INFORM

INFORMATION FOR HISTORIC BUILDING OWNERS

Fire Safety in the Home

HISTORIC SCOTLAND
ALBA AOSMHOR

NATIONAL CONSERVATION CENTRE
IONAD GLEIDHTEACHAIS NÀISEANTA

Introduction

This INFORM is intended to familiarise owners and occupiers of older domestic properties with how to protect themselves and their property from fire. Owners of non-domestic premises will require additional information. The INFORM explains, in outline: legislative requirements, vulnerability of traditional buildings, fire development, fire prevention and protection, Fire and Rescue Service requirements and damage limitation planning.

Fire is the single greatest threat to the occupants, fabric and contents of any building (Fig. 1). In a small-scale domestic incident, an out-of-control room fire can reach destructive temperatures of 1000°C in just over three minutes. Whilst safety of occupants is paramount, where a fire occurs in a historic building there is the added loss of authentic fabric and valuable contents. Between 2007 and 2009 there were over 900 recorded incidents in Scotland's listed buildings; as listed buildings are only a small percentage of the stock of traditional buildings (those constructed pre-1919) this alludes to the full extent of the threat facing the wider built environment. The common mindset of 'it will never happen to me' is a dangerous assumption.

Fig. 1 *The catastrophic effects of a fire in a Glasgow townhouse. © RCAHMS*

Fig. 2 *Fire damage to a property during conversion works.*

Legislative requirements

In domestic properties fire safety is likely to stem from a homeowner's personal desire to protect themselves and other occupants and their property. For all non-domestic properties (including care homes and houses in multiple occupancy), compliance with The Fire (Scotland) Act 2005 is a legislative requirement; the onus is on owners and managers to ensure the safety of occupants from harm caused by fire and central to this is a statutory requirement to undertake a fire risk assessment. Whilst generally exempt, owners of private dwellings must be aware that if any commercial activity is undertaken, even for a few weekends annually, they may fall under the remit of the legislation.

In a domestic context fire safety can also become a legislative obligation under the Building (Scotland) Act 2003 where a change of use is involved (e.g. converting a garage into a bedroom or an attic conversion). Fire improvements may include upgrading doors, sub-division of attics and enhancing the fire resistance of floors. As the building standards are designed for new build, their overly rigid application to heritage buildings can cause significant loss of historic fabric, and innovative and sympathetic solutions should be sought.

Vulnerability of traditional buildings

The concept of protecting buildings from fire is not new; however traditional buildings were predominately constructed without regard to fire safety and lack any deliberate fire protection measures. Consequently traditional buildings are particularly vulnerable to the effects of fire. This inherent structural vulnerability is due to a combination of factors including: abundant use of timber in construction; combustible linings such as wall panelling; hidden, and often interconnected, voids such as behind plaster linings and redundant flues; large open roof spaces; and a history of uncontrolled building alterations. Other factors can increase vulnerability, for instance remote rural locations where fire service response times may be lengthy, conversion or renovation works, and properties that are periodically empty where discovery of fire may be delayed (Fig. 2).

Fire: the basics

Understanding how fires start and spread is fundamental to reducing the likelihood of and impact of fire. A combination of heat, oxygen and fuel must be available for fire to start; remove one and fire will be extinguished. This is commonly known as the fire triangle (Fig. 3). Whilst each fire develops in its own complex manner, there are four recognised stages:

- **Incipient** (ignition) – All three ingredients of the fire triangle come together to create a chemical reaction.
- **Growth** – Available combustibles and oxygen are used to fuel the growing fire.
- **Fully developed** – All available combustibles have been ignited.
- **Decay** – The fire has consumed all available fuel and intensity decreases.

Heat, a product of combustion, can transfer to other combustible materials by convection, conduction and radiation. The ease by which transfer can occur will influence the rate at which the fire grows and spreads. Typical attic space clutter such as paperwork, Christmas decorations, cardboard boxes, old clothes, disused furniture, etc. will facilitate rapid growth.

Unless quickly controlled and extinguished in the incipient stage, a fire will escalate. Over the course of the four stages the atmosphere develops from being unpleasant with reduced visibility to becoming intolerable and ultimately lethal for remaining occupants. Smoke containing irritants and toxic gases is particularly life-threatening.

As a fire develops combustible structural elements and building contents become smoke tainted, blackened, charred and, eventually, destroyed. As temperatures rise above 500°C, a deadly situation called 'flashover' can occur where all remaining combustibles in a room simultaneously ignite – with considerable intensity. Even non-combustible structural elements can suffer during a fire, becoming heated and eventually distressed. Stonework, for example, can experience micro-cracking, loss of surface material and mineralogical changes.

During each stage of a fire the financial implications escalate dramatically. In an historic building the level of cultural loss also increases incrementally, where the authentic value of what remains is greatly reduced or totally eliminated.

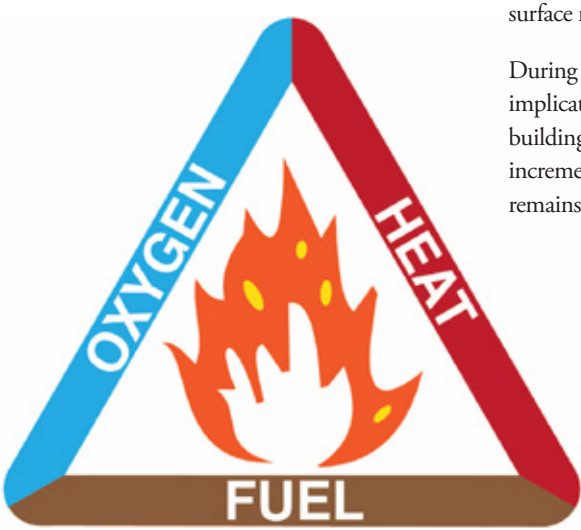

Fig. 3 *The fire triangle.*

Fire prevention

Most fires are preventable through good house-keeping, by stopping the three ingredients of the fire triangle from coming together. Central to fire prevention is maintaining a hazard free environment; minimising fuel sources and keeping them separate from potential heat sources; being vigilant of hazards and removing or controlling them.

Identifying potential heat sources

Heat sources that can trigger ignition are many, and include faulty wiring, overloaded sockets and extension leads, defective electrical equipment, misuse of portable heaters, DIY, smoking, careless use of candles, cooking, open fires, and chimney flues that haven't been swept (Fig. 4).

Fig. 4 *Faulty wiring was the possible cause of fire in this sub-divided townhouse.*

Identifying potential fuel sources

Anything which is liable to burn adds to a building's fuel load. Within a domestic setting flammable contents include furniture, textiles, paintings, and loosely stored materials. Attic spaces and cupboards are common areas for concern with a tendency for accumulation of seldom used household items; storage in such areas should be minimised and orderly, with ignition sources controlled. A building's elements can also add to the overall fuel load such as wall and ceiling linings, timber floors, and the supporting roof structure.

Identifying oxygen sources

Oxygen is essential to human life, but also feeds a developing fire. Good compartmentation, which involves creating fire-tight cells or distinct zones within a building, will help reduce the amount of oxygen available in a fire situation. At its most basic level, this might simply involve closing doors, particularly at night. Properties with mechanical air venting systems may have to consider additional measures.

Fig. 5 *Breaches such as this hole in a brick masonry wall can facilitate fire and smoke spread.*

Fire protection

Whilst preventing fires is the best approach, fire protection measures are also essential to protect occupants in the event of fire. For example, means of escape will be critical and even in a domestic setting it is beneficial to plan the best escape route. Any physical changes to listed buildings will require Listed Building Consent and early advice should be sought from the Conservation Officer and the Building Control Department of the local authority.

Creating fire compartments

Compartmentation seeks to contain any outbreak of fire within the area of origin. Large continuous roof spaces, hidden voids behind plasterwork in masonry partition walls, and holes left in walls during alterations all increase the likelihood of fire spreading between compartments.

Compartmentation upgrades such as sub-dividing corridors or enclosing staircases can be extremely invasive and require careful consideration in their design. Most buildings have existing lines of compartmentation and enhancing these may be less invasive. Examples include:

- Fire retardant (intumescent) paint or varnish applied to timber elements such as doors.
- Subdivision of roof spaces by inserting solid or flexible cavity barriers.
- Blocking holes where services pass through walls with products such as a cementitious mortar or intumescent putty (Fig. 5).
- Inserting fire resisting material in the void under floorboards such as mineral wool or plaster boards.

Where compartmentation is inadequate and upgrades would be overly damaging to the historic building fabric, alternative solutions may be acceptable, for example improved evacuation procedures combined with enhanced fire detection.

Detection and alarm systems

Fire detection is an essential life safety tool, especially in areas of high risk such as kitchens or where there is a sleeping risk, but it also serves to enhance property protection. Recognising a fire as early as possible provides the best chance of escape, timely fighting of the fire and thus reduced property damage.

Depending on requirements, detection systems can be battery operated, mains fed or utilise wireless technology (wire free). In a domestic setting, where smoke is the primary killer, standard battery operated smoke detectors are relatively flexible and easily installed. Heat detectors may be more suited to kitchens or utility areas to reduce the likelihood of false

alarms. Hard wired systems require more care in their installation, particularly in historic properties with richly decorated interiors.

More sophisticated systems may be required where a fire might develop unnoticed in a large complex property, in remotely located properties, where a building and its contents are historically significant or as a compensating feature for inadequate compartmentation. Systems can also be linked to a remote alarm receiving centre which automatically receives activation signals and alerts the fire service.

First aid fire-fighting

Where safe to do so, it may be possible to fight a fire in the very early stages. Various types of extinguishers exist for different classes of fire and it is essential that extinguishers match the types of fires anticipated. Where fixing an extinguisher to a wall might be damaging to architecturally fine interiors a free-standing base offers an alternative (Fig. 6).

Automatic suppression systems

Suppression systems act as an alarm but also automatically operate to control a fire. There are different extinguishing mediums available and likewise a variety of discharge heads. In historic interiors, careful consideration is required in the design of suppression systems to sensitively integrate them with internal finishes. Ideally, coinciding the installation with other major works will minimise disruption. As with other types of invasive service installation such as heating pipework, the joint expertise of building conservation professionals and fire engineers needs to be brought together to achieve the most appropriate solution for each particular set of circumstances – often on a room by room basis (Fig. 7).

Fire and Rescue Service

When dealing with an incident, the primary needs of the fire service are access and water supplies, both of which may have to be improved. Lack of hardstanding areas, weak bridges and low archways can all potentially hinder access for fire appliances. If water is unreliable, additional sources may have to be considered such as natural water features or installing well maintained private hydrants. For large complex historic properties it may be beneficial to engage with the local Fire and Rescue Service.

Fig. 6 *An alternative to wall fixing.*

Fig. 7 *Circular concealed sprinkler head beside the bird's beak on a decorative plaster ceiling.*

Damage limitation planning

Damage limitation planning sets out the response to an emergency and may be advantageous for heritage properties that house valuable contents. Skilful utilisation of even restricted resources can make a considerable difference to reducing the impact of fire and ensure a quicker recovery. A damage limitation plan may encompass; a site sketch, identification of priority items for removal, availability of basic salvage equipment and contact details for conservators and storage facilities. Items of value that cannot be removed may be afforded some protection from water and smoke damage by covering in flame retardant polythene sheets.

Conclusion

Fire poses a serious threat to both life and property. Addressing fire safety, whether for personal or property protection reasons, or to satisfy legislative requirements, is important to help protect Scotland's historic environment. Whilst protection measures such as detection systems and compartmentation play an important role, fire prevention is the best approach.

Further reading

Guide for Practitioners 6 –
Conversion of Traditional Buildings: Application of the Scottish Building Standards,
Historic Scotland, 2007

Guide for Practitioners 7 –
Fire Safety Management in Traditional Buildings, Historic Scotland, 2010

'Fire Law', Scottish Government (online):
http://www.scotland.gov.uk/Topics/Justice/public-safety/Fire-Rescue/FireLaw

Scottish Fire and Rescue Service: http://www.firescotland.gov.uk/

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