LONDONASSEMBLY

Planning and Housing Committee

Fire safety in London

Fire risks in London's tall and timber framed buildings

December 2010

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Foreword

Nicky Gavron

Jenny Jones

This report sends a wake-up call to Government, the fire service, the construction industry and all public landlords in London.

Since 1666 it has been recognised that London presents some very specific challenges for building and fire regulation - and this remains true today. Two pressing challenges are the increasing concentration of high rise residential buildings in the capital, and the growing trend for timber frame construction.

As London's population continues to grow and we look to preserve London's green spaces we are going to see a lot more people living at heights - already more than half a million Londoners live in tall buildings. The drive to use more low carbon construction materials will also shape London's housing mix as it results almost inevitably in more timber framed buildings. As we build at higher densities and with more environmentally friendly materials it is vital to current and future residents that we get fire safety absolutely right.

Our report looks at ways to reduce the fire risks inherent in constructing timber framed buildings, and to improve fire safety for people living in high rise flats.

It is the task of all of those involved in the issue of fire safety to ensure that the regulations and practices that guide construction of residential properties in London are sufficiently robust and effectively enforced - no matter how the methods devised to build London's homes change.

While our report shows that timber construction can be safe and building at greater heights does not automatically equate to greater

danger, our investigation has uncovered a number of gaps in fire safety policy and practice. These must be addressed urgently to improve fire safety both while buildings are under construction, and once they are occupied.

People need to have confidence that their homes are being built strictly in accordance with the fire regulations. Those responsible for identifying the dangers must be competent to undertake the risk assessments. And finally, the residents themselves must have the information that these safety checks have been carried out and they know exactly what do to in the event of fire.

Our report makes a number of practical recommendations for change that we believe would see London's fire safety record to continue to improve, and ensure policy and practice meets our future housing and environmental challenges.

Nicky Gavron
Chair, Planning and Housing Committee

Jenny Jones
Deputy Chair, Planning and Housing Committee

Executive summary

The risk of death from fire in London's residential buildings is low. In 2008 there were 46 fire deaths, a figure lower than for those killed on motorbikes on London's roads.

In January 2010 the London Assembly called for an inquiry into the fire safety of London's tall and timber framed buildings. It was prompted by a series of fires that included the fatal Lakanal House blaze in July 2009 that cost six lives.

This inquiry was commissioned specifically to look into issues around fire safety in London's residential buildings, with a particular focus on timber frame structures and tall buildings, and to make recommendations to the Mayor of London and to Her Majesty's Government with regard to building regulations.

London's tall and timber framed residential buildings present very different issues in terms of fire safety and the potential impacts on lives and property but they are considered together in this report because these two types of buildings are set to increase in the capital.

Policy priorities demanding more new homes at higher densities and the use of sustainable materials are driving an increase in the number of tall and timber framed residential buildings in London, making improving fire safety in these types of buildings critical.

Tall residential buildings are the home for more than 527,000 Londoners. Fires at the highest levels are relatively rare but when fires occur in them they are very dangerous. The biggest risk in the event of fire is the inability for occupants to escape and evacuate the building. These risks increase significantly as buildings get higher.

The effects of fire on large timber frame construction sites are significantly greater due to the large amount of exposed wood, the rapid spread and the radiated heat that can impact on surrounding buildings. All this can affect the ability of fire fighters to tackle the blaze.

Over the last 40 years building standards and regulations have been reviewed and updated but retain a requirement for materials and construction methods to offer a minimum period of fire resistance. There is a view that the regulations have not kept pace with innovation in the construction industry and some within the design,

building and fire safety community believe that the regulations governing the way that timber framed construction have developed is flawed.

A fire test on a six storey timber framed building carried out in 1999 paved the way for greater use of this type of construction. Regulations and guidance that followed referred back to this test and rely heavily on the quality of workmanship and correct installation of various fire stopping measures to retain the integrity of the structure.

Questions have been asked as to whether the "laboratory" conditions of that test accurately reflect the reality of today's construction sites, processes and workmanship and the performance of the material and the resilience of the system in the event of fire.

Timber frame is an approved method of construction under the Building Regulations and there is evidence that, once constructed and maintained correctly, they pose no significantly greater risk of fire than conventionally constructed buildings. Timber framed construction offers potential benefits to London but the Committee recommends that Government, in conjunction with industry partners, should take action to examine recent concerns over the safety of this building system. A review of the Building Regulations needs to focus on the relationship between current guidance and how it is being put into practice on site. There needs to be a prompt resolution to this debate to address the crisis in confidence developing in the industry.

Fire risks in timber framed buildings are greatest during the construction phase when the fire resistant elements such as internal fire separating walls, protective linings and claddings and fire stopping in cavities are incomplete. Only once the buildings are complete are all the necessary fire measures in place. The timber frame industry is working towards improving site safety but to minimise the risk of fires spreading fire suppression systems such as temporary sprinklers should be installed in large timber framed construction sites as well as some form of surveillance during non working hours.

Because of the ferocity of fires on timber framed sites the Fire Brigade must know if it is being called to deal with this kind of fire. It should be a requirement for all building inspectors to inform the emergency services when a timber frame building is being built.

It is vital that buildings using materials and methods of construction that have passed approval are constructed according to regulations. This is particularly true for timber frame buildings that rely on more complex fire stopping construction. The building control process should be strengthened to ensure a minimum number of visits are made during the construction process for timber framed buildings. The industry needs to identify the key and safety critical stages in the construction of timber framed buildings and ensure that inspections are made at these stages in construction.

Given the risks of fire during construction, and the likely spread and intensity of fires at that stage, timber frame buildings are not safe for occupation where there is still construction on site. Government should issue guidance to local authorities that, as a matter of strict safety policy, they do not permit the partial occupation of timber framed developments until the whole development is complete and signed off as complying with the approved building regulations.

The management of fire risk in occupied residential buildings is governed by the Regulatory Reform (Fire Safety) Order 2005 and the Housing Acts 1985 and 2004. Legislation now requires the owners of buildings or "the Responsible Person" to undertake regularly reviewed risk assessments of their buildings or to employ a competent person to do so.

The Committee has seen worrying evidence that many of these risk assessments fall below the standards required; that many staff are insufficiently trained to carry out risk assessments; and that the advice and guidance given to staff is too complex. It is unacceptable that one in five risk assessments in London are inadequate. There must be mandatory minimum standards of competence for training and accrediting fire risk assessors and this should be a legal requirement to comply with the relevant fire safety regulations.

While the conduct of risk assessments is a legal responsibility the Committee believes residents must be informed of the findings of the assessments and whatever remedial action plans are in place. By 2012 the Department for Communities and Local Government should require all social landlords to publish a full register of fire risk assessments for the residential properties that they are responsible for. This register should be available online but also available to residents

in their buildings for inspection and to tenant and residents representatives.

Over time, wear and tear and major building refurbishment, as well as professional and DIY alterations can increase the risk of fire spread in completed buildings, even if workmanship on the original construction was good. Buildings have collapsed because of uncontrolled modifications. Landlords must ensure that alterations carried out to their properties either by approved contractors or tenants do not compromise the fire safety of their buildings. The "responsible person" should work with the construction and installation trades to ensure works are carried out by appropriately certified professionals who are aware of the fire safety requirements.

Finally, one of the fundamental elements of the risk assessment process is to ensure that the people using the building understand what to do in case of a fire. All landlords should provide residents with the necessary information on what to do in the event of a fire. This advice must be tailored to the specific circumstances of each residential building, updated and communicated regularly in different languages where appropriate. It needs to form an essential part of the "key collecting" process for all new tenants and new tenants should confirm they have read and understood the information provided.

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Robert S Lamb, ARIBA

UK Timber Frame Association

Introduction and background

Background

1.1 Lakanal House in Camberwell, south London, is a conventionally constructed 14 storey block of flats completed in 1959[1]. On 3 July 2009 a fire started on the ninth floor. The fire cost the lives of six residents – three women and three children including a three-week old baby. Along with the loss of life, over 90 families had to leave their homes.

1.2 Three years earlier on 12 July 2006 a fire broke out in a timber framed building that was under construction in Colindale, north London. Nobody was injured but the ferocity of the blaze caused the building to collapse within 20 minutes of the fire starting.

1.3 Two more fires, both on timber framed construction sites, at Camberwell again in November 2009 and Peckham in January 2010[2] prompted the London Assembly to agree the following motion on 13 January[3]:

The Assembly is mindful of the recent fire in Peckham, which is the latest major fire involving a timber-frame or tall building in London.

In light of these concerns, the Assembly calls upon the Assembly Planning and Housing Committee to set up a scrutiny investigation into issues around fire safety in buildings, with a particular focus on timber frame structures and tall buildings, and to make recommendations to the Mayor of London with regards to the London Plan and to Her Majesty's Government with regard to building regulations.

Fire risk in perspective

1.4 The risk of death from fire in London's residential buildings is mercifully low. In 2008 there were 46 fire deaths in people's homes – considerably fewer than the 196 in 1980, that represented a recent high point.

1.5 Nevertheless, there are more than 18 residential fires in London each day. In 2008 there were 6,622 fires in residential dwellings in London. Over 1,000 of these broke out on the third storey or above, with 92 of them occurring on the tenth floor or higher. While the percentage of fires happening in tall buildings is not

great the risks, and the potential dangers they present, are very much greater than those of fires in low rise dwellings. Appendix 2 details further information about the incidence of fire in London.

1.6 There have been five fires in timber frame buildings under construction in the London area over the last five years. These were in Colindale, Charlton, Hackney, Peckham and Camberwell[4].

1.7 London's tall and timber framed residential buildings are the focus of this investigation. They have different issues in terms of fire safety but are considered together because these two types of buildings are set to increase in the capital. As the report will show their development is the result of wider policy priorities but they also present specific fire risks and potentially serious issues in terms of fire safety and the level of impact on lives and property.

Policy priorities

1.8 The demand for new homes in London is well documented. The Strategic Housing Market Assessment, which informs both the London Plan and the Mayor's Housing Strategy, suggests that London requires 32,600 new homes per year in the decade up to 2017. Government has long been concerned to increase the efficiency of the construction industry to deliver homes more quickly and cheaply.

1.9 There is a Mayoral commitment that London should meet its need for new homes within its existing boundaries without encroaching on green space. This is likely to mean building at higher densities and, quite probably, at increasing heights.

1.10 Sustainability is a further consideration. The Government has expressed the aim that all new homes should be zero carbon by 2016 and timber is carbon neutral – "essentially a carbon sink" - and a naturally renewable building material.

1.11 These policy priorities are driving the increase in the number of tall and timber framed residential buildings in London.

High rise living

1.12 This review has concentrated on fire risks in tall residential buildings – those defined as five or more storeys (or higher than 15 metres)[5]. In England high rise living is largely a London phenomenon. Sixteen of the 19 English local authorities, where more than 2 per cent of the population live on the fifth floor or higher, are in London[6].

1.13 There are some 30,000 tall residential buildings in London, containing over 300,000 individual flats and home to more than 527,000 Londoners. The vast majority of these buildings (84 per cent) are in Inner London, with six boroughs having more than five per cent of their households living above the fifth floor[7]. Appendix 3 maps the location of London's tall residential buildings.

1.14 Timber framed buildings are rarely built over seven storeys – more often the maximum is five or six storeys. The UK Timber Frame Association estimate that only one per cent of buildings are above this height[8]. However, technology is moving rapidly and in 2009 London saw the completion of "the tallest habitable timber building in the world" a nine storey block of flats in Murray Grove, London, N1. It is constructed from cross-laminated timber panels from the first floor upwards as opposed to the more commonly used solid structural timber framing.

Timber framed construction

1.15 Timber framed buildings have a main structural frame made of timber. Timber is not necessarily a cheaper building material but it does have some economic advantages. A recent National Audit Office report confirmed it should be possible to build up to four times as many timber framed homes with the same on-site labour as a "conventional" building and on-site construction time can be reduced by over a half[9].

1.16 Data from the UK Timber Frame Association indicates the likelihood of an increasing market share for timber frame housing, benefitting as it does by being seen as a sustainable form of construction, with advantages such as speed, lighter foundation and ease of prefabrication[10].

1.17 It has been estimated that the timber framed share of UK housing has risen from around eight per cent in 1998, to 24 per cent in 2009[11].

1.18 The available projections of the demand for housing and the options to meet this demand sustainably within the capital's existing boundaries indicate that there is likely to be a greater number of both tall and timber framed constructions being built in London over the coming years.

Identifying fire risks in tall and timber framed buildings

1.19 All buildings have inherent strengths and weaknesses and, whatever their construction method, are at risk from fire. This report focuses on those two types of construction that seem to present the greatest threat to Londoners in terms of scale and impact of any fire – tall residential buildings and those based on structural timber frames.

1.20 Evidence from the fire brigade, construction industry and other experts suggests that a timber framed building is at the greatest risk of fire during the early stages of construction. Recent Department for Communities and Local Government (DCLG) statistics confirm this. In the twelve months to March 2010 there were 450 fires in buildings under construction, 50 of which were in timber framed sites meaning timber framed construction accounted for more than 12 per cent of construction site fires. Completed timber framed buildings however account for just one per cent of all building fires[12].

1.21 Fires during the construction phase of tall conventional buildings are relatively rare[13]. However, when fires occur in occupied tall buildings they are potentially very dangerous and the biggest risk in the event of fire is the inability for occupants to escape and evacuate the building. Tower blocks have largely been built with the concept of "stay in place" protection. It is usual that only the occupants directly involved in the flat where the fire occurs will need to escape. The remainder of the occupants should be safe to stay in their premises unless evacuated by the fire service if the fire spreads.

1.22 Fire risks increase significantly as buildings get higher. This is reflected in the design requirements related to fire fighting that

must be observed for tall buildings such as protected staircases, fire fighting shafts and fire suppression systems (e.g. sprinklers) to allow fire fighters to quickly access the fire source. Appendix 4 sets out some of the fire risks and fire safety features of the different methods of construction.

1.23 A further risk highlighted to the Committee concerns the risk from inappropriate modifications that may compromise certain fire safety features that are designed to reduce the spread of fire.

Legislation and application to the building process

1.24 There is a significant body of relevant legislation that applies to residential buildings – including building design and materials, construction methods, and post occupation risk assessment. Over time there has been a moving away from prescriptive regulation to functional requirements with non-mandatory guidance issued by DCLG and its predecessors.

1.25 Appendix 5 sets out a matrix showing the complexity of regulations and responsibilities across the different phases of design, construction and the management of occupied buildings. This report seeks to assess the effectiveness of these regulations as they apply to each stage of the design, construction and occupation of a building.

Role of the Mayor

1.26 The Mayor sets the budget and the strategy for the provision of fire services in London.

1.27 The London Fire Brigade is the UK's largest fire and rescue service and employs approximately 7,000 staff, of whom about 5,800 are operational fire fighters. It is run by the London Fire and Emergency Planning Authority (LFEPA). The 17 members of the Authority are appointed by the Mayor. Eight are nominated from the London Assembly, seven from the London boroughs and two are Mayoral appointees.

1.28 The Mayor has a wider stake in promoting fire safety in London. In policy terms, his greatest impact on London's built environment is through the London Plan[14] and LFEPA believes that the London Plan has the potential to introduce or promote

procedures and criteria, which would cause a practical response from developers. It stresses that density, building quality and design are all factors which can affect aspects of fire safety[15] and has urged the Mayor require developers to include extra-statutory fire safety features into specified classes of development such as schools and some categories of special needs housing as well as in some domestic properties.

1.29 However, most of the issues in the Committee's terms of reference are more relevant to national Building and Fire Regulations rather than the planning system and Government discourages use of the planning system to address issues that are dealt with through other regulatory systems. This position is not set to change in the near future.

1.30 Nonetheless, the Mayor does have a role in encouraging fire safety through his role as Chair of the Homes and Communities Agency London Board and through the exercise of his strategic planning powers. This gives him the opportunity to be proactive in seeking additional fire safety measures, such as the use of sprinklers, in major planning applications or in regeneration schemes such as the Olympic Park.

1.31 The Assembly will seek Mayoral support for the recommendations made in this report and look to jointly promote them to Government.

Evidence base used in this investigation

1.32 This investigation drew on a considerable base of evidence. The Committee thanks all those who contributed. Forty-five written submissions were received with those responding including 16 London boroughs; six housing providers; seven trade organisations; four fire brigades; four consultancies and two insurers. Two formal Committee meetings were held (16 March and 8 June) at which a total of ten organisations were represented. The London Fire Brigade also provided Members with an informal briefing on the issues involved. Appendix 6 lists those organisations that submitted written views to this investigation.

Legal implications

1.33 Throughout the investigation, Members have been mindful of the fact that their work should not prejudice any formal investigation process being carried out by the police. The fires at Lakanal and in Peckham and Camberwell[16] are still subject to active criminal investigation and the inquest into the Lakanal deaths is not expected to conclude until well into 2011. Members therefore had to exercise extreme caution when discussing these incidents to avoid any possibility that the investigations would be compromised.

Building design and materials - the building regulations

2.1 This section of the report looks at the particular aspects of legislation relating to the design and materials of tall and timber framed buildings and the extent to which current guidance adequately addresses the concerns that some have raised over timber framed construction.

2.2 Building Regulations set standards for design and construction which apply to most new buildings and many alterations to existing buildings in England and Wales. They cover definitions, procedures, and what is expected in terms of the technical performance of building work. Appendix 7 sets out more details of the structure and contents of the Building Regulations and Approved Documents.

2.3 Over the last 40 years previous building standards and regulations reviewed, updated and incorporated into the Approved Documents to the Building Regulations. These Approved Documents offer practical guidance on ways to comply with the functional requirements in the Building Regulations. In terms of fire safety, the Regulations and guidance documents set out the minimum period of fire resistance for different parts of a building.

2.4 The Approved Documents are intended to provide guidance for some of the more common building situations. However, there will be alternative ways of achieving compliance with the requirements. There is no obligation to adopt any particular solution contained in an Approved Document if the designer wishes to meet the requirement in some other way[17]. This flexibility has been highlighted as being positive and encourages innovation in building design and construction techniques compared with more prescriptive systems used in other countries.

2.5 There is a view among some in the construction industry and the fire services that the Approved Documents are not keeping pace with innovation in the construction industry and, when they are amended, the changes tend to be reactive and not wide ranging enough[18].

Approval of timber framed construction materials and techniques

2.6 The Committee has heard views from some in the "conventional" building sector that timber framed construction has yet to convince them that aspects of this technique are safe enough in relation to fire[19]. There is a debate as to whether the Regulations are sufficiently robust in terms of recognising the need for new materials and innovative methods of construction to comply strictly with specifications in relation to fire safety.

2.7 It is said by the Fire Protection Association that traditional building techniques and materials contain high safety factors that tolerate deviations from the building codes. The Association believes that "newer building techniques possess no such comfort zone and as such strict and absolute compliance is essential"[20]. Furthermore, the Association believes the existing Approved Document B is open to abuse and that DCLG needs to act immediately to review the level of fire resistance demanded of timber framed construction, related external fire spread and the inspection process needed to ensure compliance with the standards.

2.8 Central to this debate is the test that led to the approval of timber framed construction as a safe and valid method of building (see Appendix 8 for more details). In 1999 the Building Research Establishment carried out a test on a six storey timber framed building to evaluate the performance of the construction method when exposed to "severe natural fire exposure". The subsequent design guide BR454[21] documents the results of the test and Approved Document B refers designers to the guidance in BR454 showing how timber framed structures need to comply with fire resistance requirements.

2.9 While the "test" fire was thought to be extinguished after 64 minutes, it resurfaced some hours later and spread "with abnormal rapidly fire development". Nevertheless, the construction method was passed on the basis of the test fire being extinguished. Detractors of the technique claim the test bore little relation to the way construction is actually taking place. Crucially they claim that the test occurred "under laboratory conditions" with all timber voids being carefully packed with fire resisting insulation in accordance with the

regulations. The Fire Protection Association believes that the reality of construction sites, processes and workmanship bears little reality to the conditions created in the test.

2.10 Further details of the Building Research Establishment test and the debate this has generated in relation to the safety of timber framed construction and associated regulations and guidance are set out in Appendix 8.

Review of official guidance

2.11 DCLG periodically reviews the guidance contained in the Approved Documents. Part B was last amended in 2006 and another review will not start again until 2012/13 and finish in 2015/16. Government policy encourages timber frame building in relation to achieving increased house building targets and greater sustainability as well as part of ongoing efficiencies in the construction sector[22]. However, criticism is growing, particularly from the "conventional" industry, and this may be affecting the decisions of many developers whether to use timber framed construction on the basis of safety concerns. The guidance contained in Part B needs to be reviewed to resolve these questions.

Conclusions

2.12 Timber framed construction is an approved method of construction under the Building Regulations. There is evidence that once constructed, and maintained correctly, timber framed buildings pose no significantly greater risk of fire than conventionally constructed buildings as long as modifications are managed appropriately. But there are also suggestions that some social landlords are becoming wary of tall timber framed construction[23].

2.13 Timber framed construction offers potential benefits to London but doubts still remain over performance of the material and the resilience of the building system in the event of fire. The Committee recommends that DCLG, in conjunction with industry partners, should take action to review recent concerns over the safety of this building system with reference to the fire risks and the inspection process. A review specifically needs to focus on the relationship between the regulations and how they are being put into practice on site. There needs to be a prompt resolution

to this debate to address the crisis in confidence developing in the industry.

Recommendation 1

DCLG should act immediately to review Approved document B of the building regulations in relation to timber framed buildings particularly those parts which refer to BR454.

DCLG should not wait until the proposed review planned for 2012/13.

2.14 This recommendation to DCLG, to review the Building Regulations, is supplemented by further recommendations urging Government to issue further guidance and advice to London's landlords who are responsible for the safety of their tenants. These are set out in the remainder of the report.

Fire risks during construction

3.1 All buildings are vulnerable to fire during the construction phase due to the existence of "hot works" (activity that produces heat, sparks or flame) such as cutting and welding or the use of blow lamps and torches, and the fact that fire protection measures are likely to be incomplete. Sites where security at night is insufficient or surveillance is inadequate are at increased risk from fire[24]. The Health and Safety Executive (HSE) estimates that there are around eleven construction site fires every day.

Timber framed construction sites

3.2 As set out in paragraph 1.20 above, a timber framed building is at the greatest risk of fire during the early stages of construction. Timber framed buildings rely on a variety of elements that have to be integrated to enable them to withstand fire such as internal fire separation, fire protective linings and claddings and fire stopping barriers within cavities and voids within the structure[25]. These are usually only applied after the frame is erected and so a period of high risk during construction is almost unavoidable.

3.3 Zurich Insurance has pointed out that timber framed buildings under construction "offer limited resistance until virtually the final stages of construction... This contrasts significantly to that provided in a more traditionally constructed or fire resisting construction system where the applied protection measures offer an immediate benefit in being applied to a non-combustible and generally more stable building elements"[26].

3.4 Further details of the risks posed by partially completed timber framed buildings, the safety regulations and some of the measures now being put into place are set out in Appendix 10. This Appendix also deals with a range of issues that are relevant to the Building Control process.

3.5 The Committee heard from a number of stakeholders that fire risk on construction sites can increase during non-working hours when there is limited surveillance and security is less visible. The UK Timber Frame Association estimates that two out of three fires on construction sites are started deliberately with motives ranging from revenge, fraud, crime concealment and vandalism[27].

3.6 Given the higher risk of fire during construction, the industry should be actively promoting measures for ensuring site safety during non-working hours when the danger of arson or accidental fires is highest. This will require close liaison with the police, fire service and local planning authorities.

Recommendation 2

By the end of 2011 the UK timber frame construction industry should actively promote to its members a variety of fire safety measures, including fire suppression systems and site security measures, that are designed to reduce the risk of fire on construction sites during non-working hours when the danger of arson or accidental fires is highest. The HSE should then consider whether any of those fire safety measures should be promoted for use on construction sites

Notifying the fire and rescue service

3.7 Buildings constructed of different materials behave differently in fires. The effects of fires on large timber framed construction sites are significantly greater due to the large amount of exposed timber and the greater "radiated heat flux" that can impact on surrounding buildings, affect the ability of fire fighters to tackle the blaze and pose potential risks for the residents of adjoining buildings. Given these greater effects, it is vital that the Fire Brigade is aware of the dangers when called to fight fires in timber framed buildings.

3.8 Building Control is either undertaken by the local authority or by a private sector Approved Inspector (third party inspectors). Under the law the building control body must consult the fire brigade on a Building Regulations application and at that stage it would be possible to highlight the fact that this is a timber frame construction.

3.9 The UK Timber Frame Association now reports the location of all new large timber frame construction sites[28] to the local fire service. However, this is not being done consistently across the building control profession. The London Fire Brigade states that while they are notified of timber framed construction from local authority building control they do not yet routinely receive notice from Approved Inspectors and "that is a development that still needs to happen"[29].

3.10 Fire risk management dictates that the Fire Brigade must know if it is being called to deal with a timber framed (or modern method of construction) building blaze. Mechanisms do exist for reporting such construction and the opportunity must be taken to ensure such buildings are recorded by the emergency services. This must apply to all parts of the building inspection industry.

Recommendation 3

That the Association of Consultant Approved Inspectors (ACAI) makes it a requirement to inform the HSE and Fire Brigade that inspected buildings are being constructed using either timber frame or modern methods of construction. This should be mandatory across the building inspection industry by the end of 2011.

3.11 Where proposals for large timber framed buildings are made on sites in built-up areas consideration should also be given to the needs of evacuation of residents in any surrounding buildings. This will require multi-agency co-operation and planning if fire risks to residents are to be reduced.

Quality of workmanship

3.12 It is of utmost importance that materials and methods of construction that have passed approval are built according to regulations. Enforcement of design and construction regulations is the job of Building Control.

3.13 The quality of workmanship is vital in relation to the success of fire safety provisions. These make it clear that the correct location and installation of cavity barriers and fire stopping is important in maintaining the integrity of the structure whatever the material. The risk of fire spread in the event of a fire occurring can increase dramatically should there be any aspects of poor workmanship and so the reliability of contractors is critical. However, even the Construction Industry Council (the body that represents more than 25,000 construction firms) acknowledges that "there are contractors around who do not have the requisite integrity"[30].

3.14 Boroughs responsible for building control have said it is impossible for officers visiting sites from time to time to find all

problems, "many of which are covered up"[31]. Pressures on their ability to provide an adequate service have also resulted from the requirement for local authorities to provide a self financing service[32]. Budget reductions have also had an impact on local authority capacity for on-site inspection[33].

3.15 In their submission, Kent Fire and Rescue Service[34] argues that building control inspections should be made mandatory at regular stages during the construction and recorded for review at a later date should there be a fire in which the fire safety measures fail.

Conclusion

3.16 The Committee supports the view of Kent Fire and Rescue Service that the building control process should be strengthened to ensure a minimum number of visits are made during the construction process for timber framed buildings, particularly as they affect the installation of cavity barriers where these represent a significant element of fire safety protection.

3.17 The industry should work to identify the key and safety critical stages in the construction of timber framed buildings and ensure that inspections are made at these stages in construction. This will mean identifying a minimum and mandatory number of inspections.

Recommendation 4

DCLG and the Health and Safety Executive should review the Construction (Design and Management) Regulations and the Building Regulations to ensure that the building control process is strengthened in relation to timber framed buildings. Following the review of the building regulations (set out in Recommendation 1), the industry must identify the safety critical stages of timber framed buildings (for example the installation of cavity barriers in buildings) and ensure a specified minimum number of visits are made by building inspectors during these stages.

3.18 The Committee is conscious not to recommend any measure that might delay the construction process while waiting for the safety critical building inspections. It is also mindful of the pressures that budget reductions might add to the availability of

inspectors in the future. Constructors of large timber frame buildings should plan ahead to ensure that these key inspections, by local authority building control or approved inspectors, can take place without delaying the construction process.

Partially constructed timber framed buildings

3.19 Given the risks of fire during construction, and the likely spread and intensity of fires at that stage, timber frame buildings are not safe for occupation where there is still construction ongoing on site. Incomplete fire compartmentalisation would make this extremely dangerous as fires can spread quickly to the occupied parts of the building and more so than "conventional" buildings[35]. Fortunately, in the 2006 Colindale incident, the local authority had made it a condition that occupation of the building would not take place until the whole of the construction was complete. However, this is not universal practice.

Recommendation 5

DCLG should issue guidance to local authorities that, as a matter of strict safety policy, they do not permit the partial or full occupation of timber framed developments until the whole development is complete and signed off as complying with the approved building regulations.

Fire risks in occupied buildings

4.1 The management of fire risk in occupied residential buildings is governed by the Regulatory Reform (Fire Safety) Order 2005 (Fire Safety Order) and the Housing Acts 1985 and 2004.

4.2 When the Fire Safety Order came into effect in 2006 it applied to over 600,000 premises in London. It rationalised over 90 pieces of fire safety legislation and gave responsibilities for fire prevention and protection measures to the "Responsible Person" who normally is the employer or owner in control of a building. The Responsible Person is required to undertake regularly reviewed risk assessments of their buildings or to employ a competent person to do so. Fire Authorities retain the legal ability and duty to audit buildings to check compliance with the regulations and are responsible for the enforcement of these preventative and protective measures[36].

4.3 The Housing Acts 1985 and 2004 apply regulation and control to residential property, including high rise blocks. These Acts make housing authorities specifically responsible for keeping the condition of all housing in their area, including their own housing stock, under review and for checking all aspects of health and safety, including fire safety.

4.4 Under the Housing Acts, risks are identified under a Housing Health and Safety Rating System[37] assessment of the building. Government guidance is that these checks should be undertaken as part of a local authority's ongoing review of their housing conditions. The "Responsible Person" must undertake a fire risk assessment and implement appropriate fire protection precautions under the Fire Safety Order. Appendix 11 sets out the legislation and duties placed on various bodies in more detail.

Fire risk assessments

4.5 Risk assessments are now the cornerstone of managing fire safety. A fire risk assessment is an organised and methodical look at a building, the activities carried out there and the likelihood that a fire could start and cause harm to those in and around the building. It places direct significance on the introduction of preventative measures and protective measures to deal with remaining risk to protect people from death or injury in the event of fire[38].

4.6 The Committee has heard evidence that many of these risk assessments are inadequate. The Committee supports the view of the Chief Fire Officers Association that there are an excessive number of poor quality risk assessments being done by Responsible Persons or consultants that they engage, which fall significantly short of confirming whether buildings and their subsequent refurbishment works are protected from fire[39].

4.7 In 2006 (the first year of operation of the Fire Safety Order) the London Fire Brigade completed around 10,000 inspections. About 40 per cent to 50 per cent of fire risk assessments were deficient in some aspect. According to the London Fire Brigade the situation is improving but in 2009 of the 15,000 inspections undertaken across a range of categories of building approximately 18 per cent to 20 per cent of risk assessments were still found to be in need of some remedial action[40].

4.8 After the Lakanal House fire it was reported that one leading residential management services company undertook an inspection of 500 tall buildings across London and the south east and found 12 per cent of apartment blocks contained serious fire hazards[41]. In the past year the Fire Brigade and Tenant Services Authority have found it necessary to remind landlords of their responsibilities over this matter[42] and the BBC reported that its investigation uncovered at least 300 high-rises in London that had no valid risk assessment from the landlord[43].

4.9 It is of concern to Committee Members that there is evidence of the absence of appropriate fire safety measures, and this cannot be right.

Risk assessors

4.10 The Committee has heard that many staff are insufficiently trained to carry out risk assessments; that the advice and guidance given to staff is too complex; there is confusion over what constitutes a sufficient risk assessment; and there is ambiguity around the definitions of competent and qualified persons who are expected to carry out risk assessments[44]. Unsurprisingly there are calls to have a defined standard of competency for people undertaking risk assessments and a register that assures quality.

4.11 It is unacceptable that one in five risk assessments in London are inadequate. There must be mandatory minimum standards of competence for training and accrediting fire risk assessors and this should be a legal requirement to comply with the relevant fire safety regulations.

Recommendation 6

By 2012, LFEPA should review whether more proactive enforcement activity is needed with managers of large scale tall residential buildings who are not able to demonstrate a history of compliance with the Fire Safety Order.

4.12 The Fire Service cannot inspect every fire risk assessment but, instead, works on an approach that concentrates on auditing the highest risk buildings[45]. The Committee remains concerned that the desire to remove prescriptive regulation and replace it with non-mandatory guidance may have created a situation where the fire authorities do not have sufficient capacity to ensure the risk management process is always robust.

Recommendation 7

By 2012, DCLG in association with relevant bodies such as the Local Authorities Co-ordinators of Regulatory Services (LACORS) and Chief Fire Officers Association should draw up national guidance to ensure mandatory minimum standards of competence for training and accrediting fire risk assessors.

Availability of fire risk assessments

4.13 The conduct of regular risk assessments is a legal responsibility. However, the information that these have been done, what risks have been identified and what remedial action has taken place is less easy to find out.

4.14 At present, the responsible person is required to be able to produce a current risk assessment if the fire authority wishes to inspect it and audit the premises. The fire service does not automatically inspect every single fire risk assessment, but instead works to target the high risk buildings.

4.15 In July 2010 the London borough of Southwark announced that residents now have access to an online register of fire risk reports[46]. This is a welcome move which we support and wish to see rolled-out across London.

Recommendation 8

By 2012 DCLG should require all social landlords to publish a full register of fire risk assessments for the residential properties that they are responsible for. This will enable all residents to be informed of the findings of the relevant risk assessments and whatever remedial action plans are in place. This register should be available online but also available to residents in their buildings for inspection and to tenant and residents representatives.

Fire risks after modification and alteration of buildings

4.16 The Committee heard from a number of stakeholders that there is concern that, in the longer term, wear and tear and major building refurbishment, as well as professional and DIY alterations, will increase the risk of fire spread in completed buildings, even if workmanship on the original construction is good[47]. Buildings have collapsed because of uncontrolled modifications that have not been picked up through inspection. Some examples of these cases are set out in Appendix 12.

4.17 Ongoing fire risk assessments should identify the problems but third party fire risk assessors frequently state they will not inspect above false ceilings due to risks such as asbestos or the working at height regulations[48].

4.18 Landlords must ensure that alterations carried out to their properties either by approved contractors or tenants do not compromise the fire safety of their buildings. The "responsible person" should work with the construction and installation trades to ensure works are carried out by appropriately certified professionals who are aware of the fire safety requirements.

Recommendation 9

DCLG should write to public sector "responsible persons" as identified under the Fire Safety Order 2005 and Housing Acts 1985 and 2004 to remind them of the need to:

- **Make tenants aware of the need to seek permission to undertake relevant modifications to their properties and ensure that the terms of the tenancy agreements are enforced should unauthorised actions be discovered.**
- **Ensure that contractors are appropriately certified professionals who are aware of the fire safety requirements.**
- **Ensure that inspecting for unauthorised or damaging works are part of routine estate inspections by housing staff.**

Raising awareness - fire safety information for tenants

5.1 One of the main factors in reducing the risk of fire in tall buildings is the ongoing education and awareness of residents. The Committee agrees with the London Fire Brigade that one of the fundamental elements of the risk assessment process is to ensure that the people using the building understand what to do in case of a fire.

5.2 There are concerns about the lack of fire drills in residential buildings. Landlords are in agreement that in most tall residential blocks conducting fire drills is impractical because, unlike workplaces or hotels that have alarm systems and staff assigned to fire marshalling, this is rarely the case for residential blocks[49]. In sheltered housing however, this is possible, and does seem to occur.

5.3 Following the Lakanal House fire the Fire Brigade issued advice online for residents living in high rise properties and the national magazine Inside Housing launched a "Safe as Houses" campaign which included a call for emergency procedure notices to be placed in every corridor of high rise blocks.

5.4 Tenants must have access to comprehensive information about the specific fire safety aspects of their homes so that they understand what to do in case of fire. The turnover of residents within individual blocks means that regular information must be given to new residents and to update procedures. Newsletters, notices, fire action plans are all ways used to convey information to tenants.

5.5 While landlords and the Fire Service must ensure that the relevant legislation is acted upon and the enforcement process is robust, fire risk assessments should also be publicly available to ensure transparency.

5.6 Just as risk assessments should only be carried out by people with relevant qualifications and experience, tenants and residents may need assistance to interpret fire risk assessments. Landlords should work to improve the capacity of their tenant and resident representatives to understand the risk assessments where necessary. It would be good practice for DCLG to publish a register of those who have met this requirement or make it part of some other existing reporting system.

Recommendation 10

DCLG should immediately write to all social landlords to advise them of their responsibility to ensure that they provide residents with the necessary information on what to do in the event of a fire. This advice must be tailored to the specific circumstances of each residential building, updated and communicated regularly in different languages where appropriate. It needs to form an essential part of the "key collecting" process for all new tenants and new tenants should confirm they have read and understood the information provided.

Social landlords should be asked to report these actions to the Homes and Communities Agency (when it takes over responsibility from the Tenant Services Authority) to ensure this takes place.

Recommendations

Recommendation 1

DCLG should act immediately to review Approved document B of the building regulations in relation to timber framed buildings particularly those parts which refer to BR454.
DCLG should not wait until the proposed review planned for 2012/13.

Recommendation 2

By the end of 2011 the UK timber frame construction industry should actively promote to its members a variety of fire safety measures, including fire suppression systems and site security measures, that are designed to reduce the risk of fire on construction sites during non-working hours when the danger of arson or accidental fires is highest. The HSE should then consider whether any of those fire safety measures should be promoted for use on construction sites

Recommendation 3

That the Association of Consultant Approved Inspectors (ACAI) makes it a requirement to inform the HSE and Fire Brigade that inspected buildings are being constructed using either timber frame or modern methods of construction. This should be mandatory across the building inspection industry by the end of 2011.

Recommendation 4

DCLG and the Health and Safety Executive should review the Construction (Design and Management) Regulations and the Building Regulations to ensure that the building control process is strengthened in relation to timber framed buildings. Following the review of the building regulations (set out in Recommendation 1), the industry must identify the safety critical stages of timber framed buildings (for example the installation of cavity barriers in buildings) and ensure a specified minimum number of visits are made by building inspectors during these stages.

Recommendation 5

DCLG should issue guidance to local authorities that, as a matter of strict safety policy, they do not permit the partial or full occupation of timber framed developments until the whole development is complete and signed off as complying with the approved building regulations.

Recommendation 6

By 2012, LFEPA should review whether more proactive enforcement activity is needed with managers of large scale tall residential buildings

who are not able to demonstrate a history of compliance with the Fire Safety Order.

Recommendation 7

By 2012, DCLG in association with relevant bodies such as the Local Authorities Co-ordinators of Regulatory Services (LACORS) and Chief Fire Officers Association should draw up national guidance to ensure mandatory minimum standards of competence for training and accrediting fire risk assessors.

Recommendation 8

By 2012 DCLG should require all social landlords to publish a full register of fire risk assessments for the residential properties that they are responsible for. This will enable all residents to be informed of the findings of the relevant risk assessments and whatever remedial action plans are in place. This register should be available online but also available to residents in their buildings for inspection and to tenant and residents representatives.

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DCLG should write to public sector "responsible persons" as identified under the Fire Safety Order 2005 and Housing Acts 1985 and 2004 to remind them of the need to:

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- Ensure that contractors are appropriately certified professionals who are aware of the fire safety requirements.
- Ensure that inspecting for unauthorised or damaging works are part of routine estate inspections by housing staff.

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DCLG should immediately write to all social landlords to advise them of their responsibility to ensure that they provide residents with the necessary information on what to do in the event of a fire. This advice must be tailored to the specific circumstances of each residential building, updated and communicated regularly in different languages where appropriate. It needs to form an essential part of the "key collecting" process for all new tenants and new tenants should confirm they have read and understood the information provided.

Social landlords should be asked to report these actions to the Homes and Communities Agency (when it takes over responsibility from the Tenant Services Authority) to ensure this takes place.

Appendix 1 Specific London fires mentioned in the report

Colindale fire

In the afternoon of Wednesday 12 July 2006 there was a serious fire at a timber framed development situated between Aerodrome Road and Grahame Park Way in Colindale, London NW9.

In response to the fire about 100 fire fighters spent five hours at the scene, during which time a number of neighbouring premises, including Colindale Police Station and Hendon police college on opposite sides of the site, were evacuated and a stretch of the nearby A41 through Hendon was closed until 21:30 hours. Some 2000 local residents were evacuated from their homes. An adjoining building occupied by Middlesex University as halls of residence, was severely damage as a result of the fire spreading. Radiated heat also severely damaged 30 cars parked in the roads nearby.

At the height of the fire, flames were reported to be rising hundreds of feet into the air and the plume of smoke could be seen several miles away.

No one was injured but the fire was notable for the speed and ferocity of the blaze. The building was fully alight about ten minutes after ignition. The Fire Brigade reported full structural collapse within 20 minutes shortly after the Brigade arrived on site. Fire spread to neighbouring buildings and the terrific heat caused hazards to fire fighting personnel and equipment

The first call to the fire brigade was made at 15:39 hours. Fire brigade resources deployed included 20 fire appliances. The first crews reported radiated heat to be so intense that it was not possible for them to approach nearer than 50m to the burning building.

Fire Protection Association report April 2007

Carisbrooke Gardens fire

On 27 November 2009, at 0430 GMT a fire broke out at a timber framed construction site at Carisbrooke Gardens in Peckham. At the height of the blaze there were 30 fire engines and over 150 fire fighters tackling the fire. The whole of the site was on fire and the fire also affected two nearby blocks of maisonettes and a pub. Around 310 people were evacuated from their homes and moved to emergency accommodation provided by the local authority.

The cause of the fire is under investigation.

http://www.london-fire.gov.uk/LastestIncidentsContainer_27nov09a.asp

Camberwell Station Road fire

On 6 January 2010 a fire broke out at a timber framed building site in the early hours of the morning. Fifteen fire engines and around 75 fire fighters tacked the blaze. The five storey building was badly damaged by the blaze. Fire crews worked hard to contain the fire, preventing it from spreading to any neighbouring buildings. Around 150 people were evacuated from adjacent premises as a precaution. The Brigade was called at 0228 and the fire was under control by 0614, though fire crews remained on the site for some time.

The cause of the fire is under investigation.

http://www.london-fire.gov.uk/LastestIncidentsContainer_06jan7.asp

Lakanal House fire

The blaze at the 14-storey Lakanal House on the Sceaux Gardens Estate, Camberwell started on the ninth floor, at 1620 BST on Friday 3 July 2009. The fire left six people dead, including a three-week-old baby and two children. About 30 people were rescued from the fire.

Eighteen fire engines were used to tackle the blaze with 100 fire fighters at the scene with some specialist fire rescue units attending as well.

Assistant Commissioner Nick Collins, of the London Fire Brigade, said it was "one of the most significant fires in some time in terms of lives lost". He said the block's construction was "common" in the capital but the blaze's rapid spread unusual.

http://news.bbc.co.uk/1/hi/england/london/8134734.stm

Appendix 2 London fire statistics

It is important to state that the risk of death from fire in London is low; in 2008 there were 46 fire deaths. This is more than four times lower than the high numbers in 1980 (196).

It compares favourably with other cities – for example, in New York there were 86 fire deaths in 2008[50] but of course the conditions there are different in terms of the numbers of high buildings.

In terms of fire, London is relatively safe. The rate of fire deaths in London has fallen to seven people per million (2007)[51] compared with about ten per million in New York[52].

Since the mid 1960s there has been an increase of almost one million households in London, yet the rate of dwelling fires has remained fairly constant (at around 3 dwelling fires per 1,000 households) and has been reducing since 2003.

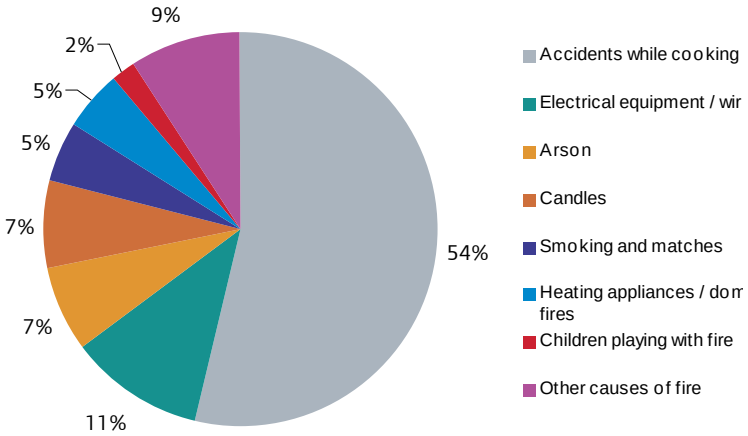
In 2008 there were 6,622 fires in residential dwellings in London[53]. The Fire Brigade report that while in 2009 14.3 per cent of fires (1,035 fires) happened above three floors and 3.5 per cent of fires occurred above seven floors, less than 1.5 per cent of domestic fires (92 fires) occurred on the tenth floor or above[54].

There have been five fires in timber frame buildings under construction in the London area over the period of the last five years[55]. These were in Colindale, Charlton, Hackney, Peckham and Camberwell[56].

Causes of domestic fires

A 2006 report showed the clear majority (54 per cent) of domestic fires were caused by accidents while cooking. A further eleven per cent were caused by electrical equipment or wiring. Other categories of note include arson and candles, each of which was estimated to have caused seven per cent of the total domestic fires[57].

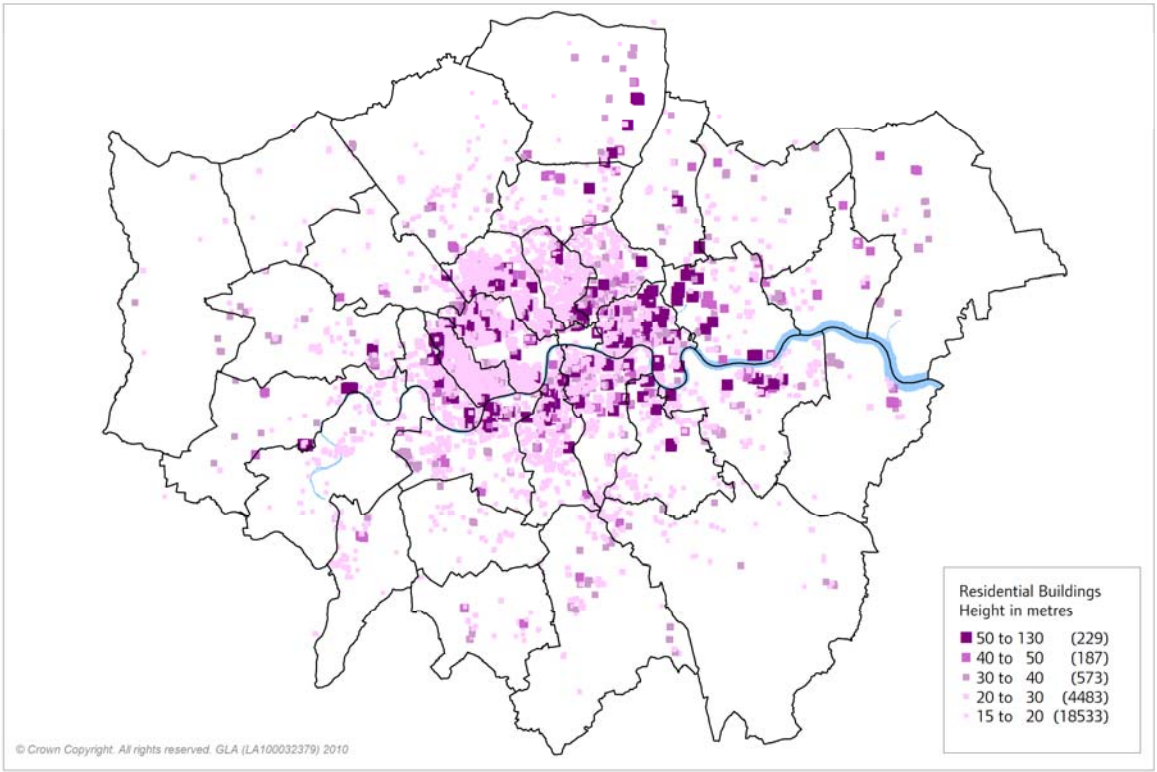
Causes of domestic fires



Source: Fires in the home, ODPM 2006

Appendix 3 Location of London's tall residential buildings

Location of Residential Buildings Over 15m



Appendix 4 Fire risks and features of different methods of construction

Performance of different materials

All buildings have inherent strengths and weaknesses and, whatever their construction method, are at risk from fire[58].

Wood, quite obviously, burns. The surface chars and eventually breaks down the structural integrity of the timber. But, "whilst it is true that timber is combustible, this does not confirm that there is a specific risk associated with timber frame, as many construction materials are either combustible, have poor fire resistance or both"[59].

The characteristics of more "conventional" building materials in the event of fire include:

- Brickwork and blockwork copes well in a fire but is not infinitely fire resistant and will expand and crack.
- Concrete can spall under the influence of fire. If the metal reinforcement lies near to the surface of the concrete it will heat up, expand at a different rate to the surrounding concrete and expand and fracture[60].
- Steel is non combustible but has progressively less fire resistance as it heats up and the molecular structure weakens. It loses up to half its strength above 500 degrees and this can cause the collapse of structures as it weakens and buckles.

Fire safety in tall buildings

Fires during the construction phase of conventional buildings are relatively rare. One representative of the "conventional" building industry states that the UK has not experienced a fire above the tenth floor on a concrete framed building during construction[61].

But, once built, the problems of tackling fires and evacuating buildings increase significantly as buildings get higher. This is reflected in the design requirements related to fire fighting that must be observed as buildings increase in height:

- Eleven metres is the height at which a simple single staircase can no longer be provided and a protected staircase must be installed.
- 18 metres is the height at which a fire-fighting shaft (to allow fire fighters to approach safely from within) needs to be provided inside a building.

- 30 metres is the height at which fire fighters are no longer able to tackle a building fire from outside and special measures need to be put in place (such as fire suppression systems) to control a fire.

In tall buildings, once occupied, the ability for occupants to escape in the event of a fire in the building is the biggest problem. Tall buildings have largely been built with the concept of "stay in place" protection. It is usual that only the occupants directly involved in the flat where the fire occurs will need to escape. The remainder of the occupants should be safe to stay in their premises unless evacuated by the fire service if the fire spreads. "You should be safe if the building is properly constructed and properly maintained for at least an hour"[62].

This is based upon an assessment of the risk of all of the residents trying to evacuate the building in the event of a fire in a single compartment that heightens the likelihood of other injuries to fleeing occupants and could severely hamper the fire service in tackling the incident.

The appropriate evacuation/response in a fire is dictated by the presence or otherwise of inbuilt structural fire safety features. In cases where these measures are missing, faulty or inadequate this can greatly increase the risk of fire.

Appendix 5 Regulations and responsibilities across organisations

Stage	Appropriate regulations	Responsibility for enforcement and inspection
Design and planning	Building Regulations; London Building Acts; Town and Country Planning Acts	Local Planning Authority; Building Control Body
Construction	Construction (Design and Management) Regulations; Health and Safety guidance; Building Regulations; Town and Country Planning Acts; Joint Code of Practice (Protection from Fire of Construction Sites and Buildings undergoing Renovation)	Health and Safety Executive; Building Control Body; Fire and Rescue Authority; Local Planning Authority
Building in use	Regulatory Reform (Fire Safety) Order; Housing Acts 1985 and 2004; Housing Health and Safety Rating System	HSE, Fire and Rescue Authority
Modification and renovation	Building Regulations; also the best practice contained in the Joint Code of Practice (Protection from Fire of Construction Sites and Buildings undergoing Renovation)	Health and Safety Executive; Building Control Body; Fire and Rescue Authority; Local Planning Authority

Appendix 6 Organisations submitting written views

Organisation	Reference
Association for Specialist Fire Protection	FS022
Aviva Insurance UK	FS003
British Precast Concrete Association	FS009
Chief Fire Officers Association	FS008
City of London Corporation	FS034
Civil Engineering Contractors Association	FS010
Commission for the Built Environment	FS041
Concrete Today	FS031
Department of Communities and Local Government	FS035
East Thames Group	FS028
Family Mosaic	FS021
Fire Protection Association	FS025
Greater London Authority - London Plan Team	FS004
Health and Safety Executive	FS036
Homes for Islington	FS024
Kent Fire and Rescue Service	FS006
Local Authority Building Control	FS015
London Borough of Barking and Dagenham	FS045
London Borough of Barnet	FS027
London Borough of Bexley	FS033
London Borough of Haringey	FS013
London Borough of Harrow	FS012
London Borough of Hounslow	FS019
London Borough of Lambeth	FS042
London Borough of Merton	FS014
London Borough of Newham	FS018
London Borough of Richmond-upon-Thames	FS020
London Borough of Southwark	FS038
London Borough of Wandsworth	FS044

London Councils	FS001
London Fire and Emergency Planning Authority	FS011
Mayor of London	FS040
Modern Masonry Alliance	FS043
Morgan Professional Services	FS002
National House-Building Council	FS023
Passive Fire Protection Federation	FS037
Peabody Trust	FS039
Richmond Housing Partnership	FS026
Royal Borough of Kensington and Chelsea	FS032
Royal Borough of Kingston-upon-Thames	FS005
Stewart Milne Group	FS029
The Concrete Centre	FS030
UK Timber Frame Association	FS017
Westminster City Council	FS007
Zurich Insurance	FS016

Appendix 7 The building regulations

Buildings must be designed and constructed to meet the requirements of the regulations. In terms of fire safety the Building Regulations demand an "appropriate period of fire resistance from all buildings" regardless of their construction materials and methods.

The Regulations set out the minimum period of fire resistance (in terms of collapse of load bearing capacity, fire penetration and the transfer of heat/insulation) for different parts of a building – for example dwellings more than five metres high must offer a minimum fire resistance of 60 minutes[63].

The last 40 years have seen previous building standards and regulations reviewed, updated and incorporated into the Approved Documents to the Building Regulations. These Approved Documents offer practical guidance on ways to comply with the functional requirements in the Building Regulations.

Approved Document A relates to the structure. Approved Document B is the document which relates directly to the fire safety design aspect of the Building Regulations (other documents relate to issues such as ventilation, drainage, electrical safety etc.).

Approved Document B is sub-divided into sections relating to: Means of escape; Internal fire spread (linings and structure); External fire spread and Access and facilities for the fire service.

Each document contains: general guidance on the performance expected of materials and building work in order to comply with each of the requirements of the Building Regulations; and practical examples and solutions on how to achieve compliance for some of the more common building situations.

The Approved Documents are intended to provide guidance for some of the more common building situations. However, there will be alternative ways of achieving compliance with the requirements. There is no obligation to adopt any particular solution contained in an Approved Document if the designer wishes to meet the requirement in some other way.

The flexibility of the UK system has been highlighted as being positive as it is designed to encourage innovation as opposed to more prescriptive systems in other countries. However, there is a view that

the Approved Documents are not keeping pace with innovation in the construction industry and tend to be reactive[64].

Others believe that "the changes are generally iterative and not wide ranging. To some extent they lag behind current trends[65]".

Although the regulations are regularly updated they are not retrospective and do not apply to existing buildings. This is why buildings such as Lakanal do not have sprinkler systems whereas all new blocks taller than 30 metres are required to have such systems under present Building Regulations.

It is said that the nature of traditional building techniques and materials contain high safety factors that tolerate deviations from the building codes. The Fire Protection Association believes that "newer building techniques possess no such comfort zone and as such strict and absolute compliance is essential".

The Association goes on to say that "a standard that is easily abused or un-policeable is a poor standard. It is our opinion that Approved Document B could be improved to make it more resilient to abuses of this type and that DCLG should act immediately to review this and the complimentary issues of the inspection process and external fire spread. To date DCLG have stated that building methods seem to be changing daily, yet they are unprepared to review Approved Document B until 2012 – this appears a contradiction and poor judgement[66]."

This appears to be a clear reference to the fact that timber frame has yet to convince many construction industry experts that aspects of this technique is safe in relation to fire.

Appendix 8 Building Research Establishment timber fire test

Tall timber frame building fire test

Extract from "Smouldering Issue", RIBAJournal.com

In 1999 a fire test was carried out by BRE on a six-storey timber framed block of flats. The fire brigade put out the fire after 64 minutes. However, some hours later the fire reignited in a cavity in the structure on the third floor and spread with 'abnormal rapid fire development – through cavities on floors three through to six. "If it had been a real building people would have moved back in, played with their kids, read books, watched TV and gone to bed"[67].

Architect Sam Webb claims that a full report was produced by the BRE stating that: "the compartment fire test met the stated objectives of the programme." He claims this was misleading because "If you have a fire test in which a secondary fire causes considerable damage you are duty bound to report that".

BRE however claims that the primary objective of the compartment fire test was to 'evaluate the performance of a medium-rise six storey timber-frame building subject to a severe natural fire exposure' and the report BR 454 is a direct consequence of this evaluation.

It points out that quality of workmanship is vital in relation to the success of fire safety provisions. It also makes clear that the correct location and installation of cavity barriers and fire stopping is important in maintaining the integrity of the structure wherever the material within the cavity provides a medium for fire spread.

Appendix 9 Achieving efficiency in the construction industry

The 1994 Latham report called for improved efficiency and a reduction in real construction costs by the year 2000. In addition, the Egan report (1998) and other Government initiatives have maintained the momentum for improvement, fully recognising the need for sustainable construction processes.

Regulation changes in England and Wales in recent years mean that timber frame buildings can reach seven storeys without loss of economy from excessive fire protection requirements: http://projects.bre.co.uk/tf2000/index.html

Modern Methods of Construction/ Innovative Construction Products and Techniques

Timber framed construction is not the only alternative to conventional construction techniques. The Government is encouraging modern methods of construction (MMC), which it says can achieve "a step change in the construction industry to produce the quantity and quality of housing we need". Modern methods of construction incorporating innovative construction products and techniques are a response to the demand for new homes.

The Homes and Community Agency insists that 25 per cent of its available grant (for new publicly funded social housing) must be used for developments that incorporate some form of MMC.

In order to meet the challenging requirements of the modern built environment many new Innovative Construction Products and Techniques (ICPT) are being developed and they are probably most prevalent in the residential sector.

The London Fire Brigade have suggested the main forms of ICPT used for residential buildings include[68]:

- Light steel frame – this includes frames constructed using sticks, panels and modules using light gauge galvanised steel.
- Steel frame – construction using hot-rolled steel components 'traditionally' used in commercial applications but now increasingly used for apartment buildings when height exceeds six storeys.
- Timber frame. – this includes on-site and off-site systems.
- Structural insulated panel systems (SIPS)

Appendix 10 Fire risks in partially completed timber framed buildings

The fire safety of a building is far more complicated than whether the materials are combustible or not – the characteristics of the entire system must be taken into account.

Timber framed buildings rely on a variety of elements that have to be integrated to ensure their ability to withstand fire such as internal fire separation, fire protective linings and claddings and fire stopping barriers within cavities and voids within the structure. These are usually only applied after the frame is erected and so a period of high risk during construction is almost unavoidable[69].

While fire risks are reduced at the more advanced stages of construction, conventional fire protection measures (i.e. internal fire separation, fire stopping etc.) offer limited resistance until virtually the final stages of construction in a timber framed structure. This contrasts significantly to that provided in a more traditionally constructed or fire resisting construction system (i.e. steel, concrete, traditional masonry) where the applied protection measures offer an immediate benefit in being applied to a non-combustible and generally more stable building elements[70].

There are a number of reasons for this; some apply to the low weather resistance of typical timber frame wall claddings meaning that the protection this provides is not applied until the structure has been weather-proofed[71]. Others point to the fact that the rate of speed of constructing large open wall panel systems is faster than the ability of other trades to clad the timber framework which exposes large volumes of timber that can result in very serious fire spread[72].

Timber framed buildings under construction therefore "offers limited resistance until virtually the final stages of construction... This contrasts significantly to that provided in a more traditionally constructed or fire resisting construction system where the applied protection measures offer an immediate benefit in being applied to a non-combustible and generally more stable building elements[73]".

As a result fires in timber framed construction sites often develop quickly due to the large amount of exposed and unprotected combustible elements and where there is minimal active or passive form of fire protection[74].

The potential for rapid fire spread and early structural collapse coupled with difficult access and water supplies for fire fighting has been realised in several incidents[75].

These types of fires also present serious risks to affecting surrounding buildings and fire fighting infrastructure because fire development and spread are rapid and generate extremely large amounts of radiant "heat flux" (the transfer of heat to other surfaces). "The heat produced by the fire was so intense as to hamper fire fighting operations and resulted in fire spread by radiant heat to the adjacent building which also was totally destroyed[76]".

There is a general consensus that fire risk on timber construction sites can increase during non-working hours when there is limited surveillance and security is less visible. It is estimated that two out of three fires on construction sites are started deliberately with motives ranging from revenge, fraud, crime concealment and vandalism[77].

The Timber frame Association is funding research into fire retardants and sprinkler systems to reduce risk during construction. In 2008 it introduced 16 Steps to Fire Safety on Timber Frame Construction Sites that reminds constructors of safety issues.

Despite these measures major fires are still occurring on timber frame construction sites (e.g. Glasgow 17 August 2010[78] and Basingstoke, Hampshire 10 September 2010[79]).

Appendix 11 The Regulatory Reform Order and the Housing Acts

In relation to the management of fire risk in occupied residential buildings there are two principal means of regulation and control: the Regulatory Reform (Fire Safety) Order 2005 and the Housing Acts 1985 and 2004.

The Fire Safety Order 2005 applies to virtually all premises including offices and shops, schools, hospitals, hotels, factories etc. It does not apply to individual, domestic premises occupied by a single family group but does apply to the parts of blocks of flats that are used in common by the occupants of more than one dwelling in the premises. This includes common staircases, corridors, structure and services.

When the Fire Safety Order came into effect in 2006 it applied to over 600,000 premises in London. It rationalised over 90 pieces of fire safety legislation, built on the Workplace Regulations and shifted responsibility from the Fire Authority (which previously made prescriptive inspections of premises and issued Fire Certificates) to the "Responsible Person".

The Fire Safety Order defines the "responsible person" as[80]:

(a) in relation to a workplace, the employer, if the workplace is to any extent under his control;

(b) in relation to any premises not falling within paragraph (a)—

(i) the person who has control of the premises (as occupier or otherwise) in connection with the carrying on by him of a trade, business or other undertaking (for profit or not); or

(ii) the owner, where the person in control of the premises does not have control in connection with the carrying on by that person of a trade, business or other undertaking.

The "Responsible Person" tends to be; the employer in control of a workplace; the occupier or person who has control of any premises; or the owner where neither of the above has control. The Responsible Person is required to undertake regularly reviewed risk assessments of their buildings or to employ a competent person to do so.

The Housing Acts 1985 and 2004 apply regulation and control to residential property, including high rise blocks. These Acts make

housing authorities specifically responsible for keeping the condition of all housing in their area, including their own housing stock, under review and for checking all aspects of health and safety, including fire safety. The legal duty on local housing authorities applies in respect of the whole building including the private living accommodation (i.e. the individual flats).

Risk assessments

Risk assessments for fire were originally introduced by the Fire Precautions (Workplace) Regulations 1997 and extended by the Fire Safety Order to most buildings in 2006. Single private dwellings or individual flats within blocks are however excluded (corridors and stairs etc are covered).

It places direct significance on the introduction of preventative measures and protective measures to deal with remaining risk to protect people from death or injury in the event of fire.

A fire risk assessment is an organised and methodical look at a building, the activities carried on there and the likelihood that a fire could start and cause harm to those in and around the building.

DCLG Guidance[81] sets out what is expected from a Responsible Person in terms of carrying out a risk assessment the aims of which are to:

- To identify the fire hazards;
- To reduce the risk of those hazards causing harm to as low as reasonably practicable;
- To decide what physical fire precautions and management arrangements are necessary to ensure the safety of people if a fire does start.

The London Fire Brigade have highlighted some difficulties relating to blocks of flats where, for example, the duty to ensure appropriate general fire precautions are in place rests with the landlord but the front doors to flats (which should be fire resisting in order to protect the means of escape) have become the property of the owner/lessee of the flat who chooses to change the door to a non fire resisting one[82].

Questions have also risen more recently regarding:

- What constitutes a “suitable and sufficient” fire risk assessment as ‘suitable and sufficient” is not defined term in the Fire Safety Order;
- How competency to carry out a fire risk assessment can be determined by a responsible person who is seeking to appoint a third party to carry out fire risk assessments for them; and
- What constitutes a simple or complex building (and so determines whether the responsible person may be able to carry out a fire risk assessment themselves (in house) or will need to appoint an expert).

Appendix 12 Fire risks after modification of buildings

There is concern that, in the longer term, wear and tear and major building refurbishment, as well as professional and DIY alterations, will increase the risk of fire spread in completed buildings, even if workmanship on the original construction is good[83].

The London Fire Commissioner told the Committee that "we have seen buildings collapse in London because of uncontrolled alterations and because, necessarily, the building is not always inspected as often as the frequency should be, those things do not get picked up and, therefore, there is inherent fire risk or fire spread risk that has been introduced through people not understanding the way the building has been designed and constructed"[84].

Unregulated or unreported work either by contractors or occupants of flats that compromise the fire stopping or fire compartmentation allowing smoke and fire to spread via the cavities is a considerable danger in occupied premises. Even approved work, for example major upgrades to buildings to replace windows, has been proven to compromise the fire safety of buildings when specified or undertaken incorrectly[85].

These risks are significant as there is no statutory requirement for building control inspectors to inspect these "follow on" works if they don't require building or planning consent.

London Fire Brigade has highlighted some recent fires to show that simply replacing windows with uPVC items can allow a relatively small fire to spread from the flat of origin into voids and then destroy most of the building. This may occur where replacement windows do not adequately cover voids and allow fire to travel within the walls[86].

DIY type works by residents can affect the inbuilt fire precautions or exacerbate problems caused by lack of fire precautions that should exist. Alterations carried out by residents inside their flats often remain completely unknown to the landlord or building manager. Residents of timber framed buildings are usually unaware that many routine DIY activities like installing extra plug sockets perforate fire resisting walls and compromise the fire resistance of buildings[87]. Over time, there will be many such breaches and the likelihood of fire spread increases.

Control of such matters should be by means of landlords enforcing terms of tenancy or lease agreements.

It is therefore particularly important to continuously inform and educate residents about the potential risks and appropriate methods for renovation works.

Much work in residential accommodation is not subject to any statutory approvals and can be carried out by the occupier or a local tradesperson. Such works can affect the common fire precautions for the premises by removing or changing fire protection measures such as fire resisting doors. Introduction of new cables (for IT or TV) frequently leads to holes in fire stopping and cavity barriers which can allow fire and smoke spread from flats to common areas and vice versa and which can impede fire fighters when responding to an incident.

Ongoing fire risk assessment should identify the problems but third party fire risk assessors frequently state they will not inspect above false ceilings etc. due to risks such as asbestos or the working at height regulations[88].

Appendix 13 Orders and translations

How to order

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Chinese

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Email 与我们联系。

Hindi

यदि आपको इस दस्तावेज का सारांश अपनी भाषा में चाहिए तो उपर दिये हुए नंबर पर फोन करें या उपर दिये गये डाक पते या ई मेल पते पर हम से संपर्क करें।

Vietnamese

Nếu ông (bà) muốn nội dung văn bản này được dịch sang tiếng Việt, xin vui lòng liên hệ với chúng tôi bằng điện thoại, thư hoặc thư điện tử theo địa chỉ ở trên.

Bengali

আপনি যদি এই দলিলের একটা সারাংশ নিজের ভাষায় পেতে চান, তাহলে দয়া করে ফো করবেন অথবা উল্লেখিত ডাক ঠিকানায় বা ই-মেইল ঠিকানায় আমাদের সাথে যোগাযোগ করবেন।

Greek

Εάν επιθυμείτε περίληψη αυτού του κειμένου στην γλώσσα σας, παρακαλώ καλέστε τον αριθμό ή επικοινωνήστε μαζί μας στην ανωτέρω ταχυδρομική ή την ηλεκτρονική διεύθυνση.

Urdu

اگر آپ کو اس دستاویز کا خلاصہ اپنی زبان میں
درکار ہو تو، براہ کرم نمبر پر فون کریں
یا مذکورہ بالا ڈاک کے پتے یا ای میل
پتے پر ہم سے رابطہ کریں۔

Turkish

Bu belgenin kendi dilinize çevrilmiş bir özetini okumak isterseniz, lütfen yukarıdaki telefon numarasını arayın, veya posta ya da e-posta adresi aracılığıyla bizimle temasa geçin.

Arabic

الحصول على ملخص لهذا المستند بلغتك،
فرجاء الاتصال برقم الهاتف أو الاتصال على
العنوان البريدي العادي أو عنوان البريد
الإلكتروني أعلاه.

Punjabi

ਜੇ ਤੁਸੀਂ ਇਸ ਦਸਤਾਵੇਜ਼ ਦਾ ਸੰਖੇਪ ਆਪਣੀ ਭਾਸ਼ਾ ਵਿਚ ਲੈਣਾ ਚਾਹੋ, ਤਾਂ ਕਿਰਪਾ ਕਰਕੇ ਇਸ ਨੰਬਰ 'ਤੇ ਫ਼ੋਨ ਕਰੋ ਜਾਂ ਉਪਰ ਦਿੱਤੇ ਡਾਕ ਜਾਂ ਈਮੇਲ ਪਤੇ 'ਤੇ ਸਾਨੂੰ ਸੰਪਰਕ ਕਰੋ।

Gujarati

જો તમારે આ દસ્તાવેજનો સાર તમારી ભાષામાં જોઈતો હોય તો ઉપર આપેલ નંબર પર ફોન કરો અથવા ઉપર આપેલ ટપાલ અથવા ઈ-મેઈલ સરનામા પર અમારો સંપર્ક કરો.

Appendix 14 Principles of scrutiny page

An aim for action
An Assembly scrutiny is not an end in itself. It aims for action to achieve improvement.

Independence
An Assembly scrutiny is conducted with objectivity; nothing should be done that could impair the independence of the process.

Holding the Mayor to account
The Assembly rigorously examines all aspects of the Mayor's strategies.

Inclusiveness
An Assembly scrutiny consults widely, having regard to issues of timeliness and cost.

Constructiveness
The Assembly conducts its scrutinies and investigations in a positive manner, recognising the need to work with stakeholders and the Mayor to achieve improvement.

Value for money
When conducting a scrutiny the Assembly is conscious of the need to spend public money effectively.

Endnotes

[1] http://www.communities.gov.uk/documents/housing/pdf/1279954.pdf

[2] Details of these London fires are set out in Appendix 1

[3] Report to London Assembly (Mayor's Question Time) 13 January 2010 www.london.gov.uk/assembly/assemmtgs/2010/plenaryjan13/item08.rtf

[4] UK Timber Frame Association, written submission, 4 March 2010 FS017a

[5] This correlates with the DCLG guidance document "Fire safety risk assessment - sleeping accommodation" which advises that for premises used as sleeping accommodation that have more than four floors, expert advice should be sought. http://www.communities.gov.uk/publications/fire/firesafetyrisk4

[6] City of London has 32 per cent of households above the fifth floor, Westminster 9.65 per cent, Tower Hamlets 8.53 per cent, Southwark 6.28 per cent, Camden 5.58 per cent and Kensington and Chelsea 5.11 per cent. The only local authorities in England that have more than 2 per cent of their residents living above the fifth floor are Brighton and Hove (2.39 per cent), Salford (2.32) and Newcastle (2.20). Source, 2001 Census http://www.statistics.gov.uk/StatBase/Expodata/Spreadsheets/D8362.xls

[7] Data Management and Analysis Group, GLA

[8] UK Timber Frame Association, supplementary written submission 22 March 2010 FS017

[9] Using modern methods of construction to build homes more quickly and efficiently, National Audit Office, 22 November 2005 http://www.nao.org.uk/publications/0506/modern_methods_of_construction.aspx

[10] LFB written submission 5 March 2010

[11] UK Timber Frame Association, Market Update 2009, May 2010

[12] Fire statistics monitor, April 2009 to March 2010, DCLG, August 2010 http://www.communities.gov.uk/documents/statistics/pdf/1693248.pdf

[13] The Concrete Centre, written submission 7 March 2010 FS030

[14] Policy 7.13 - Safety, security and resilience to emergency and supporting text referring to "new development should incorporate fire safety solutions and represent best practice in fire safety planning in both design and management. The London Fire and Emergency Planning Authority (LFEPA) should be consulted early in the design process to ensure major projects and venues have solutions to fire engineering built-in."

[15] LFEPA, 25 June 2009: "A New Plan for London", proposals for the Mayor's London Plan – consultation; Ref FEP 1376

[16] The HSE are also investigating the Peckham and Camberwell fires

[17] Chief Fire Officers Association, written submission 5 March 2010 FS008

[18] For example, National House Building Council, written submission 5 March 2010, FS023, London Fire Brigade, supplementary written submission 5 March 2010, FS011

[19] For example, British Pre-Cast Concrete Federation FS009, Concrete Today FS031

[20] Fire Protection Association, written submission 5 March 2010 FS024 (Timber Frame Note to Minister)

[21] Multi-storey timber frame buildings: A design guide (Ref Code: BR454), 2003 http://www.brebookshop.com/details.jsp?id=140327

[22] This is a central part to achieving the target of all new homes to be zero carbon by 2016 and as outlined in the Latham and Egan reviews into the construction industry (see Appendix 9)

[23] The London borough of Newham has no timber framed housing stock and East Thames Group has a policy of not building timber framed buildings above the fourth floor. Planning and Housing Committee, 8 June 2010

[24] Geoff Arnold, Chairman UK Timber Frame Association, Planning and Housing Committee, 16 March 2010

[25] Royal Borough of Kingston upon Thames, written submission 22 February 2010 FS005

[26] Zurich (Insurance) written submission 4 March 2010 FS016

[27] 16 Steps to Fire Safety on Timber Frame Construction Sites, UK Timber Frame Association

[28] Large is defined as being over four storeys in height or over 2,500 m^2 in aggregate floor area. UK Timber Frame Association, written submission 4 March 2010 FS017a

[29] London Fire and Emergency Planning Authority, Planning and Housing Committee March 2010

[30] Construction Industry Council, Planning and Housing Committee, March 2010

[31] LB Haringey, written submission 3 March 2010

[32] Local Authority Building Control, Planning and Housing Committee, March 2010

[33] Chief Fire Officers Association, written submission 2 March 2010

[34] Kent Fire and Rescue Service, written submission 1 March 2010 FS006

[35] Fire Protection Association, written submission 5 March 2010 FS024

[36] London Fire Brigade, written submission 5 March 2010 FS011

[37] The Housing Health and Safety Rating System is a risk assessment tool used to assess potential risks to the health and safety of occupants in residential properties in England and Wales. The legislation came into effect in England on 6 April.

http://www.communities.gov.uk/documents/housing/pdf/150940.pdf

[38] London Fire Brigade, written submission 5 March 2010 FS011

[39] Chief Fire Officer's Association National Housing Working Group written submission 5 March 2010

[40] London Fire Brigade, Planning and Housing Committee, 8 June 2010

[41] The survey took place between April and July 2009 http://www.insidehousing.co.uk/story.aspx?storycode=6505457

[42] http://www.communities.gov.uk/documents/fire/doc/1279941.doc

[43] http://news.bbc.co.uk/1/hi/england/london/8290103.stm

[44] London Fire Brigade, Planning and Housing Committee, June 2010

[45] London Fire Brigade, Planning and Housing Committee, June 2010

[46]

http://www.southwark.gov.uk/press/article/127/southwark_council_publishes_online_fire_risk_register

[47] Association for Specialist Fire Protection, written submission 5 March 2010 FS022

[48] London Fire Brigade Technical Note, 26 February 2010 FS011

[49] London boroughs of Barnet and Newham and East Thames Housing Group, Planning and Housing Committee 8 June 2010

[50] www.nyc.gov/html/fdny/pdf/publications/annual_reports/2008_2009/2008_2009_annual_report.pdf

New York has a population of 8.25 million (London 7.62 million) and a land area of 83,000 hectares (London 159,000 hectares). New York is also experiencing a decreasing incidence of fire deaths.

[51] Statistics from LFEPA written submission 10 March 2010

[52] http://quickfacts.census.gov/qfd/states/36/3651000.html

[53] DCLG figures - the peak in fire numbers since 1966 was 9,056 in 2000

[54] LFB written submission, 5 March 2010

[55] UK Timber Frame Association, written submission 4 March 2010

[56] Outside London two major fires occurred on timber framed building sites in Glasgow and Hampshire while this report was being drafted.

[57] Fires in the Home: Findings from the 2004/05 Survey of English Housing, ODPM, January 2006 http://www.communities.gov.uk/documents/fire/pdf/143501.pdf

[58] DCLG, written submission 12 March 2010 FS035_100310

[59] UK Timber Frame Association, written submission 4 March 2010

[60] The Concrete Centre says however that "Engineers know to follow design codes and embed reinforcement deep enough in the concrete to ensure it does not get too hot in the event of fire & make elements thick enough so that they retain sufficient strength capacity. Written submission 7 March 2010 FS030

[61] The Concrete Centre, written submission 7 March 2010 FS030

[62] Steve Turek, Assistant Commissioner and Head of Fire Safety Regulation, London Fire Brigade, Planning and Housing Committee 8 June 2010

[63] http://www.planningportal.gov.uk/uploads/br/BR_PDF_ADB1_2006.pdf

[64] National House Building Council, written submission 5 March 2010, FS023

[65] London Fire Brigade, supplementary written submission 5 March 2010, FS011

[66] Fire Protection Association, written submission 5 March 2010 FS024

[67] Architect Sam Webb, http://www.ribajournal.com/index.php/feature/article/smouldering_issue_july10/

[68] London Fire Brigade written submission 5 March 2010 FS011

[69] Royal Borough of Kingston upon Thames, written submission 22 February 2010 FS005

[70] Zurich (Insurance) written submission 4 March 2010 FS016

[71] Westminster City Council, written submission 26 February 2010, FS007a

[72] Stewart Milne Timber Systems, written submission 5 March 2010, FS029

[73] Zurich (Insurance) written submission 4 March 2010 FS016

[74] Fire and Rescue Service Practitioners Forum, written submission 2 March 2010

[68] Kent Fire and Rescue Service, written submission 1 March 2010 FS006

[76] Chief Fire Officers Association, written submission 2 March 2010 FS008

[77] 16 Steps to Fire Safety on Timber Frame Construction Sites, UK Timber Frame Association

[78] http://www.bbc.co.uk/news/uk-scotland-glasgow-west-11003890

[79] http://www.bbc.co.uk/news/uk-england-hampshire-11268241

[80] http://www.legislation.gov.uk/uksi/2005/1541/article/3/made

[81] Fire safety risk assessment: sleeping accommodation, DCLG 2006
http://www.communities.gov.uk/documents/fire/pdf/151339.pdf

[82] London Fire Brigade, written submission 3 March 2010 FS011

[83] Fire Protection Association, written submission 4 March 2010 FS024

[84] Ron Dobson, LFB, Planning and Housing Committee meeting 16 March 2010

[85] Kent Fire and Rescue Service, written submission 1 March 2010 FS006

[86] Planning and Housing Committee meeting, 16 March 2010

[87] Association for Specialist Fire Protection, written submission 5 March 2010 FS022

[88] London Fire Brigade, technical advice note 26 February 2010, FS011

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