a compartment wall.

Compartment walls should be able to accommodate the predicted deflection of the floor. This can be achieved in one of the two following ways.

a) A head detail may be provided between the compartment wall and the floor, which is capable of deforming while maintaining its integrity when exposed to a fire.

Or:

b) The design of the compartment wall may be such that it maintains its integrity by resisting the additional vertical load from the floor above when forced to sag under fire conditions.

*NOTE Further information can be found in the Building Regulations 2000 – Approved Document B [11], **8.27**, Note, and Diagram 29.*

29 External fire spread and building separation

NOTE 1 A roof is not subject to the provisions in this clause unless it is pitched at an angle greater than 70° to the horizontal. Similarly, vertical parts of a pitched roof such as dormer windows (which taken in isolation may be regarded as a wall), would not need to meet these provisions unless the slope of the roof exceeds 70°. It is a matter of judgement whether a continuous run of dormer windows occupying most of a steeply pitched roof should be treated as a wall rather than a roof.

NOTE 2 The measures recommended in this clause will not necessarily protect a building from a fire in an existing building on an adjoining site. The property loss prevention aspects of the situation need to be assessed in each case.

29.1 General

The guidance given in this clause is concerned with the measures available to restrict potential to spread fire from the building of origin to a neighbouring structure. Two basic methods of fire spread between buildings are considered:

a) direct impingement of flames from one building on another; and

b) radiation (possibly supplemented by burning debris).

For buildings within 1 m of the relevant boundary (see **29.3.1**), flame spread is the main mechanism for fire spread. Beyond this distance, the mechanism for fire spread is assumed to be radiation.

Fire spread from building to building by radiation is dependent on:

1) the distance between and orientation of the building of origin and the neighbouring structure (radiator to receiver) [this is based on the principles of configuration (or view) factor];

2) the extent of the building surface capable of transmitting heat (external construction that has fire resistance is considered to have sufficient insulating properties, such that heat transfer can be ignored); and

3) the intensity (emissive power) of the source radiation.

The radiative energy emitted by the building of fire origin is dependent on the size and severity of the fire.

For the purposes of the guidance given in this clause, it is assumed that:

i) fire does not spread beyond the compartment of origin;

ii) the compartment of origin has reached flashover;

iii) all unprotected areas of one compartment will be radiating with equal intensity;

iv) radiation intensity at each unprotected area is 84 kW/m^2:

v) radiation is halved by the action of an automatic sprinkler system; and

vi) any glazing, and/or the supporting structure, in the façade of the building of fire origin has failed in terms of integrity, unless the glazing system is classified for fire resistance according to the relevant part of either BS 476 or BS EN 13501 to the same standard as the wall as recommended in Table 3, because the radiation levels will vary between insulating and non-insulating glass.

No account is taken of the attenuation of the level of radiation.

In terms of external fire spread between buildings, the acceptable risk to life is based on the relevant boundary being half the distance between buildings. Neighbouring buildings are assumed to have similar unprotected areas.

The boundary separation calculations of unprotected areas should relate to a notional boundary between the building and any other building on the site. In this instance, the distance to the relevant boundary (see **29.3**) should be taken as the actual measured distance between the buildings.

29.2 External fire spread over the external faces of buildings

External walls should be constructed using a material that does not support fire spread and therefore endanger people in or around the building.

Flame spread over or within an external wall construction should be controlled to avoid creating a route for rapid fire spread bypassing compartment floors or walls.

This is particularly important where a stay put strategy (see **E.1**) is in place. Combustible materials should not be used in cladding systems and extensive cavities.

External wall surfaces near other buildings should not be readily ignitable, to avoid fire spread between buildings.

External walls should either meet the performance criteria given in BRE Report BR 135 [N1] for cladding systems using full scale test data from BS 8414-1 or BS 8414-2, or meet the following recommendations.

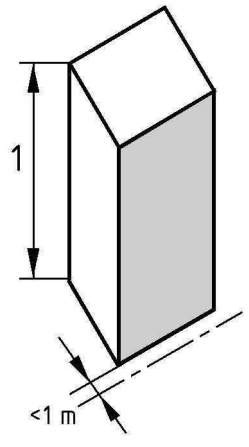
a) The external surfaces of walls should meet the provisions in Figure 19.

b) In a building with a storey 18 m or more above ground level, any insulation product, filler material (not including gaskets, sealants and similar), etc., used in the external wall construction should be of limited combustibility. This restriction does not apply to masonry cavity wall construction that conforms to Figure 27.

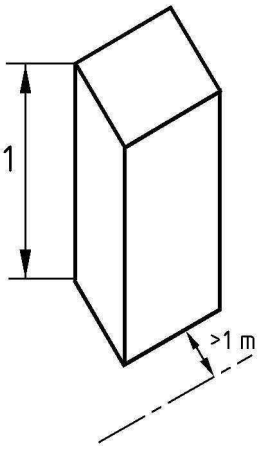
c) Cavity barriers should be provided in accordance with Clause **30**.

d) External balconies that are enclosed should be constructed and separated from other enclosed balconies with compartmentation and fire-resisting construction in accordance with Clause **30**.

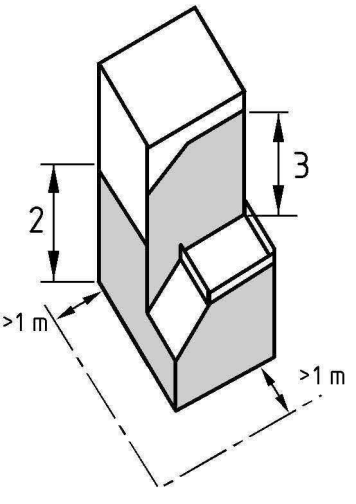
Figure 19 **Provisions for external surfaces of walls**



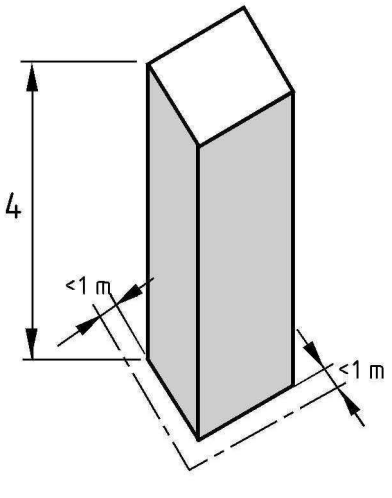
a) Any building



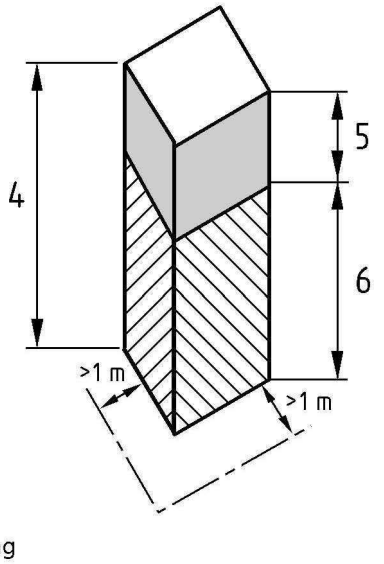
b) Any building other than c)



c) Assembly or recreation building of more than one storey



d) Any building



e) Any building

Key

1 Building height <18 m

2 Up to 10 m above ground level

3 Up to 10 m above a roof or any part of the building to which the public have access

4 Building height 18 m or more

5 Portion of building more than 18 m above ground level

6 Portion of building up to 18 m above ground level

Relevant boundary

No provision in respect of the boundaries indicated

Class 0 (national class) or class B-S3, d2 or better (European class). Profiled or flat steel sheet at least 0.5 mm thick with an organic coating of no more than 0.2 mm thickness is also acceptable.

Index (I) not more than 20 (national class) or class C-s3, d2 or better (European class). Timber cladding at least 9 mm thick is also acceptable. (The index I relates to tests specified in BS 476-6.)

NOTE 1 The national classifications do not automatically equate to the equivalent European classifications, therefore products cannot typically assume a European class unless they have been tested accordingly.

NOTE 2 When a classification includes "s3, d2", this means that there is no limit set for smoke production and/or flaming droplets/particles.

29.3 Boundaries

29.3.1 Relevant boundary

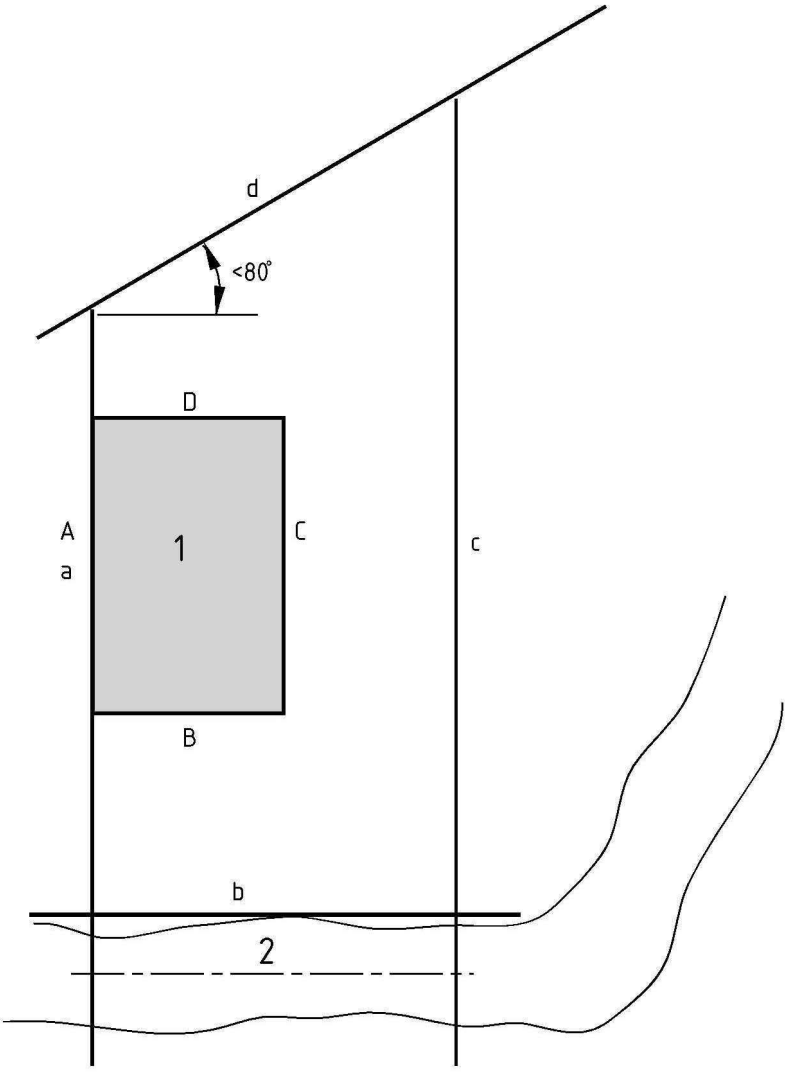
The relevant boundary is the boundary to which separation distance is measured.

NOTE A notional boundary can be a relevant boundary.

The relevant boundary is usually the site boundary. However, where a wall faces onto a space that is unlikely to be developed, such as a road, canal or river, then the boundary can be assumed to be an imaginary line half way across this feature.

A wall is treated as facing a boundary if it makes an angle of 80° or less (see Figure 20).

Figure 20 **Relevant boundaries**



Key

1 Building

2 Relevant boundary may be the centre line of a road, railway, canal or river

Boundary a is coincident with and therefore relevant to side A.

Boundary b is the site boundary.

As the building overlooks a river, canal, road or similar feature, boundary b is taken as relevant to side B.

Boundaries c and d are parallel with, or less than 80° to, sides C and D and are therefore relevant to them.

29.3.2 Notional boundary

A notional boundary is an imaginary line assumed to exist between two buildings. (See Figure 21.)

Separation between buildings on the same site that are operated/managed by the same organization can usually be ignored for life safety purposes.

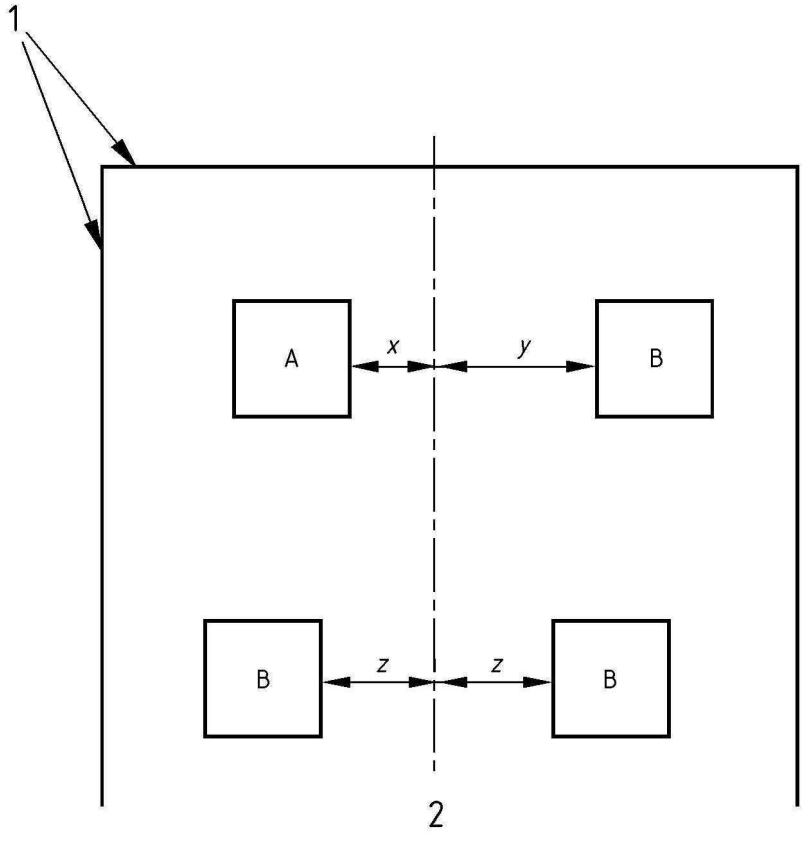
It is assumed that building A is existing and building B is new/proposed. When the need for a notional boundary is determined, its location is established according to Figure 21.

Where both buildings are new, one should be designated as existing and the recommendation for notional boundary assessed accordingly.

When considering the location of a new building, the position of the notional boundary should be set according to the amount of unprotected area (see **29.4**) in the façade of the existing building. A proposed new building should be subject to the restrictions on proximity and extent of unprotected area relevant to this notional boundary. (See **29.5.3**.)

Where both buildings are new, the notional boundary can be assumed to exist half-way between the two buildings and the location of each is set accordingly.

Figure 21 **Notional boundaries**



Key

1 Site boundary
2 Notional boundary line between buildings
A Existing building
B New/proposed building
x Notional boundary set by existing building
y New building positioned according to notional boundary
z Notional boundary half-way between two new buildings

29.3.3 Property protection between buildings on the same site

The principle of a notional boundary can be applied to any building for property protection purposes.

29.4 Unprotected area

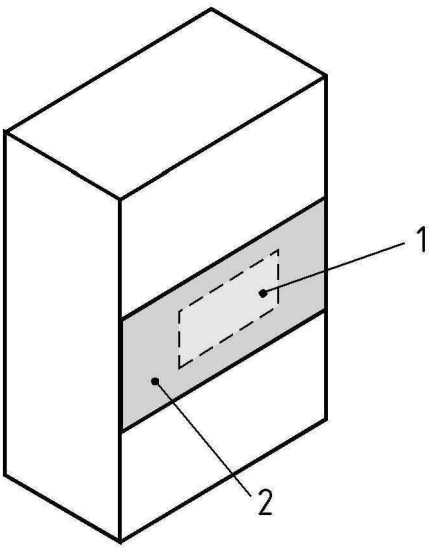
29.4.1 General

For life safety, any part of an external façade that has a period of fire resistance less than the appropriate level recommended in Table 2 is counted as an unprotected area.

Included in the unprotected area calculation is any section of external wall which has the appropriate standard of fire resistance, but has a combustible material more than 1 mm thick as its external surface. However, this section of wall is counted as having an unprotected area amounting to half the actual area of the combustible surface (see Figure 22).

The amount of unprotected area in the façades of buildings needs to be restricted according to the distance between these façades and the relevant (or notional) boundaries (see **29.5**).

Figure 22 **Combustible surface material as unprotected area**



Key

1 Area of surface counted as unprotected (50% of area of actual surface)

2 Area of combustible surface material (>1 mm thick)

The following are not considered to contribute to the extent of unprotected area:

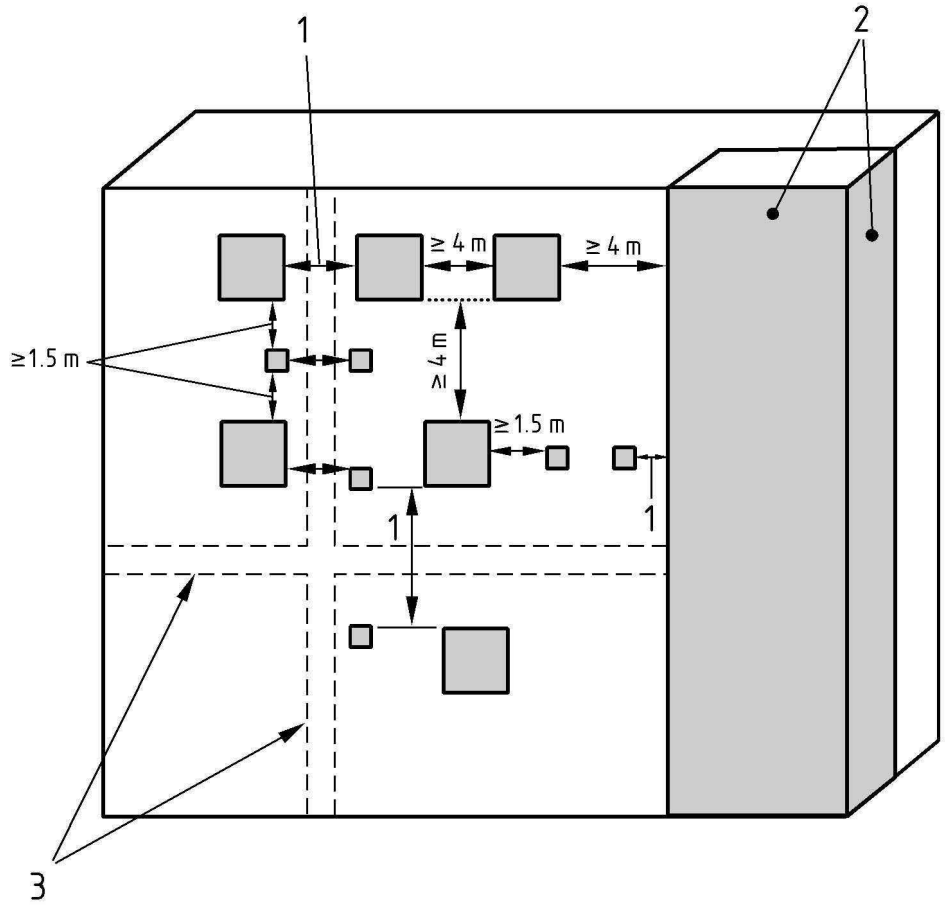
a) any part of an external wall of a stairway in a protected shaft;

b) parts of the external wall of an uncompartmented building that are more than 30 m above mean ground level;

c) small unprotected areas in an otherwise protected façade according to the constraints shown in Figure 23.

Small unprotected areas pose a negligible risk of fire spread.

Figure 23 **Exclusions from unprotected area calculations**



Key

1 Unrestricted

2 External wall of shaft that is enclosed by a minimum of 60 min fire resistance from the accommodation side

3 Compartment boundaries

29.4.2 Automatic sprinklers

Where a building is provided with automatic sprinklers, the amount of unprotected area may be doubled or the distance to the boundary for a given amount of unprotected area may be halved.

29.5 Degree of separation

29.5.1 General

*NOTE The guidance in **29.6** also relates to the separation distance between a roof and a relevant boundary.*

A building should be separated from the relevant boundaries by at least half the distance at which the total thermal radiation intensity, received from all unprotected areas in the external façade, would be 12.6 kW/m^2.

The intensity of radiation to cause ignition of wood in still air conditions is 12.6 kW/m^2. Ignition inside a receiver building is dependent on the amount of unprotected area in its façade.

The use of distance to a relevant boundary, rather than to another building, allows development on the neighbouring site without prejudice.

29.5.2 External walls within 1 m of the relevant boundary

Where an external wall is coincident with (see Figure 19) or within 1 m distance of a relevant boundary it should:

a) achieve the appropriate level of fire resistance in terms of integrity and insulation (see Table 2) from both sides when tested in accordance with BS 476-22 or BS EN 1634-1;

b) have only small, unprotected areas conforming to the limits shown in Figure 22;

c) resist direct flame impingement and high levels of radiation from the adjoining site;

d) have non-combustible surfaces;

e) be an effective barrier to a fire either inside or outside the building.

NOTE 1 These recommendations are aimed at protecting neighbouring buildings from direct flame impingement as well as radiation.

*NOTE 2 See **29.2** for guidance and recommendations on external wall materials and construction.*

29.5.3 External walls 1 m or more from the relevant boundary

Where a wall is situated at least 1 m from all points on the relevant boundary:

a) the extent of unprotected area should not exceed that given by one of the appropriate methods in **29.5.4**;

b) the rest of the wall (if any) should have the fire resistance stated in Table 3 or Table 4 (with 15 min in terms of insulation).

If a building has an automatic sprinkler system, the incidence of radiation to adjoining buildings will be much reduced. However, if a building is not sprinklered, or if property protection is a consideration, the proportion of external wall that is not fire-resisting should be limited. These limitations are based on the distance to the relevant boundary and the likely intensity of the fire.

29.5.4 Calculation methods

There are four methods for determining the maximum permissible amount of unprotected area between a building and a relevant boundary.

a) *Small residential*. Table 6 should be used to determine the appropriate boundary separation distance when the building is intended for residential use and is:

   1) no greater than 3 storeys in height; and

   2) no more than 24 m in length.

b) *Enclosing rectangles*. For details of this method refer to part 1 of BRE Report 187 [14].

c) *Aggregate notional area*. For details of this method refer to part 1 of BRE Report 187 [14].

d) *Fire engineering calculation (see BS 7974)*. Small residential unprotected area limits and boundary distances.

Table 6 **Small residential unprotected area limits and boundary distances**

Minimum distance between façade and relevant boundary	Maximum total unprotected area per compartment
m	m^2
1	5.6
2	12
3	18
4	24
5	30
6	No limit

29.6 Roofs

29.6.1 General

The recommendations in this subclause are principally concerned with the performance of roofs when exposed to fire from the outside. They limit the use, near a boundary, of roof coverings that are unlikely to give adequate protection against the spread of fire over them.

NOTE 1 The term "roof covering" is used to describe a construction that may consist of one or more layers of material, but does not refer to the roof structure as a whole.

*NOTE 2 The circumstances when a roof is subject to the provisions for space separation are explained in Clause **29**, Note 1.*

*NOTE 3 Subclauses **31.1** and **29.6.3** give guidance on the internal surfaces of roof lights as part of the internal lining of a room or circulation space;*

*NOTE 4 Guidance on roofing materials is given in **31.4**.*

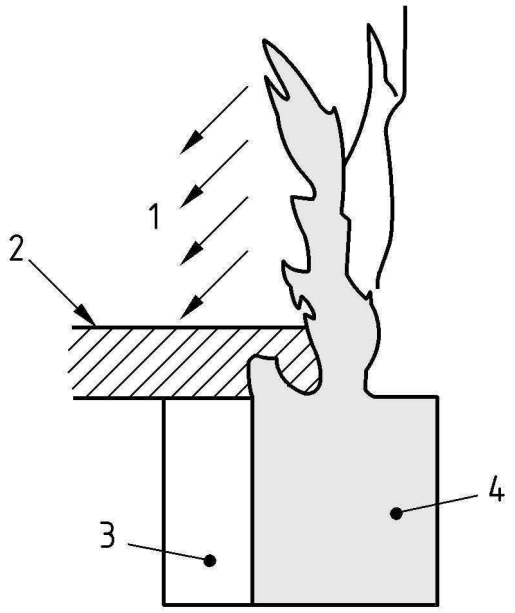
Relevant test methods for the external fire performance of roof systems are BS 476-3 and DD ENV 1187:2002, Test 4.

For restriction of fire spread over roofs the properties of a roof covering are only of relevance:

a) if the roof is close enough to a boundary to be at risk of ignition from a fire in other buildings; and

b) in the vicinity of a compartment wall, to avoid fire spread between compartments via a roof covering (see Figure 24).

Figure 24 **Roof covering adjoining line of compartmentation**



Key

1 Radiation and flame impingement
2 Roof
3 Compartment wall
4 Fire in adjoining compartment

29.6.2 Separation distances

The separation distance is the minimum distance from the roof (or part of the roof) to the relevant boundary, which may be a notional boundary. Separation distances should be as recommended in Table 7 for the appropriate type of roof covering and building use.

NOTE Advice on fire protection of thatched buildings is available from the Dorset Building Control Technical Committee [15][1)].

Table 7 **Separation distances for roof coverings**

Designation of covering of roof or part of roof[A)]	Distance of roof from any point on relevant boundary			
	Less than 6 m	At least 6 m	At least 12 m	At least 20 m
AA, AB or AC	Acceptable	Acceptable	Acceptable	Acceptable
BA, BB or BC	Not acceptable	Acceptable	Acceptable	Acceptable
CA, CB or CC	Not acceptable	Acceptable[B), C)]	Acceptable[B)]	Acceptable
AD, BD (or CD[B)])	Not acceptable	Acceptable[C)]	Acceptable	Acceptable
DA, DB, DC (or DD[B)])	Not acceptable	Not acceptable	Not acceptable	Acceptable[C)]

NOTE 1 Unwired glass at least 4 mm in thickness has an AA designation.

NOTE 2 See Table 7 for limitations on plastics roof lights.

A) The performance of roof coverings is designated by reference to the test methods given in BS 476-3 (or DD ENV 1187).

B) Not acceptable on buildings with a volume of more than 1 500 m^3.

C) Acceptable on buildings not listed in footnote B, if part of the roof is no more than 3 m^2 in area and is at least 1.5 m from any similar part, with the roof between the parts covered with a material of limited combustibility.

1) http://www.dorset-technical-committee.org.uk/reports/report1.asp

29.6.3 Roof lights

The separation distance for plastics roof lights should be as recommended in Table 8 for the appropriate classification. Roof lights should be at least 1.5 m from a compartment wall.

Plastics roof lights should not be used in protected stairways.

NOTE 1 When used in roof lights, a rigid thermoplastic sheet product made from polycarbonate or from unplasticized PVC, which achieves a Class 1 rating for surface spread of flame when tested in accordance with BS 476-7 or the European equivalent, is deemed to have an AA designation.

The roof covering material surrounding a plastics roof light should be of limited combustibility for at least 3 m distance.

The designation of external roof surfaces is defined in BS 476-3.

Products may have upper and lower surfaces with different properties if they have double skins or are laminates of different materials, in which case the more onerous distance applies.

*NOTE 2 The method of classifying thermoplastic materials is given in BS 9999:2008, **35.1.2**.*

Table 8 **Separation distance for plastics roof lights**
Dimensions in metres

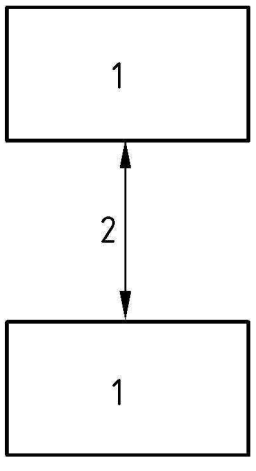
Space that roof light can serve	Minimum classification on lower surface [A]	Minimum distance from any point on relevant boundary to roof light			
		Class 3 plastics roof lights		TP(a) and TP(b) plastics roof lights	
		AD, BD, CA, CB, CC, CD	DA, DB, DC, DD	TP(a)	TP(b)
Balcony, veranda, carport, covered way or loading bay, which has at least one longer side wholly or permanently open	Class 3	6	20	—	—
	TP(b)	—	—	N/A	6
Detached swimming pool	Class 3	6	20	—	—
	TP(b)	—	—	N/A	6
Conservatory, domestic garage or outbuilding, wholly or permanently open with a maximum floor area of 40 m^2	Class 3	6	20	—	—
	TP(b)	—	—	N/A	6
Circulation space [B] (except a protected stairway)	Class 3	6	20	—	—
	TP(b)	—	—	N/A	6
Room [B]	Class 3	6 [C]	20 [C]	—	—
	TP(b)	—	—	N/A	6 [C]
Any space except a protected stairway	TP(a) rigid	—	—	6	N/A

[A] See also the limits in Table 7.

[B] Single skin roof light only, in the case of non-thermoplastic material.

[C] The roof light should also meet the provisions of Figure 25.

Figure 25 **Limitations on spacing and size of plastics roof lights having a Class 3 or TP(b) lower surface**



Key

1 Roof light, max. area 5 m^2, or group of roof lights amounting to no more than 5 m^2

2 Not less than 3 m between any two roof lights in any direction

30 Concealed spaces

30.1 General

Concealed spaces or cavities in the construction of a building provide a ready route for smoke and flame spread. This is particularly so in the case of voids in, above and below the construction of a building, e.g. walls, floors, ceilings and roof spaces. As any spread of fire or smoke is concealed, it presents a greater danger than would a more obvious weakness in the fabric of the building. Provisions can be made to restrict this by interrupting cavities which could form a pathway around a barrier to fire, subdividing extensive cavities, and closing the edges of openings.

The unseen spread of fire or smoke via voids and cavities can be a threat to occupants if it bypasses compartment boundaries or elements protecting the means of escape.

It can also be a threat to fire-fighters in large spaces if it leads to the obstruction of their line of retreat.

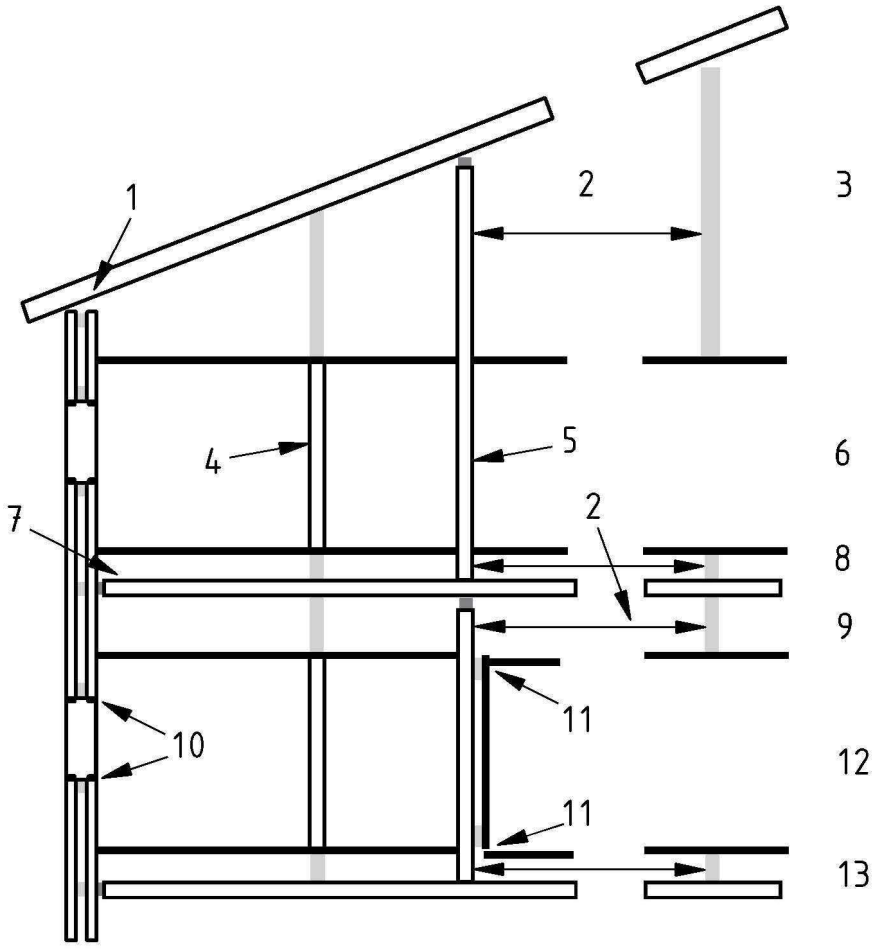
A cavity in an external wall can behave as a chimney, accelerating fire spread up a façade. This can be a threat to occupants or fire-fighters if the cavity is open to the exterior. Sealed cavities are generally not a problem.

Recommendations for cavity barriers are given in this clause for specific locations. The provisions necessary to restrict the spread of smoke and flames through cavities are broadly for the purpose of subdividing cavities, which could otherwise form a pathway around a fire-separating element and closing the edges of cavities, therefore reducing the potential for unseen fire spread.

*NOTE These should not be confused with fire-stopping details; see **35.4** and Figure 26.*

Consideration should also be given to the construction and fixing of cavity barriers provided for these purposes and the extent to which openings in them should be protected. For guidance on these issues, see **30.2**.

Figure 26 **Provisions for cavity barriers**



Key

1 Close top of cavity
2 Subdivide extensive cavities
3 Roof space
4 Wall forming bedroom or protected escape routes
5 Compartment wall
6 Accommodation
7 Compartment floor
8 Floor space
9 Ceiling space
10 Close around openings
11 Close around edges
12 Accommodation
13 Floor space

Cavity barrier (30 min integrity/15 min insulation as in Table 2)

Fire-stopping (same fire resistance as compartment – not cavity barrier)

30.2 Provision of cavity barriers

30.2.1 Junctions and compartment walls

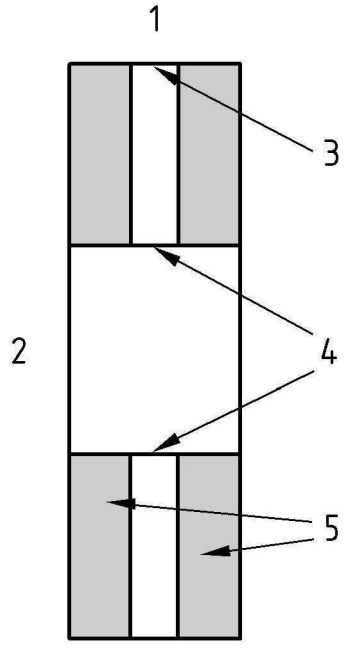
Cavity barriers should be provided to close the edges of cavities, including around openings.

Cavity barriers should also be provided:

a) at the junction between an external cavity wall (except where the cavity wall conforms to Figure 27) and every compartment floor and compartment wall; and

b) at the junction between an internal cavity wall (except where the cavity wall conforms to Figure 27) and every compartment floor, compartment wall, or other wall or door assembly which forms a fire-resisting barrier.

Figure 27 **Cavity wall excluded from provisions for cavity barriers**



NOTE 1 Cavities may be closed with a material that might not conform to the various recommendations in Table 2 for cavity barriers. The purpose of closing the cavity is to restrict airflow within the cavity.

NOTE 2 Cupboards for switch boards, service boxes, service panels etc. may be installed provided that:

- *there are no more than two cupboards per compartment;*
- *the openings in the outer wall leaf are not more than 800 mm × 500 mm for each cupboard; and*
- *the inner leaf is not penetrated except by a sleeve not more than 80 mm × 80 mm, which is fire-stopped.*

NOTE 3 Combustible materials may be placed within the cavity.

Key

1 Section through cavity wall
2 Opening
3 Close cavity at top of wall (unless cavity is totally filled with insulation)
4 Close cavity around opening
5 Two leaves of brick or concrete each at least 75 mm thick

It is important to continue any compartment wall up through a ceiling or roof cavity to maintain the standard of fire resistance, therefore compartment walls should be carried up full storey height to a compartment floor or to the roof as appropriate (see BS 9999:2008, **32.5.2** to **32.5.5**). It is therefore not appropriate to complete a line of compartmentation by fitting cavity barriers above the compartment wall.

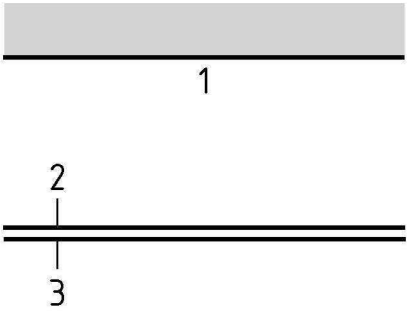
30.2.2 Protected escape routes

For a protected escape route, a cavity that exists above or below any fire-resisting construction because the construction is not carried to full storey height or, in the case of a top storey, to the underside of the roof covering, should either be:

a) fitted with cavity barriers on the line of the enclosure(s) to the protected escape route; or

b) for cavities above the fire-resisting construction, enclosed on the lower side by a fire-resisting ceiling having fire-resistance tested in accordance with the applicable parts of BS 476 for exposure above and below the ceiling and which extends throughout the building, compartment or separated part (see Figure 28).

Figure 28 **Fire-resisting ceiling below concealed space**



The ceiling should:

- *have at least 30 min fire resistance;*
- *be imperforate, except for an opening described in **35.4**;*
- *extend throughout the building or compartment; and*
- *not be easily demountable.*

NOTE 1 The national classifications do not automatically equate to the equivalent European classifications, therefore products cannot typically assume a European class unless they have been tested accordingly.

NOTE 2 When a classification includes "s3, d2", this means that there is no limit set for smoke production and/or flaming droplets/particles.

Key

1 Cavity

2 Ceiling surface/product exposed to cavity – Class 1 (national) or Class C-s3, d2 or better (European)

3 Soffit of ceiling – Class 0 (national) or Class B-s3, d2 or better (European)

30.2.3 Double-skinned corrugated or profiled roof sheeting

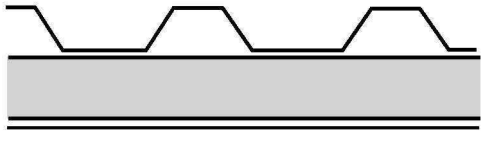
Cavity barriers need not be provided between double-skinned corrugated or profiled insulated roof sheeting, if the sheeting is a material of limited combustibility and both surfaces of the insulating layer have a surface spread of flame of at least Class 0

or 1 (national) or Class Cs3, d2 or better (European) and make contact with the inner and outer skins of cladding (see Figure 29).

*NOTE 1 See also BS 9999:2008, **32.5.5** regarding the junction of a compartment wall with a roof.*

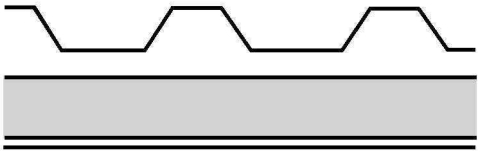
NOTE 2 When a classification includes "s3, d2", this means that there is no limit set for smoke production and/or flaming droplets/particles.

Figure 29 **Provisions for cavity barriers in double-skinned insulated roof sheeting**



The insulation should make contact with both skeins of sheeting. See also Figure 25 regarding the need for a fire break where such roofs pass over the top of a compartment wall.

a) Acceptable without cavity barriers



b) Cavity barriers necessary

30.2.4 Cavities affecting alternative escape routes

Cavity barriers might be needed where corridors are be subdivided to prevent alternative escape routes being simultaneously affected by fire and/or smoke (see BS 9999:2008, **17.3.11.3** and Figure 8).

30.2.5 Separation of bedrooms

A cavity that exists above or below partitions between bedrooms because the enclosures are not carried to full storey height, or, (in the case of the top storey) to the underside of the roof covering, should either be:

a) fitted with cavity barriers on the line of the partitions; or

b) for cavities above the partitions, enclosed on the lower side by a fire-resisting ceiling which extends throughout the building, compartment or separated part.

30.3 Construction and fixings for cavity barriers

Every cavity barrier should be constructed to provide at least 30 min fire resistance. It may be formed by any construction provided for another purpose if it meets the provisions for cavity barriers (see Table 3). Cavity barriers in a stud wall or partition, or provided around openings, may be formed of:

a) steel at least 0.5 mm thick;

b) timber at least 38 mm thick;

c) polythene-sleeved mineral wool, or mineral wool slab, in either case under compression when installed in the cavity; or

d) calcium silicate, cement-based or gypsum-based boards at least 12 mm thick.

NOTE 1 Cavity barriers provided around openings may be formed by the window or door frame if the frame is constructed of steel or timber of the minimum thickness in a) or b) above as appropriate.

A cavity barrier should, wherever possible, be tightly fitted to a rigid construction and mechanically fixed in position. Where this is not possible (for example, in the case

of a junction with slates, tiles, corrugated sheeting or similar materials) the junction should be fire-stopped. Recommendations for fire-stopping are given in **35.4**.

Cavity barriers should also be fixed so that their performance is unlikely to be made ineffective by:

1) movement of the building due to subsidence, shrinkage or temperature change and movement of the external envelope due to wind; or
2) collapse in a fire of any services penetrating them; or
3) failure in a fire of their fixings (but see note below); or
4) failure in a fire of any material or construction which they abut. (For example, if a suspended ceiling is continued over the top of a fire-resisting wall or partition and direct connection is made between the ceiling and the cavity barrier above the line of the wall or partition, premature failure of the cavity barrier can occur when the ceiling collapses. However, this might not arise if the ceiling is designed to provide fire protection of 30 min or more.)

NOTE 2 Where cavity barriers are provided in roof spaces, the roof members to which they are fitted are not expected to have any fire resistance for the purpose of supporting the cavity barrier(s).

Any openings in a cavity barrier should be limited to those for:

i) doors which have at least 30 min fire resistance (see **35.1**) and are fitted in accordance with the provisions of **35.1**;
ii) the passage of pipes which meet the provisions in **35.4**;
iii) the passage of cables or conduits containing one or more cables;
iv) openings fitted with a suitably mounted automatic fire damper (see BS 9999:2008, **33.4.5**); and
v) ducts which (unless they are fire-resisting) are fitted with a suitably mounted automatic fire damper where they pass through the cavity barrier.

If a cavity barrier is provided above a partition separating bedrooms in accordance with **30.2.5** which do not need to be fire resisting partitions then i) to v) need not apply. However, openings in the barrier should be kept to a minimum and any penetrations should be sealed to restrict the passage of smoke.

31 Materials

31.1 Internal linings

Although they are unlikely to be the first materials to ignite, the choice of materials for wall and ceilings can significantly affect the spread of a fire and its rate of growth and should be selected carefully. Selecting internal linings for circulation spaces having non-flammable characteristics that can delay the spread of fire is particularly important so that the occupants' means of escape is not compromised.

The internal linings within circulation spaces within dwellings should either conform to Class 1 surface spread of flame in accordance with BS 476-7, when tested in accordance with BS 476-6; or conform to Class C-s3, d2 when tested in accordance with BS EN 13501-1.

The internal linings within other circulation spaces, including the common areas of blocks of flats should meet national Class 0 (national) or Class B-s3, d2 (European).

Small rooms of area not more than 4 m^2 should have internal linings conforming to Class 3 (national) or Class D-s3,d2 (European).

*NOTE Further guidance on the classification of linings together with limitations on their use is given in BS 9999:2008, Clause **35**.*

31.2 Suspended or stretched-skin ceilings

The ceiling of a room may be constructed either as a suspended or stretched skin membrane from panels of a thermoplastic material of the TP(a) flexible classification, provided that it is not part of a fire-resisting ceiling. Each panel should not exceed 5 m^2 in area and should be supported on all its sides.

31.3 Non-combustible materials

Non-combustible materials should be used in the following situations:

a) ladders forming part of an escape route in ancillary accommodation identified as higher fire risk;

b) refuse chutes;

c) suspended ceilings and their supports where the undivided cavity exceeds 40 m in extent (see also BS 9999:2008, **34.3**);

d) as a sleeving where a pipe penetrates a compartment wall or floor [see BS 9999:2008, **33.4.17**c)];

e) walls of a flue that penetrates a compartment floor or wall (see BS 9999:2008, Figure 29);

f) construction of an open-sided car park.

31.4 Special roof coverings

Special roofing types include:

- air-supported structures;
- flexible membrane roofs;
- PTFE-coated roof membranes.

Any flexible membrane covering a structure, other than an air-supported structure, should conform to BS 7157:1989, Annex A.

Guidance on the use of PTFE-coated materials for tension membrane and similar roofs and structures is given in BRE Report 274 [16].

32 Service ducts, pipes and shafts

32.1 Service shafts

Lift wells (other than within a protected stairway) should be enclosed throughout their height with fire-resisting construction.

Service shafts and other vertical ducts should be enclosed throughout their height with fire-resisting construction. Service ducts should conform to BS 8313 and ventilation and air conditioning duct-work should conform to **32.2**. Access hatches for service shafts should not be situated within a means of escape staircase unless providing smoke control or pressurization for that staircase.

NOTE The penetration of fire-resisting floors by services and vertical shafts can reduce the safety of occupants and create points of weakness in the compartmentation of the building.

Wherever practicable, services should not be run within common access corridors, including the corridor access for fire-fighting shafts. Where this is unavoidable, they should be run in a fire separating construction or in a secured fire-resisting method.

32.2 Installation of ductwork systems

When ductwork systems are installed within a building it is important that the ductwork does not assist in transferring fire and smoke through the building and put at risk the protected means of escape from the accommodation areas.

Any exhaust points should be sited so as not to further jeopardize the building in the event of a fire, i.e. away from final exits, combustible building cladding or roofing materials, and openings into the building.

Ventilation ducts, and their associated plant supplying or extracting air directly to or from a protected escape route, should not also serve other areas. A separate ventilation system should be provided for each protected stairway.

Where a ductwork system serves more than one part of a compartment or fire separated protected escape route, smoke detector operated fire dampers should be provided where ductwork enters each fire separated or smoke separated section of the escape route.

*NOTE See BS 9999:2008, **33.4.5 f**or further information.*

The smoke detector operated fire dampers should be caused to close if smoke is detected. Any ductwork passing through an accommodation space should be fire-resisting, i.e. the ductwork should be constructed in accordance with Method 2 or Method 3 given in BS 9999:2008, **33.4.3.3** and **33.4.3.4**.

Any ductwork passing through a protected stairway, lobby or corridor without an opening into that area should be fire-resisting, i.e. the ductwork should be constructed in accordance with Method 2 or Method 3 given in BS 9999:2008, **33.4.3.3** and **33.4.3.4**.

In single stairway buildings, the ductwork enclosure should be imperforate where it passes through the stairway or any protected lobby or protected corridor.

In multi-stairway buildings, ductwork access panels within protected escape routes should not reduce the fire resistance of the ductwork enclosure from the inside.

*NOTE See also BS 9999:2008, **33.4.9**, for information and recommendations regarding transfer grilles.*

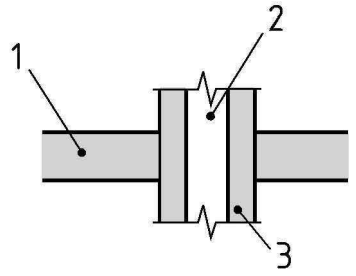
Where a service duct enclosure is provided with a level of fire resistance in accordance with BS 8313, and the service duct itself is also used for ventilation purposes, any grille or opening through the enclosure for ventilation purposes should be protected by a fire damper.

Service pipes containing toxic or flammable substances should not be routed in, or through, ductwork provided for ventilation purposes.

32.3 Flues

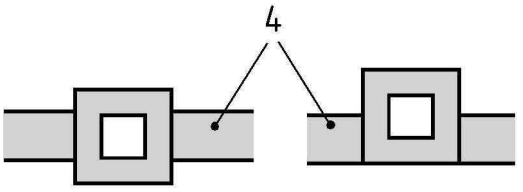
If a flue, or duct containing flues or appliance ventilation duct(s), passes through a compartment wall or compartment floor or is built into a compartment wall, each wall of the flue or duct should have a fire resistance of at least half that of the wall or floor (see Figure 30).

Figure 30 **Flues and compartment walls and floors**



Flue walls should have a resistance of at least one half of that required for the compartment wall or floor, and should be of non-combustible construction.

a) Flue passing through compartment wall or floor



In each case flue walls should have a fire resistance at least one half of that required for the compartment wall, and should be of non-combustible construction.

b) Flue built into compartment wall

Key

1 Compartment wall or floor

2 Flue

3 Flue wall

4 Compartment wall

32.4 Protection of pipe openings

Pipework that breaches compartment walls and compartment floors can compromise compartmentation if fire protection is not provided to the pipework. Pipes may be constructed from many different materials and all these materials behave differently in a fire situation. The size of the opening is a major factor in the spread of heat and flame and should therefore be restricted when a pipe breaches a compartment wall or compartment floor. When it is not possible to maintain pipe diameters below the diameter recommended in Table 9, then alternative methods of protection are available.

Table 9 **Maximum nominal interior diameter of pipes passing through a compartment wall/floor**
Dimensions in millimetres

Situation	Maximum nominal internal diameter		
	a) Non-combustible material[A)]	b) Lead, aluminium, aluminium alloy, PVC[B)], fibre-cement	c) Any other material
1) Structure (but not a wall separating buildings) enclosing a protected shaft which is not a stairway or a lift shaft	160	110	40
2) Compartment wall or compartment floor between flats	160	160 (stack pipe)[C)] 110 (branch pipe)[C)]	40
3) Any other situation	160	40	40

[A)] A non-combustible material (such as cast iron or steel) which, if exposed to a temperature of 800 °C, will not soften or fracture to the extent that flame or hot gas will pass through the wall of the pipe.

[B)] uPVC pipes conforming to BS 4514 and uPVC pipes conforming to BS 5255.

[C)] These diameters are only in relation to pipes forming part of an above-ground drainage system and enclosed as shown in Figure 31. In other cases the maximum diameters against situation 3) apply.

Pipes that pass through a compartment wall or compartment floor (unless the pipe is in a protected shaft), or through a cavity barrier, should be in accordance with one of the following alternatives.

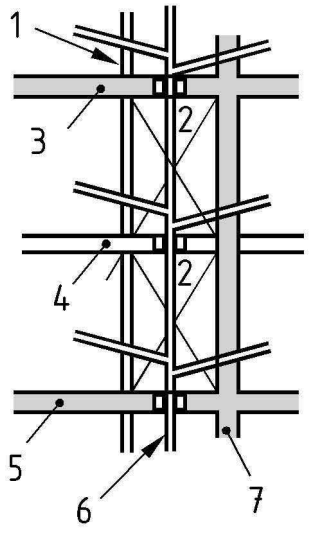
a) For proprietary seals of any pipe diameter, a proprietary sealing system may be provided that has been shown by test to maintain the fire resistance of the wall, floor or cavity barrier.

b) For pipes with a restricted diameter, where a proprietary sealing system is not used, fire-stopping may be used around the pipe (see **35.4**), keeping the opening as small as possible. The nominal interior diameter of the pipe should be not more than the relevant dimensions given in Table 9. The diameters given in Table 9 for pipes of material b) used in situation 2) assume that the pipes are part of an above-ground drainage system and are enclosed as shown in Figure 31. If they are not, the smaller diameter given in situation 3) should be used.

c) A pipe of lead, aluminium, aluminium alloy, fibre-cement or PVC, with a maximum nominal diameter of 160 mm, may be used with a sleeving of non-combustible pipe as shown in Figure 32.

Tests carried out in accordance with BS EN 1366-3 are specific to service penetrations. Ad hoc tests should only be used where directly relevant to the application.

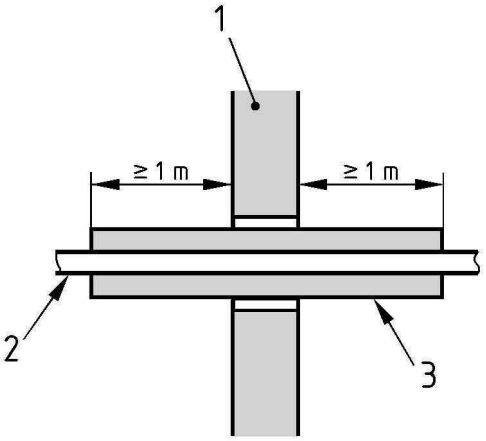
Figure 31 **Enclosure for drainage or water supply pipes**



Key

1 Casing
2 Enclosure
3 Compartment floor carried through to seal enclosure – provide fire-stopping between stack pipe and floor
4 Intermediate floor carried through to seal enclosure – provide fire-stopping between stack pipe and floor
5 Compartment floor
6 Stack pipe
7 Compartment wall

Figure 32 **Pipes penetrating structure**



Key

1 Structure
2 Pipe specification (b) (see Table 9)
3 Sleeve (or pipe) of specification (a) (see Table 9) to be in contact with pipe

33 Glazed fire-resisting elements

33.1 General

The fire resistance of a fire-resisting glazed assembly is influenced by a number of factors, such as:

a) type of glass and function;
b) pane size and shape;
c) glazing layout and number of panes;
d) orientation of the glazed element;
e) framing and framing junctions;
f) glazing seal;
g) beads and bead fixings; and
h) fixing of the assembly to the support structure.

The class of fire resistance of the glazed element used in a fire-resistant construction depends on whether:

1) the glazed element is there to provide the same level of protection as the remainder of the enclosure in which it is situated to act as a barrier to fire spread; or

2) it is sufficient for the glazed element to provide protection against the passage of flames and hot gases (i.e. integrity, non-insulation performance) sufficient for the purpose of protected escape.

The level of fire resistance of a representative example of the glazed element should be tested in accordance with BS 476-22 or classified in accordance with BS EN 13501-2. Where the test evidence is not exactly the same as the glazed element to be installed (e.g. where the proposed glass size is greater than that tested) then a Notified Body, or an otherwise appropriately qualified body, might be able to undertake an assessment based on test evidence, or an extended application in accordance with the relevant CEN EXAP standard. Assessments should only be based on relevant and applicable test evidence for the system under consideration. The proposed glazing design should be within the scope of the available test evidence and the system should be specified and installed as tested and classified. There should be no changes in tested components unless authorized by the responsible glazing manufacturer.

For façade design, fire-resisting glazed elements may be used at appropriate locations to minimize the risk of fire spread in the same building from floor to floor, or on the same floor across re-entrant corners, by preventing flame break-out and break-in. The recommended distance for the application of fire-resisting glazing either side of such a re-entrant corner, or on either side of a protected stairway with an external glazed wall, is 1 800 mm.

*NOTE 1 See BS 9999:2008, **18.2.3** for further information.*

NOTE 2 Specific guidance for all-glass constructions in atria is given in BS 9999:2008, Annex B.

Where applicable, glass in fire-resisting glazed elements should conform to BS 6262-4 for impact safety, BS 6180 if used in a barrier, and the relevant part of BS 5234 if used in a partition.

All fire-resisting glass should be marked, as a minimum, with an identifiable name or trademark, or other mark, capable of unambiguous identification to the manufacturer or supplier. For example, this could be a product name, manufacturer's name or code. Installations should be in accordance with glazing guidelines provided by the manufacturer, and the glass should be installed in such a way that the identification mark is visible after installation. Appropriate documentation to confirm the system level of fire resistance should be provided on completion of the installation.

33.2 Limitations of non-insulating fire-resisting glazing

Restrictions apply to the use of non-insulating fire-resisting glazed elements because of the risks that they pose from their relative inability to provide adequate protection against transmitted heat. In this respect there are four possible hazards to consider, even if the integrity of the glazed element as a flame and smoke barrier is maintained. These are:

a) direct exposure to potentially high levels of radiant heat with the risk of burns to exposed skin;

b) convective heating of the atmosphere in the escape way;

c) smouldering smoke generation (before ignition) from floor coverings, fixtures and fittings in the corridor;

d) secondary ignition and flaming of fixtures and fittings in the escape way.

To minimize the risk of ignition of adjacent floorings or floor coverings, non-insulating glazed areas in fire-resisting structures should be at least 100 mm above floor level. The risk of smouldering combustion before flaming occurs can also be heightened on the nominally protected side of non-insulated glazing under developed fire conditions. It might therefore be appropriate to raise the limiting height above floor level for non-insulated fire-resisting glass (e.g. from 100 mm to at least 500 mm) to minimize the risk of smoke generation in the escape route affecting safe escape or fire-fighter access, depending on the anticipated fire load and escape conditions.

Glazed elements that are fire-resisting in terms of integrity only (i.e. non-insulating) should be in accordance with the limitations given in Table 10.

In the case of houses, glazed elements that are fire-resisting in terms of integrity only may be used in fire-resisting screens and in door panels and fanlights for fire and smoke separation on the basis that escape to a place of ultimate safety outside the building is relatively short and direct compared with other building types.

In the case of buildings containing flats or maisonettes, glazed elements that are fire-resisting in terms of integrity only should conform to the limitations given in Table 10, appropriate to their position for fire and smoke separation on the basis that escape to a place of ultimate safety outside the building is relatively short and direct compared with other building types.

NOTE 1 For mixed-use buildings, see BS 9999:2008, Table 29.

Glazed elements that are fire-resisting in terms of both integrity and insulation to the required level may be used without restriction.

*NOTE 2 See BS 9999:2008, **21.2**, regarding fire-fighting shafts.*

Similar considerations also govern the use of integrity with insulation fire-resisting glazed elements, instead of integrity only fire-resisting glazed elements, for the protection of property against fire, when fire exposure may be prolonged.

33.3 Glazed screen separating protected shaft from lobby or corridor

A non-insulated fire-resisting glazed screen may be incorporated in the enclosure to a protected shaft between a stair and a lobby or corridor which is entered from the stair if the following conditions are satisfied:

a) the standard of fire resistance for the stair enclosure is not more than 60 min; and

b) the glazed screen:

   1) has at least 30 min fire resistance in terms of integrity; and

   2) meets the limits on areas of non-insulated glazing given in Table 10;

c) the lobby or corridor is enclosed to at least a 30 min standard.

Table 10 **Limitations on non-insulating fire-resisting glazed elements installed in buildings containing flats or maisonettes**

Position of glazed element	Maximum total glazed area	
	Fire-resisting walls[A)]	Any leaf of a fire door[B)]
Part of the enclosure of a protected entrance hall or protected landing within a flat or maisonette	In fixed fanlights only	Unlimited above 1.1 m in height
Between a flat or maisonette and a protected lobby, a common corridor or a protected stairway	Nil	Nil
Between a protected lobby or common corridor and a common stair	Unlimited above 0.1 m in height	Unlimited above 0.1 m in height
Subdividing corridors	Unlimited above 0.1 m in height	Unlimited above 0.1 m in height
Between a protected lobby or an internal common corridor and a communal lounge, a common amenity area or a low voltage or extra-low voltage service installation room	Unlimited above 1.1 m in height	Unlimited above 1.1 m in height
Between a common stair and ancillary accommodation	Nil	Nil
Between an escape route and a higher fire risk area of ancillary accommodation	Nil	Nil
Between a dwelling and an open access balcony with escape in one direction only	Unlimited above 1.1 m in height	Unlimited above 1.1 m in height

A) The size of individual panes of glass making up the permitted total glazed area should be limited to sizes that have been satisfactorily demonstrated to conform to the integrity criterion for an appropriate duration under test. Similarly, any mullions or transoms, especially between adjacent glazed elements, should also be proven.

B) The suitability of any door with respect to incorporating fire-resisting glass should be established before glazing. Moreover, not all doors can be glazed without affecting the integrity of the door assembly.

33.4 Glazing and the effects of sprinklers

Sprinklers reduce both the growth and the size of a fire. It might be possible either to reduce the required fire resistance of an element of glazing, or to use non-insulated fire resisting glazing, where sprinklers are fitted. This should be subject to a risk assessment, which should include an assessment of all the elements of the glazing system, the protection offered by the sprinklers, and the criticality of the element of glazing to the fire safety of the building.

Where sprinklers are provided to directly protect an element of glazing, then this should also be included in the assessment.

34 Active fire curtain/barrier assemblies

Active fire curtain/barrier assemblies used in life safety and property protection applications can be horizontal, vertical or angled. For example, in certain end-use applications, these could be used in place of fire doors, non-loadbearing walls, non-loadbearing ceilings and glazed elements.

NOTE 1 The type of active fire curtain/barrier assembly permitted in a fire-resisting construction depends on whether the barrier needs to afford the same protection as the remainder of the enclosure in which it is situated, or whether it is only necessary for the fire barrier to afford protection against the passage of flames, hot gases and smoke at ambient temperatures.

Active fire curtain/barrier assemblies in dwellings should:

a) be deployed by an appropriate automatic fire detector;

b) be capable of multi-stage deployment to initially act as a smoke barrier relevant to the risk, where deemed necessary;

c) have emergency retract buttons relevant to the risk;

d) have built in anti-obstruction detectors, full coverage of area to prevent furniture being positioned in the barrier's path;

NOTE 2 These need to have timers set for a maximum of 10 min.

e) have controls and associated wiring that is appropriate to the risk and type;

f) have deployment speeds in ranging between 0.06 m/s and 0.15 m/s;

g) achieve the same standard of smoke separation as the element of structure being replaced;

h) have automatic monthly testing and logging;

i) have monitoring of the battery condition;

j) have display panels having visual and audible provision to:

1) indicate any faults; and

2) indicate if the batteries (for emergency retract) need replacing.

NOTE 3 Further information regarding fire curtain/barrier assemblies can be found in PAS 121.

35 Openings

35.1 Fire doors

35.1.1 General

Doors in fire-separating elements are one of the most important features of a fire protection strategy, and it is important to select a fire door that is suitable for its intended purpose. They are normally self-closing unless they give access to cupboards or service risers, in which case they should be kept locked. The reliability of a fire door, especially in heavily-trafficked places, can be improved by hold-open devices that release the door automatically in response to a fire.

Fire doors have at least one of two functions:

a) to protect escape routes from the effects of fire so that occupants can reach a final exit;

b) to protect occupants, fire-fighters and the contents and/or structure of a building by limiting the spread of fire.

Fire doors need to have a certain level of integrity but they do not usually need to be insulated, as there is no fire load immediately next to a door (it is normally part of a circulation route) for fire to spread by contact with the door surface. However, if fire doors are not insulated there needs to be some limitation on the proportion of doorway openings in compartment walls and, with the exception of walls less than 5 m in length, no more than 25% of the length of a compartment wall should consist of door openings.

35.1.2 Installation

The failure of doors under fire conditions usually occurs either at the gap between the door and the frame, or at one or more of the points where building hardware is fixed (particularly at the hinges or lock positions) or, in the case of glazed doors,

at the line of the junction between the glazed area and the rest of the door. For this and other reasons, it is particularly important to ensure that doors installed on site conform, in dimensions and workmanship, to the manufacturer's specification for the appropriate fire resistance test report/assessment. Doors should be hung to ensure a good fit to the frame when closed and the junction between door assembly and surrounding structure should be adequately sealed.

NOTE 1 Recommendations for the specification, installation and maintenance of hinged or pivoted pedestrian fire doors are given in BS 8214.

Security requirements should not override the need to provide adequate means of escape. All security locks and/or devices fitted to a dwelling entrance or alternative exit door should be openable from the inside by a single manual operation not requiring the use of a key.

Integrated elements such as locks, letter plates and security viewers should not reduce the fire resistance of the door.

NOTE 2 Advice on the selection of door furniture and the positioning and size of cut-out is available from the Association of Builders' Hardware Manufacturers' "Code of practice for hardware essential to the optimum performance of fire-resisting timber doorsets" [17] and the Door and Hardware Federation and Guild of Architectural Ironmongers' "Code of practice for fire and escape doors" [18].

Doors forming part of the means of escape from, and within, the building should:

a) be fitted only with simple fastenings that can be operated from the escape side of the door without the use of a key;

b) be hung clear of any change of floor level;

c) be hung so that they do not reduce the effective width of any escape route across a landing;

d) if opening into a corridor, be recessed to the full width of the door;

e) where hung to swing both ways (double swing), or subdividing corridors, be provided with a minimum of a vision panel;

NOTE 3 For further information, see BS 8300.

f) open to an angle not less than 90°.

35.1.3 Fire resistance

NOTE 1 Fire authorities and insurance companies might require a higher fire performance than that recommended in this British Standard.

NOTE 2 Guidance of performance appropriate to insurance requirements can be found in the LPC design guide for the fire protection of buildings [19]. This addresses the use of uninsulated doors and criteria for longevity and robustness in normal usage.

In any dwelling, the minimum fire resistance should be FD 30 for a fire door forming part of the enclosure of any of the following:

a) a protected escape route within a house;

b) a protected entrance hall within a flat;

c) a protected entrance hall and landing within a maisonette;

d) a partition separating living and sleeping accommodation.

For other locations, the fire resistance of fire doors should be not less than the value given in Table 11 for the appropriate location. Unless otherwise recommended, the fire resistance should in all cases be not less than 30 min from either side, except in the case of doors to lift wells, where the fire resistance only needs to be from the landing side.

NOTE 3 In Table 11, where a fire door also needs to provide smoke control it has the suffix "S".

Table 11 **Provisions for fire doors**
Values in minutes

Position of door		Minimum fire resistance of door in terms of integrity[A]	
		When tested in accordance with BS 476-22[B]	**When tested in accordance with BS EN 1634-1**
1	In a compartment wall separating buildings	As for the wall in which door is fitted, but not less than 60 min	As for the wall in which the door is fitted, but not less than 60 min
2	In a compartment wall:		
a	if it separates a flat from a space in common use	FD 30S[C]	E 30 S_a[C]
b	enclosing a protected shaft forming a stairway situated wholly or partly above the adjoining ground	FD 30S[C]	E 30 S_a[C]
c	enclosing a protected shaft forming a stairway not described in 2b)	Half the period of fire resistance of the wall in which it is fitted but not less than 30 min and with suffix S[C]	Half the period of fire resistance of the wall in which it is fitted but not less than 30 min minimum and with suffix S_a[C]
d[D]	enclosing a protected shaft forming a lift or service shaft	Half the period of fire resistance of the wall in which it is fitted but not less than 30 min	Half the period of fire resistance of the wall in which it is fitted but not less than 30 min
e	not described in 2a), 2b), 2c) or 2d)	As for the wall it is fitted in, but with suffix S if the door is used for progressive horizontal evacuation	As for the wall it is fitted in, but add S_a[C] if the door is used for progressive horizontal evacuation
3	In a compartment floor	As for the floor in which it is fitted	As for the floor in which it is fitted
4	Forming part of the enclosure of:		
a	a protected stairway (except where described in item 10)	FD 30S[C]	E 30 S_a[C]
b	the separation between upward and downward flights of a basement stair	FD 30S[C]	E 30 S_a[C]
c[D]	lift shaft, which does not form a protected shaft in 2b), 2c) or 2d)	FD 30	E 30
5	Forming part of the enclosures of:		
a	a protected lobby approach (or protected corridor) to a stairway, except for a fire-fighting stair	FD 30S[C]	E 30 S_a[C]
b	any other protected corridor, or	FD 30S[C]	E 30 S_a[C]
c	a protected lobby approach to a lift shaft	FD 30S[C]	E 30 S_a[C]

Table 11 **Provisions for fire doors** *(continued)*
Values in minutes

Position of door		Minimum fire resistance of door in terms of integrity[A]	
		When tested in accordance with BS 476-22[B]	When tested in accordance with BS EN 1634-1
6	Forming part of the enclosures of:		
a	evacuation lifts or refuges, except for lift landing doors	FD 30S[C]	E 30 S_a[C]
b[D]	evacuation lifts, where the door is a lift landing door	FD 30	E 30
7	Affording access to an external escape route	FD 30	E 30
8	Subdividing:		
a	corridors connecting alternative exits	FD 30S[C]	E 30 S_a[C]
b	dead-end portions of corridors from the remainder of the corridor	FD 30S[C]	E 30 S_a[C]
9	Any door:		
a	within a cavity barrier	FD 30	E 30
b	forming part of the enclosure to a communal area in sheltered housing	FD 30S[C]	E 30 S_a[C]
10	Any door:		
a	forming part of the enclosure to a protected entrance hall or protected landing in a flat	FD 30	E 30
b	within any other fire-resisting construction in dwelling accommodation not described elsewhere in this table	FD 30	E 30

*NOTE 1 For fire-fighting shafts, see Clause **19**, Clause **26** and BS 9999:2008, **21.2**.*

NOTE 2 The national classifications do not automatically equate with the equivalent classifications in the European column, therefore products cannot typically assume a European class unless they have been tested accordingly.

*NOTE 3 For the separation between upward and downward flights of a basement stair (item 4 b), see BS 9999: 2008, Section **5**.*

[A] Fire doors are designated by reference to their recommended performance (in minutes) for integrity only, and whether they need to retard the passage of smoke at ambient temperature. The need to include insulation as part of the specification is dependent on the function of the door. For example, reference FD 60 is to a door that should achieve not less than 60 min integrity when tested in accordance with BS 476-22 or BS EN 1634-1.

[B] Or with BS 476-8, in respect of items tested or assessed prior to 1 January 1988.

[C] See **35.1.7**.

[D] Lift doors tested to the appropriate fire resistance in accordance with BS EN 81-58 may also be used.

Two doors in series of half the level of fire resistance of a compartment wall may be used instead of a single door, provided that neither of the two doors has a fire resistance of less than 30 min and each door is capable of closing the opening. In such a case, if the opening is provided as a means of escape, both doors should be self-closing. Neither should be a shutter, but one of them may be fitted with a self-closing device and be held open by a fusible link if the other door is capable of being easily opened by hand.

Where a fire resistance period in excess of 60 min is to be achieved by the use of two doors in series, the incorporation of materials sensitive to thermal shock, such as glass, should be avoided unless test evidence is available to support the use of these materials.

35.1.4 Glazing in fire doors

Where glazed elements in fire-resisting enclosures and doors are only able to meet the relevant performance in terms of integrity (i.e. they are unable to meet the relevant performance in terms of insulation), the use of glass should be limited in accordance with Clause **33**.

35.1.5 Lift landing doors

Where lift landing doors need to be fire doors, they should achieve the appropriate level of fire resistance in terms of integrity (see Table 2 and Table 11) when tested in accordance with BS 476-22 or BS EN 1634-1 or BS EN 81-58.

Imperforate steel panel lift landing doors are acceptable, provided that all of the following criteria are met:

a) they are not directly exposed to the effects of fire through a fire-resisting lobby doorway to the accommodation; and

b) the structure of the lift lobby, including its floor, is of non-combustible construction; and

c) the lobby contains no significant fire load and its wall and ceiling linings are classified as Class 1 when tested in accordance with BS 476-7 or European Class C-s3, d2; and

d) the lift car is of substantially non-combustible construction.

35.1.6 Closure systems

35.1.6.1 Self-closing devices

Fire doors can only operate correctly if they are fully closed at the time of fire. It is, therefore, normally necessary for them to be fitted with a self-closing device. Fire doors, except those leading to a cupboard or service duct (both of which are normally kept locked shut) and with the exception of lift landing doors, should be fitted with a self-closing device (other than rising-butt hinges) that should:

a) be of a type that cannot readily be disconnected or immobilized and does not embody a mechanical hold-open facility unless it automatically releases the door in a fire situation (see **35.1.6.2**); and

b) override any latches fitted to the door, or in the absence of a suitable latch or other positive device for holding the door shut in its frame, be of a type that when tested in accordance with BS 476-22 or BS EN 1634-1 is shown to be able to hold the door closed in the frame for a sufficient period of time for the closing role to be taken over by a thermally activated sealing device (e.g. an intumescent seal), or throughout the full period of exposure if such seals are not incorporated; and

c) for swing doors, conform to BS EN 1154.

Self-closing fire doors are more likely to be propped open, and thus rendered ineffective, by the occupants of a building if the doors are regarded as an impediment to access. Poorly specified self-closing devices can make fire doors virtually impassable to some people, e.g. wheelchair users and those with limited upper body strength. Door closer forces should be limited to the minimum necessary to close the door reliably and effectively.

If the force needed to open a door on a circulation route exceeds 30 N, or if an automatic self-closing device would be considered a hindrance to the occupants of the building, then hold-open devices conforming to **35.1.6.2** should be used.

Self-closing devices need not be provided on fire doors within a dwelling, flat or maisonette, except between an attached or integral dwelling and on the door between a flat and communal areas.

NOTE 1 BS 8300 states that, for most disabled people to have independent access through single or double swing doors, the opening force, when measured at the leading edge of the door, should be not more than 30 N from 0° (the door in the closed position) to 30° open, and not more than 22.5 N from 30° to 60° of the opening cycle. BS 8300 also gives more detailed guidance on the design of buildings and their approaches to meet the needs of disabled people.

NOTE 2 The opening force can be checked using a plunger-type force measuring instrument. Where measurements cannot be taken at the leading edge, they may be taken at a point on the face of the door up to 60 mm from the leading edge, a position approximately in line vertically with the spindle of a lever handle or the centre line of a pull handle or push plate, in which case the opening force limits can be increased by approximately 2 N. The accuracy of force measuring instruments available on the market varies and there are inherent difficulties in measuring forces on site. It is recognized, therefore, that any measurements are subject to a degree of imprecision which could give rise to variations of between 2 N and 3 N.

35.1.6.2 Hold-open devices

Hold-open devices are used either to hold a fire door in the open position, against the action of a door closer, or to allow it to swing freely, automatically releasing the closing mechanism in a fire situation. Fire doors may be held open by one of the following:

a) a fusible link or heat detector (unless the door is fitted in an opening provided as a means of escape, or to protect a means of escape);

b) an automatic release mechanism actuated by an automatic fire detection and alarm system;

c) a delayed closing device with the delay adjusted not to exceed 25 s.

The automatic release mechanism should allow the door closing device to resume its self-closing function in the event of one or more of the following:

a) the detection of smoke by suitable automatic apparatus;

b) the detection of heat or smoke by any in-built sensing device;

c) failure of the power supply;

d) operation of the fire alarm system;

e) local manual operation;

f) if the facility is provided, a manual operation at a central control point.

NOTE 1 BS EN 1155 specifies requirements for separate hold-open devices and also for hold-open mechanisms incorporated in a door closer. Devices manufactured in accordance with BS EN 1155 can hold a swing door at a fixed position or can allow the door to swing freely. BS 5839-3 specifies requirements for certain automatic release mechanisms intended to hold open (or closed) fire protection equipment, such as fire doors, fire shutters, fire dampers, etc., which are outside the scope of BS EN 1155.

NOTE 2 BS 7273-4 gives recommendations for the design, installation, commissioning and maintenance of electrical control arrangements for actuation of mechanisms that unlock, release or open doors in the event of fire.

35.1.7 Smoke sealing of fire doors

A fire door that is needed to resist the passage of smoke at ambient temperature conditions, i.e. fire doors having the suffix S (see **35.1.3** and Table 11), should either:

a) have a leakage rate not exceeding 3 m^3/h per metre, when tested in accordance with BS 476-31.1 with the threshold taped and subjected to a pressure of 25 Pa; or

b) meet the classification requirement of S_a when tested in accordance with BS EN 1634-3.

When installed, the threshold gap should, where practicable, be sealed by a (flexible edge) seal either with a leakage rate not exceeding 3 m^3/h per metre at 25 Pa, or just contacting the floor, giving an even contact with the floor but not exhibiting significant increased frictional forces that could interfere with the closing action of the door. Where this is impracticable, the threshold gap should not exceed 3 mm at any point.

NOTE 1 When other methods of smoke control are provided in buildings, e.g. pressurization, the smoke control criteria for doors might not be applicable, depending on the design of the system, and in particular the air flow path(s).

NOTE 2 Smoke leakage control can be applied to non-fire-resisting doorsets.

35.1.8 Building hardware

Building hardware used on fire-resisting doors can significantly affect their performance in the event of a fire.

NOTE Specific guidance is available in the DHF/GAI "Code of practice – Hardware for fire and escape doors" [18]. General guidance is given in BS 8214. A "Code of practice for fire-resisting metal doorsets" is given in DHF publication CP 101/2 [20].

Unless shown to be satisfactory when tested in accordance with BS 476-22 or BS EN 1634-1, no part of a hinge on which any fire door is hung, and which provides the means of support at the hanging edge, should be made either of combustible material or of non-combustible material having a melting point of not less than 800 °C.

All items of hardware for use on fire doors should be suitable for the type of door to which they will be fitted.

35.1.9 Fire door signage

All fire doors other than lift entrance doors should be marked with the appropriate fire safety sign conforming to BS ISO 3864-1 according to whether the door is:

a) to be kept closed when not in use;

b) to be kept locked when not in use; or

c) held open by an automatic release mechanism.

Fire doors to cupboards and to service ducts should be marked on the outside. All other fire doors should be marked on both sides.

NOTE Lift entrance doors do not need to be marked.

35.2 Shutter assemblies

Shutter assemblies across a means of escape should be released only by a heat sensor, such as a fusible link or electric heat detector, in the immediate vicinity of the door. Closure of shutters in such locations should not be initiated by smoke detectors or a fire alarm system, unless the shutter is also intended to act as a smoke curtain.

Shutter assemblies should achieve the appropriate level of fire resistance in terms of integrity (see Table 2 and Table 11) when tested in accordance with BS 476-22 or BS EN 1634-1.

35.3 Access panels

Access panels should be of a construction that has at least the same fire resistance as the element they fit into. This can be achieved by having:

a) the recommended fire resistance from both sides; or

b) an automatic heat activated sealing device, which in the event of fire will close the opening to maintain the fire resistance recommended for the compartment wall or floor.

35.4 Fire-stopping

35.4.1 General

When a building service passes through a compartment wall or floor there can be an imperfection of fit, which results in gaps in the walls between compartments. This presents a risk of allowing smoke and flame to breach a compartment wall via these gaps. It is therefore necessary to fill these gaps with a material that will restrict the passage of smoke and flame. Various materials can be used, but certain materials are more suited to certain applications.

35.4.2 Applications

Joints between elements that serve as a barrier to the passage of fire should be fire-stopped and all openings for pipes, ducts, conduits or cables to pass through any part of an element that serves as a barrier to the passage of fire should be:

a) kept as few in number as possible;

b) kept as small as practicable; and

c) fire-stopped (which in the case of a flue or duct, should allow thermal movement).

35.4.3 Products and materials for fire-stopping

The selection of products and materials used for fire-stopping should take account of the size and nature of the gap and any anticipated differential movement.

Proprietary fire-stopping and sealing systems (including those designed for service penetrations) are available and may be used provided that they achieve the appropriate level of fire resistance (see Table 2) when tested in accordance with BS 476-22 or BS EN 1634-1.

In the case where minimum differential movement is anticipated and where the gap does not exceed 25 mm, the following fire-stopping materials may be used without specific test evidence:

a) cement mortar;

b) gypsum-based plaster;

c) cement or gypsum-based vermiculite/perlite mixes.

To maintain the physical integrity of fire-stopping, it should be reinforced with (or supported by) non-combustible materials, or materials of limited combustibility, in the following circumstances:

1) in all cases where the gap between elements that need to be fire-stopped is greater than 100 mm; and

2) in any other case where non-rigid or flexible materials are used (unless substantiated by fire test evidence).

36 Floors and ramps on escape routes

The floors of an escape route, including the treads of any stair and the floor of any landing, should have non-slippery, even surfaces.

Ramps should have a gradient of no more than 1 in 12.

37 Design and construction of common stairs

Common stairs should:

a) be designed and constructed in accordance with BS 5395-1;

b) meet the recommendations for width given in Clause **11**;

c) have flights and landings constructed of materials of limited combustibility, with the exception of:

   1) stairs in multi-stair buildings with no floor at 18 m or more above ground level; or

   2) two or three storey buildings, or parts of a building, served by a single stair;

d) be formed of straight flights in all buildings of more than three storeys.

Ladders should not form part of a means of escape route from any dwelling. Ladders designed and constructed in accordance with BS EN ISO 14122-4 may form part of a means of escape route from areas of a building where access is limited to occasional purposes of maintenance and repair.

NOTE Guidance on the fire assessment of timber stair construction is given in CLG publication "Fire performance of escape stairs: BD 2569" [21].

Section 7: Mechanical systems for ducted heating, ventilation and air conditioning (HVAC)

38 HVAC systems within individual dwellings

Ducted HVAC systems should be arranged such that fire and smoke is not transferred from the room of fire origin in a manner that could inhibit the safe use of protected internal means of escape routes or allow the undue spread of fire.

Any house, flat, maisonette or other residential unit with a floor over 4.5 m above ground level or to any basement should conform to the following recommendations.

a) Transfer grilles should not be fitted in any wall, ceiling, floor or door enclosing a protected internal hallway or stair enclosure.

b) Where practicable, ducts should be routed such that they do not pass through protected internal hallways or stair enclosures.

c) Where the duct does pass through a protected internal hallway or stair enclosure, then the duct should:

   1) be provided with ES rated fire and smoke dampers conforming to BS EN 1366-2 where penetrating the fire-resisting enclosure (such dampers should be accessible for maintenance); or

   2) be of fire-resisting construction achieving 30 min integrity when tested from the inside (see Section **6**); or

   3) the ceiling zone containing the duct should be bounded by the protected enclosure and provided with an imperforate ceiling construction achieving 30 min fire resistance integrity and insulation when tested from above (see Section **6**) and have an upper surface of Class 1 surface spread of flame when tested in accordance with BS 476-7 or the European equivalent.

d) Where an HVAC system re-circulates air and serves the protected internal hallway or stairway and other rooms, smoke detectors should be provided within the ductwork that switches the mode to shutdown upon detection.

e) HVAC ducted systems that link between dwellings or serve common areas should be in accordance with Clause **39**.

39 HVAC systems serving the whole building or interconnecting dwellings and other residential units

Mechanical HVAC systems serving the whole building should be designed to prevent the spread of fire and smoke from the room of fire origin throughout the building. In particular, measures should be taken to ensure that air movement in the system prevents incursion of fire and combustion products into protected escape routes or allows lines of fire compartmentation to be breached.

HVAC systems should be compatible with smoke control systems installed in the building (whether natural, mechanical exhaust or pressurization) when operating under fire conditions.

Measures to aid fire-fighting control should be incorporated, including the following.

a) Ventilation systems serving protected escape routes should not serve other areas and the normal airflow pattern should be directed away from the escape route.

b) Separate ventilations systems that do not allow for the re-circulation of air within them should also be provided for:

   1) each protected stairway;

   2) plant areas;

   3) car parks;

   4) non-domestic kitchens; and

   5) residential parts of mixed-use buildings.

c) Ducts passing through the enclosure of a protected escape route should conform to the relevant fire-resistance recommendations (Method 2, protection using fire-resisting enclosures, or Method 3, protection using fire-resisting ductwork) given in BS 9999:2008, **33.4.3.3** and **33.4.3.4**.

d) Where a ductwork system serves more than one part of a compartmented or fire separated escape route, smoke detector operated fire dampers should be provided where the ductwork enters each fire separated or smoke separated section of the escape route. Where a fire damper is used to protect an escape route, it should be tested in accordance with BS EN 1366-2 and an ES classification equal to or greater than 60 min in accordance with BS EN 13501-3.

   *NOTE See also **32.2**.*

e) Ducts passing through compartment walls and floors and other fire separating elements should maintain the fire integrity using one of the following methods given in BS 9999:2008, **33.4**:

   1) Method 1 (using fire dampers);

   2) Method 2 (using fire resisting enclosures); or

   3) Method 3 (using fire resisting ductwork).

f) The fire resistance of ducts and dampers should be equal to the fire resistance required for the building element being penetrated. All ducts should be fire-stopped where they penetrate compartments and fire-resisting enclosure of escape routes.

g) Systems which re-circulate air should be fitted with smoke detectors in the extract ductwork before the point of separation of the re-circulated air and the air to be discharged and before any filters or other air cleaning equipment. Detection should cause the system to immediately shut down or switch to extract the air to an external location.

   *NOTE 1 Further detail is given in BS 9999:2008, **33.4.8**.*

h) Systems should be provided with overriding fire-fighting controls in accordance with BS 9999:2008, **33.4.10**.

i) Air transfer grills should not be positioned in enclosures to protected stairways, protected lobbies, protected corridors, fire-fighting stairways and lobbies, protected shafts and compartment walls or floors.

   *NOTE 2 Further detail is given in BS 9999:2008, **33.4.9**.*

j) Exhaust outlets should be positioned such that they:

1) do not discharge products of combustion close to final exits or other parts of escape routes;

2) are not close to any combustible or other wise vulnerable element of the building construction;

3) do not enable re-entry of exhaust products back into the building or other ductwork.

k) Ducts should be designed and constructed in accordance with BS 8313.

l) Where pressurization or other smoke control systems are installed within a building any ventilation and air conditioning system should be compatible with its operation under fire conditions.

m) Where plant areas are within the building, they should be treated as separate fire compartments in order to isolate any fire source.

*NOTE 3 Further guidance is given in BS 9999:2008, **33.4**, ASFP Blue Book [22] and ASFP Grey Book [23] and BS 5839-1.*

Section 8: Ancillary accommodation to flats and maisonettes

40 Ancillary accommodation

The following recommendations are applicable to ancillary accommodation.

a) Ancillary accommodation should have escape routes of such number and be situated such that the travel distance from any point does not exceed the limitations given in Table 12.

b) Ancillary accommodation should not connect with any part of the only escape route from one or more dwelling(s) on the same storey as the ancillary accommodation unless it conforms to **7.5** and **13.2**.

c) In multi-stair buildings:

1) ancillary accommodation should be separated from any stair by a protected lobby or protected corridor at the storey in which the accommodation is situated;

2) ancillary accommodation should be separated from any common corridors by a protected lobby.

d) Ancillary accommodation should be separated from other parts of the building in accordance with Table 13 and, where necessary, have ventilated lobbies conforming to Clause **25** and **26.1.6**.

e) Glazed areas separating escape routes from ancillary accommodation should be in accordance with Clause **12** and Clause **33**.

f) Emergency escape lighting should be provided in accordance with **46.2**.

*COMMENTARY ON **40***
Ancillary accommodation covers all those parts of buildings containing flats or maisonettes that are ancillary to the dwellings. It includes engineering services and such accommodation as common amenity areas, refuse rooms and covered car parks.

Engineering services include the following:

a) gas services;

b) electrical services and wiring;

c) lighting;

d) lift machine rooms/machinery spaces;

e) communal heating, ventilation and air conditioning systems;

f) refuse storage, disposal and incineration;

g) car parks.

Ancillary accommodation generally presents a greater fire hazard than the dwellings themselves because the accommodation might only be visited occasionally and is thus not under regular surveillance.

All ancillary accommodation, with the exception of communal lounges, common amenity areas and transformer, switchgear and battery rooms for low voltage or extra low voltage equipment, should be treated as higher fire risk areas.

Table 12 **Maximum travel distances in areas of ancillary accommodation**

Ancillary accommodation	Maximum part of travel distance within the room or area		Maximum travel distance to the nearest storey exit	
	Escape in one direction only m	Escape in more than one direction, in directions 45° or more apart m	Escape in one direction only m	Escape in more than one direction, in directions 45° or more apart m
1. Engineering services installation rooms 2. Boiler rooms 3. Fuel storage areas 4. Transformer, battery and switchgear rooms	6	12	18	45 [A)]
5. Communal lounges and common amenity areas	18	45 [A)]	18	45 [A)]
6. Covered car parks	18	45 [A)]	18	45 [A)]

[A)] This may include up to 18 m with escape in one direction only.

Table 13 **Structural fire protection of areas of ancillary accommodation**

Ancillary accommodation	Structural fire protection
	Separation of area of ancillary accommodation from other parts of the building by:
1. Communal lounges 2. Transformer, switchgear and battery rooms for low voltage or extra low voltage equipment	Robust construction having a minimum standard of fire resistance of 30 min [A)]
3. Engineering services installation rooms other than those covered by items 2 and 6 to 8 inclusive 4. Refuse chutes and refuse storage areas 5. Covered car parks within or adjoining the building and not greater than 450 m^2 in area	Robust construction having a minimum standard of fire resistance of 60 min [A)]
6. Engineering services installation rooms, housing fixed internal combustion engines 7. Boiler rooms and fuel storage spaces 8. Transformer and switchgear rooms for equipment above low voltage 9. Covered car parks within or adjoining the building and greater than 450 m^2 in area	Robust construction having a minimum standard of fire resistance equivalent to that required for the elements of construction and in no case less than 60 min [A)]

[A)] Any openings in the required construction should be protected by doors having a similar standard of fire resistance and capable of resisting the passage of smoke at ambient temperature.

41 Installation of engineering services

Some engineering services are known potential sources of fire. The importance of correct installation in the first place is emphasized, because lighting, heating and ventilation systems are often concealed above suspended ceilings and within service ducts.

Control gear is also often located behind ceiling and wall panels. Installation faults that might lead to fire are particularly dangerous because the fire is likely to remain undiscovered for some time if it is concealed. The equipment associated with them should be installed and maintained in accordance with the relevant codes of practice.

42 Engineering service installation rooms

Engineering service installation rooms include electrical switchgear rooms, boiler rooms, fuel storage spaces, mechanical ventilation and air conditioning plant rooms, lift motor rooms, rooms housing fixed internal combustion engines and battery charging rooms.

Service installation rooms should be sited such that escape from other exits is not prejudiced by any risk that they could pose.

Service installation rooms in which flammable liquids are used or stored should have imperforate sills to doorways and any necessary drainage should be provided with interceptors.

Service installation rooms should, where necessary for the safe operation of the equipment and to avoid undue build-up of heat, be ventilated (either directly or indirectly) to the outside air. The provision of such ventilation should not impair any fire resistance requirements for the structure.

*NOTE This ventilation may be combined with the provisions for smoke ventilation (see Clause **26**).*

Service installation rooms adjoining a building (including those on top of a flat roof) should be separated from the building in accordance with Table 11 and Table 13.

43 Gas services, installation and service pipes

Installation and service pipes should not be run through escape routes unless this cannot be avoided.

All gas services and installation and service pipes should be installed such that the fire resistance of the building is unimpaired.

*COMMENTARY ON **43***
Attention is drawn to the Gas Safety (Installation and Use) Regulations 1998 [5] which cover the installation of gas fittings, including installation pipework, meters and appliances.

Further guidance may also be found in the following publications:

a) Gas services: Institution of Gas Engineers and Managers' Publication IGE/TD/4 [24].

b) Low pressure installation pipes: BS 6891.

44 Electrical services

44.1 Electrical service installations

Electrical services should be installed and maintained in accordance with BS 7671.

44.2 Transformer, battery and switchgear rooms

A transformer, battery or switchgear room, unless situated on the roof or in a separate enclosure, should be sited adjacent to an external wall and entered only from the open air.

A transformer, battery or switchgear room should have adequate provision for ventilation.

44.3 Fire-fighter's emergency switches for discharge lighting installations

Discharge lighting installations can operate at voltages that are a hazard to fire-fighters. An exterior discharge lighting installation, or an interior discharge lighting installation, operating unattended or operating at a voltage exceeding low voltage should be controlled by a fire-fighter's emergency switch. The fire and rescue authority should be consulted for advice regarding fire-fighter's emergency switches.

NOTE Attention is drawn to BS 7671 (IET Wiring Regulations) which determines requirements for the installation and situation of fire-fighter's emergency switches.

45 Gas and electricity meters

A gas or electricity meter can be a fire risk to a building and it is essential that such meters are properly and safely located and installed.

The location of meters should be agreed with the supply authority at the planning stage.

Gas meters and associated equipment should be installed in accordance with BS 6400 (all parts). The distance between electricity meters and gas meters not placed in meter boxes should be in accordance with BS 6400 (all parts). Wherever practicable, gas meters should not be installed in corridors in single-stair buildings or in dead-end corridors.

NOTE 1 Attention is drawn to the requirements for installation and connection set out in the Pipelines Safety Regulations 1996, SI 1996 No. 825 [6] and the Gas Safety (Installation and Use) Regulations 1998, SI 1998 No. 2451 [5].

Electricity meters and associated equipment should be installed in accordance with BS 7671.

Where meter boxes are required, gas meters and electricity meters should be housed in separate boxes, each large enough only for the meter and associated equipment.

Wherever practicable, gas and electricity meters should not be located in the entrance hall of a dwelling but if a meter is so positioned, it should be contained within a suitably constructed cupboard that is large enough to contain only the meter(s).

A meter should not be installed on or under a stairway, or in any other part of a building that has a maximum of one floor above the ground floor, for which the

stairway, or that other part of the building, provides the only means of escape in the event of a fire, unless:

a) the meter is:

1) of fire-resisting construction; or

2) housed in a protected compartment; or

NOTE 2 A protected compartment refers to an enclosure of fire-resisting construction fitted with a fire door that is kept locked shut. Further details are given in the Gas Safety (Installation and Use) Regulations, 1998 [5].

b) the pipe immediately upstream of the meter, or a governor (where a governor is adjacent to the meter) incorporates a device to automatically cut-off the flow of gas when the temperature of the device exceeds 95 °C.

A meter should not be installed on or under a stairway, or in any other part of a building having two or more floors above the ground floor, where the stairway, or that other part of the building, provides the only means of escape in case of fire, unless the meter replaces an existing meter and conforms to either **45**a) or **45**b).

In single-stair buildings, an electric meter should not be installed within a common escape route unless it is enclosed within a secure cupboard (allowing access only to the electricity supply company) which is separated from the common escape route by construction having a fire resistance of 30 min.

To facilitate external meter reading and attendance, the meters in flats and maisonettes may be located to be accessible or visible from a common circulation space (not a common stair) through robust doors provided with locks. Glazed viewing panels large enough to expose dials and meter number may be provided, where desired. Where meters are inset into a fire-resisting wall or partition, they should be separated at the back and sides from the dwelling by non-combustible construction having the same fire resistance as that recommended for the element in which they are placed.

46 Lighting

46.1 Types of luminaire

Incandescent filament lamps and high pressure discharge lamps operate at elevated temperatures, and where these are used they should not be close to or fixed to materials that are readily ignited. Minimum separation distances should be applied in accordance with BS 7671. Care should be taken in the selection of plastics materials or finishes and preference should be given to those with superior flame retardant qualities.

46.2 Lighting of common escape routes in buildings containing flats or maisonettes

Provision should be made for lighting along common escape routes (except in two-storey blocks of flats) so that that occupants and visitors to the building can see their way to safety, even in the event that the main electricity supply fails. The lighting should be such that directional or warning signs associated with common escape routes, changes in floor level, the location of fire alarm call points and fire-fighting equipment are also visible. Where an emergency escape lighting system is provided, it should conform to the appropriate recommendations of BS 5266-1.

NOTE The essential feature of emergency escape lighting is that it is designed to illuminate when part or all of the normal lighting has failed. There are various types of emergency escape lighting, e.g. lighting that is continuously alight; lighting that is not

illuminated until the mains fail, but lights automatically; single independent luminaires or central battery or generator systems.

Emergency escape lighting should also be provided within:

a) ancillary accommodation normally accessible to the occupants;

b) common stairs;

c) all common escape routes in sheltered housing;

d) common escape routes across a flat roof;

e) windowless accommodation within live-work units.

Where an emergency escape lighting system is not provided along common escape routes, it is essential that the lighting uses only protected circuits (see **46.3**).

46.3 Protected circuits

A protected circuit should:

a) consist of Category 2 cable conforming to BS 8519:2010, Table 1;

b) follow a route selected to pass only through parts of the building in which the fire risk is negligible;

c) be separate from circuits provided for any other purpose.

47 Lift machine rooms and machinery spaces

Where a lift well is located within a common escape route, the lift machine room should be either above or outside of the common escape route.

Lift machine rooms or machinery spaces should conform to the appropriate part of BS EN 81.

Hydraulic lifts designed without a machine room and which incorporate all of the plant and hydraulic oil reservoir within the lift shaft should not be used in blocks of flats having a single stair.

48 Communal heating, ventilation and air conditioning systems

The principal risks associated with communal heating, ventilation and air conditioning systems are concerned with the plant, equipment and distribution systems involved, particularly boiler rooms, heat exchange equipment, fuel storage, and distribution ducting.

The following recommendations are applicable.

a) Oil-fired boilers should be installed and maintained in accordance with BS 5410-1 and BS 5410-2.

b) Gas-fired boilers should be installed and maintained in accordance with BS 6798 or BS 6644.

c) Boiler rooms, other than those installed in accordance with BS 5410-2, should have adequate provision for the venting of smoke.

d) Oil fuels should be stored in accordance with BS 5410-1 and BS 5410-2 and BS 799-5.

e) Solid fuel should be stored in bunkers protected by non-combustible walls of sufficient thickness to prevent heating of the fuel by nearby boilers or steam pipes.

f) Bulk storage of liquefied petroleum gas, should be in accordance with the UKLPG guidance [N2] and the HSE guidance note CS4 [N3].

g) Ducts for engineering and building services should conform to BS 8313; ducts and ductwork for ventilation and air conditioning should conform to Clause **32**.

NOTE With emerging technology in heating design, it might be advisable to consider in the design of a boiler room and ancillary spaces the possibility of a future change to other fuels.

49 Refuse storage, disposal and incineration

It is essential that provision is made for the safe storage and disposal of refuse from dwellings.

In low-rise, multi-stair blocks, rooms might be provided for the storage of refuse (in lieu of a refuse chute system). However, it is important that any access lobby to such a room is of the smallest size possible in order to prevent its use for the storage of refuse and that access to the room is not by way of a dead-end corridor.

NOTE BS 5906 recommends that a refuse chute system is provided in blocks of more than four storeys: refuse hoppers are provided on each storey served by the refuse chute, with the refuse falling through the chute into a refuse storage chamber located at a level accessible directly by refuse disposal vehicles.

The following recommendations are applicable for refuse storage, disposal and incineration.

a) Refuse storage chambers, refuse chutes and refuse hoppers should be sited and constructed in accordance with BS 5906.

b) Refuse storage chambers should be approached solely from the outer air and should be separated from other parts of the building in accordance with Table 13. Access to refuse storage chambers should not be sited adjacent to escape routes or final exits or near to windows of dwellings.

c) Refuse chutes and rooms provided for the storage of refuse should be separated from other parts of the building in accordance with Clause **25**. They should not be located within common stairs or protected lobbies. Rooms containing refuse chutes or provided for the storage of refuse should be approached only by way of a protected lobby having not less than 0.2 m^2 of permanent ventilation.

d) Refuse incinerators should be located in a separate building.

50 Car parks and domestic garages

50.1 General

Car parks and domestic garages within or adjoining a building pose additional fire risks to a building.

NOTE 1 Attention is drawn to the Petroleum (Consolidation) Act 1928 [7] which might require licensing for car parks and domestic garages together with any storage of petrol in cans, drums or other receptacles. This might be enforced through the Petroleum Licensing Authority for the area.

NOTE 2 A covered car park in a single-stair building served by the stair or lift needs to be provided with permanent cross-ventilation.

NOTE 3 Attention is drawn to the Dangerous Substances and Explosive Atmospheres Regulations 2002 [8] which might require consideration during the design of the car park in order to limit any fire risk assessed under these regulations.

50.2 Car parks within or adjoining buildings

Any car park within or adjoining the building (whether required to be licensed or not) should:

a) have any external openings situated so as not to endanger any escape route or final exit from the residential accommodation;

b) have adequate provision in accordance with Clause **26** for venting smoke;

c) be provided with suitable access for fire-fighting (see Section **4**);

d) be provided with fire-resistance as follows:

1) a minimum of 60 min fire resistance for basement car parks that are no more than 10 m in depth; or a minimum of 90 min fire resistance for basement car parks that are more than 10 m in depth;

2) a minimum of 60 min fire resistance for any open-sided car park within a building;

3) a minimum of 60 min fire resistance for enclosed car parks within a building up to 18 m in height; a minimum of 90 min fire resistance for enclosed car parks within a building up to 30 m in height; and 120 min fire resistance where the building is more than 30 m in height (though this may be reduced to 90 min fire resistance for elements not forming part of the structural frame).

*NOTE See **7.5** for small buildings and connections to car parks.*

50.3 Domestic garages adjoining buildings

Domestic garages adjoining buildings should conform to the following recommendations.

Where a door is provided between a domestic garage and a house, the floor of the domestic garage should be laid to allow fuel spills to flow away from the door to the outside. Alternatively, the door opening should be placed at least 100 mm above the domestic garage floor level.

Fire resistance should be provided (the wall and any floor should have 30 min fire resistance with a self-closing fire door).

NOTE 1 A covered car park in a single-stair building served by the stair or lift needs to be provided with permanent cross-ventilation.

NOTE 2 This guidance does not cover car lifts or car stacking systems.

Section 9: Management

*COMMENTARY ON SECTION **9***
*Section **9** gives advice for owners and occupiers of flats and maisonettes and also provides guidance for the owners and managers of buildings containing flats or maisonettes to help them to make the best use of the design features of the building.*

Attention is drawn to the Building (Amendment) Regulations 2011, Section 38 [1], and BS 9999 regarding guidance for designers on information to pass on to their clients concerning fire precautions designed into a building.

Advice to occupiers of domestic residential buildings on precautions against fire that they may take can be found in BS 9999.

51 Management of sheltered housing

The fire strategy should be based upon a realistic in-use management regime and the design process should ensure compatibility between the fire protection provisions and management.

A fire risk assessment should be conducted and appropriate evacuation and management measures should be adopted based on the results.

52 Evacuation of disabled occupants or occupants that require assistance to escape

Providing an accessible means of escape should be an integral part of fire safety management in all residential buildings. Fire safety management should take into account the full range of people who might use the premises, paying particular attention to the needs of disabled people. It is important to note that it is the responsibility of the premises management to assess the needs of all people to make a safe evacuation when formulating evacuation plans.

An evacuation plan should not rely on the assistance of the fire and rescue service. This is an important factor that needs to be taken into account in the building design.

It cannot be assumed that facilities provided in a building to make it accessible will be usable in a fire evacuation. For example, lifts that are not appropriately designed for emergency evacuation might not be usable for evacuation. This needs to be considered at the design stage when it is relatively easy to incorporate accessible escape features which will make evacuation planning more effective, an evacuation easier to manage and help to preserve the dignity of disabled people in an evacuation.

*NOTE For evacuation lifts, see **8.4**.*

Many people other than wheelchair users are considered to have mobility impairments. This category includes people who can use stairs but might not be able to reach a place of ultimate safety in the normal movement times used to calculate evacuation times. Awareness of this is particularly relevant if a time-to-safety calculation is used to assess the evacuation plans in the premises. It might, therefore, be necessary to include any of the following features in the design of an escape route:

a) the use of horizontal evacuation to a different fire compartment;

b) the use of lifts;

c) the accessibility of all escape routes, e.g. adding ramps where necessary;

d) the implementation of extra hand rails and step edge markings.

In sheltered housing a log should be kept of any residents who are likely to require assistance in the event of a fire in order to evacuate their dwelling and/or the building. The fire and rescue service should be made aware of the log and its location. The log may form part of the fire safety manual for the premises.

*NOTE For warning signals in sheltered housing and extra care housing, see **22.1**.*

53 Residents

Where a building is occupied, or partially occupied, by residents, it is important that they are integrated into the fire safety arrangements for the building and do not negate the fire safety arrangements for the building. The responsible person should advise such persons formally of the fire safety arrangements for the building, what to do to prevent fires occurring, and what to do in the event of a fire. This information should be contained within a handbook which should also address the potential for particular problems arising where residents employ sub-contractors, e.g. for fit-out work.

NOTE 1 The responsible person in this instance could be the owner, occupier or management of the building.

NOTE 2 Annex D contains information that can be given to owners and occupiers of dwellings in residential buildings (including flats) along with examples of fire instruction notices for residential buildings.

54 Caretakers

Where a caretaker or other person is employed to maintain common areas within a building, the responsible person should advise such persons formally of the fire safety arrangements for the building.

NOTE The responsible person in this instance could be the owner, occupier or management of the building.

55 Maintenance of fire protection measures

It is essential that the fire protection measures integrated in a building function in a fire. The fire protection measures should be inspected on a regular schedule to ensure that they are available and functional at all times.

Inspections should include, but not necessarily be limited to, compliance with the following recommendations.

a) Escape routes should be kept clear at all times. Storage of goods and equipment could block exits and provide an unwanted fire load and potential source of ignition.

b) Door locks, panic bars and automatic door release mechanisms should be maintained so that they are easily openable in an emergency.

c) Whenever additional or replacement services breach compartment walls or floors, the integrity of fire separation should be maintained through the use of appropriate fire-resisting materials in spaces where breaches of compartmentation have occurred.

d) Fire safety equipment such as fire extinguishing and fire main inlet and outlet values should not be obstructed by stored goods, machinery or parked vehicles.

e) All fire safety equipment, e.g. fire alarms, emergency lighting, automatic fire suppression systems, smoke control systems and fire extinguishers, should be maintained and tested in accordance with the relevant standard by competent persons.

f) Fire doors should be maintained in accordance with **35.1**. When a fire occurs in the premises, the safety of occupants and their means of escape rely heavily on the flat front doors retaining their self closing devices and their fire resistance.

NOTE Ongoing control over the repair, maintenance and replacement of doors and self closers is an important issue that needs to be effectively planned, monitored and reviewed by the responsible person in order to ensure ongoing compliance with the Regulatory Reform (Fire Safety) Order 2005 [2]. This might include the need to ensure the issue is specifically covered in leases and tenancy agreements to make certain that appropriate remedial works can be carried out as the need arises.

56 Maintenance of building plant and equipment

Fire can start in machinery and equipment which is not adequately maintained or cleaned.

The responsible person should check that the equipment and plant is regularly maintained. Electrical and gas installations are required to be regularly examined by a competent person who, if not qualified, should have authority to engage a qualified person to carry out any investigations and/or repairs deemed necessary for safety reasons.

NOTE Attention is drawn to the Gas Safety (Installation and Use) Regulations [5] and BS 7671 (IET Regulations).

57 Ensuring that systems respond properly in an emergency

57.1 General

It is essential that in the event of a fire, all fire safety provisions function as intended and all fire emergency procedures are implemented in order to facilitate appropriate action. As it can never be foreseen when a fire might occur, it is part of the role of the responsible person to ensure that all of the built-in passive and active safety systems operate (or are effective) on demand.

NOTE The responsible person in this instance could be the owner, occupier or management of the building.

57.2 Escape routes

In order to ensure that escape routes are available for use at all times when the building is occupied:

a) all escape routes should be kept free from obstruction;

b) goods, materials, unwanted furniture, etc., should not be stored within escape routes. Any obstruction should be removed immediately;

c) all escape routes should be inspected frequently. A log detailing the frequency and results of inspection should be included in the fire safety manual and corrective measures should be taken where necessary;

d) fire doors that are intended to be kept closed should remain closed and unobstructed;

e) fire doors on hold-open devices should be operable and should be unobstructed;

f) the exterior of the building should be inspected to ensure that final exits and routes to assembly points are not blocked;

g) entrance halls, lobbies or corridors should not contain furniture or fittings that would reduce, at any point, the required exit width;

h) in a building or part of a building served by a single stair, and in fire-fighting stairs, furniture should not be placed within the stair enclosures and exits there from;

i) fire safety signs and notices, fire extinguishers, emergency escape lighting, fire doors and shutters should not be obscured;

NOTE Further information and guidance regarding fire safety signs and notices can be found in the Building Regulations 2000 – Approved Document B [11].

j) seating areas should not be provided within escape corridors;

k) maintenance and redecoration of surface finishes and floor coverings should not use materials that might propagate surface spread of flame and/or fire, or adversely affect the means of preventing such propagation;

l) the floor surfaces (including stairs, stair nosings and ramps) within escape routes should be maintainable, even and non-slip. Resilient floor surfaces should be maintained in accordance with BS 6263-2. Only emulsion polish (not wax polish) should be used on such floor surfaces.

57.3 Maintenance of fire safety equipment and provisions

Planned inspection, maintenance and testing procedures should be established and used to ensure that all fire protection systems can operate effectively when required. Arrangements should be made for all fire safety equipment, installations and systems (including fire detection systems, automatic suppression systems, door control mechanisms, smoke control systems, evacuation and fire-fighting lifts, emergency lighting, standby power systems, escalators, and all passive fire protection provisions) to be inspected and tested on a regular basis by a competent person. Material alterations, additions, repairs or modifications to services and equipment should be carried out only by competent persons.

The following British Standards should be used for the routine maintenance, inspection and testing of particular systems:

a) BS 5839-1 and BS 5839-6 for fire detection and fire alarm systems;

b) BS 5266-1 for emergency and escape lighting systems;

c) BS 9251 or BS EN 12845 for automatic sprinkler systems in residential and domestic buildings;

d) DD 8458-1 or DD 8489-1, as applicable, for watermist systems;

e) BS 8214 for fire doors;

f) BS 7273-4 for fire door automatic release mechanisms;

g) BS 7346-3 or the relevant part of BS EN 12101 for smoke control systems;

NOTE Further information regarding testing, inspection and maintenance of mechanical smoke ventilation systems can be found in BS 9999.

h) BS 5306-3 for portable fire extinguishers;

i) BS 9990 for fire hydrants and fire mains.

57.4 Fire-fighting access and equipment

One or more of the passenger lifts in the building may be made available for the exclusive use of fire-fighters in an emergency, when a switch at fire and rescue service access level (usually the entrance level) marked "Fire-fighting lift" is operated. Any lift that is designated as a fire-fighting lift should receive early attention when it breaks down. Regular inspections of the fire-fighting lift switch should be made to check for any unauthorized use. Operational tests, routine inspections and maintenance of fire-fighting lifts should be carried out in accordance with BS EN 81-72 and the lift owner's manual.

Wet or dry rising fire mains and the accompanying inlet and/or outlet boxes, together with any foam inlets to oil-fired boilers, should be regularly inspected for damage and repaired where necessary. Where provided, outlet straps to fire mains should be checked to see that they are in place and secure.

Fire and rescue service access roads and gates leading to the building can become seriously obstructed by the indiscriminate parking of cars and other vehicles using the site. Management procedures should exercise control over the parking of vehicles on private access roadways also used for fire and rescue service access, so that fire appliances are not obstructed in an emergency and are able to proceed to within the required distance of fire main, foam or other inlets. In the interests of security, it might be deemed necessary, in agreement with the fire and rescue service, to restrict unauthorized entry along such roadways.

Control and enforcement of parking restrictions can prove difficult, but the provision and maintenance of notices giving clear instructions regarding parking arrangements can go some way to alleviating this problem.

57.5 Contingency planning

In some buildings, particularly complex ones and those with fire-engineered solutions, where the effective operation of fire safety systems is critical, it might be necessary to implement contingency arrangements in the event of safety systems being unavailable, for example due to maintenance or repair. The fire risk assessment should be used to identify critical systems and inform contingency planning in terms of additional management actions and timescales.

Section 10: Building works: Material alterations, extensions, refurbishment, change of use, disuse, decommissioning and demolition

58 Design of works

The effect of material alterations to a building should never increase fire risk; however, it can be beneficial to improve fire safety through building works, wherever practicable.

A fire risk assessment should be carried out regarding the impact of any proposed material alterations to ensure that:

a) no unacceptable existing fire risks are continued;

b) existing fire safety measures are not compromised; and

c) no new fire risks are created.

NOTE 1 Attention is drawn to the Building Regulations 2000 – Approved Document B [11].

NOTE 2 Attention is also drawn to buildings that are covered by the Regulatory Reform (Fire Safety) Order [2], which are required to undergo a fire risk assessment for their post-altered state.

59 Change of use

A new fire risk assessment should be conducted to cover the changed circumstances.

NOTE Attention is drawn to the Building (Amendment) Regulations 2011 [1]. Changing the use of a building might alter the regulations which are applicable to the building.

60 Refurbishments

When undertaking a refurbishment, whether or not directly related to fire safety, fire safety improvements should be considered.

61 Dwellings in disuse and areas decommissioned

Despite the supportive value of automatic detection and fire extinguishing systems, surveillance by human presence and immediate action taken in the very first stages of fire represent the most effective way of limiting its effects. When the human element is not present, as in the case of an unoccupied dwelling or a decommissioned part of a building, the occupants of the remainder of a building or complex are deprived of a first line of defence against fire.

Even if a temporarily discontinued occupancy results in a reduction of the combustibles normally expected to be present in a dwelling, the importance of automatic fire protection within that dwelling or area is increased rather than diminished, particularly if work such as shop fitting is in progress.

Under these circumstances, surveillance by staff should be intensified to prevent any form of careless practice and to ensure that protective systems remain fully operative.

Any decommissioned area, unoccupied dwelling, or any dwelling that is in the process of being fitted out should be either:

a) physically separated from the rest of the building by construction having not less than 60 min fire resistance; or

b) protected by other fire protection measures as agreed by the relevant enforcing authorities.

In either case, the unused part of the building should be subject to routine inspection, as determined by a risk assessment.

62 Managing building work and material alterations

Experience demonstrates that fires are more likely to occur when buildings are undergoing works of maintenance and alteration and therefore building work and material alterations should be managed and carefully monitored.

Designers and contractors should be made aware of the existing fire safety features of the building.

A fire risk assessment should be conducted that identifies and deals with all risks across the duration of the building project.

Building works should be continuously monitored to prevent the creation of unplanned extra and undue risks.

NOTE 1 Attention is drawn to the Construction (Design and Management) Regulations 2007 [9].

*NOTE 2 Further guidance can be found in BS 9999:2008, Clause **48**, the HSE publication, "Fire safety in construction" [25] and the Construction Confederation and Fire Protection Association publication, "Fire prevention on construction sites – The joint code of practice on the protection from fire of construction sites and buildings undergoing renovation" [26].*

63 Building works to occupied or partly occupied buildings

Where works are to be conducted to an existing occupied building or where a new building might be partly occupied before full completion, added vigilance against fire risk is necessary.

A fire risk assessment should be mutually evolved between both the responsible person for the building and the contractor. This risk assessment should be continually reviewed during the period of occupation. Where such an assessment process shows that the safety of persons is difficult to ensure then alternative approaches should be considered. These might include the provision of extra fire precautionary measures or the prohibition of contemporaneous occupation.

*NOTE Further guidance is available in BS 9999:2008, Clause **47**.*

Annex A (normative) Additional considerations for property and business continuity protection

A.1 General

The recommendations given in this British Standard are primarily concerned with the protection of life. The provision of fire safety systems for life safety do not necessarily give adequate protection to property or the business carried out in the building. Therefore, the aim of this annex is to ensure that the potential for property and business loss is assessed so that risks are understood and acceptable. It is also important to understand that fire presents a significant challenge to any business. In communal dwellings a fire which is contained to the dwelling of origin can very easily cause damage which will affect the habitability of other dwellings, for example through the damage of shared services.

Continuing operations of a business in the event of a fire is a fundamental requirement for any organization. It is appropriate that any business should have business continuity plans appropriate for its business. Further advice can be found in BS 25999 which provides a basis for understanding, developing and implementing business continuity within your organization.

A.2 Fire risk assessment

The primary method for examining the potential for property and business loss should be a fire risk assessment. This should account for the fire safety provisions in the building and the level of fire prevention management. The risk assessment for property and business continuity protection could be an extension to other risk assessments carried out for life safety as required under various legislation.

By carrying out a property and business continuity protection risk assessment, the consequences of fire on property and business loss can be highlighted to the owner, occupier, operator, tenant, designers and insurers. The risk assessment should take into account the existing fire safety systems and equipment in the building, and the level of fire prevention management intended for the building. It should then be clear what overall fire safety systems and equipment are required, what function they have in relation to property protection and what management responsibilities are required to maintain and operate these systems.

A.3 Aims of a property and business continuity protection risk assessment

NOTE Further advice and guidance can be obtained from the Fire Protection Association "Design guide for the fire protection of building: Essential principles" [27].

One aim of such a risk assessment is to provide a link between the provisions for life safety and those for property and business continuity protection. In consequence the risk assessment should ensure that, as far as is reasonably practicable, the design of fire precautions and fire prevention management provides adequate control against fire development in order to protect:

a) property:
   - contents;
   - fabric and building services;

b) business:
   - loss of dwellings and the social cost to the community;
   - need to provide rehousing;
   - loss of personal effects of the tenants;
   - loss of operational continuity for the business providing the housing.

A.4 Responsibilities

The responsibility for agreeing the level of fire precautions, and fire prevention management in relation to insurance, lies solely with the insurers or their agents and their client. The result of these discussions might result in a change of brief or increased fire precautions in the building. Consequently, discussions with the insurers should occur at an appropriate phase in the design and should allow for any contingency planning.

As part of the development of the brief, the responsibility for carrying out a property and business continuity protection risk assessment should be taken by one of the following:

- owner, occupier, operator, tenant or concessionaire, for self assessment;
- suitably competent member of the design team;
- insurer's fire surveyor;
- risk manager/engineer;
- fire safety engineer.

The level of detail required should also be decided upon when allocating responsibility.

Any changes in the design should be discussed with the relevant authorities to ensure that there is no adverse impact on life safety. If a conflict exists between the provisions for life safety and property protection that cannot be resolved, then life safety takes priority.

There is frequently a life safety benefit as a result of a property protection measure. It might be possible to remove or simplify some life safety measures, in negotiation with the relevant authorities, when more stringent property protection measures are adopted.

A.5 Acceptable level of risk

The acceptable level of risk to property or business should be established at an appropriate stage in the design. This acceptable level of risk to property or business should then be compared with the design criteria necessary for life safety. Any increases in performance standards required for property or business continuity protection can then be identified and incorporated in the design.

A.6 Risk assessment methodology

Initially, the appropriate type of risk assessment should be agreed. The risk assessment could range from a simple statement outlining the potential property and business losses which are acceptable to business managers and their insurers, through to a rigorous quantified analysis of probabilities and consequences of fire.

As the design develops it is possible that the level of detail will change, especially for fitting out. This might lead to a change in the type of risk assessment required.

Whatever method is employed, the aims of the risk assessment should be met so that all concerned are aware of the potential risks and the required performance of the fire safety systems and equipment and management of fire safety.

NOTE Whilst life safety takes priority in case of conflict, it is possible that improved property protection might replace a life safety feature without compromising overall safety.

The first stage in the process is to assess the level of property and business continuity protection inherent in the design to meet the life safety provisions. This might be sufficient for many buildings equipped with active suppression systems, compartmentation, structural fire protection, and provisions to prevent external fire spread.

The second stage is to identify any additional fire protection provisions. Care should be taken to identify any single points of failure that could have significant effects on business operations. Additional protection or some form of redundancy might then be required, not only for key elements of the business but also for services supporting that key element.

A.7 Qualitative risk assessment

A.7.1 General

For many buildings some form of qualitative risk assessment will be appropriate. There are a number of hazard and risk assessment techniques. These should be discussed and the technique to be used agreed at an appropriate stage of the design.

When the aims or objectives for property and business continuity protection have been agreed, then a strategy for achieving those aims can be developed. The strategy can be developed from the risk assessment, which will take into account various methods to prevent fire occurring and developing. These methods are referred to here as controls on fire development and they take into account both fire prevention management and the design of fire precautions.

Controls on fire development can be assessed against the way the fire is likely to start and then grow. The growth of the fire and the actions of various controls on fire development can be assessed in a sequential order known as a time line.

The following controls on fire development approximate to a time line for many fires:

- fire prevention management: control of ignition sources and combustible material, training of staff and work procedures, maintenance and upkeep of fire safety systems;
- detection and alarm; first aid fire-fighting;
- smoke management;
- compartmentation and structural fire protection;
- fire-fighting facilities; external and internal;
- external fire spread and building separation;
- automatic suppression systems.

As the fire grows, different controls to fire development will dominate the probability that the fire is controlled in size or extinguished. The success or failure of each control mechanism can be considered in the risk assessment of potential damage to the property and business. Any improvements in the management system can also be identified together with contingency plans, as necessary.

A.7.2 Fire prevention management

The first barrier to property and business loss is the level of fire prevention management in the building. This is to ensure that ignition hazards are controlled or eliminated, that operations in the building are carried out appropriately and that combustible loads are subject to control and good housekeeping. It is also important to recognize that in domestic dwellings, the owner or occupier of that dwelling may have little expertise or understanding of the fire protection and prevention measures in their home. In assessing the risk from fire, this should be recognized and might influence the level of additional protection provided, both in terms of fire safety feature of the built environment and in advice given to occupants for managing the risk from fire in their dwellings.

A.7.3 Detection, alarm and first aid fire-fighting

If a fire occurs and grows then the first barrier to its development will be by first aid fire-fighting. The usual advice to home owners is to refrain from first aid fire fighting, leave the dwelling and call the fire and rescue service. In situations where staff are available, first aid fire-fighting might be appropriate, and any enhanced provision should be incorporated into the risk assessment.

A.7.4 Automatic fire suppression and smoke control

If first aid fire-fighting is unsuccessful and the fire continues to grow then the next barrier to fire development is likely to come from any automatic fire suppression systems in the building. When assessing the adequacy of the system, reference should be made to the design objectives of the system to ensure it is sufficient for the aims of property and business continuity protection. Automatic fire suppression or control systems can be in the form of sprinklers, other automatic water based systems, fixed dry powder systems or gaseous suppression systems.

Smoke control systems can also contribute to property protection and business continuity. They can either be active or passive. Active smoke management systems can be turned on automatically via the detection and alarm system and take one or all of the following forms:

- mechanical and natural smoke extract with appropriate means to allow make-up air. These are designed to either limit the extent of smoke spread and/or to reduce the build up of heat in the compartment;
- pressurization systems to prevent the flow of smoke from one area to another by raising the pressure in the protected space;
- depressurization systems to prevent the flow of smoke from one area to another by lowering the pressure in the fire-affected space;
- directional fans designed to force smoke in one direction.

With active suppression systems the fire can be assumed to be controlled or extinguished. Either way, a degree of smoke damage can be anticipated within the compartment or smoke reservoir depending on whether or not it is an active or passive smoke management system. The potential for smoke damage can be assessed qualitatively for its impact on property and/or business. Care should be taken that any single points of failure that are likely to affect business operations are identified.

A.7.5 Compartmentation and structural fire resistance

If there are no active fire suppression systems, or if for the purposes of an extreme event analysis it is decided to assume that the fire is not controlled by active means, then the next level of control on fire development will be fire compartments and fire resistance to the structure. Compartmentation is often an important feature of residential building design.

Compartmentation is the provision of fixed horizontal and vertical barriers with designated fire resistance, including adequate fire-stopping; cavity barriers; dampers or seals; doors or shutters all of which are commensurate with the barrier in which they are housed.

When assessing the adequacy of the compartment and structural fire resistance, reference should be made to the design objectives to ensure it is sufficient for the aims of property or business continuity protection and day-to-day operation.

If a building is compartmented, smoke and heat damage can be assumed to occur throughout the compartment. There is also a risk that the compartmentation

could be breached as a result of inadequate fire-stopping between floor slabs and the external façade, or by external fire spread via the façade.

Care should be taken to identify single points of failure that are likely to affect business operations.

A.7.6 Fire-fighting facilities

Although fire-fighting facilities are included here as the fifth control to fire development, they could be equally applicable from any moment that a fire is detected.

The speed of response to the fire and availability of fire-fighting provisions play an important role in limiting the potential damage to property.

There are two factors to consider:

- provision for external fire-fighting;
- provision for internal fire-fighting.

The principal aim of these activities is life safety. For most buildings it is expected that these provisions will also be adequate for property protection.

A.7.7 Insurance industry guidance

The insurance industry has produced various guides which are directed at property protection (including Fire Protection Association *"Design guide for the fire protection of buildings: Essential principles"* [27] and the CLG publication, *Arson control forum annual report* [28], the Arson Prevention Bureau publication, *How building design can reduce the threat from arson* [29] and Zurich Municipal [30]). Arson and vandalism are addressed the CLG publication, *Arson control forum annual report* [28] and the Arson Prevention Bureau publication, *How building design can reduce the threat from arson* [29].

Many insurers use the *LPC design guide for the fire protection of buildings* [19] as a basis for providing guidance to the building designer on what they require.

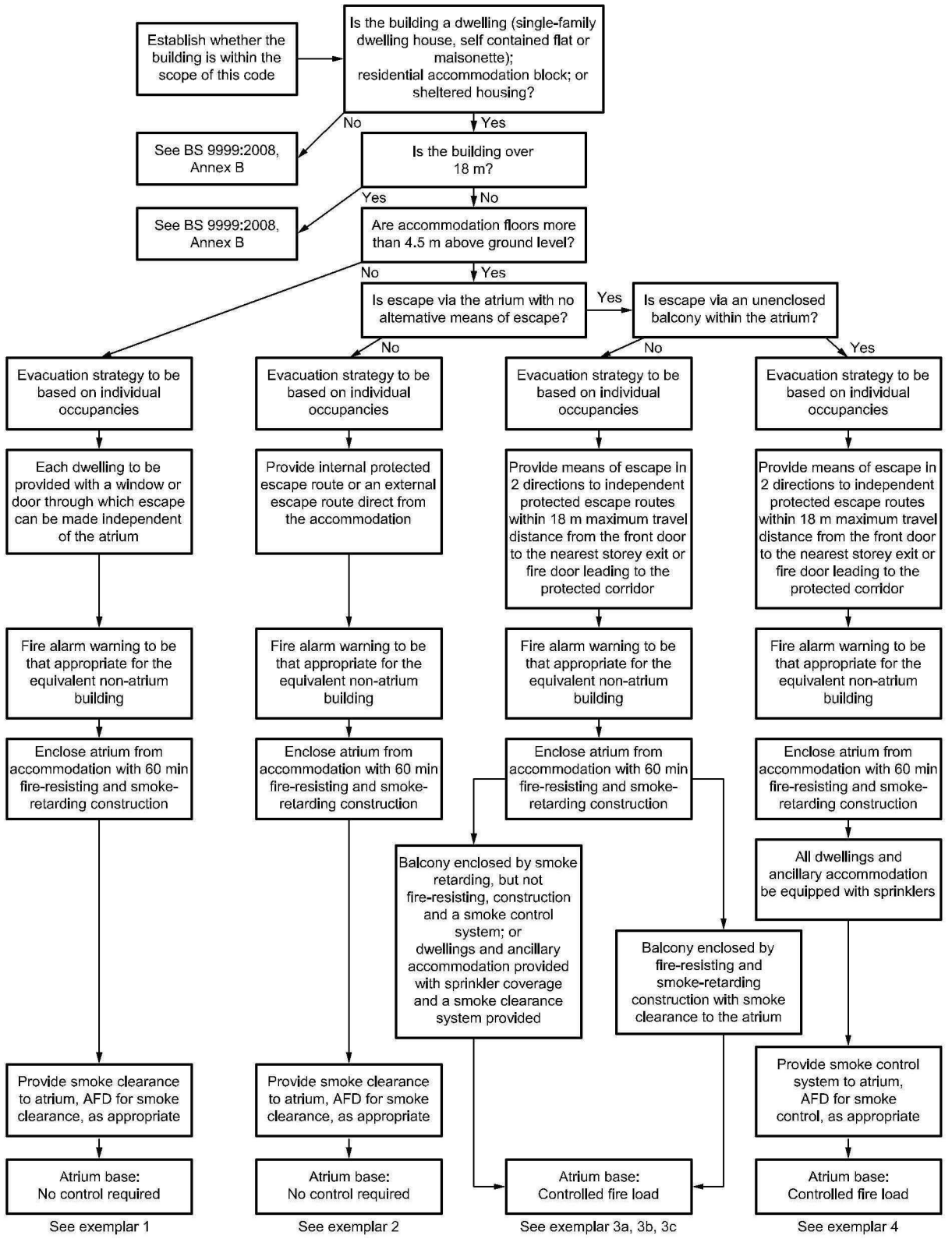
Annex B (normative) Atria

B.1 General

This annex contains different design options for the inclusion of atria in residential buildings. The exemplars given cover buildings up to 18 m in height, incorporating both enclosed and unenclosed balconies. The flowchart in Figure B.1 should be used to determine whether the atrium building falls within the scope of BS 9991 and, if it does, it should be used to determine a design solution.

Where specific reference is not made to a particular element of design and/or construction, such elements should be designed in accordance with the recommendations given elsewhere in this standard for non-atrium buildings.

Figure B.1 **Occupancy category decision process**

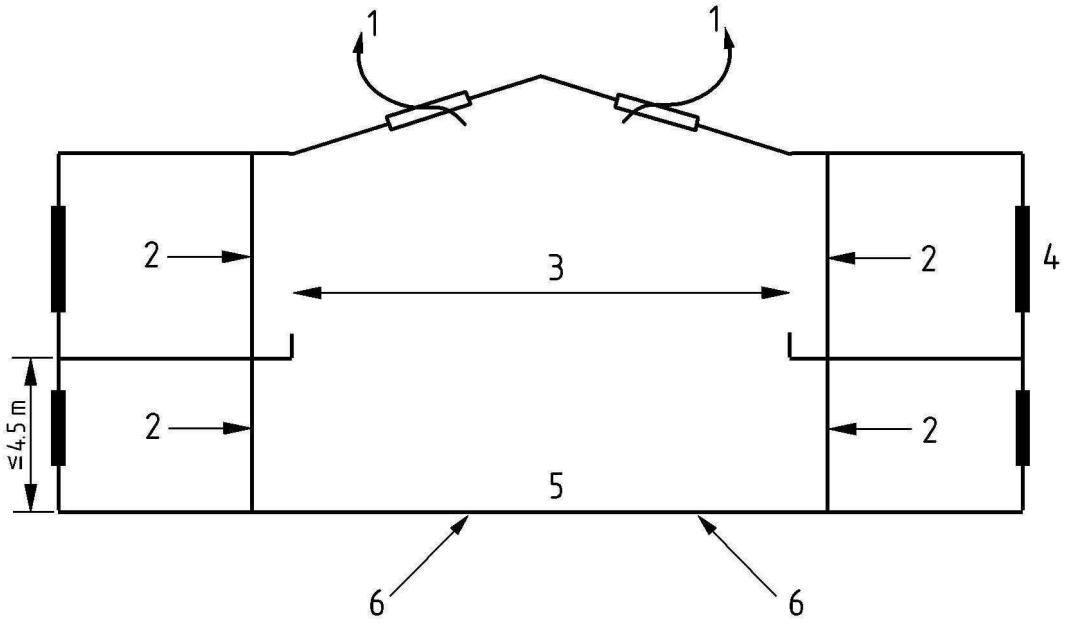


A) Where balconies are enclosed, ventilation should be provided in accordance with Clause **13**.

B) Where sprinklers are required within dwellings, they should be installed in accordance with BS 9251 or BS EN 12845. Where sprinklers are required in ancillary accommodation and/or to cover the atrium base, they should be installed in accordance with BS EN 12845.

Note For exemplars 1 to 4, see figures B.2 to B.7.

Figure B.2 **Exemplar 1: Atrium base, no control required**



Key

1 Smoke clearance system

2 Accommodation with 60 min fire-resisting (integrity and insulation) and smoke-retarding construction

3 Unenclosed balconies

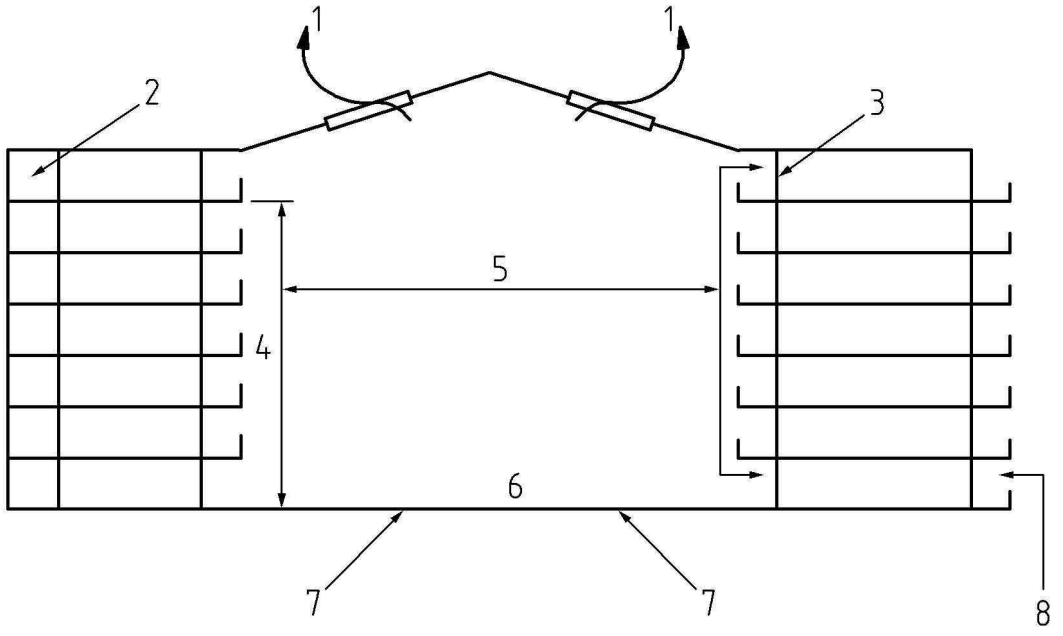
4 External wall having a window or door through which escape can be made

5 Atrium base: no control required

6 Make-up air

The fire alarm and warning should be appropriate for the equivalent non-atrium building.

Figure B.3 **Exemplar 2: Atrium base; no control required**

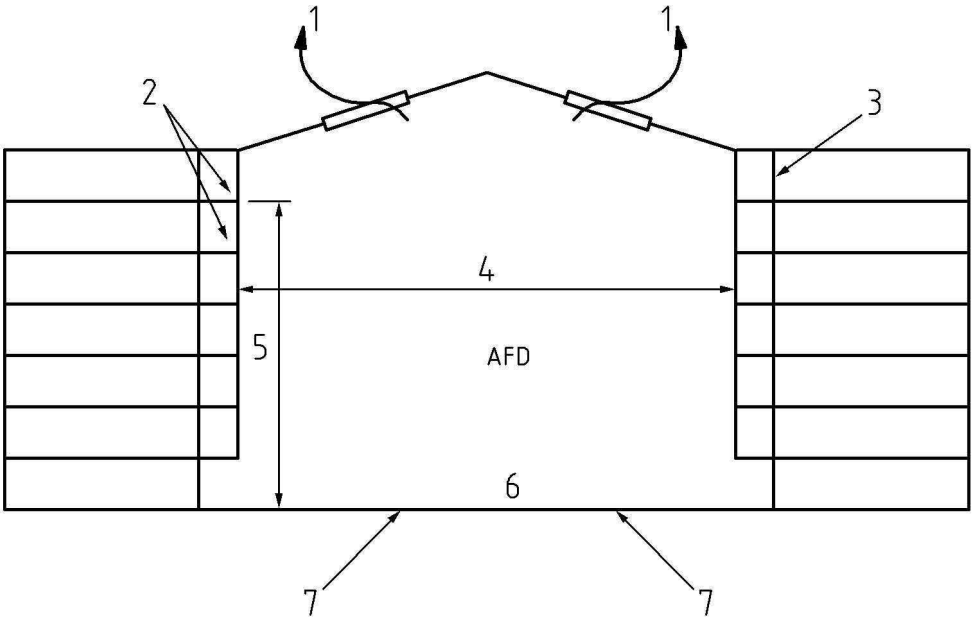


Key

1 Smoke clearance system
2 Protected internal escape route
3 Accommodation with 60 min fire-resisting (integrity and insulation) and smoke-retarding construction
4 Height up to 18 m
5 Unenclosed balconies
6 Atrium base: no control required
7 Make-up air
8 External escape

The fire alarm and warning should be appropriate for the equivalent non-atrium building.

Figure B.4 **Exemplar 3a: Atrium base; controlled fire load**



Key

1 Smoke control system

2 Means of escape in two directions to independent, protected escape routes with a maximum travel distance in one direction of 18 m

3 Accommodation with 60 min fire-resisting (integrity and insulation) construction

4 Enclosed balconies with a smoke-retarding construction

5 Height up to 18 m

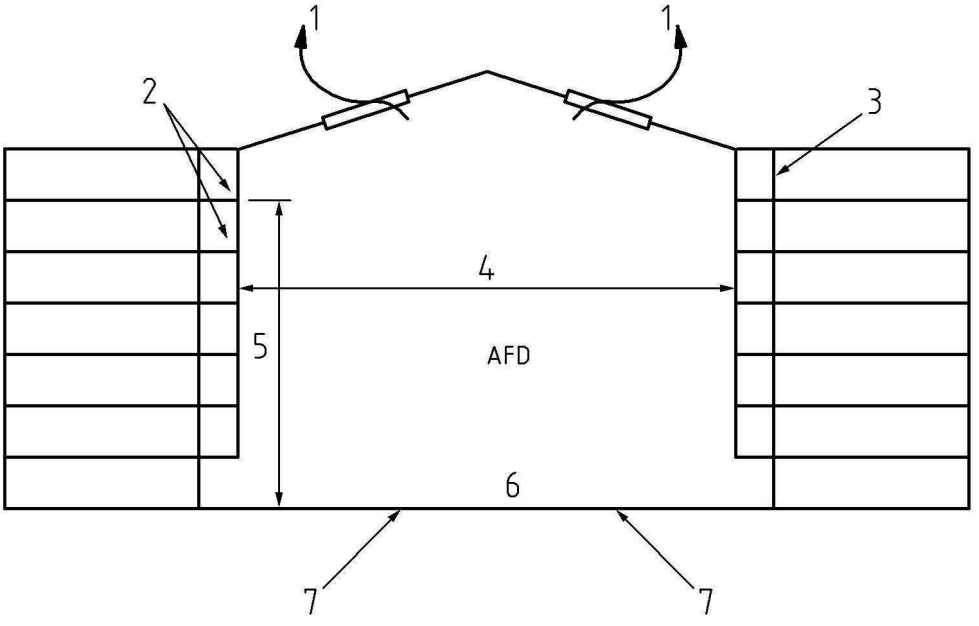
6 Atrium base: controlled fire load

7 Make-up air

AFD Automatic fire detection appropriate to the smoke control system

The fire alarm and warning should be appropriate for the equivalent non-atrium building.

Figure B.5 **Exemplar 3b: Atrium base; controlled fire load**



Key

1 Smoke clearance system

2 Means of escape in two directions to independent, protected escape routes with a maximum travel distance in one direction of 18 m

3 Accommodation with 60 min fire-resisting (integrity and insulation) construction

4 Enclosed balconies with fire-resisting and smoke-retarding construction

5 Height up to 18 m

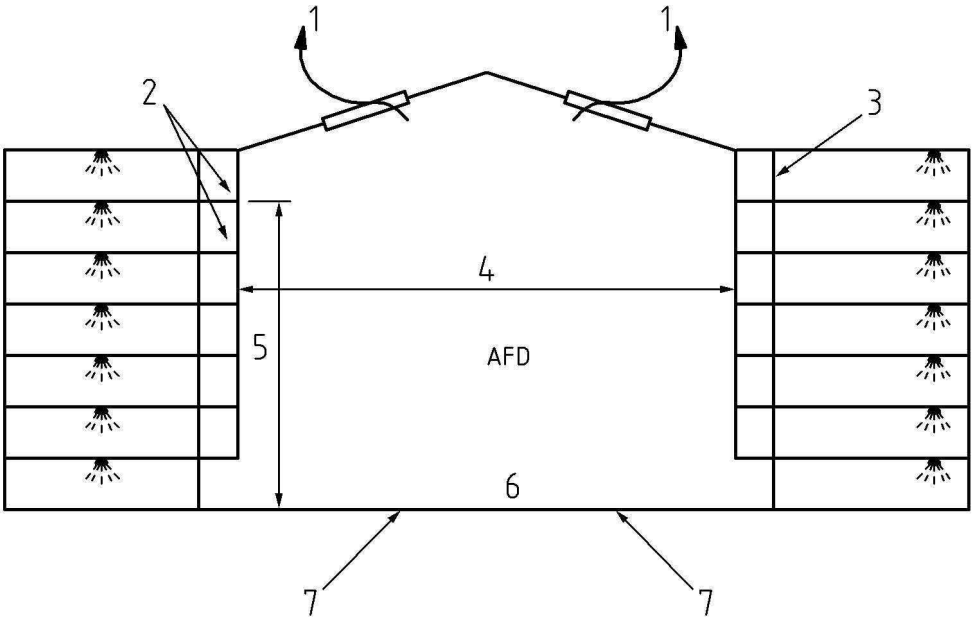
6 Atrium base: controlled fire load

7 Make-up air

AFD Automatic fire detection appropriate to the smoke control system

The fire alarm and warning should be appropriate for the equivalent non-atrium building.

Figure B.6 **Exemplar 3c: Atrium base; controlled fire load**



Key

1 Smoke clearance system

2 Means of escape in two directions to independent, protected escape routes with a maximum travel distance in one direction of 18 m

3 Accommodation with 60 min fire-resisting (integrity and insulation) construction

4 Enclosed balconies with smoke-retarding construction

5 Height up to 18 m

6 Atrium base: controlled fire load

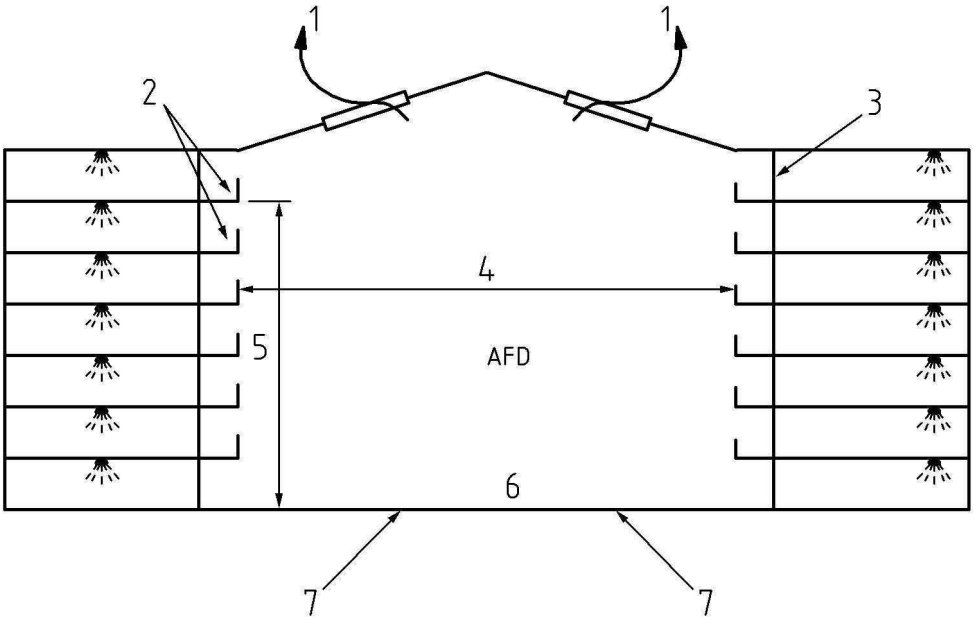
7 Make-up air

AFD Automatic fire detection appropriate to the smoke control system

Automatic sprinkler protection

The fire alarm and warning should be appropriate for the equivalent non-atrium building.

Figure B.7 **Exemplar 4: Atrium base; controlled fire load**



Key

1	Smoke control system
2	Means of escape in two directions to independent, protected escape routes with a maximum travel distance in one direction of 18 m
3	Accommodation with 60 min fire-resisting (integrity and insulation) construction
4	Unenclosed balconies
5	Height up to 18 m
6	Atrium base: controlled fire load
7	Make-up air
AFD	Automatic fire-detection, appropriate to the smoke control system
	Automatic sprinkler protection

The fire alarm and warning should be appropriate for the equivalent non-atrium building.

B.2 Means of escape

B.2.1 General

The inclusion of active and passive fire and smoke control systems within an atrium is intended to ensure that the means of escape provided remains available to occupants throughout the evacuation of the building under fire conditions.

As a high degree of compartmentation is provided and therefore there is a low probability of fire spread beyond the dwelling of origin, it is unlikely that simultaneous evacuation will be necessary (see **E.1** regarding stay-put strategy). However, there might be some occasions where operational conditions are such that the fire and rescue service decide to evacuate the building. In these situations the occupants of the building might need to use the escape route; this might be while fire-fighting is in progress. As such, the recommendations in this standard for the protection of common escape routes and stairs are designed to ensure they remain available for use over an extended period.

It is essential, therefore, that the provision of means of escape follows established guidance, appropriate to the risk concerned, other than where specifically allowed for within this guidance.

B.2.2 Escape routes

When evacuating a building the occupants have a natural tendency to leave via the same route by which they entered. In planning for escape it is normally desirable that the escape routes coincide with circulation routes. However, in a building containing an atrium this is not always feasible and might not be desirable if it requires travel close to the edge of an open atrium.

Occupants of a building generally need to have alternative directions of escape, and the circumstances where a single direction of travel is acceptable are limited. This principle and others such as maximum distances of travel apply equally to a building containing an atrium as to one that does not. In circumstances where the atrium is not separated from the accommodation by fire-resisting construction, it is necessary to consider escape within and from the atrium, and escape from the associated areas, as an entity. It is particularly important to consider the effect the atrium might have on escape from upper storeys open to the atrium in view of the potential for a fire in the atrium to affect those storeys.

B.2.3 Balcony escape

Escape via a balcony within the atrium space is acceptable without the need for an alternative protected escape route away from the atrium, provided that the balcony is protected from the effects of heat and smoke. Where there is an alternative protected escape route from the accommodation, these restrictions need not apply and open balcony escape routes are acceptable (see Figure B.2, exemplar 1 and Figure B.3, exemplar 2).

Where the means of escape is via a balcony within the atrium (i.e. where no alternative route from the accommodation is available), it should conform to one of the following options.

a) *Option 1*:
   1) the balcony should be enclosed with fire-resisting and smoke-retarding construction that conforms to the same specifications to that of the atria; and
   2) a smoke clearance system should be provided from the atrium in accordance with **B.6** and Figure B.5, exemplar 3b);

b) *Option 2*:
   1) the balcony should be enclosed by smoke-retarding but not fire-resisting construction; and
   2) a smoke control system should be should be provided from the atrium in accordance with **B.3** and Figure B.4, exemplar 3a);

c) *Option 3*:
   1) the balcony should be enclosed by smoke-retarding but not fire-resisting construction;
   2) all dwellings and ancillary accommodation should be provided with a sprinkler system; and
   3) a smoke clearance system should be provided from the atrium in accordance with **B.6** and Figure B.6, exemplar 3c).

Where the means of escape from the balcony is not separated from the atrium, a smoke control system should be provided in the atrium in accordance with **B.6** and

all dwellings and ancillary accommodation should be provided with a sprinkler system (see Figure B.7, exemplar 4).

Escape within the atrium should be available in at least two directions with the travel distance within the atrium to the nearest storey exit not exceeding 18 m.

In all cases the atrium base should only contain a controlled fire load.

B.2.4 Fire alarm and detection system

Fire detection and alarm systems should conform to the recommendations given in Section **5**, as appropriate for the equivalent non-atrium building.

B.3 Building characteristics and recommendations

B.3.1 Fire resistance of structure

Recommendations and guidance are provided in this annex on alternative methods of preventing the flow of hot gases and flames from a fire in the associated dwelling to the atrium and subsequently having a possible effect on other dwellings via the atrium.

Various strategies have been developed to ensure that this can be achieved, including the following:

a) fire-resisting and smoke-retarding construction can be placed between the atrium and the associated dwellings in conjunction with natural exhaust vents;

b) smoke-retarding construction between the atrium and the associated dwellings can be used in conjunction with a smoke control system;

c) smoke-retarding construction between the atrium and the means of escape from the associated dwellings can be placed in conjunction with a sprinkler system within all dwellings and ancillary accommodation and a smoke clearance system.

B.3.2 Fire-resisting construction

Where the accommodation needs to be separated from the atrium by a fire-resisting construction, then either side of the construction should be capable of meeting the integrity criterion specified in BS 476-22 for a period of not less than 30 min, or the classification specified in the relevant part of BS EN 13501, unless otherwise recommended elsewhere in this standard.

B.3.3 Smoke-retarding construction

In many instances it is not necessary to enclose the atrium with fire-resisting construction. However, a smoke-retarding enclosure might be needed to prevent the early ingress of smoke to those levels that are not directly affected by fire. Some forms of construction which are fire-resisting (e.g. traditional roller shutters) would not be sufficiently impervious to smoke to be considered as smoke-retarding. Where smoke curtains are used, they should be in accordance with BS EN 12101-1.

In the absence of an appropriate method of test and performance criteria, such construction should not contain unsealed joints and permanently open, or openable, areas. Joints between such construction and any abutting element should be tight and preferably sealed with a filler conforming to BS EN 1366-3 or BS EN 1366-4 (e.g. plaster), a mastic, or a flexible strip (e.g. neoprene), as appropriate.

Any doors in an atrium, when tested in accordance with BS 476-31.1 with the threshold taped, and subjected to a pressure of 25 Pa, should have a leakage rate not exceeding 3 $m^3/h/m$.

B.3.4 Enclosure

The enclosure of an atrium by imperforate construction (such as a glazed screen) can significantly reduce the probability of smoke damage to storeys removed from the fire. However, if the fire grows large, the temperature build-up within the atrium is likely to lead to failure of float and other annealed glasses, and smoke and flames can spread between storeys. If a fire continues to develop unchecked, the build-up of heat is likely to lead eventually to the failure of non-fire-resisting glazing systems used for the atrium enclosure. Therefore, to achieve an additional level of protection the provision of a fire-resisting enclosure to the atrium can be beneficial.

B.3.5 Connection of an atrium to below-ground storeys

There is essentially little difference in the potential for fire and smoke spread between an atrium penetrating below ground level and an atrium that is wholly above ground, and it is not necessary to separate the below-ground sections of an atrium and its associated floor areas from the upper storeys by means of fire-resisting construction. No specific recommendations are made for atria connecting with below-ground storeys, but it should be ensured that protected escape routes and fire-fighting provisions are in accordance with the recommendations for the equivalent non-atrium building.

B.4 Glazing

B.4.1 General recommendations for overhead glazing

Overhead glazing should be designed to minimize the risk of injury due to falling glass. This generally requires the use of polyvinylbutyral (pvb) laminated safety glass on the inner pane facing into the atrium space. Relevant guidance on the limitations of other glass types can be found in BS 5516-2.

Up to a height of 5 m above floor level, glass should consist of:

a) *single glazing:* toughened glass, heat-soaked toughened glass, pvb laminate safety glass, or Georgian wired glass; or

NOTE Georgian wire glass contains a wire mesh within the body of the glass.

b) *insulating glazed units:* the lower pane should be one of the above types. If the lower pane is either toughened or heat soaked toughened glass then the upper pane of the unit should also be one of the glass types given above.

At a height of between 5 m and 13 m above floor level, glass should consist of:

i) *single glazing:* Georgian wired glass or a glazing including pvb laminated safety glass as the outer layer. Heat soaked toughened glass may be considered provided that the glass thickness is not more than 6 mm with a maximum pane size of 3 m^2;

ii) *insulating glazed units:* lower pane in accordance with **B.4.1**i). Where the lower pane is toughened glass then the upper pane should also be according to **B.4.1**i).

At a height of more than 13 m above floor level, glass should consist of single glazing and the lower pane of insulating glass units: either Georgian wired glass or a glazing including pvb laminated safety glass as the inner pane.

B.4.2 Fire protection of glazed walls and the atrium roof

Glazed atrium walls and the atrium roof should conform to the following recommendations.

a) If one or more of the sides of the atrium form a vertical escape and access stair then the vertical glazing either side of the corner, for a distance of at least 3 m on both sides, should be a minimum of 30 min insulation and integrity for the full height of the atrium.

b) The roof glazing should be part of a classified minimum 30 min integrity fire-resisting glazed system combined with a smoke-retarding construction.

c) Any façade glazing outside and above the atrium should be part of a fire-resisting glazed system for a distance of at least two floors above the atrium roof, and having a minimum of 30 min insulation with integrity.

B.5 Load-bearing elements

The anticipated fire load (per m^2 of floor area) in a building incorporating an atrium would normally be no greater than in the equivalent non-atrium building. Load-bearing elements of structure that are fire-resisting should therefore be of an equal level of fire resistance as those appropriate for the equivalent non-atrium building.

B.6 Smoke control and controlling the fire load on the atrium base

B.6.1 General

Smoke control systems are designed to move or control the smoke and fire effluent in a predetermined manner in order to minimize the threat to life. Smoke control can be achieved in a number of different ways, such as through a smoke clearance system which assists fire-fighters in removing smoke from the building in the aftermath of a fire.

NOTE For general guidance on smoke control systems, see Annex E.

Smoke control systems should:

a) maintain a clear layer of not less than 3 m above the top open-occupied storey, or 2.5 m above the floor of fire origin; and

b) prevent the smoke layer temperature from exceeding 200 °C.

Where the design of the smoke control system allows the layer of smoke to descend below closed storeys, smoke should be prevented from leaking into these floors or, where applicable, the smoke control system design should ensure by dilution that the optical density per metre does not exceed 0.1 at all points on the top storey open to the atrium. This measure is intended to ensure that the visibility on the open storeys does not become lower than the accepted 8 m to 10 m range which is deemed adequate for safe use of the escape routes.

B.6.2 Make-up air

It is essential that any smoky gases exhausted from the atrium are replaced by clean, fresh air. This replacement air should enter below any buoyant smoke layer to avoid immediate mixing with smoke, and to allow the best conditions for the use of escape routes and for fire-fighting.

B.6.3 Calculation procedures

It is important that designers establish that the calculation procedures used are relevant to the circumstances in which they are intended to be used. The procedures and calculations should be fully documented.

NOTE Guidance on calculation procedures for the design of smoke and heat control systems can be found in a number of documents, e.g. BS 7346-4 and BS 7346-5, BRE Report 368 [12] and CIBSE Guide E [31].

B.6.4 Interaction with other systems

HVAC ductwork used in conjunction with a smoke control system presents a risk as inlet air and exhaust air can spread smoke and fire within the atrium building. Therefore careful consideration needs to be given to fire protection, integrity of construction, ventilation controls, and routing of ductwork used for smoke and heat control systems.

B.6.5 Post-fire suppression ventilation

Smoke and heat from a building might need to be released after the fire has been suppressed by the fire and rescue service. Ventilation for this purpose is usually obtained by opening windows to provide cross-ventilation and smoke clearance. In a building with an atrium, the spread of smoke to a number of storeys can make it more difficult to open windows on every storey affected by smoke. In such circumstances, a mechanical or natural ventilating system capable of clearing the smoke from the atrium and the affected floor area should be provided.

Where a smoke control system is provided for means of escape purposes, it is not generally necessary to provide additional facilities specifically for the fire and rescue service. However, where such a system is not provided, the provision of smoke clearance facilities for operation by the fire and rescue service is recommended.

Stand-alone manual override facilities should be provided that allow the fire and rescue service to have direct control of the smoke control and normal ventilation systems within the building.

B.6.6 Natural smoke control for atria

A smoke control system operating on natural ventilation principles should be designed to remove residual smoke, taking due account of mixing effects, when relying solely on the thermal stack effect created by the buoyancy of the smoke and on the areas of openings provided.

NOTE A separate low level inlet is not always required. Inlet air can be provided by fire-fighters opening windows and doors.

Natural smoke clearance for atria should conform to the following.

a) Natural exhaust vents should be provided in the atrium roof. The total area of vents should be not less than 10% of the maximum plan area of the atrium.

b) Vents should be located in such a way that ensures adequate coverage and cross-ventilation of the total atrium.

c) Vents and associated controls should conform to BS EN 12101-2.

B.6.7 Mechanical smoke control for atria

A mechanical smoke ventilation system should be provided having a low-level inlet within the atrium to provide replacement air changes every hour based upon the

total volume of the atrium including the largest floor open to it. The mechanical smoke ventilation system should provide:

a) four air changes per hour in sprinklered buildings where the atrium base has a controlled fire load;

b) six air changes per hour in unsprinklered buildings.

B.6.8 Automatic control

Smoke control systems should be actuated by means of smoke detection in the common access space to flats.

B.6.9 Ventilation and smoke controls for the fire and rescue service

In order to assist the fire and rescue service in rescue, fire-fighting and clearance of smoke after the fire has been extinguished, it has become normal practice to provide switches at suitable locations by which fire and rescue service or other authorized personnel can override the operation of smoke exhaust fans and ventilators and alter the configuration of the normal air handling system. Careful consideration should be given as to the extent of such provisions.

NOTE It might be advisable to seek the advice of the fire and rescue service regarding designing ventilation and smoke controls.

B.6.10 Controlling fire load on the atrium base

Where it is necessary to control the fire load within the atrium, the following recommendations apply.

a) If the total weight of combustibles on the atrium base exceeds 160 kg, the materials should be confined to isolated islands, each island containing a maximum of 160 kg of combustible material, covering a maximum floor area of 10 m², and being separated from other areas of combustible materials by a distance of at least 4 m (except where those areas are protected by a sprinkler system, see **B.6.11**).

b) When tested in accordance with BS 476-7, all wall and ceiling linings should have at least a Class 1 surface spread of flame.

c) When tested in accordance with BS 5852, all upholstered furniture should resist ignition from the smouldering source and the flaming source.

NOTE Attention is drawn to the provisions of the Furniture and Furnishings (Fire) (Safety) Regulations 1988 [10] in respect of filling materials.

d) All textiles (drapes and curtains) should conform to BS 5867-2.

e) Where an automatic suppression system is provided, the fire load can be considered to be controlled.

B.6.11 Sprinkler protection to the atrium base

Where sprinkler protection is provided to an atrium base, the objective is to limit the heat output of the fire to 2.5 MW convective heat flux. In atria, the effectiveness of sprinklers diminishes with an increase in height above the atrium base. This should be taken into account in their design and installation in order to ensure that they are correctly placed to be capable of achieving control of a fire. Sprinkler systems should be installed to BS EN 12845.

Annex C (normative) Private Balconies (open or enclosed)

C.1 Balconies

All balconies should be guarded with a protective barrier conforming to BS 6180.

Balconies that are enclosed or partially enclosed should be designed in accordance with BS 9999:2008, **36.6**.

C.2 Private balconies (balconies for the use of only one dwelling)

No store or other fire risk should be erected externally on a balcony.

Balconies no more than 4.5 m above ground level should conform to **5.1**c)3).

NOTE It is important to ensure that there is sufficient space to bring in and safely erect a suitable ladder.

Enclosed balconies should be treated as inner rooms.

Where balconies are enclosed and are contiguous with enclosed balconies to other flats, the fire resistance of the balcony structure and the compartmentation between balconies should be the same as the fire resistance required for the building.

C.3 Private balconies more than 4.5 m above ground level

Balconies more than 4.5 m above the ground level should conform to the following recommendations.

a) The escape route from the balcony should not pass through more than one access room.

b) The interior of the access room should be clearly visible from all parts of the balcony.

c) The travel distance from any point on the balcony to the exit(s) from the access room should not exceed the allowable one-way travel distance.

d) Any cooking risk in the access room should be enclosed with fire-resisting construction unless:

   1) the open cooking risk is remote from the balcony and positioned in such a way that it does not prejudice the escape route through the access room; and

   2) a system of automatic smoke detection conforming to BS 5839-6 is provided to the access room with an alarm system on the balcony.

e) Where the travel distance to any point on the balcony exceeds 7.5 m, it should be provided with an alternative escape route without going via the same access room or the access room should be provided with automatic smoke detection.

C.4 Communal roof gardens, terraces and balconies

Roof spaces, terraces or balconies (used as a common amenity) having a travel distance exceeding 45 m should have an alternative escape route provided in accordance with **7.2**c). Where alternative escape is provided, roof space may be of any dimension.

The staircase leading to or from the roof garden, terrace or balcony should be protected from all floors (excluding an open roof area) in accordance with **26.1.2** for small buildings, or with **26.1.3** for buildings exceeding 11 m in height.

Where a roof garden is fully or partially enclosed, it should be considered as a floor for means of escape and the same protection should be provided to the staircase.

The lift serving any roof space, terrace or balcony should conform to BS 9999:2008, **16.7** and **46.9**.

Where it is necessary to provide an alternative escape to a common amenity due to travel distances or enclosure and access to the common amenity is via a lift, consideration should be given to provisions for the safe and convenient use of the alternative escape by any persons with mobility impairments.

C.5 Communal roof gardens, terraces and balconies in sheltered housing

Careful consideration should be given to the size and design of all balconies and roof terraces used in sheltered housing for access and egress, whether assisted or unassisted.

C.6 Communal roof gardens and other open spaces

Communal roof gardens and other open spaces should conform to the following recommendations.

a) Access to communal roof gardens and similar places should be from a protected stairway enclosure or a protected ventilated lobby/corridor.

b) Where the roof garden is open to the air, there should be no limit on the travel distance on the roof garden.

c) Where the roof garden is enclosed:

   1) it should be separated from the approach stairs or lobby/corridor by a protected lobby; and

   2) travel distances within the roof garden space should be limited to 18 m where there is only a single direction of escape; or

   3) travel distances within the roof garden space should be limited to 45 m where escape is possible in more than one direction.

d) An alarm, audible throughout the roof garden, should be sounded upon activation of any fire detection system in the stairs or lobby/corridor access space.

Annex D (informative) Advice to occupiers of dwellings in residential buildings

D.1 General

This annex contains information regarding fire safety advice that can be given to occupiers of flats and other dwellings in residential buildings which are not single private dwellings. In general the same information applies to both occupiers of flats and occupiers of other domestic residential buildings. Where the information differs, the difference is highlighted in the text. The fire and rescue service can generally provide additional advice on fire safety if it is felt to be necessary. Examples of suitable fire instruction notices (see **53**) are given in Figure D.2 and Figure D.3.

D.2 Smoke alarms

The longer a fire burns before it is discovered, the more likely it is to cause death or injury. A fire that starts smouldering at night is therefore very dangerous.

People are not always awoken by the smell of smoke. A fire involving certain furnishings can produce poisonous gases that prevent people from recovering

consciousness. Even when people do wake up, their means of exit can be blocked by thick smoke.

Installing smoke alarms in a dwelling does not stop fires starting and does not put a fire out, but if properly installed and looked after they can give an early warning of fire and increase the chances of escape.

Guidance on the selection and installation of smoke alarms can be obtained from local fire and rescue services.

D.3 Ways in which fires can start

Fires in domestic buildings can start in many ways, including:

- careless use of matches, candles, cigarettes and pipes;
- careless use of cookers, especially leaving chip pans without watching them;
- drying and airing of clothes and other items that could burn near heaters (such as gas fires and electric radiant, storage and convector heaters);
- no fire guards to prevent objects from falling into an open fire;
- children playing with matches and cigarette lighters;
- old or faulty domestic appliances, including electric blankets;
- putting portable heaters close to furniture and curtains;
- not taking out the plugs from electrical appliances at night or when away from home, unless they are designed for continuous operation, e.g. refrigerators, video recorders, clocks;
- use of paraffin heaters;
- covering of storage and convector heaters thus preventing air from getting to them;
- irregular or poor servicing of heating appliances.

D.4 General fire safety advice

Figure D.1 shows an example of general fire safety advice that can be given to occupiers of dwellings in residential buildings.

Figure D.1 **General fire safety advice for occupiers of dwellings in residential buildings**

Small fires are common, causing serious injuries and extensive damage to property and possessions. By following a few simple steps and maintaining a basic level of awareness you can considerably reduce the chances of fire in your home. The easiest and most effective way of protecting your home is by fitting at least one smoke alarm, and regularly making sure it works.

The following 13 tips will help keep your family and home safe:

1. Fit smoke alarms on each level in your home. Keep them free from dust and test them once a week. Consider buying a 10-year alarm; otherwise change the batteries in your alarm every year.
2. Make a fire action plan so that everyone in your home knows how to escape if there is a fire.
3. Keep the exits from your home clear so that people can escape if there is a fire.
4. Make sure that everyone in your home can easily find the keys for doors and windows.
5. Take extra care in the kitchen – accidents while cooking account for over half of fires in homes. Never leave young children alone in the kitchen.
6. Take extra care when cooking with hot oil. Consider buying a deep-fat fryer which is controlled by a thermostat (if you don't already have one).
7. Never leave lit candles in rooms that nobody is in or in rooms where children are on their own. Make sure candles are in secure holders on a surface that doesn't burn and are away from any materials that could burn.
8. Make sure cigarettes are stubbed out properly and are disposed of carefully, and never smoke in bed.
9. Get into the habit of closing doors at night. If you want to keep a child's bedroom door open, close the doors to the lounge and kitchen; it might help to save their life if there is a fire.
10. Don't overload electrical sockets. Remember, one plug for one socket.
11. Keep matches and lighters where children can't see or reach them.
12. Take special care when you're tired or when you've been drinking.
13. Don't leave the TV or other electrical appliances on standby as this could cause a fire. Always switch it off and unplug it when it is not in use.

If you or a member of your household has any difficulty seeing, hearing or moving about the home, you will need to take extra care to deal with the risk of a fire. Your local fire and rescue service will be able to assess how safe your home is and help to fit fire safety equipment such as smoke alarms.

High-rise flats are built to be fire-resisting, and most fires won't spread further than one or two rooms. Walls, ceilings and doors will hold back flames and smoke, so if there's a fire somewhere else in the building, you're usually safest staying in your flat unless you're affected by heat or smoke. You should plan how to escape if there is a fire in your home. It is likely that the flat will share common areas with other flats. The owner or occupiers of the flats will have the responsibility of making sure that the necessary fire precaution measures needed in these areas are installed. For example, there may be a fire alarm and the doors and fire resisting features of the common areas will need to be maintained. It is important that occupiers understand the fire precaution measures built into the common areas and that they ask the landlord to explain the safety plans for the premises and make sure that they are familiar with what they should do when a fire happens. If you cannot escape you will need to find a room where you can wait for assistance. This is particularly important if you have difficulty moving around or using stairs. It is advisable for your safe room to have a window that opens, and a phone.

D.5 Heating

Most dwellings, including flats, are provided with a fixed heating system. The risk of a fire occurring can be reduced if the fixed heating system is used rather than heaters, as all types of portable heaters can start a fire if they are not properly sited, used correctly and maintained in good working order.

The entrance lobby and corridor of a flat is the normal escape route in the event of a fire, so it is essential that portable radiant heaters are not used in these areas. It is not advisable to use paraffin heaters. Special care needs to be taken with portable bottle gas heaters, particularly when changing cylinders. The manufacturer's instructions for all portable heaters include guidance on where they should be placed, how they should be used and how they can be kept in safe working order.

D.6 Doors

Self-closing doors are provided in flats and other dwellings in residential buildings, to stop the spread of fire and smoke. It is most important that they are not wedged open and that the self-closing mechanism works correctly.

If self-closing doors do not close themselves, it is the responsibility of the occupants to ensure that the defect is reported to the porter, caretaker or landlord, or to the local housing authority.

It can help to prevent the spread of fire if occupants tightly close as many doors as possible before going to bed or when leaving the premises empty.

D.7 Abuse of fire-fighting equipment

Fire-fighting equipment (in the form of fire extinguishers, fire mains and outlets) and fire safety signs are installed in flats and other residential buildings. It is the responsibility of all occupants to ensure that such equipment is not interfered with, and if any item of equipment is found damaged, to report it immediately.

D.8 Access roads

It is important that fire and rescue service access roads to blocks of flats and other residential buildings are kept clear and unobstructed, to allow access by the fire and rescue service and other emergency vehicles at all times. It is the responsibility of all occupants to ensure that they do not park their cars in these roads or allow their visitors to do so, and if they see any vehicles parked there, to report them.

D.9 Sprinkler systems

Sprinkler systems are activated by heat from the fire, and release water onto it. They are designed to prevent the fire growing, so that much less smoke and heat are produced and people have more time to escape. In many cases a sprinkler system will put the fire out. Where a sprinkler system is installed it is important that the sprinklers are not painted over, since this can slow their response to a fire. Concealed sprinklers hide the sprinkler using a cover plate, which falls away when the solder holding it in place melts. It is particularly important that this cover plate is not painted over.

D.10 Examples of fire instruction notices

The fire instruction notice provides instructions on fire precautions and actions to take in the event of a fire. This annex gives examples of fire instruction notices for a range of situations.

An example of a suitable fire instruction notice for flats is shown in Figure D.2.

An example of a suitable fire instruction notice for other residential buildings is shown in Figure D.3.

Figure D.2 **Example of a fire instruction notice for use in flats**

This building has been built in such a way as to protect the people in it if a fire breaks out. The important thing to remember is that if the fire starts in your home, it is up to you to make sure that you can get out of it.

AT ALL TIMES

— Make sure that the smoke alarms in your home are working.

— Do not store anything in your hall or corridor, especially anything that will burn easily.

— Use the fixed heating system fitted in your home. If this is not possible, only use a convector heater in your hall or corridor. Do not use any form of radiant heater there, especially one with either a flame (gas or paraffin) or a radiant element (electric bar fire).

— Do not store things in the cupboard(s) where your gas and electricity meters are fitted.

— Do not block access roads to the building.

IF A FIRE BREAKS OUT IN YOUR HOME

— If you are in the room where the fire is, leave straight away, together with anybody else, then close the door.

— Do not stay behind to try to put the fire out.

— Tell everybody else in your home about the fire and get everybody to leave. Close the front door and leave the building.

— Do not use the lift (unless it is a designated evacuation lift).

— Do not use a balcony unless it is part of the escape route from the building.

— CALL THE FIRE AND RESCUE SERVICE.

IF YOU SEE OR HEAR OF A FIRE IN ANOTHER PART OF THE BUILDING

— It will usually be safe for you to stay in your own home.

— You must leave your home if smoke or heat affects it. Close all doors and windows.

CALLING THE FIRE AND RESCUE SERVICE

The fire and rescue service should always be called to a fire, even if it only seems a small fire. This should be done straight away.

The way to call the fire and rescue service is by telephone as follows.

1) Dial 999.

2) When the operator answers, give the telephone number you are ringing from and ask for FIRE.

3) When the fire and rescue service reply, tell them clearly the address where the fire is.

4) Do not end the call until the fire and rescue service have repeated the address to you and you are sure they have got it right. The fire and rescue service cannot help if they do not have the full address.

Figure D.3 **Example of a fire instruction notice for use in other residential buildings**

If a fire starts in your home, it is up to you to make sure that you can get out of it. Do not wait until a fire happens. Read these instructions and find out the best way for you and your family to get out of your home and also out of the building if a fire started somewhere else. There may be more than one way out. If you and all the other people in the building follow these rules you will all be much safer and less likely to start a fire or be injured in one.

AT ALL TIMES

— Make sure that the smoke alarms in your home are working.

— Do not store anything in your hall or corridor, especially anything that will burn easily.

— Use the fixed heating system fitted in your home. If this is not possible, only use a convector heater in your hall or corridor. Do not use any form of radiant heater there, especially one with either a flame (gas or paraffin) or a radiant element (electric bar fire).

— Do not store things in the cupboard(s) where your gas and electricity meters are fitted.

— Do not block access roads to the building.

IF A FIRE BREAKS OUT IN YOUR HOME

— If you are in the room where the fire is, leave straight away, together with anybody else, then close the door.

— Do not stay behind to try to put the fire out.

— Tell everybody else in your home about the fire and get everybody to leave. Close the front door and leave the building.

— Do not use the lift (unless it is a designated evacuation lift).

— Do not use a balcony unless it is part of the escape route from the building.

— CALL THE FIRE AND RESCUE SERVICE.

CALLING THE FIRE AND RESCUE SERVICE

The fire and rescue service should always be called to a fire, even if it only seems a small fire. This should be done straight away. The way to call the fire and rescue service is by telephone as follows.

1) Dial 999.

2) When the operator answers give the telephone number you are ringing from and ask for FIRE.

3) When the fire and rescue service reply tell them clearly the address where the fire is.

4) Do not end the call until the fire and rescue service have repeated the address to you and you are sure they have got it right. The fire and rescue service cannot help if they do not have the full address.

Annex E (informative) Methods of smoke control

E.1 General

In residential buildings designed on a stay put strategy, only the occupants from the dwelling of origin evacuate and all other occupants remain in place, unless directly affected by heat or smoke, or the fire and rescue service deems it necessary to evacuate other residents at a later stage. As a result of this strategy, special provisions are necessary to ensure that the stairway(s) remain relatively free from smoke and heat in the event of a fire within a dwelling. This is of particular importance where only one staircase serves the building.

The implementation of a smoke control system can be used as one such provision. The primary objective of smoke control in residential buildings is to protect the

staircase enclosure; however, the adjacent protected corridor or lobby might also gain some protection.

For extended corridor scenarios, the primary objective of the smoke control system is to protect both the common corridor and the staircase enclosure for means of escape.

NOTE Further information regarding smoke control can be found in the Smoke Control Association publication, "Guidance on smoke control to common escape routes in apartment buildings (flats and maisonettes)" [32].

E.2 Natural and mechanical smoke control

There are two main methods of smoke control, as follows.

a) *Natural smoke control systems*. The general principle is that a vent is provided to the lobby or corridor adjoining the stair to facilitate the removal of smoke through the vent prior to it entering the staircase enclosure. The vents can either be located on an external wall or in a vertical shaft. A vent is also provided from the top storey of the stairway to outside air to act as an outlet if smoke enters the staircase or as an inlet to make the system more efficient prior to the arrival of the fire and rescue service.

b) *Mechanical smoke control systems*. This can take the form of either a pressure differential system (see **E.3**) or a mechanical smoke ventilation system (see **E.4**).

E.3 Pressure differential systems

A pressure differential system can be either in the form of a pressurization system or in the form of a depressurization system. A depressurization system decreases the air pressure within the area of a fire or its adjacent areas so that it is lower than the air pressure within the protected area. A pressurization system is usually used to protect staircases.

A pressurization system can be provided within the staircase or fire-fighting shaft enclosure. The general principle is that it injects air into these spaces to create a higher pressure than in the adjoining spaces. This prevents any combustion products from entering the staircase or fire-fighting shaft. For these systems it is necessary to determine not only where the fresh air supply for pressurization is to be introduced into the building but also where that air and smoke will leave the building and the paths it will follow in the process. Pressurization systems can be designed and installed in accordance with BS EN 12101-6.

E.4 Mechanical smoke ventilation systems (MSVS)

The general principle is that a vent is provided to the lobby or corridor adjoining the stair to facilitate the removal of smoke through the vent prior to it entering the staircase enclosure. An MSVS uses fans to provide ventilation, rather than relying on buoyancy and wind forces as natural ventilation does. Most systems use a vertical shaft.

Adverse wind or building stack pressures are less likely to affect a pressure differential system or an MSVS than a natural smoke control system.

E.5 Extended corridors

Where the design of a block is such that travel distances exceed those shown in Figure 6 and Figure 7, a fire-engineered MSVS may be provided to compensate for the extended travel distance.

The primary objective for this type of system is to maintain tenable conditions within the extended corridor and the associated staircase enclosure for means of

escape purposes. Information regarding tenability criteria (such as temperature and visibility) for assessing the performance of the MSVS can be found in PD 7974-6.

It is important to ensure that the location of the inlet air in relation to the point of extract does not create dead spots in the protected zone.

*NOTE Recommendations for primary and secondary power supplies can be found in BS 9999:2008, **38.2.3.3**.*

E.6 Considerations for the selection of an MSVS

When selecting an MSVS, it is important to take into account a number of considerations regarding the design and functionality of the system.

For the MSVS to operate effectively, consideration needs to be given to the route of the exhaust air, the inlet replacement air supply and the air flow within the space being ventilated. A judicial selection of the MSVS ventilation rate and adequate provision for replacement air is essential to ensure that air is extracted from the protected lobby or protected corridor without allowing smoke from the flat of fire origin to be drawn in. The presence of smoke in the protected lobby or protected corridor can prove hazardous to occupants trying to escape. It is also important to ensure that replacement inlet air is provided, with careful consideration given to its location in relation to the point of extract, so that the system works to effectively extract smoke from the relevant space.

It can be beneficial to consider selecting an MSVS having a two-stage extract system incorporating a fire-fighter's control switch. Such a system can work in one of two ways: either through an extraction rate that remains constant throughout all of the different phases of a fire, or through an extraction rate that varies, depending on the stage and development of a fire. For example, during the early stages of a fire (means of escape phase) an MSVS might be designed to run at a preselected low extract rate, but incorporate the facility for fire-fighters (via a manual control point) to increase the extract rate (the function is often referred to as a boost facility) to aid fire-fighters when carrying out fire-fighting operations. This type of MSVS can also help in maintaining reasonable conditions for means of escape.

It is important that the ventilation rate of an MSVS is decided through an assessment of any specific risks within the building and verification through a computational fluid dynamics (CFD) analysis or mathematical calculation. A CFD analysis is based upon building specific geometries and, ideally, will include a sensitivity analysis. Factors covered by a sensitivity analysis will be dependent upon whether the purpose of the MSVS is purely to protect the means of escape or whether the aim is also to aid fire-fighting operations.

When the sole purpose of an MSVS is to protect the means of escape, it is important that the following aspects are taken into account with regard to their effect on the ability of the system to meet its performance criteria.

a) Different fire locations (both close to and far from the point of extract).

b) Pressure differences across a flat front door with a variety of extraction rates.

c) A negative wind coefficient at the stair head vent.

d) Fire pressure and increasing fire growth.

When the purpose of an MSVS is also to aid fire-fighting operations, it is important that the following aspects are taken into account with regard to their effect on the ability of the system to meet its performance criteria, in addition to those aspects given in a) to d).

1) A variety of door opening sizes for the stair or corridor door (when closed, partially open and fully open).
2) Increased ventilation to a fire due to a broken window.
3) Low-level ventilation to the stair.

NOTE There are numerous different types of fan assisted system including a mechanical extract /natural inlet and a mechanical extract/mechanical inlet system. Further information on these can be found in the Smoke Control Association publication, "Guidance on smoke control to common escape routes in apartment buildings (flats and maisonettes)" [32]. This document also includes information regarding system controls (control panels, indication/ status panels, manual control points, etc.), which can be important considerations when selecting an MSVS.

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