

The image features a dark blue background on the left and a white background on the right, separated by a vertical line. The left side is decorated with numerous thin, yellow, curved lines that sweep across the space. The BRE logo, consisting of the letters 'bre' in a bold, yellow, sans-serif font, is positioned on the blue background.

bre

The authors of this report are employed by BRE. The work reported herein was carried out under a Contract placed by the Communities and Local Government. Any views expressed are not necessarily those of the Communities and Local Government.

**Communities and Local
Government Final
Research Report:**

BD 2651

Investigation of real fires

254156 (D13V1)

CI 71/5/43

Prepared for:

Brian Martin
Communities and Local
Government
Sustainable Buildings Division
Zone 2/J6, Eland House
Bressenden Place
London, SW1E 5DU

17 November 2009

Fire Safety

BD 2651

Investigation of real fires

Final Research Report

Prepared for Brian Martin

Prepared by Martin Shipp, Kelvin Annable, David Crowder and Róisín Cullinan

BRE output ref. 254156 (D13V1)

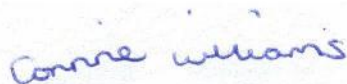
Approved on behalf of BRE

Name Dr Corinne Williams

Position Fire Safety Framework Reviewer

Date 25 November 2009

Signature



BRE
Bucknalls Lane
Garston
Watford
WD25 9XX

Tel : 
Fax : 

Email : shippm@bre.co.uk
Website : www.bre.co.uk

Executive Summary

This is the Final Research Report for the Communities and Local Government Sustainable Buildings Division project titled "Investigation of Real Fires", Communities and Local Government Contract reference CI 71/5/43, BD 2651, which started in April 2007 and has initially run to March 2009, extended to November 2009.

Data have been gathered from on-site visits, from a network of other fire investigators in the fire and rescue service, police and specialist consultancies, and from the media (primarily the web). The information gathered is primarily used to inform Approved Document B (Fire safety) for England and Wales (AD B) with occasional input to the regulatory documents in Scotland and Northern Ireland. This information must offer effective solutions to real fire problems, which can only be done by examining information from real fires. Positive feedback is provided where guidance has helped to minimise fire spread and threat to life. It is the aim of this project to draw the attention of Communities and Local Government to potential or developing life safety issues rather than explain them after the event.

The objectives of this project have been:

- To monitor the effectiveness of Part B of the Building Regulations and the guidance in Approved Document B (AD B) in achieving fire safety in real buildings in England and Wales and in providing protection for firefighters, with particular consideration of the impact of the 2006 revisions.
- To monitor the impact of British and European Standards on building products and systems and to monitor the role and use of Fire Safety Engineering approaches and other means of meeting the Building Regulation requirements.
- To monitor the impact of the Regulatory Reform (Fire Safety) Order 2005 on fire safety in buildings and particularly the interface with Part B.
- To improve understanding of how unusual fires develop and grow, particularly in domestic properties, through site investigations where appropriate and through consideration of events in other countries.
- To identify and indicate the need for research or for changes to Part B/AD B arising out of specific problems highlighted in fire investigations and to provide timely feedback to Communities and Local Government on the above issues.
- To maintain close contacts with other investigators in the brigades and elsewhere to encourage the exchange of information on unusual fires that will be of benefit to Communities and Local Government and to disseminate findings from fire investigations to the fire and rescue service, building designers and owners and others, as relevant.

The findings from this project have reaffirmed the overall effectiveness of the Building Regulations and AD B in providing for the safety of life in the event of fire and most of the significant issues that have been identified during this study fall outside the scope of these regulations.

However, a number of areas of concern have been identified, and some of these may need to be the subject of further study in future years.

Contents

1	Introduction and objectives	4
2	Programme of work	6
3	Conclusions	13
4	Acknowledgements	17
Appendix A – Summary of the Research		

1 Introduction and objectives

This is the Final Research Report for the Communities and Local Government, Sustainable Buildings Division project titled "Investigation of Real Fires", Communities and Local Government Contract reference CI 71/5/43, BD 2651, which started in April 2007 and has initially run to March 2009, extended to November 2009.

Data have been gathered from on-site visits, from a network of other fire investigators in the fire and rescue service, police and specialist consultancies, and from the media (primarily the web).

The information gathered is primarily used to inform Approved Document B (Fire safety) for England and Wales (AD B) with occasional input to the regulatory documents in Scotland and Northern Ireland. This information must offer effective solutions to real fire problems, which can only be done by examining information from real fires. Positive feedback is provided where guidance has helped to minimise fire spread and threat to life. It is the aim of this project to draw the attention of Communities and Local Government to potential or developing life safety issues rather than explain them after the event.

Fire safety systems differ from nearly every other engineering system in a building; any faults or failures in design, implementation or maintenance will only become apparent during the very emergency for which they are required. So it is essential that Communities and Local Government constantly reviews its regulations, guidance documents, codes and standards, to ensure that these are being effective, and remaining so, yet are not unnecessarily onerous or expensive. The systematic, scientific and specific fire investigations carried out by BRE for Communities and Local Government underpins all of the Communities and Local Government fire safety research programme and gives essential credibility to the guidance produced from this research. With the recent profound changes in both legislation and engineering that are affecting fire safety in England and Wales, perhaps more than ever, fire investigations need to continue to provide a basis for the Communities and Local Government fire safety strategy.

The results from this project have been demonstrated (from the previous programmes) to assist Communities and Local Government in keeping Ministers informed of high profile incidents, and, from site investigations of fires of interest, ensure that AD B and other guidance published by Communities and Local Government properly and accurately reflects what is happening in real buildings in England and Wales.

The impact of European Standards on building materials and systems needs to be continually monitored in the context of real fires as new designs and methods of construction are adopted. Similarly, the impact of new designs and new methods of construction, and the use of (or increasing use of) innovative or unusual materials needs to be kept under review. Communities and Local Government must be kept aware of any consequent increase in risk to building occupants and this was achieved through the reporting system in this project.

Currently acceptable fire safety provisions in new buildings in England and Wales can be achieved by compliance with the guidance in Building Regulations Approved Document B (Fire safety). However, there is no obligation to adopt any particular solution contained in the Approved Document and the user (designer or fire engineer) may prefer to meet the relevant requirement in some other way by Fire Safety Engineering (or the application of BS 9999). This project has also sought to monitor the effectiveness and safety of alternative methods, and provide feedback to Communities and Local Government.

Life safety is the prime concern of the Building Regulations and the highest risk is in dwellings. Within the broader remit, this project has sought to identify those aspects of design and construction methods in new

build that may lead to unusual or unexpected spread of fire. In addition, the project has maintained a watching brief on the performance of older property to identify areas that may result in amendments to the guidance in Approved Document B for future build.

Similarly, the introduction of the Regulatory Reform (Fire Safety) Order 2005, which took effect in October 2006, and the Fire and Rescue Services Act 2004, which came in to force on 1 October 2004, should both have an effect (hopefully, beneficial) on fire safety in (mostly non-domestic) premises, and the impact of these new pieces of legislation needs to be assessed and disentangled from any considerations of the effectiveness of AD B.

This programme also ensures that all fire-related research carried out for Communities and Local Government is based in reality avoiding any risk of the accusation of "ivory tower" research by Communities and Local Government and ensures the credibility of guidance generated by or on behalf of Communities and Local Government. It also provides a vehicle for Communities and Local Government to network with the fire industry at its widest, but in particular with the Fire and Rescue Service, and provide a means of coordination, communication and feedback within the wider fire investigation community.

The overall aim of this project has therefore been to provide Communities and Local Government with rapid and accurate feedback on the performance of real buildings in real fires.

The specific objectives of this project have been:

- To monitor the effectiveness of Part B of the Building Regulations and the guidance in Approved Document B (AD B) in achieving fire safety in real buildings in England and Wales and in providing protection for firefighters, with particular consideration of the impact of the 2006 revisions.
- To monitor the impact of British and European Standards on building products and systems.
- To monitor the role and use of Fire Safety Engineering approaches and other means of meeting the Building Regulations requirements.
- To monitor the impact of the Regulatory Reform (Fire Safety) Order 2005 on fire safety in buildings and particularly the interface with Part B.
- To improve understanding of how unusual fires develop and grow, particularly in domestic properties, through site investigations where appropriate and through consideration of events in other countries.
- To identify and indicate the need for research or for changes to Part B/AD B arising out of specific problems highlighted in fire investigations.
- To provide timely feedback to Communities and Local Government on the above issues.
- To maintain close contacts with other investigators in the brigades and elsewhere to encourage the exchange of information on unusual fires that will be of benefit to Communities and Local Government.
- To disseminate findings from fire investigations to the fire and rescue service, building designers and owners and others as relevant.

The project included a small amount of resource to provide for the carrying out of supporting laboratory research/ testing or supplementary research and to provide advice to the Fire and Rescue Service on a quid pro quo basis, including small experimental projects.

The contract allowed for an option to provide a detailed "snapshot" of all fire deaths in a particular location, focussing on the fire protection arrangements in place and how they functioned in practice, and identifying any trends or conclusions that might impact on future changes for the Building Regulations. This option was not called upon and is not discussed further.

2 Programme of work

The work programme comprised the following tasks:

- Continuous monitoring of national and international news and other sources of information.
- Continuous appraisal of relevant fire safety issues and research.
- Acquisition and collation of information about relevant fires.
- Site investigation of specific fires.
- Analysis of fires, in relation to Building Regulations and AD B and other legislation (e.g. RR(FS)O, DSEAR) and in relation to fire safety engineering and scientific content.
- Reporting to Communities and Local Government as required, including identification of any potential need for further research or for changes to the Building Regulations or AD B.
- Dissemination to a broader audience of interested parties where relevant and agreed with Communities and Local Government.
- Supplementary support activities; laboratory research/ testing, supplementary research and the provision of advice to the Fire and Rescue Service.

These are detailed below as Tasks 1 to 8.

All of the objectives were met. The achievements of each objective were as follows.

Task 1: Continuous monitoring of national and international news and other sources of information

Fires of interest were monitored by a large number of BRE staff on a continuous basis which ensured maximum coverage. All available media, including television, CEEFAX, radio, and web pages were continuously monitored for fires of relevance. Those in the fire community (especially other fire investigators) who are aware of our research also provided information to us directly. Public domain material and broadcast material on fires was collected from newspapers, transcription services where appropriate, the BRE Press Office and the internet.

Detailed information was gathered through BRE's wide network of contacts with the fire and rescue service, police, consultancies and forensic science service.

Information about fires of interest has been reviewed in relation to the effectiveness or otherwise of AD B and related guidance, and Communities and Local Government has been kept informed of findings on a regular basis.

Over the period of the project, 546 fires have been reported upon.

Task 2: Continuous appraisal of relevant fire safety issues and research

Experienced fire scientists have continuously reviewed information on fires that occur to identify those events with implications for Building Regulations and/or factors of particular interest and/or where further research is needed. The criteria have included (inter alia):

- The state and age of the building.
- Any unusual spread of fire and/or smoke.
- Any unusual performance of materials in the fire. Any effects of British and/or European Standards.
- Where the fire occurred in a building using fire safety engineering or very new techniques of design and build.
- How the occupants behaved; did they survive?
- How the incident was managed.
- Whether the investigators had problems identifying how the fire developed.
- Whether the fire provided a good example of compartmentation, i.e. where the regulatory requirements were successful.
- Where active or passive fire protection systems were effective.
- Where there were problems for the fire and rescue service.
- Where there were other research issues.

Communities and Local Government was notified by telephone within 48 hours about fires where issues of special relevance were identified.

Task 3: Acquisition and collation of information about relevant fires

Once a fire of interest was identified and appraised, more detailed and direct information was gathered from a variety of primary sources including the police, fire and rescue service, forensic scientists and fire consultants in the private sector.

The locations of fires investigated were primarily confined to England and Wales but information has been sought on relevant fires outside this area, including overseas.

Task 4: Site investigation of specific fires

When attending fire scenes, the BRE Fire Incident Team has been led by an experienced BRE investigator assisted by the appropriate colleagues for the particular site investigation. When a visit has been thought to be required, the prior approval of Communities and Local Government has been obtained.

Information of fires of interest has been reviewed in relation to the effectiveness or otherwise of AD B and related guidance, and findings reported to Communities and Local Government on a regular basis.

The BRE Fire Investigation team attended those fires identified as being of particular interest. During this project, these were:

1. Ogard Road, Hoddesdon, 1st April 2007
2. Penhallow Hotel, Newquay, 18th August 2007

3. Warehouse, Atherstone on Stour, Warwickshire, 2nd November 2007 (BRE has been separately commissioned by Warwickshire Police to assist the inquiry into this fire.)
4. Manthorpe Avenue, Salford, Greater Manchester, 7th December 2007
5. Marston Way, Upper Norwood, South London, 25th December 2007
6. Brent Cross Car Park, London, 27th December 2007
7. Royal Marsden Hospital, London, 2nd January 2008
8. Camden Market, London, 9th February 2008
9. Curle Street, Glasgow, 26th February 2008
10. Shaw Lodge, Rochdale, 23rd April 2008
11. Wentworth Mews, London, 8th June 2008
12. Lancaster Square, London, 9th June 2008
13. Bennett Close, London, 10th June 2008
14. Warehouse, Rye, 10th July 2008
15. Block of flats, London, 11th August 2008
16. Car park, Dublin, 17th August 2008
17. Basement car park, Manchester, 5th November 2008
18. Office building, Watford, 16th November 2008
19. Chancery Lane, London, 18th March 2009
20. Waterfront Apartments, Manchester, 8th April 2009
21. Talbot Road, Blackpool, 24th April 2009
22. Barnhill Road, Brent, Greater London, 7th June 2009
23. Lakanal House, Camberwell, London, 3rd July 2009
24. Chartered Accountants, Horsham, West Sussex, 25th October 2009.

Detailed information has been obtained from FRSs or other fire investigators on the following fires:

25. Abbey Walk, North Yorkshire, 27th May 2007
26. Sunrise Senior Living care home, Westbourne, Dorset, 27th May 2007
27. Milton Road, Portsmouth, Hampshire, 17th September 2007
28. Winston Way Primary School, Ilford, 25th January 2008
29. Portland Street, Exeter, Devon, 1st October 2009

30. Mid City Place, High Holborn, London, 12th October 2009

31. West Wycombe Road, High Wycombe, 20th October 2009.

BRE staff have been actively involved, via separate funded commissions, with the fires at Bray (County Wicklow, Ireland; for the Health and Safety Authority of the Republic of Ireland), Atherstone-on-Stour (Warwickshire; for Warwickshire Police), Little Holme Walk (Greater Manchester; for Greater Manchester FRS), Penhallow Hotel (Cornwall; for Cornwall Fire and Rescue Service) and Royal Marsden Hospital (London; for London Fire Brigade).

BRE has been providing support to the Metropolitan Police in respect of the fire at Lakanal House, Camberwell as part of this contract of work and expects to continue to do so under direct commission from the Metropolitan Police Service.

Task 5: Analysis of fires, in relation to Building Regulations and AD B and other legislation (e.g. RR(FS)O, DSEAR) and in relation to fire safety engineering and scientific content

The analysis of fires examined issues in relation to Building Regulations, AD B, and other relevant legislation, in particular, the Regulatory Reform (Fire Safety) Order 2005 and DSEAR.

This project has been intended to assist Communities and Local Government in keeping Ministers informed of high profile incidents and fires of national importance by providing information and opinion specific to the needs and interests of Communities and Local Government. The work identifies and examines fires with implications for AD B and other current regulations, codes, standards and government fire safety guidance. The information is gathered with the primary purpose of giving an early warning of topics that need to be addressed during updating of documentation. This continuous review also underpins the usefulness and effectiveness of current guidance by highlighting its successes and to ensure that the guidance published by Communities and Local Government reflects what is happening in real buildings in England and Wales.

The project also has identified and examined fires which have implications for current research (which itself is aimed at the development of guidance). Where appropriate, these studies have been supported by analysis of the Communities and Local Government Fire statistics database.

Task 6: Reporting to the Department as required, including identification of any potential need for further research or for changes to the Building Regulations or AD B

Findings and conclusions (in particular with regards to any potential need for further research or for changes to the Building Regulations or AD B) have been made exclusively to Communities and Local Government on a regular basis.

Day-to-day communications regarding the project have been with the Project Officer, Mike Payne of AEA Technology, or directly with Communities and Local Government. Urgent news items and briefings have been made directly to Communities and Local Government.

There is no direct input from this work into standards work. But where a particular fire has implications for standards the BRE Project Manager has briefed the BRE staff attending the relevant committee on behalf of Communities and Local Government.

Task 7: Dissemination to a broader audience of interested parties where relevant and agreed with Communities and Local Government

With the agreement of Communities and Local Government, the findings of the project are disseminated in journal articles, lectures and presentations to other investigators, building designers, owners and others as relevant. A number of presentations based on the work on the project have been given over the period of the project, as follows:

1. Shipp M. 'Fire Investigation in Fire Engineered Buildings: Is there a major difference?'. Paper given the Institution of Fire Engineers AGM and Conference "Extending the boundaries of fire engineering", Cambridge, 12th and 13th July 2007.
2. Shipp M. 'How BRE works with the UK's Fire and Rescue Service'. Presentation to Hong Kong Fire Service visit to BRE, Garston, 16th July 2007.
3. Shipp M. 'Engineering findings'. Fire Prevention/Fire Engineers Journal, September 2007.
4. Cullinan R. 'Fire Investigation at BRE'. Presentation at IAAI-Ireland Committee Meeting, McKee Military Barracks, Dublin, 3rd December, 2007.
5. Shipp M. 'What have we learnt from (real) fires?'. Presentation at "Fire Tests – Evolution and Development", BRE Seminar, Garston, Watford, 4th December 2007.
6. Shipp M. 'Recent findings of BRE fire investigations' and 'The Management of Major Fire Investigations'. Presentations at the BRE Seminar "Let's discuss the future of fire investigation and research – Part II", 20th February 2008, BRE, Watford.
7. Crowder D. 'Fires in timber frame buildings – Manthorpe Avenue and BRE Fire Investigation' IFE North West Chapter, Manchester, 12th March 2008.
8. Shipp M. 'Fire investigation as a Component of Community Risk Reduction'. Presentation at the Institution of Fire Engineers AGM and Conference 2008 - Innovation in Community Risk Reduction in Blackpool on 2nd and 3rd July 2008.
9. Crowder D. 'Lessons from Healthcare Fire Investigations'. Paper presented at the BRE Fire Health Check event on 8th July 2008.
10. Shipp M. 'Fire Investigation – the Impact of New and Emerging Technology'. Presentation at the IFE 90th year celebratory conference "Fire Engineering – Past, Present and Future" at Heriot-Watt University, Edinburgh, on 31st October 2008.
11. Shipp M. 'Fire precautions – structural safety and protection'. Presentation at the HSE Fire awareness course, Lee Wood Hotel, Buxton, 6th November 2008 and 4th December 2008.
12. Shipp M. 'The National Arson Control Forum' and 'Fire Investigation and the Regulatory Reform (Fire Safety) Order 2005'. Presentations at the BRE Seminar "Let's discuss the future of fire investigation and research – Part 3", 12th February 2009, BRE, Watford.
13. Crowder D and Cullinan R. 'Recent Findings of BRE Fire Investigations'. Presentation at the BRE Seminar "Let's discuss the future of fire investigation and research – Part 3", 12th February 2009, BRE, Watford.

14. Annable K. 'Fire safety in prisons'. Presentation at the BRE Seminar "Let's discuss the future of fire investigation and research – Part 3", 12th February 2009, BRE, Watford.
15. Shipp M, and Williams C. 'Recent BRE Global Research & CLG Research'. Presentation at the BRE Seminar "Let's discuss the future of fire investigation and research – Part 3", 12th February 2009, BRE, Watford.
16. Alalouff R. 'The advantage of hindsight'. Fire Safety Engineering, March 2009. (Report of the BRE Seminar, February 2009.)
17. Shipp M. 'How BRE works with the UK's Fire and Rescue Service'. Presentation for the West Midlands Fire and Rescue Service visit to BRE, Watford, 6th November 2009.

BRE is a members of the (revived) National Arson Control Forum and has attended the first three meetings on 30th September 2008, 16th January 2009 and 21st October 2009. BRE was represented at the ACF Annual Conference on 29th April 2009.

A number of BRE staff (with Brian Martin representing Communities and Local Government) participated in a meeting with London Fire Brigade at BRE on 10th September 2008 to discuss some ongoing concerns and recent notable fires. The meeting focussed on the recent set of fires in MMC/ICPT buildings and on the particular issues these were highlighting.

On 3rd October 2008, the BRE Trust hosted a free "Workshop" to bring expertise on the management of Major Fire Investigation from across the UK together at BRE. 20 delegates attended and very useful discussion ensued. It is intended to continue with this initiative. Notes from the meeting were circulated to attendees on 27th April 2009.

As noted above, following the success of the 2007 joint IFE/BRE Fire Investigation Workshop, an annual workshop has been organised at BRE to exchange information and keep other investigators aware of developments in fire research that are of relevance. The workshops are self-financing (i.e. not funded by this project).

The BRE fire investigation team continue to be active members of the UK Chapter of the International Association of Arson Investigators (IAAI) and IAAI-Ireland (see below).

Information on various aspects of the investigations has been shared with interested parties such as Fire and Rescue Service Officers, Scenes of Crime Officers and Building Control Officers as the opportunity arises. BRE continues to raise awareness of fire and rescue services, forensic scientists and other investigators to the relevance of their findings for regulators. Findings from the project have provided input to a number of other Communities and Local Government funded fire safety projects.

The dissemination process also provides the opportunity for BRE (on behalf of Communities and Local Government) to maintain BRE and Communities and Local Government networks and profile within the fire investigation community.

BRE attended a meeting on 27th May 2009 at the request of Greater Manchester Fire and Rescue Service to discuss concerns they had with the type of construction encountered at the Waterfront Apartments incident. The meeting included discussion on the need to ensure the fire safety of these buildings (e.g. making the style of construction more resilient to poor workmanship) and the need to modify their firefighting tactics to suit this and other innovative construction products and techniques. An article was published on 11th November 2009 on the Fire Safety Engineering magazine website related to this fire and

the findings from subsequent research work commissioned by Greater Manchester Fire and Rescue Service.

BRE has provided support to London Fire Brigade in their investigation of the initial spread and development of the fire at Royal Marsden Hospital on 2nd January 2008. Tests have been conducted at Bureau Veritas and witnessed by BRE, to investigate the reaction to fire properties of the insulation at the base of the services tower. London Fire Brigade met with BRE on 22nd May 2009 to discuss the findings of these tests and it was decided to run finite element models of the tests and the incident in order to further investigate the phenomena involved. The findings have been passed on to London Fire Brigade for use in the ongoing investigation.

A "Dear Chief Officer" letter was sent to all local authority fire and rescue services in England and Wales during October 2007. It resulted in a number of responses and contact names. Partly as a result, and partly as a continuation of existing liaison, BRE continues to receive a high level of co-operation from all local authority fire and rescue services.

The Fire Investigators Association of Ireland (incorporating Northern Ireland and the Republic of Ireland), FIAI, was founded in March 2003 as the Irish chapter of the International Association of Arson Investigators, IAAI. Róisín Cullinan has become an FIAI committee member as a representative of BRE.

Róisín Cullinan attended a committee meeting of the Fire Investigators Association of Ireland (Irish chapter of the International Association of Arson Investigators) at the Fire Brigade Headquarters of Cavan, Ireland, on 3rd June 2008, and the third Fire Investigators Association of Ireland committee meeting of 2008 held on 4th December 2008 at the Police Service of Northern Ireland Headquarters in Belfast.

Róisín Cullinan attended the IAAI Summer Training Conference, in Guernsey, on 17th July 2009.

David Crowder delivered a three hour guest lecture for the University of Central Lancashire's MSc Fire Investigation course. The lecture was on fire investigation as a means of improving the built environment. The functions and principles of the Building Regulations, associated codes and standards, and the Regulatory Reform (Fire Safety) Order were explained, along with the role of fire investigators as a means of assessing and reporting back on the effectiveness of Approved Document B, and any weaknesses. Some case examples of BRE Fires of Special Interest were given, with the research that they led to and subsequent changes to codes and standards. Finally, the potential use of computer modelling as an aid to fire investigation was explained with supporting case studies.

Task 8: Supplementary support activities

The objectives of the programme are strengthened by the carrying out of supporting laboratory research/ testing or supplementary research and the provision of advice to the Fire and Rescue Service on a quid pro quo basis, including small experimental projects.

BRE has responded to a number of ad hoc inquiries from fire and rescue service contacts over the period. These have all been straightforward and call upon information readily available at BRE.

Some small-scale experiments have been carried out by BRE on a number of incidents, in connection with our own investigations. Some structural modelling was carried for London Fire Brigade as part of their investigation into the Royal Marsden Hospital fire. (Laboratory work has been carried out directly for Warwickshire Police and for Greater Manchester FRS, under direct commissions.)

3 Conclusions

The findings from this period have reaffirmed the overall effectiveness of the Building Regulations and AD B in providing for the safety of life in the event of fire and most of the significant issues that have been identified during this study fall outside the scope of these regulations.

The key findings from the programme, many of which have been identified in earlier years and therefore reflect some continuing and consistent trends, include:

- The vast majority of fatalities and injuries are in residential buildings.
- The importance of smoke alarms is again demonstrated and the risks of allowing them to be out of order. Where smoke alarms are not provided (or are out of order, or not heard) then safety may depend upon neighbours alerting people. However, even where smoke detectors have operated properly, there are cases of injuries.
- The number of deliberate (arson) fires is notable, including a number of fires started in stairwells or other communal spaces of blocks of flats (with residents becoming trapped). (The BBC (Crime Watch) has reported that more people are killed each year from arson attacks than from gun crime).
- There have been some instances of escape routes in blocks of flats being made impassable by smoke. While this may not necessarily be life-threatening, it does have a disruptive (often distressing) impact on the residents. The potential dangers of carpet on the stairs of single-stairway blocks of flats have been highlighted.
- There have been a number of deliberate (arson) fires started in wheelie bins or bin/refuse stores or rubbish against properties. There have been at least three news items run by the BBC on the dangers of wheelie bin fires and the incidences of these fires increasing (in certain locations in the UK).
- In residential premises, there were several cases of fire spreading to neighbouring houses, also incidents involving severe fires in thatched cottages, 'rapid fire spread', fire and rescue service access issues and firefighter injury.
- There were several fires in residential premises (some resulting in fatalities) started by unattended chip pans.
- There have been several fires in residential premises (some resulting in fatalities) started by lit cigarettes. There have been other examples of surreptitious smoking causing significant fire incidents.
- In residential premises, there were a number of multiple rescues from fires in blocks of flats and several cases of fire spreading to flats above shops. In a number of cases, flats were evacuated.
- There has been a trend of an increasing number of serious fires in residential care (hostel or sheltered housing complex) premises. A number of these fires resulted in evacuations and injuries with two fatal incidents.
- There have been a number of fires involving asbestos with associated difficulties for firefighting operations. Fires involving asbestos also present a hazard for nearby residents (or businesses).

- A continuing trend of a significant number of major fires in industrial premises which often result in large firefighting operations, local road or rail closures and residential evacuations. Gas cylinders continue to appear as an issue, either because they explode, or because they limit firefighting. These incidents require the setting-up of a hazard zone. Similarly, fires in garages or car repair workshops continue to be a problem as they sometimes involve the discovery of gas cylinders, which results in the setting up of a hazard zone and the associated disruption (often resulting in significant number of residents being forced to leave their homes). London Fire Brigade has reported that the number of acetylene incidents in the early part of 2007 had more than doubled compared with the previous year. A chemical factory fire in Scotland, which involved a number of explosions and 30m tall flames, resulted in a 1km exclusion zone being set up.
- There have been a number of fires involving fireworks, some indoors, resulting in injury or property damage.
- There are an increasing number of fires where it is reported that there was a significant amount of water damage as a result of (successful) sprinkler operation. It is not clear how this damage compares with that which might otherwise have resulted from firefighter action, or the fire.
- There have been a number of fires in timber frame flats where the fire has penetrated the wall cavity and caused significant structural damage. Quality of construction has been an issue at these fires, in particular with respect to cavity barriers in the walls of timber frame constructions, and truss-rafter roofs. The fire safety measures in some new methods of construction are very dependent upon them being properly installed.
- In the same incidents, there were fire and rescue service recalls due to the (unseen and undetected) development of fire within the cavity. Firefighters at the scene are reluctant to carry out the necessary destructive degree of exposure of the building exterior to be certain that there is no residual fire. Infra-red cameras are evidently less effective in identifying fire behind brick cladding.
- There are related concerns that firefighters may not recognise the nature of some types of (innovative) construction and may use inappropriate firefighting strategies. Some of these new forms of construction may need new firefighting strategies to be developed. In a couple of incidents, fire crews have successfully tackled MMC building fires using tactics that were based solely on the knowledge they had gained from previous very similar incidents (with respect the building construction) and it was a coincidence that the same crew attended who knew how to proceed.
- There have been a number of fires where fire has spread into and through roof spaces. Quality of construction has been an issue at (at least some of) these fires, in particular with respect to cavity barriers in the walls of timber frame constructions, and truss-rafter roofs. The fire safety measures in some new methods of construction are very dependant upon them being properly installed.
- Again this year there have been cases of fires caused by hot work near to inappropriate materials. Often the workman is not aware of the types of materials in the vicinity. This may be helped by the introduction of Regulation 16B since combustible construction materials might be declared.
- There have been a few cases again this year of fires, and firefighting, being affected by weather conditions, especially wind. The potential effects of wind should be considered in any fire safety engineered design, but this is not an issue discussed in AD B.

- There were numerous reports over the winter months of firefighting operations hampered by adverse weather conditions including difficulties due to strong winds (including increased fire spread), snow and freezing temperatures. There have been a number of instances where a lack of available water (due to freezing conditions) has affected firefighting operations.
- The problems of evacuation from a building into adverse weather conditions, especially cold, were again demonstrated. The fire emergency plan, as required by the Regulatory Reform (Fire safety) Order 2005, should include such contingencies.
- In some instances, firefighters were hampered in their work, and in evacuating the premises, because residents did not speak English.
- Fire crews attending a particular incident highlighted an issue with plastic service/waste pipes. It has been found that the associated contamination and health and safety issues during firefighting are a general concern among fire and rescue services.
- There have been several hospital fires this year involving evacuations of significant numbers of patients and staff.
- There have been a number of school fires this year causing extensive damage and the associated disruption to pupils and parents.
- There have been a significant number of fires in chimneys and from open fires inside houses.
- There have been several fires where people have been either injured or killed jumping from height to escape.
- There have been a number of fires involving recycling plants and/or scrap yards. As the demand for recycled material fluctuates so does the possibility of such fires – when demand is low so the stocks are likely to increase, and, hence, the size of potential fires.
- The fatal fire at Lakanal House, Camberwell, has focussed attention on blocks of flats and the responsibilities of the owners of the properties to satisfy the requirements of the Fire Safety Order. This incident is still subject to a Metropolitan Police investigation. More information from this incident, of relevance to Communities and Local Government, will become available once this investigation is completed.

Some individual fires of interest during this period (but which do not necessarily reflect a trend) include the following:

- One hotel fire was efficiently extinguished by firefighters. This success was partly attributed to a visit by fire and rescue service personnel to the hotel prior to the fire which allowed fire and rescue service personnel to familiarise themselves with the building and layout.
- There was a major fire, attracting substantial news coverage, in a commercial building in Manchester. The fire caused major disruption and debris from the blaze ignited a building opposite, a significant distance away.
- A school fire resulted in the rescue of a teacher.
- Two, separate, industrial fires were reported to have been controlled by a sprinkler system.

- One care home fire (in Ireland) was reported to have been controlled by a sprinkler system.
- In one case, sprinklers in individual flats were provided with taps and the system could be turned off within the individual flat (ostensibly for maintenance). Sprinklers in flats are usually intended for the protection of all residents and the need to avoid such a design feature may need to be the subject of revised guidance.
- Firefighters were hampered in their rescue efforts in one block of flats by the security barriers.
- There were a number of other high profile fires including the severe fire on the Cutty Sark in London, at York Racecourse and a major fire in a coastal arcade at Skegness. There continue to be many fires involving derelict or unused buildings (including a double fatality incident).
- A major fire in a Russian care home resulted in 63 fatalities. Severe forest fires in Greece resulted in 64 fatalities and the decimation of a massive land area.
- One fire resulted in damage to a row of fourteen houses (nine completely destroyed).
- One hospital fire resulted in the evacuation of 64 patients including four in an intensive care unit.
- Firefighters were hampered in their firefighting efforts in one storage barn fire by standard hose reels not being long enough to reach the nearest water hydrant.
- A fire in a care home, originating in a living room, and, separately, a fire in a nursing home bedroom, each resulted in a fatality.
- A fire in a highly insulated building which appeared smaller (from an external vantage) to the Fire and Rescue Services than it actually was, with associated implications for fire crews sent into the building.
- In one fatal fire, the response of a fire crew in the locality was delayed due to the lack of an immediately available incident commander.
- There were two pier fires of national interest which resulted in extensive damage and major firefighting operations.
- There was at least one large fire that was identified by a CCTV operator who raised the alarm.
- There was one incident in a nightclub in which indoor pyrotechnics resulted in minor injury and a major evacuation (similar fires started by indoor pyrotechnics overseas have resulted in multiple fatalities).
- There was one underground fire in which tonnes of liquid nitrogen were used in an attempt to extinguish the blaze.
- A fire involving a car underneath part of a hotel caused substantial damage.
- A fire starting in a car in a car park underneath an office block caused substantial damage. The severity of the fire was exacerbated by the insulation material on the car park ceiling.

In a couple of incidents (and not detailed here) the fire and rescue service investigation has been hampered by the lack of documentation or plans since they were destroyed in the fire; under the Regulatory Reform

(Fire Safety) Order 2005 there is no obligation to keep a copy of the Fire Safety Risk Assessment (or associated documentation) away from the premises. In any case, the occurrence of two fatal hotel fires since October 2006 has brought attention to the RR(FS)O.

There have also been a number of large fires involving timber frame flats under construction during the year, particularly in Scotland and most recently in Blackpool. Although this is not a Building Regulations issue there are concerns regarding the partial occupation of buildings under construction.

Again in this period, problems arose from obtaining information into investigations of fatal fires, where the incident is under investigation by the police, or with the Coroner's court or at inquest. Although follow ups were made, this is a protracted process and could extend over a period of twelve months following the incident.

4 Acknowledgements

The BRE Fire Investigation team over this period has comprised (at various times): Martin Shipp, Sam Greenwood, Brian Martin, Kelvin Annable, David Crowder, Róisín Cullinan, Chris Mayfield, Tom Lennon, Phil Clark, Sarah Colwell, Richard Chitty, Danny Hopkin and Antonia Crawford.

Special thanks go to the various FRSS, Police and other agencies who have assisted BRE in this work.

Appendix A – Summary of the Research

BRE was commissioned by Communities and Local Government Sustainable Buildings Division to carry out a project titled “Investigation of Real Fires”, Communities and Local Government Contract reference CI 71/5/43, BD 2651, which started in April 2007 and has run to November 2009.

Data have been gathered from on-site visits, from a network of other fire investigators in the fire and rescue service, police and specialist consultancies, and from the media (primarily the web).

It is the aim of this project to draw the attention of Communities and Local Government to potential or developing life safety issues rather than explain them after the event.

The findings from this period have reaffirmed the overall effectiveness of the Building Regulations and AD B in providing for the safety of life in the event of fire and most of the significant issues that have been identified during this study fall outside the scope of these regulations.

The key findings from the programme, many of which have been identified in earlier years and therefore reflect some continuing and consistent trends, include:

- The vast majority of fatalities and injuries are in residential buildings.
- The importance of smoke alarms is again demonstrated and the risks of allowing them to be out of order. Where smoke alarms are not provided (or are out of order, or not heard) then safety may depend upon neighbours alerting people. However, even where smoke detectors have operated properly, there are cases of injuries.
- The number of deliberate (arson) fires is notable, including a number of fires started in stairwells or other communal spaces of blocks of flats (with residents becoming trapped). (The BBC (Crime Watch) has reported that more people are killed each year from arson attacks than from gun crime).
- There have been some instances of escape routes in blocks of flats being made impassable by smoke. While this may not necessarily be life-threatening, it does have a disruptive (often distressing) impact on the residents. The potential dangers of carpet on the stairs of single-stairway blocks of flats have been highlighted.
- There have been a number of deliberate (arson) fires started in wheelie bins or bin/refuse stores or rubbish against properties. There have been at least three news items run by the BBC on the dangers of wheelie bin fires and the incidences of these fires increasing (in certain locations in the UK).
- In residential premises, there were several cases of fire spreading to neighbouring houses, also incidents involving severe fires in thatched cottages, ‘rapid fire spread’, fire and rescue service access issues and firefighter injury.
- There were several fires in residential premises (some resulting in fatalities) started by unattended chip pans.

- There have been several fires in residential premises (some resulting in fatalities) started by lit cigarettes. There have been other examples of surreptitious smoking causing significant fire incidents.
- In residential premises, there were a number of multiple rescues from fires in blocks of flats and several cases of fire spreading to flats above shops. In a number of cases, flats were evacuated.
- There has been a trend of an increasing number of serious fires in residential care (hostel or sheltered housing complex) premises. A number of these fires resulted in evacuations and injuries with two fatal incidents.
- There have been a number of fires involving asbestos with associated difficulties for firefighting operations. Fires involving asbestos also present a hazard for nearby residents (or businesses).
- A continuing trend of a significant number of major fires in industrial premises which often result in large firefighting operations, local road or rail closures and residential evacuations. Gas cylinders continue to appear as an issue, either because they explode, or because they limit firefighting. These incidents require the setting-up of a hazard zone. Similarly, fires in garages or car repair workshops continue to be a problem as they sometimes involve the discovery of gas cylinders, which results in the setting up of a hazard zone and the associated disruption (often resulting in significant number of residents being forced to leave their homes). London Fire Brigade has reported that the number of acetylene incidents in the early part of 2007 had more than doubled compared with the previous year. A chemical factory fire in Scotland, which involved a number of explosions and 30m tall flames, resulted in a 1km exclusion zone being set up.
- There have been a number of fires involving fireworks, some indoors, resulting in injury or property damage.
- There are an increasing number of fires where it is reported that there was a significant amount of water damage as a result of (successful) sprinkler operation. It is not clear how this damage compares with that which might otherwise have resulted from firefighter action, or the fire.
- There have been a number of fires in timber frame flats where the fire has penetrated the wall cavity and caused significant structural damage. Quality of construction has been an issue at these fires, in particular with respect to cavity barriers in the walls of timber frame constructions, and truss-rafter roofs. The fire safety measures in some new methods of construction are very dependent upon them being properly installed.
- In the same incidents, there were fire and rescue service recalls due to the (unseen and undetected) development of fire within the cavity. Firefighters at the scene are reluctant to carry out the necessary destructive degree of exposure of the building exterior to be certain that there is no residual fire. Infra-red cameras are evidently less effective in identifying fire behind brick cladding.
- There are related concerns that firefighters may not recognise the nature of some types of (innovative) construction and may use inappropriate firefighting strategies. Some of these new forms of construction may need new firefighting strategies to be developed. In a couple of incidents, fire crews have successfully tackled MMC building fires using tactics that were based solely on the knowledge they had gained from previous very similar incidents (with respect the

building construction) and it was a coincidence that the same crew attended who knew how to proceed.

- There have been a number of fires where fire has spread into and through roof spaces. Quality of construction has been an issue at (at least some of) these fires, in particular with respect to cavity barriers in the walls of timber frame constructions, and truss-rafter roofs. The fire safety measures in some new methods of construction are very dependant upon them being properly installed.
- Again this year there have been cases of fires caused by hot work near to inappropriate materials. Often the workman is not aware of the types of materials in the vicinity. This may be helped by the introduction of Regulation 16B since combustible construction materials might be declared.
- There have been a few cases again this year of fires, and firefighting, being affected by weather conditions, especially wind. The potential effects of wind should be considered in any fire safety engineered design, but this is not an issue discussed in AD B.
- There were numerous reports over the winter months of firefighting operations hampered by adverse weather conditions including difficulties due to strong winds (including increased fire spread), snow and freezing temperatures. There have been a number of instances where a lack of available water (due to freezing conditions) has affected firefighting operations.
- The problems of evacuation from a building into adverse weather conditions, especially cold, were again demonstrated. The fire emergency plan, as required by the Regulatory Reform (Fire safety) Order 2005, should include such contingencies.
- In some instances, firefighters were hampered in their work, and in evacuating the premises, because residents did not speak English.
- Fire crews attending a particular incident highlighted an issue with plastic service/waste pipes. It has been found that the associated contamination and health and safety issues during firefighting are a general concern among fire and rescue services.
- There have been several hospital fires this year involving evacuations of significant numbers of patients and staff.
- There have been a number of school fires this year causing extensive damage and the associated disruption to pupils and parents.
- There have been a significant number of fires in chimneys and from open fires inside houses.
- There have been several fires where people have been either injured or killed jumping from height to escape.
- There have been a number of fires involving recycling plants and/or scrap yards. As the demand for recycled material fluctuates so does the possibility of such fires – when demand is low so the stocks are likely to increase, and, hence, the size of potential fires.
- The fatal fire at Lakanal House, Camberwell, has focussed attention on blocks of flats and the responsibilities of the owners of the properties to satisfy the requirements of the Fire Safety Order. This incident is still subject to a Metropolitan Police investigation. More information from this

incident, of relevance to Communities and Local Government, will become available once this investigation is completed.

Some individual fires of interest during this period (but which do not necessarily reflect a trend) include the following:

- One hotel fire was efficiently extinguished by firefighters. This success was partly attributed to a visit by fire and rescue service personnel to the hotel prior to the fire which allowed fire and rescue service personnel to familiarise themselves with the building and layout.
- There was a major fire, attracting substantial news coverage, in a commercial building in Manchester. The fire caused major disruption and debris from the blaze ignited a building opposite, a significant distance away.
- A school fire resulted in the rescue of a teacher.
- Two, separate, industrial fires were reported to have been controlled by a sprinkler system.
- One care home fire (in Ireland) was reported to have been controlled by a sprinkler system.
- In one case, sprinklers in individual flats were provided with taps and the system could be turned off within the individual flat (ostensibly for maintenance). Sprinklers in flats are usually intended for the protection of all residents and the need to avoid such a design feature may need to be the subject of revised guidance.
- Firefighters were hampered in their rescue efforts in one block of flats by the security barriers.
- There were a number of other high profile fires including the severe fire on the Cutty Sark in London, at York Racecourse and a major fire in a coastal arcade at Skegness. There continue to be many fires involving derelict or unused buildings (including a double fatality incident).
- A major fire in a Russian care home resulted in 63 fatalities. Severe forest fires in Greece resulted in 64 fatalities and the decimation of a massive land area.
- One fire resulted in damage to a row of fourteen houses (nine completely destroyed).
- One hospital fire resulted in the evacuation of 64 patients including four in an intensive care unit.
- Firefighters were hampered in their firefighting efforts in one storage barn fire by standard hose reels not being long enough to reach the nearest water hydrant.
- A fire in a care home, originating in a living room, and, separately, a fire in a nursing home bedroom, each resulted in a fatality.
- A fire in a highly insulated building which appeared smaller (from an external vantage) to the Fire and Rescue Services than it actually was, with associated implications for fire crews sent into the building.
- In one fatal fire, the response of a fire crew in the locality was delayed due to the lack of an immediately available incident commander.

- There were two pier fires of national interest which resulted in extensive damage and major firefighting operations.
- There was at least one large fire that was identified by a CCTV operator who raised the alarm.
- There was one incident in a nightclub in which indoor pyrotechnics resulted in minor injury and a major evacuation (similar fires started by indoor pyrotechnics overseas have resulted in multiple fatalities).
- There was one underground fire in which tonnes of liquid nitrogen were used in an attempt to extinguish the blaze.
- A fire involving a car underneath part of a hotel caused substantial damage.
- A fire starting in a car in a car park underneath an office block caused substantial damage. The severity of the fire was exacerbated by the insulation material on the car park ceiling.

In a couple of incidents (and not detailed here) the fire and rescue service investigation has been hampered by the lack of documentation or plans since they were destroyed in the fire; under the Regulatory Reform (Fire Safety) Order 2005 there is no obligation to keep a copy of the Fire Safety Risk Assessment (or associated documentation) away from the premises. In any case, the occurrence of two fatal hotel fires since October 2006 has brought attention to the RR(FS)O.

There have also been a number of large fires involving timber frame flats under construction during the year, particularly in Scotland and most recently in Blackpool. Although this is not a Building Regulations issue there are concerns regarding the partial occupation of buildings under construction.

Again in this period, problems arose from obtaining information into investigations of fatal fires, where the incident is under investigation by the police, or with the Coroner's court or at inquest. Although follow ups were made, this is a protracted process and could extend over a period of twelve months following the incident.

Some of these issues may need to be the subject of further study.