BRITISH STANDARD

BS 5588-7:1997
Incorporating Amendments Nos. 1 and 2

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

Part 7: Code of practice for the incorporation of atria in buildings

ICS 13.220.20; 91.060.99

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Committees responsible for this British Standard

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

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

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

Access Committee for England
British Automatic Sprinkler Association
British Council of Shopping Centres
British Fire Protection Systems Association
British Fire Services' Association
British Property Federation
Flat Glass Manufacturers' Association
Hevac Association
Institute of Fire Safety
Institution of Fire Engineers
Intumescent Fire Seals Association
Nationwide Fire Services
Warrington Fire Research Centre

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Foreword

This British Standard was prepared under the direction of the Fire Standards Policy Committee and is published as a part of BS 5588.

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

Other parts of BS 5588 which are already published are as follows.

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

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

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

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

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

— *Part 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 certain schemes, rigid conformity to the recommendations of this code might prove unduly restrictive or inappropriate, and it may be preferable to incorporate the general principles embodied in this code into a fire safety engineering approach.

If an atrium is to be separated from the remainder of the building by construction with the same standard of fire resistance as that required for the structure, it will not be necessary to apply the recommendations given in this code.

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.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 89 and a back cover.

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Section 1. General

1 Scope

This part of BS 5588 provides guidance on the incorporation of one or more atria into new and existing buildings. The primary objective of the code is to ensure that the incorporation of an atrium into a building does not present an increased risk to life as a result of fire and smoke spread.

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

The principles presented in this standard are applicable to all building types containing atria other than:

a) prisons or other buildings intended for the confinement of persons;

b) auditoria in theatres or similar places of entertainment, for which guidance is given in BS 5588-6;

c) malls in shopping complexes for which guidance is given in BS 5588-10.

d) small premises covered in Clause **10** of BS 5588-11;

e) buildings in occupancy categories A & B (see **7.2**) containing a two-storey atrium, with one of the two storeys being at ground level, which are designed for simultaneous evacuation with storey exits remote from the atrium.

This code deals only with those aspects of design, construction and management that relate specifically to the presence of an atrium within the building. Other aspects of fire safety design should be followed in accordance with appropriate legislation and codes of practice.

A range of design solutions for atrium buildings presented in this code is based on four different occupancy types:

1) awake and familiar with building layout;

2) awake and unfamiliar with building layout;

3) sleeping risk; and

4) significant number of people requiring medical or nursing care.

In addition to making recommendations intended to establish the basic requirements for life safety, this code gives guidance on measures that may be taken to reduce the potential for damage to the contents and finishes of a building.

This code presents the general principles to be adopted in the design and management of a building containing one or more atria, together with a number of exemplars for different types and occupancy of building.

The solutions are not exhaustive and other methods may exist by which an equivalent level of fire safety can be achieved. All designs based on calculations to the extent recommended in this code can be considered to be a form of fire safety engineering, and should be supported by documentation fully detailing the calculations and assumptions made, and the values of any input parameters.

The paramount importance of building management in ensuring staff training, equipment maintenance and evacuation management is recognized, and this code provides guidance to building managers on the development, documentation and implementation of a fire safety management plan.

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

NOTE 1 There is a significant increase in fire hazard during maintenance and alterations, and this should be considered when this type of work is being undertaken (see BS 5588-12).

NOTE 2 All management guidance is now located in BS 5588-12.

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2 References

2.1 Normative references

This part of BS 5588 incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the cited publications are listed on page 88. For dated references, only the edition cited applies; any subsequent amendments to, or revisions of the cited publications apply to this part of BS 5588 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on page 89, but reference should be made to the latest editions.

3 Definitions

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

3.1
active fire protection system
a fire suppression or protection system that operates only when activated either manually or by a device sensitive to the products of combustion (usually heat or smoke), e.g. sprinklers, smoke control, fire detection and alarm systems, etc.

3.2
associated floor area
any floor area in an atrium building not separated from the atrium by construction having a fire resistance equal to that required for the elements of the structure of the building

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

3.3
atrium (plural: atria)
a space within a building, not necessarily vertically aligned, passing through one or more structural floors

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

3.4
atrium base
the plan area of the lowest floor level, bounded by lines projected down from the edge of the floor slab immediately above the lowest floor level within the atrium

3.5
atrium building
a building containing one or more atria

3.6
(fire) compartment
a building or part of a building, comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to or from another part of the same building, or an adjoining building

3.7
controlled fire load
a fire load that will be limited by means of management controls on the quantities of combustible material that are present on the atrium base (see Clause **10**) or where the fire load is limited by an effective automatic suppression system

3.8
equivalent non-atrium building
a notional building of a similar size and the same usage as the atrium building under consideration, but which does not contain an atrium

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3.9
final exit
the termination of an escape route from a building giving direct access to a street, passageway, walkway or other open space, sited to ensure the rapid dispersal of persons from the vicinity of a building so that they are no longer in danger from fire and/or smoke

3.10
fire resistance
the ability of a component or construction of a building to satisfy for a stated period of time some or all of the criteria specified in the relevant part of BS 476

3.11
height (of an atrium)
the level of the surface of the highest point of the floor of the highest storey adjacent to the atrium measured from the level of the atrium base

3.12
height (of a building)
the distance of the surface of the highest point of the floor of the highest storey (excluding any such storey consisting exclusively of plant rooms) measured at the centre of that face of the building where the measurement is greatest from the level of the footway or paving in front of that face, or, if there is no such footway or paving, from the level of the ground (see Figure 1)

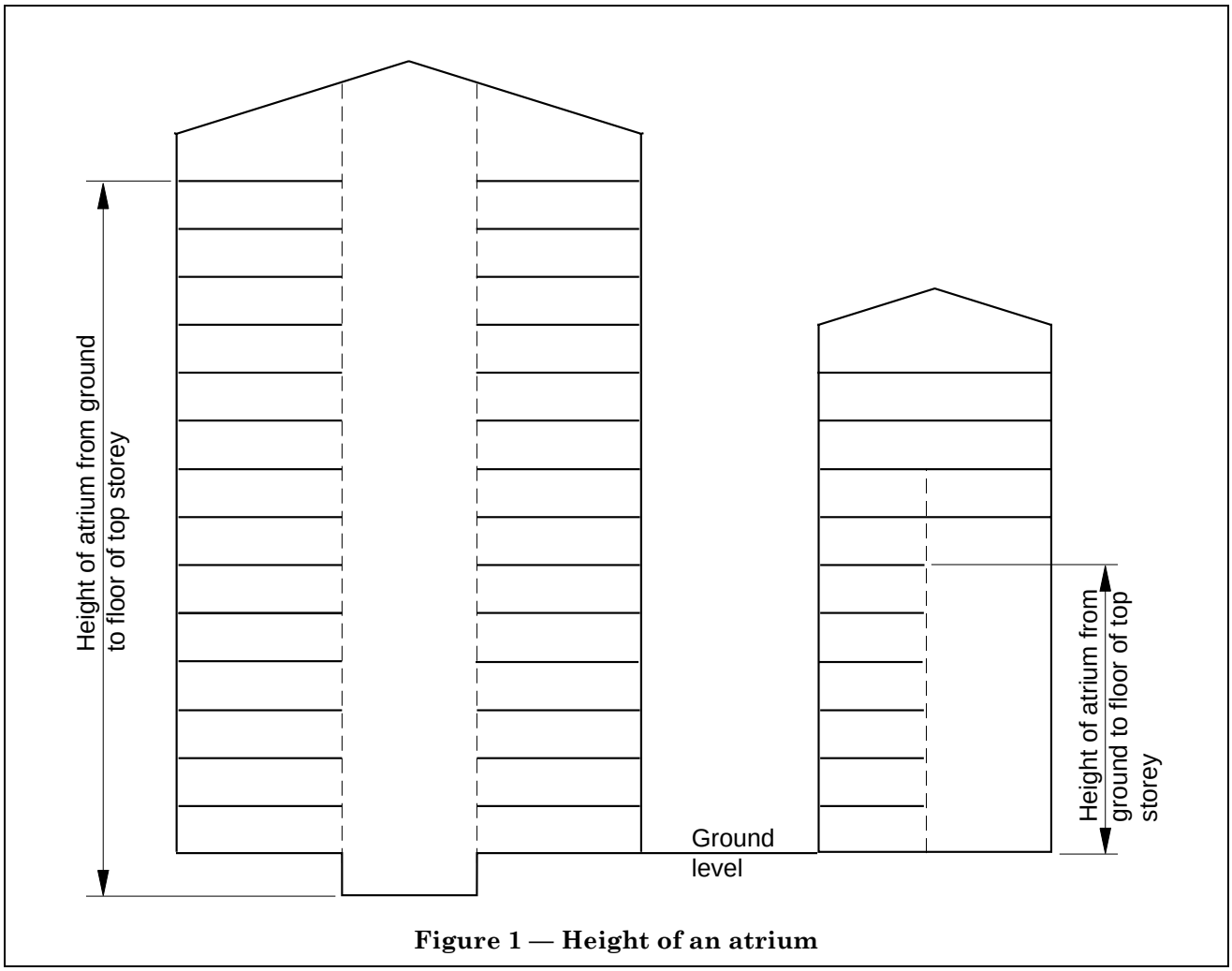

Figure 1 — Height of an atrium

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3.13
means of escape
structural means whereby a safe route or routes is or are provided for persons to travel from any point in a building to a place of safety

3.14
phased evacuation
a system of evacuation in which different parts of the building are evacuated in a controlled sequence of phases, those parts at greatest risk being evacuated first

3.15
place of safety
place in which persons are in no danger from fire

3.16
pressure differential system
a smoke control system designed to minimize the spread of smoke from one part of a building to another via gaps and small openings in the construction, by maintaining a pressure differential relative to the space containing the fire

3.17
protected lobby/corridor
a circulation area consisting of a lobby or corridor enclosed with a fire-resisting construction (other than any part that is an external wall of a building)

3.18
protected stairway
a stair discharging through a final exit to a place of safety (including any exit passageway between the foot of the stair and the final exit) that is enclosed with fire-resisting construction

3.19
simultaneous evacuation
an evacuation procedure in which all persons within a building or part of a building are evacuated simultaneously following discovery of a fire within the building

3.20
smoke
visible suspension in atmosphere of solid and/or liquid particles resulting from combustion or pyrolysis

3.21
smoke clearance system
a smoke control system designed to remove the products of combustion following a fire and used at the discretion of the fire service to assist firefighting operations

3.22
smoke control
any technique used to control the movement of smoky gases within a building in order to protect the structure, the contents, the means of escape, or to assist firefighting operations

3.23
smoke dilution
smoke control achieved by mixing the smoky gases with enough clean air to achieve less hazardous conditions

3.24
smoke exhaust ventilation system
a smoke control system designed to remove a sufficient volume of smoke to minimize the possibility of inter-connected spaces becoming untenable as a result of the spread of smoke

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3.25
smoke retarding construction
construction that will adequately retard the passage of smoke (see **16.2**)

3.26
storey exit
a final exit (see **3.9**), or doorway giving direct access to a protected stairway, firefighting lobby, or external escape route

3.27
temperature control system
a heat control system using the principles of smoke exhaust ventilation, sufficient to reduce gas temperatures in the smoke layer formed within the atrium to permit the use of construction/glazing systems in the atrium facade which, whilst capable of preventing the passage of smoke, are not fire-resisting. Examples of such construction/glazing systems may include float and other annealed glasses, tempered glass, etc.

3.28
travel distance
the actual distance to be travelled by a person from any point within the floor area to the nearest storey exit, taking into account the layout of walls, partitions and fittings

3.29
voice alarm system
a fire warning system using a monitored audio system that provides means for broadcasting warning signals, and live and recorded speech messages for use in an emergency or as a fire alarm

4 Use of the code

4.1 Framework

The recommendations in this code are intended to provide a framework of guidance on the additional fire safety measures that may be necessary when designing and constructing atria.

One of the major differences between the fire precautions recommended or required for atrium and non-atrium buildings are the arrangements for restricting fire and/or smoke spread. Such arrangements contribute to the provisions for means of escape or the restriction of fire spread between buildings. In non-atrium buildings these restrictions are commonly based on physical sub-division; whilst this code proposes other methods of restricting spread, appropriate to particular designs of atria.

Except where specifically stated otherwise, the recommendations of codes of practice appropriate to the equivalent non-atrium building should be applied in addition to the recommendations of this code.

4.2 Sections

The layout of this code has been developed to assist in the design of an atrium within a building. The document is structured into a series of sections, and incorporates a decision tree process which is supported by a number of tables summarizing the technical solutions that have been reached.

Section 2, Section 3 and Section 4 give a commentary on the fire, occupancy, building and protection issues related to atrium buildings; Section 5 gives recommendations on the appropriate fire safety designs, and Section 6 gives recommendations on the fire protection facilities. BS 5588-12 gives guidance on management issues that will need to be considered.

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The sections are summarized as follows.

Section 2 *Analysis of the problem*

Gives guidance on the behaviour of fire and smoke spread within a building and atrium space, and potential design objectives.

Section 3 *Occupancy and building characteristics*

Gives guidance on the characteristics of the occupants and buildings that have a significant effect on the ultimate fire safety design.

Section 4 *Fire protection facilities*

Gives guidance on the means of escape, evacuation strategies and active fire suppression systems and other issues that have to be considered in atrium buildings.

Section 5 *Design solutions*

Enables the designer to determine the design and technical provisions that will be necessary to ensure adequate safety levels. This is accomplished by the use of decision trees, supported by a series of tables which summarize the technical requirements of the solutions that have been reached. Exemplars, which are a pictorial representation of the solutions that are recommended by the decision trees, are given in Annex A.

Section 6 *Recommendations*

Gives recommendations on the means of escape, evacuation strategies and active fire suppression systems and other issues that have to be considered in atrium buildings.

Text deleted

4.3 General

The wide range of designs possible in atrium buildings makes it impossible for this code to cover every conceivable scheme and its associated fire risk, and it is necessary to apply an intelligent appreciation of the principles of fire safety design to the application of the recommendations of this code.

This code identifies the following characteristics associated with the form and usage of atrium buildings that may affect fire risk and proposes a range of solutions according to the particular combination of these characteristics.

Building characteristics

occupancy

atrium height

separation between atrium and associated floor areas

fire load on atrium base

Protection strategies

evacuation strategy

automatic fire detection

fire warning systems

smoke and heat ventilation

automatic suppression systems

In certain schemes, rigid conformity to the recommendations of this code might prove unduly restrictive or inappropriate, and it may be preferable to incorporate the general principles embodied in this code into a fire safety engineering approach. However, to demonstrate clearly that the life safety objectives have been met, it is recommended that a fully documented manual (see BS 5588-12) is drawn up at an early stage in design for subsequent submission to enforcing authorities and ultimately, after completion of the building, for future reference by the person responsible for the management of the building.

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The development of the fire safety strategy for the building has to take into account not only the provisions for fire safety but also the cost and design objectives of the scheme. The following building characteristics, which may significantly influence the fire protection measures required, should be established as early as possible in the design process:

a) building occupancy type;

b) degree of separation between atrium and associated floor area;

c) size and geometry of the atrium;

d) use of the atrium base and control of fire load;

e) relationship of the building to site boundaries; and

f) height of the building.

4.4 Relationship with statutory provisions

4.4.1 *General*

It is important to appreciate the relationships between this code and the various statutory provisions relevant to the design and construction of buildings and to the fire precautions to be provided in existing buildings.

It is advisable that there should be preliminary design consultation to avoid the need to make changes to a design at a late stage. For England and Wales, reference should be made to the guidance document *Building Regulation and Fire Safety, Procedural Guidance* [1], published by the Department of the Environment, Home Office and Welsh Office. For Scotland, reference should be made to the *Building (Procedure) (Scotland) Regulations* 1981 [2] and the *Building (Procedure) (Scotland) Amendment Regulations* 1990 [3].

4.4.2 *Building regulations*

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

England and Wales: *The Building Regulations*

Scotland: *The Building Standards (Scotland) Regulations*

Northern Ireland: *Building Regulations (Northern Ireland)*

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

In addition to the controls mentioned in **4.4.2**, fire safety and means of escape for a wide variety of buildings is dealt with under the following legislation.

England and Wales:

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

The Building Act 1984.

The Fire Certificates (Special Premises) Regulations 1976, SI 1976 No. 2003 (as amended).

Scotland:

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

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

The Fire Certificates (Special Premises) Regulations 1976, SI 1976 No. 2003 (as amended).

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Northern Ireland:

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

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

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

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

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

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

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Section 2. Analysis of the problem

5 Fire in the atrium building

5.1 General

An atrium provides a route by which smoke and fire may spread from storey to storey much more rapidly than in the equivalent non-atrium building, and the volume of smoke may increase manyfold due to the entrainment of air into the rising plume. During this period the considerable quantities of smoke and corrosive fumes produced, if allowed to spread through the building via the atrium to other open storeys, may cause damage that is out of proportion to the scale of the initial fire.

Such spread of fire and smoke can have a significant effect upon the number of persons initially at risk, the time available for escape and the activities of firefighters.

5.2 Spread of fire and smoke

When an atrium has an enclosure that does not confine the smoke from a fire to the space in which it originated then, even if that enclosure is of fire-resisting construction, the buoyancy and expansion of the fire gases can cause smoke to pass through any openings or gaps into other adjacent spaces which, in the absence of the atrium, might otherwise not have been affected.

If a fire occurs and continues to develop on a storey directly open to an atrium, hot smoke will rise to the ceiling level of that storey and spread outwards from the fire to form a layer beneath the ceiling. If that storey opens directly onto an atrium, smoke will flow from the ceiling layer into the atrium void, where it will tend to rise upwards owing to its buoyancy. As the smoke rises through the atrium it will entrain large quantities of cool air from its surroundings, reducing the temperature of the plume and increasing its mass and volume. As the smoke plume rises it cools and its buoyancy reduces to such an extent that at some height its temperature may fall to that of the surrounding air and it will cease to rise by its own buoyancy. In such circumstances a stable layer of smoky gases may form some distance below the atrium roof. Having risen to an upper limit, the smoke will then tend to build downwards, producing a layer of increasing depth which will spread horizontally into any open storeys within the depth of the layer.

Because a substantial proportion of the smoke and toxic fumes arising from a fire on a storey open to an atrium will spread directly into the atrium void, the rate of smoke layer development on the fire floor will be reduced. In a large atrium this can provide a significant increase in the time available for escape on the storey on which the fire started but may lead to a rapid build-up of smoke on any upper storeys open to the atrium, which will require immediate evacuation.

5.3 Occupants

In the early stages of a fire, the most important effects will usually be those of smoke and other products of combustion. In addition to reducing visibility, smoke will produce discomfort to the eyes and difficulty in breathing, both of which will hamper the efforts of occupants to find their way towards the exits. People who are prevented from escaping by dense smoke, or who are exposed to it while escaping, may suffer from the toxic effects of the products of combustion that accompany the smoke and the asphyxiant effect caused by lack of oxygen. Intoxication, incapacity, unconsciousness and possibly death may result. These considerations are particularly important when dealing with large numbers of persons, some of whom may be unfamiliar with their surroundings, and who may vary widely in age and degree of mobility.

5.4 Structure

The enclosure of an atrium by imperforate construction (such as a glazed screen) will significantly reduce the probability of smoke damage to storeys removed from the fire. However, if the fire grows large, the temperature build-up within the atrium is likely to lead to failure of float and other annealed glasses, and smoke and flames may spread between storeys. If a fire continues to develop unchecked, the build-up of heat is likely to lead eventually to the failure of non fire-resisting glazing systems used for the atrium enclosure. Therefore, to achieve an additional level of protection the provision of a fire-resisting enclosure to the atrium may be beneficial.

5.5 Firefighting

In order to assist the fire service in rescue, firefighting and in clearance of smoke after the fire, additional smoke clearance measures may be necessary. It should be noted that smoke control provisions provided specifically for fire service use are not generally appropriate for the purpose of protecting means of escape.

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6 Functional design requirements

6.1 Life safety

Legislation and regulations for fire safety are primarily designed to protect life by ensuring that:

a) the occupants are able to leave the building safely in the event of a fire;

b) collapse of the building, wholly or in part, does not endanger the people in or around the building;

c) fire spread to adjacent sites is controlled;

d) firefighters can more easily effect rescue and fight the fire.

The recommendations of this code and BS 5588-12 provide a range of options that may include one or more of the following:

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

2) limitation of fire development by the control of materials or the provision of automatic suppression systems;

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

4) separation of the atrium from associated floor areas;

5) provision of smoke, pressure and temperature control systems to maintain the effectiveness of escape routes and access for firefighters;

6) effective management control.

This code does not preclude the use of any form of building design incorporating an atrium, provided that it can be explicitly demonstrated that the fire protection measures are adequate to ensure the achievement of the life safety objectives.

6.2 Protection of property

Measures taken to fulfil statutory obligations in respect of fire safety may help to reduce any loss. However, even relatively small fires that do not endanger the occupants can create substantial damage as a result of the spread of smoke and fumes. Therefore this code provides guidance so that an informed choice can be made about the benefits of fire protection measures for property loss.

However, since property protection is not generally a statutory requirement, a clear distinction is drawn in this code between property protection and the recommendations for life safety. Loss can result from:

a) damage to the fabric of the building;

b) damage to the contents of the building;

c) disruption to the use of the building (during or after the fire);

d) business interruption (i.e. inability to trade).

In an atrium building, particularly one that has a number of storeys open to the atrium, the potential for smoke and fire spread is greater than in the equivalent non-atrium building, in which the effects of fire and smoke are more likely to be confined to a single storey. Many of the recommendations of this code are only intended to ensure the safe evacuation of the building and hence may provide little protection against the spread of smoke. It may, therefore, be desirable to provide additional measures to reduce the degree of damage resulting from fire and smoke spread.

The main concern of insurers when fire occurs in an atrium building is to reduce the potential for rapid fire and smoke spread via the atrium, and insurers may compensate for this perceived risk by looking for a combination of both active and passive fire protection. It is recommended that the insurers are consulted at an early stage in the development of the project to establish the implications of the atrium design on potential insurance premiums.

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Section 3. Occupancy and building characteristics

7 Occupancy characteristics

7.1 General

In determining the fire safety facilities to be incorporated into the design of the atria consideration should first be given to the use of the building and the nature of the occupancy.

The management regimes that are likely to be in place for monitoring and maintaining the passive and active fire safety provisions incorporated into the atria design can have a significant influence on the decision process. In addition, the mobility and the alertness of the occupants and their familiarity with their surroundings can have an effect upon the time required to complete the evacuation process in an emergency.

7.2 Occupancy categories

For the purposes of this code, four main categories of occupancy have been specified and are listed below.

a) Category A: Occupants who are awake and, predominantly, are familiar with the building (e.g. office and industrial premises, teaching areas of schools and colleges).

b) Category B: Occupants who are awake but may be unfamiliar with the building (e.g. shops, exhibitions, museums, leisure centres, other assembly buildings, etc.).

c) Category C: Occupants who are likely to be asleep:

1) Category C1 – Long term individual occupancy (e.g. individual flats without 24 h maintenance and management control on site);

2) Category C2 – Long term managed occupancy (e.g. serviced flats, halls of residence, sleeping areas and boarding schools);

3) Category C3 – Short term occupancy (hotels, schools).

d) Category D – Occupants requiring medical or nursing care.

7.3 Buildings in different occupation

The design of the atrium building should consider the different type of occupancies within the building, and each category should have its associated fire safety measures. Each category is then checked to ensure that any provision from one category does not adversely affect the fire safety of the other occupancy types.

8 Compartmentation and fire resistance

8.1 General

The severity of a fire and its potential to cause failure of the structural elements is dependent largely upon the quantity and nature of combustibles likely to be present in a particular building and the presence of any fire suppression systems.

8.2 Fire resistance of structure

Guidance is provided in this code on alternative methods of preventing the flow of hot gases and flames from a fire in the associated floor area to the atrium and subsequently into other storeys via the atrium.

Various strategies have been developed to ensure that this can be achieved, as follows:

a) fire-resisting and smoke retarding construction between the atrium and the associated floor area;

b) smoke retarding construction between the atrium and the associated floor area, used in conjunction with temperature control and sprinklers;

c) heat and ventilation extraction from each storey.

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8.3 Loadbearing elements

The anticipated fire load (per m^2 of floor area) in a building incorporating an atrium would normally be no greater than in the equivalent non-atrium building. Therefore those loadbearing elements of structure that are fire-resisting need to satisfy the same standard of fire resistance as is appropriate to the equivalent non-atrium building.

8.4 Glazing elements

In the event of a fire, the glazing elements, whether they have a designated fire resistance or not, will provide some fire resistance and/or smoke retarding functions. The ability of the glazing or glazing elements to perform these functions will need to be assessed.

8.5 Ancillary accommodation

The fire risks associated with ancillary accommodation are, in most cases, higher than those of the main use of a building. Ancillary accommodation such as loading bays, main storage areas, refuse rooms and kitchens, together with any part of the building containing highly flammable materials, needs to be separated from the atrium and any associated floor areas by means of fire-resisting construction appropriate to the specific risk. The need for such separation applies to all types of buildings, whether they contain an atrium or not.

9 Connection of atrium to below-ground storeys

There is essentially little difference in the potential for fire and smoke spread between an atrium penetrating below ground level and an atrium that is wholly above ground, and it is not necessary to separate the below-ground sections of an atrium and its associated floor areas from the upper storeys by means of fire-resisting construction. No specific recommendations are made for atria connecting with below-ground storeys, but it should be ensured that protected escape routes and firefighting provisions are in accordance with the recommendations for the equivalent non-atrium building.

10 Use of atrium base

It is often not possible to provide effective sprinkler protection to combustibles on the atrium base. Therefore in situations where sprinkler protection is a recommendation of this code but cannot be provided to the atrium base, the fire load should be controlled. This is achieved by limiting the combustible materials to isolated islands. If an effective automatic suppression system is provided, the fire load can be considered as a controlled fire load (see **3.7**).

For detailed guidance regarding the control of fire loading on the atrium base see Clause **27**.

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Section 4. Fire protection facilities

11 Means of escape

11.1 General

The inclusion of active and passive fire and smoke control systems within an atrium is intended to ensure that the means of escape provided remain available to occupants throughout the evacuation of the building in fire conditions.

It is essential, therefore, that the provision of means of escape follows established guidance, appropriate to the risk concerned, other than where specifically allowed for within this document.

11.2 Escape routes

When evacuating a building the occupants have a natural tendency to leave via the same route by which they entered. In planning for escape it is normally desirable that the escape routes coincide with circulation routes. However, in a building containing an atrium this may not always be feasible and may not be desirable if it requires travel close to the edge of an open atrium.

Occupants of a building generally need to have alternative directions of escape, and the circumstances where a single direction of travel is acceptable are limited. This principle, and others such as maximum distances of travel and capacities of exits, apply equally to a building containing an atrium as to one that does not, and are set out in the appropriate codes. In circumstances where the atrium is not separated from the accommodation by fire-resisting construction, it is necessary to consider escape within and from the atrium, and escape from the associated areas, as an entity. It is particularly important to consider the effect the atrium may have on escape from upper storeys open to the atrium in view of the potential for a fire in the atrium to affect those storeys.

11.3 Balcony escape

Escape via a balcony within the atrium space is acceptable without the need for an alternative protected escape route away from the atrium, provided that the balcony is protected from the effects of heat and smoke. Where there is an alternative protected escape route from the accommodation, these restrictions need not apply and open balcony escape routes are acceptable (except in occupancy category D).

12 Evacuation procedures

12.1 Evacuation strategy

The purpose of an evacuation strategy is to ensure that, in the event of a fire, the occupants are able to use the escape routes provided without being exposed to untenable conditions.

Basic evacuation strategies available comprise:

a) total evacuation of the occupants, by either simultaneous or phased procedures;

b) evacuation of the occupants to a place of relative safety within the building, where they can remain and, if necessary, complete the evacuation in safety as part of a managed system; or

c) the occupants remain in a place from which evacuation could not normally be contemplated for functional reasons, with the design ensuring that the location of the occupants remains a place of relative safety throughout.

The evacuation strategy should not rely on direct assistance to the occupants, except for special cases such as the evacuation of the infirm. The choice of evacuation strategy must be carefully matched to the nature of the building and its occupants, with some strategies being inapplicable to certain types of buildings. For example, in hospitals or premises providing medical or nursing care appropriate evacuation strategies might include those where occupants evacuate to a place of relative safety within the building by progressive horizontal evacuation or are afforded protection while remaining in-situ.

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12.2 Simultaneous evacuation

Where there are open connections between storeys or the enclosure to an atrium is of non smoke retardant instruction, it is unrealistic to expect the occupants to remain on an open storey for a prolonged time when there is a fire, even if sprinkler and smoke control systems are designed to maintain such storeys free from smoke and fire. Therefore, in view of the likely psychological response of the occupants to a fire threat, simultaneous evacuation would be the preferred option.

12.3 Phased evacuation

In high rise buildings where the floor areas are separated from the atrium by smoke retarding and fire-resisting enclosures, phased evacuation procedures may be adopted. Phased evacuation may also be acceptable in low rise buildings when a smoke retarding but non fire-resisting enclosure is provided. The appropriate degree of fire resistance is shown in the relevant decision tree.

12.4 Evacuation phasing

An atrium building may contain both areas subject to phased evacuation and areas subject to simultaneous evacuation. The most appropriate phasing of evacuation for any particular building needs to be determined on the basis of the mode of evacuation (phased, simultaneous or both), the nature of the occupants and the fire risk present (see Table 5).

The fire alarm system needs to be designed so as to enable the sounding of the evacuation signal in a sequence that will ensure the safe egress of all of the occupants should a fire continue to develop. Details of the evacuation strategy and alarm system should be given in the fire safety manual (see BS 5588-12).

13 Fire control centre

A fire control centre is necessary for atrium buildings where a system of phased evacuation is proposed, to enable the fire service to assume control of an incident immediately on arrival. The fire control centre needs to be readily accessible with direct access from the open air, and because of the possible need for it to be operational over an extended period of time, it should be located in a room with structural fire separation and should incorporate facilities to enable it to function as normal during an emergency. It should contain all control and indicating equipment for the fire alarm and other fire safety systems for the building.

NOTE The fire control centre may form part of the general management offices for the building.

14 Fire warning systems

People respond more quickly to informative warning systems than to the traditional type of fire alarm sounder. This provision of information can be particularly important when many of the building's occupants are unfamiliar with their surroundings. If phased evacuation is used or where large numbers of the public are present, it is necessary to be able to provide clear instructions to the occupants via a voice alarm system, (except in premises providing medical or nursing care), so that the evacuation can be managed in an orderly manner.

15 Automatic fire detection

It is possible that smoke from a fire in an unoccupied area could spread via the atrium and rapidly hazard the escape from other levels within the building. Therefore, to ensure safety throughout an atrium building, it may be necessary to install a comprehensive automatic fire detection and alarm system.

A fire detection system can initiate a variety of functions, including closing down ventilating and air conditioning plant, bringing fire control systems into operation, opening ventilators and starting fans for the control of smoke.

Several detection methods may be incorporated into the same automatic system so that the most suitable detection method can be chosen for any location where the fire characteristics can be predicted or where they present a particularly significant hazard. It is desirable that advice is sought from specialists as to the correct type of system for given circumstances.

BS 5839-1 gives recommendations on general design, zoning and location of detectors, control and indicating equipment, power supplies etc., and contains advice relevant to buildings in multiple occupation.

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16 Separation between atrium and associated floor area

16.1 General

In order to control the spread of fire and/or smoke, the construction separating the atrium and associated floor areas will have to be either fire-resisting, and/or smoke retarding.

Smoke retarding construction is only suitable when the smoke temperatures can be effectively controlled by the use of sprinklers and/or temperature control systems which will limit the growth of the fire.

16.2 Smoke retarding construction

In many instances it is not necessary to enclose the atrium with fire-resisting construction. However, a smoke retarding enclosure may be required to prevent the early ingress of smoke to those levels that are not directly affected by fire. Some forms of construction which are fire-resisting (e.g. traditional roller shutters) would not be sufficiently impervious to smoke to be considered as smoke retarding.

In the absence of an appropriate method of test and performance criteria, such construction should not contain unsealed joints and permanently open or openable areas. Joints between such construction and any abutting element should be tight and preferably sealed with a filler (e.g. plaster), a mastic, or a flexible strip (e.g. neoprene), as appropriate.

Any doors in an atrium, when tested in accordance with BS 476-31.1 with the threshold taped, and subjected to a pressure of 25 Pa, should have a leakage rate not exceeding 3 m^3/h per metre.

17 Smoke control for means of escape

17.1 General

Smoke control systems are designed to move or control the smoke and fire effluent in a pre-determined manner in order that their threat to life can be minimized. Smoke control can be achieved in a number of different ways.

a) A smoke exhaust ventilation system of which it is possible to identify two different types:

1) to establish a stable smoke layer providing clear air to enable safe escape of the occupants;

2) to dilute the smoke in order to maintain tenable conditions.

b) A temperature control system.

c) A pressure differential system of which it is possible to identify the following types.

1) Atrium pressurization

Where there is no appreciable fire-load in the atrium, and all storeys are separated from the atrium by fire-resisting construction, the atrium can be regarded as being fully analogous to a protected stairway and can be pressurized in a similar way relative to the accommodation to prevent ingress of smoke into the atrium from any storey.

2) Pressurization of the associated floor areas

Where there is a sprinklered or controlled fire load in the atrium base, smoky gas can fill all or part of the atrium. Where storeys are separated from the atrium by fire-resisting construction and are also sprinklered, and where there is no smoke exhaust ventilation from the atrium, the adjacent accommodation spaces (and/or any stairwells or shafts communicating via doors into the atrium) may be pressurized relative to that atrium.

3) Atrium depressurization

Where there is a controlled fire load in the atrium base, and where some or all higher storeys are separated from the atrium by fire-resisting construction, and where there is smoke exhaust ventilation for the atrium, it may be feasible to reduce the pressures in the atrium sufficiently to prevent smoke entering adjacent spaces through leakage paths.

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17.2 Activation of smoke control systems

It is essential that any smoke control system intended to protect the means of escape is capable of operation before the arrival of the fire service. Consequently all such provisions should be initiated automatically on detection of any fire which might threaten the atrium and its adjacent spaces.

17.3 Smoke clearance systems

The smoke resulting from the latter stages of a fire that has been brought under control is likely to be relatively cool and will not be maintained in a well defined layer or be rapidly removed by means of a smoke clearance system. Therefore, whilst a smoke clearance system may reduce the total quantities of smoke accumulating within the atrium, such a system is unlikely to be sufficiently effective in preventing smoke damage unless used in conjunction with some form of physical separation such as an atrium enclosure.

As the provision of smoke clearance systems are primarily for the benefit of the fire service appropriate recommendations are given in Clause **29**.

17.4 Make-up air supply

It is essential that any smoky gases exhausted from the atrium are replaced by clean, fresh air. This replacement air should enter below any buoyant smoke layer to avoid immediate mixing with smoke, and to allow the best conditions for the use of escape routes and for firefighting.

17.5 Air conditioning/ventilation (HVAC) ductwork used to form smoke and heat control systems

HVAC ductwork used in conjunction with a smoke control system presents a risk in that inlet air and exhaust air could spread any smoke and fire within the atrium building. Careful consideration, therefore, needs to be given to fire protection, integrity of construction and routeing of ductwork used for smoke and heat control systems (see **24.9.2**).

18 Sprinkler systems

18.1 General

The provision of sprinkler systems should be considered at an early stage within the building design, bearing in mind the following:

a) sprinkler systems will limit the size of a fire and in most cases suppress it;

b) by limiting the growth of a fire with an automatic sprinkler system it is possible to extend the time available before untenable conditions develop;

c) the design of certain types of smoke control systems may also need a sprinkler system to be installed to restrict the size and hence smoke production of a fire;

d) a sprinkler system may need to be installed in some buildings as a result of the fire safety requirements for the equivalent non-atrium building;

e) if a fire is allowed to spread unchecked throughout a large atrium it can become extremely difficult for firefighters to control and there is often an increased risk of fire spreading to adjacent buildings.

18.2 Protection of atrium base

If sprinklers are mounted at high level below the atrium ceiling they will react much more slowly, if at all, than if mounted below a typical 3 m high ceiling.

In atria where the ceiling is more than 20 m above the atrium base, ceiling mounted sprinklers are unlikely to be effective and there is therefore little benefit in their installation.

Where it is not practical or desirable to provide the traditional type of thermally operated sprinkler heads to protect the atrium base, it may still be possible to provide some alternative form of fire suppression system that provides a similar level of performance.

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19 Electrical services

19.1 Electrical power supply

All electrical supplies to life safety and fire protection installations need to be separated from other circuits at the point of entry into the building, so that the failure of other equipment does not render the installations 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 routeing 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.

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

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.

19.3 Primary and secondary power supplies

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 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 needs 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 to operate. 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 separated from each other, so that the failure of cables or equipment in any one system, either by mechanical breakdown or damage by fire, 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 by the provision of additional fire protection.

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20 Facilities for firefighting

20.1 General

The provisions for fire service access and firefighting in an atrium building should generally be in accordance with the requirements for the equivalent non-atrium building, although the geometry of the building might result in more firefighting shafts being needed than in the equivalent non-atrium building (although the area of the atrium void should be ignored for the purposes of calculating the number of firefighting shafts required).

20.2 Smoke clearance for firefighting

The fire service may need to release smoke and heat from a building after the fire has been suppressed. Ventilation for this purpose is usually obtained by opening windows to provide cross ventilation and smoke clearance. In an atrium building, the spread of smoke to a number of storeys can make it more difficult to open windows on every storey affected by smoke. In such circumstances, a mechanical or natural ventilating system capable of clearing the smoke from the atrium and the affected floor area should be provided.

Where a smoke control system is provided for means of escape purposes, it will not generally be necessary to provide additional facilities specifically for the fire service. However, where such a system is not provided, the provision of smoke clearance facilities for operation by the fire service is recommended.

Stand alone manual override facilities should be provided that will afford the fire service direct control of the smoke control and normal ventilation systems within the building.

20.3 Ventilation and smoke controls for the fire service

In order to assist the fire service in rescue, firefighting and clearance of smoke after the fire has been extinguished, it has become normal practice to provide switches at suitable locations by which fire service or other authorized personnel can override the operation of smoke exhaust fans and ventilators and alter the configuration of the normal air handling system. Careful consideration should be given as to the extent of such provisions (see Clause **29**).

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Section 5. Design solutions

21 General

21.1 Structure

This code employs a decision tree process which takes the user through a series of questions and recommendations for determining the appropriate design solutions. Following each decision tree (Figure 2a to Figure 6) is a table (Table 1, Table 2, Table 3 and Table 4) which identifies a number of solutions for each category. The tables do not identify the complete range of solutions determined by the decision trees and should not be used in place of the decision trees.

The technical recommendations determined as a result of the decision tree process are specified in Section 6.

21.2 Decision trees

Each decision tree comprises essentially two elements:

a) a question box which asks a fundamental question of the user. Depending on the answer given the user may be guided to further question boxes providing recommendations;

b) a recommendation box, which gives a solution for the aspect of design. The user may then be taken to other boxes providing more recommendations.

NOTE This process may be interrupted by further question boxes.

Each decision tree process is structured to follow, where possible, a common pattern related to the technical issues that need to be considered. These are:

1) consideration of the appropriate evacuation procedure;

2) the type of fire alarm/automatic fire detection system to be provided;

3) the type of separation between the atrium and the remainder of the accommodation;

4) the type of smoke control system to be provided;

5) the use of the atrium base; and

6) the provision of automatic suppression systems.

At the end of the selection process the user is referred to an exemplar in Annex A.

In employing the decision tree process, the user should strictly follow the line of decisions and resulting solutions given. No attempt should be made to pick solutions from branches of the tree that are not part of the decision process.

Advice on the specific recommendations is detailed in Section 6.

21.3 Design solution documentation

The fire safety strategy and design determined as a result of the guidance given in this code should be clearly documented, so as to provide a clear and readily understandable justification of the design for submission to the statutory authorities, in accordance with BS 5588-12.

Text deleted

NOTE The following recommendations in Clauses **22** to **29** support the provisions identified in Figure 2a to Figure 6 and Table 1, Table 2, Table 3 and Table 4.

Clauses **22** to **27** deal with those recommendations which depend on the particular solution adopted. Therefore it is the responsibility of the reader to ascertain from the appropriate figure/table which of those recommendations are relevant to the particular design.

Clauses **28** and **29** deal with those recommendations that apply to all designs.

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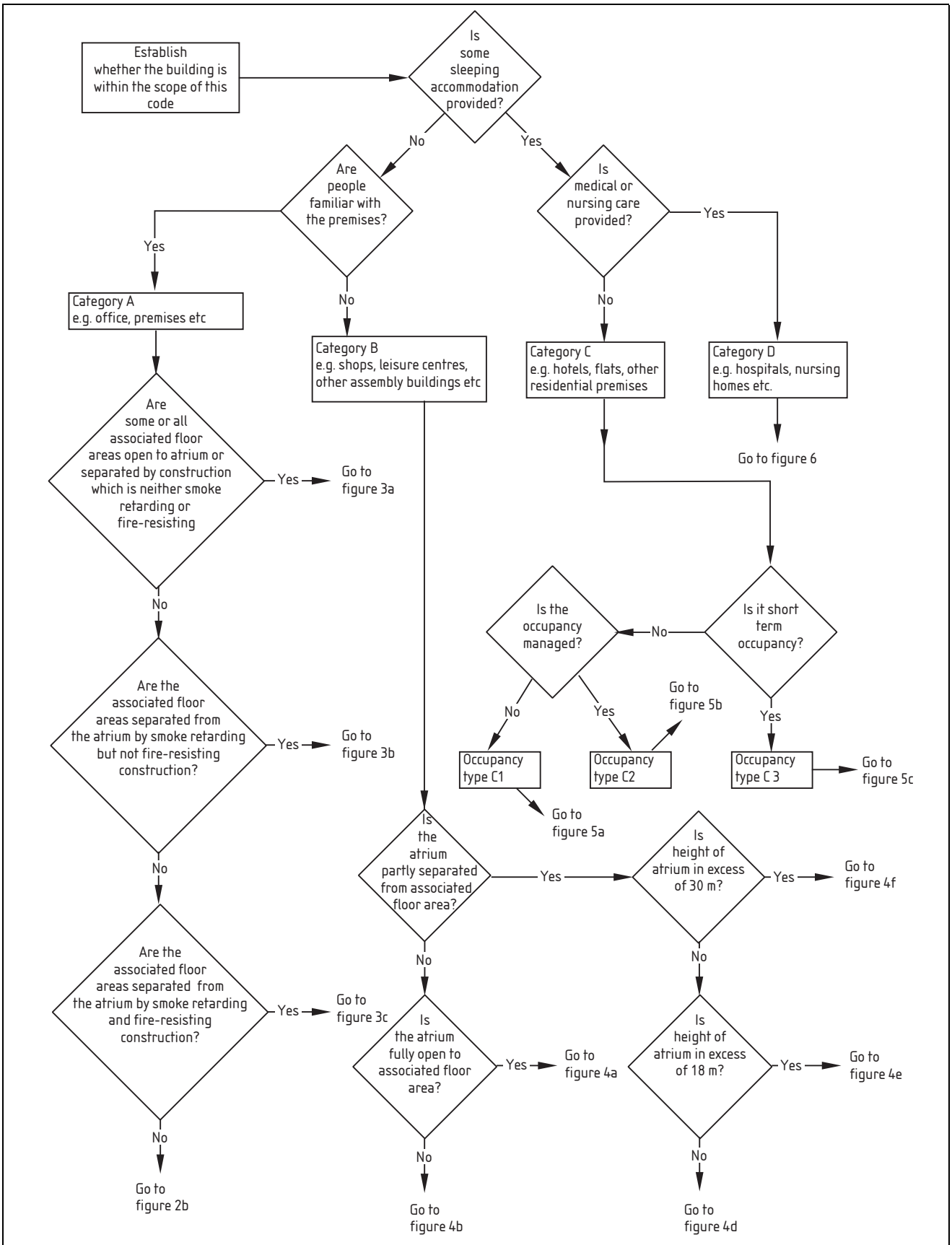

Figure 2a — Occupancy category decision process

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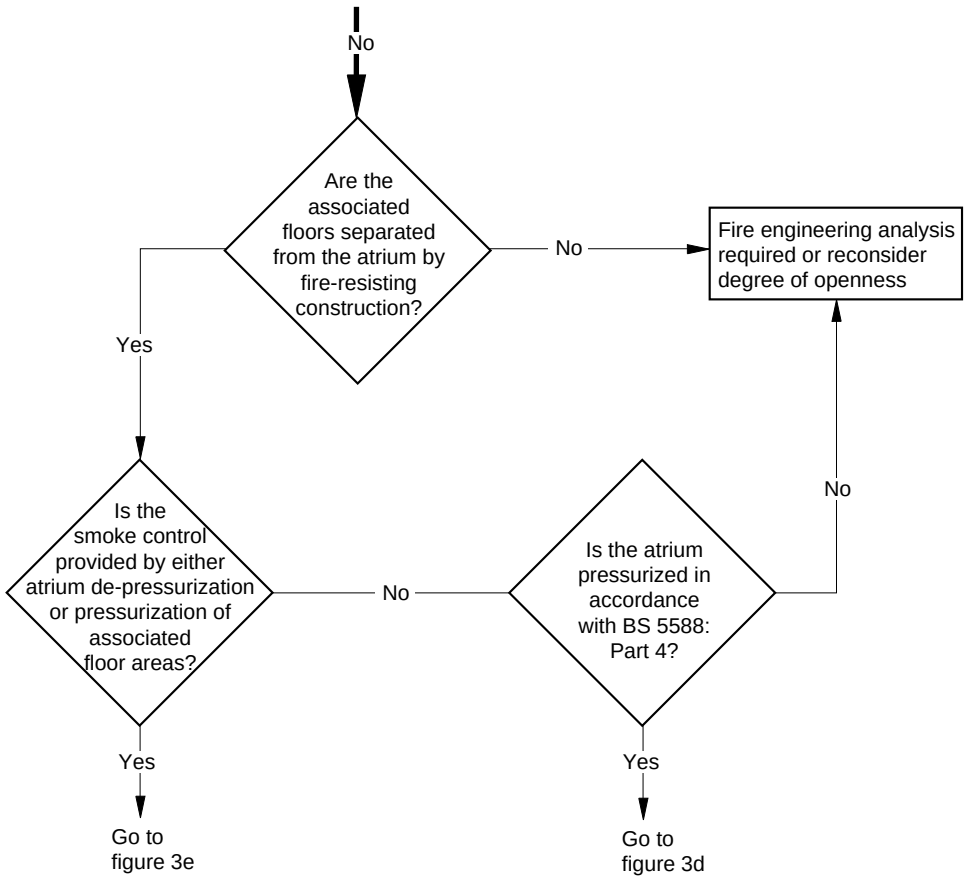

Figure 2b — Occupancy category decision process

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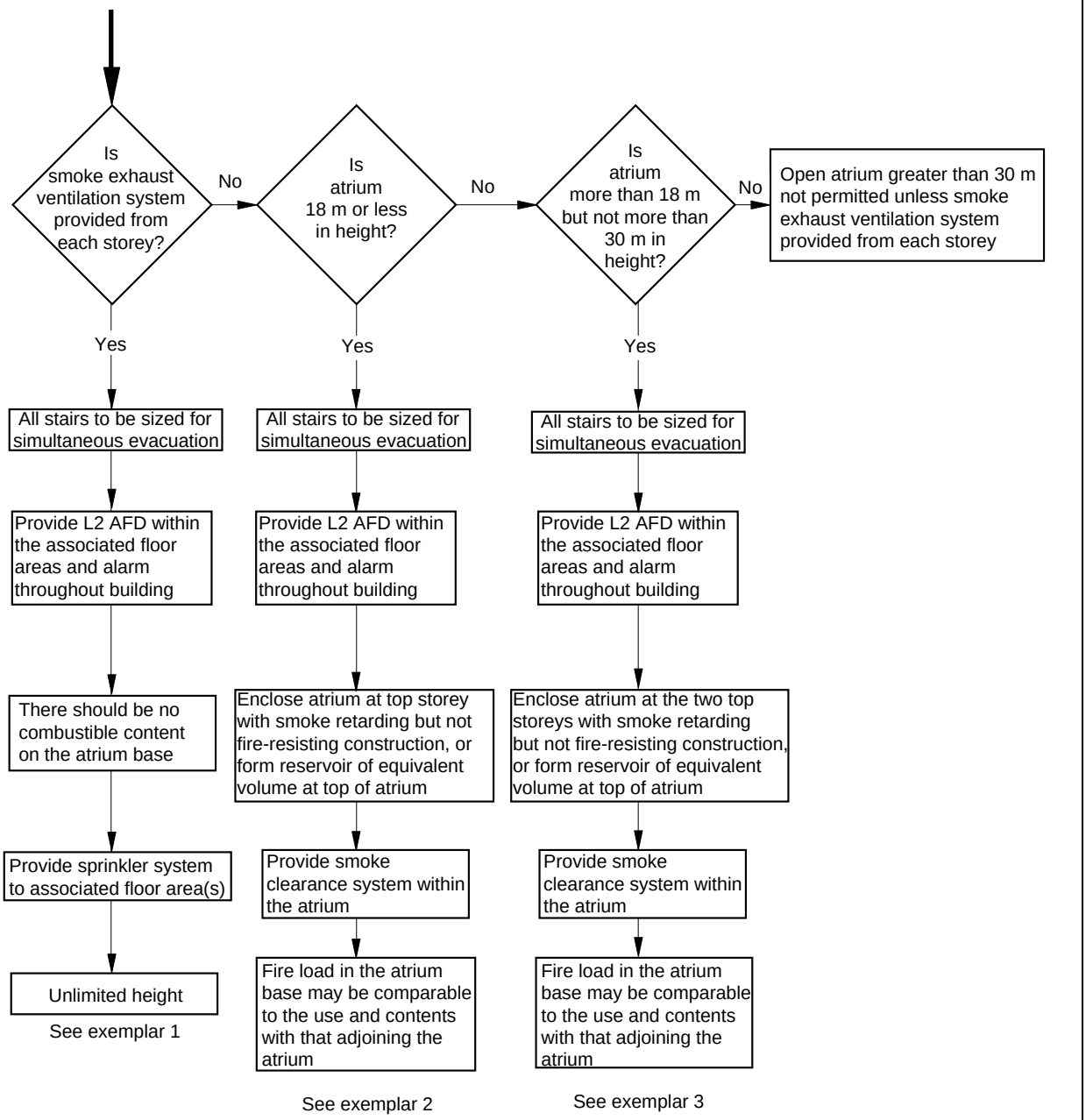

Figure 3a — Occupancy category A: occupants who are awake — Atrium partially or fully open

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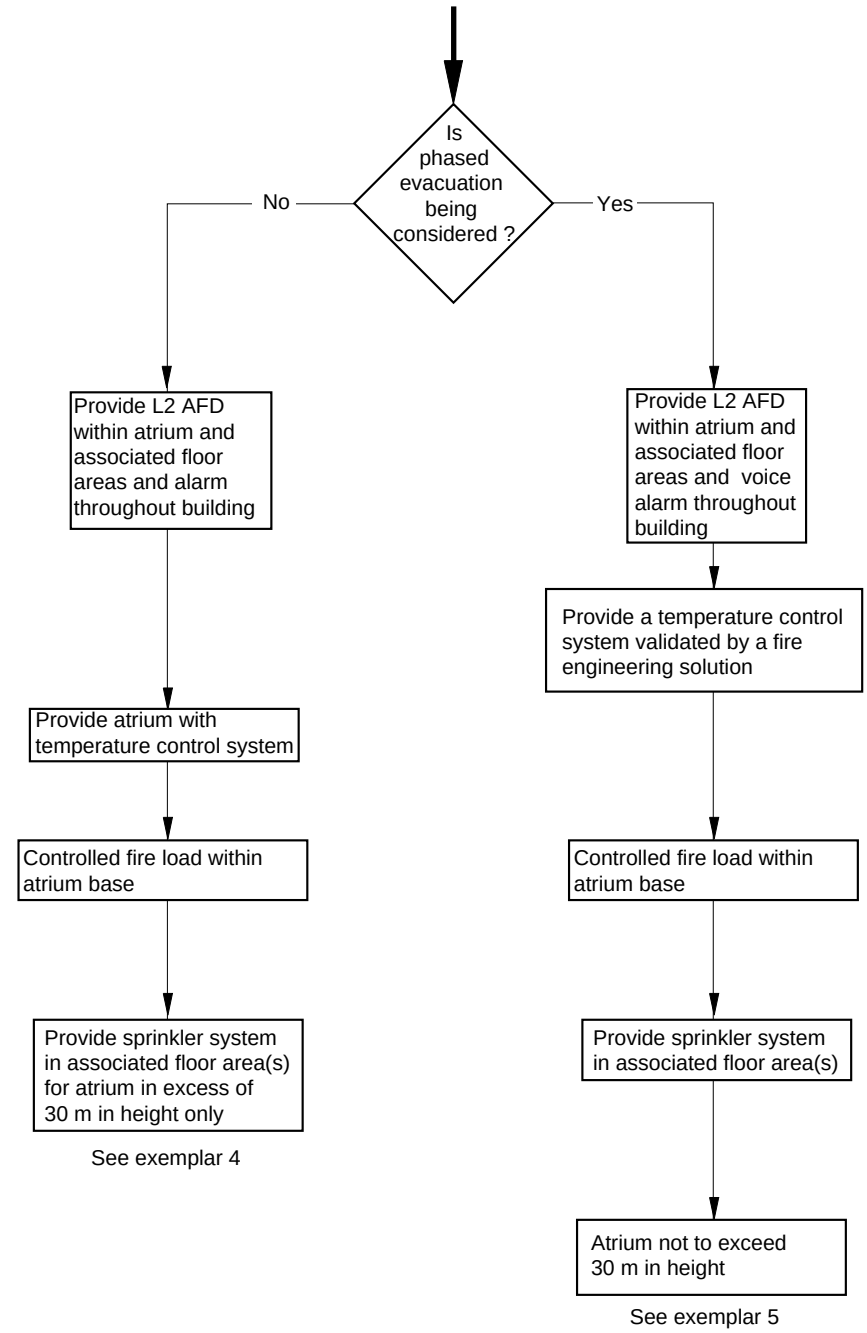

Figure 3b — Occupancy category A: occupants who are awake and, predominantly, are familiar with the building — Atrium enclosed with smoke retarding construction

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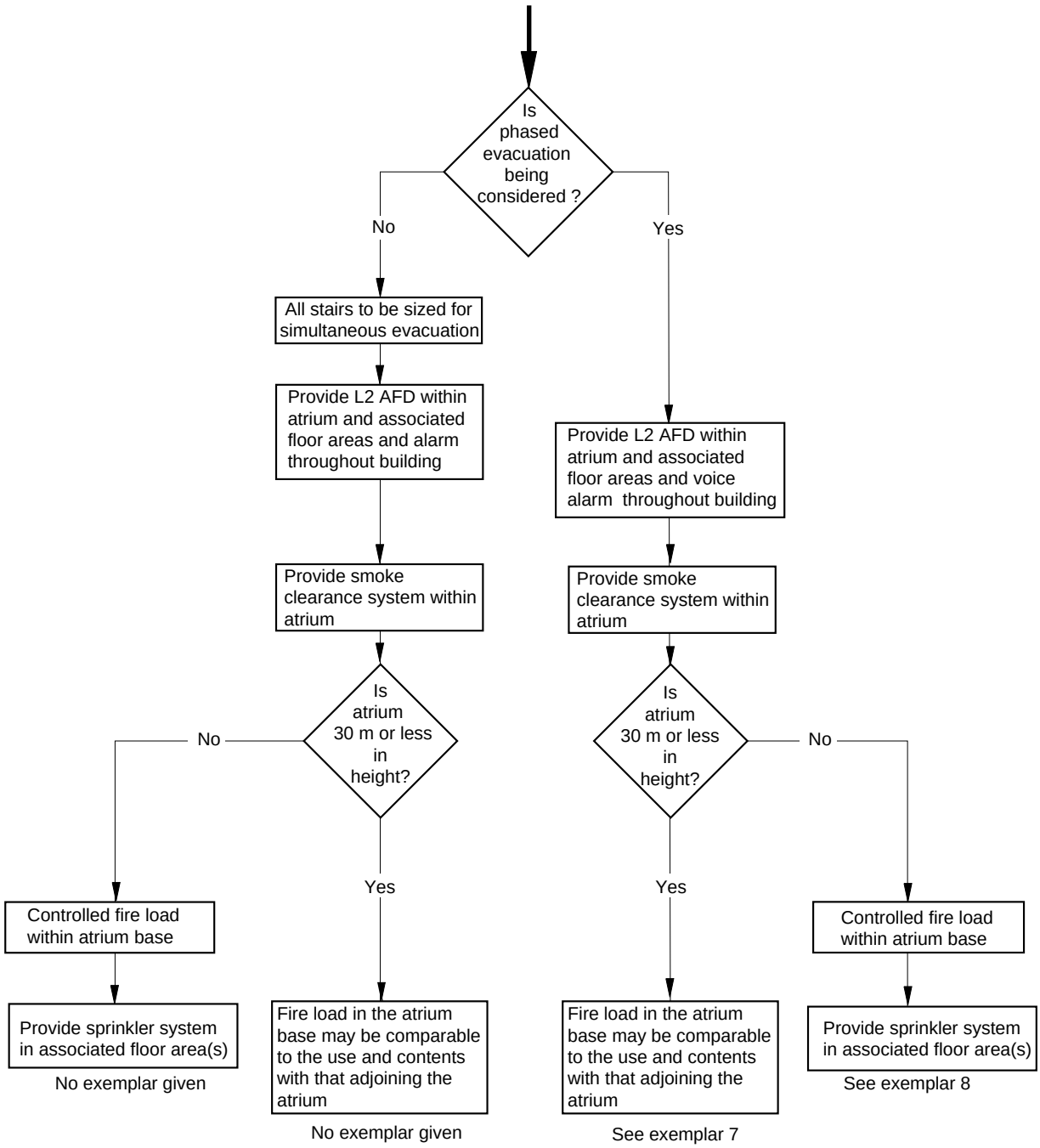

Figure 3c — Occupancy category A: occupants who are awake and, predominantly, are familiar with the building — Atrium enclosed with smoke retarding and fire-resisting construction

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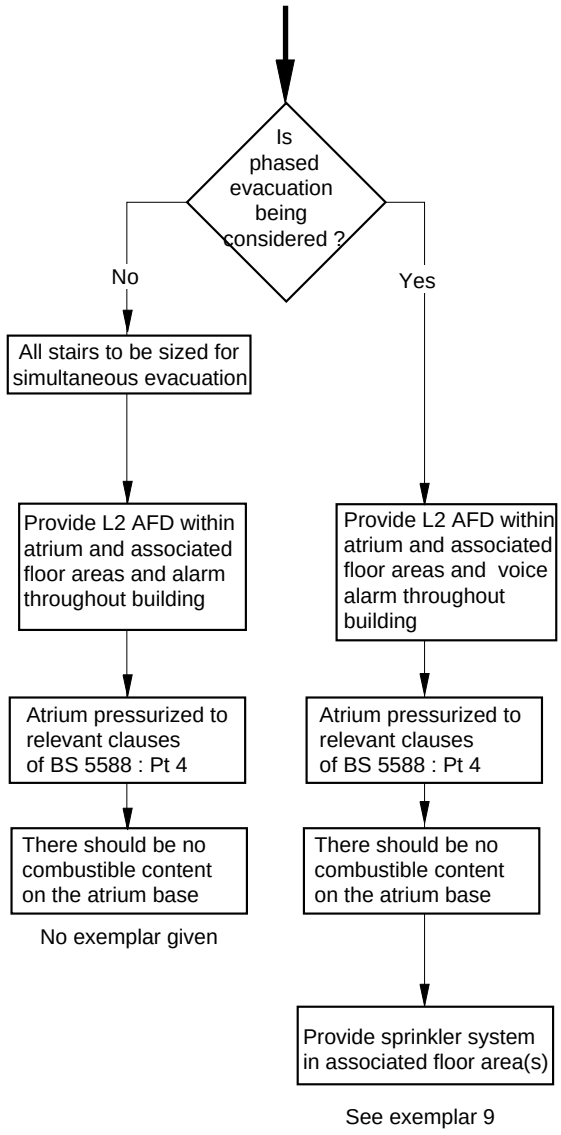

Figure 3d — Occupancy category A: occupants who are awake and, predominantly, are familiar with the building — Atrium enclosed with fire-resisting construction and using pressurization

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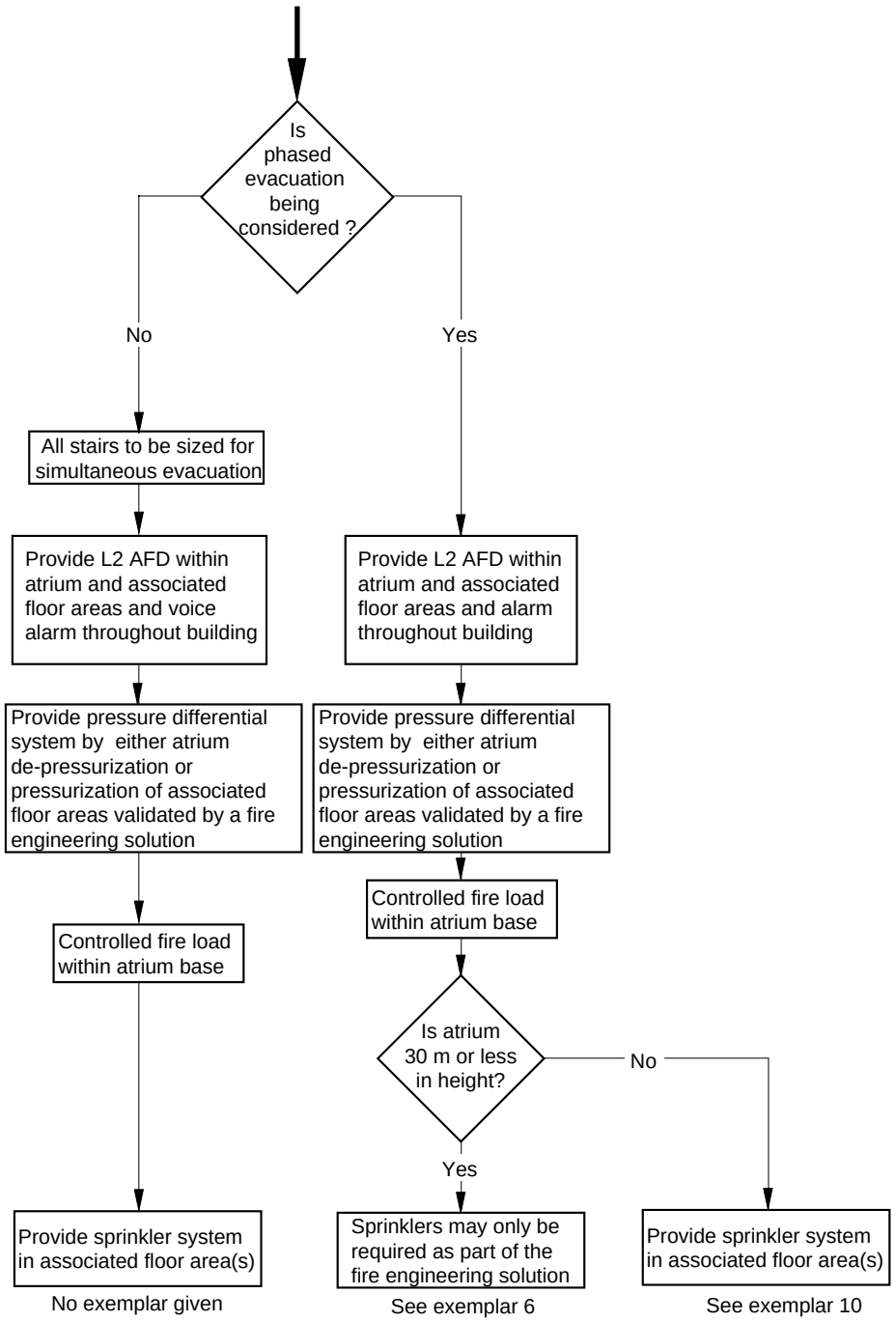

Figure 3e — Occupancy category A: occupants who are awake and, predominantly, are familiar with the building — Atrium enclosed with fire-resisting construction and using pressurization

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Table 1 — Occupancy category A: occupants who are awake and, predominantly, are familiar with the building

Evacuation strategy: simultaneous							
Atrium height m	**Atrium/accommodation method of separation**	**Smoke control system**	**Associated areas sprinkler system**	**Fire alarm and warning system**	**Use of atrium base**	**Reference/notes**	**Exemplar**
≤ 18[a]	Enclosed or open: + Reservoir see Note 1	Smoke clearance	No	Provide L2 AFD[b] within atrium and associated areas and alarm system throughout	Use and contents comparable with that adjoining the atrium	Note 1 Enclose top storey with smoke retarding but not fire-resisting construction or form reservoir of equivalent volume at top of atrium	2
>18 ≤ 30	Enclosed or open: + Reservoir see Note 2	Smoke clearance	No	Provide L2 AFD[b] within atrium and associated areas and alarm system throughout	Use and contents comparable with that adjoining the atrium	Note 2 Enclose the two top storeys with smoke retarding but not fire-resisting construction or form reservoir of equivalent volume at top of atrium	3
>30	Open	Smoke exhaust per storey	Yes	Provide L2 AFD[b] within atrium and associated areas and alarm system throughout	No combustible content		1
	Enclosed: Smoke retarding	Temperature control	Yes	Provide L2 AFD[b] within atrium and associated areas and alarm system throughout	Controlled fire load		4

[a] This table is not applicable for buildings of two storeys [see **1**e)].
[b] L2 AFD = Automatic fire protection system type L2 (see BS 5839-1).
[c] Sprinklers may be required as part of the fire engineering solution.

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Table 1 — Occupancy category A: occupants who are awake and, predominantly, are familiar with the building (*continued*)

Evacuation strategy: phased							
Atrium height m	**Atrium/accommodation method of separation**	**Smoke control system**	**Associated areas sprinkler system**	**Fire alarm and warning system**	**Use of atrium base**	**Reference/notes**	**Exemplar**
≤ 30	Enclosed: Smoke retarding	Temperature control	Yes	Provide L2 AFD[b] to atrium and associated areas, including voice alarm throughout	Controlled fire load		5
	Enclosed: fire resistance 30 min integrity & smoke retarding	Smoke clearance	No	Provide L2 AFD[b] to atrium and associated areas, including voice alarm throughout	Use and contents comparable with that adjoining the atrium		7
	Enclosed: fire resistance 30 min integrity	Pressure differential system: see Note 3	No[b]	Provide L2 AFD[b] to atrium and associated areas, including voice alarm throughout	Controlled fire load	Note 3 Provide fire engineering solution by either atrium depressurization or pressurization of associated floor areas	6
>30	Enclosed: fire resistance 30 min integrity and pressure differential system	Pressure differential system: see Note 3	Yes	Provide L2 AFD[b] to atrium and associated areas, including voice alarm throughout	Controlled fire load	Note 3 Provide fire engineering solution by either atrium depressurization or pressurization of associated floor areas	10
	Enclosed: fire resistance 30 min integrity and smoke retarding	Smoke clearance	Yes	Provide L2 AFD[b] to atrium and associated areas, including voice alarm throughout	Controlled fire load		8
	Enclosed: fire resistance 30 min integrity and pressure differential system	Pressure differential system: see Note 4	Yes	Provide L2 AFD[b] to atrium and associated areas, including voice alarm throughout	No combustible content	Note 4 Atrium pressurization by applying all relevant clauses of BS 5588-4:1997	9

[a] This table is not applicable for buildings of two storeys [see **1**e)].
[b] L2 AFD = Automatic fire protection system type L2 (see BS 5839-1).
[c] Sprinklers may be required as part of the fire engineering solution.

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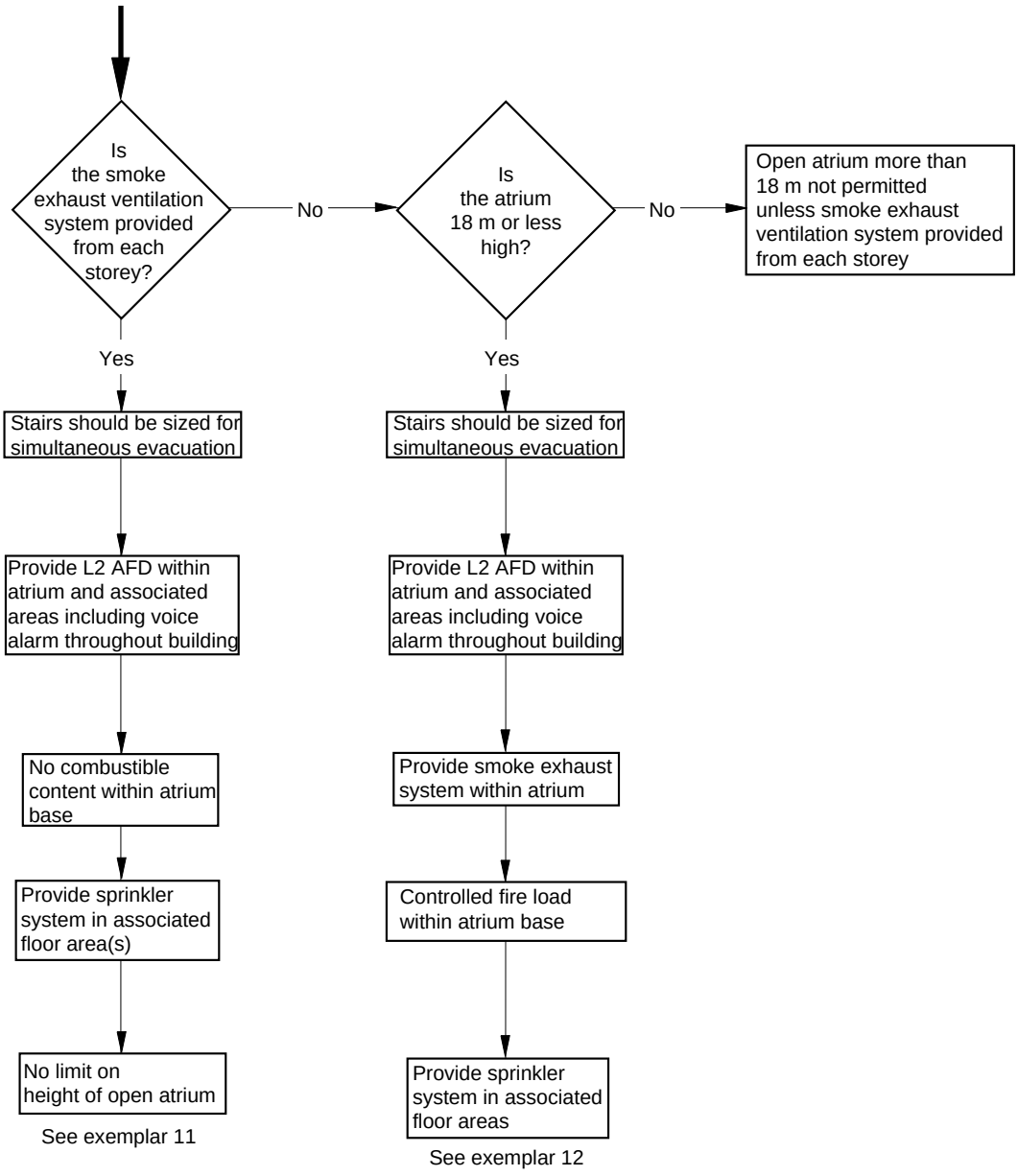

Figure 4a — Occupancy category B: occupants who are awake but may be unfamiliar with the building — Atrium open

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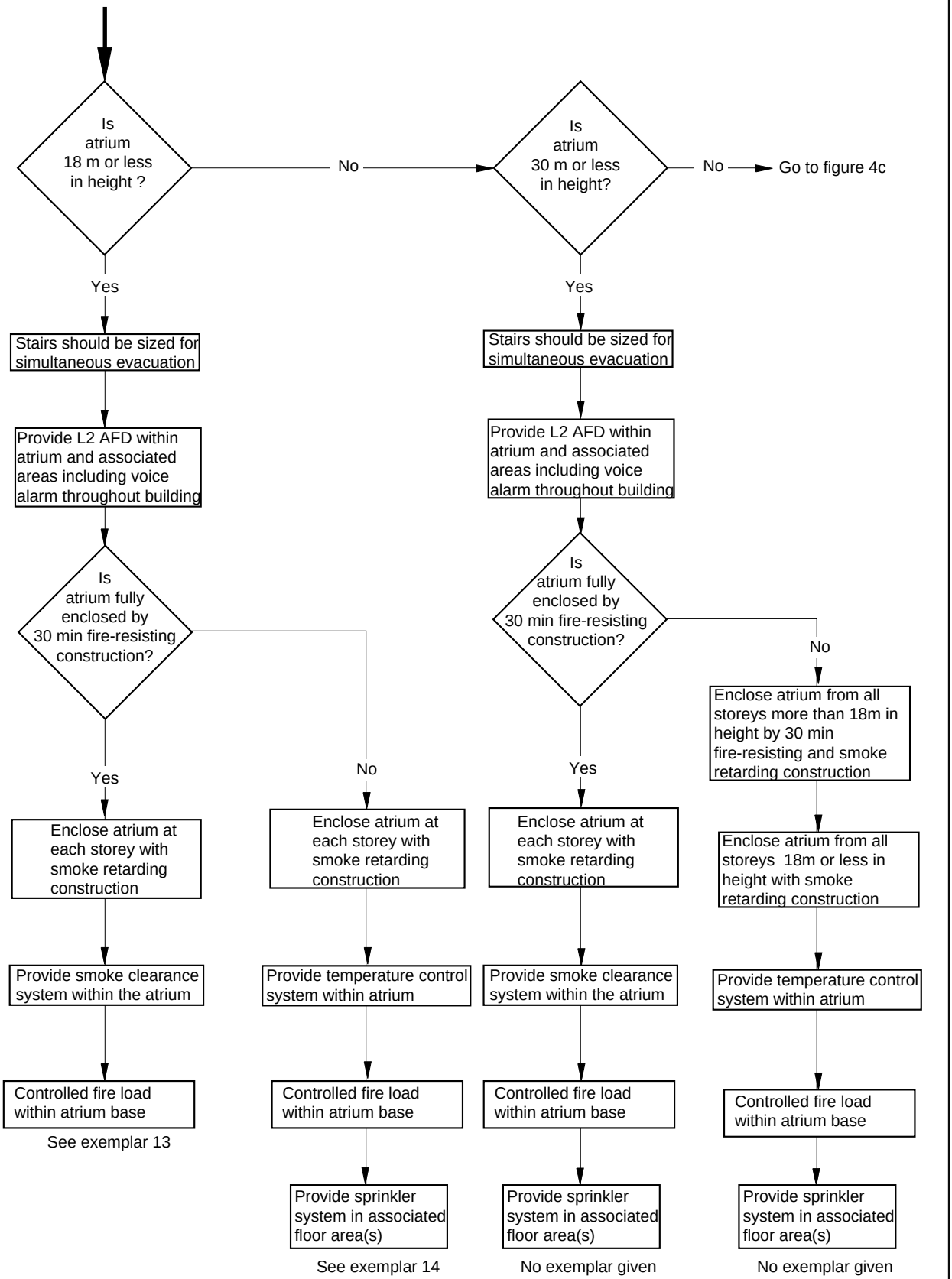

Figure 4b — Occupancy category B: occupants who are awake but may be unfamiliar with the building — Atrium over 30 m in height, enclosed

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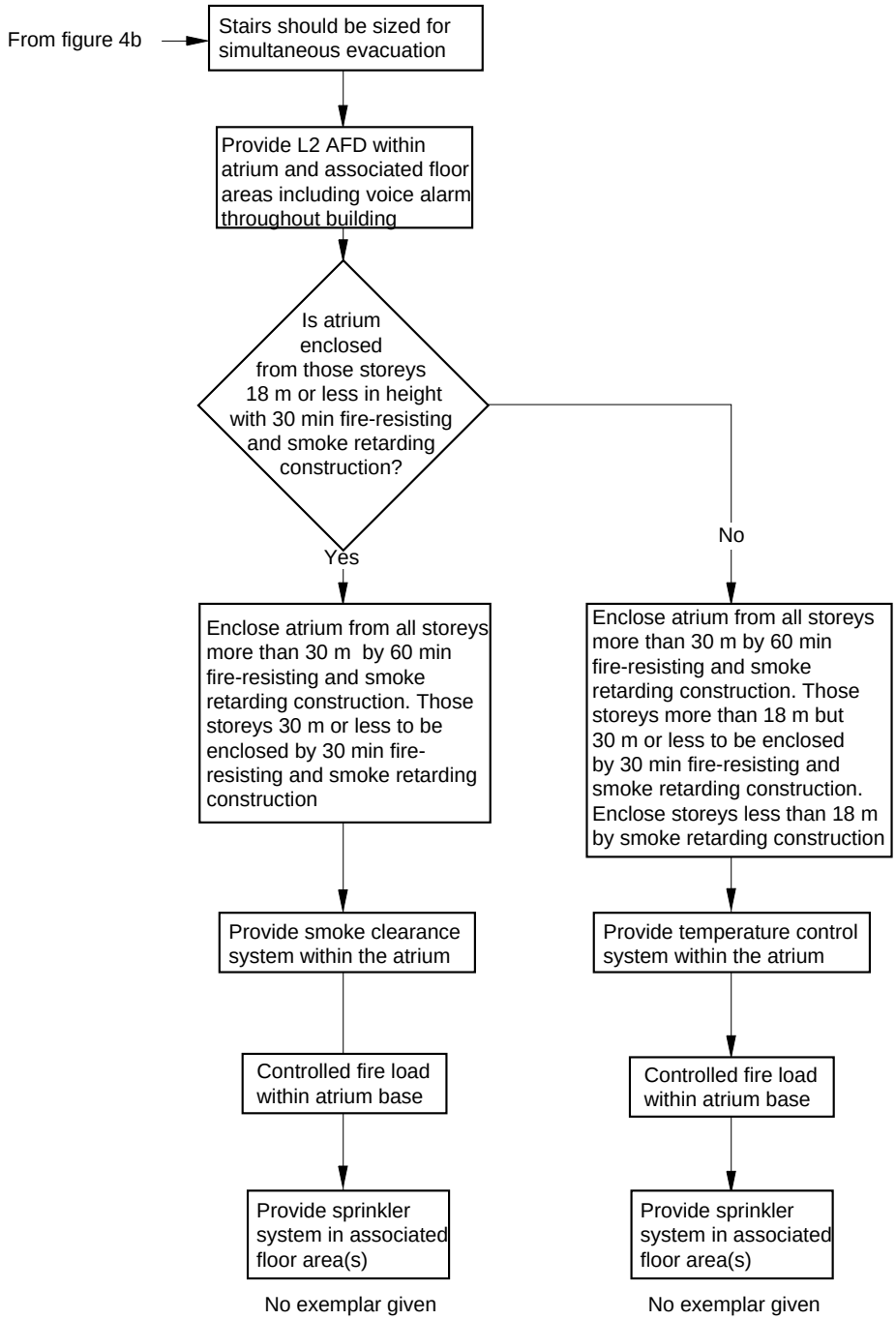

Figure 4c — Occupancy category B: occupants who are awake but may be unfamiliar with the building — Atrium over 30 m in height, enclosed

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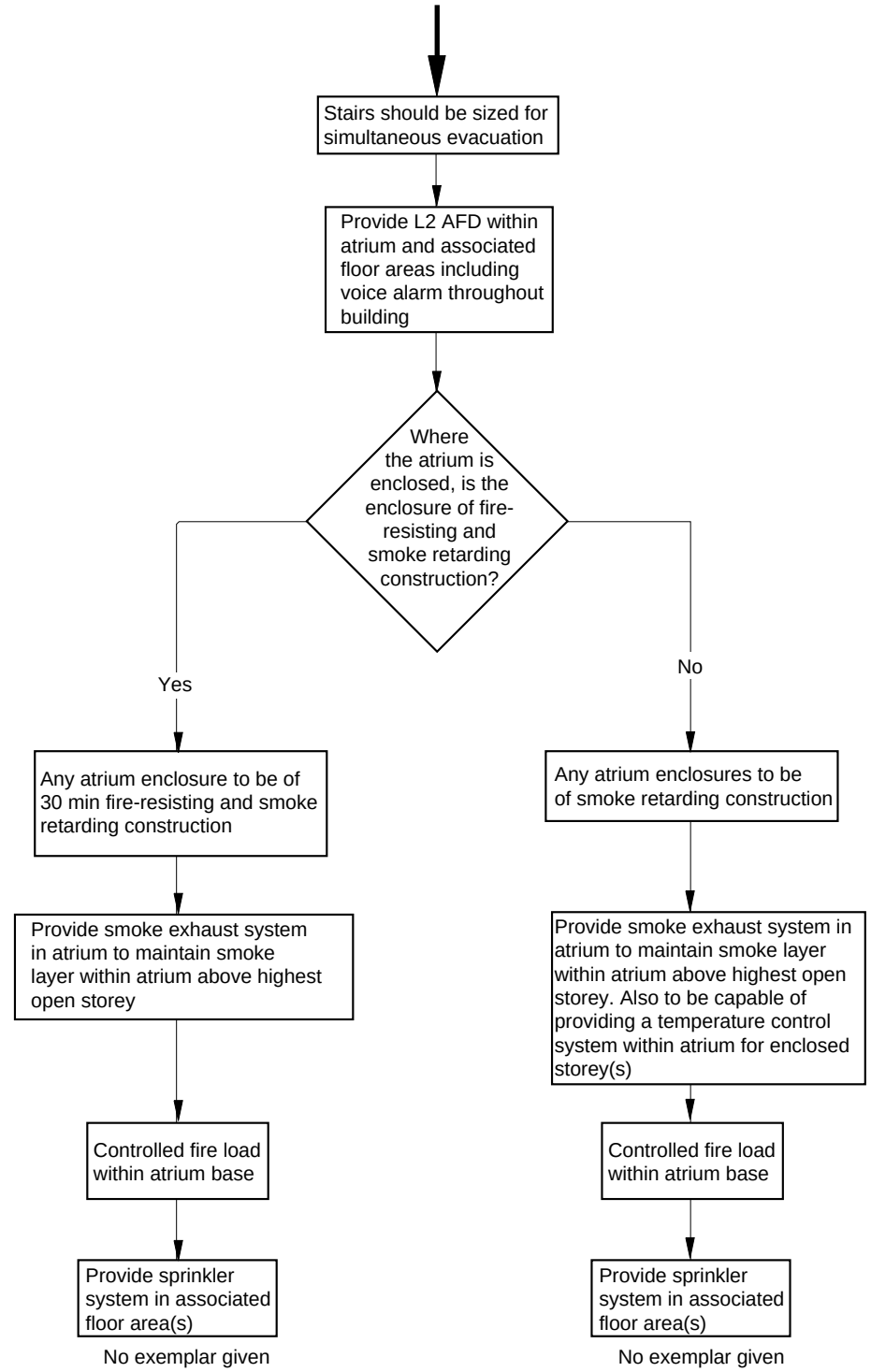

Figure 4d — Occupancy category B: occupants who are awake but may be unfamiliar with the building — Atrium 18 m or less in height, partly enclosed

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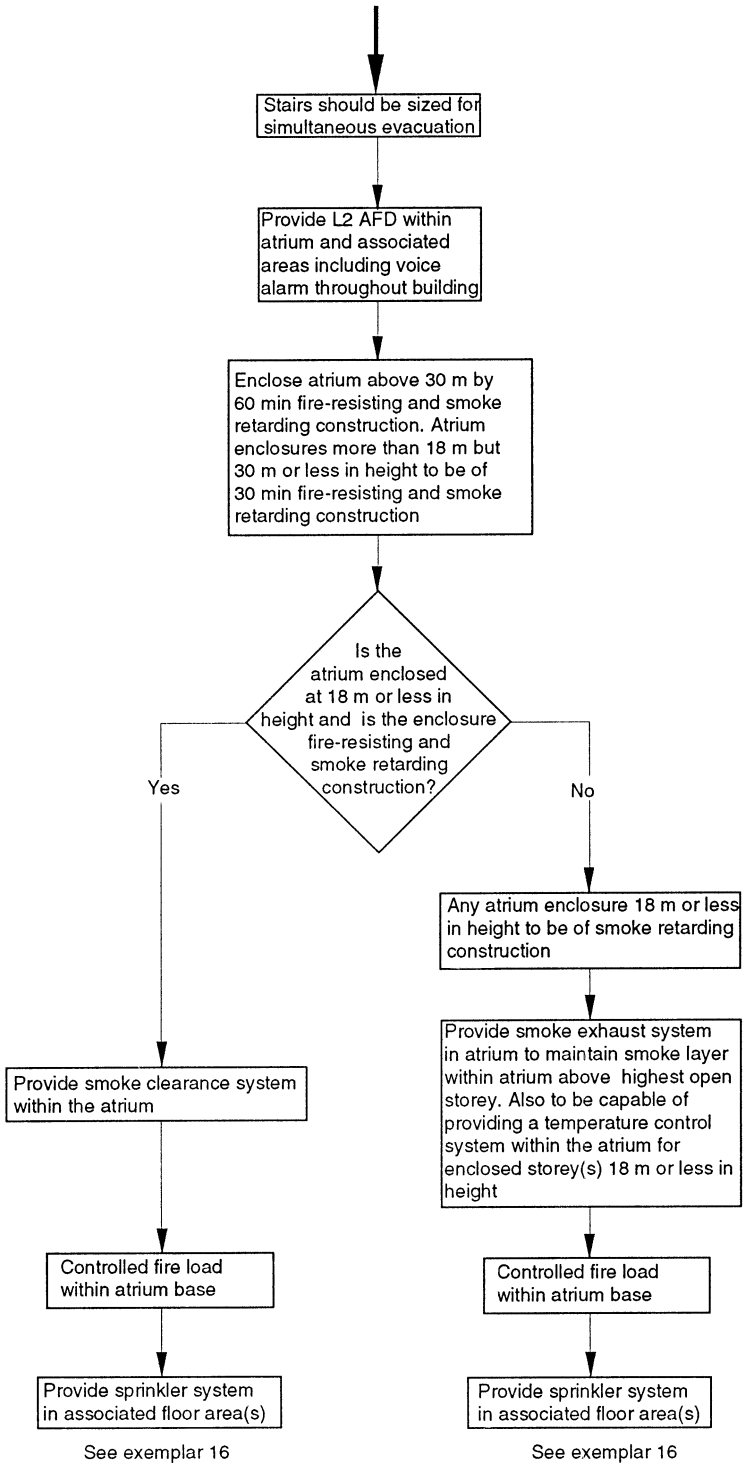

NOTE Alternatively all storeys within 18 m of the floor level of the highest storey abutting the atrium may be designed as if the atrium were 18 m high provided that:

a) storeys below are enclosed with 30 min fire resistance and are smoke retarding;

b) smoke exhaust is installed; and

c) the atrium base has no combustible content (see exemplar 15).

Figure 4e — Occupancy category B: occupants who are awake but may be unfamiliar with the building —Atrium 18 m to 30 m in height, partly open

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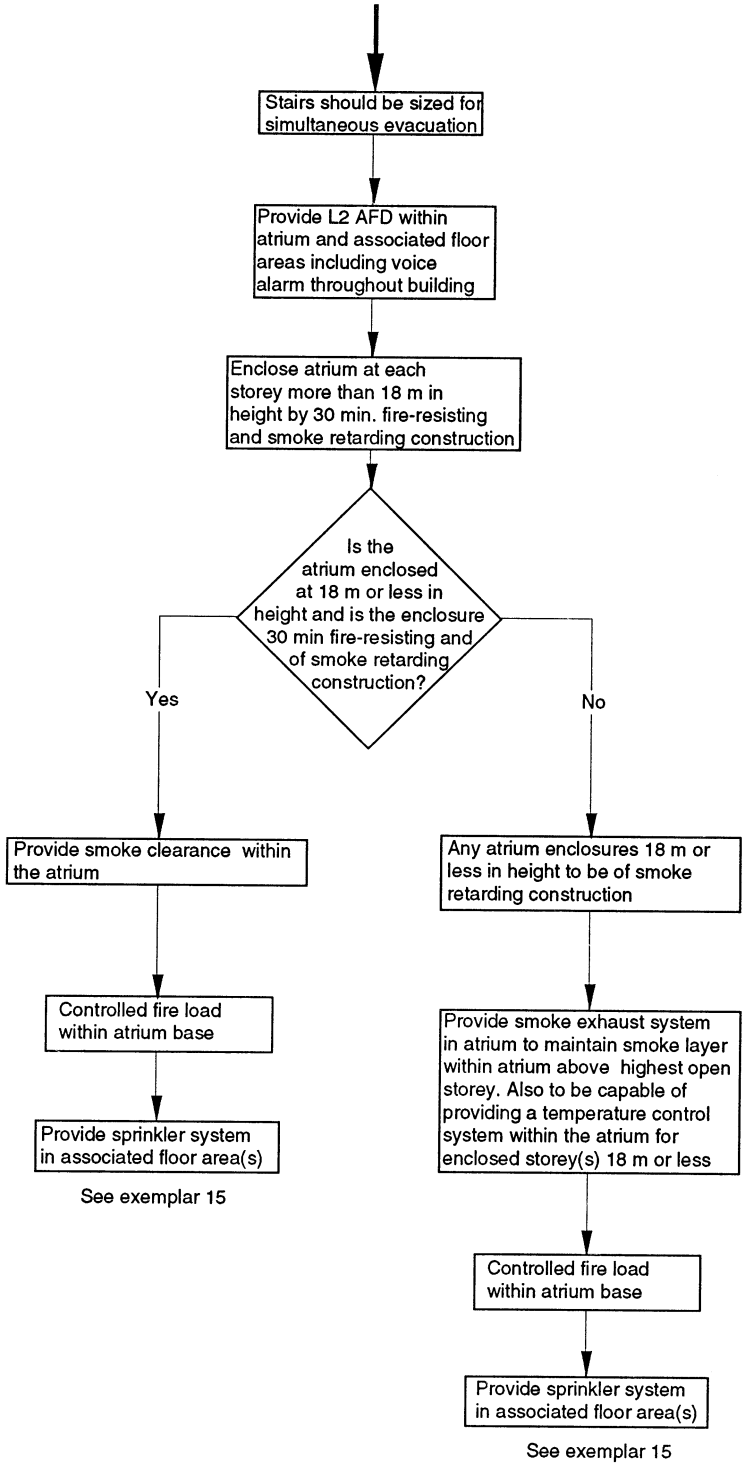

NOTE Alternatively all storeys within 30 m of the floor level of the highest storey abutting the atrium may be designed as if the atrium were 30 m high provided that:

a) storeys below are enclosed with 60 min fire resistance and are smoke retarding;

b) smoke exhaust is installed; and

c) the atrium base has no combustible content (see exemplar 17).

Figure 4f — Occupancy category B: occupants who are awake but may be unfamiliar with the building — Atrium more than 30 m in height, partly enclosed

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Table 2 — Occupancy category B: occupants who are awake but may be unfamiliar with the building

Evacuation strategy: simultaneous							
Height m	**Atrium/accommodation method of separation**	**Smoke control system**	**Accommodation sprinkler system**	**Fire alarm and warning system**	**Use of atrium base**	**Reference/notes**	**Exemplar**
≤ 18[a]	Open	Smoke exhaust	Yes	Provide L2 AFD[d] to atrium and associated areas, including voice alarm throughout	Controlled fire load		12
	Enclosed: smoke retarding	Temperature control	Yes	Provide L2 AFD[d] to atrium and associated areas, including voice alarm throughout	Controlled fire load		14
	Enclosed: fire resistance 30 m integrity and smoke retarding	Smoke clearance	No[b]	Provide L2 AFD[d] to atrium and associated areas, including voice alarm throughout	Controlled fire load		13
>18 ≤ 30[b]	All storeys above 18 m to be enclosed: 30 min fire resistance and smoke retarding	Appropriate for atrium/ accommodation enclosure for floors below 18 m	Yes	Provide L2 AFD[d] to atrium and associated areas, including voice alarm throughout	Controlled fire load		15
>30[c]	All storeys above 30 m to be enclosed: fire resistance 60 min integrity and smoke retarding	Appropriate for atrium/ accommodation enclosure for floors below 18 m	Yes	Provide L2 AFD[d] to atrium and associated areas, including voice alarm throughout	Controlled fire load		16
Unlimited	Open	Smoke exhaust per storey	Yes	Provide L2 AFD[d] to atrium and associated areas, including voice alarm throughout	No combustible content		11

[a] This table is not applicable for buildings of two storeys [see **1**e)].
[b] For storeys 18 m or less in height, the method of separation and appropriate smoke control should be as recommended above.
[c] For storeys less than 30 m in height, the method of separation and associated smoke control should be as recommended above, as appropriate.
[d] L2 AFD: Automatic fire detection system type L2 (see BS 5839-1).

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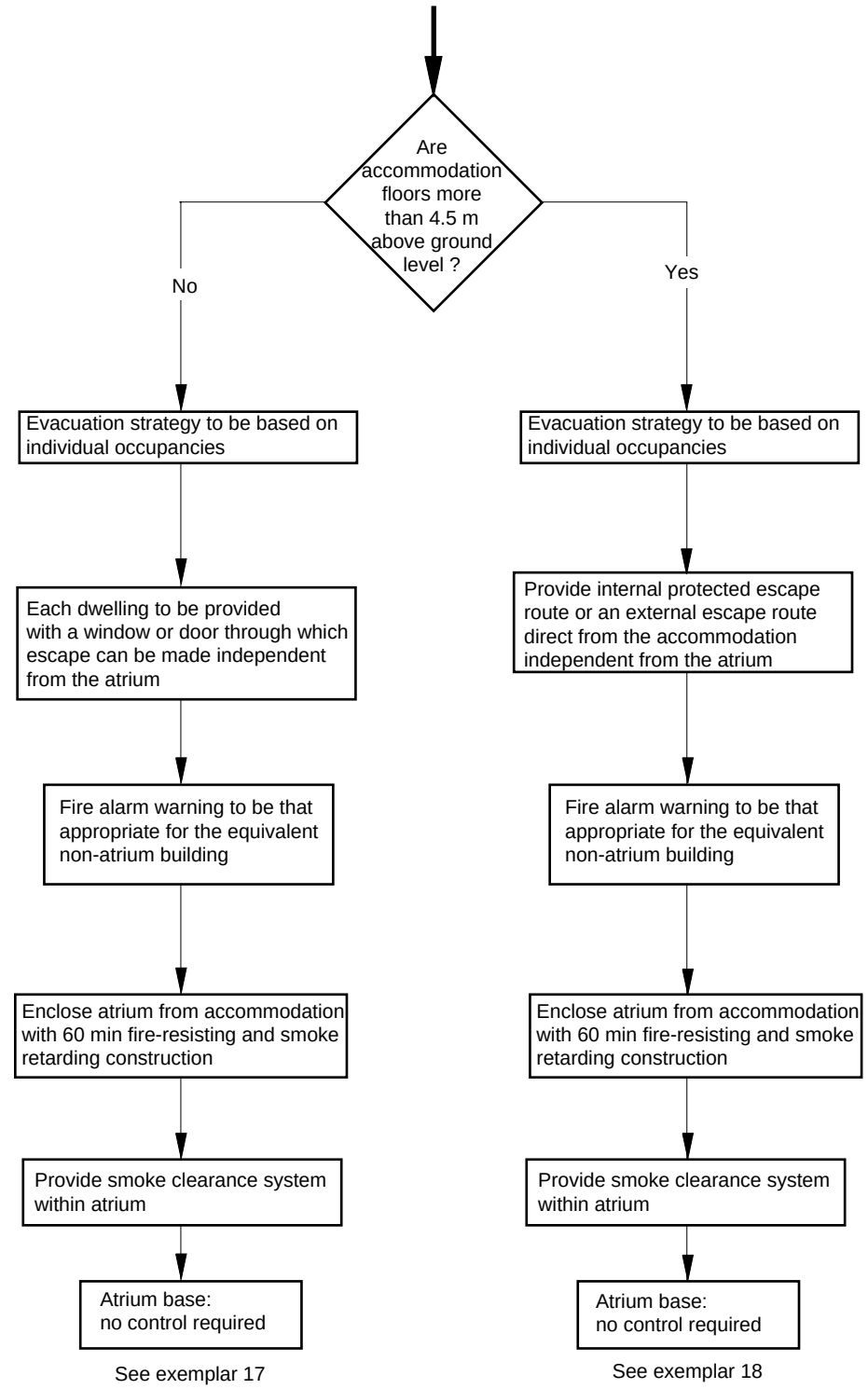

Figure 5a — Occupancy category C: occupants who are likely to be asleep — Category C1: long term occupancy, non-managed

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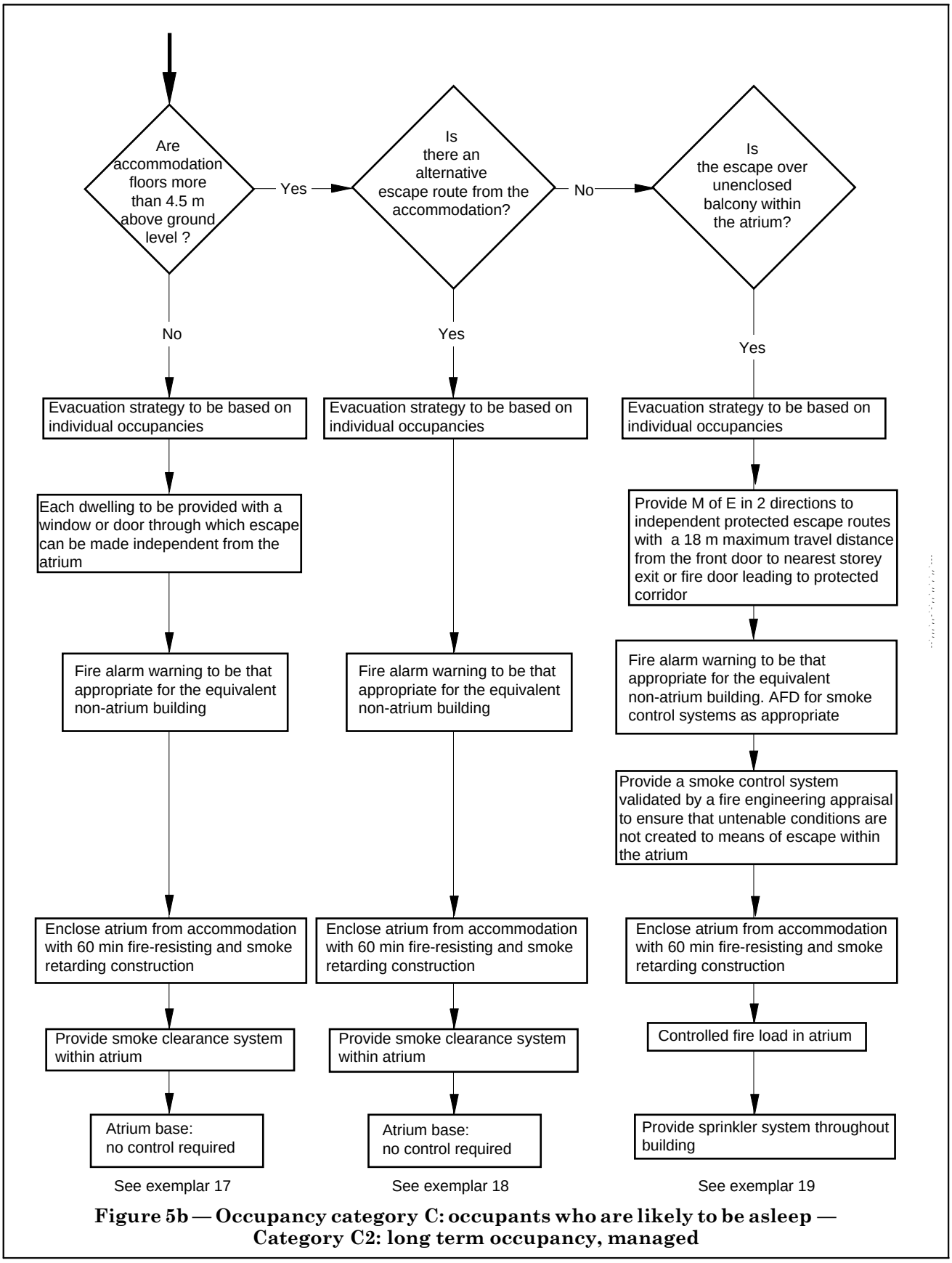

Figure 5b — Occupancy category C: occupants who are likely to be asleep — Category C2: long term occupancy, managed

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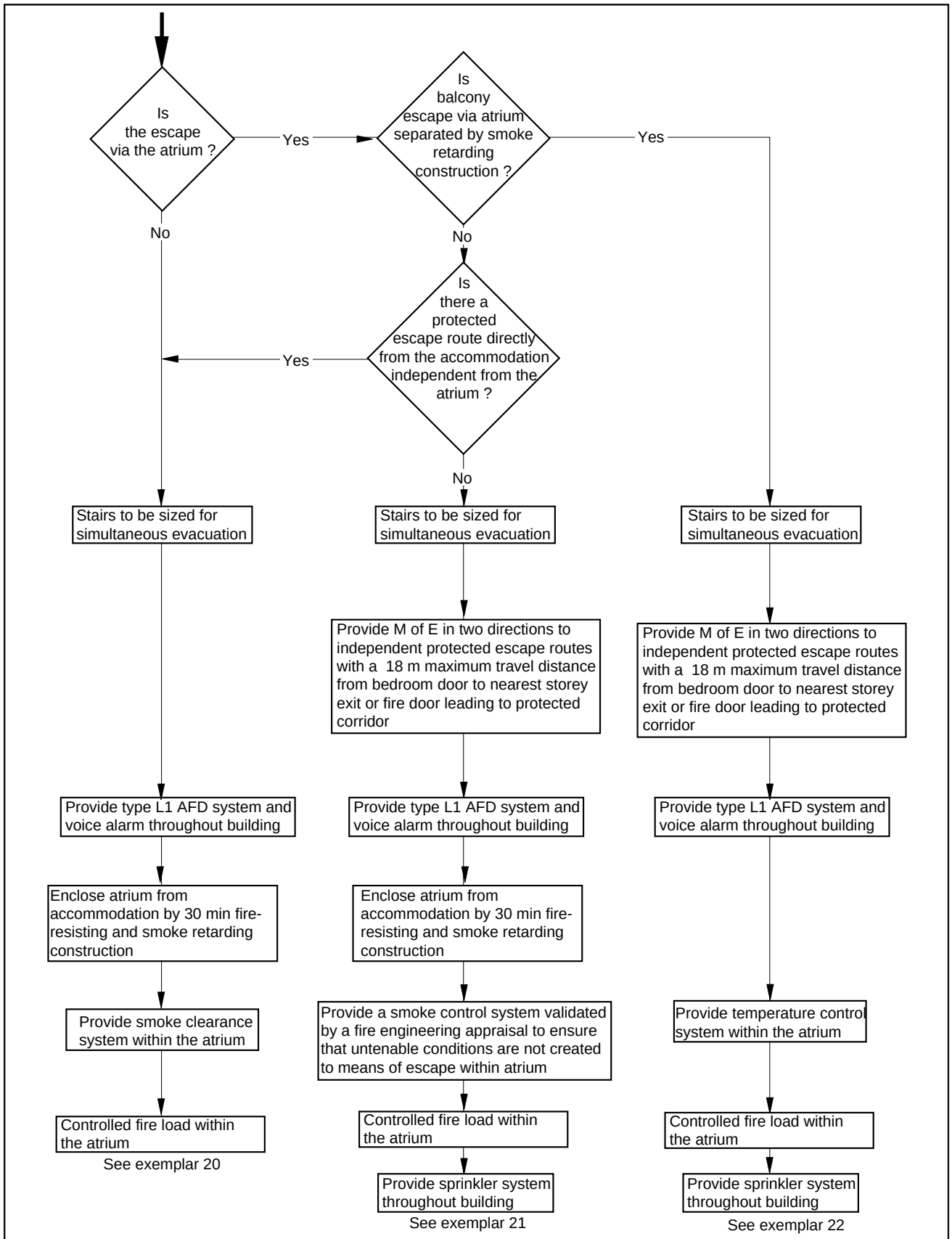

Figure 5c — Occupancy category C: occupants who are likely to be asleep — Category C3: short term occupancy

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Table 3 — Occupancy category C: occupants who are likely to be asleep

Occupancy category C.1: long term occupancy, non-managed		Evacuation strategy. Individual occupancy				
Atrium/accommodation method of separation	**Means of escape provision**	**Smoke control system**	**Associated areas sprinkler system**	**Fire alarm and warning system**	**Use of atrium base**	**Exemplar**
Enclosed: 60 min fire-resisting (integrity and insulation) and smoke retarding	Where accommodation storeys are not more than 4.5 m above ground level, each dwelling should have a window or door through which escape could be made independent from the atrium	Smoke clearance	No	Appropriate for the equivalent non-atrium building	No control required	17
	Where accommodation storeys are more than 4.5 m above ground level, each dwelling should be provided with an internal protected escape route or an external escape route direct from the accommodation	Smoke clearance	No	Appropriate for the equivalent non-atrium building	No control required	18
Occupancy category C.2: long term occupancy, managed		**Evacuation strategy. Individual occupancy**				
Enclosed: 60 min fire-resisting (integrity and insulation) and smoke retarding	Where accommodation floors are not more than 4.5 m above ground level, each dwelling should have a window or door through which escape could be made independent from the atrium	Smoke clearance	No	Appropriate for the equivalent non-atrium building	No control required	17
	Where accommodation storeys are more than 4.5 m above ground level, each dwelling should be provided with an internal protected escape route or an external escape route direct from the accommodation	Smoke clearance	No	Appropriate for the equivalent non-atrium building	No control required	18

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Table 3 — Occupancy category C: occupants who are likely to be asleep (*continued*)

Occupancy category C.2: long term occupancy, managed		Evacuation strategy. Individual occupancy				
Atrium/accommodation method of separation	**Means of escape provision**	**Smoke control system**	**Associated areas sprinkler system**	**Fire alarm and warning system**	**Use of atrium base**	**Exemplar**
Enclosed: 60 min fire-resisting (integrity and insulation) and smoke retardant construction	Where escape from the accommodation is to be via the atrium, means of escape in two directions to independent protected escape routes should be provided. There should be an 18 m maximum travel distance from front door to nearest storey exit or a fire door leading to a protected corridor	Smoke control system designed to ensure that untenable conditions are not created in means of escape in atrium (see **24.2**)	Yes	Appropriate for the equivalent non-atrium building. Automatic fire detection for atrium, smoke control as appropriate	Controlled fire load	19
Occupancy category C.3: short term		**Evacuation strategy. Simultaneous**				
Smoke retardant construction	Where escape from the accommodation is via a balcony, which is separated from the associated floor area by smoke retarding construction, means of escape in two directions to independent protected escape routes should be provided. There should be an 18 m maximum travel distance from bedroom door to nearest storey exit or a fire door leading to a protected corridor	Temperature control	Yes	Type L1 AFD system, and voice alarm throughout the building	Controlled fire load	22
30 min fire-resisting (integrity and insulation) and smoke retardant construction	A protected escape route directly from the accommodation independent from the atrium	Smoke clearance	No	Type L1 AFD system, and voice alarm throughout the building	Controlled fire load	20

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Table 3 — Occupancy category C: occupants who are likely to be asleep (*continued*)

Occupancy category C.3: short term		Evacuation strategy. Individual occupancy				
Atrium/accommodation method of separation	**Means of escape provision**	**Smoke control system**	**Associated areas sprinkler system**	**Fire alarm and warning system**	**Use of atrium base**	**Exemplar**
30 min fire-resisting (integrity and insulation) construction with:	Where escape from the accommodation is via a balcony, which is separated from the associated floor area by smoke retarding construction, means of escape in two directions to independent protected escape routes should be provided. There should be an 18 m maximum travel distance from bedroom door to nearest storey exit or a fire door leading to a protected corridor	Smoke control system designed to ensure that untenable conditions are not created in means of escape in atrium	Yes	Type L1 AFD system, and voice alarm throughout the building	Controlled fire load	21

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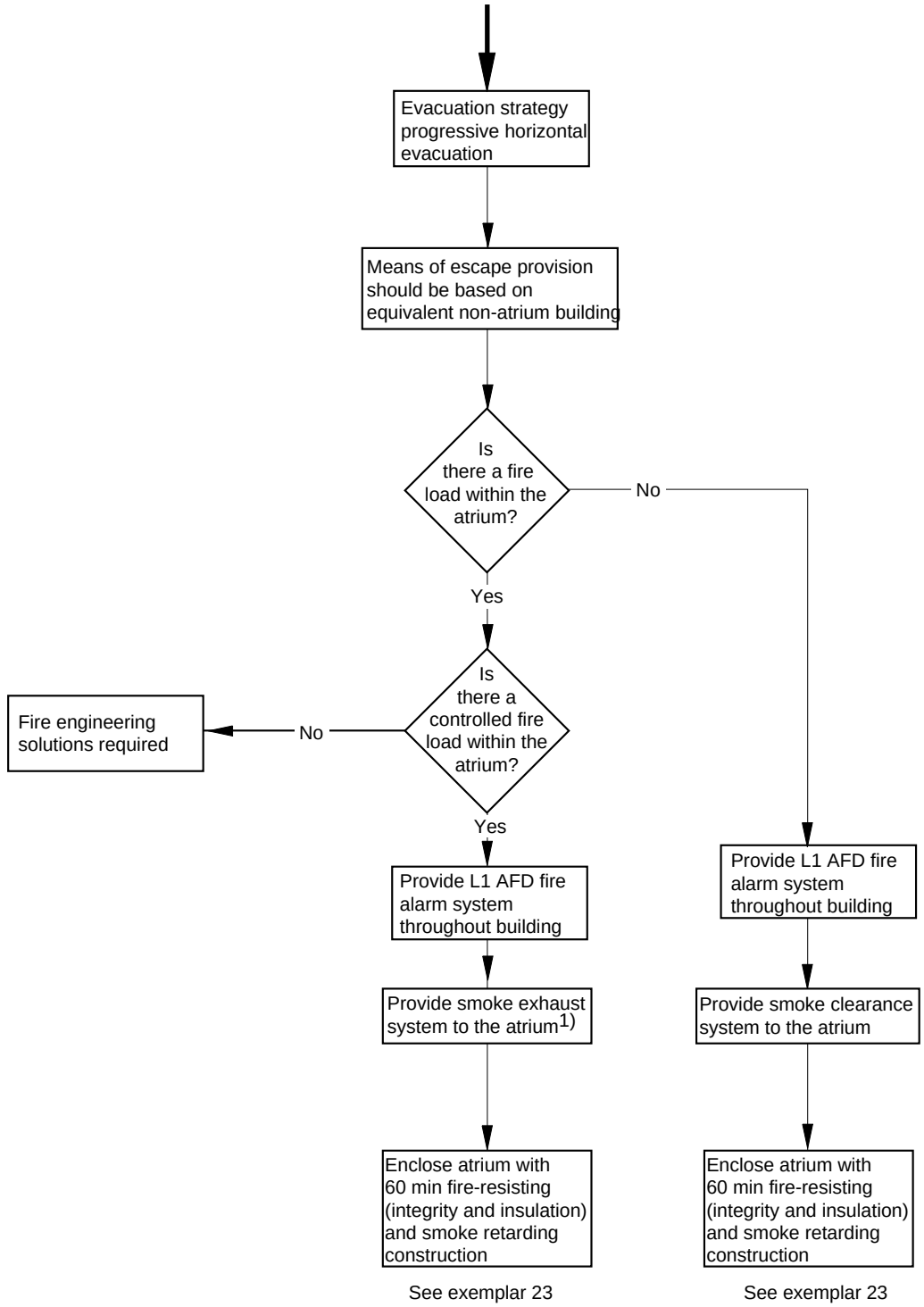

1) Occupants of category D premises are a particularly vulnerable section of society and in certain circumstances evacuation may cause them harm, or delayed recovery, or aggravate their medical condition. To ensure that smoke does not enter spaces adjoining the atrium, a smoke exhaust system is required to maintain a stable smoke layer 1 m above the uppermost opening into the atrium.

Figure 6 — Occupancy category D: occupants requiring medical or nursing care

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Table 4 — Occupancy category D: occupants requiring medical or nursing care

Evacuation strategy. Progressive horizontal evacuation							
Height m	**Atrium/accommodation method of separation**	**Smoke control system**	**Accommodation sprinkler system**	**Fire alarm and warning system**	**Use of Atrium base**	**Reference/notes**	**Exemplar**
Unlimited	Enclosed 60 min fire resistance (integrity and insulation) and smoke retarding	Smoke clearance	No	L1 Automatic fire detection in atrium and compartments adjoining the atrium	No combustible content	See Note 1	23
Unlimited	Enclosed 60 min fire resistance (integrity and insulation) and smoke retarding	Smoke exhaust system	No	L1 Automatic fire detection in atrium and compartments adjoining the atrium	Controlled fire load	See Notes 1, 2, 3	23

NOTE 1 The following facilities should not be provided in the atrium: sleeping accommodation, nursing or medical care, balcony seating areas.

NOTE 2 Occupants of category D premises are a particularly vulnerable section of society and in certain circumstances evacuation may cause them harm, or delayed recovery, or aggravate their medical condition. To ensure that smoke does not enter spaces adjoining the atrium, a smoke exhaust system is required to maintain a stable smoke layer 1 m above the uppermost opening into the atrium.

NOTE 3 In hospitals, where operating theatres, intensive therapy units and other areas providing similar levels of care, have openings onto the atrium, these openings should be provided with protected lobbies.

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Section 6. Recommendations

22 Recommendations for means of escape

22.1 Escape routes

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

The solutions are not exhaustive and other methods may exist by which an equivalent level of fire safety can be achieved. All designs based on calculations to the extent recommended in this code can be considered to be a form of fire safety engineering, and should be supported by documentation fully detailing the calculations and assumptions made, and the values of any input parameters.

In a building where the accommodation is separated from the atrium by smoke retarding construction, the means of escape from the accommodation should be in accordance with the recommendations of the codes for the equivalent non-atrium building.

In a building where the accommodation is open to the atrium or not enclosed by smoke retardant construction, the following recommendations are applicable:

a) storey exits should be sited away from the atrium so that escape routes do not approach the atrium edge;

b) maximum travel distances from the atrium, together with the associated areas, to the nearest storey exit should not exceed the distances appropriate to the equivalent non-atrium building;

c) in category A and category B buildings, escape should be away from the atrium void and the subsequent escape route should not pass within 4.5 m of the atrium void (see Figure 7).

The capacities of exits and means of escape should be in accordance with the recommendations of the appropriate codes for the equivalent non-atrium building.

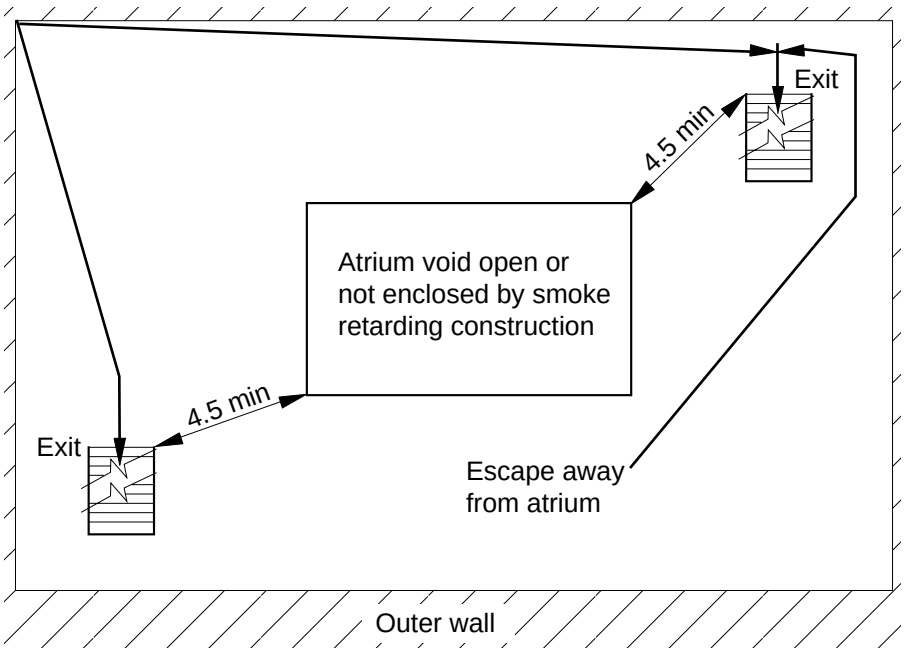

Figure 7 — Escape route on associated floor areas

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22.2 Balcony escape

NOTE Where a balcony or bridge is used as the alternative means of escape from accommodation see **11.3**.

Where the means of escape is via a balcony within the atrium (i.e. where no alternative route from the accommodation is available) the following recommendations are applicable:

a) the building should be equipped throughout with sprinklers (unless not required for the smoke control design);

b) escape within the atrium should be available in at least two directions with the travel distance within the atrium to the nearest storey exit not exceeding 18 m;

c) if the balcony is enclosed by smoke retarding but not fire-resisting construction, a temperature control system should be provided;

d) if the balcony is open, a smoke exhaust ventilation system should be provided, such that any smoke layer is confined to a level not less than 3 m above the top most balcony or bridge;

e) where the balcony is enclosed, fire-resisting and smoke retarding construction should be to the same specifications to that of the atria;

f) the atrium base should only contain a controlled fire load.

22.3 Evacuation procedures

22.3.1 *Simultaneous evacuation*

All storeys not separated from the atrium by smoke retarding construction need to be designed on the basis of the simultaneous evacuation of all levels.

Variations of the simultaneous evacuation of all levels are:

a) initially the floor on which a fire is suspected (e.g. due to the operation of a single detector) would be evacuated, possibly in conjunction with the floor above;

b) an investigation period would follow (typically 1 to 3 min);

c) if a fire is confirmed or the investigation period lapses without the alarm being cancelled the evacuation signal should be broadcast;

d) if, during the investigation period, a second detector or a break glass call point is operated, the evacuation signal should be broadcast immediately.

NOTE Fire alarms in most smaller atrium buildings are best operated in a "single stage" mode in which the actuation of a call point or detector gives an instantaneous warning from all fire alarm sounders for an immediate evacuation.

22.3.2 *Phased evacuation*

In compartmented buildings several storeys in height, it is possible in some occupancies to design escape stairs on the principle of phased evacuation. Such an approach provides for significant economies in the plan area occupied by protected stairways, but demands the provision and maintenance of a range of additional active and passive fire protection measures, together with supportive management arrangements.

22.3.3 *Evacuation phasing*

The most appropriate phasing of evacuation for any particular building should be determined on the basis of the mode of evacuation (phased, simultaneous or both), the nature of the occupants and the fire risk present (see Table 5). Details of the evacuation strategy and alarm system should be given in the fire safety manual (see BS 5588-12).

Table 5 — Recommended evacuation phasing

Fire in area subject to:	First phase	Second phase	Third phase
Phased evacuation	Fire storey and storey immediately above	Areas subject to simultaneous evacuation	Remaining storeys subject to phased evacuation[a]
Simultaneous evacuation	All storeys subject to simultaneous evacuation	Areas subject to phased evacuation[a]	—

[a] The phase may include a number of sub-phases for the evacuation of two storeys at a time.

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22.4 Fire control centres

22.4.1 *General*

Buildings that are designed for phased evacuation should be provided with a fire control centre, containing controls for the operation of all fire safety equipment. The fire control room should be separated from the atrium, any associated floor areas, and any ancillary accommodation by construction capable of satisfying, for a period of not less than 60 min, the integrity, insulation and, where appropriate, loadbearing criteria of BS 476 Parts 20, 21 and 22.

The fire control centre should be either:

a) a room dedicated solely as a fire control centre; or

b) combined with the management central control room (if provided).

NOTE 1 The console layout within a combined fire control centre/central control room should clearly differentiate between the fire and security systems.

NOTE 2 Although it is not a recommendation of this code that a fire control room is provided in all atrium buildings, because the need for such a facility will be determined generally by the complexity of the building and its associated building management systems, most atrium buildings are likely to contain some fire safety systems that might not be needed in an equivalent non-atrium building. Consequently, the provision of a fire control room should be considered.

22.4.2 *Control systems and facilities*

The fire control centre should contain the following:

a) indicator panels showing the status of all automatic fire protection installations and facilities;

b) manual override switches associated with all automatic fire protection installations and facilities (other than those which are required to be located either adjacent to their equipment or elsewhere, e.g. overrides for gaseous fire extinguishing systems or sprinkler system main or floor isolating valves);

c) manual overrides for air conditioning systems or ventilation systems involving recirculation;

d) a fire telephone providing a direct link between the control room and all firefighting lobbies and fire service access point(s);

e) an exchange telephone with direct dialling for external calls;

f) a voice alarm system;

g) if provided for the control of evacuation, controls and monitor screens for closed circuit television (CCTV);

h) the telephone numbers of principal staff/building engineers.

The control room should also contain the following facilities if the building is designed for phased evacuation:

1) a facility to sound the evacuation signal in each evacuation zone by individual switches, or throughout the building by means of a single switch;

2) a facility to sound the alert signal throughout the building;

3) a clock to time phases of evacuation;

4) a visual indication of status of storeys, i.e. those storeys in which an evacuation signal has been given; and

5) a facility to cancel any automatic sequencing of phases, but not the initial phase (i.e. evacuation of the fire storey and storey above);

6) a wall mounted writing board with suitable writing implements for displaying important and relevant "notes".

NOTE In large complex buildings consideration should be given to equipping the control room operators with closed circuit television for the surveillance of floor areas, and means to introduce live voice messages to over-ride the alert signal so that messages may be directive.

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23 Recommendations for separation between the atrium and the associated floor area

23.1 Fire-resisting construction

Where this code recommends that the accommodation should be separated from the atrium by a fire-resisting construction, this should be taken (in the absence of any recommendation to the contrary) that either side of the construction should be capable of satisfying the integrity criterion specified in BS 476-22 for a period of not less than 30 min or as otherwise specified.

Satisfactory performance of fire resistance of elements of construction is ascertained by conformity to one of the following.

a) Specifications tested or assessed by a competent body, in accordance with the appropriate part of BS 476.

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

b) Conformity to British Standard design codes, e.g. BS 5268-4, BS 5950-8, etc.

c) Specifications permitted under the relevant building legislation.

23.2 Glazing

Where this code recommends that the accommodation should be separated from the atrium, glazing provided as part of the atrium structure should conform to the following.

a) In the event of the glazing failing, it should fail safely and not have an adverse effect on people using escape routes (e.g. falling glass).

b) Glazing used to separate an atrium from the associated floor area or to provide a roof for the atrium should conform to the following.

1) When glazing separating an atrium from the associated floor area is used in conjunction with a temperature control system which limits the temperature of the hot gases, the temperature requirements detailed below apply and ensure the stability of the glazing.

2) When a smoke retarding construction is used in the absence of any temperature control of the hot gases, the glazing should be either:

i) part of a system that is capable of achieving 30 min integrity; or

ii) toughened glass to BS 6206 Class A; or

NOTE 1 The performance of toughened glass is dependent on the rate of temperature rise and the method of glazing. When used in a smoke retarding construction, the performance of the glass and glazing system should be assessed against the predicted time/temperature of the smoke layer.

iii) laminated glass with a polyvinyl butyral (pvb) interlayer, provided that fire engineering studies indicate that the hot gases will not exceed 400 °C temperature.

NOTE 2 If a laminated glass is required for other reasons and the hot gases may exceed 400 °C, the glass used in the laminate construction should be toughened glass in accordance with BS 6206 Class A.

3) Atrium roof. Where the escape of people could be threatened by falling glass caused by hot gases getting into a smoke reservoir, any glazing directly above an escape route should be either:

i) a laminated, toughened or wired glass system that is capable of achieving 30 min integrity when tested horizontally; or

ii) toughened glass in accordance with BS 6206 Class A; or

iii) integral wired glass; or

iv) laminated glass with a pvb interlayer, provided that fire engineering studies indicate that the hot gases will not exceed a temperature of 400 °C.

NOTE 3 If a laminated glass is required for other reasons and the hot gases may exceed 400 °C, then the glass used in the laminate construction should be toughened glass in accordance with BS 6206 Class A.

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24 Recommendations for smoke and heat control systems

24.1 General

In the fire safety design of atrium buildings, smoke control can be utilized to satisfy one or more of the following objectives:

a) to maintain tenable conditions on escape routes within the space in which the fire originates (smoke ventilation system);

b) to reduce fire gas temperatures in the smoke layer formed within the atrium to permit the use of materials in the atrium facade which are not fire-resisting (temperature control system);

c) to limit the spread of smoke between spaces that would otherwise occur as a result of leakage paths in a construction that is not wholly imperforate (pressure differential system);

d) to assist firefighters in removing smoke from the building in the aftermath of a fire (smoke clearance system).

24.2 Calculation procedures

Guidance on calculation procedures for the design of smoke and heat control systems can be found in a number of documents, for example, *Design approaches for smoke control in atrium buildings*, Building Research Establishment Report 258, 1994 [4]; and in CIBSE Guide E *Fire engineering* [5].

It is important that designers establish that the calculation procedures used are relevant to the circumstances within which they are intended to be used. The procedures and calculations should be clearly identified in any submission for regulatory approval.

24.3 Design fire

The first step in the design of a smoke control system is the design fire size. Fires are essentially unsteady state events in that they grow from the time of ignition to a maximum size and then decay as a result of extinguishing activities or the limited quantity of combustible materials available. However, for the purposes of design, the problem may be simplified by defining a steady state fire of constant heat release. The steady state fire is assumed to be a maximum limited by fire protection measures such as compartmentation or sprinklers. Guidance on appropriate design fires can be found in a number of publications (see **24.2**).

24.4 Smoke exhaust ventilation systems

24.4.1 A smoke exhaust ventilation system should:

a) maintain a clean layer of not less than 3 m above the topmost open occupied storey, or 2.5 m above the floor of fire origin; and

b) ensure that the smoke layer temperature does not exceed 200 °C;

c) ensure that, where the smoke layer descends below closed storeys, smoke cannot leak into these floors; and, where applicable, ensure by dilution, that the optical density per metre will not exceed 0.1 at all points on the topmost storey open to the atrium. This measure is intended to ensure that visibility on the open storeys does not reduce below 8 m to 10 m, which is deemed adequate for safe use of the escape routes.

24.4.2 Natural and mechanical ventilation will both achieve the desired formation of a stable smoke layer, providing that the average design smoke layer temperature is greater than 20 °C above ambient. If the temperature differential is lower, both systems can tend to create a dilution process instead, and the layer may become inherently unstable.

24.4.3 A smoke control system operating on natural ventilation principles should be designed to remove the required volume of smoke, taking due account of mixing effects, when relying solely on the thermal stack effect created by the buoyancy of the smoke and on the areas of openings provided at high and low levels.

24.4.4 Smoke control systems operating on mechanical ventilation principles should be designed to remove the required volume of smoke, taking due account of mixing effects, when relying solely on the negative pressures created by exhaust fans to extract smoke at high level and to draw in fresh air at low level.

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24.4.5 The design of mixed (i.e. powered and natural ventilation) systems should be such as to ensure complementary operation of each element and to prevent both systems operating simultaneously in the same smoke reservoir.

24.5 Temperature control systems

The designer of the smoke control system should identify the materials on the atrium facade having the lowest critical temperature for failure, and which, upon failure, would allow the integrity of the atrium facade to be breached. The guidance given in **23.2** on the behaviour of different types of glasses should be followed.

Using the design fire appropriate to the atrium (see **24.2**), identify the temperature with the heat flux entering the atrium's buoyant smoke layer to calculate the mass flow rate of smoky gases entering that layer. From this, calculate the height of layer base allowing this mass rate of air to be entrained into the combustion gases using the appropriate criteria given in **24.4**. The exhaust and inlet can be calculated using the same methods as in **24.4**.

NOTE It is possible, by careful design, to combine a temperature control system of this type with a smoke exhaust ventilation system meeting the recommendations of **24.4** (for example, so that storeys below the design layer base can be open to the atrium).

24.6 Pressure differential system

There are three different options for designing pressure differential systems. These are:

a) atrium pressurization;

b) atrium depressurization;

c) pressurization of associated floor areas.

The following recommendations apply to one or more of the options. Following each recommendation, the option(s) to which it applies is identified.

1) The building should be protected with a sprinkler system designed and installed in accordance with the life safety provisions of BS 5306-2, except where the atrium is less than 30 m high and the atrium is separated from the associated areas by fire-resisting construction and there is a pressure differential system protecting the associated areas from smoke in the atrium and the fire safety engineering design solutions do not require the presence of sprinklers.

This recommendation applies to atrium pressurization, atrium depressurization and pressurization of associated floor areas.

2) The maximum force required to open any door within the escape route should in no circumstances exceed 100 N, applied at the door handle.

This recommendation applies to atrium pressurization, atrium depressurization and pressurization of associated floor areas.

3) Where the atrium may contain smoke, and it is desired to pressurize adjacent accommodation storeys and/or stairwells and/or shafts, the height of the neutral pressure plane in the atrium should be assessed by calculation, allowing for normal building leakage.

This recommendation applies to atrium pressurization and pressurization of associated floor areas.

4) The minimum design pressure difference across a closed door (or other leakage path) between an atrium and an adjacent pressurized space should be 50 Pa for heights up to 10 m above the neutral pressure plane, and 75 Pa for heights between 10 m and 25 m above the neutral pressure plane.

5) Any part of the enclosure separating the atrium from the associated storey areas, which is more than 25 m above the calculated neutral pressure plane, should be of smoke retarding construction as well as having a fire resistance of not less than 30 min, irrespective of any other requirements.

The two recommendations 4) and 5) apply to pressurization of associated floor areas.

6) Where there is no combustible content in the atrium and the adjacent spaces are separated from the atrium by a fire-resisting construction, smoke ingress into the atrium may be prevented by pressurizing the atrium on the same basis as if it were a pressurized stairwell, in accordance with the relevant sections in BS 5588-4.

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This recommendation applies to atrium pressurization.

7) Where smoke exhaust is used to reduce the pressure in an atrium containing thermally-buoyant smoky gases, the design objective should be to raise the neutral pressure plane above the highest vulnerable leakage path, allowing for external wind pressures explicitly in the design calculation.

This recommendation applies to atrium pressurization.

24.7 Smoke clearance

As the provision of smoke clearance systems is primarily for the benefit of the fire service, appropriate recommendations are given in Clause **29**.

24.8 Make-up air supply

For smoke control, ventilation and smoke clearance systems, make-up air is essential.The following conditions should apply.

a) It is essential that there should be sufficient provision of make-up air, with a velocity into the atria base not exceeding 2 ms^{-1} for the proper functioning of any smoke ventilation, temperature control or smoke clearance system specified for the atrium.

b) If not permanently open, all inlets should open simultaneously on activation of the smoke ventilation system that they serve.

c) Powered inlets should only be used with powered exhaust fans where the objective is to design a smoke clearance system in accordance with **29.2**.

d) The maximum velocity of air passing through an escape route should be 5 ms^{-1} and the smoke control system should be designed to avoid excessive pressures opposing the opening of escape doors located in the air flow [see **24.6**2)].

e) The inlets for replacement air should be located at a low level in the atrium, or alternatively at high or low level in other smoke control zones unaffected by the fire and communicating with the affected smoke control zone only at low level.

24.9 Smoke control equipment

24.9.1 *Activation of smoke control systems*

a) With the exception of smoke clearance systems, any smoke control systems recommended in this code should be activated by an automatic smoke detection system designed and installed in accordance with BS 5839-1.

b) All systems should be capable of manual override by fire service personnel, subject to the provisions of **29.2**.

c) Smoke clearance systems as detailed in **29.2** need only be provided with a manual switch limited to the use of security and fire service personnel.

NOTE For ventilation controls for the fire service, see **29.2**.

24.9.2 *HVAC ductwork*

HVAC ductwork used in conjunction with smoke and heat control systems inlet air and exhaust air should:

a) be adequately protected against fire penetration and should be installed in accordance with the relevant recommendations of BS 5588-9;

b) not be fitted with fusible link type fire dampers;

c) be adequately constructed and 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; and

d) be designed to ensure that all materials associated with the system will continue to operate when any part is exposed to fire.

Unless the design of the smoke/heat control system specifically does not allow the possibility, fire/smoke dampers that are operated by smoke detectors associated with the HVAC system(s) should all fail-safe to the correct position for the system(s) to work satisfactorily in the smoke exhaust ventilation mode.

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24.9.3 *Equipment for smoke/heat ventilation systems*

The specification for smoke/heat ventilation systems should include the following provisions.

a) Components of powered ventilation systems should have a minimum temperature classification, relating to the calculated temperatures produced, to conform to the appropriate class in accordance with BS 7346-2.

b) Natural smoke and heat exhaust ventilators should conform to BS 7346-1.

c) The specification for any smoke curtains should conform to BS 7346-3.

d) Each atrium smoke control system should be provided with sufficient fans or ventilators to enable the smoke and heat to be exhausted in such a way as to maintain the base of the smoke layer at or above its design height, and/or the temperature of the smoke layer equal to or below the design temperature depending upon the design objective.

e) At least two ventilators should be provided to each atrium smoke reservoir. The aggregate capacity of the ventilators serving each atrium smoke control zone should be such that recommendation d) will be met when the largest powered ventilator in each atrium smoke zone is disconnected.

NOTE 1 This recommendation may be met by either:

1) providing additional powered exhaust ventilators; or

2) providing ventilators with excess capacity.

f) When calculating the number of exhaust openings for a sprinklered building provided with a natural smoke exhaust ventilation system, one exhaust vent needs to be discounted on the assumption that it would be too close to the sprinklers that were operating.

NOTE 2 Exhaust openings could be either fans, natural ventilators, or duct inlets leading to fans or natural ventilators.

g) The stand-by fans and ventilators to meet recommendations should be automatically activated in the event of failure of a fan.

NOTE 3 Detection of fault of a fan may be achieved by either:

1) monitoring the fan power circuit; or

2) monitoring the air flow produced by the fans.

h) Where natural ventilators are powered open by an energy source external to the ventilator (e.g. electricity or pneumatic pressure) there should either be stand-by provision for the maintenance of that energy source in the event of a failure of the primary supply, or the ventilators should open automatically when the primary supply fails.

25 Recommendations for sprinkler systems

25.1 Sprinklers

NOTE Whilst the recommendations of this code are made on life safety grounds, local legislation or the insurers of the building may require sprinkler protection in other circumstances.

When recommended by this code the sprinkler system should be designed and installed in accordance with the appropriate hazard class, and should, in addition, meet the life safety recommendations of BS 5306-2.

The system should be correctly maintained, ensuring that any changes to occupancy, goods stored, building interior designs and extensions, etc. are appropriately protected.

25.2 Sprinkler protection to atrium base

Where this code recommends sprinkler protection to the atrium base, the objective is to limit the heat output of the fire to 2.5 MW convective heat flux. This may generally be achieved by restricting the maximum height at which heads are located to:

a) quick response sprinklers 10 m;

b) standard response sprinklers 7.5 m.

NOTE These height limits apply to heads with an operating temperature of 68 °C. If higher temperature heads are utilized, the maximum acceptable height will be reduced. The response of other types of high level sprinkler may be assessed using appropriate calculation techniques.

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26 Recommendations for fire alarm and warning systems

26.1 Fire warning systems

26.1.1 *General*

In all atrium buildings where significant numbers of the public are likely to be present or where phased evacuation is adopted, the provision of a voice alarm system is recommended (except in premises providing medical or nursing care). If phased evacuation is utilized it is necessary to be able to provide clear instructions to the occupants so that the evacuation can be managed in an orderly manner.

26.1.2 *Single stage alarms*

Fire alarms in most smaller atrium buildings are best operated in a "single stage" mode in which the actuation of a call point or detector gives an instantaneous warning from all fire alarm sounders for an immediate evacuation.

26.1.3 *Voice alarm*

A voice alarm system should:

a) on the initiation of a fire alarm, automatically discontinue the operation of any other public address messages, music, information, etc. within the building;

b) be installed with a wiring system capable of functioning under fire conditions for a minimum period of 30 min (this time may need to be extended, depending upon the projected total evacuation time for the building);

c) be audible throughout and be capable of communicating with all parts of the building simultaneously or with individual areas such as storeys, so arranged that the loss of any speaker or speakers on any storey does not prevent communication with other storeys or areas.

NOTE The public address system may also be utilized as the method of sounding/giving an audible fire alarm. Where used for both fire alarm and public address, the system should be capable of providing both evacuation/alert signals and messages.

26.2 Automatic fire detection

The following recommendations are applicable.

a) The associated floor areas of an atrium should be provided with an L2 fire alarm system in accordance with BS 5839-1, except where that standard would require a type L1 system for the occupancy concerned.

b) Areas separated from the atrium by means of fire-resisting and smoke retarding construction should be provided with a system of detection and/or manual call points appropriate to the equivalent non-atrium building.

c) The system should be zoned to arrange for fire warning signals (including, if necessary, different kinds of signal) to be given on selected storeys or areas of the building, depending on the location of the activated detector or manual call point.

d) In spaces where smoke control arrangements are used, the fire alarm system should be zoned in accordance with the smoke control zoning arrangements.

e) Where automatic fire control systems are designed to be actuated by automatic fire detectors, the systems will be inter-linked and therefore should be commissioned and tested together.

f) The installation, servicing, testing and maintenance of all automatic fire detection equipment in atrium buildings should conform to the relevant recommendations of BS 5839-1.

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27 Recommendations for controlling fire load on the atrium base

Where it is a recommendation of this code that the fire load within the atrium should be controlled, the following provisions apply.

a) If the total weight of combustibles on the atrium base exceeds 160 kg, the materials should be confined to isolated islands.

b) Each island should:

1) contain a maximum of 160 kg of combustible material;

2) cover a maximum floor area of 10 m^2;

3) be separated from other areas of combustible materials by at least 4 m (except where those areas are protected by a sprinkler system).

c) All wall and ceiling linings should have at least a class 1 surface spread of flame when tested in accordance with BS 476-7.

d) When tested in accordance with BS 5852, all upholstered furniture should resist ignition by the smouldering source (ignition source 0) and the flaming source (ignition source 5).

NOTE 1 Attention is drawn to the provisions of the Upholstered Furniture (Fire Safety) Regulations in respect of filling materials.

e) All textiles (drapes and curtains) should meet the requirements of BS 5867-2.

NOTE 2 For further guidance see BS 5852:1990, BS 7176:1991, BS EN 1021-1:1994 and BS EN 1021-2:1994.

28 Recommendations for all designs

28.1 Ancillary accommodation

Ancillary accommodation should be separated from the atrium and any associated floor area by a fire-resisting construction to a standard appropriate to that of the equivalent non-atrium building.

28.2 Restricting the spread of fire to adjacent sites

If the atrium building is sprinklered, the area of fire involvement will be reduced to such an extent that the potential for fire spread to adjacent buildings can be regarded as being comparable to that of an equivalent non-atrium building that is compartmented at each level and protected by a sprinkler system.

In an unsprinklered atrium building, space separation needs to be calculated on the basis that all storeys not separated from the atrium by fire-resisting construction (capable of satisfying the integrity criteria of BS 476-22 for at least 30 min) may be involved in the fire (see Figure 8).

NOTE If more than one storey is likely to be involved in a fire, a larger radiating area may be expected and hence a greater separation distance (or reduction in unprotected areas) is normally needed.

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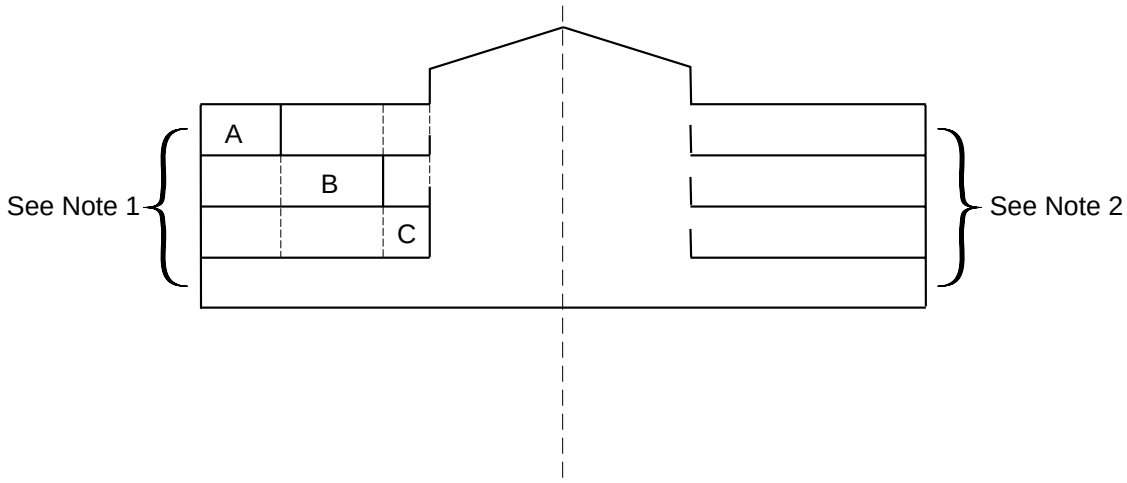

NOTE 1 External firespread may be evaluated on the basis of a single storey if, on each storey, there is a fire-resisting partition at A or B or C.

NOTE 2 External fire spread should be evaluated on the basis of all four storeys.

Figure 8 — Location of fire-resisting barriers to limit fire spread between buildings

28.3 Electrical services

28.3.1 *General*

All electrical services should be installed, and periodically inspected and tested (with any necessary maintenance carried out), by suitably qualified engineers in accordance with BS 7671:1992 (IEE Wiring Regulations).

28.3.2 *Electrical power supply*

The electrical power supply to life safety and fire protection equipment should be separate from all other circuits in the building so that the failure of other equipment does not render the installation inoperative.

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.

The supply to these isolating protective devices should be independent of the main switch for the building and be appropriately labelled in accordance with the principles detailed in **16.2** of BS 5839-1:1988.

Monitoring facilities should be provided at the central control room (where provided) to show, as far as is reasonably practical, that power is available up to the final control point, e.g. motor contactor, to all fire safety systems.

28.3.3 *Protected circuits for the operation of equipment in the event of fire*

The wiring system should either:

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

b) be protected against exposure to the fire by separation from any significant fire risk by a wall, partition or floor having at least 60 min fire resistance in terms of integrity and insulation from the side of the construction remote from the cable.

NOTE 1 The mechanical protection of cables by conduit, ducting or trunking should not be considered to give protection against fire.

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The wiring systems should be separate from any circuit provided for any other purpose, be adequately protected from any mechanical damage, and be such that they cannot be affected by fire at any position where cable connections are made.

NOTE 2 To achieve greater integrity of the system, separate or independent sources of electrical supply are necessary (see **28.3.4**).

28.3.4 *Primary and secondary power supplies*

The fire procedures of the building should not include the isolation of circuits supplying power to the life safety and fire protection equipment.

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 three hours any powered smoke control systems (including systems using pressure differentials) and any other fire protection or firefighting equipment.

The secondary power supply should be capable of providing the power supply for these functions 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 three hours without replenishment of fuel.

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.

Cables supplying current to the life safety and fire protection installations should be installed in accordance with BS 7671:1992 (IEE Wiring Regulations) and the manufacturer's instructions. The cables should have an inherently high resistance to fire and be protected where necessary against mechanical damage. Cables, switchgear and other equipment transmitting the secondary power supply should be separate from those of the primary supply, or be physically protected so that a breakdown, or any cause of breakdown, on one supply would not lead to a simultaneous failure of the other supply.

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 the primary to the secondary power supply if the primary supply to the particular plant fails.

Any electrical substation or enclosures containing any distribution board, generator, powered smoke control plant, pressurization plant, communication equipment and 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 two hours.

Secondary power supplies should be provided to all the smoke control systems.

29 Facilities for firefighting

29.1 General

The following recommendations are made to assist the fire service during firefighting (see Clause **20**).

29.2 Smoke clearance

29.2.1 *Atria not exceeding 18 m in height*

Natural exhaust vents should be provided in the atrium roof. The total area of vents should not be less than 10 % of the maximum plan area of the atrium.

29.2.2 *Atria of any height*

A mechanical smoke ventilation system should be provided within the atrium to provide replacement air changes every hour based upon the total volume of the atrium, including the largest floor open to the atrium with an inlet at low level, as follows:

a) four air changes per hour in sprinklered buildings where the atrium base has a controlled fire load (see Clause **27**);

b) six air changes per hour in unsprinklered buildings.

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29.3 Ventilation controls for the fire service

To ensure the effective use of ventilation systems or override controls provided for fire service use, it is essential that the provision, location and the mode of operation of such facilities are discussed and agreed with the fire service, the designer of the systems, the user of the premises and the building control authority before any decision to provide override facilities for either fire safety or normal air handling systems.

The location of the controls and their functions should be clearly marked in accordance with Table 6, and the signage should be in accordance with BS 5499-1

Table 6 — Location and signing of ventilation controls for fire service use

Ventilation system	Location of control panel	Facilities and marking
Atrium ventilation (temperature control system)	Fire control centre or adjacent to fire alarm panel if fire control centre is not required	"FIRE SERVICE VENTILATION CONTROL" "Atrium Emergency Ventilation Control" "Automatic" "Off" "Extract only"
Smoke exhaust ventilation system	Fire control centre	"FIRE SERVICE VENTILATION CONTROL" "Automatic" "Off" "Extract only"
HVAC incorporating smoke exhaust ventilation system	Adjacent to fire alarm panel	"FIRE SERVICE VENTILATION CONTROL" "Automatic" "Off" "Extract only"

Where the systems are relatively simple and the areas covered by these systems can be readily seen, manual control can be exercised to make the best use of the systems according to the extent of the fire and amount of smoke present. This enables the fire service to better deploy their resources to suppress the fire, minimize smoke damage and finally remove residual smoke when the fire is suppressed.

Firefighting controls should be provided to enable:

a) normal ventilation systems to be switched off or to be operated only on full exhaust to outside the building with the dampers in recirculation air ducts closed;

b) powered smoke exhaust ventilation systems to be operated fully on or to be switched off;

c) natural smoke ventilators to operate fully to open position.

NOTE 1 The provisions of indicator lamps at the controls' positions showing clearly the mode of operation of the controls is useful.

A warning sound and visual indicator should be given at the control position when the firefighting control of any smoke control system is in the isolated condition.

NOTE 2 The warning indicator should be maintained until the systems are restored and fully functionable.

The controls should be accessible without the use of a key but protected to prevent operation by unauthorized persons, e.g. located in an enclosure with a front made of transparent frangible material. The purpose and operating positions of the control(s) should be clearly indicated with permanent marking or labels.

Where the arrangement of the ventilation system is not immediately apparent, a suitable schematic diagram should be provided at the control's position, indicating the locations of all the ventilation fans/ventilators controlled by the firefighting controls.

Any arrangement for the interconnection of the ventilation controls with a central processing system should be such that any fault developing on the system or any change from its normal operation (including when it is being maintained) will not jeopardize the operation of the firefighting controls.

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Section 7. Management

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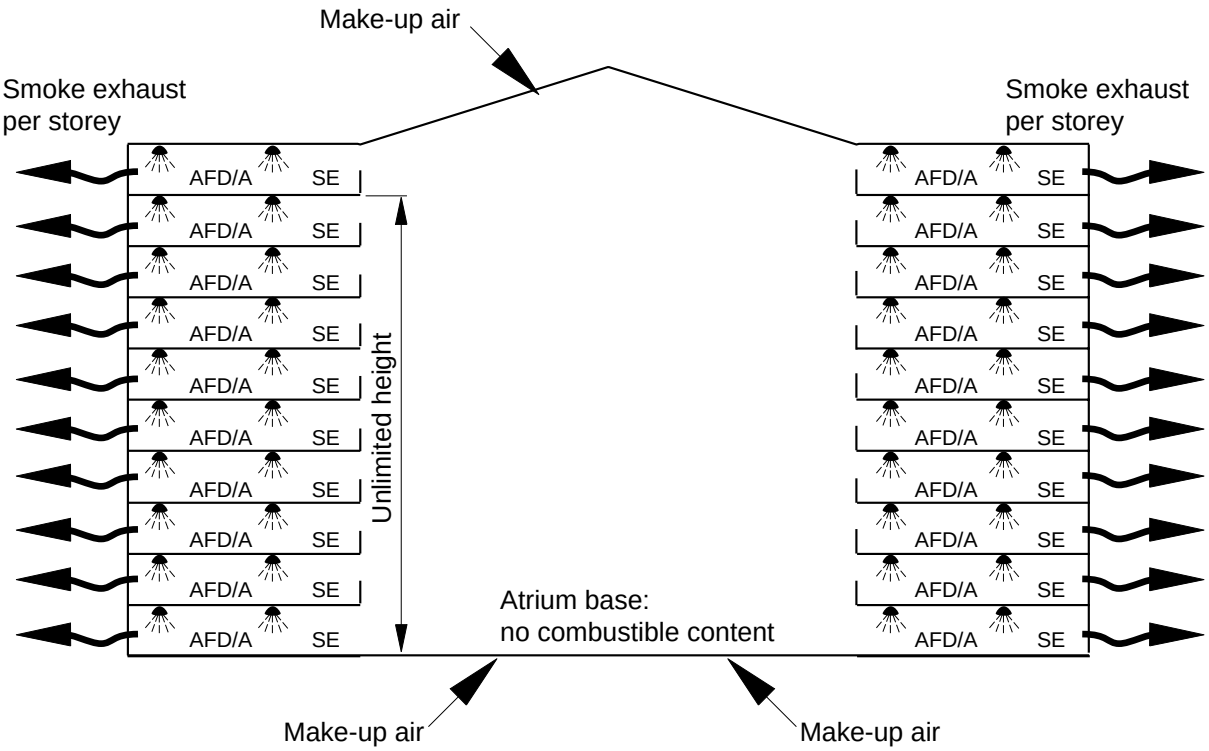
Annex A
Exemplars



AFD/A denotes L2 automatic fire detection within associated floor area and alarm throughout the building
SE denotes simultaneous evacuation
denotes sprinkler protection

Exemplar 1 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): greater than 30 m, simultaneous evacuation

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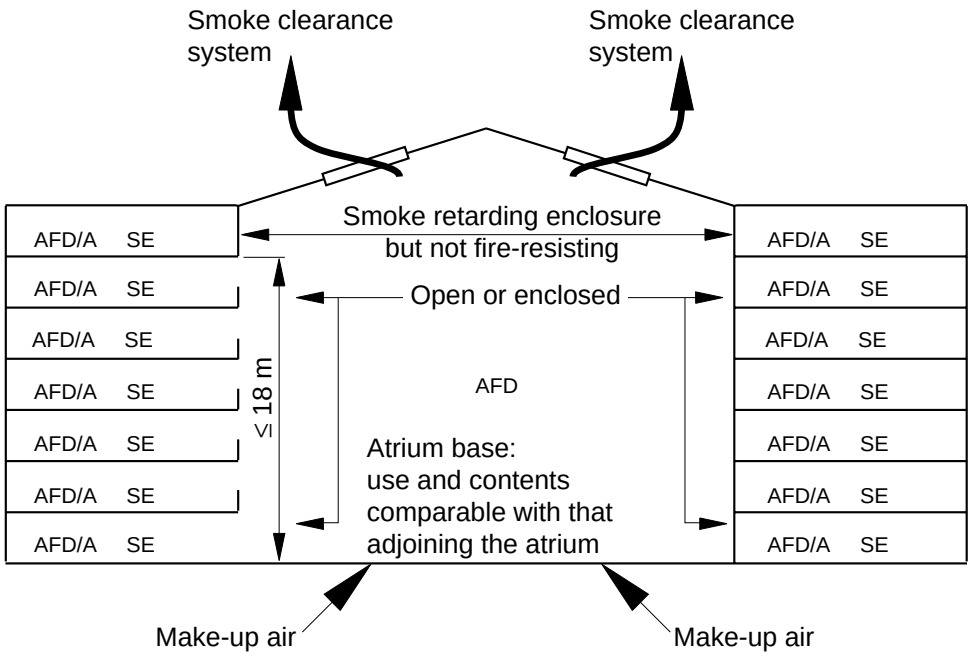

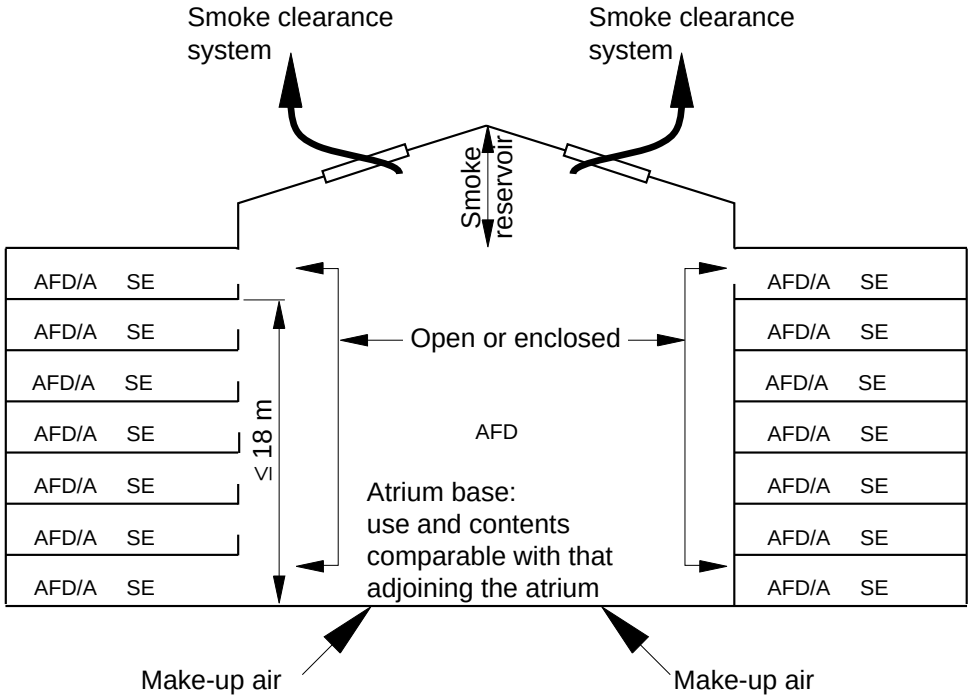

AFD/A denotes automatic fire detection within atrium and associated floor areas and alarm throughout building
SE denotes simultaneous evacuation
AFD denotes automatic fire detection connected to the building alarm system

Exemplar 2 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): open or enclosed, simultaneous evacuation, 18 m or less in height

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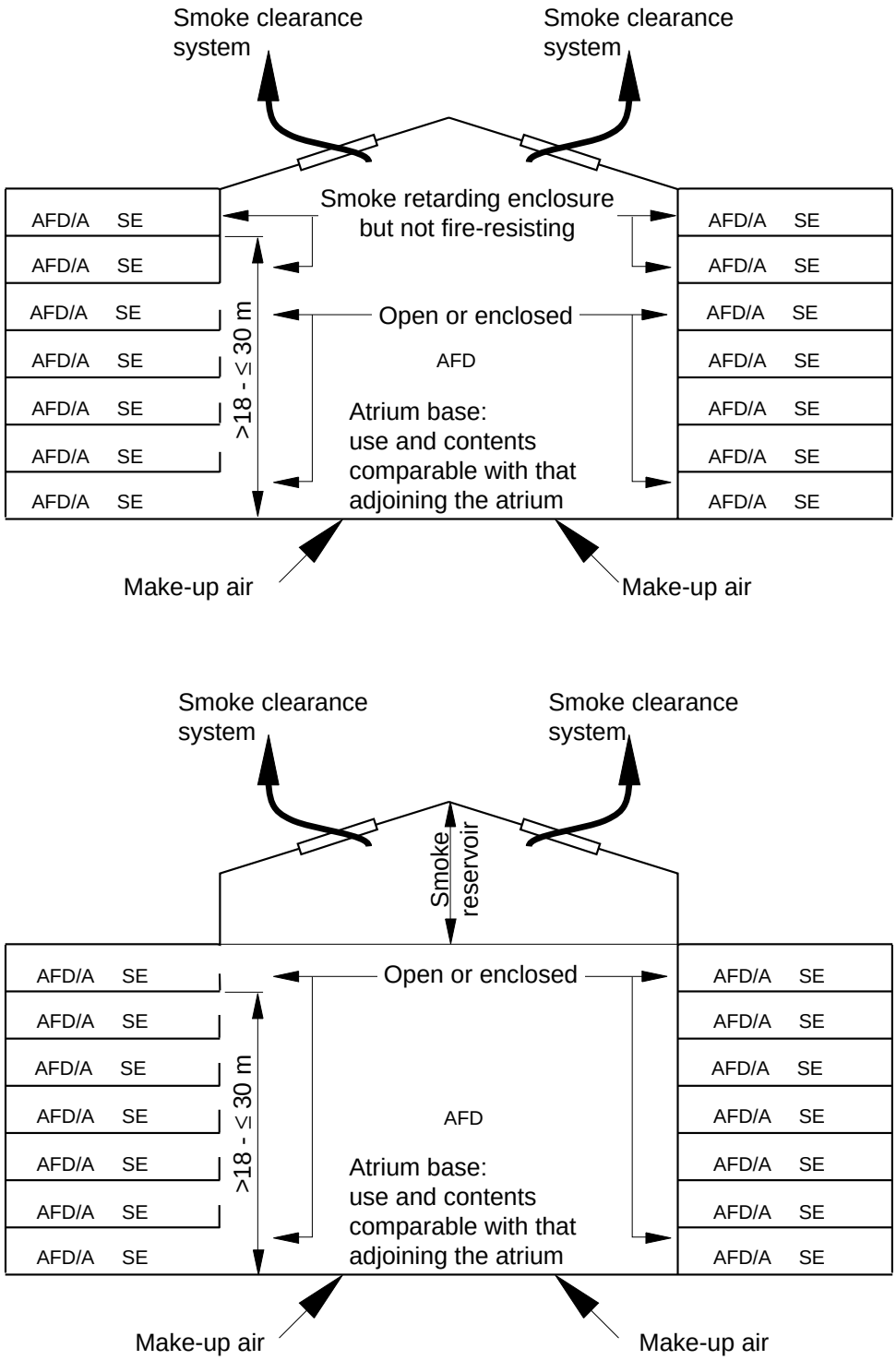

AFD/A denotes automatic fire detection and alarm throughout
AFD denotes automatic fire detection connected to building alarm system
SE denotes simultaneous evacuation

Exemplar 3 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): open or enclosed, simultaneous evacuation, more than 18 m but not more than 30 m in height

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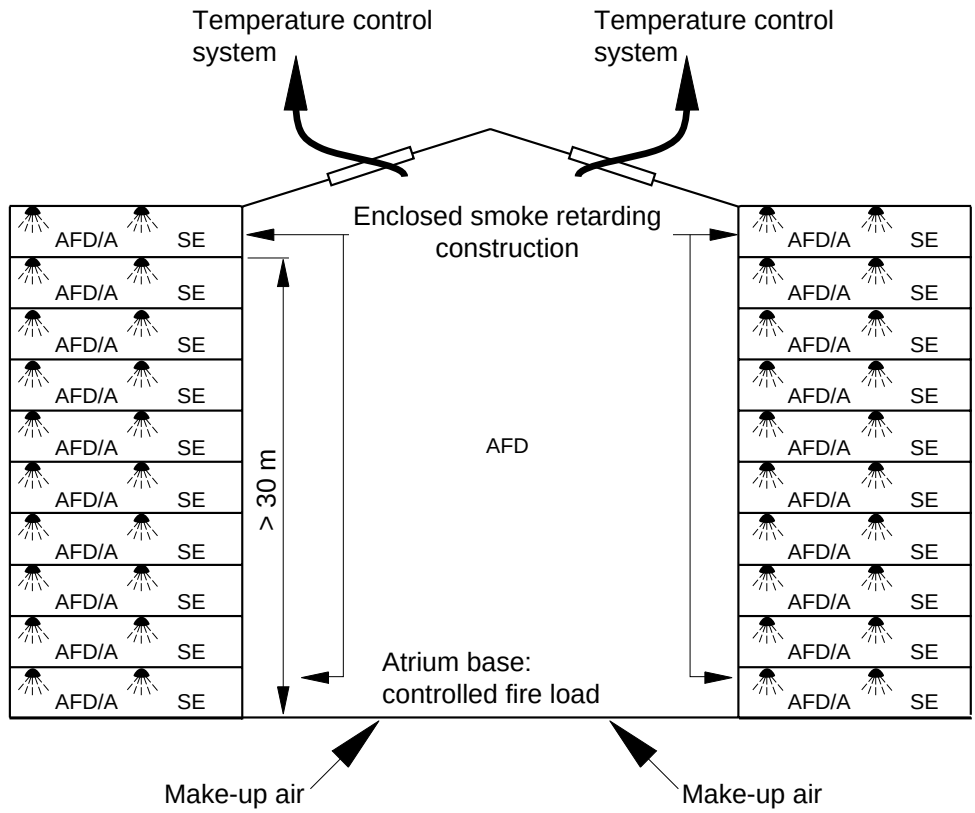

AFD/A denotes L2 automatic fire detection within atrium and associated areas and alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
SE denotes simultaneous evacuation
denotes automatic sprinkler protection

Exemplar 4 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): greater than 30 m, simultaneous evacuation

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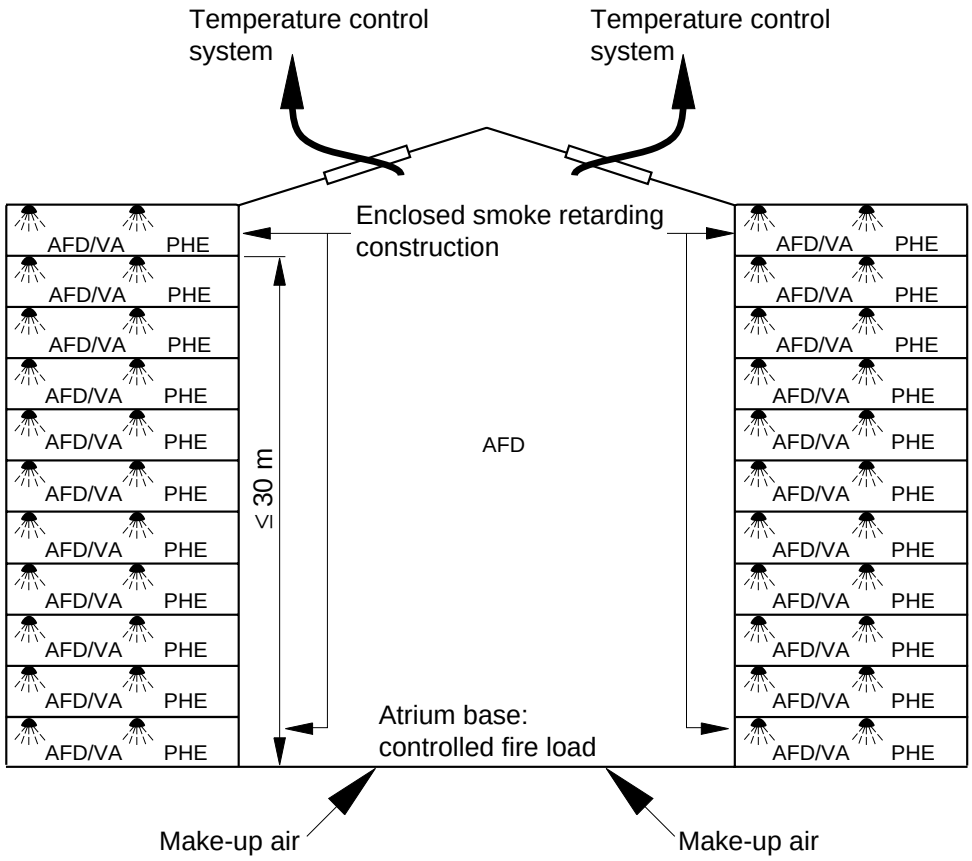

AFD/VA denotes L2 automatic fire detection within atrium and associated floor areas and voice alarm throughout the building
AFD denotes L2 automatic fire detection connected to building alarm system
PHE denotes phased evacuation
denotes automatic sprinkler protection

NOTE Not applicable for atria uniting two storeys only [see **1**e)].

Exemplar 5 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): enclosed 30 m or less in height, phased evacuation

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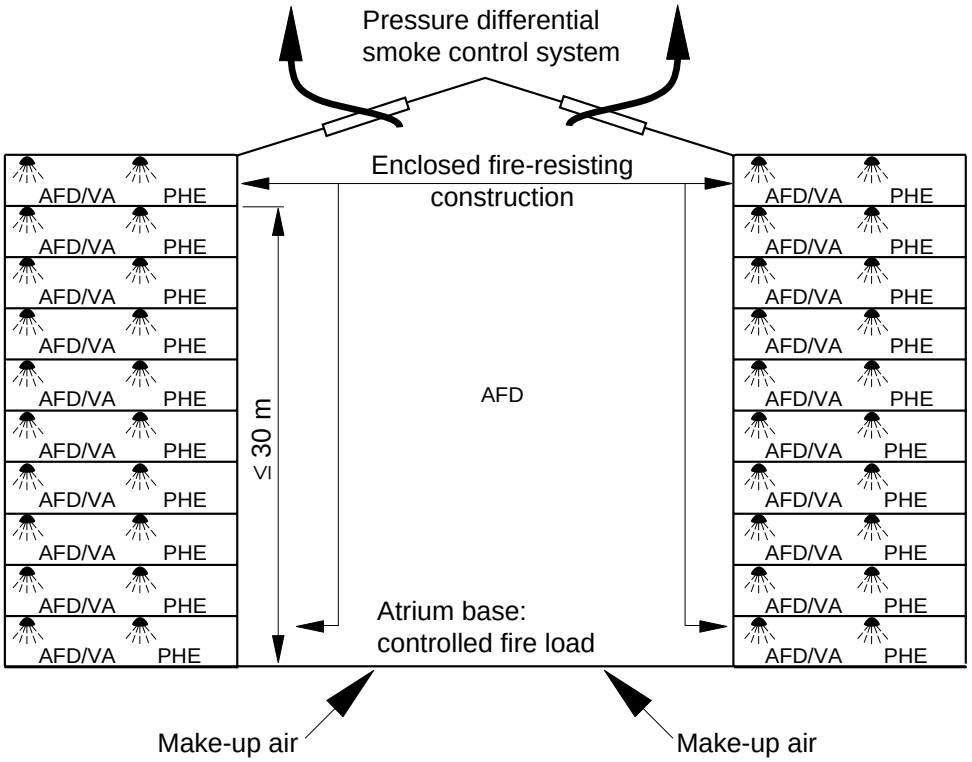

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
PHE denotes phased evacuation
denotes automatic sprinkler protection will only be required as part of the fire engineering solution

a) Pressure differential systems using atria depressurization

NOTE Pressure differential systems using smoke exhaust ventilation to de-pressurize the atrium with a high neutral plane method [see **17.1**c)3) and **24.6**d)].

Exemplar 6 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): enclosed 30 m or less in height, fire-resisting, pressure differential, phased evacuation

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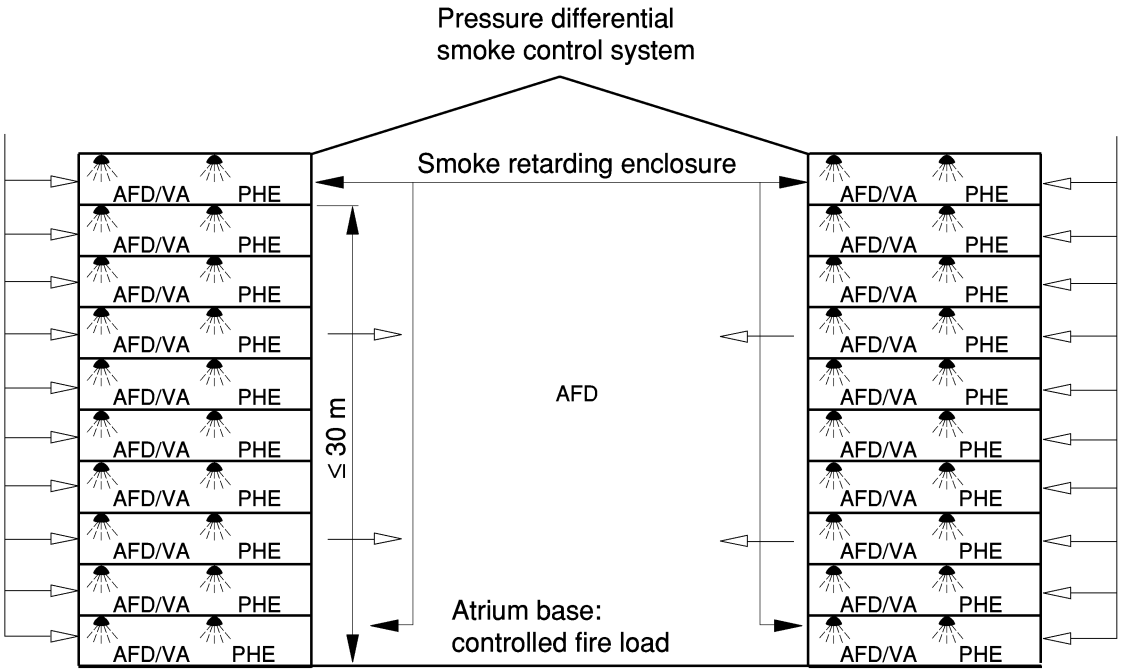

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
PHE denotes phased evacuation
denotes automatic sprinkler protection will only be required as part of the fire engineering solution

a) Pressure differential systems to pressurize the associated floor areas

NOTE Pressure differential systems using smoke exhaust ventilation to de-pressurize the atrium with a high neutral plane method [see **17.1**c)3) and **24.6**d)].

Exemplar 6 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): enclosed 30 m or less in height, fire-resisting, pressure differential, phased evacuation (*continued*)

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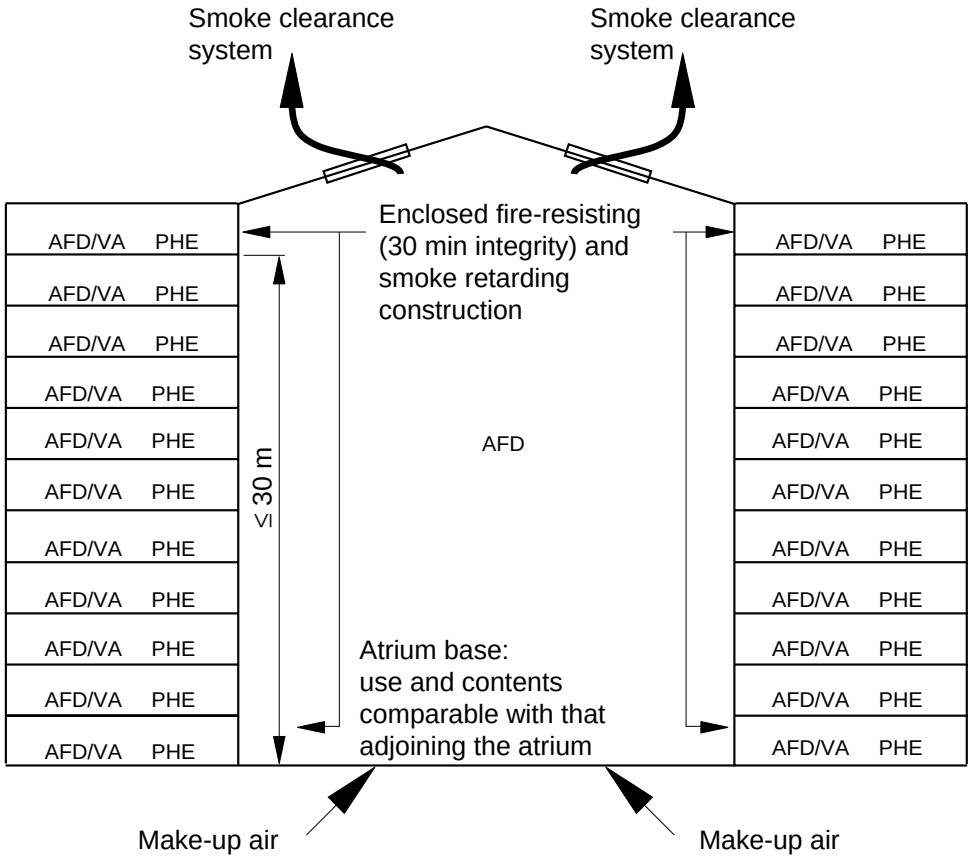

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
PHE denotes phased evacuation

NOTE Not applicable for atria uniting two storeys only [see **1**e)].

Exemplar 7 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): enclosed 30 m or less in height, fire-resisting, smoke retarding, phased evacuation

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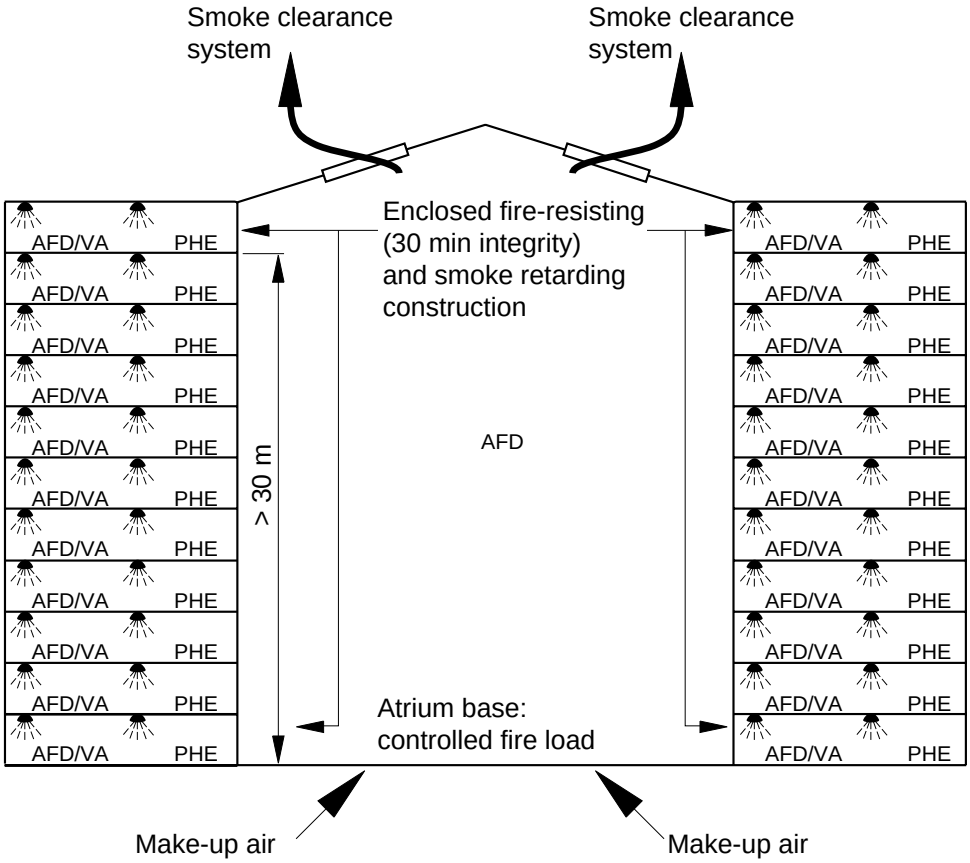

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
denotes automatic sprinkler protection

Exemplar 8 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): enclosed greater than 30 m in height, fire-resisting, pressurization, smoke retarding, phased evacuation

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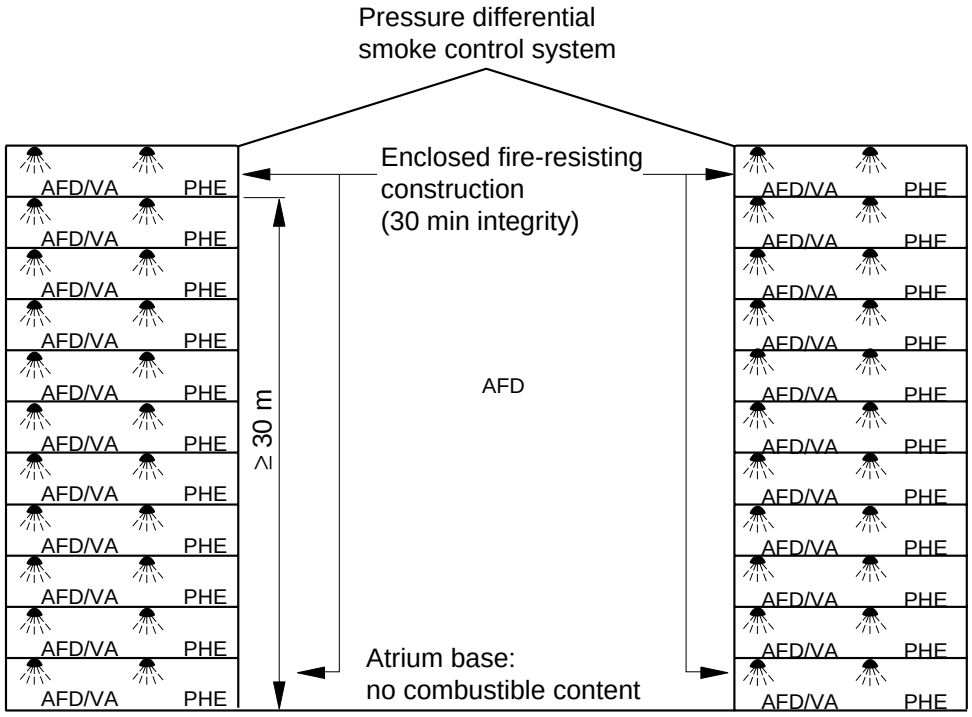

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
PHE denotes phased evacuation
denotes automatic sprinkler protection

NOTE Pressurization by applying all the relevant clauses of BS 5588-4:1998 [see **17.1**c)i) and **24.6**b)].

Exemplar 9 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): enclosed greater than 30 m in height, pressurization, fire-resisting, phased evacuation

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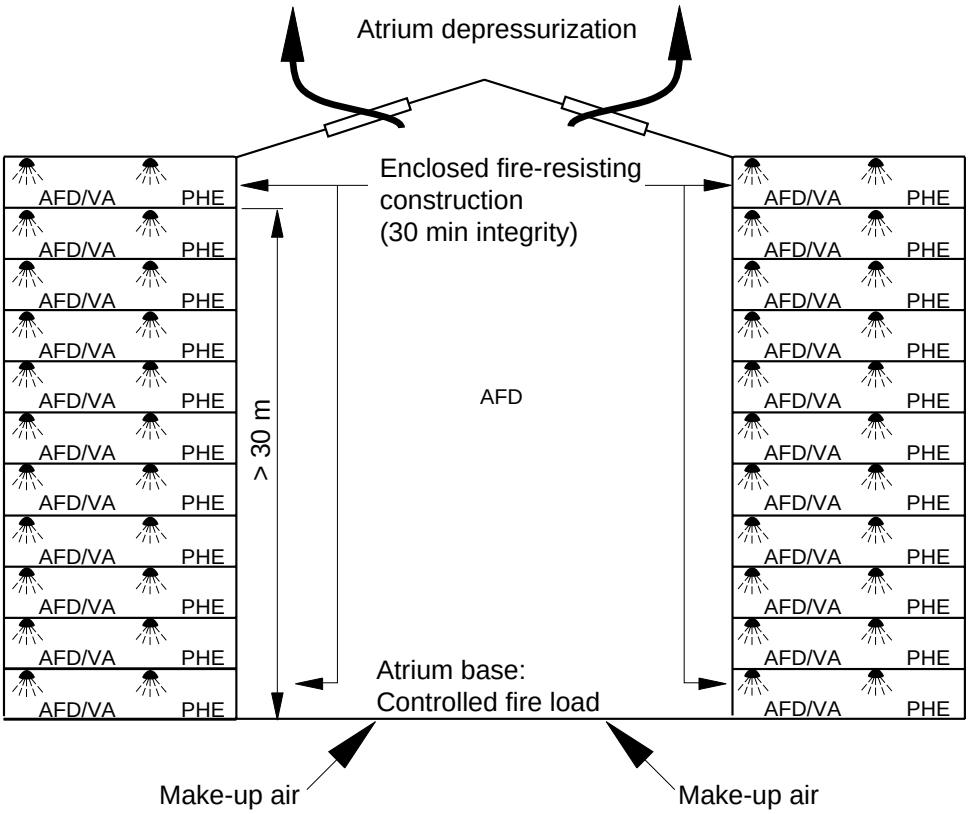

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire protection connected to building fire alarm system
PHE denotes phased evacuation
denotes automatic sprinkler protection

a) Pressure differential systems using atria depressurization

NOTE Pressurization of the adjacent spaces as there is no possibility of adjusting the neutral plane [see **17.1**c)ii) and **24.6**c), e), f) and g)].

Exemplar 10 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): enclosed greater than 30 m in height, fire-resisting, pressure differential, phased evacuation

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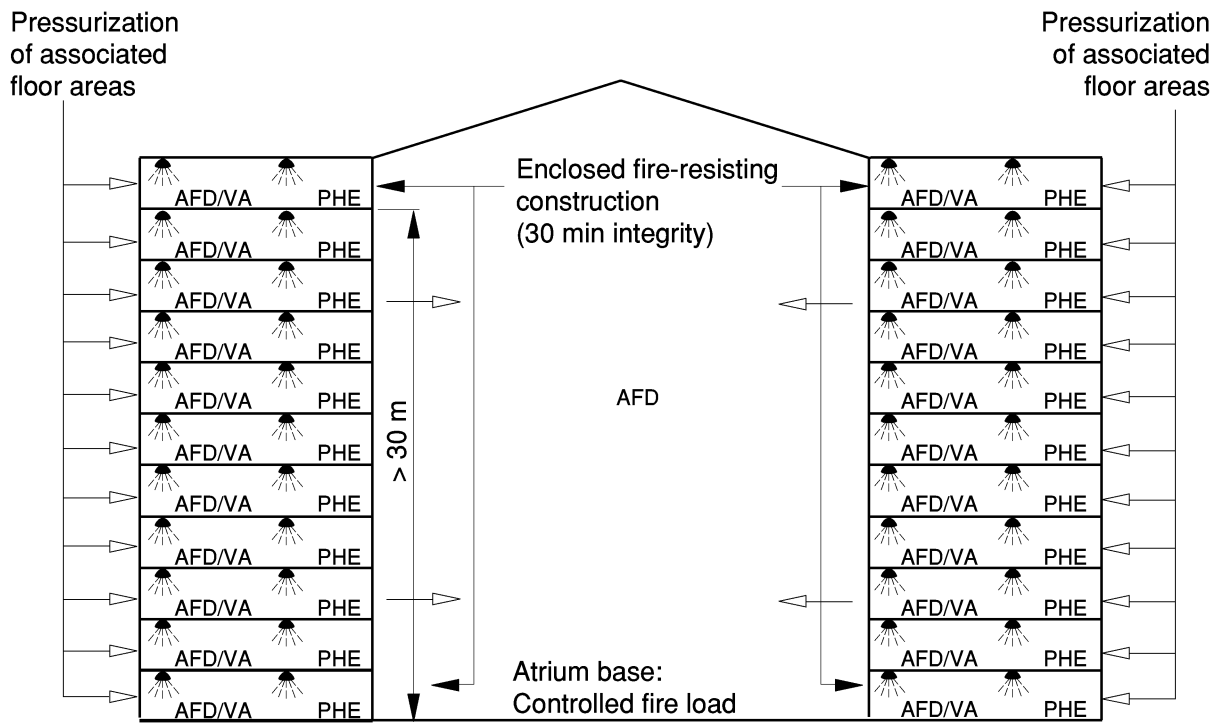

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire protection connected to building fire alarm system
PHE denotes phased evacuation
denotes automatic sprinkler protection

b) Pressure differential systems to pressurize the associated floor areas

NOTE Pressurization of the adjacent spaces as there is no possibility of adjusting the neutral plane [see **17.1**c)ii) and **24.6**c), e), f) and g)].

Exemplar 10 — Occupancy category A (occupants who are awake and, predominantly, are familiar with the building): enclosed greater than 30 m in height, fire-resisting, pressure differential, phased evacuation (*continued*)

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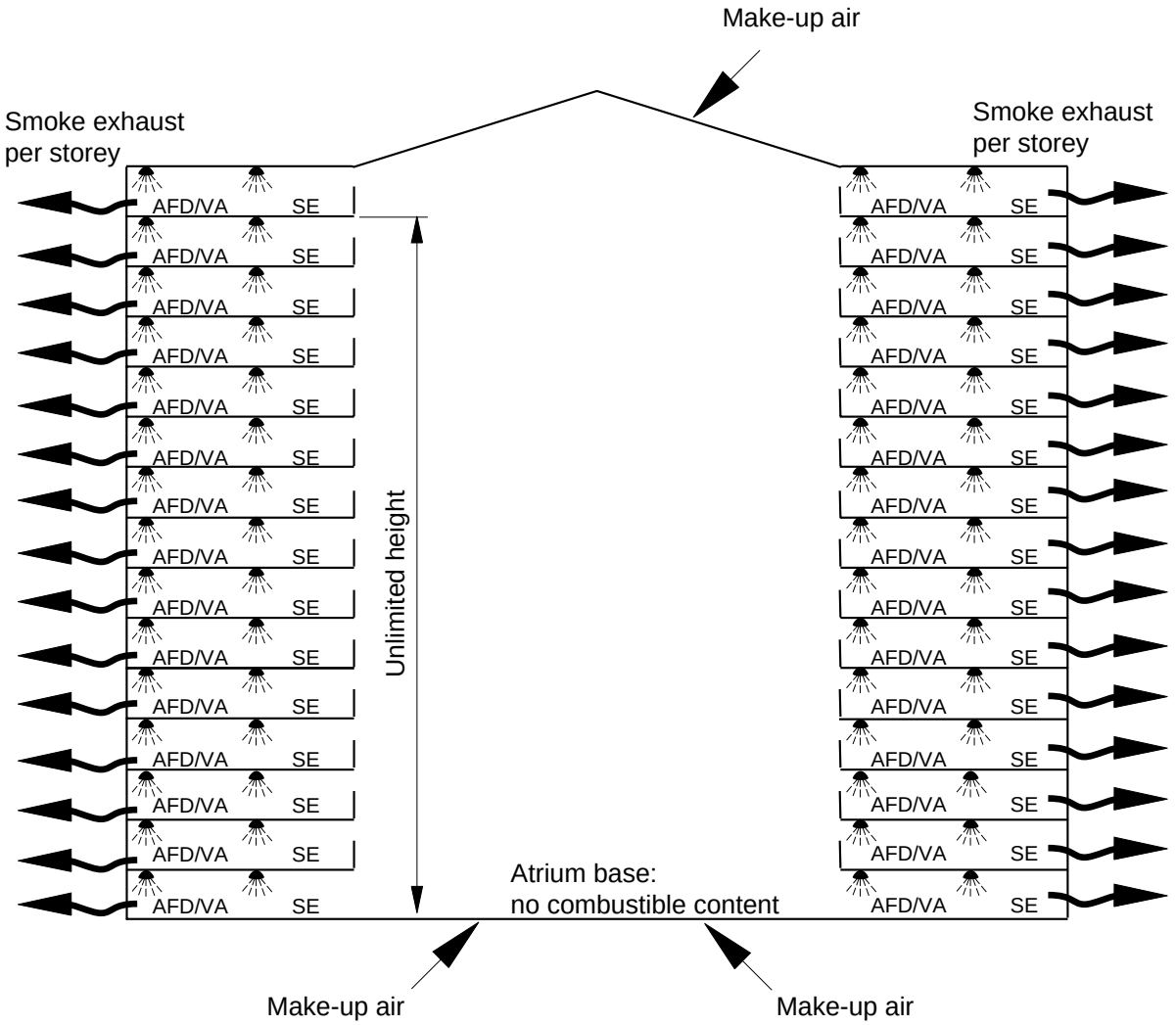

AFD/VA denotes L2 automatic fire detection and voice alarm throughout the building
SE denote simultaneous evacuation
denotes automatic sprinkler protection

NOTE Not applicable for atria uniting two storeys only [see **1**e)].

Exemplar 11 — Occupancy category B (occupants who are awake but may be unfamiliar with the building): unlimited height, open, simultaneous evacuation

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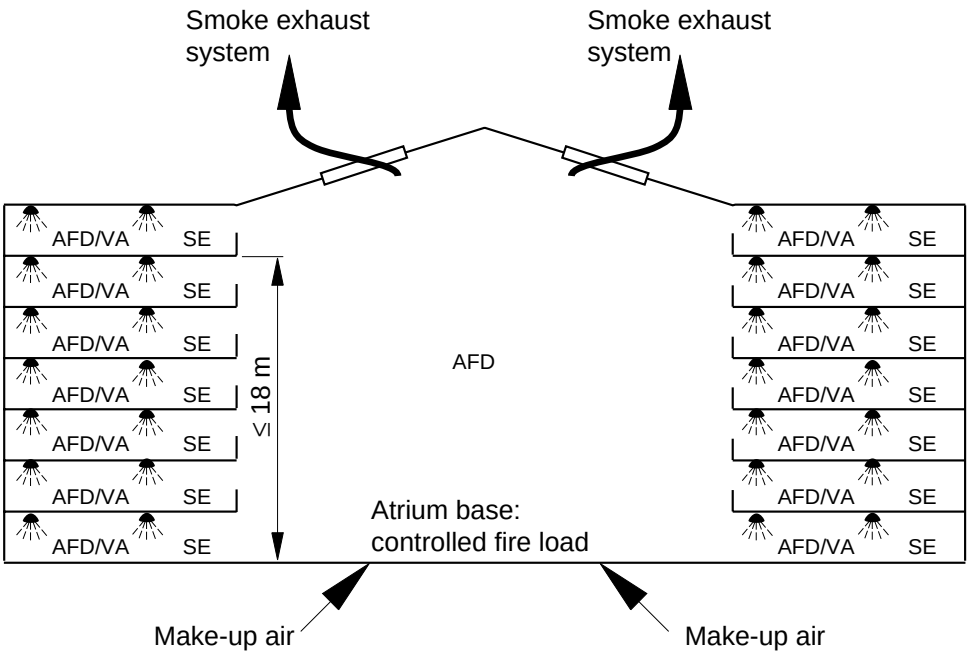

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
SE denotes simultaneous evacuation
denotes automatic sprinkler protection

NOTE Not applicable for atria uniting two storeys only [see **1**e)].

Exemplar 12 — Occupancy category B (occupants who are awake but may be unfamiliar with the building): 18 m or less in height, open, simultaneous evacuation

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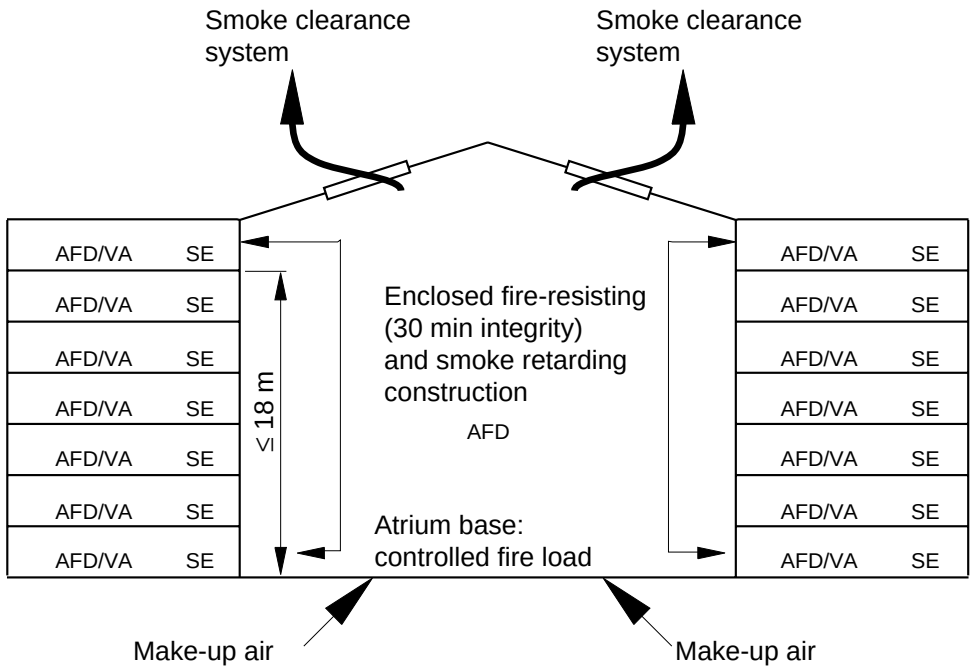

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
SE denotes simultaneous evacuation

NOTE Not applicable for atria uniting two storeys only [see **1**e)].

Exemplar 13 — Occupancy category B (occupants who are awake but may be unfamiliar with the building): 18 m or less in height, enclosed, fire-resisting, simultaneous evacuation

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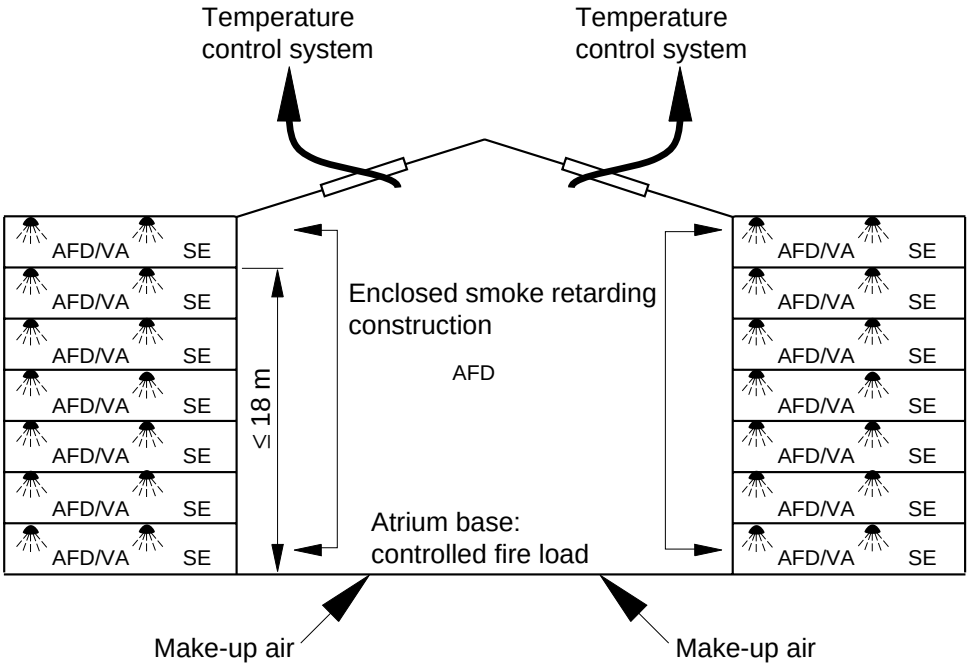

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
SE denotes simultaneous evacuation
denotes automatic sprinkler protection

Exemplar 14 — Occupancy category B (occupants who are awake but may be unfamiliar with the building): 18 m or less in height, enclosed, smoke retarding, simultaneous evacuation

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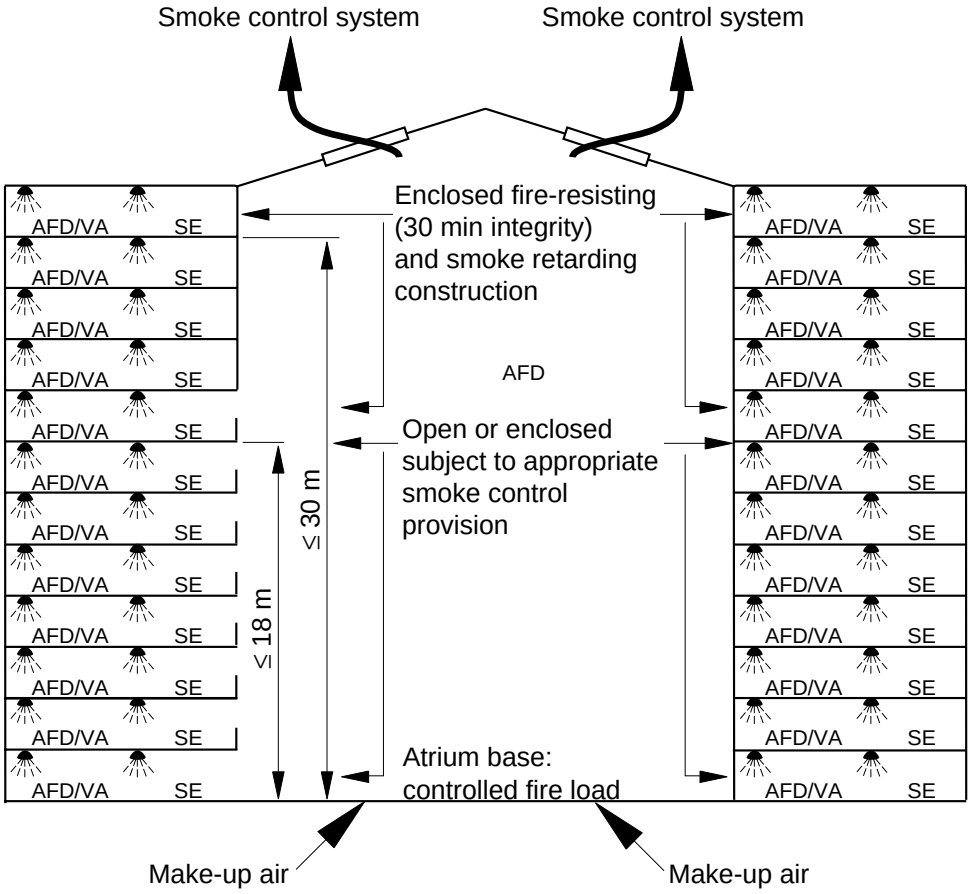

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
SE denote simultaneous evacuation
denotes automatic sprinkler protection

Exemplar 15 — Occupancy category B (occupants who are awake but may be unfamiliar with the building): partly open, 30 m or less, simultaneous evacuation

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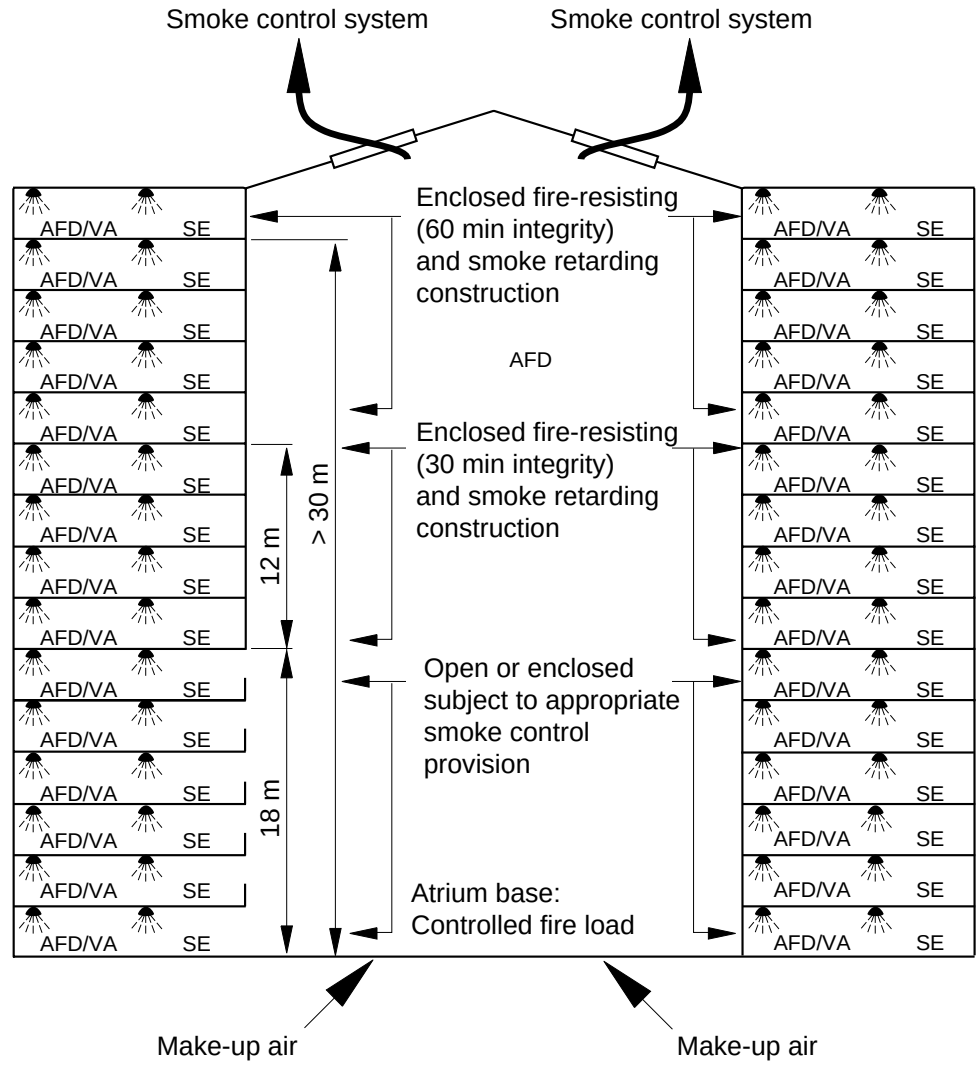

AFD/VA denotes L2 automatic fire detection within the atrium and associated floor areas and voice alarm throughout the building
AFD denotes automatic fire detection connected to building alarm system
SE denotes simultaneous evacuation
denotes automatic sprinkler protection

Exemplar 16 — Occupancy category B (occupants who are awake but may be unfamiliar with the building): partly open, greater than 30 m in height, simultaneous evacuation

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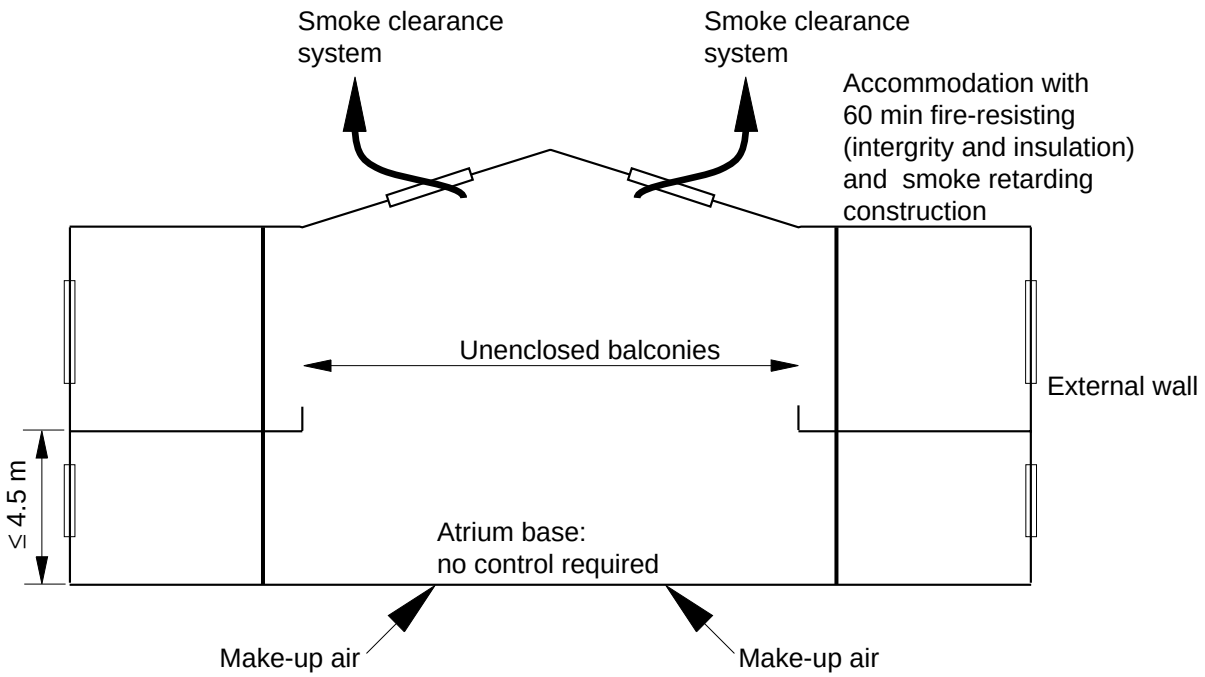

Fire alarm and warning to be that appropriate for the equivalent non-atrium building

Exemplar 17 — Occupancy category C1 and C2 (occupants who are likely to be asleep): long term, low rise

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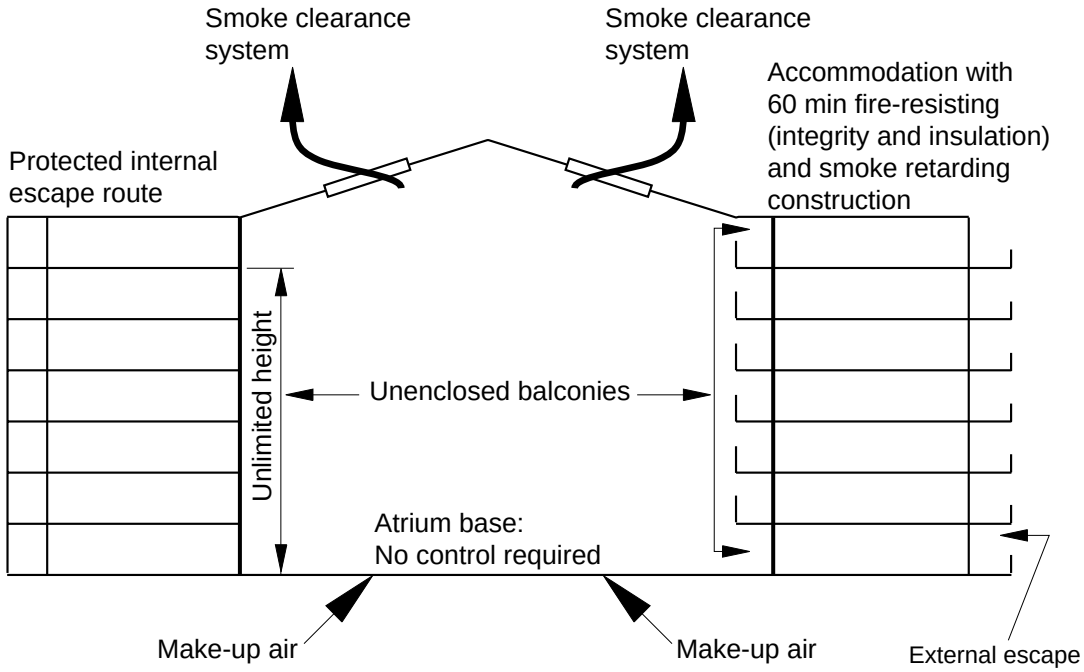

Fire alarm and warning to be that appropriate for the equivalent non-atrium building

Exemplar 18 — Occupancy category C1 and C2 (occupants who are likely to be asleep): long term occupancy, unlimited height

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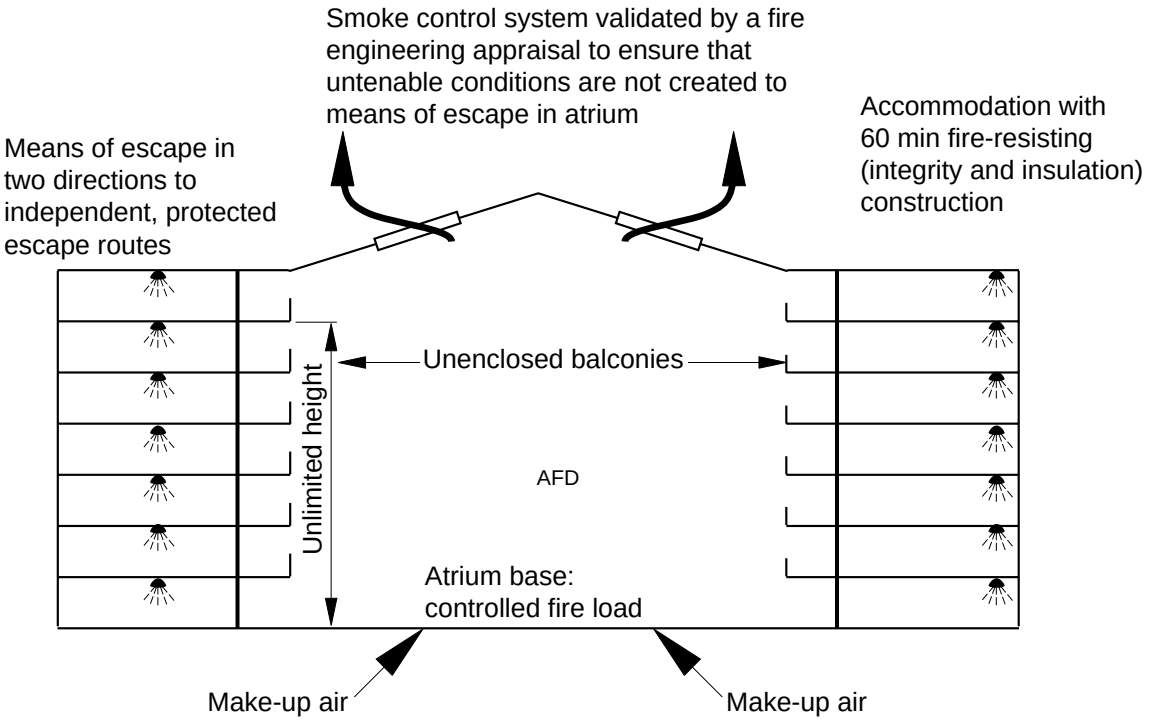
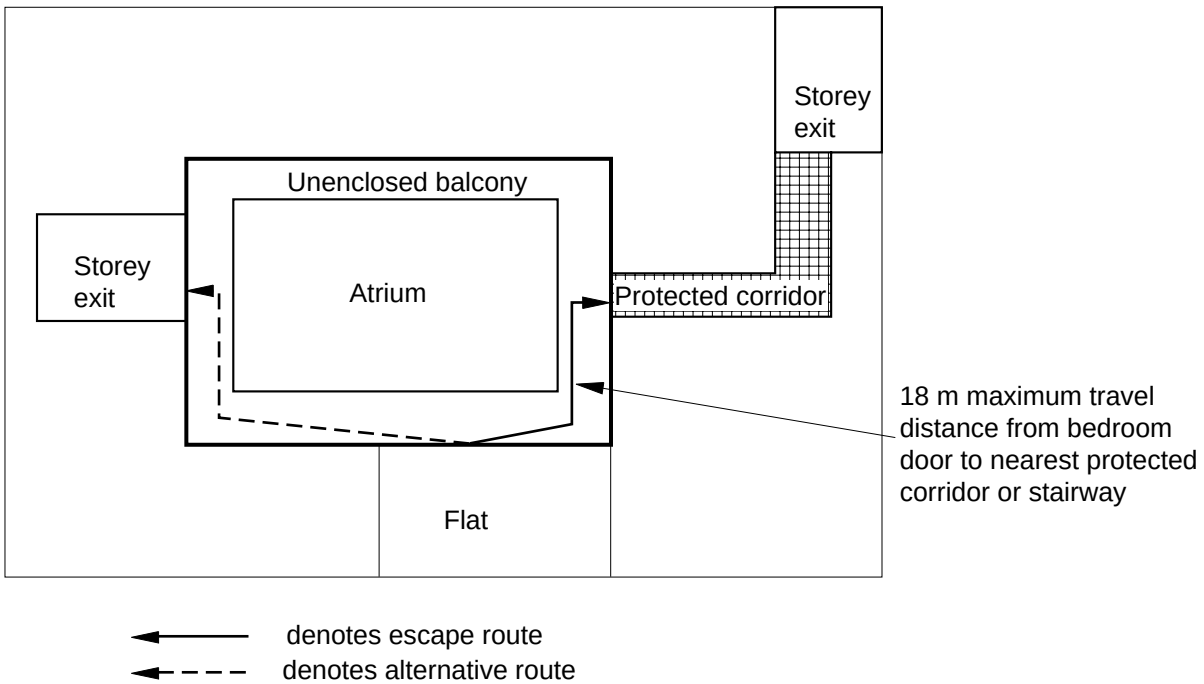


Fire alarm and warning system to be that appropriate for the equivalent non atrium building

denotes automatic sprinkler protection

AFD denotes automatic fire detection appropriate to smoke control system



Exemplar 19 — Occupancy category C2 (occupants who are likely to be asleep): long term occupancy, unlimited height, managed

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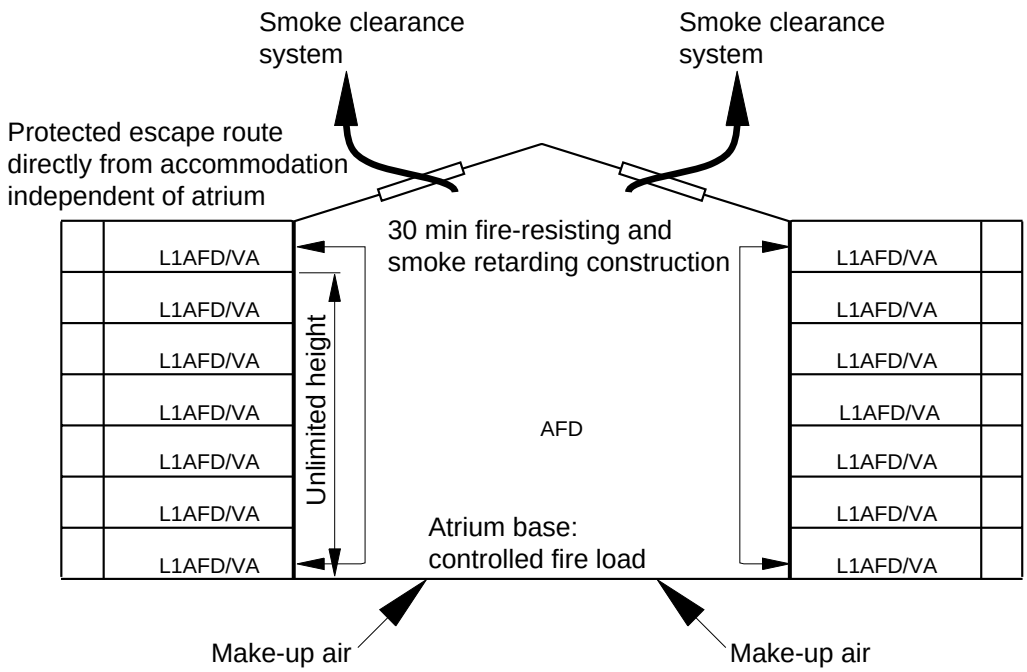

L1AFD/VA denotes automatic fire detection to BS 5839, L1 standard and voice alarm throughout the building
AFD denotes automatic fire detection connected to the building alarm system

Exemplar 20 — Occupancy category C3 (occupants who are likely to be asleep): short term occupancy, protected escape route

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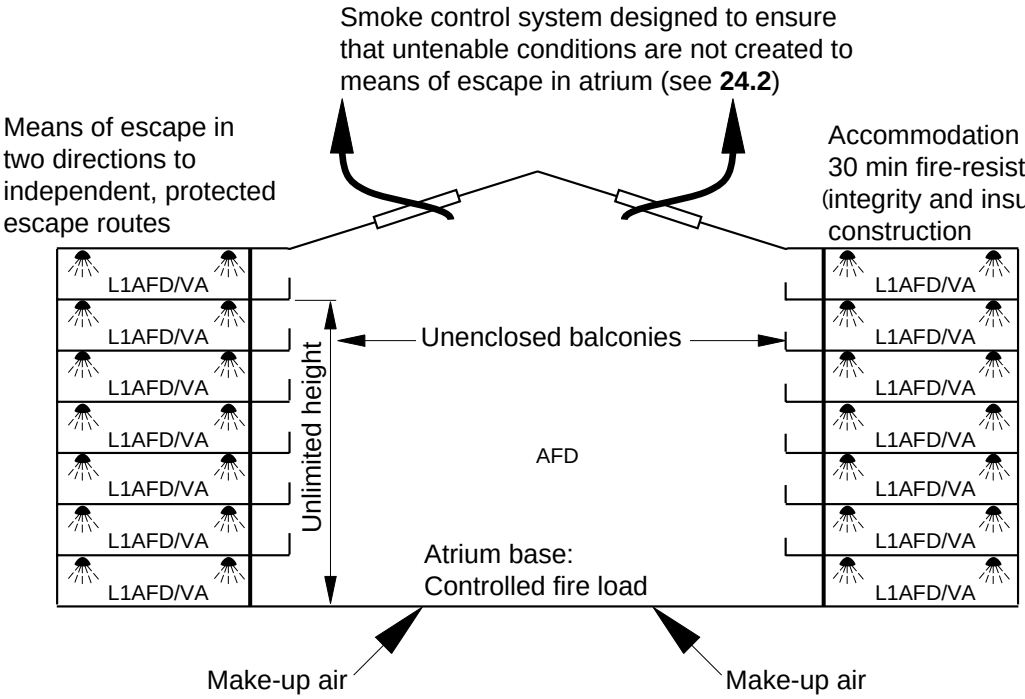
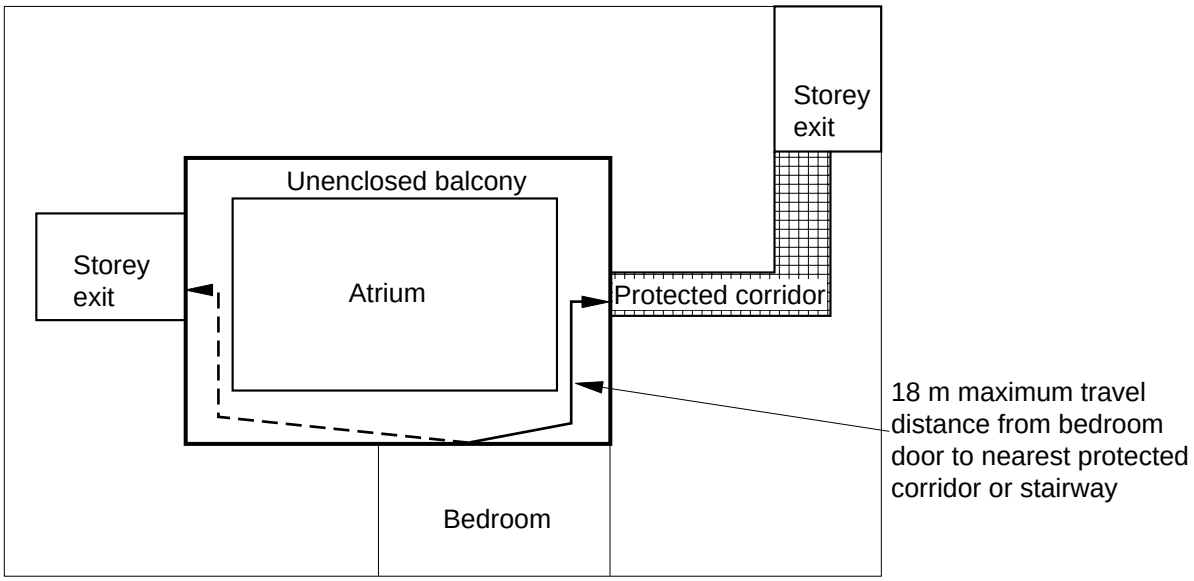


L1AFD/VA denotes automatic fire detection to BS 5839, L1 standard and voice alarm

denotes automatic sprinkler system



denotes escape route

denotes alternative route

Exemplar 21 — Occupancy category C3 (occupants who are likely to be asleep): short term occupancy, unenclosed balcony escape route

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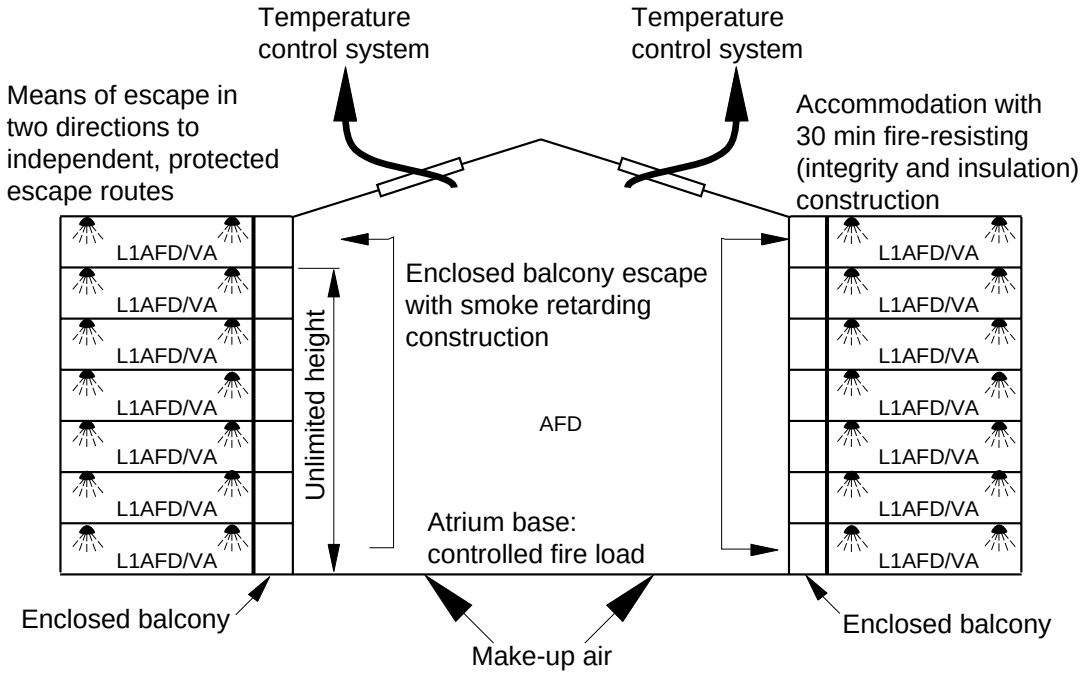
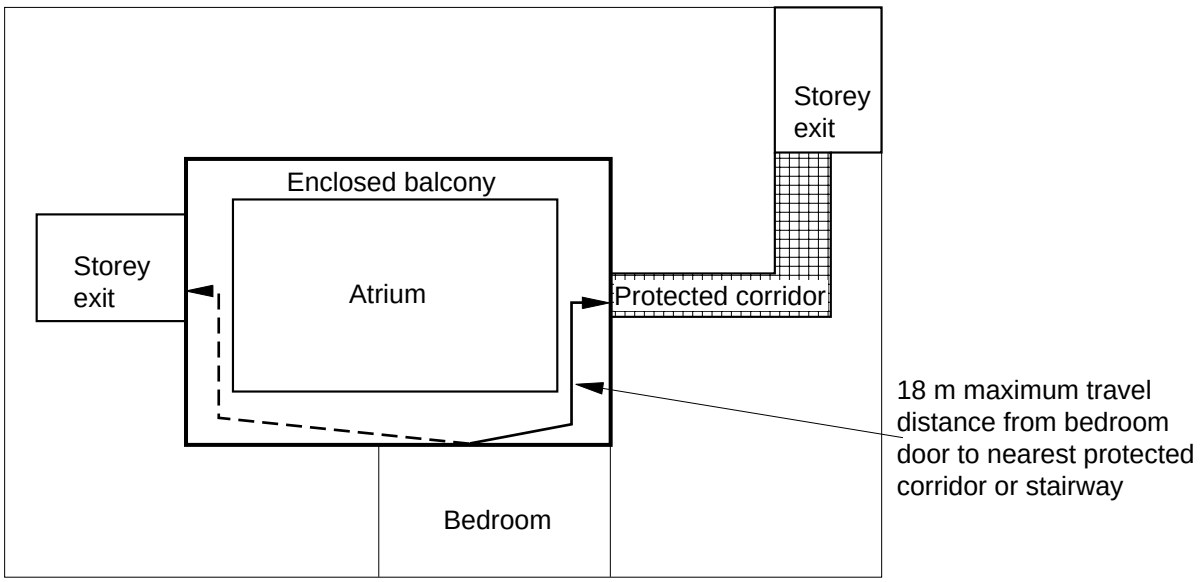


L1AFD/VA denotes automatic fire detection to BS 5839, L1 standard and voice alarm throughout the building
AFD denotes automatic fire detection connected to the building alarm system
denotes automatic sprinkler protection



Exemplar 22 — Occupancy category C3 (occupants who are likely to be asleep): short term occupancy, enclosed balcony escape route

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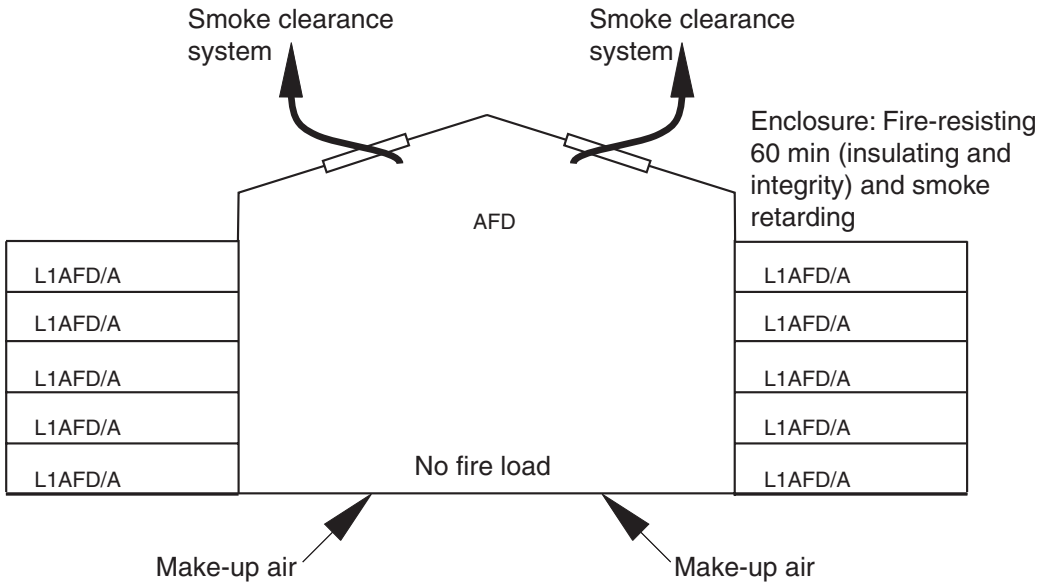

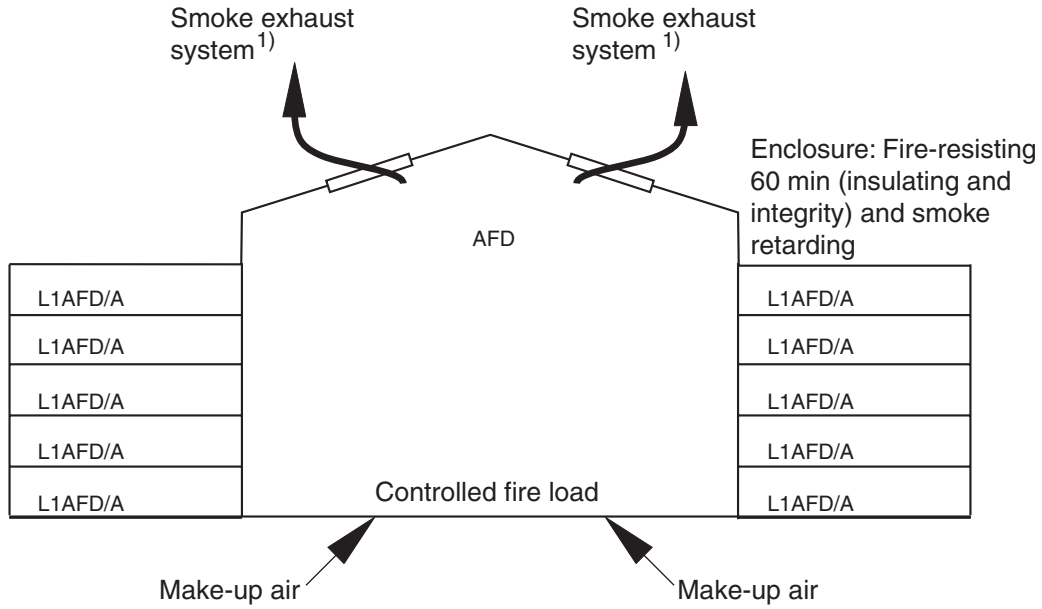

1) L1AFD/A denotes automatic fire detection and alarm

NOTE Occupants of category D premises are a particularly vulnerable section of society and in certain circumstances evacuation may cause them harm, or delayed recovery, or aggravate their medical condition. To ensure that smoke does not enter spaces adjoining the atrium, a smoke exhaust system is required to maintain a stable smoke layer 1 m above the uppermost opening into the atrium.

Exemplar 23 — Occupancy category D: occupants requiring medical or nursing care

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Annex B (normative)
Commissioning and hand-over of smoke control systems

NOTE 1 This annex should be read in conjunction with BS 5588-12.

NOTE 2 Where various functions interface, e.g. smoke detection and smoke control, these systems should be commissioned together to ensure that the prescribed fire safety procedure is implemented.

B.1 Smoke ventilation systems

B.1.1 *General*

On completion of the smoke ventilation system, the complete installation should be checked for conformity to the approved drawings and system design. Instruction on its use, planned maintenance and testing should be supplied to the owner of the premises.

The hand-over procedure should include operation of the system by actuating smoke detectors in each atrium. All elements of the system and control interfaces for ventilators or extract fans, curtains and air inlets should then operate automatically.

All fire safety systems should be individually tested to establish that the final installation conforms to the specified design, is functioning properly and is ready for acceptance testing. It should be documented in writing that the installation of each system component is complete and that the component is functional.

Acceptance testing should demonstrate that the final integrated system installed conforms to the specified design and is functioning correctly. The acceptance tests should include demonstrations that the correct outputs are produced for given inputs for each control sequence specified. Upon activation, operation of all fans, dampers, doors and related equipment should be recorded and verified. The pressure differences and air-flow quantities across smoke-protected enclosures and protected stairways, and at mechanical make-up air supply and smoke ventilation systems, should be measured and recorded.

There is a need to check the volume flow of inlets for mechanical systems, and quantities, size and location of inlets for natural systems. It should be noted that whether security doors are opened to provide inlets, or if security is maintained by means of an open mesh shutter, the inlet area could be reduced. In such circumstances, an assessment of the free area should be made and a correction factor applied in respect of any such door.

The extent and form of any acceptance tests should be agreed with the enforcing authority at the design stage.

B.1.2 *Powered smoke exhaust systems*

The volume exhaust rate should be measured for the design fire. This should be obtained at ambient temperature equivalent to the required volume exhaust rate at the calculated gas temperature, or class C temperature (in accordance with BS 7346-2), whichever is appropriate.

NOTE 1 The volume extract (or supply) airflow readings should be taken by either using a vane anemometer at each extract grille, then totalling the readings, or by taking a Pitot traverse in an appropriate straight section of ductwork (approximately 4 m from any obstruction or outlet, etc.) for each fan, then totalling the results.

Further information can be found in the *CIBSE Commissioning Code A* [7].

If standby generators are installed to provide emergency electrical power, these should be checked.

NOTE 2 If the standby generator(s) are common to other emergency systems, these other systems should be powered by the generator(s) to ensure that a reliable power supply is provided.

B.1.3 *Natural smoke ventilation systems*

The areas of the ventilators should be measured, and along with test certificates for ventilator aerodynamic coefficients, these should be compared with the figures required by the approved design.

NOTE This can be done by measuring a sample of each ventilator size and calculating the measured area by totalling the numbers of vents.

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B.2 Smoke control systems employing pressure differentials

The following check tests should be performed when accepting a smoke control system employing pressure differentials.

a) All detection devices should be tested for correct initiation and operation of the system.

b) Air relieving systems should be checked for correct operation.

c) Measurements should be taken of air velocities as specified in BS 5588-4.

d) Measurements should be taken of the pressure differential between each pressurized space and its adjacent unpressurized space, with all doors in the closed position.

e) Operation of standby fans and motors should be checked for correct changeover, etc.

Annex deleted

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List of references (see Clause 2)

Normative references

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BRITISH STANDARDS INSTITUTION, London

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BS 476-20:1987, *Fire tests on building materials and structures — Part 20: Method for determination of the fire resistance of elements of construction (general principles).*

BS 476-21:1987, *Fire tests on building materials and structures — Part 21: Methods for determination of the fire resistance of loadbearing elements of construction.*

BS 476-22:1987, *Fire tests on building materials and structures — Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction.*

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Text deleted

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

BS 5499-1:1990, *Fire safety signs, notices and graphic symbols — Part 1: Specification for fire safety signs.*

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

BS 5588-6:1991, *Fire precautions in the design, construction and use of buildings — Part 6: Code of practice for places of assembly.*

BS 5588-9:1999, *Fire precautions in the design, construction and use of buildings — Part 9: Code of practice for ventilation and air conditioning ductwork.*

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BS 5588-12, *Fire precautions in the design, construction and use of buildings — Part 12: Managing fire safety.*

BS 5839-1:1988, *Fire detection and alarm systems for buildings — Part 1: Code of practice for system design, installation and servicing.*

BS 5852:1990, *Methods of test for assessment of the ignitability of upholstered seating by smouldering and flaming ignition sources.*

BS 5867-2:1980, *Specification for fabrics for curtains and drapes — Part 2: Flammability requirements.*

BS 6206:1981, *Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings.*

BS 6207, *Mineral-insulated cables with a rated voltage not exceeding 750 V.*

BS 6387:1994, *Specification for performance requirements for cables required to maintain circuit integrity under fire conditions.*

BS 7346-1:1990, *Components for smoke and heat control systems — Part 1: Specification for natural smoke and heat exhaust ventilators.*

BS 7346-2:1990, *Components for smoke and heat control systems — Part 2: Specification for powered smoke and heat exhaust ventilators.*

BS 7346-3:1990, *Components for smoke and heat control systems — Part 3: Specification for smoke curtains.*

BS 7671, *Requirements for electrical installations — IEE Wiring Regulations.*

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[2] GREAT BRITAIN. *Building (Procedure) (Scotland) Regulations* 1981, SI 1981/1499. Edinburgh: The Stationery Office.

[3] GREAT BRITAIN. *Building (Procedure) (Scotland) Amendment Regulations* 1990, SI 1990/11358. Edinburgh: The Stationery Office.

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BS 5268-4*, Structural use of timber — Part 4: Fire resistance of timber structures.*

BS 5950-8:1990*, Structural use of steelwork in building — Part 8: Code of practice for fire resistant design.*

BS 7176:1995*, Specification for resistance to ignition of upholstered furniture for non-domestic seating by testing composites.*

BS EN 1021-1:1994*, Furniture — Assessment of the ignitability of upholstered furniture — Part 1: Ignition source: smouldering cigarette.*

BS EN 1021-2:1994*, Furniture — Assessment of the ignitability of upholstered furniture — Part 2: Ignition source: match flame equivalent.*

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