

**Fire Protection and the Built Heritage**  
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**FIRE SAFETY MANAGEMENT**

*Some problems in the protection of historic buildings from fire.*

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**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.

It is perhaps ironic that the event which triggered the setting up of the UK Working Party on Fires in Historic Buildings which produced the publication *Heritage under Fire*<sup>2</sup> was the Hampton Court Fire. Ironic, because the Windsor Castle fire 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.

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. 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 as recently as 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 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.

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 which may be 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.

In the last decade a historic building of national and international importance in the UK has been seriously destroyed or damaged by fire every year. 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 (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 expected to cost more than £40 million (US\$60 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 by 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 constructional 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 impossible to specify the 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 occupant 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 achieving 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<sup>3</sup> 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. Location 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 an institution, 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 premises. 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 fire-fighting 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 signed.

## **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, in the UK, 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 mains water supply.

Buildings in isolated rural areas will normally only have a mains 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 agency 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 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.

The debris should be searched for any valuable items. These should be labelled and the position in which they 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 so the building should 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.

## References

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- <sup>3</sup> Bailey, Alan and others (1993) *Fire Protection Measures for the Royal Palaces*, London: HMSO