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Information File

Automatic Fire Suppression Systems and Heritage Protection

2nd Issue
April 2013
BIF 3

Newhailes House, Edinburgh: A sprinkler system now protects this important A listed National Trust for Scotland property

Introduction

Fires are perhaps the greatest threat, which face those responsible for safeguarding heritage buildings. While other risks such as theft, flood and even insect or fungal infestation can damage buildings and their contents only fire can destroy them completely. Each year, throughout the world, there are fires in all types of historic and heritage buildings. A number of these outbreaks reach serious proportions where measurable fire loss can soar to millions of pounds. The loss of important artifacts, cultural resources and national heritage mean such fires are among the most feared.

The Extent of the Problem

While it is difficult to determine the exact extent of the loss, there is broad agreement that in the UK, a building of major national importance is lost or seriously damaged by fire each week. The latest published data from Historic Scotland (2008-9) suggests that there are probably more than 600 fires in listed buildings each year in Scotland alone. *See table 1.*

Extrapolating such data for the UK might suggest that there may be at least 200 - 250 fires each year in Grade 1/A buildings. All heritage organisations agree that the best way to guarantee the future of a building is to keep it in use for its original purpose. Only where this is not possible should a change of use be considered although it is clear that significant strides have been made in finding appropriate alternative uses for many historic buildings. Dwellings have been created from structures as diverse as places of worship, mental hospitals and barracks, old spinning mills have provided units for small businesses and shops have been created out of flourmills and warehouses. The conversion of an Edinburgh orphanage into the Dean Gallery of Modern Art is an excellent example of this practice. One hotel chain has successfully provided new uses for a seamen's mission, municipal tramway company offices and even a prison!

Following the 1992 Windsor Castle fire, the Bailey Report concluded that automatic fire suppression systems could play a useful role in the protection of heritage buildings especially where it was difficult to introduce other fire protection measures such as improved compartmentation. In fact, just as in new buildings, where the introduction of sprinklers can greatly assist the architect in bringing to life exciting new concepts in building design, sprinklers can make it possible for a historic building to meet current fire safety standards with minimal impact on heritage fabric and values. In the UK, much of the pioneering work in this field has taken place in Scotland and Historic Scotland has played a leading part in the wider promotion of the sensible use of fire suppression systems. There are now many diverse examples of important buildings now fitted with fire suppression systems. *See Table 2.*

Table 1

Fires in Scottish Heritage Buildings 2008/9

Service	A Listed	B Listed	C Listed	Total
Central	4	12	1	17
Dumfries & Galloway	2	8	2	12
Fife	2	8	9	19
Grampian	5	43	12	60
Highlands & Islands	2	11	6	19
Lothian & Borders	30	130	71	249
Strathclyde	*No Data Available*			
Tayside	8	23	11	42
Totals	62	244	112	428

Source: Scottish Historic Buildings National Fire Database 2010

Note that the totals could be increased by extrapolation to add perhaps 10% - 20% to account for no data being provided by Scotland's largest region.

Triggers for Consideration of Fire Suppression Systems

In Chapter 5 of Historic Scotland's Guide for Practitioners No 7: *Fire Safety Management in Traditional Buildings*, this Approved Code of Practice sets out the criteria which must be followed when adaptive reconstruction of historic

buildings takes place. In particular, the text reviews the difficulties which may follow in providing adequate means of escape in case of fire, taking the example of the conversion of a 19th Century office building into an hotel considers the difficulty of fully complying with building regulations and asks:
How then can one approach the problem described above in relation to making changes to the listed building to permit its use as the hotel without wide scale destruction of the authenticity of the features which make it worth listing?

One of the suggested remedies is the use of a fire suppression system and the Guide adds that:
Considerable benefits can accrue from the introduction of well-designed automatic fire suppression systems even where these are not specifically required under Scottish Building Standards.

Part 2 of the Guide goes into considerable detail on the use of fire suppression systems and makes it clear that this may be the only way of achieving a change of use commensurate with the appropriate levels of compliance with building regulations:

The value of automatic fire suppression systems has also been recognized in building regulations and in guidance produced to accompany UK fire regulations. Three case studies effectively illustrate the diverse benefits of sprinklers and watermist.

Case Study 1: National Library of Scotland

National Library of Scotland George IV Bridge, Edinburgh

The George IV Bridge Building was purpose-built to house Scotland's premier library and collections and is a Category B listed building. The building has a complex layout over three floors above the level of the George IV Bridge and seven below it.

In 1988 the 'ownership' of the Library was transferred from the Crown to the Library's Board of Trustees. At this point it became clear that not only did the building not have a fire certificate but that the only compliance activity related to fire protection was the provision of doubtful means of escape in case of fire. Following an internal review, the Trustees were informed that:

- the physical structure and layout of the George IV Bridge building bridge structure was fundamentally unsafe and unsatisfactory for its purpose;
- these problems, combined with the fuel load which the mainly paper based collections constituted, made it inevitable that anything other than a minor fire would be utterly disastrous;
- the building design did not comply with the requirements of fire safety legislation so that continued occupation by staff and users was highly problematic

The discussions which took place looked at two possible alternatives:

- vacating the building - that is, relocate the archive/ storage functions to another site. This was unrealistic and incompatible with the Library's mission and objectives;
- protecting the building - by installing an active fire fighting system (probably based on automatic water sprinklers) which would provide immediate response to any fire in the library and ensure that the steelwork was kept below its deformation temperature and prevent structural collapse.

The decision to undertake a major programme of fire protection improvements was taken in 1992 building on studies undertaken in 1989. The comprehensive plan was implemented in two phases over 8 years including creation of a new fire escape staircase running the full height of the building, a new fire detection system, wet risers and full sprinkler protection.

The work was undertaken without decanting the collections and has meant that an important part of Scotland's cultural resources remain accessible to all in the building designed for their safekeeping protected all day, every day.

Case Study No 2: Corgarff Castle

Corgarff Castle, a Scheduled Ancient Monument and Grade A listed building where the sprinkler system provides compensation for its location, absence of water supply, restricted F&RS response and impaired means of escape

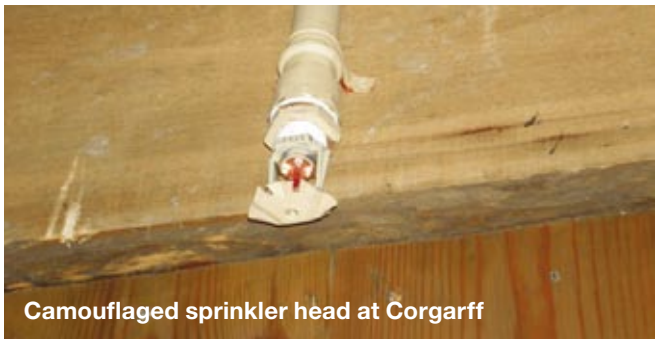
A Scheduled Ancient Monument and Grade A listed building; Corgarff dates from the 16th century and is in the care of Historic Scotland. The castle has been restored

to its layout as it was in the 18th century when it housed a military detachment engaged in enforcing the Hanoverian government's rule in the Highlands following the second Jacobite uprising.

In 2005 the Crown Fire Inspector reported concerns about the life safety elements of the structure in respect of the means of escape by visitors from its upper floors via a single internal timber staircase. As the castle was much used for educational visits it was agreed that to keep it in use would require upgraded fire safety facilities. Other aspects of fire safety matters which concerned the owners were the poor access to the site especially in winter and the likely limited initial fire and rescue service response.

It was decided that an automatic fire suppression system would provide both life safety and property protection year round and compensate for restricted access and the remoteness from major fire fighting cover. A BS EN 12845 sprinkler system with agreed deviations in respect of water storage was installed. Great care was taken to minimise the visible intrusion of sprinkler heads into visitor spaces. Where exposed, the yokes and deflectors of the sprinkler heads have, with the consent of the manufacturers, been painted with a water-based paint to further disguise them.

The presence of the sprinkler system has therefore guaranteed continuing access to and use of the building, compensated for its remote location and poor water supplies and ensured its future existence.



Camouflaged sprinkler head at Corgarff

Case Study No 3: Old Palace, Stirling Castle

Old Royal Palace, Stirling Castle, said to be the finest late renaissance building in Scotland

Stirling Castle one of Scotland's most iconic sites is close to two of Scotland's major battlefields, Stirling Bridge (1297) and Bannockburn (1314) The Grade A listed Old Palace, forms a key structure within the Castle, was completed in 1542 and is one of the most important, late medieval buildings in Scotland.

The major refurbishment of the Royal Apartments which were contained in the Old Palace (completed in the summer of 2011) generated an opportunity to consider the benefits of providing fire suppression in a larger structure where property protection would be the primary benefit. The extensive nature of the refurbishment (amounting almost to an internal reconstruction) allowed a fire risk assessment to consider wider issues and a decision was made to install the first watermist system in protecting all of a Scottish historic structure.

The owner expressed a preference for watermist on this project as it permitted the use of small diameter CPVC pipework and reduced requirement for water storage.

The watermist system not only protects the historic fabric of the building but also its contents (including the iconic Stirling Heads now located in their own display gallery on the first floor of the building) but also provides enhanced safety for visitors and staff. Indeed, it was the presence of the system that enabled the Crown Fire Inspector to accept a form of alternative compliance in respect of certain aspects of the building's furnishings. The fire suppression system allowed the use of non compliant surface coverings in the form of these tapestries.

Mist head protecting the Strling Heads with yellow transit cap still visible

Benefits of Heritage Sprinklers

Where once the idea of installing sprinkler systems into mansions, castles, churches, museums and libraries may have seemed absurd it's now clear that a sprinkler system can protect nationally and internationally important structures and their contents. Sprinklers have also been used as a compensating feature in developments where building regulations cannot be complied with in respect of means of escape or access for the fire brigade. Some projects have even reported that providing sprinklers has resulted in a cost saving where the building authority has permitted trade-offs in respect of means of escape facilities and structural fire protection measures and surface spread of flame requirements.

Standards for Installation

Sprinklers can be installed using any one of a number of accepted standards. In the UK, for non-residential buildings this is BS EN 12845 (2009). BS 9251: 2005 may be used for smaller residential and domestic buildings. Watermist systems should be designed and installed to BS DD 8458 (2011) for residential properties and BS DD 8489 (2011) for other properties.

Types of Systems

While there are a range of different types of sprinkler systems used in a range of premises it is considered that only wet systems should be specified in heritage buildings. These systems are the simplest, easiest to maintain and are also the most cost effective. Pipework can be in copper, steel, stainless steel or in CPVC (chlorinated polyvinyl chloride) which is approved for the purpose. For more information on sprinkler systems refer to BIF 15, *Types of Sprinkler Systems*.

For information on watermist systems see BIF 9 *Water Mist.*

System Design and Installation

The high reliability and effectiveness of these systems has come about over the years by strict adherence to design standards. It would be wise to select a contractor who is not only capable and competent but who also has an established track record and who can offer proof of compliance with an established quality assurance system.

Full information on the various third party certification schemes can be found in BIF 20, *Third Party Certification*.

Table 2

Some UK Heritage Buildings Protected by Automatic Fire Suppression Systems

A La Ronde, Exmouth
Abbey School, Sherborne
Advocates Hall Library, Edinburgh
Arden Manor, West Midlands
The Barn, Lundy Island
Beaminster House, Beaminster
Bicester Priory
British Library, London
Broughton House, Dumfries
Buchanan House
Buckingham House, Portsmouth
Chitcombe House, Salisbury
Clavell Tower, Kimmeridge
Cloford Manor, Frome
College Bounds, Aberdeen
Corgarff Castle, Aberdeenshire
Damens Signal Box, Yorkshire
Daimler Heritage Trust Museum
Douai Abbey, Woolhampton
Duff House, Aberdeenshire
Flatford Mill, Suffolk
Friends Meeting House, Stourbridge
The Hyde, Bridport
Gilbert White's House, Selborne
Lambeth Water Tower
National Library of Scotland, George IV Bridge, Edinburgh
National Library of Scotland, Causeway End, Edinburgh
National Library of Wales, Aberystwyth
National Portrait Gallery, London
Norwich Castle Museum
Portland Magistrates Court
Old Lighthouse, Portland Bill
Old Mill, Selborne
Old Palace, Stirling Castle
Old Presbytery, Frome
The Old Post Office, Lacock
Old Vic Theatre, Bristol
Parliament House, Edinburgh
Newhailes House, Edinburgh
Pound House, Cattistock
Riber Castle, Derbyshire
Rolvenden Water Tower
Porthcurno Museum, Cornwall
Sadler's Mill, Romsey
Shockerwick House, Bath
Snape Maltings
Staplehurst Manor, Staplehurst
Standerwick House, Broadway
Studland Bay House, Swanage
Tudor House Hotel, Lyme Regis
Tudor House Museum, Southampton
Warsash Clock Tower
Wat Tyler Inn, Dartford
Whately Manor, Malmesbury

In addition, there are a significant number of hotels in listed buildings operated by the Marriott, Malmaison and Hotel Des Amis chain which are part or fully sprinkler protected.

Presented by

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