



Nigel Hiorns discusses the challenges of applying Firecode and other associated fire safety guidance in healthcare

CONSIDERABLE EFFORT and commitment has gone into the development of the Department of Health's (DoH's) healthcare guidance, Firecode, and associated fire safety guidance. However, disparities in the guidance, as well as discrepancies in its application, compromise the ability to deliver best-value hospitals on programme.

The principal reasons are:

- the application of the Firecode suite of documents and associated guidance (for example, BS 5588-7: *Fire precautions in the design, construction and use of buildings. Code of practice for the incorporation of atria in buildings*) create different standards of fire safety. An inappropriate disparity of fire safety within a building causes an

inefficient and unfocused design. These disparities arise from the guidance and the interpretations of the guidance

- the performance implied by the guidance is not clear, which constrains the ability of engineers to develop best solutions and creates risk in the design, management and operation of the hospital
- subjectivity in interpretation of guidance can cause, or be used to cause, significant delays and risks. This subjectivity makes the guidance unsuitable for design, and wholly unsuitable for negotiated contracts such as Private Finance Initiative (PFI) – the procurement route for the majority of hospital capital expenditure in England and Wales. On one PFI project, principles for design of a hospital facility were agreed by effective teamwork by the contractor and the health board in a single day. On another PFI project, the same principles took over six months to agree

The objective of this article is to facilitate an informed discussion and to highlight the benefits of a framework for common understanding in healthcare fire safety. This will help: develop coordinated and coherent guidance, ensure consistent understanding and application; form the basis for continuous improvement and ingenious, robust solutions; enable better fire safety management; and therefore to deliver better hospitals, with less risk, in less time.

Capital expenditure in the National Health Service (NHS) has increased from £1.1bn in 1997/98 to £5.5bn in 2007/08. In total, 88 major hospital schemes (67 PFI and 21 public capital) worth over £4.9bn have opened since 1997. Another 24 are under construction (19 PFI and five public capital), worth £4.6bn, and 111 new major hospital schemes will be open by the end of 2010 (worth £8.5bn).

A successful fire strategy will minimise its impact on the design, cost and operation of a hospital. However, anomalies in the fire strategies developed for hospitals (fire engineered and non-engineered) are indicative of a failure in process. This article looks at some causes of these anomalies by examining:

- fire strategy design principles
- what is an appropriate standard of safety in hospitals?
- what are acceptable escape times and escape distances?
- the application and interpretation of Firecode and associated guidance, considering, as examples, the design of atria and incorporation of commercial premises in hospitals

Design principles

The governing principle is to develop a safe and effective fire strategy enabling the desired health-planning solution, operational requirements and design quality.

The principal benefit of a fire engineered approach is to enable the operational and design objectives in the most practical and pragmatic way; to develop the best technical solutions, fully coordinated within the design, and achieving best (whole-life) value for money. This ensures that the facility can operate efficiently and competitively.

HTM 05-02: *Guidance in support of functional provisions in healthcare premises*, one of the new Firecode documents, describes a way of achieving an acceptable standard of fire safety in new and modified healthcare buildings. However, it recognises that there may be other ways of satisfying the functional requirements by adopting a fire safety engineering approach. 'The complex nature of healthcare buildings will sometimes require a more flexible approach to ensure that the correct balance is achieved between fire safety and the requirements for treatment and nursing care,' it says.

The key point is that the fire strategy needs to be developed in the context of a 'whole hospital' approach:

- the legislative fire safety performance must be achieved as a minimum standard
- there may be inherent features of the design (or straightforward solutions that can be readily applied with little design, operation or cost impact) that further enhance fire safety
- Firecode compliance is a gateway check in the procurement process for hospitals, although there may be limited circumstances where derogations are acceptable

Atria and commercial premises

EXAMINING two aspects of design – incorporation of atria and commercial premises in healthcare buildings – gives an insight into the problems that can arise in the application and interpretation of Firecode and associated guidance.

BS 5588-7: *Fire precautions in the design, construction and use of buildings. Code of practice for the incorporation of atria in buildings* provides guidance for atria in hospitals. The principle of this standard is that the building with the atrium is no less safe than the same building without the atrium. Application of this fundamental principle, using a fire engineering approach, can result in a very successful design for atria.

Fire engineering consultancy SAFE developed the fire strategy for the recently-completed Royal Alexandra Children's Hospital in Brighton. The atrium fire strategy has been independently cited in recent European/world conferences as 'where innovation has worked best'. The ten-storey atrium has open accommodation within the atrium at all storeys, toughened glazing in the atrium façade, and a smoke control system to enable toughened glazing to achieve a compartmentation performance.



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However, consider some examples of the application of the BS 5588-7 guidance in hospitals.

Example 1

1. An HTM 05-02 guidance-compliant single-storey waiting department (for example, 700m² floor area) serving adjacent clinical departments. The boundary of this waiting area is a compartment with FD60S doors.

2. This same waiting area, but now a double-height space. A double-height space will inherently create safer conditions within the waiting space and pose less threat to the compartment doors, due to the presence of a reservoir and reduction in smoke temperature and pressure. However, as an atrium, the guidance in BS 5588-7 is that the waiting area would additionally need:

- use of the waiting area to be based on a controlled fire load

- a smoke control system to maintain a clear-layer 1m above the compartment-door openings. This can have significant implications on provision of exhaust and make-up air
- a smoke clearance system (unless it can be demonstrated that the clear-layer solution is sufficient)

Example 2

1. An HTM 05-02 guidance-compliant single-storey circulation zone serving adjacent compartments, without any fire load.

2. The same space, but now a double-height space. In this situation, the guidance in BS 5588-7 is that the space, now an atrium (yet without any fire load) would additionally need:

- maintaining the atrium base as sterile
- openable vents in the roof, equivalent to 10% of the floor area. For example, for a 700m² floor area, the guidance would be for 70m² of roof-vents
- provision for make-up air to the atrium base. The area for make-up is not specified in BS 5588-7; a rule of thumb often applied is a 1:1 or 1:2 relationship, which would imply 35m² to 70m² of inlet area

Example 3

1. A multi-storey internal courtyard, without any roof. In this situation, any windows opening onto this (external façade) could be opening (including the façade to any hospital street overlooking this courtyard). Open balconies for patient access are permitted. The external façade of any fire hazard rooms would not require to be fire-rated, and thus could comprise permanent louvres. In the event of a fire at ground storey, smoke can readily spread between compartments and there is no designed air-flow (no make-up air at the courtyard base) to encourage an exhaust of smoke through the courtyard 'roof'. There is no control of adverse wind effects.

2. If the same space were roofed, it would then be regarded as an atrium. The guidance in BS 5588-7 is that the following additional fire safety provisions would be required:

- the façade would need to be 60 minutes (integrity and insulation)
- balconies are allowed, yet no seating areas are permitted. The door to the balcony would need to be FD60S
- if the atrium base is not sterile (or if there is accommodation that is not fire separated from the atrium), as for Example 1:
 - the fire load would need to be controlled
 - a smoke control system is required to maintain a clear layer 1m above any opening windows (or the door-openings to the balconies). A natural ventilation smoke control system maintaining a three-storey clear layer from a spill plume would typically require 80m² of high-level exhaust vents (protected against adverse wind effects) and 40m² of low-level make-up

- a smoke clearance system (unless it can be demonstrated that the clear-layer solution is sufficient)

In the case of atria, application of the guidance in these three typical situations has clearly resulted in levels of fire safety that are significantly higher than the same building without the atrium. Furthermore, the smoke control system implied, particularly the low-level make-up, is often impracticable to achieve. While the engineer will use ingenuity to develop better ways of providing this make-up, the disparities due to the BS 5588-7 guidance creates unduly high performance expectations.

Commercial enterprises

The Firecode guidance for commercial enterprises is HTM 05-03: Part D: *Operational provisions: Commercial enterprise*, which defines a commercial enterprise as:

'Any undertaking established on hospital premises or within part of a building forming a hospital to which persons, including members of the public, may resort for the purposes of trading or business, whether such transactions are for gain or not, and whether the undertaking forms the whole or part of a private venture or a healthcare organisation's activity'.

While arguably the entire hospital could be regarded as a commercial enterprise, the typical application is for a shop. Retail enterprises are an integral element within the planning of new hospitals as they satisfy a demand and provide a beneficial income stream. Detailed data from HTM 05-03: Part L for 2004/2005 records one injury due to shop fires.

HTM 05-03: Part D recognises that there are a wide variety of scales of commercial enterprises within hospitals, with significantly different levels of fire risk. Guidance is provided on different options that could be considered, including:

- sprinklers (including those activated by smoke detection)
- smoke extract
- fire enclosure of unit
- compartmentation of commercial area
- a smoke control system to maintain a clear layer 1m above head-height on circulation routes
- ventilated lobbies between the commercial area and any surrounding in-patient departments

HTM 05-03 does not apply to commercial enterprises in atria, for which the cited reference is BS 5588-7. This standard has no explicit guidance for retail in hospitals, other than the implicit recommendations on fire load control and smoke-layer height.

In the situation of commercial enterprises, the lack of a common understanding has resulted in a variety of different applications of the guidance. A pragmatic approach would be to develop the fire strategy for the commercial enterprise such that the risk posed is no greater than the risks by a standard hospital (HTM 05-02 guidance-compliant) activity in that same space ■



Fire safety enhancements (above those necessary for Firecode and legislative compliance) can then be driven from a ‘whole hospital’ cost-benefit analysis, which would also include consideration of business continuity management. However, there are challenging healthcare delivery targets that NHS Trusts have been set – for example, lowering patient waiting times, reducing healthcare infections such as MRSA, focusing on health inequalities, and tackling financial deficits in NHS organisations. It is unlikely that fire safety enhancements will represent value in responding to these challenges.

Appropriate standard

Ultimately, with any fire safety design, there is the need to understand what is an acceptable standard of safety.

Fire statistics have been collated by the DoH in HTM 05-03: Part L: *Operational provisions: Statistics*. This document shows that, for the period 1994/95 to 2004/05:

- 10,662 fire incidents were reported
- the cost of these fires amounted to £14.6m (this does not include the costs for 2002/03. This is because of a single



serious fire incident resulting in £10m damage, and the DoH considered that including this would have shown an unbalanced trend)

- there were 17 fatalities and 651 injuries. Ten of these fatalities occurred on mental health wards
- since 1994, there has not been a fire incident that involved more than one fatality
- the injuries incurred due to fire incidents were divided between burns, smoke inhalation, and injuries resulting from evacuation (272, 344, and 35 respectively)
- detailed data from 2004/2005 indicates that 84% of reported fires were confined to the room of fire origin

From the available data, the overall conclusion drawn in HTM 05-03: Part L is that, over the past ten years, the prevalence of fire in the NHS in England has remained relatively constant. The number of fatalities and injuries has also remained reasonably static.

The DoH has used these statistics to argue that the Firecode guidance achieves an appropriate standard of safety. If this is the case, then two key questions arise:

1. What is implicit within Firecode? For example, what are acceptable escape times and escape distances? Quantifying and understanding these factors will enable a consistent and robust approach to fire safety
2. Is there a disparity of safety throughout a hospital? It is unlikely that there are significant situations where people are less safe than required, since the level of safety is determined by this minimum standard. However, there may be situations that are significantly safer than others, either due to the guidance or the application of the guidance. As examples, atria and commercial enterprises are considered in this article. Unnecessary disparity of fire safety causes inefficiency in design

Escape times and distances

A basis of guidance such as Approved Document B (ADB) to the Building Regulations in England and Wales is being able to escape from a fire-affected area within a ‘flow time’ of 150 seconds. However, there are unlikely to be few, if any, hospital areas that can be evacuated within this period:

- the assumption is that the evacuation is by staff, and the HTM 05-02 guidance states that there need only be two staff present at all times for a department of up to 30 patients
- before a patient can be moved, it could be necessary to detach them from bedhead services. Similar situations can exist in non-bedded areas, such as renal dialysis

Thus, in the event of a fire, even discounting the time prior to staff reacting, the time taken to evacuate patients from a fire-affected zone can be considerably in excess of 150 seconds. This raises the questions:

- is 150-seconds flow time an appropriate basis for design for other premises, as experience in healthcare indicates that (with times well in excess of 150 seconds, and with people who are likely to be less tolerant of smoke) an acceptable level of safety is being achieved?
- if 150 seconds is appropriate to other premises, do any additional fire precautions in hospitals justify the extension of this period?
- if there is a different standard of safety associated with hospitals, is this justifiable?
- what is an appropriate time for evacuation of a fire-affected zone (sub-compartment)?
- what is an appropriate time for an evacuation of a compartment?

Eight minutes has been quoted for evacuation of a sub-compartment/fire-affected zone, and 20 to 40 minutes for evacuation of a compartment.

Guidance on evacuation times is vital for three reasons:

- to enable development of a design
- to enable NHS Trusts to plan and train appropriate resourcing of the evacuation
- to ensure consistent enforcement by the authorities – for example, the local fire authority (as enforcer of the

Regulatory Reform (Fire Safety) Order in England and Wales) might otherwise expect demonstration that a zone can be evacuated within an inappropriately fast 150-seconds flow time

The guidance on travel distance can be similarly interrogated. Where escape is only available in one direction, the guidance is based on ensuring that the risk of the route being blocked by fire is acceptably low and also to limit the travel within smoke:

- in office buildings, where the occupants are considered alert and capable of independent escape, the guidance within ADB is a maximum 'single-direction' travel distance of 18m
- within hospitals, where patients are dependent on staff for escape and less tolerant of smoke, the guidance maximum 'single-direction' travel distance is 15m

Is 15m too long travel distance for hospitals? Is 18m unduly short for offices?

While there is considerable knowledge and experience in healthcare fire safety, there is insufficient knowledge sharing. A common understanding is needed to ensure successful fire strategies and successful hospitals ■

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