COST ACTION C17: "BUILT HERITAGE: FIRE LOSS TO HISTORIC BUILDINGS – THE CHALLENGE BEFORE US"

INGVAL MAXWELL, DA(Dun) RIBA FRIAS AABC FSAScot

Director, Technical Conservation, Research and Education Group,
Historic Scotland,
Longmore House,
Salisbury Place,
Edinburgh, EH9 1SH,
Scotland
Telephone +44 (0)131 668 6819
Fax +44 (0)131 668 8620
e-mail : Ingval.Maxwell@scotland.gsi.gov.uk

ABSTRACT

The current high level of loss of historic buildings to the effects of fire is a cause for significant 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 best follow the principle of minimum intervention. Schemes should be specifically tailored for each buildings need, taking into account its importance, function, character, construction, finishes and detail.

Historic buildings are a finite resource, and their loss to the effects of fire is an issue of international importance. The intention of "COST Action C17: Built Heritage: Fire Loss to Historic Buildings" is to investigate the consequences of the significant physical cultural loss of Europe's built heritage to the damaging effects of fire. Initiated in December 2002 this four-year programme will be achieved in a multi-disciplinary, multi-national manner through the collaboration and integration of a variety of related projects and partnership country interests. It will also build upon the range of current research initiatives, and recently published associated material. The outcomes will be the promotion of data and information on methodologies and management systems. This will assist a wide range of end-users balance fire engineering needs with conservation requirements in the future preservation of European patrimony.

Keywords

COST; Fire loss; Historic Buildings.

THE HISTORIC PERSPECTIVE

Historically, fire fighting has been a feature of architects' thinking since the mid-18th Century. Ornamental ponds that served as landscape features provided fire fighting water supplies near mansion houses, and various devices were contrived to effect escape from buildings in an emergency. But essentially primitive ladders, hoses and pumps, sand buckets, and water bucket chains were relied upon to control any fire that broke out. The alternative was to let the fire burn itself out, leading to the loss of building and contents.

Whilst modern fire protection installations can readily be designed to be technically efficient, there is a tendency for many systems to be less than sympathetic in their appearance following installation in a sensitive historic building interior. This is largely because the engineering design profession and manufacturers do not think laterally about the conservation issues that are involved. As result suppliers tend to offer limited options in the choice of available equipment. Equally, architects and designers do not fully understand the complexities and sensitivities of the issues involved and, in consequence, the internal appearance of important buildings frequently suffers as a result of insensitive detailing.

Although retrofit detection schemes are considered and implemented, more often than not, a holistic approach is left unresolved - with the building being offered little or no suppression protection. To be more effective, the need is for owner, architect, engineer, contractor and supplier to be more in tune with the degree of risk, and the physical and aesthetic attributes of what needs to be protected. All professional interests must learn to work towards achieving a better balance in the final results and this ideal is behind the COST C17 project.

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 illustrated the special dangers of fire in historic buildings and towns and showed what measures were appropriate for dealing with them. It specifically targeted building 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, also provided valuable information to those responsible for implementing measures to counteract the effects of fire. Through a dramatic series of case studies, the publication brought into a sharp visual perspective the impact of heritage fire loss. Whilst at the time this document was an essential reference work, it has become outdated.

The 1994 NFPA publication “Recommended Practice for Fire Protection in Historic Structures” also 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 given its provenance, the emphasis was inevitably placed on what might be described as “modern” buildings from a European perspective.

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 and 1998:

- Timber panelled doors and fire
- The use of intumescent products in historic buildings
- Fire safety management in cathedrals
- Prevention of loss or damage by fire in cathedrals
- Smoke detection systems for cathedrals

Figure 1 Cowgate, Edinburgh. 8-10 December 2002. 11 building destroyed in blaze in the centre of the World Heritage Site, Unknown cause, but probably an electrical fault.

CAUSES OF FIRE

It is necessary to be precise when analysing the cause of a fire incident in a historic building to help get a broader picture of the types of causes that are most prevalent. This is required to formulate an appropriate response to stemming the scale of the loss levels. As a result, broad categories of cause can be identified:

- electrical faults
- open fires and defective flues
- building maintenance work
- vandalism
- arson
- smoking
- lightning strike
- accident

Taking into account traditional building construction, 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 the integration of these problems need to be addressed in a framework that gives equal weight to conservation needs and fire engineering thinking. Balancing all the conflicting issues is necessary to ensure that the best possible solution can be achieved. This is the fundamental thinking behind the COST Action C17 approach. However, during the 4 years of the Actions' life, much needs to be done to create a meaningful impact.

FIRE ENGINEERING AND CONSERVATION NEEDS

When designing and inserting an improvement on the level of fire protection in a historic building, a balance must always be struck to ensure that the significance and authenticity of the original building or site is retained (these are, after all, the special qualities we value). Minimal intervention should be a key principal to guide any new or retrofit work. In consequence, works to improve compartmentation, or to provide fire detection or suppression, should not cause unnecessary disruption or damage during installation, maintenance or eventual removal and replacement. Ideally, work should be designed and executed on a totally reversible basis, adopting a "plug in-plug out" philosophy. But, realistically, installing any systems or new equipment will create a physical demand on the building fabric. This will vary dependent upon the type and scale of the retrofit, and the intended functions that the building will have to accommodate.

With traditional building construction, some room for manoeuvre does exist in the hidden voids that, perversely, increase the risk in the first place. It should be possible to thread, service runs of flexible electrical supply, detection and

monitoring cables, and air sampling tubes through the hidden voids to cause little damage, although careful planning and detailed site supervision will be called for in advance to ensure that they are also fire-stopped. It is recognised that the sensitive positioning of exposed detection equipment and associated apparatus in aesthetically and historically important interiors can be difficult to decide upon, and requires detailed guidance. Sharing knowledge on how others have addressed and overcome such problems is another objective of the COST Action.

Looking at the topic from two different perspectives, 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 the buildings:

- form and layout
- age and value
- occupancy and use
- location and character of internal spaces
- quality and importance of finishes
- contents
- site location and accessibility

At the heart of the COST C17 Memorandum of Understanding is the desire to work towards an integrated policy that balances fire engineering and conservation needs which have joint regard for the-

?? protection of life

?? protection of the building, its finishes and contents

?? routine training of staff and promotion of awareness

?? highest standard of risk management

Figure 2 Bower Building, University of Glasgow. 24 November 2001. Category A Listed building extensively damaged with an estimated £7 million loss. Many historic books also lost. Cause unknown, but thought to have started by fireworks.

HISTORIC SCOTLAND'S FIRE RESEARCH PROGRAMME

Historic Scotland initiated research into the protection of historic buildings from fire in 1994. The overall aim of the programme was to ensure that measures required to protect occupants, users, and the fabric of historic buildings are appropriate, consistent with conservation principles, and make the best use of the available resources. This work has been supported by an industry-wide Scottish Historic Buildings Fire Liaison Group. The Group convenes, as necessary, to discuss matters of mutual interest, and has advised on the development and drafting of pragmatic published technical guidance.

TAN 11: FIRE PROTECTION MEASURES IN SCOTTISH HISTORIC BUILDINGS

Specifically examining the integration of fire engineering and conservation related issues the intention of Technical Advice Note 11 was to offer a practical guidance for dissemination amongst those responsible for the nation's historic structures. Released in September 1997, it summarised the available literature and the problems of working with respect for historic building details in effecting retrofit schemes.

TAN 14: INSTALLATION OF SPRINKLER SYSTEMS IN HISTORIC BUILDINGS

The second technical publication on fire related topics to be produced by Historic Scotland's TCRE Group considered the appropriateness of sprinkler systems in more detail. This aimed to develop a more focused awareness of the problems, and the benefits of installing suppression systems in sensitive interiors.

The foundation for the Advice Note lay in Historic Scotland's own experience, in 1994, of installing detection and a fully-charged water sprinkler system in Duff House, dating to 1735, on the outskirts of Banff, in north-east Scotland. This was the first fully comprehensive installation of its kind in the United Kingdom.

TAN 22: FIRE RISK MANAGEMENT IN HERITAGE BUILDINGS

Under current UK legislation, a life safety fire risk assessment is legally required to be undertaken for all workplaces and must be kept up-to-date to ensure protection for occupants and users. Released in 2001, TAN 22 is the latest fire-related technical advice note to be published by Historic Scotland. Being complimentary to the two previous notes, it shifts the focus in offering management guidance on the protection of culturally significant buildings and their contents.

SCOTTISH HISTORIC BUILDINGS NATIONAL FIRE DATABASE PROJECT

Following a practical demonstration of the results of a pilot project carried out by Strathclyde Fire Brigade East Command in 1998 and the examination of descriptive data contained in Historic Scotland's Listed Buildings CD-ROM, agreement was reached on the need to create a National Fire Database. This aims to present operational fire-fighters with up-to-date computerised information on what is at risk from the effects of fire in Scotland's Category A listed buildings, and to create a reporting mechanism for the gathering of accurate statistics on fires in historic buildings.

The Chief and Assistant Chief Fire Officers Association Fire Safety and Operations Committees endorsed the project intentions and encouraged its development. A Minute of Agreement was subsequently drawn up and initiated in 2002 between Historic Scotland and Grampian Fire Brigade on behalf of the eight Scottish Fire Brigades who will participate in completing the project over the next 3 years.

WHY A COST ACTION ON THIS TOPIC

In addition to associated levels of life loss, the number, authenticity and quality of European historic buildings is being steadily eroded through the effects of fire. In 1983 this was recognised by the Council of Europe Committee of Ministers, who recommended '*That the governments of the member states adopt all legislative, administrative, financial, educational and other appropriate measures'* to protect the built heritage from fire and other natural disasters.

Despite all the technical guidance that has already been produced, there is a need to find a balance between technological and management solutions to counter these disastrous effects. Across Europe the real scale of loss of historic buildings to fire is unknown, but superficial data suggests that the

annual and aggregated effect is considerable, perhaps as high as one important historic building each day. There is a general lack of statistical information, and a common lack of understanding and appreciation of what measures are available and required, to counter the effects of fire.

The term “historic building” should be taken to be synonymous with the entire architectural heritage - comprising monuments, groups of buildings and sites, as well as movable objects having particular historical or aesthetic association with the protected building. There are a considerable number of historic buildings requiring protection. It is important to recognise that these structures are a major contributor to the ‘sense of place’ and recent research indicates that they are of great importance to both inhabitants and tourists. In some countries, the most important historic buildings are included on statutory lists, but those that are listed form only a small percentage of the total number that can be considered as part of the built heritage.

To be effective in the resolution of the degree of loss, the requirement is to develop a high level of international co-ordination, and strengthen the levels of trans-national multi-disciplinary co-operation. The need is to exchange and enhance experiences to increase awareness and understanding, and to focus future action. The associated skill and knowledge needs to be pooled, assessed and best practice developed. The underlying objective must be to retain the remaining cultural built heritage in an authentic state for future availability, access and enjoyment by all.

COST C17 WORKING GROUP ACTIVITIES

With a commitment to strengthen trans-national co-operation in the field, “COST Action C17 Built Heritage: Fire Loss to Historic Buildings” will exchange and enhance experiences to increase awareness in addressing the issues. It will also pool skills to develop and promote best practice.

Whilst additional Working Groups may have to be established during the course of the Action, the initial Four groups will address the following matters:

WORKING GROUP 1: DATA, LOSS STATISTICS AND EVALUATING RISKS

1.1 Data and Fabric analysis

1. Establish available information about the total number of cultural heritage buildings to be considered, their value in cultural and financial terms and the actual risks they are subjected to
   - *Make contact, in all member countries, with government departments responsible for listing cultural heritage to establish:*
     - *Number of listed buildings*
     - *Criteria for listing*
   - *Make contact with co-ordinating bodies for buildings insurance in each member country to establish the cost of losses to the cultural heritage*

2. Compile available statistical data on the extent of the built heritage at risk
   - *Action point to be progressed once data is gathered*

3. Balance the impact of physical interventions and of potential fire damage with the "value" and "significance" of the site
   - *Establish detailed case studies from each member country*
     e.g. December 2002 fires in Edinburgh, Scotland and Trondheim, Norway.

4. Identify, analyse, and report on minor fire incidents (where the fire is extinguished without fire brigade attendance, false alarms etc.).
   - *Identify reporting mechanisms for fires in each member country to test feasibility of getting comprehensive statistics on minor fires.*

?? *If not available, gather case study data from each member country*

1.2 Qualitative Risk analysis

1 Establish common definitions of terms to be used

?? *Draw up list of terms to be defined*

?? *Gather authoritative definitions of each term as used in each member country*

2 Investigate the history, (and relevant advantages and disadvantages) of buildings with different types of structure and materials and of installing detection and suppression systems in historic properties. Evaluate the risks involved and issues of risk transference.

?? *Order gathered case studies by construction type and date and fire protection systems installed.*

?? *Seek additional case studies for any identified gaps*

3 Establish a well-documented survey of the degree of existing usage

?? *Prepare questionnaire for listed properties in each member country*

?? *In Scotland the developing Fire Database will include information on fire protection measures in Category A listed buildings*

4 Establish a common risk assessment methodology, following a critical review of existing methodologies

?? *TAN 22 Fire Risk Management in Heritage Buildings provides a basis from which to work.*

?? *Gather best practice from member countries*

5 Consider remoteness of sites and compile an understanding of the impact of response time “delay” factors

- *Identify case studies of remote buildings*
- *Liaise with fire brigades regarding response times and consequent increased risks*

WORKING GROUP 2: AVAILABLE AND DEVELOPING TECHNOLOGY

2.1 Available technology (Fabric and materials)

1 Establish how historic building construction and traditional materials actually perform under fire conditions, when compared to statutory obligations.

- *Modelling fire behaviour*
- *Gather data*
- *Fire Tech questionnaire results*

2 Consider how to obtain a balance between technological and management solutions to counter the effects of fire

- *Establish criteria for decision making, these may include:*
  - *Physical impact on a building*
  - *Cost and reliability*
- *Work through decision making for a number of properties based on criteria*

3 Consider the provision of available traditional skills and materials that will be required in post-fire situations.

- *Conservation Register in Scotland - are their similar databases in other member countries?*
- *Seek figures for total heritage spend per year in each member country*

4 Promote research into the consequences of fires and the causes of fires common and how well the building and its construction performed under fire conditions

- *English Heritage Fire Research Database - assess current research initiatives*
- *Seek information on current research initiatives in each member country*

5 Re-consider appropriateness of applying current codes, standards and risk assessment methods to heritage properties. In particular, consider the application of fire engineering techniques and performance standards to historic buildings.

- *Fire Tech questionnaire results*
- *English Heritage document on Fire Engineering for Historic Buildings*
- *Case studies of sites where fire engineering principles have been used in heritage properties.*

6 Assess provision of means of escape, salvage techniques and access for fire-fighters

- *In Scotland, Fire database holds information for Category A listed properties*
- *Seek similar information from other member countries*
- *If not, seek case studies to illustrate range of situations found.*

2.2 State-of-the-art solutions

1. Define range of alternative solutions and undertake risk assessments of the technologies in terms of false alarms, benefits and conservation implications

- *Literature review of current facilities*
- *Analyse data gathered in relation to:*

- *False alarms*
- *Physical impact*

- *Test against real detection from listed building installation*

2. Consider relevance of current expertise on new and developing detection and suppression concepts, and technical techniques.
   - *Identify trends in technical developments e.g. radio links, miniaturisation*
   - *For each trend assess benefits/disbenefits for listed buildings*

3. Demonstrate the benefits of numerical simulation, such as Computational Fluid Dynamics.
   - *Smoke behaviour modelling*

4. Identify an appropriate range of passive and active technical equipment counter-measures
   - *Follow on activity from 2.2.1*

5. Consider how to minimise the aesthetic and physical impact of the installation of new fire protection technology on historic fabric
   - *Case studies to be sought from member countries*
   - *Manufacturers information may hold useful data*

6. Consider the prevention of fire growth and smoke spread
   - *Following on activity from all preceding action points*

7. Consider design issues associated with the extinguishment of fire and smoke release

WORKING GROUP 3: CULTURAL AND FINANCIAL VALUE

3.1 Financial data and risk

1. Insurance companies have insufficient data to calculate the extent of the real heritage that is at risk. Work with insurance companies to compile statistical data on the annual cost of fire losses to historic buildings, using this information to effect understanding and change.
   - ?? *Identify relevant body responsible for insurance of buildings*
   - ?? *Insurance body Questionnaire*

2. Given the total loss of authentic fabric as a result of fire, consider principles of deciding what should be built in its place – a recreation of what was there before, or a modern replacement.
   - ?? *Case studies of examples recreation vs. modern replacement*
   - ?? *Consider types of authenticity*
   - ?? *Gather press cuttings in relation to current debates on recreation vs. modern replacement for sites destroyed by fire*

3. Re-state the importance of historic and cultural "authenticity" and significance, in particular the importance that historic buildings may have for the community and society.
   - ?? *Literature review of international research charters including any relevant charters from member countries*
   - ?? *Gathering information from each to compile composite document*

4. Determine how size, value of property, and content impacts on risks.
   - ?? *Draw on available data to assess level of risk for properties of different size, value and content*

5. Compile relevant statistics to assess correlation between early detection, response time and degree of loss.
   - *Assess feasibility of using gathered data*
   - *Identify case studies which illustrate relationship between early detection, response time and degree of loss*

6. Promote findings and benefits of relevant assessment methodologies and risk assessment gains.
   - *Assess feasibility of using gathered data to indicate effectiveness of risk assessment to reduce impact of fire.*
   - *Use of case studies*

7. Promote awareness of the real financial and cultural costs of fire loss to private historic building owners
   - *Identify bodies in each member country that can reach private owners of listed buildings*
   - *Press releases*
   - *Written and published articles*
   - *Conference and seminars*

3.2 Loss recovery

1. Accumulate, interpret and disseminate the analysis and conclusions of fire loss events, using case study examples, and including their impact on historic authenticity.
   - *Assess impact of all types of authenticity*

2. Consider alternative approaches to assist in stemming loss levels, or where these continue to occur, what other approaches may be considered as appropriate.

- *Gather best practice in management techniques for reducing fire loss*
- *Consider the unthinkable… e.g. disallowing access to certain listed buildings to protect from fire*

3. Reconsider approach to first-loss insurance, identifying real value and building costs.
   - *Gather guidance on insurance for historic buildings from member countries*
   - *Establish current best practice*
   - *Include question in survey of insurance bodies regarding appropriateness of current insurance types and levels for historic properties*

4. Consider if future insurance premiums might be established on the basis of sound statistical data, of "retention" needs, "replacement" requirements, or new work.
   - *Feasibility study into likely improvements in data gathering on costs of fire losses as a basis for setting insurance premiums*
   - *Include question in survey of insurance bodies*

WORKING GROUP 4: PROPERTY MANAGEMENT STRATEGIES

4.1 Support for property managers

1. Devise appropriate management regimes, learning from others in Europe, through studying best practice in policy, regulations, planning, organisation, checklists, training, monitoring, hot work permission etc.
   - *Gather information from member countries of current best practice*
   - *Fire Questionnaire results*
   - *Compile clear and easy to use best practice document for property managers*

2. As support for property managers, provide models for risk analysis of a building, training of the staff, handling of contents in case of fire.
   - *Liaise with bodies responsible for moveable heritage in each member country*
   - *Compile clear and easy to use best practice document for property managers*

3. Establish a balance between technical and management contributions to combat the effects of fire
   - *In conjunction with WG 2.*

4. Consider the management measures that will contribute to the prevention of fire ignition
   - *Gather best practice information from member countries*
   - *Compile clear and easy to use best practice document for property managers*

5. Consider how the complexity of the building may initially dictate search and rescue, and then fire fighting
   - *Gather best practice information from member countries, including Fire Database in Scotland*
   - *Compile clear and easy to use best practice document for property managers*

4.2 Staff training

1. Offer guidance on handling of contents in the event of fire
   - *Gather best practice from member countries*
   - *Compile clear and easy to use best practice document suitable for use by volunteers and other staff*

2. Suggest organisational arrangements to assist in the implementation of staff training regimes
   - *Gather best practice from member countries*
   - *Compile clear and easy to use best practice document suitable for use by volunteers and other staff*

CONCLUSION

It is anticipated that the COST C17 programme progress will be monitored by means of brief annual reports from each participating partner country. These will describe the results of research obtained through concerted action. An intermediate report after 2 years of joint activity will be presented to the COST Technical Committee for their review and to the COST Senior Officials Committee for information. A final report will be prepared at the end of the Action to inform non-participants about the results. It is anticipated that Action participants will also present reviews and progress reports for publication in International Journals, and that related papers will be presented at appropriate conferences, during the duration of the programme. To conclude the Action a Symposium will be held to review the final results.

A variety of end users and beneficiaries can be identified. These include historic building owners, public asset managers, official bodies, fire brigades and fire authorities, fire industry equipment manufacturers and suppliers, professional and technical bodies, building and artefact conservation interests, Insurance companies, heritage bodies and organisations, and the tourist industry. The beneficiaries will also include the various individual historic buildings themselves, the national physical identities that aggregate into the European patrimony, and the international cultural heritage at large.