

7  
GUIDE FOR  
PRACTITIONERS

FIRE SAFETY  
MANAGEMENT  
IN TRADITIONAL  
BUILDINGS

PART 1  
PRINCIPLES AND  
PRACTICE

TECHNICAL  
CONSERVATION  
GROUP



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Published by  
Historic Scotland  
© Crown copyright  
ISBN 978-1-84917-035-2  
Edinburgh 2010

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## **Acknowledgements**

This publication has been developed with the support, assistance and knowledge of many individuals and groups. Input from the members of the Scottish Historic Buildings Fire Liaison Group has been invaluable and the Group has been involved with suggestions, feedback and advice throughout the development of this Guide.

Individual contributions which must be gratefully acknowledged include the section on Scottish Building Standards drafted by Hugh Adie, Building Standards Division, Graham Goodall of the Scottish Fire Service Advisory Unit for proofing the fire legislation section and Mike Coull of Grampian Fire and Rescue Service/Historic Scotland for material on fire service operations. Steve Emery of English Heritage gave much in the way of constructive advice on text improvements. The National Trust for Scotland in addition to providing general feedback gave permission for photographs to be taken of some of their properties, including Newhailes House. The Case Studies were produced by Mike Coull, Bill Jackson of National Libraries of Scotland, Sharon Haire of Historic Scotland (with input from Alba Conservation Trust and Allan Cumming Associates) and the author. Nick Jordan of National Trust for England, Wales and Northern Ireland provided the Lanhydrock House Annex and also made useful suggestions.

It is also important to pay tribute to the authors and contributors of earlier TANs, 11, 14, 22 and 28, including Ingvál Maxwell (former Director of Technical Conservation, Research and Education Group, now Technical Conservation Group) from where some of the content of this Guide has been extracted.

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# LIST OF ILLUSTRATIONS

- COVER During conversion to luxury flats this category A listed terrace in Glasgow was destroyed by fire
- 1 The aftermath of a serious fire in this category A listed terrace undergoing refurbishment
  - 2 A fully developed fire in a country house
  - 3 This charred timber door panel, illustrates the destructive and irreversible nature of fire
  - 4 In addition to the historic building fabric itself, contents are often also of great importance
  - 5 Variety of traditionally constructed buildings in Scotland
  - 6 The Georgian New Town of Edinburgh, a masterpiece in urban planning
  - 7 The 18th century Stanley Mills lay derelict for many years, but is now an award winning conversion project comprising a heritage centre and riverside flats
  - 8 Templeton Carpet Factory
  - 9 The striking modern addition to the rear elevation of the India of Inchinnian Tyre Factory makes allusion to airships and aircraft wings, both of which were made in that location
  - 10 Successful conversion of the redundant Old Royal Station at Ballater into a museum, restaurant, shops and tourist centre
  - 11 The Scotsman, former newspaper headquarters, now a luxury hotel
  - 12 The regeneration of the declining Blackness area centred on the conversion of several prominent 19th century textile mills including, as illustrated here, Tay Works
  - 13 Aerial view of Leslie House, a category A listed mansion, that was severely damaged by fire during sub-division to luxury flats
  - 14 The haphazard installation of services can compromise a compartment wall
  - 15 This compartment wall was compromised by a structural roof timber travelling through it
  - 16 The lack of stopping around service installation has adversely affected the compartmentation
  - 17 This post-fire image from a category A listed building clearly illustrates the gap that exists behind traditional lath and plaster walling (essential for ventilation)
  - 18 A traditional technique in early buildings was to decoratively paint the underside of floorboards. Although this offers little fire resistance, where such decoration survives it is important to retain it
  - 19 It is common practise in traditional buildings for floor and ceiling timbers to be built into supporting walls
  - 20 Original Georgian doors whose retention was facilitated by partial sprinklering of the property
  - 21 Doors in principle reception areas often can be elaborately detailed, so their retention is preferable
  - 22 In the upgrading of these double doors in a reading room at the National Library of Scotland, cold smoke seals were run along the stile
  - 23 In this heritage property doors have been carefully removed to go into storage
  - 24 Attic roof void with the additional fuel loading of a timber vaulted dome, Culross Palace, Fife
  - 25 Substantial hidden void above a combed ceiling in a traditionally constructed building. Voids can aggravate fire spread and should be considered when assessing risk
  - 26 Large attic spaces with no compartmentation are common and facilitate the rapid spread of fire
  - 27 A common occurrence in various types of properties is the storage of infrequently or unused items in attic spaces, adding to the fuel load in these vulnerable area
  - 28 Dumb waiters, often disused, provide a large hidden passage that can aid the rapid travel of fire between floors
  - 29 When notching structural elements, such as floor timbers, for the installation of services fire stopping must also be addressed
  - 30 A localised fire that has caused discoloration of the sandstone in the area affected by flames and the stone above has been covered by soot. The heat also caused fracturing of the stone and loss of material
  - 31 Fires have always been a threat – here the effect of a historical fire is evident by the severe spalling of the granite, especially around the windows
  - 32 These listed residential properties, one large scale, the other small scale, both illustrate that there is often a high timber component in traditional buildings – floors, panelled walls and ceilings
  - 33 Due to their thickness structural ceiling timbers can burn slowly and perform their function for a long period
  - 34 Fire initially attacks areas of weakness as seen in this furnace test where the thin door panels have failed early in the test
  - 35 The back of traditional lath and plaster showing the wooden lattice structure that provides a key for the applied plaster
  - 36 During a fire, expansion of the girders has caused movement in the walls of this listed property
  - 37 Expansion of the internal beams has applied pressure to the external walls, causing large cracks along a section of the stringcourse
  - 38 In industrial conversions, such as this pictured, it is common for the metal elements to be coated with intumescent paints. This is the Scottish Borders Enterprise business gateway in Ettrick Mill, Selkirk, 1836-1850, where steel was inserted around ground floor machinery in the early 20th century. The conversion lifted part of a timber floor to make a light reception area
  - 39 Thatched property in a traditional blackhouse village on the Isle of Lewis

- 40 Fire represents a serious risk for thatched properties. Here the design for a contemporary enclosure for a fire hose has employed random rubble stonework like that used in the adjacent blackhouses, a visually sensitive approach
- 41 In this heritage visitor attraction, this storage area presents a fire hazard
- 42 In this category B listed building, sub-divided into flats, a fire is believed to have been caused by faulty electrical services in the attic. Early detection restricted damage to the roof
- 43 Some major contributory causes of fire include; overloading of circuits, neglecting to undertake routine electrical equipment checks, church candles, deep fat fryers, combustible material in close proximity to heaters and blow torches
- 44 As illustrated in this unlisted thatched cottage, chimney flues require ongoing maintenance to prevent the build up of soot and grime, a cause of chimney fires
- 45 Regeneration of the centre of Hawick has focused on the conversion of Tower Mill into a variety of uses
- 46 The benefits of compartmentation: complete loss on one side of the compartment wall and fire door and on the other side only superficial fabric damage and minor smoke damage to an archive of rare books
- 47 Examples of fire stopping to improve compartmentation
- 48 Suspended ceiling in this church, a consequence of a decreasing congregation size, has created a large cavity above
- 49 Statistics suggest that traditional buildings are at greater fire risk during construction works and consequently additional controls and procedures should be implemented to minimise risk
- 50 Fire Service personnel amidst the rubble, following a gas explosion at Guthrie Street, Edinburgh
- 51 The sensitive introduction of fire measures into traditional measures can help prevent their destruction. This large country house, category A listed, has been totally devastated and recovery firm has been mobilised to remove the debris
- 52 Where fire extinguishers are required to comply with legislation, subject to agreement with the fire authority there is no reason why they can't be allowed to be free standing as opposed to being physically attached to the wall
- 53 A concealed sprinkler head has been installed immediately in front of the bird's beak, almost invisible to the untrained eye
- 54 With the approval of the manufacturer sprinkler pipes have been painted to blend in with the open timber ceiling
- 55 The wires have been fixed using cable clips rather than notching the timbers
- 56 Reversibility – In this highly decorated Austrian palace interior, a contemporarily detailed floor fixed 'pole' houses a sprinkler head, electrical services and emergency lighting – thus providing an innovative and reversible solution avoiding damage to historic wall finishes which conventional installations give rise to
- 57 Eliminating hazards can help reduce the probability of serious fires such as the Old Town Fire in Edinburgh, a World Heritage Site
- 58 Portable heater in office
- 59 A crumpled carpet preventing the opening of a fire escape door. It also presents a trip hazard
- 60 High intensity quartz halogen lights in a church surrounded by timber features
- 61 Storage of material in a back room of a heritage centre
- 62 Theatres often have high intensity lighting, upholstered seating, large open-plan auditoriums, combustible props, stage production areas and special effects, all of which can create a high fire risk
- 63 A category A listed University chemistry building is an obvious high fire risk
- 64 To control an identified risk, flammable liquids should be stored in a proper flammable liquid storage cabinet
- 65 The build up of storage areas such as these should be highlighted and removed

## Part 2

- 1 Morgan Academy, a category A listed school was gutted by fire in 2001
- 2 This category A listed terrace was severely damaged by fire during sub-division into luxury flats
- 3 Sound management should ensure that hazards and risks are eliminated or reduced, so situations like blocked fire escapes are avoided
- 4 Part of this listed terrace was badly affected by fire during refurbishment work and the spread of the fire was facilitated by the earlier removal of the doors
- 5 If detector heads are covered during works, or systems switched off, compensatory measures must be implemented during work hours. Temporary covers should be removed at the end of the working day
- 6 If heat producing equipment is used in a traditional property it is essential that it is managed by a hot works permit
- 7 The Bower building, University of Glasgow. Severe fire damage to the roof and interior of this category A listed teaching and laboratory building
- 8 In these examples, where services have transversed fire resisting walls, the openings have been fire stopped, firstly with intumescent caulking and secondly with intumescent pillows
- 9 A thermographic survey at Stirling Castle kitchen block unearths a redundant chimney flue at parapet level
- 10 Wherever possible historic hardware should be retained, and only upgraded for fire resistance as necessary
- 11 Destructive furnace tests to determine the fire performance of traditional doorsets, during and post-test
- 12 This image from a property undergoing refurbishment clearly shows the sizable gaps that can exist between a door frame and the supporting wall
- 13 Intumescent products are increasingly available in a range of colours. The timber laminate intumescent strips (the dark band that goes round the door hinge) seen here match the surrounding timber
- 14 A concealed overhead closer – a discreet solution
- 15 As seen here in the aftermath of the 1824 Great fire of Edinburgh, fire is not a new threat, but the technology available in the modern era to tackle the threat is constantly evolving
- 16 Manual call points can be located unobtrusively
- 17 1) Visual impact is minimised as the ceiling is so elaborate and the detector, to the base of the large panel, is white.

- 2) The positioning of this wall mounted beam detector has avoided disruption to the elaborate ceiling plasterwork
- 3) & 4) Discreet sampling holes through which air is drawn in
- 18 It is clearly seen in these two images the difference between careful consideration of the building fabric and a standard approach when selecting detection equipment
- 19 This is an example of bad design where the break glass call point and electric door release are too closely located
- 20 Example of an addressable wireless fire alarm system (wireless can be beneficial where hard wiring would be disruptive to the fabric)
- 21 Two listed properties, with extinguishers housed in purpose-made bases or free-standing rather than being physically attached to the wall
- 22 In an A listed property the hose reel has been carefully hidden in a cupboard
- 23 Historic fabric impact minimised by locating dry riser inlet valves beneath cast iron cover in footpath
- 24 A Norwegian example where a drencher system has been installed to the exterior of the building on the right to prevent fire spread from or to the neighbouring timber building
- 25 In Newhailes house, a visitor attraction, the fabric and contents are protected by a sprinkler system, sympathetically installed to minimise fabric impact
- 26 Parliament House in Edinburgh installed sprinklers, with pipework painted black to blend in with the elaborate ceiling
- 27 To satisfy the required volume of water for the sprinklers in the National Library of Scotland, two purpose built water tanks were constructed and housed in the historic vaults below the street
- 28 Sprinkler components such as water tanks, pumps and valve sets can sometimes be discreetly housed in outbuildings as here at Newhailes house
- 29 An example of a main stop valve for a sprinkler system, located out of sight in a basement area
- 30 Chlorinated PVC plastic pipework, a possible alternative to metal pipework
- 31 The operation of a sprinkler head
- 32 In any given installation, there may be a number of different types of sprinkler head installed, as here in one of the reading rooms at the National Library of Scotland
- 33 Two examples of discreetly installed sprinkler heads in heritage properties
- 34 Recessed sprinkler head
- 35 Concealed sprinkler head
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- 39 A range of approved signs for use in respect of fire safety
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- 41 This totem pole is a novel solution – incorporating an exit sign and emergency lighting in addition to video surveillance, break call glass point and audio alerter
- 42 A water tender in attendance at a fire at a category A listed property
- 43 On occasions, in the event of a fire it may be more beneficial to locate to the rear of a property or as here, the service courtyard to the side elevation, due to proximity to such features as the gas shut-off
- 44 A damage limitation exercise at Duff House gallery
- 45 The fire database displayed onboard a fire appliance
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- 67 Concealed sprinkler head in the ornate plasterwork in the vestibule ceiling (circle beside the bird's beak)
- 68 The National Library of Scotland installed a sprinkler system to compensate for deficiencies in the fire safety provisions in the property
- 69 Sprinkler head discreetly integrated into bookshelves in one of the public reference rooms
- 70 The new north staircase that was constructed to allow a direct fire exit route from the Reading Room and to provide a second stairway
- 71 During the refurbishment, all the collections were kept in situ, but encased in special fire-retardant sheeting
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- 75 The water tanks and pumps were housed in a lean-to out-building, a former brew house
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- 77 Concealed sprinklers do not distract from the original Jacobite graffiti on the ceiling of the former barracks room
- 78 Sprinkler and detection heads and exposed pipework have been painted to blend in with the timber ceiling
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# FOREWORD

Fire continues to pose a serious threat to Scotland's built heritage, capable of destroying a building and its contents in a matter of hours. Historic fabric lost to fire is lost forever. Often constructed without regard to fire safety, traditional buildings can be inherently vulnerable to fire due to a combination of factors including traditional construction techniques, undivided roof spaces, hidden voids, historic furnishings, high fire loads and a history of alterations and changes.

Concerned about the scale of loss, estimated at one major historic building in Scotland lost each month, since the mid-1980s Historic Scotland has been involved in fire-related research, often in collaboration with a wide range of external organisations. Four Technical Advice Notes (TANs) have subsequently been produced, dealing with fire protection measures, sprinklers, fire risk management and fire safety management.

In addition to the TANs, two noteworthy initiatives have been a four-year pan-European funded programme entitled *Cost Action C17: Built Heritage: Fire Loss to Fire* (Cost Action C17) which investigated the consequences of heritage fire loss and involved the participation of over twenty countries and the Scottish Historic Buildings Fire Database project (SHBFD). The SHBFD continues to encourage partnership working with Scotland's Fire and Rescue Services, improving the operational preparedness of firefighting crews. Under the umbrella of this project, a major achievement has been quantification of the real loss of heritage buildings to fire through the introduction of reporting measures. Statistics gathered by the Scottish Fire and Rescue Services on fire incidents in listed properties recorded 418 incidents between 2008 and 2009, a significantly higher figure than previously supposed.

Whilst the TANs have proved extremely useful to a wide-ranging audience, some aspects have become outdated. There have been a number of changes and developments such as the introduction of new legislation governing the provision of fire safety in buildings and building regulations, the increasing adoption of a fire engineered approach to fire safety and technical advancements in fire detection and suppression systems. This led to the decision to update and amalgamate the TANs into a single reference document in the series of Historic Scotland's Guides for Practitioners.

In 2005, the Fire (Scotland) Act became operational, followed shortly in 2006 by associated regulations. Part 3

of the Act is aimed at non-domestic properties (including houses in multiple occupancy and care homes) and has shifted the onus on the provision of fire safety to the owner of the property or those responsible for the property, as opposed to the fire service. The new fire safety regime is based on the principles of risk assessment: identifying risks, eliminating or reducing risks and the introduction of appropriate technologies to achieve an adequate level of fire safety.

The Building (Scotland) Act came into being in 2003 and the associated Regulations in 2004. The main change is that prescriptive standards have been replaced with expanded functional standards; what must be achieved when a building is in use. The move away from prescriptive to performance-based standards means that designers can adopt a more flexible approach to fire safety, thus catering more sympathetically to the needs of traditional buildings. This Guide is intended to be read along with the Guide for Practitioners 6: *Conversion of Traditional Buildings: Application of the Scottish Building Standards* (Guide for Practitioners 6), produced by Historic Scotland in 2007.

A dilemma exists when attempts are made to introduce fire safety measures into traditional buildings to satisfy either the Fire Safety Regulations or Building Regulations. A balance must be achieved between the historic value of the fabric and the fire safety measures introduced to protect that fabric. This publication aims to demonstrate how to find sensitive solutions and also the importance of sound management systems. Fire protection may be straightforward, but for more complex properties, a developed fire-engineered approach may be required. The Guide emphasis is that a building must be addressed holistically and that each traditional building is unique. Experience indicates that traditional buildings can be protected from fire in a sensitive manner and this is encouraging in view of the national drive towards sustainability; retaining Scotland's huge stock of traditional buildings is central to this drive.

The safety of building occupants remains of paramount importance, but to look beyond the immediate requirements of life safety and encompass the building fabric and contents as well, will undoubtedly have a positive knock-on effect to life safety.

This Guide draws together the legislative viewpoint of the various agencies involved and, as the attached formal letter from the Chief Executive of the Scottish

Buildings Standards Division indicates, this Guide legally sits alongside other guidance documents. It serves as a reference document that will be useful to building and fire enforcement officers, building professionals, heritage organisations and owners/managers.

**David Mitchell**  
**Director**  
**Technical Conservation Group**  
**Historic Scotland**  
**March 2010**





Chief Executives – Scottish Local Authorities  
Copy to: Local Authority  
Building Standards Managers

**Directorate for the Built Environment**

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Our ref: QTO 2/4  
31 March 2010

Dear Chief Executive

**Building (Scotland) Act 2003 – Notice Under Section 4(2) and 4(4) Relating to Guidance Documents**

Under the provisions of Section 4(1) of the Building (Scotland) Act 2003 (the Act), which came into force on 1 May 2005, Scottish Ministers may issue guidance documents for the purpose of providing practical guidance with respect to the requirement of any provision of building regulations and may issue revisions of the whole or any part of any guidance document

Guidance documents issued under Section 4(1) of the Act take effect in accordance with a notice issued by Scottish Ministers under Section 4(2) of the Act. This letter, issued on behalf of Scottish Ministers, constitutes such a notice.

From 1 April 2010 the following document is added to the guidance documents for purpose of building regulations:

***Guide for Practitioners 7: Fire Safety Management in Traditional Buildings***, issued by Historic Scotland.

The guidance documents are issued with respect to the provision of Regulations 1 to 15 of The Building (Scotland) Regulations 2004.

As provided for by Section 4(3) and 4(4) of the Act, this document will cease to have effect in relation to building warrant applications when notice is given by Scottish Ministers.

Yours sincerely

**Bill Dodds**  
**Head of Building Standards Division**



*Illus 1 The aftermath of a serious fire in this category A listed terrace undergoing refurbishment*  
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PART 1:  
PRINCIPLES AND PRACTICE



*Illus 2 A fully developed fire in a country house © Central Fire and Rescue Service*

# 1 INTRODUCTION

While hazards such as insect infestation, floods and severe weather can endanger the future existence of traditional buildings, no other hazard is quite as destructive as fire. Given also that most fires are followed by water damage (the residual effect of firefighting water which usually has to be applied in large quantities at high pressure) it follows that those who own, occupy or manage traditional buildings (or those that advise them) have very special responsibilities to discharge and ensure that Scotland's built heritage remains intact for the enjoyment of future generations. Approached in isolation the package of measures and precautions which may have to be implemented to protect such buildings can be daunting and impartial advice may not always have been easy to obtain.

Recognising the need for authoritative public domain guidance of a suitable quality, between 1997 and 2005 Historic Scotland issued four TANs relating to best practice in the protection of heritage buildings against fire. The primary motivation for the production and promulgation of the advice was the serious threat to Scotland's built heritage posed by fire and the lack of accurate statistics on fires in listed buildings in Scotland. These unique publications were well received by

practitioners, regulators and the fire and rescue services not only in Scotland but internationally and provided accessible and reliable information on issues for which little written guidance previously existed.

Despite their usefulness, the four TANs whilst still containing valuable information, like all paper publications, aspects have become outdated. With the publication of Historic Scotland's series of Guides for Practitioners, it was realised that a new publication in the same series could not only update much of the information contained in the TANs but also ensure its survival. Therefore this publication brings the advice and information from the TANs together for the first time in one document, in a format that is consistent with Guide for Practitioners 6. The two publications are mutually supportive and should be read together when issues regarding fire safety in adaptive reuse of traditional buildings are being considered.

During the 1990s as work progressed on putting in place a more organised approach to the matter of protecting heritage buildings from fire it became obvious that there was a complete lack of national data on the number of historic building fires. The SHBFD was established in



*Illus 3 This charred timber door panel, illustrates the destructive and irreversible nature of fire*

2002 as a joint initiative between Historic Scotland, The Royal Commission on the Ancient and Historical Monuments of Scotland and the Scottish Fire and Rescue Services. Its key objective was to improve operational preparedness by making available information on category A listed properties to firefighting crews attending any future incidents at these properties thus helping to mitigate damage through improving the effectiveness of firefighting operations.

A secondary significant aim of the project was to develop mechanisms for accurate reporting of fires in Scottish listed buildings, to identify the true extent of the problem. To assist in identifying listed properties, Historic Scotland provided each fire service with a database detailing the location of all listed properties in their area. An interim reporting procedure was therefore established and for the first time it has been possible to establish a real insight into the scale of fire incidents in heritage properties across Scotland. As it currently stands, there is arguably no more comprehensive a system of historic building fire reporting in existence anywhere in the world.

The data collected by Historic Scotland from the eight Scottish Fire and Rescue Services shows that between 1 April 2007 and 31 March 2008, 509 listed buildings were damaged or destroyed by fire (Table 1) and for the same period 2008-9, 418 listed buildings were affected (Table 2). Over the two reporting periods, this includes 131 fires affecting category A listed buildings.

Service	A-listed	B-listed	C(S)-listed	Total
Central	1	8	1	10
Dumfries & Galloway	3	6	4	13
Fife	1	14	5	20
Grampian	1	29	24	54
Highlands & Islands	0	15	5	20
Lothian & Borders	36	128	65	229
Strathclyde	12	64	48	124
Tayside	15	17	7	39
	69	281	159	509

Table 1: Fires in Scottish listed buildings 2007-8 (Historic Scotland)

Service	A-listed	B-listed	C(S)-listed	Total
Central	4	12	1	17
Dumfries & Galloway	2	8	2	12
Fife	2	8	9	19
Grampian	5	43	12	60
Highlands & Islands	2	11	6	19
Lothian & Borders	39	139	71	249
Strathclyde				
Tayside	8	23	11	42
	62	244	112	418

Table 2: Fires in Scottish listed buildings 2008-9 (Historic Scotland)<sup>1</sup>

In recognising the vulnerability of traditional buildings to fire, probably the most important piece of international research work addressing the protection of traditional buildings from fire was that undertaken by the Cooperation in Science and Technology Action group C17 (COST Action C17).<sup>2</sup> This work was undertaken under the auspices of the EU Framework Programme and the European Science Foundation. Involving the participation of 22 countries and a wide range of seminars, conferences, short-term scientific missions and a great deal of original research, the Action finalised its work at the end of 2007. The resulting seminal report has made a significant contribution to the understanding of the problems of fire safety in traditional buildings.

The intentions at the outset of the Action were to address the physical and significant cultural loss of Europe's built heritage to the damaging effects of fire. The programme was to be multi-disciplinary and multi-national through the collaboration and integration of a variety of related projects. It built upon current research initiatives and recently published material resulting from a number of relevant international conferences. Data collected during the COST Action C17 shows that the 2007-8 and 2008-9 toll of damaged and destroyed buildings experienced in Scotland is not unique to Scotland, but a continuation of a serious international problem. At the end of the four-year programme, the action has more than delivered its promised outcomes and has promoted data, methodologies and management systems to assist a wide range of end-users balance fire engineering needs with conservation requirements in the future preservation of European heritage.

1 Figures are incomplete for 2008-9 due to systems development work in Strathclyde Fire and Rescue.

2 Findings emanating from COST Action C17 have been published by Historic Scotland in 2007.

## 1.1 Scope

This Guide is intended to provide guidance to practitioners, developers, building owners/occupiers, local authorities and the fire and rescue services on issues surrounding the application of fire safety measures in traditional buildings, including those which have been listed as being of historic or architectural importance or whose contents are of cultural significance. The Guide will be of particular value where measures relate to compliance with the Fire (Scotland) Act 2005 and associated Regulations (applicable to non-domestic properties, houses in multiple occupancy and care homes) and the Building (Scotland) Act 2003 and associated Regulations.

The Fire (Scotland) Act 2005 (the 2005 Act) and the Fire Safety (Scotland) Regulations 2006 replace the previous fire safety regime where fire certificates were required for certain building uses. The new fire safety regime is based on the principles of risk assessment and the requirement to take steps to prevent fire and mitigate the detrimental effects of a fire on the premises to ensure the safety of persons. Such a risk-based approach introduces a degree of flexibility in satisfying the regulations, with the associated Technical Annexes (contained in the Sector Specific Guides) to be used in a non-prescriptive manner. This is of benefit to the built heritage, where a sensitive approach is required. The law applies to nearly all non-domestic premises in Scotland including houses in multiple occupation.

Likewise, in terms of protection of our built heritage, the implementation of the Building (Scotland) Act 2003 (the 2003 Act) has been encouraging. The Act and associated Regulations are based upon expanded functional standards, which set out what a building must achieve when in use. This permits greater flexibility in satisfying the standards, and allows the needs of traditional buildings to be met in a sympathetic manner. This Guide sets out the conservation principles which must be complied with when it does become necessary to introduce equipment, systems or materials for the purposes of providing fire safety for the occupants or the buildings themselves – and their contents.

The Guide will be very useful in assisting in decisions that need to be taken in respect of the conversion or alteration of traditional buildings under the 2003 Act. There will always be a risk, when attempting to satisfy the requirements of any of the building standards, such as noise or energy conservation, that the introduction of improvements (in terms of the standards) may affect adversely the historic character of the building or may damage historic fabric or material of cultural value. This would appear to be especially true of the introduction of fire safety measures of all types. By utilising the functional nature of the current regulations the Guide provides practical advice that will help the practitioner

to reach acceptable solutions to the often complex fire safety problems encountered in these buildings.

While the Guide is focused on the application of the fire safety measures within a Scottish context, the underpinning principles may be applied to traditional buildings everywhere. It does not address, nor seek to constrain, the potential for creative interventions into traditional buildings.

The Guide is divided into three parts. Part 1 is primarily devoted to identifying the threat that fire poses, the inherent vulnerability of traditional buildings to fire, the conservation issues that impinge on addressing fire safety in heritage buildings, relevant legislation and adaptive reuse.

Part 2 takes a two-pronged approach, addressing both the various technical and management solutions to fire safety. Considerably more detail is provided on the types of systems, equipment and material which are available to provide compliant fire safety measures whilst also addressing the way in which fire safety should be managed in traditional buildings.

Part 3 provides a number of case studies detailing traditional properties where the issue of improving fire safety measures has been managed. The case studies highlight the various issues discussed throughout Parts 1 and 2 and illustrate how problems in addressing fire safety in traditional properties can be overcome with sensitive regard to the historic fabric.

The text of this publication includes selected extracts from TANs 11, 14, 22 and 28. Given that these useful documents are now either out of print or likely to be in that state soon, it is considered that the technical information which the TANs brought together for the first time should, where still relevant, continue to be available to the widest possible audience.

## 1.2 Definitions

### 1.2.1 Traditional and Historic Buildings

The term 'traditional building' as applied in this publication signifies a building of traditional construction built before circa 1919. The definitions are not confined to listed buildings or buildings within conservation areas and indeed, it is estimated that there are probably around 500,000 such buildings across Scotland (Illus 5 provides some examples). Built by craftsmen using traditional indigenous building materials, a defining characteristic of the traditional building in its widest context is that its construction evolved over many years, adapting to the climate to promote the dissipation of water vapour. Its materials are breathable and attempts to introduce modern standards of impermeability are likely to have unintended consequences.

Likewise, 'historic building' as defined in the Procedural Handbook to the Building (Scotland) Regulations 2004 and Historic Scotland's Guide for Practitioners 6, are of some kind of historic interest or significance, but again are not restricted to statutorily protected listed buildings:

*'A building of architectural or historic interest or significance. The interest or significance may be local or national, and may be a consequence of, for example, the building's age, built form or location. It may result from its connection with a person or persons, or with local or national events or industry; or from a combination of these or other factors. A building does not have to be listed by Scottish Ministers or lie within a conservation area to have interest or significance.'*

Much that is in this Guide applies to all buildings of traditional construction, whether or not they are considered to have special merit as defined above or as confirmed by statutory designation, such as listing. Where technical performance is discussed the text will usually refer to 'traditional building'.

In 2008, Historic Scotland published *Scotland's Historic Environment Policy* (SHEP) with regards to managing the historic environment. The historic environment is defined in this document as incorporating the whole environment whether rural or urban, on land or under water, and incorporates ancient monuments, archaeological sites and landscapes, historic buildings, townscapes, parks, gardens, designed landscapes and marine heritage. In defining the historic environment, SHEP states that:

*'Importantly it also includes our buildings erected before 1919. Although the majority of older buildings are not listed, most provide flexible and often spacious domestic and non-domestic accommodation. A huge investment of money, energy and materials went into these buildings – it would be poor stewardship of this inheritance to neglect this.'*

For traditional properties that are not statutorily listed or of specific interest that marks them out from others of their type, employment of good conservation practice with regards to fire safety as detailed in this Guide will ensure the health of these building and their contribution to the local environment. The importance of these buildings to Scotland's built environment and our identity cannot be over-emphasised, yet the stock of 18th and 19th century buildings is constantly being eroded, either through demolition or alteration that adversely affect their character.

### 1.2.2 Listed Buildings

As stated above, statutorily protected buildings are effectively a sub-section of the historic environment, though a significant one. The Planning (Listed Buildings



*Illus 4 In addition to the historic building fabric itself, contents are often also of great importance*

and Conservation Areas) (Scotland) Act 1997 (the 1997 Act) requires Scottish Ministers to compile lists of buildings of special architectural or historic interest. The criteria for selection have evolved to broadly include age and rarity, architectural or historical interest and close historical associations.

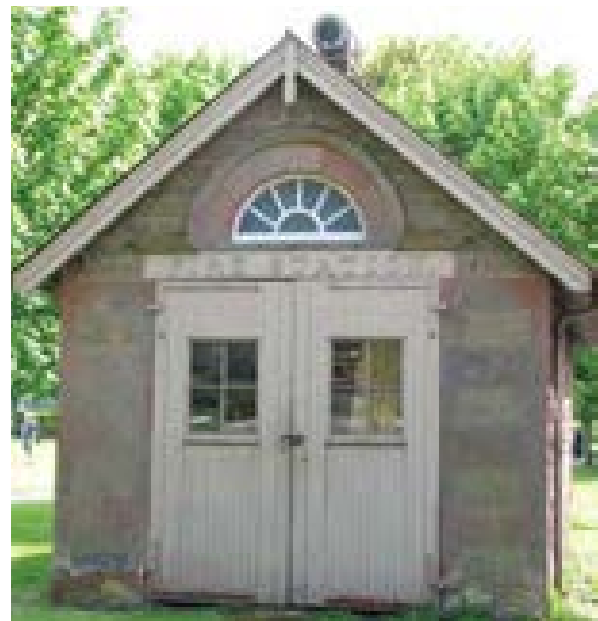
There are three categories of listed buildings:

**Category A:** Buildings of national or international importance, either architectural or historic, or fine little-altered examples of some particular period, style or building type.

**Category B:** Buildings of regional or more than local importance, or major examples of some particular period, style or building type which may have been altered.

**Category C(S):** Buildings of local importance, lesser examples of any period, style, or building type, as originally constructed or moderately altered: and simple, traditional buildings which group well with others in categories A and B or are part of a planned group such as an estate or an industrial complex.





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*Illus 5 Variety of traditionally constructed buildings in Scotland*

There are some outstanding 20th century buildings, built using contemporary materials and methods of construction, some of which are listed. However, for the purposes of this Guide, the advice will be confined to buildings of traditional construction that were built in Scotland up to around 1919.

In Scotland there are approximately 47,400 listed buildings (as at 2010), about 8% of which are listed at category A, 51% at category B, and the remainder at category C(S). The term 'building' is broadly defined in the legislation and can include (for example) non-habitable structures such as, fountains, sundials, statues, bridges, bandstands and telephone boxes. The protection afforded by listing extends to the whole building at the address given, including both its interior and exterior and may extend to any associated buildings or structures.



### 1.2.3 Conservation Areas

Under the 1997 Act, planning authorities also have a duty to identify and designate areas of historic or architectural interest and to ensure that development preserves or enhances the character of those areas. There are over 600 conservation areas in Scotland (as at 2010) ranging from historic urban centres to isolated rural settlements, and often incorporating both listed and unlisted buildings, many traditionally constructed.

### 1.2.4 Scheduled Ancient Monuments

Under the Ancient Monuments and Archaeological Areas Act 1979, nationally important structures can be scheduled as Ancient Monuments. The Act places a duty on Scottish Ministers to compile a schedule (list) of ancient monuments. Ancient monuments usually comprise archaeological remains and uninhabited historic buildings and are given protection against unauthorised change.

## 1.3 Broad Principles Affecting Works to Historic Buildings

For any type of works affecting historic buildings for instance implementing fire safety measures required either under fire safety regulations in an existing building or building standards during a conversion, due respect must be paid to the cultural value of the building, its form, structure and internal arrangements, so that risks of damaging the character are minimal. The broad principles for the conservation of historic buildings are set out in British Standard (BS) 7913: 1998 *Guide to the Principles of the Conservation of Historic Buildings*. This standard suggests a range of criteria for alterations work. (refer to Box 1)

In addition, there are a range of international charters, conventions and recommendations that have a bearing on how works to historic buildings must be planned and organised such as The Venice Charter (1964), The Bura Charter (1979) and The Washington Charter (1987). Historic Scotland's *SHEP*, provides more current policies and principles involved in managing the historic environment.

*Illus 6 The Georgian New Town of Edinburgh, a masterpiece in urban planning*

**Box 1 Extract from BS 7913: 1998 *Guide to the Principles of the Conservation of Historic Buildings*, Section 7.4.3**

Criteria for alteration work:

- a) Sufficient survey, investigation, recording, documentary research and analysis should be undertaken in advance of design work to ensure that the building is as well understood as reasonably possible and that the risks of accidental damage, destruction, missed opportunities or unexpected discoveries are minimised.
- b) Disturbance of significant existing fabric should be avoided and any unsound work retained and repaired in association with alteration work wherever possible. The need for alterations should not be used to justify avoidable damage or destruction. The level of intervention should be at the lowest appropriate level, and this should be capable of being substantiated.
- c) Some buildings or parts of buildings are of such quality, importance or completeness that they should not be altered at all except in the most exceptional circumstances.
- d) The need for alteration can, nevertheless, sometimes justify the removal of earlier work which, though part of the history of the building, is not of appropriate quality, is not well integrated architecturally, and manifestly detracts from the overall quality of the architecture.
- e) The need for alteration can sometimes justify the restoration of the layout or of missing parts of the building according to an original or earlier design.
- f) Even materials now regarded as hazardous can be of historical significance, and if so may best be left undisturbed.
- g) New work in alterations should always be of appropriate quality, should not draw attention disproportionately, and should contribute to the architectural integrity of the altered building as a whole. In many circumstances it is appropriate for new work to be different and distinguishable from pre-existing work and to be in a natural contemporary manner. In other circumstances it may be appropriate for new work, even when it is not restoration according to an original or earlier design, to be carefully matched in materials, construction and details to existing work, subject to appropriate identification and records.
- h) Consideration should always be given to the desirability of carrying out alterations in such a way that they could be reversed quite easily; that is, new work could be removed and the building reinstated to its previous state without further significant damage to the pre-existing fabric. This is particularly desirable in alterations like the installation of services, where the life of such services is likely to be short compared with that of the building as a whole.



*Illus 7 The 18th century Stanley Mills lay derelict for many years, but is now an award winning conversion project comprising a heritage centre and riverside flats*

## 2 ADAPTIVE REUSE OF TRADITIONAL BUILDINGS

It is widely agreed that the best way to protect and preserve traditional buildings is to ensure that they remain in use. The philosophy of 'use it or lose it' has a firm foundation in that there is strong and clear evidence to demonstrate the risks to which empty buildings are exposed.

According to the Fire Protection Association, there are probably around 9000 fires in empty buildings in the UK each year. For many properties, these fires come as the last act in a well-understood decline into dereliction that starts with minor vandalism (graffiti and broken windows) and ends in total destruction. In *Heritage Under Fire*<sup>3</sup> it is estimated that around 27% of the heritage and historic buildings which are damaged or destroyed by fire could be classified as 'empty, unused or otherwise at risk'. Likewise, a survey of fire in historic buildings under the COST Action C17 revealed that 27% were to disused/derelict buildings. It should also be understood that firefighters are at particular risk when tackling such fires, as often there are weakened structures and holes in floors following vandalism or previous fires

Most existing traditional buildings can continue in their original use and in general this will be the best option to protect the special qualities of the building and minimise the need for physical upgrading of the fabric. If this is not possible, the majority of traditional buildings are capable of adaptive reuse, bringing new life to them and enabling them to continue to benefit society. When making decisions on the future of buildings, typically only the short-term return on investment capital is considered. For existing buildings, it is much more appropriate to consider whole-life costs and use these figures to guide the decision-making process.

The problems engendered by vacancy and redundancy results from the changing needs of society, industry and commerce. For example, the decline in churchgoing has resulted in significant numbers of places of worship becoming redundant. Indeed, they feature disproportionately high in the UK annual fire statistics and a significant proportion of these fires are deliberate.<sup>4</sup> Also, the loss of manufacturing industry in textiles

<sup>3</sup> *Heritage Under Fire*, report of the UK Working Party on Fire Safety in Historic Buildings, Fire Protection Association/S. Kidd.

<sup>4</sup> Guidance on fire safety management in places of worship can be obtained from the appropriate insurance company and from a series of English Heritage publications developed for cathedrals. Chapter 10 of the US National Fire Protection Association's Code for the Protection of Cultural Resources 909 also provides a useful overview (2005).

and heavy engineering has resulted in mills, factories and warehouses being left to their fate. Elsewhere the change in the way businesses are run has resulted in empty banks and derelict office blocks in the cities. Even in retailing, the move away from the traditional city centre department store to the out of town mall has left prominent buildings searching for new uses.

The maintenance burden and possible liability issues of these older buildings can result in their demolition or abandonment.<sup>5</sup> On occasions there are no concerted or co-ordinated plans to try to find new uses for many redundant buildings and sometimes it would seem that planning law actually militates against this. Sometimes interim uses are found for buildings, the former department store becomes a kind of bazaar for small business and infelicitous divisions and non-compliant changes often follow.

The barriers to reuse revolve mainly (but not solely) around the constraints imposed by planning laws and building standards (aimed primarily at new-build) and while it is important that the sensible intentions of those who framed these laws are complied with, it is also clear that there can often be room for flexibility. While this does not (and certainly should not be taken to mean) that 'anything goes', the wider benefit to the community of a new use for an old building and its continued existence should be seen as a first resort once it is clear that the building's original purpose is no longer viable. The phrase 'use it or lose it' should be the watchword and presumptions in favour of sensitive reuse and conversion should be exercised in favour of the building and its surroundings.

One of the principal differences between a new building and the conversion of an existing one is that the selection of materials, constructional forms and techniques may be limited in the latter, whereas in new-build the choice is wide and limited mostly by cost. In conversion work, each project is unique and experience gained in one building, especially relating to cost data, cannot always be transferred directly to another building. The room to manoeuvre may seem to be less than with new-build, as options relating to choice of materials or construction methods may be limited to those that will perform well

<sup>5</sup> The present system of permitting business to be exempt from paying local rates for empty buildings which are roofless seems designed to promote this and recent changes in the way business rates are levied on empty buildings in England and Wales has positively encouraged the demolition of older buildings.

in conjunction with existing fabric. A large part of the success or failure of a development may be attributed to initial decisions, but at each stage of the process it is necessary to consider what effect changes to the building will have on ultimate value, both financial and cultural.

## 2.1 Successful Adaptive Reuse Projects

Despite the issues highlighted above, there have been many major successes in the search for alternative uses across the country. These have involved a wide range of building types from churches to farm steadings and from lighthouses to castles and vary in scale from conversion of an individual building to a mixed-use, phased development of a large complex.

Throughout the industrial heartlands of the UK, there have been many successful conversions of former mill buildings, maltings and the like. The late 19<sup>th</sup> century Templeton Carpet Factory in Glasgow, with its distinctive polychromatic brickwork, modelled on The Doge's Palace in Venice, has been converted into a 'lifestyle village'. The complex incorporates offices, apartments, a gym, food and drink outlets and even a micro-brewery. In 1986, the complex was the winner of the supreme award in the Regeneration of Scotland Design Awards.

Another success story has seen the conversion of the redundant 18<sup>th</sup> century Stanley Mills, famously associated with the industrial inventor Richard Arkwright, into a heritage centre and riverside apartments.

Having lain vacant for years, the India of Inchinnan, an Art Deco building designed in 1930 for India tyres, was converted to UK head offices for a worldwide technology company. Whilst the front façade has been preserved, there is a striking modern addition to the rear elevation.

Buildings related to transport and communications continue to evolve and modernise, the consequence of which can lead to redundancy. In 1998 the last lighthouse in Scotland was automated, removing the need for accommodation associated with the lighthouses. At some lighthouses, the keepers' cottages have since been converted to self-catered holiday accommodation, such as the Mull of Kintyre, Mull of Galloway, Covesea and Stoer Head lighthouses.

Redundant railway stations are often candidates for conversion. In Scotland, the smaller scale conversion of the Old Royal Station at Ballater into a museum and restaurant, shops and tourist information centre can be counted as a great success as much of the internal fabric and layout has been preserved intact. On a grander scale,



Illus 8 Templeton Carpet Factory © Crown Copyright: RCAHMS. Licensor [www.rcahms.gov.uk](http://www.rcahms.gov.uk)



*Illus 9 The striking modern addition to the rear elevation of the India of Inchinnian Tyre Factory makes allusion to airships and aircraft wings, both of which were made in that location*



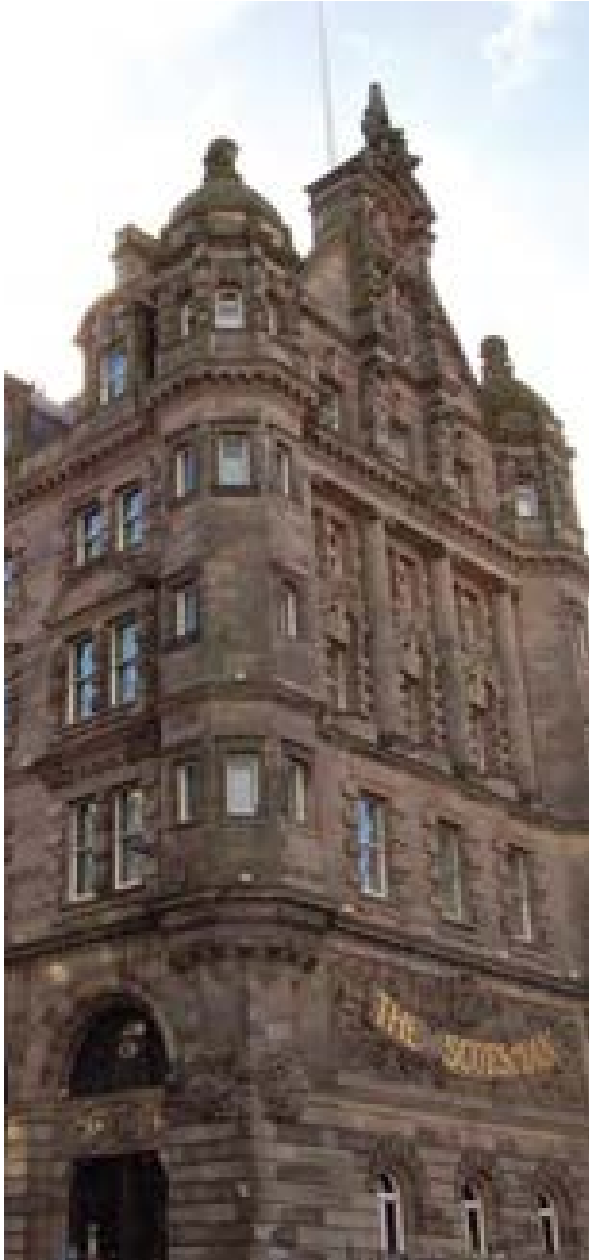
*Illus 10 Successful conversion of the redundant Old Royal Station at Ballater into a museum, restaurant, shops and tourist centre*  
© Denis Urquhart

in Manchester a major exhibition and conference centre has been inserted into the former Central Station and its nearby goods depot and warehouse, derelict and the prey of arsonists in the 1980s, is now an up-market shopping centre, entertainment facility and apartment complex.

A common occurrence in the commercial world is for companies to move to modern open-plan offices on the outskirts of urban areas, leaving large city centre properties without a lifeline. The former printing and

editorial offices of The Scotsman, a prominent local landmark in Edinburgh, has found a new lease of life as a five star boutique hotel, complete with restaurants, cinema and spa and health club. The impressive wooden panelled reception room survives as a brasserie.

Redundant churches are an increasing dilemma and research is clear that they are frequently the target of wilful fire raising. Glasgow has many fine examples of church conversions. St Andrews in the Square, an



Illus 11 The Scotsman, former newspaper headquarters, now a luxury hotel

early Classical church (1739) has been converted to a cultural centre, housing spaces for music, drama, dance, conferences, seminars and concerts. Another Glasgow success story, 'Oran-mor', formally a Parish church, re-opened in 2004 as a cultural centre with two bars, two restaurants, a nightclub and an auditorium for private events. The centre has gained a reputation for its lunchtime theatre programme. Similar examples exist throughout the country with churches being converted to a variety of uses such as community centres, antique galleries, workshops and even as residences.

Whilst adaptive reuse can breathe new life into individual buildings, it can also play a crucial role in area

regeneration. Former docklands across the country have or are undergoing redevelopment, often with conversion of existing traditional buildings being a focal point of these wider regeneration schemes. Examples include the Govan area of Glasgow, Dundee docks and the Leith, Granton and Newhaven coastline of Edinburgh. A former riverside Seaman's Mission in Leith was converted by the Malmaison hotel chain into a boutique hotel, a conversion that was seen as a turning point in the revival of Leith.

Decaying textile areas have often been given a new lease of life through adaptive reuse projects. Conversion of former textile mills such as Tay Works in the industrial Blackness area of Dundee acted as a catalyst for urban regeneration of the entire area. With the history of Dundee inextricably linked with the textile industry, survival of this significant area was crucial.

A £10 million Lottery funded regeneration project in Hawick, entitled 'The Heart of Hawick' is aimed at the social, cultural and economic regeneration of Hawick. Central to the project has been the conversion of two derelict buildings, one of which was Tower Mill, a former spinning mill. The Mill now houses an auditorium for cinema, theatre and conference events, a coffee house, meeting rooms and rental space for creative workshops and exhibitions (see illus 45).

## 2.2 Adaptive Reuse and Sustainability

The adaptive reuse of buildings relates closely with the issue of sustainability. Sustainable development is defined by the Brundtland Report, 'Our Common Future', 1987 as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

The conversion of existing buildings, instead of creating a completely new building, takes advantage of the energy already embodied in the fabric of that building. The energy expended in the manufacture of materials, transportation and construction of new buildings is estimated to equal the energy necessary to heat, light and ventilate or condition the building for between five and ten years. Therefore sustainability favours the retention of existing building stock, advocated by the Sustainable Development Commission (2005).

Historic Scotland's SHEP, Section 1.31 emphasises:

*'the contribution made to sustainable Scotland by the repair, maintenance and reuse of our older buildings, particularly the half million traditionally-constructed domestic buildings built before 1919....the waste caused by the unnecessary demolition and replacement, with consequent loss of embodied energy, the need for landfill and the sourcing and transport of new materials, should be avoided wherever possible.'*





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Illus 12 The regeneration of the declining Blackness area centred on the conversion of several prominent 19th century textile mills including, as illustrated here, Tay Works

The Scottish Government's drive towards sustainability is recognised in Scottish Planning Policy: *Planning and the Historic Environment* (SPP 23)<sup>6</sup> that encourages the reuse of existing buildings:

*'The historic environment .... is a finite resource and its conservation and management contributes directly to sustainability. From the energy and materials invested in a building, the scope for adaptation and reuse, to the unique quality of historic settlements with their mix of uses and good connectivity, the historic environment is a vehicle for achieving sustainable development and adapting to social and economic change.'*

6 The Scottish Government is rationalising national planning policy and SPP 23: Planning and the Historic Environment (2008) is to be incorporated into a combined Scottish Planning Policy (draft consultation, 2009).

SPP 23 also states that with the careful application of planning policies:

'the historic environment can often be adopted to new uses, offering opportunities for new and creative design, whilst retaining its special character.'

The *Scottish Sustainable Communities Initiative* launched in 2008 aims to create sustainable living environments and encourages, 're-using existing building, either in terms of conversion for new uses or by recycling the building materials.'

The 2003 Act also recognises the drive for sustainability and encourages furthering the achievement of sustainable development, responsibility for which in terms of the regulations rests with the owners of the building, as a new objective.



*Illus 13 Aerial view of Leslie House, a category A listed mansion, that was severely damaged by fire during sub-division to luxury flats © Crown Copyright: RCAHMS. Licensor [www.rahms.gov.uk](http://www.rahms.gov.uk)*

### 3 VULNERABILITY OF TRADITIONAL BUILDINGS TO FIRE

Pre-1919 traditional buildings include almost every building type, from crofts to palaces, warehouses to farm steadings, lighthouses to railway stations and church halls to cathedrals. The range is enormous with immense differences in scale, complexity and construction. Built with little or no concern for fire, traditional buildings are often more vulnerable to fire and its effects than new build.

Regardless of the age of the building, it follows that their vulnerability to fire also varies considerably and a central theme of this Guide is that each building is unique and may be vulnerable in its own distinct manner requiring individual assessment and, if necessary, precautionary measures. As with other performance criteria, a building's performance in fire cannot be compared directly with any other building: there are huge variations in the scale, complexity, construction, materials, fire load and fire risk between buildings. The use and occupancy of traditional buildings may also produce special circumstances. Large numbers of visitors, coupled with historic furnishings and decoration present one type of risk while the very remoteness and lack of occupancy of some buildings creates another, because of the time taken to raise the alarm and for the fire service to arrive at the building. The vulnerability of a historic school or church is very different during the periods of intense use compared with the often longer periods when the building may be empty and unvisited.

Many traditional buildings have grown and been adapted over several generations greatly changing their vulnerability, as has the reuse of some buildings for new purposes. Sometimes this is beneficial in fire risk terms, for example, the decline in use of open fires. However, in other cases the careless introduction of new services, or use of inappropriate materials may increase risk, both through the creation of routes for fire spread and an increase in possible sources of ignition, for example the proliferation of electrical appliances. Poorly executed work can create openings that will encourage the spread of fire, especially openings into hidden voids. This is particularly true as a result of the haphazard installation of services, where little attention has been paid to the resultant impact on fire risk.

Interconnecting voids probably present the greatest hazard to the traditional building in a fire. Ducts, chases, chimney flues and ventilation shafts all provide easy routes for fire and smoke to spread and may allow



*Illus 14 The haphazard installation of services can compromise a compartment wall © Stewart Kidd*

a fire to smoulder unnoticed for many hours before breaking out some distance from the actual point of origin. The need for individual appraisal of the building under consideration is paramount in this respect, and in most cases careful research is required to understand the construction and the connection of voids in often quite complex buildings.

Classic examples of the detrimental impact of hidden voids are the fires at Windsor Castle and Hampton Court Palace, which spread more rapidly due to the presence of hidden voids. Another example where voids aided unpredictable and rapid fire spread, is the 2002 fire in the Old Town of Edinburgh, a World Heritage Site. The difficulties encountered while fighting it, the extent of damage and the unpredictable fire spread, all serve as an exemplar of the problems of fire spread in traditional buildings, the impact of uncontrolled adaptation and the failure to introduce basic fire safety measures when changes of use had taken place. There is a fuller account of the fire and its implications for the fire and rescue service and the building occupiers in Annex V.

### 3.1 Structural Vulnerability of Critical Construction Elements in Fire

Construction techniques employed in traditional buildings, and constructional elements can also create particular areas of risk. To some extent fire resistance is helped by the limitations of historic materials, which often dictated small spans of floor beams compared to modern buildings and consequently a tendency to cellularity in the form of thick stone walls at frequent intervals which can restrict lateral fire spread. The advantage of a cellular plan arrangement, is however, offset by other features that have a negative effect on fire risk, such as:

- Timber floors
- Timber staircases
- Walls lined with plaster on timber laths
- Timber-framed internal load-bearing partitions
- Timber built into masonry walls
- The presence of interconnected flues and voids
- Combustible linings
- Large, interlinked roof voids
- Complex timber support structures to create vaults and domes
- Timber doors which may be too thin or poorly fitted
- Obsolete electrical wiring
- Unprotected iron and steel supporting structures.

Examination of most buildings will show that each has its own natural lines of compartmentation, which can be utilised to provide separation elements that, with a little attention, are capable of providing at least thirty minutes of fire protection, and often provide an hour or more. An assessment of the existing compartments should thus form an important part of the fire protection strategy for the building.

The design of fire safety measures for a traditional building should respect these natural compartments or cells, as their removal or alteration could have a serious impact on fire safety, development economics and, not least, historic fabric. It follows that, when deciding on a compartment strategy for the building, a full understanding of the location of all the hidden voids should be available to those responsible for the decisions.

#### 3.1.1 Walls

Thick stone walls have a great resistance to the passage of smoke, heat and flame. However, in many buildings



*Illus 15 This compartment wall was compromised by a structural roof timber travelling through it*



*Illus 16 The lack of stopping around service installations has adversely affected the compartmentation*

numerous flues and other voids weaken their integrity in fire. Over time 'feathers' forming the sub-division between flues may have become damaged, ceiling or roof timbers may be built directly into or against a chimneybreast, mortar may have loosened, or holes may have been created for services. Voids can exist behind window shutters or around door frames set into masonry walls, and these spaces may link throughout a building in unexpected ways.

The common construction of walls lined with lath and plaster or timber panelling creates narrow continuous cavities, and these present one of the most vulnerable elements in terms of fire resistance. The cavities often link with those present in floors and can run throughout a building, giving an easy fire path with both fuel (timber) and air present. A fire can smoulder unnoticed for many hours before breaking out some distance from the actual point of origin.

Care is also required in assessing other types of internal wall. Timber stud walls, with lath and plaster on each side may have reasonable fire resistance from room to room, but the void between the studs can provide a fire path



*Illus 17 This post-fire image from a category A listed building clearly illustrates the gap that exists behind traditional lath and plaster walling (essential for ventilation)*



*Illus 18 A traditional technique in early buildings was to decoratively paint the underside of floorboards. Although this offers little fire resistance, where such decoration survives it is important to retain it*

with little resistance at the foot or head. Stud infilled with brick is also a common internal construction and can go undetected, appearing solid at first examination, but containing continuous timbers.

### 3.1.2 Vaults

Vaulted masonry construction can give excellent fire performance and can occur as medieval or ecclesiastical vaulting or as industrial brick vaulting. The construction can usually be readily seen, but careful assessment is required as the presence of cracks, fissures, built-in timbers, size of spans, proportion of openings, later intrusions and breaches of the vaulting (eg for services) will all affect fire performance. The type of material and its resistance to thermal effects and thermal shock are also a consideration. Careful repair and reinstatement of the integrity of the masonry will enhance fire resistance.

### 3.1.3 Floors

Floor construction in traditional buildings presents a special area of vulnerability. Apart from a small number of buildings that have stone or brick vaulted floors with excellent fire resistance, the most common floor constructions in traditional buildings are of timber construction which rely on timber joists or a system of heavy timber beams with lighter intermediate joists.

Early forms of construction lacked an applied ceiling, with the floor boarding itself laid over the joists (sometimes with the underside decoratively painted) providing little fire resistance. Later buildings have separating floors with plaster ceilings below on timber laths and ash deafening in the intermediary voids, which will perform significantly better, particularly if the plaster is sufficiently thick and sound. They may however still be vulnerable to fire spread through the ceiling voids or gaps at the perimeter. Floor timbers are usually built into



*Illus 19 It is common practice in traditional buildings for floor and ceiling timbers to be built into supporting walls*

walls and it is not uncommon for timbers to be built into masonry containing flues or into walls under hearths. For example, sparks from fires or embers falling through a cracked hearthstone can lead to ignition followed by the rapid spread of fire within the floor cavity which all too often links with the voids behind the wall strapping.

Whilst the fire resistance of floor constructions will often be compromised by the presence of cavities at the perimeter, filling or sealing the space can be unacceptably disruptive and may interfere with the natural ventilation necessary to maintain the timber elements in good condition. The application of intumescent strips at the floor edge, concealed behind skirtings may address these problems, but installation is disruptive and as yet, there is little practical experience of this application or its effectiveness.

As with all historic elements of structure, it is essential to assess the actual fire resistance of a floor. Timber floors are classified as 'combustible construction', and any upgraded floor must prevent fire from spreading from one floor to another. In essence, the protection offered by a floor to a fire from below depends on the plaster ceiling below, as the age and condition of the plaster and the strength of its key to the lath will greatly affect its ability to perform in fire.

Although timber is a combustible material, the structural timbers in many traditional buildings tend to be generously sized in relation to the spans and imposed loads. The fire resistance of a timber section can usually be predicted and is based on the rate of charring: timber suffers no appreciable loss of strength until charring occurs. However, an oversized timber beam can achieve a significant level of fire protection, as charring of the outer surface will reduce air supply for combustion below the char layer and thus inhibit the rate of loss of strength of the beam. Treating the undersized timber elements of a floor with an intumescent coating will increase further their fire resisting capabilities. Section 3.2.3 details other factors that can affect timber performance in fire such as rot or insect attack

Upgrading the fire resistance of a floor can be a difficult task, which may result in some loss of historic fabric, but there are a number of recognised upgrading methods (refer to Section 2.2.3, Part 2, Guide for Practitioners 6):

- Consolidate any deficiencies in the original construction
- Introduce mineral fibre quilt supported between or below the joists
- Insert intumescent sheet material over or under existing surfaces
- Insert intumescent material at the perimeter of the floor to close the link with the wall cavities in the event of a fire
- Apply intumescent coatings to ceilings
- Apply additional layers of fire resistant boards to ceilings.

It may be more practical in certain cases to consider concentrating on reinstating the integrity of walls, perhaps increasing the number of fire divisions in plan to compensate for the weaknesses in the floors, coupled with other fire precaution measures such as detection or suppression.

### 3.1.4 Doors

Despite frequently being of intrinsic historic value, doors are often the fundamental weakness in a separating wall. Upgrading the fire resistance of doors is a substantial topic in its own right and the subject of extensive debate and advice. Doorsets that have gaps in their construction, or contain glazing, may readily allow fire to spread beyond the compartment of origin. As a result of research<sup>7</sup> there is now a better understanding of the actual performance of doors in fire, which permits a more realistic assessment of historic doors in these situations, leading to solutions that can retain them in place.

There are a number of techniques that can be employed to improve the fire resistance of a door (remedial joinery work is also often required), including:

- Facing the door with non-combustible boards, which can be removed at a later date with minimum damage
- Sealing all cracks and gaps with an intumescent paste and applying coats of intumescent paper, varnish or paint
- Fitting proprietary intumescent strips and flexible cold smoke seals to seal the gap between the door and frame.



*Illus 20 Original Georgian doors whose retention was facilitated by partial sprinklering of the property*

<sup>7</sup> English Heritage: *Technical guidance note on upgrading the fire resistance performance of timber panelled doors and frames*: 1997.



*Illus 21 Doors in principle reception areas often can be elaborately detailed, so their retention is preferable © Crown Copyright: RCAHMS. Licensor [www.rcahms.gov.uk](http://www.rcahms.gov.uk)*



*Illus 23 In this heritage property doors have been carefully removed to go into storage © Stewart Kidd*



*Illus 22 In the upgrading of these double doors in a reading room at the National Library of Scotland, cold smoke seals were run along the stile*

Further information on improving the fire resistance of doors can be found in Part 2, Section 3.5. There may be some situations where it is not practical to improve the fire resistance of a door, either because of its method of construction or because its intrinsic value makes alteration unacceptable. In the latter situation and as a last resort, the doors might be removed and placed in storage keeping the doors safely in a controlled environment to prevent damage or distortion, preferably in the building itself.<sup>8</sup> Listed building consent may be required in the case of listed buildings, and it may be found that some alternative use, or the blocking up of the side that is of lesser importance behind doors that are fixed shut, offer a more appropriate outcome.

<sup>8</sup> Care should be taken to ensure that the doors are securely labelled with the details of their original location.

### 3.1.5 Roofs and Roof Voids

Roof voids are also an important feature of the fire resistance characteristics of any building, making their investigation an important aspect of the fire risk assessment (refer to Part 1, Section 8). Fire attack from external sources such as sparks, fires from neighbouring buildings and lightning strikes requires consideration, particularly when thatch or shingle finishes are present or buildings are in close proximity. However, the complete destruction of roofs from fire originating within the building is, unfortunately, a more common occurrence.

Many compartment walls do not continue up into the roof void, or are compromised by openings, thus permitting the unhindered and rapid spread of fire along the roof space. This is common in terraces, such as Edinburgh's New Town, where individual terraced residences may be linked via the attics. Compartmentation of the roof void is an essential element of upgrading the fire performance of the building. This may be less disruptive to address within roof spaces than in other occupied parts of the building. The historic fabric must be considered as installing fire-insulating barriers that do not line up with the existing compartment lines in the accommodation below will undermine the fire integrity of the structure.<sup>9</sup>

Regarding compartmentation, some buildings have particularly large volume roofs, for example, domes in churches or civic buildings, and are vulnerable due to the ease with which fire can spread unhindered. It may be possible to consider their sub-division. Tall structures

<sup>9</sup> However the presence of established bat roosts in a roof space will inevitably constrain measures that can be taken to introduce fire compartmentation or upgrading of fire barriers. Specialist advice should be sought before taking any steps which might contravene the Nature Conservation (Scotland) Act 2004 and the Wildlife & Countryside Act 1981.



*Illus 24 Attic roof void with the additional fuel loading of a timber vaulted dome, Culross Palace, Fife © Stewart Kidd (by kind permission of the National Trust for Scotland)*

such as bell towers or spires can present special risks and are frequently poorly separated from other roof spaces.

Roofs may contribute to the overall fuel loading (literally, the potential quantity of combustible material) of a traditional building, as roofs often have substantial timber structural elements and timber sarking. For example large roof domes in civic buildings are often double skinned and contain large quantities of structural timbers with little fire resistance from below and little internal division.

Structural roof timbers may have also been rendered friable as a result of insect attack. Some forms of timber treatments that use a flammable liquid as a carrier for the insecticide, may aggravate this problem.

The fuel loading is also commonly enhanced as roof voids have a tendency to be used as storage spaces. This poses an additional fire hazard due to the build up of combustible materials and debris. Fire strategies should ensure that all debris is removed.



*Illus 25 Substantial hidden void above a coombed ceiling in a traditionally constructed building. Voids can aggravate fire spread and should be considered when assessing risk*



*Illus 27 A common occurrence in various types of properties is the storage of infrequently or unused items in attic spaces, adding to the fuel load in these vulnerable areas © Crown Copyright: RCAHMS. Licensor [www.rcahms.gov.uk](http://www.rcahms.gov.uk)*



*Illus 26 Large attic spaces with no compartmentation are common and facilitate the rapid spread of fire © Crown Copyright: RCAHMS. Licensor [www.rcahms.gov.uk](http://www.rcahms.gov.uk)*



### 3.1.6 Service Routes, Ducts and Shafts

In addition to flues (often a concern due to their frequent poor condition and the presence of hot gases and sparks) other long forgotten ducts or shafts may be part of the original construction – waste shafts, natural ventilation stacks, bell pulley routes, dumb waiters and so on. Such voids, often interconnecting, are extremely hazardous to a traditional building, providing fire and smoke with an easy route by which to spread and care is required in dealing with them. A number of products exist for improving fire resistance including intumescent ‘pillows’ that can be packed into voids, but are completely ‘reversible’.

While the blocking of any unused ducts that may contribute to fire spread should be considered, it is important that the role of the ducts in providing internal ventilation is also taken into account. Traditional buildings rely on relatively high air change rates to ensure that damp and rot are kept at bay, and upsetting this balance may have far-reaching consequences. One way to avoid such unwanted side effects is to use mechanically or electrically operated fire dampers that operate to close off ducts when a fire is detected.



*Illus 28 Dumb waiters, often disused, provide a large hidden passage that can aid the rapid travel of fire between floors*  
© Stewart Kidd



*Illus 29 When notching structural elements, such as floor timbers, for the installation of services fire stopping must also be addressed*  
© Stewart Kidd

Many traditional buildings have suffered from the careless installation of services, often over several generations. Apart from the risks emanating from the condition of the services themselves, all too frequently routes have been driven through walls and floors destroying their effectiveness as fire barriers. Within floors the notching of joists, loss of deafening and the puncturing of finishes, often seriously reduces fire resistance. These routes and the materials comprising the services or service ducts create paths for fire to spread along. Ductwork, particularly when associated with catering, can be particularly hazardous, becoming lined with grease deposits over time. PVC-sheathed insulated wiring and plastic pipework also pose risks. Older electrical systems, insulated with vulcanised India-rubber are a potential source of ignition through the cracking of the insulation and consequent exposure of the live conductors.

Much can be done to complete the effective natural compartmentation of a building by attending to these issues. Where it is not possible to remove services, attention is required to build-up openings, firestop holes, restore deafening and other finishes and where necessary fit fire dampers to ducts or fire collars to pipework.

### 3.1.7 Aged Construction

The age and condition of historic construction elements may present particular concerns. Some examples include:

- Drying and shrinkage of timber features. For example, a warped or poorly fitting door will seriously reduce its fire performance
- Water penetration may weaken mortar, rot timber fixings (such as dooks to wall linings) or lead to loss of bonding between plaster and laths, all of which affect fire performance.

Frequently it is the very age and character of such elements that enhances the value of the building, and careful assessment is required to balance the need to protect and conserve the original construction against the desire to protect from loss or damage by fire.

### 3.2 Fire Performance of Traditional Materials

In assessing the vulnerability of traditional buildings, in addition to constructional elements, building use and occupancy pattern, knowledge of the behaviour of materials in general terms when subjected to attack by fire is useful. It may also be necessary to consider how the effects of age, physical treatments and other degradations on the material could alter their behaviour in fire. In considering the options available for directly improving their behaviour in fire of any materials, using other protective coatings and devices, possible effects on the physical appearance or original form, must be understood.

### 3.2.1 Testing

Information on the likely performance of some materials or forms of construction can be obtained from published test data. Useful information can be found in the following:

- Timber Research and Development Association (TRADA) publications
- Warrington FIRAS publications
- LPCB/BRE Certification publications
- National Fire Protection Association data (NFPA is based in the USA)
- English Heritage publications
- Manufacturers' literature detailing the application of fire protective treatments.

In newly constructed buildings, prototypes of 'standard' combinations of materials can be tested without restrictions to BS476-10: 2009 *Fire Tests on Building Materials and Structures*. This is not the case for historic buildings where each component exists in situ, is unique and has value. All other options should be considered before subjecting historic fabric to destructive furnace tests.

### 3.2.2 Masonry

Stone and brick are non-combustible and when built in mass form, combined with appropriate mortar binding, can have great resistance to the passage of smoke, heat and flame. In addition to the construction of external walls, internal dividing walls and floors using vaulted construction, masonry is used to enclose fireplaces and form hearths on otherwise combustible constructions.

Although non-combustible, stone is not an immutable material. Masonry, including columns, walls or delicate cantilevered staircases, may be vulnerable to thermal shock experienced during fire, which can cause reduction in strength, loss of surface material and damage to the structural integrity of the stone. The condition of stonework and pointing prior to a fire are critical to overall fire performance. Fire damage to masonry, particularly to fine carving or tracery, is often irreversible. In fires of very high temperature it is possible for water particles contained within masonry to expand and cause a sudden fracturing of stones. In such cases, rapid cooling by water from fire hoses, a sudden reversal of the initial thermal shock, can lead to loss of surface material.

A research team from Queen's University, Belfast and Instituto Geologia Economica, Spain, has been researching the effect of fire on heritage stone. Subsequent research papers include *Impacts of Fire on Stone*<sup>10</sup> 2009 and a research paper from the COST

<sup>10</sup> *Impacts of Fire on Stone-Built Heritage*. Miguel Gomez-Heras, Stephen McCabe, Bernard J Smith and Rafael Fort, 2009



*Illus 30 A localised fire that has caused discoloration of the sandstone in the area affected by flames and the stone above has been covered by soot. The heat also caused fracturing of the stone and loss of material © Dr Stephen McCabe*



*Illus 31 Fires have always been a threat - here the effect of a historical fire is evident by the severe spalling of the granite, especially around the windows © Dr Miguel Gomez-Heras*

Action C17, *Fire Damage of Heritage Building Stones: Methodological Considerations on Current Research*.<sup>11</sup> All stone undergoes an ongoing process of decay through thermal variation caused by environmental cycles of heating and cooling, but a fire accelerates this natural process. The research summarised that there were two main types of stone decay resulting from thermal shock during fire:

- Short-term macroscopic effects - mechanical breakdown (diminishing strength caused by the differential expansion of minerals at high temperatures) presents itself as microcracking, cracking and spalling. Fire can also deposit a layer of soot that can reduce permeability and exhibit hydrophobic tendencies and later detach itself. Chemical effects can also occur such as discolouration caused by the thermal oxidation of iron-bearing minerals.

<sup>11</sup> Cost Action C17: *Built Heritage: Fire Loss to Historic Buildings: Final Report Part 1*. Historic Scotland 2007

- Long-term microscopic effects: chemical changes to the mineralogy and texture. For example, porosity properties can be altered or ions from the products of the combustion process can enter through pores and lead to the formation of new compounds such as salt that will accelerate decay.

Whereas earlier research concentrated on the macroscopic effects, now there is a realisation that fire can leave a stress legacy that can subsequently be exploited by other decay processes such as salt and freeze/thaw weathering for many years.

The research suggests that the effect of fire on stone is dependent on the stone type. In harder stones such as igneous rocks mechanical/physical breakdown will be the main decay process whereas granular, more porous stone types, such as sandstone tend to absorb mechanical impact with the main impact being alterations to the chemical and mineralogical makeup of the stone (although some mechanical symptoms will still occur in granular stone types post-fire such as spalling).

### 3.2.3 Timber

Traditional buildings often have a substantial amount of timber and as a combustible material, timber can contribute rapidly to a fire within a building and the effect is catastrophic. Timber does, however, also have a degree of fire resistance that increases with the thickness of the component under attack. Hence, while thin timbers such as window shutter and door panels, decorative wall lining boards and other trims will readily burn, large timber stud frames, and structural elements such as beams, columns and roof members will burn at a slower rate and may perform their function for longer and even beyond the duration of the fire.

In addition to thickness, fire resistance may also be affected by:

- The species, moisture content and growth characteristics of the timber
- Subsequent treatments and applied finishes. Timber finished with polishes, waxes and paints or treated with spirit-based insecticides or anti-fungal treatments, could increase the potential for fire development
- Attack by insects or wet rot and dry rot fungi can also weaken structural strength and hence ability to resist fire
- The presence of shakes, splits or shrinkage cracks will adversely affect the behaviour of timber in fire.

Care must also be taken to assess whether hidden timbers have undergone repairs or been notched to enable service pipes or cables to be inserted into the building.



*Illus 32 These listed residential properties, one large scale, the other small scale, both illustrate that there is often a high timber component in traditional buildings – floors, panelled walls and ceilings*  
© Crown Copyright: RCAHMS. Licensor [www.rcahms.gov.uk](http://www.rcahms.gov.uk)



*Illus 33 Due to their thickness structural ceiling timbers can burn slowly and perform their function for a long period*



*Illus 34 Fire initially attacks areas of weakness as seen in this furnace test where the thin door panels have failed early in the test*

Although a number of treatments exist to improve the fire resistance of timber elements, these must be carefully assessed as they may produce major, often unacceptable changes in appearance and chemical composition. Where the surfaces are of historic importance, for example decoratively painted timber ceilings, these treatments are unlikely to be appropriate.

#### **3.2.4 Plaster**

Traditionally plaster was applied directly onto solid masonry, but later the primary technique employed was lath and plaster. This involved applying plaster to a timber frame, comprising thin strips (laths) that were nailed to upright studs attached to the wall. A cavity was left between the wall and plaster. Whilst theoretically giving a good level of fire resistance, the performance of traditional plaster is usually reliant on the condition of the mechanical bond ('key') between the plaster and laths, and if lost, plaster will start to detach. The condition of the plaster's key with the background wall varies enormously; a good bond cannot be guaranteed. Performance in fire may be unpredictable and at a certain stage in a fire complete failure may occur. Failure can be sudden where the key was already in a weakened state, possibly the result of rotten laths.

While there have been some interesting developments in the manufacture and effectiveness of intumescent paints and varnishes, there are to date, no recognised, independently tested methods currently available for



*Illus 35 The back of traditional lath and plaster showing the wooden lattice structure that provides a key for the applied plaster*

directly protecting valuable ornamental plasterwork from fire by the application of fire resisting coatings. While some measure of protection might well be gained it is not yet clear whether such applications could be hostile to the surfaces of the plasterwork. This is an area where additional work would be useful.

### 3.2.5 Glass

During a fire, glass can melt in intense temperatures, or shatter due to gaseous explosions. Glazed openings are a potential weakness in the passive control of fire in otherwise sealed compartment walls, and there may therefore be great pressure to create improved fire resistance to these openings. Every effort should be made to retain historic glass and replacement should be seen as an option of last resort. Any glass removed should be handled carefully and stored for repairs or reuse.

The range of options that could be considered includes improvements to the way glass is held into its frame, provision of secondary glass and frames and replacement of existing glass with thicker or fire resistant glass.

Fire resistant glass is now available in several forms, including 'wired' glass, modified toughened or laminated glasses and insulated glass, to comply with BS 476: 22 1987 *Fire tests on building materials and structures. Methods for determination of the fire resistance of non-loadbearing elements of construction* (for glazed partitions in timber doors).<sup>12</sup> Most products in these categories rely for success on combination with an appropriate frame and fixing system, and therefore their consideration for use in traditional buildings must be carefully judged. Specialist advice may be required.

### 3.2.6 Steel, Wrought and Cast Iron

One reason for the development of metal as a structural element was specifically as a response to the performance of timber structures in fire. Whilst metals can be considered effectively as non-combustible, and therefore offering a degree of fire resistance, they also have characteristics which are themselves potential risks in a fire.

Metal structures will commonly be embedded with other constructional materials; brick, stone and timber. All metals have a crystalline structure and will expand when exposed to heat. In a fire this expansion can disrupt the end supports of steel and wrought iron beams and dislodge elements supported on iron columns. Beyond the natural period of fire resistance of the metal structural element, complete failure can be expected.

Cast iron is a brittle material, due to the arrangement of its crystalline structure, and failure is most likely to be a fracture across the material, which will occur suddenly and without warning. The application of water during a fire can trigger this sudden cracking and collapse of structural cast iron (to be taken into consideration if selecting suppression systems). Equally some cast iron elements can withstand the effects of fire, depending

<sup>12</sup> See also BS EN 1634-1: 2000 *Fire Resistance and Smoke Control Tests for Doors, Shutter and Openable Window Assemblies and Elements of Building Hardware. Fire Resistance Tests for Doors, Shutters and Openable Windows.*



*Illus 36 During a fire, expansion of the girders has caused movement in the walls of this listed property*



*Illus 37 Expansion of the internal beams has applied pressure to the external walls, causing large cracks along a section of the stringcourse*



*Illus 38 In industrial conversions, such as this pictured, it is common for the metal elements to be coated with intumescent paints. This is the Scottish Borders Enterprise business gateway in Ettrick Mill, Selkirk, 1836-1850, where steel was inserted around ground floor machinery in the early 20th century. The conversion lifted part of a timber floor to make a light reception area*

upon the type of fire to which the structure is exposed, and it may be possible for these to be reused in repair.

Conventional methods of fire protecting metal structures involved encasing them in mortar, concrete sprayed material or fireproof board and filling hollow sections with concrete.

Modern methods include coating with intumescent material, which can provide up to two hours fire resistance. This is common in industrial mill and warehouse conversions.

### **3.2.7 Thatch**

Thatch is by its very nature a combustible material and is vulnerable to fire from defective chimneys and flues which allow hot gases to escape. In the event of a defective flue, heat will build up deep within the thickness of the material, the insulating properties of which cause temperatures to rise to a level at which combustion will occur. Chimney fires, particularly where wood is used as a fuel, and wind-blown sparks from fires outwith the property can also cause fires in thatch roofs. Higher temperature heating appliances, such as multi-fuel stoves are likely to increase the risk of fires occurring, as flue temperatures will be increased with little corresponding cooling.

Thatch can be up to one metre in depth and once started, thatch fires are very difficult to extinguish, as fires can burn unseen within its depth and smouldering materials cannot be reached. Wire netting, commonly found enclosing thatch to provide protection against vermin, also renders access difficult. As a thatched roof is designed to resist water, normal methods of firefighting can be ineffective.



*Illus 39 Thatched property in a traditional blackhouse village on the Isle of Lewis*



*Illus 40 Fire represents a serious risk for thatched properties. Here the design for a contemporary enclosure for a fire hose has employed random rubble stonework like that used in the adjacent blackhouses, a visually sensitive approach*

Due to the difficulty of extinguishment, the aim must be to prevent fires occurring at all. Consideration should be given to lining, for example with a pumice liner, and regularly maintaining flues in their entirety, but the section of the flue that passes through the thatch requires special attention. Spark arrestors can be fitted to chimney cans but they require regular cleaning as blockages may increase the pressure within the flue. Although fire retardant chemical treatment may be applied (which will provide some protection to thatch), their effectiveness is questionable and may themselves cause earlier degradation of the material. Inserting barriers such as foil or inflexible fire retardant board between the thatch and the roof timbers may also be considered, but these can be detrimental as the health of thatch depends on free ventilation (especially a tight thatch laid over turf). Traditional treatments that involved the use of clay dressing may also be worth considering.

### **3.2.8 Paint and Other Surface Treatments**

Surface treatments and decoration in traditional buildings require careful consideration. In addition to acting as a fuel source, they are extremely vulnerable to damage from fire and smoke and also from fire suppression media, such as water or foam. The combustibility of materials such as polishes, varnishes, wallpapers and fabrics may be obvious, but the accumulation of years of paint can also create risk by feeding fires and giving off thick smoke and toxic fumes. Laboratory analysis can help determine the depth, chemical composition and degree of fire hazard of painted surfaces and also determine the nature of the original treatments and colour scheme. There may be circumstances where painting schedules should be restricted to prevent further coats being added to surfaces. This would allow a balance to be made between the increasing risk from thick paint layers and loss of information of historic paints and decorative room treatments.

Where paint removal from surfaces in listed buildings is being considered, such work may require listed building consent and detailed investigation and analysis of the paint and methods to be employed prior to work starting. Care must be taken in the method of removal of paint. Tools such as blow lamps or hot air guns are themselves hazardous and a fire risk, and physical abrasion can cause damage. The use of chemical poultices or hot steam strippers may be successful, provided their use is carefully controlled, and only after thorough test samples are carried out. Traditional methods of cleaning existing paintwork, rather than repainting, may be more appropriate in certain circumstances.

### **3.3 Additional Fuel Loading**

An additional problem when considering the risks of fire in traditional buildings is the fuel loading of the building – literally, the potential quantity of combustible material. Such buildings may have, for example, substantial timber roof members and large amounts of timber wall panelling.

As a further example, many forms of traditional upholstered furnishing will not meet modern standards of fire resistance. This may increase the amount of material which will readily burn; however, experience also confirms that some natural materials (such as horsehair stuffing) are actually much less combustible than many contemporary upholstery materials.



*Illus 41 In this heritage visitor attraction, this storage area presents a fire hazard*

In many museums and galleries (as well as country houses) the revenue obtained from catering, shops and conference/seminar activities is now a significant factor in the economics of heritage management. At the same time it must be realised that many of the materials brought into traditional buildings may contribute to the fuel load. Care must be taken to ensure that storage of bulk stocks of leaflets, brochures and books or catering supplies and equipment does not create a fire hazard. It is also important to remember the fuel load implicit in associated packaging materials. In particular, cardboard boxes and other combustible rubbish could form the basis for a serious fire and have on many occasions been used by wilful fire raisers as a fuel.

The fire fuel load implications of any materials brought into heritage buildings should always be assessed – this is particularly relevant in the case of temporary exhibits and similar activities. In many cases, ill thought-out schemes have had a significant impact on the fire risk. The likely fire hazard presented by display stands, backing materials and fabrics used as part of a display should also be considered. When selecting or specifying materials, items that ignite easily or promote rapid spread of fire should be avoided. Clearly labelled, fire-rated materials can be procured easily and exhibition organisers or designers should be asked to provide the appropriate certification or test results if the appropriateness of a particular substance is in doubt.

### 3.4 Investigative Techniques for Traditional Buildings

The previous sections highlight the unpredictability of traditional buildings and their vulnerability to fire. Many traditional buildings are variable in their form or construction. Rooms and spaces may not be symmetrical, wall thickness can vary, construction methods and materials can change with alterations to the building over time and parts of the building or historic features may be covered up.

Traditional buildings may have walls containing large numbers of hidden voids, for instance large complex properties and those that previously were or are currently in multiple occupation. Redundant spaces may have been covered up. In addition, buildings of traditional construction are well ventilated and require the presence of ventilation pathways within the construction to remove moisture.

Therefore, due to the unpredictability of traditional buildings, any works to such buildings should involve a detailed building survey. However, as the above factors often make such a survey a more demanding exercise than in a modern building, some traditional buildings may demand a survey that will be outside conventional skills and expertise of practitioners using traditional

survey methods and may require a specialist surveyor. The special demands of recording a traditional building are explained in Historic Scotland's Guide for Practitioners 4: *Measured Survey and Building Recording*, 2003.

Identification of all hidden voids during a survey is of vital importance when the fire safety requirements of a building are being addressed. The presence of undetected voids offer routes for the spread of fire, or they may be inadvertently sealed up and thus limit the ability of the structure to remove moisture from the construction. The investigation of voids inaccessible to the naked eye can be carried out relatively simply by endoscopy (sometimes referred to as borescopy), in which it is necessary to drill a small diameter hole (normally less than 12mm) to gain access. Endoscopes are also extremely useful for inspecting flues and voids and other narrow spaces where conventional access is impossible or restricted.

All investigative methods used on traditional buildings should respect the historic fabric and, as far as possible, avoid damage to the fabric. A number of non-invasive investigation and recording methods (TAN 23, *Non-Destructive Investigation of Standing Structures*, 2001) can be grouped into three main categories:

- Electro-magnetic methods (impulse radar, thermography and metal detection)
- Nuclear methods (radiography)
- Mechanical methods (ultrasonic pulse velocity and impact-echo).

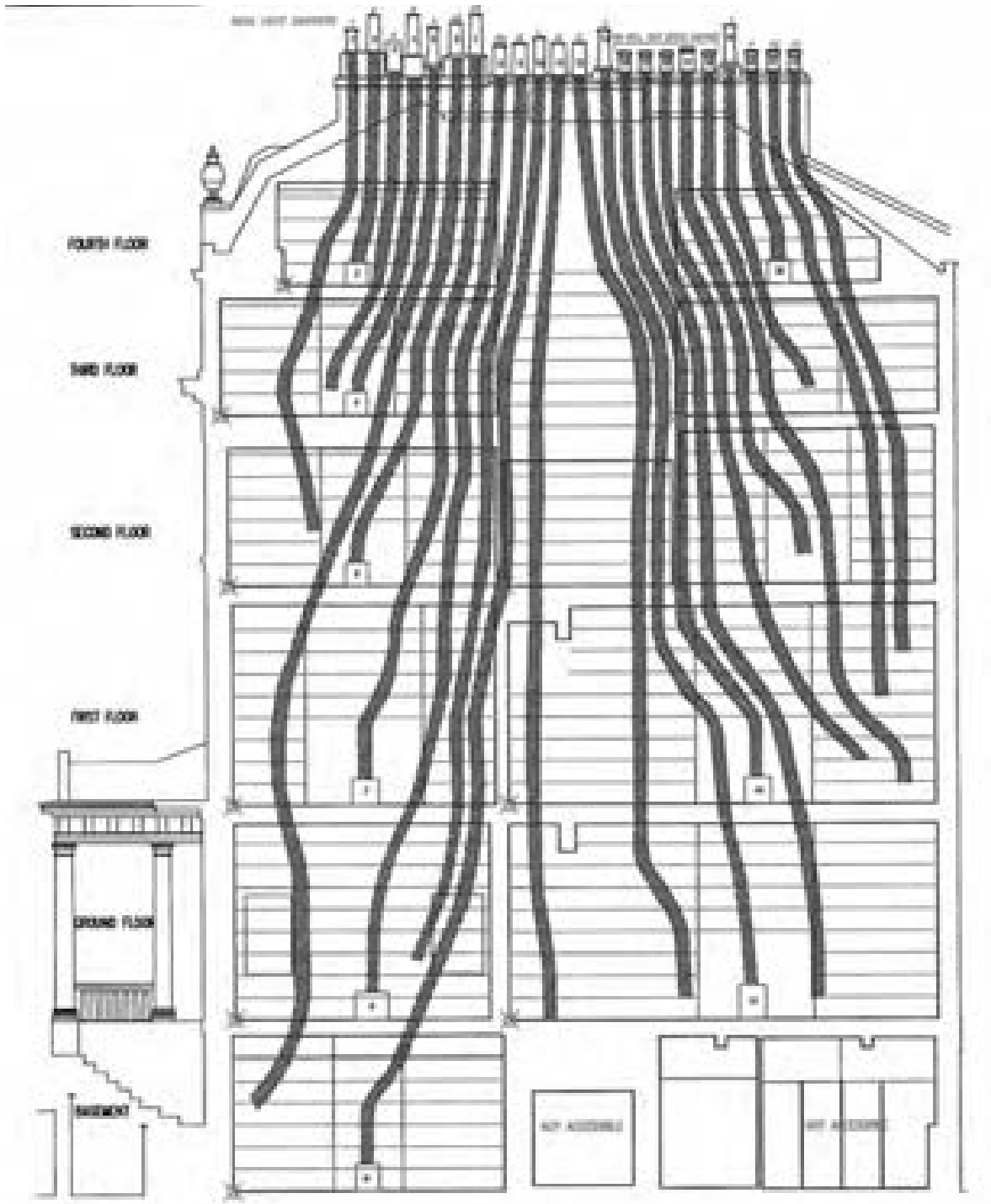
For example, radiography has been used to help select routes for fire suppression system pipework, able to highlight unknown voids and ducts and consequently indicate where pipework could be run with the least impact on heritage fabric.

#### 3.4.1 Post-fire Inspections and Surveys

It is essential that a full structural survey and inspection by a suitably qualified building professional takes place after a fire in a traditional building where there is any damage to the elements of structure or to any fine fabric. Care needs to be taken in the case of listed buildings, that local decisions regarding whether the building or part of the building has become a dangerous structure, are properly informed and include input from historic building specialists.

A full account of the actions to be taken and likely problems to be encountered can be found in Annex X – Post-fire Structural Stability.





**KEY**  
RADAR AND FEMR  
SURVEY

Survey datum  
Radar survey position

Well resolved flue  
Poorly resolved or  
inferred flue

**BALL TEST RESULT**

Maximum distance that 200mm ball could be lowered down flue measured in metres from pot  
Ball would not fit into chimney pot - no measurement possible

**SMOKE TEST RESULT**

Open fireplace  
Reference to chimney pot from which smoke was observed

Fig 1 Results of a radar investigation to identify flues and voids in the wall construction



*Illus 42 In this category B listed building, sub-divided into flats, a fire is believed to have been caused by faulty electrical services in the attic. Early detection restricted damage to the roof*

## 4 CAUSES OF FIRES IN TRADITIONAL BUILDINGS

### 4.1 Causes of Fire

The key to reducing loss in traditional buildings is gaining an understanding of the most common causes of fire, be they accidental or deliberate, and the precise sources of ignition.

Traditional buildings may be particularly vulnerable to fire in numerous ways, however the following represent some of the more common causes:

- **Electrical faults** are considered to be a major fire hazard. In many buildings the wiring itself may be of considerable age and where insulated with vulcanised India rubber deterioration over time leads to the hardening and cracking of the rubber. Alterations over a period of years, or circuits becoming overloaded by the connection of too many appliances, can lead to installations becoming unsafe. Faulty appliances can be a source of fire and consequently electrical appliances require regular checking and maintenance.

- **Building or maintenance work** – several major fires have been caused by the careless application of heat. Leadwork to roofs, plumbing and paint stripping present particular risks. Hot work should be avoided or strictly controlled and monitored.

- **Vandalism and malicious damage** – wilful fire raising has claimed many buildings, both in cities and at remote locations.<sup>13</sup>

- **Open fires, stoves, grates and hearths** are a serious risk. Many fires have started with a spark from a fire or because of a cracked hearth.

- **Defective flues** – chimney fires are common and fire can spread to other parts of the building due to cracked or faulty flues or where timber joists project into the flueway. Birds' nests in flues have also resulted in fires.

- **Accidents** include everything from carelessly dropped cigarette ends and matches, to attended open fires or the careless use of portable heaters.

- **Lightning strikes** have started a number of fires.

- **Miscellaneous** – a number of known fires have occurred for reasons including: candles or spotlights

<sup>13</sup> The Arson Prevention Bureau provides independent advice on undertaking an arson risk assessment and in practical steps for property owners. A free publication intended to be used by places of worship is highly relevant to traditional buildings. [http://www.arsonpreventionbureau.org.uk/viewDocument.aspx?Document\\_ID=499](http://www.arsonpreventionbureau.org.uk/viewDocument.aspx?Document_ID=499)

close to flammable material, rodents gnawing through cables and mirrors or glass focusing sunlight onto flammable material.

The UK fire statistics<sup>14</sup> (based on information submitted by UK fire and rescue services) consider causes and ignition sources as related but separate categories – citing as an example the careless disposal of the cigarette as a cause, the cigarette itself as the source of ignition.

During the course of COST Action C17, survey work was carried out to try to establish an estimate of the real scale of loss by fire to historic buildings in the United Kingdom. For practical purposes this was assumed to be from January 2002 until June 2006, a period of four-and-a-half years.

For the COST Action C17 survey, in the majority of cases, it proved difficult to examine the causes separately due to consistently detailed information being unavailable. As shown in Fig 2 eight categories were established instead, each of which, for the sake of simplicity, was called a 'cause'. As a result, by far the most common single known cause, at 30%, was deliberate fire-starting (in reality, this figure will vary slightly as some fires will have been misdiagnosed as deliberate, whilst some designated as unknown will most certainly have been deliberate).

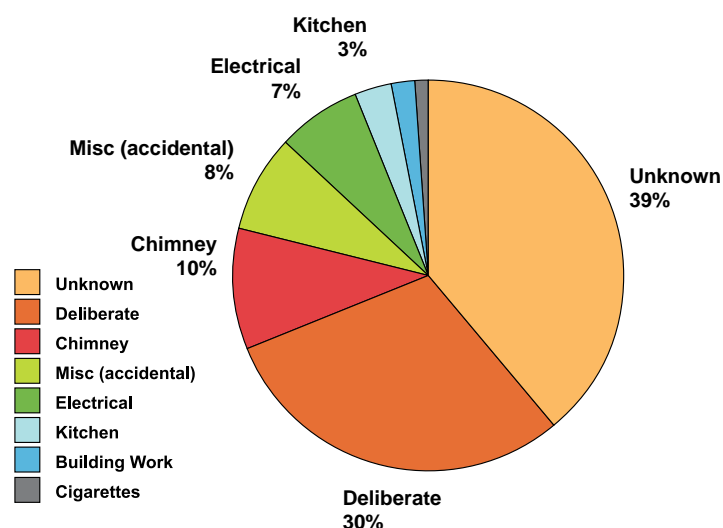


Fig 2 Causes of Fire loss to UK Historic Buildings (Jan 2002-June 2006)

<sup>14</sup> Collated by the Department of Communities and Local Government – <http://www.communities.gov.uk/fire/researchandstatistics/firestatistics/firestatisticsuk/>



*Illus 43 Some major contributory causes of fire include; overloading of circuits, neglecting to undertake routine electrical equipment checks, church candles, deep fat fryers, combustible material in close proximity to heaters and blow torches © Stewart Kidd*

If these fires are excluded as illustrated in Fig 3 then it's clear that the major causes are chimney fires (33%) electrical fires (23%) kitchen fires (10%) building work (6%) and cigarettes (3%) with 25% undetermined or unclassified.

The large number of chimney fires (a category that also includes incidents resulting from open fires, wood burners, etc) is worrying, given that such fires have long been on the decline. The term 'chimney fire' is used in the UK statistics, but in the specific context of 'any fire

in an occupied building where the fire was confined within the chimney structure' and as such are recorded as 'secondary fires' in the national statistics. As these tend not to result in damage to the building fabric, they are not relevant here. Instead, the chimney fires in the COST Action C17 survey generally *have* resulted in significant physical damage to the building structure, as a result of out of control open fires, faulty wood-burning stoves or sparks from chimneys setting fire to thatch or the roof structure.

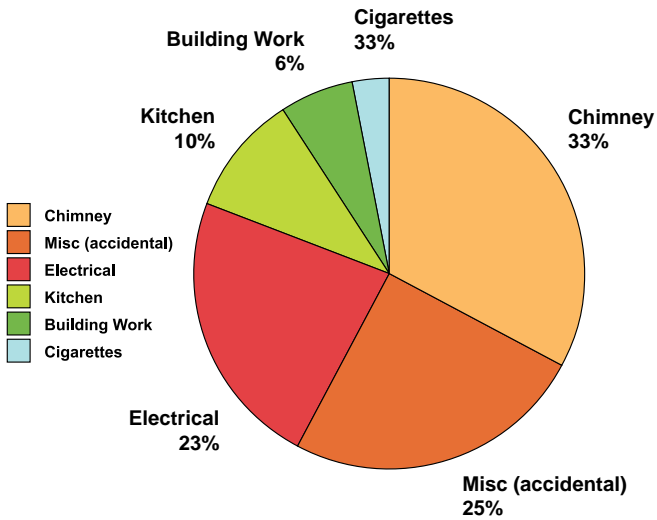


Fig 3 Accidental Fires to UK Historic Buildings (Jan 2002-June 2006)



Illus 44 As illustrated in this unlisted thatched cottage, chimney flues require ongoing maintenance to prevent the build up of soot and grime, a cause of chimney fires

This discrepancy between the national figures and this survey is unsurprising, given that traditional properties are far more likely to utilise wood or coal fire as a heat source, and to have faulty, unsound or dirty flues. The risk to owners of traditional properties of using coal or wood as a fuel is therefore disproportionately high.

#### 4.2 Deliberate Fires

The proportion of total fires in the COST Action C17 survey that were deliberate, or suspected to be deliberate,

is approximately equal to the longer-term, UK-wide statistics; that is, around 30%. Moreover, the survey data is roughly in accordance with the national statistics, with wilful fire raising/arson accounting for 15% of fires to private dwellings versus 13% nationally.<sup>15</sup> For comparison, it is worth looking at data collected by the Scottish Fire and Rescue Services 2008-2009 (reporting measures introduced through the SHBFD project) where the following causes of fire were abstracted from the 418 reported fires in listed buildings.

Cooking	120
Electrical appliances/Installation	119
Wilful	71
Smoking materials	36
Heating appliance	31
External source	12
Blow torch/Hot work	10
Unknown/undetermined	8
Candles	7
Chemical reaction	4

Table 3 Causes of Fires in Scottish Listed Buildings, Scottish Fire and Rescue Services (Apr 2008- Mar 2009)

It should be noted that these figures may not include some chimney fires as these figures are based on primary fires and, as stated earlier, chimney fires are recorded by the fire services as secondary fires.

When comparing the running total of Scottish figures against the COST Action C17 survey results, electrical equipment or installation fires occupy 28% of accidental fires in comparison with the COST figure of 23%. Kitchen fires make up 33% of the Scottish figures and yet only 10% of accidental fires in the COST survey, while building work accounted for 3% of the Scottish figures but a worrying 6% of survey figures. Again, this discrepancy may not be all that surprising given the type of building repair works that are required on traditionally constructed buildings and the risks that are involved in carrying them out. Finally, cigarettes accounted for a 3% proportion in the COST survey, compared to 9% in Scotland.

In 2009 the Department of Communities and Local Government completed the move to electronic capture of fire data. This should provide much more useful and accurate information for fires in historic and heritage buildings and will supplement the work done in Scotland by the SHBFD.

<sup>15</sup> Fire Statistics, 2004, the Office of the Deputy Prime Minister (now the Department of Communities and Local Government), Feb. 2006



*Illus 45 Regeneration of the centre of Hawick has focused on the conversion of Tower Mill into a variety of uses*

## 5 LEGISLATION, GOVERNMENT POLICY AND GUIDANCE AFFECTING TRADITIONAL BUILDINGS

This section is not a definitive list of all legislation that may apply to addressing the fire safety of traditional buildings, but rather a summary:

- Fire (Scotland) Act 2005 and Fire Safety (Scotland) Regulations 2006
- Building (Scotland) Act 2003 and Building (Scotland) Regulations 2004
- Statutory Protection of the Historic Environment
- The Construction (Design and Management) Regulations 2007
- Other relevant legislation.

Sometimes there is overlap. For instance obligations pertaining to means of fire detection and escape under the Fire (Scotland) Act 2005 (the 2005 Act) and associated Regulations, may have been met during the conversion by the application of building regulations in these areas, as these are essential standards.

### 5.1. Fire Safety Legislation

Scotland has its own fire regulations which govern how fire safety is to be managed in regulated premises. The 2005 Act replaces the previous fire safety regime and the system of fire certificates. The new fire safety regime is based on the principles of risk assessment (refer to Part 1, Section 8) and the requirement to take steps to prevent fire and mitigate the detrimental effects of a fire on the premises to ensure the safety of persons. Such a risk-based approach centred on fire risk assessment, introduces more flexibility in satisfying the regulations. Indeed, the Technical Annexes (contained in the Scottish Government's Sector Specific Guides) are intended to be used in a non-prescriptive manner which is of benefit to the built heritage, where a sensitive approach is required.

The law applies to nearly all non-domestic premises in Scotland. It does not regulate individual dwellings except for care homes and houses in multiple occupancy (HMOs). HMOs include shared flats and houses, bed-sits, lodgings, communal accommodation such as student residences and hostels. A property needs to be licensed for multiple occupancy if:

- It is the only or main home of three or more residents; and

- The residents are members of more than two families.

The 2005 Act and the Regulations made under this requires the necessary provision of such things as:

- Means of escape in case of fire
- The way in which the means of escape will be available at all material times
- Means for detecting and giving warning of fire
- Means for fighting a fire (both automatic and manually operated)
- The maintenance regime to be followed in respect of all fire safety provisions.

The following summarises the legislation which forms or is consequential to the fire safety regime for non-domestic premises in Scotland, namely Part 3 of the 2005 Act and associated subordinate legislation. This Guide should therefore be read in conjunction with the relevant legislation and is not meant to be a comprehensive description of the legislation. Users are advised to consult the legislation referred to throughout this Guide as the definitive source of powers, duties and obligations. The Scottish Government's website has comprehensive information on the fire legislation ([www.infoscotland.com/firelaw](http://www.infoscotland.com/firelaw)).

### Chapter 1 (of Part 3 of the 2005 Act): Fire Safety Duties

*Chapter 1 contains information on the obligations in regards to fire safety of employers, other duty holders and employees.*

#### Section 53 - Duties of employers to employees

Section 53 contains an employer's duty to ensure the fire safety of employees in respect of a workplace. The effect of this section is to give employers responsibility for the safety of their employees in case of fire. Subsection (1) stipulates that the employer's level of duty is to ensure the fire safety of employees in the workplace 'so far as is reasonably practicable'.

An employer is required to carry out a fire safety risk assessment of the workplace to identify risks and to take fire safety measures which are necessary to achieve compliance with subsection (1). When a fire safety risk

assessment has been carried out, an employer must review the assessment in accordance with regulations, and fire safety measures that are identified as necessary, as a result of this review, should be taken to achieve compliance with the general duty under subsection (1).

### **Section 54 – Duties in relation to relevant premises**

Section 54 identifies those responsible for the fire safety of premises to ensure the fire safety of relevant persons in relevant places.

Subsections (1) and (2) of Section 54 requires that a person who has control to any extent of relevant premises must carry out a risk assessment to identify fire safety risks to relevant persons in respect of harm caused by fire in the relevant premises and take fire safety measures which are necessary to ensure the safety of relevant persons.

Where the person in control of relevant premises is neither the owner nor a person carrying on an undertaking, subsection (3) requires the owner of the relevant premises to carry out a risk assessment and take necessary fire safety measures. This is in addition to the obligations which sit with other persons who have control of premises.

Subsection (4) extends the requirement to carry out a fire safety risk assessment and put in place fire safety measures, to persons who have an obligation, of any extent, as a result of tenancy or contract in respect of maintenance, repair or fire safety, to the extent of their obligation.

Subsection (5) requires the persons who have an obligation to carry out a fire safety risk assessment under Section 54, to review that fire safety risk assessment in accordance with regulations and to take such fire safety measures as is reasonable for a person in that position to take. The duty to review the assessment is in Regulation 3 of the 2006 Regulations.

### **Section 55 – Taking of measures under Section 53 or 54: considerations**

While Sections 53 and 54 contain provision for the taking of fire safety measures, Section 55 lists considerations which should be taken into account when duty holders are taking these fire safety measures for example, avoiding risk, evaluating risks which can't be avoided, replacing the dangerous with the non-dangerous and developing a coherent overall fire prevention policy.

### **Section 56 – Duties of employees**

This section contains duties which are imposed on an employee while at work. Every employee should take

reasonable care for their own safety in respect of fire and of any other relevant persons who may be affected by their actions. The employee should also co-operate with the employer, so far as is necessary, to enable the employer to comply with their obligations and duties under Part 3 of the Act.

## **Chapter 2: Enforcement**

### **Section 63 – Prohibition notices**

Section 63 provides that an enforcing authority (as identified in Section 61) is able to prohibit or restrict the use of relevant premises in serious cases by use of a prohibition notice. It is designed for the more serious cases to prevent loss of life or serious injury. A prohibition notice may specify steps which may be taken to remedy the matters specified in the notices.

A prohibition or restriction contained in a prohibition notice shall take effect immediately it is served if the enforcing authority considers that the risk of serious personal injury is or will be imminent, and in any other case will take effect at the end of the period specified in the notice.

### **Section 64 – Enforcement notices**

Section 64 contains provision in respect of the use of enforcement notices by the enforcing authority in cases where the enforcing authority considers that there is non-compliance with the Chapter 1 duties (other than the employee's duty in Section 56).

### **Section 65 – Alterations notices**

Section 65 introduces a procedure for issuing alterations notices, which can be used at the discretion of the enforcing authority. The alterations notice procedure has been introduced to allow enforcing authorities to require notification of proposed changes in higher risk premises. An alterations notice can only be served in relation to relevant premises that either constitute a serious fire risk to relevant persons or where, if particular changes are made to the relevant premises, such as to their nature or use, it is likely that a serious fire risk would be posed to relevant persons.

The issue of an alterations notice does not prevent the appropriate person from undertaking the changes proposed. However, it requires them to notify the enforcing authority in advance of the change(s) being made and allows the enforcing authority the opportunity to intervene if they consider this appropriate, before the changes are made.

### **Section 66 – Appeals**

Section 66 contains provision for appeal to the sheriff



against the operation of a prohibition, enforcement or alterations notice. Where an appeal is made, subsection (1) allows the sheriff to make an order revoking, varying or confirming the notice. The appeal can be made by the person on whom the notice is served or, where it is a prohibition notice, by any duty holder in respect of the premises to which the prohibition notice relates. Subsection (2) specifies that an appeal can be made to the sheriff within 21 days from the day on which a notice is served.

#### **Section 67 – Determination of disputes**

Section 67 introduces a new non-judicial review procedure for use in situations where the enforcing authority and a duty holder fail to agree on compliance issues. Use of the procedure is not compulsory, but enforcing authorities are expected to make the duty holder aware of the process where appropriate.

### **Chapter 4: Offences**

#### **Section 72 – Offences**

Section 72 contains provision for offences and associated penalties in respect of compliance failure. The most serious offences are subject to a maximum penalty on summary conviction of a fine not exceeding £20,000 or on conviction on indictment to imprisonment not exceeding two years or to a fine, or to both. In other cases on summary conviction the statutory maximum applies and on conviction on indictment the penalty is a fine. Other less serious offences are subject to lesser maximum penalties.

#### **Section 73 – Offences by bodies corporate and partnerships**

Subsection (1) provides that where an offence by a body corporate is proved to have been due to consent or connivance or attributable to neglect by a director, manager, secretary or other similar officer of that body, or a person purporting to act in any such capacity, that person is also guilty of that offence and is liable to be proceeded against and punished.

Subsection (2) provides that subsection (1) also applies to the acts and defaults of a member in connection with management functions where the affairs of a body corporate are managed by its members.

Where an offence has been committed by a partnership, subsection (3) provides for a partner to be guilty of an offence as well as the partnership where it is proved that the offence has been committed with the consent or connivance of a partner, or is attributable to their neglect.

#### **Section 74 – Offences due to fault of other person**

Where the commission of an offence by a person under Part 3 is due to the act or default of another person, then the other person can be guilty of the offence. Subsection (2) provides that the other person can be charged regardless of whether proceedings are taken against the first person.

#### **Section 75 – Employee’s act or omission not to afford employer defence**

Section 75 provides that the act or omission of an employee is not a defence for an employer in the commission of an offence. Regulation 26 of the 2006 Regulations further specifies that the actions of competent persons nominated for particular tasks in accordance with those regulations, similarly do not afford a defence.

### **Fire Safety (Scotland) Regulations 2006**

The Fire Safety (Scotland) Regulations 2006 (the 2006 Regulations) are made under the 2005 Act and contain provisions which are part of the fire safety regime. The 2006 Regulations cannot be looked at in isolation; the fire safety regime in Scotland is split into primary and secondary legislation and duty holders have obligations under both. In some respects the primary legislation (the 2005 Act) contains a broad brush approach to fire safety measures while the 2006 Regulations, the secondary legislation, contain more detailed provisions.

Part two (Regulations 3 to 9) of the 2006 Regulations is concerned with risk assessments, whilst part three (Regulations 10 to 22), as summarised below, covers fire safety:

Regulation 10 requires a duty holder when taking fire safety measures as a result of the fire assessment or review of an assessment in Section 53 or 54 of the 2005 Act, to make appropriate arrangements for effective planning, organisation, control, monitoring and review of the fire safety measures.

Regulation 11 imposes obligations on all Section 53 and 54 duty holders where there is a dangerous substance in relevant premises.

Regulation 12 contains specific requirements in respect of means for fighting fire and giving warning. A duty holder must, where necessary, to ensure the safety of relevant persons, ensure that premises are equipped with appropriate means for fighting fire and giving warning in event of fire.

There is also an obligation, where necessary, to take firefighting measures and nominate competent persons

to implement these measures; and a requirement to arrange any necessary contacts with external emergency services.

Regulation 13 contains specific provisions for means of escape which are imposed where necessary.

Regulation 14 requires a duty holder to put in place procedures for serious and imminent danger from fire including persons to operate and to put them into operation where necessary. This effectively requires an emergency fire action plan to be established. To allow the implementation of those procedures, competent persons should be nominated for evacuation of the premises.

Regulation 15 contains further provision for dangerous substances which is closely modelled on the wording in Regulation 8 of DSEAR.<sup>16</sup> However, Regulation 15 does not apply where there is only slight risk to relevant persons because of the quantity of dangerous substances and where measures taken under Regulation 11 are sufficient to control the risk.

Regulation 16 requires maintenance of premises and maintenance of fittings, equipment and devices provided under the 2006 Regulations; or any enactment where they are provided in conjunction with fire safety measures. There is also provision for a duty holder to make arrangements with occupiers and owners of other parts of a building to ensure these maintenance requirements.

Regulation 17 requires a duty holder to nominate one or more competent persons to assist in undertaking measures to comply with the Chapter 1 duties, and arrange time and means to achieve the function. Where there is more than one person, arrangements should be made for coordination. There are exclusions in this regulation for certain self-employed persons and partners.

Regulation 18 imposes obligations on employers: they must give relevant information to employees, including the risks identified by the assessment carried out or reviewed under Section 53, the fire safety measures taken and the procedures referred to in Regulation 14.

Regulation 19 requires a duty holder to give information on risks, fire safety measures and the identity of a person nominated to implement procedures under Regulation 14, to the employer of employees from an outside undertaking working in the premises. Instruction and information on risks and the identity of that nominated person must also be given to those employees.

Regulation 20 imposes obligations on an employer to ensure the employees have adequate fire safety training. Paragraph 2 sets out the requirements in respect of training: it should include instruction and training on

precautions and actions to be taken by an employee to safeguard themselves and others on premises, be repeated periodically, adapted to take account of new or changed risks from fire, be provided in a manner appropriate to the risk assessment and take place during working hours.

Where responsibility in premises is shared between duty holders, Regulation 21 requires duty holders to co-operate with each other to enable each to comply, to co-ordinate measures and inform each other of risks.

Regulation 22 contains a requirement for employees while at work, to inform their employer or an employee with fire safety responsibility where there is serious and imminent danger, or shortcomings in an employer's protection arrangements where the matters affect the persons own fire safety or in connection with their own work activities.

Regulations 23 and 24 do not relate to the safety of relevant persons, rather they are designed to ensure that facilities for firefighters are maintained. In Regulation 23 duty holders are required to maintain the premises and any facilities, equipment and devices for the use by or for the safety of firefighters.

While the above section summarises the impact and requisites of the general requirements of current fire safety legislation in Scotland, a series of occupancy-specific guides (Sector Specific Guides) published by the Scottish Government explains the requirements of Part 3 of the 2005 Act and the 2006 Regulations made thereunder, in more detail. These guides contain Technical Annexes and do not offer prescriptive guidance, solutions are offered but do not have to be adopted if the outcomes of a fire risk assessment can be met in some other way. Readers of the guides are referred to Historic Scotland's TANs (all now replaced by this Guide) where the property:

*'is, or includes, a listed building ... there may be a need to consider the character of the building inside as well as out. Measures to prevent fire, to limit its spread, and to ensure life safety will be as necessary in a historic building as in any other.... Alternatives could be considered to some of the conventional fire safety measures set out in the Technical Annexes, as these may, in some cases, harm the character of historic buildings. A fire engineering approach combining automatic fire detection, fire suppression system and smoke control is recommended in the Historic Scotland Technical Advice Notes 11, 14, 22 and 28.'*

There are Sector Specific Guides providing advice and information on the following occupancies:

- Care Homes
- Offices, Shops and Similar Premises
- Factories and Storage Premises

<sup>16</sup> Dangerous Substances and Explosive Atmospheres Regulations 2002

- Educational and Day Care for Children Premises
- Small Premises providing Sleeping Accommodation
- Medium and Large Premises providing Sleeping Accommodation
- Transport Premises Guide
- Places of Entertainment and Assembly Guide
- Healthcare Premises Guide.

Additional information can be found at: [www.infoscotland.com/firelaw](http://www.infoscotland.com/firelaw)

## 5.2 Building Control Legislation

### 5.2.1 *The Building (Scotland) Act 2003 and its application to traditional buildings*

The Building (Scotland) Act 2003 (the 2003 Act) and associated Building Procedure (Scotland) Regulations 2004 (the 2004 Regulations) has had a fundamental impact on the methods for setting and enforcing standards on building work in comparison to the previous prescriptive Building (Scotland) Regulations 1990 and the Building Operations (Scotland) Regulations 1975. These changes were necessary to permit European harmonised standards to be used in Scotland, as required under the Construction Products Directive.

The 1990 Regulations could only be complied with by following the Technical Standards laid down in support of the regulations. It was this prescriptive approach that led to the conflict between meeting the standards and the needs of traditional buildings. However the 2004 Regulations are based upon the use of expanded functional standards that define what the building must achieve when in use. Functional standards rather than prescriptive standards permit:

- Greater flexibility in achieving the minimum standards - a variety of ways of complying
- Cater more sympathetically to the needs of traditional buildings undergoing conversion.

Technical Handbooks provide practical guidance on achieving the required standards and are available in two volumes, domestic and non-domestic. The fire safety legislation and associated Technical Handbooks are all supported by the Procedural Handbook, a non-legal document that explains the various procedures detailed in the 2003 Act and associated Regulations and is designed to aid the application of these.

Within Schedule 2 of the 2004 Regulations the term 'conversion' has been given a specific meaning and is restricted to prescribed changes of intended use or occupation (see Box 2). After a conversion, the

regulations require a building to comply with all the standards. However, there is an important qualification because few existing buildings can reasonably be expected to meet all aspects of the current standards. Therefore, for specific standards as identified in Schedule 6 of the 2004 Regulations, the requirement is for existing buildings to be improved 'to as close to the full requirements as is reasonably practicable'. The building regulations define reasonably practicable as 'having regard to all circumstances including the expense involved in carrying out the work.' This means that an existing building will now have to be improved, even if meeting the full standard is not practically achievable. It will only be in exceptional circumstances that taking no action will be acceptable, although it is recognised that the full requirement will not be met for many of the identified standards.

For purposes of enforcement under Section 35 of the 2003 Act, the following buildings are designated as historic buildings:

- Those included in the schedule of monuments compiled under Section 1 of the Ancient Monuments and Archaeological Areas Act 1979.
- Listed buildings under Section 1 of the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997.
- Buildings subject to the Buildings Preservation Notices under Section 3 of the Listed Buildings and Conservation Areas (Scotland) Act; and
- Those buildings in conservation areas subject to the control of the demolition under Section 66 of the Listed Buildings and Conservation Areas (Scotland) Act.

In these cases, Scottish Ministers, the planning authority or such persons as the local authority think fit – must be consulted prior to the service of notices, such as building warrant enforcement or a defective buildings notice.

For historic buildings Schedule 6 has specific relevance, enabling judgment on what is 'reasonably practicable' to be made in a wider context. Whilst Section 35 of the 2003 Act gives specific protection to certain historic buildings in relation to statutory notices (refer to tinted box), the Procedural Handbook notes that 'sympathetic consideration' may be given to a wider range of 'historic buildings' (as defined in 1.2 of this Guide). Such buildings require the 'sensitive application of the standards'. The particular matter that is significant or important should inform the application of the functional standards. In applying the standards, rather than adopting the methods and materials promoted by the Technical Handbooks – which assume current materials and construction techniques – the construction and materials of the

historic building must be recognised and retained where they are significant to the character or historic value of the building. The change in occupation or use of a historic building, where this does not fall under the definition of conversion, does not attract application of the standards, unless there is alteration or extension to the building, in which case the full standards apply. However, in such cases, other legislation may have to be satisfied, which may itself have a potential impact on historic fabric, for example houses in multiple occupation and disability discrimination legislation.

In the case of traditional buildings, it is possible that an approved certifier (refer to 5.2.3) may not have a full understanding or experience of design and construction associated with conversion of such buildings. Clients or their professional advisors are strongly advised to ensure that the approved certifiers, who are employed for design and construction certification purposes, have the necessary skills and experience to interpret and apply the standards sympathetically to traditional buildings, and to recognise that what is appropriate for new build may be detrimental to the performance and historical integrity of a traditional building.

### **5.2.2 Balancing Conservation with Conversions, Alterations and Extensions**

#### *5.2.2.1 Conversions*

A historic building may usually be converted provided that it does not compromise the character that is the special interest, significance or appearance of the building. Conversion of a listed building to change its occupation or use is often the only means of ensuring its retention and future viability (this is applicable to traditional buildings in general). Achieving a proper balance between the development requirements of a conversion, the building regulations and the special needs of historic and traditional buildings is a demanding task that requires specialist advice and negotiation with the verifiers. However, the new inherent flexibility embedded in the functional standards facilitates this.

#### **Box 2: Conversions to which regulations apply:**

- (1) Changes in the occupation or use of a building to create a dwelling or dwellings or part thereof.
- (2) Changes in the occupation or use of a building ancillary to a dwelling to increase the area of human occupation.
- (3) Changes in the occupation or use of a building which alters the number of dwellings in the building.
- (4) Changes in the occupation or use of a domestic building to any other type of building.

(5) Changes in the occupation or use of a residential building to any other type of building.

(6) Changes in the occupation or use of a residential building which involves a significant alteration of the characteristics of the persons who occupy, or who will occupy, the building, or which significantly increase the number of people occupying, or expected to occupy the building.

(7) Changes in the occupation or use of a building so that it becomes a residential building.

(8) Changes in the occupation or use of an exempt building (in terms of Schedule 1) to a building which is not exempt.

(9) Changes in the occupation or use of a building to allow access by the public where previously there was none.

(10) Changes in the occupation or use of a building to accommodate parts in different occupation where previously it was not so occupied.

Conversion can apply to part of a building as well as the whole building.

#### *5.2.2.2 Alterations*

Within the Building Regulations the terms alteration and conversion must be clearly distinguished. Conversion is confined to situations where the building is subject to a change in occupation or use, and as such falls within one of the classes in Schedule 2 of the Building Regulations (refer to tinted box).

Alterations refer to work carried out on an existing building where no change of use or occupation is involved. In this case there are no qualifications; alterations attract the full current standards relevant to alteration work. In addition, the whole building must not, as a result of the alterations, fail to comply with building regulations if it complied originally or fail to a greater degree if it failed to comply originally. However, alterations to a building that are part of a conversion in terms of the 2003 Act are subject to a wider application of the regulations, so that the building being converted complies fully.

#### *5.2.2.3 Extensions*

Extensions to existing buildings must be constructed in such a way that the extension complies with all the current standards that are relevant to the construction and use of the extension. However, where the extension is to a historic building that is being converted, the standards that apply to the building, other than the extension, remain those that apply to a conversion of a type set out in Schedule 2 of the Building Regulations (see Box 2).

#### 5.2.2.4 Ruined Buildings

Some historic buildings are in a ruinous condition, but may still be proposed for conversion or alteration. It is also possible that some ruined buildings being considered for conversion will be scheduled. Then, even if also listed, scheduled monument consent rather than listed building consent will be required. It is essential that anyone considering such a step should first consult Historic Scotland before carrying out any work to a Scheduled Ancient Monument. Note that even essential repair works require consent.

When a ruin is being brought back into use, the way in which the building regulations will apply depends on the following circumstances:

- (1) If the past use of the building is known, then work on the ruin should be regarded as a conversion if it falls within one of the classes in Schedule 2 of the Building Regulations.
- (2) If the past use of the building is unknown, or is outside these classes, it should be regarded as an alteration. In this case alterations attract the full current standards relevant to the alteration work. For further guidance refer to the Procedural Handbook.

#### 5.2.3 Roles, Duties and Responsibilities

A significant difference between the old and new building legislation is the change in the roles, duties and responsibilities of the various bodies charged with the implementation of the standards. The system is overseen by the Building Standards Division, which is an integral part of the Scottish Government. Enforcement of the regulations is by local authorities, but the responsibility for checking compliance, and certification of design and construction, rests with two new groups of people, verifiers and approved certifiers respectively. Detailed information on the appointment and role of verifiers and approved certifiers is found in the Procedural Handbook.

Verifiers are appointed by Scottish Ministers. While the 2003 Act provides for other bodies to act as verifiers, the only appointed verifiers to date are the Scottish local authorities, who will be responsible for their own areas. It is the role of the verifier to protect the public interest by providing an independent check of applications for building warrants.

In the Act, two approved certifier roles are established, certifiers of design and certifiers of construction. This permits suitably qualified people, businesses or other bodies, as approved by Scottish Ministers, to certify that certain design or construction work complies with the building regulations.

The certification of design is at the warrant application stage and allows certifiers of design to certify to verifiers that prescribed aspects of the design meet

the requirements of the regulations. This replaces the process of self-certification of structures under the old regulations, and has the potential to permit other specialisms to be included as well. Approved certifiers of design may be responsible for either:

- Specified aspects of the building design (such as the structure, energy design or fire safety)
- Specific parts of a building (such as a space heating system or a sprinkler system).

If the approved certifier is satisfied that the proposed design meets the relevant standard or standards, a certificate may be issued for submission with the application for a building warrant. The certificate is taken as proof that the standards have been met for those aspects of the design that are relevant; the verifier will not check the design against these standards.

Approved certifiers of construction are responsible for the construction or installation of specified parts of a building, such as the structural frame, the electrical installation or a combustion appliance. As with the design certificate, the certificate of construction is taken as proof that the construction complies with the full range of relevant requirements. The verifier will not check the elements covered by the certificate of construction.

For further information on the certification process, reference should be made to the Scottish Buildings Standards Division website (<http://www.scotland.gov.uk/Topics/Built-environment/Building/Building-standards/certregister>)

### 5.3 Summary of Scottish Building Standards – Section 2 of the Technical Handbook – Fire

Life safety is the paramount objective of fire safety. Buildings should be designed and constructed in such a way that the risk of fire is reduced and if a fire does occur, there are measures in place to restrict the growth of fire and smoke to enable the occupants to escape safely and firefighters to deal with the fire safely and effectively.

In the event of an outbreak of fire, it is important that the occupants are warned as soon as possible. The guidance to Standard 2.11 provides recommendations for the installation of alarm and detection systems in domestic buildings and for non-domestic buildings, in buildings where people may be asleep or where there is a particularly high risk.

It should be made absolutely clear from the outset that building regulations are concerned primarily with the safety of occupants and not with the protection of property. So even where a building is deemed to comply with the requirements of Scottish Building Standards this does not mean that issues concerned with the protection of the structure and its contents have been satisfied. It

must be accepted that matters related to the detection of fire and its suppression have always been left to the owners and occupiers of buildings and their insurers to address. This implicitly means that compliance with building regulations is the very minimum which must be done in respect of buildings subject to the regulations.

In the case of historic buildings it may be that the requirements of conservation of Scotland's cultural assets and continued use are seen to be almost as important as the safety of the occupants. However the added benefit of some life safety measures will provide a degree of property protection. It is hard to envisage how structure or contents of a building can be made safer without some degree of improvement in the provision of the safety of its occupants. The building regulations are concerned with the protection of people from the dangers inherent in buildings, rather than protecting the owners of buildings from any economic loss which might occur. Therefore it is important for designers and owners of buildings to understand that following this guidance will not necessarily provide sufficient fire protection to prevent the total destruction of the building and the subsequent economic loss. High standards of fire prevention and fire protection will not only save the lives of occupants and firefighters, but will reduce environmental pollution in respect of the generation of greenhouse gases, fire water run-off and contamination of water courses and airborne pollutants emanating from elements of structure.

The standards and guidance are designed to work together to provide a balanced approach for fire safety. Where a building element, material, component, or other part of a building is covered by more than one standard, the more demanding guidance should be followed.

In order to achieve these objectives, the building elements, materials, components or other parts of the building identified in the guidance should follow the appropriate performance levels that are recommended throughout the guidance.

The following section provides a short overview of each of the fire-related Scottish Building Standards (SBS) and associated Requirements contained in Section 2 of the technical handbook (note that the topics are covered in much greater detail in Part 2 of this Guide). Whilst there is a significant amount of overlap between the domestic and non-domestic technical handbooks, this overview concentrates on non-domestic properties.

In the following sections, the numbering in brackets refers to the paragraph numbers from the Technical Handbook.

### **5.3.1 Compartmentation (2.1)**

The aim of compartmentation is to divide the building into a series of 'fire-tight' boxes or compartments which will form a barrier to the products of combustion

(smoke, heat and toxic gases) and inhibit rapid fire spread within the building. The intention is to limit the size of the fire which in turn should help the occupants to evacuate the building and assist fire service personnel with firefighting and rescue operations.

Building owners should ensure that as far as is practicably possible their building is designed and constructed in such a way that in the event of an outbreak of fire within the building, fire and smoke are inhibited from spreading beyond the compartment of origin until any occupants have had the time to leave that compartment and any fire containment measures have been initiated.

The use of a building, the height of the topmost storey, the inclusion of automatic fire suppression systems and the fire resistance duration will determine the maximum area of the compartments within a building. Designers may also choose to construct compartments based on client and aesthetic needs.

Where services pass through a compartment floor, wall or cavity barrier then fire stopping should be provided to maintain (60min) fire-resistance. All pipes should be fitted with a proprietary sealing system capable of maintaining the fire-resistance of the floor, wall or cavity barrier. Ventilation ducts penetrating compartments, should be fitted with fire dampers actuated by smoke detection which close automatically thereby maintaining the fire-resistance duration of the compartment concerned.

Any door in a compartment wall should be a self-closing fire door with the same fire-resistance duration as the wall and in multi-occupied buildings, where premises are put to different uses within the building, there should be compartment walls and compartment floors between the premises.

### **5.3.2 Separation (2.2)**

Buildings or parts of a building in different occupation pose particular problems in terms of fire safety. This is because one occupier usually does not have any control over the activities or working practices of their co-occupiers and in such cases, separating walls and separating floors are recommended. The intention of separation is to limit fire spread and thereby give adjoining occupiers more time to escape before they are threatened by fire or smoke.

In the case of buildings which are divided into more than one area of different occupation, the building owners should ensure that as far as is practicably possible their building is designed and constructed in such a way that in the event of an outbreak of fire within the building, fire and smoke are inhibited from spreading beyond the area of occupation where the fire originated, therefore compartment walls or floors should be provided between parts of a building where they are in different occupation.



*Illus 46 The benefits of compartmentation: complete loss on one side of the compartment wall and fire door and on the other side only superficial fabric damage and minor smoke damage to an archive of rare books, Anna Amalia Library, Weimar © Per Rohlén*



Illus 47 Examples of fire stopping to improve compartmentation  
© Stewart Kidd

However, it is possible to have no separating walls or separating floors between the different occupiers of a multi-occupied building when the building is under a single management regime. For example, multi-occupied offices with a shared reception and sanitary facilities may be regarded as being in the same occupation. In such cases, the building should have a common fire alarm system / evacuation strategy and the same occupancy profile. This philosophy is in effect very similar to individual departments within one large organisation. However, where each unit is under the control of an individual tenant, employer or self-employed person, separating walls and separating floors should be provided between the areas intended for different occupation.

Every part of separating wall or separating floor should be constructed from materials that are non-combustible. Where materials are combustible then they should possess (60min) fire resistance duration or higher. The wall should contain no pipes, wires or other services within the wall but where these already exist then they should be fire-stopped and protected by intumescent materials which achieve a medium duration (60min) fire resistance.

### 5.3.3 Structural Protection (2.3)

In order to prevent the premature collapse of the load-bearing structural elements of a building, appropriate levels of fire resistance duration should be provided to all elements of structure. The purpose of structural fire protection is to minimise the risk to the occupants, some of whom may not evacuate the building immediately; and to reduce the risk to firefighters who may be engaged in firefighting or rescue operations.

Building owners should ensure that as far as is practicably possible their building is designed and constructed in such a way that in the event of an outbreak of fire within the building, the load-bearing capacity of the building will continue to function until all occupants have escaped, or been assisted to escape from the building and any fire containment measures have been initiated.

It is essential that during a fire the elements of structure should continue to function. They should remain capable of supporting and retaining the fire protection to floors, escape routes and fire access routes, until all occupants have escaped, been assisted to escape by staff or been rescued by the fire service. The added benefit to structural fire protection means that the risk to people in the vicinity of the building or in adjoining buildings from collapse of the structure is reduced.

### 5.3.4 Cavities (2.4)

Fire and smoke spread in concealed spaces is particularly hazardous because fire can spread quickly throughout a building and remain undetected by the occupants of the



building or by fire service personnel. Ventilated cavities generally promote more rapid fire spread around the building than unventilated cavities due to the plentiful supply of replacement air. Buildings containing sleeping accommodation pose an even greater risk to life safety and demand a higher level of fire precautions. For these reasons, it is important to control the size of cavities and the type of material in the cavity.

Building owners should ensure that as far as is practicably possible their building is designed and constructed in such a way that in the event of an outbreak of fire within the building, the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited.

A cavity is a concealed space enclosed by elements of a building (including a suspended ceiling) or contained within a building element, but not a room, cupboard, circulation space, stair enclosure, lift well, flue or a space within a chute, duct, pipe or conduit. A cavity includes a roof space, a service riser or any other space used to run services around the building.

In order to inhibit fire spread in a cavity, every cavity within a building should have cavity barriers, with at least a short duration (30min) fire-resistance installed around the edges of the cavity. This includes for example, around the head, jambs and sill of an external door or window opening. A cavity barrier should also be installed between a roof space and any other roof space or between a cavity and any other cavity such as at the wall-head between a wall cavity and a roof space cavity.



*Illus 48 Suspended ceiling in this church, a consequence of a decreasing congregation size, has created a large cavity above*  
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### 5.3.5 Internal Linings (2.5)

The building contents are likely to be the first items ignited in a fire but their protection is beyond the scope of this guidance. Materials used in walls and ceilings can however, significantly affect the spread of fire and its rate of growth. Fire spread on internal linings in escape routes is particularly important because rapid fire spread in protected and unprotected zones could prevent the occupants from escaping.

Wall and ceiling surfaces mean the substrate or lining material including any treatment thereof to restrict flame spread, but excludes any decorative wallpaper or paints. Whilst it is accepted that such wallpaper or paints are not controlled by the guidance, multiple layers applied to the face of a wall or ceiling surface can increase flame spread and hence the fire growth rate. For this reason, multiple layers are not recommended when carrying out refurbishment work involving the redecoration of wall and ceiling surfaces.

Building owners should ensure that as far as is practicably possible their building is designed and constructed in such a way that in the event of an outbreak of fire within the building, the development of fire and smoke from the surfaces of walls and ceilings within the area of origin is inhibited.

### 5.3.6 Minimising Fire Spread (2.6)

This would normally be accomplished by the same compartmentation measures provided to ensure that the means of escape are accessible when there is a fire, but in addition it would also be necessary to ensure that the spread of flame is inhibited. Part 2.5 of the SBS Non-domestic handbook requires that *'Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the development of fire and smoke from the surfaces of walls and ceilings within the area of origin is inhibited.'*

This is best accomplished by ensuring that the construction materials, furnishings and in particular the wall and ceiling coverings do not significantly affect the speed of growth of a fire. This is relatively simply achieved by adhering to the guidance spelt out in 2.5.1 and 2.5.2 of the SBS Technical Handbooks – this should not be a significant factor in the protection of heritage fabric except possibly in the need to secure a low risk internal lining for a firefighting shaft.

One factor which must not be overlooked is the possible hazard engendered by multiple layers of oil-based paint which may have built up over the years in a corridor or staircase. While there will be a natural desire on the part of the designer or consultant to try to preserve such features as an integral part of the property's history this

may have to be tempered by an understanding of the real nature of the hazard presented by this type of feature.<sup>17</sup>

### 5.3.7 Spread on External Walls (2.7)

There is a risk of fire spread on the external walls of a building. For most buildings it is only necessary to consider this if the external wall is in close proximity to the boundary.

Residential care buildings and hospitals present a greater risk because the mobility, awareness and understanding of the occupants could be impaired and as a consequence, full evacuation immediately a fire is discovered may not be the most appropriate course of action.

In high rise buildings, there is a need to take further precautions as external fire spread could involve a large number of floors thus presenting greater risk both to the occupants of the building and to firefighters. The 'reaction to fire characteristics' of cladding materials are therefore more demanding the taller the building.

Building owners should ensure that as far as is practicably possible their building is designed and constructed in such a way that in the event of an outbreak of fire within the building, or from an external source, the spread of fire on the external walls of the building is inhibited.

### 5.3.8 Spread from Neighbouring Buildings (2.8)

Building owners should ensure that as far as is practicably possible their building is designed and constructed in such a way that in the event of an outbreak of fire in a neighbouring building, the spread of fire to the building is inhibited.

Buildings are at risk from fires starting beyond their boundaries. The area of greatest vulnerability is the roof and there may be a risk of ignition or penetration by burning brands, flames or heat. The degree of protection for roofs is dependent upon the distance to the boundary.

### 5.3.9 Provision of Means of Escape and Related Facilities (2.9, 2.10)

Modern buildings that are designed from first principles should include provision for adequate means of escape as a given. These will demand that occupants in all parts of the building are able to exit the premises or reach a place of safety in a short time, by their own unaided efforts, without the aid of tools or specialist knowledge and without resorting to features such as vertical ladders, ropes or hoists.

<sup>17</sup> This danger has been specifically recognised for a wide range of occupancy risks and multiple paint layers have been adjudged to have been responsible for serious fires and even two fire deaths in the UK. A build-up of paint layers on the ceilings of King's Cross underground station was cited as one of the reasons for the rapid spread of that multi-fatality fire.

In the past, the prescriptive approach to building regulations laid out the maximum distances which an occupant could be required to travel. Now, time is used rather than distance and the applicable legislation does not specify any actual times. The objective as specified in 2.9 of the SBS Technical Handbook states that the means of escape '*should be short enough for them to escape from the building before being affected by fire or smoke.*' This would normally require a progressive route from the area of the fire, placing fire-resisting structure between the occupants and the fire as they move to the open air. In some cases this may involve three distinct stages:

- Escape from the room or compartment of origin until the safety of a fire resisting barrier is reached
- Escape from the floor of origin to a protected area such as an escape stair
- Escape from the building to a place of safety at ground level – which may be some distance from the building.

Other essential elements needed for safe egress in the event of fire include:

- Early warning of fire – except in the very smallest building this will usually involve the provision of automatic fire detection
- Exit signs to indicate the way out of the building
- Adequate lighting to illuminate the ways out of the building, including escape lighting, in case there is a failure of the electrical supply
- Door hardware which permits easy and swift access – even where doors are locked for security purposes
- Doors which open in the direction of travel in the case of buildings where the occupancy capacity is more than 10 persons (factories and warehouses) or 60 persons (all other buildings).

As stated earlier, these provisions are relatively simple in new buildings and follow a well-established set of principles. Problems can arise where such requirements need to be provided in traditional buildings – especially where the building is being modified or refurbished for a change of use.

A good example of the issues which need to be considered can be demonstrated by taking as an example the conversion of a listed 19<sup>th</sup> century office building into an hotel. The fire risk assessment regimes currently in use in the UK adjudge that the highest risks to occupants relate to the following categories of people:

- Persons asleep
- The very old or the very young
- Persons not familiar with the layout of the building

- Persons who may have disabilities or may not understand English well
- Persons whose senses and abilities may be impaired due to the use of alcohol or drugs
- Large numbers of persons.

Clearly, the occupants of any hotel will include many or all of the above groups and as such, hotels have always been perceived as being classified as among the highest occupancies (as such, this was why hotels were closely controlled by the fire certificate process under previous fire safety legislation).

How then can one approach the problem described above in relation to making changes to the listed building to permit its use as the hotel without wide scale destruction of the authenticity of the features which make it worth listing?

To apply the strict criteria of Part 2 of the SBS design guide in any new or refurbished non-domestic building some or all of the following may be required:

- Fire-rated doors on all bedrooms and utility rooms
- Upgraded fire barriers around certain high hazard areas such as linen stores or catering kitchens
- Installation of fire dampers in ventilation and extract ducting where this passes through a fire barrier
- Creation of smoke lobbies on each floor
- Sub-division of long corridors by smoke stop doors
- Creation of additional fire exits or escape stairs
- Installation of a fire alarm and detection system with fire sensors in most rooms and compartments – this would also require installation of alarm sounders throughout the building (especially in bedrooms) as well as the fitting of fire call points on exit routes and near each storey exit
- Installation of a range of signs including exit and fire action signs
- Installation of escape lighting
- Provision of portable fire extinguishers and/or fire hose reels
- Adaptation of doors to open in the direction of escape
- Exit doors across escape routes which can be opened at any time even when normally secured against unauthorised access
- Provision of access routes and facilities for the fire and rescue service (which could include a firefighting shaft, installation of a dry riser system, availability of firefighting water, access to the

exterior of the building for fire appliances and suitable areas for positioning these).

Any or all of these provisions could be a factor which could act negatively on the authenticity, appearance, value and interest of the building. Some, like driving a new staircase through the heart of a building could be so destructive of historic fabric that they should not normally be contemplated. However, what is unacceptable for one building might be acceptable in another. For example two new fire escape staircases were accommodated in the major refurbishment and fire upgrade of the National Library of Scotland's George IV Bridge building (refer to Part 3, Case Studies). Other provisions such as the creation of smoke lobbies will create a visual intrusion but using, for example, decorative fire resisting glazing, could minimise this. Equally, such a lobby could be acceptable under the Conservation Principles (refer to Section 7.1) given that they could be reversed at some future date.

Some requirements may be of little concern – for example replacement of doors where these are of no historic interest (but refer to Section 3.5 Doors and Door Fittings in Part 2, for a further discussion on what can be done with a little imagination). Upgrading fire barriers can be accomplished with little or no visual impact and an acceptable level of intrusion into historic fabric. Equally, combined exit signs and emergency escape lighting units are available which are relatively unobtrusive and which will not impose a major visual intrusion on a corridor or compartment. Portable extinguishers and fire hose reels can be located in niches or even in cupboards (providing that their presence is suitably signed). Fire call points could be located unobtrusively and even flush mounted to minimise their impact.

#### ***5.3.10 Facilities for the Fire and Rescue Service (2.12, 2.13, 2.14)***

The provision of facilities which will enable the fire and rescue service to do their job more efficiently and in safety is an important functional requirement reflected in the SBS Technical Handbook. The relevant sections are 2.12 dealing with access, 2.13 on water supplies and 2.14 on general facilities.

The facilities, features and other things which need to be provided will include some or all of the following:

Access arrangements to allow fire appliances to approach and park within a reasonable distance so that firefighters can use their equipment without too much difficulty. These facilities may consist of access roads to the building, hard standing areas and access into the building for firefighters.

Firefighting shafts may have to be provided in tall buildings to provide firefighters with a protected route

from the point of building entry to the floor where the fire has occurred and to enable firefighting operations to commence. A stairway within the shaft is likely also to be in daily use by the occupants and will usually form part of the means of escape from the building. Entry points from a stairway in a firefighting shaft to a floor will be via a protected lobby.

In larger buildings (such as hotels, offices and very large care homes) firefighting shafts may also incorporate a firefighting lift. The lift will have a back-up electrical supply and car control overrides. A function of the lift is to transport firefighters and their equipment to the fire floor. Firefighting lifts are often used as freight lifts or bed lifts in care homes.

### **5.3.11 Other Facilities**

Smoke ventilators or outlets may be required particularly in basements and escape stairs to be provided for the specific purpose of assisting firefighters in gaining access and clearing smoke. These facilities may also help to minimise damage to the building and contents from heat and smoke.

Luminous discharge ('neon') lighting is frequently used in the retail sector. Safety switches are normally provided to isolate electrical power from the high-voltage luminous signs. The switch requires to be in a suitable location and appropriately identified.

### **5.3.12 Water Supplies for Firefighting**

External, underground fire hydrants provide a water supply for use by firefighters. Where no piped water supply is available, or there is insufficient pressure and flow in the public service main,<sup>18</sup> an alternative supply may have been provided such as an underground cistern, swimming pool, ornamental lake or access provided to some other source of water. In this case, hard standing for fire appliances may have to be provided to enable pumping from the water source. In some cases, for very large premises additional fire hydrants may have to be installed and these and their water supplies may be under the control of the premises' management. Where private hydrants or an external source of water is to be relied on then these should be provided with the appropriate 'H' or 'EWS' signs. The local fire and rescue service can advise on this.

In taller buildings, one or more dry rising mains may have to be provided. This consists of an inlet box on the outer face of the building in an accessible location within 18m of the street or road or fire appliance parking area, where firefighters can connect a hose. This feeds a pipe running up or through the building (usually in a staircase) which is provided with outlet valves on each

floor level to which can easily be connected lengths of fire hose. Even where a riser is not required under SBS it is worth considering as it makes the job of the firefighter much easier and reduces the time taken to get water to a fire. Risers will also minimise the risks of water damage caused by leaking or bursting fire hoses which have to run through a property.

Note also the following:

- Car parking should be prohibited in front of the inlet box
- The inlet box door should be secured in such a way that firefighters can readily open the door
- The outlets (landing valves) should be secured in the closed position, usually with a leather strap and padlock to prevent tampering. The valves should be maintained so that they are easily operable.

### **5.3.13 Automatic Life Safety Suppression Systems (2.15)**

Considerable benefits can accrue from the introduction of well-designed automatic fire suppression systems even where these are not specifically required under SBS. It is probable that such systems will take the form of sprinklers or water mist. In both cases water is applied directly to the seat of a fire via a system of pipes. The pipes are fitted with thermal devices (sprinkler or mist 'heads') which respond to predetermined temperatures by opening to allow a flow of water.

As only specified high temperatures (and not smoke) operate these heads together with the fact that only the heads in the area of the fire will operate restricts the volume of firefighting water applied to the fire.

There is more information about automatic fire suppression systems and their applications in Part 2 of this Guide, Section 4.3.

### **5.3.14 Maintenance and Liaison**

While there are no specific maintenance criteria for fire protection systems and equipment laid down in the Technical Handbooks (except in 2.15 in respect of automatic fire suppression systems), in common with the fire and rescue services, SBS considers that adequate and appropriate maintenance of all fire protection systems and facilities is of the utmost importance as all of these requirements should be available and in good condition at all times. Failure to do so will not only endanger a building and its occupants and place firefighters lives at risk, but could also render a duty holder (for example an employer or property owner) liable to prosecution and civil suit.

In complex buildings, there may be a requirement for layout plans to be made available for firefighters

<sup>18</sup> Previously known as the 'towns main'.

or information on the presence of particular hazards. Such information can be supplemented by locating the control panel for the fire detection and alarm system (or a repeater panel) close to the point where firefighters are likely to want to access the premises.

It will also be helpful to provide information to the fire and rescue service if there is a temporary loss of a firefighting facility or a change in access arrangements. Regular liaison with local fire stations is also recommended and in larger premises this should include invitations to visit the premises to discuss access arrangements, water supply and fire and rescue service support in respect of salvage and damage limitation. It should also be understood that each fire and rescue service have developed Integrated Risk Management Plans which set out their priorities for Prevention, Protection and Intervention. Providing plans to the local fire and rescue service will enable them to decide how to integrate these into their planning process.

## **5.4 Traditional Buildings and Statutory Protection**

### **5.4.1 Listed Buildings and Conservation Areas**

As detailed in Section 1.2.2, under The Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997, Scottish Ministers are empowered to compile or approve lists of buildings of special architectural or historic interest and local planning authorities to identify and designate areas of historic or architectural interest.

The character of listed buildings and conservation areas are controlled via a change management system:

- Alterations to the character of a listed building require listed building consent from the planning authority. The act also directs planning authorities, in considering whether to grant planning permission for a development which affects a listed building or its setting, to have special regard to the desirability of preserving the building, or its setting, or any features of special architectural or historic interest which it possesses.
- To help preserve or enhance the character or appearance of a conservation area, most works to the outside of a building or structure within a conservation area will require planning permission. Additional controls may be applied to changes within conservation areas through the introduction of Article 4 Directions. Conservation area consent is normally required in cases of demolition of unlisted buildings within a conservation area.

### **5.4.2 The Ancient Monuments and Archaeological Areas Act 1979**

Where a building is a Scheduled Monument, included under the Ancient Monuments and Archaeological Areas Act 1979, scheduled monument consent rather than listed building consent will be required for changes to it, including repairs. Around 8000 (at 2010) archaeological sites and monuments, architectural objects and marine sites are recorded in Scotland. Once a monument is scheduled, it becomes an offence to carry out, without the prior written consent of Scottish Ministers, any works which would have the effect of demolishing, destroying, damaging, removing, repairing, altering, adding to, flooding or covering up the monument.

As the presumption is that a scheduled monument be preserved in the manner that it has come down to us, it is less likely to be converted to another use than would be a listed building. However, there have been instances where this has been permitted, in the best interests of the preservation of the monument. Should the conversion be to a residential or ecclesiastical use, the building would then be de-scheduled. Since it is possible that some buildings being converted will be scheduled monuments, scheduled monument consent rather than listed building consent will be required.

### **5.4.3 Government Policy and Guidance – Scottish Planning Policy 23: Planning and the Historic Environment 2008 (SPP 23)**

Government policy on the built heritage is set out in SPP 23. SPP 23 supersedes and consolidates National Planning Policy Guideline 18: *Planning and the Historic Environment*. It is intended that the planning policy set out in SPP 23 will be incorporated into a combined Scottish Planning Policy during the course of 2009/10. SPP23 sets out the policies for planning and development in the historic environment with a view to its continued protection, conservation and enhancement and indicates how the planning system will contribute towards the delivery of the Scottish Ministers' policies as detailed in SHEP (refer to Section 5.4.4 below) produced by Historic Scotland. It recognises the value of the historic environment, even where this does not have statutory protection through listing or inclusion in a conservation area. SPP 23 advocates a positive approach and emphasises the need to find ways in which the active life of historic buildings and areas can be extended. This SPP also demonstrates how action to achieve conservation objectives can yield wider social, economic and environmental benefits and be consistent with the principles of sustainable development.

#### 5.4.4 Scottish Historic Environment Policy (SHEP)

The primary sources of guidance on Scottish Ministers' interests and responsibilities in relation to listed buildings and conservation areas was previously *The Memorandum of Guidance on Listed Buildings and Conservation Areas* (1998). The Memorandum was withdrawn and replaced by the SHEP in 2009 that sets out Scottish Ministers' policies for the historic environment, provides greater policy direction for Historic Scotland and provides a framework that informs the day-to-day work of a wide range of public sector organisations that have a role in managing the historic environments. The SHEP has the same authority as the Scottish Planning Policy Series and complements SPP23.

The detailed guidance contained in the annexes of the Memorandum has been superseded by the new *Managing Change in the Historic Environment Guidance Notes* series. These are being produced by Historic Scotland between 2009-10 and will provide operational guidance to assist planning authorities in their consideration of applications for conservation area and listed building consent.

#### 5.4.5 The Construction (Design and Management) Regulations 2007 (CDM Regulations)

Construction remains a disproportionately dangerous industry, so improvements in health and safety are required. The 2007 Regulations revise and bring together the CDM Regulations 1994 and the Construction (Health Safety and Welfare) Regulations 1996 into a single regulatory package.

The CDM Regulations focus attention on how construction projects should be designed and managed to ensure health and safety, from design concept onwards, to requirements on site during the construction phase. The aim is for health and safety to be an integral part of a project's development rather than an after thought. The CDM Regulations impose duties on duty holders; clients (excluding domestic clients where no developer has been appointed), CDM coordinators, designers and contractors. The regulations apply to all projects involving construction, including:

- New construction, alteration, conversion, repair



*Illus 49 Statistics suggest that traditional buildings are at greater fire risk during construction works and consequently additional controls and procedures should be implemented to minimise risk © Stewart Kidd*

and maintenance, fitting out and renovation of a building

- Installation, commissioning, maintenance of services
- Preparation for an intended structure including site clearance
- Demolition and dismantling of structures
- Assembly or disassembly of prefabricated structures.

The Regulations apply to all construction sites, there are no exceptions, but there are additional duties for 'notifiable' sites where construction work lasts for more than 30 days or takes more than 500 person days of construction work. For notifiable projects, clients must appoint a CDM co-ordinator (this replaces the Planning Supervisor under the 1994 regulations) and a principal contractor for their construction project and ensure they are competent and have sufficient information relevant to the health and safety of the project. The CDM coordinator will prepare the health and safety file.

With respect to the conversion of historic buildings, additional responsibilities and specific duties to those imposed by the Building (Scotland) Regulations 2004 are placed directly on designers, developers and owners. These duties can influence the choice of materials to be used in the conversion and might, as a result, affect the character of the historic building if the CDM Regulations are not sympathetically applied. CDM does not require the elimination of attractive or historic features that are important to the building, such as cupolas, nor does it require designers to take into account unforeseeable hazards. CDM, however, does place certain specific duties directly on designers – they have to eliminate hazards and reduce risks from the outset of the design stage and designs should be safe to construct, to use, to clean and maintain and to demolish: the entire life cycle. For example:

- Eliminate hazards where feasible – when specifying rooflights, specify non-fragile materials
- Reduce risks from those hazards that cannot be eliminated – specify designs and coatings for materials that reduce the need/frequency for replacement, cleaning and re-painting
- Provide information on residual risks if they are significant – if a set sequence of assembly or demolition is necessary to maintain stability.

Designers also have to ensure that any workplace they design complies with Workplace (Health, Safety and Welfare) Regulations 1992.

#### **5.4.6 Other relevant legislation:**

- Management of Health and Safety at Work Regulations 1999
- Workplace (Health, Safety and Welfare) Regulations 1992
- The Work at Height Regulations 2005
- The Civic Government (Scotland) Act 1982 (Licensing of Houses in Multiple Occupation) Amendment Order 2002
- Control of Substances Hazardous to Health Regulations 2002
- Control of Asbestos at Work Regulations 2002
- The Electrical Safety, Quality and Continuity Regulations 2002
- The Electricity at Work Regulations 1989
- The Gas Safety (Installation and Use) Regulations 1998
- Licensing Scotland Act 2005.



*Illus 50 Fire Service personnel amidst the rubble following a gas explosion at Guthrie Street, Edinburgh  
© Lothian and Borders Fire and Rescue Service.*



# 6 USING BRITISH STANDARDS GUIDANCE FOR FIRE SAFETY AND FIRE ENGINEERING TO PROVIDE ALTERNATIVE COMPLIANCE WITH BUILDING STANDARDS AND FIRE SAFETY LEGISLATION

## 6.1 Approaches to Fire Safety Provision

In the UK it has been a long-established principle that when assessing whether a new building is 'fit for purpose' in respect of its fire safety provisions there are three possible ways in which this can be assessed:

a. The 'General Approach'. This is applicable to the majority of new building work undertaken within the UK. In this case the fire precautions designed into the building usually follow the guidance contained in the documents published by the relevant government departments to support legislative requirements. In the case of Scotland this would be Part 2 of the Non-Domestic Technical Handbook 2009, in England and Wales Approved Document B: 2006.

b. The 'Advanced Approach'. This is now supported by the publication of BS 9999<sup>19</sup> *Code of Practice for Fire Safety in the Design, Management and Use of Buildings (BS 9999)*. The information and guidance provided in this document should provide a more transparent and flexible view of fire safety design using a structured approach to risk-based design where designers can take account of varying physical and human factors. Much of the guidance in BS 9999 is based on fire safety engineering principles, although it is not intended as a guide to fire safety engineering.

c. The 'Fire Safety Engineering Approach'. This is the level for which the BS 7974 series of documents is provided. The series should be cited as BS PD 7974: *Code of Practice for Application of Fire Safety Engineering Principles to the Design of Buildings*, 2001. This level provides an alternative approach to fire safety and can be the only practical way to achieve a satisfactory standard of fire safety in some large and complex buildings, and in buildings containing different uses. Caution should be exercised in adopting this approach without specialist input from a competent fire engineering practice.

## 6.2 Fire Safety Measures

The provision of fire safety measures can be relatively easily summarised under six headings:

- The provisions of means of escape
- The structural protection of escape facilities and the structural stability of the building in the event of a fire
- The provision of access and facilities for the fire and rescue service
- Early detection and warning of fire
- Facilities for fighting fires (manual and automatic)
- An effective fire safety management regime.

Traditionally, the first three of these have been imposed on new or buildings being converted or altered under Building Standards while the remainder have been the subject of requirements imposed on the building occupier by the fire and rescue authority, under fire safety legislation.

However the requirements are to be specified, it is important to understand that all these elements form important components of an integrated package of fire safety measures – for example, a building could be provided with more than adequate means of escape for the occupants but these would be of no value if they were locked while the building was occupied. The means of escape are valueless if they are not accompanied by a management system to ensure that the routes to them are kept clear and accessible at all material times.

<sup>19</sup> BS 9999: 2008 *Code of practice for fire safety in the design, management and use of buildings*. (This document replaces all but Part 1 of the BS 5588 series).



*Illus 51 The sensitive introduction of fire measures into traditional buildings can help prevent their destruction. This large country house, category A listed, has been totally devastated and a recovery firm has been mobilised to remove the debris*

# 7 INTRODUCTION OF FIRE PROTECTION MEASURES INTO TRADITIONAL BUILDINGS

## 7.1 The Conservation Principles

In most of their work, architects and fire consultants will try to achieve a balance between the simplest, most cost-effective means of minimising the risks of fire and the effect of these on the building's usefulness, its earning capacity and its real estate value. However, for a historic building, exactly the same criteria will be addressed, but in a way that causes minimal or no damage to whatever gives the building its special quality. Effectively, this is a readjustment of the standard decision-making process, rather than simply accommodating fire measures to the buildings usefulness or economic value, the design takes the preservation of the existing fabric and aesthetic into consideration. This 'conservation approach' (as described below) is effectively a brief within a brief; exactly the same aim – the protection of life and property – but with different constraints for decision-making. In effect, the normal design process is given an unaccustomed focus by the overlaying need to conserve and protect the interests of posterity.

## 7.2 The Rules

The most difficult question any owner of a traditional property can be asked is what they would wish to have left after a fire. Whilst 'everything' might be an obvious response, the answer in reality needs to consider a complex set of interlinked issues, including the safety of the building structure, the contents of the building and crucially, human safety. Achieving this balance requires careful consideration of some of the basic principles of fire protection measures such as detection and suppression systems. Primarily, the insertion of fire protection systems in historic buildings should be:

1. **Essential** – The fire systems should be central to meeting the objectives of the protection of life, buildings and contents.
2. **Appropriate to risk** – Any system that is installed should be apposite to the risks being considered.
3. **Compliant with legislation** – Systems should be installed according to demonstrable performance-based and other legislatively prescribed standards of safety.
4. **Minimally invasive** – The retrospective fitting of fire systems should involve minimal degrees of physical intervention on the historic structure.

5. **Sensitively integrated** – Installed systems should be designed to be integrated sympathetically with the historic fabric and its detail.

6. **Reversible** – Fire systems should be installed according to a reversible, 'plug-in, plug-out' installation philosophy.

### 7.2.1 Essential

Much of the basic hand-held firefighting equipment commonly available in homes and many buildings today have changed surprisingly little over the last century or so. While such equipment may provide owners with a degree of comfort (one estimate suggests that more than 80% of fires are extinguished this way), it is limited in that it is only effective when the building is occupied and there is a means of early detection of the fire, which may put the buildings and contents at risk at other times. The financial burden of introducing modern technologically effective solutions needs to be carefully weighed against the cost of real loss, should a potentially serious fire situation emerge.

### 7.2.2 Appropriate to Risk

Inevitably, different risks occur in different circumstances. These can vary according to the construction, function, contents and value of the building. A rural or urban situation, the distance from emergency firefighting services, availability of firefighting water supplies and the local knowledge and experience of those tackling the blaze can also contribute to the degree of risk that should be assessed. The function for which the building was designed or converted is also a key issue; an industrial-age mill building still in operation may be subject to as many, if not more, risks than an open-fired thatched cottage. Suitably balanced measures need to be considered for each situation.

### 7.2.3 Compliant with Legislation

Current legislation dealing with fire safety has invariably been driven principally by the desire to protect persons from harm caused by fire. This fundamental point cannot be ignored, and the appropriate guidance must be followed. Yet, with a general move away from prescriptive legislative to performance-based standards, there is an opportunity to develop and enhance the fire protection



*Illus 52 Where fire extinguishers are required to comply with legislation, subject to agreement with the fire authority there is no reason why they can't be allowed to be free standing as opposed to being physically attached to the wall © Stewart Kidd*

of buildings and contents in ways that will meet the statutory functional requirement whilst respecting the building's architectural integrity and historical context.

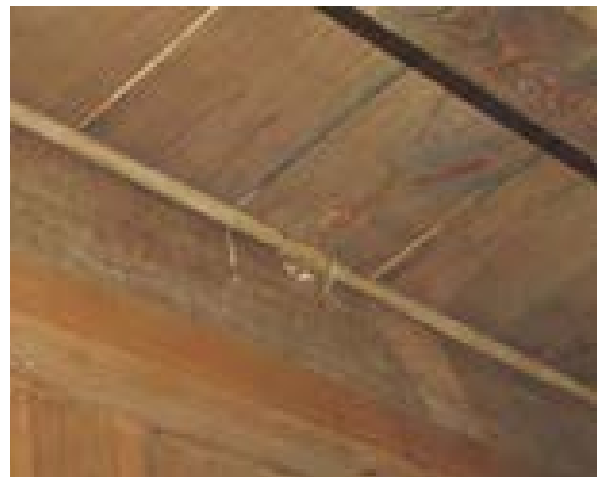
#### **7.2.4 Minimally Invasive**

Understanding the historic structure, how it functions and performs is critical to the sensitive retrospective fitting of modern detection and firefighting technology. Equally, different types of traditional buildings will present different opportunities and constraints. The value and significance of each part of the structure needs to be appropriately identified and assessed. Secondary apartments, vertically aligned storage areas on different floors and other original functional features can generally tolerate a greater degree of intervention than principal areas and features.

Within the structure of industrial architecture, surface-mounted equipment and supply pipes may already be prevalent throughout, allowing additional pipe work and cabling to be introduced without undue concern. In more refined, architecturally sensitive buildings this may not be possible. In every case, fire engineers and conservation practitioners should be encouraged to work closely together, pooling their expertise for the best and most appropriate result.



*Illus 53 A concealed sprinkler head has been installed immediately in front of the bird's beak, almost invisible to the untrained eye © Stewart Kidd*



*Illus 54 With the approval of the manufacturer sprinkler pipes have been painted to blend in with the open timber ceiling*

#### **7.2.5 Sensitive Integrated**

Careful consideration should be given to the location of all retrofitted equipment before any physical installation work is initiated, especially if exposed. In a valued historic interior the challenges of dealing with the aesthetics of discretely positioning the equipment should initially be considered separately from the functional needs of connecting the apparatus to the complete system. This approach can help make the process of sympathetically designing the integration of equipment with the historic detailing an easier prospect. By integrating or aligning the apparatus with prominent architectural features, finishes and details, minimal visual intrusion can be achieved in the most sensitive of apartments without sacrificing functionality. Such an approach is likely to



*Illus 55 The wires have been fixed using cable clips rather than notching the timbers*

cause knock-on practical difficulties, for instance in getting hidden cabling or pipe work to the particular position. A degree of lateral thinking will therefore be required to help overcome the problems and achieve the correct balance.

#### **7.2.6 Reversible**

Installing a fire system in an entirely reversible manner that causes no damage to the building fabric is a laudable aim, but one difficult to achieve in reality. Innovative thought, aesthetic considerations, technical requirements and functional needs should be combined to determine optimal locations for the positioning of equipment. Integrating a range of service requirements, whilst ensuring functional effectiveness, can assist in providing an appropriate answer if they are jointly packaged and designed. In recent years, as confidence has grown about how to fit historic structures with modern equipment in an aesthetically relevant manner, innovative solutions have emerged that warrant wider exposure and consideration. In particular, benefits from bespoke designs are likely to have a broader range of applications if the acquired knowledge is shared effectively.

### **7.3 Other Requirements for Retrofitting Fire Protection Measures**

The successful retrofitting of fire protection measures requires an understanding of the entirety of the traditional structure, and awareness of the above conservation principles. Designers also need to be sympathetic in the choice, integration and application of the modern equipment.

Design shortcomings and flawed installation techniques can result in a loss to traditional structure, fabric or detail that could permanently disfigure the building and greatly reduce its original value and authenticity.



*Illus 56 Reversibility - In this highly decorated Austrian palace interior, a contemporarily detailed floor fixed 'pole' houses a sprinkler head, electrical services and emergency lighting – thus providing an innovative and reversible solution avoiding damage to historic wall finishes which conventional installations give rise to © Stewart Kidd*

Building managers should plan effectively for every step involved, and take nothing for granted. The need for adequate supervision and for using specialist support trades with relevant conservation skills and understanding is self-evident. The full co-operation of the entire project team is required at every stage. An agreed method statement that everyone involved can recognise and abide by would be of some assistance in the process.



*Illus 57 Eliminating hazards can help reduce the probability of serious fires such as the Old Town Fire in Edinburgh, a World Heritage Site. Crown Copyright: © RCAHMS. Licensor [www.rahms.gov.uk](http://www.rahms.gov.uk)*

# 8 RISK MANAGEMENT AND FIRE RISK ASSESSMENT

Risk assessment is now a requirement of legislation arising from the European Community under the Framework Directive (June 1989) and the Workplace Directive (November 1989). Originally implemented in the whole of the UK by the Management of Health and Safety at Work Regulations 1999 and the Fire Safety (Workplace) Regulations 1997 (as amended), in Scotland, fire risk assessment is now at the heart of the Fire (Scotland) Act 2005 (refer to Section 5.1). This requires duty holders (normally employers) to assess all risks caused by fires to the safety of those who may be in the duty holders' premises. An employer who employs more than five persons must record the significant findings of the risk assessment in writing. It must be emphasised that where a statutory fire risk assessment has to be undertaken, such an assessment is legally required only to consider matters related to life safety, that is the safety of occupants or those who may be nearby and who could be affected by a fire. However, when dealing with traditional buildings, if adopting a conservation approach, the risk assessment can be expanded to take into account risks to the building fabric and/or contents.

## 8.1 Introduction to Fire Risk Assessment

Risk assessment is an essential part of the risk management process. Confusion has often arisen between 'risk assessment' and 'risk management'. Risk management in the present context is best described as the application of standard management techniques to the identification, elimination, control and acceptance of the hazards to which buildings and their contents might be exposed, as identified by the fire risk assessment. Risk assessment not only assists the owner or manager of a building to understand the hazards to which that building is exposed, but also helps to prioritise remedial measures.

Note that worked examples of fire risk assessments can be found in Annex IV.

### 8.1.1 Objectives of a Fire Risk Assessment

The objectives of a fire risk assessment are:

- To identify hazards and reduce the risk of those hazards causing harm to as low as is reasonably practicable; and
- To determine what fire safety measures and management policies are necessary to ensure the safety of people in the building should a fire occur.

The whole assessment procedure should be undertaken to assist in the management of risk and to prioritise the allocation of resources to reduce or eliminate the hazards which remain. If a project needs to be undertaken to address outstanding hazards or deficiencies, the rationale of the project should be continuously borne in mind. Is the work being undertaken to:

- Prevent fire
- Contain fire
- Control the spread of smoke
- Protect the structure of the building from collapse?

A satisfactory outcome will only be achieved through continuous re-appraisal of the objectives.

Specific advice from the Scottish Government in the form of Sector Specific Guides has already been mentioned (refer to Section 5.1) and examples of completed risk assessments can be viewed at: <http://www.infoscotland.com/firelaw/v2.jsp?pContentID=240>. A good example of a simple assessment for a small hotel, undertaken in accordance with the guidance document, and a larger, more complex property (reproduced from TAN 22), are detailed in Annex IV. However, the way in which a risk assessment is undertaken is a matter for the dutyholder who is at liberty to decide which approach to follow.<sup>20</sup>

One of the problems with the perception of risk assessment is the loose way in which certain terms are used in everyday speech. 'Risk' and 'hazard' are often used interchangeably, but the two words are distinct. A hazard is essentially an unsafe condition which could lead to harm – such as a loose piece of carpet upon which someone could trip. The risk is the possible impact on the person or property which might result from interaction with the 'hazard', ie tripping on the carpet and falling, and the likelihood that this will happen. Risk is more correctly defined as 'the probability that a particular adverse event occurs during a stated period of time.'<sup>21</sup> In this Guide, the term risk is used to encompass not only the probability of harm but also the possible consequences of the impact of the hazard.

<sup>20</sup> Bear in mind however, that an inspecting officer from the fire authority will almost certainly expect to find the assessment undertaken in accordance with the guidance documents and any alternative approach may have to be explained in detail before the assessment can be reviewed and accepted as suitable and sufficient.

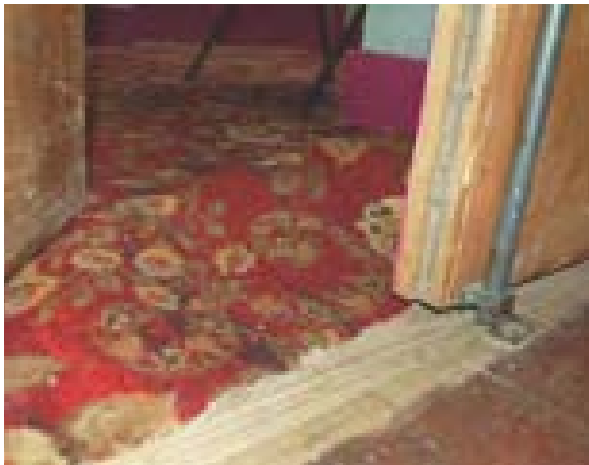
<sup>21</sup> Royal Society: Risk: Analysis, Perception and Management, London 1992.



Illus 58 Portable heater in office © Stewart Kidd



Illus 60 High intensity quartz halogen lights in a church surrounded by timber features © Stewart Kidd



Illus 59 A crumpled carpet preventing the opening of a fire escape door. It also presents a trip hazard



Illus 61 Storage of material in a back room of a heritage centre

### 8.1.2 Application of Risk Assessment Techniques

As already stated, the objectives of fire risk assessment are to ensure that fire safety risks are eliminated or managed in order to ensure that fires are prevented or the impact of those fires which do take place is minimised. It is axiomatic that there is no 'right' way in which the fire risk assessment at a particular building should be undertaken. However, certain elements of the process will be common to any activity of this sort, regardless of whether the process is being undertaken for statutory reasons (for life safety) or to determine the appropriate levels of protection for building and/or contents. The five main parts involved in a risk assessment process are:

- Identification of hazards
- Identification of who or what is at risk
- Evaluation of the risk and the carrying out of improvements

- Recording findings and action needed
- Review and revision.

At its simplest, risk assessment demands that one consider the following:

- Building use
- Materials likely to be ignited
- Layout and structure of the building, including features which will permit fire or smoke spread
- How the building fabric or contents are likely to be affected by fire (important in considering historic buildings)
- Means of escape
- Occupants.





*Illus 62 Theatres often have high intensity lighting, upholstered seating, large open-plan auditoriums, combustible props, stage production areas and special effects, all of which can create a high fire risk © Crown Copyright: RCAHMS. Licensor www.rcahms.gov.uk*

**8.1.3 Reviewing and Recording of Risk Assessments**

One of the more common reasons for rejection of a risk assessment will be the fact that it has not been kept up to date. A fire risk assessment for a large country house undertaken when it was occupied by a single family will have to be repeated if the owners decide to take in paying guests.

To be effective risk assessments must be reviewed on a regular basis, probably not less than annually for all but the smallest or simplest occupancy. Assessments should also be reviewed when any of the following take place:

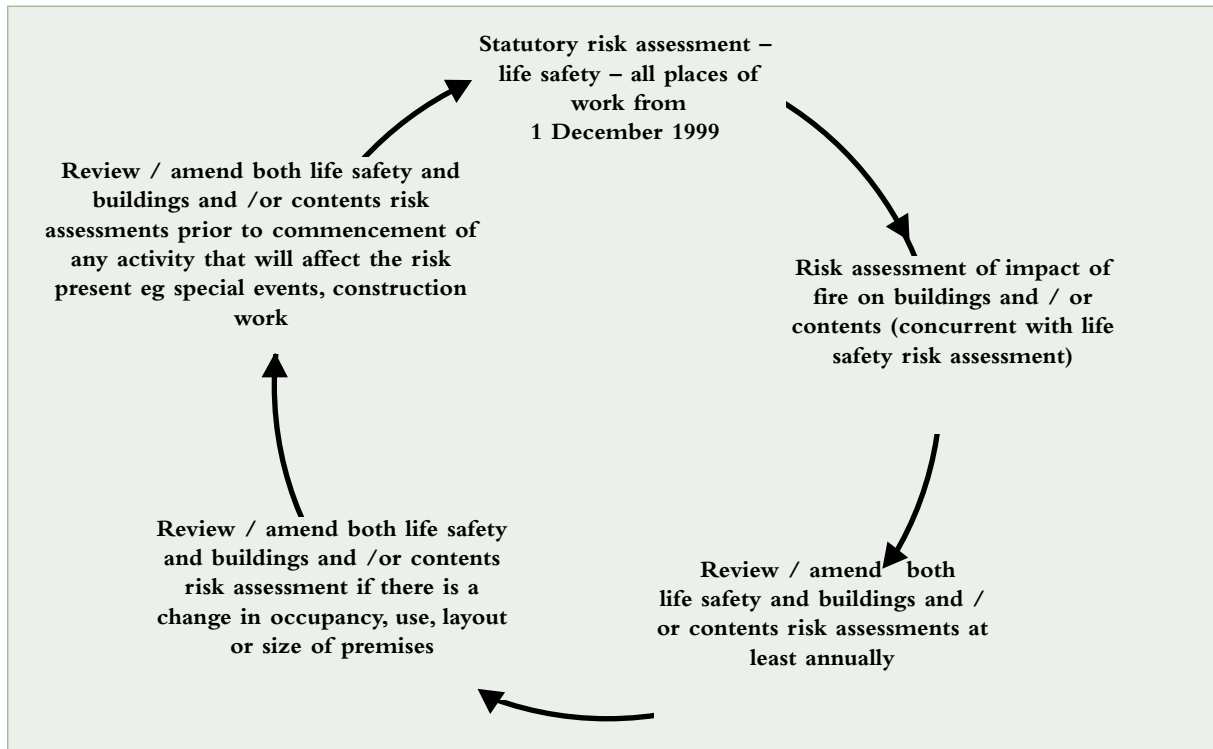
- When the nature or type of people at risk changes
- When materials in use or processes change
- When new equipment is introduced
- When chemicals, gases, etc are first introduced
- When contractors are present
- Before special events or temporary exhibitions.

Other possible considerations may include:

- Presence or absence of fire detection, fire suppression or adequate fire compartmentation
- Presence of trained persons to counter an outbreak of fire
- Proximity to a fire station
- Time it will take for a fire and rescue service unit to intervene
- Availability of firefighting water.

**8.2 Risk Management**

Part 2 of this Guide includes a great deal of information on the measures which must be taken to ensure that the risks from and of fire are minimised. After the first step in the risk management process is carried out, a fire risk assessment, the next step is to consider how these risks can be reduced. The case studies in Part 3 provide some excellent examples of this process in practice.



*Fig 4 The Risk Assessment Cycle*



*Illus 63 A category A listed University chemistry building is an obvious high fire risk © Crown Copyright: RCAHMS. Licensor [www.rcahms.gov.uk](http://www.rcahms.gov.uk)*

Two examples of risk management in practice can be considered:

Firstly, one might consider the risks which arise from open fires in a wholly domestic context. The fire is identified as a hazard (sparks may escape from the fireplace and chimney to set the house on fire). The risk (the impact of the fire hazard on the building) can be managed as follows:

- Risk elimination – replace open fire with another form of (safer) heating
- Risk control – use a fire guard to retain sparks; sweep chimney regularly; use only seasoned wood to minimise tars and soot; re-point/reline chimney; replace or upgrade hearthstone; replace or upgrade structural elements which abut chimney or where chimney passes through floors
- Risk avoidance – do not have open fires
- Risk transfer – [not appropriate in this case]
- Risk financing – ensure that the house insurance covers risks resulting from open fires
- Risk acceptance – after reviewing the whole process decide that the risk is acceptable.

Where risks cannot be ameliorated and have to be accepted as part of the price of doing business then it is essential that proper business continuity plans are in place to manage the situation which might follow a fire.



*Illus 64 To control an identified risk, flammable liquids should be stored in a proper flammable liquid storage cabinet © Stewart Kidd*

A second example postulates that in an office it may be necessary to use a particular flammable, solvent-based chemical. The solvent is a hazard as it can easily be ignited and may cause a fire. The risk to the premises and their contents is the fire which may occur. The risk can be managed in the following ways:

- Risk elimination – find a non-flammable alternative
- Risk control – minimise the quantity of liquid stored in the building; keep it in a secure container inside a proper flammable liquid storage cabinet; ensure that adequate fire protection measures to



*Illus 65 The build up of storage in areas such as these should be highlighted and removed © Stewart Kidd*

prevent, detect and extinguish fires are in place; ensure that structural fire precautions will contain the fire and minimise fire spread and damage

- Risk avoidance – do not undertake the activity which necessitates the use of the liquid
- Risk transfer – contract out the process to another organisation
- Risk financing – take out insurance or make financial provision to underwrite the risk
- Risk acceptance – after reviewing the whole process, decide that the risk is acceptable.

### ***8.2.1. Applying Risk Assessment Data to Inform the Management of a Traditional Building***

The above examples should make it clear that risk assessment is the first step in the risk management process, to understand and control risks. The proper application of risk assessment principles in any given building will identify many fire hazards.

Once hazards have been identified, efforts can be made to reduce, eliminate or control these using the tools already mentioned. At the same time, if the risk assessment process has been followed, the scoring or ranking of risks and their possible consequences also allows for

prioritisation of a work programme to tackle fire risks and allocation of the necessary funding or resources.

A typical risk assessment in a traditional building might indicate the following unsatisfactory features or hazards:

- High fire risk from old chimney breast where roof timbers are exposed inside the flue
- Possibility of delayed discovery of fire as building is often empty
- Probability of fire spread from kitchen via unstopped disused service shaft
- Wilful fire setting risk from insecure windows of storerooms.

These factors can be ranked according to probable consequences or likely cost of rectification and a work programme established.

The simplest (and cheapest) way to counter the risk of fire in the chimney would be to discontinue the practice of using the fireplaces which lead to that particular chimney. If this was not possible then the chimney flue and breast would have to be repaired or the flue slip lined. In the case of a delayed discovery of a fire, either a 24-hour presence would need to be assured or an automatic fire detection system installed. In the case of a kitchen fire spreading, fire-resistant materials could be used to seal the service shaft. In the case of the risk of a deliberate fire, security weakness could be eliminated by adequate physical security measures to prevent entry.

It should also be noted that the approaches proposed in official guidance is primarily intended to cover the life safety risk and in a heritage context it is likely that the actual cause of a fire may not, of itself, be significant. In the case of heritage buildings and their contents it is suggested, however, that it is worth looking at the more likely causes of fire, if only to see whether they might be eliminated or reduced before the risk assessment is undertaken.

ISBN: 978-1-84917-035-2



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