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Emergency planning for fire in historic buildings

Abstract

The continued occurrence of fires in historic buildings suggests that, despite the best attempts to prevent fires occurring, the reality is that the very real possibility of a fire is something that needs to be accepted and that therefore emergency planning for fire is an essential process to undertake. Numerous experiences of actual fires have shown the value of such planning in reducing the impact of a fire on building fabric and particularly on the contents of the building, and could help to reduce the loss of important cultural heritage as a result of fire. Not all historic buildings have many resources to apply to emergency planning, but even limited resources used carefully can have a positive impact. Of particular importance is establishing a good working relationship with the local fire and rescue service, involving it in all aspects of the planning process. Lack of firefighting water, particularly in rural locations has been a significant factor in past fires and should be a priority for discussion. Assessing and cataloguing any valuable artefacts in the building and developing a plan for the removal of these in a fire is also of key importance.

Key words: historic buildings, heritage management, historic building fires, fire safety, emergency planning, salvage.

Introduction

The importance of planning for fire in historic buildings

This article addresses the ever-present threat of fire in historic buildings and investigates the associated pre-planning for such an event, as well as the factors that require consideration in order to minimise the impact of a fire, particularly in terms of loss of historic fabric (the building) and of the historic artefacts (contents) it may contain.

No coverage is given here to preventing the outbreak of fire, or to reducing the development and spread of a fire using physical interventions to the building which, combined with a carefully judged fire safety management strategy, aim to establish a good overall level of fire safety. The article assumes rather that there is an actual fire scenario and considers the emergency response to that fire. This is not an unreasonable position given that, despite the widespread and well-informed adoption of fire prevention and protection measures, serious fires continue to occur in historic buildings. When considered in the light of the finite nature of heritage stock, the resultant losses of fabric or content, or both, in such fires has a 'significant and relentlessly cumulative cultural impact'¹ with the conclusion being drawn that loss to the built heritage as a result of fire represents a considerable negating factor regarding its significance, authenticity and continuing wellbeing². Additionally there is a potentially serious financial impact from fire loss, with the heritage tourism sector being an important part of the UK economy, contributing £20.2 billion to UK GDP and supporting 386,000 jobs³. It is acknowledged that emergency planning in heritage may likely have other concerns besides fire, with flooding and terrorism in particular being of frequent importance, but it is nevertheless fire that potentially has the greatest negative impact due to the irreversibility of fire damage and the potential to involve the whole building.

It has been suggested that it is only when an incident occurs that lack of planning and preparation is exposed⁴, and additionally that following a significant fire there is an immediate response to it in terms of improvements but that complacency might subsequently creep in with the passage of time⁵. This article seeks to challenge this by presenting a collation and analysis of current best practice in preparedness and planning for fires at heritage properties. This article is innovative in that it seeks to present this in a rigorous but practice-focused manner that is readily understandable and actionable by heritage professionals, such advice having previously only been published in technical publications and media reports concerning individual fires.

In order to identify and analyse current best practice, the study informing this article started with an examination of the literature, the emerging themes were then explored in discussion with a range of key stakeholders, including interviews with conservators, curators, specialist advisers, operations managers and fire and rescue service commanders and managers who are engaged with heritage, in some cases having experience from actual fires. This was integrated with lessons that have been learnt from important past fires and measures adopted in practice, with the aim of presenting an article which distils the key areas requiring consideration in emergency planning for fire. After introducing the key fires and a brief discussion of significance, the article follows a systematic path through emergency planning. This starts with a comment on resources and establishes a context for planning, before looking firstly at documenting a plan and organisational challenges; then dealing with practical considerations during a fire: highlighting early stage concerns, fire service issues and salvage.

Although many aspects of emergency planning for fire will apply to all historic buildings, some of the discussion is specific to buildings which have contents or collections that are valuable in monetary or heritage terms, or both, and which may be a prime concern in the event of fire.

Notwithstanding that the buildings considered in this article are British buildings of high status, aspects of the findings are relevant to all historic buildings, whether these are of more modest size or located internationally. Indeed, the recent and devastating fire at the Bishop's Palace in Oradea in Romania (August 2018), where there were initial problems with firefighting water supply⁶, emphasises the universality of the requirement for emergency planning for fire.

Key fires in historic buildings

This section summarises the key historic building fires that have formed the basis of this article's study. Analysis of these fires, and how they were responded to, can valuably inform understanding of the importance of, and best arrangements for, planning effectively for fire in historic properties. In the sections that follow this synopsis of the case studies, the article presents a discussion of key elements of the process of planning for such fires. The scope and nature of this planning has itself changed based on lessons learnt from these fires.

Hampton Court Palace

A fire in March 1986 partly destroyed what is one of Britain's most celebrated historic buildings, which has been a royal palace since 1529 and is famous for being Henry VIII's palace by the Thames⁷. The Palace is Grade I listed as well as being a Scheduled Monument⁸. The cause of the fire was most probably a naked flame in a bedroom of one of the 'grace and favour'⁹ apartments, whose occupant sadly died¹⁰. The fire had burnt for some time before it was discovered due to shortcomings in the fire detection and alarm system¹¹. The response by the fire and rescue service (hereafter referred to as 'the fire service') to the initial alarm was quick - two appliances arrived within 6 minutes - and this is credited with preventing fire spread to adjoining sides of Fountain Court, where the fire was centred¹².

The final cost of the post-fire restoration of the building (not including include professional fees and the cost of refurnishing) was £8.5 million¹³.

Uppark House

Owned by the National Trust, Uppark House in West Sussex was built in 1689 and is Grade I listed. The listing, from 1959, stated that the interior decoration dated from about 1770 and had 'hardly been altered in any respect since, most of the rooms having never even been repainted and even still retaining their original curtains'¹⁴. This situation had not changed by the time of the fire and everything was 'untouched and unmoved'¹⁵.

The fire in August 1989 caused substantial damage to the building and its contents, with the post-fire restoration costing £20 million¹⁶. The fire is thought to have been caused by an Oxy-acetylene lead-welding torch which was being used by workmen renovating the leadwork on the roof¹⁷.

Windsor Castle

The fire at Windsor Castle in Berkshire in November 1992 burned for 12 hours, destroying 115 rooms; with 31 appliances fighting the fire at its height and one and a half million gallons of water being used¹⁸. The subsequent restoration cost £36.5 million (equivalent to £68 million as of 2016)¹⁹. The castle is listed as Grade I and is a Scheduled Monument.

A report following the fire²⁰ made many important points regarding planning and is still a key document used by Historic Royal Palaces²¹. Reflections about lessons learnt included the two key aspects of the value of pre-planned salvage arrangements and the excellent liaison with the fire service on the day, including the provision of detailed plans.

The latter was augmented by the detailed knowledge of the castle that the Castle Fire Brigade was able to share.

Glasgow School of Art

The fire occurred in May 2014 and was caused by flammable gases coming into contact with hot components in a projector. It resulted in the loss of the Charles Rennie Mackintosh building's library, which was regarded as one of the most important interiors of the 20th century²² and one of world's finest examples of art nouveau design, which housed rare and archival materials, together with original furniture and fittings²³. 90% of the Grade A²⁴ listed building survived the fire due to a fast response because of the city-centre location (the first appliance was on scene within 4 minutes of the alarm call and resources were able to be very rapidly increased) and an aggressive and determined attack on the fire by the Scottish Fire and Rescue Service, aided by good knowledge of the building.

A second and much more serious fire occurred in June 2018 during the refurbishment works following the first fire and has resulted in the building being reduced to little more than a shell. Many of the restored fixtures and fittings for the Mackintosh Library were in storage, and were thus undamaged by the second fire²⁵.

Clandon Park

The fire at the National Trust property Clandon Park in Surrey, which occurred in April 2015, is one of the most serious recent fires that has occurred in a substantial and important (Grade I listed) heritage building. The insurance pay out as a result of this fire was reported to be the region of £65 million²⁶, with the large loss being cited as contributing to a reduction in Business Operating Profit and Combined Ratio by the insurer in the first half of 2015²⁷. A further pay out for a single painting worth £4.2 million which was lost in the fire was made by the UK government on an ex-gratia basis (subsequent to a claim under an indemnity scheme which insures works on loan to public venues being ruled invalid)²⁸. The estimated project cost for the forthcoming restoration is £30 million²⁹.

The probable cause of the fire was a fault in the electrical distribution board in the basement and subsequent fire spread was rapid, the fire moving up a vertical lift shaft, spreading to all the floors and into the roof space, with numerous voids and service penetrations likely contributing to the fire spread³⁰. The strong wind on the day drove the fire from one side of the roof to the other and it then burnt down to the floors below³¹. The fire gutted the interior of the building (with the exception of one ground floor room which

escaped almost intact); the roof and internal floors were lost and post-fire only the structural shell of the building remained, with the fire report noting that Clandon Park was 95% damaged by fire³².

The first step in planning is understanding what you've got

Significance

The exact nature of planning for a fire emergency depends on an assessment of what is most significant in heritage terms. The most important aspect might either be the historic fabric (the building); the artefacts within it (the contents, or collection), or in many cases both. A useful distinction can be drawn here between the potential impacts of a fire, since the methods of attempting to prevent such an impact are different. Whilst there is a possibility that historic artefacts might be able to be removed from a building during a fire, via salvage efforts, this possibility does not exist for the building itself. Indeed interior and exterior features of the actual fabric of the building, which may add a great deal to the significance of the historic asset, are potentially the most problematic to protect in the event of a fire occurring.

In certain situations it may be possible to protect specific parts of the building, for example an ornate ceiling, from the effects of fire, smoke and water. Such an operation, requiring the fire service to have detailed knowledge about the building, is referred to as 'damage control' and the London Fire Brigade consider this to be a key factor which should be fully considered³³. It has also been suggested that rooms which are of special value, or where artefacts can't be removed (or might be built into the room) should be given a priority code in fire and rescue service plans, such that this can be taken into account in firefighting operations³⁴.

In a fully developed fire, the most that can be hoped for might be to save the structural shell of the building. The key intervention here is in cooling the structure to prevent permanent damage or collapse due to heat and there is an implication here in terms of the weight of fire service response and availability of firefighting water (see below). At Clandon Park, although the interior was lost, it was possible to save the main structure of the building, though this outcome was in doubt during firefighting operations³⁵. Conversely, following the devastating 2018 fire at the Glasgow School of Art, the building was left in a perilous state and dangerous sections have had to be dismantled in a controlled manner³⁶. Saving the structural shell, in combination with suitable documentation, salvaged artefacts (included

those salvaged post-fire) and sufficient financial resources might allow for a building to be returned to a pre-fire state via repair and restoration, although of course replaced elements - roof, floors and plasterwork for example - will not be the original historic fabric and there is consequently the possibility of some loss of significance (this depending on the exact nature of the significance).

Resources

It is acknowledged that larger properties (for example Blenheim Palace in Oxfordshire, Castle Howard in North Yorkshire and Chatsworth in Derbyshire³⁷) and organisations responsible for a number of properties (for example English Heritage and the National Trust) are likely to have far greater financial and manpower resources able to be devoted to emergency planning for fire, when compared to an independent and perhaps smaller property. However, it is thought that skilful use of even limited resources can have a significant positive impact³⁸ and any improvements in emergency planning that can be made are beneficial. It is hopefully the case that the owner or manager with more modest resources available may be able to learn something from the level of preparedness achieved by larger organisations.

Organisations such as the National Trust and Historic Royal Palaces also have an advantage in being able to call on and share resources and expertise between sites in the event of an emergency. The National Trust also operates a 'buddy system', where for example two or more nearby properties might share a comprehensive set of salvage equipment (in addition to their own on-site salvage stores), which is easily transportable because it is kept in a towable trailer³⁹, thus at Clandon Park it was possible to summon additional resources from nearby Trust sites to help with salvage operations in the immediate aftermath of the fire. It is suggested that a similar form of 'buddy system', on a smaller scale, might be a useful idea also for smaller independent properties, such that they can assist each other in a fire, however it is recognised that these may currently operate independently without any contact with similar properties⁴⁰.

How to plan for a historic building fire

Context of planning

Emergency planning for fire needs to assume a 'worst case scenario' in order to make sure that all potential requirements have been addressed and suitable responses worked out. In this context the 'worst case' would be that a serious fire has developed in the building and

that as a result there are a lot of people on site, including a sizeable emergency services presence, and that it will be necessary to remove objects from the building. There is the potential for a lot of confusion and great care is needed in the planning process to ensure that this is reduced to a minimum. It is assumed that all persons have been evacuated from the building at an early stage.

It is stressed that in terms of the planning, the sequence is to identify and work out all the required procedures, whilst developing supporting documentation, and then train staff to carry these out. Practice exercises to test procedures should be carried out as well as table-top exercises to examine various scenarios⁴¹. Both may well reveal that changes are required and the planning process is very much an iterative one⁴².

Documentation of planning

It is suggested that two specific documents are required related to planning for an actual fire event. The first is a holistic document covering all aspects of planning, this being most likely prepared and maintained by the management of a property who are well versed in the operational and building details⁴³, and which can be referred to as the 'Emergency Plan'. This should be kept as a live document, with the likelihood that continual revision will be required. Examples of why this is the case would be the need to allow for special events or building work - both of which could require temporary changes in the plan. This stands alongside a comprehensive document called the Fire Safety Strategy, which details all fire safety systems and components, including information about detection and alarm systems, suppression systems, compartmentation and so on. In the event of a major incident it is likely that the fire service will need to consult this document. It is also recommended that a Fire Safety Logbook is kept, this being a day-to-day working document⁴⁴ and containing details of drills and training carried out, as well as records of all equipment inspections and maintenance, fire service liaison visits, fire incidents and so on.

The second specific document is an action document, called the 'Emergency Response Plan', which deals with just what will be done in the event of an actual fire and may consist of a number of removable sections. This has a more limited scope and is mostly concerned with incident management and salvage, having the aim of ensuring that salvage operations are undertaken safely and that damage and long term deterioration of the building and its contents are minimised. Historic England's website provides guidance on writing an Emergency Response Plan and provides a range of templates that can be used for doing so⁴⁵.

All relevant documentation should be available both in the building and remote from the building in a format which is readily accessible in all situations. It should be backed up securely and remotely in a digital format.

Organisational concerns

Any fire will be managed overall by the fire service once it has arrived on site, but from the perspective of the historic building it is important to establish a chain of command and to firmly establish who is in overall control, in the role of Emergency Response Manager (or Incident Coordinator), with a clear understanding established in planning that this person is in charge and that their authority to make decisions should be respected by all. There is the added complication that the fire service will monopolise this person in order to most efficiently fight the fire, and they are effectively removed from making a multitude of decisions which are very likely to be required. Such was the case in the fire at Clandon Park, and has been acknowledged as a factor to consider for future incidents⁴⁶. To represent the building therefore two persons should be available and able to make decisions, with the proviso that safeguards are made to avoid potential confusion as a result of this duplication. Larger organisations often have well-developed command structures with team leaders and members made up of staff, but this represents a challenge for a building with more limited resources and fewer staff.

It is strongly recommended that staff undergo continuous training⁴⁷ and that the mantra should be "practice, practice, practice"⁴⁸. Any tenants within the building, such as persons living in the property and other businesses operating from the premises, must be included in any training. At Clandon Park there was a delay in raising the alarm due to staff of the tenants in the building not knowing what to do when they discovered the fire and looking for a member of National Trust staff rather than raising the alarm directly⁴⁹. Persons on site temporarily, such as contractors and event personnel, must also have relevant fire training.

It is important to think about how communication is to be maintained during a fire. The use of short wave radios with back-up batteries is recommended. Possible disruption to IT systems should also be considered, since reliance is normally placed on these both for communication and access to information.

Another factor that must be taken account of is the mental welfare of staff, in what can be an extremely stressful and emotional situation. Indeed mental stress can have negative

impact on decision making and highlights the need to have a well-considered and rehearsed plan so that everyone knows what is expected of them. There is also a potential problem with staff who might be emotionally deeply invested in the building and its' contents and who might consequently take ill-judged risks in a dangerous situation. This needs to be recognised in the planning process and in a fire event, needs to be policed by persons of sufficient authority who are able to remain objective.

It is assumed the building will suitably insured and in the event of fire, one of the first calls should be to the insurance company. Prior discussions with the insurer as part of the planning process would be beneficial (and might in any case be required by the insurer as part of a wider fire risk assessment⁵⁰) and could prevent any potential delay in acting if approval might be needed from the insurer for a particular action.

Planning for the early stages of an incident

The three priorities

There are three priorities on discovering a fire - evacuating people from the building, raising the alarm and first-aid firefighting. Although life safety is paramount, if we appreciate that all three priorities really need to be carried out simultaneously then the need for good organisational planning is immediately apparent. Given that what happens in the very early stages is time-critical and may well govern the outcome of the fire in relation to the building and its contents, raising the alarm with the emergency services and attempting first-aid firefighting measures where appropriate need to be as fast and effective as possible. It should be stressed that all fires should be treated as serious, since both rapid fire spread and unseen fire spread are both common occurrences in historic building fires.

Evacuation

Given the importance of life safety, evacuation should in all cases be the first priority. Once the fire service arrive this will also be their first priority - aiming to confirm with the building management that the building has been evacuated and everyone is accounted for, with this involving an assessment of the accuracy of the information they are receiving. Obviously having a robust system in place for accounting for persons in the building will be a big advantage. The National Trust for example operates a system whereby room stewards are responsible for the room that they are in, moving everybody out and closing the door behind them, which means that the management can subsequently confirm that all areas are empty⁵¹. Chatsworth also carries out a systematic physical 'sweep' of the building to make sure that

everyone is out. If there is any doubt about the credibility of the information, or if anyone is reported missing, the fire service will enter the building and search.

Raising the alarm

Quick contact with the fire service to confirm the fact that there is a fire and thus trigger the dispatch of fire appliances is potentially problematic and needs careful consideration. The service will respond either if they have received a call from the property informing them of a fire, or if an alarm receiving centre has been able to confirm a fire. The former requires a reliable means of contacting the service and the latter has implications for unattended properties.

At Clandon Park, an unforeseen issue caused a delay in the attendance of the fire service. Because the fire involved the electrical distribution board, the power was switched off early in the fire and this disabled the telephone system. Unfortunately the mobile phone signal at the property was poor and the house manager was therefore delayed in contacting the fire service by trying to get a phone signal⁵² (the automatic alarm receiving centre was also unable to make contact to confirm the alarm⁵³).

Some larger buildings have a 24 hour presence on site and are able to respond to an alarm quickly at any time, many others are closed and unattended at night, and this could cause some delay in responding to an alarm. With a simple alarm system sending a signal to a remote alarm receiving centre for example, the first response might be to contact a key holder to attend site and confirm the situation. Many more modest historic buildings may not have this type of external alarm contact, and an important point for contemplation is what would happen if there were a fire while the building was unattended.

First-aid firefighting

Fighting a fire at an early stage might have a significant influence on the outcome, with early and successful first-aid firefighting fire potentially limiting fire growth and consequent spread, and preventing a much bigger fire developing. Outside help at this point should not be relied on, and instead as soon as the alarm is raised (and with good detection in place it can be hoped that this is soon after ignition) action should be taken. This presupposes having the correct equipment and well-trained staff (or owners/tenants/occupiers), on the premises to operate it.

For buildings in rural areas in particular, and there are many of these, it is reasonable to assume that the fire service response might be slower, given the likely distance from a fire

station (often staffed by on-call firefighters), quality of roads and influence of weather on road conditions. Therefore in this situation the emphasis should be on self-sufficiency and attempting first-aid firefighting measures where appropriate assumes a greater importance. Standard advice is that staff should only attempt to fight a fire if they are trained to do so, if the fire is small enough that their intervention is worthwhile and most importantly, if it safe to do so. In response to its location, and at least a 20 minute wait before any response arrives, Chatsworth has a well-established fire team, which has been trained in firefighting techniques and dynamic risk assessment⁵⁴.

Planning ahead

Fire and rescue service considerations

The importance of involving the fire service in emergency planning for fire, with the aim of minimising the impact should a fire occur, is widely acknowledged⁵⁵ and establishing and maintaining a good working relationship with the fire service should be a key priority.

Furthermore, the effectiveness of a fire service intervention is better if firefighters have a good level of familiarity with the building⁵⁶ and indeed, the more that firefighters know about a building, the greater the chances of that building being saved⁵⁷. Thus in addition to consultation with fire protection officers about a range of issues (most likely related to life safety), it is essential that firefighters are invited to the building for orientation visits and to take part in emergency drills or exercises (both will also enable fire commanders to make informed judgments about risk levels to fire crew carrying out firefighting and salvage operations). These are discrete events; the former involving firefighters learning about the building and its layout and contents, perhaps walking through the building with a manager; the latter being a simulation of the response to an actual fire event.

It is also important that crews working on different shifts from all fire stations likely to be involved in responding to a fire are involved in any such visits. However it should be recognised that any carefully nurtured local relationship could potentially be jeopardised by local crews being occupied with another incident and crews arriving from further afield, and this emphasises the need to have a competent manager on site, or on call and able to arrive quickly, and a clear and detailed fire plan available to attending crews.

The responsibility for establishing and maintaining such a relationship necessarily sits with the historic building, since because of the breadth of the fire service remit, combined with limitations in resources, it is unlikely that the fire service will be always proactive

towards heritage. This position may change when there are life safety issues, but in this case the main focus of the fire service will be life risk rather than heritage concerns. There is also the issue of operational risk, and again, fire services may be more proactive in cases where this is high, though again the focus is likely to be quite specific.

Distinct from concerns about salvage of artefacts from the building (detailed below) there are a number of issues that should be addressed in collaboration with the fire service.

Access for fire appliances

Access for fire appliances must be taken into account in pre-incident planning. There was a serious fire at Wardington Manor in Oxfordshire (Grade II* listed) in 2004 and no prior discussions had taken place with the fire service. An aerial platform appliance needed to fight the fire was unable to get past a protected tree and a "traffic jam of fire engines" developed due to the narrowness of the country lane outside the property⁵⁸. Conversely, at Haddon Hall in Derbyshire (Grade I listed) where there is a proactive approach to engaging with the local fire service, possible access issues for larger fire appliances have been assessed with the use of a practical exercise and are detailed on the mobile data terminal on attending vehicles⁵⁹.

A further consideration is hardstanding for fire appliances whilst conducting firefighting operations. Simply put, fire appliances are heavy (the lightest being 12 tonnes) and will sink into the ground if not on a suitable hardstanding. Fire services are able to pump water for some distance if required, though this is slower to set up and less efficient in use; and so planning might include the installation of suitably located hardstanding, which can be disguised if necessary.

Water supplies

The importance of a good supply of firefighting water is to be stressed. A suitably robust supply could have a decisive impact in terms of putting the fire out; allowing salvage operations to take place and ultimately saving the building. Supply of water needs to be discussed in detail with the fire service and contingency made for the possibility of a large fire, since experience has shown that these are not always preventable and represent the situation where the greatest demands are made on water supplies. In such a situation, even where mains water is available via hydrants, water flow and pressure may be insufficient. The problem is compounded in rural locations, where in around 30% of historic building fires there has been a shortage of available water⁶⁰. Here access to mains water may be limited or

lacking altogether and, although having good-sized rivers or lakes nearby may get round this issue, a property may be remote from such supplies.

During the fire at Uppark House there were considerable problems with the supply of firefighting water since Uppark is on top of a hill and remote from rivers. On-site water supplies were quickly exhausted and hose was laid to the water main in the nearby village (some 100 metres lower), which was unable to sustain the demands being made upon it and collapsed within minutes⁶¹. Water was subsequently fetched from a larger main a few miles away (using fire tenders and 5,000 gallon water carriers working a shuttle system) and water was pumped from a private fishing lake near the village and later from another private tank. That further supplies of water were found was largely down to the efforts made by the fire service in searching for possible sources of water, however during the course of the firefighting operation valuable time was lost⁶². Following the fire and subsequent restoration of Uppark, an emergency water pond has been dug, screened by trees but close to the house and with a capacity of 250,000 gallons. This is not the only case where the solution adopted has been to provide for water storage nearby: at Brodsworth Hall in South Yorkshire (Grade I listed) for example a new water tank has been installed under the car park to provide better access to firefighting water⁶³.

There were also problems with the supply of firefighting water during the fire at Clandon Park. Mains pressure was unable to keep up with the demand and additional water supplies were pumped from a lake 1.4km away and also brought in by four water tankers. However, firefighters complained in post-incident reports that they were hampered by lack of water while fighting the fire, with the additional water supplies becoming available too slowly⁶⁴. Surrey Fire and Rescue Service however have made the point that better water supplies would have been unlikely to alter the outcome of the fire due to the rapid fire spread and the complex building structure⁶⁵.

In some rural locations lack of accessible water has been recognised and a number of country houses have historically been provided with fire ponds. An example is Hardwick Hall in Derbyshire (Grade I listed), which is in an upland position and which has both a fire pond and an underground tank, the former being installed in the early 1900s when there were concerns about the militant tactics being employed by the suffragettes, which included arson⁶⁶. They have a joint capacity of 286,000 litres⁶⁷. This is a very good example of effective interaction with the fire service, since the reason that this figure is known is due to both having been deliberately drained during exercises to measure the capacities. The fire

service is thus able to calculate exactly how long water supplies will last in a big fire and plan for additional supplies if the situation demands (via water tankers, or high volume pumps set into more distant ponds).

The fire service is generally very resourceful in obtaining water, but the key point is that this takes time and could result in a crucial delay. Careful planning, which should include a strategy for potentially providing a high volume of water, means that such a delay can be avoided.

Operational risk

Fighting fires in historic buildings represent challenging conditions, with increased hazards and elevated risk levels for fire service personnel. There is an important distinction here between life safety and property protection and once all persons are safely accounted for, the exact nature of firefighting operations and whether or not salvage operations can take place is the decision of the fire service and depends on dynamic risk assessment by incident commanders.

For more complex buildings, it is likely that considerable information about the building will be required by the fire service and although, in buildings classified as high operational risk, some information will be provided on attending appliances, more detailed information will generally need to be available on arrival at a suitable location. This may be close to the fire alarm panel⁶⁸, and should normally include layout plans, circulation routes and details of particular hazards within the building. The fire alarm panel may itself be duplicated in a nearby building, so that if it wasn't possible to access that in the main building, information would still be available.

Planning for salvage

Salvage operations

The term 'salvage' as used here denotes the removal of artefacts from a building. To make the salvage operation as effective as possible a good understanding of the layout of the building is required in combination with careful planning, training and practice. In a number of fires in heritage buildings it has been possible to carry out salvage operations during the fire, often with a significant proportion of important artefacts being saved as a result.

During the fire at Hampton Court the Palace salvage squad was able to carry to safety all the irreplaceable paintings, furniture, ceramics and tapestries from the State Apartments

and only one painting was lost⁶⁹, demonstrating the value of having a discrete and well-trained salvage team.

At Uppark House a salvage exercise with the involvement of West Sussex Fire and Rescue Service had been carried out several weeks before the fire. As a result, successful salvage operations were carried out on the day of the fire, continuing for several hours despite challenging conditions and 95% of the basement and ground floor contents were saved⁷⁰. Unfortunately a decision was made early in the fire to move some valuable pictures from one end of the first floor to the other and subsequent fire spread meant that this became inaccessible to further salvage and the paintings were lost to the fire⁷¹. Thus in removing items, it is important that they are moved to a place clear of the potential effects of fire.

In the Windsor Castle fire there was a massive salvage operation which involved far more personnel, including removal companies and the army, than were initially planned for. This was due to the large scale of the fire and the perceived danger to artefacts within adjacent areas⁷². Staff training which had taken place on actions to be taken in the event of a fire contributed to the salvage of priceless works of art and pieces of furniture and in fact the salvage effort succeeded in saving almost all of the movable contents⁷³.

At Clendon Park there was a detailed salvage plan and staff had carried out salvage training just 6 weeks before the fire⁷⁴. This contributed to a significant number of valuable items being saved from the fire including paintings, silver and furniture, with a total of more than 400 items being rescued⁷⁵. The fire service made a firefighting retreat through the building, containing the fire using phased firefighting operations so that salvage operations could be carried out⁷⁶. In fact, when the fire is not going to be put out quickly, holding the fire back to allow salvage operations is an important tactic, but depends on having sufficient prior knowledge of the building. In the 2014 Glasgow School of Art fire, a fire-break was made in the centre of the building and, although one of the rooms with valuable contents was lost to the fire (the Mackintosh Library), fire crews were able to carry out effective salvage operations behind the fire-break, resulting in around 70% of the items inside being recovered⁷⁷.

Although it is a sensible suggestion that salvage planning should be for the worst case scenario and the removal of all objects⁷⁸, this is not always practicable in a fire when there may actually be only limited opportunities for removing artefacts, and so it is important to prioritize what are the most important items to target. A 4-tier hierarchical system has been

suggested⁷⁹ however in practice a simpler system may be adopted which includes only the really important items⁸⁰.

The salvage operation during a fire will very likely be carried out by the fire service but if the risk is judged to be low enough trained salvage staff from the building may be allowed to be involved where joint exercises have been carried out previously and personal protective equipment is suitable for the conditions⁸¹.

If the circumstances allow for and require the removal of all items of a large collection, the amount of personnel required should not be underestimated, with the possibility that a 'human chain' might be required to move objects. In some fires ad-hoc summoning of additional help - the army at Windsor Castle and local villagers at Wardington Manor for example - has worked well, but this is clearly not the ideal scenario and is best considered in advance.

Many buildings contain artefacts which are financially valuable. With all the activity during salvage operations and subsequently, there is the possibility of theft and therefore security must be considered and the site secured. Prior discussion with the local police force would be beneficial in this respect. During the fire at Clandon Park a perimeter was established and the police controlled entry and exit to the site⁸².

Salvage information and equipment

The first stage of planning for salvage is to identify and record what is in the building which is valuable, both in heritage and financial terms, and merits removal in a fire emergency. It is worth pointing out that an artefact may have inherent heritage value, for example where it is associated with the building, perhaps without any corresponding financial value⁸³.

Once this cataloguing and ranking has been carried out, it is necessary to document each item. Templates are available for doing this, for example those provided by Historic England⁸⁴, and the ideal output are laminated sheets, available in packs to salvage teams. These are sometimes referred to as 'snatch lists'.

Details required are:

- priority level of item;

- a basic description and a photograph of the item - the description should be generic: 'the large picture on the wall opposite the door' being far more useful than 'the portrait of the 5th Earl' for example⁸⁵;
- a plan of the room showing where the item is located and
- details for removing the item - for example tools required (if any), dismantling, removing from a wall, handling, number of persons required.

It is also really important that records of what is actually within a room are kept up to date, otherwise valuable time could be wasted looking for something that isn't actually there, having been lent to an exhibition or sent away for restoration for example, and it is for this reason (as well as for security for high value artefacts) that this information is not available to attending crews⁸⁶. It should however be available to them on arrival. The system mentioned above, with packs of laminated sheets, makes it easy to manage information about what is in-situ by adding or removing sheets as necessary.

Everything should be done to make sure that artefacts are as easy to remove as possible in a fire. An example might be tapestries which are attached to their wall fixings with Velcro and can be literally torn from the wall if required. The distinction should also be made between artefacts that can be removed and those which due to their size and weight can't be moved and require to be protected in-situ. This is obviously not ideal in the event of a serious fire but nevertheless should be included in the planning process. One solution would be to have protective sheets stored nearby to cover such items.

It is worthwhile to prepare all the equipment that may be needed to help with salvage and to keep it together in one place, this being preferably not in the main building in case access to it is compromised by an advancing fire. This might range from a storage room in an ancillary building to a dedicated trailer, as mentioned above, which can easily be towed around a large site, or even to another site.

Artefacts removed from danger from fire

Thought needs to be given to what will happen to items once they have been removed from danger. This is an important planning concern; the worst case scenario would be undamaged but sensitive and delicate items removed from a building which is on fire only to be damaged by a cloudburst. Early salvage efforts at Uppark House resulted in historic furniture, books and porcelain being 'piled up on the grass'⁸⁷ and at Windsor Castle highly valuable paintings including Canalettos, Zoffanys, Zuccarellis and Gainsboroughs 'all came

rolling on to the Quadrangle lawn⁸⁸. The latter account goes on to comment on the great luck that it was a dry day. It is suggested therefore that a suitable quantity of quickly erected temporary storage such as tents or marquees is available as part of the salvage equipment, or quickly available and planned for. At Clandon Park emergency shelters were erected on the lawns to protect contents as they were taken out from the house.

Subsequent removal of artefacts from the site will likely be necessary both for conservation reasons and for security, and a pre-planned destination for such objects should be established. At Uppark the nearby Petworth House was used to store salvaged artefacts⁸⁹ and at Clandon the local primary school was initially used⁹⁰. A careful inventory of everything being removed from site and its destination will need to be made and the use of removals companies trusted to handle delicate items may be required and again this should be explored in planning.

Planning for the aftermath of the fire

Depending on the nature of the building and the fire, a fire event could last for a considerable time, is by no means over from an organisational point of view once the fire is extinguished and must be taken into account in planning. Although every fire is different, and to some extent measures employed post-fire might require some level of ad-hoc decision making, relatively simple planning can be employed to make the process smoother. For the immediate aftermath, when there will still be a lot to do, the management must plan for the need to rest and replace staff, as well as for welfare facilities.

Past experience, for example at Clandon Park, has shown that media interest can be intrusive and difficult to handle. It is therefore recommended that a media-trained spokesperson deals with the media and makes all comments⁹¹, and this practice has been adopted following the 2018 Glasgow School of Art fire.

Prior thought should be given to draining firefighting water, which could need pumping out of basements for example. Hazard management may also be required, perhaps to deal with toxic substances. Many historic buildings have lead roofs which are likely to melt in a serious fire, contaminating runoff firefighting water and debris (which might later be subject to post-fire or archaeological salvage). Asbestos may also have been exposed and disturbed by the fire.

Beyond the fire event there is the larger issue of business continuity and this should be part of wider operational planning.

Conclusion

The pervading theme of this article is that emergency planning for fire offers significant advantages in the event of an actual fire, and offers the possibility firstly that the fire might be extinguished at an early stage via first-aid firefighting and, should a serious fire develop, that the fire might be contained whilst effective salvage operations are carried out, and finally that in the absolute worst case scenario that the building might be saved.

The planning for an actual fire event should be accepted as a necessity, included as a component of a holistic approach to fire safety and undertaken as a key priority by all historic buildings. Whilst it is clear that the ideal is to prevent the outbreak of fire, and in fact a fire occurring represents a failure of preventative measures, it should be recognised that a fire is a possibility and must be planned for. This recognition is the first step providing impetus to reducing the impact of a fire on a building and its contents. Where circumstances allow the possibility to do so, the potential for fire spread should be limited with effective compartmentation and the use of fire suppression; this in tandem with emergency planning gives the building and its contents the best chances for survival if a fire breaks out.

A number of key requirements have been identified and of these perhaps the most important is to establish and maintain a good relationship with the fire service, who should be involved in all aspects of planning for fire. Furthermore, an emergency response to fire is an iterative process that only becomes smooth and efficient by gradually perfecting all aspects of it with regularly repeated joint training exercises. The training of staff in evacuation measures and effective first-aid firefighting is also very important, the latter particularly in respect of the outcome for the building and its contents since outside help should not be relied on and early-stage intervention in fighting a fire can have a significant positive impact. With potentially difficult conditions and limited time, careful planning of salvage operations has been shown to be effective in past fires. Well-presented information, which clearly identifies priority artefacts and how to handle them is required, as well as a plan for what to do with such items once they are clear of the building.

Fire safety management is central in the planning of an emergency response to fire in a historic building and the effectiveness of such planning depends on having suitable and adequate resources available. This notwithstanding, planning for fire is of such importance and there is sufficient information and advice readily available that, even with limited resources, it is an area that shouldn't be overlooked by those responsible for any scale or type

of historic building. Furthermore, using the experience of large organisations perhaps on a smaller and more local scale, the possibility of sharing information and resources should be explored wherever it might offer an advantage.

Despite the best planning that can be achieved, there will always be some level of ad-hoc decision making required at a fire. Having suitably experienced persons, well versed in the essence of the planning process, in charge and able to think quickly, clearly and objectively underlines the need to appoint high-quality managers.

¹ Maxwell 2015, 5.

² *ibid.*

³ Figures for 2015; Oxford Economics 2016.

⁴ Daniels & Dodd 2015.

⁵ Crowdy 2017.

⁶ Antena 3, 2018.

⁷ New York Times 1986.

⁸ Grade I and II* listed buildings are of 'exceptional interest' and 'particularly important buildings of more than special interest' respectively (Historic England 2018a). Significant heritage assets sometimes carry a dual protection as listed buildings and as scheduled monuments, with the latter having a wider scope and carrying precedence.

⁹ 'grace and favour' denotes accommodation occupied free or at a low rent by permission of a sovereign or government.

¹⁰ HC Deb 1986 (House of Commons).

¹¹ *ibid.*

¹² Fishlock 1992.

¹³ *ibid.*

¹⁴ Historic England 2018b.

¹⁵ Nicholson 1990.

¹⁶ Rowell and Robinson, 1996.

¹⁷ West Sussex Fire Brigade, 1989.

¹⁸ Nicholson 1997.

¹⁹ The History Press 2018.

²⁰ Bailey, Insall & Kilshaw, 1993.

²¹ Crowdy 2017.

²² ICON 2016.

²³ Guardian 2014.

²⁴ Grade A listing in Scotland is equivalent to Grade I listing in England and Wales (Northern Ireland has a separate system). Both represent the highest category of listing in their respective systems.

²⁵ Guardian 2018.

²⁶ Insurance Times 2015.

²⁷ Zurich 2015.

²⁸ Department for Culture, Media and Sport 2016, 120 and 2017, 137.

²⁹ Malcolm Reading Consultants 2017.

³⁰ Strudwick 2015.

³¹ National Trust 2015.

³² Strudwick 2015.

³³ London Fire Brigade 2015.

³⁴ Derbyshire Fire and Rescue Service 2015.

³⁵ Owen-Hughes 2017.

³⁶ Construction Manager 2018.

³⁷ These are examples of a group of 10 substantial properties making up 'The Treasure Houses of England' (treasurehouses.co.uk) which are marketed as a "collection of 10 of the greatest houses in England" and all of which contain extensive collections. All are Grade I listed and Blenheim is also a World Heritage Site.

³⁸ Coull 2016.

³⁹ Murray 2018.

⁴⁰ Parker 2018.

⁴¹ Axon 2018, Crowdy 2018.

⁴² Axon 2018, Ridgway 2018.

⁴³ Maxwell 2007a.

⁴⁴ Kippes 2007.

⁴⁵ Historic England 2018c.

⁴⁶ Clowes 2017.

⁴⁷ Maxwell 2015.

⁴⁸ Axon 2018.

⁴⁹ Murray 2018.

⁵⁰ Emery 2018.

⁵¹ Abram 2018.

⁵² Clowes 2017.

⁵³ Emery 2018.

⁵⁴ Axon 2018.

⁵⁵ Bailey, Insall, and Kilshaw 1993, Kippes 2007, Kidd 2010, Coull 2014.

⁵⁶ CFPA-E 2013.

⁵⁷ Maxwell 2015.

⁵⁸ Emery 2008.

⁵⁹ Derbyshire Fire and Rescue Service, 2018.

⁶⁰ Kidd 2008.

⁶¹ Nicolson, 1990.

⁶² Rowell and Robinson, 1996.

⁶³ Emery 2018.

⁶⁴ Get Surrey 2016a.

⁶⁵ Get Surrey 2016b, Owen-Hughes 2017.

⁶⁶ Riddell 2018.

⁶⁷ Bramley 2018.

⁶⁸ Coull 2014.

⁶⁹ Fishlock 1992.

⁷⁰ Kidd 1995.

⁷¹ Rowell and Robinson, 1996.

⁷² Nicolson 1997.

⁷³ Bailey 1993.

⁷⁴ Emery 2018

⁷⁵ National Trust 2016.

⁷⁶ Owen-Hughes 2017.

⁷⁷ Scottish Fire and Rescue Service 2014 & 2015.

⁷⁸ London Fire Brigade 2015.

⁷⁹ Coull 2008.

⁸⁰ Emery 2018.

⁸¹ Dadson 2012.

⁸² Murray 2018.

⁸³ Abram 2018.

⁸⁴ Historic England 2018c.

⁸⁵ Murray 2018.

⁸⁶ Abram 2018.

⁸⁷ Rowell and Robinson 1996, 16.

⁸⁸ Nicholson 1997, 17.

⁸⁹ Rowell and Robinson, 1996.

⁹⁰ Murray 2018.

Bibliography

Abram, M. (National Fire and Rescue Service Heritage Coordinator, Cheshire Fire and Rescue Service). *Heritage Protection planning*. Interview with the author, 20 February, 2018. Personal communication.

Antena 3. *Incendiu devastator în Oradea. Câteva turnuri ale Episcopiei s-au prăbușit*. Published August 25, 2018. Accessed September 20, 2018.

<https://www.antena3.ro/actualitate/incendiu-devastator-in-oradea-cateva-turnuri-ale-episcopiei-s-au-prabusit-483994.html>

Axon, R. (Head of Operations, Chatsworth House Trust) *Emergency Planning at Chatsworth*. Interview with the author, 29, June 2018. Personal communication.

Bailey, A., D. Insall, and P. Kilshaw. *Fire Protection Measures for the Royal Palaces*. London: HMSO, 1993.

Bramley J. (Watch Manager Bolsover fire station, Derbyshire Fire and Rescue Service). *Heritage protection planning*. Interview with the author, 11 June, 2018. Personal communication.

CFPA-E (Confederation of Fire Protection Associations in Europe). *CFPA-E Guideline No 30:2013 F: Managing fire safety in historical buildings*. 2013. Accessed May 25, 2018. http://cfpa-e.eu/wp-content/uploads/files/guidelines/CFPA_E_Guideline_No_30_2013_F.pdf

Clowes, G. (Head of Operational Risk, National Trust). *Presentation to Heritage Fire Safety Event: Derbyshire Fire and Rescue Service and National Trust, Hardwick Hall, 4 April 2017*. Personal communication.

Construction Manager. *Mackintosh building to be rebuilt within four to seven years*. Published 17 September, 2018. Accessed September 18, 2018. <http://www.constructionmanagermagazine.com/news/mackintosh-building-be-rebuilt-within-four-seven-y/>

Coull, M. "Damage Limitation Planning and Implementation". 2008. Edited by I. Maxwell , 222-224. 2008b.

Coull, M. *Fire Risk Management in Heritage Properties Handbook*. Moreton in Marsh: Fire Protection Association, 2014.

Coull M. *Heritage Protection*. 2016. Accessed June 28, 2018.

<http://www.heritagefireandsafety.co.uk/heritage-protection.html>

Crowdy T. (Fire and Emergency Planning Adviser, Historic Royal Palaces) *Fire safety in Historic Royal Palaces*. Interview with the author, 20 February, 2017. Personal communication.

Crowdy T. (Fire and Emergency Planning Adviser, Historic Royal Palaces) *Emergency Planning in Historic Royal Palaces*. Telephone interview with the author, 29 June 2018. Personal communication.

Dadson E. *Emergency Planning and Response for Libraries, Archives and Museums*. London, Facet Publishing, 2012.

Daniels M. and Dodd K. *Managing Visitor Safety in the Historic Built Environment: principles and practice*. London, Visitor Safety in the Countryside Group, 2015.

Department for Culture, Media and Sport. *Annual Report and Accounts For the year ended 31 March 2016*. Accessed June 18, 2018.

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/538369/DCMS Annual Report and Accounts 2015-16_Web_Optimised_Version_.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/538369/DCMS_Annual_Report_and_Accounts_2015-16_Web_Optimised_Version_.pdf)

Department for Culture, Media and Sport. *Annual Report and Accounts For the year ended 31 March 2017*. Accessed June 18, 2018.

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/631336/DCMS Annual Report and Accounts 2016 to 2017 - web_optimised_version.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/631336/DCMS_Annual_Report_and_Accounts_2016_to_2017_-_web_optimised_version.pdf)

Derbyshire Fire and Rescue Service. *Operational Incident Plan: Haddon Hall*. 2018. Unpublished.

Derbyshire Fire and Rescue Service. *Heritage Premises: Fire Safety Guidance*. 2015.

Accessed June 2, 2018. http://www.derbyshire.gov.uk/files/3714/6287/3511/DFRS_Heritage_Fire_Safety_Guidance_v2.pdf

Emery S. "Wardington Manor, Oxfordshire, England". 2008. Edited by I. Maxwell , 75-76. 2008b.

Emery S. (Oxford University Fire Officer). *Emergency Planning for Fire in Heritage*.

Interview with the author, 28 June 2018. Personal communication.

Fishlock M. *The Great Fire at Hampton Court*. London, The Herbert Press, 1992.

Get Surrey. *Clandon Park fire: Firefighters' criticism of 'water delays' revealed in frank post-fire review*. 2016a. Published January 15, 2016. Accessed May 12, 2018.

<https://www.getsurrey.co.uk/news/surrey-news/clandon-park-fire-firefighters-criticism-10735701>

Get Surrey. *Clandon Park fire: Historic building 'was always going to burn down' - fire chief*.

2016b. Published January 15, 2016. Accessed May 11, 2018.

<https://www.getsurrey.co.uk/news/surrey-news/clandon-park-fire-historic-building-10736043>

Historic England. *Listed Buildings*. 2018a. Accessed June 5, 2018.

<https://historicengland.org.uk/listing/what-is-designation/listed-buildings/>

Historic England. *Uppark (National Trust): List Entry Summary*. 2018b. Accessed May 18,

2018. <https://historicengland.org.uk/listing/the-list/list-entry/1025979>

Historic England. *Writing an Emergency Response Plan*. 2018c. Accessed June 4, 2018.

<https://historicengland.org.uk/advice/technical-advice/emergency-and-fire/response-plans/>

House Of Commons. 3 July Debate (vol 100 cc592-3W). 1986. Accessed March 12, 2018.

<https://api.parliament.uk/historic-hansard/written-answers/1986/jul/03/hampton-court-palace-fire>

ICON (The Institute of Conservation) *Remains of the day: the Glasgow School of Art fire two years on*. Published May 17, 2016. Accessed March 12, 2018.

<https://icon.org.uk/news/remains-day-glasgow-school-art-fire-two-years>

Insurance Times . *Zurich's Clandon Park fire seen costing £65m*. 2015. Accessed May 25, 2018. <https://www.insurancetimes.co.uk/zurichs-clandon-park-fire-seen-costing-65m/1416507.article>

Kidd S. *Heritage Under Fire, A guide to the protection of historic buildings*. 2nd ed., London, The Fire Protection Association, 1995.

Kidd S. "Water in fire protection of historic buildings". 2008. Edited by I. Maxwell, 122-130. 2008a.

Kidd S. *Guide for practitioners 7: Fire safety management in traditional buildings: Part 2*. Edinburgh, Historic Scotland, 2010.

Kippes W. "Working Group 4: Property Management Strategies, Introduction". 2007. Edited by I. Maxwell, 260-274. 2007b.

London Fire Brigade. *Fire safety guidance note: Heritage and Buildings of Special Interest (GN80)*. 2015. Accessed June 26, 2018. <http://docplayer.net/23972182-Fire-safety-guidance-note-heritage-and-buildings-of-special-interest.html>

Malcolm Reading Consultants. *Clandon Park International Design Competition: Search Statement*. 2017. Accessed June 8, 2018. <https://competitions.malcolmreading.co.uk/clandonpark/downloads>

Maxwell I. ed. *COST Action C17 Built Heritage: Fire Loss to Historic Buildings: Executive Summary of Recommendations*. Edinburgh, Historic Scotland, 2007a.

Maxwell I. ed. *COST Action C17 Built Heritage: Fire Loss to Historic Buildings: Final Report Part 1*. Edinburgh, Historic Scotland, 2007b.

Maxwell I. ed. *COST Action C17 Built Heritage: Fire Loss to Historic Buildings: Conference Proceedings, Part 1*. Edinburgh, Historic Scotland, 2008a.

Maxwell I. ed. *COST Action C17 Built Heritage: Fire Loss to Historic Buildings: Conference Proceedings, Part 3*. Edinburgh, Historic Scotland, 2008b.

Maxwell I. *Fire and Flood in the Built Environment: Keeping the Threat at Bay. Part 1: Fire. A COTAC Report, July 2015*. Accessed June 5, 2018. <http://cotac.global/resources/BIM4C+Disaster-Fire-Pt1.pdf>

Murray C. (Preventive Conservation Adviser, National Trust). *Emergency planning for fire at the National Trust*. Interview with the author, 16 March 2018. Personal communication.

National Trust. *A new life for Clandon*. 2016. Accessed May 18, 2018.

<https://www.nationaltrust.org.uk/news/a-new-life-for-clandon>

Nicolson A., The National Trust. *The fire at Uppark*. London, Toucan Books Limited, 1990.

Nicolson A. *Restoration: The Rebuilding of Windsor Castle*. London, Michael Joseph Ltd, 1997.

Owen-Hughes S. (Assistant Chief Fire Officer, Surrey Fire and Rescue Service; Incident Commander after 6pm at Clandon Park fire). *Fire safety in historic buildings*. Interview with the author, 26 May 2017. Personal communication.

Oxford Economics. *The impact of heritage tourism for the UK economy, August 2016*. Accessed June 2, 2018. <https://www.oxfordeconomics.com/recent-releases/the-impact-of-heritage-tourism-for-the-uk-economy>

Parker R. (Technical Adviser, Historic Houses). *Emergency planning for fire*. Interview with the author, 25 June 2018. Personal communication.

Pearce P. "After Uppark Burned Down: Reflections". *West Dean School of Conservation blog: miscellany*. 2013. Accessed June 8, 2018. <https://www.westdean.org.uk/study/school-of-conservation/blog/miscellany/after-uppark-burned-down-reflections>

Riddell F. *British Library: Votes for Women; Suffragettes, violence and militancy*. 2018. Accessed June 17, 2018. <https://www.bl.uk/votes-for-women/articles/suffragettes-violence-and-militancy>

Ridgway C. (Curator, Castle Howard) (2018). *Salvage exercises*. Telephone conversation with the author, 21st June 2018.

Rowell C. and Robinson JM. *Uppark Restored*. London, National Trust Enterprises Ltd, 1996.

Scottish Fire and Rescue Service. *Update: Incident at the Mackintosh building in Glasgow*. 2014. Accessed June 3, 2018. <http://www.firescotland.gov.uk/news->

[campaigns/news/2014/05/update-incident-at-the-mackintosh-building-in-glasgow.aspx](https://www.glasgowfire.co.uk/campaigns/news/2014/05/update-incident-at-the-mackintosh-building-in-glasgow.aspx)

Scottish Fire and Rescue Service. *Glasgow School of Art Fire, a Case Study by SFRS*. [Video file]. 2015. Accessed June 3, 2018. <https://www.youtube.com/watch?v=O8bjOmqIlds>

Strudwick, B. *Report of Fire, Incident No: 007905/2015, Address: Clandon Park, The Street, West Clandon. Surrey Fire and Rescue Service/South East Fire Investigation Group*. 2015. Accessed May 31, 2017. <https://www.surreycc.gov.uk/people-and-community/surrey-fire-and-rescue/surrey-fire-and-rescue-services-fire-investigation-report-clandon-park>

The Guardian. *Glasgow School of Art fire caused by gases from foam canister, says report*. Published November 26, 2014. Accessed May 15, 2018. <https://www.theguardian.com/education/2014/nov/26/glasgow-school-of-art-fire-foam-canister-report>

The Guardian. *Glasgow School of Art: sprinklers had not been fitted after first fire*. Published June 17, 2018. Accessed May 22, 2018. <https://www.theguardian.com/education/2018/jun/17/glasgow-school-of-art-fire-rennie-mackintosh-sprinklers>

The History Press. *The Windsor Castle fire: 25 facts*. 2018. Accessed April 22, 2018. <https://www.thehistorypress.co.uk/articles/the-windsor-castle-fire-25-facts/>

The New York Times. *Henry VIII Palace damaged in blaze*. Archives no date, 1986. Accessed February 25, 2018 <https://www.nytimes.com/1986/04/01/world/henry-viii-palace-damaged-in-blaze.html>

West Sussex Fire Brigade. *Fire Investigation Report, Call No. 010606; Uppark House, The B2146 Road, South Harting, West Sussex*. 1989. Obtained in June 2017 from West Sussex Record Office, County Hall, Chichester, West Sussex PO19 1RN.

Zurich. *Zurich UK half year results 2015: August 6, 2015*. 2015. Accessed June 5, 2018. <https://www.zurich.co.uk/en/about-us/media-centre/company-news/2015/zurich-uk-half-year-results-2015>
