Compartmentation in roof voids
BD2846
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Online via the Communities and Local Government website: www.communities.gov.uk

October 2010

ISBN: 978 1 4098 2576 0
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1 Acknowledgements

Exova Warringtonfire and BYL would like to express their sincere thanks and appreciation to the following for their significant contributions without which information would have been difficult to obtain.

• Avon Fire and Rescue Service
• Bedfordshire and Luton Fire and Rescue Service
• Cheshire Fire and Rescue Service
• Cumbria Fire and Rescue Service
• Essex County Fire and Rescue Service
• Greater Manchester Fire and Rescue Service
• Hampshire Fire and Rescue Service
• Hereford and Worcester Fire and Rescue Service
• Kent Fire and Rescue Service
• Lancashire Fire and Rescue Service
• London Fire Brigade
• Lothian and Borders Fire and Rescue Service

The views expressed in this report are those of the authors and do not necessarily represent the views or proposed policies of the Department for Communities and Local Government.
2 Introduction

2.1 Background

As part of the Sustainable Buildings Research and Development Programme the Department for Communities and Local Government (CLG) have commissioned a research study to investigate a number of specific issues with respect to fire compartmentation in roof voids. The project has been carried out by a team comprising Exova Warringtonfire and Butler and Young Ltd (BYL),

The research was instigated following a number of fires in relatively modern apartment buildings which resulted in fires in roof voids which spread quickly throughout the roof affecting all the top floor flats despite the provisions in the Building Regulations (and supporting guidance) intended to ensure that the fire resisting separation between individual flats is maintained.

The purpose of the investigation was twofold:

a) to determine if recent, and current building practice follows the guidance in Approved Document B and if not, why not; and

b) to research actual fires within roof voids

In line with the project brief, the focus of this report is confined to common practice associated with pitched roofs in apartment building and presents the findings of the research undertaken over a relatively short period during February and March 2010.

It should be noted that the information contained in section 4 of this report was taken from initial applications for Building Regulations approval and as such may contain insufficient information to allow acceptance or contained certain details which would not be acceptable practice. Any inadequacies were identified or rectified before being approved by Building Control.

The information used in this report was obtained from a number of different sources including; the web based data project management tool operated by BYL, news reports, first hand accounts from fire officers who attended the referenced incidents and on site inspections of current buildings under construction.
3 Executive summary

Construction details shown in Building Regulations applications for approximately 750 residential buildings were reviewed.

There was a large variation of the amount of detailed information provided in the submissions with a large proportion containing insufficient design detail of roof void compartmentation to allow the inspector to confirm compliance at the plan checking stage. Without this level of detail being confirmed as compliant at this stage, the confirmation of compliance is then reliant on the inspector being on site at the time the compartmentation installation is completed. It also relies on the Inspector making a judgement of whether the completed construction will provide the required fire resistance, often without detailed supporting evidence. As this is not a statutory notification inspection stage, and certain aspects of compartmentation requirements are very difficult to confirm without invasive, or aggressive inspection techniques which may damage the building, it is occasionally not specifically checked.

It was noted however that a number of submissions were considered as good practice as they were clear and concise and were supplemented by three dimensional drawings of the wall and roof interface showing the multiple interface layers. These summary drawings were additionally supported by written detailing of installation techniques especially in cases where unusual or uncommon designs were used. Examples of these types of drawings are shown in figures 4.1.10.2 and 4.1.15.3.

The analysis into real fires reviewed incidents within the last 12 months. Over seventy property fires were assessed. From the incidents investigated more recently eight fires have been included in this report. In addition more than one hundred other incidents were assessed as not being relevant to this research project.

The research focused on fires within residential roof voids, irrespective of whether the fire spread past compartment barriers. It was hoped that this would therefore identify situations where fires had spread past compartment barriers, but also cases where the compartmentation had prevented fire spread.

Four potential mechanisms of fire spread were identified namely; a) combustible materials spanning beneath the non-combustible roof covering, b) absent or poor installation of cavity barriers/compartmentation, c) fire spread along the soffit and d) heat transfer through penetrations.

All eight incidents included in this report involved substantial damage to the property, one of which however was actually cited as an example of excellent performance with respect to compartmentation, as the damage to the property did not spread beyond the boundary walls of residence of origin despite being a very severe fire in a timber framed building.

Discussions with fire officers having attended the incidents indicates that some extenuating circumstances existed which lead to the events and possible causes
for lack of performance for example unusually high fire loading in one case.

Of particular note is the use of timber-framed construction and the difficulty of fire crews gaining access to the cavities and voids, particularly where full panels of oriented strand board (OSB) or plywood board is used extensively for rigidity and added strength behind frames. Whilst not strictly related specifically to the research into compartmentation in roof voids the issue is causing problems in operational fire fighting and ensuring fire has not spread. However, for each fire that was investigated, the evidence showed that where the compartmentation was designed and installed in line with the recommendations of Approved Document B, it succeeded in preventing fire spread.
4 Synopsis of the research

4.1 Information on current practice

In this section a number of examples of current practice are reproduced which have been found to be typical of the designs which are being investigated.

4.1.1 SAMPLE 1 DEVELOPMENT OF TWO-STOREY FLATS WITH TIMBER FRAMED CONSTRUCTION

*Figure 4.1.1.1 Timber frame two-storey flats*
The specific design detail for the compartmentation requirements is shown in figure 4.1.1.2 and consists of the following:

- 50mm cavity
- two skins 89mm x 38mm insulated timber spandrel panels each with outer facing of 2 layers 12.5mm Gyproc TE Wallboard capped at underside of roof batten with 6mm non combustible Superlux board
- fire stop between battens with 25mm wire reinforced mineral wool

This methodology is considered to be compliant with the recommendations contained in section B3 of Approved Document B Volume 2.
4.1.2 SAMPLE 2 DEVELOPMENT OF TWO-STOREY FLATS WITH TIMBER FRAMED CONSTRUCTION

Figure 4.1.2.1 Timber frame two-storey flats Block A Section A-A

Figure 4.1.2.2 Timber frame 2-storey flats Block A Section B-B
The only design detail supplied in this application dealing with the compartmentation requirements is shown in figure 4.1.2.3 below and consists of the following:

- 2 no layers 12.5mm plasterboard each side of vapour barrier
- 2 no skins 89mm timber frame with 60mm rockwool insulation
- 9mm OSB board each side of cavity

*Figure 4.1.2.3 Timber frame two-storey flats Block B Section A-A*

The details submitted did not allow compliance to be fully checked due to lack of detail at the junction of the wall with the roof soffit.
4.1.3 SAMPLE 3 TIMBER FRAME TWO-STOREY FLATS

Figure 4.1.3.1 General details submitted for various construction methods on the project

Figure 4.1.3.1 Separating wall detail
This sample contains evidence to a similar standard of detail as is contained in many design submissions which refer to general details of construction. This particular project provided for the following:

- 2 layer SoundBloc + scim - 12.5mm +2.5mm
- 1 layer WBP Ply - 12mm. Gypframe 70 s 50 studs @ 600mm Centres
- Isover APR 1200 Insulation to cavity - 50mm
- 1 layer WBP ply - 12.5mm

Although the general details of the compartment wall meets 60 minutes fire resistance, the submitted details do not show junction with pitched roof details and so it is not possible to confirm that it complies with ADB.

4.1.4 SAMPLE 4 TRADITIONAL CAVITY CONSTRUCTION SEMI-DETACHED BUNGALOW

*Figure 4.1.4.1 Section of traditional cavity construction showing details of separation at roof details*

This is still a common method of construction this development has the following details in construction:

- 2 skins blockwork
- 50mm cavity with top of cavity filled with cavity barrier and 50mm thick wire
reinforced Rockwool Rollbatt between top of wall and U/s of felt

- Rockwool RW2 flexible slab between roof tiles and battens, thickness to be only slightly greater than depth of void to be filled

The section through the bungalow shows the use of Rockwool flexible slab between the tile battens. This may be acceptable but paragraph 5.12b of AD B Vol 1 specifically mentions bedding in mortar or other suitable material. Rockwool may become dislodged.
4.1.5 SAMPLE 5 TRADITIONAL CAVITY CONSTRUCTION TWO-STOREY FLATS

Figure 4.1.5.2 Written design detail only, provided with the submission

PARTY WALLS

2 NOS. LEAVES DENSE AGGREGATE BLOCKWORK (OR AS SPECIFIED BY STRUCTURAL ENGR’S) BLOCK DENSITY 1850–2300 kg/m³.
100mm WIDE CAVITY FILLED WITH 95mm ISOVER PARTY WALL ROLL.
PLASTERBOARD WITH MINIMUM DENSITY OF 9.8 kg/m² ON DABS BOTH SIDES.

It can be seen that the design detail only consists of written details, which is acceptable providing that sufficient information is contained, however in this particular case, there was lack of design detail to enable a compliance check of the plans to be made at the junction of the wall and the roof.
4.1.6 SAMPLE 6 FIVE-STOREY, CONCRETE FRAME FLATS WITH METAL PROFILE ROOF

Figure 4.1.6.1 Five-storey flats submitted detail

Figure 4.1.6.2 Design detail contained in submission

4.5 Separating Walls:
Party/separating walls to be constructed as either:
   i) Robust Detail E-WM-1 comprising two leaves of 140mm blocks
      with a density of 1850 - 2300kg/m³ with a 75mm cavity. Both
      sides to be finished with 13mm plaster (min 10kg/m³), or
   ii) Robust Detail E-WM-2 - as i) but with blocks of density
        1350-1600kg/m³.

4.6 Party walls to be taken up to underside of roof and fire stopped with
mineral wool. Mineral wool sound deadening/fire stop and dpc also
to be provided at junction of party walls with external wall.
Whilst not in strict accordance with the full scope of the research as this building does not have a pitched roof, it can be seen from figure 4.1.6.3 above that there is a common roof void above the top flats and has therefore been included as a sample of method of current practice. The content of submission describes the construction in detail and consists of the following:

- robust detail E-WM-1 compromising two leaves of 140mm blocks with a density of 1850 - 2300kg/m³ with a 75mm cavity
- both sides to be finished with 13mm (min 10kg/m²)
- party walls to be taken up to underside of roof and fire stopped with mineral wool
- mineral wool sound deadening/fire stop and dpc also to be provided at junction of party walls with external wall
- eaves fire stopping with 6mm mineral wool fibre board

From the details supplied and experience of the reviewer it is considered that the eaves insulation will be difficult to install and may dislodge. Therefore the robust detail checklists will need signing off by site manager.
4.1.7 SAMPLE 7 TRADITIONAL CAVITY CONSTRUCTION THREE-STOREY RETIREMENT FLATS

Figure 4.1.7.1 Top floor layout detail

Figure 4.1.7.2 Party wall design detail supplied
It can be seen that the design details contained within figures 4.1.7.2 and 4.1.7.3 provide for the following:

- 2 no skins 100mm thick 10.4N solid block (density 1850 to 2300kg/m³) with...
75mm clear cavity

- cavity barrier at top to provide one hour fire resistance
- in roof void - metal stud wall comprising Gypframe metal stud covered exposed side with 2 layers BG Soundbloc board with staggered joints
- top of partition wall fire stopped at abutment with roof finish with stone mineral wool

This was considered as very good design details received, although clarification that stone mineral wool laid between battens may have been of benefit.
4.1.8 SAMPLE 8 DEVELOPMENT OF TWO-STOREY CONVERSION OF HOUSES TO FLATS

The specific design detail for fire stopping was provided in drawings submitted to Building Control and supplemented by design notes, (it was not possible to obtain permission from the authors to include extracts from the submission in this report) the details of the submission consisted of the following:

- existing walls at min 215mm wide brickwork to be retained as separating walls between flats
- new walls to be constructed as 215mm wide concrete block work to provide separating walls between flats

The detail submitted did not allow compliance to be confirmed due to the lack of drawings detailing the construction at the junction of the roof.

4.1.9 SAMPLE 9 DEVELOPMENT OF TWO-STOREY TRADITIONAL CAVITY CONSTRUCTION FLATS

*Figure 4.1.9.1 Proposed plans two-storey traditional cavity construction for flats*
The specific design detail from figure 4.1.9.1 for the fire stopping requirements at the junction roof is shown in figure 4.1.9.2 and consists of the following:

- 2 skins 100mm blockwork (density 1350 - 1600 kg/m³)
- 75mm cavity with 35mm isover RD35 insulation

The detail submitted did not allow compliance to be confirmed due to the lack of drawings detailing the construction at the junction of the roof.

*Figure 4.1.9.2 Proposed plans two-storey traditional cavity construction for flats*

4.1.10 SAMPLE 10 TWO-STOREY TRADITIONAL CAVITY CONSTRUCTION FLATS

*Figure 4.1.10.1 Proposed plans two-storey traditional cavity construction for flats*
The specific design detail for the fire stopping requirements at the junction roof is shown in figures 4.1.10.1 and 4.1.10.2 and the detail consists of the following:

- 2 skins 100mm blockwork (density 1350 - 1600 kg/m³)
- 75mm filled cavity with 50mm wire reinforced mineral wool packing between rafters

The detail and drawings submitted did allow compliance to be confirmed and was a considered to be a very good example of design details showing the construction at the junction of the roof.

*Figure 4.1.10.2 Proposed plans two-storey traditional cavity construction for flats*

4.11 SAMPLE 11 THREE-STOREY CARE HOME TRADITIONAL CAVITY CONSTRUCTION FLATS

The specific design detail for fire stopping was provided in drawings submitted to Building Control and supplemented by design notes, (it was not possible to obtain permission from the authors to include extracts from the submission in this report) the details of the submission consisted of the following:

- 2 skins of 100mm blockwork with 50mm cavity
- Walls taken to underside of roof and fire stopped

The lack of detail submitted did not allow compliance to be confirmed due to the lack of drawings detailing the construction at the junction of the roof.
4.1.12 SAMPLE 12 CONVERSION OF HOUSE INTO FLATS

The specific design detail for fire stopping was provided in drawings submitted to Building Control and supplemented by design notes, (it was not possible to obtain permission from the authors to include extracts from the submission in this report) the details of the submission consisted of the following:

- existing solid brickwall 50 mm cavity
- 9mm OSB sheathing
- 75mm sw stud with 75mm acoustic mineral wool sound insulation
- polythene vapour barrier and 2no layers 12mm plasterboard and skim

The proposal submitted did not allow compliance to be confirmed due to the lack of drawings detailing the roof void.

4.1.13 SAMPLE 13 CONVERSION OF HOUSE INTO FLATS

*Figure 4.1.13.1 Proposed plans conversion of house into flats*
The specific design detail from figure 4.1.13.1 for the fire stopping requirements at the junction roof is shown in figure 4.1.13.2 and consists of the following:

- solid wall construction of min 215mm thick dense concrete block laid flat (tarmac dense topcrete 1900-2000kg/m³ or similar) with 13mm plaster both sides to active min mass of 415kg/m²
- ensure all gaps are sealed with certified fire/acoustically rated product

The lack of detail submitted did not allow compliance to be confirmed due to the lack of drawings showing detailing for the roof void. More detail on methods of fire stopping at the junction of the roof would have been beneficial.

Figure 4.1.13.2 Conversion construction notes

| New Blockwork Party Walls and Infill Areas: (Where supporting structure capable of taking loads); Type 1.1: Solid wall construction of min 215mm thick dense concrete block laid flat (tarmac dense topcrete 1900-2000kg/m³ or similar) with 13mm plaster both sides to achieve min mass of 415kg/m² complying with E2 of the Building Regulations. Bond new blockwork into existing and ensure all gaps are sealed with certified fire/acoustically rated product. This wall type will require pre-completion testing in accordance with Part E of Building Regulations. |
The specific design detail from figure 4.1.14.1 for the fire stopping requirements at the junction roof is shown in figure 4.1.14.2 and consists of the following:

- 2 no 70mm independent Gypframe C metal studs with 50mm cavity faced with 19mm plywood and 2 layers 12.5mm Gyproc high density plasterboard of min mass 22kg/m2 scrim and set with plaster

- sound deadening quilt to be hung in cavity

- partitions to continue up to the underside of the existing fire lined soffits and any gaps to be fully filled with intumescent fire stopping
The details submitted were not sufficient to allow compliance to be confirmed. Detail on methods of fire stopping at the junction of the roof should have been more specific in stating that intumescent fire stopping at the junction of the roof is not appropriate for larger gaps. Non-combustible mineral wool quilt would be more suitable.

Figure 4.1.14.2 Timber frame three-storey flats construction notes

4.1.15 SAMPLE 15 THREE-STOREY FLATS OF TIMBER FRAME CONSTRUCTION

The specific design detail for fire stopping was provided in drawings submitted to Building Control and supplemented by design notes, (it was not possible to obtain permission from the authors to include extracts from the submission in this report) the details of the submission consisted of the following:

- timber cavity wall to consist of 2no 38 x 89mm softwood studs with sheathing or diagonal timber brace to timber frame suppliers details to cavity side
- each leaf to be filled with 90mm un-faced non-combustible glass mineral wool timber frame insulation retained in accordance with timber frame suppliers requirements
- fire stop the junction between the compartment wall and the external wall using wire reinforced wool
- ensure cavity is closed
- fire stop the junction between the compartment wall and the roof finish
- ensure that the eaves void is suitably filled where it passes the compartment wall

The detail submitted did allow compliance to be confirmed and is a good example of a drawing containing good detail.
Figure 4.1.15.2 Timber frame three-storey flats construction notes

3.0 Party Wall (250mm structural width)
3.1 Timber cavity party wall to consist of 2 no. 38x89mm softwood stud panels with sheathing or diagonal timber brace to Timber Frame suppliers details to cavity side. Each leaf to be filled with 90mm unfaced non-combustible glass mineral wool Timber frame Insulation, (isowool or approved equal 10kg/m² min. density) retained in accordance with Timber Frame suppliers requirements. Wall to be finished with 2 no. 12.5mm thick sheets plasterboard (combined min density 21kg/m²) fixed in accordance with manufacturers recommendations. Joints to be staggered. Joints to be taped and jointed with screw holes spotted.

NOTE: Communal corridor / staircase side of party walls to receive 3mm plaster skim coat in lieu of taped joints.

Refer to drawing 1071/SD/1083 for fire stops in compartment walls.
Refer to drawing 1071/SD/1084 for wall linings.

Figure 4.1.15.3 Timber frame three-storey flats cavity barrier and fire stop detail

Cavity Barriers
1. External walls:
Close cavity at top of external walls with either 47 x 47mm treated timber batten (with DPC over) or mineral wool in polythene sleeve (TOG).

2. Compartment floors:
Close the external wall cavity at compartment floor level with mineral wool in polythene sleeves (TOG). Do not incorporate an additional cavity tray as this will create a risk of condensation.

3. Party wall cavity at compartment floor level with wire reinforced mineral wool.

3. Openings: In external walls, i.e., windows, doors etc.
Close the external wall cavity around the opening with 47 x 47mm treated timber cavity batten.

Fire stops
5. Compartment walls:
Fire stop the junction between the compartment wall and the external wall using wire reinforced wood. Ensure cavity is closed.

Fire stop the junction between the compartment wall and the roof. Ensure that the same method is suitably filled where it passes the compartment wall. See detail.
4.1.16 ONSITE INSPECTION OF TYPICAL EXAMPLES OF COMPARTMENTATION DETAILS

a) Onsite inspection showing prefabricated compartment wall

*Figure 4.1.16.1 Prefabricated timber stud panel compartment wall*

The image in figure 4.1.16.1 shows a compartment wall where a prefabricated timber stud panel is craned into the roof void to sit on top of a traditional cavity construction.

In this case the compartment wall panel is too small and is short of the external cavity wall and requires remedial work in order to meet requirements for compliance.
b) Compartment wall and roof interface

*Figure 4.1.16.2 Compartment wall with no fire boarding at the roof interface*

The image in figure 4.1.16.2 shows a well built block work compartment wall but with no attention to fire boarding between the underside of the roof covering and the top of the compartment wall. This non-compliance requires remedial work in order to gain building regulation approvals.
c) Onsite inspection of prefabricated panel

*Figure 4.1.16.3 Over-sized prefabricated panel*

The image in figure 4.1.16.3 shows a prefabricated panel which is too large for the roof void and projects over the roof line. This panel requires alteration in order to meet the requirements for building regulation approvals.
d) Compartment wall detail

Figure 4.1.16.4 Cavity barrier installed as a compartment wall

The image in figure 4.1.16.4 shows a cavity barrier type construction acting as a compartment wall in the roof void. This installation requires rectification work in order to replace the cavity barrier with a compartment wall.

This is an example of a fairly common misconception within the construction industry regarding the difference between a 'compartment wall' and a 'cavity barrier'. Within the construction industry, the phrase ‘cavity barrier’ is often used to refer to any wall or barrier within a cavity. However, under Approved Document B, if a barrier or wall within a cavity is an extension of a ‘compartment wall’, the barrier within the cavity should also be referred to (and be to the standard of) a ‘compartment wall’. As the fire performance requirement for 'cavity barriers' can vary significantly from that of a 'compartment wall', this can sometimes lead to incorrect specification, as shown above.
5 Investigation into real fires

5.1 Fire incidents

This section was completed following research from a number of sources and is typical of information and anecdotal evidence discussed with investigating fire officers.

5.1.1 INCIDENT 1

Date of fire: January 2010

Fire service contact: Watch Manager Graham Cross (Northwich Fire Station)

Type of building: Semi-detached dormer bungalow circa 1935-1955

Location and cause of fire: The fire started in the boiler unit which was located in a cupboard below the first floor dormer conversion of the semi-detached bungalow; it is considered that an electrical fault had occurred. The building was estimated to be circa 1935-1955.

The fire: The fire spread through the upper section of the boiler cupboard into the ceiling cavity and then into the roof space. The roof space area contained a large amount of house hold material such as clothes and records etc which readily ignited. The fire brigade attended the scene within nine minutes of being contacted and external areas of the roof were already breached by flames. Due to the size of the fire in the roof of the property of origin, further fire spread to the attached property was of high concern to the attending fire service personnel. The use of an aerial appliance and hydraulic platform allowed access to the roof area of the entire semi-detached property in order to reduce fire spread. The fire was extinguished by crews wearing four breathing apparatus who used two hose reels and a main jet. Various sections of the roof were removed in order to suppress the fire and monitor fire spread to the adjacent property. Upon investigation no passage of smoke or flame took place via the roof void to the roof space of the attached property.

Potential implications for building regulations

Means of escape – Means of escape were not compromised during this incident.

Compartmentation – Compartmentation between the two properties was provided by a vertical brick wall with unknown surface finishing. It would appear that the wall was taken to the underside of the roof covering with mortar bed below the sarking felt. It is not known if the clay tiles were bedded on mortar above the felt but fire and smoke spread were limited. The construction provided adequate measures in preventing the passage of smoke and fire in this incident.

Fire service considerations – Cheshire Fire Service reported that previous experience of roof fire showed that monitoring and control of the adjacent property was required in order to reduce the spread of flame by internal and external means. Thermal image cameras were also used to assess any passage of heat within concealed areas within the roof void.
General conclusions – The compartment wall of this building was sufficient to prevent fire spread to the adjacent property via the roof void in conjunction with the method used to monitor and suppress the fire.

Compartmentation and cavity barriers provided did withstand the passage of smoke and flames. The exact detailing of the fire stopping was unconfirmed as an onsite full fire investigation was not warranted in this case. The inclusion of a Dorma conversion to the roof area did not affect the compartmentation or fire stopping provisions.

*Figure 5.1.1.1 Fire affected property dormer section*

(Photograph courtesy of Cheshire Fire and Rescue Service)
Figure 5.1.1.2 Fire affected property aerial platform

(Photograph courtesy of Cheshire Fire and Rescue Service)

Figure 5.1.1.3 Attached property not affected by fire

(Photograph courtesy of Cheshire Fire and Rescue Service)
5.1.2 INCIDENT 2

Date of fire: February 2010

Fire service contact: Officer-On-Scene Javon Heaney (Warrington Fire Station)

Type of building: Semi-detached bungalow

Location and cause of fire: The fire origin was located within the roof void area above the kitchen and was caused by a faulty power supply unit for a Halogen lamp unit. This power supply unit was located in the kitchen roof void and the fire spread through the void/upper floor space of the ‘Dormer’ bedroom conversion. The fire was contained within the floor void area of the roof and generated considerable amount of smoke in the roof void

The fire: Upon attending the scene flames within the floor void space were visible at the lower roof area at the fascia and soffits, which were immediately suppressed using a hose reel. Upon entering the roof void large quantities of smoke were present and a thermal image camera was used to identify that the fire was contained within the floor void of this area. Considerable smoke was present in the roof area of the dwelling of fire origin. In the adjacent property smoke but not flame was evident in the roof space. The fire was extinguished by crews wearing breathing apparatus using a high pressure hose reels. Various sections of the roof to both sides of the property were removed in order to suppress the fire and monitor fire spread to the adjacent property. The adjacent property was ventilated using positive pressure ventilation fans.

Potential implications for building regulations

Means of escape – Means of escape were not compromised during this incident.

Compartmentation – Compartmentation between the two properties was provided by a vertical brick wall with unknown finishing. The construction provided adequate measures in preventing the passage of fire in this incident but not the passage of smoke. The fire officer commented that the interface between the compartment wall separating the semi-detached properties did not appear to be adequately fire stopped at the roof level between the compartment wall and felting/roof slates and this allowed the passage of smoke to the adjacent property.

Fire service considerations – Cheshire Fire Service reported that previous experience of roof fire showed that monitoring and control of the adjacent property was required in order to reduce the spread of flame by internal and external means. Thermal image cameras were also used to assess any passage of heat within concealed areas within the roof void.

General conclusions – The provisions of construction and the quality of workmanship for this building in conjunction with the fire fighting techniques used were sufficient to prevent fire spread to the adjacent property via the roof voids. The compartmentation provided did withstand the passage of flames but not smoke. Inadequate fire stopping at the compartment wall roof interface allowed the passage of smoke to the adjacent property. The exact detailing of the fire stopping was unconfirmed as a full fire investigation was not warranted in this case.
inclusion of a Dorma conversion to the roof area did not affect the compartmentation or fire stopping provisions.
5.1.3 INCIDENT 3

**Date of fire:** February 2010

**Fire service contact:** Group Manager Dave Edgar

**Type of building:** Terraced house, two storeys, circa early 1900s

**Location and cause of fire:** The fire occurred in the roof area of the property because the chimney stack was in a state of disrepair and combustion products from the flue entering the roof voids caused ignition of the materials stored in the roof. The fire service had attended the location previously and recommended that repairs to the flue/chimney be carried out urgently.

**The fire:** Soot and embers from the damaged chimney and flue entered the roof space and caused ignitions of materials within the roof space. The fire was extinguished using two hose reels and the roof was accessed using a 13.5 metre ladder. No fire or smoke spread occurred to adjacent properties in the terrace row.

*Potential implications for building regulations*

**Means of escape** – Fire was contained within the roof area and means of escape were not compromised during this incident.

**Compartmentation** – The compartment walls separating the properties in this terrace row were of brick construction of an unknown finish and were adequate to prevent passage of smoke and flames to adjacent terrace occupancies in this incident.

**Fire service considerations** – Property owner had been previously informed about the issue with the damaged chimney.

**General conclusions** – The compartmentation between the fire affected building and the adjacent terraced buildings in conjunction with the fire fighting techniques used were adequate to prevent the passage of smoke and flame in this incident. Exact detail of the fire stopping provisions was not investigated as the cause of the fire being the disrepair of the chimney stack and flue was easily identified and a fire investigation study was not required.
5.1.4 INCIDENT 4

Date of fire: November 2009

Fire service contact: Group Manager Adrian Holme

Type of building: Mid-terraced house, two storeys, circa early 1970s

Location and cause of fire: The fire occurred in the wall void of the property at the ground floor level and spread via the wall cavity to the roof area. The occupier had installed a wood burning stove and fire stopped the area surrounding the flue with a duvet and wooden board in order to prevent draughts.

The fire: The wood burning stove had been or was in use at the time of the fire and the materials used for fire stopping the area around the flue subsequently ignited due to the surface temperature of the flue in operation. Fire spread via the wall cavity to the adjacent garage of the same property and then spread to the roof area of the garage and the property. Fire spread to adjacent properties was via external means only. The fire service suppressed the fire using three hose reels, one main jet and access was provided using an aerial ladder platform.

Potential implications for building regulations

Means of escape – Occupants were able to make escape and means of escape were not compromised during this incident.

Compartmentation – The compartment walls separating the properties in this terrace row were of brick construction of an unknown finish. Provisions of compartmentation for this terrace construction were adequate to prevent passage of smoke and flames to adjacent terrace occupancies. Unsuitable materials were used to perform fire stopping around the flue and these materials were ignited by the operation of the hot flue and contributed to fire spread within the wall void.

Fire service considerations – In order to suppress the fire of the adjacent property the fire service remove roof tiles of these properties which allowed them to suppress and monitor any adjacent fires.

General conclusions – The primary cause of the fire spread in this incident is the use of incorrect fire stopping materials around the flue. This caused fire to spread within the wall cavity and into the roof voids of the properties. The provision of adequate roof void compartmentation and the firefighting techniques employed to fight the fire prevented the fire spread to adjacent properties.
Figure 5.1.4.1 Fire service attending incident 4

(Photograph courtesy of Cumbria Fire and Rescue Service)

Figure 5.1.4.2 External view of properties

(Photograph courtesy of Cumbria Fire and Rescue Service)
5.1.5 INCIDENT 5

Date of fire: January 2009

Fire service contact: Watch Manager Ballard

Type of building: Mid-terraced house, two storeys circa early 1940s

Location and cause of fire: The house was circa 1940s and was undergoing maintenance by roofing contractors who were felting at the time. The felting hot work was considered to be the source of the fire.

The fire: The terrace contained a back addition building to the terraced property which included an adjacent roof where the fire occurred. The pitch of the addition building roof was at a shallower angle than that of the adjacent property and these roof areas were connected. Smoke and flames were present in both roof voids of the property where the fire originated; smoke was also present in the adjacent property although no flames had passed from property to property.

Potential implications for building regulations

Means of escape – Two men and one woman left the property before the fire service arrived and means of escape were not compromised during this incident.

Compartmentation – Compartmentation was achieved via vertical wall of solid brick construction of an unknown finish erected between each property. Provisions of compartmentation for this terrace construction were adequate to prevent passage of flames to adjacent terrace occupancies but the interface between the compartment wall and roof were not suitably fire stopped to prevent the passage of smoke.

Fire service considerations – London Fire Service reported that previous experience of roof fire showed that monitoring and control of the adjacent property was required in order to reduce the spread of flame by external means. Thermal image cameras were also used to assess any passage of heat and or smoke within areas of the adjacent roof voids and also access was gained to the adjacent properties roof voids if further monitoring or suppression was required.

General conclusions – The fire was caused by on going works in the roof area which did spread to the adjacent roof of the same property by the roof void. Provisions for compartmentation between the terraced occupancies prevented fire spread to any other dwelling. The lack of or incorrect installation of the fires stopping material at the interface between the compartment wall and roof joint allowed the passage of smoke to adjacent properties. Experienced fire fighting techniques in tackling roof fires were used to monitor and suppress the fire in this incident and help to prevent the spread of fire to adjacent properties.
5.1.6 INCIDENT 6

**Date of fire:** March 2010

**Fire service contact:** Watch Manager Steve Kendrick

**Type of building:** 18th Century Grade II Listed Town Houses separated by vertical parapet walls.

**Location and cause of fire:** The fire broke out on the third floor of the property in one of the areas being used as a music studio. It is considered that the cause of the fire is electrical overloading within this area due to overloaded or faulty wiring.

**The fire:** The third floor and roof void of the property were being used as a music studio and were linked via a stairway which did not provide any fire separation between the two levels. It is considered that the third floor room was the room of fire origin with the most probable cause being an electrical fault. The fire spread in to the roof void via the stairway.

**Potential implications for building regulations**

**Means of escape** – Means of escape were not compromised during this incident and the property was unoccupied at the time.

**Compartmentation** – The compartment walls within the building were of a single brick vertical parapet type construction which provided separation between other occupancies in the row. The vertical parapet walls continued above the roof line (as shown in figure 5.6.1) and were jointed at the internal interface of the roof line with a cement screed. The compartmentation had been previously modified when existing pass doors had been removed and in-filled with suitable brick construction. Provisions for compartmentation were adequate during this incident to prevent passage of smoke and flame to adjacent properties. Photos are not available of the fire affected area at present as the area is unsafe to access.

**Fire service considerations** – The fire was attended by 20 firefighters using two 45mm jets and three high pressure hose reels and turntable ladder. Additional access was gained by the use of scaffolding erected at the building. Access was a key issue in talking this fire and was suitably addressed with the provisions noted above.

**General conclusions** – The fire cause was most likely due to faulty wiring and the fire spread to the roof was via an unprotected stair. It was noted by the fire service that the modifications to the compartment wall was performed to a high standard this in conjunction with the parapet design and the methods employed to fight the fire helped to prevent fire spread to adjacent properties by internal or external means.
5.1.7 INCIDENT 7

Date of fire: January 2010

Fire service contact: Group Manager Craig Thomson

Type of building: Four storey block of flats comprising two adjoining blocks, each with single stair access with two flats per floor giving a total of 16 residential properties in total. The building was of traditional construction built circa 1960.

Location and cause of fire: The fire broke out in a third floor flat of the property. The cause of the fire is as yet under investigation but it has already been established that it is likely that the cause was due to a heater within the fire compartment which had set fire to combustible material and had been burning for some considerable time, i.e. 10 - 12 hours. There was extreme fire loading within the compartment in terms of rubbish and other combustible textiles and this added to the fire development and spread. This would account for the rapid development once the windows had failed and the crews had opened the front door. This was initially thought to be as a result of the occupant hoarding large quantities of newspaper and other combustibles in every room.

Injuries: No injuries have been reported at this incident though the fire lead to 34 occupants of all 16 dwellings being evacuated from their homes and subsequently requiring nine people requiring re-housing.

The fire: The fire spread from the third floor into the roof void and penetrated above the stairwell into an adjoining property. It is thought that the heating system which consisted of a hot air ducted vent which penetrated from ground floor up to the roof void was another contributing factor for the development and spread of
that the council owned flats were refurbished some time ago and had originally had a flat roof which had been converted to a pitched roof construction.

Potential implications for building regulations

Means of escape – Means of escape were not compromised during this incident and though the property was occupied at the time people evacuated before the arrival of the fire and rescue service.

Compartmentation – The compartment walls taken to the underside of the previous roof line but it is not known what methods had been adopted to separate the flats from each other above.

Fire service considerations – The fire was attended by 20 firefighters. Additional access was gained by the use of an aerial platform.

General conclusions – The fire cause is, at the time of writing still under investigation but it is evident that there were significant failings in the expected level of compartmentation between dwellings at roof level. It can be seen in figure 5.1.7.1 that the pitched roof of each of Block 1 and 3 has been destroyed in the fire with little or no separation being provided by compartmentation.

Figure 5.1.7.1 Blocks 1 and 3

(Photograph courtesy of Lothian and Borders Fire and Rescue Service)
5.1.8 INCIDENT 8

Date of fire: November 2009

Fire service contact: Watch Manager Mike Kelly

Type of building: Four storey block of flats with two flats per storey and single stair access to each floor. The building was of timber framed construction with brick cladding with pitched tiled roof constructed in 1991 and so can be considered a fairly modern building.

Location and cause of fire: The fire is believed to have been started accidentally in a third floor flat with the use of candles in a bedroom and spread quickly through bedding to involve the whole room. The fire is believed to have spread through the ceiling into the roof void when the glazing failed and caused damage to the rafters (see figure 5.1.8.1) directly above the seat of the fire. The Fire Service contact described the fire as very severe and “virtually destroyed by fire heat and smoke”. The information available was somewhat unusual in that the Fire Engineering team were asked to investigate the incident specifically to determine if compartmentation had been breached and if the methods used complied with the guidance in Approved Document B.

The fire: Due to the nature of construction and severity of the fire, the operational crews requested the attendance of GMFRS Fire Engineering section to give their opinion on the performance of the construction in relation to the recommendations of Approved Document B.

Potential implications for building regulations

Means of escape – Means of escape were not compromised during this incident.

Compartmentation – Though this was a timber framed building, compartmentation was achieved with breeze block construction. The block work was taken up to the underside of the roof covering with a mineral fibre insulation material closing any gaps below the sarking felt. It is not known if there was continuation of this above the felt to the underside of the tiles.

Fire service considerations – This building had a similar construction to one in which the building had to be demolished following a serious fire which spread from a cavity into a roof void and other fires within this Fire Service area which lead to the dissemination locally of information on how to deal with incidents, given the difficulty in gaining access. Whilst not strictly the focus of this research the nature of timber framed construction means that it is very difficult for fire crews to gain access to cavities to extinguish a fire or equally importantly to ensure that it has not spread without actually destroying the construction. This is very often due to walls being provided with a board fixed to the rear of the frame (often oriented strand board OSB or ply) to provide additional rigidity and strength.

General conclusions – The fire in this instance was considered by the attending fire crews as very severe and following fatal flat fires which occurred elsewhere earlier in the year, a joint inspection was carried out with Manchester Building Control and GMFRS Fire Engineering section to establish the performance of the
building following such a severe fire. It was concluded by the investigation team that the building performed extremely well in terms of compartmentation and fire stopping though it was difficult to gain access to cavities when checking to ensure the fire spread had not penetrated beyond the compartment.

*Figure 5.1.8.1 Damaged rafters above the seat of the fire*

(Photograph courtesy of Greater Manchester Fire and Rescue Service)
6 Conclusions

6.1 Review of actual construction detail

The review identified a number of different types of construction detailing that are used within the construction industry.

It was found that the details which are submitted for Building Regulations approval often do not contain adequate details to prove compliance with Building Regulations. In particular, fire-stopping was regularly found to require correction.

Misunderstandings about the difference between a ‘cavity barrier’ and ‘compartment wall’ is one cause of these errors.

In most cases it would be expected that the Building Regulations approval body would highlight these deficiencies and require correction as part of the approval process.

However, it was also found that it is common practice within the industry for only limited construction details to be included within the Building Regulations application, which puts the onus on the contractor to ensure the correct detailing. Subsequent on-site verification of actual construction details can be difficult as it may require partial demolition of the wall to check the details fully.

6.2 Review of actual fire incidents

The real fires investigated would appear to indicate that the construction methods adopted over many years can provide adequate compartmentation as the Building Regulations require.

However what is evident is that the quality of installation is at best variable with a number of examples being identified as being inadequate. The lack of specific design detail may also lead to inappropriate acceptance of building systems which may provide some fire resistance but not perform the function of a compartment wall.