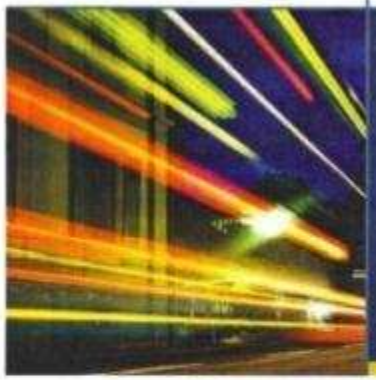
IBCI Building Control Conference 2009

Introduction to BS9999:2008 Code of Practice for fire safety in the design, management and use of buildings

Maurice Johnson Fire Safety Engineer

BS 9999:2008



BSI British Standards

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

Contents of Presentation

- History of BS9999
- Standards Superseded
- Scope of the BS9999 standard
- Relationship to guidance documents and full fire engineering
- Key aspects of the standard
- Design Examples

History of BS 9999

- Review of BS5588 standards in 1997 identified problems re duplication, anomalies, out-of date guidance
- Work started in 1998 to replace the BS5588 codes with a 4 part standard
- Draft for Public Comment issued 2001
- Change of Direction leading to issuing Draft for Development DD9999:2005 in July 2005
- Further development leading to draft for Public Comment in Jan 2008 and subsequently to publication of BS9999 in October 2008
- 11 YEAR PROCESS

Standards Superseded

Publishing information

This British Standard is published by BSI and came into effect on 6 October 2008. It was prepared by Technical Committee FSH/14, *Fire precautions in buildings*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes the following publications, which will be withdrawn on 6 April 2009:

- BS 5588-0:1996;
- BS 5588-5:2004;
- BS 5588-6:1991;
- BS 5588-7:1997;
- BS 5588-8:1999;
- BS 5588-9:1999;
- BS 5588-10:1991;
- BS 5588-11:1997;
- BS 5588-12:2004;
- DD 9999:2005.

BS 5588-1 is not being superseded by BS 9999 but is expected to be revised in due course and issued with a new identifier.

Scope of the Standard (1)

All categories of building other than:

- MOE from Apartments (OC = Ci)
- Hospitals, nursing homes (OC = D)
- Detention facilities
- Airports and railway stations(OC = E)

440 pages! Compared to 800 pages in documents it replaces. Also costs 25% less

Scope of the Standard (2)

Comprises a Foreword and 9 Sections

1. General including scope, terms and definitions)
2. Risk Assessment and Risk Profiles
3. Ensuring Effective fire Protection
4. Managing Fire Safety
5. Designing Means of Escape
6. Access and Facilities for fire-fighting
7. Designing the Building Structure
8. Special Risk Protection
9. Managing Occupied Buildings

Has 26 Annexes covering subjects such as

1. Provisions for special categories of building such as atria, shopping complexes, seated audiences, process plant and outdoor structures
2. Detailed fire safety management advice
3. Evacuation of disabled

Relationship to guidance documents and full fire engineering (1)

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 this document 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.

Relationship to guidance documents and full fire engineering (2)

1. General Approach – Guidance documents (TGDB, UKADB, NITBE) – Difficulty with Irish TGDB as it refers to the withdrawn BS5588 codes

2. "Advanced" Approach – BS 9999 offers greater design flexibility

3. Fire safety engineering –
   - BS 7974 provides framework/data
   - Evacuation modelling – e.g. STEPS, Simulex
   - Smoke movement – Zone (e.g. CFAST), CFD models (e.g. FDS)
   - Structural Response – Eurocodes, FEL models (e.g. Vulcan)

Relationship to guidance documents and full fire engineering (3)

Alternative Solutions

0.1.4 The detailed provisions set out in this Document are intended to provide guidance for some of the more common building situations. In other situations, alternative ways of achieving compliance with the requirements of Part B of the Second Schedule to the Building Regulations may be appropriate. There is no obligation to adopt any particular solution contained herein. **The use of alternative design solutions, standards, systems or methods of fire protection to those outlined in this document are acceptable, provided the level of fire safety achieved is adequate to satisfy the requirements of the Building Regulations.**

Alternative approaches (see 0.2) based on fire safety engineering may be employed to satisfy the requirements of the Regulations. These may be based on a fundamental analysis of the fire safety problem or involve a comparative analysis between a provision of this technical guidance document and an alternative solution. Where appropriate, compensating fire safety measures should be considered and evaluated. A qualitative assessment of the alternative design may be adequate in some cases, but generally quantitative analysis will also be required.

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BS9999 Key Aspects and changes

- Risk Profiles
- Management Levels
- Means of Escape
  - ✓ Minimum package
  - ✓ Additional Measures/Trade-offs
- Structural Fire Protection
- Annexes

Risk profiles (1)

Occupancy Characteristics

A = awake/familiar(offices)
B = awake unfamiliar (shops)
C = asleep
- C i = long term individual (flats)
- C ii = long term managed (H of R)
- C iii = Short-term (hotel)

D = medical care (hospitals, NH) – Outside scope of BS 9999

E = in transit (airports) – Outside scope of BS 9999

Fire Growth rate

1 = Slow (Limited combustibles)
2 = Medium
3 = Fast
4 = Ultra-fast

- $Q = \alpha(t - t_i)(t-t_i)$ (kW)

Table NA.3 – Fire growth rate parameters

Classification	Fire growth parameter α (kJ/s^3)
Slow	0,0029
Medium	0,012
Fast	0,047
Ultrafast	0,188

2) The t^2 parameters represent fire growth starting with a reasonably large flaming ignition source. With a smaller source, there is an incubation period before established flaming occurs.

3) The design fire growth rates for different occupancies are given in Table NA.4

4) The characteristic fire growth rates given in Table NA.4 should be used for general design purposes for different types of occupancies. For mixed building use, the faster growth rate should be used.

Risk Profiles (2)

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)]

A) These categories are unacceptable within the scope of BS 9999. Addition of an effective localized suppression system or sprinklers will reduce the fire growth rate and consequently change the category (see **6.5**).

B) Risk profile C may be divided into sub-categories, viz. Ci1, Cii1, Ciii1, etc.

C) Risk profile C3 will be unacceptable under many circumstances unless special precautions are taken.

Risk Profiles (3)

- Typical Examples
  - ✓Office = A2
  - ✓Shop = B3
  - ✓Classrooms = A2
  - ✓Nursing Home/Residential Care = D
- Automatic suppression risk reduction
  - ✓Sprinklers to BS5308/EN12845
  - ✓Residential Sprinklers to BS9251 do NOT reduce RP
  - ✓*Re*duction by one sub-grade e.g. A3 + sprinklers = A2
- RP Impacts on MOE and SFR
- Mixture of Uses/Occupancies

Risk Profiles (4)

Sprinkler trade-off Versus travel distance also in American codes such as NFPA Life Safety Code 101

Assembly :	61m →	76m	+25%
Offices :	61m →	91m	+50%
Shops :	45m →	76m	+67%
Warehouse:	61m →	122m	+100%
Car parks:	45m →	60m	+33%

Risk Profiles (5)

Fire Growth rates ex National Annex to I.S. EN1991-1-2:2002

Table NA.4 – Design fire growth rates

Building use	Fire growth rate
Picture gallery	Slow
Transport (public place)	Slow
Classroom (school)	Medium
Dwelling	Medium
Office	Medium
Hotel reception	Medium
Hotel bedroom	Medium
Hospital room	Medium
Library	Fast
Theatre (cinema)	Fast
Shop	Fast
Industrial storage or plant room	Ultra-fast

Management Levels (1)

- Level 1 = High
- Level 2 = Normally Acceptable
- Level 3 = Basic Level (may not be acceptable at all)
- Minimum Acceptable level related to Risk Profile (Table 6)

Management Levels (2)

Minimum Management Levels vs. Risk profile

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.

Note: Level 3 is unacceptable in all but lowest risk.
Clause 10.2 says “speculative” = 3 so can code be used!

Factors determining Management Levels (3)

- 1. Planning for changes in RP
  - L1 = anticipates
  - L2 = as they occur
  - L3 =Periodic audit
- 2. Resources and Authority
  - L1 = single person with autonomy, resources, funds
  - L2 = # of persons, approval of others,
  - L3 = FSM needs approval to act

Factors determining Management Levels (4)

- 3. Staffing Levels
  - L1 = sufficient for assistance of all, contingencies, security patrols
  - L2 = no contingency or security patrol provision
  - L3 =modest staffing levels
- 4. Fire training
  - L1 = sufficient fully trained staff to cover contingencies
  - L2 = no contingency cover but fully trained
  - L3 = periodic training only

Factors determining Management Levels (5)

- 5. Work Control
  - L1 = proactive, permit system, logging and audit..
  - L2 = reactive, permit system…
  - L3 =reactive
- 6. Communication procedures
  - L1 = full communication with all involved and contingency for system failure
  - L2 = full communication but no contingency
  - L3 = necessary information to all but no contingency

Factors determining Management Levels (6)

- 7.Contingency Planning
  - L1 = proactive, range of issues/scenarios
  - L2 = planned for a lesser range of issues
  - L3 =no pre-planning

Fire Safety Manual – ALL BUILDINGS

Clause 10.2 “Speculative” = L3

Designers – Regulatory Authorities (7)

- Key areas for agreement at outset
  - Risk Profiles
  - Management Level (L1, L2, L3)
  - Method of Documentation of RP, ML

- Management Levels and Ongoing Compliance – Independent Audits

Problem Areas/Solutions (8)

- Legislative control UK vs. ROI
- Ongoing compliance with management standards – Auditing
- End User not Known vs. Management Levels. Level 3 not allowable for most RP so code cannot be used?
- Designing in features for management
  - Maintainability, duplicate, durability, simplicity, redundancy

Legislative Control UK v ROI (9)

Fire Services Act 1981-2003

''(2) It shall be the duty of every person having control over premises to which this section applies to—
(*a) take all reasonable measures to guard against the* outbreak of fire on such premises,
(*b) provide reasonable fire safety measures for such* premises and prepare and provide appropriate fire safety procedures for ensuring the safety of persons on such premises,
(*c) ensure that the fire safety measures and procedures* referred to in paragraph (*b) are applied at all* times, and
(*d) ensure, as far as is reasonably practicable, the safety* of persons on the premises in the event of an outbreak of fire whether such outbreak has occurred or not.'',

REGULATORY REFORM, ENGLAND AND WALES

The Regulatory Reform (Fire Safety) Order 2005

Risk assessment

- **9.—(1) The responsible person must make a suitable and sufficient assessment of the risks to** which relevant persons are exposed for the purpose of identifying the general fire precautions he needs to take to comply with the requirements and prohibitions imposed on him by or under this Order.

Fire safety arrangements

11.—(1) The responsible person must make and give effect to such arrangements as are appropriate, having regard to the size of his undertaking and the nature of its activities, for the effective planning, organisation, control, monitoring and review of the preventive and protective measures.

Possible need to strengthen Irish legislation

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Means of Escape(1)

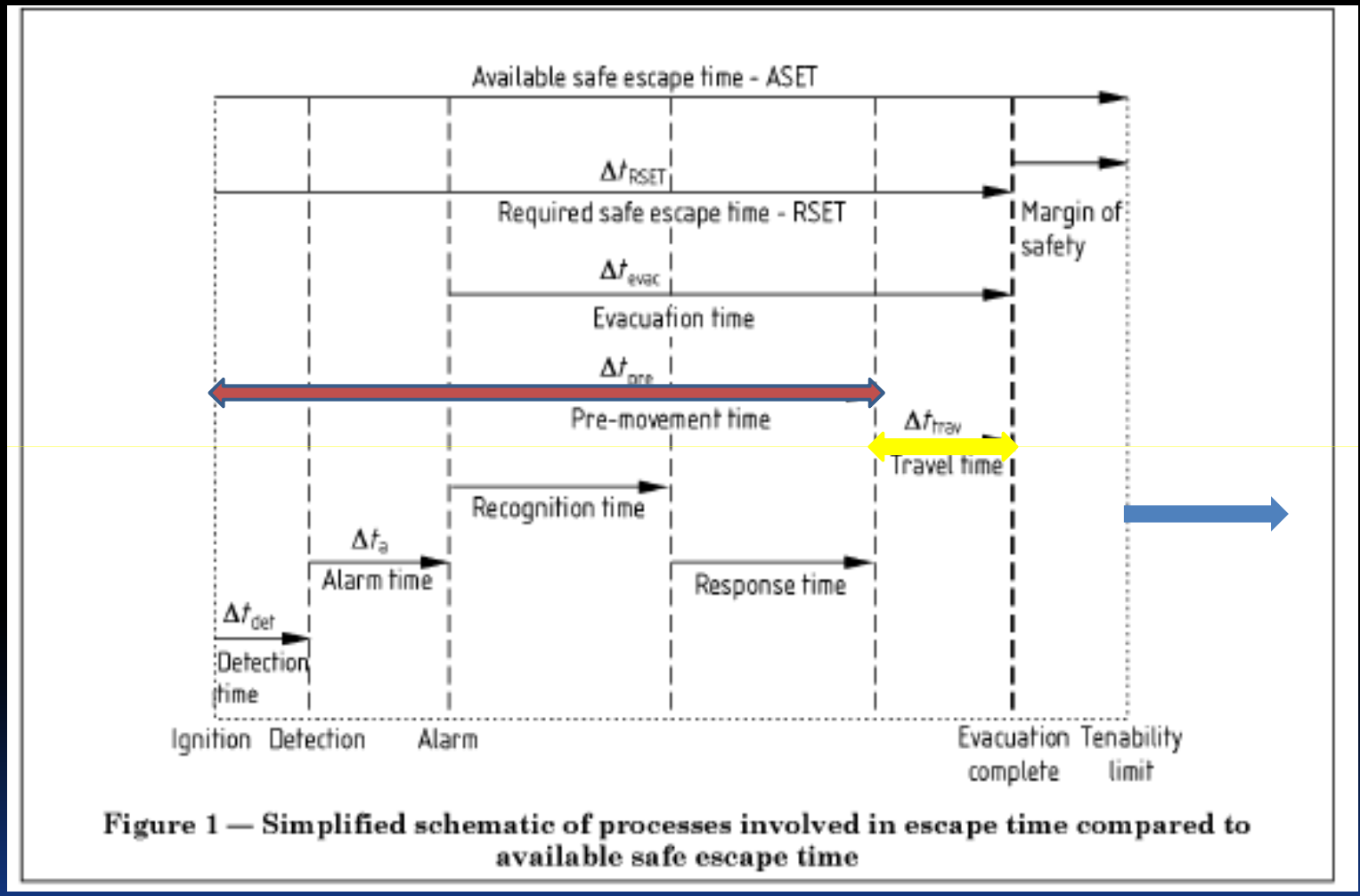


Figure 1 — Simplified schematic of processes involved in escape time compared to available safe escape time

Enhanced detection and alerting

Increased headroom

Means of Escape (2)

- Trade-off possibilities ("off the shelf" fire engineering)
  - Sprinklers (improved Risk Profile)
  - Reduction of time to alarm (increased detection + improved alerting)
  - Reduction of pre-movement time (superior management/alerting)
  - Increased time to untenable conditions(high ceilings, smoke control)
- Increased time available for escape (travel distance and exit widths)

Means of Escape (3)

- Step 1 – Evaluate Risk Profile

- Option 1: Design using minimum package of fire protection
- Option 2 : Design using "additional" fire protection measures (special consideration of disabled where TD > 50m)
- Option 3 : Quantative fire engineering

Means of Escape (4)

Fire Detection and Alarm systems

Minimum requirements

- Offices (RP = A2): Type M
- Shops (RP = B3) : Type L2
- Exhibition Centre(RP = B3): Type L2
- Theatre (RP = B2) : Type M (SURPRISING)

Up to 15% increase in TD and reduction in EW if enhanced detection or enhanced warning(needs case specific consideration / judgment) -

Means of Escape (5)

Fire Detection and Alarm systems

Table A.1 — Choice of appropriate category of a fire detection and alarm system

Type of premises	Typical Category of system	Comments
Common places of work, such as offices, shops, factories, warehouses and restaurants	M or P2/M or P1/M	A Category M system normally satisfies the requirements of legislation. It is, however, often combined with a Category P system to satisfy the requirements of insurers, as company policy for protection of assets, or to protect against business interruption.
Hotels and hostels	L1 or L2	In bedroom areas, the design requirements are usually based on the recommendations for a Category L3 system. Detectors are, however, typically installed in most other rooms and areas, as a fire in almost any area of the building could pose a threat to sleeping occupants; the system Category is, therefore, at least L2. In practice, few, if any, areas are left unprotected and the system Category is effectively L1, except that a variation from the recommendations applicable to a Category L1 system may apply to the siting of heat, smoke or carbon monoxide detectors in bedrooms; this often follows the recommendations of 22.3e) for detectors in a Category L3 system.
Large public houses (No residential accommodation)	M	—
Public houses with residential accommodation	L2	—
Schools, other than small single storey schools with less than 160 pupils	M or M/P2 or M/P2/L4 or M/P2/L5	System Category is normally based on a fire risk assessment. In many schools, a Category P system is installed to combat the hazard of arson. In schools that are partly occupied at certain times (e.g. during evening classes or community use), a Category L4 or L5 system is sometimes considered appropriate.
Hospitals	L1 (with possible minor variations)	Detailed guidance on areas to be protected and possible variations is given in HTM 82.
Places of assembly, (e.g. cinemas, theatres, nightclubs, exhibition halls, museums and galleries, leisure centres and casinos):		
Small premises (e.g. accommodating less than 300 persons)	M	—
Other premises	L1 to L4	L1 systems are often provided in large or complex buildings.

Means of Escape (6)

Travel Distances with Min Measures

USE	SUPPRESSION	RP	BS9999	TGDB/BS5588	CHANGE
Office (A)	Un -Sprinklered	A2	22/55	18/45	+22%
	Sprinklered	A1	26/65	18/45	+45%
Retail (B)	Un -Sprinklered	B3	16/40	18/45	-11%
	Sprinklered	B2	20/50	18/45	+11%
Warehouse(A)	Un -Sprinklered	A3	18/45	25/45	NC
	Sprinklered	A2	22/55	25/45	+22%
Hotel (C)	Un -Sprinklered	C2	9/18	20/45	-60%
	Sprinklered	C1	13/27	20/45	-40%

Means of Escape (7)

Door Widths with Min Measures

USE	SUPPRESSION	RP	BS9999	TGDB/BS5588	CHANGE
Office	Un -Sprinklered	A2	3.6	5	-28%
	Sprinklered	A1	3.3	5	-34%
Retail	Un -Sprinklered	B3	6	5	+20%
	Sprinklered	B2	4.1	5	-18%
Warehouse	Un -Sprinklered	A3	4.6	5	-8%
	Sprinklered	A2	3.6	5	-28%
Hotel	Un -Sprinklered	C2	4.1	5	-18%
	Sprinklered	C1	3.6	5	-28%
"WIDTH" =	*Clear of ironmongery*			*Ave*	*-17.75%*
<1100mm	*No reduction in flow capacity per unit width*				

Means of Escape (8)

Stairs Widths (mm/person) with Min Measures

RP	BS9999 Stairs one floor	BS9999 Doors	TGDB BS5588:Part11	Stairs to Door ratio
A1	3.9	3.3	5	118%
A2	4.5	3.6	5	125%
A3	5.4	4.6	5	117%
B1	4.2	3.6	5	117%
B2	4.8	4.1	5	117%
B3	7.0	6	5	117%
C1	4.2	3.6	5	117%
C2	4.8	4.1	5	117%
C3	7	6	5	117%
NFPA code = 150% ratio		*Sports grounds = 150% ratio*		
Different approach to staircase sizing				
Anomalies in BS5588 tables for phased evacuation removed				

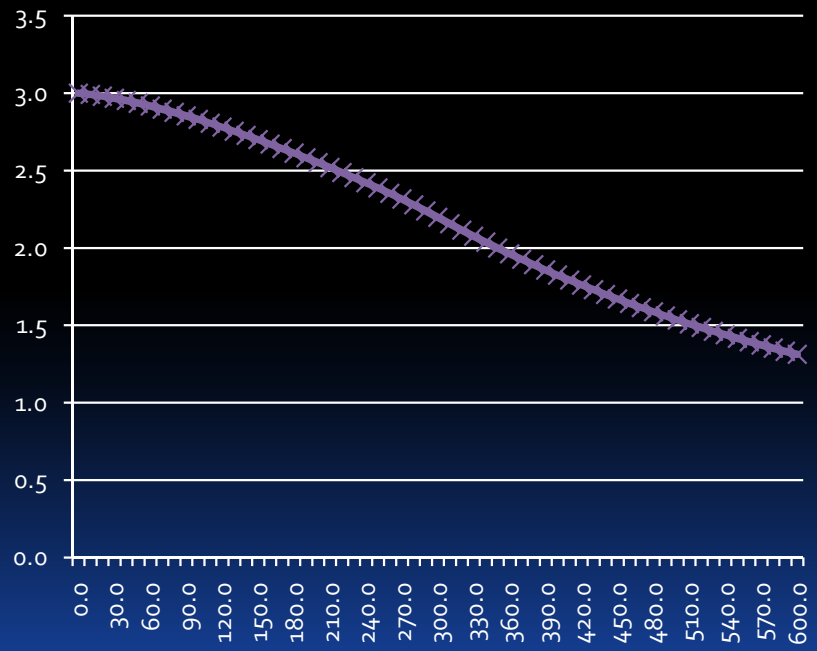
Means of Escape(9)
Additional Fire Protection Measures

- Enhanced detection/alarm = 15% increase in travel distance and 15% reduction in exit width
- Ceiling height > 3m = increase in TD and reduction in EW of up to 30%
- Overall limits set on increase/reduction

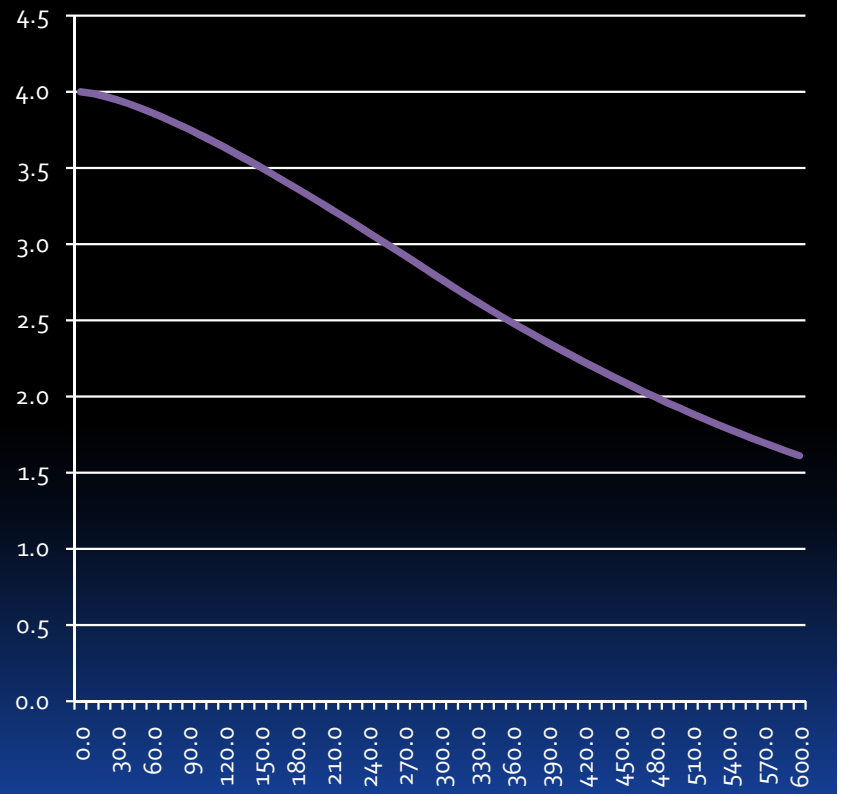
Means of Escape(10)

Additional Height – CFAST output

1000sqm, moderate growth rate, 3 m height



1000sqm, moderate growth rate, 4 m height



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Means of Escape (11)

Enhanced fire protection measures - widths

RP	BS9999 Doors without enhancements	BS9999 Doors with enhancements (LIMITS)	Max variation to BS9999	TGDB BS5588	Max variation from TGDB
A1	3.3	2.4	-27%	5	-52%
A2	3.6	3	-17%	5	-40%
A3	4.6	4.1	-11%	5	-18%
B1	3.6	2.4	-33%	5	-52%
B2	4.1	3.3	-20%	5	-34%
B3	6	5.3	-12%	5	+6%
C1	3.6	2.4	-33%	5	-52%
C2	4.1	3.3	-20%	5	-34%
C3	6	5.3	-12%	5	+6%
		Ave	-20.5%	Ave	-30%

Means of Escape (12)

Enhanced fire protection measures - stairs widths

- Maximum reduction in stairs width = 25% e.g. enhanced AFDS/VA and headroom
- 18.3.2 also says **no discounting** if sprinklers fitted in addition to reduced risk profile!!
- Major reduction in staircase sizing possible

Means of Escape (13)

Enhanced fire protection measures - max travel distances

RP	BS9999 TD with enhancements (LIMITS)	TGDB BS5588	Max variation from TGDB
A1	90/30	60/45	+50%
A2	75/24	45/25	+67%
A3	60/22	25/12	+180%
B1	90/28	45/18	+100%
B2	75/24	45/18	+60%
B3	60/20	45/18	+33%
C1	37/18	39/16.5	0%
C2	27/13	45/20	-35%
C3	18/9	45/20	-67%

Means of Escape (14)
Example 1

Single storey supermarket

2000 sqm plan area

BS5588:Part11

- Occupant capacity = 2000/2 = 1000persons
- Exits required = 1000x5/1000 = 5m
- Maximum travel distance = 45m

Means of Escape (15)
Example 1

BS9999 with minimum fire protection measures

- Risk Profile = B3
- Min management level = 1 (and not speculative)
- Min alarm = Type L2 + sounders
- Exits required = 1000x6mm/p = 6m
- Travel distance limit = 40m

Means of Escape (16)
Example 1

BS9999 with minimum FP measures + sprinklers

- Risk Profile = B2
- Min management level = 2 (and not speculative)
- Min alarm = Type M + sounders
- Exits required = 1000x4.1mm/p = 4.1m
- Travel distance limit = 50m

Means of Escape (17)
Example 1

BS9999 with additional FP measures + no sprinklers

Risk Profile = B3

Min management level = 1 (and not speculative)

Enhanced alarm = Type L1 and VA = 15%

Ceiling height = 4.5m = 10%

Total allowance from enhancements = 25%

Exits required = 1000x(max of 6x75% or 5.3)mm/p = 5.3m

Travel distance limit = Min(40 x 125% or 60m) = 50m

Means of Escape (18)
Example 1

BS9999 with additional measures + sprinklers

Risk Profile = B2

Min management level = 2 (and not speculative)

Enhanced alarm = Type L1 and VA = 15%

Ceiling height = 4.5m = 10%

Total allowance from enhancements = 25%

Exits required = 1000x(max of 4.1x75% or 3.3)mm/p = 3.3m

Travel distance limit = Min(50 x 125% or 75m) = 62.5m

Means of Escape (19)
Example 1(SUMMARY)

		4 OPTIONS			
	BS5588 Pt11	BS9999 basic	BS9999 basic with sprinklers	BS9999 with enhancements	BS9999 with sprinklers and enhancements
Sprinklers	NA	No	Yes	No	Yes
Risk profile	NA	B3	B2	B3	B2
Minimum management level	NA	1	2	1	2
Fire alarm	M	L2	M	L1 and VA	L2 and VA
Exit width required	5	6	4.1	5.3	3.3
Travel distance limit	45	40	50	50	62.5

Means of Escape (20)
Example 2

3 Storey Office building 900sqm per floor and 2 stairs

Occupant level per floor (open plan) = 900/5 = 180 persons

Means of Escape (21)
Example 2(SUMMARY)

		4 OPTIONS			
	BS5588 Pt11	BS9999 basic	BS9999 basic with sprinklers	BS9999 with enhancements and no sprinklers	BS9999 with sprinklers and enhancements
Floor to ceiling height	NR	3	3	4	4
Sprinklers	NA	No	Yes	No	Yes
Risk profile	NA	A2	A1	A2	A1
Minimum management level	NA	2	3 !!	2	3 !!
Fire alarm	M	M	M	L2/L3	L2/L3
Storey Exit width required	2@1100 = 220 persons	180x3.6 = 648mm therefore 2@800	180x3.3 = 594, therefore 2@800	180x3.6x(100-15%-5%)=180x2.88<180x3 = 540, therefore 2@800	180x3.3x(100-15%-5%)=180x2.64(>2.4!) = 475.2, therefore 2@800
Travel distance limit	45	55	65	55+(15%+5%)=66<75, therefore 66m	65+(15%+5%)=78<90, therefore 78m
Stairs width based on demand of 180 per storey x 2 storeys	2 @ 1500mm (capacity 360 persons)	360 x 3.8 = 1368mm	360x3.4 = 1224mm	1368x(1-15%-5%)=1094mm	1224x80%=979.2<1000, therefore 1000mm
NOTE: Additional avoidance of staircase discounting with sprinklers					

Fire Resistance Ratings (1)

Option 1: Table 25 unventilated fire

- similar to Table A2 of TGDB
- More discrete groups depending on Risk Profile

Option 2: Well ventilated compartment – Table 26 /27

- Greater flexibility ,
- Reduced ratings in some circumstances, increased in other circumstances
- Based on a combination of Deterministic Analysis (time equivalent based on BSEN parametric fires) and Probabilistic Risk/Consequence Analysis (Risk = Φfrequency x Likelihood x Consequence)
- Height bands are related to fire-fighting height thresholds: i.e. ladder, high reach, dry riser, wet riser
- Applicable only to above ground storeys

In both cases ratings are related to height above "access level" NOT ground level

Fire Resistance Ratings (2)

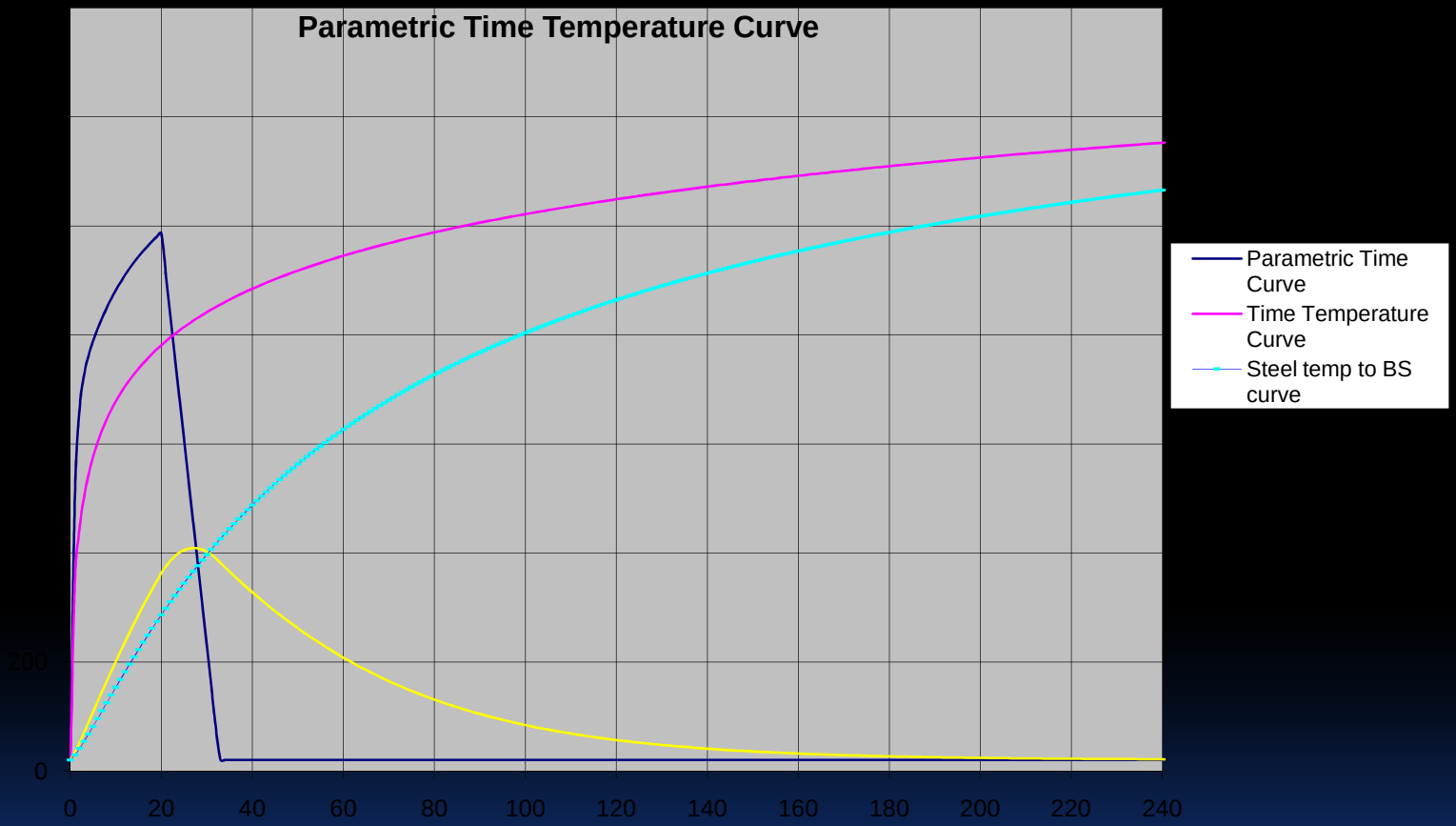
Table 25 Fire resistance periods for elements of structure (independent of ventilation conditions)

OC [A]	Use	Sprinklered or unsprinklered [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	Unsprinklered	90	60	30	60	90	Not allowed
		Sprinklered	60	60	30	30	60	120
A	Industrial: high hazard	Unsprinklered	N/A [D]	120	90	120	150	Not allowed
		Sprinklered	150	90	60	90	90	120
A	Industrial: ordinary hazard	Unsprinklered	N/A [D]	120	60	90	120	Not allowed
		Sprinklered	90	60	30	60	60	90
A	Industrial: low hazard	Unsprinklered	90	60	30	60	90	Not allowed
		Sprinklered	60	30	30	30	60	60
A	Storage: low hazard	Unsprinklered	90	60	30	60	90	Not allowed
		Sprinklered	60	30	30	30	60	60
A	Car parks: - open-sided car park	Unsprinklered	—	—	15 [E]	15	30	30
	- any other car park	Unsprinklered	90	60	30	60	90	120
B	Shops and commercial	Unsprinklered	90	60	60	60	90	Not allowed
		Sprinklered	90	60	30	60	60	120
B	Assembly: high hazard	Unsprinklered	N/A [D]	90	60	90	120	Not allowed
		Sprinklered	120	60	60	60	90	120
B	Assembly: ordinary hazard	Unsprinklered	90	60	60	60	90	Not allowed
		Sprinklered	60	30	30	60	60	120
Ci	Individual residential	Unsprinklered	90	60	30	60	Not allowed	Not allowed
		Sprinklered	90	60	30	60	90	120
Cii and Ciii	Other residential	Unsprinklered	90	60	30	60	90	Not allowed
		Sprinklered	60	30	30	30	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 Ciii, 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.

Comparison with Table A2 of TGDB

Fire Resistance Ratings (3)



Parametric Curve as Annex A of IS EN 1991-1-2:2002 and associated Irish National Annex

Fire Resistance Ratings (4)

Table 27 **Ventilation conditions for application of Table 26**

Occupancy characteristic [A]	Use	Ventilation parameter	
		Minimum potential area as a percentage of the floor area %	Height of opening [B] as a percentage of the compartment height (i.e. from floor to ceiling) %
A	Office	5	30 to 90
A	Industrial: low hazard	2.5	30 to 80
A	Industrial: high hazard	2.5	30 to 80
B	Shops and commercial	5	50 to 100
B	Assembly: low hazard	2.5	30 to 80
B	Assembly: medium hazard	2.5	30 to 80
B	Assembly: high hazard	2.5	30 to 80
Ci	Individual residential	10	30 to 90
Cii and Ciii	Other residential	10	40 to 90

[A] As defined in Table 2.

[B] This is the weighted mean height (by ventilation area) of the potential openings. If a compartment has openings each with an area of $A_1, A_2, A_3, \ldots A_n$ and heights of $h_1, h_2, h_3, \ldots h_n$, then the total area of the openings $A = A_1 + A_2 + A_3 + \ldots A_n$, and the weighted mean height, h, is given by:

$$h = \frac{A_1h_1 + A_2h_2 + A_3h_3 + \ldots\ldots A_nh_n}{A}$$

NOTE In the calculation of the weighted mean height it is also acceptable to selectively consider only the height(s) of the openings that achieve the minimum ventilation area.

If h is the weighted mean height of all the openings and H is the height of the compartment then h/H should be between the values given in the end column.

Fire Resistance Ratings (5)

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 (Offices)	15 30	30 30	30 30	60 60	75 120/90	90 120/90
A2	30 [D]	30	60	90	120	150
A3	60	60	90	120	300	300
A4 [E]	—	—	—	—	—	—
B1 (Assembly)	30 30	30 60	30 60	60 60	60 120/90	75 120/90
B2 (Shops)	30 30	30 60	60 60	75 60	90 120/90	120 120/90
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]	—	—	—	—	—	—

NOTE 1 For occupancy characteristic A covering storage and car parks, and all basements, the fire resistance periods are as given in Table 25.

NOTE 2 Variation of the risk profile by the addition of sprinklers conforming to BS EN 12845 (new systems) or BS 5306-2 (existing systems) can be used to reduce the fire resistance as described in 6.5.

Comparison with Table A2 of TGDB - Sprinklered

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Fire Resistance Ratings (6)

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 (offices)	30 [D] 30	30 60	60 60	90 90	120 N/A	150
A3	60	60	90	120	300	300
A4 [E]	—	—	—	—	—	—
B1	30	30	30	60	60	75
B2 (Assembly)	30 60	30 60	60 60	75 90	90 N/A	120 N/A
B3 (Shops)	30 60	45 60	75 60	105 90	135 N/A	180 N/A
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]	—	—	—	—	—	—

NOTE 1 For occupancy characteristic A covering storage and car parks, and all basements, the fire resistance periods are as given in Table 25.

NOTE 2 Variation of the risk profile by the addition of sprinklers conforming to BS EN 12845 (new systems) or BS 5306-2 (existing systems) can be used to reduce the fire resistance as described in 6.5.

Comparison with Table A2 of TGDB - Unsprinklered

MISCELLANEOUS ISSUES

- Requirement for pressurization of firefighting shafts exceeding 30m in height i.e. natural venting not permitted
- Compartment Size limits are significantly different from TGDB and relate only to RP and height – DoE consideration
- E3.1.2 allows for increased TD in malls (B3 + sprinklers = B2, TD = 20/50, potential to increase based on smoke layer height in mall up to 24/75m i.e. 150m centres at ground floor level of multilevel mall)
- Sprinkler protection in malls not explicitly excluded. Sprinkler requirement in car parks in shopping complexes removed
- 120 minute rating in shopping centre removed

CONCLUDING COMMENTS

- BS9999 is significant addition to the current standards/codes and offers greater flexibility to Designers in particular circumstances
- Raises certain issues regarding ongoing compliance particularly in relation to management levels and Risk Profile
- Requirement for reform of Irish Technical Guidance Document B
- THANK YOU VERY KINDLY FOR YOUR ATTENTION and I HOPE YOU ENJOY THE REMAINDER OF THE CONFERENCE

Maurice Johnson Fire Safety Engineer