BRITISH STANDARD

BS 5588-11:1997
Incorporating Amendments Nos. 1, 2 and 3

Fire precautions in the design, construction and use of buildings —

Part 11: Code of practice for shops, offices, industrial, storage and other similar buildings

ICS 13.220.01; 91.040.20

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee FSH/14, upon which the following bodies were represented:

Association of Building Engineers
British Retail Consortium
British Standards Society
British Telecommunications plc
Chartered Institution of Building Services Engineers
Chief and Assistant Chief Fire Officers Association
Consumer Policy Committee of BSI
Department for Education
Department of Health
Department of the Environment — Building Research Establishment
Department of the Environment — Construction Sponsorship Directorate
Department of the Environment for Northern Ireland
District Surveyors Association
Electricity Association
Fire Brigades Union
Health and Safety Executive
Home Office
Institute of Building Control
Institution of Gas Engineers
Institution of Structural Engineers
London Fire and Civil Defence Authority
Loss Prevention Council
National Association of Fire Officers
Royal Institute of British Architects
Scottish Office — Building Directorate
Timber Research and Development Association

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Access Committee for England
Association of British Theatre Technicians
British Automatic Sprinkler Association
British Woodworking Federation
Cinema Exhibitors Association
Flat Glass Manufacturers' Association
Guild of Architectural Ironmongers
Hevac Association
Institute of Fire Safety
Institution of Fire Engineers
Intumescent Fire Seals Association
National House-building Council
Steel Window Association
Theatres Advisory Council

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Amendments issued since publication

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The following BSI references relate to the work on this British Standard:
Committee reference FSH/14
Draft for comment 91/46632 DC

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Contents

Foreword

This Code of practice was prepared by Technical Committee FSH/14 Fire precautions in buildings and like structures. It incorporates revisions of BS 5588-2:1985 and BS 5588-3:1983, which are withdrawn.

All matters dealing with fire safety management are now located in BS 5588-12.

Other Parts of BS 5588 are as follows:

— *Part 0: Guide to fire safety codes of practice for particular premises/applications*;

— *Part 1: Code of practice for residential buildings;*

— *Part 4: Code of practice for smoke control using pressure differentials*;

— *Part 5: Code of practice for firefighting stairs and lifts*;

— *Part 6: Code of practice for places of assembly*;

— *Part 7: Code of practice for the incorporation of atria in buildings*[1)];

— *Part 8: Code of practice for means of escape for disabled people*;

— *Part 9: Code of practice for ventilation and air conditioning ductwork*;

— *Part 10: Code of practice for shopping complexes*;

— *Part 12: Managing fire safety*.

Some of the more important changes from the text of Part 2 and Part 3 are as follows.

a) Travel distances in ancillary accommodation are related to hazard.

b) Stairs do not always need to be discounted when determining exit capacity.

c) Guidance has been included on smoke ventilation measures to assist firefighting.

d) Guidance has been included for phased evacuation procedures in office buildings.

e) In Section 5, Section 6 and Section 7 the provisions relating to means of escape in case of fire, and those giving guidance on good practice, are dealt with separately.

f) A different method for the calculation of stair widths for simultaneous evacuation is given in Table 4.

In this code a commentary on the relevant principles is followed by any recommendations that are made. The commentary is intended to provide an explanatory background to recommendations, especially if the recommendations might otherwise appear to be arbitary.

NOTE 1 Commentary text is printed in italics.

In this code, normative reference is made to documents which are essential for the application of the code, (see **2.1**), informative reference is made to documents which provide information or guidance (see **2.2**). Some documents are called up normatively and informatively in different places in the text. Such documents are listed as normative references.

NOTE 2 Legislation is referred to informatively only, as the user of the standard is expected to obey the law, irrespective of compliance with standards.

1) *Footnote deleted*

It has been assumed in the drafting of this code that the execution of its provisions will be entrusted to appropriately qualified and experienced people.

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

It should be noted that the guidance given in this code with regard to, among other things, the widths of escape routes, is based upon the standard widths necessary for means of escape and may not be the widths required to enable persons with disabilities, particularly those in wheelchairs, to have access to and move around buildings.

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

Compliance with a British Standard does not of itself confer immunity from legal obligations.

In particular, attention is drawn to **4.3**.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 117 and a back cover.

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Sidelining in this document indicates the most recent changes by amendment.

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Section 1. General

1 Scope

This Part of BS 5588 relates to the following buildings:

a) shops and similar premises used for retail trade or business, including:

1) large premises such as department stores, supermarkets and hypermarkets excepting communal parts of shopping complexes (which are covered by BS 5588-10);

2) premises where goods may not necessarily be sold over the counter but in which a trade or business is carried out, such as hairdressers' salons, television rental shops and auction rooms;

3) cafes, restaurants, public houses and other places of refreshment;

4) premises where goods are received for treatment or repairs, such as dry cleaners, launderettes and shoe repair shops;

b) office buildings and offices incorporated in premises of other uses;

c) industrial buildings;

d) storage buildings;

e) similar buildings to those listed above including plant, but not buildings or parts of buildings used for assembly, or places of assembly;

f) laboratories.

This Part of BS 5588 deals with planning, construction, and facilities for occupant safety in the event of fire by warning systems, limiting travel distances, the provision of protected escape routes and safe access for firefighting, in new buildings and in alterations and extensions to existing buildings. It includes measures and facilities necessary for restricting the spread of smoke and fire beyond the source, and to prevent the ingress of smoke and heat into protected escape routes by pressure differential systems or other means. It also makes specific recommendations in terms of protection, number and location of exits and those measures to assist fire fighting, providing guidance on suppression and controlled ventilation systems for smoke and heat clearance. The recommendations and guidance are intended to safeguard the lives of occupants in the event of fire, and could also protect the building and its contents against the effects of fire.

Advice for owners and managers is located in BS 5588-12.

This code does not address any additional requirements for process plant that may be made under specific legislation to guard against premature failure of such plant which might lead to an untenable escalation of the incident. Further guidance on this is given in BS 5908.

This code is not intended to apply to buildings during the course of construction. However, guidance is given on the necessary precautions to be taken during alterations to occupied buildings.

This Part of BS 5588 does not apply to those parts of hospital premises that are covered by Hospital Technical Memoranda, e.g. an office within a hospital. An office building or warehouse building on hospital premises is covered by this Part, [see items b) and d)].

2 References

2.1 Normative references

This Part of BS 5588 incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the cited publications are listed on pages 112 to 114. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 5588 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on pages 115 to 117, but reference should be made to the latest editions.

3 Definitions

For the purposes of this Part of BS 5588 the following definitions apply.

3.1
access room
a room through which passes the only escape route from an inner room

3.2
accommodation stair
a stair, additional to that or those required for escape purposes, provided for the convenience of occupants

3.3
ancillary accommodation
all parts of the building that are ancillary to the main use of the building, such as rooms associated with engineering services, refuse rooms, and covered car parks

3.4
atrium (plural atria)
a space within a building, not necessarily vertically aligned, passing through one or more structural floors

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

3.5
basement
a storey that is below the ground storey (see **3.22**)

3.6
borrowed light
light received from another room

3.7
(fire) compartment
a building or part of a building, comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to or from another part of the same building, or an adjoining building

3.8
compartment floor/wall
a fire resisting floor or wall used in the separation of one fire compartment from another

3.9
dead end
a 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

3.10
depth (of a building)
distance between the lowest point of the floor of the lowest storey of a building, to the ground level measured at the centre of that face of the building where the distance is greatest. (See Figure 1)

NOTE Ground level is the level of the footway or paving, if present, in front of the relevant face of the building.

3.11
direct distance
the shortest distance from any point within the floor area, measured within the external enclosures of the building, to the nearest storey exit, ignoring walls, partitions and fittings, other than the enclosing walls/partitions of protected stairways. (See Figure 2)

NOTE See also **3.40** travel distance.

3.12
escape lighting
lighting provided, for use when the supply to the normal lighting fails, to ensure that the escape routes are illuminated at all material times

3.13
escape route
a route forming part of the means of escape from any point in a building to a final exit (see **3.14**)

NOTE It might be necessary to pass through further doorways before reaching a place of safety, for example if escape were via an internal courtyard.

3.14
final exit
the termination of an escape route from a building giving direct access to a street, passageway, walkway or other open space sited to ensure the rapid dispersal of persons from the vicinity of a building so that they are no longer in danger from fire and/or smoke

3.15
fire alarm/fire detection zone
a subdivision of the building such that the occurrence of a fire within it will be indicated by the fire alarm system separately from an indication of fire in any other subdivision

3.16
fire door (assembly)
a 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

3.17
firefighting lift
a lift designed to have additional protection against fire with controls that enable it to be used under the direction control of the fire service in fighting a fire

3.18
firefighting lobby
a protected lobby providing access from a firefighting stair to the accommodation area, and to any associated firefighting lift

3.19
firefighting shaft
a protected enclosure containing a firefighting stair, firefighting lobbies and, if provided, a firefighting lift together with its machine room

3.20
firefighting stair
a protected stairway communicating with the accommodation area only through a firefighting lobby

3.21
fire resistance
the ability of a component or construction of a building to satisfy for a stated period of time some or all of the appropriate criteria specified in the relevant Part of BS 476

NOTE See **13.3**.

3.22
ground storey
a storey, the floor of which is situated at such a level or levels that any given point on its perimeter is at, or about, or not more than 1.2 m below, the level of the finished surface of the ground adjoining the building in the vicinity of that point

3.23
height (of a building)
the distance of the surface of the highest point of the floor of the highest storey (excluding any such storey consisting exclusively of plant rooms) measured at the centre of that face of the building where the measurement is greatest from the level of the footway or paving in front of that face, or if there is no such footway or paving, from the level of the ground (see Figure 1)

3.24
inner room
a room from which escape is possible only by passing through another room (the access room, see **3.1**)

3.25
material of limited combustibility
one of the following:

a) a non-combustible material; or

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

3.26
means of escape
structural means whereby a safe route or routes is or are provided for persons to travel from any point in a building to a place of safety

3.27
mezzanine
a partial storey within another storey

NOTE In Scotland this is known as a "gallery".

3.28
non-combustible material
any material capable of satisfying the performance requirements specified in BS 476-4, or any material which when tested in accordance with BS 476-11 does not flame or cause any rise in the temperature on either the centre (specimen) or furnace thermocouples

3.29
open storey (horizontal) planning
planning where almost the whole floor area of a storey is undivided by partitions

3.30
phased evacuation
system of evacuation in which different parts of a premises are evacuated in a controlled sequence of phases, those parts of the premises expected to be at greatest risk being evacuated first

3.31
place of safety
place in which persons are in no danger from fire

3.32
protected circuit
an electrical circuit protected against external fire

3.33
protected escape route
that part of an escape route which comprises a protected lobby (see **3.34**), protected corridor (see **3.34**) or protected stairway (see **3.35**)

3.34
protected lobby/corridor
a 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)

3.35
protected stairway
a 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 enclosed with fire resisting construction

3.36
self-closing fire door
a fire door (see **3.16**) fitted with a device which fully closes the door overriding the resistance of any latch

3.37
shopping complex
a structural combination of a number of commercial premises that includes areas providing common access for the public, principally for shopping purposes

3.38
special premises
premises subject to the Fire Certificates (Special Premises) Regulations 1976 [1]

3.39
storey exit
a final exit (see **3.14**), or doorway giving direct access to a protected stairway, firefighting lobby, or external escape route

3.40
travel distance
the actual distance to be travelled by a person from any point within the floor area to the nearest storey exit, having regard to the layout of walls, partitions and fittings (See Figure 2)

NOTE See also **3.11** direct distance.

3.41
width

a) of a doorway. The clear width of the doorway when the door is open;

b) of a corridor or other escape route. The clear width of the corridor or other escape route, measured at 1 500 mm above floor level, defined by walls or other fixed obstructions;

c) of a stairway. The clear width of the stairway measured between the walls or balustrades maintained clear for a vertical distance of 2 m measured from the pitch line or landing floor level

NOTE All obstructions, i.e. door hardware, handrails and strings, which do not intrude more than 100 mm into these widths are disregarded.

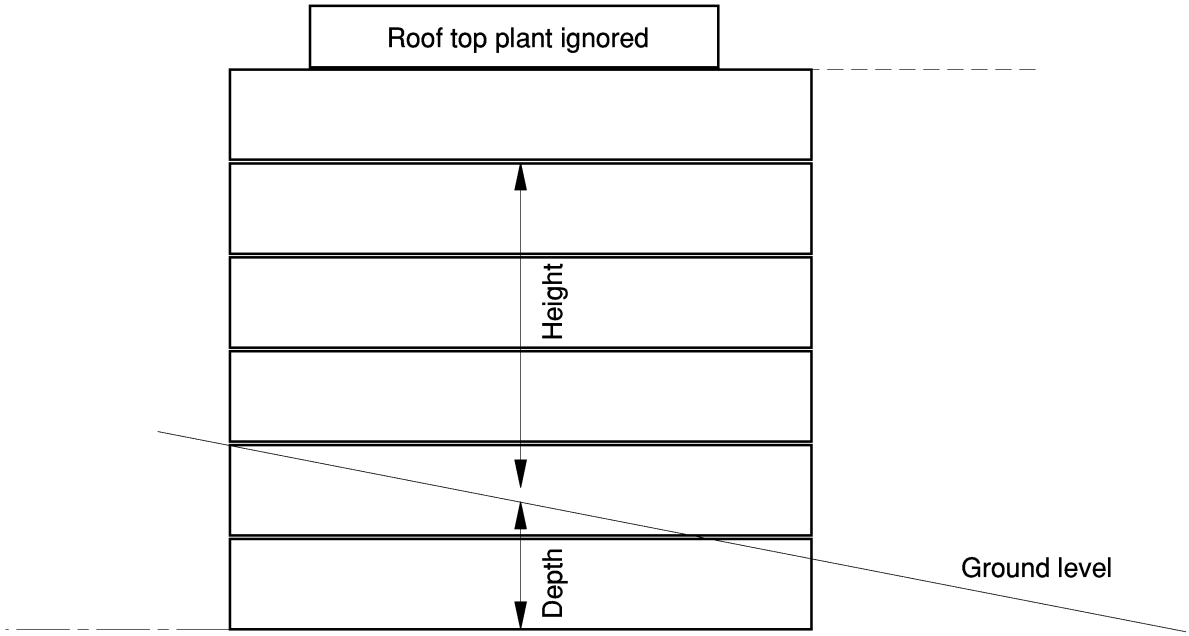

Figure 1 — Height and depth of a building

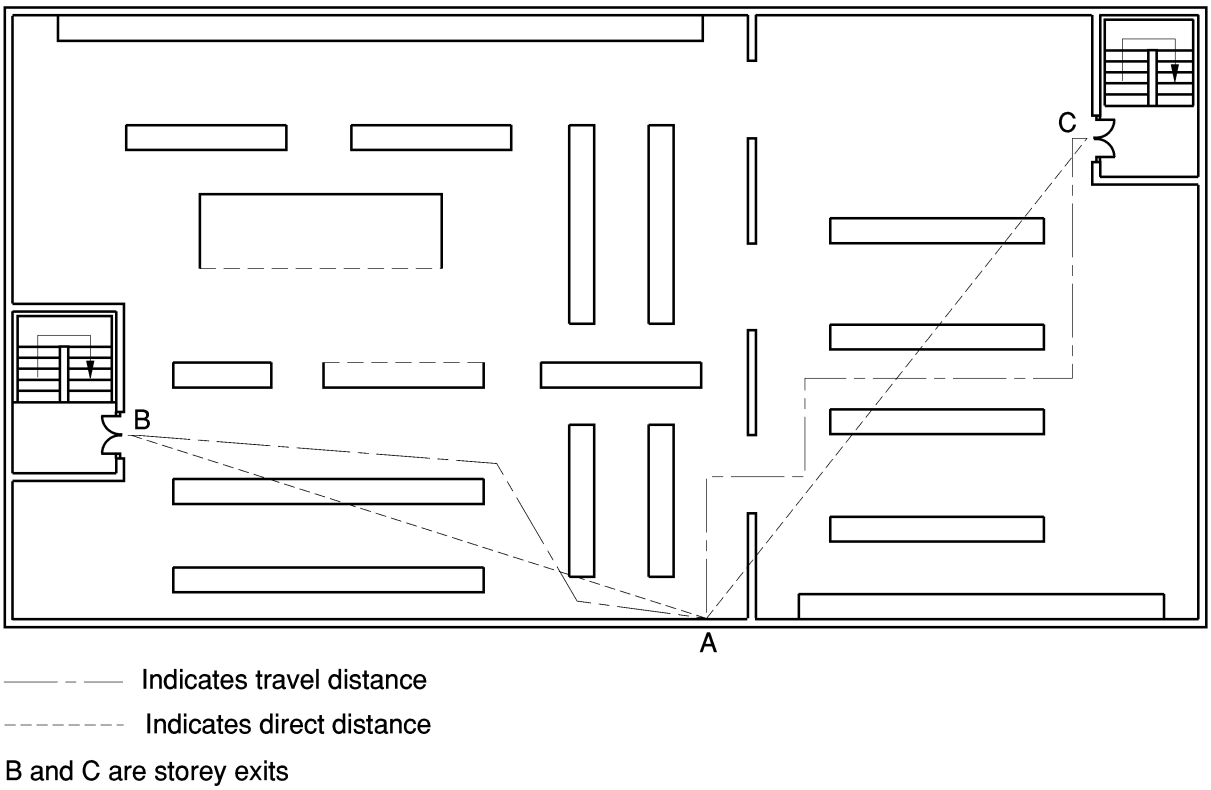

Figure 2 — Travel distance and direct distance

4 Use of this code

4.1 Safety measures

The recommendations in this code are intended to provide safety from fire by promoting safe aspects of design, construction and management in the following areas:

a) planning and protection of escape routes from any area that may be threatened by fire;

b) construction and finishing with suitable materials and embodying fire resistance in the structure;

c) segregation of high fire risk/hazard areas;

d) fire warning systems and, where appropriate, systems for the automatic detection of fire;

e) automatic fire extinguishing systems to limit the growth of fire;

f) smoke control measures to maintain the effectiveness of escape routes and to assist fire fighters;

g) the provision of firefighting equipment, whether for use by the staff in containing fire in its early stages, or by way of assistance to the fire service;

h) the provision of reasonable access to the building for the fire service, including facilities for the safe and rapid extinction of fire by the fire service and for the safety of the fire service personnel when firefighting;

i) effective management control.

4.2 Use of the principles and application of the recommendations

It is not possible to make comprehensive recommendations capable of covering every possible risk, and an intelligent appreciation of the principles and application of the recommendations of this code is therefore essential. The fire hazard of a particular type of building and its contents, and the kinds of occupant together with their likely state of awareness and/or distraction, have to be appreciated in the design of a building. To use this code effectively, the behaviour of a fire occurring anywhere in the building and the response from people thus put at risk has to be anticipated.

Individual recommendations of this code applied in isolation may give little or no benefit, and could even reduce the level of fire safety. Although the basic principles and recommendations for escape from floor areas are described in Section 3, the most conscientious application of these recommendations could be undermined unless supported by the necessary measures relating to construction, ancillary accommodation, engineering services, fire protection facilities and management set out in Section 4, Section 5, Section 6, Section 7 and BS 5588-12.

Although it is difficult to achieve a consistent standard of safety for buildings which vary in size, location, facilities and design, the adoption of certain arbitrary values ought to provide some guarantee of a basic standard of safety.

This approach does not, however, make allowance where buildings incorporate features that enhance some particular aspect of safety.

Therefore, an understanding and flexible use of the recommendations in this code is encouraged as it is not intended to enforce particular forms of design. However, it is particularly important that any variations from the code should be subject to a rigorous examination and justification.

4.3 Relationship with statutory provisions

4.3.1 *General*

It is important to appreciate the relationships between this code and the various statutory provisions relevant to the design and construction of new buildings and to the fire precautions to be provided in existing buildings. The relevant legislation indicated in general terms in **4.3.2** and **4.3.3** has to be complied with in the event of a conflict with this code. However, there are two main ways in which this code is intended to supplement the legislation. The first is that, since Acts and Regulations are necessarily drafted in broad terms and cannot deal in detail with a wide variety of different situations, one of the objects of this code is to provide guidance for the building designer in matters not covered in sufficient detail by the legislation. Secondly, because the objectives of the legislation are mainly concerned with the health and safety of the general public, this code is of wider scope and includes matters relevant to the protection of the building and its contents from fire as well as the safety of the occupants.

It is advisable that there should be preliminary design consultation to avoid the need to make changes to a design at a late stage. For England and Wales, reference should be made to the guidance document *Building Regulation and Fire Safety, Procedural Guidance* [2]. For Scotland, reference should be made to the Building (Procedure) (Scotland) Regulations 1981 [3] and the Building (Procedure) (Scotland) Amendment Regulations 1990 [4].

4.3.2 *Building regulations*

The design and construction of new buildings, and alterations of existing buildings, are controlled by the following statutory provisions collectively referred to as building regulations in this code.

England and Wales: The Building Regulations

Scotland: The Building Standards (Scotland) Regulations

Northern Ireland: The Building Regulations (Northern Ireland)

4.3.3 *Legislation and other regulations for fire safety in shops, offices, industrial, storage and other similar buildings*

In addition to the controls mentioned in **4.3.2**, fire safety and means of escape for a wide variety of buildings is dealt with principally under the following legislation.

England and Wales:

The Fire Precautions Act 1971, as amended by the Health and Safety at Work etc. Act 1974 and the Fire Safety and Safety of Places of Sport Act 1987.

The Building Act 1984.

The Fire Certificates (Special Premises) Regulations 1976 (as amended).

Scotland:

The Fire Precautions Act 1971, as amended by the Health and Safety at Work etc. Act 1974 and the Fire Safety and Safety of Places of Sport Act 1987.

The Building (Scotland) Act 1959 (as amended).

The Fire Certificates (Special Premises) Regulations 1976, (as amended).

Northern Ireland:

The Fire Services (Northern Ireland) Order 1984 and the Health and Safety at Work (Northern Ireland) Order 1978.

The Planning and Building Regulations (Amendment) (Northern Ireland) Order 1990.

There are also a number of local Acts as well as entertainment and other licensing legislation which deal with fire safety and means of escape. The designer should consult the fire authority and building authority at an early stage to make certain that the building as planned will meet the requirements those authorities may make, particularly if a fire certificate or licence may be necessary.

NOTE 1 Under the Fire Precautions Act 1971, fire authorities cannot require structural or other alterations relating to escape from the premises as a condition of the issue of a fire certificate, or under an improvement notice, if the plans of the building comply with building regulations, unless:

a) there are regulations made under Section 12 of the Act and it is necessary to make requirements in order to satisfy those regulations; or

b) the fire authority is satisfied that the means of escape in case of fire are inadequate by reason of matters or circumstances of which particulars were not required to be supplied to the local authority in connection with the deposit of plans for building regulation purposes.

NOTE 2 If a building is in a low category of hazard, the designer and owner should be aware that a change of use could cause the building to be placed in a higher category of hazard and have to comply with more onerous requirements.

4.4 Protection of property

Fire safety is often interpreted as meaning only the safety of persons (life safety), but it also includes the protection of property (property safety). For property safety a different level of protection is usually required than for life safety purposes alone, where the evacuation time for persons to reach safety is as short as possible.

Fire safety requirements imposed in connection with building regulations are limited to health and safety, e.g. The Building Regulations 1991 for England and Wales state that "Parts A to K and N of Schedule 1 shall not require anything to be done except for the purpose of securing reasonable standards of health and safety for persons in or about buildings (and any others who may be affected by buildings, or matters connected with buildings)". Even so, some life safety measures may also contribute to property protection.

Property protection includes the building and its contents, hence a higher level of fire resisting separation and greater compartmentation than recommended in this code may be required to minimize loss or damage. As well as passive protection (see Section 3, Section 4 and Section 5), active protection (see Section 7) should be considered. The level of active protection required will depend upon the nature and quantity of the contents and may contribute to life safety protection. Both passive and active protection will assist firefighters. For these reasons it is strongly recommended that the insurers be consulted at the design stage.

4.5 Diagrams

The figures in this code are intended to clarify concepts, and should not be taken as indicating the only acceptable forms of planning. Features not relevant to the concepts or principle(s) being illustrated are not shown.

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Section 2. Analysis of the problem

5 Planning in relation to fire

5.1 Spread of fire

A common basis of designing means of escape from fire 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 the routes smoke and hot gases might take through the building and how these may affect the process of evacuation.

Fires do not normally start in two different places in a building (unless arson is involved). Initially, a fire will create a hazard only in the part in which it starts and is unlikely to involve a large area. Subsequently, it may spread to other parts, usually along circulation routes.

In buildings designed, maintained and supervised in accordance with this code, the risk of fire starting in passages, corridors, lobbies or stairways intended for use only for access or means of escape may be regarded as low as long as they are kept clear of combustibles, and convenient protected storage space is provided so that circulation spaces are not used for storage purposes. It is also unlikely that fire will originate in the structure itself. Outbreak of fire is more likely to occur in furnishings, decorations, finished goods, raw materials and/or chemicals, equipment, process plant or service plant in the building, and the point of origin is therefore likely to be in display areas, factory areas, store rooms/areas, kitchens or offices, or possibly in the service installations.

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

Once ignited, combustible products give off hot smoke-laden and toxic gases. Deflection and radiation also occur rapidly and, because of the extremely high temperature of the gases, other combustible materials and products within the area of the fire will ignite more easily, further accelerating the progress of the fire.

It cannot be assumed that the effects of the fire will be confined to the space in which it originated. If the enclosing walls have no fire resistance or do not form a fire-tight joint with a fire resisting floor (or ceiling) above, the fire will soon penetrate at ceiling level, where the attack from the flames or hot gases is most severe, to the adjoining space. Even with fire resisting construction, the buoyancy and expansion of the fire gases can cause them to be driven out of the space to affect other parts of the building.

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

A fire occurring anywhere within a compartment of a building has, therefore, to be regarded as presenting a hazard to all occupants within that compartment, even though in the initial stages of fire development it might seem that persons are well removed from immediate danger. It should also be realized that there may also be a risk to persons in other parts of the building.

5.2 Smoke

In the early stages of a fire, the most important effects will usually be those of smoke and other products of combustion. Often smoke will be the first evidence of fire detectable by the occupants and is thus likely to be the first cause of alarm. When first present, smoke tends (in the absence of any strong air currents) to collect at ceiling level, filling the space from the top downwards. When it extends down to head height it will produce difficulty in breathing and impair visibility, which will interfere with the efforts of occupants to find their way towards the exits. The extremely hot, smoke-laden and toxic gases will add considerably to their difficulties. People who are prevented from escaping by dense smoke, or who are unduly retarded from escaping by it, may suffer from the toxic effects of the products of combustion that accompany the smoke, the asphyxiant effect caused by lack of oxygen or by the intense heat of the gases making up the smoke. Intoxication, disorientation, incapacity, unconsciousness and possibly death may result.

These considerations are particularly important when dealing with large numbers of persons, some of whom may be unfamiliar with their surroundings, and who may also vary widely in age and degree of mobility.

To facilitate escape it is necessary:

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

b) to regulate the distance people have to travel before they reach a storey exit or final exit.

A means of smoke ventilation may be necessary to assist the fire service and, if operated automatically, would also assist escape from the building.

After the outbreak of fire, there may be only a short time during which the actions necessary for ensuring the safety of occupants can be carried out. This time will be sufficient only if all contributing factors, e.g. the design of the building, the materials at risk, the co-operation of the staff, and the functioning of equipment, are planned and managed so as to be effective when the occasion arises.

5.3 Site planning

Siting of a building may be dictated by restrictions imposed by urban development. These restrictions may produce conditions potentially dangerous from the point of view of fire spread from a building on fire to another exposed to its effects.

At the planning stage, the building control authority should be consulted regarding such matters as access to buildings by fire appliances and the effects of car parking adjoining the building.

A further site planning consideration is the safety of escape routes outside the building, and outside neighbouring buildings, from the effects of fire in the building concerned.

Consultation with the water supply company is necessary regarding the adequacy of water supplies for firefighting.

5.4 Mixed user developments

The principles and recommendations of this code will apply straightforwardly where premises have a single main use and are contained in a single, separate building. However, complications may 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.

It is therefore important to consider whether completely separate routes of escape should be provided from each different use within the building or whether other effective means to protect common escape routes can be provided.

In reaching a conclusion, the following factors need to be considered in addition to items a) and b) of **5.2**:

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 management and control of the building or development, from a fire safety point of view.

The recommendations of the relevant Part of BS 5588, or the provisions of legislation, appropriate to each use are applicable to the whole of any escape route which passes through a different use, right up to the final exit. Where different levels of protection could apply, the higher level of protection should be provided.

NOTE Attention is drawn to the fact that different uses might be covered by different legislation.

5.5 Premises in different occupation

See BS 5588-12.

5.6 Internal subdivision

5.6.1 *General*

The manner in which a building is subdivided internally will affect the risk to users and their ability to use the means of escape arrangements in case of fire. The various forms of subdivision and their effects on users are considered in **5.6.2**, **5.6.3**, **5.6.4** and **5.6.5**. For atrium buildings see BS 5588-7.

5.6.2 *Compartments*

The internal subdivision of a building into fire compartments influences the escape arrangements, particularly as regards evacuation procedures and the number of stairs and exits. This is because only the occupants and contents within a fire compartment have to be regarded as being initially at risk from a fire occurring anywhere within that compartment.

NOTE This assumption cannot be made where openings in compartment floors and in compartment walls are protected by steel fire shutters held open by fusible links. Evacuation procedures may be based on individual compartments if openings are fitted with self-closing fire resisting doors.

In an uncompartmented building all the occupants and contents of the building have to be considered at risk in the event of fire.

5.6.3 *Cellular planning*

Cellular planning is the subdivision of all or part of office floor areas into separate rooms with access corridors.

5.6.4 *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. In this case many of the occupants of one storey may be aware of smoke from a fire at the outset and this will give the advantage of early warning. Nevertheless, the rapid spread of fire and smoke by some modern materials in the early stages of a fire can produce very hazardous conditions.

5.6.5 *Open spatial (vertical) planning*

In open spatial planning several storeys are contained in one uncompartmented volume such that smoke and heat will travel readily throughout all levels. This form arises (for example) by the adoption of one or more of the following planning arrangements:

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.

5.7 Ancillary accommodation and high fire risk areas

Section 3 and Section 4 contain principles and recommendations for the planning and construction of those parts of the building devoted to the main use of the building and that are likely to be occupied by the staff and any members of the public. Other parts, ancillary to the main use of the building, are referred to in this code as ancillary accommodation, and are covered in Section 5.

Where highly flammable or explosive substances are stored or used in excess of prescribed amounts, the area is considered to be of high fire risk. Special requirements for such areas may be imposed under the Health and Safety at Work etc. Act 1974 [5] by the relevant enforcing authority, and by the fire authority under the Fire Precautions Act 1971 [6]. Early consultation with the relevant authorities is therefore recommended when the storage and use of such substances is proposed; as is the provision of a brief as to the intended use of the premises and the materials to be stored or used, since this may overcome the need for costly and additional fire safety measures being required after the premises are occupied.

6 Escape from fire

6.1 General

In an emergency there have to be sufficient exit facilities to allow all the occupants to reach an area of relative safety without delay. The place of safety is beyond the final exit but it may not always be practicable to evacuate the whole of the building immediately upon the incidence of fire in any part. Nevertheless, it is essential that the occupants are able to reach, without undue delay, areas of relative safety, e.g. protected routes and stairways within the building that lead ultimately to the open air.

The assumption need not be made that the whole building necessarily has to be evacuated in a fire emergency. If measures are taken in large premises, it may be practical and suitable to evacuate in stages. Where compartments are separated in such a manner as to prevent the spread of smoke in the early stages of a fire, or there is a system controlling the movement of smoke, the occupants may remain in a fire compartment not affected by the fire, provided that they are still free to leave the building by protected escape routes. Evacuation procedure is dealt with in BS 5588-12.

NOTE Capacities of exits have been based on the assumption that a unit width of 500 mm permits a flow of 40 persons per minute. The time taken to travel to a protected escape route is controlled implicitly through the recommendations limiting exit capacity and travel distance (see Clause **8**). These figures are based on the Post-War Building Studies No 29 [7].

6.2 Motivation to escape

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 any immediate 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. To overcome these problems it is necessary to provide a package of related fire precautions measures, complementary staff training and evacuation management procedures, and to introduce appropriate means of escape criteria, aimed at achieving an acceptable level of means of escape conditions in these areas. These aspects are dealt with in Section 3, Section 4, Section 5, Section 7 and BS 5588-12.

6.3 People with disabilities

Building regulations include requirements for access (and facilities) for disabled persons. BS 5810 gives guidance on access for people with disabilities, whilst BS 5588-8 gives guidance on the provision of means of escape for persons with disabilities, with particular emphasis on the need for effective management of the evacuation.

6.4 Avoidance of manipulative apparatus for means of escape

Reliance for fire safety on manipulative apparatus for means of escape, or on external rescue from the lower storeys of a building by the fire service using mobile ladders, is not normally satisfactory. This code provides for the occupants on any storey of a building being able to escape safely from the building without outside assistance, should a fire occur.

6.5 Distances of travel

Some of the recommendations in this code include limitations on the distance of travel between two points. Although it could not be said that a slightly greater distance would be so unsafe that it should under no circumstances be adopted, designers should aim to keep travel distances as short as possible, rather than designing to the maximum distance recommended.

Section 3. Planning of escape

7 General

Planning of means of escape involves consideration of a number of interrelated elements. These elements will include the limitation of travel distance which will determine the position of exits, whilst the number of persons to be evacuated will determine the size and number of exits and escape routes required.

For example, although maximum distances of travel (see **8.1**) may have a major influence on the number of escape routes and stairs required and their disposition, the geometry of the building (see **9.3**) and the number of persons to be evacuated (see **8.5** and **9.4**) will also have a bearing on the size and disposition of the stairs. Although these factors may in some circumstances suggest that a single stair may suffice, the height and size of the building may nevertheless necessitate the provision of more than one stair (see **9.3**) or stairs for firefighting purposes (see **40.4**).

Clause **8** deals with horizontal escape along a suitable escape route to a storey exit. The recommendations are mainly concerned with providing more than one escape route (except in severely restricted circumstances), limiting the distance to be travelled, and ensuring that the routes are wide enough.

Clause **9** deals with vertical travel down or up a stair towards a final exit. The recommendations are mainly concerned with the provision of a sufficient number of protected stairways of appropriate width.

Clause **10** deals with small premises having floor areas so small as to render onerous the application of all of the recommendations for larger premises.

Clause **11** deals with means of escape from "special premises" as defined in the Fire Certificates (Special Premises) Regulations 1976 [1], where the recommendations of Clause **8** and Clause **9** are not appropriate.

Clause **12** deals with the problems of wayfinding and spatial orientation. In that context it is desirable to avoid confusing spatial layouts in the initial design, as these can lead to wayfinding difficulties.

When designing the means of escape from any building in the event of fire, a full appreciation of the probable behaviour of fire is necessary. The overall design for a building needs, therefore, to be carefully assessed section by section to determine the danger that might arise either from a fire in that location or from a fire elsewhere in the building.

The primary danger associated with fire in its early stages is not flame, but the smoke and noxious gases produced by the fire. Measures designed to provide safe means of escape should include provisions to limit the spread of smoke and gases.

The basic criteria which have been adopted in determining the design for the means of escape are as follows.

a) Generally there should be alternative means of escape.

b) Every part of the building should be within a reasonable distance from either:

1) an exit to a place of safety at ground or access level; or

2) an exit to a protected stairway which leads to a place of safety

The following facilities are not acceptable for use as means of escape in case of fire:

i) lifts (except suitably designed and installed firefighting lifts or evacuation lifts for the use of disabled persons, see **26.5**);

ii) passenger conveyors and escalators (but see **26.5.2**);

iii) portable ladders, throw-out ladders and self-rescue apparatus.

Means of escape from ancillary accommodation is dealt with in Clause **15**.

8 Escape routes within, and exits from, a storey

NOTE 1 Crèches are covered in **8.11**.

NOTE 2 The provision of escape routes in weather housed plant, weather protected plant and external plant is covered in **11.3**.

8.1 Distances of travel

8.1.1 *Commentary*

*For the purpose of determining the means of escape in a building, travel distances (see **3.40**) are used. However, for the purposes of design direct distances (see **3.11**) are normally adopted (see Figure 2, Figure 3, Figure 4 and Figure 5). In this case, before any floor space is subdivided, furnished or fitted out, or positions of plant or equipment finalized, the resultant travel distances need to be checked so that in use they will not exceed the recommended maximum travel distances. If, at the design stage it is possible to establish what the travel distance will be in a particular case, the direct distance measurements are not relevant.*

Where the occupants have no choice but to make their way along a single escape route, the travel distance needs to be more restricted than if escape is possible in more than one direction.

In some buildings travel distances are given according to whether the premises (or part of the premises) is considered to be of low, normal or high hazard. Examples of the different types of hazard are as follows.

a) *Normal hazard. Where any outbreak of fire is likely to remain localized or is likely to spread only slowly, and where there is little hazard of any part of the building structure igniting readily.*

b) *Low hazard. Where there are very few flammable and no explosive materials present and where the hazard of fire breaking out and smoke or fumes spreading rapidly is minimal.*

c) *High hazard. Where there are:*

1) *materials stored or handled in such quantities or dispositions that they would be likely, if ignited, to cause the rapid spread of fire, smoke or fumes. For example, processes handling large quantities of highly flammable liquids, gases and solids, such as polyurethane foam;*

2) *unusual circumstances relating to the occupants; or*

3) *certain areas which, due to their function, may present a greater risk of fires occurring and developing than elsewhere.*

Further information on assessment of risk is given in Fire Precautions Act 1971. Guide to fire precautions in existing places of work that require a fire certificate. Factories, offices, shops and railway premises [8]. *The choice of hazard category will have to satisfy the appropriate authority. This is particularly important if a fire certificate is required. Information on the classification of fire hazard, with particular reference to Special Premises (see **3.38**) is also given in the Health and Safety Executive booklets* Guide to general fire precautions at premises subject to the Fire Certificates (Special Premises) Regulations 1976 [9] *and* Assessment of fire hazards from solid materials and the precautions required for their safe storage and use guide HS(G)64 [10].

If it is desired to use travel distances greater than those given in Table 1, it is necessary to show that the occupants will still be able to escape long before they are likely to be exposed to smoke or other fire danger (see DD 240 which deals with the use of fire safety engineering in buildings).

8.1.2 *Recommendations*

The following recommendations are applicable.

a) The escape routes from any storey should be of such a number and so situated that the travel distance from any point to the nearest storey exit does not exceed the appropriate limits set out in Table 1.

NOTE The distance to an alternative exit may exceed that given in Table 1.

b) If travel is initially in one direction only, then:

1) the total travel distance to the nearest storey exit (including that part in one direction only) should not exceed the appropriate limit given in column (2) of Table 1; and

2) either:

i) the travel distance to the point at which travel is possible in more than one direction should not exceed the appropriate limit given in column (1) of Table 1; or

ii) in a dead end in part of a storey served by two or more storey exits the angle subtended by the storey exits at the point at which the escape routes diverge should be not less than 45° plus 2.5° for every metre travelled in one direction up to the point at which the escape routes diverge (see Figure 4).

c) For travel to be considered to be in more than one direction, either:

1) the routes should be not less than 45° apart; or

2) the routes should be separated from each other by fire resisting construction (see Figure 5).

Table 1 — Maximum distances of travel in a storey

Accommodation	Maximum travel distance m		Maximum direct distance m	
	Escape in one direction only (1)	Escape in more than one direction (2)	Escape in one direction only (3)	Escape in more than one direction (4)
1. *Industrial, storage buildings and laboratories*				
a) low hazard[a]	45	60	30	40
b) normal hazard[a]	25	45	16	30
c) high hazard[a]	12	25	8	16
2. *All other buildings*	18	45	12	30

NOTE 1 See Table 6 for maximum distances of travel in small premises, Table 7 for weather housed and protected plant and external plant, and Table 10 for ancillary accommodation.

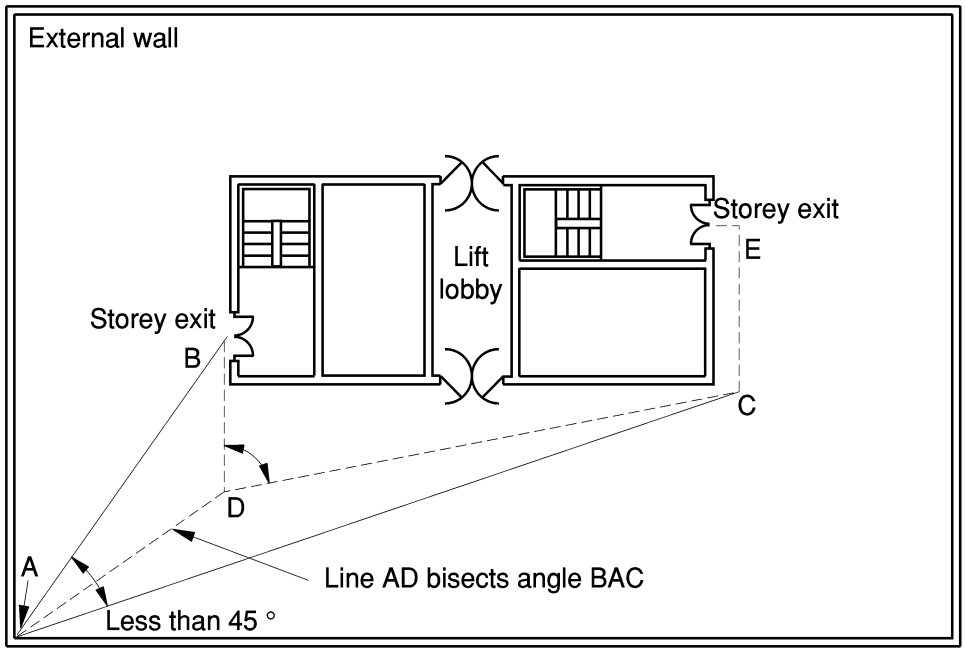
NOTE 2 Direct distances are for design purposes only. The limitations on travel distance need to be met when the floor space is subdivided or furnished.

NOTE 3 The grading of direct distances of travel in relation to categories of hazard could lead to future problems if an optimistic approach is adopted on a speculative development.

NOTE 4 With the discretion of the enforcing authority, variation of the travel distance may be permitted if additional fire protection facilities are provided (see Section **7**).

NOTE 5 For atrium buildings see BS 5588-7.

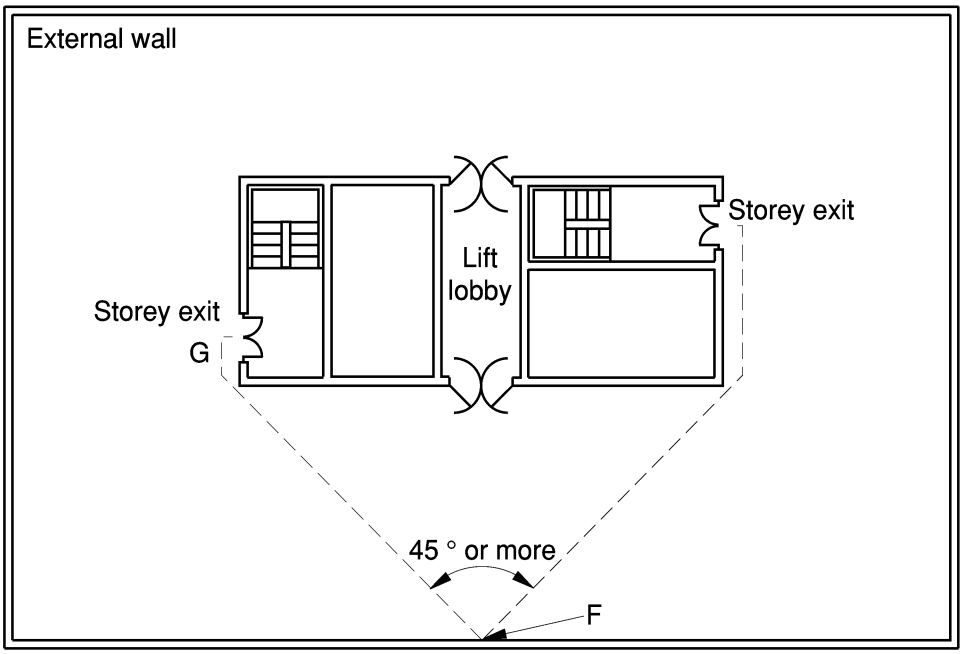
[a] Examples of different types of hazards are given in **8.1.1**.



– – – – – – Indicates direct distance

a) Dead end

NOTE A is a dead end because angle CAB is less than 45° and there is no fire resisting construction between BA and CA. If angle CDB is greater than 45° (+ 2.5° or every metre travelled from A to D) then the dead end may be assumed to be served by two storey exits. The shorter of ADB and ADCE should not exceed the figure in column 4 of Table 1.

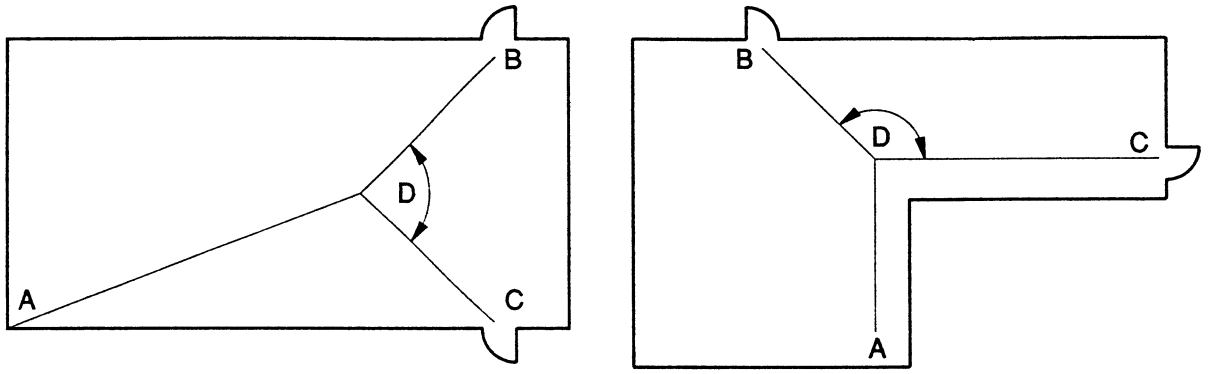


– – – – – – – – Indicates direct distance

b) Escape in two directions

NOTE Direct distance FG is in accordance with Table 1 column 4.

Figure 3 — Direct distance: central core with open storey planning



NOTE Travel from A to D is along the line equidistant from both exits

Figure 4 — Dead ends

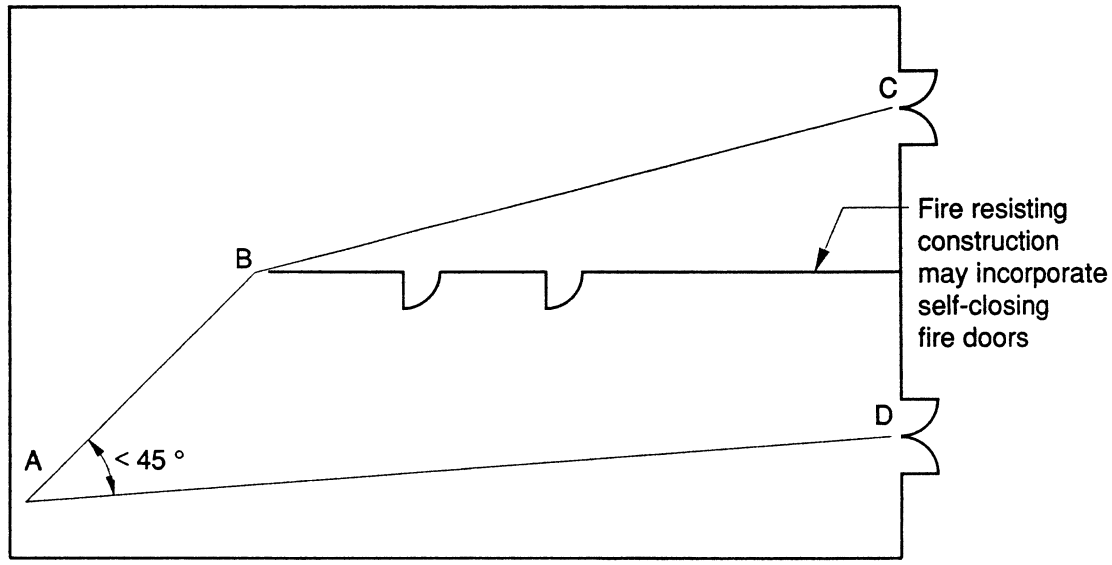


Figure 5 — Escape routes less than 45° apart separated by fire resisting construction

8.2 Number of escape routes from a storey

8.2.1 *Commentary*

*Escape routes from each storey (or level) ought to be so sited that a person confronted by fire can turn away and make a safe escape through an alternative exit. To achieve this, two exits therefore need to be accessible in substantially different directions in order to avoid both becoming inaccessible at the same time from one fire. If the two directions diverge by less than 45° and are not separated by fire resisting construction they are considered to provide escape in one direction only (see Figure 3, Figure 4, Figure 5 and Figure 6). A situation in which this occurs is a dead end (see **3.9**).*

In certain circumstances, one of the two escape routes from a storey may be by way of an opening into an adjoining compartment. This compartment may be provided to meet the requirements of building regulations or it may be provided solely for means of escape purposes. The circumstances under which this may be considered to be a safe arrangement are that:

a) *the building is in one occupancy;*

b) *the compartment to which persons can make their escape is separated from the fire affected area in such a way that persons escaping to it are no longer in immediate danger from fire;*

c) *the compartment is capable of accommodating the number of persons likely to evacuate to it; and*

d) *the compartment is provided with at least one storey exit of sufficient capacity to cater for the number of persons escaping to it.*

*If a fire occurs in a small storey it will have developed to such a small extent by the time the occupants become aware of it that they will normally be safe even if there is a single exit door as long as the storey contains no special fire risk, the number of people is not excessive and the storey so small (and therefore the travel distance so short) that the evolution of heat and smoke from the fire will not prevent them reaching the exit. Therefore a single exit is acceptable where the travel distance from all parts of the storey does not exceed the limits for dead ends (e.g. small shops, see Clause **10**). Escape in one direction is also acceptable from parts of a storey (see Figure 3 and Figure 4).*

*Although generally undesirable, there are instances when ancillary accommodation may need to be used as part of an escape route for the public. Recommendations for escape from ancillary accommodation are given in Clause **15**.*

*Mezzanines are covered in **8.4**.*

8.2.2 *Recommendations*

The following recommendations are applicable.

a) At least two escape routes should be provided from every storey or floor level (except any storey within the limits for escape in one direction only given in Table 1). These escape routes should provide travel in different directions and should give direct access to a storey exit.

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

1) the building is in one occupancy;

2) the adjoining compartment is separated from the fire affected area by walls of fire resisting construction with the openings therein fitted with self closing doors;

3) the adjoining compartment is of sufficient size to accommodate both its own occupants and those exiting to it from the fire affected area; and

4) 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 occupants in the adjoining compartment and the number of persons escaping to it.

c) Where unavoidable, an escape route for the public may be via an area of ancillary accommodation, other than an area of high 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 guard-rails.

d) Where a storey in a shop includes a restaurant area, or is divided into separate floor areas, each area [except inner rooms in accordance with **8.3.2**b)] should be provided with not less than two escape routes, one of which should lead directly to a storey exit without entering any area of high risk.

8.3 Number of escape routes from a room

8.3.1 *Commentary*

*The basic concept of providing alternative means of escape (outlined in **8.2.1**) also applies to rooms. However, the number of exits from rooms needs to be considered separately as, although a storey may require two or more exits, it may be reasonable for each of the individual rooms within that storey to be served by a single exit.*

*If the only escape route from a room (i.e. an "inner room", see **3.24**) is by way of another room (i.e. an "access room", see **3.1**), an outbreak of fire in the access room may not immediately come to the notice of the occupants of the inner room and their escape may therefore be jeopardized. Because of this risk, various safeguards are necessary where there is an inner room, and these safeguards include the provision of early warning in the event of an outbreak of fire in the access room.*

In parts of premises considered to be high fire hazard, it is necessary to impose limitations on the number of persons permitted.

8.3.2 *Recommendations*

Not fewer than two exits should be provided from every room, except in the case of:

a) a room which is not likely to be used by more than 50 persons and the portion of the travel distance within the room does not exceed the appropriate limit given in column (1) of Table 1 (see Figure 6); or

b) an inner room which is not likely to be used by more than 50 persons and the portion of the travel distance within the room does not exceed the appropriate limit given in column (1) of Table 1 (see Figure 6); and where

1) the escape routes are arranged to pass through not more than one access room, and the travel distance, including the portion through the access room, does not exceed the appropriate limit given in Table 1; and

2) the access room is not an area of high hazard (see **8.1.1**) and is in the control of the same occupier; and

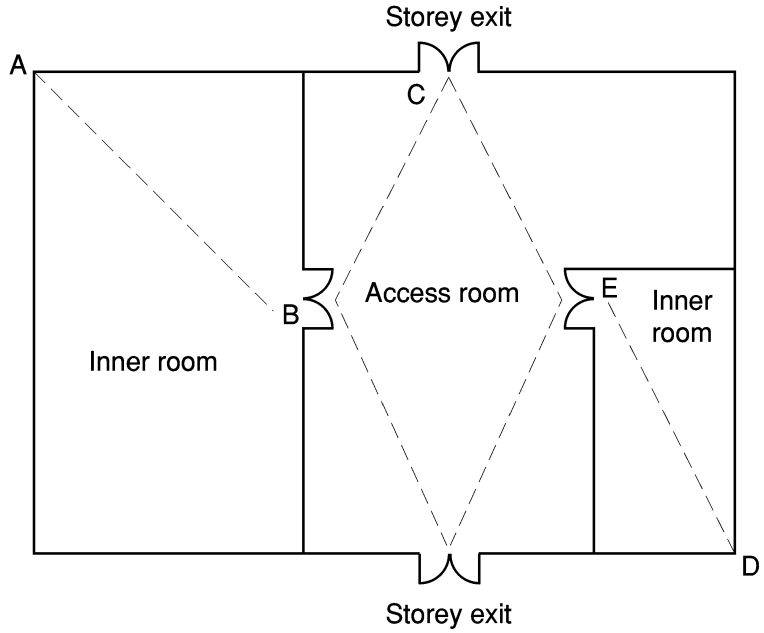
3) except in the case of a fitting room in a shop and a photograph processing room, at least one of the following provisions is made:

i) the enclosure between the inner room and access room is constructed to maintain a gap of at least 500 mm between the top of the wall and the ceiling; or

ii) a suitably sized and located vision panel is provided between the two rooms; or

iii) the access room is protected by an automatic smoke detector that operates an alarm which is audible in the inner room, to a sound pressure level in accordance with the minimum specified in BS 5839-1:1988. Alternatively, where noise levels are so great as to make an alarm inaudible, a visual indication in the inner room would be acceptable.

NOTE The vision panel in item ii) should have an area not less than 0.1 m^2, and the bottom of the panel should be located not less than 900 mm or more than 1 500 mm above the floor level.



AB and DE are distances in accordance with column 1 of Table 1
ABC and DEC are distances in accordance with column 2 of Table 1

Figure 6 — Travel distances from within rooms

8.4 Escape from mezzanines and galleries

8.4.1 *Commentary*

*Many buildings utilize mezzanines 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 with a solid floor (as in some DIY outlets) there is always the risk that fire growth may be very rapid, resulting in flames spreading beyond the edge of the mezzanine floor and hence posing a grave threat to life safety, particularly when the occupants of the building are members of the public. Although as a general principle the considerations outlined in **8.1**, **8.2** and **8.3** apply to the planning of means of escape from mezzanines, additional safeguards may be necessary to compensate for the increased level of hazard if a fire occurs below the mezzanine.*

8.4.2 *Recommendations*

The following recommendations apply.

a) At least two escape routes should be provided from a mezzanine which is regularly occupied or accessible to members of the public, one of which should be via a protected stairway. The travel distance from any point on the mezzanine to the nearest storey exit should be in accordance with Table 1. [See Figure 7a).]

b) If combustible goods are stored or displayed under a mezzanine with a solid floor, the travel distance from any point on the mezzanine to the nearest storey exit, should be limited to that given in Table 1 for escape in one direction only unless a smoke detection system is installed on the underside of the floor which is linked to a fire alarm system or gives an audible warning of fire to the occupants of the mezzanine.

c) The travel distance from any point on a mezzanine which is only used for storage or access (for servicing or maintenance purposes) to the nearest storey exit on the storey below the mezzanine should be in accordance with Table 1. [See Figure 7b).]

8.5 Width of exits and escape routes

8.5.1 *Commentary*

Every exit needs to be wide enough to enable the quick passage of all the occupants who may need to use it. For corridors, etc., the width needs to be not less than the required door width to the stairway or the width of the final exit as appropriate.

Except where a single exit is acceptable, it needs to be assumed that one of the exits may become obstructed by the fire. Therefore, where two exits are provided, each needs to be capable of letting all the occupants pass. Where three or more exits are provided, each exit in turn needs to be discounted in assessing the widths of the others.

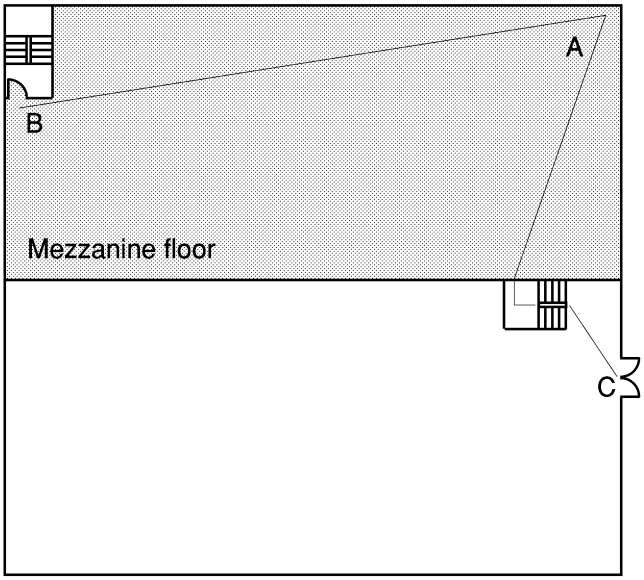
The number of occupants for whom provision has to be made may be known for certain areas, otherwise the numbers may be calculated from the floor space per person given in Table 2. In that case the number of occupants of a room or storey can be estimated from the following expression:

$$number\ of\ occupants = \frac{area\ of\ room\ or\ storey\ (in\ square\ metres)}{floor\ space\ per\ person\ (in\ square\ metres)}$$

NOTE The list given in Table 2 is not exhaustive, and when the number of occupants is not known, and the use is not given in Table 2, the occupancy factor for a use with a similar density should be used.

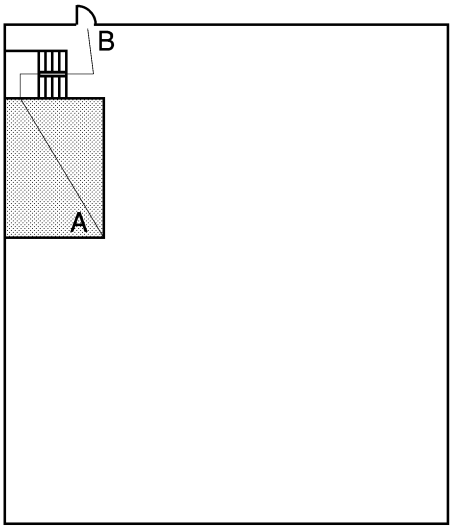
Whatever method is used for assessing the number of persons using a room or storey, the appropriate authority will need to be satisfied that appropriate exits and widths of exits are provided for the number of persons actually using the premises when occupied. This is particularly important if a fire certificate is required.

The number of occupants of a building is the sum of the numbers of occupants of the storeys in the building.

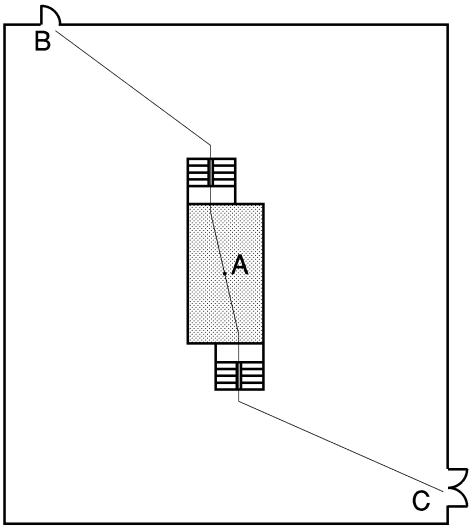


Travel distances AB, AC within overall limits given in Table 1 for escape in more than one direction

a) Occupied mezzanine



Travel distance AB within limits given in Table 1 for escape in one direction



Travel distances AB, AC within overall limits given in Table 1 or escape in more than one direction

b) Mezzanines used for storage or access

Figure 7 — Escape from mezzanines

Table 2 — Suggested floor space factors[a]

Description of room or storey	Floor space per person, excluding stair enclosures, lifts and sanitary accommodation m^2
Retail premises where the occupancy is known and the floor space factor can be ascertained by reference to similar premises	2.0 to 10.0[b]
Retail premises where the occupancy is not known or the floor space factor cannot be ascertained by reference to similar premises	4.0
Public restaurants and lounges	1.0[c]
Bars	0.3[c]
Staff coffee lounge, committee room, conference room, dining room, meeting room, restaurant, common room, lounge, reading room, staffroom, waiting room	1.0[c]
Open plan offices, factory production areas, workshops	5.0
Library and other offices, kitchens	7.0
Warehouse and storage accommodation	30.0
Car park	2 persons per parking space

[a] These floor space factors are for guidance only and should not be taken as the only acceptable densities.
[b] The floor space factor for each room or storey should be determined by reference to actual data taken from similar premises. The data should reflect the average occupant density at a peak trading time of year.
[c] For seated areas, the number of seats provided may be used.

8.5.2 *Recommendations*

The following recommendations are applicable.

a) The capacities of exits or escape routes within a storey should be calculated in accordance with Table 3. The capacity or aggregate capacity of exits and escape routes should be not less than the number of occupants of the storey. If two or more exits or escape routes are required, the capacity or aggregate capacity should be not less than the number of occupants of the storey when the capacity of each exit or escape route is discounted in turn.

NOTE The total number of persons which two or more available exits can accommodate is found by adding the maximum number of persons for each exit width. For example 3 exits each 900 mm wide will accommodate 3 × 110 = 330 persons (not the 540 persons accommodated by a single exit 2 700 m wide).

b) If a storey exit (or final exit) in a shop is approached through a check-out point (e.g. in a supermarket) each check-out passage should be not less than 500 mm in clear width and the combined width of the check-out passageways should be not less than twice the required width of the storey exit, unless further exits with a width not less than that of the storey exit, and independent of the check-out points, are provided.

c) No escape route should have a clear headroom of less than 2 m (except doorways and other exits which should have a clear headroom of not less than 1.96 m) and there should be no projection from any wall (except normal handrails) or from the ceilings (including suspended ceilings) below this height which would impede the free flow of persons using the escape route.

Table 3 — Capacities of escape routes within a storey and of any exit leading therefrom

Maximum number of persons	Width mm
50	800[a]
110	900
220	1 100
240	1 200
260	1 300
280	1 400
300	1 500
320	1 600
340	1 700
360	1 800[b]

[a] A width of 600 mm is permissible for any escape route that is not a protected corridor or part of an external escape route, in:

a) process plant buildings and other locations where the primary purpose of the passageways and walkways is to provide access to and from plant and equipment; and

b) any other location which is not an area of high fire hazard;

providing it is demonstrable that the persons in these locations need to be fully ambulant to carry out the tasks expected of them, that the maximum number of people expected to use the route does not exceed 10 and they are not members of the public.

[b] Other values of width for a maximum number of persons greater than 360 may be obtained by extrapolation.

8.6 Corridors

8.6.1 *Commentary*

Where a corridor provides escape in one direction only, i.e. from a dead end, it is necessary for its construction to enable occupants to pass safely a fire in any adjacent room and reach an exit or protected stairway.

To prevent a corridor that connects alternative exits becoming smoke logged along its length, it is necessary to divide that corridor. Similarly, communicating corridors need to be separated so as to restrict the movement of smoke.

*The separating doorset needs to be suitably positioned between the two exits it is to separate. If there are doors serving the same room on both sides of the separating doorset [see Figure 9a)] and the corridor is not a protected corridor (see **3.34**), then the doors to the room need to be self-closing.*

NOTE The location of the separating doorset in such corridors is not an arbitrary restriction on the length of undivided corridors, but reflects the need to maintain the integrity of the means of escape.

8.6.2 *Recommendations*

The following recommendations are applicable.

a) Corridor partitions should be carried up to the underside of the structural floor above, or to an imperforate suspended ceiling. All openings, other than to an enquiry or reception area, should be fitted with doors.

b) Dead end corridors and service corridors should be protected corridors.

c) Communicating corridors and dead end corridors should be separated as indicated in Figure 8, Figure 9a) and Figure 9b) and in Figure 9c), respectively. Corridors connecting alternative exits more than 12 m apart (measured along the centre line of the corridor) should be subdivided as indicated in Figure 9. Any doors to the accommodation that would allow smoke to bypass the separating door should be self closing.

NOTE 1 Dead end portions of corridors need not be separated from the remainder of the corridor by a fire door as shown in Figure 9c) if the protected stairways and corridors are protected with a smoke control system using pressure differentials that is in accordance with BS 5588-4.

NOTE 2 Recesses off corridors as shown in Figure 10 and extensions of corridors beyond protected stairways as shown in Figure 11 need not meet the recommendations of items b) and c) in respect of dead end situations unless:

a) the corridor otherwise should be a protected corridor; or

b) the accommodation served otherwise should be separated from other parts of the building by fire resisting construction.

8.7 Multi-occupied premises

8.7.1 *Commentary*

If a building is in multiple occupancy, people in one part of the premises may not be aware of an outbreak of fire in a different part of the premises, particularly if it is empty. It may be necessary in certain circumstances to provide fire resisting separation between different occupancies, to ensure that escape routes are planned to be independent of each other and to provide a suitable common alarm system, installed to provide warning throughout the premises of any outbreak of fire in any part of the premises.

8.7.2 *Recommendations*

The following recommendations are all applicable to all premises other than offices. For offices, recommendation a) and either recommendation b) or recommendation c) are applicable.

a) The means of escape from each occupancy should be independent of, and should not pass through, any other occupancy.

NOTE Any future subdivision of the storey may cause additional means of escape to be required.

b) Any common corridor between different occupancies should comprise a protected corridor.

c) A common automatic fire detection and alarm system that conforms as a minimum to Type L3 of BS 5839-1:1988 should be installed throughout the building.

8.8 Escape routes using service corridors, unloading areas and service roads

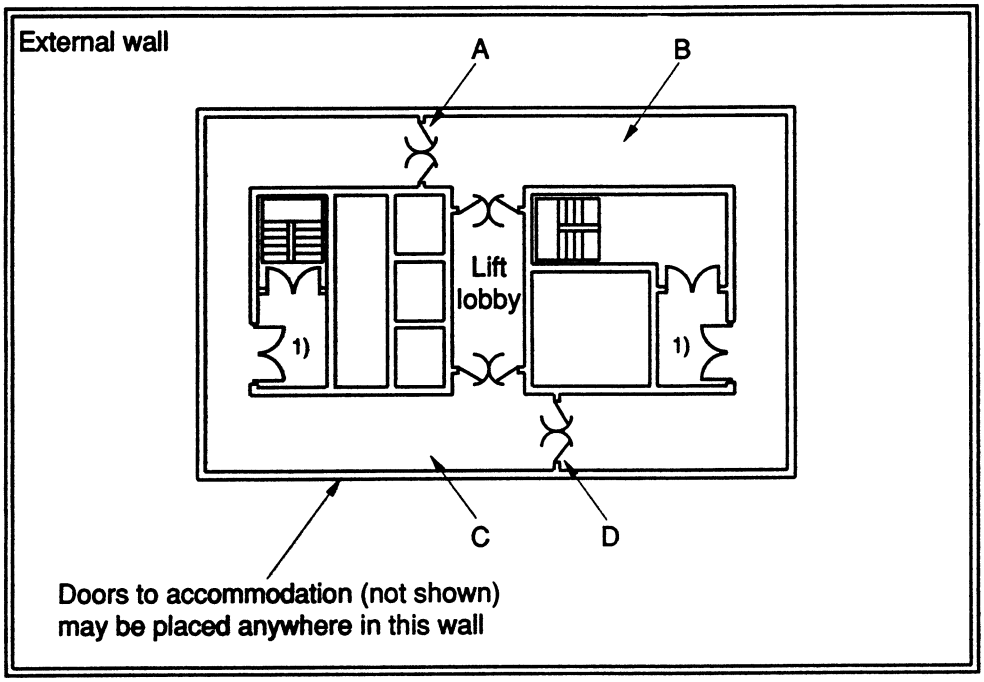
8.8.1 *Commentary*

Any necessary alternative means of escape should be planned so as to be independent of service corridors, unloading areas and internal service roads. However, in unusual cases it may be necessary owing to site restrictions to use such ancillary accommodation to provide alternative means of escape.

Service corridors may be used if restrictions are imposed regarding their use and measures incorporated to ensure their suitability and availability. For instance it may be necessary to allow an extra 1 m of width in an escape route for any goods that may be in transit.

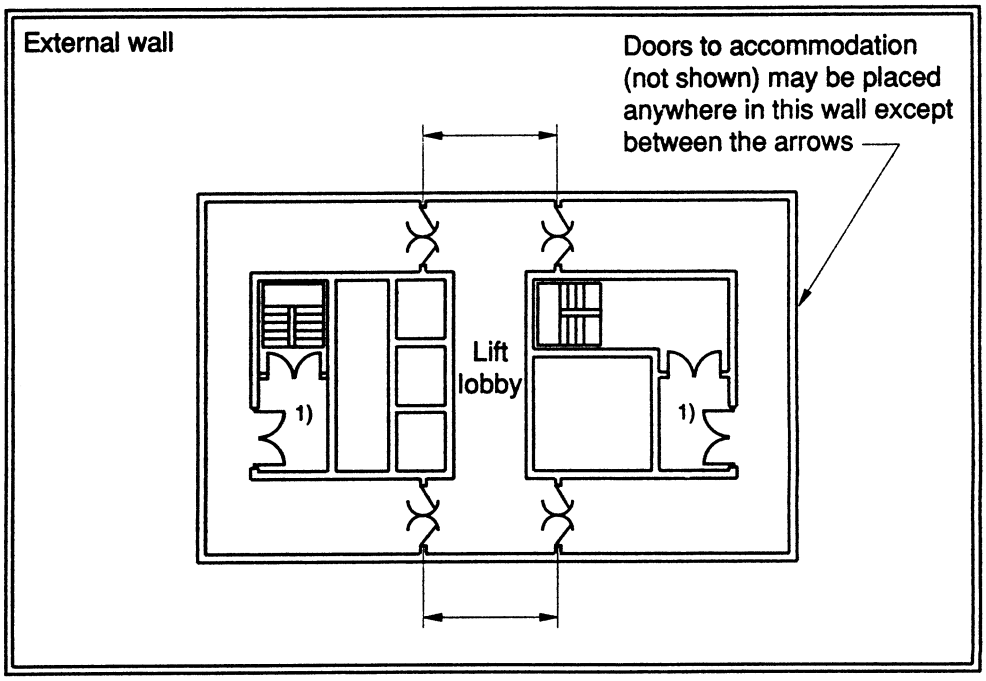
Similarly unloading areas and service roads may be used in exceptional circumstances provided that the escape routes remain unobstructed and available for use.

A service corridor, which is a corridor common to a number of fire separated occupancies, may be used as a common escape route.



Two doors may be at A and D, or at B and C, but not at A and C, or at B and D

a) Example 1

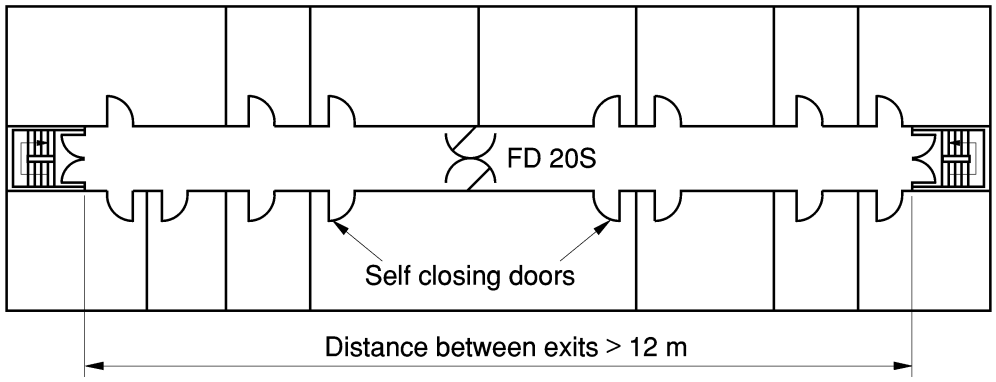


b) Example 2

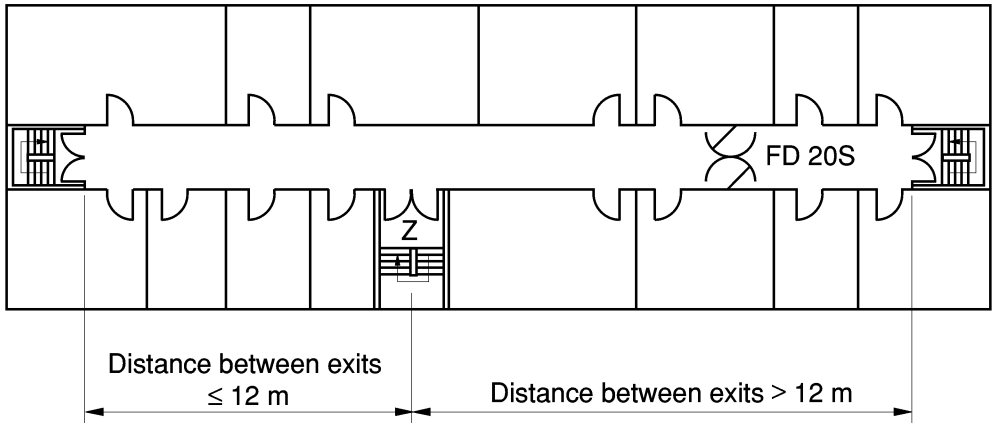
A corridor connecting both stairs should be divided both sides of the central core by doors arranged as indicated in a) or b).

[1] Stairs require lobby approach in buildings over 20 m in height.

Figure 8 — Corridor layouts: central core

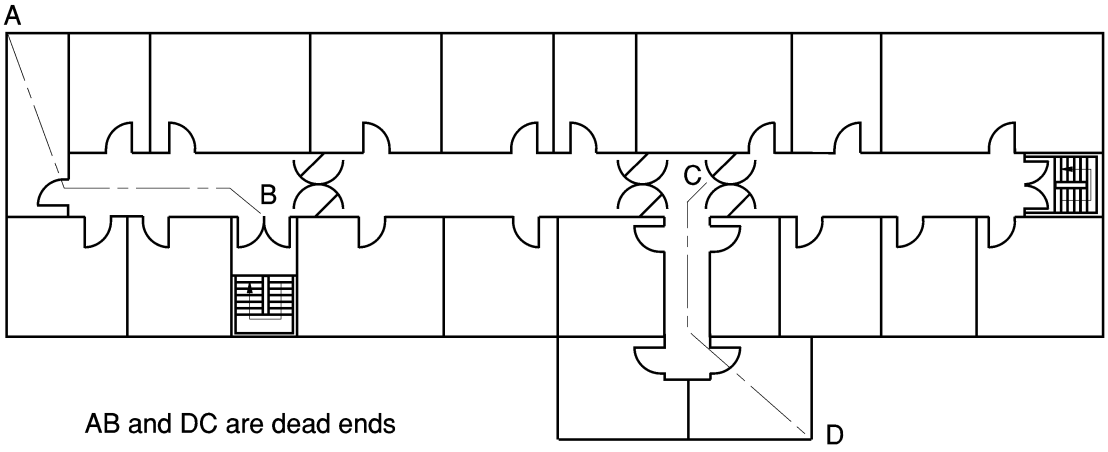


a) Corridors connecting two exits



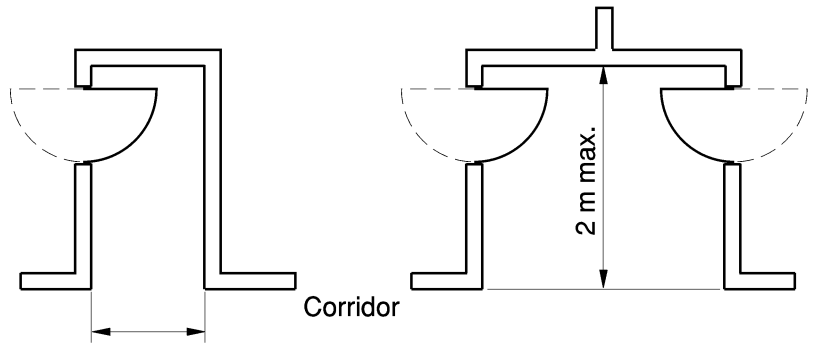
NOTE. Doors to central stair should be at position Z

b) Corridors connecting three exits

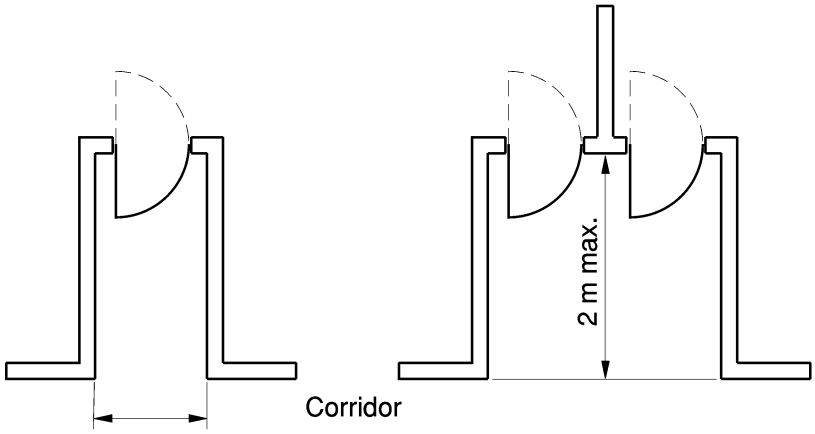


c) Dead end corridors

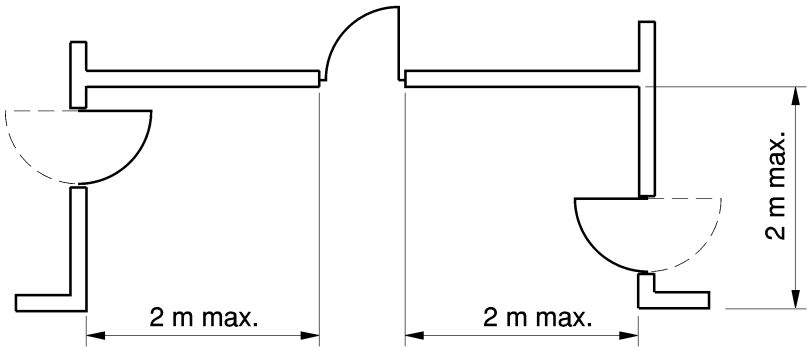
Figure 9 — Corridors connecting alternative exits



a)

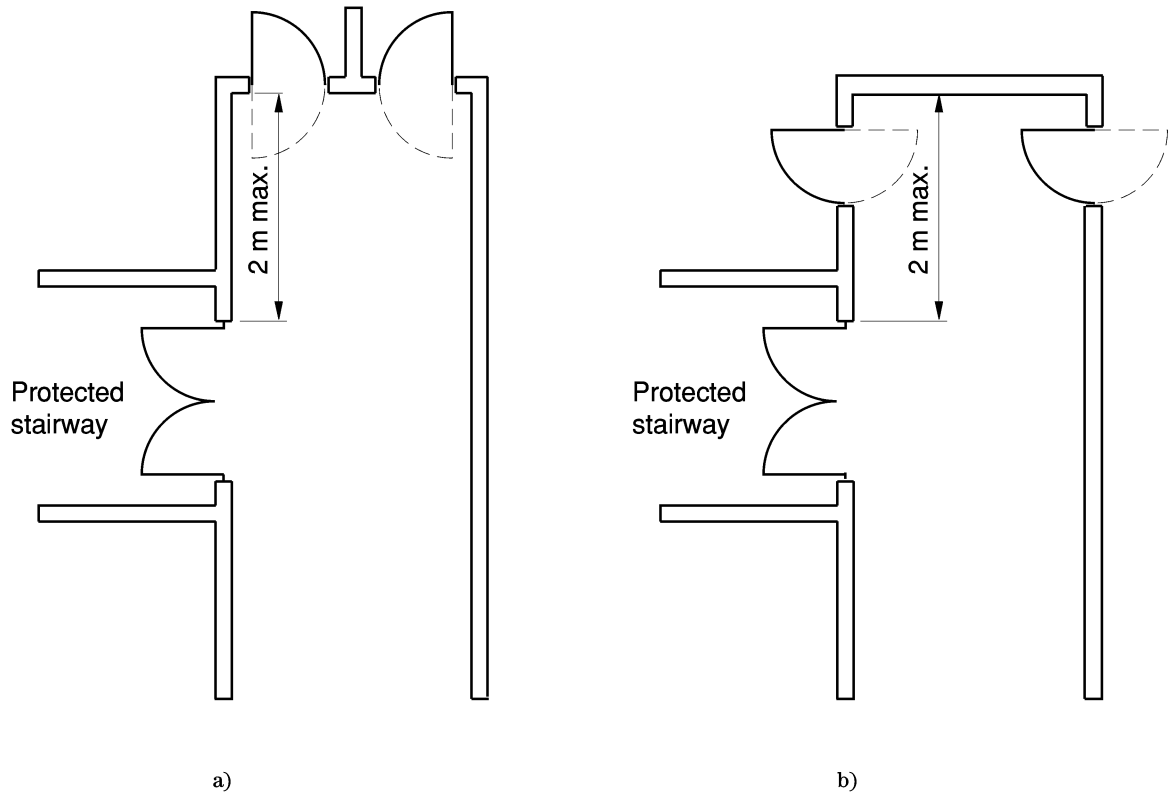


b)



c)

Figure 10 — Recesses off corridors



a) b)

Figure 11 — Extension of corridor beyond a protected stairway

8.8.2 *Recommendations*

The following recommendations are applicable.

a) Where any service corridor is to be used to provide alternative means of escape:

1) it should be a protected corridor;

2) any area served by the corridor should have not more than one exit onto the corridor;

3) the corridor should lead directly to a storey exit;

4) the corridor should be at least 2 m wide but not more than 3 m wide;

5) the corridor should be separated from any goods lift by a protected lobby.

b) To ensure that the corridor remains relatively free of smoke:

1) each unit should be separated from the corridor by a protected lobby arranged so that the doors do not obstruct the corridor; or

2) if the corridor links two or more storey exits, it should be subdivided with self closing fire doors in accordance with **8.6.2**c); or

3) a smoke control system giving an equivalent standard of protection to that afforded by items 1) and 2) should be provided.

NOTE Where a service corridor is in accordance with b) 1), b) 2) or b) 3), the exit into the service corridor may be considered as the storey exit from the unit provided that the maximum distance to an exit from the corridor from any unit is 45 m.

c) Any escape route that passes through a covered unloading area or internal service road should:

1) be in accordance with the recommendations in Section 5;

2) be clearly defined and guarded with protective barriers in accordance with BS 6180;

3) be continuous and of adequate width for the number of persons expected to use it but not less than 2 m wide.

8.9 Escape routes across a flat roof

8.9.1 *Commentary*

*Wherever possible, escape routes should not involve crossing a roof (particularly escape routes used by members of the public). This does not preclude, however, exits being by way of a high level walkway or podium which acts as a street. In other situations, the portion of the escape route between the final exit and street level may involve access across a roof at low level [see **9.8.1**c)].*

However, occasionally the planning of the building may be such that to satisfy travel distances (particularly those involving dead ends) it may be necessary to consider access on to an adjacent flat roof and thence to the head of a stair leading to a final exit. Escape routes over flat roofs may, of course, be necessary in the case of ancillary accommodation situated at roof level.

Measures need to be taken to prevent escape routes across a flat roof being made slippery by rain or ice or made dangerous by strong winds. These may be prevented by providing a roof and partially covering the sides, or by taking other measures to ensure that the escape route would not become dangerous in the presence of strong winds, snow or ice by providing, for example, handrails and trace heating. Protection is not required against rain. It is also necessary to ensure that the use of such a route at the time of a fire cannot be prejudiced by smoke and flames.

8.9.2 *Recommendations*

The following recommendations are applicable:

a) If more than one escape route is available from a storey, one of the escape routes from that storey may be by way of a flat roof provided that.

1) (except in the case of a building within the boundaries of a "special premises") the roof is part of the same building from which escape is being made;

2) the route across the roof:

i) leads to a storey exit;

ii) is defined and guarded with protective barriers in accordance with BS 6180;

3) such a part of the escape route and its supporting structure is constructed as a fire resisting floor.

b) Any door, roof light or window that is not fire resisting, and any ventilation inlet or outlet or other extract system, should not be sited within 3 m of such a route.

c) The escape route across a flat roof should be protected so that strong winds, snow or ice do not prevent use of the escape route.

d) The escape route across a flat roof should be available for use at all times.

NOTE The escape route should also be provided with both normal and escape lighting (see **26.3.2**).

8.10 Final exits

8.10.1 *Commentary*

All escape routes need to lead to a place of safety. However, consideration may be given to final exits discharging into arcades, courtyards and compounds providing this does not result in entering an area of high risk and provision is made to ensure that egress from such areas is not restricted.

NOTE Where premises form a unit in a shopping complex, reference should be made to BS 5588-10.

Any portion of the escape route that may lead (for example) across a concourse, a pedestrian walkway or a roof, needs to be clearly defined and protected where necessary.

8.10.2 *Recommendations*

The following recommendations are applicable.

a) Final exits should have a capacity not less than that of the escape routes they serve. If a final exit serves both the ground floor and a stair, the capacity of the exit and of the common part of the corridor between the stair and the final exit, should be increased accordingly.

b) A final exit from a shop may discharge through a display window area. In such a case, the final exit is deemed to be the exit from the display window area.

c) Any external portion of an escape route between a final exit and the place of safety should be clearly defined and if necessary guarded with protective barriers in accordance with BS 6180.

d) Final exits should be sited so that the hazard to persons from the fire in the building is minimized.

e) Transformer chambers, boiler rooms, refuse storage areas and similar risk areas should not have any openings that would prejudice the means of escape from the building.

f) Final exits should, if possible, be distributed around the perimeter of a building, although the access to a particular plot might make adjacent final exits the only practicable option.

8.11 Crèches

8.11.1 *Commentary*

Where a crèche is provided for children separately from their parents or guardians, the siting of the crèche is important in relation to escape routes. It is important to ensure that the crèche is 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.

8.11.2 *Recommendations*

The following recommendations are applicable.

a) 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.

b) 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.

9 Stairs

9.1 Accommodation stairs

9.1.1 *Commentary*

*Whilst it is recognized that in practice accommodation stairs will be used for escape if free from smoke and heat, they are discounted when assessing protected stairway capacity. Therefore, they should not be the sole means of access between different storeys (except where permitted from mezzanines, see **8.4**, and in small premises, (see **10.2.4**).*

The siting of accommodation stairs in open wells allows the passage of smoke from one storey to another, and therefore it is necessary to ensure that any fire at the lower level(s) will not adversely affect the escape routes on the upper floor level(s).

*NOTE The provision of vertical escape from process plant buildings is covered in **11.2**.*

9.1.2 *Recommendation*

Accommodation stairs should be so sited that their location does not prejudice the access to the means of escape at the upper floor level(s).

9.2 Protected stairways

9.2.1 *Commentary*

*Except where permitted from mezzanines (see **8.4**) and in small premises (see Clause **10**), stairs provided for means of escape need to have a fire resisting enclosure, i.e. form a protected stairway (see **3.35**). This enclosure is intended to prevent:*

a) *smoke and heat from entering the stairway and rendering it impassable for escape purposes;*

b) *fire spreading from one storey to another.*

Where there is more than one protected stairway, it is important to arrange any access to an alternative protected stairway so that, in the event of a failure in a fire of the enclosure to a protected stairway, persons do not need to pass through that stair enclosure in order to reach an alternative protected stairway [see Figure 9b)]. It is also important to ensure that there are no fire risks within a protected stairway.

*In general, every protected stairway should be entered from only one storey exit at each level. Where it is necessary to provide more than one storey exit into a protected stairway in order to meet the limitations on distances of travel, such exits should not also form the sole means of access between different parts of the same storey, unless the parts of the storey are occupied by different tenants and it is unlikely that there will be regular contact between them. Otherwise, unless the doors to the stairway are provided with a suitable hold-open system (see **13.7**) such doors will tend to become either wedged open or the self-closing devices removed or tampered with, so destroying the effectiveness of the fire resisting enclosure to the protected stairway.*

*Some or all of these protected stairways may need to be designed as firefighting stairs (see **40.4**).*

9.2.2 *Recommendations*

The following recommendations are applicable.

a) A protected stairway (other than a firefighting stair) may contain only the following:

1) sanitary accommodation or washrooms, provided that the accommodation:

i) is not used as a cloakroom;

ii) does not contain any portable heating appliance;

iii) does not contain any gas appliance other than a room-sealed balanced-flue appliance, water heater or sanitary incinerator;

iv) is separated from the stairway by 30 min fire resisting construction and an FD 30S fire door;

2) a reception area or enquiry office, occupying a total area not exceeding 10 m^2, at ground or access level but not in the case of a building, or part of a building, served by a single stair;

3) cupboards enclosed with fire resisting construction (except in the case of a building, or part of a building, served by a single stair);

4) lift wells (except lift wells which are sited directly above lift machine rooms in buildings, or parts of buildings, served by a single stair).

NOTE 1 Engineering services such as gas and electricity should be in accordance with the recommendations given in Section 6.

b) Where a protected stairway is served by more than one storey exit at the same level, and the stairway links different parts of the building in the same occupation/tenancy, unless the doors to the stairway are provided with a hold-open system in accordance with **13.7**, provision should be made for normal communication between those parts to be independent of the protected stairway.

c) Where two protected stairways adjoin, they should be separated by imperforate construction, i.e. there should not be any openings, doors etc. in the separating elements common to both stairway enclosures.

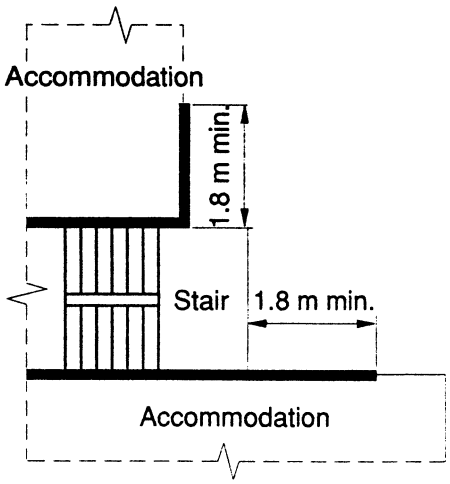
d) If any storey of a building (or part of a building) is required to have more than one escape route, protected stairways should be sited so that access to alternative protected stairways may be obtained from any point on that storey without passing through any other such stairway.

e) If a protected stairway projects beyond, or is recessed from, the external enclosures to a building:

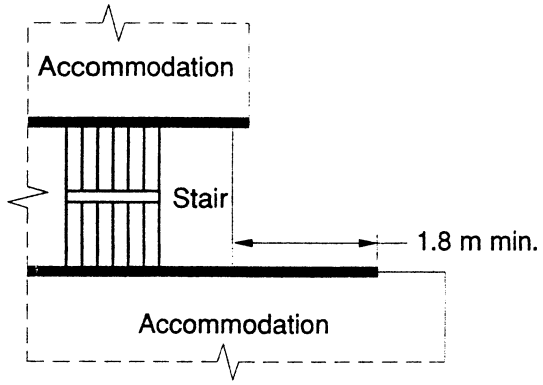
1) the distance between any opening in the external enclosure to the building and any opening in the enclosure to the stairway should be not less than 1.8 m (see Figure 12);

NOTE 2 The Technical Standards to the Building Standards (Scotland) Regulations [11] require a minimum separation of 2 m.

2) the enclosures within that distance and up to 9 m vertically below should be of fire resisting construction. Any glazed areas should be fire resisting and fixed shut.



a)



b)

Fire- resisting construction

NOTE See **9.2.2** item e)1).

Figure 12 — External protection to protected stairways

9.3 Number and siting of protected stairways

9.3.1 *Commentary*

The safety of a protected stairway cannot be ensured for an unlimited period of time. Therefore a building with only one protected stairway can only be considered safe if it is of limited height and area. If there is more than one protected stairway, all but the one nearest the fire may be expected to remain usable until any necessary evacuation is complete. However, if each stair is approached through a protected lobby or is protected with a smoke control system using pressure differentials, all stairs can be expected to remain usable.

Except where a single stair is permitted (and therefore the siting of the stair is controlled by distance of travel), protected stairways need to be located so that they are remote from each other in order to enable people to turn away from any fire to make their exit (other than in permitted dead end situations). Therefore, if a building incorporates a central core arrangement, it is necessary to ensure, in the event of one stairway becoming affected by fire and/or smoke, that any other stairway and its access remain available for escape purposes.

Basement storeys should generally be provided with alternative means of escape. However, in office buildings a single stair is considered reasonable if the area of the basement is limited and it is the only storey below ground level.

*NOTE Where the storeys above ground level are served by a single stair, this stair may not also serve the basement [see **9.5.2**a)].*

9.3.2 *Recommendations*

The following recommendations are applicable.

a) There should be access to at least two protected stairways from all parts of each storey except in the case of:

1) small premises (see **10.2.4**);

2) a storey that is the only basement storey to a normal or low risk building, provided that the direct distance from every point in the storey to the storey exit does not exceed the value given in column (3) of Table 1.

b) Additional protected stairways should be provided as necessary to meet recommendations for travel distance.

c) The siting of protected stairways should be such that they afford effective alternative directions of travel from any relevant point in a storey.

d) In buildings having a central core arrangment, the access doors to the protected stairways should be sited remote from one another and should not be approached from a lobby, an undivided corridor, or a lift hall common to both stairways (see Figure 8).

9.4 Width of protected stairways

9.4.1 *Commentary*

*Protected stairways need to be of sufficient width to allow the full number of occupants who may need to use them for escape purposes to do so without risk of overcrowding or delay. In determining the number of persons on any storey who may need to use a stair, the considerations of **8.5** apply. It should be noted that, if one or more central handrails are provided, then each section of the stair so formed is treated as a separate stair for calculations of capacity.*

The normal evacuation arrangement for buildings covered by this code is simultaneous evacuation, i.e. the stairways need to have sufficient capacity to enable all occupants to leave the building immediately if an alarm of fire is given.

However, in office buildings, it may only be necessary to evacuate two storeys initially on the discovery of fire and to evacuate other parts of the building progressively. This concept is known as phased evacuation. This arrangement is normally only considered to be suitable for office buildings as the fire load in the other types of building covered by this code is likely to be such that a fire, unless extinguished immediately, will grow rapidly to a size which warrants the immediate evacuation of all the occupants. Phased evacuation is only suitable in buildings in which each storey is an individual compartment and the stairways are provided with added protection against the ingress of smoke.

Table 4 gives values suitable for all buildings and Table 5 gives values for office buildings only.

Table 4 is based on the total evacuation of all storeys simultaneously, whereas Table 5 is based on the immediate evacuation of two floors only. However, if the values in Table 5 are used the stair needs to be approached through a protected lobby or protected corridor at each level and regard has also to be paid to the necessity of providing a staged fire alarm system and means for managing a controlled evacuation of the premises.

The tables are straightforward in their application in cases where the population of the building is distributed evenly among storeys. However, if the population of the building is not evenly distributed, the stair width will be determined by the storey which has the largest population and the width will need to be at least maintained from that storey to the final exit level.

Except where a single stair is acceptable, or where all stairs are protected against the ingress of smoke by protected lobbies or by a smoke control system using pressure differentials, the number and widths of stairs have to be adequate when one stair is discounted.

People tend to stay within reach of a handrail when making a prolonged descent, so that the centre part of wide stairs is little used and could be hazardous. Therefore the width of stairs in high rise buildings needs to be limited.

Where a storey exit is unavailable, this will lead to an excess of persons discharging onto the other stair(s) on the fire floor and may have repercussions regarding the capacity of the unaffected stair.

9.4.2 *Recommendations*

The following recommendations are applicable.

a) The capacities of stairs should be calculated in accordance with Table 4 or Table 5 as appropriate. The capacity of exits leading from stairs should be calculated in accordance with Table 3. In determining required capacity, the ground floor is discounted if it has final exits separate from the exits for the stairs [see **8.10.2**a)].

If a final exit serves both the ground storey and a stair, the capacity of the exit and of the common part of the corridor between the stair and the exit need to be increased accordingly.

If two or more protected stairways are required, at each storey their aggregate capacity should be not less than the total number of occupants of that storey (when Table 4 is used) or the maximum number of occupants per storey for the building (when Table 5 is used).

Unless each stair is approached through a protected lobby or is protected with a smoke control system using pressure differentials in accordance with BS 5588-4, the capacity (or aggregate capacity) should be adequate when each stair is discounted in turn.

b) The width of the stair should not:

1) narrow in the direction of escape;

2) exceed 1 400 mm if the vertical extent of the stairway is more than 30 m;

3) exceed 1 800 mm unless it is provided with a central handrail in which case it is treated as two sections for the purposes of Table 4 and Table 5.

c) Table 4 should be used for:

1) all shops (except small shops), factories and warehouses;

2) all basements;

3) buildings comprising open spatial planning;

4) all other buildings where Table 5 is not appropriate;

d) If Table 5 is used:

1) all protected stairways should be approached only by way of a protected lobby or protected corridor or should be protected with a smoke control system using pressure differentials in accordance with BS 5588-4;

NOTE Firefighting shafts should incorporate lobbies. (See BS 5588-5.)

2) every floor should be constructed as a compartment floor (see **13.2.2**);

3) a staged fire alarm system and means for managing a controlled (phased) evacuation of the building should be provided (see **35.2**).

Table 4 — Capacity of a stair or section per floor for simultaneous evacuation of a building

Number of floors served	Maximum number of persons for a stair width of:									
	900[a] mm	1 000 mm	1 100 mm	1 200 mm	1 300 mm	1 400[b] mm	1 500 mm	1 600 mm	1 700 mm	1 800[c] mm
1	50	150	220	240	260	280	300	320	340	360
2	50	95	130	145	155	170	180	195	205	220
3	50	75	100	110	120	130	140	150	160	170
4	50	70	85	95	105	110	120	130	140	145
5	—	60	75	85	90	100	110	115	125	130
6	—	60	70	80	85	95	100	110	115	125
7	—	55	65	75	80	85	95	100	110	115
8	—	55	65	70	75	85	90	95	105	110
9	—	50	60	65	75	80	85	95	100	105
10	—	50	60	65	70	80	—	—	—	—
15	—	45	50	60	65	70	—	—	—	—
20	—	45	50	55	60	65	—	—	—	—

NOTE In buildings over 30 metres in height, stairs over 1 400 mm in width will need to be at least 2 000 mm in width, which will provide two flights of 1 000 mm.

[a] Single stair buildings only.
[b] Maximum width of flights serving buildings of height (see **3.23**) greater than 30 m [see **9.4.2**b)2)].
[c] For safety in use generally, stairs wider than 1 800 mm should have a central handrail (see BS 5395).

Table 5 — Capacity of a stair in an office building for evacuation of two adjacent floors at a time

Maximum number of persons per storey	Width of stair mm
100	1 000
120	1 100
130	1 200
140	1 300
150	1 400[a]
160	1 500
170	1 600
180	1 700
190	1 800[b]

[a] Maximum width of flights serving buildings of height (see **3.23**) greater than 30 m [see **9.4.2**b)2)].
[b] For safety in use generally, stairs wider than 1 800 mm should have a central handrail (see BS 5395).

9.4.3 *Examples based on Table 4 and Table 5*

9.4.3.1 *General*

In the examples given in **9.4.3.2** and **9.4.3.3**, the minimum number of protected stairways is assumed to be two because the sizes of both buildings in the examples are such that a single stair would not meet the recommendations in **9.3.2**. The actual number of protected stairways may depend on the need to satisfy the maximum permitted travel distances and on any dead-end situations (see **9.3.2**), and whether one stair has to be discounted [see **9.4.2**a)].

NOTE The width of the stair at every storey level should be not less than that of the storey exit at that level. Where only two stairs are provided, one storey exit needs to be discounted to follow the recommendations in **8.5.2**a) even though one stair may not need to be discounted. Therefore, if the calculated stair width for two stair buildings is less than that given in Table 3, then the widths of the stairs need to be increased accordingly.

9.4.3.2 *Using Table 4 (simultaneous evacuation)*

a) Example A

Use of building: any.

Height of building: less than 18 m.

Number of floors (excluding ground and basement storeys): 4.

Total population (excluding ground and basement storeys): 572 evenly distributed, i.e. 572/4 = 143 persons per storey.

1) If the stairs are approached through a protected lobby/corridor, or the stairways are protected with a smoke control system using pressure differentials [see **9.4.2**a)], then all stairs can be used to evacuate the building. Therefore:

i) if only two stairs are provided, then both need to be able to accommodate half the population per storey, i.e. 143/2 = 72 persons;

ii) the width of one stair serving 4 storeys to accommodate 72 persons is 1 100 mm (maximum capacity 85 persons);

iii) thus both stairs need to be not less than 1 100 mm wide (this width is also adequate for a storey exit serving 143 persons);

iv) if three stairs were provided, each would need to have a capacity of 143/3 = 48 persons, i.e. each would need to be not less than 1 000 mm wide.

2) If the stairs are not so protected, then:

i) the width of one stair to accommodate 143 persons is 1 800 mm (maximum capacity 145 persons);

ii) two stairs each not less than 1 800 mm have therefore to be provided for means of escape (allowing for one to be discounted);

iii) if three stairs were provided, each would need to have a capacity of 143/2 = 72 persons (allowing for one to be discounted), i.e. each would need to be not less than 1 100 mm wide.

b) Example B

Use of building: any.

Height of building: in excess of 18 m.

Number of floors (excluding ground and basement storeys): 8.

Total population (excluding ground and basement storeys): 1 240 evenly distributed, i.e. 1 240/8 = 155 persons per storey.

As the height-to-floor level of the topmost storey containing accommodation exceeds 18 m, every protected stairway has to be approached through a protected lobby or protected corridor [see **9.6.2**b)]. Therefore all stairs can be used to evacuate the building [see **9.4.2**a)].

1) If only two stairs are provided, then both need to be able to accommodate half the population per storey, i.e. 155/2 = 78 persons.

2) The width of one stair serving 8 storeys to accommodate 78 persons is 1 400 mm (maximum capacity 85 persons).

3) Thus both stairs need to be not less than 1 400 mm wide (this width is also adequate for a storey exit serving 155 persons).

4) If three stairs were provided, each would need to have a capacity of 155/3 = 52 persons, i.e. each needs to be not less than 1 000 mm wide.

NOTE At least one of the stairs would also need to serve as a firefighting stair. Therefore if three stairs are provided, the firefighting stair(s) would need to be at least 1 100 mm wide to be in accordance with BS 5588-5.

9.4.3.3 *Using Table 5 (phased evacuation)*

Example C

Use of building: office.

The height of building, number of floors and total population is assumed to be as in example B.

a) Every stair needs to be approached through a protected lobby or protected corridor [see **9.6.2**f)]. Therefore all stairs can be used to evacuate the building [see **9.4.2**a)].

b) Number of persons per storey is 1 240/8 = 155 persons.

c) If only two stairs are provided, then both stairs need to be able to accommodate half the population of one storey (i.e. 155/2 = 78 persons).

d) The width of one stair to accommodate 78 persons is 1 000 mm (maximum capacity 100 persons).

e) Thus both stairs need to be not less than 1 000 mm wide. However, this needs to be increased to 1 100 mm to be in accordance with Table 3 for 155 persons.

f) If three stairs were provided, then each would need to be not less than 1 000 mm wide (i.e. the minimum width given in Table 5).

NOTE At least one of the stairs would also need to serve as a firefighting stair. Therefore if three stairs were provided, the firefighting stair(s) would need to be at least 1 100 mm wide to be in accordance with BS 5588-5.

9.4.3.4 *Comments on examples*

In each of the examples the population was assumed to be evenly distributed on each floor. However, where this is not the case the following apply.

a) If using Table 4, then the width of the stair:

1) at every storey level should be not less than that of the storey exit at that level; and

2) should not narrow in the direction of escape [see **9.4.2**b)1)].

b) If using Table 5, then the floor with the greatest population should be used.

9.5 Basement stairs

9.5.1 *Commentary*

Areas below ground level, especially if used for storage, are more likely to become completely filled with smoke and heat from a fire than are the ground and upper storeys. There is, therefore, a greater risk that a stair in a basement will become obstructed by smoke and heat, particularly in a fully developed fire. For this reason, it is preferable that all stairs to basements be entered at ground floor level from the open air and only from such positions that smoke from any basement fire will not obstruct any exit serving the ground and upper storeys of the building.

However, in buildings having two or more stairs available for escape from the upper storeys, no objection is seen to one or more stairs continuing down to the basement provided each such storey is protected from ingress of smoke from the basement and at least one stair serving the upper floors of the building (or part of the building) is terminated at ground level.

9.5.2 *Recommendations*

The following recommendations are applicable.

a) Except for small premises (see Clause **10**), if a protected stairway forms part of the only escape route from an upper storey of a building (or part of a building), it should not serve any basement storey.

b) If there is more than one protected stairway from an upper storey of a building (or part of a building), at least one such stairway serving the upper storeys of the building (or part) should be terminated at ground level. Any other stair may connect with the basement storey(s) provided that it is separated from each basement level by a protected lobby or protected corridor in accordance with **9.6.2**, or the stairway is provided with a smoke control system using pressure differentials in accordance with BS 5588-4.

9.6 Access lobbies and corridors to protected stairways

9.6.1 *Commentary*

Because the hazard to the occupants of a high building is greater than that of a low one, the protection afforded to stairs serving high buildings needs to be increased. Similarly, because of the greater risk that a single stair will become unusable in fire, extra protection is needed for the stair in a building (or part of a building) served by only one stair. However, this extra protection is not considered necessary in two-storey buildings and in small premises. In high buildings and in buildings (or parts of buildings) permitted to be served by a single stair, access to the stair needs to be by way of a protected lobby or protected corridor. A protected lobby or protected corridor is not required at the top storey level because no other occupants will be passing the top storey accommodation.

Lobby protection to protected stairways is necessary if the capacity of the protected stairways allows the simultaneous evacuation of only two floors, and to safeguard stairs connecting with ancillary accommodation (see Section 5).

*Still greater protection is necessary in connection with any firefighting stairs (see **40.4**).*

9.6.2 *Recommendations*

If a protected stairway, other than an external stair, serves a storey or storeys in any of the following circumstances, it should be approached only by way of a protected lobby or protected corridor at the levels indicated.

a) If the stair is the only stair serving a building, or part of a building, there should be a protected lobby or protected corridor at every level other than at the top storey level.

b) If it is not intended to discount a stairway in calculating stair capacities, there should be a protected lobby or protected corridor at every level other than at the top storey, unless stairways are provided with smoke control systems using pressure differentials.

c) If the stair connects the ground or upper storeys with a basement storey or storeys, or serves only basement storeys, there should be a protected lobby or protected corridor at every basement level, unless the stairway is provided with a smoke control system using pressure differentials [see **9.5.2**b)].

d) If the stair directly serves a boiler room or transformer chamber, there should be a protected lobby or protected corridor at that level.

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

f) If the capacity of the stair has been determined using Table 5, there should be a protected lobby or protected corridor at every level (excluding the top storey).

g) If the stair is in a building of height (see **3.23**) greater than 20 m, and serves any storey more than 20 m above ground or access level, there should be a protected lobby or protected corridor at every level other than at the top storey.

9.7 External escape stairs

9.7.1 *Commentary*

*Whilst not desirable, external stairs which are provided for means of escape purposes (i.e. to meet the recommendations of **9.3.2**) are deemed to be protected stairways, and hence need to satisfy the appropriate recommendations given in **9.2.2** and **9.4.2**, as well as those given in **9.7.2**.*

NOTE Lobbies are not required to an external escape stair.

External escape stairs need to be protected from the effects of adverse weather conditions to avoid the stair being made slippery by rain or ice. It is also necessary to ensure that their use at the time of a fire cannot be prejudiced by smoke and flames from nearby openings.

9.7.2 *Recommendations*

If more than one escape route is available from a storey, or part of a building, one of those routes may be by way of an external escape stair provided the following provisions are met.

a) The stair is:

1) roofed and at least partly covered in at the sides (depending upon the degree of exposure) so as to ensure freedom at all times from adverse weather conditions; and

2) constructed of non-combustible material.

b) Any wall (or portion of a wall) (other than one that is more than 1.1 m above the top floor level of a stair which is not a basement stair) within 1.8 m of, or within 9 m vertically below any external escape stair, is of fire resisting construction. (See **13.3.2**.)

NOTE It may contain fire resisting glazed areas provided that these are fixed shut.

c) The doors to the stair (other than the door(s) at the top floor level of a stair serving storeys above ground level) are fire resisting and self-closing (see Figure 13).

d) Any doors, roof lights, or windows, that are not fire resisting, and any ventilation inlets or outlets or other extract system, are not sited within 1.8 m of such a route.

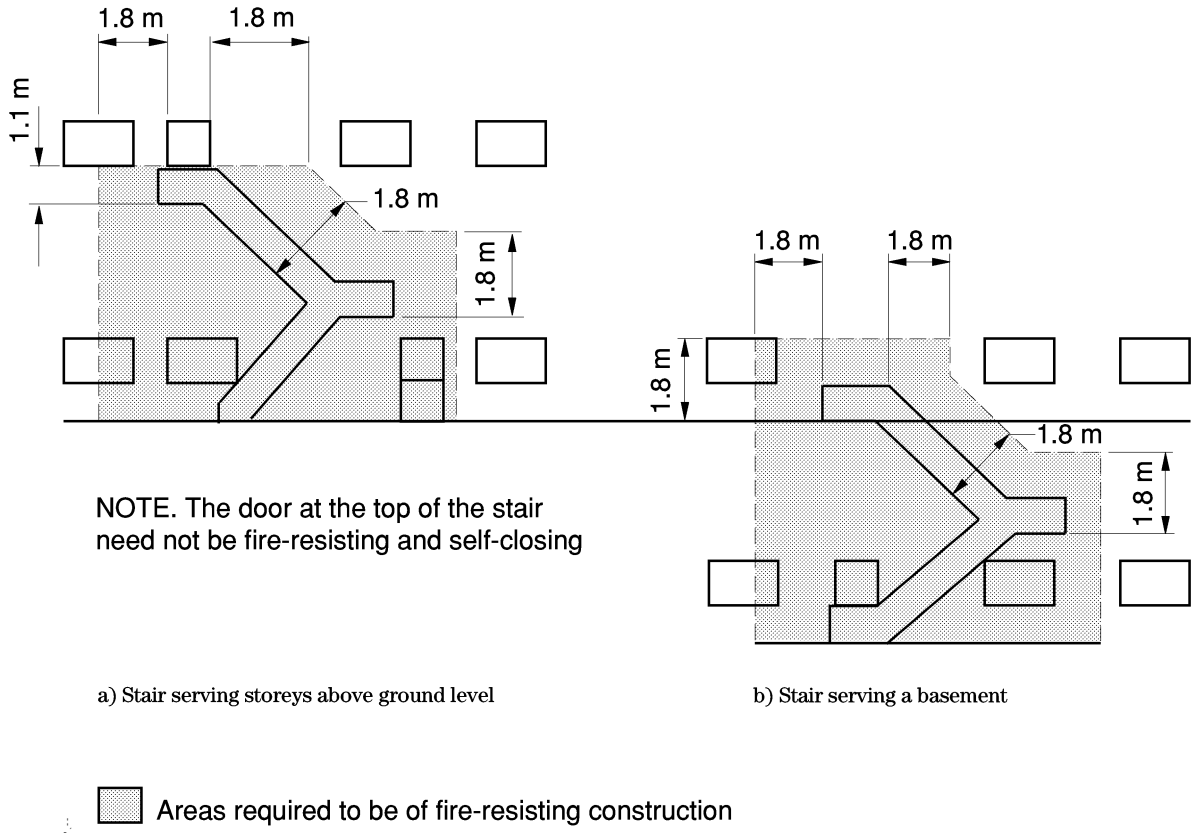


Figure 13 — Fire resistance of areas adjacent to external stairs

9.8 Discharge from protected stairways

9.8.1 *Commentary*

The general principle to be followed is that all occupants of the building using the stairs to reach safety in the open air need to be assured of the same degree of protection from the effects of smoke and heat in this part of the escape route as that provided in other parts. The following need to be taken into consideration.

a) *The safest arrangement is for the stair to discharge directly through doors to the street at ground level. However, consideration may be given to external stairs discharging into courtyards and compounds providing that this does not result in people entering an area of high risk and that provision is made to ensure egress from such areas are not restricted. Stairs should not discharge into covered shopping malls or arcades.*

b) *An arrangement by which two stairs terminate in the same enclosure at final exit level should not be employed because an outbreak of fire leading to penetration of the enclosure at that level would render both stairways simultaneously unusable. Final exits should, if possible, be distributed around the perimeter of a building, although the access to a particular plot might make adjacent final exits the only practicable option.*

c) *If a tower block rises above a podium, it is preferable that the escape stair from the tower descends through the podium to ground level; any firefighting stair should certainly do so. If other stairs cannot be so arranged and occupants are required to use the stairs of the podium, there should be protection of the escape route connecting the two stairs such that the occupants of the building can be assured of safety until street level is reached.*

d) *Any final exit needs to be immediately apparent to people using a stair that serves storeys both above and below the point of final exit, in order to prevent people who are escaping from passing the point of discharge. One way of doing this would be to divide the landing at the final exit level, although a door may be provided in the dividing structure for normal circulation between the upper and lower storeys.*

9.8.2 ***Recommendations***

The following recommendations are applicable.

a) Where the exit passageways from two protected stairways adjoin, they should be separated by an imperforate fire resisting construction, i.e. there should not be any openings, doors, etc. in the separating element common to both passageways.

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

c) Final exits should be in accordance with the relevant recommendations in **8.10.2**.

10 Small premises

10.1 Commentary

*This clause is concerned with the planning of means of escape from small premises which may involve a departure from the recommendations outlined in Clause **8**.*

The small size of these premises limits their capacity in terms of the number of persons using them at any one time. Therefore the occupants should be able to quickly reach a single entrance/exit in an emergency and the limited size of the premises ought to enable clear vision of all parts when undivided, thereby ensuring early warning. Thus, consideration may be given to a reduction in the number of exits and stairs and, in certain cases, to the omission of a protected stairway.

*However, where the sale, storage or use of highly flammable materials is involved, it is necessary for persons to rapidly vacate the premises in the event of a fire. To facilitate this, the recommendations in **10.2** would not apply. Instead the recommendations in Clause **8** and Clause **9** would need to be strictly observed.*

10.2 Recommendations

10.2.1 *General*

The following recommendations apply in place of only those recommendations in Clause **8** and Clause **9** relating to the number and siting of exits and protected stairways and measurement of distances of travel.

NOTE 1 They do not apply to premises used principally for the storage and/or sale of highly flammable liquids or materials.

NOTE 2 In covered shopping complexes, the size of small units that may be served by a single exit is further restricted. This is dealt with in BS 5588-10.

a) The premises should be in a single occupancy and should not comprise more than a basement, a ground floor and a first storey. No storey should have a floor area greater than 280 m^2 (see Figure 14).

b) Any kitchen or other open cooking arrangement should be sited at the extremity of any dead end remote from the exit(s).

c) The planned seated accommodation or the assessed standing accommodation (see Table 2) for small premises comprising a bar or restaurant should not exceed 30 persons per storey. This figure may be increased to 100 persons for the ground storey if that storey has an independent final exit.

10.2.2 *Construction* (see also Clause **13**)

The following recommendations are applicable.

a) The floor areas should be generally undivided (except for kitchens, ancillary offices and stores) to ensure that exits are clearly visible from all parts of the floor areas.

b) Store rooms should be enclosed with fire resisting construction.

c) Sufficient clear glazed areas should be provided in any partitioning separating a kitchen or ancillary office from the open floor area to enable any person within the kitchen or office to obtain early visual warning of an outbreak of fire. Alternatively, an automatic fire detection and alarm system may be provided in the outer room.

NOTE The clear glazed area or vision panel may need to be provided for other reasons.

10.2.3 *Distance of travel and number of escape routes*

The following recommendations are applicable.

a) The escape routes from any storey should be of such a number and so situated that the distance of travel from any point to the nearest storey exit does not exceed the appropriate limits set out in Table 6.

NOTE The distance of travel in a small premises with an open stairway is measured to the foot of the stair in a basement or to the head of the stair in a first storey.

b) The siting of two or more exits or stairs should be such that they afford effective alternative directions of travel from any relevant point in a storey.

Table 6 — Maximum distances of travel[a] in small premises

Storey	Maximum travel distance m	Maximum direct distance[b] m
Ground storey with a single exit	27	18
Basement or first storey with a single stair	18	12
Storey with more than one exit/stair	45	30

[a] See note to **10.2.3**a).
[b] Direct distances are for design purposes only.

10.2.4 ***Stairs***

The following recommendations are applicable.

a) There should be not less than two protected stairways available from each storey except in the case of any of the following:

1) small premises other than bars or restaurants;

2) an office building comprising not more than five storeys above the ground storey, provided that:

i) the travel distance from every point in each storey does not exceed that given in Table 1 for escape in one direction only; and

ii) every storey at a height (see **3.23**) greater than 11 m has an alternative means of escape;

3) a factory comprising not more than:

i) two storeys above the ground storey (if the building, or part of the building, is of low risk); or

ii) one storey above the ground storey (if the building, or part of the building, is of normal risk);

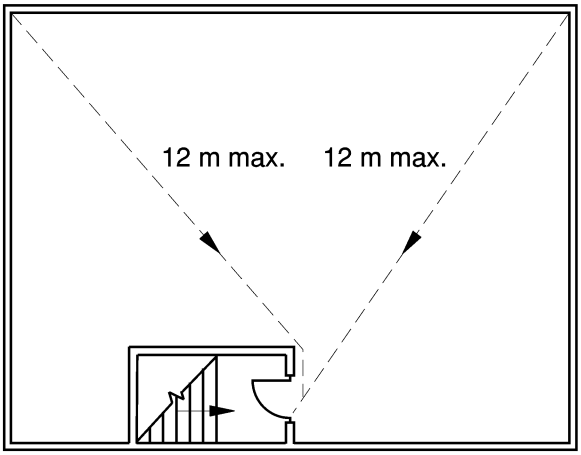
provided that the travel distance from every point on each storey does not exceed that given in Table 1 for escape in one direction only;

4) process plant buildings with an occupant capacity of not more than 10.

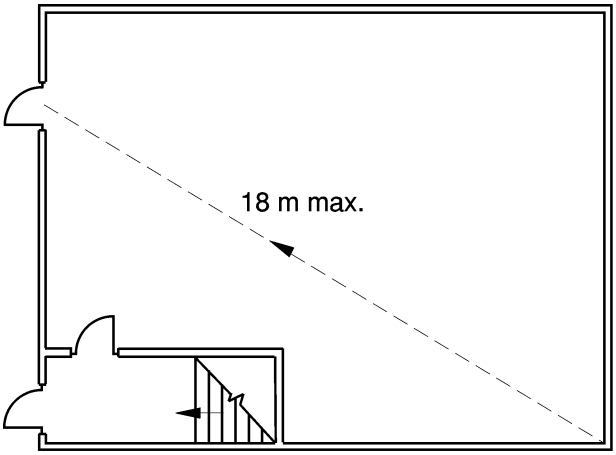
b) Stairs should be protected stairways discharging to a final exit, except that a stair may be open if it does not connect more than two storeys and delivers into the ground storey not more than 3 m from the final exit (see Figure 15 and Figure 16), and either:

1) the storey is also served by a protected stairway; or

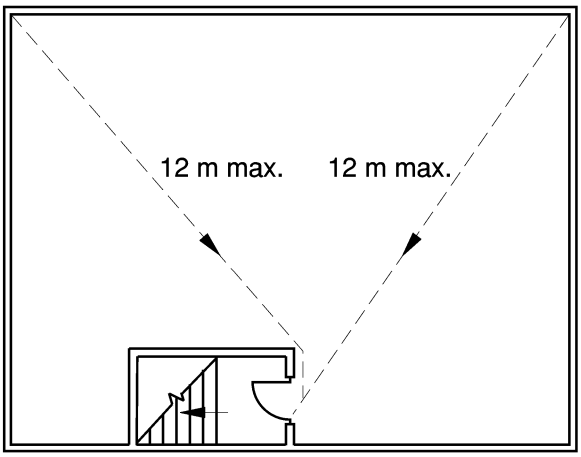
2) it is a single stair in a small premises with the floor area in any storey not exceeding 90 m^2 and, if the premises contains three storeys, the stair serving either the top or bottom storey is enclosed with fire resisting construction at the ground storey level and discharges to a final exit independent of the ground storey (see Figure 16).



a) First storey



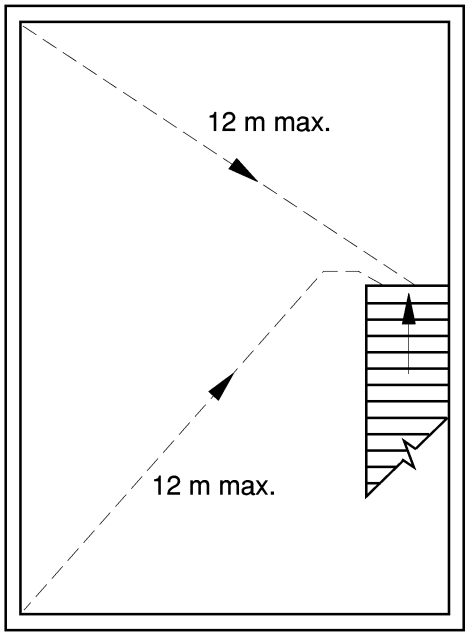
b) Ground storey



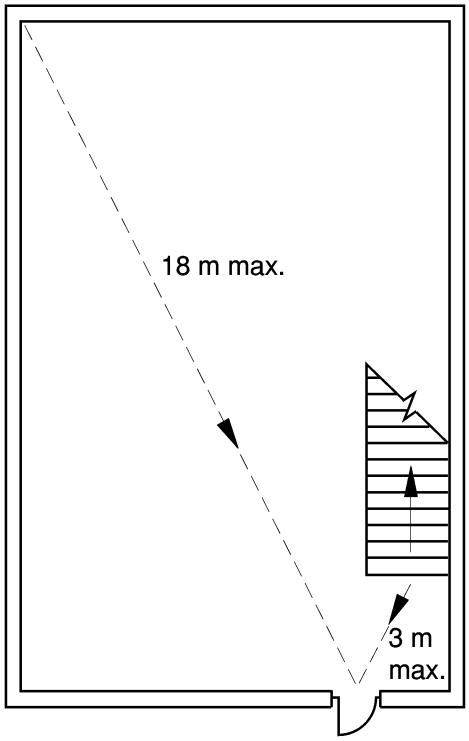
c) Basement

NOTE Maximum floor area on any storey 280 m^2. Restricted accommodation if used as a restaurant or bar.

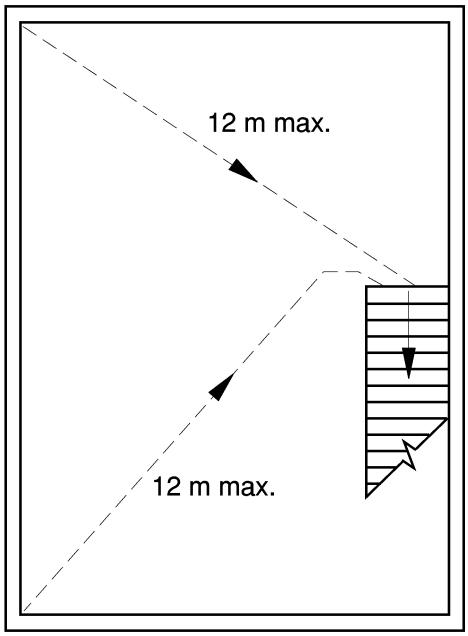
Figure 14 — Maximum direct distances in a small two- or three-storey premises with a single protected stairway to each storey



a) First storey



b) Ground storey

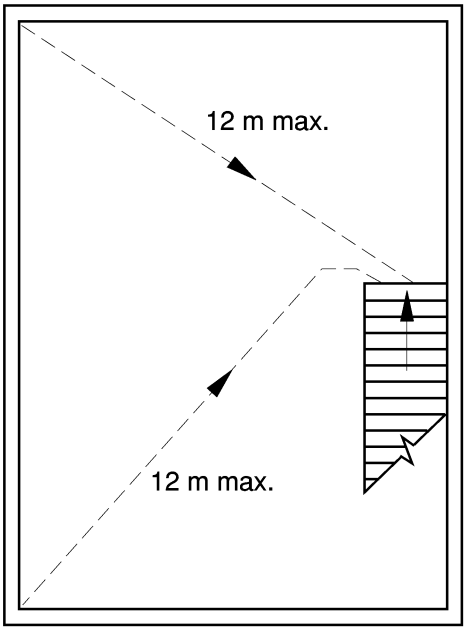


c) Basement

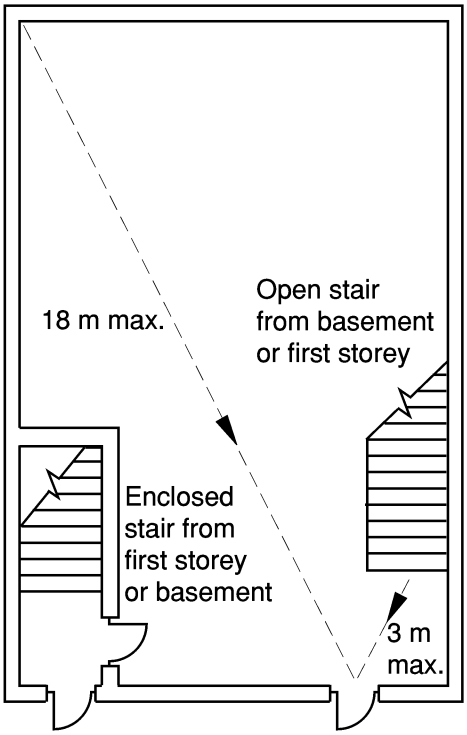
NOTE 1 Maximum floor area in any storey 90 m^2.

NOTE 2 The premises may not be used as a restaurant or bar.

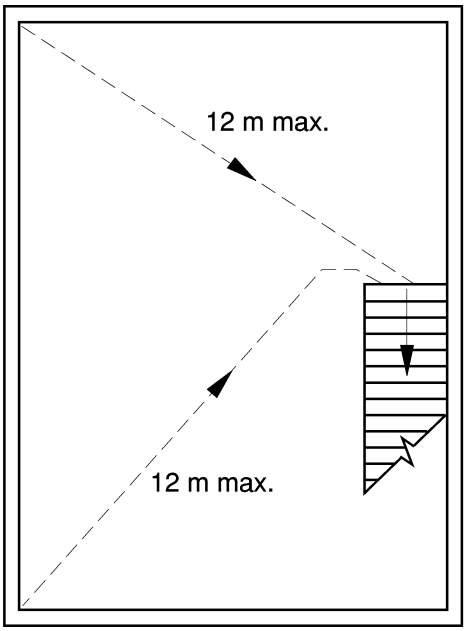
Figure 15 — Maximum direct distance in a small two-storey premises with a single open stair



a) First storey



b) Ground storey



c) Basement

NOTE 1 Maximum floor area on any storey 90 m².

NOTE 2 Enclosed stair at ground storey level may be from either the basement or the first storey.

NOTE 3 The premises may not be used as a restaurant or bar.

Figure 16 — Maximum travel distance in a small three-storey premises with a single stair to each storey

11 Process plant and structures

11.1 Commentary

11.1.1 *General*

As a general principle the recommendations of this code are to be applied to all buildings. However, in respect of certain buildings and structures, in particular those purpose designed to house process and storage plant, these recommendations may be either inappropriate or unreasonably restrictive.

The design of these buildings and structures can range from fully enclosed buildings to open structures, such as external plant, and, whilst they may be large, internal divisions may be absent or largely incomplete. In addition, they characteristically have a low occupancy, typically not more than 10 persons.

*In such cases the recommendations given in this clause are applicable. The guidance is specifically applicable to those buildings and structures at special premises (see **3.38**). Application of these recommendations is also considered to be good design practice for such buildings and structures housing plant, which are outside the scope of the Fire Certificates (Special Premises) Regulations 1976 [1].*

Because of the wide variety of process plant buildings and external plant, and therefore the range of appropriate safety requirements, consultation at an early stage with the Health and Safety Executive is desirable. It is also advisable that the relevant authorities are consulted on any requirements of building regulations, and for those premises outside the scope of the Fire Certificates (Special Premises) Regulations 1976 [1], any requirements of the Fire Precautions Act 1971 [6].

11.1.2 *Process plant buildings*

Buildings containing process plant are often distinguished from conventional buildings by greater ceiling heights and the presence of a larger number of openings in floors, which effectively increase the volume of space beyond that of a single storey building. There are often openings in floors around large items of plant, for the passage of pipes and services, and around stairs. Ceiling heights, particularly immediately below the roof, are often sufficient to allow smoke and hot gases to collect and layer above a person's head.

The unprotected openings in the floors affect the spread of the products of combustion through the upper floors and a fire may lead to significant smoke logging between floors affecting the means of escape. In some situations the smoke may rise and collect below the roof during the early period of a fire (provided that the smoke reservoir at the top of the space is of sufficient size) without threatening the means of escape, the main hazard to persons then being heat radiation.

It is essential that the rapidity with which smoke is produced during a fire is not underestimated. In a 30 m × 30 m area that is 15 m high to the underside of the roof, an 0.5 MW hydrocarbon pool fire at floor level may cause the top 3.5 m to become smoke logged within about 90 s. For example, such a pool fire would be not more than 0.5 m in diameter. A jet of flame from a flange leaking highly flammable liquid near floor level at a rate of about 0.5 l/min would have a similar effect. Properly designed smoke ventilation at roof level would, of course, considerably alleviate such a situation.

*A wide range of solutions to means of escape problems will be applicable in process plant buildings because of their large variety, and may include active fire precautions such as automatic fire detection, extinguishing and smoke control systems (see Clause **39**). Departures from the recommendations for conventional buildings will be appropriate in situations where the potential fire is unlikely to threaten escape routes before evacuation is complete. One factor which reduces the risk to life from heat and smoke in such interconnected spaces is the increased chance of a person becoming aware of a fire in the early stages of its development, independent of the alarm being raised by others. Another that influences the means of escape provisions in these buildings is that only a small number of persons are likely to be present and they will be able bodied and familiar with the premises. Upper levels are usually only visited occasionally by a routine patrol or for maintenance purposes.*

The following items give an illustration of some of the possibilities.

a) *If the major threat is principally one of heat radiation, where smoke and other products of combustion can pass upwards into the roof space or some other smoke reservoir without initially threatening the escape routes, a lower standard of enclosure around stairs than that for protected stairways (see **9.2**) may be reasonable. At least one other alternative route to ground level incorporating stairs or ladders, that is external to the building, should be available.*

b) *A lesser standard for provision of escape stairs than that recommended in Clause **9** may be appropriate where the threat of smoke logging is reduced by the extent of the openings in the floors and the likely size of the fire in relation to the space. In such cases a single protected stairway (see **9.2**) or external escape stairs (see **9.7**) with alternative means of escape by stairs or ladders, preferably external to the building, may be reasonable.*

*NOTE A single protected stairway would only be acceptable in buildings deemed a high fire hazard (see **8.1.1**) in certain limited circumstances. For example, in small buildings with low or infrequent occupancy in which any developing fire would be seen in its early stages and would not immediately affect the stair.*

c) *Accommodation stairs (see **9.1**) may only form part of an escape route in buildings which are not more than two storeys high (including the ground floor) and are low hazard (see **8.1.1**). Their acceptability is dependent upon there being more than one stair from the upper storey and these being sufficiently separated so that a developing fire will not immediately affect both stairs. The base of each of the stairs should be near to a final exit and the distance travelled along the stair is to be taken into account in calculating the overall travel distance.*

11.1.3 *Weather housed plant buildings*

These buildings have the process plant enclosed to control the environment for operator comfort or to protect the plant from the effects of the weather. They are large, usually hangar or shed-like buildings, where, whilst there are a minimum number of discernible floors, there may be a number of galleries, walkways and connecting stairs associated with the process plant and in which there is a substantial head space to act as a smoke reservoir between the highest visited level and the underside of the roof.

*In a building of this size the hazard from smoke logging may be greatly reduced in comparison with multi-storey buildings to a degree that travel distances suitable for conventional buildings may be unnecessarily restrictive. (However, the rapidity with which smoke is produced during a fire should not be underestimated [see **11.1.2**]). Conversely, the danger associated with fire is likely to be higher than in similar plant sited in the open air (see **11.1.4** and **11.1.5**) because of the confinement of the fire within the enclosure, and consequently travel distances associated with external plant are not appropriate.*

*The travel distances for weather housed plant given in Table 7 are appropriate only if the means of escape are not likely to be affected by radiated heat, smoke or other products of combustion during the early period of a fire. In these circumstances a protected stairway may be unnecessary, the vertical components of the escape routes forming part of the overall travel distance (see **11.3** and Table 7) to a final exit. Where there is a danger of smoke logging unenclosed vertical components of escape within the building, external escape routes with a reduced level of fire resistance may offer a satisfactory solution provided that the external wall gives smoke containment and protection from potential radiation.*

11.1.4 *External plant*

The different types of risk in external plant are classified as follows.

a) *Normal fire hazard outdoor zones. Units of plant where there is not a high fire danger. These generally include all tank farms, silos, pipe rack areas and storage locations.*

b) *High fire hazard outdoor zones. Those zones which contain units of plant which present a high fire danger, for example where highly flammable liquids are being processed under pressure and above their flashpoint, where flammable gases are being processed, or where materials are processed above their auto-ignition temperature, and throughout which a rapid spread of flames, smoke and fumes could reasonably be expected.*

NOTE The processing of toxic materials will not lead to special zone status unless either the process involves other flammable materials, the material itself is flammable or toxic release is probable in the early stages of a fire.

Although units of external plant are often very large, the number of personnel operating them is usually small, even when routine maintenance operations are taken into account. Most plants have a routine patrol to check gauges, flanges, pumps, etc. and to take samples, in addition to the routine monitoring functions associated with control of the process. Such routine patrols may not cover all parts of the plant and these remaining parts may be above ground level and not frequently visited. Access is provided to such parts for regular but infrequent checks, e.g. a monthly safety inspection, or for maintenance purposes. The time taken to visit a particular location can be very short, for example in the case of the top of a 50 m high column, it may be a 20 min per month safety inspection, or maintenance work completed during a single shift. Therefore, two frequencies of visit are distinguished, i.e. "frequently visited" and "not frequently visited".

"Frequently visited" means:

a) *visited once a day or more; or*

b) *visited once a week or more by a group of three or more persons.*

Because of the risk of an incident occurring, locations visited for the purposes of taking samples of flammable gas or liquid at a temperature above its flashpoint are classified, for the purposes of fire precautions, as "frequently visited" irrespective of the frequency of visits.

Many of the factors determining provision of means of escape in buildings are of lesser importance when applied to external plant. For example, smoke logging may not be a significant problem, and generally it is neither necessary nor practicable to construct protected escape routes.

The main dangers are the immediate engulfment of personnel in flames and the effects of radiated heat. The provision of means by which personnel may move quickly away from a fire is, therefore, essential.

*Generally a minimum of two escape routes will be required from any part of the plant, so sited that they are clear alternatives, i.e. not likely to be involved in the same initial fire. Unavoidable dead end conditions need to be kept short. Having escaped from the immediate area of the fire, it is not necessary for the person to come down to ground level straightaway, indeed, in some cases it will be safer to walk away from the fire at high level before descending to the ground. The overall travel distances (see **11.3** and Table 7) will comprise both horizontal and vertical components, the appropriate distances depending on the fire hazard and the frequency of visiting.*

A major contribution to ensure the availability of an alternative escape route is the control of the spread of fire at ground level to prevent it immediately jeopardizing all the vertical escape routes. This might be achieved by low bunds or the sloping of the ground to a suitable collecting point.

11.1.5 *Weather protected plant*

*Like weather housed plant, some external plant is partially enclosed for weather protection purposes. However, such enclosures are distinguished from weather housed plant buildings by large areas of openings which breach the enclosure. The openings are usually at high and low levels e.g. ridge vents at high level, and louvres or open sides at low level. These openings are usually provided for ventilation purposes to prevent a build up of flammable gases and vapours. The provision of high level permanent ventilation has the added advantage of smoke release during a fire, thus preventing the potential for smoke logging inherent in buildings. Where the fire dangers on such plant are more akin to those for external plant than in weather housed plant buildings, it is appropriate to use the travel distances for external plant (see **11.3** and Table 7).*

11.1.6 *Tall free-standing plant*

Tall, vertical components of plant, e.g. columns and stills, are often isolated and free-standing and hence are deemed dead ends for means of escape purposes. If they are not frequently visited it would not generally be reasonable to require alternative escape routes, even though the dead end travel distance may considerably exceed that given in Table 7.

In cases where such plant is frequently visited, but the hazard does not warrant a relaxation of the travel distance and it is not reasonably practicable to provide an alternative escape route, other risk reduction measures need to be taken. The purpose of these measures, such as modification to the plant, would be to significantly reduce and ideally remove the need to visit the remote areas of the plant, whilst the hazard is present.

11.2 Recommendations for process plant buildings

The following recommendation may be applied in place of the recommendations of Clause **9**.

Process plant buildings which, by virtue of their design, pose a reduced threat of smoke logging and from heat radiation, and which are expected to have a low occupancy, may be provided with a single protected or external route, with alternative means of escape incorporating stairs and/or ladders, both internal and external.

NOTE For all other process plant buildings the recommendations of Clause **9** should be followed.

11.3 Recommendations for weather housed plant, weather protected plant and external plant

The following recommendations may be applied in place of the recommendations of Clause **8**.

a) The travel distance from any point in weather housed, weather protected and external plant should not exceed the appropriate limits set out in Table 7.

b) For travel to be considered to be in more than one direction, either:

1) the routes should be not less than 90° apart; or

2) the routes should be separated from each other by fire resisting construction and the vertical components should either:

i) be a minimum of 20 m apart; or

ii) descend at opposite extremities of the structure.

c) The travel distance should be measured to a point at ground level, outside the confines of the plant or structure housing it, such as an access roadway or open ground, which provides unrestricted egress to an assembly point in a safe location, where persons are no longer in danger from the effects of fire or smoke.

Table 7 — Maximum distances of travel for weather housed plant buildings, weather protected plant and external plant[a]

Situation	Maximum travel distance m		Maximum direct distance[b] m	
	Escape in one direction only	Escape in more than one direction	Escape in one direction only	Escape in more than one direction
Weather housed plant buildings				
a) normal fire hazard[c]	18	100	12	66
b) high fire hazard[c]	12	60	8	40
External plant/weather protected plant				
a) normal fire hazard outdoor zones[d]	24	200[e]	16	133
b) high fire hazard outdoor zones[d]				
1) frequently visited	12	100[e]	8	66
2) not frequently visited	24[f]	200[e]	16	133

[a] See Table 1 for maximum distances of travel in buildings.
[b] Direct distances are for design purposes only.
[c] See **8.1.1**.
[d] See **11.1.4**.
[e] Plus an additional 50 m at ground level where the direction of travel is substantially unrestricted.
[f] 100 m from the top of a storage tank or silo, provided that a person is not required to cross the top of more than one other tank to reach alternative "plant clearways" or a vertical route to ground level.

12 Wayfinding and spatial orientation (architectural design, fire safety signs and messages)

12.1 Commentary

Research into the public's comprehension of the layout and ease of finding destinations in large public settings has revealed significant spatial orientation and wayfinding problems. While spatial "complexity" can be alleviated by effective signs, wayfinding problems originate in the architectural design of a setting. Factors such as the lack of correspondence between the outside shape of a building and the internal plan, access to the building at different levels, and lack of architectural reference points by which visitors can readily establish where they are in relation to exits and destinations, cause confusion in the everyday use of many large buildings. Such confusion can jeopardize people in an emergency situation.

Careful attention is needed in the positioning, content and presentation of all safety signs, and it is important that the effects of smoke on the visibility and effectiveness of such signs is given due consideration. To promote efficient crowd circulation in the everyday use of a building where large numbers of persons may be present, and therefore efficient evacuation in an emergency, the fire authority needs to be consulted with regard to the siting, positioning and information displayed through destination, escape route, and fire exit signs and other visual displays (including "you-are-here" maps indicating the direction of exits, facilities and layout of the building). When considering the allocation and position of safety signs regard should be given to the detrimental effect the general and any decorative lighting could have on the clarity of the signs.

Mention is made in BS 5588-12 of the value of public address systems in providing emergency information. However, the effectiveness of verbal guidance can be seriously diminished if it is stated in terms of directional bearings, relative positions or the names given to the various entrances which are not readily apparent from within the building. Appropriate signs are therefore important to complement public address announcements.

The enforcing authority also needs to be consulted with regard to the provision of fire safety signs (other than exit signs), e.g. to draw attention to the necessity to keep escape routes clear of obstructions and to identify those areas where smoking is not allowed.

It has been established that in a fire the hot smoke will stratify or layer, creating worst case conditions at ceiling height and leaving cleaner, cooler conditions at floor level. Consideration, therefore, needs to be given to low level wayfinding and escape lighting systems. A highly visible system of route marking, comprising arrows and exit signs mounted close to floor level and no higher than handrail level can improve wayfinding and safe movement by the public, staff and fire service personnel in the event of an escape route becoming filled with smoke or when normal lighting fails.

12.2 Recommendations

The following recommendations are applicable.

a) All exits should be marked and be readily visible.

b) Intermediate exit signs should be provided in areas used by the public so that no part of such an area is more than 25 m from an exit sign or directional exit sign.

c) All fire safety signs should conform to BS 5499-1.

NOTE There is a requirement for certain fire safety signs under the Health and Safety (Safety Signs and Signals) Regulations 1996 [12]. Signs containing symbols or pictograms which conform to BS 5499-1 satisfy these regulations.

d) Emergency announcements on any public address system, and any electronic visual displays, should be related to, and should augment, exit signs and directional signs.

e) The enforcing authority should be consulted about the siting and positioning of fire safety signs and other visual displays.

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Section 4. Construction

13 Construction

13.1 General

The recommendations in Section 3 are made on the assumption that the provisions for structural fire protection of any building to which this code applies satisfy the appropriate building regulations. Structural fire protection embraces the following matters, but the actual requirements of some of these depend on the size of the building and its relation to the site boundary:

a) fire resistance of structural elements;

b) subdivision of the building into compartments;

c) protection of all shafts connecting different compartments;

d) provision of cavity barriers and fire stops;

e) restriction of spread of flame on surfaces of walls and ceilings;

f) construction of roofs;

g) construction of external walls.

Structural fire protection is intended to ensure that the building will not collapse prematurely in a fire, and that the means of escape will remain unaffected by fire for long enough to ensure that the escape of the occupants can take place without undue risk. It will not, however, necessarily avoid the material loss of property.

It may therefore be desirable, in consideration of interests other than life safety, for designers to seek to provide a higher standard or a more comprehensive application of passive or active fire protection measures than is recommended here.

13.2 Compartmentation

13.2.1 *Commentary*

In order to reduce the possibility of fire spreading uncontrolled throughout the building, consideration needs to be given to dividing the building into two or more fire compartments.

Where the means of escape has been designed on the basis of phased evacuation, then every storey needs to comprise a fire compartment.

Compartment walls and/or floors may also be needed to satisfy the appropriate building regulations.

Guidance on the compartmentation needed for building regulatory purposes is given in technical standards published in support of building regulations. Insurance interests may dictate that a greater degree of compartmentation than that necessary to satisfy building regulations is required.

Within a single occupancy, separation of the different levels of hazard is also generally required. The form and type of this separation will relate to the activities and processes carried out.

Guidance on many of these have been published and are listed in BS 5588-0. Advice may also be obtained from the relevant enforcing authority.

NOTE If the building is to contain an atrium, reference should be made to BS 5588-7.

13.2.2 *Recommendation*

Where phased evacuation is proposed, every floor should be constructed as a compartment floor.

13.3 Fire resistance

13.3.1 *Commentary*

Beams and columns of a structure may not inherently possess sufficient fire resistance. A variety of methods of providing additional fire protection is available in the form of protective coverings, casings or membranes but designers should consider the risk of mechanical or other damage when selecting methods and materials. In some cases such damage can easily reduce or destroy the fire resistance of the element.

Some forms of protection to structural members may suffer the disadvantage that weaknesses may occur at the joints because of the method of fixing. Care also needs to be taken to eliminate any continuity of cavities between adjacent elements.

In the case of suspended ceilings, protecting steel beams, a further weakness may be caused by the introduction of recessed light fittings, ventilation ducts or other features that necessitate the introduction of access panels. These will all reduce the protection afforded by the ceiling and if they have not been tested in such a ceiling their influence should be assessed by a competent body.

A 30 min period of fire resistance is generally considered adequate for means of escape purposes. However, increased periods of fire resistance for some elements of structure may be necessary to ensure the stability of the structure during fire, not only to meet with the building regulations, but also to ensure adequate safety for firefighting. Increased periods of fire resistance may also be needed for property protection and insurance purposes and it is recommended that insurers should be consulted early in the design process.

The fire resistance of elements of construction can be considered satisfactory if they are in accordance with one of the following.

a) *If the elements have been tested, or assessed by a competent body in accordance with the appropriate part of BS 476. The current method of test for fire resistance is published in BS 476-20 to BS 476-24. Although this series of standards replaced BS 476-8 in 1987, guidance in support of the Building Regulations may still refer to BS 476-8. Because of the differences in the way the test was performed prior to the end of 1981, constructions tested to BS 476-8 between the end of 1981 and the end of 1987 are acceptable for the purposes of this code. It should be noted that under BS 476-8 all constructions were evaluated for stability, which in the case of non-loadbearing elements was not well defined. In BS 476-20, non-loadbearing elements are only evaluated with respect to "integrity and insulation" and in the case of load-bearing elements the term "stability" is replaced by "loadbearing capacity", in line with international practice. Brief details of these tests are given in PD 6520.*

b) *If the elements are in accordance with the relevant British Standard design codes, e.g. BS 5268-4, BS 5950-8.*

c) *If the elements conform to specifications permitted under the relevant building legislation (see **4.3**).*

13.3.2 *Recommendations*

The following recommendations are applicable.

a) Where a period of fire-resistance is recommended in this code, the period of resistance should be taken (in the absence of any recommendation to the contrary) as being not less than 30 min. Elements of construction should have the following fire resistance.

1) Loadbearing walls should have equal fire resistance with respect to loadbearing capacity, (and integrity and insulation where appropriate) from either side, [except for walls covered in item 7)] and uninsulated glazed elements permitted in **13.5**).

2) Non-loadbearing walls and partitions should have equal fire resistance with respect to integrity and insulation, from either side [except for walls covered in item 7)] and uninsulated glazed elements permitted in **13.5**).

3) Floors should have fire resistance with respect to loadbearing capacity, integrity and insulation from the lower side.

4) Doors, should have equal fire resistance with respect to integrity from either side, except in the case of doors to:

i) lift wells where fire resistance is with respect to exposure of the landing side only;

ii) external escape routes where fire resistance should be from the inside.

5) Suspended ceilings (other than suspended ceilings protecting structural members), should have fire resistance with respect to integrity and insulation from the underside.

6) Conveyor system enclosures should have equal fire resistance with respect to integrity and insulation from either side.

7) External walls adjacent to an external escape stair (see Figure 13) should have fire resistance with respect to integrity from the inside.

b) Any floor that covers (or partially covers) a fire service access roadway or a public roadway, and any wall separating a covered roadway from the remainder of the building, should have a fire resistance of not less than:

1) 240 min, if it is a floor over a basement, or a wall in a basement; or

2) 120 min, at any other level.

c) The fire resistance of any element of structure should be not less than that required for any element which it supports.

13.4 Vertical shafts for lifts, hoists, services, etc.

13.4.1 *Commentary*

The penetration of fire resisting floors by services and vertical shafts can prejudice the safety of occupants and create points of weakness in the compartmentation, if any, of the building. There are provisions in technical standards published in support of building regulations for the penetration of compartment walls and compartment floors by service ducts and shafts.

*The use and installation of lifts are dealt with in **26.5** and Clause **32**.*

13.4.2 *Recommendations*

The following recommendations are applicable.

a) Lift wells (other than within a protected stairway, see **9.2.2**) where contained wholly within one compartment and located such as to be prejudicial to the means of escape, should be enclosed throughout their height with fire resisting construction.

b) Service shafts and other vertical ducts should be enclosed throughout their height with fire resisting construction. Service ducts should be in accordance with BS 8313 and ventilation and air conditioning ductwork should be in accordance with BS 5588-9.

13.5 Glazed elements

13.5.1 *General*

Glazed elements, when incorporated into walls, partitions and screens which are required to be fire resisting, will need to provide a level of fire resistance (when tested in accordance with BS 476-22) equivalent to that of the structure into which they are installed. For situations subject to the provisions of the Building Regulations (e.g. compartment walls and enclosures to protected shafts) the integrity and insulation of any glazed elements are also subject to these provisions. Glazed elements that are unable to satisfy the insulation criterion may not be acceptable in all instances.

Because of the inability of non-insulating fire resisting glazed elements to afford adequate protection from radiated heat, restrictions may be imposed by Table 8 on the total percentage area permitted or their use may not be recommended unless justified (in fire safety terms) either entirely or below 1.1 m above floor level. To minimize the risk of ignition of adjacent floorings or floor coverings, non-insulating glazed areas in fire resisting structures should be at least 100 mm above floor level.

13.5.2 *Commentary*

The relationship between glass and its supporting structure in combination is very important when considering the performance of a glazed screen or door. The performance of different types of glass when tested in accordance with BS 476-22 cannot be looked at in isolation from the whole assembly under consideration.

In order to design fire resisting glazed assemblies, the following points need full and careful consideration.

a) *Type of glass. The selection of glass is critical and is dependent on the fire performance required, based on tested constructions. In addition the selection of glass may be influenced by a need for sound insulation, anti-bandit or bullet resistance or aesthetic appearance. In addition, glasses may also need to have certain levels of human body impact resistance as recommended in BS 6262.*

b) *Pane size. The maximum pane size suitable for use in the proposed system should be determined by testing in accordance with BS 476-22. If this information is unavailable for a given system, assessments from qualified people need to be obtained.*

c) *Pane shape. There is little information available on the fire resistance of panes in frames other than rectangular. However, the performance of different shapes of glass should be taken to be that of a known shape of equivalent area.*

NOTE The interaction between glass, glazing systems and framing system is complex and can significantly influence the fire resistance performance of the glazed element. Further information on these aspects is to be found in the Code of practice for fire-resistant glazing [13] *produced by the Fire Resistant Glass and Glazed Systems Association (FRGGSA).*

d) *Number of panes. Test evidence on single panes of glass should not be assumed to be relevant when considering a multiple parted situation.*

e) *Orientation. The performance of most fire resisting glazed systems has been confirmed by testing in the vertical position only. If vertically tested systems are to be used in either an inclined or horizontal panel their performance under fire test conditions will be significantly reduced. In such situations assessments from qualified people will need to be obtained.*

The performance of glazed systems in terms of fire resistance and external fire exposure should, wherever possible, be confirmed by test evidence. Where this cannot be provided, or where the proposed glass size is greater than that able to be tested, an expert assessment should be obtained.

Increased periods of fire resistance and/or larger glass sizes than those for which evidence of performance based upon BS 476-22 is available may be possible. However, this may require a change in the glazing or framing system and an assessment of the altered performance should be obtained.

All the glass in all fire resisting glazed elements should conform to the appropriate safety category specified in BS 6206.

13.5.3 *Recommendations*

The following recommendations are applicable.

a) Glazed elements that are fire resisting, in terms of integrity and insulation, to the required level may be used without restriction.

b) Glazed elements that are fire resisting in terms of integrity only should be in accordance with the limitations given in Table 8 appropriate to their position and the provision of escape stairs.

Table 8 — Limitations on non-insulating fire resisting glazed elements

Position of glazed element	Parts of premises with access to more than one stairway		Premises or parts of premises served by a single stairway	
	Maximum total glazed area in		Maximum total glazed area in	
	fire resisting walls[a]	any leaf of a fire door[b]	fire resisting walls[a]	any leaf of a fire door[b]
Directly between a protected stairway and the floor area or a non-fire resisting corridor	Unlimited above 1.1 m height[c]	50% of door area	Nil	25 % of the door area
Between a protected stairway and an enclosed car park	Nil	50% of door area	Nil	25 % of the door area
Between a protected stairway and a protected lobby or protected corridor	Unlimited above 0.1 m height[d]	Unlimited above 0.1 m height[d]	Nil below 1.1 m	Unlimited above 0.1 m height[d]
Between a protected lobby and the floor area	Unlimited above 0.1 m height[d]	Unlimited above 0.1 m height[d]	Nil below 1.1 m	Unlimited above 0.1 m height[d]
Between a protected corridor forming a dead end and the floor area	Unlimited above 1.1 m height[c]	Unlimited above 0.1 m height[d]	Unlimited above 1.1 m height[c]	Unlimited above 0.1 m height[d]
Between a protected corridor not forming a dead end and the floor area	Unlimited above 0.1 m height[d]	Unlimited above 0.1 m height[d]	Not applicable	Not applicable
Subdividing corridors	Unlimited above 0.1 m height[d]	Unlimited above 0.1 m height[d]	Not applicable	Not applicable
Between any escape route and ancillary accommodation	Nil	0.1 m^2 maximum	Nil	0.1 m^2 maximum
Adjacent to an external stair [see **9.7.2**b)]	Unlimited above 1.1 m height[c]	Unlimited above 1.1 m height[c]	Nil	25% of the door area

[a] The size of individual panes of glass making up the permitted total glazed area should be limited to sizes that have been satisfactorily demonstrated to conform to the relevant criteria for an appropriate duration under test. Similarly, any mullions or transoms, especially between adjacent glazed elements, should also be proven.

[b] The suitability of any door with respect to incorporating fire resisting glass should be established before glazing. Moreover, not all doors can be glazed without affecting the integrity of the door assembly.

[c] Measured vertically from the landing floor level or the stair pitch line.

[d] See **13.5.1**.

13.6 Fire doors

13.6.1 *Commentary*

*Fire doors (see **3.16**) are one of the most important links in the chain of fire safety precautions, and the need for care in their selection to ensure that they are adequate for their purpose cannot be over emphasized.*

The failure of doors under fire conditions usually occurs either at the gap between the door and the frame, or at one or more of the points where ironmongery is fixed (particularly at the hinges or lock positions) or, in the case of glazed doors, at the line of the junction between the glazed area and the rest of the door. For this and other reasons it is particularly important to ensure that doors delivered on site conform precisely, in dimensions and workmanship, to the manufacturer's specification for the appropriate fire resistance test report/assessment. Doors should be hung so as to ensure a good fit to the frame when closed.

The ability of fire doors to perform their designed function will depend upon their being fully closed at the time of a fire. They are, therefore, normally required to be fitted with self-closing devices. However, a closing device should not apply significantly more force than is necessary to close the door effectively (and latch it if appropriate). Latches and any seals should be selected and fitted so as not to require an unreasonable opening and closing force.

Where a closed door would cause problems to the normal usage of and circulation in the building, and therefore the door is vulnerable to damage or to being wedged or otherwise held open or to having the closer disconnected, use of electromagnetic (or similar) "hold open" systems may be considered.

The performance of a fire door when tested in accordance with BS 476-22 is judged by its time to failure (in minutes) for each of the criteria of "integrity" and "insulation"; however, requirements and recommendations made in connection with regulations and codes of practice do not normally specify or recommend any performance for "insulation".

*For the purposes of this code, fire doors are designated by reference to their required performance (in minutes) for integrity only, e.g. a reference FD 20 implies that the door in that situation should achieve not less than 20 min integrity, and a reference FD 30 implies not less than 30 min integrity, when tested in accordance with BS 476-22. Where doors are also required to control the passage of smoke at ambient temperature, the suffix "S" is added (see **13.6.2**).*

NOTE 1 The method for the evaluation of the ability of door assemblies to control the movement of smoke at ambient temperature is included in BS 476-31.1. Other sections were intended to be published describing the methods for evaluating the control of medium and high temperature smoke but these will not now be published. The CEN method for evaluating smoke control (prEN 1634-3), which will replace BS 476-31 in due course, will include methods for determining the leakage of ambient and medium temperature smoke. In the context of this standard, only the ambient temperature method is applicable.

NOTE 2 Further information on fire door assemblies and on their installation and maintenance is given in BS 8214.

Although the above-mentioned system of designation specifically excludes any reference to performance with respect to insulation properties, Table 8 recommends limits to the extent of the non-insulating glazed areas in fire doors in certain positions because of the problems of radiation through traditional fire resisting glass. Non-insulated fire doors of a metallic construction can present similar hazards to persons attempting to escape.

Any reference to performance of fire doors when tested in accordance with BS 476-22 is for the purposes of this code only. Depending upon the position of the fire door, a higher performance may be necessary to satisfy building regulations or insurance requirements for structural fire protection.

Guidance on central rebates and selective closures is given in specifications and codes of practice relating to hardware for, and installation of, fire doors, such as BS 5725-1, BS 8214, the ABHM Code of practice for hardware essential to the optimum performance of fire resisting timber doorsets [14] *and the Guild of Architectural Ironmongers (GAI) Code of practice [15].*

13.6.2 *Recommendations*

The following recommendations are applicable.

a) The performance of a fire door should be in accordance with the designation given in Table 9 applicable to its position.

b) Fire doors required to resist the passage of smoke at ambient temperature (i.e. those having the suffix "S" in Table 9), when tested in accordance with BS 476-31.1 with the threshold taped, and subjected to a pressure of 25 Pa, should have a leakage rate not exceeding 3 m^3/h/m. When the door is installed, the threshold gap should be sealed by a seal either with a leakage rate not exceeding 3 m^3/h/m at 25 Pa or just contacting the floor. Where this is impracticable, the threshold gap should not exceed 3 mm at any point.

NOTE If a smoke control system using pressure differentials is used to protect any of the spaces enclosed partly by such doors, then edge seals may be unnecessary and undesirable, depending on the design of the system, and in particular the air flow path(s).

c) A fire door [except to a cupboard, refuse chamber, store room, plant room or service duct, see item d)] should be fitted with a self-closing device (other than rising butt hinges) that is of a type that cannot readily be disconnected or immobilized, does not embody a mechanical hold-open facility, and either:

1) overrides any latches fitted to the door(s); or

2) in the absence of a suitable latch or other positive device for holding the door shut in its frame, is of a type that has been shown by test in accordance with BS 476-22 to be capable of holding the door closed in the frame for:

i) a sufficient period of time for the closing role to be taken over by a thermally activated sealing device (such as an intumescent seal); or

ii) the full period of exposure if such seals are not incorporated.

d) A fire door to a cupboard, refuse chamber, store room, plant room, or service duct, not fitted with a self-closing device, should have means to enable it to be kept locked shut when not in use and should be so marked on both sides with the appropriate sign conforming to BS 5499-1.

e) Unless shown to be satisfactory when tested in accordance with BS 476-22, no part of a hinge on which any fire door is hung, and that provides the sole means of support at the hanging edge, should be made either of combustible material, or of non-combustible material having a melting point of less than 800 °C.

f) Hold-open systems in accordance with **13.7** may be provided for holding open fire doors, or for overriding their self-closing devices. Such doors should be marked on both sides, at about eye level, with the appropriate sign conforming to BS 5499-1.

g) All fire doors should be marked on both sides, at about eye level, with the appropriate sign conforming to BS 5499-1 to the effect that they should be kept closed when not in use.

13.7 Hold-open systems

13.7.1 *Commentary*

A hold-open system is used to hold a fire door in the open position, against the action of a door closer, automatically releasing the door in a fire situation. There are various types of hold-open system available, as follows.

a) *Automatic-release mechanisms that are not part of the door closing device, usually consisting of two separate components, one attached to the door and the other to the building structure.*

b) *Door closing devices that incorporate a hold-open mechanism.*

NOTE Some door closing devices allow the door to swing freely, with the door closer operating only in a fire situation.

To date, a specification has been published only for the automatic-release mechanisms described in item a) (see BS 5839-3).

13.7.2 *Recommendations*

The following recommendations are applicable.

a) Automatic-release mechanisms should conform to BS 5839-3.

b) Other systems should release the door to close automatically in the event of any of the following occurring:

1) the detection of smoke by suitable automatic apparatus;

2) failure of the power supply;

3) operation of the fire alarm system;

4) local manual operation;

5) by a manual operation at a central control point (if provided).

Table 9 — Performance of fire doors

Position of fire doors	Minimum performance designation when tested to BS 476-22 or BS 476-8 as appropriate
A fire door in or forming part of the enclosure of:	
a) a protected stairway	FD 30S
b) a protected lobby (unless it is a firefighting lobby) or protected corridor approach to a protected stairway (see **9.6.2**)	FD 30S
c) a corridor forming a dead end not also being as given in item b) [see **8.6.2**b)]	FD 20S
d) any other protected lobby [see **8.8.2**a)5)] or protected corridor [see **8.7.2**b) and **15.2.2**d)]	
e) a compartment wall provided for horizontal evacuation (see **8.2**)	FD 30S (see note)
f) any accommodation listed in items 1 to 3 of Table 11	FD 30S
g) any accommodation listed in items 4 to 13 of Table 11	FD 60S
h) all lift shafts enclosed with fire resisting construction [see **13.4.2**a)]	FD 30
i) building services ducts etc. [see **13.4.2**b)]	FD 30S
A fire door subdividing:	
a) corridors connecting alternative exits [see **8.6.2**c)]	FD 20S
b) dead-end portions of corridors from the remainder of such corridors [see **8.6.2**c)]	FD 20S
A fire door affording access onto an external stair [see **9.7.2**b)]	FD 30
NOTE Any door situated in a compartment wall should have at least the fire resistance required for that wall.	

13.8 Doors on escape routes

The following recommendations are applicable.

a) Any door provided for means of escape should:

1) be capable of being easily opened;

2) open not less than 90°;

3) be hung to open in the direction of escape, except where the number of people expected to use the door will not exceed 50 and the door does not lead from a room in which a fire may develop very rapidly;

4) be hung so as not to reduce the required width of any escape route;

5) be so sited that any change of floor level occurs more than 400 mm away from the edge of the door when it is open at 90°.

b) Where doors subdivide a corridor or are hung to swing both ways they should be provided with a vision panel in both leaves.

c) Fire doors on escape routes, except external fire doors, should not be fitted with threshold upstands.

d) Automatic doors, turnstiles and revolving doors should not be provided across escape routes unless either 1 or 2 applies as follows:

1) they are to the required width and are automatic doors in accordance with the relevant Part of BS 7036 and one of the following applies:

i) they are arranged to fail safely to outward opening from any position of opening; or

ii) they are provided with a monitored fail-safe system to open the doors if the mains supply, or any alternative power supply, fails; or

iii) they fail safely to the open position in the event of a power failure;

2) non-automatic doors to the required width that open in the direction of escape are provided immediately adjacent.

e) Security grilles and shutters (roller, folding or sliding), loading doors, goods doors, sliding doors and up-and-over doors should not be provided across escape routes 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.

f) Power operated doors should be capable of being easily and quickly opened manually unless an alternative power supply having a capacity of 1 h is provided.

NOTE 1 The alternative power supply should be as described in **29.4.2** if continued operation of the doors on mains failure is desired.

g) Wicket doors and gates should not be provided at exits from high risk areas. Elsewhere, they may be fitted, 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.

NOTE 2 If the fail-safe system recommended in item d)1)ii) relies on electrical power for its operation, the power supply should be continuously monitored to ensure that the power available is sufficient to open the doors. BS 7036 gives guidance and recommendations for automatic power operated door systems.

13.9 Door fastenings

13.9.1 *Commentary*

Doors used for means of escape need to be kept unlocked at all times when persons are in the building and in no case be so fastened that they cannot be easily and immediately opened without the use of a key by the persons escaping.

Where it is necessary to have a fastening it is preferable only to have one. However, where more than one fastening cannot be avoided, all but the single emergency fastening need to be kept released at all times when persons are on the premises.

Where the door is likely to be used at the time of a fire by more than 50 persons, or is an exit from an area in which fire may develop very rapidly or where members of the public are present, and has to be kept fastened while persons are in the building, it is essential that a simple system to open or release the door is utilized.

In other locations where escape is required, the doors need to be easily opened from the risk side without a key. It should be noted that turn buttons and smooth door knobs can be difficult to operate by persons with wet or greasy hands or those with physical disability. The use of lever handles or push pads will reduce these problems.

Where there is a need to fasten doors for security reasons, some other form of fastening may be acceptable. Any such fastenings will need to ensure that the door can be easily opened by persons escaping. It will also be necessary for persons who may have to use the door to understand the method of operation.

Emergency releases of security devices of an electrical type should be linked to the fire alarms system and/or a central control point to ensure their release.

Advice on the security of buildings against crime is given in BS 8220.

13.9.2 *Recommendations*

The following recommendations are applicable.

a) Any door:

1) intended for use by more than 50 persons; or

2) which provides an exit from an area in which fire may develop rapidly; or

3) where members of the public are present; should either be free from fastenings or be fitted with emergency exit devices conforming to BS 5725-1.

b) Doors other than those covered by item a), should be fitted only with simple fastenings that can be operated from the escape side of the door without the use of a key. Lever handles should be provided where possible.

c) Security devices, additional to those mentioned in items a) and b), should be fitted only subject to the agreement of the enforcing authority.

NOTE 1 Where a special form of mechanical fastening is used, a notice providing clear instructions as to its use should be prominently displayed. The use of electrically operated fastenings requires special consideration to ensure that they are readily operable at all material times and will fail safely in the unlocked position.

NOTE 2 Consultation with insurers with respect to any security implications is recommended.

d) Where revolving or sliding doors are used as final exits the recommendations given in **13.8**d), **13.8**e) and **13.8**f) should be followed.

e) If an emergency release is provided at the door it could for example be:

1) a simple switch;

2) a guarded switch to prevent inadvertent operation;

3) a switch of the "break glass to operate" type.

13.10 Recommendations for escape routes

The following recommendations are applicable.

a) All floorings and floor coverings of escape routes including the treads of any stair should be chosen so as to minimize slipperiness when wet.

b) All escape routes should be of the width necessary for the numbers of persons using them (see **8.5** and **9.4**) and should be provided with a clear headroom of not less than 2 m. There should be no intrusion into this width or height other than handrails, door frames and skirtings.

c) There should be no projection from any wall on any part of an escape route, other than normal handrails, which impede the free flow of persons using the escape route.

d) Ramps should have an easy gradient, in no case steeper than 1 in 12.

e) Clear gangways should be provided from all parts of each storey up to and between stairs and exits.

13.11 Recommendations for stairs

The following recommendations are applicable.

a) Stairs should be designed and constructed in accordance with the appropriate part of BS 5395.

b) If an escape route is used by members of the public, the stair should be in accordance with BS 5395-1, or should be a type E (public) stair in accordance with BS 5395-2:1984.

c) Every escape stair and its associated landings should be constructed of materials of limited combustibility if it is:

1) the only stair serving the building (or part of the building);

2) within a basement;

3) serving any storey having a floor level more than 18 m above ground or access level; or

4) an external escape stair [see **9.7.2**a)].

13.12 Ladders

13.12.1 *Commentary*

Portable ladders and throw-out type ladders are not considered suitable means of escape.

Fixed vertical or raking ladders will be suitable only in exceptional circumstances, e.g. for plant rooms that are not normally manned or in process plant buildings and external plant for a limited number of persons who are able-bodied and active enough to be able to negotiate them without difficulty. Where ladders form the means of gaining access to working places it will be reasonable to accept them for means of escape purposes.

13.12.2 *Recommendations*

The following recommendations are applicable.

a) Ladders should not be provided as means of escape for members of the public.

b) Ladders should be provided only as means of escape for not more than 10 able-bodied and active members of staff in circumstances where it is impractical to provide a stair in accordance with **13.11**.

c) Ladders provided as means of escape should be in accordance with BS 5395-3.

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Section 5. Accommodation ancillary to the main use of the building

14 General

This section covers all those parts of the building which are ancillary to the main areas occupied by staff and possibly the public, and which are necessary for the proper functioning of the building, such as:

a) kitchens, staff restaurants and canteens;

b) covered loading bays;

c) engineering services installation rooms;

d) walk-in refrigerated cold rooms;

e) facilities for waste storage and treatment;

f) main storage areas (including receiving and dispatch areas);

g) car parks;

h) repair or maintenance workshops and reprographic rooms;

i) data processing areas;

j) laboratories.

NOTE 1 Where any of these is the main use of the building, the special recommendations in this section would nevertheless apply in addition to other relevant recommendations in Section 3 and Section 4.

NOTE 2 Clause **15** deals with those provisions which relate to means of escape in case of fire. The other clauses in this section provide guidance on good practice.

15 Means of escape provisions for ancillary accommodation

15.1 Escape routes and exits

15.1.1 *Commentary*

The recommendations in Section 3 generally apply, except that in some cases limitations on travel distance within the accommodation are necessary because of the greater risk to persons present in the event of fire. Also, additional measures to safeguard the means of escape from the remainder of the building may be necessary in some cases.

Corridors are commonly formed to provide access to ancillary accommodation. In view of the special risks associated with ancillary accommodation, such corridors need to be enclosed with fire resisting construction.

Preplanning of emergency procedures for car parks needs to take into account the likelihood that a high proportion of the users of the building may have arrived by car and would therefore in an emergency tend to leave via any associated car park. A further consideration is the problem which would be caused if all drivers were motivated simultaneously to remote their vehicles from danger which threatened to include the car parking area.

Unless adjoining car parks are separated from the building and the escape routes therefrom, there is a risk to the occupants of the building in the event of a fire in an associated car park.

15.1.2 *Recommendations*

The following recommendations are applicable.

a) Ancillary accommodation should have means of escape in accordance with the recommendations of Section 3, except that the travel distance from any point should not exceed the limitations given in Table 10.

NOTE Additional recommendations relating to means of escape from kitchens are given in **15.3**.

b) If the travel is initially in one direction only, then:

1) the total travel distance within the room or area to the nearest storey exit (including that part in one direction only) should not exceed the appropriate limit given in Table 10; and

2) either:

i) the travel distance within the room or area to the point at which travel is possible in more than one direction should not exceed the appropriate limit given in column (1) of Table 10; or

ii) in a dead end in part of a storey served by two or more storey exits the angle subtended by the storey exits and the point at which the escape routes diverge should be not less than 45° plus 2.5° for every metre travelled in one direction (see Figure 4).

c) For travel to be considered to be in more than one direction, either:

1) the routes should be not less than 45° apart; or

2) the routes should be separated from each other by fire resisting construction (see Figure 5).

d) Corridors serving ancillary accommodation should:

1) be protected corridors unless the ancillary accommodation does not contain quantities of flammable materials and is under regular surveillance; and

2) be in accordance with the relevant recommendations in **8.6**.

e) Any enclosed car park within or adjoining the building should:

1) have any permitted access between the car park and a stair serving the rest of the building only by way of a ventilated or pressurized protected lobby [see **9.6.2**e)]; and

2) have any external openings situated so as not to endanger any escape route or final exit from any associated accommodation.

Table 10 — Maximum travel distances in areas of ancillary accommodation

Accommodation	Maximum part of travel distance within room or area m	
	Escape in one direction only (1)	Escape in more than one direction (2)
Areas classified as high hazard (see **8.1.1**)	12	25
Any other areas	25	45
NOTE For design purposes direct distance may be used, where the direct distance is two thirds of the travel distance.		

15.2 Separation and enclosure of ancillary accommodation

15.2.1 *Commentary*

Because the fire risks associated with ancillary accommodation are, in most cases, higher than those associated with the main use of the building, ancillary accommodation needs to be separated from the remainder of the building (and especially from any accommodation used by the general public). The degree of separation needed varies with the risk. The recommendations below should be read in conjunction with Section 4.

Ancillary accommodation that may contain quantities of flammable materials, or that may be only occasionally visited and therefore is not under regular surveillance, presents a greater fire hazard than the main accommodation presents. Ancillary accommodation such as offices, staff rest rooms, control rooms and telephone exchanges are considered to present no greater fire hazard than the main accommodation.

Small ancillary offices in shops, factories and warehouses are not likely to pose an undue hazard. Therefore separation from the main floor areas with fire resisting construction need only be provided if such separation is a necessary part of the means of escape of the shop, factory or warehouse as a whole.

*Covered loading bays generally require large openings into the building for easy movement of goods. It is essential to ensure that, should fire occur in a covered loading bay, there can be no rapid spread into the building [see **40.6.2**a)].*

15.2.2 *Recommendations*

The following recommendations are applicable.

a) Ancillary accommodation (including that on the top of a flat roof) should be separated from other parts of the building in accordance with Table 11.

b) Glazed areas separating escape routes from ancillary accommodation should be in accordance with **13.5.3**.

c) Except for small areas of low fire hazard, ancillary accommodation should not open directly into a protected stairway enclosure [see **9.2.2**a)].

d) Boiler rooms, transformer chambers and car parks should be separated from any protected stairway by a protected lobby or protected corridor at the storey in which such accommodation is situated [see **9.6.2**d) and **9.6.2**e)].

e) Covered loading bays should be separated from sales areas in shops by fire resisting construction to a standard equivalent to the fire resistance of the building as a whole.

15.3 Kitchens, staff restaurants and canteens

15.3.1 *Commentary*

In kitchens, staff restaurants and canteens, the main fire risk is associated with the kitchen; it is therefore desirable that the kitchen be separated from its associated restaurant/canteen area by fire resisting construction. This may not always be convenient, in which case the protection needs to encompass the kitchen and restaurant/canteen areas and the kitchen needs to be sited remotely from the restaurant/canteen exit. The recommendations do not apply to a staff kitchen where staff prepare food for their own consumption.

15.3.2 *Recommendations*

The following recommendations are applicable.

a) A kitchen should have at least one escape route independent of any service door to the restaurant or canteen area.

b) Any escape route from a restaurant or canteen area should not pass through the kitchen.

Table 11 — Structural fire protection of areas of ancillary accommodation

Area of ancillary accommodation	The area should be separated from other parts of the building by (see 13.3):
1) Storage areas not greater than 450 m^2 (other than refuse storage areas) 2) Kitchens (separately or in conjunction with an associated staff restaurant or canteen) 3) Engineering services installation rooms [other than those covered by items 9), 10) and 11)] 4) Repair and maintenance workshops where flammable or highly flammable liquids are not used or stored 5) Laboratories classified as high fire hazard areas	Robust construction having a minimum standard of fire resistance of 30 min (see Note 1)
6) Repair and maintenance workshops where flammable or highly flammable liquids are used or stored 7) Storage areas greater than 450 m^2 (other than refuse storage areas) 8) Car parks within or adjoining the building and not greater than 450 m^2 in area 9) Covered loading bays	Robust solid non-combustible construction having a minimum standard of fire resistance of 60 min
10) Refuse storage areas 11) Rooms housing fixed internal combustion engine(s) 12) Boiler rooms and fuel storage spaces 13) Transformer and switchgear rooms for equipment above low voltage 14) Car parks within or adjoining the building and greater than 450 m^2 in area	Robust solid non-combustible construction having a minimum standard of fire resistance equivalent to that required for the elements of construction of the building, and in no case less than 60 min
NOTE 1 Any openings in the required construction should be protected by doors having a similar standard of resistance. NOTE 2 Structural fire protection of areas containing equipment associated with life safety and fire protection are covered in **29.4.2**.	

16 Engineering services installation rooms

16.1 Commentary

Engineering services installation rooms include electrical switchgear rooms, boiler rooms, fuel storage spaces, mechanical ventilation and air conditioning plant rooms, lift machine rooms, rooms housing fixed internal combustion engines, rooms housing refrigeration plant that utilizes a flammable or toxic refrigerant (other than equipment of a domestic nature) and battery charging rooms.

If there is cause to store or use highly flammable substances, the attention of building designers and management is drawn to the relevant legislation and the need to consult the fire authority.

*The enclosure of lift shafts is covered in **13.4**.*

16.2 Recommendations

The following recommendations are applicable.

a) Service installation rooms should be sited so that escape from other exits is not prejudiced by the risk of an outbreak of fire in such a room.

b) Service installation rooms in which flammable liquids or gases are used or stored should have imperforate sills to doorways and any necessary drainage should be provided with interceptors.

c) Service installation rooms should, where necessary for the safe operation of the equipment and to avoid undue build-up of heat, be ventilated (either directly or indirectly) to the outside air. The provision of ventilation for the safe operation of equipment and to avoid undue build-up of heat should not impair any fire resistance requirements for service installation rooms.

17 Walk-in refrigerated cold rooms and associated systems

17.1 Commentary

Refrigerated cold rooms, cold stores and other refrigerated enclosures of the walk-in type (all referred to as cold rooms) are within or part of another building; a cold warehouse is the building itself.
The recommendations apply to cold rooms erected within other buildings. Refrigerators of a domestic type and refrigerated display cabinets are not of themselves considered to need any special consideration.

Cold rooms can be considered to be areas of low risk because in use sources of ignition can be reduced to a minimum. However, in the event of a fire external to the cold room, insulating materials used in the construction of pre-fabricated cold rooms and in the lining of purpose-built cold rooms may be a hazard both to people working in the cold room and to those attempting to put out the fire. During construction and maintenance, care therefore needs to be taken to avoid using heat sources in close proximity to combustible insulating materials and firefighting equipment should be provided within the cold room (see BS 5588-12).

In particular, some modern cellular plastics insulating materials give off large volumes of dense toxic smoke. It is therefore essential that such materials are protected from flame by suitable facings that, if exposed to a localized high intensity fire external to the cold room, do not rapidly fall away. The effects of fire on ceiling panels and their support system also need to be considered. Protection of the insulation may be achieved by incorporating returns to all panels and incorporating some means of ensuring that close contact is maintained between mating faces under fire conditions, or by covering all joints.

If the cold room is large enough, mechanical aids for loading and unloading may be provided, and care needs to be taken to minimize damage to the lining, usually by the provision of suitable barriers or a thicker lining. In large and/or deep cold rooms access points need to be provided to enable firefighting to be more effective.

Refrigeration systems associated with cold rooms should be in accordance with the current codes of practice issued by the Institute of Refrigeration[2)]*, e.g.* A safety code for compression refrigerating systems utilizing ammonia. Part 1: Design and construction [16] *and* Safety code for compression refrigerating systems utilizing chlorofluorocarbons. Part 1: Design and construction [17] *and, where applicable, should conform to BS 4434. Refrigeration plant rooms are covered in Clause* ***16****.*

17.2 Recommendation

Cold rooms and stand alone cold stores should be designed in accordance with the RFIC *Guide to the management and control of the fire risks in temperature controlled structures of the refrigerated food industry* [18], published by the Cold Storage and Distribution Federation.

18 Boiler rooms, fuel storage areas, transformer, battery and switchgear rooms, and rooms housing internal combustion engines

18.1 Recommendations for boiler rooms

The following recommendations are applicable.

a) Oil-fired installations should be in accordance with BS 5410-1 and BS 5410-2.

b) Town, natural and liquefied gas boiler installations should be in accordance with BS 6798 or BS 6644.

c) Boiler rooms (other than those covered by BS 5410-2) should have provision for smoke venting.

NOTE In the design of a boiler room and ancillary spaces the possibility of a future change to other fuels may require consideration.

[2)] Institute of Refrigeration, Kelvin House, 76 Mill Lane, Carshalton, Surrey SM5 2JR.

18.2 Recommendations for fuel storage spaces

The following recommendations are applicable.

a) Oil should be stored and supplied in accordance with BS 5410-1 and BS 5410-2 and BS 799-5.

b) Solid fuel should be stored in bunkers protected by non-combustible walls of sufficient thickness to prevent heating of the fuel by boilers or steam pipes.

c) Fuel storage areas (other than those covered by BS 5410-2) should:

1) have provision for smoke venting;

2) if used for the bulk storage of liquefied petroleum gas, be in accordance with the Health and Safety Executive Guidance Booklet HS(G)34 [19] and Health and Safety Executive Guidance Note CS4 [20].

18.3 Recommendations for medium and high voltage transformer and switchgear rooms, and battery rooms

The following recommendations are applicable.

a) A medium or high voltage transformer, or switchgear room, or battery room, unless situated on the roof or in a separate enclosure should be sited adjacent to an external wall and entered only from the open air.

b) A medium or high voltage transformer, or switchgear room, or battery room, should be ventilated.

18.4 Recommendation for rooms housing fixed internal combustion engines

The following recommendations are applicable.

a) Rooms housing fixed internal combustion engines should have escape routes of such a number and so situated that the part of the travel distance within the room from any point does not exceed the limitations given in Table 10.

b) Liquefied petroleum gas fired engines should be surrounded by a vapour dispersion wall in accordance with the Health and Safety Executive Guidance Booklet HS(G)34 [19] and Health and Safety Executive Guidance Note CS4 [20]. [See **18.2**c)2) for storage of liquefied petroleum gas.]

c) Rooms housing fixed internal combustion engines should be separated from any protected stairway by a fire resisting lobby or corridor.

19 Waste storage and treatment

19.1 Commentary

Waste retained in premises constitutes a fire risk, particularly if it is bulky. BS 5906 gives advice on the collection, storage and disposal of waste, together with information about on-site treatment systems such as compactors, balers and incinerators which reduce the volume of waste and its fire risk.

19.2 Recommendation

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

20 Main storage areas (including receiving and dispatch areas)

20.1 Commentary

*Main storage areas include areas to be used for the storage of goods for sale/dispatch, furniture, stationery, waste paper/packaging and similar combustible material (see Clause **19**), receiving and dispatch rooms and packing and sorting rooms.*

Smoke-venting of large storage areas is important, especially those below ground level where windows cannot normally be provided. If possible, storage areas need to be sited adjacent to an external wall to facilitate the provision of clean air inlets and smoke extracts, which should discharge at or above ground level and be so situated that smoke from them cannot jeopardize the means of escape from the building. It is preferable, moreover, that storage areas are not sited adjacent to escape routes to which the public have access.

Examples of highly flammable or explosive substances are highly flammable liquids with a flashpoint below 21°C, liquefied petroleum gases and highly flammable solids. If there is cause to store or use highly flammable substances, the attention of building designers and management is drawn to the relevant legislation, and advice should be sought from the fire authority or, in appropriate cases, the Petroleum Licensing Authority. The authority will impose appropriate requirements and these may be additional to any recommendations in this code.

Office and sales areas generally, and areas used by the public in particular, need to be kept free of highly flammable substances to avoid their being considered as areas of high risk. Such substances need to be kept in stock rooms to which the public is not admitted.

20.2 Recommendation

Main storage areas, if either:

a) situated below ground level; or

b) exceeding 450 m^2 in area;

should have provision for smoke venting in accordance with **40.6**.

21 Recommendations for car parks

Any enclosed car park within or adjoining the building should:

a) be provided with means for venting smoke (see **39.2.1**);

b) be provided with suitable access for firefighting (see Clause **40**); and

c) have imperforate sills to doorways and any necessary drainage should be provided with interceptors.

22 Repair or maintenance workshops and reprographic rooms

In some shops and large office buildings space may be required for workshops, for instance for the repair of goods or for maintenance or repair of equipment.

Reprographic facilities are common in many buildings and where the facilities are relatively small special protection is not necessary. However, in some cases reprographic facilities may be sufficiently extensive to justify accommodating the equipment in rooms separated from any associated accommodation.

If highly flammable materials are used or stored in any of these areas, special requirements may be imposed by the fire authority or Inspectors of the Health and Safety Executive.

23 Data processing areas

Some rooms may be used for the accommodation of data processing equipment, which is not only of great intrinsic value but also susceptible to damage by fire, heat, smoke or water. Such rooms do not normally offer any substantial risk of fire but, for the protection of the contents from a fire occurring elsewhere, the room needs to be enclosed. Many other special precautions may have to be considered in relation to these rooms, including the choice of materials for enclosure and interior surfaces, the restriction of entry by ventilation or service ducts into the rooms, the provision of fire detection equipment, and the provision of special firefighting equipment. These matters are dealt with in detail in BS 6266. Advice is also obtainable from the Loss Prevention Council.[3)]

24 Laboratories

24.1 Commentary

*Laboratories can fulfil a wide range of functions, involving the testing, research and development of products. The scale of these may range from small-scale "bench-top" work to "pilot-scale" manufacture and full-scale test facilities. Where these activities involve the storage, handling and use of significant quantities of highly flammable, reactive or explosive materials, the laboratories should be classified as High Fire Hazard Areas [see **8.1.1**c)].*

Fires involving such materials are likely to be very intense and escalate rapidly, possibly generating smoke and fumes that are significantly more toxic than those from fires involving standard building materials. It is therefore important that people are able to evacuate the laboratory quickly, and that the laboratory enclosure is sufficiently robust to withstand the intensity of the fire until people have reached a place of safety.

A common feature of laboratories is local exhaust and general mechanical ventilation systems. Careful thought needs to be given to the design and installation of these to ensure that they do not provide a weak point for fire to break through to the rest of the building.

*Specific requirements, not necessarily confined to the fire hazard, often apply to operations involving highly flammable, reactive or explosive materials. Early consultation with the relevant enforcing authorities is therefore recommended (see **4.3**). BS 5588-0 also lists relevant guidance.*

24.2 Recommendations

Laboratories classified as high fire hazard areas should:

a) be enclosed and separated from the rest of the building (see Table 11);

b) have restricted travel distances (see Table 10).

Where ventilation ductwork is provided it should be designed and installed to prevent the spread of flames and hot gases to the rest of the building (see **26.4**).

3) The Loss Prevention Council, Melrose Avenue, Borehamwood, Hertfordshire, WD6 2BJ.

Section 6. Engineering services

25 General

In this code engineering services comprise the following:

a) gas services;

b) electrical services and wiring;

c) lighting;

d) heating systems;

e) mechanical ventilation and air conditioning systems;

f) lifts, escalators and conveyor systems;

g) incinerators.

NOTE Clause **26** deals with those provisions which relate to means of escape in case of fire. The other clauses in this section provide guidance on good practice.

26 Engineering services for means of escape

26.1 Recommendations for gas services

New installation and service pipes should not be run in a protected stairway or lobby, where this provides the only means of escape in case of fire. Where installation and service pipes in such a stairway or lobby are to be replaced, consideration should be given to the possibility of their re-siting outside the stairway or lobby.

NOTE It may be impractical to avoid running installation and service pipes through protected stairways or lobbies in extensions and alterations to existing buildings.

26.2 Recommendations for electrical services

The following recommendations are applicable.

a) Electrical risers within any protected stairway should be separated therefrom by 30 minute fire resisting construction and access doors, which should be kept locked shut and be openable only by the management responsible for the building.

b) Meters installed within any protected stairway should be enclosed within a secure cupboard, which is of 30 minute fire resisting construction.

26.3 Lighting of escape routes

26.3.1 *Commentary*

Regular occupants of buildings can be expected to be familiar with the normal circulation stairs, corridors etc., which could also be the escape routes. Members of the public cannot be expected to be familiar with all of the various circulation routes within a shop, although they may be aware of the access to and egress from a particular sales floor. In order to clearly delineate internal circulatory routes, lighting needs to be provided and maintained in all escape routes.

Special provisions also need to be made for the lighting of escape routes in certain places to ensure good visibility should the main or local electricity supply fail for any reason. It should also be possible to see any directional or warning signs associated with escape routes, changes in floor level and the location of fire alarm call points and firefighting equipment.

The essential feature of escape lighting is that it is designed to provide illumination when part or all of the normal lighting has failed. There are various types of escape lighting, e.g. maintained alight continuously; not alight until the local circuit has failed, then lighting automatically;
single-independent self-contained, battery-powered luminaires or systems powered by a central battery or generator.

When determining the need to provide escape lighting, factors such as the number of members of the public and staff likely to be on the premises and any adjacent occupancies may have to be taken into account. It is therefore advised that consultation with the appropriate enforcing authorities should be sought at an early stage.

26.3.2 *Recommendations*

The following recommendations are applicable.

a) Artificial lighting should be provided to all escape routes, and should be of a sufficient standard to enable persons to see to escape.

b) In addition to the system of artificial lighting, and subject to item c), escape lighting should be provided in all escape routes within the following:

1) underground or windowless accommodation;

2) all stairs without natural or borrowed light and all stairs serving storeys 18 m or more above ground level;

3) internal corridors without borrowed light;

4) external escape routes, other than stairways, not having a satisfactory amount of borrowed normal lighting from a street (see Note 1);

5) those parts of a shop or commercial premises used by members of the public (including their escape routes), except that such lighting need not be provided in small shops (see Clause **10**) provided that the shop is not or does not contain a restaurant or bar;

6) premises or areas of premises regularly used outside normal daylight hours (see Note 3);

7) all escape routes in public car parks;

8) electricity generator rooms, switch rooms and battery rooms for emergency lighting systems, central control rooms and fire control centres.

c) Infrequently used areas and areas not exceeding 10 m^2 in area, need not be provided with escape lighting.

d) Escape lighting should be in accordance with the appropriate recommendations in BS 5266-1.

NOTE 1 In extensive external areas it may be appropriate to consider alternative methods of ensuring that escape routes are illuminated at all times escape is necessary, e.g. dual supplies or standby generators.

NOTE 2 Where there are a large number of other signs within a floor area, consideration should be given to the provision of internally illuminated exit signs.

NOTE 3 In buildings used only intermittently or for short periods during the hours of darkness, e.g. by cleaners, or during the late afternoon in the winter, the provision of exit signs illuminated by escape lighting is considered adequate in place of a full escape lighting system.

NOTE 4 The recommendations of BS 5588-5 for lighting within a firefighting shaft may be more onerous than the recommendations of BS 5266-1.

26.4 Mechanical ventilation and air conditioning systems

26.4.1 *Commentary*

These systems may vary from a simple ventilation system to full air conditioning. In large buildings extensive ductwork is likely to be required, and an understanding of the principles of passive fire protection in such systems is essential to avoid fire hazards, of which the main ones are as follows.

a) *Flames and hot gases (smoke), by breaking into and out of horizontal or vertical ductwork, can spread a fire from one part of the building to another. If the ductwork insulation is flammable, this hazard is greater.*

b) *Flames may spread to another part of the building because of the lack of fire-stopping around ductwork where it penetrates fire resisting separation.*

c) *In the event of a fire, a ventilating or air conditioning system using a proportion of recirculated air may distribute smoke and hot gases throughout the building.*

d) *In higher buildings with sealed windows, the smashing of glass to facilitate smoke removal could result in a hazard to people from falling glass or flying shards. This situation may be avoided if smoke venting facilities are provided in accordance with the recommendations of **40.6.2**c) and **40.6.2**g).*

Although environmental air movement may have ceased, the buoyancy inherent in fire gases can cause smoke to enter ductwork through any grilles or openings, to move along the ductwork and to exit via other grilles or openings.

It is also important to ensure that the movement of air is away from escape routes so as to prevent, as far as possible, smoke-laden air being carried into protected escape routes and exits.

Mechanical ventilation and air conditioning plant rooms are most likely to be situated in a basement, on the roof, or possibly both. The main risk of fire in such areas, provided the enclosures are adequate, is from the nature of the installation itself, unless there is provision for an automatic fire detection system to close down the plant, and unless adequate fire dampers are included in the ductwork system.

Smoke control systems using pressure differentials are covered in BS 5588-4. However, if such a system is to be provided for the protection of escape routes against the ingress of smoke and toxic gases, the accepted practice in the design of ventilation and air conditioning systems should be modified so as to achieve compatibility between the two systems. BS 5839-1 gives guidance on the siting of smoke detectors.

26.4.2 *Recommendations*

The following recommendations are applicable.

a) Ventilation and air conditioning ductwork should be installed in accordance with BS 5588-9.

b) Mechanical ventilation and air conditioning plant should be installed in accordance with BS 5720.

c) Service ducts should be installed in accordance with BS 8313.

NOTE 1 See also **39.5** if the system is also used for smoke ventilation arrangements.

d) Except for a smoke control ventilation system, arrangements should be made in a ventilation and air conditioning system either so that smoke detected is discharged to the outer air according to the recommendations of BS 5588-9, or so that the system is shut down.

e) The operation of the normal mechanical ventilation system should not jeopardize the operational efficiency of any life safety system within the building.

NOTE 2 Where the normal mechanical ventilation system is also used for any smoke control ventilation arrangements, the whole of the system (including fans, ductwork, controls and wiring) should be of a standard suitable for the smoke temperatures and pressures likely to develop. (See **39.5**.)

f) Any system of mechanical ventilation should be designed to ensure that in the event of fire the airflow pattern is away from protected escape routes and exits. This pattern may be achieved by the use of automatic change-over devices operated by the fire detection and alarm system, which should also be capable of manual operation.

g) Ventilation and air conditioning systems should be compatible with any smoke control system installed employing pressure differentials (see BS 5588-4).

26.5 Lifts and escalators

26.5.1 *Commentary*

Experience in fires has shown that misuse or malfunctioning of lifts has caused a number of deaths, attributed amongst other things to failure of the power supply or lifts being called to or held at the fire floor. For these reasons it is not appropriate to use passenger lifts (other than lifts designed specifically for the evacuation of disabled persons) for means of escape. For the same reasons, it is not appropriate to use goods and service lifts in the event of fire.

Although escalators cannot be considered as escape stairs (see Clause ***7****), measures need to be taken to safeguard any persons using them at the time of the fire. Escalators need to be under management control (see BS 5588-12).*

26.5.2 *Recommendations*

The following recommendations are applicable.

a) Evacuation lifts should be in accordance with BS 5588-8.

b) *Text deleted.*

c) Escalators may continue to run, but should be disregarded for means of escape purposes and access to them controlled by management.

d) Goods and service lifts should be entered from protected lobbies on all levels above and below any loading dock.

27 Enclosure of engineering services

27.1 Commentary

Some engineering services are potential sources of fire, and it is essential that the equipment associated with them is installed and maintained in accordance with the relevant codes of practice and safety regulations.

The importance of correct installation in the first place is emphasized, because electrical, lighting, heating and ventilation systems may be concealed above suspended ceilings and/or within service ducts. Electrical control gear is also often located behind ceiling and wall panels. Installation faults that might lead to fire are particularly dangerous because the fire is likely to remain undiscovered for a time.

*NOTE Rooms in which engineering services are contained are dealt with under ancillary accommodation in Clause **16**.*

Platform floors may be provided in some buildings for the installation of services to equipment and work stations. Two types of platform floors are in common use:

a) *those with limited access, having runs of removable panels, individual access traps, or both;*

b) *those with full access, having a loadbearing deck comprising removable panels supported on adjustable pedestals.*

*With either type, a fire may develop in the void formed between the underside of the platform floor and the upper surface of the structural floor beneath. The platform floor needs to retain its loadbearing function and contain the fire for a period of time sufficient for the occupants to escape. The usual conditions of test for determining the fire resistance of elements (currently BS 476-20 to BS 476-23) are not appropriate for determining the fire behaviour of a platform floor. A small-scale fire could occur, however, and hence the tests for such conditions published by the Property Services Agency should be used [see **27.2**b)].*

In this context, a reference to a "structural floor" includes the oversite or sealing floor slab of the lowest floor in the building.

27.2 Recommendations

The following recommendations are applicable.

a) Ducts for engineering and building services should be in accordance with BS 8313; ductwork for ventilation and air conditioning should be in accordance with BS 5588-9.

b) Any platform floor where the depth between the top of the structural floor beneath and the underside of the platform floor above is more than 200 mm, or where the total area of the floor is more than 64 m^2, should satisfy the requirements given in *Method of Building MOB PF2 PS and MOB PF2 PS/SPU Performance specification: Platform floors* (1990) [21], published by the Department of the Environment, Property Services Agency, for a period of not less than 30 min. The test should be performed in accordance with the test procedure for partial access floors (T40.00) or for full access floors (T19.00) as appropriate.

28 Gas services

28.1 Natural gas

28.1.1 *Commentary*

The installation of gas fittings, including installation pipework, meters and appliances, is controlled by the Gas Safety (Installation) (Amendment) Regulations 1996 [22]. Service pipes are subject to the provisions of the Gas Safety Regulations 1972 [23]. These Regulations should be referred to for specific details.

Further guidance may be found in the following publications.

a) Recommendations on Transmission and Distribution Practice IGE/TD/4: *Edition 3:1994 Gas Services [24].*

b) Gas installation pipework, boosters and compressors on industrial and commercial premises (*with amendments) Institution of Gas Engineers publication IGE/UP/2 (1994) [25].*

c) Fire precautions for use in buildings in the Gas Industry *Institution of Gas Engineers publication IGE/SR/17 (1992) [26].*

28.1.2 *Recommendations for service and installation pipework*

The following recommendations are applicable.

a) All gas service and installation pipes should be installed such that the fire resistance of the building is unimpaired.

b) In large buildings emergency control valves should be located external to the building.

28.2 Meter installations

The meter installation is covered by the Gas Safety (Installation) (Amendment) Regulations 1996 [22] and by the Institution of Gas Engineers publication IGE/GM/1 *Gas meter installations for pressures not exceeding 100 bar* [27].

28.3 Liquefied petroleum gas (LPG)

The recommendations detailed for natural gas services are also considered appropriate to LPG services and in general the principles detailed in the guidance referred to are also applicable to LPG services. Further guidance on LPG pipework is to be found in LPGITA (Liquefied Petroleum Gas Industry Technical Association) Code of Practice No. 22 (1990) *LPG piping system design and installation* [28] published by the LP Gas Association. For further advice, the appropriate body should be consulted.

29 Electrical services

NOTE This clause does not cover automatic fire detection and alarm systems.

29.1 Recommendations for electrical installations

The following recommendations are applicable.

a) All electrical services should be installed, and periodically inspected and tested (with any necessary maintenance carried out), by suitably qualified engineers in accordance with BS 7671 (IEE Wiring Regulations).

b) The size of the electrical risers should be only large enough to accommodate the electrical services, and/or any working space needed to install/maintain the equipment.

c) Electrical risers where installed elsewhere than in a stairway should be enclosed with fire resisting construction of a standard equivalent to the elements of structure of the building and the doors thereto should be kept locked shut.

However, where each floor is continued into the riser shaft so that each floor is separated from the other, the riser need not be enclosed with fire resisting construction.

29.2 Electrical power supplies to life safety and fire protection equipment

29.2.1 *Commentary*

Since it is not possible to determine where a fire may start, all power supplies to life safety and fire protection equipment, and their associated control equipment back to the origin of the supply within the building should be regarded as being within the hazard/risk area. Therefore great care needs to be taken in the design to ensure power is available at all times.

Consideration also needs to be given, not only to routing of cables, but to positions of terminations, circuit protection facilities and control panels, to ensure that these are also provided with protection from the effects of fire.

29.2.2 *Recommendations*

The following recommendations are applicable.

a) The electrical power supply to life safety and fire protection equipment should be separate from all other circuits in the building so that the failure of other equipment does not render the installation inoperative.

b) Each connection to the power supply should be via an isolating protective device reserved solely for the life safety and fire protection equipment and independent of any other main or submain circuit. Such isolating protective devices (with high-rupturing safety devices) should be clearly labelled and identified as to their purpose. They should be secured against unauthorized operation and should, except for maintenance, be kept locked-on.

c) The supply to these isolating protective devices should be independent of the main switch for the building and be appropriately labelled.

d) Where a central control room is provided, monitoring facilities should be provided at the central control room to show, as far as is reasonably practical, that power is available up to the final control point, e.g. motor contactor, to all fire safety systems.

29.3 Protected circuits for the operation of equipment in the event of fire

29.3.1 *Commentary*

Wiring systems for the power supply to electrical equipment required to operate in the event of fire need to be of a type or installed in a manner such that, in the event of fire anywhere in the building, the circuits will continue to operate and the cables will maintain circuit integrity.

29.3.2 *Recommendations*

The following recommendations are applicable.

a) The wiring systems should either:

1) consist of mineral-insulated, copper-sheathed cables conforming to BS 6207-1, or consist of cables conforming to the requirements for classification as CWZ in accordance with BS 6387:1994; or

2) be protected against exposure to the fire by separation from any significant fire risk by a wall, partition or floor with a fire resistance of not less than that required for the building.

NOTE 1 Where appropriate, conformity is for integrity and insulation from the side of the construction remote from the cable.

NOTE 2 The mechanical protection of cables by conduit, ducting or trunking should not be considered to give protection against fire.

b) The wiring systems should be separate from any circuit provided for any other purpose.

c) Jointing and termination methods should conform to BS 6207-2 and should be chosen to minimize any reduction in reliability and resistance to fire below that of unjointed cable.

d) Wiring systems in accordance with items a), b) and c) should be provided for fire extinguishing systems, sprinkler systems, smoke control systems, firefighting shaft systems, motorised fire shutters, CCTV systems installed for monitoring means of escape, and data communications systems that link fire safety systems.

e) The wiring systems should be protected from mechanical damage.

29.4 Primary and secondary power supplies

29.4.1 *Commentary*

To reduce the risk of the loss of electrical supply in a fire, a secondary power supply is essential. This supply needs to be from a generator or a separate substation, which is of sufficient capacity to maintain supplies to the life safety installations, including powered smoke control systems and systems using pressure differentials and ancillary equipment and fire safety systems. The secondary power system needs to be designed to operate safely in fire conditions. Consideration of the means for the provision of a secondary supply ought to include the overall electrical distribution system within the building, and also the power needs for other equipment requiring a secondary power supply.

NOTE A power supply from a second substation would not offer protection, against the occurrence of a fault that may be on the high-voltage distribution network unconnected with a fire in the building (such as the severing of a high-voltage cable during construction work), as this could affect both substations. If protection against such faults is required, then either a generator needs to be provided, or a power supply needs to be taken from a high-voltage distribution network different to that normally supplying the building.

The changeover from the primary to the secondary power supply needs to be automatic so that the life safety installations continue operation. Both the primary and secondary supplies to the life safety installations need to be sufficiently protected against fire and water damage, and also separated from each other, so that the failure of cables or equipment, either by mechanical breakdown or damage by fire, in any one system, does not affect the other supply. Protection against fire may be achieved by choice of cable, choice of route (for example, through protected areas, or external to the building) or by the provision of additional fire protection.

It is essential that the fire procedures of the building do not include the isolation of circuits supplying power to the above mentioned equipment.

29.4.2 *Recommendations*

The following recommendations are applicable.

a) A secondary power supply independent of the primary power supply to the building, e.g. an automatically started generator or a supply from another substation, should be provided which, independently of the primary supply, will be of sufficient capacity to maintain in operation for at least 3 h the following:

1) any powered smoke control systems (including systems using pressure differentials);

2) any fire service communication systems; and

3) any other fire protection or firefighting equipment; except automatic fire detection and alarm systems.

b) The secondary power supply should be capable of providing the power supply for items 1), 2) and 3) within 15 s of the failure of the primary electrical supply. Where the alternative power source is a generator, it should be capable of providing the power necessary for at least 3 h without replenishment of fuel.

c) Where the secondary electrical supply is to be taken from a separate substation to that supplying the primary electrical supply, the following criteria should be satisfied.

1) The electrical supplies to the two independent substations should be taken from two separate high-voltage supplies, and not originate from the same substation.

2) The failure of one substation should not lead to the failure of the other.

3) The two independent substations should be adequately separated. Where the substations are located within the building they serve, the following criteria should be satisfied:

i) each substation should be enclosed within a fire resisting structure having a minimum of two hours fire resistance;

ii) the two sub-stations should be located in two separate parts of the building.

4) Supply cables from the high-voltage substations should enter directly the high-voltage/low-voltage switchrooms and not pass through the building.

5) The two sets of supply cables should be adequately separated from each other to avoid a single fault affecting both supplies.

d) Whichever secondary power source is provided, the distribution should be organized such that the secondary supply remains live when the remainder of the supplies in the building are isolated in an emergency.

e) Cables supplying current to the life safety installations should be installed in accordance with BS 7671 and manufacturer's instructions. The cables should have an inherently high resistance to fire and be protected where necessary against mechanical damage. Cables, switchgear and other equipment transmitting the secondary power supply should be separate from those of the primary supply, or be physically protected so that a breakdown, or any cause of breakdown, on one supply would not lead to a simultaneous failure of the other supply.

f) The primary and secondary power supply cables should be terminated in a change-over device located within the plant room(s) housing the life safety and fire protection equipment. The change-over device should automatically effect the transition from the primary to the secondary power supply if the primary supply to the particular plant fails.

g) Any electrical substation or enclosures containing any distribution board, generator, powered smoke control plant, pressurization plant, communication equipment, and any other equipment associated with life safety and fire protection systems, should be separated from the building by construction with a duration of fire resistance of not less than 2 h.

h) Secondary power supplies should be provided for the following:

1) sprinkler pumps;

2) wet riser pumps;

3) firefighting lifts;

4) firefighting intercommunications installations;

5) pressurization fans (air supply and pressure relief);

6) depressurization fans (air supply and pressure relief);

7) smoke control system.

30 Lighting

30.1 Types of luminaire

30.1.1 *Commentary*

Luminaires range from tubular fluorescent to filament and high-pressure lamps, Fluorescent luminaires operate at relatively low temperatures and the tubes themselves are not likely to be a source of fire. Electrical breakdown of associated gear and wiring in the luminaire, however, may lead to ignition of adjacent combustible materials. Correct installation is therefore essential.

All incandescent filament lamps and high-pressure discharge lamps operate at elevated temperatures, and where such lamps are used they should not be close to or fixed to materials that are readily ignited. Care should be taken in the selection of plastics materials or finishes, some of which can be highly flammable.

Methods of lighting can be subdivided broadly into three groups:

a) *recessed luminaires;*

b) *illuminated ceilings;*

c) *luminaires at or below ceiling level.*

30.1.2 *Recommendation*

Luminaires should conform to the relevant Part and Section of BS 4533.

30.2 Recessed luminaires

30.2.1 *Commentary*

When recessed luminaires are within suspended ceilings they can overheat, resulting in failure of the insulation of electric wiring and apparatus. The control gear of fluorescent luminaires is particularly likely to cause overheating, as is the use of incandescent lamps of a wattage in excess of the design standard.

Such overheating may result in fire within a concealed space, with consequential problems of detection and extinguishment. A ceiling having recessed luminaires may be intended to contribute to the fire resistance of beams or a floor above. In such a case, any perforations for fittings or access are a potential source of failure of the ceiling.

30.2.2 *Recommendation*

Where luminaires are recessed into a fire resisting/fire protecting suspended ceiling, the protection afforded by the ceiling should be maintained by the provision of a fire resisting barrier behind the fitting and any accessway to the fitting.

30.3 Illuminated ceilings

By the nature of their function and the construction and materials used, these ceilings contribute nothing to the fire resistance of the structure. The materials might be combustible and care in their selection is important in order to reduce to a minimum their contribution to any fire that may occur.

30.4 Luminaires at or below ceiling level

Luminaires at or below ceiling level, if properly fitted and maintained, usually present a negligible fire risk, but care is necessary in siting to avoid interference with the water distribution pattern of sprinkler heads (if fitted). Care is also necessary to prevent accidental operation of sprinklers and fire detectors by heat from luminaires. Where spot and other low-level luminaires are used, care needs to be taken to avoid close proximity to combustible goods and materials and to ensure that there is no heat built up within a confined area. In service corridors, loading bays and engineering services rooms the use of pendant-type luminaires should be avoided; bulkhead type luminaires are preferable.

30.5 Firefighters' emergency switches for discharge lighting installations

30.5.1 *Commentary*

Discharge lighting installations, such as floodlights and neon advertising signs, may operate at voltages that are a hazard to firefighters.

30.5.2 *Recommendation*

An exterior or interior discharge lighting installation operating at a voltage exceeding low voltage, should be controlled by a firefighters' emergency switch, installed and situated in accordance with BS 7671 and the requirements of the fire authority.

31 Heating systems

31.1 Commentary

Experience has shown that, in buildings of all sizes, few fires are caused by central-heating systems. Most fires from heating appliances are produced by local heating units, particularly those that are not fixed (see BS 5588-12).

NOTE The installation of heating appliances and systems is controlled by building regulations and by regulations applicable to the fuel(s) used.

31.2 Recommendation

All heating appliances and systems should be in accordance with, and should be installed in accordance with, the relevant specifications and codes of practice.

NOTE Attention is drawn to the relevant legislation (see Note to **31.1**).

32 Lifts, escalators and conveyor systems

32.1 Commentary

*The enclosure of lift shafts is covered in **13.4.2**. Firefighting lifts are covered in **40.4**.*

32.2 Recommendations

The following recommendations are applicable.

a) Lifts for passengers and goods, goods hoists, passenger conveyors and escalators, should be installed in accordance with the relevant Part(s) of BS 5655.

b) Lift machine rooms should conform to the appropriate Part of BS 5655.

c) Where escalators connect different compartments:

1) the shutter(s) protecting the opening(s) should not be connected to a fire alarm system or to a central control point;

2) on the fusing of the link operating the shutter(s), an audible warning should sound for a period of 30 s, and during the sounding of the warning the escalator should steadily come to a standstill if still moving.

d) Where goods conveyors connect different compartments:

1) the closure(s) protecting the openings should either be connected to the fire detection and alarm system, or operated automatically by local heat or smoke detectors;

2) closures on goods conveyors should be controlled in such a way that they seek or make a suitable gap in the payload to allow full closing.

33 Incinerators

33.1 Commentary

There are two main types of incinerators:

a) *incinerators for the disposal of bulk waste;*

b) *sanitary incinerators for toilets.*

Incinerators may be fired by gas or electricity, but, irrespective of the source of heating, the fire risk arises from the nature and bulk of the waste to be consumed.

All types of incinerators, except those fired by electricity, are controlled (as fittings) by building regulations. The means of flueing incinerators, including those fired by electricity, are also controlled by building regulations with regard to the discharge of products of combustion and the risk of fire spread.

33.2 Recommendation

Incinerators, other than sanitary incinerators, require special consideration, and preferably should be isolated in a separate building.

Section 7. Fire protection facilities

34 General

Section 3, Section 4, Section 5 and Section 6 of this code cover those passive aspects of fire protection in which the fixed and permanent features of the design and construction of the building are so selected and disposed as to provide either control of the progress of a fire or protection of the occupants of the building in the event of fire, or both. This section and BS 5588-12 cover active measures of fire protection such as detecting a fire, giving the alarm, restricting the development of a fire, extinguishing a fire, and securing the safe escape of the occupants. This section also deals with access and facilities for the fire service. These elements are closely related and some introduction in the procedures which should be adopted in case of fire are necessary in order that guidance on active fire protection facilities may be given proper perspective.

Active fire protection is divided into mechanical and electrical equipment and systems covered in this section, and organizational and managerial activities and responsibilities covered in BS 5588-12. It should be noted, however, that although much of BS 5588-12 is concerned with the correct action to be taken by managements of buildings, either to avoid the occurrence of fire altogether, or to ensure appropriate action in the event of fire, significant responsibilities are also set out for the servicing and maintenance of those provisions which are described in this section.

Some of the recommendations of this section arise from legal requirements relating to life safety, whereas the remainder refer to installations or equipment that a wise owner will prescribe in the building for reducing risk of property loss. Many of the recommendations are consequent upon the requirements of the Fire Precautions Act 1971 [6] in connection with the issue of fire certificates and the statutory duty imposed on occupiers of factories, offices, shops and railway premises not required to have a fire certificate. Because of these statutory requirements, consultation at an early stage with the fire authority is desirable. (See also **4.4** in connection with protection of property.)

NOTE Clause **35** deals with those provisions which relate to means of escape in case of fire. The other clauses in this section provide guidance on good practice.

35 Fire protection facilities for means of escape

35.1 Fire detection and alarm systems

35.1.1 *Commentary*

Irrespective of any other devices that may be installed in a building to detect and give warning of a fire outbreak, most office buildings, shops and factories are required by law to have some means whereby the alarm of fire may be given by a person discovering a fire.

Mandatory requirements for the provision of fire warning systems are contained in the Fire Precautions Act 1971 [6] and the Fire Certificates (Special Premises) Regulations 1976 [1]. The fire authority or the Health and Safety Executive needs to be consulted as appropriate.

Generally, the minimum statutory requirement for premises requiring a fire certificate will be an electrical system in accordance with the recommendations applicable to a Type M system as described in BS 5839-1. In some very small premises, a less sophisticated system of manually operated sounders may be acceptable.

If a building is designed for phased evacuation, automatic detection of fire will be essential in order to initiate an evacuation.

NOTE BS 5839-1 gives recommendations on the design of fire detection and alarm systems, and includes advice relevant to buildings in multiple occupancy.

35.1.2 *Recommendations*

The following recommendations are applicable.

a) The installation, design, servicing, testing and maintenance of all fire detection and alarm systems should be in accordance with BS 5839-1.

b) Fire warning that is audible/perceptible throughout the premises should be installed in a building if any outbreak of fire cannot be readily seen from any part of any floor area.

NOTE Attention is drawn to the legal requirements for provision of fire warning systems (see **35.1.1**).

c) In a small single or two-storey building, one or more manual fire alarms may be installed. If manual alarm(s) are installed:

1) the alarm should be audible throughout the building when any one manual fire alarm is operated;

2) each manual fire alarm should be placed in a safe area near an exit;

3) the mechanism of any manual fire alarm should be reliable.

d) Where a phased evacuation strategy has been adopted, a type L3 automatic fire detection system, in accordance with BS 5839-1:1988 should be installed.

e) Where automatic, fire control systems are designed to be actuated by automatic fire detectors, the combined systems should be commissioned and tested together (see BS 5588-12).

f) In spaces where smoke control and/or other automatic fire protection devices are employed, the automatic fire detection system should be zoned in accordance with the zoning arrangements for those facilities.

g) Where automatic fire detection systems are employed to initiate fire protection measures, care should be taken to ensure that the operation of a detector, other than in the fire zone, cannot prejudice the effective operation of those measures.

h) Where active fire protection measures can (or need) to be activated, care should be taken to ensure that actuation signals from each system are compatible and complementary.

35.2 Staged alarms and evacuation procedures

35.2.1 *Commentary*

NOTE 1 Phased evacuation is a system of evacuation in which different parts of the building are evacuated in a controlled sequence of phases, those parts of the building expected to be at greatest risk being evacuated first. A phased evacuation will normally require at least a two-stage alarm system.

NOTE 2 A staged alarm system enables two or more stages of alarm to be given within a given area e.g. "alert" or "evacuate" signals or "staff alarm" and "evacuate" signals.

In many premises it is best if operation of a manual call point or fire detector gives an almost instantaneous warning from all the fire alarm sounders for a simultaneous evacuation of the premises.

However, in some very large or complex buildings the evacuation procedure may be based upon the initial evacuation of the area most at risk. In this procedure the operation of a call point or detector gives an evacuation signal in the areas at risk, and an alert or standby warning in all other parts of the premises. An evacuation signal may then be sounded in all other parts of the premises as necessary. In this respect, a public address system is likely to be more effective than fire alarm sounders as a means of initiating and managing an evacuation.

If a multi-stage fire alarm system is considered it is essential that there is early consultation with the fire authority.

A two-stage fire warning may be provided for the evacuation of the fire floor and the floor above, followed by evacuation of the remainder of the building. In such a case, the evacuation procedure is not described as phased evacuation because the means of escape provisions are based on simultaneous evacuation. The second phase is initiated automatically unless the alarm of fire is acknowledged at the fire alarm control panel within a predetermined time.

35.2.2 *Recommendations*

The following recommendations are applicable.

a) *Text deleted.*

b) Where necessary to facilitate the agreed evacuation procedure, the fire alarm system should be capable of giving two distinctive forms of audible warning to signify "evacuate" and "alert" respectively. The distinction between these two stages of alarm should be consistent throughout the building.

c) A central control room should be provided from which the supervision of all matters relating to the fire and safety of the building may be efficiently carried out. The central control room should have overriding control of audible warning devices to permit the use of the public address system.

d) Provision should be made for automatic operation of the agreed emergency procedures if manual control of the system has not been put into effect within a predetermined time, following the initiation of the first alarm of fire. This should include the operation of pre-recorded messages where appropriate.

e) On the initiation of a fire alarm, the transmission of other public address messages, music etc., should be automatically discontinued. The public address system should automatically reset to the predetermined emergency status in respect of volume, sector divisions, etc.

f) The use of CCTV, fire telephones and personal radios is subject to agreement with the appropriate enforcing authority.

35.3 Communications with the occupants

35.3.1 *Commentary*

*The need for verbal guidance in an emergency has already been mentioned in **35.2** and, therefore, alarms other than via the public address system should be avoided.*

35.3.2 *Recommendations*

The following recommendations are applicable.

a) A public address (voice alarm) system in accordance with BS 5839-1 should be provided where the building is designed for phased evacuation.

b) Emergency announcements should be preceded by a distinctive intrusive sound unique to all emergency conditions.

c) The facilities for public address in the central control room should include arrangements for making separate announcements in each part of the building and for addressing all parts of the building simultaneously.

d) The volume of emergency announcements made from the central control room should be at least 5 dB(A) above the ambient background noise level anticipated in an emergency, in every part of the building.

NOTE If a powered smoke ventilation system is provided, the volume of any emergency announcements needs to take account of any noise generated by that system.

35.4 Smoke control arrangements

35.4.1 *Commentary*

If stairways are likely to be used by occupants of a building to escape from fire it is essential that they remain free from smoke and heat for sufficient time for evacuation of the building. This need is considered to be met under normal circumstances by the provision of fire resisting enclosures and fire resisting self-closing doors.

NOTE 1 For fire fighting shafts see BS 5588-5.

NOTE 2 For atrium buildings see BS 5588-7.

35.4.2 *Recommendation*

Any scheme for smoke control using a powered pressure differential system should be designed and installed in accordance with BS 5588-4.

36 Fire detection and alarm systems

36.1 Fire detection systems

36.1.1 *Commentary*

*In the arrangements described in **35.1**, reliance is placed on people for discovering and giving warning of fire. In most instances this is adequate in terms of compulsory provision for life safety but it will not suffice in large or complex buildings nor will it suffice for the protection of property.*

In parts of a building only visited occasionally and in buildings or premises left unattended at night, a fire detection system may reduce the time between the outbreak of fire and its discovery. This will only be fully realized if the system is connected to a central fire alarm station.

A fire detection system can initiate a variety of functions, including closing down ventilation and air-conditioning plant, bringing fire control systems into operation, opening ventilators or starting fans for the control of smoke, and operating door release mechanisms. Where an automatic fire detection system is installed solely to activate fire protection devices, then a distinct signal should be provided at any central control room to indicate that there is a fire, and that the system has been activated.

36.1.2 *Recommendations*

The following recommendations are applicable.

a) Where automatic fire control systems are designed to be actuated by automatic fire detectors, the systems will be combined and should therefore be commissioned and tested together (see BS 5588-12).

b) Areas provided with a smoke control system should be protected by an automatic fire detection system using smoke sensitive detectors.

c) In spaces where smoke control and/or other automatic fire protection devices are employed, the automatic fire detection system(s) should be zoned in accordance with the zoning arrangements for those facilities.

d) Where automatic fire detection systems are employed to initiate other active fire protection measures, care should be taken to ensure that the accidental operation of a detector other than in the fire zone cannot prejudice the operation of the active fire protection devices.

e) Where active fire protection measures can (or need to) be activated from one or more zones, care should be taken to ensure that the actuation signals from each system are compatible and complementary.

f) The performance of all automatic fire detection equipment designed for life safety or property protection should be in accordance with the recommendations of BS 5839-1.

g) The installation, servicing, testing and maintenance of all automatic fire detection equipment should be in accordance with the relevant recommendations of BS 5839-1.

36.2 Communications with the fire service

36.2.1 *Commentary*

It is essential that the fire service is alerted in every emergency. This can be done in a number of ways, usually via the 999 telephone system. It may also be achieved by installing an automatic system relaying fire alarms to a central alarm station. Guidance on the choice of system in given in BS 5839-1 and early consultation with the fire authority is advised.

36.2.2 *Recommendations*

The following recommendations are applicable.

a) *Text deleted.*

b) If a control room is provided in a building, provision should be made for telephone communication with all the public emergency services to be independent of all other telephone traffic.

37 Automatic fire protection systems and special risk protection

37.1 General

The value of automatic extinguishing systems in buildings lies in overcoming delays in fire-fighting. Automatic extinguishing systems may also be necessary to protect special risks. They are useful in high and deep buildings, and buildings with basements where fire-fighting may be difficult.

Several forms of automatic fire protection systems may be appropriate to provide effective protection for life safety, or property, or both. Guidance on the selection of automatic fire extinguishing systems is given in BS 5306-0.

A distinction has to be made between "space protection" i.e. covering the bulk of the building space likely to contain predominantly carbonaceous materials for which water is a suitable extinguishing medium, and protection covering a special risk, which may need a particular extinguishing medium.

37.2 Sprinkler systems

37.2.1 *Commentary*

Automatic water sprinkler systems will provide efficient means of fire control throughout most parts of office buildings, shops, factories and warehouses, ensuring:

a) *detection of a fire at an early stage;*

b) *control of fire growth, fire spread, heat and smoke generation, by delivering water to the seat of the fire;*

c) *the provision of a local alarm of system operation, and transmission of the alarm of fire to any central control room; and*

d) *if appropriately arranged, the transmission of an alarm to the fire service.*

The following are some of the main points to be considered in the design, installation and maintenance of a sprinkler system.

1) *The decision to install a sprinkler system needs to be taken at an early stage in the design of the development; early decision to install a sprinkler system could avoid the necessity of installing unsightly (and costly) exposed pipe runs. Supplies of water, and possibly storage space for water tanks, will be required.*

2) *A sprinkler system needs to be integrated with other fire safety systems, and especially with a smoke control system.*

The efficient operation of a sprinkler system depends upon the heat of a fire opening the appropriate sprinkler head or heads. Any obstruction to the flow of heated air to the heads by a suspended ceiling, light fittings or partitioned off areas closed at the top, can severely interfere with the system. It is desirable that within a radius of each sprinkler head a clear space be maintained below the level of the sprinkler deflector plate. In rooms used for storage, goods need to be stacked to a limited height. Recommendations for these distances are included in BS 5306-2.

37.2.2 *Recommendations*

The following recommendations are applicable.

a) Sprinkler protection should be provided in:

1) a shop having a fire compartment exceeding 1 000 m^2;

2) buildings with a height (see **3.23**) exceeding 30 m;

3) large storage buildings.

b) The design, installation, maintenance and user responsibilities of sprinkler systems, and the operating temperatures of the sprinkler heads, should be in accordance with BS 5306-2. If a sprinkler system is provided as part of a smoke control system, or if it is to be in a building designed for phased evacuation, it should also meet the life safety recommendations of BS 5306-2.

37.3 Special risk protection

37.3.1 *Commentary*

Apart from the general coverage by a sprinkler system, there may be special risks which justify the installation of an automatic extinguishing system associated with the risk alone. Examples already mentioned elsewhere in this code are engineering services installation rooms, e.g. transformers and switchgear rooms, data processing equipment and air filters and oil baths in ventilation systems.

Automatic fixed gas, powder, water spray deluge systems or other purpose-designed extinguishing systems are appropriate in certain locations such as machinery or transformer and electrical switchgear rooms. In some instances, they may be needed as an adjunct to sprinkler systems to protect equipment in service areas or hot processes (such as bakers' ovens and deep fat fryers).

In general, systems for the protection of special risks require to be designed to suit the specific circumstances, and specialized designers and manufacturers should be consulted. Guidance on the selection of automatic fire extinguishing systems is given in BS 5306-0. Carbon dioxide systems are covered in BS 5306-4, halon systems in BS 5306-5, foam systems in BS 5306-6 and powder systems in BS 5306-7. The protection of data processing equipment is covered in BS 6266.

NOTE For environmental reasons, halon systems should be installed only where there is no other practicable alternative extinguishing agent.

If the application of foam by the fire service is considered, it needs to be discussed with the fire service first, as many fire appliances are no longer fitted with the necessary foam-generating equipment.

*Standard automatic sprinkler protection ought to be used in the remaining areas of the rooms listed in **37.3.2** items a), b) and c).*

37.3.2 *Recommendations*

The following recommendations are applicable.

a) Rooms containing oil-filled electrical gear should be protected by automatic high-velocity waterspray systems conforming to BS 5306-2.

b) Rooms containing machinery and non-oil-filled electrical gear should be protected by gaseous extinguishing systems conforming to BS 5306-4 or BS 5306-5.

c) Rooms containing oil-fired boilers and oil fuel stores should be protected by automatic high-velocity waterspray systems conforming to BS 5306-2 over the oil tanks and the oil-firing ends of boilers, or (where considered appropriate) by automatic foam systems or foam inlets for fire service use.

d) Automatic fire extinguishing systems, foam inlets and equipment on premises should be installed, in consultation with the fire authority, in accordance with the appropriate Parts of BS 5306, or for data processing equipment, in accordance with BS 6266.

38 Portable firefighting equipment

38.1 Commentary

Irrespective of the provision of fixed fire protection facilities such as sprinklers within a building, firefighting equipment such as portable extinguishers or hose reels should be provided. This may be a legal requirement under the Fire Precautions Act 1971 [6] and the Fire Certificates (Special Premises) Regulations 1976 [1]. Portable firefighting equipment enables trained staff to tackle a fire whilst the fire brigade is on its way.

Portable firefighting equipment can be used to good effect if a fire is detected in its early stages before any automatic system has operated. This will inhibit the growth of the fire and so reduce life hazard and financial loss.

Hose reels are best suited to large open floor areas where they will not obstruct fire doors, whilst extinguishers should be provided where accommodation is divided into rooms and corridors. Where there is a special risk or process, appropriate extinguishers should be provided adjacent to that risk.

Where automatic systems may be out of service during maintenance, additional firefighting equipment may be necessary.

It is essential that the relevant enforcing authority is consulted regarding the provision, siting and maintenance of portable firefighting equipment.

38.2 Recommendations

The following recommendations are applicable.

a) Suitable means for manually fighting fire should be provided throughout the building for use by persons in the building.

b) Portable fire extinguishers should conform to BS EN 3 and should be installed and maintained in accordance with BS 5306-3.

c) Hydraulic hose reels should conform to BS EN 761-1:1995 and should be installed in accordance with BS 5306-1.

d) Equipment should be so sited as to be readily available in areas not likely to be involved in the early stages of a fire and should, if possible, be grouped at fire points (preferably adjacent to storey exits or by fire alarm call points).

39 Smoke control provisions

39.1 General

Smoke control in buildings is used for:

a) the protection of means of escape;

b) assistance to the fire service during firefighting operations;

c) damage limitation.

NOTE 1 Smoke control arrangements for means of escape are dealt with in **35.4**

NOTE 2 Smoke control arrangements to assist firefighting are dealt with in **40.6**.

The initial aim of smoke control is to raise smoke above head height by venting smoke and hot gases by direct means to the external atmosphere.

The recommendations made in Section 3 and Section 5 to enable the occupants of a building to escape safely in the event of a fire occurring anywhere in that building are based on limiting travel distances and providing, where necessary, protected escape routes. The measures in those sections for smoke control in corridors and protected escape routes are based on the principle of containment.

Where the nature, use or occupancy of a building appear to pose a greater threat to the rapid and efficient evacuation of the building, or where the limitations on unprotected travel distances impose constraints on the use of the building, a fire safety engineering solution may require the provision of a smoke control system.

Although the role of any such smoke control system may be principally one of life safety, it should also be remembered that firefighting becomes both difficult and dangerous in a smoke-logged building.

Other clauses of this code are concerned with detection and alarm systems to give early warning of a fire, sprinklers to control the spread of fire, and planning of escape. The interaction between the smoke control system and these other arrangements needs to be considered at the design stage.

The design of smoke control systems is a specialized field and advice should be sought from appropriately qualified and experienced persons.

Further guidance may be found in references [29] to [35]. Information on design fires is given in BR 258 [35]

39.2 Smoke control arrangements

39.2.1 *Recommendation for smoke control in enclosed car parks*

Enclosed car parks including underground enclosed car parks should be provided with one of the following means for venting smoke:

a) permanent vents with a total free area not less than 2.5 % of the floor area, uniformly distributed to produce cross-ventilation; or

b) a powered smoke exhaust system as described in the BRE Report BR 186 *Design principles for smoke ventilation in enclosed shopping centres* [36].

39.2.2 *Recommendations for smoke shafts*

The following recommendations are applicable.

a) If smoke shafts are led up through the building to discharge direct to the open air, the outlets should be maintained unobstructed, or be covered only with:

1) non-combustible grilles and/or louvres; or

2) smoke outlet terminals conforming to BS 7346-1 or BS 7346-2.

b) Shafts serving smoke outlets should:

1) be provided separately from different basement levels and from such accommodation as boiler rooms, rooms containing oil-filled switchgear, storage spaces and car parks;

2) for natural (buoyancy driven) systems, have throughout their length a cross-sectional area not less than the smoke outlets they serve, or have their size (area) supported by appropriate hydraulic calculations;

3) be enclosed with solid non-combustible material having a fire resistance not less than that required for the storey served, or through which they pass, whichever is the higher.

39.3 Control of automatic smoke ventilation

39.3.1 *Commentary*

It is important for life safety purposes that the arrangements for the control of smoke come into effect without delay once the presence of smoke is detected. The automatic detection of smoke and the automatic operation of the smoke ventilation equipment needs to take precedence over the provision of any manual controls that may appear to be desirable. A fire service override needs to be provided at a location to be agreed with the fire authority.

Such arrangements include the automatic shutting-down of mechanical ventilation and air-conditioning plant, including air curtain systems at doorways and circulatory systems connected with energy conservation, the opening of smoke ventilators, the release of smoke curtains and the energizing of powered smoke ventilation plant. The sequencing and extent of the replacement air arrangements for the smoke ventilation system are very important and may depend on the location at which smoke is detected. They require detailed consultation with the fire authority.

39.3.2 *Recommendations*

The following recommendations are applicable.

a) All arrangements for the control of smoke should be either permanently fixed in position or automatic in operation and, where possible, fall safe.

b) The control system for a powered smoke ventilation system should be designed so that in the event of any failure in the control circuit, whether caused by fire or not, the system will be actuated.

c) Automatic fire detection equipment used in connection with the control of smoke should operate on the principle of smoke detection and should be installed in accordance with BS 5839-1.

d) Automatic electrical connections by means of relays or similar devices to shut down or operate circuitry for the purpose of the control of smoke should be initiated immediately a fire is detected.

e) The extent and nature of the arrangements controlled by, or brought into operation by, the automatic detection of smoke, should be adequate for the control of smoke resulting from a fire at the location where smoke has been detected. Zoning arrangements should be appropriate for this purpose.

f) All equipment for the control of automatic operations should be the direct responsibility of the management of the building and should be under the control of that management.

39.4 Air-conditioning/ventilation ductwork used for smoke ventilation

39.4.1 *Commentary*

Air-conditioning/ventilation ductwork used in conjunction with smoke ventilation systems presents a risk of the spread of smoke and fire within the building. Careful consideration therefore needs to be given to fire protection, integrity, construction and routing of air-conditioning/ventilation ductwork used for smoke ventilation.

39.4.2 *Recommendations*

The following recommendations are applicable.

a) Air-conditioning/ventilation ductwork used for smoke ventilation should be protected against fire penetration where it is routed beyond a fire resisting barrier. If the ductwork requires fire protection to be installed external to the ductwork, the fire protection should be supported such that it will remain in place and retain its effectiveness when subjected to fire from either side of the ductwork. Additional insulation should be supported from the building structure unless the ductwork supports are designed to bear the additional load.

b) Fusible link and intumescent type fire dampers should not be fitted in the ductwork.

c) The construction of the ductwork should be braced to maintain the integrity of the ductwork at the high temperatures and pressures that may exist when smoke is being vented, and should be designed to accommodate thermal expansion without distortion or damage.

d) All the materials associated with air-conditioning/ventilation systems used for smoke ventilation should be designed to ensure that the system will continue to operate when any part is exposed to fire.

e) Unless the design of the smoke ventilation system specifically does not allow the possibility, fire/smoke dampers which are operated by smoke detectors associated with the air-conditioning/ventilation system(s) should all fail-safe to the correct position for the system(s) to work satisfactorily in the smoke ventilation mode. Where there is no fail-safe position possible (e.g. where one fan or one set of fans is intended to serve one of several smoke control zones, selectable by controllable dampers), the reliability of the dampers should be acceptable to the approving authority.

39.5 Powered smoke ventilation systems

39.5.1 *Commentary*

It is essential that powered smoke ventilation systems provided for life safety purposes remain operational at all times. Because of the risk that one of the extractor fans might be unserviceable, it is essential that the capacity of the system is oversized, or that standby fans are provided. Fans may be located within the smoke control zone or in a plant room remote from, and connected by ductwork to, the smoke control zone(s). Fans may be mounted in plant rooms within the building, or on the exterior of the building, usually in groups serving one or more smoke control zones.

39.5.2 *Recommendations*

The following recommendations are applicable.

a) Components of powered smoke ventilation systems should have a minimum temperature classification in excess of the calculated temperature of the smoke layer. The classifications are given in BS 7346-2:1990.

b) Each smoke control zone should be provided with sufficient fans to enable smoke to be extracted in such a way as to maintain the base of the smoke layer at or above its design height.

c) If the smoke ventilation is achieved by the provision of powered exhaust ventilators, then at least two ventilators should be provided for each smoke reservoir, and the aggregate capacity of the ventilators serving the smoke control zone should be such that recommendation b) will be met when, in turn, the largest capacity ventilator in each reservoir is discounted.

NOTE 1 This recommendation may be met by either:

1) providing an additional powered exhaust ventilator; or

2) providing ventilators with excess capacity.

d) There should be no fewer than two fans in each plant room or group of fans serving a single smoke control zone, and the aggregate capacity of the fans serving the smoke control zone should be such that recommendation b) will be met when, in every plant room or group of fans serving the zone, the largest capacity fan is discounted.

NOTE 2 This recommendation may be met by either:

1) providing an additional fan; or

2) providing fans with excess capacity.

e) In each plant room or group of fans serving two or more smoke control zones there should be:

1) no fewer than two fans, and the aggregate capacity of the fans should be such that recommendation b) will be met for each smoke control zone served by the plant room or group of fans; and

2) an additional fan with a capacity of not less than that of the largest fan in the plant room or group of fans.

f) An additional fan provided to meet recommendation d) or e) 2) should be automatically activated in the event of failure of a fan in the plant room or group of fans.

NOTE 3 Detection of failure of a fan may be achieved by either:

1) monitoring the fan power circuit; or

2) monitoring the air flow produced by the fans in the plant room or group of fans.

40 Facilities for the fire service

40.1 General

In order for firefighters to deal with a fire in a building, it is first necessary for them to drive their fire appliances to entrances giving them access to the interior of the building. They then need to transport themselves and their equipment from this point to the scene of the fire. In extensive multi-storey buildings, this route may be long and involve travel to upper or lower levels. Even in single-storey buildings, travel within the building may be extensive. Having reached the scene of the fire they will need, amongst other things, a supply of water at sufficient pressure to enable them to deal with the fire.

The presence of smoke and heat may also seriously hamper and delay firefighters' efforts to effect rescues and carry out firefighting operations. The provision of smoke control measures required to assist means of escape will also aid firefighting, and will be necessary to assist firefighting in some areas such as enclosed car parks and covered service areas where it is not required for means of escape.

Good communications between firefighters at the scene of an incident are vital to successful firefighting, particularly in buildings where the design makes personal contact between firefighting teams and management difficult.

Effective command and control of firefighting operations is essential in large/high/complex buildings, preferably carried out from an agreed location. Many fire services have their own mobile command centres which need to be located outside the building, but more effective command and control is possible from a fire control centre sited within the building from which control of communications and fire safety systems is possible and where there is contact with the management of the building.

It is important that the time taken to reach the actual scene of a fire, by a sufficient number of firefighters provided with resources to effect any necessary rescues and commence firefighting operations, is kept to an absolute minimum. Early consultation with the fire and local authorities is advised to identify and remedy potential difficulties in providing facilities to assist the fire service.

Guidance on access and facilities for the fire service can be found in approved documents published in support of the building regulations. However, as fire appliances are not standardized it is essential that the fire authority is consulted at an early stage regarding its requirements for access roadways.

40.2 Single-storey buildings

40.2.1 *Commentary*

Single-storey buildings pose fewer difficulties for firefighters than multi-storey buildings. However, a single-storey building may cover an extensive area and therefore access roadways may still be necessary to enable fire appliances to drive near to entry points of the building.

Firefighters will still have to lay hose between the fire appliance and the fire, and therefore it is desirable that this distance be kept to a minimum. The provision of a wet fire main system will reduce the amount of hose which needs to be laid.

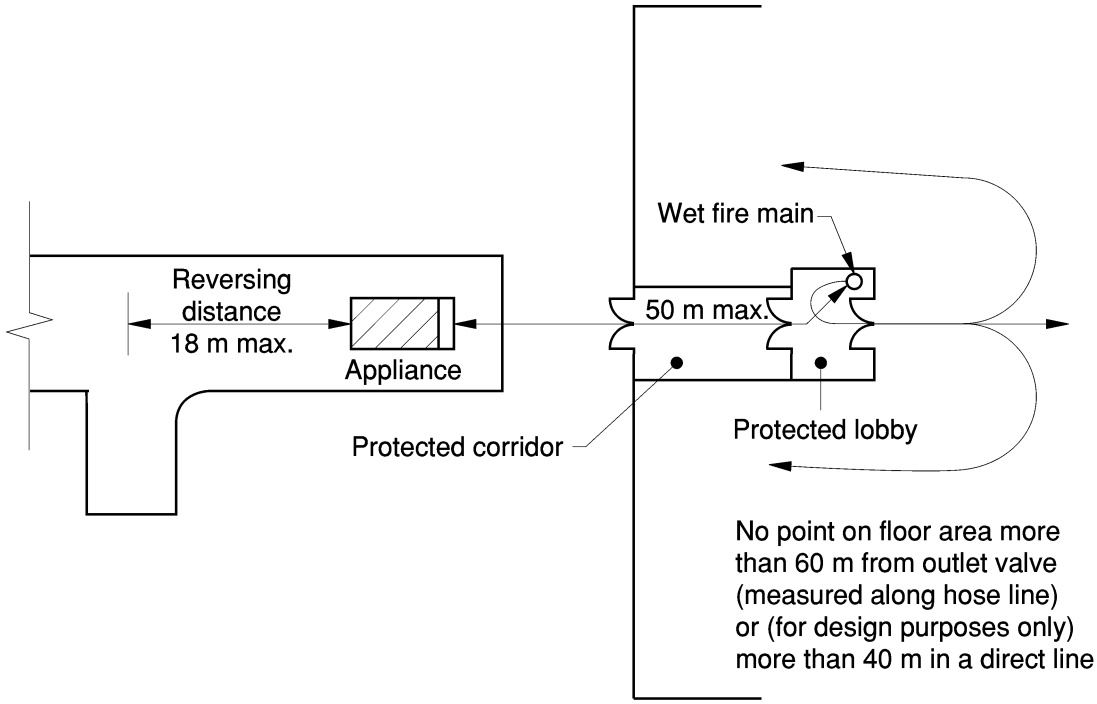


Figure 17 — Access to floor areas in single-storey complexes with wet fire main

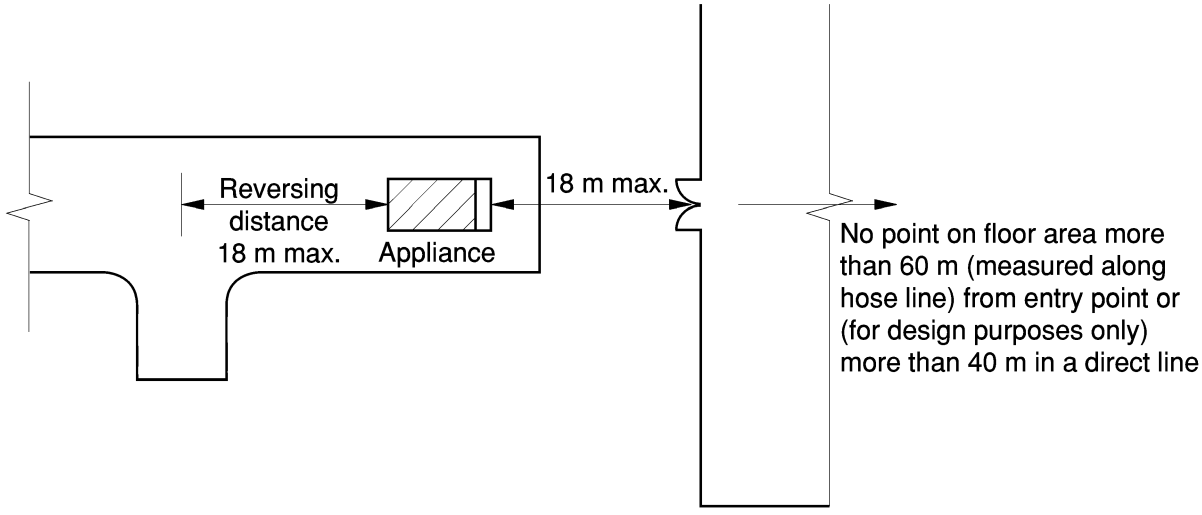


Figure 18 — Access to floor areas in single-storey complexes with no fire main

40.2.2 *Recommendations*

The following recommendations are applicable.

a) Roadways should be constructed to allow access for fire appliances.

b) Entry points to buildings should be readily identifiable to the fire service.

c) If a wet fire main system conforming to BS 5306-1 is installed, fire appliance access should be provided to within 50 m of each of a sufficient number of outlet valves such that no point in the building is more than 60 m from an outlet valve, measured along a route suitable for laying hose (see Figure 17).

d) If a wet fire main system is not installed, fire appliance access should be provided within 18 m of each of a sufficient number of entry points so that no point in the building is more than 60 m from an entry point, measured along a route suitable for laying hose (see Figure 18).

NOTE If the internal layout is not known at the planning stage, a direct line measurement of 40 m may be used for design purposes, provided that the building when occupied satisfies the 60 m criterion.

e) Turnround facilities should be provided so that fire appliances do not have to reverse more than 18 m.

f) The relevant recommendations in **40.6** to **40.10** should be followed.

40.3 Fire appliance access roadways to multi-storey buildings

40.3.1 *Commentary*

Roadways of the required width, loadbearing capacity and suitable gradient will enable fire appliances to reach the perimeter of the building and gain access to the entry point(s) into the building. These roadways may be public highways or, if within the boundaries of a large site, they may be service roadways used by vehicles delivering goods. These access roads may be covered and at any level. If they are covered, or are at low level, and are to be used by fire appliances to gain access into the building, then special provisions will be needed to make this possible. The fire resistance of any floors over an access roadway will need to be such that possibility of collapse onto fire appliances at work during a fire is remote. If access roads are enclosed at any level, then venting of exhaust fumes will be necessary. Emergency lighting and communications facilities will also need to be considered.

The provision of turnround facilities or hammer-heads should be considered so that fire appliances do not have to reverse over extended distances.

40.3.2 *Recommendations*

The following recommendations are applicable.

a) Access roadways should:

1) be constructed to meet the requirements of the fire authority;

2) be positioned such as to allow pumping appliances to proceed to within either:

i) 18 m of, and in sight of, each dry fire main inlet connection point (see Figure 19); or

ii) the distance given in **40.5.2**b) if a wet fire main system is installed;

3) be positioned such as to allow pumping appliances to proceed within 18 m of, and in sight of, any other inlet points, e.g. foam inlet, or infill points to sprinkler or wet main storage tanks;

4) be provided with turnround facilities so that fire appliances do not have to reverse more than 18 m (see Figure 19).

b) Hard standings should be level or not exceed a gradient of 1 in 12.

c) Enclosed or covered access roadways at any level should be in accordance with recommendations in **13.3.2**b) and, in addition to the recommendations in item a), should be provided with:

1) ventilation to remove exhaust fumes from a pumping appliance in operation;

2) fire telephones in accordance with **40.7.2**;

3) primary lighting;

4) a 3 h emergency lighting system in accordance with BS 5266-1.

40.4 Access for firefighters to the interior of multi-storey large buildings

40.4.1 *Commentary*

Access roadways enable fire appliances to reach entry points into the building. Generally these entry points will be the normal means of ingress/egress used by the occupants of the building, unless they are located in service areas.

From these entry points, facilities are needed to enable firefighters to reach any point on the premises, and to take with them easily and quickly such items of equipment as they require for an immediate attack on the fire. These facilities take the form of firefighting stairs, but a firefighting lift, which enables the speedy transport of personnel and equipment to upper and lower floors, will be appropriate in certain circumstances.

The advantages gained by providing stairs and lifts will be lost if firefighters then need to lay hose from the appliance via the stairway to the fire. Therefore a fire main with landing valves in each lobby of the firefighting stair is needed. This main will generally be dry, but in large or complex buildings a wet main system may be necessary.

These facilities, namely the stair, lobbies, fire mains, and where necessary the firefighting lift, combine to form a firefighting shaft. The number of firefighting shafts required will generally depend on the number of floors and the area covered by the building. However, that number and location should be such that firefighters do not have to cover extensive areas from any one shaft.

There is no restriction on the use of firefighting stairs for the normal movement of people between storeys or their use as means of escape stairs in an emergency.

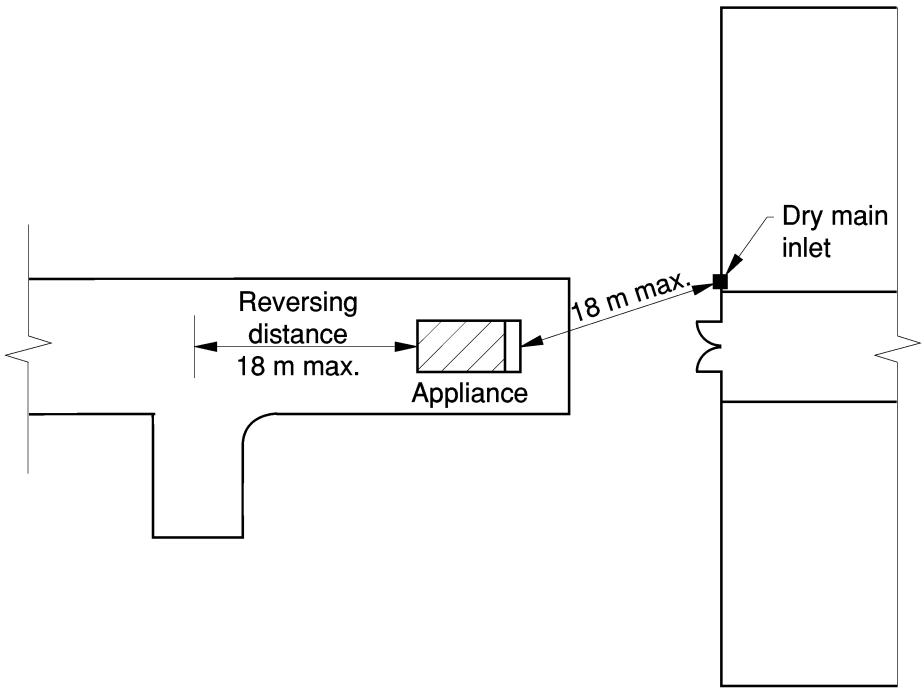


Figure 19 — Access to fire main inlets in multi-storey complexes

40.4.2 *Recommendations*

The following recommendations are applicable.

a) Buildings or parts of buildings exceeding 18 m in height or 9 m in depth should be provided with firefighting shafts (each incorporating a firefighting lift) in accordance with BS 5588-5.

b) Buildings exceeding 7.5 m in height with the area of any storey above the ground storey exceeding 600 m^2 should be provided with firefighting shafts (which need not incorporate a firefighting lift) in accordance with BS 5588-5.

c) In buildings identified in items a) and b), sufficient firefighting shafts should be provided so that on every storey:

1) exceeding 18 m in height; or

2) exceeding 9 m in depth; or

3) above the ground storey in buildings described in item b);

the area on that storey served by any firefighting shaft does not exceed 900 m^2 and every part of that storey is not more than 60 m from a fire main outlet valve, measured along a route suitable for laying hose.

NOTE 1 If the building is fitted throughout with an automatic sprinkler system, the number of firefighting shafts may be as given in Table 12.

NOTE 2 If the internal layout is not known at the planning stage, a direct line measurement of 40 m may be used for design purposes, provided that the layout of the building when occupied satisfies the 60 m criterion.

NOTE 3 Each firefighting shaft should also contain a fire main (see **40.5.2**).

d) Entry points to firefighting shafts should be readily identifiable to the fire service.

Table 12 — Minimum number of firefighting shafts in buildings fitted with sprinklers

Floor area of largest storey m^2	**Minimum number of firefighting shafts where largest storey is over 20 m above ground level**
less than 900	1
900 up to and including 2 000	2
over 2 000 up to and including 3 500	3
over 3 500	3, plus 1 for every additional 1 500 m^2 floor area or part thereof

40.5 Fire mains

40.5.1 *Commentary*

The time taken by firefighters to reach the scene of a fire and commence firefighting operations should be kept to a minimum. The most important consideration is the overall distance (both horizontal and vertical) that firefighters need to travel between the appliance parking position and the point where a firefighting bridgehead can be established within the building (usually a firefighting lobby on the affected floor). Account needs also to be taken of the amount of heavy equipment that needs to be carried to this position. It is therefore important that a maximum distance between those two points be imposed. The time taken to travel that distance and begin firefighting operations, and the relative positions of the fire appliance and the firefighting bridgehead, can however be influenced by two important factors:

a) *whether water for firefighting is readily available from a wet fire main; and*

b) *whether a firefighting lift is available to transport personnel and equipment to eliminate the more physically arduous and time-consuming travel via stairs.*

A fire main system, whether wet or dry, removes the need for firefighters to lay hose up stairs, which is both arduous and time-consuming, and also obstructs the stairs in an emergency.

The time and energy saving benefits of a firefighting lift are recognized by discounting any vertical travel by lift when assessing the overall distance between the appliance and the outlet valve. Conversely, the additional time and physical effort required due to the lack of a firefighting lift is reflected by using 150 % of the actual vertical travel necessary via stairs when calculating the overall distance between the appliance and the outlet valve.

If a dry main system is installed together with a firefighting lift, then the appliance needs to be within a reasonable distance of the inlet so that the minimum length of hose is needed to connect the appliance to the inlet and to afford better observation for the appliance pump operator. Connecting the fire appliance to a street hydrant and to the fire main inlet and charging the riser with water is time-consuming and therefore the overall distance which firefighters need to travel needs to be reduced to compensate for the additional time taken to supply water for firefighting.

If a wet main system and firefighting lift are installed, the location of appliance parking points and siting of firefighting shafts within the building are more flexible. If the firefighting shafts are sited some way within the building, then the route taken by firefighters from the access point to the shaft needs to be a protected route.

*NOTE Although **40.5.2**a) recommends the provision of fire mains for only those buildings provided with firefighting shafts, it would be wise to consider their provision in any extensive building.*

40.5.2 *Recommendations*

The following recommendations are applicable.

a) Wet or dry fire mains should be installed in accordance with BS 5306-1 and BS 5588-5 to serve those firefighting shafts recommended in **40.4.2**.

NOTE 1 If the height of the highest floor does not exceed 60 m above ground or fire service access level, dry mains may be installed; but if 60 m is exceeded, wet mains will be necessary.

b) If a wet main system is provided, then the maximum distance between the fire appliance parking position and the outlet valve in the highest firefighting lobby should be not more than 50 m when calculated in accordance with item d).

c) If a dry main system is provided, then the maximum distance between the fire appliance parking position and the outlet valve in the highest firefighting lobby should be not more than 30 m when calculated in accordance with item d).

NOTE 2 The fire appliance parking position should be within 18 m of, and in sight of, the dry main inlet.

d) In calculating the distance referred to in items b) and c):

1) if a firefighting lift is provided, only horizontal travel needs to be taken into account;

2) if a firefighting lift is not provided, both horizontal and vertical distances of travel should be taken into account, and the distance of any travel necessary via stairs should be taken to be 150 % of the vertical distance travelled.

Figure 20 — *Deleted.*

40.6 Smoke control provisions to assist firefighting

40.6.1 *Commentary*

The build-up of smoke and heat as a result of a fire can seriously inhibit the ability of the fire service to carry out rescue and firefighting operations in a building. Facilities are therefore needed to enable the fire service to release smoke from any protected stairway and from floor areas. The provision of any smoke control measures for means of escape together with those associated with firefighting shafts will assist firefighters in their tasks.

Smoke control for firefighting shafts is covered in BS 5588-5.

Smoke control is usually obtained by opening windows. Unfenestrated walls, or walls sealed for the purpose of air-conditioning, will need to be provided with other openable means to serve the same purpose. In basements, smoke outlets may need to be provided if windows cannot be provided. It should however be appreciated that such smoke control provisions are not required for means of escape purposes or for use by the occupants.

Details and plans showing the provisions for the release of heat and smoke from floor areas should be submitted to the fire authority for approval before building work commences.

Firefighting in enclosed car parks and covered service areas is more difficult and therefore provision needs to be made for smoke control to assist firefighting operations. Such provisions will also benefit salvage operations following a fire, facilitating a speedier return to normal operation of the building.

The objective of smoke control measures for firefighting is to prevent a build-up of smoke and heat and to make conditions tenable for firefighters wearing appropriate equipment (including breathing apparatus) to enter and deal with the fire and carry out any necessary rescues. For this reason a system diluting the smoke from a fire in that area to a level compatible with the fire service operations based on straightforward air changes is acceptable. A system designed to maintain a region of clear air below a buoyant smoke layer for means of escape is also acceptable.

The vehicle exhaust fume extraction systems in all enclosed loading docks and covered roadways should remain running during a fire in order to cater for the fumes generated by pumping appliances, unless a fire occurs within one of these areas, in which case the vehicle exhaust fume extraction system in that area should cease to operate in favour of the smoke exhaust system. All exhaust fume extraction systems in remaining unaffected areas should continue to operate as normal.

40.6.2 ***Recommendations***

The following recommendations are applicable.

a) All enclosed loading docks exceeding 200 m^2 and covered service roadways should be provided with:

1) a smoke control system capable of either:

i) maintaining a clear air layer below the smoke for not less than 1.75 m above any point on the loading dock floor or roadway, when a fire of 15 m perimeter with a convective heat output of 7 MW occurs in that area; or

ii) exhausting smoke at a minimum rate equivalent to 10 air changes per hour in the affected area; or

2) a smoke control system of a design acceptable to the fire authority.

NOTE 1 Referring to **40.6.2**a)1)i), where members of the public may be present, consideration should be given to a clear height compatible with safe evacuation, within the constraints imposed by the structure. Providing the means of escape from the area are in accordance with all the recommendations of Section 3, then the minimum clear height should be 3 m above any public escape route.

NOTE 2 In some circumstances the design of the building will dictate the eventual smoke movement, and may require no additional smoke control provisions.

b) The design of smoke control systems permitted under item a) should take into account the circumstances relevant to each affected area, and should be accompanied by a clear statement of justification by the designer.

c) Ground and higher storeys should be provided with either:

1) a powered smoke exhaust system based on 6 air changes per hour; or

2) openable windows with an aggregate area not less than 2.5 % of the floor area arranged to induce cross-ventilation.

d) All basement storeys [except those areas covered in item a)] should:

1) be provided with openable vents with an aggregate area of not less than 2.5 % of the floor area, arranged to induce cross-ventilation; or

2) be provided with smoke outlets that:

i) are situated at high level in well-distributed positions along street frontages or adjacent to external walls easily accessible to the fire service;

ii) have an aggregate area not less than 2.5 % of the floor area they serve;

iii) if covered, have breakable covers;

iv) are sited away from exits; or

3) be provided with a smoke exhaust system capable of providing at least 10 air changes per hour in the fire-affected area; or

4) be provided with a smoke control system of a design acceptable to the fire authority.

NOTE 3 *Rooms not more than 450 m^2.* Where there is a larger space adjacent [see Figure 21a)], the room may not need to be provided with its own ventilation arrangements. Smoke and heat issuing from the room may (if necessary) be vented from the adjacent larger space, using the smoke control system in that space.

Where the room has only corridor access [see Figure 21b)], then the room should be vented by the provision of one of the following:

i) 2.5 % ventilation arranged around the room [see items d)1) and d)2)]; or

ii) at least 10 air changes per hour [see item d)3)]; or

iii) other means acceptable to the fire authority [see item d)4)].

NOTE 4 *Rooms greater than 450 m².* Where there is a larger space adjacent [see Figure 21c)], the room may have the smoke and heat vented into the larger adjacent space by ducting and fans designed to remove the smoke and heat from the room at a rate of at least 10 air changes per hour [see item d)3)]. The smoke control system in the adjacent space should operate simultaneously with that in the room.

Where the room has a corridor access or larger space adjacent which can provide an inlet air supply to the room [see Figure 21d)], then the room should be vented in accordance with items d)2), d)3) or d)4).

e) Breakable covers provided in accordance with item d)2)iii) should be capable of being opened by the fire service from outside the building, and a permanent notice identifying the area they serve should be provided on or adjacent thereto.

f) A protected stairway which is not provided with a smoke control system using pressure differentials (other than a firefighting stair) should be provided with either:

1) openable windows at each upper storey or landing level having a clear openable area not less than 15 % of the cross-sectional area of the stairway; or

2) a window or vent at the top having a clear openable area of not less than 1 m^2.

g) All openable windows and vents provided for smoke control should be clearly identifiable and should be fitted with:

1) simple lever handles; or

2) locks that can be operated by the fire service.

NOTE 5 If openable windows and vent openings are not easily accessible, provision should be made for their operation by a remote control mechanism that, in the case of any vent provided in accordance with item f)2), should be located adjacent to the fire service entrance in the ground/access storey and be clearly marked as to its function and means of operation. Vents provided in accordance with item f)2) should also be provided with local control at the topmost storey served by the stair.

h) If it is not possible or convenient for a smoke outlet to terminate at a level accessible to the fire service, the shafts may be led up through the building if they are in accordance with **39.2.2**.

40.7 Communications for fire service use

40.7.1 *Commentary*

*Firefighters normally use personal radio sets for communicating with each other and with their own command points. However, personal radio sets have disadvantages such as occasional poor reception due to local screening and limited battery life. It is therefore desirable that in large or complex buildings mobile communications should be supplemented by some form of fixed communications system enabling contact between individual teams of firefighters and also with the fire control centre (see **40.8**).*

40.7.2 *Recommendations*

The following recommendations are applicable.

a) Fire telephone handsets should be provided at strategic points, at each entrance and in the control room and should be permanently fixed equipment.

b) The fire telephone system should:

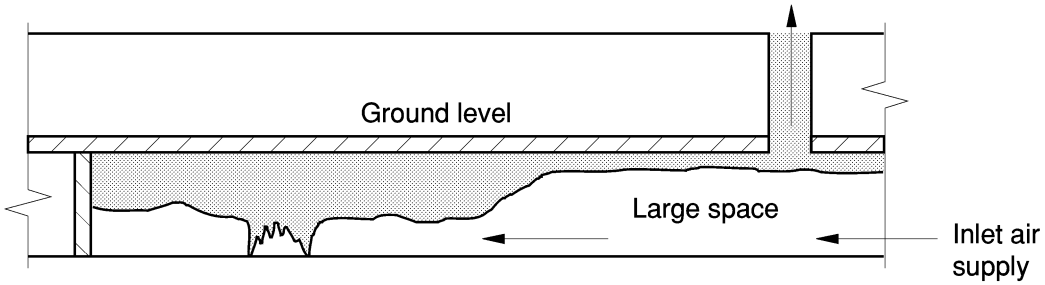
1) have a wiring system in accordance with **29.3.2**;

2) be provided with a battery backup capable of maintaining the system in standby mode for at least 24 h, after which sufficient capacity should remain in the battery to operate the system for 3 h.

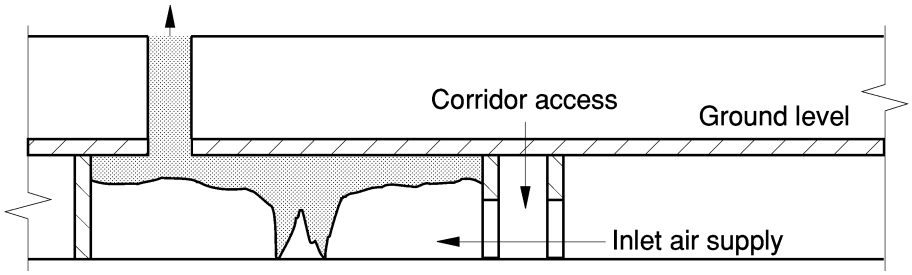
40.8 Fire control centre

40.8.1 *Commentary*

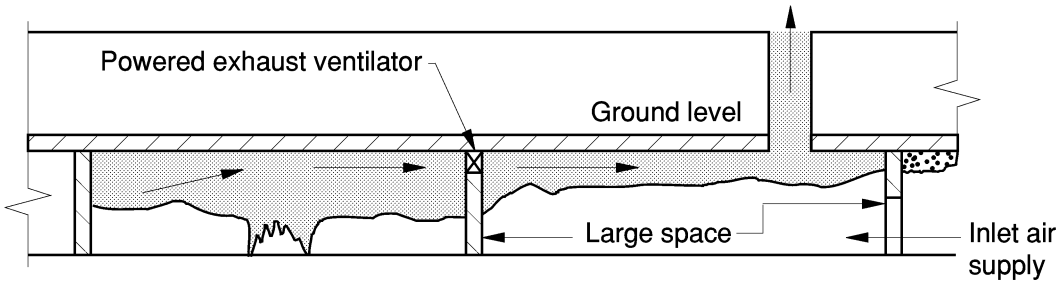
A fire control centre is necessary in buildings designed for phased evacuation, and may be necessary in large or complex buildings, to enable the fire service to assume control of an incident immediately on arrival. The fire control centre needs to be readily accessible to the fire service, preferably with direct access from the open air. The fire compartmentation and structural fire separation should be such that the control centre staff should be able to remain within the control centre safely during any emergency situation elsewhere in the building. Because of the possible need for it to be operational over an extended period of time, it should be located in a room with structural fire separation and should incorporate facilities to enable it to function as normal during an emergency. It should contain all control and indicating equipment for the fire alarm and other fire safety systems for the building.



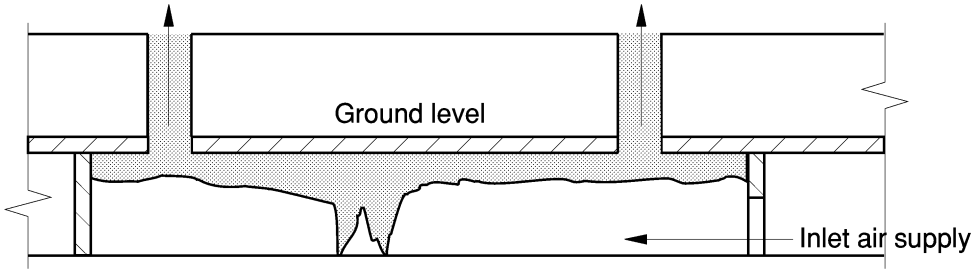
a) Small room (≤ 450 m^2) with access via a large space



b) Small area (≤ 450 m^2) with corridor access only



c) Large basement area (> 450 m^2) with smoke vented via an adjacent large space



d) Large basement area (> 450 m^2) provided with an inlet air supply

Figure 21 — Ventilation provisions for basement rooms

40.8.2 ***Recommendations***

The following recommendations are applicable.

a) In buildings where phased evacuation is proposed, and in large or complex buildings, a fire control centre should be provided that should be either:

1) a room dedicated solely as a fire control centre; or

2) combined with the management central control room.

b) A fire resistance of 2 h is recommended for the structure.

c) The control centre should be adjacent to a fire service access point and either have direct access to the open air or to an escape stair enclosure.

d) The fire control centre should be provided with a 3 h non-maintained system of emergency lighting supplied from a source independent of the normal lighting to enable the control centre to operate satisfactorily in the absence of the normal lighting supply.

e) Throughout the building, a reliable means of communication with the fire control centre, either a fire telephone system (see **40.7.2**) or a radio telecommunication system acceptable to the fire authority, should be provided:

1) for use by the management of the building in conjunction with the fire control system and control of evacuation; and

2) for communications between fire service personnel.

f) The fire control centre should contain the following:

1) indicator panels showing the location of the incident and status of all automatic fire protection installations and facilities;

2) manual override switches associated with all automatic fire protection installations and facilities (other than those which are required to be located either adjacent to their equipment or elsewhere, e.g. overrides for gaseous fire extinguishing systems or sprinkler system main or floor isolating valves);

3) manual overrides for air conditioning systems or ventilation systems involving recirculation;

4) a fire telephone providing a direct link between the control room and all firefighting lobbies and fire service access points;

5) an exchange telephone with direct dialling for external calls;

6) a public address system;

7) if provided for the control of evacuation, controls and monitor screens for closed circuit television (CCTV);

8) the fire routine for the building;

9) keys or other devices needed to facilitate access throughout the building and to operate any mechanical and electrical systems;

10) floor plans of the building as described in **40.10**;

11) telephone numbers of principal staff/building services engineers;

12) a facility to sound the evacuation signal in each evacuation zone by individual switches;

13) a facility to sound the alert signal throughout the building;

14) a clock to time phases of evacuation;

15) a visual indication of status of relevant storeys, i.e. those storeys in which an evacuation signal has been given;

16) a facility to cancel any automatic sequencing of phases but not the initial phase;

17) a wall mounted writing board with suitable writing implements for displaying important information.

g) The control centre should be staffed by a competent person, familiar with the use and operation of the equipment contained therein, while the building is occupied.

h) Clear differentiation should be provided where possible between fire, security and building management systems within the room.

NOTE 1 In large or complex buildings consideration should be given to equipping the control room operators with closed circuit television for the surveillance of floor areas, so that messages may be directive.

NOTE 2 Management responsibilities in respect of general efficiency, staffing and organization of a control centre are outlined in BS 5588-12.

40.9 Water supplies for fire service use

40.9.1 *Commentary*

Water supplies for firefighting are normally provided from hydrants, either those of the water authority on street mains or private hydrants installed by the building owner or developer.

Hydrant systems include internal fire mains, either wet or dry, fitted with landing valves, and private hydrants on water mains external to the building.

For effective firefighting, it is essential that mains and hydrants are able to supply water at suitable pressures. Hydrants need to be located in positions which are both near to building entry points (which may also be entry points to firefighting shafts containing fire mains) and to fire appliance parking positions. These requirements apply whether fire appliance access is at ground level, at upper deck level or below ground level. Water supplies should be discussed with the enforcing authorities and local water authority at an early stage.

In areas without available mains, a bulk or static supply should be arranged. If this takes the form of a static tank or dam, a capacity is required related to the size of the building and the risk involved. The capacity should be agreed with the fire authority.

An unlimited and guaranteed water source will be acceptable to the fire authority subject to access and hard standing for appliances being provided. The water supply and position of fire appliance access points should be agreed with the enforcing authorities.

40.9.2 *Recommendations*

All premises should be provided with a supply of water for firefighting by one, or a combination of, the following means:

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

b) private hydrants designed and installed in accordance with BS 750, ideally forming part of a ring main system. Hydrant outlets should be positioned not more than 70 m from an entry to any building on the site and not more than 150 m apart. They should preferably be sited immediately adjacent to roadways or hard standing facilities provided for fire brigade appliances, and not less than 6 m from the building or risk so that they remain usable during a fire. (Generally, a water supply capable of providing a minimum of 1 500 l/min at all times will be required);

c) a static or natural water supply providing a minimum capacity of 67 500 l (sufficient to supply three firefighting jets at a total rate of 1 500 l/min for 45 min).

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

NOTE 2 If a building exceeds 120 m in height, additional water capacity may be required to boost the wet mains.

40.10 Plans of the building for fire service use

40.10.1 *Commentary*

In large or complex buildings and those having extensive accommodation below ground level, it is of assistance to the fire service if plans of the building showing fire protection and escape facilities are made available. Such plans should be drawn to a scale agreed with the enforcing authorities. The plans need to be displayed where they can be readily referred to in an emergency. Normally this would be near the fire service access. If there is basement accommodation, plans of such accommodation need to be displayed at the fire service access storey in any stairway (or lobby) leading to a basement. It is desirable that additional copies of the plans be furnished to the fire authority so that it can preplan for an emergency. Plans should include, if necessary, sections through the building.

40.10.2 ***Recommendations***

The following recommendations are applicable.

a) Scale plans and, if necessary, sections through the building, for the guidance and use of the fire service should be prepared in consultation with the enforcing authorities.

b) The plans should clearly indicate the location of (for example):

1) surrounding streets;

2) exits, stairs, corridors, evacuation lifts and any refuges for disabled persons;

3) fuel storage areas, gas and oil main controls;

4) electrical main and submain controls, including stand-by generators;

5) ventilation plant and control switches, including controls for any smoke control system using pressure differentials;

6) sprinkler valves;

7) hose reels;

8) hydrants and fire mains;

9) shutters and doors released automatically in the event of fire, and any central control point for release;

10) smoke outlets and control systems;

11) openable windows for smoke ventilation in sealed buildings;

12) main and any secondary fire alarm panels, and zoning of fire alarm systems;

13) pump rooms supplying fire protection systems;

14) firefighting stairs and lifts;

15) automatic fire extinguishing systems;

16) foam inlets;

17) telephone communication points and any fire control centre.

c) The direction of north, a linear scale bar and a "You are here" indicator should be included on the plans.

d) The plans should be displayed in any fire control centre and other locations agreed with the fire service.

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Section 8. Management

Management is now dealt with in BS 5588-12.[4)]

[4)] *Footnote deleted*

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Annex A (normative)
Commissioning and hand-over of smoke control systems

NOTE Where various functions interface, e.g. smoke detection and smoke control systems, these systems should be commissioned together to ensure that the prescribed fire safety procedure is implemented.

A.1 Smoke ventilation systems

A.1.1 *General*

On completion of the smoke ventilation system, the complete installation should be checked for conformity to the approved drawings and system design. Instructions on its use, planned maintenance and testing should be supplied to the owner of the premises.

The hand-over procedure should include operation of the system by actuating smoke detectors in each smoke reservoir. All elements of the system and control interfaces for ventilators or extract fans, smoke curtains and air inlets should then operate automatically.

A.1.2 *Powered smoke exhaust systems*

The volume exhaust rate should be measured for the design fire.

NOTE 1 The volume extract (or supply) airflow readings should be taken by using either using a vane anemometer, averaging the results at each extract or inlet grille, then totalling the readings, or by taking a Pitot traverse in an appropriate straight section of ductwork (approximately 4 m from any obstruction or outlet, etc.), and multiplying by the cross-sectional area of the duct. Where more than one fan is provided this process should be carried out for each fan.

NOTE 2 The volume extract of the fan(s) is assessed utilizing air at ambient temperature; the resulting volume should be corrected to take account of fans' differing performance at the design temperature of the system and ambient conditions.

Further information can be found in the CIBSE (Chartered Institution of Building Services Engineers) Commissioning Code A [40].

If standby generators are installed to provide emergency power, the fan(s) volume exhaust rate should additionally be assessed with the fan(s) connected to the emergency power supply.

NOTE 3 If the standby generator(s) are common to other emergency systems, these other systems should be powered by the generator(s) to ensure that an adequate and reliable power supply is provided.

A.1.3 *Natural smoke ventilation systems*

The area of the ventilators should be measured and multiplied by the ventilator aerodynamic coefficient obtained from the test certificates for the ventilator. The total aerodynamic free area should then be compared with the figures required by the approved design.

A.2 Smoke control systems employing pressure differentials

The following check tests should be carried out when accepting a smoke control system employing pressure differentials:

a) All detection devices should be checked to ascertain that they operate correctly and initiate operation of the system.

b) The air relieving systems should be checked to ascertain that they operate.

c) Measurements should be taken of air velocities as recommended in BS 5588-4 and BS 5588-5.

d) Measurements should be taken of the pressure differential between each pressurized space and its adjacent unpressurized space, with all doors being closed.

e) Operation of standby fans and motors should be checked for correct changeover, etc.

Annexes deleted

List of references (see Clause 2)

Normative references

NOTE Some documents are called up normatively and informatively in different places in the text. Such documents are listed as normative references. This list should not be used to judge whether a document is being used normatively.

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BRITISH STANDARDS INSTITUTION, London.

BS 476-4:1970, *Fire tests on building materials and structures — Part 4: Non-combustibility test for materials.*

BS 476-8:1972, *Fire tests on building materials and structures — Part 8: Test methods and criteria for the fire resistance of elements of building construction*[5)].

BS 476-11:1982, *Fire tests on building materials and structures — Part 11: Method for assessing the heat emission from building materials.*

BS 476-20:1987, *Fire tests on building materials and structures — Part 20: Method for determination of the fire resistance of elements of construction (general principles).*

BS 476-21:1987, *Fire tests on building materials and structures — Part 21: Methods for determination of the fire resistance of loadbearing elements of construction.*

BS 476-22:1987, *Fire tests on building materials and structures — Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction.*

BS 476-23:1987, *Fire tests on building materials and structures — Part 23: Methods for determination of the contribution of components to the fire resistance of a structure.*

BS 476-24:1987, *Fire tests on building materials and structures — Part 24: Method for determination of the fire resistance of ventilation ducts.*

BS 476-31.1:1983, *Fire tests on building materials and structures — Part 31: Methods for measuring smoke penetration through doorsets and shutter assemblies — Section 31.1: Method of measurement under ambient temperature conditions.*

BS 750:1984, *Specification for underground fire hydrants and surface box frames and covers.*

BS 799-5:1987, *Oil burning equipment — Part 5: Specification for oil storage tanks.*

Text deleted

BS 4533, *Luminaires.*

BS 5266-1:1988, *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 5306-0:1986, *Fire extinguishing installations and equipment on premises — Part 0: Guide for the selection of installed systems and other fire equipment.*

BS 5306-1:1976, *Fire extinguishing installations and equipment on premises — Part 1: Hydrant systems, hose reels and foam inlets.*

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

BS 5306-3:1985, *Fire extinguishing installations and equipment on premises — Part 3: Code of practice for selection, installation and maintenance of portable fire extinguishers.*

BS 5306-4:1986, *Fire extinguishing installations and equipment on premises — Part 4: Specification for carbon dioxide systems.*

BS 5306-5.1:1992, *Fire extinguishing installations and equipment on premises — Part 5: Halon systems — Section 5.1: Specification for halon 1301 total flooding systems.*

BS 5306-5.2:1984, *Fire extinguishing installations and equipment on premises — Part 5: Halon systems — Section 5.2: Halon 1211 total flooding systems.*

BS 5395-1:1977, *Stairs, ladders and walkways — Part 1: Code of practice for the design of straight stairs.*

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

[5)] BS 476-8:1972 has been withdrawn but it is still available from BSI Customer Services.

BS 5395-3:1985, *Stairs, ladders and walkways — Part 3: Code of practice for the design of industrial type stairs, permanent ladders and walkways.*

BS 5410-1:1977, *Code of practice for oil firing — Part 1: Installations up to 44 kW output capacity for space heating and hot water supply purposes.*

BS 5410-2:1978, *Code of practice for oil firing — Part 2: Installations of 44 kW and above output capacity for space heating, hot water and steam supply purposes.*

BS 5499-1:1990, *Fire safety signs, notices and graphic symbols — Part 1: Specification for fire safety signs.*

BS 5588-0:1996, *Fire precautions in the design, construction and use of buildings — Part 0: Guide to fire safety codes of practice for particular premises/applications.*

BS 5588-1:1990, *Fire precautions in the design, construction and use of buildings — Part 1: Code of practice for residential buildings.*

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 5588-5:1991, *Fire precautions in the design, construction and use of buildings — Part 5: Code of practice for firefighting stairs and lifts.*

BS 5588-6:1991, *Fire precautions in the design, construction and use of buildings — Part 6: Code of practice for places of assembly.*

BS 5588-7, *Fire precautions in the design, construction and use of buildings — Part 7: Code of practice for the incorporation of atria in buildings.*

BS 5588-8:1999, *Fire precautions in the design, construction and use of buildings — Part 8: Code of practice for means of escape for disabled people.*

BS 5588-9:1999, *Fire precautions in the design, construction and use of buildings — Part 9: Code of practice for ventilation and air conditioning ductwork.*

BS 5588-10:1991, *Fire precautions in the design, construction and use of buildings — Part 10: Code of practice for shopping complexes.*

BS 5588-12, *Fire precautions in the design, construction and use of buildings — Part 12: Managing fire safety.*

BS 5655, *Lifts and service lifts.*

BS 5720:1979, *Code of practice for mechanical ventilation and air conditioning in buildings.*

BS 5725-1:1981, *Emergency exit devices — Part 1: Specification for panic bolts and panic latches mechanically operated by a horizontal push-bar.*

BS 5839-1:1988, *Fire detection and alarm systems for buildings — Part 1: Code of practice for system design, installation and servicing.*

BS 5839-3:1988, *Fire detection and alarm systems for buildings — Part 3: Specification for automatic release mechanisms for certain fire protection equipment.*

Text deleted[6)]

BS 5906:1980, *Code of practice for storage and on-site treatment of solid waste from buildings.*

BS 6180:1995, *Code of practice for protective barriers in and about buildings.*

BS 6207-1:1995, *Mineral insulated cables with a rated voltage not exceeding 750 V — Part 1: Cables.*

BS 6207-2:1995, *Mineral insulated cables with a rated voltage not exceeding 750 V — Part 2: Terminations.*

BS 6266:1992, *Code of practice for fire protection for electronic data, processing installations.*

BS 6387:1994, *Specification for performance requirements for cables required to maintain circuit integrity under fire conditions.*

6) *Footnote deleted*

BS 6644:1991, *Specification for installation of gas-fired hot water boilers of rated inputs between 60 kW and 2 MW (2nd and 3rd family gases).*

BS 6798:1987, *Specification for installation of gas-fired hot water boilers of rated input not exceeding 60 kW.*

BS 7036-1:1996, *Code of practice for safety at powered doors for pedestrian use — Part 1: General.*

BS 7036-2:1996, *Code of practice for safety at powered doors for pedestrian use — Part 2: Straight and curved sliding doors and prismatic folding doors.*

BS 7036-3:1996, *Code of practice for safety at powered doors for pedestrian use — Part 3: Swing doors and balanced doors.*

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BS EN 3:1996, *Portable fire extinguishers.*

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[18] COLD STORAGE AND DISTRIBUTION FEDERATION[7]. *Guide to the management and control of the fire risks in temperature controlled structures of the refrigerated food industry.* CSADF, Bracknell, 1996.

[19] HEALTH AND SAFETY EXECUTIVE. *Storage of LPG at fixed installations Guidance Booklet.* HS(G)34. HSE Books, 1987.

[20] HEALTH AND SAFETY EXECUTIVE. *Keeping of LPG in cylinders and similar containers.* Guidance Note CS4. HSE Books, 1986.

[21] DEPARTMENT OF THE ENVIRONMENT, PROPERTY SERVICES AGENCY. *Performance specification: Platform floors (Raised access floors)* Method of Building MOB PF2 PS and MOB PF2 PS/SPU(1992).

[36] MORGAN, H. P. and GARDENER J.P., *Design principles for smoke ventilation in enclosed shopping centres.* BRE Report BR 186, Garston CRC, 1990.

[39] *Text deleted*[8]

[7] Cold Storage and Distribution Federation, Down Mill Road, Bracknell, Berks RG42 1GH.
[8] *Footnote deleted*

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DD 240-1, *Fire safety engineering in buildings — Part 1: Guide to the application of fire safety engineering principles.*

DD 240-2, *Fire safety engineering in buildings — Part 2: Commentary on the equations included in Part 1*[9)].

PD 6520:1988, *Guide to fire test methods for building materials and elements of construction.*

[9)] In preparation.

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NOTE The remaining numbered references are normative references.

[1] HEALTH AND SAFETY Fire Certificates (Special Premises) Regulations 1976. SI 1976/2003. London, HMSO, 1976.

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