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| **Title:** | Fires in buildings under construction or demolition |
| **Project Executive:** | CFO Phil Loach, West Midlands FS |
| **Synopsis:** | The guidance has two main themes: It supplements the previously published National Operational Guidance on Fires in the built environment by providing more specific guidance where the hazard may be increases by the incomplete nature of the building, and provides guidance for the hazards unique to a building in the construction, demolition or building process. |
| **Published:** | 11/04/2016 |
| **Next Review Date:** | 11/04/2019 |
| **Status:** | Approved |
| **Version:** | First edition version one |
| **Latest Position:** | First edition version one published 13/06/2014 |

*National Operational Guidance – Fires in buildings under construction and demolition first edition version one (ARCHIVED on 20-09-17)*

## Introduction

This guidance deals with fires in buildings under construction or demolition, including those undergoing building work. Depending on the nature and scale of the operational incident, a variety of significant hazards may be encountered. Where appropriate, refer to other sections of National Operational Guidance.

This guidance is directly supported by National Operational Guidance: Fires in the built environment, which focuses on how the design and construction materials of buildings, along with their facilities and systems, can have an impact on, or assist with, fire and rescue service operations.

It is also underpinned by comprehensive information from the Building Research Establishment (BRE), making it easier for the user to find their way through this guidance without an overload of technical information. The BRE knowledge sheets, originally developed to support the National Operational Guidance: Fires in the built environment, have been enhanced to include additional information on:

- Construction and demolition sites
- Scaffolding
- Incomplete buildings and structures
- Temporary accommodation units
- Legislation relevant to construction, demolition or building work

The BRE knowledge sheets are supplemented with fire and rescue service considerations. This guidance provides references to the technical information contained in them.

### Legislation

A legislative framework addressing fire safety in buildings can be found in the BRE knowledge sheets.

### 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 consider all stakeholders, including local emergency planning groups and the fire and rescue service risk management plan.

### Responsibility of fire and rescue services

Fire and rescue services are responsible, under legislation and regulations, for developing policies and procedures and to provide information, instruction, training and supervision to their personnel about foreseeable hazards and the control measures used to mitigate the risks arising from those hazards.

This guidance sets out to provide fire and rescue services with sufficient knowledge about the potential hazards their personnel could encounter when attending fires at waste sites. Fire and rescue services should ensure their policies, procedures and training cover all of the hazards and control measures contained within this guidance.

## Hazard and control statement

| Hazards | Control measures |
|---|---|
| Fires in buildings under construction or demolition | Apply control measures, as detailed in National Operational Guidance: Fires in the built environment<br>Look for signs of collapse<br>Liaise with the responsible person (or appointed competent person) for the site<br>Seek specialist advice |
| Partial or structural collapse | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Position cordons appropriately<br>Take preventative action<br>Make a tactical and controlled withdrawal |
| Fires in timber buildings under construction | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Carry out appropriate intervention<br>Carry out external surveys<br>Provide external protection |
| Lack of fire protection features | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Identify compartmentation<br>Identify and investigate concealed spaces<br>Survey adjacent areas or compartments<br>Consider the effects of ventilation<br>Give authority to operate or alter fixed installations |

| | |
|---|---|
| Buildings that are unoccupied, derelict or awaiting demolition | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Establish the previous use of the building<br>Consider making a forcible entry<br>Proceed with caution where there are signs of disrepair or structural weakening |
| Scaffolding | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Establish alternative means of access and egress<br>Seek specialist advice about scaffolding<br>Identify the presence and type of netting<br>Consider the appropriate use of scaffolding |
| Buildings undergoing building works | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Consider the occupation status of the building<br>Consider if fire protection features have been removed or deactivated |
| Electrical equipment or installations | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Consider isolating the electrical supply |

## Fires in buildings under construction or demolition

| **Hazard** | **Control measures** |
|---|---|
| Fires in buildings under construction or demolition | Apply control measures, as detailed in National Operational Guidance: Fires in the built environment<br>Look for signs of collapse<br>Liaise with the responsible person (or appointed competent person) for the site<br>Seek specialist advice |

### Hazard knowledge

When dealing with any fire in buildings under construction or demolition, whatever its size or complexity, the generic control measures for this hazard and the generic control measures for the

hazard 'Fires in the built environment' (found in **National Operational Guidance: Fires in the built environment**) should be applied.

When dealing with a fire in a building under construction or demolition, the hazards in this guidance supplement those detailed in **National Operational Guidance: Fires in the built environment**.

This guidance presumes that construction, demolition or building work complies with relevant regulations. However, this may not always be the case; if work is unregulated or in direct contravention of regulations, this could have a significant impact on the incident and firefighter safety.

Some small construction sites or buildings undergoing building work may be unknown to fire and rescue services, making pre-planning difficult. Sites known to fire and rescue services may alter significantly throughout the life of the project. For example, there could be changes to access and egress, hazardous material storage, layout and fire protection features. Information obtained from site visits and inspections should be regularly reviewed, updated and communicated to relevant fire and rescue service personnel.

Existing buildings may contain hazardous substances that are associated with either the previous use of the building or building materials. This could include substances such as asbestos, which may not have been highlighted in a survey. If disturbed during building work or firefighting, asbestos presents a significant risk to health.

Shipping (ISO) containers are sometimes used on site for storage purposes and may lack signage; if they are affected by fire, it could be difficult to establish what is being stored in them or gain access.

Although sites should be well-secured, using high fencing, hoardings or other security measures, these may be compromised allowing the public to gain unauthorised access. This may make it difficult for fire and rescue services to gain immediate access, but may also provide a pre-existing cordon.


Figure 1: Large building site showing high fences and gates, and shipping containers – photograph courtesy of Brian Massie

Large quantities of combustible building materials and waste may be stored on the site during various phases of the project. They may have a direct impact on the incident due to the effect of fire loading.

A building site is a working environment that may have physical hazards such as:

- Restricted access and egress
- Confined spaces
- Groundworks, excavations and trenches
- Open pits and sewers
- Uneven ground and debris
- Plant and machinery
- Silos
- Skips and rubbish chutes
- Exposed utilities
- Hazardous substances, such as fuel or asbestos
- Unguarded edges and openings
- Fragile surfaces
- Objects falling from height
- Guard dogs

Control measures for physical hazards can be found in National Operational Guidance: Operations and National Operational Guidance: Hazardous materials.

Figure 2: Building under construction showing cranes and scaffolding – photograph courtesy of Brian Massie

Sites may have various temporary accommodation units, like portable cabins or converted shipping (ISO) containers, which may be difficult to identify as such. These units may be used for a number of purposes, so the following should be considered:

- LPG for cooking and heating may be present
- The unit may be used inappropriately, such as for storing hazardous materials or as sleeping accommodation
- There may be high fire loading due to poor housekeeping
- Difficult to gain access and egress due to security
- Temporary accommodation units may be located within the structure of a building
- There may be live electricity, temporary cables and cable fixings

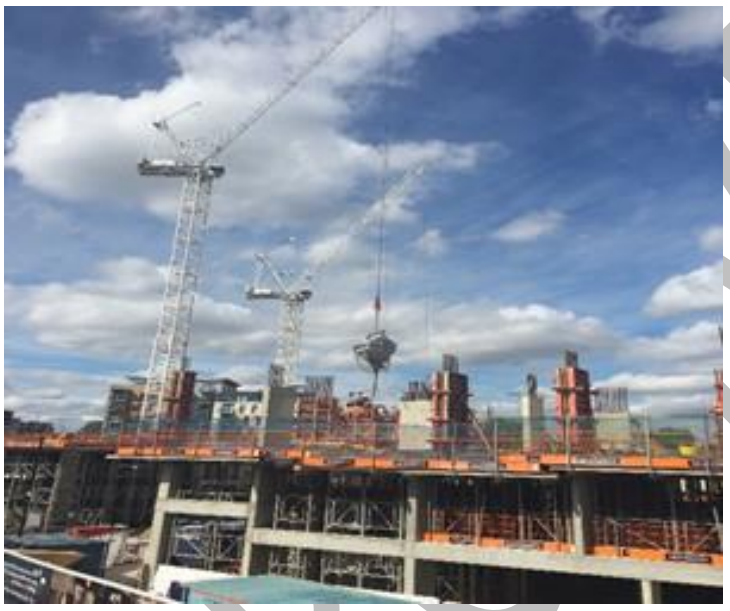


Figure 3: Large construction site – photograph courtesy of Brian Massie

Large construction or demolition sites may result in a protracted incident. The sites may also be exposed and subject to extreme weather conditions with little shelter available. Wind speed and direction may have a direct impact on fire development. Refer to National Operational Guidance: Fires and firefighting for information on fire development and National Operational Guidance: Operations for information on welfare at incidents.

It is possible that contractors working on sites, or security guards, may not use English as their first language and therefore they may find it very difficult to communicate risk critical information about the site to the incident commander. Refer to the hazard for 'Restricted ability to communicate' in National Operational Guidance: Operations.

## Control measure – Look for signs of collapse

*Control measure knowledge*

Some types of buildings under construction or demolition, when subjected to fire, may collapse suddenly with little or no warning. It is important to understand the type of construction involved and the method and sequence of building work being undertaken.

This information should assist in assessing the likelihood of partial or structural collapse. For example, masonry is vulnerable to cracking and bulging, which can lead to sections becoming overloaded. Older buildings may have no mechanical connection between floors, beams and walls so any separation causes collapse.

Any localised collapse or demolition work could either leave slender sections of the structure vulnerable to wind or other load, or could result in the weight of upper parts being redistributed, which in turn can lead to further overload and progressive collapse.

Fire may spread through voids undetected. This may have a direct impact on the stability of the building and be difficult to predict. Buildings may have varying degrees of structural stability even if they are not affected by fire, for example:

- When buildings are incomplete
- During structural alterations
- During demolition
- When there has been neglect and poor maintenance

Further information about signs of collapse can be found in National Operational Guidance: Fires in the built environment – Look for signs of collapse.

*Strategic actions*

Fire and rescue services should:

- Provide operational personnel with risk information about current construction or demolition sites if available

*Tactical actions*

Incident commanders should:

- Identify the type of building or structure and the method of construction
- Assess the likelihood of collapse
- Consider the structural integrity of the building and the effect of heat and weight from firefighting media
- Look for signs of collapse, which may include:
    - Cracks in walls

  - Sagging floors or floors deflecting from wall
  - Displaced columns
  - Dropping arches
  - Bulging walls
  - Buckling columns or beams
- Establish the type and extent of structural work being undertaken
- Look for signs of structural support that has been compromised or is missing
- Look for signs of temporary supports or propping
- Look for signs of compartmentation or of fire stopping that has been damaged or removed
- Establish the location, extent and impact of the fire – refer to the hazard of 'Undetected firespread' in the National Operational Guidance: Fires in the built environment
- Consider appointing safety officers
- Consider requesting specialist advice from local authority building control teams, structural engineers or urban search and rescue tactical advisers

## Control measure – Liaise with the responsible person (or appointed competent person) for the site

*Control measure knowledge*

In the context of a construction site the responsible person will be the client, when any part of the site falls under their control, or the principle or main contractor, normally through a site manager, when the site is in their control.

Through various phases of construction or demolition, the responsible person (or appointed competent person) should have the appropriate level of knowledge and skills to be able to provide accurate and relevant information on their specific area of the site and the building work being carried out. They should be able to interpret and translate this understanding into information that would be useful in support of fire and rescue service operational activities.

The responsible person (or appointed competent person) may also be able to direct fire and rescue service personnel to other subject matter experts who have information about the processes being carried out on-site. Their business continuity plan may hold additional information that could be useful to the incident commander.

On larger construction sites, site layout plans should include the following information:

- Access, egress and rendezvous points (RVPs) for the fire and rescue service
- Firefighting shafts, firefighting lifts and temporary hoist facilities
- Dedicated emergency escape routes and staircases
- Fixed installations

- Isolation points for utilities
- Fixed plant and machinery
- Silos
- Fire barriers such as fire stopping pillows
- Floor loading limitations
- Positions of hydrants on or near the site, dry riser and wet riser inlets
- Temporary buildings and temporary accommodation
- Unguarded edges or openings
- Hazardous materials
- Underground structures or groundworks

*Strategic actions*

Fire and rescue services should:

- Engage with site operators for familiarisation and pre-planning
- Record the contact details of the responsible person (or appointed competent person) who can assist the responding fire and rescue service personnel at an incident
- Obtain information through site visits and inspections; this should be regularly reviewed, updated and communicated to relevant fire and rescue service personnel

*Tactical actions*

Incident commanders should:

- Identify and engage with the responsible person (or appointed competent person) at the earliest opportunity on site, and confirm the accuracy of both site layout plans and fire and rescue service information
- Record the details of the responsible person (or appointed competent person)
- Record the advice given by the responsible person (or appointed competent person)
- Consider inviting the responsible person (or appointed competent person) to attend command meetings

## Control measure – Seek specialist advice

*Control measure knowledge*

The local authority building control department is responsible for ensuring compliance with construction and design requirements.

Local authority building control teams help contractors comply with building regulations by giving feedback on plans and providing site inspections. A private 'approved inspector' may provide this service, but only local authorities have the power to enforce compliance with building regulations.

Local authority building control teams should liaise with fire and rescue services at the planning submission stage. Fire safety inspectors should attend construction sites throughout the building work on part-occupied buildings and also on completion. On unoccupied construction sites the Health and Safety Executive is responsible for enforcing fire safety regulations and for general health and safety during the construction phase.

Where the responsible person (or appointed competent person) for the site is not available, the incident commander should consider requesting the assistance of local authority building control teams or structural engineers. The local authority may have plans or knowledge of the site, enabling them to provide valuable information to the incident commander.

If there is machinery or equipment on site which may be affected, such as cranes, hoists, high reach plant or vehicles, ionising radiation sealed sources or X-ray testing equipment, the incident commander should seek specialist advice from the owner or operator of the machinery or equipment.

*Strategic actions*

Fire and rescue services should:

- Makes arrangements with local authorities to establish the type and level of response they can provide if specialist advice from building control teams or structural engineers is required
- Ensure personnel are aware of local arrangements and specialist advice available

*Tactical actions*

Incident commanders should:

- Recognise the need for specialist advice
- Consider requesting specialist advice from local authority building control teams, structural engineers or urban search and rescue tactical advisers
- Seek specialist advice from the owner or operator of machinery or equipment on-site which may be affected

## Partial or structural collapse

| Hazards | Control measures |
|---|---|

| | |
|---|---|
| Partial or structural collapse | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Position cordons appropriately<br>Take preventative action<br>Make a tactical and controlled withdrawal |

## Hazard knowledge

There is an increased risk of partial or structural collapse in fires in buildings under construction or demolition. See National Operational Guidance: Fires in the built environment – Partial or structural collapse. This may be as a result of:

- Their derelict or deteriorated condition
- Structural alterations that have weakened the structure
- The building not being complete
- Structural fire protection features being removed or not yet installed

Lack of fire compartmentation or fire stopping may result in rapid fire development. This will increase the speed at which the integrity of the building is affected, resulting in sudden collapse.

Fire can spread rapidly through voids and cavities or outside the building, affecting the cladding and glazing systems of buildings. Glass (glazing) or other flat panels or lightweight systems, such as rain screens used for cladding, may travel significant distances from the building when falling from height, particularly in windy conditions. Cordon distances should be set accordingly.

Figure 4: Fire in timber building under construction – photograph courtesy of London Fire Brigade

Structural timber buildings under construction are particularly vulnerable to rapid firespread, which may lead to early collapse. Collapse may not just be limited to the building or structure itself, as scaffolding or tower cranes, for example, may be affected by intense radiated heat, putting them at

higher risk of collapse. Therefore, the footprint of the area affected may be significantly larger than that of the building or structure itself. The potential impact of any collapse on surrounding properties should be considered.

False chimneys may be a considerable weight, as they are only supported by roof timbers and do not form part of the structural fabric of the building. If roofing timbers and lightweight trusses are involved in fire they may collapse through the roof, endangering those working below. A false chimney may be made of glass-reinforced plastic or in some cases, especially in conservation areas, they may be constructed from heavy masonry.

Structural steel elements are vulnerable during the construction phase because fire protection elements such as intumescent coatings, sprays and boards may not yet have been installed. Inappropriate storage of combustible materials on-site, if not carefully managed, can increase the risk of firespread.

The applied load of firefighting media used in the building may affect structural stability, particularly in incomplete buildings or structures.

### Control measure – Position cordons appropriately

*Control measure knowledge*

Refer to National Operational Guidance: Incident command and National Operational Guidance: Fires in the built environment for general information on cordons

Cordons on a construction site may also need to take the potential collapse of scaffolding and tower cranes into account. These could be outside of any existing hoarding or site boundary that may initially be used as a pre-existing cordon.

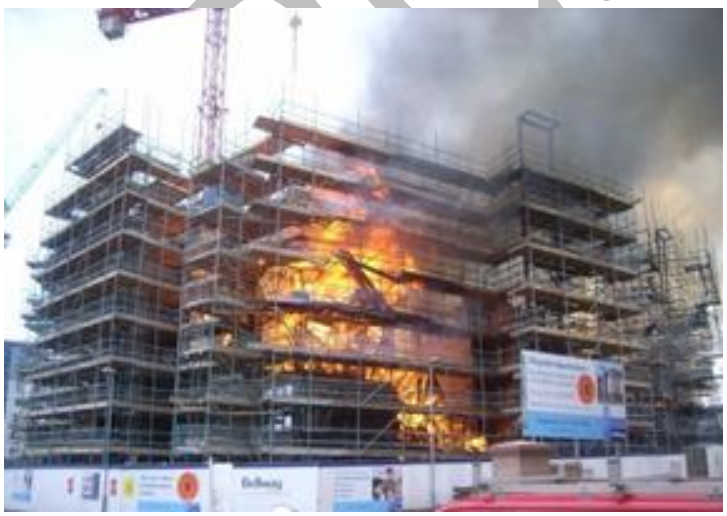


Figure 5: Building construction showing hoarding as a site boundary – photograph courtesy of John Dickie

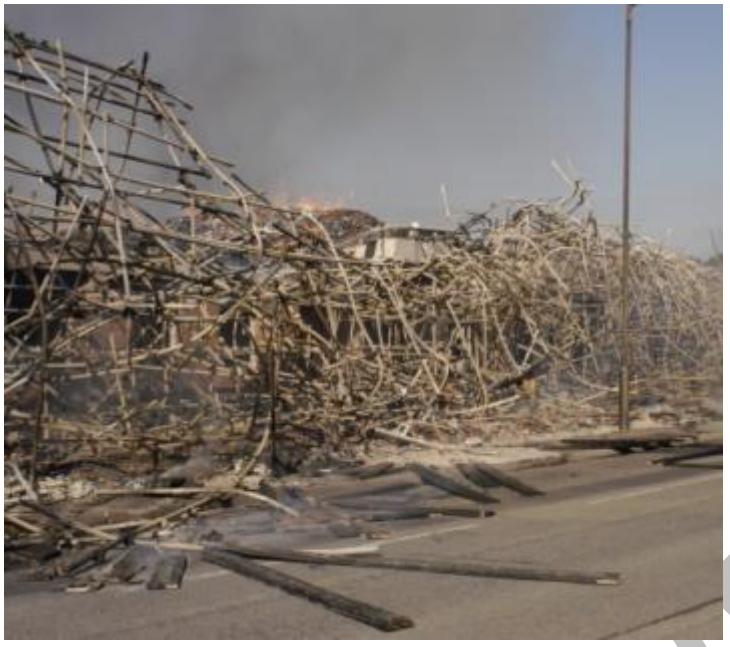


Figure 6: Post-fire incident site showing debris outside of site boundary – photograph courtesy of London Fire Brigade

*Strategic actions*

Fire and rescue services should:

- Provide operational personnel with risk information about current construction or demolition sites if available

*Tactical actions*

Incident commanders should:

- Evaluate the potential footprint of collapse and debris
- Position the cordon at an appropriate distance to ensure the safety of members of the public and responders
- Consider that cordons may need to be positioned beyond any existing hoarding or site boundary that may initially be used to provide a pre-existing cordon
- Review cordon distances throughout the incident

## Control measure – Take preventative action

*Control measure knowledge*

Any intervention to prevent partial or structural collapse should be carefully considered as part of an appropriate risk assessment, particularly before commencing internal firefighting operations. Collapse can occur suddenly and without warning. A rapid intervention in the early stages of fire development may prevent partial or structural collapse.

*Strategic actions*

Fire and rescue services should:

- Provide operational personnel with risk information about current construction or demolition sites if available

*Tactical actions*

Incident commanders should:

- Consider early intervention
- Consider the potential footprint of collapse and debris
- Consider the structural stability of the building before deploying personnel for internal firefighting
- Consider applying water sprays to unprotected steel, temporary supports and scaffolding

### Control measure – Make a tactical and controlled withdrawal

*Control measure knowledge*

If the potential for collapse is recognised, the areas affected and proximity of personnel should inform the decision on the scale of withdrawal.

For strategic actions and tactical actions refer to the control measure of 'Make a tactical and controlled withdrawal' in National Operational Guidance: Fires in the built environment.

## Fires in timber buildings under construction

| Hazard | Control measures |
|---|---|
| Fires in timber buildings under construction | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Carry out appropriate intervention<br>Carry out external surveys<br>Provide external protection |

### Hazard knowledge

Through advances in technology and engineering, timber buildings are becoming more common. Rather than the traditional timber post and beam frame, they now use many different types of construction. The BRE knowledge sheets contain information on this type of construction method.

Timber buildings may include:

- Structural insulated panels

- Cross laminated timber
- Glued laminated timber
- Laminated veneered lumber
- Gang nailed timber truss
- Engineered timber joists

Timber construction is sometimes used when extending buildings that were constructed using more traditional methods. They may be extended at ground level or as an additional structure on the top of an existing building.

New builds could also have lower floors of traditional masonry or steel construction, with upper floors using timber construction methods.

Figure 7: Timber frame extension on a traditionally constructed building – photograph courtesy of the Building Research Establishment

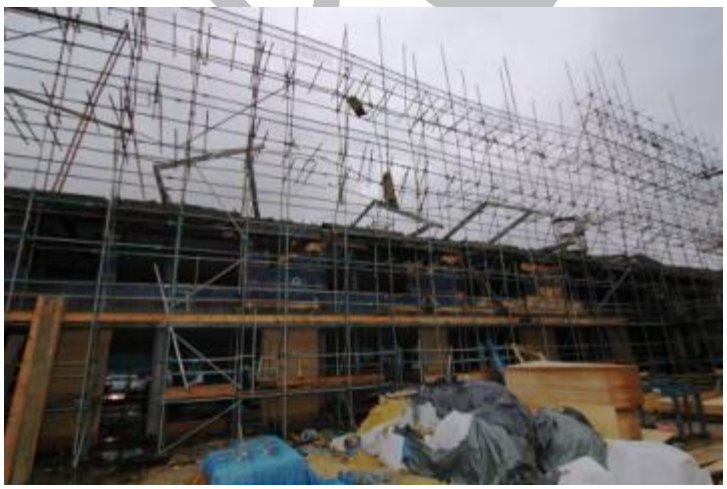


Figure 8: The same building following a fire in the timber frame extension – photograph courtesy of the Building Research Establishment

Timber construction relies on passive and active fire protection, which should be in place in a completed building. However, if the timber construction is incomplete, without elements of fire

protection, the timber provides a combustible fuel source. Refer to National Operational Guidance: Fires and firefighting for information on fire loading.

Previous incidents, such as a new development of flats in Colindale, North London in 2006 (image below) prove that the physical principles and phenomena of fire are fairly consistent and not restricted by size.

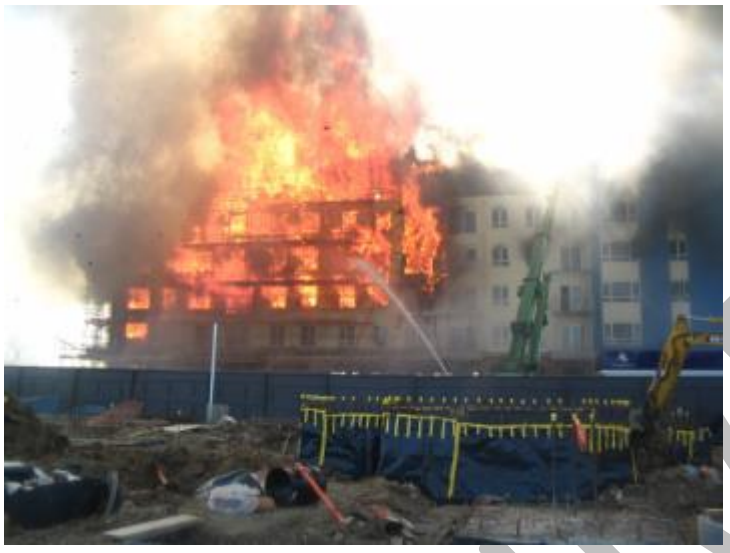


Figure 5: Timber building under construction at Colindale, London – photograph courtesy of London Fire Brigade

**Collapse**

The speed of combustion may result in a rapid and sudden collapse, not just from timber burning through, but also at the points where different structures are joined. This can be due to the fixings themselves or because the timber in the area of the fixing has burned away. The heat generated means that other structural members may collapse, along with any scaffolding or temporary supports.

The collapse of a timber building may also impact on scaffolding, other temporary structures, and plant and machinery, such as cranes and lifts.

**Access and egress routes**

Due to the speed of fire development in timber buildings, access and egress routes may quickly become compromised. This may impact on the evacuation of the building, and on access and egress routes for firefighters or fire and rescue service vehicles.

There may be a temporary external means of escape for a timber building, provided for use until the permanent means of escape is completed, but this may become quickly compromised in a fire.

**External firespread**

Building regulations provide guidelines for separating distances between existing properties and newly constructed timber buildings. However, the radiated heat or firespread may affect adjacent or adjoining property, vehicles, street furniture and road surfaces. Large volumes of flying embers

(firebrands) may travel some distance from the initial incident, resulting in spot fires. For further information refer to the hazard of 'External firespread' in National Operational Guidance: Fires in the built environment.

## Control measure – Carry out appropriate intervention

*Control measure knowledge*

Fires in large timber buildings under construction may be resource intensive. Additional resources may be needed including personnel, equipment and water, and this should be given consideration early in the incident. Further information about this can be found in National Operational Guidance: Operations and National Operational Guidance: Fires and firefighting.

The speed and weight of attack required will depend on the stage of fire development and the construction of the building. Early intervention may prevent escalation, but if this is not possible, defensive tactics may need to be adopted. Refer to National Operational Guidance: Fires and firefighting.

*Strategic actions*

Fire and rescue services should:

- Provide operational personnel with risk information about current timber building construction sites if available

Note that the Structural Timber Association (STA) requires their members to inform the local fire authority of any timber frame project. There is also a memorandum of understanding between the STA and the Chief Fire Officers' Association.

*Tactical actions*

Incident commanders should:

- Determine the need for additional resources – refer to National Operational Guidance: Incident command
- Identify the stage of fire development – refer to National Operational Guidance: Fires and firefighting
- Consider the level of fire protection – refer to National Operational Guidance: Fires in the built environment and the BRE knowledge sheets
- Deploy appropriate firefighting tactics – refer to National Operational Guidance: Fires and firefighting
- Consider a tactical and controlled withdrawal – refer to the control measure of 'Make a tactical and controlled withdrawal' in National Operational Guidance: Fires in the built environment

### Control measure – Carry out external surveys

*Control measure knowledge*

External surveys will be necessary to identify internal and external firespread. External surveys should also be used to look for signs of collapse.

Safety officers should be appointed at appropriate locations within sectors, to ensure all potential areas of the structure affected are monitored.

*Tactical actions*

Incident commanders should:

- Consider appointing safety officers to monitor structural stability and firespread
- Ensure access and egress routes remain uncompromised
- Consider evacuating surrounding buildings that may be affected by firespread

### Control measure – Provide external protection

*Control measure knowledge*

If the radiated heat from the fire in a timber building could affect the surrounding area, external protection, such as using water curtains, sprays or compressed air foam, may be needed. Refer to the control measure of 'Provide external protection' in National Operational Guidance: Fires in the built environment for control measure knowledge, strategic actions and tactical actions.

## Lack of fire protection features

| Hazard | Control measures |
|---|---|
| Lack of fire protection features | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition'] |
| | Identify compartmentation |
| | Identify and investigate concealed spaces |
| | Survey adjacent areas or compartments |
| | Consider the effects of ventilation |
| | Give authority to operate or alter fixed installations |

### Hazard knowledge

Without fire protection features, fires in buildings under construction or demolition may develop more easily and spread unchecked with little or no warning.

Temporary fire protection features may be installed prior to the permanent measures that will protect the completed building. These can include temporary fire stopping pillows, wireless detection systems, sheeting on scaffolding to prevent firespread, temporary rising mains or sprinkler systems.

**Passive fire protection**

Fire compartmentation may not have been constructed or installed, or may have been altered, compromised or removed in a building under construction or demolition.

Without compartmentation the scenario presented is one of a fuel controlled fire and not a ventilation controlled fire. This is not to be confused with a fire that has vented.

A fuel controlled fire will rapidly develop and spread unchecked until the fuel has been consumed or firefighting action is undertaken to extinguish the fire.

This hazard is not confined to timber structures as even concrete or masonry buildings may have timber floors and stairs, stud walls, timber roof structures, electric cabling and other flammable building materials may be stored.

With buildings under construction or demolition the breaches made in compartmentation may allow fire to spread into construction voids more easily, as well as into the voids and ducts where services may run.

Without fire compartmentation a fire may develop rapidly, leaving a building susceptible to premature collapse.

The unfinished nature of the building allows a good oxygen supply to the fire, compounding the hazard that fire can spread easily in an incomplete building. In a building under construction or demolition, various components, such as doors, windows and roofs may be missing. This can result in a fuel controlled fire as ventilation is not restricted. Refer to National Operational Guidance: Fires and firefighting for information on fire behaviour.

One of the last measures in completing a building is installing fire stopping. Fire stopping will be installed in cavities during construction – where services such as cables and pipework have been situated and they breach compartments, fire stopping is used to complete the compartmentation and prevent firespread. This could be permanent fixings, such as cement, or ‘pillows’ that can be removed easily if additional cables or pipework need to be added.

This means that in the later stages of building completion before fire stopping is installed, although compartmentation may appear to be complete, any concealed spaces will be particularly vulnerable to undetected firespread.

**Active fire protection**

Active fire protection features are systems that react when the signs of a fire are detected. The level of protection installed in a building is designed to manage the level of risk identified for the final use and occupation of the completed building.

The design of these systems will relate to other fire protection measures installed. As these may not be in place until completion, temporary systems to protect site personnel may need to be provided. A lack of passive fire protection or protected escape routes or high fire loading can increase the risk to site personnel. Risks such as these can mean temporary measures such as wireless detection and alarm systems are used to provide early warning of the outbreak of fire.

### Control measure – Identify compartmentation

*Control measure knowledge*

Refer to the control measure of 'Identify compartmentation' in National Operational Guidance: Fires in the built environment and information contained in the BRE knowledge sheets.

*Strategic actions*

Fire and rescue services should:

- Provide operational personnel with risk information about current construction or demolition sites if available

*Tactical actions*

Incident commanders should:

- Liaise with the responsible person (or appointed competent person) to establish the status of compartmentation
- Consider referring to building plans if available
- Consider carrying out reconnaissance to establish the extent of or lack of compartmentation
- Gather information from personnel deployed internally

### Control measure – Identify and investigate concealed spaces

*Control measure knowledge*

Refer to the control measure of 'Identify and investigate concealed spaces' in the National Operational Guidance: Fires in the built environment.

However, in buildings under construction or demolition, it should be assumed that fire stopping in voids may not be installed or may have been removed or compromised.

### Control measure – Survey adjacent areas or compartments

*Control measure knowledge*

Refer to the control measure of 'Survey adjacent areas or compartments' in the National Operational Guidance: Fires in the built environment.

However, in buildings under construction or demolition, there are more likely to be breaches of compartmentation or a lack of fire stopping, causing the fire to breach the compartment.

## Control measure – Consider the effects of ventilation

*Control measure knowledge*

A lack of compartmentation allows a good oxygen supply to the fire, compounding the hazard that fire can spread easily in an incomplete building. The breaches in compartmentation will provide good circulation to release hot gases and draw in fresh air. The level of completion of the building will determine whether the fire is fuel controlled or ventilation controlled.

Actions taken by firefighters, such as opening or closing windows or doors, may have an impact on fire development.

Refer to the control measure of 'Consider employing ventilation' in National Operational Guidance: Fires and firefighting for information about wind-driven fire and the Coandă effect.

*Tactical actions*

Incident commanders should:

- Consider the impact of ventilation on the fire, including an assessment of:
- Height of the building
- Internal layout – consider the use of the building
- Fire loading
- Location of the fire
- Wind speed and direction
- Consider tactical ventilation
- Consider making a tactical and controlled withdrawal

## Control measure – Give authority to operate or alter fixed installations

*Control measure knowledge*

When buildings are under construction or demolition there may be temporary fixed installations. Some fixed installations may not be fully operational and therefore not automatically operated in a fire.

These installations could possibly be triggered manually. Temporary sprinkler systems may be installed in some high-risk construction sites such as timber structures close to adjacent buildings.

Refer to the control measure of 'Give authority to operate or alter fixed installations' in National Operational Guidance: Fires in the built environment for strategic actions and tactical actions.

## Buildings that are unoccupied, derelict or awaiting demolition

| Hazards | Control measures |
|---|---|
| Buildings that are unoccupied, derelict or awaiting demolition | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br>Establish the previous use of the building<br>Consider making a forcible entry<br>Proceed with caution where there are signs of disrepair or structural weakening |

### Hazard knowledge

Buildings that are unoccupied, derelict or awaiting demolition may be well-secured to prevent trespassing or unauthorised habitation, but may also restrict access and egress. Security measures to doors or window openings include:

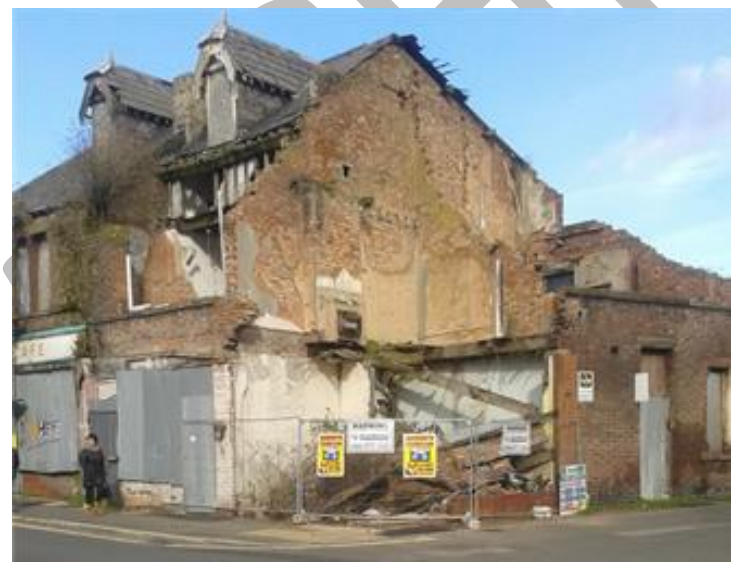
- Timber boarding
- Metal security screens could be installed, and
- Bricks or blockwork
- 

Figure 10: Derelict building – photograph courtesy of G. Pottenger

Although buildings should be secure, security features may not have yet been installed or may have been compromised to gain unauthorised access resulting in the presence of:

- Children
- Rough sleepers
- Discarded drug paraphernalia

- Illegal activities including the cultivation and production of illegal drugs
- Tampered utilities and meters
- Malicious traps
- Illegal storage of hazardous materials, including gas cylinders
- Fly-tipped waste, which could increase fire loading
- Various animals, animal waste and carcasses

There may be vandalism and theft, with damage to internal and external features. This may include:

- Pipework being removed
- Stairs, doors and floors damaged or removed
- Damage to electrical cabling

The removal of fire doors and other passive fire protection features may directly impact on the rate of firespread through compartments. Poor maintenance may mean that fire protection features have been removed, deactivated or may not operate. They may not detect or help reduce or control fire development.

Although buildings may appear to be unoccupied, the property owner or management company may have 'property guardians' living in the building to provide security and general maintenance.

Although the building may appear to be empty, personnel should not assume that utilities have been isolated.

The previous use of the building should be considered to assist in identifying hazards – an abattoir may present a biological hazard or a vehicle servicing premises may have inspection pits, for example. Depending on the previous use of the building, dust may have collected on surfaces such as rafters, roofs, suspended ceilings, ducts and other equipment. If the dust is disturbed, a serious explosion could occur. The build-up of even a very small amount of dust can cause serious damage.

The structure of a building will deteriorate through being left open to the elements or without maintenance. This may result in additional hazards including:

- Weakened or unsafe elements of structure
- Exposed utilities
- Unguarded edges
- Objects falling from height

When buildings are in disrepair or scheduled for demolition, systems may be made redundant or often reclaimed for salvage. Compartmentation may be compromised if salvageable items have been removed, such as piping and wiring, and possibly doors or timber floors. A demolition project may involve:

- Asbestos removal and disposal
- Removal of non-structural elements such as:

- Plasterboard
- Pipes
- Cables
- Doors and windows
- Structural demolition or dismantling
- Decommissioning of hydrants

Larger demolition sites are generally well-managed and secured. During the demolition process, materials are generally sorted on site and arranged in piles.

On smaller demolition sites, combustible materials, such as timber, may be burned on-site to reduce costs. This may result in firespread and larger fires that are left to burn uncontrolled.

Contractors may unintentionally weaken the structure of the building prior to demolition – removing floors or joists that provided restraint, for example, could result in walls being less stable. Contractors may also deliberately weaken the structure to assist in a controlled collapse. This can involve:

- Removing masonry panels or steelwork tie bars that provided bracing to a framed structure
- Cutting fully or partly through steelwork columns or beams
- Drilling holes into or through concrete walls
- Exposing and/or cutting concrete reinforcement bars

Demolition sites may contain a variety of hazards including:

- Weakened structures
- Specialist plant
- Explosives
- Dust explosion
- Debris, rubble, sharps
- Unmarked basements or shafts

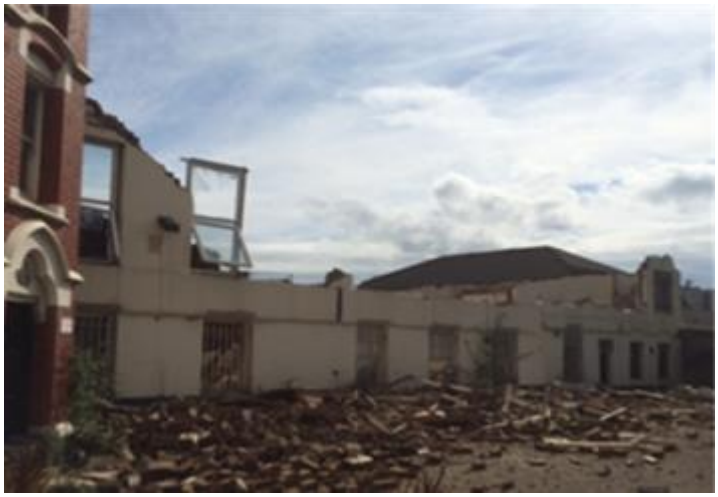


Figure 11: Demolition site showing rubble – photograph courtesy of Brian Massie

The demolition contractor may not be demolishing the whole building. Sometimes sections of buildings are removed, leaving exterior facades standing, ready for reconstruction using modern building methods.

Façade retention is a specialist area that involves installing temporary supports – often a large frame – to hold up the façade before (not after) the rest of building is taken down. Any incident involving freestanding, unsupported, tall masonry walls presents a high risk of collapse without warning.

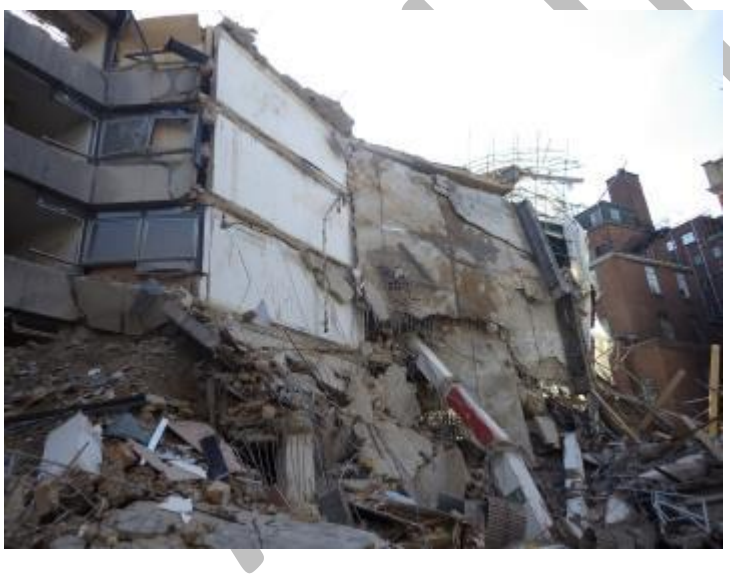


Figure 12: Building collapse during demolition at a site in Aldwych, London – photograph courtesy of London Fire Brigade

Full demolition is more commonly performed using specialist high reach equipment, such as hydraulic 'nibbling' equipment, creating ramps out of demolition rubble to enable them to reach higher up the structure. On larger sites, flammable and hazardous materials should usually be removed before demolition.

Using explosives for demolition is strictly controlled, and they should be securely stored until the time of detonation. Buildings due for explosive demolition should have been stripped out and prepared. This usually involves considerable pre-weakening that can leave a structure vulnerable to

high winds or other disturbances. If pre-weakening has been carried out ready for controlled demolition, collapse could occur without warning.

Explosives are used only in small quantities and will not be brought to site until shortly before the demolition. However, in some cases placing and connecting explosive charges may take several days, during which time the demolition contractor should ensure the site is not left unattended.

## Control measure – Establish the previous use of the building

*Control measure knowledge*

Establishing the previous use of the building may indicate the potential hazards that may be present, for example:

- Complex internal layout
- Inspection pits
- Raised walkways and vertical ladders
- Hazardous processes and substances
- Hazardous building materials, including asbestos
- Machinery

*Strategic actions*

Fire and rescue services should:

- Provide operational personnel with risk information about current demolition sites if available

*Tactical actions*

Incident commanders should:

- Establish the previous use of the building
- Consider requesting specialist advice

## Control measure – Consider making a forcible entry

*Control measure knowledge*

If security features such as boarding or security screens are fitted and there is no on-site security, a forcible entry into an unoccupied or derelict building may be required. Information about making a forcible entry can be found in the National Operational Guidance: Fires and firefighting.

### Control measure – Proceed with caution where there are signs of disrepair or structural weakening

*Control measure knowledge*

If a building is showing signs of lack of maintenance or neglect, personnel should consider the likelihood of unsafe elements, like floors, walls or roofs.

If a building is in the process of being demolished, it is possible that the structure has been intentionally weakened.

*Tactical actions*

Incident commanders should:

- Look for signs of collapse, disrepair or structural weakening
- Consider adopting defensive tactics such as external firefighting
- Position cordons appropriately
- Maintain access and egress routes
- Liaise with demolition contractor or urban search and rescue tactical adviser to establish structural stability of the building
- Metal security screens may be heavy and should be removed with care, ensuring that they are not dropped onto personnel operating below

## Scaffolding

| Hazard | Control measures |
|---|---|
| Scaffolding | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition'] |
| | Establish alternative means of access and egress |
| | Seek specialist advice about scaffolding |
| | Identify the presence and type of netting |
| | Consider the appropriate use of scaffolding |

### Hazard knowledge

Scaffolding is used to provide a means of access, working platforms or support to structures under construction or demolition. Refer to the BRE knowledge sheet for scaffolding. The construction site may have an external lift (also known as a hoist) for transporting site personnel and materials.

As it relies on suitable anchors to the building for support, scaffolding may be unstable. Heat and fire may affect the anchor bolts, fixings or tubing, leading to weakening or failure. Methods of scaffold construction can cause a collapse on one side of a building, pulling other scaffolding sections with it.

Different materials and methods are used in scaffolding, depending on the requirement. Some scaffolding components that can span across a fragile roof or shop front, particularly beams, may be aluminium. Not all scaffolding structures are load-bearing; this is considered during the design stage and scaffolding constructed accordingly. Scaffolding can be mobile or fixed, with common structures being the 'tower scaffold' or 'tube and fittings' type of fixed scaffold, which may be independent or dependent.

Scaffolding may also be covered in sheeting or netting to:

- Prevent falls from height
- Prevent tools, materials and debris falling
- Provide a more aesthetic appearance
- Provide fire protection

There is no method of evaluating the integrity of scaffolding, particularly where it is covered in sheeting or netting.

Sheeting is rated to prevent firespread, but printing on the sheeting may affect the fire retardant qualities of the material.

If netting is used to prevent items falling it may present an entrapment hazard, particularly if breathing apparatus is being worn. It could also contribute to external firespread and may then fall from the scaffolding.

On some construction sites scaffolding may also be fitted with lighting and cables, resulting in entanglement or exposure to electricity.

Figure 13: Scaffolding involved in a fire – photograph courtesy of John Dickie

## Control measure – Establish alternative means of access and egress

*Control measure knowledge*

There is a possibility that the fire and rescue service may attend a fire when there is no one on site or the security staff present have no information. Scaffolding is generally used to provide work

platforms for the outside of the structure and where information on using scaffolding cannot be obtained, alternative means of access and egress should be established. This could be by using staircases that have been built inside the building or by using fire and rescue service ladders or aerial appliances to gain access and egress.

In certain situations, additional staircases will have been required to provide sufficient means of escape for site personnel and will be clearly visible, either on their own or as part of the scaffolding system. These will provide an additional option for gaining access to other levels.

The use of construction site lifts must be subject to an appropriate risk assessment if it is necessary for fire and rescue service personnel to use them. This should include the integrity of the three-phase power supply and whether it can be maintained during the incident. Power may be mains electricity or provided by a large site or dedicated local generator.

Figure 14: Scaffolding lift or 'hoist' – photograph courtesy of Brian Massie

*Tactical actions*

Incident commanders should:

- Consider using fire and rescue service ladders or aerial appliances to gain access to floor levels through the window openings
- Determine whether there is a site-trained operator and a manual procedure to safely lower trapped personnel in a timely manner – goods-only hoists should not be used for transporting personnel
- Identify access and egress routes from the internal staircases that may be inside the building

## Control measure – Seek specialist advice about scaffolding

*Control measure knowledge*

The competent person or scaffolding provider should have knowledge of the scaffolding and its status, such as whether it has been handed over for use, is complete and physically tied to the building or is designed to be self-supporting, and whether it has been inspected within the last seven days.

Scaffolding tags, normally found near the primary access point, should provide information about the scaffolding provider and their contact details.

Statutory checks must also be undertaken, such as daily checks or weekly written inspections. Scaffolds not ready for use should be clearly signed so that they are not used. A scaffold that is not correctly braced, not tied to the building or is overloaded is liable to either peel away from the building or buckle and collapse on itself.

*Tactical actions*

Incident commanders should:

- Refer to the scaffolding tag if available
- Liaise with the competent person or scaffolding provider to confirm if scaffolding is safe to use

## Control measure – Identify the presence and type of netting

*Control measure knowledge*

The risk will be affected by what personal protective equipment (PPE) and respiratory protective equipment (RPE) firefighters are wearing and the task they are undertaking. The size of the netting should be evaluated, particularly when breathing apparatus is worn, as the breathing apparatus set may become entangled. If there is a risk, the necessity of the task, need for breathing apparatus and possible removal of the netting should all be considered.

Netting on scaffolding may be used as either fall protection or to prevent debris falling from height. Netting should not be relied on as the sole means of preventing a fall from height.

Figure 15: Debris netting in place – photograph courtesy of Janet Guthrie

*Tactical actions*

Incident commanders should:

- Identify when netting is in place
- Determine the type of netting
- Liaise with the competent person or scaffolding provider to determine the integrity of netting
- Assess the level of risk posed to firefighters depending on the personal protective equipment (PPE) and respiratory protective equipment (RPE) they are wearing and the equipment they are using
- Consider removing the netting if necessary, subject to the implementation of suitable control measures

### Control measure – Consider the appropriate use of scaffolding

*Control measure knowledge*

Fire and rescue service personnel should not use the scaffold if there is any doubt about its integrity. Other means of access should be evaluated.

However, if there are urgent circumstances that suggest it could be used, an appropriate risk assessment must be carried out. If the decision is taken to proceed, it must be with the minimum numbers of personnel and equipment with regard to weight limitations and lateral loading. Consideration must also be given to the Work at Height Regulations 2005.

*Tactical actions*

Incident commanders should:

- Confirm with the competent person or scaffolding provider that the scaffolding is safe to use
- Deploy the minimum numbers of personnel and equipment required for the task
- Ensure the appropriate work at height equipment is used

## Buildings undergoing building works

| Hazard | Control measures |
|---|---|
| Buildings undergoing building works | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br><br>Consider the occupation status of the building<br><br>Consider if fire protection features have been removed or deactivated |

## Hazard knowledge

Building work may include demolishing parts of a building to make structural alterations. Information should be obtained to confirm the location of any alterations, the structural integrity of the building and of any temporary works being used to support parts of the structure. Temporary works can range from a few 'Acrow props' to major steelwork structures.

This hazard may be amplified if the building is occupied or part-occupied, or if the work is unregulated, substandard or not subject to the appropriate inspections.

Buildings may become more hazardous if fire protection features are removed or disabled. Fire alarm panels may indicate the zone of detection when the fire or smoke has actually spread from an isolated zone.

Escape routes may be altered as building work progresses or they may be compromised by obstructions, making escape for occupants or firefighters difficult.

Any alterations should be reflected in the fire risk assessment, along with temporary measures being put in place. The responsible person (or appointed competent person) should be able to provide this information to the incident commander.

From outside, it may not look as though building work is ongoing or that the structure is not complete, with holes in floors, walls and temporary load bearing supports. Structural alterations may have an impact on the stability of the building, even when not involved in fire. Breaches in compartmentation during works could result in rapid spread of fire and smoke.

The responsible person (or appointed competent person) should be able to provide information regarding the construction method being used and the phase the building works are in. They should be able to confirm if there are any hazardous materials on site and if an asbestos survey has been carried out.

Large quantities of combustible building materials may be stored on the site during various phases of the project, and they may have a direct impact on the incident due to the effect of fire loading. The status of utilities and temporary supplies that may have been installed should be considered.

Fire and rescue services may not have been made aware of building work being carried out in a building and therefore will not hold any up-to-date risk information. When consulting on building regulations applications, local authority building control should inform fire and rescue services about proposed building work. Operational information regarding building work should be circulated.

In domestic properties, building alterations could include removing a chimney breast, leaving the chimney above poorly supported and liable to collapse if disturbed. The load this places on a wall makes collapse more likely.

## Control measure – Consider the occupation status of the building

*Control measure knowledge*

Buildings undergoing building work may be occupied or part-occupied, and this may not be immediately obvious to attending fire and rescue service personnel. Building escape routes may become compromised by building materials or equipment being stored inappropriately. Access and egress routes should be established with the help of the responsible person (or appointed competent person).

*Strategic actions*

Fire and rescue services should:

- Engage with building owners and contractors to confirm whether the building is occupied, and to carry out familiarisation visits and pre-planning
- Ensure that building regulations applications are communicated to appropriate personnel
- Record details and nature of occupancy and ensure they are made available to responding fire and rescue service personnel

*Tactical actions*

Incident commanders should:

- Identify any life risk within the building
- Identify escape routes for use by occupants
- Consider roll call status with the responsible (or appointed competent person)
- Consider the need to perform rescues – refer to the hazard of 'Lack of co-ordinated search plan (generic)' in National Operational Guidance: Performing rescues

## Control measure – Consider if fire protection features have been removed or deactivated

*Control measure knowledge*

While a property is undergoing building work, active or passive fire protection features may have been removed or deactivated, including the means of detection and raising the alarm. This could have an impact on the activation of sprinkler systems, extraction systems, other suppression systems, fire doors, shutters and other measures.

The consequences of any deactivation of a system should be considered, particularly when complex fire engineering is installed. Refer to National Operational Guidance: Fires in the built environment for further information.

With the deactivation of detection zones it is possible for the fire alarm panel to give a false indication of the seat of fire. This is because the fire or smoke may travel from an isolated zone to a live zone before being detected. The same may be true where covers are placed over detectors to prevent dust or contaminants causing activation.

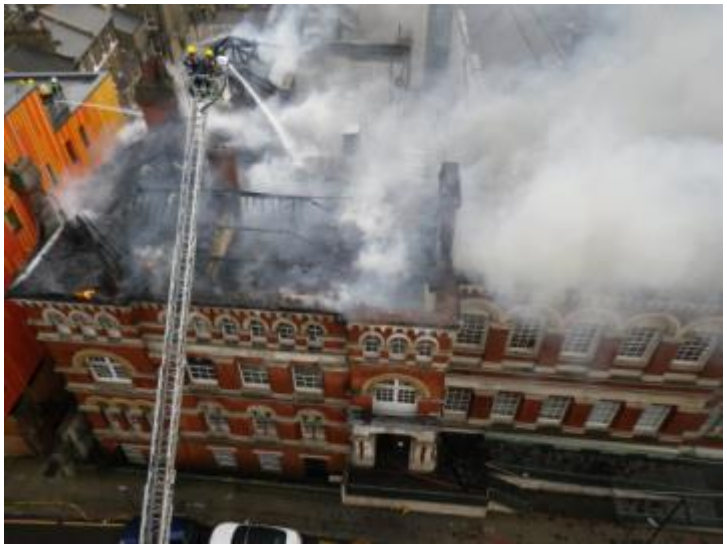


Figure 16: Fire in Walworth Town Hall, London, thought to have been started during building work to repair the roof – photograph courtesy of London Fire Brigade

*Strategic actions*

Fire and rescue services should:

- Engage with the responsible person to confirm the status of fire protection systems in the building and to conduct familiarisation visits and pre-planning

*Tactical actions*

Incident commanders should:

- Identify signs that fire protection features or systems have been removed or deactivated
- Liaise with the responsible person (or appointed competent person) to establish the status of fire protection features
- Confirm the location of the fire - the fire alarm panel may indicate the zone of detection when the fire or smoke has actually spread from an isolated zone
- Consider the impact that the removal or deactivation of fire protection features or systems may have on fire development and on the evacuation of occupants

## Electrical equipment or installations

| Hazard | Control measures |
|---|---|
| Electrical equipment or installations | Apply generic control measures [as detailed for the hazard of 'Fires in buildings under construction or demolition']<br><br>Consider isolation of electrical supply |

## Hazard knowledge

Personnel attending fires in buildings under construction or demolition may be presented with electrical hazards that differ depending on the type of construction or demolition site, such as:

- Electrical systems that have been partially or completely isolated
- Temporary electrical supplies
- Portable generators
- Uninterrupted power supplies (UPS), which could range from small units to large rooms containing lead acid batteries

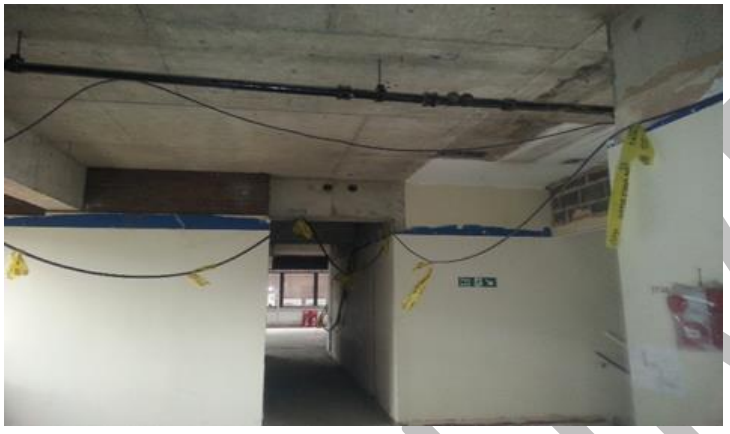


Figure 17: Live cabling during construction phase should be labelled; labelling may be destroyed by fire – photography courtesy of Nick Lacey

Electricity may be supplied by underground or overhead cables. Live overhead cables present a significant hazard, particularly when fire and rescue service equipment, such as ladders or aerial appliances, is being used. Contact with live electrical systems will cause electric shock or burns and, in severe cases, loss of life.

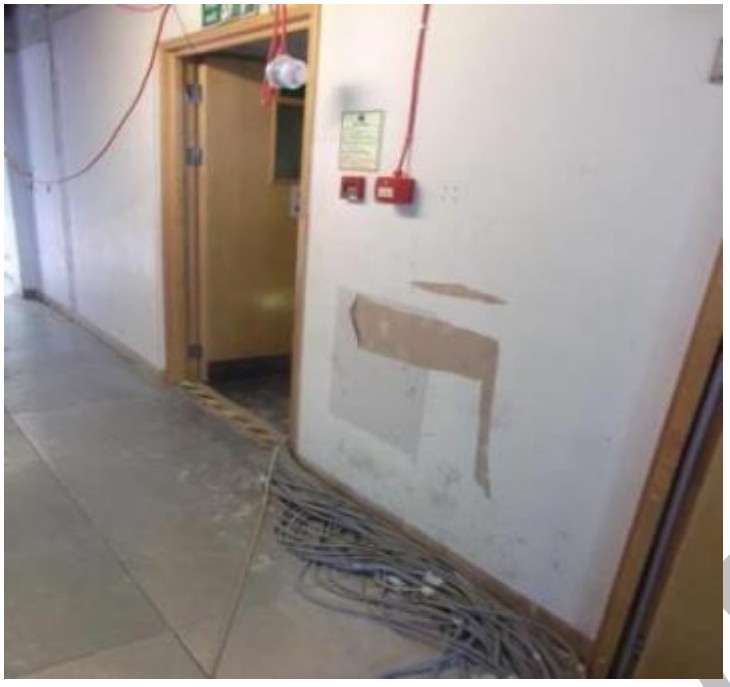
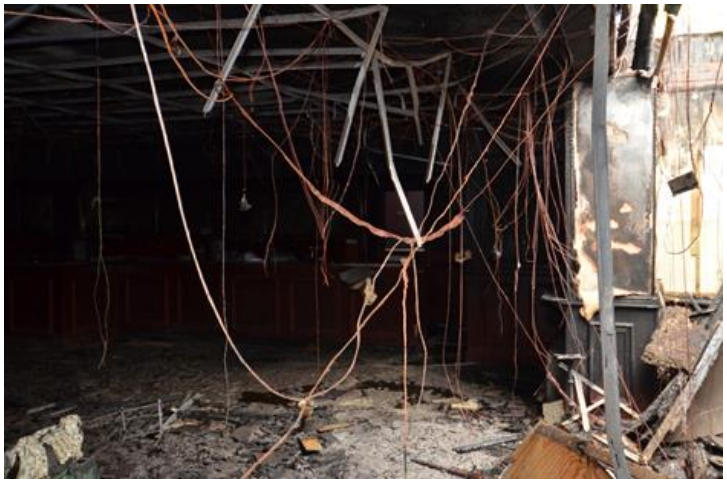


Figure 18: Unsecured electrical cables during refurbishment – photograph courtesy of Robert Bacon

If temporary lightweight fixings or unsecured cables concealed above suspended ceilings fail, the risk of entanglement is increased. These fixings or cables can fall and obstruct access or egress routes. Refer to the hazard of 'Cable entanglement' in National Operational Guidance: Fires in the built environment.

Electrical equipment on-site could range from small handheld devices to large machinery. Hazards presented by electrical equipment could include:

- Power tools that are poorly maintained or poorly repaired, which could result in electric shock
- Cables supplying electrical equipment that may present a tripping hazard or could be damaged causing electric shock
- Plant or machinery that may have moving parts and that may present a risk of entrapment, crush injury or lacerations



- Figure 19: Failure of a suspended ceiling in an unoccupied building, resulting in a release of unsecured cables – photograph courtesy of Brian Massie

## Control measure – Consider isolating the electrical supply

*Control measure knowledge*

Isolating any electrical supplies should be considered as soon as possible, taking into account any wider impact on other essential systems, installations or work processes.

Mains supplies may have been isolated before contractors began work, or a temporary mains supply may have been installed. Portable generators may be used on some sites and can be switched off to isolate the supply. Sites may contain battery back-ups or uninterrupted power supplies (UPS) that may be difficult to isolate. There may also be temporary lighting systems and cable reels, which increase the risk of entanglement.

If power cables are damaged or inappropriately repaired and they come into contact with unprotected steel framing, scaffolding or water run-off, personnel may be at risk of electrocution. For strategic actions refer to the control measure 'Consider isolation of utilities' in National Operational Guidance: Operations.

*Tactical actions*

Incident commanders should:

- Refer to the control measure 'Consider isolation of utilities' in National Operational Guidance: Operations
- Identify any temporary installations, power tools, machinery and generators
- Confirm that the electricity supply has been isolated with the contractor or responsible person (or appointed competent person)
- Consider entanglement hazards

## Glossary

| Term | Acronym (if applicable) | Description |
|---|---|---|
| Fire loading | | The fire loading of a building or compartment is a way of establishing the potential severity of a hypothetical future fire. It is the heat output per unit floor area, often in $kJ/m^2$, calculated from the calorific value of the materials present. |
| Local emergency planning groups | | Known as:<br>• Local resilience forums (England and Wales)<br>• Regional or local resilience partnerships (Scotland)<br>• Emergency preparedness groups (Northern Ireland) |
| Personal protective equipment | PPE | Personal protective equipment includes items such as fire tunics, over-trousers, helmets, fire hoods, gloves and boots. Enhanced personal protective equipment may be used for certain types of incident. |
| Respiratory protective equipment | RPE | Respiratory protective equipment includes breathing apparatus, particle masks and respirators |
| Responsible person | | The person responsible for a site, building, or similar. Used in a legislative context they are known as:<br>• Responsible Person (England, Northern Ireland and Wales)<br>• Duty Holder (Scotland) |
| Safety officer | | Safety officers are appointed by the incident commander. They will be located at points that provide them with an overall view and control of the inner cordon and scene of operations. |
| Structural | | Relating to a load-bearing element of a building |
| Thermal imaging camera | TIC | A thermal imaging camera is a type of camera used in firefighting. By rendering infrared radiation as visible light, such cameras allow firefighters to see areas of heat through smoke, darkness, or heat-permeable barriers. |
| Urban search and rescue | USAR | Urban search and rescue teams locate, extricate and provide initial medical stabilisation of casualties trapped in collapsed structures, natural disasters, mines or collapsed trenches |

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