

Code of practice for fire safety in the design, construction and use of buildings

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Committees responsible for this Draft for Development

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- Association of British Fire Trades
- Association of British Theatre Technicians
- Association of Building Engineers
- Association of Corporate Approved Inspectors
- Association of Specialist Fire Protection
- British Cables Association
- British Standards Society
- Chief and Assistant Chief Fire Officers Association
- Consumer Policy Committee of BSI
- Department for Education and Skills
- Department of the Environment for Northern Ireland
- Department of Health — NHS Estates
- District Surveyors Association
- Door and Shutter Manufacturers' Association
- Fire Brigades Union
- Fire Safety Development Group
- Guild of Architectural Ironmongers
- Health and Safety Executive
- Heating and Ventilating Contractors' Association
- Institution of Fire Engineers
- Institute of Structural Engineers
- Line of Fire
- London Fire and Emergency Planning Authority
- Ministry of Defence — UK Defence Standardization
- National House-Building Council
- Nuclear Industry
- Office of the Deputy Prime Minister — Building Division
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- Royal Institution of Chartered Surveyors — Building Control Forum
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- Steel Window Association
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Foreword

This Draft for Development has been prepared by Technical Committee FSH/14. When this Draft for Development is published in due course as BS 9999, it will supersede a majority of the BS 5588 series of British Standards, which will then be withdrawn.

The guidance in DD 9999, in particular for means of escape, is based on fire safety engineering principles, although it is not intended as a guide to fire safety engineering.

The concept behind the development of DD 9999 is that technical guidance on fire safety is provided for the user at three different levels. This permits the user to adopt a design approach that corresponds to the complexity of the building and to the degree of flexibility required. The three levels are as follows.

- a) *General approach.* This level is applicable to a majority of building work undertaken within the UK, and consists of compliance with the guidance documents published to support legislative requirements.
- b) *Advanced approach.* This is the level for which DD 9999 is provided. Guidance provided in this document gives a more transparent and flexible approach to fire safety design through use of a structured approach to risk-based design where designers can take account of varying physical and human factors.
- c) *Fire safety engineering.* This level provides an alternative approach to fire safety and can be the only practical way to achieve a satisfactory standard of fire safety in some large and complex buildings, and in buildings containing different uses. Detailed guidance on fire safety engineering is given in BS 7974.

It is essential to ensure that a single approach is used in any one building, rather than a mixture of recommendations from different publications. However, there might be circumstances where it is necessary to use one publication to supplement another.

Whilst primarily intended for designers, fire engineers and fire safety managers, it is expected that DD 9999 will also be of use to:

- specifiers, contractors, site supervisors and site safety officers;
- owners, tenants, occupants, facility managers, safety officers and security staff;
- regulators and enforcers, including building control bodies, fire authorities, health and safety inspectors, environmental health officers, and environmental agencies.

DD 9999 contains a number of important changes from the guidance in the BS 5588 series, particularly in the approach for design of means of escape — the primary control is now travel time instead of travel distance — and also in the guidance on construction which introduces a number of new features.

DD 9999 also introduces the concept of the risk profile (Clause 5).

DD 9999 is designed as a co-ordinated package covering the four main areas that influence fire safety measures, namely:

- fire safety management;
- the provisions of means of escape;
- the structural protection of escape facilities and the structural stability of the building in the event of a fire;
- the provision of access and facilities for fire-fighting.

It is important, however, to recognize that the final package of fire safety measures will be a mixture of all of the above with each being interdependent on the other three.

Individual recommendations of this code applied in isolation might give little or no benefit, and might even reduce the level of fire safety. Although the basic principles and recommendations for escape from floor areas are described in Clause 8, the most conscientious application of these recommendations could be undermined unless supported by other necessary measures.

Whatever fire safety provisions are made, they can be seriously compromised by a lack of management of fire safety. Recommendations for fire safety management are given in BS 5588-12. Lack of appropriate related measures on construction of the building (see Clause 9) and facilities for fire fighting (contained in BS 5588-5) can also compromise overall fire safety provisions.

It is important therefore that all those involved in either designing, or approving, the package of fire safety measures appreciate these interactions and influences. In addition it is important that a record is made of the basis for any package of fire safety measures proposed and approved, whether at the initial design stage or at any subsequent alteration to the building and/or its occupancy.

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because major changes were found to be necessary following the original Draft for Public Comment and also pending changes in the UK legislative regimes. It should be applied on this provisional basis, so that information and experience of its practical application can be obtained.

A review of this Draft for Development will be carried out not later than two years after its publication. Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development, will be made in an announcement in the appropriate issue of *Update Standards*.

According to the replies received, the responsible BSI Committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.

Observations which it is felt should receive attention before the official call for comments will be welcomed.

These should be sent to the Secretary of BSI Technical Committee FSH/14 at British Standards House, 389 Chiswick High Road, London W4 4AL.

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

Compliance with a Draft for Development does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to viii, pages 1 to 257 and a back cover.

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Introduction

NOTE Information on legal obligations and statutory duties is provided in Annex A.

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

The recommendations and guidance given in this Draft for Development 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 BS 5588-12:2004, Clause 4.

The recommendations given in this Draft for Development are general, and all fire safety protection 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. Further guidance is given in BS 5588-12:2004, 4.2.

In both new construction and in 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. DD 9999 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 expected 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 Draft for Development 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 or hotel 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:

- a) the hazard posed by one occupancy to another;
- b) provision for giving warning in case of fire, including any automatic fire detection;
- c) the provision of sprinkler protection and smoke control arrangements;
- d) the overall management and control of the building or development, from a fire safety point of view.

DD 9999 provides guidance on the use of constructional features 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 will also have the effect of assisting the fire service and/or of providing some property protection, in many situations. There are references throughout the document to occupant safety, fire-fighter safety and property protection, to draw attention to the different considerations these could raise.

Clause 5 is very important as it sets out the principles behind the guidance and introduces the concept of the risk profile. The guidance on the provision of means of escape and on construction has been developed to reflect the nature of the occupants and the use of the buildings as well as the likely fire growth and resulting risks associated with that use — the risk profile.

It is a fundamental assumption that features described in DD 9999 will require management throughout the life of the building. This applies to protection services as well as to the elements of construction. Routine maintenance will be required, as well as replacement or renewal of elements of structure and services. Further guidance is given in BS 5588-12.

1 Scope

This Draft for Development gives recommendations and guidance on the construction and use of buildings to maximize fire safety including the provision of fire precautions and means of escape. It is applicable to new buildings and also to existing buildings, especially when alterations to the structure of an existing building or to its use are being considered, and covers the entire life cycle of a building.

NOTE 1 When this Draft for Development is published as a British Standard it will also incorporate the recommendations and guidance on access and facilities for fire-fighting and fire safety management, currently given in BS 5588-5 and BS 5588-12 respectively.

The recommendations and guidance given in this Draft for Development are to safeguard the lives of building occupants and fire-fighters. However, some of the recommendations and guidance are also of relevance to the protection of property, the environment and business/service viability. This Draft for Development does not cover fire safety engineering.

NOTE 2 Guidance and recommendations on fire safety engineering are given in BS 7974.

2 Normative references

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: Specification for oil storage tanks*.

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 4533 (all parts), *Luminaires*.

BS 4790, *Method for determination of the effects of a small source of ignition on textile floor coverings (hot metal nut method)*.

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

BS 5266-1:1999, *Emergency lighting — Part 1: Code of practice for the emergency lighting of premises other than cinemas and certain other specified premises used for entertainment*.

BS 5266-7 (BS EN 1838), *Lighting applications — Emergency lighting*.

BS 5306-2:1990, *Fire extinguishing installations and equipment on premises — Part 2: Specification for sprinkler systems*.

BS 5395-2:1984, *Stairs, ladders and walkways — Part 2: Code of practice for the design of helical and spiral stairs*.

BS 5395-3, *Stairs, ladders and walkways — Part 3: Code of practice for the design of industrial type stairs, permanent ladders and walkways*.

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 5438:1989, *Methods of test for flammability of textile fabrics when subjected to a small igniting flame applied to the face or bottom edge of vertically oriented specimens*.

BS 5499-1, *Graphical symbols and signs — Safety signs, including fire safety signs — Part 1: Specification for geometric shapes, colours and layout*.

BS 5499-4, *Safety signs, including fire safety signs — Part 4: Code of practice for escape route signing*.

BS 5588-4:1998, *Fire precautions in the design, construction and use of buildings — Part 4: Code of practice for smoke control using pressure differentials*.

BS 5588-5:2004, *Fire precautions in the design, construction and use of buildings — Part 5: Access and facilities for fire-fighting*.

- BS 5588-12:2004, *Fire precautions in the design, construction and use of buildings — Part 12: Managing fire safety.*
- BS 5651, *Method for cleansing and wetting procedures for use in the assessment of the effect of cleansing and wetting on the flammability of textile fabrics and fabric assemblies.*
- BS 5655 (all parts), *Lifts and service lifts.*
- BS 5839-1:2002, *Fire detection and alarm systems for buildings — Part 1: Code of practice for system design, installation, commissioning and maintenance.*
- BS 5839-3, *Fire detection and alarm systems for buildings — Part 3: Specification for automatic release mechanisms for certain fire protection equipment.*
- BS 5839-6, *Fire detection and 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 5852:1990, *Methods of test for assessment of the ignitability of upholstered seating by smouldering and flaming ignition sources.*
- BS 5867-2:1980, *Specification for fabrics for curtains and drapes — Part 2: Flammability requirements.*
- BS 5906, *Code of practice for storage and on-site treatment of solid waste from buildings.*
- BS 6073-1, *Precast concrete masonry units — Part 1: Specification for precast concrete masonry units.*
- BS 6180, *Barriers in and about buildings — Code of practice.*
- BS 6206:1981, *Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings.*
- BS 6387:1994, *Specification for performance requirements for cables required to maintain circuit integrity under fire conditions.*
- BS 6644, *Specification for installation of gas-fired hot water boilers of rated inputs between 60 kW and 2 MW (2nd and 3rd family gases).*
- BS 6798, *Specification for installation of gas-fired boilers of rated input not exceeding 70 kW net.*
- BS 7036 (all parts), *Code of practice for safety at powered doors for pedestrian use.*
- BS 7157:1989, *Method of test for ignitability of fabrics used in the construction of large tented structures.*
- BS 7346-1, *Components for smoke and heat control systems — Part 1: Specification for natural smoke and heat exhaust ventilators.*
- BS 7346-2, *Components for smoke and heat control systems — Part 2: Specification for powered smoke and heat exhaust ventilators.*
- BS 7346-4, *Components for smoke and heat control systems — Part 4: Functional recommendations and calculation methods for smoke and heat exhaust ventilation systems, employing steady-state design fires — Code of practice.*
- BS 7346-6, *Components for smoke and heat control systems — Part 6: Specifications for cable systems.*
- BS 7671, *Requirements for electrical installations — IEE Wiring Regulations — Sixteenth edition.*
- BS 8300, *Design of buildings and their approaches to meet the needs of disabled people — Code of practice.*
- BS 8313, *Code of practice for accommodation of building services in ducts.*
- BS 8434-1, *Methods of test for assessment of the fire integrity of electric cables — Part 1: Test for unprotected small cables for use in emergency circuits — BS EN 50200 with addition of water spray.*
- BS 8434-2, *Methods of test for assessment of the fire integrity of electric cables — Test for unprotected small cables for use in emergency circuits — Part 2: BS EN 50200 with a 930°C flame and with water spray.*
- BS EN 54-7, *Fire detection and fire alarm systems — Part 7: Smoke detectors — Point detectors using scattered light, transmitted light or ionization.*
- BS EN 81 (all parts), *Safety rules for the construction and installation of lifts.*
- BS EN 378 (all parts), *Specification for refrigerating systems and heat pumps.*
- BS EN 1125, *Building hardware — Panic exit devices operated by a horizontal bar — Requirements and test methods.*

BS EN 1154:1996, *Building hardware — Controlled door closing devices — Requirements and test methods.*

BS EN 1155, *Building hardware — Electrically powered hold-open devices for swing doors — 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 doors and shutters.*

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

BS EN 12101-2, *Smoke and heat control systems — Part 2: Specification for natural smoke and heat exhaust ventilators.*

BS EN 12845:2003, *Fixed fire-fighting systems — Automatic sprinkler systems — Design, installation and maintenance.*

BS EN 13501-1:2002, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests.*

BS EN 60702-1, *Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V — Part 1: Cables.*

BS EN 60702-2, *Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V — Part 2: Terminations.*

BS EN ISO 306, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST).*

BS EN ISO 1182, *Reaction to fire tests for building products — Non-combustibility test.*

ISO 834-1, *Fire-resistance tests — Elements of building construction — Part 1: General requirements.*

3 Terms and definitions

For the purposes of this Draft for Development the following definitions apply.

3.1

access panel

fire-resistant panel used to gain access to service ducts and shafts

3.2

access room

room that forms the only escape route from an inner room (**3.53**)

3.3

accommodation stair

stair, additional to that or those required for escape purposes, provided for the convenience of occupants

3.4

air handling void

duct which forms part of either the supply or the return air distribution system

NOTE This is usually a ceiling or floor void and is usually known as a plenum.

3.5

air transfer grille

fixed grille not connected to the ductwork system allowing the free transfer of air between adjacent rooms and/or spaces

3.6**allowable travel time**

time taken to escape from a building to a place of safety or, in some circumstances, a protected zone, including walking and queuing

3.7**ancillary accommodation**

all parts of a building that are ancillary to the main use of the building and under the control of the management of the overall premises

NOTE Examples of ancillary accommodation include rooms associated with engineering services, service areas and refuse rooms.

3.8**associated floor area**

floor area in an atrium building not separated from the atrium by construction having a fire resistance equal to that required for the elements of the structure of the building

NOTE The area of the atrium base should be included in the calculation of the associated floor area.

3.9**atrium (plural: atria)**

space within a building, not necessarily vertically aligned, passing through one or more structural floors

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

3.10**atrium base**

plan area of the lowest floor level, bounded by lines projected down from the edge of the floor slab immediately above the lowest floor level within the atrium

3.11**available safe escape time**

calculated time available between the ignition of a fire and the time at which the conditions for escape become untenable to the occupants

3.12**basement**

storey with a floor which at some point is more than 1.2 m below the highest level of ground adjacent to the outside walls

3.13**boundary**

edge of the land belonging to a building, or, where the land abuts a road, railway, canal or river, the centreline of that road, railway, canal or river

3.14**cavity barrier**

construction provided to close a concealed space against penetration of smoke or flame, or provided to restrict the movement of smoke or flame within such a space

3.15**ceiling void**

cavity between a structural floor or roof and the suspended ceiling below, through which building services may pass

3.16**Class 0 material or surface**

either:

- a) composed throughout of materials of limited combustibility; or
- b) material classified as Class 1 when tested in accordance with BS 476-7, which has a fire propagation index I 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.

3.17

compartment wall or floor

fire-resisting wall or floor used in the separation of one fire compartment from another

3.18

concealed space or cavity

space enclosed by elements of a building (including a suspended ceiling) or contained within an element, but not a room, cupboard, circulation space, protected shaft or space within a flue, chute, duct, pipe or conduit

3.19

controlled fire load

fire load that is limited by means of management controls on the quantities of combustibile material that are present on the atrium base or where the fire load is limited by an effective automatic suppression system

3.20

dead end

place from which escape is possible in one direction only, or in directions less than 45° apart that are not separated by fire-resisting construction

3.21

ductwork

system of enclosures of any cross-sectional shape for the distribution of extraction of air

3.22

element of structure

member forming part of the structural frame of a building or any other beam or column

NOTE An element of structure can be a load-bearing wall or load-bearing part of a wall; a floor; a gallery; an external wall; or a compartment wall (including a wall common to two or more buildings).

3.23

emergency lighting

lighting provided for use when the supply to the normal lighting fails

3.24

escape route

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

3.25

final exit

termination of an escape route from a building giving direct access to a street, passageway, walkway or open space, and sited to enable the rapid dispersal of persons from the vicinity of a building so that they are no longer in danger from fire and/or smoke

3.26

fire damper

mobile closure within a duct, which is operated automatically or manually and is designed to prevent the passage of fire and which, together with its frame, is capable of meeting for a stated period of time the fire resistance criterion for integrity

3.27

fire/smoke damper

combined fire damper and smoke damper

NOTE See also “fire damper” and “smoke damper”.

3.28 fire doors

3.28.1

fire door

door or shutter provided for the passage of persons, air or objects which, together with its frame and furniture as installed in a building, 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

NOTE 1 A fire door may have one or more leaves, and the term includes a cover or other form of protection to an opening in a fire-resisting wall or floor or in a structure surrounding a protected shaft.

NOTE 2 For the purposes of this Draft for Development, the term “fire door” includes:

- a) side-hung or pivoted fire doors;
- b) shutter assemblies;
- c) access hatches that are fixed or hinged.

3.28.2

self-closing fire door

fire door fitted with a device which fully closes the door, overriding the resistance of any latch but not including rising butts

3.29

fire-fighting lift

lift with fire protection measures, including controls that enable it to be used under the direct control of the fire service in fighting a fire

3.30

fire-fighting lobby

protected lobby provided within a fire-fighting shaft giving access from a fire-fighting stair to an accommodation area, and normally to any associated fire-fighting lift and fire main

3.31

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

3.32

fire-fighting stair

protected stairway communicating with an accommodation area only through a fire-fighting lobby

3.33

fire growth rate

characteristic rate at which a fire is assumed to grow

3.34

fire load

quantity of heat that would be released by the complete combustion of all the combustible materials in a volume, including the facings of all bounding surfaces

NOTE The fire load is expressed in joules.

3.35

fire main

water supply pipe, fitted with an outlet and control valve at specified points, installed in a building for fire-fighting purposes

3.36

fire protection measure

passive or active measure taken within a building to increase the level of protection to the occupants

3.37

fire resistance

ability of a component or construction of a building to meet for a stated period of time some or all of the appropriate criteria specified in the relevant part of BS 476

NOTE These criteria can include stability and/or integrity and/or thermal insulation and/or expected duty.

3.38

fire service access level

level at which there is suitable entry to a building and to a fire-fighting shaft from an area to which fire service appliances have access

3.39

fire-stopping

sealing or closing an imperfection of fit between elements, components or construction of a building, or any joint, so as to restrict penetration of smoke and flame through the imperfection or joint

3.40

flashover

transition from localized burning to full room involvement in a fire

3.41

floor area

area enclosed by the inner surfaces of a wall, including internal walls

3.42

floor void

cavity between a structural floor and a platform above, through which building services can pass

3.43

flow rate

number of persons passing a point in a unit of time on a path having a specific width

3.44

fly gallery

narrow balcony or gantry, usually running from front to back of the stage on one or both sides and occasionally continuing across the back wall, used for securing suspension lines, loading counterweights and operating suspension lines, and occasionally for rigging lighting equipment

3.45

fuel load

total amount of combustible material expressed either in megajoules (MJ) or as an equivalent mass of wood

3.46

fuel load density

fuel load per unit area, expressed in megajoules per square metre (MJ/m²)

3.47

fusible link

device that releases a component such as a fire damper or fire shutter at a set temperature

NOTE This incorporates either a solder link or a frangible glass bulb.

3.48

grid

open framework of beams over the stage which is used (primarily) for the suspension of scenery and lighting equipment or to provide a platform for access to the pulleys for such suspension systems

3.49

grille

security or protective mesh positioned over the opening to a duct or in a door to allow air discharge into a room or space

3.50**height (of an atrium)**

level of the surface of the highest point of the floor of the highest storey adjacent to the atrium measured from the level of the atrium base

3.51**height (of a building)**

distance of the surface of the highest point of the floor of the highest storey (excluding any such storey consisting exclusively of plant rooms) to the fire service access level measured at the centre of that face of the building where the distance is greatest

3.52**holding capacity**

ability of a stair to hold a specified number of people during an escape

3.53**inner room**

room from which the only escape route is through another room

NOTE The room that provides the escape route from an inner room is known as an access room (3.2).

3.54**integrity**

ability of a separating element when exposed to fire on one side, to prevent the passage of flames and hot gases or the occurrence of flames on the unexposed side, for a stated period of time in a standard fire resistance test

NOTE This may be expressed as integrity criterion "E" (see BS EN ISO 13943).

3.55**lift landing**

floor space from which a lift car is normally entered at each level

3.56**lift landing door**

hinged or sliding portion of a lift well enclosure at each landing that gives access to a lift car when open

NOTE This is separate from the lift car door.

3.57**lift well**

space in which a lift and counterweight (if any) move

NOTE This space is enclosed by the bottom of the pit, the vertical walls and the ceiling.

3.58**mall exit**

final exit from a mall, or storey exit, or exit from a mall that leads directly to a storey exit or final exit by way of a protected corridor/passageway

3.59**mall section**

length of a mall between two mall exits

3.60**management of fire safety**

tasks carried out by a defined individual or individuals with appropriate powers and resources to ensure that the fire safety systems, passive, active and procedural, within the building are working properly at all times

3.61

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 has a rise in temperature on the furnace thermocouple of not more than 20°C ; or
- c) any material with a non-combustible facing (on one or both sides) not more than 0.5 mm thick

3.62

means of escape

structural means whereby a safe route in the event of fire is provided for persons to travel from any point in a building to a place of safety

3.63

non-combustible

not capable of undergoing combustion under specific conditions
[BS EN ISO 13943]

3.64

open-sided car park

car park that:

- a) is not a basement storey;
- b) has natural ventilation not less than 5 % of the floor area at that level of which at least half is in two opposing walls;
- c) is separated from the rest of the building if the building is also used for any other purpose

3.65

open spatial planning

internal arrangement of a building in which more than one storey or level is contained in one undivided volume

NOTE Split-level floors are an example of open spatial planning.

3.66

overcladding

addition of an external cladding to an existing building, usually to improve thermal protection or weather protection

3.67

phased evacuation

process where a limited number of floors are evacuated at the same time

NOTE This is usually the floor containing the fire and the floor above. The remaining floors are evacuated at later stages if required.

3.68

place of safety

place in which persons are in no immediate danger from the effects of a fire

3.69

pre-movement time

interval between the time at which a warning of fire is given and the time at which the first move is made towards an exit

3.70

pressure differential system

system of fans, ducts and vents provided for the purpose of creating a pressure differential between a fire zone and a protected space

3.71**pressurization**

method of smoke control using pressure differentials, where the air pressure in the spaces being protected is raised above that in the fire zone

3.72**protected**

enclosed (other than any part which is an external wall of a building) with fire-resisting construction

3.73**protected lobby/corridor**

circulation area consisting of a lobby or corridor enclosed with fire-resisting construction (other than any part that is an external wall of a building)

3.74**protected shaft**

stairway, lift, escalator, chute, duct or other shaft of fire-resisting construction which enables persons, objects or air to pass from one fire compartment to another

3.75**protected stairway**

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

3.76**protected zone**

area in a building that is protected from the effects of fire and smoke

3.77**purpose group**

classification of a building according to the purpose to which it is intended to be put

3.78**radial gangway**

gangway at an angle to the rows of seating or a stepped gangway in tiered seating

3.79**refuge**

area that is both separated from a fire by fire-resisting construction and provided with a safe route to a storey exit, thus constituting a temporarily safe space for disabled people to await assistance for their evacuation

3.80**risk profile**

means of categorizing the risks for a range of occupancies based on the occupancy profile and the fire growth rate

3.81**seatway**

distance between adjacent rows of seats

3.82 shopping complexes

3.82.1

covered shopping complex

shopping complex that includes a covered mall, i.e. any mall section (3.59) in which:

- a) more than 15 m of the length of the mall is covered by a bridge or roof; or
- b) (where the mall has an open slot above it, formed for example by projecting continuous canopies) more than 50 % of its plan area is obscured; or
- c) (in any other case) at least 25 % of its plan the area is obscured by a roof or by floors, bridges, galleries or canopies

3.82.2

shopping complex

structural combination of a number of commercial premises that includes areas providing common access for the public, principally for shopping purposes

3.82.3

uncovered shopping complex

shopping complex that does not include a covered mall

3.83

shunt system

system in which branch ductwork turns through an angle and runs parallel to the main ductwork for a specific distance before turning into and connecting with the main ductwork

3.84

smoke clearance system

smoke control system designed to remove the products of combustion following a fire and used at the discretion of the fire service to assist fire-fighting operations

3.85

smoke control

technique used to control the movement of smoky gases within a building in order to protect the structure, the contents, the means of escape, or to assist fire-fighting operations

3.86

smoke damper

mechanical device which, when closed, prevents smoke passing through an aperture within a duct or structure

NOTE The device may be open or closed in its normal position and may be automatically or mechanically closed.

3.87

smoke dilution

smoke control achieved by mixing the smoky gases with enough clean air to achieve less hazardous conditions

3.88

smoke exhaust ventilation system

smoke control system designed to remove a sufficient volume of smoke to minimize the possibility of inter-connected spaces becoming untenable as a result of the spread of smoke

3.89

smoke-retarding construction

construction intended to retard the passage of smoke

3.90**sprinkler**

temperature-sensitive sealing device, which opens to discharge water for fire extinguishing

3.91**sprinkler installation**

part of a sprinkler system comprising a set of installation main control valves, the associated downstream pipes and sprinklers

3.92 sprinkler systems**3.92.1****life safety sprinkler system**

sprinkler system forming an integral part of measures required for the protection of life

3.92.2**sprinkler system**

system for providing sprinkler protection in a building, comprising one or more sprinkler installations, the pipe work to the installations, and the water supply or supplies except town mains and bodies of water such as lakes or canals

3.93**suspended ceiling**

ceiling suspended below a floor, which contributes to the fire resistance of the floor

3.94**temperature control system**

heat control system using the principles of smoke exhaust ventilation, sufficient to reduce gas temperatures in the smoke layer formed within the atrium to permit the use of construction/glazing systems in the atrium facade which, whilst capable of preventing the passage of smoke, are not fire-resisting

NOTE Examples of such construction/glazing systems include float and other annealed glasses, tempered glass, etc.

3.95***t*-equivalent**

exposure time in a fire resistance test which gives the same heating effect on a structure as a given compartment fire

3.96**thermally actuated device**

device that releases a fire damper closing mechanism when the temperature in the vicinity of the fire damper rises to a predetermined value

3.97**transverse gangway**

flat gangway parallel to the rows of seating

3.98**travel distance**

actual distance a person needs to travel from any point within a building to the nearest storey exit, having regard to the layout of walls, partitions and fittings

3.99**vent**

device that is permanently open or can be opened to permit the passage of air or smoke between a part of a building and the external air

NOTE Examples include windows, roof lights, doors, louvres and grilles.

3.100

vitiated air

air in which the oxygen content has been reduced

NOTE In a fire, this is produced by combustion.

3.101

working fly gallery

fly gallery, usually the lowest if more than one gallery is provided, which is likely to be occupied during performances by staff operating suspension lines

4 General

4.1 Variation of guidance

The guidance on means of escape in Clause 8 permits variations to be made to travel distances and door and/or stair widths on the basis that the level of risk can be reduced by the provision of additional fire protection measures. Such measures include an increased level of management of fire safety, the provision of an automatic sprinkler system, the provision of a smoke management system or the provision of an additional level of automatic fire detection.

Equally, the guidance on construction in Clause 9 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 Draft for Development.

NOTE A fire safety engineering approach as detailed in BS 7974 gives greater flexibility and might be more appropriate in the design of complex buildings and spaces.

4.2 Property and business protection

The guidance and recommendations in this Draft for Development are primarily concerned with the protection of life. The provision of fire safety systems for life safety might or might not give adequate protection to property or the business carried out in the building. It is, however, recommended that the potential for property and business loss is assessed so that such risks are understood and accepted. Such assessment should be carried out in accordance with Annex B.

4.3 Environment

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

This Draft for Development is concerned 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, whilst 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.

4.4 Additional recommendations for specific building types/occupancies

In addition to the general guidance given in Clauses 6, 7, 8, 9 and 10, specific recommendations for particular building types/occupancies are given in a series of annexes:

- a) atria should meet the recommendations given in Annex C;

NOTE Exemplars are given in Annex D.

- b) places of assembly should meet the recommendations given in Annex E;
- c) shopping complexes should meet the recommendations given in Annex F;
- d) process plant and structures should meet the recommendations given in Annex G;
- e) refuges should meet the recommendations given in Annex H.

5 Risk assessment and risk profiles

5.1 Risk assessment

A risk assessment should be carried out in order to determine the potential for fire risks to people, property and business. This should account for the fire safety provisions in the building and the level of fire prevention management (see BS 5588-12). The risk assessments for property and business protection can be undertaken as an extension to that carried out for life safety.

By carrying out a risk assessment, the consequences of fire on people, property and business can be highlighted to the owner, occupier, operator, tenant, designers and insurers. It should then be clear what fire safety systems are required, what function they have in relation to the protection of people, property and business and what management responsibilities are required to maintain and operate these systems.

NOTE Further information on risk assessment is provided in *Fire safety — An employer's guide* [1]. Generic information, mainly related to health and safety risk assessment, is given in HSG 183 [2]. Information on quantitative risk assessments for fire safety design is given in PD 7974-7.

Factors that should be taken into account in assessing the fire risk for both new construction and existing premises are:

- a) the anticipated likelihood of a fire occurring;
- b) the anticipated severity and potential spread of any fire;
- c) the ability of the structure to resist the spread of fire and smoke;
- d) the consequential danger to people in and around the building; and
- e) the need to address property and contents protection, and business interests.

The basic factors that should be taken into account during such a risk assessment are shown in Table 1, which also gives cross-references to the relevant clauses of this Draft for Development.

Table 1 — Basic factors in assessing fire risks

Factor	Comments
Adequacy of means to prevent fire	A comparison of conditions with and without these measures should be made to indicate the considerable advantage that should be available where they are provided.
Early fire warning by an automatic detection and warning system	This provision can lead to “first aid” or fire service fire-fighting in the early stages of fire development. Modern systems can be unobtrusive (aspirating), addressable (by which a fire location and development can be identified), and can even come with a guarantee against unwanted alarms.
The standard of means of escape	See Clause 8 and Clause 9 (for which structural enclosure and separation would be a part).
Provision of smoke control	See Clause 9 (in conjunction with sprinklers to estimate smoke temperatures and volumes and by which fire severity is reduced).
Control of the rate of fire growth	This item particularly includes spread of flame over surfaces and behind linings, and within contents. The successful action of sprinklers can significantly reduce rate of fire growth — see Clause 9.
Adequacy of the structure to resist the effects of fire	The successful action of sprinklers can significantly reduce rate of fire growth, avoid flashover and the need for fire resistance — see Clause 9.
Degree of fire containment	Includes containment by sub-compartmentation, cavity barriers, and fire-stopping. The successful action of sprinklers can significantly reduce rate of fire growth, avoid flashover and the need for the same degree of compartmentation — see Clause 9.
Fire separation between buildings or parts of it	The successful action of sprinklers can avoid flashover and reduce probability of fire spread between buildings. Boundary distances can be reduced — see Clause 9.
Standard of active measures for fire extinguishment or control	The successful action of sprinklers can significantly reduce rate of fire growth, avoid flashover and reduce the need for fire resistance and traditional levels of compartmentation — see Clause 9.
Facilities to assist the fire services	See BS 5588-5.
Quality of premises management	Applies especially to maintenance of passive provisions, and active provisions made in lieu of passive measures — see BS 5588-12.
Provisions for staff training and on-going controls	These factors should not be dismissed; they can make real contributions to design flexibility — see BS 5588-12.

5.2 Risk profiles

5.2.1 General

A risk profile should be established for each building in order to determine the appropriate means of escape (Clause 7) and the appropriate constructional features of the building for life safety (Clause 8).

The risk profile should reflect the occupant characteristics (5.2.2 and Table 2) and estimated fire growth rate (5.2.3 and Table 3) for a building, and should be expressed as a value combining these two elements (5.2.4, Table 4 and Table 5). Risk profiles for specific building purpose groups are given in 5.2.5 and Table 6.

5.2.2 Occupant characteristic

The occupant characteristic is principally determined according to whether the occupants are familiar or unfamiliar with the building and whether they are likely to be awake or asleep. Occupant characteristics should be categorized in accordance with Table 2.

Table 2 — Occupant risk category

Risk category	Description	Examples
A	Occupants who are awake and familiar with the building	Office and industrial premises
B	Occupants who are awake and unfamiliar with the building	Shops, exhibitions, museums, leisure centres, educational establishments, other assembly buildings etc.
C	Occupants who are likely to be asleep:	
Ci	— Long-term individual occupancy	Individual flats without 24 h maintenance and management control on site
Cii	— Long-term managed occupancy	Serviced flats, halls of residence, sleeping areas and boarding schools
Ciii	— Short-term occupancy	Hotels
D ^a	Occupants receiving medical care	Hospitals
E	Occupants in transit	Railway stations, airports

^a Currently category D, medical care, is dealt with in other documentation and is outside the scope of this Draft for Development.

5.2.3 Fire growth rate

The fire growth rate is the rate at which it is estimated that a fire will grow. Fire growth rates should be categorized in accordance with Table 3.

NOTE A building with a high fire load density will not necessarily have a rapid fire growth rate, and low fire load density will not necessarily have a slow fire growth rate.

Table 3 — Fire growth rates

Category	Fire growth rate	Examples	Fire growth parameter ^a kJ/s ³
1	Slow	Open plan office, limited combustible materials	0.002 9
2	Medium	Stacked cardboard boxes, wooden pallets	0.012
3	Fast	Baled thermoplastic chips, stacked plastic products, baled clothing	0.047
4	Ultra-fast	Flammable liquids, expanded cellular plastics and foam	0.188

^a This is discussed in PD 7974-1.

5.2.4 Typical risk profiles

Risk profiles are given as a combination of occupant risk category and fire growth rate, as shown in Table 4. Typical risk profiles are given in Table 5.

The examples in Table 5 should be used for guidance only, and risk profiles for specific premises should be determined in accordance with 5.2.2 and 5.2.3.

NOTE As risk profile assessments are carried out on a case-by-case basis, it is possible that there might be, for example, A1 or A3 offices or a B2 shop. However, there are certain circumstances where a combination of the occupant's unfamiliarity with the building and the potential for a very fast growing fire is deemed to be unacceptable (e.g. B4 and C4) unless an effective localized suppression system (see Clause 11) or sprinklers are added.

Table 4 — Combination of risk profile and fire growth rate

Category		Growth rate	Risk profile	Examples
A	1	Slow	Occupants who are awake and familiar with the building	Open-sided car park
	2	Medium		Office
	3	Fast		Filing room
	4	Ultra-fast		Plant room
B	1	Slow	Occupants who are awake and unfamiliar with the building	Reception area
	2	Medium		Bar, gymnasium
	3	Fast		Shop
	4	Ultra-fast		— ^a
C	1	Slow	Occupants who are likely to be asleep	House conservatory
	2	Medium		Hotel bedroom
	3	Fast		Hotel store room
	4	Ultra-fast		— ^a
^a These categories are unacceptable unless an effective localized suppression system or sprinklers are added.				

Table 5 — Typical risk profiles

Occupancy	Risk category	Occupancy	Risk category
Administration office	A2	Gymnasium	B2
Amusement arcade	B2	Indoor games/training rooms in schools	B2
Archive/library reading area	B3	Kitchen	A3
Art gallery	B1/B2	Licensed betting office (public area)	B1
Assembly hall	B2	Lobbies	B1
Banking hall	B1	Lounge (other than dwelling)	B2
Bar	B2	Machine/printing room	A3
Bazaar	B2/B3	Mechanical plant room	A4
Bedroom/study bedroom	Cii2	Meeting room	B2
Bed-sitting room	Cii2	Museum	B2
Billiards or snooker room	B2	Office (closed-plan or office less than 60 m ²)	B2
Bingo hall	B2	Office (open-plan exceeding 60 m ²)	A2
Bowling alley	B2	Reading room	B2
Business centre	B2	Reception area	B1
Canteen	A2	Restaurant	B2
Classroom	A2	Shop sales area ^a	B3
Club	B2	Shop sales area ^b	B3
Committee room	A2	Showrooms	B3
Common room	A2	Skating rink	B1
Computer room	B2	Stadia and grandstands	B1
Concourse or shopping mall	B2	Staff room	A2
Conference room	B2	Storage and warehousing	A4
Crush hall	B2	Studio (radio, television, film, recording) non-public	A2
Dance area	B2	Studio (radio, television, film, recording) public	B2
Deposit/strong room	A2/A3	Teaching laboratories	A3
Design studio / Drafting office	A2	Theatre/cinema auditoria	B2
Dining room	B1	Trading floor	B2
Dormitory	Cii2	Trading gallery	B2
Exhibition areas	B2/B3	Venue for pop concerts	B1
Factory production area	A3	Waiting area/visitors lounge	B1
Filing room/store	A3	Waiting room	B1
Foyers	B1	Workshop	A3

^a Excluding those in covered shopping complexes and excluding department stores but including those that trade predominantly in furniture, floor coverings, cycles, prams, large domestic appliances, or other bulky goods, or cash and carry shops.

^b Including supermarkets, department stores, shops for personal services like hairdressing, shops for the delivery and collection of goods for cleaning/repair/treatment or for members of the public themselves carrying out such cleaning/repair/treatment.

5.2.5 Risk profiles for specific purpose groups

Generic risk profiles for a number of specific building purpose groups are given in Table 6. These risk profiles are only typical, and may be varied for a particular building where the validity of the alternative can be demonstrated.

NOTE Although designing according to purpose groups allows maximum design flexibility, it can limit the building's ability to accommodate variations in future usage.

The purpose group is determined by the main use of the building or compartment, but account should be taken of the fact that different uses within the same purpose group can have different fire load densities and occupant risk classes.

Table 6 — Risk profiles for specific purpose groups

Title	Group	Purpose for which the building or compartment is intended to be used	Occupant risk category	Fire growth rate
Residential (dwellings) ^a	1a)	Flat and maisonette.	Ci	2
	1b)	House containing a habitable storey at a height exceeding 4.5 m.		
	1c)	House not containing a habitable storey at a height exceeding 4.5 m.		
Residential (institutional)	2a)	Hospital, home, school or other similar establishment used as living accommodation for, or for the treatment of, persons suffering from disabilities due to illness or old age, or other physical or mental disability or handicap, or for children under the age of 5 years.	D	2
Residential (other)	2b)	Hotel, boarding house, residential college, hall of residence, hostel or any other residential purpose not mentioned above.	Cii or Ciii	2
Office ^a	3	Offices or premises used for office, administrative or clerical purposes financial transactions (including banking and building society work) and communications (including postal, radio, television, film, audio or video recording or performance not attended by the public).	A	2
Shop and commercial ^b	4	Shops or premises used for retail or wholesale trade or business, including sales by auction, self-selection and over-the-counter wholesale trading; hairdressing, and beauty or body care; restaurants, cafes, snack bars, public houses; lending books or recordings for gain.	B	3
Assembly and recreation (high hazard)	5 ^a	Places of assembly, entertainment or recreation; (other than sports stadia) including theatres, broadcasting, recording, and film studios (attended by the public), casinos, dance halls, funfairs and amusement arcades, non-residential music or dancing clubs.	B	3

Table 6 — Risk profiles for specific purpose groups (*continued*)

Title	Group	Purpose for which the building or compartment is intended to be used	Occupant risk category	Fire growth rate
Assembly and recreation (ordinary hazard)	5b)	Conference, exhibition and leisure centres (except where consisting predominantly of a swimming pool), licensed betting offices, museums and cinemas, bingo halls, concert halls and educational establishments.	B	2
Assembly and recreation (low hazard)	5c)	Any other places of assembly, including swimming pool buildings, churches and other places of religious worship, crematoria, art galleries, law courts, libraries open to the public, non-residential day centres, clinics, health centres and surgeries, passenger stations and termini for air, road, rail or sea travel, public toilets, ice rinks, gymnasia, sports stadia, zoos and menageries.	B or E	1
Industrial (high hazard)	6a)	Manufacturing, processing, repairing, cleaning or otherwise treating any hazardous goods or materials ^b .	A	4
Industrial (low hazard)	6b)	Any other industrial building including buildings used for generating or supplying power or slaughtering livestock.	A	2
Storage and other non-residential (high hazard)	7a)	Storage of hazardous goods or materials, and storage of vehicles containing hazardous goods ^b .	A	4
Storage and other non-residential (low hazard)	7b)	Storage of any goods or materials, and car parks and parking garages not coming within purpose sub-group 7a) or 7c).	A	2
Storage and other non-residential (open-sided car parks)	7c)	Open-sided ^c car parks and parking garages, designed to admit or accommodate only passenger or light goods vehicles not exceeding 2 500 kg gross.	A	1

^a Includes any surgeries, consulting rooms, offices or other accommodation not exceeding in the aggregate 50 m² forming part of a dwelling and used by an occupant of the dwelling in a professional or business capacity.

^b Designers need to be aware that, in addition to the obvious hazardous materials such as petrol, fuels, solvents, etc., certain everyday objects such as polystyrene packaging, crisp packets, cooking fats etc., can represent a hazard when stored in large quantities.

^c For the purpose of this description “open-sided” means naturally ventilated to provide an adequate supply of air to dissipate heat from a fire.

6 Management systems

General guidance relating to fire safety management, including information on the spread of fire, is given in BS 5588-12:2004, Clauses 4 and 5.

NOTE When DD 9999 is published as a British Standard, it will supersede a majority of the BS 5588 series, which will be withdrawn. At this time, BS 5588-12:2004, Clauses 4 and 5 will be moved in their entirety into the present clause of the new British Standard.

7 Designing so that a building can be managed

Buildings should be designed in accordance with BS 5588-12:2004, Clauses 6 and 7.

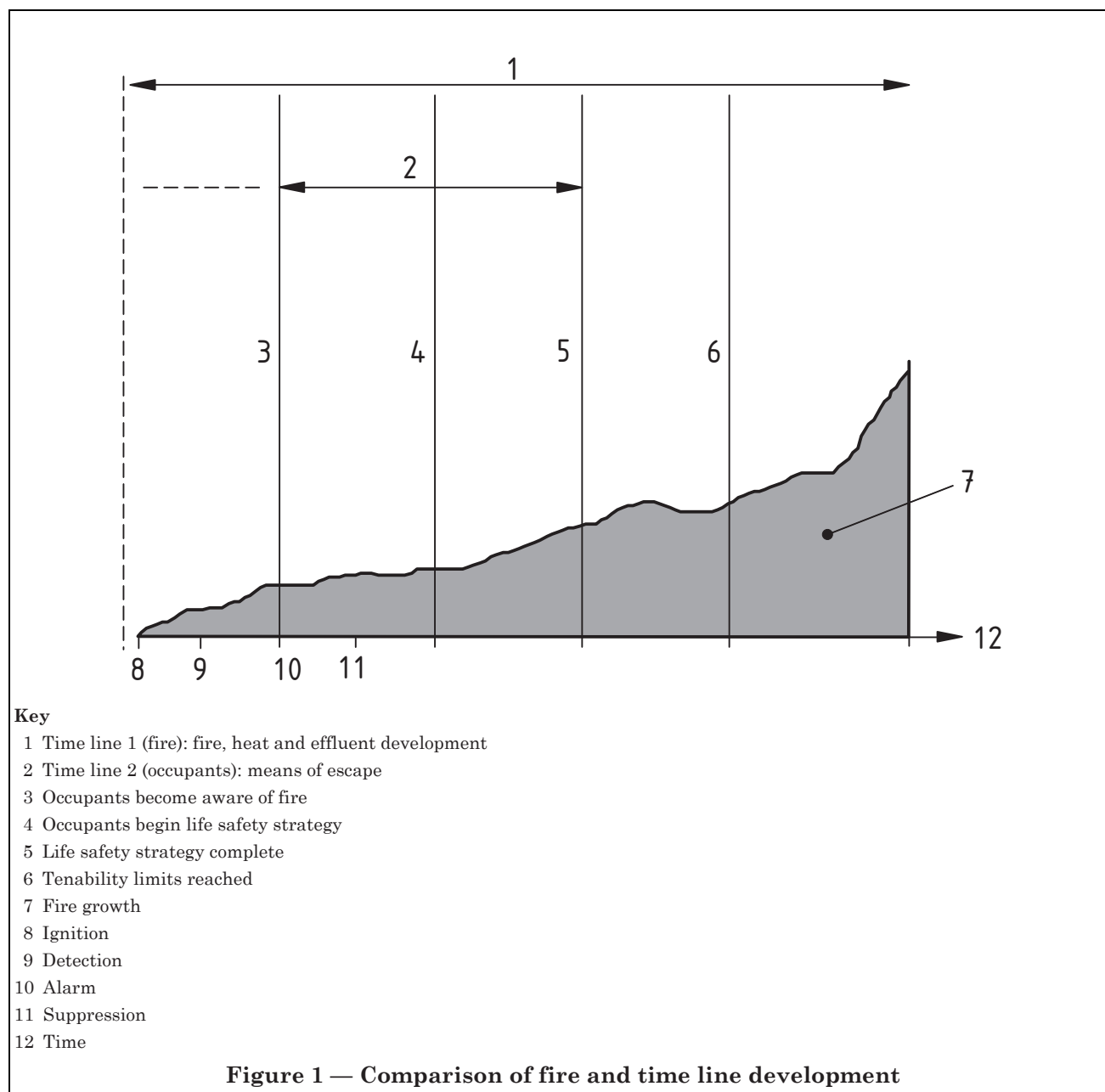
NOTE When DD 9999 is published as a British Standard, it will supersede a majority of the BS 5588 series, which will be withdrawn. At this time, BS 5588-12:2004, Clauses 6 and 7 will be moved in their entirety into the present clause of the new British Standard.

8 Means of escape

NOTE The importance of management in relation to all aspects of escape is covered in BS 5588-12.

8.1 Principles of means of escape

The expected reaction and subsequent actions of those responsible for the management of the building should be assessed against the development of the fire threat and time, and the provision of adequate means of escape should be determined accordingly. Figure 1 shows an example of the relationship between the development of the fire threat and time.

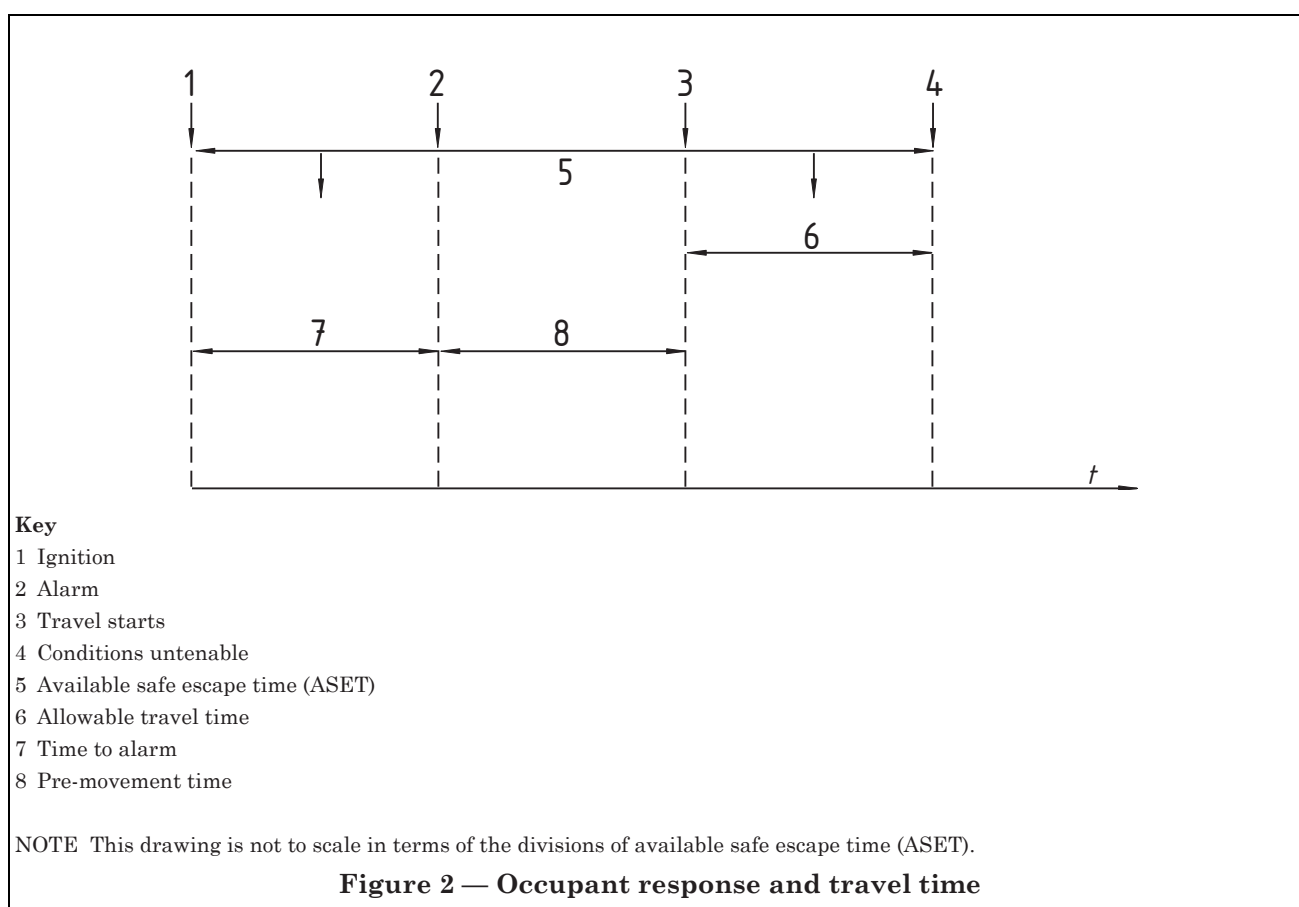


Each building type should be allocated a risk profile (see 8.5) depending on the occupancy characteristics and the fire growth rate associated with its use. The time to escape to a relative place of safety should be less than the allowable travel time (see Figure 2), which is based on the risk profile.

The major stages of occupant response that should be taken into account in determining the provision of means of escape are:

- a) time to detect a fire and sound an alarm;
- b) pre-movement time which consists of the recognition time and the response time;
- c) travel time to a relative place of safety, including queuing;
- d) movement within a relative place of safety (e.g. protected stair or adjacent compartment).

The relationship between these factors is shown in Figure 2. The objective is to limit the time taken to travel through those areas of a building which could potentially be exposed to fire and smoke.



As shown in Figure 2, there are two primary early stages that occur before the occupants start to move to escape:

- 1) time from ignition to warning using manual or automatic detection (time to alarm);
- 2) time from warning to the start of the movement to escape (pre-movement time).

Both of these stages are related to the management, the occupancy characteristics, fire growth rate and the package of active and passive fire protection measures.

NOTE The movement to escape in many cases might not be along the optimum travel route as predicted in the design, particularly in situations where occupants are unfamiliar with the building. This is less important in cases where queuing at a door is the primary control of the exiting time. However since no evacuation is perfect and human behaviour can be uncertain, relatively slow travel speeds have been used to provide a margin of comfort to allow for potential unknowns.

In an emergency there should be sufficient escape capacity to allow all the occupants to reach an area of relative safety, e.g. protected routes, separate fire compartments or stairways leading to a final exit, without delay. The place of ultimate safety is beyond the final exit but it is not always practicable or desirable to evacuate the whole of the building immediately upon the incidence of fire in any part. In large premises, it is sometimes practical and appropriate to evacuate in stages, which is also beneficial for escape for disabled people.

Where compartments are separated in such a way as to prevent the spread of smoke in the early stages of a fire, or if there is a suitable smoke control system controlling the movement of smoke, the occupants can escape to a fire compartment not affected by the fire. They should however still be free to leave the building without being affected by the fire.

Motivation to escape is important. Research into several major fatal fires and evacuations suggests that in large internal spaces people in a crowd have difficulty in recognizing the threat from a fire elsewhere in the building. People are also likely to underestimate how quickly a fire can spread. In a fire disaster, the uncertainty of the situation in its early stages is usually compounded by a serious delay in warning the occupants in time for them to start to evacuate and reach safety.

8.2 Types of evacuation procedure

8.2.1 General

The primary objective of a means of escape strategy is to ensure that in the event of a fire, the occupants of a building can reach an ultimate place of safety outside the building. The evacuation procedures are therefore an essential part of the overall fire strategy.

The evacuation strategy should not rely on external assistance (e.g. from the fire service) and should be chosen to take into account the risk category of the building and the allowable travel time.

There are two basic categories of evacuation procedure:

- a) *total evacuation* of the occupants to a place of ultimate safety, by either simultaneous or phased procedures (see 8.2.2);
- b) *progressive evacuation* of the occupants, initially to a place of relative safety within the building where they can remain or, if necessary, complete the evacuation to ultimate safety as part of a managed system (see 8.2.3).

NOTE In exceptional circumstances, e.g. a terrorist attack, it is sometimes not practical to evacuate a building. It is therefore essential to ensure that the building is designed and constructed to maximize the safety of occupants in the event of a fire. Further information is given in BS 5588-12 and in Clause 8.

8.2.2 *Total evacuation*

8.2.2.1 *Simultaneous evacuation*

Simultaneous evacuation is a common approach adopted in premises where it would be unreasonable to expect the occupants to remain in an affected area for a prolonged time when there is a fire. This takes into account not only the physical effects of the fire, but the psychological response of occupants confronted by an outbreak of fire.

NOTE Recommendations for widths of escape stairs for simultaneous evacuation are given in 8.8.4.2.

There are two categories of simultaneous evacuation.

a) *Single-staged evacuation*

In a single-staged evacuation, the activation of a call point or detector gives an instantaneous warning from all fire alarm sounders for an immediate evacuation.

b) *Two-staged evacuation*

In a two-staged evacuation, there is an investigation period (or grace period) before the fire alarm sounders are activated. A typical sequence of events for two-staged evacuation is as follows.

- 1) Initially a coded staff alert is given.
- 2) There is then an investigation period (or grace period).
- 3) The evacuation signal is broadcast:
 - if a fire is confirmed; or
 - if an agreed investigation period lapses without the alarm being cancelled; or
 - if a second detector is activated, “break glass” operated or sprinkler flow switch operated during the investigation period.

8.2.2.2 *Phased evacuation*

Phased evacuation is a common approach adopted in high-rise premises where the floors are separated by fire-resistant construction. In a phased evacuation the first people to be evacuated are all those of reduced mobility and those on the storeys most immediately affected by the fire, usually the fire floor and the floor above; the remaining floors are then evacuated, two floors at a time, at phased intervals.

NOTE Recommendations for widths of escape stairs for phased evacuation are given in 8.8.4.3.

Such an approach provides for significant economies in the plan area occupied by the protected stairways, but demands the provision and maintenance of a range of additional passive and active fire protection measures, together with supportive management arrangements (see BS 5588-12).

Where a building has a phased alarm system, it allows disabled people to be evacuated into another protected zone in some instances.

8.2.3 *Progressive evacuation*

8.2.3.1 *Progressive horizontal evacuation*

Progressive horizontal evacuation is the process of evacuating people into an adjoining fire compartment on the same level, from which they can later evacuate to a place of ultimate safety.

8.2.3.2 *Zoned evacuation*

Zoned evacuation is a common approach adopted in large retail developments, where an operational loss could be created by evacuating a large building for a relatively small fire. The zoned evacuation is achieved by moving the occupants away from the affected zone to an adjacent zone. An example of this would be a shopping centre where the occupants would be moved to the adjacent smoke control zone while the fire-affected zone was brought under control.

Such an approach demands the provision and maintenance of a range of additional passive and active fire protection measures, together with supportive management arrangements (see BS 5588-12).

8.3 Internal subdivision and spatial/visual orientation

8.3.1 General

The manner in which a building is subdivided internally affects the risk to users and their ability to use the planned means of escape in the event of a fire. The following subclauses give advice on the various aspects of internal subdivision that should be taken into account when designing means of escape.

8.3.2 Compartments

The internal subdivision of a building into fire compartments influences the escape arrangements, evacuation procedures and the number of stairs and exits. Only the occupants and contents within a fire compartment have to be regarded as being initially at risk from a fire.

In an uncompartmented building, all the occupants and contents of the building have to be considered at risk in the event of fire. However, larger, higher spaces are not so quickly affected by smoke from a developing fire.

8.3.3 Cellular planning

Cellular planning is the subdivision of all or parts of floor areas, e.g. into separate rooms with access corridors.

Cellular planning carries a risk of fire being undiscovered, which could threaten escape routes unless appropriate precautions are taken.

8.3.4 Open storey (horizontal) planning

In open storey planning, almost the whole floor area of a storey is undivided by partitions, although there may be some screens or high furniture for display purposes in, for example, office storeys and in shop sales areas, or to give privacy to some areas. With open storey planning many of the occupants are likely to be aware of smoke from a fire at the outset and this gives the advantage of early warning.

8.3.5 Atria

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.

All buildings with a void through structural floors should be designed in accordance with Annex C.

NOTE Design solutions and exemplars for atria are given in Annex D.

8.3.6 Ancillary accommodation and high fire risk areas

Where a significant amount of dangerous substances or preparations, e.g. substances or preparations that have a fast or ultra-fast fire growth rate (see 5.2.3) or are classified as explosive, oxidizing, extremely flammable, highly flammable under the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 [3], are stored and/or used, the area is considered to be of high fire risk (see 8.5.2).

Early consultation with the relevant authorities is therefore recommended when the storage and use of such substances is proposed.

NOTE 1 Attention is drawn to the Dangerous Substances (Explosive Atmospheres) Regulations 2002 [4] and specifically in the case of petroleum spirit, i.e. petrol, to the Petroleum (Consolidation) Act 1928 [5].

NOTE 2 Attention is drawn to the Fire Precautions Act 1971 [6] and the Fire Precautions (Workplace) Regulations 1997 (as amended) [7].

8.3.7 Process plant and outdoor structures

The means of escape (Clause 8) and construction (Clause 9) recommendations for buildings and structures that are purpose-designed to house process and storage plant may be modified in accordance with Annex G.

8.4 Designing means of escape

8.4.1 General

The package of fire precautions provided for a building should reflect the nature of the use of the building, the occupants, the processes, the materials stored and used, and the fire safety management provided (see also BS 5588-12). These characteristics are categorized as risk profiles, which provide a basis against which the risk to occupants can be assessed and the appropriate level of fire precautions determined. The risk profile should be determined in accordance with Clause 5.

There are a number of general principles in respect of what is or is not acceptable as a means of escape; these are listed in 8.4.2 and 8.4.3 respectively. However, circumstances can vary and the means of escape chosen for a building should take into account the particular needs of that building.

A flowchart showing the basic process for designing means of escape is given in Figure 3. The following general guidance should also be taken into account.

- a) The floorings of all escape routes (including the treads of steps, and surfaces of ramps and landings) should be chosen to minimize their slipperiness when wet.
- b) Where a crèche is provided for children separately from their parents or guardians, it should be sited adjacent to escape routes used by parents or guardians on their way out to avoid the clashing of streams of people as parents or guardians collect their children. A crèche should be at or as near ground level (or the level at which the final exits discharge) as practicable. In no circumstances should the accommodation for children be:
 - 1) on a floor above the level at which their parents or guardians are accommodated, unless the escape route is through the upper level; or
 - 2) at basement level, unless the final exit is at basement level.

The crèche should preferably be adjacent to an external wall and should not have fewer than two exits, one of which should be a final exit.

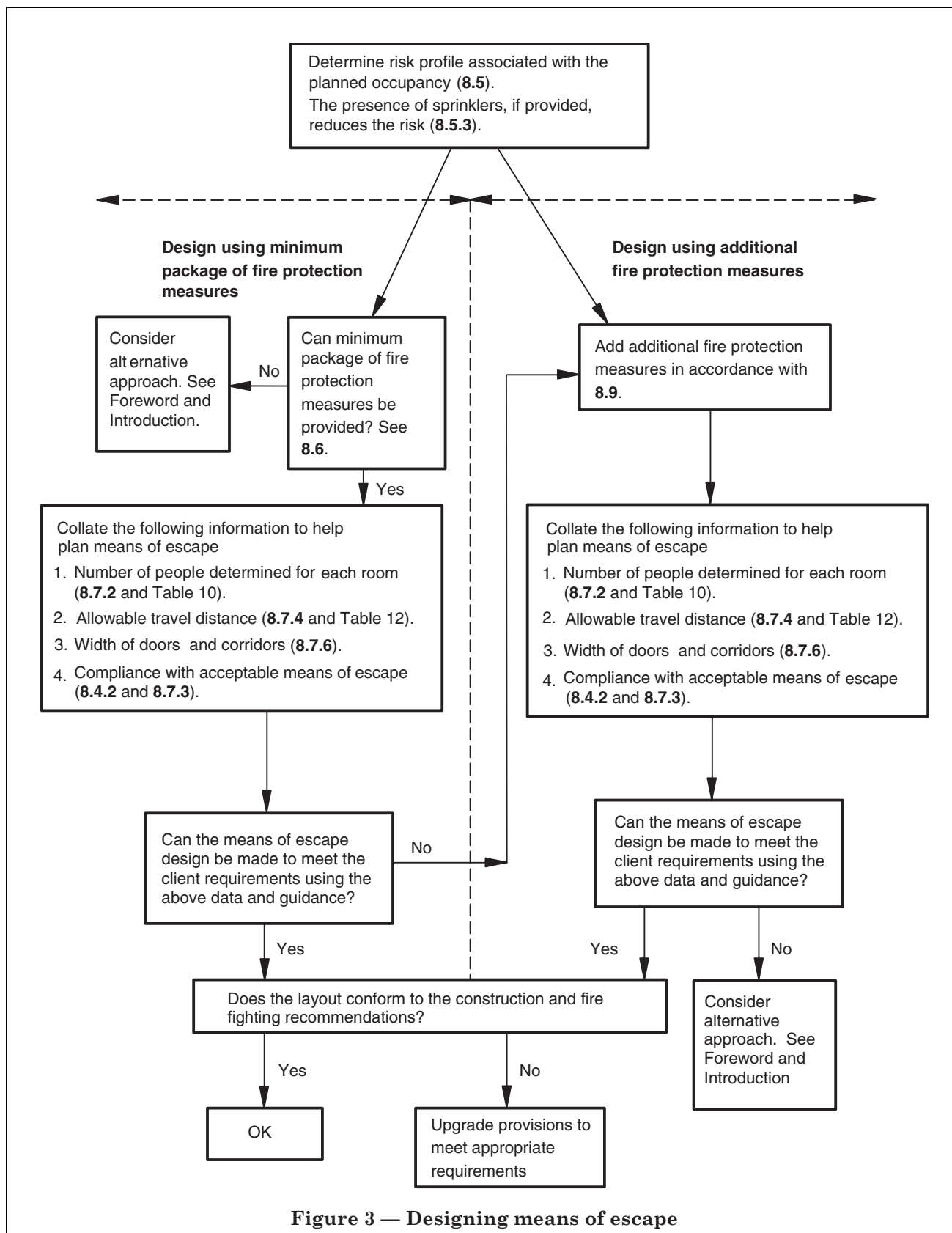
- c) Other potential reverse flow situations, e.g. fire-fighters entering the building, should be taken into account for both horizontal and vertical means of escape strategies.
- d) Many buildings use mezzanines or galleries as a way of creating additional space for various purposes. When large quantities of readily combustible products are stored or displayed under a large plan mezzanine or gallery with a solid floor (as in some DIY outlets) there is always a risk of rapid fire growth resulting in flames spreading beyond the edge of the mezzanine or gallery floor and hence posing a threat to life safety, particularly when the occupants of the building are members of the public. Additional safeguards might therefore be necessary to compensate for the increased level of hazard if a fire occurs below the mezzanine or gallery.

The following conditions should be met in any building or part of a building that is designed on the basis of phased evacuation.

- 1) The stairways should be approached through a protected lobby or protected corridor at each storey, except a top storey consisting exclusively of plant rooms.
- 2) Every floor should be a compartment floor.
- 3) If the building has a storey with a floor over 30 m above ground level, the building should be protected throughout by an automatic sprinkler system conforming to Category I or Category II as defined in BS EN 12845:2003.
- 4) The building should be fitted with a fire warning system, conforming to at least the L3 standard given in BS 5839-1:2002.
- 5) An internal speech communication system, such as a telephone or intercom system, should be provided to permit conversation between a control point at fire service access level, and a fire warden on every storey. This can also be extended to refuges to facilitate the evacuation of disabled people.

NOTE See also BS 5588-5.

- 6) Lifts should be approached through a protected lobby.



8.4.2 *Acceptable means of escape*

The following means of escape are generally deemed to be acceptable for all buildings:

- a) door leading directly to outside air (final exit);
- b) door leading to a protected staircase (storey exit);
- c) doors leading to another fire compartment (progressive horizontal evacuation);
- d) open staircase (accommodation stairs) where the distance along the length of the stair is part of the travel distance;
- e) ramps conforming to BS 8300, at a gradient of no more than 1:12;

NOTE 1 Attention is drawn to the Building Regulations 2000 [8], Approved Document K and Approved Document M; to the Building Standards (Scotland) Regulations 1990 [9]; and to the Building Regulations (Northern Ireland) 2000 [10], in respect of the design of ramps and associated landings, and in respect of aisles and gangways, from the aspect of safety in use.

f) moving walkways where the distance is part of the travel distance and the moving walkway is designed to come to a slow stop;

g) wicket doors and gates (except from high risk areas), provided that:

- 1) they are not intended to be used by members of the public;
- 2) not more than 10 persons are expected to use them in an emergency;
- 3) they provide an opening at least 500 mm wide, with the top of the opening not less than 1.5 m above the floor level and the bottom of the opening not more than 250 mm above the floor level;

h) fail-safe turnstiles, revolving doors and automatic doors conforming to the relevant part of BS 7036, provided that either:

- 1) they are arranged to fail safely in the open position or be easily openable in an emergency; or
- 2) outward opening hinged doors, of an appropriate width and fastened in accordance with 8.6.6.2 are provided immediately adjacent to such doors or turnstiles.

NOTE 2 These restrictions are imposed because revolving doors, automatic doors and turnstiles can obstruct the passage of persons escaping.

8.4.3 *Generally unacceptable means of escape*

The following systems are not normally deemed to be acceptable as means of escape, but they may be used in some situations provided that the reliability of the method can be demonstrated to the appropriate authorities:

- a) lifts, except for a suitably designed and installed evacuation lift that may be used for the evacuation of disabled people in a fire;
- b) fixed ladders, except those in plant rooms which are rarely used and accommodate less than 10 able-bodied people. Where such ladders are used they should conform to BS 5395-3;
- c) portable ladders and throw-out ladders;
- d) manipulative apparatus and appliances, e.g. fold-down ladders;
- e) power-operated or manually operated sliding doors, except those designed to fail open on loss of power or that can break open from any position throughout their operating parameters;
- f) security grilles and shutters (roller, folding or sliding), loading doors, goods doors, sliding doors and up-and-over doors, unless they are capable of being easily and quickly opened. If power operated they should:
 - 1) be provided with a fail-safe system for opening if either the mains supply and/or any alternative power supply fails;
 - 2) be capable of being easily and quickly opened manually;
- g) wicket doors and gates at exits from high risk areas;
- h) escalators.

The use of escalators for the evacuation of people from a building is generally not permitted, as it is possible that escalators could discharge occupants onto the fire level; also, the risers and treads on escalators are not the same as staircases and could slow down the evacuation. However in certain circumstances, escalators are the only means of reaching ground level. The risk of people stumbling or falling whilst using an escalator as a stairway should be taken into account when selecting escalators as walking routes. When assessing the use of escalators for the use of means of escape they should be considered as part of the overall strategy and should be programmed to stop on actuation of a fire alarm in the building. Their capacity should be assessed on the basis of their use as a walking route, while in the static mode. Evacuation routes involving multiple sequential storeys of escalators are not acceptable.

8.5 Allocation of risk profile

8.5.1 General

Risk profile assessments should be made on a case-by-case basis following the recommendations given in Clause 5.

NOTE Examples of typical risk profiles are given in Table 5.

8.5.2 Enclosure of fire risks

Areas of high fire risk (see 8.3.6) are generally allocated at least fire growth rate category 3 (see Table 3). However, if an enclosure or compartment that contains a localized area of high fire risk (such as a cooking range within a catering area) is provided with an effective localized suppression system (see Clause 11), then the overall risk category can be considered as medium risk rather than high risk (e.g. B2 rather than B3).

High fire risk areas within a building should be enclosed so that they do not affect the means of escape. The following are examples of areas that should be enclosed in fire-resisting construction providing a minimum of 30 min fire resistance:

- a) kitchens (naked flame, hot oil etc.);
- b) storage areas classified as high fire risk;
- c) laboratories classified as high fire risk;
- d) engineering services installation rooms (see 9.8.1) classified as high fire risk.

The following areas are not considered a high fire risk and do not need to be enclosed in fire-resisting construction:

- 1) kitchens (reheat only);
- 2) water storage tank rooms;
- 3) plant rooms with air handling units only.

8.5.3 Variation of risk profile by the addition of life safety sprinklers

Automatic sprinkler installations can provide an efficient means of fire control within a building compartment. Such provision limits the control of fire growth, fire spread, heat and smoke generation and can extinguish the fire, or at least reduce the fire growth rate. This means that if sprinkler systems are installed, the fire growth rates as given in Table 3 can be taken to be one category lower than if no sprinklers are provided (i.e. fire growth classification drops from 4 to 3, 3 to 2 or 2 to 1). This reduction applies to the room of origin. It includes corridors and linking spaces only when all the spaces connected to the room of origin are sprinklered or the rooms are separated by fire-resisting construction.

EXAMPLE The provision of an automatic sprinkler installation appropriate to the building risk category permits a reduction in the risk profile giving a larger allowable travel distance and smaller doors. An unsprinklered building with a risk profile B3 would have the risk profile reduced to B2 with the introduction of a suitable automatic sprinkler system. This would also have the effect of reducing a “not allowable” B4 profile (see 8.7.4 and 8.7.6) to a B3 category.

8.6 Minimum package of fire protection

8.6.1 General

Every building should incorporate as a minimum the fire protection measures described in 8.6.2 to 8.6.11, and where appropriate the measures described in 8.6.12, to allow the occupants to escape from the building in the event of a fire and to ensure that there are appropriate management systems in place.

NOTE 1 These include both active and passive measures of fire protection, e.g. detection, alarm, restricting the development of a fire and securing the safe escape of the occupants.

NOTE 2 The package of fire protection measures for specific building types might need to be varied to meet the needs of that particular building type. Guidance for specific building types is given in the following annexes:

- a) Annex C and Annex D — atria;
- b) Annex E — places of assembly;
- c) Annex F — shopping complexes;
- d) Annex G — process plant and structures.

8.6.2 Management levels

The provision and auditing of fire safety management is an essential component of the fire precautions package for a building. The provision of means of escape is dependent on the appropriate level of management being provided and maintained.

NOTE BS 5588-12 gives detailed guidance on establishing the appropriate provision of fire safety management.

A minimum level of fire safety management associated with each risk category should be provided in accordance with Table 7. The use of higher levels of management can provide additional benefits.

Table 7 — Management levels

Risk profile ^a	Management level ^b
A1	3
A2	2
A3	2
A4	2
B1	2
B2	1
B3	1
Ci2	3
Ci3	2
Cii2	2
Cii3	1
Ciii2	1
Ciii3	1
^a See Clause 5. ^b See BS 5588-12.	

8.6.3 Fire detection and alarm systems

NOTE Generally, the minimum requirement for premises is an electrical system in accordance with the recommendations applicable to a Type M as described in BS 5839-1:2002 or in accordance with the recommendations applicable to a Type F as described in BS 5839-6:1995. Premises with a higher fire growth rate usually require a more sophisticated system. In some small premises a less sophisticated system of manually operated sounders might be more appropriate.

The minimum level of fire alarm and detection systems for premises other than small premises should be in accordance with Table 8.

Table 8 — Minimum level of fire alarm/detection system for premises other than those classified as small premises

Premises risk profile	Minimum acceptable alarm/detection system ¹
A1	M
A2	M
A3	L2
A4	L1
B1 ^a	M
B2 ^{a,b}	M
B3 ^a	L2
B4 ^a	L1
Ci2	Automatic fire detection in individual units
Ci3	L3
Cii2	L2
Cii3	L1
Ciii2	L1
Ciii3	L1
NOTE Type M, L3, L2 and L1 systems are defined in BS 5839-1:2002.	
^a In some circumstances where people are in an unfamiliar building the provision of a voice alarm system can help reduce evacuation time.	
^b Not including primary or special needs schools — L3 system advisable.	

Automatic fire alarm and detection systems do not provide any degree of fire containment. However such systems, in addition to giving an alarm, can be used to initiate such functions as:

- a) closing down ventilation and air conditioning plant;
- b) operating smoke control systems;
- c) releasing passive fire protection equipment (e.g. automatic closing doors and shutters);
- d) activating ventilation systems.

As a minimum, an L3 detection and alarm system should be installed where a phased, staged or zoned evacuation is proposed.

Multiple occupancy premises should be provided with a common detection and alarm system appropriate to the individual risks.

In areas with noisy environments or where people might otherwise have difficulty in hearing the fire alarm, flashing warning beacons can be useful.

8.6.4 Artificial and emergency escape lighting

Suitable lighting should be provided to all premises to enable the safe movement of persons along escape routes to a place of safety. Emergency escape lighting, when needed, should be provided in accordance with BS 5266-1 and BS 5266-7.

NOTE Attention is drawn to BS 5266-1:1999, Clause 1, in respect of buildings to which the provisions of that standard are not applicable.

Emergency escape lighting should be provided in accordance with Table 9.

Guidance on types of luminaire and recommendations for the installation of luminaires is given in 9.9.4.

Table 9 — Provisions for emergency escape lighting

Purpose group of the building or part of the building	Areas needing emergency escape lighting
Residential	All common escape routes ^a , except in two-storey flats
Office, shop and commercial ^b industrial, storage, other non-residential	Underground or windowless accommodation Stairways in a central core or serving storey(s) more than 18 m above ground level Internal corridors more than 30 m long Open-plan areas of more than 60 m ²
Shop and commercial ^c and car parks to which the public are admitted	All escape routes ^a (except in shops of three or fewer storeys with no sales floor more than 280 m ² provided that the shop is not a restaurant or bar)
Assembly and recreation	All escape routes ^a , and accommodation except for: — accommodation open on one side to view sport or entertainment during normal daylight hours — parts of school buildings with natural light and used only during normal school hours
Any purpose group	Windowless sanitary accommodation with a floor area not more than 8 m ² All sanitary accommodation with a floor area over 8 m ² Electricity and generator rooms Switch room/battery room for emergency lighting system Emergency control room
^a Including external escape routes. ^b Those parts of the premises to which the public are not admitted. ^c Those parts of the premises to which the public are admitted.	

8.6.5 Exit signs

Every doorway or other exit providing access to a means of escape, other than exits in ordinary use (e.g. main entrances), should be distinctively and conspicuously marked by an exit sign in accordance with BS 5499-1 and BS 5499-4.

NOTE In some buildings additional signs might be needed to meet legislative requirements.

8.6.6 Doors

8.6.6.1 General

The time taken to negotiate a closed door can be critical in escaping. Doors on escape routes (both within and from the building) should therefore be readily openable by all people including disabled people.

8.6.6.2 Door fastenings

In general, doors on escape routes (whether or not the doors are fire doors) should either not be fitted with lock, latch or bolt fastenings, or they should only be fitted with simple fastenings that can be readily operated from the side approached by people making an escape. The operation of these fastenings should be readily apparent and without the use of a key and without having to manipulate more than one mechanism.

NOTE This is not intended to prevent doors being fitted with hardware to allow them to be locked when the rooms are empty. There are also some situations, such as hotel bedrooms, where locks may be fitted that are operated from the outside by a key and from the inside by a knob or lever etc.

Where electromagnetic locking devices are provided they should be provided with a means of being opened in the direction of escape e.g. local break glass. Where door fastenings are provided they should be at a height of about 1 m from the floor.

In buildings where outward opening final exit doors need to be secured, the doors should be fastened with panic bars conforming to BS EN 1125 or similar fastenings that yield to internal pressure on the door. These doors may be fitted with additional fastenings or devices to disable the panic bar fastenings when the premises are not in use. Security devices requiring the use of keys or the breaking of glass can hinder the flow of people escaping, particularly where the devices need to be operated by people unfamiliar with their use. Such devices should only be fitted to doors on horizontal escape routes used solely by members of staff trained in the operation of the device.

8.6.6.3 Automatic 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 an automatic self-closing device.

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. Some automatic self-closing devices can make doors virtually impassable to some disabled people. If self-closing fire doors are fitted, the design chosen should be such as to ensure that the inconvenience that they present is restricted to a reasonable level whilst maintaining an adequate level of fire safety.

All fire doors except for fire doors to cupboards, refuse chambers, store rooms, plant rooms and to service ducts which are normally kept locked shut should be fitted with an automatic self-closing device capable of closing the door from any angle and against any latch fitted to the door.

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 a hold-open device should be installed that will allow a door held open by it to close automatically in the event of each of the following:

- a) detection of smoke by automatic apparatus suitable in nature, quality and location;
- b) operation of a hand-operated switch fitted in a suitable position;
- c) failure of electricity supply to the device, apparatus or switch;
- d) operation of the fire alarm system if any.

NOTE 1 BS EN 1154 gives requirements and test standards for controlled door closing devices. BS EN 1154:1996, Annex A gives specific requirements for devices fitted to fire doors and states that a minimum of power size 3 should be specified for fire doors. However where a latch is fitted to the door and the fire resistance of the doorset has been tested without the restraint provided by a door closer then a less powerful closer can be used. BS 5588-4:1998, Annex B gives a test method for measuring the opening force at a door.

NOTE 2 BS 8300 gives more detailed guidance on the design of buildings and their approaches to meet the needs of disabled people.

8.6.6.4 Direction of opening

The door leaf of any doorway or exit should, where reasonably practicable, be hung to open in the direction of escape, and should always do so if the number of persons that might be expected to use the door at the time of a fire is more than 60.

NOTE With respect to industrial activities where there is a high fire risk with potential for rapid fire growth, it might be necessary (e.g. as a result of risk assessment) for doors to open in the direction of escape regardless of the number of occupants.

8.6.6.5 Amount of opening and effect on associated escape routes

All doors on escape routes should be hung to open not less than 90°, and with a swing that is clear of any change of floor level (see also 8.8.2.7).

A door that opens towards a corridor or a stairway should be sufficiently recessed to prevent its swing from encroaching on the effective width of the stairway or corridor.

8.6.6.6 Vision panels in doors

Vision panels should be provided where doors on escape routes subdivide corridors, or where any doors are hung to swing both ways.

NOTE Attention is drawn to the Building Regulations 2000 [8], Approved Document M in respect of vision panels in doors across accessible corridors and passageways, and to Approved Document N in respect of provisions for the safety of glazing.

8.6.6.7 *Final exits*

Final exits need to be dimensioned and sited to facilitate the evacuation of persons out of and away from the building. Accordingly, they should be not less in width than the escape route(s) they serve and should also meet all of the following conditions.

- a) Final exits should be sited to ensure rapid dispersal of persons from the vicinity of the building so that they are no longer in danger from fire and smoke. Direct access to a street, passageway, walkway or open space should be available. The route clear of the building should be well defined, and if necessary suitably guarded.
- b) Final exits should be apparent to persons who might need to use them. This is particularly important where the exit opens off a stair that continues down, or up, beyond the level of the final exit.
- c) Final exits should be sited so that they are clear of any risk from fire or smoke in a basement (such as the outlets to basement smoke vents, or from openings to transformer chambers, refuse chambers, boiler rooms and similar risks).
- d) Where a final exit leads to steps outside the building, care should be taken to ensure that there is space for a wheelchair user to move so they do not obstruct the flow of other people leaving the building. Wherever possible final exits should provide a level or ramped route away from the building.

8.6.7 *Protected power circuits*

The cables for fire alarm circuits should conform to BS 5839-1:2002, **26.2**.

The cables for all other circuits should conform to BS 7346-6.

8.6.8 *Lifts*

8.6.8.1 *General*

Generally lifts are not considered in the evacuation procedures in buildings for the following reasons:

- a) it is possible for the occupants using the lift to become trapped due to loss of power;
- b) it is possible that lifts could discharge occupants onto the floor containing the fire;
- c) people sometimes have to wait for long periods for the lift car to arrive, extending the escape time.

However, lifts that are specifically designed for the purpose can be used to evacuate disabled people safely and effectively. Any lift provided for the evacuation of disabled persons should conform to the relevant requirements in BS EN 81-70.

NOTE Further guidance on the systems and procedures necessary to support the use of these lifts for evacuation is given in BS 5588-12.

8.6.8.2 *Fire protection of lift installations*

Lift wells should either be contained within the enclosures of a protected stairway, or be enclosed throughout their height with fire-resisting construction. A lift well connecting different compartments should form a protected shaft.

In basements and enclosed car parks the lift should be approached only by a protected lobby (or protected corridor) unless it is within the enclosure of a protected stairway. This is also the case in any storey that contains high fire risk areas, if the lift also delivers directly into corridors serving sleeping accommodation. Examples of fire risk areas in this context are kitchens, lounges and stores.

A lift should not be continued down to serve any basement storey if it is in a building (or part of a building) served by only one escape stair, or if it is within the enclosures to an escape stair that is terminated at ground level.

Lift machinery spaces should be sited over the lift well whenever possible. If the lift well is within a protected stairway which is the only stairway serving the building (or part of the building), then if the machinery space cannot be sited above the lift well it should be located outside the stairway (to avoid smoke spread into the stairway from a fire in the machinery space).

A corridor can be protected from a lift shaft by means of sealing the lift doors with additional automatic fire/smoke doors or fire/smoke barriers, thus eliminating the need for a lobby.

In buildings designed for phased or progressive horizontal evacuation, where the lift well is not contained within the enclosures of a protected stairway, the lift entrance should be separated from the floor area on every storey by a protected lobby.

Lifts, such as wall-climber or feature lifts, which rise within a large volume such as a mall or atrium, and do not have a conventional well, might be at risk if they run through a smoke reservoir and should not be used for evacuation. Such lifts should return to the ground floor (or final exit storey).

8.6.9 Mechanical ventilation and air conditioning systems

Any system of mechanical ventilation should be designed to ensure that in a fire the air movement in the building is directed away from protected escape routes and exits, or that the system (or an appropriate section of it) is closed down. (See also 9.4.4 for guidance on fire protection for these systems.) In the case of a system which recirculates air, it should meet the relevant recommendation for recirculating distribution systems in 9.4.4.7, in terms of its operation under fire conditions.

Where a smoke control system is installed, ventilation and air conditioning systems in the building should be compatible with it when operating under fire conditions.

8.6.10 Refuse chutes and storage

Refuse storage chambers, refuse chutes and refuse hoppers should be sited and constructed in accordance with BS 5906.

Refuse chutes and rooms provided for the storage of refuse should:

- a) be separated from other parts of the building by fire-resisting construction; and
- b) not be located within protected stairways or protected lobbies.

Rooms containing refuse chutes, or provided for the storage of refuse, should be approached either directly from the open air or by way of a protected lobby provided with not less than 0.2 m² of permanent ventilation.

Access to refuse storage chambers should not be sited adjacent to escape routes or final exits, or near to windows of dwellings.

8.6.11 Smoke control systems

Smoke control systems can be designed into buildings to keep the escape routes tenable for the time required to evacuate the occupants (see 8.1).

Guidance on the design and use of such systems is given in BS 7346-4 for smoke and heat exhaust ventilation systems and BS 5588-4 for pressure differential systems.

8.6.12 Building services and means of escape

Building service systems can be beneficial in the provision of means of escape by increasing the time for escape via a variety of measures, as follows.

NOTE Many of these measures are not included in the minimum package of fire protection measures for some of the risk profiles. However, they can be added to further improve the means of escape provisions.

- a) *Fire and smoke detection and alarm systems.* Early detection and alarm helps reduce the time from the start of a fire to the commencement of evacuation of the building.
- b) *Active fire-fighting systems.* Automatic sprinklers, foams and gaseous fire-fighting systems are designed to suppress the fire or reduce its growth rate, and can therefore increase the available travel time in some situations.
- c) *Communications systems.* Communications systems and their effective use by management can be key factors in reducing the time between alarm and the start of the movement to escape (pre-movement time).
- d) *Smoke control systems.* Smoke control systems can increase the available safe escape time. They can be either active systems consisting of fans, vents, etc. or passive systems consisting of suitably arranged smoke-resisting construction.
- e) *Building management and surveillance systems.* Building management systems, including CCTV, can assist management to maximize the available escape time and to minimize the evacuation time.

8.7 Horizontal means of escape

8.7.1 General

This subclause deals with the provision of means of escape from any point in a storey to the nearest storey exit of the floor in question, for all types of building other than dwellings, prisons, hospital, flats, atria and shopping centres. Means of escape for atria should be provided in accordance with Annex C, and for shopping complexes in accordance with Annex F.

Escape routes from each storey (or level) should be so sited that a person confronted by fire can turn away and make a safe escape through an alternative exit. The time between the fire ignition and the start of the evacuation and the time taken to travel to a relative place of safety have a significant affect on the safety of the occupants. In spaces where there are relatively few people it is the distance to a relative place of safety that has the main influence on the travel time. Where there are relatively large numbers of people on a floor it is the queuing at the exits that has the main influence on the travel time.

The preferred method of evacuation for disabled people is by horizontal evacuation to the outside of the building or another fire compartment or by fire evacuation lift. If these are not available or not in operation, then it might be necessary to carry a person with limited mobility up or down the escape stair. Means of escape for disabled people may comprise a combination of structural provisions (e.g. lifts, refuge areas, ramps) and management procedures (e.g. assisted escape). A strategy should be designed to enable a flexible response to different situations.

8.7.2 Number of occupants

A realistic estimate should be made of the maximum occupancy associated with the intended use of the building. The occupant capacity of a room, storey, building or part of a building is either:

- a) the maximum number of persons it is designed to hold; or
- b) the number calculated by dividing the area of room or storey(s) (m^2) by the appropriate floor space factor (m^2 per person) such as those given in Table 10.

NOTE 1 "Area" excludes stair enclosures, lifts, sanitary accommodation and any other fixed part of the building structure, but includes such features as counters, bars, seating and display units.

NOTE 2 The factors given in Table 10 are only typical and higher or lower factors might be more appropriate depending on the circumstances of the intended use.

The capacity of the stairs should not be used as a basis for determining the occupancy capacity of a room, as this might result in an estimated occupancy that could not be controlled in the event of an emergency.

Table 10 — Floor space factors

Accommodation type	Floor space factor m ² per person	Accommodation type	Floor space factor m ² per person
Administration office	5.0	Individual seating	0.4
Amusement arcade	0.5	Indoor games/training rooms in schools	10
Archive/library reading area	5.0	Kitchen	7.0
Art gallery	5.0	Licensed betting office (public area)	1.0
Assembly hall	0.5	Lobbies	2.0
Banking hall	3.0	Lounge	1.0
Bar	0.3	Machine/printing room	10.0
Bazaar	2.0	Mechanical plant room	30.0
Bench seating	0.4	Meeting room	1.0
Billiards or snooker room	10.0	Museum	5.0
Bingo hall	0.5	Office (closed-plan or less than 60 m ²)	8.0
Bowling alley	10.0	Office (open-plan or exceeding 60 m ²)	5.0
Business centre	7.0	Queuing area	0.5
Car park (per parking space)	2.0	Reading or writing room	2.0
Classroom	2.0	Reading room	1.0
Club	0.5	Reception area	2.0
Committee room	1.0	Restaurant	1.0
Common room	1.0	Shop	2.0
Computer room	7.0	Showrooms	7.0
Conference room	1.0	Skating rink	2.0
Crush hall	0.5	Space with loose seating	0.75
Dance area	0.5	Space with loose tables	1.0
Deposit/strong room	30.0	Stadia and grandstands	0.6
Design studio/Drafting office	7.0	Staff room	1.0
Dining room and canteens	1.0	Storage and warehousing	30.0
Dining rooms with loose tables	1.0	Studio (radio, television, film, recording)	1.5
Dormitory	5.0	Teaching laboratories	3.0
Exhibition areas	1.5	Venue for pop concerts	0.5
Factory production area	5.0	Waiting area/visitors' lounge	2.0
Filling room/store	10.0	Waiting room	2.0
Foyers	2.0	Workshop	5.0
Gymnasium – open plan (where fixed machines are used, the occupancy is based on the number of machines provided)	0.6		

8.7.3 Layout and number of escape routes and exits

8.7.3.1 Minimum number of escape routes

An escape route can be rendered impassable by fire, smoke or fumes. Generally, therefore, at least two alternative escape routes should be provided from every storey or floor level. However in certain circumstances a single direction of escape (from a dead end) can provide reasonable safety (see 8.7.3.3). The number of escape routes and exits from any room, tier or storey should be not less than the minimum recommended in Table 11 for the intended number of occupants.

NOTE 1 The numbers given in Table 11 are the absolute minimum; the actual number of escape routes and exits that will be needed depends on the risk profile (see Clause 5), the number of occupants in the room, tier or storey in question, and the limits on travel distance to the nearest storey exit (see 8.7.4), and is likely to be higher than the numbers in the table.

NOTE 2 It is only the distance to the nearest exit that is so limited. Any other exits may be further away than the defined distances.

Table 11 — Minimum number of escape routes and exits from a room, tier or storey

Minimum number of persons	Minimum number of escape routes/exits
60	1
600	2
More than 600	3

One of these escape routes may be to an adjoining compartment provided that:

- the building is one occupancy;
- the adjoining compartment is separated from the fire-affected area by walls of fire-resisting construction with openings therein fitted with self-closing fire doors;
- the adjoining compartment is of sufficient size to accommodate both its own occupants and those exiting to it from the fire-affected area; and
- the adjoining compartment has storey exits of sufficient capacity to cater for 50 % of the total occupancy of the compartment taking into account both the number of the occupants in the adjoining compartment and the number of persons escaping to it.

Where unavoidable, an escape route for the public may be via an area of ancillary accommodation, other than an area of special fire hazard, provided that it is not the only available escape route from the area concerned. The route through the area of ancillary accommodation to a storey exit should be clearly defined by means of guardrails.

In multi-storey buildings more than one stair might be needed for escape, in which case every part of each storey should have access to more than one stair, including areas in dead-end conditions. For areas in dead-end conditions, the alternative stair should be accessible in case the nearest one is not usable.

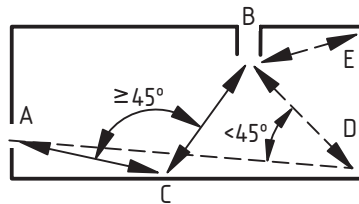
In mixed use buildings, separate means of escape should generally be provided from any storeys (or parts of storeys) used for residential or assembly and recreation purposes (see also Annex E).

8.7.3.2 Alternative escape routes

If alternative escape routes are provided, they need to be sited so as to minimize the possibility of all being rendered unavailable at the same time. Alternative escape routes should therefore be either:

- 45° or more apart (see Figure 4); or
- if less than 45° apart, separated from each other by fire-resisting construction.

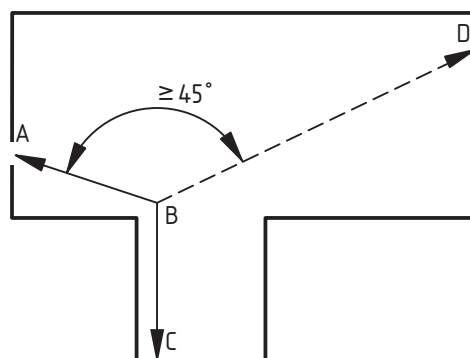
NOTE Fire-resisting construction may incorporate self-closing fire doors.



Alternative routes are available from C because angle ACB is 45° or more, and therefore CA or CB (whichever is the less) should be no more than the maximum distance for travel given for alternative routes.

Alternative routes are not available from D because angle ADB is less than 45° . There is also no alternative route from E.

a) Option 1



Angle ABD should be at least 45° plus 2.5° for each metre travelled from point C. CBA or CBD (whichever is less) should be no more than the maximum distance of travel given for alternative routes, and CB should be no more than the maximum distance for travel where there are no alternative routes.

b) Option 2 (travel distance in dead-end condition)

Figure 4 — Escape routes 45° or more apart

8.7.3.3 Single escape routes and exits

A single escape route is acceptable in the following situations:

- a) parts of a floor from which a storey exit can be reached within the travel distance limit for travel in one direction, provided that, in the case of places of assembly and bars, no one room in this situation has an occupant capacity of more than 60 people, or 30 people if the occupants require assistance to escape;
- b) storeys with an occupant capacity of not more than 60 people, provided that the travel distance limit for travel in one direction only is not exceeded (see 8.7.4).

In many cases there is no alternative at the beginning of the route. For example, there might be only one exit from a room to a corridor, from which point escape is possible in two directions. This is acceptable provided that the overall distance to the nearest storey exit is within the limits for routes where there is an alternative, and the “one direction only” section of the route does not exceed the limit for travel where there is no alternative.