National Operational Guidance Programme

Local Government Association | CFOA Chief Fire Officers Association | in partnership with LFB London Fire Brigade

Title:	Fires in the built environment
Project Executive:	CFO Phil Loach, West Midlands FS
Synopsis:	This guidance focuses on how the design and construction materials of buildings, along with their facilities and systems, can impact on, or assist with, fire and rescue service operations.
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National Operational Guidance – Fires in the built environment second edition version one (ARCHIVED on 03 08 2016

National Operational Guidance Programme

Fires in the built environment

Second edition version one

Fires in the built environment

Introduction

This section of National Operational Guidance identifies the hazards and control measures that should be considered when writing policies for dealing with fires in the built environment. For the purposes of this guidance the built environment has been defined as “permanent surface or sub-surface structures that are partially or wholly covered”.

It contains information relating to various types of building design and construction materials and describes how building facilities and systems can affect and even improve fire and rescue service intervention. The guidance recognises and reflects findings from significant incidents in the UK in recent years and draws on observations of relevant fires in buildings worldwide.

Depending on the nature and scale of the operational incident, a variety of significant hazards may be encountered. Where appropriate, other sections of National Operational Guidance should be consulted, including:

- Operations guidance
- Incident command guidance
- Performing rescues guidance
- Environmental protection guidance

Guidance for fires in the built environment is supported by National Operational Guidance: Fires and firefighting, which includes:

- Fire loading
- Fire development
- Firefighting media and techniques
- Damage control and salvage

This guidance should be read together with information on the aims and intended use of the National Operational Guidance Programme, which can be found at www.ukfrs.com.

Legislation

A legislative framework addresses fire safety in buildings.

Building Act 1984

This is the primary legislation covering building work in the UK. Among other things, it provides for preparing Building Regulations and identifies the duties of local authorities in enforcing the Act and Building Regulations. It also sets out the basis for approaching the design of buildings, with designers free to adopt any approach they can justify (i.e. fire engineering). Approved Documents should be used to inform the design process if no alternative approach is put forward.

Building Regulations 2010

The Building Regulations set out the duties of those carrying out building work. Specific to fire safety, Part B of Schedule 1 of the Building Regulations requires that buildings meet certain functional objectives:

- Providing alarms and suitable means of escape
- Limiting fire spread over internal linings (i.e. in rooms)
- Limiting fire spread over the structure (i.e. fire resistance and concealed spaces)
- Limiting fire spread over the external envelope of the building (both across the surface of one building and building-to-building fire spread)
- Facilities to assist firefighters in protecting lives

The Regulations require building work to be carried out with appropriate materials and to a suitable standard of workmanship. They also now require that information on the building's fire safety design be made available to the responsible person to assist them in their duties under the Regulatory Reform (Fire Safety) Order 2005.

Regulatory Reform (Fire Safety) Order 2005

The fire safety order sets out the duties of the responsible person (normally the owner or manager of a building) in ensuring a building's ongoing fire safety. The Fire Safety Order takes a risk based approach to fire safety, but does assign some specific duties to the responsible person.

the fire safety order requires a responsible person to carry out a fire risk assessment and take measures to ensure the building is suitably safe for all relevant people. It also refers to some general fire precautions:

- Reducing the risk of fire and the risk of fire spread
- Means of escape
- The safe and effective use of the means of escape
- Means for fighting fires
- Means for detecting fire and giving warning
- Arrangements for the actions to be taken in a fire

The Fire Safety Order does not require the introduction of anything for the purpose of firefighting, but existing features for the assistance of firefighters should be maintained to help them protect the relevant people.

To ensure the safety of all relevant people, the responsible person must make suitable arrangements with the fire and rescue service where necessary.

Fire and Rescue Services Act 2004

Among other things, the Fire and Rescue Services Act 2004 sets out the duties of fire and rescue services in making arrangements for:

- Promoting fire safety and providing fire safety advice where requested
- Familiarisation to inform firefighting operations
- Water supplies

Risk management plan

Each fire and rescue authority must develop their strategic direction through their risk management plan. To determine the extent of their firefighting capability, strategic managers will consider their statutory duties and the foreseeable risk within their area.

Work to identify risk and prepare operational plans should be carried out with regard to all stakeholders including local resilience forums and the fire and rescue service's risk management plan.

Fires in the built environment: Hazard and control statement

Hazards	Control measures
Fires in the built environment	Apply situational awareness Gather and apply site specific risk information (SSRI) Building systems and facilities Establish scene safety and cordons Carry out appropriate intervention Understand signs and symptoms of backdraught Understand signs and symptoms of flashover Consider employing tactical ventilation Gas cooling
Undetected fire spread	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Identify and investigate fire in concealed spaces Access the concealed area Consider the effects of ventilation
Fire spread within a compartment	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Identify and consider the impact of wall linings
Fire spread breaching a compartment	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment']

Hazards	Control measures
	Identify compartmentation Identify and secure access and egress routes Survey adjacent areas or compartments
External fire spread	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Carry out an external survey Co-ordinate external and internal activity Provide external protection
Cable entanglement	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Isolate the electricity supply Identify whether lightweight conduit, trunking and cable fixings are present Avoid or secure areas of loose cabling
Partial and structural collapse	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Look for signs of collapse Position cordons appropriately Maintain safe access and egress routes Take preventative action Make a tactical withdrawal or emergency evacuation
Fixed installations fail or do not operate correctly	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Liaise with responsible person Gather and apply site specific risk information (SSRI) Give authority to operate or alter fixed installations Develop contingency arrangements
Complex engineered solutions	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Carry out information gathering Identify firefighting access points Use integral communications

Hazards	Control measures
Design features causing delayed intervention	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Consider making a forcible entry Maintain safe access and egress Control fixed installations and integral communication systems Identify appropriate location(s) for a bridgehead (forward BA entry control point) Confirm the occupier evacuation policy or strategy Consider how time delays may affect incident development

Fires in the built environment

Hazard	Control measures
Fires in the built environment	Apply situational awareness Gather and apply site specific risk information (SSRI) Building systems and facilities Establish scene safety and cordons Carry out appropriate intervention Understand signs and symptoms of backdraught Understand signs and symptoms of flashover Consider employing tactical ventilation Gas cooling

Hazard knowledge

This section contains generic control measures that should be applied when dealing with any fire in the built environment, whatever its size or complexity.

This guidance is underpinned by comprehensive information from the Building Research Establishment (BRE) making it easier for the user to find their way through the guidance without an overload of technical information. The knowledge sheets include information on:

- Building design
- Construction materials

- Fire protection
- Facilities for firefighters
- Building occupancy

The knowledge sheets have been supplemented with considerations developed by fire and rescue service contributors.

Throughout the guidance there are references to the technical information contained in the knowledge sheets. These are shown in italics for initial publication but will be replaced with hyperlinks early in 2015.

The guidance presumes that buildings comply with relevant regulations. However some buildings may have been altered or changed since their original construction, such as a change of use, extensions or conversions. These changes may have been unregulated and could have an impact on the incident. For example, the structure or compartments may have been breached due to modifications to the original construction. As a result, fire separation within the building may have been compromised.

When dealing with incidents, illegal activities should be considered as they can present significant hazards including the deliberate setting of fires and booby traps. Illegal activities can include the cultivation and production of illegal drugs, tampering with utilities and meters, or illegal storage of hazardous materials including fireworks or fuel.

Control measure – Apply situational awareness

Control measure knowledge

Situational awareness concerns the perception and understanding of a situation and the anticipation of how the situation may develop in the near future. For further information refer to the Incident Command guidance.

Understanding a building's design, construction, nature of occupancy (including the type of *population*) and its performance in a fire, will assist incident commanders and firefighters to make safe, informed decisions.

Depending on the size and complexity of the incident, other agencies may attend, making effective joint working critical for safety on the incident ground. Shared situational awareness is a multi-agency, common understanding of the circumstances and immediate consequences of the emergency, together with an appreciation of the capabilities available and the priorities of the emergency services. Further information can be found in the Joint Emergency Services Interoperability Programme (JESIP) Joint Doctrine, Joint Decision Model.

So that fire and rescue service personnel can operate safely and effectively at incidents involving fires in the built environment, they should develop an appropriate understanding of building design and construction materials, along with building use and occupancy. They should also appreciate the effects of fire and firefighting activity on a structure. To make a judgement on an effective

deployment, the incident commander should also be aware of the capabilities of the resources at the scene.

The following sources of information should be considered throughout the incident:

- Building use and occupancy
- Site specific risk information
- Building and site plans
- Premises information box
- The responsible person
- Building facilities and systems, such as:
    - Fire detection systems
    - Fixed installations
    - Control rooms or closed-circuit television (CCTV)
- Signage
- Observation, including:
    - External surveys of the building – consider the use of thermal imaging cameras
    - Identifying the location of the fire and assessing fire development
    - Reconnaissance of the location reported as involved
- Information from:
    - Occupiers
    - Personnel operating in the building
    - Other agencies

See National Operational Guidance: Operations – Impaired mental and physical ability caused by alert/notification to respond.

See National Operational Guidance: Incident command – situational awareness

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and appropriate operational systems to assist control room personnel in updating and informing incident commanders at the scene of an incident
- Liaise and consult with partner agencies to develop mutual understandings on interoperability arrangements for fires in the built environment

Tactical actions

Incident commanders should:

- Ascertain the cause of fire considering the potential for deliberate or accidental ignition and legal or illegal activities (e.g. alcohol distilleries, drugs factories, IEDs and the potential for improvised explosive devices or 'booby traps')

Control measure – Gather and apply site specific risk information (SSRI)

Control measure knowledge

Each fire and rescue service must assess the hazards and risks in their area, with site specific risk plans established for locations where hazards and risks are significant. A site specific assessment includes information relating to the pre-planning of firefighting tactics. Further information can be found in National Operational Guidance: Operations – Failure to identify foreseeable risk

UK legislation sets the requirement for site specific assessment. Collating and disseminating SSRI involves a number of tasks:

- Selecting premises to be inspected
- Assessing the nature and magnitude of the risk
- Considering a proportionate response
- Recording significant findings
- Making sure information is available in a useable form

A site specific assessment takes account of current legislation on inspection information and includes information on preplanning firefighting tactics.

See National Operational Guidance: Operations – Information gathering

Strategic actions

Fire and rescue services should:

- Develop mutual understandings with building developers, owners and occupiers on the exchange of information about alterations to any parts of a building which may have effect on firefighting operations.
- Ensure communication systems are in place to inform relevant personnel, stakeholders and partner agencies.
- Develop systems and processes to embed a culture of risk information gathering, recording and communication.
- Consider the requirement for the provision of specific equipment and training in relation to buildings identified as specific risks within the area of the service.

Tactical actions

Incident commanders should:

- Access site specific risk information via available means (e.g. MDT or hard-paper copy)
- Gather additional information from the scene and from responsible person(s) to support and confirm SSRI
- Identify, communicate and implement control measures in accordance with SSRI and any additional current information
- Liaise and share relevant site specific risk information with other responding agencies
- Provide additional information to review current SSRI, following attendance at incidents

Control measure – Building systems and facilities

Control measure knowledge

Some premises have facilities that can assist the fire and rescue service in obtaining information about the nature of an incident, including fire alarm systems and security systems. Provision for emergencies and heating, ventilation and air conditioning (HVAC), as well as suppression systems, may provide valuable detail on a building's possible behaviour and the scope of an incident. Refer to the Building Research Establishment knowledge sheets for further information.

Strategic actions

Fire and rescue services should:

- Develop systems and processes to enable personnel to access SSRI, site visit information and/or record such information on any building systems and facilities which could assist, or be considered hazardous during, firefighting operations
- Develop service structures to enable relevant building system and facility information to be exchanged between service prevention and response departments

Tactical actions

Incident commanders should:

- On arrival, make use of any systems to gain further knowledge of the incident. These could identify the initial location and time of any actuations, and any subsequent spread
- Liaise with a responsible person (or appointed competent person) on site who can assist with the operation of such systems
- Use available slave control panels to indicate the status of facilities, which may be helpful for gathering information but do not always have the same degree of control as the main control panels

- Post-incident, use the system's memory to augment other data when establishing a timeline of the events leading up to the fire and rescue service intervention

Control measure - Establish scene safety and cordons

Control measure knowledge

See National Operational Guidance: Incident command – Structuring an incident

Scene safety

Effective information gathering during an incident should identify hazards and associated risks. Evaluating the risks and considering suitable control measures should lead to a safe system of work. Operational risk assessments and procedures should be produced to support the process.

The incident or sector commanders should ensure that a risk/benefit analysis is made for all activities to minimise injuries. Assessment outcomes should be communicated to the appropriate personnel and/or agency through timely briefings with any updates communicated throughout the incident.

Initial cordon

Setting up an initial cordon may be carried out by the police or the fire and rescue service. Cordons may be physical barriers such as a perimeter fence, or a temporary barrier like traffic tape. The IC must consider the safety of firefighters, other emergency services, other agencies attending (including voluntary agencies) and members of the public. Individual agencies should ensure that personnel arriving at the scene have appropriate Personal Protective Equipment (PPE) and that they are adequately trained and briefed for the work they will undertake inside the cordon.

Cordons are an effective method of controlling resources and maintaining safety at the incident ground. After establishing the initial cordon the incident can usually be covered with two types of cordon:

Inner cordon

An inner cordon controls access to the immediate scene of operations. Access to the inner cordon area, which by definition is a high hazard zone, should be kept to a minimum, restricted to only those required for work to be carried out safely and effectively. However, if the incident is the consequence of a suspected criminal act, the police will assume overall control of the area. The two services will liaise to determine entry and exit protocol. Personnel should only enter after a full briefing and the allocation of specific tasks. Fire and rescue services are trained and equipped to manage 'gateways' into the inner cordon if the police request assistance.

Hazard or restricted area (within the inner cordon)

Sometimes a 'restricted area' is needed in an inner cordon, which may have been identified before the inner cordon is established. All personnel working in the inner cordon must be made aware of the conditions that apply to the restricted area.

Outer cordon

The outer cordon prevents public access to an area being used by the emergency services when attending an incident. The police will usually control outer cordons, and a traffic cordon may then further supplement the outer cordon. The police, in liaison with the fire and rescue service and the ambulance service, will identify safe routes into and out of the cordon for emergency vehicles and other attending agencies. Where one or more marshalling areas are established, they are usually located in the outer cordon area.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements on the hazards and actions taken in establishing scene safety and cordons

Tactical actions

Incident commanders should:

- Establish an appropriate cordon based on incident information and accounting for risks including thermal radiation and structural collapse.

Control measure – Carry out appropriate intervention

Control measure knowledge

Underpinning knowledge of the built environment, compartment fire behaviour and whether any occupants are present and at risk will determine the timing and level of intervention. In particular, gaining knowledge of any fire protection systems and facilities for firefighters in the building is necessary, including how they are operated and whether they are functioning. To make an effective deployment the incident commander should be aware of the capabilities.

See National Operational Guidance: Fires and firefighting – Appropriate speed of intervention

See National Operational Guidance: Incident command – Command decision making

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and appropriate operational systems to assist control room personnel and the incident commander for the operational decision making process

Tactical actions

Incident commanders should:

- Consider the construction type, size, age and maintained condition of the building.

- Assess and monitor the speed of fire development (e.g. surrounding surfaces gassing-off, visible flame, volume, colour and pressure of fire gases, severity of the fire and area involved in fire in relation to the size of the building)

Control measure – Understand signs and symptoms of backdraught

See National Operational Guidance: Fires and firefighting

Control measure – Understand signs and symptoms of flashover

See National Operational Guidance: Fires and firefighting

Control measure – Consider employing tactical ventilation

See National Operational Guidance: Fires and firefighting

Control measure – Gas cooling

See National Operational Guidance: Fires and firefighting

Undetected fire spread

Hazard	Control measures
Undetected fire spread	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Identify and investigate fire in concealed spaces Access the concealed area Consider the effects of ventilation

Hazard knowledge

Concealed spaces in a building's construction may provide a route for combustion products. If cavities in the construction are extensive, a fire can develop undetected – smoke may spread or fire break through in unpredicted areas, possibly at some distance from the area of fire origin.

Concealed spaces may include external wall cavities, suspended ceilings, roof spaces, utility ducting or space under floors and behind cladding. Combustible insulation used in wall cavities and insulated panels can contribute to undetected fire spread. Fire involving the core of sandwich panels and structural insulated panels (SIPs) may result in elements of the panel failing and leading to partial or structural collapse.

Control measure – Identify and investigate fire in concealed spaces

Control measure knowledge

The use of site specific risk information, if available, can provide information on building design and construction materials, like the presence of insulated panels or timber frame construction and may identify concealed spaces. Early investigation of such features reduces the risk of fire spread both within the concealed space and to other areas of the structure.

Electrical fittings like sockets or switches may provide signs, such as blackening around the area of fire spread within a wall cavity. Damage to panels, from fire or other causes, may indicate the type of insulation used in their construction and allow the risks associated with the particular type of panel to be assessed. Combustible sandwich panels may cause dense, corrosive and toxic smoke. However, it is important to consider that a single building may feature more than one type of sandwich panel.

It may be difficult to identify the structural elements and materials of the building if they are hidden behind facades and cladding.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the hazards and the actions to be taken in the identification and investigation of fire in concealed spaces
- Ascertain and provide specific equipment, training and process arrangements to enable personnel to conduct identification and investigation of fire in concealed spaces

Tactical actions

Incident commanders should:

- Consult and liaise with owners, occupiers and responsible persons to ascertain the location of and access to concealed areas
- Consider the possibility of any building modifications. (e.g. the construction and/or removal of partition walls and/or doors, addition of plant, electrical and mechanical systems)
- Examine ducting or heating, ventilation or air-conditioning outlets for heat or smoke
- Identify fire spread in voids and *cavities* by cutting away and opening up for examination
- Pay attention to the ongoing status of the fire detection system, further alarms or alarms activating remotely from the initial zones

Control measure – Access the concealed area

Control measure knowledge

Inspection covers or doors may provide access to a concealed area if fire spread is suspected. Lifting floorboards or ceiling tiles and opening loft access hatches may allow access to areas under the floor or above the ceiling areas. Other techniques like cutting away or removing areas of brickwork to

expose wall cavities may be required. To avoid the risk of electrocution or damaging pipework, isolate utilities before accessing concealed areas. Concealed areas may contain hazardous materials such as asbestos.

Strategic actions

Fire and rescue services should:

- Consult and liaise with developers, owners, occupiers and responsible persons to produce effective plans for access to concealed areas in specific buildings
- Develop tactical guidance and support arrangements on the hazards and the actions to be taken in establishing access to concealed areas where fire is suspected

Tactical actions

Incident commanders should:

- Establish the location and integrity of fire protected areas of construction
- Identify the location of potential fire spread in concealed areas
- Establish where fire stopping materials are present in the construction. (e.g. fire socks within wall cavities, fire resistant materials (collars, dampers) used to seal ducting and pipework between compartments and fire resisting construction)
- Consider the potential for rapid fire spread within and beyond concealed areas. Conduct a thorough check of concealed areas internally and externally, before exposing the fire. (e.g. ducting, flues, chimneys and cavities including insulation cavities)
- Isolate utility supplies before cutting away, having liaised with the responsible person to ensure fixed installations will not be affected
- Consider the impact on structural stability before cutting away
- Avoid the unintentional creation of flow paths that could develop and/or worsen any fire spread

Control measure – Consider the effects of ventilation

Control measure knowledge

Natural or mechanical ventilation can have a considerable effect, intensifying the speed of fire spread through a concealed space. Sources of ventilation should be identified, evaluated and monitored to establish the potential effects on fire development.

For further information, see Ventilation

Further reading

Leo’s Supermarket (Bristol Fire and Rescue Service)

Sun Valley (Hereford and Worcester Fire and Rescue Service)

Fire spread within a compartment

Hazard	Control measures
Fire spread within a compartment	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Identify and consider the impact of wall and ceiling linings

Hazard knowledge

This hazard involves the impact of fire on the compartment structure. It should be read in conjunction with National Operational Guidance: Fires and firefighting.

The Building Regulations cannot control the effects a permanent resident may have on a building with regard to fire safety. This can include factors like decorative linings along with other fire safety provisions.

The resident may have installed decorative wall and ceiling linings made from flammable materials such as timber, plastics or polystyrene. The spread of flame involving a lining within a compartment may not be predicted under normal fire development conditions but may contribute significantly to fire spread as well as toxic fume emission. Layers of paint applied to a substrate may create a layer that is sufficiently thick to have become flammable over time.

Even though the linings of walls and ceilings may not be items first ignited, they are likely to have a significant effect on the fire spread and rate of growth. Therefore, it is important to consider the effects wall and ceiling linings may have, particularly in circulation spaces where fire spread is likely to prevent occupants from escaping.

Control measure – Identify and consider the impact of wall and ceiling linings

Control measure knowledge

Along with general considerations of compartment fire behaviour, the presence of wall and ceiling linings and the type of material used may directly influence the speed and intensity of fire development. A lack of building controls on substrate material selection can lead to significant effects on the spread of fire and rate of fire growth in an area.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and the actions to take to limit the impact of wall and ceiling linings in fires

Tactical actions

Incident commanders should:

- Consider the type of building construction and be aware of sandwich panels and modular or pod type constructed buildings, which can cause rapid intensification of fire.
- Consider the age of the property. Although not a definitive guide, newer buildings are more likely to conform to building regulations on wall and ceiling linings

Firefighters should:

- Check the wall and ceiling construction and linings in adjacent compartments within the building/dwelling to identify potential risks
- Observe the rate of fire development and production and volume of fire gases, which will give an indication of the heat release rate and flammability of materials

Further reading

DCLG - The impact of European fire test and classification standards on wallpaper and similar decorative linings

The Building Regulations - Approved Document B2 – Internal fire spread (linings)

Fire spread breaching a compartment

Hazard	Control measures
Fire spread breaching a compartment	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Identify compartmentation Identify and secure access and egress routes Survey adjacent areas or compartments

Hazard knowledge

Fire will breach a compartment when an element or elements of compartmentation fails, either through the period of fire development or because inappropriate building methods or materials have been used. Operational firefighters may interpret individual rooms within a building as ‘compartments’ though this does not necessarily constitute true compartmentation. Factors that may lead to a breach of compartmentation include:

- Retrofitted cabling or pipework with ineffective fire stopping
- Failure of devices such as collars or dampers that are designed to stop the spread of smoke/heat
- Severity of fire within the compartment
- Duration of fire development
- Interference with integral fire safety provisions (like wedged fire doors for example)
- Firefighting tactics

Control measure – Identify compartmentation

Control measure knowledge

Fire compartmentation is achieved with fire resisting construction aimed at preventing or delaying the spread of fire and smoke from one space in a building to another. Occasionally this includes limiting external fire spread from the building.

Dividing spaces into cells or compartments or separating the buildings by walls and floors constructed as compartment walls and compartment floors can restrict fire spread within buildings. Factors like occupancy, fire loading, height to its top storey and the presence of sprinklers can affect the level of compartmentation. Together these factors determine evacuation needs in a fire. The effectiveness of fire compartmentation relies on good workmanship at installation and a good state of repair. Penetrations that are not fire stopped, defects or a lack of maintenance can lead to the early failure of compartmentation. The state of compartmentation in the building should be investigated.

Compartmentation is particularly relevant in residential buildings and the occupants of a house need to be reasonably protected from a fire in an adjoining house – walls separating one house from another need to be compartment walls. The same applies to occupants of flats and maisonettes.

Fire doors are installed at strategic locations in a building, where passage through a line of fire resisting construction is required. Not all doors in a building are fire doors, but general purpose doors may carry some inherent fire resisting properties.

Where there are not enough fire resisting elements, such as doors or separation that are not designed to provide a level of fire protection, fire may spread beyond the fire compartmentation.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and the actions to take when identifying compartmentation in a building
- Develop systems and processes to provide appropriate access to identified building risk and/or floor plans at incidents

Tactical actions

Incident commanders should:

- Consider the aspects which may affect the integrity of compartmentation like fire doors, means of escape and protected shafts using site specific information and visual indications
- Consider the original use of the building and if this has changed, which may have an effect on the internal layout (e.g. compartmentation altered to large open spaces and vice-versa)

- Request the attendance of a fire safety officer to provide advice and assistance on building fire safety measures and potential intelligence on the use and fire safety standards within the building

Control measure – Identify and secure access and egress routes

Control measure knowledge

To prevent access, egress and escape routes becoming compromised, compartmentation and suitable access and egress routes for firefighting teams should be identified and secured at the earliest opportunity.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and the actions to take when identifying and securing access and egress routes

Tactical actions

Incident commanders should:

- Investigate, identify, record and communicate all available access and egress routes and refuge points, using SSRI, recce information and building plans where available
- Consider the flammability of access and egress areas and routes and the potential for fire spread into them
- Ensure access and egress points are suitably and sufficiently protected using personnel with fire-fighting media and/or building fixed installations and/or the structure and integrity of fire protected areas
- Consider using ladders, aerial appliances and firefighting lifts for access/egress and reducing travel distances to the scene of operations
- Consider designating separate routes for access and egress of firefighting personnel and emergency evacuation of residents and members of public
- Beware of potential security systems and devices which could isolate personnel in risk areas
- Consider the use of tactical ventilation to maintain smoke free access and egress routes

Control measure – Survey adjacent areas or compartments

Control measure knowledge

If there are breaches in protection, fire may spread. Identify areas or compartments surrounding the fire, including concealed spaces such as wall cavities, and also inspect openings made in walls or ceilings to accommodate retrofitted services to check fire stopping.

Collars are devices designed to stop fire and/or smoke passing through pipework, through a line of fire resisting construction. There may be fire dampers or smoke and fire dampers, designed to prevent the passage of fire, or smoke and fire.

The stack or chimney effect creates the potential for smoke and fire gases to spread fire and trap occupants in buildings, particularly in those with large floor to roof open areas accessing upper floors; an open plan office areas with central atria, for example. In such circumstances consideration should be given to:

- Closing doors/windows/open areas to upper floors
- Open/create high level ventilation ports and/or use fixed ventilation systems where appropriate/approved and/or pre-defined according to SSRI
- Provide advice to occupants on simultaneous or vertical phased evacuation or defend in place (stay put) safety

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and the actions to take when surveying adjacent areas or compartments

Tactical actions

Incident commanders should:

- Ensure all areas above, below and adjacent to the fire compartment are checked for potential fire spread and position fire-fighting or observation crews to communicate/deal with any compartment breach
- Consider whether a breach of the fire compartment would spread fire to another room, floor, area or other building and evaluate the possible resultant hazards
- Consider using appropriate and effective fire-fighting media as a compartment boundary coolant
- Look for signs of smoke, fire or gas coming from other parts of building unaffected by fire
- Consider requesting the attendance of a local authority building inspector to provide advice on building structural integrity

Further reading

Telstar House (London Fire Brigade)

Rose Park (Strathclyde Fire and Rescue Service)

External fire spread

Hazard	Control measures
External fire spread	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Carry out an external survey Co-ordinate external and internal activity Provide external protection

Hazard knowledge

If a fire in a building is sufficiently intense it may breach the external envelope of the building. This may be a result of external window glazing or wall panels failing, or via open windows. External fire spread may compromise compartments above the fire floor or floors at other levels of the building. Fire spread may also occur from an external source such as a refuse container, vehicle or adjacent premises. Particular attention should be given to external overhead canopies, which have the potential to radiate heat back into an area, intensifying the fire and driving it inside a building.

External cladding of a building may also be a means for fire spread. Materials used for external cladding vary extensively and include; timber (hard and softwood, plywood and oriented strand board), concrete, granite, stone and clay tiles, slate, copper, aluminium, zinc, coated steel, polymeric render, fibre cement sheet, PVC weatherboarding and glass reinforced plastic (GRP). In addition to the cladding materials, consideration should also be given to the design, for example; insulated or non-insulated and the methods of fixing; for example, timber batten, light steel stud work or cement, all of which will have an effect on any fire spread.

Control measure – Carry out an external survey

Control measure knowledge

Evaluating the likelihood and impact of external fire spread requires an appropriate understanding of the building design, construction materials and status of the fire. Depending on the building, site specific risk information may be available to indicate construction materials and compartmentation.

Falling combustible cladding may cause the fire to spread to the floors below the original or primary seat of fire.

In addition to the generic considerations when carrying out a 360° survey identified in incident command the following may be relevant to a fire in the built environment:

- The location of people in the building in need of rescue
- Safe access and egress areas including upper/lower storey access
- Identify breaches in windows and external wall panels or open windows

- Check any external fire spread has not compromised the structural elements or compartmentation of the building
- Consider using police helicopter support and take any limitations of their use into account
- Floor levels directly above or below the suspected fire compartment
- Any sources of renewable energy, like photovoltaic panels, which may generate fire spread and/or fall from height

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take when carrying out an external survey

Tactical actions

Incident commanders should:

- Conduct a 360^{o} reconnaissance of the building to assist development of tactical plans
- Anticipate potential hazards associated with fire spread and development and implement appropriate cordon controls (e.g. falling glass and other building materials, flashover, backdraught and surrounding flammable materials)
- Beware of the Coandă effect and the potential for fire spread to upper floors and ensure fire-fighting media is positioned to cover external apertures. This may involve the use of aerial appliances
- Carry out regular external surveys of the building, the frequency dictated by the nature and severity of the fire and fire spread

Control measure – Co-ordinate external and internal activity

Control measure knowledge

To limit fire spread and/or prevent deterioration of internal conditions it may be necessary to direct external hose lines or monitors into compartments. It is essential that any external activity does not compromise the safety of personnel operating inside the building – internal and external activities should be assessed for risk and strictly co-ordinated.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and the actions to take to co-ordinate effective external and internal activity
- Provide appropriate resources and equipment to enable the co-ordination of external and internal activity

Tactical actions

Incident commanders should:

- Ensure effective systems of communications for co-ordinating personnel are provided to prevent external activities compromising firefighter safety and internal operations
- Ensure both internal and external firefighting crews are aware of all firefighting activities and briefed to provide regular updates on progress and additionally identified hazards

Control measure – Provide external protection

Control measure knowledge

To limit fire spread or prevent internal conditions deteriorating, external firefighting tactics and various types of firefighting media may be necessary. The resources required to provide external protection and any impact on safety should be appraised before proceeding.

A thatched roof is created by laying layers of straw, hay or other similar material on the roof framing until it forms a solid and watertight mass. If involved in fire externally, it will tend to burn downwards into the thatch.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and the actions to take to provide external protection to eliminate or limit external fire spread

Tactical actions

Incident commanders should:

- Consider removing any potential external fire loading (e.g. limit external fire spread by creating fire breaks in thatched roofs or green roof /walls)
- Consider the compatibility of fire-fighting media and the potential effects of internal and external firefighting operations
- Consider using external fixed fire-fighting installations (e.g. curtain wall drencher systems to protect the building)
- Consider using fixed, aerial appliance mounted and/or fire-fighting monitors

Cable entanglement

Hazard	Control measures
Cable entanglement	Apply generic control measures [as detailed for

	the hazard of 'Fires in the built environment'] Isolate the electricity supply Identify whether lightweight conduit, trunking and cable fixings are present Avoid or secure areas of loose cabling

Hazard knowledge

Electrical and data cables are used extensively in buildings, with an increased reliance on surface mounted conduit and trunking during installation.

Plastic conduit or trunking that is surface mounted on ceilings and walls will fail at relatively low temperatures (more than 100°C). Thin section aluminium trunking may also fail.

When the conduit or trunking fails cables may be released. Because they can fail at relatively low temperatures, cables may drop some distance from the seat of fire and may hang down, presenting a risk of entanglement and/or electrocution. Hanging cables pose a significant hazard for firefighters and have contributed to firefighter deaths in the past. This hazard must be considered in any building with an electrical supply.

Control measure – Isolate the electricity supply

Control measure knowledge

Large or complex sites or buildings may have more than one electrical intake that must be located and isolated. Site specific information may provide the relevant information, as could liaison with the responsible person. Specialist advice on zone/area isolation may be required for large buildings.

Strategic actions

Fire and rescue services should:

- Liaise and make appropriate arrangements with electricity suppliers (power networks) and develop tactical guidance and support arrangements on electrical supplies and associated equipment/plant hazards and the actions to take in the event of an emergency
- Develop tactical guidance and support arrangements on the associated hazards and the actions to take to isolate

Tactical actions

Incident commanders should:

- Ascertain the location of electrical supply isolation points as early as possible
- Where necessary, isolate the electricity supply at the earliest opportunity to mitigate the risk of electrocution but make sure the wider impact of electricity isolation on the incident is

understood. (e.g. would isolation of electricity affect lighting in other parts of the building or emergency medical care equipment)

- If illegal extraction of electricity is evident, it may be difficult to isolate the supply. Request specialist advice from the electricity supplier
- Check other areas of the building where fire-fighting operations are taking place/likely to take place to ensure that electricity has been isolated and the safety of occupiers and emergency service personnel is not compromised

Control measure – Identify whether lightweight conduit, trunking and cable fixings are present

Control measure knowledge

Where areas involving lightweight conduit, trunking and cable fixings are identified, effective control measures must be implemented to limit the hazards to emergency service personnel and occupants.

Cabling and cable installation in buildings can pose three separate issues:

- Entanglement hazard to Firefighters
- Breeching of fire resistant compartmentation
- Hazardous products of combustion (Dioxins)

Most electrical cables are sheathed or protected with Polyvinyl Chloride (PVC), polyethylene (PP) or Thermoplastic Urethane (TPU). In a fire, these plastic material releases Dioxins (a range of complex chemical compounds), Hydrogen Cyanide and Hydrogen Chloride. Dioxins are extremely harmful to life. Hydrogen Cyanide (HCN) and Hydrogen Chloride (HCl) are both poisonous gases. Hydrogen Cyanide is highly toxic (35 times more toxic than Carbon Monoxide) and Hydrogen Chloride is a poison that forms Hydrochloric acid when it comes in contact with water.

Electrical upgrades and retrofitting additional electrical sockets, lights fittings, security/fire alarms and data cables may mean that lightweight cable fixings are more common in older buildings. Cabling may also be concealed above suspended ceilings, with little or no fixing. Suspended ceilings may also become distorted or fail at relatively low temperatures.

From 1 January 2016, all new wiring systems must now use metal, rather than plastic, to support cables in escape routes to prevent their premature collapse in a fire. Electrical installations fitted before changes to the regulations may still present a hazard to fire crews.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the hazards and actions to take when the presence of conduit, trunking and cable fixings are identified in fire situations
- Develop standard operating procedures to be adopted in event of cable entanglement

- Provide information, instruction and training for BA wearers and operational personnel in cable entrapment release techniques.
- Provide adequate equipment or engineering controls that minimise the risk of entanglement and optimise the likelihood of successful self-release (e.g. straps and wire cutters).
- Identify and allocate appropriate equipment to minimise hazards
- Develop fire protection protocols and arrangements to ensure legislative compliance with BS 7671 and the sharing of relevant information with partners and stakeholders

Tactical actions

Incident commanders should:

- Identify and communicate the presence of lightweight conduit, trunking and cable fixings and assess the likelihood that they will fail. Presence may be identified by inspecting other similar properties (flats, houses, dwellings) or compartments in other areas of the building
- Ensure personnel are committed into risk areas with appropriate tools and equipment to safely deal with cables in accordance with service defined procedures
- Consider a controlled release of cables from trunking
- Establish appropriate emergency arrangements for the release of a fire crew from an entrapment situation

Control measure – Avoid or secure areas of loose cabling

Control measure knowledge

Any identified alternative route should be risk assessed before proceeding. Before touching or securing damaged cables, the electrical supply should be isolated.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance, support arrangements and standard operating procedures for the hazards and actions to take to avoid or secure areas of loose cabling

Tactical actions

Incident commanders should:

- Identify, risk assess and use safe alternative access and egress routes to avoid contact with loose cables or consider defensive tactics
- Secure loose cables by suitable means and consider removing them if the electrical supply has been isolated and secured

Further reading

Harrow Court (Hertfordshire Fire and Rescue Service)

Shirley Towers (Hampshire Fire and Rescue Service)

Fire and Rescue Service Immediate Bulletin 4/2011

Partial or structural collapse

Hazard	Control measures
Partial and structural collapse	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Look for signs of collapse Position cordons appropriately Maintain safe access and egress routes Take preventative action Make a tactical withdrawal or emergency evacuation

Hazard knowledge

Behaviour of structural materials

Elements of construction may distort or fail at different temperatures and speeds, depending on how the various construction materials have been used or combined. This can mean varying stages and severity of collapse.

Degrees of collapse

Lightweight or fragile building features may collapse, including non-structural elements like conservatories or felt covered roofs.

Elements of structure, floors, walls, ceilings, ancillary items, fixtures and fittings can partially collapse. Partial collapse can follow on from the collapse of lightweight or decorative features. This may expose elements of the structure and if not controlled, a structural collapse may follow.

Complete structural collapse can follow on from the partial collapse of floors, walls, ceilings and/or significant features and fittings.

Control measure – Look for signs of collapse

Control measure knowledge

An appropriate understanding of building design and construction materials and the size, severity and effects of the fire both internally and externally will help identify and evaluate signs of partial or structural collapse.

Factors that may affect the structural integrity of a building include:

- The construction type and fire engineered active and passive protection systems
- Structural inadequacy, poor construction, illegal or non-engineered renovations/modifications
- Fire conditions on arrival; size, severity, location and number of fire breached compartments
- Age of building
- Information/intelligence on previous fire
- Fire load applied to structural members
- Backdraught/flashover or explosions
- Engineered timber, truss joists, nail plates
- Applied load increase as a result of water loading
- Cutting structural members during venting operations
- Weather extremes

Potential signs of collapse may include the following:

- Cracks in walls
- Sagging floors or floors deflecting from wall
- Displaced columns
- Dropping arches
- Bulging walls
- Buckling columns or beams
- Water or smoke that pushes through what appears to be a solid masonry wall
- Unusual noises coming from building or dwelling

Strategic actions

Fire and rescue services should:

- Make arrangements with appropriate agencies to provide advice on the structural integrity of a building involved in fire
- Develop tactical guidance, support arrangements and standard operational practices on the associated hazards and actions to take in the event of, or potential for building collapse
- Provide information, instruction and training to incident commanders and fire crews in signs and symptoms of potential building collapse

Tactical actions

Incident commanders should:

- Consider seeking specialist advise from subject matter expert or tactical adviser
- Assess and continuously monitor the buildings for signs of failing structural integrity

Control measure – Position cordons appropriately

See National Operational Guidance: Incident command

Control measure knowledge

Authorised fire and rescue service employees are empowered under current legislation to: restrict the access of persons to premises or a place.

When positioning cordons construction materials, thermal radiation the height of the building and the weather conditions should be taken into account. The wider impact of any collapse, such as damage to surrounding premises, the environment, utilities and infrastructure, must be considered. Appropriate cordon distances must be implemented when mitigating the hazard of an entire building collapse.

In the UK a portal or rigid frame construction is designed for inward collapse – in a fully developed fire a basic single storey structure may be expected to collapse within 30 minutes. Portal frame structures are generally designed so that they collapse within their own footprint.

Glass (glazing) or other flat panels falling from height may travel significant distances from the building, particularly in windy conditions. Cordon distances should be set accordingly.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take to implement appropriate cordon controls at incidents involving fires in the built environment

Tactical actions

Incident commanders should:

- When establishing cordons, assess the likelihood and impact of any collapse, including objects falling from the building
- Continually re-evaluate cordon distances, particularly as the incident or adverse weather conditions develop
- Consider specialist advice on cordon positioning from a building surveyor, subject matter expert or tactical advisor

Control measure – Maintain safe access and egress routes

Control measure knowledge

The location of access points, in relation to the fire and its impact on structural elements, must be considered. Safe access and egress points can be identified by recognising any construction materials that have been or are likely to be affected by fire and hot gases, and predicting the likelihood and impact of collapse. Consideration must be given to establishing additional points or methods of egress and ensuring they remain in use by implementing appropriate control measures.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take to maintain safe access and egress within risk areas

Tactical actions

Incident commanders should:

- Consider the location of the point of access in relation to the fire and any impact or collapse
- Consider the travel distances within the building, for emergency service personnel to reach the scene of operations
- Consider alternative means of access and egress (e.g. using ladders, windows)
- Consider establishing an additional point or method of egress to avoid the area involved. Ensure it remains usable at all times
- Consider areas where additional points of egress can be created in an emergency, taking into account the structural integrity of the building and impact on the fire and others inside the risk area

Control measure – Make a tactical withdrawal or emergency evacuation

See National Operational Guidance: Incident command

Control measure – Take preventative action

Control measure knowledge

Considering preventative action can minimise the potential impact of a fire on the inherent structural stability of a building. Preventative action may include cutting away cladding to expose concealed areas or using sprays to reduce temperatures. Partial collapse may expose structural elements to fire and/or heat and therefore speed up the potential for further collapse.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take to enable incident commanders to take preventative action

Tactical actions

Incident commanders should:

- Establish, develop and communicate anticipated and planned fire stop areas and ensure that resources are sufficient to control and extinguish the fire
- Consider cooling using sprays to reduce the temperature of the structure (caution should be exercised where rapid cooling could weaken structure)
- Consider cutting away and opening up to expose and inspect structural elements to check whether they have been affected by fire

Further reading

Atherstone on Stour (Warwickshire Fire and Rescue Service)

Failure or inappropriate operation of fixed installations

Hazard	Controls
Fixed installations fail or do not operate correctly	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Liaise with responsible person Give authority to operate or alter fixed installations Develop contingency arrangements

Hazard knowledge

Personnel should assume that fixed installations are functioning correctly. If there are indications that fixed installations have failed or are not operating correctly the dynamic risk assessment should be adjusted. Fixed installations are designed to perform a specific function and for a range of purposes including:

- Protecting lives
- Protecting escape routes
- Firefighting and fire suppression
- Building protection
- Environmental protection

Systems may already be operating before the fire and rescue service arrives, or they may not be functioning because of poor maintenance or defective design or installation. If systems are not operating correctly the incident may be more hazardous and/or arduous. Firefighting tactics may

influence the effectiveness of any fixed installations, such as the efficiency of mechanical smoke controls following gas cooling techniques. See National Operational Guidance: Fires and firefighting for detail on firefighting tactics.

Fixed installation and facilities for firefighters may include the following:

- A firefighting shaft. A protected enclosure provided for firefighters containing a firefighting stair and firefighting lobby
- Fire mains. Provided in buildings to ensure firefighting water supplies can be provided from outside the building to various strategic locations inside the building
- A firefighting lift. Designed to operate, so long as it is practicable to do so, when the building fire is beyond the confines of the firefighting shaft. It is used to transport firefighters and their equipment to a floor of their choice.
- Fixed communication systems. Normally provided in large or complex buildings and underground structures. They are provided to support firefighter communications where standard radios may be compromised.
- Fire detection systems. Various types of mechanism may be present to detect fire, heat and smoke in a building
- Sprinkler systems. Sprinkler heads apply water to a fire once temperatures in the local area have reached a threshold temperature. Sprinklers are connected to a water supply, commonly a sprinkler tank, sprinkler pump set, sprinkler valve sets and network of pipes.
- Other fixed installations, which include ventilation systems, foam, steam, drenchers, water mist, dry powder, oxygen-reduction (Redox) and CO2

Control measure – Liaise with the responsible person

Control measure knowledge

Pre-planning should be carried out to identify the types of fixed installations installed. This should determine good practice and alternative actions in the event of failure or inappropriate operation, and the responsible person should be involved if required. This may include the use of aerial appliances, hose lines as temporary rising mains and supplementary water supplies. The impact of these actions on resources should be considered.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take to enable incident commanders to liaise with responsible persons
- Consult and liaise with developers, building owners, occupiers and responsible persons of specifically identified buildings on pre-planning arrangements
- Where required and appropriate, share information with partner agencies

Tactical actions

Incident commanders should:

- Identify and/or confirm if fixed installations are present and their purpose (e.g. life safety or building protection)
- Seek advice on operating fixed installations
- Evaluate the effectiveness of fixed installations in operation
- If the system is not operating appropriately, consider methods or tactics to overcome, or where appropriate, supplement fixed installations

Control measure – Gather and apply site specific risk information (SSRI)

See National Operational Guidance: Operations – Risk information gathering

Control measure – Give authority to operate or alter fixed installations

Control measure knowledge

Incident ground operations should include steps to ensure that no adjustments are made to fixed installations during the incident without authority of the fire and rescue service. It is essential to assess the situation before altering the state of the fixed installation; if the situation is under control or is improving, do not change the state of the fixed installation.

Fixed installations, such as sprinkler systems, should only be altered or switched off under direct instruction from the incident commander, who should first be satisfied that this will not increase the severity of the fire, compromise the safety of building occupants or worsen conditions for firefighters. Local familiarisation to confirm location of fixed installations, supplies and control systems is recommended.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take to enable Incident Commanders to give authority to operate or alter fixed installations within buildings

Tactical actions

Incident commanders should:

- Consider requesting specialist advice before attempting to alter or disable any fixed installation
- Appoint appropriate personnel to manage the controls for the fixed installation (e.g. valves and switches)

- Controls for fixed installations should not be altered unless the fire is under control, and only on the direct instruction of the incident commander
- Consider isolating the sprinkler alarm to improve fire ground communications
- Consider the impact of large volumes of water (e.g. damage and/or the environmental effects of water run off)
- Ensure all operational activities and whereabouts of all personnel are considered before operation of any fixed installation
- Ensure all personnel are informed of any intended tactics on fixed installation systems

Control measure – Develop contingency arrangements

Control measure knowledge

The failure of a fixed installation can have potentially catastrophic consequences. Emergency responders should therefore consider the requirement to implement suitable contingency plans to mitigate associated hazards. Pre-planning should be carried out to identify the types of fixed installations within specific buildings. Liaison with the responsible person should determine good practice and alternative actions in the event of failure or inappropriate operation.

Contingencies for the failure of fixed firefighting installations may include the following:

- Checking the structural integrity and protecting firefighting shafts and fire protected areas
- The use of aerial appliances to provide a temporary fire main
- The use of firefighting lifts or in their absence, the use of stairs, ladders or aerial appliances
- The use of equipment to supplement, enhance and or replace a buildings integral communication system
- A full reconnaissance of a building and gathering regular information updates from emergency responders, to ascertain the severity of fire and extent of fire spread
- Supplementing water supplies to sprinkler, foam, steam, drenchers, water mist systems and/or providing external firefighting media to surround the fire
- A means to provide ventilation of fire gases in the event of a failure of fixed ventilation systems

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take in order ensure that contingency plans are effectively considered and implemented where necessary

- As part of a site specific risk information process, consult and liaise with developers, building owners, occupiers and responsible persons of specifically identified buildings, on contingency planning arrangements for fire emergencies
- Where required and appropriate, share information with partner agencies

Tactical actions

Incident commanders should:

- Ascertain and implement pre-planned contingency arrangements using site specific risk information and liaison with the responsible person
- If the system is not operating appropriately and in the absence of a pre-defined contingency, consider methods or tactics to overcome, or where appropriate to supplement, fixed installations

Further reading

Digital (Hampshire Fire and Rescue Service)

Complex engineered solutions

Hazard	Controls
Complex engineered solutions	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Carry out information gathering Identify firefighting access points Use integral communications

Hazard knowledge

Buildings with complex fire engineering solutions rely on pre-planning by local fire and rescue services to identify systems and establish site specific plans and/or procedures.

Complex fire engineering has been identified as a specific issue that needs to be considered in this guidance as a wide variety of approaches are permitted. These varied approaches mean that buildings may behave in a range of ways during the course of a fire – most are consistent with the behaviour of a 'traditional' or 'Approved Document B' building, but some may behave significantly differently.

For example, a building incorporating an innovative smoke control system may be capable of forcing smoke to move in directions that are not expected by attending firefighters. Equally, firefighting attack that makes heavy use of gas cooling may have an adverse effect by reducing the buoyancy of the smoke and dropping it beneath the system's zone of operation.

Fire engineering is defined by the Institution of Fire Engineers as:

"… The application of scientific and engineering principles, rules [codes], and expert judgment, based on an understanding of the phenomena and effects of fire and of the reaction and behaviour of people to fire, to protect people, property and the environment from the destructive effects of fire."

Approved Document B makes the following statement on fire engineering:

"Fire safety engineering can provide an alternative approach to fire safety. It may 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, for example; airport terminals. Fire safety engineering may also be suitable for solving a problem with an aspect of the building design which otherwise follows the provisions in this document.

British Standard BS 7974 [Fire safety engineering in buildings] and supporting published documents (PDs) provide a framework and guidance on the design and assessment of fire safety measures in buildings. Following the discipline of BS 7974 should enable designers and Building Control Bodies to be aware of the relevant issues, the need to consider the complete fire-safety system and to follow a disciplined analytical framework.

Factors that should be taken into account include:

- The anticipated probability of a fire occurring
- The anticipated fire severity
- The ability of a structure to resist the spread of fire and smoke
- The consequential danger to people in and around the building

A wide variety of measures could be considered and incorporated to a greater or lesser extent, as appropriate in the circumstances. These include:

- The adequacy of means to prevent fire
- Early fire warning by an automatic detection and warning system
- The standard of means of escape "structural means whereby [in the event of fire] a safe route or routes is or are provided for persons to travel from any point in a building to a place of safety."
- Provision of smoke control
- Control of the rate of growth of a fire
- Structural robustness and the adequacy of the structure to resist the effects of a fire
- The degree of fire containment
- Fire separation between buildings or parts of buildings
- The standard of active measures for fire extinguishment or control
- Facilities to assist the fire and rescue service
- Availability of powers to require staff training in fire safety and fire routines

- Consideration of the availability of any continuing control under other legislation that could ensure continued maintenance of such systems
- Management

It is possible to use quantitative techniques to evaluate risk and hazard. Some factors in the measures listed above can be given numerical values in some circumstances. The assumptions made when quantitative methods are used need careful assessment."

Fire safety engineering uses calculations and quantitative data on numerous topics including:

- Ignition
- Fire growth
- Compartment fire behaviour
- Production of smoke and toxic gases
- Structural response
- Fire detection
- Fire suppression
- Human behaviour
- Firefighting

The responsible person must ensure that facilities provided for fire and rescue service personnel are maintained effectively and make information about their operation available.

Systems are interdependent – if one element fails it is likely to affect other elements. Fire and rescue service personnel should consider the following when attending buildings with fire engineering solutions:

- Extended travel distances to the scene of operations
- Larger compartments
- Specific access location for fire and rescue service personnel
- Fixed installations
- Complex smoke/heat control systems

Control measure – Carry out information gathering

Control measure knowledge

Information on the presence and status of fire engineering solutions and associated fixed installations should be available from the responsible person, the building's fire control room or from pre-planned, site specific risk information.

A reliable means of fixed communications for firefighters may be installed throughout the building. Where provided, it should be connected with the building's fire control room.

Strategic actions

Fire and rescue services should:

- Consult, liaise and engage with relevant building developers, owners, occupiers and responsible persons to develop mutual understanding of essential information required during a fire
- Establish processes and procedures to enable effective interchange of information, knowledge and understanding between prevention and response departments
- Share relevant information with partner agencies and develop processes to check and test interoperability
- Develop tactical guidance and support arrangements for the associated hazards and actions to take to carry out relevant information gathering

Tactical actions

Incident commanders should:

- Access available site specific risk information and/or building plans and information on fire engineered solutions
- Liaise with the responsible person to ascertain information and the status of fire engineered solutions
- If available, consider using fire control room facilities to inform progress on the tactical plan and the effectiveness of the building's facilities
- Identify the potential benefits of systems and any hazards that may arise due to operation or failure during a fire

Control measure – Identify firefighting access points

Control measure knowledge

The fire and rescue service initial fire appliance should attend the specific access points and make use of any identified integral communication facilities and/or the fire control room. Specified access points may affect the location of any RVP [EP1] or bridgeheads (forward control points) required.

Strategic actions

Fire and rescue services should:

- Consult, liaise and engage with relevant building developers, owners, occupiers and responsible persons to identify, record and communicate suitable firefighting access points
- Develop tactical guidance and support arrangements on the associated hazards and actions to take to identify firefighting access points

Tactical actions

Fire control operators should:

- Confirm most suitable firefighting access points with the responsible person and communicate to responders

Incident commanders should:

- Using available risk information, local knowledge and on-site information, report to the designated firefighting access points on arrival

Control measure – Use integral communications

Control measure knowledge

In large, complex or fire-engineered buildings a reliable means of communicating from the fire service access level to all firefighting lobbies is needed, such as a fire telephone. Where fire telephone handsets are provided they should be located at strategic points. For example, they may be located at each building entrance, in firefighting lobbies or in the building's fire control room and should be permanently-fixed.

Firefighters will normally use hand-held radio sets for communicating with each other and with their own command points. However, hand-held radio sets have disadvantages, such as occasional poor reception due to local screening or limited battery life. Some buildings may have a leaky feeder radio signal booster system installed for the benefit of services that use this equipment.

Strategic actions

Fire and rescue services should:

- Consult and liaise with developers, owners, occupiers and responsible persons to identify and make use of building integral communications
- Develop tactical guidance and support arrangements for the associated hazards and actions to take when using integral communication systems
- Ascertain and provide specific communication equipment, designed to supplement existing building integral communication systems and fire and rescue service communications equipment

Tactical actions

Incident commanders should:

- Identify pre-planned information to determine the location and suitability of fixed communications system like leaky feeders, refuge communications or public announcement systems

- Be aware that the system may have a dual use (e.g. it may also be used by people in refuge areas)
- Exercise caution when using fixed communications systems, as people other than fire and rescue service personnel may also use them
- Not broadcast sensitive information using these systems (e.g. about casualties or fatalities)
- Identify, develop and communicate contingency arrangements which can be quickly implemented should failure of integral communication systems occur

Design features causing delayed intervention

Hazard	Control measures
Design features causing delayed intervention	Apply generic control measures [as detailed for the hazard of 'Fires in the built environment'] Consider making a forcible entry Maintain safe access and egress Control fixed installations and integral communication systems Identify appropriate location(s) for a bridgehead (forward BA entry control point) Confirm the occupier evacuation policy or strategy Consider how time delays may affect incident development

Hazard knowledge

Gaining access to the location of a fire in large, complex or secure buildings due to travel distance or security measures, may significantly delay firefighting operations. This delay may contribute to, or result in, increased fire development. Security measures in premises such as places of lawful detention or banks may also restrict access, resulting in delay.

Buildings with basements or windowless areas can have restricted access and may only contain a single point of access. Size, construction and internal layout can mean that incident ground communications may also be challenging.

Control measure – Consider making a forcible entry

Forcible entry may be used to gain access to a building in an emergency when normal means of entry are locked, secured, obstructed, blocked or unable to be used.

See National Operational Guidance: Fires and firefighting – Consider making a forcible entry

Control measure – Maintain safe access and egress

Control measure knowledge

Safe routes for accessing the scene of operations should be identified, taking account of compartmentation and other engineered solutions. These routes should be monitored and maintained.

Premises with enhanced security may have features that could delay assessment and subsequent firefighting operations. These features may include:

- Security doors and glazing
- Reinforced walls
- One way access doors (that can only be opened by a key from the secure side)
- Control lobbies or holding areas under electronic door control
- Time delay locks
- Limited access and egress routes
- Limited firefighting facilities in older premises
- Entry control systems

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take to maintain safe access and egress
- Develop processes and systems to ensure protective measures are complied with in accordance with the Regulatory Reform (Fire Safety) Order and building regulations 2010, approved document B

Tactical actions

Incident commanders should:

- Liaise with the responsible person on the location and operation of any door locking arrangements
- Consider overriding of door locks or positioning on-site personnel to secure access and egress
- Consider contingency arrangements, which can be quickly implemented if emergency personnel become isolated in unsafe areas

Control measure – Control fixed installations and integral communication systems

Control measure knowledge

In large or complex buildings, fixed installations like sprinkler systems may be operating, and may be able to suppress and contain a fire within a compartment while access is gained to the location of the fire and firefighting can commence. Fixed installations, such as sprinklers, should only be altered or switched off under direct instruction of the incident commander. The incident commander should first satisfy themselves that this will not increase the severity of the fire or worsen conditions for firefighters.

Facilities for firefighters such as fire mains and firefighting lifts should be identified. Lifts, including firefighting lifts, may be used as part of the building evacuation policy. Fixed communication systems may be provided in large or complex buildings and underground structures to support firefighter communications where standard radio communications may be compromised. Integral communications such as refuge communication systems may not be exclusively used by the fire and rescue service.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take to control fixed installations and integral communication systems in buildings

Tactical actions

Incident commanders should:

- Commandeer and control firefighting lifts, while considering their wider use for evacuation purposes
- Ensure the appropriate fire main is charged and maintained to the scene of operations

Control measure – Identify appropriate location(s) for a bridgehead (forward control point)

Control measure knowledge

A firefighting shaft is a protected enclosure provided for attending firefighters, containing a firefighting stair and firefighting lobby. If a lift is provided, this may or may not be a firefighting lift. These features are provided to assist firefighters and should be considered when deciding on an appropriate location for a bridgehead.

The term bridgehead is referred to in the Operational Guidance: Breathing apparatus as:

'This may be considered necessary by the Incident Commander in situations where there is a requirement to provide a BA entry control point at some distance from the initial point of access into a building or risk area, whilst still remaining in a safe air environment.'

This arrangement allows an incident to be dealt with through the deployment of BA wearers from a safe air environment within a structure whilst being as close as practical to the scene of operations. This may be necessary for example in high-rise buildings or in large complex structures such as shopping malls.

The location of the BA entry control point in these circumstances will be determined by the Incident Commander based on the operational plan and the level of risk faced by the BA wearers.

Some of the factors that should be taken into account when determining the location of a bridgehead or forward BA entry control point are:

- The potential for an escalation of the incident
- The safe air environment necessary to start up BA
- The best access and egress routes to the scene of operations
- Crew safety and welfare
- Availability of water supplies
- Effective communication with BA wearers
- Effective communication with the incident commander
- The level of supervision and support necessary for the BA Entry Control Operative
- The distance from the initial point of access to the BA entry control point"

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take to identify appropriate location(s) for a bridgehead (forward BA entry control point)
- Develop processes and systems via consultation and liaison with developers, owners, occupants and responsible persons to identify, record and communicate potential bridgehead areas within specific buildings, as part of the service risk planning arrangements

Tactical actions

Incident commanders should:

- Identify firefighting shafts, firefighting lobbies and other elements of fire protection when determining the suitable location for the bridgehead
- Consider the likely development of the incident when positioning the bridgehead and protect these areas to prevent the bridgehead being compromised by fire or smoke
- Ensure that the bridgehead is in close proximity to sufficient water supplies or fire main
- Consider establishing a staging area for resources on a floor(s) below the bridgehead

- Check communications relative to the reception of radio transmissions between the bridgehead and the control point
- Consider developing contingency arrangements for the movement of a bridgehead location

Control measure – Confirm the occupier's evacuation policy or strategy

Control measure knowledge

To determine an occupier evacuation policy, liaise with the responsible person. Consider the impact of phased evacuation, risks to the occupants exiting along firefighting access routes, and exposure to potential hazards – occupier evacuation strategies may need to be revised to maintain the safety of occupants.

Occupier evacuation or escape strategies vary in differing buildings. Some buildings have a policy to simultaneously evacuate when hearing an alarm, others maintain a 'stay put' or 'defend in place' policy and some adopt a vertical phased approach.

In deciding on the strategy for evacuation of a building the following considerations will be taken into account:

- Do occupants have a clear passageway to all evacuation routes?
- Will any occupants require assistance to evacuate?
- Are evacuation routes clearly marked, short and as direct as possible?
- Are enough exits and routes available for all people to evacuate?
- Do emergency doors open easily in the direction of evacuation
- Is there emergency lighting provided where needed
- Has training taken place for all staff/occupants to know and use the evacuation routes
- Has a safe meeting/assembly point for staff/occupants been designated and communicated

In the event of fire, the 'stay put' or 'defend in place' strategy may be considered in blocks of flats where each flat has a minimum 60 minutes fire resisting compartment.

Strategic actions

Fire and rescue services should:

- Liaise and consult with developers, owners, occupiers and responsible persons of buildings, to provide expert safety advice and to develop tactical guidance and support arrangements for the associated hazards and actions to take to confirm the occupier's evacuation policy or strategy

Tactical actions

Incident commanders should:

- Identify the evacuation strategy and potential evacuation routes via site specific risk information, responsible person and building plans
- Ascertain if any occupants are in need of assistance to evacuate (e.g. people with physical or mental disabilities and the location of any refuge points in the building)
- Consider methods of communication to inform occupants of the evacuation strategy
- Locate fire spread and smoke boundaries to ensure the safety of evacuating occupants
- Evaluate the impact of an evacuation on operational activities (e.g. a high-rise building with only one stairwell to access or egress the upper floors)
- Maintain continued observation of compartment fire spread and amend plan when conditions change

Control measure – Consider how time delays will affect incident development

Control measure knowledge

Any delay in accessing the location of the fire and commencing firefighting will have an impact on fire development and therefore the severity of the incident. Tactical plans should anticipate how the incident may escalate and the resources that are required to resolve this safely and effectively.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the associated hazards and actions to take to enable incident commanders to consider how time delays will affect incident development

Tactical actions

Incident commanders should:

- Gather essential information quickly to inform decisions and tactical plans
- Anticipate fire development and the escalation of the incident
- Consider resource requirements in line with the tactical plan
- Consider the anticipated development of fire and subsequent increase in hazards, within the time period of developing a tactical plan and implementing appropriate control measures and tactics

Additional information on situational awareness can be referenced in National Operational Guidance: Incident command