INFORM

INFORMATION FOR HISTORIC BUILDING OWNERS

Fire Safety

Creating an Awareness of the Fire Threat

HISTORIC SCOTLAND

Introduction

This leaflet is intended to familiarise building owners and occupiers with the issues surrounding the consequences of loss of built heritage due to the effects of fire. It explains, in outline, what creates a fire risk and how -

- fires develop
- to reduce risk through identifying the constituent parts of a fire
- fire safety management can assist in addressing the problem
- suppression and detection systems can impact on the issue
- creating separate zones in a building (compartmentation) is essential

Finally, it reveals how a recent initiative in conjunction with the Scottish Fire and Rescue Services is being developed to assist fire-fighters deal with future fire incidents at historic buildings.

Photo © Historic Scotland

Fire is the single greatest threat to occupants, contents and fabric of any building. Whilst life safety should always remain paramount, where fire occurs in a historic building the loss of authentic fabric and valuable contents is inevitable. As an out-of-control room fire can reach temperatures of 1000° Celsius in just over 3 minutes, the risks are considerable. During the last 12 years press reports have revealed that at least one Category A or B Listed Building in Scotland is lost, or significantly damaged, each month as a result of fire, and it is believed that many others suffer lesser damage. So, an awareness and implementation of fire management measures is essential if the current levels of loss to the effects of fire are to be reduced.

What creates a fire risk?

A combination of heat, oxygen and fuel has to be available for fire to take hold and develop. For fire to be able to spread, it requires unhindered progress through apartments adjacent to where it started. In this regard, historic buildings are particularly vulnerable. This is due to their traditional methods of construction, the numerous voids which can exist between apartments, and the lack of effective separation between various rooms and large enclosed spaces. Frequently, this combination of factors has lead to the total loss of the building, and all its contents.

Given that smoke inhalation is the principle cause of fire-related deaths, in the early stages of a fire it is important that the building's occupants are alerted to its outbreak as soon as possible. Early detection of fire is therefore essential, especially in areas of high risk such as kitchens or where naked flames might be present. Detection systems are vital in alerting occupants to escape, so they may summon support from the local Fire and Rescue Services. But, due to the time it will take for the Services appliances to arrive and set up fire fighting actions, degrees of loss will have already occurred.

The development of fire

Each fire incident develops in its own complex manner, but all fires fall into four distinct stages:

- Embryonic fire following a malfunction or incident
- Fire growth following ignition
- Developed fire following a "flashover"
- Fire decay with the destruction of all consumable fuel

The primary production of combustion is heat, and this can transfer to other materials (fuel) by convection, radiation and conduction. The ease by which this can occur will influence the rate at which the fire spreads. The amount of smoke that is produced will be dependant upon what is burning and the amount of air (oxygen) that is available in the room where the fire is. Smoke contains irritants and toxic gases, which are particularly life-threatening. Freely burning materials will quickly produce high temperatures. The presence of flame reveals that a quantity of high temperature particles has been created. Unless the flames are quickly controlled and extinguished, the fire will speedily develop and lead to a greater degree of destruction and loss. As it grows, the increasing temperatures will lead to a situation called "flashover" where all remaining combustible fuel sources ignite - with some considerable intensity.

During these four stages the atmosphere develops from being polluted to becoming unpleasant, intolerable and, subsequently, lethal for remaining occupants. The combustible building contents and structure become smoke tainted, blackened, charred and, eventually, destroyed. The incombustible structure becomes warmed, heated and, eventually, distressed through melting or expansion and fracturing, leading to partial or complete destruction. During each stage the financial implications and associated remedial costs escalates dramatically. In a historic building, the level of cultural, architectural and artistic loss at each of the four stages also increases incrementally where the authentic value and quality of what remains following the fire is greatly reduced, or eliminated.

The reality, and consequences, of these factors are generally not appreciated, and much complacency exists in the minds of building owners and occupants on the basis *"that it will never happen to me"*. A more realistic consideration might lie in reflecting on the difficult question – *"What do you want left after the fire?"* In numerous cases in the past, the reality of a fire has been *"a burnt out shell."*

Compartmentation

Historic buildings were built when an understanding of the effects of fire did not exist in the way it does today. Continuous roof spaces over the entire building or wings, hidden voids behind plasterwork in masonry partition walls, and holes left in walls during later works, all contribute to a high risk of a rapid spread of fire should an incident occur. They can also contribute to fire growth by allowing a continuous supply of fresh air (oxygen) into the seat of a developing fire.

The concept of compartmentation involves finding an appropriate way of effectively blocking up any voids, and/or creating fire breaks in spaces of large volume (such as in roof spaces, or improving the fire resistance of doors), so that distinct "compartments" or sections of the building are created within which any outbreak of fire might be contained, fought and controlled. It is work that requires careful consideration, design and implementation if the welfare, quality and value of the building is not to suffer through the installation work.

Reducing the risk

Risk of fire can be greatly reduced by a proper awareness of how fires start and how they can spread. Effective fire safety management of properties will greatly reduce the impact and consequences of fires. A better understanding of all the issues involved can also assist in overcoming any complacency. By focusing on the three factors heat, oxygen and fuel much can be done at a basic level to reduce the levels of risks through greater vigilance.

Heat

Heat can be produced by a wide variety of sources. These include –

- Paint stripping (especially with the use of blow lamps)
- Plumbing work
- Smoking material
- Naked flames, including the use of candles
- Cooking
- Faulty appliances
- Electrical faults and lack of maintenance
- Open fires, cracked hearths and faulty flues
- Glass items focusing the sun's rays
- Fire-raising

Awareness of the risks and proper controls of these activities can do much to stop fire from starting, and taking hold.

Oxygen

Oxygen is essential to both human life and fire. Whilst modern fire fighting techniques have created systems that can reduce the oxygen content inside buildings so that fires are prevented from developing, such techniques are only applicable to very specific situations. Building owners can reduce the air supply available to encourage a fire by ensuring that there is adequate separation (compartmentation) between the various apartments in their building. At its most basic level, this might simply mean that all separating doors between different rooms in the building are closed (particularly at night) to help prevent any outbreak of fire from spreading. Along with other more invasive works, this might also involve installing intumescent strips round the separating door edges. These strips expand with heat and seal the gaps around the door in event of a fire.

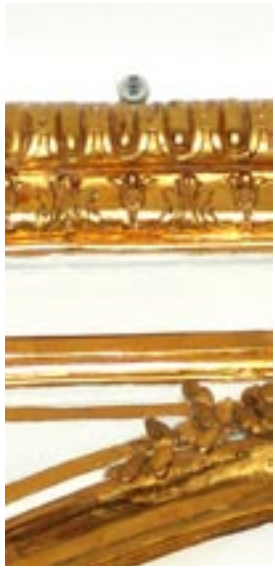
Fuel

Anything which can burn should be considered as adding to the fuel load inside a building. Some materials, such as flammable liquids, will obviously ignite sooner than a library shelf of books, and building contents will generally ignite quicker that the building's structure. Within a historic interior the contents - furniture, carpets, curtains, paintings, wall finishes and loosely stored materials (particularly in boiler rooms and roof attics) - can all be deemed as providing a source of fuel. From the building's structural point of view original timber floors, supporting joists, waxed panelling, doors, shutters, lath and plaster work, and the roof construction can all add to the overall fuel loading. Particular care therefore needs to be paid to where any combustible materials are liable to exist in the near vicinity to a likely source of ignition.

Suppression and Detection

Fire detection is an essential tool to help ensure life safety and offer early warning of a fire incident occurring. Battery operated smoke alarms are cheap, relatively flexible and easily installed, but require regular checking to keep them operative. Alarms linked to the mains electrical supply will require more consideration in where they should be placed and wired, particularly in finely detailed and decorated important historic interiors. In such cases, air-aspirating detection systems offer more flexibility in the placing of the air sampling points, and are less visually invasive. These systems work by frequently drawing, and monitoring, the quality of samples of air from the room. Airborne contaminants, such as smoke, are readily detected and a consequential alarm sounded.





Suppression systems will not only activate as an alarm if a fire occurs, they also operate to fight and control its growth through water sprinkling, water misting or oxygen reduction techniques. Designing and installing such systems into sensitive historic interiors require careful consideration to integrate them with the internal finishes and details. They should be considered as a part of a more comprehensive system of fire protection. Here, the joint expertise of building professionals versed in conservation working techniques, and fire engineers, need to be brought together to assess, balance, and achieve the most appropriate solution for each particular set of circumstances - often on a room by room basis.

The introduction of a suite of fire engineering solutions into a historic building is best considered when other major works are planned. That way they can be more successfully integrated during the course of the other disruptions. The introduction of such schemes will require Listed Building Consent, and early advice should be sought when thinking about proceeding in this manner.

Fire and Rescue Services

Given the known scale of loss to the built heritage from the effects of fire, in 2003 Historic Scotland and the Royal Commission of the Ancient and Historical Monuments in Scotland started co-operating with the eight Scottish Fire and Rescue Services to create a Scottish Historic Buildings National Fire Database. This has subsequently emerged as part of the Services' current approach to Integrated Risk Management. The database will provide fire fighting crews with relevant information about the importance and value of each Category A listed building in Scotland. This will assist them in managing their attendance at any future incidents at these properties. A second stage to this process will involve producing generic guidance, established from the first phase of the database, so that this might be applied to assist in the management of future fire incidents at other historic buildings in the country.

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Further Reading

- TAN 11 - *Fire Protection Measures in Scottish Historic Buildings*
  1997, ISBN 900168 41 3
- TAN 14 - *The Installation of Sprinkler Systems in Historic Buildings*
  1998, ISBN 1900168 63 4
- TAN 22 - *Fire Risk Management in Heritage Buildings*
  2001, ISBN 1900168 71 5
- TAN 28 - *Fire Safety Management in Heritage Buildings*
  2005, ISBN 1904966 11 X
- *Sprinklers and Heritage* (online) British Automatic Fire Sprinkler Association (BAFSA)
  Available at http://www.basa.org.uk/pdfs/publications/00000004.pdf
- *An insurance manual for historic houses*: Historic Houses Association London.
- *Heritage Under Fire. A guide to the protection of Historic Buildings*: Fire Protection Association, London. (Available as a CD ROM)
- *Sprinklers for Safety Uses and Benefits of Incorporating Sprinklers in Buildings and Structures*
  A Report by Arup Fire: British Automatic Fire Sprinkler Association (BAFSA)

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