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Incorporating Corrigendum No. 1

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

bsi.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to xiv, pages 1 to 400, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 January 2017. It was prepared by Technical Committee FSH/14, *Fire precautions in buildings*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 9999:2008, which is withdrawn.

Information about this document

This is a full revision of the standard, and introduces the following principal changes:

- inclusion of flowchart showing the sequential steps in the design process, to assist users in the application of the standard;
- revision of management system levels and inclusion of references to PAS 7;
- inclusion of watermist fire suppression systems;
- expansion of fire growth rates table to give more information;
- expansion of guidance on voice alarms;
- revision of recommendations for smoke and heat control;
- addition of recommendations for fire curtain barrier assemblies;
- revision of recommendations for mechanical ventilation and air-conditioning systems;
- revision of recommendations for shopping complexes;
- removal of content now covered by BS 9991;
- general update to take into account new and revised standards published since 2008.

The concept behind the development of BS 9999 and BS 7974 is that technical guidance on fire safety is provided at three different levels. This permits a design approach to be adopted that corresponds to the complexity of the building and to the degree of flexibility required. The three levels are as follows.

a) **General approach**. This level is applicable to a majority of building work undertaken within the UK. In this case the fire precautions designed into the building usually follow the guidance contained in the documents published by the relevant government departments to support legislative requirements.

b) **Advanced approach**. This is the level for which BS 9999 is provided. The provisions of this document allow a more transparent and flexible approach to fire safety design through use of a structured approach to risk-based design where designers can take account of varying physical and human factors. Many of the measures recommended in BS 9999 are based on fire safety engineering principles, although it is not intended as a guide to fire safety engineering.

c) **Fire safety engineering**. This is the level for which BS 7974 is provided. This level provides an alternative approach to fire safety and can be the only practical way to achieve a satisfactory standard of fire safety in some large and complex buildings, and in buildings containing different uses.

There might be circumstances where it is necessary to use one publication to supplement another, but care needs to be taken when using a "pick-and-mix" approach as it is essential to ensure that an integrated approach is used in any one building.

When evaluating an existing building, e.g. when carrying out a fire risk assessment, it is important to review all general fire precautions and not to use parts of the standard in isolation.

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

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

BS 9999 is designed as a coordinated package covering the four main areas that influence fire safety measures, namely:

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

Individual recommendations of this British Standard applied in isolation might give little or no benefit, and might even reduce the level of fire safety. Although the basic principles and recommendations for escape from floor areas are described in Section **5**, the most conscientious application of these recommendations could be undermined unless supported by other necessary measures.

Whatever fire safety provisions are made, they can be seriously compromised by a lack of management of fire safety (see Section **4** and Section **9**); inadequate facilities for fire-fighting (see Section **6**); or a lack of appropriate related measures on construction of the building (see Section **7**).

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

In developing this British Standard, cognisance has been taken of the guidelines given in CEN/CENELEC Guide 6.

These issues will also form essential components of the overall fire safety strategy adopted in the occupied building to ensure compliance with relevant fire safety legislation.

Assessed capability. *Users of this British Standard are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body.*

Text introduced or altered by Corrigendum No. 1 is indicated in the text by tags [C1] 〈C1〉. Minor editorial corrections are not tagged.

Further information

Advice is available from a number of bodies, depending on whether they have a direct responsibility for the enforcement of fire safety in the building concerned. The bodies concerned include:

- local authorities;
- fire and rescue authorities;
- the Health and Safety Executive;
- building control bodies;
- environmental health departments;
- social services;
- education authorities;
- health authorities;
- the Environment Agency;
- consumer protection departments;
- petroleum licensing authorities;
- insurers;
- trade associations.

Advice is also available in books and documents published by:

- Communities and Local Government (for planning and building construction matters and compliance with fire safety in occupied buildings) (http://www.communities.gov.uk [1)]);
- Buildings Regulations Wales (http://gov.wales [1)]);
- the Health and Safety Executive (for general and specific health and safety matters concerned with work activities) (http://www.hse.gov.uk [1)]);
- Scottish Government Building Standards (http://www.gov.scot [1)]);
- the Department of Finance and Personnel (https://www.finance-ni.gov.uk/ [1)]) and the Department of Health, Social Services and Public Safety (https://www.health-ni.gov.uk/ [1)]) in Northern Ireland.

Use of this document

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

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations. Some variation from the recommendations might be necessary for certain specialist buildings or areas of buildings, e.g. areas of lawful detention.

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

[1)] Last accessed 4 January 2017.

Presentational conventions

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

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

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

The word "should" is used to express recommendations of this standard. The word "may" is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word "can" is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this standard. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

Contractual and legal considerations

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

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

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

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

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

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

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

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

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

g) demolition – fire safety arrangements during demolition work;

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

Attention is drawn to the following specific regulations:

- Building Regulations 2010 [1];
- Regulatory Reform (Fire Safety) Order 2005 [2];
- Building (Amendment) (Wales) Regulations 2014 [3];
- Building (Scotland) Regulations 2004 [4];
- Building Regulations (Northern Ireland) 2012 [5];
- Fire Safety (Scotland) Regulations 2006 [6];
- Fire Safety Regulations (Northern Ireland) 2010 [7].

Particular attention is drawn to the legal requirement under Regulation 38 of the Building Regulations 2010 [1] for relevant fire safety information to be provided to the responsible person on completion of the building, and to the requirements of the Construction Products Regulations 2013 [8].

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

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

Section 1: General

0 Introduction

0.1 General principles

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

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

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

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

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

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

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

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

f) business continuity.

Historic buildings present particular challenges, as many are listed and permitted material alterations are therefore limited without the agreement of the appropriate authorities. For such buildings, it is advisable to seek the advice of consultative bodies, such as Historic England, Cadw, Historic Scotland and the Northern Ireland Environment Agency, in the early stages of design. The appropriate authorities sometimes agree to limited modifications to improve life safety where, in turn, there will be added long-term protection and preservation of the original building fabric.

NOTE Historic Scotland Guides for Practitioners 6 [9] and 7 [10] contain guidance on, respectively, conversion and fire safety management of traditional buildings.

Specific issues relating to historic buildings can be divided into four areas:

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

2) the existing construction of the building, including hidden features such as the extent of cavities through which fire could spread and the quality of walls, partitions and floors (the fire resistance of which might be unknown

or questionable). Life safety can often be addressed by the use of suitable compensating features, but these do not always cover property protection and business interests;

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

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

In both new construction and upgrading existing buildings, the various aspects of fire precautions are interrelated and weaknesses in some areas can be compensated for by strengths in others. A higher standard under one of the areas might be of benefit in respect of one or more of the other areas. BS 9999 provides a level of flexibility that allows the fire protection measures and the risks to be assessed to enable reasonable practical solutions to be designed.

Fire precautions in all premises – however old – need to be seen as a whole, a package aimed at achieving an acceptable standard of fire safety. In modifying existing structures, if the new work can be shown not to have a negative impact on the remainder, it is possible that no work will be needed on the remainder, although it might be possible to offer improvement as good practice. Whilst existing buildings need not be retrospectively subject to the same standards as new buildings, however, it is important that designers apply the general principle that the safest practicable design is to be sought, and that the prior existence of an unsafe situation is not allowed to persist if it is practicable to provide remedy.

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

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

i) the potential users of the building;

ii) the hazard posed by one occupancy to another;

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

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

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

vi) structural fire protection and compartmentation;

vii) the security of and access to the building.

BS 9999 provides recommendations and guidance on the provision of measures to control or mitigate the effects of fire. The primary objective is to ensure that an adequate standard of life safety can be achieved in the event of fire in the building. A secondary objective is to provide a level of protection for property and businesses against the impact of fire, e.g. in close proximity to residential buildings or as part of the same building or building complex. These can also have the effect of assisting the fire and rescue service and/or of providing environmental protection. There are references throughout this British Standard to occupant safety, fire-fighter safety and property protection, to draw attention to the different issues these could raise. It is, however, important to be aware that provisions solely for life safety are unlikely to provide the full level of protection for buildings and property in a fully developed fire scenario.

Section **2** sets out the principles behind the recommendations and introduces the concept of the risk profile. The recommendations for the provision of means of escape and on construction have been developed to reflect the nature of the occupants and the use of the buildings as well as the likely fire growth and resulting risks associated with that use – the risk profile.

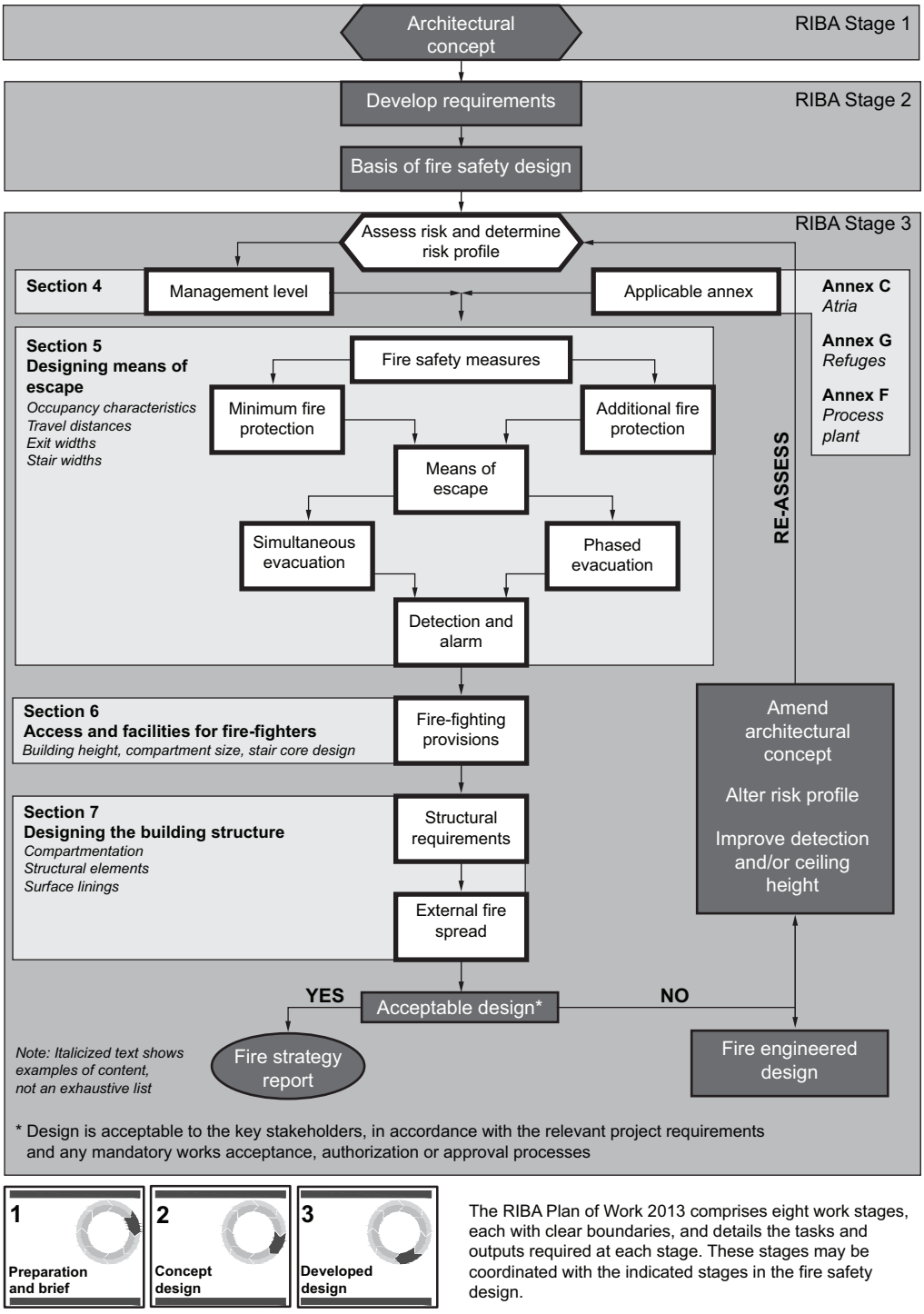
0.2 Application of BS 9999 to the design process

Users of this British Standard will usually be working within the design environment associated with a particular construction project, governed by legislation, processes, constraints, programmes and deliverables that might vary depending on premises type, location, client and regulatory requirements. Having said this, it is possible to propose a framework for the application of this standard that might help the user to optimize its contribution to a typical project, by offering guidance regarding the stages in that project when certain fire engineering and fire protection design activities might most usefully take place. As an example, it is often important that means of escape and fire-fighting access and facilities are considered reasonably early in the design process, as these often significantly influence the structural engineering and architectural design. If fire safety design input is sought or offered too late, it might prove difficult, time-consuming or costly to rectify.

It is also the case that by its nature this standard cannot be configured to present all the guidance applicable to any particular type of premises in the same place: it offers general recommendations and asks the user to cross-refer to different parts of the standard for situation-specific content (often contained in the annexes). Because of this, there is a risk that users might refer to parts of the general recommendations without acknowledging the existence of the specific recommendations, or might use only the specific recommendations without considering the general recommendations in the body of the standard. It is important that users of this standard use it as a whole; the use of individual parts in isolation (e.g. to justify variation from other codes or standards) might not necessarily result in acceptably safe design solutions.

Figure 1 seeks to assist users in the application of this standard to a typical construction project by suggesting when certain activities might most usefully and constructively be carried out, and by guiding the designer as to which parts of the document would usually be consulted at those stages. It uses as a reference the Royal Institute of British Architects (RIBA) Plan of Work 2013 [11], which describes eight work stages for construction projects from business case and strategic brief through to handover into occupation and use. Each stage has defined boundaries, and the RIBA Plan of Work details the tasks and outputs required at that stage.

Figure 1 **Example of the application of BS 9999 to a typical design process**



The RIBA Plan of Work 2013 comprises eight work stages, each with clear boundaries, and details the tasks and outputs required at each stage. These stages may be coordinated with the indicated stages in the fire safety design.

Whilst other project frameworks will be used according to need, with the RIBA plan not being used in many circumstances, it is widely applied and is included to illustrate how the fire-related design activities might most usefully and efficiently be coordinated with civil, architectural and building service design. It is an example of a typical design management process for a building – the activities in the chart will vary from project to project and it is not to be inferred that compliance with this British Standard requires the adoption of the RIBA plan, nor that the stages depicted are to be rigidly applied. The intention is that the principles therein can be adapted to suit the particular design management framework that is to be applied to the building.

Whilst the key components of the fire safety design can be established within the stages represented in the chart, it can be prudent to retain the services of any specialist fire engineering designer responsible for producing the fire strategy beyond these activities. Their support and advice during subsequent work stages up until and including completion and handover can contribute significantly to the safe, successful and timely delivery of the project.

0.3 Tall and very tall buildings

The recommendations in this British Standard can be applied to buildings of any height.

However, the increased design demands on structural integrity, services, fire safety systems, means of fire-fighting and evacuation generated by buildings in excess of 50 m high might mean that specific evaluation of all fire safety provisions is needed using a qualitative design review in accordance with BS 7974. This is to determine whether the recommendations in BS 9999 are appropriate, or whether a full fire engineered solution is required.

0.4 Management of fire safety

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

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

NOTE Attention is drawn to Regulation 38 of the Building Regulations 2010 [1]. Attention is also drawn to the Regulatory Reform (Fire Safety) Order 2005 [2] and to the equivalent regulations in Scotland [6] and Northern Ireland [7].

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

There have been numerous fire incidents, both large and small, where there have been lives lost or put at risk as a result of the safety systems provided being inappropriate or not being used effectively. In some occupancies (such as football grounds), fire is not always seen as the biggest safety problem and care is needed to avoid it becoming a neglected issue.

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

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

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

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

b) by carrying out effective risk assessments and reviewing the adequacy of fire safety precautions and built-in measures, including compartmentation and essential elements such as fire doors and fire-resisting walls and screens;

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

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

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

f) by training staff and organizing the evacuation plan, to ensure that occupants leave quickly if a fire occurs;

g) by taking command in the event of a fire until the fire and rescue service arrives.

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

1 Scope

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

This British Standard is not applicable to the following types of building, which are covered in BS 9991:

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

b) residential accommodation blocks (e.g. for students or hospital staff), with individual bedrooms and the provision of kitchen/sanitary facilities constructed within a fire compartment;

c) specialized housing.

It is not applicable to houses of multiple occupancy (HMOs) or buildings in which occupants receive medical care. It might have only limited applicability to certain specialist buildings and areas of buildings (e.g. areas of lawful detention).

This British Standard is applicable to the design of new buildings, and to material alterations, extensions and material change of use of an existing building.

NOTE Attention is drawn to the Building Regulations 2010 [1] and equivalent national variations ([3] to [5]) in respect of the definition of material alterations, extensions and material change of use.

It also provides recommendations and guidance on the ongoing management of fire safety in a building throughout the entire life cycle of the building, including measures for designers to ensure that the overall design of a building assists and enhances the management of fire safety. It can be used as a tool for assessing existing buildings, although fundamental change in line with its recommendations might be limited or not practicable.

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

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

2 Normative references

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

Standards publications

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

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

BS 1635, *Recommendations for graphic symbols and abbreviations for fire protection drawings*