Conference Proceedings

Conference Proceedings

Fire Protection and the Built Heritage

TECHNICAL CONSERVATION, RESEARCH AND EDUCATION DIVISION

HISTORIC SCOTLAND

Fire Protection and the Built Heritage

Historic Scotland Technical Advice Notes

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Conference Proceedings

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Technical Conservation, Research and Education Division
Scottish Conservation Bureau
Longmore House
Salisbury Place
EDINBURGH
EH9 1SH

Tel 0131 668 8668
Fax 0131 668 8669

email cbrown.hs.scb@gtnet.gov.uk

CONFERENCE PROCEEDINGS

FIRE PROTECTION AND THE BUILT HERITAGE

Edited by
I Maxwell
N Ross
A Dakin

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General Register House plan by courtesy of the Scottish Record Office.

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FOREWORD

Following major fires such as those at Hampton Court, York Minster and Windsor Castle, it has been established that, on average, one major Scottish listed historic building is currently being lost to the effects of fire every month. The built heritage is irretrievably reduced each year as a result. To help address this issue, an international conference, *Fire Protection and the Built Heritage*, was jointly organised by staff from Historic Scotland, Duff House Country House Gallery and Grampian Fire Brigade. Held at Duff House on 7-8 October 1998, the aim was to create an increased public and professional awareness of the risk to the built heritage with a view to help stem this high level of loss.

80 delegates from the United Kingdom, North America and Europe heard 14 specialist speakers deal with issues such as fire legislation; insurance; salvage; risk assessment in historic buildings in the UK and Europe; the implementation of fire protection measures; sprinkler installations; and fire management. We are greatly indebted to the Conference Chairmen, speakers, delegates and the many behind the scenes support staff for making the event so successful.

The venue, of William Adam's 1735 Duff House, was a perfect location for the conference, being a good example of a significant historic building where a full fire protection and suppression system has been successfully installed. When the house was restored in 1994 as a Country House Gallery out-station of the National Galleries of Scotland, the opportunity was taken to introduce the latest systems. As a result, Duff House became the first major historic building in the United Kingdom to be protected in such a comprehensive manner. The recipient of a number of project Awards, this innovative approach was singled out for particular comment in the citation that the scheme received as a 1998 Europa Nostra Award winner.

The second of Historic Scotland's Technical Advice Notes to deal with fire matters, *TAN 14 The Installation of Sprinkler Systems in Historic Buildings*, was launched during the Conference. This volume was written to support and augment the earlier Note, *TAN 11 Fire Protection Measures in Scottish Historic Buildings*, published in September 1997. Thoughout the event, trade information and literature was provided by a number of manufacturers and suppliers. Operational Brigade equipment was also put on display in the house grounds by courtesy of Grampian Fire Brigade.

From the outset, the conference was conceived as being the first of a proposed series of European conferences on fire protection in historic buildings. Building upon the international success of the Duff House event a subsequent meeting, *Fire Protection in Historic Buildings*, has been arranged. This will be held at Schonbrunn Akademie, Schonbrunn Palace, Vienna on the 29-30 April 1999.

Ingval Maxwell, Neil Ross, Audrey Dakin
Technical Conservation, Research and Education Division, Historic Scotland, Edinburgh
April 1999

FIRE PROTECTION MEASURES IN SCOTTISH HISTORIC BUILDINGS - AN INTRODUCTION

INGVAL MAXWELL DA(Dun) RIBA FRIAS FSAScot
Director, Technical Conservation, Research and Education Division, Historic Scotland

Background

The current level of loss of historic buildings to fire is a cause for grave concern. With a greater awareness of the issues involved, and the increased adoption and utilisation of modern fire-fighting technology, this can be combated and reduced. However, the installation of fire protection measures, as with all conservation work, should follow the principle of minimum intervention. Schemes should be specifically tailored for each building, taking into account its importance, character, construction, finishes and detail.

Historically, fire fighting has been a feature of architects' thinking since the mid-18th Century with, for example, the provision of fire ponds that also served as ornamental landscape features near mansion houses. Various devices were also contrived to effect emergency escape from property. But, essentially, primitive hose and pumps, sand buckets, and water bucket chains were relied upon to control the fire and its devastating effects on structural timbers and the flammable contents of the building

Fig. 1 Elgin Cathedral. Molten lead from the roof can still be seen bonded to the upper level masonry, resulting from torching of the Cathedral in 1390.

Whilst modern fire protection installations can readily be designed to be technically efficient, there is a tendency for many to be less than sympathetic in practice during installation, especially in historic buildings. This is largely because the engineering profession does not often think laterally about the conservation issues that might be involved. In addition, engineers customarily pass project detail-design decisions directly to contractors. This can lead to some loss of direct control of the project with consequential unfortunate results. Manufacturers and suppliers of equipment also tend to be limiting in the options and choice of equipment they offer.

In sensitive interiors of quality this can result in a clumsy compromise, where neither the protection measure, nor the building, emerge successfully handled. To be more effective the need is for architect, engineer, contractor and supplier to be more in tune with the physical and aesthetic attributes of the building. All must work towards achieving a better balance in the final results.

The Historic Perspective

Throughout history, as a number of ruined ancient structures can testify, there has been no shortage of fire incidents. At Elgin Cathedral for example, remains of molten roofing lead can still be seen on the upper level masonry (Fig 1). Resulting from "The Wolf of Badenoch" torching of the building in 1390, the upper facing buttress masonry of the West Tower reveals where the lead flowed and solidified on the stonework. Linlithgow Palace was rendered roofless and ruined by a fire in 1746 whilst temporarily occupied by soldiers. Penicuik House was also reduced to a burnt-out shell in 1899 following a chimney fire incident (Fig 2).

Dating from Georgian and Victorian times, evidence of attempts to counteract fire can still be found around many country houses. Often the ornamental character of designed water features in the grounds conceals their functional role as a source of water for fire fighting purposes. A reference to a "Fire Pond" near the house might be noted on estate plans. With a view to raising

Fig. 2 Penicuick House. Although internal plasterwork fragments remain after 100 years of being roofless, nature has invaded the fire damaged interior. Structural disruption of the masonry has also occurred, with wallheads, chimneys, flues and openings being particularly vulnerable.

Fig. 3 House of Dun. Raising the alarm has always been important in the event of an incident occurring. Hung on well designed wrought-iron brackets, a manually operated fire alarm bell is positioned above the rear service court wall of the house.

the alarm and initiating first response fire fighting and escape, period bells (Fig 3), sand buckets (Fig 4) and extendible ladders on wheels (Fig 5) might still be found.

Significant and major conflagrations, such as the great fire of London in 1666, that of Edinburgh in 1824, and of Chicago in 1871, had disastrous consequences, as large parts of the cities were destroyed (Fig 6). But, each in their own way, also had positive effects through resulting regulation, and changed attitudes and approaches being promulgated to prevent similar situations from occurring in the future. Such statutes frequently form the basis for present-day regulations.

Historic Building Construction Details

With the increasing use of lime plaster finishes on walls and ceilings from the eighteenth century onwards, much of the hitherto open and exposed structural timber was disguised. But, as ceilings became more ornate and heavy the need emerged for carpenters to develop their skills and devise new constructional methods to support the applied plaster. Using roughly split lengths of small-sectioned timber laths, an appropriate method was found. These were secured by nails to supporting timbers with a small gap between each strip. This provided the interface between the primary structure and the intended finishes. Onto this base, wet plaster was applied and squeezed through the gaps to spread out and form a mechanical key. When it dried, this firmly anchored the finish to the supporting framework (Fig 7). Such a process relied on a firm structural support being created with adequate ventilation to keep the timbers rot-free. With ceilings, the laths were fixed directly to the underside of the spanning floor joists. For walls, anchor points were provided by a series of timber wedges driven into the masonry joints and beds in a regular pattern. The vertical supporting timbers were secured to these once the wedge tails were sawn off to create a series of fixing points on a flat plain and to accommodate a free air flow. Although creating a structure that was reasonably effective in combating dampness in walls, this system also provided a situation that allows easy flame spread behind the plasterwork should a fire take hold.

Additional fixing requirements were created by the need to secure fireplaces, door surrounds, window panelling finishes and other details. Again, the fundamental connection which existed between such

architectural features and the underlying masonry was the timber wedge, or "dook", driven into the stonework so that the 'finishes' could be held free of the wall. Again, hidden voids were created that could assist in the spread of undetected fire.

Timber was often used in a structural and functional capacity to overcome a variety of operational difficulties. Large section timber lintels are frequently found as the only structural member over doorways in internal walls. Dimension timbers were also positioned immediately behind masonry lintels over external doors, windows and other wall openings. Non-load bearing partitions might be constructed with braced vertical timber studs; the voids sometimes solidly infilled with materials such as wattle and daub, stone or brickwork. Curved ceiling coombes, and vaulted passageways, were created through fixing a series of timber formers, secured to the structural ceiling members (Fig 8). Complex timber floor structures may also be found where primary, secondary and tertiary members might be mortise and tenon jointed to create an integral frame. Such approaches can add to the potential of fire spread where they result in the creation of dead and interlinked air spaces within the structure. From Georgian times the introduction of deafening, where ash and other materials were inserted in the construction between the flooring and ceiling, can be found to be of some considerable help in controlling the spread of fire (Fig 9).

Through understanding basic construction techniques it should be possible to effect greater control of fire spread in historic buildings and to use the opportunities created by the voids to aid the installation of both services and fire protection measures. There is also a need to be rigorous in ensuring that adequate compartmentation is in place to stop fire spread.

Promoting the awareness of heritage fire losses

Based on a translation of the German work "Brandschutz in der Altstadt" the FPA edition of "Fire Protection in Old Buildings and Town Centres" in 1992[1] illustrated the special dangers of fire in historic buildings and towns and showed what measures were appropriate for dealing with them. It specifically targeted those professionals involved in modernisation and repair works and did much to increase an awareness of how fires could be avoided.

The FPA publication "Heritage under Fire", originally published in 1990 and enhanced by a second edition in 1995,[2] also provided valuable information to those

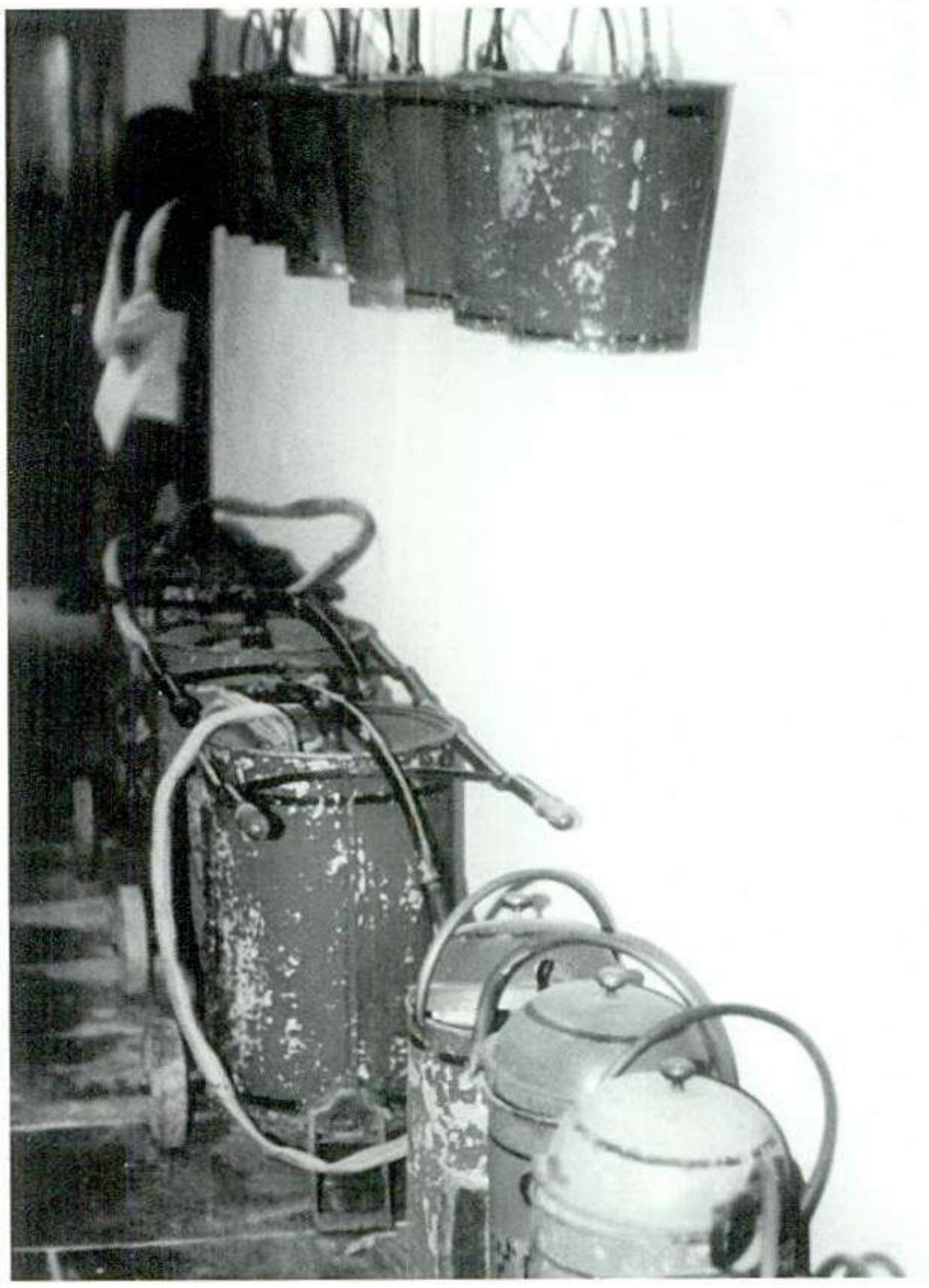

Fig.4 Firefighting apparatus. In some country houses, unique collections of early hand operated fire fighting extinguishers and sand buckets can still be found.

Fig. 5 Escape ladders. Displaying the skills of estate craftsmen in metal and wood, this extending escape ladder was easily transported around on its two cart wheels. A ratchet device on the winding drum prevented the ladder from accidentally retracting whilst in use.

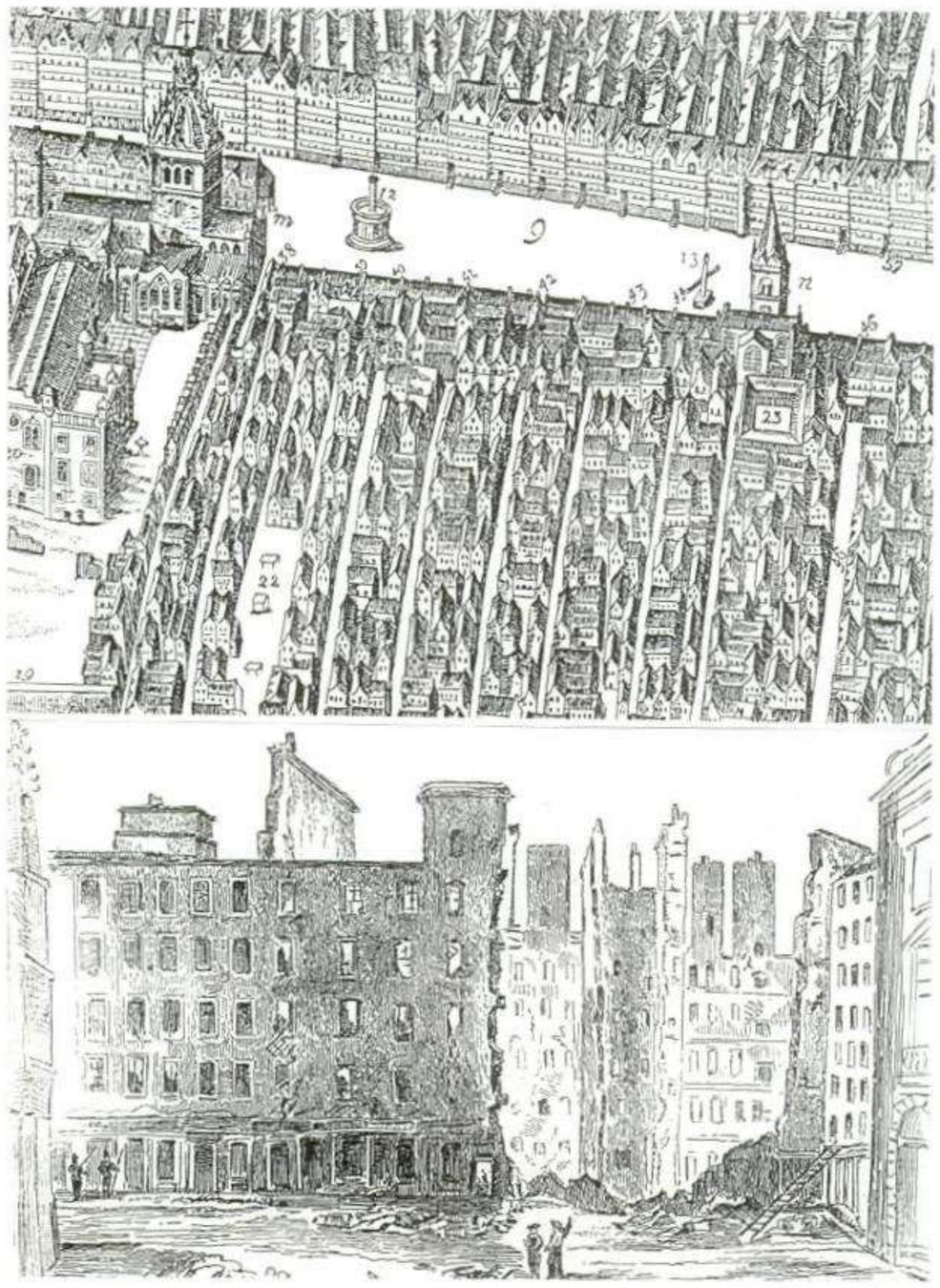

Fig. 6 The Great Fire, Edinburgh, 15-18 November 1824. Contemporary reports illustrate the devastating effects of the Great Fire of 1824. Many tightly packed tenement blocks, up to eleven storeys high, on the south side of Parliament Square were destroyed in a fire that started in an engravers' workshop. (Old and New Edinburgh)

Fig. 7 Lath and plaster. To protect the plaster finish and supporting timbers from coming into direct contact with the more moist structural masonry-work, air spaces usually exist between the two. Whilst required to ensure effective environmental conditions, these spaces can also aid undetected fire spread.

responsible for implementing measures to counteract the effects of fire and did much to increase the understanding of the issue. In addition, through a series of dramatic case studies, the publication brought into a sharp visual perspective the impact of heritage loss to fire. This document remains an essential work of reference.

Although produced from an American point of view, the 1994 NFPA publication "Recommended Practice for Fire Protection in Historic Structures" (3) did much to explore the technicalities of preventing historic building loss to fire and promoted a wide-ranging series of appropriate recommendations and effective practice. Perhaps inevitably, the emphasis is placed on what might be described as "modern" buildings from a European perspective. Nonetheless the publication contains essential guidance that many would benefit from following.

Significant losses through fire have been experienced world-wide:

In the USA, it is estimated that over the period 1980 to 1993 some 30,000 heritage-related fires occurred, amounting to a level of loss in the region of $40 million in value. In these properties, only one third had detection apparatus, and fewer than 10% were fitted with sprinkler protection. (4)

In Canada, with an average of 30 incidents per annum, some 316 museum, art gallery and library fires occurred between 1982 and 1993, creating an estimated loss of almost $17 million(5). Other incidents, such as that at St George's Church in Halifax, Nova Scotia revealed the vulnerability of major historic structures to fire. Here, arson by children caused $3 million worth of fire damage in June 1994. In line with other countries, the Canadian authorities are concerned about the level of loss (6).

During the period 1990 - 1993, at least seven major European heritage fire losses occurred -

Date	Building	Cause of Fire	Cost
February 1992	Proveantgarden, Copenhagen, Denmark	Stored materials	-
April 1992	Odd Fellow Palace, Copenhagen (1795), Denmark	Cigarette	-
June 1992	Christianborg Palace Church, Copenhagen, Denmark (1826)	Fireworks	[£5m]
November 1992	Redoutensal, Hofburg Palace, Vienna, Austria	Unknown	[£60m]
February 1993	Lundby Church, Goteborg, Sweden	Arson	-
1993	Chapel Bridge, Lucerne (14th C), Switzerland	Unknown	[£2.2m]

In England recent significant major losses have occurred at Windsor Castle, Hampton Court Palace, Uppark House and York Minster (South Transept). The Minster also suffered a serious fire in the Nave during the early nineteenth century, and the central block and tower of Castle Howard was badly damaged by fire during the 1940s.

In 1989, the publication "Disaster"[7] graphically illustrated a number of major Scottish fire incidents. Included in these were the 1905 blaze at the Peebles Hydropathic, the 1909 great fire in the Ingram Street-High Street area of Glasgow, the 1916 fire at Mugdrum House in Fife, the Inveraray Castle incident of 1975, and the 1978 Glasgow Grosvenor Hotel conflagration.

There are presently some 43,000 listed buildings in Scotland. From recent research, it is estimated that one Category A or B listed historic building is affected by fire every month in Scotland. (Fig 10) (Annex A). However, as no national statistics are kept which enable historic buildings to be identified as a class of their own, the loss level is believed by some to be greater. Over time, total, or even partial devastation by fire, constitutes a considerable threat to the quantity and quality of the country's built heritage stock.

Historic Buildings Fire Research Co-ordinating Committee (HBFRCC)

This committee was established following the publication of the Bailey Report in 1993[8]. Its aim is to provide co-ordination of fire safety research between the official bodies who are concerned with, and have a major responsibility for, fire safety in historic buildings.

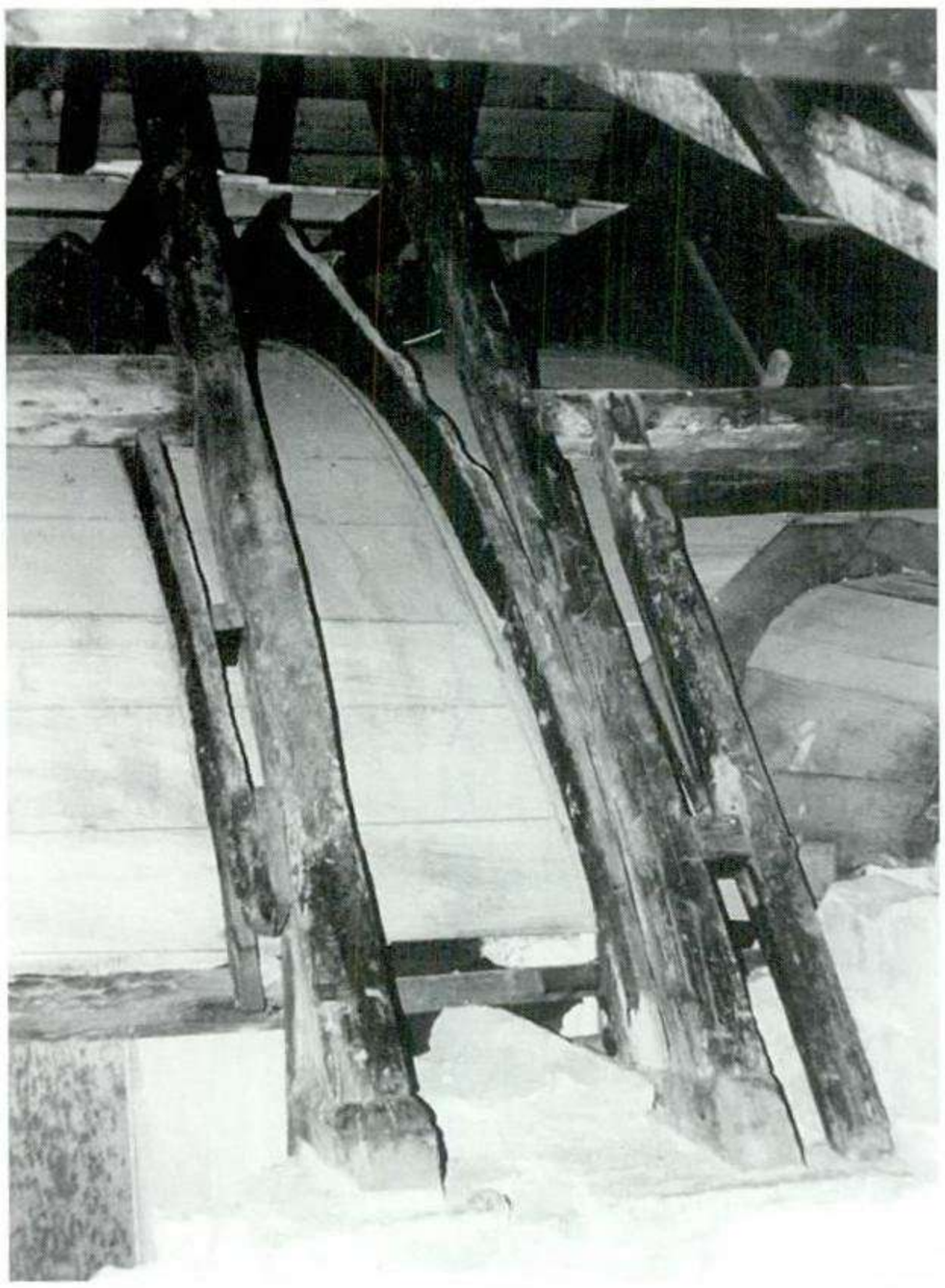

Fig. 8 Culross Palace. Complete original historic timber roof constructions are relatively rare in Scotland. More normally only partial remains exist. Where they survive, particular care and attention to detail is required to ensure that they are fully protected.

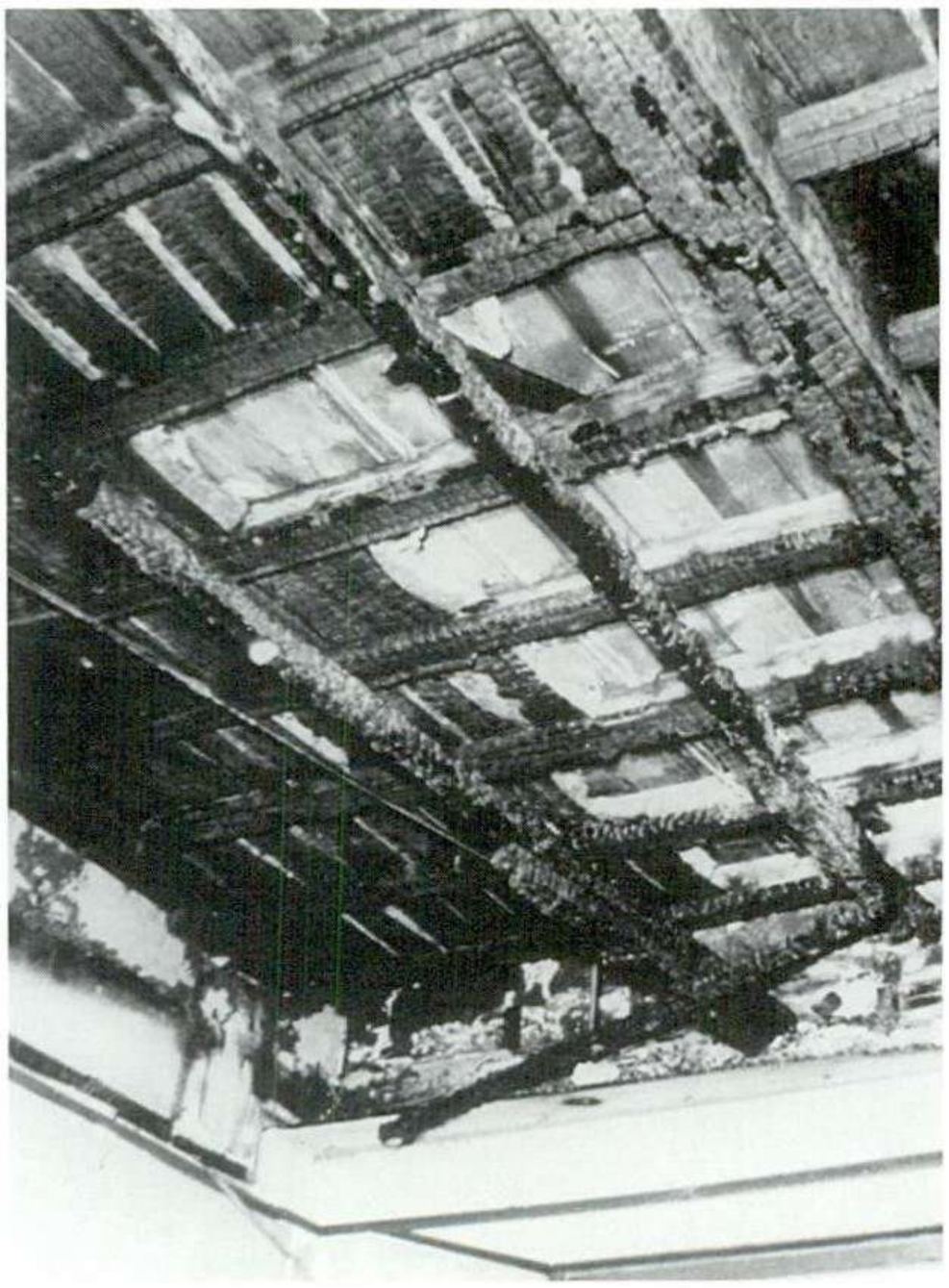

Fig. 9 "Deafening" in Georgian Tenement Construction. The use of ash and other inert building materials set on top of intermediate planking to create sound deafening in Georgian tenement floor construction can also assist in preventing the spread of fire from one property to another.

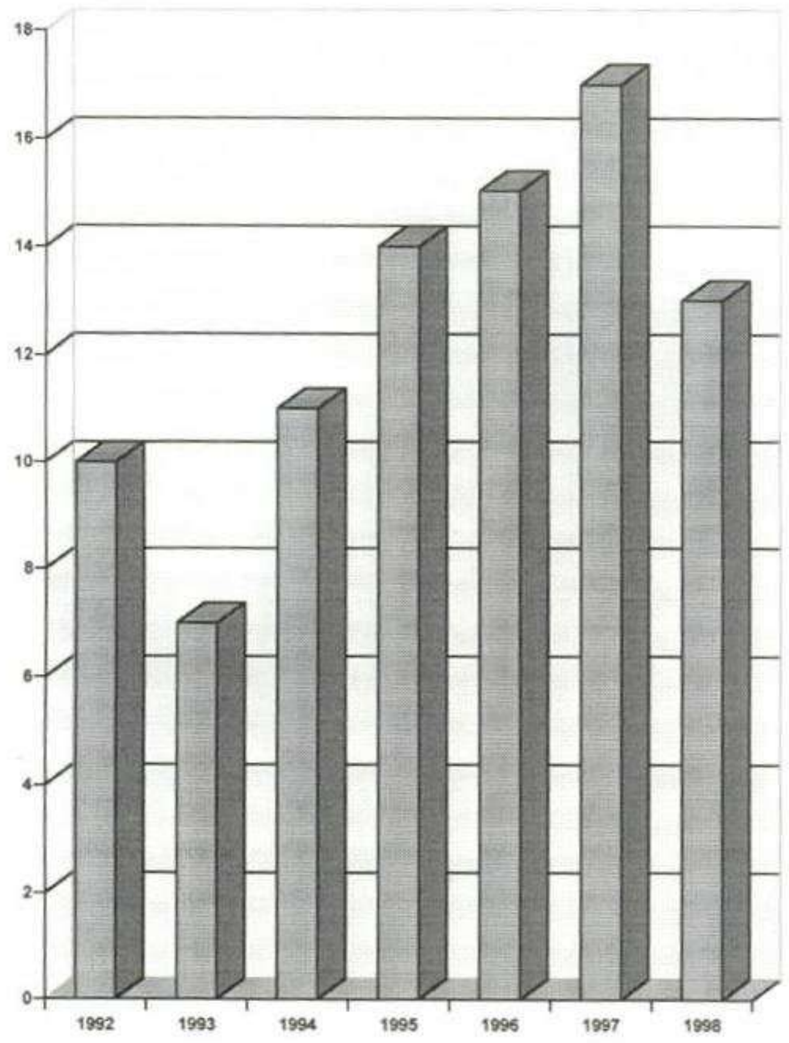

Fig. 10 Fires in Listed Scottish Historic Buildings. Covering the period January 1992 to September 1998, the average loss of a Category A or B listed building to the effect of fire runs at just over one per month

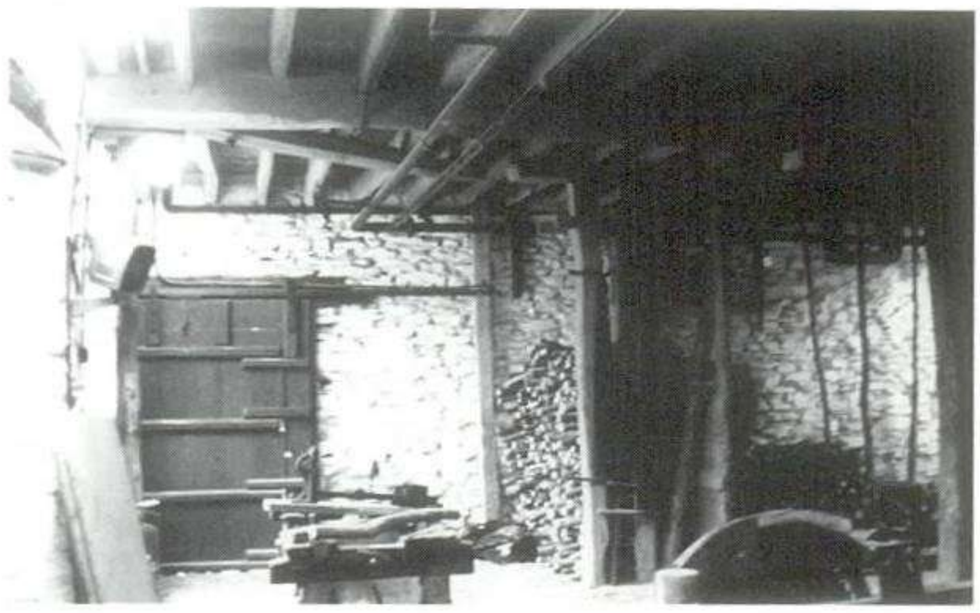

Fig. 11 System installation. When contemplating the installation of fire detection and suppression equipment, different aspects need to be considered in different circumstances. Given the nature of retro-fit servicing, it will be a much simpler job to install such systems into a historic industrial interior than it would be into an eighteenth century domestic one.

Meeting under the chairmanship of English Heritage, the committee has drawn its members from:

- Department for Culture, Media and Sport
- Historic Scotland
- Heritage and Environment Services (Northern Ireland)
- CADW - Welsh Historic Monuments
- Historic Royal Palaces Agency
- Palace of Westminster
- PACE Central Advice Unit
- The National Trust
- The Royal Household
- Fire Protection Association
- The Home Office

With the intention of disseminating information on research and providing guidance to those concerned with historic buildings fire safety, English Heritage published the following material during 1997/1998 :

- Timber panelled doors and fire [9]
- The use of intumescent products in historic buildings [10]
- Fire safety management in cathedrals [11]
- Prevention of loss or damage by fire in cathedrals [12]
- Smoke detection systems for cathedrals [13]

A further series of associated technical material is planned for publication in the future.

Causes of fire

It is necessary to be precise when analysing the causes of fire incidents to get a broader picture of the types of causes that are most prevalent. This is required to help formulate an appropriate response to stemming the problem. As a result, broad categories of the cause of fire have been identified as follows-

- electrical faults
- open fires and defective flues
- building maintenance work
- vandalism

- arson
- smoking
- lightning strike
- accident

As to the actual split of occurrences, the most accurate available statistics were produced by the FPA in 1995 when 456 fire incidents were analysed. However, these relate to all occupancy properties where fire damage was in excess of £50,000. It was found that 43% of the fires could be attributed to arson, 22% to electrical appliance or equipment failure, 7.2% to smoking, 3.7% to hot work, 1% to cooking, and 1.9% to chimney fires.

Other, more recent, statistics gathered by the HBFRCC indicate that in the historic buildings sector, arson may well be responsible for 52% of fires, and chimney fires could account for over 30% of incidents.

Supplementary factors contributing to the spread of fire in a historic building can also be identified as being :

- open and ill-fitting doors
- thin wall construction
- structural discontinuity
- unknown wall and floor voids
- unstopped ventilation and service routes
- roof voids and lack of compartmentation

Overcoming these problems need to be addressed within a conservation framework - where the preservation of existing fabric and aesthetic considerations are paramount. Balancing all the (sometimes conflicting) issues will be necessary to ensure that the best possible solution can be achieved.

Construction work and fire loading

Excluding the contents and their contribution to the potential overall fire load, the amount of timberwork in a historic interior results in an ample supply of fuel. A fire can be ignited in many different ways. Whilst prudent steps, such as installing effective lightning conductors and maintaining an adequate security vigil, can assist in reducing the likelihood of fires from natural causes and arson, developing an increased awareness of other risk factors can help further reduce the risk. This is especially important whilst construction work is in progress.

Enforcing strict controls on project contractors, including adopting clearly defined work method statements and the use of Hot Work permits (if hot work is to carried out at all), will go some way towards reducing the risk of accidental fire occurring. Other aspects should focus on :

- planning for all eventualities
- training and familiarising site operatives with job circumstances
- installing and routinely testing temporary detection equipment
- keeping a tidy and clean site
- ensuring the integrity of the water supply throughout operations
- being vigilant at all times

Central to this approach is the need to fully understand all the resources of the building and its site. This will involve creating an awareness of the building's construction and design detail, the micro-climatic and environmental conditions, and the operational parameters of any proposed temporary or permanent equipment.

Fig. 12 Detection equipment. With a limited choice of sympathetically designed equipment being available to the specifier, it can be difficult to be sensitive in the appropriate positioning of smoke detector heads. Due to their size and required operating parameters, in certain situations it may be more relevant to install an air sampling system.

Planned Preventative Maintenance

Much can also be done through improving planned preventative maintenance regimes. Early warning of potential problems should be achieved by ensuring routine chimney sweeping and checks on existing services, wiring circuits and heating installations are carried out. A regular process of inspection to a prescribed schedule should be established, and effective maintenance and repair works rapidly carried out whenever the inspection process identifies a need for action.

Fire Engineering and Conservation Needs

When designing with a view to improving the level of fire protection in an historic building, a balance must always be struck to ensure that the significance and authenticity of the building or site is retained (these are, after all, the special qualities we value). Minimal intervention into the fabric should be a key principle to guide any new work. Thus, works to improve compartmentation, or to provide fire detection or suppression, should not cause unnecessary disruption or damage during installation, maintenance or eventual removal. Ideally they should be designed on a totally reversible basis, adopting a plug in - plug out philosophy.

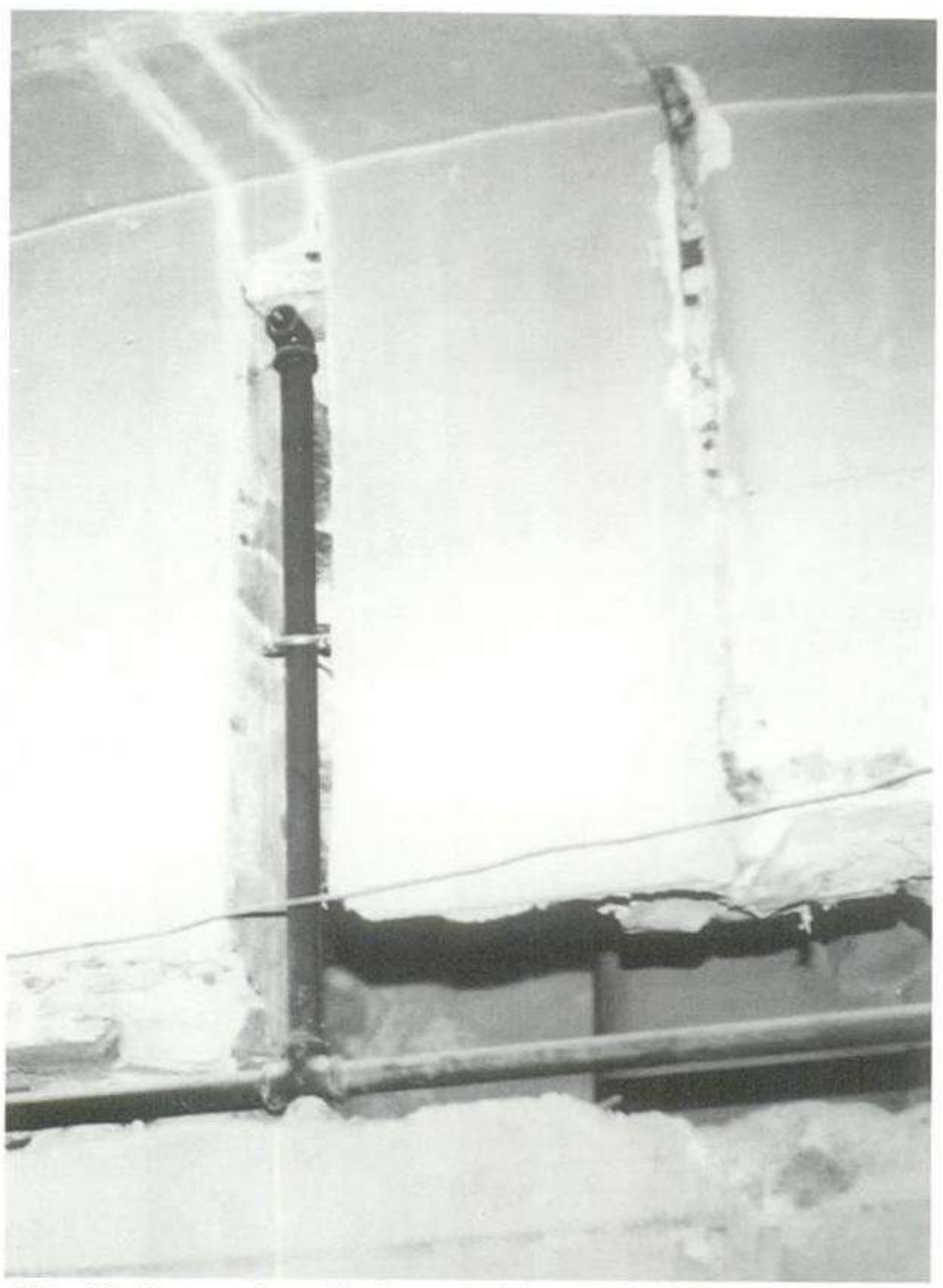

Fig. 13 System installation. In historic buildings, what is apparent on the surface may not accurately reflect that which is underneath. When planning to undertake notching or cutting work consideration needs to be given to uncovering variations in the original construction process. This may require changes during the progress of the work so that it is carried out more sympathetically with the buildings detail. Minimal intervention should always be the aim.

But, realistically, installing detection and suppression systems will create a physical demand on the building fabric. This will vary depending on the type under consideration (Figs 11a and b).With traditional historic building construction, some room for manoeuvre does exist, although in places it will be restricted. As electrical supply, detection and monitoring cables, and air sampling tubes are reasonably flexible, it should be possible install these in a historic building with little or no damage. The sensitive positioning of exposed detection equipment can be difficult (Fig 12). Steel water sprinkler supply pipes tend to be still more demanding, as they require predetermined straight runs, angled bends and alignments. In consequence, their installation could require some notching into the structure to accommodate the runs. The quantity and method of notching must be carefully controlled, as it is not unusual to find that the perceptions of priorities, need and function differ between the various professional disciplines that might be involved (Fig 13).

From the fire engineering point of view there will be a desire to accommodate -

- life safety provisions
- fire safety management and prevention
- detection and alarm systems
- means of escape
- control of fire growth and spread
- structural stability
- smoke control
- fire fighting access

From the conservation perspective, it will be necessary to consider the preservation of -

- form and layout
- all authentic fabric
- occupancy and use
- location and character of internal spaces
- quality and importance of finishes
- contents
- site location and accessibility

An integrated policy, balancing fire engineering and conservation needs should, therefore, be devised with joint regard for-

- protection of life
- protection of the building, its finishes and contents
- routine training of staff and promotion of awareness
- highest standards of risk management

Fire Risk Assessment

A detailed fire risk assessment should be at the heart of any project that has the aim of protecting life, and the contents and fabric of a historic building. Founded on a detailed physical survey of the building's condition, this assessment should aim to identify and categorise all fire hazards throughout the property. It should establish this through estimating the potential fire loading, and hence potential fire duration in each compartment, and determining ways whereby the fire spread to adjacent rooms might be eliminated. This may involve assessing the building with a view to sub-dividing it into a manageable series of compartmented fire zones. Within each zone, the areas or items which have the lowest fire resistance should be identified as this will influence the course of action chosen.

In this process, a full understanding of the building's fire loading will be required. Using this knowledge, risk reduction and control strategies can be determined to minimise the possibility of ignition occurring and the fire spreading. Working in sympathy with historic constructional detailing, damage to the original fabric and finishes can be minimised. But the range of fire barriers to reduce fire spread in historic buildings need to be carefully devised. (Fig 14)

Underlying many of these considerations will be the estimated response time of the local fire brigade in the event of an incident occurring. This time, and the number of fire appliances available in a rural location, are likely to be very different from those which might apply in an urban situation.

Should a fire incident take place in an unprotected building the effects are likely to be devastating. After only a few minutes, the majority of the contents and the decorative timbers will be lost or considerably

Fig. 14 Listed building adaptation. Through adopting an approach that separated the modern structure from the historic construction, a sympathetic conversion has taken place in this redundant church. However, the requirement to have a fire extinguisher, push-bar door-pad, pendent emergency lighting, fire alarm point and three stick-on instruction labels create a distracting, non-integrated appearance around the escape door.

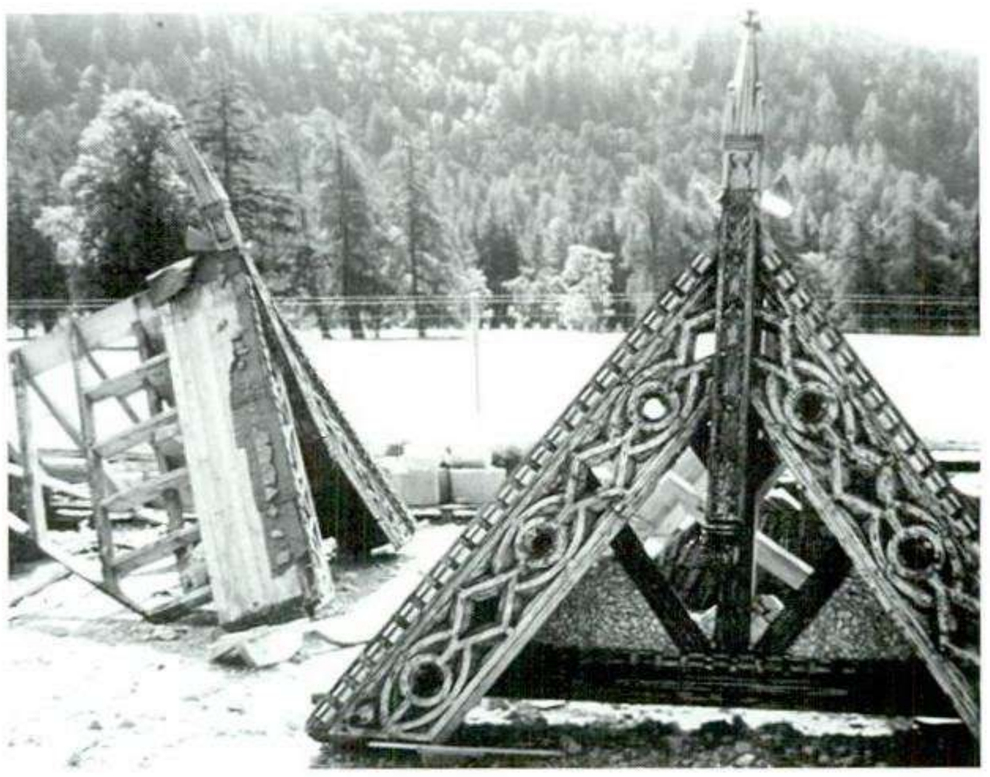

Fig. 15 Salvage. If no accurate records exist of a fire-damaged building, the period following a fire might be the only possible time to research the building's construction and finishes. Recording where burnt roof trusses and floor beams fell can assist in an accurate structural reconstruction of the premise, and the savage of architectural features during an incident might allow their reuse.

deformed in the incident area. If a building is fire-gutted, many philosophical issues will also arise when deciding what the best course of action should be thereafter.

Post-fire Archaeology and Salvage

If the property has been inadequately recorded, the period immediately following an incident might be the only chance left to try to gain some detailed understanding of its quality, features and finishes.

Whilst this might not be appropriate in all situations, adopting an archaeological approach to the surveying, recording and analysis of the undisturbed burnt-out remains of a structure can produce some meaningful results. Measured survey, photographic or photogrammetric means may be deployed to obtain an appropriate record. Such an approach may be considered as an integral element of salvage, and be timed so that maximum benefits can be secured from the records produced.

Following a fire, effective salvage of the fragments of the original internal details will require careful consideration to allow for their effective analysis and possible reuse. This may require adequate key-referencing to the found location, appropriate transportation and storage arrangements. It can also mean painstaking detection work if the loss has been of major significance. Again, the archaeological model provides useful guidance. (Fig 15a and b)

Thoughts of salvage should also be borne in mind during an incident. Here, it may be appropriate to identify external and internal features that might be saved as a fire burns. Close collaboration with the Officer in Charge of the incident will be required so that needs can be indicated, and possibilities established, whilst fully taking the prevailing circumstances into account.

Historic Scotland's Fire Research Programme

Due to the high level of loss that is being experienced throughout the country, Historic Scotland initiated research in 1994 into the protection of historic buildings from fire. The preliminary work has since been expanded to include an investigation of the appropriateness of installing active suppression systems, such as water sprinklers. To assist practitioners in their understanding of the processes involved, and to aid effective dissemination of the research findings, Historic Scotland has published the emerging technical advice.

The overall aim of the research programme was to ensure that measures required to protect occupants, users, and the fabric of historic buildings in Scotland are appropriate, consistent with conservation principles, and make the best use of the available resources. Such an approach has not, in any way, undermined the fundamental need to ensure effective life-saving measures as a first priority.

TAN 11: Fire Protection Measures in Scottish Historic Buildings

The initial step, which was supported by a specially convened industry wide Fire Liaison Group, specifically examined fire engineering and conservation related issues, and considered available literature on fire protection and historic building details. The aim was to produce a Technical Advice Note[14] for use within Historic Scotland, and for dissemination amongst those responsible for the nation's built fabric. This publication, released in September 1997, includes material on the following topics -

- The Vulnerability of Historic Buildings to Fire
- How Fires Develop
- Fire Safety Management and Fire Precautions
- Compartmentation
- Doors and Door Closers
- The Performance of Historic Building Materials in Fire
- Fire Detection
- Alarm, Escape, Lighting and Signs
- Fire Suppression
- Smoke and its Control
- Fire Engineering and Historic Buildings

In the Appendices a number of case studies are presented, along with a Glossary of Terms. In addition other appendices deal with:-

- Legislation
- Risk Assessment Methodology
- Planning for Damage Control
- Insurance
- Organisations
- Bibliography

Suppression Systems

It is readily recognised that technology can assist in the provision of a satisfactory level of fire protection. The installation of fire suppression systems, such as water sprinklers, can be extremely effective in stopping the

spread of fire within a building. Experience has shown that sprinkler protection is one of the most reliable forms of fire suppression available.

Although sprinkler protection is highly developed and has been in use for over 100 years, little evidence exists to show that it is wholeheartedly accepted for installation in historic buildings (Fig 16). Primarily this is due to the misinformed, yet popularly-held, opinion that the installation would introduce new risks to endanger the historic fabric and contents and cause too much damage in itself.

This concern is ironic, given that a sprinkler system is designed to be operated by the heat of a fire, discharging a minimal amount of water directly onto any burning material, i.e. only where it is needed to effect early suppression. The system ensures a rapid reaction to the fire, with minimal generation of smoke and damage to property. By contrast an unrestrained fire will inevitably result in greater loss of fabric and damage will occur well beyond the seat of the blaze, so more time and water will be needed to bring the fire under control.

The efficacy of the system depends on having a sufficient and reliable supply of clean water delivered through carefully installed pipes to individual water sprinkler heads. The style of heads must be chosen to give an adequate density of discharge and full coverage throughout the building. A partial installation in areas of high fire risk is an option that may be appropriate in some circumstances but is not generally recommended. This is because in areas without sprinkler protection a fire might be allowed to develop and take hold. When such a fire does spread to areas that are sprinkler protected, the heads may not be able to suppress the developed fire. A full installation should always be aimed for.

Present day automatic sprinkler installations use a range of fittings. These include side wall, recessed and concealed sprinkler heads. Acting as a detector head for the suppression system, sprinklers operate

Fig. 16 Sprinkler installation. The historic uses of sprinkler systems in Britain tend to predominate in industrial and commercial buildings. This is, perhaps, not surprising. What is of interest is this case, where the original sprinkler installation was left in-situ following conversion of the industrial premises, it was not retained in an active mode!

Fig. 17 Additional fire risks. Fires need ignition, oxygen and fuel to gain hold. Through effective management and training much can be done, without additional cost, to reduce the risks involved. Human nature tends to hoard material things, and if storage space is available, it will be filled with items - valuable or not. Attic spaces are particularly vulnerable to this phenomenon. They should be regularly inspected and any unwanted or high risk items removed, especially if they contribute to an increased fire load.

individually when the thermal elements contained within them reach their defined operating temperature. This can be set at one of a series of seven points in a range between 57°C and 260° C. The sprinkler should operate as early as possible in the development of a fire. The chosen temperature rating should be the lowest possible, given the environmental limits of the room in which the head is to be installed.

An analysis of fires that have occurred in sprinkler-protected buildings indicates that 26% were controlled by one head, 44% by 2 heads, and 65% by the operation of up to 5 heads. Water discharges from a single sprinkler head at a rate between 30 and 100 litres per minute. This compares very favourably with the likely discharge of 600 litres per minute from a hand-held hose and 1,100 litres per minute from a hydraulic platform or turntable ladder monitor. Reflecting on such statistics, the case for installing sprinkler protection in Canadian museums is ably described in CCI Notes 2/8 [15].

If a fire is allowed to develop in an unsprinkled building, considerable quantities of water will be required to extinguish it. During the 1992 Windsor Castle fire up to 31 jets and 2 hydraulic platform monitors were deployed. These would have delivered approximately 20,000 litres of water per minute into the building at the height of the incident. The consequences of deploying such a high volume of water to control a fire is immense. The structure will quickly become saturated, and the subsequent drying out problems are often greatly underestimated. Timbers that survive a blaze could well fall victim to subsequent fungal attack.

There are however a number of factors that need to be considered when undertaking the detailed design of a sprinkler system. Included might be -

- the selection of the equipment
- how the exposed fittings relate to the internal detail and finishes
- the service pipe runs and cable routes
- associated facility needs such as supply tanks, pump houses etc.
- back up requirements and power supplies
- aesthetic considerations and impact
- instructions, emergency lighting and signage

TAN 14: Installation of Sprinkler Systems in Historic Buildings

The second technical publication to be produced by Historic Scotland's TCRE Division considers the appropriateness of sprinkler systems to stem the high level of fire loss in more detail. This aims to develop a more focused awareness of the problems and benefits of installing such suppression systems in historic buildings. The foundation for the TAN[16] lay in Historic Scotland's own experience of installing a fully charged water sprinkler system in William Adam's 1735 Duff House on the outskirts of Banff, in north-east Scotland. This property was converted in 1994-1995 in conjunction with the local authority, Aberdeenshire Council, into a country house gallery to operate as a National Galleries of Scotland outstation. During the works to install the water sprinkler and fire detection systems and to improve compartmentation much was learned regarding the difficulties and benefits of undertaking this type of work. It was the first installation of its kind in the United Kingdom.

TAN 14 deals with the history and effectiveness of sprinkler installations and sets out the case for installing them in historic buildings. It analyses the component parts of the system and deals with issues liable to emerge during the installation process. A section also addresses care and maintenance considerations and training matters, to ensure that the system remains in full working order.

Staff Training and Education - an Essential Management Issue

An integral part of any fire assessment programme should be the establishment and maintenance of a fully comprehensive staff training and education policy. Without this essential component, much of what can be achieved through the adoption of a fire risk assessment and acceptance of fire protection technology can easily be negated. Due regard must be paid to the need for all staff to be familiar with equipment and systems, routine and other maintenance regimes, salvage techniques and disaster planning,

To help prepare for the worst, a disaster plan should be put in place. This process should include the consideration of post-fire salvage and recovery needs. At a more basic level, emphasis should be placed on the requirement to effect good housekeeping at all times. Storage areas should be regularly inspected and rubbish removed to minimise fire risk (Fig 17). The operational effectiveness of installed equipment should be routinely monitored and any deficiencies in their efficient functional capability addressed. A routine check should be made to ensure that the suppliers of equipment can, and will, continue to service and support the installation. A stock of relevant spare parts should be kept, as should a well-maintained stock of emergency supplies for use in the event of a disaster.

Effective routine on-site exercises, in conjunction with the fire brigade and other services as necessary, are essential to simulate emergency fire response action.

The fire action plan is a key document and it should be constantly kept up to date by staff who know exactly what they are doing.

Training and education needs should also be evaluated afresh when construction works are being carried out. Stringent control should be maintained over hot working and the issue of Hot Work Permits effectively controlled and monitored. Guidance should be offered on controlling the storage of flammable liquids, and safe site storage devised. Any temporary fire fighting equipment should be positioned in obvious locations and staff made familiar with their operation. Careful consideration should be given to the positioning of temporary site huts and other accommodation so as not to create an unnecessary risk to adjacent premises.

Firefighters, too, need to minimise the risks they face in an operational situation. Historic buildings can create an additional encumbrance given the value of the fabric of the building and its contents. Within the wider context, recent advice [17] ably describes how firefighters can manage risk to ensure their own safety.

Fig 18. Redoutensal, Hofburg Palace, Vienna. Where fire devastation is total, philosophical and ethical arguments can often arise as there is little left to conserve. Restoration may be inevitable, but what constitutes authenticity? A bold solution was adopted at the Hofburg when deciding how to bring the damaged interiors back into use following the fire of 1992.

Conclusion

The possible consequences of a fire in a historic building deemed to be a high hazard subject in a risk assessment analysis must be carefully thought through. A detailed understanding of the building's construction, and how it might react to fire, is an essential pre-requisite before any decisions are made or work carried out. Risk assessment, in all its guises, is a useful managerial tool. Each building should have its fire risks eliminated wherever possible. This will only be possible if owners, professionals, and others involved in the well-being of historic structures are adequately informed and vigilant. Education is essential, and Historic Scotland's research work aims to part-answer that need by explaining the current understanding and appreciation of problems associated with fire.

There is always the chance of physically conserving something that is wet, but it is generally impossible to reconstitute something that is burnt! On that basis alone, the case for installing suppression systems in appropriate circumstances is strong. Other relevant factors, such as fire brigade response time, building quality and the value of contents will play a part in the decision on when it is relevant to install such a system.

Should a fire occur in a historic property it will lead to a degree of cultural loss. The extent of that will greatly depend upon the scale of the fire and how quickly it can be brought under control. Should it lead to the situation where the building has been burnt out, other factors emerge. These centre on philosophical and ethical arguments about what to replace and how (Fig 18). Whatever is decided - to restore, recreate or design anew - the heritage value of the building will be diminished and its integrity will be partly if not totally compromised.

The ultimate objective must be to reduce the overall fire loss, for this is steadily eroding the quality and quantity of the historic building stock. To assist in this process, Technical Advice Notes 11 and 14 offer guidance on the principles involved. They are not intended as prescriptive documents nor to offer definitive specifications for on-site use. Rather, their intention is to give advice and information. It is hoped that their contents should be of value to those who have to consider implementing fire risk assessment and protection measures in historic buildings. They represent only the first steps in the process and more searching deliberations are required if the significant level of heritage property loss is to be reduced.

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Annex A
FIRES IN SCOTTISH HISTORIC BUILDINGS

The under-noted list of fire in Scottish historic properties is by no means exhaustive. The data was compiled as a result of a trawl of press clippings that was started towards the end of 1996, supplemented by information contained in the Scottish Civic Trust's Buildings at Risk database.

This unusual method of gathering research material stems from the fact that it is impossible to extract data on fires occurring in historic buildings from official sources. Although this deficiency is recognised by the authorities, it is unlikely that the reporting procedure will be changed to enable the easier extraction of relevant data in the future. The current method of data gathering will therefore continue.

One clipping, covering the period 1985 -1990, is of particular general interest. In The Scotsman of 3 March 1991 it was reported that Lothian and Borders Fire Brigade attended fires affecting 2848 homes, 151 shops and stores, 69 offices, 66 warehouses, 58 factories and 24 hotels in their region. Although no subdivision of property types were available, given the high number of listed premises in the area, it is likely that a considerable number of these incidents occurred in listed buildings.

Date and Property	**Category of Listing**
Fires of Uncertain date	
Dalquharran Castle, Dailly, South Ayrshire, 1789-1792	A listed
Towerview Unit, Leverndale Hospital, Glasgow, late C19 / early C20	A listed
Duke St. Parish Church, 176 Duke Street, Glasgow, 1857-8,	A listed
Former Erskine Church, 15 Bank Street, Annan, 1834-5	B listed
Craig House, Crosshouse, Nr Kilmarnock, 1780s	B listed
Ballumbie House, Ballumbie, Dundee, 1810	B listed
Links House, Mid Yell, Yell, Shetland, 1770	B listed
Linside Mill, Anchor Mills, Seedhill, Paisley, 1859	B listed
The Clyde Estuary Hotel, 78 Princes Street, Ardrossan, mid C19	B listed
Rosewell Institute, Carnethie Street, Rosewell, 1917	B listed
The Colwyn, 868 Great Northern Road, Woodside, Aberdeen, c1830	B listed
77-83 High Street, Airdrie, North Lanarkshire, 1911	C(S) listed
The Avenue, Girvan, South late C18	C(S) listed
Corston, Morton reservoir barn, near Mid Calder	Unlisted
Church of Scotland (The Tower House), Castlebay, Barra, 1892-3	Unlisted
Mill of Forse, Nr Latheron, early C19	Unlisted
Lathallan House, by Falkirk, C19	Unlisted
Former Dundyvan Manse, Oxford Street, Coatbridge, 1905	Unlisted
Stromeferry Hotel, Stromeferry, Nr Plockton, C19	Unlisted
Corrour Lodge, Loch Ossian, Rannoch Moor	Unlisted
Fires of Uncertain date during 1970's	
Mavisbank House, Polton, Midlothian, 1723-7, 1973	A listed
Knightsbridge House, Deerpark, Livingston, 1831	B listed
21a and 22 Adelphi, Aberdeen, 1815 and early C19	B and Unlisted
Logie House, Pitcaple, Gairloch, Aberdeen, 1680, 1974	B listed
Fires of Uncertain date during 1980's	
Greenlaw House, Castle Douglas, 1741	A listed
Corskie, Banff, early C18	B listed
St. Helens, 474 Perth Road, Dundee, 1850	B listed

Woodilee Hospital (main block), Lenzie, 1871-5	B listed
Brabstermire House, Canisbay, Caithness, Early C19	Unlisted

Fires of Uncertain date during 1990's

Baldovan House, Strathmartine, Dundee, early C18	B listed
Dolphin Arts Centre, 7 James St and Greenhead St, Glasgow, 1890-93	B listed
Spoonish House, Lochmaddy, North Uist, 1804	B listed
Main Street, Kilsyth	B listed
31, Muiryhall Street, Coatbridge, North Lanarkshire, 1898	C(S) listed
1-9 Falcon Square (Falcon Foundry), Inverness, c1840-50	C(S) listed
Craighead Mill, Lesmahagow, Lanarkshire, C19	Unlisted

Early fires

c1775	
Sauchie Tower, Alloa, early C15	A listed + SM
1899	
Penicuik House, Penicuik, 1761	A listed
1919	
Ketternear House, Kemnay, c1566	B listed
1928	
Glenlair House, Nr Kirkpatrick Durham, C19	B listed
1938	
Castlewigg, near Whithorn, C16	B listed
1941	
Barnbarroch House, Whauphill, near Wigtown, 1780	B listed
1947	
Auchingray House, 101 Forrestfield Rd, Caldercruix, 1820s	C(S) listed

Fires in 1982

Barkly House, Braehead, Cromarty, late C18	B listed

Fires in 1984

Earls Lodge (Buchaness Cottage), Boddam, Nr Peterhead, 1840	Unlisted

Fires in 1985

Tower of Dunmore Castle, Tarbert, C19	B listed
Trumland House, Rousay, Orkney, 1870-73	B listed
Rannoch Lodge, Bridge of Gaur, Perthshire, mid C18	B listed
Leethland, Glenpatrick Road, Elderslie, Nr Paisley, 1930	B listed

Fires in 1986

St Machar's Cathedral, Aberdeen	A listed
Edinburgh Castle Piping School	A listed
Charleton House, Montrose, early C19	B listed

Fires in 1987

Ca d'Oro Building, Glasgow	A listed
Tarbat House, Kildary, Nr Invergordon, 1787-1902	A listed
Cullen House, Banffshire 16th C	A listed
Dunbar Parish Church	
Greenmount Hotel, Greenmount Road North, Burntisland, 1860	B listed

Fires in 1988

Liberton House	A listed

Fires in 1989

6-14 John Finnie Street, Kilmarnock, 1874	B listed
Bellevue Hotel, Queen's Road, Dunbar, 1896-7	B listed
Guthrie Street, Edinburgh	Unlisted
Chalmers Memorial Church, Anstruther, 1889	Unlisted

Fires in 1990

York Place tenement, Edinburgh	A listed
Edinburgh University Students Union	B listed
Lomond Castle (formerly Auchenheglish), Balloch, 1865	B listed
Netherkirkton House, Neilston Road, Neilston, mid C19	B listed
Old House of Orchill, Dunblane	

Fires in 1991

Portmore House, Eddleston	A listed
Grand Theatre, Stockbridge, Edinburgh	B listed
Ascog House, Rothesay	B listed
West George Street building, Glasgow	B listed
Mar Lodge, Braemar, 1896	B listed
Palace Hotel, 108-110 Princes Street, Edinburgh, 1869	B listed

Fires in 1992

Broughton House, Kirkcudbright	A listed
Strathleven House, Alexandria C18	A listed
Pitfour Castle, Glencarse	A listed
Newton House, Nr Elgin, Moray, 1793	B listed
Nicholson Square tenement, Edinburgh	B listed
Queensgate Hotel, Inverness	B listed
Seafield Arms Hotel, Keith	B listed
Kilnside House, Paisley	B listed
Butler's Lodge, Glasserton, Whithorn mid C19	B listed
Former Counting House, Anchor Mills, Seedhill, Paisley 1874	B listed
Old Corn Exchange, Kirkstyle/ Tower Dykeside, Hawick 1860s	Unlisted
Ferryhill North Church, Aberdeen	Unlisted
Old Court House, Dunfermline	Unlisted
Torsonce House, Stow 1886	Unlisted
Wrangholm Hall, Motherwell	Unlisted

Fires in 1993

Strathleven House, Alexandria C18	A listed
Chapel Works, Eastern Road, Montrose, 1795	A and B listed
1, 2 and 3 Park Gardens, Glasgow 1855	A listed
Beach Ballroom, Aberdeen	B listed
Linside Mill, Anchor Mills, Seedhill, Paisley, 1859	B listed
Mid Dykebar, Grahamston Road, Paisley, 1909	B listed
A and S Henry Building, Victoria Road, Dundee	B listed

Fires in 1994

Aberuchill Castle, Comrie	A listed
St. Peter's College, Cardross, 1966	A listed
Castlemilk House stables, 59 Machrie Road, Glasgow, c1800	A listed
Kilkerran House, Crosshill, Maybole	A listed
Lanrick Castle, Doune, 1803	B listed
Kilmarnock Infirmary	B listed
Stirkoke House, Nr Wick, 1858	B listed
Skibo Castle, Dornoch	B listed
Bridgend Mills and Millhouse, Dalry, North Ayrshire, c1877	B listed
Scotstoun West Parish Church, Glasgow	B listed
Sherbrooke St Gilberts Church, Glasgow	C(S) listed
Lochailort Inn, Lochailort	Unlisted
Foley House, Isle of Bute, late 18th C	Unlisted

Fires in 1995

Caldwell House, Lugton, Renfrewshire, from 1773	A listed
Cambusnethan Priory, Wishaw, 1819	A listed
Aberdeen Academy Belmont Street, Aberdeen	A and B listed
Stanley Mills, Stanley, Perthshire, from 1786	A listed
Moy House, West Moray, mid C18	A listed
Dunblane Hydro	B listed
Crawford Priory, Cults, Nr Cupar, 1809	B listed
Knightsbridge House, Deerpark, Livingston, 1831	B listed
British Ropeworks, Lloyd Street, Farme Cross, Rutherglen. 1912	B listed
Greens Playhouse, Dundee.1936	B listed
Knightsridge House, Livingston (derelict)	B listed
Rhindmuir House, Swinton, Glasgow	B listed
Carriages Restaurant, 1050 Great Western Road, Glasgow, 1897	B listed
Ferguslie Threadworks, Paisley and Johnstone Canal, Paisley, c1850	C(S) listed
North Church, Dumbarton	Unlisted
Hunter House, East Kilbride	Unlisted
Rockvilla School, Glasgow	Unlisted

Fires in 1996

Woodbank Hotel, Balloch, Dumbarton	A listed
Coodham House, Symington, 1831	A listed
Kirkoswald Parish Church, Kirkoswald	A listed
Middleton House, Midlothian, 18th C	A listed
Mitchell Library, Glasgow	B listed
British Ropes Factory, Rutherglen	B listed
Gartsherrie Academy, 30 Academy Street, Coatbridge 1870	B listed
6 Rhughasinish, South Uist, c1900	B listed
Mill Inn, Dunottar Avenue, Stonehaven, late C18	B listed
Towans Hotel, Prestwick	B listed
Hallside School, Rutherglen	B listed
Kilbarchan School, Renfrewshire	C(S) listed
Treesbank Stables, Ayr Road, Kilmarnock, c1770	C(S) listed
Kinfauns Parish Church, Kinfauns 1868-9	C(S) listed
Baronald House stables ,Cartland Bridge Hotel, early C19	C(S) listed
Lodge House, Arkleston Cemetery, Paisley, C19	Unlisted
Philipburn House (Hotel), Selkirk 1751	Unlisted
Duke of Gordon Hotel, Kingussie	Unlisted
Potterton House, Grampian	Unlisted

Fires in 1997

Forth Rail Bridge; South Pier Pontoon	A listed
Lennoxlove House, Haddington	A listed
The Institute (Disco), Maxwellton Road, Paisley. C1880	A listed
Granton House, Moffat. 1830/40	A listed
Cullen House, Banffshire. 16th C	A listed
Newhall House, Penicuik C17	B listed
The Heckling Shop, Robert Burns House , Irvine, Ayrshire	B listed
Hallgreen Castle, Inverbervie	B listed
Bankend Farm, Cumnock	B listed
Mrs Archibald Coats Girl's Hostel, Weighhouse Close, Paisley 1890's	B listed
Meldrum House Hotel, Oldmeldrum. 17th C	B listed
Scotstoun Church, Glasgow. 19th C	B listed
Novar House, Evanton	B listed
Castle Avenue, Uddingston	B listed
Templars Hall, Bank Street, Irvine. 1880	C(S) listed
Edinburgh University Staff Club	C(S) listed
Cara Mill, South Ronaldsay late C18	C(S) listed
Loch Lomond Distillery Bonded Warehouse, Alexandria mid 19th C	Unlisted
Stewart Park Pavilion, Aberdeen	Unlisted

Fires in 1998

Townhead Blochairn Church, Glasgow. 1865-66	A listed
Crescent Hotel, Bon Accord Crescent, Aberdeen	A listed
People's Palace, Glasgow	A listed
Forth Rail Bridge North Bothy	A listed
Acanthus Restaurant Waverly Station, Edinburgh	A listed
Spiers Wharf, Glasgow	A listed
Stables to former Larbert House, Old Denny Road, Larbert	B listed
Luscar House, Dunfermline. 1838	B listed
Connell and McIntosh Joiners, Gateside Place, Kilbarchan.	B listed
Arnage Castle. Ellon, Aberdeenshire	B listed
Grange Cricket Pavillion, Edinburgh. 1896	B listed
Caledonian Hotel, Bannatyne Street, Lanark	C(S) listed
New Inn Hotel, Ellon	C(S) listed
Dean Castle Assloss Cottage, Kilmarnock	Unlisted
Old Mill, Victoria Bridge, Haddington	Unlisted

CURRENT TRENDS IN FIRE SAFETY LEGISLATION

G D GOODALL, Assistant Inspector of Fire Services, The Scottish Office

Introduction

In the United Kingdom there have been a number of reviews of the scope and content of fire safety legislation in recent years. All have highlighted a need for some rationalisation and consolidation of the existing complex web of legislation although each has suggested a different way forward. Over the same period European harmonisation of health and safety law has resulted in further regulation for places of work. This paper considers the background to these developments, where they may lead and what this may mean for those responsible for historic buildings.

The Development of Fire Safety Legislation

It is customary when talking about the development of fire safety legislation to refer to a number of fires in the 1960s and 70s which led directly to those Acts of Parliament and Regulations containing specific fire safety provisions. In the context of historic buildings, however it is appropriate to start a little further back in time.

Perhaps one of the earliest categories of building to come to the attention of legislators was the theatre. A series of disastrous fires led gradually to the very strict licensing regime for theatres which is still largely in force today.

1835 - Lehman's Theatre, St Petersburg - 800 dead

1846 - Royal Theatre, Quebec - 200 dead

1881 - Opera House, Nice - 62 dead

1881 - Ring Theatre, Vienna - 450 dead

1887 - Theatre Royal, Exeter - 186 dead

1903 - Iroquois Theatre, Chicago - 566 dead

1911 - Empire Palace Theatre, Edinburgh - 10 dead

Many of the basic principles and concepts of fire safety and fire protection that we know today had their origins in the effort to make theatres safer. For example, in 1812 a very early form of sprinkler system was installed in the Theatre Royal, Drury Lane, London - in fact little more than a system of perforated pipework. Attempts had also been made to provide structural fire separation between the auditorium and the stage by the proscenium wall and safety curtain. Research on the design and capacity of escape routes carried out by the Austrian Society of Engineers following the fire at the Ring Theatre in Vienna still forms the basis of current requirements for means of escape. Finally, the haystack lantern light fitted over the theatre stage to release heat and smoke automatically in the event of a fire could be regarded as a precursor to the modern smoke control system.

As a result of these developments, theatres became safer but in turn other forms of entertainment came into fashion, each bringing their own particular risks of fire and further loss of life before the relevant lessons were learned and suitable regulations were introduced. This slow cycle of disaster and response has continued through the twentieth century.

1929 - Cinema, Paisley - 70 children dead

1973 - Summerland, Isle of Man - 50 dead

1981 - Stardust Discotheque, Dublin - 48 dead

1985 - Bradford City Football Ground - 56 dead

This gradual process of regulation has led to the situation where there are now a multitude of different Acts of Parliament and Regulations which contain some reference to fire safety as part of the mechanism for controlling specific types of work or activity. At the same time other activities remained largely free from control until relatively recently when new regulations applying to places of work were introduced.

Why the need for change?

There is clearly a need to develop a mechanism where risks from fire can be predicted and controlled before such loss of life occurs. Legislation must be proactive rather than reactive and should apply to all types of premises and activities whilst recognising that some situations present a greater risk and therefore require a higher degree of control.

Many of the traditional forms of legal control are not sufficiently responsive to change. Systems of licensing, registration or certification normally require an inspection by the enforcing authority who assess the premises and issue a detailed list of recommendations or requirements. The applicant merely has to comply. There is little incentive or opportunity for him or her to appreciate the nature of the hazards present or to

understand the reasons behind the control methods specified. There is an obvious danger that once the licence or registration has been obtained little further attention will be given to fire safety until it is to be renewed.

There is an increasing view in society that the person creating the risk should be responsible for its control and that such control should be an ongoing and integral part of the management of the premises or activity. Whilst the applicant always foots the bill, the task of assessing the risk and determining the necessary control measures has in the past fallen largely on the enforcing authority. Similarly when changes are made to premises, prior approval must be sought from the relevant authorities causing further delay and more paperwork even though the changes may not increase the overall risk.

The administrative burden of enforcing these regulations has now become significant and is not always commensurate with the risk. The prime function of fire safety legislation is to save life and preventative measures must therefore be directed at where the need is greatest.

Statistics show that fires in the home now account for some 80% of annual fire deaths. These figures clearly indicate that if significant progress is to be made in reducing the level of fatalities from fire then some resources may need to be redeployed from the enforcement of fire safety legislation towards educating the community with regard to fire safety in the home. At the same time it must be recognised that the relatively low level of deaths outside the home may well be due to the existing statutory controls and care must be taken to ensure that standards of fire safety in these premises are maintained at a sufficient level.

The challenge for the legislators, therefore, is to develop a system of control which is dynamic, flexible, universal in its application and simple to administer.

What form is any future legislation likely to take?

Increasingly the influence of the European Community is making itself felt in this field as in many others. European Directives on health and safety, based on a risk assessment approach, have already been applied to places of work. Any future fire safety legislation for the UK, whether emanating from Westminster or from the new Scottish Parliament, will undoubtedly adopt a similar approach and include:

1. a duty to assess the risk to persons from fire

Risk assessment has been the guiding principle in safety legislation over the past decade. It is the key to predicting and controlling risks before disasters occur and to tailoring solutions to meet the individual circumstances.

2. a set of broad general duties to ensure safety of life in the event of fire

These duties would include the fundamental requirements for life safety which are already implicit within existing fire safety legislation i.e.

- means of escape from fire
- means of giving warning in case of fire
- means of fighting fire

In addition they may include the requirements for the effective management of fire safety and evacuation procedures specified under existing health and safety legislation.

3. an enforcement regime which is simple, fair and where the sanctions are appropriate to the risk

The range of sanctions available to enforcing authorities in the UK has gradually increased over the years. Cases of serious or repeated non-compliance can as always be dealt with through the criminal courts. Similarly, in situations where there is a serious and immediate risk to life a prohibition notice can now be issued quickly to restrict the use of a specific area until remedial action is taken. Other forms of enforcement notice are also available. It is likely that the range of enforcement options will continue to increase, particularly to cater for less serious contraventions where a lighter touch may be more appropriate.

What is the effect of these changes?

In places of work we are already seeing a shift in the burden of responsibility from the enforcing authority to those having control of the premises concerned. Employers and other persons having control will therefore need to develop or have access to appropriate skills and knowledge which can be identified under the following headings;

- fire risk assessment
- fire safety engineering
- fire safety management

These skills do not necessarily require a high level of expertise merely a thorough and systematic consideration of the potential for the ignition, development and spread of fire and of the physical and organisational countermeasures which can be applied.

Whilst these considerations will naturally concentrate on the construction, contents and operation of the premises concerned it should be noted that they may also extend to factors outside the control of local management such as neighbouring risks, fire brigade attendance times, vehicle access and water supplies. A fire in a large building in a remote rural location may well develop faster than fire-fighting resources can be deployed to the scene. Under such circumstances active fire protection methods such as sprinklers may be the only effective method of preventing major loss.

The role of fire authorities is also changing. They will continue to inspect premises periodically but rather than preparing detailed schedules of recommendations and requirements they will seek to ensure that management have adequately recognised and controlled those risks which cannot be eliminated. They will spend less time devising fire safety solutions and more time on inspections and fire safety education.

There will still be premises which by virtue of their construction, contents or use present a particularly high risk to life. It is likely that society will still expect some more formal mechanism of control or approval for these premises but neither the type of premises involved nor the appropriate form of control has yet been determined.

At the same time there is a continuing move away from the old prescriptive approach to fire safety standards and towards a more flexible approach with legislation setting the basic objectives or functional requirements but allowing greater freedom of choice in how those requirements are met. This will encourage a more holistic approach to fire safety design utilising the latest techniques of fire safety engineering as well as more effective use of active fire protection measures such as automatic sprinkler installations and smoke control systems.

A good example of this is in the recent reconstruction of Shakespeare's Globe Theatre - the first thatched building to be allowed in London since the great Fire of 1666. This has been built as far as possible using authentic materials and techniques whilst incorporating modern methods of fire protection to meet the standard of safety required by today's legislation.

So what does this mean for those who own or manage historic buildings?

With the publicity following the fires at Windsor Castle and other historic buildings across Europe they should already recognise the serious threat that fire poses to their property.

Legislation will aim to ensure that this awareness is followed by a systematic and comprehensive assessment of the risk from fire, that appropriate action is taken and that the highest standards of fire safety management are maintained. The new enforcement regime should enable them to develop and agree sensitive and effective engineering and management solutions from a position of knowledge rather than being the unwilling recipient of a list of arcane and prescriptive fire safety requirements.

These developments provide both challenge and opportunity. The challenge is for society to recognise that fire presents perhaps the greatest single threat to our built heritage. The opportunity lies in the fact that the technology, the techniques and the legislative framework now exist to enable this risk to be reduced in a less intrusive but equally effective manner.

INSURANCE MATTERS

JAMES CAMPBELL, Penrose Forbes Ltd

"I have been asked to address you on insurance matters and in the context of this conference, what I have to say will revolve around the fire aspect of insurance.

Therefore, I intend to go through those things that insurers bear in mind when considering a risk and expand a little on them. It is inevitable that what I have to say will be or will have been, to some extent, echoed by other speakers. I don't think that it would be enough for me to turn up and announce that insurance was a good thing and a vital protection against the consequences of a fire and go away. However, insurance is a fairly dry topic, so I may well take less than the alloted span for speaking and make myself available for any questions.

First of all let me make a general point. I have the greatest sympathy for all those involved in the task of maintaining and keeping safe those buildings that are considered to be part of the "built heritage". It is often a thankless task, particularly when you consider the burdens and limitations imposed upon private owners especially in the name of conserving the nation's heritage.

The first problem faced is that of value. It is very difficult to accurately work out what the sum insured should be for many of the buildings that make up our built heritage. The standard method, for insurance purposes, of multiplying the square footage of a building by the up to date building cost often does no more than provide a starting point. I would hazard that one of the most popular methods of determining the sum insured on a building, of the sort that is within the context of this conference, is to think of a figure and double it. Surveyors are understandably reluctant to commit themselves to a very specific figure. I know of of one instance of a very large house in England that in one survey was valued at £4 million. Three years later, another survey came in with a figure of £40 million. All an owner can do is rely on professional advice and insist that his insurer carry out a survey of the building themselves. If that is done, there is less scope for an insurer to try and evade their responsibilities. It has been known!

The second thing that needs to be sorted out, at the outset, and before considering the various specific things that I will go onto, is the basis of cover. Generally speaking, there are two choices. Either a building should be insured on a full reinstatement basis, or it is suitable for insurance on a First Loss basis. In my view, First Loss should be treated very carefully. It should be used on buildings that lend themselves to the concept. That concept is based upon the ability to make the judgement that, in the event of a fire, the worst case scenario, in terms of damage, is likely to be *x*. The *x* figure is then taken as the sum insured on a First Loss basis. I would say that a building such as Hopetoun House is a classic example of this. It is basically made up of three parts - the centre section plus the two wings. In this case it seems reasonable to make the assumption, given the proximity of the Fire Brigade, that the worst case scenario is the destruction of one of the three sections.

I cannot stress highly enough that to insure a building on a First Loss basis with the saving of insurance premium as the rationale is a dangerous thing to do. Obviously, there are situations where an owner, if a historic house was burnt down, would simply want to replace it with another house that was comfortable, economical to heat, easy to maintain etc. However, this simply may not be an option given that the onus is upon the owner to carry sufficient insurance to reinstate a building. Only bodies such as Historic Scotland have the key to this sort of dilemma.

Before going onto the "list" part of my talk, it may be worth reminding ourselves of the purpose of fire insurance, indeed, the basic purpose of most insurance. That purpose is to put the insured, following a loss, back into the same position that he was in prior to that loss. No more, no less. There should be no betterment, to use a word beloved by insurance loss adjusters. Although, of course, by the very fact that of replacing old with new, there is, de facto, an element of betterment involved in every rebuilding. Some here, of course, might argue that point.

Now to turn to those things that are considered by an insurer when deciding what rate to charge for insuring a building, particularly of the type that we are concerned with here. Fortunately, everything that I am about to mention comes into the category of common sense. But like all things in life a happy and affordable balance needs to be struck. An insurer does not expect any risk to be perfect. Indeed Sod's law being what it is, the building with the most attributes, in terms of fire prevention measures may well be the one to go up! Different measures will be appropriate for different buildings.

Basis of Occupation. This is important on the simple premise that if a building is occupied, then it is hoped that a fire will be discovered and responded to more rapidly than one that is not. Therefore the number of days in the year in which a building is occupied is considered. Is there a caretaker in the building? If the building is unoccupied, are there buildings nearby which are occupied which again increase the chances of reaction to a fire? Is the building inspected every day?

Public Access. A very relevant feature now, given the number of buildings that are open to the public. If a building is open to the public, the main question asked will be what level of control is exercised over the visitors - smoking ban, numbers, fire exits, monitoring of their progress and so on. Of course, the question of public liability is paramount here, which, in many ways, revolves around the question as to whether the building is a safe environment for the public to be in.

The burnt-out Dunbar Hotel

Construction. This is perhaps the most obvious element for consideration by an insurer. Different materials have different degrees of flammability. What is the timber content of the house, is there a lot of panelling? A thatched building is of particular concern; not that there are that many in Scotland. Is the building well compartmentalised, with doors which would impede the progress of a fire? Or is it of open layout with such things as large stairwells and large roof voids which give a fire encouragement? Obviously with things like this, there is not much can be done about them physically. The recourse is detection measures.

Fire Brigade. The insurer will want to know a number of things in this regard - how remote is the property ie how long does it take the fire brigade to get there? Is the brigade full time or part time? Is there good access to the property? Is there a good water supply for the brigade? Amongst my clients the water supply ranges from hydrants provided all around the house to a muddy pond out the back, or a river at the bottom of cliff. In all cases, so long as the local fire service is happy to do it, a check of the property at the least is a good idea. Full-scale rehearsals are the ideal.

Fire Detection Systems. You have heard all about these, so I won't dwell on them other than to say how popular they are with insurers. The only additional point that I would make is that there is little point having these measures unless they are turned on and maintained. Insurers will often ask to see the maintenance contracts and make them a warranty under the insurance policy. (The same applies to Fire Extinguishers. I am sure that there is many a house with ancient extinguishers gently rusting in the corners.)

Maintenance/Management. This is one of those things that can be fairly intangible, but does have an impact on how a building is viewed by an insurer. If there is professional management, admittedly only really relevant to a house open to the public, the insurer is reassured. But with or without that the insurer will be looking for signs that there is a definite and continual maintenance programme in the building. At the most basic level this will manifest itself in the shape of good housekeeping.

Electrical. Along with the construction of the building, this aspect is of greatest interest to the insurer. What is the condition of the wiring coupled with its age? Insurers have built up significant statistics on the cause of fires. I think that electrical faults takes the number one spot, by a fair margin. I have to make clear, we are not just talking of the wiring in the building but also of the electrical appliances used in the building. The more evidence that this aspect is controlled, with certification of appliances etc, the happier the insurer will be.

Heating. Following on from the electrical side of things, you will be unsurprised to know that an insurer likes to know the type of heating used.

Contractors. This is a very important consideration and it is often overlooked; sometimes to the detriment of the insured. Buildings that are considered part of the built heritage often need renovation work. This work is generally carried out by contracters of one kind or another. The work carried out often increases, significantly, the risk of fire in a building. Something as simple as the storage of paint coupled with a cigarette end can result in a fire. But the real danger can be when hot work is carried out - the best example is blow torches being used to strip paint or mould lead. A number of things are vital: control of the workmen; employing contractors with a good track record and membership of a relevant reputable body; ensuring the

contractors have their own insurance (if they don't arrangements must be made with the building's insurers). In all cases the insurer must be made aware of the situation and given the opportunity to comment, lay down conditions etc before any work is carried out. There have been a number of cases where there has been a fire in a building arising from contractors at work, where the insurer has refused to pay because they were not aware of the situation. Most policies now state that the insurer must be advised if any work is to be carried out as a condition of insurance.

Contingency Planning. You will be glad to hear that this is the last of my list. If all that has gone before fails to protect the building, it is sensible to have a plan in the event of the worse happening. Again this is more relevant to those buildings that are open to the public and have a number of staff to call upon. Staff should be trained in both preventive and fire limiting measures ie correct use of fire extinguishers; plan of evacuation of valuables from a building; how to direct the fire brigade etc.

Past loss history of a building. One other point for consideration. Some buildings are downright unlucky!

Now that is quite a long list of things to consider when thinking about making a building as desirable an insurance risk as possible. Some may not be feasible either from a practical or cost point of view. However, I think that you will agree that the points raised above are not just abstract ideals put together for the benefit of an insurance company. Most of them are things that are of benefit to the building and its continued existence. The bonus is that a building's insurance cost may well be appreciably less. The saving over the years may make it easier to afford some of the measures mentioned.

There are two other things that I would like to mention of a more general nature before going onto the final part of my talk. The first is whether there are any ramifications, from the insurance angle, if a building is listed. The short answer, I believe, is no. It is irrelevant to an insurer whether a building is listed or not. It won't have any individual impact on rating from a fire risk point of view. I go back to one of the early points that I made - that being the importance of the correct sum insured being arrived at. The valuation should take into account the reasons why a particular building has attracted a listing; whether it be particularly fine mouldings or whatever.

The second is a brief word on the effect that the insurance cycle will have on all that we have talked about. I would say that the cycle has a bigger impact on the cost of insurance than all the things that I have just mentioned. This means that in a soft market as we are now in (where the cost of insurance is comparatively cheap) the reward for implementing fire measures will not be so discernible. In a soft market, insurers are keen to both retain their existing book of business and buy in more business. To a very great extent this is done on price. However, in a hard market, the benefit of taking good risk control measures will most certainly pay dividends. Therefore, the moral of the story is that you should implement best practice in terms of fire risk control for your own and the building's sake. It is merely convenient that they are of benefit when it comes to insurance.

I suppose having listed those things that an insurer will consider when rating the fire risk on a building, it would be sensible to make brief mention of what happens if a fire actually occurs. As in many things, speed is of the essence. It is sensible to advise the insurer as soon as possible either direct (some policies provide a claims helpline telephone number) or through the insurance broker.

In either case, the insurer will appoint an insurance Loss Adjuster to examine the case. It is important to stress that the Loss Adjuster is an agent of the insurer and therefore represents the insurer's interest; whereas the insurance broker is an agent of the insured. In most cases this distinction is not of any real significance. If it is, then the insured should consider appointing his own Loss Assessor. This person will represent the insured's interest in a contested claim. One could liken this situation to a law case where both the plaintiff and defendant have their own expert witnesses.

To get back to the case: the Loss Adjuster will ascertain whether the policy provides cover against the peril, in this case fire. He will check that there are no particular aspects of the policy that have a bearing. For example, there may be a condition on the policy that the fire detection system is turned on at all times. He will also check that the sum insured was appropriate. If he decides that the building was under-insured, the average clause may be applied. This clause has caused a great deal of rancour between insurer and insured. Hence the stress on making sure that the valuation is done and confirmed by the insurer. The clause basically reduces the amount that an insurer will pay by the proportion that the building was under-insured. For example, if a building was insured for £1,000,000, but it was deemed that the value should have been £2,000,000, then the insurer will pay half of the claim amount, the building being under-insured by half. (The answer is to have your insurance broker persuade the insurer to delete the average clause from the policy; not that, I stress, it gives a licence to under-insure!)

That process having been completed, which, I may add, may involve discussions between the Loss Adjuster and Fire Brigade, the building can begin the process of being rebuilt/repaired. Insurers have

become a great deal more reasonable and speedy at this aspect. A contractor and an estimate is agreed upon. Not unreasonably the insurer needs to be satisfied that the cost is reasonable and given that insurers are inolved in this all the time; they have a pretty good idea of what reasonable is!

That is a fairly rapid run through of the process which, I hope, has been of benefit and even interest within the context of this conference. If I had to leave you with one point to remember, it would be to get the value right and therefore insure for the right sum insured. In the context of insurance and the well being of the person or persons who have to insure buildings, I put that ahead of fire detection systems and their ilk."

FIRE SAFETY MANAGEMENT

Some problems in the protection of historic buildings from fire.

STEWART KIDD, MA, MSc, FRSA, FIFireE, FIRM, CPP

Introduction

Fire can cause the total destruction of a building and its contents in only a few hours; areas not directly damaged by flame or heat may be damaged by smoke, dirt and falling debris or by the huge volumes of water used in fighting the fire. Following the fire, the building may be structurally unstable, open to wind, weather and vandalism, and susceptible to decay caused by the high residual moisture content in the fabric.

The event which triggered the setting up of the UK Working Party on Fires in Historic Buildings which produced the publication *Heritage under Fire*[1] was the Hampton Court Fire. The Windsor Castle fire six years later could serve as an exemplar of the problems of fires in historic buildings. The fire took place while contractors were working in the building, there are indications that staff responses were not in accordance with the laid down procedures, extinguishers failed to work, the fire spread because of a lack of compartmentation and so on.

Fig. 1 Inverary Castle ablaze.

The blazes at York Minster in 1984 and at Hampton Court Palace in 1986 brought fires in historic buildings to the forefront of concern in the UK, but there have been a succession of less well publicised disasters over the years (Fig. 1).

The tragic fires at the Church of St. Mary-at-Hill in the City of London, at Uppark House in Sussex and in the historic town centre of Totnes emphasise yet again (if any emphasis is needed) the vulnerability of historic buildings and their contents to the effects of fire and its aftermath. In August 1992, a serious fire damaged a number of listed buildings in the historic centre of Canterbury and the same thing happened in Marlborough on 1 January 1993. Only determined and skilful efforts by the Kent and Wiltshire fire brigades averted major conflagrations. Internationally, fires at the Oddfellow Palace in Copenhagen, the Hoffburg Palace in Vienna and the Venice Opera House all highlight the need for adequate and appropriate fire precautions in heritage buildings of all sizes and uses.

One of the main intentions of this paper is to emphasise the need to balance fire safety requirements with the special interests of our heritage and, I hope, to provide a brief guide to the way in which governments (local, regional and national), owners, occupiers and managements of all types of historic buildings can help to ensure that our heritage will remain for future generations.

The Problem

While (as already stated) fire is a threat to all kinds of buildings it is only in the case of an historic building that there is a further dimension - the loss of property that forms part of a cultural resource which is finite, irreplaceable and whose architectural and historical integrity can be destroyed as easily by inappropriate fire precautions as by fire itself. No insurance policy can replace a unique structure which may have survived the ravages of war, famine and strife only to fall victim to an accidentally discarded cigarette end.

In the last decade a historic building of national and international importance in the UK has been totally destroyed by fire every month. These tragedies emphasise the vulnerability of historic buildings and their contents to fire and its aftermath. Although many lessons have been learned and approaches to fire safety in historic buildings grow more sophisticated, one simple fact remains - most fires occur as a result of human action or negligence.

The fire at Windsor Castle in 1992 was no exception. It was probably caused by a curtain being ignited by a

wall mounted spotlight which was too close behind it. The resulting damage is reported to have cost more than £40 million to repair.

Such disasters highlight the need for effective fire precautions to minimise the risk of a fire occurring and to mitigate losses in the event of fire. However, historic buildings can be disfigured and damaged as easily bv inappropriate fire protection measures as by fire itself.

Traditionally fire protection in buildings has been largely based on structural (or "passive") fire protection where the spread of fire and smoke is controlled by structural elements such as walls, doors and floors. In historic buildings this approach often involves upgrading these elements to achieve a specified period of fire resistance and this can adversely affect the architectural character of the building and involve an unacceptable degree of disturbance to its fabric.

Problems may occur when the use of a building is changed - for example, a country house converted to a school or hotel, or a church turned into a dwelling or used as a venue for entertainments.

Difficulties will often arise when additional staircases for means of escape are required. The incongruity of fire precautions "hardware" such as exit notices, emergency lighting, fire detection, warning and suppression equipment is another facet of this problem. There may thus be a conflict of interests between, on the one hand, the need to provide adequate fire safety and, on the other, the need to preserve the architectural and historic character of the building.

In such cases a logical and systematic fire safety engineering approach to the assessment of fire safety requirements is needed to reveal alternative methods of achieving adequate, appropriate, and cost-effective standards of fire safety. The analysis and evaluation of the problems that exist in a specific building make it essential to specify an appropriate package of fire precautions and management actions for that building.

For example, in some situations it may be possible to adopt an alternative approach which places more emphasis on the early detection of fires to provide for the evacuation of the occupants at the earliest possible opportunity thereby permitting conventional standards of fire resistance to be reduced. This does not imply a lowering of safety standards but achieves a comparable standard by an alternative approach more suited to the needs of the building.

There is, of course, a need to differentiate between provisions for life safety and measures intended to protect property. Whilst standards of fire safety required for the safety of the occupants of the building will generally help to reduce damage to property in the event of fire, additional measures may well be required to minimise the potential for loss in respect of the building and its contents.

Measures to improve fire safety should be arranged according to priority. Some may be needed immediately. Less important ones may be delayed until there is a suitable opportunity.

When fire precautions involving alterations to the building cannot be avoided, careful and sympathetic design is needed to minimise the impact these have on the architectural and historic character of the building. In some cases, a more satisfactory approach will be to avoid the circumstances that bring about the requirements for alterations.

A Plan For Action

It is essential that fire safety be managed in a systematic way and the following plan, based on the recommendations of Sir Alan Bailey's report[2] into the fire at Windsor Castle makes an excellent starting point:

1. Each historic house or premises should have a written fire safety policy statement. Effective internal mechanisms should exist to ensure that the policy is properly implemented and the policy should cover not only the normal operating regime of the location but take into account special or occasional events.

2. Each location should appoint an individual at senior level as fire safety manager with specific responsibility to implement the fire safety policy.

3. Where appropriate, particularly in larger premises, the fire safety manager (who may have other duties) may be assisted by a full-time, specialist, fire officer. (In some locations, this role may be combined with a similar activity such as security.)

4. Each location should compile a fire safety manual setting out its strategy and detailing its plans in case of fire and as a basis for training. Locations should also maintain a log book to record all fire-related events such as training, drills, inspections and equipment maintenance.

5. Premises should undertake (or commission from a reputable consultancy) a detailed fire risk assessment. This should make recommendations for fire safety improvements consistent with the preservation of historic fabric.

6. The installation of a modern, reliable fire detection and alarm system should be seen as a high priority. Such systems should be closely monitored by senior management to ensure that unwanted alarms do not undermine confidence in the system. Maintenance of such systems should be to the highest standard.

7. Following the fire risk assessment, locations should establish a priority for implementation of physical fire safety improvements including establishing or upgrading fire compartments, segregation of areas of high fire risk and providing protected escape routes.

8. Where legally required, fire certificates should be obtained and their requirements fully complied with.

9. Systematic and effective training programmes should be introduced to ensure that all staff know how to minimise fire risks, how to raise the alarm in case of fire and to provide enough trained staff to tackle incipient fires quickly.

10. Private apartments, where they are found, should be included in fire surveys and re-inspected at least every five years. (These inspections should include electrical equipment, and the occupants should be given the opportunity of obtaining reliable fire safety advice.)

11. Clear fire safety requirements should be included in all contracts for building, maintenance and other work and for special events. Management must check to ensure that the requirements are being carried out.

12. Larger locations should form and train a salvage/damage control team.

13. Management should liaise regularly with local fire brigades on risk management, fire fighting and salvage. Exercises should be arranged periodically.

14. Consideration should be given to the advantages offered by sprinkler systems for the protection of areas where effective compartmentation or segregation cannot be carried out or for high risk areas.

15. A proper programme of preparation and safe storage (possibly off-site) of architectural and other information should be put in place.

Immediate Action in the Event of an Incident

The first few minutes following an incident like a fire or flood are the most significant and any action (or inaction) at this stage can have far-reaching consequences. Just as the correct first aid applied in the immediate aftermath of an accidental injury can save life and promote rapid recovery, so too the correct response can ensure that the effects of an incident are minimised.

Preplanning

While it is impossible to predict every kind of possible incident that may threaten a building, it is simple to set out basic plans which can be implemented to cover a wide range of possible actions. For example, plans designed to protect a collection from the effects of fire and flood can be simply modified to be equally effective if objects are threatened by a possibly unsafe roof. So too, plans designed to enable staff to evacuate visitors in the event of fire can be utilised with little modification to provide a bomb threat evacuation plan.

Liaison with the Emergency Services

Just as the moment after you discover that your new car has been in an argument in a parking space is not the moment to check that your insurance cover is valid, so too is it important to talk to the emergency services before you need them. In the case of larger premises, the police and fire service may already have an emergency plan to deal with incidents on your site. It makes sense to ensure that your plan dovetails with theirs.

Early contact with an appropriate officer will pay substantial dividends at that 3 am rendezvous which you hope will never happen !

In the case of the fire brigade, it is possible that you may have contact with more than one part of that organisation. Personnel from your local fire station may pay regular visits to your institution. These are essentially familiarisation tours for the firefighters and you will find that it pays to make certain that each group is provided with up to date information. Don't forget to pass on information about special activities - major exhibitions or special functions, temporary changes in room or gallery layouts and most importantly, the presence of contractors on your site. Very large institutions may receive a visit from a fire safety specialist, and this officer will want a more in-depth appreciation of your site and its features. Finally, you will, from time to time, probably find that an officer from the enforcement or legislative branch will visit. The latter individual is primarily concerned to ensure that staff and visitors are able to escape from the premises in the event of a fire. He or she will require that activities on the site comply with appropriate legislation.

Contact with police personnel will focus around evacuation in case of bomb threats or indeed, the way in which police will actually control any major emergency affecting your premises. You may also have contact with the police prior to special events or a VIP visit.

Access for the fire brigade

In the event of a fire, it is vitally important that there is suitable access for fire brigade appliances and equipment. In urban areas the existing situation will have to be accepted as it is, but the owner of the

property should nevertheless liaise with the fire brigade on access routes and water supplies. In other cases, roads and footpaths on private property should be designed to provide adequate access for fire appliances. Detailed guidance on turning circles etc. is available from fire authorities. Roads of suitable material should be provided to within 45 metres of a suitable entrance to the building and depending on the size and height of the building, appliances may require additional access for rescue or firefighting purposes. In the UK, guidelines suggest that access roads should not be less than 3.7 metres wide or, if they form part of a clearly marked one-way traffic system, 3 metres wide. Gateways should be a minimum of 3.1 metres wide and have a minimum height clearance of 3.7 metres or 4 metres if high-reach fire appliances could be deployed, Footpaths likely to be traversed by fire brigade personnel should not be less than 0.75 metres wide. Roads should have no overhead cable less than 4.5 metres above the ground. Wherever practicable roads and footpaths should be suitably lit. Emergency vehicle routes within the grounds should be kept clear of obstruction at all times. There must be adequate hard-standing areas adjacent to access points for water supplies. Roadways and hard-standing areas should be capable of supporting fire appliances which have minimum carrying capacities of 12.5 tonnes for pumping appliances and 16.25 tonnes for high-reach appliances.

The name of the institution should be conspicuously displayed at all entry points from public roads. Sites with multiple entry points should ensure that prior agreement has been reached with the fire service as to which will be used by the first responding fire crews. Very large sites will need to formalise a series of rendezvous points which will need to be marked by signs.

Water supplies

When summoned to a fire, the fire brigade will respond with a number of vehicles, including specialist appliances, and manpower, which their inspections indicate will be required for normal purposes. This response will normally consist of appliances carrying 1800 litres of water, a high-capacity pump, hose reels and rolled hose, and breathing apparatus. The water carried by the tender is sufficient to extinguish the majority of small fires. For larger fires, firefighters will need to use the fire hydrants forming part of the public water supply.

Buildings in isolated rural areas may only have a water supply for domestic purposes, in this case the fire brigade will have to use bulk water carriers and hose-laying vehicles for relaying water from ponds, lakes or streams. This will take time.

The preferred solution is for the installation of some form of tank (it is suggested that a minimum of 20 000 litres should be provided). Tanks should be clearly indicated and easily accessible. Swimming pools, ornamental lakes and ponds may be suitable for this purpose. If the mains water supply has sufficient pressure and flow then private hydrants can be installed (to the same standards as applies to public hydrants). Excavations for this purpose may require consent; advice should be sought initially from planning authorities. If a 'top-up' system (using electric pumps) is provided for the reserve supply, it is advisable to ensure that the electric supply is wired separately from the rest of the building to ensure continuity even if the building's supply has to be isolated.

Advice on these matters and, in particular, the amount of water likely to be needed for fire-fighting operations should be obtained from the fire brigade and water supply utility as appropriate.

Planning to reduce the disruption caused by a fire

The disruption caused by a fire and the time during which the building is out of use can be minimised by proper planning. In larger buildings, a contingency planning committee should be set up. A list of the telephone numbers and addresses of all key services should be kept, including:

- Local authority departments
- Architect/surveyor/engineer
- Building contractors - plumbers, carpenters, electricians, heating engineers
- Experts in the salvage of historic items (conservation specialists)
- Smoke residue removal experts
- Utility emergency telephone numbers: electricity, gas, water
- Insurers/loss adjusters
- Plant hire contractors (for pumps, generators, heating equipment etc.).

Photographs, drawings and other records of the building should be kept either off-site or in a fire-resisting cabinet so that a record of what the building should look like is readily available. These photographs can then be used to good effect during rebuilding. In cases where drawings showing the floor layout of historic buildings do exist the owner should arrange to make them available to the fire brigade as part of the preplanning arrangements.

A selection of salvage equipment should be kept on the premises: waterproof sheets, squeegees, shovels,

ladders, ropes, brooms, hard hats, gloves, emergency lighting equipment, heavy-duty plastic sacks and plastic sheeting. The necessary equipment and tools for specialist personnel (conservators, surveyors and other professional advisers) should be easily accessible at all times. In some countries, private specialist salvage firms are available.

Salvage and damage control

Fire fighting and control methods during a fire can be extremely damaging if executed without thought. There have been cases, for example, where patently charred and self-extinguished baulks of structural timber are sometimes "felled" by chain saw without reference to specialist engineering advice on stability and salvage. Smoke venting by smashing decorative glass might be achieved by alternative means thus saving the glass. A dialogue on fire-fighting methods with the local conservation officer, the fire brigade and national conservation bodies or similar organisations should form part of any preplanning for such contingencies.

In larger institutions, special consideration should be given to the formation of "in-house" fire teams and damage control squads. Trained employees can be mobilised rapidly on the sounding of the fire alarm to extinguish or contain a small fire before the fire brigade arrives. They can also check that the evacuation of the building is complete and that all doors have been closed to minimise the rate of fire spread.

The fire brigade should be consulted about the setting up of these teams and they can give advice on training. (Some brigades may be able to help by providing some of this training.) The fire brigade also need to be aware of any formal arrangements that may result in employees continuing to work inside a building after an evacuation.

The information available for salvage and damage control teams (staff, volunteers or fire brigade) should include separate cards for each room including lists, in priority order, for items to be removed. It may be appropriate for the cards to include relevant photographs of specific items. Members of fire teams and salvage squads should be volunteers and must be physically fit. Where employers' liability insurance is legally required, the policy should should be checked to ensure that it covers such activities.

After the fire

Access to the site may be restricted by considerations of structural integrity or for the investigation of the cause of the fire. Indeed, the structural integrity of the building or its remains must be established as a first priority by specialist advisers and any stabilising measures carried out before access is allowed for any other purposes (Fig. 2).

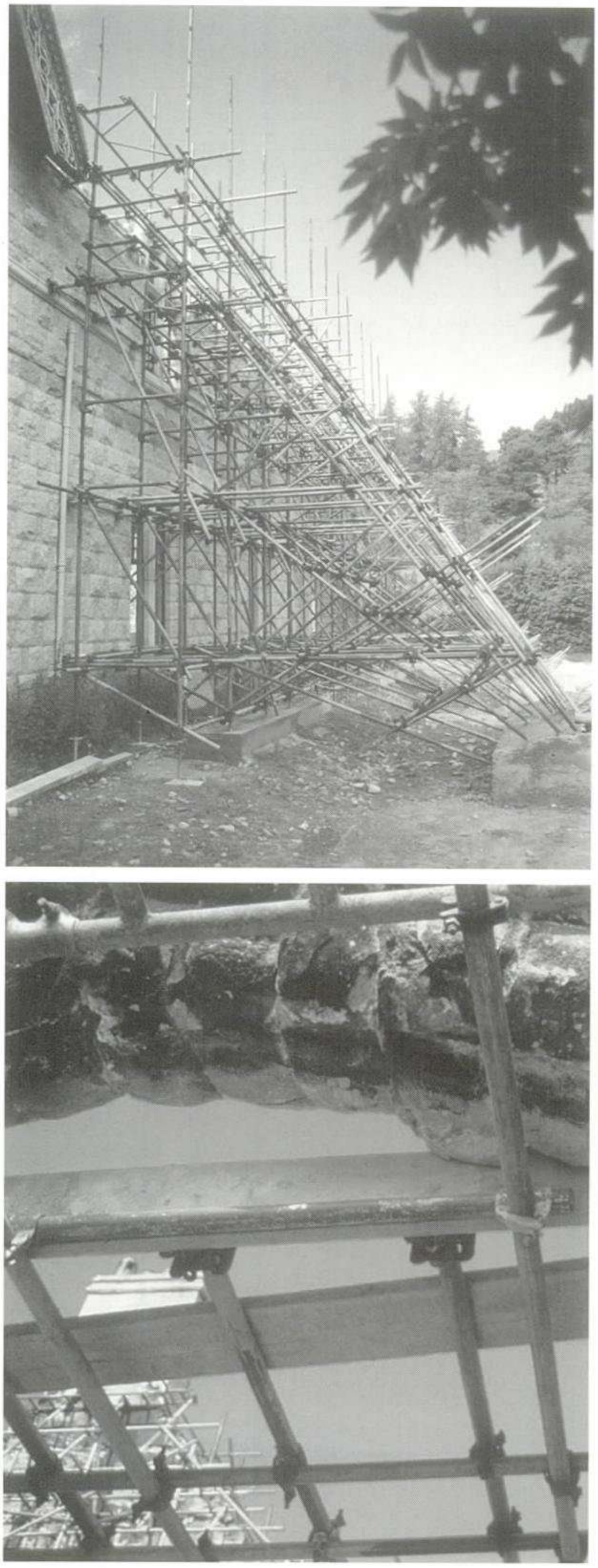


Fig. 2 Temporary support in place at Mar Lodge after the fire

The debris should be searched for any valuable items. These should be labelled and the position in which thev were found recorded. A damaged roof should be covered with tarpaulins in order to minimise subsequent rainwater damage. Appropriate warning signs, barriers etc. should be erected. As far as possible, residual water should be removed using squeegees, cloths and suction equipment.

Drainage of fire-fighting water is especially important in cathedrals, churches and mediaeval buildings with masonry vaults. A Belgian cathedral nave vault collapsed some years ago under the weight of water collected on the upper side during a roof fire. All vaults should have draining plugs in their lower parts.

Besides the physical force of pressurised water damaging friable materials, water will also put soluble materials into solution and literally begin to wash them away. After the fire is doused, masonry structures will have absorbed huge quantities of moisture and several damaging processes then begin. In winter, freezing conditions can cause frost and saturated, soft masonry may crack and exfoliate. As the water dries out of materials it draws inherent and nearby groundwater salts in solution to the surface where they crystallise, causing efflorescence, powdering and surface crumbling. Moulds and fungi are also encouraged and they thrive on timber and other organic material causing rot and decay. The building should therefore be thoroughly dried (for example, by using dehumidifiers), but special care must be taken not to start another fire or to overdry old buildings.

Specialist advice should be sought on damaged artifact conservation from the appropriate conservation unit of either a university or museum. This should be done without delay as combustion products can be highly acidic and therefore very corrosive. As an emergency measure, certain valuable items (for example books but not photographs), can be frozen in commercial freezers (for example in abattoirs). This will arrest further damage until assistance can be obtained.

Consideration should be given to the need to plan for suitable, secure storage space for salvaged materials.

To remove the smoke odour it may be necessary to use a process in which a deodorising liquid is passed through electrically driven sprayers.

Used fire extinguishers should be recharged, hose reels should be wiped clean and rewound and alarm systems reinstated. Premises should be safeguarded against theft. Broken windows should be boarded up and broken doors should be repaired and padlocked and consideration should be given to the need for the premises to be guarded.

Notes

1 Kidd. S (Ed.) (I 995) Heritage Under Fire, London: The Fire Protection Association

2 Bailey, Alan and others (1993) Fire Protection Measures for the Royal Palaces, London: HMSO

FIRE RISK ASSESSMENT

NICK ARTIM, Director, Fire Safety Network

"Fire risk assessment: what is it? I suppose probably the best way to start off is with an analogy. In order for a doctor to properly prescribe medical treatment, they have to first diagnose what the problem is. They have to look at their options for medical treatment and then select the option or the options which have the best chance of success. A civil engineer designing a waste water treatment plant will look at what is the likely inflow rate, what are the environmental discharge requirements, what are the options to meet that and which option has the best chance of success. In solving the fire safety problem in a heritage building, we basically follow these two examples. We define the problem, we look at the options to solve the problem and then we look at those choices which have the best chance of success and, I might also add, that we can afford. One of my main roles is as the in-house fire engineer for a number of different agencies. The largest group I work for is the United States National Park Service, which for those of you who are not familiar with the Park Service, is not just the operator of places like Yosemite or Yellowstone but is the largest operator of heritage properties in the United States. The Park Service is responsible for the Washington Monument, the Gateway Arch, Longfellow's House, as well as many provincial mansions. In all of these properties, we were faced with the dilema of really wanting to protect them all, but not being able to afford to do so. So how do we get the best value for money?

Starting with the ideal: a scenario in which a fire isn't happening. This should be what we aim for in the risk assessment process. However, fires do happen. Accidents happen and unfortunately, we are always susceptible to terrorist incidents. So when that happens, we want to go to a second desirable level. And that is to contain the level of loss to a recoverable level. And the recoverable level will be variable. We have some buildings in the Park Service where if we lose them, we lose them - well, OK, we can build a new one. We have others where the contents, where perhaps even the contents of a single room, are so valuable that if we loose them, the whole mission of that institution will be impaired. I don't necessarily mean 'value' just in cash terms, but rather the intrinsic worth of the item which might be fundamental to the nation's heritage.

This is a historic theatre and what you can see in here is the scene approximately 5 minutes after the fire brigade arrived. (Obviously we are now past our first objective of not having a fire.) It was difficult for them to access the building, they had no idea where the fire was in there and about 20 minutes later, they ended up with this as the whole roof collapsed. So now we've moved past that second desirable point - we've been unable to minimise the damage.

First of all, a quick summary, why do these buildings burn? The first reason is because we build them out of things that can burn. In some cases this is quite obvious, for example a timber-framed church in Nova Scotia is (to those of us in the fire protection business) a big fuel package. Now it makes a curator uneasy when you go into a building and start talking about fuels, but in fact that's what we have. Any time we have something that can burn, it's fuel. Now I'm sure many of you may be sitting there saying 'Oh yeah. But a building is built out of stone, it's non-combustible. What can burn?' Well, take Duff House. It's a non-combustible building and yet if we look around that we find many different fuels, we find carpeting, we find wood and we find fabrics. We bring things into the buildings that can burn. Equally, we bring in things that can start a fire, we have lighting units, we have computers, we have various electrical installations in the building.

At the beginning I mentioned religious properties. An apparently non-combustible structure, a 156 year-old central synagogue in the middle of New York City, burnt to the ground recently. In another example, I gave a presentation to a group of people on the protection of religious property in the City of New York. The owners and the architects of another synagogue came to me during a break and said "Yeah, you know we've been thinking over this fire safety stuff but we have to get the air conditioning in first". The contractors were working in the loft area installing an air conditioning system with an open flame torch. A small fire started but they thought they had put it out and didn't bother calling the fire brigade. Shortly after they had left the site for the evening, passers-by on the New York streets looked up and said "Peculiar glow in the sky." The building wasn't then fully involved. Right in the middle of New York with one of largest fire brigades in the world yet two hours later the building collapsed.

Apart from bringing hazards in to the building, like contractor activity, we do things to the building which often help foster the growth of fire. Well, if we have a fire, lets really help things move along - creating voids

that allow passage of fire from a point of origin, thereby going beyond our recoverable level.

So the first action is the risk assessment programme. I'm not going to be able to go into a great amount of detail but I'm going to give you some of the principles and basics of it so that you can go on and start this yourself and do this on an ongoing basis.

First the primary objectives: we want to keep the building, we want to keep the building's contents, we want to keep the mission of the building. We start off by looking at the fuels, and fuels come in a wide range - you've got to realise that anything that can burn is a fuel. The structure can be a fuel. This particular building happens to be a 175-year-old coach barn that was occupied by one of our presidents and this is 175-year-old timber. It's dried, it's lost its moisture content, it's a fuel. We also need to assess where fuels may not be that significant, and as one does a risk assessment to look at the relative risk. If one has a limited budget, then it's probably not a good idea to spend the money in a room with limited fuel. You get areas full of fuel and that's where the fire is likely to start. In this example, inside the State Capitol of Vermont, we see a higher level of fuel, this space in itself has a relatively low chance of a fire starting but there are some very significant items in here. This series of flags are important to this particular institution. Very high density fuels, such as those found in standard library bookshelfing can be a problem. This type was used from about 1880 to 1925 -1930 on both sides of the Atlantic. There was a big movement towards self-supporting cast iron stacks. Relatively speaking, while this is a high-fuel package, it is fairly dense storage which means it's going to be slower burning fire, but once it gets going, look out!

Something as simple as a bag of waste can really cause quite a disturbance and the thing to keep in mind is when such things are found, do we really need them to be there? Is there not a benefit in moving sacks of refuse out of the building? For example, an underground garage next to a library obviously has a very high density fuel package (including the vehicles which back in here). They're a risk, they're part of the normal operation, so the key to preventing the large fire is in ensuring that any fire that starts here does not progress beyond this space.

Things that are finely divided burn faster than those that are solid. For example, a log in a fireplace is very difficult to start burning; paper will very quickly catch light. How can we minimise the risk? By removing some fuels, by enclosing them, the simple act of keeping paper in a filing cabinet can go a long way toward limiting our fuel risks. Flammable liquids and gases, I find them so often in historic structures and one of the very simple risk management tools, is 'Get it out of there'. There is really no reason for us to have a drum of whatever-it-is in there and there is always a risk of leakage. Trouble waiting to happen.

Its also important to keep in mind when undertaking a risk assessment that things are always changing, - be aware of how they may influence the safety of your building. This particular space is normally used as a legislative office room and hazard levels are quite typical. However, they then put this exhibition in. They have changed the dynamics quite a bit and unfortunately they put it in without any sort of fire retardant treatment on the panels, or on the wood assemblies and so we know they created a hazard. Fuel identification is the first step and when you identify fuels, ask "do I need this, can I minimise this risk? get rid of the kindling?".

Now, fuel in itself isn't really a problem as long as there is no ignition source. We could fill this room full of loose paper and that would be fine as long as there's nothing in here to start a fire. Once an ignition source comes along, that's a different scenario and so the thing to keep in mind is, what are the ignition sources in the building? Are there heating units? One of the common scenarios I find is whole areas jammed full of paper, in this case, just sitting there very close to the oil-fired burner. In another example, portable space heaters are being used next to the polyurethane foam cushion and in fact, this particular cushion was showing signs of drying out and decay which is the first step toward combustion.

Do I need that particular device there? And if I do need it there, what are the precautions one can take to keep it away from the fuels? One of the main causes of fire is mechanical equipment breakdown and often during budgetary crunches, the first thing to be cut is maintenance. I think that's probably the last thing you should do. Doing simple things like keeping bearings lubricated and belts maintained goes a long way towards minimising risk. The other area where ongoing maintenance is of primary importance is with electrics - from issues as simple as making sure that we aren't piling combustible items near them, that they aren't overloaded. Regular inspection and maintenance goes a long way toward minimising fires.

Also, don't forget seasonal or special issues like the use of candles or naked flames. If these really are essential for cultural or religious reasons, then adequate precautions must be taken (including perhaps the provision of a fire watch or security guard).

One has also to ask whether some operations actually have to be where they are. This particular printing and photocopying operation was in a heritage building and it was recognised that it really didn't need to be in the heritage building. We managed to move it to an adjacent occupancy where, if there is a problem, the photocopier and paper will be lost but its not going to destroy or harm the building.

The same questions should be asked about conservation laboratories and workshops. The question is :"do we need them in there?". If we do need them in there, then we're going to have to be looking to supplemental means to safeguard them and any temporary ignition sources that may be in use. This situation is not all that different from the scenario that started the fire in Windsor Castle. High-intensity lamps coming into contact with something that can burn. Here's the fuel, we have our ignition source, and so a fire follows. This is actually in an art gallery that was being refurbished. The people who were doing this were the caretakers of the particular property, who were generating the hazard.

Now to the difficult one: smoking. In fact, the truth is it doesn't belong in any of our buildings and yet it still exists. Smokers are often pushed outside buildings - this is difficult to police and somewhat unfair, especially in bad weather. In addition, the image which crowds of puffers can create for visitors is less than positive. The lesser evil may well be to create a smoking room which must be properly ventilated and fitted with a fire detection system which will not false alarm on cigarette smoke. Needless to say, the room should be equipped with proper, sand-filled ashtrays and a good fire door with an automatic door closer.

This illustration is of battery back up for emergency power and it happens to be right inside a library bookstack. Obviously, there's a need for these batteries, but the need to have them in close proximity to the highest value things in the building is questionable. And then of course, the other ignition source scenarios we always have to be aware of are people. Security has an important role in minimising the chance of an arsonist getting in to create a fire.

After looking at the fuels and at the ignition sources, the next step to consider is how does the building behave? Now what we see here is a very ornate corridor. Going into fire engineering mode, I see there a horizontal flue. So, any fire that begins at one end has the chance of travelling to the other very quickly. Now, it is a fairly sterile area as we can see, constructed of marble and granite and plaster, which of themselves will not burn, but should I end up with a fire in one of these adjacent offices and have smoke and gases spreading into the corridor, then a fire can migrate through to destruction. The question is, of course, can we improve the situation either by some intermediate corridor or improving the doors to the offices ? Here you see that the doors are fire-rated reproductions which will minimise the chances of the fire getting to the building core.

Perhaps the most important consideration is how can we make the building work to our advantage? As I said earlier we want to prevent fires but should a fire happen we want to keep it confined and that's where building construction comes in. Doors, when propped open, allow smoke and fire gases to migrate. The act of keeping doors closed when not in use is a major contribution to fire safety and doesn't cost anything. Even authentic, old doors that are are part of the period of the building may have some inherent fire resistance. We are quite often able to estimate how long a period door will last and then can look at options to improve the door, replace the door, or provide a supplemental means to keep the door cool and thereby confine the fire.

During risk assessment we look for patterns of how fires spread, and realise that fire will spread anywhere that it can, particularly along voids, up chases and within cavities. So the key to a risk assessment is to identify these locations where there is an opening and use a non-combustible sealant to stop it up.

The other thing that has to be taken into account are the things that are beyond our control, notably our neighbours. This Park Service site and house has a really well protected structure, the place next door has not. As it isn't ours, we don't have any control over it and yet it is presents a risk to our building and so part of the emergency procedures which have been adopted in this case (in the city of Boston) is that if there is a fire in this neighbouring building, the Fire Department will dispatch an extra fire engine whose sole role is to take care of our building.

Other things to look at in a risk assessment include the need to put a relative value on the different occupancies within the structure as well as the contents. Obviously, illustrated here is an area of extremely high value where we have all these paintings. A book such as the Gutenberg Bible also requires a high level of protection. The architectural significance of the structure is also part of the risk assessment equation. How important is this particular ceiling in our overall survival structure, can we afford to lose it ? Equally, what is the mission of the structure? This is something that is often overlooked. The question should be asked: If we lose the building, do we have a reason for the organisation that runs the building to exist ?

We also need to keep in mind life safety issues. Part of the risk assessment is to make sure that the means of escape are operable. Chairs piled up in a corridor pose a problem and may reduce the escape capacity of that corridor. Propped open doors may pose a problem in that they reduce the effectiveness of that escape route. In addition to the building itself, we start to look at what are the supplemental measures that we have and where can we maybe implement them, to start to take into account any deficiencies that exist. Smoke detection devices are one means of improving the fire safety of the building by providing early warning.

Co-ordination with the fire brigade is critical. Keeping them involved in the risk assessment process and in any improvements is highly beneficial. In the risk assessment, you also want to know what their capabilities are. In some of our sites, the closest fire brigade may be 45 minutes away.

So where does that leave us? It leaves us with a need to identify the fuels, identify the institution's mission, look at the strengths and weaknesses of the buildings and then look at the supplemental systems that are available.

To help you, there are a number of useful texts. The publications that Historic Scotland have put together are certainly a good start. There are two UK FPA documents and the National Fire Protection Association documents: 909, which is a standard for fire protection in libraries, museums and places of worship and 914, which covers the fire protection of historic structures."

DYNAMIC RISK ASSESSMENT

JOHN RYAN, Divisional Officer, Grampian Fire Brigade

"This session is concerned with what happens when something goes wrong and you find yourself confronted with an emergency situation. I hope that by the end you are able to say to yourself, 'Well he hasn't told me anything I didn't already know'!

The fire brigades of the United Kingdom are heavily involved in conducting risk assessments of activities at all their premises, such as fire stations, administration buildings, vehicle workshops and training areas, some of which, it could be argued, are also historic properties! However, the fire service also has another workplace to consider as regards risk assessment. It has to risk assess activities at its operational sites - the places it fights fires, the places where it rescues road crash victims and people from hazardous situations and where it deals with hazardous chemical incidents. The list of potential operational incidents is very long and will, no doubt, be added to as time goes on. The fire service is different from most other organisations because it has to predict the incidents that it might be called to deal with. As with any risk assessment it is necessary to know what control measures are in place and those it is necessary to introduce before an incident occurs to help make fire service personnel and other people safer. A mammoth task, particularly as these activities do not take place in what could be described as a normal place of work.

However, the business of risk assessment does not finish here for the fire service. This is where the word 'dynamic' comes in. As the word itself implies, it refers to *an ongoing process which is subject to constant review as a situation develops.*

So, what is dynamic risk assessment?

It is the continuous process of identifying hazards, assessing risk, taking action to eliminate or reduce the risk, monitoring and reviewing.

The key word here is 'continuous'. Dynamic risk assessment comes into operation at an uncontrolled emergency situation. The fire service, therefore, is a good example to use, as dynamic risk assessment is part of its normal operational procedures and is put into use at the many emergency incidents it deals with daily.

When we face a fire situation we are operating in an inherently dangerous workplace which is impracticable or impossible to make safe. It could not be termed a normal place of work. It is, rather, a hostile, dangerous environment which, initially at least, we have no control over. As we cannot make the workplace as safe as we would like, we, therefore, have to resort to making sure our firefighters are as safe as possible.

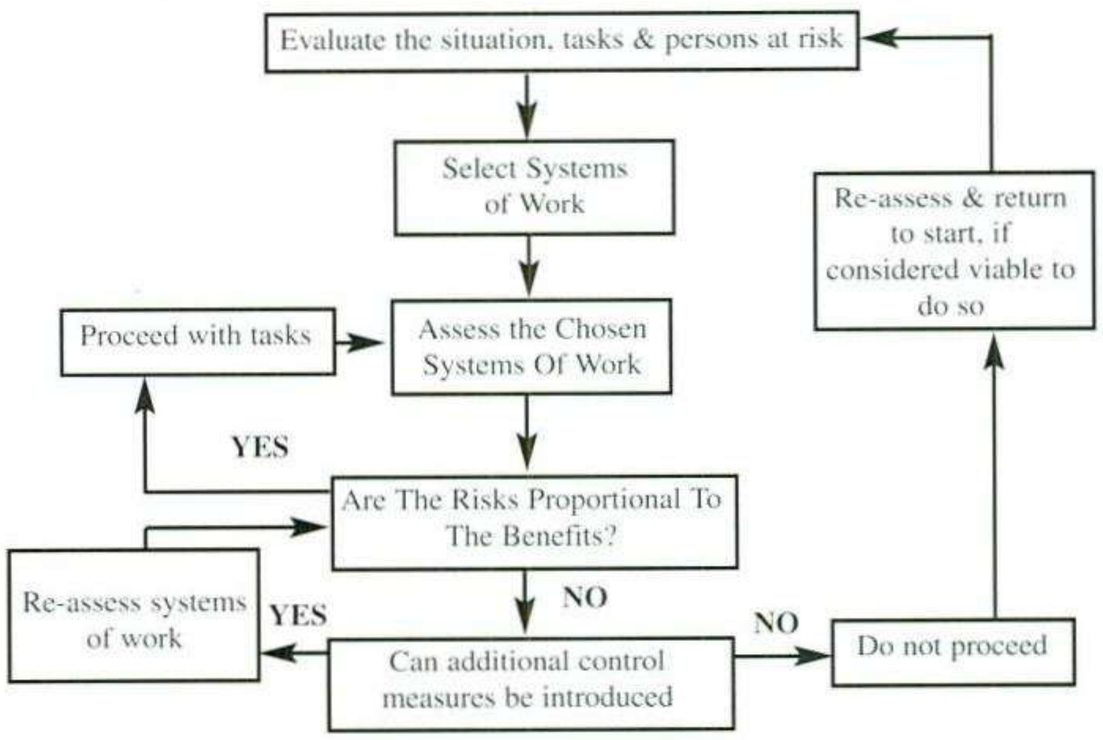
The UK fire service has adopted what we call the *safe person concept*, which details both organisational and personal responsibilities regarding safety at an incident. Included in personal responsibility for a firefighter is the ability to adapt to changing circumstances and to be vigilant for his or her own safety and that of colleagues and others. So all firefighters have a 'dynamic' safety responsibility, but overall responsibility lies with the officer in charge. The officer in charge must ensure that safe practices are followed and that, so far as is reasonably practicable under the circumstances, risks are eliminated or, if not, reduced to the minimum commensurate with the needs of the task.

If we take a developing emergency situation, in sequence, we can see how dynamic risk assessment operates. The first task of the officer in charge of the first appliance to arrive at an incident must be to gather information, evaluate the situation and then apply professional judgement to decide the most appropriate course of action. Hazards must be identified and the risks to firefighters, the public and the environment considered. The benefits of proceeding with the task must be weighed carefully against the risks. It is imperative that a right judgement is made as the consequences of a wrong decision at this stage may be irreversible.

You can imagine the pressure on an officer if he or she is faced with, say, a multiple rescue situation and a rapidly developing fire. The resources to deal with such an incident possibly won't yet have arrived and he or she will have to use the available resources as effectively as possible. Once a course of action is decided on, the officer in charge will have to assess the chosen system of work and keep asking themselves 'are the risks we are taking proportional to the benefits of the outcome?' If the answer to that question is 'No' then either additional control measures will need to be introduced or the task is halted. Only when the answer to the question is 'Yes' should the tasks continue.

As an emergency incident develops the original course of action might become inappropriate for a number of reasons. New hazards and their associated risks may arise (e.g. a building on fire might become unstable); firefighting activities might produce risks to people and/or the environment (e.g. contaminated run-off water). It is imperative, therefore, that any chosen system of work is continually assessed.

This process is shown in diagrammatic form in the Dynamic Assessment Flow Chart.



If we follow the path through the flow chart we can see how dynamic risk assessment works. The first step is to evaluate the situation, tasks and persons at risk by considering;

- the tasks that need to be carried out;
- the hazards there are in carrying out these tasks;
- the risks that are associated with these hazards - to firefighters, other emergency service personnel, the public and the environment;
- the available resources.

The next step is to select the system of work by:

- considering the possible systems of work available, taking into account agreed procedures and training;
- ensuring that all personnel are competent to carry out the tasks they have been allocated.

We then assess the chosen systems of work by considering whether they, together with the existing control measures, eliminate the risks or reduce them to an acceptable level and ask ourselves 'are the risks proportional to the benefits? If they are then we can proceed with the task. If they are not then we need to consider introducing additional control measures (e.g. extra or specialist equipment or the use of appointed safety officers).

We then have to reassess the systems of work and the additional control measures to see what risks, if any, remain. A judgement is then made on whether the benefit gained from carrying out the tasks outweigh the possible consequences if the risks are realised.

It might be necessary, if the additional control measures do not significantly improve the situation to go back to the start and evaluate the situation, tasks and persons at risk again.

You will notice that this chart doesn't lead anywhere. It just keeps going around in circles. What, I hope, this demonstrates is that dynamic assessment is continuous and even if things appear to be going allright, a proper re-assessment needs to be made all the time.

The Phoenix Fire Department in Arizona has a maxim which demonstrates the correct attitude towards safety:

We may risk our lives a lot, in a highly calculated manner, to protect saveable lives.

We may risk our lives a little, in a highly calculated manner, to protect saveable property.

We will not risk our lives at all for lives or property that are already lost'

This puts into perspective what dynamic risk assessment is all about. It's a balancing act.

For instance, in a derelict building fire in Aberdeen earlier this year, firefighters lives were not unnecessarily put at risk because a proper dynamic assessment was made. Although the building was known to be a haunt for squatters the officer in charge decided that there was not enough evidence to suggest that there were people in the building who could be saved. Coupled with the fact that this particular block was awaiting demolition to make way for new flats and was well alight when the Brigade arrived the officer in charge decided that the building was 'already lost'. If by some chance there had been someone still in the building they would also have been considered 'already lost'. So there was no need to take any risks by putting firefighters into the building whatsoever. The surrounding property was protected and the fire was fought from outside.

It is important to remember as we enter the closing stages of an incident that the process of dynamic risk assessment is continuous and does not end until after the incident is closed. At this stage there are usually fewer reasons for accepting risks, because there are fewer benefits from the tasks being carried out. The chance of an accident occurring at this stage must not be underestimated as personnel become tired and are therefore not as alert as they were in earlier stages. The effects of fatigue on personnel coupled with a possible

degree of complacency must be a consideration for the officer in charge.

Dynamic risk assessment is not exclusively for fire service use. There may come a day when you are faced with a fire or other unforeseen incident at a heritage property. Before the arrival of outside assistance you may consider deploying fire and/or salvage teams into a hazardous situation. You will make your decision-making task a lot easier by applying the dynamic risk assessment process.

The principles can also be applied to simple everyday tasks. There is nothing new about this and I am sure that to some degree we have all been thinking along these lines for years, but perhaps in a less formal fashion. For example, when you cross a road you make a dynamic assessment based on the principles outlined in this presentation. You assess the task (to cross to the other side safely), identify the hazards (the traffic) and the risks associated with the hazards (how likely is it that an accident will occur). You then select a system of work (which may be to run across when a gap appears in the traffic). You then assess this system of work taking into account whether you consider what you are about to do is worth taking the risk for. You might decide that it is too risky, so you introduce an additional control measure (by going to a pedestrian crossing). You then re-assess and would perhaps decide that the risk of crossing at a pedestrian crossing is worth taking. However, when you are using the pedestrian crossing you still re-assess the course of action (there have been plenty of accidents on pedestrian crossings!). So you have got to the other side of the road only after continually re-assessing the situation and adopting appropriate control measures.

I hope that in this short time I have been able to give you an appreciation of the principles of dynamic risk assessment. It is a simple thought process which helps us to focus on the right action to take at a time when rapid decisions have to be made. Although I have used fire service operations as an example, the process can be used to help select systems of work in other areas.

If you take one thing away from this presentation, I hope it is that if you are ever faced with a situation where you have to apply dynamic risk assessment that you remember to ask yourself 'are the risks I am taking worth what I am trying to achieve?' Only you can make a judgement and decide. If you can answer that question honestly, your course of action is made that much simpler to choose and, more importantly, helps provide you with a much safer working environment."

PROTECTING THE BUILDING

RICHARD EMERSON, Principal Inspector of Historic Buildings, Historic Scotland

Fire is an interesting destroyer of buildings as, unlike dry rot, it can be used aggressively.

More than we realise our perception of our past and our architectural history is coloured by fire. To take just two examples: Dryburgh Abbey was burnt, deliberately, by the English in 1322, 1385, 1523 and 1544. This last raid by some 700 men on 4 November was described as follows: "they rode into Scotland upon the Water of Tweide to a town called Dryburgh with an Abbey of the same, which was a pretty town and well buylded, and they burnt the same town and Abbey, saving the churche, and they tarried so long at the said burnynge and spoylage that it was Saturday at eight of the cloke at nycht or they came home".

In the same year Melrose Abbey was burnt by Sir Ralph Evers and again in 1545 by the Earl of Hertford, who went on to burn Edinburgh. Lest anyone think that this is a Borders problem, Edward III burnt Kinloss, Forres and Aberdeen in 1336. Nor was it limited to the Mediaeval period, Hawley's Dragoons burnt Linlithgow on 1 February 1746 in a move which has modern resonances: when the Croatians were shelled at Dubrovnic, they painted the word Museum on a roof to protect the building, only to find it was made a particular target. As Hawley's men and the Serbian Gunners knew, to destroy a nation's history and culture is to destroy its identity.

In case anyone thinks I am advancing an argument that the English are the single greatest cause of fire in Scotland, I should point out that this was a two-way affair. The Battle of Otterburne from Scot's Minstrelsy of the Scottish Border describing Douglas's raid of 1388 begins:

> It fell about the Lammas tide,
> When the muir-men win their hay,
> The doughty Douglas bound him to ride
> Into England, to drive a prey.
>
> He chose the Gordons and the Graemes,
> the Lindesays, light and gay,
> But the Jardines wald not with him ride,
> And they rue it to this day.
>
> And he has burned the dales of Tyne,
> And part of Bambrough shire;
> And three tall towers of Reidswire fells,
> He left them all on fire.

Nor was it restricted to men. The suffragettes burnt both Whitekirk Parish Church, East Lothian, one of our finest mediaeval churches, and David Bryce's enormous baronial pile Castlemilk, Dumfriesshire, in 1914.

More private scores were also settled by the torch. In 1630 James Crichton of Frendraught, (a dozen miles to the south of Banff) in furtherance of a family feud deliberately fired the tower in which were sleeping his guests: Lord Aboyne and Gordon of Rothiemay, with their servants and pages.

The consequences of this history of fire-raising are varied and subtle. Unlike France, Spain or Germany, we have no mediaeval town buildings, unlike these countries, and also England, we now have no early timber framed buildings either in our towns or in the country. We have instead a monochrome inheritance of stone ruins. All our early traditions in timberwork, painting, stained glass or textiles are so fragmentary as to be virtually lost.

On the other hand, we have learned to build well in stone, and to roof in slate. In 1621 the Parliament passed its first Building Regulations as follows:

> this present Parliament CONSIDDERING that sindrie personnes of meane qualitie acquyre to thame selffis the heritable right of sindrie ruinous landis and waistis within the toun of Edinburgh, and for want of meanis to build the same sufficientlie theikis the same with straye thank and daillis, quhairby the landis adiacent to the same buildit upoun the gryit charis and expensis of the heritouris are often brocht in gryit hasert and sumtyme to decaye in tyme of suddent fyre THAIRFORE and for the farder decoratione of the said burgh being heid burgh of this realme OURE SOVERANE LORD with consent of the saidis estaittis statutis and ordanis that in all tyme to cum na maner of persone or persones salbe sufferit or permittit to builde onye housis within the said burgh of Edinburgh bot sick as salbe coverit with sklaitt skailyi leade tyild or thak stane, and als statutes and ordanis that the heritouris of sick housis as ar alreddie theikit with thak and straye (giff the samen thak and straye ruiffes sal heir after at onye tyme becum ruinous) salbe astrictit to theik the same agane with sklait, or skaliyie, leade, tyild

> or thankstane. And . . . ordanis the provest and bailyeis of the said burgh to put this act to execution[1]

This instruction was given a boost in 1674 when the City Council of Edinburgh promoted a 17 year exemption from taxes on any new stone-fronted building which replaced a timber-fronted one.

In the constricted and hugger-mugger conditions of Edinburgh Old Town however catastrophic fire was still an ever-present danger. Parliament Close was burnt in 1676, and in February 1700 when Duncan Forbes of Culloden wrote:

> All the pryde of Edenr is sunk; from the Cowgate to the High Street all is burnt, and hardly one stone left upon another..... These babells, of ten & fourteen story high, are down to the Ground, and their fall's ver terrible[2]

The same story was repeated in 1824 when, from the Tron to George IV Bridge, the heart of the Old Town was again laid waste.

Mill buildings were notoriously subject to accidental fire and huge strides were made in the development of fireproof building construction in the eighteenth century. This brought in its train the development of system building and prefabrication through iron, steel and concrete-framed buildings with non-structural external walls, which led more or less directly to skyscraper construction.

Theatres have burnt with, in hindsight, complete predictability, (usually some poor dancer's tutu caught an arc-lamp, turning her immediately into a fire brand) and it is astonishing that anyone ever rebuilds one.

Department stores, once developed in the 1870's with their huge uncompartmented floor areas, immediately started to go up in flames. Jenners was a famous fire and when rebuilt in 1895 was, like the Old North British Hotel, (now the Balmoral) a triumph of Stuarts' Granolithic fireproof construction.

This brings us to the modern period. Sir Robert Lorimer used to write, shamelessly, to the shattered owners of fire-damaged country houses offering to rebuild them with concrete, fireproof floors. Ellary, Dunrobin, Midfeld and Monzie were amongst the commissions won for the price of a stamp and the diligent scanning of the Scotsman.

Perhaps architects still write out in this way, but after a major fire at a listed building it is likely that amongst the first to call will be the Building Control Officer and the Planning Officer, and shortly afterwards perhaps the Historic Buildings Inspector.

It is the in the aftermath of fire that the consequences of owning a listed building begin to bite. The advice to Planning Authorities in the Secretary of State's *Memorandum of Guidance on Listed Buildings and Conservation Areas* is quite explicit.

3.0.0 Making Good Fire Damage

In choosing an appropriate level of insurance for a building, most owners will simply consider safeguarding the market value of the building as a financial asset. They will probably give little thought to how they may be required to make good damage caused by a fire. In the case of listed buildings and, to a lesser extent, buildings within conservation areas, an owner's freedom of action following a fire is limited by the legislation which seeks to protect the architectural and historic interest of these buildings. If a listed building or building within a conservation area is partially destroyed, demolition of the remains will require consent. If the remains of a listed building are to be kept and the damaged area replaced in a way which does not replicate exactly what was there before the fire, consent will again be needed.

In most cases of total loss, it is likely that the special interest of the building will be considered to have been irrevocably lost. Where this is so, the construction of a replica will probably serve little purpose and rebuilding in a different manner using different materials may be acceptable. However, if the building formed an integral part of a larger architectural entity such as a square or terrace, the exact reinstatement of at least the exterior will almost certainly be required.

This ceiling at Cullen House was destroyed by fire. As the loss of original material was total, recreation was not appropriate and a ceiling of new design has been installed in its place.

Partial loss is much more common, and potentially more problematic. The extent to which full restoration can reasonably be required is a matter of judgement, based on a full and careful assessment of what constituted the special architectural or historic interest of the building. It is difficult to identify the point at which a building becomes so damaged that full reinstatement is not worthwhile. Clearly the type and extent of the damage and the importance of the damaged part to the overall architectural quality of the whole must be considered in each case and it is consequently impossible to provide hard and fast rules. In some instances it may be considered essential to reinstate fully even though a substantial proportion of the historic fabric has been lost. This may be the case, for example, where the damage affects a building of undoubted architectural quality or one which is symmetrical, and will almost inevitably be required where the damaged building forms part of a formal composition.

If the interior is almost entirely lost but the shell remains substantially intact, repair of the external walls and reinstatement of the roof to their appearance before the fire may be required but rebuilding of the interior in a different manner permitted. However, where fragments of the interior survive, replicating the lost elements may be encouraged in some cases and required in others. A great deal will depend upon the quality of the interior in whole or in part before the fire and the ability accurately to recreate it on the basis of surviving fragments of the built fabric, photographs and drawings. In general the reinstatement of interior spaces of acknowledged architectural merit will be sought where this is feasible. Certainly the destruction of surviving, albeit incomplete, high quality decorative work to permit a refitting in a different style is most unlikely to be viewed favourably.

Where it may be acceptable to rebuild a partially damaged building in a different manner, it is essential that replacement respects the character of the surviving building. Proposals which are inappropriate in terms of design and materials should not receive consent.

The fact that the building owner may wish reinstatement or the Planning Authority require it should always be borne in mind. Immediately following the fire it is therefore important to sift carefully through the debris and set aside all items, no matter how small or damaged, which may assist reinstatement at a later date. In the case of buildings of outstanding architectural quality nothing should be removed until there has been a full archaeological survey of the interior and of the debris.

After the fire the building will need protection from the weather. Temporary propping and stabilisation of the structure may also be required. Both should be arranged speedily to avoid the risk of further damage to the fabric. A photographic record of the damage should be made. At the earliest opportunity, the Planning Authority and the Historic Buildings Inspectorate should meet to discuss and agree future action and should thereafter promptly advise the building owner what will be required of him.[3]

If an owner fails to proceed with repairs or wishes to demolish the fire damaged structure or rebuild it in a different form or different materials, the legislation will take effect, probably under the wider building control powers. Here I must quote from the *Memorandum* again:

Dangerous Buildings

3.12 Building control authorities may serve a notice requiring the owners of a building, including a listed building, to execute works to make safe or to demolish the building because of its dangerous state or other major defect.

These powers have effect only insofar as they are consistent with the provisions for work to listed buildings, and unlisted buildings in conservation areas, contained in the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997. The existence of an order does not relieve the owner of a property in respect of which such a notice has been served of their normal obligations to obtain listed building consent or conservation area consent for the works which the notice requires.

If a listed building upon whose owner a dangerous buildings notice has been served is also a scheduled monument, the owner must obtain scheduled monument consent from the Secretary of State before undertaking any works to the building.

However, works which are urgently necessary in the interests of health or safety are permitted, provided that (a) the works are limited to the minimum measures immediately necessary, and (b) notice in writing justifying in detail the need for the works is given to the Secretary of State as soon as practicable. In any such case, the owner is advised to make contact with Historic Scotland at the earliest opportunity.

3.13 It is clearly very important that building control and planning departments liaise closely when service of a notice requiring works to a listed building is under consideration.

Where a local authority serves a notice, makes an order or proposes to take action under any enactment requiring either the demolition of, or works to, a listed building it owns, leases or occupies, or which affects such a building, it shall immediately give written notice of the fact to the Secretary of State.

Where the safety of the public requires that the works be carried out without delay, notice, which in such cases may initially be oral, will be given as soon as possible before the works commence. This latter provision seeks to ensure that the earliest possible warning of threats to such listed buildings and that wherever possible listed building consent is sought and obtained for emergency works to make safe or to demolish the listed building.

3.14 The Secretary of State hopes that in all cases where the need for demolition of a listed building, or a building in a conservation area, is not immediate, planning authorities will consider whether it might not be preferable instead to issue a repairs notice [which are discussed later in the paper].

To avoid the service of unnecessary notices, it is strongly suggested that building control departments contact planning departments in advance of formal service of a notice wherever possible so that discussions can take place about the best way of safeguarding both public health and safety and, wherever possible, the listed building itself.

Occasionally it will be necessary to carry out emergency demolition works at very short notice, particularly where fire, flood or other natural disaster has radically altered the condition of a building over a very short space of time.

3.15 Where emergency demolition does have to be undertaken, the need to obtain listed building consent is not abrogated but the defence of urgent necessity can be claimed if consent had not been obtained and proceedings for unauthorised works are initiated.

It is necessary not only to prove that works to the building were urgently necessary, but that it was not practicable to preserve the building by works of repair, or works of temporary support or shelter, and that the works carried out were limited to the minimum measures immediately necessary.

Given this restriction, building control authorities should be careful in their notices to specify only such demolitions and/or repair works as are immediately necessary to prevent danger. It is possible for building authorities to specify demolition or alteration of particularly dangerous parts of a structure only, for example, leaning parapets or pinnacles etc.

The onus of proof will be on individuals who demolish their property, whether or not it was subject to a notice under the Building Acts, to show not only that works were urgently necessary but that no lesser solution than demolition was feasible. Individuals must also give notice in writing justifying in detail the carrying out of the works to the planning authority as soon as possible.

3.16 The Secretary of State is concerned to avoid the unnecessary demolition of listed buildings and worthwhile buildings in conservation areas wherever possible, and hopes that planning authorities will make full use of the repair and compulsory purchase order powers outlined below.

In cases where the building control authority believes that it may have to carry out demolition works itself, it should notify both the planning authority and the Historic Buildings Inspectorate at the earliest possible opportunity, and certainly before any works are undertaken on site to permit consideration of alternative measures. Building control authorities are reminded that where work must be carried out they should only proceed with demolition to the point where the building is made safe.(4)

Separate powers are available to the Planning Authority for the urgent works for the preservation of Listed Buildings and again I quote from the *Memorandum*:

Repair and maintenance of historic buildings

3.17 The preservation of historic buildings requires their regular maintenance and timely repair. Expenditure on routine maintenance and repairs can avoid the need for more expensive work caused by their neglect.

While there is no specific obligation on the owner of a listed building to maintain it, there are statutory powers available to planning authorities and the Secretary of State to take action where listed buildings have deteriorated. These powers allow them to carry out urgent works for the preservation of listed buildings, to serve 'repairs notices' and to compulsorily acquire listed buildings in need of repair.

Urgent works for the preservation of listed buildings

3.18 The planning authority or the Secretary of State may carry out emergency works for the preservation of listed buildings in their area. Such works may consist of or include works for affording temporary support or shelter to the building, for example, planning authorities may erect supporting scaffolding or put in place a temporary roof covering.

If the listed building is partly occupied works may be carried out only to those parts which are not in use. The Secretary of State may direct that an unlisted building in a conservation area should come within the scope of these powers.

No action may, however, be taken under the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997 in respect of ecclesiastical buildings in use as such, subject to future limitations of the exemption by order, and scheduled monuments. The owner of the building must be given not less than 7 days' notice in writing of the intention to carry out the works and the notice must describe the works which the planning authority proposes to carry out.

3.19 The planning authority or the Secretary of State may require the owner of the building to pay the expenses of the works undertaken. Such expenses may include continuing expenses involved in making available such necessary apparatus as scaffolding, and the owner may be notified from time to time of the cumulative total of such continuing expenses.

Within 28 days of receipt of a notice requiring payment, the owner may represent to the Secretary of State that some or all of the works were unnecessary for the preservation of the building, that the amount claimed is unreasonable, that recovery of the cost would cause hardship, or that temporary arrangements for support of the building have continued for an unreasonable length of time.

3.20 Planning authorities are encouraged to use these powers not only at the point where deterioration is so far advanced that without emergency intervention irretrievable loss is inevitable, but preferably at earlier stages when relatively inexpensive works can halt a building's deterioration and greatly improve its chances of economic re-use.

Planning authorities will also wish to take into account the power (see 3.18) to undertake works of temporary support on a continuing basis. The erection of supportive scaffolding or temporary measures to prevent water penetration can often afford a useful breathing space in which the future of the building can be properly considered.

3.21 Authorities should, however, take care to ensure that any work done on a building is the minimum required for its preservation and is carried out at a reasonable cost. Expensive permanent repairs should not be undertaken using these powers.

> Works undertaken should normally be those designed to keep a building wind and weatherproof, to provide necessary structural support in cases of potential danger or to prevent damage by vandals.(5)

Listed Buildings in need of repair may be compulsorily purchased by the Local Authority or the Secretary of State. A similar mechanism exists for Ancient Monuments.

Compulsory acquisition of listed buildings in need of repair

3.22 Planning authorities and the Secretary of State are empowered to acquire compulsorily listed buildings which are not being properly conserved. Compulsory purchase proceedings can only be initiated following service of a repairs notice. Ecclesiastical buildings in use as such, subject to variation of the current exemption by order, and scheduled ancient monuments are exempt from compulsory acquisition under the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997. This section does not apply to unlisted buildings in conservation areas, or to Crown property.

The procedure for compulsory purchase is set out in the Acquisition of Land (Authorisation Procedure) (Scotland) Act 1947: the forms to be used are prescribed in the Compulsory Purchase of Land (Scotland) Regulations 1976 (SI 1976/820).

Planning authorities may wish to note that certain additional paragraphs are required to be included in the form of notice sent out to interested parties where a listed building is the subject of the order. A compulsory purchase order made by a planning authority requires the Secretary of State's confirmation in the usual way.

3.23 The compulsory purchase order may include, besides the building, any neighbouring land required for preserving the building or its amenities, or for giving access to it for its proper control or management.

3.24 Anyone having an interest in a building on which a compulsory purchase order has been made under this section may apply to the sheriff within 28 days after the service of the CPO notice for an order prohibiting further proceedings on it. If the sheriff is satisfied that reasonable steps have been taken to preserve the building an order prohibiting further proceedings may be made. There is a right of appeal against the sheriff's decision to the Court of Session, but on a point of law only.

3.25 Before confirming a compulsory purchase order, the Secretary of State must be satisfied that the building ought to be preserved and that it should be compulsorily acquired for that purpose. The Secretary of State must also have regard to objections to the order made in writing.

Where the objection is not one which may be disregarded and is made by a statutory objector, the Secretary of State is required to afford the objector an opportunity to appear before and to be heard at a public local inquiry or, if the objector agrees, at an informal hearing.(6)

Finally to turn briefly to Insurance, which James Campbell has covered in some detail already, it is important, first, to be aware that:

An owner is not required by statute to take out heavier or more extensive insurance cover for a listed building. As with other buildings, it is for each owner to decide what is appropriate or prudent to cover possible risks and to protect the value of an asset.

Repairs to the fabric of a listed building, and consequently insurance of buildings, by virtue of the building's age and character, may be more expensive than repairs to an equivalent modern building. The owner is not however obliged to insure against more risks that would be covered for any building of similar use or value.(7)

Excellent guidance on the Insurance of both churches and chapels and secular listed buildings was produced recently by a joint English Heritage/RICS working party, which sought to give clarity to what is a myth-ridden area of concern to those who own or manage historic buildings.

Historic Scotland has no major disagreement with any of this advice and commends it to you with the following important caveat.

The EH/RICS guidance attempts to put a percentage on the amount of fabric lost beyond which reinstatement is not likely to be insisted upon. This we feel is a very difficult area. Just what is to be measured in coming to this decision - how much does the roof and roof volume add up to if the plasterwork and finishes of the ground and first floor are intact, though sodden? What of a shell, like Mavisbank, where the whole internal volume is destroyed but the external elevations remain, and remain of national importance?

To cope with this difference of approach, Historic Scotland has prepared a draft advice note on the Insurance of Churches which will be put out to wide circulation.We will also publish, in due course, a similar advice note on secular buildings.

In the meantime, Historic Scotland's position is of course set out in the *1998 Memorandum* which I have already quoted at length, and those professionals and owners seeking definitive advice from Historic Scotland should refer to this in the first instance. We are of course happy to give more detailed advice on individual buildings, should that be helpful.

Notes

1. City Charters, Bundle 34, No.20 (see 29th October 1624) Extract from the Acts of Parliament by Sir George Hay of Kinfauns, Kt., Lord Clerk Register.
2. I G Brown, Building for Books, p.24.
3. 1998 Memorandum of Guidance on Listed Buildings and Conservation Areas, Historic Scotland, Edinburgh, 159
4. 1998 Memorandum of Guidance on Listed Buildings and Conservation Areas, Historic Scotland, Edinburgh, 42-44
5. 1998 Memorandum of Guidance on Listed Buildings and Conservation Areas, Historic Scotland, Edinburgh, 44-45
6. 1998 Memorandum of Guidance on Listed Buildings and Conservation Areas, Historic Scotland, Edinburgh, 45-46
7. 1998 Memorandum of Guidance on Listed Buildings and Conservation Areas, Historic Scotland, Edinburgh, 4

SALVAGE AT HERITAGE PROPERTY

TOM CARROLL, Chief Fire Officer, Oxfordshire Fire Service

"Because of my occupation I have an obvious interest in fires in heritage properties and the performance of the service at the scene. It is pretty well guaranteed that the brigade crews will acquit themselves well as far as "direct" or actual firefighting is concerned. However, included with our duties is the much more difficult area of salvage and it is on this topic that I wish to address you today.

There is a statutory requirement on all fire authorities to provide "efficient arrangements for ensuring that reasonable steps are taken to prevent or mitigate damage to property resulting from measures taken in dealing with fires in the area of the fire authority". (Fig. 1)

Fig. 1(a) Ca d'aro building, Glasgow, ablaze.

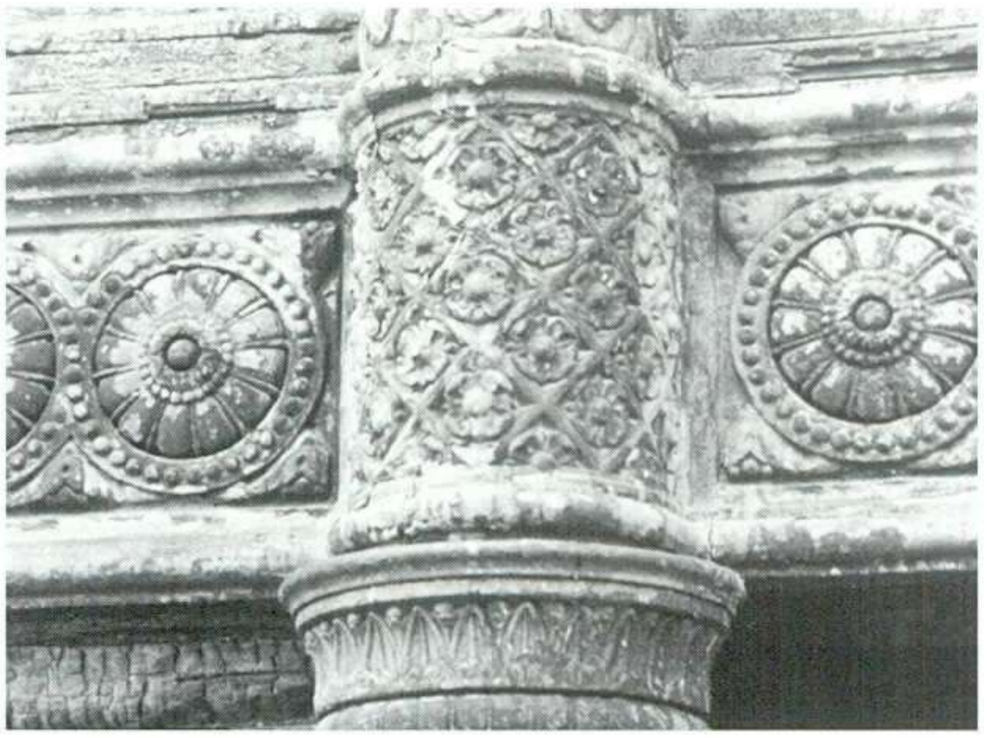


Fig. 1(b) Fire damage on a cast iron panel at the Ca d'aro building, Glasgow.

There is therefore no choice except to meet this statutory obligation if the authority is to remain within the law. The section is well intended but has two major inadequacies -

- it applies a blanket coverage for all properties, ignoring the variety of incidents attended by brigades, and
- it only relates to fires

Taking the latter point first, the service is called to attend "special service" incidents such as storm or flood damage, even damage following terrorist attacks but the statutory requirement in relation to salvage only exists where actual firefighting is involved. At a time of reducing budgets and scarce financial resources, some authorities may decide to withdraw from all attendances apart from those where their presence is legally required, thereby creating a hole in the damage limitation plans of all properties including those dear to the hearts of the majority of this audience.

I mentioned earlier the "blanket" coverage of the relevant legislation in that it refers to all properties attended by brigades thereby failing to highlight the very special needs of some incidents such as those in heritage properties. By this I mean that in general, salvage operations in shops, factories etc can be approached in a fairly general manner and generic procedures adopted. But when faced with an incident involving heritage property and articles, the officer in charge has a much more complicated and nebulous task on his/her hands.

Whilst some may gain comfort from looking back at the inadequacies of existing arrangements (we tend to do this a lot, ie discuss past incidents *ad nauseum*) what is needed is some foresight to help both the fire service and those we serve to prepare better for those days we hope never occur. Be assured, if we do nothing we will be found wanting - if we are well prepared but never called upon, (except to practice) we can at least live in the comfort that we have done all we can to preserve the artifacts of our ancestors and therefore the history of their times.

Perhaps now we can take a short look at how Oxfordshire Fire Service approaches the problem. I am not one to claim that everything which happens in my brigade is a model procedure - it would be folly to do so. What I would like to do is to share our experience on heritage salvage which I hope can be built upon to provide a better overall approach. Before starting on this I must emphasise that nothing could have been achieved without the help of others outside the brigade. We have got to where we are through collaboration with colleague departments within Oxfordshire County Council and encouragement from others. Although much of this work was under way before the election of the present government, the approach ties in very nicely with one of the first consultation papers produced by the Blair administration which was entitled "Working Together" and which looked at increasing the efficiency of the fire service through encouraging a shared approach to mutual problems.

That is a good place to commence a short history of what has happened in Oxfordshire. The brigade has always prided itself in placing much emphasis on salvage to the extent that this process and associated equipment is referred to as "damage control" which is thought to sound a little less negative than salvage, the latter being more associated with shipping and wrecks than buildings and contents.

It was obvious from my earliest days in Oxfordshire that there was a high number of "heritage risks" within the county. Just taking the college buildings and their contents in Oxford city into account one could argue that we had more than our fair share (if there is such a number!) - at least as far as shire counties are concerned. A number of square kilometres of Oxford host little else than heritage property and, conceited as we may have wished to be about our performance, it was obvious that outside help would be needed if we were to give of our best. We were lucky in that we did not have far to look. Within the County Council our very own museums, arts, leisure and libraries department were not only willing to be involved, but also brought much needed expertise on this important subject that firefighters cannot be expected to have in addition to all else we ask of them.

Much against the commonly-held inaccurate perception of local authority workers, a number of personnel agreed to remain on pager contact out of normal hours so that they could be called upon should their help be required. They also volunteered to take part in training sessions as well as giving instruction to our operational personnel on how to approach the removal of artifacts. Their presence and input gives fire crew members the comfort of having specialist advice right at the scene of operations and reduces the worry that they might have to visit the Chief for destroying the Van Gogh they thought was a Rolf Harris! But no matter how willing both groups were to progress, it would have been impossible to do so without the all important third side of the triangle, ie the owners and occupiers of relevant properties. Their willingness to allow drills and practice sessions to take place and to give up "inside knowledge" on their property (sometimes their home) was and is invaluable. The benefits of being able to do "dummy-runs" with all agencies present ensure proper performance when an incident occurs. Before anyone challenges me on how I know that this will actually be the case when a real incident occurs, allow me to cite the following example. Some of you will have read about this in edition 295 of *Fire Prevention*.

"Listed building saved from destruction"

On 20 June 1996 fire broke out at the mansion house, Radley College, near Abingdon, Oxfordshire. A potentially very serious incident was averted by preplanning, good risk information, appropriate speed and weight of attack and early attention to damaged contents.

The mansion house is one of the focal structures in the college complex. A grade II listed building of traditional construction with four floors and basement, it contains school administration offices, masters' common room and accommodation for staff. Built in 1727 as a country house it was converted into a school by the Reverend William Sewell in June 1847, thereby founding Radley College. Quite apart from the architectural and historical value of such a building it contains a significant number of important and valuable paintings, antiques and furnishings.

On the day of the fire, the chaplain of the college, asleep in his quarters on the second floor of the mansion house, was woken by a smell of burning. On investigation he discovered signs of a fire in the masters' common room on the first floor. The panel doors to the affected rooms were preventing the fire

spreading, which gave him time to raise the alarm and call the fire brigade. The call was received at 0305 hours, together with one from the AFD system which was triggered at about the same time. Two pumping appliances from Abingdon together with an officer were mobilised.

On arrival the officer in charge of the first attendance was faced with a serious fire involving about 25% of the first floor and spreading above and below. Flames had penetrated several windows and a section of the first floor had already burnt through and collapsed. At that stage it was not clear if anyone was still in the building.

Being aware of the nature of the premises, extra breathing apparatus crews and the damage control team were requested. Staff followed established evacuation procedures and soon the "all persons accounted for" message was sent.

At the height of the blaze there were eight pumping appliances, hydraulic platform, rescue tender, damage control and incident control units in attendance. The fire was brought under control by crews using 20 sets of breathing apparatus but only two jets and eight hosereels supplied from a hydrant in the college grounds augmented by a water relay from a nearby lake.

Hidden fire spread

A predominant feature of this old building was the many voids and hollow walls. This meant that crews were faced with the potential of undetected fire spread around and above them, especially to the second floor and attic. To ensure this did not occur, it was necessary to take up a large area of flooring immediately over the affected rooms. However, to achieve this, many valuable and historical items of furniture and fittings had to be removed to safety.

Great care was taken during cutting away operations to ensure, wherever possible, materials were removed in a manner which enabled them to be reused during restoration. To further reduce disturbance the brigade's fibre optic boroscope equipment was used to check voids both during and after intervention firefighting.

While this work was progressing further damage control measures were undertaken in the rooms below the fire where, until recently, the main library had been located. Again care had to be taken during the damping down and turning over process in order to recover and protect as many artifacts as possible.

Salvage

The incident received widespread coverage in the national press. Quite a few enquires have been received about the purpose of the clear polythene sheeting seen hanging from the windows (Fig.2). These are salvage chutes down which tons of books, paintings and other items were removed. This was a much practised routine which, due to the familiarity of all involved, went like clockwork.

Fig. 2 Salvage chutes at Radley College.

Successful firefighting and salvage work limited damage to four large rooms and adjacent areas on the first floor plus a section of the ground floor. Smoke damage to the rest of the building was controlled by the initial attack and by historic panel doors to the affected areas which maintained their integrity.

Numerous exercises previously held at this building, including one for Her Majesty's Inspector of Fire Services, proved invaluable. Crews now have a good working knowledge of the site, supported by a pre-determined fire plan which was put to the test by the brigade's senior fire safety officer, DO Karras, who was in command of the incident.

Any satisfaction in having been able to save this architecturally and historically important building has to be tempered somewhat by the realisation that to restore it may well cost between five hundred thousand and one million pounds. The relatively small area of destruction serves to give some idea of the total loss value.

The cause of the fire was an electrical short circuit in the ground floor ceiling void, igniting adjacent woodwork. (The location of the initial outbreak explains the delay in AFD detection).

The school was back in operation the morning after the fire even though staff and pupils were in the middle of "A" level examinations. The warden of the college, in a letter expressing his appreciation for the brigade's assistance, wrote: "Radley College will always be in debt to you and your colleagues. You were magnificent in the professionalism which contained the fires to those rooms in the mansion house - if you had failed to do so then I believe that the consequences for other buildings, including the chapel, might have been dire and Radley as we know it would be in ruins today".

Whilst I would love to claim that our work, including that at Radley, is unique and all of our own initiative, it is not. What we do was laid down in Sir Alan Bailey's report "Fire protection for historic palaces" in which section 4.8 is entirely devoted to "Salvage in Palaces". please allow me to quote a short section to you.

4.8 Salvage in palaces: works of art, furnishings etc.

1. The Royal Palaces and their architectural interiors are themselves valuable original works of architecture: in addition, they contain a unique treasury of works of art, furnishing and irreplaceable contents. These are in turn highly vulnerable by fire.

2. The greatest risks to the display of valuable contents are accidental damage and theft. Households and staff at the palaces are alert to possible damage during everyday residential use (e.g. cleaning) and by visitors; and security provisions are in general highly organised.

3. In the event of fire it becomes necessary to organise an immediate salvage operation, the value of which has been well-demonstrated both at Hampton Court and at Windsor. The first requirement is that all available personnel should have a clear understanding of rescue priorities, vis-a-vis essential human safety and fire control measures. We believe that, in general, households and staff are well-trained in salvage; and indeed a very high level of skill has been demonstrated. But some palaces can still usefully learn from others, in their techniques of maintaining clear and ready information for firefighters and rescue squads.

4. Emergency demands quite exceptional clarity; and clear lists of salvage items and plans identifying their whereabouts and priorities are invaluable at such times. These should state any special requirements (e.g. should pictures be cut from their frames? Can objects be carried by one person? or e.g. dismantled? are they flammable? vulnerable by water?).

5. We recommend the urgent completion of exemplary salvage plans and schedules, based on and combining the best experience available to all the agency managements and to other property-owning bodies such as the National Trust. Each room with significant and valuable contents should then have its own clear salvage plan, agreed with palace curators and based on this model, to be held on-the-spot for urgent reference and use.

6. Provisions should further, in each instance, be made for maintaining, checking and regular updating of such plans, as well as for regular training and practice salvage exercises, to be held jointly between staff and fire brigades, as far as these can be achieved consistent with risks of accidental damage.

This direction was given to us following the most talked about fire in a heritage property, at Windsor Castle, yet very few seem to have picked up its importance. Many, it would appear, dwell on the event rather than the outcomes, which included Royal Berkshire fire brigade's liaison with the staff at the castle being singled out for praise as an excellent example.

So what of the future?

I have long held the belief that one of our best talents is re-invention! Whatever our problems in Oxfordshire in relation to heritage property they will differ little from those in Grampian, Cornwall, Armagh or Athens. Yet, with the exception of excellent fora such as this we seem to work in isolation from each other. We complain about lack of resources and yet seem reluctant to share. We all want to give of our best yet sometimes prevent ourselves from doing so through maintaining independence. We seem to forget that some of our colleagues in Europe have a wealth of knowledge on this subject from which we can all benefit through exchanging ideas and experiences.

Consider the following for a moment: if all of us who claim an interest in this subject pooled our resources, how much more could we attain?

I believe that we should work together to create a model which provides specialist damage control units in 8 to 10 locations in the U.K capable of dealing with heritage property fires. The operational side of this arrangement can be hosted by fire brigades chosen through their strategic location ensuring equi-distance to all/most areas (it may of course be necessary to make special arrangements for our capitals and major cities). The nearest unit carrying the specialist equipment required to meet the task of damage control, would then be mobilised to all confirmed incidents at heritage property. Fortunately there are not many

occasions at present when this would be necessary and therefore the drain on host brigade's resources would not be excessive.

Through partnerships at local level involving all interested parties and stakeholders, training in all aspects of artifact retrieval/recovery should take place (as recommended in the Bailey report) with the hardware, shelters, etc. being provided on the mobile units - a good example of working together!

This will no doubt create at least a few whispers of "where is the money going to come from?" There are a number of sources. I cannot think of a much more deserving cause for a grant from the National Lottery Heritage Fund. We must also explore the availability of funding through Europe and attract subscription from the major property holders. The main costs are in the setting up of the system and initial purchase of equipment, but once in place running costs would be minimal. We will never get anything if we don't ask and the chances of success of any bid will be influenced by the unity (or otherwise) of all interested parties.

Finally, I have mentioned Europe on a few occasions. I have been fortunate to visit a number of cities on projects through various European programmes and I know that there are a number of interested potential partners for a project related to preserving our heritage. The Raphael programme would be an excellent vehicle to facilitate joint research and development of this theme. Colleagues in Pamplona, Prague and Warsaw are in regular contact on this matter and I sincerely hope we can pursue it. It would be easy for Oxfordshire to go it alone but I believe we should take a much wider view and involve the U.K. as a whole. Heritage and its value does not stop at the borders of my county! - nor does my interest in preserving it.

Let me close by detailing two examples which illustrate the necessity to, and importance of, working together.

When fire broke out in the Turin Cathedral it destroyed the Guorini Chapel and would have also consumed the famous Turin Shroud had firefighter Mario Trematore not smashed through four layers of bullet proof glass using an axe to rescue the Catholic relic from the silver reliqary that contains the shroud. This achievement, which was almost superhuman, would not be necessary if proper planning and trust existed between the church authorities and the fire service.

The magnificent painting illustrated on my final overhead transparency (Retrato del Principe de Viana) - which hangs in the palace of Navarra in Pamplona, measures 2.5 metres x 5.1 metres. Salvage teams would obviously need to expend quite an amount of energy and time removing it and would probably be very disappointed to later learn that it is actually a replica and not the original. Such information and knowledge can only be achieved through all of us working together to provide a partnership approach."

FIRE PROTECTION MEASURES IN SCOTTISH HISTORIC BUILDINGS

ALAN S MARSHALL, BArch, RIBA, FRIAS, MaPS, Partner, Gray, Marshall & Associates
& STEPHEN NEWSOM, BArch, RIBA, RIAS, MaPS.

"We are here to talk about Technical Advice Note (TAN) 11 which we were involved with from the beginning, in the latter stages together with Dr Marchant as the joint editors of the publication. The starting point of the publication is the statistic you heard yesterday, that one important Scottish historic building is being lost to the effects of fire every month. The new British Standard on conservation makes it clear: fire is the single greatest threat to the fabric and contents of any building. In the case of an historic building the loss of authentic fabric in a fire is irretrievable and yesterday we heard a lot about salvage, damage limitation and so on. But the aim of the Technical Advice Note is very much about preventing fire in the first place. It follows that the conservation of our historic buildings must involve giving them the best possible protection from fire. Of course, life safety remains of first importance, but it's really beyond the scope of a Technical Advice Note to deal with this, although measures taken to protect building very often increase life safety as well, not always the other way round. Yesterday we heard quite a lot about legislation, focusing on life safety and I think it's because of this concentration on life safety that Historic Scotland considered it necessary to provide additional advice and guidance on the preservation of the fabric and contents of historic buildings. As we heard, all too often owners derive a sense of security from an expensively installed fire detection and alarm system designed to meet life safety legislation, only to find that the property itself isn't adequately protected.

In preparing TAN 11, the target audience was seen as Historic Scotland inspectors, building owners and other professionals working in conservation. The approach, first of all, was to gain an understanding of fire in relation to historic buildings by looking at the process of fire and the destructive consequences in real building fires. Regrettably during the two years it took to research the TAN there were several fires; these were of benefit to the study, but very sad nonetheless.

This led on to a study of fire safety management and effective fire precaution measures. Good housekeeping, proper training and sound management are very central to the Technical Advice Note. We then moved on to a review of the technical aspects, which involved a broad review of the available technology and the effects of introducing these to historic buildings. It's a very wide subject, and very difficult to cover in any depth today, though later we will try. Underlying this all is the single, general conclusion that the application of fire engineering principles enables a rational approach to the balancing of different components of fire protection with the needs of individual buildings.

Right at the outset of the project it became necessary to set out a viable conservation philosophy in relation to fire protection measures. I'm sure with this audience I don't need to cover some of the fundamental points about listed buildings, but there are people out there we thought might need a reminder. Listed buildings have a special value, they need as much protection as we can give them, but the work needs to be carried out in a careful way and it's this extra degree of care that makes the conservation approach different from the normal. Nor I hope do I need to explain the ethos of minimal intervention which has become one of the basic principles of good conservation. At the beginning of the TAN project this concept gave quite a lot of difficulties to some of those coming to the subject from the engineering aspects of fire protection, where the solutions are often seen as applying technology to a problem. The conservation approach is simple: only change which is essential for the building's own good is acceptable. Any change should be designed to have the least possible effect on the fabric, structure and appearance; it should be reversible and it should be discernible to close inspection. And above all, it should only be carried out after all options have been assessed. I think this point really has to be stressed at the beginning.

The conservation approach underlies the Technical Advice Note. Rather than imposing fire prevention and protection measures on the building, the approach takes the preservation of the existing fabric and aesthetic as the primary constraint.

Since usefulness, for example, may not be the primary criterion for listed buildings as it is in most buildings, there may come a time where it's possible or necessary to restrict use or even withdraw use. The point was made that if you've got a dangerous use in the building, look first at removing it. It may come to removing people from some of our finest buildings.

This leads to the central dilemma that underlies all the work in this field: that to give the building and it's contents the best level of protection from fire may require a level of intervention in the fabric which is unacceptable in conservation terms. At the same time the loss of the building to fire is unacceptable, so we could go round in circles debating this one for a long time.

So how do we protect our listed buildings?

The best form of protection is to prevent fire happening in the first place. Every effort should be made in terms of training and management and in particular the removal of risks. Many practical common sense fire precaution measures can be implemented at no significant cost. Beyond that, systems of detection, alarm and suppression require to be considered for each building individually. In some instances such technology demands a level of intervention in the fabric that's unacceptable in conservation terms, so measures taken to protect the fabric must not damage what they set out to protect. A balance needs to be established.

The approach must be building-specific. Each listed building requires special treatment, careful research and solutions which balance fire engineering practice with good conservation methods. I think it's important to stress that TAN 11 is not really about post-fire recovery. Although salvage and disaster planning are part of good management the TAN is about protection.

Fig. 1 Dunbar Parish Church after a fire in 1987 which destroyed the interior and roof.

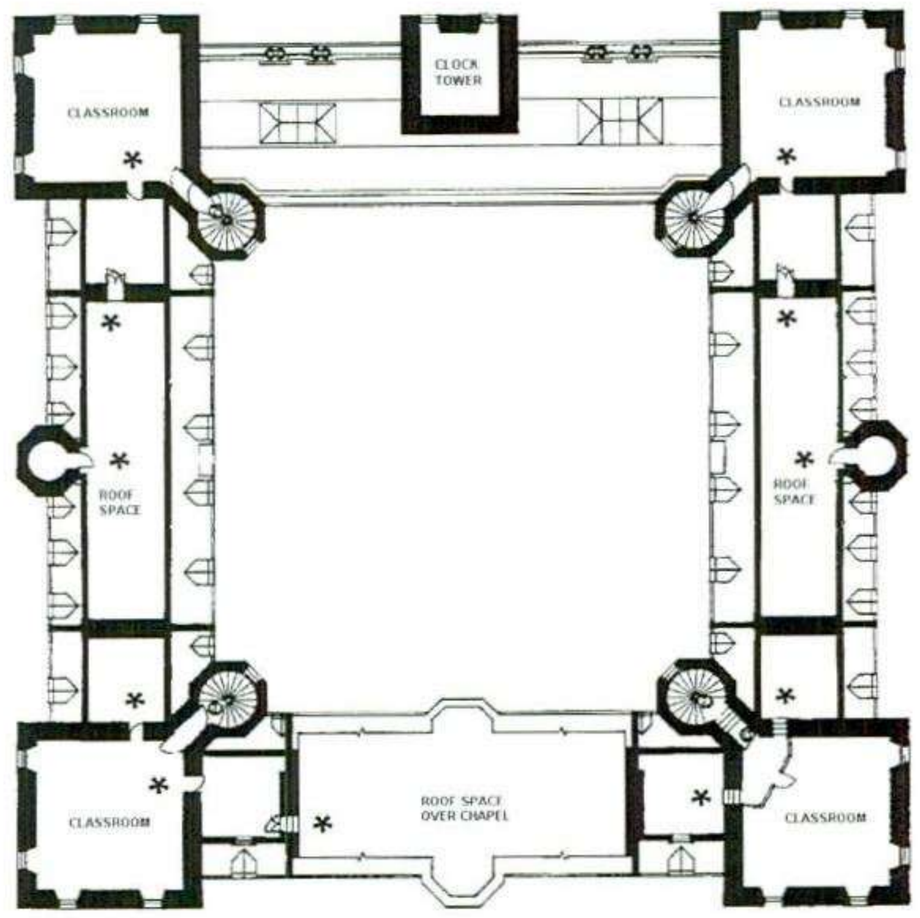


Fig.2 George Heriot's School, Edinburgh. Plan of third floor.

The vulnerability of Historic Buildings to Fire

At this point in the TAN we developed a chapter establishing the particular vulnerability of historic buildings to fire. You can ask the question at the beginning, are historic buildings more vulnerable than other types of buildings?

Dunbar Parish Church (Fig. 1) is vulnerable to fire because of the way it was built. It had a large open roof space and once alight, the whole roof was consumed in minutes and went on to destroy the rest of the building. There are, however, other types of vulnerability.

George Heriot's School has one type of vulnerability (Fig. 2), particularly in terms of its use because during termtime it's occupied by schoolchildren who do lots of experiments. I've found rooms where they've left electrical experiments connected up and heating away gently. The rest of the time (at night and during the holidays) it's completely empty, which is a very different kind of situation, one which the fire prevention system must be designed to cope with.

How fires develop

We then moved on to looking at how fires develop (see Fig. 3). This is an important diagram in understanding the process of management. All fires tend to develop in the same way. What's different is the rate they develop at and how they spread through the building. All fires need a source of ignition, fuels (which can be the building itself) and air, and all fires produce to some extent or other heat, smoke, gases, (some of which are lethal and acidic, and have a damaging effect on historic buildings) and flames. The diagram shows the development of the fire and I think the important

part is the incipient fire when it's just getting going. Then the point of ignition marks where it starts to get worse and worse until eventually a fully-developed fire has developed and consumes the whole building. When there's nothing left to burn, the fire starts to die down.

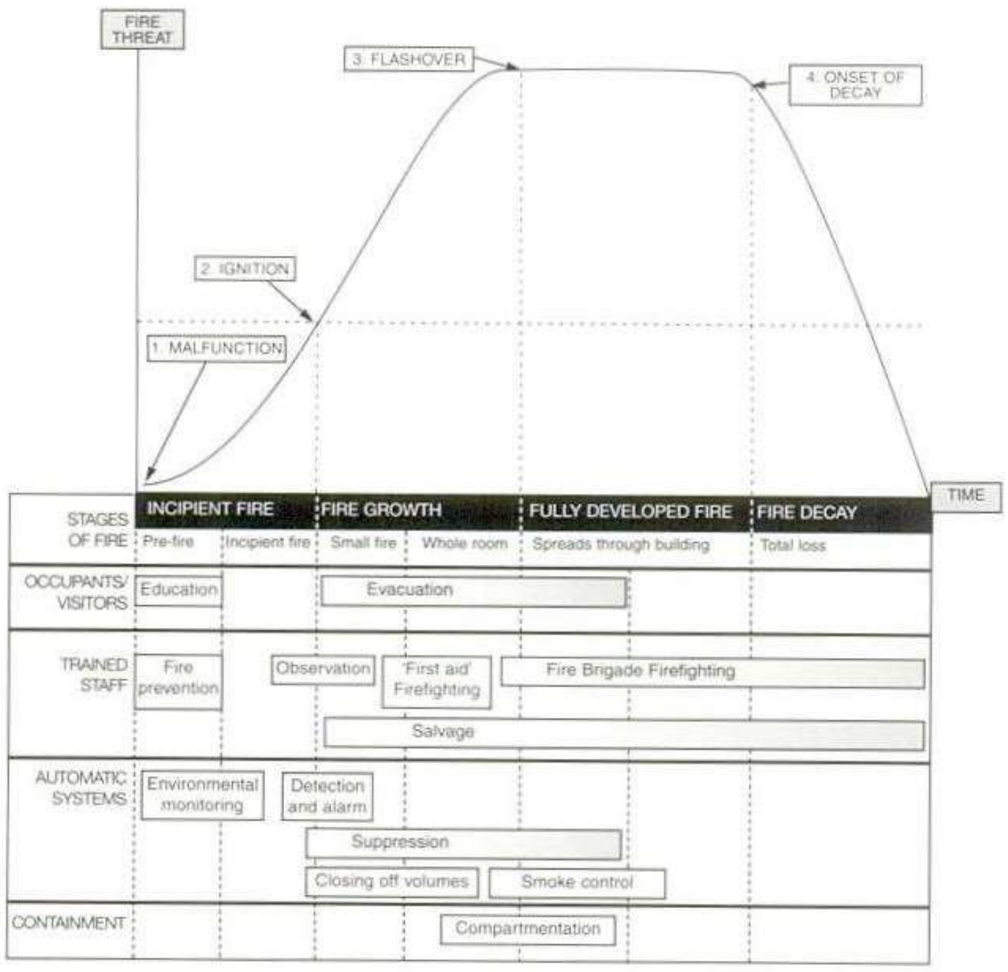


Fig.3 Activities in the duration of a fire

Fire safety management

If you bear the diagram in mind, when it comes to management, it's a key part of developing a strategy and it's central to the TAN. But we didn't reinvent the wheel. We looked at publications from English Heritage, the Fire Protection Association's excellent book 'Heritage Under Fire', the appendix to the Council of Europe recommendations has fire as one of its themes, the Department of National Heritage fire protection measures for the Royal Palaces etc. All these set out fire management principles and they're all really singing from the same hymn sheet. I think one interesting thing to me was that the National Trust for Scotland have detailed emergency measures that I think are excellent because they make specific reference to Scottish problems (like the remote location of properties and often the absence of a fire brigade, in the absence of people other than volunteers).

Coming to fire management as an architect I found it all a bit confusing, particularly when fire engineers started talking about the components of fire safety and I wasn't sure what it meant. Going back to the diagram it's really all about where you intervene in the process. If you take that development of the fire, the very best intervention of course is right at the beginning: if you can educate, remove risk and so on, then you won't have a fire. Then the different components come in: how do you detect the fire? There is observation, there are various automatic systems that detect a fire, and these can come in as early as possible. There are some very sensitive systems now that can detect and even put out a fire before it becomes established. If you fail to intervene at certain points, then you have to think of the other management issues: what does the fire brigade do? when does salvage start? how do you suppress the fire? An automatic system is one thing but you've got to think about everything from the extinguishers to the hose reels. So each of these comes in at a certain point and by thinking about the process it began to make a lot more sense, certainly to me.

Right at the bottom of the diagram, compartmentation comes in. You'll see that's it is in the middle because that's assuming that the fire starts in one part of the building. If there's effective compartmentation you can contain it and hopefully prevent its full development.

I think what I'll do now is run through the fire management measures, as described in the TAN. Every building should have a fire safety policy. Every historic building should have a fire safety manual. Building contracts and maintenance work are a major headache and again there's guidance in the TAN. Fire risk assessment, is something we covered in some depth and we have a checklist.

Owners or Residents Check List

Grounds and Access

- Access routes kept clear for emergency vehicles
- Procedures agreed for fire brigade attendance
- Supply of fire fighting water available

Adjacent Structures

- Consider implications of adjacent building uses
- Include procedures for fire fighting in outbuildings

External Fabric

- Access to all elevations for evacuation and fire fighting
- External security arrangements and effect on the above

Interiors

- Roof spaces free of combustible materials
- Fire break walls intact and continous through attic
- Flues swept and suitable for type of heating appliance
- Fires in grates properly controlled and protected
- Principal living rooms protected by adequately closed doors
- Smoke and heat detectors in high risk areas
- Fire detection systems maintained and tested
- Exit routes kept clear and properly marked

Management

- Adequate fire precautions taken during maintenance or alteration work
- 'Snatch list' for salvage of contents
- Evacuation procedures in place
- Adequate records of building and contents

This is a very short list designed for owners just to think about the fire risk assessment process in relation to their own building. We also have a longer one running to several pages, which perhaps those involved more professionally may wish to consult. However, at what point does an ordinary architect or an owner carry out a risk assessment and at what point do you involve a professional? I think it really just depends on the situation and when the owner might feel they're getting out of their depth. It is a difficult one to know, but these lists give some basis for carrying out the fire risk assessment.

In terms of management, we look at fire safety (fire drills, the reaction of visitors, people sleeping and so on are covered and also particular events like today). I assume Duff House has its own plan for the time when there are 50 people sitting up in the top room. Then we go through, in the management section, looking at fire fighting, automatic fire suppression, containment and compartmentation as a sort of management process, procedures and staff training - it's a long chapter!

Salvage and damage control, reinstatement and insurance and record keeping are touched on in terms of management. Service and maintenance is a major cause of fire. Finally the need for regular review of management resources is stressed.

I think I should add a personal note because when I first became involved with the study, I thought fire protection was all about fitting all sorts of unsightly technical gadgets to historic buildings and that as architects the best we could do was a kind of damage limitation exercise. But I was greatly encouraged as we began to get into the study, I felt I had a better understanding of the process of fire and I realised how much could be achieved before we had to turn to technology. Obviously technology has it's place but a lot can be achieved before that point. In particular the process is very much one of looking carefully at individual buildings and taking a balanced view between suitable management measures and then appropriate intervention.

The end of the management section marks the end of the first part of the TAN, and then we move on to the review of the more technical measures.

Compartmentation

Many fires develop because they spread throughout buildings in unknown voids and cavities. When you mention compartmentation, most people think about the Building Regulations and start to panic, thinking they're going to have to have fire walls and fire doors and all sorts of things imposed on the building. Although a knowledge of the Building Regulations is an important starting point, they're not often applied afresh to buildings, (not unless there's a change of use) so it's worth bearing them in mind, but I think it is much more important to look at what compartmentation is trying to achieve in a listed building. The purposes of compartmentation are:

- it limits damage from fire and smoke
- it limits the size of the potential fire so it can be controlled more readily by the fire fighters
- it creates spaces protected from fire (which is a major benefit, not only to life safety, but also to minimising the damage or loss of historic fabric and contents)
- it aids access for fire fighting
- it reduces the likelihood of structural failure during a fire.

The concept is simple but in practice many historic buildings present difficulties by nature of their construction. The first step is to assess the completeness of existing compartments. This assessment will involve analysing the construction of the building for its strengths and weaknesses and starts with a thorough investigation. This is a common sense approach relating to a particular building, rather than looking at particular regulations. Considering the roof spaces around George Heriot's school as an example (Fig. 2) when I came to the building there was nothing to stop fire travelling all the way round. Luckily, it was a fairly simple matter of putting steel fire doors wherever we found a solid masonry wall and dividing up the building that way, and coupling it with a fire detection system. But an important part of it was having fire detection in the roof spaces, using an addressable fire alarm system, keyed back to a schematic in the building that would allow the fire brigade, when arriving at the building, to know where the alarm had gone off and deal with the fire straight away.

Survey and assessment goes far beyond simply examining the building. This is the architect's bit, I suppose, a plea for architects. An appraisal from the original and subsequent plans and records is very important. Consider General Register House (Fig. 4), that's the Robert Adam building at the end of Princes Street in Edinburgh, as a example. When Robert Adam was designing the building, he needed a good M & E engineer so he consulted James Watt. We were given written records of the correspondence between them and there a reference to warm air ducts spiralling up the

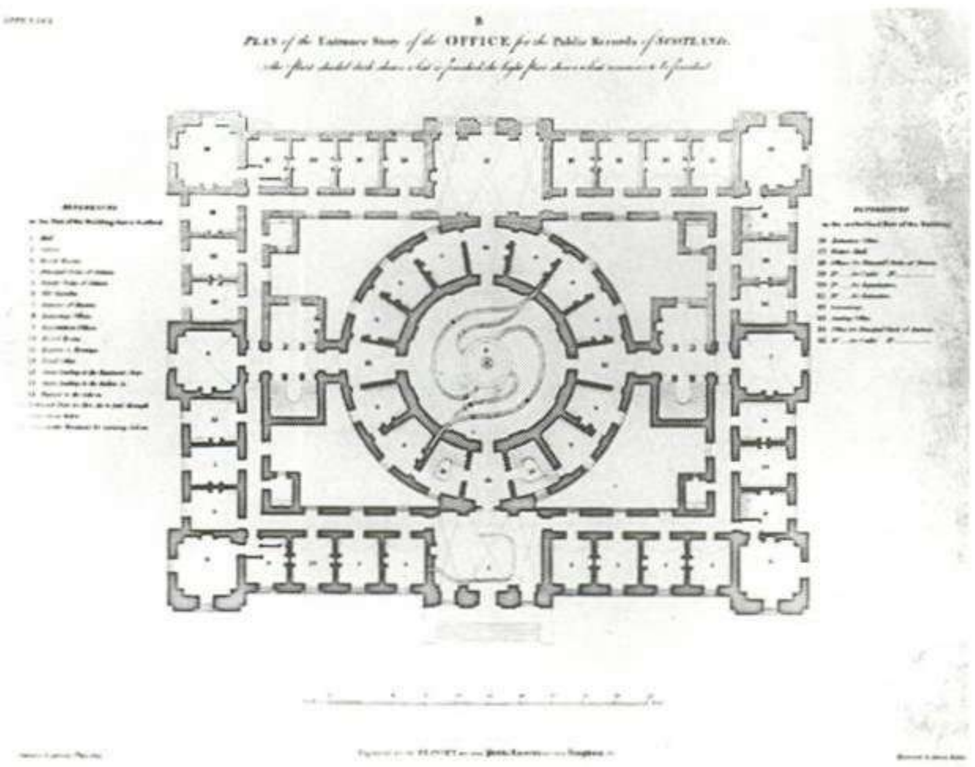


Fig. 4 General Register House, Edinburgh

dome in the middle of the building. The building is built round a rather splendid circular space with a dome on it, so, did that mean there were all sort of voids and routes for fire to travel around the walls? But by getting the original drawings, this turned out to be the flues that were taken round the floor of the dome from fireplaces in the basement. These were no longer in use and we were able to determine that the flues had been built as described.

Knowledge of the construction method is also extremely valuable in a assessment of the effectiveness of compartmentation. General Register House is significant in that it's I think the oldest building built for the purpose still in use in Europe. There are a lot of small, stone-vaulted, brick-vaulted rooms with masonry walls and very little timber in the construction. It was also built over a long period so it was built up to roof level and lay for about 6 years before eventually the roof was finished. They obviously had forgotten about fire-proofing by then, and there's nothing to stop fire travelling right round the roof. You think you've found a fire-proof building, but the fire-proofing is not complete. Beyond that we began to worry about where other voids might be. We can do dimensional surveys but this still doesn't get to the bottom of it. Opening up is possible, but again with fine buildings (and particularly when they're in use) is not always practical. So there are a number of non-destructive survey techniques which are available. These include, for example, radar surveys. A specialist consultant mapped all the walls, and they were able to determine the pattern of flues. General Register House is curious in that there were fire places in a lot of the rooms but the chimneys on the roof don't correspond. The flues wander around through the walls. Non destructive surveys, as well as picking up flues are actually quite good at picking up voids (interstitial voids in the stonework and other cavities) so it's a very useful technique. Other techniques involved video surveys (if you can get your camera down a flue or a duct); bore scope investigation, (although you need a little pot luck with them in hitting the right spots); air pressure tests or smoke tests. The smoke test is the usual Edinburgh New Town way of finding where your flue goes - you light a fire and see which neighbour's house fills up with smoke!

The Performance of Historic Buildings in Fire

The understanding of the building can only be complete when the survey and assessment is coupled with a knowledge of the construction.

Masonry gives excellent fire performance, but it's severely compromised by the presence of built-in timbers or degraded masonry, and this is a typical situation. We've certainly come across this in Great King Street, Edinburgh. What seems like a solid masonry wall included a couple of flues. The flues may well have been damaged by the chimney sweeps' balls going down them in the past. So hidden voids and openings exist. Another classic Scottish construction detail consists of a floor with a suspended ceiling below it (with an air space between). Their cavity very often links with those in present in walls and roof spaces throughout the building. We looked at whether these could be filled or sealed, but it's probably unacceptably disruptive and there's also the worry that if you stop these cavities you're also shutting off natural ventilation. There was thought of applying intumescent strips around the skirtings. This it seemed like a good idea: take the skirtings off, fit intumescent strips behind them and if a fire occurred these would expand to firestop the space. But one of the problems in dealing with the TAN was there wasn't a practical example of the technique in use. So it would be interesting to find out if these methods have been tried.

Getting back to the theme of the TAN, it may be more practical to reinstate the integrity of the walls rather than to concentrate on the floors, perhaps increasing the number of divisions in plan to compensate for weaknesses in section. It may be in the end you cannot achieve effective compartmentation and you have to look to the other components of fire engineering, such as better detection or some sort of suppression method.

So the main conclusion of this part of the TAN is that the process starts with thorough research into a particular building, coupled with detailed surveys and a good knowledge of historic construction. The strengths of the building have to be exploited and the weaknesses either dealt with or compensated for, possibly by means of limited intervention. In other words, it's a balance between good conservation practice and fire engineering principles.

Case Studies

Once the scope of the TAN had been more or less agreed, it was thought that real and practically based experience could be used to strengthen the messages that could be conveyed. A number of examples of relatively recent fires in historic buildings were selected. They proved to combine a sense of drama that catastrophic fires always create for the observer, with relevance to the main aims of the TAN. These case studies are included as appendices in the TAN document. I'm going to explain these buildings and their fires to you, firstly to give examples of how fires commonly start and develop, and secondly to highlight the particular vulnerability of historic buildings to fire.

The case studies have mostly been in the category of rural country houses. That's just a particular quirk but one should be aware that there are many different types of historic building, each having it's own particular potential fire risks. Each must be considered by careful survey and investigation to identify the unique factors that will effect the choice of appropriate fire protection measures.

The first case study is Moy House, it's an A listed country house near Forres, (Fig. 5).

Fig. 5 Moy House, Forres.

It's mainly eighteenth century but contains parts of an earlier building and this suffered a disastrous fire in the early hours of the morning of 18 August 1995, during the course of our preparation of the TAN. The fire started in an unused workshop area to the back of the building and quickly spread to engulf the whole house. An occupant of an adjacent building within the estate alerted the 10 people who were asleep in the building at the time. The fire brigade response, we understand, was prompt given the rural location. The fire could not be contained. I understand that the lack of a adequate water supply hampered fire fighting (a common difficulty in properties that we looked at). Eventually water was pumped from a stream about 400 metres away. The lessons of Moy are that the rapid growth of the fire may in part have been due to the spread of the fire through hidden ducts and cavities. The next day there were still glowing embers (Fig.6) and it was possible to see a vertical duct rising through the structure.

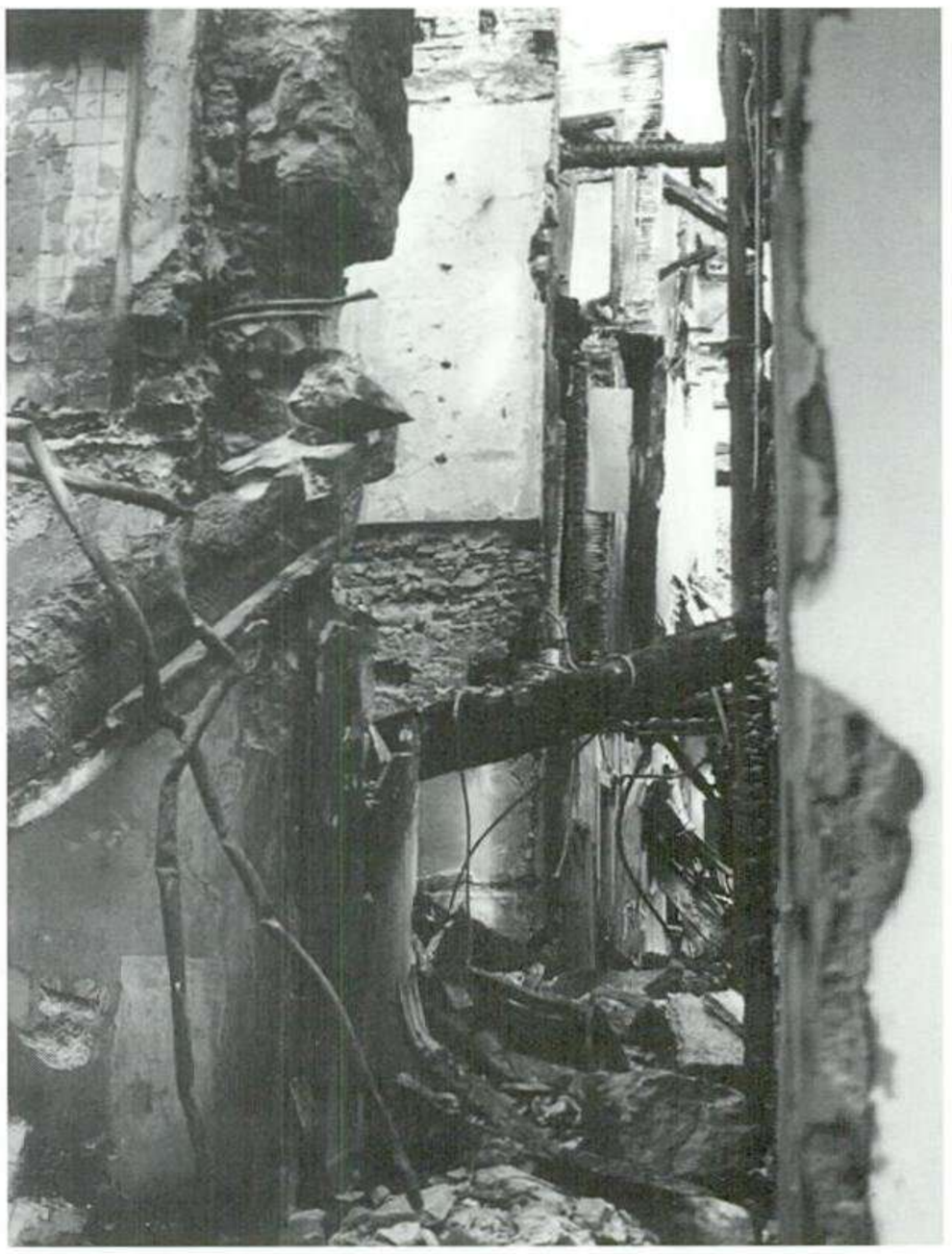


Fig. 6 Interior of Moy House.

These ducts also quickly routed the fire into the upper floors and ultimately to the roof space. The roof timbers were almost completely destroyed, as were the greater part of the upper floors. Although the house did have internal subdivisions, which might have been expected to contain the fire, one must assume that the forms of construction, the nature and location of the fire and the availability of ready sources of fuel all combined to virtually destroy the house.

This is Kilkerran House, near Maybole in Ayrshire (Fig.7). It's a category B building of the late eighteenth century, but much altered and with various additions. A fire occurred in the morning of the 14 April 1994. One wing of the house, on the right hand side of the photograph with the curved bay, was completely destroyed. A fire in the grate of the first floor drawing room the previous evening had included logs that were observed by the owner to be causing sparks. As a precaution, the fire guard was placed across the grate at the end of the evening, but a fire caught hold and spread quickly to engulf the house. The official report

at the time suggested that the fire started in the floor timbers that were housed below the stone hearth, which was found to be cracked. These timbers are usually built into the walls for support and it is not uncommon for them to be built into masonry containing flues, or into walls under hearths. It's also possible that some unextinguished sparks ignited the carpet below a settee in front of the fire place and this was the suspicion of our team when we visited. Whichever was the cause, the fire appears to have smouldered under the floorboards until they burnt through. It then spread quickly within the first floor void. It reached the outer walls, then travelled through the lath and plaster.

Fig. 7 Kilkerran House, Maybole, Ayrshire.

The fire travelled through a partition and through the panelling at the window, quickly up into the roof, doing minimal damage to the room above. It was seeking sources of air, and finding them around the perimeters of the building. The rapid development of the fire was due in part to the fact that the first floor had no ceiling below it. The plaster had been removed during an outbreak of dry rot and was never reinstated. There was also quite a large void between the floorboards and the ceiling, which meant that air was able to pass horizontally under that plane. The drawing room in which the fire was started was sealed horizontally by the doors to the other parts of the house being closed, and interestingly its contents were not destroyed by the fire. In fact, a grand piano and various bits of music in the drawing room had not been burnt. The windows didn't shatter during the fire, so the fire found more readily available fuel and air supplies by travelling vertically, and the roof was completely destroyed.

This is a small house called Logie, which is near Dunfermline (Fig.8). This is a nineteenth century category B house. The fire started on 6 January 1988, so we cannot see any damage because it's all been reinstated. There was a room on the first floor to the right of the photograph with the arch headed opening which was completely destroyed by fire. The family had left the house that morning and within two hours the alarm was raised by the occupant of an adjacent wing, who heard the sound of breaking glass. The source was attributed to probably the most common source of fire, an electrical fault in a wire in the skirting board near the fireplace. The room and its contents were very badly damaged by the fire, but the fire had not spread to other parts of the house before the Fire Services reached the scene. The plaster ceilings and ash-deafened floors formed an effective barrier in this instance. These materials act as insulants in much the same way that modern applied materials can be used to protect historic structures against fire. Traditional lime or gypsum plasters are inherently resistant to fire. However, where plaster keyed onto its substrate is damaged, it's ability to withstand fire will be significantly reduced.

Fig. 8 Logie House, Dunfermline, Fife.

Now, unfortunately, the door of the room was left open and an acrid and blackening smoke escaped to virtually all parts of the house which were not sealed. Doors may be the only combustible element in a wall that is otherwise considered as a compartment. It goes without saying that an open door will present no barrier at all to the spread of fire and smoke. Where doors in the rest of the house were closed, the rooms were hardly affected. But smoke damage in circulation areas and rooms throughout the house which were not shut off was extensive. Smoke damage caused probably the greater part of the financial loss, estimated by the owners to be about a quarter of a million pounds in what is really a very small house. On part of the stair wall, all the plasterwork had to be very carefully cleaned by hand. The lessons here are (apart from keeping doors closed in historic buildings wherever possible) of the expense of cleaning up after a fire. We learnt of the need to clean soot and smoke staining from decorative plasterwork and specialist cleaning was required for paintings, tapestries and carpets.

Fig. 9 Dunbar Parish Church, East Lothian.

The next one is Dunbar Parish Church (Fig. 7).

The fire is believed to have started following yet another electrical fault, this time in the roof space. Virtually all the timber roof structure in the church was destroyed as the roof space was a single void and fire spread through it very rapidly. The other interesting thing about Dunbar, was the damage to the masonry walls. Intense heat can cause spalling as can the application of fire fighting water, which creates rapid cooling on the surface and here this caused the very clear thinning of the columns and the colonnades to one of the side aisles. The tower, the external walls and the two masonry colonnades survived but substantial repairs to them were necessary in the reconstruction which followed the fire.

The final case study is interesting in that it actually isn't a listed building, although I believe that in any reconsideration of the list, which was ongoing at the time, it would probably have been added. So it's a rather anachronous example. It's Torsonce House near Stow, in what was Roxburghshire. The house is Victorian and had a number of Edwardian extensions, built with early cavity wall construction, through which the timber of the floor structure extends into the masonry of the outer walls. The source of the fire isn't known, although it's quite possible that this form of cavity construction was the cause of the rapid spread of the fire. The difficulties encountered in fire fighting were those which have already been stated: the remote location and water supply problems being amongst them. Fortunately both elderly residents were able to escape unharmed but the house was totally destroyed. The photograph shows the house a day or two after the fire. It appears to have most of its masonry intact. However, a combination of local authority concerns about stability and the fact that the insurers would not meet the full repair costs of the building has meant that the house has been partially demolished. It has since been partially rebuilt to a lesser scale. Remember in this case the building is not listed, so listed building consent was not required. It was rebuilt using many of its original components: cast-iron balconies, stone jambs, chimney heads and so on, which were very carefully salvaged, laid on the lawn and eventually re-used. It was this kind of conservation approach which I'd recommend to other architects faced with a similar situation.

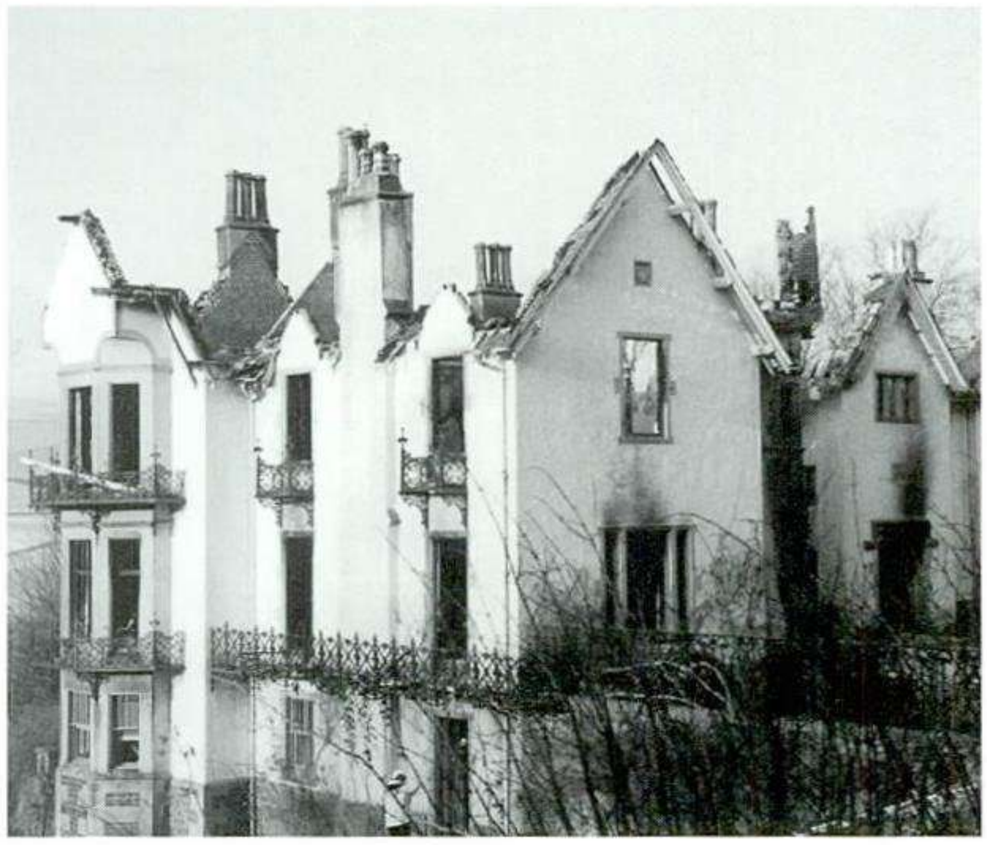


Fig. 10 Torsonce House, Stow, Roxburghshire

That concludes the description of the case studies, hopefully giving an insight in to some of the problems of historic buildings and fire. There are many reasons why historic buildings are being lost at the rate they are. It is evident that they are vulnerable because they are complex. They can be altered to improve the level of fire protection. This must be carefully considered, taking into account a wide range of factors. The TAN contains a great deal of detailed advice, of which we have given only a selection today. Changes in the original construction over time may sometimes be beneficial in fire risk terms, but the careless

introduction of new services or the use of inappropriate materials or details may increase risk, both through the creation of routes for fire spread and the increase in possible sources of ignition. The age and condition of historic constructions may present particular concerns, including drying and shrinkage of timber causing widening gaps in construction and water penetration that may weaken, or rot timber fixings.

Doors and Door Closers

We looked in quite a lot of detail at doors. Doors present a particular source of difficulty and a chapter of the document focuses on them. A door must perform as a fire-resisting entity, including the door, the frame and its ironmongery. Considering how a door will perform you have to consider the thickness of the different materials, the overall size of the door and its method of construction. Any gaps between the door, its frame and the enclosing wall will affect its performance. The presence of glass panels or fabric linings, the method of latching and closing, the condition of materials should all be recorded.

Before considering methods of improving the fire resistance of doors, it's necessary to decide on the appropriate level of intervention. Some important doors would be best removed to storage and replaced with another of higher fire resistance, rather than attempt to alter them. If it is decided that improving the performance of a door's fire resistance will create benefits for the building and its occupants, the primary aim should be minimal intervention. Better understanding of the performance of doors in fire has been developed, leading to more confident predictions of resistance to fire and many of you will know of the existence of the English Heritage technical guidance notes, which have very current information and I would commend them to you.

Local authorities frequently require a fire test certificate for a door, or compliance with published standards of construction. In many cases an independent assessment by a fire safety consultant taken in the context of other fire protection measures may lead to more sympathetic solutions, and these may also be acceptable to the local authorities. In new buildings, combinations of materials can be tested without restrictions. This is not the case in historic buildings however, where a historic door may have to be destroyed to enable those concerned to be satisfied that a standard can be met. All other options should be considered before destructive testing is undertaken. It would be helpful if one could refer to data gathered from other such tests to avoid unnecessary duplication and waste. There is at present no co-ordinated data on Scottish building materials such as is provided by the National Fire Protection Association of the USA.

The Performance of Historic Building Materials in Fire

Whilst also a fuel, timber does have a degree of fire resistance, which increases with the thickness of the component under attack. Thin timbers such as shutter and door panels will burn quickly, whilst large timber stud frames and structural elements such as beams will burn at a slower rate and may perform their function for longer and even beyond the duration of the fire. This case can sometimes be argued where consideration is being given to suitability of construction in terms of fire resistance. There are massive timber sections used in the structures of many historic buildings. However some paints, polishes and varnishes may be liable to ignition. The heavy build-up of layers of paint which some historic surfaces have received renders them potentially vulnerable to fire and also the fumes are potentially dangerous to people escaping from a fire. Further painting of such surfaces may have to be restricted to prevent the fire risk from being increased. It's also worth stressing that great care must be taken in the method of removal of the paint. Tools such as blow lamps or hot air guns are a fire risk, as is any hotwork. In order for appropriate solutions to be found for fire protection measures in historic buildings, a thorough understanding of the constructional systems, of both existing and possible new materials, is necessary.

The concluding chapters of the TAN deal with methods for improved levels of protection primarily through intervention with one or more applied systems.

Fire Detection

Even a small fire can cause widespread, irreversible damage. The risk to life and property will be reduced if early detection of a fire can be achieved. We stress the need for formalised management procedures and training to ensure that the most effective action is taken in the event of a fire. The effective deployment of the fire brigade will depend on their prompt arrival at the scene. As the case studies showed, early detection and alarm are essential, particularly where a building is unoccupied or in a remote location. People can be the most sensitive detectors of fire, but they may be remote from the building at the time of ignition, hence the need for automatic sensing systems (sensing changes in physical or chemical phenomena). The design of a system to suit historic buildings may have to use available guidance in a flexible way to achieve adequate coverage while taking into account the physical characteristics of the individual building. For example, in George Heriot's School, a VESDA air sampling system has been installed. Sampling takes place through a tube poking through the cornice, measuring 10mm in diameter. A cupboard immediately above the room in question houses a small sampling

unit and the pipe work was very carefully installed. The lesson here is that other methods of detection were chosen in other parts of the building, depending on what was most appropriate in each case.

How the fire detection systems work, the different types, what they detect, how and where sensors should be located and how the signal is transmitted to the alarm are all dealt with in the TAN. The installation of concealed wiring may result in significant damage to surfaces and can cause damage through, for example, the notching of joists. This shows where minimal notching has occurred, perhaps 35mm. This may be an appropriate solution in very dilapidated buildings undergoing repair or during a general upgrading of electrical services. Surface wiring can be visually unobtrusive and routes should be chosen to hide or minimise their visual impact. It may be acceptable to consider surface wiring as the least physically damaging option and having the benefit of being reversible. The detection and alarm system is to facilitate early evacuation of the building, to alert the emergency services and activate fire suppression and smoke control systems at the early stages of a fire.

Fire Suppression

The value of the material at risk must be considered. For example, here at Duff House, the contents require a special degree of protection over and above considerations due to the building fabric.

Traditional water sprinkler, water mist, water spray, dry powder, foam and gaseous suppression systems are all described in the TAN. In many cases it's possible to install a combination of these systems to enable the control of fires in historic buildings. A carefully designed suppression system may be able to control a fire with only a limited release of suppressant, in many instances this may be more acceptable than the loss of fabric or contents by fire. The disruption of the building's fabric caused by the installation of extensive pipe work requires careful consideration and may be more acceptable when repairing a badly dilapidated building.

Smoke and its Control

60% of the victims of fire succumb to the effects of smoke and toxic gases. Potential for loss of the building's fabric and contents through smoke damage during a fire which is then controlled, is much greater than through that of the fire itself, as was the case at Logie House. The principal concepts of smoke control are containment and release which can be achieved by a combination of active and passive measures. Historic buildings are complex in their construction and understanding the pathways for smoke and fire will require detailed study. In anything other than the simplest buildings, specialist advice should be sought on the application of smoke control techniques.

Fire Engineering and Historic Buildings

In the final selection of fire protection systems, it is important that fire safety advisors work closely with those responsible for the building to ensure the most sympathetic and least damaging integration of these elements into the building. This need for collaboration is at the heart of a holistic fire engineering approach.

We've referred throughout this talk to fire engineering, but what does it mean? Within the last 20 years, fire engineering has developed into a recognised practice, but, in spite of this, few people outside the discipline fully understand the term fire engineering and a good simple definition is elusive. It's easier to define the objectives of fire engineering. These include

- ensuring the safety of the occupants of the building and others who may be affected by a fire,
- preserving heritage by protecting property contents and artefacts from a fire,
- preventing or minimising environmental damage,
- minimising the damage to the fabric and contents of a building should fire occur and
- prevention of fire spread to other buildings.

Now these of course are precisely the concerns of the TAN, and it's this coming together of the conservation approach and the fire engineering disciplines that's so important. What is an engineering approach? It is just a scientific approach. It starts with the research, observation and investigation; these results are evaluated; hypotheses are proposed; they're tested then applied and they're appraised. So it's really just applying method.

I think this is in line as well with the changing approach to setting standards. We heard yesterday about recent trends in the UK and elsewhere in Europe where we'll be moving away from prescriptive standards towards regulations more based on performance and an understanding of problems. I think this is enormously beneficial when dealing with listed buildings. It allows us to look at different approaches. It allows us to balance fire engineering with conservation aims.

On one side we have the components of fire engineering I talked about. Management is perhaps most important of all because it deals with things like fire prevention. The detection and alarm systems, means of escape, control of fire growth, control of spread, structure, smoke control, firefighting all have their place. But we have to balance these with the

demands of the historic building, it's location and accessibility, the form and layout of the building, the age and value, the occupancy and use, the location and character of important spaces, the quality of finishes and the contents in particular. The essence is in assessing the individual needs of the building.

The level of fire engineering applied to historic buildings will vary according to the identified fire hazards and the importance attached to the building's structure, finishes and content. This is quite a big area of debate. I do not mean to say that everybody has to call in a fire engineer. Nor on the other hand should owners say "it's all too complicated for me so I won't do anything". I think the principles can be applied by all those involved up to a level where your own experience and knowledge runs out, then the advice of experts should be brought in.

The levels of fire engineering practice encompass judgement based on experience, the application of the codes, tests etc, compensatory engineering, quantitative analysis and computer modelling are increasingly specialized. But it's the application to historic buildings I think that's important. Again, just to go over these points;

- each risk can be assessed individually
- precise safety objectives can be used as a basis for design, whether it's people, whether it's artefacts in the building, or the building itself
- life safety and property protection can be considered simultaneously, they're not different systems, it's all about the same thing.

Having an objective approach allows us to balance the relative merit of design solutions and compare these in a logical way."

SPRINKLERS IN HISTORIC BUILDINGS

C S YATES, Senior Consultant, Loss Prevention Council (LPC)

"The Great Fire of London was the start of the quest to develop a means of automatically fighting a fire. Nobody wanted that to happen again so engineers began their search for the answer.

The first automatic sprinkler was invented in the UK by Major A Stewart Harrison but he unfortunately never patented it. That was left to the American Henry Parmalee, who went on to develop the first commercial automatic sprinkler head. The first automatic sprinkler system was fitted to a mill in Bolton using the Parmalee No 5 sprinkler head.

In the sprinkler industry we try to engineer solutions to problems, to make the installations more flexible and adaptable to a growing number of building types. It seems somewhat of a ridiculous scenario to install a system which will, hopefully, never be used but, if ever it is needed, it will pay for itself many times over - certainly in terms of historic buildings.

Q. Why do we need to install an automatic sprinkler system in our historic buildings?

A. Historic buildings are, because they are so old, very dry places. They also, in many cases, contain artefacts which are very easily ignited. Take these two ingredients, add the fact that historic buildings are commonly constructed from combustible materials (at least in part), stir well together and you have a recipe for disaster.

Electrical faults (which are probably the most common single cause of fires in the UK) can happen anywhere, at any time and, in the case of historic buildings, a smouldering wire or an arcing electrical connection would have little difficulty in igniting the surrounding materials. Once ignited, it would take very little time to spread throughout such a building, the result of which (without adequate means of fire detection and suppression) would be a very large pile of ashes.

Automatic sprinkler installations are designed to detect and control a fire in its infancy. From statistics we can see they are very good at doing just that.

In the UK, the British Automatic Sprinkler Association (BASA) tells us that, over a twelve year period, the number of fires in sprinklered buildings was 16,800. Almost half of these were controlled by one or two sprinkler heads operating. If you think that is impressive, in Australia and New Zealand (where the recording of such information is more comprehensive) of some 9,022 reported fires in sprinklered buildings over a one hundred year period to 1986, only 49 were not controlled by the sprinklers. A staggering 99.5% success rate. Of the remaining 8973 fires, 64.55% were controlled by only one sprinkler operating. Insurers, both in the UK and overseas, agree - There is no alternative loss reduction and protection measure, or system, which can provide such a solid record of success.

When all is said and done we are protecting our heritage which, as far as I am concerned, is something we must preserve. I am sure the vast majority of people are at this conference because they agree with me and, I suggest, the installation of automatic sprinklers is the most effective way to do that.

Q. What about water damage?

A. There are two ways in which water can get out of sprinkler installations. Water leakage and water discharge.

Water leakage refers to the loss of a small quantity of water from a sprinkler system. It can happen but, in practice, it does not occur very often. It is very difficult to find statistics for this type of occurrence as, in the majority of cases, there is very little lasting damage and it may never even reach insurance claim status.

What I can say is that, assuming a competent sprinkler installing contractor is carrying out the work, the engineer responsible will be using the best pipe jointing compounds, materials and practices, LPCB approved sprinkler equipment and pipe supports and will test the completed pipe network, either in phases or in total, to at least one and one half times the working pressure of the system. Once this is done successfully, there is very little likely to happen, certainly in an historic building, which will alter the *status quo*. In the main, it is accidental or frost damage which is responsible for sprinkler system leakage and neither of these should occur in an historic building providing the management of the building and sprinkler system is effective.

Some might say "Of course there is always the chance that a sprinkler operating spuriously, due to a manufacturing defect perhaps, can cause water

damage.". Yes, there is, but, on the basis that current statistics pitch the odds at 1:500,000 against, this is very unlikely.

Water discharge is water damage during and after a fire incident. Of course there is going to be water damage but it will be minimal. Because each individual sprinkler head is an independent heat detector, they only operate when the temperature around each one reaches the predetermined level so, contrary to popular belief, only the sprinkler head(s) in the immediate vicinity of the fire will operate, thus the least amount of water possible will be used. In fighting a fire, the fire brigade would use some 60 to 70 times more water than a properly designed sprinkler installation. This is said with no disrespect to fire brigades as I am sure you will all agree they do a magnificent job. It is merely a statement of fact with which firefighters would also agree.

It should be remembered that a large number of historic buildings are situated in very rural locations. It would take the fire brigade 17 minutes to get to Duff House, for instance, and 45 minutes for back-up to arrive from Aberdeen. I dread to think what this beautiful place would be like after it had been burning for 17 minutes, let alone 45.

If you imagine the scenario of any building where the fire brigade are the only means of protection, significantly more of these will be destroyed by fire and they will suffer significantly more water damage. If the worst comes to the worst, there could be nothing left to save. Modern technology and procedures enable us to restore water and smoke damaged items, and even slightly charred ones, but no-one can do anything with a pile of ashes!

Q. What are the chances of sprinkler heads not operating?

A. The short answer is very slight. Again statistics show the odds of a sprinkler failing mechanically in fire conditions are 1: 14,000,000.

The sprinkler head itself is such a simple piece of engineering that it is almost impossible for it not to operate under fire conditions. On the rare occasions when sprinklers did not work, there has normally been an obvious explanation.

It would be quite wrong to say there are no sprinkler installation failures, but they are, invariably, due to the interface between sprinklers and the Human Race. The most common reasons being: -

- the system turned off in error
- an inadequate water supply
- the hazard is increased without re-assessing the sprinkler system
- poor or inadequate maintenance
- changes in building layout occuring without re-assessing the sprinkler system
- exposure from non-sprinklered buildings or areas
- system frozen due to heating failure.

Q. To what specification should a sprinkler system be designed and installed in an historic building?

A. The Loss Prevention Council Rules for Automatic Sprinkler histallations, incorporating British Standard 5306:Part2:1990 is the standard used in the UK for all sprinkler design and installation. The BSI issue the standard whilst the Loss Prevention Council (LPC) issue the Technical Bulletins which enhance it. Together they form a complete specification for a sprinkler installation whatever hazard classification it may be.

There are three hazard classifications, Light, Ordinary and High and an historic building will probably fall into the *Ordinary Hazard* bracket due to its combustibility.

The Loss Prevention Certification Board (LPCB) approve all products for, and competent installers of, sprinkler installations and identify them in *The List of Approved Fire and Security Products and Services (The Red Book)* which is published each year. It is always advisable to find a sprinkler contractor who has experience of carrying out similar work.

Within an historic building, a sprinkler installation should also automatically call the fire brigade. This is an optional extra to any sprinkler installation but, given the combustible nature of these buildings, this facility should be provided in every case.

Q. What parts of an historic building require sprinkler protection?

A. The rules to which I referred previously are written on the basis that the whole building or buildings are fully sprinkler protected. This is because the sprinklers, in order to be as effective as possible, must tackle the blaze in its infancy. If there is any area, or interconnecting building, which is not properly spnnklered, it may allow a fire to grow to a proportion which could overpower the sprinklers before they have had a chance to control it.

There are, of course, some exceptions and these would be identified by the fire engineering consultant who would recommend alternatives. Areas where no active protection system is provided, must be considered in terms of fire resistance. This includes the floor and ceiling or roof. In the event of a fire starting in such an area, it would need to be contained until the fire brigade arrive.

Q. What type of sprinkler head will best suit an historic building?

A. It very much depends on the architecture. Some areas can be protected using concealed sprinkler heads where only the flat cover plate is conspicuous. This would perhaps suit a ceiling with decorative plaster patterns on it in which can hide the cover plate effectively (it can be coloured to suit its surroundings by the manufacturer).

The sprinkler and pipework are all above or within the ceiling, so an adequate void would be necessary, access to which, for installation purposes, would probably be from the floor above.

Standard sidewall and extended throw, horizontally - mounted sidewall sprinklers also lend themselves to this application as they are installed on the walls of a room rather than the ceiling (Fig. 1).

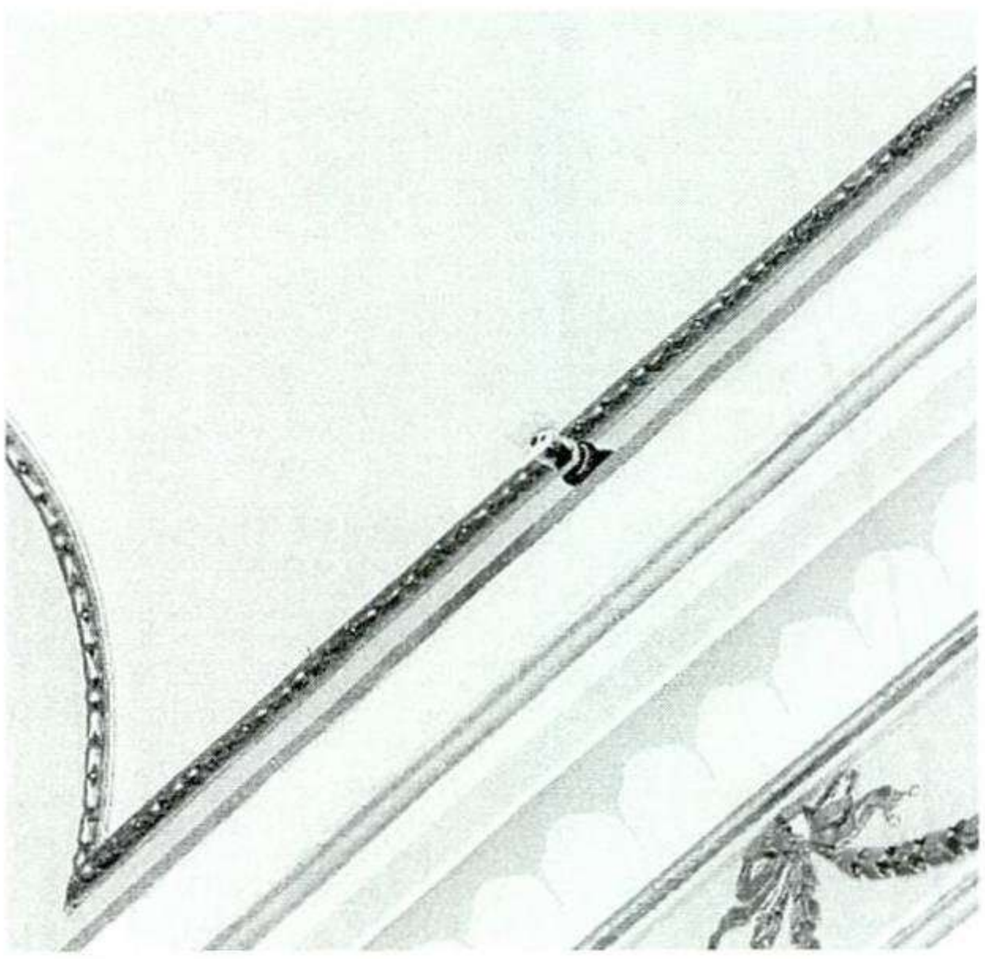


Fig. 1 Detail of sidewall sprinkler above the cornice

Of course there is always the standard sprinkler which can be used to protect service ways and voids where appearance is not an issue.

As with the concealed sprinkler, the standard and sidewall sprinklers can be blended into their surroundings using powder-coated colour finish to the frame and deflector. Again, this must always be provided by the manufacturer and not painted on site.

No part of a sprinkler head must ever be painted and they should always be kept free from an accumulation of dust and dirt. Paint on the seal or the fusible element can prevent a sprinkler operating altogether and paint on the deflector plate can seriously affect the distribution of water by preventing the correct spray pattern from being produced. Painted sprinklers must always be replaced rather than cleaned.

The response time of the sprinkler heads is important and it must be remembered that any sprinkler whose fusible element is not immediately below the ceiling will take significantly longer to operate. Invariably the choice of sprinkler is a compromise.

Q. What type of sprinkler installation would best suit an historic building?

A. There are a number of types of installation, each of which has its *raison d'etre*, but we do not have the time to discuss them all. Suffice it to say the standard wet system, which is the least complex and the one preferred by the insurers, should be the first choice. This is a system which is charged with water throughout the year, discharging it immediately a sprinkler head operates.

Where there is a susceptibility to frost damage, such as in a roof void, thermal insulation and trace heating of the pipework can be considered (as was the case here in Duff House) or, alternatively, a wet/dry system in which the pipework is charged with compressed air during severe weather and water the remainder of the year.

These are just two of the types of system available, and the most commonly used in the UK, but there are others which a qualified and experienced consultant in fire engineering can consider.

The choice of system will also depend upon what level of sprinkler installation is required for the particular building. For instance, if a given premises is required to be fitted with a sprinkler installation to *Life Safety* standards, then only a wet installation can be installed. This classification will be assessed by the insurance company. In the absence of an insurance company, it will be the responsibility of the fire engineering consultant to evaluate the risk and, in liaison with all other interested parties (fire brigade, local authority, HSE etc.) come to a mutually satisfactory conclusion.

Q. How difficult is it to install sprinklers in an historic building?

A. It very much depends upon the works proposed for the building concerned. If it is due for a complete refurbishment (as was the case at Duff House) it is less difficult to install sprinklers than it would be if the project is solely to fit a sprinkler system (Fig. 2).

During a refurbishment there are far more floors, wall panels etc. being removed as part of the refurbishment exercise, so concealing the pipework is an easier task. For example, two services can be co-ordinated to run on the same route to minimise disruption to the structure.

Co-ordination is the key to the task of installing any service in an historic building, but the materials used

can play a significant role. Where it is difficult to get a standard length of steel pipe into a confined space, it may be necessary to cut it into shorter pieces. There is, however, a plastic pipe available, which is approved by the LPCB up to 80 mm nominal bore. This allows more flexibility than standard steel tube, and it has a cleaner jointing method which does not require the access room necessary for conventional screwed pipes.

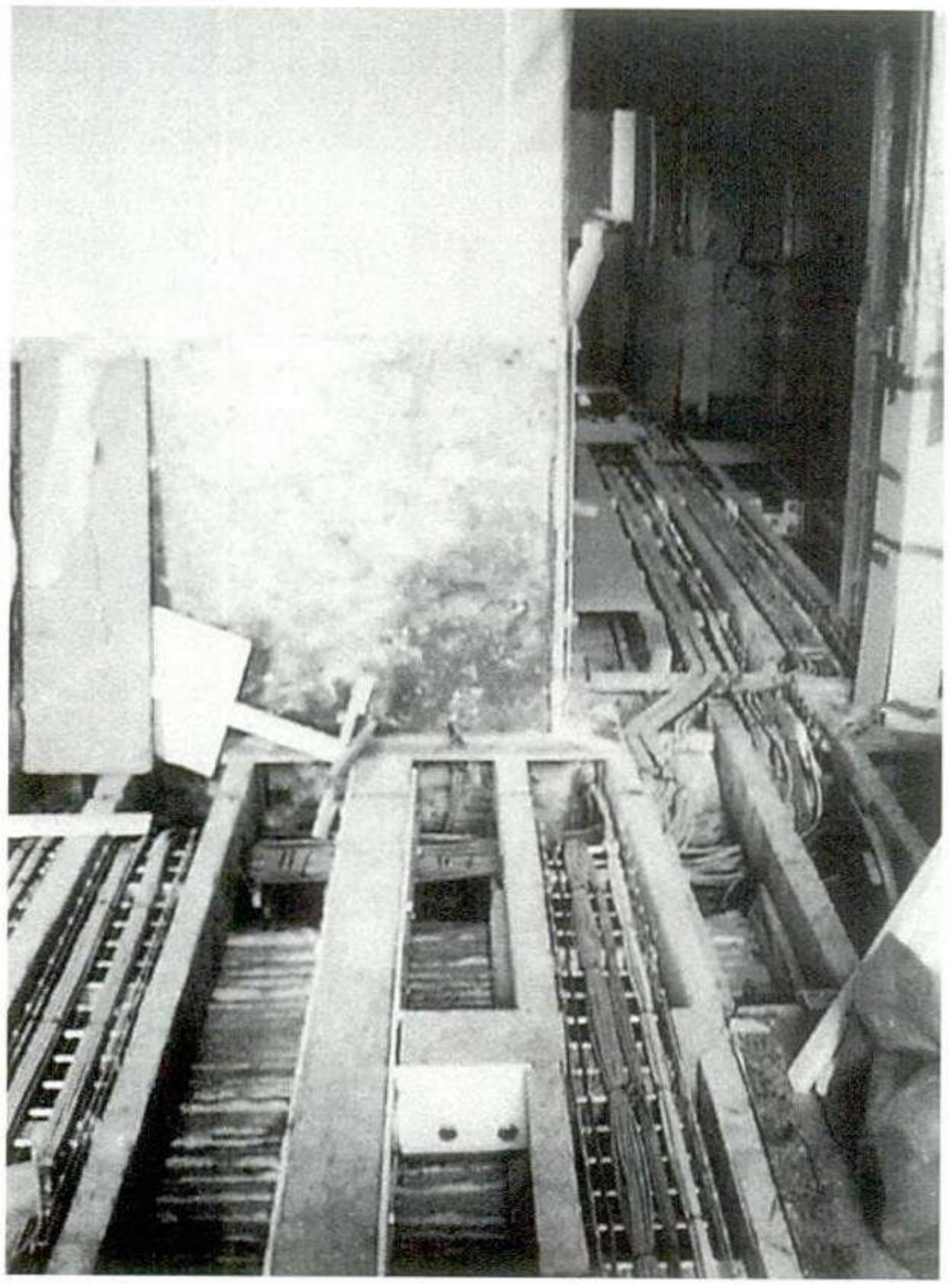


Fig. 2 The timber floor at Duff House was lifted to allow access to the underfloor area for laying pipework.

Q. How is the water supplied for sprinkler installations?

A. It can either be taken directly off the town water main or from a reservoir, via automatic firepump(s), to the installation. It should, however, be remembered that the water supply must be reliable at all times. This can sometimes cause a problem with a direct connection from a town water main. In their efforts to minimise leaks from the pipe networks, the water authorities are closing, or partly closing, valves to reduce pressure. This has the unfortunate effect of also reducing flow which, for a sprinkler installation, is critical.

Having already stated that a large number of historic buildings are in remote locations, it has to be said that, for those so located, a town main connection is unlikely to be an option. It then comes down to a reservoir and pump(s).

Lakes, a common feature in the grounds of historic buildings, are also reservoirs. If they are of sufficient capacity they are acceptable for use but, before making a decision to use one, remember they can be full of very dirty water and the pumping equipment required becomes more expensive. It is quite easy to sink a storage tank into the ground, as is the case here at Duff House, but location and landscaping should be given careful consideration.

Life Safety sprinkler installations will also have an impact on the water supply utilised.

Summary

I hope I have answered at least some of the questions which may have been in your minds when thinking about sprinklers, and fire protection measures in general, for historic buildings. I also hope that I have made you aware of the efficiency, efficacy and flexibility of the good old sprinkler installation.

All buildings are different as are their fire fighting needs, but a sprinkler installation can be provided for practically any building. Engineering a solution for historic buildings may not, necessarily, be easy but it is possible and it would be well worth it in the event of fire."

FIRE MANAGEMENT: DUFF HOUSE - A CASE STUDY

CHARLES JOHN BURNETT, FSAScot, Chamberlain of Duff House

"William Duff of Braco (1697-1763) was Member of Parliament for Banffshire and an extremely wealthy landowner who retired from parliament in 1734, the year he was granted the Irish peerage title of Lord Braco. The following year he commissioned the foremost Scottish country house architect, William Adam (1689-1748) to design an appropriate mansion in the current fashionable Baroque style.

Adam's design consisted of a central three-storey block flanked by curving wings which ended in two storey pavilions crowned with a cupola. Construction started on 11th June 1735.

Client and architect did not draw up a written building contract which resulted in a legal dispute. In 1739 building work stopped, leaving Duff House as an empty roofed shell, lacking the east and west wings included in the original design. Duff House stood forlorn until 1754 when Lord Braco resumed work on the interior. In 1759 Braco was raised in peerage rank and became Earl Fife.

Although unfinished Duff House is a superb example of Baroque architecture created for effect, but was only one of several Duff family residences. At one time the family owned Balvenie House, Innes House, Delgaty Castle, Rothiemay House, Mar Lodge, and Fife House in London. Lacking the wings, Duff House was always somewhat cramped and in 1870 a wing was constructed on the east side.

The 6th Earl of Fife, who had married the eldest daughter of Edward Prince of Wales in 1889, became the 1st Duke of Fife in 1899. His Duchess did not care for Duff House, and in 1906 he donated the House and surrounding parkland to the Burghs of Banff and Macduff.

Duff House opened as a hotel in 1908. Then in 1913 it was leased as a sanatorium. The sanatorium proved so successful that the accommodation available became too restrictive and the sanatorium moved to a new location in Wales during 1923. From then until 1928 Duff House reverted to being a hotel again. With the outbreak of the Second World War, the House was requisitioned and adapted as a prisoner of war camp. Duff House was damaged by bombing in July 1940, when the 1870 wing suffered a direct hit, thereafter the German prisoners were removed. Various military units, from Norway, Britain and Poland were stationed in the House for the remainder of the conflict. When war ended the two councils were in no position to effect repairs and refurbishment and even considered demolition as a solution to the problem.

In 1956, the Secretary of State for Scotland took the House into his care as a Scheduled Monument thus preserving the structure for future generations. By 1985, Duff House had been made wind and watertight, and the damaged 1870 wing had been removed. Some public access to the empty, silent rooms became possible. However, Historic Scotland realised that the full potential of the House was not being properly exploited. Local opinion expressed the same view.

In the late 1980s a meeting was arranged between Historic Scotland and the local authorities to explore the possibilities of giving Duff House a greater role so that the outstanding architectural quality of the House with its superb interior spaces could be made available to a much wider public. Although little came from that meeting the seed was sown and in due course on 26 November 1990 another meeting was held which included the National Galleries of Scotland. A crucial decision was made to form a working party drawn from Historic Scotland, the National Galleries of Scotland, Banff and Buchan District Council and Grampian Regional Council. The working party devised the Duff House Project.

The exterior of Duff House is like an elaborate jewel box but it contained no priceless treasures. The Duff House Project aimed to restore and conserve the interiors in order to accommodate paintings and furniture which would become the jewels. As the House is located one hundred and seventy-five miles from Edinburgh an added bonus would be that the north-east of Scotland would gain the most important and largest collection of national treasures from the National Galleries of Scotland.

Between 1991 and 1995, a considerable investment in money, historic building expertise, staff time and craft skills was made by Historic Scotland, the National Galleries of Scotland, Banff and Buchan District Council and Grampian Regional Council, and Grampian Enterprise Limited.

Restoration included strengthening some floors, the complete renewal of electrical, heating, and plumbing systems, the installation of security, fire detection and fire prevention devices, total internal redecoration, and the creation of a new car park. The National Galleries located suitable furniture, arranged for its conservation, and chose over one hundred and eighty paintings from the national collection for display in Duff House.

The end result was the complete transformation from an empty architectural jewel box to a treasure house of international importance. Once again the interior with contents matched the breathtaking exterior in a way which had not been seen since the Duke and Duchess of Fife left Duff House in 1906. It was a glorious day for all concerned with the Duff House Project when His Royal Highness the Duke of Rothesay officially opened the stately mansion in its new role on 28 June 1995.

The decision to install sophisticated fire detection and fire prevention systems was the result of the work undertaken by an American firm of specialist fire engineers, Fire-Safety Network. Nick Artim, who has already delivered a paper at this Conference, came to Duff House in 1992 and subsequently prepared a Fire Protection Analysis which identified high and low risk areas and activities, as well as assessing the fire resistance of structural components.

These vary in the House, from structural walls to timber connecting doors, but William Adam's design does provide good vertical and horizontal escape routes which satisfy current regulations. But in view of the new use of the House as a public art gallery and cultural centre, Mr. Artim proposed a number of important recommendations to minimise risk and maximise speed of detection, containment and suppression should fire break out.

One significant recommendation was that caused by the expected delay in the fire brigade response time. Banff is served by a part-time fire station with a response time of 10 to 15 minutes in a worst case scenario, supported by full time appliances with a 30 minute effective response time. These facts, balanced against the unique heritage value of the House and its contents, suggested that the installation of a comprehensive automatic sprinkler system, combined with an automatic fire detection system, would provide the most effective form of protection.

A great deal of effort and expertise has gone into the design and installation of the automatic fire suppression system, and every effort was made to minimise damage to the historic fabric, and the visual intrusion of the system's components. As far as we know Duff House is the first scheduled monument in the United Kingdom to have a fully integrated fire detection and suppression system.

The water storage tanks for the domestic supply and the ten cubic metres storage capacity for the pressurised sprinkler system with associated switch and pump gear, including an emergency diesel-powered generator, could not be accommodated in the House. Any structure above ground would have devalued the architectural integrity of the House, so the tanks and associated plant are located in a purpose-build underground chamber to the east of Duff House.

I am no engineer, and in this room are experts who can provide more detailed information on the systems we are fortunate to possess in Duff House. I suggest you ask them if you require specific details.

The sprinkler system is maintained at a constant water pressure of 90lbs per sq. inch which is achieved with electric pumps. In the event of power failure from the national grid an automatic diesel generator cuts in to maintain the pressure. This engine is run for several hours once a month to ensure its efficiency. Smoke detectors throughout Duff House are vacuum-cleaned on an annual basis to prevent a build-up of dust.

Apart from an air-analysis device which automatically triggers the fire alarm when carbon particles are detected in the air, there are manual fire alarm devices in strategic positions throughout the building, along with hand-held water and powder-based fire extinguishers. These are also maintained on an annual basis through a contract let by Historic Scotland.

As well as routine testing of the fire alarm systems, two practice exercises have been held. The first, in 1976, was filmed, and a video is available. A controlled fire was deliberately started in the dry goods store which is situated in the north-east pavilion basement. Grampian Fire Brigade was present in strength to monitor the situation. The sprinkler system was activated as a result and worked perfectly. Various lessons were learned and these have been incorporated in the Duff House Fire Procedure.

The second exercise was held last year at the request of Grampian Fire Brigade which wished to test the evacuation of objects from the building. This room, the Long Gallery, was filled with various items of furniture and panels to simulate paintings. The alarm was raised by imagining a fire had broken out in the roof attic space above. The local fire brigade arrived, advised Aberdeen Headquarters that additional help was required and fifty minutes later the two units on display outside for this Conference reached Duff House. The process of erecting a temporary shelter and salvaging the material from this room then took place using the central staircase. Items were carried down through the four-storey building and were checked in to the temporary shelter. Extending ladders with high-level hoses were used to tackle the simulated fire at roof level.

Grampian Fire Brigade salvage units on display at Duff House

Again important lessons were learned both by the Brigade and the staff of Duff House and I cannot emphasise enough how important it is to allow both Fire Brigade and staff the opportunity to stage these exercises. However simulated, they bring home the realities of fire danger and allow the Fire Brigade to become familiar with the buildings under their protection.

Our Fire Procedure is as follows:

Chubb Alarm systems provided a central control point near the East Door of the House which gives the exact location of any fire emergency. Our stewarding staff are then advised by my colleague, Mr John Mair the Factor of Duff House, via two-way radio the escape route which should be used by staff. Under their guidance, any members of the public who are in the building at the time are escorted from the building. All congregate on the West side of the House where a roll call is made.

Emergency vehicles draw up on the East side of the House where hydraulic risers are located. An emergency air-filled tent can be erected to contain any salvaged material which circumstances require to be removed from the House.

In his report, Nick Artim emphasised a No Smoking policy in Duff House. As a pipe smoker this makes life hard on me and members of my staff who are also smokers. We have 24 hour security in Duff House provided by the Factor. He and his wife live in Duff House, it is their home, and naturally at times they entertain their family and friends. All must adhere to the no-smoking ban.

Only in this way can there be a guarantee of no fire incidents caused by careless smoking habits. Visitors appreciate the reasons, particularly those using the tea-room and we have had few complaints. One other result causes a slight problem. To raise revenue corporate occasions are held in the splendid rooms. These often take the form of dinners. Sadly we cannot have candles on the table so that the ambience is not the same. If anyone here can recommend to me period fittings with electric candles and a built-in battery I would be delighted to hear about such a thing!

Delegates can judge for themselves whether, in this superb building with quality period interiors, the fire detection and prevention systems are overtly intrusive. I do not think so, and I commend to you the feeling of safety these systems inspire in me. It can be done. I hope that all who care for the architectural heritage of the United Kingdom will seriously consider installing similar systems in the buildings for which they are responsible."

THE RISK ASSESSMENT IN EUROPEAN HISTORIC BUILDINGS PROJECT

WOLFGANG KIPPES, Dipl.Ing and JAN HOMBERG, Eur. Ing

"In 1997 Ingval Maxwell and I were talking about the many problems facing us professionally in the area of protecting our historic buildings and we exchanged many ideas. One of these was the possibility of applying to Brussels for a grant from the Raphael programme.

In the Official Journal of the European Communities there has been a second call for ideas for projects falling within the ambit of the Raphael project (activity in the area of conservation, safeguarding and enhancement of the European cultural heritage through European cooperation). Grants are awarded under very strict rules, for example they state that they will only contribute fifty percent of the total cost of any work. In the application, our approach is as follows:

We have asked for the maximum amount of money available within the project from Brussels. We have arranged a balanced budget so that we would be capable of running some 6 + 4 seminars in different locations in Europe, with at least 20 people attending each seminar. The idea is that people attending should contribute 'in kind' with their time and the project will pay for all travel and living expenses. By circulating or having these meetings around Europe we hope to include local people who should know more about the problems facing them.

Who are the partners? Well we are, for the time being! There is a co-ordination group of Historic Scotland, Schönbrunn Palace and Versailles. They have a workhorse, that's Jan Holmberg, and the people involved in the industrial side, Wormald in Manchester, Rambol in Copenhagen, the Austrian insurance group, RCA in Paris. There's also the Fire Protection Association, a Swedish organisation that's very like Historic Scotland (they own and run the royal palaces in Sweden). There's also the Bundesdenkmalrat in Austria and a Slovenian group that we have cooperated with before. And the National Trust of course.

I quote from the project application: how do we intend to approach the problem? We intend to try to define a series of open questions and determine how to find the proper answers. We intend to establish and provoke a statement of the state of the art expertise, and, as I said, we intend to organise a series of conferences and workshops to develop and promote understanding. We will produce and publish proceedings and recommendations. We have asked for money to print these in different languages. And finally to the detailed strategies associated with such topics: development of countermeasure equipment including a broad range of training courses. So this is what the application is about and we are using this opportunity to tell you why we sent in this application. We are hopeful, but you never know what happens in Brussels!

To explain why we have done it, let me give you some information in advance which you ought to consider. I'm here to learn, to export your know-how to Austria and all the other countries in the middle of Europe that may join our group. Secondly, I would like to point out that this is an pan-European problem. Every organisation dealing with built heritage in Europe has the same problems but not the same expertise. The third point you ought to know is some background information about my company. We are a private company with shares held by our Minister of Economic Affairs, not the Finance Minister, and we have to pay taxes (but we can avoid that by investing all our profits into the palace) so we try very hard!

According to Austrian law, managers of a private company have personal responsibility for all damage done to the owner's property, so the managers of a company are very much interested in doing their best!

Now I would like to cover the reasons why we are dealing with fire protection and risk assessment. I would like you to consider that every one of the points I make as to the background of my work in Schönbrunn is equally relevant to all heritage properties throughout Europe. We have a fire alarm system in Schönbrunn and the reaction time of the fire brigade (we've tested it several times with false alarms) is about four minutes. I remember when I discussed with the senior members of our fire brigade standing in front of our main building which is 140 metres long, he told me, "Well, you have to consider that having a small fire in the east end, it will take you 20 minutes to have a full blaze in the main building which is 140 metres long". We thought, "But they will be here within four minutes so what is the risk?"

I then remember I discussed the problems of fire protection with Ingval Maxwell whenever we met in the COST group and I was impressed when he told me he was compiling his own statistics on losses due to

fires in the built heritage - and there's one total loss per month. This impressed me in several ways because first of all there are no statistics in Austria so nobody knows what the risk is - one loss per month is an enormous amount. So how can we apply this data to Schönbrunn? Still I thought, four minutes reaction time from the fire brigade, this is sufficient and we don't face any problems with that. Next, in early spring this year, I met Jan Holmberg and Ole Johannsen, a Swedish insurance company fire specialist, and they told me that, according to Swedish data, it will take the Stockholm fire brigade up to 17 minutes to be able to fight a fire efficiently, even if there is an immediate fire detection and alarm. This was the first time that I began to doubt the information I had been given by the Vienna fire brigade. If it will take 20 minutes maximum to have a full blaze in the palace and, if it will take the brigade 17 minutes on average to begin effective firefighting operations, we have a problem. So these are some of the reasons why we need to consider how to handle fire in a more rational, organised manner.

Another fact you have to consider is that sprinkler systems never have been considered to meet the needs of historic buildings in any of the German-speaking countries because of the perceived risks. We ought to discuss this as well.

Another point I would like to stress is insurance. As I told you, being a private company we have to be insured. This was a new idea for the Austrian market because before that it was state-owned property - and still is technically state-owned property - but we are running it on a private basis so we have to be insured. There was no insurance company in Austria who was able to define the value. It took nearly six years for us to be able to value Schönbrunn but at last we are insured. The value now has been decided at some £230 million pounds but valuation discussions continue. The insurance company was never able to give us first loss cover. This is interesting because if you add all the buildings together it makes approximately 6 km. This is approximately the distance of the Ringstraße, which is round the centre of Vienna. There are several hundred buildings there and having the same rules there, every one of these buildings would have to have the same insurance contract to meet the same risk, so this is a bit strange. But so far, the insurance has not been willing to change the contract.

When we started to negotiate with the insurance company, BundesInderversicherung, they became one of the partners in our project now because they see the problems as well. Every Austrian insurance company wanted to insure Schönbrunn because it is a national property. The Schönbrunn Palace is seen as part of the national identity of Austria so if you are its insurer, you have a major marketing advantage! This means that we got cover at a low price.

Unfortunately three months later there was the fire in the Hofburg. The insurance company cancelled the contract immediately and we had to negotiate a new one, the price being four times as high. So since then they earn a lot of money marketing Schönbrunn. But in the meantime we became a member of the European Union and this brings us new competition in the insurance market which we never had before. So all the insurance companies are interested in having this prestige contract for the Schönbrunn. On the other hand, this means that our insurance company has to increase the premiums every year. But even though we are covered by the biggest insurer in Austria, it and its reinsurers (MunichRe) don't have any understanding of the risks. They are not able to calculate the risks because there are no statistics. There are plenty of statistics of fires in residences and this is the how they work out the risk and how they work out the price for the risk, but no information about historic buildings, except theatres. As we heard yesterday, as a result of big theatre blaze in 1881, the Ringtheaterbrand, which was an important factor in the development of legal aspects at that time, we have detailed statistics for all fires in Austrian theatres. So it's very interesting to see that, while you can safely predict with 95% accuracy the causes of fires in theatre and take precautionary measures, there is no information at all in historic buildings. This seems to me an excellent reason for setting up European cooperation in this area."

REPORT ON DISCUSSION SESSION HELD ON 7TH OCTOBER 1998

Firemaster Williams, the Convenor of the session, opened by asking to what depth should a risk assessment go and how should it be recorded.

Mr Kidd responded by reminding the audience that, as he had stated, that there is no single correct way in which to undertake a risk assessment. He said that the regulations as they presently stand only require a risk assessment to be recorded if more than five persons are employed in the premises. He felt this was not helpful as how could someone prove, perhaps to a court, that they had done a risk assessment if it had not been written down?

He emphasised that risk assessment should be a continuous process, so unless a record is made it would be impossible to determine what might have changed.

The detail to which one should go depends very much on the size of premises, the complexity of the processes that take place there and the people at risk. If the risk is children who are mentally handicapped, or old people with Alzheimer's disease then although the risk is classified as a 'sleeping risk' it would be very different from that of a hotel. He said that he thought the Home Office guide to the Place of Work Regulations was not the most helpful document when it comes to actually carrying out a fire risk assessment and suggested that the Fire Protection Association's "Fire Risk Management in the Workplace" which contains two worked examples of two different approaches to risk assessment could be more useful in this situation.

Mr Kidd then asked Paul Stollard of the Scottish Office Development Department if there were plans to produce a Scottish Office guide and Mr Stollard confirmed that this was the case.

Mr Kidd then acknowledged part of what Nick Artim had said about the use of consultants. While such individuals have their uses it was important to be aware that in many cases the owner or occupier could carry out the risk assessment without expensive assistance. He did accept that in more complex properties using a consultant might be appropriate but he felt that in most stand-alone heritage buildings this could be done by using the published guidelines and a bit of common sense. He reminded the audience to talk to the local fire safety officer for additional help if necessary.

A member of the audience asked if an individual who might own a castle or historic building (which doesn't belong to the National Trust or Historic Scotland) might be compelled to install fire protection systems because of the building's heritage value.

Mr Emerson said that there is no obligation to do so, but that Historic Scotland are prepared to consider applications from property owners for grant-aid towards the cost of installing fire protection systems - this had been done for some National Trust for Scotland properties.

Mr Maxwell reminded the audience that one of the reasons for publishing the two Technical Advice Notes was to provide an authoritative source of advice on how owners and practitioners could implement sensitive and appropriate fire protection measures.

Mr Kidd raised the problems of insurance premiums and property values. He said that shortly before the fire, Uppark House would been valued at £5 - 6 million on the open market, but the cost of its re-building was between £13 - 15 million. The National Trusts' insurers covered those costs that because the National Trust purchase indemnity cover, and the insurers were therefore liable for full instatement costs.

Mr Kidd went on to comment that if the house had been insured with a declared value it would be unlikely that the insurers would paid the full reinstatement costs. He said that there was a need for discussions between English Heritage/Historic Scotland and the insurers to prevent problems arising in future.

Mr Campbell said that market value will be irrelevant, for example, a house which would cost two million pounds to rebuild could be bought for £500,000. Generally speaking the owner is required to fix a value. There are number of ways of doing it, though it is essential to ascertain the correct value.

Mr Emerson responded by saying that if a house like Duff House, in private ownership, were to burn down it would not be for Historic Scotland to take the initiative. The onus would be on the owners to identify what they wanted to do, and for the planning authority to determine what the owners will be required to re-build. The planning authority might ask Historic Scotland for advice, but it is for them to decide what they advise the

owner to do in terms of rebuilding. He said that it was really a myth to say that if a building is totally destroyed someone from Historic Scotland will come along and say "You've got to rebuild that". This is why both Historic Scotland and English Heritage produce advice on insurance.

A delegate asked if Historic Scotland might take a different view of a major public building being lost.

Mr Emerson said that in that case, assuming the building belonged to a local authority, the planning authority would probably be the Secretary of State. Historic Scotland would then advise on what it felt should be done, and certainly this decision would depend very much on the circumstances and the heritage value of the building.

REPORT ON DISCUSSION SESSION HELD ON 8TH OCTOBER 1998

Convenor's Preliminary Remarks

Firemaster Williams began by alluding to comments made by two speakers about the attendance times of the fire brigade to Duff House. He assured the audience that, under normal conditions, Grampian Fire Brigade can get two appliances to the House within 7 minutes, and 30 firefighters to the site within 30 minutes. He then mentioned work done for the Home Office in 1995 in which consultants had produced the report "In the line of fire". This used a risk assessment approach to assess future fire cover needs for the United Kingdom. The draft report suggested that areas of less than 3000 people might not necessarily require the provision of fire cover at present levels. While this might be demonstrated as valid solely on a cost/benefit basis, it was clearly worrying for some semi-rural areas - such as the one around Duff House. The Firemaster said that some of these conclusions would be the subject of future consultation and urged the audience to respond vigorously to any consultation document to ensure that their voice was heard.

Open Forum

Mr Kidd said that he stood second to no one in his admiration for the fire service but that it was important to remember that in looking at local response times there are two very important caveats to bear in mind. The first and most important point is that the fire brigade can only respond when they have been called, so the response time for Duff House is 7 minutes from the time the call is received at the fire brigade control centre. There could be a 3 to 4 minute delay between an automatic fire detection system operating and the alarm central station operator passing it on to the fire brigade.

The second point is the fact that Grampian Fire Service can respond from Macduff and Banff stations only if the fire appliances (which are crewed by part-time fire fighters) are near their stations and available for call. If these appliances are already committed to another incident clearly the response may well take longer. If the Windsor Castle fire was considered, at the time the alarm was raised, the castle's own "in-house" fire brigade was at the other end of Windsor Great Park dealing with a chemical spill. At the same time, the fire appliances from the Berkshire fire brigade station nearest the castle were dealing with a call in a different part of the county.

He then recalled that a speaker had mentioned the Norwich City Library fire; the library is less than 150 yards from the main city fire station. At the time of the fire, one of the station's pumping appliances was out, the turntable ladder was not available for mechanical reasons, and the second pumping appliance was not fully manned. He said that it can be dangerous to assume that general response times for a community will always apply to a single set of premises at any given time.

The Firemaster said he fully supported Mr Kidd's observations and agreed that the brigade response time starts at the time the call is received. What happens before that is down to premises management. He then emphasised that he carefully used the phrase "normal conditions" because it would be impossible for the service to plan to take account of every type of situation that might arise - the legislative basis on which the fire service operates is to assume normal conditions apply. He felt that the discussion on response times highlights the value of sprinklers which will respond to a fire in a few minutes. A voice from the audience added "In a few seconds!"

A member of the audience said that part of any heritage building's risk assessment is the acceptability of the intervention which would result from introducing fire protection equipment. Where a programme of general repairs is to take place then it may be relatively simple to include with this the installation of a sprinkler system. In other cases, the disruption to historic fabric may be totally unacceptable. In this case, other approaches to dealing with risk, such as the way the property is managed, could reduce the hazards sufficiently to outweigh the need for active fire suppression measures.

Nick Artim raised the issue of risk assessment and fire brigade response times. He noted the need for a cultural change in approach; from simply expecting a fire appliance "within three minutes" to a more reasoned approach to considering the time it takes to actually initiate suppression of the fire - and this will vary from building to building and site to site.

Apart from road conditions and weather there is also the complexity of the building. There are some

buildings where it takes three minutes to get to the front door. It may be another 20 -25 minutes before the fire brigade has identified where the fire is, how to access that point, and then how to find the source of fire-fighting water. In some situations we find that the crew of the first appliance to arrive may be committed to search and rescue operations, and will not even begin to fight the fire.

It is also possible to install devices which help the brigade, for example, smoke extract systems. He stressed the need to think ahead and to use budgets to their best advantage, for example, if a slightly larger fire alarm control panel than might be immediately called for is bought, then the detection system can be expanded in the future as more funds become available. Sprinkler systems should be fitted to counter the greatest hazard - and if this is not possible then owners should take a holistic, long-range approach and do what they can today to lessen the risk of a fire occurring and spreading.

Mr Artim then mentioned the American standard document NFPA 909 and said that it contained information and advice which was very much in line with what had been discussed during the session on risk assessment. Although it was a US/Canadian document, there had been UK input and it had taken into account the performance-based objectives of codes in Japan and Australia. He said that the NFPA Cultural Resources committee would be willing to provide assistance and to exchange information.

Mr Artim also drew the attention of the audience to another US publication, NFPA 914, which was also highly relevant to many UK and European properties. This was based on research undertaken in the early 1980s by the US Housing and Urban Development Administration to determine the fire resistance ratings of archaic structures. The idea was to determine how building elements performed when compared to contemporary structures, recognising that the reason why archaic building methods and materials are no longer used may be purely economic rather than related to any technical failings. The document contains a range of tests undertaken on lath and plaster, plaster, timber-panelled doors, and information on how timber behaves in fires.

Mr Maxwell then referred to the Museums Association conference in Portsmouth two weeks previously. When he had asked an audience of 70 which of them would think about installing a sprinkler system in their museum, four hands went up and when he pressed the issue further, asking "Why not?", the response was: "You should consider the damage that water could cause". While sharing of information on the actual failure rates experienced with sprinkler systems will go a long way towards breaking down this sort of barrier, there is also a challenge for the manufacturers, designers and suppliers to improve the way they do things because there is no doubt that historic buildings do create problems in the way systems have to be installed.

The Fire Protection industry should ensure that suppliers come up with sprinkler systems and components which can deliver water effectively while causing minimal disruption to the fabric - such as quick-response heads. He felt that there was a whole range of issues where research into the way in which installations are undertaken should be informed by the conservation principle of minimum intervention.

Stephen Newsom asked about the comparability of the data in NFPA 914. He said that he was aware that we are continually destroying bits of our fabric to try and test how they perform in a fire. He quoted an example where a building control officer insisted on testing a door from a particular listed building to verify its performance. He was aware of the NFPA data but wondered now much much credence would be placed on these by UK local authorities. He suggested that a European approach to this could be productive and asked if this had been considered.

There was general agreement that this should be tackled as part of the proposed European project

Dr Marchant said that in his experience, dealing with a castle in Perthshire, building control departments would not accept the information in NFPA 914, because they could not define where the source information came from and because Appendix D is part English and part American. It was therefore deemed, at least in this case, to be irrelevant.

He said that he was completely behind the proposal to move to performance-based standards and also supported the European risk assessment initiative. He noted that the proceedings of the 7th International Fire Protection Seminar in Karlsruhe in 1976 contains some useful data on fire and materials. It also includes an Austrian example of fire engineering applied to the partial reconstruction of a building. He then told the conference about a proposal to produce a new British Standard in four parts, one of which will refer to fire safety management and include an outline on fire risk assessment.

Jo Thwaite of Historic Royal Palaces, said that she wanted to support the point that was made earlier on the use of sprinklers both by Mr Maxwell and the representative of the National Trust for Scotland. Historic Royal Palaces had installed a sprinkler system in a remotely sited cottage at Kew to "buy some time" because of the likely fire brigade response time.

A special sprinkler system, probably more of a drencher system, was installed during the process of re-

thatching the building (the work would have otherwise been too intrusive). This had to be specially designed and it is important to accept that a standard approach based around the simplistic statement "Will we put sprinklers into this building" is unrealistic. It is essential to design systems to make sure they are adequate for the specific requirements of that particular historic building.

Therefore Historic Royal Palace's answer to the question, "If we had the money would we put in a sprinkler system ?" may be "No". The question should rather be " Would we consider putting sprinkler systems in particular buildings given the risk to those buildings ?". She continued to say that it had sometimes seemed that sprinklers were being proposed as the solution to all our problems at the conference but they are not. Sprinklers may be appropriate, but the decision can only be made after all aspects of the fire and conservation problems have been considered. It will also be necessary to ensure the design process is properly carried out, and the system can be installed without undue damage to the fabric of the building.

She then went on to what a speaker had said regarding owners taking on responsibility for fire risk assessment of their own buildings. She felt that for many people who might not have the appropriate resources that this could be a particularly onerous responsibility and what concerned her is that while large clients have access to consultants, the vast majority of historic building managers in, say, local authorities, may not have funds available for this type of work. She added that she was delighted to hear of the European initiative and hoped it would publish the results of the larger organisations' fire tests.

Chris Hood of Wormald Engineering said that his company had installed the system at Kew Gardens and what was at risk there was not just the cottage itself but its location and the trees that surrounded it. He then referred to Mr Maxwell's comments about the Portsmouth conference and said that if people were concerned about water damage then they should speak to the companies who had experience of this sort of equipment and to people who had installed systems in similar premises.

Jim Leith, a fire alarm supplier, said that this was the first conference of this type that he had attended in 12 years in the fire industry. He had thoroughly enjoyed it and had learned a great deal. He asked if anyone knew of any committees or relevant meetings which he, as a designer and installer of fire alarm systems, could attend.

Paddy Elson of English Heritage said that she now chaired the Historic Buildings Fire Research Co-ordinating Committee set up by the Department of National Heritage (now the Department of Culture, Media and Sport) following one of the recommendations of the Bailey report. The Department of National Heritage was concerned that there should be proper co-ordination of the research work which is relevant to the palaces and to ensure that adequate dissemination of knowledge and results was accomplished among the various groups with an interest in this area. She felt that there was an ongoing need for this sort of co-ordination work both nationally and internationally

A member of the audience then said that he was interested in the question of technical standards. He felt that requiring a fire test on doors, for example, should be a last resort, and it would be better to be involved in an exchange of information. He felt that fire tests themselves have limits and it is naive to believe that any test replicates exactly what will happen in a fire. A test for a 30-minute fire door only shows that the door passes a 30-minute fire test, it can never be a test of how the same door would behave in a fire because we cannot predict what will happen in a fire. He hoped that when proper records and data were available that this sort of testing could stop.

Conclusion

Mr Maxwell was invited to sum up and concluded that the Conference had been a very significant event indeed. There was a clear message that no one organisation can do everything, and that there is a need for co-ordination, cooperation and partnership between all interested bodies. The benefits of addressing a problem from different perspectives and the added value possible from such a collective approach both suggest that this will prove the best way forward.

RISK ASSESSMENT IN EUROPEAN HISTORIC BUILDINGS PROJECT PRIVATE COMMITTEE MEETING

Present:

Nick Artim, Fire Safety Network, Vermont, USA

Gilles Astrom, National Property Board, Sweden

Charles Burnett, Chamberlain of Duff House

Tom Carroll, Chief Fire Officer,
Oxfordshire Fire Service

James Campbell, Pembrose Forbes Insurance Brokers

Mike Coull, Grampian Fire Brigade

Audrey Dakin, Historic Scotland

Richard Emerson, Historic Scotland,
Historic Buildings Inspectorate

Graham Goodall, HM Fire Service Inspectorate,
Scotland

Jan Holmberg, Haftcourt Ltd, Sweden

Stewart Kidd, Heritage Loss Prevention Consultant

Wolfgang Kippes, Schönbrunn Palace, Vienna

Alan Marshall, Grey, Marshall and Associates,
Architects, Edinburgh

Ingval Maxwell, Historic Scotland (Convenor)

Neil Ross, Historic Scotland

Stuart Yates, Loss Prevention Council

Mr Maxwell opened by welcoming the delegates to the meeting and explaining that a note would be taken of the discussions and this would be published as part of the Proceedings of the Conference. The delegates then identified themselves and their organisations. Mr Maxwell said that the meeting had been arranged to brief interested parties on an application which had been made to the European Union for funding under the Raphael Project. He explained that the deadline for the Raphael submissions was 10 September, so that the application had already been submitted and the meeting was in the nature of an affirmation of the proposed project.

He then circulated a summary of the bid which had been prepared by Jan Holmberg and Wolfgang Kippes. This identified the objectives of the project which would be exploring the concept of risk assessment in the heritage context. The bid relates to a programme of seven phases, the first of which was the present conference, The second step was to distribute the proceedings of the conference internationally and that is planned for April 1999.

Step 3, which is planned for May 1999, would be building a core group of interested people and organising and supporting a two-year programme of research and education - assuming that an agreement with DG X (that part of the European Commission responsible for cultural matters) agreed to the balance of the funding. The bid was originally submitted with a request for the full, likely costs of the project and it was hoped that the EC would accept that the balancing funding could be by injection of resources or some form of participation by industry.

There was a brief discussion involving Mr Maxwell and Mr. Kippes regarding how this form of participation might be viewed in Brussels. Mr Maxwell said that he felt the programme needed to raise something like 168,000 Euro (approximately £117,000) from the EC. His initial thoughts had been that the matching balance could be raised by industry participation and involvement.

Mr Kippes agreed that he would continue to maintain a watching brief over the progress of the bid and also take on the role of "Project Accountant" ie, to be responsible for the receipt of the funding from Brussels and to ensure that records are maintained so that a proper accounting of expenditure can be provided.

The fourth step which was due a year from now was to define problem areas, list priorities and then publish a "White Book" under the auspices of DG X. This would represent a significant summary of the current "State of the Art" as applied to heritage protection and fire safety.

The fifth step will build on the publication of the White Book. There will be six further workshops or similar events addressing the contents of the publications. These will run from January 2000 through to June 2001, and it was hoped that they could be organised at different locations in Europe. Locations tentatively suggested in the Raphael bid included the Schönbrunn Palace, Vienna; Versailles, Paris; Edinburgh and a Swedish venue.

The meeting agreed to the proposals and delegates commented that it was important to run such conferences in places where those responsible for

heritage buildings could assist in setting up the meeting and where case study material could be investigated as part of the programme. The importance of getting the right audience - not fire protection specialists but those actually responsible for managing heritage buildings - was emphasised. The meeting agreed with these views although one questioner did ask how much confidence there was in getting the right audiences to attend. Mr Maxwell asked Mr Astrom whether, from his experience in Sweden, he could comment on the attitudes of property managers to the concept of fire safety management.

Mr Astrom said that they were more aware of problems nowadays and while the building is standing, there may be no problems but when the building burns down, there clearly is a big problem! He noted that while it was not possible to install sprinklers in every building under the control of the National Property Board they had started a programme to install detection and alarm systems.

Mr Maxwell said that it was important to produce a programme which would appeal to the target audience i.e. owners of private houses, their advisers and their agents by delivering a practical set of solutions to meet their needs.

Mr Maxwell then related the outline of a discussion he had had earlier with Mr Campbell of Pembrose Forbes Insurance Brokers. They had both concluded that it was clear that valuations of heritage buildings relative to insurance premiums and rebuilding costs was an area which required careful consideration. Mr Maxwell was sure that there was a better way of ascertaining value, possibly in relation to the authenticity of the building. If this was done then it was perhaps possible for a new sort of "insurance" to be put in place where grant-giving bodies might assist with the cost of installing detection and suppression systems provided that real efforts had been made to protect the building. It was equally obvious that the present system of tying premiums to replacements costs benefited nobody when a building was lost - rebuilding work being no more than a modern interpretation of the original fabric.

Mr Kippes commented that for them, the Schönbrunn Palace in Vienna was a sort of flagship in this area of concern because of their investment programme. He felt that others in the heritage field in Austria were happy to learn from the projects Schönbrunn was pioneering.

The meeting agreed to a suggestion, that, if possible, the project team should sign up the principal organisations, such as the Historic Houses Association, the National Trust and the National Trust for Scotland and secure their support for the project and related activities. It might then be possible to optimise attendance by making it clear that the staff of supporting organisations could attend at no, or at a very low, cost.

Mr Kidd noted that he been involved in around 15 heritage fire safety seminars over the past 10 years and it had proved consistently difficult to reach the the owner-occupier, such people will only come if it's convenient, if it's affordable and if they think there's a clear benefit.

He suggested that it might help if attendees at the workshops were issued with a Certificate that says "Mr/Ms X attended this European Commission funded activity and has received training in an approved approach to managing fire safety in heritage buildings". It would be like getting a "Vocational Qualification" in fire risk management. There has to be a *quid pro quo*, he said, and a perception that the seminars would offer something which the owners can't get anywhere else.

Mr Maxwell drew the audience back to the draft proposal. Step six would involve setting up working groups to develop standards by March 2001, and this would be followed by the completion of the project by September 2001 - including the establishment of a European body to provide support and advice on risk assessment for historic houses established, hopefully, in cooperation with DG X and the European insurance organisations.

The meeting returned to the topic of attracting the desired audiences. A delegate pointed out that, in the UK, one way would be to ask a representative from the Historic Houses Association to sit on the organising committee so that, if they agree, their members' publications could reflect the HHA's official support of the project. It was suggested that in each country the private house owners federations (or similar organisations) should be involved with the working group so that they could claim some credit for these initiatives.

Mr. Marshall pointed out that when dealing with private clients, there's a great reluctance to do anything unless it's actually required by law, but an organisation like Historic Scotland has quite good leverage in terms of the grants that it administers.

The installation of fire protection measures in George Heriot's School in Edinburgh (which was referred to during the conference) was a good example and grant funding provided an important incentive to include these measures alongside other work being carried out. Mr Marshall said that he felt this might be typical of many similar situations - where organisations just "happen" to have a historic building. Some of them see it as a millstone rather than an asset. He said that we

needed to do much work with groups like churches. Trying to persuade church congregations to look at fire precautions and risk assessment is very difficult - "why do we have to do it?" being a common response despite the high incidence of fires in places of worship.

Mr Maxwell continued by noting that Historic Scotland has grant-aided the National Trust for Scotland, in particular, with the installation of fire detection in some of their "great house" schemes. He had recently put a paper in front of the Historic Buildings Council for Scotland to consider, in certain circumstances, grant-aid support for fire suppression schemes and this proposal was still being considered.

This has yet to be debated in detail, but he could anticipate, in time, allowances being made to grant-aid detection and suppression in some circumstances. Mr Maxwell said that he felt able to promote such an approach now that authoritative, practical advice in the form of the two Technical Advice Notes (TANs) - TAN 11 and TAN 14 - was available. Therefore if architects or owners come across a specific situation, where it is felt that fire protection improvements are appropriate then at least there is some public domain technical information which is now freely available to assist in the decision-making and specifying processes.

He said that he thought that there was now recognition that fire protection improvements had their place, but that there was a need for an expressed lead to ensure the importance of the authenticity of the historic structures is also taken into account.

Mr Emerson agreed with this approach and went on to say that one of the interesting things that Wolfgang Kippes had said was that the German-speaking world didn't use sprinklers in cultural property. He asked Mr Artim what the practice was in the US.

Mr Artim said that sprinklers were used extensively in American museums and galleries.

A delegate commented that this change in attitudes was in a sense what the whole project should be about. It was certainly true that many curatorial personnel needed to be educated in the technical capabilities and limitations of such things as sprinklers. Frequently, the best person to do this would be a colleague from another institution who had installed sprinklers and was happy with the protection they afforded.

Mr Kidd said that this was already happening to a certain extent as the FPA had made available, as a training video, the NFPA/US Department of the Interior project on this theme, where a number of interviews with key heritage specialists argue the case for automatic suppression.

A speaker commented that many of the fears often expressed were rather silly. He noted that the audience had all been staring at the concealed sprinkler heads in the meeting room and could see that they are considerably less visually intrusive than the light fittings. He suspected that, given that there were many more lights involving much more cabling, lighting probably represented a much greater intrusion into the fabric of any building than a sprinkler installation. There was a need to improve education and awareness of the technical aspects and benefits involved.

Another speaker observed that the same was true of other features and services such as lavatory plumbing. No one has ever said that art galleries shouldn't have plumbing just in case it leaked !

Mr Maxwell asked whether there was general agreement that the proposed seven step plan in the project bid was the right way forward.

It was clear that there was a strong agreement in favour of the plan and Mr Kidd said that he was sure everyone was supportive of the full initiative. He then said that attitudes were changing as when he had first been involved in heritage fire safety in 1989 the idea that a senior management member of an international or national heritage organisation would be standing beside him promoting good fire protection was unthinkable. He felt that Historic Scotland was now leading the field in this area.

A speaker asked who were the other partners in the funding application?

Mr Kippes said that it was a joint group of Schönbrunn, Swedish colleagues, Historic Scotland and Versailles.

Mr Maxwell said that there was formal UK Government support for the proposal, and that there were also formal letters of support from Denmark, Sweden and Austria.

Ireland and Spain were both suggested as possible partners and Historic Scotland's links with Slovenia were also mentioned in the discussion which followed. This also reviewed other contacts in Greece, Eastern Europe and the work done by the US NFPA Cultural Resources committee. It was agreed that the potential for major international collaboration was very high indeed. This could be followed up if the bid in the proposal was successful.

The meeting turned to the summary of the proposal and it was agreed that there was a need for much better statistical information. Mr Maxwell mentioned that Historic Scotland was planning to issue a CD ROM containing details of listed buildings in Scotland. He had spoken to the Grampian Firemaster and had suggested that this would go some way towards remedying the problem of recording when a building

that had suffered a fire was listed and allow some correlation of the fire service's information with that of Historic Scotland's. It was planned to hold further discussions on this approach.

The meeting then discussed the use which the insurance industry made of statistics. While it was accepted that some of the information obtained might be helpful, it was also clear that in many cases insurance ratings/data might not be relevant because the raw information held does not accurately categorise heritage buildings

Mr Artim said that this was much in line with US experience. There were some notable exceptions but many US insurers do not even report whether a structure which has suffered a loss was actually a historic building. Factory Mutual is looking very closely at the idea of recording whether a risk they underwrite is a historic structure. The Chubb Group, which is part of the largest insurer of historic properties and museums in the North American market, is also trying to get some solid statistics in this area.

After some discussion it was agreed that part of the project should focus on the need for better statistical information and to encourage cooperation with fire brigades, insurers and other bodies to make available regular reports and produce statistics.

It was pointed out that the project should not record just losses and failures but also successes - where buildings have been saved or where fire protection systems have operated to protect contents or buildings. Mr Artim mentioned a fire incident in the Hermitage State Museum in St. Petersburg where a smoke detector installed about two weeks earlier identified an overheating light unit in a room which contained some US$ 25 million worth of Chinese artifacts. This was clearly a success.

The meeting then addressed the question of whether "listed building" and "historic building" were the same thing. From comments made by Mr Emerson and others it was clear that the question of "listing" is very different across Europe and North America. A speaker noted that Austria has 36 000 listed buildings, Bavaria has 110 000 and Scotland has 43 000. It was remarked that this did not mean that Bavaria is three times as historically interesting as Austria! Another speaker noted that for the whole of Germany there were reportedly 1.5 million listed buildings.

There was a view expressed that if a building appeared to be of historic interest or was in a conservation area and/or contained culturally-important objects then it was of interest to the project.

The meeting then discussed the way risk assessment gains could be quantified and it was agreed that this, together with technology and know-how transfer, should prove attractive to DG X. Mr Kidd said that one of the most important outputs would be case studies - not only negative issues but also "near misses," should be recorded.

The meeting agreed to these suggestions and also the proposed timetable for the project as a whole.

Mr Maxwell and Mr Kippes mentioned that a response to the bid had been promised by Christmas 1998. Mr Holmberg noted that there were some risks to the success of the bid: some unanswered questions remained on the application (for example, his company might be deemed to be too small to administer the project) but he felt that Mr Maxwell and Mr Kippes, particularly, were suitable "fronts" for the project given their interests and experience.

Mr Maxwell said that from a UK perspective, there were two ways of keeping the impetus of the project work going. The first involved the recently-renamed Historic Buildings Fire Research Coordinating Committee which was chaired by Paddy Elson and on which Historic Scotland is represented. This could be used as an additional forum to integrate UK experience over a wider front.

The other is the "Industry" group which Historic Scotland set up to advise on the production of TAN 11 and which was asked to give advice on TAN 14. He suggested that this group might be re-convened and asked to meet every 6 or 12 months as part of Historic Scotland's programme to disseminate information and achieve feedback. The group includes representatives from the fire brigades, the National Trust for Scotland, academics, other government departments and the Architectural Heritage Society of Scotland, etc.

He stressed that the partners in the bid were happy for others to join, either in the core group, or as one of those bringing "in kind contributions". He also noted Mr Holmberg's comments and said that they ought to have an alternative strategy in place in case the project bid fails. If necessary this would be considered further once the status of the bid was known.

Mr Maxwell closed the meeting by thanking all those who had participated and emphasising how important it was to keep information flowing and maintaining the dialogue which the conference had initiated. He also undertook to keep those involved in touch with developments as and when they occurred.

Agreements reached at the meeting

1. Mr Wolfgang Kippes, Schönbrunn Palace, Vienna to act as financial manager of Project.

2. The meeting agreed as a whole to the Seven Steps of the Project and to the proposed timetable and the tentative venues for the proposed seminars/conferences.

3. There was general agreement on the importance of attracting the right audience.

4. The Project group should sign up the principal heritage organisations as 'supporters' in planning the seminars or other educational activity and offer low or no cost attendance to relevant employees or members.

There was full agreement on the need for international co-operation and to bringing-in additional partners.

5. It was agreed that there was a need for better collaboration in the acquisition, analysis and dissemination of heritage fire statistics - both positive and negative.

6. The meeting agreed that if a building was of historic value, contained heritage artifacts or was in a conservation area then it was a heritage building.

7. There was strong agreement that the outputs from the project should include technology and know-how transfer, regular statistics and a method of quantifying risk assessment gains.

Post-Meeting Notes

1. A subsequent Conference on fire protection has been arranged at Schönbrunn Palace, Vienna for April 1999.

2. The Duff House Project has received a 1998 Europa Nostra Award "for the nationally important restoration and cultural re-use of a major country house, in particular for the innovative fire protection measures."

3. NFPA Cultural Resources Committee Meeting is being arranged in Edinburgh from 11-13 August 1999. Attendance to the educational parts of the meeting will be by invitation which would be freely extended to those with an interest.