NHS National Services Scotland

# NHSScotland 'Firecode'

## Scottish Health Technical Memorandum 81

Part 3: Atria in healthcare premises

Health Facilities Scotland
Property and Capital Planning

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# Contents

# About this publication

This Scottish Health Technical Memorandum (SHTM) provides recommendations and guidance for the fire safety of atria in healthcare buildings and supplements the guidance contained in SHTM 81 Parts 1 and 2 for new health buildings. It should not be quoted or treated as a specification, and any claim of compliance with the contents of the guidance should be carefully considered to ensure it is appropriate for the specific project application.

SHTM 81 Part 3 recognises the special requirements in regard to fire precautions for the design of atria within healthcare premises and should allow the statutory requirements to be applied sensibly in a risk appropriate framework.

This guidance recognises the interaction between:

- the physical fire precautions;
- the dependency of the patient;
- fire hazards within the healthcare premises;
- the management policies; and
- the availability of sufficient and adequately trained staff in achieving an acceptable level of fire safety within healthcare premises.

The primary responsibility with regard to fire safety is the safety of patients, visitors and staff. For all premises under their control, NHS bodies should select and effectively implement a series of measures to achieve an acceptable level of fire safety, taking into account:

- the guidance in this SHTM and relevant guidance in other components of NHSScotland Firecode;
- the Fire (Scotland) Act 2005 as amended and the Fire Safety (Scotland) Regulations 2006;
- the Building (Scotland) Regulations 2004 and supporting technical handbooks.

# 1. Introduction and scope

1.1 An atrium within a building usually provides not only a readily identifiable focal point for visitors to the main building entrance but also a welcoming introduction to the building and it's facilities. Atria are widely recognised as attractive and desirable design features that permit natural light to penetrate the internal areas of the building and create stimulating space that reduces what may otherwise have an institutional ambience.

1.2 It is now common practice to incorporate atria in the design of new healthcare premises and it is therefore essential that any potential negative impact on the fire safety of the building is considered and mitigated.

## Who should use this guidance?

1.3 This guidance explains the topics involved and the inter-related nature of the component parts that comprise a safe and cost effective design solution for atria in healthcare buildings. It is intended as a reference resource for those who are new to, or who only occasionally encounter, the fire engineering matters related to atria design.

1.4 It may be used by design teams involved in projects that include atria and other non-fire safety professionals who have a stakeholder interest in the project.

1.5 The guidance may be of particular value to Directors of Estates and Facilities, NHSScotland fire safety advisors, fire safety engineers, building standards surveyors, fire safety officers and others with responsibility for fire safety.

## Competency

1.6 Whilst the guidance contained in this document may be of value to those described in 1.3 to 1.5 to assist their understanding of the issues and concepts regarding the fire safety matters relating to atria, the actual determination and design of the specific fire safety measures should only be undertaken by those who are qualified and competent to do so e.g. a fire safety engineer, in consultation with other relevant professionals such as architects and structural engineers.

In this context competent means; *'someone who has sufficient technical training and actual experience or technical and other qualities, both to understand fully the dangers involved and to undertake properly the measures referred to in this document'.*

## General application

1.7 This SHTM provides guidance on the fire precautions that are necessary when an atrium is incorporated in the design of a healthcare building.

1.8 It is not intended to be a one stop shop for the resolution of fire engineering issues related to atria in the design process of healthcare buildings. It should be read in conjunction with other documents intended to give guidance on fire engineering, means of escape and other fire safety measures applicable to the premises, in particular SHTM 81: Part 2: Guidance on the fire engineering of healthcare premises.

1.9 It also provides guidance on managerial and organisational issues, in addition to structural matters, that need to be considered holistically to ensure fire safety matters associated with the atrium are effectively controlled in accordance with an integrated fire safety strategy.

1.10 These recommendations should be applied to each atrium formed by the conversion, extension, adaptation, modernisation or refurbishment of an existing building, and should be incorporated into the design of any new healthcare building that includes an atrium.

**Note:** The need to conduct a fire risk assessment in pursuit of compliance with the Fire (Scotland) Act 2005 as amended and the Fire Safety (Scotland) Regulations 2006 should also be considered in determining the appropriateness of applying the measures contained in this document.

1.11 The recommendations of this SHTM cannot take account of all the circumstances that may be found in healthcare buildings, but are intended to highlight the fire safety implications of atria in the wider context of healthcare provision, and the need to consider carefully such impacts when considering the fire precautions to be applied.

## Consultation

1.12 In order to ensure that the atria meets the specific requirements of the relevant regulatory bodies and the design objectives of the procuring body itself, including the appropriate standards fire safety, the health and nursing care objectives and other related matters; it is essential that early consultation takes place between relevant stakeholders i.e. the design team, the client, the Health Board fire safety advisor, the relevant regulatory authorities and where appropriate, the client's insurers.

Where a fire engineering solution is adopted, early discussion and consultation is essential to ensure all the parties with an interest in the project have a full understanding of the relevant standards, design objectives and regulatory requirements having specific regard to the inclusion of appropriate fire safety measures.

## Existing guidance

1.13 The guidance in this SHTM supplements and should be read in conjunction with that contained in other documents comprising NHSScotland Firecode.

1.14 The guidance in this SHTM is supplementary to BS 9999; 13.5 and Annex C (previously provided in BS 5588-7; superseded by BS 9999).

1.15 The additional guidance in this SHTM is necessary because of the specific fire safety issues atria present to those who must ensure adequate and appropriate fire safety measures for the building e.g. the protection of routes through which smoke and fire may spread from storey to storey (much more rapidly than it would in an equivalent building without an atrium); the impact of possible fire spread on the number of persons initially at risk, the time available for escape, and the activity of fire-fighters.

1.16 An atrium space in healthcare buildings may contain high numbers of dependent older people, or others with some degree of disability, for whom additional time and assistance to escape will be necessary. To address this concern, it is necessary to provide atria with higher standards of fire protection than would normally be provided within similar buildings put to a different use.

# 2. The fire safety implications of atria

## Smoke and fire spread

2.1 Smoke and fire may spread from storey to storey much more quickly when an atrium is included in a building design – the atrium provides a route by which smoke and fire can spread to areas of the building that are somewhat remote from the fire incident itself.

2.2 Since, by definition, an atrium is higher than a single storey, the smoke plume resulting from a fire is likely to rise further than it would in a similar building that does not have an atrium. As the smoke plume rises it entrains surrounding air, resulting in a much larger volume of smoke than would be the case if there were no atrium.

2.3 The combination of increased quantities of smoke and the potential for that smoke to spread far beyond the area of the fire itself may result in many more building occupants being at risk simultaneously than would be the case in a similar building without an atrium. Such a scenario may require the simultaneous evacuation of patients from a number of departments across multiple floors.

2.4 The large volumes of corrosive smoke produced and the capacity for that smoke to spread via the atrium may result in damage to the building which is out of proportion to the potential damage than otherwise might reasonably be expected from the fire incident itself.

## Utilisation of the atrium space

2.5 An atrium often accommodates the main reception area. Most visitors will therefore make use of the atrium both as their introduction to the building and as a through route to the building's amenities and healthcare departments.

2.6 For many visitors, this will be the first time that they have entered the building. They will be unfamiliar with the building layout and the facilities for escape should a fire prevent their exit via the main entrance.

## Balconies and bridges

2.7 In some cases, an atrium is provided with balconies and/or bridges across the upper levels. Where provided, these may be used for access to departments adjacent to, but on opposite sides of the atrium space. A rising smoke plume produced by a lower level fire may impact significantly on the safety of those on any bridge or balcony, and their ability to escape safely.

2.8 Atrium balconies and bridges have been used to provide seating and waiting areas as well as other facilities such as coffee shops. However, such provisions not only introduce additional fire load to the atrium space, but also present a

static occupancy whose evacuation in the event of a fire within the atrium and possibly the adjacent areas will need to be managed.

2.9 The provision of a balcony and/or bridge seating area presents particular fire-safety challenges. Such seating areas may be many storeys above the atrium base and, as a result, users of these areas may be relatively remote from a fire. However, since any smoke plume is likely to rise above the atrium base and result in smoke filling downwards from the top of the atrium, occupants of seating areas on the upper level of the atrium are potentially at a greater risk during the early stages of a fire incident than any other occupants of the atrium.

2.10 Occupants of seating areas on balconies or bridges above the atrium base may be sufficiently remote from any fire incident and its direct effects that the risk associated with the smoke produced by a fire on the atrium base may go unnoticed, which could delay their evacuation.

## Commercial enterprises

2.11 Commercial enterprises such as coffee shops, restaurants and newsagents may be provided in an atrium. Where this is the case, the fire load density of the area occupied by each commercial enterprise may be significantly greater than that of most hospital departments.

2.12 Where the atrium is put to such uses, it may be difficult to adequately control the fire loading of the space and in particular the transient fire loads associated with restocking the commercial enterprises.

2.13 The occupant-to-staff ratio is often significantly larger in the atrium than in any other department of the building. In addition, most staff present in the atrium are unlikely to be employed directly by the healthcare organisation that occupies the building as a whole. In some cases, the only directly employed members of staff present within the atrium are those manning the reception desk, the remainder of staff being employed by the owners of the commercial enterprises.

2.14 It is unlikely that staff not directly employed by the healthcare occupier will take responsibility for evacuating occupants beyond the commercial facility in which they are employed. Consequently, the safe and controlled evacuation of occupants of the atrium space may rely on the actions of the limited number of staff present who are directly employed by the healthcare organisation unless additional staff are required to do so as part of the emergency response procedures.

2.15 Given that the atrium space might have many uses, it is likely that several parties will each have responsibility for separate parts of the atrium's facilities. Such an arrangement can result in a lack of overall ownership and insufficient management responsibility for the atrium, its contents and the uses to which it is put.

2.16 In circumstances where more than one party has responsibility for the activities undertaken within the atrium, particular attention should be paid to the duties of responsible persons to cooperate with each other and to coordinate their

activities as detailed in the Fire Safety (Scotland) Regulations 2006; reg. 21 - Co-operation and co-ordination.

# 3. Technical recommendations

## Aims and objectives

3.1 The aims and objectives of this SHTM support the Fire Policy for NHSScotland 2011; CEL 11 (2011), by providing further information and guidance, in particular, consistent with Annexe A; Statement 6.

3.2 These technical recommendations seek to deliver a level of fire safety at least equivalent to that of a similar building that does not have an atrium.

## Relationship to other departments

3.3 To minimise the potential for a large fire to develop and spread via the atrium space, any department that presents a significant fire hazard should not be located within the atrium. This principle includes temporary or permanent cooking facilities and arrangements introduced by third parties such as external catering companies. Such provisions are defined for the purpose of this guidance as fire hazard departments.

3.4 Fire hazard departments are those identified in the Non-domestic Technical Handbook; Annex B; 2.B.1; List A; headed ‘Fire hazard departments’.

3.5 Where a fire hazard department is to be located adjacent to an atrium, the fire precautions detailed in that standard should be applied.

3.6 Departments that provide care for very high dependency patients should not be located adjacent to an atrium, nor should any part of the department or their supporting facilities be located within the atrium.

3.7 Departments that provide care for dependent patients should only provide access to the atrium via circulation spaces.

## Use of atria

3.8 Most of the visitors to a healthcare building will make use of the atrium space and its facilities. Whilst in the main these users will be independent, a significant number may still require some degree of physical or other assistance.

3.9 Many of the uses to which an atrium may be put will result in a static occupancy i.e. as a waiting space in which people are mostly stationary. Where this is the case, suitable management arrangements must be in place to ensure the safe evacuation of all the occupants, in the event of a fire affecting the atrium (refer also to paragraphs 5.8 and 5.9).

3.10 The following facilities should not be provided in an atrium:

- sleeping accommodation;
- nursing or medical care; or

- seating areas such as dayrooms or lounges for use by in-patients.

## Fire loads

3.11 Unless an atrium is clearly empty and will contain no combustible materials, it is assumed to contain a fire load. In most circumstances the atrium space will include a fire load to some degree. The nature of the fire load and the area that it occupies will largely determine the extent of fire precautions that should be applied to the atrium space.

3.12 The fire load within an atrium should be controlled both by active management measures and through the limitation of combustible materials in terms of type, quantity and proximity.

3.13 The atrium is considered to have a limited fire load:

- where all the combustible materials are arranged in discrete islands of up to 10m$^2$ with a fire load density of up to 115 MJ/m$^2$; and
- where each island is separated from other areas of combustible materials by at least 4m or is protected by a sprinkler system.

The calorific values (MJ/kg) can be obtained from numerous fire engineering sources including BS7974: 2001 or International Fire Engineering Guidelines: 2005 (IFEG).

3.14 The atrium is considered to contain a significant fire load where the arrangement and/or nature of combustible materials do not meet the above parameters.

3.15 Wherever a significant fire load exists within an atrium, control measures must be applied to limit the quantity of combustible materials that may become involved in any fire incident, and therefore the size of fire, within the atrium. Such control measures may include:

- limiting the type and quantity of combustible materials that may be present in any portion of the atrium; or
- active measures such as automatic sprinkler systems intended to extinguish, or limit the size of, the fire involving those combustible materials.

**Note:** Where the fire load is limited as an alternative to installing a fire suppression system, responsibility is placed on duty holders to ensure that the fire load remains within the permitted limits at all times.

3.16 To calculate the performance of other fire safety measures, the actual fire load and size of potential fire resulting from the ignition of the combustible materials within the atrium should be determined.

3.17 Details of the fire load should be included in the fire engineering strategy report. (refer to SHTM 81 Part 2 Guidance on the fire engineering of healthcare

premises; Appendix B; fire strategies, for further information). This report should be used for reference by those responsible for managing the atrium when considering any proposed changes to the quantity or nature of combustible materials, or the use to which the atrium is put.

3.18 Where the atrium has no access to adjacent accommodation above the atrium base level, there is no requirement to control the fire load present within the atrium other than those measures detailed in the Non-domestic Technical Handbook; Annex 2B; where applicable.

## Fire detection and alarm

3.19 Adequate means of detecting a fire and raising the alarm is of vital importance to ensure:

- an immediate response to the fire incident; and
- the earliest possible commencement of evacuation; and
- the initiation of active fire protection systems and early fire-fighting intervention.

3.20 The need for fire detection and alarm applies whether or not the fire load in the atrium is limited.

3.21 The detection and alarm system for the atrium should be designed in accordance with NHSScotland Firecode SHTM 82; Alarm and detection systems and BS 5839-1; 2002+A2; 2008, and should be an integrated part of the fire detection and alarm systems covering the remainder of the building.

3.22 Particular consideration should be given to alarm signal perception and consideration may need to be given to the use of alternative signals for those with limited ability to respond to an alarm signal e.g. visual signals, vibrating pagers or similar devices. It may not be appropriate to reduce sound-pressure levels, as provided for in SHTM 82; Alarm and detection systems, from those stated in the British Standard, as the atrium space is not occupied by patients whose evacuation is under the direct control of ward staff. The alarm signal in the atrium space is therefore intended to alert those present and to initiate immediate evacuation.

3.23 The fire alarm installation covering the atrium space should be configured as a separate zone in the fire detection and alarm system.

3.24 The interaction of alarm signals between the atrium zone and adjacent zones should be in accordance with the fire alarm strategy for the remainder of the building. However, it may be necessary for an alarm signal to be given in areas outside the atrium space itself e.g. lift landings, stairways or in adjacent circulation spaces which are not within the relevant detection zone.

## Automatic fire detection

3.25 When designing the detection system, careful consideration should be given to the type of detection devices used e.g. the use of an aspirating fire detection system may be of significant value in some situations.

3.26 Detectors should be provided and sited, consistent with the specification for a category L1 system.

3.27 Automatic fire detectors should be provided in any area that contains combustible materials as well as within the atrium volume itself. Where appropriate and necessary the automatic fire and smoke detectors should initiate any active fire protection measures such as smoke control systems.

3.28 The design of the fire detection system for the atrium should take account of the possibility and potential for stratification of the smoke layer within the atrium stack, which may prevent the fire detection system from operating at upper levels.

3.29 At the design stage, the accessibility of components for their ongoing maintenance should be considered. In particular, the need for access to high level fire alarm devices and the relative location of high reach equipment within the atrium space should be considered having regard to the safety of those conducting such maintenance, and others using the atrium.

3.30 Manual call points should be provided at all exits from the atrium and at intermediate locations, as required, so call points are no more than circa 30m apart and are sited no more than 1.4m from the floor level.

## Fire alarm warnings

3.31 The fire alarm warning system is an integral part of the evacuation strategy and should be arranged so as to minimise unnecessary distress and disturbance to patients and staff. However, designers should be aware of the likelihood that the occupant to staff ratio will be higher than in any other department of the healthcare building. As a result, greater emphasis should be placed on the self evacuation of the atrium's occupants.

3.32 Automatic fire alarm warning signals should be clear and distinctive so as not to be confused with other signs and signals that may be present. The use of combined detector and sounder heads will provide a more even distribution of the alarm signal at lower individual sound pressure levels from each device and therefore eliminate the need for fewer, higher sound pressure output devices.

3.33 Consideration should be given to the use of a voice alarm system in the atrium where there is a potential for large numbers of the public to be present. This will provide information about the nature of the incident and accurately direct escape in a controlled fashion. Such systems can significantly increase the effectiveness and efficiency of occupant response to fire alarm signals.

3.34 Voice alarm systems should be designed in accordance with BS 5839-8.

## Emergency escape routes

3.35 Where the atrium occupants are independent, the maximum travel distance in a single direction should be no more than 18 metres. This should be reduced to 15 metres where occupants are not considered to be independent.

3.36 A minimum of three exits should be provided from the atrium base, arranged so that at least two exits remain available in the event of any single fire. In any case the number of exits provided should be proportionate to the potential occupant load of the space in accordance with the Non-domestic Technical Handbook.

3.37 A minimum of two exits should be provided from each balcony or bridge so that at least one remains available in the event of a fire.

3.38 The provision of exits should take account of the additional occupant load of any balconies or bridges across the upper levels of an atrium. (see Table 1).

| Maximum number of occupants | Minimum number of exits |
|---|---|
| Up to 600 | 2 |
| More than 600 | 3 |

**Table 1: Minimum number of exits**

3.39 Where the atrium's occupants are independent, the maximum travel distance should be limited to 45 metres unless otherwise justified by engineering analysis and consideration of the available safe escape time (ASET) and the required safe escape time (RSET). Travel distance from any point within the atrium should be measured to;

- the circulation space of an adjoining compartment;
- a hospital street;
- a stairway; or
- a final exit.

3.40 The maximum travel distance should be limited to 32 metres where occupants are not considered to be independent.

3.41 The minimum clear width of escape routes in the atrium base and on each balcony and bridge should be 1200mm for an occupancy loading up to 200 people per area. Where the occupancy of the atrium base, balcony or bridge is more than 200 people, the minimum clear width of escape routes should be increased by 275mm for every additional 50 people, or part thereof.

3.42 Evacuation from adjacent accommodation into the atrium should only be considered when supported by the fire safety strategy, the local fire evacuation procedures and appropriate management arrangements for relevant spaces.

3.43 Particular consideration should be given where evacuation through the atrium at levels above the atrium base involves the evacuation of a mental health facility.

## Escape lighting

3.44 Guidance on emergency escape lighting is contained within BS 5266-1. For hospital buildings, this is supplemented by SHTM 06-01 – 'Electrical services: supply and distribution' and Chartered Institute of Building Services Engineers (CIBSE); 'Lighting guide LG2: Hospitals and healthcare buildings'.

## Escape signage

3.45 Clear escape-route signage is essential for directing the atrium occupants to a place of safety. The need for clear escape signage is particularly important where escape routes are provided through departments that would not usually be accessed by atrium occupants.

3.46 Escape and evacuation plans complying with ISO 23601 should be conspicuously displayed to assist those unfamiliar with the building to identify specific fire safety measures including appropriate escape routes, locations of safe refuge and assembly points. These plans may also prove useful to attending fire response and fire-fighting personnel.

3.47 Escape signage should comply with BS 5499-4.

## Atrium enclosure

3.48 An atrium should be enclosed to provide compartmentation between the atrium space and adjacent accommodation, with construction having a minimum period of fire resistance of medium duration (60 minutes.) for integrity, insulation and load bearing capacity.

## Glazed elements forming part of the atrium enclosure

3.49 Where the atrium enclosure incorporates glazed elements, the glazed elements must provide the minimum period of fire resistance (integrity and insulation) of the atrium enclosure.

3.50 In circumstances where the rise in smoke temperature within the atrium can be demonstrated not to exceed 140°C above ambient temperature, and there are no balconies or bridges on the atrium side of the enclosure, any glazed elements incorporated into the atrium enclosure at levels above the atrium base need not meet the requirement for insulation.

3.51 Glazed elements forming part of the atrium enclosure must include appropriate framing structures that are certified to provide at least the same minimum period of fire resistance as the atrium enclosure.

3.52 Glazed elements forming the external façade of an atrium need not provide a minimum period of fire resistance. The only exceptions to this are those areas of the external elevation that require fire resistance to limit external fire spread.

3.53 Since the behaviour of glazing systems in a fire, other than those specifically tested to provide a minimum period of fire resistance, is unpredictable, they

should not be considered suitable where the enclosure of the atrium is required to be fire resisting.

3.54 Non-rated glazing systems are more likely to fail when subjected to temperature gradients, and minor imperfections in the surface of the glass may increase the likelihood of premature failure when heated. Additionally, the use of such glazing systems is likely to permit a fire in the accommodation adjacent to the atrium to spread into the atrium enclosure. This would result in a spill plume flowing into the atrium that may present a significantly larger volume of smoke than would be expected to be produced by a plume rising from a fire on the atrium base. As a consequence, any smoke ventilation provided in the atrium may be overwhelmed, unless it has been explicitly taken into account by the smoke control design. This could result in smoke logging of the atrium space, which may in turn necessitate the evacuation of the atrium's occupants even though the fire has originated in an adjacent department.

## External fire spread

3.55 To restrict the spread of fire externally, from the atrium to adjacent buildings, adjacent compartments of the same building and/or adjacent sites, sufficient separation is required in terms of either distance or fire resistance. The standard that should be applied is that provided in the Non-domestic Technical Handbook; Fire; section 2.6.

## Smoke control

3.56 Where access is possible from the atrium space to adjacent accommodation above the atrium base level, or the atrium is not considered to have a limited fire load, smoke control measures are necessary to prevent the spread of smoke to areas adjacent to the atrium.

3.57 Where there is no access to adjacent accommodation from the atrium space above the atrium base level, the compartmentation enclosing the atrium space should be sufficient to prevent the spread of smoke to adjacent areas. Therefore, additional passive or active smoke control measures are not required.

## Passive smoke control measures

3.58 Openings at all levels within the atrium enclosure should be limited to doors provided with protected lobbies unless appropriate active smoke-control measures have been provided. The protected lobbies should:

- have the same period of fire resistance as the atrium enclosure; and
- be sized such that the length of the lobby is at least 1.5m; and
- not form part of a communication through route between departments or areas of the same department (see Figure 1).

3.59 The fire doors to protected lobbies should not be provided with hold open devices unless justified by a detailed risk assessment that includes a consideration of the following:

- the impact of the potential loss of integrity of the atrium enclosure;
- the potential for smoke layer stratification;
- the potential for a delayed activation of the fire detection system and subsequent release of the lobby doors;
- the risk of smoke permeating into an adjacent department before the lobby doors are released.

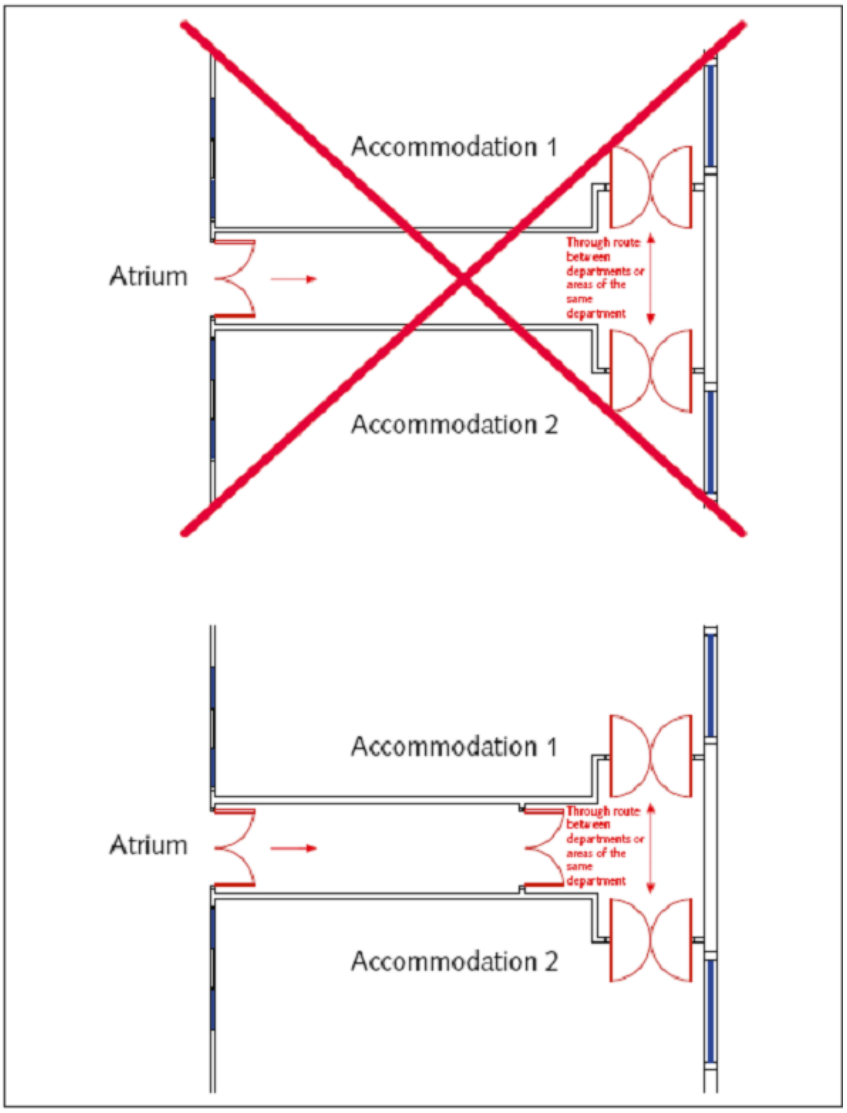


**Figure 1: Protected lobbies must not form part of through route**

3.60 The findings of this risk assessment should be appended to the fire strategy and the fire safety manual as appropriate.

## Active smoke control measures

3.61 Where active smoke control measures are required, an appropriate smoke exhaust system should be provided within the atrium space that is automatically activated either by the detection and alarm system or by other appropriate means. The smoke control measures should be designed to maintain a steady buoyant layer of smoke at least 1 metre above the uppermost opening in the atrium enclosure.

3.62 Where balconies or bridges are provided within the atrium, the smoke control measures should ensure that:

- smoke is maintained at least 3 metres above the balcony or bridge level; and
- the temperature of the smoke layer does not exceed 200°C for at least the period of time required to evacuate any occupants of the balcony or bridge.

3.63 Where active smoke control measures are provided, suitable arrangements for replacement air should be provided in the atrium design to ensure the correct operation of the smoke exhaust system.

3.64 Inlets for replacement air should be located at low level in the atrium so that the velocity of air drawn in through the inlets is no greater than 2 m/s.

3.65 Where automatic entrance doors are used to provide replacement air inlets, consideration should be given to the potential conflict with security measures, particularly outside the hours that the atrium operates, and the need for an alternative power supply capable of driving the doors open should the mains supply fail.

3.66 Power supplies for active smoke control measures should be provided in accordance with BS EN 12101-10.

## Natural smoke exhaust ventilation systems

3.67 Natural smoke exhaust ventilation systems rely largely on the pressure differential arising from a ‘stack effect’. Movement of air and smoke within an atrium is driven by the temperature differentials between the external and internal climates. Provided that the temperature of air inside the atrium is higher than that outside, opening outlet vents at high level in addition to low level inlet vents will cause smoke within the atrium to rise and vent to the outside.

3.68 Smoke and air will escape through high level vents because the pressure within the smoke layer inside is higher than that outside the building. Cooler air will be drawn through lower level inlets because the pressure at low level is less than that outside.

3.69 For this pressure differential to exist, there needs to be a point at some height within the building where the pressure inside is equal to that outside (referred to as the neutral pressure plane). Any openings in the atrium enclosure above the

neutral pressure plane will exhibit airflow outwards from the atrium to the surroundings through any leakage path that might exist. Any openings in the atrium enclosure below the neutral pressure plane will exhibit airflow inwards towards the atrium where leakage paths exist.

3.70 Where inlet and exhaust vents are the same size, the neutral pressure plane will be approximately midway within the smoke layer. If the inlet vent area is smaller than the exhaust vent area, the neutral pressure plane will move upwards. By considering;

(i) the inlet and exhaust vent areas; and

(ii) their relative positions; and

(iii) the potential leakage paths;

it is possible to manipulate the specific height of the neutral pressure plane height.

The design of a natural smoke exhaust ventilation system should aim to position the neutral pressure plane above the openings in the atrium enclosure.

3.71 Natural smoke exhaust ventilation systems can be affected by a number of external factors. For example, where the atrium's internal temperature is less than that of the outside air (such as when the atrium is air conditioned), opening high level and low level vents may result in a reversal of the stack effect, thereby forcing smoke and air out of the low level vents and drawing air in through the high level vents.

3.72 Care should be taken to ensure that the arrangement of vents is such that prevailing winds do not affect the operation of the smoke exhaust system, as adverse wind pressures acting on the ventilation openings may detract from the system's operation.

3.73 Natural smoke exhaust ventilators should comply with BS EN 12101-2.

## Powered smoke exhaust systems

3.74 Powered smoke exhaust systems use a fan or a series of fans to extract smoke either local to the fire or from a smoke reservoir at the top of the atrium.

3.75 Whilst a powered system is less likely to be adversely affected by changes in wind and ambient temperatures, care must be taken to ensure that the fan or series of fans are specified with consideration for the maximum design wind velocity to cater for all adverse wind pressures.

3.76 The powered smoke exhaust system fan or series of fans must be specified in terms of:

- the required extract rate;
- the minimum time for which they are expected to run; and

- the maximum temperature at which they are expected to operate.

3.77 When a powered smoke exhaust system is brought into operation, the normal hospital ventilation system should cease to operate unless specifically allowed for in the design of the smoke exhaust system.

3.78 Powered smoke exhaust ventilators should comply with BS EN 12101-3.

## Sprinklers

3.79 An effective, correctly installed and maintained sprinkler system will reduce the risk of a fire developing and spreading, and will limit the quantities of heat and smoke produced. The design of certain types of smoke control system may also require a sprinkler system to restrict the fire size, and therefore the volume of smoke produced by it.

3.80 Where the extent of the fire load present within the atrium is not clearly defined, the sprinkler system should be capable of effectively controlling a fire anywhere within the atrium space.

3.81 Where a discrete fire load or separate fire loads are clearly defined and their extent is adequately controlled or restrained, partial sprinkler coverage may be provided only to the area/s containing the defined fire loads.

3.82 The design of the sprinkler system should take into account the reduced effectiveness of sprinkler heads when they are located high above the seat of a fire.

3.83 Where the atrium provides access to adjacent accommodation above the atrium base level, an automatic sprinkler protection system should be provided unless the fire load is otherwise suitably controlled.

3.84 The design of a sprinkler system should comply with the recommendations of BS EN 12845.

## Facilities for fire-fighting

3.85 The Non-domestic Technical Handbook; Fire; sections 2.12, 2.13 and 2.14 and Annex 2.B provide guidance on appropriate access, water supply and other facilities for Fire and Rescue Service use. However, it is likely that the Fire and Rescue Service will need to release smoke and heat from the atrium after the fire has been suppressed.

3.86 Where a smoke exhaust system has been provided, the requirement to provide additional facilities for use by the Fire and Rescue Service, described in paragraph 3.85, may be significantly less onerous.

3.87 Where a smoke exhaust system has not been included as part of the fire safety measures, it will be necessary to provide smoke clearance facilities for operation by the Fire and Rescue Service.

3.88 For an atrium no higher than 18 metres, the smoke clearance system may be provided by means of natural exhaust vents in the atrium roof, which are operated under the control of the Fire and Rescue Service. The total area of vents should be not less than 10% of the maximum plan area of the atrium.

3.89 A mechanical smoke clearance system should be provided in any atrium that is higher than 18 metres. A mechanical smoke clearance system may also be specified instead of natural exhaust vents in buildings less than 18 metres

3.90 A mechanical smoke clearance system should be designed to provide replacement air changes every hour based on the total volume of the atrium, as follows:

- four air changes per hour in a sprinklered atrium or where the atrium has a limited fire load (see paragraph 3.13); or
- six air changes per hour in a non-sprinklered atrium.

3.91 Power supplies for operating the smoke clearance system vents should be provided in accordance with BS EN 12101-10.

## Ventilation controls for the Fire and Rescue Service

3.92 In addition to the normal ventilation controls provided for the Fire and Rescue Service, detailed in The Non-domestic Technical Handbook; Fire; 2.14.6; controls should also be provided for the control of active smoke control systems, whether they are natural smoke exhaust or powered smoke exhaust.

3.93 Such controls should allow either:

- the powered smoke exhaust ventilation system to be manually switched to full extract, or to be switched off; or
- the natural smoke ventilators to be fully opened, or to be closed.

3.94 Where a smoke clearance system is provided, controls for use by the Fire and Rescue Service should be located in a suitably accessible position within either the atrium base or an adjoining compartment adjacent to the atrium entrance. The controls should allow the clearance system to be manually turned on/off and should be clearly indicated by a notice identifying the purpose and use of the controls.

## Segregation of hospital services

3.95 To ensure that a fire within an atrium cannot disrupt or damage any of the services supplying hospital departments, it will be necessary to segregate hospital services from the atrium.

3.96 Services supplying hospital departments should not be routed through atria spaces. Where this is not practical, they should be accommodated within medium duration enclosures (minimum period of fire resistance of at least 60 minutes).

3.97 Piped medical gases should not be routed through an atrium; see also SHTM 02-01 – ‘Medical gas pipeline systems’ for further guidance.

# 4. Fire engineering considerations

4.1 The following details are not intended to provide a guide for fire engineering calculations and models, but are intended to provide:

- a reference guide to those tasked with developing fire engineering solutions; and
- a starting point for those without a fire engineering background who may be asked to comment on or accept a fire engineered solution.

**Note:** Experience of numerous healthcare design projects has shown that many of the issues discussed here have required further consideration by the design team and have led to proposals being rejected and/or alternative solutions being sought.

## Fire loads

4.2 Determining the appropriate fire loads for the purposes of fire engineering calculations requires specific knowledge of the nature and quantities of combustible materials likely to be present in the atrium space.

4.3 Generally, details regarding the contents of the atrium space are unlikely to be finalised by the time that engineering calculations are required to determine the fire protection measures appropriate for the atrium. Therefore, it is usual for assumptions to be made regarding the nature and quantity of combustibles or average fire load densities that may be present.

4.4 All such assumptions should be documented and sufficiently detailed to allow all stakeholders to consider the basis of such assumptions and to afford an opportunity for some degree of validation of the assumptions.

4.5 The utilisation of the atrium is likely to result in some fire loads that are fixed (such as reception desks and seating areas), whilst other fire loads may only be present infrequently or at certain times of the year e.g. health promotions or seasonal decorations.

4.6 If transient fire loads are likely to be introduced e.g. for the restocking of commercial enterprises or for quantities of personal belongings, a consideration of such fire loads should be included in the fire engineering assumptions and the proposed solution.

4.7 Commercial enterprises such as shops and cafeterias present particular challenges when incorporated within an atrium space. Not only does the commercial enterprise represent a particular fire load, but the activities of the commercial tenant are invariably beyond the direct control of the building managers. Also, it is not uncommon for building managers not to have access to the commercial outlet outside its usual hours of business.

4.8 Where commercial outlets are provided within the atrium, fire load assumptions should:

- define the fire load attributable to each commercial outlet;
- include a significant margin to reflect the potential variations of stock level and day-to-day management controls; and
- consider the possible impact due to the potential for delayed or limited access to begin first aid fire fighting (fire control measures).

4.9 Sufficient separation, in terms of distance or fire resistance, should be provided between commercial outlets to prevent radiation or fire impingement resulting in the spread of fire to other fire loads within the atrium space.

## Controlling fire loads

4.10 It is inherent in any fire engineering solution that the fire load should be controlled within the limits considered by the fire engineering study. In practice the management process required to adequately control the fire loads present is not straightforward.

4.11 It is often the case that the utilisation of the atrium space incorporates significant fire loads associated with commercial enterprises. Whilst it is usual for the activities of commercial tenants to be regulated by means of a tenancy agreement, day to day control of individual tenants and their activities, which may affect the fire loads present within the atrium, is considerably more difficult. Clear unambiguous limits must be set out to ensure that the activity of commercial tenants can be managed properly on a day to day basis. See also paragraph 3.15.

Examples of unacceptable practice may include the spread of shop display material such as news stands to the atrium, beyond the boundary of the shop itself or the delivery of excessive stock quantities at high turnover times such as Christmas.

4.12 Where the main entrance to the building provides direct access to an atrium, it is common for the space to be utilised for health promotion displays, charitable sales and/or seasonal decorations, all of which are likely to increase the overall fire load in the atrium space itself.

4.13 The design team should consider the potential for such additional fire loads and should provide an indication of the practical extent and limitations for such material, to assist and inform the managers who will be responsible for the control of any such additional fire loads. Such details should be provided in a useful format such as a number of display boards for a health promotion or a number of tables for a charitable sale. They should include:

- the quantity and nature of combustibles that may be permitted within the atrium space without compromising the fire engineered solution;
- the appropriate location(s) for additional fire loads; and

- the minimum separation between any additional fire loads and:
  - the building structure;
  - fixed fire loads;
  - any other additional fire loads; and
  - any sprinkler head, where fitted.

## Fire plumes

4.14 Where active smoke control measures are required, the specification of the smoke exhaust system capacity is largely dependent on the volume of combustion gases (smoke) produced by the fire. The most significant effect on the quantity of smoke rising in the smoke plume is the amount of air that is entrained by the plume as it rises.

4.15 The entrainment of air is largely dependent on the geometry and surface area of the rising plume:

- where the plume from a fire originating on the floor rises away from the walls and is unobstructed in its ascent, air is entrained from all sides. In these cases, the plume geometry is considered to be axisymmetric i.e. the plume will appear to be approximately symmetrical about the centre line from its base to the extent of its rise;
- where a plume results from a fire originating on the floor close to a wall, the rising plume entrains air only from the sides that are away from the wall;
- where a plume rises beneath an obstruction, such as a lower level ceiling or the underside of a balcony, the vertical movement of the plume is halted and the hot gases will turn and move sideways until they reach the edge of the horizontal structure. At this point the hot gases will turn again and effectively spill over the edge of the low level structure before continuing its vertical rise. A number of mathematical formulae have been developed to allow calculation of the mass flow of air entrained into a rising plume e.g. BS 7974-2: 2002; however, such calculations are beyond the scope of this SHTM.

4.16 A reasonable approximation to compare the characteristics of each of the above plume types is that the mass flow of air into a plume against a wall is approximately half that of an axisymmetric plume resulting from a similar sized fire and rising over a similar height.

4.17 The mass flow rate of air entrained into a spill plume can be more than twice that of an axisymmetric plume from a similar sized fire and rising over a similar height.

4.18 Ensuring that the correct plume type and corresponding mathematical formulae are used in developing the fire engineering solution is of vital importance in determining the appropriate parameters for the operation of smoke control systems.

## Maintenance of smoke control systems

4.19 In some cases, smoke control systems have been deployed with little consideration given to the process of maintaining such systems in an operational healthcare building. In particular, where mechanical smoke exhaust ventilation has been provided, routine maintenance requirements can have an adverse impact on the day to day operation of the building and its occupants.

4.20 The periodic testing of mechanical smoke extract can introduce significant levels of noise and disturbance, which can be of particular concern when such effects are experienced in areas that may be occupied by in-patients and are adjacent to the atrium.

4.21 Where the healthcare premises operate 24 hours a day, it may not be possible to test the mechanical smoke extract system without disturbing patients.

4.22 Since it will be necessary to test the operation of active smoke control measures using both their primary and secondary supplies, the maintenance regime must ensure coordination with the testing of the standby generators where these are used as the secondary supply for the smoke control system.

4.23 Since testing of the standby generators usually takes place for a specified short duration, there is a limited opportunity to complete the maintenance tests for the smoke control system using the secondary supply, where this is provided by a generator.

4.24 Whilst it is possible to verify the opening of passive vents and the running of mechanical extract fans during routine maintenance testing, it is not usually possible to test the effectiveness of the smoke control system once it has been commissioned.

## Evacuation process

4.25 In a healthcare building, it is likely that most of the occupants will exhibit some degree of reduced mobility or cognitive impairment, and this should be considered in any calculations e.g. the required safe escape time (RSET).

4.26 It is likely that when visitors to a healthcare building, especially a hospital, encounter a fire, their expectation is likely to be that they will be directed and assisted by staff and that their evacuation to a safe place will be managed and controlled by others. However in an atrium the number of staff on hand to assist and direct the evacuation of people is likely to be limited.

4.27 It is necessary to determine the roles and responsibilities for all staff that are likely to be present, both directly employed and those employed by commercial or other occupiers of the atrium, should a fire occur.

4.28 Where facilities such as a waiting area, cafeteria or restaurant are provided within the atrium space, it is also usual for toilet facilities, accessed from the atrium, to be provided. Such provision is likely to include an accessible toilet for use by disabled persons and a parent and baby changing room, whose

occupants may be delayed before starting their evacuation. It will therefore be necessary to ensure that staff are aware of the need to check such areas and provide assistance as necessary for the safe evacuation of these facilities.

4.29 Where escape routes from the atrium pass through adjacent departments, sufficient staff should be available to direct those evacuating from the atrium to a suitable place of safety, whilst also minimising the disturbance to patients and the impact on the department's preparations in readiness for their own evacuation should it be necessary.

## Fire incident control

4.30 The internal response to a fire incident usually relies on the coordination of a small team of responders. In healthcare premises, occupants of a compartment involved in a fire are evacuated to a place of relative safety initially by those members of staff present at the time of the fire. It is usual to draw additional members of staff from other areas to assist in the evacuation of patients and other occupants from the compartment containing the fire.

4.31 The task of coordinating such responses and of getting additional members of staff to assist in the evacuation process is far more complex where the evacuation is taking place from multiple compartments or on multiple levels simultaneously. In the case of an atrium, particularly one with seating areas on balconies or bridges at several levels, it is likely that the complexities of coordinating a safe evacuation of all the atrium's occupants will place a significant burden on the organisation's incident command and control until the arrival of the Fire and Rescue Service.

**Note:** It is not part of the role of the Fire and Rescue Service to supervise or assist with the management of an evacuation. On arrival, their role will be initially to investigate the source of the incident and thereafter deploy their resources to deal with any fire. They will assist with an evacuation only where it is evident that a degree of harm from fire or smoke is likely to those being evacuated, or where persons clearly need to be rescued and it is not within the capability of staff to continue their activities due to the environmental conditions in the space being evacuated.

Responsibility for the safe conduct of an evacuation lies with those who have responsibility for managing the premises, except in the circumstances detailed in the previous paragraph.

4.32 Where waiting or seating areas are provided within the atrium, it should not be assumed that staff from an adjacent compartment will be immediately on hand to ensure the safe evacuation of the atrium occupants, even though the waiting or seating area may form part of the same department. It is possible that staff in the adjacent compartment will be occupied in the treatment and/or care of patients and on hearing an intermittent alarm signal may have to complete this activity before being able to assist with the evacuation of the atrium.

4.33 The use of an automatic voice alarm can significantly reduce the pre-movement time of occupants in waiting areas, thus reducing the reliance on staff assistance in the event of a fire.

## Potential effects on patients in adjacent areas

4.34 It is usual for the atrium enclosure to include windows and other glazed elements, which allow light into the atrium space and other accommodation. If a fire occurs, these windows may provide a view of the smoke rising within the atrium and the gradual descent of the smoke layer from the atrium roof or soffit.

4.35 Those witnessing a fire are likely to become spectators of the event until they feel threatened by the fire or the smoke and fumes it produces. Such behaviour may impede the safe evacuation of the atrium's occupants or those in adjacent areas.

4.36 Where areas adjacent to the atrium accommodate patients that are not able to evacuate without assistance, witnessing the atrium filling with smoke may increase patients' anxiety and exacerbate their condition, particularly if staff are unable to provide assistance or reassurance due to their being involved in the evacuation of the atrium's occupants.

4.37 So far as possible within the resources available, it is desirable that the fire safety procedures provide external measures to control both those congregating outside the building, and to keep access areas clear for the arriving emergency vehicles.

4.38 The fire safety training of staff who will work in or around the atrium space should reflect the specific matters and issues related to evacuation and fire safety generally of the atrium. (see also paragraphs 5.13 to 5.17).

# 5. Organisation and management

5.1 An atrium in a healthcare building presents specific fire safety challenges.

5.2 The effective management of fire safety within the atrium is of critical importance in ensuring the safety of the atrium occupants and potentially those occupying adjacent departments, should a fire occur within the atrium.

## Roles and responsibilities

5.3 Effective fire safety management requires that the roles and responsibilities of staff are clearly defined and communicated. It is essential that an appropriate individual has delegated responsibility for the day to day fire safety management of the atrium and associated issues e.g. areas adjacent to the atrium that may affect it, or be affected by a fire within the atrium.

5.4 The nominated person, and where appropriate their deputies, should be available on site at all times that the atrium is in use:

- to ensure that the fire load is controlled and within the permissible limits; and
- to provide assistance and advice to the senior person responsible for co-ordinating the emergency response to a fire incident.

5.5 The nominated person, and where appropriate their deputies, should have sufficient authority, supported by sufficient training to allow them to undertake their roles effectively. In particular, the nominated person or their deputies will be required to understand the parameters of the fire load considered in the fire safety design, the constraints placed on the use of the atrium and the procedures that should be adopted in the event of fire.

5.6 Since the atrium's occupant to staff ratio is likely to be significantly larger than in any other department of the building, it is essential that those staff present in the atrium know what to do to ensure the safe evacuation of the atrium occupants in the event of a fire.

5.7 Each member of staff on duty within the atrium, whether directly employed by the healthcare organisation or employed by others (such as commercial tenants), should clearly understand their roles in the management of fire safety and in coordinating the safe evacuation of the atrium occupants.

5.8 Where waiting areas associated with adjacent departments are located within the atrium space, it is important to ensure that the responsibility for the safe evacuation of occupants of those waiting areas, and other facilities such as toilets, is clearly defined. See also paragraph 4.29.

5.9 It is necessary to determine whether responsibility for the evacuation of departmental areas located within the atrium rests with the departmental staff or

those on duty within the atrium, and the results clearly set out in the atrium fire procedure and the fire procedure for affected departments.

## Emergency action plans

5.10 Each atrium space should have a written emergency action plan that provides details specific to that area and which is coordinated with the emergency action plans of adjacent departments and the organisation's major incident plan.

5.11 The emergency action plan should include:

- means for raising the alarm in case of fire;
- the arrangements for managing and coordinating the evacuation of the atrium occupants;
- the number of staff that should be on duty during periods when the atrium is occupied;
- the number of staff required to assist in a fire emergency and their duties, and where there are commercial or other occupiers, the duties and responsibilities of their staff;
- the procedures in place to ensure that staff identified as being required to assist are available during all periods when the atrium is occupied;
- a detailed description of the evacuation process including the process and responsibilities for evacuating commercial enterprises, departmental areas and common facilities such as toilet areas;
- the availability of equipment and the methods to be used for the movement or evacuation of those occupants with mobility or cognitive impairment;
- means for first aid fire fighting;
- periodic and formally recorded staff training in all these matters.

5.12 The emergency action plan should be subject to regular, routine review and additionally when there is any significant change in the management, staffing, utilisation or internal layout of the atrium that may affect the arrangements or effectiveness of the plan.

## Staff training

5.13 To minimise the potential for fire and to ensure that the emergency action plan can be effectively implemented, training specific to the circumstances of the atrium workplace must be provided for all relevant staff members.

5.14 An analysis of staff training needs should be undertaken to ensure that members of staff receive training relevant to their duties and responsibilities, the fire hazards, the control measures and the emergency action plan for the atrium.

5.15 All members of staff, whether directly employed by the healthcare organisation or employed by others, should receive fire safety and emergency training as determined by the training needs analysis.

5.16 It is recommended that staff who may be involved in assisting and directing persons evacuating the atrium space, should receive training that reflects the special characteristics of evacuation from an atrium space e.g. human behaviours (see example; paragraphs 4.35-6), the concept of pre-movement time and their role in commencing action immediately, evacuation of higher levels in the atrium, evacuation of bridges and open plan seating areas, the importance of checking enclosed spaces such as toilet areas, whether or not the progressive horizontal evacuation is to be adopted for some areas or persons, and for others evacuation to the open air is to be adopted.

5.17 Further guidance on the fire safety training of staff in healthcare premises can be found in SHTM 83; General fire precautions.

# Appendix 1: Glossary of terms

**Atrium** (plural **atria**)**:** a space, or system of conjoined spaces, within the building that adjoins more than one storey.

**Note:** Shafts used solely for stairs, escalators, lifts, or services are not classified as atria.

**Atrium base:** the plan area of the lowest floor level within the atrium.

**Atrium enclosure:** the walls and, where applicable, the roof or other structure that form the boundary of the atrium space(s).

**Available Safe Escape Time [ASET]:** the calculated time available between ignition of a fire and the time at which tenability criteria are exceeded in a specified space in a building.

**Compartmentation:** the fire resisting elements including walls, floors, and where applicable, roofs and/or other structures used in the separation of one fire compartment from another. (See also **'Fire compartment'**.)

**Commercial enterprise:** any undertaking established on healthcare premises or within part of a healthcare building 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.

**Emergency lighting:** lighting provided for use when the power supply to the normal lighting fails.

**Escape lighting:** that part of the emergency lighting which is provided to ensure that the escape routes are illuminated at all material times.

**Fire compartment:** a building or part of a building, comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to or from another part of the same building, or an adjoining building.

**Fire engineering:** the application of scientific and engineering principles to the protection of people, property and the environment from fire.

**Fire load:** the sum of the calorific energies that could be released by the complete combustion of all the combustible materials in a space including the facing of the walls, partitions, floors and ceilings. The following fire loads are referred to in this SHTM:

- **limited fire load:** an arrangement of combustibles in discrete islands of up to 10m$^2$ each with a fire load density of less than 115 MJ/m$^2$, and each island separated from adjacent combustibles by at least 4m, or protected by a sprinkler system;

- **significant fire load:** a fire load other than one that is limited.

**Fire load density:** the fire load divided by the floor area that contains the fire load.

**Fire plume:** the buoyant gas stream rising above a localised area undergoing combustion. The following plume types are referred to in this SHTM:

- **axisymmetric plume:** a coherent fire plume rising into a surrounding space of essentially uncontaminated air away from physical obstructions and with a broad appearance of symmetry about its longitudinal axis;
- **spill plume:** a rising fire plume emanating from beneath the edge of a lower level soffit where its buoyant rise continues into a space of greater height.

**Fire resistance:** the ability of an element of building construction, component or structure to fulfil, for a stated period of time, the required load bearing capacity, fire integrity and/or thermal insulation and/or other expected duty in a standard fire resistance test.

**Healthcare building:** a hospital, treatment centre, health centre, clinic, surgery, walk-in centre or other building where patients are provided with medical care.

**Height of an atrium:** the level of the surface of the highest point of the floor of the highest storey adjacent to the atrium measured from the lowest level of the atrium base.

**Mechanical smoke exhaust ventilation system:** a ventilation system intended to exhaust smoke by means of electrically powered fans.

**Natural smoke exhaust ventilation system:** a ventilation system intended to exhaust smoke by means of buoyancy forces due to difference in density of the air arising from the effects of temperature differences.

**Occupant dependency:** the categorisation of occupants on the basis of their likely need for assistance to effect their safe evacuation in an emergency. The following categories are referred to in this SHTM:

- **independent:** occupants will be defined as being independent:

  (i) if their mobility is not impaired in any way and they are able to physically leave the premises without staff assistance; or

  (ii) if they have a degree of mobility impairment and rely on another person to offer minimal assistance.

  This would include being able to negotiate stairs unaided or with minimal assistance, as well as being able to comprehend the emergency wayfinding signage around the facility.

- **dependent:** all occupants except those classified as ‘independent’ or ‘very high dependency’.

- **very high dependency:** those whose clinical treatment and/or condition creates a high dependency on staff. This will include those in critical care areas, operating theatres, coronary care etc and those for whom evacuation would prove potentially life threatening.

**Pre-movement time:** The time interval between the warning of fire being given, by an alarm of fire or by direct sight of fire or smoke, and the commencement of movement towards an exit.

**Progressive Horizontal Evacuation (PHE):** Progressive horizontal evacuation. The process of moving persons from a compartment or sub-compartment where they are or may be in danger from fire or the products of fire, to an adjacent compartment or sub-compartment on the same level where they are safe from the effects of fire, and from which further escape is possible.

**Place of safety:** A place where persons are in no danger from fire.

**Required Safe Escape Time (RSET):** the calculated time available between ignition of a fire and the time at which occupants in a specified space in a building are able to reach a place of safety or relative safety.

**Smoke control:** any technique for dealing with smoke gases within the building, or other structure, in order to protect the structure, the contents, the means of escape, or to assist fire-fighting operations.

**Smoke layer:** the observable zone of buoyant smoke that collects beneath a roof, soffit or layer of warm air.

**Smoke logging:** the condition arising when the accumulation of smoke results in the smoke layer descending to a point that affects a significant proportion of the surrounding space.

**Stratification:** the phenomenon whereby the upward movement of the smoke plume may cease due to a lack of buoyancy usually as a result of the ambient temperature at ceiling level being significantly higher than that at the level where the fire starts.

**Travel distance:** the horizontal distance to be travelled by a person from any point within the floor area to the nearest adjoining compartment, escape stairway or external exit, having regard to the layout of walls, partitions, fittings and furniture.

**Voice alarm system:** a sound distribution system that provides means for automatically broadcasting speech messages and warning signals.

# Appendix 2: References

## Acts and Regulations

**Building (Scotland) Regulations** 2004

**Fire safety policy for NHSScotland 2011**; CEL 11 (2011)

**Fire Safety (Scotland) Regulations** 2006

**Fire (Scotland) Act 2005** as amended

**Scottish Building Standards**; Non-domestic Technical Handbook
http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards

## NHSScotland Firecode

**SHTM 81: Part 1: Version 4:** Fire precautions in new healthcare premises; 2009

**SHTM 81: Part 2: Version 1:** Guidance on the fire engineering of healthcare premises; 2009

**SHTM 82: Version 3:** Alarm and detection systems, 2004

**SHTM 83: Version 3:** Fire safety in healthcare premises: General fire precautions, 2004

**SHTM 85 Version 4:** Fire precautions in existing hospitals, 2007

**SHTM 86 Version 4 Part 1:** Fire risk assessment in community healthcare premises, 2007;
(currently under revision; to be replaced by SHTM 86; version 5; 2011)

**SHTM 86 Version 4 Part 2:** Fire risk assessment in healthcare premises, 2007;
(currently under revision; to be replaced by SHTM 86; version 5; 2011)

**SHTM 87: Version 3:** Textiles and furniture, 2009

**SFPN 3: Version 3:** Escape bed lifts, 2010

**SFPN 4: Version 2:** Hospital main kitchens, 1999

**SFPN 5: Version 2:** Commercial Enterprises on Hospital Premises, 1999

**SFPN 6: Version 3:** The prevention and control of deliberate fire-raising in NHS healthcare premises, 2007

**SFPN 7: Version 2:** Fire precautions in patient hospitals, 2004

**SFPN 10: Version 2:** Laboratories on hospital premises, 1999

**SFPN 11: Version 1:** Reducing unwanted fire signals in healthcare premises, 2006

**A Model Management Structure for Fire Safety**, 1999

## Scottish Health Technical Memoranda

**SHTM 06-01:** Electrical services – supply and distribution, 2006

**SHTM 02-01:** Medical gas pipeline systems, 2001

## British, European and International Standards

The latest version of any standard should be used, provided that it continues to address the relevant requirements of this guidance.

**BS 5266-1:2005**. Emergency lighting. Code of practice for the emergency lighting of premises. British Standards Institution, 2005.

**BS 5499-4:2000**. Safety signs, including fire safety signs. Code of practice for escape route signing.

**BS 5839-1:2002+A2:2008**. Fire detection and alarm systems for buildings. Code of practice for the system design, installation, commissioning and maintenance.

**BS 5839-8:2008.** Fire detection and alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of voice alarm systems.

**BS 9999: 2008.** Code of Practice for fire safety in the design, use and management of buildings.

**BS EN 12101-2:2003.** Smoke and heat control systems. Specification for natural smoke and heat exhaust ventilators.

**BS EN 12101-3:2002**. Smoke and heat control systems. Specification for powered smoke and heat exhaust ventilators.

**BS EN 12101-10:2005**. Smoke and heat control systems. Power supplies.

**BS EN 12845:2004+Amendment 2:2009**. Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance.

**ISO 23601:2009**. Safety identification. Escape and evacuation plan signs.

**PD 7974-1:2003** .Application of fire safety engineering principles to the design of buildings. Initiation and development of fire within the enclosure of origin (Subsystem 1).

British Standards Institution **(**http://www.bsi-global.com/**).**

## Other guidance

**CIBSE; Lighting guide LG2;** Hospitals and healthcare buildings

**Fire prevention on construction sites, 6th Edition**; Joint code of practice by the Building Employers Federation – Loss Prevention Council – National Contractors Group; ISBN 9781902790336

**Construction Information Sheet 51** (CIS 51); Construction Fire Safety; HSE

**Standard fire precautions for contractors engaged on Crown works**; Dept of the Environment; TSO; ISBN 0-11-75223-5