BRITISH STANDARD

BS 5588-6:1991
Incorporating Amendments Nos. 1, 2 and 3

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

Part 6: Code of practice for places of assembly

ICS 13.220.01; 91.040.10

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Fire Standards Policy Committee (FSM/-) to Technical Committee FSM/14, upon which the following bodies were represented:

Association of Metropolitan Authorities
British Fire Services' Association
British Gas plc
British Retailers' Association
British Telecommunications plc
Building Employers' Confederation
Chartered Institution of Building Services Engineers
Chief and Assistant Chief Fire Officers' Association
Consumer Policy Committee of BSI
Department of Education and Science
Department of Health
Department of the Environment (Property Services Agency)
Department of the Environment (Building Research Establishment) (Fire Research Station)
Department of the Environment (Construction Directorate)
Department of the Environment for Northern Ireland
Electricity Industry in United Kingdom
Fire Brigades' Union
Health and Safety Executive
Home Office
Incorporated Association of Architects and Surveyors
Institute of Building Control
Institution of Fire Engineers
Institution of Gas Engineers
Institution of Structural Engineers
London Fire and Civil Defence Authority
Loss Prevention Council
National Association of Fire Officers
National Council of Building Materials Producers
Royal Institute of British Architects
Royal Institution of Chartered Surveyors
Scottish Office (Building Directorate)
Society of Chief Building Regulation Officers
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 Sports and Allied Industries Federation
Cinema Exhibitors' Association
Flat Glass Manufacturers' Association
Hevac Association
Intumescent Fire Seals Association
National House-building Council
Society of Fire Protection Engineers
Sports Council
Steel Window Association
Theatres Advisory Council

This British Standard, having been prepared under the direction of the Fire Standards Policy Committee, was published under the authority of the Standard Board and comes into effect on 31 October 1991

Amendments issued since publication

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The following BSI references relate to the work on this British Standard:
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Contents

Foreword

This code of practice was prepared under the direction of Technical Committee FSH/14.

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

The other parts which comprise 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 7: Code of practice for the incorporation of atria in buildings;*

— *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 11: Code of practice for shops, offices, industrial, storage and other similar buildings;*

— *Part 12: Managing fire safety.*

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 arbitrary.

NOTE Commentary text is printed in italics.

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.

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 **3.3**.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 75 and a back cover.

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Section 1. General

1 Scope

This code of practice provides guidance for designers and the building construction team in their task of incorporating into new buildings, or into alterations to existing buildings, measures that should, in the event of fire, safeguard the lives of the public, staff and performers in assembly buildings of all sizes and that may help to protect the building and its contents against the effect of fire.

NOTE 1 Guidance on fire precautions in existing places of assembly has been published by the Home Office (see Appendix A).

This code applies to buildings used for indoor entertainment and/or assembly, but does not apply to those areas of sports grounds covered by the Safety of Sports Grounds Act 1975. Assembly use may also intermingle with other uses, e.g. a dance area associated with a restaurant or a public house (shop use), and the guidance in this code should be applied to such assembly areas.

An assembly building may contain a number of different assembly type activities to which this code should be applied but, where parts operate in their own right as shops or offices, reference should be made to BS 5588-11 for those parts which should be provided with independent escape routes. Similarly, an assembly building may form part of a shopping complex, and it is particularly important where there is an entrance to an assembly building from a shopping mall that the guidance given in BS 5588-10 is followed.

This code deals with planning, construction and equipment for fire safety, and the provision of escape routes in case of fire, in new assembly buildings and in alterations and extensions to existing assembly buildings. It includes measures and equipment required to assist firefighting in buildings with upper storeys beyond the reach of mobile fire appliances operating outside the building. This code makes specific recommendations in terms of protection, number and position of exits, provides guidance on design principles for preventing the spread of fire, and indicates the fire precautions necessary in these buildings. Guidance for managers of places of assembly can be located in BS 5588-12.

In a building that has to have a fire certificate, the advice given may have to be varied in accordance with the conditions of the fire certificate. Guidance is also included to cover those cases where a building is in course of construction or alteration and is in part used.

This code is not intended to apply to buildings during the course of construction or alteration.

NOTE 2 The titles of the publications referred to in this standard are listed on page 73.

2 Definitions

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

2.1
access room
a room that forms the only escape route from an inner room

2.2
class 0 material or surface
either:

a) composed throughout of materials of limited combustibility; or

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

2.3
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

2.4
depth (of a building)
the level of the surface of the lowest point of the floor of the lowest storey, 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

2.5
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

2.6
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

2.7
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

2.8
firefighting lift
a lift designated to have additional protection, with controls that enable it to be used under the direct control of the fire service in fighting a fire

2.9
firefighting lobby
a protected lobby providing access from a firefighting stair to the accommodation area and to any associated firefighting lift

2.10
firefighting shaft
a protected enclosure containing a firefighting stair, firefighting lobbies and, if provided, a firefighting lift together with its machine room

2.11
firefighting stair
a protected stairway communicating with the accommodation area only through a firefighting lobby

2.12
fire resistance
the ability of a component or construction of a building to satisfy for a period of time some or all of the appropriate criteria specified in the relevant part of BS 476

2.13
fly gallery
a narrow balcony or gantry, usually running from front to back of the stage on one or both sides and occasionally continuing across the back wall, used for securing suspension lines, loading counterweights and operating suspension lines, and occasionally for rigging lighting equipment

2.14
grid
an open framework of beams over the stage which is used (primarily) for the suspension of scenery and lighting equipment or to provide a platform for access to the pulleys for such suspension systems

2.15
height (of a building)
the level 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

2.16
inner room
a room from which escape is possible only by passing through another room (the access room, see **2.1**)

2.17
material of limited combustibility
either:

a) a non-combustible material; or

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

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

2.18
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

2.19
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 nor cause any rise in the temperature on either the centre (specimen) or furnace thermocouples

2.20
place of safety
a place in which persons are in no danger from fire

2.21
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)

2.22
protected space
an area, forming part of an escape route, separated from the remainder of the building by fire-resisting construction

2.23
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 adequately enclosed with fire-resisting construction

2.24
radial gangway
a gangway at an angle to the rows of seating or a stepped gangway in tiered seating

2.25
seatway
the distance between adjacent rows of seats

NOTE See Clause **8** for the determination of seatway width.

2.26
storey exit
a final exit (see **2.6**) or a doorway giving direct access to a protected space, protected stairway, firefighting lobby or external escape route

2.27
transverse gangway
a flat gangway parallel to the rows of seating

2.28
travel distance
the actual distance to be travelled by a person along an escape route to the nearest storey exit, having regard to the layout of walls, partitions and fittings

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2.29
vent
a window, rooflight, door, louvre, grille or other device either open, or capable of being opened, to permit the passage of air between a part of the building and the external air

2.30
working fly gallery
a fly gallery, usually the lowest if more than one gallery is provided, which is likely to be occupied during performances by staff operating suspension lines

3 Use of this code

3.1 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, finishing and furnishing with suitable materials and embodying adequate fire resistance in the structure;

c) segregation of higher fire risk areas;

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

e) 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, or for automatically extinguishing an outbreak of fire;

f) the provision of adequate and 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 fire service personnel when firefighting;

g) effective management control.

3.2 Use of the principles and application of the recommendations

It is not possible to make comprehensive recommendations covering every possible risk, and an intelligent appreciation of the principles and applications of the recommendations of this code is therefore essential. The fire hazard of a particular building and its contents, and the kinds of occupant together with their likely state of awareness and/or distraction, have to be appreciated when designing an assembly 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. For maximum benefit all the recommendations should be applied. Although the basic principles and recommendations for escape from assembly areas are described in Section 3, the most conscientious application of these recommendations would be undermined unless supported by the necessary measures relating to ancillary accommodation, construction, engineering services, and fire protection facilities set out in Section 4 to Section 7.

3.3 Relationship with statutory provisions

3.3.1 *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 **3.3.2** and **3.3.3** 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 building designers in matters not covered in sufficient detail by 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.

3.3.2 *Building regulations*

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

England and Wales: The Building Regulations;

Scotland: The Building Standards (Scotland) Regulations;

Northern Ireland: Building Regulations (Northern Ireland).

3.3.3 *Legislation and other regulations for fire safety in buildings*

In addition to the controls mentioned in **3.3.2**, 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

Theatres Act 1968

Cinemas Act 1985

The Cinematograph (Safety) Regulations 1955

The Cinematograph (Children) Regulations 1955

Licensing Act 1964

Gaming Act 1968

London Government Act 1963 (Greater London only)

Local Government (Miscellaneous Provisions) Act 1982

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)

Theatres Act 1968

Cinemas Act 1985

The Cinematograph (Safety) Regulations 1955

The Cinematograph (Children) Regulations 1955

Local Government (Miscellaneous Provisions) Act 1981

Civic Government (Scotland) Act 1982

Northern Ireland:

The Fire Services (Northern Ireland) Order 1984, the Miscellaneous Provisions (Northern Ireland) Order 1985 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 the building as planned will meet the requirements those authorities may make, particularly if a fire certificate or licence may be necessary.

NOTE 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 the 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 made 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.

3.4 Protection of property

Fire safety is often interpreted as meaning only the safety of persons (life safety), but also includes the protection of property (property safety). For property, 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 life safety, i.e. The Building Regulations for England and Wales state that in connection with any requirement "No obligation imposed by these regulations shall require anything to be done beyond what is necessary to secure reasonable standards of health and safety for persons in or about the building and others who may be affected by any failure to comply with that requirement". 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 4 and Section 5), active protection (see Section 6) 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.

3.5 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.

3.6 Information to be given to clients

Designers are advised to inform their clients of the nature, function and capabilities of the fire precautions that have been designed into the building, and especially those whose nature may be less evident. This will enable a better understanding of the responsibility for ensuring that a high standard of safety is maintained.

The advice given in BS 5588-12 is intended, not only as a guide to the management of fire precautions in a place of assembly, but also as a guide to the information concerning the fire precautions that have been designed into the building which designers are advised to pass to their clients.

Section 2. Analysis of the problem

4 Planning in relation to fire

4.1 Spread of fire

The only sound basis for designing means of escape from fire is to attempt to identify the positions of all possible sources of outbreak of fire and to predict the courses that might be followed by a fire as it develops, or, more particularly, the routes that smoke and hot gases are likely to take, including concealed spaces. Only against this background is it possible to design and protect escape routes with some confidence that they will be safe.

In assembly buildings designed, maintained and supervised in accordance with this code, the risk of fire starting in passages, lobbies or stairs intended for use only for access or means of escape may be regarded as low. It is also unlikely that fire will originate in the structure itself. Outbreak of fire is more likely to occur in equipment, furnishings, decorations or service plant in the building, and the point of origin is therefore likely to be in stage areas, lounge areas, store rooms, 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, upholstery, scenery, equipment and other products, particularly those wholly or partly comprising cellular plastics, burn rapidly giving off hot smoke-laden and toxic gases. The horizontal deflection and downwards radiation also occurs rapidly and, because of the extremely high temperature of the gases, other 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 they 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 offering an immediate risk 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.

4.2 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 discomfort to the eyes and difficulty in breathing, both of which will interfere with the efforts of occupants to find their way towards the exits. The extremely hot, smoke-laden and toxic gases, particularly those from burning cellular plastics, 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, incapacity, unconciousness and possible death may result.

These considerations are particularly important when dealing with large numbers of persons, many 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) 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 cooperation of the staff, the functioning of equipment, are planned and managed so as to be effective when the occasion arises.

4.3 Site planning

Siting 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. Building regulations accordingly require adequate separation between the side of any building and its boundary. There are also legal requirements for access to buildings by fire appliances; these, together with the effect of car parking adjoining the building, have to be considered at the planning stage. A further site planning consideration is the safety of escape routes outside the building, and outside neighbouring buildings, from the effects of a fire in the building concerned.

4.4 Mixed user developments

The principles and recommendations of this code will apply straightforwardly where the entire building comprises a place of assembly. However, complications may arise where a place of assembly forms part of a mixed development. In such cases it is important to consider the effect of one risk on another. A fire in a place of assembly could have serious consequences for a residential or office user in the same 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 **4.2**:

a) the extent of a risk and its relationship 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 legislation appropriate to each use should be applied 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 highest level of protection should be provided.

4.5 Internal subdivision

The internal subdivision of buildings into compartments is an effective means of inhibiting the spread of fire and is basically advocated by building regulations. Nevertheless, some assembly buildings, e.g. sports arenas, are likely to exceed the maximum compartment size specified but this may be accepted by a building authority where it is satisfied that such limitations are inappropriate. It will need to be shown that separations are provided where possible and that suitable measures will be incorporated in the design to inhibit the spread of fire (see Section 4, Section 6 and Section 7).

4.6 Ancillary accommodation and higher fire risk areas

Section 3 and Section 4 contain principles and recommendations for the planning and construction of those parts of the building used for assembly purposes and occupied by the public and staff. Other parts, ancillary to the main use, including any stage area, are referred to in this code as ancillary accommodation and are covered in Section 5.

5 Escape from fire

5.1 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. There should also be exit routes capable of allowing the occupants to continue to progress to a final exit.

NOTE Capacities of exits from assembly areas 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 **6**).

In assembly buildings, escape routes should be designed so that in the event of a fire they should be capable of enabling the occupants to evacuate the whole building. The actual method of evacuation in a building comprising a number of different assembly areas will depend upon procedures discussed in BS 5588-12.

5.2 Disabled persons

The Chronically Sick and Disabled Persons Act 1970 and the 1976 amendment, and for Northern Ireland, the Chronically Sick and Disabled Persons (Northern Ireland) Act 1970, require that buildings are designed so that they are accessible to disabled persons wherever this is reasonable and practicable. Building regulations also make requirements for access (and facilities) for the disabled.

As the design of escape routes and the organization of management procedures are particularly critical in assembly buildings, these considerations have often led to restrictions on the access of disabled persons, and one of the purposes of BS 5588-8 is to show that such restrictions are unnecessary. There are clearly problems in stepped auditoria, grandstands and similar buildings, but an aim of the designer should be to provide some, or indeed many, locations for disabled persons to be integrated with the assembly as a whole from whence they may be evacuated.

Normally the number of severely disabled persons in an assembly building is likely to be small, but in the event of a large group attending an event, it is sensible that the organizers of the group should discuss the arrangements with the management of the building.

So far as possible, wheelchair places should be accessible on the level direct from the street or by suitably designed lifts to level viewing positions. Where seating is provided on stepped tiers, the best wheelchair position is one directly accessible from a front, back or cross gangway leading to a suitable lift.

Together with careful planning goes the need for an effective management (see BS 5588-12).

5.3 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 satisfactory. This code provides for the public and staff on any storey being able to escape safely from the building without outside assistance, should a fire occur.

5.4 Distances to travel

Some of the recommendations in this code include limitations on the distance of travel between two points: these are based on past experience and practice and represent the maximum distance a person can reasonably be expected to walk to escape from fire. 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.

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Section 3. Planning of escape from public areas

6 Planning of escape routes

6.1 General

Planning of means of escape from each public assembly area involves consideration of a number of interrelated elements.

NOTE Public assembly areas include areas such as public changing rooms and multi-use areas (which might be used for transitory storage).

These elements will include the limitation on travel distance which will determine the position of exits, whilst the number of persons to be evacuated will regulate the size and number of exits and escape routes. The nature of escape routes also needs to be considered as they comprise two principal parts: the travel distance within an enclosed space and, if appropriate, within a protected space leading to a final exit.

If seating in rows or blocks is provided or exhibition stands are provided, the gangways may also have a bearing on the location of exits.

6.2 Separate accommodation for children

6.2.1 *Commentary*

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

6.2.2 *Recommendations*

The following recommendations are applicable.

a) Separate accommodation for children 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 children are adjacent to the accommodation for parents or guardians.

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

c) If the room adjoins the parents' accommodation, the aggregate width of the escape routes from both areas (exclusive of any doors between such areas) should be sufficient for the total number of children and parents or guardians accommodated.

6.3 Escape routes within, and exits from, a storey

6.3.1 *Commentary*

Exits ought to be sited so that a person confronted by an outbreak of fire can turn and make a safe escape. To achieve this, two exits ought to be accessible in substantially different directions. Escape in one direction is, however, acceptable from small rooms, but in this case the distance of travel has to be restricted.

It is essential that ancillary accommodation does not form any part of an escape route for the public.

There may, however, be situations where escape routes for the public incorporate ancillary accommodation, such as bars, souvenir shops and fast food outlets. In such cases it is essential that either the areas of ancillary accommodation are separated from the escape routes to the appropriate standard of fire resistance, or other measures are taken, for example the provision of sprinklers and smoke control and fire shutters operated by smoke detectors, to ensure that an outbreak of fire can be rapidly brought under control or contained and the smoke produced reduced to such a level that the route remains usable.

An alternative approach would be to segregate the escape routes in such a fashion that, if a fire broke out in one escape route, the remaining escape routes would have sufficient capacity to allow for the total evacuation of the public area. In such cases it would not be necessary for the areas of ancillary accommodation (other than high risk areas such as kitchens) to be separated from the escape routes.

6.3.2 *Recommendations*

The following recommendations are applicable.

a) Escape routes from public areas should give direct access to a final exit, or give access thereto only by way of a protected space or a protected corridor and protected space.

b) Alternative escape routes should be so planned that it is not necessary for them to pass through the same protected space.

c) Where an escape route contains an area of ancillary accommodation:

1) the ancillary accommodation should be separated from the escape route by construction complying with the appropriate standard of fire resistance; or

2) other measures should be taken (such as the provision of sprinklers and smoke control and fire shutters operated by smoke detectors) to ensure that the escape route remains available; or

3) where escape routes are separated from each other by the appropriate standard of fire resistance and the capacity of all escape routes is sufficient to enable the total evacuation of the public area when one escape route is discounted, only areas of high fire risk such as kitchens need be separated from the escape routes by fire-resisting construction.

d) Exits should be distributed uniformly.

6.4 Number of escape routes

6.4.1 *Commentary*

The basis of means of escape from assembly buildings is to provide a choice of escape routes leading to different final exits. The number of exits required interacts with a number of other factors, e.g. travel distance and capacity of routes, and is normally at least two. In assembly buildings where there is a heavy concentration of people, it is important to relate the number of escape routes to the number of people involved to avoid congestion and achieve wide dispersal. Assembly areas that are to be used with both open floor areas and seating in rows need to meet the recommendations for travel distance for both configurations.

Figure 1 — *Deleted*

6.4.2 *Recommendation*

The number of escape routes from any room, tier of seating or storey should be in accordance with Table 1, except that a single escape route is acceptable in the case of a room not comprising a whole storey accommodating not more than 50 persons in which the travel distance does not exceed that given in item a) of Table 2.

Table 1 — Minimum number of escape routes prior to discounting

Number of persons accommodated	Minimum number of escape routes
1 to 600	2
more than 600	3

Table 2 — Maximum travel distances

Available direction of escape	Areas with seating in rows m	Open floor areas m
a) In one direction only	15	18
b) In more than one direction	32[a]	45[b]

[a] This may include up to 15 m in one direction only.
[b] This may include up to 18 m in one direction only.

6.5 Travel distance

6.5.1 *Commentary*

Travel distance needs to be limited as persons escaping may continue to be exposed to a fire risk until they have reached a storey exit. The recommended travel distances also take into account the standards of fire-resisting construction and surface spread of flame ratings required by building regulations as well as the recommendations of this code dealing with the heating, ventilation and electrical installations.

If escape is possible in two directions, these have to be significantly different directions, otherwise the routes will be close enough to become impassable at the same time. If 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, and a situation in which this occurs is considered to be a dead end.

It is desirable that the direction of travel should be away from a stage (apart from any initial travel along a seatway).

It should be noted that travel distance is the actual distance to be travelled to a storey exit and this will be apparent at the outset where permanent provision is made for a closely seated audience. In the case of multi-purpose halls and, in particular in exhibition halls, the erection of display stands will create a greater travel distance than would be the case for an open floor area. Designers should bear this in mind and it is suggested that at the design stage the travel distance in open floor areas should be based on two-thirds of the distances given in Table 2.

There may be cases in arenas or exhibition halls where the travel distances in Table 2 will be unrealistically restrictive.

6.5.2 *Recommendations*

The following recommendations are applicable.

a) Either:

1) the travel distances within any storey or tier of seating to the nearest storey exit should not exceed the appropriate limits set out in Table 2; or

2) exits should be sited uniformly around the perimeter of the assembly area at intervals not exceeding 32 m, and either:

i) at least two subways should be constructed as protected routes leading from the central areas of arenas and exhibition halls to final exits and access to the subways should be carefully located (preferably at "D" ends of tracks in athletic arenas) to eliminate or reduce, as far as possible, excess travel distances and to avoid all courts and pitches in sports arenas; or

ii) a smoke control system complying with **30.2.3** should be provided.

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

1) the travel distance to the point at which travel is possible in more than one direction should not exceed the appropriate limit given in item a) of Table 2; and

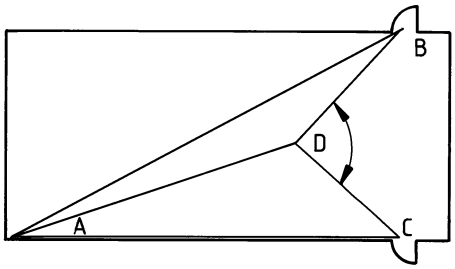
2) the total travel distance to the nearest storey exit (including that part in one direction only) should not exceed the appropriate limit given in item b) of Table 2.

NOTE If the nearest exit is unavailable then travel distances may be exceeded.

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

1) the routes should be not less than 45° apart (see Figure 2); or

2) the routes should be separated from each other by fire-resisting construction.



$B\hat{A}C < 45°$

$B\hat{D}C \geq 45°$

Figure 2 — Divergence of alternative escape routes

6.6 Width of escape routes

6.6.1 *Commentary*

Every exit and escape route should be wide enough to enable the quick passage of all the occupants who may need to use it. Whilst it is convenient to consider the doorways as the narrowest element of an escape route, it needs to be borne in mind that the escape route will start at an occupied part of the building and its capacity is determined by the width of the narrowest part of the route.

Providing that all escape routes from an assembly building can be used in the event of fire, it is sufficient for the aggregate capacity of exits to be enough for the maximum number of occupants. This will often be the case in large assembly rooms with all exits discharging direct to open air (i.e. all exits are final exits).

However, since one cannot rule out the possibility of one escape route being made impassable due to fire, in most circumstances calculations will need to be made on the basis of discounting one exit. The risk is greater when only two exits are provided, or when some exits from the place of assembly are not final exits. If all exits from the assembly space are final exits, then the fire cannot affect any part of the escape routes outside the assembly space. As any fire should be visible to the occupants at an early stage, it is not considered necessary to discount one of the exits from such assembly areas if three or more exits are provided.

Where the number of occupants for whom provision needs to be made is not known, it may be estimated from the net internal area of the space available for a particular use or activity (exclusive of any area occupied by stair enclosures, lift wells, escalators, accommodation stairs and toilet accommodation) calculated on the basis of the appropriate floor space factors listed in Table 3. In seated areas, the number of occupants should be the number for whom seats are provided unless this is not known. Designers should consider using the most onerous occupancy factor to ensure that future use of a building is not restricted by the provisions for means of escape.

Whatever method is used for assessing the number of persons using any floor space, the appropriate authority will need to be satisfied that adequate exits and width of escape routes are provided for the number of persons actually using the premises when occupied.

Table 3 — Suggested floor space factors

Description of floor space	Floor space per person m^2
1. Individual seating	0.4 to 0.5
2. Bench seating	0.3[a]
3. Dance area	0.5
4. Ice rinks	1.2
5. Restaurants and similar table and chair arrangements around a dance area	1.1 to 1.5
6. Bars without seating and similar refreshment areas	0.3
7. Standing spectator areas	0.3
8. Exhibition	1.5[b]
9. Bowling alley/billiard or snooker hall	9.5
10. Museum/art gallery	5.0
11. Studio (radio, television, film, recording)	1.4

NOTE These floor space factors are for guidance only and should not be taken as the only acceptable densities. Where the number of seats is known this should be used in preference to the floor space factors.

[a] If the number and length of benches is known, a factor of 450 mm per person should be used.

[b] Alternatively, a factor of 0.4 m^2 may be used over the gross area of gangways and other clear circulation space between stalls and stands.

6.6.2 *Recommendations*

The following recommendations are applicable.

a) The capacities of exits and escape routes within a storey should be calculated in accordance with Table 4. 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 mm wide).

b) *Text deleted.*

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 4 — Capacities of exits and escape routes

Maximum number of persons	Width mm
50	800
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

NOTE Capacities of other widths exceeding 1 100 mm may be obtained by linear interpolation or extrapolation.

6.7 External escape routes and stairs

6.7.1 *Commentary*

Wherever possible, escape routes for the public in assembly buildings should not be by way of a roof or an external stair. This does not preclude, however, exits being by way of a high level walkway or podium which acts as a street.

However, occasionally the planning of a building may be such that to satisfy travel distances it may be necessary to consider access on to an adjacent flat roof and thence to an external stair leading to a final exit.

External escape routes and stairs should, however, be protected from the effects of adverse weather conditions. It is also necessary to ensure that their use at the time of a fire cannot be prejudiced by smoke and flames from nearby doors and windows.

6.7.2 *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) 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 adequately 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) Where an escape route is in one direction only, any ventilation outlets or other extract system, and any doors, rooflights, or windows that are not fire-resisting, should not be sited within 3 m of such a route.

c) The route is roofed and at least partly covered in at the sides (depending on the degree of exposure) so as to ensure freedom at all times from the effects of adverse weather conditions.

NOTE Routes should also be provided with both normal and escape lighting (see **18.5**).

d) Any wall (or portion) (other than more than 1.1 m above the top floor level of a stair not being a basement stair) within 1.8 m of, or within 9 m vertically below, any external escape stair, should be of fire-resisting construction that may contain non-opening fire-resisting glazed elements. The doors to the stair (other than the door(s) at the top floor level of a stair serving storeys above ground level) should be fire-resisting and self-closing.

6.8 Fire safety signs and notices

6.8.1 *Commentary*

The relevant authority should be consulted with regard to the siting and positioning of all relevant fire safety signs and notices.

*Consideration also needs to be given to the advantages of a photoluminescent, or other luminous, wayfinding system of exit signs and directional markers on escape routes as a supplement to escape lighting (see **18.5**). A luminous system of directional lines (on walls near floor level and/or on floors), arrows, maps, exit signs, handrails and on the edge of steps, can make a significant contribution to wayfinding by the public, staff and fire service in unfamiliar surroundings.*

Guidance on the use of photoluminescent markings for escape routes is given in BRE Information Paper IP 17/89.

6.8.2 *Recommendations*

The following recommendations are applicable.

a) Exits should be marked and be readily visible so that the occupants of a building can clearly and readily see where the exits are and where to go in an emergency at any time.

b) Fire safety signs and notices should comply with the relevant requirements of BS 5499.

NOTE Stages, fly galleries and grids provided with non-maintained escape lighting should be provided with either self-luminous or maintained, internally illuminated exit signs.

7 Stairs and final exits

7.1 Protected stairways

7.1.1 *Commentary*

The fire-resisting enclosure of a protected stairway is provided to prevent smoke and heat entering the stair enclosure and rendering it impassable for escape purposes, and to prevent fire spreading from one storey to another.

It is also important to ensure that there are no fire risks within a protected stairway, although sanitary accommodation is permissible, as are properly enclosed built-in cupboards.

It is essential that the width of a storey exit onto a stair does not exceed the width of the stair if potentially dangerous bunching of escapees is to be avoided.

Where there is more than one doorway from an auditorium, the doorways need to be placed carefully so as to ensure a smooth escape flow, and consideration should be given to limiting wide stairs to serving one level only, as the flows into a wide stair at various levels could cause congestion. However, a stair serving a large auditorium may also serve an adjacent small auditorium.

7.1.2 *Recommendations*

The following recommendations are applicable.

a) The capacities of protected stairways should be calculated in accordance with Table 5, and the aggregate capacity of protected stairways, and of exits leading therefrom, should be not less than the number of occupants of the storey or tier of seating when, in turn, each protected stairway is discounted.

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 a stair:

1) at any storey should be not less than the width of the widest storey exit at that storey; and

2) should not narrow in the direction of escape.

c) For the purposes of Table 5, the width of a stair is between the walls and/or balustrades and should be maintained clear for a vertical distance of 2.0 m, measured from the floor level or pitch line stringers, with the following exceptions:

1) strings, each intruding into the stair not more than 30 mm;

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

NOTE If a handrail intrudes more than 100 mm into a stair, for the purposes of calculating the capacity of the stair, the stair width should be regarded as reduced by the amount that the intrusion exceeds 100 mm.

d) A protected stairway 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 appliances;

iii) does not contain any gas appliance other than a water heater or sanitary incinerator;

2) cupboards enclosed with fire-resisting construction.

e) 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 stairs.

f) Access from any point on a storey or tier of seating to separate protected routes should be so sited that it is not necessary to pass through one protected route to reach another.

g) If a protected stairway projected 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[1)];

2) the enclosure within that distance and 9 m vertically below should be of fire-resisting construction that may contain non-opening fire-resisting glazed elements.

h) Stairs serving public areas should not serve ancillary accommodation except small areas of low fire risk.

[1)] The Technical Standards to the Building Standards (Scotland) Regulations require a minimum separation of 2.0 m.

Table 5 — Capacities of stairs

Number of floors served	Maximum number of persons accommodated on one stair of width:								
	1 000 mm	1 100 mm	1 200 mm	1 300 mm	1 400 mm	1 500 mm	1 600 mm	1 700 mm	1 800 mm
1	150	220	240	260	280	300	320	340	360
2	190	260	285	310	335	360	385	410	435
3	230	300	330	360	390	420	450	480	510
4	270	340	375	410	445	480	515	550	585
5	310	380	420	460	500	540	580	620	660
6	350	420	465	510	555	600	645	690	735
7	390	460	510	560	610	660	710	760	810
8	430	500	555	610	665	720	775	830	885
9	470	540	600	660	720	780	840	900	960
10	510	580	645	710	775	840	905	970	1 035

NOTE The capacity of stairs serving more than 10 floors may be obtained by linear extrapolation.

7.2 Basement stairs

7.2.1 *Commentary*

Areas below ground level 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. Nevertheless, for the purpose of normal circulation in a building, it may be necessary for some of the stairs from the upper levels to continue down to the basement. There is no objection to one-half of the stairs serving the upper storeys or tiers of seating continuing down to the basement, provided that each such stair is adequately protected from the ingress of smoke from the basement.

7.2.2 *Recommendations*

The following recommendations are applicable.

a) Not more than 50 % of the protected stairways serving the upper storeys or tiers of seating in a building should continue down to basement level.

b) Stairs which connect with basement levels should be separated from each basement level by a protected lobby in accordance with **7.3.2**.

7.3 Access lobbies and corridors to protected stairways

7.3.1 *Commentary*

Because of the greater hazard to occupants of a high building than of a low one, the protection afforded to a stair serving high buildings should therefore be greater.

This can be achieved by the stair serving only one storey, or by providing access to the stair by way of a protected lobby or corridor. Where there is a high concentration of persons using the stairs, the former solution is to be preferred.

Ancillary accommodation of significant fire risk ought not to be accessible from public stairs.

Normal circulation demands that some stairs will need to connect with enclosed car parks and, in these cases, lobby (or corridor) protection to the protected stairway is necessary.

7.3.2 ***Recommendation***

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

a) If the stair is in a building of height (see **2.15**) greater than 18 m, there should be a protected lobby or corridor at every level excluding a top storey consisting exclusively of plant rooms.

b) If the stair connects the ground or upper storeys with a basement storey or storeys, or serves only basement storeys, there should be a ventilated protected lobby or corridor (see **30.2.2**) at every basement level.

c) If the stair provides access to an enclosed car park, there should be a ventilated protected lobby or corridor (see **30.2.2**) at every car park access level.

7.4 Discharge from stairs and final exits

7.4.1 ***Commentary***

The general principle to be followed is that all occupants of the building descending the stairs to reach safety in the open air should be assured of the same degree of protection from the effects of smoke and heat in this part of the escape route as has been assured in the other parts. In achieving safety in this part of the route, the following considerations may apply.

a) The safest arrangement is for the stair to discharge direct to open air through doors at ground level. The exit doors should not immediately adjoin an exit from a basement from which smoke and heat could obstruct the stair exit.

b) If the stair is not adjacent to an external wall, there is no objection to its discharging through a protected corridor leading directly to a final exit and having access only to the accommodation listed in item d) of ***7.1.2****.*

c) If the escape route from a place of assembly terminates on a higher level than the street, the occupants should be assured of safety until street level is reached. This will be achieved only if:

1) the final exit discharges onto a walkway complying with item d) of ***7.4.2****;*

2) any escape route which passes through a part of the building that is in another occupancy is fully independent of, and protected from, that occupancy, and the final exit is independent of final exit(s) from the other occupancy.

It has been usual practice in the design of assembly buildings to provide stairs from various assembly levels to discharge into the main entrance foyer. In particular, the design of arena buildings lends itself to this arrangement. As foyers are areas with which the public will be familiar, they are likely to use them in the event of an emergency. If the foyer is regarded as one escape route from any level or area it serves, it is necessary to enclose it with fire-resisting construction and to ensure that adequate alternative escape routes are provided in accordance with ***6.3.2****. If a foyer serves different auditoria, more stringent precautions are necessary, since a fire in an unoccupied auditorium could hazard other auditoria which are occupied. As the foyer is the most used route in the building, there may be demands for the inclusion of areas for the sales of refreshments and merchandise. If this is so, the enforcing authority may not regard the foyer as an escape route unless it is satisfied that the extent of the use is limited or protected and that there are no cooking facilities.*

7.4.2 *Recommendations*

The following recommendations are applicable.

a) Where an escape route or routes from one or more tiers in a place of assembly discharge into a foyer, the foyer should be enclosed with fire-resisting construction.

b) Where escape routes from different auditoria within a place of assembly, e.g. from different cinemas within a multi-cinema complex, discharge into a common foyer, the foyer should be enclosed with fire-resisting construction and protected lobbies should be provided between the foyer and the escape routes discharging therein.

c) The foyer may be part of an escape route from an assembly area only if the other escape route(s) from that area lead directly to a place of safety.

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

e) The width of a final exit should be not less than that of the escape route leading to it.

f) Any external portion of an escape route between a final exit and street level, e.g. across a concourse or pedestrian walkway, should be clearly defined and if necessary guarded with protective barriers in accordance with BS 6180.

g) Final exits should be so sited that they are clear of any risk from fire and/or smoke.

h) Transformer chambers, boiler rooms and similar areas of risk should not have openings near any exits from the building.

8 Seating and gangways

8.1 General

The limitations on travel distance (see **6.5**) control the maximum spacing of exits but the actual seating layout may call for some adjustment of exits so that they are conveniently sited for the gangways. Traditionally, the number of seats in a row has been limited to an arbitrary figure, although a good seating layout can assist orderly movement to the exits. Where gangways are provided at each end of the rows of seating, the number of seats in a row is relatively unimportant given that travel distances are complied with and generous seatways are provided.

In a sports arena, where the risk from the activity area is negligible, exits may be sited so that spectators move towards the activity area but exits sited towards the back of the seating will reduce travel distance and possibly assist planning, although it may be necessary to provide some form of smoke control to prevent the routes leading to the exits becoming smoke logged.

8.2 Seat layout

8.2.1 *Commentary*

The seatways provide the initial parts of escape routes and hence need to be of sufficient width to enable all persons in a row easy movement towards the gangway(s).

Dining facilities are frequently provided within auditoria as restaurant theatres and in sports arenas as hospitality boxes. Where these facilities are provided for a closely seated audience the seatway ought not to be encroached upon by the tables, and the chairs ought to be swivel mounted for easy use.

8.2.2 *Recommendations*

The following recommendations are applicable.

a) The number of seats in a row should be in accordance with Table 6.

b) Seatway widths (see Figure 3) should be not less than 300 mm and should be constant throughout the length of the row. Where seats tip up automatically, the seatway width should be measured between the back of one seat unit and the maximum projection of the seat unit behind when the seat is in the up position.

NOTE Seatways in front of blocks of seating may be up to 900 mm in width without being treated as a gangway.

c) The slope of a tier of seating should not exceed 35° above the horizontal.

d) Balconies should be guarded with protective barriers in accordance with BS 6180 (see also Figure 4).

e) Where dining facilities are provided for a closely seated audience:

1) the travel distances in Table 2 should be complied with;

2) tables should be arranged so that there is no encroachment on the seatway width;

3) there should be no more than 12 seats in a row.

Table 6 — Number of seats in a row

Seatway width mm	**Maximum number of seats in a row**	
	Gangway on one side	**Gangway on two sides**
300 to 324	7	14
325 to 349	8	16
350 to 374	9	18
375 to 399	10	20
400 to 424	11	22
425 to 449	12	24
450 to 474		26
475 to 499		28
500 or more		Limited by the travel distance (see **6.5**)
NOTE An example of the application of Table 6 is shown in Figure 5.		

8.3 Gangways

8.3.1 *Commentary*

*Gangways should be carefully detailed to provide an unhindered flow towards the exits. Gangways may be flat, sloping or stepped. Where stepped, excessively long flights should be avoided, particularly where the seating is at the maximum slope [see item c) of **8.2.2**].*

NOTE 1 Stepped gangways should not be treated as stairs. Consideration should be given to the provision of central handrails to stepped and sloping gangways.

NOTE 2 Central handrails should be discontinuous, with gaps every few rows to improve access to seats and to permit crossing from one side of the gangway to the other. The addition of an intermediate rail below the main handrail facilitates use by children.

8.3.2 *Recommendations*

The following recommendations are applicable.

a) Gangways should be not less than 1 100 mm wide, unless used by not more than 50 persons in which case they should not be less than 900 mm wide.

b) There should be no projections which would diminish the clear width of the gangway, other than any handrails each intruding not more than 100 mm.

NOTE 1 If a handrail intrudes more than 100 mm into a gangway, for the purposes of calculating the capacity of the gangway (see Table 4) the gangway width should be regarded as reduced by the amount that the intrusion exceeds 100 mm. Central handrails with a width not exceeding 100 mm should be ignored when determining gangway width.

c) The ends of all rows of seats should be so aligned as to maintain a uniform width throughout the length of a gangway, unless the escape flow would be in one direction only (i.e. access to any alternative means of escape is along the rows), in which case the gangway may widen towards the storey exit.

d) Storey exits provided within the body of a seating layout[2)] should be approached from the side by transverse gangways.

e) Transverse and radial gangways in auditoria with tiered seating should not cross each other (i.e. any intersections should be "T" junctions) (see Figure 6). Connections between transverse and radial gangways should be offset to ensure a smooth flow to the exits.

f) In stepped tiers, the height of each step in a gangway should be not less than 100 mm and should not exceed 190 mm. Where there are two or more rises to each row of seats each step should be of equal height.

NOTE 2 In some auditoria, the seating rake is a parabola and, as long as the variation in step rise is uniform, adjacent steps are deemed to be of equal height.

g) The number of steppings in a tier uninterrupted by cross-gangways should not exceed 40 if the rake exceeds 25°.

h) Where exits are approached from a stepped gangway, there should be a landing the width of the exit and at least 1 100 mm deep immediately in front of the exit doors.

i) Stepped side gangways should be provided with a handrail fixed at a height of 840 mm measured vertically from the centre of the steps and projecting not more than 100 mm from the wall. If the gangway is at the side of a tier which does not extend up to a wall, the edge of the tier should be protected by a balustrade or guardrail to a height of not less than 1 100 mm above the centre of the steps.

j) In stepped tiers there should not be a change of level between the seatway and the nearest step.

8.4 Fixing of seats for closely seated audiences

8.4.1 *Commentary*

Seating needs to be securely located in position to avoid gangways and exits being obstructed by displaced and overturned seats, especially in a hurried evacuation.

Seating may be permanent or temporary depending on the use of the assembly area but the rules governing the layout and gangways apply in either case.

Temporary seating consists of three types.

a) Retractable or telescopic seating (normally used in a multi-purpose hall or sports arena). This may be a fixed installation drawn out from the surrounding enclosure or the whole unit may be moveable to form a number of seating layouts.

b) Demountable seating. This comprises tiered seating assembled from kits of parts, and disassembled after use.

c) Rows of portable seating. This may be provided in the activity area of a sports arena or on the open space of a multi-purpose hall and may be provided on a structure to provide satisfactory sight lines.

[2)] Such exits are often called vomitory exits.

8.4.2 *Recommendations*

The following recommendations are applicable.

a) Where the seating layout is permanent, all seating (except for chairs in boxes and similar small enclosures) should be firmly fixed to the floor.

b) Retractable or telescopic seating, when in the extended position, should be provided with locking devices to prevent movement.

c) Where the seating layout is temporary, the following apply.

1) Seating for more than 50 persons laid out on the floor area should be secured together in lengths of not fewer than four seats.

2) If seating for more than 250 persons is required, provision should be made for fixing to the floor the rows of seating flanking the front, the back and the cross gangways and the seats near exits, although only the end seats of the rows need to be fixed to the floor if all the seats are secured together.

3) Where seats are secured together, it should not be possible to separate them, nor for a row to "snake", merely by pushing one or more seats in a row.

NOTE Where the fixing of seating to the floor is impracticable or undesirable (e.g. on polished dance floors), floor bars instead of screws may be used. Floor bars should have a cambered top surface so as to avoid the risk of tripping by persons using the seating. This form of securing seating is not recommended where a very lively audience is anticipated, such as at a pop concert.

d) All seats on telescopic or retractable units and tiered platforms of any type should be securely fixed.

e) Access should be available beneath all temporary tiered seating to clear any accumulated rubbish.

f) The underside surfaces of all plywood decks to temporary seating should be class 0 (see **2.2**).

All surfaces of side panels, back panels and fascias to temporary tiered seating should be class 0 (see **2.2**).

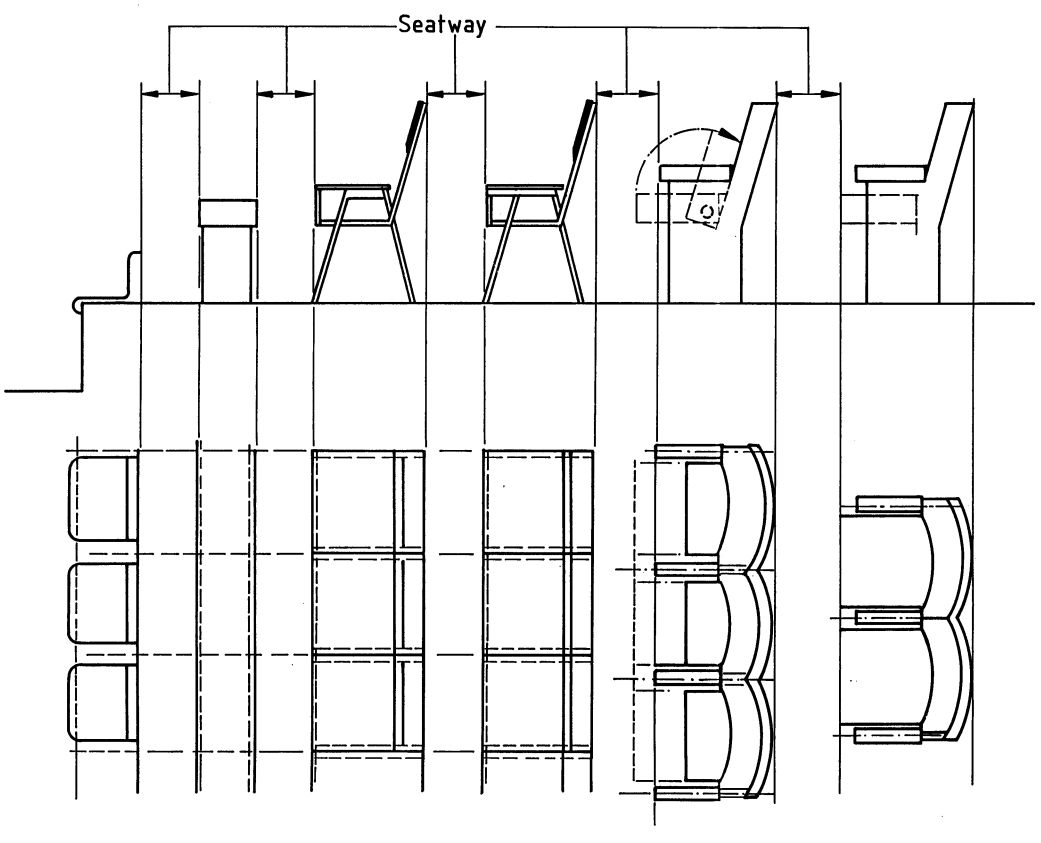


Figure 3 — Determination of seatway

All dimensions are in millimetres, unless otherwise stated

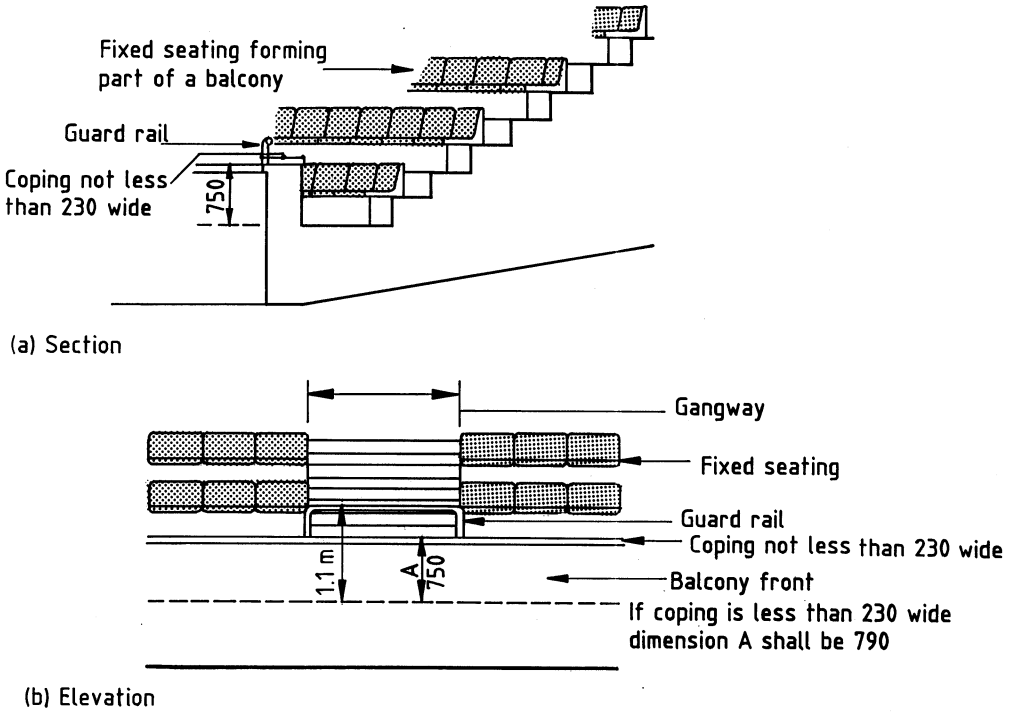


Figure 4 — Example illustrating protection of balconies with fixed seating

All dimensions are in millimetres

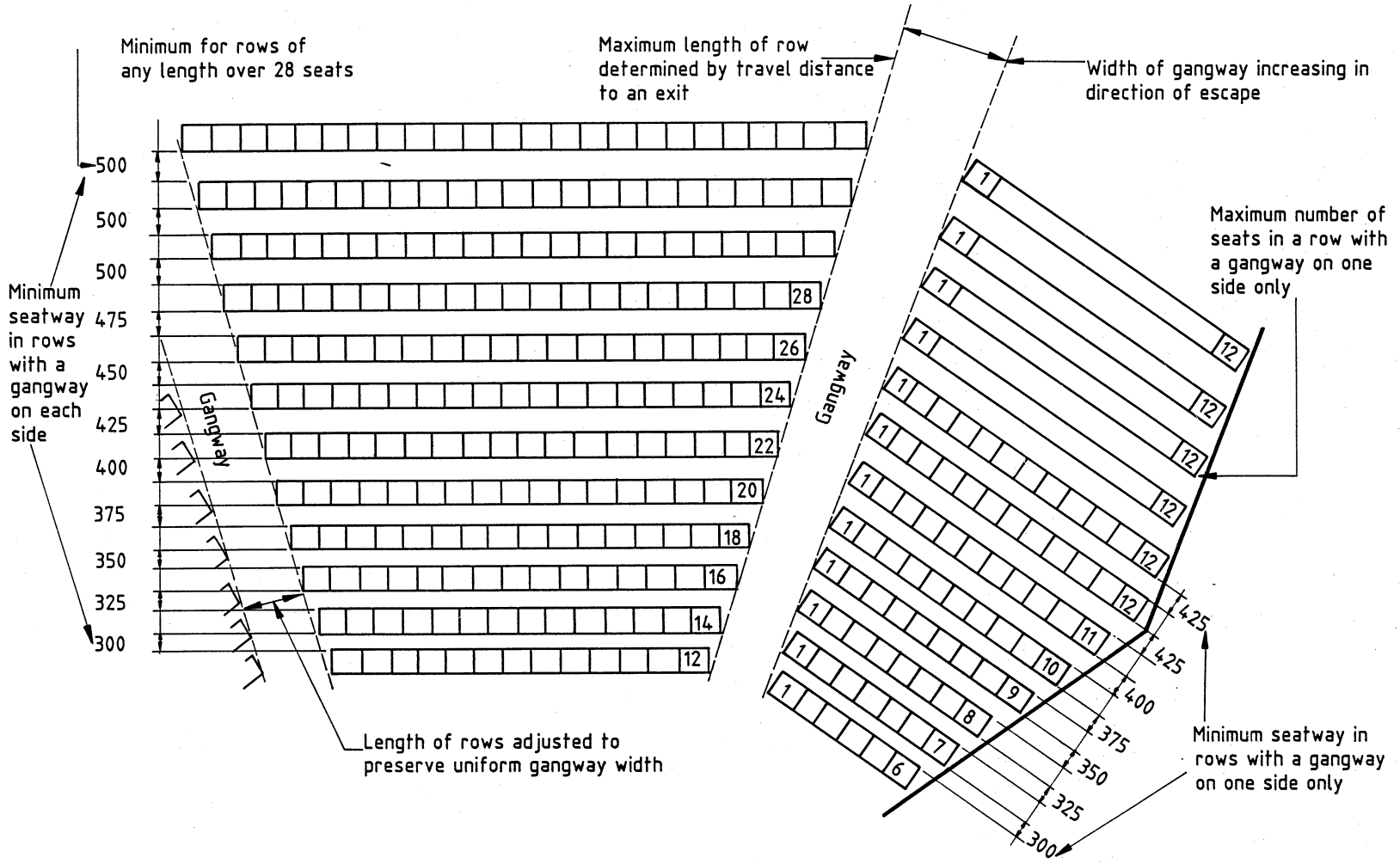


Figure 5 — Seatway width and number of seats in a row

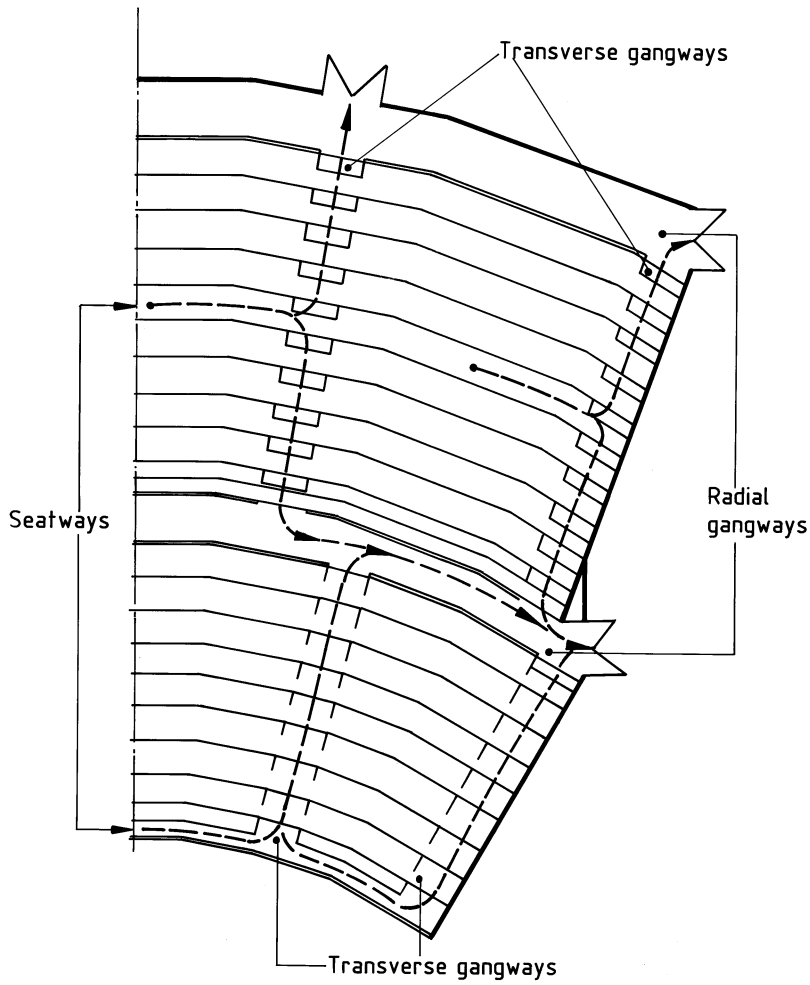


Figure 6 — Transverse and radial gangways

8.5 Fire rating of seating

8.5.1 *Commentary*

*As previously discussed in Clause **6**, the construction of the building, the standard of linings and the heating, lighting and ventilation standards provide a level of safety upon which travel distance is based. The standard of seats is also an important consideration.*

8.5.2 *Recommendation*

Seats provided for a closely seated audience should satisfy the pass criteria for smouldering ignition source 0, flaming ignition source 1 and crib ignition source 5 when tested in accordance with Section 5 of BS 5852:1990.

8.6 Furnishings, fabrics and decorative features

8.6.1 *Commentary*

Furnishings, fabrics and decorative features (which include drapes and artificial foliage) need to be of materials which in themselves do not present an unacceptable increase in the combustible materials within the building or which would cause rapid spread of fire or smoke generation if involved in a fire.

8.6.2 *Recommendations*

The following recommendations are applicable.

a) Furnishings, fabrics and decorative features should be non-combustible or should comply with the requirements for classification as type B in accordance with BS 5867-2:1980 after being subjected to the appropriate wetting or cleansing procedure described in BS 5651.

b) Furnishings, fabrics and decorative features should not be provided within enclosed escape routes (other than foyers) unless made from non-combustible materials.

c) Drapes should not be provided in front of exit doors or across escape routes.

d) Textile floor coverings, together with any underlay, should, when tested in accordance with BS 4790, using the test procedure reflecting the method used for securing the floor covering to the floor, either:

1) not ignite; or

2) have effects of ignition on both the use-surfaces and under-surfaces not extending beyond a circle of radius 35 mm centred on the central point of application of the nut.

Section 4. Construction

9 Construction

9.1 General

The recommendations in Section 3 are made on the assumption that the provisions for structural fire protection of the building comply with 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) possible 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.

The provision of structural fire protection is intended to ensure that the building will not collapse prematurely in 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.

9.2 Fire resistance

9.2.1 *Commentary*

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

For the purposes of complying with the recommendations for means of escape in case of fire, a 30 min period of fire resistance is generally considered adequate. However, increased periods of fire resistance for some elements may be necessary for structural fire protection, not only to comply with building regulations, but also to ensure adequate safety for firefighting. Higher periods of fire resistance may also be needed for insurance purposes and, therefore, the insurers should be consulted at the design stage.

Satisfactory performance of fire resistance of structural elements is ascertained by compliance with one of the following:

a) specifications tested, or assessed, in accordance with the appropriate part of BS 476[3)];

NOTE Requirements made in connection with statutory provisions may still refer to BS 476-8 although it has been superseded by BS 476-20, BS 476-21, 22 and BS 476-23, with the tests relevant to loadbearing elements published in Part 21, and those for non-loadbearing elements in Part 22. The criterion of "stability" has been replaced by the criterion of "loadbearing capacity". In line with international practice, non-loadbearing elements tested in accordance with BS 476-22 are assessed only for integrity and insulation. Brief details of these tests are given in PD 6520.

b) appropriate British Standard specifications or codes of practice;

c) specifications referred to under building legislation.

[3)] Although BS 476-8 was superseded in 1987, specifications tested to Part 8 before January 1988 are acceptable for the purposes of this code.

9.2.2 *Recommendations*

The following recommendations are applicable.

a) Fire resistance, where recommended in this code, should be taken (in the absence of any recommendation to the contrary) as being not less than 30 min, and implies the following:

1) for loadbearing walls, equal compliance for loadbearing capacity, integrity and insulation from either side;

2) for non-loadbearing walls and partitions, equal compliance for integrity and insulation from either side;

3) for floors, equal compliance for loadbearing capacity, integrity and insulation from the lower side;

4) for glazed elements, equal compliance for the appropriate criteria (see **9.4.2**) from either side;

5) for doors, compliance for integrity from either side, except in the case of doors to lift wells, where performance is in respect of exposure of the landing side only.

b) The fire resistance of any element of structure should be not less than that required for any element which it supports, and in no case less than 60 min.

c) Floors and beams should achieve the appropriate standard of fire resistance without taking account of any additional protection afforded by any suspended ceiling beneath them.

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

9.3.1 *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 building regulations for the penetration of compartment walls and compartment floors by service ducts and shafts.

If a lift well is located within a protected lobby or protected stairway, the preferred location of the lift machine room is either above the lift well or outside the stair and lobby enclosures. Lift wells located in the accommodation ought to be sited so as not to prejudice escape routes.

9.3.2 *Recommendations*

The following recommendations are applicable.

a) Lift wells (other than in a protected stairway), 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 comply with BS 8313 and ventilation and air conditioning ductwork should comply with BS 5588-9.

9.4 Glazed elements

NOTE The recommendations given in BS 6262 should also be followed. These recommendations may impose further restrictions on the position, size and composition of glazed elements.

9.4.1 *Commentary*

Partitions, doors and windows can be glazed with a variety of products, e.g. traditional annealed wired glass based on soda-lime-silica, or clear borosilicate glass. Although able to satisfy the integrity criterion of BS 476-22 for periods in excess of 90 min, these permit local heat transmission and radiation through the glass and so are unable to satisfy the insulation criterion for more than a limited period of time. Such heat transmission and radiation can constitute a hazard to people escaping nearby and could ignite adjacent combustible materials. Some laminated glasses (intumescent or gel-interlayer) can achieve in excess of 90 min *for integrity and insulation in specific glazing constructions.*

NOTE 1 PD 6512-3 gives advice and information on the fire performance of glazed elements in buildings.

The type of glazed element permitted in a fire-resisting construction depends on whether either:

a) the glazed element should afford the same protection as the remainder of the enclosure in which it is situated; or

b) it is necessary for the glazed element to afford protection only against the passage of flames and hot gases.

NOTE 2 Additional restrictions may be imposed in connection with the construction of firefighting shafts (see BS 5588-5).

9.4.2 *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 comply with the limitations given in Table 7 appropriate to their position.

Table 7 — Limitations on non-insulating fire-resisting glazed elements

Position of glazed element	Maximum total glazed area in	
	the fire-resisting wall[a]	any leaf of a fire door[b]
a) Directly between a protected stairway and the assembly area or a non-fire-resisting corridor[c]	Unlimited above 1.1 m height[d]	50 % of door area[e]
b) Between a protected stairway and a protected lobby or protected corridor	Unlimited above 0.1 m height[f]	Unlimited above 0.1 m height
c) Between a protected lobby and the assembly area	Unlimited above 0.1 m height[f]	Unlimited above 0.1 m height[f]
d) Between a protected corridor forming a dead end and the assembly area	Unlimited above 1.1 m height[d]	Unlimited above 0.1 m height
e) Between a protected corridor not forming a dead end and the assembly area	Unlimited above 0.1 m height	Unlimited above 0.1 m height
f) Subdividing corridors	Unlimited above 0.1 m height	Unlimited above 0.1 m height
g) Between certain ancillary accommodation and other parts of the building (see **10.4**)	Nil	0.1 m^2 maximum

[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 comply with 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-resistant glass should be established before glazing. Moreover, not all doors can be glazed without affecting the stability of the door leaf.
[c] Measured vertically from the landing floor level or the stair pitch line.
[d] Nil in parts of buildings served by a single stair.
[e] 25 % of the door area in parts of buildings served by a single stair.
[f] Nil below 1.1 m in parts of buildings served by a single stair.

9.5 Fire doors

NOTE The term "fire door" includes both the door frame and the door leaf or leaves.

9.5.1 *Commentary*

Fire doors are one of the most important links in the chain of fire safety precautions, and 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 comply precisely, in dimensions and workmanship, with the manufacturer's specification for the appropriate fire resistance test report/assessment. Doors should be hung to ensure a good fit to the frame when closed.

The ability of fire doors to perform their designed function will depend upon their being fully closed at the time of fire; they are, therefore, normally required to be fitted with self-closing devices. However, closers ought not to have significantly more force than is necessary to close (and latch if appropriate) the door effectively; latches should be selected and fitted so as not to require an unreasonable closing force.

Where a closed door would cause problems to the normal usage of the building, and therefore might be wedged or otherwise held open or have the closer disconnected, electromagnetic (or similar) "hold open" systems may be considered for use except in critical situations, for example the doors to protected lobbies of firefighting lifts or to the sole escape stair to a building.

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 made in connection with regulations and codes of practice do not normally specify any performance for "insulation".

*For the purposes of this code, fire doors are designed by reference to their required performance (in minutes) for integrity only, e.g. a reference FD 30 implies that the door in that situation should achieve not less than 30 min integrity, when tested in accordance with BS 476-22. Where doors are also required to resist the passage of smoke at ambient temperature, the suffix "S" is added (see **9.5.2**).*

NOTE 1 Methods for the evaluation of doors to control the movement of smoke will be published as Sections of BS 476-31. The methods take account of three different stages of a fire:

a) ambient temperature;

b) medium temperature;

c) high temperature conditions.

NOTE 2 Further information on the performance and function of fire doors is given in PD 6512-1, and on the installation and maintenance of fire door assemblies in BS 8214.

Although the above-mentioned system of designation specifically excludes reference to any performance for insulation (because of the problems of radiation through traditional fire-resisting glass), Table 7 recommends limits to the extent of the non-insulating glazed area in fire doors in certain circumstances.

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

9.5.2 ***Recommendations***

The following recommendations are applicable.

a) A fire door should be provided to comply with the minimum performance recommended for any of the following circumstances:

1) a fire door forming part of the enclosures of:

i) a protected stairway, FD 30S;

ii) a protected lobby or protected corridor approach to a protected stairway [see item a) of **7.3.2**], FD 30S;

iii) ancillary accommodation [see Table 9, items 1) to 6)], FD 30;

iv) ancillary accommodation [see Table 9, items 7) to 15)], FD 60;

v) all lift shafts except those within enclosures of a protected stairway [see item a) of **9.3.2**], FD 30;

vi) builders' ducts, etc. [see item b) of **9.3.2**], FD 30;

2) a fire door subdividing:

i) corridors connecting alternative exits [see item c) of **10.3.2**], FD 20S;

ii) dead-end portions of corridors from the remainder of such corridor [see item c) of **10.3.2**], FD 20S;

3) a fire door affording access on to an external stairway (see **6.7**), FD 30.

b) A fire door (e.g. FD 30) required to resist the passage of smoke at ambient temperature conditions [i.e. those having suffix S in item a)] should be tested complete with smoke seals in accordance with BS 476-31.1.

NOTE 1 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, 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 or service duct, see item e)] should be fitted with a self-closing device (other than rising butt hinges) that:

1) should be of a type that cannot readily be disconnected or immobilized and does not embody a stand-open action; and

2) should override any latches fitted to the door(s); or

3) in the absence of a suitable latch or other positive device for holding the door shut in its frame, should be 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) 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.

e) A fire door to a cupboard or refuse chamber or service duct, in lieu of being self-closing, should have means to enable it to be kept locked shut when not in use and be so marked on the outside with the appropriate sign complying with BS 5499-1.

f) Except for doors to firefighting lobbies, to firefighting stairs or to the only protected stairway in a building or part of a building, hold-open systems complying with **9.6.2** may be provided for holding open fire doors, or for overriding their self-closing devices. Such doors should be suitably marked on both sides, at about eye level, with the appropriate sign complying with BS 5499-1.

g) All fire doors, except doors to cupboards or service ducts [see item e)], or doors held open by a hold-open device [see item f)], should be marked on both sides, at about eye level, with the appropriate sign complying with BS 5499-1 to the effect that they should be kept closed when not in use.

NOTE 2 Advice on the selection of door furniture for fire doors is given in "Code of practice for hardware essential to the optimum performance of fire-resisting timber doorsets" (1983), prepared by and available from the Association of Builders' Hardware Manufacturers, Heath Street, Tamworth, Staffordshire, B77 7JH.

9.6 Hold-open systems

9.6.1 *Commentary*

Hold-open systems are 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 two main types of hold-open system available:

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 may be set to allow the door to swing freely, with the door closer operating only in a fire situation.

A specification has been published only for the automatic release mechanisms described in item a).

9.6.2 *Recommendations*

The following recommendations are applicable.

a) Automatic release mechanisms should comply with BS 5839-3.

b) The hold-open system should release the door to close automatically in the event of each or any one of the following:

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) if the facility is provided, by a manual operation at a central control point.

9.7 Recommendations for doors on escape routes

The following recommendations are applicable.

a) Doors affording means of escape from, and within, the common areas of the complex should:

1) be hung to open in the direction of escape;

2) be hung so that any change of floor level occurs beyond the edge of the door when open at an angle of 90° to the closed position;

3) be hung so that they do not reduce the effective width of any escape route across a landing;

4) if opening towards a corridor, be recessed to the full width of the door;

5) where hung to swing both ways, and on all doors subdividing corridors, be provided with at least an adequate vision panel in each leaf;

6) open not less than 90°.

b) Fire doors on common escape routes should not be fitted with threshold upstands.

c) Automatic doors and revolving doors should not be provided across escape routes unless:

1) they are to the required width and are automatic doors complying with BS 7036 and either:

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 for opening the doors if the mains supply fails; or

2) swing doors to the required width are provided immediately adjacent.

d) Security grilles and shutters (roller, folding or sliding) should be capable of being easily and quickly opened manually (even if normally power operated) unless an alternative power supply is provided.

9.8 Recommendations for fastening of doors on escape routes

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

The following recommendations are applicable.

a) Exit doors from areas holding more than 50 people should either be free from fastenings or be fitted with panic bolts complying with 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.

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

9.9 Recommendations for construction of escape routes

The following recommendations are applicable.

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

b) All escape routes should have a clear headroom of not less than 2 m and there should be no projection from any wall (except normal handrails), ceilings (except door frames), or false ceilings, below this height which would impede the free flow of persons using it.

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

d) Clear gangways should be provided from all parts of assembly areas up to and between stairs, the doors to stairs and other exits from assembly areas.

9.10 Surfaces of escape routes

9.10.1 *Commentary*

In premises used by the public, particularly in large numbers, it is important that the construction of wall and ceiling linings is such that they do not contribute to the spread of fire nor give off excess heat when burning.

This is particularly the case in areas such as protected stairways and escape routes. It should be noted that large rooms need to be treated in the same manner as protected stairways and escape routes.

9.10.2 *Recommendations*

The following recommendations are applicable.

NOTE These recommendations may be more onerous than those required to meet building regulations.

a) Wall and ceiling linings in protected stairways and escape routes, rooms and areas holding more than 50 people, and auditoria should have class 0 surfaces.

b) Wall and ceiling linings in other areas should have surfaces that would be classified as class 1 if tested in accordance with BS 476-7.

9.11 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 comply with BS 5395-1 or should be a type E (public) stair complying with BS 5395-2.

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 **6.7.2**).

9.12 Ladders

9.12.1 *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, for example for plant rooms that are not normally manned and for galleries not manned during performances.

9.12.2 *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 exceptional circumstances where it is impractical to provide a more satisfactory escape route.

c) Ladders provided as means of escape should be constructed of non-combustible materials, and should comply with BS 5395-3.

Section 5. Ancillary accommodation

10 General

10.1 Ancillary accommodation

Ancillary accommodation covers car parks and all those parts of the building to which the public generally do not resort and which are necessary for the proper functioning of the building, such as:

a) plant rooms, e.g. boiler rooms, transformer chambers;

b) storerooms;

c) kitchens and staff canteens;

d) changing and dressing rooms;

e) stage areas;

f) workshops;

g) loading bays and scene docks;

h) control rooms.

With few exceptions, e.g. small offices and control rooms, these areas present a greater fire hazard than the public assembly areas. This is partly because they contain quantities of flammable material or workshops involving flammable material and partly because they may be visited only occasionally and, therefore, are not under constant supervision. Large areas of office accommodation, and restaurants (unless for staff only, see Clause **15**) and shops should be dealt with in accordance with BS 5588-11.

10.2 Escape routes and exits

10.2.1 *Commentary*

Escape routes from ancillary areas should be planned independently from those for public areas, with the recommendations of Section 3 applying generally, but with the following differences:

a) limitations on the part of the travel distance within some ancillary accommodation because of the greater fire risk to persons in the event of fire;

b) inner rooms may be provided where necessary to supervise the activities in an outer room;

c) prop rooms and quick-change rooms may open directly off the stage.

It is essential that the occupants of an inner room or a prop room have a warning of fire in the access room at an early stage.

Small security offices may be located within escape routes, subject to restrictions on any upholstered furniture they contain.

10.2.2 *Recommendations*

The following recommendations are applicable.

a) Ancillary accommodation should have means of escape in accordance with Section 3, provided that the travel distances do not exceed those recommended for open floor areas in Table 2, and that the part of the travel distance within ancillary accommodation does not exceed the distances recommended in Table 8.

If travel is initially in one direction only then:

1) the travel distance within the ancillary accommodation to the point at which travel is possible in more than one direction should not exceed the appropriate limit given in Table 8; and

2) the total travel distance within the ancillary accommodation (including that part in one direction only) should not exceed the appropriate limit given in Table 8.

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

i) the routes should be not less than 45° apart (see Figure 2); or

ii) the routes should be separated from each other by fire-resisting construction.

b) Escape routes from ancillary accommodation (other than small areas of low fire risk [see item h) of **7.1.2**] should be independent of the escape routes serving public areas.

c) An inner room, a prop room or a quick change room should be provided with escape routes arranged to pass through not more than one access room, and at least one of the following provisions should apply to inner or prop rooms:

1) the enclosures between the inner or prop room and the access room are not carried full height;

2) a vision panel is provided between the two rooms in a suitable position and of a suitable size;

3) the access room is fitted with at least one smoke detector that operates an alarm in the inner or prop room.

d) Corridors serving ancillary accommodation may contain a security office only if:

1) its floor area does not exceed 10 $m^{2;}$

2) any upholstered furniture complies with **8.5.2**.

Table 8 — Maximum part of travel distance within ancillary accommodation

Area of ancillary accommodation	Cross-reference	Maximum part of travel distance within the ancillary accommodation[a]	
		For escape in one direction only m	For escape in more than one direction m
1 Ancillary accommodation other than items 2, 3, 4, 5, 6 and 7		18	45[b]
2 Dressing rooms	**13.3**	9	18[c]
3 Engineering services installation rooms	**16**		
4 Transformer and switchgear rooms	**10.6**		
5 Boiler rooms	**19.6**		
6 Fuel storage spaces	**19.7**		
7 Rooms housing fixed internal combustion engines	**19.8**		

[a] See Table 2 for maximum travel distances.
[b] Including up to 18 m in one direction only.
[c] Including up to 9 m in one direction only.

10.3 Corridors

10.3.1 *Commentary*

Where corridors are provided to serve dressing rooms and other ancillary accommodation, the corridors should be enclosed and should lead to alternative exits. Ancillary accommodation should be arranged so that the corridors serving dressing rooms and changing rooms are separate from the corridors serving other ancillary accommodation such as boiler and transformer chambers.

To prevent a corridor that connects alternative exits becoming smoke logged throughout its length, it is necessary to divide that corridor by the erection of a smoke control door and associated screen.

Similarly, connecting corridors and dead-end corridors need to be separated so as to restrict the movement of smoke.

10.3.2 *Recommendations*

The following recommendations are applicable.

a) Corridors serving ancillary accommodation should provide access to alternative exits, one of which should be a storey exit, and those serving dressing rooms and changing rooms should be separated from other ancillary accommodation.

b) Corridors serving ancillary accommodation should be enclosed by construction with a fire resistance of not less than 30 min and all doors within the enclosure should be fire-resisting and self-closing.

c) Corridors connecting alternative exits more than 12 m apart (measured along the centre line of the corridor), communicating corridors and dead-end corridors should be subdivided and separated as indicated in Figure 7 and Figure 8. Any doors to ancillary accommodation that would allow smoke to bypass a separating door should be provided with door closers complying with BS 6459-1.

d) Corridors serving ancillary accommodation may contain a security office only if:

1) its floor area does not exceed 10 m^2;

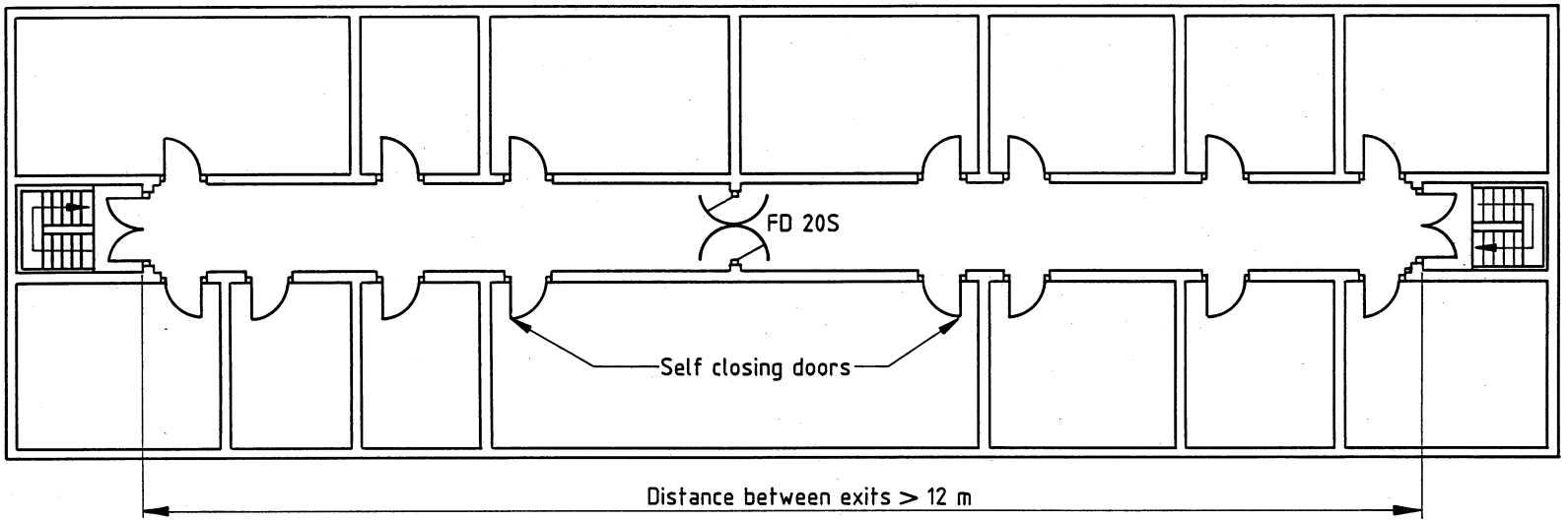
2) any upholstered furniture complies with **8.5.2**.

10.4 Separation and enclosure of ancillary accommodation

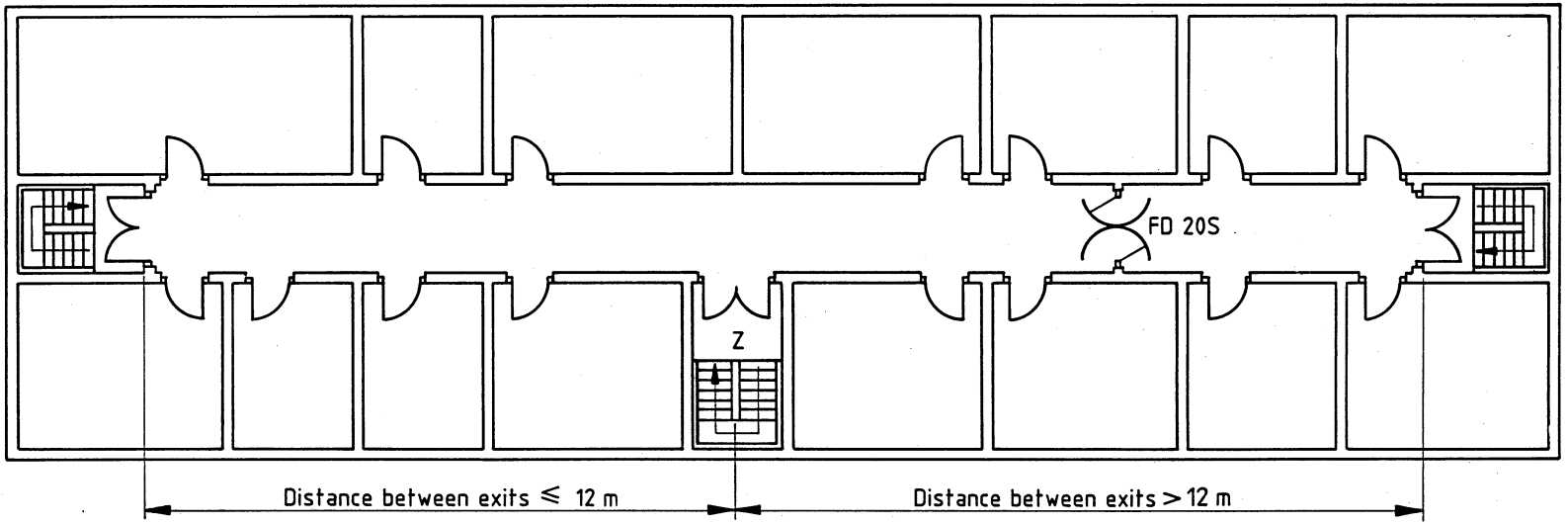
10.4.1 *Commentary*

Because the fire risks associated with ancillary accommodation are, in most cases, higher than those associated with the public areas, ancillary accommodation needs to be enclosed and separated from public areas. The degree of separation needed varies with the risk and appropriate recommendations are given below. These should be read in conjunction with Section 4.

The recommendation for enclosure of projection rooms is in respect of non-flammable film, and the Cinematograph (Safety) Regulations 1955 and subsequent amendments should be consulted in respect of flammable film and for the arrangement of projection rooms generally. It should be noted that the Regulations do not permit any door or hatchway to connect a projection or rewind room directly with the auditorium or parts used by the public, and any escape route from a projection room through the public area ought, therefore, to be lobbied.



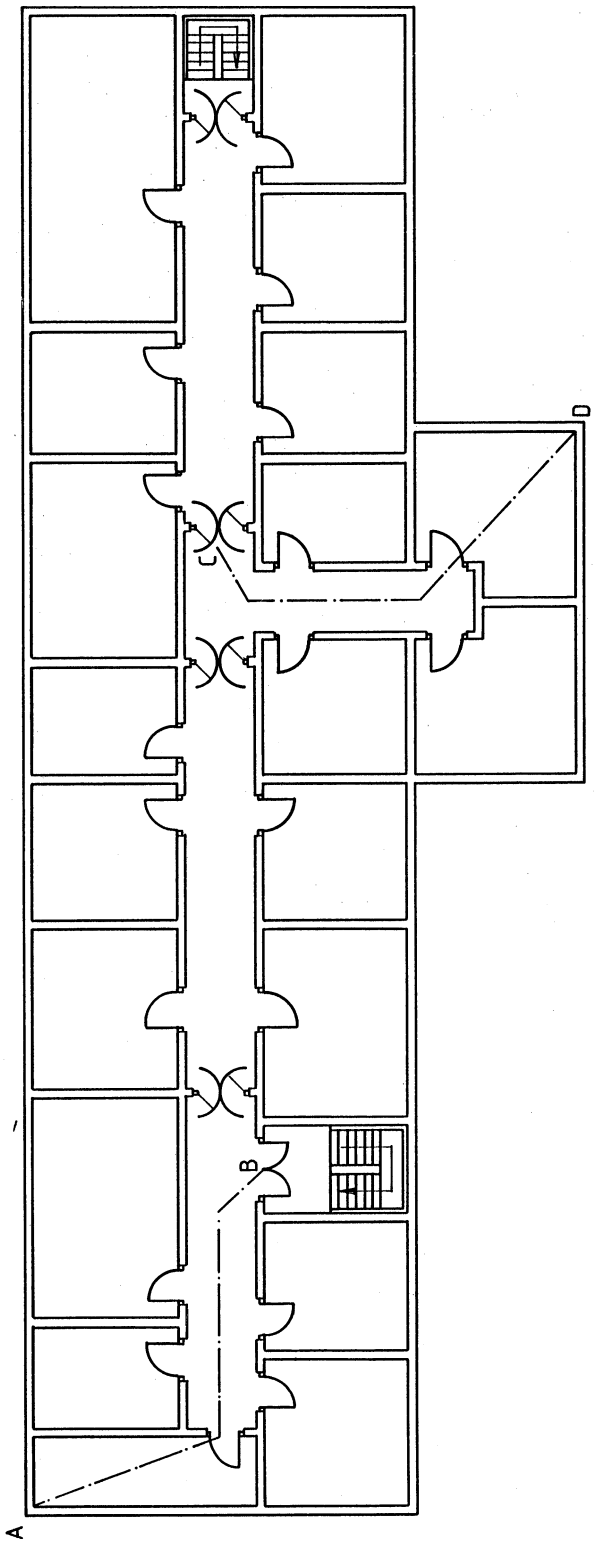
a) Corridors connecting two exits



NOTE Doors to central stairway should be at position Z.

b) Corridors connecting three exits

Figure 7 — Corridors connecting alternative exits in ancillary accommodation



AB and DC indicate travel distances within dead ends.

Figure 8 — Subdivision of dead-end corridors in ancillary accommodation

10.4.2 *Recommendation*

Ancillary accommodation should be separated from other parts of the building in accordance with Table 9.

10.5 Service installation rooms

10.5.1 *Commentary*

Service 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.

10.5.2 *Recommendations*

The following recommendations are applicable.

a) Service installation rooms having an exit situated at basement level should be sited so that escape from other exits is not prejudiced by the risk of 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 such ventilation should not impair any fire resistance requirements for the structure.

10.6 Recommendations for medium- and high-voltage[4] transformer and switchgear rooms

The following recommendations are applicable.

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

b) A transformer or switchgear room should:

1) have adequate provision for ventilation;

2) 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 8.

c) A transformer chamber should be separated from any protected stairway by a fire-resisting lobby or corridor.

11 Storage areas (including loading bays)

11.1 Commentary

Storage areas range from confectionery stores to chair stores and scenery stores. They are a particular fire risk because the fire loading may be high and they may be visited infrequently. In sports arenas there will be stores for practice exercise mats which may present a particularly severe fire risk in terms of generation of heat and smoke. Combustion modified high resiliance foams will improve the situation but, nevertheless, it is essential that these stores, or indeed any storage area, do not open directly onto public escape routes.

Smoke venting of large storage areas is important especially where the stores are windowless. If possible, storage areas should be sited adjacent to an external wall to facilitate the provision of air inlets and smoke extracts. These should be so sited that smoke from them, particularly from basement areas, is unlikely to jeopardize means of escape from the building.

*NOTE Scene docks are covered in **13.4**.*

[4] Voltages greater than 450 V.

11.2 Recommendations

The following recommendations are applicable.

a) Storage areas if either:

1) situated below ground level; or

2) exceeding 450 m^2 in area;

should have adequate provision for smoke venting in accordance with **31.3**.

b) Storage areas should not open into public escape routes.

Table 9 — Structural fire protection of areas of ancillary accommodation

Area of ancillary accommodation	Cross-reference	Type of construction needed to separate ancillary accommodation from other parts of the building
1. Storage areas not greater than 450 m^2[a b]	**11**	Robust construction having a minimum standard of fire resistance of 30 min[c]
2. Repair or maintenance workshops[a]	**12**	
3. Kitchens, staff restaurants, canteens	**15**	
4. Transformer, switchgear, and battery rooms for low-voltage or extra-low-voltage equipment		
5. Dressing rooms or changing rooms	**13.3**	
6. Projection rooms for non-flammable film	**10.4**	
7. Covered loading bays and storage areas greater than 450 m^2[a b]	**11**	Robust solid non-combustible construction having a minimum standard of fire resistance of 60 min[c]
8. Service installation rooms other than those covered by items 4 and 11 to 14 inclusive	**10.5**	
9. Car parks within or adjoining a development and not greater than 450 m^2 in area	**14**	
11. Car parks within or adjoining a development and greater than 450 m^2 in area	**14**	Robust solid non-combustible construction having a minimum standard of fire resistance equivalent to that required of the elements of construction of the building and in no case less than 60 min[c]
11. Boiler rooms	**19.6**	
12. Fuel storage	**19.7**	
13. Transformer and switchgear rooms for equipment above low voltage	**10.6**	
14. Rooms housing fixed internal combustion engines	**19.8**	
15. Scene docks	**13.4**	
16. Covered loading bays and storage areas other than those covered in items 1 and 7	**11**	

[a] Not higher fire risk areas.
[b] Other than waste storage and treatment areas (see Clause **22**).
[c] Any openings in the required construction to be protected by doors having a similar standard of fire resistance.

12 Repair or maintenance workshops and paint shops

In most assembly buildings, particularly theatres and sports arenas, there will be a requirement for workshops varying widely from construction of scenery, painting of scenery to small costume repair shops. The fire risk will vary widely and the size of some workshops may make them subject to the Factories Acts.

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

13 Stage areas

13.1 Commentary

The stage area comprises the stage and its ancillary areas, such as property stores and quick-change rooms.

There may be a high fire loading on the stage, particularly because of the quantities of scenery and curtains involved. The risk of fire may be increased because of temporary and flimsy properties and furniture and temporary lighting equipment. It should be noted, however, that the stage area is likely to have close supervision whenever the public is present.

By the end of the 19th century, the traditional theatre form had evolved providing facilities for changing and displaying scenery in a stage enclosed by three walls, with the fourth wall almost completely omitted to allow the audience to view the spectacle through the proscenium arch. This fourth wall is known as the proscenium wall.

There were frequent and disastrous theatre fires during the 19th century because of the use of naked gas flames for lighting and the provision of large quantities of untreated scenery in order to satisfy a growing demand for spectacle. Consequently the safety curtain was devised and with it associated stage venting, whereby a barrier could be dropped in order to protect the audience from the effects of fire on stage for sufficient time to allow them to evacuate the premises.

Where the fullest flexibility as to the types of scenery and effects on the stage is required, a proscenium wall and safety curtain and stage ventilation is necessary.

With the introduction of electric lighting and the consequent abandonment of gas lighting, together with substantial improvements in the standards of treatment of scenery with flame retardants, the need for safety curtains has diminished.

At the same time, a demand has occurred for other stage forms in which the audience may be more closely associated with the performance, e.g. the open or end stage (where the proscenium wall is omitted), theatre-in-the-round or arena stage (where the audience sits on all sides of the stage) and the thrust stage (where the audience sits on three sides of the stage). Such stages cannot easily be separated from the audience and escape routes for the players on the stage may include audience gangways. Where an arena stage is the permanent stage arrangement, there need to be separate access routes for the players from the dressing rooms. Where practicable, additional escape routes separated from audience escape routes also need to be provided. Such provisions are generally impracticable where the arrangements are temporary, e.g. in a multi-purpose hall with a flat floor and temporary seating.

Where the stage does not have a safety curtain, the licensing authority may limit the amount and type of scenery used. If there is no safety curtain, the need for higher standards of flame retarding may limit the materials used for the construction of scenery and may materially increase running costs whilst limiting the types of use: for example touring productions intended for separated stages may not be permitted. A detailed discussion of these matters is beyond the scope of this code and the licensing conditions of the relevant authority should be consulted.

The grid and fly galleries provide facilities for flown scenery. These involve working above the stage and are particularly hazardous situations in the event of fire on the stage. Those working in these areas will be active able-bodied persons and working access has been traditionally by ladders. In a fire situation this is unsatisfactory and it is essential that there is access to alternative means of escape.

13.2 Recommendations

The following recommendations are applicable.

a) Escape routes from the stage and stage basement should comply with Section 3 and travel distances should comply with those listed in Table 2 for open floor areas.

b) Protected lobbies should be provided between:

1) the stage and the dressing room corridor(s);

2) the stage and a final exit to the open air;

3) the stage and the auditorium when a "pass" door is provided in a proscenium wall;

4) the stage basement and the orchestra pit.

NOTE The stage basement is considered to be part of the stage and hence there is no need for fire-resisting separation between it and the stage.

c) A proscenium wall, where provided, should be of non-combustible construction having a standard of fire resistance equivalent to that required for the elements of construction of the building and in no case less than 60 min. The wall should be carried up from the lowest level of the stage basement to the under-side of the roof.

d) Where a safety curtain is provided:

1) it should be of robust and rigid construction;

2) it should consist entirely of non-combustible materials;

3) it should be able to withstand damage by scenery, properties or falling debris, and be of such strength and stiffness as to resist the pressure of air likely to be caused by fire in the stage area without such distortion as would cause its withdrawal from its retaining guides;

4) an adequate seal against the passage of smoke between the moveable curtain and the fixed structure should be provided;

5) it should be able to withstand the effect of fire for a sufficient period to allow the complete evacuation of the building;

6) it should be so designed (with any necessary counterweight) that, notwithstanding the air pressure on the face of the curtain which may result from a fire, it will close the proscenium opening completely within 30 s from the operation of the release mechanism;

7) the words "safety curtain" should be painted conspicuously on the curtain so as to be clearly visible to the audience;

8) the stage should be ventilated in accordance with **30.2.4**;

9) the curtain and the curtain guides should be protected by a hand-operated drencher system which should be fitted with suitable heads adequate to spray the whole of the stage face of the curtain and to keep the curtain and guides cool in the event of fire whilst the curtain is descending;

10) hand release gear, to cause the descent of the curtain and the operation of the curtain drencher system, should be provided in duplicate and be clearly indicated. One such release should be on the working side of the stage and the other in a position outside the stage, e.g. by the stage door office, readily accessible to firefighters or authorized staff;

11) means should be provided for testing the operation of the curtain drencher system.

e) The grid and galleries, including lighting galleries and perches, should be of non-combustible construction, except that superimposed walkways to galleries may be of other material acceptable to the licensing authority.

f) The working fly gallery(s) and the grid should each be provided with an escape route independent of the stage by way of:

1) a storey exit to an external route; or

2) a doorway to another part of the building leading to a storey exit.

13.3 Dressing rooms

13.3.1 *Commentary*

Theatre dressing rooms are areas of intense activity during a stage presentation. There may be flimsy and flowing dresses, and hot electrical equipment. For these reasons, dressing rooms need to be enclosed with fire-resisting construction. At least one escape route from dressing rooms should be independent of the stage, but the recommendation for travel distance may be met by an escape route via the stage.

13.3.2 *Recommendations*

The following recommendations are applicable.

a) Escape from dressing rooms should be in accordance with the recommendations of Section 3 provided that the distances within individual rooms do not exceed those given in Table 8.

b) At least one escape route should be independent of the stage.

13.4 Scene docks

13.4.1 *Commentary*

Scene docks are high fire risk areas because they might contain large quantities of combustible materials, and the fire-resisting separation from the stage might be open during a performance to allow the movement of scenery.

13.4.2 *Recommendations*

The following recommendations are applicable.

a) Any opening between a scene dock and the stage should be protected by a fire door.

b) Scene docks should be ventilated in accordance with **30.2.4.2** other than item b). A manual operating device should be sited in a readily accessible position outside the scene dock.

14 Car parks

14.1 Commentary

Unless adjoining car parks are adequately separated from the parts of the building used for assembly and the escape routes therefrom, there is a risk to the occupants of the assembly building in the event of a fire in the car park.

14.2 Recommendation

Any car park within or adjoining an assembly building:

a) should have any permitted access between the garage or car park and the rest of the building protected by a ventilated lobby;

b) should have any external openings situated so as not to endanger any escape route or final exit;

c) should have adequate provision complying with **31.3** for venting smoke.

15 Kitchens, staff restaurants and canteens

15.1 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 conveniently possible, in which case the protection ought to encompass the kitchen and restaurant/canteen areas and the kitchen ought to be sited remotely from the canteen exit.

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

Section 6. Engineering services (other than fire safety installations)

16 General

Some engineering services are known potential sources of fire. The installation of equipment associated with them is covered by safety regulations and should also be installed in accordance with the relevant codes of practice. The importance of correct installation in the first place is emphasized, because electrical, heating and ventilation systems are often concealed above suspended ceilings or otherwise hidden, and control gear is often located behind ceilings and wall panels. Installation faults that might lead to fire are particularly dangerous because the fire is likely to remain undiscovered for a time. Rooms in which engineering services are contained are dealt with under ancillary accommodation in **10.5**.

Engineering services include the following:

a) electrical services and wiring;

b) lighting;

c) heating;

d) ventilation and air conditioning systems;

e) lifts and escalators;

f) refuse compaction and/or incineration.

17 Electrical services

17.1 General

17.1.1 *Commentary*

An assembly building may contain additional risks of fire because of the number of electrical appliances in use and temporary connections thereto.

17.1.2 *Recommendation*

Electrical services should use the systems of wiring recommended in **17.2**, and should be installed and maintained in accordance with the IEE Wiring Regulations.

17.2 Systems of wiring

17.2.1 *Commentary*

Systems of wiring employed for permanent electrical installations need to be those in which all the cables and conductors are enclosed throughout by material of adequate strength to resist mechanical damage, with provision for satisfactory electrical conductivity to earth where necessary.

17.2.2 *Recommendations*

The following recommendations are applicable.

a) The following systems of fixed wiring should be employed for low-voltage circuits:

1) armoured cable complying with BS 5467 or BS 6346;

2) mineral-insulated copper-sheathed cables complying with BS 6207;

3) insulated cables protected by metal conduit complying with BS 4568 or class B of BS 31:1940;

4) insulated cable protected by type AH rigid PVC conduit complying with BS 4607-2:1970 or type 405 rigid conduit complying with BS 6099-2.2:1982;

5) cables and conductors protected by trunking complying with BS 4678; in damp positions or where exposed to external weather conditions such trunking should be proofed against the ingress of moisture;

6) insulated cables protected by metal conduits complying with class A of BS 31 in which electrical and mechanical continuity across all joints is provided by means of clamping devices.

NOTE 1 Item 6) is suitable only where there are no long runs of conduits and should not be used in damp positions, or where exposed to external weather conditions.

b) Circuits providing power for portable equipment should be protected using residual current devices complying with BS 4293.

NOTE 2 Special considerations apply to circuits supplying stage lighting equipment and professional advice should be sought.

c) The use of unprotected flexible cords or cables should be avoided wherever practicable and should be limited to lighting pendants and connections to portable equipment. Where such cords or cables are used they should be as short as practicable and sheathed with tough rubber or plastic sheathing so as to provide the conductor with adequate protection against mechanical damage.

d) Every socket outlet except outlets for deaf aids, telephones and communication apparatus should be shuttered or switched.

NOTE 3 Special considerations apply to circuits supplying stage lighting equipment and professional advice should be sought.

e) Switches, fuse boards and other control apparatus should be installed so as to be inaccessible to, or inoperable by, unauthorized persons.

f) Electrical apparatus in connection with the intake from each independent source of supply and apparatus used for generating, converting, transforming or rectifying electricity should be installed in ventilated enclosures. Electric motors and other electrical plant or machinery should be installed in separate ventilated enclosures. Any storage battery should be installed in a separate ventilated enclosure. Such enclosures should be of adequate size and reserved exclusively for the accommodation of such apparatus. Pipes for other services should be excluded from such enclosures unless jointfree within the enclosure.

g) All switch-gear equipment and distribution boards should be clearly marked to indicate the circuits controlled. A diagram and/or schedule indicating clearly the arrangement of the circuits and subcircuits, the position of distribution boards and the sizes of cables should be provided and kept in an accessible position on the premises. Permanent conspicuous warning notices should be provided adjacent to any equipment operating on voltages exceeding 250 V.

17.3 Electrical power supplies

17.3.1 *Commentary*

All electrical supplies to life safety and fire protection installations need to be derived from the point at which the electrical supply enters the building, so that the failure of other equipment does not render the installation inoperative. Since it is not possible to determine where a fire may start, all power supplies and their associated control equipment back to the supply intake position 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 adequate protection from the effects of fire.

17.3.2 *Recommendations*

The following recommendations are applicable.

a) The electrical power supply to the life safety and fire protection equipment should be separate from all other circuits in the building.

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 sub-main 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.

17.4 Protected circuits for the operation of equipment in the event of fire

17.4.1 *Commentary*

Wiring systems for the supply of 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.

17.4.2 *Recommendation*

Wiring systems for the operation of equipment in the event of fire should:

a) either:

1) consist of mineral-insulated, copper-sheathed cables complying with BS 6207, or consist of cables complying with the requirements for classification as CWZ in accordance with BS 6387; or

2) be protected against exposure to the fire by separation from any significant fire risk by a wall, partition or floor having at least 1 h fire resistance;

NOTE 1 Where appropriate, compliance 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) be separate from any circuit provided for any other purpose;

c) be such that they cannot be affected by fire at any position where cable connections are made.

NOTE 3 To achieve greater integrity of the system, separate or independent sources of electrical supply are necessary (see **17.5**).

17.5 Primary and secondary power supplies

17.5.1 *Commentary*

To reduce the risk of the loss of electrical supply in a fire, a secondary power supply is considered essential. A supply is required from a generator, or a separate substation, which is of sufficient capacity to maintain supplies to the life safety and fire protection installations, including smoke control systems, systems using pressure differentials and ancillary equipment. 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.

It should be noted that a power supply from a second substation would not offer protection against the occurrence of a fault (unconnected with a fire in the building) on the high-voltage distribution network (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 ought to be provided, or a power supply needs to be taken from a high-voltage distribution network different from that normally supplying the building.

The changeover from the primary to the secondary power supply needs to be automatic so that the life safety and fire protection installations continue operation.

Both the primary and secondary supplies to the life safety and fire protection installations need to be sufficiently protected against fire and water damage, and also to be separated from each other, so that the failure of cables or equipment, either by mechanical breakdown or damage by fire, on 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.

17.5.2 *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 will, independently of the primary supply, 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 other fire protection or firefighting equipment.

The secondary power supply should be capable of providing the power supply for items 1) and 2) 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. A supply from another substation should be from a substation which does not normally provide the incoming supply to the building.

b) Whichever secondary 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.

c) Cables supplying current to the life safety and fire protection installations should be installed in accordance with the IEE Wiring Regulations and manufacturer's instructions. The cables should have an inherently high resistance to fire and be protected against mechanical damage as described in **17.2.2**. 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.

d) The primary and secondary power supply cables should be terminated in a changeover device located within the plant room(s) housing the life safety and fire protection equipment. The changeover device should automatically effect the transition from primary to secondary power supply if the primary supply to the particular plant fails.

e) Any electrical substation or enclosures containing any distribution board, generator, powered smoke control plant, pressurization plant, and any other equipment associated with life safety and fire protection systems, should be separated from the building by construction with a fire resistance of not less than 2 h.

18 Lighting

18.1 Types of luminaire

18.1.1 *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.

18.1.2 ***Recommendation***

Luminaires should comply with BS 4533.

18.2 Recessed luminaires

18.2.1 ***Commentary***

When luminaires are recessed 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 over. In such a case any perforations for fittings or access are a potential source of failure of the ceiling.

18.2.2 ***Recommendation***

Where luminaires are recessed into any fire-resisting ceiling, the integrity of the ceiling should be maintained by the provision of a fire-resistant barrier behind the fitting and any access way to the fitting.

18.3 Illuminated ceilings

The most common illuminated ceilings are the perforated types, e.g. louvre or egg crate diffusers. 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 may be combustible and care in their selection is important in order to reduce to a minimum their contribution to any fire that may occur.

18.4 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. Care is also necessary to prevent accidentical operation of sprinklers and fire detectors by heat from luminaires. Where spot or other low-level luminaires are used, care needs to be taken to avoid close proximity with combustible goods and materials and to ensure that there is no heat built up within a confined area. In higher risk areas, the use of pendant-type luminaires should be avoided; bulkhead type luminaires are preferable.

18.5 Lighting of escape routes

18.5.1 ***Commentary***

There needs to be a sufficient level of artificial lighting at all times in the absence of adequate natural lighting to enable the public and staff to move about the premises and reach the final exits.

To guard against the failure of the normal supply, two systems need to be provided, usually referred to as normal and escape lighting. In cinemas and theatres (and places where entertainments take place in a darkened situation) licensing authorities usually require a minimum level of lighting maintained at all material times to include part of the normal and escape lighting. On stages, including fly galleries and grids, non-maintained escape lighting is preferable as this allows a sufficient level of light to be provided in an emergency without interfering with the working of the stage in normal conditions. The escape lighting on its own should also allow the public and staff to see any directional and warning signs associated with escape routes, changes in floor level, and where appropriate the location of fire alarm manual call points and firefighting equipment.

External escape routes require escape lighting to ensure the occupants of the building can reach a place of safety.

18.5.2 *Recommendations*

The following recommendations are applicable.

a) Adequate artificial lighting should be provided throughout the premises and should be of sufficient standard to enable people to escape.

b) In addition to the system of artificial lighting, escape lighting should be provided throughout the building except that such lighting need not be provided in toilets, store rooms and similar areas, not exceeding 10 m^2 in area, intended for use by staff only.

c) Escape lighting systems should comply with BS 5266-1 or CP 1007.

19 Heating and fuel storage

19.1 General

Experience has shown that, in buildings of all sizes, few fires are caused by central-heating systems, i.e. those in which energy conversion takes place at one point in the building. Most fires from heating appliances are produced by local heating units, particularly those that are not fixed, and hence the design of the heating system should obviate any need for the use of portable heaters.

NOTE The installation of heating appliances and systems is controlled by building regulations and by regulations applicable to the fuel(s) used.

19.2 Central heating (water)

Central heating (water) systems, whether high or low pressure, and whether fired by solid fuel, gas, oil or with a facility to burn alternative fuels, should give rise to little fire risk if installed in accordance with building regulations and relevant standards.

19.3 Warm air heating

Considerations similar to **19.2** apply. With this form of heating, rigorous precautions are necessary to avoid any risk either that the system will permit the products of combustion to be distributed through the ductwork or that a fire starting in one part of the building will be transferred to another part of the building; further details are given in BS 5588-9.

19.4 Electric and gas heaters

Electric and gas heaters should be of the convector rather than the radiant open-element type and, if so, should present little fire risk. Although gas convector heaters are available in flued and flueless versions, the former are preferable. Gas fires have to be flued.

19.5 Electric thermal storage

An electrical thermal storage system, whether used as underfloor heating or as individual heaters, depends for its safety on being installed in such a manner or in such positions that the risk of overheating and ignition of adjacent materials is eliminated.

19.6 Recommendations for the installation of heating appliances and systems

The following recommendations are applicable.

a) All heating appliances and systems should comply with the appropriate standards and should be installed in accordance with the relevant standards and codes of practice.

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

c) Town, natural and liquified petroleum gas boiler installations should be in accordance with BS 6644 or BS 6798.

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

19.7 Recommendations for fuel storage spaces

The following recommendations are applicable.

a) Oil should be stored 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.

19.8 Recommendation for rooms housing fixed internal combustion engines

Rooms housing fixed internal combustion engines should be separated from any part of the building to which the public are admitted, and any protected stairway, by a fire-resisting lobby or corridor.

20 Ventilation systems

20.1 General

Ventilation and smoke control are clearly interrelated and the two systems need to be compatible in operation with each other. Smoke control systems are dealt with in Clause **30**.

20.2 Mechanical ventilation and air conditioning

20.2.1 *Commentary*

Mechanical ventilation may vary from a simple ventilation system to full air conditioning. In the event of fire, the movement of air should be away from escape routes so as to prevent, as far as possible, smoke-laden air being carried into protected zones and exits. In a theatre the stage is likely to be the principal fire risk and air flows should be away from the auditorium towards the stage.

Where the system of ventilation in an auditorium is downwards with extract grilles at floor level, there needs to be an arrangement to reverse the flows in the event of fire unless the system is automatically closed down.

Ventilation systems utilizing ductwork can transport flame, smoke and hot gases and may:

a) break into and out of horizontal or vertical ductwork, spreading fire from one part of the building to another; if the ductwork is flammable this hazard is greater;

b) spread to another part of the building because of lack of fire stopping around ductwork;

c) recirculate smoke and hot gases throughout the building.

Mechanical ventilation and air conditioning plant rooms are most likely to be situated in a basement or on a 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. The potential for smoke spreading from one area to another should be minimized, for example by using separate systems or by providing dampers actuated by the fire detection and alarm system, unless there would be a total evacuation of the premises should there be a fire in any part.

20.2.2 *Recommendations*

The following recommendations are applicable.

a) Mechanical ventilation and air conditioning plant should be installed in accordance with BS 5720. Separate systems should be provided for public and non-public areas.

b) Any system of mechanical ventilation should be designed so as to ensure that, in the event of fire, the airflow pattern is away from protected spaces and exits. This pattern may be achieved by the use of automatic changeover devices operated by the fire detection and alarm system, which should also be capable of manual operation.

c) If a system of mechanical ventilation recirculates air, smoke detectors should be provided within the extract ductwork which, on operation, will cause the recirculation of air to stop and the diversion of all extract air to the outside of the building.

d) Where more than one assembly area is provided in a building, a separate system of ductwork should be provided to each separate area.

e) Ductwork serving kitchens and other higher risk areas should be separate from each other and from other ductwork serving other parts of the building.

f) Service ducts and ventilation ductwork should be installed in accordance with BS 8313 and BS 5588-9 respectively.

g) Ventilation and air conditioning systems should be compatible with any smoke control or pressurization system installed.

20.3 Air conditioning/ventilation ductwork used for smoke control

20.3.1 *Commentary*

Air conditioning/ventilation ductwork used in conjunction with smoke control 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 ventilation ductwork used for smoke control.

20.3.2 *Recommendations*

The following recommendations are applicable.

a) Air conditioning/ventilation ductwork used for smoke control should be adequately protected against fire penetration where it is routed beyond a fire-resisting barrier. If the ductwork requires fire protection installed external to the ductwork, the fire protection should be adequately supported such that it will remain in place and retain its effectiveness when subjected to fire from either the internal side or external side of the ductwork. Where the ductwork supports are designed without reference to any additional insulation, that insulation should be supported from the building structure.

b) Fusible link type fire dampers should not be fitted in the ductwork.

c) The construction of the ductwork should be adequately braced to maintain the integrity of the ductwork at the high temperatures and pressures that may exist, and should be designed to accommodate thermal expansion without distortion or damage.

d) All materials associated with air conditioning/ventilation systems used for smoke control 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 control system specifically does not allow the possibility, fire/smoke dampers which are operated by smoke detectors and which are 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 control mode. Where there is no fail-safe position possible (e.g. where one fan or one set of fans are intended to serve one of several smoke reservoirs, selectable by controllable dampers), the reliability of the dampers should be acceptable to the approving authority.

21 Lifts

21.1 Use of lifts

Unless a lift is designed as a firefighting lift or an evacuation lift (see BS 5588-5 and BS 5588-8 respectively) lifts should not be used for escape from fire. 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 to lifts being called to or held at the fire floor. Once the car and landing doors open in a fire area, their design is normally such that they remain open, exposing the occupants to fire.

Goods and service lifts should not be used in the event of fire.

The enclosure of lift shafts is dealt with in **9.3**.

Firefighting lifts are dealt with in Clause **29**.

21.2 Lift machine rooms

21.2.1 *Commentary*

Lift machine rooms should preferably be sited over the lift well; where they have to be at the foot of the well, the fire separation from the well is crucial.

21.2.2 *Recommendation*

Lift machine rooms should comply with the appropriate part of BS EN 81.

22 Waste storage and treatment and incinerators

22.1 Waste storage and treatment

22.1.1 *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.

22.1.2 *Recommendation*

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

22.2 Incinerators

22.2.1 *Commentary*

There are two main types of incinerator:

a) 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 incinerator, except those fired by electricity, are controlled (as fittings) by building regulations. The means of flueing, including those fired by electricity, are controlled by building regulations with regard to the discharge of products of combustion and the risk of fire spread.

22.2.2 *Recommendation*

Incinerators with a capacity larger than 0.08 m^3 require special consideration, and preferably should be isolated in a separate building.

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Section 7. Fire protection facilities

23 General

The contents of 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, checking the development of a fire, extinguishing a fire, and securing the safe escape of the occupants.

These active features of fire protection are divided into physical and mechanical equipment and systems, dealt with in this section, and those organizational or managerial activities dealt with in BS 5588-12 that are designed to ensure that any action taken by occupants, either to avoid the occurrence of fire altogether or in the event of fire, is appropriate.

24 Fire alarms and automatic fire detection

24.1 General

A prompt and unambiguous warning of fire is fundamental to the organization of the safe evacuation of buildings.

The means of warning normally employed in small buildings (i.e. premises accommodating not more than 300 persons) or where the level of staffing is such that a managed evacuation of the building is not practicable, is an electrical fire alarm system in which the alarm of fire is initiated manually from a "break-glass" manual call point, with the fire warning produced automatically by the electrical operation of suitable warning devices.

This type of system is not suitable for larger places of public assembly as the majority of the occupants of the building are unfamiliar both with the layout of the building and its escape routes, and with the routine to be followed in the event of fire.

It is the responsibility of management to organize the evacuation of the public in the event of an outbreak of fire. The most suitable system to achieve this objective is a staff alarm system whereby the operation of a call point alerts management and staff by visual means that an emergency has arisen. They can then organize an orderly evacuation of the building. This may be done after the activity, performance or entertainment has been stopped, by means of a direct announcement by the manager over a secure public address system, or by means of a pre-recorded announcement.

This arrangement would not, however, preclude the provision of audible warning devices in areas not occupied by the public provided that these are not audible in public areas.

In order to ensure that the fire service is alerted in every emergency, it is essential that fire alarms are automatically relayed to the fire service control room (see BS 5839-1). It is acceptable for such messages to be combined with provisions for the relaying of security alarms, provided that separately identifiable signals are used for each type of emergency.

It is also necessary to provide audible warning devices in public areas to warn staff working in them when the building is not open to the public (and the management element not present), e.g. during rehearsals. These audible warning devices should be rendered inoperative when the building is open to the public, and the fire alarm control and indicating equipment should indicate whether the audible warning devices in public areas are operative.

All call points and fire detectors should be linked to a fire alarm control panel in a central control point.

BS 5839-1 gives recommendations for the planning, design and installation, and maintenance of fire alarm systems including control and indicating equipment, zoning, power supplies, call points and many other details.

24.2 Staff alarm systems

This type of system is most suitable for places of public assembly. The initial alarm caused by the operation of call points or detectors should warn the management and staff via the fire alarm control panel and by means of visual signals or unobtrusive sounders in public areas.

In non-public areas audible signals may be provided but, as far as possible, they should not be audible in the public areas.

There should be a secure public address system complying with BS 5839-1 whereby management can inform and instruct the public on the appropriate action they should take.

Where a staff alarm system is used there should be adequate means of communication between floor areas, zones and the central control point, to put into operation the evacuation of the building as necessary.

24.3 Automatic fire detection

In the arrangements described in **24.2**, reliance is placed on the human element for discovering and giving warning of fire. In some instances this is adequate in terms of the minimum provision for life safety, but it will not suffice in all buildings nor may it suffice for the protection of property, particularly:

a) in parts of a building visited only occasionally, such as store rooms;

b) in buildings or premises left unattended at night.

A fire detection and alarm system may be of great value in reducing the time between the outbreak of fire and its discovery; for property protection this value will be fully realized only if the system is connected either to a fire service control room or to a central fire alarm station. Fire detection and alarm systems are now available that respond to a variety of phenomena associated with fire, such as the detection of heat, an unnaturally rapid rise in ambient temperature, smoke, the products of combustion, and flame. Of particular value are addressable systems in which signals from each detector and/or call point are individually identified at the fire alarm control panel. The recommendations of BS 5839-1 should be studied and advice may need to be sought as to the correct type of system for given circumstances.

If it is intended to provide a fire detection and alarm system in a building that will also be fitted with a manual system, the two should be designed as one system in accordance with the recommendations of BS 5839-1.

A fire detection and alarm system will give warning of fire but cannot itself take appropriate action to contain it. However, it is possible for a fire detection and alarm system, in addition to giving an alarm, to initiate a variety of functions, such as closing down ventilation or air conditioning plant, opening vents for the removal of smoke from escape routes, bringing a pressurization system into operation or releasing doors that close automatically.

24.4 Recommendations for fire detection and alarm systems

The following recommendations are applicable.

a) There should be a means of warning public and staff throughout the building in case of fire.

b) The means of initiating a fire alarm system should be by fire alarm manual call points or by fire detectors in accordance with the relevant recommendations in BS 5839-1. In large or complex buildings, a type L1 system as defined in BS 5839-1:1988 should be provided.

c) Except in the case of buildings accommodating not more than 300 persons, or where a very low level of staffing is provided, the system should operate by initially alerting management and staff and then the public by public address system. The management and staff in public areas should be alerted by visual or unobtrusive audible signals.

d) All alarms of fire should be transmitted automatically to a remote manned centre or to the control room of the fire service.

25 Automatic fire extinguishing systems and special risk protection

25.1 General

The provision of means for automatically attacking a fire as soon as it has started is necessary in some parts of all assembly buildings, except for those that are very small. Systems for this purpose are available in various forms and use a variety of extinguishing media; an important distinction that has to be made is that between “space protection”, i.e. protection covering the bulk of the building space likely to contain predominantly carbonaceous material for which water is a suitable extinguishing medium, and protection covering a special risk, which may need a particular extinguishing medium.

25.2 Sprinkler systems

25.2.1 *Commentary*

For what has been termed "space protection" in the non-public areas of assembly buildings, in particular in areas used for storage purposes, the practice has for many years centred on the provision of automatic water sprinkler systems, and it is doubtful whether there is any alternative with equal advantages. A sprinkler system ought to ensure, without any need for manual intervention:

a) delivery of water to the seat of the fire, in so far as it may be exposed;

b) the simultaneous giving of an alarm;

c) the giving of an alarm to the fire service, where appropriate.

The success rate of sprinkler systems in containing fire outbreaks until the arrival of the fire service is very high if the system is in operative order at the time of the fire.

Sprinklers are generally not used in auditoria or in halls where provision is made for a closely seated audience because of the risk of accidental discharge. The provision of automatic fire detection is preferred, particularly if the auditorium is high, as it is unlikely that sprinklers would operate early enough to prevent a fire from spreading through the auditorium.

The provision of sprinklers is, however, strongly recommended in halls used for exhibitions and in large foyers and other similar public areas, e.g. in conference centres, if these spaces are intended to house exhibitions or displays.

In art galleries or other premises where the effect of water damage on the contents could be extremely serious, if sprinkler protection is provided it needs to be a pre-action system linked to an automatic fire detection system.

If parts of the building are occupancies that in themselves require sprinkler protection, the installations designed to serve those parts need to be totally independent of an installation provided to protect the assembly premises.

Automatic sprinkler systems are particularly appropriate to deal with the kind of fire that could be experienced where a separated stage with flown scenery is in use and also in those parts immediately associated with it where properties and scenery are stored, together with workshops and stores areas.

Every permanent stage equipped with fly galleries, a grid or other provisions for movable scenery needs to have a system of automatic sprinklers installed below the ceiling or grid, whichever is the lower. In addition, sprinklers need to be provided in usable spaces under the stage or platform and in auxillary spaces and dressing rooms, storerooms and workshops. If the stage floor is modular and removable, either the understage sprinkler system needs to be modular, or sidewall sprinklers ought to be used.

When openings are provided in the stage floor for stage lifts, trap doors, or stairs, sprinklers spaced at 1.5 m centres need to be provided around the opening at the ceiling below the stage, and baffles at least 300 mm in depth need to be installed around the perimeter of the opening.

The following are some of the main points to be considered in the design, installation and maintenance of a sprinkler system in assembly premises.

1) The decision to install a sprinkler system should be taken at an early stage in the design of the building. By so doing, the necessity of installing unsightly (and costly) exposed pipe runs may be avoided.

2) The design of suspended ceilings, light fittings, ventilation systems and display units will be affected by the installation of sprinklers.

3) Careful thought has to be given to the disposal of water from sprinkler heads in the event of fire, so as to minimize water damage in the protected spaces.

The efficient operation of a sprinkler system depends upon the heat from a fire opening the appropriate sprinkler head or heads. Any obstruction to the flow of heated air to the heads by suspended ceilings, light fittings or partitioned-off areas closed at the top can severely interfere with the system. It is desirable that, within a radius of 600 mm of each sprinkler head, a clear space of not less than 300 mm be maintained below the level of the sprinkler deflector plate. In rooms used for storage, goods should not be stacked higher than 300 mm below the level of the deflector plates anywhere in the room. BS 5306-2 should be consulted for details of sprinkler systems.

25.2.2 *Recommendations*

The following recommendations are applicable.

a) A sprinkler system should be installed in the following areas:

1) in exhibition halls and other extensive areas used for exhibition purposes;

2) throughout the stage area of a separated stage including dressing rooms, scene docks, other storerooms and workshops;

3) in storerooms for hazardous substances.

NOTE Storerooms containing substances that should not come into contact with water should be treated as special risks (see **25.3**).

b) The design and construction of sprinkler systems and the operating temperatures of the sprinkler heads should be in accordance with BS 5306-2.

c) If an area (e.g. a covered loading bay) is protected by sprinklers, any fusible link or other heat sensitive device designed to close a fire door or fire shutter within its surrounding walls either:

1) should operate before the sprinklers; or

2) should be so located that the cooling effect on the device of the water from the sprinklers cannot jeopardize the effective operation of the door or shutter.

25.3 Special risk protection

25.3.1 *Commentary*

*Apart from the need for general protection by a sprinkler system, there may be specific hazards which justify the installation of an automatic extinguishing system associated with that risk alone. Examples already mentioned elsewhere in the code are service installation rooms (see **10.5**), transformers and oil-filled switchgear (see **10.6**), and air filters and oil baths in ventilation systems (see Clause **20**). In general, systems for the protection of individual risks require to be designed individually to suit the specific circumstances, and BS 5306-0, specialized designers and manufacturers should be consulted. Carbon dioxide (CO_2) systems are covered in BS 5306-4, halon systems in BS 5306-5, foam systems in BS 5306-6, powder systems in BS 5306-7 and electronic data processing installations 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 should be discussed with the fire service first, as many fire appliances are no longer fitted with the necessary foam generating equipment. Where automatic foam systems are to be installed, it should be noted that it is difficult to flood large areas and that it constitutes a hazard to life.

Fire risks, such as oil storage tank chambers and oil-fired boiler rooms, for which foam is used as the extinguishing medium, may be situated where the fire service cannot obtain access to the space for the purpose of applying foam. The most common situation is where such fire risks are below ground. If it is not possible to apply foam through windows, louvres, etc., then foam inlets complying with BS 5306-1 are required. These consist of an inlet or inlets to which fire service equipment can be connected, piping from that external point to inside the space, and a fitting or fittings at the delivery end of the pipe suitably placed for the protection of the risk.

25.3.2 *Recommendation*

Where a special risk is identified, the fire (and licensing) authority should be consulted, and automatic fire extinguishing systems and foam inlets should be installed in accordance with the appropriate part of BS 5306 or, for electronic data processing installations, BS 6266.

26 Manual firefighting equipment

26.1 Commentary

Hose reels and/or portable extinguishers are needed so that the staff can make an attempt to fight or contain a fire in its early stages (if this is consistent with personal safety) whilst the fire service is on its way.

*Water supplies for firefighting are dealt with in Clause **27**.*

Hose reels provide the best means whereby a fire can be fought with water by persons who have not received much training; the apparatus is light and simple to operate, the water flow is continuous and maintenance is minimal.

26.2 Recommendations

The following recommendations are applicable.

a) Portable fire extinguishers should comply with BS 5423 and should be installed in accordance with BS 5306-3.

b) If provided, hydraulic hose reels should comply with BS 5274 and should be installed in accordance with BS 5306-1.

c) Where appropriate, equipment should be grouped at fire points, preferably adjacent to exits from nominated rooms or storey exits, or by fire alarm call points.

d) Where fire blankets are provided they should comply with BS 6575.

27 Water supplies for firefighting

27.1 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: these include fire mains, whether wet or dry, fitted with landing valves, and private hydrants on water mains external to the building.

However, in areas without a suitable mains supply, a bulk or "static" supply needs to be arranged. If this takes the form of a static tank or dam, the capacity (related to the size of the building and the risk involved) should be agreed with the fire authority. An unlimited and guaranteed natural water source may be acceptable to the fire authority subject to adequate access and hard standing for appliances being provided.

27.2 Recommendation

All premises should be provided with an adequate supply of water for firefighting purposes by one of the following means:

a) hydrants complying with BS 5306-1; or

b) a static or natural water supply satisfactory to the fire authority.

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

28 Firemen's emergency switches for discharge lighting installations

28.1 Commentary

Discharge lighting installations, e.g. floodlights and neon advertising signs, may operate at voltages that are a hazard to firefighters.

28.2 Recommendation

An exterior discharge lighting installation, or an interior discharge lighting installation operating unattended, and operating at a voltage exceeding low voltage, should be controlled by a firemen's emergency switch, installed and situated in accordance with the IEE Wiring Regulations and the requirements of the fire authority.

29 Access for firefighting

29.1 Access for fire appliances to the exterior of a building

In making provision for access for fire appliances, it will be necessary to consult the fire authority to ascertain its recommendations relating to access roads in terms of loadbearing capability, turning circles, width, headroom, etc., provision of hard standing areas adjacent to buildings for external escape routes for the occupants [see item c) of **7.4.2**] and for rescue purposes, and proximity to dry riser inlets.

29.2 Access for firefighters to the interior of a large building

29.2.1 *Commentary*

In high buildings or buildings with a number of basements, it is necessary to provide firefighters with a firefighting lift to take them and their equipment to the fire, so as to avoid the delays and fatigue that would occur in walking up or down stairs with heavy equipment. Associated with a firefighting lift is a firefighting stair for access and escape in emergency, with protected lobbies at each landing, containing a landing valve on a dry or wet rising or falling fire main. In large buildings which, although not high or deep enough to warrant a firefighting lift, are sufficiently large to make firefighting from outside the building difficult, a firefighting stair without a firefighting lift may be required. The envelope enclosing a firefighting stair and its associated firefighting lobbies and, if provided, a firefighting lift is known as a firefighting shaft.

*Fire mains enable the fire service to attack a fire on any storey of a building, however high, without the time-wasting necessity for laying out hose to that storey. All buildings with a height (see **2.15**) exceeding 18 m need to be provided with fire mains as part of the firefighting shaft, but it would be wise to consider this provision in extensive buildings less than 18 m in height.*

29.2.2 *Recommendations*

The following recommendations are applicable.

a) Buildings or parts of buildings of height (see **2.15**) exceeding 18 m or depth (see **2.4**) exceeding 9 m should be provided with firefighting shafts (each incorporating a firefighting lift) complying with BS 5588-5.

NOTE 1 The reference to parts of buildings covers situations such as a tower block rising above a podium.

b) Buildings of height (see **2.15**) exceeding 7.5 m with the area of any storey above the ground storey not less than 600 m^2 should be provided with firefighting shafts (which need not incorporate a firefighting lift) complying with BS 5588-5.

c) In buildings where the provision of firefighting shafts is recommended [see items a) and b)] sufficient firefighting shafts should be provided such that on every storey:

1) with a height (see **2.15**) exceeding 18 m; or

2) with a depth (see **2.4**) exceeding 9 m; or

3) above the ground storey in buildings described in item b);

the distance along which hose can be laid from the doorway between the firefighting shaft and the accommodation to any point on that storey does not exceed 60 m.

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.

30 Smoke control for means of escape

30.1 Smoke control using pressure differentials

30.1.1 *Commentary*

If a powered pressure differential system is to be employed 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 needs to be modified so as to achieve compatibility between the ventilation system and the pressure differential system.

NOTE Any firefighting stairs will also need to be pressurized.

30.1.2 ***Recommendation***

Any pressure differential system should be installed in accordance with BS 5588-4.

30.2 Smoke control by ventilation

30.2.1 ***Commentary***

Smoke control and ventilation are clearly interrelated, and hence the two systems need to be compatible in operation with each other. Smoke control in respect of protected spaces and protected stairways is basically achieved by the fire-resisting enclosure and self-closing fire-resisting smoke control doors which are designed to prevent the ingress of smoke during evacuation of the building in the event of fire. Where stairs serve basement areas or areas of higher fire risk, additional protection by means of natural ventilation of lobbies is necessary unless a pressurization system is installed. Smoke control in the occupied areas of the building, such as auditoria, sports arenas, exhibition or assembly halls and floor areas generally, should not be necessary during evacuation of the building unless travel distances are extended [see item a) of ***6.5.2****].*

In a theatre, the stage is likely to be the principal fire risk; air flows should be away from the auditorium and towards the stage in so far as this is practicable.

30.2.2 ***Recommendation for permanent ventilation of protected lobbies***

A protected lobby recommended in **7.3.2** and item c) of **10.6**, where associated with a protected stairway in any of the following circumstances, should be ventilated by means of permanent openings not smaller than the following areas:

a) if the protected stairway connects an enclosed car park with the remainder of the building, 0.4 m^2;

b) if the protected stairway directly serves a boiler room, transformer chamber or other area of a higher fire risk, 0.4 m^2.

30.2.3 ***Recommendations for smoke control in assembly areas with extended travel distances***

The following recommendations are applicable.

a) Unless protected routes from the centre of the assembly area are provided [see item a)2)i) of **6.5.2**], the smoke control system should ensure that a clear air space will remain (beneath any smoke layer) enabling safe evacuation. The design fire size and smoke volumes should reflect the volume of the arena or hall and the likely levels and types of materials in it. The bottom of the smoke layer should be:

1) a minimum of 2.5 m above the highest point of any unprotected escape route from the assembly area, where this is less than 5 m above the floor level of that area;

2) a minimum of 3.5 m above the highest point of any unprotected escape route from the assembly area, where this is 5 m or more above the floor level of that area;

and in unsprinklered assembly spaces the smoke layer temperature should not exceed 200 °C for the chosen design fire size.

b) The smoke ventilation system design should be acceptable to the appropriate authorities.

c) The smoke ventilation system should be actuated by each or any of the following:

1) smoke or heat detectors in the affected space, or smoke detectors in exhaust or recirculation ventilation ductwork;

2) sprinkler flow switches (where applicable);

3) manually, by control devices situated at locations agreed with the fire authority.

d) The smoke ventilation system should be designed to be effective in all wind directions.

e) Means should be provided to enable the ventilators and their mechanisms to be regularly maintained. In addition, means should be provided whereby the ventilators can be closed following a test without recourse to the roof.

f) Haystack lantern light ventilators should comply with **30.3**.

g) Natural and powered smoke and heat exhaust ventilators should comply with BS 7346-1 and BS 7346-2 respectively.

30.2.4 *Separated stage ventilation*

30.2.4.1 *Commentary*

*Natural ventilation by means of openable vents above the stage grid is essential if the safety curtain is to be effective in a fire. This ventilation may be provided by openable vents (in theatres these are often known as the haystack because of the shape of the traditional lantern light ventilator) or by a powered system. Catastrophic theatre fires have shown that it is difficult to prevent the passage of smoke (and heat) from a fire in the stage area to the auditorium in the early stages of a fire. Measures designed to overcome this problem have traditionally been the use of a heavy fire safety curtain, and ventilation above the stage. The use of the safety curtain imposes a severe restriction on the flow of replacement (inlet) air to the stage area, causing the neutral pressure plane in the stage area to rise above the proscenium arch, reducing the efficiency of the ventilation system. This ensures that the pressure differential established across the leakage paths between the stage area and the auditorium prevents smoke from being forced into the auditorium, although the stage area is likely to become totally smoke logged. Once the auditorium has been evacuated, the subsequent increases in the volume of replacement air available caused by the fire service opening doors to the stage area, and possibly raising the safety curtain, will lead to an increased rate of smoke extraction through the stage vents, but with the likelihood of smoke leaking into the auditorium. For this purpose it is important that the lobbies referred to in item b)3) of **13.2** are unventilated.*

30.2.4.2 *Recommendations*

The following recommendations are applicable.

a) A separated stage should be provided with ventilation at high level above the stage grid by either:

1) natural exhaust ventilators or haystack lantern light ventilators, providing an aerodynamic free area of 10 % of the area of the stage; or

2) two or more powered exhaust ventilators designed to provide a total exhaust airflow equivalent to that recommended in item 1).

NOTE Very large stages with separated side or rear stages may have separate ventilators for each stage area.

b) Stage ventilators should open automatically:

1) on operation of a fusible device designed to operate at a temperature not exceeding 74 °C and so sited below the base of the ventilator as to be clear of the water spray from any sprinkler or drencher system provided; and

2) on operation of the sprinkler system protecting the stage; and

3) on operation of a manual release [see item c)].

c) There should be means for manually operating the stage ventilators; such devices should be provided in duplicate and should be clearly indicated. One such device should be on the working side of the stage and the other in a position outside the stage, e.g. by the stage door office, readily accessible to firefighters or authorized staff.

d) The stage ventilation system should be designed to be effective in all wind directions.

e) Means should be provided to enable the ventilators and their mechanisms to be regularly maintained. In addition, means should be provided whereby the ventilators can be closed following a test without recourse to the roof.

f) Powered ventilation systems operating within the stage area should cease functioning on the operation of the stage ventilation system.

g) Haystack lantern light ventilators should comply with **30.3**.

h) Natural and powered smoke and heat exhaust ventilators should comply with BS 7346-1 and BS 7346-2 respectively.

NOTE Powered smoke ventilators should be in accordance with class C as specified in BS 7346-2.

30.3 Recommendations for haystack lantern light ventilators

The following recommendations are applicable.

a) The sashes on each side of any lantern light should be bottom hung so as to open outwards under the force of gravity and be glazed with either thin sheet glass, or a thin alloy or plastics sheet that would rupture or melt when subject to uncontrolled fire conditions.

NOTE Glass may shatter inadvertently.

b) Provision should be made for all sashes in any lantern light to be opened simultaneously.

c) Safety chains or shock absorbers may be fitted to the sashes provided that they allow the sashes to open to the full extent required to satisfy item a).

31 Smoke control for firefighting

31.1 Commentary

Smoke control is necessary to enable the fire service to sustain an attack on a fully developed fire. Well distributed natural ventilation openings need to be provided where a smoke control system designed using fire engineering principles is not provided.

This form of ventilation for firefighting is normally provided by openable windows, but in auditoria, halls and arenas the enclosing walls are not normally penetrated. In these areas suitable openable vents need to be provided with controls sited for operation by the fire service.

NOTE Smoke control for firefighting stairs is covered in BS 5588-5.

31.2 Recommendation for smoke control on a protected stairway

A protected stairway enclosure, unless pressurized or a firefighting stair enclosure, should be provided with:

a) openable windows at each upper storey or landing level; or

b) a window or vent at the top having a clear openable area of not less than 1 m^2.

31.3 Recommendations for natural smoke control vents (other than for stage areas)

The following recommendations are applicable.

a) Well distributed openable vents with a free area of not less than 2.5 % of the floor area should be provided.

b) In the case of basements the vents should:

1) be situated at high level in well distributed positions along street frontages or adjacent to external walls easily accessible to the fire brigade;

2) if covered, have breakable covers;

3) if permanently open, be sited away from exits.

31.4 Recommendations for means of opening windows and vents for smoke control

The following recommendations are applicable.

a) All openable windows and vents provided for smoke control should be clearly identifable and should be fitted with:

1) simple lever handles; or

2) locks that can be operated by the fire service with a square-ended key.

b) If openable windows and vents 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 b) of **31.2**, should be located adjacent to the entrance doorway in the ground/access storey and be clearly marked as to its function and means of operation.

31.5 Recommendation for breakable covers

Breakable covers provided to basement smoke outlets 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 to them.

31.6 Recommendations for shafts for smoke outlets

The following recommendations are applicable.

a) 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 to discharge direct to the open air at a suitable point, and the outlets should be maintained unobstructed or be covered only with an exhaust ventilator complying with BS 7346-1, or a non-combustible grille and/or non-combustible louvres.

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) have throughout their length no less cross-sectional area than the smoke outlet they serve;

3) be enclosed with solid non-combustible material having not less than the period of fire resistance required for the storey served, or through which they pass, whichever is the higher.

32 Plans for fire service use

32.1 Commentary

In large or complex premises it is of considerable advantage 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 linear scale acceptable to the fire authority. The plans need to be permanently 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 stairs (or lobby) leading to a basement. It is desirable that additional copies of the plans be furnished to the fire service so that they can preplan for an emergency.

32.2 Recommendations

The following recommendations are applicable.

a) Scale plans of the building for the guidance and use of the fire service should be prepared in consultation with the fire service.

b) The plans should clearly indicate the location of:

1) surrounding streets;

2) exits, stairs, corridors and any refuges for disabled persons;

3) fuel storage areas, gas and oil main controls;

4) electrical main and sub-main controls;

5) ventilation plant and control switches, including pressurization controls;

6) sprinkler valves;

7) hose reels;

8) hydrants and rising mains;

9) shutters and doors released automatically in the event of fire, and any central control point for release;

10) smoke outlets;

11) openable windows in sealed buildings;

12) main and any secondary fire alarm panels;

13) pump rooms supplying fire protection systems;

14) firefighting lifts;

15) automatic fire extinguishing systems;

16) foam inlets.

The direct of north, a linear scale bar and a "You are here" indicator should be included.

c) The plans should be mounted on a rigid surface and should be displayed in a location or locations agreed with the fire service.

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Section 8. Management

Management is now dealt with in BS 5588-12.

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