ENGLISH HERITAGE

Fire Safety in Historic Town Centres

Bergen Wooden Town protected by Sprinkler System

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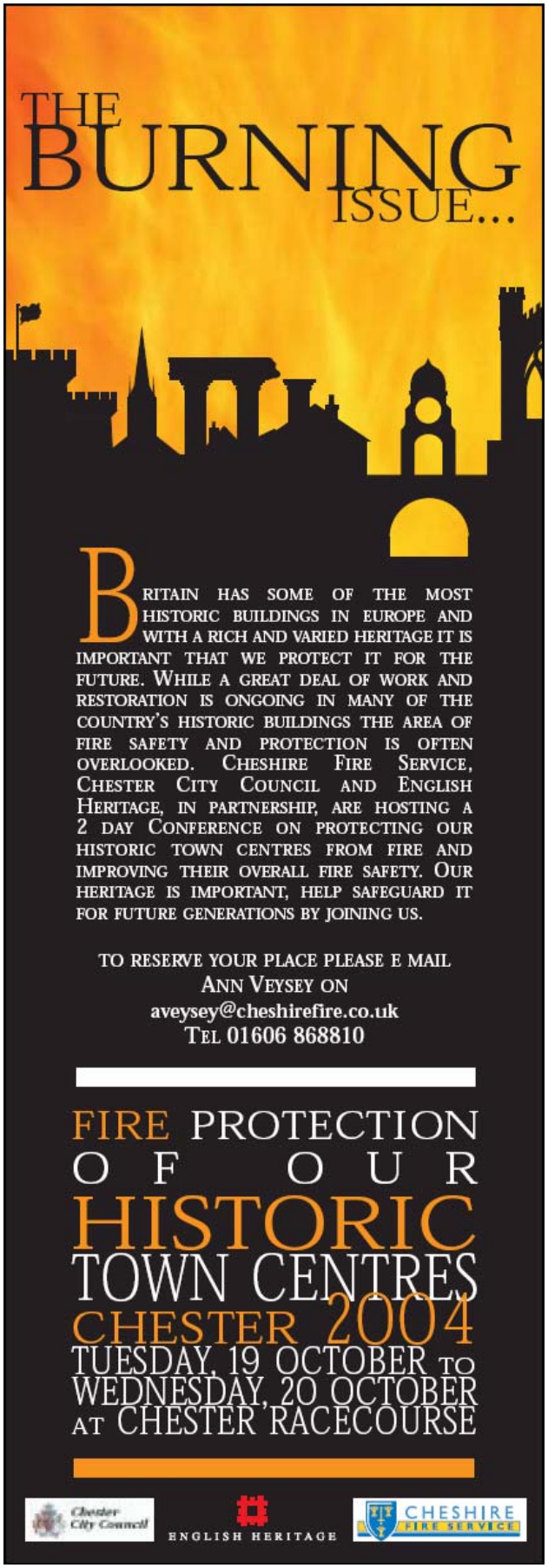
South Bridge, Edinburgh 2002



Introduction

Following the fire that destroyed two historic properties in Bridge Street, Chester; English Heritage, Cheshire Fire Brigade and Chester Building Control collaborated to produce this paper. It seeks to identify the problems of fire safety in historic city centre situations, the measures that could be taken to address these problems and the balance to be made between conservation and fire safety measures.

This paper was updated in 2008 to mark the progress of the initiatives in Chester Rows and to note the impact of national changes such as;

- The Fire Services Act 2004 and the way that Fire and Rescue Services work,
- the Regulatory Reform (Fire Safety) Order 2005 and changes made to fire safety enforcement.
- The fire services' integrated risk management plans (IRMPs),
- Fire Services Emergency Cover (FSEC) tool and
- The guidance on fire service response to automatic fire alarm signals issued by the Chief Fire Officers Association.

South Bridge Edinburgh after the fire

History of Fires in Historic Town Centres.

There have been numerous fires in historic town centres, which have spread beyond the building of origin. These recently include

Totness, The Clock Tower 1990
Canterbury, Stour Street 1992 and Butchery Row 2001
Chester, The Rows in Bridge Street, 2002
Edinburgh, Cowgate & Southbridge 2002
Trondheim, Norway 2002
Marlborough, High Street 1966, 1975, 1993, 1998
Shrewsbury, Bear Steps 2002

South Bridge Edinburgh

These fires were serious or had the potential to become even more so, because of various common factors

- Fire spread to adjoining buildings, often at roof level. This fire spread occurs for a number of reasons, such as hidden voids, common roof spaces, proximity of the adjacent structures or due to collapse, allowing direct impingement of flames.
- Difficult access for the fire brigade, either internally or externally.
- Late detection of the fire and therefore late notification to the fire service, leading to well established fires on arrival.

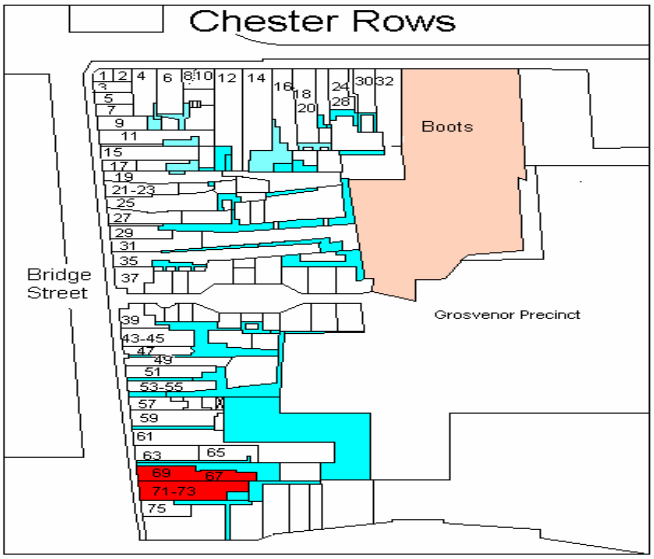
- Strong winds were also a contributory factor in several of these fires

Adjacent Roofs in Bridge Street

The Bridge Street fire was thought to have started in number 61and to have burned for some time before it was noticed by a passer-by, who called the fire service. It was therefore well developed before the first call was received.
The access to the fronts of the properties is at Row level, which is above street level. This meant that the fire fighters had to take their equipment up the narrow steps to the walkway or by ladder to the floor above.

Difficult access to 63 Bridge Street

The fire service successfully prevented further spread, because they were able to get to the rear of the buildings, via alleyways. This would not have been possible if the fire had occurred further up the street where the buildings are landlocked. Two buildings were seriously damaged by fire and some demolitions were required to make the site safe for redevelopment.



Steps taken To Prevent Subsequent Fires.

Setting up of a Multi-discipline group

Following the fire at Chester the financial implications became apparent, both direct losses and the subsequent fall off in trade for surrounding businesses.
A multi-discipline group called the Rows Fire Safety Group was set up to investigate ways of improving fire safety and mitigate the effects of any future fires. The members of the group consisted of representatives from

Cheshire Fire Service
Chester City Building control
Chester City Conservation and Planning Department
Chester City Corporate Service
Owners Representatives

English Heritage
City Centre Manager
The first meeting was held in August 2002 and the initial discussions centred around;

- The current fire safety provisions within the individual premises making up the Rows.
- Undertaking a fire risk assessment survey of the Rows
- The methods that could be adopted to persuade owners, occupiers and employers to improve the fire safety provisions within their premises.
- The statutory powers available to bring about fire safety improvements
- Stock Control
- Improvements to passive fire protection. i.e. compartment walls and ceilings
- Improvements to active fire protection i.e. fire detection and suppression systems
- Finance/Staff time
- Funding
- The cost of the fire, including Loss of historic fabric, Rebuilding costs, Stock, Fixtures and fittings, Business interruption, Clean up.
- Sources of funding for fire safety improvements to be investigated

Rear of Bridge Street

It was felt that the group should be the driving force behind improving the fire protection in the Rows and not merely a talking shop.
It was agreed that Cheshire Fire and Rescue Service would provide personnel for the surveys and English Heritage would provide the services of their Fire Safety Adviser.

In 2003 the group under the new leadership of a local councillor took a slightly more expansive role to include liaison with other historic towns and the aim of changing fire safety law to include property protection. A successful seminar was held in Chester in October 2004 which attracted much interest from around the country.

At this time the Fire and Rescue Services Act 2004 was enacted and fire and rescue authorities were introducing their Integrated Risk Management Plans, with a focus on Community Fire Safety. The Rows Fire Safety Group was then subsumed in a Community Safety Partnership. Unfortunately the fire protection of Chester Rows became one agenda item among many others rather than the main business.

Between 2004 and 2008 there were many personnel changes in almost all of the organisations represented in the original Rows Fire Safety Group including the fire service, and the City Corporate Services; without a succession plan some of the original proposals were not carried out. A meeting was convened in March 2008 with many of the original group and the local councillor to assess the situation and plan for the future. The results of this assessment and future plans are to be found at the appropriate sections of this paper.

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The existing fire safety provisions at the time of the fire

The Chester Rows is a unique system of covered walkways at first floor level. The

building of the Rows has evolved over the last 400 years, so there are a number of variations in the building materials and design, including

- medieval basement stone arches,
- Timber framed buildings with a variety of infill panels such as brick, wattle and daub or lath and plaster.
- Brick built Georgian buildings
- Victorian mock Tudor designs.

The current fire safety provisions within the individual buildings that make up the Rows varies according to the use of the premises, the date of construction, the last time that it had been altered, or if it is subject to any fire safety legislation. Where Building Control approval has been sought for a change of use or alterations improvements such as the upgrading of the construction or provision of automatic detection may have taken place.

Undertaking a Fire Risk Assessment of the Rows

An initial survey of the premises in the Rows was undertaken to determine which premises had the benefit of automatic detection, sprinklers or other active fire protection. The fire service then surveyed the boundaries of the premises to see where there were deficiencies in the passive fire protection, especially the boundary fire separation, either in the form of party walls or space separation.

The provision of fire safety measures and the awareness of occupiers in different premises varied dramatically. Some premises were provided with automatic fire detection systems and sprinklers, while others had no protection at all.

The Row walkways were also inspected and it was apparent that some parts were very low risk with non-combustible floors and non-combustible, fairly high ceilings. Some areas even benefited from sprinkler protection or smoke detection and automatic smoke ventilation.

Low risk Rows with tiled floors and high ceilings

Some parts of the first floor walkway around the Rows presented a much higher fire risk, having wooden floors, low ceilings and suffering from neglect. Gaps in boarding or around pillars allow the build up of discarded smoking materials and other combustibles.

Higher risk Rows with
Wooden Floors and low ceilings

It was thought to be a cigarette lodged in a crack in a shop front that caused the fire below Blossoms hotel in June 2003.

Will the building survive a fire?

One method that can be used to determine the likely affect of fire on a building and its contents is the Building Fire Performance Evaluation Methodology.

This involves identifying the room in which a fire is most likely to start. It is then assumed that a fire occurs which has enough energy to spread. Whether this occurs or whether it just burns out will depend on the amount of combustibles, how close they are to each other, the available ventilation, the volume of the room, the combustibility of the wall and ceiling linings and the ceiling height. The probability of the fire reaching full room involvement can be described simply in descending order as Very Likely, Likely, Unlikely or Very Unlikely. An assessment also needs to be made of how quickly it will reach full room involvement, by looking at the volume and flammability of the materials involved.

Historic warehouse fire, Newcastle-upon-Tyne

Using the methodology, a judgement can then be made as to the probability that the fire will spread to an adjacent space and then the probability that it will involve the whole floor and then the whole building. This can be judged by looking at the fire resistance of the partitions, ceilings and doors

The time taken for fire to spread from the room of origin will also depend on the fire resistance of these various elements of structure.

Historic Warehouse fire from above

The time taken before an intervention, such as first-aid fire fighting or fire service attendance, is then assessed by looking at the following factors:

- How quickly will the fire be detected?
- Is automatic detection provided and is it heat or smoke activated?
- How long will it take before first-aid fire fighting commences?
- Is there a 24-hour presence so that first-aid fire fighting can be instigated?
- If there is not a 24-hour presence, is the fire alarm monitored so the fire service can be called automatically?
- How long will it take for the fire service to attend? This will vary according to the time of day, whether brigade personnel are full-time or retained, the distance from the fire station to the scene of an incident, the traffic conditions and the ease of access.
- When the fire brigade arrive, how quickly can water be applied to the fire? This will depend on how close

the fire appliances can get to the building, the available water supplies, the distance between the water supplies and the appliance and between the appliance and the fire.

No Vehicle access to Clovelly

Fire growth is proportionate to the time elapsed, so the longer it takes to notify the brigade and for them to reach the scene, the greater the possibility that the fire will threaten adjoining buildings and will need to be fought externally.
This is intimated by the Entec Report, a Home Office commissioned risk assessment toolkit for the fire service (March1999). The Entec report was a precursor to the Fire Services Emergency Cover (FSEC) tool. This enables fire authorities to make decisions on the level of fire cover, and what proportion of their resources to allocate to Community Fire Safety
The fire performance of the building is rated according to the probability of a fire involving the whole building, so this would be as shown in the table below.

Probability of fire involving whole building	**Fire Performance of building**
Very Unlikely	Very Good
Unlikely	Good
Likely	Poor
Very Likely	Very Poor

If the fire performance of the building has been determined as poor or very poor, it would be advisable to improve the fire protection measures.

Remedial action and listed buildings

There will probably be a whole range of possible actions to take to improve the building fire performance. Not all of them may be possible because of listed building constraints, cost or desirability. The following questions may help decide on which course of action to take.

- What factors have been identified as the biggest threats to the building and contents?

- Can these threats be reduced to an acceptable level that does not involve any upgrading, such as reducing the fire load, or changing the use of the building or parts of the building?

- If improvements are necessary, are they reversible, sympathetic to the appearance and character of the building and avoid damage to the historic fabric?

- Will the improvements be effective? For instance, the provision of a fire alarm and detection system, which is not monitored, will not provide any protection when the building is unoccupied.

- The provision of an automatic detection system may cut down the time before a fire is discovered, but is it reduced sufficiently so that it is unlikely that fire will spread to adjoining spaces. If not, another layer of improvements, such as improved compartmentation, a sprinkler system or local water mist system may be necessary.

- Will the improvements be affordable and if not is there a more cost-effective alternative?

Methods that could be adopted to persuade owners, occupiers and employers to improve the fire safety provisions within their premises.

There are traditionally three ways of improving safety in the community, known as the three E's :-

Enforcement,

Education,

Environmental Changes.

Enforcement through Fire Safety Legislation

Enforcement, relies on

- there being relevant legislation available to make the responsible person undertake improvements and
- the enforcing authority having sufficient capacity to take action.

The Regulatory Reform (Fire Safety) Order 2005, enforced by the fire authority, came into effect in October 2006. This repealed all previous fire related legislation and removed references to fire in all other legislation, such as the Licensing Act, The Miscellaneous Provisions Act and the Theatres Act.

This legislation does not specifically encourage property protection, particularly the spread of fire from one building to the next, but has been enacted to ensure the safety of people; however there are duties which will help to protect the premises, i.e.

" Duty to take general fire precautions

8. *—(1) The responsible person must—*

(a) take such general fire precautions as will ensure, so far as is reasonably practicable, the safety of any of his employees; and

(b) in relation to relevant persons who are not his employees, take such general fire precautions as may reasonably be required in the circumstances of the case to ensure that the premises are safe."

'General fire precautions' means 'measures to reduce the risk of fire on the premises and the risk of the spread of fire on the premises'."

Fire risk assessments are required for all premises except single occupied dwellings; the risk assessment should highlight any steps that are necessary to ensure the safety of relevant persons (employees, contractors, visitors and other occupants). A series of guides are available from The Stationery Office to help the Responsible Person to undertake their fire risk assessments in various uses of premises, such as Offices and Shops, Places of Assembly, Factories and Warehouses, Educational Establishments etc.

Guide 1

The fire authority is the enforcing authority for the RRO and most

authorities are auditing all premises within their area to ascertain the risk profiles for an inspection regime to follow. The fire authorities have a number of tools to use when enforcing the legislation, in escalating order;

- Verbal Advice, or
- Agreed Action Plan or
- Enforcement Order, or
- Alterations Notice and ultimately
- Prohibition of Use.

To avoid conflict between the Requirements of the RRO and the legislation designed to protect the historic fabric; *The Planning (Listed Buildings and Conservation Areas) Act 1990* and *The Planning (Listed Buildings and Conservation Areas) Regulations 1990 [SI 1990/1519] as amended*, there is a duty on Fire authorities to consult with the enforcing authority before issuing an Enforcement Notice. Failure to consult may result in the Responsible Person unable to comply with the Fire Authorities requirements without breaking the law.

The Building Regulations 2000

Building Regulations approval is required if building works are taking place, or if there is a change of use to which a building is put. A suite of technical guidance booklets, called Approved Documents support the regulations, the fire safety guidance being Approved Document B, which is in two volumes to cover dwelling houses (part 1) and buildings other than dwelling. In both volumes there is scope to vary the prescriptive approach of the guidance in the case of existing or historic buildings. The Building Control Departments or Approved Inspectors have control only over building works. They do not have continuing control over the building once it is completed and occupied. This control is passed onto the fire authorities.

Education

Education is a very effective tool to show building occupiers and owners the dangers of fire and what measures they can take to minimise the dangers. The main difficulty is in getting the owners and occupiers to spare the time to attend lectures or presentations. It was disappointing that very few of the traders from the Chester Rows, attended the 2004 seminar.
A better local attendance was made at a subsequent seminar in Shrewsbury which was achieved by targeting traders groups and holding it after trading hours. The most effective, but labour intensive method is one to one when inspecting the premises
Community Fire Safety relies on well targeted educational campaigns and the results are measurably successful.

Environmental Solutions
Fire Prevention

Fire prevention is a term, which has fallen out of use recently, being replaced with the term ‘fire safety’ because of the doubt about being able to prevent fires. There are some areas where it is applicable because the intention is to eliminate ignition sources.

Hot Works

A hot work permit system should be used when undertaking any works in historic buildings. A template for a hot work permit is shown in appendix 1. This system is not always adhered to and the lack of control was highlighted recently when decorators using blowtorches were spotted in two locations in the Chester Rows. Upon investigation it was found that the surveyors for both premises had stipulated to their contractors that no hot works were to be undertaken, but the works were sub-contracted and all control had ceased to exist. The staff within the

premises concerned did not feel that the works being carried out on their shops were of any concern to them because 'head office' had organised it.
Chester had a system of Street Envoys and it was felt that they could be trained to look out for anyone doing unauthorised hot work and to report it to the City Centre Manager. However these envoys were no longer employed after 2005 and there is no watch is currently being kept.

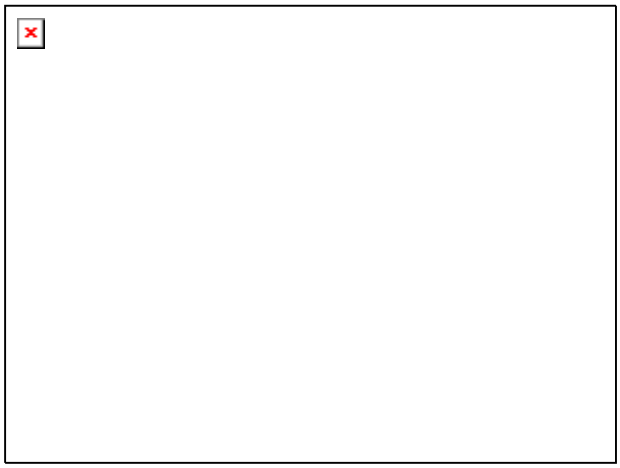
The Regulation of smoking on the Rows was considered, but rejected because of the problems enforcing the current alcohol ban. However there are certain higher risk areas because of gaps between the boards and the build up of discarded cigarettes and wrapping materials is providing fuel in areas below the floorboards.

Smoking materials between boards

It was felt that these particular risks could be highlighted to the individuals concerned and encouragement given to them to smoke further up the street where there are stone floors.

The National Smoking Ban has now been applied to the Rows under the Smoke-free (Premises and Enforcement) Regulations and Smoke Free (Signs) Regulations 2006 and discrete signs are provided at all entrances. The council is considering more cctv cameras to help enforce the ban.

No Smoking signs in the rows



Arson

Arson is a major cause of fires throughout Europe and affects many historic buildings, including churches. Arson attacks seem to follow a pattern, starting with groups of youths gathering and at first just socialising. Then graffiti appears followed by damage and scorching of windowsills, all of which escalate culminating in an arson attack.

Invitation to arsonist

There are steps that can be taken to avert the escalation. One of the most important preventative measures is to keep the area looking well cared for, removing

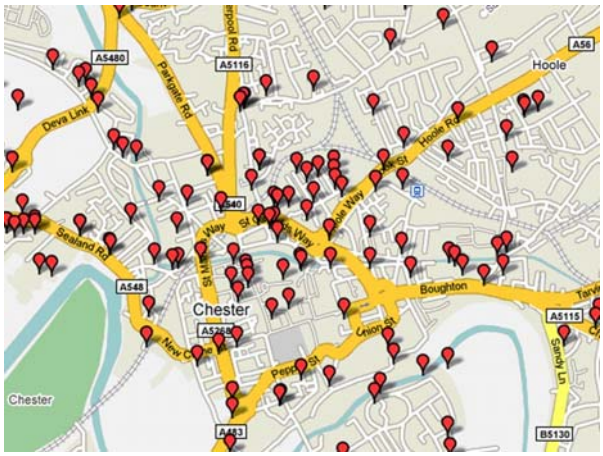
graffiti and repairing damage immediately it happens.
There are some systems for persuading youths not to gather, such as the playing of classical music, or a high pitched whine, which cannot be heard by the over 25s

The build up of rubbish and the practice of keeping waste bins in the alleyways for long periods between collections could lead to arson attacks and help the spread of fire between one property and the next. To combat this problem the frequency of collections could be increased or the bins could be kept indoors for longer.
The Street Envoys were being asked to look out for the build up of rubbish and report it to the City Centre Manager, but as they are no longer employed the fire service patrol the streets in the evening on a weekly basis. In one particular alleyway where rubbish bins are located a self closing, self locking door has been provided to prevent access to potential arsonists.

Scorch marks in Ludlow

There have been a number of fires involving rubbish outside the timber framed building in the photograph above. The obvious solution is to put the rubbish out on the day of collection, rather than the previous evening.
Cheshire Fire and Rescue Service are mapping the incidence of deliberately started rubbish fires within the rows and can target problem areas to ensure repeat fires are eliminated.

Small fires over the last 2 years in Chester



Fire Protection

Fire separation

There are three methods of preventing fire spread between buildings,

- The provision of fire resisting boundary or party walls.
- Space separation between buildings.
- Suppression systems

Boundary Protection in Trondheim

Approved document B of the Building Regulations gives guidance on suitable separation and the acceptable amount of unprotected boundary such as windows,

or other openings. If this guidance cannot be met because of the existing conditions, then an alternative strategy such as the improvement of the fire performance of the individual buildings will need to be adopted.

Use of premises

The use of the premises can very often affect the fire performance of the building. A shop stocking polystyrene foam or video cassettes would be far more hazardous than one selling fish or jewellery.
The upper floors of some of the premises often have no commercial value and are left vacant. This leads to neglect and sometimes deterioration through the ingress of water, which could cause problems if the services remain live.

Dereliction at rear of Bridge Street

Some of these upper floors are used for the dumping of rubbish, which exacerbates the problem. Bringing these upper floors back into use will have the advantages of preventing dereliction and improving the fire protection for life safety purposes to comply with the Building Regulations.

Suppression Systems

The most obvious way of protecting the properties within the Rows would be to provide sprinkler systems to BS5306 part 2, or other fixed fire fighting or preventative systems (e.g. water mist or Oxygen reduction). This would almost certainly prevent a serious fire spreading from one property to the next and threatening the town centre.

Vacant upper floor used for storage of rubbish

The retro-fitting of a suppression system to a particularly fine historic building in the centre of Chester was investigated to see if it could be achieved without affecting the character or the aesthetics of the building.

A sprinkler system and a water mist system were looked at to see which one could be most easily accommodated. While there were no problems with fitting the water mist system in a sympathetic manner, the sprinkler system required the fitting of a 150mm rising water main. There were no suitable internal spaces to accommodate it, but an external site was identified at the rear of the building, on a wall that had a number of waste pipes and gutter down pipes already fitted. Internally there were ceilings that were too sensitive to run pipes across, but an opportunity existed for the pipes to be routed behind wooden panelling to sidewall sprinkler heads.
The water mist system has the advantage over the sprinkler system in terms of pipe size, but requires almost twice as many

heads to provide the same extinguishing capacity.

The cost of providing sprinkler systems for every property was investigated and was less than the losses incurred as a result of the fire in Bridge Street. However the properties are almost all in multiple occupancy and there is great difficulty in persuading responsible persons to pay for a sprinkler system when the means of escape is satisfactory and there is therefore no legislative requirement.
The provision of suppression systems may well be a long term solution, but in the interim a quick-fix solution is required and to this end the provision of detection has been considered as detailed later.

Sprinklers protecting first floor walkway in Bergen

The historic wooden town of Bergen in Norway has had sprinkler systems fitted both internally and externally, since a disastrous fire destroyed many of the buildings in 1978. This has successfully limited the spread of fire ever since. The pipes have been coloured the same as the buildings and are therefore quite discrete.
The World Heritage Site of Roros, also in Norway is a wooden town which could not be protected by sprinklers because of the cold winters.

Roros in the Spring

Here some of the roof voids are being protected by a dry low pressure water mist system, with the water supplied by the fire brigade via a fixed inlet.

The system is designed to prevent flashover in the roof, which stops high level fire spread to adjoining premises.

Water mist protecting roof space

A test of the system was carried out in a wooden farmhouse in 2003 when it was shown that flashover could be prevented in the loft when a serious fire existed below with a direct link between the two spaces in the form of a hole in the first floor ceiling.

Fire test in wooden farmhouse

Detection systems

The Rows Fire Safety group was keen to implement some preliminary fire protection to all the premises within the Rows and considered setting up a radio network linked to the City control room. This would enable radio linked fire detection to be provided in all roof voids of premises currently without fire detection systems. Those premises already provided with a detection system not currently monitored could also have their system radio linked to the control room.
By 2008 the provision of detectors in the roof voids had not been started, but a detailed radio signal survey had been completed to establish suitable locations for placing indicator panels; there are now 10 panels, each capable of 99 zones and 1000 devices. They needed to be secured in metal cabinets because they are located in external public areas. These indicator panels are monitored by a call receiving centre via 3 monitoring lines. These monitoring lines are capable of monitoring the complete Rows fire detection system. The system can be linked to existing fire alarm systems through an interface with monitoring offered by Chester City Council.
The rows have now been provided with 1200 metres of line detection (heat loop) along the most vulnerable sections.

Red Line Detection in Rows

This will detect heat from a fire in the rows walkway or when heat escapes from one of the premises at this level. It will also register faults or of it is cut.

Positioning and choice of detectors

Point Detectors

Method of operation
Point detectors give the most choice of all systems in the method of operation, with heat (fixed temperature and/or rate of rise) smoke (ionisation or optical), combined heat and smoke, or Carbon monoxide detection being readily available. This enables the system to be tailored to the risk being monitored, to give the best coverage whilst avoiding false alarms.

Type of system

The system can be a simple zoned system, where the indicator panel shows

in which part of the building a detector has activated or a sophisticated analogue addressable system, where each detector has an ‘address’. The usual and probably the most reliable way of linking the detectors to the indicator panel is via electrical cables. However some disruption would be unavoidable and where this is unacceptable a radio linked system could be fitted. This relies on good reception between the indicator panel and the devices linked to it, so a comprehensive radio survey needs to be undertaken before this type of system is considered.

This type of radio linked system has recently been fitted in the Shambles in York, as the nature of the buildings made it too difficult to install a hard wired fire alarm system.
It is the second generation radio linked system, which has recently replaced the original system.

The Shambles, York

The original system was proving unreliable because of problems with battery life, particularly in unheated spaces. As the improved battery technology of the latest generation of radio-linked fire detection systems makes them more reliable, they were chosen as a replacement.

Indicator Panel the Shambles

The main problem with providing one system to cover a multitude of premises is how to limit the evacuation signal to those premises where the occupants need an early warning of fire to evacuate safely. The rate of false alarms at the Shambles seems to be running at about one per month, which can lead to complacency about the veracity of the alarm.

Siting of detectors

The ideal position for detectors in terms of early detection of fire is, as central to the room as possible, as detailed in the British Standard 5839 Part 1 2002. Where there are historic ceilings, this central position of point smoke detectors may spoil the appearance of the room. For this reason they are often placed close to the wall above the door, so that they cannot be seen when entering the room.
Recent smoke testing in a variety of premises has shown that in the early stages of a fire, natural air currents influence the movement of smoke, as much as the convection currents set up by the fire. Doorways and windows often provide these natural air currents which keep the smoke away from the detectors, rendering them ineffective. The photograph below shows an example of a well sited detector in terms of its function,

but this may not always be acceptable for aesthetic reasons.

Smoke detector highlighted

On very ornate ceilings the detectors will become ‘invisible’ because the eye is drawn away from the detector towards the pleasing features.

Detector invisible

Detectors that are recessed, or placed above holes in the ceilings, or hidden behind beams and lights are also ineffective.

Beam Detectors

In large rooms with ornate ceilings the use of beam detectors could be considered. These detectors have a transmitter and receiver and work when the beam is interrupted by smoke. The beam is not very wide, so there is no guarantee that smoke will interrupt it on the way up. It should therefore be located as near to the ceiling as possible, so when the smoke spreads out it will interrupt the beam causing it to actuate. The lower the beam is located the longer it will take for the smoke layer to fill down to it. These detectors are prone to false alarms if the beam is broken by birds, bats or even ladders. The beams can go out of focus, particularly if the buildings move, as sometimes happens with timber framed construction. There are systems available to reduce the rate of false alarms by a double knock, and also automatic adjustment of the focus.
A new development not yet commercially available, but eagerly awaited, is the infra red beam detector that promises to overcome all the problems of conventional beam detectors.

Aspirating systems

These systems are also known as air sampling systems and only require a small sampling tube to be inserted through the ceiling, so in terms of aesthetics they seem ideal. They either have a central sampling point, so that air from all the rooms covered is drawn along tubes to it, or there are a number of local sampling points connected to fewer tubes. There are some points to bear in mind,

- The size of the tubes between the small bore tube, which penetrates the ceiling and the sampling chamber may make it difficult to install sympathetically. Lifting of floorboards above will be required.
- There needs to be a large enough space for the sampling chamber, which should be conveniently located to avoid long pipe runs.
- The noise of the fan, which is running continuously, may be obtrusive in certain situations.

- The running costs, which include replacement filters and power to the fan should be taken into account.

Line Detection

Line detection was developed to provide fire detection in cable tunnels where other types of detection are not suitable.

Video Detection

Video detection has been promoted for very large spaces such as churches or large halls where the smoke would cool and stop rising before it reaches conventional detectors sited at ceiling height. Fixed video cameras are linked to a computer, which is programmed to recognise the movement of smoke and raise the alarm. The software is very expensive, but can be offset by the fact that fewer cameras are needed than point detectors in a conventional detection system and the system can incorporate some security features.
If the premises are smoke-logged when the fire brigade arrives, they can rewind the tape to find the origin of the fire to make fire fighting more effective. This form of detection does rely on there being a good contrast between the smoke and the background, so sufficient lighting and emergency lighting is essential. This will probably rule out its use in anything other than large commercial buildings where there is a 24 hour operation, which requires high levels of lighting and supervision.

Voice Alarms

The 'voice alarms' fitted in some properties have a proven record of cutting down the time from actuation, to people responding (the response time). This can cut the total evacuation time, which may allow some leeway in other fire safety provisions. Sounders can be built into the base of the detectors, but this can make the whole unit quite large.

Monitoring of Fire Detection Systems

For a fire detection system to provide property protection when the premises are vacant, it needs to send a signal to a call receiving centre, so that the fire brigade can be called out when a fire is detected.

The radio network proposed for Chester will be monitored by the City Centre Control Room. The system can also be used to provide a security emergency call-point system, which would enable the City Centre Closed Circuit Television cameras to be trained on the property concerned and for the police to be called. This link between fire protection and security will make the system more attractive to occupiers.

A new innovation is the Broadband System, which can operate via hard wire or radio. This would have inputs from a variety of sources, such as fire detection systems, burglar alarm systems, Closed Circuit Television, Noise monitors, Numberplate Recognition systems, etc.

The outputs would go via the Broadband link to the City Centre Control Room or an alarm receiving centre, who would notify the appropriate authority, emergency service or owner whenever an emergency occurs.

The fire brigade, police, ambulance, owner and even the general public can access those parts of the broadband. If a shop owner or key holder was notified that the burglar alarm was activating, they could access the broadband by computer or mobile phone to look at the CCTV inside their premises. They could then call the police if required or if there is no sign of intruders they could simply go and reset the system.

The cost of this type of system could be offset by using the cameras for tourism and allowing shopping online or for looking at sample menus and booking restaurant tables. This has been piloted successfully in Brick Lane, London.

Fire Service Response to Automatic Alarms

The Chief Fire Officers Association (CFOA) has published the Model Agreement for a new Policy to reduce false fire alarms generated by remotely monitored fire alarm systems.
A false fire alarm is a fire alarm signal resulting from a cause other than a fire. In 2005, there was a total of 867,000 calls to the Fire Service, but 438,000 (50%) were false alarms. Of these 285,000 (65%) were due to false activation of the equipment. The rate of general false alarms has fallen recently, but those due to false activation of the equipment has not been reduced significantly.

The CFOA policy requires all premises with remotely monitored fire alarm systems to be registered with the Fire and Rescue Service and to receive a Unique Reference Number (URN). Premises with poor performing systems will have the Fire Service response level to their premises either reduced or even withdrawn. Responsible persons would need to demonstrate that remedial measures have been taken to reduce false activations to have their response restored.
This policy has been adopted by all fire services, but the interpretation differs from one authority to another, the extreme position being no response to automatic alarms unless a 999 back up call is received. This would require a key holder to be notified at the same time as the fire service and for them to have a similar response time. As this is not always possible the effectiveness of the fire detection system for property protection is called into doubt.

General Fire Fighting Considerations

Fire Fighting Tactics

Fire fighting tactics can be pre-planned by undertaking familiarisation visits by fire crews under sections 7 (2)(d) and (e) of the Fire and Rescue Services Act 2004. The plan of attack needs to take into account the protection of adjacent properties and so the Pre-Determined Attendance of the fire brigade can be adjusted accordingly.

The amount of water required for the successful protection of adjoining premises will be considerably more than for fighting a fire in a single compartment or building.
If the supply from existing hydrants is not sufficient additional resources such as the use open water, water carriers or bowsers will be necessary. The positioning of pumping appliances can be pre-planned to avoid blocking access roads. The New Dimension High Capacity pumps

External Access for Fire Brigades

Fires can be fought and contained more successfully when all sides of a building can be approached. Current Building Regulations require fire brigade access to all new buildings, the degree of which is dependent on its size.

External vehicle access to premises in historic town centres does not very often meet these standards. Narrow roads, alleyways, parked vehicles, pedestrian schemes, street furniture, steps, overhanging buildings and low bridges can hamper fire engines and delay the start of fire fighting operations.
When it becomes necessary to fight a fire from the rear of a terraced building it may

be possible to go through the adjoining buildings.

The fire brigade has right of access to adjoining premises for fire fighting purposes under the Fire Services Act 2002. However this is only used as a last resort as security arrangements could make it arduous and time consuming. It would also be unsuccessful if there were no open air at the rear from which to enter the building on fire or mount fire fighting operations,

Internal Access for Fire Brigade

The start of fire fighting operations can be delayed by problems encountered gaining internal access. These delays can be caused by

- Security of buildings when unoccupied.
- Single staircases, often with restricted width and winders.
- Deep buildings with narrow frontage.
- No direct access from street levela\

Roof spaces are often used for the storage of combustibles and together with the roof timbers provide fuel for a serious fire. Fire fighting water is prevented from being applied from the outside because the roofs are designed to keep water out. In addition, internal access to roof spaces is usually restricted and, even if crews were able to enter to tackle a fire, the conditions inside could be extremely hazardous because of the lack of ventilation. Other problems include:

- hidden voids can lead to unseen fire spread to areas remote from the origin of the fire and a fire in these spaces is extremely difficult to fight

- the upper floors are more difficult to access to fight fires and hose may need to be laid up stairs and along corridors. This will lead to delays before a fire can be tackled

Fire fighter safety

Fire fighters ensure their own safety by undertaking a dynamic risk assessment when determining how rescues are to be performed and how a fire will be fought. Fire brigades are required, by Health and Safety Legislation to keep a written record of this risk assessment, so radio messages are sent back to their control to state that the incident is either being tackled ‘offensively’ from the inside, or ‘defensively’ from the outside. (Occasionally it may be a combination of the two and is known as ‘transitional’).

The most effective way of performing rescues and fire fighting is ‘offensively’ by entering the building and tackling it internally. This has the following advantages;

- **Speed.** The fire can be fought quickly and easily because access is gained through the doors and internal stairs, without recourse to ladders or other high reach equipment, which take time and need space to set up.
- **Safety.** Rescues do not have the added hazard of negotiating a ladder or reaching a hydraulic platform.
- **Damage Limitation.** The fire may be stopped internally with hose reels using the minimum amount of water, preventing secondary damage.

There may be a number of reasons why it is too dangerous to enter the building, such as the severity of the fire or the potential for structural collapse. In these cases, if there are no lives to be saved the fire will be fought ‘defensively’ by staying at a safe distance and applying water from the outside. There will be less control over water damage when fighting fires defensively.

Span of Control

All fire services use a command and control system to limit the span of control by individual officers to a manageable level. This is achieved by dividing a fire incident into sectors, with a commander for each sector, who takes control of their area of the fireground and report to the Fireground Commander. In particularly large or complex incidents, commanders may be appointed to manage functions in addition to the sectors. Fires may then be fought defensively in some sectors and offensively in other sectors.
The Pre-Determined Attendance to properties within Chester City walls has recently been increased so that a plan of attack, which gives protection to adjacent properties, can be quickly implemented.
The

Cheshire Fire and Rescue Service Integrated Risk Management Plans

All fire and rescue authorities now prepare Integrated Risk Management Plans, with National guidance being provided by the department for Communities & Local Government. The guidance for heritage properties is summarised as;-

FRAs are required to produce a local IRMP that sets out the authority's strategy, in collaboration with other agencies, for reducing the commercial, economic and social impact of fires and other emergency incidents. Furthermore, safeguarding the environment and heritage (both built and natural) is an essential component of this strategy.

Whilst FRAs have a legal responsibility to ensure that effective arrangements are in place to deal with an incident that could adversely affect the rich heritage of our country through both planning and response, a moral responsibility also exists to ensure that the quality of life of the public is improved through the concept of sustainable development.

The protection of built and natural heritage is seen as a core function in an Integrated Risk Management Plan that is designed to improve the safety of the community.

The following extracts are from Cheshire Fire and Rescue Service's 2008-2009 Integrated Risk Management Plan;
Vision
Our vision is a Cheshire where there are no preventable deaths, injuries or damage from fires and other emergencies.
Mission
Our mission is to help create safer communities, to rescue people and protect economic, environmental and community interests.
Key Aims
1. Respond effectively to emergency incidents
2. Improve community safety by risk reduction

***4 of 7 organisational objectives are**:*

- *Identify the risks facing local communities and ensure plans and resources are in place to respond*
- *Provide a flexible, efficient and resilient response to emergency incidents*
- *Prevent dangerous anti-social and careless behaviour*
- *Protect life, property and other interests through detailed risk analysis and assessment*

Key Proposals

***Sprinklers** - we will re-launch our sprinkler campaign, with a particular focus on high risk premises such as schools and major domestic and commercial premises.*

***Access to critical information** – to help us tackle business fires and improve firefighter safety, we will improve how we*

record and access information on the design and structure of commercial and industrial buildings.

Emergency Response

• Develop a dedicated incident command training, assessment and planning centre at our Winsford Headquarters to develop and improve the Service's level of skills in managing emergency incidents
• Achieve the Cheshire standards of emergency response overall on 92% of occasions
• Meet the Cheshire emergency response resilience standards on 95% of occasions
• Ensure that 95% of fires are confined to the room of origin

Targets

Reduce the number of deliberate primary fires by 8.2% in 2008/09 and deliver the national target of a 10% reduction by 2010 from the baseline of 2001/02

Create a resilience team to ensure the Service learns the lessons from serious incidents in Cheshire and elsewhere and responds appropriately
Reduce the numbers of fires caused by anti-social behaviour and youth nuisance by 15% compared to 2007/08
Ensure that 100% of premises identified as very high or high risk under the Fire Safety Order, are audited within the prescribed timescale
• Reduce the numbers of fires within non domestic properties to no more than 11 per 1000 properties in 2008/09
While the emphasis is on finding the best local solutions, there are still requirements on each authority to:
• help the achievement of national targets for the reduction of fire deaths and deliberate fires
• contribute to major emergencies which transcend local boundaries, such as flooding and terrorist incidents
• reduce the commercial, economic and social impact of fires and other emergencies
• safeguard the environment and heritage

As well as standards for emergency response, we also have standards for the time it takes our control room to handle 999 calls and alert our stations. The standards, with our 2006 performance in brackets are as follows:
• 50% of all calls to be handled in 45 seconds or less (55.49%)
• 75% in 60 seconds (79.54%)
• 90% in 90 seconds (96.46%)
• 99% in 120 seconds (99.24%)

New analysis techniques

While local knowledge is always important in spotting possible risks and trends, the Service also uses a range of sophisticated analysis tools and techniques so it can target its resources where and when they will have most impact.
A key tool is the national Fire Service Emergency Cover toolkit (FSEC) which brings together data on issues such as previous emergencies, population and buildings. It can then show what happens to risk levels if the number and availability of fire appliances changes.
In addition, we have worked in partnership with a specialist computer modelling company to develop our own programmes:
• The Incident Analyser provides sophisticated and detailed examination of incidents to enable best use of both our emergency response and fire prevention work
• The Simulator Toolkit allows the Service to run detailed 'what if' scenarios to help in planning the best use and location of its resources.
Our dedicated Risk, Analysis and Intelligence Team co-ordinates this research and information to ensure that we are able to plan our response to the risks facing our communities with more

certainty and confidence. During 2008/09 we intend to extend the role of the Unit and the way in which we use risk analysis and intelligence to inform our development of policies and how we use our budget and other resources. In addition, we have adopted a risk-based inspection programme for the 32,000 commercial premises within the Fire Authority's area which are now required to do their own risk assessment under the Fire Safety Order. This involves targeting high risk premises and working with businesses to improve their overall safety, with the ultimate use of enforcement action through the courts.

***Preventing arson** - we will continue our work to prevent arson and will focus on reducing high cost incidents involving antisocial behaviour. We will work with youth engagement staff to educate and divert young people from getting involved in anti-social behaviour and support joint initiatives agreed with partners through local area agreements. We will also work with local authorities to highlight increased risks from wheelie bins being set on fire and the potential dangers when this happens near to homes and other premises. In addition we will launch a campaign to raise awareness of arson risks among local businesses and extend our traditional audit of premises to highlight wider safety risks.*

***Access to critical information** - as part of moves to both assist in tackling fires at commercial premises and to further increase firefighter safety, we will be improving our systems for capturing, interpreting, recording and accessing the information we store about the design and structure of buildings. We will also be developing our Incident Recording System (IRS) so it provides better information locally and can support the needs of the national IRS.*

One of the targets set in IRMP 4 was to reduce the number of fires within non-domestic premises to no more than 17 per 1,000 non domestic premises in 2007/08. Data collated to January 2008 and projected to the end of the year suggests performance will be 27.2% below this target, at 12.4 incidents per 1,000 non domestic premises. Since 2005/06, there has been a 20.6% reduction in this type of incident, from 15.6 to 12.4 fires per 1,000 non domestic premises. This has resulted in a clear downward trend over the past three years.