British Automatic Fire Sprinkler Association

bafsa

Technical Guidance Note No 2

Issue No 1: October 2011
Amendment 1: Feb 2012
ISBN 0-9552628-8-7

Using Sprinkler Systems in Buildings and Structures

Compliance with current fire safety guidance

In this Technical Guidance Note readers will find extracts from official documents or summaries thereof reproduced in boxes, frequently followed by notes entitled 'Sprinkler Compensation Benefits'. Such notes describe the positive contributions which sprinkler installations can make to the fire prevention/protection issue which is under consideration.

This document is issued for the guidance of BAFSA members and should be used in accordance with the contents of BS EN 12845: 2009, BS 9251: 2005 and the *LPC Rules for Automatic Sprinkler Installations*. (It may be worth noting that many sprinkler installations in the UK were designed and installed by reference to BS 5306: Part 2, which has been withdrawn.)
In providing this information BAFSA makes no warranties or undertakings as to its accuracy or completeness and assumes no liabilities in connection with the way the advice and information is used. Any deviations from BS EN 12845: 2009 or BS 9251: 2005 which may be contemplated should be agreed with the Authority Having Jurisdiction and any minor deviations recorded on the Certificate of Compliance detailing the Originator of the Deviation. BAFSA's advice is that Certificates of Compliance should not be issued where a system has been installed with major departures from the requirements of BS EN 12845: 2009 or BS 9251: 2005.

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1. Introduction

Altough there has been a welcome decline in the number of fires in the UK over the past five years, annual fire losses, including the costs of fire, have continued to rise. The same data makes it clear that most of the fatalities and injuries in fire affect the most vulnerable members of our society such as the very young, the elderly and the socially disadvantaged, all of whom are disproportionately represented.

There is now broad acceptance that the most effective way of protecting such groups (who are in the 'hardest-to-reach' community in respect of the fire safety message) is to consider whether the use of an automatic fire sprinkler system might provide the protection which cannot be provided by other forms of fire safety measures.

The installation of sprinklers can result in considerable savings in building construction costs, the provision of flexibility of design, enhanced levels of occupant safety and improved levels of property protection. At the same time, improved levels of business resilience can be provided in commercial and industrial occupancies.

This Technical Guidance Note provides 'one-stop' access to a range of information to demonstrate the benefits of incorporating automatic fire suppression into a particular building design. It will allow all those involved in the building process, such as property developers, authorities having jurisdiction, architects, designers and end users to determine which approach to compliance with building regulations is the most advantageous. It also includes consideration of cost savings which can be achieved.

Authorities Having Jurisdiction (AHJ) include building control departments, Approved Inspectors, fire authorities and, in some cases, insurers.

1.1 Sprinkler Standards

1.1.1 BS EN 12845: 2009

British Standard BS EN 12845: *Fixed firefighting systems – Automatic sprinkler systems – Design, installation and maintenance*, replaces BS 5306: Part 2: 1990 which itself was based on an insurance standard, the 29th edition of the Fire Offices' Committee's Sprinkler Rules. The FOC Rules, which originated in the closing years the nineteenth century, set out how sprinklers should be designed and installed for the protection of commercial and industrial premises.
BS EN 12845 also forms part of the LPC Rules for Automatic Sprinkler Installations. The latter, known widely as the LPC Rules, are now extensively used in the UK and elsewhere and tend to be imposed for all sprinkler installations which are either mandated by an insurer or where a property owner wishes to avoid higher insurance premiums if a sprinkler system is not provided.

1.1.2 BS 9251: 2005

The standard BS 9251: 2005: *Sprinkler systems for residential and domestic occupancies. Code of Practice*, provides recommendations for the design, installation, components, water supplies, commissioning and maintenance of fire sprinkler systems for use specifically in residential and domestic occupancies.

The recommendations contained in this British Standard result from the best technical information available to the committee at the time of writing. This BS is currently (July 2011) undergoing a major review by BSI and BAFSA suggests that, until the review is complete and a revised version becomes available, reference should also be made to its revised Technical Guidance Note No 1, *The design and installation of residential and domestic sprinkler systems* which will be published at the same time as this document.

The design and installation of any critical fire system should be entrusted only to a suitably qualified and experienced sprinkler contractor.

Attention is drawn to the requirements of BS 6700 with special regard to back-flow prevention and to BS 1710 for guidance on identification and marking of pipework. Special attention is also drawn to the requirements of the Water Regulations.

1.1.3 NFPA 13, 13R, 13D Sprinkler Standards

The US National Fire Protection Association (NFPA) publishes all US technical standards relating to fire protection and fire fighting. NFPA 13: 2010 covers industrial and commercial systems, NFPA 13R: 2010 covers sprinklers in residential buildings and 13D:2101 [???date] covers domestic premises.

The NFPA 13 series of document is revised and updated every three to five years in revision cycles that begin twice each year and normally take approximately two years to complete. Each revision cycle proceeds according to a published schedule that includes final dates for all major events in the process

1.1.4 FM Sprinkler Standards

FM Global is a major international engineering insurer which has produced not only its own sprinkler standards but also runs its own product approval service, FM Approvals. FM Approvals not only evaluates sprinklers and sprinkler system components for compliance with existing standards, but it also works closely with manufacturers to evaluate new products and develop appropriate standards. If FM has a particular strength it is in its willingness to fund and undertake research into new protection technology and it has largely been responsible for the introduction of improvements in sprinkler head design for storage occupancies – including much of the development of ESFR sprinklers.

1.2 Compliant Installations

1.2.1 LPC Rules for Automatic Sprinkler Installations

Sprinkler systems can only be effective if designed, installed and maintained correctly. The Fire Protection Association issues the *LPC Rules for Automatic Sprinkler Installations* on behalf of UK insurers through RISCA and develops and issues Technical Bulletins (TBs) which

supplement the BS EN standard. These TBs cover issues which are not included in the BS EN document or where UK insurers believe that the BS EN requires elaboration. The LPC Rules include the text of BS EN 12845.

1.2.2 Certification of Installers

It is widely agreed that third-party certification of installers is the most effective way of ensuring that a system is correctly designed and installed and the UK sprinkler industry has operated under such controls since the early 1990s.

(See, for example, Approved Document B (both parts) of the Building Regulations 2010, page 6, 'Independent certification schemes' and also the recent statement from the Scottish Building Standards Agency at: http://www.firelawscotland.org/v25e5e.html?pContentID=243)

There are two certification bodies presently operating schemes for installers of industrial and commercial sprinkler systems.

(a) Loss Prevention Certification Board (LPCB)

The Loss Prevention Certification Board (part of BRE) runs a certification scheme based on Loss Prevention Standard (LPS) 1048: *Requirements for the approval of sprinkler contractors in the UK and Ireland*. It specifies requirements for certified sprinkler installers, supervising bodies and supervised installers. A key element of the LPS 1048 scheme is the LPCB Certificate of Conformity, which is issued upon completion of the works. It is important that specifiers always request Certificates at the completion of the installation, to provide the necessary assurance that the system/s have been designed and installed by certificated installers in accordance with the requirements of the scheme which includes the need to use only approved, tested components.

(b) Warrington Certification Limited

This organisation runs a scheme (FIRAS) for industrial and commercial installers which provides similar assurances to specifiers, end users and regulators.

Both the LPC and Warrington also run schemes for installers of residential and domestic systems.

1.3 Residential and domestic sprinkler systems

The primary purpose of a residential/domestic sprinkler system is to provide life safety protection for the occupants. Such systems are designed to control any fire that occurs to allow time for the occupants to escape or be rescued. The operation of any sprinkler system will also provide a significant degree of property protection by minimising damage to the room of origin of the fire.

The provisions of BS 9251: 2005: *Sprinkler systems for residential and domestic occupancies* have been in existence for more than 10 years, since its inception as DD 251 in 2000.

While the advice and information in the standard has been found to be generally sound, a number of its clauses have given rise to differences and difficulties in interpretation. This Guidance Note is designed, among other things, to clarify matters.

Since BS 9251: 2005 is a Code of Practice it presents guidance through a series of recommendations. Thus the strongest directive word in the document is 'should', rather than ‘shall’ or ‘must’. Designers and installers, however, in the opinion of the British Automatic Fire Sprinkler Association, ought to ensure that where a system design or installation deviates from the recommendations in BS 9251 such deviations are brought to the attention to the Authority Having Jurisdiction (AHJ) for acceptance. To this end, BAFSA produced its Technical Guidance Note No 1 in 2006 and that provides a commentary on the contents of BS 9251 and suggests ways in which it can be more effectively used as a basis for the design and installation of sprinkler systems in residential and domestic premises.

Any minor deviations from BS 9251 in system design or installation must be recorded in writing in the Certificate of Compliance (or completion or other document) provided to the end user or owner by the installer. The deviations recorded should indicate who had originated or requested the deviations and that they have been accepted by the AHJ or the owner.

1.4 Third-party certification schemes

The high reliability and effectiveness of sprinkler systems has come about over the years by strict adherence to national standards (and before these to the Sprinkler Rules). Therefore, it would be wise to select a contractor who is not only capable and competent but who also has an established track record and who can offer proof of compliance with an established quality assurance system.

For example, all third party certificated, installer members of the British Automatic Fire Sprinkler Association can provide documentary proof of compliance with international quality assurance standards and all also hold an approval (Registration or Certification) from a third-party certification service which itself is accredited by a Government-approved body, the United Kingdom Accreditation Service (UKAS).

Most BAFSA installer members have been in business for more than ten years and some for more than 30 and all can provide documentary evidence of their competence.

The use of third-party certificated components and materials in sprinkler systems is also extremely important and mandated by the LPCB scheme, LPS 1048. The only UK agency undertaking such testing and certification is the LPCB. However, most AHJs (including insurers) will accept test certificates issued by any reputable test house including the German VdS, and the USA’s FM and UL (Underwriters’ Laboratories).

1.5 Maintenance of sprinkler systems

Once a sprinkler system has been handed over to its owners, the responsibility for the equipment will rest with them. Whether or not the system will operate as designed when required will depend on whether the correct maintenance procedures are carried out.

Article 17(1)[1] of the Regulatory Reform (Fire Safety) Order 2005, which came into effect in England Wales on 1 October 2006, imposes significant liabilities on the 'Responsible Person', (for which read employer or property owner, 'dutyholder; in Scotland)) who fails to maintain fire safety equipment (including sprinkler systems) intended for the protection of life from fire.

To maintain the validity of a Certificate of Conformity the system must be serviced and maintained by a sprinkler servicing contractor (as defined in LPC Rules' Technical Bulletin TB 203.3.2.8) under a maintenance contract, from the time the sprinkler system is commissioned.

1.5.1 It is quite acceptable, subject to the approval of the insurers (if involved), for routine weekly and monthly maintenance checks for industrial and commercial sprinkler systems to be undertaken by suitably trained personnel working for the owner. Quarterly, half-yearly and annual maintenance checks should be undertaken by specialist contractors.

1.5.2 Note that part of the quarterly maintenance required by both BS 12845 and the *LPC Rules* is the Hazard Review[2]. This is intended to ensure that the sprinkler system is still fit for purpose in respect of the 'structure, occupancy, storage configuration, heating, lighting or equipment of the building or hazard classification or installation design' (*LPC Rules*: TB 203:2009: 3.2.2). Hazard Reviews should only be undertaken by persons deemed to be competent for this task and it should be noted that failure to determine that a sprinkler system is deficient in some way might not only render insurance cover invalid but it may be a breach of legislation by way of failure to maintain a system provided for the safety of life.

2.0 Approved Document B: Fire safety

Schedule 1 of the Building Regulations for England and Wales contains provisions with regard to securing reasonable standards of health and safety for persons in or about buildings. Part B of the Schedule deals with fire safety. Approved Document B, *Fire safety*, is one of a series issued by the Department for Communities and Local Government to aid compliance with the Building Regulations, and it contains practical guidance and recommendations, concerning some of the more common building situations, which can be followed by those seeking to comply with the legal provisions of Part B of the Schedule. There is no obligation to adopt any particular solution contained in an Approved Document if an alternative is preferable – it contains guidance only and its recommendations are not legal requirements. It has always been possible to prove compliance with the standards of fire safety required by a number of ways including compliance with the BS 5588 series (now replaced - see BS 9999 below).

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[1] This reads: "17. —(1) Where necessary in order to safeguard the safety of relevant persons the responsible person must ensure that the premises and any facilities, equipment and devices provided in respect of the premises under this Order or, subject to paragraph (6), under any other enactment, including any enactment repealed or revoked by this Order, are subject to a suitable system of maintenance and are maintained in an efficient state, in efficient working order and in good repair".

[2] In some buildings, fire hazards (i.e. the contents and storage) change from time to time and it is important that the sprinkler system be maintained appropriate for the hazard to be protected."

Since 2006 Approved Document B has been issued in two volumes:

Vol. 1: Dwellinghouses

Vol. 2: Buildings other than dwellinghouses

2.1 Summary

There are five key areas covered within Approved Document B which are:

B1 Means of warning and escape
B2 Internal fire spread (linings)
B3 Internal fire spread (structure)
B4 External fire spread
B5 Access and facilities for the fire service

In turn, these five key areas are sub-divided into 18 sections covering the detailed Building Regulations' requirements. Most of these sections describe the role sprinklers have in building fire safety and the design trade-offs or advantages that can be realised if they are incorporated in a design.

For example, in vol.2, on page 11, under the heading of General Introduction, reference Paragraph 0.16 (part of which is reproduced below), the compensatory features of sprinklers are described. This paragraph/mention is repeated at least 14 times throughout the various sections of Approved Document B.

SPRINKLER SYSTEMS
0.16 Sprinkler systems installed in buildings can reduce the risk to life and significantly reduce the degree of damage caused by fire. Sprinkler protection can also sometimes be used as a compensatory feature where the provisions of this Approved Document are varied in some way. Where sprinklers are provided, it is normal practice to provide sprinkler protection throughout a building. However, where the sprinklers are being installed as a compensatory feature to address a specific risk or hazard, it may be acceptable to protect only part of a building. As is made clear elsewhere, BAFSA do not recommend partial protection and where this is to be provided, it is essential to obtain the written agreement of the AHJ or where there is no AHJ, the architect, developer or owner. Further guidance can also be found in *Sprinklers for Safety: Use and Benefits of Incorporating Sprinklers in Buildings and Structures*, BAFSA 2006 (ISBN: 0 95526 280 1). . .

2.2 Means of escape

2.2.1 Schedule 1, Part B, Requirement B1

Means of warning and escape
B1. The building shall be designed and constructed so that there are appropriate provisions for the early warning of fire, and appropriate means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times.

2.2.2 Approved Document B, B1 Means of escape from flats, paragraph 2.7

Paragraph 2.7. Balconies and flat roofs

Any balcony outside an alternative exit to a flat more than 4.5m above ground level should be a common balcony and meet the conditions in paragraph 2.17.

A flat roof forming part of a means of escape should comply with the following provisions:

a. the roof should be part of the same building from which escape is being made;

b. the route across the roof should lead to a storey exit or external escape route; and

c. the part of the roof forming the escape route and its supporting structure, together with any opening within 3m of the escape route, should provide 30 minutes fire resistance (see Appendix A Table A1).

Paragraph 2.7 - Sprinkler Compensation Benefit
Escape travel distances are limited by the prescriptive guidance in order to limit the time taken to reach an exit. Extension of escape travel distances may be facilitated by the provision of automatic sprinklers (among other considerations). This is because sprinklers have the ability to control fire growth and hence conditions can remain tenable for longer than if sprinklers were not present. This allows extra time for escape and therefore it may be acceptable to travel farther to an exit.

Means of escape in the common parts of flats
Paragraph 2.20. Number of escape routes
Every flat should have access to alternative escape routes so that a person confronted by the effects of an outbreak of fire in another flat can turn away from it and make a safe escape. However, a single escape route from the flat entrance door is acceptable if either:

a. the flat is situated in a storey served by a single common stair and:

i. every flat is separated from the common stair by a protected lobby or common corridor (see Diagram 7); and

ii. the travel distance limitations in Table 1(see paragraph 2.23), on escape in one direction only, are observed; or

b. alternatively the flat is situated in a dead end part of a common corridor served by two (or more) common stairs and the travel distance complies with the limitations in Table 1 on escape in one direction only (see Diagram 8).

Paragraph 2.20b - Sprinkler Compensation Benefit
When an escape stair opens into open plan area, this will be allowed when sprinkler protection is provided within the open area.

2.2.3 Means of escape from flats (non dwellings)

Internal planning of flats with more than one storey
Paragraph 2.16
Four acceptable approaches to planning a multi-storey flat, which does not have its own external entrance at ground level but has a floor at more than 4.5m above ground level, are:

a. to provide an alternative exit from each habitable room which is not on the entrance floor of the flat, (see Diagram 5); or

b. to provide one alternative exit from each floor (other than the entrance floor), with a protected landing entered directly from all the habitable rooms on that floor, (see Diagram 6); or

c. where the vertical distance between the floor of the entrance storey and the floors above and below it does not exceed 7.5m, to provide a protected stairway plus additional smoke alarms in all habitable rooms and a heat alarm in any kitchen; or

d. to provide a protected stairway plus a sprinkler system in accordance paragraph 0.16 (smoke alarms should also be provided in accordance with paragraph 1.9).

Paragraph 2.16d - Sprinkler Compensation Benefit
The installation of a sprinkler system within a protected stairway dispenses with the additional costs associated with meeting the requirements for alternative exits and additional smoke alarms in all habitable rooms.

2.2.4 Means of escape from residential care homes

Residential care homes are diverse, catering for a wide variety of residents each requiring different types of care to suit their specific needs. These residents include the elderly, children and people who are physically or mentally disabled. Therefore, the choice of fire safety strategy for a residential care home is dependent upon the building design and the way it is furnished, staffed, managed and also the level of dependency of the residents.

Planning for progressive horizontal evacuation
Paragraphs 3.41-3.51
Residential care homes should be designed for progressive horizontal evacuation (PHE) in accordance with the recommendations of paragraphs 3.41 to 3.51 that propose additional compartment walls and floors, exits, fire doors, free swing closers in bedrooms and hold-open devices in circulation areas. In addition as many as 12 different types of auxiliary/storage rooms may need to be constructed using fire-resisting materials.

Paragraph 3.52 - Sprinkler Compensation Benefits
The installation of a sprinkler system in accordance with paragraph 0.16 dispenses with the additional costs associated with meeting the recommendations of paragraphs 3.41 to 3.51.
Note: *Management procedures will need to take account of the larger number of residents that may need assistance and the need for manual closure of bedroom doors during sleeping hours.*

2.2.5 Design for vertical escape – buildings other than flats
An important aspect of means of escape in multi-storey buildings is the availability of a sufficient number of adequately sized and protected escape stairs so that most people can independently reach the safety of a protected escape route or final exit. However, some people may not be able to reach the stairs without assistance. Therefore, it may be necessary to use refuges on escape routes or suitable lifts. Alternatively, they may require assistance down (or up) stairways.

Escape stairs and refuges, buildings other than flats
Paragraphs 4.2 – 4.19
Vertical escape from these types of buildings should be designed in accordance with the recommendations of paragraphs 4.2 – 4.19. These include additional stairways, their minimum and maximum widths, access for the Fire & Rescue Service, their ability to use these stairways for firefighting purposes and the provision of refuges for disabled people. To facilitate the effective evacuation of people from refuges an emergency voice communication (EVC) system should be provided in accordance with paragraphs 4.11 – 4.13. It is essential that the occupants of each refuge are able to alert other people that they are in need of assistance and for them to be reassured that this assistance will be forthcoming.

Paragraph 4.20 - Sprinkler Compensation Benefits
Although the discounting of stairs is still required for calculations associated with occupancy in sprinklered buildings, the presence of a sprinkler system dispenses with the additional costs associated with providing additional stairways, meeting their width requirements and the provision of refuges and their associated ECV systems.

Paragraph 4.29d - Sprinkler Compensation Benefits

All buildings (except car parks for light vehicles) over 30m high must be sprinklered to 'life safety standard', when using a phased evacuation plan. Compliance with this recommendation compensates for the difficulties the fire service has in performing external rescue at this height.

Paragraph 5.58 - Sprinkler Compensation Benefits
Fully enclosed walk-in store rooms in shops (unless provided with an automatic fire detection and alarm system or fitted with sprinklers) should be separated from retail areas with fire-resisting, if they are sited so as to prejudice the means of escape construction (see Appendix A, Table A1, item 13b of Approved Document B, volume 2).

2.3 Compartmentation

2.3.1 Schedule 1, Part B, Requirement B3

The spread of fire within a building can be restricted by sub-dividing it into compartments separated from one another by walls and/or floors of fire-resisting construction. This will ensure that both the spread and growth of a fire is limited to a specific area and can be dealt with more effectively and efficiently by firefighters.

Design for compartmentation in flats
Paragraph 8.13
In buildings containing flats, the following should be constructed as compartment walls or compartment floors:
a. every floor (unless it is within a flat, i.e. between one storey and another within one individual dwelling); and

b. every wall separating a flat from any other part of the building; and

Note: Any other part of the building does not include an external balcony/deck access.

c. every wall enclosing a refuse storage chamber.

Paragraph 8.14 - Sprinkler Compensation Benefits
Blocks of flats with a floor more than 30m above ground level should be fitted with a sprinkler system in accordance with paragraph 0.16. The presence of a sprinkler system dispenses with the additional construction costs associated with paragraph 8.13

Note: *Sprinklers need only be provided within the individual flats, they are not required in the common areas such as stairs, corridors or landings. For the purposes of this paragraph the limit on the scope of BS 9251: 2005 to buildings below 20m in height can be ignored.*

Approved Document B, Appendix A, Table A2
Maximum dimensions of building or compartment (non-residential buildings)
Maximum dimensions of a building or compartment are limited or restricted for many purpose groups.

Table 2 - Sprinkler Compensation Benefits
Maximum dimensions of a building or compartment are significantly increased for many purpose groups if the premises are sprinklered.

2.4 Fire resistance

2.4.1 Approved Document B, Appendix A, Table 2

Issues relating to fire resistance are dealt with in Appendix , 'Performance of materials, products and structures'. Factors that have a bearing on fire resistance include fire severity, building height and its type of occupancy.

Minimum periods of fire resistance
Table A2
Table A2 sets out the minimum periods of fire resistance for elements of structure within six different purpose groups, many of which are referred to in the Table as 'not sprinklered' or 'sprinklered'.

Table A2 - Sprinkler Compensation Benefits
If a sprinkler system is installed within any of the six purpose groups included in Table A2, the fire resistance periods cited are significantly reduced to such an effect that credible savings can be made on conventional construction costs.

2.5 Mechanical smoke extract from basements

2.5.1 Schedule 1, Part B, Requirement B3

The ability of firefighters to carry out rescue and firefighting operations can be seriously impaired by the build-up of smoke and heat as a result of a fire. With this fact in mind, the provision of smoke extraction and venting systems can significantly improve conditions for firefighters. Section 18 of Approved Document B, volume 2, covers the requirements for the venting of heat and smoke from basements.

Venting of heat and smoke from basements
Paragraphs 18.3-18.12
Smoke outlets/vents allow heat and smoke to escape to the open air from basement level(s). They can also be employed by the Fire & Rescue Service to 'draw in' cooler air into

basement(s) to reduce the temperature within the basement(s). Therefore, smoke extraction systems should be designed in accordance with the requirements of paragraphs 18.3 – 18.12. These outline the types of extraction (mechanical or natural) systems that can be used, the numbers required and where they can be positioned.

Paragraph 8.14 - Sprinkler Compensation Benefits
As an alternative to natural venting, mechanical smoke extraction can be used provided the basements are sprinklered. It is also worth noting that the presence of a sprinkler system will prevent a small fire from developing into a large fire in the first place. The discharge spray from a sprinkler head will also aid the dispersal of smoke and toxic gases and will help to create a 'safer environment' for firefighters tackling a fire.
Note: *The exception is basement car parks where mechanical ventilation may be used in the absence of sprinklers.*

2.6 Access to buildings for firefighting personnel

2.6.1 Schedule 1, Part B, Requirement B5

In low-rise buildings without deep basements fire and rescue service personnel access requirements will be met by a combination of the normal means of escape and the measures for vehicle access in Section 16 of Approved Document B, volume 2, which facilitate ladder access to upper storeys. In other buildings, the problems of reaching the fire and working inside near the fire necessitate the provision of additional facilities to prevent delay and to provide a sufficiently secure operating base to allow effective action to be taken. These matters are dealt with in Section 17 of the Approved Document.

Design, construction, provision, number and location of firefighting shafts
Paragraphs 17.2-17.10
Paragraphs 17.2 – 17.8 outline the recommendations for the types of firefighting lifts, firefighting stairs and firefighting lobbies that can be combined in a protected shaft known as the firefighting shaft. These paragraphs also explain what firefighting shafts can be used, the numbers required and where they can be positioned. If the building is not fitted with sprinklers then every part of every storey that is more than 18m above fire and rescue service vehicle access level (or above 7.5m where covered by paragraph 17.3), should be no more than 45m from a fire main outlet contained in a protected stairway and 60m from a fire main in a firefighting shaft, measured on a route suitable for laying hose.
Note: In order to meet the 45m hose criterion it may be necessary to provide additional fire mains in escape stairs. This does not imply that these stairs need to be designed as firefighting shafts.

Paragraph 17.9 - Sprinkler Compensation Benefits
If the building is fitted throughout with an automatic sprinkler system in accordance with paragraph 0.16, then the number of firefighting shafts may be reduced along with the number of fire mains in the escape stairs.

2.7 Internal fire spread

2.7.1 Schedule 1, Part B, Requirement B3

A building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period. A wall common to two or more buildings shall be designed and constructed so that it adequately resists the spread of fire between those buildings. Where reasonably necessary to inhibit the spread of fire within the building, measures shall be taken, to an extent appropriate to the size and intended use of the building.

Fire resistance of structure
Paragraph 7.8
A structure which does not have the appropriate fire resistance given in Appendix A, Table A1 of the Approved Document (volume 2) is acceptable provided the conditions such as the number of tiers within the structure, the number and type of people working within the area and the size of the floor, its openings and means of escape are satisfied.

Paragraph 7.8, Note 3 - Sprinkler Compensation Benefits
Note 3 to paragraph 7.8 states that if a building is fitted throughout with an automatic sprinkler system in accordance with paragraph 0.16, then there are no limits on the size of the floor. Considerable savings can be made without the need for fire resistant compartmentation to prevent the internal spread of fire.

2.8 External fire spread

2.8.1 Schedule 1, Part B, Requirement B4

Provisions are made in this section for the external walls of the building to have sufficient fire resistance to prevent fire spread across the relevant boundary. Space separation provisions limit the extent of unprotected areas in the sides of a building (such as openings and areas with a combustible surface) which will not give adequate protection against the external spread of fire from one building to another. Note that the Regulatory Reform (Fire Safety) Order 2005 introduced the concept of the duty of care owed by employers and/or property owners to persons other than those present in buildings. Known as 'Relevant Persons', group includes anyone who might be affected by a fire in a building (other than fire and rescue service personnel engaged in fire fighting). The new duty of care is therefore much more widely drawn and could include persons outside a building and its immediate vicinity. It is BAFSA's view that it may be that the courts would regard the installation of a sprinkler system in a building as an effective way of discharging the legal obligation.
[I respectfully suggest that the bit highlighted in red is reviewed and possibly redrafted. There was occupiers' liability legislation from as far back as 1957. And maybe what is the intention is simply to put a bit more flesh on the term 'relevant person. Not sure if the concluding sentence would not be a hostage to fortune. Mike Gale]

2.8.2 Space separation

Space separation
Paragraph 13.2
Assumptions are made that the size of a fire will depend on the compartmentation of the building, so that a fire may involve a complete compartment, but will not spread to other compartments. Other assumptions include whether the intensity of the fire is related to the use of the building and whether Residential and Assembly and Recreation Purpose Groups represent a greater life risk than other uses.

It also assumes that there is a building on the far side of the 'relevant boundary' that has a similar elevation to the one in question and that it is at the same distance from the common boundary and that the amount of radiation that passes through any part of the external wall that has fire resistance may be discounted.

Paragraph 13.2b - Sprinkler Compensation Benefits
Space separation between buildings can be modified where sprinklers are fitted due to reduced fire intensity. The boundary distance, as determined by the various methods, may thus be halved for sprinklered premises (13.17) and the unprotected areas may double if the boundary distance is maintained.

2.8.3 Unprotected area

Note to paragraph 13.7
Note: Any part of an external wall which has less fire resistance than the appropriate amount given in Appendix A, Table A2, is considered to be an unprotected area.

2.9 Fire safety information: building plans and records

2.9.1 Approved Document B. Volume 2, Appendix G

This Appendix is only intended as a guide as to the kind of information that should be provided to the 'responsible person'. For clarity, the guidance is given in terms of simple and complex buildings, although the level of detail required will vary with each building and should be considered on a case by case basis.

Building plans and records
Appendix G, Notes 2 and 3
In Simple Buildings the location of any sprinkler system(s), including isolating valves and

control equipment, should be provided on an 'As-built' plan of the building (Note 2e). For more complex buildings a more detailed record of the fire safety strategy and procedures for operating and maintaining any fire protection measures of the building will be necessary. These records should include details of all active fire safety measures such as sprinkler system(s) design, including isolating valves and control equipment (Note 3f).

3.0 Scottish Technical Handbook 2005

3.1 Summary

Life safety is the paramount objective of fire safety. The aim of the Scottish Technical Handbook is that all non-domestic and domestic buildings should be designed and *constructed* in such a way that the risk of fire is reduced and, if a fire does occur, there are measures in place to restrict the growth of fire and smoke to enable the occupants to escape safely and fire-fighters to deal with fire safely and effectively.

The standards and guidance in the Scottish Technical Handbook are designed to work together to provide a balanced approach for fire safety. Where a building element, material, component, or other part of a building is covered by more than one standard, the more demanding guidance should be followed.

In order to achieve these objectives, the building elements, materials, components or other parts of the building identified in the guidance should follow the appropriate performance levels that are recommended throughout the guidance.

3.2 Non-domestic buildings

3.2.1 Compartmentation

Paragraph 2.1.1. Mandatory Requirement – Compartmentation
Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, fire and smoke are inhibited from spreading beyond the compartment of origin until any occupants have had the time to leave that compartment and any fire containment measures have been initiated. Single-storey buildings and compartmentation between single-storey and multi-storey buildings where appropriate have a maximum compartmentation size and minimum fire resistance duration for compartmentation.

Paragraph 2.1.1. Notes1 and 2 - Sprinkler Compensation Benefits
If the building is fitted throughout with an automatic sprinkler system in accordance with paragraphs 2.1.2 and 2.1.3 then compartment areas may be doubled. Considerable savings can be made without the need for maximum Compartmentation sizes to prevent the internal spread of fire.

3.2.2 Fire resistance requirements

Paragraphs 2.1.5 and 2.6. Mandatory Requirement – Fire resistance for compartmented, separated and external walls
Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the spread of fire to neighbouring buildings is inhibited. The distance between a building and its relevant boundary is dictated by the amount of heat that is likely to be generated in the event of fire. Generally, this will be influenced by how the building is used.

Paragraphs 2.1.5, 2.6.1, 2.6.2 & 2.6.3 Clauses - Sprinkler Compensation Benefits
For buildings with different uses, the presence of sprinklers allows lower fire resistance durations to be permitted and considerable savings may be achieved in this respect. This also includes the reduced fire resistance of external walls and reduced boundary distances that are permitted for shop, entertainment, Class 1 factory and storage buildings if sprinklers are present.

3.2.3 Occupancies requiring sprinklers

Clause 2.15.1, Annex 2B and 2C. Mandatory Requirement – Automatic sprinkler systems
Residential care buildings, enclosed shopping centres and sheltered housing require life safety sprinklers. Some areas in hospitals may require automatic fire suppression (depending on hospital layout). Exceptions for areas of sprinkler coverage in shopping centres are given in Annex 2C (e.g. car parks, malls >10m in height, stair enclosures).

3.2.4 Mechanical smoke extract from basement

Clause 2.14.7. Requirement - Venting of heat and smoke from basements
A *basement storey* is any *storey* below the *ground storey*. Ventilation should be provided to assist fire-fighting operations and to allow smoke clearance after the fire. Smoke outlets, communicating directly with the external air, should be provided from every *basement storey*, and where the *basement storey* is divided into *compartments*, from every *compartment*.

Clause 2.14.7 Note 6 - Sprinkler Compensation Benefits
However, smoke outlets need not be provided where the basement storey has an automatic fire suppression system (which conforms to BS 5306: Part 2: 1990 or BS EN 12845: 2004) and is ventilated by a mechanical smoke and heat extraction system incorporating a powered smoke and heat exhaust ventilator which has a capacity of at least 10 air changes per hour and conforms to BS 7346: Part 2: 1990 with a class D level of performance or BS EN 12101-3: 2002 Class F300.

3.3 Domestic buildings

2.15 Mandatory Requirement – Life safety fire suppression system
Every high rise domestic building, residential care building or a building that forms the whole or part of a sheltered housing complex over a height of 18 metres must be designed and constructed in such a way that, in the event of an outbreak of fire within the building, fire and smoke will be inhibited from spreading through the building by the operation of an automatic life safety fire suppression system.

2.9.17 Smoke control in corridors

IMPORTANT NOTE: This guidance document has now been superseded by BS EN 12101: *Smoke and heat control systems*, Part 6: 2005: *Specification for pressure differential systems*.

BS EN 12101 – 6: Table 7 - Sprinkler Compensation Benefits
Where an automatic sprinkler system is installed it allows the temperature rating of fans and ductwork to be reduced where mechanical air release is adopted.

4.0 BS 5588: Part 1

4.1 Overview of impending changes to BS 5588: Part 1

BS 5588 was originally introduced to deal with the generic issue of 'fire safety in the design, management and use of buildings' (the words in quotation marks was the overall title of the BS 5588 series of Standards) and Part 1 was a Code of Practice for Residential Buildings.
All but Part 1 of BS 5588 was withdrawn in April 2009 when BS 9999 was introduced to supersede most of the BS 5588 series (the requirements of BS 9999 are described in Section 14 of this Technical Bulletin, see page 00). BS 9999 covers everything except residential accommodation and even covers some of that so far as common parts of buildings which house multiple residential units are concerned.

A full revision of BS 5588: Part I is currently taking place and as a result it will be withdrawn and replaced by a new BS 9991 standard, which is due for publication by the end of 2011. It cannot be confirmed exactly what will be in the document but in principle it will be a full revision and update of BS 5588-1 and will incorporate some of the ideas promulgated in BS 9999 together with the introduction of guidance on current fire safety issues affecting residential buildings. Cognisance will also be taken of the variations in guidance currently provided by legislators in support of fire safety issues in new buildings, in particular the differing requirements between the various national administrations within the UK. The issue of use of automatic sprinklers as a life and property safety/conservation issue will also be covered.

5. Health Services Technical Memorandum 05-02, 86,88

5.1 Summary

Health Technical Memorandum 05-02 is a Code of Practice which recognises the special requirements of fire precautions in the design of healthcare premises and should allow the current statutory regulations to be applied sensibly within a framework of understanding.

This guidance recognises: the interaction between physical fire precautions, the dependency of the patient, and the fire hazards within the healthcare premises: the management policies: and the availability of sufficient and adequately trained staff to achieve an acceptable level of fire safety within healthcare premises.

5.2 Means of escape

5.2.1 Progressive horizontal evacuation

Paragraph 3.10. Mandatory requirement – Life safety
The principle of progressive horizontal evacuation is that of moving occupants from an area affected by fire through a fire-resisting barrier to an adjoining area on the same level, designed to protect the occupants from the immediate dangers of fire and smoke (a refuge).

Paragraph 3.11 - Sprinkler Compensation Benefits
Where a sprinkler system is incorporated into a building, the evacuation travelling times can be extended.

Paragraph 5.6 - Sprinkler Compensation Benefits
On floors above ground-floor level where sprinklers are installed, the fire-resistance of the compartment walls required by paragraph 5.4(b) may be reduced to 30 minutes (integrity and insulation).

5.2.2 Separation of patient-access areas from other parts of a hospital

Paragraph 3.14. Requirement - Separation of patient-access areas from other parts of a hospital
The location and fire separation of fire hazard departments in relation to patient-access areas on healthcare premises may be adjacent but should always be separated by 60-minute fire-resisting construction as outlined in Table 2.

Paragraphs 5.6 & 5.8 - Sprinkler Compensation Benefits

60 minutes' fire resistance may be reduced under certain circumstances (for example if sprinklers are fitted see paragraphs 5.6 and 5.8).

Paragraph 5.9. Requirement - Floors over 12m above ground level
Every level over 12m above ground that contains patient-access areas should be divided into a minimum of four compartments. Where no hospital street is provided, each compartment should have a minimum area of 500m^2; where one of the compartments is a hospital street, the area of the hospital street may be less than 500m^2. All compartments must be interconnecting. Unless the design incorporates a hospital street, there should be a minimum of three exits from each compartment.

Paragraph 5.9 - Sprinkler Compensation Benefits
Where sprinklers are installed, the minimum floor area of each compartment required by paragraph 5.9 may be reduced to 350m^2.

5.2.3 Glazing in sub-compartment walls

Paragraph 5.29, notes a & b, and paragraph 5.30. Requirement – Limits on fire resisting glazed screens
Un-insulated fire-resisting glazed screens may only be provided in sub-compartment walls provided the glazing should provide a minimum period of 30 minutes' fire resistance (integrity only) and the area of integrity-only glazing should be limited to a maximum of 1000mm^2 in any room. However, paragraph 5.30 states that there is no limit on the use of glazed screens that provides a minimum period of fire resistance of 30 minutes (integrity and insulation).

Paragraph 5.31 - Sprinkler Compensation Benefits
Where sprinklers are fitted, there is no limit on the use of glazed screens that provides a minimum period of fire resistance of 30 minutes (integrity only), provided the glass is not of the type referred to as 'modified toughened'.

Paragraphs 5.34 and 5.35 Requirement - Single direction of escape
Paragraph 5.34 states that any part of an enclosed escape route that has single direction of escape only, and exceeds 4500mm, should be protected by 30-minute fire-resisting construction (integrity and insulation). This does not include travel within a room, but applies to 'stub' corridors or a small corridor recess. In addition, paragraph 5.35 states that only glazing that provides a minimum period of fire resistance of 30 minutes (integrity and insulation) may be provided on circulation spaces that give a single direction of escape, provided the glass is not of the type referred to as 'modified toughened'.

Paragraph 5.35 - Sprinkler Compensation Benefits
Where a sprinkler system is installed, there is no requirement for insulation.

5.3 Fire resistance of elements of structure

5.3.1 Compartmentation

Table 2. Requirement – Minimum periods of fire resistance provided by compartmentation
Table 2 sets out the minimum periods of fire resistance for elements of structures that are either 'Sprinklered' or 'Un-sprinklered' for:

- Single-storey healthcare buildings
- Healthcare buildings with storeys up to 12m above ground or basements no more than
- 10m deep
- Healthcare buildings with storeys over 12m above ground or basements more than 10m deep
- Healthcare buildings with storeys over 30m

Table 2 - Sprinkler Compensation Benefits
If a sprinkler system is installed within any of the four purpose groups outlined in Table 2, the fire resistance requirements are significantly reduced to such an effect that credible savings can be made on conventional construction costs.

Clause 6.11 - Sprinkler Compensation Benefits
Where sprinklers are installed throughout the whole building, the requirement for the elements of structure and compartment walls to be constructed of materials of limited combustibility may not apply

Clause 6.8b - Sprinkler Compensation Benefits
In sprinklered healthcare buildings the minimum fire resistance of compartment walls can be reduced from 60 minutes to 30 minutes for buildings up to 12m above ground level.

5.3.2 Fire hazard rooms and areas

Paragraph 6.30. Requirement – Fire-resisting construction (integrity and insulation)
Fire hazard rooms and areas should be enclosed in 30 minutes' fire-resisting construction (integrity and insulation). Walls may be terminated at ceiling level provided that:

a. the ceiling is non-demountable and has a minimum period of fire resistance of 30 minutes when tested (complete with any lighting units) from below in accordance with BS 476 (Parts 20 and 22);

b. ducts perforating the ceiling are fitted with fire shutters operated by heat-activated fire dampers;

c. conduits, pipes etc. perforating the ceiling are fire-stopped and comply with the requirements of paragraph 6.16.

Clause 6.31 - Sprinkler Compensation Benefits
Where sprinklers are installed, the need to enclose fire hazard rooms in fire-resisting construction should be risk assessed.

5.3.3 Permitted unprotected area – Method of determining the amount of unprotected area in an external wall

Figure 16. Requirement
This chart illustrates the required distance between the face of building and relevant boundary (m) in relation to the percentage of unprotected area.

Clause iii, Figure 16 - Sprinkler Compensation Benefits
Where sprinklers are installed throughout the building, the distance to the relevant boundary may be halved subject to a minimum distance of 1000mm being maintained.

5.3.4 Junctions of walls and low-level roofs

Paragraph 6.73. Requirement – Fire-resistance (integrity and insulation)
Where a roof abuts an external wall, the roof should provide a minimum period of fire resistance of 60 minutes (integrity and insulation) for a distance of 3000mm from the wall.

Clause 6.74 - Sprinkler Compensation Benefits
Where sprinklers are installed throughout the area below a low-level roof, paragraph 6.73 does not apply.

5.3.5 Junctions of compartment and sub-compartment walls and external walls

Paragraph 6.75. Requirement – Fire resistance
Where: **a**. A compartment wall (or sub-compartment wall) meets an external wall; or **b**. A protected shaft meets an external wall, a 1000mm wide storey-height strip of external wall that

has a similar period of fire resistance should be provided to prevent lateral fire spread.

Clause 6.76 - Sprinkler Compensation Benefits
Where sprinklers are installed on both sides of the compartment (or sub-compartment) wall, paragraph 6.75 does not apply.

5.3.6 Sprinklers

Clauses 6.94 to 6.107 - Outline of Standards

With the exception of buildings over 30m in height, the guidance in this document does not require the installation of sprinklers in patient care areas of healthcare buildings. However, the design team is expected to consider the advantages that might be gained by installing life-safety sprinklers throughout the building.

Any decision should be considered as an integral part of the fire safety strategy and should clarify the decision to select low or ordinary hazard. However, sprinklers or automatic fire suppression should be installed in commercial enterprise areas in accordance with Health Technical Memorandum 05-03: Part D – 'Commercial enterprises on healthcare premises'.

Where a sprinkler system is specifically recommended within this document, it should be provided in the building or separated part and designed and installed in accordance with either:

a. the requirements of BS 5306-2, including the relevant hazard classification together with the additional requirements for life safety; or

b. the requirements of BS EN 12845, including the relevant hazard classification together with the special requirements for life safety systems.

5.4 Effect on other fire precautions

Clause 6.108 - Sprinkler Compensation Benefits
In those parts of healthcare buildings where sprinkler systems are provided, the effect of sprinklers on the overall package of fire precautions has to be considered to ensure that a cost-effective fire safety strategy is provided. Where sprinklers are installed in healthcare premises in accordance with the above guidance, some of the requirements of this document (HSTM 05-02) may be modified to take account of the effect of sprinkler operation at an early stage of fire development.

Clause 6.109 - Sprinkler Compensation Benefits
Where sprinklers are installed, the guidance may be modified subject to a suitable and sufficient risk assessment being undertaken and the information being recorded in the fire safety manual.

5.4.1 Number and location of firefighting shafts

Clause 7.19 - Sprinkler Compensation Benefits

The number of fir-fighting shafts required should be such that there is at least one for every 1000m² of floor area (or part thereof). However, if the building is fitted with sprinklers and is five or more storeys' high, a minimum of two shafts should be provided, with an extra firefighting shaft for every additional 1500m² (or part thereof) when the floor area exceeds 2000m².

Clause 7.20a - Sprinkler Compensation Benefits
If the building is fitted throughout with an automatic sprinkler system, sufficient firefighting shafts should be provided such that every part of every storey that is more than 18m above fire-service-vehicle access level should be no more than 60m from a fire main outlet in a firefighting shaft or hospital street, measured on a route suitable for laying hose.

5.4.2 Mechanical smoke extraction

Clause 7.44 - Sprinkler Compensation Benefits
As an alternative to natural venting, provided the basement is fitted with a sprinkler system to BS EN 12845, a mechanical extract system may be employed.

5.4.3 Specific periods of fire resistance for building elements

Table A1. Requirement - Load-bearing capacity, integrity and insulation
This table outlines the minimum provisions when tested to the relevant part of BS 476 (minutes) and relevant European standard (minutes).

Table A1, Note 7 - Sprinkler Compensation Benefits
Compartment walls in single-storey buildings may have fire resistance reduced if sprinklers are installed.

5.4.4 Table B1. Location of Fire Doors

Table B1. Requirement – Fire door integrity performance
This table outlines the minimum fire door provisions when tested to the relevant part of BS 476-22 (minutes) and relevant European standard (minutes). In compartment walls within single storey buildings they should meet FD30S requirements and in storeys up to 12m above ground level they should meet FD60S requirements.

Table B1, Note 7 - Sprinkler Compensation Benefits
If a sprinkler system is installed in a building with storeys up to 12m above ground level, then the fire door integrity performance can be reduced from FD60S to FD30S. This benefit can have a significant impact on overall construction costs.

6.0 Fire risk assessment in hospitals

Health Technical Memorandum 86/Scottish Health Technical Memorandum 86

6.1 Summary

HTM 86 and SHTM 86 is a Code of Practice for fire risk assessments in hospitals that is designed to ensure that a hospital is inherently fire rated (fire resistant) to a specific requirement and provides structural integrity.

Section 33 - Sprinkler Compensation Benefits

Section 33 within this Code of Practice states that if sprinklers are provided they may be used partly to compensate for higher levels of risk/hazard or deficient precautions when undertaking a fire risk assessment. This benefit can have a significant impact on overall construction costs.

7.0 Scottish Health Technical Memorandum (SHTM) 82

Supplement A, Clause 3.4 - Sprinkler Compensation Benefits

Supplement A in this Code of Practice illustrates the benefits of automatic fire control systems and voice alarm systems (for new healthcare premises). Where patients are highly dependent and moving the patients in a fire scenario may not be practical or advisable (except as a last resort), patient access areas and adjacent areas below and/or above should be provided with an automatic sprinkler system. This affords a very high degree of protection for highly dependent patients, which may reduce the need for patient evacuation and allow staff to remain in attendance for a longer period of time.

8.0 HTM 88 – Fire Precautions in housing providing NHS-supported living in the community

8.1 Summary

HTM 88 is a Code of Practice that provides recommendations and guidance to address the special requirements of fire safety in community-based premises providing supported living for people who have learning difficulties or mental illness (including those with physical handicap).

Clauses 11.4, 11.9 and Appendix 2, Note 1 - Sprinkler Compensation Benefits

Where an open plan stairway forms part of the escape route, it will be necessary either fully to enclose the stairway or to install a residential sprinkler system throughout the premises to an appropriate standard. Open plan stairways are not acceptable without the provision of a residential sprinkler system installed throughout the premises. Where the situation already exists within a property currently used for the provision of supported living, remedial action must be taken.

9.0 Building Bulletin 100: 2007. Design for fire safety in schools

9.1 Summary

This guide, issued by the Department for Children, Schools and Families (DCSF), provides fire safety design guidance for schools in England and Wales. The guidance applies to nursery schools, primary and secondary schools including sixth form colleges, academies and city technology colleges, special schools and pupil referral units.

The guide is intended for all those with an interest in fire safety in schools but, in particular, designers, fire engineers, building control officers (or equivalent) and fire safety officers. Head teachers, governors, teaching staff and facilities and maintenance staff will find it of interest to underpin their role as fire safety managers.

While formal requirements for life safety are covered by national legislation (Building Regulations) and supporting technical guidance with respect to fire, BB 100 acknowledges the important role of sprinklers. Sprinkler systems installed in buildings can significantly reduce the degree of damage caused by fire and can reduce the risk to life.

9.1.1 DCSF policy regarding sprinkler systems

Paragraph 1.6 - Sprinkler Compensation Benefits

On 1 March 2007 the DCSF announced the new policy on sprinklers and their value as a measure against the risk of fire and arson. All new schools should have fire sprinklers installed except in a few low risk schools.

9.1.2 Property protection

Paragraph 1.7 - Sprinkler Compensation Benefits

An automatic sprinkler system should be installed in order to meet the objectives outlined in paragraph 1.7. These objectives include protecting the school from a fire and minimising the effects of fire on the operation of the school, limiting the effects of interruption to the school and seeking to have the school operational within 24 hours of a fire incident.

9.1.3 Risk assessment and the provision of sprinkler systems

Paragraph 9.1.4 - Sprinkler Compensation Benefits

To help clients, local and authorities and design teams assess the level of risk and make the right decisions, the DCSF has developed two practical aids. The first is an interactive tool to aid fire risk assessment. DCSF expects that this risk analysis will always be carried out and new schools being planned that score medium or high risk using the Risk Analysis Tool will have sprinklers fitted.

9.1.4 Cost-benefit analysis and the provision of sprinkler systems

Paragraph 2.4.1 - Sprinkler Compensation Benefits
The second tool included in a CD-ROM with BB100 is a cost benefit analysis tool. This tool helps users decide whether sprinklers or other approaches represent good value for money. Version updates will be published by DCSF on their fire safety website.

9.1.5 Sprinkler systems

Paragraphs 2.5.7 and 3.3 - Sprinkler Compensation Benefits
Sprinkler systems installed in buildings can reduce the risk to life and significantly reduce the degree of damage caused by fire. Sprinkler protection can also sometimes be used as a compensatory feature. For life safety sprinkler systems, fire resistance requirements can be halved, travelling distances can be doubled and the number of firefighting shafts and fire mains can be reduced. In addition, compartment sizes may be considerably larger, boundary distance calculations can be halved and basements may have mechanical extraction of smoke, rather than provide a vent to the outside.

9.2 Open spatial planning

Paragraph 4.3.2.8 - Sprinkler Compensation Benefits
In sprinklered schools, rooms which are accessed by an open balcony less than 4.5m wide, and which do not have an alternative escape route away from the balcony, should satisfy the conditions set out within the document.

9.3 Discounting of stairs

Paragraph 4.4.5.2 - Sprinkler Compensation Benefits
Where two or more stairs are provided, it should be assumed that one of them might not be available due to fire. It is therefore necessary to discount each stair in turn in order to ensure that the capacity of the remaining stair(s) is adequate for the number of persons needing to escape. ***The stair discounting rule applies to a building fitted with a sprinkler system.***

9.4 Compartmentation

Paragraph 6.3.1 - Sprinkler Compensation Benefits
The degree of compartmentation should be such that the maximum loss from a fire should never exceed 25% of the whole building. The appropriate degree of sub-division depends on the availability of a sprinkler system which affects the growth rate of the fire and may suppress it altogether.

9.4.1 Provision of compartmentation

Paragraph 6.3.2 - Sprinkler Compensation Benefits
The maximum dimensions of compartments within schools are given in Table 9. Note: 'Sprinklered' means that the school is fitted throughout with an automatic system meeting the relevant recommendations of BS 5306: Part 2, i.e., the relevant occupancy rating plus requirements for life safety. (Note that this BS although referenced was withdrawn in 2004 and has been superseded by BS EN 12845 2009 and this standard

is indeed referred to in Part 8.5 of the document).*The benefit to the designer from the installation of such a suppression system is that compartments can more than double in size.*

Table 9. Maximum dimensions of compartments within schools	
Floor area of any one storey in the school or any one storey in a compartment (m^2)	
In multi-storey schools	In single storey schools
Not sprinklered - 800	Not sprinklered - 800
Sprinklered - 2000	Sprinklered – No limit

9.4.2 Openings in compartmentation

Paragraph 6.3.4 - Sprinkler Compensation Benefits
If the compartment is sprinklered then modified toughened fire-resisting glass types should not be used because of the risk of unpredictable shattering of the glass when the sprinklers activate in a fire. The cost comparison between ordinary glazing and fire-resisting glass in a modern school building can result in considerable savings.

9.5 Space separation

Paragraph 6.3.4 - Sprinkler Compensation Benefits
The provisions within this document limit the extent of unprotected areas in the sides of a building (such as openings and areas with a combustible surface) which will not give adequate protection against the external spread of fire from one building to another. However, these provisions can be moderated by the installation of a sprinkler system.

9.6 Number and location of firefighting shafts

Paragraph 8.4.3 - Sprinkler Compensation Benefits
If the building is fitted throughout with an automatic sprinkler system then sufficient firefighting shafts should be provided such that every part of every storey, that is more than 7.5m above Fire and Rescue Service vehicle access level (where covered by paragraph 8.4.2), is no more than 60m from a fire main outlet in a firefighting shaft, measured on a route suitable for laying hose.

9.7 Mechanical smoke extract

Paragraph 8.5.2.2 - Sprinkler Compensation Benefits
As an alternative to natural venting, providing the basement is fitted with a sprinkler system, a mechanical extract system may be provided to remove smoke and heat in the event of a fire.

9.8 Appendix G - Fire safety information

Building Regulation 16B requires that, where building work involves the erection or extension of a relevant building or a relevant change of use of a building, fire safety information shall be given to the responsible person at the completion of the project or when the building or extension is first occupied.

9.8.1 Simple buildings

The 'responsible person' shall be given information as required in Note e. on any sprinkler system(s), including isolating valves and control equipment.

9.8.2 Complex buildings

The 'responsible person' shall be given information as required in Note f. of all active fire safety measures including any sprinkler system(s), isolating valves and control equipment.

10.0 Building Research Establishment documents BRE 186 and 368

10.1 Summary

These guides summarise the advice available from the Fire Research Station [???}, to designers of Smoke and Heat Exhaust Ventilation Systems (SHEVS) for atria and other buildings. They build upon currently available published advice (especially BRE Report *Design approaches for smoke control in atrium buildings* and also BRE Report *Design principles for smoke ventilation in enclosed shopping centres*).

10.2 BR 186 – Smoke ventilation in enclosed shopping centres

Chapter 2. Requirement - Design procedures for the mall smoke control system
High smoke layer temperature will result in intense heat radiation causing difficulties for people escaping beneath the smoke layer in the mall. To reduce the intensity of heat radiation the smoke layer temperature in the malls should be less than 200°C.

Chapter 2 - Sprinkler Compensation Benefits
Sprinkler cooling can be used in shopping malls to reduce the smoke layer temperature to below 200°C, above which heat radiation from the layer is likely to impede escape beneath. Sprinklers in shops are an essential part of the smoke ventilation design in order to prevent a fire growing beyond the design fire size.

10.3 BR 368 – Design methodologies for smoke and heat exhaust ventilation

Chapter 11. Requirement - Interactions with other systems in the building
Smoke ventilation systems have a very clear life-safety role for certain types of building in order to protect the escape routes during the early stages of a fire. Examples include enclosed shopping malls and many atrium buildings. These buildings demand operation of the smoke

ventilation system earlier than the arrival of the fire services – usually on the first detection of smoke.

Chapter 11 - Sprinkler Compensation Benefits

Sprinklers and smoke ventilators are both important for life safety and for property protection, although smoke ventilation should only be seen as being useful for property protection by making firefighting easier and faster. It is therefore reasonable to expect both sprinklers and smoke ventilators to be used together, both for life safety and for property protection.

11.0 Domestic and residential sprinkler systems using BS 9251

11.1 Summary

British Standard 9251: 2005 is a Code of Practice and, as such, represents guidance through a series of recommendations. Designers and installers, however, in BAFSA's opinion, should to ensure that where a system design or installation deviates from the recommendations in BS 9251 such deviations should be minor in nature and brought to the attention to the Authority Having Jurisdiction (AHJ) for acceptance. Any such deviations must be recorded in writing in the Certificate of Compliance issued by the installer to the owner of the premises. The deviations recorded should indicate who had originated or requested the deviation.

11.2 BAFSA's Technical Guide No 1

BAFSA's Technical Guide No 1 , *The design and installation of residential and domestic sprinkler systems*, provides supplementary guidance and clarification of the requirements in BS 9251 which it felt were unclear, inappropriate or contrary to the recommendations of Approved Document B. The second edition of TG 1 is published simultaneously with this document.

11.3 Review of BS 9251

Note that BS 9251 itself will be the subject of a major review commencing in Summer 2011 with a revised version of the document due for publication, it is hoped, in early 2012.

12.0 Regulatory Reform (Fire Safety) Order 2005

12.1 Sprinkler systems

Sprinkler systems can be very effective in controlling fires. They can be designed to protect life and/or property and may be regarded as a cost-effective solution for reducing the risks created by fire. Recent research by BRE has shown that, in most cases in residential premises, there can be worthwhile safety and financial benefits in fitting a sprinkler system. Where installed, a sprinkler system is usually part of a package of fire precautions in a building.

Sprinkler protection provides additional benefits, such as a reduction in the amount of portable firefighting equipment necessary or a relaxation of restrictions in the design of buildings

(including the lengths of escape routes, the provision of fire-resisting barriers or the provision of some self-closing fire doors). There may also be additional benefits such as more favourable insurance premiums and, for example, a significant reduction in the risks of major disruption of the activities of a care provider.

If an occupier already has, or intends to install, a sprinkler system, they should seek specialist advice on the design, installation and maintenance of the system, and also on the benefits it can provide in respect of a premises' risk assessment.

Guidance on the design and installation of new sprinkler systems and the maintenance of all systems is given in reference documents such as the LPC Sprinkler Rules, BS EN 12845 or BS 9251.

Routine maintenance by on-site competent people may include checking of pressure gauges, alarm systems, water supplies, any anti-freezing devices and automatic booster pump(s).

A competent maintenance contractor should carry out all major servicing and can provide guidance on what records need to be completed.

If a sprinkler system forms an integral part of the fire strategy for a premises it is imperative that adequate management procedures are in place to cater for those periods when the sprinkler system is not functional. These should form part of the emergency plan. Although the actual procedures will vary, such measures may include any or all of the following:

- Restore the system to full working order as soon as possible.
- Limit any planned shutdown to low-risk periods when numbers of people are at a minimum or when the building is not in use. This is particularly important when sprinklers are installed to a life safety standard or form part of the fire safety engineering requirements.
- Inform the insurers as quickly as possible and comply with any additional requirements they may impose.
- Avoid higher-risk processes and consider prohibiting all 'hot-work'.
- Impose stricter security and access control on the site and undertake more frequent patrols using additional or redeployed staff.
- Revising any evacuation strategy.
- Carrying out maintenance on a zoned basis, to prevent the whole system being out of commission at the same time.
- Inform the local fire and rescue service and implement any advice they may offer.

12.2 Other fixed installations

There are a number of other fixed installations including water mist, gaseous, deluge and fixed powder systems. If premises have a fixed firefighting system with which management is unfamiliar, then they should seek advice. Where a fixed firefighting system forms an integral part of the fire safety strategy for the premises, it should be maintained by a competent person in accordance with the relevant standard.

A simulated evacuation of each protected area should be conducted to assess whether the evacuation times achieved are reasonable and consistent with those recommended for the likely levels of occupants' mobility. If movement times to an adjoining protected area are adjudged excessive then the following options should be considered:

- reducing the size of the protected area (this may be no more than dividing the wing of a building by positioning a set of fire-resisting self-closing doors across a corridor);
- providing additional staff to assist with the horizontal evacuation;
- accommodating fewer people in the protected area, or:
- providing additional fire protection systems, such as an appropriately designed sprinkler system, to the protected areas to suppress the fire growth.

Building Regulations and relevant Acts, including local Acts, may have required firefighting equipment and other facilities to be provided for the safety of people in the building and to help firefighters. Fire safety law places a duty on appropriate persons to maintain such facilities in good working order and at all times. These may include:

- access roads for fire engines and firefighters;
- firefighting shafts and lifts;
- fire suppression systems, for example, sprinklers, water mist and gaseous;
- smoke-control systems;
- dry or wet rising mains and firefighting inlets;
- information and communication arrangements, for example, fire telephones and wireless signals; and firefighter's switches.

The Workplace (Health, Safety and Welfare) Regulations 1992 also require that systems provided for safety within a workplace are maintained. It is necessary to establish contacts with the emergency services and it may be appropriate to invite the fire and rescue service to familiarise themselves with site layouts and fire systems as a precautionary measure.

13.0 Fire (Scotland) Act 2005

13.1 Summary

Part 3 of the Act covers the fire safety duties of employers to employees and the obligations of the 'dutyholder' (note the term 'responsible person' is not used in the Scottish legislation) for the relevant premises. These duties include the safety of the employees in respect of harm caused by fire in the workplace as far as is reasonably practicable.

This involves undertaking a risk assessment of the workplace for the purpose of identifying any risks to the safety of the employer's employees and implementing any fire safety measures as are necessary to ensure the safety of employees in the workplace.

13.2 Fire safety in relevant premises

Part 3, Chapter 1, Paragraph 58. Requirement – Fire safety in relevant premises
Notes (a) to (i) cover the precautions that must be taken or observed, such as fire safety awareness training in what to do in the event of fire, means of escape, compartmentation, fire resistant elements of structure, fire hazard rooms and areas, smoke extraction, access to

buildings for fire-fighters and the number and location of firefighting shafts.

Part 3, Chapter 1, Paragraph 58 - Sprinkler Compensation Benefits
Independent research undertaken throughout the world has shown that, there can be worthwhile safety and financial benefits in fitting a sprinkler system within a building. Where installed, a sprinkler system is usually part of a package of fire precautions in a building.

Sprinkler protection can give additional benefits, such as a reduction in the amount of portable fire-fighting equipment necessary or a relaxation of restrictions in the design of buildings (including the lengths of escape routes, the provision of fire-resisting barriers or the provision of some self-closing fire doors). There may also be additional benefits such as more favourable insurance premiums and a significant reduction in the risks of major disruption to established business and commercial activities.

If an occupier has, or intends to install, a sprinkler system, they should seek specialist advice on the design, installation and maintenance of the system, and also on the benefits it can provide in respect of a premises' risk assessment.

Guidance on the design and installation of new sprinkler systems and the maintenance of all systems is given in the LPC Rules for automatic sprinkler installations*, BS EN 12845, BS 5306-2 or BS 9251.*

14.0 BS 9999 – A new approach to fire risk management

14.1 Introduction

Following the introduction of BS 9999 most of the BS 5588 series of British Standards have now been withdrawn. (BS 5588 Part 1 covering fire safety in domestic premises remains in effect at the time of writing but is expected to be replaced by BS 9991 later in 2011.) The concept behind the development of BS 9999 (and the related standard, BS 7974 which covers fire engineering) 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. Guidance provided in BS 9999 gives a more transparent and flexible approach to fire safety design through use of a structured approach to risk-based design where designers can take account of varying physical and human factors. Much of the guidance in BS 9999 is 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 contemplating a 'pick-and-mix' approach as it is essential to ensure that an integrated approach is used in any one building.

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, facilities 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 co-ordinated package covering the four main areas that influence fire safety measures, namely:

- Fire safety management;
- The provision 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 firefighting.

Individual recommendations from 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.

CAUTION:
For example, one of the questions regularly raised with the new standard is in relation to the guidance dealing with the specification of automatic sprinkler systems. The guidance in the standard differs significantly from that in Approved Document B to the Building Regulations in England and Wales and other guidance produced by the Government (such as the BB 100 guidance for schools), in that BS 9999 makes no reference to the additional life safety requirements for sprinkler systems that are listed in Annex F of BS EN 12845: Fixed fire-fighting systems, Automatic sprinkler systems, Design, installation and maintenance.

The confusion arises because the guidance given in BS 9999 states that sprinkler systems should be designed, installed and commissioned in accordance with BS EN 12845, but omits the reference to the additional requirements for life safety listed in Annex F of that standard (referred to in Approved Document B). This has given rise to confusion because, in the

absence of any explanation in BS 9999, there are two possible interpretations of the BS 9999 guidance that are both potentially equally valid, as follows:

Interpretation 1:

By referring to BS EN 12845, it is assumed that the designer will revert to BS EN 12845 for all aspects of the sprinkler design. The guidance of BS EN 12845 refers to sprinkler systems for life safety designs also meeting the additional provisions in Annex F of BS EN 12845. Where BS 9999 is being used to provide a life safety fire strategy design, then it can be assumed that these additional provisions are therefore needed.

Interpretation 2:

That, by virtue of the fact that current statutory guidance (such as Approved Document B and BB 100) specifically refer to additional requirements for life safety systems listed in BS EN 12845, the omission of any similar text in BS 9999 could be taken as meaning that these additional requirements are not needed to comply with a life safety fire strategy designed to BS 9999.

14.2 Risk assessment and risk profiles

An assessment should be carried out in order to determine the risk profile, that is, the fire risks which might affect people, property and business continuity. By carrying out a risk assessment, the consequences of fire on people, property, business and the environment can become clearer to the owner, occupier, operator, tenant, designers and insurers.

It should then be evident what fire safety systems are required, what function they have in relation to the protection of people, property, business and the environment, and what management responsibilities are required to maintain and operate these systems.

Basic factors that should be taken into account in assessing the fire risk for both new construction and existing premises are shown in Table 1 and include:

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

Table 1: Basic factors in assessing fire risks

Factor	Comments
Adequacy of means to prevent fire	The assessment should identify the scope for fire prevention measures, and indicate the associated management systems needed
Early fire warning by an automatic detection and warning system	This provision can lead to 'first aid' or fire and rescue service fire-fighting in the early stages of fire development. Modern systems can be unobtrusive (aspirating), addressable (by which a fire location and development can be identified),

	and can reduce unwanted alarms
The standard of means of escape	See Section 5 and Section 7 (for which structural enclosure and separation would be a part)
Provision of smoke control	See Sections 5, 6 and 7
Control of the rate of fire growth	This item particularly includes spread of flame over surfaces and behind linings, and within contents. See Section 7
Adequacy of the structure to resist the effects of fire	See Section 7
Degree of fire containment Includes containment by sub-compartmentation, cavity barriers, and fire-stopping	See Section 7
Fire separation between buildings or parts of a building	See Section 7
Standard of active measures for fire extinguishment or control	See Section 7
Facilities to assist the fire and rescue service	See Section 6
Quality of premises management	See Sections 4 and 9
Provisions for staff training and on-going controls	See Section 9
Occupancy characteristics and risk profiles	See Clause 6

14.3 Risk profiles

Paragraph 6.1. Requirement – Risk profiles
A risk profile should be established for each building in order to determine the appropriate means of escape (Section 5) and the appropriate design features of the building for life safety (Section 7). The risk profile should reflect the occupancy characteristic (6.2 and Table 2) and fire growth rate (6.3 and Table 3) for a building, and should be expressed as a value combining these two elements (6.4, Table 4 and Table 5). Account should be taken of the fact that different uses within the same building can have different fire load densities and occupancy characteristics. There is a minimum package of fire protection measures and management levels associated with each of the risk profiles. These are identified throughout this British Standard.

14.4 Occupant characteristics

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

Table 2: Occupant risk category

Risk category	Description	Examples

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

14.5 Fire growth rate

The fire growth rate is the rate at which it is estimated that a fire will grow. Fire growth rates should be categorised in accordance with Table 3 of BS 9999. Note: A building with a high fire load density will not necessarily have a rapid fire growth rate, and low fire load density will not necessarily have a slow fire growth rate.

Table 3: Fire growth rates

Category	Fire growth rate	Examples
1	Slow	Open plan office, limited combustible materials
2	Medium	Stacked cardboard boxes, wooden pallets
3	Fast	Baled thermoplastic chips, stacked plastic products, baled clothing
4	Ultra-fast	Flammable liquids, expanded cellular plastics and foam

14.6 Typical risk profiles

Risk profiles are given as a combination of occupant risk category and fire growth rate, as shown in Table 4. Typical risk profiles are given in Table 5. The examples in Table 5 should be used for guidance only. But note: since risk profile assessments are carried out on a case-by-case basis, it is possible that there might be, for example, A1 or A3 offices or a B2 shop. However, there are certain circumstances where a combination of the occupant's unfamiliarity with the building and the potential for a very fast growing fire is deemed to be unacceptable (for example, B4 and C4) unless an effective localised suppression system or sprinkler installation is added.

Table 4: Combination of risk profile and fire growth rate

Category	Growth rate	Risk profile	Examples

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

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

Automatic sprinkler installations can provide an efficient means of fire control within a building compartment. Such provision limits the control of fire growth, fire spread, heat and smoke generation and can extinguish the fire, or at least reduce the fire growth rate simultaneously giving an immediate alarm on operation.

This means that if sprinkler systems are installed, the fire growth rates as given in Table 3 can be taken to be one category lower than if no sprinklers are provided (that is, fire growth classification drops from 4 to 3, 3 to 2 or 2 to 1). This reduction applies to the room of origin. It includes corridors and linking spaces only when all the spaces connected to the room of origin are sprinklered or the rooms are separated by fire-resisting construction.

EXAMPLE: The provision of an automatic sprinkler installation appropriate to the building risk category permits a reduction in the risk profile giving a larger allowable travel distance and smaller doors. An un-sprinklered building with a risk profile B3 would have the risk profile reduced to B2 with the introduction of a suitable automatic sprinkler system.

This would also have the effect of reducing a 'not allowable' B4 profile to a B3 category. Table 25 (see page 42) also provides an excellent example of fire resistance reductions for elements of structure if they are sprinkler protected.

Table 25 Fire resistance periods for elements of structure (independent of ventilation conditions)

OC A)	**Use**	**Sprinklered or Un-sprinklered** B)	**Minimum periods of fire resistance**, in minutes	
			Depth below access level of lowest basement	**Height** C) **of top occupied storey above access level**

			More than 10 m	Not more than 10 m	Not more than 5 m	Not more than 18 m	Not more than 30 m	More than 30 m
A	Office	Un-sprinklered	90	60	30	60	90	Not allowed
		Sprinklered	60	60	30	30	60	120
A	Industrial High Hazard	Un-sprinklered	N/A D)	120	90	120	150	Not allowed
		Sprinklered	150	90	60	90	90	120
A	Industrial Ordinary Hazard	Un-sprinklered	N/A D)	120	60	90	120	Not allowed
		Sprinklered	90	60	30	60	60	90
A	Industrial Low Hazard	Un-sprinklered	90	60	30	60	90	Not allowed
		Sprinklered	60	30	30	30	60	60
A	Storage Low Hazard	Un-sprinklered	90	60	30	60	90	Not allowed
		Sprinklered	60	30	30	30	60	60
A	Car parks:							
	-open-sided car park	Un-sprinklered	—	—	15 E)	15	30	30
	-any other car park	Un-sprinklered	90	60	30	60	90	120
B	Shops and commercial	Un-sprinklered	90	60	60	60	90	Not allowed
		Sprinklered	90	60	30	60	60	120
B	Assembly High Hazard	Un-sprinklered	N/A D)	90	60	90	120	Not Allowed
		Sprinklered	120	60	60	60	90	120
B	Assembly Ordinary Hazard	Un-sprinklered	90	60	60	60	90	Not Allowed
		Sprinklered	60	30	30	60	60	120
Ci	Individual Residential	Un-sprinklered	90	60	30	60	Not Allowed	Not Allowed
		Sprinklered	60	30	30	60	60	120
Cii & Ciii	Other Residential	Un-sprinklered	90	60	30	60	90	Not Allowed
		Sprinklered	60	30	30	60	60	120

A) Occupancy characteristic, as defined in Table 2.
B) "Sprinklered" indicates sprinkler systems conforming to BS EN 12845 or BS 5306-2, with the exception of occupancy characteristic Ci and Cii, for which it indicates sprinkler systems conforming to BS 9251.
C) Refers to height of occupied floor, therefore does not apply to high single-storey buildings.
D) Floors below this level may be used for other occupancy characteristic given an appropriate fire resistance rating
E) Provided that arrangements are made for natural ventilation equivalent to an open-sided car park above ground level.