

Designing Buildings for Fire Safety BS 9999: 2008

**Code of practice for fire safety in the design,
management and use of buildings**

Martin Edwards

P R O B Y N · M I E R S
CHARTERED ARCHITECTS · DISPUTE RESOLUTION



Alternative Approaches to Design for Fire Safety

Design Approach	Design Code	Date	Application
General approach	AD(B)	2006	Majority of buildings.
Advanced Approach	BS 9999	2008	Buildings of intermediate size and complexity. Unusual designs requiring a flexible approach.
Fire Safety Engineering	BS 7974	2001-4	Large and complex buildings.

Superseded Standards

BS 5588			Fire precautions in the design, construction and use of buildings
BS 5588	- 0	:1996	Guide to fire safety codes of practice for particular premises / applications
BS 5588	- 1	:1990	Residential buildings STILL CURRENT
BS 5588	- 5	:2004	Access and facilities for fire-fighting
BS 5588	- 6	:1991	Places of assembly
BS 5588	- 7	:1997	Atria in buildings
BS 5588	- 8	:1999	Means of escape for disabled people
BS 5588	- 9	:1999	Ventilation and air conditioning ductwork
BS 5588	- 10	:1991	Shopping complexes
BS 5588	- 11	:1997	Shops, offices, industrial, storage and other similar buildings
BS 5588	- 12	:2004	Managing fire safety



BS 9999 – Selected Sections

- | | |
|-----------|---|
| Section 5 | equivalent of Approved Document B1 Means of Escape incorporating BS 5588 Part 8 Provisions for Disabled People |
| Section 6 | equivalent of Approved Document B5 on fire-fighting, incorporating BS 5588 Part 5 fire-fighting stairs and lifts |
| Section 7 | equivalent of B2 Internal Fire Spread (Linings),
B3 Internal Fire Spread (Structure)
B4 External Fire Spread
Appendices to ADB, and
some remaining parts of BS 5588 |
| Section 9 | Building management |



Table 1 **Basic factors in assessing fire risks**

Adequacy of means to prevent fire

Early fire warning by an automatic detection and warning system

The standard of means of escape

Provision of smoke control

Control of the rate of fire growth

Adequacy of the structure to resist the effects of fire

Degree of fire containment

Fire separation between buildings or parts of a building

Standard of active measures for fire extinguishment or control

Facilities to assist the fire and rescue service

Quality of premises management

Provisions for staff training and ongoing controls

Occupancy characteristics and **risk profiles**



Table 2 Occupancy characteristics

Occupancy characteristic	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, other assembly buildings, etc.
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 or boarding schools
Ciii	• Short-term occupancy	Hotels
D ^{A)}	Occupants receiving medical care	Hospitals, residential care facilities ^{B)}
E ^{C)}	Occupants in transit	Railway stations, airports

A) Currently occupancy characteristic D, medical care, is dealt with in other documentation and is outside the scope of this British Standard.

B) Under some circumstances, residential care facilities may be classified as occupancy characteristic Cii.

C) This occupancy characteristic is included for completeness within this table but is not referred to elsewhere in this British Standard.



Table 3 Fire growth rates

Category	Fire growth rate	Examples
1	Slow	Banking hall, limited combustible material
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

Table 4 Risk profiles

Occupancy characteristic (from Table 2)		Fire growth rate	Risk profile
A (Occupants who are awake and familiar with the building)	1	Slow	A1
	2	Medium	A2
	3	Fast	A3
	4	Ultra-fast	A4 ^{A)}
B (Occupants who are awake and unfamiliar with the building)	1	Slow	B1
	2	Medium	B2
	3	Fast	B3
	4	Ultra-fast	B4 ^{A)}
C (Occupants who are likely to be asleep)	1	Slow	C1 ^{B)}
	2	Medium	C2 ^{B)}
	3	Fast	C3 ^{B), C)}
	4	Ultra-fast	C4 ^{A), B)}



Table 5 Examples of typical risk profiles

Occupancy	Risk profile	Occupancy	Risk profile
Administration office	A2	Indoor games/training rooms in schools	B2
Amusement arcade	B2	Kitchen	A3
Archive/library reading area	B3	Licensed betting office (public area)	B1
Art gallery	B1/B2	Lobbies	B1
Assembly hall	B2	Lounge (other than dwelling)	B2
Banking hall	B1	Machine/printing room	A3
Bar	B2	Mechanical plant room	A4 ^{A)}
Bazaar	B2/B3	Meeting room	B2
Bedroom/study bedroom	Cii2	Museum	B2
Bed-sitting room	Cii2	Office (closed-plan or office less than 60 m ²)	B2
Billiards or snooker room	B2	Office (open-plan exceeding 60 m ²)	A2
Bingo hall	B2	Reading room	B2
Bowling alley	B2	Reception area	B1
Business centre	B2	Restaurant	B2
Canteen	A2	Shop sales area ^{B)}	B3
Classroom	A2	Shop sales area ^{C)}	B3
Club	B2	Showrooms	B3
Committee room	A2	Skating rink	B1
Common room	A2	Stadia and grandstands	B1
Computer room	B2	Staff room	A2
Concourse or shopping mall	B2	Storage and warehousing	A2/A3/A4 ^{A)}
Conference room	B2	Studio (radio, television, film, recording), non-public	A2
Crush hall	B2	Studio (radio, television, film, recording), public	B2
Dance area	B2	Teaching laboratories	A3
Deposit/strong room	A2/A3	Theatre/cinema/concert hall auditoria	B2
Design studio/drafting office	A2	Theatre stages	A2/A3
Dining room	B1	Trading floor	B2
Dormitory	Cii2	Trading gallery	B2
Exhibition areas	B2/B3	Venue for pop concerts	B1
Factory production area	A2/A3	Waiting area/visitors lounge	B1
Filing room/store	A3	Waiting room	B1
Foyers	B1	Workshop	A3
Gymnasium/leisure centre	B2		

^{A)} See Table 4. Risk profile A4 is unacceptable unless a sprinkler system or another appropriate fire suppression system is installed.

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Occupancy	Risk profile	Occupancy	Risk profile
Administration office	A2	Indoor games/training rooms in schools	B2
Amusement arcade	B2	Kitchen	A3
Archive/library reading area	B3	Licensed betting office (public area)	B1
Art gallery	B1/B2	Lobbies	B1
Assembly hall	B2	Lounge (other than dwelling)	B2
Banking hall	B1	Machine/printing room	A3
Bar	B2	Mechanical plant room	A4 ^{A)}
Bazaar	B2/B3	Meeting room	B2
Bedroom/study bedroom	Cii2	Museum	B2
Bed-sitting room	Cii2	Office (closed-plan or office less than 60 m ²)	B2
Billiards or snooker room	B2	Office (open-plan exceeding 60 m ²)	A2



Building Management

Management / Staffing Level

Building Security

Access and Facilities for Fire-Fighting



Table 6 Management levels for different risk profiles

Occupancy characteristic (Table 2)	Fire growth rate (Table 3)	Risk profile (Table 4)	Management level
A (Occupants who are awake and familiar with the building)	1 Slow	A1	3 ^{A)}
	2 Medium	A2	2
	3 Fast	A3	1
	4 Ultra-fast	A4 ^{B)}	Not applicable ^{B)}
B (Occupants who are awake and unfamiliar with the building)	1 Slow	B1	2
	2 Medium	B2	2
	3 Fast	B3	1
	4 Ultra-fast	B4 ^{B)}	Not applicable ^{B)}
C (Occupants who are likely to be asleep)	1 Slow	C1	2
	2 Medium	C2	1
	3 Fast	C3 ^{B)}	1
	4 Ultra-fast	C4 ^{B)}	Not applicable ^{B)}

^{A)} A level 3 system might not be acceptable in some circumstances (see 8.2).

^{B)} See Table 4.



Management Levels

- **Level 1**
Sufficient trained personnel to assist all occupants to exit in an emergency
Building security
Provision for contingencies
- **Level 2**
No arrangements for security or contingencies
- **Level 3**
Very basic level of management

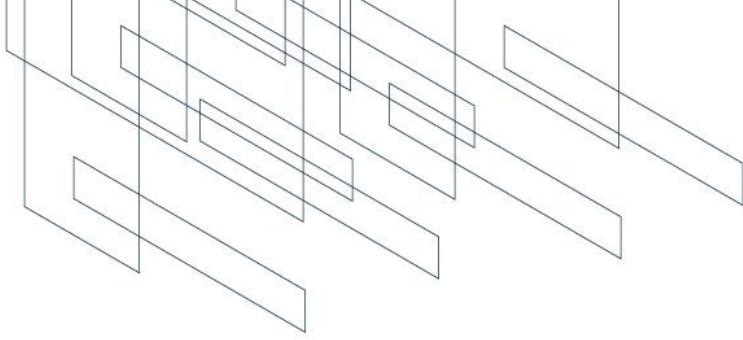


Building Security

Consider:

- security against intruders
- intruder detection
- means of controlling of ignition sources and ignitable materials
- segregation of materials and / processes that present risks
- the proximity of external storage, especially combustible waste





Designing Means of Escape

Means of Escape for Disabled People

PEEPS (Personal Emergency Evacuation Plans)

Evacuation Lifts

Wheelchair Refuges





Means of Escape for Disabled People

Additional measures to assist evacuation:

- Extension of CCTV coverage to refuges
- Installation of communication facilities in refuges
- Handrails along corridors
- Additional way-finding devices to assist blind people
- Early warning of an impending escape



PEEPS (Personal Emergency Evacuation Plans)

BS 9999 recommends the preparation of PEEPS for:

- Wheelchair users
- People who are deaf or hard of hearing
- Blind and partially sighted people
- People with cognitive disabilities



Designing Means of Escape

Means of Escape for Disabled People

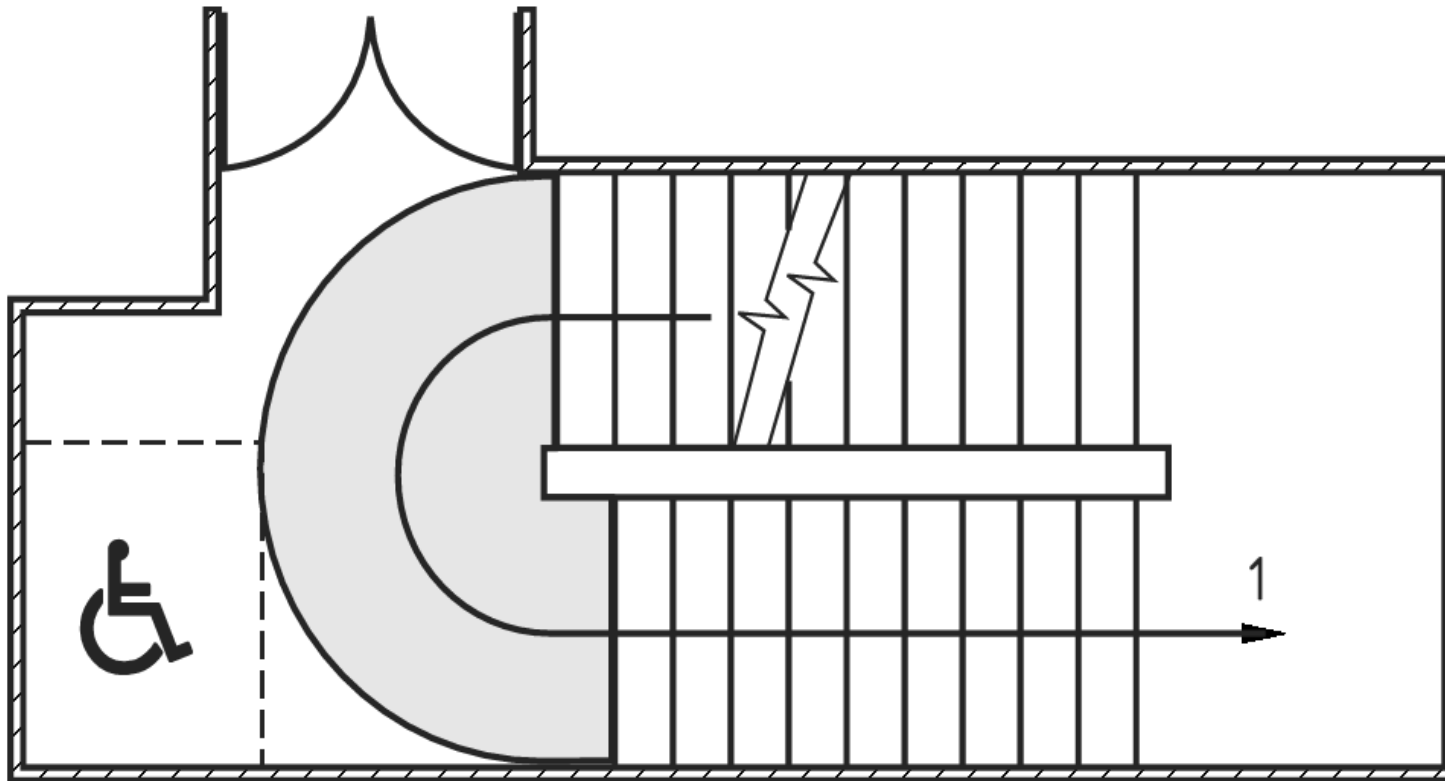
PEEPS (Personal Emergency Evacuation Plans)

Evacuation Lifts

Wheelchair Refuges



Wheelchair Refuge



a) Provision where access to the wheelchair space is in the same direction as the escape flow within the stairway

Table 8 Minimum level of fire alarm/detection system for premises

Risk profile	Minimum acceptable alarm/detection system
A1	M
A2	M
A3	L2
A4 ^{A)}	Not applicable ^{A)}
B1 ^{B)}	M
B2 ^{B), C)}	M
B3 ^{B)}	L2
B4 ^{A)}	Not applicable ^{A)}
Ci1	Automatic fire detection in individual units
Ci2	Automatic fire detection in individual units
Ci3 ^{A)}	L3
Cii1	L2
Cii2	L2
Cii3 ^{A)}	L1
Ciii1	L1
Ciii2	L1
Ciii3 ^{A)}	L1
C4 ^{A)}	Not applicable ^{A)}

Fire Detection and Alarm Systems



Table 12 Maximum travel distance when minimum fire protection measures are provided ^{A)}

Travel Distance

Risk profile	Travel distance, in metres (m)	
	Two-way travel	One-way travel
A1	65	26
A2	55	22
A3	45	18
A4 ^{B)}	Not applicable ^{B)}	Not applicable ^{B)}
B1	60	24
B2	50	20
B3	40	16
B4 ^{B)}	Not applicable ^{B)}	Not applicable ^{B)}
C1	27	13
C2	18	9
C3 ^{B)}	14	7
C4 ^{B)}	Not applicable ^{B)}	Not applicable ^{B)}





Designing Means of Escape

Smoke Detection

Informative Warnings

The Effect of Ceiling Heights

Maximum Acceptable Variations



Table 17 Maximum travel distances when additional fire protection measures are provided

Travel Distance

Risk profile	Maximum permissible travel distance	
	Two-way travel m	One-way travel m
A1	90	30
A2	75	24
A3	60	22
A4 ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}
B1	90	28
B2	75	24
B3	60	20
B4 ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}
C1	37	18
C2	27	13
C3 ^{A)}	18	9
C4 ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}

^{A)} See Table 4.



Table 12 Maximum travel distance when minimum fire protection measures are provided ^{A)}

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C1	27	13
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C3 ^{B)}	14	7
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A3	60	22
A4 ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}
B1	90	28
B2	75	24
B3	60	20
B4 ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}
C1	37	18
C2	27	13
C3 ^{A)}	18	9
C4 ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}

A) See Table 4.



Table 26 Fire resistance periods for elements of structure
(based on the ventilation conditions given in Table 27^{A)})

Risk profile	Minimum periods of fire resistance, in minutes ^{B)}					
	Height ^{C)} of top occupied storey above access level					
	Not more than 5 m	Not more than 11 m	Not more than 18 m	Not more than 30 m	Not more than 60 m	More than 60 m
A1	15	30	30	60	75	90
A2	30 ^{D)}	30	60	90	120	150
A3	60	60	90	120	300	300
A4 ^{E)}	—	—	—	—	—	—
B1	30	30	30	60	60	75
B2	30	30	60	75	90	120
B3	30	45	75	105	135	180
B4 ^{E)}	—	—	—	—	—	—
Ci1 ^{F)}	45 ^{G)}	60	75	75	90	105
Ci2 ^{F)}	60 ^{G)}	90	105	120	—	—
Cii1 or Ciii1	30	30	30	45	60	60
Cii2 or Ciii2	30	45	60	75	90	105
C3 ^{E)}	—	—	—	—	—	—
C4 ^{E)}	—	—	—	—	—	—

Table 30

Maximum dimensions of compartments

Risk profile	Single storey	Multi storey	
	Maximum floor area m ²	Height of top floor m	Maximum floor area m ²
A1	No limit	No limit	No limit
A2	No limit	<30	No limit
		>30	Not applicable
A3	No limit	<18	14 000
		18 to 30	4 000
A4 ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}
B1	No limit	<30	No limit
		>30	Not applicable
B2	No limit	<18	8 000
		No limit	4 000
B3	2 000	No limit	2 000
B4 ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}
C1	No limit	No limit	No limit
C2	No limit	<30	No limit
C3 ^{A)}	No limit	Not applicable	Not applicable
C4 ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}	Not applicable ^{A)}

^{A)} See Table 4.





Ancillary Accommodation

storage areas (2 sizes)

workshops

kitchens

transformer rooms (low and high voltage)

plant rooms

dressing rooms

changing rooms

projection rooms

car parks (2 sizes)

high fire risk areas

refuse areas

boiler rooms

fuel stores

engine rooms





Other Provisions of BS 9999

Additional Recommendations

- Fire Doors and Ironmongery
- Ductwork and fire dampers
- Unprotected Areas
- Property Protection
- Recommendations for Atria
- Recommendations for Theatres and Cinemas
- Recommendations for Shopping Complexes
- Process Plant and Outdoor Buildings
- Management of Houses in Multiple Occupation
- Engineering Services





Alternative Design Approaches:

- **AD (B)**
- **BS 9999**
- **Fire Engineering**



BS 9999 supersedes BS 5588

except BS 5588-1 (Residential)

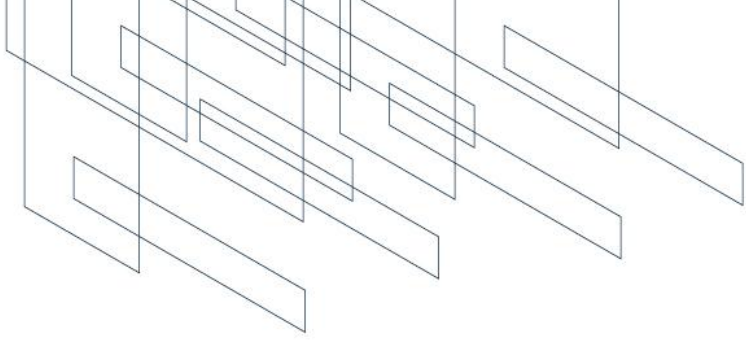




Factors in assessing the Fire Risk

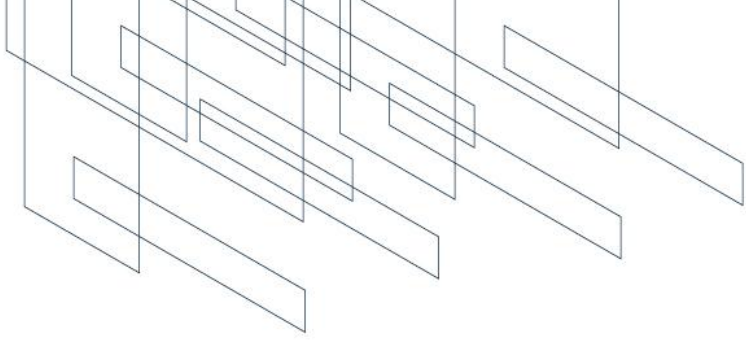
Concept of "Risk Profiles"

- Occupancy characteristics
- Fire growth rates



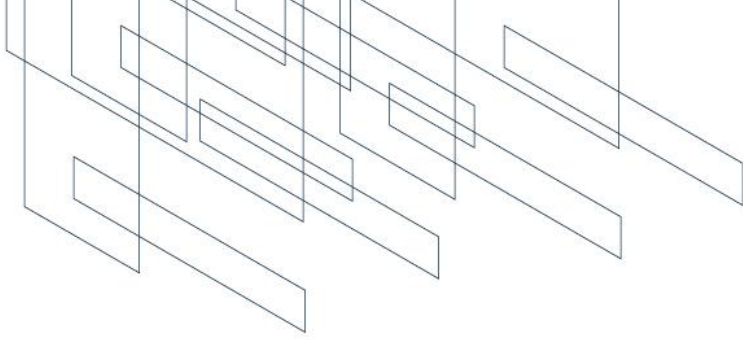
Building Management Levels

- Staffing levels
- Building Security
- Access for Fire Fighters



Design of Means of Escape:

- Measures for Disabled People
- PEEPS and Buddies
- Evacuation Lifts
- Wheelchair Refuges

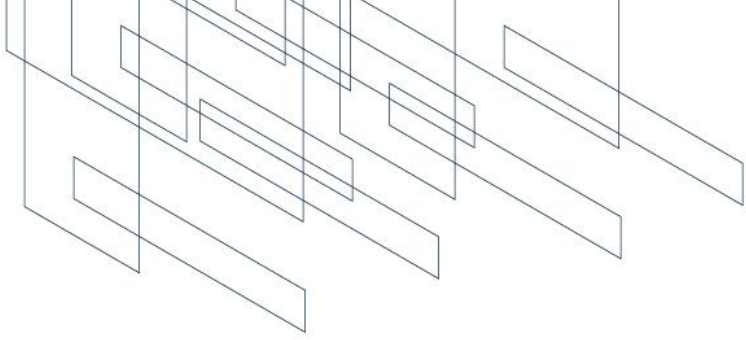


Effect on Permitted Travel Distances

- Fire Detection and Alarm Systems
- Sprinklers / other Suppression Systems
- Smoke Detection
- Ceiling Heights

Absolute Limits:

- Width of Staircases
- Travel Distances

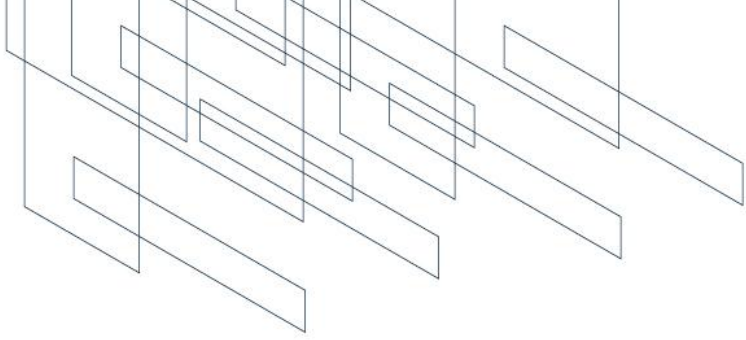


Fire Resistance of Elements of Structure

by risk profile

- concept new to BS 9999



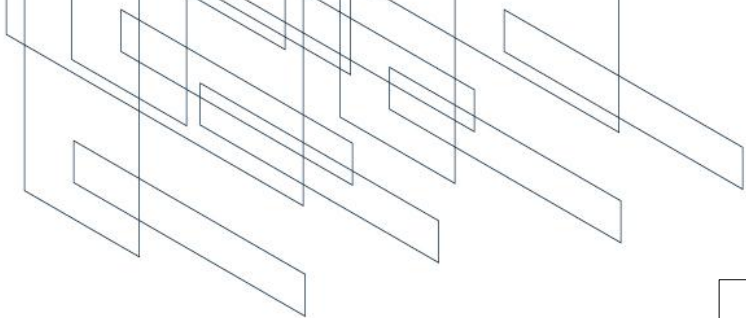


Maximum Dimensions of Fire Compartments

Ancillary Accommodation

Other Provisions of BS 9999 (in Annexes)





BS 9999:2008



BSI British Standards

Code of practice for fire safety in the design, management and use of buildings

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